

TERRITORIAL BEHAVIOUR OF PRAIRIE  
POTHOLE BLUE-WINGED TEAL

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ABSTRACT

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TERRITORIAL BEHAVIOUR OF PRAIRIE  
POTHOLE BLUE-WINGED TEAL

The territorial behaviour of wild Blue-winged Teal (Anas discors) was studied in pothole country near Minnedosa, Manitoba. Most of the data used were derived from information on 456 interactions and from extensive observations of marked individuals.

Aggressive behaviour in the form of Threat, Overt Rush and Pursuit Flight contributed to the establishment and maintenance of Blue-winged Teal activity centers. Pursuit Flights, which were more effective than other forms of aggression in expelling intruders from activity centers, increased dramatically during nest establishment and activity center delineation.

Activity centers averaged 0.69 ha (1.7 a) and were comprised of one or two potholes or portions thereof. They were found to be discrete, well defined areas and remained stable from the time of nest site selection up to the third week of incubation.

A probable function of Blue-winged Teal Activity centers is to provide an exclusive feeding area for females where they are free from harassment from other individuals during the nesting period.

## RESUME

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### COMPORTEMENT TERRITORIAL DE LA SARCELLE A AILES BLEUES DANS LA REGION DES MARES DES PRAIRIES

Une étude du comportement territorial de la sarcelle à ailes bleues (Anas discors) a été réalisée dans la région des mares, près de Minnedosa au Manitoba. La plupart des données utilisées provient d'informations sur 456 interactions et d'observations intensives d'individus marqués.

L'établissement et la défense des centres d'activité des sarcelles à ailes bleues est principalement dû au comportement agressif, qui se manifeste sous forme de menaces, de ruées et de poursuites aériennes. La forme d'agression la plus efficace est la poursuit aérienne; le nombre de poursuites a augmenté énormément durant la période critique correspondant au début de la nidification et de la délimitation du centre d'activité.

La surface moyenne des centres d'activité était de 0.69 ha (1.7 a). Ces centres, comprenant une ou deux mares ou des portions de mares, étaient des aires distinctes et bien définies demeurant stables du début de la nidification jusqu'à la troisième semaine d'incubation.

Chez la sarcelle à ailes bleues, la fonction du centre d'activité est probablement de fournir aux femelles un endroit où elles peuvent se nourrir et où elles ne sont pas harcelées par d'autres individus durant la période critique de la nidification.

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## INTRODUCTION

Published accounts of territorial behaviour by Blue-winged Teal (Anas discors) are conflicting. Bennett (1938) saw a regular pattern to the spacing of Blue-winged Teal on the breeding grounds but stated that "males were not observed defending or fighting over waiting sites". Hochbaum (1944) suggested that Blue-winged Teal and other members of the genus Anas defended breeding territories in a manner similar to that described by Howard (1920) for song birds. McKinney (1965, 1967) has associated chasing with the spacing of several Anas species. Dzubin (1955), SOWls (1955) and McHenry (1969) found that the areas occupied by Blue-winged Teal during the breeding season overlapped and hesitated to ascribe fixed boundaries to these areas. It was hoped that a clearer understanding of Blue-winged Teal territorial behaviour would emerge from intensive observations of known individuals throughout the breeding season.

According to Tinbergen (1957) site attachment and hostility are the two major characteristics of territorial behaviour. The object of this study was to attempt to document site attachment and hostility in a wild



population of Blue-winged Teal. The study was designed to obtain quantitative data on the forms of aggression that function in the establishment and maintenance of Blue-winged Teal territories. Changes in the frequency and form of aggression were observed as the breeding season progressed. My hypothesis was that the pursuit flight is one of the more important means of expelling individuals from the defended area as Titman (1973) found in Mallards (A. platyrhynchos) and Seymour (1974 a, b) in Shovelers (A. clypeata).

#### STUDY AREAS

The study was conducted in the Minnedosa pothole district of south-western Manitoba during the 1974 and 1975 breeding seasons. Waterfowl studies have been conducted in this region for over 20 years. It consists of undulating terrain where small wetlands, agricultural fields and bluffs of aspen (Populus sp.) and oak (Quercus sp.) characterize the landscape. A detailed description of the Minnedosa area is given by Eyans, Hawkins, and Marshall (1952). Kiel, Hawkins, and Perret (1972) provide additional information concerning history, habitat conditions, and waterfowl population trends.

In April, 1974, a 283 ha (700 a) area situated 4.8 km (3 miles) south-west of the town of Minnedosa was

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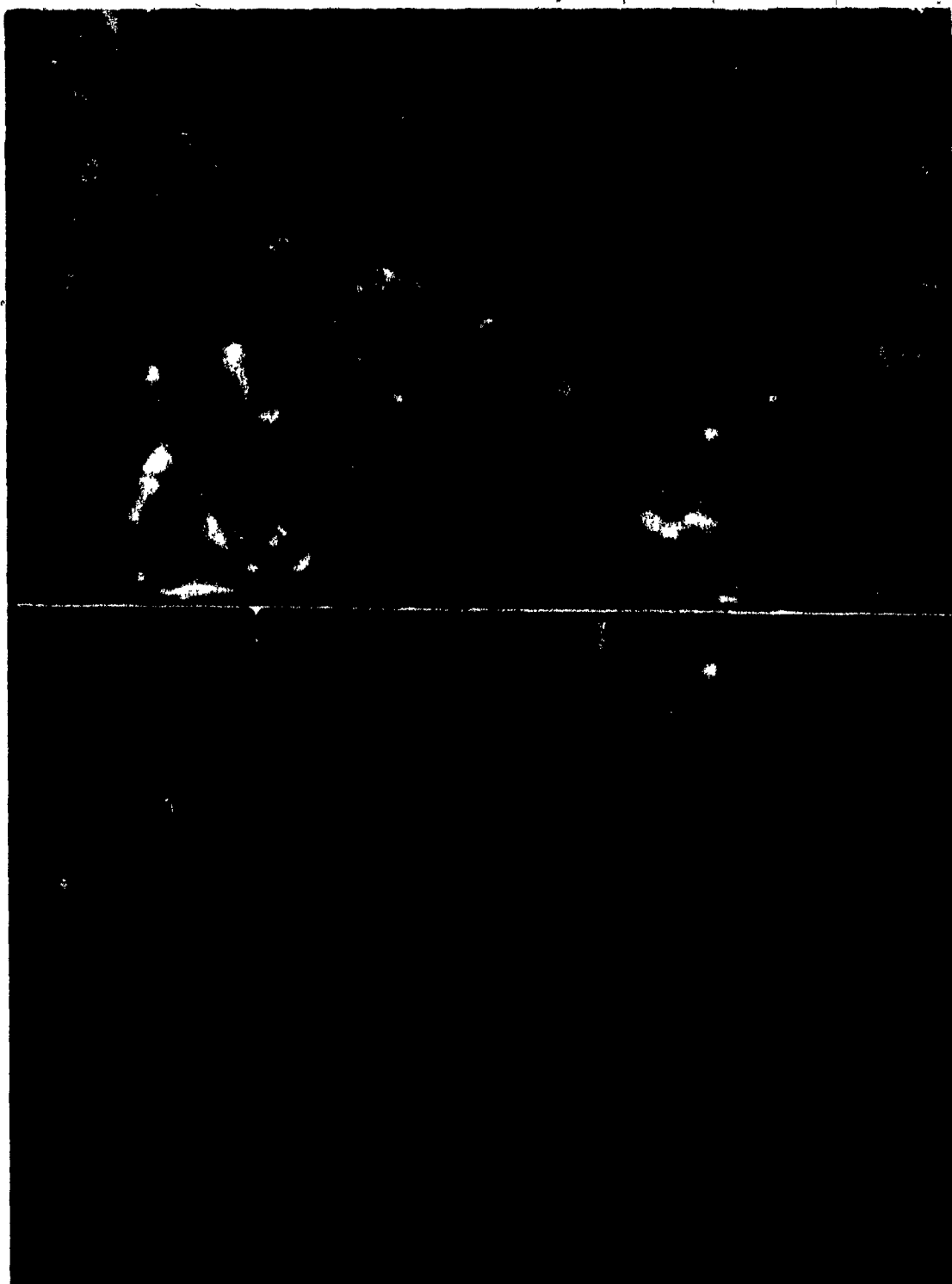


Figure 1. Aerial view of 1974 Study Area. Photo by Canadian National Air Photo Library, 1965.

100 m

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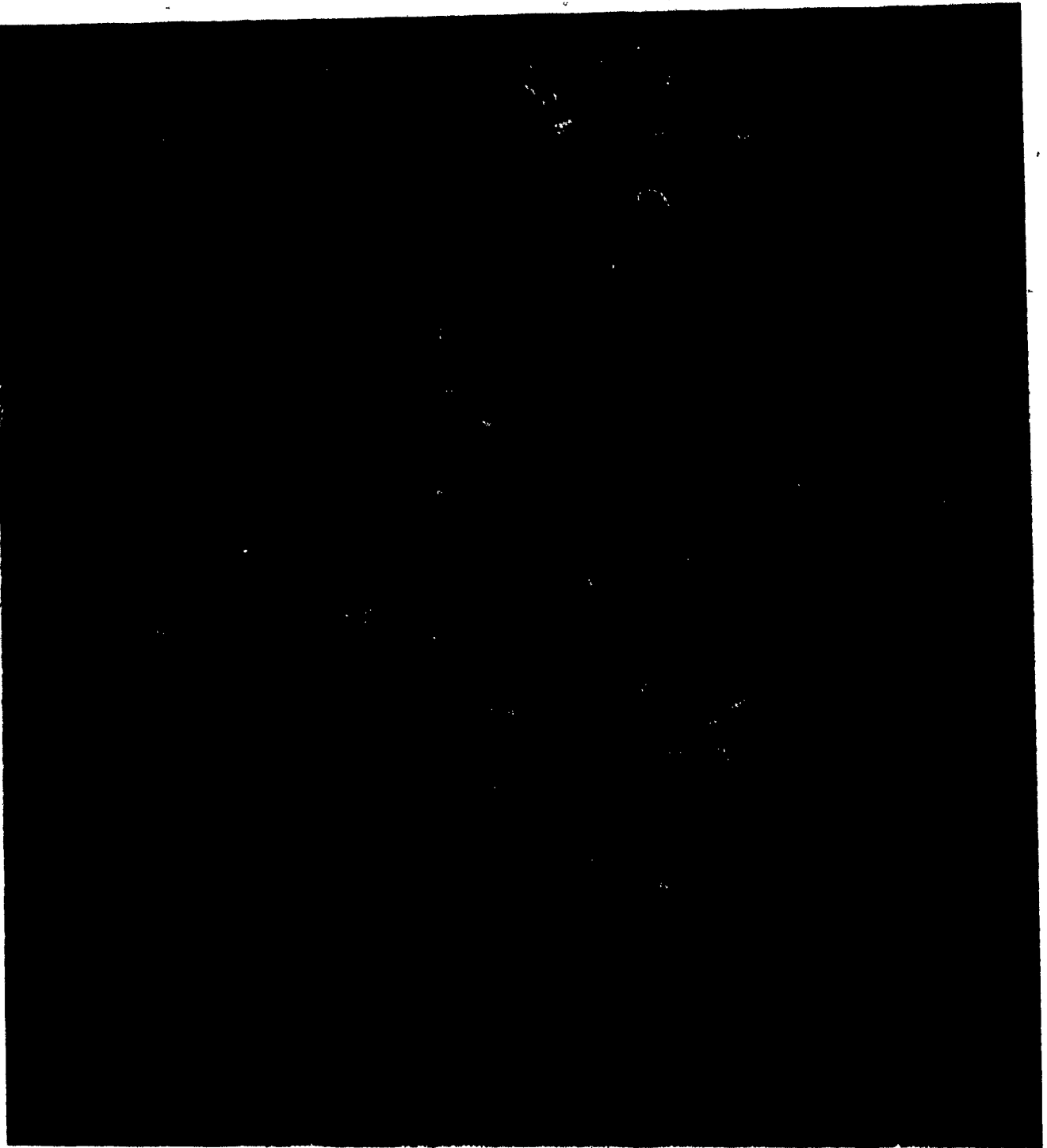


Figure 2. Aerial view of 1975 Study Area. Photo by  
Canadian National Air Photo Library, 1965.

100 m

selected as the study area for that season (Fig. 1). This area included 55 potholes ranging in size from 0.1 ha to 13.2 ha (0.25 a to 32.7 a) (Table I). The south half of the study area was used primarily as pasture and hay land for approximately 100 head of Hereford cattle. The remainder of the study area was planted in grain crops with one 16 ha (40 a) segment left in summer fallow.

In April, 1975, a different 291 ha (720 a) study area situated approximately 9.6 km (6 miles) south-east of the town of Minnedosa was selected on the basis of the large number of small ephemeral and semi-permanent ponds which comprise preferred habitat for breeding Blue-winged Teal (Fig. 2). This area included 123 potholes at the beginning of the season ranging in size from 0.1 ha to 5.9 ha (0.25 a to 14.6 a) (Table I). One quarter section (56.7 ha) of the south half was left in summer fallow, approximately 8 ha (20 a) were used to pasture 20 head of beef cattle and the remainder was planted in grain crops.

## MATERIALS AND METHODS

### 1. Observations

During this study all the data were collected by observing wild Blue-winged Teal in their natural habitat. Observations were aided by the use of 7x50 binoculars and a 25x spotting telescope. A 35 mm reflex camera and

Table 1. Areas of potholes of two regions studied near Minnedosa, Manitoba, as determined from aerial photographs of 1965.

Area Classes	1974		1975	
	Study Area No.	%	Study Area No.	%
$\leq 0.8$ ha( $\leq 2.0$ a)	43	78	95	77
$> 0.8 \leq 1.6$ ha( $> 2.0 \leq 4.0$ a)	2	4	17	14
$> 1.6 \leq 2.4$ ha( $> 4.0 \leq 6.0$ a)	4	7	3	2.5
$> 2.4 \leq 4.0$ ha( $> 6.0 \leq 10.0$ a)	-	-	2	1.5
$> 4.0 \leq 5.6$ ha( $> 10.0 \leq 14.0$ a)	4	7	5	4
$> 5.6$ ha( $> 14.0$ a)	2	4	1	1
Total	55	100	123	100

Super 8 mm movie camera were used to record selected behavioural activities. Observations were made from a car, a portable burlap blind and from natural cover. At all times emphasis was placed on the observation of known individuals on the study area.

During 1974, no set time periods were designated for observations. The lack of data collected during the first three weeks of the season reflects a combination of rainy weather and inexperience. During 1975, observation periods lasting from two to four hours were staggered to cover all daylight hours in each seven day period. Additional observations ranging from 11 - 18 hours per week were conducted giving a total of 27 - 34 hours observation per seven day period (except for the last two weeks of field study). The additional observations were concentrated in the morning and evening when teal were found to be most active.

Particular attention was paid to interactions between neighbouring birds. Time spent by individuals in all daily activities (feeding, loafing, hostile encounters, etc.) was recorded when possible. Observations were recorded on a portable cassette tape recorder and in a field notebook and later transcribed onto data sheets (Appendix I). The time, date, weather conditions, location, number and breeding status of individuals involved,

type(s) of aggression, duration, height and distance travelled where applicable, and landing location were recorded when possible. A stop watch was used to measure the duration of the interactions. Wooden stakes were placed at 25 or 50 m intervals in potholes where males established territories to assist in the estimation of areas occupied by males and lengths of chases. Telephone poles, buildings and trees were used as aids to estimate heights. The exact breeding status of the individuals involved was determined for marked birds whose nest location was known. Records of movements of all marked birds were kept.

## 2. Trapping

A modified walk-in decoy trap after the design of McHenry (1971) was used to capture most of the adult Blue-winged Teal (Figs. 3 and 4). The trap was "baited" with hand reared wild strain female Blue-winged Teal overwintered at the Delta Waterfowl Research Station and placed near a male's major loafing spot in a pothole. Two funnel entrances led into the outer compartment. The decoy females were rotated on a regular basis to rest them and provided with a block of wood to enable them to get out of the water and feed while in the trap. A total of 67 male and 14 female Blue-winged Teal were caught using

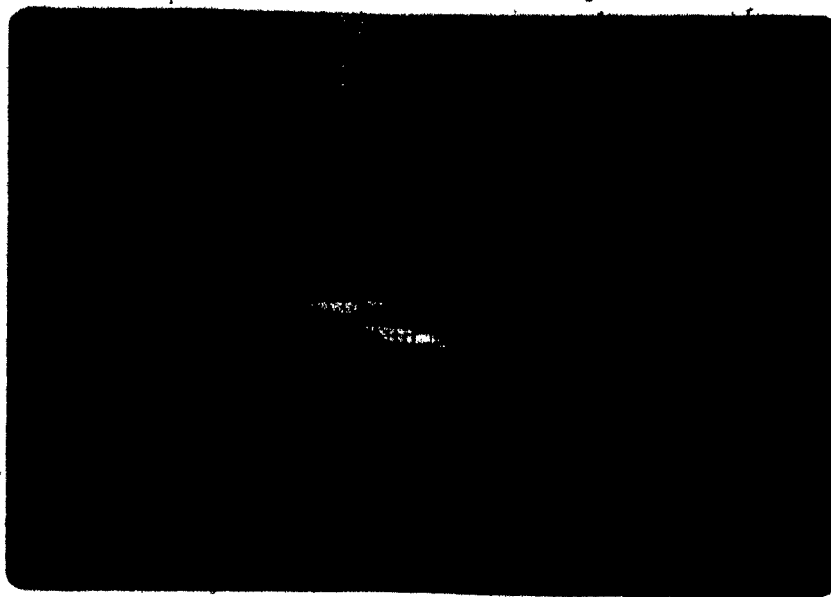


Figure 3. Walk-in decoy trap "baited" with captive female Blue-winged Teal.

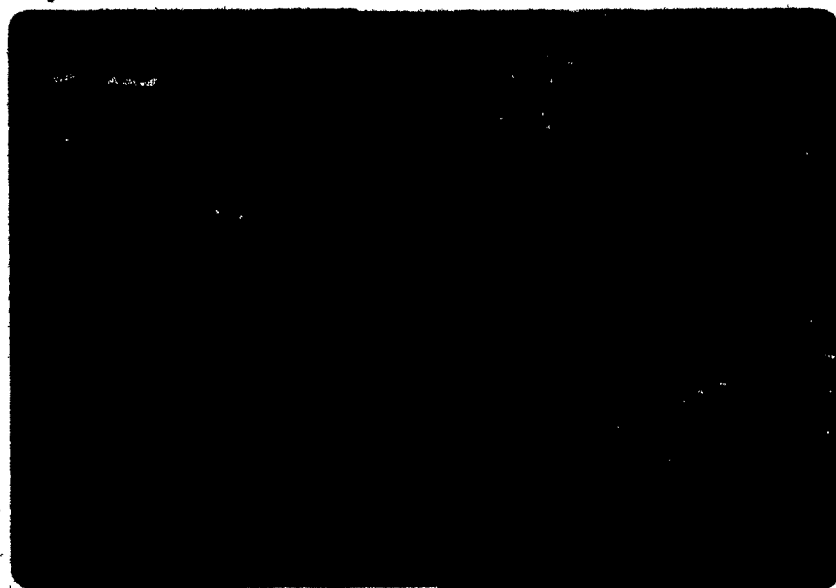


Figure 4. Pair of Blue-winged Teal captured in decoy trap displaying hostile pumping towards decoy female.



this method.

In addition six females were caught on their nests: one was flushed into a mist net; two were caught with nest traps (Sowls, 1955); and three by placing a long handled wide-hoop-net over them while they were incubating.

### 3. Marking

Each captured bird was banded with U. S. Fish and Wildlife Service metal leg bands. Date, time, location where captured, location after release and weights, wing, tarsus, and culmen measurements were recorded. Birds were examined for individual identifying characteristics and females were checked for brood patches and the presence of eggs.

The birds were marked with individually numbered plastic nasal saddles (Figs. 5 and 6). During 1974, yellow saddles with one black letter, number or symbol on each side after that developed by Bartonek and Dane. (1964), were used. In 1975, in addition to the yellow saddles with black marking, blue and white saddles with black marking made from polyvinyl tape were used (Sugden and Poston, 1968). "Letraset" letters, numbers, and symbols were placed on the saddles and covered with two coats of Epoxy glue. Having identical marking on each side of the saddle enabled individuals to be recognized by seeing only one side of the saddle.



Figure 5. Female Blue-winged Teal with nasal saddle after that developed by Bartonek and Dane (1964).



Figure 6. Male Blue-winged Teal with nasal saddle after that developed by Sugden and Poston (1968) and materials used to process captured birds.

#### 4. Censusing

During the 1974 season a count was made on the 283 ha study area at least once every two weeks. During 1975 a survey of the new 291 ha study area was conducted each week from 6 May to 6 July. In addition another 259 ha area, 4.8 km (3 miles) from the 1974 study area was surveyed weekly from 18 May to 7 July, 1974 and from 6 May to 23 June, 1975. Counts began in the early morning and lasted from 2 - 4 hours. Numbers and species of all waterfowl species present were recorded.

The purpose of the weekly counts was to provide population data and information concerning the diversity of species throughout the season and to locate Blue-winged Teal activity centers.

During six weeks of the 1975 season a weekly road-side transect covering 16 km (10 miles) of roads bordering and bisecting the study area was run with the hope of locating marked individuals that had dispersed from the main study area.

All Blue-winged Teal associations observed during censusing were recorded as "sightings". "Spot sightings" differed in that they required continuous observation of marked individuals in an area for a minimum of 10 minutes.

## RESULTS

### 1. Chronology and Dispersion

Blue-winged Teal were the most abundant species of breeding waterfowl in the Minnedosa pothole district comprising over 30% of the total number of breeding ducks in 1974 and 35% in 1975 (Stoudt, Trauger and Kraft, 1975). They are gregarious most of the year flocking with others of their kind. During February they begin their northward migration from as far south as South America (Bellrose, 1976) and by the time they reach south-western Manitoba in late April and early May, few females are unpaired. In 1974, there were Blue-winged Teal in the Minnedosa area by 30 April and there appeared to be a major arrival of migrants on 3 May. In 1975, the first Blue-winged Teal was recorded in the area on 22 April, and most had arrived by 7 May. Surveys revealed 23 pairs and 7 unmated males on the 1974 study area on 10 May, and 40 pairs and 22 unmated males on the 1975 study area on 14 May. During their first week after arrival they associated loosely in groups of up to four pairs and three unmated males. Little hostility was recorded at this time. During the first week of May intolerance was observed and the birds began to disperse. Early performances of threat display appeared to provide "moving territory" type of defense of females (Dzubin, 1955). Following this, aggression

increased as pairs were isolated from each other for up to seven weeks of the season. This aggression is discussed in detail in a later section (p.25).

To measure dispersion, observations of Blue-winged Teal associations during weekly censuses were made from 5 May to 10 June, 1974, and 30 April to 15 June, 1975. Information was also obtained from five roadside transects in 1975. In over 81% of sightings either a solitary male or a pair occurred alone on one pothole (Table 2). Forty-six sightings of a pair and a male on one pothole appeared to depict the "novice drake" phenomenon that Hochbaum (1944) referred to, whereby an inexperienced unmated male is tolerated close to a pair. On eight of the 45 occasions when two males were sighted together on a pothole both birds were marked and known to be unmated males. In four other instances one of the two males was marked and identified as an unmated male. It is likely that most two male associations included two unpaired males because of the high number of unpaired males in the area and the intolerance of most paired males to other individuals. Of the remaining 75 (8.3%) associations involving 3 or more individuals recorded, 11 were made on a communal feeding area and 22 were recorded prior to nesting. After initial dispersion, when more than one pair was observed on a pothole invariably the pairs were

Table 2. Frequency of Blue-wing Teal associations during the 1974 and 1975 breeding seasons near Minnedosa, Manitoba.

Number of Birds Per Pond		Times Observed During Study Area Surveys and Roadside Transects	
PAIR(S)	MALE(S)	NUMBER OF OBSERVATIONS	%
-	1	415	45.6
1	-	330	36.2
1	1	46	5.0
-	2	45	4.9
2	-	18	2.0
1	2	15	1.6
-	2	9	1.0
-	3	7	0.8
2	1	6	0.7
-	3	6	0.7
1	3	5	0.6
3	1	2	0.2
4	-	2	0.2
-	5	1	0.1
2	2	1	0.1
2	3	1	0.1
2	4	1	0.1
3	4	1	0.1
TOTAL		911	100.0

separated from one another and were usually recorded at opposite ends of the water area.

## 2. Site Attachment By Known Individuals

Of 87 wild Blue-winged Teal individually marked with nasal saddles 67 were seen again at least once on the study area. Those that were not seen again appeared to move completely out of the region either during migration or later during apparent renesting attempts. As many as 12 biologists working in a 256 km<sup>2</sup> area (100 square mile) near Minnedosa were alerted to watch for marked Teal, yet no sightings were reported. Observations of eleven marked pairs in 1974 and 1975 revealed strong site attachment as they confined their activity to discrete areas which were termed activity centers after Dzubin (in litt), Barclay (1970), and Titman (1973). An "activity center" is the defended portion of a pair's home range and is considered interchangeable with the term "territory". Blue-winged Teal activity centers were defended against intruders from the time of nest site selection until the third week of incubation. The behaviour by male Blue-winged Teal, responsible for the establishment and maintenance of these areas can be considered territorial. Quantitative descriptions of all eleven activity centers are found in Table 3 and case histories of each pair appear in Appendix II. The general form of activity

Table 3. Observations concerning the location of activity of eleven territorial pairs of Blue-winged Teal near Minnedosa, Manitoba during the 1974 and 1975 breeding seasons.

PAIR		No. Minutes <sup>a</sup>	No. Spot	No. Interactions	No. of Distinct	Estimated Maximum
Male	Female	Under Observation	Sightings	Observed	Water Areas Included in Activity Center	Size of Activity Center
CY	IYY	3156	86	49	1	0.57 ha (1.4 a)
HY	Unmarked	1854	64	15	2	0.97 ha (2.4 a)**
8W	8B	1620	54	17	2	0.73 ha (1.8 a)
11W	1GW	1344	55	27	2	0.81 ha (2.0 a)
LY	FY	864	22	18	1	0.53 ha (1.3 a)
3W	unmarked	854	48	7	2	0.93 ha (2.3 a)
2EY	3CY	486	34	8	2	0.77 ha (1.9 a)
7Y	unmarked	432	11	6	1	0.45 ha (1.1 a)
3Y	7AY	360	20	10	1	0.41 ha (1.0 a)
CW	unmarked	180	11	10	1	1.01 ha (2.5 a)
Unmarked	PB	180	34	6	2	0.45 ha (1.1 a)
	Total	11,130	439	171	16	7.63 ha (18.8 a)
	Average	1,011.8	39.9	15.6	1.5	0.69 ha (1.7 a)

\* A spot sighting required that marked individuals be observed in one location for a minimum of 10 minutes and is distinct from the number of hours observation.

\*\* Size of activity center prior to June 11, 1974; after this time the area defended included only one pond and its size was reduced to 0.65 ha (1.6 a) - See Fig 11.



centers is shown graphically in Figures 9 and 10 with special conditions depicted in Figures 9 and 11, Appendix III.

Hochbaum (1944) described a duck territory as containing four major components; water, loafing areas, nesting cover (adjacent or nearby), and food. These components were evident in the eleven activity centers described. In nine instances the nest site of the pair under observation was located within the activity center. Loafing spots were noted within each activity center and were usually elevated areas such as grass hummocks or rocks providing an unobstructed view of the surrounding area. When not feeding, nesting or swimming residents spent most of their time at these spots. Most interactions originated at or near the loafing spots (142 of 171 interactions = 83%). Following an interaction the aggressor commonly returned to the loafing spot or its general vicinity (within 30 m in 126 of 171 interactions = 74%). Altogether 409 (92.5%) spot sightings were recorded on the activity centers of the pairs under observation. Aquatic invertebrates which comprise up to 95% of the diet of breeding prairie Teal (Swanson, Mayer and Serie, 1974) are abundant in the numerous potholes throughout the area (Bartonek and Hickey, 1969).

Overlap in Blue-winged Teal activity centers was

documented only once (Fig. 9). Intensive observation of the neighbouring pairs in this case revealed each to be occupying a distinct area. On 26 May, 1975, four interactions between these pairs including two bouts of circular fighting (also called territorial boundary disputes, McKinney, 1967) were observed. These encounters appeared to result in the establishment of the overlapping boundaries shown in Figure 9. The boundaries then appeared to remain stable until one female lost her nest to a predator and that pair left the area. No further boundary disputes were observed after 26 May. On four separate occasions interactions by both marked territorial males with the same unmarked male showed classical territorial defence and recognition of a boundary (Tinbergen, 1957). In each case an unmarked male landed in one of the activity centers. Immediately each respective territorial male chased him into the adjacent activity center. The pursuing male did not cross the invisible boundary but rather swam back towards his loafing spot. As the intruder swam into the other activity center the resident territorial male intercepted him and chased him back onto the other male's activity center. On one occasion the intruder was chased three times by each of the territorial neighbours before finally being expelled from the pothole. In each case the intruder was

eventually expelled from the pothole, twice by each of the territorial males. Throughout, each territorial male did not enter the activity center of the other.

One marked paired male localized his activity along a small stream and a nearby pothole edge for at least three weeks during the breeding season. He was never observed defending this area although he did appear to be attached to it. Behavioural information indicated that his mate was nesting nearby and they were observed on 11 occasions feeding in the stream and nearby pothole where no other Teal activity centers were known. In five confrontations with two different pairs this pair exhibited avoidance twice and hid in vegetation on three occasions.

During the prenesting period, the areas occupied and defended by breeding pairs were usually larger than the eventual activity centers I delineated. Prior to laying most pairs were using two, and in two instances, three potholes within close proximity. With nest site selection and the onset of laying, activity was restricted to one or two potholes or portions thereof and appeared to remain stable until pair-bond dissolution or the nest was destroyed. Activity centers included a pothole or portion thereof in five cases and two small potholes or portions of potholes in the remaining six cases (Table 3).

The average distance between the two water areas in the latter cases was 67 m with a range of 40 to 100 m. The average distance from 10 nests (belonging to 9 females) to respective activity centers was 16.7 m with a range of 5 to 60 m. In all cases the activity center of the pair always included the water area closest to the nest.

One exception was documented in 1974 when an activity center did not remain stable throughout a nesting attempt (Fig. 10, Appendix III). In this case the activity center included two potholes for the nine day period 2 to 10 June. During this time the pair was observed feeding, preening, loafing and interacting with intruders in both water areas approximately equally. On 11 and 12 June, four interactions were observed on one pothole (15 A) between the marked territorial male and an unmarked pair. The marked male was chased from this pothole to the other (14) by the unmarked paired male during each interaction. Subsequent to this the original male and his mate restricted their activity to pothole 14 even though their nest was believed to have been located near the south-east corner of pothole 15.

In the six cases where the activity center comprised two distinct water areas there appeared to be a change in the amounts of time spent at the different ponds as the breeding season progressed. Just prior to and during

laying pairs spent up to 60% of their time on the water area closest to the nest. Males waited for their mates here while the females chose their nest sites and then laid their first eggs, usually in the morning. The remaining time was spent feeding and loafing on the other pond. Most aggression was recorded at this time (Table 5). During the final stages of laying and early incubation males began spending from 60 to 90% of their time on the water area farthest from the nest, frequently flying from one water area to the other. As incubation progressed males spent more and more time on the ponds farthest from the nests. When females took a recess they usually landed on the ponds closest to their nests, drank, called and then flew to the other pond and joined their mates.

Time budgets for five marked territorial females (Table 4) revealed that they spent an average of over 65% of their time feeding throughout the breeding season. All but 3% of the total feeding activity recorded for these five females occurred on their respective activity centers. Three females that had activity centers comprising two distinct water areas spent only 7% of their total feeding time on the ponds closest to their nests.

Females spent more than twice the proportion of time

Table 4. Percentages of time spent by five marked territorial paired female Blue-winged Teal in four categories of activity while off the nest during the 1974 and 1975 breeding seasons near Minnedosa, Manitoba.

Period	Loafing or Sleeping	Bathing or Preening	Feeding	Interaction	Total Minutes Under Observation
Prenesting	32.4	14.6	51.9	1.1	1112
Laying	26.0	7.1	66.3	0.6	827
Incubation	11.2	9.8	78.3	0.7	1726
Overall	23.2	10.5	65.5	0.8	3665

Table 5. Percentages of time spent by six marked territorial paired male Blue-winged Teal in four categories of activity during the 1974 and 1975 breeding seasons near Minnedosa, Manitoba.

Period	Loafing or Sleeping	Bathing or Preening	Feeding	Interaction	Total Minutes Under Observation
Prenesting	58.2	8.6	29.0	4.2	1340
Laying	52.0	7.6	38.8	1.6	1162
Incubation	61.8	7.8	29.4	1.0	2460
Overall	57.3	8.0	32.4	2.3	4962

feeding than did males (Tables 4 and 5). Attempts were made to measure the intensity of feeding by both members of a pair (i.e. counting the number of tipups while both were feeding) and these data revealed that besides feeding longer females were often feeding at up to twice the intensity of their mates (Average number of tipups/5 minute observation period of feeding activity = 42 for females and 26 for males; average of counts made during observations of 145 minutes of feeding activity).

The time spent by females in interactions with other individuals averaged 0.8% of total activity and was highest in the prenesting period (Table 4). Similarly, males had their highest interaction activity during the prenesting season but were found to be spending almost four times the amount of time females were in interactions with other Teal.

Blue-winged Teal pairs restricted their movements to activity centers until the last week of incubation. Three males whose mates nested successfully were no longer seen on their territories when their females had 6, 7, and 13 days left to incubate. One pair continued to restrict their movements and defend an area during a renesting attempt until 8 July, 1975. At that time other unsuccessful females and most males were congregating on larger potholes. The male of this pair was seen again

on 11 July accompanying four unmarked males.

2 (a) Communal feeding area

One pothole (#18 B, Fig. 10, Appendix III) was used as a communal feeding area (Dzubin, 1955) by Blue-winged Teal for  $2\frac{1}{2}$  weeks of the 1974 season (1 June to 18 June). Teal were observed coming to this area to feed for short periods of time (15 to 60 min) with up to 3 pairs and 4 unpaired males recorded at one time. On one occasion a marked territorial pair from 1.5 km away was observed feeding on this area for 26 min. During this period hostility was generally restricted to Threat and short Overt Rushes and only two Pursuit Flights were recorded during 22 hours of observation. cursory examination of the food resource of this pothole revealed an abundance of Gastropods, Gammarus sp. and other aquatic invertebrates. Shovelers, Mallards, Gadwall (A. strepera) and Pintail (A. acuta) were observed feeding along with Blue-winged Teal on most occasions. A Blue-winged Teal communal feeding area was not found on the 1975 study area even though the population that year was almost double that found on the 1974 study area.

3. Aggressive Behaviour

Three main types of hostile behaviour were performed by the birds I was observing - Threat, Overt Rush and Pursuit Flight (Table 6). McKinney (1965, 1970) and



Table 6. Type of hostility recorded in 456 interactions involving breeding Blue-winged Teal, in two Minnedosa study areas during 1974 and 1975.

Type of Hostility	No. Times Observed	%
Threat	128	28
Overt Rush	198	43
Pursuit Flight	130	29
Total	456	100

Dzubin (1955) have described these displays for Blue-winged Teal during the breeding season. The purpose of this section is to elaborate upon their descriptions and present quantitative and qualitative information on the form of these aggressive behaviour patterns.

### 3(a) Threat

The main component of the Threat display is hostile pumping which is usually accompanied by the peeping call. On occasion this behaviour, either with the defending male remaining stationary or swimming towards the intruder was sufficient to expell him from an activity centre. In other instances threat display was exhibited with the defending male holding his head high in the air with bill pointed upwards. In some cases this display was accompanied by a 0.5 to 1.0 m rush over the water toward the intruder and was most effective in discouraging intruders that were going to land on the territory. It also appeared to be most successful when directed toward intruders that had previously encountered the defending male.

Threat displays were short in duration, seldom lasting over a minute and commonly ending after 5 to 20 seconds. If the intruders were not expelled, then a more intense form of aggression such as an Overt Rush or a Pursuit Flight was performed. Often several exhibitions

of Threat were observed before an interaction ended.

In 128 interactions Threat was the only form of aggressive behaviour performed by the birds I was observing (Table 6). The subject was a male on 73% of the occasions and it could not be distinguished whether Threat was directed toward either member of a pair in the remaining 27% of the occasions recorded (Table 7). Pairs were most often the subject of Threat in the early and final weeks of the season, and also during week 5 (see Fig. 7), the period during the 1975 season when the greatest number of nest initiations was observed.

An attempt was made to determine the location of the subject at the end of each of the 128 Threat interactions observed (Table 8). Distance intervals of 30 m were chosen as representing increasing degrees of intolerance by aggressive males. After 59% of the Threat encounters the subject stayed within 30 m of the aggressor. The subject had moved greater than 60 m from the aggressor (on most occasions out of his activity center) after 8% and to a completely different pothole or out of sight after 17% of the Threats.

In 91% of the Threat interactions recorded the aggressor was identified as a paired male (Table 7). Marked paired males who were defending activity centers returned to them on all but one occasion. The remainder

Table 7. Identity of the subject and aggressor in Blue-winged Teal Threat interactions near Minnedosa, Manitoba during the 1974 and 1975 breeding seasons.

SUBJECT	No.	%	AGGRESSOR	No.	%
Pair	34	27			
Paired Male	13	10	Paired Male	117	91
Unpaired Male	12	9	Unpaired Male	3	3
Unknown Male(s)	69	54	Unknown Male	8	6
Total	128	100		128	100

Table 8. Location of the subject at the end of Blue-winged Teal Threats during the 1974 and 1975 breeding seasons, near Minnedosa, Manitoba.

Location	No.	%
$\leq 30$ m from the aggressor	76	59
31 to 60 m from the aggressor	20	16
$> 60$ m away from the aggressor	10	8
to a different pothole or flying out of sight	22	17
Total	128	100

of the aggressors, whose activity centers were not known, always returned to within 30 m of the location where the interaction was initiated.

### 3(b) Overt Rushing

If an intruder remained in an activity center then Threat display proceeded to Overt Rushing where the aggressive resident male places his head sleekly at the water surface and rushes at the intruder, attempting to bite his tail. Many variations of this display were observed. It was not always preceded by hostile pumping. In one interaction between two males, a territorial male chased an intruder for over 14 minutes and rushed at him 11 times before finally expelling him from his activity center. Often after an Overt Rush an intruder usually flew a short distance (3 - 10 m) before alighting on the same pothole. When this occurred the aggressive male flew or swam toward the intruder and rushed at him again. Frequently two or three such Overt Rushes were necessary before an intruder was expelled from an activity center.

Overt Rushes were the most common form of hostility witnessed among breeding Blue-winged Teal, comprising 43% of the total interactions (Table 6). They were longer in duration than Threat interactions averaging from 30 to 40 seconds with a range of 10 seconds to 14½ minutes. In

Table 9. Identity of the subject and aggressor in Blue-winged Teal Overt Rushes during the 1974 and 1975 breeding seasons, near Minnedosa, Manitoba.

Subject	No.	%	Aggressor	No.	%
Pair	13	6			
Paired Female	6	3			
Paired Male	23	12	Paired Male	187	94
Unpaired Male	37	19	Unpaired Male	2	1
Unknown Male(s)	119	60	Unknown Male	9	5
Total	198	100		198	100

198 Overt Rushes the subject was a male on a majority of occasions and a pair or paired female on only 9% of the total Overt Rushes (Table 9). The aggressor in Blue-winged Teal Overt Rushes was a paired male 94% of the time (Table 9). On 56 occasions (28%) females of a pair were recorded initiating the hostile behaviour towards intruders. As soon as their mates began to pursue they terminated their aggressive behaviour.

After 39% of 198 Overt Rushes the subject stayed within 30 m of the aggressor; 20% of the time the subject was between 31 and 60 m from the aggressor; 9% of the time the subject moved greater than 60 m away; and 32% of the time the subject was expelled to a different pothole or out of sight. At the end of all but 6 of the 198 Overt Rushes, aggressors were located either on their activity centers (when the birds were marked and their activity centers known) or within 30 m of the starting point of the interaction (when activity centers were not known).

### 3(c) Pursuit Flights

Pursuit Flights have been described for many members of the genus Anas, notably the Mallard (Geyr, 1924; Dzubin, 1957; Lebreton, 1961; McKinney, 1965; Titman, 1973) and the Shoveler (McKinney, 1965, 1970; Seymour, 1974 b). Dzubin (1955) states that territorial pursuits in Blue-

Table 10. Identity of the subject and aggressor in Blue-winged Teal Pursuit Flights during the 1974 and 1975 breeding seasons near Minnedosa, Manitoba.

Subject	No.	%	Aggressor	No.	%
Pair	45	35			
Paired Female	3	2			
Paired Male	12	9	Paired Male	104	80
Unpaired Male(s)	12	9	Unpaired Male	8	6
Unknown Male(s)	58	45	Unknown Male	18	14
Total	130	100		130	100



winged Teal "closely resemble those described for the Mallard, except that aerial fighting between drakes usually occurs". A Blue-winged Teal Pursuit Flight involves the pursuit of an individual or pair by one or more individuals and usually arises in defense of an activity center.

In 48 (37%) Pursuit Flights the subject was a pair or a female (Table 10). In 12 cases (9%) the subject was a paired male and in the remaining 70 cases it was either an unpaired male or a male of unknown status (Table 10). The aggressors were always males and in 80% of the pursuit flights recorded the principal pursuer was paired (Table 10).

In 81 cases (62%) only two birds were involved in Blue-winged Teal Pursuit Flights. In all but two instances both birds were male with a paired male usually being the aggressor toward another paired male, female or unpaired male. Male to male aggression appears a much more frequent occurrence in Blue-winged Teal than Mallards where the most common form of aerial pursuit is the "three-bird flight" where a territorial male chases a pair. Blue-winged Teal resemble Shovelers in exhibiting frequent occurrences of male to male aggression (McKinney, 1967; Seymour, 1974 a, b).

The aggressor landed within 30 m of the point of

Table 11. Height to which participants in Blue-winged Teal Pursuit Flights rose as related to the number involved in the interactions during the 1974 and 1975 breeding season near Minnedosa, Manitoba.

No. BWT Involved	≤ 10m	Height 11-20m	> 20m	Totals
2	58	21	2	81 (62.5)
3	18	11	5	34 (26)
4	2	3	3	8 (6)
> 4	1	2	4	7 (5.5)
Total	79(61)*	37(28)	14(11)	130 (100)

\* Numbers in parentheses represent percentages.

Table 12. Duration of Blue-winged Teal Pursuit Flights as related to the number involved in the interactions during the 1974 and 1975 breeding season, near Minnedosa, Manitoba.

No. BWT Involved	≤ 15s	Duration 16-30s	> 30s	Totals
2	54	14	13	81 (62.5)
3	19	5	10	34 (26)
4	2	1	5	8 (6)
> 4	1	-	6	7 (5.5)
Total	76(58)*	20(16)	34(26)	130 (100)

\* Numbers in parentheses represent percentages.

Table 13. Distance travelled by participants in Blue-winged Teal Pursuit Flights as related to the number involved in the interactions during the 1974 and 1975 breeding seasons, near Minnedosa, Manitoba.

No. BWT Involved	Distance Travelled			Totals
	$\leq 100\text{m}$	101-200m	$> 200\text{m}$	
2	52	9	20	81 (62.5)
3	12	7	15	34 (26)
4	-	2	6	8 (6)
$> 4$	2	-	5	7 (5.5)
Total	66(51)*	18(14)	46(35)	130 (100)

\* Numbers in parentheses represent percentages.

Table 14. Landing location of subjects and aggressors at the end of Blue-winged Teal Pursuit Flights during the 1974 and 1975 breeding seasons, near Minnedosa, Manitoba.

LANDING LOCATION	SUBJECT		AGGRESSOR	
	No.	%	No.	%
within 30 m of start of interaction or on aggressors activity center	12	9	115	88
on a different pothole and/or out of sight	109	84	6	5
Unknown	9	7	9	7
Total	130	100	130	100

initiation of the pursuit or on his activity center following 88% of the Pursuit Flights recorded (Table 14). In 109 (84%) instances the subjects landed on a different pothole and/or out of sight. Subjects landed within 30 m of the point of initiation or on the aggressors activity center following only 9% of Pursuit Flights.

Most Pursuit Flights were short, lasting less than 15 s, rising less than 10 m and travelling less than 100 m (Tables 11, 12, and 13). Pursuits involving more than three participants were longer. Eighty per cent of Pursuit Flights involving more than three individuals lasted more than 15 s, rose to a height greater than 10 m and travelled more than 100 m. Titman (1973) found a similar occurrence in Mallards and attributed the increase to one male continuing to pursue while another gives up. Pursuit Flights performed by marked territorial males of known breeding status were most common during the prenesting period (Table 16). As laying and incubation progressed Pursuit Flights tended to last longer, rise higher and travel farther.

### 3 (d) Comparison of Aggressive Behaviours

The comparative success of the three levels of aggression performed by Blue-winged Teal was measured in terms of non-return of the subjects at the end of each

interaction (Table 15). When activity center boundaries were known aggression was unsuccessful if the subject was allowed to remain within these boundaries. When activity center boundaries were not known aggression was considered unsuccessful if the subject was not greater than 60 m away at the end of the interaction. Threat was least successful, expelling individuals only 25% of the time. Overt Rushing, a more intense form of aggression, was considered successful on at least 81 (41%) occasions. Pursuit Flight, the most intense form of aggression witnessed, was by far the most successful, expelling intruders 90% of the time.

The subject of aggression was a pair in 35% of Pursuit Flight interactions (Table 10), 27% of Threat interactions (Table 7) and only 6% of Overt Rush interactions (Table 9). Over 61% of Threat interactions in which the subject was a pair reflect the "moving territory" type of defense commonly observed when Teal first arrived on the breeding grounds and during late incubation (Dzubin, 1955). It appears that the Pursuit Flight, the most intense and successful form of aggression witnessed, is also the most common form of aggressive behaviour performed by defending males in encounters with intruding pairs.

Female Blue-winged Teal spend about one fourth the

Table 15. Location of the subject in relation to the aggressor at the end of 447 Blue-winged Teal interactions near Minnedosa, Manitoba during the 1974 and 1975 breeding seasons.

TYPE OF INTERACTION	LOCATION OF THE SUBJECT					
	$\leq 30$ m or on his activity center		31 - 60 m		$> 60$ m or off his activity center	
	No.	%	No.	%	No.	%
THREAT	76	59	20	16	32	25
OVERT RUSH	77	39	40	20	81	41
*PURSUIT FLIGHT	12	10	-	-	109	90

\* Excluding nine interactions when the landing locations of both the aggressor and subject were unknown.

time of males involved in interactions with other Teal (Tables 4 and 5). The aggressor in all Teal interactions was a male. Females were observed initiating aggressive behaviour in 41% of Threat interactions, 28% of Overt Rushes and 9% of Pursuit Flights. The pair was together prior to the start of an interaction in 88% of Threats, 61% of Overt Rushes and 24% of Pursuit Flights. The presence of his female is not a prerequisite for a male's aggressive behaviour. The high frequency of Pursuit Flights in which the female was not present (76%) indicates defense of an area and not defense of a female. McHenry (1971) states that the motivation of all Blue-winged Teal aggressive behaviour is defense of the female, even if she is on a nearby nest. The discrete boundaries of activity centers I mapped and the frequency of Pursuit Flights initiated while females were on nests up to 100 m away support the theory of defense of an area rather than defense of a female.

### 3 (e) Change in Form of Aggressive Behaviour

During the 1975 breeding season the three types of aggressive behaviour were analyzed week by week during the 10 week period that Blue-winged Teal were found to be active (Figs. 7 and 8). Altogether 301 interactions were recorded during the 1975 breeding season.

The interactions, expressed as percentages of each type

of aggression per week, are graphically described in Figure 7. The bottom graph represents the nest initiation dates of 84 nests that were located in the area during the 1975 season. Figure 8 plots the frequencies of the different types of aggression per pair against time from 275 hours of observation over the 10 week period.

During week 1 Threat was the most frequent form of aggression performed by Blue-winged Teal. At this time migrants were still arriving on the breeding grounds and Threat reflects the "moving territory" type of defense that Dzubin (1955) refers to. Upon arrival Teal exhibited gregarious behaviour to a limited degree. Several pairs and unpaired males were observed on potholes in loose association with one another and paired males were defending only a small area around their mobile females. The frequency of Threat display declined after week 1 but was high again during weeks 5 and 7 (Fig. 8), when all Blue-winged Teal activity increased dramatically. During the last two weeks of the season unsuccessful pairs began to congregate on potholes and pair bonds were waning, resulting in the next increase in Threat, recorded at this time.

Overt Rushing was the most frequent form of aggressive behaviour witnessed in all but weeks 1 and 10. It became prominent around the first week of May when the birds had



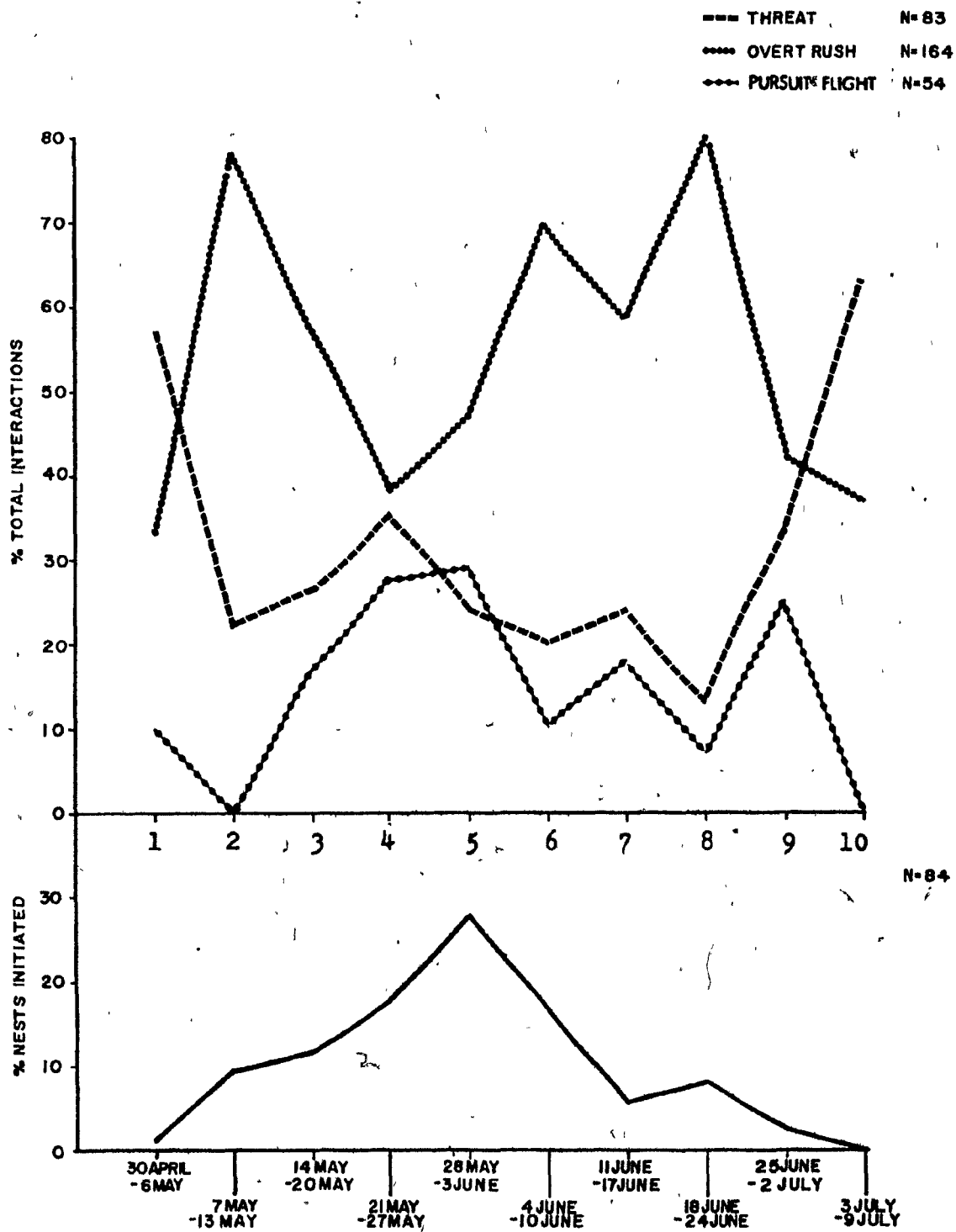


Figure 7. Percentage of each of the three types of aggression compared to nest initiation dates by week throughout the 10 week 1975 breeding season.

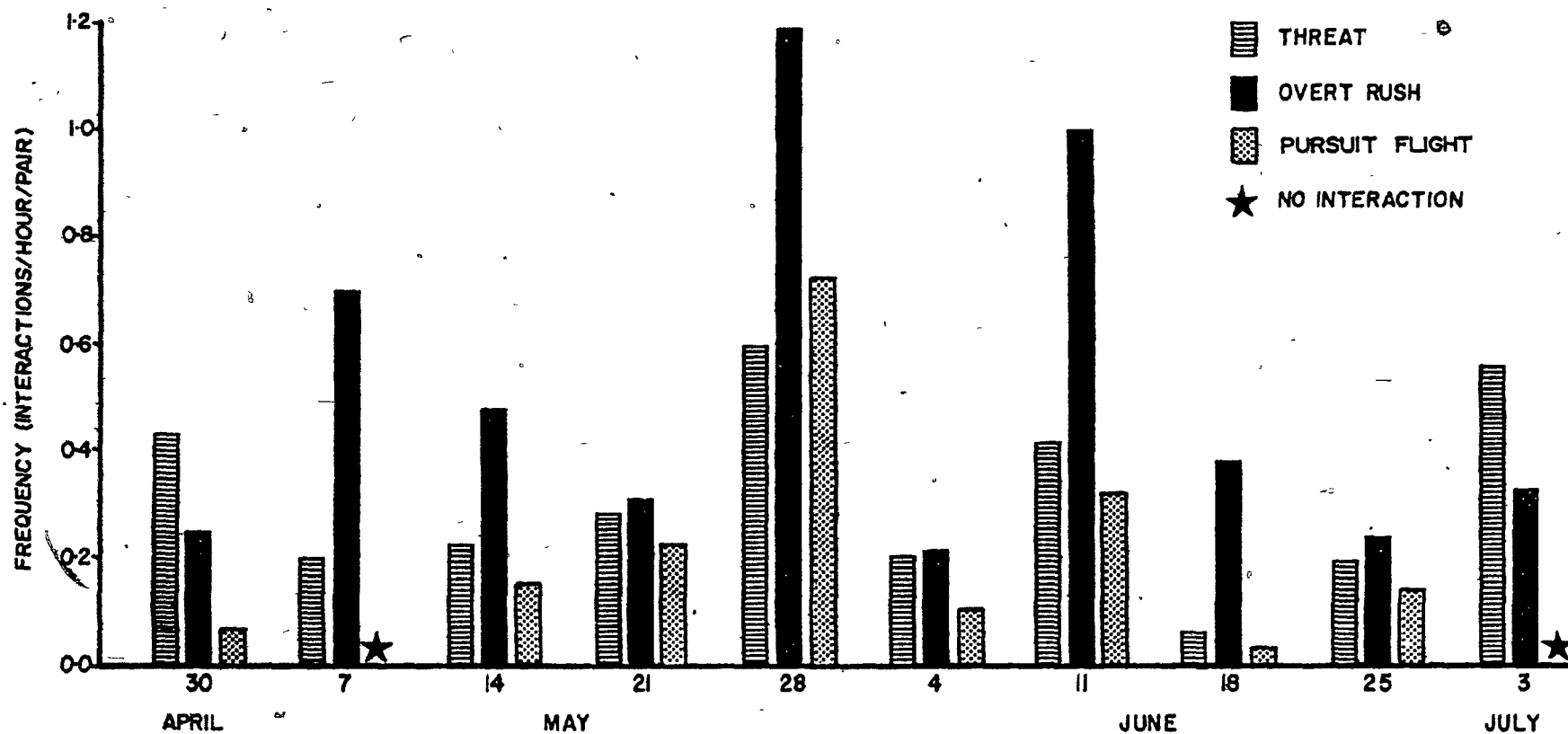


Figure 8. Frequency of Blue-winged Teal Threat, Overt Rush and Pursuit Flight interactions during the 10 week 1975 breeding season.

dispersed and territories were being established. It also was highest during weeks 5 and 7.

Pursuit Flights comprised 18% of the total interactions. A significant increase in the number of Pursuit Flights was recorded during week 5 when the greatest nesting effort of the season occurred (Fig 7). A second peak in Pursuit Flight activity during week 7 does not correspond with the nest initiation peak but appears to be the result of reneesting activity. Two pairs which were being observed at this time were believed to have begun reneesting attempts after the loss of original nests.

Table 16 summarizes 145 interactions involving nine different marked territorial males of known breeding status. Sixty-nine percent of Pursuit Flights occurred during the prenesting period when nest sites were being selected and activity centers established. This information concerning known individuals confirms the trends illustrated in Figures 7 and 8.

### 3 (f) Raping

I observed eight attempted rapes during the two seasons. The two observed in 1974 occurred late in the season - 23 June and 7 July. Both encounters involved two pairs and were similar in the following respects. Hostility in the form of Threat and Overt Rushing was

Table 16. Type of aggression performed by nine territorial males of known breeding status during the 1974 and 1975 breeding season, near Minnedosa, Manitoba.

TIME OF SEASON	THREAT		OVERT RUSH		PURSUIT FLIGHT	
	No.	%	No.	%	No.	%
Prenesting	20	48	28	38	20	69
Laying	9	21	28	38	6	21
Incubation	13	31	18	24	3	10
Total	42	100	74	100	29	100

Table 17. Chi-square values testing three pairs of aggressive behaviour at different distance intervals.

PAIRS OF AGGRESSIVE BEHAVIOURS TESTED	DISTANCE INTERVALS		
	30 m	31-60 m	60 m
Threat-Overt Rush	6.9	0.9	5.7
Threat-Pursuit Flight	43.1**	18.8**	46.6**
Overt Rush-Pursuit Flight	22.6**	24.5**	30.4**

\*\* Significant at 0.005 level.

initiated by the resident male who was with his mate when the other pair landed nearby. The chased female and her mate were thus considered to be the intruders. The resident male mounted the intruding female. The mate of the intruding female actively defended his female and in one instance circular fighting was recorded. The resident male returned to his mate directly after he pursued the intruders. The resident pair remained where they were prior to the encounter while the intruding pair was driven off to a nearby pond.

Five of the six attempted rapes observed in 1975 were also similar to one another in many respects. In each case a male attempted to rape a nesting female. In three cases the exact breeding status of the females was known and both females and their territorial mates were marked. Two of the females were three days into incubation while the other had just laid her fourth egg of an eventual clutch of nine. The other two females were not marked and their nests were not located, however, strong behavioural evidence indicated they were nesting nearby. In the three cases involving marked pairs each was known to be occupying activity centers comprising two distinct, visually isolated water areas. In each of these three cases the females flew from their nests and landed on the water area closest to the nest. Their mates were not waiting for them there and immediately males flew from

nearby (in one case the male was marked and known to be a different paired, territorial male), chased after the females and were observed mounting them for 34, 25 and 20 s. No precopulatory head pumping was observed. Avoidance was displayed by each female and hostile pumping by a female was recorded once prior to the apparent copulation. As soon as they struggled free the females flew to the other pond on their activity centers with the raping males in close pursuit. Repulsion was displayed by one female in flight. The females then landed beside their mates and the raping males landed nearby. Immediately the paired males rushed at the raping males and chased them out of the activity center, and then returned to their females. The pairs then began other activities.

In the other two cases females flew from nesting cover and landed on potholes. Unmarked males flew from nearby, chased the females and attempted to climb on their backs. Immediately the females' mates flew out of the vegetation, rushed at the unmarked males and chased them out of the pothole. In each case the pair was then observed swimming off together.

The other attempted rape occurred early in the 1975 season (8 May, 1854 h) following a Pursuit Flight of the "attempted rape flight" category (McKinney, 1965). A pursuit involving six birds flew overhead and landed on a

nearby pothole. Four males (two were marked and known to be unpaired) were pursuing a marked pair which had been caught the previous day in the same pothole where the flight landed. Upon landing the pursuing males attempted to approach the female. The paired male rushed at each in turn across water and land, succeeding in keeping them 5 - 10 m from his mate. During the next 36 minutes six vigorous Pursuit Flights were recorded. In the first five flights the marked female was the first to take to the air, immediately followed by her marked mate and the remaining males. In flight males vied for a position close to the female. There was much contact as the paired male attempted to get between his female and the other males. Inciting by the female in the air was recorded. Each flight was progressively longer, the first lasted 12 s, travelled 300 - 400 m, and rose to a height of 20 m; the final flight lasted 109 s, travelled 1600 - 1800 m, and rose approximately 40 m. After each Pursuit Flight the birds landed in the same initial pothole, and the males immediately rushed at the female again, attempting to mount her. The paired male vigorously rushed at the attackers numerous times, appearing to be influenced by the Inciting behaviour of his mate. After the fifth flight the paired male appeared to be tiring and when the female took off on the final flight he was the last to

join. He dropped from the final pursuit after one minute and appeared to land about 1.0 km away. The female and four remaining males continued and landed in the original pothole. Immediately two males attempted to rape the female but she avoided them. There was a flurry of fighting among three males and when it was over one of the unmarked males appeared to be defending the female. He chased two males away that tried to approach the female, then swam back to her as she greeted him (slow head pumping, bill pointed downward). The male reciprocated and the new "pair" swam away together with the three males following. They were observed preening and loafing together in the pothole for the next 18 minutes, without exhibiting any apparent aggression. The three males stayed close by (10 - 15 m away) but did not attempt to approach the "new pair". The pair flew out of the pothole at 1950 h without being pursued. The marked female was never again observed in the area. The marked male was sighted alone on three occasions during the next two days in the same pothole and then was never seen again.

#### DISCUSSION

The observations made on Blue-winged Teal associations indicate that members of a pair or males with nesting females separate themselves from other members of the



( ) species during the breeding season. Marked individuals demonstrated a high degree of site attachment. Hostility, in varying degrees of intensity, was directed towards intruders - males, pairs, and caged females in decoy traps - within the area where site attachment had been demonstrated. Territorial behaviour appeared to be well developed in the Blue-winged Teal I was observing.

O The concept of territoriality was first applied to ducks by Hochbaum (1944), a theory propounded by Howard (1920), Noble (1939), Tinbergen (1939), Lack (1943) and others. Noble (1939) stated that a "... territory is any defended area". Tinbergen (1957) cites two criteria, "site attachment and hostility" as being the major components of territorial behaviour and his definition is adhered to in this paper.

Much controversy has arisen over the concept of duck territoriality since Hochbaum (1944) first delineated territories with definite boundaries. Dzubin (1955), SOWLS (1955) and McHenry (1971) found that the areas occupied by Blue-winged Teal during the breeding season overlapped and hesitated to ascribe fixed boundaries to them. However, these authors were documenting Blue-winged Teal home ranges and not activity centers. McHenry (1971) working in the Minnedosa region found the average size of 41 Blue-winged Teal home ranges to be 16.98 a. His

minimum size of 1.42 a corresponds to the average estimated maximum size of 1.7 a for the eleven activity centers I describe and represents the area of one pothole that a pair was found to be using. His maximum size of 78.59 a included ten potholes. Other authors have found Blue-winged Teal home ranges to be much larger. Evans and Black (1956) working in South Dakota found the average size of 11 Teal home ranges to be 87.33 a, while Drewien (1968), also working in South Dakota, estimated the average size of 14 home ranges to be 160 a. Dzubin (1955) found the size of one Blue-winged Teal home range in the Minnedosa region of Manitoba to be 250 a. My observations indicate that during the breeding season Blue-winged Teal pairs do restrict their movements to a definable area from the time of nest site selection until the third week of incubation. There can be slight boundary overlap, changes in size of areas and the exhibition of varying degrees of hostility towards intruders entering these defended areas. However, the proportion of times pairs were sighted and observed on their territories (406, (92.5%), of 439 spot sightings; 172.5, (93%) of 185.5 hours of observation) indicates that they are strongly attached to these small defended portions of their home ranges.

Blue-winged Teal territories though not exclusive areas, rarely overlapped and intruders were seldom

tolerated within their boundaries. Titman (1973), working in similar pothole habitat, found that Mallard activity centers could not be classed as exclusive areas since "... each pair does not occupy one area to the complete exclusion of all other Mallard pairs". Blue-winged Teal activity centers were occupied until the third week of incubation appearing to remain stable up to a week longer than Mallard activity centers (Titman, 1973). The long lasting pair bond in Blue-winged Teal is probably a result of their breeding strategy. Since most first nests appear to be lost to predation (21 of 24, 88%, in 1975) then it is to the paired male's advantage to remain with his mate for probable renesting attempts to improve his chances of leaving progeny that season.

Smith (1968) found that promiscuous raping was a breeding strategy of the Pintail. Raping has also been recorded as a regular occurrence in Mallards (Weidmann, 1956; Lebreton, 1961; McKinney, 1965) but not as common in the territorial Shoveler (McKinney, 1965; Seymour, 1974 b) or its closely related cousin the Blue-winged Teal (McKinney, 1965). It appears that the strategy of the Blue-winged Teal, like that of the Shoveler (Seymour, 1974 b) is to expend time and energy in establishing and maintaining an area during the breeding season in order to be available for copulation with their mates for any

nesting attempts. My observations and those of others (Bailey, Seymour and Stewart, in press) indicate that raping in Blue-winged Teal occurs infrequently. I believe that rapings by paired male Blue-winged Teal fall under the category of "stolen matings" which McKinney (1975) refers to. He believes that a male of any status will rape strange females when the opportunity presents itself. It is just another way of increasing a male's chances of leaving progeny. Raping appears to be an incidental breeding strategy in the Blue-winged Teal. The preponderance of male to male aggression witnessed among breeding Blue-winged Teal and Shovelers (Seymour, 1974 a,b) and the lack of it in Pintails (Smith, 1968) and Mallards (Hori, 1963; Titman 1973) upholds this contention. If the main avenue of ensuring that a male's genes enter the population is by defending exclusive areas and maintaining long pair bonds then unpaired males will continually be entering activity centers and attempting to sever existing territory ties and pair bonds. During the breeding season unpaired males present more of a threat than paired males as the latter are not attempting to find mates.

The attempted rape witnessed early in the 1975 season resulted in the break-up of one pair bond and in the formation of a new one. Possibly early pursuit flights involving many birds function to test and in some

cases sever existing pair bonds as most females are not at that time receptive to fertilization. The subsequent lone sightings of the original paired male on the same pothole could be evidence of the male's choice in the location of the activity center and his attachment to it.

It appears that the location of the nest and food resource of the defended area are two of the main components of a Blue-winged Teal activity center. In five cases these two components were satisfied in one water area. In the remaining six cases most feeding activity occurred on one water area while members of a pair came together on another water area. The temporal change in use where activity centers included two water areas revealed that during the establishment of the nest and early laying periods the males were spending most of their time on the ponds closest to the nest. When females left their nests they joined their mates on these nearby areas. During the final stages of laying and incubation most activity occurred on the water area farthest from the nest. Observations indicated that the water area closest to the nest was seldom used for feeding. It is likely that the male or pair would attract fewer intruders or predators to the nest by going away from it. In five cases where activity centers consisted of only one pothole or portion thereof, almost all feeding activity recorded occurred

there.

Blue-winged Teal activity centers became well defined during the critical period of nest establishment. During the period (nest site selection - early laying) when females were receptive to fertilization, males were most intolerant of intruders. Activity centers were defended up to the third week of incubation. After pair bond dissolution nesting females were occasionally observed feeding on their activity centers but usually secretively. It appears that after the males' late departure the female may occasionally be exposed to harassment from other individuals while continuing to use a familiar feeding area. Brood utilization of the activity center was not recorded. One marked female (IYY) moved her brood of ten to a large (60 a) pothole approximately 1 km from her activity center within two days of hatching.

The lack of communal feeding areas on the 1975 study area was probably due to the abundance of preferred, shallow, ephemeral potholes found there. The 1974 study area had a preponderance of large, deep potholes and this combined with the late spring and high water levels probably resulted in the opportunistic communal feeding on a temporarily abundant food resource.

Three forms of aggressive behaviour, Threat, Overt Rush and Pursuit Flight were performed by the breeding

Blue-winged Teal I observed. Threat display appeared to be of lowest intensity. It was the shortest in duration, least successful in expelling individuals from the defended area and resulted in the lowest expenditure of energy. It was the common form of aggression witnessed when males were defending only the small area surrounding his moving female. Threat was often performed prior to and during interactions that continued to a more intense form of aggression. Overt Rushing, the most common form of aggression observed, was second in duration, success and energy expenditure. Pursuit Flights, the most intense form and requiring the greatest expenditure of energy, were successful in expelling intruders 90% of the time. When viewing this information from a cost - benefit point of view it becomes apparent that intense aggression (i.e. Pursuit Flight) is only used when absolutely necessary. In the case of the Blue-winged Teal it appears that the period when the female is choosing the nest site and laying the first eggs is the critical period for the delineation of an exclusive area. At this time territorial males are most intolerant of other individuals and this intolerance is exhibited by performance of the most hostile form of aggressive behaviour recorded, Pursuit Flights.

The primary aggressor was always a male and the

subject was almost always a pair or male(s). The motivation of the three Pursuit Flights in which the subject was a lone female appeared to be raping. Four of the six Overt Rushes involving a lone female occurred very late in the season, a time when most pair bonds had dissolved or were waning and birds were beginning to revert back to a gregarious state. The male is responsible for the defense of the activity center and is equally aggressive towards males as pairs.

#### FUNCTION OF BLUE-WINGED TEAL TERRITORIES

McKinney (1965) noted that hostility, in the form of aerial chasing, was responsible for the spacing of the pairs of some waterfowl species on their breeding grounds. Titman (1973) and Seymour (1974 a, b) working with Mallards and Shovelers respectively, found that the pursuit flight was the form of aggression responsible for dispersion in these species. My observations indicate that the intense aggression witnessed during the critical period of nest establishment (notably the Pursuit Flight) does function in spacing Blue-winged Teal pairs throughout their breeding habitat. Site attachment, the other component of territorial behaviour (Tinbergen, 1957), occurs in conjunction with hostility to isolate pairs.

The functional significance of territorial behaviour



has long been debated. Hochbaum (1944) suggested that the primary function of territorial behaviour in ducks was to establish isolation from sexually active birds of the same species during the mating period. McKinney (1967) pointed out that the dispersion of pairs brought about by territorial behaviour probably acts as an anti-predator device. Others have postulated that territories might function to ensure an adequate food supply for the nesting female (Geyr, 1924; Siegfried, 1968).

In Blue-winged Teal territorial behaviour does appear to prevent harassment and possible fertilization by other sexually active males as the incidents of rapes indicate. It appears advantageous for activity centers to be established close to the females nests so the paired male can be readily available whenever she leaves the nest. However, this is probably little more than a secondary consequence of territory as Seymour (1974 a) pointed out. The intense aggression witnessed during the critical period of nest establishment did serve to space nests and no doubt served as an anti-predator device as McKinney (1967) pointed out. In line with the findings of Evans and Black (1956) I found no brood use of territorial ponds. However, the amount of time spent feeding by laying and incubating females (97% of female feeding activity recorded occurred on their activity centers) indicates that the defended

area plays an important role in providing a food supply for this selective feeder. Perhaps more important, the territorial behaviour of Blue-winged Teal and subsequent establishment and maintenance of activity centers enables females to utilize these areas for feeding with little interference from intruders during the critical nesting period.

#### SUMMARY

The Blue-winged Teal I observed behaved territorially in that both members of a pair showed site attachment and hostility towards other Teal, satisfying Tinbergen's (1957) criteria. Ground censuses revealed pairs to be isolated throughout the breeding season. Observation of marked pairs revealed they restricted their activity to well defined activity centers from the time of nest site selection up to the third week of incubation. Females were found to be using these areas for feeding until just prior to successful hatching.

Blue-winged Teal performed three main forms of aggressive behaviour towards intruders. In increasing order of intensity, energy expenditure and success they were Threat, Overt Rush and Pursuit Flight. There was a dramatic increase in the frequency of Pursuit Flights during the critical period of nest establishment. At this

time activity centers were delineated and subsequent aggression functioned to maintain them throughout all but one of the nesting efforts documented (male HY and unmarked mate, Fig. 10).

Raping in Blue-winged Teal appears to fall under the "stolen matings" McKinney (1975) refers to. They are incidental to a breeding strategy of exclusive areas, long lasting pair bonds and subsequent male availability during potential renesting attempts.

Activity centers were found to occupy an average of 0.69 ha (1.7 a) and were comprised of one or two water areas or portions thereof (Table 3). The function of territorial behaviour in Blue-winged Teal may be to provide an exclusive feeding area for females where they are free from harassment from other individuals during the critical nesting period.

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Number: \_\_\_\_\_  
Tape: \_\_\_\_\_

Time \_\_\_\_\_ Wind \_\_\_\_\_ mph. Direction \_\_\_\_\_

<u>Time</u>	General Cycle	_____	1. Migrant	4. Incubation
	Aggressor's Cycle	_____	2. Prenesting	5. Brood (f)
	Subject's Cycle	_____	3. Laying	Moulting (m)
				6. Renesting

Status    Subject \_\_\_\_\_  
Aggressor \_\_\_\_\_

Location \_\_\_\_\_ pothole re: nest or terr. \_\_\_\_\_

Others present \_\_\_\_\_

Distance \_\_\_\_\_ Height \_\_\_\_\_

Landing Location    Aggressor \_\_\_\_\_ Time \_\_\_\_\_  
                                 Subject \_\_\_\_\_ After \_\_\_\_\_

Behaviour 1. Subtle Threat \_\_\_\_\_  
Recognition \_\_\_\_\_  
Avoidance \_\_\_\_\_

2. Hostile Pumping \_\_\_\_\_  
Peeping \_\_\_\_\_

3. Mild Rush

4. Overt Rush \_\_\_\_\_ no flight.  
one flies

## 5. Fighting \_\_\_\_\_

## 6. Aerial Pursuit

Intensity \_\_\_\_\_

Description	Quantity	Unit	Value	Total
1.00	1.00	1.00	1.00	1.00
2.00	2.00	2.00	2.00	2.00
3.00	3.00	3.00	3.00	3.00
4.00	4.00	4.00	4.00	4.00
5.00	5.00	5.00	5.00	5.00
6.00	6.00	6.00	6.00	6.00
7.00	7.00	7.00	7.00	7.00
8.00	8.00	8.00	8.00	8.00
9.00	9.00	9.00	9.00	9.00
10.00	10.00	10.00	10.00	10.00
11.00	11.00	11.00	11.00	11.00
12.00	12.00	12.00	12.00	12.00
13.00	13.00	13.00	13.00	13.00
14.00	14.00	14.00	14.00	14.00
15.00	15.00	15.00	15.00	15.00
16.00	16.00	16.00	16.00	16.00
17.00	17.00	17.00	17.00	17.00
18.00	18.00	18.00	18.00	18.00
19.00	19.00	19.00	19.00	19.00
20.00	20.00	20.00	20.00	20.00
21.00	21.00	21.00	21.00	21.00
22.00	22.00	22.00	22.00	22.00
23.00	23.00	23.00	23.00	23.00
24.00	24.00	24.00	24.00	24.00
25.00	25.00	25.00	25.00	25.00
26.00	26.00			

\_\_\_\_\_

APPENDIX IICase Histories of Territorial PairsPair of Male CY and Female IYY (Fig. 9)

The male was captured in a decoy trap located in the south end of pothole 5, 12 May, 1975 at 1205 h. A decoy female was not in the trap at the time. He was recaptured in the same location at 1850 h the same day, this time with a decoy female in the trap and again on 18 May. On all occasions, upon release, he flew into pothole 5 and joined his female there. The female was nest trapped 18 June and found to be incubating an 11 egg clutch. Her first nest (No I, Fig 7) was located 21 May and found to contain one egg at that time. Investigation 5 June revealed that nest to have been preyed upon. This pair was kept under observation for 3156 minutes, sighted on 86 occasions and observed in 49 interactions from 12 May to 23 June, 1975. Copulation was observed between the members of this pair on their activity center at 0740 h, 16 May and 0730 h, 27 May. It is believed that they occupied an activity center of approximately 0.57 ha (1.4 a) for both nesting attempts. The male was no longer sighted after 23 June. The female was sighted on six occasions between 25 June and 5 July. She successfully hatched 10 eggs on 7 July, and she and her brood were located 15 July on a pothole approximately 1.0 km west of

her activity center.

Pair of Male HY and Unmarked Female (Fig. 11)

Male HY was caught in a decoy trap in pothole 14 on 2 June, 1974 at 1000 h. A male had been observed defending this location for several days prior to his capture. The female's nest was not located but observations indicated that she was nesting along the north side of the road by pothole 15 A. From 2 June to 10 June they were believed to be occupying an activity center of 0.97 ha (2.4 a) including two distinct visually isolated water areas (Fig 11). Intense interactions on 11 and 12 June with an unmarked pair appeared to compress their activity center to include only pothole 14 and their activity center from then until the male was last sighted on 17 June was estimated to be 0.65 ha (1.6 a). They were observed for 1854 minutes, sighted on 64 occasions and observed in 15 interactions. On three occasions the pair and on one occasion the male was sighted feeding on pothole 18 B (Fig 9), an area that was later described as a communal feeding area (Dzubin, 1955). A marked unpaired male was commonly observed tolerated close to male HY, even in the presence of his mate. This association depicted the "novice drake" phenomenon that Hochbaum (1944) described. Nest predation is a probable

cause of the departure of this pair from the area.

Pair of Male 8W and Female 8B (Fig. 9)

This pair was caught in a decoy trap 20 May, 1975, at 2200 h in a pothole approximately 600 m north of pothole 5 (Fig 7). The presence of a near full term egg was noticed while processing the female. Upon release both birds flew north out of sight. The pair was not seen again until 26 May when they were observed for several hours in pothole 5. They established an activity center which included the north end of pothole 5 and pothole 5A (Fig 7), and which was estimated to contain 0.73 ha (1.8 a). On 8 June female 8B was flushed from a nest of 5 eggs 6 m south of pothole 5A. It is my belief that this was a renesting attempt by the pair. On 18 June the nest was found destroyed, probably by a mammalian predator, and remnants of at least 8 eggs were in evidence. The pair remained on their activity center and continued to defend it for the next five days. However, after 23 June, the pair was never seen again. Two copulations were observed occurring between the pair; one at 1000 h, 6 June on the north end of pothole 5 and one at 1445 h, 12 June on pothole 5A. The first copulation was recorded on movie film. This pair was under observation for 27 hours, spot sighted on 54 occasions and observed in 17 interactions.

Pair of Male 11W and Female 1GW

Male 11W was caught at 0745 h, 2 June, 1975, in a pothole that was later identified as one of the two water areas comprising his activity center. The nest of his mate was located 12 June, at 1210 h, 11 m. from the edge of the other water area that comprised their activity center. She was incubating 9 eggs at that time. The two water areas were on opposite sides of a gravel road and the activity center was similar to that portrayed in Figure 11. On 10 June at 1530 h, when she was three days into incubation the female was raped by a marked paired male. She had just left her nest and landed on the nearby water area included in her activity center. Her mate was waiting on the water area across the road. Several attempts were made to capture the female at her nest and she was finally flushed into a mist net 17 June. Unfortunately the capture appeared to upset her as the nest was discovered abandoned on 20 June. The pair was under observation for 22.4 hours, spot sighted on 55 occasions, and observed in 27 interactions. It is believed that they occupied an activity center comprising two water areas of 0.81 ha (2.0a).

Pair of Male LY and Female FY (Fig. 10)

This pair was caught 6 May, 1975, at 2030 h, in a decoy trap in pothole 5 (Fig 9). Intense aggression was displayed by both members of the pair towards the decoy

female as I watched the male, followed by the female, enter the trap. This was the first pair captured during the 1975 season. The pair was sighted again on 9 May and 11 May in potholes about one kilometer north-east of pothole 5. On 21 May the pair appeared to localize their activity on one pothole 0.8 km north-east of pothole 5 (Fig 10). For the next 39 days the pair or paired male was observed consistently on this pothole. Numerous unsuccessful attempts at locating female FY's nest were made, though, she was believed to be nesting along the fringe of the pothole. This male was extremely intolerant of intruders and immediately expelled all from the pothole in the 18 interactions I witnessed. Several were recorded on Super 8 mm movie film. They were under observation 14.4 hours and spot sighted on 22 occasions. Their activity center was typical of those including only one water area (Fig 10) and was found to comprise an area of 0.53 ha (1.3 a).

#### Pair of Male 3W and Unmarked Female

Male 3W was caught 26 May, 1975, at 0930 h, in a pothole that was later included in his activity center. The nest of the female was located 30 May, 5 m from the edge of this pothole and had 11 eggs at that time. Investigation 6 June revealed the female to be incubating 12 eggs. On 3 June this female was raped, apparently successfully, by an unmarked male as she left her nest and

landed on the nearby pothole. After struggling free she joined her mate on the other water area included in their activity center. Male 3W immediately chased the raping male away. Several attempts during the middle of June to nest trap the female were unsuccessful. Possibly this activity alerted predators to the location of her nest as it was discovered destroyed on 17 June. The pair was sighted again on their activity center on 20 June. On 3 July, male 3W and an unmarked male were sighted on one of the potholes included in their activity center. This pair was under observation for 10.9 hours and spot sighted on 48 occasions. They were observed in 7 interactions. It is believed that they occupied an activity center comprising one small pothole and a portion of another, of 0.93 ha (2.3 a).

Pair of Male 2EY and Female 3CY.

This paired male was caught 10 June, 1975, at 1300 h in a small stream that was later found to be included in his activity center. Upon release he flew into the small pothole the stream emptied into and his female joined him there. The nest of the female was located 13 June at 1030 h, 7 m from the edge of the stream. It contained 2 eggs at that time. On 15 June at 1105 this female was raped as she left her nest and landed on the stream. Male 2EY was out of sight on the pothole included in their activity center. The raping male followed her to this pothole after she

struggled free and male 2EY immediately rushed at him and chased him in the air out of the pothole. Investigation 26 June revealed the female to be incubating 11 eggs. On 30 June the female was caught on the nest with a long handled net, saddled and released. On 2 July, at 1800 h, the female was flushed from the nest and found to be incubating only one egg. On 3 July, at 0800 h, investigation of the nest revealed no eggs. There was evidence of blood and feathers around the nest site indicating possible capture by a fox or some other mammalian predator. This pair was under observation for a total of 8.1 hours and was spot sighted on 34 occasions. They were observed in 8 interactions with other Blue-winged Teal. They were believed to be occupying an activity center consisting of a small pothole and a portion of another and a small stream connecting them. The area of their activity center was estimated to be 0.77 ha (1.9 a).

Pair of Male 7Y and Unmarked Female

Male 7Y was caught in a decoy trap 24 May, 1975, at 1030 h in a pothole that was later found to comprise his activity center. His female was around the trap when he was captured and upon release he joined her in the nearby pothole she had flown to. The nest of his female was located 18 June, 5 m from the fringe of this pothole. She was found to be incubating 11 eggs at this time. This



activity center was isolated and rarely visited except on weekly study area surveys. However, 11 out of the 13 times the area was visited either the pair or male 7Y was sighted. No attempt was made to capture the female. On 6 July, a 1 - 2 day old, 11 duckling brood of Blue-winged Teal was observed on a pothole approximately 200 m from the nest. Investigation of the nest revealed a recent, apparently successful hatch. This pair was observed for 6 hours and was involved in 10 interactions. Male 7Y was last seen on his activity center 30 June. They were believed to be occupying an activity center comprising one pothole of 0.45 ha (1.1 a) area.

Pair of Male 3Y and Female 7AY

Male 3Y was caught in a decoy trap 5 June, 1975, at 1030 h, in a pothole that was later found to comprise his activity center. His female's nest had been located 30 May, 18 m from the fringe of the pothole. She was incubating 11 eggs at that time. It is likely that the pair had been occupying the area for some time prior to the males capture. On 12 June the female was caught in a nest trap and found to be still incubating 11 eggs. On 23 June investigation of the nest revealed a successful hatch. Male 3Y was last seen on his activity center 17 June. On 10 July, female 7AY was observed with 9 ducklings on the same pothole that female 1YY was observed on with her brood. This pothole

was over 1.0 km from the nest location of female 7AY.

This pair was under observation for 6 hours and were spotted on 20 occasions. They were observed in 10 interactions. It is believed that they occupied an activity center comprising one pothole of an area of 0.41 ha (1.0 a).

Pair of Male CW and Unmarked Female

This paired male was caught at 1015 h, 14 May, 1975, in a pothole that was later found to comprise his activity center. Upon release he flew back to the same pothole. The nest of his female was located 27 May, 30 m from the activity center. It contained 8 eggs at that time. Subsequent checks on 2 June and 8 June revealed her to be incubating 11 eggs. Investigation 12 June revealed the nest had been preyed upon. The pair was last sighted 11 June, on their activity center. This pair was observed only for 3 hours but during that time and also during the 11 sightings, they were involved in 10 vigorous interactions with other Blue-winged Teal. In all cases male CW succeeded in expelling intruders from his activity center. They were believed to be occupying an activity center comprising one pothole of 1.01 ha (2.5 a).

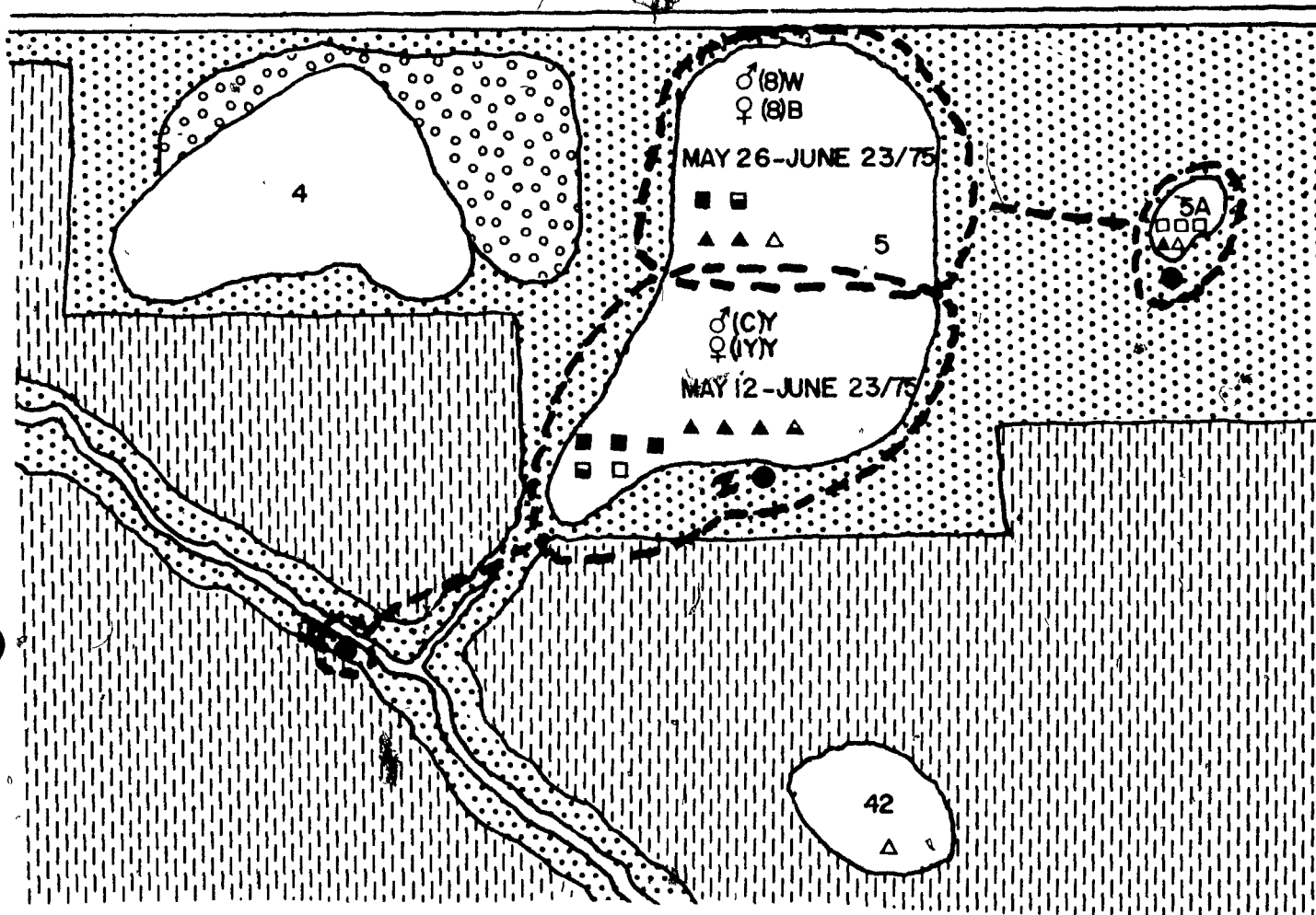
Pair of Female PB and Unmarked Male

This pair was caught together at 1740 h, 13 May, 1975, in a pothole that eventually was included in their activity

center. Unfortunately, while processing the female the male escaped before he had been saddled. They were observed on only one occasion during the next two weeks and that sighting occurred on a pothole almost 2 km from their site of capture. On 31 May, they appeared to localize their activity on two small potholes on opposite sides of a gravel road. On 12 June female PB was flushed from her nest in a roadside ditch 26 m from where she was captured. She flew to her mate who was waiting for her there. There were 7 eggs in the nest at that time. On 15 June, she was found to be incubating 9 eggs. On 18 June, the nest had been abandoned. Only 3 hours were spent observing this pair. They were sighted on 34 occasions, equally on each of the two water areas comprising their activity center and observed in 6 interactions. They were believed to have occupied an activity center consisting of two small potholes and covering 0.45 ha (1.1 a).

## APPENDIX III

## Activity Center Maps



POTENTIAL  
NESTING COVER

TREES

WATER

50M

CULTIVATED OR  
FALLOW FIELD

NEST LOCATION

1 SIGHTING - PAIR OR FEMALE

5 SIGHTINGS

10 SIGHTINGS

1 SIGHTING - MALE WITHOUT FEMALE

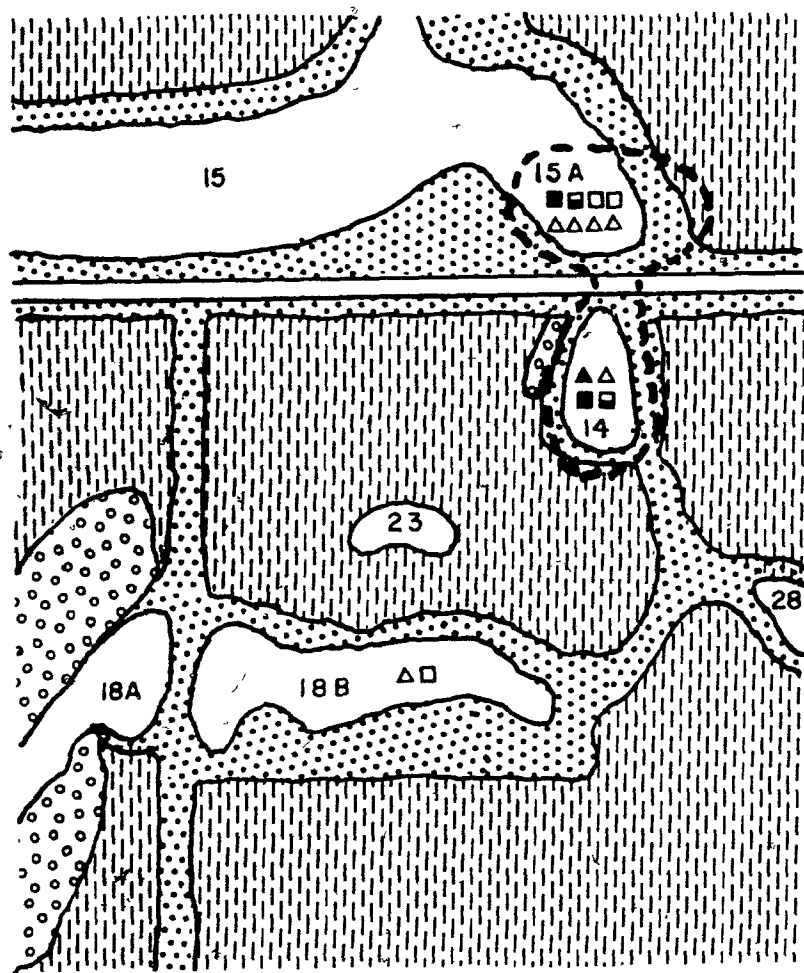
5 SIGHTINGS

10 SIGHTINGS

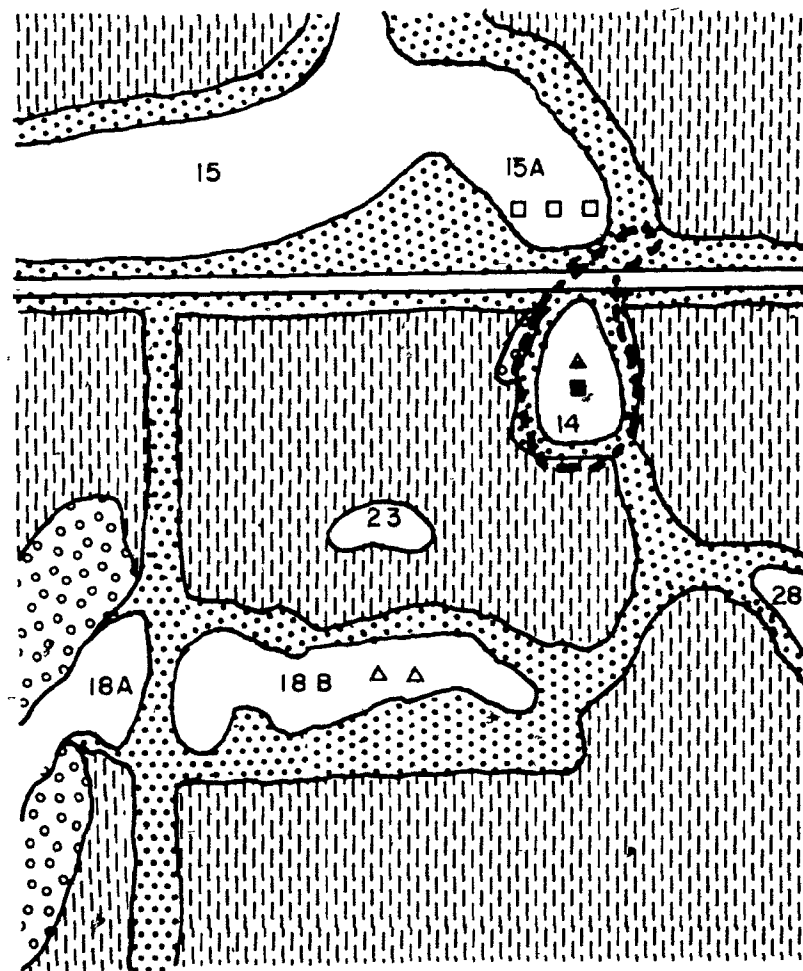
ESTIMATED LIMITS OF ACTIVITY CENTER

Figure 9. Location record of male CY and mate IYY and of male 8W and mate 8B.

Figure 10. Location record of male HY and unmarked mate.



JUNE 2 - JUNE 10/74



JUNE 11 - JUNE 17/74

POTENTIAL  
NESTING COVER

WATER

△ 1 SIGHTING - PAIR OR FEMALE

△ 5 SIGHTINGS

▲ 10 SIGHTINGS

□ 1 SIGHTING - MALE WITHOUT FEMALE

■ 5 SIGHTINGS

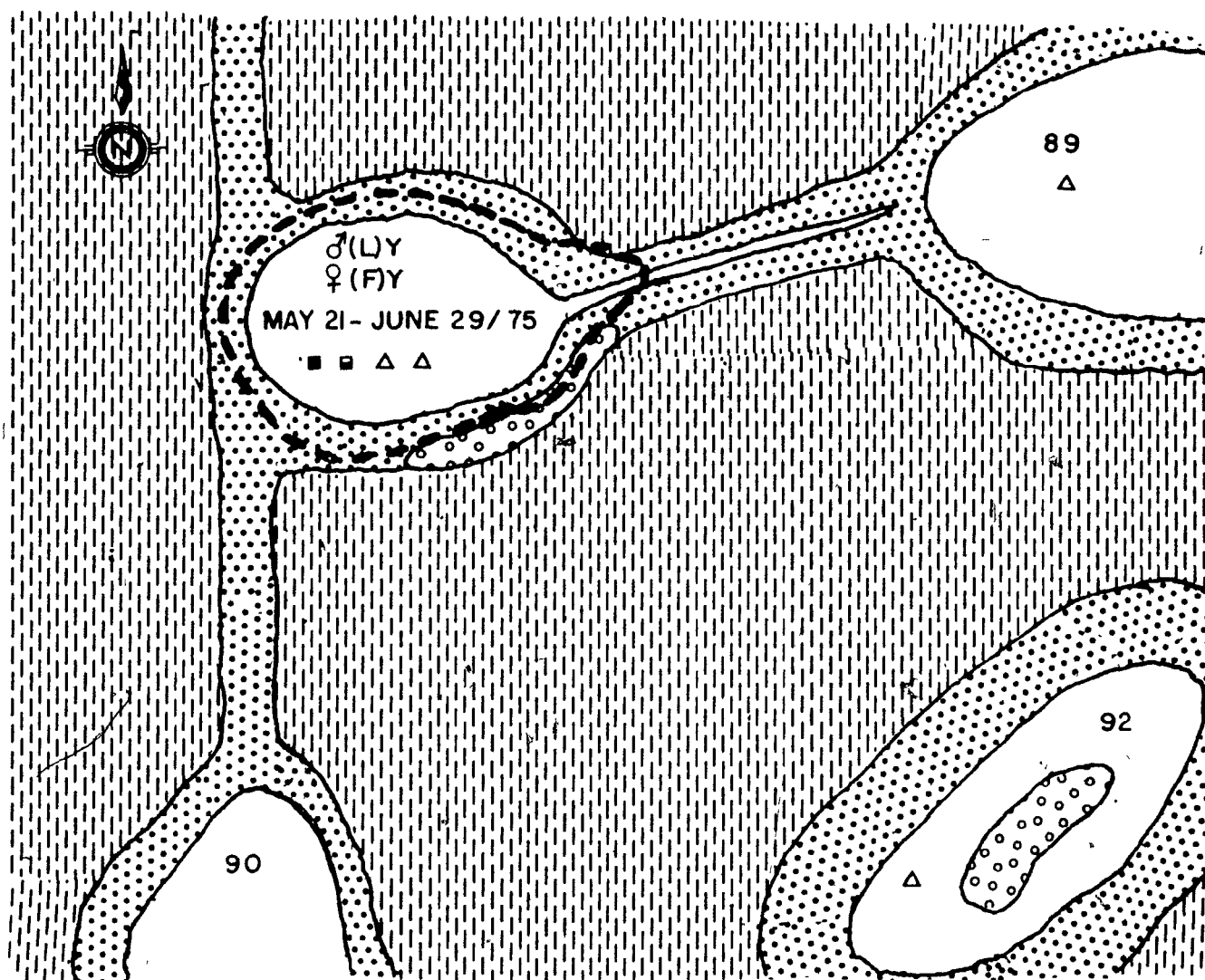
■ 10 SIGHTINGS

TREES

AGRICULTURAL  
LAND

50 METERS

ESTIMATED LIMITS OF ACTIVITY CENTER



■ POTENTIAL  
NESTING COVER

○ TREES

■ CULTIVATED OR  
FALLOW FIELD

□ WATER

50M

△ 1 SIGHTING-PAIR OR FEMALE

△ 5 SIGHTINGS

△ 10 SIGHTINGS

□ 1 SIGHTING-MALE WITHOUT FEMALE

■ 5 SIGHTINGS

■ 10 SIGHTINGS



ESTIMATED LIMITS OF ACTIVITY CENTER

Figure 11. Location record of male LY and his mate, female FY.