Rice Fields for Wildlife

History, Management Recommendations and
Regulatory Guidelines for South Carolina's Coastal Impoundments

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Savannah River Rice Fields, 1936. Library of Congress.

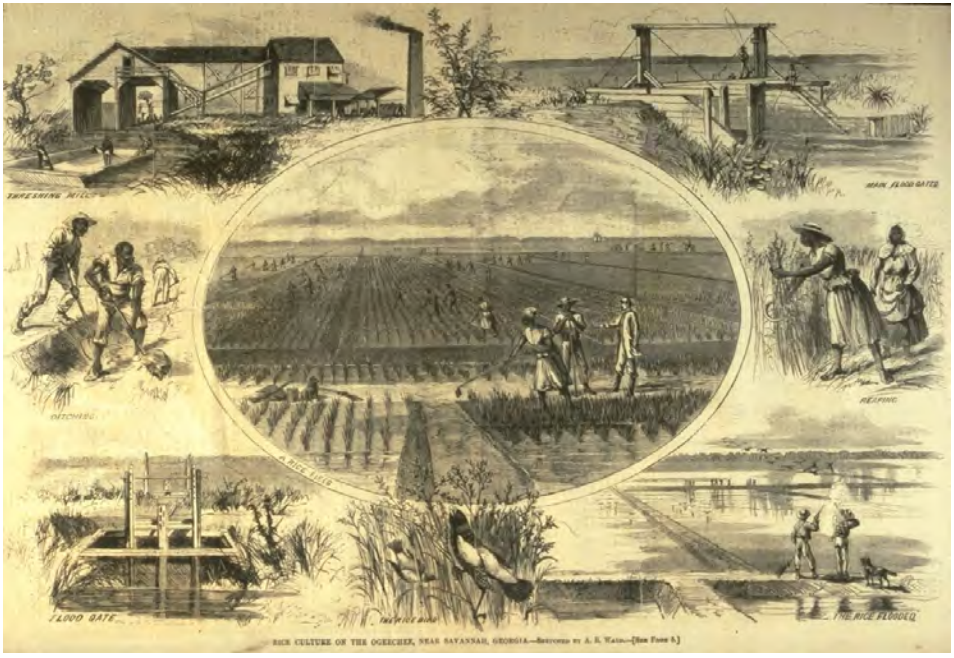
South Carolina's Rice Fields

Travis Hayes Folk, Ph.D.

How an agricultural empire created a conservation legacy

Few landscapes bear the vestiges of an agricultural empire the way rice culture has influenced the Lowcountry. Dikes, quarter drains, and rice field trunks are some of the unique features of rice culture along the coast of South Carolina. When viewed from the air, rice fields appear as a series of straight and parallel creeks and dikes; an intricate geometric puzzle that evokes the feelings of the Nazca Lines in Peru. These features remind us that an entire landscape was transformed into a large "hydrological pump" designed for the planting and harvesting of one crop: rice. While rice culture in the Lowcountry is now relegated to history, these managed, wetland landscapes are now playing an integral role in the conservation of the Lowcountry. These historic rice fields, slave-created systems from the 18th and 19th centuries, are being used as tools for conservation in the 20th and 21st centuries.

While all of these features have their origins over 200 years ago, many have been maintained over generations, from one planter to another and now from one sportsman to another. The success of these planters led to vast fortunes which allowed the construction of plantation empires. Rice was not to last though, and the story of rice fields after commercial production is one of evolution and persistence towards a conservation goal. South Carolina rice fields have evolved into a major conservation tool in addition to serving as visual reminders of the region's long, rich agricultural heritage and the tremendous landscape transformation created by slaves.



Rice culture on the Ogeechee, near Savannah, Georgia. *Harpers Weekly*, January 5, 1862. Collection of T. H. Folk

THE BEGINNINGS OF RICE IN CAROLINA

"There has been more pure bunk written and believed about the Southern planters than about any other class in American history, particularly bunk of a romantic sort"

- Samuel Gaillard Stoney

Despite its ultimate rise to an agricultural empire, little definitive information is known about the introduction of rice to South Carolina. As commercial rice production waned in the first decades of the 20th century, many authors described the introduction and success of rice as inevitable, a history that was without trial, failure, or experimentation. In fact a history of rice culture is beginning to emerge with academic research in the last 30 years. It reveals several periods of rice culture and a constant effort by planters to experiment and improve husbandry techniques to increase crop yields.

The year of rice introduction to the Carolinas is a topic fraught with myth and lore. Several accounts place the introduction of rice after the 1670 establishment of Charles Towne on the banks of the Ashley River. John Drayton in *A View of South Carolina (1802)* suggests the first introduction was in 1688 but he says an enhanced variety was also introduced in 1696. An account given in David Ramsay's *History of South Carolina (1809)* indicates in 1693 Thomas Landgrave Smith received a bag of Madagascar rice from a ship captain. Alexander Salley, secretary of the Historical Commission of South Carolina, suggested in a 1936 publication that the *true* introduction of rice to South Carolina was in 1685 when a Captain John Thurber gave Dr. Henry Woodward of Charles Towne "a peck of gold seed rice" (Salley 1936). The famed *Seed from Madagascar (1937)* by Duncan Clinch Heyward takes the later story as the true introduction of rice to the Lowcountry.

Hoeing Rice *(c.1907)*
Private Collection of T. H. Folk

Whatever the true date and instance of rice introduction to Carolina, it became a successful commodity in short time. For example, rice was valuable enough by the 1690s that the colonial legislature decided in 1691 to allow tax bills to be paid with rice. Regardless of timing of introduction, export records from Charles Towne indicate rice was shipped out of the province as early as 1698. This suggests that whatever the true date of introduction, early planters and slaves had developed the skills to grow and produce enough rice for economic gain by the start of the 18th century.

The first type of economically successful rice was grown in non-tidal, freshwater swamps. This form of rice culture, called inland rice, started in the late 1600s and began to decline in the mid to late 1700s, although some inland fields were utilized until the early 20th century. Inland rice fields were developed from linear wetlands dominated by bottomland hardwood forests. These wetlands were cleared of trees, stumps removed, and rice

field beds leveled. Dikes would also have been constructed across the newly leveled rice field bed perpendicular to the flow of water. These cross dikes would have allowed a planter to retain water in the area immediately upstream. When he needed to dewater the field, a water control structure in the downstream cross dike could be opened.

These fields also had a distinctive type of dike and canal still used today to identify former inland rice fields. These embankments, called diversion dikes and diversion canals, would be built on either side of the linear rice field and were placed immediately before the ground transitioned into upland. These diversion dikes and canals served several purposes. Most importantly, they prevented heavy rainfall runoff in spring and summer from flooding the planted rice. Runoff would first drain into a diversion canal and be prevented from further running into the field by the diversion dike. The diversion canal would allow this "freshet" water to run parallel to the field and down the diversion canal. These diversion structures can still be seen in many Lowcountry inland rice fields.

Most inland rice fields occur in the coastal plain just upstream from tidal influence. Yet, inland rice culture has been located in several unlikely places. Diversion dikes and level planting beds have been located on Johns Island, Daufuskie Island, and even Cherokee County in the Piedmont region of South Carolina. Small communities like Rice Patch in the north-western corner of Colleton County attest to the presence of rice culture many years ago. Documentary work has also shown the use of inland fields for rice production in Mars Bluff, Florence County. This area was planted into the 20th century by African American descendents of slaves. While inland fields existed in numerous unlikely places, it is difficult to know whether these fields were for economic gain or merely for producing a subsistence crop.

Inland rice culture was a lucrative agricultural endeavor, but several factors contributed to its decline. This method of rice cultivation relied heavily on rain water for irrigation. In drought years planters' crops suffered or wouldn't materialize at

Unloading the Rice-Barges, from Edward King's *The Great South (1875)*

all. This made investment in new fields and infrastructure difficult if crop success was subject to the vagaries of weather. Also, by the late 1700s per acre yields began to diminish and the American Revolution disrupted rice plantation activities. After the war many planters decided to adopt newer tidal rice cultivation methods rather than renovate inland fields.

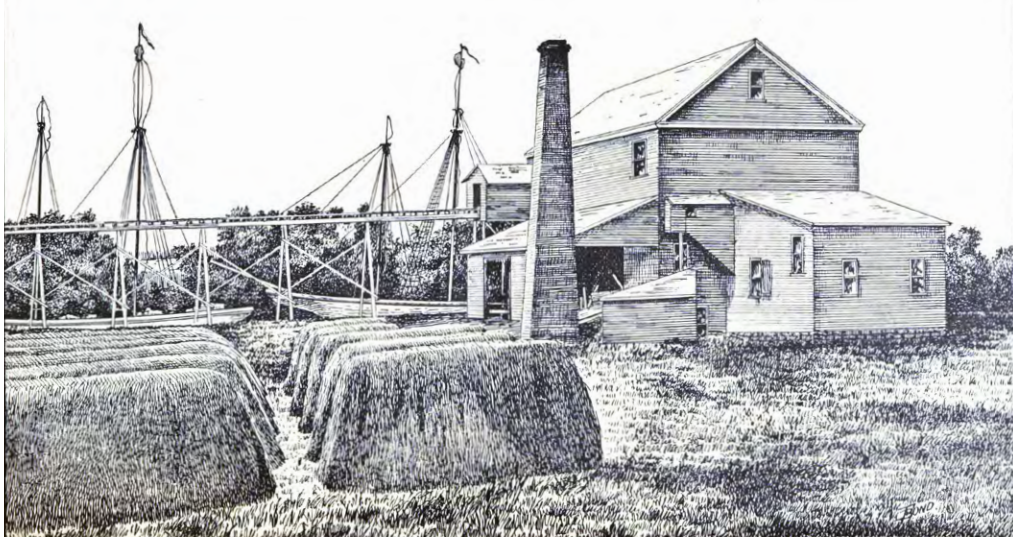
Limited work with tidal rice culture began in the 1730s, but by the 1750s Johnstone McKewn of Georgetown had developed a system of using tidal, fresh, water for flooding rice. Under this system, rice fields were constructed along portions of coastal rivers and creeks that possessed two traits: they were close enough to the coast to be tidally influenced yet far enough inland to have fresh water. This form of rice culture greatly increased per acre yields as compared to inland fields. Tidal water also allowed planters to more consistently flood growing rice as compared to inland fields that depended on rainfall and stored water in reserves. Tidal rice culture represents the culmination of generations of planters and slaves working with (and sometimes against) the forces of nature. These fields were intricate mazes of dikes, canals, and quarter drains with water control structures spread across the miles of dike. Tidal rice fields are perhaps the most commonly known type of rice field. Few visitors to the Lowcountry can pass through the region without chancing upon a beautiful vista across a tidal rice field. These impoundments can cover hundreds and thousands of acres.

A LANDSCAPE IN TRANSITION

"….the rice-fatted wild-duck of Carolina…. doubtless God never did create a better duck…."

-W. Elliott in
Carolina Sports by Land and Water (1867)

The planting of rice made many a Lowcountry planter wealthy and the nature of the rice plantations became a culture unto their own. Society recognized the "planter" as a well established and revered societal class. The Civil War removed an essential ingredient to this scenario: slave labor capable of performing all of the arduous tasks to bring



Threshing Mill, Combahee River from F. Bond and G. H. Keeney's *Irrigation of Rice in the United States (1902).* US Department of Agriculture.

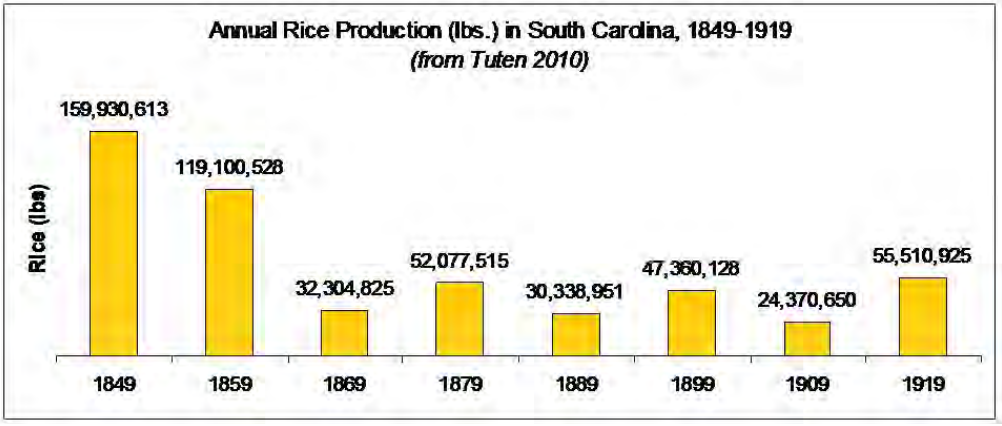
the crop to market. After the war, planters sought to resume rice planting and many freed slaves sought to remain in the only place they had ever known.

While sharecropping or land tenancy became a common pattern across the South after the war, rice plantations developed a different system to obtain labor from freed slaves. Labor contracts were used as the primary method of rice planters to employ former slaves. Under this system, a contract was developed by the planter, signed by freedmen, and witnessed by a third party. These contracts, in some cases, attempted to impose pre-Civil War controls on newly freed slaves. In many cases fair market wages were not paid for labor performed. These inequities led to numerous labor riots in the post-war years. Despite these inequities, rice plantations were rebuilt. Dikes and trunks were fixed after the ravages of war. Rice was grown, and profit was again made.

The rice economy recovered to a limited degree. The year of 1879 was the post war peak for rice production in South Carolina, although that represented only one third of the production before the war. Declining rice prices, increasing competition from other rice growing regions (e.g., Louisiana, Texas, California) and rice field infrastructure destroyed by a series of severe hurricanes all contributed to the decline in rice as a profitable venture for Lowcountry plantation owners.

Southern plantations have long been recognized for their sporting opportunities. One of the earliest and most interesting recollections is that of William Elliott (b. 1788, d. 1863). In his *Carolina Sports by Land and Water* (1867) he recounts tales of hunting and fishing, especially in the lands between the Ashepoo and Cheeha Rivers. His statement concerning a "rice-fatted duck" was likely appreciated by planters from the very first days of rice culture. As rice became less of a profitable endeavor, hunting began to be the predominant activity of former rice plantations.

The convenience of east coast rail travel, milder winters, and abundant sporting opportunities made former rice plantations in the Lowcountry an attractive winter retreat for many northerners. The purchase of these properties in the late 19th and early 20th centuries was timely as well. Many plantations had not been well maintained or managed. New ownership injected the capital necessary to maintain a rice plantation, especially when considering the infrastructure associated with former rice fields.



The sale of these rice plantations in the early 1900's was a pivotal point for conservation in the Lowcountry. How would the next owner manage and care for these properties? Would they be willing to invest the money required to maintain rice field infrastructure if a commercial crop was not being grown? Would the properties be subdivided? All of these questions, in retrospect, have great influence on the landscape we see today. Luckily, many of these properties were bought by passionate sportsmen and were indeed well managed.

Historic rice fields are conservation in the 21st century

"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."

Aldo Leopold
A Sand County Almanac (1949)

Conservation of a species, a unique habitat type, or any other ecological resource is not a discrete event. Single acts rarely result in long term ecological benefits. Rather, multiple acts of conservation must occur over a period of time to ensure the ecological integrity of a landscape. The history of rice plantations and their fields is replete with generations of owners striving to conserve the ecological heritage of the Lowcountry. As rice plantation properties transitioned away from agricultural pursuits, they also evolved into fish and wildlife havens. As we step into the 21st century, wildlife biologists are continuing to develop greater ecological understanding and management capability of rice fields. Hopefully rice field will continue to serve as a reminder of the positive management impact land stewards can have on the natural world.

Pounding Rice on Sapelo Island, circa 1915.

Understanding and Using the US Army Corps of Engineers Managed Tidal Impoundment General Permit (SAC 2017-00835)

Travis Hayes Folk, Ph.D.

The Corps of Engineer's Managed Tidal Impoundment General Permit (MTI GP) is a useful tool in the maintenance and repair of many impoundments along the South Carolina coast. In this chapter I describe all of the various sections of the MTI GP. In general, the chapter is organized as follows: 1) a summary of terminology used in wetland regulations, 2) description of criteria and registration process for having an impoundment deemed qualified to use the MTI GP, 3) a description of the activities covered by the MTI GP and notes pertaining to the use of the MTI GP, 4) discussion of the Post Construction Form (Post CN) and its importance to the MTI GP, 5) summary of special conditions for the MTI GP, and finally 6) summary of the general conditions of the MTI GP. Note: Many portions of text used in this chapter are taken verbatim from the MTI GP in order to minimize confusion.

TERMINOLOGY FOR WETLANDS REGULATIONS

A unique and specific vocabulary is used for governmental wetland regulations. Below is a summary of terms used most frequently when referring to Managed Tidal Impoundments (MTI) and the General Permit (GP). Some of these definitions come from the MTI GP.

Area of Potential Effect – This is an area in which the State Historic Preservation Office (SHPO) is required to consider how a project may impact historic resources. This requirement comes from the National Historic Preservation Act. For the MTI GP the Area of Potential Effect consists of tidal impoundments whose qualification has been certified plus a 500' buffer extending from the impoundment edge into the adjacent uplands. Historic features that will be considered may include structures built during the period of economically successful rice production and any Native American artifacts

Winnowing House on Mansfield Plantation, Georgetown County, SC. *Structures like these (used to separate rice seed from chaff) are typically located near rice fields and would be included in the Area of Potential Effect.* HABS, Library of Congress

Berm – An area of horizontal grade between the dike base and canal edge. The berm for the MTI GP is considered to be a similar grade as the rest of the impoundment.

Contraction Embankment - A new embankment built to replace a section of failed or failing outer or perimeter dike of a tidal impoundment. The contraction embankment is constructed to the interior of the failing

outer or perimeter dike with the same height and width of the original and connecting embankments.

Embankment - An earthen mound constructed to limit water movement. For the purpose of the MTI GP, an embankment in tidal impoundments consists of three parts: a field-dike, which is the elevated portion of an embankment above the water level; a berm, or maintenance shelf that is located to the interior of the field-dike, which helps to stabilize the field-dike; and a canal, which is located to the interior of the field-dike and berm, and facilitates water circulation.

Emergency Repair – Actions in response to situations or events that are unforeseen and cause damage to the infrastructure of a tidal impoundment. Situations that may lead to an emergency repair could include a severe storm event, wildlife damage, and unusually high tides. Emergency repairs typically focus on failure of the tidal impoundments infrastructure including rapid subsidence of a dike that leads to unimpeded tidal flow into the impoundment, dislodgment of a trunk from a dike, and erosion of a dike due to water flowing over the top. Emergency repairs in the MTI GP are limited to the perimeter dike and exclude repairs to interior cross dikes.

Field - An individual management unit located within the tidal impoundment. A series of fields make up a tidal impoundment. For historic rice fields, these have also been referred to as "squares."

Forested - An area is considered to be forested if the area has 5% or more tree cover.

Footprint - Refers to the area or limits of the existing fill, canal, water control structure and bulkhead.

General Permit – A general permit is developed when a USACE regulatory district identifies a set of wetland activities that are similar in nature, continual, and have minimal individual and cumulative environmental impacts. Wetland work that is in accordance with a general permit will not require the scrutiny and time that an individual permit requires. The issuance of a general permit is intended to reduce the regulatory burden for USACE and individuals conducting this type of work. General permits can have certain eligibility and notification requirements to allow covered work to be conducted. Certain state certifications and permits may still be applicable.

Individual Permit – The primary process by which the USACE allows wetland impacts. It requires submitting a wetland permit application, public notice, and review by other resource and regulatory agencies. Wetland activities not covered by a general permit or activities that exceed thresholds in a general permit can potentially be allowed by application for an individual permit.

Inlet Canal - An excavated canal that directs water from the exterior of the tidal impoundment into a field through a water control structure. The footprint of an inlet canal can extend inside and outside of a tidal impoundment.

Interior Embankment - An interior embankment is an embankment having the three parts as described above that is constructed interior of the perimeter embankment. For the purposes of this General Permit, an interior embankment is constructed to subdivide an existing, functional impoundment typically along differences in elevational or salinity gradients for the purpose of enhanced wetland management and water quality.

Interior Field Drains- For the purpose of this General Permit, interior field drains are canals within an impoundment that are typically located between interior fields. Interior field drains allow water to flow to-and- from quarter drains and can vary greatly in width and depth. Refer to definition of quarter drains.

Invasive or Non-Native Species - A species that is not native to Managed Tidal Impoundments, and introduction of which causes or is likely to cause environmental harm.

Managed Tidal Impoundments (MTIs) - Impounded tidal wetlands and waters that have a system of functioning embankments, canals, and water control structures that create a series of fields where the water regimes of the fields are currently manipulated for wildlife management and/or where the fields have ALL of the necessary embankments and structures in place to allow for the manipulation of water regimes for wildlife management.

Nationwide Permit – This is a type of general permit issued to cover particular types of activities or wetland impacts that would occur nationwide. Examples include the repair and replacement of an existing water control structure and certain mechanized management activities associated with moist-soil management for wildlife. If certain conditions are met, the specified activities can take place without the need for an individual or regional permit. Prior to the MTI GP, some but not all of the provisions in the MTI GP were done through coverage of a Nationwide Permit.

Non-emergency Repair - Routine and normal maintenance and repair activities that are foreseen and can be planned for in advance. These types of repairs can apply to dikes and water control structures.

Normal or Regular Maintenance – Required routine maintenance activities that are predictable, necessary, and that may occur frequently, to maintain the functional integrity of the existing tidal impoundments and fields, as well as their enclosing field-dikes, berms, canals, and water control structures.

Perimeter Dike – Encloses the impoundment and prevents tidal water from entering the impoundment. It is this dike where emergency procedures are needed as a result of a breach. Other dikes inside of the impoundment are referred to as interior dikes.

Post Construction Notice - All completed activities under the MTI GP require within 30 days of completion that this notice be submitted to Charleston District USACE. A Post Construction Notification Form can be

Combahee-Style Rice Field Trunk. *Wooden structures, like this trunk, have a limited lifespan and are subject to repair and eventual replacement.* T.H. Folk

obtained from the Charleston District office. This Post Construction Notice demonstrates to the USACE that the MTI GP is being utilized by owners and managers of impoundments.

Quarter Drains - Linear, parallel ditches, typically 2 feet wide x 2 feet deep, located within rice fields and excavated for the purpose of circulating water throughout the fields as well as for directing water to and from the water control structures.

Rice Field Trunk – A wooden water control structure consisting of a box that passes through a dike and has adjustable articulating doors on either end. Typically, a trunk allows control of tidal water into and out of the tidal impoundment. There are several types of trunks (e.g., Combahee and Georgetown style) that are commonly used in managed tidal impoundments.

Set-Back Embankment - A set-back embankment is an embankment having the three parts as described above that is constructed parallel and interior of the perimeter embankment. For the purposes of this General Permit, a set-back embankment is constructed to replace the perimeter embankment because due to storm damage or sea-level rise the perimeter embankment is failing en mass and will be abandoned from future maintenance

Spillway Box and Riser – A wooden, metal, or concrete box that passes through a dike and the vertical portion attached to one or both ends of the spillway box. Horizontal boards are placed in the riser to control the level of water in the field. Typically a spillway box and riser are placed in interior dikes and are used to move water from field to field (as opposed to a rice field trunk that typically moves water from tidal water body to a field).

Splash-apron - For the purpose of the MTI GP, a splash-apron is a horizontal platform located at the openings of a water control structure to prevent erosion. It is most commonly used on rice field trunks.

Tree Stratum - A tree stratum consists of woody plants, excluding woody vines, approximately 20 feet (6 m) or more in height and 3 inches (7.6 cm) or larger DBH (diameter at breast height)

Water Control Structure - For the purpose of this General Permit, a water control structure is a structure in a managed tidal impoundment or adjacent field that conveys water, controls the direction or rate of flow, and maintains a water surface elevation. WCS in managed tidal impoundments typically consist of trunks, culverts and/or spillway boxes.

Wing-wall - For the purpose of this General Permit, a wing-wall is a vertical bulkhead extending laterally from the opening of a water control structure to prevent erosion of the field-dike.

Quarter Drains in Combahee River Rice Field.
These parallel, shallow ditches facilitate water circulation and de-watering of historic rice fields

MTI GP QUALIFICATION AND REGISTRATION

For wetland activities to be covered by the MTI GP, a property must be deemed qualified by USACE. Qualification is determined by meeting several criteria and submission of a Managed Tidal Impoundment General Permit Qualification Letter Request Form. Below, are the criteria to be met and the materials for a complete qualification application.

CRITERION #1

An impoundment must be located in the coastal zone of Beaufort, Berkeley, Charleston, Colleton, Dorchester, Georgetown, Horry, and Jasper counties in South Carolina to be considered qualified.

For the purposes of the MTI GP, the Coastal Zone is limited to the eight coastal counties of South Carolina and can be considered coastal waters and submerged bottoms that extend seaward to the state's jurisdictional lines. Location alone of an impoundment within one of these counties though is not sufficient to consider the impoundment covered by the MTI GP.

CRITERION #2

A tidal impoundment must be currently functioning

For an impoundment to be qualified, it must have the infrastructure in place (i.e., dikes, water control structures) that allow for control of water flow. The MTI GP is not intended to permit activities that create new impoundments on areas that are not currently impounded. For example, the MTI GP would not permit impoundment of salt marsh currently subject to free tidal flow. Nor does it cover the repair of impoundments where the damage did not recently occur. (i.e., fixing broken dike rice fields)

Coastal zone counties in South Carolina

Snowy Egret on a trunk door. E.P. Wiggers

CRITERION #3

An impoundment must be capable of flooding and/or draining through tidal water flow.

Numerous impoundments exist in the coastal counties of South Carolina; however, only those that are able to be flooded by tidal water and/or drained through low tides are eligible for coverage by the MTI GP. For example, fully functioning, historic tidal rice fields along the margins of tidal rivers would be covered by the MTI GP. These fields were built in the 18th and 19th centuries because they could capture tidal water for growing rice. Some fields that are not directly adjacent to tidal water bodies but do have a water connection to a tidal body are also covered by the MTI GP. As an example, many inland rice fields ultimately drain to a tidal rice field or a tidal water body. These fields are not typically thought of as tidal because they do not flood as a result of tidal waters. Some inland rice fields; however, require low tides at the lower reaches to fully dewater. The MTI GP covers inland fields that depend on low tides to fully dewater.

Nemours Plantation rice field trunk. E.P. Wiggers

CRITERION #4

An impoundment must have been deemed qualified by USACE

To use the MTI GP, a landowner must first submit a Managed Tidal Impoundment General Permit Qualification Letter Request Form to USACE Charleston District. USACE will review the application and issue a Qualification Letter if the property's impoundments are deemed qualified. An application for Qualification determination must include the following items:

1. Managed Tidal Impoundment General Permit Qualification Letter Request Form.
2. A USGS topographic map clearly showing the location of the entire property.
3. A map or drawing of the managed tidal impoundment(s) with each field and water control structure labeled with a unique identifier, types of water control structures noted, also provide summary list of all impoundments.
4. Description of the existing site conditions for each field in the impoundment to include the vegetation present, water regime, and acreages of the tidal impoundment.
5. A management plan or description of current management practices for each impoundment.
6. A map with the Section 106 Review Area clearly defined. The Section 106 Review Area is defined as all impoundments the landowner submits for coverage by MTI GP plus a 500' buffer into any adjacent uplands and wetlands, but stopping at a property boundary. For tidal rice fields, this buffer will encompass portions of the "hill" side of fields while for inland rice fields, it will extend into uplands that parallel those rice fields. Any known historic structures or archeological sites within the Section 106 Review Area must be identified on this map. Historic and archeological sites are cataloged on the ArchSite (archsite.cas.sc.edu/ArchSite) and can assist in preparation of this portion of the application.
7. Ground level photographs of impoundments proposed for Qualification Determination with a map showing the location and direction of these photos.

Upon receipt of the materials listed above, USACE will issue the land owner a Qualification Letter. This recognizes that MTI GP activities can occur on this property; however, some MTI GP activities may require a PCN. Qualification of a property ceases upon sale of the property and/or transfer of ownership and the new owner must then submit an updated Qualification Letter Request Form to USACE Charleston District. If management of a specific field changes significantly (i.e., shifting from wildlife management to crop production), the new owner must submit a revised management plan for the specific field(s) where management strategies will change.

Duration of Managed Tidal Impoundment General Permit

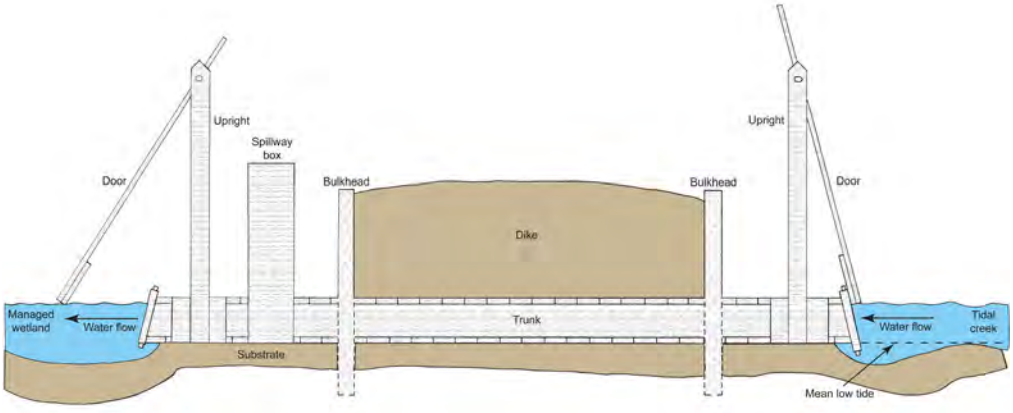
General permits are efficient regulatory tools that allow USACE to deal with specific type of activities; however, the type and extent of work allowed under a general permit will be reviewed annually and can be modified or suspended by the District Engineer. USACE will consider whether the work conducted under the MTI GP is resulting in large cumulative impacts. If USACE deems the cumulative impacts to be significant, the MTI GP will be revoked. A public notice will be issued to notify the public of cessation of coverage by the MTI GP.

The current MTI GP will cover activities started within five years and completed within six years of the issuance of this GP (i.e., 10 July 2012). Work started before the date of revocation of the MTI GP will be permitted to completion.

AUTHORIZED ACTIVITIES AND NOTES FOR THEIR USE

These activities described below are the most common and useful maintenance and repair activities in coastal impoundments.

1. Installation of new water controls structures, relocation or replacement of existing water control structures, and/or installation of associated bulkheads, splash aprons and wingwalls;
2. Replacement of existing culverts with water control structures;
3. Removal or abandonment of existing water control structures, including excavation of fill material necessary for the work;
4. Excavation of new and maintenance of existing inlet canals associated with water control structures;
5. Construction of new and maintenance of bank stabilization structures and fills;
6. Excavation and/or fill activities necessary for re-topping field-dikes, constructing berms, and constructing, relocating or maintaining canals and drains. This includes spreading or side-casting excavated material;
7. Construction of new interior embankments and rehabilitation of remnant interior embankments to subdivide tidal impoundments;
8. Construction of new set-back and/or contraction embankments to replace failing perimeter and interior embankments, including construction of temporary cofferdams;
9. Construction of road crossings across interior canals or drains;
10. Moist Soil Management activities;
11. Emergency repairs to and emergency construction of structures and fills that are necessary to restore or maintain water management capabilities to a tidal impoundment that may have been lost, or is anticipated to be lost, as a result of events and situations such as, but not limited to, storms, strong currents, unusually high tides, or wildlife activity;
12. Removal or destruction of invasive and/or non-native species; and
13. Maintenance and repair of all authorized work.

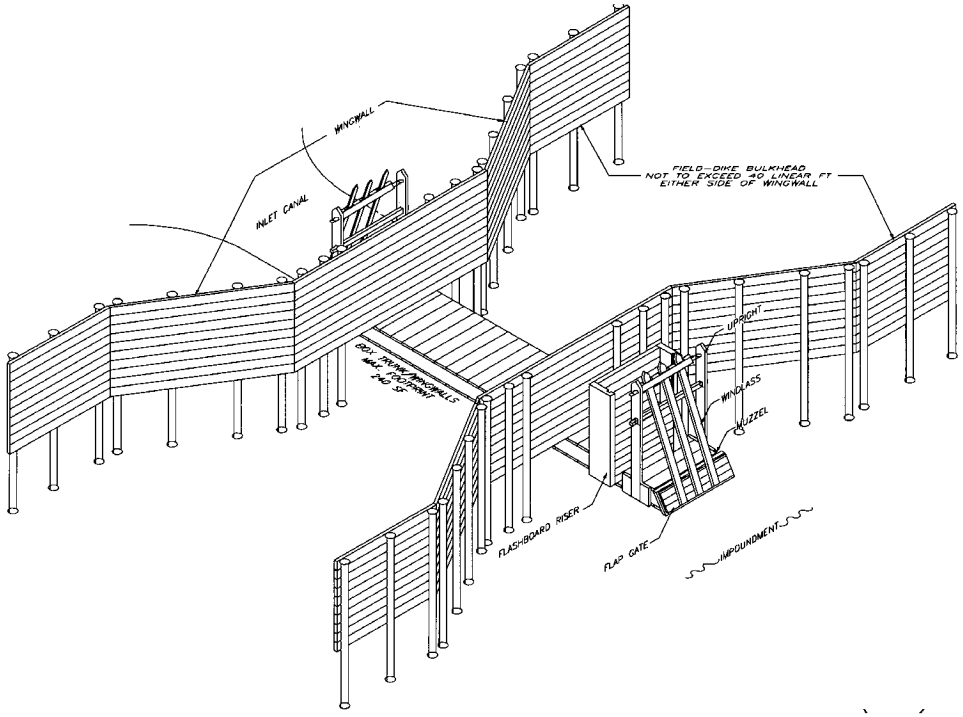


Cross section of Combahee style rice field trunk. SCDNR

NOTE 1: The construction of bulkheads, splash aprons, and wingwalls associated with water control structures, the excavation of inlet canals associated with water control structures, and bank stabilization to the outside of perimeter embankments are the ONLY activities authorized by the General Permit that may be constructed OUTSIDE of currently functioning managed tidal impoundments.

NOTE 2: All excavation of inlet canals OUTSIDE of the perimeter embankments of currently functioning managed tidal impoundments that occur in emergent vegetated wetlands OR that exceed 40 cubic yards of excavated sub-tidal sediment will require the submittal of a permit application to the Corps PRIOR to construction. The Corps will coordinate the excavation of the inlet canal with the National Marine Fisheries Service (NMFS).The inlet canal shall not be constructed until the Corps issues a verification letter.

NOTE 3: A prospective permittee shall submit a permit application prior to conducting activities authorized by this General Permit if a Federal project is located in or near the vicinity of the activity.



Typical Combahee style rice trunk water control structure. Ducks Unlimited

ACTIVITIES NOT COVERED BY THE MTI GP

While many useful activities are permitted by the MTI GP, several significant activities are not. The following are activities not permitted by the MTI GP. Were someone interested in completing these activities, they should consult with the Charleston District of the Corps of Engineers.

1. The construction of new managed tidal impoundments and/or new fields located outside of currently functioning impoundments.
2. The restoration of remnant embankments outside of currently functioning managed tidal impoundments.
3. The restoration of areas not currently functioning as managed tidal impoundments.
4. The conversion of forested wetlands to non-forested wetlands.
5. The expansion of the perimeter embankment to the outside of the currently functioning managed tidal impoundment beyond the original footprint.

POST CONSTRUCTION FORM AND PROCEDURES

An important component of utilizing procedures in the MTI GP is the Post Construction Form. This allows the Charleston District to demonstrate the value of the MTI GP. These forms are to be submitted to the Charleston District office within 30 days of completing the authorized work.

A Post Construction Form is provided with the Qualification Letter received after submitting impoundments for review. It must be accompanied with appropriate drawings describing the completed work.

Early Evening on Folly Creek.
T. H. Folk

SPECIAL & GENERAL CONDITIONS

There are several special and general conditions of the MTI GP. These should be fully understood and all provisions complied with when utilizing the MTI GP.

SPECIAL CONDITIONS

A. Work shall occur in dry or low-water conditions when possible.

B. All fill material shall be stabilized upon completion of work.

C. All work conducted in accordance with this General Permit must be the minimum necessary to accomplish the authorized work.

D. The permittee shall submit the attached Tidal Impoundment General Permit Post Construction Form found in Appendix C, and provide the required information to the Corps within 30 days following completion of the authorized work. Failure to provide the required Post theConstruction Form will be considered non-compliance with this General Permit and may result in enforcement actions.

GENERAL CONDITIONS

A. This General Permit authorizes only those activities specifically addressed above in Section I of this permit. The permittee must obtain Department of the Army authorization,such as issuance of an individual permit, for all other activities that are regulated pursuant to 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act.

B. All activities identified and authorized herein shall be consistent with the terms and conditions of this General Permit; any variance not specifically identified and authorized herein shall constitute a violation of the terms and conditions of this permit and may result in the modification, suspension, or revocation

of the General Permit, as set forth more specifically in General Condition F. below and in the institution of such legal proceedings as the United States Government may consider appropriate.

C. The permittee must make every reasonable effort to conduct the work authorized herein in a manner so as to minimize any adverse impact to fish, wildlife, and other environmental resources.

D. The permittee must make every reasonable effort to conduct the work authorized herein in a manner so as to avoid and minimize degradation of water quality.

E. The permittee shall allow the District Engineer or his authorized representative(s) to make periodic inspections at any time deemed necessary in order to assure that the activity being performed under authority of this General Permit is in accordance with the terms and conditions prescribed herein.

F. Authorization of a specific work or structure authorized herein may be summarily suspended in whole or in part upon finding by the District Engineer that immediate suspension would be in the general public interest or there has been violation of any terms or conditions of this permit. Such suspension shall be effective upon receipt by the permittee of a written notice thereof which shall indicate 1) the extent of the suspension, 2) the reasons for this action, and 3) any corrective or preventative measures to be taken by a permittee which are deemed necessary by the District Engineer to abate imminent hazards to the general public interest. A permittee shall take immediate action to comply with the provisions of this notice. Within ten (10) days following the receipt of this notice of suspension, the permittee may request a meeting with the District Engineer or public hearing to present information relevant to a decision whether their permit should be reinstated, modified, or revoked. If a public hearing is requested, it shall be conducted pursuant to procedures prescribed by the Chief of Engineers. After completion of the public hearing or within a reasonable time after issuance of the suspension notice to the permittee if no hearing is requested, the authorization of the specific work or structure will be reinstated, modified, or revoked. Any modification, suspension, or revocation under this General Permit

Impressive birdlife found in Nemours Plantation rice field. *Rice field trunks are a perfect tool to manage impoundments for species like Roseate Spoonbill, White Pelican, Snowy Egret, Great Egret (as seen in this photo) and many others.* USACE

shall not be the basis for any claim for damages against the United States.

G. Upon receipt of a notice from the District Engineer for failure to comply with the terms, conditions, or standards of this General Permit, the project owner must within sixty (60) days without expense to the United States and in such a manner as directed by the District Engineer of his authorized representative(s), effect compliance with the terms, conditions, and standards or remove the previously authorized work or structure.

H. This General Permit does not convey any property rights, either in real estate or material, or any exclusive privileges; it does not authorize any injury to property or invasion of rights or any infringement of Federal, State, or local laws, nor does it obviate the requirement to obtain other Federal State, or local assent or to comply with any applicable standards required by ordinance for the activities authorized herein. Other Federal, State, or local agencies are not limited by this document and may impose more stringent requirements than those stated herein as they see fit.

I. Any activity that may adversely affect any federally listed threatened or endangered species, a species proposed for listing, or designated critical habitat is NOT authorized by this General Permit. These activities will be evaluated under the individual permit review process as specified in 33 CFR 325.

J. Any activity that may adversely affect any historic properties listed, or which may be eligible for listing on the National Register of Historic Places is NOT authorized by this General Permit. These activities will be evaluated under the individual permit review process as specified in 33 CFR 325.

K. If the permittee, prior to or during the performance of the work authorized herein, encounters previously unidentified archeological remains or cultural resources within the area subject to the Department of the Army authorization, the permittee agrees to cease work and contact the District Engineer, so that further coordination with the South Carolina Institute of Archaeology and Anthropology and the South Carolina Department of Archives and History may be conducted.

L. The District Engineer, at his discretion, may determine that this General Permit will not be applicable to a specific construction proposal. In such case the procedure for processing an individual permit in accordance with 33 CFR 325 will be available.

Adjusting Inner Door of Rice Field Trunk.
D. Harrigal

ANTICIPATED GENERAL QUESTIONS THAT APPLY TO THE ENTIRE MTI GP.

When the MTI GP says an activity is not allowed by its authorization, does that mean I can't get a permit for that work?

No, the MTI GP was developed for only certain low impact, routine and emergency activities. Projects that would exceed the thresholds of what is described here may be permissible, but one would have to go through the individual permit process to obtain authorization.

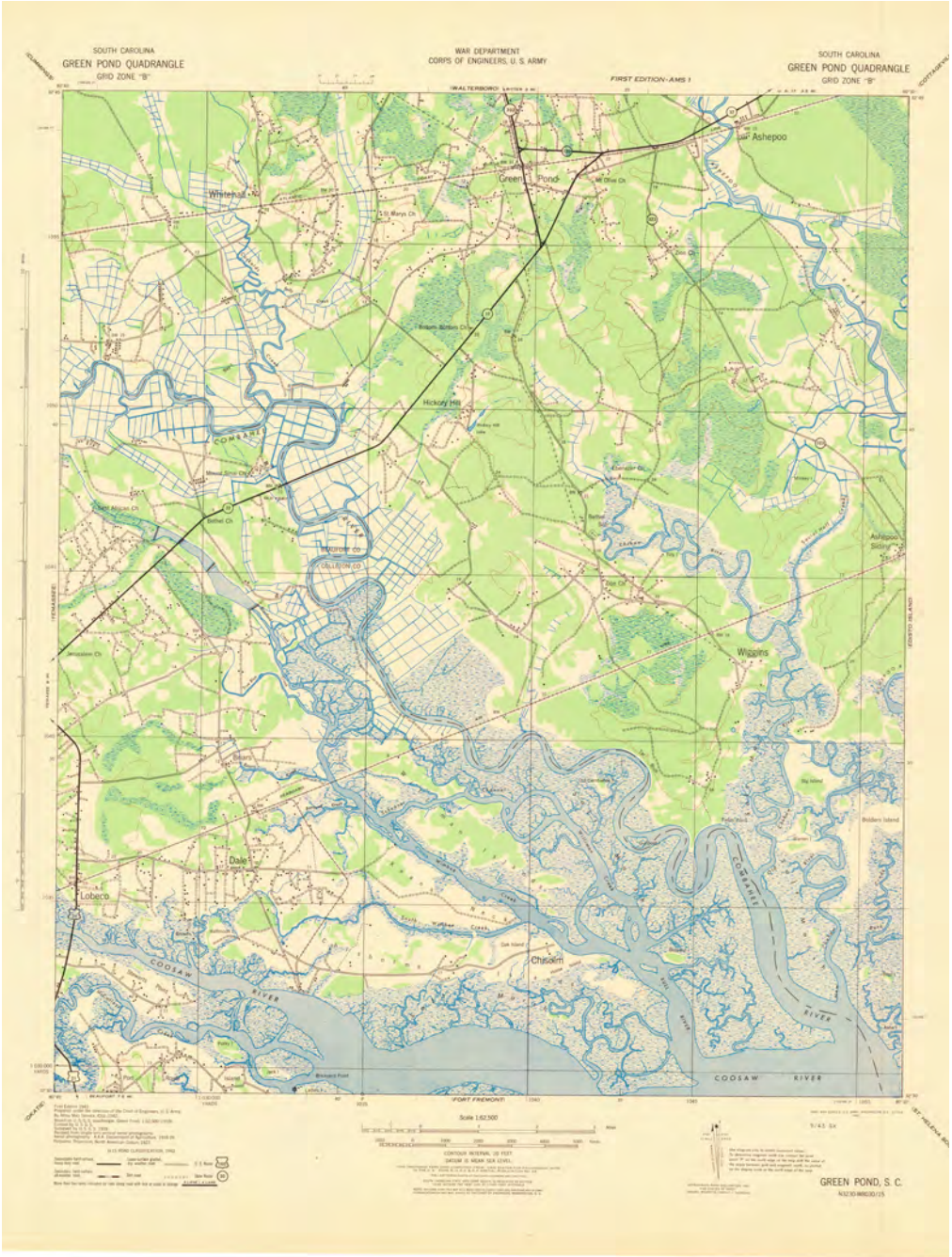
Post Construction Notices: what are they and when do I need to prepare one?

All work performed under the MTI GP requires that a Post Construction Notice be submitted to the Charleston District USACE within 30 days of completing the work. A Post Construction Notification and Certification Form can be obtained from this office. This Post Construction Notice demonstrates to the USACE that the MTI GP is being valuable to owners and managers of impoundments.

Where do you go for additional information to ensure compliance with the MTI GP?

While USACE tried to anticipate most common scenarios in MTIs, there will inevitably be peculiar situations that don't fit into the provisions described here. If you have further questions, you are urged to contact the Regulatory Division of USACE – Charleston District at 1-866-329-8187.

Rice Field along Ashepoo River. T. H. Folk



Topographic maps, like this one produced in 1942 of the Combahee River area, were one of the first large scale mapping efforts in the United States. In the lowcountry, historic rice fields are easily seen by the straight blue lines denoting canals. *Collection of T.H. Folk.*

Management of South Atlantic Coastal Wetlands for Waterfowl and Other Wildlife

R. K. "Kenny" Williams, Robert D. Perry, Michael B. Prevost

INTRODUCTION

Approximately 40% of the wetland acreage existing in the South Atlantic during the late 1700s has been either lost or significantly altered. These changes have impacted water quality, flood frequency and magnitude and populations of culturally and economically important fish and wildlife species. Wetland destruction and alteration can affect quality of human life as well as sustainability of water quality and diversity of fish and wildlife populations.

Because large acreages of remaining wetlands are controlled by private interest, landowners play a crucial role in wetland conservation and management. Private landowners can increase the functional value of wetlands by restoring hydrology and water chemistry, which positively influences plant growth and builds the food and cover habitat base that supports a diverse fish and wildlife community. Wetland management also can contribute to improved local and regional water quality because wetland plants and soils are effective filters of nutrients and contaminants. Wetlands also function to store and slowly release flood waters minimizing economic impacts on local and regional infrastructure.

While traditional wetlands management has focused on waterfowl, landowners are becoming more aware that other wildlife, along with economic, ethical and aesthetic values are impacted by wetland loss and degradation. Depending on a landowner's interests and objectives, management plans can be tailored to benefit waterfowl as well as a variety of other wildlife species. Trade-offs often exist in targeting wetland management for a particular group of species, such as waterfowl, but managers are realizing that by maintaining diversity and adaptability in their approaches, a variety of wildlife species can be sustained and enjoyed throughout each year.

This handbook was written primarily to assist landowners in managing coastal wetlands for waterfowl and wetland dependent waterbirds. Attention also was given to other wetland-dependent fish and wildlife species as well as other wetland functions. Because each wetland type presents a unique collection of plant species and management issues, techniques are presented according to the prevailing hydrology (water depth and flooding frequency) and water chemistry (salinity).

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VALUES OF WETLAND MANAGEMENT
LANDOWNER BENEFITS

Landowners are becoming increasingly aware that wise management of natural resources on their property results in the greatest economical, recreational and aesthetic values. In particular, restoration and management of wetlands in the South Atlantic can:

1. Decrease flooding and improve water quality
2. Improve aesthetic values
3. Improve hunting and recreational opportunities
4. Provide opportunities for ecotourism
5. Increase property values

By storing runoff during intense rain events, wetlands buffer upland property damage. The filtering effect of wetland plants and soils also reduces stormwater erosion and enhances water quality. Many landowners consider well-managed wetlands aesthetically pleasing and deem them to be an ethical responsibility of future generations.

Landowners also can benefit from quality wetland management by selling hunting and fishing rights. In many regions of the country, leasing hunting rights is more economically beneficial than traditional ranching and agriculture.

Ecotourism is rapidly growing industry in the South Atlantic region. Landowners have capitalized on the growing numbers of non-consumptive users by selling recreational and educational opportunities such as bird watching, natural trails and small-scale overnight accommodations (e.g., bed and breakfast). Many South Atlantic properties also have historical significance, further enhancing tourism value. Because wetlands attract large concentrations of visible wildlife they are particularly marketable in ecotourism.

ENVIRONMENTAL BENEFITS

Quality wetland management not only improves local water quality and flood control, but also enhances these values on a regional scale. Nutrients, heavy metals and other chemicals in stormwater runoff are absorbed by wetland plants and soils, protecting human, wildlife and fisheries populations

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from exposure and deleterious effects. Circulation of tidewater through managed wetlands further can improve water quality by increasing dissolved oxygen, reducing the opportunity for algal blooms and fish kills.
Water quality and flood control functions provided by wetlands not only benefit wetland-dependent wildlife populations, but also local economies. Wetlands perform flood control and water purification at a fraction of the costs (often <10%) required for comparable engineered systems.

WILDLIFE & FISHERIES BENEFITS

In many areas, including the South Atlantic, the bulk of the remaining wetlands exist on private lands. When a complex of well-managed private wetlands exists in conjunction with state and federal management areas, waterfowl and other wetland-dependent wildlife are more dispersed, decreasing competition for food and cover, nesting sites and brood-rearing sites as well as the potential for catastrophic events such as disease outbreaks. These larger wetland complexes support a greater number and variety of wildlife than is often possible on a single, isolated property, which benefits all adjacent landowners by improving hunting and viewing opportunities. When increased food resources are available to wildlife, body condition is generally improved by increasing survival and reproductive output, which carry over to sustaining future generations.

By managing for moist-soil and submergent wetland plants, landowners contribute to a greater food base for area fish and invertebrates than would be possible from unvegetated or perennial wetlands. Moist-soil and submergent plants are digested and degraded easily, compared to more fibrous perennial plants. Proper circulation of tidewater through managed wetlands can improve water quality and allow marine fish and invertebrates access to quality nursery grounds within managed wetlands. Increased survival and reproduction of fish and invertebrates not only enhance landowner recreational opportunities, but also help support regional commercial and recreational fisheries.

HABITAT MANAGEMENT PRINCIPLES
SETTING OBJECTIVES

Objectives of wetland management typically focus on improving carrying capacity for target species or species groups by increasing food and cover plants, invertebrates and open water areas. Target species may include migrating and wintering waterfowl and shoreline birds; breeding wood ducks, egrets and herons; as well as other wildlife and fish. A clear understanding of management objectives is crucial for consistent, successful management. First however, managers should examine the potential of habitats on the property to support various wildlife species. Identifying wetland types, water quality and dominant plant species are the first steps toward identifying realistic objectives (Table 1). Finally, with the end product in mind, management activities can be focused on providing the necessary biological and physical factors.

Evaluations of water sources, embankments (dikes), elevations, water control structures and overall objectives are most essential. Managers should identify opportunities for the following improvements:

1. Few or additional water control structures for improved water level and salinity management
2. Cross-diking to compartmentalize areas with elevational differences
3. Internal ditching to improve drainage for prescribed burning, mowing, disking, rotovating, planting and enhanced water circulation
4. Diversion ditches to discharge excess rainwater during the growing season.

No two management areas are exactly alike. Subtle differences in soil composition, soil

chemistry, hydrology, acreage, juxtaposition, local and regional wildlife populations, hunting, disturbance and management history may affect success of management programs.

THE BIOLOGY OF MANAGEMENT

Distributions of wetland plant species are determined by numerous physical and chemical factors including tidal influence, water depth, water quality, soil texture, soil pH, soil moisture and soil organic matter. Competition, disturbance, tidal influence, water depth and water quality are the principal factors responsible for plant community composition. The most important techniques in coastal habitat management for wildlife involve:

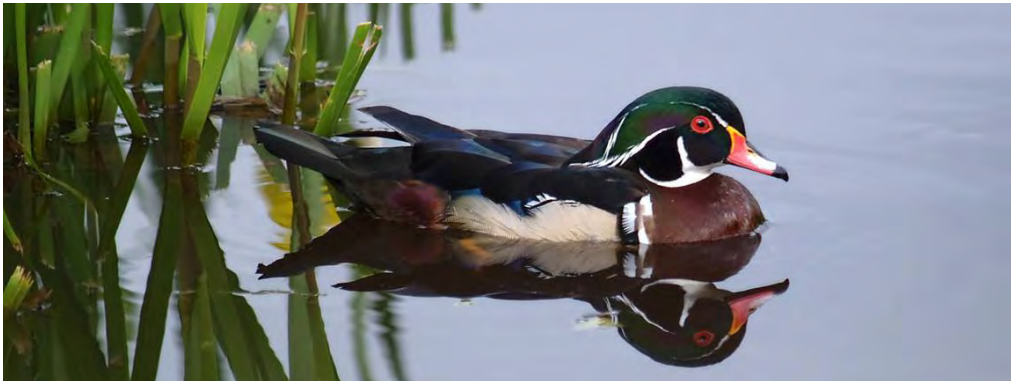
1. Manipulation of water levels to control soil moisture and flooding depth
2. Manipulation of water quality; primarily salinity

Water levels and salinity are manipulated to retard growth of undesirable, competing vegetation and promote establishment and growth of preferred plant species (i.e., food and cover plants attractive to waterfowl and other wetland wildlife). Plant succession is an ongoing natural process in wetlands; favoring dominant plant species in the absence of disturbance. Many management scenarios are designed to mimic natural disturbance, which interrupts plant species. Early successional habitats produce plants with abundant seed resources and can support a diverse group of invertebrates.

Manipulation of the physical and chemical factors affecting plant community composition is required to succeed in managing coastal habitats for waterfowl and other wildlife. While all physical and chemical factors affecting plant succession are important, manipulation of water levels and salinity are most effective in improving habitats on managed properties.

Well-designed embankments and water control structures are fundamental to management programs. Management plans should consider all physical and chemical factors affecting each habitat and be adaptable to seasonal and annual climatic variations. Managers should follow typical scenarios when conditions are favorable, but adjust objectives and techniques during adverse conditions in an annual cycle.

Some freshwater wetlands offer little potential for water level manipulation. Ponds and lakes designed for warm-water fisheries or livestock watering often do not have structures for manipulating water levels. These habitats may have little shallow water and are difficult to manage for waterfowl. However, some lakes and ponds may provide excellent food and cover resources in the form of naturally



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occurring floating or submergent plants and/or flooded timber. Water control structures can be installed in these deepwater habitats for water level manipulation to improve wildlife habitats.

CEREAL GRAINS IN MANAGEMENT

Landowners often are persuaded to plant freshwater wetlands with cereal grains such as millets, grain sorghum, corn, rice or other planted species such as chufa in lieu of moist-soil or other natural wetland plants. Declining or limited waterfowl use of managed wetlands is the typical rationale for turning to high energy cereal grains. These food sources are attractive to wintering waterfowl, particularly during prolonged cold periods. Research and management experience have shown that habitat use by waterfowl is complex and varies depending on behavioral and nutritional requirements during various stages of the annual cycle. The most successful management programs contain a complex of wetland habitats that provides diverse food sources, a variety of vegetative cover and open water and controlled levels of human disturbance. Thus, management of naturally-occurring plant communities is the best approach to meet the overall nutritional and behavioral requirements of wintering and migrating waterfowl. Cereal grains are suitable only as a partial food source for waterfowl because they lack essential proteins. Cost of managing wetlands for naturally-occurring foods are low (about one third) compared to cereal crops. Naturally-occurring plants are almost always productive whereas crop failures are common with cereal grains. Additionally, diverse populations of invertebrates, amphibians, reptiles and mammals usually are present in natural plant communities.

If a manager decides to incorporate cereal grains into management plans, then trade-offs should be understood and success evaluated. Planted crop production often requires specialized and expensive farm machinery as well as extensive ditching, drainage networks and mechanical pumps. Pesticides and herbicides are also necessary for successful crop production. Adverse weather and flooding from extreme tides or intense rainfall make row crop production more difficult. However, if cereal grains are included in the overall management plan, millet is the recommended crop. Because millet strains were developed from natural wetland plants, they often produce excellent and attractive yields. Naturally-occurring, moist-soil food plants often grow in or adjacent to areas cultivated for millet, offering nutritional supplements. Finally invertebrate populations usually thrive in flooded millet, augmenting the benefits to waterfowl and other wetland birds by providing additional protein.

FRESHWATER RESERVES

Many historic rice plantations created freshwater reserves by constructing dikes at the lower ends of swamps or at the upper reaches of tidal streams. The reserves were used during drought periods when rivers and streams normally used to flood rice fields became brackish. Most reserves had water control structures which allowed gravity flow of freshwater into lower elevational rice fields. Due to upland runoff, reserves often had tannin-strained, acidic waters leading to the term blackwater reserve.

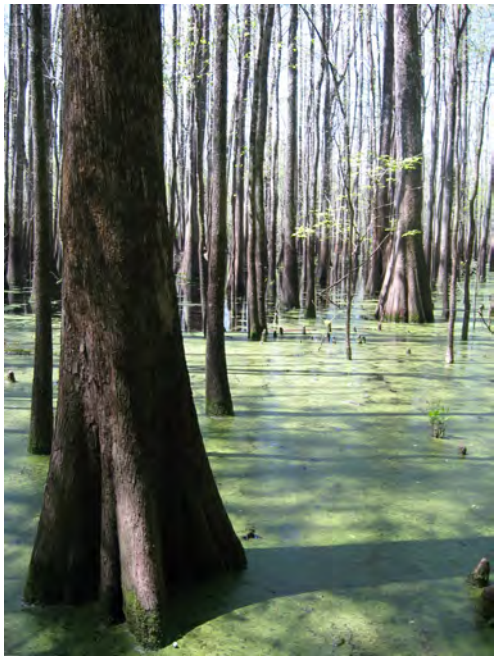
Semi-permanently flooded freshwater reserves offer an alternative to moist-soil management in freshwater wetlands. These wetlands provide year-round habitat for breeding wood ducks, wading birds and wetland songbirds. Flooded reserves also provide foraging habitat for ospreys, bald eagles, river otters and alligators. Populations of warm-water fishes and amphibians (e.g., bullfrogs) may also increase providing recreational opportunities. However, sustained flooding may cause increased growth of undesirable emergent plants and woody shrubs as well as

increased organic matter accumulations on pond bottoms. Organic accumulations can and should be reduced periodically through draining, drying and/or burning.

Typical Management Scenario for Semi-permanently Flooded Freshwater Reserves

The following treatment is recommended before managing a freshwater reserve as a semi-permanently flooded system.

1. Completely drain the reserve by late January to mid-February for drying and winter kill of emergent vegetation.
2. Conduct a hot, prescribed burn of the drained reserve when conditions are optimal (dry bed, dry vegetation, favorable winds, low humidity; and water control structures, bulkheads, blinds and bridges secured).
3. Mow woody shrubs and emergent vegetation that were not reduced to stubble during prescribed burns. Small islands and patches of woody shrubs can be left in the reserve to provide nest sites for songbirds and wading birds and cover for wood duck broods. Do not allow shrub patches to spread throughout the reserve as this would result in decreased habitat value to waterbirds.
4. After mowing, treat all woody growth with appropriate herbicides or where feasible immediately re-flood the reserve with stream runoff, tidal inflow or pumping. Flood the moved reserve as deeply as possible given the existing dikes and risers (ideally, 30" or more).
5. Monitor risers to maintain deep flooding which will retard growth of woody shrubs and perennials.



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Semi-permanently flooded reserves will provide several years of quality habitat for many wildlife species. As the wetland begins to show signs of habitat change (woody shrubs, cattails, giant southern wildrice, floating islands, fish kills, etc.), the above procedures should be repeated.

FRESHWATER TIDAL WETLANDS

Freshwater tidal wetlands occur where salinity averages less than 1 ppt (parts per thousand) throughout the year, and are found along the South Atlantic Coast from southeastern North Carolina to northern Florida. Most managed tidal wetlands are former rice fields that were diked and cleared during the late 1700s and early 1800s. Water control structures installed in embankments, locally known as "rice field trunks", were used to drain or flood rice fields with semi-diurnal tides. Rice fields are located in zones of tidal rivers and streams that were primarily freshwater during the rice culture era. Some former rice fields are brackish or transitional due to changes in river salinity caused by upstream damming, industrial and municipal water use and construction of the Atlantic Intracoastal Waterway. More recently, managed tidal wetlands have been established in brackish and saline zones more seaward of historic rice plantations.

Abandoned rice fields have left a diverse collection of coastal marshes, unique to the South Atlantic Coast, with varying salinity, tidal ranges and accompanying management potential. Also unique to the South Atlantic Coast are wooden rice field trunks with two flap gates and a flashboard riser constructed as a single structure. Trunks are used to drain, flood, mix and circulate tidewater of varying salinity to promote establishment and growth of food and cover resources for waterfowl and other wetland wildlife. The circulation of water through the flap gates also enhances ingress and egress of marine and freshwater fish and invertebrates as well as improving water quality (e.g., dissolved oxygen).

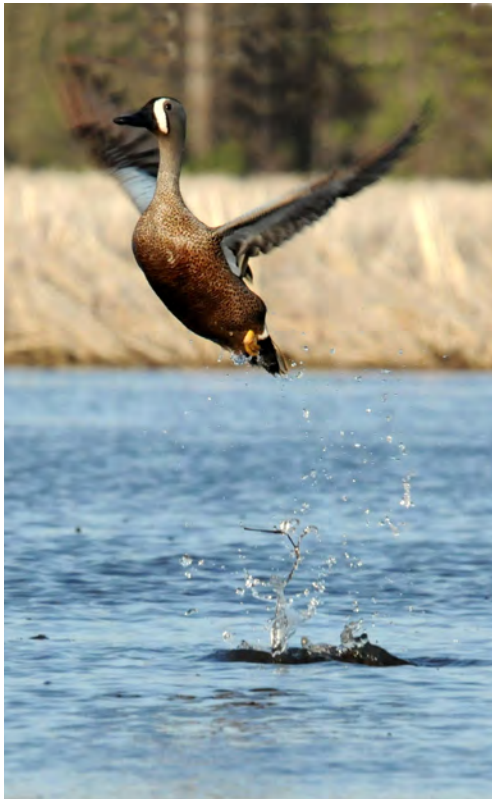
Repair of broken embankments and installation of water control structures in abandoned tidal rice fields that are not currently managed requires permits from state (South Carolina Office of Coastal Resources Management) and federal (U.S. Army Corp of Engineers) regulatory agencies. In recent years, permits to restore management capability of abandoned tidal rice fields have been difficult to obtain due to concerns on ingress and egress of marine fishes and invertebrates. Additional scientific data is needed to determine the effects of tidal wetlands management and infrastructure on populations of marine fishes and invertebrates.

Freshwater tidal wetlands are typically managed by moist-soil techniques which include a drawdown during the growing season followed by shallow flooding during fall and winter. Wetlands managed by moist-soil habitats not only offer excellent wintering waterfowl habitat, but also are attractive to marsh rabbits, shorebirds, wading birds and many other breeding bird species. Due to summer drawdown, moist-soil wetlands also provide increased storage capacity for runoff due to heavy rainfall and tropical storms protecting landowner infrastructure. Productivity of moist-soil plants is not adversely affected by runoff inundation during the growing season as long as water does not cover the marsh bed for more than one or two days.

Shaping Up Freshwater Tidal Wetlands

During the initial year, the following procedure is recommended to prepare the wetland for subsequent management activities:

1. Completely drain the managed wetland by mid-March for drying and winter kill of emergent vegetation.
2. Burn each wetland with a hot fire when conditions are optimal (dry bed, dry vegetation, favorable winds, low humidity; and trunks, bulkheads, blinds and bridges secured).



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3. Mechanically disturb (disk or rotovate) as much of the exposed bed as is accessible with tractors. Areas that did not burn to stubble should be mowed prior to disking and rotovating. Concentrate tractor work on previously unproductive areas first, then work remaining marsh as time and conditions allow. Ideally, all mowing, disking and rotovating should be completed by the end of April. Disk rough areas, then rotovate for a mulching and leveling effect.
4. Circulate tidewater into and out of managed wetlands through properly adjusted trunks from April through mid-September. Adjust trunk doors and flashboard risers (spillways) to maintain water levels at or slightly below the marsh bed through the growing season. Soil moisture is critical for growth of desirable waterfowl food plants. The marsh bed should not be saturated or covered with water.
5. After mid-October, gradually lower water levels in ditches to remove sheet water and hasten plant senescence prior to spot burning in November.
6. In late October, check conditions for spot burning. Optimum burning occurs when the weather has been dry or after a series of early frosts. Spot burns are conducted by alternately setting fire and leaving unburned strips. Ideally, a mosaic of burned and unburned emergent vegetation will result. Consider using a backfire if the fire is burning too hot with the wind.
7. Flood managed wetlands in mid-November to an average depth of 4-6 inches. Postpone flooding if there is an abundance of green, emergent vegetation. Flooding green vegetation can produce a souring effect and promote algal growth. When fall burning cannot be accomplished or does not create the desired interspersion of food plants, cover and open water; raise the water level to 18 in., then gradually lower the level to an average of 4-6 inches. Deep flooding followed by gradual lowering of water levels causes vegetation to decompose and fall, increasing food availability and open water. This technique is known as "nursing" or "weathering down" standing vegetation.
8. Monitor water levels throughout fall and winter to maintain the optimum waterfowl feeding depth of 4-6 inches until drawdown in late winter.

TYPICAL MOIST-SOIL MANAGEMENT SCENARIO FOR FRESHWATER TIDAL WETLANDS

A typical moist-soil scenario can be used for many years once competing vegetation has been eliminated through mowing, burning, mechanical disturbance, and water level manipulation, and a diverse community of natural waterfowl food plants and invertebrates has been established.

1. Slowly drawdown managed wetlands during late February to early March to expose and dry marsh soils. Drawdown should be gradual to concentrate invertebrates for waterfowl and shorebirds, and forage fish for wading birds.
2. Maintain water levels at marsh elevation through March and April for germination of target plant species. No standing water should cover the marsh bed during this period.
3. In late April to early May, circulate tidewater through perimeter and internal ditches. The marsh bed should be covered with sheet water during shorebird migration. Maintain water levels in the ditches at the marsh elevation.
4. Continue circulation of tidewater until mid-October, then gradually lower water levels in ditches to 10 inches below the marsh bed.
5. Conduct spot burn in late October-early November when conditions are optimal.
6. Flood the managed wetland during mid-November to an average depth of 4-6

inches or more, depending upon success of the partial burn or condition of standing vegetation. Delay flooding if standing vegetation is green.

7. Closely monitor water levels throughout fall and winter to maintain an average depth of 4-6 inches over the bed.

SALINE WETLANDS AND INTERMEDIATE TIDAL WETLANDS

Intermediate tidal wetlands occur where salinity averages 1-5 ppt. Management is similar to freshwater tidal wetlands. However, certain undesirable plants as well as certain target plants tend to thrive at low soil salinity.

Shaping Up Intermediate Tidal Wetlands

Managers should reduce or eliminate competing stands of giant cordgrass and saltgrass before initiating management. Procedures to reduce undesirable plants may have to be repeated for several years to achieve desired results.

1. Drain wetlands completely in late January for drying and winter kill of emergent vegetation.
2. Conduct a hot cover burn from February to March to reduce emergent vegetation to stubble.
3. Flood as deeply as possible after burning (outside trunk doors completely open, riser boards to top of riser).
4. Maintain deep flooding until mid-July or longer for best results. If giant cordgrass cover is extensive, it may be necessary to sacrifice an entire growing season by maintaining deep flooding.
5. Drain in mid-July if deep flooding has reduced giant cordgrass stands and created open water.
6. Saltmarsh bulrush should germinate first on the exposed bed followed by other target plant species as the growing season progresses.

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7. Adjust trunks to circulate tidewater through managed wetlands until mid-October. Maintain water levels at or slightly below the marsh bed during this period. Marsh soils should not be covered with water for longer than one to two days.
8. In late October, gradually lower water levels to 10 inches below the marsh bed to remove sheet water and hasten plant senescence prior to burning.
9. Conduct spot burns when conditions are favorable. Optimum burning occurs when the weather has been dry or after a series of early frosts. Spot burns are conducted by alternately setting fire and leaving unburned strips. Ideally, a mosaic of burned and unburned emergent vegetation will result. Consider using a backfire if the fire is burning too hot with the wind.
10. Flood in mid-November to an average depth of nine inches. Delay flooding if there is an abundance of green emergent vegetation. Flooding green vegetation can produce a souring effect and promote algal growth. When fall burning does not accomplish the desirable mix of plants and open water, raise water levels to 18 inches, then gradually lower to 9 inches. This procedure will cause vegetation to weaken and fall, increasing food availability and open water.
11. Maintain water levels at an average depth of nine inches throughout fall and winter.

TYPICAL MOIST-SOIL SCENARIO FOR INTERMEDIATE TIDAL WETLANDS

A typical moist-soil scenario can be used for many years once competing vegetation has been eliminated through mowing, burning, and water levels manipulation, and a diverse community of natural waterfowl food plants has been established.

1. Drawdown during late February-early March to expose marsh soils. Drawdowns should be gradual to concentrate invertebrates for waterfowl and shorebirds, and to concentrate forage fish for wading birds.
2. Maintain drawdown through April for germination of target plant species. Standing water should not cover the marsh during this period.
3. In late April to early May, flood ditches by circulating tidewaters through trunks. The marsh should not be covered with water; maintain water levels slightly below the marsh bed.
4. Continue circulating tidewaters through ditches until late September.
5. In early October, gradually lower water levels to 10 inches below the marsh bed. Conduct spot burns from October to November when conditions are optimal.
6. Flood in mid-November to nine inches or more, depending upon burn success and condition of vegetation. Delay flooding if standing vegetation is green.
7. Monitor and maintain water levels at nine inches throughout fall and winter.

BRACKISH TIDAL WETLANDS

Brackish tidal wetlands occur where salinity averages between 5-20 ppt. Water levels, salinity, and dissolved oxygen manipulations are extremely important in managing these wetlands. Most undesirable plants can be controlled by water levels and salinity manipulations.

T.H. Folk

SHAPING UP BRACKISH TIDAL WETLANDS

Reduce competing stands of giant cordgrass, smooth cordgrass, cattails, and saltgrass by the following procedures prior to intensive management.

1. Drain managed wetlands completely in late January.
2. Conduct a hot cover burn to reduce emergent vegetation to stubble (mid-February to mid-March).
3. Flood as deeply as possible with spring tides (outside trunk doors completely open, riser boards to top of riser) immediately after burning.
4. Maintain deep flooding at least through May. Deep flooding through August may be necessary to reduce dense stands of completing plants.
5. Drain in late May to early June (depending upon effects of deep flooding) to 10-18 inches below marsh elevation.
6. Allow emergent vegetation to germinate and grow to 6 inches (approximately 2 weeks). Saltmarsh bulrush will invade higher elevations during this period.
7. Begin flooding to stimulate widgeongrass growth in late June to early July. Flood marsh six to eight inches using 10-15 ppt tidewater.
8. Continue flooding by adding four to six inches of tidewater twice monthly until mid-October. Highest tides occur on new and full moons. Maintain water levels slightly above widgeongrass and salinities at 5-15 ppt during the growing season.
9. Begin drawdown in early November by removing one riser board weekly to achieve an average depth 10-15 inches by early December. This will allow waterfowl access to food plants.

TYPICAL MANAGEMENT SCENARIO FOR BRACKISH TIDAL WETLANDS

Once brackish wetlands have been managed to reduce undesirable plants for at least one year, implement the following procedure for production of desirable food plants:

1. Gradually lower water levels during late February to early March by removing one riser board each week. This allows germination of saltmarsh bulrush at higher elevations and dwarf spikerush at lower elevations and also concentrates fish and invertebrates for shorebirds and wading birds. Water levels should be below bed level by late March.
2. Circulate tidewater through the wetland while maintaining water levels at four to six inches below the marsh bed through May to allow marsh sediments to consolidate. Excessive drying during this period may cause acid soils also known as cat clays. Use caution to not excessively dry brackish soils.

Brackish/Saline and Saline Tidal Wetlands

Brackish/saline wetlands occur where salinity averages 20-30 ppt while saline wetlands occur where salinity averages 30-35 ppt. Water level and salinity manipulations of these two habitat types are similar. Higher salinities in these marshes preclude growth of competing species such as cattail and giant cordgrass as well as desirable saltmarsh bulrush. Small stands of saltmarsh bulrush that persist may increase temporarily during seasons of abundant rainfall and accompanying lower salinity. However, the primary foods encouraged are widgeongrass and dwarf spikerush.

TYPICAL MANAGEMENT SCENARIO FOR BRACKISH/SALINE AND SALINE TIDAL WETLANDS

1. Generally lower water levels during late February to early March by removing one riser board each week. Water levels should be below bed level by late March.
2. Circulate tidewater into and out of the wetland while maintaining water levels at four to six inches below the marsh bed through April to allow marsh sediments to consolidate.

3. Flood during May with six to eight inches of tidewater to promote growth of widgeongrass, dwarf spikerush, and muskgrass.
4. Continue adding four to six inches of tidewater twice monthly until mid-October.
5. In early November, drawdown by removing one riser board each week for an average depth of 10-15 inches by early December. Lowering water levels to 10-15 inches will allow waterfowl access to food plants' foliage and seeds. Various riser board widths should be available at each trunk to effectively lower water levels to the desired depth.

WILDLIFE USE OF MANAGED WETLANDS

Food resources, plant structure and water depth influence wildlife use of wetland habitats. Diversity within and among wetlands provides a variety of foods and cover utilized by dabbling and diving ducks as well as shorebirds, wading birds and songbirds. Seeds, tubers, and foliage of plants produced in managed coastal wetlands contain important nutrients. Standing emergent vegetation and woody shrubs provide nesting and cover sites for waterfowl and other wetland birds. A diverse diet of natural plant foods together with associated invertebrates provides energy, protein, and minerals required by waterfowl. Water depth, plant density, and plant height influence wildlife selection of specific habitat types. Forested wetlands attract wood ducks, mallards, and black ducks as well as breading songbirds (e.g., warblers, vireos, flycatchers) and wading birds. In South Atlantic GTRs, waterfowl primarily feed on acorns and seeds of gums and associated moist-soil plants. Freshwater reserves and semi-permanently flooded freshwater marshes with abundant pad and submergent plants attract wood ducks, ring-necked ducks, American widgeon, and gadwall as well as breeding osprey, bald eagles, bitterns, egrets and herons. Freshwater reserves also provide quality habitat for alligators, otters, amphibians, and fishes.

Ducks Unlimited

Table 1. Wetland types, salinity, dominant plants, and target plants for South Atlantic coastal wetlands

Wetland type	Salinity	Domiant plant species	Target plant species
1. Semi-permanently Flooded Freshwater Marsh (Reserves)	< 1 ppt	giant cutgrass, white waterlily, cowlily, lotus, alligatorweed, black willow	white waterlily, watershield, pond-weeds, coontail
2. Freshwater Marsh	< 1 ppt	giant cutgrass, pickerel-weed, arrow-heads, arrow arum, smartweeds, alligatorweed, gums, bald cypress	smartweeds, panic-grasses, flatsedges, Asiatic dayflower, arrow arum, redroot (organic soils); planted crops-corn, rice, Japanese millet, grain sorghum
3. Intermediate Marsh	1-5 ppt	giant cutgrass, giant cordgrass, narrowleaf cattail, bulrushes	fall panicgrass, wild millet, saltmarsh bulrush, giant foxtail, dotted smartweed, flatsedges
4. Brackish Marsh	5-20 ppt	giant cordgrass, narrow-leaf cattail, smooth cordgrass, bulrushes, saltgrass	saltmarsh bulrush, dwarf spikerush, widgeongrass, sprangletop
5. Brackish/Salt Marsh	20-30 ppt	smooth cordgrass, giant cordgrass, black needlerush, saltgrass	widgeongrass, dwarf spikerush, sea purslane
6. Salt Marsh	30-35 ppt	smooth cordgrass, black needlerush	widgeongrass, sea purslane, Gulf Coast muskgrass

Seeds of white waterlily, watershield, and banana waterlily, as well as seeds and foliage of pondweeds are preferred food of waterfowl in freshwater reserves.

Tidal freshwater wetlands with a good mix of seeds and tubers are used by a wide variety of dabbling ducks including wood ducks, green- and blue-winged teal, mallards, black ducks, northern pintails, American widgeon and northern shovelers. Seeds of smartweeds, panicgrasses, flatedges, Asiatic dayflower, planted crops, and tubers of redroot are preferred foods of waterfowl in moist-soil wetlands. Moist-soil wetlands also are used extensively by white-tailed deer and many songbird species. In intermediate and brackish wetlands, seeds of fall panicgrass, wild millet, saltmarsh bulrush, giant foxtail, dotted smartweed, and flatsedges attract mallards, northern pintail, black ducks, green- and blue-winged teal and northern shovelers. Open water ponds, supporting dwarf spikerush, and widgeongrass can attract northern pintails, American widgeon and gadwall as well as egrets and herons. Saline managed wetlands containing sea purslane and widgeongrass typically have sparse emergent cover and can attract teal and northern pintails. Late winter and spring drawdowns which concentrate invertebrates and small finfishes attract large number of wading and shorebirds.

In addition to quality of food, cover and water, other factors affect wildlife use of managed wetlands, these include:

1. Weather – inclement weather usually increases waterfowl use. Windy weather can cause bird movements to increase. Warm weather reduces energy demand and waterfowl movements and use of some habitats. Managers should limit hunting during periods of mild weather to allow resource utilization. Hunting stress without environmental stress will cause waterfowl to leave high quality habitat.
2. Hunt Management – limit the number of guns per area. Limit the number of shells to three to five per bird in the legal bag limit

so that hunters are forced to be careful and accurate. One recommended formula is two guns per every 50 acres and three shells per bird. Shooting should cease by 9:00 a.m. and all hunters should vacate hunt sites by 9:30 a.m.

3. Disturbance – excessive disturbance of migrating and wintering waterfowl limits use of managed wetlands, especially during balmy weather. Shooting is the primary disturbance, both within and around managed areas. Managers should keep disturbance to a minimum. Limit vehicle driving on dikes to inspections of water levels and trunks, scheduled observations of bird use, and trespass investigations.
4. Water Levels – water level maintenance is critical to wildlife use. Do not allow leaking of water control structures or excess rainfall to flood managed wetland systems too deeply. Waterfowl will move to other areas quickly when conditions are not favorable for feeding and/or loafing. Favorable feeding depths for dabbling ducks are equal to body length from breast to tail. More energy is required for waterfowl to dive than to dabble. During severe weather, more energy is used for heat regulation which may cause waterfowl to conserve energy by feeding on lower quality food sources at shallower depths.

To assist in restoring and protecting the nation's declining wetlands and waterfowl populations, many public and private conservation agencies have developed private lands programs. In the South Atlantic Coastal Region, Ducks Unlimited, Inc. (843-745-9110), U.S. Fish & Wildlife Services (803-727-4707) USDA Natural Resources Conservation Service (formally SCS) (803-253-3894), Cooperative Extension Services (e.g., Clemson University, 864-656-3117), South Carolina Department of Natural Resources (803-734-3888), North Carolina Wildlife Resources Commission (919-733-3391), Georgia Department of Natural Resources (404-656-3510), and Florida Game and Freshwater Fish Commission (904-488-1960) offer technical assistance for wetland and waterfowl management and conservation on private lands. Financial incentives to landowners may be available in some cases where unique wetland habitats exist and/or where wetlands are particularly valuable to waterfowl and other wildlife.

For lands considered to be agricultural, landowners may receive financial assistance through the Conservation Reserve Program (CRP) and/or the Wetland Reserve Program (WRP) administered through the USDA Natural Resources Conservation Service for restoring and/or protecting wetland habitat and managing their lands for waterfowl and other wetland birds. Funds to restore and enhance wetlands may also be available through the U.S. Fish & Wildlife Service's Partners for Wildlife program and federal grants administered through state forestry agents for forested wetland enhancement and restoration.

EQUIPMENT AND MAINTENANCE

The following items are needed for effective management of most coastal habitats:

1. Tractor – Preferably 4-wheel drive to facilitate mowing, disking and rotovating managed wetlands, particularly freshwater systems.
2. Tractor Implements – Disk harrow, rotary mower, rotovator and sprayer.
3. Drip torch – for prescribed burning.
4. Refractometer – Salinity testing device essential for use in management of brackish and saline wetlands.
5. Bottom sampler – Bottle with stopper on long pole for sampling tidewater from bottom of inlet canal at structures during high tide.
6. Rain gauge – to record rainfall.

7. Staff gauge – graduated in one in. and one ft. increments and installed at strategic locations inside managed wetlands adjacent to water control structures. Staff gauges should be installed after recording and averaging marsh elevations across a managed wetland.
8. Field Notebooks – for recording dates, salinity readings, water levels, unusual weather conditions, observations of plant growth and observation of wildlife populations to evaluate annual success of management programs and determine if goals are being reached.

Herbicide applications are normally not recommended for control of undesirable vegetation in coastal wetlands due to expense and short-term results. Successful management of coastal wetlands can usually be achieved through water level and salinity manipulations and prescribed fire or mechanical techniques. Therefore, herbicides should be applied only in dense areas of difficult to control species such as common reed (phragmites), cattails and giant southern wildrice.

Dikes and water control structures require annual maintenance. Bulkheads should be carefully inspected for erosion, washouts, and undermining. Water control structures must be in good working order prior to critical management periods and irrespective of habitat types or management objectives.

Travis Folk

Detail from Robert Mills' 1825 Georgetown District map showing prominent rice planting families.

Managing Impoundments for Multiple Species of Water Birds

Ernie P. Wiggers, Ph.D., Christine Hand, Felicia Sanders

Modern day managed impoundments are historical and cultural treasures whose value did not fade in the 1920s as commercial rice production disappeared. Instead, thanks to conservationists, these impoundments were perpetuated and have become an ecological treasure we are still learning to fully appreciate. Although the primary focus of managed impoundments has been waterfowl management, we should not forget many wildlife species depend upon these wetlands to thrive. These include resident species which spend all of their life on our wetlands, while others use these impoundments only during their migrations. What is important for landowners and managers to understand and embrace is wildlife need well managed, healthy wetlands all 12 months of the year. In return, these wetlands provide us incredible opportunities to view and enjoy nature every day of the year.

A brief look back in time demonstrates how critical managed impoundments have been to the survival and restoration of some of our most iconic wildlife. In 1977 the South Carolina Department of Natural Resources (DNR) completed their first Bald Eagle nesting survey and found 13 nests, 12 occurred in association with managed impoundments while one occurred on Lake Marion. Similar surveys

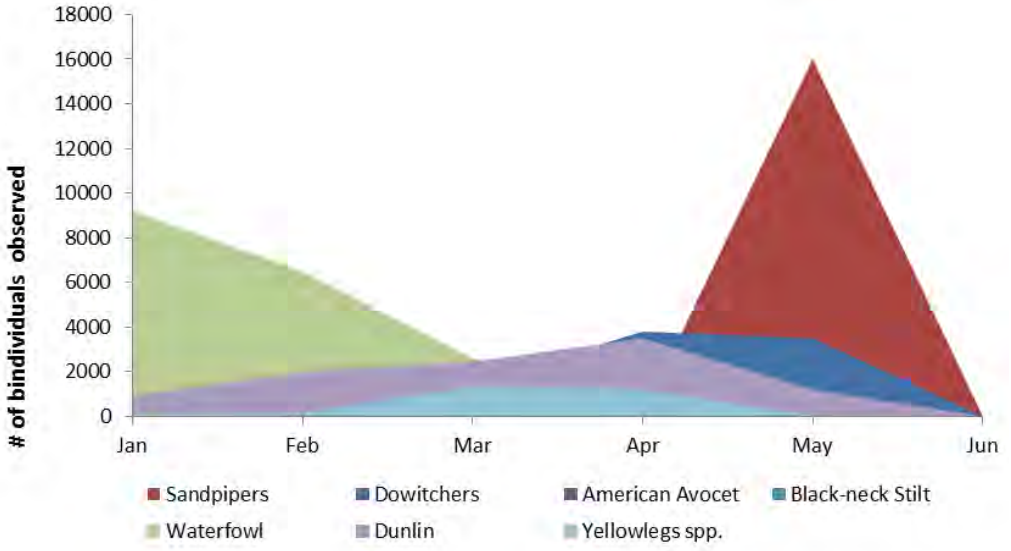
When managed with the right mix of open water and shallow water depth, tidal impoundments become critical stop-over habitat for migrating shorebirds.

in Georgia and North Carolina produced no nests. During this same timeframe, the DNR surveyed for alligator nests and found 296. Seventy-three percent occurred within managed impoundments. Today, both the Bald Eagle and American Alligator have been removed from the endangered species list, but the importance of managed impoundments to species on the endangered list remains. The Black Rail is one of the current species of concern and biologists have found some of the highest counts of these birds along the east coast in marsh habitats associated with our coastal managed impoundments.

During recent times, our managed impoundments have been discovered and colonized by several new species of waterbirds including Wood Storks, White Pelicans, Roseate Spoonbills, and Black Bellied Whistling Ducks. Whooping Cranes, one of our country's most endangered species, have over-wintered in our impoundments; therefore, SC wetlands may have a role to play in the restoration of this fabulous bird. So, no longer should we look at impoundments as just for waterfowl. These impoundments are important to and used by a rich diversity of wildlife. As good stewards we should consider the needs of these other denizens of impoundments. Fortunately, management recommendations for these others species often do not conflict with waterfowl management protocols and the incredible show of bird life throughout the year will more than justify the extra effort.

Shorebirds

Shorebirds are a diverse group of birds that includes sandpipers, plovers, dowitchers, and avocets. Some 33 species of shorebirds use our wetlands in SC and the population of most

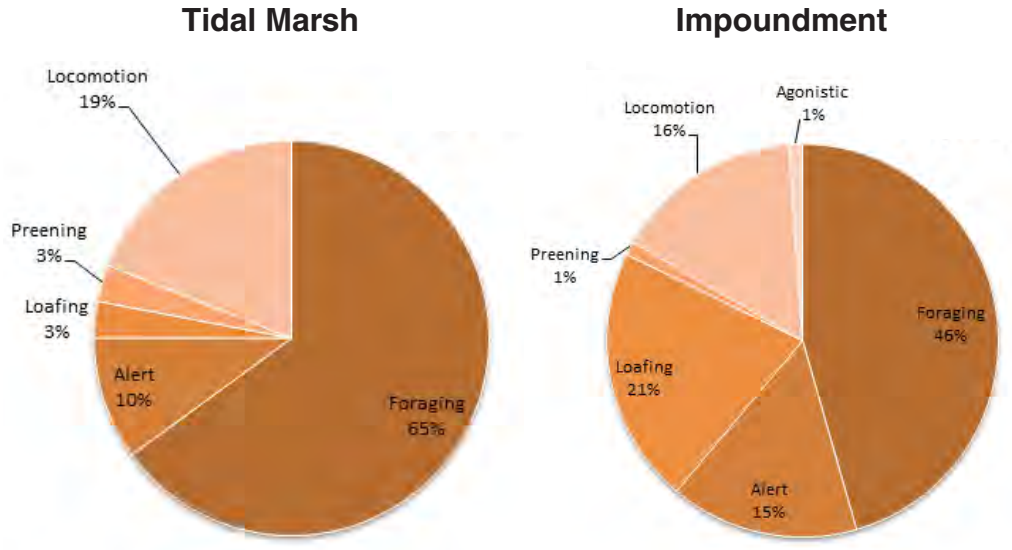


General pattern of appearance based on number of birds counted for waterfowl and shorebirds within coastal impoundments on South Island, SC. Note waterfowl abundance is declining while shorebirds numbers increase as spring progresses. By maintaining shallow water depths in impoundments from February through May, managers can provide habitat for shorebirds without impacting waterfowl. From L.M. Weber and S.M. Haig, Journal of Wildlife Management 60(1):73-82, 1996.

of these species is in decline. As their name implies these birds tend to live along coastal and wetland shorelines but some use more inland dry habitats. While we tend to think shorebirds nest in the upper prairie and tundra regions of the United States and Canada, about one third nest in more temperate regions of the U.S. For example, Black-neck Stilts nest in our coastal impoundments.

Beginning in August and continuing through fall, these birds leave their nesting grounds for their wintering grounds which can extend from our coastal wetlands to the southern tip of South America. Not all shorebirds leave our coast during the winter; some of our highest counts of shorebirds can occur in February. In March and continuing through May they make their return flights to their nesting grounds. To complete their migratory route, some birds fly 18,000 miles. During these incredible movements it is critical to

Taller shorebirds like the Black-necked Stilt can forage in water up to several inches in depth, but smaller species like the sandpipers need water less than an inch in depth with some exposed mud for foraging.



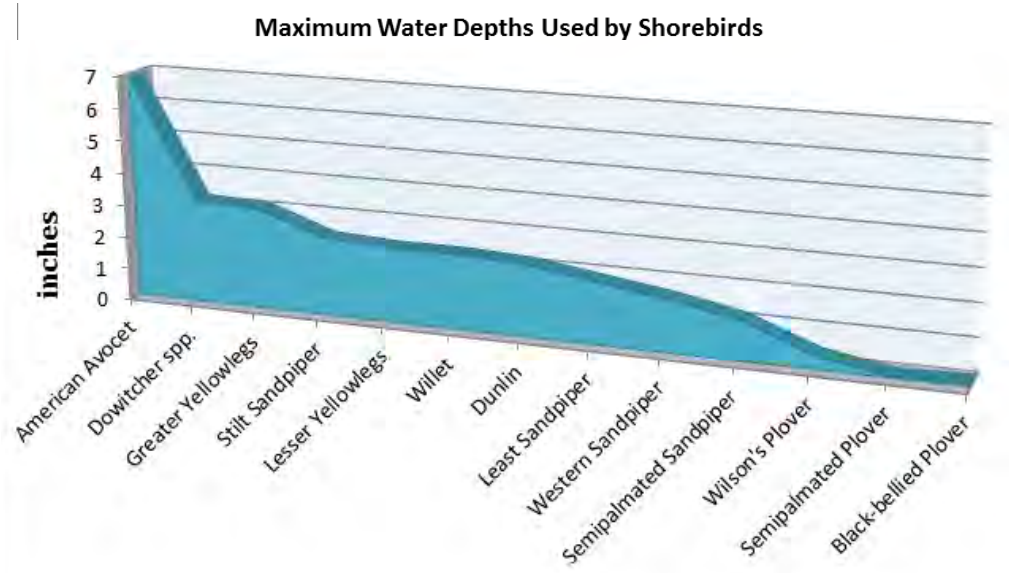
Frequency of occurance of behaviors by Lesser Yellowlegs (n=25) within natural tidal marsh versus managed impoundments at the Ernest F. Hollings ACE Basin NWR and Nemours Wildlife Foundation, Beaufort County, SC (NAREFF et al. 2015)

have stop-over points where birds can forage, rest, and rebuild energy reserves.

When these birds begin their migration, they are scattered across the vast grasslands, tundra and beaches of the U.S., Canada, and into the Arctic Circle where they nested. Over centuries of time their migration routes have taken shape. Along these routes are select points where birds stop to recharge their energy reserves. As birds funnel into these areas, they can concentrate in very large numbers on relatively small tracts of habitat. These stop-over points or staging areas play very significant roles in the life cycle of these birds. The staging areas have historically provided concentrations of habitats and especially food resources the birds need to complete their journey.

Sustaining high quality staging areas is important to the long-term conservation of shorebird populations, and coastal impoundments can play a pivotal role meeting these habitat needs. Additionally, in southern regions, such as South Carolina, managed impoundments can provide habitat all winter for large numbers of shorebirds. Several studies have shown shorebirds will select managed impoundments over natural marshes when these choices are available. This may be due to several factors including different or greater variety of prey, greater availability of prey, and more stable water levels within the impoundments as opposed to the constant change in natural marshes. Prey for these birds consist of small crustaceans, worms, and insect larvae occurring in the water column and soil substrate. The stable water conditions allow shorebirds to complete other behavioral activities such as feather preening and resting. The ability to complete these activities may be important in the social organization of the population and provides better opportunities for birds to rebuild body reserves.

Our current understanding of shorebird ecology suggests the use of a wetland is



Maximum water depth used by shorebirds in coastal impoundments on South Island, SC. From L.M. Weber and S.M. Haig, Journal of Wildlife Management 60(1):73-82, 1996.

largely dependent on water depth. Shorebird species differ in their leg length, bill size, and bill shape. They use these differences to define their niche, which allows different species to use the same wetland without direct competition. The unevenness of the bottom substrate and occurrence of a gradient from the outer edge of an impoundment to the drainage canal help to ensure a natural variation in water depth across most impoundments. Smaller shorebirds have the most constraining requirement associated with water depth. These birds need access to mudflats and extremely shallow water and are unable to forage in deeper water. The taller birds can forage in both deep and shallow water (sheet water). Therefore, the exposed mud/water-line edge should be a target during water management manipulations because this habitat might be the least abundant and most species - specific habitat at any given time during draw down.

To balance their diet, shorebirds may even use multiple wetlands within a given landscape because the variability of wetland substrates, organic matter, water chemistry, and management history among impoundments can produce different invertebrate communities. Therefore, the availability of diverse wetlands in the landscape is important.

Wading and other Birds

Wading birds come in a range of sizes, shapes and colors. Included in this category are storks, egrets, herons, ibises, rails, and spoonbills. They tend to have long legs and in many cases specialized bills, and long necks. Often these birds forage individually, but during a drawdown of an impoundment they will congregate in large numbers and a mix of species to forage on the abundant fish, crabs, and crustaceans pushed into the shallow pools.

Water depth should vary from exposed mud to water up to five to seven inches deep to meet the habitat requirements of the different species of shorebirds.

Felicia Sanders

Many species of wading birds will nest together in large rookeries. These rookeries will be used for many successive years so protecting these sites is vital. Because of the large congregation of birds and their need to feed offspring, the management of surrounding impoundments as foraging habitat becomes important. Therefore, some consideration of timing drawdowns to coincide with chick rearing (May - July) and then fledging (July-August) is very beneficial.

A variety of marsh birds such as rails, gallinules, grebes, and bitterns rely on coastal impoundments throughout the year. Statewide surveys conducted during the 1990s concluded fresh and brackish managed impoundments were by far the most productive habitat for marsh birds in South Carolina. These species tend to be secretive and are heard more often than seen.

The unevenness of an impoundment's basin can naturally create the right habitat mix beneficial to some of our more obscure wildlife species. A good example is the Black Rail, a secretive marsh bird whose population status is of concern. Higher sites within an impoundment can develop patches of saltgrass, clump cordgrass, and saltmeadow cordgrass (*Distichlis spicata, Spartina bakeri,* and *Spartina patens*) which provides suitable cover and nesting habitat for Black Rails. These types of sites in our managed impoundments have produced some of the highest counts of Black Rails along the entire Atlantic Coast. While small patches of saltmarsh bulrush, narrow-leaf cattail, giant cordgrass and black needlerush in areas dominated by meadow-like grasses are desirable, large monocultures of these species tend to indicate water levels are too deep and/or flooding is too frequent to be suitable for Black Rails.

Ernie Wiggers

General Management Considerations for Shorebirds and Wading Birds

- Shorebirds seem to select brackish wetlands over fresh-water wetlands. This may be due to differences in the abundance of prey (invertebrates), amount of vegetation, substrate, or water management. Based on available information, management success may be more evident in brackish tidal wetlands.
- Do not compromise the long-term quality of a wetland in an attempt to provide shorebird and wading bird habitat in any given year. In most wetlands, competition from spreading vegetation is an ongoing battle. Striking the right balance between the amount of a wetland covered in vegetation and amount in open water is a dynamic challenge and periodically requires flooding the wetland to hold deep water during spring to control vegetation. Therefore, holding shallow water for shorebirds may not be possible in the same wetland every year. Rotate shallow water management among wetlands, selecting those with the most open water as shorebirds tend to select this type of habitat.
- Stagger dewatering of wetlands throughout spring so new mud flats and shallow water wetlands are being provided. This staggered approach may fit well when managing competing vegetation and will benefit wading and shorebirds.
- The gradual dewatering of an impoundment is beneficial to waterfowl because it will concentrate the prey when waterfowl are switching their diets to invertebrates as a source of much needed protein.
- It is neither practical nor desirable to have all wetlands under the same water management regime as this will diminish the diversity of habitats provided.
- It may be possible to re-flood an impoundment and repeat the gradual dewatering process to prolong the availability of shorebird habitat as long as the soil is not allowed to dry completely. It could take months for the prey base to recover if the soil bed is allowed to dry.

Spring Migration (February - May)

- At the conclusion of the waterfowl hunting season, select some impoundments for gradual dewatering, while leaving others with deep water to accommodate large ducks or manage for competing vegetation. Dewatering can be accomplished by removing narrow flash boards periodically (7-10 days) or by cracking the trunk door.
- By mid-late February some impoundments being dewatered should have mud-flats (bare soil) showing.
- Continue periodically removing a flash board or widening the opening of the trunk door so that the water-line and mudflat edge migrate across the wetland.
- Allow exchange of water within these impoundments if possible.
- By April most large dabbling ducks have moved north and those impoundments that were holding deep water may be gradually dewatered. Stagger dewatering among impoundments to diversify habitats.
- By late April, most remaining ducks will be teal which do very well in very shallow water.
- Continue to dewater individual impoundments to expose new mud flats through at least mid-May.

Water Management for Wading Birds

- Wading birds generally benefit from water management for shorebirds but critical time periods for these birds are during chick rearing (May-June) and fledging (July-August).
- Drawn down impoundments near nesting rookeries during the peak of nesting

season. This drawdown can be used with widgeongrass production.

- Draw down impoundments in July-August to provide foraging for fledglings. This can also encourage dwarf spikerush production.

Fall Migration (August – October)

- Providing shallow water depths at this time may be difficult with most management regimes geared toward growing plants beneficial to waterfowl. However, it is not essential to commit all wetlands to shorebird management. Having one or two wetlands for shorebird management in the fall may be sufficient.
- Ponds that have a good standing crop of dwarf-spike rush can be dewatered in August and September to water depths just to the top of the spike rush without compromising the health of the spike rush.
- An impoundment that is not producing waterfowl foods can be dewatered to sheet level. This water management will attract shorebirds and may stimulate some late growth by dwarf-spike rush or widgeon grass for waterfowl.
- Stagger the timing of flooding impoundments as much as possible to diversify habitat resources.

G.E. Nareff, S.H. Schweitzer, E.P. Wiggers, and W.E. Mills. 2015. Time-activity budgets of yellowlegs in managed tidal impoundments and adjacent tidal marshes. Journal of Southeastern Association of Fish and Wildlife Agencies 3:220-224.

G. E. Nareff. 2009. Ecological value and bird use of managed impoundments and tidal marshes of coastal South Carolina. M.S. Thesis, University of Georgia, Athens, GA. 122 p.

Weber, L.M. 1994. Foraging ecology and conservation of shorebirds in South Carolina coastal wetlands. Ph.D. dissertation, Clemson University, Clemson, SC.

Weber, L.M. and S.M. Haig. 1996. Shorebird use of South Carolina managed and natural coastal wetlands. Journal of Wildlife Management 60:73-82.

Impoundments with a diversity of wetland herbaceous species provide valuable wildlife habitat, especially for rare species like the Black Rail.

Travis Hayes Folk, Ph.D.

A Success in Conservation and Partnership.

The Ashepoo, Combahee, and Edisto Rivers are located along the lower South Carolina coast. Collectively, the watershed they create is known as the ACE Basin and covers roughly 1.6 million acres of largely undeveloped land in Colleton, Beaufort, Charleston, Dorchester, Bamberg, Orangeburg and Hampton counties. The habitats in the ACE Basin are ecologically diverse and significant. Thirty three distinct habitats have been identified ranging from fire maintained pine savannas to historic rice fields, to barrier islands and beaches, to bottomland hardwood forests. These diverse environs have and continue to provide valuable habitat for numerous fish and wildlife species, especially threatened and endangered ones like bald eagles, wood storks, loggerhead sea turtles, and shortnose sturgeons.

The ACE Basin (green line)

The ecological value of this area has not persisted by chance. In the late 1980s when confronted with potential development, a group composed of nonprofit conservation organizations, state and federal agencies, and private landowners banded together to create the ACE Basin Task Force. The primary mission of this group was to conserve the ecological value of the upland and wetland habitats throughout the basin. Increased communication amongst stakeholders and collaborative approaches to conservation challenges have been a hallmark of the success of the ACE Basin Task Force. Today, more than 220,000 acres have been protected in the ACE Basin through conservation easements and establishment of SCDNR Wildlife Management Areas, USFWS National Wildlife Refuges, and NOAA's National Estuarine Research Reserve. Despite numerous development threats in its nearly 30-year history, the unique public-private partnership of the ACE Basin Task Force has been recognized as a model for long-term conservation.

The opportunity to create a successful conservation group in the late 20th century comes from historical patterns in ownership started in the 17th century. In the late 1600s and early 1700s much of the ACE Basin was granted to early colonists by large land grants given from the Lords Proprietors or the King of England. These large swathes of land under single ownership created the formation of a plantation society. Ultimately, these plantations found economic success

transformed the area in ways that are still appreciated today. Rice in the Lowcountry was grown with periodic inundation by fresh water. To harness this resource, planters cleared, diked, and planted areas along the rivers of the ACE Basin and the rest of the South Carolina coast. As the economic success of rice waned in the decades after the Civil War, southern owners of plantations found it increasingly difficult to retain ownership. At the same time, northern families were on the second and third generation of financial success from the Industrial Revolution. Seeking a milder winter climate and increased hunting opportunities, many of these families purchased former rice plantations in the ACE Basin and Georgetown area. The conservation ethic of many of these families allowed their plantations to remain undivided and managed for a diversity of wildlife. This conservation legacy of plantation owners persists today and has a partner in the ACE Basin Task Force. By 2017, over 250,000 acres had been conserved within the ACE Basin through easements, state, federal and NGO ownership.

Current partners in the ACE Basin Task Force include:

National Oceanic and Atmospheric Administration

U. S. Fish and Wildlife Service

South Carolina Department of Natural Resources

The Nature Conservancy

Ducks Unlimited

Nemours Wildlife Foundation

Folk Land Managment

WestRock

Private Landowners

Edisto Island Open Land Trust

Lowcountry Land Trust

Beaufort County Open Land Trust

Example of a contraction dike replacing a failed or failing perimeter dike.

Terminology used to describe rice fields is as old as the rice fields themselves. Throughout this agricultural history, many colloquial and regional words have developed to describe conditions only found within historic rice fields. This glossary is one of the only places to organize all of these terms.

Apron – a series of boards laid flat on top of mud in front of the muzzle of a rice field trunk, especially on the creek side of a dike. These boards reduce erosion associated with water draining out of a rice field. Were an apron not installed, water could erode underneath the muzzle and potentially lead to trunk movement and failure.

Bank - term synonymous with dike; see definition below.

Berm – horizontal grade between a dike and canal. Presence of this horizontal area provides increased stability for a dike. The potential for dike failure is increased when a canal is placed directly parallel to a dike.

Bulkhead – a series of horizontal boards installed on the edge of a dike for purposes of increasing dike stability. Most commonly bulkheads are installed directly above a rice field trunk or spillway to ensure a stable dike. Bulkheads are also used to stabilize a section of dike that has eroded or where the quality of fill does not permit construction of a stable dike.

Combahee Style Trunk – a rice field trunk primarily used in the rice growing region from the Ashley River south. It is typified by a door that hangs at 15^{o} and pivots on a windlass that is held by uprights. The Combahee trunk design is derived from the Georgetown design; however, several improvements were made in the modifications. This design has also been referred to as the Savannah River or McAlpin design in historical documents.

Cross Dike – a dike constructed in inland rice fields that extends across the rice field perpendicular to water flow. Its terminus is either at diversion dikes or the edge of fields or the adjacent high ground to the field.

Diamond Gate - a water control structure that was typically placed in a canal. Where a trunk controls water flow between river and field, a diamond gate prevented water flow further down a canal. It was constructed of solid walls and floor where the walls are parallel to waterflow and at the edge of a dike. Four doors pivot off of two posts. Each of these posts were installed vertically and attached to the middle of the wall. Walls were made of tabby, brick, or occasionally wood planks. Viewed from above, the four doors formed a

diamond. To allow water flow, one set of doors was opened. Water flowed through the open doors and pushed the second set of doors open. When the tide receded, water behind the closed doors would hold them closed. (from SHPO 2011)

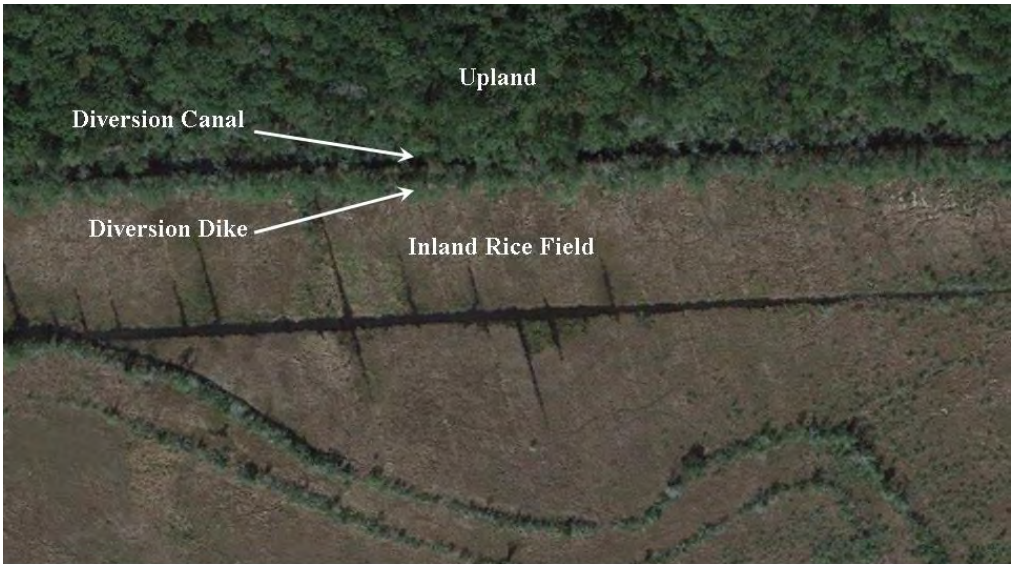
Dike – a linear pile of dirt constructed to contain or restrict water flow from one area in a rice field to another. Different types of dikes are primarily determined by their location and the form of rice culture. For inland rice fields there are diversion dikes (that run parallel to water flow) and cross dikes (that run perpendicular to water flow). In tidal fields there are river dikes (that separate the field from the tidal river), interior dikes (that separate one field from another), and line dikes (that are an interior dike that creates the property boundary from one plantation to another).

Diversion Canal and Dike – a canal and dike that run parallel to water flow in an inland field. The diversion dike is constructed from material taken to create the canal. The original purpose of the dike and canal was to prevent rainfall runoff from flooding an inland field when rice was being grown. Traveling from a higher elevation towards the rice field, runoff would first encounter the diversion canal. Immediately past the canal was the diversion dike. The dike prevented the runoff from entering the field and the canal provided quick transport of water downstream. Runoff collecting in a rice field after heavy rainfall could damage a growing or maturing rice crop. These diversion canals and dikes have commonly been used as property boundaries.

Embankment – term synonymous with dike; see definition above.

Floodgate – a water control device located at the head of a canal. Most tidal rice fields were designed such that a canal extended from the tidal river and the rice fields were located on either side. Water would be controlled at the start of the canal by floodgate, which was typically a diamond gate design. Water would pass into the canal and then be fed into the adjacent rice fields by rice field trunks.

Freshet – A hydrological event in spring time caused by excessive rains that could flood rice fields. Freshets could destroy a recently



planted crop by inundating an inland or a tidal field at an inappropriate time and eroding or breeching dikes.

Georgetown Style Trunk – a rice trunk primarily used in the rice growing region north of Charleston. It is typified by a door that is held five degrees off of vertical. Whereas a Combahee style trunk door swings from the windlass, the entire door of a Georgetown style trunk moves in or out in response to water movement through the trunk. This is considered to be the first style of tidal rice trunk and the Combahee River design is a derivative.

Half Moon Dike – a dike constructed to the interior of a river dike, if appears as a crescent from above. This type of dike is in response to a breeched interior dike. When a river dike is breeched, the rate of water flow through the break is such that a repair can not be made at that point. Instead, the half moon dike is placed farther in the field where water has not eroded the field bed significantly. This emergency repair technique has and is currently considered the best way to repair a dike.

the Hill – a colloquial term used to refer to any upland area adjacent to a ricefield.

Inland Rice Field – a rice field not subject to tidal flow and the first form of commercially successful rice cultivation in the Lowcountry. Rice crops were irrigated by water held upstream (typically in reserves) and then dewatering passed the irrigation water further downstream. This type of field was first developed in the early 1700s and was slowly replaced by tidal rice fields in the late 1700s and early 1800s. This field type was used consistently for pasturage because per acre productivity was higher than on upland soils.

Mill Race – a brick, timber, or tabby lined canal in which a water wheel would have operated. The water wheel was typically placed deep enough in the mill race to be a breast shot construction. The resulting rotating shaft powered machinery for the milling of rice seed. Jonathan Lucas constructed the first water powered mill in 1787 at Peach Tree Plantation on the South Santee River.

Moist-Soil Management – a form of impoundment management whereby water control, prescribed fire, selective herbicide application, and disking are used through the growing season to promote the growth of native grass and forb species. An area of moist-soil management is typically flooded in winter to provide habitat for wintering waterfowl and water bird species.

Muzzle – A muzzle is composed of the horizontal and vertical boards that comprise the end of the trunk body. The trunk door creates a seal on the muzzle to prevent water flow. (from SHPO 2011)

Puncheon – colloquial term used to describe a vertical post that is driven into the ground at the side of a dike in response to dike failure. Horizontal boards were then placed on the dike side of the puncheon which would allow the dike to be rebuilt and water control regained.

Quarter Drain – a small ditch that is excavated across the bed of a rice field. Multiple quarter drains were typically excavated and all parallel to each other. They were placed 50' apart (although some fields were spaced at 35' or 40') and facilitated getting water off of the rice field bed quicker. They were a part of rice field construction during commercially successful rice cultivation. Some plantations continue periodically excavating silt from these drains.

Reserve - A reserve is a natural or artificial place where water is collected and stored for irrigating land. In some cases, the upper dike in an inland rice field held back water to create a reservoir. Natural geography allowed some planters to construct an exterior reservoir out of a natural pond or small wetland lying above and adjacent to an inland rice swamp. Colonial era field designers located their reservoirs inside one of their squares or in a portion of unbanked swamp directly adjacent to their fields. Generally, reserves were used in inland fields, but there are examples of a reserve sitting behind a tidal field. Reserves typically lacked the level grade and diversion dikes that an inland rice field possessed. (from SHPO 2011)

Rice Field Bed – horizontal grade between dikes where rice would have been planted. Typically the bed of a rice field is considered to start on the inside of a perimeter canal and does not include the berm.

Riser – a vertical box placed on spillway boxes and rice field trunks. One side of the riser has boards that can be removed to set the water level in a rice field. For a trunk, water above this board falls into the trunk body and then passes into the tidal river on low tides. For a spillway, water above this board falls into the spillway body and passes into the adjacent field only if the water level there is lower than the field from which the water came.

Spillway – a general term in rice culture referring to a wooden, metal, or concrete

structure that connects two rice fields. A spillway has some form of water control (e.g., riser, flap) which distinguishes it from a culvert.

Square – A unit of area measurement within a rice field; although, the area of a square varied across rice fields and plantations. Squares were useful in assigning daily tasks to slaves. Squares were either numbered or named for reference. Examples of rice field square names include Dunbar (Combahee River), Raccoon (Savannah River), Leather Breeches (Cuckold Creek), and Peafield (South Santee).

Tidal Rice Field – rice fields where the flooding was dependent on high tides of fresh water in the adjacent tidal river or creek. Rice planters began experimenting with tidal rice culture in the mid 18th century but full scale conversion of bottomland hardwood swamp to tidal rice culture did not begin until after the American Revolution.

Upright – a vertical board placed near the ends of a rice field trunk. Uprights would be placed on either side of the trunk and between which were the windlass and two other supporting beams. The windlass suspends the door over the muzzle.

Wing Wall – a type of bulkhead constructed to the sides of a rice field trunk or spillway box. Its primary purpose is to prevent erosion of a dike where a water control structure has been placed.

Raid of Second South Carolina Volunteers (Col. Montgomery) among the rice plantations on the Combahee, S.C. From *Harper's Weekly, July 4, 1863.*

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Sources for Technical Assistance and Cost Share Opportunities

The following agencies and organizations provide technical assistance pertaining to coastal impoundments

Clemson University Cooperative Extension Service
http://www.clemson.edu/extension/

Beaufort County	(843) 255-6060
Berkeley County	(843) 719-4140
Charleston County	(843) 722-5940
Colleton County	(843) 549-2596
Dorchester County	(843) 563-0135
Georgetown County	(843) 546-4481
Horry County	(843) 365-6715
Jasper County	(843) 726-3768

Ducks Unlimited (843) 377-0667
http://www.ducks.org/south-carolina

Natural Resource Conservation Service
www.sc.nrcs.usda.gov

Beaufort County	(843) 522-8100
Berkeley County	(843) 719-4146
Charleston County	(843) 727-4160
Colleton County	(843) 549-1821
Dorchester County	(843) 563-3218
Georgetown County	(843) 546-7808
Horry County	(843) 365-8732
Jasper County	(843) 726-7611

South Carolina Department of Natural Resources
www.dnr.state.sc.us (803) 734-3886

South Carolina Waterfowl Association
www.scwa.org (803) 452-6001

U.S. Fish and Wildlife Service – SC Ecological Services Office
www.fws.gov/charleston (843) 727-4707

A list of private providers of wildlife management services can be found at:
http://www.dnr.sc.gov/wildlife/docs/wildlifetech.pdf

A list of private providers of wetland permitting services can be found at:
http://www.sac.usace.army.mil/assets/pdf/regulatory/consultants.pdf

The following programs provide financial assistance for coastal impoundment projects:

Cooperative Agreements through Coastal Program (USFWS)
http://www.fws.gov/charleston/coastal.html

Environmental Quality Incentives Program (NRCS)
http://www.sc.nrcs.usda.gov/programs/eqip/eqip2012.html

NAWCA (USFWS)
http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm

Partners for Fish and Wildlife (USFWS)
http://www.fws.gov/charleston/partners.html

Wetland Reserve Program (NRCS)
http://www.sc.nrcs.usda.gov/programs/wrp.html

Wildlife Habitat Incentive Program (NRCS)
http://www.sc.nrcs.usda.gov/programs/whip.html

NEMOURS WILDLIFE FOUNDATION

The Nature Conservancy
Protecting nature. Preserving life.

U.S. FISH & WILDLIFE SERVICE

DUCKS UNLIMITED

LOWCOUNTRY LAND TRUST

EDISTO ISLAND OPEN LAND TRUST

Coastal Program

ACE Basin
National Estuarine Research Reserve

Folk Land Management, Inc.

NOAA

Private Landowners