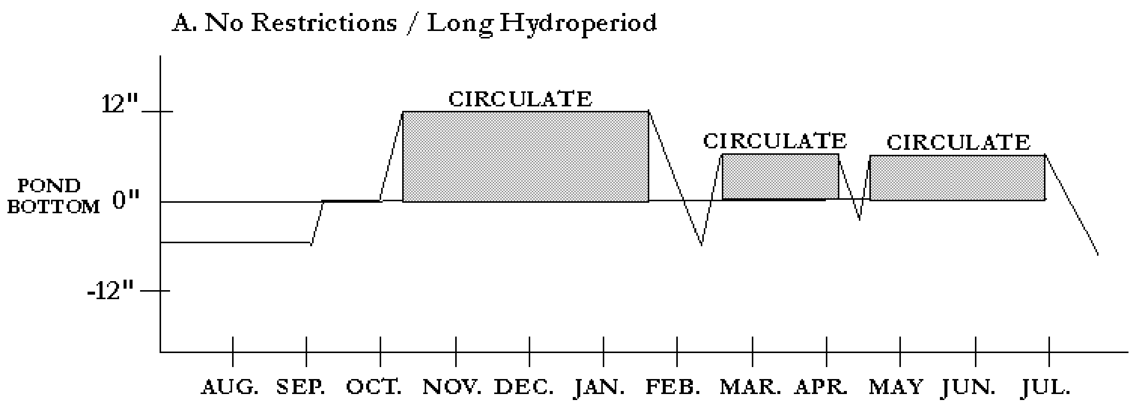
Water Management Schedules for Growth of Wildlife Food and Cover Plants

Introduction

SRCD developed 11 water management schedule guidelines to assist wetland property owners and managers. These schedules are intended as guidelines because site-specific factors will influence actual management decisions that will be made to reach the objectives for the property, and because water management schedules will change for different regions in the Marsh and for different water years.

Factors which influence the selection of the yearly water management schedule for an individual property are: 1) the wetland managers wildlife habitat management objectives, 2) physical management constraints, 3) the yearly influence of environmental constraints, and 4) regulatory restrictions on wetland maintenance and water diversion activities in the Suisun Marsh. For those properties with isolated water control systems, the selection of two or three different water management schedules for one piece of property may be possible. Location in the marsh dictates what, if any, a regulatory restriction a property is affected by. For example, the northwest portion of the Suisun Marsh, on Cordelia Slough, is unaffected by endangered species closures; Montezuma Slough is affected by all closures; the northeast corner above Nurse Slough is under chinook salmon restrictions but not under delta smelt restrictions; and the Grizzly Bay and Honker Bay properties are under delta smelt restrictions but not under chinook salmon restrictions (Fig. 2 and 3).

Factors determining what plants can grow on a property include the east-west and north-south salinity gradients; length soil is submerged; soil salinity; water depth; and salinity of applied water. For example, the southwest properties, nearest the ocean, have higher channel water salinity than properties in the southeast near Collinsville, where the water is less saline. The stream flows from Suisun Creek, Green Valley Creek, and Denverton Creek create fresher channel conditions in the northern Marsh.



A. No Restrictions / Normal Flood Date / Long Hydroperiod

The first type of water management schedule is the “No Restrictions/Normal Flood Date/Long Hydroperiod” schedule. This schedule is for properties unrestricted by chinook salmon and delta smelt water intake closures. Using this schedule requires the manager to fill the ditches without flooding the ponds on September 1 (to meet Solano County Mosquito Abatement District (SCMAD) restrictions, p. 80), and circulate out the high salinity ditch water. The property is flooded on October 1 as quickly as possible to allow water to run over the soil surface and push salts downward. The property should be drained and reflooded if time allows. This is an effective way of draining off the initial surface salts, and decreasing mosquito production (see **B, “No Restrictions/Early Flood/Long Hydroperiod”**).

Ponds are flooded to winter level, which should not be deeper than 12” over much of the ponds, and keeping as much circulation as possible while maintaining the appropriate winter level. During the season, a beneficial management scheme is to lower the winter level of the ponds to 6” to 8” deep, eventually bringing it back up to normal winter level (12”). This will serve two purposes: (1) exchanging high volumes of water will help maintain natural soil salinities, and (2) establishing new wildlife habitat. This management scheme gives wildlife more edge for feeding and loafing and allows wildlife to use areas of the pond that were previously too deep or flooded. This water fluctuation technique should be used in early winter when high volume water exchanges are productive. When this water fluctuation technique is employed in late winter, the water level should not be brought back up to normal winter level because rainfall should keep the ponds at normal winter water level and also will add fresh water to the ponds.

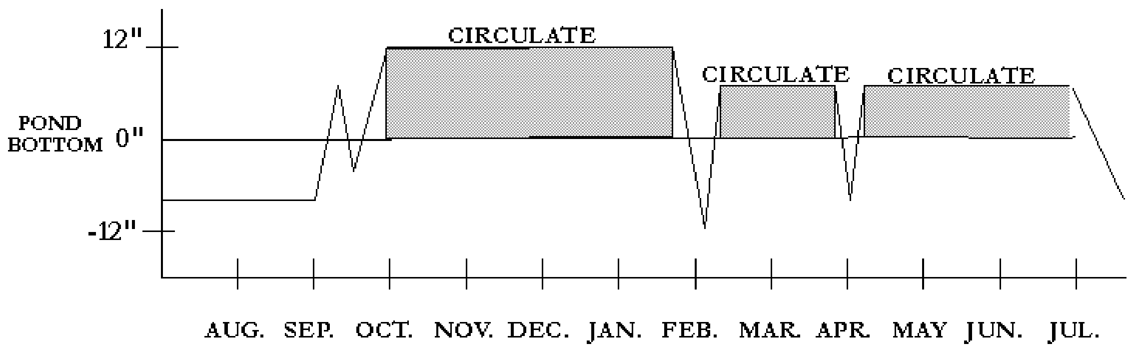
In mid-January managers should close the intake and set the property on drain. Each property has a different drain time, depending on pond bottom elevation, facilities, weather, and tides. Timing the first drain is the most critical step because seedlings are susceptible to salt toxicity. The property should be drained to pond bottom and then watched very closely; as the water drops below pond bottom, the soil is susceptible to drying, which allows salts to rise to the surface.

Many factors are involved in how long this draining process should take. Weather is the primary factor; warm or windy weather will dry the soil out faster and give the drainage process less time. Evaporation rates are 4 to 5 times lower in February, during the first leach, than they are in April during the second leach. The process can take longer if the weather is cold, calm, or rainy. The main objective is to drain 12” below pond bottom without letting the soil dry out**.**

Regardless of how far below pond bottom the water is drained, the pond must be reflooded if the soil surface starts to dry. If necessary, reflood the ponds approximately 6 inches, which should be 50% to 60% of the ponded area at winter level. This allows the greatest diversity in plant communities and allows plant germination in the shallow water (fig. 4). Germination time is highest from February to April, and a low water level during this time is essential for growth. Circulate as much water as possible while keeping the water at the 50% to 60% ponded area. Moisture just beneath the surface of the higher ground will also provide suitable growing conditions for fat hen *(Atriplex triangularis)*, purslane *(Sesuvium verrucosum)*, brass buttons (*Cotula coronopifolia*), and pickleweed *(Salicornia virginica)*. Plant community diversity is the key to providing suitable habitat for many species.

Around April 1 water can be drained using the same drainage principals as with the first leach, again making sure not to dry out the soil. Water can then be brought back up to the same low level with circulation. The final drain date for summer work should be based on slough salinity and seed development. When slough salinity reaches 12 to 15 mS/cm (Appendix D), circulation should cease and the property should be drained; in dry years this might occur in May or June. If seeds have not yet developed, keep the soil moist so plants will not be moisture stressed and cease seed production. Seeds should be the first concern, but if the seeds have already matured, then salinity becomes the critical and limiting factor in determining final drain time.

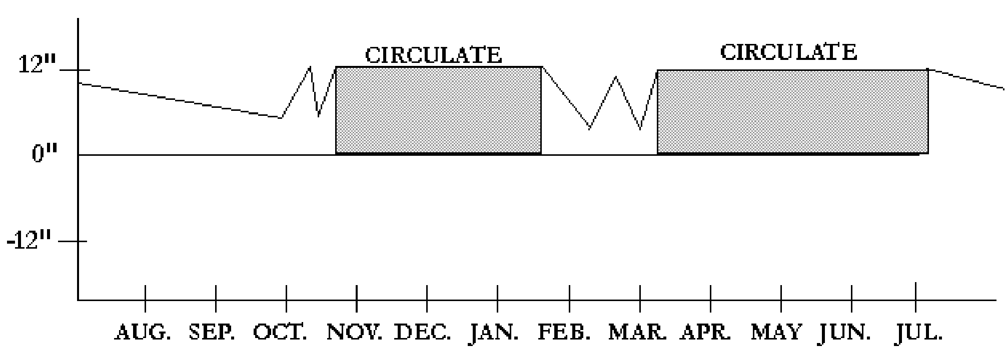
B. Early Flood / No Restrictions / Long Hydroperiod



B. No Restriction/Early Flood/Long Hydroperiod

This water management schedule is virtually the same as "**A. No Restrictions**," but early flood properties typically drain in less than seven days. This quick-drain time allows for a deeper leach without drying out the soil, and also allows time for a partial leach before winter. A leach before winter (1) allows the salt that built up over the summer to dissolve and drain out of the soil, and (2) serves as mosquito control by draining off the larvae. If the water is drained quickly, the water movement or drainage will kill the larvae and instar. If the property is reflooded before the soil dries out, the mosquitoes will not have a chance to lay more eggs and the chances of mosquitoes reproducing and the property being sprayed are reduced considerably.

C. Brood Pond / Permanent Pond

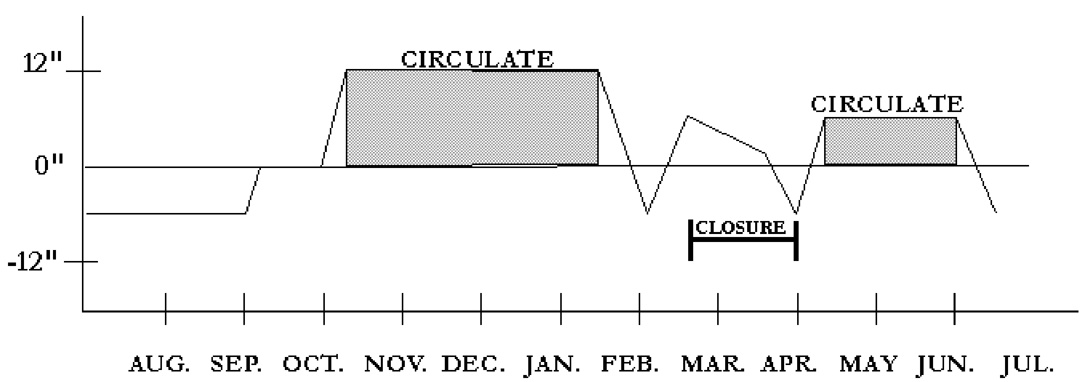


C. Permanent Pond/Brood Pond (p. 55)

This water management schedule is designed to meet the main objective of permanent ponds, which is to establish submergent vegetation such as sago pond weed *(Potamogeton pectinatus)* and wigeon grass (*Ruppia martima*)
for food and invertebrate structure, tall emergents like cattail *(Typha spp.)* and tule *(Scirpus acutus)* for cover, and to exchange high volumes of low salinity water. The goal is to exchange the high salinity pond water with the lower salinity channel water when the river runoff is high and channel water salinity drops to low levels. This slough-pond water exchange should occur as often as necessary to lower the level of pond water salinity.

March is a critical month to establish a stable water level for waterfowl choosing a nest site. Waterfowl will likely choose a nesting site that is close to stable or permanent water. Nest site selection starts in early March and continues until May. Permanent ponds should be available April through August when broods need water, cover, and food. A permanent pond is an ideal way to encourage emergent cover like cattail and tule, and a good way of lowering the soil salinity by continually flushing salts if maintenance is unnecessary on the property. If the soil does not dry out, salts will not have a chance to rise to the surface and into plant root zones. Reducing soil salinity allows soils the chance to recover and be more fertile for the following years. Emergent cover can be established by keeping ponds flooded to a shallow depth and letting tule root balls float freely in the ponds (p. 37). By keeping a low water level, growth on the shallow, upper margins of the pond can also provide food value.

D. Salmon Closure / Long Hydroperiod



D. Salmon Closure/Long Hydroperiod

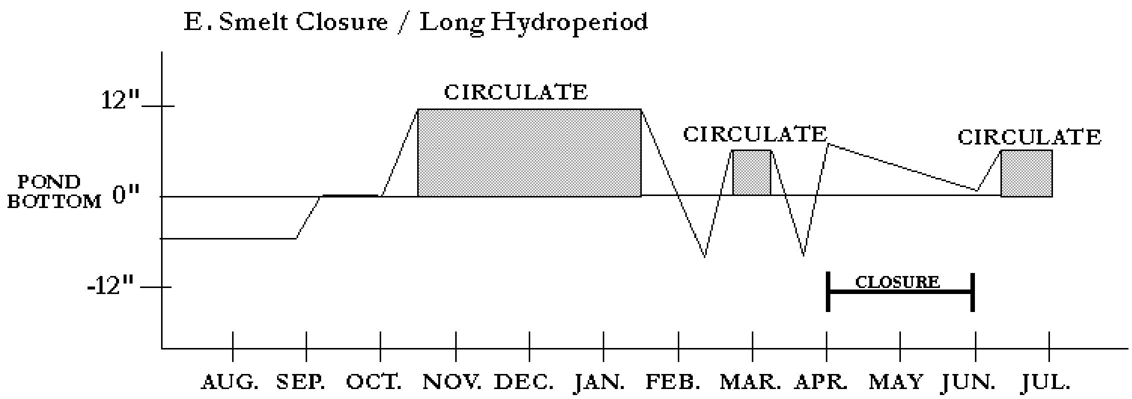
This water management schedule deals with concerns specific to maintaining chinook salmon habitat. Under SCMAD restrictions, ditches should be filled on September 1 without flooding the ponds, and water should be circulated through the ditches to flush out high salinity water. The property is then flooded on October 1 as quickly as possible to allow water to run over the surface and push salts downward. If time permits, an effective way of draining off the initial surface salts is to draw down and reflood (see “**B**. **No Restrictions/Early Flood/Long Hydroperiod**”).

The ponds are flooded to winter level, no more than 12” deep over much of the ponds, and with as much water circulation as possible to maintain an appropriate pond level. Throughout the winter, a beneficial management practice is to fluctuate the winter level by lowering the ponds to 6” to 8” deep, and then eventually bringing it back up to 12 inches. This serves two purposes: (1) exchanging high volumes of water will maintain natural soil salinities, and (2) establishing new wildlife habit, giving wildlife more edge for feeding and loafing and use of the pond areas that were previously too deep or flooded.

In mid-January, managers should close the intake and set the property on drain. Every property has a different drain time, depending on pond bottom elevation. If the property takes more than 20 days to drain, then the drainage process should begin the first week of January to allow time to exchange the maximum amount of water before reflooding in February. Timing the first drain is the most critical step because seedlings are susceptible to salt toxicity. The property should be drained to pond bottom and then watched very closely; as the water drops below pond bottom, the soil is susceptible to drying that allows salts to rise to the surface.

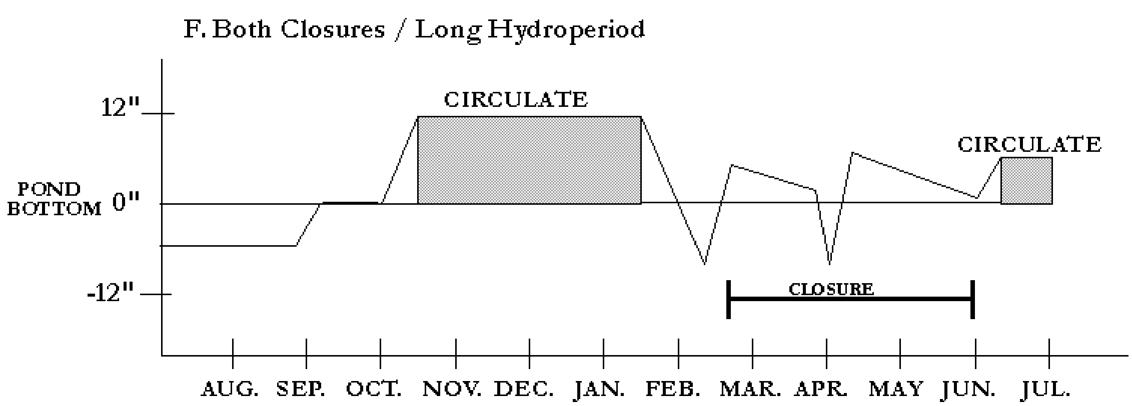
Many factors are involved in how long this draining process should take. Weather is the primary factor; warm or windy weather will dry the soil out faster and give the drainage process less time. Evaporation rates are 4 to 5 times lower in February, during the first leach, than they are in April during the second leach. The process can take longer if the weather is cold, calm, or rainy. The main objective is to drain 12” below pond bottom without letting the soil dry out**.**

Regardless of how far below pond bottom the water is drained, the pond must be reflooded if the soil surface starts to dry. If necessary, reflood the ponds approximately 6 inches, which should be 50% to 60% of the ponded area at winter level. This allows the greatest diversity in plant communities and allows plant germination in the shallow water (Fig. 4). As February 21 approaches, reflood the property regardless of where the property is in its drain cycle. On February 21 all gates must be closed for the salmon closure and the next 5 to 8 weeks is the most important growth period for food and cover plants. A slow drain should occur, but do not drain so fast that the soil dries before reflooding on April 1. The ideal situation is to be at pond bottom 3 to 10 days before April 1 and then set the whole property on drain. Drain as far below pond bottom as possible without drying the soil. If the weather is hot, wait until 3 to 5 days before March 31 to drain below pond bottom before reflooding. Reflood and circulate the water until the slough water salinity rises to 12 to 15 mS/cm. If seed heads are still immature, the water must not be drained or the seed will not develop. Once plants have germinated, they can tolerate slightly higher salinities, however they must have water to develop seed heads and complete the growing cycle. Once this has occurred, drain the property for summer work.



E. Delta Smelt Closure/Long Hydroperiod

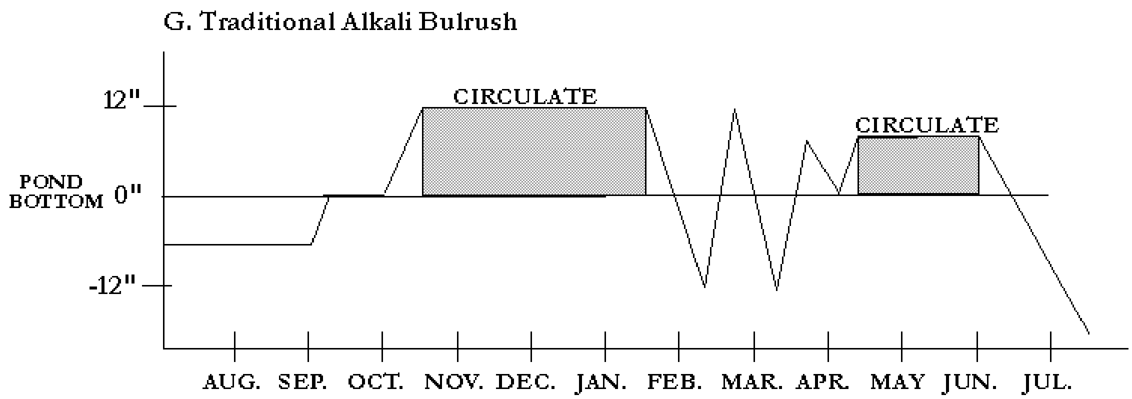
The delta smelt closure is April through May during wet and above normal water years. The difference between this schedule and "**D. Salmon Closure/Long Hydroperiod**" is that it starts at the end of the February. After the first water exchange, reflood the property to 50% to 60% of winter level and circulate. The smelt closure begins on April 1, so begin the drainage process to allow time to exchange pond water and reflood before the closure begins. During the closure, from April 1 to May 31, the property needs to maintain soil moisture to allow plant growth and germination. A slow drain is necessary to maintain soil moisture and plant growth, so the pond water elevation is at mudflat in late May, or maintaining a low water level until a full drain in late May. Water quality for reflooding on June 1 should be acceptable. Reflood the property to 50% to 60% of winter level and circulate until water salinity rises to unacceptable levels (12 to 15 mS/cm) or seed heads have matured and then drain the ponds for summer maintenance work.



F. Both Closures/Long Hydroperiod

Although similar to "**D. Salmon Closure/Long Hydroperiod**," this water management schedule is different because of its mandatory closure from April 1 to May

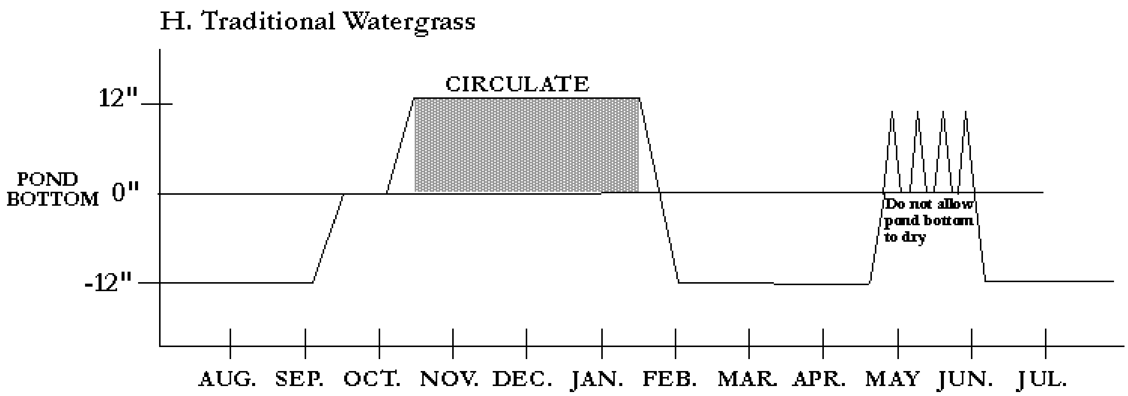
31, which prevents water circulation during that time. There is a two-week window that allows property owners the opportunity to intake water and to reestablish a relevant level, except in the first wet year. In subsequent wet years, water circulation is allowed with a 1- to 2-inch gate opening. This circulation rate is not enough water for most duck clubs to sustain a constant water level. Therefore a slow drain should occur without dropping the water level to pond bottom too long before the June 1 reflood date. Water quality for reflooding on June 1 should be acceptable because the delta smelt closure from April through May occurs only in wet and above normal years. Reflood the property to 50% to 60% of winter level and circulate until water salinity rises to unacceptable levels, or the seed heads have matured, and then drain the ponds for summer maintenance.



G. Traditional Alkali Bulrush *(Scirpus maritimus)* / **Intermediate Hydroperiod**

The traditional alkali bulrush schedule follows the same principles as "**A. No Restrictions/Normal Flood/Long Hydroperiod**", with some specific differences. The second leach cycle (outlined under **A**, between mid-February and mid-March) is unrealistic if the property is within the salmon closure, which takes place from February 21 to March 31. Another important difference is that the leach cycles in this water management schedule are to 12 inches below pond bottom, which is good if the drainage facilities are adequate to drain within a few days. This schedule shows a two-week period where water will be below pond bottom. This might be realistic if the weather cooperates; if the weather is warm and windy, then the soil will dry out and salts will rise to the surface of the soil and root zones of young plants. If water is not put back on the soil before this happens, then the plants can be stunted or killed.

Soil moisture for plant germination is critical to getting lush stands of all vegetation, not just bulrush. The moisture that is kept just beneath the surface of the higher ground will also provide suitable growing conditions for fat hen, watergrass, purslane, brass buttons, and pickleweed. Diversity in plant communities is the key to providing suitable habitat for many wildlife species.



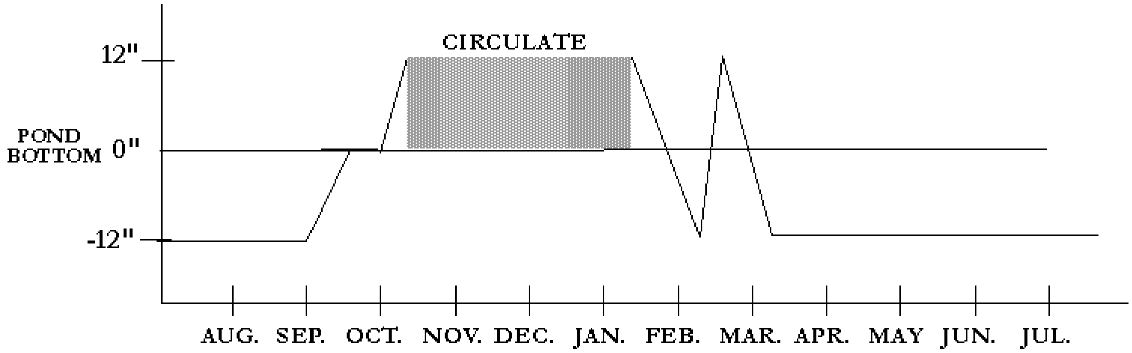
H. Traditional Watergrass

Traditional watergrass management does not undergo a leach cycle, therefore this type of water management schedule is not recommended unless the water quality is excellent (under 7 mS/cm) and pond soil salinity is extremely low (under 7 mS/cm). Under this schedule, water is drained in mid-January and the soil is allowed to dry and crack. This serves two purposes: (1) to discourage competitive plants from growing by drying the soil, and (2) to allow equipment to lightly disturb the soil to prepare the seedbed. The less competition watergrass has from competitor plants, the higher its germination rate. Watergrass germinates late in the year in areas with low salinity, and unless drainage takes place at the designated time, other early germinating plants will take over potential watergrass areas.

The ponds are reflooded in April and receive a series of quick irrigations between April and June. Traditionally four irrigations are used, which can cause a tall dense stand of watergrass to grow. The more irrigations that are applied, the more new shoots will sprout, creating a denser stand of vegetation. If only two irrigations are applied, it is likely the plants will be 2 to 4 feet high instead of 6 to 8 feet high. A two-irrigation cycle is a more realistic management technique because the seed heads are more accessible to waterfowl.

This water management schedule is not recommended for several reasons. For example, soil salinities will rise above natural levels and a dry pond will not grow any moist soil plants resulting in bare ground without a leach cycle. If the channel water salinity rises and ponds dry, there is a chance of not being able to grow any important plants. Furthermore, the watergrass schedule encourages mosquito production because after ponds dry, mosquito eggs laid on the soil surface will hatch upon getting wet. If the property cannot be drained in less than 7 days, the property may be aerial sprayed by SCMAD. All property managers following this schedule must be able to flood and drain the property in less than 10 days to complete the cycle. If this is not possible, than another water schedule is recommended.(See “**K. Modified Watergrass**.”)

I. Traditional Fat hen



I. Traditional Fat hen/Short Hydroperiod

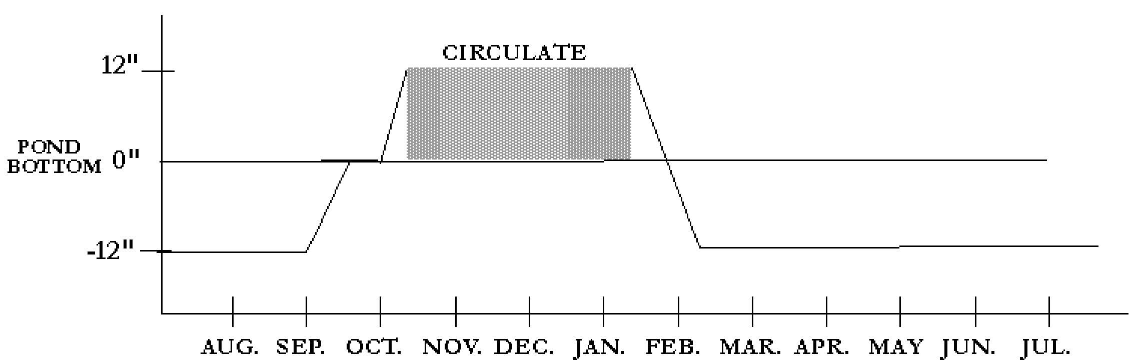
The fat hen schedule is based on a short hydroperiod that inundates the property for less than 6 months. Elevation and salinity give fat hen a competitive edge over less salinity tolerant pond bottom plants.

The single leach in late February and early March will drain the high saline pond water and replace it with lower salinity channel water. The short hydroperiod allows salts to rise to the surface, which prevents less tolerant plants from germinating and creating an advantage for fat hen.

Fat hen areas should be disced or mowed every 4 to 5 years to remove decaying vegetation and control undesirable plants such as saltgrass. Disturbing the soil will create a competitive advantage for fat hen and also create favorable conditions for brass buttons. The problem with using this water management schedule is it limits plant community diversity.

If another water management schedule is followed, and the water is kept at half winter level, then the upper margins of the pond will grow fat hen and pickleweed because of the short hydroperiod (5 to 6 months). Fat hen and pickleweed typically grow on the upper margins of the pond when water is drained. Traditional fat hen management limits plant diversity to a couple of salt tolerant species, whereas similar fat hen plant densities can be achieved with more diverse plant communities by using a longer hydroperiod. If the wetlands are managed properly, diversity through hydroperiod and topography can be achieved throughout the Marsh.

J. Pickleweed Schedule



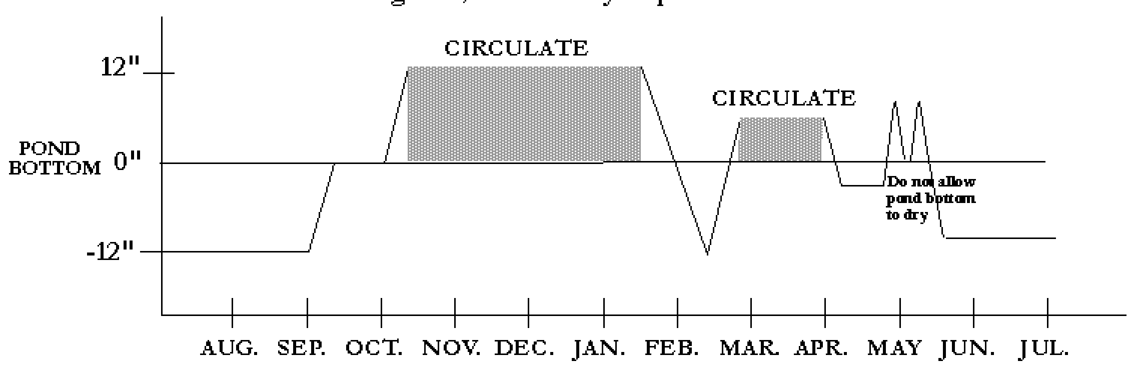
J. Pickleweed Schedule

Areas of pickleweed habitat within the managed wetlands provide numerous waterfowl and wildlife values. Omnivorous waterfowl species such as wigeon, gadwall, green-winged teal, and northern shoveler utilize pickleweed for the seed it produces, its ability to support populations of invertebrates, and cover value provided in open ponded areas. Additionally, pickleweed and associated salt-tolerant plants provide important habitat for the endangered salt marsh harvest mouse. Maintaining and supporting areas of pickleweed with the managed wetlands will ensure the protection of existing populations of this endangered species, and may even aid in the recovery of this species, while also providing a diversity in habitats within the managed wetlands which is attractive to waterfowl.

The pickleweed schedule is based on a very short hydroperiod and minimal or no leach cycles. In January begin draining the property and allow the water to drain below pond bottom. This water management technique will encourage salts to rise to the soil surface to discourage other fresher-water pond bottom plants from out-competing pickleweed. Another water management strategy, which may encourage pickleweed success, is the application of water in late summer when the channel water salinities are the highest. These summer irrigations should apply water shallowly and only occur in those ponds that have good drainage capabilities to avoid mosquito production and the need for abatement spraying. Pickleweed will grow in high saline pond bottoms where other plants cannot tolerate the high salinity levels. Proper wetlands management can also establish pickleweed and fat hen on pond peripheries where the pond bottom is flooded in winter but dry in spring (Fig. 4 and 5).

When following this water management schedule the potential exists to increase soil salinities to levels which cause increases in bare ground or which negatively impact pickleweed success. The increase in bare ground is not desirable and should be monitored to prevent it from occurring. Depending on the salinity of the water applied to the managed wetland, soil salinities can increase gradually over time or may increase quickly in times of drought. Excessive salt accumulation can be minimized through water management activities such as high circulation rates in the fall or by completing a partial leach cycle in the spring. Modifications of water management activities will need to be considered yearly based upon the vegetative response and habitat quality.

K. Modified Watergrass / Erratic Hydroperiod



K. Modified Watergrass/Erratic Hydroperiod

This is the same schedule as "**H. Traditional Watergrass**," but options are not limited if the channel water salinity rises. The leach and circulation after the season will flush salts that have deposited during fall flooding. Typically the water in late winter is fresher and will have a higher salt dilution potential when flooding the wetlands. This schedule will also encourage alkali bulrush growth if channel water salinities remain too high for watergrass irrigation. The channel water salinity should be less than 7 mS/cm for successful watergrass management. Water can be drained as soon as late March, so watergrass irrigation can occur earlier in the year when channel water salinities are lower. This schedule is unlikely to result in a monotypical stand of watergrass, but will promote plant species diversity. The two watergrass irrigations in May will encourage a short erratic stand of watergrass in areas with low enough salinities to promote growth.

The biggest problem with this schedule is the potential for mosquito production. The fluctuations in water levels will create mosquito-breeding areas. When the water level is brought up, eggs laid on the mud could hatch. Unless the area is drained quickly, there is a chance of control by SCMAD, which could include aerial spraying.

Conclusion

Whatever water management schedule a property manager chooses has many variables, and managers must be flexible in carrying out their schedules. Weather, tides, water year type, and location in the Marsh dictate which water management schedule to use. In dry years, ponds may need to be dried up earlier so slough salts are not deposited on the pond bottom. During wet years, water can be kept on the property later into the summer, and late germinating plants such as watergrass can be established. With higher runoff, the water quality will be better as fresh water from the Sacramento and San Joaquin rivers flows through the Marsh; tides will also be higher making the drainage process slower. Each landowner has to apply an adaptive management strategy that may change monthly or yearly. Diversity in water schedule will also create species diversity and a more prolific environment.

Natural topography is another key factor in water management schedules used to promote diversity. The undulations in the land create different hydroperiods, depths, and salinities, which result in a variety of plant communities. The level at which spring water is held will directly affect these plant communities. Many factors are involved in brackish marsh management, but dedication and knowledge will lead to successful results.

Water depth

Water depth is one of the most important aspects of wetland management. During the winter, water level should be at 10 - 12 inches above mean pond bottom for optimum use by waterfowl. Less than 10% of wetland birds can forage efficiently in water over 10 inches deep. Therefore if ponds are kept 3 - 10 inches deep wetland birds will have access to food and increase foraging efficiency (Fig. 6). Therefore, if the water is too deep, no matter how much wildlife food is grown, it will not be accessible.

Water depth manipulation is one of the most important items for wetland habitat management. Water depth during the growing season (February - June) is just as, if not more, critical as salinity for its effect on wetland plants growth. For example, if the salinity is low and the water depth is high, there may be no plant growth. A very shallow depth (< 6 inches) is critical to allow plants to break through the water surface and utilize oxygen, which is required for plant growth. If germination occurs and the plant cannot consume oxygen, then the stored energy from the seed is depleted and the plants will die. The topography of the land inhibits uniform water depth throughout the whole pond, and this uneven topography will create a wider diversity of plant species. The rule of thumb for effective wetland management is to ensure that the majority (50% - 60%) of the wetland is flooded or saturated to a shallow depth. The upper margins that dry out will produce brass buttons, fat hen, and pickleweed, the intermediate areas will grow bulrush, water grass, tule, and cattails, and the areas that are too deep will be open areas that will not need to be mowed. These open areas will serve as landing areas for the waterfowl.

Hydroperiod

Length of hydroperiod directly affects what plants will have the competitive advantage. Pickleweed and fat hen require a hydroperiod of less than 6 months, bulrush has an optimum hydroperiod of 7 to 8 months, and both cattail and tule require 9 months or more to germinate and grow. Pond topography usually allows all three hydroperiods and plant communities to be established on one property. Winter water level is approximately 12 inches, so drawing the water down in February and keeping the spring water level to approximately 6 inches will allow the upper edges of the pond to grow fat hen and pickleweed. The hydroperiod for these plants would be October to February. This water level also will allow alkali bulrush and possibly water grass to germinate in areas less than 6 inches deep. A late May or early June drawdown will create an optimal hydroperiod of 7 - 8 months for these plants.

By keeping the water relatively fresh and circulating at only a 2 - 3 inch level, cattails and tules can be established in the low areas of the pond. Salinity is a major concern with cattail and tule because of late summer increases in salinity can be detrimental to these species. Salinities of 15-17 mS/cm can inhibit or stunt the grow of cattails and tules and possibly even kill them.

Circulation

Circulation of pond water is an important factor in keeping a healthy marsh environment for the reasons outlined below.

- Circulation freshens pond water as channel water salinity typically improves during the winter months.
- Circulation provides good conditions for aquatic invertebrate habitat which will increase waterfowl food and decrease the chances of a botulism outbreak.

- Circulation decreases mosquito populations by creating good habitat for mosquito larvae predators such as mosquito fish and insect predators.
- Circulation removes discolored water due to rotting vegetation and iron floc from the wetlands.

Soil Salinity Control

Although the leaching process is complicated, new information explaining the relationship between flooding and draining and soil water salinity is making the process more understandable. Leaching is the process of applying water to the soil and then letting the water drain through the soil profile. The applied water dilutes the salts, which are then drained out of the soil. Leaching mostly affects the top 12 inches of the soil, and it is less effective the deeper it is used in the soil profile. This process is vitally important in maintaining natural soil salinities and creating a better soil for wildlife food plants. Successful seed germination requires managers to control soil salinity to natural levels.

The depth of primary and secondary ditches is a major factor in reducing soil salinity in the root zone. Your primary ditches should be between 12 - 20 feet wide and 4 to 4.5 feet below winter water level (Fig. 8). With winter water level at 12 inches, ditches should be 3 - 3.5 feet deep from pond bottom elevation. The secondary ditches should be 3 - 3.5 feet below winter water level to receive a proper leach and to create proper land drainage (Fig. 9). Water naturally seeks its own level, so if the ditches are deep, the water will travel horizontally through the soil profile and carry salts out of the soil and into the ditch. If facilities on the property are good and drain time is quick, this can be accomplished effectively by draining deeper into the soil profile and still maintaining soil moisture at the surface. If this cannot be established quickly, then the surface soil moisture should be carefully monitored.

A leach cycle is very important, but keeping the soil moisture high is probably a greater factor in getting good plant growth. This requires the pond water to be drained to pond bottom and then watched closely as the pond drains. Regardless of how far below pond bottom the water is drained, the pond must be reflooded if the soil surface starts to dry. This prevents surface salt from rising, and allows seeds to germinate. A salt bank 18 - 36 inches below the surface has a continuous supply of salt, and once the soils dry, soil salts rise to the surface and into the root zone due to evapotranspiration. Rising salts creates an environment that is too saline and sometimes toxic to most young plants.

Several factors play a role in the number of days that the water level can be below pond bottom. These factors include wind, sun, rain, and tides (Appendix C), all of which contribute to evaporation rates. The evaporation rates are 4 - 5 times lower in February, during the first leach, than they are in April during the second leach. During the first leach, the weather will likely be cooler, which will allow more time to drain the property without the possibility of drying the soils.

The effectiveness of the leaching process depends on the water applied to the soil. Applying water with 1 mS/cm onto ponds with a soil salinity of 20 mS/cm can result in an effective leach. In a drought year, if the applied water is 20 mS/cm and soil salinity is 20 mS/cm, then the leach will not be effective. If soil salinity and applied water salinity are similar, then it might be beneficial to add water to the ponds, not to leach the pond but to keep soil saturation high enough to encourage seed formation. When applied water levels surpass the soil salinity, then it is probably not beneficial to flood the soil. These variables make it important for the property manager to carefully observe and time the draining and flooding of the property.

Another important element of the leaching process are V ditches. V ditches are 18-inches wide by 18-inches deep, and provide drainage in low spots that pool water (Fig. 9). These “hot spots” are never drained properly and the water that pools there eventually evaporates and leaves salts behind. These salts accumulate on the soil surface and soil salinity may rise to levels that prevent any plants from growing. Correct drainage of these areas will control soil salinity and encourage plant growth and diversity. Typically the first plant to occupy the pond bottom is purslane or pickleweed, followed by alkali bulrush; if low enough soil salinities are achieved, a variety of brackish water plant species can be grown.

Suisun Marsh soils are naturally saline and no matter how many leaches are performed, all salts will never be completely removed from the soil. The objective is to allow food, cover, and nesting plants to flourish in Suisun Marsh wetlands; therefore adding low saline water to dilute the existing water is the best way to keep the upper root zone low in salinity and high in moisture.