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Duck Populations and Kill

An Evaluation of Some Waterfowl Regulations in Illinois

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This paper is a contribution from the Section of Wildlife Experimental Areas.

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An Evaluation of Some Waterfowl Regulations in Illinois

FRANK C. BELLROSE, JR.

ONLY after a wildlife regulation has been in force for a number of years is it possible to evaluate its total effect. To check depletion of the duck population of North America, several new waterfowl hunting regulations and drastic modifications of existing regulations were inaugurated in the United States and Canada during the 1930's. It is evident to all now that the added restrictions, combined with increased waterfowl productivity resulting largely from greater precipitation on the breeding grounds and a program of habitat restoration, swung the duck population pendulum upward. Populations have made a noticeable comeback since the low ebb of 30,000,000 ducks estimated for 1934, and, as duck numbers have increased, some of the waterfowl regulations have been relaxed.

Demands for abolishing certain regulations and relaxing others have increased in tempo with mounting waterfowl numbers. Some sportsmen desire the return of decoys, others want to use bait and still others would like to see larger bag limits and longer seasons. What effect might the relaxing of each or all of the existing regulations have on the duck kill? With an army of almost 1,500,000 hunters pursuing waterfowl in the United States, an unwise loosening of restrictions might halt, if not actually cause a decline in, waterfowl on the comeback trail.

The U. S. Fish and Wildlife Service through its flyway biologists, its cooperative waterfowl observers, its refuge personnel and game agents, and its midwinter inventory of the population annually ascertains the status of the continent's waterfowl population (Gabrielson & Lincoln 1941). Cottam (1935) and Pirnie (1935) have studied and discussed the broad aspects of the influence of gunning practices and waterfowl regulations. But little has been done to evaluate each of the various regulations employed to limit the waterfowl kill.

This paper was conceived and written in an attempt to evaluate the effect of various hunting regulations on the kill of ducks in Illinois, and to ascertain the optimum dates for Illinois hunting seasons of various lengths.

Acknowledgments

The writer of this paper is indebted to Messrs. Homer Bradley and Milfred J. Smith of the U. S. Fish and Wildlife Service stationed at the Chautauqua National Wildlife Refuge, Havana, Illinois, for their co-operation in making censuses on that refuge. He appreciates the constructive criticisms of the manuscript by Dr. Clarence Cottam and Messrs. Cecil Williams and Robert H. Smith of the U. S. Fish and Wildlife Service. Mr. Ferd Luthy of Peoria not only provided helpful suggestions on the study but furnished kill records of the Duck Island Preserve dating back to 1885. Dr. Ralph E. Yeatter and Dr. David H. Thompson of the Illinois Natural History Survey furnished unpublished data they compiled from the Duck Island Preserve kill records. Dr. Thompson also aided the writer in the statistical analyses of duck population and kill data. Miss Eleanor G. Wolff, Assistant Technical Editor of the Survey, aided in compiling

the history of waterfowl regulations. Grateful appreciation is due to Mr. Bob Becker, writer on wildlife, for photographs used for the frontispiece and five other halftones. The frontispiece pictures sunrise on a bayou along the Illinois River, as seen from a duck blind. Appreciation is due also to Mr. Arthur S. Hawkins for his encouragement, which he has continued even while on leave for military service.

Legal Protection

Written laws establishing closed seasons on waterfowl date back at least to Henry VIII of England. In the year 1533 his government decreed partial protection for waterfowl "between the last Day of May and the last Day of August" and, beginning in 1534, full protection for their eggs "from the first Day of March . . . . unto the last Day of June then next ensuing" (Anonymous 1770). As early as 1846 in the United States, Rhode Island passed a law prohibiting spring shooting of certain waterfowl (Palmer 1912). Although this law was later repealed, by 1900 in 9 states, or the territory now covered by them, all spring shooting had been abolished, and in 38 some form of legal protection for migratory waterfowl had been passed. By 1918 the number of states prohibiting all spring shooting had increased to 31, and only 3 states afforded no legal protection whatever for waterfowl (Lawyer 1918).

Up to 1913, no important waterfowl hunting regulations had been enacted by the federal government except in relation to territories. Although many attempts had been made by conservationists to establish uniformity in the laws among different groups of states, very little had been accomplished. Finally, a federal law known as the Migratory Bird Act, placing birds that regularly migrate beyond state limits under the protection of the federal government, was passed and made effective in 1913. In 1916, a treaty was signed with Canada, which, besides covering certain migratory non-game birds, provided for limited open seasons on migratory game birds. The Migratory Bird Treaty Act, making this treaty effective in the United States, was passed in 1918. Regulations issued in conformity with this act then and since then over a period of years include a reduction in the length of season, in bag limit, daily shooting hours and number of shells in gun; prohibition of the use of bait and live decoys; the placing of some species under complete protection, and others under special protection by limiting the number taken.

Regulations for Illinois

The principal federal waterfowl regulations that apply to Illinois relate to open season, shooting hours, bag limit, the increased or complete protection of certain species, use of bait and live decoys, and number of shells in gun.

Open Season.—Changes in the length of the waterfowl hunting season in Illinois from 1900 through 1944 are shown in fig. 1. The long open season on waterfowl prevailing throughout the nation until enactment of the federal Migratory Bird Act is indicative of the desire of state legislators to get for the hunters of their respective states as many birds as possible before their passage into other states. "The fact that seasons and bag limits on migratory birds have remained so much more liberal than seasons on resident game," states Leopold (1933), "strongly substantiates the assertion . . . . that people can be induced to conserve what stays on their own land, but only the exceptional individual will voluntarily conserve what he shares with the community at large." In 1913, through federal regulations, the Illinois waterfowl hunting season was shortened from 225 days to 105 days and from that time until the drastic cut of 1931 the length of the waterfowl seasons changed little.

Information on hunting seasons and other federal waterfowl regulations as they applied to Illinois from 1929 through 1944 are given in table 1. Even for seasons of the same length, there were various opening and closing dates. A 30-day open season extended through November in 2 years, from October 21 through November 19 in another year. A season of 45 days

extended from October 15 through November 28 in 1938 and from October 22 through December 5 the following year. In 1934 a season having rest days or lay days was permitted; states were given the option of having 30 shooting days run consecutively or at

Fig. 1.—Length of the waterfowl hunting seasons in Illinois, 1900–1943. The length was determined in some years by state law and in others by federal regulations.

intervals over a period not to exceed approximately 3½ months. Only two states selected a season of 30 consecutive days. A few states chose a season of 5 days a week for 6 weeks and a few 2 days a week for 15 weeks; 30 states chose a season of 3 days a week for 10 weeks. Illinois chose 2 days a week, October 6–January 13. According to More Game Birds in America, a sportsmen's organization that has since disbanded, in the 48 states there were 21 different combinations of shooting days and 17 different opening and closing dates (Anonymous 1936).

The Migratory Bird Act of 1913 empowered the Secretary of Agriculture to prescribe and fix closed seasons on waterfowl, "having due regard to the zones of temperature, breeding habits, and times and line of migratory flight." The Migratory Bird Treaty Act of 1918 in granting similar powers included references to "zones of temperature," and "times and lines of migratory flight" with respect to the hunting of migratory birds.

The 1913 regulations divided the United States into two zones with respect to closed seasons, a northern "breeding zone" and a southern "wintering zone," but within the zones made several local exceptions to the general dates established for these zones. For the next few years, numerous variations in the dates of hunting seasons were tried. In 1918, four zones, on the basis of opening dates, were established. In 1935, the states were grouped into two zones, with the open season October 21 through November 19 for the northern zone and November 20 through December 19 for the southern zone. In 1936, three zones were established, with the hunting season October 10 through November 8 for the northern zone, November 1 through November 30 for the central zone and November 26 through December 25 for the southern zone. These zones followed closely the zones of temperature as determined from records of the U. S. Weather Bureau. In most instances zones were established along state lines and thus kept at a minimum the confusion and

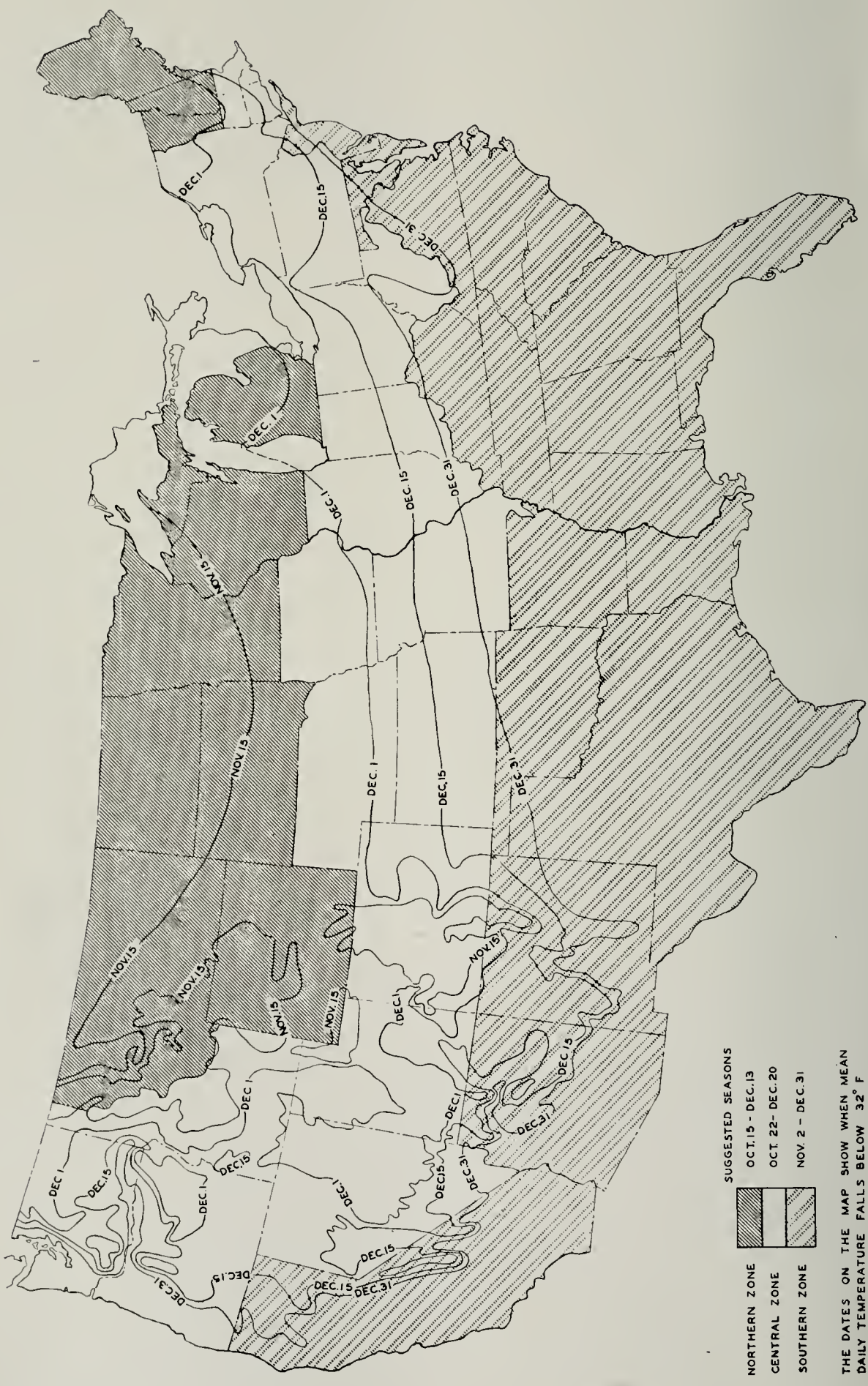

Fig. 2.—Separation of the United States into three waterfowl hunting zones, as advocated by More Game Birds in America, 1936. Zones are based [illegible] Weather Bureau records over a period of about 46 years. Date lines show when the mean daily temperature drops below 32 degrees F.

the difficulty of law enforcement that are apt to arise when a single state lies in two or more zones.

More Game Birds in America, after objecting to drastic year-to-year changes in waterfowl regulations, proposed in 1936 to standardize these regulations and to divide the nation into three definitely prescribed hunting zones (Anonymous 1936). The criterion for placing states in the various prescribed zones (as well as for establishing the opening and closing dates of a 60-day season for each zone) was temperature records reported by the U. S. Weather Bureau over a period of about 46 years. This foundation proposed a season from October 15 through December 13 for the northern zone; October 22 through December 20 for the central zone; and November 2 through December 31 for the southern zone.

Fig. 2 shows the zoning of the United States as proposed by More Game Birds in America and average dates on which the mean daily temperature falls below 32 degrees F. The report of this organization (Anonymous 1936) contains the following: "It . . . . . is reasonable to state that the bulk of our wild ducks and geese migrate with the annual sweep of Old Boreas from the north to the south. And it is equally reasonable to assume that open seasons, based on the average freezing or 'freeze-up' dates in various sections of the country, provide a far sounder basis for fixing open seasons than arbitrary dates set by human decision and subject to political or other pressure."

Recent federal regulations have arranged the states, with minor exceptions, into zones similar to those shown in fig. 2. In the 1943 regulations, Iowa, Ohio and Pennsylvania were in the northern zone instead of the central, as in fig. 2; and California, Kentucky, New Jersey and Oklahoma in the central instead of the southern zone. In 1942, Iowa and Pennsylvania had been in the central zone and, in 1940, Ohio also had been in the central zone. Other

Table 1.—Federal duck hunting regulations as they applied in Illinois, 1929–1944.

YEAR	OPEN SEASON, DATES INCLUSIVE	DAYS	BAG	POSSESSION	TIME*	LIVE DECOYS	BAIT	MISCELLANEOUS
1929	Sept. 24–Jan. 7.....	106	25†	Undefined†	a	Yes	Yes	
1930	Sept. 24–Jan. 7.....	106	15	30	a	Yes	Yes	
1931	Nov. 1–Nov. 30.....	29½	15	30	a	Yes	Yes	Season opened at noon
1932	Oct. 16–Dec. 15.....	60½	15	30	a	25 limit	Yes	Season opened at noon
1933	Oct. 16–Dec. 15.....	60½	12	24	a	25 limit	Yes	Season opened at noon
1934	Oct. 6–Jan. 13‡.....	30	12	24	b	25 limit	By permit	Duck stamp
1935	Oct. 21–Nov. 19.....	30	10	10	c	No	**	Duck stamp; 3-shell law
1936	Nov. 1–30.....	30	10	10	c	No	No	Same as for 1935
1937	Nov. 1–30.....	30	10	10	c	No	No	Same as for 1935
1938	Oct. 15–Nov. 28	45	10	20	c	No	No	Same as for 1935
1939	Oct. 22–Dec. 5.....	45	10	20	c	No	No	Same as for 1935
1940	Oct. 16–Dec. 14.....	60	10	20	d	No	No	Same as for 1935
1941	Oct. 16–Dec. 14.....	60	10	20	d	No	No	Same as for 1935
1942	Oct. 15–Dec. 23.....	70	10	20	e	No	No	Same as for 1935
1943	Oct. 15–Dec. 23.....	70	10	20	a	No	No	Same as for 1935
1944	Oct. 14–Jan. 1.....	80	10–15††	20–30††	a	No	No	Same as for 1935

*Shooting hours:
a. One-half hour before sunrise to sunset.
b. Sunrise to sunset, except that in 1934 on baited grounds closing time was 3 P.M., Central Standard Time.
c. 7 A.M. to 4 P.M., Central Standard Time.
d. Sunrise to 4 P.M.
e. Sunrise to sunset.

†Illinois law specified bag limit 15, possession 60.

‡Thirty days within the period October 6–January 13 (Illinois chose Saturdays and Sundays). Baiting was allowed only if a permit had been obtained from the U. S. Bureau of Biological Survey.

**Baiting prohibited but law so interpreted as to allow feeding on parts of premises not shot over.

††Bag limit 10 plus 5 mallards, widgeons or pintails; possession limit 20 plus 10 mallards, widgeons or pintails.

borderline states have been shifted from one zone to another from time to time. Hunters in certain borderline states prefer to have their states in the northern zone because of the later opening date in the central zone.

Recent shifts in the populations of various waterfowl species and the variety of experiments in setting the dates and lengths of the waterfowl hunting seasons suggest a need for additional information on the seasonal waterfowl flight and kill in various sections of the country. If lowered waterfowl populations necessitate shortening of the shooting season, it is important to adjust the open season to a time that favors any endangered species and yet furnishes hunting that is as good as possible under the circumstances. On the other hand, if increases in the waterfowl populations seem to justify a lengthening of the shooting season, it is equally important to adjust the dates to place the greatest pressure on the species that can best withstand increased shooting.

Shooting Hours.—The Migratory Bird Act regulations of 1913 provided that there be no waterfowl hunting between sunset and sunrise. The Migratory Bird Treaty Act regulations of 1918 stipulated shooting hours of one-half hour before sunrise to sunset. Since 1918, shooting hours have changed from time to time upon recommendation of the Secretary of Agriculture, 1918 through June 30, 1939, and the Secretary of the Interior, July 1, 1939, to date. Table 1 gives the changes in shooting hours from 1929 to the present. They have gone through a complete cycle: from one-half hour before sunrise to sunset, then from sunrise to sunset, from 7 A.M. to 4 P.M., from sunrise to 4 P.M., again from sunrise to sunset, and finally, in 1943 and 1944, from one-half hour before sunrise to sunset.

Bag Limit.—Legal restrictions on the take of waterfowl have been in operation since 1887 (Palmer 1912), when the federal government limited the number of ducks that could be taken per day in the Dakota Territory to 25. Illinois did not have a duck bag limit until 1903, when the number of ducks taken by a shooter in a day was limited to 50. In 1905, the Illinois limit was lowered to 35 per day; in 1907 to 20; and in 1909 to 15. From 1918 through 1929, federal regulations limited the daily bag to 25. During those years the Illinois bag limit remained at 15, 10 under the federal limit. In 1930 the federal limit became 15, and since then the Illinois bag limit has conformed to the federal limit: in 1930 and the 2 following years it was 15; in 1933 and 1934 it dropped to 12 per day; from 1935 to date it has been 10 per day, except that in 1944 five additional mallards, widgeons or pintails could be taken. As the nation's waterfowl supply dwindled, bag limits were reduced in an effort to restrict the kill.

Favoring Depleted Species.—Regulations authorized by the Migratory Bird Act of 1913 placed a 5-year closed season on swans, certain other migratory game birds and, in a number of states, wood ducks. The Migratory Bird Treaty Act of 1918 in giving effect to the Treaty of 1916 extended the closed season on swans and placed a closed season on wood ducks for at least 5 years in all states. The protection has been extended but in recent years somewhat altered. Commencing in 1932, several other species have been given increased or complete protection. Ruddy ducks and buffleheads could not be taken legally from 1932 through 1937; canvasbacks and redhead ducks were placed on the closed list in 1936 and 1937. There was, in 1932, a daily limit of not more than 10 of any one, or in the aggregate of two or more, of the following species: canvasback, redhead, greater scaup, lesser scaup, ringneck, blue-winged teal, green-winged teal, cinnamon teal, shoveler and gadwall. (Scientific names of duck species common in Illinois are listed in table 12.) In 1933 not more than eight alone or in the aggregate of the above named species could be taken, and in 1934 not more than five alone or in the aggregate. In 1938, 1939 and 1940, it was permissible to take three alone or in the aggregate of ruddy, bufflehead, redhead and canvasback ducks. In 1941, 1942 and 1943, this limit was left on the redheads and buffleheads but removed from the others. In 1944, it was re-

moved from redheads and buffleheads. In 1941, one wood duck could be taken in 15 states. The 1942 and 1943 regulations permitted throughout the nation one wood duck in each hunter's daily bag or in his possession. The 1944 regulations on wood ducks were the same except that in South Dakota and Massachusetts no wood ducks could be taken.

Bait and Live Decoys.—The first Illinois restriction on the employment of bait to attract waterfowl dates back to a state law effective in 1909. This was repealed in 1911, and it was not until federal regulations prohibited baiting in 1935 that this method of enticing ducks to a shooting stand was again illegal. In 1934 it was necessary to secure a permit from the federal government to employ bait; a federal regulation prohibited the use of bait in 1935, but it was interpreted to permit feeding on one section of the premises if the shooting stand was sufficiently remote to allow birds free access to the feed without being shot at. The regulation was so worded the next year as to prohibit feeding under any shooting conditions.

Prior to 1900, baiting was almost unknown in Illinois. The consensus of old-time duck hunters is that baiting of ducks began in the early 1900's in the bottoms of the Sangamon River, near the confluence of this river with the Illinois. It seems to have started there because diversion of water from Lake Michigan resulted in raised water levels in the Illinois River valley that brought about a paucity of native duck foods in the Sangamon bottoms.

From the mouth of the Sangamon, the practice of employing bait to attract ducks spread up and down the Illinois River bottomlands; by the 1920's it was widespread throughout most of the valley. In the early 1920's, it was discovered that bait placed on the uplands in Mason County would attract ducks. Soon baited areas with pens of decoys dotted the sand hills of that area.

Live decoys were limited by federal regulations to 25 in 1932, 1933 and 1934; they have been prohibited since that time.

Three-Shell Limit.—Beginning in 1935, federal regulations have prohibited the taking of migratory game birds with a shotgun capable of holding more than three shells at any one loading.

Evaluating Regulations

The seasonal chronology of the flight of the more important duck species in Illinois was determined from censuses made by the author in the Illinois River valley from Bureau to Meredosia, a distance of 140 miles, each week, 1938–1942, figs. 3–15. Fortunately, the Illinois River waterfowl habitat consists of open lakes, averaging about 1,000 acres each, which are readily accessible to observers and many of which can be viewed from bluffs or other high points. It is the belief of Robert H. Smith, Mississippi Flyway Biologist of the U. S. Fish and Wildlife Service, that these circumstances make it possible to census waterfowl in the Illinois River valley more quickly and with a greater degree of accuracy than in any other region of comparable size in the nation.

It is popularly supposed that the larger the flock or raft of resting ducks, the greater is the error in the estimate of its numbers. However, in my opinion, the reverse is more likely to be true, for the larger the flock size the smaller is the per cent of error in the measurement of its surface. The basis for making estimates used by the U. S. Fish and Wildlife Service (one duck per square yard minus one-third for gaps) applies as well to large rafts as to small flocks.

The duck kill data in this paper were taken from the records of duck clubs. The game code of Illinois requires that all waterfowl clubs report the kill, by species, for each day and for each hunter. There has been an average of about 700 waterfowl clubs in Illinois during recent years. In the Illinois River valley, clubs own about 90 per cent of the hunting land. Printed forms to record the kill are provided clubs by the State Department of Conservation. Many clubs recorded their kill for years before being required to do so. Club records are the most nearly complete ones available for a long period of time.

Banding data, as well as kill records,

offer a means of determining comparative mortality rates among waterfowl by species or by years. The ratio of the number of first-year returns (bands recovered before the beginning of the hunting season next after banding) to the number of birds banded gives a comparative, if not quite accurate, measure of mortality. The actual hunting mortality among waterfowl is higher than that indicated by band returns, for a recent study made by the writer revealed that Illinois hunters report only about two-thirds of the bands taken.

Of about 30,000 ducks banded by the Illinois Natural History Survey, only three species—mallard, black duck and pintail—are in significant numbers. The banding data we have obtained can be used to compare mortality rates for each of these three species from year to year, but, because of the few species banded, we cannot employ such data to compare mortality rates among all the species of ducks in Illinois.

To determine the optimum dates for the open duck season in Illinois, it is necessary first to evaluate the vulnerability to hunting of each important species and the shooting pressure placed upon it. Because the ducks banded in Illinois do not include all species in significant numbers, we have not used banding data but have compared the Illinois kill of each principal species with its Illinois population during the open season to determine its vulnerability to hunting in relation to the vulnerability of other species. The term *vulnerability*

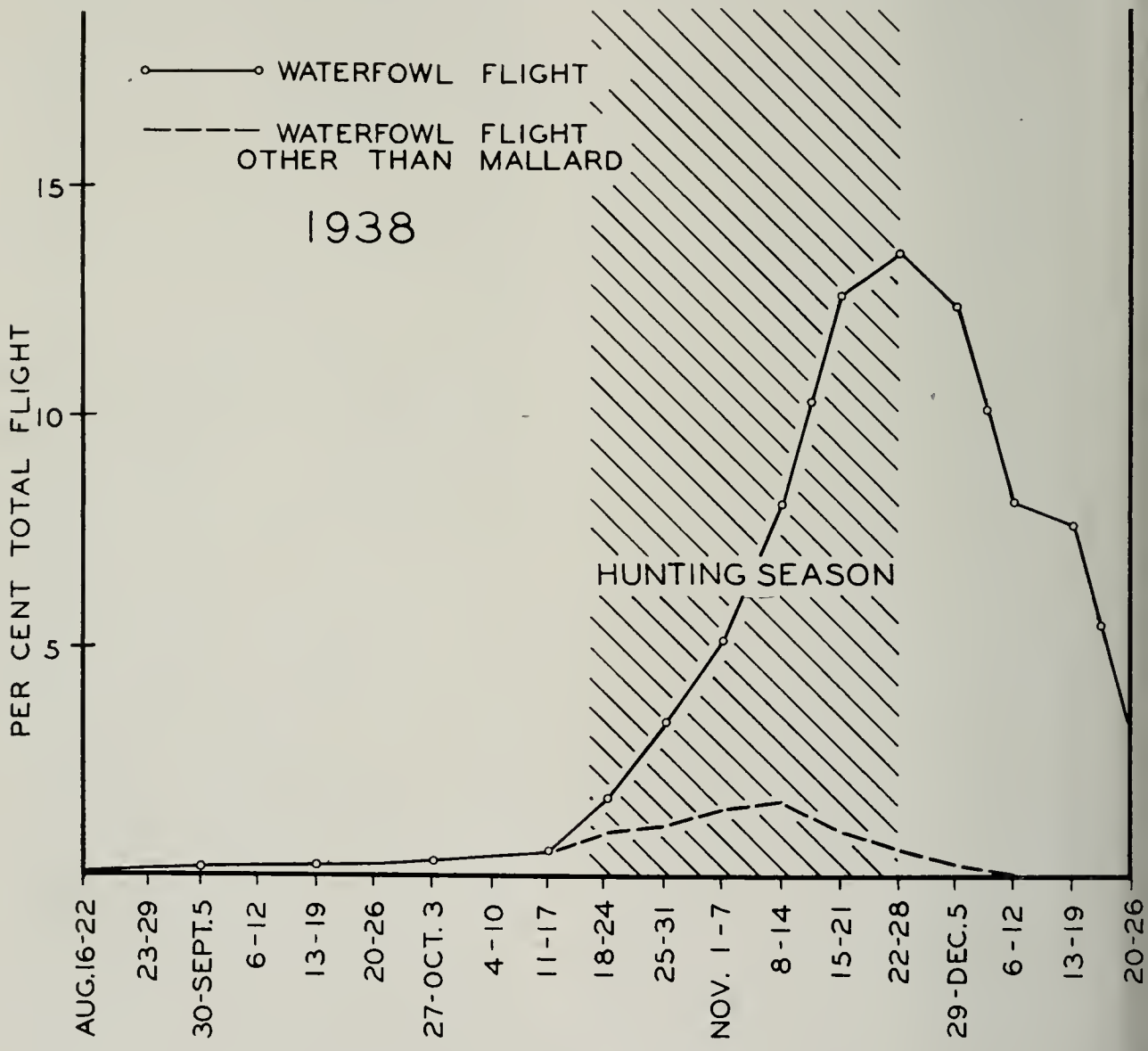

Fig. 3.—Chronology of flight of all duck species, and species other than mallard, in relation to the hunting season in the Illinois River valley, 1938.

quotient is given to the ratio that exists between the percentage a species contributes to the duck bag and the percentage that species makes of the duck

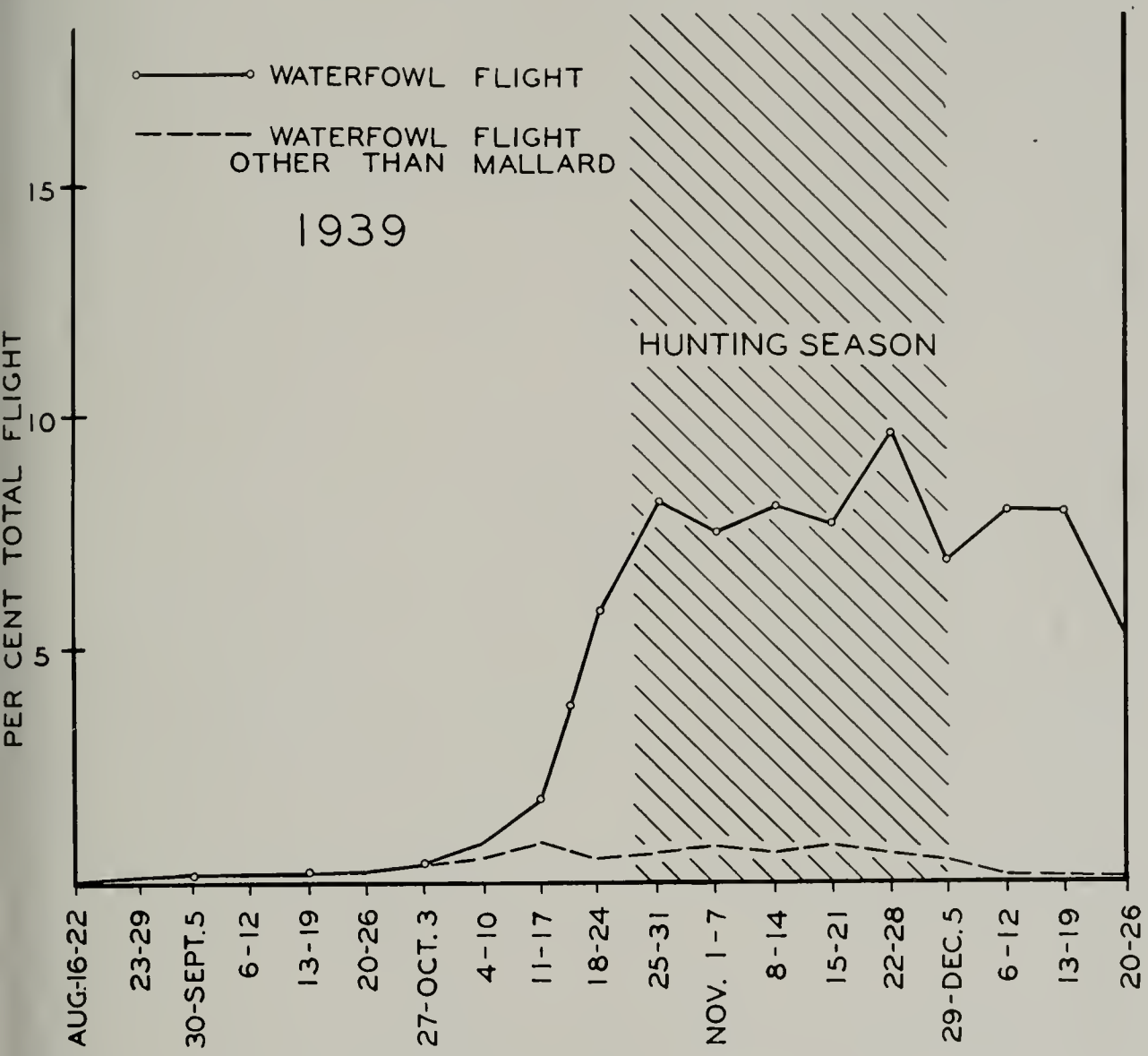

Fig. 4.—Chronology of flight of all duck species, and species other than mallard, in relation to the hunting season in the Illinois River valley, 1939.

flight during the *open season*. For example, the pintail, which for a 5-year period contributed 9.65 per cent of the total Illinois bag, comprised 1.17 per cent of the total Illinois flight during the open season. The vulnerability quotient for this period is 9.65 divided by 1.17, or 8.25, table 2. This quotient, when compared with vulnerability quotients for other ducks, may be considered as a relative measure of the killability of the pintail, or the relative ease or difficulty with which it is bagged.

The relationship of the bag for any species to the *entire fall flight* of that species also is necessary in determining optimum dates for the hunting season. This relationship is expressed by a *mortality quotient*, which is similar to the vulnerability quotient except that it takes into account a longer period of migration, tables 2–7. It is a measure of the shooting pressure placed upon a species by its vulnerability and its chronology of migration in relation to the hunting season.

The comparative influence on each principal duck species of changes in the hunting season may be obtained by finding the ratio of the mortality quotient to the vulnerability quotient. A numerical expression of this relationship, obtained by dividing the mortality quotient by the vulnerability quotient, is termed the *shooting pressure quotient*, tables 2 and 8. In this figure, vulner-

ability differences between the species are partially or entirely nullified, and a measure is derived for the influence of the open season. The shooting pressure quotient can be changed for any species by altering the opening or closing dates of the season.

The relative vulnerability, or killability, of species is summarized for a 5-year period, 1938–1942, in table 2. A period of this length, rather than a shorter period, was used because we believe there is little difference from year to year in the inherent wariness, or in the flight, flocking and feeding habits, changed materially from year to year in the period 1938–1942.

Vulnerability of Species

Because of variations in habits, species of ducks differ in their likelihood of being killed by hunters. Species differ in inherent wariness. Food habits influence the killability of species; preference for a certain food may entice one kind of duck into heavily gunned areas, while another kind remains in open water, out of reach of hunters. Flocking habits also influence the vulnerability

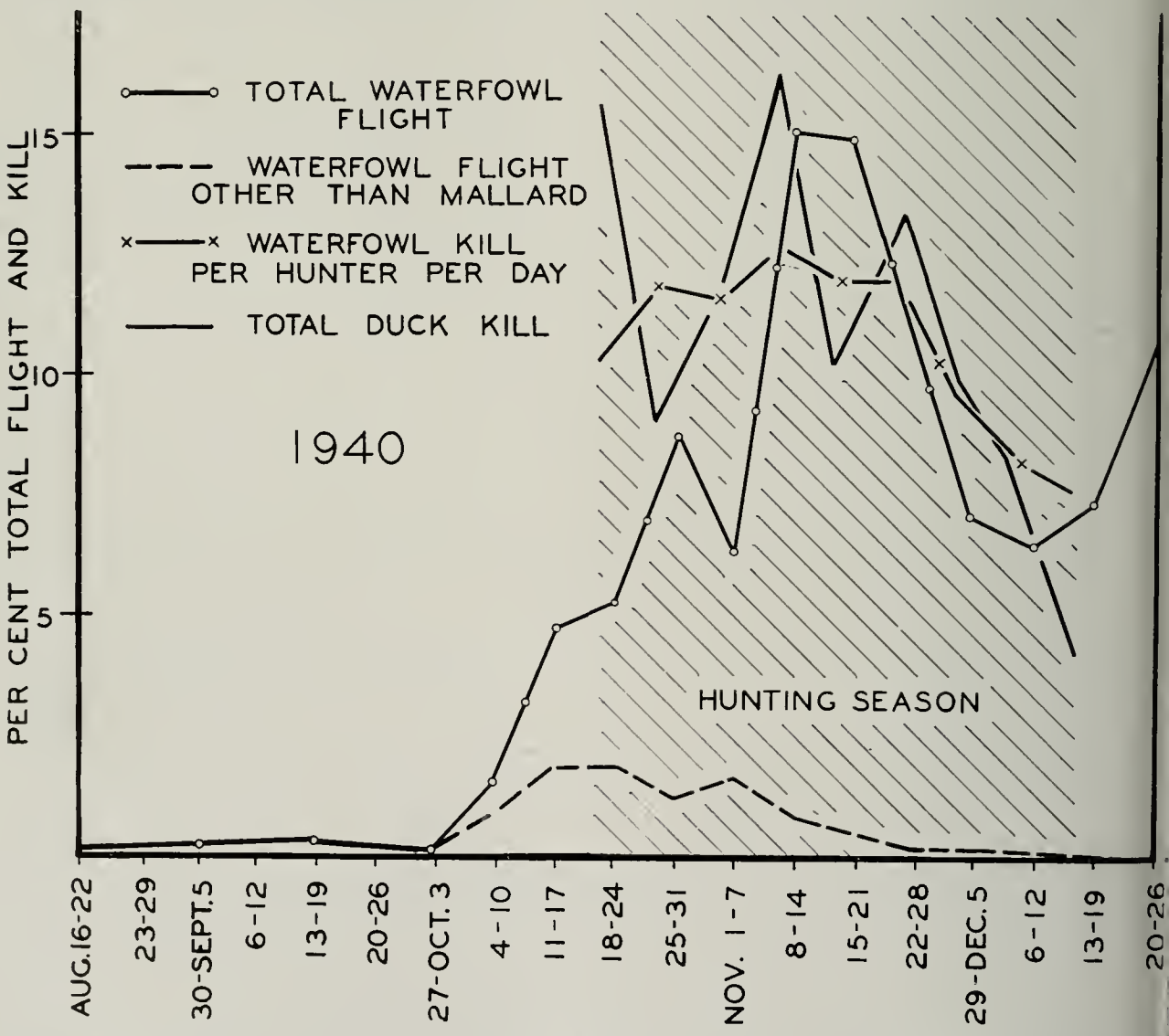

Fig. 5.—Chronology of flight of all duck species, and species other than mallard, bag per hunter per day and total daily duck kill (weekly averages expressed as per cent of yearly total) in the Illinois River valley, 1940.

of a given species. However, in evaluating the comparative mortality of duck species, we used yearly data, tables 3–7, because the hunting regulations and chronology of migration—which may greatly influence the kill of a species—

of species, for, generally, singles are more readily decoyed than a flock of 10, which in turn is more readily decoyed than a flock numbering 100. As figs. 5–7 show, the greater the concentration of ducks, under ordinary conditions, the

smaller is the percentage of ducks likely to be killed. A flock of 1,000 mallards or bluebills passing over a blind is unlikely to have many more individuals killed from it than a flock numbering only 10 or 100, for after the first shot the individuals left are warned and have an opportunity to swing or climb out of range. Experienced duck hunters usually refrain from shooting into large flocks, for they know such shooting "educates" ducks to avoid the area from which the shots have been fired.

Of all kinds of Illinois ducks, mallards and black ducks, considered together, were found through this study to be the least vulnerable to hunting, table 2. In sporting circles, many heated debates have arisen over the question of whether the mallard, the black duck or the pintail is the wariest of our ducks. While many instances can be cited favoring each species, veteran duck hunters generally give the edge to the pintail. However, in Illinois, the flocking and feeding habits of mallards and black ducks are such that a much lower percentage of the flight is killed.

Mallards and black ducks now frequent the open waters of large lakes much of the day and night during the fall migration season in Illinois. Near sunset or before sunrise, they wing high overhead to feed in cornfields. Pintails obtain most of their food from small-seeded plants growing in marshes and along the edges of lakes. In seeking this food, they generally come within gun range much more frequently than do mallards. The mallard habit of concentrating by the tens of thousands on about a dozen large lakes of the Illi-

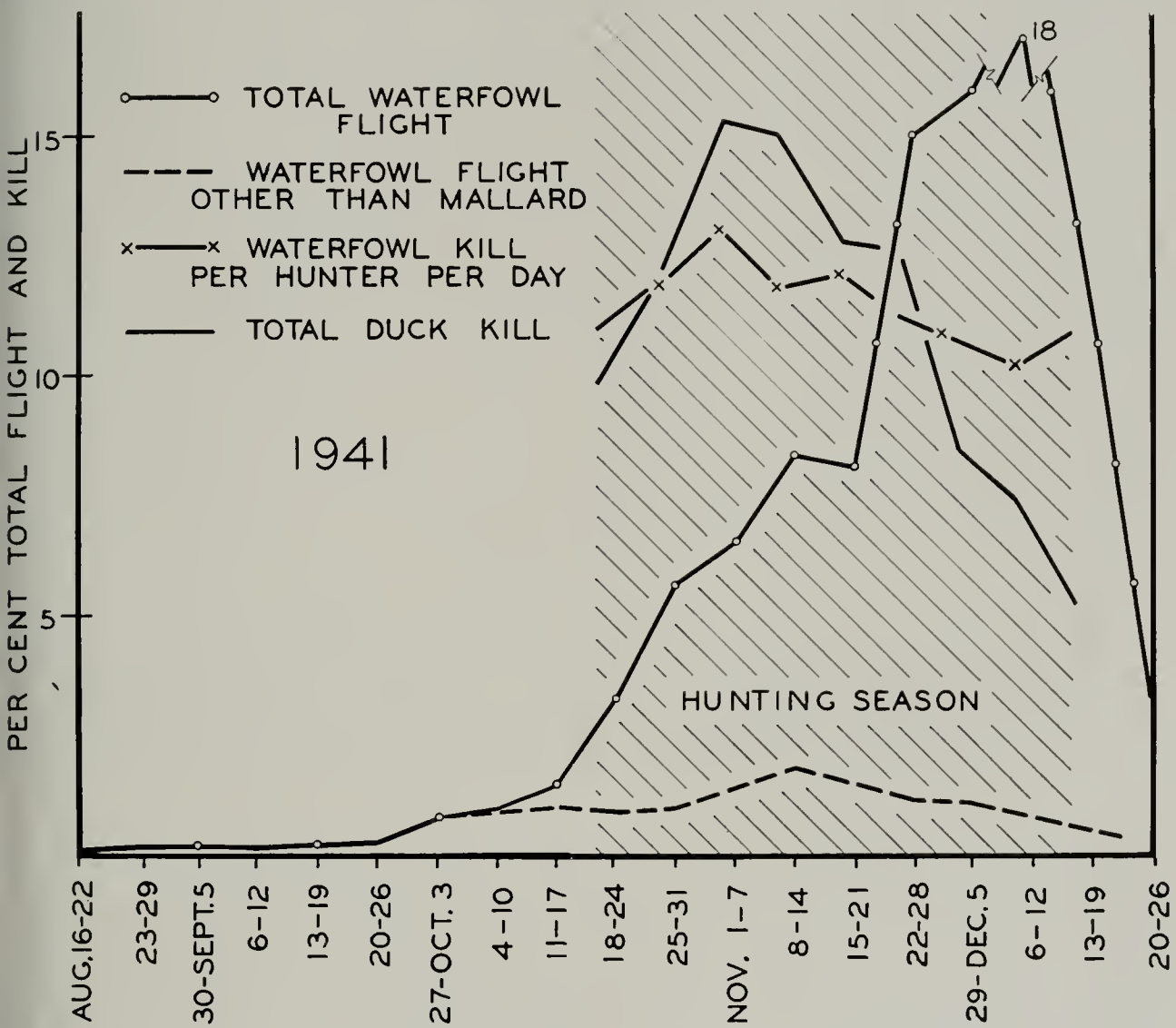

Fig. 6.—Chronology of flight of all duck species, and species other than mallard, bag per hunter per day and total daily kill (weekly averages expressed as per cent of yearly total) in the Illinois River valley, 1941.

nois River valley results in a lower proportional kill than if the population were more evenly distributed over more areas and in smaller flocks, as in the case of the pintail.

Widgeons and gadwalls were taken in the years of this study more readily than were pintails by Illinois hunters, table 2. These "gray ducks" feed principally on coontail (*Ceratophyllum demersum*) in Illinois, and, in most instances, this plant reaches peak development in the ponds and potholes of river bulrush (*Scirpus fluviatilis*) marshes. Widgeons and gadwalls consequently chance to come within range of hunters frequently, and, while they may not respond to calling and decoys as readily as do mallards or pintails, the "gray ducks," once they decide to decoy, approach with much less caution.

Blue-winged and green-winged teals were killed in greater proportion to numbers present than was either species of "gray ducks," table 2. Teals, which feed extensively on the seeds of smartweeds (*Polygonum* spp.), nutgrasses (*Cyperus* spp.) and other small-seeded plants, spend much time along the edges of marshes and lakes. While teals are fast and erratic flyers, and are thereby responsible for more misses than most of the other species, they are very unwary. They decoy readily, often with no more than a half circle to the blocks, and frequently return after being shot at. Kortright (1942) says that their habit of flying in a dense, closely bunched flock renders them very vulnerable to the fire of the gunner, and two or more birds will often fall from a single shot. They are easily killed when hit.

Shovelers, or spoonbills, were found

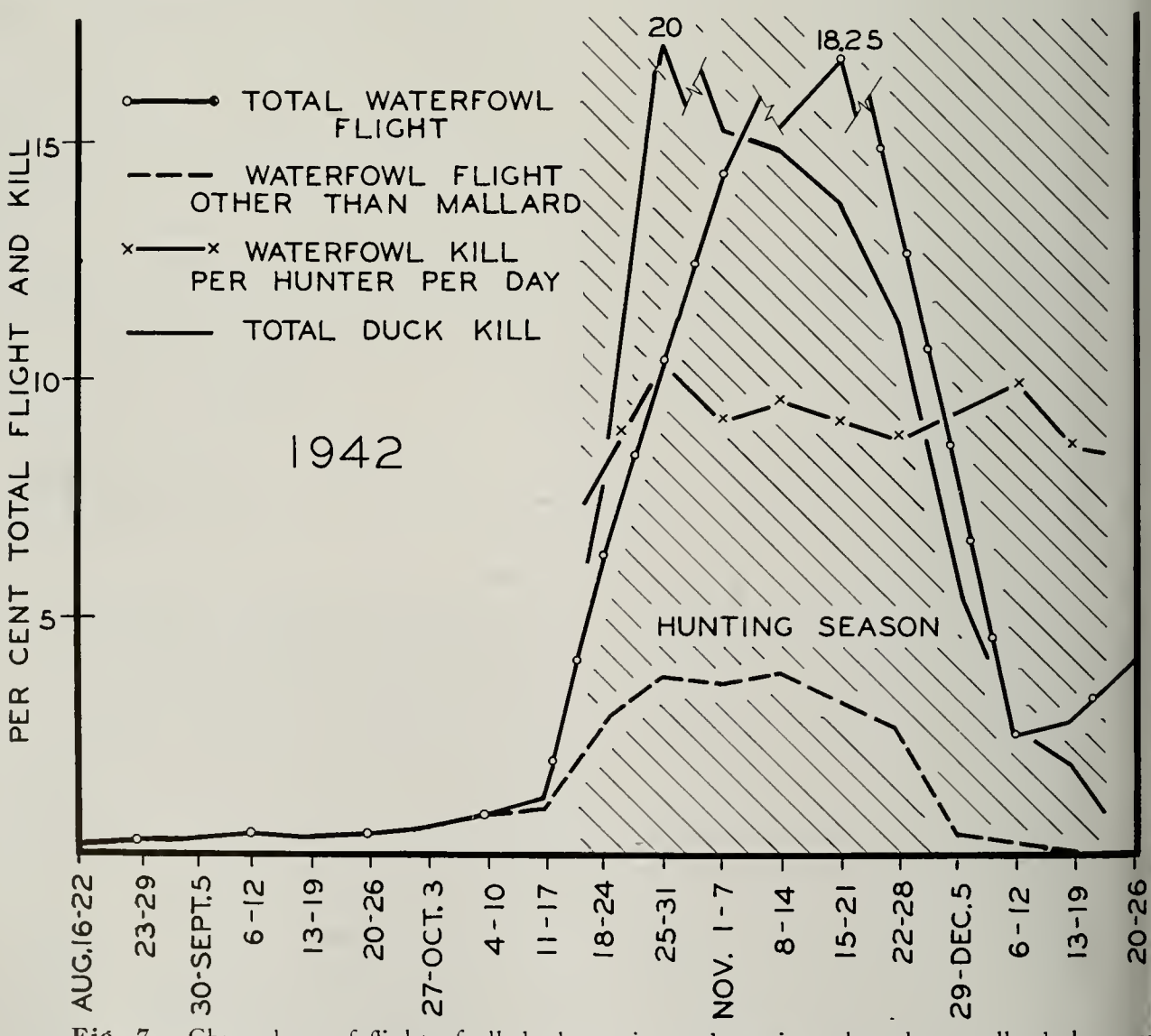

Fig. 7.—Chronology of flight of all duck species and species other than mallard, bag per hunter per day and total daily kill (weekly averages expressed as per cent of yearly total) in the Illinois River valley, 1942.

to be the most vulnerable of Illinois ducks, table 2. Their feeding habits frequently bring them within range of the hunter. Spoonbills do not furnish

River valley. This is partly the result of their habit of seeking the extensive open water areas of large lakes and congregating in tremendous rafts, which in

Table 2.—The vulnerability, mortality and shooting pressure quotients for each of the important duck species or groups in the Illinois River valley, 1938–1942. The higher the figures, the greater is the vulnerability, mortality and shooting pressure.

Species	Per Cent of Flight During Open Season	Per Cent of Total Bag	Vulnerability Quotient	Per Cent of Flight During Entire Fall	Per Cent of Total Bag	Mortality Quotient	Shooting Pressure Quotient
Mallard and black duck*	91.39	66.46	0.73	89.70	66.46	0.74	1.01
Pintail	1.17	9.65	8.25	1.80	9.65	5.36	0.65
Widgeon and gadwall*	0.43	5.40	12.56	0.51	5.40	10.59	0.84
Green-winged and blue-winged teals	0.09	6.42	71.33	0.74	6.42	8.68	0.12
Shoveler	0.01	1.32	132.00	0.02	1.32	66.00	0.50
Lesser scaup	5.96	6.45	1.08	6.53	6.45	0.99	0.92
Canvasback	0.30	1.04	3.47	0.22	1.04	4.73	1.36
Ruddy duck	0.16	0.56	3.50	0.13	0.56	4.31	1.23
Ring-necked duck	0.49	2.70	5.51	0.35	2.70	7.71	1.40
	100.00	100.00		100.00	100.00		

*Species with similar inherent wariness, flying, flocking and feeding habits were combined to reduce possible error resulting from small proportional amount of data on certain species. The comparatively small population and kill data for certain species was due to the enormous population and kill of mallards; some species have been omitted because of insufficient data on them. The great range in percentage figures has caused some inexactness in the smaller figures, especially those for the teals and shoveler, with a resulting distortion in the quotients. However, differences in quotients for the various species are large enough to be significant, and the figures are statistically useful.

as difficult a target as do teals, for their flight is slower and less erratic. They are undoubtedly one of the least wary of ducks, frequently dropping into decoys without circling, and decoying to the same blind after being shot at.

As a group, diving ducks were found to be less vulnerable to shooting than were dabbling ducks in the Illinois River valley, undoubtedly because of the fact that most diving ducks congregate in the open water of large lakes. In Illinois, where duck hunting consists almost entirely of marsh and lake shore shooting, ducks at a distance from shore furnish few shots. All diving species were bagged in proportionally smaller numbers than was the wary pintail, table 2. Diving ducks are reputed to be able to carry more lead than dabbling species, and it is evident that many crippled diving ducks escape capture because of their diving ability.

Lesser scaups, or bluebills, have a lower proportional kill, table 2, than any other diving duck in the Illinois

size are next to those of the mallard. As discussed elsewhere, the greater the concentration of ducks the smaller is the percentage killed.

Canvasbacks, bagged in proportion to their numbers more often than lesser scaups, are credited with being more wary, table 2. However, canvasbacks are more readily decoyed along the Illinois River than lesser scaups, perhaps because they assemble in smaller flocks. Canvasbacks frequent the inshore areas of large lakes more than lesser scaups, probably because of the occurrence there of wild celery (*Vallisneria spiralis*), duck potato (*Sagittaria latifolia*) and other aquatic plants which form the bulk of their food. Many hunters make a greater effort to bag canvasbacks than lesser scaups.

Ruddy ducks, taken by Illinois River club hunters in only slightly greater proportion to population than canvasbacks, are fast flyers, but they are unsuspicious and fly at low levels across the water, making them easy targets

for open water hunters, table 2. Because of their aversion to crossing marshes or timbered necks of land, they do not furnish many targets for shore and marsh hunters. Club hunters in Illinois seldom resort to open water gunning, but where this type of hunting occurs, as at the Sparland Public Shooting Ground, large proportions of the ruddies present are taken (Bellrose 1944).

Proportionally more ring-necked ducks than ruddies were bagged by club hunters in the years of this study, table 2. There can be little doubt that much of the difference in vulnerability between blackjacks, as ring-necked ducks are often called in Illinois, and the lesser scaups resulted because blackjacks inhabit small bodies of water and marshy or inshore areas of large lakes instead of open water, and are more likely to pass under the muzzles of guns than are bluebills, as lesser scaups are sometimes known. The greater fondness of ringnecks for shoal water is reflected in their food habits; Cottam (1939) reports 81.47 per cent of the ring-neck's food consists of aquatic plants, about the same per cent as is found in the canvasback's diet, whereas only 59.55 per cent of the lesser scaup's diet is made up of aquatic plant items.

Evidence obtained in 1941 and 1942 indicates that redheads are much more readily bagged in proportion to the population than are ring-necked ducks. I believe that redheads are the least wary of the *Nyroca*, the most important group of diving ducks. They decoy more readily in Illinois to blocks than other members of the genus, but whether this is due to their flying in small flocks or to lack of wariness, or to both, is uncertain. In Illinois, redheads frequent marshy lakes and the inshore of large lakes more than any other diving ducks with the possible exception of the ring-necks. Cottam (1939) reports the food of the redhead to be 89.66 per cent vegetable material; this is the largest proportion of plant items in the diet of any diving duck important in Illinois.

Because of differences in flocking and feeding habits, types of habitats in which they are hunted and methods by which they are hunted, the ducks discussed above may not have the same relative vulnerability to the shotgun throughout North America. However, the ratings determined by this study show which species are in need of the most protection in Illinois, and probably they may serve as useful indicators of the species that are most likely to suffer from overshooting in the Midwest.

Observations made in 1943 on Grass Lake, in northeastern Illinois, suggest that coots may be more readily killed than ducks (Bellrose 1944). Careful calculations indicate that, on the opening day of the hunting season, 18,225 coots and 108 ducks were killed. These figures represent about 95 per cent of the coot and 15 per cent of the duck population then present. The ducks that made up the bulk of the population on Grass Lake were blue-winged teals, considered highly vulnerable in comparison with most other duck species.

Influence of Open Season.—Because duck species differ from each other to some extent in the chronology of their migration, figs. 8–10, if the relative vulnerability of species is known the opening and closing of the hunting season may be adjusted to lift some or all of the shooting pressure from the most vulnerable species, or those most needing protection.

Leopold once wrote (1933) that a number of states purposely set the open season on deer late in the year so that severe weather will keep all but the hardiest hunters at home. He also remarked that several states, including Michigan, open the season on prairie chickens at a late fall date to take advantage of the fact that these birds are harder to kill late than early in the autumn.

How have the open seasons from 1938 through 1942 influenced the duck species that migrate through Illinois? We have attempted to answer this question by comparing the vulnerability quotient with the mortality quotient for each important species to obtain what we have termed the shooting pressure quotient. This shooting pressure quotient gives a comparative evaluation of the effect of the open season on important duck species in Illinois for the

1938–1942 period, table 2, and for each year during the period, table 8.

Comparative Shooting Pressure.—Table 8 discloses that the blue-winged teal had the lowest shooting pressure quotient of all important ducks in Illinois during the years of this study and may therefore be considered as the species most favored by the open seasons from 1938 through 1942. A glance at fig. 8 and figs. 11–15 reveals that most blue-wings passed through the valley

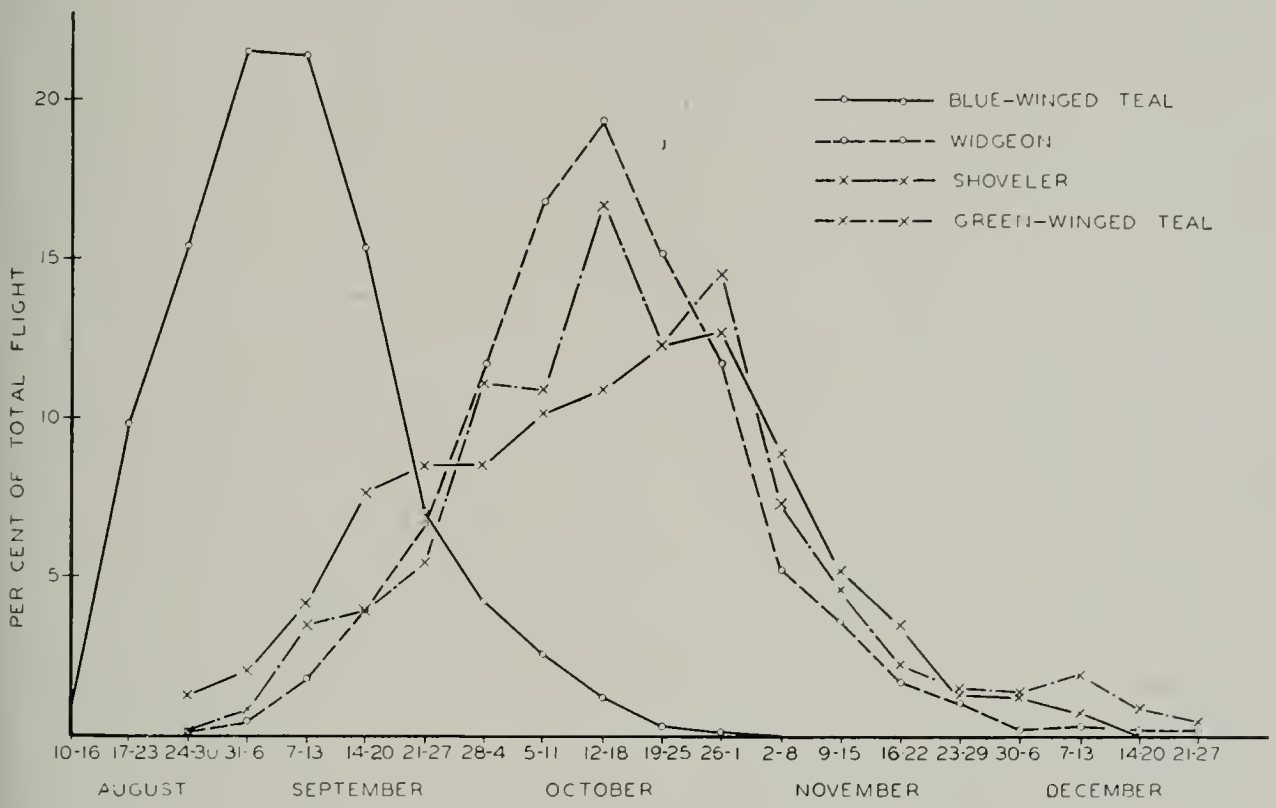

Fig. 8.—Five-year average, 1938–1942, of the seasonal migration of the blue-winged and green-winged teals, widgeon and shoveler in the Illinois River valley.

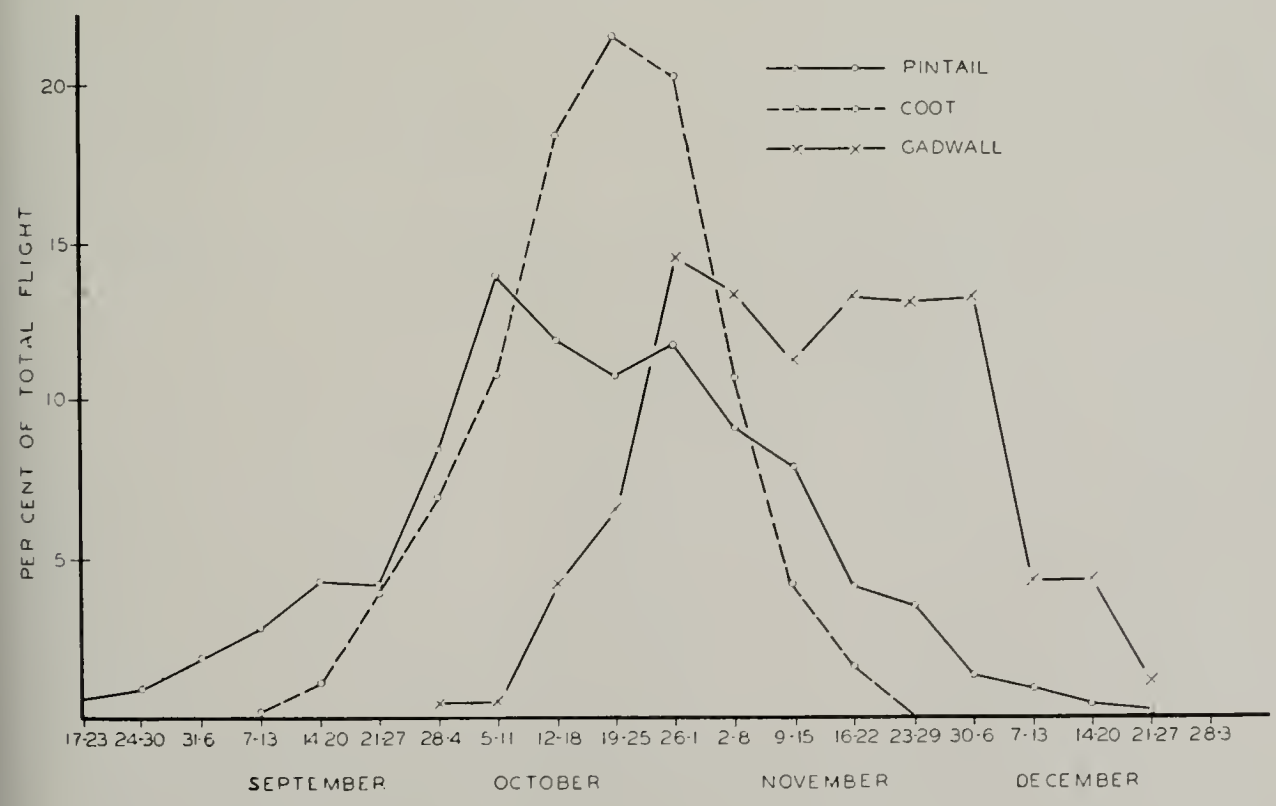

Fig. 9.—Five-year average, 1938–1942, of the seasonal migration of the pintail, coot and gadwall in the Illinois River valley.

prior to the opening of the hunting season. A greater proportion of the flight was present during the open seasons of 1938 and 1941 than during the other three seasons. Table 8 shows for 1938 and 1941 the highest shooting pressure quotients for this species.

Second among the species most favored in Illinois by the established open seasons, 1938–1942, was the shoveler. As shown by fig. 8 and figs. 11–15, much of the shoveler migration in this state occurred before the season opened. A larger proportion of the population of this species than of any other species, except the blue-winged teal, passed south before opening day. Data in table 8 disclose that extending the season to 60 days in 1940 and 70 days in 1942 did not increase the shooting pressure quotient for this species in those years.

Figs. 11–15 reveal that much of the green-winged teal flight, like that of the blue-winged teal and shoveler, had passed through Illinois by opening day, 1938–1942. Table 8 shows that the green-wing was the third most favored species. High water in 1941 caused a large part of the green-winged teal flight to leave the Illinois River valley earlier than usual. In that year, green-wings were under less shooting pressure than in other years and were next to the blue-winged teal in being little affected by the open season, table 8.

Next to the blue-winged teal, the pintail was, in the years of this study, the earliest migrant to arrive in Illinois, fig. 9. However, because greater proportions of its flight occurred during the hunting season, figs. 11–15, the pintail was subject to more shooting pressure than either of the teals or the shoveler, table 8. High water in 1941 resulted in a mass exodus of pintails from the Illinois River valley early in October, accounting at least in part for a low shooting pressure in that year, table 8 and fig. 14. While the 1942 flight was small, the majority of birds arrived during the hunting season. A late flight in 1938 helped to place pintails under greater shooting pressure in that season than in others.

The widgeon, in the years of this study, was subject to more shooting pressure in Illinois than was the pintail, table 8. The figure for 1938 indicates that the later-than-usual widgeon flight in that year contributed to a heavier-

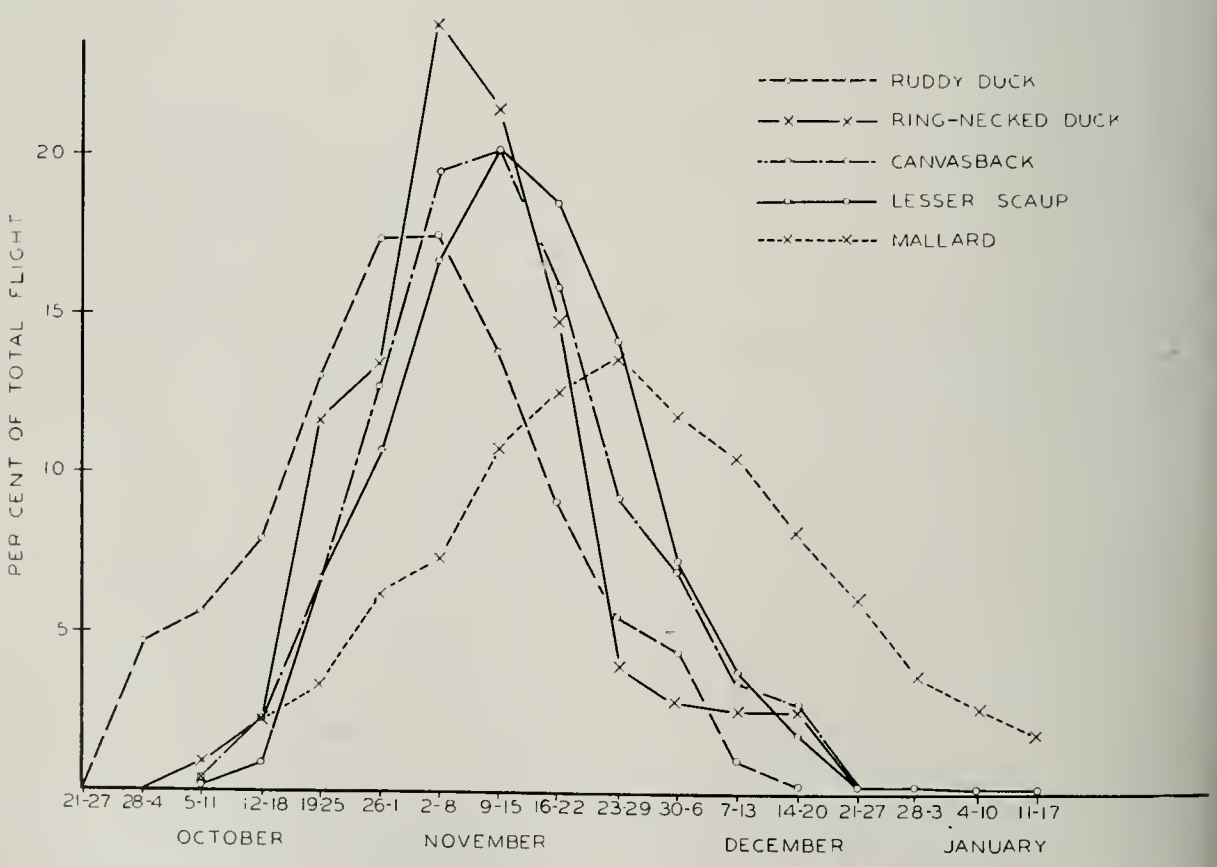

Fig. 10.—Five-year average, 1938–1942, of the seasonal migration of the ruddy duck, ring-necked duck, canvasback, lesser scaup and mallard in the Illinois River valley.

Table 3.—Per cent of entire fall flight, per cent of total bag, and mortality quotient (indicating relative mortality from hunters) for each of the important duck species or groups in the Illinois River valley, 1938.

SPECIES*	PER CENT OF FLIGHT DURING ENTIRE FALL	PER CENT OF TOTAL BAG	MORTALITY QUOTIENT
Mallard and black duck	94.61	57.07	0.60
Pintail	1.44	12.76	8.86
Green-winged teal	0.10	9.54	95.40
Blue-winged teal	0.35	3.35	9.57
Widgeon	0.30	7.27	24.23
Gadwall	0.06	2.27	37.83
Shoveler	0.02	2.43	121.50
Lesser scaup	3.01	4.48	1.49
Canvasback	0.07	0.40	5.71
Ruddy duck	0.04	0.43	10.75
	100.00	100.00	

*Certain species omitted because of lack of sufficient data.

than-usual hunting pressure. Comparative figures show that hunting pressure on the widgeon was least in 1940 and 1942, table 8; in those years the widgeon population in the Illinois River valley was relatively high, tables 3–7.

The gadwall, which appears to be similar to the widgeon in most habits, including wariness, was subject to about three times as much shooting pressure. This disparity existed because more of the gadwall flights than of the widgeon flights occurred during the hunting seasons, figs. 11–15. The seasons of 1939 and 1940, which ended before the gadwall flight had passed through the Illinois River valley, were marked by shooting pressures that were comparatively low for this species, table 8. There is no apparent reason for the comparatively low pressure in 1942.

In calculating the kill of the widgeon and the gadwall, it was necessary to begin with the total kill of the two species for 1938 through 1940 as reported by duck clubs; hunters often placed widgeons in the gadwall column. An attempt was then made to correct this error through use of data obtained from our own inspecting of hunters' bags to determine the ratio between the

Table 4.—Per cent of entire fall flight, per cent of total bag, and mortality quotient (indicating relative mortality from hunters) for each of the important duck species or groups in the Illinois River valley, 1939.

SPECIES*	PER CENT OF FLIGHT DURING ENTIRE FALL	PER CENT OF TOTAL BAG	MORTALITY QUOTIENT
Mallard and black duck	93.47	62.90	0.67
Pintail	2.19	11.54	5.27
Green-winged teal	0.28	7.23	25.83
Blue-winged teal	0.79	1.53	1.94
Widgeon	0.40	5.16	12.90
Gadwall	0.09	2.72	30.22
Shoveler	0.04	1.67	41.75
Lesser scaup	2.61	6.38	2.44
Canvasback	0.07	0.35	5.00
Ruddy duck	0.06	0.52	8.67
	100.00	100.00	

*Certain species omitted because of lack of sufficient data.

Table 5.—Per cent of entire fall flight, per cent of total bag, and mortality quotient (indicating relative mortality from hunters) for each of the important duck species or groups in the Illinois River valley, 1940.

SPECIES*	PER CENT OF FLIGHT DURING ENTIRE FALL	PER CENT OF TOTAL BAG	MORTALITY QUOTIENT
Mallard and black duck	92.76	72.66	0.78
Pintail	3.35	11.67	3.48
Green-winged teal	0.18	4.19	23.28
Blue-winged teal	0.63	1.39	2.21
Widgeon	0.56	2.14	3.82
Gadwall	0.04	1.14	28.50
Shoveler	0.04	1.09	27.25
Lesser scaup	1.97	3.36	1.71
Ring-necked duck	0.21	1.81	8.62
Canvasback	0.17	0.37	2.18
Ruddy duck	0.09	0.18	2.00
	100.00	100.00	

*Certain species omitted because of lack of sufficient data.

two species. Numerals applying to these species in 1938–1940 are based upon the ratio obtained. In 1941 and 1942 the kill record sheets were more clearly marked to differentiate the species.

Hunting seasons following 1938 placed the mallard and black duck under more shooting pressure than in that year. An early ingress of mallards and black ducks into the valley in 1939, together with a season that was set 1 week later than in 1938, placed more pressure on these species in 1939 than in the previous year, fig. 12 and table 8. The season was extended in 1940 from 45 to 60 days. It resulted in a marked increase in shooting pressure on mallards and black ducks because most of the extension was on the end of the season, when about 95 per cent of the waterfowl population in Illinois was made up of these species. There was a slight drop in shooting pressure on these species in 1941, because high water, which prevailed throughout the season, made them difficult to kill. Still more days were added to the end of the water-

Table 6.—Per cent of entire fall flight, per cent of total bag, and mortality quotient (indicating relative mortality from hunters) for each of the important duck species or groups in the Illinois River valley, 1941.

SPECIES*	PER CENT OF FLIGHT DURING ENTIRE FALL	PER CENT OF TOTAL BAG	MORTALITY QUOTIENT
Mallard and black duck	88.07	64.24	0.73
Pintail	2.48	8.67	3.49
Green-winged teal	0.12	1.64	13.67
Blue-winged teal	0.71	2.34	3.30
Widgeon	0.37	3.15	8.51
Gadwall	0.05	1.91	38.20
Shoveler	0.01	0.95	95.00
Lesser scaup	6.68	7.92	1.19
Ring-necked duck	1.00	6.68	6.68
Canvasback	0.33	1.68	5.09
Redhead	0.01	0.31	31.00
Ruddy duck	0.17	0.51	3.00
	100.00	100.00	

*Certain species omitted because of lack of sufficient data.

Table 7.—Per cent of entire fall flight, per cent of total bag, and mortality quotient (indicating relative mortality from hunters) for each of the important duck species or groups in the Illinois River valley, 1942.

SPECIES*	PER CENT OF FLIGHT DURING ENTIRE FALL	PER CENT OF TOTAL BAG	MORTALITY QUOTIENT
Mallard and black duck	84.98	75.12	0.88
Pintail	1.18	6.16	5.22
Green-winged teal	0.03	1.48	49.33
Blue-winged teal	1.22	2.54	2.08
Widgeon	0.99	1.98	2.00
Gadwall	0.04	1.20	30.00
Shoveler	0.03	0.94	31.33
Lesser scaup	10.14	5.29	0.52
Ring-necked duck	0.55	2.31	4.20
Canvasback	0.47	1.78	3.79
Redhead	0.01	0.41	41.00
Ruddy duck	0.36	0.79	2.19
	100.00	100.00	

*Certain species omitted because of lack of sufficient data.

fowl season in 1942. This extension in the season placed the mallard and black duck under greater shooting pressure in 1942 than in any other year of this study, table 8. Other species were not materially affected adversely by the lengthened seasons, according to the comparative data in table 8. Whereas this table discloses an almost uninterrupted rise in the shooting pressure on mallards and black ducks during the 5 years of this study, it indicates that no such trend has occurred in other species.

As a group, diving ducks were under more shooting pressure in recent open seasons than were dabbling ducks, table 8. Figs. 10–15 disclose that most of the diving ducks arrived after October 16, and that most of them departed southward by December 16; thus, most of the migration occurred during the hunting season.

There is comparatively little difference in the shooting pressure on most species of diving ducks; as fig. 10 shows, the species migrate at almost the same time. Shooting pressure was unusually high on the ruddy duck in 1938 and 1939 when the population was relatively low.

Shooting pressure on most of the duck species varied from year to year during

Table 8.—Shooting pressure quotient for important Illinois River valley ducks, 1938–1942; derived by comparing vulnerability quotient of species (5-year average) with mortality quotient for 5 separate years.

SPECIES*	1938	1939	1940	1941	1942
Mallard and black duck	0.82	0.92	1.07	1.00	1.20
Pintail	1.07	0.63	0.42	0.42	0.63
Green-winged teal	1.33	0.36	0.32	0.19	0.69
Blue-winged teal	0.13	0.03	0.03	0.05	0.03
Widgeon	1.93	1.03	0.30	0.68	0.16
Gadwall	3.01	2.40	2.27	2.90	2.38
Shoveler	0.92	0.32	0.21	0.72	0.24
Lesser scaup	1.38	2.26	1.57	1.10	0.48
Ring-necked duck	....	....	1.57	1.21	0.76
Canvasback	1.65	1.44	0.63	1.47	1.09
Ruddy duck	3.07	2.48	0.57	0.86	0.63

*Figures for ring-necked duck omitted, 1938 and 1939, and figures for redhead omitted, 1938–1942, because of insignificant population and kill data. Figures for widgeon and gadwall for 1938–1940, calculated as explained in text.

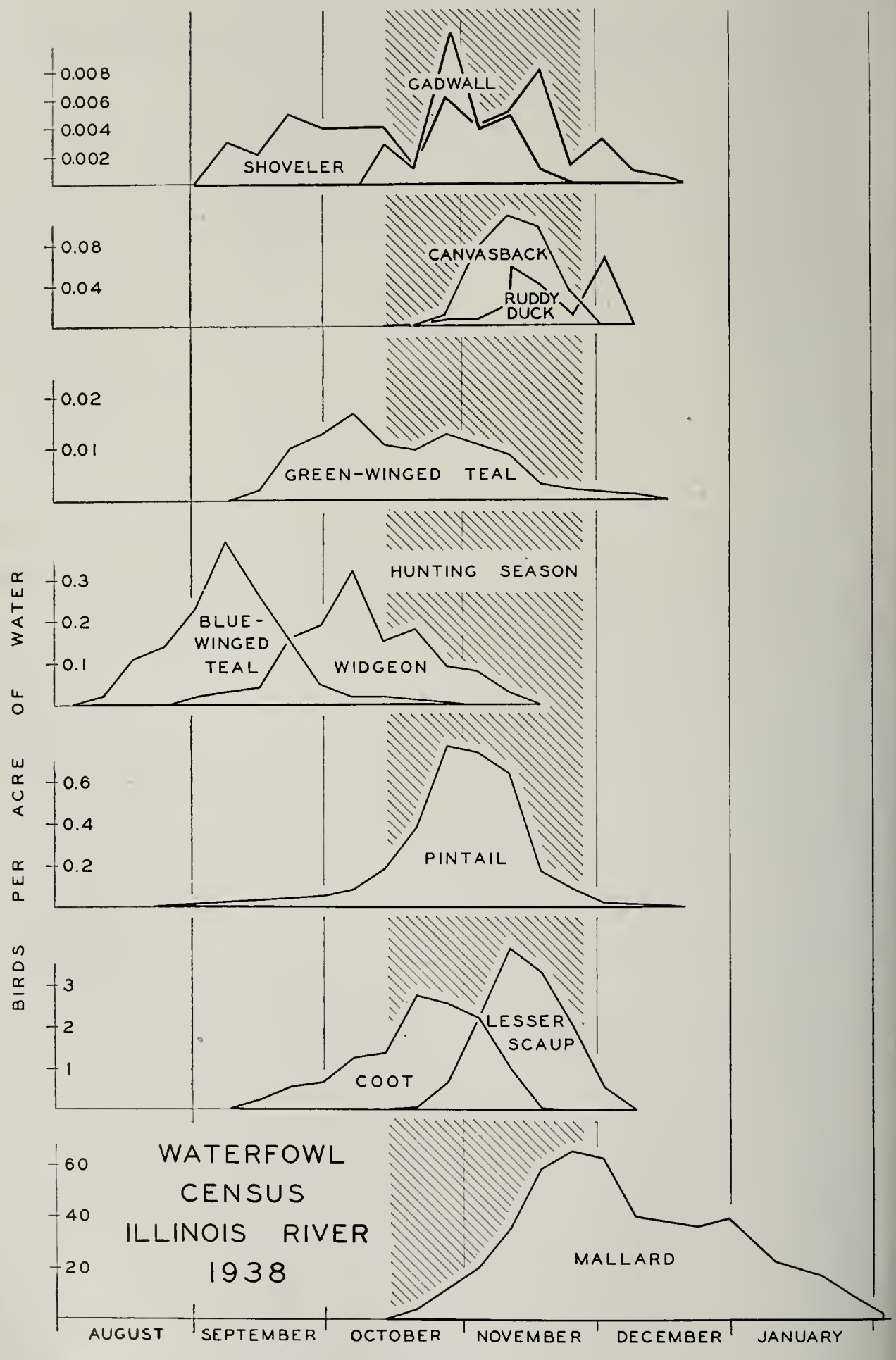

Fig. 11.—Polygons, based upon number of birds per acre of water surface in the Illinois River valley in 1938, showing the chronology of flight of 11 species of waterfowl in relation to the hunting season.

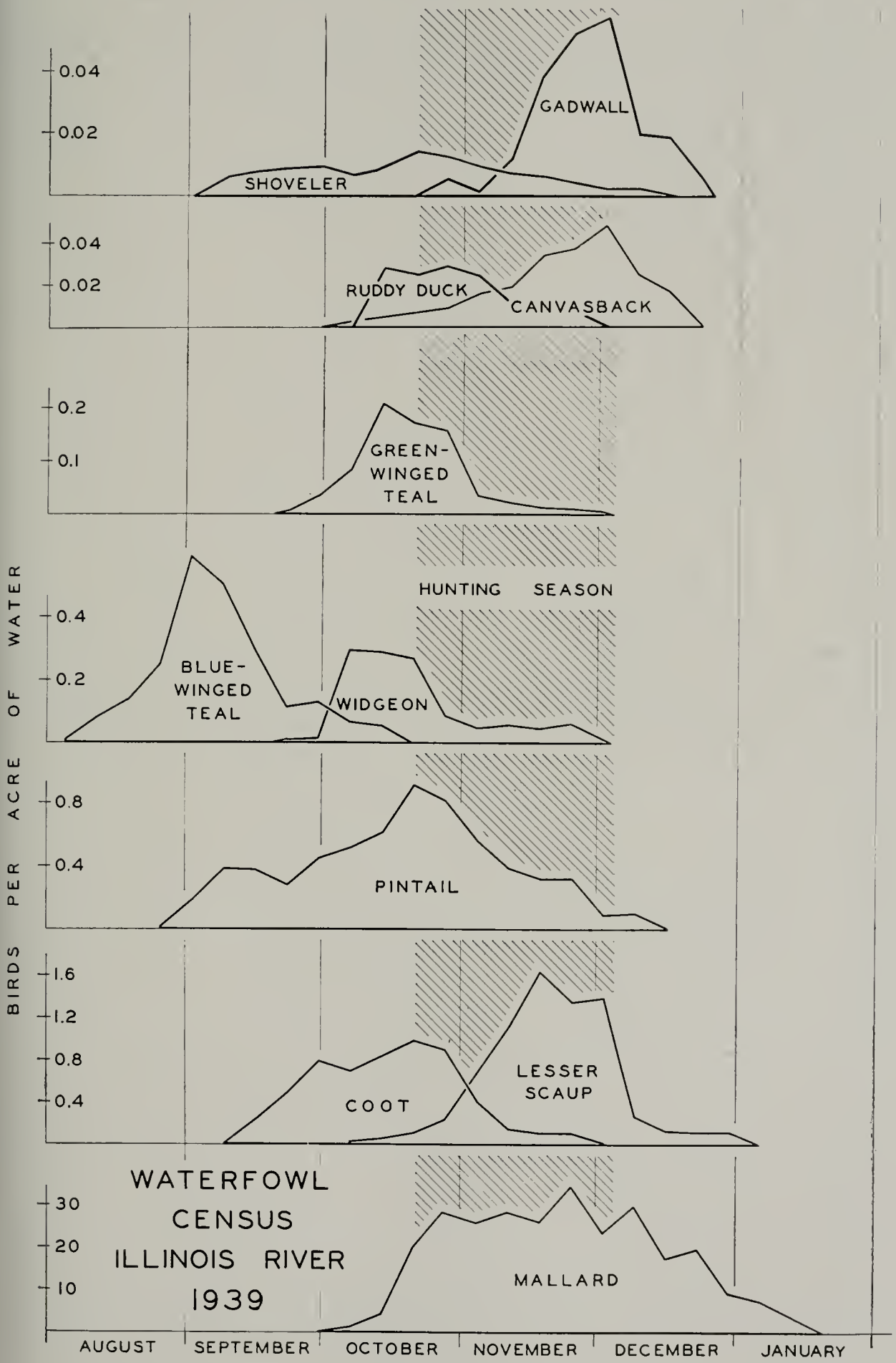

Fig. 12.—Polygons, based upon number of birds per acre of water surface in the Illinois River valley in 1939, showing the chronology of flight of 11 species of waterfowl in relation to the hunting season.

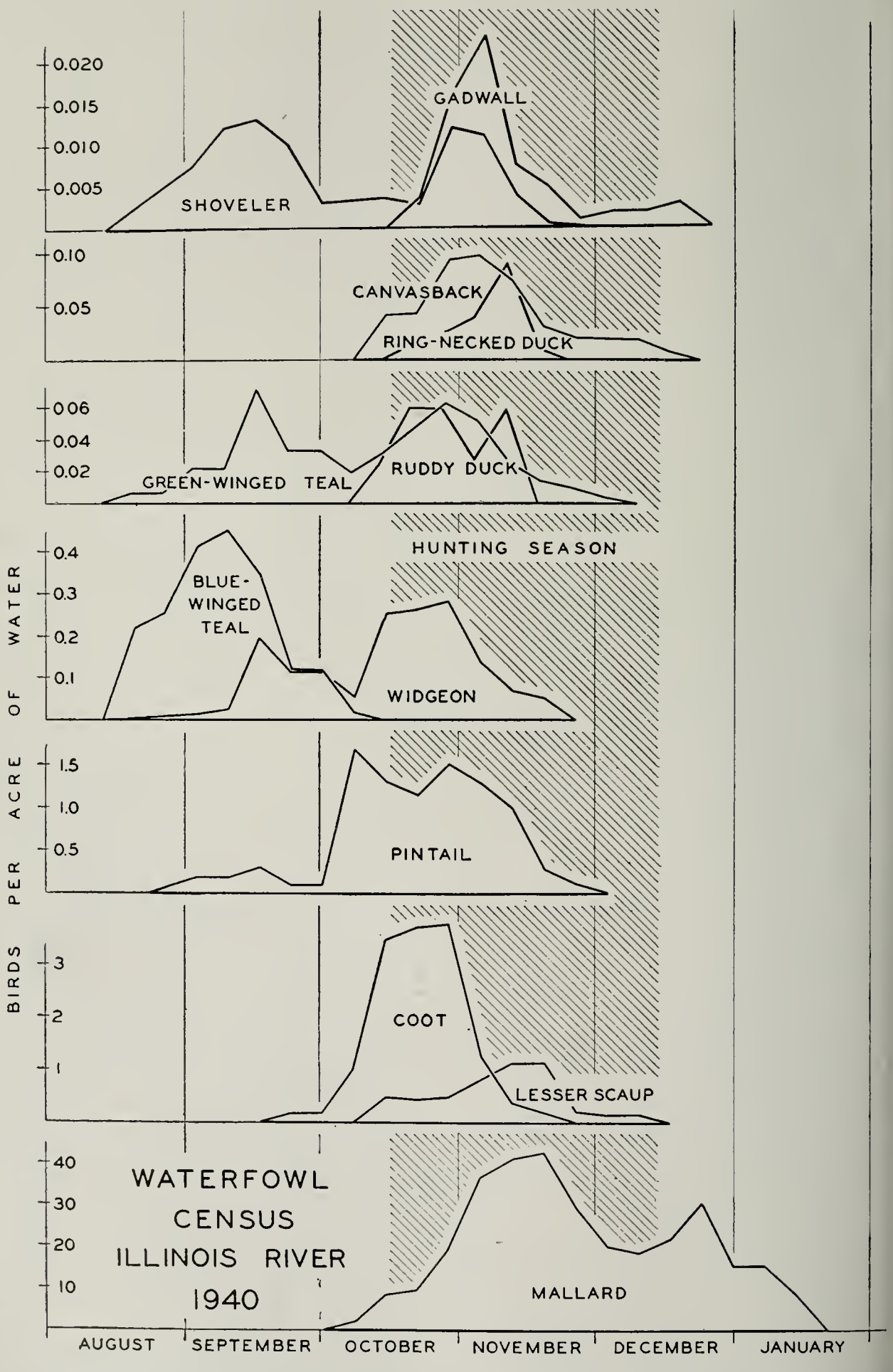

Fig. 13.—Polygons, based upon number of birds per acre of water surface in the Illinois River valley in 1940, showing the chronology of flight of 12 species of waterfowl in relation to the hunting season.

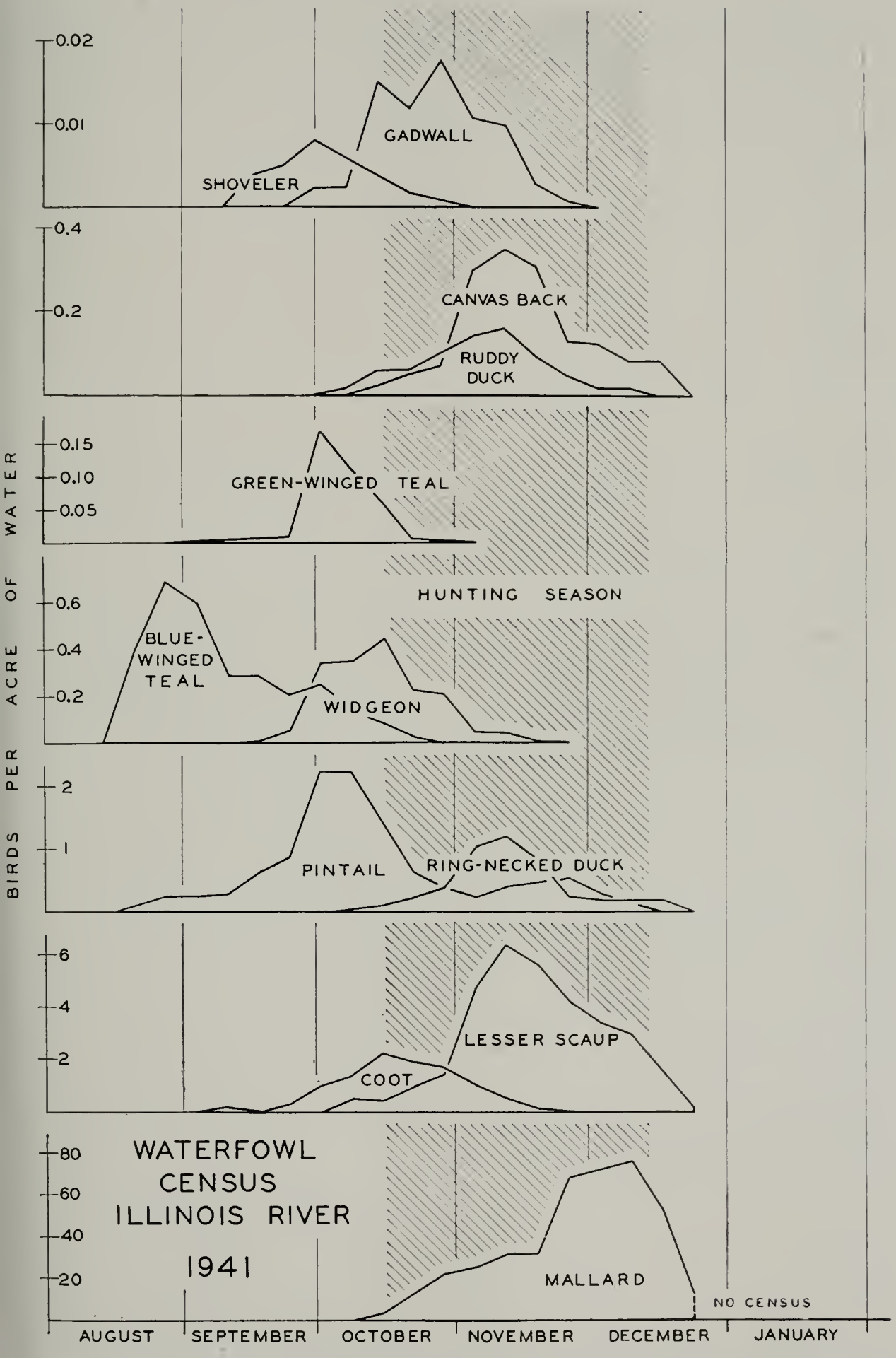

Fig. 14.—Polygons, based upon number of birds per acre of water surface in the Illinois River valley in 1941, showing the chronology of flight of 12 species of waterfowl in relation to the hunting season.

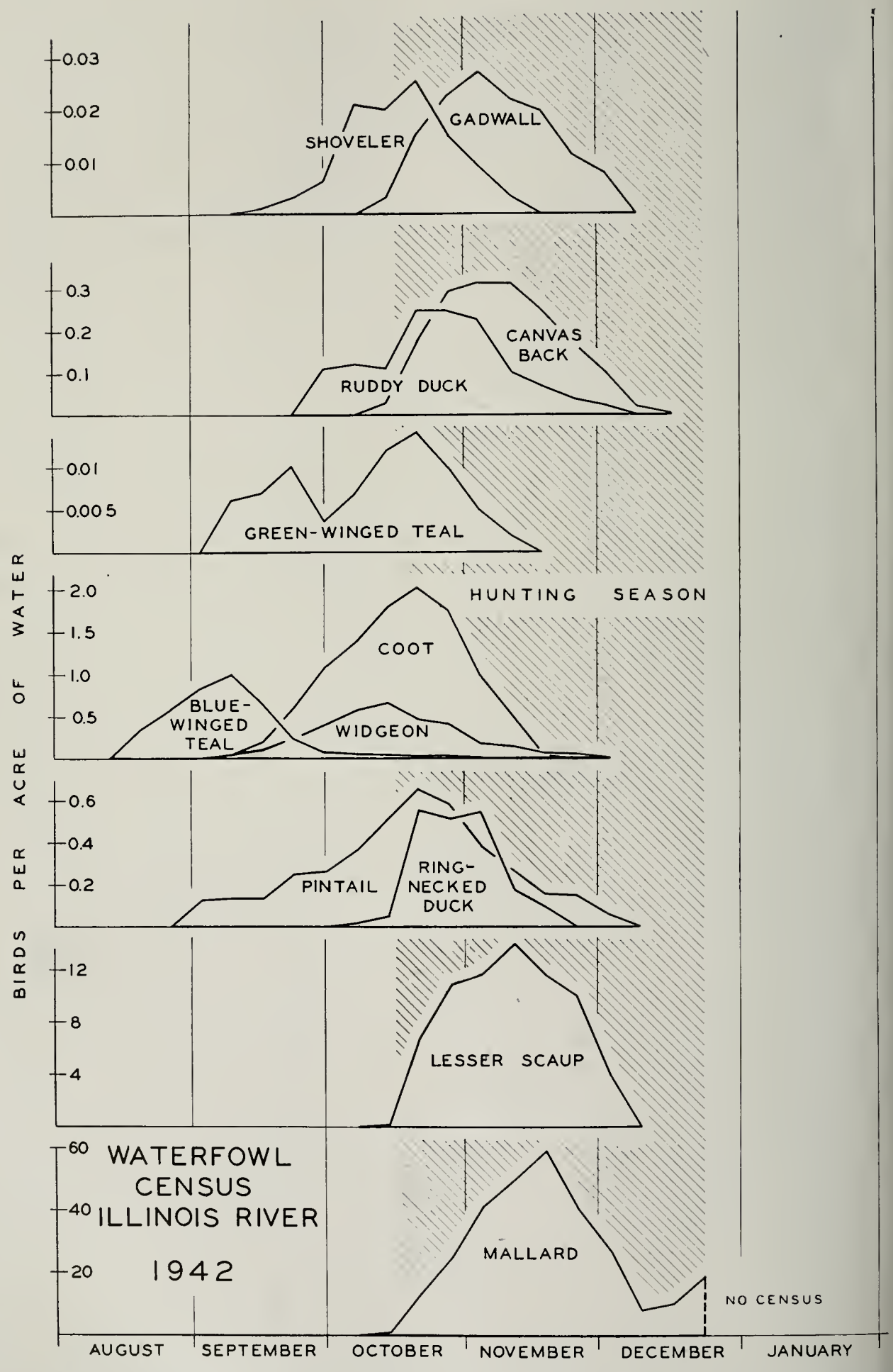

Fig. 15.—Polygons, based upon number of birds per acre of water surface in the Illinois River valley in 1942, showing the chronology of flight of 12 species of waterfowl in relation to the hunting season.

Table 9.—Average daily kill per shooter, Duck Island Preserve, 1914–1936.*

WEEK	MALLARD	PINTAIL	BLUE-WINGED TEAL	GREEN-WINGED TEAL	ALL OTHER DUCKS†	TOTAL
Sept. 13–19	0.8	1.3	6.8	...	0.3	9.2
Sept. 20–26	1.6	2.2	6.7	0.3	1.0	11.8
Sept. 27–Oct. 3	2.4	3.0	3.6	0.1	1.3	10.4
Oct. 4–10	2.9	3.8	3.2	0.2	1.6	11.7
Oct. 11–17	7.2	2.4	1.9	0.5	0.7	12.7
Oct. 18–24	8.5	2.1	0.6	0.3	1.0	12.5
Oct. 25–31	10.9	0.8	0.2	0.4	0.7	13.0
Nov. 1–7	11.4	0.5	0.1	0.4	0.5	12.9
Nov. 8–14	11.7	0.4	0.1	0.2	0.4	12.8
Nov. 15–21	11.4	0.3	...	0.3	0.4	12.4
Nov. 22–28	10.8	0.2	...	0.4	0.3	11.7
Nov. 29–Dec. 5	10.2	...	...	0.2	0.3	10.7
Dec. 6–12	6.6	0.2	...	1.4‡	0.7	8.9
Dec. 13–19	7.1	...	...	...	0.7	7.8

*Data assembled by Dr. R. E. Yeatter and Dr. D. H. Thompson of the Illinois Natural History Survey.
†Designated in the record book as canvasback, redhead, gadwall, golden-eye, blackjack, bluebill, spoonbill, widgeon, butterball and black mallard.
‡This figure is unusually high because of 157 green-winged teals killed December 8–9, 1920.

the period of this study due to differences in the chronology of flight, but the low pressure on lesser scaups in 1942 appears attributable to the fact that the enormous numbers present in that year materially lowered the percentage killed, tables 7 and 8.

In the years of this study, coots, or mud hens, were subject to little shooting in the Illinois River valley because most club hunters there showed little interest in pursuing them. Mississippi River shooters killed coots in somewhat greater numbers per hunter-day. In the Chain-o'-Lakes region of northeastern Illinois, coots were considered a sporting bird, worthy of real hunting effort. On Grass Lake, opening day, 1942, hunters killed at least 24,000 coots (Bellrose 1944). Evidently, most waterfowl hunters in that region were interested mainly in coots, for, as the coot bag declined, fewer persons hunted, despite an increase in the daily individual duck bag.

About 40 per cent of the coot flight, fig. 9, had arrived in the Illinois River valley by the middle of October, the opening date for most recent waterfowl seasons. If the opening date were earlier, undoubtedly many more coots would be killed by Illinois hunters.

Influence of Population Density.—The popular assumption that the waterfowl kill is directly proportional to the population is not substantiated by data gathered during this study. Both per-hunter and total daily kills were highest during the early part of recent seasons, figs. 5–7, before flights had reached their peaks.

Records of the Duck Island Preserve, near Banner, Illinois, from 1914 through 1936, table 9, show that the average daily kill per member at this hunting club varied but little from September 20 through December 5.* The daily kill before and after those dates was somewhat lower. Table 9 shows that blue-winged teals and pintails made up the bulk of the early season bag, with mallards not forming an appreciable part of the daily kill until the week of October 11–17. As shown by figs. 3–7, ducks do not arrive in large numbers in the Illinois River valley until the middle of October. The fact that the waterfowl population was many times greater from October 15 through December 5 than up to that time does not appear to have added much to the daily kill of the hunter.

The comparatively high kill per hunter-day early in the season might indicate (1) that more hunters hunt during the latter part of the season than the

*Records on which table 9 and fig. 17 are based were made available through courtesy of Ferd Luthy, Secretary-Treasurer, Duck Island Preserve; figures summarized by Dr. R. E. Yeatter and Dr. D. H. Thompson of the Illinois Natural History Survey.

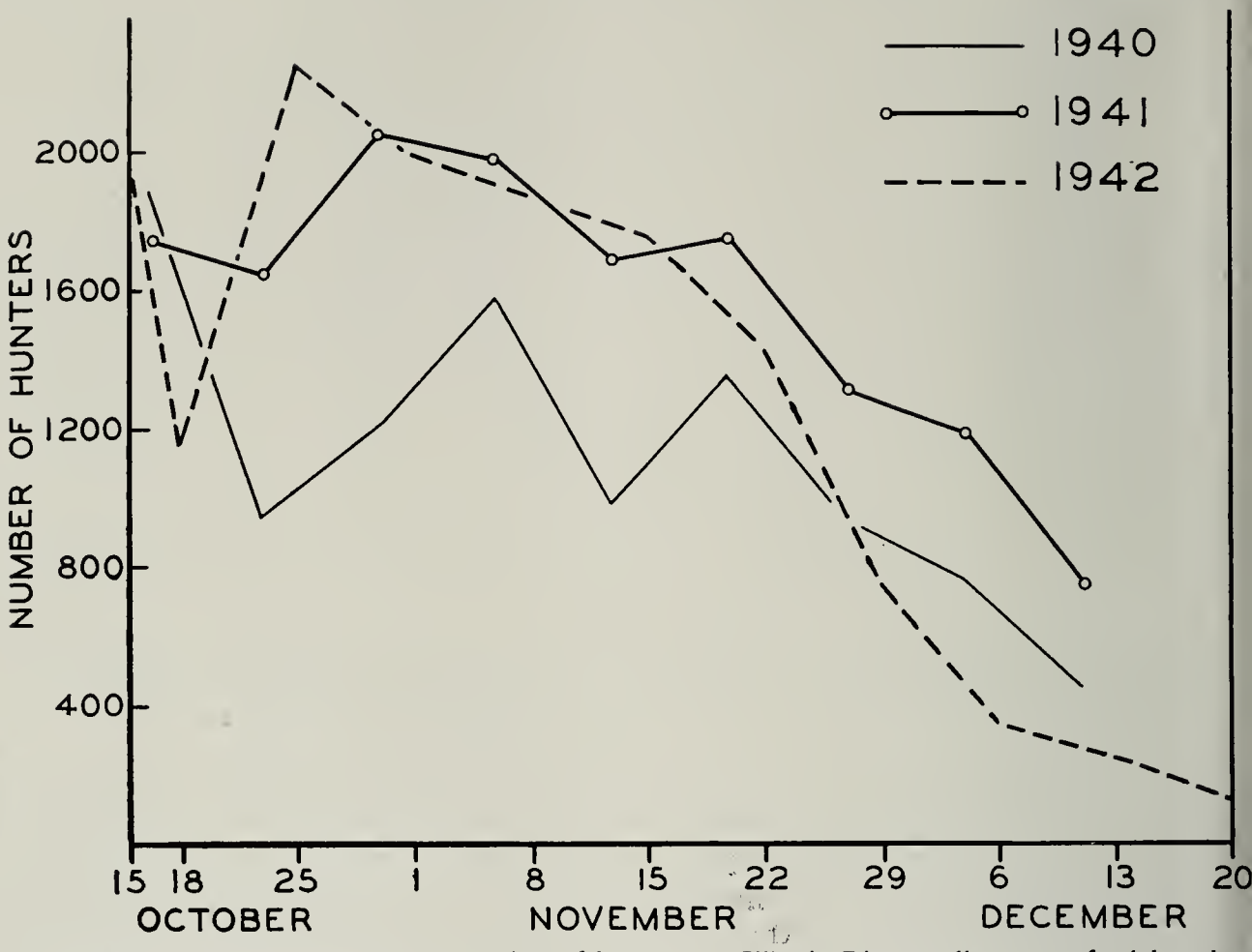

Fig. 16.—Seasonal trend in activity of hunters at Illinois River valley waterfowl hunting clubs, 1940–1942.

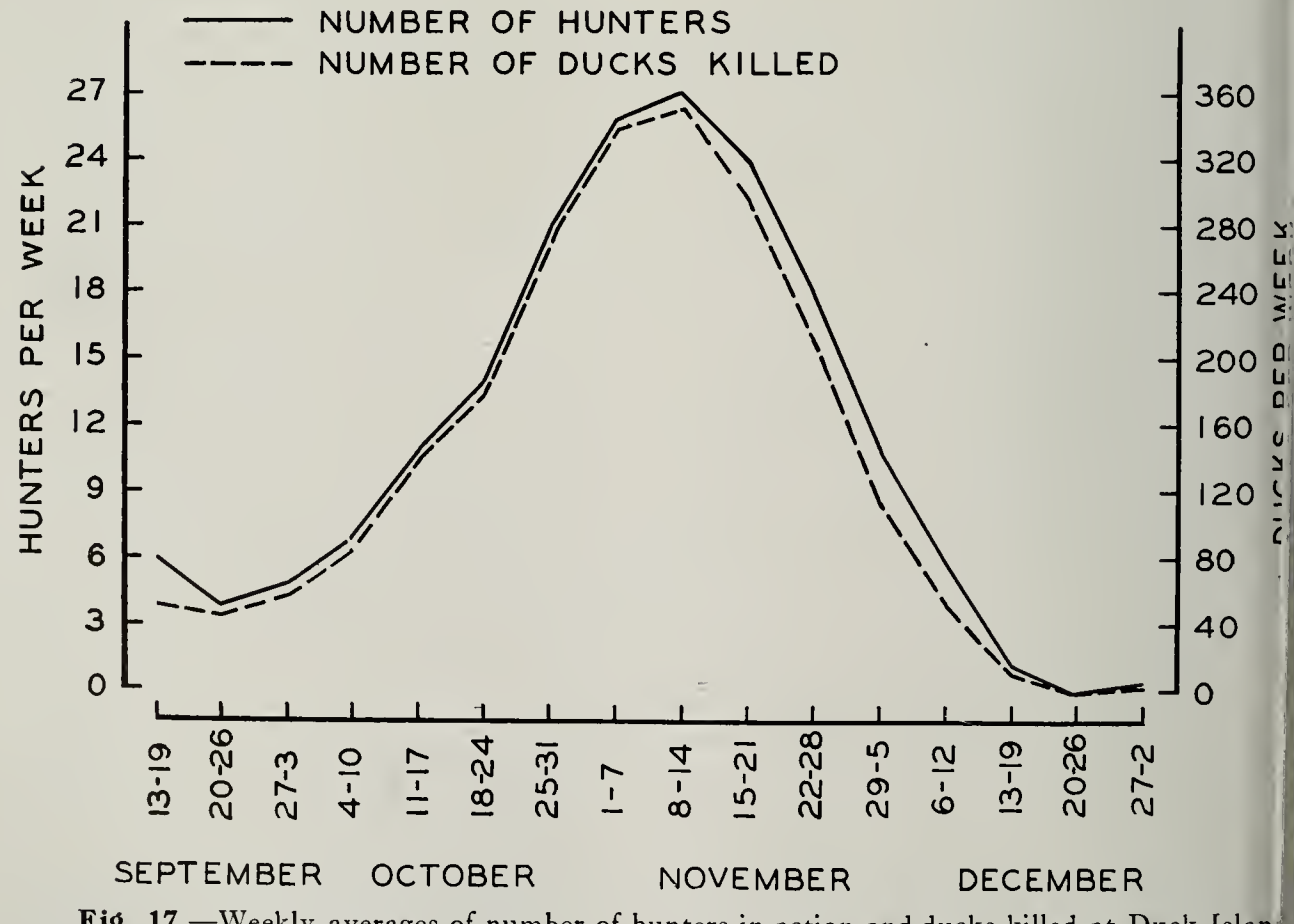

Fig. 17.—Weekly averages of number of hunters in action and ducks killed at Duck Island Preserve over a 23-year period, 1914–1936.

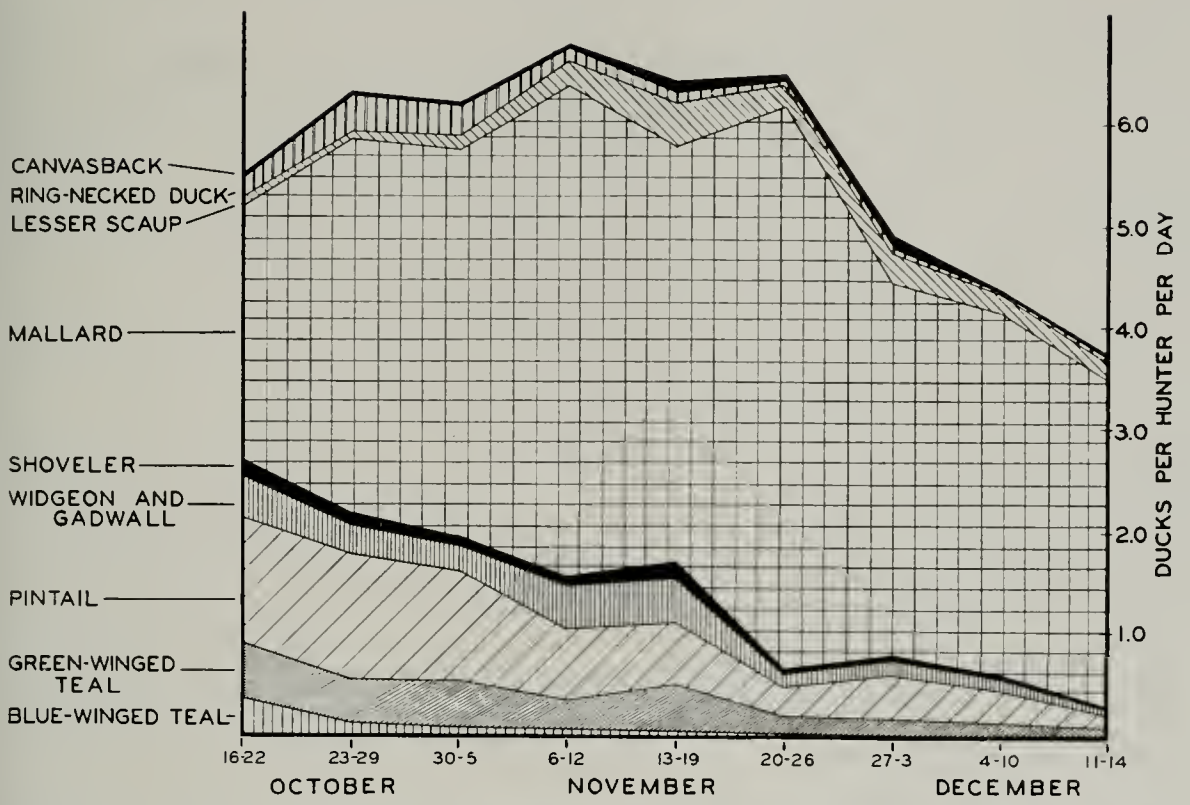

Fig. 18.—Seasonal composition of the duck bag made by Illinois River valley club hunters in 1940.

early part, and so increase the competition for ducks as the season progresses, or (2) that the composition of the flight is such that a large bag is more easily made early in the season than later.

As fig. 16 shows, from 1940 through 1942 more hunters were in action at Illinois River valley duck clubs during the first 2 weeks than during the last 2 weeks of the season, and there was a general decline in number of hunters as the season progressed.

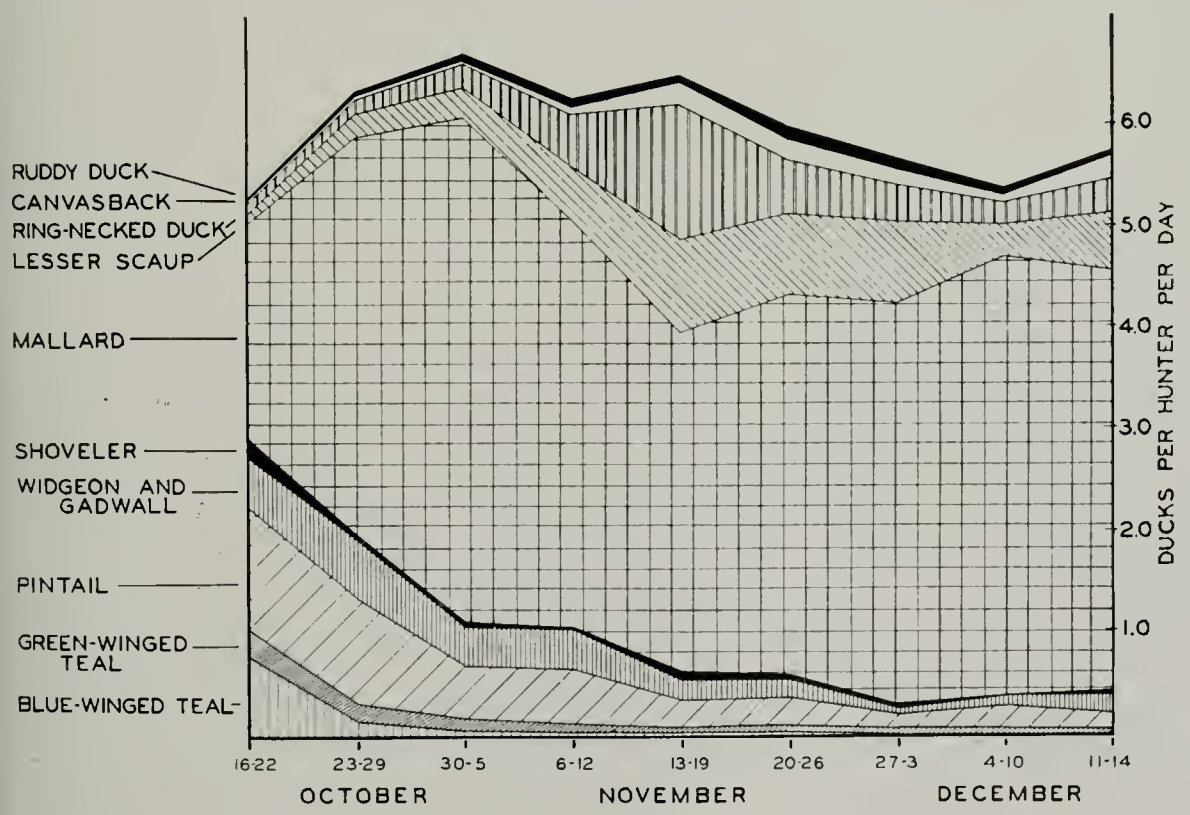

Fig. 19.—Seasonal composition of the duck bag made by Illinois River valley club hunters in 1941.

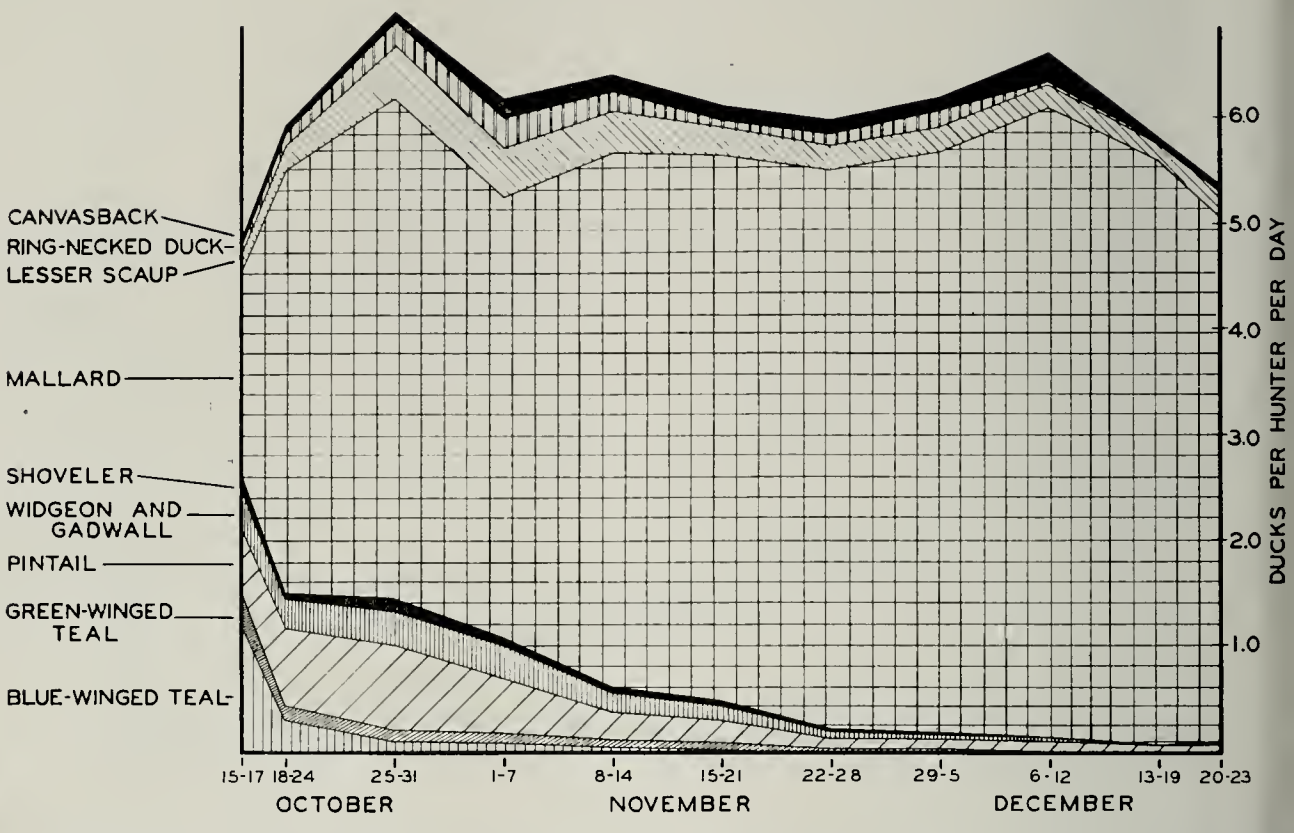

Fig. 20.—Seasonal composition of the duck bag made by Illinois River valley club hunters in 1942.

Fig. 17 shows the seasonal trend in the number of hunters shooting and the number of ducks killed per week over a 23-year period at the Duck Island Preserve. This duck club is not typical of many Illinois River valley clubs in that most of its members reside within 30 miles of the club and are able to respond readily to hunting conditions, as shown by the close correlation between number of hunters in action and number of ducks killed. But even at this club, over a 23-year period, the number of hunters in action early in the season was larger than the number late in the season.

From previous discussion, we know that mallards and black ducks as a group are the most difficult species to bag in Illinois. Figs. 11–15 show that as the season progressed, 1938–1942, these species comprised relatively more of the population. Figs. 18–20 show that as the season progressed, 1940–1942, there was a steady decline in the kill per hunter-day of blue-winged and green-winged teals, pintails, widgeons and shovelers, while there was at least a comparative increase in the number of mallards and black ducks taken per hunter-day. It is evident that the composition of the flight makes for a comparatively high bag early in the season.

Studies made by the Illinois Natural History Survey demonstrate that juvenile ducks are about twice as easy to kill as adults and that, generally, juveniles of a species predominate among the early arrivals of that species. These findings account in part for a greater kill being made in proportion to the population of some species in the early part of the hunting season than later.

Optimum Shooting Dates

A waterfowl hunting season commencing, as it did in the past 6 years, no earlier than October 15 and running into late November or December was probably optimum for these years in Illinois in that it afforded good duck hunting and placed most of the shooting pressure on species best able to take it. From evidence previously presented, it is obvious that, with a season set at such a late date, shooting pressure falls to a greater extent on mallards, black ducks and diving ducks than on the more vulnerable teals, shovelers, pintails and widgeons.

Some hunters believe that the season might well be set earlier. As fig. 16 shows, most Illinois duck hunters prefer to do the greater part of their hunting early in the season, when waterfowl are rather evenly distributed and temperatures are comfortable. While an earlier season of 60 days or more would include a smaller proportion of the waterfowl flight, records of the Duck Island Preserve, table 9 and fig. 17, and figs. 5, 6 and 7 indicate that it would increase the kill of ducks in Illinois. The greater vulnerability of the species and individuals present early in the season more than compensates for the reduced population in Illinois at that time.

Setting the season earlier would enable waterfowl hunters to bag more coots. It is generally agreed among wildlife technicians that a greater kill of coots could and probably should be made, and, since almost half of the coot population of the Illinois River valley is present by the middle of October, an earlier opening would result in a greater kill of that bird.

Although an earlier season might provide a more equitable distribution of the take and more comfortable hunting, it must be realized that in Illinois such a season would tend to increase the pressure on species that are least able to withstand it.

The closing date for the waterfowl hunting season in Illinois should probably be December 10 or earlier. According to records of the Peoria weather station, the average date of closing of the Illinois River by ice (1867–1930) is December 10. In most states of the central zone the mean daily temperature falls below 32 degrees by December 15, fig. 2. While, as fig. 10 discloses, a large percentage of the mallard and black duck populations remain after the freeze-up in the Illinois River valley, winter conditions then usually do not favor duck hunting. The remaining mallards and black ducks concentrate on only a few lakes and, partly because of such local concentrations, only a small percentage of hunters continue hunting, fig. 16. Under such rigorous weather and feeding conditions as occur after the freeze-up, few ducks may be killed, or, occasionally, excessively many. Because most duck hunting ends with the winter freeze-up, there is little reason to extend the season in Illinois beyond December 10 or 15. The same closing dates may be applicable to other states in the central zone.

If, in the future, it is necessary once again to shrink the open season to 30 days, I believe that for Illinois the season should be set from November 1 through 30. This would place most of the shooting pressure on mallards and black ducks, species that are, as already discussed, best able to take it. If conditions were critical enough to warrant a 30-day season, they would almost certainly justify giving greater protection to some species than to others. The ducks in need of greatest protection would probably be the blue- and green-winged teals, shoveler, widgeon and ruddy duck, species that complete a large part of their fall migration through Illinois by November 1.

If the status of waterfowl is such that a 45-day season is desirable, I believe the optimum period for Illinois is from October 22 through December 5. This would place flights of mallards, black ducks, lesser scaups, ring-necked ducks and canvasbacks under shotgun pressure longer than other species less able to withstand this pressure, and it would cover the period in which ducks are most abundant in Illinois.

Should an abundance of waterfowl permit a 60-day shooting season, and most species are sufficiently numerous to be secure, the optimum season for Illinois would be from October 10 through December 8.

Should the continent's waterfowl population justify a 70-day season, then I believe the season, insofar as Illinois is concerned, might best be set at October 1 through December 9.

Recommended dates for an 80-day season are September 26 through December 14; recommended dates for a 100-day season are September 20 through December 28.

Optimum Season Lengths

Does the duck kill increase in direct ratio to the length of the hunting season? Waterfowl investigators have done little

to evaluate the influence on the kill of seasons of various lengths.

Fig. 21 shows the influence of open seasons of various lengths on the total yearly kill of three Illinois River valley clubs. While various shooting hours

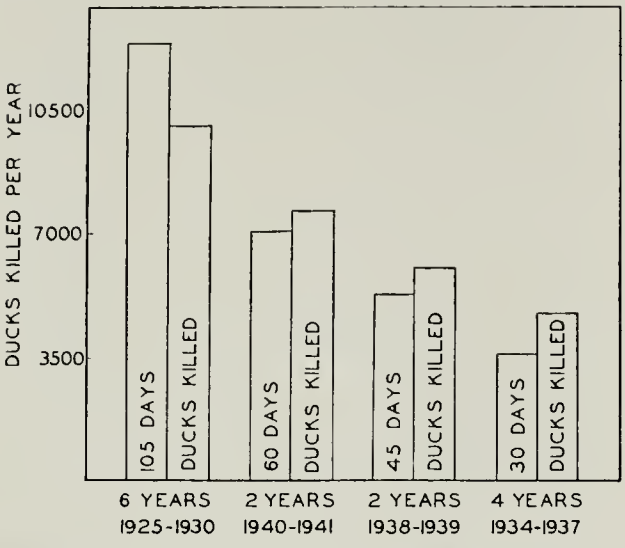

Fig. 21.—Influence of open seasons of various lengths on the total yearly kill of ducks at three Illinois River valley clubs where, even when baiting was legal, little bait was used.

were in effect during the years represented, evidence presented later indicates that these hours had little influence on the kill. Baiting and use of live decoys were permitted during some of the years, but the three clubs studied did little and sometimes no baiting. As the seasons decreased in length there was an increase in the duck kill per day. For example, with seasons of 105 days, the average total kill of the three clubs was 94 ducks per day. With 30-day seasons, it was 151 ducks per day.

Many of the seasons of 105 to 107 days provided proportionally fewer good hunting days than some of the shorter seasons because of the freeze-up and the exodus of most waterfowl long before the closing date. As shown in fig. 16, the greatest hunting intensity occurs during the first half of the season.

Probably a larger daily kill is made in short seasons than in long seasons in most states of the central and northern zones. In the southern zone, it is quite possible that longer seasons may result in average daily kills as large as in short seasons and in total waterfowl kills proportional to the length of the seasons, for the composition and the density of the population are more nearly uniform in that zone during the hunting season than in the other zones. Despite the fact that the duck kill in Illinois is not in direct ratio to the length of the season, altering the length of the season is obviously one of the most expedient ways to regulate the duck kill. It must be remembered, however, that the kill during a 30-day season is apt to be considerably more than half the kill made during a 60-day season.

Optimum Shooting Hours

The daily shooting hours are of great concern to Illinois waterfowlers. This is due to the fact that mallards and black ducks, which over the season as a whole in recent years comprised about 85 per cent of the duck population, have two principal feeding periods during the day. One is early in the morning; the other late in the afternoon. During these periods most of the mallards leave the large rest lakes, flying to cornfields a few hundred yards to 40 miles distant. Some hunters, especially those in the public shooting group, believe they have greatly increased chances of killing ducks in the cornfields. Usually, only on the morning and evening flights or on cold, windy days is cornfield shooting profitable.

Do earlier and later shooting hours appreciably increase the total kill? What has been the effect of altered shooting hours upon the behavior of ducks?

When the 7 A.M. to 4 P.M., Central Standard Time, shooting regulations were in operation, hunters claimed facetiously that mallards carried watches, for in the morning slightly before 7 the birds would leave the cornfields and return to the lakes. The ducks had flown to the fields slightly before or at daybreak. In the afternoon, they would, as a rule, leave the lakes at 4 o'clock to feed in the cornfields until dusk. As the fields became enshrouded in darkness, seemingly endless streams of mallards could be seen winging their way back to the valley rest lakes.

With the return of sunrise shooting in

940, it was not long until the mallards were flying to the cornfields before daybreak and leaving 15 to 30 minutes later for the rest lakes. Where formerly massed thousands of ducks could be seen streaming back to the lakes in the bright light after sunrise, now entire cornfields appeared to rise into the air as tens of thousands of ducks left with the first streaks of dawn.

In 1942, waterfowl shooting hours were extended from 4 P.M. until sunset. The result was that mallards, after the first few days, would not alight or attempt to alight in cornfields until sunset or shortly thereafter. Consequently, their feeding activities occurred later than under the 4 P.M. closing hour. During cold, blustery weather, when the thermometer was below freezing, mallards forsook their morning and evening routine, feeding throughout the day in fields close to their rest lakes.

In 1943, shooting hours were further extended, the legal starting time being placed at one-half hour before sunrise. This change served no useful purpose to most hunters in Illinois; in fact, it was detrimental to duck hunting in many places. Disturbances caused by hunters in going to their shooting stands at an hour when the ducks were commencing to feed resulted in considerable avoidance of those areas by mallards.

Field observations in 1943 revealed that, because of hunting disturbance during the early morning hours, mallards fed very little in cornfields close to the Illinois and Mississippi rivers until after the end of the open season. The bulk of the population obtained food in the mechanically picked cornfields 20 to 40 miles from the rest lakes. In this vast territory, mallards were able to find fields where there was little hunting disturbance.

Because of the distance they traveled for food, mallards frequently returned from the morning feeding to their rest lakes as late as 10 A.M., Central War Time. The time of return probably depended upon the availability of the

Photo by Bob Becker

Duck club caretaker (left) and Illinois Natural History Survey game technician checking the composition of duck bags at a shooting club in the Illinois River valley.

waste corn. In returning to the lakes, they flew high, out of shotgun range, until over the safety of the open waters.

The evening flight to cornfields commenced at about 5 P.M., C.W.T., almost daily in the 1943 hunting season, and, even though this was before the legal closing time, hunters seldom had targets because the mallards, after leaving open waters, usually flew out of shotgun range. The ducks that arrived at the cornfields before sunset circled over them before alighting until darkness commenced to shroud the fields.

Because of these changes in feeding habits to compensate for changes in shooting hours, the extension of shooting hours apparently did not result in a larger kill of mallards and black ducks in Illinois. Probably the reverse was true, for mallards, in avoiding cornfields near the river (evidently the result of pre-dawn flushing), had more extensive feeding places, and hence were exposed to less intensive shooting pressure.

Mallards and black ducks altered their morning and evening feeding routines even in the baiting days. In an official report, Uhler (1933) states: "By the middle of the hunting season, the ducks became so wary that the major portion of them remained in these rest areas all day, and about 20 minutes after sunset (the close of the legal shooting period) they would start to fly to the surrounding baited pens. Just before dark, literally thousands of mallards could be seen milling over the heavily baited spots, alighting only long enough to fill up on corn and then go back to the rest lakes. On moonlight nights they fed actively all night long. As a result many of the sand hill shooting places fed large quantities of corn but were never able to get much shooting."

A valid objection to permitting waterfowl shooting until sunset is that many shooters—particularly those in the cornfields—defy the law and shoot after sunset, when detection and apprehension are difficult. Hunters are more apt to disregard the sunset closing hour than the 4 P.M., C.S.T., closing hour because of the shorter time from sunset until darkness. Observations in the Sangamon bottoms and Thompson Lake drainage district indicate that shooting after dark in 1942 soon resulted in mallards being "burned out" of certain sections of those areas. Shooting in darkness more than any other disturbance makes ducks avoid or leave areas. Thus, late or pre-dawn shooting not only disturbs the ducks but reacts against the hunters.

At the conclusion of the 1942 waterfowl season, the Illinois Natural History Survey canvassed the opinion of Illinois duck hunters relative to shooting hours. The returns received show the following: Seventy hunters preferred the 1942 regulations, permitting waterfowl hunting from sunrise to sunset. Fifty-two hunters voted for the cessation of hunting at 4 P.M., C.S.T. Twenty-two of these wanted the opening hour kept at sunrise. Thirty hunters voted that waterfowl hunting be permitted only from 7 A.M. to 4 P.M., C.S.T. No canvass of opinion was made following the 1943 hunting season, but the general

Table 10.—Influence of shooting hours on duck kill as derived by comparing the kill during hunting season with the duck population, Illinois River valley, 1938–1942.

Year	Number of Ducks per Acre During Season*	Number of Ducks Estimated Killed	Per Cent of 5-Year Population	Per Cent of 5-Year Kill	Shooting Pressure Index†	Shooting Hours‡
1938	207.39	103,877	15.0	16.3	1.09	7 A.M.–4 P.M.
1939	199.05	100,210	14.4	15.8	1.10	7 A.M.–4 P.M.
1940	216.60	110,000	15.7	17.3	1.10	Sunrise–4 P.M.
1941	390.21	159,400	28.3	25.0	0.88	Sunrise–4 P.M.
1942	367.18	162,500	26.6	25.6	0.96	Sunrise-Sunset

*Sum of weekly averages for season.
†Ratio of per cent of kill to per cent of population.
‡Hours are for Central Standard Time.

expression was that the half hour before sunrise shooting was very detrimental to hunting.

Some hunters who expressed a preference for shooting hours of sunrise to sunset explained that waterfowl occurred on their property only at sunrise and sunset. The principal reason advanced by hunters for ending shooting daily at 4 P.M., C.S.T., was that it kept waterfowl from being "burned out" of a region.

Have longer shooting hours resulted in a greater kill of waterfowl? Shooting hour regulations are difficult to evaluate because of the influence of such other variables as length of season, population, weather and food conditions. Length of seasons has changed with shooting hours; so in order to reduce the influence of varying lengths of seasons, as well as variations in the duck flight, the percentage of the 5-year duck population present during the open season of each year has been compared with the percentage of the 5-year kill, table 10, to give an index of the shooting pressure resulting from various shooting hours. The highest index numbers indicate the greatest shooting pressure and kill.

Because of better hunting conditions in certain years than in others the data are inconsistent, but they show no evidence that larger kills were made in seasons of sunrise or sunset shooting than in seasons of shorter shooting days. The index figure for 1940, when sunrise shooting was permitted, was the same as for 1939, with 7 A.M. shooting, table 10. In 1941 and 1942, with sunrise shooting, the shooting pressure, a measure of the comparative kill, was actually less than that with 7 A.M., C.S.T., shooting in 1938 and 1939.

Effect of Bag Limit

In recent years, several biologists have questioned the value of bag limit as an effective measure in restricting the total game kill.

Fig. 22, based on data assembled by Dr. Yeatter and Dr. Thompson, shows for most years from 1885 through 1938 the average daily bag of Duck Island Preserve members and the observed bag

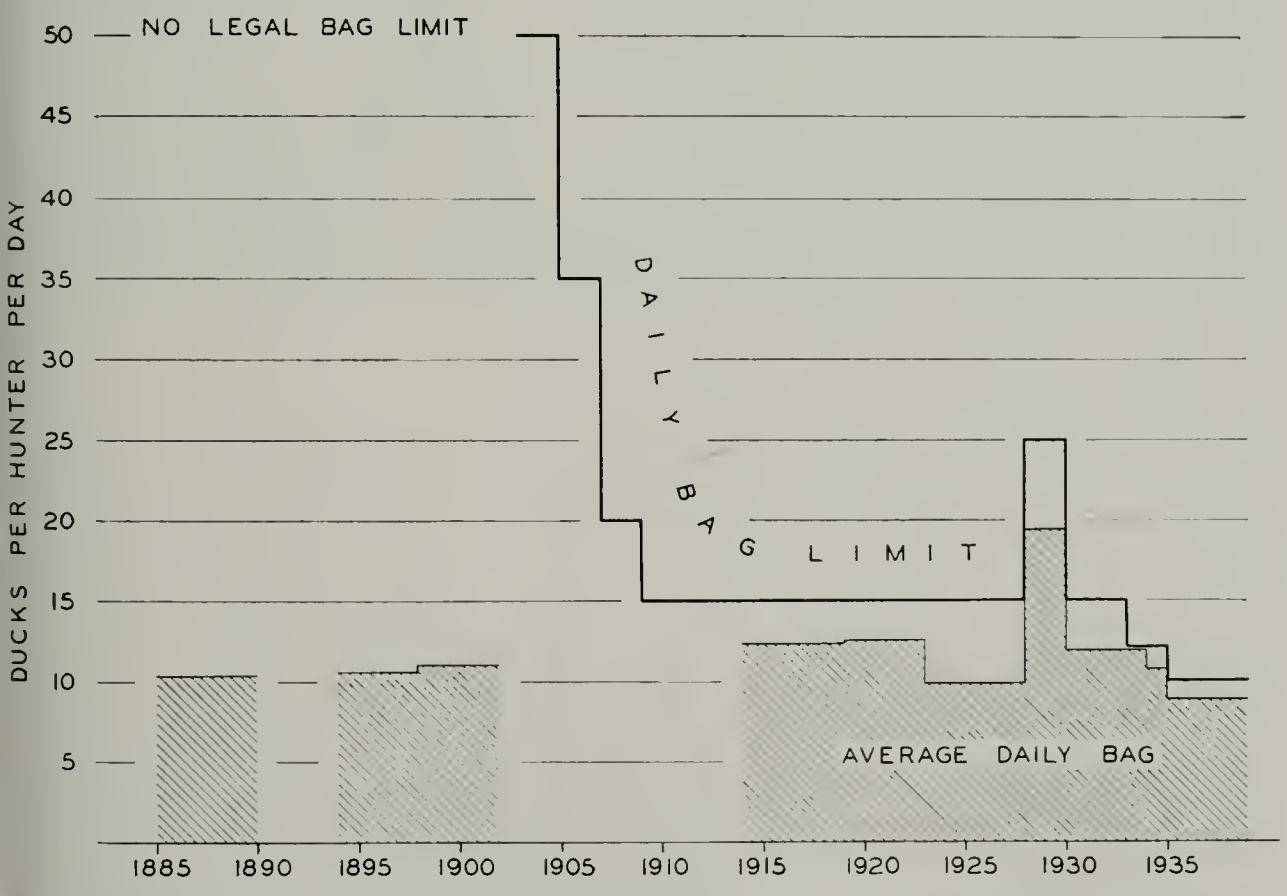

Fig. 22.—Average daily duck bag made by members of the Duck Island Preserve near Banner, Illinois, during certain periods from 1885 through 1938 in relation to the bag limit observed by the club.

limit.* Gaps in the graph are due to missing records. In "the good old days" with no legal restrictions, the kill per shooter per day was little greater than it was in 1938. From 1885 through 1889 and from 1894 through 1901, the kill per hunter-day averaged slightly over 10 ducks. From 1914 through 1927, when the club followed the state legal daily bag limit of 15, club members took an average of about 10 to 12 ducks per day each. In 1928 and the succeeding years the club regulations conformed with the federal limit. When the club elected to observe the federal bag limit of 25 in 1928 and 1929, rather than the state limit, the members' average individual daily bag rose to about 19. But in 1930 through 1932, with the federal limit lowered to 15, the Duck Island Preserve bag dropped to about 12. A further drop in the legal limit to 12, in 1933 and 1934, produced a further decrease in the individual daily kill. In 1935, the legal bag limit of ducks was cut to 10 per day, and again the average daily bag made by individual members of this club dropped.

It is apparent that a legal limit of 50 had little influence on the average daily kill of Duck Island Preserve members. However, as the bag limit decreased, it had increasingly greater influence on the average daily take per hunter. With a bag limit of 25, Duck Island Preserve hunters averaged each about 5 less than the limit; with a limit of 15, they averaged about 3 less; and, with a limit of 10, they averaged about 1 less than the regulations permitted. Since this duck club enjoys better shooting than most clubs in Illinois, the lag of the actual bag below the bag limit is much less than that of the average duck hunter. The better the habitat and the hunter, the more effective is the

*Record book made available by Ferd Luthy.

Photo by Bob Becker

Bag limits in the lower figures are effective means of preventing overshooting of waterfowl. A mallard and two pintails are shown above.

legal bag limit in placing a ceiling on the daily kill per hunter. Few public shooting ground hunters in Illinois are limited in their kill of ducks by the bag limit. But the bag limit is an effective measure in restricting the individual kill of the better hunters at the best Illinois clubs. All evidence points to the probability that in this state it is just as effective in limiting the total kill, for membership in Illinois waterfowl clubs has not materially increased, nor has the hunting intensity increased noticeably as a result of lowered bag limits. The individual daily bag limit ranks next to limitation of length of season as an effective regulatory measure in management of migratory ducks in Illinois.

Laws for Depleted Species

As previously discussed, because of differences in native wariness, feeding, flocking and migrating habits, some kinds of ducks are more readily killed by hunters than others. Some have higher rates of productivity and so can recover more quickly from the effects of heavy shooting, drought or other disaster. Some are affected more than others by adverse weather conditions. Because of differences in numbers or in attractiveness to hunters, as well as in certain habits, some are subject to greater shooting pressure.

Federal regulations of 1938–1940 restricting the daily individual bag of canvasbacks, redheads, ruddy ducks and buffleheads to three alone or in the aggregate of these species were not very effective in reducing the shooting pressure on, or the total kill of, these species in Illinois.

The shooting pressure quotient on the canvasback was 1.65 in 1938, 1.44 in 1939 and 0.63 in 1940, with the restrictions; 1.47 in 1941 and 1.09 in 1942, without the restrictions, table 8. The shooting pressure quotient on the ruddy was 3.07 in 1938, 2.48 in 1939 and 0.57 in 1940, with the restrictions on the take; 0.86 in 1941 and 0.63 in 1942, when there were no such restrictions, table 8. This situation alone does not necessarily mean that in other sections of the United States the restricted limit did not lower the total kill of these species, but it indicates that in states where these species made up only a small part of the population, and where no special effort was made to bag them, such measures had little effect on the kill.

Table 11.—Per cent of bands returned from 11 species of ducks within the first year after being banded. Ducks were banded in the United States and Canada, principally since 1938.*

Species	Number of Banded Ducks	Per Cent of Bands Returned First Year
Wood duck	1,271	5.4
Mallard	48,652	6.4
Pintail	9,072	6.0
Green-winged teal	659	5.2
Blue-winged teal	6,705	2.4
Gadwall	362	10.5
Widgeon	892	6.4
Shoveler	488	8.0
Lesser scaup	1,824	5.3
Ring-necked duck	392	4.5
Redhead	1,629	8.0

*To Richard Griffith and Frederick C. Lincoln of the U. S. Fish and Wildlife Service and to B. W. Cartwright of Ducks Unlimited (Canada) is due the credit for making banding data available.

Although in certain areas the three per bag limit regulation undoubtedly reduced the kill in those species to which it applied, we wonder if it reduced the continental take materially. Despite restrictive regulations on the take of redheads in recent years, this species has suffered high shooting losses, table 11. Recent first season band returns show that a greater percentage of redheads was taken by hunters than of any other species but the gadwall and shoveler, and banding data on these latter species may not be large enough to be significant.

Because the wood duck was in a precarious position in the early part of this century, it was given complete legal protection in some states by the Migratory Bird Act of 1913. This protection was extended to all states under the Migratory Bird Treaty Act of 1918 and was in force until 1941, when one wood duck in possession was allowed in 15 states. In 1942 and 1943 one wood duck was permitted in possession

in all 48 states; in 1944 in all states but South Dakota and Massachusetts.

The regulation allowing one wood duck in possession has caused a great deal of controversy among bird lovers, conservationists and duck hunters. Does it permit too high a kill of this species? Will the status of the species once again become critical? In order to answer these questions, at least in a limited way, let us examine the kill records of Illinois duck clubs and ratios of band returns to birds banded.

Table 12.—The numbers and species of ducks killed at 276 clubs in the Illinois River valley, 1942.

SPECIES*	NUMBER KILLED
Wood duck, *Aix sponsa* (Linnaeus)	675†
Redhead, *Nyroca americana* (Eyton)	332
Ruddy duck, butterball, *Erismatura jamaicensis rubida* (Wilson)	627
Shoveler, spoonbill, *Spatula clypeata* (Linnaeus)	751
Gadwall, gray duck, *Chaulelasmus streperus* (Linnaeus)	953
Green-winged teal, *Nettion carolinense* (Gmelin)	1,171
Canvasback, can, *Nyroca valisineria* (Wilson)	1,415
Widgeon, baldpate, *Mareca americana* (Gmelin)	1,563
Ring-necked duck, blackjack, *Nyroca collaris* (Donovan)	1,824
Blue-winged teal, *Querquedula discors* (Linnaeus)	2,006
Lesser scaup, bluebill, *Nyroca affinis* (Eyton)	4,161
Pintail, sprig, *Dafila acuta tzitzihoa* (Vieillot)	4,875
Mallard, *Anas platyrhynchos platyrhynchos* Linnaeus Black duck, black mallard, *Anas rubripes* Brewster	59,545

*Other duck species occasionally seen in Illinois include the bufflehead, *Charitonetta albeola* (Linnaeus), and the American golden-eye or whistler, *Glaucionetta clangula americana* (Bonaparte).

†The actual number recorded killed was 476; however, since there was no designated place for wood ducks on the kill sheets, some club members recorded them in the unspecified duck column. Based upon number classified as unspecified in 1941, it is believed that about 200 wood ducks were so classified in 1942.

Relatively few wood ducks were killed in the Illinois River valley in 1942, table 12. While these ducks were relatively numerous, most hunters in this region passed up shots at them to kill other species. Occasionally one was shot to add to a low bag, and birds were shot accidentally in 1942, just as when given complete legal protection. Because the legal 1942 kill of wood ducks in the Illinois River valley was probably little greater than the estimated illegal kill (Hawkins & Bellrose 1939) in the 1938 season, it must not be assumed that the one wood duck law had little adverse effect on the species.

Undoubtedly where other species of ducks were less abundant than along the Illinois River, proportionally more wood ducks were taken by hunters. Kill records from duck clubs along the Mississippi River in 1942 disclose that one-third more woodies were bagged there per hunter-day than along the Illinois River. Harry Maltby, U. S. Game Agent, reporting (letter December 27, 1943) on conditions along the Mississippi River in Iowa during the 1943 season, stated that a larger number of wood ducks were killed in that region in 1943 than in 1942. This was due to the greater scarcity of other species early in the season.

From the first season band returns before and after full legal protection was removed, table 13, it may be possible to evaluate the effect of the regulation allowing one wood duck in possession. Only the bands reported from wood ducks either shot or "found dead" were recorded; the "found dead" woodies are assumed to have been shot, for it is evident, after comparing the proportion of other species reported found dead and after noting the greatly reduced number of woodies reported "found dead" when it was legal to take one, that the "found dead" report was sometimes only a subterfuge on the part of hunters to escape being penalized. Nevertheless, a surprisingly large number of protected wood ducks were actually reported shot. Doubtless some

bands were not turned in because the hunters finding them feared apprehension.

Data presented in table 13 show that even when wood ducks were given complete legal protection a significant proportion of the population was killed by hunters. There was apparently a decrease in the proportion killed in 1941, although, for the first time since complete legal protection was given the wood duck, one such duck was permitted in the bag in 15 southern states. The lower proportion killed in that year may have been due to improved hunting conditions, causing more hunters to pass up shots at wood ducks for the larger ducks, or to some habitat conditions—such as high water—which favored a low wood duck kill.

In 1942 and 1943, when one wood duck could legally be taken in all 48 states, the ratio of first year band returns to wood ducks banded over the nation rose to 5.4 per cent. This would indicate about two-thirds greater kill in those years than when the species was given complete legal protection.

Has the increased kill resulting from the one wood duck law been too high? Only time and an adequate check on the wood duck population status will provide this answer, but we can compare the relative take of these ducks at present with that of other species, table 11. It is evident that over the nation, even with a one in bag or possession limit, wood ducks suffered a hunting mortality rate comparable to that of most other species.

How the wood duck ranks in productivity with other species has at present not been determined. There can be little doubt that during the past 2 years in many sections of the United States wood duck mortality from all causes exceeded productivity.

In the Illinois River valley, in sections of the Mississippi River valley and in parts of Maine, Arkansas, Iowa and Missouri, wood duck productivity was abnormally low in 1942 and 1943. Floods, combined with excessive raccoon predation, destroyed most of the nests in the Illinois River bottomlands. Raccoons, and also squirrels, raided many nests in the uplands. In Illinois, raccoons were more abundant in 1942 and 1943 than at any other time in the past decade.

The kill of wood ducks in 1942 and 1943, amounting as it did to proportions as great or almost as great as the kill of other species, indicates that this kill may be a serious threat to the species if its reproduction rate is low. A close watch on the population should be maintained, and, if a decline continues, the species should either be placed under complete protection or the hunting

Table 13.—Number of wood ducks reported banded in North America, place of banding and per cent of bands reported recovered from banded birds shot or "found dead" within a year after being banded (first season returns).

Place of Banding	Prior to 1941 (Closed Seasons)		1941 (One in Possession in 15 States)		1942–1943 (One in Possession in All States)	
	Number Banded	First Season Returns, Per Cent	Number Banded	First Season Returns, Per Cent	Number Banded	First Season Returns, Per Cent
Northern Illinois	21	0.0	163	2.5	518	5.2
Central Illinois	62	3.2	51	1.9	303	7.9
Wisconsin	309	3.8	102	2.0	...	0.0
Michigan	328	3.7	128	0.8	104	2.0
New York	63	8.0	...	0.0	228	4.4
Maine	318	2.8	216	2.2	57	8.8
Vermont	...	0.0	...	0.0	61	3.3
British Columbia	142	1.4	...	0.0	...	0.0
North American Average		3.4		2.3		5.4

season adjusted to provide less shooting pressure. In the northern and central zones, a late opening would see most of the wood ducks gone before shooting commences. Census and banding records in Illinois reveal that most of these ducks have departed from this state by November 1.

Effect of Bait and Live Decoys

In the years when baiting was permitted along the Illinois River, there were two diverse types of baited areas. In the bottomlands, bait was placed in small timbered ponds, or at shooting stands in the marshes and on the large lakes. Differing widely from such baited areas were the upland field pens, each of which consisted merely of a pen of decoys, bait and, usually, a small pond of water.

The bottomland areas most successfully baited were small timbered ponds and potholes. For the reason that the region near the mouth of the Sangamon River contained many such areas and was almost devoid of natural foods, it was the scene of the heaviest baiting. Leopold (1931) reports that in that region in 1928 clubs were putting out, on a 20-acre tract, as high as 7,000 bushels of corn per season and that rates per acre ran up to 430 bushels per season.

According to Uhler (1933) field-pen shooting reached its maximum development in Mason County. The success there was due largely to the proximity of three large "rest" lakes—Clear, Jack and Crane—which at the time were not adapted to the growth of first-class duck food plants because of their extreme fluctuation in water levels. Mallards were readily attracted from these lakes to the nearby heavily baited field pens. From a plane, Uhler enumerated 250 field pens in Mason County and in the adjacent part of Tazewell County. Most of these were within 5 miles of the Illinois River bottomlands, but a few were nearly twice that distance from the river.

Uhler's description of a dry-land club is as follows: "A typical field-pen consists of a small artificial pond supplied by water which is usually pumped from a nearby well by means of a portable gasoline engine. The basin of the pond is lined in a variety of ways to prevent seepage. . . . . The pond is equipped with a flock of live decoys and baited heavily with corn on the cob or shelled. Sometimes, the entire pond is enclosed with poultry mesh about four feet high. Other ponds have the decoys confined

Photo by Bob Becker

Corn being scattered at an Illinois River valley shooting stand in the days of baiting, 10 o more years ago. Mallard and pintail silhouettes are shown being used as decoys. The combinatio of baiting and live decoys resulted in a duck kill so high that restrictive measures were inaugurate in an effort to prevent rapid depletion of the population.

to one or more small pens extending into the pond. . . . . Usually from 3 to 5 blinds made of corn stalks, leafy oak branches, or rushes fastened to portable frames surround these ponds. Many dry pens were also noted. These consist of a pen of live decoys placed in some remote field and surrounded with long bands of shelled corn or corn on the cob. The only water involved in this set-up is placed in a trough or other receptacle for the decoys to drink."

Photo by Bob Becker

A pen of live decoys in front of a blind, once a familiar scene in the Illinois River valley.

Uhler reported that one of the most successful commercial shooting places fed at four field pens from 1,400 to 2,500 bushels of corn per season. He estimated that 6,000,000 bushels of corn were fed by Illinois clubs during the 1933 season. Sixty-seven clubs reported feeding an average of 1,243 bushels of corn and other grains.

What was the influence of baiting and decoy pens on the kill of ducks in Illinois? In addition to Uhler's 1933 report on the estimated duck kill and populations in the Illinois River valley, we have waterfowl kill records from the State Department of Conservation for 2 years in which corn was put out for ducks, 1933 and 1935. Through band returns, we can roughly compare differences in mallard mortality during and after the baiting period.

Besides the 250 field pens enumerated by Uhler in Mason County and an adjoining part of Tazewell County, there were probably 200 others in the vicinity of the Illinois River. Leopold (1931) reports that 4,000 ducks were killed in 60 days on one 40-acre commercial dry-land club. Uhler says that at one commercial dry-land club in 1933 an average of eight shooters per day were assured the limit up to the time of his visit in mid November. That would mean a kill of about 2,400 ducks during the first half of the season. These were among the dry-land places at which the highest kills were made. Reports of local hunters familiar with the situation indicate that an average of 500 ducks were killed at each field pen. If there were 450 field pens, the total annual kill made by these dry-land clubs amounted to about 225,000 ducks.

Bottomland clubs were not affected as greatly as upland field-pen clubs by the outlawing of bait and live decoys. However, many clubs in the Sangamon River bottoms disbanded because of the low duck kill resulting from the no-bait, no-live-decoy law. With no bait or live decoys, the kill at several of the large Sangamon River clubs dropped from 7,000 or more to less than 500 per year.

Some indication of the influence of bait and live decoys on the duck kill in

Table 14.—Total reported kill of ducks at Illinois River valley waterfowl hunting clubs; average kill per club and per hunter-day.

YEAR	DAYS IN SEASON	NUMBER OF CLUBS	TOTAL DUCKS REPORTED KILLED	AVERAGE ANNUAL KILL PER CLUB	AVERAGE KILL PER HUNTER-DAY
1933	60½	99	60,467	611	7.50
1934	30	...	.....	...	....
1935	30	214	84,733	396	7.18
1936	30	260	56,860	219	6.14
1937	30	289	38,063	132	5.23
1938	45	252	60,102	239	5.51
1939	45	138	36,783	267	....
1940	60	243	66,502	274	6.03
1941	60	308	89,670	291	6.12
1942	70	276	80,339	291	6.25

Illinois may be derived from a study of table 14. In 1933, during a 60½-day season, in which baiting and live decoys were allowed, 99 clubs reported a kill of 60,467 ducks, or 611 per club. During a season of 60 days in 1941, when baiting and live decoys were prohibited, 308 clubs reported a kill of 89,670 ducks or 291 per club. Even in 1935, when no live decoys were permitted, when the season lasted but 30 days and feeding was permitted in sections of the premises not shot over, 214 clubs reported a kill of 84,733 ducks or 396 per club. In two seasons of equal length, 1936 and 1937, in which live decoys and all types of baiting were outlawed, 260 and 289 clubs reported kills of 56,860 and 38,063 ducks in the 2 years, respectively, or 219 and 132 per club.

Uhler estimated the Illinois duck club kill in 1933 at 926,000. This may have been too high since the kill was computed on the basis of 20 clubs that probably had higher than average kills. He estimated the total number of mallards and pintails in baited portions of Illinois at "from 3,000,000 to 4,000,000 birds." During 1941, a season similar to 1933 except for outlawing of bait and live decoys, we estimated the Illinois River valley kill (based on club records and observations in the field) at 175,000. We estimated the mallard and pintail population in 1941 for the same section included by Uhler at 6,175,000. On the basis of Uhler's figures for the first year and our figures for the second, the duck kill in relation to the population was about 8 to 11 times as great in 1933 as in 1941.

A greater proportion of the shooting

Table 15.—Composition of waterfowl bag at Illinois River valley waterfowl hunting clubs, 1933 and 1935–1942. Each figure represents per cent of total bag (all species) in year.

SPECIES	1933	1935	1936	1937	1938	1939	1940	1941	1942
Mallard and black duck	83.80	88.79	79.34	69.28	55.70	61.80	72.10	63.72	74.20
Pintail	6.55	4.01	7.01	13.16	12.60	11.29	11.59	8.60	6.05
Green-winged teal	2.48	1.48	2.81	4.58	9.40	7.16	4.16	1.63	1.46
Blue-winged teal	0.65	1.11	0.56	0.98	3.30	1.53	1.38	2.32	2.50
Widgeon*	0.87	0.60	0.41	0.82	7.16	5.10	2.13	3.12	1.94
Gadwall*	0.59	0.87	1.12	1.83	2.27	2.70	1.13	1.90	1.18
Shoveler	0.40	0.37	2.36	2.05	2.40	1.67	1.08	0.94	0.93
Lesser scaup	2.01	1.24	2.76	3.64	4.40	6.36	3.34	7.85	5.20
Ring-necked duck	1.33	0.65	1.06	0.72	0.59	0.70	1.80	6.62	2.28
Canvasback	0.09	0.08	†	†	0.40	0.35	0.37	1.67	1.76
Ruddy duck	†	†	†	†	0.43	0.52	0.17	0.51	0.78
Other ducks	0.54	0.30	1.34	2.16	....	....	....	0.31	0.41
Coot	0.69	0.50	1.23	0.78	1.35	0.82	0.66	0.81	1.31

*Figures for widgeon and gadwall previous to 1941 calculated from 1941–1942 data for reasons explained in text.

†Given complete legal protection in this year.

pressure resulting from baited areas and live decoys fell upon the mallard and black duck than upon other species. Table 15 shows that, in 1933, 83.80 per cent of the bag was made up of mallards and black ducks. In the 1941 season, of comparable length and dates, only 63.72 per cent of the bag was composed of these species. Even in 1935, when feeding was done in areas not shot over and live decoys were outlawed, the mallards and black ducks comprised 88.79 per cent of the total bag; in 1938, mallards and black ducks formed only 55.70 per cent of the bag. The large proportion of those species in the 1936 and 1937 bags, when baiting and use of live decoys were illegal, was due to the fact that the open season extended from November 1 through 30, a period in which mallards formed over 90 per cent of the waterfowl population.

Photo by Bob Becker

Mallard and pintail blocks, or wooden decoys, being picked up in a marsh smartweed area that has yielded large kills of Illinois River valley ducks.

Banding returns show that baiting and live decoys resulted in heavy shotgun mortality to the mallard. A study of tables in *Returns from Banded Birds, 1920 to 1923* (Lincoln 1924) indicates that 218, or 16.4 per cent, of the mallards banded by Lincoln during the autumn of 1922 near Browning, Illinois, were killed that hunting season in Illinois; a mallard kill rate much higher than in recent years in this state.

From 1939 through 1943, the Illinois Natural History Survey banded about 28,000 mallards at the Chautauqua National Wildlife Refuge, near Havana. As indicated by band returns, the shotgun mortality, the first season, of 27,680 fall banded mallards was 2.9 per cent in 1939; 6.8 per cent in 1940; 2.6 per cent cent in 1941; 7.0 per cent in 1942; and 5.7 per cent in 1943. Lincoln banded his mallards at a gun club, and we banded ours at a wildlife refuge. While this difference contributed to the greater survival of Chautauqua-banded mallards, the kill rate of Illinois mallards in 1922 must have been at least twice as great as it has been since 1939. Returns from 2,452 mallards banded in Canada* show a shotgun mortality, the first year, of only 8.9 per cent in 1940, 5.7 per cent in 1941 and 6.4 per cent in 1942. These mallards had to face shotguns in the northern zone as well as in the central and southern zones and therefore had more time in the season of banding in which to be killed than did those banded by Lincoln near Browning.

Data on duck mortality obtained from Illinois State Department of Conservation kill records, from Uhler's 1933 report and from a comparison of first hunting season band returns indicate that the kill rate under baiting and live decoy conditions was two to three times as great as after their prohibition.

*Information furnished by B. W. Cartwright of Ducks Unlimited (Canada).

In Illinois, the improved survival rate has applied mainly to mallards and pintails; however, all species have benefited from the no-baiting, no-live-decoy regulations, for all species—including canvasbacks, scaups, redheads and ringnecks—were attracted by bait and live decoys.

Credit for the greater survival rate cannot be given entirely to prohibition of baiting and live decoys, for other conservation measures were put in force at about the same time.

However, these prohibitions increased the rate of duck survival more than did shortening the seasons, reducing bag limits or limiting the shooting hours. Because the bans on bait and live decoys were initiated at approximately the same time it was not feasible to evaluate the effectiveness of each of these two separately.

Despite the great reduction in kill following outlawing of the use of bait and live decoys, no catastrophe has befallen either the waterfowl club or the individual hunter. True, the disbanding of all dry-land duck clubs has resulted, but these clubs contributed little to the welfare of the birds. They were parasitic. In some sections, notably near the mouth of the Sangamon River, bottomland waterfowl clubs have passed out of existence, but in other sections they have held their own or even increased in number. In 1941, there were 792 registered waterfowl hunting clubs in Illinois, more than in the last years of the baiting and live decoy era.

The free-lance hunter has materially benefited from the discontinuance of baiting. Where formerly ducks were concentrated in a few private, heavily baited areas, today they are more evenly distributed. Now public hunters may find fair shooting not only on several state-owned public shooting grounds and other waters not under private control, but in cornfields as well.

Ducks have not left the Illinois River valley, as many hunters feared would happen without bait to hold them. Mallards, pintails and black ducks have found a ready source of food in the waste corn left in fields by the mechanical pickers, and they remain in the valley in numbers comparable to those during the baiting era. Natural food resources in the Illinois River valley have increased in recent years because navigation dams have been built on the river and because hunting clubs have made greater attempts to control their water levels. Uhler (1933) estimated that mallards comprised 85 per cent of the waterfowl population of the valley at the time he made his report. Mallards and black ducks, although increasing in numbers, formed a successively smaller part of the total duck population between 1938 and 1942, dropping from 94.61 to 84.98 per cent, tables 3–7. Other species of ducks are forming a greater percentage of the waterfowl population in the Illinois River valley. Improved environmental conditions for diving ducks are largely responsible for this trend.

Effect of Three-Shell Law

Because of lack of specific data, it has been impossible to evaluate the three-shell limit for shotguns. In the days of live decoys and baiting, when pot-shooting on massed ducks was common, the limitation of three shells to a gun would have been an important factor in reducing the carnage at baited pens. However, the three-shell law went into effect in 1935 after live decoys had been banned and outright baiting prohibited.

Ferd Luthy and other veteran Illinois duck hunters are of the opinion that the three-shell law lessens the chance of crippling ducks by reducing the number of out-of-range shots. Since studies we conducted in 1938 and 1939 disclosed that about 3 ducks were crippled and lost for every 10 bagged, it is evident that this loss is serious. If more shells in the gun would result in greater crippling losses, it would appear advisable to retain the present three-shell limit.

Illinois Duck Harvest

What per cent of the duck populations passing through the Illinois River valley in 1938–1942 was harvested by hunters in this state? An answer to this question may be found by comparing the kill with the population, table 16. At present we must base the population

figures on peak numbers of each species during the season, without any compensation for turnover of the populations. When banding data are analyzed to the end of showing the rate of movement of ducks through the valley, then we shall be able to determine fairly accurately the number of ducks that actually pass through the Illinois River valley.

The ratio between the number of ducks banded each year on the Chautauqua National Wildlife Refuge near Havana and the number of returns from them in Illinois during the same season should indicate the minimum per cent of kill. Since only the mallard, black duck and perhaps the pintail were banded in sufficiently large numbers to be significant, the band return figures apply principally to those species. The figures indicate a minimum kill ranging from 1.8 per cent of the flight in 1939 and 1941 to 5.0 per cent in 1940, table 16. There is a greater annual variation among the banding ratios obtained than among the figures obtained from a comparison of the population-kill data. This is due probably to the fact that the chronology of banding did not correspond to the chronology of migration. The low per cent of 1.8 in 1939 and 1941 occurred as the result of a disproportionate number of birds being banded late in the season; the banded birds, therefore, received less shooting pressure than the population as a whole.

Population-kill figures for all ducks tend to verify the band recovery data, which were principally for mallards, black ducks and pintails. These figures indicate that during the 1938–1942 period, 3.3 per cent of the ducks of all species in the Illinois River valley were taken by hunters, table 16. The band return data may be too low in some years because of a disproportionate amount of late season banding. After making allowances for inaccuracies in data, we estimate that, in the period of this study, Illinois hunters annually harvested between 3 and 5 per cent of the duck flight passing through the state.

Table 16.—The approximate per cent of ducks bagged in the Illinois River valley, 1938–1942.

Year	Calculated Minimum Duck Population	Calculated Minimum Duck Kill	Per Cent of Flight Killed	Per Cent of Bands Returned in Year of Banding*
1938	2,860,000	103,877	3.6	...
1939	2,496,000	100,210	4.0	1.8
1940	3,023,000	110,000	3.6	5.0
1941	6,175,000	159,400	2.6	1.8
1942	4,971,000	162,500	3.3	3.0
Total	19,525,000	635,987		
Average	.....	.....	3.3	

*Only mallard, black duck and pintail.

Total Effect of Regulations

The cumulative effect of federal regulations on the continental take of ducks in the past decade may perhaps best be measured by ratios of first-season band returns to birds banded.

A study of data presented by Lincoln (1924) reveals that of about 1,330 mallards banded near Browning, Illinois, in the fall of 1922, approximately 20 per cent were killed before the end of the hunting season. The Illinois Natural History Survey duck banding program was begun almost 20 years later, after important federal restrictions had been placed in force. Banding was done on the Chautauqua National Wildlife Refuge, near Havana, some 20 miles north of Lincoln's station, usually from October until the freeze-up in early December. Notwithstanding the fact that we banded on a refuge, the high proportion of local returns demonstrated that the ducks we banded suffered a high local kill. Yet the same-season band

returns over the nation from approximately 28,000 mallards banded on the Chautauqua Refuge, 1938–1943, amounted to only about 5 per cent, approximately one-fourth the proportion recorded by Lincoln near Browning.

Pirnie (1935) reported that 20.5 per cent of 1,607 black ducks banded at the Munuscong Waterfowl Refuge in Michigan's upper peninsula between 1928 and 1934, before drastic waterfowl restrictions were inaugurated, were reported shot the same season as banded. Of 1,251 black ducks banded from 1939 to 1942, inclusive, on the Seney National Wildlife Refuge in Michigan's upper peninsula, only 9.2 per cent were reported shot during the same season as banded (reported by C. S. Johnson to Richard Griffith). This is approximately half the percentage reported by Pirnie for the earlier period from the same region.

According to Phillips & Lincoln (1930) the annual duck mortality up to the time they wrote (as based on first-season band returns from stations scattered over the continent) was about 13 per cent. Banding data supplied by B. W. Cartwright of Ducks Unlimited (Canada) disclose that, in 1940, 6.7 per cent first-season band returns were received; in 1941 the returns amounted to 5.6 per cent; and in 1942 to 7.5 per cent. These figures represent about half the percentage reported by Phillips & Lincoln.

Although these figures are only small samples, their consistency is indicative that regulations in force in the past 10 years cut about in half the rate of kill made by hunters in the previous decade. On the whole, the measures enacted by the federal government to reduce the kill of ducks accomplished their purpose.

Summary

1. In order to manage well the harvest of the continental crop of migratory waterfowl, it is necessary to evaluate as closely as possible the influence each hunting regulation has on the kill and to determine the optimum dates for open seasons. Obviously, a close evaluation covering all of North America is impossible at present, but it is feasible in a smaller area, such as Illinois.

2. All important waterfowl hunting regulations except those relating to territories were made by the individual states until the federal Migratory Bird Act was passed in 1913.

3. The Migratory Bird Act of 1913 and the Migratory Bird Treaty Act of 1918 applied the first major federal restrictions on the taking of waterfowl. However, federal regulations were not very stringent until a shrinking waterfowl population, alarmingly evident by 1933, necessitated a great reduction in the kill.

4. Various restrictive measures imposed on duck hunting, most of them in 1935, included reduction in the open season to 30 days, reduction in the bag and possession limits to 10 birds, limitation of shooting to the hours between 7 A.M. and 4 P.M., prohibition of the use of bait and live decoys, limitation of shells in gun to three or less, and reduced limits or no open season on certain species of waterfowl.

5. It is possible to regulate the kill of certain species of waterfowl in Illinois by opening and closing the hunting season to include all or certain proportions of the flight of these species within the open or closed periods. Species differ in the time of arrival in Illinois, in reaching maximum numbers and in departing.

6. It may be necessary to protect certain species more than others, for each kind of duck varies in vulnerability to the shotgun as well as to natural conditions. Inherent wariness, flight, flocking and feeding habits of ducks and shooting practices of hunters are factors that affect the kill of each duck species.

7. In Illinois, mallards and black ducks, as a group, were found to be the least vulnerable to the shotgun, 1938–1942, followed by lesser scaups, canvasbacks, ruddy ducks, ring-necked ducks, pintails, widgeons and gadwalls, green-winged and blue-winged teals, and shovelers.

8. Recent open seasons in Illinois (1938–1942) have protected blue-winged teals more than any other species. These open seasons have protected other species in the following descending

order: shovelers, green-winged teals, pintails, widgeons, mallards and black ducks, ring-necked ducks, canvasbacks, lesser scaups, ruddy ducks and gadwalls.

9. In general, the duck species that migrate through Illinois during the early part of the fall migratory season are the ones most easily killed. Ducks of many species are most easily killed during the early part of the season, probably because at that time juveniles predominate in the population.

10. The dates for the waterfowl hunting season in Illinois should depend upon what species of ducks need the greatest protection, and whether the hunter or the waterfowl population should be favored. Open dates suggested by this study are as follows: For a 30-day season, November 1–30; for a 45-day season, October 22–December 5; for a 60-day season, October 10–December 8; for a 70-day season, October 1–December 9; for an 80-day season, September 26–December 14; for a 100-day season, September 20–December 28.

11. Although, in Illinois, the total duck bag does not vary proportionally with the number of days in the hunting season, altering the length of the season is one of the most expedient ways to regulate the duck kill.

12. Shooting hours, which were from 7 A.M. to 4 P.M., 1935–1939, from sunrise to 4 P.M., 1940–1941, then from sunrise to sunset, 1942, and from one-half hour before sunrise to sunset, 1943–1944, appear to have affected the flight habits of cornfield feeding ducks more than the kill of those ducks. Mallards, black ducks and pintails feeding in cornfields have changed the time of their daily flights so that they still generally feed before and after shooting hours. To date there is apparently no evidence that changes to earlier and later shooting hours increased the duck kill; probably the changes lowered the kill.

13. Evidence derived from records of the kill of ducks at one Illinois River valley club that furnished good shooting shows a close correlation between legal bag limits in the lower figures and the number of ducks killed per hunter-day. The higher the bag limit, the less it seemed to influence the duck kill; there was much less difference between actual daily bag and legal limit when the limit was 10 than when it was 25. The individual daily bag limit is an effective regulatory measure in management of migratory ducks in Illinois.

14. Special protection has in some years been given through reduced bag limits to several species of waterfowl: canvasbacks, redheads, ruddy ducks and buffleheads. Some doubt exists as to the effectiveness in Illinois of this measure in reducing the kill of species it is intended to protect.

15. While wood ducks were killed in considerable numbers even when given complete legal protection, the regulation permitting one such duck in bag or in possession probably increased the kill as much as two-thirds. The hunting mortality rate of wood ducks in 1942 and 1943 was comparable to the kill of other species of ducks under no special bag restriction. Whether the productivity of the wood duck will keep pace with the increased kill must be determined by closely checking the population.

16. In 1933, when use of bait and live decoys was permitted, the kill of ducks in the Illinois River valley was, it is estimated, 8 to 11 times as great in proportion to the population as in 1941, when use of bait and live decoys was banned. The ban on the use of bait and live decoys eliminated about 450 commercial dry-land pens in Illinois. Most bottomland hunting clubs were not seriously affected by the ban on such practices. In 1941, there were 792 registered waterfowl hunting clubs in Illinois, more than in the last years of the baiting and live decoy era.

17. The three-shell limit on shells in gun appears to be a desirable restriction.

18. In the 1938–1942 period, about 3 to 5 per cent of the migratory ducks passing through the Illinois River valley were taken by Illinois hunters.

19. Restrictive waterfowl regulations enacted in recent years have aided in the survival of migratory ducks in North America. Available data indicate that over the North American continent the proportional kill in the past 10 years was about half that in the previous decade.

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A.—ILLINOIS NATURAL HISTORY SURVEY BULLETIN.

Volume 21, Article 3.—Studies of Nearctic Aquatic Insects. By H. H. Ross and T. H. Frison. September, 1937. 52 pp., frontis. + 86 figs., bibliog. 50 cents.

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