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HISTORY OF THE WHITE-TAILED DEER IN NEW YORK[1]

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ABSTRACT

The white-tailed deer is New York's most important big game species. Its history in the State is traced as a background for understanding its present status and the kind of management called for. While deer were plentiful in many localities in colonial times, they are generally not abundant there today —chiefly because such areas have been largely taken over for agricultural and urban development. Nevertheless, the total deer population of the State is much greater now than then. For the period since 1880 conditions are discussed separately and in some detail for the Adirondack, Catskill, and Central and Western regions, and Long Island. A summary of open seasons and hunting regulations is given, as well as a county by county record of the legal kill since 1900.

The trails of the white-tailed deer have not been marked with historical signs. Nevertheless, deer made an important contribution to the welfare of the pioneers and, indirectly, to the development of our country. Through the years they have been the quarry of armies of hunters who valued them highly for food, clothing, recreation, or as trophies.

The settlers cleared the land with little, if any, consideration for the possible effects on game. Indeed, by the middle of the nineteenth

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[1] A contribution of Federal Aid in Fish and Wildlife Restoration Project W-28-R. This is the first of a series of papers regarding the ecology and management of deer in New York. They are based on 25 consecutive years of field investigation. Although there remains much more to learn, it seems appropriate at this time to bring together the major findings to date. It is hoped that the material presented will contribute to an understanding of the multiple and complex problems of deer management, and of the necessity for holding the deer population at levels compatible with the good of the deer, their range, and the human economy. It is hoped, too, that the reader will gain a better appreciation of the fact that the deer population throughout the State cannot be managed as a unit because of the diversity of physical and economic conditions in the various regions.

The authors wish to acknowledge the contributions of the many others who have participated in the project since its inception, especially Dr. E. L. Cheatum, R. A. Cookingham, N. Drahos, Dr. F. C. Goble, A. G. Hall, H. F. Maguire, G. H. Morton, and J. E. Tanck.

century deer were in serious danger of extermination throughout the State, except in the wilderness areas. However, as the poorer farm lands were abandoned deer exhibited remarkable ability to adapt themselves to the change in environment and reoccupied most of their former range. In recent years, and in spite of heavy hunting pressure, they have become so abundant locally as to interfere seriously with agricultural and forestry enterprise.

Since the white-tail is New York's most important big-game animal it was inevitable that it would be the subject of much concern and study by sportsmen, game officials, and biologists. The management of this magnificent animal has been a controversial subject for many years. Almost every community has its individuals or groups who are vitally interested, in one way or another, in any legislative or management measure which affects the deer population. Each group is a strong champion of its own interests and convictions. There seems to be an almost universal desire to evolve a simple panacea which will solve the problem of the local group, yet be acceptable on a statewide basis. Thus, those charged with the management of the deer herd have a host of people looking over their shoulders. In addition to the farmers and foresters already mentioned, hunters, resort and hunting camp owners, restaurateurs, sporting goods dealers, and many others have a vital interest in the welfare of the deer.

To provide a background for discussing the present status of the species in New York, it seems worthwhile to trace its history in this State. In the following account the early history is treated briefly, while that of the past half century is recounted in some detail, by regions.

DISTRIBUTION AND ABUNDANCE OF DEER IN PRE-COLONIAL TIMES

North American deer are thought to have descended from Asiatic forms which reached this continent at various times from the middle Miocene to the late Pleistocene epochs, i.e., sometime between one million and 18 million years ago. In terms of geologic time our deer, elk, moose, and caribou are comparatively recent imigrants and they are still quite similar in form to the Asiatic and European representatives of the deer family.

Knowledge of these prehistoric forms is based upon the findings of paleontologists and zoologists who have studied fossil and other buried remains. Hartnagel and Bishop (1922) described fossil remains of deer found in the muck of a swamp at Cedar Hill (Albany

County) in 1908, as well as a set of deer antlers found at Hinsdale in Cattaraugus County. The latter were discovered in gravel and sand 16 feet below the surface. The same authors reported the finding of deer and elk antlers 12 feet below the surface in a muck deposit in the town of New Hudson in Allegany County, and mentioned records of deer remains, from Cattaraugus County, found in sand and gravel with mastodon bones. They also noted several deer bones having been excavated from peat deposits near the east shore of Onondaga Lake at a depth of 10 feet.

Writing of more recent times, Ritchie (1950) stated: "No single game animal played as great a role in the economy of the Indian population of ancient New York as the Virginia deer. I venture this statement on the basis of twenty-five years of field research on scores of aboriginal camp and village sites pertaining to all periods of occupation, from the remote cultures of the Archaic horizon [about 4000 to 1000 B.C.] to those of historic times [about 1600 A.D.]. The direct evidence consists of the bone remains of food animals found as discards in the rubbish-filled pits and dumps, called middens . . . Of the birds, the turkey was apparently the most esteemed; of the mammals certainly the deer, of both sexes and all ages, furnished the bulk of the protein element, except on coastal sites and inland fishing camps . . .

"From our excavations in nearly all parts of the State we may conclude that although the deer was everywhere present, certain regions probably contained a heavier concentration of those animals and this may well account, at least in part, for the differences in population density of the Indian groups, especially of the ancient hunters who, unacquainted with agricultural practices [these started about 800 B.C.], depended solely for subsistence upon wild animals and vegetal foods."

Ritchie (1932) recorded the exhuming of the remains of literally thousands of deer at the site of an Indian village between Lomoka and Waneta Lakes in Schuyler County. This village has been dated around 3000 B.C. from study of radioactive charcoal discovered at the site. The same author mentioned (1945) that other Archaic and later sites in the Finger Lakes area were rich in deer remains, and later (1950) stated: "Large numbers of deer bones also occur in Iroquoian and earlier sites in western New York, throughout the Mohawk Valley, in Jefferson County, and along the Susquehanna River and its tributaries.

"On the other hand, the general areas embraced by the Adirondack and Catskill mountains are poor in Indian remains and therefore, in terms of our archeological knowledge, also in remains of deer and other food animals. The archeological record would at least suggest a cause and effect relationship in this connection."

It has been widely believed that large numbers of deer roamed the forests of the Northeast before the advent of the colonists. This apparently was true in local situations where the deer found suitable environment. However, the early explorers found the region now known as New York State rather completely covered with mature forests, varying in species composition according to latitude, topography, and other site characteristics (Bray, 1930; Smith, 1955).

We know that deer do not thrive in large tracts of undiversified cover, particularly mature forest having practically no undergrowth. Instead, they seek out the borders of clearings, lakes, and streams where food is accessible and cover close at hand. Known to biologists as "edge", this preferred habitat fulfills the needs of deer to a much greater degree than large areas of uniform forest cover. Thus, it appears questionable if deer found more than comparatively small areas of suitable habitat in the vast expanses of virgin timber.

Some of these exceptions were described in early records. Openings of various sizes existed in oak forests in what are now Erie, Genesee, and Livingston Counties. Other grassy openings occurred between Cayuga and Owasco Lakes (O'Callaghan, 1853:251; Edson and Merrill, 1894:40; White, 1898:2-3). These tracts were kept open by the Indians largely through periodic burning. It is assumed that the purpose was to prevent encroachment by the forest and to encourage the growth of smaller shrubs and grass that attracted deer.

The explorers found the Indians living chiefly in the fertile valleys, the Lake Plains, and the Finger Lakes regions. Since the Indians relied heavily on venison and deer hides, it seems logical to infer that the deer were found in greatest abundance in these regions and that the Adirondack and Catskill highlands harbored comparatively few of these animals.

As an interesting sidelight, two primitive methods of killing deer are outlined from the description of DeVries (1857). In a general hunt a hundred Indians, more or less, walked about 100 paces apart while beating on hollow bones with sticks. In this manner they drove deer ahead of them into water (in this case, the Hudson River), where waiting Indians in canoes threw snares around the animals' necks and

Mature evergreen timber in the Adirondack region showing lack of undergrowth, i.e., deer browse.

drowned or choked them. Another practice consisted of driving deer into a trap made from palisades split from trees, the stakes being 8 or 9 feet high and set close together. The trap was 1,400 or 1,500 paces along each side, the mouth being 2,000 paces wide and the narrower end about 5 feet wide. Making noises in imitation of wolves, the Indians drove the deer through the narrow end where they were easily snared.

There are many historical records concerning pre-colonial conditions in New York, but comparatively few details are available relative to the status of wildlife. Father L'Allemant, quoted by Edson and Merrill (1894:40), wrote of conditions among the Indians in 1641: "They are much employed in hunting deer, buffalo, wildcats, wolves, wild boar,[2] beavers and other animals. Meat is very abundant this year on account of the heavy snow, which has aided the hunters. It is rare to see snow in this country more than half a foot deep [far western New York], but this year it is more than three feet deep."

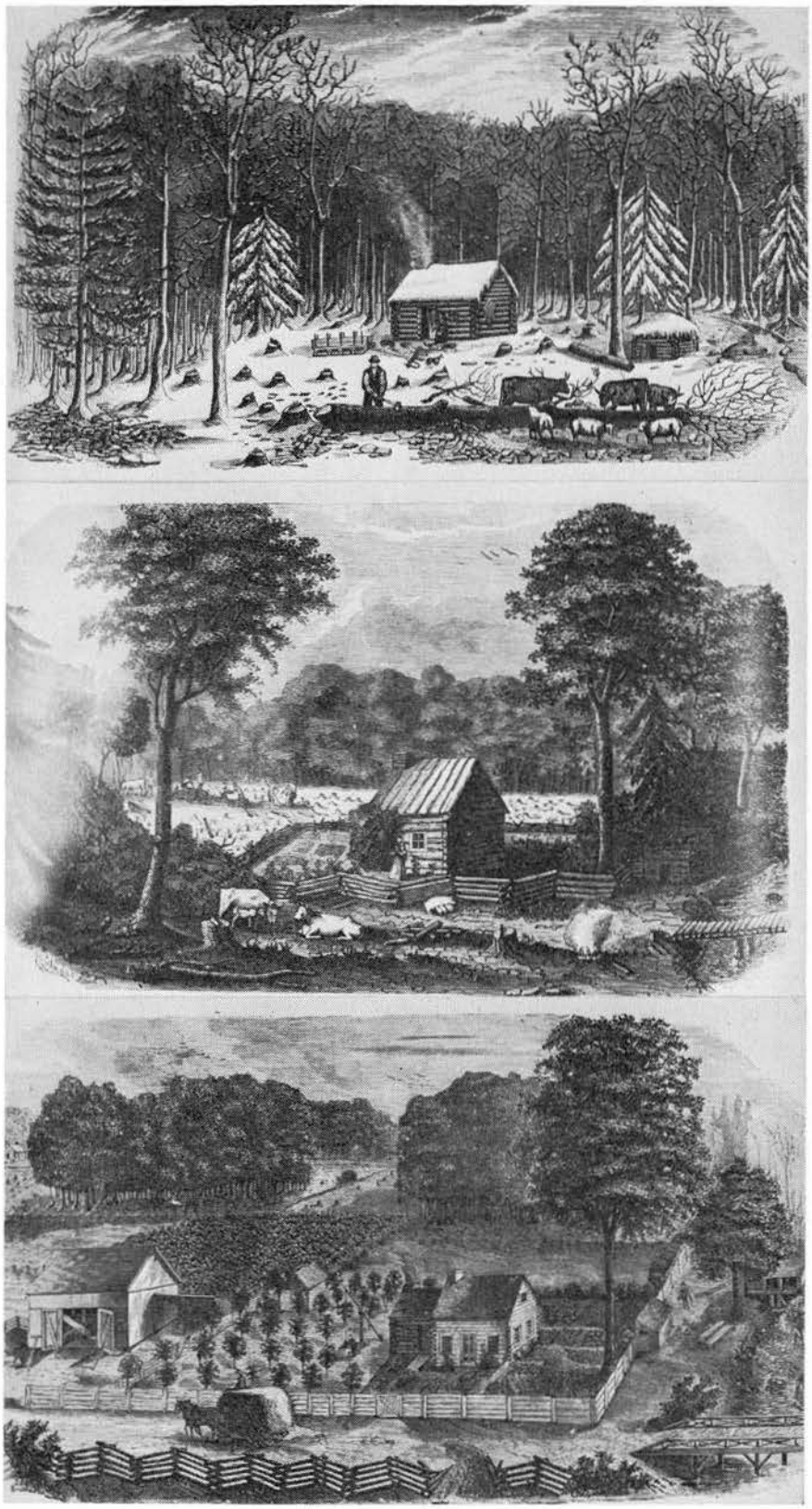
The Jesuit missionary Peter Raffiex wrote in 1670: "More than a thousand deer are killed annually in the neighborhood of Cayuga" (O'Callaghan, 1853:251). Henry Hudson found deer in the valley which now bears his name, and Champlain likewise found them in the Mohawk lowlands. Edson and Merrill (1894:40) quoted from letters written in 1687 by Baron LaHouton about that part of Chautauqua County between the highlands and Lake Erie: "I cannot express what quantities of deer and turkeys are to be found in these woods and in the vast meads that lie upon the south side of the lake."

DISTRIBUTION AND ABUNDANCE OF DEER FROM THE COLONIAL PERIOD TO 1880

The advance of the white settlers into the wilderness was accompanied by changes which profoundly affected the wildlife. Trees were felled for the construction of homes, and more were cut and burned in order to clear land for crops and pasturage. A thriving trade developed in the export of lumber to Europe. The opening of the forest canopy caused by these activities resulted in excellent conditions for game. Encouraged by the sunlight, berry bushes, shrubs, and tree reproduction flourished except where kept down by farming operations and burning. The deer responded and were plentiful about the edges of the clearings. In this connection, it is interesting to note a colonial law of 1741 which prohibited the killing of deer from January through May, but permitted farmers to shoot deer in their cornfields (New York State, 1894b). Another factor which presumably affected the deer population was the gradual extermination of wolves and panthers by the settlers.

Published records vary widely as to the abundance of deer during the 18th century. Peter Kalm reported that the snow was very deep during the winter of 1705, and that great numbers of deer were found

[2] Translated by other historians as "black beasts" or "black squirrels"; there were no wild boar in New York at that time, either native or introduced.



Initial opening of forest and progressive clearing of land by pioneer settler and farmer. (Reproduced from History of Niagara County, N. Y. Sanford & Co., N.Y. 1878)

dead in the woods the next spring (Benson, 1937:310-311). Major Rogers, in his diary (Hough, 1883:107), wrote of his travels between Ticonderoga and Fort William Henry in December, 1755: "We found our boats in safety, and had the good fortune (after being almost exhausted with hunger, cold and fatigue) to kill two deer . . ." Later, following the battle of Rogers' Rock in March, 1758, he wrote: ". . . two officers and five English surrendered themselves prisoners, because they were wandering in the woods, dying of hunger." These men had wandered for 5 days without seeing game to shoot at. By way of contrast, Rogers found deer plentiful along the St. Lawrence River in the vicinity of old Fort Frontinac (now Kingston, Ontario) in September, 1760. He wrote (p. 179): "The Indians . . . supplied us with great plenty of venison and wild food." On the same trip, Rogers continued to find sufficient deer for his needs as he proceeded to the south side of Lake Erie. On January 8, 1761, while on his way to Fort Pitt, he wrote (p. 180): "I went a-hunting with ten of the Rangers, and by ten o'clock got more venison than we had occasion for."

From such reports it appears that deer were scarce on the eastern side of the Adirondacks between 1755 and 1760, but that they were quite abundant in 1761 in extreme western New York. Bruce (1896:936, 962) cited records of the abundance of deer in Onondaga County about 1790. Also, a Captain Williamson, writing in 1799, mentioned that about 500 deer were being killed annually in the vicinity of Bath in what is now Steuben County (O'Callaghan, 1849:1155).

Additional methods by which the Indians secured deer were described by writers of this era. Turner (1850:381), with reference to about 1795, described an area near what is now Groveland (Livingston County) where about 500 Indians set fire to a tract 7 miles on a side. Some stationed themselves inside the area, essentially a large opening in oak forest, and killed 17 deer, several bears, and other game as the fire drove the animals ahead of it. Another such burning area was located near Masonville in Delaware County, and it is conjectured that the Moose River Plains and Oswegatchie River Plains in the Adirondacks may have been used as burning grounds. Fleming (1789:507-508) described a fence of logs and brush, seen in 1789 west of the Unadilla River near the Madison-Chenango County line, that was used by the Indians to guide deer toward the hunters. Another brush barrier, this one with several openings, was located between the

northern ends of Skaneateles and Owasco Lakes. Deer were snared as they were driven through the openings in the fence. The fact that the Indians went to the trouble of erecting such fences would seem to indicate that deer were not always easy to secure by ordinary hunting.

Near Cherry Valley, the inhabitants of the settlement founded by John Lindesay had lived comfortably for several years, but in the winter of 1740 they were near starvation (Goodwin, 1859). Thus, it seems that deer were not plentiful enough in the vicinity to sustain the settlement.

In the winter of 1779-80 the snow was 5 feet deep in the vicinity of what is now Letchworth Park along the Genesee River. O'Reilly (1838:46) attributed to Mary Jemison, who spent many years as a captive of the Indians, the report that almost all the wild game disappeared, and that when the snow melted deer were found dead in vast numbers. The losses were so severe that the Indians were reduced to a starvation diet for 3 or 4 years thereafter.

Sanford (1903) published the fascinating diary of Elisha Risdon, who hunted in Parishville Township (St. Lawrence County) during the years from 1804 to 1833. According to Risdon his deer kill record varied from one to 43 per year, and averaged about 20 per year. The total amounted to 579 over the 28-year period.

Another early resident of St. Lawrence County, Thomas Meacham, was reported by Simms (1850:271) to have killed 214 wolves, 77 panthers, 219 bears, and 2,550 deer during his lifetime. Meacham died in 1849 or 1850 in the town of Hopkinton.

Other famous Adirondack hunters and trappers included John Cheney (Donaldson, 1921) and Nat Foster (Simms, 1850; Byron-Curtiss, 1897). Both had impressive lifetime records of game killed, but it must be remembered that they, like Risdon, often hunted on a year-round basis and that in all probability many of the deer were killed in winter in concentration areas.

Hinton (1834:108) wrote, concerning the value of deer to the pioneers: ". . . improvements in agriculture had long since rendered this supply of food of comparatively little value to the whiteman; yet vast numbers of this species are annually destroyed . . . Notwithstanding this extensive consumption, however, this species does not appear to be rapidly diminishing, if we except the immediate vicinity of very thickly populated districts." This is significant, for previous writers usually stressed the presence of deer near most centers of population. Hinton further emphasized this point by referring to laws intended to prevent the destruction of deer during the breeding season.

DeKay (1842:114) provided a slightly different interpretation of the abundance of deer in New York just prior to the middle of the 19th century: "This well known animal is still found in almost every part of the State, where there is sufficient forest to afford them food and cover." This observation appears to tie in with the fact that the land economy of the State at that time was becoming preponderantly agricultural. The same author stated further that: "From the mountainous regions of Orange, Rockland, and Delaware the city market is supplied [with deer] in great abundance during the winter. In the most northerly counties, they are not numerous; and in other counties, the united attacks of men and wolves are daily decreasing their number." DeKay's "other counties" probably referred to those bordering the Adirondack and Catskill highlands, and to western New York.

A definite change in the trend in numbers of deer was not generally evident until about 1840 or 1850, by which time the slaughter by the settlers and the tremendous increase in farm acreage had more than counterbalanced the earlier beneficial effects of the opening of the dense forest cover. Evidence of this is found in a number of contemporary accounts.

Goodwin (1859:314), writing of deer in Cortland County during the early part of the 19th century, stated: "They were almost as numerous as the dairymens' cattle are at the present day . . . Twenty, and even thirty, noble bucks have been counted in a drove, as they swept through the woods pursued by the hunters' well trained dogs . . . Notwithstanding this horrible crusade . . . his [the deer's] progeny have not been fully exterminated, for even to this day [1855] an occasional buck . . . may be seen bounding through the southern limits of this county."

Taylor (1873:41) wrote: "The principal of these animals found existing in the wilds of the now Town of Portland [Chautauqua County] were bear, wildcat, beaver, deer, fox, rabbit, porcupine, woodchuck, raccoon, muskrat, skunk, mink, weasel, and squirrel. The first five of these have entirely disappeared . . ."

Fisher was quoted by Miller (1899) to the effect that the last deer killed near Sing Sing (Westchester County) was shot in 1861. Mearns (1898) mentioned the capture of a deer near Middletown (Orange County) in 1878, and stated that it was the only authentic record that he knew of for the Hudson highlands although deer occasionally were found in northwestern Orange County.

In its second annual report (1887:116) the Forest Commission of New York stated, with reference to the Catskill Preserve: "Hunting in

this region is confined chiefly to grouse, rabbits, squirrels and such small game. Deer are rarely seen and much more rarely killed. The last of the deer were killed off some twelve years ago when there was a great body of snow fell, on which a crust formed of sufficient strength to bear the weight of a man. Pot hunters came into this region . . . and killed large numbers of deer, from which the hides were taken and the carcasses left to rot in the woods . . . It is fair to suppose that there are not a dozen deer in this whole Catskill region . . ."

According to Minard and Merrill (1896:141) the deer were killed or driven out of Allegany County, the last ones being seen near Independence about 1881. The lack of mention of deer in the local histories of western New York in the late 1800's lends support to the conclusion that the species had been extirpated from the region by that time.

On Long Island there was some concern during the middle and late 1700's about the decrease in their numbers (Lloyd Family Letters, 1927; New York State, 1886), but the deer persisted and eventually increased. Samuel Jones (1821:332) noted: "The principal hunting grounds are in the townships of South-Hampton, Brookhaven, Islip and Huntington . . ."

Some additional light is shed on the decline of the deer population by the following from Beck (1938): "The settlement of a large part of New York State took place soon after the American Revolution . . . The number of farms increased until about 1880, when there were about 241,000 farms in the State, comprising about 22,900,000 acres. Since that time the number has declined to about 177,000 farms aggregating about 18,686,000 acres in 1935. Most of the decline has been brought about by the abandonment of the land too poor for farming."

The 1880 high in farm acreage represented about 75 per cent of the total land area of the State and, of the remaining 25 per cent, about four-fifths was in mountains and unavailable for agrciulture. Small wonder that the deer had been exterminated except in the North Woods of the central Adirondacks.

The picture, then, is one of a marked decline of the New York deer population through most of the 19th century to a low between 1880 and 1890. The decrease was statewide except for the wild, nonagricultural region of the central Adirondacks, and can be compared with essentially parallel situations in many other states, although the time element varied somewhat.

For instance, in 1842 the only recent record of deer in Connecticut was of one killed the previous year in the town of Waterbury. In Massachusetts, the chief range of the species in 1893 was a triangle about 15 miles on a side at the base of Cape Cod with possibly 300 deer living in the area. There was also a residual population in the Berkshires. Deer seem to have increased gradually in Massachusetts and Connecticut from about 1884, spreading from the Berkshires and Cape Cod into adjoining areas (Allen, 1930).

In Pennsylvania and New Jersey, deer had been virtually extirpated by about 1900 and the killing of one was front-page news. In Pennsylvania they were probably most numerous in the Pocono and South Mountain region, although a few remained in some 30 other counties. In New Jersey there were only a few scattered stragglers (Rhoads, 1903:26).

In Vermont the bulk of the deer population in colonial days occurred in the more open southern part of the state. The settlement of this region at first led to an increase, but, as the area under cultivation grew, the deer herd began to decrease. This cycle rolled northward as the wilder, more densely forested parts of the state were opened up and by 1840 deer were extremely scarce. Remnants of the herd probably persisted in Essex County and possibly in the region around Mt. Mansfield. However, a long closed season from 1865 to 1887 prevented complete extirpation. Seventeen deer were obtained from sources outside the state and released near Rutland in 1878, and the present substantial population is generally considered to have stemmed from this release (Foote, 1945).

A brief review of legal restrictions on the taking of deer in New York is of value in connection with tracing variations in the numbers of deer since colonial days. The earliest known law regulating the taking of deer was enacted in 1705 (New York State, 1894a). It prohibited the killing of deer except between August 1 and January 1 in certain counties. Such laws were continued, or amended in later years with increased penalties.

The first statewide deer law was passed in 1788 and established a closed season from January to July, inclusive (New York State, 1886). In general, the laws enacted during the succeeding century expressed increasing concern with the problem of perpetuating the deer.

DEER POPULATIONS SINCE 1880

What are considered to have been the important centers of deer population in New York and those portions of neighboring states

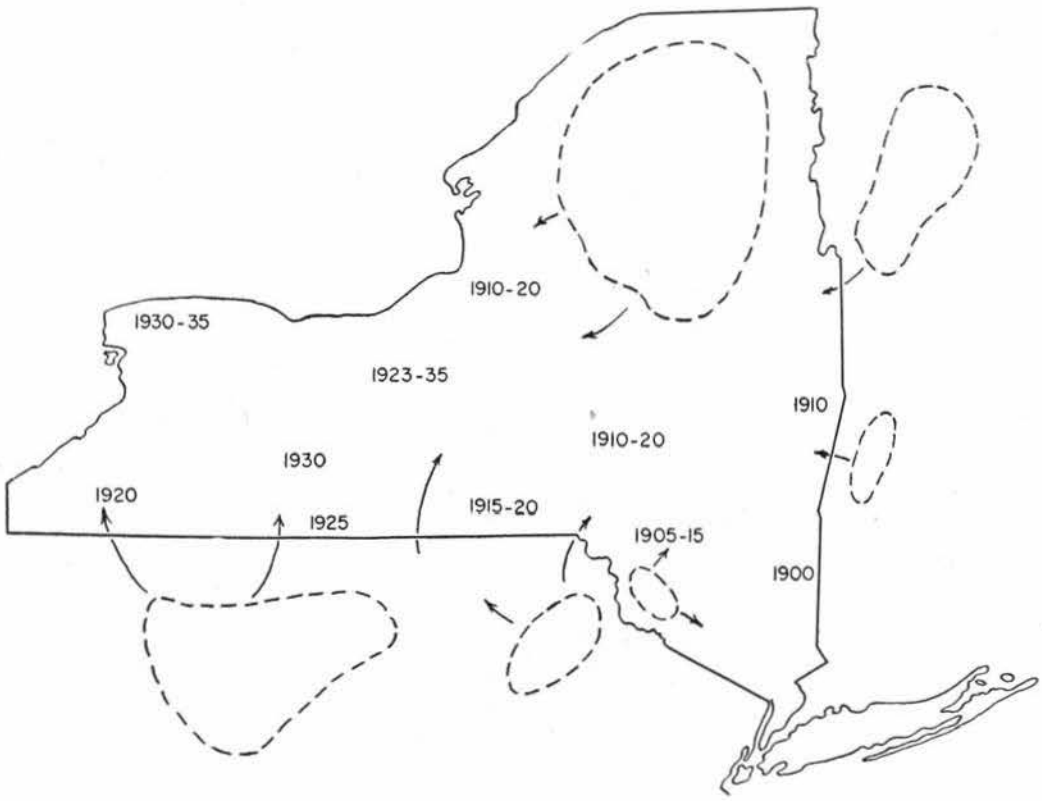


Figure 1. Major centers of population in 1890-1900 in New York and vicinity from which deer have since spread throughout the State. Dates represent approximate time deer appeared in various sections.

immediately adjacent to its borders, during the approximate period from 1890 to 1900, are shown in Figure 1. This map is based in part on published reports of Allen (1930), Foote (1945), Miller (1899), and Rhoads (1903). An attempt has been made to chart thereon the spread of deer from these centers, using information obtained through correspondence with Roger Seamans of the Vermont Fish and Game Service, Robert McDowell of the Pennsylvania Game Commission, and L. G. McNamara of the New Jersey Fish and Game Division, as well as data collected in New York by Severinghaus.

In describing the growth and spread of New York's deer population since about 1880 it has been deemed most convenient and logical to consider the following regions[3] separately: Adirondack, Catskill, central and western New York, and Long Island. These regions (Figure 2) possess physical characteristics which set them apart, and they present different problems in deer management. Although con-

[3] Cheatum and Severinghaus (1950) gave a more comprehensive discussion of these regions.

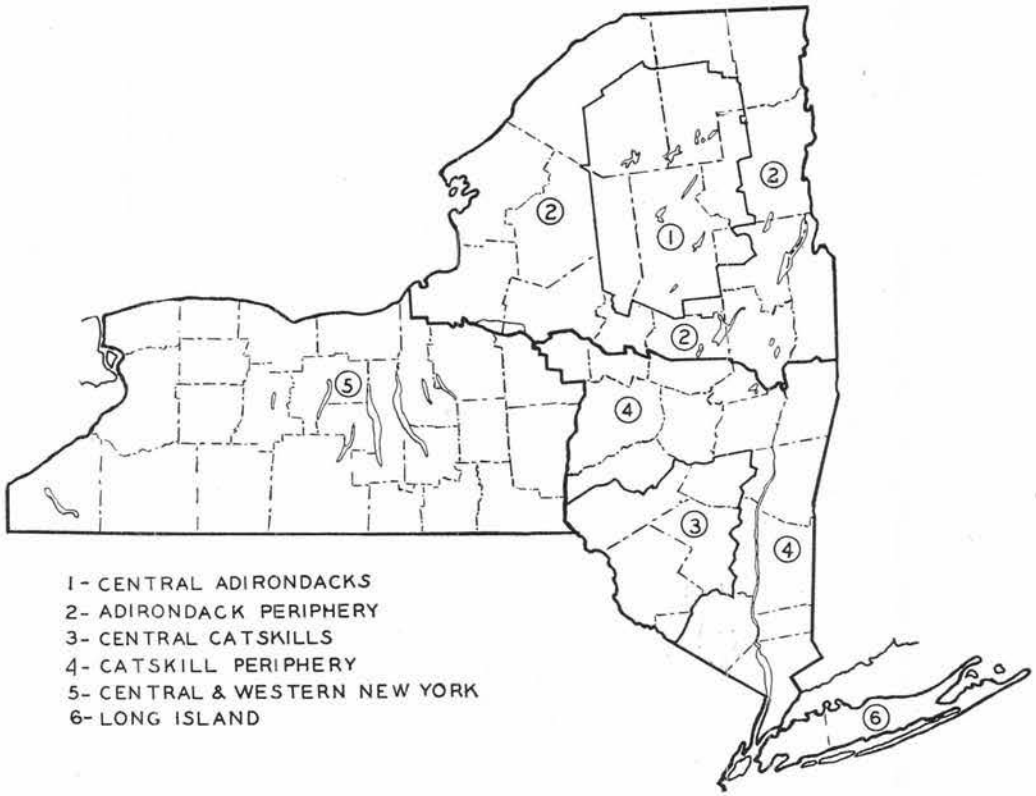


Figure 2. Regions of New York recognized with respect to deer management problems.

ditions intergrade, township boundaries have been used to approximate the lines of demarcation between them.

Adirondack Region

The number of deer in early historical times seems to have been greater in the area immediately adjoining the Adirondacks than in the central part of the region. The deer herd was reduced substantially in this peripheral area during the 1880's, but a decided increase occurred in the central portion as a result of lumbering. At first glance, one may question the latter statement since it is well known that large numbers of deer were killed for use in the lumber camps, resulting in temporary local scarcity. However, as the lumber operations moved from place to place sprouts and seedlings sprang up in their wake, encouraged by the more favorable light conditions, and the deer responded to the improved food situation. This was ably described by Fox (1896:166): "The best and most abundant feed is found in forests from which the larger spruce and pine trees have been removed years ago. These lumbering operations not only left the land well shaded by the remain-

ing hardwoods and small evergreens, but promoted a certain growth of underbrush, which is generally lacking in our primeval forests. This underbrush, together with the grasses and shrubs that spring up along the old abandoned log-roads, furnish an abundance of nutritious food . . . The reappearance of the deer on these burned and lumbered tracts, and their rapidly increasing numbers in these localities has been a matter of wonderment and frequent remark by the residents during the past few years."

This applied very well to the first selective cutting for choice pine and spruce. The deer found their food supply improved, and no real harm had been done to the forest from the standpoint of winter shelter. However, subsequent lumbering activities were not so benign. Actually, most of the larger operations since about 1905 or 1910 have been for pulpwood, whereas up to about 1850 the cutting was mostly for pine, and later for pine and spruce, for lumber. Fox (1902:24) gave the total cut for northern New York in 1900 as 533,339,072 board feet, of which 230,649,292 board feet were for pulp. The trend toward cutting for pulpwood continued at an accelerated pace as the supply of larger logs became depleted, and the value of stumpage for pulp came to exceed that for lumber. According to Fox (1901:277), "The effect on timber cutting was soon evident. Where the lumbermen formerly took nothing less than two-log trees, leaving nearly all that were 12 inches or less in diameter on the stump, the woodpulp men cut all the trees of certain species, large and small." This severe cutting of softwood species for pulp had a decidedly adverse effect on the winter range of deer, since the size of yarding areas was reduced through the removal of the protection afforded by the evergreens.

In conversations with Severinghaus, the late Wellington Kenwell described the destruction of winter deer habitat in the Moose River section as witnessed by him during the last decade of the 19th century. Removal of the spruce cover in the saddles connecting the Moose River and Red River valleys near their junction deterred deer from using the saddles for feeding or travelling from one valley to the other during periods of severe weather and deep snow, thus effectively reducing their winter range.

Subsequent adoption of scientific forestry methods by private timber owners has tended to reduce the damage done to wintering areas through cutting of softwoods, although in actual practice pulpwood still is cut to a very low diameter limit. Another development which has worked to the benefit of the deer during recent years has been the very considerable increase in the cutting of yellow birch and

other hardwoods since the advent of tractors, hard roads, and trucks has rendered their harvest economically feasible.

The peak deer population density in the central Adirondacks appears to have occurred soon after 1890 and quickly led to overbrowsing of the winter range. As a result of competition for winter food some of the better browse species were completely eliminated from many of the yarding areas. Among these was American yew (*Taxus canadensis*), sometimes known as ground hemlock or "shin" hemlock (Fox, 1896:165; Spiker, 1933:336). Witchhopple (*Viburnum alnifolium*) and white cedar (*Thuja occidentalis*), both preferred foods, became extremely scarce. Increment borings taken from white cedars in wintering areas on the south branch of the Moose River about 1945 showed the youngest specimens to be about 75 years old. These and older trees apparently were high enough to escape or survive the heavy browsing which occurred during the winters when the first overbrowsing occurred, and subsequent winter deer concentrations have prevented seedlings from developing.

Food shortages contributed to the heavy mortality which occurred in some localities during the severe winters of 1892-93, 1894-95, and 1903-04. The magnitude of the winter-kill in the first two years was appraised by Fox (1896) who mailed questionnaires to 248 reliable, permanent residents or landowners in the Adirondacks. It was clear that serious loss occurred in several areas. One correspondent, Wellington Kenwell, stated that about 250 deer died in the vicinity of Indian Clearing on the south branch of the Moose River (Hamilton County) during the winter of 1892-93, and that many died in the same area two years later. He expressed the opinion that there were too many deer for the food supply. Another, Cornelius Carter of Benson Mines (St. Lawrence County) described the heavy mortality in that region during both winters, citing the deep snow, severe cold, and lack of beechnuts. The section within which the heaviest losses were reported is shown in Figure 3.

Regarding the winter of 1903-04, the Forest, Fish and Game Commission carried on an investigation of the extent of mortality and concluded that substantial losses occurred mainly in the vicinity of Newcomb in Essex County, Big Moose Lake in Herkimer County, and the south branch of the Moose River in Hamilton County. Its 10th annual report (1905) included the autopsy records for four winter-killed deer and a discussion by Dr. Samuel B. Ward as to the probable causes of death as well as conditions in general. The dead deer examined contained large amounts of balsam needles and lesser amounts

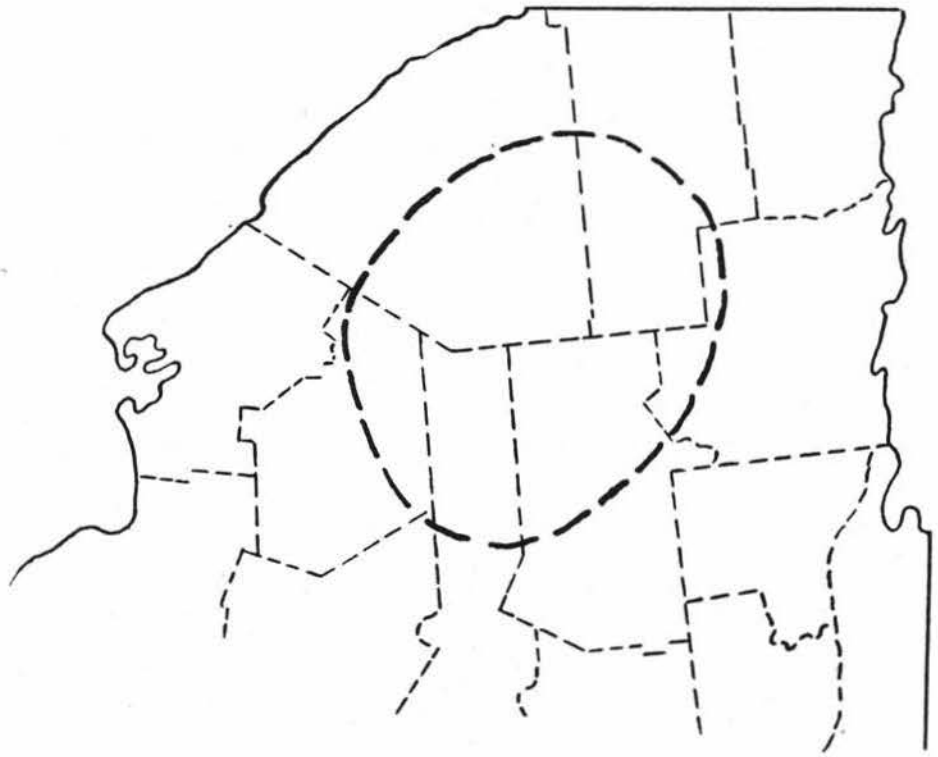


Figure 3. Portion of Adirondack region from which heaviest winter mortality was reported in 1894-95.

of hemlock browse. It is known today that a diet composed chiefly of balsam will not sustain deer, and that hemlock is but a mediocre food (Maynard *et al.,* 1935; Aldous and Smith, 1939). While Ward and his correspondents found it difficult to understand how a deer could starve with a full stomach, nevertheless several were forced to that conclusion. Others conjectured on the possibility of disease or poison, but the autopsies did not substantiate these theories. Dr. V. A. Moore, pathologist of the New York State Veterinary College, who examined three other specimens, also reported he could find no evidence of disease and concluded that the deer probably died from starvation.

The severe winter of 1903-04 was followed by several mild winters. The fact that deer mortality was negligible during these years was explained by Burnham (1907:179): "The favorable result is due to the light snow fall, which permitted the deer to travel far in search of food. During this time the heaviest cut of evergreen timber in the history of the Adirondacks has been made. Many famous yarding grounds for deer have been obliterated. The result will be that many deer will perish the first severe winter of heavy snows."

The decline in abundance of deer in the Adirondacks during the late 1800's and early 1900's spurred the enactment of measures calcu-

lated to conserve the remaining herd and, eventually, to increase it. Among these were shortening the open season in 1886[4] and reducing the legal limit from three to two deer in 1892,[4] and the outlawing of hounding as well as "floating" (hunting from boats) and the use of jack-lights in 1897 (Darrow, 1955). Throughout the region as a whole deer were at a low ebb, and these restrictions were sound in eliminating wasteful hunting methods. Nevertheless, over much of the more remote interior as well as on the larger private preserves, over-browsing continued. Here, during the ensuing 50 years, the deer population has been able to prevent recovery of the carrying capacity of the winter range, due to inadequate harvests. Temporary increases have followed mild winters, only to be lost through starvation and winter-kill during the next severe winter.

During the first quarter of the 20th century estate owners, recognizing the scarcity of winter food for deer, experimented with winter feeding and, for a few years, game protectors cut and stacked marsh or "beaver-meadow" hay for use by deer in winter (New York Conservation Commission, 1914:187). These efforts were well nigh useless in the over-all picture. Controlled feeding experiments by Department biologists since have proven marsh hay (known to be low in protein and calcium) to be practically worthless as winter feed for deer (Maynard *et al.,* 1935). Although deer still are fed on a few private estates in order to bring small numbers of semitame animals through the winter, large-scale feeding and lopping of browse have been discontinued.

The central Adirondack deer herd built up somewhat during the period from 1905 to 1910, as a result of five consecutive mild winters, but was drastically reduced during the severe winter of 1910-11. The controversial "buck law" went into effect in 1912, setting the bag limit at two deer having antlers not less than 3 inches long. The intent of this law was to increase the numbers of deer by protecting does, thus in theory permitting them to breed and produce fawns without being exposed to hunting. Unfortunately, it was not that simple. A large illegal kill of does still occurred each year, and does and fawns continued to be the chief victims of winter starvation.

Although the population increased between 1911 and 1925, the winter of 1925-26 was very severe and the heavy winter-kill was re-

[4] In the reference cited, both these dates were erroneously given as 1895. The shortening of the open season was from August 1-November 30 to August 15-November 1, although it was extended to November 15 in 1897. Also, prior to 1886, there had been no bag limit.

flected in the drastic drop in the legal take during the fall of 1926. District Game Protector Burmaster wrote to Chief Game Protector Legge on May 6, 1926, in part: "This has been the worst winter . . . I ever saw. We have had from four to five feet of snow on the level and there was no crust. This deep snow lasted all through April . . . This has been a very hard winter on deer. . . ." According to Weather Bureau records snowfall in some Adirondack localities amounted to as much as 53 inches in December, 42 inches in January, and averaged 31.6 inches in February.

Again deer numbers increased until the severe winter of 1930-31 and further growth was delayed by starvation losses until the period between 1935 and 1939. From then until 1948, moderate to heavy annual losses due to starvation prevented an increase. However, since the severe winter of 1947-48, a tremendous increase has occurred. If the pattern of the past prevails, the next severe winter will witness the loss of thousands of deer which might better have been harvested during the preceding few years.

The foregoing discussion has applied primarily to the interior of the Adirondack region in regard to the correlation of range quality and population trend. With respect to the peripheral sections as well as the vicinity of settlements and the major roads, on the other hand, the situation has been quite different. Deer abundance has seldom approached the carrying capacity of the range and winter mortality has been comparatively unimportant. It is believed that illegal hunting, both during and outside the open season, has been the chief factor in preventing an increase in the deer herd. Although this territory includes parts of counties that also fall within the central section, the following counties are considered to lie wholly within it: Clinton, Fulton, Lewis, Jefferson, Oneida, Oswego, Saratoga, and Washington.

In summation, the herd in the peripheral area is in reasonably good balance with the winter food supply and is being kept in that status by the degree to which antlerless deer are being taken illegally. By the same token it would seem desirable to provide for taking these deer legally during the open season. Over much of the central Adirondacks, however, there are too many deer for the available food and winter mortality is more important than hunting, either legal or illegal, in governing the population trend.

A long stride was taken toward the implementation of sound management plans when, during the open season of 1954, deer of both sexes were declared legal game in two large, essentially wilder-

ness tracts in New York's North Woods. This measure had been advocated by Department biologists, and was calculated to harvest surplus deer, as well as to obtain a better balance between the population and the carrying capacity of the winter range. The season was successful, by and large, although hunting pressure in the interior of the tracts was not as heavy as had been hoped.

Catskill Region

The deer population east of the Hudson River from Rensselaer County south (Washington County being considered part of the Adirondacks) was extirpated between 1850 and 1900. In the New England area to the east, only a small residual population existed in the Berkshires during the late 1870's. By the middle of the 1880's this small herd had increased and deer again were being seen in eastern Connecticut by the 1890's (Allen, 1930). As the Berkshire population grew, it spread out in all directions. The date when this expansion reached New York State has not been determined. However, the deer season was closed in Putnam County in 1902, in Rensselaer County in 1903, in Dutchess and Columbia Counties in 1904, and in Westchester County in 1905 in order to protect and encourage the increase of the few deer that had come into these areas. It was a matter of considerable interest when five deer were seen in eastern Rensselaer County in 1913 (New York Conservation Commission, 1914:187).

Since that time, deer abundance in this part of the State has increased slowly. There can be little doubt that the major factor limiting growth has been the illegal killing of female deer. Predation and other causes of loss are considered to have had a relatively minor effect. Open seasons have been provided throughout most of the area in recent years.

The virtual disappearance of deer from the Catskill region west of the Hudson River about 1875 has been mentioned previously. Small residual populations persisted in portions of Sullivan and Orange Counties adjacent to the Pennsylvania border and, in addition, a few deer drifted across into New York from time to time.

In 1887 the Legislature passed an act providing for the establishment of three parks in the Catskills for the propagation of deer and other game species (New York Forest Commission, 1889). One park of 100 acres was fenced in Shandaken Township (Ulster County) and stocked with 45 deer trapped in the Adirondacks during 1889 and 1890. The herd grew to 53 deer by 1894 (New York Forest Commis-

sion, 1895:7). It was hoped that these deer would multiply to such an extent that their progeny, released from time to time, would serve to re-establish the population in this part of the State. However, the browse supply was soon exhausted, and it became necessary to feed the animals. Furthermore, they failed to reproduce in captivity as well as expected and in July, 1895, the 45 remaining were released (Fox, 1896:202).

In the meantime the region was being reoccupied by deer, presumably from the nucleus in Sullivan and Orange Counties and from the area south of the Delaware River (New York Fisheries, Game and Forest Commission, 1897:301). Thus, those released from the Catskill Park merely served to hasten slightly the natural expansion of this population. But, the herd grew very slowly, one reason, according to the same authority, being that deer were killed by local residents at all seasons. The fact that there were few deer outside the central part of the region in the late 1800's is attested to by the report that "three were killed in Chenango, and one in Albany County" in 1895 (Fox, 1896:202). But growth continued, and more and more of the territory was opened to hunting.

Throughout most of this period, densities were highest in Sullivan County in the southern half of which the population reached the carrying capacity of the winter range between 1929 and 1932. This became evident in the winter of 1933-34 when deer died of starvation in several areas. Again in 1935-36 starvation occurred in this part of the county, and the number of areas and number of deer found dead caused alarm to many people in the area. Losses due to starvation occurred once more during the winter of 1939-40, and that spring personnel of the deer research project made their first survey of the situation. This reconnaissance was concentrated on private lands in the township of Bethel.

During the next few years the deer population continued to expand into the central part of the county, and continued to grow in the northern part. However, it did not increase in the southern and southwestern portions. During the winter of 1944-45 substantial numbers died of starvation, chiefly in the townships of Tusten, Bethel, Thompson, Highland, Lumberland, and Forestburg. The losses were so large that local leaders and county officials asked the Governor to have the Conservation Department appraise the situation and recommend ways and means of alleviating it. A survey revealed that the best deer forage in the major wintering areas had been browsed so severely for many years that much of it had been killed. It was obvious

that there were far too many deer for the available supply. Although an open season for antlerless deer was recommended, it was not supported by local sentiment.

In other parts of the Catskills west of the Hudson River the deer problem was not as serious as in Sullivan County. However, in Bear Mountain Park and Harriman Park large numbers were found dead from starvation after the winters of 1939-40 and 1944-45. Deer damage to agricultural crops had been a serious problem in parts of Orange and Rockland Counties since the early 1940's and in some years many deer were killed under permit. This problem was temporarily relieved in Rockland County by the open season for antlerless deer in 1943.

In summary, deer abundance throughout the Catskill region has increased steadily during the past 50 years, and has now reached a point where, especially in the territory west of the Hudson River, excess numbers have begun to overbrowse the winter range.

Central and Western Region

Deer had been exterminated from this part of the State by the 1860's, and did not begin to reappear until about 1910. Repopulation seems to have been a result of expansion from Pennsylvania, chiefly; there seems to have been little from the Catskill region and virtually none from the Adirondack periphery. Small permanent populations became established between 1915 and 1935 (Figure 1). This did not occur as the result of long migrations by individual deer. Rather the expansion was gradual. Apparently, a few deer moved a few miles and, as they became established and reproduced, their progeny repeated the process. The expansion seems to have been in all directions. Thus, by the mid-1930's, deer had spread throughout most of the region.

Permanent populations did not become established in central and western New York until population pressure from the south and southwest held deer there. This was true even in the northern parts of Cayuga, Onondaga, and Madison Counties. But here the expanding population encountered a belt, some 30 to 50 miles wide, representing the margin of the Adirondack region where, as already pointed out, the illegal killing of antlerless deer during the past half century has held deer abundance at a low level. As a consequence, growth in this territory has been stalemated.

This region affords the best deer range in the State. Once estab-

lished, the herd increased rapidly and, beginning in 1938[5], hunting for antlered deer has been permitted annually. As would be expected, deer reached a high degree of abundance in the Southern Tier counties bordering Pennsylvania first. By the early 1940's they had come into conflict with agriculture and during the next decade this became a problem throughout the region. As a basis for later measures to check population growth, an experimental open season for antlerless deer was held in Steuben County in 1941. Since then, provisions for taking antlerless deer have, from time to time, been extended to most of the other counties. As a result deer damage has been minimized and the population has been held at a level where range depletion has been largely avoided.

LONG ISLAND

Deer never have been exterminated from Long Island. It was reported that the species was more plentiful there in 1893 than in Connecticut and Rhode Island, and that in 1895 there was enough land open to public hunting "to permit the killing of over two hundred deer each season" (Fox, 1896:203). Miller (1899) published a letter from a Mr. Helme who stated that, although deer formerly were common throughout Long Island, they were at that time (about 1899) restricted to an area of about 25 square miles in the townships of Brookhaven and Islip.

The population remained at about the same level during the period from 1900 to 1939. The chief centers of abundance were in the vicinity of Hechscher State Park, the Southside Sportsmen's Club, and the Tangier Smith Estate near Mastic, while lesser numbers occurred in the vicinity of Cedar Point, North Haven Point, and Lake Ronkonkoma. Deer increased in numbers between 1939 and 1945, and extended their range to include about half of Suffolk County and parts of eastern Nassau County with a resultant serious increase in crop damage. Since 1945 the herd has spread gradually but apparently has not increased appreciably in number, being estimated at between 1,500 and 2,000 in recent years.

A population of this size would produce from 500 to 700 fawns per year. It follows, therefore, that stabilization of the population at its present level must entail annual losses, from all causes, equal to the annual increment. The future potentialities of the Long Island deer

[5] In 1928, hunting had been permitted in all counties of the State but this was of little significance in central and western New York.

herd will depend on the attitude and desires of the landowners and residents. It is obvious that the deer population could withstand an open season because such has existed, in effect, for many years. Comparatively little land would be open to public hunting, since the greater part of the deer range there consists of posted private land. The problems involved in eventually being able to have an open season lie in the field of human relations.

HUNTING REGULATIONS SINCE 1900

Under the foregoing topics brief references have been made to hunting regulations as related to the contemporary abundance of deer. In 1908 and 1909 more of the State was closed to deer hunting than

Figure 4. Lowest ebb of area open to deer hunting in New York (1908-09).

at any time before or since (Figure 4). In Tables 1 to 3, the regulations for the three major regions since 1900 are summarized; Long Island has had no open season since 1910[6] (except in 1928) and is

[6] From 1900 to 1909 deer hunting was permitted on the first two Wednesdays and first two Fridays after the first Tuesday in November.

TABLE 1. SUMMARY OF DEER HUNTING REGULATIONS IN THE ADIRONDACK REGION OF NEW YORK FROM 1900 TO 1955

Year	Open season	Bag limit	Remarks
1900-05	September 1–November 15	Two*	
1906	October 1–November 15	"	
1907-08	September 16–October 31	"	
1909	September 16–November 15	"	Bucks only after October 31
1910-11	September 16–October 31	"	
1912-18	October 1–November 15	" §	
1919	October 1–November 15	One	Deer of either sex, except fawns
1920-30	October 15–November 15	"	
1931	October 26–November 15	"	
1932	October 25–November 15	"	
1933-38	October 15–November 15	"	
1939-42	November 1–November 30	"	
1943	October 20–November 30	"	Anterless deer October 20-25†
1944-50	October 20–November 30	"	
1951	October 25–November 25	"	
1952-53	October 25–November 30	"	
1954	October 25–November 30	" ‡	Taking antlerless deer permitted in two wilderness tracts‡
1955	October 25–November 30	"	

* Taking spotted fawns prohibited.
§ Beginning in 1912, except as noted under "remarks", only deer having antlers 3 inches or more in length were legal game.
† Special license required.
‡ Special license required entitling hunter, if he also held a big game license, to take two deer (one antlered and one antlerless) on the wilderness tracts.

not included. The terms under which antlered deer could be hunted from year to year have been set by the Legislature. For antlerless deer or deer of either sex, however, they have ben declared by the Conservation Department within the framework of conditions fixed by law.

As defined by law, there have been minor variations from time to time in the scope of the three regions of the State. The boundary between the Adirondacks and Catskills, in particular, has been subject to adjustment. In general, in recent years, the southern portions of Herkimer, Oneida, Oswego, and Washington Counties have been part of either the Catskill or the central and western regions with respect to deer hunting regulations.

The open season dates given are the ones primarily applicable from year to year. There have, however, been various local exceptions, especially in the Catskill region since 1917, but space does not permit giving these in detail. It may be mentioned that from 1903 to 1907 parts of some western Adirondack counties had no open season. Of interest, too, is the fact that in Dutchess County from 1917 to 1934, and in Columbia and Rensselaer Counties in 1917, deer hunting was restricted to the owners or lessees of land and their immediate families.

TABLE 2. SUMMARY OF DEER HUNTING REGULATIONS IN THE CATSKILL REGION OF NEW YORK FROM 1900 TO 1955

Year*	Open season	Bag limit	Remarks
1900-01	September 1–November 15	Two§	
1902	September 1–November 15	"	Sullivan County, November 1-15
1903-05	September 1–November 15	"	Orange and Sullivan Counties, November 1-15
1906	October 1–November 15	"	
1907	September 16–October 31	"	
1908†	September 16–October 31 (a) October 16–31 (b)	"	
1909†	September 16–November 15 (a) October 16–31 (b)	"	Bucks only after October 31
1910-11†	September 16–October 31 (a) October 16–31 (c)	"	
1912-18†	November 1–15 (c)	"‡	
1919†	November 1–15 (c)	One	Deer of either sex, except fawns
1920-37	November 1–15	"	
1938	December 1–15	"	
1939-42	November 15–30	"	
1943	November 15–30	"	Antlerless deer in Putnam and Rockland Counties, December 9-11°
1944-50	November 15–30	"	
1951	November 22–December 6	"	
1952	November 15–30	"	Deer of either sex in certain counties, November 28-29
1953-54	November 15–30	"	
1955	November 21–December 6	"	

* In 1900 and 1901 there was no open season in the counties of Delaware, Greene, Sullivan, and Ulster. The next year Sullivan County was opened, but by 1905 the counties of Columbia, Dutchess, Putnam, Rensselaer, Rockland, and Westchester had also been closed. From 1908 to 1919 the area open to hunting was further restricted as shown in a subsequent footnote. In 1920 hunting was permitted in the counties of Delaware, Dutchess, Orange, Rensselaer, Sullivan, and Ulster. Since then other counties or parts thereof have been added at various times.

§ Taking spotted fawns prohibited.

† From 1908 to 1919 the seasons for the areas open are indicated as follows: (a) Dutchess County; (b) parts of Orange and Sullivan Counties; (c) the area of (b) plus Ulster County.

‡ Beginning in 1912, except as noted under "remarks", only deer having antlers 3 inches or more in length were legal game.

° Special license required.

In addition to the open seasons as shown in the tables, there has been each year since 1948 a separate season for archers under a special license. This season has constituted the 14 days immediately preceding the gunning season in those counties having such a season. From 1948 to 1951 only antlered deer might be taken; since then any deer.

TABLE 3. SUMMARY OF DEER HUNTING REGULATIONS IN THE CENTRAL AND WESTERN REGION OF NEW YORK FROM 1900 TO 1955

Year	Open season*	Bag limit	Remarks
1900-05	September 1-November 15	Two§	
1906	October 1-November 15	"	
1907	September 16-October 31	"	
1908-27	No open season		
1928	November 1-15	One†	
1929-37	No open season		
1938	December 1- 7	One†	
1939-40	November 24-30	"	
1941	November 24-30	"	Anterless deer, December 8-10‡
1942	November 24-30	"	
1943	November 24-30	"	Anterless deer, December 9-11‡
1944	November 24-30	"	Deer of either sex, November 24-30‡
1945	November 24-30	"	
1946	November 24-30	"	Anterless deer, November 24-30‡
1947	November 24-30	"	
1948	November 24-30	"	Deer of either sex, November 24-30‡
1949	November 24-30	"	
1950	November 24-30	"	Deer of either sex, November 30‡
1951	November 22-December 6	"	
1952	November 24-30	"	Deer of either sex, November 28-29‡
1953-54	November 24-30	"	
1955	November 21-December 3	"	Deer of either sex, December 3‡

* Beginning in 1938, deer hunting prohibited on Sunday falling within dates specified.
§ Taking spotted fawns prohibited.
† Beginning in 1912, except as noted under "remarks", only deer having antlers 3 inches or more in length were legal game.
‡ In certain counties or parts thereof (see text); special license required in 1941, 1943, 1946, 1948, and 1950.

In Westchester County, where deer hunting in recent years was first permitted in 1942 and where it has been limited to use of the longbow, the open season has been from November 15 to December 15 since 1945. Also, deer of either sex might be taken in 1944, 1945, and 1946, as well as since 1952.

In central and western New York, deer hunting was permitted for the first time since 1907 (except for the Statewide open season of 1928) when Broome, Cortland, Livingston, Steuben, and Wyoming Counties were opened in 1938. Most of the other Southern Tier counties were opened the next year and the rest of the region has been added subsequently.

It is in this region that the taking of antlerless deer has most often been permitted. Following the limited season in Steuben County in 1941, another was held in 1943 embracing a 13-county area largely in the Southern Tier section. The next year a still larger area was

included. In 1946 the area was restricted to the counties of Monroe, Niagara, Orleans, and Wyoming. Since 1948 (as well as in 1944), deer of either sex might be taken on such occasions rather than antlerless deer only. In that year such a season was declared for most of the western half of the region, in 1950 and 1952 virtually the entire region was included, and in 1955 five eastern and 10 western counties were involved.

With respect to hunting methods, the use of buckshot was made illegal in 1940. Beyond this, the principal change in recent years has involved the type of firearm that might be used. Prior to 1931 there was no restriction, except that in Dutchess County from 1917 on, as well as in Columbia County (1917-19) and in Rensselaer County (1917-23), only shotguns were permitted. As the territory open to deer hunting began to extend further into agricultural areas, however, it was felt that the use of rifles entailed an unwarranted hazard. For this reason, only shotguns loaded with slugs (20 gauge or larger) and the longbow may now be used outside the Adirondacks and central Catskills. Provision for legal use of the longbow was first included in the Conservation Law in 1929.

Table 4. Suspensions of Deer Season in the Adirondack Region Because of Fire Hazard

Year	Date closed	Date reopened	Season extended (number days)
1924	October 31	November 14	0
1930	October 15	October 19	0
1938	October 17	October 24	7
1947	October 17	November 1	12
1952	November 2	November 7*	5
1953	October 24	October 28	4

* Season reopened November 10 in Saratoga, Warren, and Washington Counties.

Occasionally, the hazard of fire has been so great that the Governor has been obliged to close the woods to the public, which has had the effect of suspending the open season for deer. The instances in which this has occurred are given in Table 4.

LEGAL KILL OF DEER

The number of deer taken from year to year is of interest both from a historical viewpoint and because of the value of such information in evaluating management practices. Before 1918 hunters were

not required to report game taken. The number of deer killed was compiled from estimates by game protectors, forest rangers, and other Department personnel. From 1918 to 1926 a report was required at the time a new license was purchased as it is now for small game. Up to this time the great preponderance of the deer taken were killed in the Adirondacks. The number recorded from 1900 to 1926 is given in Table 5. The figures are for the region as a whole since no county tabulation was made.

TABLE 5. REPORTED LEGAL KILL OF DEER FROM THE ADIRONDACK REGION OF NEW YORK (1900-26)

Year	Both sexes	Male	Female
1900	4,816	..	..
1901	5,144	..	..
1902	6,640	..	..
1903	9,176	..	..
1904	7,576	..	..
1905	9,936	..	..
1906	10,492	..	..
1907	8,652	..	..
1908	8,696	..	..
1909	12,100	..	..
1910	9,344	..	..
1911	7,668	..	..
1912	..	4,516	..
1913	..	5,912	..
1914	..	6,072	..
1915		(No record)	
1916		(No record)	
1917	..	5,543	..
1918	..	8,293	..
1919	..	8,470	3,444
1920	..	7,839	..
1921	..	9,065	..
1922	..	8,935	..
1923	..	8,030	..
1924	..	4,958	..
1925	..	9,492	..
1926	..	4,650	..

Beginning in 1927 a special deer license was instituted incorporating a stub to be returned to the Department if a deer was taken. Among the information called for on the stub were the date and county where taken. The records since that time have been much more accurate than previously, although it is known that many successful hunters have not complied in returning their stubs. Efforts have been made to appraise the proportion of the total legal kill repre-

TABLE 6. CALCULATED TOTAL DEER KILL BY COUNTY FOR THE ADIRONDACK REGION OF NEW YORK FROM 1927 TO 1955*

County	Year, sex, and age																			
	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943			
	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male		Female	
																	Fawn	Adult	Fawn	Adult
Clinton	79	105	108	127	112	131	187	143	357	224	165	189	229	197	159	129	5	93	7	16
Essex	749	841	805	797	948	1,019	1,159	1,149	803	1,317	1,244	1,285	1,424	1,157	988	1,000	119	852	103	495
Franklin	924	1,116	1,000	1,212	1,165	1,112	1,336	1,211	1,077	1,415	1,312	1,567	1,696	1,224	1,228	1,088	119	933	117	669
Fulton	192	248	204	213	201	220	244	224	199	207	193	175	187	123	143	99	..	76	..	..
Hamilton	1,743	1,776	2,007	1,762	1,813	1,661	2,057	1,981	1,793	2,111	2,021	1,995	2,105	1,619	1,636	1,355	137	1,248	139	848
Herkimer	1,153	1,149	1,179	1,216	1,039	992	1,132	976	844	872	1,075	1,120	1,008	772	785	596	79	609	77	424
Jefferson	21	24	17	27	20	25	31	39	16	24	24	44	31	40	29	27	..	27	..	..
Lewis	631	525	409	495	445	433	483	496	343	541	563	595	631	475	508	397	39	428	48	203
Oneida	91	91	103	127	103	127	173	137	124	140	176	163	199	167	141	115	..	135	..	..
Oswego	71	53	65	65	85	135	167	151	92	91	145	140	187	156	175	152	..	168	..	..
St. Lawrence	1,336	1,399	1,284	1,413	1,161	1,135	1,311	1,384	1,169	1,516	1,593	1,575	1,751	1,253	1,292	1,127	120	1,159	95	704
Saratoga	127	132	145	151	204	228	244	223	180	196	172	207	181	196	159	165	19	143	9	37
Warren	391	472	451	440	481	481	605	545	509	513	421	565	512	468	412	429	52	336	31	149
Washington	63	64	69	49	44	52	87	89	84	67	83	80	88	165	157	161	27	189	12	79
Unknown	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	7,571	7,995	7,846	8,094	7,821	7,751	9,216	8,748	7,590	9,234	9,187	9,700	10,229	8,012	7,812	6 840	716	6,396	638	3,624

TABLE 6. (CONTINUED)

County	Year, sex, and age															Square miles of deer range
	1944	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954				1955	
	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male		Female		Male adult	
											Fawn	Adult	Fawn	Adult		
Clinton	115	92	113	128	139	168	169	181	151	210	..	204	..	..	198	763.6
Essex	632	709	867	945	803	1,129	1,015	930	881 (1)	924 (3)	..	1,020	..	1	943 (3)	1,669.1
Franklin	783	872	956	1,140	1,097	1,297	1,407	1,485	1,776 (3)	1,635 (1)	..	1,946	..	3	1,602 (3)	1,434.5
Fulton	61	63	96	141	72	112	85	102	110	155	..	179	..	..	155	382.8
Hamilton	1,060	1,013	1,161	1,504	988	1,568	1,504	1,462	1,468 (7)	1,801 (9)	107	2,137	105	386	1,822 (5)	1,734.4
Herkimer	479	563	687	823	511	684	712	662	745 (4)	895 (3)	95	1,383	81	359	977 (9)	1,119.1
Jefferson	37	39	77	61	64	67	59	45	89	67	..	134	..	..	79	637.4
Lewis	317	288	468	557	352	465	413	477	532	534	..	743	..	..	664 (1)	1,001.1
Oneida	76	83	152	204	139	224	183	246	232	276	..	382	..	..	375 (1)	613.0
Oswego	97	84	171	179	119	199	143	143	173	243	..	275	..	..	235	617.7
St. Lawrence	909	849	1,044	1,483	1,248	1,409	1,718	1,931	2,021 (2)	2,175 (4)	83	2,754	94	339	2,106 (3)	2,034.5
Saratoga	107	120	128	228	144	184	152	157	125 (1)	162	..	191	..	..	196	558.7
Warren	281	269	363	451	333	420	391	433	273	399 (1)	..	414	..	1	434 (1)	809.8
Washington	101	140	257	281	191	223	240	306	214 (1)	323	..	402	..	4	409 (3)	404.3
Unknown	..	..	..	..	..	..	..	..	..	..	..	12	..	..	69	..
Total	5,055	5,184	6,540	8,125	6,200	8,149	8,191	8,560	8,790 (19)	9,799 (21)	285	12,176	280	1,093	10,264 (29)	13,780.0

* In 1952, 1953, and 1955 when only antlered deer might be taken during the regular season, taking antlerless deer was permitted during the special archery season; the figures are given in parentheses.

TABLE 7. CALCULATED TOTAL DEER KILL BY COUNTY FOR THE CATSKILL REGION OF NEW YORK FROM 1927 TO 1955*

County	Year, sex, and age																			
	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943			
	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male		Female	
																	Fawn	Adult	Fawn	Adult
Albany	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	24	..	..	..	..
Columbia	61	84	77	88	71	104	143	123	140	195	195	249	255	271	240	321	..	285	..	..
Delaware	96	84	83	120	119	136	340	221	171	232	325	415	419	507	483	549	..	607	..	..
Dutchess	4	3	15	15	19	28	23	29	107	113	112	245	245	267	243	353	..	399	..	..
Greene	36	40	47	84	56	65	145	157	172	192	192	331	344	335	320	353	..	359	..	..
Orange	95	128	147	312	217	227	236	341	340	367	353	417	505	485	343	485	..	528	..	..
Otsego	..	11	..	..	..	..	..	..	..	176	155	264	232	258	224	252	..	300	..	..
Putnam	..	59	..	..	..	..	..	..	..	..	..	..	..	..	..	..	60	29	55	184
Rensselaer	28	40	28	36	41	35	85	76	56	63	81	105	111	137	116	143	..	131	..	..
Rockland	..	..	..	..	..	..	..	..	..	..	..	..	..	..	197	279	25	220	23	87
Schenectady	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Schoharie	..	27	..	..	57	36	68	93	103	104	108	251	243	252	231	268	..	264	..	..
Sullivan	467	543	431	560	472	559	652	717	693	741	792	824	1,071	856	760	871	..	889	..	..
Ulster	219	204	153	229	200	204	352	288	177	259	280	405	455	439	361	393	..	397	..	..
Westchester	..	21	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	..
Unknown	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	1,006	1,244	981	1,444	1,252	1,394	2,044	2,045	1,959	2,442	2,593	3,506	3,880	3,807	3,518	4,292	85	4,409	78	271

TABLE 7. (CONTINUED)

County	Year, sex, and age															Square miles of deer range
	1944	1945	1946	1947	1948	1949	1950	1951	1952				1953	1954	1955	
									Male		Female					
	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Male adult	Fawn	Adult	Fawn	Adult	Male adult	Male adult	Male adult	
Albany	56	87	104	127	183	176	184	232	70	351	44	229	260 (1)	324 (6)	345 (8)	283.1
Columbia	287	293	304	380	403	464	399	563	..	539	..	..	745 (3)	784 (8)	917 (6)	355.4
Delaware	632	520	673	881	884	1,303	1,297	1,554	248	2,078	188	940	1,632 (6)	1,991 (10)	2,267 (16)	1,002.0
Dutchess	371	243	349	299	403	469	593	641	..	658	..	7	836 (5)	993 (6)	1,127 (13)	509.4
Greene	417	428	543	516	575	657	734	829	254	1,560	193	1,142	720 (4)	813 (9)	923 (5)	500.1
Orange	480	345	495	497	515	575	535	592	3	515	..	1	665 (4)	816 (8)	940 (9)	479.3
Otsego	308	309	389	512	500	676	679	852	152	1,003	134	686	802 (10)	1,026 (10)	1,065 (10)	530.5
Putnam	..	185	319	292	199	247	215	275	..	322	..	1	375 (6)	598 (11)	599 (11)	200.2
Rensselaer	128	97	163	163	193	201	226	213	..	187	..	..	259	311 (1)	372 (1)	383.6
Rockland	120	116	157	155	119	168	114	136	..	158	..	1	133 (3)	291 (2)	206 (9)	145.5
Schenectady	..	..	49	63	33	61	53	28	..	44	..	..	60	59	81	104.5
Schoharie	257	295	329	427	467	505	507	607	180	959	86	669	518 (4)	576 (9)	641 (10)	315.7
Sullivan	928	857	1,391	1,301	1,299	1,692	1,766	1,724	4	1,762	..	3	2,194 (30)	2,192 (10)	2,902 (27)	785.2
Ulster	428	437	660	761	683	867	874	999	..	1,017	..	..	1,440 (20)	1,440 (12)	1,504 (25)	911.3
Westchester	4	19	..	9	8	13	23	34	7	32	..	23	61 (41)	92 (48)	67 (90)	286.6
Unknown	..	..	..	..	..	..	..	..	..	..	..	..	..	8	95	..
Total	4,416	4,231	5,825	6,383	6,464	8,074	8,199	9,279	918	11,185	645	3,702	10,700 (137)	12,314 (150)	14,051 (240)	6,792.4

* In 1953, 1954, and 1955 when only antlered deer might be taken during the regular season, taking antlerless deer was permitted during the special archery season; the figures are given in parentheses.

TABLE 8. CALCULATED TOTAL DEER KILL BY COUNTY FOR THE CENTRAL AND WESTERN REGION OF NEW YORK FROM 1928 TO 1955*

County	Year, sex, and age																					
	1928	1938	1939	1940	1941				1942	1943				1944				1945	1946				1947
	Male adult	Male adult	Male adult	Male adult	Male		Female		Male adult	Male		Female		Male		Female		Male adult	Male		Female		Male adult
					Fawn	Adult	Fawn	Adult		Fawn	Adult	Fawn	Adult	Fawn	Adult	Fawn	Adult		Fawn	Adult	Fawn	Adult	
Allegany	1	..	1,990	1,649	..	1,133	..	..	1,265	265	1,792	243	826	880	2,481	853	1,625	883	..	1,339	..	..	1,224
Broome	7	322	238	270	..	184	..	..	259	24	238	22	103	136	442	133	253	213	..	276	..	..	367
Cattaraugus	7	..	1,403	1,343	..	939	..	..	1,147	144	1,621	132	640	507	1,663	492	937	702	..	1,038	..	..	1,107
Cayuga	..	..	..	..	..	228	..	..	133	..	144	..	..	..	79	..	..	61	..	85	..	..	121
Chautauqua	..	..	258	412	..	339	..	..	453	37	648	33	157	225	799	219	417	435	..	640	..	..	504
Chemung	..	..	355	252	..	240	..	..	226	30	312	27	103	132	472	127	244	174	..	301	..	..	441
Chenango	1	..	..	474	..	277	..	..	328	15	315	13	100	166	540	160	307	243	..	294	..	..	291
Cortland	..	216	180	225	..	154	..	..	136	..	226	..	..	..	135	..	..	160	..	181	..	..	336
Erie	..	..	..	..	..	492	..	..	487	36	465	33	147	138	547	133	255	160	..	432	..	..	315
Genesee	..	..	..	..	..	..	..	..	75	6	84	4	28	85	432	84	159	130	..	165	..	..	195
Livingston	..	..	..	..	..	544	..	..	460	60	502	57	232	229	780	222	424	265	..	439	..	..	604
Madison	1	..	..	..	..	..	..	..	144	..	130	..	..	..	151	..	..	132	..	153	..	..	243
Monroe	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	133	13	168	12	72	187
Niagara	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	12	105	10	73	93
Onondaga	..	..	..	..	..	..	..	..	99	..	78	..	..	..	115	..	..	66	..	99	..	..	133
Ontario	..	..	..	..	..	316	..	..	264	13	331	12	54	180	609	174	331	166	..	333	..	..	484
Orleans	..	..	..	..	..	..	..	..	..	..	..	..	..	58	289	57	109	132	42	159	39	111	144
Schuyler	..	..	250	234	..	199	..	..	241	..	216	..	..	84	274	81	154	132	..	235	..	..	163
Seneca	..	..	..	..	..	..	..	..	..	..	120	..	..	18	117	18	33	48	..	63	..	..	85
Steuben	..	1,534	1,055	1,123	174	921	211	273	1,076	219	1,373	201	631	522	1,742	505	963	744	..	1,380	..	..	1,054
Tioga	..	..	..	582	..	307	..	..	295	40	369	37	126	198	636	192	364	234	..	316	..	..	435
Tompkins	..	..	..	390	..	195	..	..	220	..	204	..	..	142	406	138	264	127	..	231	..	..	301
Wayne	..	..	..	..	..	..	..	..	..	..	..	..	..	54	250	52	102	70	..	94	..	..	94
Wyoming	1	..	..	..	..	606	..	..	534	64	625	58	252	180	576	175	333	169	82	385	76	241	468
Yates	..	..	226	190	..	162	..	..	243	..	276	..	..	108	370	103	198	142	..	237	..	..	297
Unknown	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	19	2,072	5,955	7,144	174	7,236	211	273	8,085	953	10,069	872	3,399	4,042	13,905	3,918	7,472	5,721	149	9,148	137	497	9,686

TABLE 8. (CONTINUED)

County	Year, sex, and age																				Square miles of deer range
	1948				1949	1950				1951	1952				1953	1954	1955				
	Male		Female			Male		Female			Male		Female				Male		Female		
	Fawn	Adult	Fawn	Adult	Male adult	Fawn	Adult	Fawn	Adult	Male adult	Fawn	Adult	Fawn	Adult	Male adult	Male adult	Fawn	Adult	Fawn	Adult	
Allegany	1,759	2,056	1,936	3,691	1,278	424	956	492	673	1,231	520	1,386	329	1,902	744 (17)	962 (11)	574	1,383	580	1,213	668.7
Broome	..	360	..	..	483	172	511	175	271	738	181	603	131	750	550 (2)	845 (6)	331	874	297	675	399.3
Cattaraugus	1,189	1,392	1,069	2,038	1,543	318	899	314	457	1,673	474	1,638	351	1,858	912 (35)	1,095 (14)	582	1,505	505	1,045	871.2
Cayuga	..	141	..	..	168	65	235	125	169	196	62	267	42	219	125	196 (1)	138	305	144	292	278.4
Chautauqua	885	1,035	771	1,471	910	204	626	222	240	1,226	460	1,195	312	1,382	726 (9)	900 (5)	411	1,134	361	799	597.4
Chemung	..	313	..	..	592	170	410	231	362	496	121	415	101	513	306	405 (5)	242	610	229	514	237.2
Chenango	..	510	..	..	648	237	730	225	466	1,027	341	992	207	1,211	741 (7)	1,190 (11)	882	1,810	1,020	2,108	543.8
Cortland	..	238	..	..	388	78	456	92	173	516	157	535	113	623	326	524 (5)	243	548	235	478	282.7
Erie	423	495	316	603	268	35	299	56	72	385	94	385	54	323	241 (1)	370 (4)	147	471	106	253	498.0
Genesee	205	241	186	354	142	41	159	45	97	190	53	184	33	240	137	173 (4)	86	239	69	156	186.6
Livingston	576	675	501	954	313	107	350	95	205	434	143	531	113	581	268 (3)	353 (1)	181	525	177	406	256.4
Madison	..	247	..	..	367	..	312	..	..	459	..	308	..	6	367 (7)	605 (4)	..	583	2	4	311.0
Monroe	..	118	..	..	136	44	146	53	101	118	17	125	9	95	91 (1)	127 (1)	1	118	..	2	223.1
Niagara	64	76	48	90	42	6	41	14	21	72	15	54	12	47	61	72	26	90	13	28	120.7
Onondaga	..	75	..	..	147	35	157	57	72	181	29	160	21	133	133 (1)	239 (3)	83	282	57	127	295.3
Ontario	403	472	472	901	319	77	306	90	143	404	161	483	107	623	291 (4)	401 (4)	..	535	..	4	259.1
Orleans	..	84	..	..	126	38	101	51	80	107	60	115	29	189	57	111 (4)	..	159	..	..	126.7
Schuyler	..	240	..	..	388	95	344	163	249	389	122	318	83	338	246	333 (4)	..	429	..	4	190.5
Seneca	..	69	..	..	91	6	83	21	33	125	14	98	30	83	52 (3)	134 (1)	1	147	..	..	111.9
Steuben	1,861	2,175	1,897	3,619	1,263	278	1,083	437	633	1,330	504	1,330	398	1,449	1,038 (8)	1,318 (4)	682	1,715	595	1,295	755.4
Tioga	..	489	..	..	567	173	30	294	463	653	264	673	190	822	346 (5)	625 (3)	3	723	..	1	281.1
Tompkins	..	288	..	..	429	101	42	189	342	510	133	469	116	478	300 (8)	429 (17)	2	493	..	4	258.8
Wayne	..	81	..	..	174	42	667	56	103	143	26	155	14	83	100 (1)	119	..	195	..	3	208.6
Wyoming	399	468	337	645	222	62	416	77	124	401	103	397	81	404	218 (4)	318 (1)	179	470	142	323	250.5
Yates	..	241	..	..	370	149	162	205	275	281	131	320	94	425	203	286 (3)	..	332	..	4	141.7
Unknown	..	..	..	..	..	..	2.. 3	..	..	..	..	..	..	..	..	5	24	92	9	84	..
Total	7,764	12,579	7,533	14,366	11,374	2,957	10,021	3,779	5,824	13,285	4,185	13,136	2,970	14,777	8,579 (116)	12,135 (116)	4,818	15,767	4,541	9,822	8,354.1

* In 1953 and 1954 when only antlered deer might be taken during the regular season, taking antlerless deer was permitted during the special archery season; the figures are given in parentheses.

Table 9. Percentage of Total Legal Deer Kill Represented by License Stubs Returned

Year	Region		
	Adirondack	Catskill	Central and western
1927–49	75.0	75.0	66.7
1950–52	72.8	75.5	66.3
1953	74.9	78.7	76.9
1954	75.9	79.7	79.0
1955	75.8	79.3	77.0

sented by the stubs returned. Estimates by game protectors were used for the years from 1927 to 1949. Since then, more detailed checks have been made by project technicians. The figures are given in Table 9.

Using these values as correction factors, the total legal kill has been calculated from the number reported each year since 1927. The figures are given in Tables 6, 7, and 8 for the three major regions of the State.

The past 20 years have witnessed a tremendous increase in the number of those interested in hunting deer with the longbow. Use of this weapon during the regular open season has been permitted since 1929. Beginning in 1948, however, a special season for archers only has been provided immediately preceding the regular season. The number of deer taken in each region is shown in Table 10.

Table 10. Deer Reported Taken Under Special Archery License (1948-55)

Year	Region			Total
	Adirondack	Catskill	Central and western	
1948	..	8	..	8
1949	..	13	..	13
1950	..	26	21	47
1951	3	45	27	75
1952	29	125	187	341
1953	40	253	236	529
1954	70	335	265	670
1955	40	435	464	939

In Tables 6, 7, and 8 are given, in addition to the number of deer taken, the square miles of deer range in each county. These values are of interest in connection with comparing the kill in different areas.

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RESTORATION OF BROOK TROUT FISHING IN A CHAIN OF CONNECTED WATERS[1]

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ABSTRACT

During the last half century, the introduction of yellow perch in Adirondack trout waters has caused a serious decline in the brook trout fishery. In return, these introductions have provided little, if any, angling, due to slow growth and stunting. The elimination of yellow perch from a chain of connected waters, forming the headwaters of the West Branch of the St. Regis River, was undertaken in the years 1952 to 1954. Fourteen ponds and 21.25 miles of inlets, outlets, main river and tributaries were treated with emulsifiable rotenone, 5 per cent (Noxfish), at a concentration of approximately 0.5 p.p.m. More acre-feet of water per man-hour were generally treated in larger ponds than in smaller ponds. Complete kills are believed to have been obtained in some ponds; in others, all native species were not eradicated. Netting checks and angling returns up to and including 1956 indicate yellow perch were successfully removed.

Four barrier dams were constructed to prevent the reintroduction of undesirable species of fish into reclaimed waters.

Physical and chemical characteristics are presented for waters treated. Dissolved oxygen concentrations of less than 3.0 p.p.m. in the hypolimnion are considered an aid to reclamation. Toxicity tests, using live brook trout, indicated that most waters had lost their toxicity to this species within 30 to 50

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days following treatment. However, an occasional body of water remained toxic for a much longer period.

Beaver activity is considered a severe hindrance to reclamation, particularly where beaver dams raise water levels over barrier dams or where flooding over a long period of time has created a floating bog environment. Also, unlocated springs, spring seepage areas, and aquatic mammal channels are believed to create escape zones for fish or late-spawned eggs. Such conditions are considered more likely to be responsible for failures experienced in eliminating certain species of native fish than the concentration of rotenone employed.

Growth and survival data indicated that, for other than initial hatchery plantings to provide immediate angling returns, there is little reason for stocking brook trout larger or older than fall fingerlings.

The study suggests that the reclamation of certain chains of water areas is feasible. Financially, such projects would be least expensive if they could be completed in one year. If the larger waters are located upstream in the chain, it is considered practical to treat them as a separate entity. Should treatment prove successful, then the smaller downstream waters can be treated later.

Adirondack brook trout ponds are relatively infertile, cold, unproductive bodies of water, incapable of producing large poundages of fish per unit of water. That they are best suited for producing brook trout has been learned through sad experience from the unwise introductions of yellow perch, bass, northern pike, pickerel, and other nonnative game and pan fish species. The use of rotenone to eradicate undesirable fish populations has proven to be sound management in Adirondack waters, and 54 individual ponds have been reclaimed under a Conservation Department program since 1950. With few exceptions they are providing fair to excellent fishing. The establishment of the St. Regis River project was based upon the need for perfecting plans, methods, and techniques for treating chains of closely associated tributary waters.

The objective was to destroy the unfavorable fish population, primarily yellow perch, in the headwaters of the West Branch of the St. Regis River, and to restore brook trout fishing. The project area is located 15 miles northwest of the village of Saranac Lake (Franklin County) in the northern Adirondacks. The waters lie at an elevation of approximately 1,590 to 1,700 feet above sea level. A macadam highway passes about 5 miles to the south of the area, but the area itself is not directly accessible to the public by automobile. The Conservation Department maintains a fire truck trail to Fish Pond which is located approximately in the center of the area (Figure 1). Project personnel could travel this fire trail by motor vehicle, but all waters other than Fish Pond were reached only by water, portage and trail. For the treatment of St. Regis Pond, rotenone and materials were flown in by Department airplane. The linear distance between the

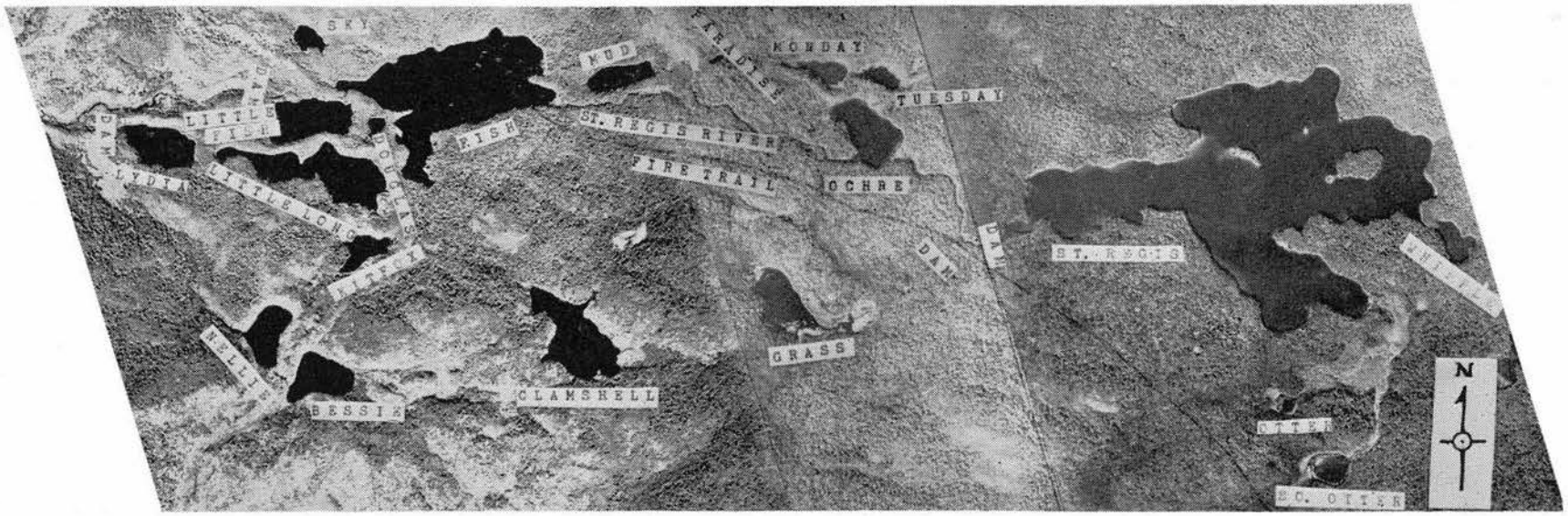

Figure 1. Aerial view of project area showing location of waters, barrier dams, and fire truck trail. Scale: 1 inch = 1,450 yards (approximately).

upstream and downstream margins of the project area is approximately 5 miles. The relative inaccessibility of the area had a bearing on the time required to accomplish the necessary field work, as well as the need for lightweight equipment.

The project was completed on schedule in three years. However, more time was necessary for full evaluation of results. The present report includes yearly field checks made up to and including 1956, which conclude all phases of the project.

MATERIALS AND METHODS

The first year (1952) was concerned primarily with conducting biological surveys of the 20 ponds and 21.25 miles of main river and tributaries located in the area. Emphasis was placed upon obtaining accurate soundings, so that the desired concentration of emulsifiable rotenone could be calculated. Also, detailed chemical analyses were conducted in order that oxygen deficiencies at various depths could be charted. Finally, intensive gill netting was undertaken to reveal the distribution of undesirable species. Four ponds were treated with rotenone during the first year. The second and third years were devoted to reclaiming additional waters, acquiring growth and survival data on stocked hatchery brook trout, and checking results in waters reclaimed in previous years.

Equipment

Lightweight but sturdy equipment was highly desirable for the application of rotenone, as only Fish Pond was accessible by motor vehicle. A Penn Yan car-top boat, weighing 65 pounds with the middle seat removed and fitted with a shoulder carrying yoke for transport over trails or through the woods, was used for pond work. This boat accommodated the pump, two or three men and up to 25 gallons of rotenone, and was propelled by an outboard motor. The pump used was a Pacific Marine Pressure Pumper, Model 5-A-8, weighing about 40 pounds with fittings and was carried on a pack board when being transported. A square-stern Adirondack guide boat, weighing approximately 65 pounds and equipped with a shoulder carrying yoke, was used for hand pumping swamps, shallow water areas, and general water transportation. Material and equipment such as nets, gasoline cans, rotenone drums, outboard motors, tool boxes and other reclamation needs were toted in on pack boards or in pack baskets. A lightweight tubular-frame canvas-covered collapsible boat

(Pack-A-Boat), which fitted into a pack basket, was found useful for netting or conducting toxicity tests on the smaller remote waters.

APPLICATION OF ROTENONE

Emulsifiable rotenone, 5 per cent (Noxfish), a product of S. B. Penick and Company, was used at a concentration of approximately 0.5 p.p.m. The same techniques and procedures were used to treat all waters in the project area, and rotenone was obtained from the same company throughout the 3-year period. This latter fact was deemed important, as results were expected to vary, and this variance could possibly be attributed to different brands of rotenone if several were used.

A pressure pump, operated in an outboard-motor-propelled boat was used to treat ponds. A fire nozzle was employed to spray the shoreline area, and a spray bar with eight nozzles, covering a swath approximately 30-40 feet wide, was used to spray the surface. Various lengths of weighted hose were towed behind the boat at various depths for deep pumping. Simultaneously with the pond treatment, another crew treated inlets, outlets, springs, and swampy areas, using 5-gallon fire-fighting hand pumps.

During the reclamation of St. Regis Pond, due to the large amount of surface acreage to be treated, the lake was divided into five equal zones of approximately 70 surface acres each which were treated on successive days. One boat was used to spray the shoreline and surface, while the deep pumping in the same zone was done from another boat on the same day. Similarly, Fish Pond was divided into two equal parts and treated on successive days, using the boat plan devised for St. Regis Pond.

SPECIAL LEGISLATION

The minnow bucket has been a recognized method of introducing undesirable species of fish into Adirondack trout waters. Recent legislation (Section 268, subdivision 9, of the New York State Fish and Game Law) prohibits the use of fish as bait, either dead or alive, in reclaimed and other remaining natural brook trout waters in most Adirondack counties. The waters in the project area are subject to this provision and have been posted with warning signs.

STOCKING POLICY

All waters in the project area are managed for brook trout. Although lake trout were found in Fish Pond, and were reported present

in St. Regis Pond, these ponds can be considered marginal for lake trout at best. The initial stocking following reclamation was in some cases made with legal-sized brook trout, in order to provide immediate returns to the angler. Other than initial stocking, all waters have been or will be stocked annually with fall fingerlings. At present, varying numbers are being stocked per surface acre in the several ponds in order to determine the stocking rate that will yield the most desirable returns to the angler.

In general, it is desirable to have fall fingerlings attain the legal length of 6 inches by the spring following release. Most of the larger project area ponds were stocked by airplane, while fish were transported to the smaller ponds in back-pack cans. During the three years of the project 70,205 fingerlings and 5,930 legal-sized brook trout were planted.

No trout were stocked in the inlets, outlets or main river involved. These waters, if suitable, can be expected to maintain trout by upstream and downstream movement from the various ponds.

Barrier Dam Construction

Four barrier dams were built to prevent the reintroduction of undesirable species into reclaimed waters of the project area, and to provide possible safeguards to waters in the area if the yellow perch were not completely eliminated. These dams are located on the outlets of St. Regis, Grass, Lydia, and Little Fish Ponds, the latter being the farthest downstream and protecting most of the project area waters (Figure 1).

Yellow perch constituted the non-native species that had invaded most waters, and whose reintroduction the barrier dams were mainly intended to bar. The authors have observed that a straight fall of water about 1 foot in height caused by a natural or artificial barrier has barred upstream migration of yellow perch in several small Adirondack streams. The barrier dams, where possible, were designed to provide about a 3-foot straight fall, with an apron calculated to prevent a deep pool for the "take off" of fish attempting to jump (Figure 2). The principal movement of yellow perch in Adirondack streams is encountered in the spring, being associated with spawning.

The labor expended in constructing the barrier dams is shown in Table 1. Due to the relative inaccessibility of the Lydia and Little Fish Pond sites, a good share of the time required was used in transporting materials and personnel.

Figure 2. Types of barrier dam: (above) Grass Pond Outlet; (below) Little Fish Pond Outlet.

TABLE 1. LABOR EXPENDED IN CONSTRUCTING FOUR BARRIER DAMS

Location	Year built	Number of men	Man-days expended	Accessibility
Grass Pond*	1950	4	20	0.1 mile by trail
Lydia Pond	1952	5	50	2.0 miles by trail and portage
St. Regis Pond	1953	9	75	0.3 mile by trail
Little Fish Pond	1954	6	87	1.5 miles by trail and portage

* Built before start of project.

FINDINGS AND DISCUSSION

Although there were some 20 ponds located in the area, only 14 were desirable for reclamation. Of the six waters not treated, Little Long Pond contained only brook trout; Sky, Kitfox, and Paradise Ponds were barren of fish life; and Nellie and Bessie Ponds contained brook trout with associated native species. Nellie and Bessie Ponds were not treated as they were known to be providing good brook trout fishing, and native species from these waters could reinvade only one reclaimed pond, Lydia.

SPECIES OF FISH PRESENT

The species found in the 14 ponds prior to reclamation are given in Table 2. All are believed to be native to this portion of the St. Lawrence River watershed, with the exception of the yellow perch. Greeley and Greene (1931) recorded a similar distribution. Common names are used according to the American Fisheries Society listing (1948).

TREATMENT OF WATERS WITH ROTENONE

Of the 14 ponds treated, four were not infested with yellow perch. Three of these were less than 6 acres in size and tributary to larger waters in the chain. Because of their small size, it was thought desirable to eliminate the native species so that they would not move into downstream waters. The fourth pond, Clamshell, contained brook trout that were heavily infested with copepod parasites (*Salmincola* sp.). Trout from this pond had access to a large portion of the project area; therefore, it appeared prudent to attempt to eradicate this ectoparasite and eliminate the possibility of infecting waters treated downstream.

TABLE 2. SPECIES OF FISH PRESENT IN 14 RECLAIMED PONDS PRIOR TO TREATMENT

Pond	Eastern brook trout	White sucker	Longnose sucker	Redbelly dace	Creek chub	Common shiner	Brown bullhead	Yellow perch	Pumpkinseed
Grass*	x	x		x	x	x	x		
Lydia§	x	x	x		x	x	x	x	x
South Otter	x	x		x	x		x	x	x
Otter	x	x		x	x		x	x	x
St. Regis	x	x	x	x	x	x	x	x	x
Whipple	x	x			x	x	x	x	
Tuesday							x		
Monday†	x			x	x		x		
Ochre	x	x		x	x	x	x	x	x
Clamshell	x	x		x	x	x			x
Fish‡	x	x	x		x	x	x	x	x
Mud	x	x			x	x	x	x	x
Little Fish	x	x	x		x	x	x	x	x
Douglas						x	x		

* Also contained Nachtrieb's minnow.
§ Also contained cut-lips minnow.
† Also contained blacknose dace.
‡ Also contained lake trout.

Clamshell Pond was reclaimed in August 1954 and stocked with brook trout fingerlings the same fall and with yearlings in the spring of 1955. No copepod parasites were found on 83 brook trout examined June 24, 1955. Lydia Pond, which was reclaimed in September, 1952, also contained brook trout infected with copepods, but fish captured while test netting with gill nets in 1953 and 1954 showed no evidence of the parasite. Unpublished data from the Department's Adirondack trout restoration program indicate that copepod parasites (*Salmincola* sp.) can be eliminated from a lake or pond, if all species of fish are eliminated. It is possible that only the brook trout have to be completely eradicated, but this supposition has not been tested.

An example is cited of how soon fish from an upstream untreated pond can be expected to invade a downstream treated pond. Nellie and Bessie Ponds, which were not reclaimed, flow via an outlet approximately a mile long into Lydia Pond. A complete kill was believed to have been obtained in Lydia Pond. Netting in Lydia Pond a year later revealed the presence of white suckers and creek chubs. Netting 2 years after treatment added the common shiner. The data indicate that these three species came down from Nellie and Bessie Ponds. Within a year following treatment of Ochre Pond, native minnows and suckers were found present. Indications are that these fish migrated from Grass Pond via an outlet approximately a mile long.

Table 3. Labor Expended in Reclaiming 14 Ponds

Pond	Acre-feet	Number of men	Man-hours expended	Acre-feet treated per man-hour*
Grass	140.0	7	82.00	1.7
Lydia	560.0	8	64.00	8.7
South Otter	35.0	8	38.00	0.9
Otter	11.2	8	38.00	0.3
St. Regis	6,256.0	10	348.00	18.0
Whipple	42.0	5	16.00	2.6
Tuesday	65.0	2	14.00	4.6
Monday	36.0	2	20.00	1.8
Ochre	378.0	16	146.50	2.6
Clamshell	525.0	18	83.75	6.3
Fish	2,310.0	8	118.50	19.5
Mud	44.0	8	9.50	4.6
Little Fish	368.0	7	15.00	24.5
Douglas	27.2	7	5.00	5.4

* Includes time expended in treatment of inlets, outlets, springs, and swamps associated with each water.

A summary of the labor required and the acre-feet treated per man-hour for the 14 ponds reclaimed is given in Table 3. In reclaiming large, 340-acre St. Regis Pond it was possible to accomplish the work at the rate of 18 acre-feet per man-hour, while in small, 15-acre Grass Pond the man-hour rate dropped to 1.7 acre-feet. Part of this difference can be explained by the time-consuming work involved in treating the swampy and boggy shoreline that characterized Grass Pond. In general, it is more efficient to operate on larger bodies of water.

Siegler and Pillsbury (1947) showed that, in spraying with dissolved derris powder in seven New Hampshire Ponds, more acre-feet were treated per labor-hour in three ponds of 90 acre-feet or more than in four smaller ponds. Acre-feet of water treated per labor-hour varied from 0.4 to 3.2. The rate of treatment for project area waters of comparable size varied from 0.3 to 24.5 acre-feet per man-hour. The ability to treat more acre-feet per unit of labor in project area waters is believed to have been due to the relatively greater ease of handling emulsifiable rotenone than powdered derris, inasmuch as the method of pond treatment was rather similar for both states.

Effect of Water Temperatures and Chemistry

Physical and chemical characteristics pertaining to the 14 ponds reclaimed are shown in Table 4. The deepest waters occurred in Ochre

TABLE 4. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR 14 RECLAIMED PONDS

Pond	Date reclaimed	Surface area (acres)	Average depth (feet)	Maximum depth (feet)	Acre-feet	Color of water	pH (surface)	Rotenone used* (gallons)
Grass	August 19, 1952	20.0	7.0	12	140.0	brown	6.3	23
Lydia	September 2, 1952	20.0	28.0	38	560.0	white	7.0	91
South Otter§	September 4, 1952 August 13, 1953	5.0	7.0	11	35.0	brown	below 6.0	23
Otter§	September 4, 1952 August 13, 1953	1.6	7.0	10	11.2	brown	below 6.0	8
St. Regis	August 5–12, 1953	340.0	18.4	30	6,256.0	light brown	6.5	1,015
Whipple	August 13, 1953	6.0	7.0	10	42.0	light brown	below 6.0	7
Tuesday	September 3, 1953	5.0	13.0	21	65.0	light brown	below 6.0	11
Monday	July 26, 1954	6.0	6.0	9	36.0	light brown	below 6.0	6
Ochre	August 4, 1954	21.0	18.0	52	378.0	light brown	6.0	62
Clamshell	August 5, 1954	35.0	15.0	28	525.0	light brown	6.6	85
Fish	August 9–10, 1954	110.0	21.0	52	2,310.0	light brown	6.8	374
Mud	August 11, 1954	11.0	4.0	6	44.0	light brown	6.4	8
Little Fish	August 12, 1954	23.0	16.0	37	368.0	light brown	6.8	60
Douglas	August 12, 1954	1.6	17.0	40	27.2	brown	6.4	5

* In addition, 380 gallons of rotenone were used in treating the 21.25 miles of inlets and outlets associated with these ponds.
§ Treated once in 1952 and three times in 1953 due to swamp and boggy nature.

and Fish Ponds, where maximum depths of 52 feet were recorded. With the exception of Lydia Pond, all of the deeper ponds evidenced oxygen depletion in the hypolimnion. Some of the shallower waters such as Otter Pond, South Otter Pond, and Grass Pond also exhibited oxygen depletion in the hypolimnion. This condition is often referred to as summer stagnation; however, some Adirondack ponds demonstrate it in the winter as well. In Ochre Pond, at time of reclamation, the approximate depth where dissolved oxygen values were below 2 p.p.m. was between 10 and 20 feet. At 30 feet only a trace of dissolved oxygen was recorded. Oxygen depletion in the deeper, colder waters is considered an aid to reclamation because the fish are forced into the deeper water by the descending rotenone. This has been vividly demonstrated by waves of certain species coming to the surface after being driven into the deeper, deoxygenated waters. Clemons and Martin (1953) found that low oxygen concentrations in the bottom waters forced fish to re-enter the upper layers of rotenone-treated waters.

The relationship of water temperatures and chemistry to the time of observed final kill is presented in Table 5. In ponds where the dissolved oxygen content was less than 2 p.p.m. in 15 feet of water or

Table 5. Relationship of Water Temperature and Chemistry to Time for Final Kill in Reclaimed Ponds

Pond	Water temperature in degrees Fahrenheit		Depth of bottom reading * (feet)	Time until first fish surfaced (minutes)	Time to final kill observed (hours)	Approximate depth dissolved oxygen less than 2 p.p.m. (feet)
	Surface	Bottom				
Grass	70	56	10	5–10	under 24	5– 8
Lydia	68	51	35	5–10	24–48	§
South Otter	69	55	9	5–10	under 24	3– 6
Otter	68	52	8	5–10	under 24	4– 6
St. Regis	76	63	20	5–10	48–72	22–25
Whipple	81	73	7	5–10	under 24	§
Tuesday	76	50	18	10–20	under 24	13–15
Monday	73	72	6	10	24–48	§
Ochre	70	43	50	35	24–48	15–20
Clamshell	72	53	23	30	24–48	20–25
Fish	73	47	50	30	24–48	27–32
Mud	74	65	4	10	under 24	§
Little Fish	73	48	30	30	24–48	15–20
Douglas	71	44	30	10	under 24	8–10

* In most cases not maximum depth of pond.
§ Good oxygen on bottom.

less, the observed final kill was generally found to occur within 24 hours, irrespective of the maximum depth of the pond. In ponds having little or no stratification, having maximum depths of less than 15 feet, and having satisfactory chemical conditions for fish life in bottom waters, it also occurred within 24 hours. In general, water deeper than 15 feet, and having satisfactory chemical conditions for fish life at a depth of 15 feet or greater, the time exceeded 24 hours. Fish struggling on the surface of the water 48 hours following treatment were observed only in St. Regis Pond. Surface temperatures varying from 68° F. to 81° F. did not materially affect the time that fish were first observed surfacing. The presence of a thermocline slowed the penetration rate of rotenone.

EFFECTS OF ROTENONE ON FISH LIFE

Yellow perch, pumpkinseeds, and native minnows were usually the first species observed to succumb to rotenone treatment. Laboratory tests by Burdick *et al.* (1956) show that yellow perch are rather easily destroyed even at relatively low concentrations of rotenone. Yellow perch were killed in less than 24 hours using concentrations as low as 0.05 p.p.m. The authors also presented toxicity data for brown trout, rock bass, creek chub, smallmouth bass, white sucker, and brown bullhead. The sensitivity of yellow perch to emulsifiable rotenone 5 per cent at various concentrations was exceeded only by that of brown trout.

The brown bullhead and white sucker were generally the last species observed struggling on the surface of the water. Burdick *et al.* (1955), using laboratory tests, reported that emulsifiable rotenone 5 per cent at a concentration of 0.5 p.p.m. killed only one out of five brown bullheads in a 24-hour period. The remaining four lost their equilibrium, but when removed to fresh water they recovered and remained normal. As this experiment was restricted to an exposure period of 24 hours, it is open to conjecture whether or not the survivors would have eventually succumbed in a time interval greater than that. These experiments also showed that toxicity curves for six species fall in the following order of increasing resistance to rotenone: brown trout, rock bass, creek chub, smallmouth bass, white sucker, and brown bullhead.

The statement, often made in the literature, that certain concentrations of rotenone did not give complete kills is misleading because it indicates the concentrations used were at fault. The fact that in-

complete kills occurred in some project area waters is not believed to have been directly due to the concentration used. Rather, it is thought that the emulsion did not reach all fish in the pond. Failures are attributed either to the habits of the fish or to physical conditions in the pond proper. Emulsifiable rotenone 5 per cent, used at a concentration of 0.5 p.p.m., is believed capable of killing all species found in the project area, provided the fish come under its influence for a reasonable length of time.

Krumholtz (1950) mentioned the difficulty encountered in eradicating black bullheads in a 1.4-acre pond. He applied several treatments of powdered derris at concentrations greater than 1 p.p.m. between 1946 and 1949. Although bullheads were killed by the thousands after each treatment, six individuals survived one poisoning and five another. He mentioned the possibility of bullheads being "mudded in" and that the few survivors might have succumbed if they had been exposed to the full concentration.

Certain species take longer to die under given concentrations than others. This fact, coupled with a bottom-dwelling habit, gives a fish such as the bullhead a greater time advantage to find spring seepage, flowing water that has become devoid of rotenone, or other possible escape areas. The ability of the bullhead, over wide areas of the United States, to survive treatment using usual field concentrations of rotenone attributes something to this species that might be termed an "escape" factor.

Duration of Toxic Conditions

Toxicity checks, using live hatchery fall fingerling brook trout in wire cages suspended at various depths, were conducted in 13 of the 14 reclaimed ponds (Table 6). Two cages of test fish, placed at different ends of the pond, were used in most cases. One cage was located near the surface and the other was set as deeply as chemical conditions would permit. In five of the smaller and more remote waters only one live cage was used. Care was observed in making the toxicity tests, so that the cages were neither suspended at a depth having unsatisfactory chemical conditions for brook trout nor resting on the pond bottom in possible rotenone residue. To eliminate water chemistry as a factor effecting the death of the test fish, chemical analyses (for dissolved oxygen, carbon dioxide, and pH) were made on samples of water from the depths at which cages were suspended. A 48-hour suspension period was deemed sufficient to give a reliable

TABLE 6. DURATION OF TOXICITY OF ROTENONE TO BROOK TROUT IN 13 RECLAIMED PONDS

Pond	Date reclaimed	Depth of live cages in pond (feet)	Period water toxic to brook trout (days)
Grass	August 19, 1952	6 and 8	less than 63
Lydia	September 2, 1952	15 and 35	less than 58
South Otter	September 4, 1952	2	less than 36
Otter	September 4, 1952	2	less than 36
St. Regis	August 5–12, 1953	20 and 30	less than 54
Whipple	August 13, 1953	6	less than 43
Tuesday	September 3, 1953	10	42–293*
Monday	July 26, 1954	6	less than 68
Ochre	August 4, 1954	1 and 8	less than 41
Clamshell	August 5, 1954	7 and 11	42– 77*
Fish	August 9–10, 1954	12 and 25	less than 50
Mud	August 11, 1954	2 and 3	52– 85*
Little Fish	August 12, 1954	10 and 18	less than 49

* Period fell somewhere between these limits.

index of toxicity. In all cases where test fish indicated that waters had become detoxicated, no losses of trout occurred when stocking ensued.

Rainfall and flow from springs, inlets, and tributaries are believed to partially affect the duration of toxicity in Adirondack ponds. Results from the toxicity tests indicate that most Adirondack waters can be expected to remain toxic to brook trout from 30 to 50 days following treatment at concentrations of approximately 0.5 p.p.m. Occasional ponds will remain toxic for longer periods of time. The data indicate that ponds with little or no inlet and outlet flow remain toxic longer than ponds with such flowage. Siegler and Pillsbury (1947) reported that for seven ponds reclaimed with derris (3.70 to 4.55 per cent rotenone), at concentrations varying from approximately 0.5 p.p.m. to 2.0 p.p.m., toxic conditions for brook trout lasted from less than 35 days to more than 137 days. These results are rather comparable to what was found in Adirondack waters. Clemens and Martin (1953) reported that emulsifiable rotenone 5 per cent, used at concentrations from 0.5 p.p.m. to 2.0 p.p.m. in highly alkaline, clear and turbid waters, became detoxicated for minnow life in less than 62 hours following treatment. Surface temperatures ranged from 78.2° F. to 91.6° F. While the average Adirondack pond will remain toxic for brook trout from 30 to 50 days following reclamation, such waters undoubtedly become nontoxic to bullheads, suckers, minnows, and other species of fish in a shorter time.

Effect of Beaver Activity

The presence of active beaver in the project area resulted in much additional labor being spent in removing both the animals and their dams and in draining impoundments. Impoundments caused by beaver dams made it practically impossible to depend upon a complete kill, due to flooding and resultant additional acre-feet of shallow swampy water or "floating bog" type of environment. Beaver were thought to have been removed from the St. Regis River between Ochre Pond and Fish Pond in 1954. However, on the morning hand sprayers started treating this section of river, they encountered new beaver impoundments. Two or three lengths of Orangeburg pipe were laid under beaver dams that caused undue flooding. This procedure restored water levels to the original streambed and was found to be foolproof against beaver for a period of several months. The pipe successfully drained off the impounded waters, and the beaver could not plug the intake end due to incasement with chicken wire. Weeks of warm, sunny weather were often needed to dry out these drained impoundments properly. Muskrat and beaver activity caused underground channels in flooded bog or floating bogs, and springs or spring seepage entered some of these hidden passages. It is not unlikely that fish or late-spawned fish eggs could be harbored in such aquatic mammal channels until the pond proper became detoxicated for the species of fish concerned. Bank beaver established in the course of slow-moving streams caused similar reclamation problems.

Success of Reclamation

In late years fishery workers using rotenone have become increasingly modest in claiming complete kills, although some workers still estimate complete kills in the same year as treatment. Zero catches of fish resulting from intensive gill netting with graded-sized nets (1¼- to 3½-inch stretched mesh) during the same year as reclamation were not found to be good criteria of success. Weier and Starr (1950) observed four species of fish present 7½ to 9 months following treatment with emulsifiable rotenone in a 250-acre body of water from which they initially presumed all fish life to have been eradicated. Similar netting results the year following reclamation could not always be considered indicative of a complete kill. However, by 2 years after reclamation, species of fish which have survived treatment are usually present in sufficient numbers to be caught in gill nets. In Grass Pond, which was reclaimed in 1952, netting following treatment captured

no fish. Netting in 1953 showed the recurrence of creek chubs and common shiners, and netting in 1954 added white suckers and brown bullheads. Grass Pond is boggy with a greater outlet flow than inlet flow denoting unlocated springs and spring seepage areas, and had harbored a beaver population for many years prior to reclamation.

The term "successful" in regard to reclamation is sometimes misleading when applied to waters where complete kills are not obtained. It would seem more advisable to use "complete" or "partially complete" according to the actual degree of kill, and to consider success in relation to the subsequent benefit to angling. Reclamation of a given water can be only partially complete, and yet the over-all operation can be considered a success on the basis of practical benefit to the angler. This was the case in Grass Pond where good brook trout fishing was provided due to the elimination of yellow perch.

Failure of observation, angling and netting, for two successive years following reclamation, to indicate any species of fish present in a reclaimed pond, except stocked trout, would appear to be a reasonable indication of a complete kill.

Based upon a 2-year interval, project area waters can be judged for success as follows: of the 14 ponds reclaimed, the degree of kill is considered to have been complete in eight (Lydia, South Otter, Otter, Tuesday, Whipple, Monday, Clamshell, and Douglas) and partially complete in six (Grass, St. Regis, Ochre, Fish, Little Fish, and Mud). In St. Regis Pond, Ochre Pond, Fish Pond, Little Fish Pond, and Mud Pond the creek chub reappeared. In Grass Pond four native species reappeared. In addition, all species present in Grass Pond have reappeared in Ochre Pond. To date, yellow perch have not reappeared in any of the treated waters. The project is considered a success based upon the apparent elimination of the introduced yellow perch and the restoration of good to excellent fishing opportunity. Due to the remote nature of the project area, the possibility of the recurring fish having been introduced by anglers is considered unlikely. All data indicate that these fish survived reclamation.

SURVIVAL OF STOCKED BROOK TROUT

Gill netting in various project area ponds has shown that good to excellent survival can be expected from stocked fall fingerling hatchery brook trout in reclaimed and barren waters. Sky Pond, a 5-acre body of water that was devoid of fish life and therefore not reclaimed, was

stocked with 100 fall fingerlings averaging 3.9 inches in length in early October, 1952. Of these, 40.0 per cent were recovered from the pond between July 30, 1953, and September 17, 1954 (Table 7). A second planting during early October of 1953 survived well, 44.0 per cent being netted on September 17, 1954. It is interesting to note that predation upon the 1953 planting by resident fish from the 1952 planting was apparently negligible.

In Table 7 is a summary of known survival in seven ponds. For two ponds some angling harvest is listed. In general, fishing pressure, which can be considered light, was exerted upon these waters by better-than-average trout fishermen. Some of the netting was done after the close of the trout season during both years. Survival data were obtained incidental to growth studies with no attempt being made to actually net all fish of a given planting. The netting results show that good numbers of legal-sized trout were present in the project area ponds after the close of the trout season, indicating that remote Adirondack brook trout ponds are not easily "fished out" under an annual stocking program. Natural reproduction is nonexistent in many Adirondack brook trout ponds, particularly those lacking inlets or outlets, or having beaver dams on the inlets or outlets. If these waters are not stocked on an annual or biennial basis, angling success becomes dependent on one or two age groups, and they soon fall into the "fished out" class of ponds.

Survival data for legal-sized and 2-year-old stocked brook trout are not presented in Table 7. The highest return from this type of stocking occurred in Lydia Pond which yielded a recovery of 2.8 per cent. Recovery from St. Regis Pond was less than 1.0 per cent. The data indicate that fall fingerlings demonstrated greater survival than legal-sized or 2-year-old fish. This presumes the use of suitable-sized gill net mesh for the method of capture and the passage of at least one winter between the dates of stocking and netting.

Growth of Stocked Brook Trout

Many individual and complexly-interrelated factors tend to affect the growth rate of fish in a given body of water. In reclaimed or barren ponds, containing a single species of trout, the factors affecting growth appear somewhat less complicated. Growth data in project area ponds point to three measurable indices that affect the growth of trout. These are: the number of trout stocked per surface acre; the physical and chemical conditions of the pond; and the presence or absence of competitive species of fish.

TABLE 7. SURVIVAL OF STOCKED HATCHERY FALL FINGERLING BROOK TROUT

Pond	Date stocked	Trout stocked		Number recovered		Period of recovery		Per cent recovery
		Number	Size*	Netting	Angling	Initial	Final	
Sky.....	October 2, 1952§	100	3.9	33	7	July 30, 1953	September 17, 1954	40.0
	October 9, 1953†	100	3.5	44	..	September 17, 1954	September 17, 1954	44.0
Kitfox.....	September 8, 1952§	270	3.3	18	31	July 29. 1953	September 15, 1954	18.1
	October 9, 1953†	270	3.5	37	..	September 15, 1954	September 15, 1954	13.7
Grass.....	November 6, 1952§	750	4.2	189	..	June 16, 1953	September 29, 1954	25.2
	September 23, 1953†	750	3.2	77	..	May 17, 1954	September 29, 1954	10.3
Little Long..	October 3, 1953	1,500	3.0	114	..	September 16, 1954	September 16, 1954	7.6
Whipple....	November 24, 1953§	400	4.0	74	..	June 15, 1954	June 15, 1954	18.5
Otter.....	November 24, 1953§	160	4.0	66	..	June 10, 1954	June 10, 1954	41.2
South Otter.	November 24, 1953§	250	4.0	42	..	June 10, 1954	June 10, 1954	16.8

* Inches.
§ Initial planting in barren or reclaimed ponds.
† Second planting.

Table 8. Growth Data for Stocked Hatchery Brook Trout

Pond	Date stocked	Trout stocked		Date netted	Trout netted			
		Rate*	Length (inches)		Number	Length (inches)	Weight (ounces)	Age (winters)
Grass	November 6, 1952	37	4.1	October 7, 1953	24§	6.9	1.9	1
				September 29, 1954	6	8.9	4.5	2
	September 23, 1953	37	3.2	September 29, 1954	39§	7.8	2.3	1
Lydia	June 1, 1953	75	9.3	October 15, 1953	27	10.2	8.0	2†
				September 28, 1954	24§	10.5	8.9	3†
	October 3, 1953	75	3.0	September 28, 1954	8§	7.4	2.7	1
Sky	October 2, 1952	20	3.9	October 6, 1953	13§	9.8	9.0	1
				September 17, 1954	2	15.4	30.0	2
	October 9, 1953	20	3.5	September 17, 1954	26§	11.0	10.3	1
Kitfox	September 8, 1952	30	3.3	September 24, 1953	10§	12.8	20.4	1
				September 15, 1954	4	16.3	36.5	2
	October 9, 1953	30	3.5	September 15, 1954	15§	11.0	10.5	1
Little Long	October 10, 1951	30	3.9	October 6, 1953	2	16.9	42.0	2
	September 8, 1952	30	3.2	October 6, 1953	13	12.6	16.0	1
				September 16, 1954	3	17.4	39.7	2
	October 3, 1953	39	3.0	September 16, 1954	42§	11.4	12.4	1
St. Regis	October 12, 1953	100	2.5	September 1, 1954	20	8.0	3.3	1
				June 22, 1955	3	11.2	10.7	2
	September 20, 1954	37	3.5	June 22, 1955	14	7.7	3.6	1
Whipple	November 24, 1953	67	4.0	June 15, 1954	26§	7.7	3.0	1
Otter	November 24, 1953	100	4.0	June 10, 1954	28§	6.0	1.5	1
South Otter	November 24, 1953	50	4.0	June 10, 1954	14§	7.1	3.5	1

* Number per surface acre.
§ Representative sample of total trout netted.
† Initial stocking comprised 2-year-old trout.

A summary of growth rate data for brook trout is presented in Table 8. Data are given for nine ponds, with one or more plantings being followed in each pond. Sky, Kitfox, and Little Long Ponds were stocked lightly (20-30 fall fingerlings per surface acre). They evidenced good to excellent chemical conditions and contained no competitive species. Specimens one and two winters old showed better growth in these three waters than in the other six ponds. Grass Pond with a low stocking rate (37 fall fingerlings per surface acre), but having very poor chemical conditions in the hypolimnion as well as competitive species, showed a much poorer growth rate. The difference in growth between brook trout of the same age from Kitfox and Lydia Ponds is portrayed in Figure 3. The upper, heavier fish is a typical specimen

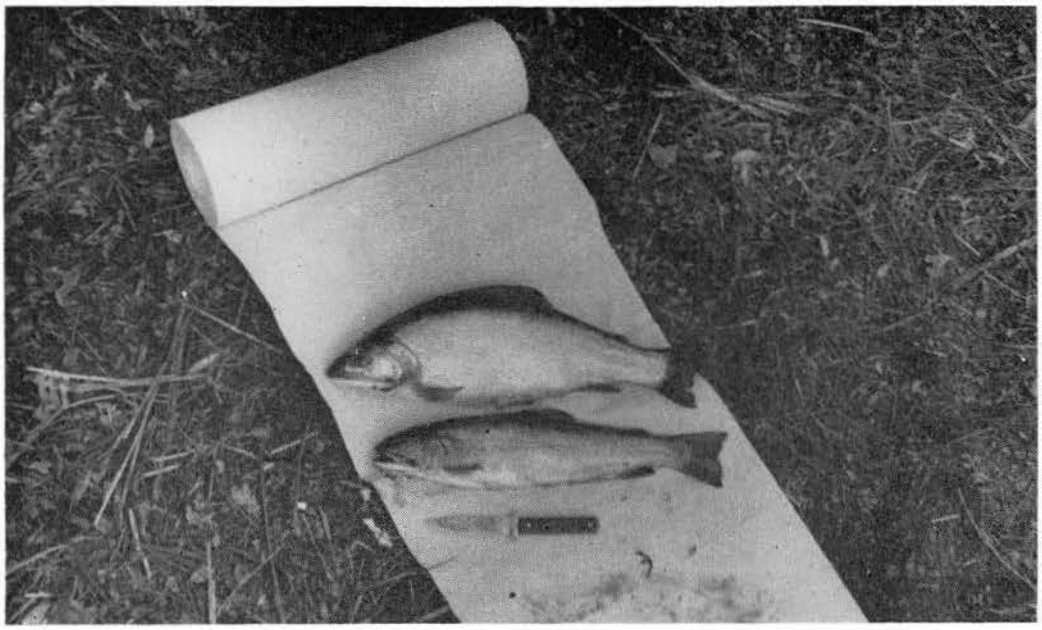

Figure 3. Comparison of brook trout of identical age from reclaimed ponds: upper trout stocked at 30 fingerlings per acre; lower trout stocked at 75 fingerlings per acre.

from Kitfox Pond which was stocked at 30 per acre, while the lower, slimmer fish is from Lydia Pond, stocked at 75 per acre. It is believed that doubling the stocking rate in Sky, Kitfox, and Little Long Ponds would reduce the weight of fish two winters old from approximately 2 pounds to 1 pound. Fall-stocked fingerlings (stocked 20-30 per surface acre) captured a year later in Sky, Kitfox, and Little Long Ponds were heavier than spring-stocked 2-year-olds (stocked 75 per surface acre) captured 15 months later in Lydia Pond. In Sky Pond the second planting (1953) grew better than the initial planting (1952).

Figure 4. Excellent condition of brook trout (dressed) from water containing no fish life other than trout.

This situation also occurred in Grass Pond, while in Kitfox Pond the initial planting (1952) made better growth than the second planting (1953).

These growth studies have undermined an Adirondack "old wives tale" which purports that large brook trout cannot be produced unless forage in the form of fish life is present. Fish of 2 to 4 pounds which have been netted or creeled in certain project area waters, devoid of any fish life but brook trout, negate this old thesis (Figure 4).

In typical accessible Adirondack brook trout waters stocking rates between 50 and 100 fall fingerlings per surface acre are usually suitable. As most project area ponds are inaccessible (several miles or more by trail), raising larger but fewer trout in certain of them can be considered good management, as it provides an incentive for anglers to walk and carry boats to these waters. If, in the future, fishing pressure in these remote waters is appreciably increased, stocking rates can be increased, thereby providing more, but smaller, fish for the angler.

CONCLUSIONS

Based upon the methods, techniques and chemical used in attempting to eradicate all fish life in these typical Adirondack brook

trout ponds, complete elimination of all species is not a certainty. Indications are that the introduced yellow perch are more easily eradicated than native species of minnows, suckers and bullheads. Ponds having firm, wooded shorelines are easier to treat with complete success than boggy or swampy ponds, or those having supported a beaver population for many years. When considering treatment of a chain or group of associated tributary waters, the size of the largest waters is not always the most important factor. Failure to eliminate key species of undesirable fish might occur in a 10-acre bog pond rather than a 300-acre pond with a firm shoreline.

It is indicated that emulsifiable rotenone 5 per cent, used at approximately 0.5 p.p.m. concentration, is capable of killing all species of fish encountered in the project area. Incomplete kills are believed to be the result of fish or late-spawned eggs being harbored in unlocated spring holes, spring seepage areas, or aquatic mammal channels and tunnels, and persisting there until toxicity levels in the pond proper became decreased within the limits of tolerance for the species involved.

Barrier dams are an important part of any reclamation project and are needed to stop the upstream migration of undersirable species of fish into treated waters, unless a natural barrier is present. The possibility of inclement weather interrupting continuous treatment of a chain of waters must be considered. Heavy rains over a period of several weeks, resulting in flooding and high water, make the construction of strategically located barrier dams a good practice.

The eradication of copepod parasites (*Salmincola* sp.) from brook trout waters appears probable, if all species of fish are successfully eliminated. The possibility exists that only the brook trout have to be completely removed to break the cycle of this ectoparasite.

Project area ponds, treated with emulsifiable rotenone 5 per cent at concentrations of approximately 0.5 p.p.m., were found to remain toxic to brook trout for an average of 30 to 50 days following treatment, and in some cases much longer. Ponds with little or no inlet or outlet flowage remained toxic longer than ponds with appreciable movement of water through them.

The presence of active beaver, impounding acres of shallow water or causing bog conditions, created additional reclamation problems. Draining the beaver impoundments by use of pipes under the beaver dams solved the flooding problem in certain situations.

Growth studies indicate that the number stocked per surface acre, the chemistry of the pond, and the presence or absence of competitive

species of fish are factors affecting the rate of growth of stocked brook trout. Most rapid growth was obtained in ponds having good chemical conditions, no competing species, and low stocking rates. Hatchery fall fingerling brook trout stocked in the reclaimed ponds, barren ponds, and ponds containing native species showed good survival. Other than an initial stocking to provide immediate returns to the angler, no basis was found for annual stocking of legal-sized trout in these waters.

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DISTRIBUTION OF BOBWHITE QUAIL IN NEW YORK[1]

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ABSTRACT

The bobwhite quail was part of the native avifauna of New York, but disappeared from most of its range in the State during the latter part of the nineteenth century. It is believed that this was due primarily to changes in agricultural practice which adversely affected food and cover conditions.

Numerous attempts have been made at reestablishing bobwhites. Chief among these was a program entailing the release of approximately 68,000 birds during the period from 1931 to 1939. In general, these efforts were unsuccessful.

The present-day range of the species is confined chiefly to Long Island, although fair numbers occur in certain counties bordering the lower Hudson and Delaware Rivers. Isolated colonies have been reported from a few upstate counties.

Bobwhite quail occurred in New York during colonial times, and were fairly numerous in some areas until late in the nineteenth century. Eaton (1910:361) summed up the status of quail in the State as follows: "The Bobwhite, or quail, was formerly well distributed throughout New York State as far north as the counties of Jefferson, Oneida, Saratoga, and Washington to an altitude of about 1000 feet, and in the southwestern portion to an altitude of 2000 feet. At the present day it is a rare bird in all portions of the State, except Long Island, the lower Hudson valley, and the Delaware valley. Numerous importations of southern or western birds have done little, if any, permanent good in restoring its former abundance".

Due to increased interest among sportsmen, the Conservation Department released 750 Mexican quail on Long Island in 1931. In addition, 4,350 bobwhites were purchased in Virginia and released during the fall of the same year, 1,350 on Long Island and 3,000 in various upstate localities.

Some of these birds survived the winter in good condition in such counties as Niagara, Orleans, Steuben, and Washington and brought off broods in the spring of 1932. However, they dispersed and very few could be found by autumn. By the end of the second winter (1932-33) it was clear that the liberated birds had been unsuccessful in establishing themselves. There were no full-time observers, but reports from cooperators revealed that winter losses and predation were the chief recognized factors which contributed to the failure.

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[1] A contribution of Federal Aid in Fish and Wildlife Restoration Project W-81-R.

In order to build up a stock which, supposedly, would be more capable of surviving New York winters the Conservation Department adapted the facilities of the Middle Island Game Farm to produce bobwhite quail by the incubator-brooder method. As a result, the Department released 7,834 birds in 1933, the goal being to establish bobwhites once more in 42 counties where quail once were resident. The contemplated stocking had been completed by 1934 in Broome, Chemung, Livingston, Otsego, Schoharie, Seneca, Tompkins, and Washington Counties.

The bobwhites disappeared within less than a year in Otsego and a few other counties and, following checks by field men in 1935, it was decided to discontinue stocking in Chenango, Erie, Madison, Monroe, and Oneida Counties. At this date bobwhites were considered to have become established in Dutchess, Niagara, and Ulster Counties, while results in Allegany, Cayuga, Cortland, and Rensselaer Counties were inconclusive (New York Conservation Department, 1936). No follow-up was undertaken in 1936 due to a shortage of personnel.

The following quotation is from the 27th Annual Report of the Conservation Department (1938:279-280): "Quail have failed to increase in numbers sufficiently to justify further experimental stocking in 23 upstate counties, the 1937 survey revealed. Investigators traveled from one end of the State to the other and interviewed over a thousand sportsmen". Accordingly, stocking was discontinued in Albany, Allegany, Cayuga, Columbia, Cortland, Delaware, Genesee, Greene, Livingston, Montgomery, Ontario, Orange, Oswego, Rensselaer, Saratoga, Schenectady, Schoharie, Steuben, Sullivan, Tioga, Wayne, Wyoming, and Yates Counties. No liberations were made in 1938, and no field checks were conducted.

The available records of stocking in New York prior to 1940 are summarized in Table 1.

In spite of the unfavorable results of these earlier attempts at restoration, many sportsmen have continued to hope that it might be possible to establish local bobwhite populations which could withstand limited hunting. In view of this interest, and as a matter of keeping abreast of local changes in game populations, a survey was undertaken to determine the present-day range of quail in New York.

PROCEDURE

During the fall of 1953 questionnaires were mailed to all game protectors in the Kingston and New York Divisions, covering the

TABLE 1. RECORDS OF BOBWHITE QUAIL RELEASED IN NEW YORK PRIOR TO 1940*

Date	Locality	Number birds	Age	Source
		Private agencies§		
1886-90	Orange County	3,000-4,000	Adult	Southern United States (?)
1924	Erie County	7	?	California
1927	Tioga County	200	?	Texas
1928	Chemung County	25	?	?
1929	Chemung County	25	?	?
		Conservation Department		
1931	Long Island	750	Adult	Purchased (Mexico)
1930-37	44 counties	23,164	Immature	Purchased (mostly Virginia)
1930-39	Southern New York	422	Adult	State game farm
1931-39	44 counties	39,672	Immature	State game farm†
1937-39	Long Island, and Westchester County	3,728	Adult	State game farm

* Data from Bump (1940) and Gould (1932). It is known that additional releases were made by private agencies, a large proportion of which were wild-trapped birds from the South and Southwest, but specific data are lacking.

§ The releases in Orange, Erie, and Tioga Counties were made by J. L. Breese, L. G. Palmerton, and L. J. Loomis, respectively; this information is lacking for the Chemung County cases.

† Produced from breeding stock obtained from Virginia, Wisconsin and Long Island.

middle and lower Hudson valley and adjoining counties, and Long Island. Individual protectors and sportsmen were contacted in other parts of the State where quail had been reported in recent years. Additional information was obtained from district game managers and research biologists.

Published accounts and Departmental records were consulted in order to learn as much as possible concerning the former distribution of bobwhite quail in New York, the results of stocking, and the environmental requirements of the birds.

FINDINGS

Study of completed questionnaires and other accumulated data shows that bobwhite quail currently occur in significant numbers only on Long Island and in four counties bordering the lower Hudson and Delaware Rivers. This area comprises Dutchess, Nassau, Putnam, Suffolk, Sullivan, and Westchester Counties. A few quail were reported from scattered localities in Orange and Ulster Counties and the essen-

tially urban territory comprising New York City and environs. Elsewhere in the State small numbers were reported from Albany, Erie, Monroe, and Orleans Counties. There is some reason to believe that most, perhaps all, of these upstate records represent birds released during 1952 or 1953 by local sportsmen's clubs.

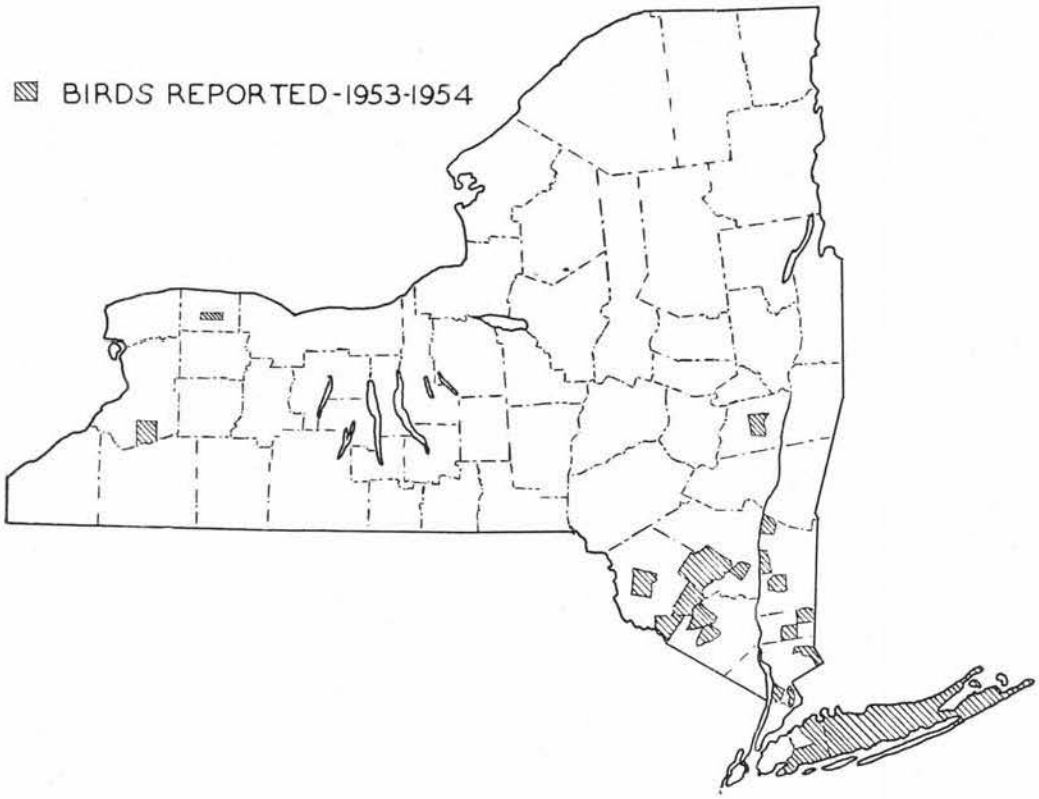

Figure 1. Current reported occurrence of bobwhite quail in New York State, by townships.

The present distribution of the species in the State, by townships, is shown in Figure 1. Specific locality records are listed in Table 2.

DISCUSSION

It is generally accepted that quail were fairly common over much of New York State during the first half of the nineteenth century, but it is difficult to find published records giving specific, factual information. Eaton (1910) mentioned that bobwhites formerly were well distributed throughout all but the mountainous sections of the State and the counties bordering the Adirondacks on the west, north, and east. Surface (1897), apparently writing at a time well past the period when quail were most abundant, stated that they were not then

numerous in any part of the State, although still fairly common on Long Island.

TABLE 2. REPORTED OCCURRENCE OF BOBWHITE QUAIL IN NEW YORK (1953-54)

County	Township	Birds seen	
		Date	Number*
Albany	New Scotland	Summer 1953	4–5
Dutchess§	Hyde Park	March 1954	8
	La Grange	February 1954	10
	Red Hook	September 1953	40†
	Red Hook	March 1954	30†
Erie	Concord	March 1954	7–8
Monroe	Irondequoit	February 1954	7
Nassau§	Hempstead	? 1953	"many"
	Oyster Bay	September 1953	15
	Oyster Bay	January 1954	5
Orange	Deer Park	July 1953	2
	Goshen	? 1953	?
	Wallkill	? 1953	?
Orleans	Albion	July 1953	1
Putnam§	Carmel	? 1953	12–15
	Patterson	Spring 1953	25
	Patterson	October 1953	10–12
Suffolk§	Babylon	March 1954	8
	Brookhaven	June 1953	35
	Brookhaven	August 1953	51
	Brookhaven	September 1953	24
	Brookhaven	November 1953	40
	East Hampton	November 1953	11
	Huntington	November 1953	30
	Huntington	February 1954	8
	Riverhead	February 1954	8
	Riverhead	March 1954	13
	Shelter Island	November 1953	3
	Shelter Island	? 1953	50–60
	Smithtown	July 1953	20
	Smithtown	September 1953	30
	Smithtown	November 1953	12
	Southampton	January 1954	10
	Southampton	March 1954	6
	Southold	February 1954	9
	Islip	December 1953	25
	Islip	March 1954	10
	Islip	March 1954	18
	Islip	March 1954	12
	Islip	March 1954	16
Sullivan	Bethel	September 1953	12
	Mamakating	October 1953	25
Ulster	Rochester	October 1953	?
	Wawarsing	October 1953	?
Westchester§	Harrison	? 1953	7
	Greenburgh	? 1953	10
	Lewisboro	Summer 1953	4-20

* In Suffolk County, where more than one record is listed for a township during the same season, it is possible that individual coveys may have been reported by more than one observer.

§ These counties have been stocked by the Conservation Department in recent years with quail reared at the Middle Island Game Farm.

† Considered to have resulted from a liberation in 1952 by the Red Hook Rod and Gun Club.

The reasons for the virtual disappearance of quail from upstate New York are obscure. One factor often suggested is the heavy snowfall. However, if quail formerly thrived over long periods in all but the mountainous areas and extreme northern New York, why should winter weather suddenly have become a prime limiting factor? It is a matter of record that our winters do not average as severe today as during the nineteenth century.

Smith (1954:11) commented on the significance of snow depth as follows: "Snowfall is of great importance to wildlife in general, and in particular to those species which must find their food on the surface of the ground. The bobwhite quail, at the time of the first settlements of Europeans in New York was confined to Long Island and the Hudson valley from Albany south, where today the annual snowfall averages less than 50 inches, and were abundant only where the snowfall is today less than 40 inches. Duration of snow upon the ground undoubtedly played an important part. The heath hen distribution was similarly limited. While bobwhites spread into the central and western parts of the State during the first half of the nineteenth century, they now occur naturally only from Westchester County south."

It seems quite possible that reports of former abundance have been somewhat exaggerated. Although there are published statements that bobwhites occurred over much of the State there is little evidence that they existed in appreciable numbers except in the lower Hudson valley and on Long Island. Indeed, Langille (1884) and Barnum (1886) listed the bobwhite as "rare". Langille was referring to the State as a whole, while Barnum had reference to Onondaga county. Likewise, Ralph and Bagg (1886) reported quail to be "rare, local" in Oneida county and Davison (1889) considered them rare in Niagara county.

Regardless of early population levels the fact remains that quail are absent today from much of their former range in the State. It seems probable that this cannot be explained on the basis of any one factor, such as weather, but that it has been due to intensification of the effect of winter extremes as food and cover conditions deteriorated. Actually, food is a much more serious consideration than cover over much of New York. Bump (1931) stated: "An adequate food supply and sufficient shelter are essential. During the lean winter months these two factors alone in a large measure determine the ability of Bobwhite to survive.

"Good cover is not scarce throughout most of the areas on which

quail have been introduced in this State. It is of little value, however, unless located close to food producing areas. Food then is the factor of which there must be an adequate supply."

Changes in farming practice have affected quail cover, particularly through the removal of brush and weeds along hedgerows near grainfields. There have been changes, likewise, in the acreage devoted to various kinds of crops. The shift to growing corn for ensilage and the reduction in acreage of all cereal crops were serious blows to the quail population. As horses were replaced by tractors and trucks there was a reduction in the amount of oats grown. Goodrum (1949) published on a study of the status of quail throughout the United States, based on questionnaires sent to conservation officials in 39 states, 25 of which reported a decline in their bobwhite populations. A majority of these states attributed the reduction to extensive changes in land use such as the increase in dairying and clean farming, and the abandonment of cropland with resultant unfavorable food and cover conditions.

Another consideration in studying possible reasons for the virtual disappearance of bobwhites is the matter of competition with other gallinaceous birds, particularly pheasants. Errington (1945:18) stated: "Preliminary to our consideration of competition between the bobwhite and the introduced ring-neck pheasant . . ., it may be explained that the evidence from elsewhere in the north-central region indicates that wintering bobwhites avoid coverts having many pheasants much as they do places overpopulated with their own kind". Later, after specific reference to Iowa data, he wrote (p. 19): "It would therefore seem that even very low densities of pheasants have their competitive significance to the bobwhite". The coexistence of quail and pheasants on Long Island suggests that this may sometimes be more apparent than real. In recent years considerable numbers of both species have been stocked annually on the Island, thus obscuring the effect of possible competition.

No attempt has been made to consider quail distribution in relation to soil types. The fact that bobwhites formerly occurred over much of the State would seem to preclude the necessity for such correlation, at least within the scope of this paper. With reference to precipitation, it is known that deep snow is a serious matter if it persists for any appreciable length of time, and that heavy rains during the nesting and brood seasons often result in substantial losses of nests and young. Thus, it seems clear that climatological data should be

studied in connection with the selection of release sites. Maps showing the physiographic subregions of New York, types of farming, precipitation, and length of growing season were included in an earlier paper on the distribution of the Hungarian partridge in New York (Brown, 1954). Extensive meteorological data for the State have been summarized by Mordoff (1949).

CONCLUSIONS

Bobwhite quail currently occur in significant numbers only on Long Island and in counties bordering the lower Hudson valley. Observations of small, isolated populations, or of individual birds, have been reported from Albany, Erie, Monroe, and Orleans Counties.

The factors which are considered to have contributed to the disappearance of quail from upstate New York, as well as to the failure of attempts at restocking, are (1) changes in farming practices with a resultant decrease in food supply and undesirable changes in cover conditions, (2) the introduction of ring-necked pheasants into many parts of the former quail range, and (3) severe winter weather. The latter factor is thought to have assumed greater significance as the decrease in availability of suitable food and cover became more pronounced.

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MODIFICATIONS OF THE WOLF-TYPE FISH TRAP[1]

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ABSTRACT

An upstream trap is added to the Wolf trap by using a conventional V-type trap under the inclined screen of the Wolf trap. The usual functioning of the Wolf trap is modified by utilizing a core of water through the dam instead of the fall over the dam. Restraint of fish movement over the main spillway by means of racks or fences is necessary.

A fish trap for capturing downstream migrants was described by Wolf (1951). In this trap, water falling over a low dam drops on an inclined screen. The water passes through the screen, but fish and debris are retained and the fish eventually flop their way into a holding box fitted to the downstream edge of the screen. During studies on fish movement and populations in Adirondack brook trout waters,

[1] Acknowledgment is made to Harry Cook of Paul Smiths (N.Y.) and R. H. Kimpton, Jr. of Saranac Inn (N.Y.) who aided in the development of these traps and are responsible for their construction and operation. The research and management program involving the use of the traps is sponsored by Mr. and Mrs. Donald P. Ross of Montchanin, Delaware. The photographs in Figure 3 were taken by Professor Elmer Phillips of Cornell University. My colleague, Dr. Alfred Eipper, has made helpful comments on the manuscript.

adaptations have been made on the Wolf trap principle which may be useful to other workers. One adaptation incorporates an upstream trap into the basic design. A modification is also described in the functioning of the usual downstream trap. The sites for the traps were dams originally installed to prevent the migration of undesirable species into the watersheds above.

The upstream trap was readily evolved by building the conventional V-type design under or immediately in front of the screen and rack forming the downstream trap. This is illustrated in Figure 1. The wings (W) of the upstream trap are made of ¼-inch hardware cloth. The box for the upstream trap (US) in the design illustrated has a V-shaped lead-in with an entrance near the bottom (F). A more efficient arrangement now in use employs a removable funnel which expedites removal of fish, as explained later.

The trap shown in Figure 2 is similar, but with the installation under the rack. The upstream trap (US) has been pulled downstream in position for tending. The water flow has been shut off and the right wing removed. The problem of cleaning the wings and funnel of

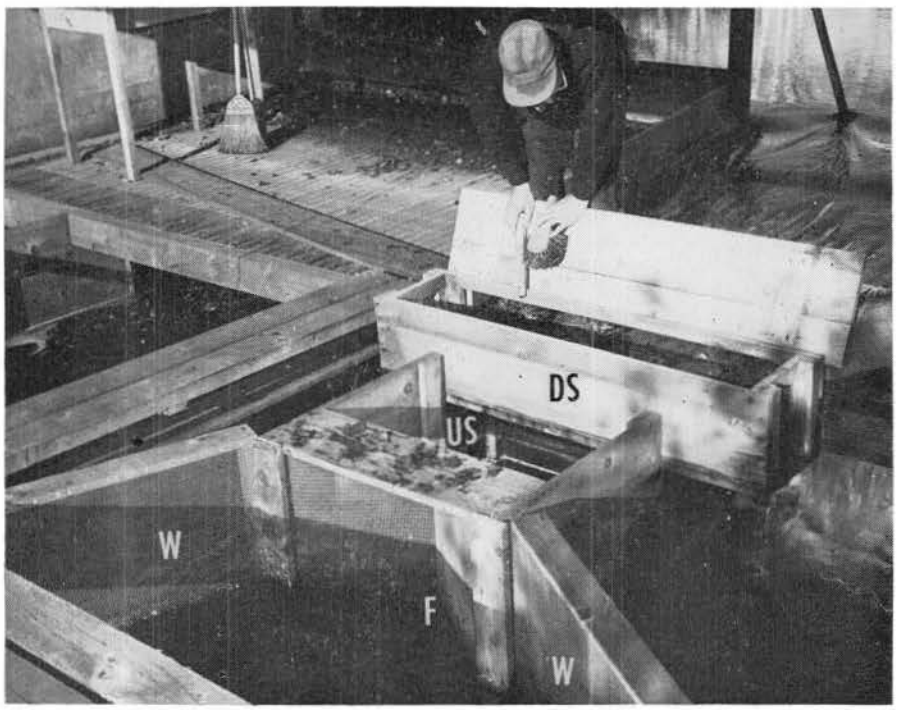

Figure 1. Upstream trap located in front of the conventional Wolf or downstream trap. (See text for explanation)

Figure 2. Upstream trap located beneath inclined rack of the conventional Wolf trap. (See text for explanation)

the upstream trap is materially reduced because the water is first strained through the screening in the racks above. Wings are removable and are held in place by cleats and water pressure.

In both Figures 1 and 2 the boxes constituting the downstream trap (DS) are located on the right half of the spillways. In the conventional Wolf trap the box runs the full width of the spillway and the water falls a short distance rather than flowing directly onto the screen. A fall is preferable, but lack of sufficient head precluded the possibility of any drop to the screens in the dams shown. A larger box is advantageous if flowing water exists above the dam and when daily attention is not possible.

The modification of the downstream Wolf trap is illustrated in Figures 3 and 4. It consists of taking water from an orifice through the dam rather than by a conventional spill over the dam onto inclined screens. In this particular site the main flow passes through iron grating (G) along a 30-foot spillway to the right of the traps. The orifice (O) is a slot approximately 4 inches high by 10 inches wide cut into a splash board in an 8-foot sluiceway. The orifice is located

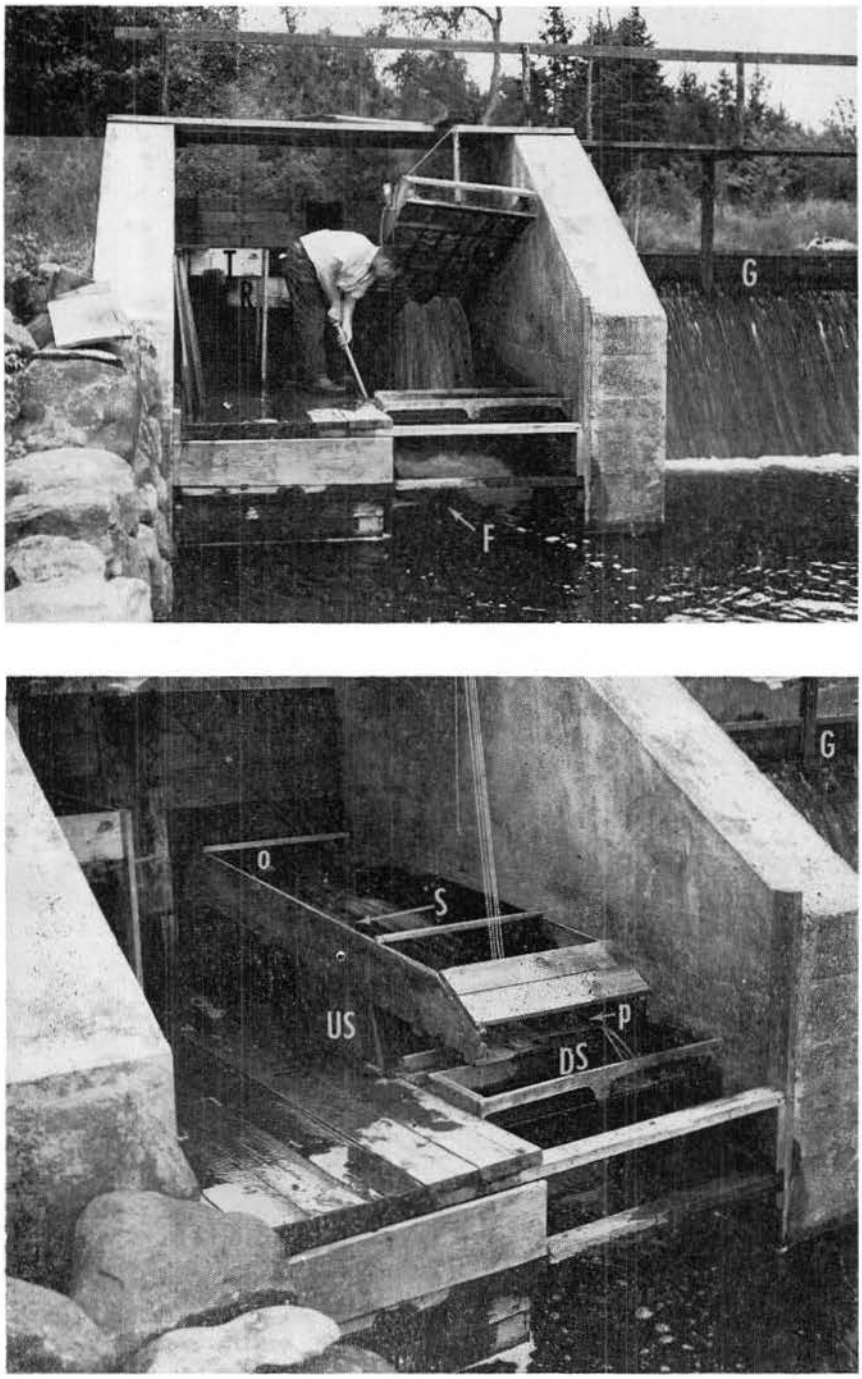

Figure 3. Modified Wolf trap with water discharging through an orifice in dam: (upper) inclined screen raised in position for tending; (lower) trap with parts in functioning position. (See text for explanation)

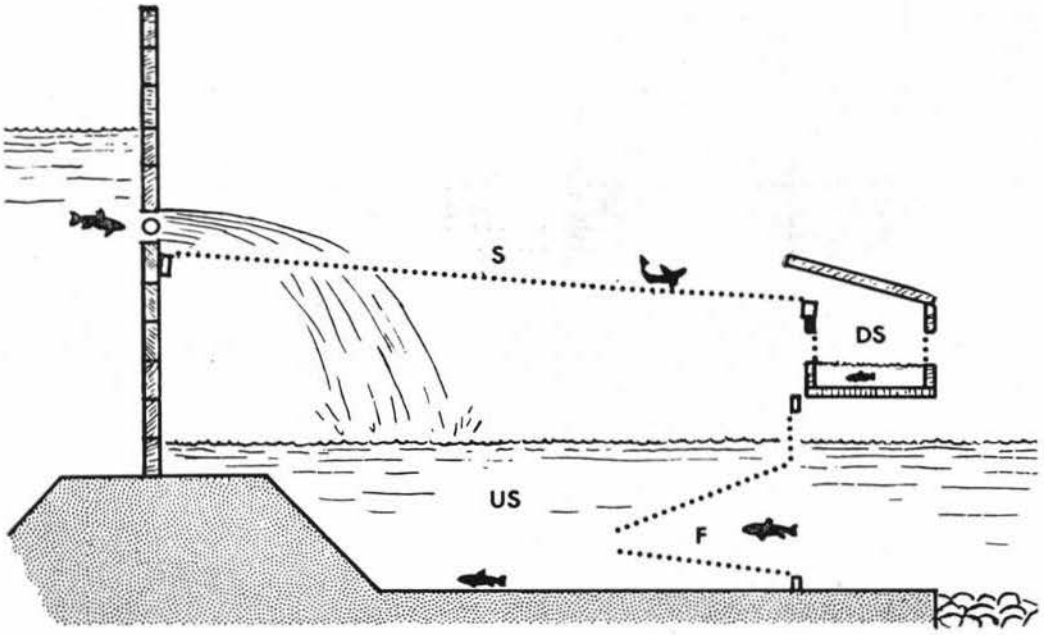

Figure 4. Sectional diagram through upstream and downstream traps of the modified Wolf trap illustrated in Figure 3. (See text for explanation)

so that it has a minimum head of about 14 inches in low water. The flow amounts to about 1½ cubic feet per second.

Water is discharged through the orifice onto the conventional inclined screen (S) and fish eventually drop into the downstream holding box (DS). A ¾-inch pipe (P) assures adequate flow of water into the box. In operation, a cover is inclined over the box to prevent occupants from jumping out. Because of the subsurface draw-off, the problem of debris plugging the screens is minor.

The upstream trap (US) is located directly under the inclined screen. It consists only of a removable funnel (F) leading into an enclosure below the screen. To tend it, the inclined screen is raised and secured. A flat stop-screen is dropped into a keyway located just downstream of the funnel. The funnel, built into a frame and fitting into an upstream keyway, is then removed. A blocking screen is worked down from the upstream end of the trap and wedged into position at about dip-net width from the temporary stop-screen. The fish are dipped out onto a screen-bottomed sorting table (T in Figure 3). Trout are removed to the small trough (R) provided with running water, while rough fish are sorted and counted from the table. In tending both traps the discharge through the orifice is shut off rather than left flowing as shown in Figure 3.

There appears no indication that fish have difficulty in locating the trap entrances, although no quantitative data are available on this point. The core of water discharging under pressure through the orifice probably has a considerable attracting force. Obviously this modification is usable only if it is possible to effectively screen the main flow of water bypassing the traps. When this is possible, however, the modification permits use of the Wolf trap principle on streams with much greater flow than can conveniently be handled by more conventional construction.

Upstream migrants might have difficulty in locating the entrance bay to the upstream trap during high water since a concrete bulkhead separates the main flow from the discharge through the trap. However, the latter flow appears close enough to be readily located. This possibility is enhanced by the fact that the main channel of the pool below the dam is on the same side (left) as the trap.

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SOME IMPLICATIONS OF WATERFOWL TRAPPING RECORDS FROM THE OAK ORCHARD GAME MANAGEMENT AREA [1]

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ABSTRACT

As part of a statewide waterfowl banding program in New York, trapping operations have been carried on at the Oak Orchard Game Management Area. During 1953 and 1954 some 3,670 mallards, black ducks, and wood ducks were taken and daily tallies were kept showing age, sex, and frequency of recurrence in the traps. These records provide data pertaining to the susceptibility of these species to trapping by age and sex, the effect of trap location, the representativeness of sex and age ratios obtained, and the local movements which occur during the fall stopover. In addition, methods by which banding and retrapping records can be used as an aid in analysis of migration data are suggested.

A program of waterfowl trapping and banding has been carried on by the Department for some time. The primary objectives have been to learn the principal breeding grounds, wintering grounds, and flight routes for the major species frequenting New York, and to determine where these birds chiefly afford hunting. At the Oak Orchard Game Management Area in Genesee County, this work was initiated in 1944 and, after a lapse of two years, has been carried on every fall since 1947. During this time more than 5,600 ducks of 12 species have been banded at this station.

In addition to data concerning the primary objectives, records of this kind are potential sources of other information of value in waterfowl management, such as age and sex ratios. In the present paper, the latter are discussed on the basis of the trapping done at the Oak Orchard area in 1953 and 1954 when daily tallies were kept showing age, sex, and frequency of recurrence in the traps. The records are sufficient only for the mallard, black duck, and wood duck, 3,670 of which were taken during these years.

The Oak Orchard area consists mostly of marsh and swamp-woodland habitat which is divided into several units by intervening

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[1] This paper is a joint contribution of Federal Aid in Fish and Wildlife Restoration Project W-39-R and the Lake Plains Game Management District. In addition to the authors, Oliver Meddaugh and Stuart S. Peters assisted in the trap tending and cloacal examination.

high land. The open-water sections of the area are all shallow. During the fall migration the area is primarily attractive to the dabbling duck species and only a scattering of diving ducks stop over. Because of the shallow water, the area is closed by ice before the larger, deep lakes and at a time when it appears some duck movement is still taking place in western New York.

In 1953 trapping operations were begun on September 2 and continued until December 14 when the traps were closed due to ice conditions. With the exception of 11 days (October 18, November 7-10 and 15-19, and December 10) traps were in operation during the entire period. Seven trap sites were established but only four were maintained through the whole period. In one case a floating-type trap was abandoned on September 25 because of a very low take of ducks and competition with muskrats which used the float as a feeding stand and clogged the entrances daily with plant refuse. Another was closed 10 days prior to the hunting season because it was too close to open shooting grounds, and a third was closed at the same time because it was taking no ducks.

The 1954 trapping operations were begun August 9 and continued through December 1 when ice conditions made it necessary to close the traps. With the exception of 5 days (October 17, 18, 24, and 25, and November 22) traps were in operation during the entire period. Fourteen trap sites, including five of those used in 1953, were established but only two were maintained through the entire season. Three had to be closed prior to the hunting season, two others were closed early because they were not taking ducks, and three were closed November 16 because of problems in tending, so that during the last 2 weeks of trapping only six sites were being used of which two had been opened in August, two in September, and one each in October and November.

In both years all ducks trapped were aged and sexed by cloacal examination. In addition to banding all new ducks with Fish and Wildlife Service aluminum butt-end bands, a complete daily record of all retrapped birds was kept. In 1953 no record was made of the take of individual traps, but in 1954 all new birds and recaptures were recorded by trap number.

Because of their bearing on the representativeness of the data pertaining to age and sex ratios, the observations made with respect to the relative susceptibility of adults and juveniles of the two sexes to trapping and the effect of trap location will be discussed first.

SUSCEPTIBILITY TO TRAPPING

The trend throughout the fall in the proportion of ducks that were retrapped at least once in the first 10 days following the initial capture on the area in a given season should offer a partial clue to the relative susceptibility of adults and juveniles to trapping. During the 1954 season 22.6 per cent of the mallards, 26.7 per cent of the black ducks, and 23.8 per cent of the wood ducks were retrapped at least once within 10 days. Examination of the data showed no significant difference in the rate of retrapping between juveniles and adults, or between the sexes. The data did indicate a definite pattern for the juveniles of both sexes showing that, as the season advanced, the proportion retrapped within 10 days fell off from over 30 per cent to less than 20 per cent. No definite pattern could be shown for the adults, although the distribution of the observed percentages by period, both above and below those of the juveniles, suggested that the samples were too small to be significant.

Another possible indicator of the readiness with which ducks are trapped should be found in the frequency with which individual birds were retaken. Combining the 1953 and 1954 records, 38.2 per cent of the mallards, 34.8 per cent of the black ducks, and 35.3 per cent of the wood ducks were retrapped. Some individuals of all three species were taken over 20 times and many individuals up to 10 times. Tabulation of the data showed no differences in frequency of recurrence in the traps by either age or sex, though the numbers of adults in the sample were too few to be conclusive. Those ducks first taken early in the trapping period provided most of the frequent repeaters, but the early trapping also apparently included those ducks which remained longest in the area.

From the evidence available there appeared to be no indication that there exists any difference in susceptibility to trapping between juveniles and adults, or between the sexes. The samples of juveniles were reasonably large and furnished good evidence. Those of adults, on the contrary, were small and scarcely conclusive, but their spread was such as to suggest that they fit into the same pattern as for the juveniles.

Associated with the susceptibility to trapping is the development of the trap habit. That some ducks became quite regular frequenters of the traps was adequately illustrated by those birds that entered them several times a week. In 1953, with mild weather and slow migration, about 13 per cent of the mallards, 5 per cent of the black ducks, and 5

per cent of the wood ducks entered the traps three or more times weekly, but in 1954, when migration was more rapid, less than 5 per cent of the three species frequented the traps with regularity. At the same time, equal or greater proportions reappeared in the traps only occasionally through the season. Many of the ducks which entered the traps several times were not considered addicts since their visits were quite irregular. The daily records showed that both the regular and irregular frequenters of the traps, for a given period, tended to disappear from the area about the same time. In general it appeared that, while some of the ducks were opportunists in making use of the feed put out, only an insignificant proportion were induced to stay beyond their normal migration time by this small scale baiting.

EFFECT OF TRAP LOCATION

In 1954 the record of success for each trap was kept separately. Tabulation of these data indicated that some selectivity was occurring. Only six of the traps took enough ducks and were in operation long enough to give representative figures. Three, which drew their take largely from shoreline and marsh feeding flocks, took an average of 45 per cent males in case of the mallard and 54 per cent males for the black duck. The other three traps seemed to be drawing ducks largely from flocks using open water to a greater degree and took nearly 70 per cent males for both species. Examination of the individual trap records by half-month periods showed these differences in selectivity to have been characteristic throughout the whole season.

None of the traps which functioned effectively throughout the trapping period showed any tendency to favor one age over the other. However, there was a higher proportion of adults present in the population late in the season than earlier. Those traps that were most productive in late season took a proportionally higher number of adults than those that took few birds after the middle of October. It appeared there was no selectivity for either the mallard or the black duck other than that associated with the dates of operation.

While trap location apparently had an effect on the observed sex ratio among mallards and black ducks, the wood duck data indicated no difference of this kind. This could be indicative that wood ducks did not tend to break up into sex flocks in late summer and fall. On the contrary, it could also have been due to either inadequate trap distribution or sample size since the largest number taken in one trap was only 61 birds.

REPRESENTATIVENESS OF AGE RATIO RECORDS

The age distribution of the mallards, black ducks, and wood ducks trapped in 1953 and 1954 is presented in Tables 1, 2, and 3.

For all three species the observed proportion of adults in the samples was lower than would be expected on the basis of other data pertaining to waterfowl productivity. For example, accumulated data from breeding season surveys in New York have indicated that on the average adults comprise 35 to 40 per cent of the early fall population and that it would take an exceptionally high crop of young to bring the proportion down to 25 per cent. The corresponding figures from the trapping samples indicated about 12 per cent adults for the mallard, 24 per cent for the black duck, and 19 per cent for the wood duck.

As already discussed, neither susceptibility to trapping nor trap location had any strong influence on the age composition of the

TABLE 1. SEX AND AGE DISTRIBUTION OF MALLARDS TRAPPED AT OAK ORCHARD IN 1953 AND 1954*

Trapping period	Number					Per cent		
	Adult		Juvenile					
	Male	Female	Male	Female	Total	Adult male	Juvenile male	Total adult
1953								
September 2-15	5	12	48	49	114	29.4	49.5	14.9
September 16-30	4	19	65	87	175	17.4	42.8	13.1
October 1-15	5	3	71	78	157	62.5	47.7	5.1
October 16-31	6	1	68	67	142	85.7	50.4	4.9
November 1-15	15	6	54	44	119	71.4	55.1	17.6
November 16-30	19	25	58	86	188	43.2	40.3	23.4
December 1-14	10	8	45	47	110	55.6	48.9	16.4
Total.....	64	74	409	458	1,005	46.4	47.2	13.7
1954								
August 11-15	..	1	11	6	18	0.0	64.7	5.6
August 16-31	2	..	63	76	141	100.0	45.3	1.4
September 1-15	4	4	63	67	138	50.0	48.5	5.8
September 16-30	6	1	68	40	115	85.7	63.0	6.1
October 1-15	14	12	84	79	189	53.8	51.5	13.8
October 16-31	12	9	39	22	82	57.1	63.9	25.6
November 1-15	13	4	46	25	88	76.5	64.8	19.3
November 16-December 1	7	..	24	18	49	100.0	14.3	14.3
Total.....	58	31	398	333	820	65.2	54.6	10.9

*Exclusive of birds retrapped during the same fall.

Table 2. Sex and Age Distribution of Black Ducks Trapped at Oak Orchard in 1953 and 1954*

Trapping period	Number					Per cent		
	Adult		Juvenile					
	Male	Female	Male	Female	Total	Adult male	Juvenile male	Total adult
1953								
September 2-15	1	4	9	9	23	20.0	50.0	21.7
September 16-30	3	3	14	11	31	50.0	56.0	19.4
October 1-15	1	4	16	17	38	20.0	48.5	13.2
October 16-31	1	2	21	21	45	33.3	50.0	6.7
November 1-15	8	1	25	20	54	88.9	55.6	16.7
November 16-30	13	24	35	52	124	35.1	40.2	29.8
December 1-14	5	6	39	28	78	45.5	58.2	14.1
Total.....	32	44	159	158	393	42.1	50.2	19.3
1954								
August 11-15	..	..	8	3	11	..	72.7	0.0
August 16-31	9	2	65	38	114	81.8	63.1	9.6
September 1-15	5	2	67	48	122	71.4	58.3	5.7
September 16-30	12	3	66	29	110	80.0	69.5	13.6
October 1-15	41	23	62	51	177	64.1	54.9	36.2
October 16-31	25	6	26	18	75	80.7	59.1	41.3
November 1-15	38	23	59	42	162	62.1	58.4	37.7
November 16-December 1	22	18	42	21	103	55.0	66.7	38.8
Total.....	152	77	395	250	874	66.4	61.2	26.2

*Exclusive of birds retrapped during the same fall.

samples recorded. From the tables it may be seen that in the mild fall of 1953 there was little change in the age composition of the samples as the season advanced. In 1954, however, both the mallard and black duck showed a gradual increase in the proportion of adults trapped. Study of the retrapping records indicated that those ducks taken later in the season tended to stay less long on the area. A corollary of this would be the probability that the late arrivals, by moving through more rapidly, would be less subject to trapping. If so, and if the 1954 data are correct in indicating that adults tend to arrive later, then it may be assumed that the adults were not being trapped in equal proportion to their occurrence on the area throughout the season as compared with the juveniles. In addition, the ponds on the Oak Orchard area tend to skim over with ice earlier than do nearby larger bodies of water and while late movement of ducks is still taking place. Thus, it appears that trapping on this area alone

does not provide a representative sample of the age ratio in the fall flight for either the mallard or black duck.

Since trapping was carried on through the whole migration period of the wood duck, the sample should have been representative if the trapping methods reached the different segments of the population equally. Nothing in the 1953 or 1954 data indicated any progressive change in the proportion of adults to juveniles with the advance of the season. Similarly, susceptibility to trapping did not appear to be a factor. Yet, in this case, the data indicated a greater reproductive success than had been observed in field surveys. Data for the individual traps gave no indication of selectivity for age groups but the samples were small and the possibility still remains that the trap distribution pattern was inadequate for sampling the wood duck population uniformly. Traps were located near most of the areas which were commonly frequented by mallards and black ducks during 1954. On the contrary, there were concentrations of wood ducks

TABLE 3. SEX AND AGE DISTRIBUTION OF WOOD DUCKS TRAPPED AT OAK ORCHARD IN 1953 AND 1954*

Trapping period	Number					Per cent		
	Adult		Juvenile					
	Male	Female	Male	Female	Total	Adult male	Juvenile male	Total adult
1953								
September 2-15	22	17	52	65	156	56.4	44.4	25.0
September 16-30	3	3	20	9	35	50.0	69.0	17.1
October 1-15	11	5	43	48	107	68.8	47.3	15.0
October 16-31	1	1	7	15	24	50.0	31.8	8.3
November 1-15	..	..	..	1	1	..	0.0	0.0
November 16-30	1	..	..	..	1	100.0	..	100.0
December 1-14§	1	..	..	1	2	100.0	0.0	50.0
Total.....	39	26	122	139	326	60.0	46.7	19.9
1954								
August 11-15	4	1	18	23	46	80.0	43.9	10.9
August 16-31	16	4	37	41	98	80.0	47.4	20.4
September 1-15	7	..	11	31	49	100.0	26.2	14.3
September 16-30	6	1	7	11	25	85.7	38.9	28.0
October 1-15	4	2	13	13	32	66.7	50.0	18.8
October 16-31§	..	..	1	1	2	..	50.0	0.0
Total.....	37	8	87	120	252	82.3	42.4	17.9

*Exclusive of birds retrapped during the same fall.
§The last wood duck trapped in 1953 was taken December 7, while in 1954 the last one was trapped on October 29.

which probably did not range near any of the trap sites. If the wood duck age-ratio sample was not representative, inadequate trap distribution could have been a factor.

Trapping samples from other stations in New York have shown a wide range of age ratios. Data obtained during the falls of 1952, 1953, and 1954 from stations on Perch Lake, Lake Alice, Tomhannock Reservoir, Oneida Lake, Montezuma, and a series of small marshes near Sodus showed the proportion of mallard, black duck, and wood duck adults as ranging from 10 to 60 per cent but averaging near 25 per cent for all three species. Disregarding the fact that there is some question as to whether all station operators were adept in making cloacal examinations, there still remains the probability that these stations provided no more representative age ratio records than Oak Orchard. Some of these stations tended to draw late summer concentrations, while at others few ducks were present until migration was well underway. Likewise trap distribution was probably inadequate on some of the areas to sample all segments of the population as appears to have been the case with respect to wood ducks at Oak Orchard.

REPRESENTATIVENESS OF SEX RATIO RECORDS

The sex ratios among both juveniles and adults for the mallard, black duck, and wood duck are also presented in Tables 1, 2, and 3. For the mallard and black duck a rise in the proportion of males to females was indicated for 1954 over 1953 in both age groups. No significance may be attached to this change since it has been shown that trap location had a definite effect on the numbers of males taken. Records from those traps which were located in 1954 at the same sites as 1953 traps indicated nearly identical sex ratios for the two years. For the wood duck no significant change was observed in the sex ratio of the juveniles between the two years and in the adults too few birds were taken to provide a representative sample.

Trapping samples for other stations in New York have indicated populations ranging from as low as 10 per cent to nearly 100 per cent males. Sample size, trap location, and habitat available could all have been factors in these variations. From these observations it appears that in their present form most trapping records (and banding data) are not representative of annual fluctuations in the sex ratio; nor do the data necessarily even approximate the sex ratio of populations passing through a region. At the same time, the records do suggest that through standardizing the traps, their location, and time

of operation phenologically it might be possible to measure the occurrence of annual changes.

LOCAL MIGRATION PATTERN

Data indicative of the extent of duck movement within the Oak Orchard area are presented in Table 4. Some 52 per cent of the mallards, 54 per cent of the black ducks, and 39 per cent of the wood

TABLE 4. RETRAPPING RECORDS FOR MALLARDS, BLACK DUCKS, AND WOOD DUCKS IN RELATION TO TRAP WHERE FIRST TAKEN AT OAK ORCHARD IN 1954

Location where retaken	Mallard		Black duck		Wood duck	
	Number	Per cent	Number	Per cent	Number	Per cent
Only where first trapped.....	90	37.9	126	39.4	27	33.8
Nearby trap...	34	13.9	45	14.1	4	5.0
Same marsh...	68	27.9	82	25.6	16	20.0
Other marsh...	52	21.3	67	20.9	33	41.2
Total.....	244	100.0	320	100.0	80	100.0

ducks were retaken only in the same trap or one nearby. Nearly 80 per cent of the mallards and black ducks and almost 60 per cent of the wood ducks were not retaken outside of the marsh where they were first trapped. Viewed on a half-month basis the records suggest somewhat greater local movement for those first trapped early in the season, but the samples were too small to carry significance and gave no indication of differences by either sex or age. Furthermore, these differences would not necessarily indicate a behavior pattern but might simply reflect greater opportunity for being retrapped.

Of the movement which was observed, a half mile to a mile was frequent. Some individuals of all three species were retaken at a distance of 2½ to 3 miles within a week's time. Even greater local movement is further indicated by band returns from hunters who took ducks within a radius of several miles often only a few days after banding or the most recent retrapping. At the same time it appears that the area was serving as a refuge for a high proportion of the ducks known still to be in the region.

The role of Oak Orchard as a congregating point for locally-reared ducks received little clarification in this study. During July, 1954, some 50 mallards, 17 black ducks, 87 wood ducks, and 18 blue-winged teal were banded on seven small marshes within a 25-mile radius south and west of the refuge. Only two mallards and three black ducks from these were subsequently recaptured at Oak Orchard. These data might be interpreted as indicating that the locally-reared ducks had little tendency to congregate at Oak Orchard, but the low return could also be attributed to the fact that only a small proportion of the mallards and black ducks and an even smaller part of the wood ducks and blue-winged teal passing through the area were sampled. In 1954 only 1.6 per cent of the mallards, 3.8 per cent of the black ducks, and 0.6 per cent of the wood ducks banded in 1953 were recaptured indicating that probably a relatively small proportion of the ducks present was being sampled.

Aerial census of waterfowl has been used in this State and elsewhere to provide a broad picture of the migration pattern. Trapping records afford supplementary information on more detailed aspects of population status such as age and sex ratios as already discussed. Also, trapping may indicate abundance more closely than aerial census when local conditions make observation difficult. Table 5 presents data based on the assumption that the numbers of ducks taken during successive half-month periods (including any also taken during a previous period) tend to reflect changes in the population present. For 1953 it appeared that peak abundance prevailed throughout October and remained relatively high through early December. The traps were closed for 5 days of the first half of November, so the apparent drop is not considered significant. In 1954 the peak was reached in early October and had passed before mid-October. During both years the wood duck provided only a small portion of the population after the middle of October. Aerial surveys over Oak Orchard on September 9, 1953, showed no correlation with the numbers known to be present, but a flight on October 8, 1953, when foliage was less dense more nearly approximated the species abundance observed during trapping operations.

Viewing the daily records from which Table 5 was compiled, the population composition with respect to new and previously recorded ducks varied considerably but in a definite pattern. This pattern consisted of the taking of many new ducks and then the gradual tapering off of the proportion of new to previously trapped and banded birds. This was accompanied by a gradual drop in the total take

TABLE 5. COMPARISON OF THE NUMBERS OF DUCKS PRESENT AT OAK ORCHARD IN 1953 AND 1954 BY HALF-MONTH PERIODS BASED ON THE TOTAL NUMBER TRAPPED*

Trapping period§	Mallard	Black duck	Wood duck	Total
		1953		
September 2-15	114	23	156	293
September 16-30	241	43	82	366
October 1-15	242	52	140	434
October 16-31	255	51	40	346
November 1-15	208	64	3	275
November 16-30	269	146	1	416
December 1-14	226	119	4	349
		1954		
August 11-15	18	11	46	75
August 16-31	145	118	113	376
September 1-15	173	158	68	399
September 16-30	170	156	36	362
October 1-15	261	268	42	571
October 16-31	110	146	3	259
November 1-15	122	202	...	324
November 16-December 1	78	166	...	244

*Includes birds previously trapped, but individuals counted only once for a given period.

§In 1953 the traps were not operated on October 18, November 7, 8, 9, 10, 15, 16, 17, 18, and 19, and December 10, and in 1954 on October 17, 18, 24 and 25 and November 22, tending to reduce the totals for the periods involved.

until a new group of arrivals again filled the traps. Oddly enough, while the general picture seemed to indicate the arrival and moving on of groups of ducks, with each influx of unbanded ducks there was always also an increase in the number of banded ducks that had not been in the traps for 2 or 3 weeks.

Another aspect of aerial census records involves the question of the extent to which ducks seen in successive flights represent new arrivals as compared with those seen on previous flights. Retrapping records provide a good base for studying this problem. Tabulation of such data by half-month periods following the time of initial capture indicated a progressive decline in the number retaken at each later period. In general it appeared that no more than 25 per cent of the ducks present at a given time were still there 2 weeks later, and as the season advanced this proportion became lower. In 1953 the ducks lingered longer than in 1954. Of the mallards first taken in early September at least 25 per cent were still present in late October of 1953, but in 1954 the proportion was only 6 per cent. The correspond-

ing figures for the black duck were 26 per cent and 15 per cent, and for the wood duck 5 per cent and zero. On the average, for all three species, close to 70 per cent of the individual ducks trapped in any one period were new birds. If these records are typical of upstate areas and some discounting is allowed for those banded ducks which remain in the region but move out of range of the traps, it seems safe to assume that probably over half the ducks observed in successive half-month periods are new arrivals.

CONCLUSIONS

There is little or no difference in susceptibility to trapping between juveniles and adults, or between males and females, for the mallard, black duck, or wood duck. Small scale baiting as done in marsh trapping will draw some ducks to the traps for food but tends to hold only a few individuals beyond normal migration time. Trap location within a marsh may have a definite influence on the proportion of males to females taken but not on the age ratio for the mallard and black duck. Neither the age nor sex ratios recorded in trapping through the fall months are necessarily representative of the populations passing through a region. Waterfowl arriving later in the season at Oak Orchard do not remain as long in the area as early arrivals and as a result are less subject to trapping. Adult mallards and black ducks tend to arrive in numbers later than juveniles.

The majority of ducks stopping over in a marsh habitat during the fall flight do not tend to move far until they leave the region. Local movement is greater among the early arrivals. In dense habitat trapping records may show relative abundance more readily than aerial observation. Retrapping records may be used as an aid in interpreting migratory behavior. At Oak Orchard there was close to a 70 per cent turnover in population by half-month periods.

WATERFOWL USE OF SMALL, MAN-MADE WILDLIFE MARSHES IN NEW YORK STATE[1]

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ABSTRACT

During 1953, 1954, and 1955 studies were conducted on 559 small marshes created under Federal Aid in Fish and Wildlife Restoration Project W-48-D. The studies included observations on the pairs of breeding ducks attracted to these areas, brood production, and fall use by waterfowl. The records obtained demonstrate the importance of these areas to waterfowl, as well as the variations in use and in the species frequenting them in different parts of the State. They also give some indication of the change in use as the number of years of flooding increased. The problems of assigning brood production values to the individual marshes are discussed.

With the establishment in 1949 of Federal Aid in Fish and Wildlife Restoration Project W-48-D, the creation of small wildlife marshes, especially on private lands, in New York State was greatly accelerated. Evaluation of the effects of these small impoundments on wildlife were assigned to the various projects which were concerned. The Waterfowl Management Research Project in 1953 was charged with determining the production and other waterfowl use creditable to these marshes. Preliminary work by project personnel was initiated in the spring of 1953. In 1954 and 1955 the aid of management personnel was enlisted to permit getting representative records from the whole State.

PROCEDURE

What basically amounted to two types of observations are involved in the data to be presented. On nearly all the areas covered by research personnel and part of those by management personnel the field surveys were intensive, with successive coverages of the areas being made. On a limited number of these marshes, surveys were conducted both during the spring to estimate the breeding population and through

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[1] This paper is a contribution of Federal Aid in Fish and Wildlife Restoration Project W-39-R but represents a compilation of records gathered by both research and management personnel. Grateful acknowledgment is made to the many individuals who helped collect these records and especially to Gerald E. Cummings, Anthony S. Taormina, Robert Cottrell, Stuart S. Peters, and Thomas W. Barry who all made major contributions.

the summer to observe brood production and use. For the other areas the reports consisted largely of chance observations. Usually these areas were visited in association with other work and often only a few minutes were spent scanning the open water. For some, only one or two visits were made and the resultant records must be considered only minimum estimates. In the tables presented, the records from all areas have been lumped together regardless of the intensity of field work. Where the results for the areas covered in more detail indicate a picture at variance from the rest of the records, this has been brought out in the text.

It should be noted that it is not claimed that all the broods seen on these areas were produced there. It is known that there was movement to and from certain areas by some of the broods seen; thus it would not be possible to calculate more closely the contribution to production made by such marshes unless considerably more field work, probably involving the color marking and banding of broods, were carried on.

FINDINGS

During 1953 some 85 areas were surveyed for breeding pairs or broods, or both; 249 were thus covered in 1954, and 225 in 1955. The 1953 coverage was primarily restricted to the Lake Plains, South Central, and North Central Game Management Districts with only a miscellany of records from the rest of the State. In 1954 and 1955 the distribution of areas was much broader, and very nearly in proportion to the number of marshes created in each district. Both breeding and brood data were collected from some areas. For the three years the respective numbers were 70, 167, and 110 areas.

The proportion of these man-made marshes which was used by ducks is partially illustrated in Table 1. These data indicate that over 80 per cent of the areas attracted breeding ducks and that nearly 70 per cent supported broods at least part of the time.

Possibly the degree of use indicated in Table 1 is a minimum estimate. In several instances nests were located even though no breeding birds had been seen. Likewise, successful nests were found even though subsequently the broods were never observed. On the contrary, those areas which were checked intensively did not show appreciably greater numbers of breeders or broods than those that were checked only once or twice. However, 347 areas were checked for both breeders and broods over the three years and 89 per cent were found to be supporting one or the other. Of the 11 per cent on which

TABLE 1. OBSERVED USE OF WILDLIFE MARSHES BY BREEDING PAIRS AND BROODS OF DUCKS

Year	Number surveyed*	Number used	Per cent used
	Breeding pairs		
1953	74	59	79.7
1954	235	196	83.4
1955	149	118	79.2
Total	458	373	81.4
	Broods		
1953	81	60	74.1
1954	181	113	62.4
1955	186	140	75.3
Total	448	313	69.9

* In each category, includes the areas surveyed for both types of data plus those surveyed for that type only.

TABLE 2. NUMBER OF BREEDING PAIRS AND BROODS OF DUCKS OBSERVED PER WILDLIFE MARSH

Year	Mallard	Black duck	Wood duck	Blue-winged teal	Total
			Breeding pairs		
1953	0.78	0.38	0.81	0.26	2.23
1954	0.73	0.42	0.54	0.19	1.87
1955	0.81	0.51	0.70	0.09	2.11
Average	0.76	0.44	0.63	0.17	2.01
			Broods		
1953	0.56	0.26	0.75	0.12	1.69
1954	0.39	0.23	0.53	0.06	1.21
1955	0.45	0.36	0.63	0.07	1.51
Average	0.44	0.29	0.61	0.08	1.42

neither breeders nor broods were located, migrants in either spring or fall were observed on over half, leaving less than 5 per cent for which no use by ducks was recorded.

The numbers of breeding pairs and broods per marsh are presented in Table 2. These data indicate that on the average there were two breeding pairs and nearly one and a half broods observed per water unit. Only four species—the mallard, black duck, wood duck,

and blue-winged teal—were noted, their relative numbers varying with the habitat. Over half the areas were supporting only one species, 25 per cent two species, and only 5 per cent had four species. Several of the marshes that were supporting up to five pairs or broods still included only one or two species. Most of those where greater than average densities of either breeders or broods were observed did not appear to be carrying these birds full time. These marshes were not necessarily larger than average but were situated near either natural or man-made potholes, slow-moving streams, or other wetland habitat.

The units studied varied in size from less than an acre to nearly 40 acres, but over 80 per cent were from 2 to 10 acres and the average was 5 acres. Based on the densities shown in Table 2, these records suggest that the marshes were attracting ducks at the rate of 40 pairs per 100 acres and producing young at the rate of 28 broods per 100 acres. These figures are in contrast to those for some of the larger marsh areas over the State, which over a period of years have averaged 10 to 15 pairs of breeders and usually half that number of broods per 100 acres. On the contrary, no greater importance may be attached to one type of area over the other because the larger units serve many more ducks during the concentration and migration periods.

Samples from some of the game management districts were too few to permit comparing the densities of breeders which were attracted to the marshes, or of the broods produced, but the records suggest that regional differences did exist. The Lake Plains region apparently provided the most productive marshes in which both the number of breeders and broods exceeded the statewide average by more than 25 per cent. In contrast to this, in the South Central district the breeding pairs were 10 per cent below the statewide average and the broods observed just equalled the average even though these marshes had been surveyed more intensively than others.

The wider distribution of samples in 1954 and 1955 provided records which give some indication of the species composition which may be expected on such wildlife marshes in this State. These data are shown in Table 3. In western New York the mallard was the most frequently observed breeding species, forming close to 40 per cent of the pairs recorded. Following in second place was the wood duck, then the black duck, and finally the blue-winged teal at about 8 per cent. In eastern New York the wood duck was the most frequent, but was followed very closely by the black duck with the two making up over 70 per cent of the pairs observed. The mallard was a strong third

TABLE 3. PERCENTAGE COMPOSITION BY SPECIES FOR BREEDING PAIRS AND BROODS OF DUCKS OBSERVED ON WILDLIFE MARSHES IN 1954 AND 1955*

Species	Eastern New York	Western New York	Total
	Breeding pairs		
Mallard	27.2	39.9	38.6
Black duck	35.1	21.8	23.2
Wood duck	36.4	29.9	30.5
Blue-winged teal	1.3	8.4	7.7
	Broods		
Mallard	10.9	32.8	30.8
Black duck	45.6	19.3	21.7
Wood duck	43.5	42.6	42.7
Blue-winged teal	0.0	5.3	4.8

* For breeding pairs, the number of areas involved was only 38 in eastern New York and 346 in western New York; for broods, the comparable figures were 34 and 333, respectively.

and the blue-winged teal constituted little more than 1 per cent of the breeding population. Even in western New York the blue-winged teal was mostly restricted to the Great Lakes lowland, and was rare in the Southern Tier hill country.

The picture of species composition appeared quite different when the brood observations were tallied. In the western New York sample the change in proportions may be accounted for in part because wood duck broods are more readily observed, while the presence of black duck and blue-winged teal broods is often difficult to detect. Also, from the areas which were worked intensively, it appeared that the wood duck most frequently moved broods into the marshes from other areas, although this was observed for the black duck and mallard too. For eastern New York it is believed the sample was too small to give significance to the brood records and that the data for breeding pairs should be considered as indicative of only a possible trend.

Most of the data in the foregoing tables were from recently flooded areas. For nearly a quarter of the marshes only the first growing season was represented; 30 per cent were in their second year, and 20 per cent in their third. Only 13 per cent had been covered with water for five or more summers, with the oldest in their seventh season. The newly-flooded marshes proved very attractive to waterfowl, and several instances were observed where the new areas appeared to have drawn ducks away from nearby older impoundments.

Contrasting the records for those marshes which had been flooded five summers or more with those for the new areas, a definitely higher number of breeding pairs and broods were located on the new areas. The distribution of marshes through the management districts in terms of years under water was not proportionate, with the result that it was difficult to differentiate variations in production due to regional location from those due to marsh age. Examination of all the records, however, strongly suggested that, with other factors being equal, these marshes were most productive during the second and third seasons of flooding.

Post-breeding season use of the wildlife marshes varied considerably. A few of the larger ones, and some of only 5 acres, were found to be serving as fall concentration points both for locally-reared ducks and migrants, often being populated with five to ten times the estimated production. Surveys during September 1955 in the South Central district showed ducks on 55 per cent of the 46 marshes which had been studied during the breeding season. Species composition on the individual ponds showed only partial correlation with that observed during the breeding season, and included pintails, blue-winged teal and green-winged teal which were not present earlier. In general, the areas that had had the most summer use also had the most birds during September, but there were exceptions. Two areas which had no ducks during either the spring or summer were harboring a September population. Fall records from the rest of the State were very scattered but observations on 20 marshes in the Lake Plains district showed all but one to have ducks on them. During the hunting season several of the larger wildlife marshes, all of which were posted, were found to be serving as effective refuge areas.

DISCUSSION

The material presented in this paper is a product of field surveys of varying intensity. From accumulated experiences in field survey work it is believed that the estimates of the breeding pairs are as accurate as the data will permit, but that they are minimum estimates. Probably complete counts of the breeding pairs were obtained on less than half the areas. No provisions were made to locate breeding pairs on nearby small natural areas, yet some of this production is at least partially creditable to the wildlife marshes, since in several instances reports indicated that these natural areas had not been used except in very wet years until the larger permanent marshes were established.

In the case of brood records, not only is there a question of their completeness but also of their significance. That the number of broods observed is only a minimum count is an accepted fact. Only with very intensive work is it possible to locate all broods. Often brood signs were observed but without the brood being seen or identified. These unseen broods were not included in the tabulations. The significance of the brood records is subject to question for the following reasons. On the areas intensively surveyed broods frequently appeared that could not be correlated with the known breeding pairs, either because that species had not been present in the breeding population or because more broods than breeders of the same species were located. Often broods of various ages prior to the time they began to fly would appear for a few days or a week and then disappear on some of the intensively worked areas, showing that there was some degree of brood movement. Fairly definite indications were found that some flightless broods were moving as much as a mile from one water unit to another.

Evans, Hawkins and Marshall (1952) in their study of waterfowl in Manitoba found that broods were often on the move and frequently visited several water units before they began to fly. One pothole over a 2-month period was visited by 19 flightless broods of eight species though only seven broods were resident at one time. Cummings (1955) in trapping during July on seven wildlife marshes in western New York located 5.8 broods per marsh in 1954 and 7.5 in 1955, and considered this a minimum production estimate because not all broods observed on the marshes entered the traps. In light of the findings in Manitoba and the observed brood movement in New York it seems unsafe to conclude that these broods necessarily represent only the production of the sampled marshes. A question then exists as to what proportion of them may be attributed to the wildlife marshes, what proportion were a product of nearby temporary water units, and what proportion wandered in from more remote areas. Only more intensive and detailed work will fully answer such questions.

CONCLUSIONS

The wildlife marshes built under Project W-48-D make a definite contribution to waterfowl habitat in New York. Over 80 per cent of them attract breeding pairs in the spring and broods may be reared on nearly 70 per cent. The marshes receive considerable use by both spring and fall migrants and some serve as late summer concentration areas and refuges during the open season. Less than 5 per cent fail to

attract ducks at any season. Mallards, black ducks, wood ducks, and blue-winged teal may all utilize these areas and the marshes tend to increase the use of temporary water units in the near vicinity. On the average the small areas attract breeding pairs and are used for rearing broods at more than twice the rate of larger marsh units. About two pairs of breeders may be expected on marsh units averaging about 5 acres, but due to brood movement no satisfactory figure for brood production can be assigned from the present studies. The productivity of these marshes and the species composition on them vary with regional differences in habitat through the State. After the third season of flooding their attractiveness and productivity tend to decline.

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OBSERVATIONS ON THE OCCURRENCE OF PARASITES IN THE FISHES OF CERTAIN SOUTH-CENTRAL NEW YORK STREAMS[1]

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ABSTRACT

In a survey of fish parasites during the summers of 1952 to 1954 from ten streams of the Susquehanna River watershed of Broome and Tioga Counties, 448 fishes, representing 23 different species distributed in 6 families, were examined and 385, or 85.9 per cent, were found to be infected with at least one species of parasite. The number infected with each parasite as well as the relative intensity of infection is presented for each species of fish examined. A list of parasites giving the number of different species infected with each is also included. The larval forms of the parasites, most of which reach sexual maturity in fish-eating birds and mammals, occurred most frequently and in more species of fish than did the other developmental stages. The larval black grub and related larval strigeid parasites (*Neascus* spp.) were found in 20 species, the larval white grub (*Posthodiplostomum minimum*) in 15, various species of gill flukes (Gyrodactyloidea) in 15, and the nematode (*Rhabdochona cascadilla*) in 11.

Stream fishes from the Susquehanna River watershed of south-central New York were examined for parasites during the summers of 1952 to 1954 in order to supplement the data contained in the report by Hunninen (1936) which stressed lentic environments, and game and pan fishes. Particularly, the present author was concerned with the parasites of cyprinid fishes inasmuch as they play a most important role in lotic environments, very often being the dominant fish population present. Hunninen gave very little information on this family of fishes, having examined only 51 as follows: 35 golden shiners (*Notemigonus crysoleucas*) listing the acanthocephalan, *Pomphorhynchus bulbocolli,* from lakes of the Susquehanna watershed; and 16 fall fish (*Leucosomus corporalis*) listing a trematode, *Allocreadium lobatum,* from streams of the Delaware River watershed. In addition Hunninen listed, from five streams of the Susquehanna watershed, the following parasites: Trematoda—larval *Clinostomum marginatum, Crepidostomum cornutum,* larval *Neascus* spp.; Cestoda—*Proteocephalus pearsei;* Nematoda—*Metabronema salvelini* (=*Cystidicoloides harwoodi*); Acanthocephala—*Leptorhynchoides thecatus, Neoechinorhynchus cylindratus.* Because of the manner in which the data were presented, it is not possible to ascertain the exact fish host(s)

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[1] Contribution No. 9 from the Department of Biological Sciences, Harpur College, State University of New York, Endicott, New York.

for each parasite with the exception of the nematode which was found in brook trout (*Salvelinus fontinalis*).

In the present study 448 fishes, representing 23 different species distributed in 6 families and collected from 10 different streams in two counties, were examined for parasites, and 385, or 85.9 per cent, were found to be infected with at least one species. Collections from Broome County were taken from Big Snake Creek (at Corbettsville), Choconut Creek (Town of Vestal), Crocker Creek (west of Union Center), Hooper Creek (at Endwell), Little Snake Creek (at Conklin Forks), Nanticoke Creek (at Maine), and Page Brook (at Chenango Valley State Park). Collections from Tioga County were taken from Apalachin Creek (east of Apalachin), Owego Creek (north of Owego), and Pipe Creek (west of Owego). The 85.9 per cent infection compares favorably with values recorded by Bangham (1946) for northern Wisconsin streams (80.2 per cent), and by Fischthal (1953) for northwestern Wisconsin streams (85.3 per cent).

PARASITES RECOVERED

For each fish host the species of parasites are listed in the order of frequency of occurrence, while the number following each name denotes the number of hosts in which that form was found. Two asterisks (**) preceding the name of a parasite indicate an immature stage within the digestive tract of the host; a single asterisk (*), a larval stage (usually encysted). References to a light infection infer the presence of 1-10 parasites of a given species; a moderate infection, 11-50; a heavy infection, 51 or more. While percentages of infection are given, their significance must be judged, in each case, in relation to the number of specimens involved.

Catostomidae (Examined 51; infected 45, or 88.2 per cent)

1. Common white sucker (*Catostomus commersonnii commersonnii*)

   Examined 40; infected 37, or 92.5 per cent.

   Parasites: **Neascus* sp.—28; *Neoechinorhynchus crassus*—19; *Triganodistomum attenuatum*—6; ***T. attenuatum*—6; ***Glaridacris catostomi*—4; *Acolpenteron catostomi*—3; *Ergasilus* sp.—2; *Glaridacris catostomi*—2; *Plagioporus sinitsini*—2; ***Rhabdochona cascadilla*—2; ***Biacetabulum* sp.—1; ***Glaridacris confusus*—1; *Hepaticola bakeri*—1; Myxosporidia—1; *Octomacrum lanceatum*—1; ***Phyllodistomum* sp.—1.

   The majority of suckers examined were small (3-5 inches), although some ranged up to 12 inches in length. They were taken from the following streams: Little Snake Creek (13), Nanticoke Creek (4),

Owego Creek (14), Page Brook (5), Pipe Creek (4). A moderate infection with Myxosporidia occurred on the gills of one Owego Creek fish. Most all specimens were lightly parasitized.

2. Hog sucker (*Hypentelium nigricans*)

Examined 11; infected 8, or 72.7 per cent.

Parasites: **Neascus* sp.—6; Gyrodactyloidea—2; Myxosporidia—2; **Contracaecum* sp.—1; *Ergasilus* sp.—1; *Glaridacris confusus*—1; **Posthodiplostomum minimum*—1; *Rhabdochona cascadilla*—1.

The fish were collected from Big Snake Creek (1), Choconut Creek (2), Little Snake Creek (4), Owego Creek (2), and Pipe Creek (2). They were lightly to moderately infected. Two from Choconut Creek were moderately infected with Myxosporidia on their gills.

CYPRINIDAE (Examined 264; infected 236, or 89.4 per cent)

3. Fallfish (*Leucosomus corporalis*)

Examined 24; infected 24, or 100 per cent.

Parasites: **Neascus* sp.—23; **Posthodiplostomum minimum*—22; *Ergasilus* sp.—8; *Allocreadium lobatum*—6; Gyrodactyloidea—6; ***Rhabdochona cascadilla*—4; *R. cascadilla*—1; *Plagioporus sinitsini*—1; ***Proteocephalus* sp.—1.

These fish were captured in Big Snake Creek (7), Choconut Creek (6) and Pipe Creek (11). Infections with *Neascus* sp., *P. minimum*, and *Ergasilus* sp. were moderate to heavy, while all others were light.

4. Northern creek chub (*Semotilus atromaculatus atromaculatus*)

Examined 40; infected 33, or 82.5 per cent.

Parasites: **Neascus* sp.—30; **Posthodiplostomum minimum*—18; *Rhabdochona cascadilla*—8; Gyrodactyloidea—4; Myxosporidia—3; *Glochidia—1; *Hepaticola bakeri*—1; *Plagioporus sinitsini*—1.

Creek chubs were obtained from Apalachin Creek (13), Crocker Creek (5), Hooper Creek (9), Little Snake Creek (10), and Owego Creek (3). Seven of the Hooper Creek fish were negative for parasites. *Neascus* sp. occurred in moderate to heavy infections. Light to moderate infections of *P. minimum* were observed. A moderate infection of larval Glochidia occurred on an Apalachin Creek specimen. Light parasitism with Myxosporidia was found on the gills. All other infections were light. The one *Hepaticola bakeri* from Crocker Creek was in the bile duct with its anterior end in the gall bladder and posterior end in the lumen of the small intestine.

5. Allegheny pearl dace (*Margariscus margarita margarita*)

Examined 1; infected 1, or 100 per cent.

Parasites: **Neascus* sp.—1; **Posthodiplostomum minimum*—1; *Rhabdochona cascadilla*—1.

The one fish from Owego Creek was lightly infected.

6. River chub (*Nocomis micropogon*)

Examined 9; infected 9, or 100 per cent.

Parasites: **Neascus* sp.—9; Gyrodactyloidea—2; **Posthodiplostomum minimum*—1.

All river chubs were taken from Little Snake Creek. They were lightly to heavily infected with *Neascus* sp. The other parasites were lightly present.

7. Eastern black-nosed dace (*Rhinichthys atratulus atratulus*)

Examined 61; infected 51, or 83.6 per cent.

Parasites: **Neascus* sp.—49; **Posthodiplostomum minimum*—8; *Rhabdochona cascadilla*—3; **Contracaecum* sp.—1; Gyrodactyloidea—1; *Heterophyid metacercaria—1; **Proteocephalus* sp.—1.

These dace were taken from Apalachin Creek (10), Big Snake Creek (1), Crocker Creek (1), Hooper Creek (7), Little Snake Creek (15), Owego Creek (15), and Pipe Creek (12). Five of those from Hooper Creek and five of those from Apalachin Creek were negative. The worm burden was relatively light, except for the moderate to heavy infection of Owego Creek specimens with *Neascus* sp. The larval *Contracaecum* occurred in the liver of an Owego Creek fish; the heterophyid cysts were on the gills of a specimen from Big Snake Creek; the larval *Proteocephalus* cyst was on the visceral mesentery of a dace from Apalachin Creek.

8. Long-nosed dace (*Rhinichthys cataractae*)

Examined 2; infected 2, or 100 per cent.

Parasites: Gyrodactyloidea—2; **Neascus* sp.—2; *Rhabdochona cascadilla*—2.

Both long-nosed dace were from Choconut Creek. *Neascus* sp. occurred moderately and heavily. The other two parasites were lightly present.

9. Cutlips minnow (*Exoglossum maxillingua*)

Examined 34; infected 33, or 97.1 per cent.

Parasites: **Neascus* sp.—31; **Posthodiplostomum minimum*—23; *Rhabdochona cascadilla*—14; ***Allocreadium lobatum*—1; Gyrodactyloidea—1.

Collections were gathered from Apalachin Creek (2), Big Snake Creek (2), Choconut Creek (5), Little Snake Creek (9), Owego Creek (10), Pipe Creek (2), and Page Brook (4). Infections with *Neascus* sp. and *P. minimum* ranged from light to heavy, the majority being moderately infected. All other parasites occurred in light infections.

10. Red-sided dace (*Clinostomus elongatus*)

Examined 2; infected 0, or 0 per cent.

The two specimens were collected from Crocker Creek.

11. Rosy-faced shiner (*Notropis rubellus*)

Examined 2; infected 2, or 100 per cent.

Parasites: **Neascus* spp.—2; **Posthodiplostomum minimum*—2.

Both shiners were from Nanticoke Creek. Two distinct species of *Neascus* were encountered. The black spot or black grub occurred

heavily in the skin and flesh, while the other was in thick hyaline cysts on the mesenteries. *P. minimum* appeared moderately and heavily.

12. Northern common shiner (*Notropis cornutus frontalis*)

Examined 45; infected 44, or 97.8 per cent.

Parasites: **Neascus* spp.—41; **Posthodiplostomum minimum*—30; ***Rhabdochona cascadilla*—11; *R. cascadilla*—7; *Heterophyid metacercaria—1; Myxosporidia—1.

Specimens of the common shiner were examined from Apalachin Creek (12), Big Snake Creek (3), Crocker Creek (3), Little Snake Creek (11), Nanticoke Creek (8), and Owego Creek (8). Two species of *Neascus* were found as recorded for the rosy-faced shiner. The black grub occurred in light to heavy infections, the light-moderate ones predominating. The heterophyid cysts and Myxosporidia were obtained from the gills. Except for *Neascus*, the other parasites listed were lightly encountered.

13. Northern swallowtail shiner (*Notropis procne procne*)

Examined 15; infected 15, or 100 per cent.

Parasites: **Neascus* spp.—15; **Posthodiplostomum minimum*—15; *Allocreadium lobatum*—1.

All fish were from Nanticoke Creek. *Neascus* was represented by light infections of two species as indicated for the rosy-faced shiner; the hyaline cyst occurred in only one host, while 14 harbored the black grub. Most *P. minimum*, present in light to heavy numbers, appeared to be disintegrating within their cysts. The author, in his examinations of northwestern Wisconsin and south-central New York fishes, does not recall seeing so many degenerating cysts of this parasite in any host. This suggests that *Notropis p. procne* is an unsuitable host for *P. minimum*.

14. Northern mimic shiner (*Notropis volucellus volucellus*)

Examined 2; infected 2, or 100 per cent.

Parasites: **Neascus* sp.—2; **Posthodiplostomum minimum*—1; *Rhabdochona cascadilla*—1.

The two mimic shiners were taken from Page Brook. The infections were light.

15. Blunt-nosed minnow (*Hyborhynchus notatus*)

Examined 7; infected 7, or 100 per cent.

Parasites: **Posthodiplostomum minimum*—7; **Neascus* sp.—5; Myxosporidia—2; **Contracaecum* sp.—1; **Tetracotyle* sp.—1.

Blunt-nosed minnows were captured in Apalachin Creek (2), Nanticoke Creek (1), and Owego Creek (4). *P. minimum* and *Neascus* occurred in light to moderate numbers. All other infections were light. The larval *Contracaecum* was found in the liver, the larval *Tetracotyle* on the eyeball, and the Myxosporidia on the gills.

16. Stoneroller (*Campostoma anomalum*)

Examined 20; infected 13, or 65.0 per cent.

Parasites: **Neascus* spp.—14; Gyrodactyloidea—3; **Contracaecum* sp.—1.

Fish were obtained from Apalachin Creek (1), Big Snake Creek (1), Crocker Creek (3), Hooper Creek (5), Owego Creek (3), Pipe Creek (2), and Page Brook (5). Those from Apalachin and Hooper Creeks were all negative. Two species of *Neascus* were recovered as reported for the rosy-faced shiner, the black grub appearing in light to moderate infections. The larval *Contracaecum* was encysted in the mesentery.

AMEIURIDAE (Examined 27; infected 23, or 85.2 per cent)

17. Northern brown bullhead (*Ameiurus nebulosus nebulosus*)

Examined 7; infected 6, or 85.7 per cent.

Parasites: Gyrodactyloidea—6; *Corallobothrium fimbriatum*—2; **Proteocephalus* sp.—1; **Spiroxys* sp.—1.

All fish were from Choconut Creek and were lightly infected. The larval parasites occurred in cysts on the mesenteries.

18. Common eastern madtom (*Schilbeodes marginatus marginatus*)

Examined 20; infected 17, or 85.0 per cent.

Parasites: *Alloglossidium corti*—13; *Crepidostomum ictaluri*—2; ***C. ictaluri*—2; Allocreadiid trematode—1; Gyrodactoyloidea—1; *Neoechinorhynchus* sp.—1; *Phyllodistomum staffordi*—1; **Proteocephalus* sp.—1.

The madtoms were obtained from Big Snake Creek (3), Choconut Creek (1), Little Snake Creek (2), Owego Creek (3), and Page Brook (11). The parasitized fish were very lightly infected. The single encysted *Proteocephalus*, recovered from the mesentery, bore an apical sucker on its scolex. The allocreadiid trematode appears to be a new form.

PERCIDAE (Examined 18; infected 15, or 83.8 per cent)

19. Tessellated Johnny darter (*Boleosoma nigrum olmstedi*)

Examined 18; infected 15, or 83.8 per cent.

Parasites: **Neascus* spp.—13; **Contracaecum* sp.—6; *Bothriocephalus formosus*—2; Gyrodactyloidea—1; *Heterophyid metacercaria—1; *Phyllodistomum etheostomae*—1.

Johnny darters were taken from Big Snake Creek (2), Choconut Creek (3), Crocker Creek (3), Nanticoke Creek (3), and Owego Creek (7). Two species of *Neascus* were observed as indicated for the rosy-faced shiner; light to moderate infections occurred in 10 with the hyaline cysts and 9 with black grubs. All other infections were light. The larval *Contracaecum* were encysted on the liver, mesenteries, and stomach. The heterophyid cyst was in the mesentery.

CENTRARCHIDAE (Examined 44; infected 44, or 100 per cent)

20. Northern smallmouth bass (*Micropterus dolomieu dolomieu*)

Examined 5; infected 5, or 100 per cent.

Parasites: ***Proteocephalus* sp.—5; **Neascus* sp.—3; **Contracaecum* sp.—2; Gyrodactyloidea—2; **Posthodiplostomum minimum*—2; *Acolpenteron ureteroecetes*—1; *Bothriocephalus claviceps*—1; Myxosporidia—1; *Rhipidocotyle papillosum*—1.

One fingerling bass was collected from each of the following streams: Big Snake Creek, Choconut Creek, Little Snake Creek, Pipe Creek, and Page Brook. *Neascus* sp. and *P. minimum* were found in light to moderate infections. Fourteen worms each of *A. ureteroecetes* from Choconut Creek and *R. papillosum* from Big Snake Creek were recovered from individual hosts. The remaining parasites occurred in light numbers. The Myxosporidia occurred in three cysts on the roof of the mouth in the one Choconut Creek bass.

21. Pumpkinseed (*Lepomis gibbosus*)

Examined 1; infected 1, or 100 per cent.

Parasites: *Crepidostomum cooperi*—1; Gyrodactyloidea—1; **Neascus* sp.—1; **Posthodiplostomum minimum*—1; ***Proteocephalus* sp.—1.

Page Brook yielded the one 3½-inch pumpkinseed. *Neascus* heavily parasitized the host, while *P. minimum* and Gyrodactyloidea were moderately, and the others lightly, present.

22. Northern rock bass (*Ambloplites rupestris rupestris*)

Examined 38; infected 38, or 100 per cent.

Parasites: **Neascus* sp.—36; **Posthodiplostomum minimum*—32; Gyrodactyloidea—21; Hirudinea—7; **Diplostomulum scheuringi*—6; *Bothriocephalus claviceps*—5; *Neoechinorhynchus cylindratus*—3; *Cryptogonimus chyli*—2; *Bucephalus elegans*—1; *Crepidostomum cooperi*—1; *Leptorhynchoides thecatus*—1.

These fish were taken from Big Snake Creek (8), Choconut Creek (6), Owego Creek (12), Pipe Creek (8), and Page Brook (4). *Neascus* sp. and *P. minimum* occurred in light to moderate numbers, although some hosts from Pipe Creek were heavily parasitized by the latter. The larval *D. scheuringi* was observed in moderate infections on five Owego Creek rock bass, and lightly on one Big Snake Creek fish. The Gyrodactyloidea on Pipe Creek hosts were observed in light to moderate amounts. All other infections were light.

COTTIDAE (Examined 44; infected 22, or 50.0 per cent)

23. Northern muddler (*Cottus bairdii bairdii*)

Examined 44; infected 22, or 50.0 per cent.

Parasites: **Neascus* sp.—17; *Rhabdochona cascadilla*—4; ***R. cascadilla*—1; **Rhipidocotyle papillosum*—1.

Muddlers were collected from Big Snake Creek (1), Choconut Creek (3), Hooper Creek (2), Little Snake Creek (8), Owego Creek (17), Pipe Creek (8), and Page Brook (5). *Neascus* sp. occurred only in the Owego Creek fish, in light to heavy infections; the cysts were of the thick hyaline type (as for the rosy-faced shiner) located on the mesenteries and viscera. Only four of the Little Snake Creek hosts were infected and accounted for all the *R. cascadilla* found. The one Big Snake Creek fish harbored a single cyst of *R. papillosum*. All other fish were negative.

Following is a list of the parasites recorded and the number of species of fish infected in each case.

Parasite	Species infected
Trematoda	
Acolpenteron catostomi	1
Acolpenteron ureteroecetes	1
Allocreadiid trematode	1
Allocreadium lobatum	3
Alloglossidium corti	1
Bucephalus elegans	1
Crepidostomum cooperi	2
Crepidostomum ictaluri	1
Cryptogonimus chyli	1
Diplostomulum scheuringi	1
Gyrodactyloidea	14
Heterophyid metacercaria	3
Neascus spp.	20
Octomacrum lanceatum	1
Phyllodistomum etheostomae	1
Phyllodistomum staffordi	1
Phyllodistomum sp.	1
Plagioporus sinitsini	3
Posthodiplostomum minimum	15
Rhipidocotyle papillosum	2
Tetracotyle sp.	1
Triganodistomum attenuatum	1
Cestoda	
Biacetabulum sp.	1
Bothriocephalus claviceps	2
Bothriocephalus formosus	1
Corallobothrium fimbriatum	1
Glaridacris catostomi	1
Glaridacris confusus	2
Proteocephalus spp.	6
Nematoda	
Contracaecum sp.	6
Hepaticola bakeri	2
Rhabdochona cascadilla	11
Spiroxys sp.	1
Acanthocephala	
Leptorhynchoides thecatus	1
Neoechinorhynchus crassus	1
Neoechinorhynchus cylindratus	1
Neoechinorhynchus sp.	1
Protozoa	
Myxosporidia	6

Parasite	Species infected
Copepoda	
Ergasilus spp.	3
Mollusca	
Glochidia	1
Annelida	
Hirudinea	1

DISCUSSION

More than 22 different species of trematodes, 7 of cestodes, 4 of nematodes, and 4 of acanthocephalans were recovered. In general the incidence and intensity of infection with larval parasites was greater, both within individuals of a given host species and among different host species, than was that of any other of the developmental stages of the life cycle. The larval trematodes (metacercariae) were most abundant, as follows: *Neascus* spp. in 20 of the 23 different hosts examined; *Posthodiplostomum minimum* in 15; a heterophyid in 3; *Tetracotyle* sp. in 1; *Rhipidocotyle papillosum* in 1; and *Diplostomulum scheuringi* in 1. All but *R. papillosum* reach sexual maturity in fish-eating birds and mammals; *papillosum* matures in a fish. Thus fishes play a most essential role in the perpetuation of these trematodes in avian and mammalian hosts. Larval cestodes of the genus *Proteocephalus* occurred in only three different host species, while the larval nematode, *Contracaecum* sp., was taken from six. Both these forms probably reach sexual maturity in other species of fishes.

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SOME OBSERVATIONS REGARDING WOODLOT FENCING UNDER THE FEDERAL AID PROGRAM IN NEW YORK[1]

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ABSTRACT

A survey was carried on to evaluate the woodlot fencing that had been done under the Pittman-Robertson habitat improvement program. It was organized to comprise a cross section of the regions of the State where appreciable work had been done. In each of the selected counties, farms that had received fencing materials were picked at random and visited. The fences were checked for erection and maintenance, and notes were taken on the degree of slope, evidence of prior grazing, and the nature of adjacent areas.

It was found that, in roughly 80 per cent of the cases, fences had been constructed and the majority of these had been satisfactorily maintained. Differences in the nature of the problem within the State were noted, being related to topography and the nature of adjacent areas. The majority of the woodlots observed showed evidence of light or moderate prior grazing, or none at all, raising the question of whether or not the fencing was of benefit to wildlife habitat. In general the farmers were quite passive to the project and its success seems to lie in the fact that such fences are multipurpose.

Under P-R Project 48-D (Improvement of Habitat on State and Private Lands) the fencing of farm woodlots has been fostered by distributing either barbed wire or wooden posts to farmers who agree to construct the fence. In order to participate, a farmer must be a member of his soil conservation district or a cooperator under the Forest Practice Act. After receiving fencing materials he is allowed from 6 months to a year to fence the area. If the job is not done within that time, he must return the materials. In a few cases farmers have supplied all of the fencing materials and the Conservation Department has constructed the fence, for which the farmer was charged 25 cents per rod.

A survey under P-R Project 61-R (Evaluation of Wildlife Habitat Improvement Practices) was begun in the spring of 1954 and continued into the summer months. Its purpose was to appraise the success of the project with respect to the actual construction of the fences and their maintenance. Also considered were related factors such as differences in the problem resulting from location within the State, extent of prior grazing on the areas to be fenced, and the role of the farmer.

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At the time of this study the program had been in progress for approximately 6 years. A summary of the number of farms involved, materials furnished, rods of fence constructed, and acreages protected is given in Table 1. The summary is broken down by game management district and also by county to indicate the amount of work done in each region which was related to the extent of dairying carried on. The counties in the Lake Plains and Allegany Game Management Districts received considerable attention while no fencing was done in the Adirondack District.

PROCEDURE

The survey was carried on in such a way as to produce a cross-sectional picture by selecting one county, or in some cases two, from regions of the State that were more or less distinct regarding land use and topography. The northeast and southeast portions of the State were omitted due to the limited amount of fencing that had been done. Nine counties were chosen to represent the six regions recognized. Farms were picked at random from the total list of those receiving material in each county. Each farm was visited and questions were asked concerning the erection and maintenance of the fences, the farmer's opinion of the project, and the degree of utilization of the woodlot by livestock before fencing. A complete circuit of each woodlot was then made to check the fence and notes were taken on such factors as the degree of slope, evidence of prior grazing, and nature of adjacent areas.

FINDINGS

A total of 174 farms was visited and information on the fencing project was obtained from 136. This information is presented under several topics.

ERECTION OF FENCES

Success of the project in regard to the actual erection of fences is summarized in Table 2. Only farms at which adequate information was obtained on the progress of the fencing are considered. Three farms that were checked are omitted since the time allowed for erecting the fence had not expired. This time allotment varied in different counties, usually being either 6 months or a year. In considering the total number of fences erected, only those that had been completed were included. Some fences had been started but at the time of the survey had not been finished.

Table 1. Summary of Woodlot and Other Fencing* Done Under P-R Project 48-D (1951-1953)

Game management district and county	Number farms	Material supplied		Rods built	Acres protected			
		Posts	Wire§		Woods	Plantation	Marsh	Wildlife area
Lake Plains								
Erie	87	5,620	124	10,413	1,710	46	7	..
Genesee	2	175	..	175	8	..	..	..
Ontario	1	279	6	...	..	..	..	..
Seneca	11	452	51	1,609	255	..	10	..
Wayne	8	526	6	111	25	2	16	25
Wyoming	61	5,084	82	7,574	982	..	..	2
Sub-total	170	12,136	269	19,882	2,980	48	33	27
North-Central								
Cayuga	8	50	33	1,570	169	..	..	..
Herkimer	2	..	8	480	71	..	..	..
Madison	2	250	12	382	30	..	..	..
Oneida	47	569	113	6,450	1,060	18	..	..
Onondaga	15	1,288	36	2,007	279	..	..	..
Sub-total	74	2,157	202	10,889	1,609	18	..	..
East-Central								
Albany	19	260	95	2,853	413	50	5	..
Fulton	1	..	3	95	6	..	..	..
Montgomery	13	..	66	2,770	246	4	..	..
Rensselaer	22	40	49	1,264	689	21	..	..
Saratoga	2	140	..	135	43	6	..	..
Schenectady	2	..	14	370	90	15	..	..
Washington	52	295	240	6,384	1,261	122	10	..
Sub-total	111	735	467	13,871	2,748	218	15	..
Catskill								
Delaware	21	380	83	1,870	949	61	11	..
Otsego	19	310	49	2,257	337	28	7	..
Schoharie	20	640	87	4,821	417	87	12	..
Sub-total	60	1,330	219	8,948	1,703	176	30	..
South-Central								
Broome	10	80	33	1,270	294	28	..	..
Chemung	11	..	40	1,242	103	10	..	..
Chenango	27	540	90	3,757	992	26	..	..
Cortland	45	4,986	3	5,138	1,850	..	..	..
Schuyler	4	..	14	399	116	..	..	..
Tioga	88	195	282	9,512	2,170	43	..	2
Tompkins	4	..	18	720	114	..	..	..
Sub-total	189	5,801	480	22,038	5,639	107	..	2
Allegany								
Allegany	46	8,966	42	9,866	1,719	80	19	..
Cattaraugus	143	8,921	303	22,115	7,492	152	133	39
Chautauqua	29	1,605	61	4,080	889	..	..	100
Steuben	66	12,915	24	12,712	1,474	85	37	17
Yates	5	..	24	635	182	..	8	..
Sub-total	289	32,407	454	49,408	11,756	317	197	156
Ontario-St. Lawrence								
Oswego	21	2,231	9	2,154	426	..	..	..
Lower Hudson								
Dutchess	1	..	..	188	11	5	..	..
Total	915	56,797	2,100	127,378	26,872	889	275	185

* Does not include marsh fencing done in 1953.
§ Spools of 80 rods.

TABLE 2. SUMMARY OF WOODLOTS CHECKED

County	Farms considered	Fences completed		Number maintained
		Number	Per cent	
Allegany	29	24	82.8	20
Delaware	17*	13	76.5	12
Erie-Wyoming	19	14	73.7	14
Oswego-Onondaga	13	10	76.9	10
Schoharie	12	10	83.3	10
Tioga	37§	32	86.5	32
Tompkins	6	4	66.7	4
Total	133	107	80.5	102

* One farm still within time limit not included.
§ Two farms still within time limit not included.

It appears that most of the fences that were erected very favorably met the purpose of the project. Only a few misuses of the wire were observed, such as an area being fenced off except for a small portion which still remained open allowing livestock to enter. The general success of the construction program seems to have been good although no figures are available upon which to make a comparison. The average of approximately 80 per cent for the proportion of fences completed is fairly high considering that in some cases reasons developed for not fencing off an area, as, for example, adjacent areas being no longer pastured. In such cases the wire was returned in accordance with the original agreement. No attempt has been made to account for variations between counties in this respect since the number of instances was quite small.

MAINTENANCE

Maintenance of completed fences is summarized in Table 2. It is apparent that most farmers who had sufficient interest to erect a fence took the trouble to maintain it. Some of the fences were not maintained because the areas adjacent were no longer utilized for pasture.

LOCATION

In breaking down the survey by county the factor of location was clearly seen to have an important influence on the need for woodlot fencing. Not only does the degree of slope and type of terrain enter in, but also the nature of the cover on areas adjacent to a woodlot seems to be quite important. For example, Delaware County in the Catskill

region is characterized by very hilly topography and also by relatively extensive areas of woodland. The steep slopes and rocky terrain obviously limit the degree to which livestock utilize wooded areas and consequently limit the amount of grazing damage. In this survey Delaware County produced the least evidence of grazing prior to fencing of all counties studied. Likewise, the effect of livestock on a woodlot considered as a wildlife unit will probably be much less if the contiguous woodland extends over a large area than if it is small. On the other hand, woodlots in a county like Erie which has a flatter terrain and less extensive woodlands will be affected in a different manner. Slope and terrain will not be as important factors in limiting use by livestock, while the small, isolated woodlots which are more characteristic of this area will be heavily grazed by livestock and may become useless as wildlife areas unless they are fenced.

Grazing

An attempt was made to evaluate the degree of prior livestock grazing according to evidence such as presence of grass, low number of tree seedlings, limited amounts of litter, compact soil, and exposure of roots. However, standardization was difficult. Very heavy grazing characterized by a complete lack of understory and very limited leaf litter was found on only one woodlot. Similarly heavy grazing, but without the floor being entirely bare, was the case in nine of the woodlots checked. Moderate grazing was noted on 24 woodlots in which evidence of heavy grazing was noted in various portions of the lot. Forty-nine had grass on the periphery and travel lanes throughout and were classed as lightly grazed. In 22 cases no evidence of prior grazing was observed and this factor was considered negligible. It can be noted that sufficient data for evaluating grazing were obtained for only 105 woodlots.

The majority of the woodlots fenced fell in the moderate, light, or negligible classes which suggests that possibly the units included under the project by chance represented the less exigent cases. This might indicate, too, that farmers who are willing to cooperate on a project of this kind are not the ones who practice livestock grazing in woodlots to the greatest extent.

Den Uyl and Day (1932) classified grazing intensity according to stages. What they termed the early stage is comparable to heavy grazing as used in the present survey, and, likewise, their transitional and open park stages are similar to very heavy grazing. Thus, in this

survey only 10 woodlots would fall into the category of early stage or later, the remainder not entering into Den Uyl and Day's classification. It should be noted that their study was carried on in Indiana where woodlots at that time were an integral part of pastureland and grazing intensities were markedly higher than is usual in New York.

Classification by stages also brings up the point of whether a grazed woodlot is in a dynamic or a static condition. Further study would be necessary to determine whether a woodlot that is exposed to livestock is destined to destruction or whether a stable balance between the woodlot and the livestock could be reached. A considerable number of woodlots were observed that merely showed signs of light grazing although they had been subjected to grazing for a considerable length of time.

ATTITUDE OF THE FARMER

The farmers in general seemed more or less passive to the project. They merely pointed out that the area had been fenced off and made few further comments. To the majority the chief value of the fence appeared to be that it prevented cows from straying into the woods and consequently made rounding them up easier. It is interesting to note that, for the most part, the farmers were not aware who had supplied the materials and had financed the project. In most cases, the Soil Conservation Service had distributed the wire while other materials were furnished by the Conservation Department. It appears to make little difference who distributed the materials, each being equally successful. Much, of course, depends on the extent of personal contact between the farmer and project representatives.

DISCUSSION

It is apparent that, besides the actual erection and maintenance of fences, other factors must be taken into consideration in evaluating a woodlot fencing project. Actual erection of the fences is the first job and its accomplishment is undoubtedly a big step. Maintenance apparently will be carried on once they are put up. The question arises then as to whether or not they will be renewed after the present material is no longer satisfactory. This, of course, will determine the duration of effectiveness of the project.

Location of a woodlot with respect to topography and agricultural utilization is a factor to be considered in evaluating a project of this sort. Woodlot fencing will be most effective in an area where livestock

would otherwise have ready access to the woodlands. Thus, it will be more effective in a region of extensive dairying than in one where few cattle are pastured. The size of the woodlot and nature of adjacent areas as has been mentioned are important factors in determining the value of such work.

The success of such a project also involves the question of whether or not the areas fenced will benefit wildlife by developing into more suitable habitat. This survey definitely points out the need for a better understanding of the effects of livestock grazing. Heavy grazing is distinctive and a number of studies have pointed out its detrimental effects. However, a very low number of the woodlots examined presented this situation. The majority showed evidence of only light, moderate, or negligible prior grazing. Unfortunately, the effects of light and moderate grazing have not been subjected to any considerable amount of study and consequently little is known regarding them. The thinning effects of livestock grazing could possibly benefit wildlife on unmanaged areas.

In discussing the success of this type of program it seems necessary to make some mention of the role of the farmer. The success of the project along this line seems to lie in the multipurpose role that fences play. Most farmers are not concerned to any great extent with the wildlife on their land. With a de-emphasis on the woodlot as a source of fuel, few are concerned whether or not their woodlots are properly managed. However, a farmer, especially if he obtains some of the material for nothing, can readily see the advantages in fencing a woodlot as a means of preventing livestock from straying. Thus, it is probably just as well that the wildlife and forestry points of view were not stressed appreciably. However, as education proceeds to win the favor of farmers in the direction of conservation, it will be increasingly desirable to emphasize the advantages which they have yet not fully grasped. Likewise, there is a need for dispelling the confusion that exists in the minds of many farmers regarding the various branches of the State and Federal Governments concerned with conservation.

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USE OF COLORED MARKERS ON DUCKLINGS[1]

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ABSTRACT

For a study of survival of three strains of mallard ducklings, the birds were marked with both plastic neck tags and celluloid leg bands. Both the tags and bands were used on 509 specimens, while 292 bore leg bands alone. The tags were made from regular Duran upholstery material and were pinned to the nape with stainless steel safety pins; the celluloid bands came from a tag and band manufacturer.

The markers were of definite value in differentiating strains as well as in making observation easier. It was also thought that reports of band recoveries were increased somewhat.

Throughout the period during which the ducklings were flightless the neck markers were retained fairly well, and even at the time the birds began flying about 70 per cent still wore them. It was believed that most of the neck markers had been lost 14 weeks after release of the ducklings, and only one was recovered during the first hunting season with a tag. Band retention was much better: during the first hunting season 74 per cent were reported as still wearing a full set; this dropped to about 23 per cent for the second and third hunting seasons.

The practicality of these as well as other marking methods, for short-term studies, is discussed.

During a study of survival of three strains of mallard ducklings in 1952 (Foley, 1954a) the various strains and age groups were color-marked for easier observation. Several types of markers were considered, but the neck markers finally used were plastic tags following the design of Wint (1951) for quail and modified by the use of stainless steel pins as described by Gullion (1951) for coot. Colored leg bands were also used on the neck-marked birds for later observation, as well as on ducklings where neck markers for strain differentiation were not needed.

A total of 801 marked mallard ducklings was released on 44 areas, chiefly small, man-made marshes which averaged 4.2 acres in size. They were located mostly in central, south-central and western New York, but a few were situated in the eastern part of the State. The number of birds marked with both neck tags and leg bands totalled 509, while 292 wore leg bands only since they were released on areas where they were not likely to be confused with any other mallards.

MATERIALS AND METHODS

The material for the neck markers was cut from 18-ounce upholstery Duran plastic in the solid colors of red, yellow, and blue. The

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[1] A contribution of Federal Aid in Fish and Wildlife Restoration Project W-39-R.

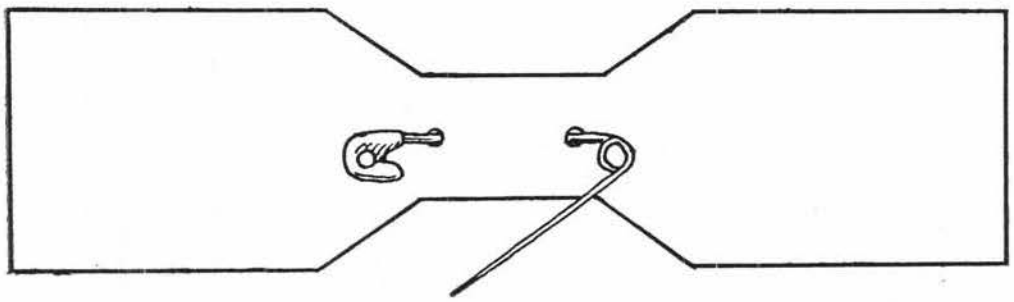

Figure 1. Type of plastic neck marker and safety-pin attachment used in this study (actual size).

tags were cut in "bow-tie" or "butterfly" shape, 1 by 4 inches except for a narrower, half-inch middle section where two 1/16-inch holes were punched 5/8 inch apart. A No. 1 stainless steel safety pin was inserted in these holes (Figure 1). The plastic sheeting was purchased from a local mail order house for $1.49 per yard, and the stainless steel safety pins from a curtain and drapery shop for $5.00 per dozen gross.

The colored bands were purchased from the National Band and Tag Company of Newport, Kentucky. Their #997 celluloid coil bands in the three primary colors served very well on 5-week-old mallards.

Trials of the neck markers on adult mallards a month before the ducklings were to be released indicated that they were retained well, caused little irritation to the birds, and remained highly visible when the ducks were on the water. As used on the ducklings, they were attached by means of the safety pin as high on the nape as possible. With one man holding the birds and another to sex them, apply leg bands and pin on neck markers, the whole operation went very smoothly. Although the birds were put out in four lots, as many as 385 were handled in one morning with no trouble.

The observational work of following these birds, their survival and the retention of colored neck markers was carried on by technicians trained in wildlife methods, and every effort was made to obtain comparable data. Some information was also taken regarding the colored leg bands in this way, but most of these data were collected later from band return follow-ups.

FINDINGS

The ducklings bearing colored tags could be more easily observed than those not so marked, and in most cases the tags were the only

means by which individual strains could be differentiated. Yellow proved to be the most visible color, with red next. All project fieldmen asserted that the blue tags were the most difficult to see, due both to the color of the material and to the greater wariness of the Canadian strain mallards on which it was used. There was no statistically significant difference in predation among the three strains, although slightly higher percentages of the birds with the more visible markers were known to have been preyed upon. However, the variations were small and the unmarked groups suffered similar mortality. This would seem to indicate that there was little or no mortality caused by the marking operation.

The colored bands were an aid in identifying strains and release groups during the summer only when the neck markers had been lost or, occasionally, when "foreign" mallards appeared. Later, however, especially with respect to hunting season recoveries, the colored bands were probably of value in increasing the percentage of returns. During subsequent breeding seasons they were also of great importance in assessing both the degree of homing of birds to the marsh where they had been released as ducklings and the establishment of such stock as breeders (Foley, 1954b).

RETENTION OF NECK MARKERS

Before the results were tabulated it was the opinion of most project fieldmen that, with a few exceptions, most of the ducklings retained their neck markers very well up to the time they began flying and that the tags were rapidly lost after that date. This impression, however, may have been influenced by the fact that they were usually successful in determining the number of ducklings surviving in each group by one means or another, e.g., appearance and behavior, general condition, or colored bands. The impression was probably heightened by the difficulty encountered in observing the colored markers on ducks once they began flying and became more wary. Careful sifting and tabulation of the recorded information revealed that the loss of markers proceeded at a rather constant rate, at least up to the time the study of any group was terminated. The birds could not be followed with any great degree of success much after they began to fly, and both the number and accuracy of observations dropped off rapidly at that time. Nevertheless, over a period of about 8 weeks after each group was liberated (they were released at 5 weeks of age) the average degree of neck-tag retention for all strains was as shown in Figure 2.

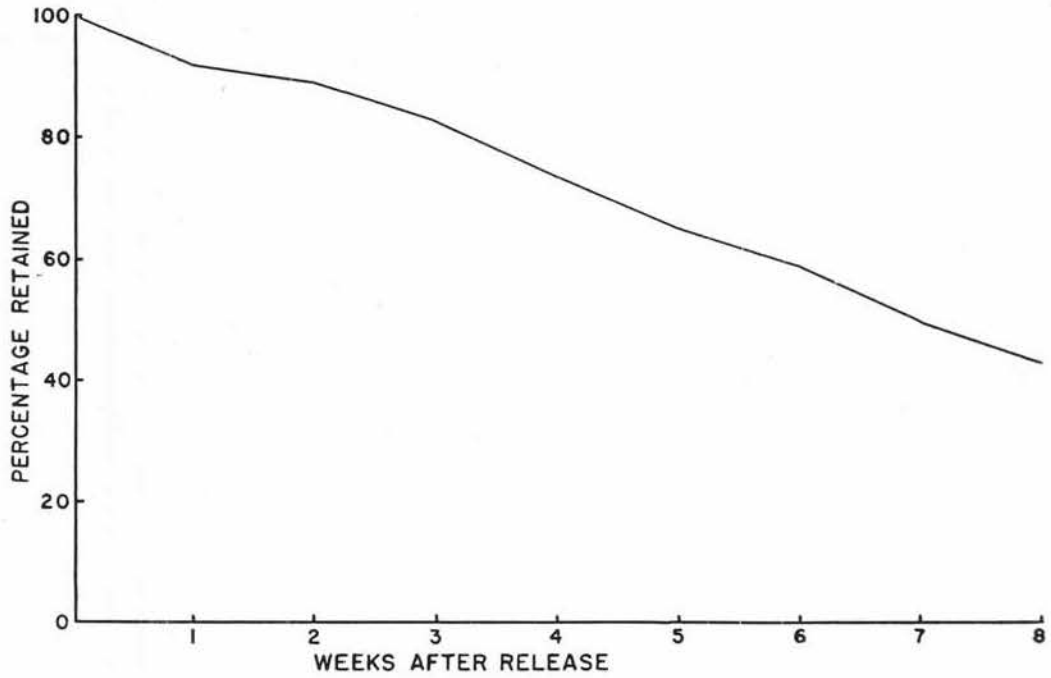

Figure 2. Average rate of loss of colored plastic neck markers among ducklings released in 1952.

There was very little variation in the generally constant degree of neck-tag loss among the strains of ducklings over the 8-week period. Only one strain showed more than a 6 per cent departure from the average during any given weekly interval, and this occurred at the end of the 8 weeks when the number and accuracy of observations were lowest.

It is seen, therefore, that, for the purpose of determining the relative survival of the three strains up to the age of flight, these neck markers served fairly well. At about the time most of the ducklings were learning to make short flights between 68 and 75 per cent of them were still wearing the easily identifiable "bow-ties".

If the tag loss proceeded at the same rate while the birds perfected and lengthened their flights in late summer and early fall, then most of them should have been without tags by about the fourteenth week after release. Since releases were made from June 25 to July 23, the dates of 100 per cent tag loss for the various groups would have been expected to fall between October 1 and 27. With a hunting season which opened on October 25 in that year, it is not surprising that only one of the 46 recovered during the first year was reported as wearing a colored neck tag. This bird was a male New York-strain

mallard shot on November 4 less than 20 miles from the marsh where it had been released. Two others were reported as still bearing safety pins.

RETENTION OF CELLULOID LEG BANDS

No detailed observations were obtained as to how well the ducklings retained the leg bands during the first summer, although it was known that most of the birds still bore them at the time they began flying. Over the first season of the experiment it is probable that most of the loss which did occur happened during the first few days. The birds were smallest then, and were subject to handling, transportation in crates, and finding their way around in strange territory. In all, 791 ducklings were marked with colored bands, and from the time of crating to that of liberation only five bands were known to have been lost.

Band recoveries reported for the hunting season following release were followed up by a letter, to each cooperating hunter, requesting information on colored markers noted at the time the bird was taken. From those gunners responding it was found that over 74 per cent of the birds still wore a full set of bands. Nearly 13 per cent had lost one band and about 13 per cent had lost two or more. Follow-ups on birds taken during the second and third falls following release indicated greater band loss with time, and only 23 per cent carried the full set of original bands when they were shot. The data are shown in Table 1. In addition, extremely valuable information as to homing and establishment as breeders was obtained the following spring from observations of the colored bands (Foley, 1954b).

TABLE 1. RETENTION, AS OF SUBSEQUENT HUNTING SEASONS, OF COLORED LEG BANDS BY MALLARDS BANDED AND RELEASED AS DUCKLINGS*

Hunting season	Number of marked birds reported§	All bands retained	Bands lost			
			1	2	3	All
First.....	31	23 (74.2)	4 (12.9)	3 (9.7)	..	1 (3.2)
Second and third..	13	3 (23.1)	3 (23.1)	5 (38.4)	1 (7.7)	1 (7.7)

* Percentages given in parentheses.
§ Returns with usable follow-up response from hunter.

DISCUSSION AND CONCLUSIONS

The use of colored markers on young game birds, as described here as well as by various other workers, seems a thoroughly practical technique and of definite aid and value. To differentiate three strains of mallard ducklings in this study some such marking method was imperative. The type of neck tag used was adequate for identification purposes at least until the time the birds were flying, and therefore aided greatly in the calculation of survival. The fact that practically all the tags were lost after about 14 weeks may actually have been another benefit of their use, since numbers of color-marked birds in evidence during the hunting season might have resulted in adverse publicity.

Coloring young ducklings by injecting the eggs (Evans, 1951) would be a method to use in following the young from hatching to the time of the juvenile moult, although its use as far as known (except in the poultry industry) has been restricted to wild birds. For waterfowl on the wing, the dyeing technique originated by Wadkins (1948) and as used by Winston (1955) might be effective for most species, although for geese the plastic collars devised by Helm (1955) would seem hard to improve upon. For other short-term experiments on adult birds, the airplane dope method of Sowls (1955) should also be excellent.

The use of colored leg bands is recommended for experimental birds being colored by other methods. Such bands offer some hope of a bird's being noticed during the experiment should the primary marking fade or be lost. They are also of definite value in providing a greater degree of reported recovery during the hunting season, and in assessing the extent of homing and establishment in following years.

With color-marking threatening to get out of hand a few years ago, the Fish and Wildlife Service has now made it mandatory that each such study be approved in advance (Aldrich and Steenis, 1955). This should obviate the confusion that might have resulted from having numerous studies underway simultaneously, many with similar marker colors and types. The Service also now serves as a clearing house for this work, keeping technicians informed of progress and on the watch for marked birds.

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GENERAL NOTES

NOTES ON RED FOX AND GRAY FOX DEN SITES IN NEW YORK

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In the spring of 1952 questionnaires were sent to professional fox trappers employed by the Conservation Department's rabies control project for the purpose of obtaining information on the denning behavior of red foxes *(Vulpes fulva)* and gray foxes *(Urocyon cinereoargenteus)* in various parts of the State. Reports were asked on only those dens from which pups were actually trapped during the spring of that year. The data requested included the habitat, topography, and soil type of the den site, distance from an open area if the den was located in woods or brushlands, distance from water, and the approximate number of years the den had been used. All or part of this information was received for 146 red fox dens and 3 gray fox dens. The accuracy of these reports was verified in subsequent years when other trappers rechecked the same dens for evidence of continued use. Four additional red fox dens were examined by the authors in 1953.

The majority of red fox dens were located in woodlands, brushy situations, and pastures (Table 1). Many of the dens in woodlands were described as being situated on ridges or knolls. Such was also frequently the case in open terrain. Of dens located on slopes, the exposure of only six was noted. Four were on west slopes, one on a southwest slope, and one on an east slope. The distance from an open area for 44 dens found in woods ranged from 5 to 3,000 feet and averaged 480 feet.

The well-known predilection of red foxes for loose and friable soils for den construction was further substantiated by the reports, as over half of the dens were in sandy or gravelly substrates. Proximity of water was apparently not an important factor in the choice of a den site, since over a third of the dens found were more than 500 feet from the nearest source. The majority of dens were reported as having been used during three or fewer years, but the trapper's familiarity with the particular region in which he worked must be taken into account. However, many of the estimates were obtained from the owner of the land on which the den was located and can thus probably be accepted as fairly accurate.

Dens were reported from three geographic areas of the State that have been denoted as the northern, Lake Plain, and southern regions. These divisions differ from one another in topography, soils, temperature, precipitation, length of growing season, and other environmental conditions as described in another paper by the authors elsewhere in this issue.

A comparison of 89 dens in the northern region with 42 in the Lake Plain was made. The number reported from the southern region was too few to be considered. In the northern counties 7.8, 2.2, and 3.4 per cent of the dens were found in cultivated areas, rock ledges, and lake shore situations, respectively, whereas no dens from the Lake Plain region were recorded in such locations. A majority of the dens were dug in loam soils in the northern region, while in the Lake Plain area gravel or sandy soils predominated. Approximately 10 per cent of northern dens, but none of those in the Lake Plain, were located in stony soils. Only 12 per cent of the Lake Plain dens were reported to have been used during more than five years as compared with 24 per cent for northern sites. These variations may merely reflect the fundamental habitat differences in the two areas or indicate an overflow of breeding foxes into less preferable den situations in the northern region due to high populations.

TABLE 1. ANALYSIS OF 146 RED FOX DENS REPORTED IN 1952 AND 4 OBSERVED IN 1953

Item	Number of dens and percentage*	Item	Number of dens and percentage*
Site§		Approximate distance from water, in feet	
Pasture	49 (34.5)	0— 25	7 (5.5)
Woodland	45 (31.7)	26— 50	14 (11.0)
Brush	18 (12.7)	51— 100	15 (11.8)
Meadow	12 (8.5)	101— 150	5 (3.9)
Cultivated	9 (6.3)	151— 200	13 (10.4)
Lake Shore	3 (2.1)	201— 500	29 (22.8)
Rock ledge	2 (1.4)	501—1,000	15 (11.8)
Creek bank	2 (1.4)	More than 1,000	29 (22.8)
Sandy knoll	2 (1.4)		
Substrate§		Estimated number of years used	
Sand	63 (42.8)	1	34 (37.3)
Loam	28 (19.0)	2— 3	33 (36.3)
Gravel	17 (11.5)	4— 5	11 (12.1)
Sand and loam	10 (6.8)	6— 7	1 (1.1)
Stony soil	7 (4.8)	8— 9	3 (3.3)
Rock	6 (4.1)	10—12	6 (6.6)
Sand and gravel	4 (2.7)	13—15	3 (3.3)
Gravel and loam	3 (2.0)		
Clay	2 (1.4)		
Gravel and rock	2 (1.4)		
Clay and loam	2 (1.4)		
Shale	1 (0.7)		
Sand and shale	1 (0.7)		
Clay and shale	1 (0.7)		

*Percentages (in parentheses) are based on the number of dens included within a particular category.
§Descriptions as given by trappers.

Only three gray fox dens were reported, indicating the relative scarcity of this species as compared to the red fox. Trappers also indicated that the gray fox is more secretive in its choice of den sites than the red fox. The three dens were found in the Lake Plain region (Cayuga County) in 1952.

One was located at the edge of a gully about 50 feet from an open area and 100 feet from water. It was dug in gravel and had been used during two years to the knowledge of the trapper. The second was excavated in sandy soil overlain by a layer of gravel. It was on the west slope of a hill in mature woodland with sparse undergrowth. The entrance was 200 feet from an open area and about 1,000 feet from water. According to the trapper it had been used approximately 12 years. Attempts to dig out the young in previous years had not caused abandonment of the site. The third den was in a level plot of rock and soil close to a road. The site was densely overgrown with underbrush and was about 10 feet from an open area and 20 feet from water.

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