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Adaptations of the Horned Grebe for Breeding in Prairie Pothole Marshes

by

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MASTER OF SCIENCE

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ABSTRACT

Field studies of the Horned Grebe (Podiceps auritus) were conducted during the breeding seasons of 1974 and 1975 near Minnedosa, Manitoba. This paper documents the reproductive biology of Horned Grebes and describes their adaptations for nesting in unstable marsh habitats.

Nesting pairs defended Type A territories which ranged in size from 0.05 to 2.70 hectares. Occupation of a pothole by two or more nesting pairs occurred only on potholes larger than one hectare. Differential selection of permanent potholes for nesting reflected the grebes' dependence on open-water feeding areas. Interspecific territoriality by Horned Grebes was related to defense of their pairing and nesting platforms. Three factors were important in nest-site selection: (1) accessibility of the site from open water; (2) protection of the nest from wave action; and (3) concealment of the nest from predators. All nesting platforms were anchored to emergent vegetation.

Annual variation in initiation of first clutches was correlated with differences in air temperature during spring. Initiation of replacement clutches was influenced by the stage of the nesting cycle at which the previous nests were destroyed. Use of the same territory following failure of an incomplete clutch facilitated rapid clutch replacement. A seasonal decline in clutch size was observed and was possibly due to depleted energy reserves of females late in the nesting season and to an allocation of energy to the prebasic molt.

Incubation was shared by the sexes, but females assumed a reduced role in incubation during the period of egg-laying. Hatching was asynchronous. Successful nests were located farther from shore and in deeper water than nests destroyed by predators. Raccoons (Procyon lotor) were responsible for most of the egg loss. Egg loss to wave action was of secondary importance. Chick development and parental behaviour are described and compared to that of the Great-crested Grebe (Podiceps cristatus). An elaborate system of parental feeding by Horned Grebes reduced competitive disparities within broods that resulted from age differences among chicks.

The reproductive strategy of Horned Grebes is examined in relation to environmental stability, and possible selection pressures influencing this strategy are discussed.

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INTRODUCTION

Marsh habitats associated with shallow lake basins of glacial origin are characterized by their instability. The 'pothole marsh' community is described by Weller and Fredrickson (1973:288) as "an unstable ecosystem with extreme, short-term fluctuation from the near-terrestrial to near-aquatic system". Seasonal and annual fluctuations in habitat quality and quantity are largely due to variations in precipitation and subsequent changes in water levels. Wetland vegetation is highly sensitive to changing water levels, and undergoes rapid and extensive changes in species composition, distribution and abundance (Millar 1969). Plant succession in pothole marshes is continually being reversed (Millar op. cit.).

Marsh-dwelling animals are therefore subjected to rapidly changing environmental conditions. Weller and Spatcher (1965) and Weller and Fredrickson (1973) investigated the impact of fluctuating habitat conditions on the distribution and abundance of several marsh bird species in Iowa. The availability of nesting cover in the form of emergent vegetation was of prime importance, and bird abundance and diversity were greatest when a well-interspersed cover-to-water ratio of approximately 50:50 prevailed.

In general, marsh birds are adapted to changing habitat conditions by their pioneering ability and mobility (Weller and Spatcher 1965). By shifting from marsh to marsh and by rapid colonization of newly-flooded habitats, overall population levels are maintained despite sub-optimal conditions in localized areas. However, adaptability of individual species is related to their degree of specialization. Relatively non-specialized species are more tolerant of changing

conditions and are able to exploit a wide range of nesting habitats. For example, Red-winged Blackbirds (Agelaius phoeniceus) frequently nest in upland habitats when emergent cover is scarce (Weller and Spatcher op. cit.), or when they are excluded from their optimal niche space by Yellow-headed Blackbirds (Xanthocephalus xanthocephalus) (Robertson 1972). Great adaptability is also evident in ducks of the genus Anas, which show remarkable flexibility in nest-site selection (Weller and Spatcher 1965).

In contrast, the grebes (Podicipedidae) form a highly specialized group of approximately 20 species. (The taxonomic status of a few forms is uncertain (see Simmons 1962; Storer 1963a).) As a result of their morphological specialization to an entirely aquatic existence, grebes are limited in both habitat and nest-site selection. Studies of the following species have demonstrated their dependence on open-water feeding areas and emergent nesting cover: Rolland's (Rollandia rolland) and Silver Grebes (Podiceps occipitales) (Burger 1974a); Horned Grebe (P. auritus) (Fjeldsa 1973a); Great-crested (P. cristatus), Red-necked (P. grisegena), Eared (P. nigricollis), and Little Grebes (P. ruficollis) (Gotzman 1965); and Western Grebe (Aechmophorus occidentalis) (Nuechterlein 1975). The use of dry-land nesting sites by Western Grebes, as reported by Nero (1958), is an exceptional occurrence.

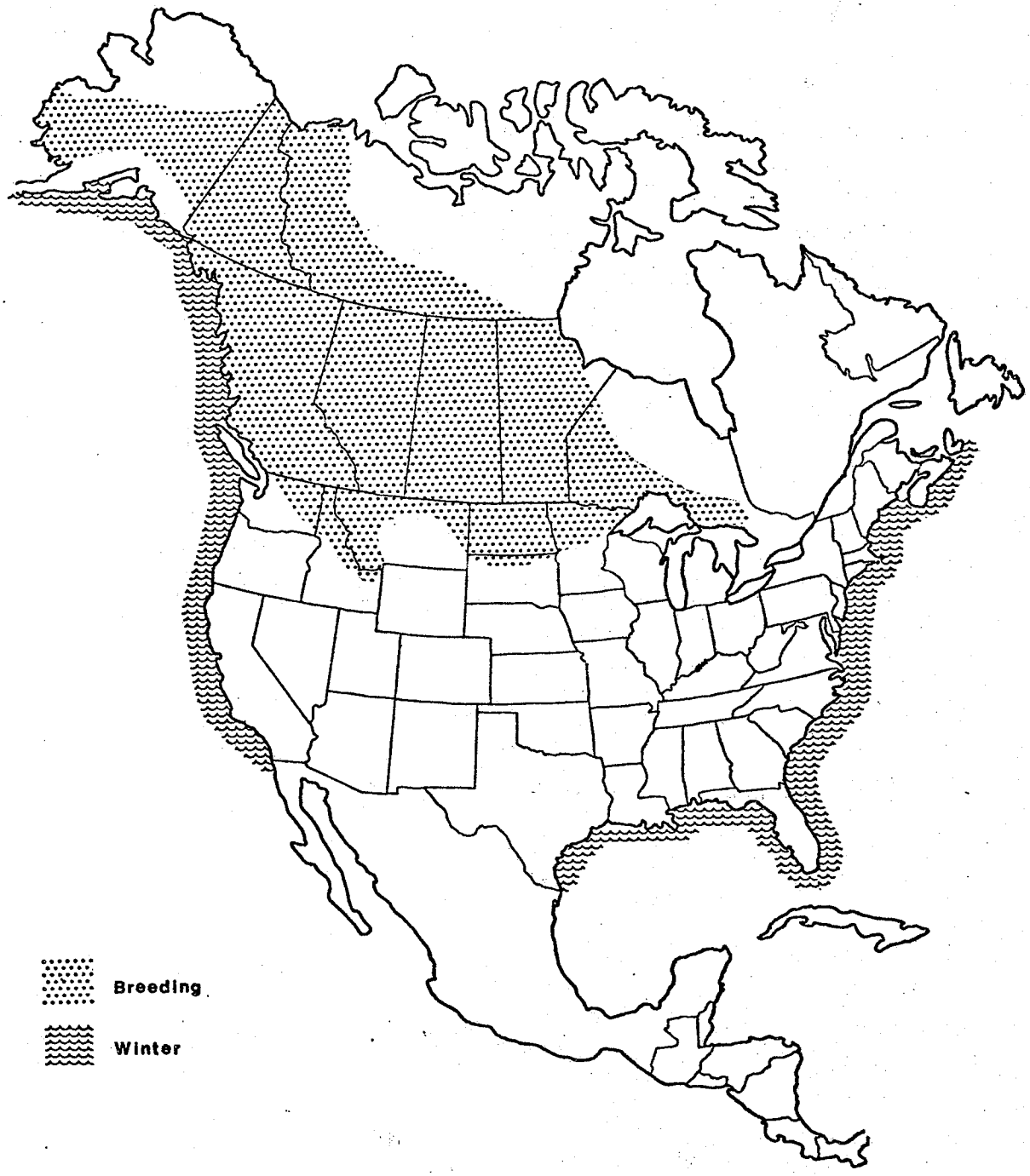
Thus, in unstable marsh habitats, the problems encountered by grebes and other specialized groups are apparent. However, considering the prominence of grebes in these habitats, it seems reasonable to expect that they have developed other breeding adaptations that compensate for their limited adaptability in habitat and nest-site selection.

Simmons (1970, 1974) suggested that many of the reproductive traits in the life history of the Great-crested Grebe are adaptations to an unpredictable food supply. Investigations of adaptive aspects of other grebes are lacking. The present study examines the reproductive biology of Horned Grebes in order to determine adaptations for nesting in prairie pothole marshes. This paper discusses adaptive aspects of territoriality, nest-site selection, egg-laying, incubation, hatching and parental behaviour.

The Horned Grebe, once considered to be a taxonomic uniform holarctic species (Parkes 1952), breeds throughout much of northern Asia, northern Europe, and northwestern North America. However, Fjeldsa (1973b) demonstrated geographical variation in this species and recognized three subspecies. Podiceps auritus auritus (Linnaeus 1758) breeds in Sweden, Finland, and the Baltic States, eastward to the Obj lowlands in the Union of Soviet Socialist Republics. P. a. arcticus (Boje 1822) breeds in Iceland, Scotland, northern Norway and, occasionally, in the Faeroe Islands. P. a. cornutus (Gmelin 1788) breeds throughout northwestern North America (and probably eastern Siberia).

The breeding and wintering ranges of P. a. cornutus (hereafter referred to as the Horned Grebe) in North America are depicted in Figure 1. Despite its widespread occurrence in western North America, no detailed accounts of its reproductive biology have been published. The reports of Bent (1919), DuBois (1919), Munro (1941), and Palmer (1962) are based on casual observations of a few breeding pairs from widely scattered localities, and are generally incomplete. More thorough ecological investigations have been conducted in Europe

Figure 1. North American distribution of the Horned Grebe. Drawn after Godfrey (1966) and Palmer (1962).


Breeding
Winter

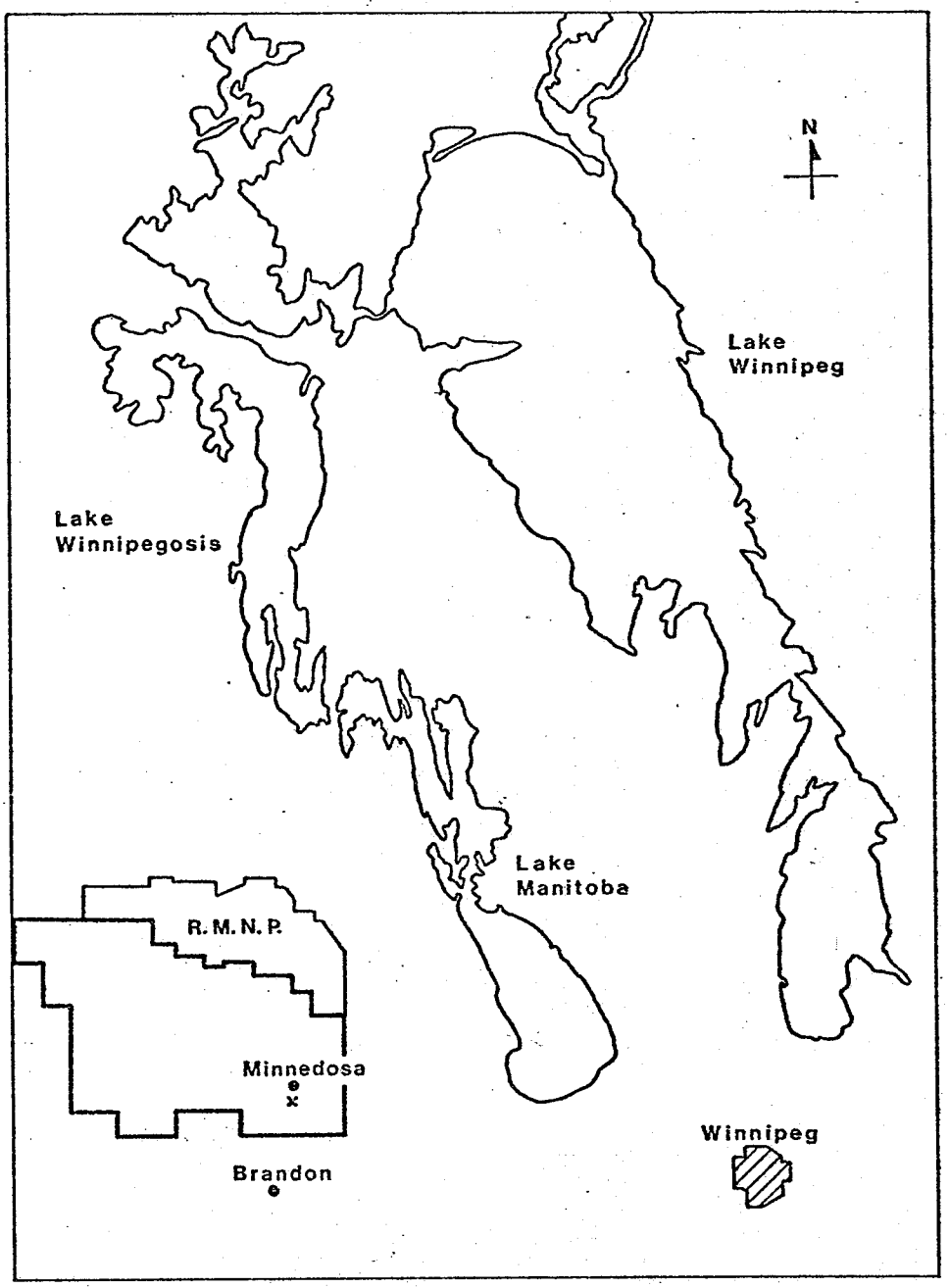
(see Clase et al. 1960; Fjeldsa 1973a,c; Hogstrom 1970; Onno 1960). Agonistic and courtship behaviour of the Horned Grebe has been described and analysed in detail by Fjeldsa (1973d) and Storer (1969).

STUDY AREA

Field work was conducted on prairie pothole marshes within the region of southwestern Manitoba frequently termed the 'Minnedosa pothole district'. Encompassing an area of over 10,000 km^2, the Minnedosa district lies within the aspen parkland, the transition zone between the grasslands on the south and the coniferous forests on the north (Bird 1930). The extent of the Minnedosa pothole district and location of the study area are shown in Figure 2. Most observations were made in an area of 75 km^2 located south of Minnedosa (50°15'N; 99°50'W) in the Rural Municipality of Odanah (Figure 3). I concentrated efforts in locating nesting pairs of Horned Grebes to a region 400 m wide (200 m on each side of the road allowance) along a 73 km transect of unpaved road, giving an area of 29.2 km^2. In addition, all wetlands within a study block of 5.2 km^2 (two adjacent sections of land) were surveyed at weekly intervals. Each year (1974 and 1975) over 450 potholes were surveyed for nesting grebes.

The glacial history of the Minnedosa region is evident from its undulating to steeply sloping topography. Drainage is poor, and runoff water accumulates in enclosed glacial basins, locally called potholes or sloughs, which in some areas occupy more than 35 percent of the total land acreage (Ehrlich et al. 1957). The rolling terrain results in a relatively small runoff area so that water levels vary directly with the amount of precipitation. Kiel et al. (1972:37) noted that "deviations of 20 percent or more from normal precipitation noticeably change pothole habitat, and the changes are accentuated by two or more successive years of above or below normal precipitation".

Figure 2. Map of southern Manitoba showing location of study area within the Minnedosa pothole district.



x Study Area

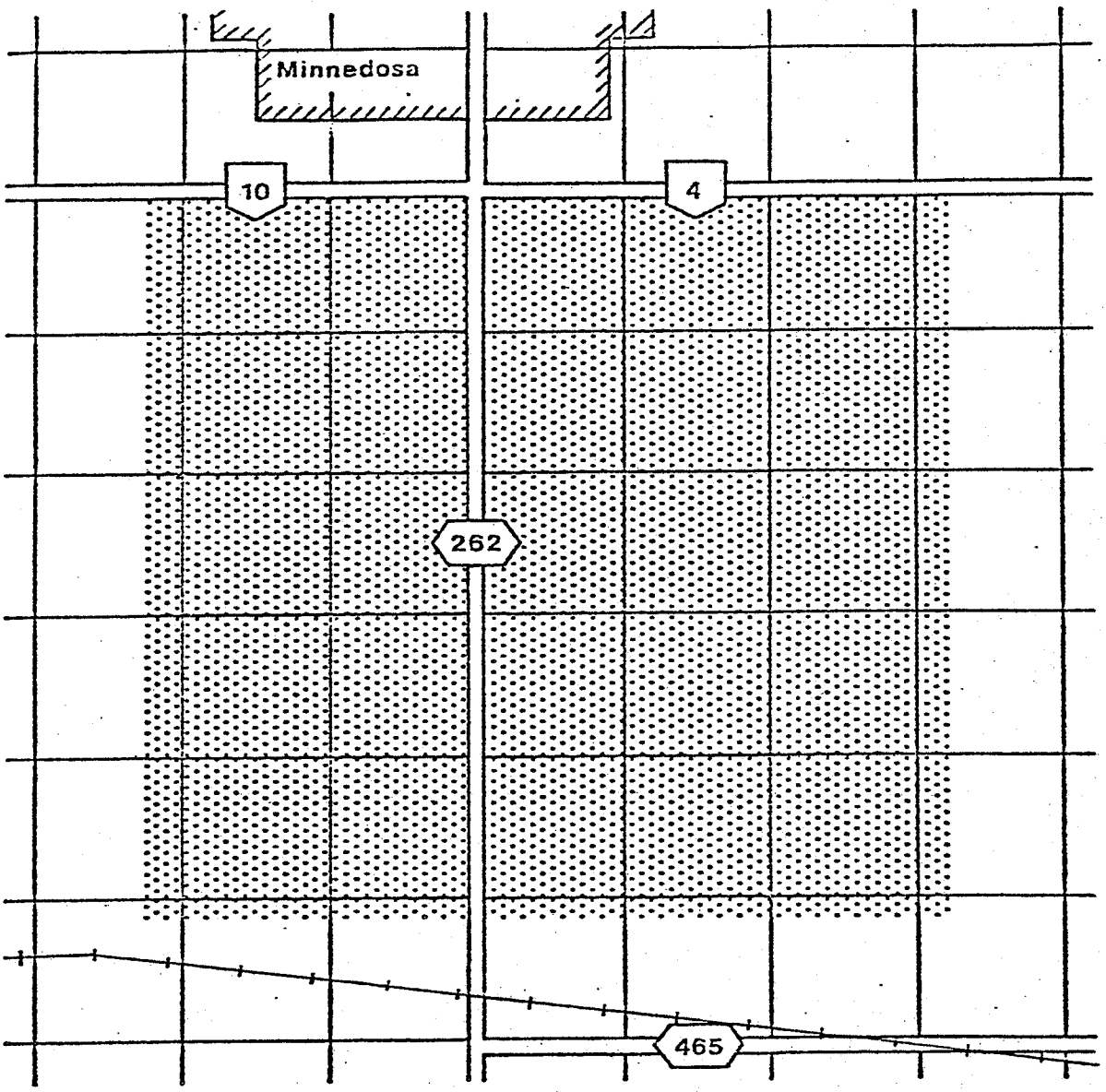
Minnedosa Pothole District

R.M.N.P. Riding Mountain National Park

Scale in km.

0 30 60

Figure 3. Location of study area, Rural Municipality of Odanah, Manitoba.



Provincial trunk highway

Provincial road

Railway

Study area

Scale in km.

0 1 2

The fertile, agricultural lands of the study area are interspersed with numerous pothole marshes (Figure 4). The number of potholes varied from eight to 21 per km^2, with a mean of 15 per km^2. Pothole size varied considerably, from 0.04 to 47.5 ha, although most were within the range 0.4 to 4.0 ha. Mixed woodlands of Manitoba maple (Acer negundo L.), balsam poplar (Populus balsamifera L.), trembling aspen (P. tremuloides Michx.) and bur oak (Quercus macrocarpa Michx.) occur as small, isolated 'bluffs' on many elevated sites.

The climate of the Minnedosa pothole district is described by Ehrlich et al. (1957). Mean annual temperature at Minnedosa is 1.1 degrees Celsius (n = 64 years). The frost-free period (the length of time between dates of the last frost in spring and the first frost in autumn) varies from 85 to 100 days. Mean annual precipitation at Minnedosa is 43.7 cm (n = 65 years), with approximately 75 percent of the total annual precipitation falling as rain during April to October. The remaining 25 percent falls as snow during November to March.

The topography, hydrology, soils and vegetation of the Minnedosa district are described by Bird (1961), Ehrlich et al. (1957) and Kiel et al. (1972).

PRODUCTIVITY OF POTHOLES

Potholes within the glaciated prairie region are highly productive. Although they are regarded as naturally eutrophic lakes, Barica (1974) points out that the eutrophication process has been accelerated in the Minnedosa district by land management practices. Extensive land clearing and the widespread use of soil fertilizers have increased the mineral and nutrient levels in many wetland systems.

Figure 4. Aerial photograph of a portion of the Minnedosa study area, July, 1974. (Roads delimit an area of 2.59 km^2.)