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DUCK HUNTING TRENDS AT WINOUS POINT SHOOTING CLUB, OHIO, 1863–1987

ROY W. KROLL, *Winous Point Shooting Club, 3500 South Lattimore Road, Port Clinton, OH 43452*

JONATHAN BART, *National Biological Survey, Ohio Cooperative Fish and Wildlife Research Unit, Department of Zoology, Ohio State University, 1735 Neil Avenue, Columbus, OH 43210*

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Although waterfowl hunting became popular in the United States by the mid-1800's, there were few published long-term studies of trends in hunter success rate (duck harvest/gun day). Previous research seldom reported hunter success from pre-1900 and relied on fragmentary data, multiple study sites, or incomplete time intervals (Hawkins and Bellrose 1939, Bellrose 1944, Bartonek et al. 1964, Green 1963, Havera 1991). Several comprehensive analyses of hunter success exist for post-1955 data (Hochbaum and Walters 1984, Trost et al. 1987, Martin et al. 1990). However, no hunter success data have been published that provide complete records and encompass the entire period of waterfowl hunting at one site.

Information on long-term trends in waterfowl hunting is important because it provides insights into the sport during former times and may reflect changes in waterfowl populations. Here, we describe long-term trends in hunter success rates at the Winous Point Shooting Club along Lake Erie in northern Ohio. These records permit calculation of success rates for each waterfowl species harvested from 1863–1987.

STUDY AREA

The Winous Point Shooting Club was founded in 1856 on the southwest shore of Lake Erie in northern Ohio (Fig. 1). The club owns 1,000 ha of lacustrine wetlands and 755 ha of palustrine emergent wetlands. The lacustrine wetlands are influenced by Lake Erie water levels and are largely barren of aquatic macrophytes. The palustrine wetlands are diked, and dominant plants in these managed marshes are narrowleaf cattail (*Typha angustifolia*), giant burreed (*Sparganium eurycarpum*), smartweed (*Polygonum* spp.), barnyardgrass (*Echinochloa* spp.), American lotus (*Nelumbo lutea*), common pickerelweed (*Pontederia cordata*), spiked watermilfoil (*Myriophyllum spicatum*) and curly leaf pondweed (*Potamogeton crispus*).

Hunting Records

Daily records of hunting effort and success of the 20–25 club members/year are available since 1863. Number of ducks killed and retrieved (i.e., harvested) by each hunter was recorded by species along with additional information describing hunting conditions (e.g., temperature, wind speed and direction, and precipitation). Club members recorded the information from 1863–1945, and the scribe was often the same person for >10 years. Scribes frequently cross-checked numerical totals and added written comments. Since 1946, resident biologists have maintained the record.

METHODS

We entered data on each hunter and the daily number of waterfowl harvested by species into computer files. All bird species taken were recorded, but we restricted this analysis to: wood duck (*Aix sponsa*), American green-winged teal (*Anas crecca carolensis*), black duck (*A. rubripes*), mallard (*A. platyrhynchos*), northern pintail (*A. acuta*), blue-winged teal (*A. discors*), northern shoveler (*A. clypeata*), gadwall (*A. strepera*), American wigeon (*A. americana*), canvasback (*Aythya valisineria*), redhead (*A. americana*), and scaup (*A.* spp.).

Harvest rate analyses were restricted to 8 October–6 December, during which most hunting (81%) occurred during 125 years. We used average hunter success rates/gunner/day (i.e., gun day) for five year periods to describe trends. For example, "harvest in 1865" is the mean number of ducks harvested/gun day during 1863–1867.

We investigated three categories of influences on harvest rates: (1) hunting strategies, (2) Winous Point habitat conditions, and (3) local abundance of ducks. We determined whether changes in influences coin-

cided chronologically with changes in harvest rates, and then retroactively inferred how these influences may have affected harvest. Changes in weaponry, hunting methods, bag limits, and hunter preferences for duck species were included as components of hunting strategies. Published accounts of wetland conditions at Winous Point and in northwest Ohio, vegetation maps, aerial photographs, Lake Erie water levels, and annual precipitation at Toledo, Ohio were used as indicators of Winous Point habitat conditions. We examined duck abundance during two periods: before 1955 and 1955–1987.

Duck Abundance Before 1955

No valid data are available to estimate North American duck populations prior to 1955. Therefore, we investigated trends in duck populations before 1955 using published accounts of waterfowl abundance in ornithological texts (e.g., Dawson 1903, Trautman 1940, Peterjohn 1989), books on duck hunting (e.g., Long 1874, Grinnell 1901, Huntington 1903, Phillips and Lincoln 1930), waterfowl status reports (e.g., Bell and Preble 1934), and two letters from waterfowl biologists (H. A. Hochbaum, Delta, Manit., unpubl. rep., 1947; A. S. Hawkins, U.S. Fish and Wildl. Serv., unpubl. rep., 1948). Additionally, we considered the initial surveys of waterfowl populations beginning in 1935 (More Game Birds in America Foundation 1935) and mid-winter waterfowl surveys (H. Bourne, U.S. Fish and Wildl. Serv., Laurel, Md., unpubl. data).

Duck Abundance Data 1955–1987

For 1955–1987, hunter success rate was correlated with changes in duck abundance using independent survey data. First, we used data collected by the State of Ohio biweekly in northern Ohio (primarily along Lake Erie) between 1 October and 15 December 1972–1987 (J. L. Weeks, Oh. Div. Wildl., Oak Harbor, Oh., unpubl. data). Data were expressed as average number of ducks of each species/day. Second, we used data on waterfowl abundance from the 1955–1987 breeding ground survey (U.S. Fish and Wildl. Serv. and Can. Wildl. Serv. 1987). Band recovery data were used to calculate the proportion of preseason-banded ducks recovered in Ohio. We selected breeding ground survey strata from regions with direct recovery rates in Ohio of ≥ 0.003 mallards/3 degree block. We estimated temporal trends (1955–1987) in abundance for each duck species using survey data from selected strata. The coefficient of determination (R^2) was used to index how well breeding duck abundance predicted harvest rate. Third, we used mid-winter inventory data (K. Gamble, U.S. Fish and Wildl. Serv., Columbia, Mo., unpubl. rep., 1989) for black ducks (Atlantic and Mississippi flyways), since this species is seldom recorded on breeding grounds surveys.

RESULTS

Number of gun days/year were high during 1865–1880 (actual interval: 1863–1882), decreased sharply during 1880–1900, and increased steadily until 1985 (Fig. 2). A daily bag limit of 25 ducks/gun day was instituted in 1902 (Fig. 2). The limit declined to 10 by 1935, to 4 in 1947, and has remained relatively stable since then.

Mean total harvest (all species combined) was generally >10 ducks/gun day until 1930 (Fig. 2). In recent decades, mean total harvest has been <4 ducks/gun day. Five periods can be distinguished: major increases in total harvest rate occurred 1865–1880 and 1895–1930, major decreases occurred 1885–1895 and 1930–1950, and harvest from 1955–1985 was fairly stable.

Annual precipitation declined during 1865–1895, increased until 1910, decreased until 1935, and generally increased since then (Fig. 3). The level of Lake Erie declined during 1865–1935 and has increased since then, reaching record highs in the late 1980's (Fig. 3).

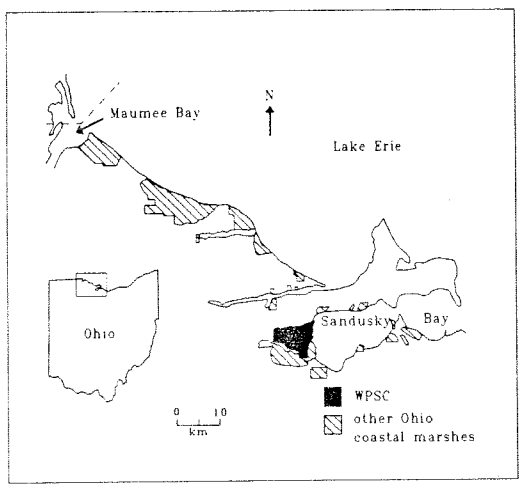

Fig. 1. Location of the Winous Point Shooting Club (WPSC), Northern Ohio.

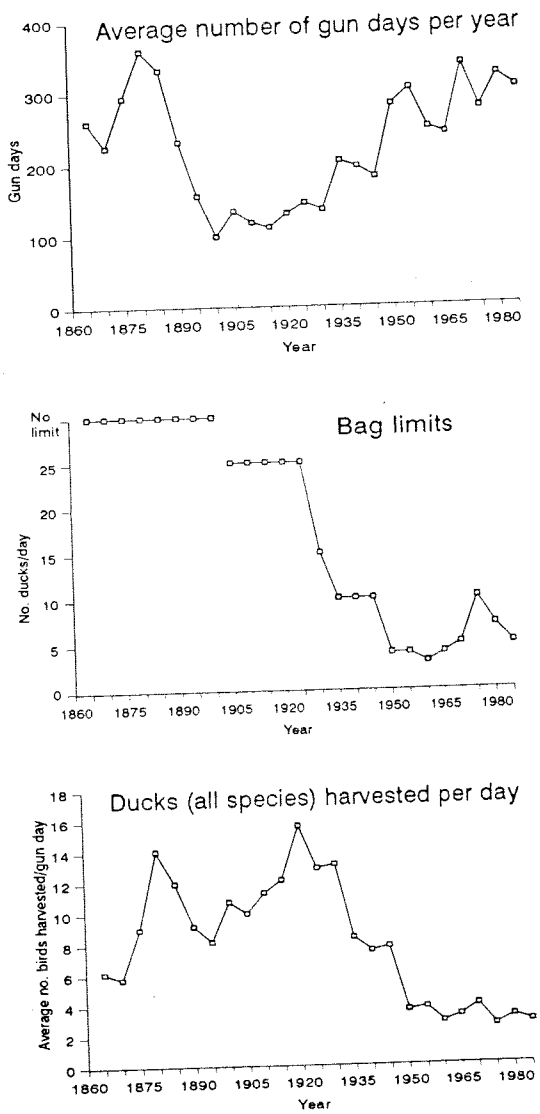

Fig. 2. Trends in the average number of gun days/year, bag limits, and duck harvest/gun day at the Winous Point Shooting Club in Ohio for 5-year intervals, 1863–1987. The 1975 and 1980 bag limit intervals include point system years 1973–1979.

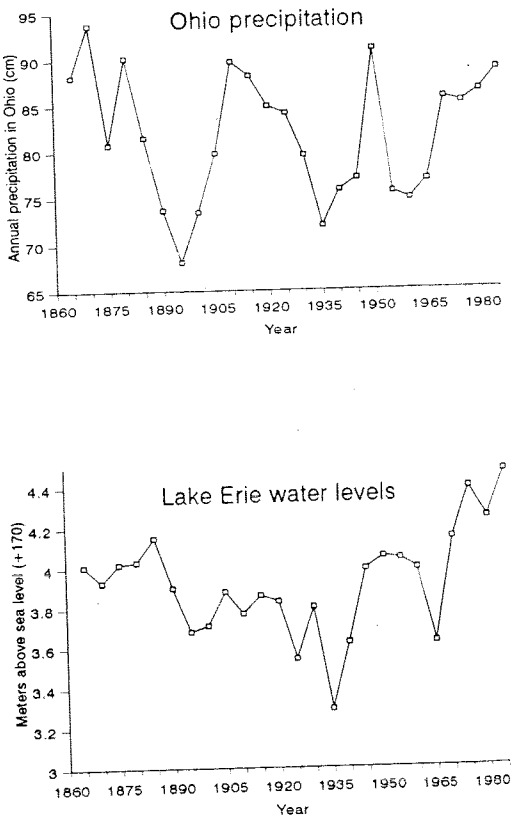

Fig. 3. Trends in water levels of Lake Erie and precipitation at Toledo, Ohio for 5-year intervals, 1863–1987.

Species Harvest Rates

During 1865–1880, increases occurred in harvest rate for most species (Fig. 4). This increase was strongest for the three diving ducks (canvasback, redhead, scaup). Divers were harvested in about equal numbers and together comprised nearly one-third of the harvest until 1880, when their harvest dropped precipitously. Since 1905, diver harvest has remained near 0. Although the trend in increased harvest rate for 1865–1880 was less obvious among dabblers, increases occurred for both teal species, wigeon, and northern shoveler. Harvest rate increased but quickly declined again for wood duck and northern pintail, and increased slightly for black duck, mallard, and gadwall.

During 1880–1895, we observed decreased hunter success rate (14–8 ducks/gun day) for most duck species. Success rate declined by virtually 100 percent for the canvasback, red-

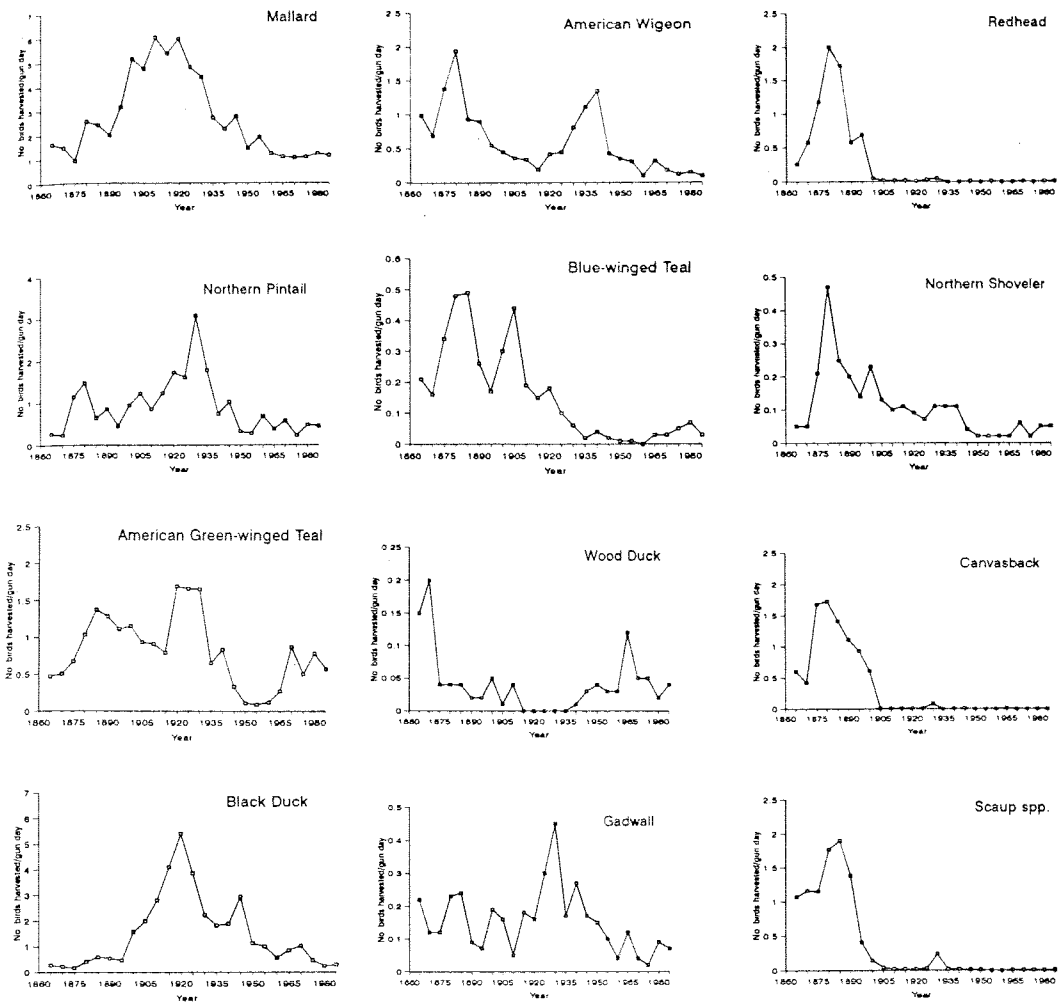

Fig. 4. Trends in hunter success rate for 5-year intervals at the Winous Point Shooting Club in Ohio for 12 waterfowl species during 1863–1987.

head, and scaup. Among dabblers, harvest rate declined sharply for wood duck, northern shoveler, and wigeon. The index showed little change during this period for the northern pintail. However, mallard and black duck harvest rates increased markedly.

During 1895–1930, total harvest increased and peaked in 1920. Much of this trend was due to mallards, black ducks, and northern pintails which together comprised 13 of the 16 birds in the mean total daily harvest in 1920. A bag limit of 25 ducks/gun day was imposed by the club in 1902 (statewide in 1904), but mean total daily harvest averaged about 12 ducks/gun day until 1930. No relationship existed between 25-duck bag limits (1902–1930) and harvest rate ($r = 0.00$, $n = 29$, $P = 1.0$).

During 1930–1950, harvest rates for nearly all dabblers decreased sharply (diver harvest remained near zero). Total harvest rate strong-

Table 1. Relationship between hunter success rate at Winous Point Shooting Club and waterfowl abundance in Ohio and on the breeding grounds.

Species	Harvest/gun day 1972–1987	R^2 (hunter success rate, abundance)	
		Ohio[a]	Breeding ground[b]
Mallard	1.13	0.38	0.52
American green-winged teal	0.62	0.66	0.62
Northern pintail	0.39	0.85	0.07
Black duck[c]	0.33	—	0.54
American wigeon	0.12	1.00	0.03
Gadwall, blue-winged teal and northern shoveler	0.04–0.06	0.37	0.27
Scaup and redhead	0.001	0.80	0.22

[a] Based on aerial surveys, 1972–1987.
[b] Based on breeding grounds surveys 1955–1987. (U.S. Fish and Wildl. Serv. and Can. Wildl. Serv. 1987)
[c] Success rate after 1983 not used because some Club members voluntarily restricted take of this species.

ly correlated with declining bag limits of 15–4 ducks/gun day in 1931–1950 ($r = 0.94$, $n = 20$, $P < 0.01$).

Since 1950, total harvest has been fairly stable at <4 ducks/gun day. Harvest rates declined for black ducks and increased for both teal species during most of the period. Total harvest rate from 1953–1987 did not strongly correlate with bag limits ($r = 0.43$, $n = 27$, $P < 0.01$; point system years 1973–1979 excluded).

Coefficients of determination (R^2) between duck hunter success rate and duck abundance in 1955–1987 indicated two trends (Table 1). For species with hunter success ≥0.04, most coefficients for abundance (either in Ohio or on the breeding grounds) were in the 0.4–0.7 range. As harvest rate declined, the coefficients became variable. Also, coefficients for abundance in Ohio tended to be higher than those for abundance on the breeding grounds. Mean coefficients were 0.68 for Ohio data and 0.32 for breeding ground data (Table 1).

DISCUSSION

Increased Harvest Rate 1865–1880

A review of literature on changes in hunting strategies, Winous Point habitat conditions, and duck abundance during 1865–1880 suggests that improved hunting strategies probably had the greatest effect on harvest rates. Shotgunning technology rapidly advanced with the introduction of uniform lead shot (1860's) and choked bored (1870), hammerless, breech-loading shotguns (1875) (Hinman 1971). As a result, wingshooting became common and hunter proficiency presumably increased (Merritt 1904:74).

Also, three components influencing duck hunter preference are species availability, duck vulnerability to the gun, and palatability. In 1865–1880, diving ducks (particularly canvasbacks and redheads) were widely reported as abundant, highly vulnerable, and most preferred for eating (Cross 1880:92–93, Leffingwell 1890:419, Huntington 1903:172–175). Thus, significant advances in weapons technology and familiarity with wingshooting occurred when the preferred, easily decoyed duck species were abundant.

Waterfowl habitat in the Winous Point marshes changed little during 1865–1880. Detailed maps of the Winous Point marshes in 1864 and 1873 show that important plants for waterfowl (e.g., American wildcelery [*Vallisneria americana*], annual wildrice [*Zizania aquatica*], stiff arrowhead [*Sagittaria rigida*], cowlily [*Nuphar* spp.], and lotus [*Nelumbo* spp.]) were abundant and interspersed with narrow streams and channels. Annual precipitation and Lake Erie water levels were fairly constant during this period. Local marshes remained flooded and accessible to migrating waterfowl, yet water levels did not reach heights sufficient to suppress aquatic macrophytes.

Outside the Winous Point marshes, however, the amount of waterfowl habitat was being reduced substantially. The most important change was drainage of the Black Swamp (encompassing 400,000 ha in northwestern Ohio) which was half completed by 1870 (Kaatz 1955). The net effect of this habitat loss was to concentrate migrating waterfowl at Winous Point. Thus, habitat changes may have contributed to increased harvest during 1865–1880. We found no reports of increased duck abundance (1865–1880) in Ohio or the Mississippi Flyway (e.g., Dawson 1903, Huntington 1903, and Trautman 1940); nor were increases mentioned in the written comments of the Winous Point hunting register.

Decreased Harvest Rate 1880–1895

Hunting strategies also improved in 1880–1895 due to the introduction of live decoys and "smokeless" powder (Grinnell 1901:89, Kimball and Kimball 1969, and W. Druyor, Winous Point Guide, pers. commun., 1990). Improved hunting strategies should not have decreased harvest.

Northwestern Ohio wetlands continued to be drained, and Winous Point marshes began to deteriorate due to introduction of the common carp (*Cyprinus carpio*) in 1879. Carp quickly became abundant in western Lake Erie (Trautman 1981) and caused the decline of most turbidity-sensitive submergent aquatic plants (Pieters 1901, Lowden 1969). However, because peak harvest rates occurred in future decades under poorer wetland conditions, it is unlikely that habitat losses substantially contributed to decreased harvest rates 1880–1895.

Drastic declines in duck abundance in Ohio and the Mississippi Flyway were widely reported during this period (e.g., Dawson 1903, Huntington 1903:172, Merritt 1904:291, Trautman 1940:177) and were often attributed to effects of market hunting. We believe that decreased duck abundance was primarily responsible for decreased harvest rates 1880–1895.

Increased Harvest Rate 1895–1930

During 1895–1930, the use of live decoys and improvements in ammunition continued (although repeating shotguns were prohibited at Winous Point), and hunter preferences may have shifted to dabblers. As harvest of divers approached zero, hunters probably shot mallards and black ducks at an increasing rate. The large dabblers were nearly as preferred for the table but were much warier quarry (Bellrose 1944:339). All these aspects of hunting strategies should have helped increase harvest rates of dabblers during the period.

The first bag limits (here, a component of hunting strategies) were imposed by the club in 1902. These limits of 25 ducks/gun day had no relationship to harvest rates ($r = 0.00$, $n = 29$, $P = 1.0$) during the period.

An area map of aquatic plant species occurrence in 1894 and a 1929 aerial photograph indicate no changes in habitat or environmental conditions at Winous Point that would suggest increased harvest rate. Although Ohio farm yield rates for corn and wheat increased during 1895–1930 (Laub 1979:277), net waste grain available to waterfowl likely changed little due to improved crop harvest machinery and decreased farmland.

Increased abundance of black ducks was likely, as they were expanding their range into the region (Phillips and Lincoln 1930:60, Trautman 1940:177). However, substantial evidence indicates a decline in numbers of waterfowl nesting in the prairie grasslands and parklands of southern Canada during 1915–1935 (Bell and Preble 1934, 1943; More Game Birds in America Foundation 1935; American Wildlife Institute 1939; H. A. Hochbaum, Delta, Manit., unpubl. rep., 1947). Most evidence suggests that mallards and other dabblers nesting in the prairie grassland region were markedly suppressed during 1915–1935. These dates correspond roughly with years of peak hunter success rate for most dabbling ducks (mallard, black duck, northern pintail, American green-winged teal, and gadwall) at Winous Point.

It seems unlikely that a large, sustained increase in success rate occurred (1895–1930) unless duck abundance also increased. Thus, dabblers produced in areas not encompassed by waterfowl surveys may have contributed significantly to high success rates in 1915–1930. J. M. Anderson (Winous Point Shooting Club, unpubl. rep., 1947), A. S. Hawkins (U.S. Fish and Wildl. Serv., unpubl. rep., 1948), Bednarik (1978) and R. E. Trost (U.S. Fish and Wildl. Serv., unpubl. rep., 1985) have previously indicated an apparent minor effect of prairie duck production on Ohio harvest.

In summary, we speculate that increased abundance of ducks from unsurveyed areas and continued improvements in hunting strategies caused the increased harvest rates in 1895–1930.

Decreased Harvest Rate 1930–1950

Decreasing harvest rates closely paralleled declining bag limits and were strongly correlated during 1931–1950 ($r = 0.94$, $n = 20$, $P < 0.00$). Baiting became common at Winous Point around 1930 and was practiced extensively until 1946. Although baiting was unlikely to decrease hunter success rates, Pirnie (1935:116) questioned its effectiveness.

Aerial photos of Winous Point marshes indicate that they continued to provide good waterfowl habitat during the period. Precipitation and Lake Erie water levels ranged from very low amounts in the 1930's to very high amounts in 1950's and had no apparent effect to decrease habitat conditions.

Literature on duck abundance in Ohio from 1930–1950 is inconclusive, but prairie waterfowl populations increased from 1935 to the mid-1940's (Bell and Preble 1943). We found no documented reason to suspect that duck abundance contributed to decreased harvest rates 1930–1950.

Stable Harvest Rates 1955–1985

Modest improvements in hunting technology continued from 1955–1985. Bag limits (1953–1987) were not strongly correlated with harvest rates ($r = 0.43$, $n = 27$, $P < 0.018$). Bag limit effects on harvest were probably greatest before 1970, after which limits increased (point system 1973–1979) as harvest rates declined.

Wetland habitat conditions continued to decline in northwest Ohio during 1955–1985. At Winous Point, scientific principles of marsh management were developed and techniques generally improved during the period (Anderson 1984). However, the Winous Point marshes were decimated during 1972–1977 by high Lake Erie water levels. After 1978, Winous Point marshes were restored to quality wetlands.

The drastic decline in North American duck populations from 1955–1987 is unrefutable and undoubtedly contributed to slightly declining Winous Point harvest rates during the period. However, a weak association (mean $R^2 = 0.32$, Table 1) existed between species abundance on prairie-grassland breeding grounds (1955–1987) and species harvest/gun day. The weak relationship is likely due to the low proportion (8%) of ducks harvested in Ohio that are produced in surveyed areas (Munro and Kimble 1982, R. E. Trost, U.S. Fish and Wildl. Serv., Arlington, Va., unpubl. rep., 1985). More importantly, the influence of bag limits on harvest may account for the relationship between harvest and breeding surveys. Survey data are not available to adequately test the relationship of Winous Point harvest rates to breeding duck members.

Correlation of local fall abundance of species (1972–1987) with species harvest indicated a stronger relationship (mean $R^2 = 0.68$, Table 1). We expected a stronger association for harvest rates with local fall abundance of migrating ducks rather than with distant spring abundance of breeding ducks. In the local survey, a large majority of the ducks counted were observed within a 10 km radius of the study area during hunting season.

Overall, during 1955–1985, hunting strategies (i.e., declining bag limits), Winous Point

habitat conditions, and reduced duck abundance maintained low harvest rates. Bag limit effects on harvest rates in 1955–1985 were less than in prior decades, and harvest rates remained stable as duck populations declined. We were unable to empirically evaluate the relative effects of each influence during the period. However, a large database exists on North American duck harvest rates since 1955.

IMPLICATIONS AND RECOMMENDATIONS

Our evaluations of Winous Point hunting records suggested a temporal breakpoint in the capability to retroactively infer causes of trends in harvest rates. Before 1950, causes for harvest trends were discernible due to large rates of change and small numbers of influences. After 1950, causes were less apparent because harvest rates remained low and relatively stable and the numbers and interactions of influences increased. Inclusion of the waterfowl breeding ground survey database (1955–1987) into analyses did not clarify relationships. The lack of application of breeding ground survey data to the Ohio duck harvest substantially restricted their use here.

Our study reinforces the need for expanded duck breeding grounds surveys and increased duck banding programs in the Mississippi Flyway. Surveys in Ontario and Quebec initiated in 1990 by the U.S. Fish and Wildlife Service, Canadian Wildlife Service, and some states should continue. These surveys may provide needed data for Ohio and other states deriving few harvested ducks from areas encompassed by traditional surveys. Alternatively, simpler regulatory strategies may be capable of providing current levels of accuracy in determining impacts of the Ohio duck harvest to breeding duck populations.

Our data demonstrated no effect of 25-duck bag limits on harvest rate and indicated that these limits (1902–1930) did not constrain harvest. Thus, it is likely that bag limits of ≥ 25 ducks/gun day currently existing in some South American countries do not regulate duck harvest there. North American waterfowl managers should recommend functional limits of ≤ 10 ducks/gun day for those hunters.

We recommend compilation of other long-term, analytically appropriate waterfowl hunting records. Despite the limitations of census data from a single site, these studies can provide needed continuity for interpretation of research based on short-term samples. The applications and importance of long-term analyses increase as waterfowl managers struggle with the inability to answer increasingly specific questions about an international migratory resource.

SUMMARY

We present the first historical evaluation of waterfowl harvest spanning 125 years for 1 North American hunting site. We analyzed waterfowl hunter success rate (ducks harvested/gun day) data for the Winous Point Shooting Club in northern Ohio from 8 October–5 December, 1863–1987. We evaluated three categories of influence (hunting strategies, local habitat conditions, and duck abundance) on Winous Point harvest rates.

During most of the 125 year period, trends were governed by decreasing rates of change for harvest rate and its influences, and increasing interactions between influences. Causes of trends before 1950 were relatively apparent. However, since 1955, harvest rate and its influences have remained relatively stable, so causes were less discernible. Analyses using waterfowl breeding ground survey data (1955–1987) did not clarify relationships due to limited application of surveys to Ohio-harvested ducks and to the low, stable harvest rates.

Average number of ducks harvested/gun day increased from 6–15 during 1865–1880, mainly due to improved hunting strategies, and then declined sharply during 1880–1895, primarily because of declining populations and local habitat degradation. By 1900, harvest rates of mallard, black duck, and northern pintail began

a sustained increase, causing total harvest to peak in 1920 at approximately 16 ducks/gun day. Increased black duck harvest likely resulted from increased black duck abundance combined with changes in hunting strategies. Published reports of abundance for mallards and other dabbler species did not agree with trends in peak harvest during 1915–1930. Increased abundance of mallards and other dabblers produced outside of the regions encompassed by reports of abundance probably contributed to high hunter success rates in 1915–1930. Hunter success rates for the black duck declined sharply around 1925, for which we found no cause. Initial bag limits of 25 ducks/gun day (1902–1930) had no effect on harvest ($r = 0.00$, $n = 29$, $P = 1.0$), but bag limits of ≤ 10 ducks/gun day from 1931–1950 ($r = 0.94$, $n = 20$, $P < 0.00$) strongly influenced harvest. As daily bag limits declined to 4 ducks/gun day (1947–1959) and baiting ceased (1946), hunter success rate declined to near 4 ducks/gun day. Since 1955, success rates have remained near 3 ducks/gun day and weakly correlated with breeding grounds survey data (mean $R^2 = 0.32$) but more strongly with counts of local migratory populations (mean $R^2 = 0.68$).

Our data reinforce the need for expanded duck breeding grounds surveys, increased banding programs, or consideration of alternative regulatory strategies for Ohio duck harvest management. We also suggest that bag limits of ≥ 25 ducks/gun day that exist in some South American countries are nonfunctional and should be reduced to ≤ 10 ducks/gun day to affect harvest rate.

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