



PRINCIPLES OF WETLAND MANAGEMENT

By California Waterfowl Association

Wetlands evolved as dynamic ecosystems, constantly changing due to the physical and chemical processes associated with floods, drought, and fire. Today, most of California's rivers have been contained, and the majority of the state's wetlands seldom experience natural seasonal flooding. Most are now controlled by levees and flooded with water from irrigation district conveyance systems, lift pumps, and/or deep wells. Whereas natural wetland hydrology was very dynamic, flooding cycles now used for managed wetlands are most often prescribed.

It is the task of the wetland manager to emulate natural hydrology and re-create a dynamic, productive wetland ecosystem. With only 5% of the state's original wetlands remaining, it is also imperative that the remaining wetlands are managed in such a way as to realize their maximum resource potential while providing diversity for wildlife. California's wetlands support the single largest concentration of wintering waterfowl in North America; with a majority of that use taking place within the Central Valley. As a result, wetland managers throughout the state have an enormous responsibility to provide optimum habitat conditions for wintering waterfowl. State wide wetland management plays a profound role in the health and productivity of hundreds of wetland dependent species such as shorebirds, wading birds, neotropical migrants, breeding/migrating ducks, birds of prey and other wildlife.

The management of productive wetland habitats requires dynamic water management, as well as periodic soil and vegetation disturbances. An adequate water conveyance system is essential for meeting water management objectives, thus pumps, delivery ditches, water control structures, and drainage systems must be maintained in functional condition. Discing, mowing, and burning can be used to interrupt the natural succession of wetland habitat and to stabilize the marsh vegetation at a point which is the most productive of those elements required by waterfowl and other wetland-dependent species. The attached wetland habitat management guide was designed to inform managers of a variety of management practices that can be used to produce a diversity of prolific wetland habitats throughout the state.

If at any time you have questions or concerns please call one of California Waterfowl's regional biologists for assistance.

Types of Managed Wetlands (3 total)

#1 - Seasonal Wetlands: Seasonal wetlands are flooded in the fall, with standing water maintained continuously throughout the winter until drawdown in the spring. A variety of annual plants germinate on the exposed mudflats of seasonal wetlands when the water is drained from the unit in spring. These plants are collectively known as "moist-soil plants". Some of these plants produce seeds, browse, and/or tubers that are important resources for waterfowl. A combination of moist-soil plants and robust emergent vegetation (typically cattails and/or tules) usually results from management practices in seasonal wetlands. A primary goal of "moist soil management" (seasonal wetland management) is to provide an abundance and diversity of seeds and aquatic invertebrates for wintering waterfowl. Although agricultural grains (e.g., rice, corn) supplement the diets of waterfowl in winter, these foods lack many of the vitamins, minerals, and proteins essential for survival and subsequent reproductive success. The seeds of moist-soil plants provide waterfowl with the essential nutritional balance lacking in grains. Invertebrates are protein-rich by-products of moist-soil management that serve as an important food source for ducks during late winter and spring. Shorebirds are also highly dependent on seasonal wetlands and the invertebrate populations they supply, particularly during spring migration. Seasonal wetland can be considered the most valuable to migrating and wintering waterbirds due to the critical resources they provide.

#2 - Semi-permanent Wetlands: Semi-permanent wetlands, commonly referred to as "brood ponds", can be flooded in the fall or flooded during the spring, but it is recommended they too experience a 2-6 month dry period each year. Semi-permanent wetlands provide breeding ducks, ducklings, shorebirds and other wetland dependent wildlife with protection from predators and abundant invertebrate food supplies. Water depths of 6-18" are necessary to allow wildlife access to

invertebrate foods, however deeper areas (e.g. channels, potholes up to 3.5') are also important in that they provide open water. Well managed semi-permanent wetlands require annual discing to prevent the vegetation from becoming too dense. In order to maximize habitat values without incurring major discing costs, it is recommended that semi-permanent wetlands be relatively small in size (4-20 acres). Various techniques have been developed for integrating semi-permanent wetlands into a moist-soil management program. Specific management practices and strategies are described in the following management guide below.

#3 - Permanent Marshes: Permanent marshes are wetlands that remain flooded throughout the year. Due to year-round flooding, permanent marshes support a diverse, but usually not abundant, population of invertebrates. However, submerged aquatic vegetation such as sago pondweed, horned pondweed, and water hyssops may occur if adequate water clarity exists. The leaves and/or nutlets of these aquatic plants are commonly consumed by waterfowl, particularly gadwalls, ring-necks, redheads, and canvasbacks. Carp and other rough fish may reduce water clarity and prohibit the growth of these desirable plants. Further, if predatory fish populations are allowed to establish a permanent marsh is potentially a detriment to ducklings and the production of waterfowl. Permanent marshes are important to resident waterfowl in mid- to late summer when local adult waterfowl are molting their flight feathers; the deep water and dense cover provide protection from predators. Permanent marshes provide very little in the way of seed resources for migrants.

Wetland Management Basics

Wildlife Values of Various Moist-soil Plants: The value of a moist-soil plant species for waterbirds is generally based on its seed production capability, the nutritional quality of its seeds, and the invertebrate habitat the vegetative plant provides. Management practices that encourage a diversity of desired moist-soil plants are considered most effective. Watergrass, swamp timothy, and smartweed are the **most desirable moist-soil plants** due to their documented value as a significant food source for wintering waterfowl. Seeds of these three plants, in aggregate, provide waterfowl and other seed-eating wildlife with a nutritionally balanced diet. However, a variety of other wetland plants are needed to provide additional nutrition, cover, and thermal protection. Some moist-soil plants are not good seed producers or produce seeds with modest nutritional value, but have a complex leaf structure and harbor rich invertebrate communities, which make them still valuable to wildlife.

Moist-soil plants with exceptional value to wildlife include watergrass, smartweed, swamp timothy (as the main three), sprangle top, ammannia, chufa, burhead, beggarticks, annual atriplex, goosefoot, and brass buttons. Spikerush, pricklegrass, alkali heath, alkali weed, aster, and alkali bulrush are moist-soil plants that are believed to be only moderately valuable to wildlife, but may be important in localized areas. Cocklebur, sweet clover, river bulrush, tuberous bulrush, bermuda grass, baltic rush, jointgrass, dock, and salt grass are generally invasive and undesirable wetland plants.

Timing of Drawdown and Soil Disturbance: Important moist-soil seed producing plants such as swamp timothy, smartweed, and watergrass are easily propagated on most seasonal wetland sites through effective water management and soil disturbance. The seeds of each of these plant species germinate best at a **specific soil temperature under early successional conditions**. Therefore, as plants compete for dominance, wetland managers can favor specific plants (or groups of plants) by: 1) timing drawdowns to coincide with optimum germination conditions (primarily soil temperature), and 2) discing periodically to maintain the early successional stage required by the target species. Although climatic conditions vary by year and location, the drawdown dates listed in the habitat management guides will generally induce germination of the target waterfowl food plant. The management strategies described in this document have been successfully implemented by wetland managers throughout California, and are only recommendations to achieve desired habitat types. Soil type and water quality also influence plant growth, so modification of these general recommendations may be necessary based on local conditions and weather patterns for specific sites on any given year.

Rate of Drawdown: The rate of wetland drawdown affects moist-soil plant composition, seed production, soil-salt levels, and the duration of food availability for waterfowl. Slow drawdowns (2-3 weeks) cause invertebrates to become concentrated in the shallow water and allow waterbirds optimum foraging conditions for a prolonged period. Slow drawdowns also typically result in high vegetation diversity. However, this may concentrate salts near the soil surface in systems with brackish or saline water. Rapid drawdowns (3-5 days) are desirable if a soil-salt problem exists, as was quite often the case in the San Joaquin or Imperial Valley's in the past.

Rapid drawdowns will produce extensive stands of desired waterfowl food plants if timed correctly, but can limit the amount of shallow water habitat associated with slow drawdowns. Although slow drawdowns are generally better for wildlife, there is no "right" or "wrong" way to drain a seasonal wetland. The rate of drawdown should be based on site-specific knowledge and what your habitat goals and objectives are. A key caveat to this is to never let your wetland units

evaporate completely. This leads to several issues such as sediment and salt build up, and also promotes undesirable plant species.

If one is going to manage for seasonal wetland habitat and seed production is your goal, it is recommended that you undertake a rapid drawdown. If you are drawing down a semi-permanent or a permanent wetland unit, carrying out a slower drawdown may provide additional resources for feeding birds. In either case, at a given time managers should pull all water control boards and release water from the unit completely. This will ensure that water control structures and pipes will remain open and flowing in the future. Evaporation of water leads to siltation and a buildup of material in front of boards and within pipes, causing issues with water movement later on.

Irrigations: Spring or summer irrigations are very important for all three desired moist soil plant species. Most will not attain maximum seed production, without conducting at least one irrigation. If you are located in a more arid region of the state, and receive little or no late spring rains, your soils are going to dry out faster and potentially additional irrigations may be needed. Irrigation schedules for all three species vary with annual weather patterns. These plants can be observed for signs of wilting to determine proper irrigation dates. Specifics on what to look for when trying to time your irrigation will be discussed in more depth within the sections below.

Fall Flooding: The timing of fall flooding is typically based on water delivery dates. Early fall flooding (August and September) is particularly important for locally-raised mallards and early migrating pintails and is highly recommended if feasible. Generally, most wetland units should be flooded prior to October 15. Since irrigation districts typically cease water deliveries by mid-December and do not resume deliveries until April, wetland managers must devise ways to maintain water in their ponds until the spring drawdowns take place. This problem is easily solved on those properties which can simply pump groundwater from deep wells in order to overcome the effects of evapo-transpiration and seepage (percolation). Properties which do not enjoy access to wells can close all of their drainage structures and rely on rainfall to maintain pond levels. In extreme cases, it may be possible to maintain pond levels by purchasing water from nearby properties that have wells.

Water Depth: Water depth is extremely important when your objectives are to provide foraging habitat for waterfowl. Dabbling ducks (e.g. mallards, pintails, green-winged teal) cannot effectively feed on the seeds and invertebrates found on wetland-bottoms if the water is deeper than 18 inches. Water depths of 4-12" are preferred for feeding. Therefore, in order to provide feeding habitat for dabbling ducks, shallow water (18" or less) must be maintained! Shorebirds are particularly dependent on shallow water and seldom use habitats in which the water is deeper than 6 inches.

Summer Wetlands: Resident wetland dependent species are significantly benefited by semi-permanent and permanent wetlands during the late spring and summer when seasonal wetlands are dry. Basically, the two primary habitat requirements for wildlife during this time period are: 1) sufficient cover for protection from predators, and 2) an abundant food supply of aquatic invertebrates. Such invertebrates are the primary source of dietary protein for ducks and other waterbirds during the breeding season. Most wetland dependent species require invertebrates as a direct or indirect food source during the spring and summer. For example, breeding ducks and shorebirds eat invertebrates almost exclusively, but herons eat other consumers of invertebrates such as fish, reptiles, and amphibians. Both semi-permanent and permanent wetlands provide ample protection from predators; however semi-permanent wetlands usually supply a much greater abundance of invertebrates. Invertebrate populations decline with prolonged flooding, thus a dry period of at least 2 months each year is essential for maintaining abundant populations of invertebrates.

Habitat Diversity: It is unlikely that wetland managers will be able to produce a monoculture of any one plant in an established wetland, particularly if wetland bottoms are of uneven topography. Furthermore, a wetland with diverse habitats is valuable to a wider variety of waterfowl and other wildlife species. Diversified habitats also provide a variety of resources throughout the fall and winter. Even though some moist-soil plants are poor seed producers, when flooded they may support excellent assemblages for invertebrate production. Waterfowl also utilize other plants (e.g. cattails and "tules") for thermal cover. An ideal seasonal wetland is dominated by waterfowl food plants, contains other moist-soil plants, and provides waterfowl with substantial cover.

Vegetation Control: Some plants reduce the value of a wetland to waterfowl if they become overly abundant. Tules and/or cattails can eventually "fill in" a pond and eliminate open water. Dense stands of tules and cattails should not occupy more than 55-65% of a wetland's acreage. The primary tools for tule/cattail control is discing however mowing, and/or burning can be used but are less effective. Mowing is only effective when followed by discing and 1-2 months of exposure to the

sun, which is necessary in order to dry out and kill the tubers and rhizomes. This is especially critical for the control of round stem tules. Discing tules and cattails also disturbs the soil and provides favorable conditions for germination of desirable moist-soil seed bearing plants the following year. Burning may be necessary if the stand is to rank for a disc to be effective. In this case burning followed by discing can produce improved results.

Periodic soil disturbance is vital to most marsh management programs, particularly those involving feed production. It reduces potential problem plants and creates conditions suitable for desirable moist soil plant establishment. Discing should be employed when it is obvious that preferred seed producing plants are no longer dominant and are being replaced by undesirable species (bermuda grass, jointgrass or spike rush for example), this normally occurs 3-5 years after the initial discing. However, discing the entire field at one time would eliminate all food and cover from the area for one season and should be discouraged. Marsh plant diversity is desirable, and discing 25-35% of the pond bottom in a random pattern will create a "mosaic" of desirable seed producing plants and dense emergent vegetation. Following discing, desirable plants will colonize the areas previously occupied by non-target species once the water is drawn down at the right time of year.

Discing is typically accomplished with either a "stubble disc" or a "finish disc". The depth of discing varies with soil type, soil moisture, implement weight, tractor size, and tractor speed. Most stubble discs have blades that range from 26-36" in diameter; these make cuts that are 7-10" deep. Stubble discs are necessary for most types of pond-bottom discing, however, a finish disc and ring-roller can be used afterward to break up dirt clods and make walking easier under flooded conditions.

Finish discs, typically have blades that range from 18-24" in diameter, usually make cuts that are 4-6" deep. Finish discs often suffice for discing low-growing vegetation such as pricklegrass and swamp timothy, but have proven totally ineffective for controlling cattails, tules, river bulrush, baltic rush, bermuda grass, joint grass or other robust wetland plants. Summer irrigations cause watergrass, smartweed, sprangletop, and other valuable moist soil plants to occur in very dense stands. Waterfowl use of these areas may be impeded unless openings are created prior to fall flooding. With the use of a finish disc or a mower, managers can create strips, channels, and potholes in the otherwise dense vegetation. The appropriate time to create such openings is in July or August prior to the fall flood-up.

Wetland Management - An Art: Wetland management is an art in as much as it is a science. Wetland management practices are continually being improved as a result of research and experimental management. The results of these learning efforts are disseminated to interested parties by the agencies and organizations involved in habitat management. However, it is to the advantage of all wetland managers to keep accurate records of habitat manipulations (e.g. dates of flooding, irrigation, drawdown, discing). Managers should eventually be able to predict how the vegetation on their property will respond to specific management practices; this in turn will allow them to consistently provide high-quality waterfowl habitat. The following management strategies are provided as a recommendation of what has been tested and shown to have positive results for several regions in California. Temperatures, drawdown timing, and soil disturbance are the key components to producing ample food resources for waterfowl. In some cases the ability to undertake management may be challenged simply due to the fact that the required infrastructure is not present to allow for wetland management to take place. There are programs and help available to ensure that you can undertake the basics when it comes to marsh management. Contact your local California Waterfowl regional biologist and we can help get you get started and also answer any specific questions you have. See the appendix for a list of staff.

WETLAND HABITAT MANAGEMENT GUIDE #1

SEASONAL WETLAND Feed Production

Targeted Waterfowl Food Plant: Smartweed (key temperatures for germination mid 60's to low 70's)

Timing of Spring Drawdown:

February ±28 - March 10: San Joaquin Valley

March ±10 – 30: Sacramento Valley

April-May: Northeastern California

Moist-soil Plant Community: In addition to smartweed, other desirable wetland plants that may occur under the following water management and soil disturbance schedule include but are not limited to tule, cattail, spikerush, chufa, fat-hen, alkali bulrush, and watergrass.

Potential Problem Plants: Some wetland plants are undesirable if they become overly abundant or create dense stands. These include but are not limited to tule, cattail, asters, cocklebur, salt grass, bermuda grass, joint grass and baltic rush.

Value to Waterfowl: A moist-soil plant community dominated by smartweed, but including various other wetland plants, is an important component of a diversified marsh management program. Also referred to as "redweed", smartweed provides ducks with a quality food source throughout the fall and winter. Smartweed produces seeds that contain balanced proportions of essential vitamins, protein, minerals, and carbohydrates. In addition, it has a complex leaf structure, which supports excellent assemblages of aquatic invertebrates when flooded. Research in the Midwest shows high invertebrate abundance and diversity in association with smartweed.

Management Strategy: Three important factors that influence smartweed growth are: (1) The timing of spring drawdown. Smartweed requires cool soil temperatures (roughly in the low 60's) and relatively high soil moisture for germination, and therefore, is usually found in wetlands that undergo early spring drawdowns. (2) The stage of succession (number of years since the area was last disturbed through discing). Smartweed is considered a "pioneer" or "early successional" plant species because it colonizes recently disturbed wetland soils. Periodic soil disturbance every 3-5 years is essential to the maintenance of smartweed stands. Eventually, competition from other wetland plants, particularly cattails and tules, will eliminate smartweed from the community. Discing should occur when smartweed abundance decreases substantially. (3) An irrigation will be needed when smartweed plants show signs of stunting (i.e. halted growth and "yellowing" of the leaves). This usually occurs 6-8 weeks after germination when plants are generally 3-12" high. The irrigation will maximize seed production and vegetative growth.

Establishment: Smartweed seeds are present in the soils of most wetlands, rice fields, and set-aside lands, which eliminates the need for any type of planting. If undesirable vegetation is dominant, the area should be disced, preferably during summer. Discing reduces plant competition and prepares the seedbed for improved smartweed production the following spring. Discing dense stands of undesirables in early summer is the most effective way to reduce competition and create conditions suitable for smartweed colonization. This method exposes rhizomes, roots and tubers to the sun and kills them, thus preventing their re-growth during fall flooding.

WETLAND HABITAT MANAGEMENT GUIDE #2

SEASONAL WETLAND Feed Production

Target Waterfowl Food Plant: Swamp Timothy

Timing of Spring Drawdown:

February 20 – March 10: San Jacinto/Imperial Valley

March 1 – March 15: Tulare Basin

March 15 – April 1: San Joaquin Valley

April 1 – 15: Sacramento Valley

May - June: Northeastern California

Moist-soil Plant Community: In addition to swamp timothy, other desirable wetland plants that may occur under the following water management and soil disturbance schedule include but are not limited to watergrass, tules, cattails, beggarticks, fat-hen, and alkali bulrush.

Potential Problem Plants: Some wetland plants are undesirable if they become overly abundant or create dense stands. These include but are not limited to tule, cattails, cocklebur, saltgrass, bermuda grass, aster, dock, jointgrass, and Baltic rush.

Value to Waterfowl: Seasonal wetlands dominated by swamp timothy are very attractive to wintering waterfowl. Swamp timothy is a low-growing (2-10" plus), seed-producing, moist-soil plant that provides sheet-water habitats when flooded. Water should be maintained at depths of 4-12" to allow optimum foraging conditions for dabbling ducks. The plant is naturally occurring on bare, poorly drained sites, but can be grown under a variety of conditions.

Pintails and green-winged teal, in particular, prefer wetland habitats dominated by swamp timothy. The seeds are important to ducks arriving in early fall (August and September) as they facilitate the accumulation of fat reserves and the restoration of nutrients expended during the molt and migration. As wetland seed resources are depleted during winter, many invertebrate populations reach maximum densities and are readily available in the shallow water of swamp timothy stands. Studies indicate that midge larvae (the worm-like larvae of the midge fly) are heavily utilized by dabbling ducks in swamp timothy habitats during late winter. In addition, these shallow, open-water habitats provide excellent sites for loafing and courtship.

Management Strategy: Swamp timothy is a drought and salt tolerant plant that germinates within 2 weeks of drawdown. The plant will achieve seed production without irrigating but will produce substantially more seed with an irrigation or two. A shallow "flash" irrigation approximately 4-5 weeks following drawdown can be given to swamp timothy stands.

Irrigations must be administered prior to development of the flowering seed head. Maturing plants will not survive flooding which overtops them for more than 10 days. Rain fall may eliminate the need for irrigations; however many areas in the state usually require at least one irrigation for optimal swamp timothy development. An additional irrigation can be applied prior to the seed head developing if a more robust stand is desired.

The periodic discing of pond bottoms (every 3-5 years) has also resulted in increased plant vigor and seed production in many locations, although managers have maintained productive timothy stands for many years without discing. In general, if the vigor of timothy stands declines significantly over time, regardless of location, discing is strongly recommended.

Establishment: Swamp timothy seeds are present in most wetlands soils, thus planting is generally unnecessary. Discing may be required to position seeds near the surface if recent soil disturbance has not occurred. If little or no timothy exists one can mow an existing stand of timothy and bag up the clippings (lawn mower with a bag works best) and simply spread the cuttings in the wetland unit prior to the spring drawdown. One may want to water log the bag of cuttings to help them sink to the bottom of the pond. Seed could also be distributed throughout the unit if water is still being delivered to the units. Empty the cuttings in to the delivered water supply and it will carry the seeds out into the unit.

WETLAND HABITAT MANAGEMENT GUIDE #3

SEASONAL WETLAND Feed Production

Target Waterfowl Food Plant: Watergrass (key temperatures for germination low 70's and above)

Timing of Spring Drawdown:

February 20 – April: San Jacinto/Imperial Valley

March 20 – May: San Joaquin Valley

April 1 – Late May: Sacramento Valley

June-July: Northeastern California

Moist-soil Plant Community: In addition to watergrass, other desirable wetland plants that may occur under the following water management and soil disturbance schedule include, but are not limited to tules, cattails, sprangletop, ammannia, fat-hen, beggarticks, and swamp timothy.

Potential Problem Plants: Some wetland plants are undesirable if they become overly abundant or create dense stands. These include but are not limited to tule, cattail, cocklebur, salt grass, bermuda grass, dock, jointgrass, and baltic rush.

Value to Waterfowl: Watergrass, also referred to as natural millet, is an important and very abundant waterfowl food plant. It is highly attractive to pintails, mallards, and other dabbling ducks, presumably due to its combination of seed production, invertebrate habitat, and thermal cover. Watergrass grows in dense stands and may produce in excess of 2,000 lbs of

seed/acre. It has substantial stem mass, which provides ducks with thermal cover and protection from predators. Through flooding and waterfowl activity, the stems eventually become matted and serve as excellent substrate for invertebrate production. Watergrass seeds provide greater balance in nutritive quality than the high-energy, low-protein cereal grains, (e.g. corn, rice). The seed is especially high in essential minerals. Marsh units dominated by watergrass typically receive heavy duck usage throughout the season.

Management Strategy: Watergrass is an easily propagated wetland plant species. Although an initial seeding may be required, a stand can be sustained for several years with proper water management, which involves late-spring drawdowns and an irrigation. Unlike other waterfowl food plants, watergrass is commonly propagated in a monoculture. The establishment (i.e. aerial seeding) of rice can even be used as a local estimate for determining the proper drawdown date for watergrass. Watergrass seed maturation takes approximately 45-80 days, but less time may be required under ideal soil and temperature conditions. Although crops can be established as late as August, seed production is limited due to the cold nights at the end of the growing season. Watergrass grows best in heavy clay or loam soils and will tolerate mildly saline conditions and needs temperatures at least in the low 70's to germinate.

Establishment: The introduction of watergrass to a seasonal wetland through seeding usually promotes rapid establishment. Optimal establishment occurs either by: 1) discing, broadcasting the seed, treating the soil with a cultipacker (ring-roller), then flooding for 3-5 days, or 2) through aerial application on saturated soils. The subsequent drawdown should be executed within the time frame in which watergrass locally germinates best (listed under "Timing of Spring Drawdown"). Seeds should begin to germinate within 2 weeks. Discing prior to seeding reduces plant competition and need not occur if the ground is sparsely vegetated. It is important to remember that watergrass is a weed and that drilling or covering the seed is unnecessary. The seed will not germinate if it is buried too deeply in the soil. "Rice screenings" can be obtained from rice mills and should be applied at 50-100b/acre. "Pure" watergrass can be purchased from seed distributors and only requires 10-15 lb/acre.

Spring Drawdown: Managers must do everything possible to maintain water until temperatures are consistently in the 70's before conducting the drawdown. Coincidentally, the retention of pond water through March assures the availability of protein-rich invertebrates to breeding ducks. Appropriate drawdown dates are listed above. Watergrass seeds should begin to germinate within two weeks of drawdown.

Irrigation: Watergrass and other millets are water-dependent plants that require at least one irrigation for seed development to occur. Watergrass plants typically show signs of turning red or purple along the stem when soil moisture becomes limiting and the plants are "stressed". Plants will usually be 3-6" high when this condition occurs.

The irrigation should occur when the majority of the plants are turning color, which is generally 6-8 weeks after drawdown. An irrigation of 4-7 days will be necessary to produce a greater stand of seed producing heads. This procedure generally produces a robust stand of watergrass with good seed development. Although ducks may initially have problems utilizing excessively tall watergrass, weather and feeding activity eventually create openings and facilitate access. Mowing or a light discing can be used to create opening to give the birds access to water. Stems serve as an excellent substrate for invertebrates when they become "matted" in the water, therefore, tall watergrass provides good invertebrate habitat.

An early fall flood-up (late August) can serve as an additional irrigation thus producing an additional crop of seed. One thing to be aware of is that this will cause additional plant growth and may cause issues with open water. Be sure to disc which will create guaranteed open areas within the marsh.

Fall Flooding: Flooding should coincide with the arrival of migratory waterfowl. Pintails begin arriving in the Central Valley in mid-August, and peak numbers of wintering waterfowl are usually present during December and January. Watergrass units should be flooded between August and October, but the delayed flooding (late November - early December) of an individual unit can make a "new" food source available to wintering waterfowl. The timing of water delivery plays a major role in the determination of flooding schedules, however. Many marsh managers simply execute their fall flooding when irrigation districts make water available. Marsh units should be gradually flooded to allow ducks maximum accessibility to seeds and invertebrates.

WETLAND HABITAT MANAGEMENT GUIDE #4

SEMI-PERMANENT BROOD POND

Flooding Schedule

Fall Flooding: After September 1

Summer Drawdown: July 15 - August 1

A semi-permanent marsh is a wetland impoundment that incorporates a semi-permanent flooding regime with dense emergent vegetation, aquatic vegetation, moist-soil plants, open water, and possibly small islands. They are typically flooded from fall until mid-summer to meet the brood-rearing habitat requirements of local waterfowl. For this reason, semi-permanent marshes are often referred to as "brood ponds". They provide critical habitat for wetland wildlife, particularly during the summer when seasonal wetlands are dry. Hardstem bulrush (tules) and cattails are characteristic of brood ponds. Brood pond management limits the growth of "moist-soil" waterfowl food plants (e.g. smartweed, swamp timothy), but creates valuable escape cover for duck broods. Brood ponds also provide ducks with a diverse food source of invertebrates and aquatic plants.

Value to Waterfowl: Ducks utilize brood ponds throughout much of their annual cycle, but are most dependent upon them during the late spring and summer when aquatic invertebrates are their primary food source and relatively few wetland areas are flooded. Invertebrates, which are high in protein, are readily available to ducks in both seasonal and semi-permanent marshes throughout the winter and during drawdowns. Seasonal wetlands are typically dry and of little value to ducks during the summer. Although permanent marshes are flooded during the summer, invertebrates are not highly available to ducks in these deep-water marshes. Research has shown that while gadwall hens and their broods utilize permanent marshes extensively, hen mallards with broods prefer shallow seasonal or semi-permanent wetlands over permanent marshes when both habitat types are available. Thus, brood ponds (especially during drawdown) and other semi-permanent wetlands appear to be the preferred feeding habitat for mallards during the summer.

Brood ponds typically support vigorous stands of cattails and/or tules. The maintenance of a productive brood pond generally requires periodic vegetation manipulation. Studies have shown that wetlands exhibiting the "hemi-marsh" 50:50 cover to open water ratio are ideal habitats for breeding ducks. Frequent discing (fall prep) will accomplish nutrient cycling and ensure that the marsh remains in a productive state.

Management Strategy: Brood ponds should be flooded continuously from the fall until at least July 15, but preferably August 1. The presence of summer water encourages cattail and/or tulle growth in shallow areas, which provides ideal escape cover for duck broods. Discing and mowing are methods that can be used to maintain brood ponds in the 50:50 "hemi-marsh" state. Moderate production of moist-soil vegetation may occur (e.g. watergrass), although seed development is hindered by the short period between drawdown and fall flooding, as well as competition from dense emergent vegetation. The timing of fall flooding is not crucial because seasonal wetlands provide the majority of the habitat for early migrant waterfowl. Flooding of brood ponds should occur after maintenance work (i.e. discing, mowing) has been completed.

WETLAND HABITAT MANAGEMENT GUIDE #5

PERMANENT MARSH

A permanent marsh is a wetland impoundment that incorporates a permanent, year-round flooding regime with dense emergent vegetation, aquatic vegetation and open water. These marshes provide critical habitat for wetland dependent wildlife, particularly during the summer when seasonal wetlands are dry. Hardstem bulrush (tules) and cattails are characteristic of permanent marshes.

Proper management of a permanent marsh satisfies brood-rearing habitat requirements for ducks, therefore, a "brood pond" that is flooded throughout the year in most years will be considered a permanent marsh. Permanent marsh management does not allow for the production of "moist-soil" waterfowl food plants (e.g. watergrass, smartweed, swamp timothy), but does provide waterfowl with a source of invertebrates and aquatic plants. One thing to note is that if fish populations establish, large predatory fish such as bass will consume ducklings readily. Permanent wetlands containing bass should not be considered preferred brood rearing habitat for waterfowl.

Waterfowl will utilize permanent wetlands throughout their annual cycle, but are most dependent upon them during the breeding season and flightless molting period (late spring and summer months). Permanent marshes provide ducks with habitat for brood-rearing, molting (feather replacement), loafing, limited foraging, and protection from predators. Nesting sites may be available for over-water nesters, such as redheads and ibis. These habitats are crucial to breeding ducks, wading birds, pheasants, shorebirds, and certain fur-bearing mammals and songbirds due to the lack of summer wetland habitat in most of California. Winter waterfowl use is usually limited due to a lack of resources although permanent marshes are usually attractive loafing sites. Sago pondweed is a preferred food of many dabbling and diving ducks and typically exists in permanent marshes.

Management Strategy: Permanent marshes are usually maintained at constant water depths, with the circulation of water an important factor in maintaining marsh productivity. Circulation can be achieved with water controls set to provide a "slow flow-through" to offset the effect of evapo-transpiration. Complete drawdown should occur every 3-5 years to recycle nutrients and control dense emergent vegetation. Overall pond vegetation will increase annually and should be reduced by discing when coverage exceeds 75% of the pond.

Size and Location: Permanent marshes can be of any size, but should be near suitable nesting habitat for ducks to utilize it as brood-rearing habitat. The creation of ponds 5-25 acres in size, scattered throughout a block of wetland habitat generally produces optimum benefits for breeding waterfowl. Generally, such ponds should total no more than 10% of the overall marsh area. The amount and location of permanent marshes on surrounding lands should be taken into consideration when designing a wetland complex.

Desired Plants

Smartweed (*Polygonum spp.*)



Smartweed Pre-flowering



Pre-irrigation Photo of Dominating Smartweed



Flowering Smartweed Following Irrigation



Seasonal Wetland Dominated by Smartweed Following 1 Irrigation

Swamp Timothy (*Crypsis schoenoides*)



Swamp Timothy Ready for Irrigation



Swamp Timothy Following One Irrigation with Flowering Seed Heads (Do not irrigate at this point)



Seasonal Wetland Dominated by Swamp Timothy Following Two Irrigations

Watergrass (*Echinochloa crusgalli*)



Watergrass Following Germination



Watergrass Starting to Stress and Ready for Irrigating



Mature Watergrass



Mature Watergrass Seed Head



Seasonal Wetland Dominated by Watergrass Following Irrigation



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