No. 4. Second spring.—2 years 1 month old. 3026, ♀, Okanagan, B. C., June 6, 1932.
No. 5. Third fall.—2 years 4 months old. 1492 Comox, B. C., Aug. 26, 1927.
No. 6. Adult. 8082, ♂, Okanagan, B. C., Nov. 5, 1935.
(Age is computed on the basis of all birds being born about July 1.)

Okanagan Landing
British Columbia

SEX RATIOS OF DUCKS IN MINNESOTA, 1938–1940 [1]

BY ARNOLD B. ERICKSON

INTRODUCTION

IN the United States it was not until about 1918, that field naturalists and bird banders began to realize that the sex ratios of certain species of ducks, especially diving ducks (Nyrocinae) were very disproportionate, the males outnumbering the females, at certain times, by eight or ten to one. In the British Islands, however, a number of ornithologists, as early as 1882, recognized the fact that very unequal sex ratios prevailed among certain species of ducks at certain times of the year and in certain localities. Payne-Gallwey (1882) comments on the large excess of male Common Pochards (*Nyroca ferina*) and female Greater Scaup Ducks (*Nyroca marila*). Boase (1926) published a paper on sex ratios of fourteen species of ducks based on observations made on the Tay Estuary between 1910–25. He found that in the Common Pochard and the Tufted Duck (*Nyroca fuligula*) the excess ran to males, but that in the Scaup Duck there was more often a preponderance of females and young. Robinson (1913) found in the Scaup Duck in the Orkney Islands a ratio of five males to one female, in the Pochard fifty to one, and in the Velvet Scoter (*Melanitta fusca*) twenty or thirty to one. Females, he found, were more numerous than males in the Eider (*Somateria mollissima*), Red-breasted Merganser (*Mergus serrator*), Goosander (*Mergus merganser*), and Tufted Duck. Millais (1913) also comments on sex ratios of diving ducks.

In 1925, Phillips called attention to some of the published information on sex ratios and made original observations on the ratios of the Greater Scaup and the Buffle-head (*Charitonetta albeola*). In 1932, Lincoln published the first account of sex ratios of banded ducks in the United States in which he showed that the males did outnum-

[1] Paper No. 1875, Scientific Journal Series Article, Minnesota Agricultural Experiment Station, St. Paul.

ber the females to a marked degree. McIlhenny (1937, 1940a, 1940b) has published sex-ratio data on twenty-one species of banded ducks. He found that in most species the males outnumbered the females about two to one, and that the sex ratios were more unbalanced in certain months than in others.

Sex-ratio counts of ducks have been made in the field by several observers, notably Bennett (1938) on the Blue-winged Teal and Hawkins (1939, 1940) on the Mallard. The counting of hunters' bags in order to ascertain the sex and age ratios of ducks has been tried by Hochbaum (1939). Furnis (1938) is one of the few observers who has published sex-ratio counts of ducks made on the nesting grounds. In Europe, Frieling (1934) brought together the sex-ratio data on 21,764 ducks of ten species. His figures, while showing a preponderance of males, indicate, according to Mayr (1939) more even ratios than those obtained by Lincoln and McIlhenny from banded birds.

Method of Making Counts

In the winter of 1937, I started to lay plans for making a three-year field study of the sex ratios of ducks. The study was to cover only the spring migration periods when ducks are seen in the greatest numbers and the sexes are most readily differentiated. I planned to make counts over the entire migration period, which in Minnesota extends from about March 20 to May 15, and to visit as many types of habitats and localities as possible, both in eastern and western Minnesota.

My object in making these counts was to determine, if possible, whether the sex ratios obtained by such counts would show the same trends as those obtained by Lincoln and McIlhenny on banded birds, and to make observations on the factors, influences, and activities that might affect the sex ratios and abundances. The sex-ratio counts were made by counting the individuals of a flock or part of a flock, and then counting the same flock or partial flock over again, first for males and then for females. When large rafts of Lesser Scaup or other species were observed, many counts were made of more or less isolated segments of the raft. Neither sex seemed to concentrate at the peripheries of these rafts. Much of the time it was possible to count a single species without the interference of another, but occasionally two or more species were mingled, thus making the counting slightly more difficult.

In 1938, observation was begun on March 27 and terminated on May 15, during which time seventeen areas in eastern and western

Minnesota were visited, some of them several times. A total of sixty-eight hours and fifteen minutes were spent in observation. The next year, observation was begun on March 26 and terminated on May 15, during which period twenty-five areas in both parts of the state were visited. A total of sixty-two hours and forty-five minutes were spent in the field. In 1940, observation was begun on March 30 and ended on May 12. Nineteen areas were visited, and fifty-four hours and thirty minutes were spent in the field. During the three years of observation one hundred and eighty-five hours were devoted to sex-ratio counts, divided as follows among the several weeks: March week 4, twenty hours; April week 1, thirty-nine hours and thirty minutes; April week 2, twenty-nine hours and forty-five minutes; April week 3, twenty-six hours; April week 4, thirty-seven hours; May week 1, nineteen hours; and May week 2, thirteen hours and forty-five minutes.

WEATHER AND MIGRATION

Climatic influences must be taken into account in a consideration of waterfowl migration and sex ratios. The average temperature for March, 1938, in Minnesota was 38° F., which is much higher than the average for the last ten years (29.2° F.). Although the season did seem to be very early, there was no great influx of ducks in March, and the species were poorly represented. During the first two weeks in April in southern Minnesota the weather was inclement, with high winds and occasional snow flurries. Near the end of the month and during the first three weeks of May, rain fell for many days, so that rivers went out of their banks, lake levels came up, and many temporary ponds were formed. This abundance of water attracted many ducks.

The average temperature for March, 1939, was normal, 29.4° F. In March, 1938, when the temperature was far above normal, the ducks came no earlier and were, with the exception of the Lesser Scaup, no more numerous than in 1939. In fact, most species were better represented in 1939 than in 1938.

In March, 1940, the temperature averaged 24.2° F., which is five degrees less than the ten-year average. The week of March 17 and the first few days of the next week were unusually cold, and on several mornings the thermometer stood at —5° F. Rivers and streams, normally open because of current, froze over, and the migration was delayed more than a week. On March 30, the first migrating ducks were seen on the Mississippi River at Minneapolis. As late as April 18, however, lakes and ponds in eastern Minnesota were still

frozen over, and the lack of open water all but restricted the migration to river channels.

The chief effect that temperature might exert on the sex ratio would be to produce a clumping of one sex at a given period, and the leveling of the sexes at another. In the spring of 1938, for example, which was warm and early, the sex ratio of 1372 ducks observed from March 27 to April 17 was 2.53 males to one female (Table 1). During the

TABLE 1

SEX RATIOS OF DUCKS BY YEARS, 1938–40 AND THREE-YEAR TOTALS
Ratios are given for the early and late migration periods and for the total period

Date	*Total*	*Males*	*Females*	*Ratio*
3/27–4/17	1372	983	389	2.53–1
4/18–5/15 } 1938	1005	655	350	1.87–1
3/27–5/15	2377	1638	739	2.21–1
3/26–4/17	734	442	292	1.51–1
4/18–5/15 } 1939	457	245	212	1.15–1
3/26–5/15	1191	687	504	1.36–1
3/30–4/17	1495	992	503	1.97–1
4/18–5/12 } 1940	945	581	364	1.59–1
3/30–5/12	2440	1573	867	1.81–1
3/26–4/17	3601	2417	1184	2.04–1
4/18–5/15 } 1938–40	2407	1481	926	1.59–1
3/26–5/15	6008	3898	2110	1.84–1

same period of 1940, when the spring was very late, the sex ratio of 1495 ducks was 1.97 males to one female. It is known, of course, that the males of most species precede the females or are more abundant during the early spring migration. The figures quoted above, then, may indicate that temperature plays a part in determining the proportion of the sexes in a given locality at a given time. A more complete discussion of this subject is given in the paragraphs below.

SEX RATIOS IN TIME AND PLACE

When sex-ratio counts are to extend over several months, it is necessary to divide the time into an early and a late spring period, which is in reality a division based on temperature. If the area on which the counts are to be made is very large or diversified, it may also be desirable to divide it longitudinally, because sex ratios and

species ratios vary in place as well as in time. The data relating to fifteen species of ducks, presented in the text and tables of this paper are divided, therefore, into an early spring period, March 27 to April 17, and a late spring period, April 18 to May 15. They indicate that there are significant differences for the two periods in the species present, their numbers, and their sex ratios.

Before considering the sex ratio of each species separately, the sex-ratio data for all ducks observed during each of the three years will be presented as units, and finally these units given as a whole. In 1938, sex-ratio counts were obtained on 2377 ducks of sixteen species (Table 1). Of this number, 1638 were males and 739 were females, making 2.21 males for one female. The sex ratio of 1372 ducks observed in the early spring migration period, March 27 to April 17, was 2.53 : 1; 983 males and 389 females were counted during this period. In the late migration period, April 18 to May 15, when the ratio tended to become more balanced, 1005 ducks, 655 males and 350 females were counted, a ratio of 1.87 : 1. In addition, according to estimate, over 10,000 ducks were observed but not determined to sex.

In 1939, counts were made on sixteen species totaling 1191 individuals, of which 687 were males and 504 were females or 1.36 males to one female. The ratio was much more, even in 1939, because of the great scarcity of the Lesser Scaup, which in the 1938 counts formed three-fourths of the ducks, and which had the unequal ratio of 2.90 males to one female. The ratio of 734 ducks counted in the early spring period of 1939 was 1.51 males to one female. This dropped to 1.15 : 1 in the late spring period when 457 individuals were counted. About 3650 ducks were observed but not determined as to sex.

In 1940, counts were made on 2440 individuals of seventeen species. Of this number 1573 were males and 867 were females, or 1.80 males to one female. The ratio in the early spring period when 1495 ducks were counted was 1.97 males to one female. In the late spring period the ratio dropped to 1.59 : 1, with a total of 945 ducks observed. About 6000 ducks were seen but not counted sexually.

A total of 6008 ducks, 3898 males and 2110 females or 1.84 males to one female were counted during the three-year period 1938–40. The total for the early spring periods of the three years was 2417 males and 1184 females or 2.04 : 1, and for the late spring period 1481 males to 926 females or 1.59 : 1 (Table 1). These results, together with the data of other field observers, may indicate that the disparity of the sex ratios obtained by trapping have been overemphasized.

RATIOS OF DIVING DUCKS AND PUDDLE DUCKS

It has been shown by several observers that the ratio of males to females is, as a rule, more unbalanced in diving ducks than in puddle ducks. In general my findings bear this out. During the three-year period, 4563 diving ducks of nine species were counted. Of this number 3094 were males and 1469 were females or 2.10 males to one female. Six species of puddle ducks, totaling 1425 individuals, 792 males and 633 females, or 1.25 : 1 were observed during the same period (Table 2).

TABLE 2

SEX RATIOS OF NINE SPECIES OF DIVING DUCKS* AND SIX SPECIES OF PUDDLE DUCKS

Year	*Total*	*Males*	*Females*	*Ratio*
1938	*1837	1327	510	2.60–1
	530	305	225	1.35–1
1939	* 787	467	320	1.45–1
	402	219	183	1.19–1
1940	*1939	1300	639	2.03–1
	493	268	225	1.19–1
Total	*4563	3094	1469	2.10–1
	1425	792	633	1.25–1

SEX RATIOS OF DUCKS BY WEEKS

Not only do the sex ratios and numbers of ducks differ in the early and late spring migration periods, but they also vary from week to week throughout the two periods. In Table 3 are shown, by weeks,

TABLE 3

SEX RATIOS OF FOUR SPECIES OF DUCKS BY WEEKS; THREE-YEAR TOTALS

Date	*Lesser Scaup*			*Ring-neck*			*Blue-winged Teal*			*Shoveller*		
1938–40	♂♂	♀♀	*ratio*	♂♂	♀♀	*ratio*	♂♂	♀♀	*ratio*	♂♂	♀♀	*ratio*
Mar. Week 4	84	35	2.40–1	21	14	1.50–1	0	0		0	0	
Apr. Week 1	308	131	2.35–1	24	17	1.41–1	3	0	3.00–1	37	32	1.15–1
Apr. Week 2	990	297	3.33–1	40	35	1.14–1	35	10	3.50–1	38	33	1.15–1
Apr. Week 3	225	88	2.55–1	141	98	1.43–1	42	23	1.82–1	25	22	1.13–1
Apr. Week 4	628	315	1.99–1	94	64	1.46–1	123	90	1.36–1	23	13	1.77–1
May Week 1	4	3	1.33–1	11	8	1.37–1	34	31	1.09–1	14	6	2.33–1
May Week 2	2	4	0.50–1	7	6	1.16–1	30	26	1.15–1	6	4	1.50–1

the sex ratios of the Lesser Scaup, Ring-necked Duck, Blue-winged Teal, and Shoveller for a seven-week period. The figures represent totals for the three years of observation. Although the number of hours spent in the field were not equal for each week (page 22) they approximated one another during the heaviest migration period—the month of April.

The sex ratio of the Lesser Scaup was most unequal in the second week of April in each of the three years. All in all, 990 males and 297 females, or 3.33 males to one female, were counted in this week. As shown in Table 3, the ratio was more equal before this period and was most uniform during the fourth week of April, when for the three-year period 628 males and 315 females or 1.99 males for one female were tallied.

The sex ratio of the Ring-necked Duck showed no marked variation from week to week. The greatest disproportion of the sexes, however, came in the third and fourth weeks of April, when for the three-year period the ratios were 1.43 males to one female and 1.46 males to one female respectively. The bulk of the migrants were observed during these weeks.

In Table 3 it is clearly shown that the Blue-winged Teal is a late migrant and that the males move northward before the females. The sex ratio during the second week of April was 3.50 males to one female. In the fourth week of April when, for the three-year period, 123 males and 90 females were counted, the ratio was 1.36 : 1. By the first week in May it had fallen to 1.09 : 1.

The sex ratio of the Shoveller was almost one to one during the first three weeks of April, but in the fourth week of April and the first week of May, males definitely predominated. The ratio for this latter period, when 37 males and 19 females were counted, was 1.94 males for one female. Admitting that the numbers of counts of Shovellers are few, it still is difficult to account for this increase of males in late April and early May. It is possible that in early springs the females might be nesting and would thus be seen less frequently than the males.

Much of the remainder of the paper is devoted to a discussion of the sex ratios and numbers of the individual species. In order to avoid repetition, ratios and numbers for the early and late migration periods and for the various years are not always given completely in the discussion. In Table 4 the data are presented in complete form.

LESSER SCAUP (*Nyroca affinis*).—The Lesser Scaup was the most abundant species observed during this study, and it exhibited the

TABLE 4

SEX RATIOS OF FIFTEEN SPECIES OF DUCKS IN THE EARLY AND LATE SPRING MIGRATION PERIODS

Species	*1938*				*1939*				*1940*				*1938–1940*			
	3/27–4/17		*4/18–5/15*		*3/26–4/17*		*4/18–5/15*		*3/30–4/17*		*4/18–5/12*		*3/26–4/17*		*4/18–5/15*	
	Total	♂ : ♀	*Total*	♂ : ♀	*Total*	♂ : ♀	*Total*	♂ : ♀	*Total*	♂ : ♀	*Total*	♂ : ♀	*Total*	♂ : ♀	*Total*	♂ : ♀
Lesser Scaup	916	3.58–1	618	2.20–1	135	2.85–1	93	1.90–1	902	2.51–1	450	1.86–1	1953	2.96–1	1161	2.04–1
Ring-neck	21	1.33–1	44	1.44–1	198	1.38–1	47	1.24–1	62	1.30–1	208	1.47–1	281	1.36–1	299	1.43–1
Blue-winged Teal	31	5.20–1	183	1.50–1	14	3.66–1	89	1.17–1	13	1.17–1	117	1.25–1	58	3.14–1	389	1.34–1
Shoveller	56	1.07–1	39	1.80–1	93	1.16–1	21	1.33–1	19	1.37–1	25	1.77–1	168	1.15–1	85	1.65–1
Pintail	36	0.64–1	44	1.60–1	53	1.30–1	9	1.25–1	178	1.17–1	2	1.00–1	267	1.10–1	55	1.50–1
Mallard	100	1.00–1	10	1.00–1	42	1.00–1	12	1.00–1	62	1.06–1	30	1.00–1	204	1.02–1	52	1.00–1
Baldpate	8	3.00–1	16	1.28–1	43	1.15–1	14	1.00–1	37	1.18–1	8	1.00–1	88	1.25–1	38	1.11–1
Redhead	101	1.46–1	13	1.17–1	9	2.00–1	8	1.00–1	31	1.58–1	48	2.00–1	141	1.51–1	69	1.65–1
Canvas-back	75	2.00–1	3	2.00–1	25	2.57–1	6	5.00–1	4	1.00–1	34	1.00–1	104	2.05–1	43	1.26–1
Am. Merganser	7	0.40–1	1	1.00–0	59	1.18–1	39	0.30–1	39	1.60–1	2	1.00–1	105	1.23–1	42	0.35–1
Red-breasted Merganser	0		9	0.80–1	36	1.57–1	0		51	5.37–1	0		51	5.37–1	45	1.36–1
Am. Golden-eye	15	6.50–1	3	0.50–1	45	1.25–1	2	2.00–1	73	1.28–1	2	0.00–2	133	1.46–1	7	0.75–1
Gadwall	3	2.00–1	4	1.00–1	8	1.00–1	4	1.00–1	0		2	1.00–1	11	1.20–1	10	1.00–1
Buffle-head	1	1.00–1	10	1.50–1	6	5.00–1	7	0.75–1	7	7.00–0	18	2.00–1	14	13.00–1	35	1.50–1
Ruddy Duck	0		0		2	1.00–1	70	0.89–1	8	1.66–1	0		10	1.50–1	70	0.89–1

most unbalanced sex ratio. In 1938, 1534 Scaups, 1142 males and 392 females, or 2.91 males to one female, were counted (Table 4). The ratio in the early spring period was 3.58 males to one female; in the late spring period it had fallen to 2.20 males to one female.

The most noteworthy feature of the 1939 migration was the comparative scarcity of the Lesser Scaup and the comparative abundance of the Ring-necked Duck. Where there had been thousands of Lesser Scaups on the Mississippi River and the lakes and sloughs in all parts of the state in 1938, there were tens the following spring. Only 228 Lesser Scaups, 161 males and 67 females, or 2.40 males to one female, were tabulated. The ratio in the early spring period of 1939 was 2.85 males to one female and in the late spring period was 1.90 males to one female.

It is interesting to speculate, but not easy to determine, why Lesser Scaups were abundant in 1938, very scarce in 1939, and abundant again in 1940. The variation in numbers may have been due to one or to many factors. The following seem to be most cogent: the 1938 breeding season was unsuccessful; hunting and other decimating factors took a heavier toll in the fall and winter of 1938–39 than during the same period of 1937–38; the migration was late and the majority of Scaups passed through western Minnesota; water and food conditions were more favorable in western Minnesota and the Dakotas and most of the Scaups passed northward through this region. Of the four suppositions, the last seems most tenable.

The 1940 migration of Lesser Scaups appeared to be equal to or greater than the 1938 migration. The ratio of 1352 individuals, 938 males and 414 females, was 2.26 : 1. The ratio of 902 birds counted in the early spring period was 2.51 males to one female, and for 450 observed in the late spring period, 1.86 males to one female.

A total of 3114 Lesser Scaups were counted during the three year period. Of this number 2241 were males and 873 were females or 2.56 : 1. The ratio of 1953 individuals counted in the early spring period was 2.96 males to one female, and for 1161 tabulated in the late spring period, 2.04 : 1.

RING-NECKED DUCK (*Nyroca collaris*).—The sex ratio of the Ring-necked Duck in Minnesota during the time covered by this study was more uniform than that of the Lesser Scaup. Also, there was no pronounced difference in the ratios of the early and late spring migration periods. It is sufficient to note here the three-year totals. In all, 580 Ring-necks, 338 males and 242 females were counted, or 1.39 males to one female.

In 1938, only 65 Ring-necks were counted. In 1939, when 245 were counted, it was in a lesser degree what the Lesser Scaup had been to the 1938 migration—the most abundant and conspicuous species. It appeared to be even more abundant in 1940, when 270 were counted.

BLUE-WINGED TEAL (*Querquedula discors*).—There is a marked tendency for the males of this species to precede the females in migration, despite the fact that Blue-winged Teals do not start to arrive in Minnesota in numbers until the second week in April. The ratio for the early spring period, three-year totals, was 3.14 males to one female, and for the late spring period 1.34 : 1. The ratio for both periods, based on 447 individuals, was 1.48 : 1.

SHOVELLER (*Spatula clypeata*).—Shovellers arrive in Minnesota as mated pairs, even at the beginning of the early spring period. The ratio for 168 individuals, three-year totals, was 1.15 males to one female. In the late spring period, three-year totals, the number of males to females was more disproportionate than in the early spring period. Of the 85 individuals observed after April 18, 53 were males and 32 females, or 1.65 : 1. It is possible that a surplus of young, unmated males occurs in the late spring migration, thus causing the disproportion.

PINTAIL (*Dafila acuta tzitzihoa*).—The Pintail is one of the most abundant ducks in Minnesota during the spring migration, particularly in the western part of the state. Its ratio seems to be very equal. In all, 322 Pintails, 173 males and 149 females were counted, or 1.16 males to one female. In 1938 and 1939 at Lake Traverse, Minnesota, many hundreds of paired Pintails were observed standing on the ice.

MALLARD (*Anas platyrhynchos platyrhynchos*).—The Mallard, like the Pintail, has a very even sex ratio; and like the Pintail, too, many hundred mated pairs were seen at Lake Traverse in 1938 and 1939. Of 256 individuals counted in various parts of the state, 129 were males and 127 were females, or 1.01 males to one female.

BALDPATE (*Mareca americana*).—Ducks of this species were not abundant in any of the three spring migration periods. Twenty-four were counted in 1938, 57 in 1939, and 45 in 1940. The sex ratio of 126 Baldpates, 69 males and 57 females, was 1.21 to one.

REDHEAD (*Nyroca americana*).—The Redhead, never abundant in Minnesota in the last decade, fluctuated in numbers during the three seasons of observation. In 1938, it was fairly common in the western part of the state, and 114 were determined to sex. The next year it seemed to have suffered a setback, and only 17 were counted. In

1940, it was more common, particularly in eastern Minnesota, where 79 were counted and about 200 others were observed. The ratio of 210 individuals, 128 males and 82 females, was 1.56 : 1.

CANVAS-BACK (*Nyroca valisineria*).—This species, like the Redhead, was observed most commonly in 1938. It decreased in numbers in 1939, and became more abundant again in 1940. The ratio of 147 individuals, 94 males and 53 females, was 1.77 : 1. About 200 other Canvas-backs were observed in eastern Minnesota but were not determined sexually.

AMERICAN MERGANSER (*Mergus merganser americanus*).—The American Merganser was, with the exception of the Ruddy Duck, the only species studied in which the females outnumbered the males. In the early spring period before April 17, the ratio was 1.23 males to one female. In the late spring period it was 0.35 males to one female. The ratio for 147 individuals observed during both periods was 0.88 males to one female. These ratios may indicate that the females remain longer than the males in southern localities, once the northward migration has started, and that the females may slightly outnumber the males. It is probable, too, that first spring males are not always distinguishable from females in the field.

AMERICAN GOLDEN-EYE (*Glaucionetta clangula americana*).—A large proportion, 133 out of 140, of the Golden-eyes counted during this investigation were observed in the early spring period. The ratio of these 133 individuals, 79 males and 54 females, was 1.46 to one. For the entire 140, the ratio was 1.41 to one.

RED-BREASTED MERGANSER (*Mergus serrator*).—This merganser does not remain in Minnesota during the winter in large flocks as does the American Merganser. As a rule, it is not a particularly common migrant. In the period covered by this study it was least common in 1938, when only 9 were seen, and most common in 1940, when 51 individuals were counted. The ratio of 51 individuals observed in the early spring period was 5.37 males to one female, and of 45 observed in the later period, 1.36 males to one female. For both periods the ratio was 2.55 males to one female.

RUDDY DUCK (*Erismatura jamaicensis rubida*).—No Ruddy Ducks were counted in 1938; 72 were counted in 1939; and 8 were counted in 1940. Ruddies are difficult to count and determine as to sex during migration because they remain well offshore, ride low in the water, and dive constantly. In good light, however, the white patches on the face of the male and the blue bill help in the separation of the sexes. Of the 80 Ruddy Ducks counted during the three years, 39 were males and 41 females, or 0.95 male to one female.

GADWALL (*Chaulelasmus streperus*).—Fewer Gadwalls were observed than any other species of puddle duck. Only 21 individuals were counted, 11 males and 10 females.

BUFFLE-HEAD (*Charitonetta albeola*).—Although only 49 Buffle-heads were observed during three springs of sex-ratio counting, the species appears to be increasing. In 1938, eleven were counted; in 1939, thirteen; and in 1940, twenty-five. Thirteen out of the fourteen Buffle-heads seen in the early spring period were males. In the late spring period, twenty-one out of thirty-five were males, or 1.50 males to one female. The ratio of 49 individuals, 34 males and 15 females, was 2.26 : 1.

POSSIBLE FACTORS CAUSING DISPARITY OF SEXES

Various ideas have been advanced to explain the unbalanced sex ratios of ducks. The reactions of ducks to biotic factors are usually the bases for these ideas. Differences in vulnerability to predators, hunting, diseases, accidents, and alterations in the environment are probably among the most important of these factors.

There seems to be no doubt that the female, which does all of the incubating and in most cases cares for the young without the assistance of the male, is more subject to predation than the male. The degree and kind of predation at the time of postnuptial molt may well vary according to the sex and species. Hochbaum (1939), for example, believes that during the flightless period, male diving ducks repair to open lakes while females remain in the marshes. Both sexes of puddle ducks remain in the marshes during the flightless period.

Types of hunting and selective shooting probably play a part in influencing the sex ratio. Hochbaum (1940) has shown that in 'jump-shooting' in northern waters the female Mallard is much more frequently killed by hunters than the male. McIlhenny (1940a), on the other hand, believes that the male is more frequently killed by hunters than the female. On the whole, however, it would seem that the large majority of hunters kill what they can and do not practice selective shooting.

Among the diseases affecting ducks may be listed lead poisoning, botulism, *Leucocytozoon* infections, and worm-parasite infections. Wetmore (1919) has intimated that lead poisoning may affect the male more than the female. Lead probably decreases the fertility of both sexes, but whether it adversely affects the female egg more than the male egg is not known. In fact, far too little is known

about the effect of diseases on sex and age classes of ducks to draw any definite conclusions. It seems reasonable, however, to assume that the female might be more subject to invasions of diseases than the male, especially after the egg-laying period and at the close of the long incubation period, during which time she has used up stored minerals in producing the eggs and probably has not been getting the proper amount and kind of food because of incubating duties.

In general, the female that nests in a greatly disturbed environment is more subject to predation and the activities of man than the one that nests in an undisturbed habitat.

Certain other biotic factors such as genetic factors (sex-linked lethals) and physiological factors (differences in rate or level of metabolism), are sometimes mentioned in relation to unequal sex ratios of ducks. They probably have little bearing on the phenomenon.

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SUMMARY

Sex-ratio counts were made on fifteen species of ducks during the spring migration periods of 1938, 1939, and 1940. The results obtained from the counts were, for each year, considered under an early spring period, March 27 to April 17, and a late spring period, April 18 to May 15. Significant differences were found in the species present, their numbers, and their sex ratios for the two spring periods.

In 1938, 2377 ducks were counted as to sex. The ratio of males to females was 2.21 : 1. The ratio of 1191 ducks counted in 1939 was 1.36 males to one female, and in 1940, when 2440 individuals were counted the ratio was 1.80 males to one female. In the three years of observation, 6008 ducks, 3898 males and 2110 females, or 1.84 males to one female, were counted. Of these 6008 ducks, 4563 were diving ducks (Nyrocinae), 3094 males and 1469 females or 2.10 : 1;

and 1425 were puddle ducks (Anatinae), 792 males and 633 females or 1.25 : 1. These results, together with the data of other field observers, may indicate that the disparity of the sex ratios obtained by trapping have been overemphasized.

The sex ratios and abundances of four species of ducks, Lesser Scaup, Ring-necked Duck, Blue-winged Teal, and Shoveller, were studied by weeks for each of the three years. It was found that both sex ratios and abundances varied from week to week.

For each of the fifteen species of ducks counted, the sex ratios and abundances are given in the text and summarized in the tables of the paper. The various ideas that have been advanced to explain the disparity of the sexes are discussed.

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CERTAIN RELATIONS BETWEEN THE PARTS OF BIRDS' EGGS

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INTRODUCTION

THICKNESS of shell has been shown by Asmundson and Baker (1940) to have a marked effect on the percentage of shell of avian eggs. They have further shown that changes in shape within ordinary limits have little effect on the percentages of shell, whereas given a constant thickness of shell, the percentage of shell increases markedly with a decrease in volume (size). Actually, however, the eggs of many species which lay small eggs have relatively less shell than the larger eggs of other species (Grossfeld, 1938). The reason for the relatively low percentage of shell on small eggs is not evident from published data since little information is available on the weight of the various parts of the eggs laid by different species of birds and even less on the thickness of shell. Eggs of different species were, therefore, obtained to secure more nearly complete data. While the number of species represented is small and the number of eggs from each species is comparatively small, the data are presented here with the hope that others will take the trouble to collect similar information when a favorable opportunity presents itself.

MATERIAL AND METHODS

Eggs were obtained from nests wherever possible while the nests were being added to. The eggs were removed as soon as possible