Activity of American White Pelicans, *Pelecanus erythrorhynchos*, at a Traditional Foraging Area in Manitoba

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We studied flocking and foraging activity of American White Pelicans (*Pelecanus erythrorhynchos*) at Grand Rapids, Manitoba. Arriving and departing pelicans used both soaring and flapping flight. Arriving birds selectively joined larger-than-average loafing or foraging groups, which may facilitate food finding. Arriving flocks often split into smaller groups which landed separately around the study area or continued to other foraging sites. It is thus unlikely that flocking functions to maintain groups from the breeding colony to foraging sites. Departures to the breeding colony originated mainly among birds on loafing bars, and were strongly clumped. Birds leaving the foraging area behaved similarly to pelicans departing a colony en route to a foraging site, which argues against colonies serving as information centers. The behavior of pelicans moving between foraging sites distinguished them from arriving and departing commuters. Maximum foraging activity occurred at night, correlating with activity of some prey fish, and permitting travel during the day when thermals and formation flocking can be used to reduce flight costs.

Key Words: American White Pelican, *Pelecanus erythrorhynchos*, flocks, foraging, local enhancement.

Previously we showed that American White Pelicans, *Pelecanus erythrorhynchos*, (hereafter referred to as White Pelicans) follow each other and form flocks when they leave their breeding colony on foraging trips (O'Malley and Evans 1982a). We concluded that flocking permits effective use of local enhancement as a means of locating thermals, which can reduce travel costs, as can adoption of specific flock formations (O'Malley and Evans 1982b). We also speculated that flock travel could facilitate group foraging, which is common in White Pelicans (Cottam et al. 1939; Behle 1958; O'Malley and Evans 1983), by ensuring that individuals don't disperse and lose the benefits of group foraging (e.g. Rand 1954). Observations of flocking behavior at a foraging site are thus crucial to the interpretation of the adaptive value of flocking in pelicans.

Although the diet of White Pelicans has been studied over much of the species' breeding range (Ferry 1910; Alcorn 1943; Behle 1944, 1958; Anderson et al. 1969; Lingle and Sloan 1980), there have been no extended studies of any aspect of White Pelican foraging behavior. We studied flocking and foraging behavior of White Pelicans at a traditional foraging site. The objectives were to determine whether flock travel from a colony to a foraging site aids in the establishment of foraging flocks, to describe the process of flock formation for the return trip to the colony, and to describe the timing of those activities in relation to foraging.

Study Area and Methods

The pelicans we studied breed at Kawinaw Lake, Manitoba (52°50'N, 99°29'W). They disperse in a wide arc north and east of Kawinaw Lake to forage, the majority travelling toward Lake Winnipeg. We studied them 40 km north of the colony, at the Grand Rapids hydroelectric dam on the Saskatchewan River near its mouth at Lake Winnipeg. We observed activities between 0430 and 2230 CDT, the daylight hours, from 21 May to 24 June 1981, for a total of 120 h. Observations were made from an elevated point (Figure 1, A) using binoculars and a 25-45X spotting scope. The numbers of pelicans foraging and loafing within the study area were recorded every 30 min during each observation period. The close packing of birds on the gravel bars used for loafing (Figure 1) often made necessary estimates of numbers rather than actual counts, but the estimates usually agreed with subsequent counts within 5%. The occurrence of foraging, and the behavior of arriving and departing pelicans, were noted throughout each observation period.

Qualitative observations were made one night from 2230 to 0430, and activity at the mouth of the river and on Cross Lake above the dam was also observed for short (<3 h) periods on several occasions. Those observations were made to determine whether foraging behavior near the dam was representative of "normal" activity and to monitor movements between foraging sites.
Flock sizes and foraging activities could be affected by the numbers of pelicans travelling between the colony and foraging sites. The number commuting each day increases greatly during the breeding season as nest attendance patterns change (O'Malley and Evans 1982a). Most of our observations were made during a period when the number of commuting adults should have remained relatively stable.

Single birds were included as "flocks" for purposes of descriptive statistics and tests. They usually comprise a significant proportion of the pelican population in an area (O'Malley and Evans 1982a). The significance levels reported are for median tests, comparing the medians of highly-skewed distributions.

Results

Arrival at the foraging area

Pelicans observed arriving at Grand Rapids from the colony (south) used both soaring and flap-gliding flight, but the latter was more common (Table 1). Few arrivals occurred before 1000, and those after 2000 were often associated with northerly (head) winds of at least 30 km/h (Figure 2A). As expected, soaring was most common during the afternoon when thermals were most abundant and well-developed. Flap-gliding flocks were significantly larger than soaring flocks ($x = 5.1$ vs. 1.8, $P < 0.001$). The difference was mainly due to the tendency of White Pelicans to disperse into smaller groups once they have gained altitude in thermals and begun soaring (O'Malley and Evans 1982a). Many birds arriving from the colony continued northward past the study area (Table 1), although some members of those flocks often "dropped out" to our area.

We recorded the destinations of individuals from most of the larger flocks which split up as they arrived. Among the 1209 pelicans in 148 flocks in the sample, 702 continued northward, and the rest landed on the river, at the dam, or more commonly joined a loafing group (Table 1). Eighty-nine flocks divided into two groups, birds from 27 flocks landed at three different sites, and the rest of the flocks sent pelicans to four or more locations. On five occasions when several flocks arrived simultaneously, the birds coalesced into a large group from which there were departures to a number of locations, while two or three new flocks formed and continued farther north. The continuing groups landed near the mouth of the river, or flew farther along the shore of Lake Winnipeg.

Other pelicans moved into or through the study area from the north. About 36% of the birds coming from the north continued past our site toward the colony (Table 1). A major influx of low, flap-gliding flocks, mainly from the mouth of the river, began each day as sunset approached; 60% of all birds arriving from the north were observed between 2030 and 2230 (Figure 2B). Among the birds from the north that landed, 55% landed on the river, 10% at the dam, and the remainder moved directly to loafing bars, in
marked contrast with the pelicans arriving from the colony. Few flocks from the north were soaring, probably because most birds from the north were moving relatively short distances between foraging areas.

We recorded the sizes of foraging flocks near which small flocks and single birds arriving from the south (\(N = 85, \bar{x} = 1.4\)) and from the north (\(N = 184, \bar{x} = 1.3\)) landed. Thirty-eight of the former and 68 of the latter flocks landed alone. The mean sizes of pelican foraging flocks selected by arrivals from the north (5.3 birds) and south (3.4 birds) were not significantly different. The foraging flocks selected by arriving pelicans were significantly larger than if they had been selected at random (\(P < 0.001\)). Similarly, loafing groups selected by arrivals from both directions were significantly larger than expected if selection was random (\(P < 0.001\)). The sizes of loafing groups joined by individuals and flocks from the south (\(N = 178, \bar{x} = 2.5\)) and north (\(N = 112, \bar{x} = 2.2\)) were not significantly different (49.5 vs. 44.8 birds, respectively). Only two birds from the south and four from the north initiated new loafing groups.

Departure from the foraging area

Flocks departing to the south from the foraging area originated most often among pelicans on the loafing bars (Table 2). The formation of a travelling flock was often signalled by a movement to the water at the edge of a loafing bar, which occasionally involved all but a few individuals on an island. Eventually such birds took flight en masse and were joined by other birds from the bars, and to a lesser extent by birds scattered over the water. Some of the latter appeared to have been actively foraging. However, most pelicans returned to a loafing bar between completion of foraging and departure to the colony; only 18% of the departing birds were on the water away from a loafing bar when they departed. The process of

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**Table 1. Number of birds and flocks observed arriving from the south and north at Grand Rapids.**

<table>
<thead>
<tr>
<th>Landing site</th>
<th>Soaring Birds</th>
<th>Soaring Flocks</th>
<th>Flap-gliding Birds</th>
<th>Flap-gliding Flocks</th>
<th>Total Birds</th>
<th>Total Flocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loafing group</td>
<td>134</td>
<td>84</td>
<td>548</td>
<td>177</td>
<td>682</td>
<td>261</td>
</tr>
<tr>
<td>River</td>
<td>60</td>
<td>42</td>
<td>119</td>
<td>68</td>
<td>179</td>
<td>110</td>
</tr>
<tr>
<td>Dam</td>
<td>223</td>
<td>139</td>
<td>73</td>
<td>27</td>
<td>296</td>
<td>166</td>
</tr>
<tr>
<td>Continued north</td>
<td>66</td>
<td>9</td>
<td>1476</td>
<td>164</td>
<td>1542</td>
<td>173</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>483</strong></td>
<td><strong>274</strong></td>
<td><strong>2216</strong></td>
<td><strong>436</strong></td>
<td><strong>2699</strong></td>
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<thead>
<tr>
<th>Landing site</th>
<th>Soaring Birds</th>
<th>Soaring Flocks</th>
<th>Flap-gliding Birds</th>
<th>Flap-gliding Flocks</th>
<th>Total Birds</th>
<th>Total Flocks</th>
</tr>
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<tbody>
<tr>
<td>Loafing group</td>
<td>-</td>
<td>-</td>
<td>432</td>
<td>185</td>
<td>432</td>
<td>185</td>
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<tr>
<td>River</td>
<td>-</td>
<td>-</td>
<td>694</td>
<td>279</td>
<td>694</td>
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<tr>
<td>Dam</td>
<td>27</td>
<td>13</td>
<td>102</td>
<td>58</td>
<td>129</td>
<td>71</td>
</tr>
<tr>
<td>Continued south</td>
<td>139</td>
<td>19</td>
<td>555</td>
<td>78</td>
<td>694</td>
<td>97</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>166</strong></td>
<td><strong>32</strong></td>
<td><strong>1783</strong></td>
<td><strong>600</strong></td>
<td><strong>1949</strong></td>
<td><strong>632</strong></td>
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</tbody>
</table>

**Figure 2. Daily patterns of flap-gliding and soaring flock arrivals at the study area from the south (A) and north (B).**
flock formation was thus similar to that observed when pelicans leave a colony en route to a foraging area (O’Malley and Evans 1982a), in that departures were strongly clumped, and there appeared to be overt flock recruitment behavior. The clumping of departures was most obvious in the early afternoon when only a few pelicans remained in the area. After perhaps an hour with no departures, a few birds suddenly left their loafing bars, joined together in a flock, and flew away southward.

Pelicans in soaring flocks represented one-third of the departures to the south, but were not common until after 0830 (Figure 3A). Flap-gliding predominated until that time. Over 80% of the southbound birds left before 1030, but, surprisingly, departures continued sporadically until as late as 2116 (Figure 3A).

Seventeen percent of all departing birds travelled north, away from the breeding colony (Table 2). Although movement past the artificial boundaries of the study area occurred throughout the day (Figure 3B), 38% of the movement was observed between 0430 and 0530. Most of that movement was related to local foraging activity rather than to travelling, as evidenced by the larger proportion, relative to southward departures, of flocks originating among actively foraging birds (Table 2). Later in the day a number of birds flew north and joined flocks soaring southwards from foraging sites farther north. Those flocks that continued past the study area toward the colony (Table 1) were significantly larger than soaring flocks leaving the study area directly (P < 0.003). The former had been in flight longer and therefore had more time to undergo growth.

Daily activity at the foraging site

The largest total population in the study area (average 369) was always recorded at 0430 (Figure 4). Departures continued steadily until the minimum daily population was reached at mid-day. The number of pelicans at Grand Rapids increased from mid-day onward as birds returned from the colony and from other foraging sites to the north.

**Table 2. Number of birds and flocks observed departing to the south and north from Grand Rapids.**

<table>
<thead>
<tr>
<th>Initiation site</th>
<th>Soaring</th>
<th></th>
<th>Flap-gliding</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Birds</td>
<td>Flocks</td>
<td>Birds</td>
<td>Flocks</td>
<td>Birds</td>
<td>Flocks</td>
</tr>
<tr>
<td>Loafing group</td>
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<td>394</td>
<td>1603</td>
<td>681</td>
<td>2418</td>
<td>1075</td>
</tr>
<tr>
<td>Water – foragers</td>
<td>69</td>
<td>43</td>
<td>167</td>
<td>78</td>
<td>236</td>
<td>121</td>
</tr>
<tr>
<td>Water – non-foragers</td>
<td>73</td>
<td>33</td>
<td>205</td>
<td>74</td>
<td>278</td>
<td>107</td>
</tr>
<tr>
<td>Total</td>
<td>957</td>
<td>470</td>
<td>1975</td>
<td>833</td>
<td>2932</td>
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<th>Initiation site</th>
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<td></td>
<td>Birds</td>
<td>Flocks</td>
<td>Birds</td>
<td>Flocks</td>
<td>Birds</td>
<td>Flocks</td>
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<td>1</td>
<td>1</td>
<td>363</td>
<td>157</td>
<td>364</td>
<td>158</td>
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<tr>
<td>Water – foragers</td>
<td>29</td>
<td>7</td>
<td>183</td>
<td>76</td>
<td>212</td>
<td>83</td>
</tr>
<tr>
<td>Water – non-foragers</td>
<td></td>
<td></td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>8</td>
<td>550</td>
<td>235</td>
<td>580</td>
<td>243</td>
</tr>
</tbody>
</table>

**Figure 3.** Daily patterns of flap-gliding and soaring flock departures from the study area to the south (A) and north (B).
More pelicans were loafing than foraging throughout most of each day (Figure 4). The proportion of pelicans foraging reached a daily minimum of 19% at 2000. Most birds arriving before 2000 joined loafing groups and did not forage immediately. The number and proportion of foraging birds increased rapidly from 2000 to 2230. The increase in foragers initially resulted from an influx of pelicans from the mouth of the river. As sunset approached these birds always joined others that had already left the loafing bars. The rate of movement from the loafing bars to the water accelerated as more birds took to the water, and the numbers left on the bars declined accordingly (Figure 4).

Pelicans continued to move into the study area from downstream until about midnight, but there was simultaneous movement back downstream. Although accurate counts were not possible after 2230, it appeared that most of the local population engaged in foraging from midnight to 0300. After 0300 they began returning to the loafing bars where they slept and preened before undertaking the return flight to the breeding colony. The proportion of birds in the study area foraging dropped to an average of 53% at 0430, when sunrise permitted the first accurate counts.

**Discussion**

The daily activity pattern we observed at Grand Rapids is consistent with activities of White Pelicans in other areas where foraging occurs at night and in the early morning (Low et al. 1950; Schaller 1964). The pattern is also similar to those reported for the Pink-backed Pelican (P. rufescens) and Great White Pelican (P. onocrotalus; Din and Eltringham 1974), and the Dalmation Pelican (P. crispus; Crivelli and Vizi 1981). Australian Pelicans (P. conspicillatus) fished during all hours of the day, but activity did not seem to be concentrated during any period (Vestjens 1977).

Many freshwater fish, including species utilized by White Pelicans (references cited above), are most active at night and in the twilight periods when they swim closer to the surface to forage (Carlander and Cleary 1949; Lawler 1969). They should be more vulnerable to predation by pelicans at that time, and it is not surprising that pelican foraging activity was greatest then. Although it was not possible to determine whether the pelicans foraged by touch, vision, or a combination during the day, vision may certainly be discounted during nocturnal foraging bouts. The pelicans further improved their foraging pros-
pects by concentrating their activity in the shallower water along the shore. The hydroelectric dam also provides the opportunity to forage successfully during the day, as fish that pass through the turbines are dazed and brought to the surface below the dam. Daytime foraging was much less common at the mouth of the river and on Cross Lake.

Another important factor affecting the daily activity pattern is the efficiency of daytime travel to and from the colony. Leaving a colony in a flock rather than singly appears to facilitate the use of local enhancement for locating thermal areas, and can provide aerodynamic advantages of a considerable magnitude (O’Malley and Evans 1982a, b). Those benefits should also apply to the return trip to the colony, and may be even more important at that time because the returning birds carry an additional load of fish for their young. Fish caught by White Pelicans range from minnows to Carp (Cyprinus carpio) weighing over 2 kg (Alcorn 1943). Hall (1925) reported that 55-day-old pelicans ate 1.8 kg of food per day. Even if half was supplied by each parent, the load would constitute a significant additional to adult body weight. Evolution of the ability to use soaring flight in thermal areas was likely a contributing factor in extending their flight range for foraging under those circumstances. Foraging at night frees the pelicans to travel during the day when thermals occur, and when vision, which is required for local enhancement and formation flight, is best.

The mass movement of pelicans from the loafing islands to the water prior to travelling flock formation may be a mechanism for flock recruitment similar to the short flights from the nesting islands which typically involved a few “stimulus” birds (O’Malley and Evans 1982a). If flock travel conserves energy, as it appears to do, then individuals should try to ensure that they don’t fly alone. In both of the above situations the obvious behavior exhibited may attract the attention of other individuals that are ready to travel, to their mutual benefit.

The flock size distributions and the proportions of soaring and flap-gliding flocks observed at Grand Rapids were similar to those recorded among pelicans departing a breeding colony in southern Manitoba (cf. O’Malley and Evans 1982b). The flock formation process apparently operates similarly in both situations. Similar flock formation at the colony and on the foraging sites was also found in Black-billed Gulls (Larus bulleri; Evans 1982), which appears to be the only other species for which similar information is available. As pelicans leaving the foraging area undoubtedly “know” how to get back to the colony, their employment of similar flock formation methods at the colony and foraging site argues against any specialized flock recruitment mechanisms that function solely for the purpose of searching for food i.e. information centers (see Evans 1982 for further discussion).

The observations of flocks arriving at the foraging area are perhaps more important than departures for assessing the relationship between flock flight and foraging activities. The significant preference of arriving birds for larger foraging flocks is likely a manifestation of socialization, a well-documented foraging mechanism (Rand 1954; O’Malley and Evans 1983). In Great Blue Herons (Ardea herodias; Krebs 1974) and in Rooks (Corvus frugilegus; Waite 1981), larger foraging groups tended to collect at better local food sites. Similarly for pelicans, preferences for larger foraging flocks should increase an individual’s chances of locating prey.

Flock travel from a colony could facilitate group foraging by ensuring the presence of a group at a foraging site (Knopf 1976; O’Malley and Evans 1982a). However, the observations reported here indicate flock travel was not essential for establishment of foraging groups at Grand Rapids. Almost 60% of the birds arriving from the colony joined a loafing group before they began foraging, and many others joined existing foraging flocks. The fact that many birds left their travelling flocks to go to one area, while others continued to other locations, also argues against group maintenance being an important reason for flocking en route. The travelling flocks per se did not give rise to foraging flocks. Although those observations do not invalidate the hypothesis, they suggest that foraging-flock formation is not a likely function of flock travel to stable foraging grounds like the one we observed at Grand Rapids, and those reportedly used by pelicans in some other areas (Knopf and Kennedy 1980; Koonz 1981).

White Pelicans have nested at Kawinaw Lake and foraged at Grand Rapids for more than a decade (Lies and Behle 1966; Vermeer 1970; Koonz 1981). The site appears to be a traditional foraging area. If that is the case, flocks are not necessary to locate the area, as each individual presumably remembers how to get there. Young birds usually follow their parents on a foraging trip when they first leave the breeding colony (O’Malley and Evans 1982a), providing the opportunity to pass on that knowledge. Flight economy remains the most likely reason for flock travel by White Pelicans foraging at traditional sites like those examined in this study.

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Literature Cited

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