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SANDHILL CRANE NEST AND EGG CHARACTERISTICS AT MALHEUR NATIONAL WILDLIFE REFUGE, OREGON

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Abstract: For the period 1969–89, greater sandhill crane (Grus canadensis tabida) nest and egg characteristics were assessed for pairs on the Malheur National Wildlife Refuge (Malheur), Oregon. Nests mostly were in broad-fruited burreed (Sparganium eurycarpum) and hardstem bulrush (Scirpus acutus) and were constructed primarily of the same vegetative species that surrounded nests. Averages for nest parameters were diameter 127 x 111 cm, crown diameter 77 x 69 cm, bowl diameter 41 x 37 cm, bowl depth 5.8 cm, nest height 12.4 cm, and water depth 25.8 cm. Nests were placed in vegetation with a mean height of 37.3 cm. Mean egg size was 98.9 x 62.3 mm. Sandhill crane nests at Malheur were larger and were built in deeper water than those reported elsewhere in the western United States. Mean egg size also was greater than has been reported from other regions.

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Key words: eggs, greater sandhill crane, Grus canadensis tabida, nest parameters, nest vegetation.

Greater sandhill cranes breed across the northern United States and southern Canada in 5 disjunct regions from the Great Lakes states and Ontario, west to the Pacific states and British Columbia (Drewien and Lewis 1987). The Eastern and Prairie Populations nest east of the 100° Meridian, whereas the Rocky Mountain, Lower Colorado River Valley, and Central Valley Populations nest to the west. Within this extended range, crane nests and eggs have been described from several regions, particularly Michigan (Walkinshaw 1965, 1973), Wisconsin (Howard 1977, Bennett 1978), Idaho (Drewien 1973), Oregon (Littlefield 1968), and California (Littlefield 1989).

While assessing crane productivity at Malheur in Harney County, Oregon, I also collected data in most years on nest concealment, nest site vegetation, nesting material, nest and egg sizes, nest site water depths, and distances both from nests to feeding meadows and to open situations. Herein, I report on data collected at Malheur for the period 1969–89: information on nests and eggs found in 1966–67 were summarized earlier (Littlefield and Ryder 1968).

STUDY AREA AND METHODS

Greater sandhill cranes nesting at Malheur are affiliated with the Central Valley Population. The southern segment of that population breeds mostly in 6 northeastern California counties and the eastern two-thirds of Oregon. Within this region, Malheur supports the greatest number of nesting pairs (Littlefield et al. 1994). Malheur is situated in the semi-arid northwestern Great Basin and lies at an elevation of about 1,240 m. Mean annual precipitation is 255 mm. Winters are generally cold and wet: the summers are warm and dry. However, cold conditions and snowfall may persist into early June. Water supplies are primarily provided by snowmelt from nearby mountain ranges, but there are a few freshwater springs.

Within the circa 75,000 ha refuge, an interspersion of marsh-meadows and shrub-covered uplands provide ideal crane habitat for both nesting and brood-rearing in most years. The center of breeding is in the Blitzen Valley, which extends south from Malheur headquarters (43°16' N, 118°53' W) for about 56 km. The valley varies in width from 0.8 to 4.8 km, bordered on the east, south, and west by shrub-covered hills and mountains: the dominant shrub is big sagebrush (Artemisia tridentata). Malheur Lake borders the valley to the north.

Some Malheur crane pairs frequently initiate nesting in early April but most wait until mid- to late April: nests used in this study were located primarily between 4 April and 15 May. When a nest was located, nest and egg parameters were usually measured, but there were exceptions. During the 21-year study, fairly complete nest measurement and water depth data were collected in 14 years, but data were incomplete or not collected for 1972, 1975, 1976, 1977, 1979, 1985, and 1988. Vegetation height was not measured in 1972, 1975, 1979, and 1988, and eggs were not measured in 1972, 1975, 1976, 1979, 1985, and 1988. Means (x) and standard deviations (SD) were calculated for all measurements and are expressed as x± SD.

Nest site parameters and water depths were measured...
with a metric tape or meter-ruler, whereas eggs were measured with a vernier caliper. Distance to nearest feeding and open sites \((n = 9 \text{ years})\) was paced and later converted to meters. Vegetation composition both in and surrounding the nests \((n = 18 \text{ years})\) was estimated ocularly. Nest concealment \((n = 16 \text{ years})\) was rated as (1) poor when a nest was visible at a distance >50 m, (2) fair when visible at a distance vented or greatly reduced the chances for dense, coarse emergents concealing markers later in the growing season.

To reduce or eliminate the potential for egg depredation by the common raven \((\text{Corvus corax})\), I covered eggs with nesting material upon departure from a site. Nests were marked with a lath stake placed >15 m from the nests, generally in the nearest open meadow: this practice prevented or greatly reduced the chances for dense, coarse emergents concealing markers later in the growing season. It also eliminated the potential for predators using markers as cues to locate nests.

### RESULTS

#### Nesting Vegetation

Most of the 1,018 greater sandhill crane nest sites sampled for vegetation were in homogeneous stands of robust emergents (Table 1). Broad-fruited burreed \((\text{Sparganium eurycarpum})\) and hardstem bulrush \((\text{Scirpus acutus})\) were the dominant nesting habitat \((76.8\%, 782 \text{ nests})\). There was less use of common cattail \((\text{Typha latifolia})\), Baltic rush \((\text{Juncus balticus})\), grasses, sedges \((\text{Carex spp.})\), and forbs. Eighty-two nests \((8.1\%)\) were in a combination of 2 or more plant species, with burreed-bulrush the most common \((2.3\%, 23 \text{ nests})\). Alkali \((\text{S. maritimus})\) and river \((\text{S. microcarpus})\) bulrushes, common reed \((\text{Phragmites communis})\), common spikerush \((\text{Eleocharis palustris})\), and flooded barley stubble had 1 to 3 nests each. Nests among shrubs were a rarity, but 2 nests were in black greasewood \((\text{Sarcobatus vermiculatus})\), 1 in willows \((\text{Salix sp.})\), and another in a Wood's rose \((\text{Rosa woodsii})\)-Baltic rush combination. Of nests found in grasses \((n = 26)\), 12 grass species were represented, with creeping wildrye \((\text{Elymus triticeus})\), sloughgrass \((\text{Beckmannia syzigachne})\), redtop \((\text{Agrostis alba})\), and meadow barley \((\text{Hordeum brachyantherum})\) dominating. At nests in sedges, only 3 species were represented \((n = 9)\): beaked \((\text{C. rostrata})\), awnend \((\text{C. atherodes})\), and Nebraska \((\text{C. nebraskensis})\) sedge. Two nests were in monotypic forb stands \((\text{mostly Rumex crispus})\), but 23 other forb species were scattered at 33 other sites. One nest was on an unvegetated island.

#### Nesting Materials

Material used in construction was usually residual vegetation from the previous year and was generally the same species that surrounded the site. For 1,011 sampled nests, 805 \((79.7\%)\) were composed entirely of either burreed or hardstem bulrush (Table 1). Sixty-five nests \((6.4\%)\) were constructed of cattails, whereas Baltic rush, sedges, grasses, and forbs composed a combined total of 57 nests \((5.6\%)\), and 78 nests \((7.7\%)\) consisted of 2 or more plant species. Nests found in common reed, spikerush, or other bulrushes were composed of those species. A nest in barley stubble was made of stubble \((\text{Littlefield 1994})\). Another nest was built of greasewood, but lined with Baltic rush.

#### Nest Characteristics

Exposed mean basal diameter for 809 nests was \(127 \pm 35.5 \times 111 \pm 25.84 \text{ cm}\), but ranged from \(39 \times 31\) to \(333 \times 327 \text{ cm}\). Three additional clutches were placed on wind-lodged hardstem bulrush with no material added. Other nest parameters were mean crown \((\text{or platform})\) diameter \(77 \pm 15.99 \times 69 \pm 12.86 \text{ cm}\) \((\text{range} = 4 \text{ had no discernable crown to} 242 \times 79, n = 713)\); mean bowl diameter \(41 \pm 7.87 \times 37 \pm 6.99 \text{ cm}\) \((\text{range} = 33 \text{ with no bowl to} 80 \times 72, n = 675)\); mean bowl depth \(5.8 \pm 2.53 \text{ (range} = 0 \text{ to} 22.5, n = 684)\); and mean height above water or ground level \(12.4 \pm 4.78 \text{ cm}\) \((\text{range} = 0 \text{ to} 36, n = 717)\). Nests in hardstem bulrush had the greatest diameter and height, whereas those in meadows \((\text{forbs, Baltic rush, grasses, sedges})\) had the smallest (Table 2). Nest placement at 727 sites was in vegetation that had a mean height of \(37.3 \pm 23.66 \text{ cm}\) \((\text{range} = 0 \text{ to} 205 \text{ cm})\) and a

### Table 1. Number and percentages of vegetation types surrounding and in greater sandhill crane nests at Malheur National Wildlife Refuge, Oregon (1969-89).

<table>
<thead>
<tr>
<th>Type</th>
<th>Surrounding Nests</th>
<th>Nest Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n)</td>
<td>%</td>
</tr>
<tr>
<td>Broad-fruited burreed</td>
<td>415</td>
<td>40.8</td>
</tr>
<tr>
<td>Hardstem bulrush</td>
<td>367</td>
<td>36.1</td>
</tr>
<tr>
<td>Common cattail</td>
<td>74</td>
<td>7.3</td>
</tr>
<tr>
<td>Baltic rush</td>
<td>29</td>
<td>2.9</td>
</tr>
<tr>
<td>Grasses</td>
<td>26</td>
<td>2.6</td>
</tr>
<tr>
<td>Sedges</td>
<td>9</td>
<td>0.9</td>
</tr>
<tr>
<td>Forbs</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>Other</td>
<td>93</td>
<td>9.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1018</td>
<td>100.2</td>
</tr>
</tbody>
</table>
**DISCUSSION**

Most Malheur crane pairs nest in fairly tall, coarse, and dense emergent vegetation. This tendency is somewhat unique for greater sandhill cranes in the western United States. For example, >91% of nests were in coarse emergent vegetation at Malheur, but only 12.1% (n = 283) were so placed in south-central Oregon (Stern et al. 1987), only 18.7% (n = 279) in southeastern Idaho (Drewien 1973), and 27% (n = 48) in northeastern California (Littlefield 1995c). The significantly (P < 0.05) greater use of robust emergents by Malheur nesting pairs may be attributed to (1) the greater prevalence of robust emergents at Malheur and (2) the history of very high predator pressure (selectively favoring pairs nesting in dense emergents in deeper water) at Malheur (Littlefield 1995c). Of course, many cranes breeding elsewhere may not have had dense cover available for nesting. This condition results from the intensive and continuous grazing by livestock for well over a century at most wetlands in the western United States. Extensive grazing leaves little residual concealing vegetation when cranes return in spring.

For greater sandhill and whooping (G. americana) cranes, Howard (1977) and Knopf (1995) noted that vegetation type at nest sites influenced both nest diameter and exposed nest height. Malheur nests were predominantly in coarse emergents and, as expected, were large (exposed basal diameter averaging 127 x 111 cm). In southeastern Idaho, where most breeding occurred in meadow habitat, mean nest diameter was 86 x 80 cm (Drewien 1973), in Michigan, where more than 50% of 115 nests were in tall emergents, the mean nest diameter was 113 x 98 cm (Walkinshaw 1965). Although nest diameter was clearly influenced by vegetative type at Malheur and elsewhere, exposed nest height seemed less influenced. The 12.4 cm mean height recorded at Malheur was similar to nests heights in Michigan (Walkinshaw 1965), but less than that for central Wisconsin (16.9 cm), where placement was primarily in beaked sedge (Howard 1977). Malheur nest height differed little from the 11.7 cm reported for southeastern Wisconsin (Bennett 1978) and 11.2 cm for northeastern California (Littlefield, unpublished data).

Coarse emergent vegetation grows in depressions interspersed among meadows at Malheur. Broad-fruited burreed occurs in shallow depressions, whereas hardstem bulrush is found in the deeper water zones. Because most Malheur cranes nest in tall emergents, mean water depths at nest sites were deeper than those reported elsewhere. Mean water depth was 25.8 cm at Malheur, compared with 6.2 cm in northeastern California (Littlefield 1995c), 11 to 12.6 cm in Wisconsin (Howard 1977, Bennett 1978), 20 cm in Idaho (Drewien 1973), and 21.2 cm in Michigan (Walkinshaw

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**Table 2. Vegetation type and mean nest diameter and height for greater sandhill crane nests at Malheur National Wildlife Refuge, Oregon (1969–89).**

<table>
<thead>
<tr>
<th>Type</th>
<th>Mean nest diameter (cm)</th>
<th>Mean nest height (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harstem bulrush</td>
<td>142 x 117</td>
<td>15.2</td>
</tr>
<tr>
<td>Common cattail</td>
<td>137 x 114</td>
<td>12.9</td>
</tr>
<tr>
<td>Broad-fruited burreed</td>
<td>122 x 111</td>
<td>11.0</td>
</tr>
<tr>
<td>Meadow</td>
<td>99 x 90</td>
<td>8.6</td>
</tr>
</tbody>
</table>

mean water depth of 25.8 ± 16.68 cm (range = 0 to 105 cm, n = 881): 34 (3.9%) were on dry sites. Mean distance from nests to the nearest feeding meadow was 40 ± 33.87 m (range = 0 to 345 m, n = 515): all but 25 (4.9%) were at distances <100 m. The mean distance to open areas (e.g., dike, island, road, open water) was 21 ± 22.62 m (range 0 to 286 m, n = 515). For 944 nests, concealment was rated as poor for 255 (27%), fair for 381 (40.4%), good for 297 (31.5%), and excellent for 11 (1.2%).

**Egg Characteristics**

Mean egg length was 98.9 ± 8.86 mm and mean egg breadth 62.3 ± 2.18 mm (n = 1,292 eggs). For 2-egg clutches, the longer egg had a mean length of 100.3 ± 4.75 (range = 87.2 to 116 mm, n = 566) and mean width of 62.3 ± 2.14 mm, whereas the shorter egg averaged 97.4 ± 4.74 x 62.4 ± 2.22 mm (range = 83.6 to 111.1 mm). The mean length and width for 3 single egg clutches was 97.5 ± 5.7 (range = 80.5 to 107.8 mm) x 61.5 ± 2.5 mm. There were 3 clutches that contained 3 eggs; mean size was 96.3 ± 6.09 (range = 87.3 to 105.5 mm) x 61.6 ± 1.5 mm. Mean size for a single 4-egg clutch (Littlefield and Holloway 1987) was 96.3 ± 1.65 (range = 95 to 98.7 mm) x 61.4 ±0.19 mm. For 890 clutches, 80.5% had eggshell ground coloration of brown hues, while 19.5% were olive (Littlefield 1995e).

Generally there was little variation in egg size between years; means ranged in length from 97.4 mm in 1986 to 100.5 mm in 1980. Mean breadth was 62 mm only in 1977. In 3 drought years (1973, 1977, 1981), egg means were 99.3 x 63, 99.1 x 61.8, and 98.5 x 62.4 mm, respectively, whereas in 3 above normal precipitation years (1970, 1978, 1983), means were 99.3 x 62.5, 98 x 62.4, and 99 x 62.7 mm, respectively. This suggests drought had little or no effect on egg size, except perhaps in 1977 when mean breadth was slightly less than in other years.
1965). However, mean water depth recorded at Malheur during a period with reduced precipitation in the late 1960s was 16.8 cm (Littlefield and Ryder 1968).

Greater sandhill crane mean egg size varied between several widely dispersed geographical areas: 98.9 x 62.3 mm in this study; 97.3 x 62.1 mm in southeastern Idaho (Drewien 1973); 96.0 x 62.2 mm in northeastern California (Littlefield, unpublished data); 95.0 x 60.8 mm in southern Michigan (Walkinshaw 1973); and 94.8 x 61.2 mm in northern Michigan (Walkinshaw 1973). Malheur eggs were significantly longer than eggs from both southeastern Idaho (Z = 4.06, P < 0.01) and northeastern California (Z = 4.63, P < 0.01), but there was no significant (P > 0.05) differences in mean breadth. However, there is probably very little biological significance to the minimal differences between areas. Standard deviations were not available for Michigan eggs, so comparisons could not be assessed statistically. A surprising find was that in Michigan, 1-egg clutches had longer eggs than those with 2 eggs, while at Malheur, 2-egg clutches had longer eggs than those containing 1 egg.

Greater sandhill crane nesting habitat varies from open meadows to deep water bogs and marshes across the subspecies' breeding range (Armbuster 1987). Cranes seem to prefer to nest in open habitats with unrestricted visibility. However, natural selection (i.e., low egg survival) probably favors use of unexposed sites (Littlefield 1995c). In regions with abundant predators, crane pairs nesting over deeper water and in tall and dense cover probably have a reproductive advantage over highly visible pairs nesting in exposed open meadows. Malheur cranes have had a long association with predators, particularly common ravens and coyotes (Canis latrans) (Littlefield 1995c). As a result, past predation pressure has perhaps influenced breeding habitat selection. Furthermore, the use of coarse emergents, particularly hardstem bulrush, also may have the added advantage of being buoyant and therefore less prone to flooding (Littlefield, personal observations). Excessive flooding characterizes many crane breeding regions in the western contiguous United States, especially those sites where water originates from snowmelt on adjoining mountain ranges.

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