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**Competition and Hostile Behaviors of Blue-Winged and Cinnamon Teal in Western Montana**

Gerald L. Dwyer  
*The University of Montana*

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COMPETITION AND HOSTILE BEHAVIORS OF BLUE-WINGED AND CINNAMON TEAL IN WESTERN MONTANA

By

Gerald L. Dwyer

B.A., University of Iowa, 1972

Presented in partial fulfillment of the requirements for the degree of

Master of Arts

UNIVERSITY OF MONTANA

1976

Approved by:

[Signature]
Chairman, Board of Examiners

[Signature]
Dean, Graduate School

[Signature]
Date June 10, 1976
Hostile behaviors and reproductive territories of Blue-winged and Cinnamon Teal were investigated in the spring of 1974 and 1975. Nine Blue-winged and 14 Cinnamon territories were mapped on the study area near Ninepipe Reservoir. Territories were mutually exclusive and territorial requirements were the same for both species. Large, permanent potholes were selected. Five hostile behaviors were described and flow charts of those behaviors were drawn. Three behaviors were previously described, but not in the natural state for Cinnamon Teal. On the study area, 938 observations were recorded, and an equal or larger number of observations were made off the study area and during 1973. Hostile behaviors were described based on 100 interactions recorded on the study area and observations off the area. The hostile behaviors of these two species were the same with the exception of vocalization. The similarity in hostile behaviors, interspecific interaction, and mutually exclusive territories pointed to direct competition between these two species on the breeding grounds. Two alternatives were suggested: (1) that competitive advantage would allow one species to supplant the other, or (2) that these two species are affected little if any by competition in this area of range overlap. The first alternative was rejected due to the long history of both species in the area of overlap, and it was suggested that these two species are partial competitors, holding each other in check in the area of overlap, with each having a competitive advantage at some other level of niche organization.
ACKNOWLEDGMENTS

I am especially grateful to Dr. Philip L. Wright, major advisor for this project, for assistance and guidance throughout this study and for critical review of the manuscript.

I would also like to thank the other members of the committee, Drs. B. W. O'Gara, S. J. Preece, and D. A. Jenni, as well as Dr. T. Rudegeair who reviewed the manuscript in Dr. Jenni's absence.

Jerry Salinas, manager of the Ninepipe Game Management Area, provided maps and useful information concerning the study area.

Mr. K. Lackschewitz, superintendent of the University of Montana botany greenhouse, aided in classification of plants from the study area.

I would like to specially thank my wife, Karen, who provided patience, understanding, and financial support during this study.

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Lastly, I thank my black Lab, Trapper, my companion and "nest finder."
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CHAPTER I

INTRODUCTION

Cinnamon Teal (*Anas cyanoptera*) and Blue-winged Teal (*A. discors*) are two very similar members of the North American Anatinae. Various authors state that these two species are closely related, have similar behaviors, are near each other in size and appearance, and breed in the same areas of western North America. The Flathead drainage in northwestern Montana is one of these areas where both species nest. During 1973 in this area, I observed Blue-winged and Cinnamon pairs engaged in interspecific aggression during April and May. I was then involved in a study of the Common (or Wilson's) Snipe (*Capella gallinago*). I later terminated that study when the excellent book by Leslie M. Tuck (1972) described the behaviors I had been studying. Observations of these teal, coupled with references in the literature concerning their similarity and readiness to breed in captivity, prompted this study. Also about that time, a hybrid drake was seen in the Blackfoot Valley (P. L. Wright, pers. comm.). Other hybrids have been recorded (Harris and Wheeler 1965).
A study area on Public Hunting Area adjacent to Ninepipe National Wildlife Refuge was chosen which offered a large prairie pothole breeding area used by both species. The primary objectives of the study were to:

1) describe and compare hostile behaviors for both species under natural conditions;

2) describe territorial requirements for both species on the breeding ground; and

3) determine the extent of competition between these two species for resources.
CHAPTER II

DESCRIPTION OF THE STUDY AREA

Location

The study area lies in the Flathead Valley, Lake County, Montana, within the boundaries of the Flathead Indian Reservation. The 129.6 ha plot is on the east side of U.S. Highway 93 just north of Allentown and is part of the Ninepipe Game Management Area acquired by the State in 1953. The description on State maps is "The western 1/2 of section 36" (Figs. 1 and 2). The study area is 1.6 km from north to south and 0.8 km from east to west.

The Valley floor in and around the study area is swell and swale topography within recessional moraines of pre-Wisconsin glaciation (Alden 1953). East of the Valley the Mission Range rises over 1,900 m. The western side of the Valley is bordered by the Flathead River and a series of low foothills. The tract is bracketed by two large reservoirs, the 810 ha Ninepipe Reservoir, part of the Ninepipe Refuge, to the south and west, and the 325 ha Kicking Horse Reservoir to the north and east. Both reservoirs serve as breeding areas, migratory stopovers, and wintering areas for waterfowl.
Fig. 1. Northern one-half of the study area.
Legend

- Irrigation or Drainage Ditch
- Road
- Temporary Pothole
- Wet 9/1/60
Fig. 2. Southern one-half of the study area.
Legend

- Irrigation or Drainage Ditch
- Road
- Temporary Pothole
- Wet 7/1/60
Geology

The area is a typical prairie pothole type. The soils are mostly silty clay loams with a scattering of other loams and silt, which are excellent water retainers (Harris 1954). The soil contains numerous rocks of all sizes up to 2 m in diameter. Potholes range in size from only a few to over 100 m in length.

Land Use

Prior to State ownership, the study area was farmland. Wheat and hay were the primary crops, and livestock were grazed. No grazing has been allowed since State acquisition. Some wheat plantings were made in 1973, and, in the spring of 1974, several areas had winter wheat. Some wheat grew again in these areas in 1975 due to unharvested seeds, but the majority of these areas were undergoing secondary succession. The majority of the area was a bluegrass-wheatgrass type with abundant forbs.

The northwest corner of the area, approximately 0.5 ha, was graded in 1973 and 1974, and several of the potholes in that section were muddied, reducing use by waterfowl. The water had mostly cleared by 1975.

Pothole Density

The study area contains a total of 105 potholes, or 0.8 potholes per ha. The entire 1,176.5 ha tract contains 686 potholes, or
0.58 per ha. This is relatively dense when compared to areas studied by Evans and Black (1956) who found 0.13 per ha in South Dakota and Keith (1961) who found 0.28 per ha in southeast Alberta. Each pothole is identified by a numbered metal tag affixed to a metal post placed north of the pothole by State personnel.

Climate

Mild to cold winters with temperatures as low as -30°C and snow cover of up to 0.6 m prevail. Spring is generally wet with about 10 cm of the 30 cm annual precipitation falling in May and June. Summers are hot and dry with temperatures up to 36°C. Autumn is generally warm with temperatures up to 25°C through October. Snow cover and spring rains are the only sources of water for the potholes; thus, annual precipitation affects the numbers of ducks nesting on the area. State maps designate any pothole containing water on 1 September 1960 as permanent since 1960 was a very dry year. The water in the potholes is alkaline, some potholes leaving a distinct white precipitate as they recede.

Vegetation

Due to wheat plantings, nonaquatic vegetation on the study area lay in zones of more or less disturbed areas. However, the majority of the study area was relatively mature grassland. Aquatic vegetation was relatively undisturbed by agricultural practices and
was typical of most pothole areas. Lokemoen (1962) compiled a list of aquatic plants for the Ninepipe area during his study of the Redhead (Aythya americana). That list and a list of nonaquatic plants are found in Appendix I. Certain avian and mammalian fauna are listed in Appendix II, and those breeding on the area are denoted. While vegetation and fauna had little effect on behaviors or territories in this study, these data are included to show what type of biome existed here and for future reference by others interested in cover, diet, predators, etc.
CHAPTER III

MATERIALS AND METHODS

Observation

This study required a great deal of time in the field rather than elaborate techniques. Eighty days were spent on the study area. Over 400 hours were spent in direct observation, and 938 observations of individuals were recorded on the study area (493 Cinnamon Teal and 445 Blue-winged Teal observations). Capturing and marking pairs was not attempted due to lack of sufficient manpower and a belief that birds so treated might abandon the area and thus bias the study. I felt I could describe territories by close, daily observations of pairs on the area, and experience proved this possible.

The study area was reconnoitered in the fall of 1973, and a route was mapped whereby all potholes could be checked. The "kettle" nature of the potholes and natural cover made unseen approaches easy. A 20X spotting scope, 6X binoculars, a map with pothole numbers, and a small tape recorder were carried on the route. All pertinent data were recorded on tapes and later transcribed into notebooks. At first, the route was covered daily, but later only every other day. On Saturdays and Sundays, human recreational use of the area disturbed
the waterfowl and made accurate recordings impossible. The first and last hours of daylight were avoided as many ducks moved in and out of the area to feed. Three to 6 hours were needed on any given day to gather data.

**Searching for Nests**

When lone drakes were seen on territories, a search was initiated in that area for the nest. In 1974, I searched, using a flushing whip, but in 1975, I used a Labrador retriever. In one case the dog caught a gadwall hen (*A. strepera*) and stepped on one of her eggs. The hen was released unharmed, and was on the nest two days later. Searches for nests were conducted after the route was covered so as not to alter recording routine. After a nest was discovered, it was visited on each trip thereafter until hatching. By 1 July of each year, most clutches had hatched and territories were abandoned by drakes, so all recording was stopped. The area was visited occasionally after 1 July to check for second nesting attempts (Sowls 1949) or late clutches.

**Pothole Classification**

I classified potholes on the area only with regard to their capacity to hold water through the breeding season. They were:

1) permanent, or always having open water;

2) semi-permanent, or always having water but becoming
covered by emergent vegetation; and

3) temporary, or those that eventually dry out.

These classifications can change from year-to-year due to variation in annual precipitation.

**Distinguishing Hens**

It was important to learn to distinguish hens. I observed hundred of pairs of both species from 1973 to 1975 and tested the theory that Cinnamon Teal have a longer and heavier bill than Blue-winged Teal by comparing pairs that were near one another. In all cases, the Cinnamon Teal appeared to have a longer and heavier bill. In many cases I tested myself by seeing a hen, and then the drake (Fig. 3). When side-by-side, the Cinnamon hen appeared brown compared to the gray cast of Blue-wing hens. Fortunately during the course of this study, I had to distinguish lone hens only 12 times.

**Movies**

In 1975, seven rolls of Super 8 movie film were made of teal engaged in hostile behavior.

**Incidental Data**

No attempt was made to measure either the productivity or the methods of rearing young for either species. Food was considered a nonlimiting resource. The study was carried out to the point of
Fig. 3. Diagram of bill difference in Blue-winged and Cinnamon Teal.
Cinnamon
A > B

Blue-winged
A < B
hatching, after which almost all pairs and territories had broken up.

During the study, a good deal of incidental information was gathered (Appendix III). Feeding behaviors were recorded during 1974, but this was not done in 1975 on the advice of the committee. I feel that feeding behaviors are very similar. Also, the bill size difference may contribute to differences in food items, as has been shown in land birds (Svardson 1949, Schoener 1965).
CHAPTER IV

BEHAVIOR AND PHYSICAL COMPARISONS

Behavior

Waterfowl behaviors were well studied following the lead of Delacour and Mayr (1945), Lorenz (1953), Johnsgard (1965), and McKinney (1965 and 1970). McKinney (1970) studied the displays of four species of a group called "Blue-winged ducks," a well-defined group within the subfamily anatinae (or dabbling ducks) containing seven species. All seven species have diagnostic blue patches on the upper wing. Both the Cinnamon and Blue-winged Teal belong to this group. The Common Shoveler (A. clypeata) is the only member of the group that shares its breeding range with these two teal, and all three are found on the study area. The shoveler does hybridize with both species, even producing fertile hybrids with the Cinnamon Teal (Johnsgard 1965). While this study emphasized behaviors and competition between Blue-winged and Cinnamon Teal, interactions with the Common Shoveler, although rare, were observed.

McKinney (1970) points up strong behavioral similarities of the Blue-winged ducks and suggests that they constitute strong evidence of taxonomic relationship. On the breeding grounds, where
this study took place, aggressive (also called hostile or agonistic) behaviors are most commonly seen. Johnsgard (1965) describes similarities in aggressive behavior:

In all species of this group [Blue-winged ducks] inciting assumes an almost uniform pattern and is characterized by marked chin lifting [called hostile pumping herein] alternated with bill lowering, but with very little lateral movement.

He continues,

Inciting in the Blue-winged ducks to some degree resembles precopulatory head-pumping and this similarity is further strengthened by the tendency of the male to respond with similar chin-lifting movements. During inciting and aggressive chin-lifting, however, the bill is tilted slightly upward, whereas in precopulatory head-pumping it is held level or is tilted downward somewhat. It is of interest that two displays which have such widely differing connotations can be of such similar appearance that they are almost never recognized as distinct in the literature.

Many authors refer to courtship rituals on the breeding ground. Since most Blue-winged and Cinnamon Teal are paired on the wintering grounds (McKinney 1970), I think these observers were primarily seeing males defending territories and/or the hen. I saw no hens that I thought were unpaired, but at times, as many as three "bachelors" would follow a pair and court the female. Most "three-duck flights" were a resident male chasing an intruding pair away from his territory.

Physical Comparisons

The "principle of Gause" (Whitaker 1970) states that no two animals can occupy the same niche at the same time. These two teal
display similar behaviors, are similar in size, and breed in the same area where their ranges overlap. The hens are very similar. Unless these two species are subdividing the available resources, it is possible that they are competing directly with one another.

Physically, the two teal are very similar. Bennett (1938) found that seven Blue-winged drakes weighed approximately 359 g in the spring, and hens 356 g. Kortright (1942) gives the weight of 13 Cinnamon drakes (season unspecified) as 12.0 oz (340 g) and 11 hens as 12.5 oz (354 g), which are almost identical. In an interspecific interaction, size could be a factor. The wings, important in some displays, are nearly identical. The hens are described repeatedly as practically inseparable (Merne 1974, Kortright 1942, Johnsgard 1965, and Delacour 1956). In addition, the two species hybridize readily, producing fertile hybrids. Delacour (1956) states:

> In captivity they [Blue-winged Teal] cross too readily with Cinnamon Teal . . . . It is the more surprising that these two closely allied teal seldom cross in the wild state in the rather narrow areas where they co-exist in North America.

The two teal differ mainly in that: 1) the males have different head and body coloration; 2) the Cinnamon drake has red rather than brown eyes; and 3) the bill of the Cinnamon Teal is larger and more shoveler like.
CHAPTER V

RESULTS

Hostile Behaviors

The main goal of the behavioral portion of the study was to determine the extent of similarities between the hostile behaviors of the two species. Strong differences in these behaviors could prevent direct competition for nesting territories. This appears to be the case for most waterfowl, as many species that can, and probably do, compete for some food items coexist peacefully on nesting grounds.

During the study, 100 hostile interactions were observed on the study area, in which ducks engaged in one or more of five behaviors described below. In 172 cases, two drakes of one or both species were present on the same pothole. Both species demonstrated the ability to discern rival drakes (or pairs) at any distance encountered on the potholes. If two drakes were in plain view, the potential for an interaction existed. It is possible but unlikely in the 72 cases of noninteraction that the birds did not see one another. Thus, out of 172 "possible" interactions, 100 actually occurred. Many other hostile interactions were observed off the area, but were
not quantified.

These observations were made from first arrival in the spring until eggs were hatched and territories were abandoned. In 1974, the first pairs arrived 22 April, in 1975 on 5 May. During both years, observations were terminated on 1 July. These arrival times are somewhat later than in some comparable northern areas (Dane 1966).

Out of 100 interactions recorded, 38 involved only Cinnamon Teal, 23 only Blue-winged Teal, and 39 were interspecific. These figures will be discussed further after the hostile behaviors have been described.

Normally, when describing behaviors for two species, the descriptions would be given separately. In this case, that would be redundant, as both are identical except for vocalization.

Hostile behavior was initiated by drakes or hens. Both used two basic methods. One method was simply to move directly to the other bird(s) and initiate hostile pumping, described below. The other was to move up to the other bird(s) and initiate one of the other hostile behaviors with hostile pumping omitted. Hens initiated interactions only when another hen was present. While hens participated in hostile pumping, they did not participate in any other hostile behavior. Even when attacked by drakes, hens did not defend themselves, but made every effort to escape. Unlike hens, a drake would
initiate interactions with any teal of the two species except his mate.

Hostile pumping and four other behaviors make up the hostile behaviors. Fig. 4 shows the "flow" of the behaviors.

**Hostile Pumping**

In hostile pumping, the body and wings were held in the normal attitude of swimming or walking. The bill was tilted upward to 30° from the horizontal, and the head was pumped up and down at a rate of about 1.5 times per second. The intensity appeared to increase with the stress of the interaction. Drakes of both species gave a typical vocalization. Blue-winged drakes gave a series of peeps, rather like a domestic chick, while the Cinnamon drakes gave a low rattling "rrrar" call. Hens were not heard to give any vocalization. Crown feathers were sleeked in some cases. Hostile pumping occurred on land and in the water, and birds were both moving or still while performing this display. In this study, most birds were in the water and moving when performing this display. Both birds of a pair perform hostile pumping, but not in unison. Hostile pumping was observed 83 times on the study area, and was seen commonly off the area during all 3 years.

**Pushing**

Single drakes would approach pairs and the paired drake would initiate hostile pumping and move toward the lone drake. The
Fig. 4. Flow chart of hostile behaviors.
lone drake would turn and move away with the pursuing drake following closely. The pursuing drake would in some cases peck at the other while "pushing" him away from the hen. In four cases, a flight chase ensued, and in one case, the pursuing drake rushed the other. At no time was pushing preceded or followed by circular fighting. Pushing lasted from a few to as much as 20 m. All pushing resulted in displacement, but some lone drakes would approach the pair as many as six times. All pushed drakes were apparently unpaired. Pushing was observed nine times on the study area, but was often seen on the nearby reservoirs, where most lone drakes were found.

Rushing

In rushing an opponent, a drake would stretch its head and neck low over the water, with the bill gaped, and rush rapidly at an opponent. In some cases, the wings appeared slightly upraised, but they were not used to propel the bird. Rushes were not completed (that is, ended in an attack) when the opponent remained facing or turned to face the rushing bird. In two cases, rushing drakes when "faced" by an opponent attacked the hen of the other pair. Rushing led to circular fights six times, and to flight chases seven times. Rushes were observed 32 times on the study area and often elsewhere.
Circular Fighting

Postures during circular fighting were variable, however drakes tended to circle one another and clash, with pecking and wing-flapping as the main components of the combat. In all cases, one or both birds were pushed partially underwater during the bout. A distance of up to 0.6 m was maintained until the clashes, which can be many (up to 10 observed) and last from 1 to 10 sec, with 1 sec being the most common length of time. Crown feathers were sleeked, and vocalizations as previously described were given. Six of seven fights observed on the study area had apparent victors, but several bouts seen off the area were apparently standoffs. On the study area, four fights led to flight chases, two of these resulting from the drake attacking the opposing hen. Birds engaged in much preening and some bathing after fights.

Flight Chasing

The "three bird flight" is often mentioned in the literature and called various names such as "territorial defense flight" (Hochbaum 1944) or "expulsion flight" (Lebret 1961). In some cases, males fought during flight by pecking, or the pursuing drake would attack the hen of the fleeing pair. The same vocalizations were given as in hostile pumping. Hens of pursuing drakes remained on the water with little or no activity until the drake returned. In two cases,
drakes rose off the water to pursue pairs passing over. Flight chases varied greatly in duration from only a few yards to out of sight (time unknown). Height did not exceed 35 m. Flight chases were observed 22 times on the study area, and were commonly seen in other areas.

Quantification

Analyzing behaviors was done using tables and flow charts (Tables 1 and 2, Figs. 5-14). Table 1 shows all interactions. Interspecific interactions occurred at nearly the same level as intraspecific interactions. Table 2 shows all interactions and separates those involving pairs and lone drakes. Figs. 5-14 are flow charts for the 10 combinations listed in Table 2, allowing for the tracing of all 100 interactions observed. The fact that a drake was alone during an interaction does not mean he was not paired.

Some explanation is necessary to clarify certain flow charts. In Fig. 6, the paired drake was always the aggressor. In Fig. 8 in two cases, the pair that was "approached" flew. In another case, a drake gave chase to a pair that flew over. In Fig. 9, the one case of approach → flight chase was also when a drake chased a pair that flew over. In the one circular fight, a lone drake was the aggressor. In all other cases, the paired drake was the aggressor. In Fig. 10, two flight chases were observed but the preceding behavior was not, thus the question mark on that chart. In Fig. 11, one interaction started with a rush, with no noticeable preceding behavior.
### TABLE 1. All hostile interactions for 1974 and 1975

<table>
<thead>
<tr>
<th>Species</th>
<th>Possible interactions</th>
<th>Actual interactions</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>CXC</td>
<td>52</td>
<td>38</td>
<td>73</td>
</tr>
<tr>
<td>BXB</td>
<td>35</td>
<td>23</td>
<td>66</td>
</tr>
<tr>
<td>CXB</td>
<td>85</td>
<td>39</td>
<td>46</td>
</tr>
<tr>
<td>Total</td>
<td>172</td>
<td>100</td>
<td>58</td>
</tr>
</tbody>
</table>

C = Cinnamon drake, whether paired or not.

B = Blue-winged drake, whether paired or not.

X = Nature of the interaction; example: CXC means an interaction involving only Cinnamon Teal.

Percentages are shown for ease of comparison.
TABLE 2. All hostile interactions for 1974 and 1975
designating pairs and single drakes

<table>
<thead>
<tr>
<th>Combination</th>
<th>Possible interaction</th>
<th>Actual interaction</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cpr X Cpr</td>
<td>31</td>
<td>26</td>
<td>84</td>
</tr>
<tr>
<td>Cpr X C</td>
<td>13</td>
<td>7</td>
<td>54</td>
</tr>
<tr>
<td>C X C</td>
<td>8</td>
<td>5</td>
<td>62</td>
</tr>
<tr>
<td>Bpr X Bpr</td>
<td>7</td>
<td>4</td>
<td>57</td>
</tr>
<tr>
<td>Bpr X B</td>
<td>16</td>
<td>10</td>
<td>62</td>
</tr>
<tr>
<td>B X B</td>
<td>12</td>
<td>9</td>
<td>75</td>
</tr>
<tr>
<td>Cpr X Bpr</td>
<td>29</td>
<td>15</td>
<td>52</td>
</tr>
<tr>
<td>Cpr X B</td>
<td>21</td>
<td>10</td>
<td>48</td>
</tr>
<tr>
<td>Bpr X C</td>
<td>15</td>
<td>10</td>
<td>67</td>
</tr>
<tr>
<td>C X B</td>
<td>20</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>172</strong></td>
<td><strong>100</strong></td>
<td><strong>58</strong></td>
</tr>
</tbody>
</table>

C = Cinnamon Teal.

B = Blue-winged Teal.

X = Nature of interaction; example: C X C = Cinnamon drake and Cinnamon drake.

pr = pair, i.e., Cpr = a pair of Cinnamon Teal.

Percentages are shown for ease of comparison.
Figs. 5-14. Flow charts for various combinations listed in Table 2. Numbers on the arrows designate how many times one behavior was followed by another. In addition to the five hostile behaviors, three other labels have been added. "Approach" designates cases where hostile pumping was not performed. "Attack" designates a rush that was carried through. "Displace" indicates that one bird moved the rival(s) out of the area. A flight chase is considered displacement. All interactions that did not end in displacement were considered draws, and an interaction can end at any level. Many, for example, went no further than hostile pumping.
Fig. 5. Flow chart for interactions involving two Cinnamon pairs.
Fig. 6. Flow chart for interactions involving a Cinnamon pair and a Cinnamon drake.
Fig. 7. Flow chart for interactions involving two Cinnamon drakes.
Fig. 8. Flow chart for interactions involving two Blue-winged pairs.
Fig. 9. Flow chart for interactions involving a Blue-winged pair and a Blue-winged drake.
Fig. 10. Flow chart for interactions involving two Blue-winged drakes.
Fig. 11. Flow chart for interactions involving a Cinnamon pair and a Blue-winged pair.
Fig. 12. Flow chart for interactions involving a Cinnamon pair and a Blue-winged drake.
Approach (4)  

Pushing

Attack

Displace

Hostile Pumping (6)

Rushing

Circular Fight

Flight Chase

Fig. 13. Flow chart for interactions involving a Blue-winged pair and a Cinnamon drake.
Fig. 14. Flow chart for interactions involving a Cinnamon drake and a Blue-winged drake.
Other Interspecific Interactions

During the study, any interactions with other species of waterfowl were noted, and this information is presented in Tables 3 and 4. The same criteria for possible and actual interactions were used. Specific names are in Appendix II.

The two interactions between Blue-winged Teal and Shovellers were as follows: in the first case, a pair of Blue-wings came close to a pair of Shovellers immediately after the Blue-winged pair had a long circular fight with a Cinnamon pair. The Blue-winged drake finally attacked the hen of the Cinnamon pair and drove them off the pothole. As the Blue-winged drake neared the Shovellers, the Shoveller drake rushed him, and the Blue-wings moved away. In the second case, a lone Shoveller drake "pushed" a Blue-winged drake around in the center of a pothole, occasionally chasing him. There was no hostile pumping or vocalization. The Shoveller drake lost interest after a few minutes.

The Cinnamon Teal did have one interaction with a Redhead drake, which was trying repeatedly to copulate with a hen in the center of a pothole. A pair of Cinnamon Teal swam rather close to the Redheads, and were chased by the drake. They moved away and the Cinnamon drake performed a "lateral dabbling" display, a display associated with pair formation (McKinney 1970). Lateral dabbling will be discussed below.
TABLE 3. Interactions of Blue-winged Teal with other species of waterfowl on the study area

<table>
<thead>
<tr>
<th>Species</th>
<th>Possible interactions</th>
<th>Actual interactions</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mallard</td>
<td>44</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Gadwall</td>
<td>33</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Shoveller</td>
<td>30</td>
<td>2</td>
<td>6.6</td>
</tr>
<tr>
<td>Redhead</td>
<td>26</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Green-wing Teal</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>L. Scaup</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bufflehead</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pintail</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wood Duck</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ruddy Duck</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wigeon</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
TABLE 4. Interactions of Cinnamon Teal with other species of waterfowl on the study area

<table>
<thead>
<tr>
<th>Species</th>
<th>Possible interactions</th>
<th>Actual interactions</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redhead</td>
<td>40</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>Mallard</td>
<td>29</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Shoveller</td>
<td>23</td>
<td>2</td>
<td>4.4</td>
</tr>
<tr>
<td>Gadwall</td>
<td>16</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Green-winged Teal</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bufflehead</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Barrow's Goldeneye</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lesser Scaup</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pintail</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ruddy Duck</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Canvasback</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wigeon</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Cinnamon Teal also had two interactions with Shovellers. In the first case, a lone Cinnamon drake swam near a Shoveller pair and the Shoveller drake initiated hostile pumping and chased the teal a few feet. The Cinnamon drake avoided the pair afterwards. In the second case, a pair of Cinnamon Teal approached a second pair and initiated hostile pumping. The two pairs, both pumping, moved along the edge of the pothole; the first pair forced the second pair out of the area. Eventually they approached a Shoveller pair, and this pair started pumping also. All three pairs milled around in one small area for several minutes before they separated. Hostile pumping was the only behavior involved.

Other Behaviors

One of the most common behaviors for both species was lateral dabbling, called "gabbling" by Lorenz (1953) and "mock feeding" by Johnsgard (1965). The drake dipped his bill into the water, with approximately one-fourth to one-third immersed. The head is oriented straight forward and the drake swims alongside of or in front of his female. The duration varies but is never more than a few seconds. McKinney (1970) states that the feathers on the flank and center of the back are conspicuously raised, but I noticed no such raising of the feathers. In some cases, drakes performed this display repeatedly, especially between or after bouts of hostile
behavior.

On three occasions, Cinnamon drakes were observed performing the precopulatory head pump, but copulation was not accomplished. Copulation itself was not seen for either species during the study, while it was frequently observed for other ducks.

In one case, a Cinnamon drake performed an apparent display. This drake was paired, but was several yards away from his hen. He oriented his body toward another Cinnamon pair and raised the wing elbows up and away from the body, while lowering the head and neck along the water surface. The bill was closed, and no vocalization was given. The effect was to conspicuously show both specula to the other pair. It was the only time I saw either species even approximate this position, and I am not aware of such a display described in the literature.

On three occasions, lone hens were involved. In one case, a lone Blue-winged hen and a Blue-winged pair shared a pothole. Shortly after I arrived, the drake flew over to the lone hen and initiated precopulatory head pumping. She flew almost immediately and he gave chase. They circled the pothole three times and then flew out of sight. The hen of the pair remained. In another case, a lone Cinnamon hen was on a pothole with a pair of Blue-wings. The Cinnamon hen approached the pair and "pushed" the hen around for 15 minutes. The hens did not head pump, but simply swam with the
Cinnamon hen constantly behind the Blue-winged hen. The drake followed both of them and performed hostile pumping, but did nothing else. Later, the Cinnamon hen was still alone and two Blue-winged drakes flew in. One of the drakes approached her, but she avoided him. The second lone drake rose and flew off, and the first started to follow but swung back and landed by the hen. He followed her again, and she finally flew with the drake in pursuit. There was no precopulatory head pumping. In a third case, an unknown hen (either Blue-winged or Cinnamon—I was too far away to tell) flew onto a pothole where there were two Blue-winged drakes. The two drakes immediately gave chase and she flew off with them in pursuit, she pecking at them when they came near her.

Vegetation

Vegetation played little or no role in behaviors except in cases where emergent vegetation prevented birds from seeing one another. This was rare on these round, relatively "clear" potholes, but could be a factor in areas where a convoluted shoreline exists.

Territoriality

Definitions of a territory are many and varied, but for avian studies two points seem to emerge.

1) The territory gives access to necessary resources.

2) In most cases, the territory is defended against
intruders (Nice 1941).

Waterfowl territories have two significant differences from those of passerines (Sowls 1955). The first is that the nest is often beyond the boundaries of the territory. The second is that the territory is usually occupied after the pair is formed. Hochbaum (1944) lists four basic requirements for a waterfowl territory: food, water, nesting cover, and loaf site. Waterfowl territories have been investigated by various authors, following the lead of Dzubin (1955). I defined a territory here as any area offering these four resources that was occupied and defended by a pair for 2 weeks or longer. The 2-week figure is arbitrary; however, I felt it was the shortest time in which the hen could build a nest, lay eggs, and start incubating. Once the hen is incubating, the drake may leave the territory. Boundaries were determined by observation, but are not rigid.

These two teals were easy to observe in that territorial pairs move very little during the day, even when disturbed. They are comparatively "tame" birds. Pairs used regular loaf sites, usually a portion of the bank due to lack of objects protruding farther out in the water in these dish-shaped potholes. Once territories were established, I was able to predict with a high degree of accuracy where I would see pairs or drakes.
1974 Territories

In 1974, ample water was on the study area. All potholes large enough (5+ m) to have a number assigned had open water on 30 April. Fourteen territories existed on the area in 1974, seven of each species (Fig. 15).

Pothole no. 511 in its entirety was a territory. This territory was held by a pair of Cinnamon Teal from 17 April to 9 May, after which it was held by a pair of Blue-wings until 3 June. Both pairs were most often seen together, whereas if a nest was present, the hen would have left. No nest was found in this area, nor was any brood seen.

Three territories existed in the area of potholes nos. 471, 472, 473, and 474. Pothole no. 473 was a Cinnamon territory from 29 April to 1 July. This pair had a nest with 10 eggs a few meters west of no. 473. All 10 eggs were destroyed by a mammalian predator on 6 June. Skunks were common in this area. A second nest was not found.

Pothole no. 474 was another Cinnamon territory from 29 April to 14 June. The pair occupying this territory was suspected of having a nest to the east, off of the study area, as the hen flew over that area several times. Nest searches were confined to the study area, so no nest was found.

A Blue-winged pair also had a territory in this area. While
Fig. 15A-E. Maps of Blue-winged and Cinnamon territories on the study area in the spring of 1974. Descriptions are in the text. See Figs. 1 and 2 for location of potholes on the study area.
This pothole was completely encircled by cattails (*Typha latifolia*).
Legend

B = Blue-winged territory

C = Cinnamon territory

* = Nest

::* = Territory boundary

#473-4 had no emergent vegetation.

#471-2 were encircled by cattail.

The pothole south of the road was surrounded by rushes (Juncus spp.).
Legend

B = Blue-winged territory

... = Territory boundary

#259 was surrounded by cattail.

#261 and #467 had patches of rushes and cattail.
Legend

= Marshy area
B = Blue-winged territory
C = Cinnamon territory
.... = Territory boundary

#286-7-8 and #493 were completely surrounded by cattail; #295 had a few small patches of cattail.
Legend

B = Blue-winged territory
C = Cinnamon territory
* = Nest
•••• = Territory boundary

Arrow points to nest site for Blue-winged hen from #267

#266-7 were completely surrounded by cattail.
#269 was surrounded by rushes with an "island" of cattail in the center.
the prime loaf site was off the study area, I included this pair since
the nest was on the study area just a few feet west of pothole no. 472.
This pair used the area from 1 May to 30 June when the 10 eggs
hatched. All three pairs having territories in this area used no. 471
where several interactions occurred.

Another Blue-winged territory was in the area of nos. 259
and 261. The entire northwest one-fourth of the study area had no
teal territories until 24 May when a pair of Blue-wings appeared. All
of pothole no. 259 and the western portion of no. 261 were the loaf
sites used. Although a nest was suspected, I could not find it, and
the pair was not seen after 14 June.

Another center of activity was around potholes nos. 286 and
287. Of the three territories in this area, one was a Cinnamon
territory, roughly the western two-thirds of no. 286. The Cinnamon
pair was present from 3 to 30 May. The hen was always with the
drake, and no nest was found.

A second Cinnamon pair used nos. 288 and the remaining
eastern one-third of no. 286 from 9 May to 1 July. This pair had a
nest near no. 291, as the hen landed twice in the grass there. The
nest was not located, but on 26 June while on pothole no. 276, the
hen performed a distraction display.

A Blue-wing territory consisted of potholes nos. 287 and
493, some 200 m south. Both areas were defended, and a Blue-wing
pair was seen from 3 to 30 May. They were always seen as a pair, and no nest was found.

A pair of Blue-wings used the southern one-half of pothole no. 295 and shared no. 493 with the above pair. Only once were both drakes on no. 493 at the same time and there was an interaction. This pair remained on this territory from 11 May to 17 June. On 26 June, a Blue-winged hen and 10 downy young appeared on no. 291, near this territory.

A Cinnamon pair held a unique territory in that they used a small part of three potholes, nos. 266, 267, and 261. All three potholes were Blue-winged territories, and surrounded no. 300 near where I felt sure there was a nest, as the hen appeared twice from the grass in this area and joined the drake. This pair was present from 14 May through 12 June. No nest was found.

Pothole no. 266 was a Blue-winged territory from 14 May through 14 June. This pair had a nest just east of the pothole, and produced young. The hen and four large ducklings were last seen on 1 July.

Still another Blue-winged pair used pothole no. 267. This pair stayed from 14 May to 28 June, when the hen hatched 12 eggs from a nest just west of no. 269.

Lastly, no. 269 was held from 20 May to 17 June by a Cinnamon pair. The hen was suspected of having a nest off the study
area to the northeast. The drake was often alone.

1975 Territories

In 1975, the area held less water. Although all numbered potholes again had open water on 30 April, many were very low, leaving large muddy areas between the water and surrounding vegetation. Nine territories existed on the area (Fig. 16). Again there were seven Cinnamon pairs, but only two Blue-winged pairs. Blue-winged numbers appeared low on the whole Ninepipe area.

Pothole no. 511 was again a territory, held by a pair of Cinnamon Teal from 10 May to 16 June, when the nest, a few meters south of the pothole, was destroyed. The nest contained 10 eggs; probably a mammalian predator ate them. The drake left on 9 June.

Pothole no. 466 had three Cinnamon territories. The pothole is large and is situated alongside the highway, and is constricted in the center. One pair used the north one-half, another the south half, and a third used the center one-half. As might be expected, interactions were frequent. The north pair stayed from 5 to 28 May, when the drake disappeared. The hen stayed until 18 June, when her clutch of seven eggs hatched. The nest was 15 m southeast from pothole no. 254.

The "center" pair stayed from 7 to 28 May and no nest was found. The southern pair stayed from 5 May to 9 June, and a nest
Legend

- Tree
- Cinnamon territory
- Nest
- Territory boundary

#511 was surrounded by cattail.
Legend

C = Cinnamon territory

* = Nest

#466 was surrounded by cattail.

..... = Territory boundary
Legend

B = Blue-winged territory
C = Cinnamon territory
* = Nest
.... = Territory boundary

#261 had patches of cattail and rush.
**Legend**

- **B** = Blue-winged territory
- **C** = Cinnamon territory
- **#266** = Territory boundary
- **#300**
- **#266** was surrounded by cattail, and **#268** by rushes.

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Legend

C = Cinnamon territory

#287-7 was surrounded by cattail.

.... = Territory boundary
was suspected off the study area to the west.

A Cinnamon pair used the western one-half of pothole no. 261 from 10 May to 23 June, when the hen hatched seven eggs in a nest between no. 261 and no. 262. The eastern one-half of no. 261 was a Blue-winged territory from 12 May to 18 June. A nest was suspected to be nearby to the north, but I could not find it. These two pairs on no. 261 had little conflict but avoided one another.

As in 1974, a pair of Blue-wings held pothole no. 266 from 2 to 27 June. A nest was found near no. 291 with 12 eggs, and the hen flew toward no. 266. The nest was destroyed by an avian predator before I could confirm where the hen's territory was.

On 16 May, a pair of Cinnamon Teal appeared on pothole no. 268 and were seen there regularly through 13 June. If a nest existed, I do not know when the hen spent any time on it.

Pothole no. 286 was again a Cinnamon territory starting on 10 May. The drake was gone by 13 June, and I was sure from the hen's actions that a nest existed just west of the pothole. On 23 June, a Cinnamon hen and 11 young were seen on no. 286, and again on 25 June, only there were 12 young.

All potholes that served as territories in 1974 and 1975 were permanent potholes. All pairs defended a certain area, but in cases where portions of potholes were used as territories, boundaries were vague. Most interactions occurred when a pair encroached on a
territory, or when territorial pairs met at a boundary. Some inter-
actions occurred on nonterritorial potholes when pairs came within
close proximity.

Vegetation

Vegetation appeared to play a small role in territory
selection, as territorial potholes differed in vegetation type. Also,
pairs fed off their territories as well as on them.
The hostile behaviors observed here include three already described by others for these two species. Johnsgard (1965) describes chin-lifting (hostile pumping) and McKinney (1970) describes hostile pumping, circular fighting, and flight chasing. McKinney was familiar with the Blue-winged Teal, however, his observations of Cinnamon Teal were based on 12 captive birds. In the natural state, I found no difference in these three behaviors as described by McKinney. I added the behaviors "pushing" and "rushing" to the hostile behaviors even though rushing is a well-known behavior in the Anatinae. I felt the hierarchy of these behaviors was important. Agonistic behavior is ritualized in these two species to a degree that only seven circular fights occurred in a sample of 100 hostile interactions.

Hochbaum (1944) suggested that hostile pumping serves as a threat in Blue-winged Teal, and McKinney (1970) feels this is the case for both species as well as a response of one male to another. I feel it is a threat display, but I feel only paired males respond with this behavior to the presence of another drake. Unpaired drakes are
commonly seen together during the breeding season, and hostile pumping is not performed.

The hostile behaviors of both species are very similar, and in this study hostile behaviors were identical with the single exception of vocalization. Of all waterfowl using the area, only the Common Shoveler demonstrated similar behaviors.

During hostile interactions, the two species treat one another in the same manner as conspecifics (Tables 1 and 2). This is not the case with any other species on the area as evidenced by Tables 3 and 4.

In the 72 cases of noninteraction, two facts must be pointed out. First in many cases, although birds were on the same pothole, they did not come near each other and possibly they did not see or recognize the other. Secondly, the data include unpaired drakes that are not likely to initiate an interaction.

Territorial requirements appeared to be the same for both species. In all cases, large permanent potholes that offered the four basic requirements were selected. In areas where territories abutted, the boundaries were vague, and overlap existed. However, neighboring pairs of either species did not use overlap areas at the same time without interaction.

These conclusions concerning territories and behaviors indicate that these two species of teal are in direct competition.
for nesting territories. All other species of Anseriformes, including the Common Shoveler, shared water areas with both species with little or no conflict. Whittaker (1970) defines a niche as "... the species' place in the community in relation to other species..."

These two teals appear to occupy the same niche on this area. Use of the same resource by two species reduces the availability of that resource to each. The growth or survival of one or both species is affected. In this case, I propose two alternatives: (1) that one species will eventually displace the other because of some competitive advantage, and (2) that neither species is detrimentally affected due to subdivision on some other level. Brewer (1963) described a similar situation for chickadees (Parus atricapillus and P. carolinensis) in that two species were in direct competition in the area of overlap but neither species was affected overall. An important factor may be the different wintering grounds for these two ducks, where the major portion of the year is spent, however, there is overlap there as well.

Since both species utilize a wide range of food, both probably compete with other waterfowl as well as with one another. Orians and Willson (1964) state:

For several reasons interspecific territoriality among birds may be much more common than currently recognized. Abundant evidence indicates that in the absence of a normal component of a community another species often occupies the habitat, suggesting that most species are prepared to expand ecologically,
but are continually held in check by competition with other species. Moreover surplus populations of sexually mature individuals are probably characteristic of many species of birds. Crowell (1961) demonstrated this in passerines. In this study, a pair of Blue-wings appropriated pothole no. 511 upon the disappearance of the Cinnamon pair that had held the territory.

Since neither species has suffered a major loss of range in North America, I think these two closely related species are held in check through competition with one another in the area of overlap, and that one cannot inhibit the reproduction of the other to the point of exclusion. Both species have actually extended their ranges into western Oregon, Washington, and southern British Columbia (Audobon Field Notes 1947-1970 and Wheeler 1965). Both species have been breeding at Ninepipes since before 1951 (Audobon Field Notes 1947-1970). Twenty-five years later, both species are still using the area, which suggests that the first alternative, that of extinction, is unlikely. The more likely situation is that these two species are partial competitors. Individuals of the two species compete, but each species has a fraction of the niche in which it has a competitive advantage over the other (Whittaker 1970). In this study, the area of competition appears to be for breeding territory on the nesting grounds. I could discern no subdivision of the available resource, and I feel it must take place during the remainder of the year. At the inception of this study, I had hoped to find and
describe differences in behaviors and resource utilization, but none were found.
CHAPTER VII

SUMMARY

Hostile behaviors and territoriality of Blue-winged and Cinnamon Teal were investigated in the springs of 1974 and 1975. Data were collected by daily observations on the prairie pothole-grassland study area near Ninepipe Reservoir in western Montana. In 80 days of observations, 938 individual sightings were recorded, 445 Blue-winged and 493 Cinnamon. Both species were commonly seen off the area. Fourteen Cinnamon territories and nine Blue-winged territories were mapped.

Hostile behaviors were recorded 100 times on the study area and were observed off the area and in 1973. Hostile behaviors were described, quantified, and flow charts were drawn. These behaviors were found to be identical in these two species with the exception of vocalization. Territories were found to be mutually exclusive, with minimal overlap.

The factors of behavior and territory pointed to direct competition between these two species on the study area. Two alternatives were proposed and discussed, and I suggested that these two species were partial competitors on the areas of range overlap, with
the area of niche subdivision existing at some level other than the breeding area. This competition could account in whole or in part for the range restrictions of both species.
LITERATURE CITED


APPENDIX I

FLORA OF THE STUDY AREA

A. Aquatic plants (from Lokemoen 1962)

<table>
<thead>
<tr>
<th>Aquatic plants</th>
<th>Taxonomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leafy liverwort</td>
<td>Drepanocladus sp.</td>
</tr>
<tr>
<td>Chara</td>
<td>Chara frigilis</td>
</tr>
<tr>
<td>Pepperwort</td>
<td>Marsilea vestita</td>
</tr>
<tr>
<td>Common Horsetail</td>
<td>Equisetum arvense</td>
</tr>
<tr>
<td>Horsetail</td>
<td>Equisetum sp.</td>
</tr>
<tr>
<td>Cattails</td>
<td>Typha latifolia</td>
</tr>
<tr>
<td>Bur reed</td>
<td>Sparganium simplex</td>
</tr>
<tr>
<td>Leafy pondweed</td>
<td>Potamogeton foliosus</td>
</tr>
<tr>
<td>Variable leaf pondweed</td>
<td>P. gramineus</td>
</tr>
<tr>
<td>Floating leaf pondweed</td>
<td>P. natans</td>
</tr>
<tr>
<td>Sago pondweed</td>
<td>P. pectinatus</td>
</tr>
<tr>
<td>Clasping leaf pondweed</td>
<td>P. zosteriiformis</td>
</tr>
<tr>
<td>Arrow head</td>
<td>Sagittaria cuneata</td>
</tr>
<tr>
<td>Water plantain</td>
<td>Alisma plantago-aquatica</td>
</tr>
<tr>
<td>Waterweed</td>
<td>Elodea canadensis</td>
</tr>
<tr>
<td>Waterweed</td>
<td>E. occidentalis</td>
</tr>
<tr>
<td>Northern manna grass</td>
<td>Glyceria borealis</td>
</tr>
<tr>
<td>Foxtail</td>
<td>Hordeum jubatum</td>
</tr>
<tr>
<td>Barnyard grass</td>
<td>Echinochloa crusgalli</td>
</tr>
<tr>
<td>Short awn foxtail</td>
<td>Alopecurus aequalis</td>
</tr>
<tr>
<td>Water foxtail</td>
<td>A. geniculatus</td>
</tr>
<tr>
<td>Washington foxtail</td>
<td>A. pallescens</td>
</tr>
<tr>
<td>Slough grass</td>
<td>Beckmania syzigachne</td>
</tr>
<tr>
<td>Needle rush</td>
<td>Eleocharis acicularis</td>
</tr>
<tr>
<td>Spike sedge</td>
<td>E. machroostachya</td>
</tr>
</tbody>
</table>

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Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Hardstem bullrush
Bullrush
Softstem bullrush
Sedge
Sedge
Sedge
Nebraska sedge
Broom sedge
Sedge
Lesser duckweed
Star duckweed
Big duckweed
Wire rush
Toad rush
Long-styled rush
Rocky mountain rush
Slender rush
Yellow flag
Water smartweed
Prostrate knotweed
Marsh smartweed
Water pepper smartweed
Willow leaved smartweed
Ladies thumb
Coontail
Water buttercup
Cursed crowfoot
Watermilfort
Willow herb
Forget-me-not
Mint
Nightshade

Scirpus acutus
S. pallidus
S. validus
Carex athrostachia
C. bebbii
C. lasiocarpa
C. nebraskensis
C. scoparia
C. stipata
Lemna minor
L. trisulca
Spirodea polyrhiza
Juncus balticus
J. bufonius
J. longistylis
J. saximontanus
J. tenius
Iris pseudacorus
Polygonum amphibium
P. aviculare
P. coccineum
P. hydropiper
P. lapathifolium
P. persicaria
Ceratophyllum demersum
Ranunculus aquatilis
R. sceleratus
Myriophyllum exalbescens
Epilobium sp.
Myosotis alpestris
Mentha arvensis
Solanum dulcamara
B. Common nonaquatic plants found on the study area

**Forbs**

- Wild hyacinth
- Plantain
- Camas
- Blue-eyed grass
- Field chickweed
- Larkspur
- Starflower
- Strawberry
- Long plumed aven
- Cinquefoil
- Rose
- Bluebonnet
- Sweet clover
- Sticky geranium
- Desert parsely
- Gromwell
- Yellow Paintbrush
- Yarrow
- Spotted knapweed
- Canada thistle
- Cutleaf Daisy
- Blanketflower
- Dandelion
- Peppergrass
- Pearly-everlasting

**Grasses**

- Bluegrass
- Canadian bluegrass

<table>
<thead>
<tr>
<th>Common Plant Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brodiaea douglassi</td>
<td>Plantago lanceolata</td>
</tr>
<tr>
<td>Camassia quamash</td>
<td>Sisyrinchium angustifolium</td>
</tr>
<tr>
<td>Cerastium arvense</td>
<td>Delphinium nelsoni</td>
</tr>
<tr>
<td>Lithophragma parviflora</td>
<td>Fragaria vesca</td>
</tr>
<tr>
<td>Geum triflorum</td>
<td>Potentilla gracilis</td>
</tr>
<tr>
<td>Rosa woodsii</td>
<td>Lupinus sericeus</td>
</tr>
<tr>
<td>Melilotus officianalis</td>
<td>Geranium viscosissimum</td>
</tr>
<tr>
<td>Lomatium dissectum</td>
<td>Lithospermum incisum</td>
</tr>
<tr>
<td>Castilleja sulphurea</td>
<td>Achillea lanulosa</td>
</tr>
<tr>
<td>Centaurea maculosa</td>
<td>Cirsium arvense</td>
</tr>
<tr>
<td>Erigeron compositus</td>
<td>Gaillardia aristata</td>
</tr>
<tr>
<td>Taraxacum officinale</td>
<td>Lepidium perfoliatum</td>
</tr>
<tr>
<td>Anaphalis margaritacea</td>
<td>Poa pratensis</td>
</tr>
<tr>
<td>Poa compressa</td>
<td></td>
</tr>
</tbody>
</table>
Orchard grass  
Smooth brome  
Foxtail barley  
Eastern meadow barley  

*Dactylis glomerata*

*Bromus inermis*

*Hordeum jubatum*

*Hordeum brachyantherum*
A PARTIAL LIST OF VERTEBRATE FAUNA
FOUND ON THE STUDY AREA

A. Common ducks, grebes, and marsh birds of the study area.
Common and scientific names from the A.O.U. Checklist, 5th edition. Those nesting in the Ninepipe area are denoted by an asterisk (*).

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Loon</td>
<td><em>Gavia adamsii</em></td>
</tr>
<tr>
<td>Western Grebe*</td>
<td><em>Aechmophorus occidentalis</em></td>
</tr>
<tr>
<td>Red-necked Grebe*</td>
<td><em>Podiceps grisigena</em></td>
</tr>
<tr>
<td>Horned Grebe*</td>
<td><em>Podiceps auritus</em></td>
</tr>
<tr>
<td>Eared Grebe*</td>
<td><em>Podiceps nigricollis</em></td>
</tr>
<tr>
<td>Pied-billed Grebe*</td>
<td><em>Podilymbus podiceps</em></td>
</tr>
<tr>
<td>Double-crested Cormorant*?</td>
<td><em>Phalacrocorax auritus</em></td>
</tr>
<tr>
<td>Great Blue Heron*</td>
<td><em>Ardea herodias</em></td>
</tr>
<tr>
<td>American Bittern*</td>
<td><em>Botaurus lentiginosus</em></td>
</tr>
<tr>
<td>Canada Goose*</td>
<td><em>Branta canadensis</em></td>
</tr>
<tr>
<td>Mallard*</td>
<td><em>Anas platyrhynchos</em></td>
</tr>
<tr>
<td>Pintail*</td>
<td><em>Anas acuta</em></td>
</tr>
<tr>
<td>Gadwall*</td>
<td><em>Anas strepera</em></td>
</tr>
<tr>
<td>American wigeon*</td>
<td><em>Anas americana</em></td>
</tr>
<tr>
<td>Shoveler*</td>
<td><em>Anas clypeata</em></td>
</tr>
<tr>
<td>Blue-winged Teal*</td>
<td><em>Anas discors</em></td>
</tr>
<tr>
<td>Cinnamon Teal*</td>
<td><em>Anas cyanoptera</em></td>
</tr>
<tr>
<td>Green-winged Teal*</td>
<td><em>Anas crecca</em></td>
</tr>
<tr>
<td>Wood Duck</td>
<td><em>Aix sponsa</em></td>
</tr>
<tr>
<td>Redhead*</td>
<td><em>Aythya americana</em></td>
</tr>
<tr>
<td>Canvasback*</td>
<td><em>Aythya valisineria</em></td>
</tr>
</tbody>
</table>

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Ring-necked Duck*       Aythya collaris
Lesser Scaup*            Aythya affinis
Common Goldeneye        Bucephala clangula
Barrows Goldeneye       Bucephala islandica
Bufflehead              Bucephala albeola
Ruddy Duck*             Oxyura jamaicensis
Common Merganser*       Mergus merganser
Red Breasted Merganser  Mergus serrator
Hooded Merganser         Lophodytes cucullatus
Sora*                   Porzana carolina
American Coot*           Fulica americana
Killdeer*                Charadrius vociferus
Common Snipe*            Capella gallinago
Spotted Sandpiper*       Actitis macularia
American Avocet*         Recurvirostra americana
Wilson's Phalarope*      Steganopus tricolor
Northern Phalarope       Lobipes lobatis
California Gull*          Larus californicus
Ring-billed Gull*        Larus delawarensis
Forsters Tern*           Sterna forsteri
Black Tern*              Chlidonias niger
Long-billed Marsh Wren*  Telmatodytes palustris
Yellowthroat*            Geothlypis trichas
Yellow-headed Blackbird* Xanthocephalus xanthocephalus
Red-winged Blackbird*    Agelaius phoeniceus
Song Sparrow*            Melospiza melodia

B. Common mammals found on the study area. Common and scientific names from Burt and Grossenheider 1964.

Vagrant shrew            Sorex vagrans
Shorttail weasel         Mustela erminea
Longtail weasel          Mustela frenata

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<table>
<thead>
<tr>
<th>Species</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mink</td>
<td><em>Mustela vison</em></td>
</tr>
<tr>
<td>Badger</td>
<td><em>Taxidea taxus</em></td>
</tr>
<tr>
<td>Striped Skunk</td>
<td><em>Mephitis mephitis</em></td>
</tr>
<tr>
<td>Coyote</td>
<td><em>Canis latrans</em></td>
</tr>
<tr>
<td>Columbian Ground Squirrel</td>
<td><em>Spermophilus columbianus</em></td>
</tr>
<tr>
<td>Northern Pocket Gopher</td>
<td><em>Thomomys talpoides</em></td>
</tr>
<tr>
<td>Deer Mouse</td>
<td><em>Peromyscus maniculatus</em></td>
</tr>
<tr>
<td>Meadow Vole</td>
<td><em>Microtus pennsylvanicus</em></td>
</tr>
<tr>
<td>Mountain Vole</td>
<td><em>Microtus montanus</em></td>
</tr>
<tr>
<td>Muskrat</td>
<td><em>Ondatra zibethica</em></td>
</tr>
<tr>
<td>Whitetail Deer</td>
<td><em>Odocoileus virginianus</em></td>
</tr>
</tbody>
</table>
APPENDIX III

INCIDENTAL DATA

This appendix is included to list information not used in my study that may be of value to others.

All Cinnamon and Blue-winged Teal nests were found in clumps of *Poa pratensis* (bluegrass) and were made of that grass and down. This is similar to other studies (Burgess et al. 1965, Bent 1923, Wheeler and Harris 1970). The four Cinnamon clutches had 10, 10, 7, and 7 eggs for an average of 8.50. The three Blue-winged clutches had 10, 12, and 12 for an average of 11.33. Cinnamon eggs from the three 1975 clutches were measured as were eggs from two Green-winged Teal clutches (Table 5).

Two out of three Blue-winged clutches hatched, and two out of four Cinnamon clutches. The others were destroyed by predators. Sightings of broods that were nearly grown led me to believe that two to four out of each brood hatched became fledglings.

Of the three Blue-winged nests found, they were 2, 2, and 15 m from water. The four Cinnamon nests were 3, 4, 10, and 25 m from water.
TABLE 5. Measurements of Cinnamon and Green-winged Teal eggs to demonstrate overlap in size

<table>
<thead>
<tr>
<th>Species</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
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<tr>
<td>Cinnamon #1</td>
<td>47</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>48</td>
<td>35</td>
</tr>
<tr>
<td>Cinnamon #2</td>
<td>45</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>34</td>
</tr>
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<td></td>
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<tr>
<td>Cinnamon #3</td>
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<tr>
<td></td>
<td>47</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>35</td>
</tr>
<tr>
<td>Average</td>
<td>46.7</td>
<td>34.9</td>
</tr>
<tr>
<td>Green-winged #1</td>
<td>44</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>44</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>47</td>
<td>36</td>
</tr>
<tr>
<td>Green-winged #2</td>
<td>46</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>46</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>46</td>
<td>32</td>
</tr>
<tr>
<td>Average</td>
<td>45.5</td>
<td>33.7</td>
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</table>