CULTIVATED WILD RICE PADDIES AND THEIR RELATIONSHIP TO WATERFOWL IN NORTHWESTERN MINNESOTA - 1995 ANNUAL REPORT

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INTRODUCTION

Wild rice (*Zizania palustris*) has long been recognized as a preferred duck food. Martin and Uhler (1939) called it one of the best known of North American duck foods, and Rogosin (1951) classified wild rice as one of the important duck foods in the United States and Canada. Cultivated wild rice is produced in diked paddies that are flooded in the spring and drained in late summer. Water levels in paddies are maintained at 15 - 25 cm throughout most of the growing season (early May - mid June), providing large expanses of shallow, open water available for use by waterfowl and other waterbirds during spring and fall migration and the breeding season.

Paddy waters are attractive to waterfowl due to invertebrates; wild rice seeds; sago pondweed (*Potamogeton pectinatus*) seeds and tubers; and arrowhead (*Sagittaria latifolia*) tubers. Heitmeyer (1990) recognized the importance of harvested white rice (*Oryzon sativa*) fields to California's wintering waterfowl and stated that food sources such as harvested grain crops, especially rice, are critical to the survival and reproduction of many migratory water birds. The amount of food found on California's cultivated rice fields may provide as much as 70 percent of the food required to meet the waterfowl population objectives of the California Central Valley Joint Venture (CVHJV), a component of the North American Waterfowl Management Plan (Heitmeyer et al. 1989).

Sorenson (1973) and Johnson (1976) found large numbers of migrant waterfowl, and many breeding duck pairs, to use Minnesota's cultivated wild rice paddies during spring. We documented significant waterfowl breeding populations as well as high fall migrant densities using wild rice paddies in our northwest Minnesota study area. This study (spring 1993 - fall 1995) will provide a more complete understanding of the extent to which waterfowl use Minnesota's cultivated wild rice paddies and associated upland nesting cover during nesting, brood-rearing, and migratory periods.

STUDY AREA

Our study area was located in northeast Polk, northwest Clearwater, and southeast Pennington counties, about 19 km north of Gully, Minnesota. It is located along a major migration corridor of the prairie pothole and lake country of western Minnesota. Agassiz National Wildlife Refuge and the Thief Lake Wildlife Management Area are located about 45 and 65 km to the northwest, respectively. The study area includ 3600 ha (14 sections) of land which contained a variety of idle brushlands, pasturelands, small grain fields, woodlands, and Conservation Reserve Program (CRP) land, in addition to about 1300 ha of wild rice distributed in some 80 paddies. The Clearwater River bisects the study area and serves as the water source for wild rice production. The land is owned and operated by John, Jim, and Ken Gunvalson, Paul Imle, and Duane Erickson. This area is representative of the prairie - forest transition area, where about half of the cultivated wild rice is produced in Minnesota.

METHODS

Objective 1: Use of cultivated wild rice paddies by migrant waterfowl.

Spring and fall census routes

Species composition and density (number of birds per flooded paddy hectare) were recorded along a pre-selected, 8-km census route. The route included up to 17 paddies (depending on paddy flooding chronology) covering up to 316 ha. The route was chosen with regard to representative habitat and vehicle access, and included paddies of various sizes (2.18 - 101 ha), shape, and surrounding habitats. The census was conducted weekly, with counts alternating between mornings (0700 - 1000) and evenings (1700 - 2000) when waterfowl were most active. Due to variation in paddy size and the potential for ducks to be hidden by vegetation along paddy and island edges, data were recorded using a combination of the single point observation method and the circuit count (Hammond 1970). Researchers stopped at several observation points when observing large paddies to more accurately record bird numbers. Birds flushed from cover along paddy edges were recorded as researchers moved from one observation point to the next and were discounted if they landed in paddies farther along the route. Spring data collection began in early April, when open water began to appear on some of the paddies, and continued to late May, when the visibility of waterfowl became restricted by standing rice. Census routes were resumed in mid to late September, once flooding on some of the paddies had begun, and continued through October until paddy freeze-up.

Paddy food resources

To estimate food resources available to migrating waterfowl, soil core samples were collected from 6 paddies from 1-10 October 1993, following cultivation and prior to fall flooding. To evaluate effects of different cultivating practices on food availability, 3 moldboard and 3 chisel - plowed paddies were sampled. A soil bulk density sampler with a diameter of 10.16 cm. was used to collect 240 cores from the top 15 cm. of paddy substrate. Samples represented the peat - water interface where food items were accessible to feeding waterfowl when paddies are flooded. Beginning at the center of the paddy, 10 cores were collected at 10 m intervals in each of the 4 cardinal directions. Half of the samples from each paddy (20) were randomly chosen for analysis. Samples were placed in warm water to loosen the mostly peat substrate, screened through a 2 mm soil screen, then transferred to a clean separation tray where food items were separated and tallied. Plant seeds and other vegetative parts were identified using Martin and Barkley (1961). Differences in the occurrence of food items in moldboard versus chisel-plowed paddies were assessed.

Objective 2: Waterfowl production and habitat use of paddies and associated uplands.

Breeding population census

Local breeding populations were estimated using methods similar to those of the Wetlands Wildlife Research Unit, Minnesota Department of Natural Resources, Bemidji (Todd Eberhardt, pers. comm.) and the Agassiz National Wildlife Refuge (Gary Huschle, pers. comm.). Census routes were chosen where vehicle access on dikes or roads was good. All ducks within a 200 - meter strip from the vehicle into a paddy were identified to species and placed into 1 of 4 categories: lone drakes, flocked drakes (<5), pairs, and groups (>5). Only the length of the 200 - meter transects along paddy edges was used in calculating total area censused. Counts were conducted during the third week in May between 0600 and 0930.

Nest searching

Nest searching began during the second week in May when some upland - nesting hens had begun incubation. Searches were conducted in several ways. Open, upland cover (i.e., CRP land) was searched by dragging a 15.2 m length of cable or a 30.5 m length of chain between 2 all - terrain vehicles (ATV's) to flush females from nests (Klett et al. 1986). Paddy dikes were searched with ATV's equipped with a rack-mounted flushing bar, and nesting cover inaccessible to ATV's was systematically searched by researchers on foot, using sticks to disturb vegetation and flush nesting hens. Potential nesting cover associated with paddies (bordered by a paddy on at least 1 side) was searched at 2 - week intervals throughout the nesting season.

Nests were marked 3 m to the north with a 1.5 m willow stake and flagged with surveyor's tape. The following information was recorded for nests: date found, location on base map, 100% visual obstruction reading (VOR) using a Robel pole (Robel, et al. 1970), number of eggs present, and laying or incubation stage when found. Information was updated each time a nest was revisited.

Trapping and marking nesting hen mallards

After a mallard nest was located, it was revisited at an estimated incubation stage of 20 days and the hen was flushed. During the visit, nest data were updated and a walk - in nest trap (Dietz et al. 1994) was placed over the bowl. If the hen's approach path to the nest could be located, the single funnel-like opening of the trap was positioned over it, allowing the hen unobstructed access to her nest. The trap was left in position for 3 hours following placement, allowing the hen time to return and resume incubation. Researchers rapidly approached the trap from the direction of the opening, and the hen was usually captured. Captured hens and the nest trap were immediately removed from the nest site to reduce the amount of disturbance to surrounding cover. Processing took place 50 to 100 m from the nest site where hens were radio-marked with anchor transmitters weighing about 3.8 grams (Source: Advanced Telemetry Systems, Esko, MN) and equipped with U.S. Fish and Wildlife Service leg bands. Transmitters were attached at shoulder level along the midline of the back where they were held in place with three polypropylene sutures and a stainless steel anchor-shaped wire that was inserted subcutaneously. Transmitter attachment procedures were similar to those described by Pietz et al. (1995). Average processing time was about 15 minutes per hen. After processing, some hens were mildly anesthetized using methoxyflurane and placed beside their nests; others were released from the site of processing. The anesthetic was used to allow researchers to leave the nest site without flushing the hen from the immediate area, reducing the risk of abandonment (Rotella and Ratti 1990).

Processing newly-hatched ducklings

Mallard nests were visited near the predicted date of hatch (24-25 days incubation). If the nesting hen had previously been equipped with a transmitter, this visit would occur while she was absent from the nest. Candling eggs at this stage of incubation allowed a more accurate estimate of hatch date. On the predicted date of hatch, the hen was flushed from the nest and the newly-hatched ducklings were processed. The entire brood, or those ducklings completely out of their eggs, were placed in a 5 - gallon container, covered with a towel and removed from the immediate nest area. All recovered ducklings were web-tagged, and up to 5 randomly chosen ducklings were equipped with 1.9 gram transmitters, using procedures similar to those described for hens. After processing, ducklings were returned to the nest bowl and covered with nesting material and/or a towel until their activity level dropped to a point where there was minimal risk of them leaving the nest bowl before return of the hen.

Monitoring movements and survival of radio-marked hens and broods

Once radioed, adult hens were located daily to monitor movements and nest status. Broods were tracked from the nest to their first wetland and then located twice daily. Broods and individual hens were monitored using truck-mounted, dual 5-element null detection systems, and locations were determined by triangulation from 2 or 3 points identifiable on base maps. Broods were tracked either by monitoring individual duckling frequencies, or in the case where only the hen had been radioed, by following her frequency. Radio-marked individuals were monitored throughout the summer until fledging, mortality, or loss of radio signal. Visual observations of broods were obtained when possible to verify survival of non-radioed ducklings. Data collected on radioed hens and broods were used to determine movements, habitat use, and survival of broods.

RESULTS

Objective 1: Use of wild rice paddies by migrant waterfowl.

Spring and fall census routes

Census route data collection began the first week in April, when open pockets of water appeared on some of the paddies flooded the previous fall. Although open water was limited, what was available held large numbers of waterfowl: particularly mallards (*Anas platyrhynchos*), pintails (*Anas acuta*), Canada geese (*Branta canadensis*), common goldeneye (*Bucephala clangula*), and ring-necked ducks (*Aythya collaris*). These 5 species accounted for 100% of birds recorded on the first spring census visit in 1993, 91.5% in 1994, and 65.6% in 1995. By mid-April, most of the fall-flooded paddies had begun to thaw, containing some open water, and pumping had begun to fill other paddies. Spring use of paddies peaked between mid-April and the first week in May when densities reached 22.5, 24.5, and 14.8 birds per flooded paddy ha in 1993, 1994, and 1995, respectively (Fig. 1). Species richness was highest during the first 2 weeks in May, when between 16 and 18 different waterfowl species were recorded during counts (Fig. 2). Species represented by greatest numbers (% composition) were; tundra swans (*Cygnus columbianus*) (21.2 - 48.4%), ring-necked ducks (5.0 - 29.4%), lesser scaup (*Aythya affinis*) (7.0 - 26.0%), mallards (5.4 - 21.7%), northern pintails (0.4 - 8.9%), American wigeons (*Anas americana*) (2.6 - 6.3%), and blue-winged teal (*Anas discors*) (0.2 - 13.0%). Also present were gadwalls (*Anas strepera*), green-winged teal (*Anas crecca*), northern shovelers (*Anas clypeata*), wood ducks (*Aix sponsa*), canvasbacks (*Aythya valisineria*), redheads (*Aythya americana*), American coots (*Fulica americana*), snow geese (*Chen caerulescens*) and Canada geese.

By mid-May, many of the more northern breeders (northern pintails, tundra swans, and most of the divers) had departed, and waterfowl densities began to decrease, stabilizing at about 10% of peak spring density (Fig. 1). By the beginning of June, wild rice had passed the floating leaf stage of development and restricted visibility to the extent that routes were discontinued. Species present at that time were mallards, gadwalls, American wigeon, blue-winged teal, wood ducks, northern shovelers, redheads, lesser scaup, ring-necked ducks, and Canada geese. All species except redheads were confirmed to have nested on the area.

To estimate paddy use by fall migrants, the census was resumed during the third week in September, the onset of fall-flooding. Waterfowl began using paddies immediately after flooding. Flooding continued until freeze-up, and waterfowl use increased as more paddies were flooded. A large influx of birds occurred just prior to freeze-up in all years, with densities in excess of 54 birds per flooded paddy ha recorded in 1993 a[illegible] 1994 and over 30 birds per ha recorded in 1995. Although peak fall densities were considerably higher than those observed during spring, the greater numbers were represented by fewer species. Tundra swans, Canada and snow geese, mallards and ring-necked ducks accounted for between 89 and 99% of all birds recorded during peak fall use periods.

Spring use of paddies varied somewhat between years, with more species arriving on the paddies earlier and remaining longer in 1994 and 1995 as compared to 1993 (Fig. 2). Maximum use was similar during the 3 years, but peaked about 2 weeks later in 1994 and 1995. Peak fall use in 1994 and 1995 also occurred almost 2 weeks later than 1993. Species observed using paddies changed little between years, except for American coots, which were very abundant on paddies throughout the spring and summer of 1993, but were seldom observed in 1994 and 1995.

<u>Paddy food resources</u>

In addition to wild rice, seeds from sago pondweed, arrowhead, smartweed (*Polygonum* spp.), and water plantain (*Alisma plantago-aquatica*) were recovered from cores. Sago pondweed and arrowhead tubers comprised the remaining major food items in samples. Total weight for the most frequently observed food items (wild rice, sago pondweed seeds and tubers, and arrowhead tubers) was calculated on a per ha basis, with fresh (wet) weights multiplied by 0.13 to obtain dry weights (Kantrud 1990). Using averages for gross energy of these items (Reinecke and Owen 1980, Fredrickson and Reid 1988), and assuming an overall 70% conversion efficiency, nutritional value and availability were calculated (Table 1). Combining the 4 food items, our samples indicated that prior to fall-flooding, a single ha of paddy contains over 315 kg (dry weight) of quality duck food. Duck use days (DUD's), the number of ducks that could survive on a ha of wild rice paddy for 1 day based on food availability, was calculated following Prince (1979) and Reinecke et al. (1989) where:

$$\text{DUD's} = \frac{[\text{food available (g dry mass) X metabolizeable energy (kcal / g dry mass)}]}{[\text{daily energy requirement (kcal / day)}]}.$$

Based on the energy requirements of mallard ducks (Prince 1979), a single ha of wild rice paddy can provide over 3200 duck use days.

Analysis of food abundance suggested that method of cultivation may affect availability of some food items. We found that chisel-plowed paddies contained significantly more wild rice and sago pondweed seeds, while moldboard-plowed paddies contained significantly more arrowhead and smartweed seeds. No differences in abundance were found for water plantain seed or sago pondweed and arrowhead tubers. Due to the soft nature of the peat, cultivation method probably has little effect on the availability of food items to long-necked species, such as geese and swans.

Objective 2: waterfowl production and habitat use of paddies and associated uplands.

Breeding population

The breeding population of ducks was estimated from total lengths of 200-meter strips along paddy edges of 19.6 km in 1993, 22.2 km in 1994, and 23.5 km in 1995. Combining the 3 year's data, 13 species were recorded (Table 2), 11 of which nested on the area. Mallards, blue-winged teal, and northern shovelers accounted for the bulk of the estimated breeding population, comprising between 78 and 88% of the total breeding birds counted during the 3 years. Density of breeding ducks was 2.61, 1.87, and 1.43 birds per ha of paddy in 1993, 1994, and 1995, respectively. This translates into roughly 675, 480, and 370 breeding ducks per square mile of paddy. Improved water conditions on the western prairies of the Dakotas and Canada may have accounted for decreased breeding pairs recorded on paddies in 1994 and 1995.

Nesting

Throughout the study, 392 upland waterfowl nests were located while cable-dragging, dike dragging, searching potential nesting cover on foot, or incidental to other field work. The peak of nest initiation for upland nesting duck species (mallards, blue-winged teal, green-winged teal, northern shovelers, gadwalls, and northern pintails) occurred during the middle of May (Fig. 3). Over 38% of all upland duck nests were initiated from 8 May to 22 May, so the peak of hatching occurred during mid-June with ducklings fledging in early August. Mallard nest initiation was relatively constant from the first week in May through the third week in June with only 7 nests initiated outside of this period. Blue-winged teal nest initiation peaked during the second and third weeks of May, gradually tapering off in early July. Most of the northern shoveler nests (28 of 34) were initiated during weeks 2, 3, and 4 of May and week 1 of June with no distinct peak. Of the 12 gadwall, 10 American wigeon, 2 green-winged teal, and 2 northern pintail nests located, all were initiated between the last 2 weeks in May and the first 2 weeks in June.
On 29, 30, and 31 May of 1993, the emergent vegetation, [mainly cattail (*Typha* spp.)], along perimeter and interior ditches of about 315 h of paddies was searched via canoe. Overwater nests of 58 American coots, 1 pied-billed grebe (*Podilymbus podiceps*) and 1 canvasback were located. Due to time constraints of other field work, nest success was not determined except for the canvasback nest which was successful. During 1994 and 1995, no American coot nests were observed on paddies.

Nest success was determined for all waterfowl found nesting on the study area during 1993, 1994, and 1995 (Table 3). Nine species nested in uplands, mainly blue-winged teal, mallards, and northern shovelers. A total of 392 nests were located and monitored, 155 of which hatched, yielding an apparent nesting success of 39.5%. Overall nesting success varied little between years with Mayfield estimates being 22.7%, 20.5%, and 21.9%, respectively. Northern shovelers had the highest success with an average Mayfield success of 30.4% for the 3 years while mallards showed the lowest success, averaging 9.1%. Because hens and broods were radioed at or near the nest site, mallard nests were visited almost twice as often as nests of other species and probably experienced lower nesting success because of it.

Analysis of nesting data from 1993 suggested nest site selection influenced success of a given nest. Hens nesting on islands, or in large blocks of cover had 41.5% apparent success, while those nesting on road sides, paddy dikes, or other strip cover showed only 7.1% success. Nest success was significantly dependent on nest site selection by upland-nesting hens (chi-square = 11.406, $P<0.001$). Investigator influences, in addition to nest site selection by hens, were also found to influence nest success or failure. Factors such as: whether or not a capture attempt was made on a nesting hen, how a nest was located, and the number of investigator visits to a nest all influenced the predictability of nest success. Analysis of 1994 and 1995 nesting data will provide a more complete understanding of factors affecting nesting success throughout the study.

Predation was the main cause of nest failure, accounting for 81% of unsuccessful nests in 1993, 85% in 1994, and 84% in 1995. Predators commonly recorded on the study area and suspected to have preyed on duck nests were: striped skunk (*Mephitis mephitis*), Franklin's ground squirrels (*Spermophilus franklinii*), mink (*Mustela vison*), red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), and coyote (*Canis latrans*). Abandonment, agricultural practices, and investigator disturbance contributed to remaining losses.

Capture, processing, and radio tracking mallard hens and broods

During the 1993, 1994, and 1995 nesting seasons, 32 mallard hens were captured on nests and tracked a total of 915 radio days. Average length of monitoring period for individual radioed hens was 28.6 days. Nineteen of these hens were successful in their nesting attempts and we radio tagged 17 of their broods at the nest. A total of 77 mallard duckling were equipped with radio transmitters, with 70 captured on the nest at hatching, representing 19 separate broods (16 with radioed hens and 3 with unradioed hens). Ducklings processed at the nest site were tracked for a total of 1,070 radio days and the average monitoring period per radioed duckling was 15.3 days (range: 1 - 65 days). In 1994, a brood of 14 - day old radio-marked ducklings was apparently abandoned by their radioed hen and adopted by a green-winged teal hen. In 1995, brood mixing occurred in a brood of 19 - day old ducklings. One radioed duckling remained with the radioed hen until fledging, and 3 radioed ducklings apparently joined