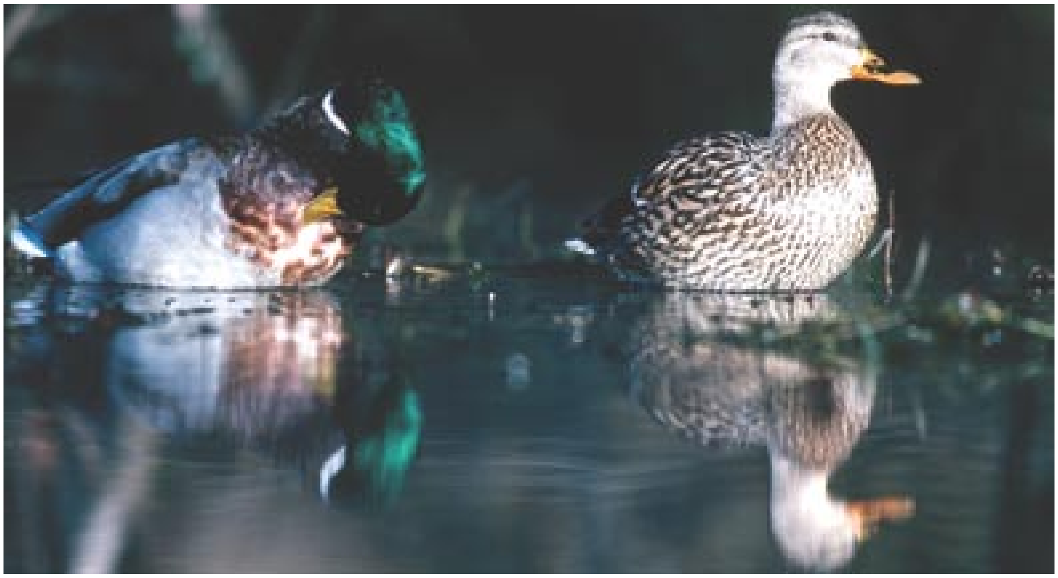
Waste Rice:
A Critical Commodity for Wintering Waterfowl



Joe Mac Hudspeth, Jr.

In November 1902, before President Theodore (Teddy) Roosevelt departed for his famous Mississippi bear hunt, the President remarked he did "...not anticipate the pleasure of killing a bear so much as the pleasure of a few days of complete recreation in the woods." Back then, the "woods" sought by President Teddy Roosevelt were breathtaking–a vast bottomland hardwood forest in an area known as "The Delta." The Mississippi River was not constrained by levees at the turn of the century, so the river and its tributaries regularly flooded forested bottomlands from southern Illinois to the Gulf Coast marshes. If you accompanied President Teddy Roosevelt on his Mississippi sojourn, you likely would have been overwhelmed by the countless ducks that used the flooded forests during winter.

The landscape of the Lower Mississippi Alluvial Valley (MAV) today is quite different from that which our 26th President experienced. During the 20th century, most of the original 25 million acres of bottomland forest were converted to croplands. Nonetheless, millions of waterfowl return annually to the MAV to survive winter before returning to northern breeding areas. Therefore, it's no surprise rice, corn, and soybean are important winter commodities for ducks and geese in the MAV.

Rice was first cropped in Arkansas in 1896, only a few years before President Teddy Roosevelt's visit to Mississippi. During the early 20th century, rice acreage expanded throughout the MAV to meet demands of millions of people worldwide. Millions of waterfowl in the MAV also eat waste rice–grain not collected by combines during harvest–in flooded fields to meet their daily energy needs.

Waste rice once was abundant in the MAV after harvest with about 125-450 pounds per acre left in the fields. Mallard ducks feast on waste rice, acquiring 3.34 kilocalories of energy per gram of rice ingested, a value greater than most other agricultural and natural seeds. Rice doesn't decompose as quickly when flooded as other crop seeds, such as soybean and corn, making rice a valuable food commodity for ducks. Also, rice is grown within levees, making it easy for landowners to close drain pipes and turn harvested fields into winter wetlands for waterfowl. Indeed, many rice producers in the MAV flood their rice fields during winter to provide habitat for waterfowl and hunting opportunities.

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The Lower Mississippi Valley Joint Venture (LMVJV) of the North American Waterfowl Management Plan is charged with providing habitat in the MAV for wintering waterfowl. When developing conservation objectives, the LMVJV specifically recommended flooding harvested croplands to provide foraging habitat for wintering waterfowl, and assumed rice fields would provide about 115 pounds of waste grain per acre. However, research conducted through Mississippi State University's (MSU) Forest and Wildlife Research Center in the late 1990s found less than 70 pounds of rice per acre in Mississippi rice fields in early winter—a time when waterfowl typically arrive to the Delta in significant numbers. Additionally, other researchers have documented ducks stop feeding in fields when rice declined below 45 pounds per acre. If these patterns existed throughout the MAV, only about 25 pounds of rice per acre may be available to foraging waterfowl.

To investigate these possibilities, scientists in the Department of Wildlife and Fisheries initiated a large-scale survey during falls 2000–2002 to estimate waste-rice abundance between harvest (mid-September) and early winter (early December) in the four major rice growing states in the MAV (Arkansas, Louisiana, Mississippi, Missouri). The researchers collected nearly 6,000 soil samples from 159 rice fields of 87 farmers across the four states. They also conducted experiments to determine how rice seed was lost, and if common post-harvest practices, such as burning, disking, rolling, or no manipulation of stubble, might conserve rice differently for wintering waterfowl.

How Much Rice Exists in Fields?

After washing, counting, and weighing tens of thousands of rice seeds and analyzing data, the researchers confirmed waste rice was abundant soon after harvest, averaging 241 pounds per acre across years (Figure 1). However, they also discovered rice abundance declined sharply during fall to 70 pounds per acre in early December—a significant 71% decline (Figure 1). As mentioned, ducks stop feeding in rice fields at about 45 pounds per acre. Thus, only 25 pounds of rice per acre might actually be available for waterfowl in the MAV. Clearly, this value is much less than the 115 pounds of rice per acre that habitat conservation planners had assumed was available.

Does Less Rice Lower Foraging Carrying Capacity?

To understand how decreased amounts of rice in fields might affect foraging ducks, the researchers needed to know how many ducks might feed on an acre of harvested rice land for a day. Waterfowl ecologists call this potential "duck-use days" (DUDs). The DUDs were calculated with an equation that considered amount of rice available, energy value of the rice (3.34 kcal per gram), and daily energy requirements of a duck (e.g., mallards require 292 kcal of energy per day).

Seventy pounds of rice per acre in early winter would provide about 363 DUDs per acre (Figure 2). However, when the "giving-up" density of 45 pounds per acre is subtracted, DUDs drop to only 132 per acre (Figure 2). Because the LMVJV believed rice fields could provide 750 DUDs per acre, the researchers concluded the carrying capacity of MAV rice fields for ducks may be reduced nowadays 52-82% (Figure 2).

What Happens to the Rice?

Several things could happen to waste rice. For example, the seed might lie on the ground and sprout during fall. Lots of animals besides ducks and geese eat rice seeds; thus, another possibility is that rice may be eaten by rodents, birds, and insects. Finally, with warm humid conditions during early fall, rice might simply decompose. An experiment was designed to determine the fates of waste rice.

Groups of 20 rice seeds each were placed in fields throughout the MAV, covering one half of the groups to exclude seed predators while leaving the other half uncovered. The experiment showed about

20% of the rice remained intact after winter, 8% sprouted, and 14% was eaten. An assumption was made the remaining 58% decomposed. Although the experiment needs to be repeated, the researchers speculated that total loss of rice during fall to these three agents (80%) was similar to the overall loss of waste rice recorded throughout the MAV (71%).

Can We Conserve Waste Rice?

Mark Twain said, "Everybody talks about the weather, but nobody does anything about it." Indeed, it was important for the researchers to determine that abundance of waste rice was much less than previously estimated, as well as attempt to understand what caused its loss during fall. But, the next obvious question was, "What can be done about it?" The scientists set out to determine if certain post-harvest field practices conserved more rice than others during fall. Specifically, they evaluated the effects of disking, rolling, burning, and not manipulating rice stubble after harvest. These were chosen because earlier research revealed most rice producers in the MAV manipulated their fields after harvest in these ways.

Between 2001 – 2003, the researchers conducted pilot experiments at MSU's Delta Research and Extension Center in Stoneville. Two tropical storms in 2002 made it impossible to implement their field treatments completely, and 2001 and 2003 results were inconsistent. Nonetheless, the best insight into conserving waste rice for wintering waterfowl in relation to common post-harvest field practices was needed.

The scientists decided to let their data from the MAV surveys reveal which field treatments may be best. Every time a field was sampled during the fall, the field practice(s) on the harvested field was recorded. Analysis suggested fields with unmanipulated stubble contained about 43% more rice in early winter than treated fields (Figure 3).

In addition, the researchers knew leaving stubble during winter could be environmentally and agriculturally beneficial (see *Research Advances Vol. 4, No. 1*). For example, previous research conducted through the Forest and Wildlife Research Center found winter-flooded rice fields where stubble was left intact only lost about 31 pounds of soil per acre during winter, whereas fields that had been disked and left to drain after winter rains lost nearly 1,000 pounds per acre. Furthermore, fewer winter weeds grew in flooded fields with standing

Figure 1. Waste Rice Abundance

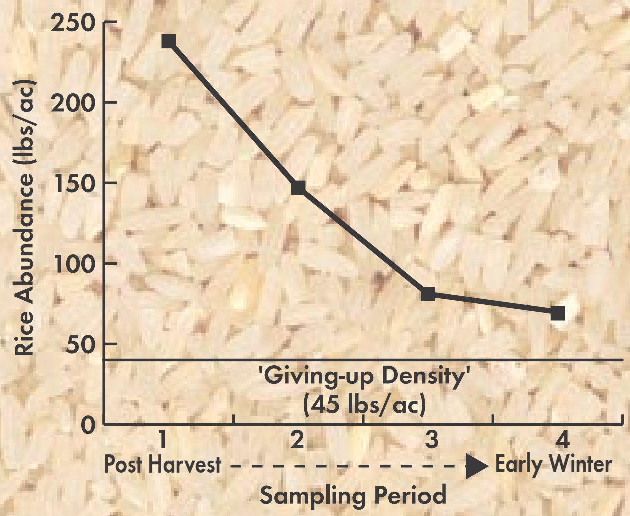


Figure 2. Duck-Use Days

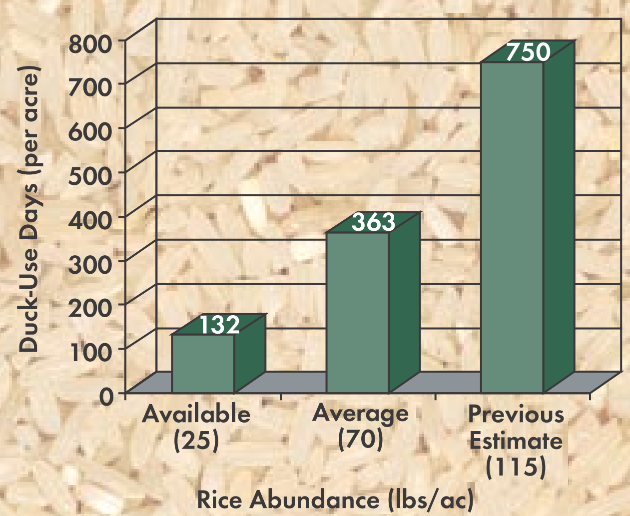
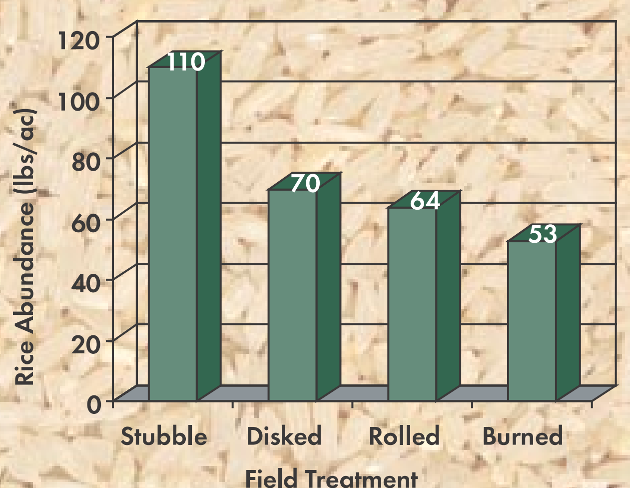


Figure 3. Post-Harvest Field Treatments



Research Advances
Volume 9, Number 1
July 2005

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stubble, potentially saving rice growers $9–$26 per acre in production costs due to reduced herbicide treatment at spring planting. Other important benefits of leaving stubble included increased sprouting of "red rice" during fall followed by its winter kill and substantial decomposition of rice straw (54%). Moreover, more aquatic invertebrates were found in fields with standing stubble than disked fields; invertebrates are important sources of protein and other nutrients for waterfowl. Finally, flooded rice fields with standing stubble provide habitat for crawfish, which can be harvested for human consumption. Considering all potential benefits, the researchers recommend leaving standing stubble during winter as a preliminary "best management practice." However, they also suggest rice producers may desire to burn, mow, or roll portions of fields to create open-water areas for waterfowl following flooding. These post-harvest treatments may be particularly important in rice fields harvested by stripper header combines, which leave 3–4-foot high stubble.

What Have We Learned?

Winter flooded rice fields in the MAV will remain an important habitat for migrating and wintering waterfowl. The LMVJV may revise habitat conservation goals to account for less waste rice in harvested fields. Although the researchers tentatively recommended leaving rice stubble standing after harvest, a new research project is ongoing in the Forest and Wildlife Research Center to evaluate post-harvest practices for conserving rice in MAV fields. The scientists believe this experiment, conducted on a large scale, will enable them to build upon previous findings and determine which post-harvest practices help save rice for waterfowl and dollars for farmers.

Although certain management practices may conserve waste rice more than others, the researchers recognized winter flooded rice fields may provide limited forage for wintering waterfowl. However, managed moist-soil wetlands with natural vegetation, such as grasses and sedges, have potential to provide great amounts of waterfowl forage and thereby help mitigate low rice abundance. Recent research in the Center found an average of 537 pounds of natural plant seeds per acre, which was nearly 6 times (2,092 DUDs per acre) the average forage value of harvested rice fields. Additionally, these natural wetlands produced over 11 times (4,041 DUDs per acre) the forage value of harvested rice fields when they were intensively managed (annual disking, irrigation, fertilization). Moreover, moist-soil wetlands provide a diversity of nutrient-rich seeds and tubers, roosting cover for waterfowl, and aquatic invertebrates. Therefore, the researchers strongly recommend increased management and integration of moist-soil wetlands in the agricultural landscape of the MAV.

Acknowledgements

Sponsors of this research were Arkansas Game and Fish Commission; Ducks Unlimited, Inc. through the Institute for Wetland and Waterfowl Research; Federal Aid in Wildlife Restoration through the Mississippi Department of Wildlife, Fisheries and Parks (Project W-48, Study 44); MSU's Forest and Wildlife Research Center and Delta Research and Extension Center; the North American Wetlands Conservation Council; U.S. Geological Survey, Patuxent Wildlife Research Center; and the U.S. Department of Interior through the Fish and Wildlife Service. We also are indebted to the farmers in the MAV who allowed us to sample their rice fields during 2000-2002; without their cooperation, our study would not have been possible. Finally, we thank the many technicians who assisted with field and lab work.