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Canvasback and Lesser Scaup Activities and Habitat-Use on Pool 19, Upper Mississippi River

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ABSTRACT

Behavior and habitat use of canvasback (*Aythya valisineria*) and lesser scaup (*Aythya affinis*) were assessed on Pool 19 of the Upper Mississippi River during the spring and fall of 1982 and the spring of 1983.

Ducks were frequently observed in three sections of the study area; on the Illinois side of the river from Hamilton to Nauvoo; between Montrose and Niota; and in spring near Dallas City. Resting behavior was most prevalent, followed by diving (feeding) and loafing (sleeping). Lesser scaup dove more and spent less time loafing than canvasbacks.

For all three seasons, within nonvegetated habitat, no significant seasonal or behavioral differences were found between male and female canvasbacks, but significant differences were found between the sexes of lesser scaup. Differences in activities between male and female lesser scaup did not persist when fall observations were excluded, suggesting seasonal differences in use of Pool 19. No significant seasonal or behavioral differences between species were observed in ducks using submergent vegetation during the spring periods. Activity patterns for both species, during the combined spring periods, were significantly different between submergent vegetation and nonvegetated areas. It appears these differences were due largely to changes in the distribution of diving and loafing activities between habitats.

Key Words: canvasback (*Aythya valisineria*), lesser scaup (*Aythya affinis*), Upper Mississippi River, benthic fauna, macrophyte, Pool 19 or Keokuk Pool

INTRODUCTION

Prior to 1955, the largest concentrations of diving ducks migrating through Illinois were often found in the Illinois River valley (Mills et al. 1966). The general degradation of aquatic habitat in this historically important area resulted in the loss of high quality macrophytes and macroinvertebrates, including fingernail clams (*Musculium* spp.). These changes, brought about by pollution and sedimentation (Havera and Bellrose 1985), contributed to the decline in diving duck use of the Illinois River valley (Mills et al. 1966). While this was occurring an increase in diving ducks was noted on the Mississippi River (Mills et al. 1966). In the late 1960's, navigation Pool 19 of the Upper Mississippi River (UMR), also known as the Keokuk Pool, became one of the critical high-use areas for diving ducks in inland North America (Thompson 1973), thus reflecting its importance to this group of waterfowl.

Because of its biological significance, a wide range of waterfowl studies have been conducted on Pool 19 including an evaluation of winter migration patterns of staging canvasbacks (Serie et al. 1983) and waterfowl harvest (Wilds 1972). Additional work has focused on food habits (Rogers and Korschgen 1966, Thompson 1973), as well as flock movements and general flock behavior during fall migration (Thornburg 1973). From his study, Thornburg concluded that flock distribution within Pool 19 was associated with abundance of benthos, an important food supply.

Food habits of lesser scaup are variable, with some reports indicating plant material as the major food (Kubichek 1933; Korschgen 1955), though many studies have shown animal material to be the typical constituent (see Bellrose 1978 for overview). Food habits of lesser scaup collected on Pool 19 revealed that gizzard contents were primarily animal material consisting of gastropods, sphaerids, and mayflies (Rogers and Korschgen 1966, Thompson 1973). Animal material accounted for over 90% of the total organic content of lesser scaup gizzards collected on both the Illinois and Mississippi Rivers (Anderson 1959).

In comparison to lesser scaup, plant material has been shown more likely to be consumed by canvasbacks (see Bellrose 1978 for an overview). On Pool 19, Thompson (1973) found a higher percentage of plant material in gizzards of canvasbacks (46%) than in lesser scaup gizzards (19%), but 80% (47) of the canvasback gizzards contained gastropods and pelecypods and more held mayflies compared to lesser scaup. Canvasback gizzards collected on both the Illinois and Mississippi rivers, contained a higher proportion of plant (65%) than animal (35%) material (primarily dipterans) compared with lesser scaup (10% plant material; 90% animal material) (Anderson 1959). Canvasbacks appear to rely extensively on vegetation, yet animal material may account for a substantial proportion of the diet.

High densities of fingernail clams (*Musculium transversum*), have been found in Pool 19, primarily in nonvegetated main channel border habitat (Anderson and Day 1986, Gale 1973). In comparison to nonvegetated habitat, invertebrate diversity increased in vegetated habitat and fingernail clam composition shifted from *M. transversum* toward *Sphaerium striatinum*. However, overall abundance and biomass of macroinvertebrates was lower in vegetated habitat compared to nonvegetated channel border habitat

(Anderson and Day 1986). This relationship is important because extensive sedimentation in the channel border areas of the lower reach of Pool 19 has been accompanied by rapid expansion of aquatic macrophyte beds comprised of various pondweeds including sago pondweed (*Potamogeton pectinatus*) and wild celery (*Vallisneria americana*) (Jahn and Anderson 1986; Paveglio and Steffeck 1978). If macrophyte beds continue to expand, a decline in fingernail clams would be expected to occur in known areas of high density. Though canvasbacks consume plant material (Korschgen et al. 1988) and may adapt to this increase in macrophytes, the ability of lesser scaups to thrive on plant food is uncertain. Thus, as a result of these ongoing habitat changes in the lower reach of Pool 19, this study was initiated to examine seasonal and habitat relationships of diving duck activities.

METHODS AND MATERIALS

Activities of canvasback (*Aythya valisineria*) and lesser scaup (*Aythya affinis*) were observed on the lower 46 km of Pool 19 during the spring and fall of 1982 and the spring of 1983 (Figure 1). Most shoreline sightings were taken using a 20X Bausch and Lomb spotting scope, from locations in Illinois between Hamilton and Dallas City and in Iowa from Keokuk to north of Ft. Madison (Figure 1). A discontinuous, instantaneous time-sampling procedure (Tyler 1979) was used to delineate each individual observation period. Instantaneous time-sampling has been used in behavior studies for a variety of animals including the spotted sandpiper (Maxson and Oring 1980) and gadwalls (Dwyer 1975).

In this study, a duck on the water was randomly selected and observed for 10 s. The behavior at the end of this period was recorded. An electronic metronome, similar to that described by Wiens et al. (1970), was used to denote the observational period.

Behavior was recorded for five general categories. Resting consisted of swimming or floating on the water with the head upright or in a "non- sleeping" mode. A duck was classified as loafing if its bill was placed under its wing. This behavior suggested a reduced state of attentiveness and has been termed "pseudo-sleep" (Cornwell and Bartonek 1963). Diving was considered indicative of foraging. A duck was recorded as diving if it dove during any part of the 10-s observation period, due to the difficulty in accurately and consistently identifying the same duck before and after diving. Duration of dives averaged 22 s for canvasbacks and 20 s for lesser scaup (Day 1984) which indicated that once diving was initiated it typically continued for at least the standard 10-s observation period. Preening consisted of maintenance of feathers, scratching or related activities. Behavior which could not be classified into these categories, including flying, was defined as "other". No distinction was made for courtship activity.

Observations were recorded only during daylight hours due to difficulties in consistently obtaining nighttime observations, even with the use of night-viewing equipment. The number and location of sites observed in a day varied and were dependent upon flock size, flock location and weather conditions. Ducks in emergent vegetation were excluded from analysis because of the low number of sightings, compared with nonvegetated or submergent vegetation. Nonvegetated habitat consisted of channel-border and main-channel areas.

A heterogeneity chi-square (Zar 1984) was used to determine if data could be pooled. Subsequently, we used a contingency chi-square table to test differences in activities. For each test we used the behaviors of diving, loafing, resting and preening. The "other" category was excluded since this activity was often too low in occurrence for use in statistical analyses.

We first tested the four categories of males and females of both species, to determine if observations could be pooled. We grouped these categories by habitat type and used all three seasons in nonvegetated habitat, but only the spring periods for submergent vegetation because of the low number of observations in this habitat during the fall. We then examined activities between males and females of each species within each habitat type to evaluate if sexes could be combined for each species (e.g. canvasback males vs. canvasback females in nonvegetated habitat). We used the contingency X^2 to compare season and habitat within each category (e.g. behaviors of male canvasbacks by season). Next we tested for differences in activity patterns between the two spring periods in nonvegetated habitat. For this we again used the four categories of males and females of each species. We then compared activities between habitat types for each species (sexes combined) (e.g. lesser scaup in nonvegetated habitat vs. lesser scaup in submergent vegetation). We used observations only from the two spring periods since an insufficient number of fall observations were obtained in submergent vegetation.

RESULTS

General use areas

In the downstream portion of the study area, ducks were frequently sighted at mid-river and along the Illinois shore from Hamilton to Nauvoo (Figure 2). In the middle section, from Montrose to Ft. Madison, ducks were concentrated in mid-river near Devil's Creek, and south of Niota along the Illinois shore. In the upper part of the study area most ducks were observed near Dallas City.

Activity patterns

Activities of 2,756 canvasbacks and 4,875 lesser scaup were observed during the three migration periods in submergent and nonvegetated habitats. For both species across all seasons and both habitat types, resting was the dominant behavior, accounting for 47.4% of all observations (Table 1). Of the remaining behaviors, 32.2% of the ducks were diving, 15.0% loafing, 4.9% preening and 0.5% in "other" activities. By habitat, 6,708 (87.9%) were recorded in nonvegetated habitat (includes main channel) and 923 (12.1%) in submergent vegetation (Table 2).

In nonvegetated habitat, little seasonal variation was observed in diving for either male or female canvasbacks (27.6% to 35.8%) while for lesser scaups the proportion of time in this activity ranged from 14.9% to 46.8% (Table 1). Loafing activity varied for both species with the lowest percent occurrence in the spring of 1982 and the highest values in the fall of 1982 (Table 1).

The percent of ducks engaged in resting activity in nonvegetated habitat declined steadily from the spring of 1982 to the spring of 1983 for all groups except lesser scaup females.

Lesser scaup females exhibited a slight rise in resting activity in the fall. The most disparate resting values were for male lesser scaups ranging from 34.5% to 56.6% (Table 1). Resting was the principal activity for all ducks except in spring 1983 when diving was observed more frequently except in canvasback males. Both preening and "other" activity were low in occurrence and showed little overall seasonal variation.

The number of observations in submergent vegetation was low compared with nonvegetated habitat. The largest number of observations was for lesser scaup in spring 1982 (Table 2). Canvasbacks were most consistently observed, but typically in low numbers (less than 50 in any category) (Table 2).

Using all three seasons, we found a significant difference (Heterogeneity $X^2 = 132$, 18 df; $P < 0.001$) among the four groups (e.g. male canvasback, female canvasback, male lesser scaup and female lesser scaup) in nonvegetated habitat. Consequently, we were unable to group all ducks. No significant difference (Heterogeneity $X^2 = 6.98$, 9 df; $P = 0.639$) was detected among these groups in submergent vegetation in spring. Thus, a significant difference existed among groups (sexes of each species) in nonvegetated habitat, but not in submergent vegetation.

After finding this significant difference among the four groups (e.g. male canvasback, female canvasback, male lesser scaup and female lesser scaup) in nonvegetated habitat, we then tested to determine if activities differed between sexes of each species (e.g. male canvasback and female canvasback). We observed no significant differences (Heterogeneity $X^2 = 4.72$, 6df; $P = 0.580$) between male and female canvasbacks from all seasons, in nonvegetated habitat. Significant differences (males $X^2 = 92.58$, 6df; $P < 0.001$; females $X^2 = 50.84$, 6df; $P < 0.001$) were, however, found when we compared season and behavior within each sex of canvasback. Of all behaviors, diving appeared most seasonally consistent for both sexes (Table 1). Thus, as groups, male and female canvasback activity patterns were not significantly different, but within each sex the behaviors changed significantly between seasons. In contrast to canvasbacks, we observed a significant difference (Heterogeneity $X^2 = 33.77$, 6df; $P < 0.001$) in activities between male and female lesser scaups, with contributions to chi-square for males higher in diving, loafing and resting compared to the same activities for females. As seen for canvasbacks, significant differences (males $X^2 = 310.54$, 6df; $P < 0.001$; females $X^2 = 56.92$, 6df; $P < 0.001$) were evident by sex for lesser scaup, in the relationships of season and behavior. Preening for both sexes and loafing for females were most consistent across seasons (Table 1). The lack of significant differences among all groups in submergent vegetation precluded assessment by species.

We likewise observed a significant difference (Heterogeneity $X^2 = 32.03$, 9df; $P < 0.001$) among groups (e.g. male canvasback, female canvasback, male lesser scaup and female lesser scaup) in nonvegetated habitat during the two spring periods. A significant difference (Heterogeneity $X^2 = 30.68$, 3df; $P < 0.001$) was observed between species. A comparison of the spring periods revealed no significant difference (canvasback Heterogeneity $X^2 = 1.09$, 3df; $P = 0.779$)(lesser scaup Heterogeneity $X^2 = 0.17$, 3df; $P = 0.982$) between sexes (e.g. male canvasback vs. female canvasback). Thus, in spring, differences in activities were between species, but not between sexes within each species.

For each species, we compared behavior during spring, in nonvegetated habitat to behavior in submergent vegetation. Significant differences (canvasback Heterogeneity X^2 = 25.39, 3df; P < 0.001) (lesser scaup Heterogeneity X^2 = 8.94, 3df; P = 0.030) in activities were found between habitats for both species. The greatest differences were observed in loafing and resting for canvasback and in diving and resting for lesser scaup.

DISCUSSION

Resting and loafing were cumulatively the most frequently observed behaviors for both species. Our results were similar to those of Thornburg (1973) except we observed more feeding and less loafing behavior. Also using daytime observations, Thornburg noted only three periods of moderate feeding activity (30-80% of a flock diving). Instantaneous scan sampling used by Thornburg, as noted by Takekawa (1987) underestimates active behaviors such as diving and flying. This shortcoming may account for the discrepancy in proportion of these activities between Thornburg (1973) and our study.

Ducks were most frequently seen in nonvegetated channel-border habitat in locations closely corresponding to those observed by Thornburg (1973). Thus, our results indicate consistency in certain long-term physical or biological features which appear to be influencing behavior. Though resting (47.4%) was the dominant behavior, diving (feeding) accounted for 32.8% of all activities. It is likely that the abundance of fingernail clams (*Musculium* spp.)(5000/m^2) and burrowing mayflies (*Hexagenia limbata*) (4000/m^2) in nonvegetated channel-border habitat of lower Pool 19 (Anderson and Day 1986) may be responsible for this feeding activity. As mentioned earlier, one or both of these prey items partially comprise the diet of canvasbacks (Thompson 1973) and lesser scaup (Rogers and Korschgen 1966; Thompson 1973). Thus, as noted by Thornburg, concentration of ducks in these areas may reflect food availability or reduced human disturbance. The distribution of observations (87.9% nonvegetated; 12.1% submergent) was similar to the proportion of each habitat (nonvegetated 87.0%) (submergent vegetation 9.5%) (Day 1984) indicating no preference for either habitat. Emergent vegetation, primarily American lotus (*Nelumbo lutea*), occurred in 3.5% of the study area. The low percent occurrence of this habitat type coupled with the apparent lack of habitat preference may partly account for the small number of observations (21) in this habitat. Compared to nonvegetated channel-border habitat, macroinvertebrate biomass has been found to be low in both submergent and emergent vegetation (Anderson and Day 1986). Thus, these vegetated habitats do not appear to be most favorable sites for consumption of animal matter.

In fall, the combined total proportion of resting and loafing for both species (nonvegetated habitat) (61.8%) was slightly higher than the proportion of time (50%) in corresponding behaviors observed on Pools 7 and 8 in Wisconsin (Takekawa 1987). The proportion of these activities on Pool 19 declined in spring to 59.0%. For all seasons, diving was observed in 30.0% of the males and 31.0% of the female canvasbacks. These were higher than reported by Takekawa (1987) (males 20.8%; females 17.9%) who surmised that greater feeding activity on Pool 19 compared to Pools 7 and 8 may be related to the lower metabolizable energy of fingernail clams consumed by ducks on Pool 19, compared with wild celery winter buds consumed on Pools 7 and 8. Thus, higher levels of feeding activity would be needed to maintain or enhance energy levels. It is

unknown if a minimum frequency is required to replenish or accumulate fat reserves for ducks staging on Pool 19, but Takekawa (1987) noted the importance of feeding on staging areas to winter survival of canvasbacks using Lake Onalaska. Similarly, a reduction in food resources on Pool 19 could hinder winter survival or reproductive success.

Activities of canvasbacks and lesser scaup were significantly different in nonvegetated habitat. Takekawa (1987) also noted significant differences in the activity of these species on Pools 7 and 8. We suggest these differences are likely attributable to availability of food items and body size. Lesser scaups on Pool 19 typically consume more animal material than canvasbacks (Thompson 1973). The abundance of "preferred" food items may enhance feeding by lesser scaup in nonvegetated habitat.

Lesser scaup are smaller than canvasback (see Bellrose 1978). The relationship between body size and energy requirements was noted by King (1974) with smaller birds more closely associated with the environment. Though waterfowl were not the target species, Gibb (1954) reported an inverse relationship between feeding activity and size of bird. If this relationship persists for non-passerine birds such as diving ducks, it may partly explain the differences in activities between lesser scaups and canvasbacks.

Seasonal differences in activities were most evident for lesser scaup. In spring, a greater proportion of lesser scaups were diving and a lower proportion were loafing compared to fall. Using all three seasons, significant differences (Heterogeneity $X^2 = 33.77$, 6df; $P < 0.001$) were found between male and female lesser scaup. No significant difference was found between sexes upon removal of the fall observations (Heterogeneity $X^2 = 0.17$, 3df; $P = 0.982$). These results may indicate an adjustment in feeding activities prior to nesting. Nutrient reserves may be essential for reproductive success, as found for female canvasbacks (Barzen and Serie 1990). With growth in reproductive status, there is also evidence of a trend towards increased consumption of animal material for canvasbacks and scaup in Manitoba (Bartonek and Hickey 1969), wood ducks (*Aix sponsa*), (Drobney and Fredrickson 1979) and pintails (*Anas strepera*) (Krapu 1974).

In comparison to daytime sightings, Takekawa (1987) observed more feeding activity at night for both canvasback and lesser scaup. If a similar increase in nighttime feeding behavior occurs on Pool 19, then our values likely underestimate the actual amount of feeding activity.

A comparison of behaviors based upon habitat types indicated feeding activity was lower in submergent vegetation, areas typically with lower fingernail clam densities (Anderson and Day 1986), than in nonvegetated habitat. Differences in depth of water in the two habitats may also play a role in diving frequency. More time may be required for feeding in the typically deeper nonvegetated habitat.

CONCLUSIONS

The major activities of canvasbacks and lesser scaups on Pool 19 were resting, loafing and diving. Resting was prevalent (47.4%), but diving (feeding) occurred in 32.8% of the observations, indicating a multi- purpose function of this area.

Sedimentation in the lower reach of Pool 19 has contributed to the development of extensive macrophyte beds. Vegetation may provide an additional food source for waterfowl, as well as a substrate for invertebrates (Krull 1970), however in Pool 19 these plant beds lead to a shift in benthic macroinvertebrates from low diversity-high density to high diversity-low density communities (Anderson and Day 1986). On Lake Onalaska tubers of wild celery are the primary foods of canvasbacks (Korschgen et al. 1988), whereas on Pool 19, foods of canvasbacks and especially lesser scaup are comprised extensively of animal matter (Thompson 1973; Rogers and Korschgen 1966). We are uncertain how changing habitats will influence diving duck use of Pool 19. If foods obtained from Pool 19 are critical for diving ducks and feeding habits do not shift with food availability, use of the pool by diving ducks will likely decline. Consequently, there is a strong need for continued monitoring of diving duck use and habitat changes in Pool 19, to provide current information for management of this critical area.

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Table 1. Number and percent composition ( ) of canvasback and lesser scaup activities on Pool 19 in nonvegetated habitat.

Species	**Behavior**					
Canvasback						
Males	Diving	Loafing	Resting	Preening	Other	Total
Spring, 1982	165 (30.6)	31 (5.8)	319 (59.2)	21 (3.9)	3 (0.6)	539
Fall, 1982	221 (29.2)	177 (23.4)	326 (43.1)	31 (4.1)	2 (0.3)	757
Spring, 1983	70 (31.5)	48 (21.6)	85 (38.3)	19 (8.6)	0 (0.0)	222
Total	**456 (30.0)**	**256 (16.9)**	**730 (48.1)**	**71 (4.7)**	**5 (0.3)**	**1518**
Females						
Spring, 1982	102 (34.2)	20 (6.7)	153 (51.3)	20 (6.7)	3 (1.0)	298
Fall, 1982	141 (27.6)	128 (25.1)	221 (43.3)	19 (3.7)	1 (0.2)	510
Spring, 1983	53 (35.8)	34 (23.0)	50 (33.8)	11 (7.4)	0 (0.0)	148
Total	**296 (31.0)**	**182 (19.0)**	**424 (44.4)**	**50 (5.2)**	**4 (0.4)**	**956**
Lesser Scaup						
Males						
Spring, 1982	498 (29.7)	134 (8.0)	950 (56.6)	86 (5.1)	9 (0.5)	1677
Fall, 1982	50 (14.9)	121 (36.0)	143 (42.6)	20 (6.0)	2 (0.6)	336
Spring, 1983	379 (46.0)	116 (14.1)	284 (34.5)	38 (4.6)	6 (0.7)	823
Total	**927 (32.7)**	**371 (13.1)**	**1377 (48.6)**	**144 (5.1)**	**17 (0.6)**	**2836**
Females						
Spring, 1982	245 (34.0)	67 (9.3)	378 (52.4)	25 (3.5)	6 (0.8)	721
Fall, 1982	34 (21.2)	25 (15.6)	89 (55.6)	10 (6.2)	2 (1.2)	160
Spring, 1983	242 (46.8)	67 (13.0)	183 (35.4)	24 (4.6)	1 (0.2)	517
Total	**521 (37.3)**	**159 (11.4)**	**650 (46.5)**	**59 (4.2)**	**9 (0.6)**	**1398**
Grand Total	**2200 (32.8)**	**968 (14.4)**	**3181 (47.4)**	**324 (4.8)**	**35 (0.5)**	**6708**

Table 2. Number and percent composition ( ) of canvasback and lesser scaup activities on Pool 19 in submergent vegetation.

Species	**Behavior**					
Canvasback						
Males	Diving	Loafing	Resting	Preening	Other	Total
Spring, 1982	6 (15.4)	6 (15.4)	24 (61.5)	3 (7.7)	0 (0.0)	39
Fall, 1982	17 (30.4)	7 (12.5)	30 (53.6)	2 (3.6)	0 (0.0)	56
Spring, 1983	18 (19.8)	32 (35.2)	36 (39.6)	5 (5.5)	0 (0.0)	91
Total	**41 (22.0)**	**45 (24.2)**	**90 (48.4)**	**10 (5.4)**	**0 (0.0)**	**186**
Females						
Spring, 1982	6 (30.0)	3 (15.0)	10 (50.0)	1 (5.0)	0 (0.0)	20
Fall, 1982	6 (25.0)	2 (8.3)	13 (54.2)	3(12.5)	0 (0.0)	24
Spring, 1983	18 (34.6)	20 (38.5)	9 (17.3)	5 (9.6)	0 (0.0)	52
Total	**30 (31.2)**	**25 (26.0)**	**32 (33.3)**	**9 (9.4)**	**0 (0.0)**	**96**
Lesser Scaup						
Males						
Spring, 1982	86 (23.5)	66 (18.0)	195 (53.3)	19 (5.2)	0 (0.0)	366
Fall, 1982	0 (0.0)	0 (0.0)	3(100.0)	0 (0.0)	0 (0.0)	3
Spring, 1983	36 (44.4)	12 (14.8)	28 (34.6)	5 (6.2)	0 (0.0)	81
Total	**122 (27.1)**	**78 (17.3)**	**226 (50.2)**	**24 (5.3)**	**0 (0.0)**	**450**
Females						
Spring, 1982	45 (30.4)	24 (16.2)	74 (50.0)	5 (3.4)	0 (0.0)	148
Fall, 1982	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1
Spring, 1983	20 (47.6)	6 (14.3)	15 (35.7)	1 (2.4)	0 (0.0)	42
Total	**66 (34.6)**	**30 (15.7)**	**89 (46.6)**	**6 (3.1)**	**0 (0.0)**	**191**
Grand Total	**259 (28.1)**	**178 (19.3)**	**437 (47.35)**	**49 (5.31)**	**0 (0.00) 9**	**23**