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WATERFOWL SEX RATIOS DURING SPRING IN WASHINGTON STATE AND THEIR INTERPRETATION

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Sex-ratio studies have received much attention from research workers in recent years. The contributions of Hochbaum (1944), Petrides (1944) and others have yielded considerable information on sex ratios in waterfowl; Beer (1945) and Yocom (1949) have presented data for the state of Washington. To interpret regional data on waterfowl sex ratios adequately, it is necessary to obtain a series of uninterrupted observations covering the entire migration period of the species concerned. In 1954, an ecologic study was conducted in the Potholes area, Grant County, central Washington (Johnsgard, 1956). During the period February 15 to May 16, sex-ratio data were collected for more than 15,000 ducks, including 17 species to be discussed in this paper. Nearly all these species wintered in the region and were present in small numbers when field work began in February (Johnsgard, 1954).

Sex counts were obtained for several types of habitat during this study. Among these were the potholes which occur between the sand dunes that were deposited in the region during glacial times (Bretz, 1928). Following the recent construction of O'Sullivan Dam and the subsequent filling of Potholes Reservoir, many of these potholes were inundated by the rapid rise of the reservoir. However, seepage below the dam has resulted in the formation of numerous lakes and smaller water areas in the scabland channels previously covered with sagebrush (*Artemisia tridentata*) and associated vegetation. Counts on these new seepage areas, as well as counts obtained on Potholes Reservoir, were recorded separately from those obtained on the sand-dune potholes.

METHODS

Sex counts were made directly with the aid of a six-power binocular during daily surveys of the study areas. Only birds definitely identified as to sex were included. There is little likelihood that many birds were overlooked because of the relative scar-

city of emergent vegetation in most of the habitats studied. However, it is probable that a certain amount of unavoidable duplication did occur. Ratios have been calculated (males per 100 females, total sample in parenthesis) in all cases where 100 or more individuals were recorded for a given time interval or habitat. In cases where fewer than 100 birds were recorded the total number of males and females is presented, but no ratios were calculated. Choosing 100 individuals as the minimum acceptable sample is wholly arbitrary and is not based on statistical tests.

OBSERVATIONS

As is usual among waterfowl, diving ducks observed in this study tended to exhibit a more disproportionate sex ratio than surface-feeding ducks. Furthermore, ratios of several diving duck species (redhead, common golden-eye, buffle-head, common merganser) tended to become less disproportionate as the migration period progressed. The ruddy duck exhibited a more disproportionate sex ratio near the end of the migration period.

Sex ratios of any single species varied at any given time as a result of at least two influences. First, sex ratios were more unbalanced on areas subject to human disturbance. Paired birds were the first to flush and the last to return to a disturbed area. Birds preoccupied in courtship display were noticeably less wary than paired birds. This same behavior was manifested by field-feeding mallards. Whenever a flock of these birds was flushed, a definite sequence of events could be observed. The first birds to return to the field were invariably a few single males, apparently searching for mates from which they had been separated during flushing. These birds would circle a few times, calling occasionally, but never landing. Later, numerous small flocks of unpaired birds would arrive, typically a single female and two or more males. These birds were the first to land, and were later followed by large groups of mostly paired birds. Thus the

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obtaining of sex counts on disturbed areas during the mating period is likely to be markedly influenced as a result of this phenomenon. Yocom (1949) indicated that sex counts of mallards obtained in winter and early spring on the Snake River near Clarkston, Washington, were usually more disproportionate than those obtained along portions of the river which are less frequented by humans.

Second, sex ratios during any single period varied with the characteristics of the habitat. Most mating activities of the surface-feeding ducks occurred on the shallow seepage areas below O'Sullivan Dam; diving ducks courted on the deeper lakes below the dam, along the edge of the reservoir, or on the deeper sand-dune potholes (Johnsgard, 1956). Following mating, many pairs separated from the main flocks and moved to the smaller *Scirpus*- and *Juncus*-lined sand-dune potholes, where food and cover were more available. Perhaps the greater seclusion and freedom from disturbance by bachelor drakes partially accounted for this behavior. Hochbaum (1944) mentioned that paired canvas-backs usually separate from the unpaired birds and frequent the tule edges. In spring observations on the Snake River near Clarkston, Washington, Stout *et al.* (1955) reported: "Early in the study most of the mallards observed in the eddy were unmated. As the study progressed the mated birds tended to move on down the river. The

bachelor drakes remained in the eddy."

As a result of the behavior described above, the sex ratios obtained in the more densely vegetated sand-dune potholes were more nearly equal than those counts obtained on the reservoir and seepage areas below O'Sullivan Dam. These differences in sex ratios are presented in Table 1 to illustrate this point. Data for the period February 15-21 are not included in the table, since the sand-dune potholes were still frozen at that time and all waterfowl were congregated in the seepage areas.

A certain degree of habitat preference is demonstrated in this table, the case of the ring-necked duck and canvas-back being most evident. The canvas-back used the seepage lakes almost exclusively during the courting period; since very few birds paired before departure, they were rarely observed in the sand-dune potholes. On the other hand, the ring-necked ducks moved from the seepage areas into the sand-dune potholes as soon as these were free of ice, where the birds continued courtship display. Common mergansers were never recorded in the potholes, but remained on the deeper lakes where they undoubtedly fed on fish and other aquatic animal life. Although the common golden-eye and buffle-head courted in the potholes as well as the seepage lakes, in the former they inhabited only those potholes that were deep and free of most vegetation.

As indicated in Table 2, there were only

TABLE 1. — LOCATIONAL VARIATIONS IN SEX RATIOS

Species	February 22 to May 16	
	Potholes	Reservoir and Seepage Areas
Mallard (<i>Anas platyrhynchos</i>)	118:100 (2,709)	150:100 (1,545)
Gadwall (<i>A. strepera</i>)	113:100 (117)	109:100 (367)
Baldpate (<i>Mareca americana</i>)	112:100 (138)	139:100 (661)
Pintail (<i>Anas acuta</i>)	113:100 (428)	135:100 (564)
Green-winged Teal (<i>A. carolinensis</i>)	105:100 (485)	121:100 (287)
Blue-winged Teal (<i>A. discors</i>)	(20:20)	(1:1)
Cinnamon Teal (<i>A. cyanoptera</i>)	(48:50)	(8:8)
Shoveller (<i>Spatula clypeata</i>)	113:100 (185)	(64:28)
Redhead (<i>Aythya americana</i>)	128:100 (476)	248:100 (111)
Ring-necked Duck (<i>A. collaris</i>)	158:100 (432)	(6:1)
Canvas-back (<i>A. valisineria</i>)	(8:6)	418:100 (294)
Lesser Scaup (<i>A. affinis</i>)	177:100 (411)	379:100 (1,423)
Common Golden-eye (<i>Bucephala clangula</i>)	97:100 (382)	170:100 (310)
Barrow's Golden-eye (<i>B. islandica</i>)	—	(26:14)
Buffle-head (<i>B. albeola</i>)	81:100 (350)	(51:38)
Ruddy Duck (<i>Oxyura jamaicensis</i>)	(30:23)	147:100 (951)
Common Merganser (<i>Mergus merganser</i>)	—	161:100 (615)

TABLE 2. — SEASONAL VARIATIONS IN SEX RATIOS

	Feb. 15-March 28	March 29-May 16	Total Feb. 15-May 16
Mallard	132:100 (3,018)	129:100 (1,996)	131:100 (5,014)
Gadwall	111:100 (175)	108:100 (335)	109:100 (510)
Baldpate	135:100 (443)	147:100 (408)	140:100 (851)
Pintail	122:100 (534)	130:100 (501)	126:100 (1,035)
Green-winged Teal	123:100 (202)	112:100 (667)	114:100 (869)
Blue-winged Teal	—	(21:21)	(21:21)
Cinnamon Teal	—	97:100 (114)	97:100 (114)
Shoveller	(16:7)	135:100 (254)	141:100 (277)
Redhead	198:100 (175)	140:100 (463)	152:100 (638)
Ring-necked Duck	171:100 (152)	159:100 (329)	163:100 (481)
Canvas-back	416:100 (558)	(15:7)	404:100 (580)
Lesser Scaup	279:100 (528)	317:100 (1,327)	305:100 (1,855)
Common Golden-eye	124:100 (689)	87:100 (170)	116:100 (859)
Barrow's Golden-eye	(8:3)	(18:11)	(26:14)
Buffle-head	103:100 (189)	81:100 (299)	89:100 (488)
Ruddy Duck	99:100 (173)	153:100 (865)	142:100 (1,038)
Common Merganser	228:100 (479)	51:100 (136)	161:100 (615)

minor variations in the sex ratios of surface-feeding species between the first and second half of the migration period. Although there are several inherent weaknesses in applying statistical tests to determine the significance of such variations, such tests suggest that the seasonal variations of the redhead, common golden-eye, ruddy duck and common merganser sex ratios are of a significant magnitude.

A differential sex migration would explain some of these variations in those species that pair on the breeding grounds (cf. Nice, 1937; and Tinbergen, 1939), but this explanation has limited application to waterfowl, which are usually paired before their arrival on the breeding grounds. Possible exceptions to this are the ruddy duck and the common merganser, both of which apparently exhibit a true differential sex migration.

An early spring preponderance of males followed by approximately equal numbers of males and females has been noticed in blue-winged teal in Minnesota (Erickson, 1943) and in teal (*Anas crecca*), shoveller, and pintail in the Netherlands (Lebret, 1950). This suggests to us that females may winter somewhat farther south than the males. Females are apparently more sensitive to cold than males (Harrison and McLean, 1947), often beginning their fall migration southward before the drakes (Leopold, 1919).

A differential migration between adult and juvenile birds would help account for a

late spring equalization in sex ratios for those cases where immature plumages of males closely resemble those of the female. This later migration of juveniles has been noted in redwings (*Agelaius phoeniceus*) (Allen, 1914), buffle-head (Munro, 1942) and other species, and very likely contributed to the apparent sex-ratio variation in the common golden-eye, buffle-head and common merganser in our study. Although juvenile males of these species were separated whenever possible, some were probably confused with females. For this reason the sex ratios presented for these species during the period February 15 to March 28 are considered most accurate.

An alternate explanation for the seasonal variations in sex ratios concerns a differential migratory behavior between paired and unpaired birds. Hochbaum (1944) mentioned that paired canvas-backs arrive at Delta marsh before the unpaired birds; this would tend to result in an increased proportion of males in later sex counts. Beer (1945) noted that paired baldpates were the first to depart from wintering grounds in southwestern Washington, and McIlhenny (1940) observed that female blue-winged teal began migrating north as soon as they were paired. A later preponderance of males was observed in the study area in the case of the ruddy duck. However, observations of the redhead indicated that most wintering birds and early migrants were not paired, and later

flocks were composed largely of paired birds. Fuller (1953) noted a similar situation with migrating pintail in Utah.

It is therefore apparent that any general statement to the effect that paired birds migrate earlier or faster than unpaired birds (or vice versa) is subject to considerable debate. However, it is possible that, through the differences in habitat preferences by paired vs. unpaired birds, sufficient cleavage of migratory routes in these two components of the populations occurs to account for paired (or unpaired) birds arriving at a particular location first. If such an influence is actually operative, it would appear logical to suspect that unpaired birds would tend to

select habitats suitable for courtship but unsuited for breeding, whereas paired birds would go directly to breeding areas and other habitats that offer most opportunities for food and shelter.

In all likelihood no single explanation will suffice; it is highly probable that all of the above complexities enter into the variations usually encountered in waterfowl sex-ratio counts. As a means of summarizing and comparing some of the available data on sex ratios, ratios observed in this study are compared with samples obtained by direct count in other areas (Table 3). Although ratios based on larger samples obtained from banding and hunter-kill data are available for

TABLE 3.—A COMPARISON OF NORTH AMERICAN WATERFOWL SEX RATIOS

Species	Sex Ratio	Location	Source
Mallard	131:100 (5,014)	Washington	Present Paper
	126:100 (6,810)	Ore., Calif., Nev.	Evenden (1952)
	109:100 (8,805)	Washington	Yocom (1949)
Gadwall	109:100 (510)	Washington	Present Paper
	101:100 (271)	Ore., Nev., Ariz.	Evenden (1952)
Baldpate	140:100 (851)	Washington	Present Paper
	114:100 (4,999)	Washington	Beer (1945)
Pintail	126:100 (1,035)	Washington	Present Paper
	126:100 (12,336)	District of Columbia	Petrides (1944)
	133:100 (11,687)	Utah	Fuller (1953)
Green-winged Teal	114:100 (869)	Washington	Present Paper
	108:100 (4,264)	British Columbia	Munro (1949)
Blue-winged Teal	144:100 (5,090)	Iowa	Bennett (1938)
Cinnamon Teal	97:100 (114)	Washington	Present Paper
	87:100 (2,379)	Utah	Spencer (1953)
Shoveller	141:100 (277)	Washington	Present Paper
	152:100 (3,190)	Ore., Calif., Nev.	Evenden (1952)
Redhead	152:100 (613)	Washington	Present Paper
	142:100 (3,400)	Iowa	Low (1945)
Ring-necked Duck	163:100 (481)	Washington	Present Paper
	193:100 (1,495)	Wisconsin	Buss & Mattison (1955)
Canvas-back	404:100 (580)	Washington	Present Paper
	162:100 (8,936)	Minnesota	Smith (1946)
Lesser Scaup	305:100 (580)	Washington	Present Paper
	201:100 (10,664)	Manitoba	Sowls (1955)
Common Golden-eye	116:100 (859)	Washington	Present Paper
	141:100 (140)	Minnesota	Erickson (1943)
Buffle-head	89:100 (484)	Washington	Present Paper
	142:100 (384)	British Columbia	Munro (1942)
	158:100 (520)	Iowa	Low (1941)
Ruddy Duck	142:100 (1,038)	Washington	Present Paper
	141:100 (850)	Iowa	Low (1941)
Common Merganser	161:100 (615)	Washington	Present Paper
	138:100 (773)	Washington	Beer (1945)

some of these species, such ratios have been shown to produce biased results (Petrides, 1944; Yocom, 1949). Thus, with the exception of Bennett's (1938) data (which are based partially on hunter-kill), the samples included are the largest available based on direct counts.

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SUMMARY

During the spring of 1954, sex-ratio studies were conducted in the Potholes area, Grant County, central Washington. Data were collected on over 15,000 ducks, including 17 species. Sex ratios during any single period were found to vary as a result of different habitat preferences and tolerance of disturbance between paired and unpaired birds. Changes in sex ratios as the migration period progressed were attributed to be the probable result of a differential migratory behavior between ages, sexes, and paired vs. unpaired birds.

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