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SOME EVIDENCES OF HOME RANGE IN WATERFOWL

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This paper has two objectives: (1) to present evidences of home range for breeding waterfowl in the pothole habitat of southwestern Manitoba; and, (2) to compile and clarify some of the conflicting data on territorialism in waterfowl.

Leopold (1933) has explained that the fundamental unit in management is the seasonal mobility or cruising radius of the species. In general, the geographic ranges of waterfowl are governed by the location of the breeding grounds, wintering areas, and migration pathways. In fact our entire flyway management schemes are based on the movement within and between these three units. There is a specific and individual variation in mobility within each unit. This affects our ability to census, harvest, or otherwise manage the ducks. The present paper is concerned with the mobility and "home range" of pairs on the breeding grounds from the time of initial settling, through prenesting and nesting, to the completion of incubation.

The home-range concept has not been studied extensively by ornithologists, although mammal workers have used it for some time. Seton (1909) has used "home range," and explains it as follows: "No wild animal roams at random over the country; each has a home region, even if it has not an actual home"; and, "In the idea of a home region is the germ of territorial thought." Burt (1943) defines home range as "that area, traversed by the individual in its normal activities of food gathering, mating. . . . Territory is the protected part of the home range, be it the entire home range or only the nest."

LITERATURE: HOME RANGE AND TERRITORY IN WATERFOWL

Sowls (1951) applied home range of waterfowl to "The area in which a bird spends its period of isolation between the breakup of spring gregariousness following spring arrival, and the reformation of fall gregariousness." He further reported that several favored areas may be used in any home range and that drakes "defend" more than one area. Defended areas did not always have definite boundaries. Similar observations were made in the present study, wherein males might show aggressive behavior at a loafing pothole, feeding area or waiting site without regard to definite boundaries. Nord, Evans, and Mann (1953) working in the pothole region of South Da-

kota have used the term home range to describe the number of water areas used by a pair. Evans and Black (1955) have more recently discussed the application of home range to waterfowl breeding on a study area at Waubay, South Dakota. Their work with marked pairs led them to plot minimum home ranges of blue-winged teal and to compute the mean radius for each pair. Their data, included in an appendix, indicate a wide use of certain fixed water areas by individual pairs. I believe that the concept of home range in waterfowl helps better to interpret observed behavior. Territories in waterfowl might be thought of as only the defended portion of the home range as similarly shown by Burt (*loc. cit.*), for mammals.

The concept of territoriality in mammals and birds has received much attention in the past and is receiving more consideration at the present time. Hochbaum (1944) has emphasized the role of territory in the breeding cycle of waterfowl. He has shown how drakes of one species protect a definite area from other pairs and certain drakes of their own species. Hochbaum (*ibid.*) and other workers (Stoudt 1952) have postulated a hypothesis of a carrying capacity on some of the waterfowl breeding grounds, on the basis of drake intolerance and water-area availability. Noble (1939) has proposed the simplest and most universally applicable definition of territory as "any defended area." Territorialism in some species of waterfowl has been questioned by other workers. For example, Munro (1943), working on the mallard (*Anas platyrhynchos*) in central British Columbia, stated that "no behavior that might be interpreted as territory defense has been observed." However Girard (1941) working in western Montana discussed how mallard drakes on "sentinel duty" kept other drakes away from mate and nest, and referred to their waiting areas as a "domain." Hochbaum (1944) described the territorial pursuits of the mallard on the Delta Marsh.

Trautman (1947) has reported that little competition was evident between males or pairs of black ducks (*Anas rubripes*) in an island-nesting situation, but that in a marsh where a larger nesting population was present males frequently pursued females. Wright (1947) found that "the territorial defense in the black duck in the Northeast takes the form of defense of the area the drake is in at the time, rather than the defense of a single area for the whole time he is with the nesting female. . . ." He later showed that "paired males will tolerate other pairs, but the approach of an unpaired male is the signal for violent reaction" (Wright 1954). Mendall (1949) believed that black duck territorialism was far less pronounced in the Northeast than it was for species in the heavily populated western marshes as indicated

by Hochbaum (*ibid.*). However he later concluded that territorialism in the black duck might be a more important factor in underpopulated marshes than previously realized.

Harris (1954) working in the potholes of eastern Washington reported that mallard, gadwall (*Anas strepera*) and shoveller (*Anas clypeata*) defended territories most ardently, but blue-winged teal (*Anas discors*), cinnamon teal (*Anas cyanoptera*) and green-winged teal (*Anas crecca*) were the most tolerant of their own species. He further noted that territorial pairs of the same species mixed in feeding areas with no apparent friction between them. Johnsgard (1955) working in the same area, noted territorial behavior in the following species: blue-winged teal, baldpate (*Anas americana*), gadwall, shoveller, redhead (*Aythya americana*), and ruddy duck (*Oxyura jamaicensis*). Bennett (1936) reports territorial defenses in the blue-winged teal in Iowa and speaks of "nesting territory," "waiting territories," and "waiting sites." Hochbaum (*ibid.*) has described territories for the blue-winged teal in the Delta Marsh, Manitoba. In the Cariboo region of British Columbia, Munro (1944) noted that there did not seem to be much competition for territories in the pintail (*Anas acuta*) but a breeding pair of bufflehead (*Bucephala albeola*) established a definite territory which the male rigorously defended from encroachment by other bufflehead males (Munro 1942). He had stated earlier that the Barrow's golden-eye (*Bucephala islandica*) also has a territory (Munro 1939).

Populations of mallards and pintails in the short grass region of Saskatchewan and Alberta do not seem to exhibit the same territorial aggressiveness as reported elsewhere. Both Gollop (1954) and J. Lynch, (communication, Dec. 1954) have observed gregarious habits of pairs through the nesting season. Gollop (*loc. cit.*) reports that paired birds loafed in flocks, fed, and nested in groups during the period of prenesting, nesting and incubation. Webb (*communication* Aug. 1954) has noted similar behavior in pintails and some mallards in southern Alberta. Aggressiveness in those species was not very evident during the nesting season. W. Leitch, (letter Feb. 1955) noted friction between pairs of blue-winged teal and shovellers on the Caron Pothole Area in southern Saskatchewan. He also noted that intensity of mallard and pintail defense may have fallen off by the time his counts were taken on the area late in May, for aggressiveness was not shown by these two species at this time. A. Smith, (letter Feb. 1955), writing of the prairie pothole areas in Alberta, believes that "the pintail is nearly colonial in its breeding habits and the mallard somewhat so, though its population is usually lower in each area than

is that of the pintail." His observations show that the blue-winged teal was the most territorial duck, but even within this species territorialism appears spasmodic. Other species showing territoriality to some degree, were the gadwall, baldpate, canvasback and ruddy duck. Further north in the parklands of Alberta, mallards, which made up the largest number of any one species, appeared as noncompetitive here as were pintails on the prairies to the south.

Up to the present time no intensive study of the territorial behavior of one species has been made, by a single observer, throughout the entire breeding range. Until this is done, the differences reported in the aggressiveness of any one species may only be differences of interpretation.

STUDY AREA AND WATERFOWL SPECIES

The area on which breeding home range of waterfowl was studied is a typical block of agricultural land, 1½ square miles in extent, some 9 miles south of Minnedosa, Manitoba. The topography is of a knob-and-kettle hole type. Upland fields of cereal grain crops are interspersed with small water areas or "potholes." It is a part of the characteristic pothole country in southern Manitoba, an area which stretches in a wide rectangular block for 4,000 square miles from Minnedosa and the Riding Mountains to the Saskatchewan border.

One hundred and ninety-five potholes of all types were found on the study area, 45 permanent, 115 semipermanent and 35 of a transient nature (modified after Bach's 1951 classification.) The emergent vegetation of potholes is varied: the main dominants are white-top (*Scolochloa festucacea*), sedge (*Carex* spp.), cattail (*Typha latifolia*) and bulrush (*Scirpus acutus, S. validus, S. paludosus*). Thirty-three per cent of the permanent areas were less than one acre in size and 75 per cent less than 2.5 acres, while 95 per cent of the semi-permanent potholes measured less than one acre and all were less than 2.5 acres. About 60 per cent of the land is under cultivation, 20 per cent is made up of potholes or wet areas, and the remainder is in permanent pasture, road allowances, fencerows and aspen-oak bluffs. For a more complete description, see Evans *et al.* (1952) and Dzubin (1954).

The total pairs of breeding ducks per square mile was 97.8 in 1954. Over a three-year period (1952-1954) mallards averaged approximately 33 per cent of the population, blue-winged teal 23 per cent, and canvasback 10 per cent. Other species breeding here in decreasing order of abundance were baldpate, pintail, redhead, ruddy duck, gadwall, green-winged teal and lesser scaup (*Aythya affinis*).

HOME RANGES OBSERVED

Twenty-three pairs of ducks were marked during the 1954 season, with the aid of boom-traps of the type described by Black and Evans (1953). Pairs were neck banded with the plastic Fabrolite. (This material was obtained at the T. Eaton Co., Winnipeg, Manitoba.) Subsequent observations were recorded on maps to show extent of home ranges. The following description of the home ranges of three breeding pairs of waterfowl, canvasback (*Aythya valisineria*), mallard, and blue-winged teal is given as an example to show the variation in size. They are presented because they were studied most thoroughly. Comments on other marked and unmarked pairs are included.

Canvasback. The minimum breeding range of one pair of neck-banded canvasback is shown in Figure 1. The maximum distance between drake observations or "range length" is 3,900 yards whereas the maximum distance between pair observations was 3,480 yards. The area shown in the map was also utilized by from 8 to 15 pairs of canvasback for feeding, loafing, waiting and nesting areas. All these ranges overlapped with the one shown and also overlapped with each other. The approximate area covered by the drake's home range was in excess of 1,300 acres. Previous observations of unmarked pairs, which were identified by certain plumage peculiarities, indicated that the area utilized by the drake was about 4 sections or 2,560 acres. During the prenesting period the pair ranged widely. This may be due in part to the wandering of the female in search of a nest site. Movements of the pair during the nesting or laying periods, and the incubation period were somewhat limited, chiefly to feeding and loafing areas. A few observations show that during incubation the drake's cruising radius increases.

The water area in the left central portion of the range (Figure 1), in which most of the observations were made has been called the "primary waiting area." At least four more such waiting areas were located immediately outside of the study block. The waiting area used by the marked drake was also utilized by three other canvasback pairs and an unmated drake during the breeding season. All drakes using this area appeared to wait here for their laying and incubating females. This same pothole was utilized as a feeding, resting and loafing area by the drakes and their hens. The five drakes fed together without friction until the females returned. Each drake of a pair would defend an area of about 16 feet about his hen. There was no clear-cut evidence that a drake protected an entire pothole or piece of shoreline in the absence of a hen. However, on several occasions, drakes were

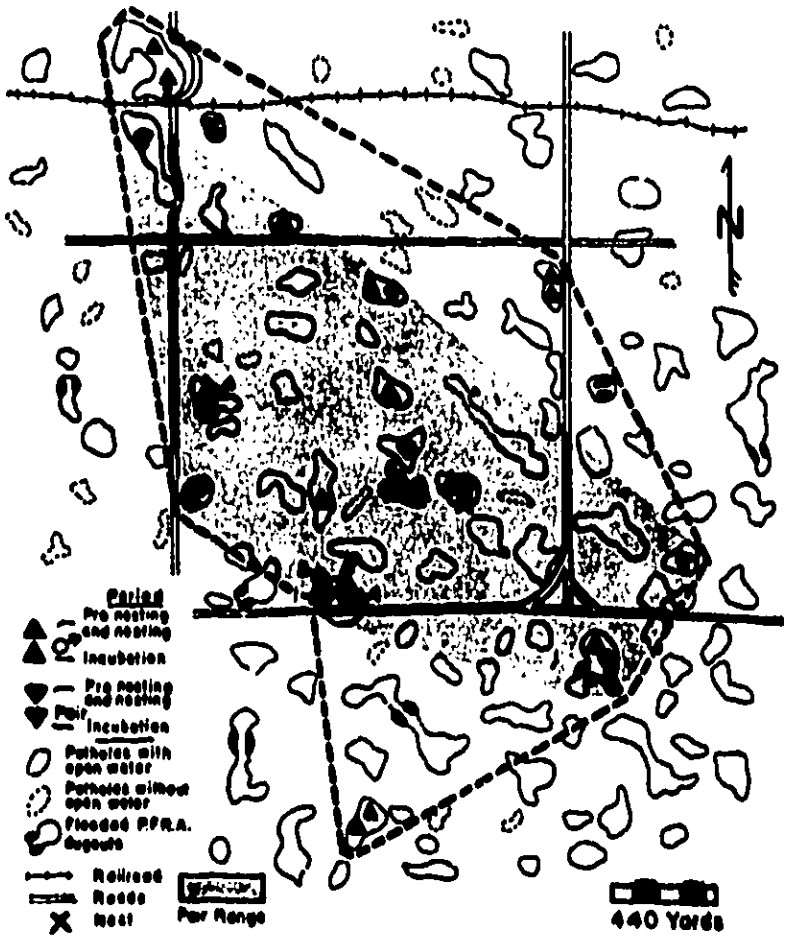

FIGURE 1: MINIMUM BREEDING HOME RANGE OF ONE PAIR OF CANVASBACK

Explanatory note: The cross-hatched portion shows the area in which the pair was seen from prenesting through incubation, while the broken line gives the entire area in which all pair and drake observations were made. This latter area is the home range. Any observation of the drake during the prenesting or nesting period is shown as a half-darkened regular triangle. Subsequent observations during incubation are shown as full-darkened triangles. Pair observations are similarly shown except that triangles are inverted. Where more than one observation was made on a pothole a numeral associated with the triangle represents numbers of times the pair or drake was noted. The prenesting period is regarded as that period of one to two weeks prior to the time the first egg is laid, while the nesting period is confined to the egg-laying stage.

seen to attack a pair that had flown into the pothole on which the nest was situated.

On the primary waiting area, the marked pair was seen to remain some distance from the groups of drakes. This pair fed here often but was also seen to feed in at least three other potholes over the home range. During incubation the female used at least three feeding potholes. Her periods off the nest occurred at various times of the day but were more frequent in the evenings. The drake was observed to use two other waiting areas, one near the nest site and one at least 1,300 yards from it. During the laying period, the drake would accompany the female to the nesting pothole in the early morning and would either wait for her nearby or return to the primary waiting area. Here, the drake would loaf, feed or rest with other drakes, which were in a loose group. Although little aggressive behavior was noted between the drakes on this primary waiting area, some individuals appeared to have priority in the use of favored loafing spots. The marked drake remained on the home range until the 16th day of incubation after which he was not seen again. Observations of other pairs showed that drakes often remained in the nesting vicinity until the 10th day of incubation and less commonly until the 18th day. Drakes then gathered into large groups of 10 to 20 and apparently left for the molting grounds.

Some indication of the sizes of potholes which contained canvasback nests during 1952 and 1953 is apparent from the following. Of 51 nests found on the study area and in a half-mile buffer strip around it, 21 were found in water areas of less than one acre and 13 were found in areas from one to two acres in size. If all nesting potholes are considered, only 9 of the 51 nests were found in semipermanent areas. The data indicate a preference for small, permanent potholes as nesting areas. The choice of the nest site does not seem to depend on the pothole, *per se*, but is influenced by the presence of certain plant types, *e.g.* cattail and also by the suitability of other potholes in the region. A large pothole, *i.e.* above 2.0 acres in size, near the nest site was usually used by the drake for a waiting area. Utilization of potholes by the pair, both for feeding and loafing, appeared to be restricted to a number of permanent areas above one acre in size, but as shown, females did use smaller areas for nesting.

In summary, the home range of a breeding pair of canvasback included many potholes of which only a few were utilized to any extent. Certain potholes were used for feeding, others for nesting and still others as waiting areas. There is, then, a community relationship

of potholes, each having one or more functions in the breeding requirement of a pair. No one pothole seemed to fill all breeding requirements completely. The home range of one breeding pair is also utilized successfully by other pairs, although the same potholes may not be used for similar daily requirements. On the study area, which includes many canvasback home ranges, there seems to be no general lack of nesting, feeding, loafing, or waiting sites, and the habitat could possibly support more pairs. However the total number of pairs has not changed materially from 1952 through 1954.

Drake aggression was confined to a small area about the female and moved with the pair. No one water area or portion of a water area was "defended" when the female was not present. However, as previously noted, the drake might show aggressive behavior toward a pair of canvasback which had flown onto the nesting pothole. This behavior did not prevent more than one canvasback female from nesting in water areas over 2.0 acres in size.

Mallard. The minimum breeding home range of one pair of mallards is shown in Figure 2. The range length is shorter and the land

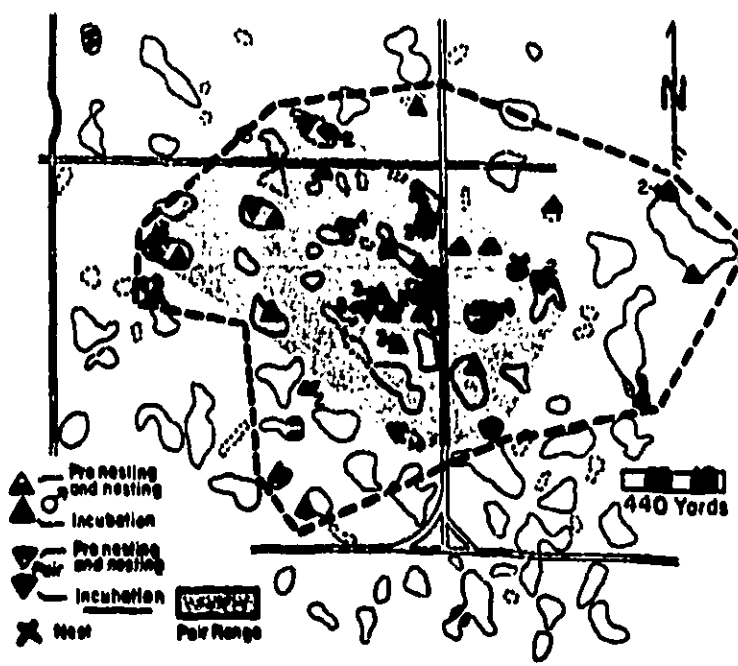

FIGURE 11: MINIMUM BREEDING HOME RANGE OF ONE PAIR OF MALLARDS

surface covered by the pair is less extensive than in the canvasback. The maximum length between drake observations was 2,590 yards and only 1,870 yards for the pair. The area covered by the drake alone was in excess of 700 acres. At least four water areas within 800 yards of the nest were commonly used by the drake, and these again have been termed waiting areas. Two of them were used more often than the other two. The range of the pair and drake during prenesting and nesting periods was somewhat variable, but was smaller than the range of the drake alone. The drake's range appeared to increase in size as soon as incubation had begun.

The feeding areas were a number of different potholes within the range. The pair or drake might utilize one area for 3 to 5 days and then feed in another pothole some distance away. The nest site logically must bear some relationship to the water areas most commonly used by the pair either for feeding or loafing but was not necessarily close to these areas. The pair fed and rested together during the afternoon, after the female had returned from the nest.

During incubation drakes visited their waiting areas in the early morning and late evening and appeared to await their females' arrival from the nest. The female usually flew to the waiting area where she would bathe, preen, and feed while the drake remained alert. The time the female spent away from the nest varied from 20 minutes to over two hours. Some females fed at various times of the day but most commonly during the early morning and late evening.

Drakes were found to associate with each other for short periods even during the late-nesting period but this was not common. Later, as incubation began, drakes started to congregate into small groups, usually away from the waiting area. These groups of 2 to 5 drakes were most evident during the late morning hours and throughout the afternoon, feeding and loafing together, with no apparent friction. Drakes often remained in the general vicinity of their waiting areas commonly up to the 14th day of incubation and less commonly thereafter until hatching. In several cases a hen and brood were seen to be accompanied by a drake but as the drake was not marked it was not known if he belonged to the family.

The territory or protected area of the home range included many of the potholes utilized by the pair during prenesting, nesting and early incubation. A pothole from which a drake might launch a territorial pursuit on one day might never be the site of such activity again. Territorial pursuits were invariably directed toward the female of the transgressing pair. The size of the territory might parallel the

size of the home range during the prenesting and nesting period. Subsequently the range was greater and the size of the protected area became smaller. The drake, on his territory, regularly drove off pairs in territorial pursuit, but even the marked pair might be chased off some of the water areas which they used regularly. The home range was utilized by many other mallard pairs which nested in the general vicinity, as was the case with the canvasback. The waiting site was the pothole or potholes from which the drake consistently showed aggressive behavior and launched territorial pursuits. However, even these sites were used by other pairs when the drake was absent.

Blue-winged Teal. The data on blue-winged teal are more complete, and this species will be treated in greater detail. The minimum breeding home-range of one pair of blue-winged teal is shown in Figure 3. This range was much smaller than either the canvasback or mallard range. The maximum length of the drake's range was 1,560 yards, while it was only 1,100 yards for the pair. The drake was seen to utilize an area in excess of 250 acres. The bluewing range was also utilized by other pairs as part of their home range. This is also characteristic of the other two species. Pairs use potholes on their range which are not at the time occupied by another pair of the same species, or they may even occupy the same pothole as another pair for feeding or resting. During the prenesting and nesting periods

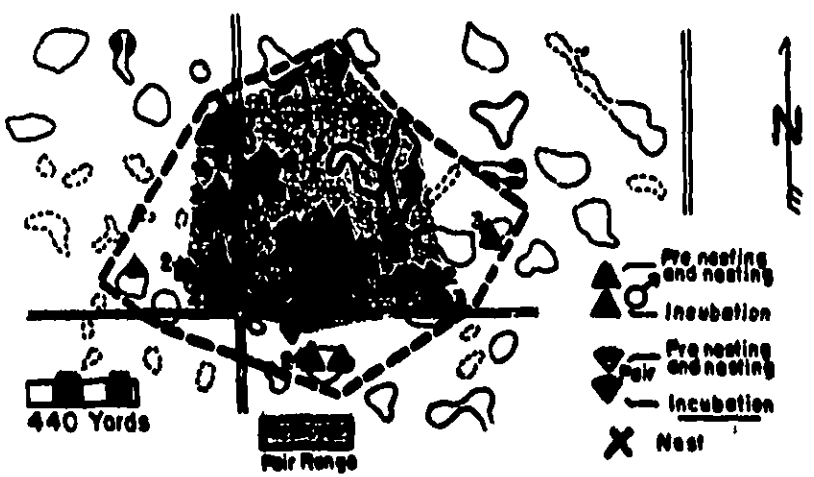

FIGURE III: MINIMUM BREEDING HOME RANGE OF ONE PAIR OF BLUE-WINGED TEAL

the pair range was not extensive. Eggs were laid in the morning hours, but some females were noted on nests even into the late afternoon. During this time, the drake awaited the female on some one or more areas close to the nest. During incubation, at least five potholes within 500 yards of the nest were utilized by the drake during some portion of the day. The resting spots, which the drake used consistently, included muskrat houses, floating vegetation, exposed shore lines and mud flats. The primary waiting area, where most drake and pair observations were made, was the nearest pothole to the nest. However, observations on other marked pairs indicated that females or pairs may be seen up to one mile from the nesting site. Certain areas within the home range seem to be more preferred as feeding, loafing or preening areas than other potholes of a similar appearing nature. The feeding potholes were scattered through the home range but each might be favored for only 5 or 6 days.

Drakes were commonly observed in the vicinity of the nest site up to the 16th day of incubation and less commonly thereafter. Small groups of drakes were seen only during late-incubation and during the brood season. Drakes were observed with broods on occasion but, as with the mallards, the drake and the female with the brood may not have been a mated pair.

During the nesting and incubation periods groups of blue-winged teal pairs seem to cluster about several water areas to form a "community of pairs" or a small "breeding colony." This behavior, in part, influences the movement of the pair over its home range. These gatherings may be due to the presence of certain preferred feeding or loafing spots in the landscape. Groups of pairs utilize a single water area only during certain portions of the day; chiefly during the morning and evening hours. Intraspecific strife between drakes and pairs is quite intense but this strife does not seem to discourage community gatherings.

Waiting areas close to the nest are the consistently protected part of the territory. The presence of the female on the protected area enhances the aggressive response of the male. The head "pumping" (Lorenz 1941) of the female appears further to initiate aggressiveness in her drake. However, when several pairs utilize one water area, each drake is not always invincible in his own waiting site. Again, as in the mallard, it is the female of the transgressing pair which is attacked. Here, however, the drake of the attacked female attempts to fight with the territorial drake in mid air: this occurs only rarely in the mallard. Blue-winged teal drakes readily attack lone drakes of their own species if they fly nearby. Females in the presence of their

drakes are aggressive to other pairs which swim into the vicinity. Much peeping and head pumping is associated with pair aggression in the potholes

The actual protected area of one drake in a group of pairs which utilize a pothole might be very small, as little as 40 square feet. The size of this area may vary with the time of day and somewhat from day to day. On areas of less than 0.2 acres, one pair of teal is usually intolerant of another pair settling there. The pothole chosen by blue-winged teal may vary from year to year. One 1.2-acre pothole which supported three territorial pairs in 1952 did not have any in 1953. A larger area that supported one pair in 1952 had six pairs congregated there in 1953. The presence of one or two pairs on an area appears to draw other pairs into the vicinity. Darling (1938, 1952), working on gulls, has suggested that colonial nesting may have important stimulating value. Even though pair counts of blue-winged teal on this area have not fluctuated widely from 1952 to 1954, there appears to be more suitable habitat available than is utilized. This is merely speculation and not a known fact. In the bluewing the territory or protected area, in a rigid topographical sense, is confined to the primary waiting area or areas. This is protected against intrusion by other drakes, females or pairs even when the female is not present. Aggression is also centered around the female, and it appears as though she is defended from other drakes. In this sense, a "moving territory" might be applicable to the blue-winged teal. The waiting area of the male is the most constantly protected site. Blue-winged teal are more prone to aggressive fighting than either the mallard or canvasback and seem to be more intolerant of surrounding pairs than either of these species. The drake's territory closely parallels the size of the home range even during the early incubation period. In view of the fact that their range and territory are more restricted than the other mentioned species, their continued fighting seems most remarkable.

Table 1 summarizes the variation in the size of range lengths and area covered by the home range, for all three examples. The drake

TABLE 1. RANGE LENGTH AND AREA OF THE HOME RANGE IN THREE WATERFOWL PAIRS.

	Drake Range Length[1] (yards)	Pair Range Length (yards)	Approximate Area of Home Range (acres)
Canvasback	3,000	3,440	1,500+
Mallard	2,690	1,870	700+
Blue-winged Teal	1,560	1,100	250+

[1]Maximum distance between observations.

range lengths are larger than pair range lengths among the species studied.

Pintail and Redhead. Preliminary observations of pintail and redhead ranges have been made on some marked and many unmarked individuals. These observations are not as extensive as the ones on the previous three species and merely indicate that further variations in home-range size may occur. Pintail ranges may well extend over five miles in any one direction from a central point. One marked drake was seen four miles west and one mile north of his original banding site. Small groups of pintail drakes were seen even during the egg-laying period, but it is not known if these were mated birds. Smith (*loc. cit.*) noted, in southern Alberta, that seven pintail drakes used the same 0.75-acre pothole for a waiting area. No apparent conflict was noted between the individual drakes even when each of their hens returned from the nest to feed in the pothole. On my own study area aggressiveness between males seems to be rare in this species although chasing of females by drakes is evident early in the breeding season. Redhead ranges cover at least five square miles and closely parallel the ranges of some canvasback. Drakes do not appear to defend any one pothole or portion thereof but merely show aggressive response to other redheads that swim within some three feet of the pair. Single males and mated birds which are separated from their females tolerate each other's presence and may be found in small, loose groups through the breeding season until late incubation. Subsequently they leave the pothole country and apparently retire to the moulting lakes.

OBSERVED TERRITORIAL BEHAVIOR

The concept of a moving territory in Canada geese (*Branta canadensis*) has been criticized by Conder (1949) who felt that territory should be limited to an area of topographical reference. The term "individual distance" was used to describe the defense outside of a specific territory. More recently Koskimies and Routamo (1953) have used this term to describe the aggressive behavior of the white-winged scoter (*Melanitta fusca*) in Finland, as the "mated-female distance." These terms have not been utilized to describe the "moving territory" of the previously described prairie-nesting species. Because of the preliminary nature of this study the term "moving territory" will be applied to aggression shown by the male off his regular territory. This aggression is usually concerned with the "defense" of the female.

Any reference to protected area or territory in waterfowl implies

some sort of aggressiveness on the part of a drake or his female to other members of the same species. Hochbaum (1944) has described pursuit flights and territorial defense in many North American waterfowl. However, aggressiveness or intolerance may not be the only explanation for these territorial pursuits. Heinroth (1910), Geyr von Schweppenburg (1924, 1929, 1930, 1953) and Christoleit (1929) have pointed out, for the mallard, the differences between true territorial pursuits, courtship parties, nuptial courtship flights, and harrying of nesting females by groups of drakes in attempted "rape." Even territorial pursuits, wherein a paired male flies at the female of an intruding pair and chases her a way while her mate follows some distance behind, might be explained as attempted rape on the part of the pursuing drake and not necessarily as a show of aggressiveness.

Mallard. The female of the mallard pair is the most consistently pursued individual in territorial encounters. Of the several hundred pursuits that I have observed, involving one or more paired drakes attacking a pair, only six were noted which showed friction between the drakes. The length of the territorial chase may vary. For instance, in one case a marked drake chased a pair for 150 yards while on another occasion the same drake chased another pair for 1,500 yards. The female during territorial pursuit, usually emits one of two calls, the call accompanying the "gesture of repulsion" or, less commonly, she may give the "inciting call" (of Lorenz, *loc. cit.*; see also Geyr von Schweppenburg, 1930). More than one drake may join a territorial pursuit for I have seen up to four drakes join a single drake in the pursuit of a mated hen. Most of my observations of the territorial pursuits in the mallard have been inconclusive since I could not follow many of the pursuits to completion. On many occasions drakes returned to their waiting area after a short chase only. Apparently successful "rape" has been seen once in the mallard and four times in the blue-winged teal. Webb, R. (*loc. cit.*) has noted it several times in pintails in Alberta. These observations show that, at least on occasion, chases are motivated by the "drive to rape." Further observations are needed to determine the frequency of this type of chase.

Contrasted to the territorial pursuit, courtship or sexual flights do also occur, as indicated by Hochbaum (*loc. cit.*). They are evident when more than 4 drakes are pursuing a female. The female in this case is usually silent and often hovers in the air for short periods. A marked drake that had a female in early incubation was seen to join such a party for a short time only. In fact many drakes which already appear to be mated join such courting groups and follow

the hen for some distance. This is not to be confused with harrying or attempted rape of lone hens by large groups of drakes (See Geyr von Schweppenburg (1953) "courtship pursuit flights"). I have seen as many as 28 mallard drakes following a lone female in apparent courtship flight.

Territorial drakes do arise to meet lone drakes, but aerial fighting is very rare between mallards. A drake which flies into another drake's waiting area is usually chased off by a minor show of aggressiveness on the part of the owner. On the area which I studied, a mated drake mallard will not usually allow another mated pair, female or drake to utilize the same small water area or portion of marsh shoreline as himself, especially during the prenesting, nesting, and early incubation periods. The spacing of pairs on the breeding grounds could be explained on the basis of intolerance, through aggressive responses by the drake or perhaps by attempted rape. Pairs may have a definite space requirement in order to breed successfully and produce a maximum number of broods.

Blue-winged Teal. Territorial pursuits in the blue-winged teal closely resemble those described for the mallard, except that aerial fighting between drakes usually occurs. The male of the attacked pair does not merely follow the territorial drake which is chasing his female but fights with him in mid-air. Courting parties or nuptial flights seem to be rare in this species on the breeding grounds, although I have seen as many as 10 drakes harrying a marked, incubating female. The territory in this species is composed of some protected waiting area or areas. Drakes also show aggressiveness to other bluewings which swim close to the female whenever the pair is off the waiting area. This last ameboid area might be described as a "moving territory" in order to differentiate between "defense of definite topographical areas" and "defense of the female."

Canvasback. Pursuit flights are not evident, although small groups of drakes do chase females early in the breeding season. These may be courting flights as described by Hochbaum (1944). Nuptial courtship is also evident in this species (Hochbaum, *ibid.*). Aggressiveness, as reported previously, is evident when a pair, drake or female swims near a mated pair or occasionally when one pair flies into another pair's nesting pothole. Drakes, then, do not appear to defend any one pothole but only show aggression to other canvasbacks that swim near the female.

DISCUSSION

From these preliminary observations in the pothole habitat, I would like to suggest the following definitions which should be useful in the

future discussion or understanding of home ranges and territorial behavior in waterfowl. They will stand the test of being used on other areas only if we realize that *territories are not as rigid as previously thought*. Each species of waterfowl will adapt to the conditions at hand, thus altering its daily pattern to conform to the characteristics of each habitat. In any event, these general definitions, which hold *for the pothole region in southern Manitoba*, will have to be subjected to a number of clarifying conditions for each species and then be tested for each habitat (*i.e.*, marshes, rivers, lakes and especially in the short-grass region where some pairs breed in close proximity).

Home range is the area in which the pair is most active during the breeding season (*i.e.* during the prenesting, nesting and incubation periods). This area must include the nest, feeding, and loafing sites, and also the territory (including a waiting area). It is the sum total of land and water areas utilized by the pair, including such areas as the male and female may use individually from the time of initial settling on an area or prenesting period to the time the drake leaves for the molting grounds and the female hatches her brood. The last two events may not be simultaneous. The home range of pairs on the breeding grounds is distinguished clearly from the brood range and the range of the birds when they leave for the molting grounds. In cases of renesting, a new home range may be established, again beginning with the initial settling of the pair with intent to nest. This home range on the breeding grounds include some areas of constant activity and other areas of secondary importance. Most activity occurs near the center of the home range and peripheral areas are visited less frequently. The home range of the breeding pair has no special form but is dependent on the location of the first-mentioned requisites. This unit can and does overlap with similar ranges of other pairs of the same species and also with the home ranges of other species.

Territory is the defended portion of the home range from which a drake attacks another pair, drake or female, of his own species. Such attacks or territorial pursuits take place from a number of different potholes over the home range. The size of the territory might be said to vary from day to day depending upon from which areas the drake pursued other drakes. It could best be described as ameboid. It may parallel the size of the home range during early periods of nesting. Such boundaries as do exist may not be defended with any degree of intensity, for time of day and chronology of the breeding season ultimately influence aggressiveness. Drakes may make repeated attacks during one portion of the day and not show any aggressiveness during other periods. In addition to these defended areas a "moving terri-

tory" is evident in some species. This may be associated with the defense of the female and not necessarily with the defence of a water area or portion thereof. Territorialism is most evident from the time of the prenesting period to early incubation. Since a defended area is the criterion for a territory, then it does overlap with the territory of other pairs of the same species and most certainly with territories of other species, for little interspecific intolerance exists. The size of this area varies between species, during different periods of the day for any one species, and during the breeding season itself. The difference between the territory and home range is often not clear cut. An area from which a territorial pursuit has taken place may not be utilized for subsequent pursuits. It is then a matter of interpretation and definition. Home range is associated with the whole portion of the land and water area utilized by the pair including the area from which the drake shows aggressiveness. It may thus include the nesting site if it is off the region regularly inhabited by the pair, part of the area over which the drake roams after incubation has started, and certain water areas from which the pair is regularly chased by another drake. The territory is not a clearly defined area with rigid boundaries. If it is not evident in some species on some habitats then, these individuals may have only a home range.

Waiting area is an integral part of the territory, comprising the site of intensive activity by the drake. It may be one pothole, a series of potholes or a portion of a marsh where the drake awaits the female during egg laying and the early incubation periods. It is persistently protected but, as in the case of the territory, may not be protected with the same intensity during all periods of a day or at all times during the breeding season. During incubation drakes use these areas most consistently in the morning and evening hours. Although it is in the home range, it may not be near the nesting site. The waiting area used by a drake may be utilized by another drake if the original one is absent.

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SUMMARY

1. Twenty-three pairs of ducks were neck-banded and followed to determine the extent of their home ranges. Three examples of home ranges are given. The maximum distance between drake observations was 3,900 yards for canvasback, 2,590 yards for the mallard, and 1,560 yards for the blue-winged teal. The approximate area of the home ranges of these three species was 1,300+, 700+, and 250+ acres, respectively. The drake's range length was larger than the range length of the pair.

2. Home range has been defined as the area in which the pair is most active during the prenesting, nesting and incubation periods. Territory is the defended portion of the home range. Waiting areas are part of the territory used, and defended, most consistently by the drake.

3. The "territory" in the canvasback was a defended area around the female, about 6 feet in diameter. The territory moved with pair activity; *i.e.* "moving territory." Mallard and blue-winged teal territories were ameboid in shape: usually including one or more waiting areas and an area of indefinite size, similar to that defended around the canvasback female. This area, in the blue-winged teal is defended by the drake wherever the pair are together. The drake, however, may defend an entire pothole when the female is on the nest. Blue-winged teal drakes fought more over territories than either canvasback or mallard drakes, apparently because of their re-

stricted home range. Territorial pursuits by mallards and blue-winged teal are directed against the female of the transgressing pair. During pursuits blue-winged teal drakes fight in the air whereas mallard drakes rarely do. Courtship flights occur in the mallard, blue-winged teal and canvasback especially early in the breeding season. Groups of mallard, blue-winged teal drakes chase lone hens during the breeding season. This behavior may be associated with attempted rape or harrying by the drakes.

4. A review of the literature on the presence of territories in waterfowl presents a confusing picture. In the pothole region I found territorial behavior well developed. According to other observers the intensity of territorial behavior varies between species and in different breeding habitats. Further detailed study is needed to clarify the situation.

5. I believe the concept of home range helps better to interpret observed behavior in waterfowl. Further intensive study of home ranges in each habitat should lead to a clearer understanding of the biology and ecology of each species of duck.

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DISCUSSION

DISCUSSION LEADER CORNELL: Thank you, Mr. Dzubin. I am sure this paper on the definition of terms is of considerable value, particularly in future studies in this field, and to the ecologists who will describe the habitats concerned. It is impossible to think constructively without exact definition of terms used, and in this paper we appear to have an excellent summary of exact definitions.

Are there any questions to be asked of Mr. Dzubin at this time?

Mr. Dzubin, is it your belief that this range concept limits the duck population density on the nesting area?

MR. DZUBIN: That is a very difficult question to answer at the present time. The birds in the short-grass prairie do not seem to be territorial and almost seem to breed in colonies; whereas the birds in my own study area seem to space them-

selves; that is, you never find two pairs of mallards in the same pothole. I am in no position to answer that question at the present time. I am sorry.

DISCUSSION LEADER CORNELL: Are there any questions from the floor? I have one more, then.

Is there enough information, from your observations, to make recommendations concerning the management of breeding areas, either in the creation of potholes, limiting their shape or size or vegetation in them?

MR. DERMIN: A study of this sort would lead us to a better appreciation of what birds need to successfully breed. However, I feel that more studies of this sort would have to be done in each habitat to find out what birds need in other habitats, and all this compared in some sort of summary, and this might be given to those states interested in creating a new waterfowl habitat.