Environmental Assessment for Control of Giant Salvinia, Salvinia molesta On Lower Colorado River Basin National Wildlife Refuges

I. Purpose

The purpose of this Action is to provide for control of an invasive aquatic weed, *Salvinia molesta*, which appeared on the Imperial and Cibola National Wildlife Refuges in August of 1999, and could spread to Havasu and Bill Williams River National Wildlife Refuges in the foreseeable future. Giant salvinia has been described as "The World's Worst Weed". It has a potentially explosive growth rate and has been known to double as quickly as every 2 ½ to 10 days, depending on fertility and salinity levels. It threatens the Colorado River, its backwaters, and fish and wildlife habitat necessary for healthy species.

II. Needs

The Service has a need to fulfill its responsibilities to protect refuge resources, endangered species, and fish and wildlife habitat. Giant salvinia threatens the health of aquatic resources and related species on the Lower Colorado River, Service refuges, river backwaters and fish and wildlife habitat necessary for healthy species. The presence of this invasive species in the Lower Colorado River increases the risk that this plant could be spread to other waters in California and Arizona.

The Service has responsibility for management of national wildlife refuges for the benefit of migratory birds and endangered species. In quiet, fertile, waters *Salvinia molesta* has been known to form mats up to 2 feet thick, dense enough to support a cement block for 30 seconds. Immature plants can remain hidden and unnoticed until they mature and multiply to form sizeable mats. If permitted to grow and expand in the Colorado River, refuge resources, endangered species and fish and wildlife and their habitats may be seriously impacted.

Communities within the Lower Colorado River system, irrigation districts, and the general public have a need for water-oriented recreational opportunities and related wildlife and wildlands-oriented recreational opportunities, for water from the Colorado River for agricultural and municipal uses, and for protection of river-side property environmental and economic values. The Colorado River provides numerous recreational opportunities, and is a popular winter and weekend vacation site for thousands of people. State wildlife agencies (California and Arizona) have a need to provide for the management of healthy populations of fish and wildlife in and along the Colorado River, and to provide for fish and wildlife-oriented recreation. The presence of giant salvinia on Federal wildlife refuges on the Colorado River could serve as a reservoir of that species for ongoing spread to the remainder of the river, and to other waters within the State.

The Bureau of Land Management and the Bureau of Reclamation, as well as Native American tribes located in the Lower Colorado River area have responsibilities for management of water and natural resources related to the Colorado River or adjacent lands. Those agencies have a need for giant salvinia to be controlled. Failure to control giant salvinia in Refuge waters could affect the ability of those agencies and tribes to accomplish their missions and fulfill their land and water management responsibilities.

III. Alternatives, Including Proposed Action

Alternative 1. No Action

This alternative would continue current efforts to survey giant salvinia, but take no direct action to control or eradicate the species from refuge waters. This alternative would continue the moderate level of outreach and education to inform the public of the seriousness of the problem, and what they can do to prevent its spread. That outreach would include periodic meetings, articles in newspapers, and signs at boat ramps encouraging people to be careful not to transport giant salvinia from the already affected area.

Alternative 2: Physical Control and Removal.

This alternative would implement physical control of giant salvinia by several methods. Those methods would include hand-removal of plants, machine removal, and blocking the movement of plants in or out of specific areas with the use of floating booms. It would also involve implementation of an extensive media and informational program to inform citizens how they can help prevent the spread of giant salvinia.

Hand removal would be used in limited areas as a means of controlling the size of some shoreline infestations, and would be applied while those infestations are relatively small. This method may also be used to hand remove floating salvinia that collects behind booms and prevent its spread. For hand removal to be effective, shoreline vegetation would have to be removed wherever salvinia has worked its way in and among it. That would probably be done by cutting the shoreline vegetation just below the surface of the water. Removal activities would also include checking of boats as they enter and leave launch areas to ensure they are not transporting giant salvinia and seeding new infestations.

Enlisting the help of volunteers, or using fire crew members help when they are not needed for fighting fires could reduce the cost of physical removal. Hand removal of attached plants at boat launches would be inexpensive and included as an incidental duty of an attendant.

There are reports of a pontoon-type boat which has been equipped to remove floating vegetation from water, and such a boat might be useful on an ongoing basis to clear specific area, such as

areas popular to boaters, and possibly areas behind booms. If such a boat could be obtained, it

would be applied for those purposes.

Several types of heavy-lifting equipment (e.g. draglines, hydraulic cranes, conveyors) would be set up and used to remove floating plants from water courses. Free-floating plants would be directed to a conveyor system by currents and booms. The conveyor would be operated on an as-needed-basis, projected into the waterway and removed the salvinia from the water and lifted it onto the bed of an awaiting truck. This equipment would not likely be effective in removing stage 1 and 2 of giant salvinia, due to their very small size. The weight of stage 3 plants is cuh that effectiveness would be limited by the onboard storage capacity of equipment used.

Floating booms would be used for controlling giant salvinia in a number of ways. They would be placed at strategic locations to prevent floating plants from entering into, and thereby clogging, water intakes, marinas, and some backwater areas. They would be used to collect or contain floating plants in moving water, and reduce the spread of new infestations along shorelines and within areas of the Refuges. They would be placed around boat launches near heavily infested areas to prevent plants from interfering with boat launching, and to reduce the likelihood of plants being transported from the launch areas to new sites.

Two permits would be needed in connection with physical removal. Placement of booms in the Colorado River system would require a Section 10 permit from the U.S. Army Corps of Engineers. Physical removal and transport of *Salvinia* from the river to land fill sites would require a permit from the Arizona Department of Agriculture, or the California Department of Food and Agriculture, Plant Health and Pest Prevention Services. Transportation would be in a manner that will ensure no possibility of plants “escaping”. Disposal would be in landfill sites where there is no likelihood that the plant could wash out and into other waters while still viable.

Alternative 2 would include a coordinated education and outreach program to promote support and enlist the assistance of others for program success. The program would be designed around a uniform message which describes the problem and the potential future threat. It would explain to the public why attention is focused on a plant that is not yet a problem, or has minimally affected them. A coordinated and cooperative effort involving government agencies, tribes, municipalities, water users, organizations and recreation groups would help develop the various types of outreach. A public education program would be initiated to encourage boat owners to check their boats and baitwaters for *Salvinia,*and to understand the role they can play in controlling the spread of this invasive aquatic weed. Future actions would include public meetings, radio messages, magazine and newsdpaper articles, signs at boat ramps, and pamphlets distributed through many outlets. These vehicles would convey the importance of preventing the spread of giant salvinia, and prevent or counter erroneous information, half truths and misleading facts that could interfere with effective control of this invasive species.

Alternative 3: Integrated Control, Including Use of Herbicides and Surfactants/Penetrants, as well as physical control. (Preferred Alternative)

Under this alternative a combination of several physical removal techniques would be combined with the use of herbicides and surfactants. Physical removal techniques that would be applied include both hand removal of plants easily accessible, for the purposes of containing larger infestations, reducing satellite infestations, removing plants that collect behind carefully placed booms and, if feasible, using boats fitted to gather floating mats and pieces of *Salvinia*. Herbicides would be combined with surfactants to permit the herbicide to penetrate the hairs and the plant cuticle more effectively. Herbicides would be applied from boats as needed to keep salvinia from spreading, and to eradicate it where feasible. Under this alternative, vegetation removal to access salvinia in and among emergent vegetation would be minimal, and only used where vegetation was blocking application of herbicides and surfactants.

Herbicides that would be applied might include any of the following, singly, or in combinations.

***Diquat dibromide* (6,7-dihydrodipyrido (2,3,-:2',1'-c)pyrazin3ediium bromide) (e.g. Reward)** (Application at label rates of ½ to 3/4 gallons/surface acre (or 1 ½ lbs AI/acre)

***Glyphosate (N-(phosphonomethyl)glycine)* [e.g. Rodeo/Accord].** Application rates to be determined prior to application, in accordance with labelling, if this herbicide were to be used.

***Chelated Copper (Cutrine-Plus 7, Komeen 7, K-Tea7, Koplex 7, Algae Pro7, etc.)* Komeen.** Chelated copper would only be used in areas not frequented by endangered fish, and only in the event that other chemical control is not successful in controlling giant salvinia. Prior to its application, a more detailed analysis would be conducted to evaluate its potential environmental impact. It is probable that electrofishing and removal of any endangered fish from treatment areas would be necessary, due to the potential toxicity of copper to endangered fish.

Chemical control would require the use of an adjuvant to be effective. Adjuvants which are being considered at this time include Kinetic and Cide-Kick. The first has been used successfully in control of giant salvinia in San Diego, the second is a citrus-based adjuvant approved for use in aquatic environments. Kinetic is on the list of approved adjuvants for use in the State of California, Cide-kick is not and could only be used in Arizona waters.

Alternative 2 would include a coordinated education and outreach program to promote support and enlist the assistance of others for program success. The program would be designed around a uniform message which describes the problem and the potential future threat. It would explain to the public why attention is focused on a plant that is not yet a problem, or has minimally affected them. A coordinated and cooperative effort involving government agencies, tribes, municipalities, water users, organizations and recreation groups would help develop the various types of outreach. A public education program would be initiated to encourage boat owners to check their boats and baitwaters for *Salvinia,*and to understand the role they can play in

controlling the spread of this invasive aquatic weed. Future actions would include public meetings, radio messages, magazine and newsdpaper articles, signs at boat ramps, and pamphlets distributed through many outlets. These vehicles would convey the importance of preventing the spread of giant salvinia, and prevent or counter erroneous information, half truths and misleading facts that could interfere with effective control of this invasive species.

IV. Affected Environment

A survey of the infested area was conducted between August 20 and September 25, 1999. The total area affected by giant salvinia includes approximately 25 miles of the Palo Verde Irrigation Drain and the Old River Channel, beginning just east of the intersection of 10th Avenue and Arrowhead Road, near Blythe, CA, and approximately 27 miles of the Colorado River beginning where the Old River Channel enters the Colorado River just below Walters Camp, down to Imperial Dam.

The area affected, or potentially affected, by this environmental assessment includes all waters of four National Wildlife Refuges including Imperial, Cibola, Bill Williams and Havasu. Sizeable infestations were found on both Cibola and Imperial National Wildlife Refuges, with both refuges reporting that approximately 60% of their backwaters had low level infestations. These areas are identified on the map attached identified as Appendix A. No *Salvinia* was found on the Colorado River above where the Old River Channel enters the Colorado River. No infestations were found either on the Bill Williams River or on Havasu National Wildlife Refuges.

The lower Colorado River supplies nearly 10 million acre feet of water each year for national and international users. In the lower basin, the water is used mainly for agricultural irrigation, municipal and industrial purposes, and power supply. Of these users, agriculture is the main consumer of water, and could incur the greatest impact. There are eight U.S. irrigation districts that use irrigation water from the infested area. These districts divert water to some 150 miles of main canals, over 750 miles of distribution canals, and over 100 miles of drains for use on about 8 million acres of farmland. Further, at least 1.5 million acre feet of Colorado River water is supplied to Mexico for use on 1/4 million acres of farmland. All of these irrigation systems could be severely impacted by an infestation of giant salvinia.

The increased loss of water through evapo-transpiration of giant salvinia could potentially lead to an additional 2 to 3 feet of water loss from the river. Reduction of the flow of water through irrigation canals and drainage ditches could be as much as 20 to 95% of the structures' capacity. Without immediate action, millions of dollars in additional operation and maintenance costs could result.

There are also four power plants in the infested area, and the Colorado River also supplies municipal and industrial users with water. Although impacts in the presently infested area could be significant, the impacts could be far greater if *Salvinia* were ever to infest lake Mead, Mohave and Havasu. These reservoirs supply water to tens of millions of people. The cost of control of

salvinia in these lakes and the distribution systems could be astronomical. The complicated set of issues that must be addressed would make chemical control difficult or impossible.

V. Environmental Consequences.

Alternative 1: No Action

All information obtained to date about this aquatic plant in other parts of the world and the United States indicates that failure to implement control on this species may result in continued spread of the plant and ultimately seriously impact the Colorado River aquatic ecosystem, and the species and human activities that depend on it. The actual speed at which this could occur may be somewhat lower in the Colorado River system due to comparatively low nitrogen levels. However, a Scientific Advisory Committee convened to provide advice on the Colorado River *Salvinia* infestation expressed the opinion that the infestation still poses a serious threat and planning should anticipate a serious infestation.

Ecosystem damage that may result from uncontrolled growth could include losses of submergent and emergent vegetation due to blocking of light by *Salvinia*, benthic organisms that depend on that vegetation, and food resources and habitat for fish, particularly two endangered fish species that are now found in the Colorado River. Tilapia, a non-indigenous fish species found in the Colorado River, may be eating some of the *Salvinia*, but that is not expected to have a significant impact on the ecosystem, though it may locally reduce the population of *Salvinia.*

Water-related recreation in *Salvinia* infested areas would be impacted, including fishing, boating, water skiing, shore-line recreational activities, along with related economic losses from local businesses that cater to those users. Other damage would be potential impacts on irrigation outlets, and eventually even a possible reduction in the available water in the Colorado river.

Impacts on Fish and Wildlife and Habitat

Evidence from other parts of the world and the United States where *Salvinia molesta* has invaded has indicated that all quiet waters of the Colorado River, including both backwaters and areas of shoreline emergent vegetation could eventually be taken over by a virtual blanket of this aquatic weed. The plant can reach depths of up to 24 inches, forming a solid mass that entirely blocks out light. After emergent plants die back in winter, their recovery from underneath such a mass would be questionable. Dense mats of *Salvinia molesta* have been known to be colonized by

other plant species as well, but it is unknown whether this would occur in quiet waters of the Lower Colorado River Basin.

The impact of giant salvinia on fish populations has been documented. In areas where this plant develops large floating mats, problems of low oxygen concentration and pH occur and can

destroy fish populations. This is caused by plant respiration, biological oxygen demand caused by decomposition of senescent plants, and by the lack of surface wind mixing. Also, preventing access to preferred habitats i.e. spawning, nursery areas and others can occur due to the physical biomass present in tertiary stands. As mentioned previously, Tilapia, a non-indigenous fish species, may be eating some of the Salvinia (though this has not been documented in the river), which could result in an increase in their numbers, possibly ultimately impacting other fish species in the river. It is possible that they may provide some degree of control of new infestations of Salvinia, but again, this is still theoretical and has not yet been documented.

Impacts on bird species that use the backwaters and riparian habitat of the river can only be guessed. There is little doubt that surface water area available to waterfowl could be seriously reduced, as well as food resources those species depend on. Loss of emergent vegetation could also reduce food available for waterfowl, and cover needed by riparian bird species. Effects on species that use trees and shrubs along the shoreline can also only be guessed. It is highly probable that insect species found among shoreline plants would be reduced, as emergent vegetation was impacted by mats of *Salvinia,* which could reduce food available for birds. Salvinia would not support native insect species to offset those losses.

Loss of cattails, bullrush, and other emergent vegetation would impact any species that use those plants, or access shoreline water. Not only could the presence of dense mats of *Salvinia* prevent some animals from reaching water, some species might walk out on the mats, expecting them to be solid ground, and find themselves in deep water. Cattle and dogs have been known to walk out on the mats and been unable to get out. This could happen to mule deer, grey fox, burros, and raccoons as well.

Impacts on Endangered and Threatened Species

There are four endangered species found in or near Refuge waters on the Colorado River: Two fish species, the razorback sucker (*Xyrauchen texanus*) and the bonytail (*Gila elegans*), and two endangered bird species, the Yuma clapper rail (*Rallus longirostris yumanensis*) and the Southwest willow flycatcher (*Empidonax traillii extimus*). Impacts on the endangered fish would be expected to be the same as those listed under *Impacts on Fish and Wildlife and Habitat,* above. Impacts on the Yuma clapper rail would be indirect, resulting from loss of cover and forage areas provided by shoreline emergent vegetation, and possibly loss of food resources. Impacts on the Southwestern Willow Flycatcher would result primarily from a possible reduction in the presence of insects, as discussed under *Impacts on Fish and Wildlife and Habitat,* above.

All endangered species in the Colorado River System could suffer losses to their populations as a result of giant salvinia.

Impacts on Water Quantity and Quality

Presence of a large infestation of giant salvinia in the river ecosystem could result in a serious reduction in water available for wildlife, agriculture, power production, and municipal uses, in the area. Increased loss of water through evapo-transpiration could lead to an additional 2 to 3 feet of water loss from the river. Giant salvinia has already spread into the irrigation systems, and perpetuation of large infestations on Cibola and Imperial NWRs would provide an ongoing source for new infestations in those irrigation systems. Reduction of the flow of water through irrigation canals and drainage ditches could potentially be as much as 20 to 95% of the structures' capacity.

If Salvinia in the backwaters becomes widespread and dense, water quality could also be impacted by plant respiration and biological oxygen demand caused by decomposition of senscent plants, and the lack of surface wind mixing. Low oxygen concentration and pH could occur.

Impacts on Aesthetic and Visual Resources

The spread of giant salvinia throughout the backwaters of the Refuge, as well as in other areas of the Lower Colorado River system could result in a significant loss of water surface if those areas become covered with giant salvinia infestations. That would have a significant impact on the visual and aesthetic quality of the river system.

Impacts on Socioeconomic Resources

Recreational use of the river by winter residents and weekend visitors to the area provides a significant source of income for numerous businesses, both within communities and in a number of locations along the river, including a concession on the Havasu NWR . Those businesses include bait and boat shops, hotels, restaurants, gasoline stations, and a host of others. Loss or degradation of recreational resources resulting from extensive infestation by giant salvinia on the refuges, and by association on other parts of the river, could seriously impact the number of visitors to the area and income derived from expenditures by those recreational users.

The Lower Colorado River supplies nearly 10 million acre feet of water each year for national and international users. In the lower basin, the water is used mainly for agricultural irrigation, municipal and industrial purposes, and power supply. Of these users, agriculture is the main consumer of water, and could incur the greatest impact. Eight U.S. irrigation districts use irrigation water from the infested area. These districts divert water to some 150 miles of main canals, over 750 miles of distribution canals, and over 100 miles of drains for use on about 8 million acres of farmland. At least 1.5 million acre feet of Colorado River water is supplied to Mexico for use on 1/4 million acres of farmland. Failure to control giant salvinia on the Colorado River Refuges could result in serious impacts on these resources if it spreads to other areas of the River system not yet infested.

The increased loss of water through evapotranspiration could lead to an additional 2 to 3 feet of water loss from the river. Reduction of the flow of water through irrigation canals and drainage

ditches could be as much as 20 to 95% of the structures' capacity. That water would no longer be available for agricultural, industrial, and municipal use along the river.

There are four power plants in the infested area of the Colorado River. Although impacts in the presently infested area could be significant, the impacts could be far greater if *Salvinia* were spread to and infest lakes Mead, Mohave or Havasu. Those reservoirs supply water to tens of millions of people. The cost of control of salvinia in these lakes and distribution systems could be astronomical, presenting serious logistical problems if chemical controls had to be implemented.

Alternative 2. Physical Control and Removal.

Impacts on Wildlife and Habitat

Physical removal alone would not be likely to control or eradicate the infestations of giant salvinia on refuge waters due to the difficulty of locating ever little tiny leaf of the plant for removal. Impacts on wildlife and habitat ultimately could be the same as those identified under the "No Action" alternative. Physical removal is an appropriate method of control while infestations are small. However, none of the methods of physical removal would provide long-term and refuge-wide control. It would be effective primarily in areas where removal efforts could be concentrated to protect key areas of the refuge. Physical removal would be an ongoing effort--in perpetuity-- and may require that Refuge staff be assigned full time solely to carry out that removal. That would take staff time away from other wildlife and habitat management activities
--unless additional staff could be hired.

Physical control would be conducted in a manner so as to minimize the chance of spreading salvinia, since any small floating pieces could escape and infest new areas. As mentioned above, that would be extremely difficult. Also, there are a limited number of places along the distance of the affected area where the collected salvinia could be removed from the river for disposal. Areas farthest from launch sites would be the most difficult to control using mechanical means because transport for removal would take an inordinate amount of time.

Physical removal could impact shoreline and benthic habitat. In order to physically control giant salvinia in and among the shoreline vegetation, much of the emergent vegetation in infested areas would probably have to be removed as well. Areas might have to be cleared to install removal systems, if they were to be used. Aside from the logistical difficulty of achieving this, physical removal could increase water turbidity, disturb benthic organisms, destroy habitat for shoreline animals, and possibly increase bank erosion.

Physical removal could temporarily disturb fish populations where it was applied, particularly in areas of shallower waters. Removal of shoreline emergent vegetation to access giant salvinia infestations could reduce fish habitat quality and reduce forage and cover in those areas.

Birds that use shoreline emergent vegetation could be affected locally where that vegetation was removed to access giant salvinia infestations. Those impacts would be temporary until the vegetation grew back, except where removal equipment was installed. Birds that use the riparian areas might be affected by activity required to accomplish physical removal. Impacts would only last for the short duration of that activity, however.

Impacts on Endangered and Threatened Species

Increased turbidity resulting from shoreline emergent vegetation removal in order to access giant salvinia infestations could impact habitat and food available for the razorback sucker and the bony tail in those areas used by those endangered fish. Even when shoreline vegetation removal was not needed, disturbance from dip nets might harrass those species in areas of shallower water, though it would not be as likely to impact those species in waters of 10 foot depth or more. Impacts would be temporary, however, as sediment stirred up settled and emergent vegetation grew back. The giant salvinia also would be likely to return, however.

Removal of shoreline emergent vegetation to access giant salvinia would reduce forage and cover available for the endangered Yuma clapper rail. Removal of shoreline vegetation to set up removal equipment could have a longer term impact. Most emergent vegetation removal would be temporary, however, and would be restricted to a limited number of sites where such removal might be needed.

Disturbance from physical removal activities in the areas frequented by the Southwest willow flycatcher would be temporary and seasonal. Disturbance during mating and nesting season could reduce nesting and fledging success, particularly if disturbance were extended over a period of days.

Impacts on Water Quality

Physical removal, and removal of shoreline emergent vegetation to access giant salvinia could temporarily affect water turbidity. Increased erosion could result from removal of shoreline emergent vegetation, adding to turbidity. Shoreline emergent vegetation would be likely to grow back in time, and sediments would settle out in quiet waters, however, so those impacts would be temporary.

Impacts on Aesthetic and Visual Resources

Physical removal of shoreline vegetation needed to access giant salvinia infestations could have a localized impact on aesthetic and visual resources where it was applied. However, most of those impacts would be temporary, and would be likely to be noticed primarily by those using refuge waters for recreational purposes (boating, fishing). If access points had to be established, and equipment were set up in strategic locations along the shore in order to physically remove giant salvinia, visual impacts could occur locally from those developments.

Impacts on Socioeconomic Resources

Recreation.

Impacts on recreation from physical control and removal would be minimal. Boaters might have to route around booms, but booms would not block off areas frequented by recreational users. Boaters would also be asked to check their boats and bait waters prior to leaving/entering areas to prevent the further spread of giant salvinia to uninfested waters. Boat traffic might have to be restricted in areas where the risk of spread is high.

Agriculture.

Physical removal activities would not likely affect agricultural resources.

Industrial/Community Water Uses.

Physical removal activities would be unlikely to affect industrial or community water users.

Alternative 3. Integrated Control, including use of some physical removal methods and herbicides in combination with surfactants. (Preferred Alternative)

Impacts on Wildlife and Habitat

Physical removal as described under Alternative 3 would have minimal impact on emergent vegetation, since it would only be removed in those limited areas that could not be accessed for herbicide treatment. Impacts also would be short-term, since the emergent vegetation would grow back.

Physical removal could temporarily disturb fish where it was applied, particularly in areas of shallower waters. Removal of shoreline emergent vegetation to access giant salvinia infestations could reduce fish habitat quality in those areas, reducing forage and cover available. Impacts would be temporary, however.

Birds that use shoreline emergent vegetation could be affected locally where that vegetation was removed to access giant salvinia infestations, reducing cover and forage areas. Those impacts would be minimal since vegetation removal would be very limited, and impacts would be temporary until the vegetation grew back. Birds that use the riparian areas might be affected by activity required to accomplish physical removal and apply herbicides. Impacts would only last for the short duration of those activities, however.

Diquat would be the herbicide of choice. (See Appendix B) It would be used, in combination with a surfactant, at such small concentrations that it would be highly improbable it would have any impact on fish or wildlife. It is contact herbicide which binds strongly and quickly to most

anything. Thus it would be expected to remain on the salvinia, not wash off it. Once the plants die, and sink, the Diquat and surfactant would be quickly diluted even further. Application rates of Diquat at 1 to 1 ½ lbs AI/acre would yield well under .74mg/L maximum concentration. The acute and chronic no effect concentrations for aquatic animals are all above 1.0 mg/L. It is also virtually impossible that birds could inadvertently ingest enough Diquat for it to have any impact on them. Rapid death and decomposition resulting from herbicide treatment of large infestations of salvinia could result in lowered dissolved oxygen in the immediate areas of treatment. That could have some impact on benthic organisms, and fish that use the areas. However, judicious and timely application of herbicide control would likely reduce the size and number of such large mats and minimize impacts. Decomposition of smaller infestations should have little impact on dissolved oxygen levels.

Both Kinetic and Cide-kick surfactants have been shown to be highly safe for fish, so their use in combination with Diquat would not add a significant risk. (See Appendix C) It is doubtful that birds could come into contact with any quantity of treated vegetation. However, even if birds were to come in direct contact with the surfactants they would be unlikely to suffer significant impacts because of the highly dilute solution used (2 quarts of surfactant per 100 gallons).

Impacts on Endangered and Threatened Species

Yuma clapper rails might be affected by spot removal of vegetation for access to apply herbicides, resulting in a temporary and small loss of cover and foraging habitat. They also might be temporarily disturbed by dip net use for spot removal of salvinia, and reduction of larger infestations. Application of herbicides would not be likely to affect the rails because of (1) the low rate of application, (2) the rapidity with which salvinia would be expected to die after application--within a few days, and (3) the fact that the herbicide would be quickly diluted by water after the plants begin to die and sink. Some limited temporary impacts on food available for rails might result from decay of the plant materials after treatment, but those effects are expected to be minimal.

Disturbance from physical removal activities and chemical treatment in the areas frequented by the Southwest willow flycatcher would be temporary and seasonal. They might be avoided or

minimized by timing of physical removal and herbicide application activities near known nesting sites.

Use of dip nets for hand removal of salvinia might disturb endangered fish in areas of shallower water, though it would not be as likely to impact those species since much of the area to be treated would be fairly deep (10 feet +/-)

Diquat, in combination with a surfactant, would be used at such small concentrations that it would be highly improbable it would have any impact on fish or wildlife. It is a contact herbicide which binds strongly and quickly to most anything. Thus it would be expected to remain on the salvinia, not wash off it. Once the plants die, and sink, the Diquat and surfactant

would be quickly diluted even further. Application rates of Diquat at 1 to 1 ½ lbs AI/acre would yield well under .74mg/L maximum concentration. The acute and chronic no effect concentrations for aquatic animals are all above 1.0 mg/L. Lowered dissolved oxygen levels could result in areas where large infestations are treated and decompose. That could have some effect on benthic organisms, and might make treated areas less desirable to fish species.

Both Kinetic and Cide-kick surfactants have been shown to be highly safe for fish, so their use in combination with Diquat would not add a risk. (See Appendix ___for toxicity data). It is doubtful that birds could come into contact with any quantity of treated vegetation, However, even if birds were to come in direct contact with the surfactants they would be unlikely to suffer significant impacts because of the highly dilute solution used (2 quarts of surfactant per 100 gallons), and the fact that the hairs on the plants could provide a barrier to direct contact.

Impacts on Water Quality

Impacts on water quality would be minimal, and limited to temporary disturbance and increased turbidity resulting from removal of emergent vegetation needed to access infestations for herbicide treatment.

Impacts on Aesthetic and Visual Resources

There would be minimal impact on aesthetic and visual resources. The only impacts would be temporary, and only in the specific sites selected for removal of submergent vegetation. Some very temporary aesthetic and visual impacts might result as the Salvinia dies from herbicide applications. Those impacts would be short-term, however, since death would be expected within a few days, and the dead plants would sink out of sight.

Impacts on Socioeconomic Resources

Recreation

This alternative should have little or no impact on recreation. The use of booms to direct salvinia into or away from areas would require boaters to make slight route changes, but those diversions would be minimal.

Agriculture and Industrial/Community Water Uses.

Diquat cannot be used within 1600 feet of a public water system. However, this alternative should have virtually no impact on agriculture, industrial or community water users since the areas being treated would be considerably fartherthan 1600 feet from those sites where water is removed from the river system for any of the above purposes. Also, the flow of water in the Colorado River varies from a low of just over 11,000 cubic feet/second to just over 16,000 cubic feet/second. That means that any herbicides that might reach the river would be quickly diluted way below detectable levels.

VI. Consultation and Coordination

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Extoxnet web site, information on Diquat.
Jim Brewer, CEO, Brewer International (Manufacturers of Cide-Kick)