Use of mini-refuges by female northern pintails wintering in southwestern Louisiana

Robert R. Cox, Jr. and Alan D. Afton

Abstract The Gulf Coast Joint Venture of the North American Waterfowl Management Plan began contracting private agricultural lands (hereafter mini-refuges) in 1988 to expand existing sanctuaries for northern pintails (Anas acuta) in southwestern Louisiana. Previous research suggested that mini-refuges may prove more attractive to pintails than permanent, open-water pools (pools) on refuges because mini-refuges provide sanctuary and food during the day, whereas pools generally provide only sanctuary (Rave and Cordes 1993). We used radiotelemetry to compare diel use of mini-refuges and pools (Lacassine Pool and Amoco Pool) by female pintails in southwestern Louisiana during winters of 1991–1992 and 1992–1993. We examined variation in use of these areas in relation to female age (immature or adult), time period (prehunting season, first hunting season, time between split hunting seasons, second hunting season, and posthunting season), and winter (1991–1992 and 1992–1993). Diurnal use of mini-refuges and pools differed among time periods, but differences were not consistent between winters. Mini-refuges accounted for <2% of diurnal use by pintails in 7 of 10 time-period and winter comparisons. Diurnal use of mini-refuges was lower than that of Lacassine Pool in 8 of 10 time-period and winter comparisons. Diurnal use of mini-refuges was lower than that of Amoco Pool during first hunting season in 1992–1993, but use of these areas did not differ within other time periods and winters. Nocturnal use of mini-refuges and pools did not differ in relation to female age, time period, winter, or individual bird. Nocturnal use of mini-refuges (\(\bar{x} \pm SE = 2.6 \pm 0.8\%\)) did not differ from that of Lacassine Pool (2.2 \(\pm 0.7\%\)), but females used both of these areas at night more than Amoco Pool (0.6 \(\pm 0.3\%\)). In contrast to predictions and findings by Rave and Cordes (1993), we found that: (1) female pintails did not use mini-refuges more than pools, and (2) female pintails used mini-refuges at night. We believe that use of mini-refuges by pintails could be increased if mini-refuges were: (1) located in areas of traditionally high pintail use, (2) increased in size, (3) flooded immediately prior to hunting season, and (4) cleared of dense vegetation by rolling, disking, or burning.

Key words Anas acuta, habitat use, Louisiana, mini-refuges, northern pintail, pools, radiotelemetry, refuges, waterfowl, winter

The Gulf Coasts of Texas and southwestern Louisiana host some of the largest concentrations of northern pintails (Anas acuta) wintering in the Central and Mississippi Flyways (Howard and Kantrud 1986). Large numbers of pintails concentrate diurnally on Lacassine National Wildlife Refuge (NWR) in southwestern Louisiana, with peak numbers from winters 1980–1981 to 1993–1994 averaging >95,000 (Lacassine NWR, unpubl. data). Pintails use Lacassine NWR, particularly a 6,793-ha impoundment known as

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Lacassine Pool, primarily as a daytime roost, dispersing at night to feed in agricultural areas (Tamisier 1976; Yakupzack 1988; Cox and Afton 1996, 1997).

In 1988, the Gulf Coast Joint Venture of the North American Waterfowl Management Plan (U.S. Fish and Wildl. Serv. [USFWS] and Can. Wildl. Serv. 1986) began contracting (at no cost) private agricultural fields (hereafter mini-refuges) in southwestern Louisiana to provide additional sanctuary for pintails (R. Helm, La. Dep. Wildl. and Fish., Baton Rouge; R. Aycock, USFWS, Jackson, Miss., pers. commun.). Rave and Cordes (1993) used time-activity budgets to determine whether pintails would use mini-refuges. They reported that pintails concentrated on mini-refuges only during the day, and suggested that mini-refuges may be more attractive to pintails than permanent open-water pools because mini-refuges provide both the security of open-water and increased food relative to pools.

In this paper, we assess the relative importance of mini-refuges and pools to female pintails wintering in southwestern Louisiana. Our specific objectives were to: (1) quantify diel use of mini-refuges and pools, and (2) examine variation in use of these areas in relation to female age, time period, and winter.

**Study area and methods**

Our study area included all lands within 80 km of the perimeter of Lacassine Pool, and extended 8 km into the Gulf of Mexico (Fig. 1). Twelve mini-refuges, each except for 3 trapped 8 km south of Gueydan, Louisiana (29°57'N, 92°31'W; Fig. 1). Following capture, we tagged females with 21-g, backpack-type radiotransmitters (Dwyer 1972). We previously described trap sites, aging criteria, selection of birds for instrumentation, and transmitter characteristics (Cox and Afton 1994, 1996).

From 6 November 1991 to 19 February 1992 and from 31 October 1992 to 28 February 1993, we attempted to locate radiotagged females once each day (either during the day or at night) in our study area. We used aircraft (Gilmer et al. 1981) to search the entire study area each day or night of tracking to avoid underestimating use of marsh areas, which generally were inaccessible by telemetry vehicles. We previously described tracking methodology, including the process of selecting which birds to locate daily, antenna systems, and point estimation and accuracy (Cox and Afton 1997).

Because each of our field seasons overlapped 2 calendar years, we refer to field seasons as winters rather than years. We divided each winter into 5 time periods based on duck-hunting seasons: (1) prehunting season (PRE; 6-15 Nov 1991 and 31 Oct-20 Nov 1992), (2) first hunting season (FHUNT; 16 Nov-6 Dec 1991 and 21 Nov-5 Dec 1992), (3) time between split hunting seasons (SPLIT; 7-27 Dec 1991 and 6-25 Dec 1992), (4) second hunting season (SHUNT; 28 Dec 1991-5 Jan 1992 and 26 Dec 1992-9 Jan 1993), and (5) posthunting season (POST; 6 Jan-19 Feb 1992 and

![Study area and methods](http://example.com/image.png)

*Fig. 1. Study area in which radiotagged female northern pintails were tracked in southwestern Louisiana during winters 1991-1992 and 1992-1993.*
testing whether least-square means of log-ratios differed ($P \leq 0.05$) from 0 within levels of explanatory variables in final-fitted models (Aebischer et al. 1993b).

We were unable to collect data at night during SHUNT in 1992-1993 because inclement weather prevented aerial tracking. Therefore, we tested for differences in nocturnal habitat use by using only PRE, FHUNT, SPLIT, and POST time periods.

## Results

### Diurnal

We obtained 1,816 diurnal locations on 265 females (Fig. 2). Our final fitted MANOVA model indicated that use of MINIREF, LACPOOL, AMPPOOL, and OTHER differed among time periods, but differences were not consistent among winters (winter x time-period interaction; Wilks' lambda $= 0.85$; $F = 5.88$; 12, 1132.7 df; $P < 0.0001$), and that individual females were consistent in their use of these areas among time periods (bird effect; Wilks' lambda $= 0.18$; $F = 1.23$; 789, 1284.9 df; $P = 0.0005$). Age effects and remaining interactions were not significant ($P > 0.48$). Females used LACPOOL more ($P < 0.02$) than MINIREF during 8 of 10 time-period and winter comparisons (Table 1). Females used MINIREF more ($P = 0.007$) than LACPOOL during SHUNT in 1992-1993, whereas use of these areas did not differ ($P = 0.85$) during SPLIT in 1992-1993. Relative use of MINIREF and AMPPOOL did not differ ($P > 0.12$) during any time-period and winter comparison.

![Fig. 2. Diurnal locations (n = 1,816) of 265 radiotagged female northern pintails during winters 1991-1992 and 1992-1993. Number of locations per habitat type are: LACPOOL = 374, AMPPOOL = 64, MINIREF = 32, OTHER = 1,314. Dashed lines show study area boundary.](image-url)
Table 1. Diurnal use (percent*) of Lacassine Pool (LACPOOL), Amoco Pool (AMPOOL), mini-refuges (MINIREF), and other areas (OTHER) by radiotagged female northern pintails in southwestern Louisiana for each time period and winter, 1991–1992, 1992–1993.

<table>
<thead>
<tr>
<th>Winter</th>
<th>Time period</th>
<th>( n^{*} )</th>
<th>LACPOOL</th>
<th>AMPOOL</th>
<th>MINIREF</th>
<th>OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>( n )</td>
<td>( \bar{x} )</td>
<td>( \bar{x} )</td>
<td>( \bar{x} )</td>
<td>( \bar{x} )</td>
</tr>
<tr>
<td>1991–1992</td>
<td>PRE</td>
<td>113</td>
<td>15.9</td>
<td>3.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1992–1993</td>
<td>PRE</td>
<td>126</td>
<td>21.8</td>
<td>3.1</td>
<td>2.4</td>
<td>1.1</td>
</tr>
<tr>
<td>1991–1992</td>
<td>FHUNT</td>
<td>94</td>
<td>50.2</td>
<td>4.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>1992–1993</td>
<td>FHUNT</td>
<td>101</td>
<td>24.8</td>
<td>3.4</td>
<td>12.7</td>
<td>2.7</td>
</tr>
<tr>
<td>1991–1992</td>
<td>SPLIT</td>
<td>55</td>
<td>22.6</td>
<td>3.8</td>
<td>0.5</td>
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</tr>
<tr>
<td>1992–1993</td>
<td>SPLIT</td>
<td>31</td>
<td>9.7</td>
<td>5.4</td>
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<td>5.4</td>
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<td>1991–1992</td>
<td>SHUNT</td>
<td>58</td>
<td>38.8</td>
<td>5.9</td>
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<td>1.9</td>
</tr>
<tr>
<td>1992–1993</td>
<td>SHUNT</td>
<td>21</td>
<td>0.0</td>
<td>0.0</td>
<td>4.8</td>
<td>4.8</td>
</tr>
<tr>
<td>1991–1992</td>
<td>POST</td>
<td>57</td>
<td>16.6</td>
<td>4.2</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>1992–1993</td>
<td>POST</td>
<td>47</td>
<td>12.3</td>
<td>3.0</td>
<td>4.7</td>
<td>1.8</td>
</tr>
</tbody>
</table>

* Percentages were computed by calculating the percentage use of each habitat for each female in each time period, and then averaging over females. Transformations were used in MANOVA analysis.

PRE = prehunting season; FHUNT = first hunting season; SPLIT = time between split hunting seasons; SHUNT = second hunting season; POST = posthunting season.

Sample size represents number of radiotagged females monitored.

except during FHUNT in 1992–1993, when use of AMPOOL was greater (\( P < 0.0001 \); Table 1). Females used LACPOOL more (\( P < 0.05 \)) than AMPOOL during all time periods and winters except SPLIT and SHUNT in 1992–1993, when use of these pools did not differ (\( P = 0.80 \) and 0.08, respectively).

Nocturnal

We obtained 1,495 nocturnal locations on 247 females (Fig. 3). Nocturnal use of MINIREF, LACPOOL, AMPool, and OTHER did not differ in relation to age, winter, time period, bird, or any interactions (all \( P > 0.10 \)). Overall nocturnal use of AMPOOL (\( \bar{x} \pm SE = 0.6 \pm 0.3\% \)) was less than that of LACPOOL (\( 2.2 \pm 0.7\% \); \( P = 0.099 \)) and MINIREF (\( 2.6 \pm 0.8\%; P = 0.004 \)), whereas use of LACPOOL and MINIREF did not differ (\( P = 0.78 \)).

Discussion

Most (99%) of our radiotagged females were captured on Lacassine NWR; thus, trapping location could have influenced subsequent use of specific refuges, at least initially. Trapping sites on Lacassine NWR were prepared by flooding and rolling vegetation in moist-soil units, attracting large numbers of pintails (maximum = 7,000) in October each winter. We did not observe pintails using mini-refuges during October of either winter, nor did we observe concentrations of >500 pintails in other portions of the study area. Of the 3 females trapped near Gueydan, Louisiana, we located 1 individual 13 times, but never on mini-refuges or pools. We also located the other 2 individuals; the first female was located 7 times (once on LACPOOL), and the second female was located 21 times (5 times on LACPOOL).

These individuals were never located on MINIREF or AMPool. Further, we recorded dense concentrations of pintails later during winters in portions of the study area that were relatively far from our primary trap site on Lacassine NWR (e.g., on and immediately north of AMPool; Figs. 1–3). Thus, we believe that trap-location bias did not seriously affect our results because: (1) we trapped pintails from the largest concentrations in southwestern Louisiana, (2)

![Fig. 3. Nocturnal locations (n = 1,495) of 247 radiotagged female northern pintails during winters 1991–1992 and 1992–1993. Number of locations per habitat type are: LACPOOL = 25, AMPool = 6, MINIREF = 28, OTHER = 1,436. Dashed lines show study area boundary.](image-url)
Northern pintails in southwestern Louisiana use shallowly flooded rice and fallow (idle) fields extensively for foraging, particularly at night.

Radiotagged females trapped near Gueydan used LACPOOL more than AMPOOL and MINIREF, consistent with those trapped on Lacassine NWR, and (3) we frequently relocated radiotagged females later during winters in areas far from our primary trap site.

Our telemetry results confirm that LACPOOL is a major diurnal concentration area, accounting for up to 50% of total use by pintails in southwestern Louisiana (Table 1). Comparison of peak numbers of pintails counted on Lacassine NWR to those counted throughout southwestern Louisiana verifies the importance of Lacassine NWR to wintering pintails. During winters 1985-1986 through 1992-1993, Lacassine NWR accounted for 11-59% of the pintail use in southwestern Louisiana (Table 2). Because diurnal feeding by pintails on LACPOOL is limited (or nonexistent for pintails in large concentrations; Tamisier 1976), the close proximity of LACPOOL to agricultural lands planted in rice or left fallow (idle) may be an important factor influencing its high use by pintails relative to other pools. Rice and fallow agriculture

collectively comprised 68-93% of nocturnal pintail use, depending on time periods and winters (Cox and Afton 1997). We found that diurnal use of LACPOOL exceeded that of AMPOOL in 8 of 10 time-period and winter combinations. Extensive rice agriculture begins adjacent to LACPOOL and extends 50 km north (Chabreck and Linscombe 1988). In contrast, AMPOOL is separated from extensive rice agriculture by 10 km of primarily marshland (Chabreck and Linscombe 1988). Furthermore, we never located radiotagged pintails on a permanent, open-water pool on Sabine NWR, which is located in the western 1/3 of our study area (Figs. 1-3), where rice and other agricultural production is low (Zapata and Frank 1993). In Mexico, pintails also selected daytime resting areas near rice fields (Migoya et al. 1994).

Pintails used AMPOOL during our study less than we initially expected. Except for LACPOOL, AMPOOL typically contains the highest diurnal concentrations of pintails and other waterfowl in southwestern Louisiana (Chabreck et al. 1989, Tamisier 1976). Unlike LACPOOL and Sabine Pool, which remain flooded throughout the year, AMPOOL typically is drained during the growing season to encourage growth of moist-soil plants. However, above-average rainfall in spring and summer of 1991 (Muller 1991) prevented managers from draining AMPOOL that year. We suspect that prolonged flooding in 1991 prevented typical growth of plant foods attractive to pintails, and effects may have lasted into the following year. We recorded a considerable number of diurnal locations in a large area of freshwater marsh immediately north of AMPOOL that was rarely hunted (B. Hardeman, Amoco Production Co., pers. commun.; Fig. 2). With less plant foods available, pintails may have chosen to roost diurnally on areas closer to agriculture (either north of AMPOOL or on LACPOOL). Diurnal use of AMPOOL was >2% during 6 of 10 time-period and winter comparisons, whereas diurnal use of MINIREF was >2% in only 3 of 10 time-period and winter comparisons. We believe that this finding is noteworthy, given that AMPOOL (2,168 ha) is much smaller than MINIREF (8,143 ha) or LACPOOL (6,793 ha).

Rave and Cordes (1993) reported that pintails used mini-refuges only during the day. In contrast, we found that nocturnal use of mini-refuges by female pintails was similar to diurnal use in most time periods and winters, averaging 2.6% overall. Cox and Afton (1996) reported that mean departure times of evening flights of female pintails from Lacassine NWR ranged from 11 to 25 minutes after sunset, depending on cloud cover, moon presence, and wind velocity. These flights lasted from 16 to 33 minutes, on average, depending on female age, winter, and date within win-

<table>
<thead>
<tr>
<th>Winter</th>
<th>Lacassine NWR</th>
<th>SW Louisiana</th>
<th>% on Lacassine NWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985-1986</td>
<td>75,000</td>
<td>299,000</td>
<td>25</td>
</tr>
<tr>
<td>1986-1987</td>
<td>92,000</td>
<td>237,000</td>
<td>39</td>
</tr>
<tr>
<td>1987-1988</td>
<td>98,000</td>
<td>319,000</td>
<td>31</td>
</tr>
<tr>
<td>1988-1989</td>
<td>33,000</td>
<td>231,000</td>
<td>14</td>
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<tr>
<td>1989-1990</td>
<td>75,000</td>
<td>128,000</td>
<td>59</td>
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<td>1990-1991</td>
<td>40,000</td>
<td>167,000</td>
<td>24</td>
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<tr>
<td>1991-1992</td>
<td>36,000</td>
<td>319,000</td>
<td>11</td>
</tr>
<tr>
<td>1992-1993</td>
<td>30,500</td>
<td>137,000</td>
<td>22</td>
</tr>
</tbody>
</table>

aLacassine National Wildlife Refuge, unpublished data.
bLouisiana Department of Wildlife and Fisheries, unpublished data.
Northern pintails in southwestern Louisiana use agricultural habitats typically flooded by large rainfall events during winter. Consequently, many pintails arrive at nocturnal destinations well after dark, when visual observations are difficult, even with the aid of a night-vision scope (Rave and Cordes 1993).

Rave and Cordes (1993) suggested that mini-refuges may be more attractive to pintails than permanent, open-water pools on refuges. In contrast, our results indicate that use of mini-refuges by female pintails was lower than that of pools. Further, we argue that the low use of mini-refuges by female pintails that we observed probably was representative of use during winters prior to our study. Daytime surveys of mini-refuges conducted from 1988-1989, the first winter in which mini-refuges were established, through 1990-1991 indicate that peak numbers of total ducks (peak numbers for each area in each winter summed) averaged 14,823 (range = 8,724-19,450; Rave 1989, Parker 1990, Lacassine NWR 1992). Further, Rave (1989) and Parker (1990) reported that pintails ranked fourth in abundance among ducks using mini-refuges. Thus, a crude, but liberal, estimate of peak numbers of pintails using mini-refuges diurnally during these winters is 0.25 x 14,823 = 3,706. Peak numbers of pintails in southwestern Louisiana averaged 211,250 during these winters (Table 2). Thus, an overall mean-use estimate of mini-refuges during winters prior to our study is 3,706 / 211,250 = 1.8% (estimates calculated for individual winters ranged from 1.3 to 3.2%). This figure is similar to our estimates based on telemetry during most time periods (≤2%). Diurnal use of mini-refuges by pintails estimated similarly from diurnal surveys in 1991-1992 was 34,257 x 0.25 / 319,000 = 2.7%, which would fall well within a 95% confidence interval calculated from our telemetry data during SHUNT in that winter (Table 1). We conclude that mini-refuges, as managed during our study, were not important diurnal roost sites for pintails in southwestern Louisiana. We attribute most discrepancies between our conclusions and those of Rave and Cordes (1993) about the importance of mini-refuges to pintails to inappropriate methodology (time-activity budgets restricted to mini-refuges) used by Rave and Cordes (1993) to make inferences regarding magnitude of use of mini-refuges by pintails.

Although we found low use of mini-refuges by pintails, we believe that these areas could receive much higher use. Pintails in southwestern Louisiana rely heavily on agricultural lands for food (Cox and Afton 1997), but agriculture is limited or nonexistent on federal and state refuges in the area. Under certain conditions, we found that pintail use of nonhunted agricultural areas could be high. For example, Lacassine NWR manages a small (362-ha) agricultural portion of the refuge known as the P & H Tract. In 1992-1993, this area consisted primarily of rice and fallow agriculture, and was harvested, disked, and flooded just prior to FHUNT. Pintails readily responded to these management practices; this area accounted for 9.6% of total diurnal habitat use during FHUNT in 1992-1993 (Cox 1996). Cover types were similar on the P & H Tract in 1991-1992, but stubble was not disked, and flooding was delayed in that winter. Use of the P & H Tract was only 0.9% of total habitat use during FHUNT in 1991-1992 (Cox 1996).

We regularly noted other instances in which pintails rapidly relocated to newly flooded habitat throughout the study area. These results are consistent with our general observations that pintails respond rapidly to newly flooded habitats with little residual cover, particularly when these areas are not abundant.

We believe that several features of mini-refuges contributed to low use by pintails. Some mini-refuges were located in portions of our study area that received limited overall use by pintails. For example, we noted generally low use of lands west of LACPOOL, where 4 mini-refuges were located (Figs. 2 and 3). Further, the small size and irregularly shaped boundaries of several mini-refuges may have precluded extensive use by pintails, particularly when hunting pressure was high on adjacent lands. Despite flooding of 550 ha on mini-refuges by 1 November during 1991-1992 of our study (more than in any previous winter; Lacassine NWR 1992), most mini-refuges were dry until rains flooded them along with other large areas of non-refuge agricultural lands throughout the study area. In addition, we observed dense, standing vegetation on several mini-refuges. If increased use of these areas by pintails is a management goal, we recommend that: (1) mini-refuges be located in areas of traditionally high pintail use; (2) size of individual mini-refuges be increased, even if this results in fewer areas included in the program, and boundaries be established to mini-
mize the perimeter:area ratio as much as possible; (3) mini-refuges be flooded in early November immediately prior to hunting season, particularly during dry years; and (4) dense, residual crop or other vegetative cover be removed by rolling, diskmg, or burning. Future studies investigating use of mini-refuges by pintails in relation to water-level and cover manipulations should be beneficial for developing detailed management plans for mini-refuges.

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Literature cited


use of mini-refuges ·cox and afton

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