Appendix B. Compatibility Determinations

Compatibility Overview

Compatibility is a tool refuge managers use to ensure that recreation and other uses do not interfere with wildlife conservation – the primary focus of refuges. For purposes of this document, uses include any recreational, economic/commercial, pest/predator control, or other use of the refuge by the public or a non-Service entity. Compatibility is not new to the Refuge System and conceptually dates back to 1918. As policy, it has been used since 1962. The Refuge Recreation Act of 1962 (Recreation Act) directed the Secretary of Interior to allow only those public uses of refuge lands that were "compatible with the primary purposes for which the area was established." This law also required that adequate funds be available for administration and protection of refuges before opening them to any public uses. Legally, refuges are closed to all public uses until officially opened through a compatibility determination.

The National Wildlife Refuge System Administration Act of 1966 set a compatibility standard which refuge managers used until new compatibility regulations, required by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act), were adopted. The Improvement Act maintains a compatibility standard but provides more detail regarding the standard and the process, and requires the process be promulgated in regulations. It also requires that a use must be compatible with both the mission of the System and the purposes of the individual refuge, which helps to ensure consistency in application across the System. The Improvement Act also requires that the public have an opportunity to comment on use evaluations.

The Improvement Act stipulates that the needs of wildlife must come first and defines a compatible use as one that "…in the sound professional judgment of the Director, will not materially interfere with or detract form the fulfillment of the mission of the National Wildlife Refuge System or the purposes of the refuge." Sound professional judgment is defined as "…a finding, determination, or decision, that is consistent with principles of sound fish and wildlife management and administration, available science and resources…" Compatibility for priority wildlife-dependent uses may depend on the level or extent of a use.

In 1978, the compatibility standard was tested in court when recreational uses at Ruby Lake NWR (water skiing and motor boating) were found to be in violation of the Refuge Recreation Act. The court determined that compatibility is a biological standard and cannot be used to balance or weigh economic, political, or recreational interests against the primary purpose of the refuge. This ruling stated that the existence of non-compatible uses on a refuge in the past has no bearing on the compatibility of present uses. In their summary of this case, Coggins et al. (1987) conclude "neither poor administration of the Refuge in the past nor prior interferences with its primary purpose, nor past recreational, nor deterioration of its wildlife resources since establishment, nor administrative custom or tradition alters the statutory standard."

The Service recognizes that compatibility determinations are complex. For this reason, refuge managers are required to consider "principles of sound fish and wildlife

management" and "available science" in making these determinations. Evaluations of the existing uses on the Sacramento River NWR are based on the professional judgment of refuge personnel including observations of refuge uses and reviews of appropriate scientific literature.

The compatibility determinations that follow are consistent with the Compatibility Policy and Regulations published in the Federal Register (FR 62484, FR 62458).

Use
Refuge Name:
Establishing and Acquisition Authorities:
Refuge Purposes:
NWRS Mission:
Description of Use
Availability of Resources:
Anticipated Impacts of the Use:
Public Review and Comment:
Determination:
Stipulations Necessary to Ensure Compatibility:
Justification

Prior to new activities being permitted on the Refuge, a compatibility determination and NEPA documentation is developed and approval and concurrence is obtained from the Regional Chief of Refuges and the California/Nevada Operations Manager.

When new activities or actions are proposed and found to have significant impacts affecting the quality of the human environment or there is disagreement on the impacts, an Environmental Assessment or Environmental Impact Statement is required and includes public input on the decision process.

The following activities were previously covered under compatibility determinations evaluated in 1994 and 2001. During the process of the Comprehensive Conservation Plan these activities have been reevaluated and determined to comply with the compatibility standards.

Compatibility determinations for the following uses are included within this appendix:

Hunting
Fishing
Wildlife Observation, Wildlife Photography, and Interpretation
Environmental Education
Research
Camping and Recreational Boating
Farming
Grazing
Mosquito and Other Vector Control

COMPATIBILITY DETERMINATION
(June 2004)

Use: Hunting

Refuge Name: Sacramento River National Wildlife Refuge, located in Tehama, Butte, Glenn and Colusa counties, California.

Establishing and Acquisition Authority(ies): Sacramento River National Wildlife Refuge (Refuge) was established in 1989. Approximately 11,000 acres of the approved 18,000 acres have been acquired. Legal authorities used for establishment of the Refuge include: the Endangered Species Act of 1973 as amended (16 U.S. Code 1531-1543: 87 Statute 884), the Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901(b) and the Fish and Wildlife Act of 1956 (16 U.S. Code 742).

Refuge Purpose(s): Sacramento River Refuge purposes include:

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. Sec. 1534 (Endangered Species Act of 1973)

".. the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..."16 U.S.C. 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. 742f (a) (4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. Sec. 742f (b) (1) (Fish and Wildlife Act of 1956)

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use: Hunting is identified in the Improvement Act as a priority use for refuges when it is compatible with other refuge purposes. As a result the Refuge encourages dove, waterfowl, coot, common moorhen, pheasant, quail, snipe, turkey and deer hunting which are currently hunted species on public land along the Sacramento River (USFWS 2004). The hunting program will be of the highest quality, conducted in a safe and cost-effective manner, and to the extent practicable, carried out in accordance with State regulations, see 605 FW 2, Hunting. The Hunting Plan was developed to provide safe and accessible hunting opportunities, while minimizing conflicts with other priority wildlife-dependent recreational uses. The Refuge hunting program will comply

with the Code of Federal Regulations Title 50, 32.1 and managed in accordance with Fish and Wildlife Service Manual Chapter 605 FW 2, Hunting.

Hunting will be permitted in accordance with State and Federal regulations and seasons to ensure that it will not interfere with the conservation of fish and wildlife and their habitats. Therefore, the sport hunting of migratory birds, upland game birds and deer on the Refuge is in compliance with State regulations and seasons, the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57), the National Wildlife Refuge System Administration Act of 1966 (1RM 5.4EE, Public Law 89-669), and the Refuge Recreation Act of 1962 (8RM 5.1, Public law 87-174).

Approximately 2,979 acres (29%) will be open by 2005 and an additional 2,592 acres (26%) within 2-10 years to total 5,571 acres (55%) open to hunting, see Figure 27, Chapter 5 CCP for details. Hunting of dove, waterfowl, coot, common moorhen, pheasant, quail, snipe, turkey and deer will be allowed in accordance with State hunting regulations during the legal hunting seasons and shooting times.

Species	**Dates**
Dove	September 1-15 AND from second Saturday in November for 45 days
Waterfowl[1] - Ducks	Third Saturday in October for 33 days AND from third Friday in November for 66 days
Waterfowl[1] - Geese	First Saturday in November extending 86 days
American Coot and Common Moorhen	Concurrent with duck season (and during split, if it occurs)
Pheasants	Second Saturday in November extending for 44 days
Quail – General	Third Saturday in October extending through the last Sunday in January
Quail – Archery	Third Saturday in August extending through the last Sunday in September
Snipe	Third Saturday in October extending for 107 days
Turkey – Fall	Second Saturday in November extending for 16 consecutive days
Turkey – Spring	Last Saturday in March, extending for 37 consecutive days
Deer – Archery (Zone C4, all units except Drumheller Unit)	Last Saturday in August extending for 16 consecutive days
Deer – General (Zone C4, all units except Drumheller Unit)	Third Saturday in September extending for 16 consecutive days
Deer – Archery (Zone D3, Drumheller Unit)	Third Saturday in August extending for 23 consecutive days
Deer –General (Zone D3, Drumheller Unit)	Forth Saturday in September extending for 37 consecutive days

Federally approved non-toxic shot will be required for all species except, deer. Weapons or ammunition for take of deer include shotgun, 0 or 00 buckshot, shotgun slug, and archery. Rifles and pistols may not be used or possessed.

Most refuge lands are accessible by only boat. Units that have an entrance road leading to a parking area will be gated. Only pedestrian traffic will be allowed on refuge lands (bicycles and motorized vehicles will not be allowed). Limited camping on gravel bars up to seven days is allowed. Camping on Refuge land, other than gravel bars, is prohibited.

There will not be any hunter check stations or method to regulate hunter quotas on each unit. It is predicted that there will be minimal hunting (2,000 annual visits) due to the limited vehicle access, dense cover, and seasonal boat access. Hunters must report take of deer according to State regulations.

Public use signs depicting allowable uses, river mile and unit name will be placed above the approximate ordinary high water mark and at parking areas. The boating guide, California Department of Boating and Waterways boating guide that depicts the unit name and river mile location, a large laminated boating guide, and the Sacramento River NWR brochure will be placed at public boat ramps and units accessible by vehicle.

Landward boundaries will be closed to discourage trespass through adjacent private lands. Random, weekly hunter field checks will occur by Refuge Law Enforcement Officers to assess type and number of harvested species. Coordinated law enforcement patrol by refuge officers, special agents, game wardens, park rangers, and deputy sheriffs will take place periodically.

Availability of Resources: The following funding/annual costs (based on FY 2003 costs) would be required to administer and manage hunting activities as described above:

	Annual Costs
Administration	$15,000
Law Enforcement	$12,000
Outreach, Education, Monitoring	$5,000
Signs, brochures, and maintenance	$3,000
TOTAL	**$35,000**

Additional funds would be required to operate and maintain the hunt program. Law enforcement staffing would be needed. Funding will be sought through the Service budget process. Other sources will be sought through strengthened partnerships, grants, and additional Refuge operations funding to support a safe and quality program as described above.

“If adequate resources cannot be secured, the use will be found not compatible and cannot be allowed” (603 FW 2.12(A)(7)(a)).

Anticipated Impacts of Use: Biological conflicts will be minimized by the following proper zoning and regulations. Refuge seasons will be designated to minimize negative impacts to wildlife. Due to difficult access to most units that allows hunting, which is primarily by boat, may limit number of hunters and visits. Sanctuary units, totaling 16% of refuge lands, are located within separate reaches of the River, which distributes areas needed by wildlife for resting, feeding, nesting, and fawning. Density of the riparian forests provides additional sanctuary for wildlife species.

Use of federally approved non-toxic shot for all hunting except deer will help minimize propensity of lead poisoning.

Conflicts between hunting and low impact activities or neighboring landowners will be minimized by the following:

- Provide 1,153 acres (11%) of the refuge for only non-hunting activities i.e. wildlife observation, photography, interpretation, environmental education and fishing activities by 2004 and an additional 1,754 acres (17%) within 2-10 year for a total of 2,907 acres (29%).
- Close landward boundaries to discourage trespass from and onto adjacent private lands.
- Hunting will not be allowed on Refuge units that are small in area and close in proximity to urban areas and private dwellings.
- Post all Refuge units with boundary signs and provide public use information signs
- On Refuge lands, excluding gravel bars, entry and departure is restricted to one hour before sunrise to one hour after sunset.
- Limited camping on gravel bars up to seven days is allowed. Camping on Refuge land, other than gravel bars, is prohibited.
- Allow pedestrian traffic only.
- Provide coordinated law enforcement patrol by game wardens, park rangers, and Refuge officers.

The populations will sustain hunting and still support other wildlife-dependent priority uses. The Refuge adopts harvest regulations set by the State within Federal framework guidelines.

Possibly target species and other wildlife will compete for habitat. While each species occupies a unique niche, there is only a finite amount of space available to satisfy various habitat requirements of water, food, cover, breeding, roosting, and fawning areas. So, while individuals of a species compete for habitat within the species niche, most species occupy space to the exclusion of many other species. Target species (dove, waterfowl, coot, common moorhen, pheasant, quail, snipe, turkey and deer) generally do not prey on other species at unacceptable levels. Occasionally, in certain areas, deer browse of seedling valley oak is particularly heavy.

By its very nature, hunting has very few positive effects on the target species while the activity is occurring. However, in our opinion, hunting has given many people a deeper

appreciation of wildlife and a better understanding of the importance of conserving their habitat, which has ultimately contributed to the Refuge System mission. Furthermore, despite the potential impacts of hunting, a goal of the Sacramento River Refuge is to provide visitors of all ages an opportunity to enjoy wildlife-dependent recreation. Of key concern is to offer a safe and quality program and to ensure adverse impacts remain at an acceptable level.

Hunters disturb non-target and target species and harvest target species. Recreational hunting will remove individual animals from wildlife populations. The California Fish and Game Commission in consultation with the Department of Fish and Game annually review the population censuses to establish season lengths and harvest levels. Each year the Refuge staff conducts habitat management reviews of each unit to evaluate wildlife population levels, habitat conditions and public use activities. The areas closed to various hunting activities do provide adequate sanctuaries for wildlife.

Additional impacts from hunting activity include conflicts with individuals participating in other wildlife-dependent priority public uses, such as wildlife observation and fishing (see Figure 24 and Table 8, CCP).

Anticipated Impacts of Uses on future lands within the approved boundary: The following conditions must be met before allowing existing uses to occur on newly acquired lands: (1) There is no indirect, direct, or cumulative threat anticipated to human health or safety; (2) There is no indirect, direct, or cumulative threat anticipated to natural or cultural resources; (3) The use is consistent with management of existing Sacramento River Refuge lands and would contribute to achieving Refuge goals. In particular, existing Refuge regulations would not be compromised; (4) The newly acquired lands represent a meaningful unit within which to manage the activity; and (5) There are no anticipated conflicts with priority public uses.

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the Draft CCP and Environmental Assessment for the Sacramento River Refuge.

Determination:

_____Use is Not Compatible

__X__Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Annually review all hunting activities and operations to ensure compliance with all applicable laws, regulations, and policies.
- Annually review population censuses with the California Department of Fish and Game to ensure that harvest from hunting is not unacceptably impacting the targeted populations. Modify the program accordingly.

- Each year the Refuge staff conducts habitat management reviews of each unit to evaluate wildlife population levels, habitat conditions and public use activities.
- Hunting must be in accordance with Federal and State regulations.
- Refuge specific hunting information will be available via signs, information panels, brochures and website.
- Monitor hunting activity in the field to assure that it does not interfere with other wildlife dependent uses.
- Dog training on the Refuge will not be allowed.
- Dogs must be confined or leashed except when participating in a legal hunt for waterfowl, coots, common moorhen, pheasants, turkey (fall only), dove, or quail.
- Hunters using boats must abide by the boating stipulations described in the State and Coast Guard regulations on boating.
- Federally approved non-toxic shot will be required for all species except deer.

Justification: Hunting is a priority public use listed in the National Wildlife Refuge System Improvement Act. By facilitating this use on the Refuge, we hope to increase the visitors' knowledge and appreciation of fish and wildlife, which may lead to increased public stewardship of wildlife and their habitats on the Refuge and along the Sacramento River. Increased public stewardship will support and complement the Service's actions in achieving the Refuge's purposes and the mission of the National Wildlife Refuge System.

Hunting is an appropriate wildlife management tool that can be used to manage wildlife populations. This may be necessary to ensure that populations above the carrying capacity are controlled to reduce impacts to habitat and other wildlife that also depend on the habitat. Some wildlife disturbance will occur during the hunting seasons. Proper zoning, regulations, and Refuge seasons will be designated to minimize any negative impacts to wildlife populations using the Refuge. Due to the difficulty of accessing the refuge units (mostly boat access from the river), we anticipate that hunter numbers will be limited. Accordingly, disturbance from the hunters will also be lessened

Based upon biological impacts described in the Hunting Plan, Comprehensive Conservation Plan and Environmental Assessment, it is determined that hunting within the Sacramento River National Wildlife Refuge will not materially interfere with or detract from the purposes for which the Refuge was established. In our opinion, implementing the hunt plan and associated stipulations will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date (October 2019):

___X___ Mandatory 15-year Re-Evaluation, Date will be provided in Final EA/CCP (for priority public uses)

_____ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

References Cited

USFWS. 2004. Sacramento River National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment. U.S. Fish and Wildlife Service, Region 1.

COMPATIBILITY DETERMINATION
(June 2004)

Use: Fishing

Refuge Name: Sacramento River National Wildlife Refuge, located in Tehama, Butte, Glenn and Colusa counties, California.

Establishing and Acquisition Authority(ies): Sacramento River National Wildlife Refuge (Refuge) was established in 1989. Approximately 11,000 acres of the approved 18,000 acres have been acquired. Legal authorities used for establishment of the Refuge include: the Endangered Species Act of 1973 as amended (16 U.S. Code 1531-1543: 87 Statute 884), the Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901(b) and the Fish and Wildlife Act of 1956 (16 U.S. Code 742).

Refuge Purpose(s): Sacramento River Refuge purposes include:

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. Sec. 1534 (Endangered Species Act of 1973)

".. the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..."16 U.S.C. 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. 742f (a) (4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. Sec. 742f (b) (1) (Fish and Wildlife Act of 1956)

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use: Currently, only Packer Lake within Packer Unit is open to sport fishing. The Refuge is proposing to open: gravel bars, sloughs, oxbow lakes, and the inundated floodplain on all Refuge units by 2004 (USFWS 2004). This will include twenty-three river front miles and all seasonally submerged areas below the Ordinary High Water Mark (Figure 27, Chapter 5, CCP).

Sport fishing is identified in the Improvement Act as one of the Big 6 legislated wildlife-dependent, priority public uses. Fishing will be permitted in accordance with State and Federal regulations and seasons to ensure that it will not interfere with the conservation

of fish and wildlife and their habitats. Sport fishing is not considered managed economic use.

Most refuge lands are accessible by only boat. There are no developed boat ramps or related facilities on the Refuge. There are existing boat ramps with related facilities that provide public access along the portion of the river where Refuge lands are located (EDAW 2002). Refuge units that have an entrance road leading to a parking area will be gated so that only pedestrian traffic will be allowed on Refuge lands (bicycles and motorized vehicles will not be allowed). Limited camping on gravel bars up to seven days is allowed. Camping on Refuge land, other than gravel bars, is prohibited.

Method of enforcement and control will take place through boundary and public use signs, information kiosks at boat ramps and routine patrol by CDFG wardens and Refuge officers. Landward boundaries will be closed to discourage trespass through adjacent private lands. Entry and departure times on the Refuge will be restricted (i.e. one hour before sunrise to one hour after sunset). In order to be consistent with the State fishing regulations, anglers do not need to obtain a refuge fishing permit or a user fee.

Game fish species which will be allowed for legal take include all native and introduced species listed in the California regulations Freshwater Sport Fishing (i.e. Pacific salmon, steelhead, trout, sturgeon, sunfish, shad, stripped bass, carp, catfish, bullhead, crappie, bass and spotted bass). These fish species occur in open water on the Refuge in the main River channel, sloughs, oxbow lakes, and on the inundated floodplain.

There will not be any method implemented to regulate fishing quotas. It is predicted that there will be minimal fishing (4,000 annual visits) due to the limited vehicle access and seasonal boat access to refuge lands. Peak fishing use is projected to occur spring through the fall. High water and flood events limit fishing opportunities during the winter (Figure 26, Chapter 5, CCP).

The Fishing Plan proposes to open more areas of the refuge to fishing and improve opportunities and access for visitors:

- Provide additional parking areas, trails, and interpretive signs to inform the public about Refuge resources.
- Improve the Packer Lake small boat launching facility in cooperation with other stakeholders.
- Provide information for fishing opportunities in the Sacramento River Refuge brochure.

The Fishing Plan and the Comprehensive Conservation Plan, Chapter 5 are herein incorporated by reference. The Refuge adopts harvest regulations set by the State, which uses the best available population information. Sources of population data for Chinook salmon include the California Department of Fish and Game and the U.S. Fish & Wildlife Service (Fisheries Resources Offices and the National Oceanographic and Atmospheric Administration).

Availability of Resources: Limited funding and staffing would be required to manage the bank and boat fishing on the Sacramento River Refuge. Refuge Officers will conduct regular patrols. Law enforcement support would also be provided by California Department of Fish and Game wardens under a memorandum of understanding with the Refuge (USFWS, CDFG & CDPR 2001). Additional funding would also be needed for the interpretive signs, interpretive materials, and kiosks. Those costs are incorporated into the Compatibility Determinations for environmental education and interpretation. The Refuge would pursue a variety of funding sources in order to fully support this use, including agreements with other agencies, grant funding and volunteer assistance for monitoring.

	One-time Costs	Annual Costs
Administration		$2,000
Law Enforcement		$5,000
Outreach, Education, Monitoring		$3,000
Signs and brochures	$3,000	$1,000
Maintenance of facilities		$3,000
TOTAL	**$3,000**	**$14,000**

Anticipated Impacts of the Use(s): Impacts are discussed in detail in the Fishing Plan, Comprehensive Conservation Plan and Environmental Assessment (USFWS 2004). Fishing and other human activities cause disturbance to wildlife (Burger 1981). Cumulative impacts of this increased use have correlating effects on wildlife, habitat and the fisheries resource (Buckley and Buckley 1976; Glinski 1976; Miller et al. 1998; Reijnen and Foppen 1994; Smith and Hunt 1995).

Biological conflicts will be minimized by the following:

- Open only riverine areas, oxbow lakes and ponds to fishing
- Close marshes and canals
- Maintain parking areas, roads, and access facilities to prevent erosion or habitat damage
- Promote use of non-toxic sinkers, split shot, and lures
- Monitor fishing activities to ensure facilities are adequate and wildlife disturbance is minimal
- Include Section 7 consultation, and other measures proposed to minimize or eliminate conflicts with endangered species or non-target species.
- Law enforcement patrol by game wardens, park rangers, and Refuge officers
- Some human disturbance of forest and shrub bird species may occur during nesting and spring/fall migration periods. However, human impacts are expected to be low since many of these areas are covered with dense vegetation, which minimizes human travel.
- Some human disturbance of gravel-scrape nesting species such as killdeer, spotted sandpiper, and lesser nighthawk will occur. The most concentrated human use of gravel bars occurs during dove season when nesting is completed. Other periods of high use may occur during early summer for camping and

angling. During this time, volunteers will be utilized to monitor and track the disturbance to utilize for future management decisions.

Conflicts between fishing and hunting, non-consumptive uses, and neighboring landowners will be minimized by the following:

- Disseminate California Department of Boating & Waterways boating guide, which depicts Refuge units by river mile, at public boat ramps i.e. Red Bluff Diversion Dam, Woodson Bridge, Irvine Finch, Ord Bend, Butte City, and Sacramento River-Colusa State Park, by 2004.
- Place public use signs at the approximate ordinary high water mark on all refuge units at access points.
- Construct information signs and place brochure holders at appropriate refuge units to provide fishing information
- Law enforcement patrol by game wardens, park rangers, and Refuge officers
- Close landward boundaries to discourage trespass through adjacent private lands
- Restrict entry and departure times on the refuge i.e. one hour before sunrise to one hour after sunset
- Public use signs depicting allowable uses will be placed above the ordinary high water mark and at vehicle access points.
- Install public use ethics panel, including a no littering or "pack it in and pack it out" message at appropriate access points.

The Refuge believes that there will be minimal conflicts between anglers and the other priority public uses since the activities differ seasonally (Figure 24, Chapter 5, CCP), activities are dispersed along the River, and most uses are not occurring on the same area at the same time. Currently, fishing and hunting occur simultaneously on the River without many known conflicts.

Anticipated Impacts of Uses on Future Lands within the Approved Boundary: The following conditions must be met before allowing existing uses to occur on newly acquired lands: (1) There is no indirect, direct, or cumulative threat anticipated to human health or safety; (2) There is no indirect, direct, or cumulative threat anticipated to natural or cultural resources; (3) The use is consistent with management of existing Sacramento River Refuge lands and would contribute to achieving Refuge goals. In particular, existing Refuge regulations would not be compromised; (4) The newly acquired lands represent a meaningful unit within which to manage the activity; and (5) There are no anticipated conflicts with priority public use.

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the Draft CCP and Environmental Assessment for the Sacramento River Refuge.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Monitor fishing use to ensure that facilities are adequate and disturbance to wildlife continues to be minimal.
- Only riverine sections, oxbow lakes and ponds, and Packer Lake of the Refuge will be open to fishing (no ditches or marshes due to disturbance of wildlife) (Figure 27, Chapter 5, CCP).
- Parking areas, roads, and related access facilities will be maintained as necessary to ensure public safety and to prevent erosion or habitat damage.
- Promote use of non-toxic sinkers, split shot, and lures.
- Proper zoning and regulations will be designated.
- Law enforcement patrol by game wardens, park rangers, and Refuge officers

Justification: Fishing is an appropriate wildlife-dependent recreational activity. Based upon biological impacts described in the Fishing Plan, Comprehensive Conservation Plan and Environmental Assessment, it is determined that fishing within the Sacramento River National Wildlife Refuge will not materially interfere with or detract from the purposes for which the Refuge was established.

Fishing is a priority public use listed in the Improvement Act. By facilitating this use on the Refuge, we hope to increase the visitors' knowledge and appreciation of fish and wildlife, which may lead to increased public stewardship of wildlife and their habitats on the Refuge and along the Sacramento River. Increased public stewardship will support and complement the Service's actions in achieving the Refuge's purposes and the mission of the National Wildlife Refuge System.

Because of the limited access and number of visitors to the Refuge, this would not pose a significant problem and could be handled with existing staff. This program as described is determined to be compatible and will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date (October 2019):

__X____ Mandatory 15-year Re-Evaluation, Date will be provided in Final EA/CCP (for priority public uses)

_____ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

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USFWS, California Department of Fish and Game and California Department of Parks and Recreation. 2001. Memorandum of Understanding. 5 pgs.

COMPATIBILITY DETERMINATION
(June 2004)

Use: Wildlife Observation, Wildlife Photography, and Interpretation

Refuge Name: Sacramento River National Wildlife Refuge, located in Tehama, Butte, Glenn and Colusa counties, California.

Establishing and Acquisition Authority(ies): Sacramento River National Wildlife Refuge (Refuge) was established in 1989. Approximately 11,000 acres of the approved 18,000 acres have been acquired. Legal authorities used for establishment of the Refuge include: the Endangered Species Act of 1973 as amended (16 U.S. Code 1531-1543: 87 Statute 884), the Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901(b) and the Fish and Wildlife Act of 1956 (16 U.S. Code 742).

Refuge Purpose(s): Sacramento River Refuge purposes include:

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. Sec. 1534 (Endangered Species Act of 1973)

".. the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..."16 U.S.C. 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. 742f (a) (4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. Sec. 742f (b) (1) (Fish and Wildlife Act of 1956)

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use: Wildlife observation, photography, and interpretation are considered together in this Compatibility Determination because all are considered to be wildlife-dependent, non-consumptive uses and many elements of these programs are similar. All three of these public uses are dependent upon establishing trails and vehicle parking areas in the Refuge as well as remote access points from boats. We estimate 15,000 visitors each year will participate in these activities. These uses are identified and discussed in detail in Chapter 5 of the CCP (USFWS 2004) and are incorporated by reference.

Some highlights are as follows:

a) Develop and maintain walking trails on Rio Vista, Pine Creek, Capay, Ord Bend, Sul Norte, Codora and Packer Units to provide wildlife viewing and photographic opportunities and to promote awareness about the value of riparian habitat, management efforts, and plant/wildlife identification tips.
b) Construct a wildlife viewing/photography blind on the Codora Unit as funding becomes available.
c) Place public use signs at the approximate ordinary high water mark on units that will be opened to the public (Figure 26, Chapter 5, CCP) at appropriate (1/2 mile intervals) accessible points. The signs will depict the unit name, river mile, and public uses allowed/ prohibited. The public will be able to access the units by boat.
d) Place interpretive signs and brochure racks at vehicle entrances and boat ramps.

Availability of Resources: The following funding/annual costs (based on FY 2003 costs) would be required to administer and manage the activities as described above:

	One-time Costs	**Annual Costs**
Administration		$20,000
Law enforcement		$45,000
Construct and maintain 7 interpretive walking trails	$60,000	$5,000
Construct and maintain photography blind	$4,000	$1,000
Interpretive panels and kiosk	$25,000	$2,000
Signs, brochures, and brochure racks at 13 vehicle parking areas/boat launches	$20,000	$3,000
Construct and maintain 8 parking areas	$80,000	$2,000
TOTAL	**$189,000**	**$78,000**

Refuge operational funds are currently available through the Service budget process to administer these uses.

Anticipated Impacts of Use: The construction and maintenance of trails, photography blind and parking lots will have minor impacts on soils and vegetation around the trails. This could include an increased potential for erosion, soil compaction (Liddle 1975), reduced seed emergence (Cole and Landres 1995), alteration of vegetative structure and composition, and sediment loading (Cole and Marion 1988).

The Refuge provides habitat for resident and migratory wildlife. As a result of these activities, individual animals may be disturbed by human contact to varying degrees. Human activities on trails can result in direct effects on wildlife through harassment, a form of disturbance that can cause physiological effects, behavioral modifications, or death (Smith and Hunt 1995). Many studies have shown that birds can be impacted from human activities on trails when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more

energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989). Herons and shorebirds were observed to be the most easily disturbed (when compared to gulls, terns and ducks) by human activity and flushed to distant areas away from people (Burger 1981). A reduced number of shorebirds were found near people who were walking or jogging, and about 50% of flushed birds flew elsewhere (Burger 1981). In addition, the foraging time of sanderlings decreased and avoidance (e.g., running, flushing) increased as the number of humans within 100 meters increased at a coastal bay refuge on the Atlantic (Burger and Gochfeld 1991). Nest predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1978), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). This could potentially limit the number of breeding pairs of certain passerine species, thus limiting production within refuge riparian habitats (Reijnen and Foppen 1994). In our opinion, due to the habitat requirements and life cycles of Valley elderberry longhorn beetle and Chinook salmon these species will not be impacted by these activities.

Of the wildlife observation techniques, wildlife photographers tend to have the largest disturbance impacts (Klein 1993, Morton 1995, Dobb 1998). While wildlife observers frequently stop to view species, wildlife photographers are more likely to approach wildlife (Klein 1993). Even slow approach by wildlife photographers tends to have behavioral consequences to wildlife species (Klein 1993). Other impacts include the potential for photographers to remain close to wildlife for extended periods of time, in an attempt to habituate the wildlife subject to their presence (Dobb 1998) and the tendency of casual photographers, with low-power lenses, to get much closer to their subjects than other activities would require (Morton 1995), including wandering off trails. This usually results in increased disturbance to wildlife and habitat, including trampling of plants.

The Wildlife Observation, Photography, and Interpretation programs have been designed to avoid or minimize impacts anticipated to Refuge resources and Refuge visitors. Hunting may be impacted by wildlife observation, photography and interpretation. However, the timing of hunt seasons minimizes the overlap with other public uses (Figure 24, Chapter 5, CCP). Accordingly, in our opinion, these uses will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Anticipated Impacts of Uses on Future Lands within the Approved Boundary: The following conditions must be met before allowing existing uses to occur on newly acquired lands: (1) There is no indirect, direct, or cumulative threat anticipated to human health or safety; (2) There is no indirect, direct, or cumulative threat anticipated to natural or cultural resources; (3) The use is consistent with management of existing Sacramento River Refuge lands and would contribute to achieving Refuge goals. In particular, existing Refuge regulations would not be compromised; (4) The newly acquired lands represent a

meaningful unit within which to manage the activity; and (5) There are no anticipated conflicts with priority public uses.

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the Draft CCP and Environmental Assessment for the Sacramento River Refuge.

Determination:

_____ Use is Not Compatible

__X__ Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Adequate areas would be designated as wildlife sanctuary with no or limited public use activities to provide high quality habitat for feeding, resting, and nesting. Trails will be designed utilizing existing service roads and open savannah habitat types to provide adequate sanctuary areas. Where site conditions permit, native trees and shrubs will be planted to create screening along trails to reduce disturbance. These measures will also enhance viewing opportunities and provide quality wildlife observation, photography and interpretation experiences.

- Regulations and wildlife friendly behavior (e.g., requirements to stay on designated trails, dogs must be kept on a leash, etc.) will be described in brochures and posted at the Visitor Contact Station(s).

- Refuge biologists and public use specialists will conduct regular surveys of public activities on the refuge. The data will be analyzed and used by the Refuge Manager to develop future modifications if necessary to ensure compatibility of the wildlife observation, photography, and interpretation programs.

Justification: These wildlife-dependent uses are priority public uses of the National Wildlife Refuge System. Providing opportunities for wildlife observation, photography, and environmental interpretation would contribute toward fulfilling provisions of the National Wildlife Refuge System Administration Act, as amended in 1997, and one of the goals of the Sacramento River Refuge (Goal 2, Chapter 5, CCP). Wildlife observation, photography, and interpretation would provide an excellent forum for allowing public access and increasing understanding of Refuge resources. The stipulations outlined above should minimize potential impacts relative to wildlife/human interactions. In our opinion, these wildlife dependent uses will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date (October 2019):

__X__ Mandatory 15-year Re-Evaluation, Date will be provided in Final EA/CCP (for priority public uses)

_____ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

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COMPATIBILITY DETERMINATION
(June 2004)

Use: Environmental Education

Refuge Name: Sacramento River National Wildlife Refuge, located in Tehama, Butte, Glenn and Colusa counties, California.

Establishing and Acquisition Authority(ies): Sacramento River National Wildlife Refuge (Refuge) was established in 1989. Approximately 11,000 acres of the approved 18,000 acres have been acquired. Legal authorities used for establishment of the Refuge include: the Endangered Species Act of 1973 as amended (16 U.S. Code 1531-1543: 87 Statute 884), the Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901(b) and the Fish and Wildlife Act of 1956 (16 U.S. Code 742).

Refuge Purpose(s): Sacramento River Refuge purposes include:

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. Sec. 1534 (Endangered Species Act of 1973)

".. the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..."16 U.S.C. 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. 742f (a) (4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. Sec. 742f (b) (1) (Fish and Wildlife Act of 1956)

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use: Currently, the environmental education program at Sacramento River Refuge serves approximately 300 students a year. The environmental education program is designed to provide effective resources, tools, and training which facilitates the teaching of accurate scientific and environmental information about the Sacramento River watershed and surrounding areas. The Refuge encourages environmental education as a process of building knowledge in students. The Refuge staff will work with schools (K-12) to integrate environmental concepts and concerns into structured educational activities. Refuge staff will promote environmental education that is: aligned to the current Federal, State and local standards; curriculum based the meets the goals of the

school districts adopted instructional standards; and provides interdisciplinary opportunities, linking the natural world with all subject areas. The environmental education program will be managed in accordance of Fish and Wildlife Service Manual Chapter 605 FW 6, Environmental Education. The proposed environmental education program is discussed in detail as part of the Proposed Action in the CCP and associated EA (CCP Chapter 5 and Appendix A), which are incorporated by reference (USFWS 2004).

Environmental education is identified in the Improvement Act as one of the Big 6 legislated wildlife-dependent, priority public uses.

Environmental education is not considered a Refuge management economic use.

The Refuge proposes to develop an environmental education program by 2005 to service about 1,000 students. Primary visitation will occur during the traditional school year of August through May. Educators will attend a teacher orientation and will design, schedule, and facilitate their own field trips on the Refuge. Refuge staff will provide teacher training, site-specific curricula, materials, and activities, and field trip assistance to enhance learning in an outdoor setting. A local school district guideline for supervision during a field trip recommends one adult for up to ten students and requires at least one credentialed teacher.

Rio Vista, Pine Creek, Phelan Island, Ord Bend, and Packer Units could be promoted as the primary units for school groups to visit (Figure 27, Chapter 5, CCP). The areas meet the basic health and safety needs for students i.e. rest rooms, trails, bus parking, etc. Students will utilize walking trails and picnic tables, to complete their activities and studies. Environmental education study sites on Phelan, Pine Creek, and Ord Bend Units will provide areas for more in-depth studies where students and teachers will participate in restoration and monitoring activities through one-time activities or more long-term monitoring studies.

Students participating in restoration and monitoring activities will work as described in the environmental education program and as permitted in their reservation form. The reservation form allows the teacher to request specific activities or materials. Students will be trained by Refuge staff before they start restoration and monitoring projects to ensure their safety while out in the field, to minimize wildlife and habitat disturbance and to maximize project success.

Future environmental education opportunities on newly acquired lands will include student and teacher participation in habitat restoration and monitoring activities that would be incorporated into the overall program. This compatibility determination will be re-evaluated if new activities in the expansion area are anticipated to significantly change the level of use or impacts.

Availability of Resources: The following funding/annual costs (based on FY 2003 costs) would be required to administer and manage environmental education activities as described above:

	One-time Costs	Annual Costs
Administration		$5,000
Establish and Maintain Study Sites	$10,000	$2,000
Staffing (teacher training, student support curriculum development, field trip assistance, teaching students, and administration)	$3,000	$1,000
Equipment, materials, and supplies	$5,000	$2,000
TOTAL	**$18,000**	**$10,000**

Funds are anticipated to be available through the Service budget process for construction of a visitor contact station, establishment of study sites, and potentially some operational costs. Additional funding for staffing and operational costs would be needed. Other sources will be sought through strengthened partnerships, grants, and additional Refuge operations funding to support a safe, quality environmental education program as described above.

Anticipated Impacts of Use: Opening the Refuge to environmental education activities will be compatible with the Refuge's purposes, goals, and objectives and the Refuge System mission.

The construction and maintenance of packed gravel or dirt trails, boardwalks, and platforms will have minor impacts on soils and vegetation around the trails. This could include an increased potential for erosion, soil compaction (Liddle 1975), reduced seed emergence (Cole and Landres 1995), alteration of vegetative structure and composition, and sediment loading (Cole and Marion 1988).

Human activities on trails can result in direct effects on wildlife through harassment, a form of disturbance that can cause physiological effects, behavioral modifications, or death (Smith and Hunt 1995). Birds can be impacted from human activities on trails when they are disturbed and flushed from feeding, resting, or nesting areas. Flushing, especially repetitive flushing, can strongly impact habitat use patterns of many bird species. Flushing from an area can cause birds to expend more energy, be deterred from using desirable habitat, affect resting or feeding patterns, and increase exposure to predation or cause birds to abandon sites with repeated disturbance (Smith and Hunt 1995). Migratory birds are observed to be more sensitive than resident species to disturbance (Klein 1989). Herons and shorebirds were observed to be the most easily disturbed (when compared to gulls, terns and ducks) by human activity and flush to distant areas away from people (Burger 1981). A reduced number of shorebirds were found near people who were walking or jogging, and about 50% of flushed birds flew elsewhere (Burger 1981). In addition, the foraging time of sanderlings decreased and avoidance (e.g., running, flushing) increased as the number of humans within 100 meters increased at a coastal bay refuge on the Atlantic (Burger and Gochfeld 1991). Nest

predation for songbirds (Miller et al. 1998), raptors (Glinski 1976), colonial nesting species (Buckley and Buckley 1978), and waterfowl (Boyle and Samson 1985) tends to increase in areas more frequently visited by people. In addition, for many passerine species, primary song occurrence and consistency can be impacted by a single visitor (Gutzwiller et al. 1994). This could potentially limit the number of breeding pairs of certain passerine species, thus limiting production within refuge riparian habitats (Reijnen and Foppen 1994).

The disturbance by environmental education activities is considered to be of minimal impact because: (1) the total number of students permitted through the reservation system is limited to 100 per day; (2) students and teachers will be instructed in trail etiquette and the best ways to view wildlife with minimal disturbance; (3) education groups will be required to have a sufficient number of adults to supervise the group; (4) trail design will provide adequate cover for wildlife; and (5) observation areas and scopes are provided to view wildlife at a distance which reduces disturbance.

Disturbance by students is considered minimal as study sites will be placed in areas already impacted by trail users and Refuge staff, and all off-trail activity will be focused in these small areas. Educators will be instructed on use of the study areas during teacher orientation workshops. Collection of samples for study (i.e., mud, water, plants) will be restricted to study areas, and samples must be used on site. Collection will be of materials needed to enhance hands-on learning and investigation and will be designed as part of structured activities and lessons, guided by teachers, and monitored by Refuge staff. These activities are an integral part of the education program design and philosophy and their impacts are considered minimal.

Education staff will coordinate with Biology staff regarding activities associated with restoration or monitoring projects to ensure that impacts to both wildlife and habitat are minimal. As with any restoration and monitoring activities conducted by Refuge personnel, these activities conducted by students would be at a time and place where the least amount of disturbance would occur.

Anticipated Impacts of Uses on future lands within the approved boundary: The following conditions must be met before allowing existing uses to occur on newly acquired lands: (1) There is no indirect, direct, or cumulative threat anticipated to human health or safety; (2) There is no indirect, direct, or cumulative threat anticipated to natural or cultural resources; (3) The use is consistent with management of existing Sacramento River Refuge lands and would contribute to achieving Refuge goals. In particular, existing Refuge regulations would not be compromised; (4) The newly acquired lands represent a meaningful unit within which to manage the activity; and (5) There are no anticipated conflicts with priority public uses.

Future environmental education opportunities in the expansion area associated with habitat restoration and monitoring will have similar impacts as described above.

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the draft CCP/EA for Sacramento River Refuge. Following the public review and comment period, comments and actions taken to address comments will be summarized here.

Determination:

_____Use is Not Compatible

__X__Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- Participants in the Refuge's environmental education program will be restricted to established trails, study sites, and other facilities including buildings and photo blinds

- All groups using the Refuge for environmental education will be required to make reservations in advance through the Refuge office. This process, which takes the place of a Special Use Permit, allows refuge staff to manage the number and location of visitors for each unit. There is a current refuge policy that educational groups are not charged a fee or required to have a SUP. A daily limit of 100 students participating in the education program will be maintained through this reservation system. Efforts will be made to spread out use by large groups while reservations are made, reducing disturbance to wildlife and over-crowding of Refuge facilities during times of peak demand.

- Trail etiquette including ways to reduce wildlife disturbance will be discussed with teachers during orientation workshops and with students upon arrival during their welcome session. On the refuge, the teacher(s) is responsible for ensuring that students follow required trail etiquette.

- Environmental education study sites will be located where minimal impact to Refuge resources will occur. Refuge biologists and public use specialists will conduct regular surveys of public activities on the refuge. The data will be analyzed and used by the Refuge Manager to develop future modifications if necessary to ensure compatibility of environmental education programs.

Justification: Environmental education is a priority public use of the National Wildlife Refuge System. It is the intent of the Refuge staff to provide a quality environmental education program. To achieve this goal, the Refuge environmental education program would provide a diversity of environmental education opportunities to students and teachers. These include: (1) facilities, materials, and training; (2) access to a variety of Refuge habitats; and (3) the ability to observe wildlife and conduct hands-on exploration. The program is intended to foster a better understanding of Refuge ecosystems and

wildlife resources, and in turn foster a public that is knowledgeable about and involved in natural resource stewardship. Although there is some impact to Refuge lands and wildlife in having an environmental education program, efforts will be made to ensure that they are kept within acceptable levels. The environmental education program, as described herein, will occur without unacceptable impacts to refuge resources. In our opinion, environmental education will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date (October 2019):

__X____Mandatory 15-year Re-Evaluation, Date will be provided in Final EA/CCP (for priority public uses)

_____ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

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Reijnen, R. and R. Foppen. 1994. The effects of car traffic on breeding bird populations in woodland. I. Evidence of reduced habitat quality for willow warbler (*Pylloscopus trochilus*) breeding close to a highway. J. Appl. Ecol 31: 85-94.

Smith, L. and J. D. Hunt. 1995. Nature tourism: impacts and management. Pp. 203-219 in Knight, R. L.; Gutzwiller, K. J. (Wildlife and recreationists: coexistence through management and research, eds.). Island Press, Washington, D. C.

USFWS. 2004. Sacramento River National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment. U.S. Fish and Wildlife Service, Region 1.

COMPATIBILITY DETERMINATION
(June 2004)

Use: Research

Refuge Name: Sacramento River National Wildlife Refuge, located in Tehama, Butte, Glenn and Colusa counties, California.

Establishing and Acquisition Authority(ies): Sacramento River National Wildlife Refuge (Refuge) was established in 1989. Approximately 11,000 acres of the approved 18,000 acres have been acquired. Legal authorities used for establishment of the Refuge include: the Endangered Species Act of 1973 as amended (16 U.S. Code 1531-1543: 87 Statute 884), the Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901(b) and the Fish and Wildlife Act of 1956 (16 U.S. Code 742).

Refuge Purpose(s): Sacramento River Refuge purposes include:

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. Sec. 1534 (Endangered Species Act of 1973)

".. the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..."16 U.S.C. 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. 742f (a) (4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. Sec. 742f (b) (1) (Fish and Wildlife Act of 1956)

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use: Two provisions of the National Wildlife Refuge Improvement Act are to "maintain biological integrity, diversity and environmental health" and to conduct "inventory and monitoring." Monitoring and research are an integral part of National Wildlife Refuge management. Plans and actions based on research and monitoring provide an informed approach, which analyzes the management affects on refuge wildlife. Sacramento River Refuge receives over 20 requests per year to conduct scientific research at the Refuge. From 1993 to 2003, there have been between two and 20 active Special Use Permits issued for research and monitoring. Special Use Permits would only be issued for monitoring and investigations which contribute to the enhancement,

protection, preservation, and management of native Refuge plant and wildlife populations and their habitats. Research applicants are required to submit a proposal that outlines: (1) objectives of the study; (2) justification for the study; (3) detailed methodology and schedule; (4) potential impacts on Refuge wildlife or habitat, including disturbance (short and long term), injury, or mortality (this includes a description of measures the researcher will take to reduce disturbance or impacts); (5) research personnel required; (6) costs to Refuge, if any; and (7) progress reports and end products (i.e., reports, thesis, dissertations, publications). Research proposals are reviewed by Refuge staff and conservation partners, as appropriate. Special Use Permits are issued by the Refuge Manager, if the proposal is approved.

Evaluation criteria will include, but not be limited to, the following:

- Research that will contribute to specific Refuge management issues will be given higher priority over other research requests.

- Research that will conflict with other ongoing research, monitoring, or management programs will not be granted.

- Research projects that can be accomplished off-Refuge are less likely to be approved.

- Research which causes undue disturbance or is intrusive will likely not be granted. Level and type of disturbance will be carefully evaluated when considering a request.

- Refuge evaluation will determine if any effort has been made to minimize disturbance through study design, including considering adjusting location, timing, scope, number of permittees, study methods, number of study sites, etc.

- If staffing or logistics make it impossible for the Refuge to monitor researcher activity in a sensitive area, the research request may be denied, depending on the specific circumstances.

- The length of the project will be considered and agreed upon before approval. Projects will be reviewed annually.

These criteria will also apply to any properties acquired in the future within the approved boundary of the Refuge.

Availability of Resources: The following funding/annual costs (based on FY 2003 costs) would be required to administer and manage research activities as described above:

	Annual Costs
Administration (Evaluation of applications, management of permits, and monitoring of research projects)	$18,000
TOTAL	**$18,000**

Refuge operational funds are currently available through the Service budget process to administer this program.

Anticipated Impacts of Use: Use of the Refuge to conduct research will benefit Refuge fish, wildlife, plant populations, and their habitat. Monitoring and research investigations are an important component of adaptive management. Research investigations would be used to evaluate habitat restoration projects and ecosystem health (Golet et al. 2003; Stillwater Sciences 2003). Specific restoration and habitat management questions would be addressed in most research investigations to improve habitat and benefit wildlife populations. Standardized monitoring would be used to insure data compatibility for comparisons from across the landscape so that natural resource bottleneck areas could be identified for habitat enhancement and restoration (Elzinga et al. 1998; Ralph et al. 1993). Focal species and indicator species would be identified and investigated and monitored to measure and track riparian habitat restoration success and ecosystem health (Riparian Habitat Joint Venture 2003; Stillwater Sciences 2003).

An expected short-term effect of monitoring and research investigations is that Refuge management activities would be modified to improve habitat and wildlife populations, as a result of new information. Expected long-term and cumulative effects include a growing body of science-based data and knowledge as new continued monitoring and new research compliments and expands upon previous investigations; and, an expanded science-based body of data and information from which to draw upon to implement the best Refuge management possible. Natural resources inventory, monitoring and research are not only provisions of the Refuge Improvement Act, but they are necessary tools to maintain biological integrity and diversity and environmental health, which are also key provisions of the act. Inventory, monitoring and research are intended to improve habitat and wildlife populations. This would improve wildlife-dependent recreation by increasing encounters with wild things.

Some direct and indirect effects would occur through disturbance which is expected with some research activities, especially where researchers are entering sanctuaries. Researcher disturbance would include altering wildlife behavior, going off designated trails, collecting soil and plant samples or trapping and handling wildlife. However, most of these effects would be short-term because only the minimum of samples (e.g., water, soils, vegetative litter, plants, macroinvertebrates) required for identification and/or experimentation and statistical analysis would be permitted and captured and marked

wildlife would be released. Long-term effects would be eliminated/reduced because refuge evaluation of research proposals would insure only proposals with adequate safeguards to avoid/minimize impacts would be accepted. Potential impacts associated with research activities would be mitigated/minimized because sufficient restrictions would be included as part of the study design and researcher activities would be monitored by Refuge staff. Refuge staff would ensure research projects contribute to the enhancement, protection, preservation, and management of native Refuge wildlife populations and their habitats thereby helping the Refuge fulfill the purposes for which it was established, the mission of the National Wildlife Refuge System, and the need to maintain ecological integrity. Additionally, Special Use Permit conditions would include conditions to further ensure that impacts to wildlife and habitats are avoided and minimized.

Anticipated Impacts of Uses on future lands within the approved boundary: The following conditions must be met before allowing existing uses to occur on newly acquired lands: (1) There is no indirect, direct, or cumulative threat anticipated to human health or safety; (2) There is no indirect, direct, or cumulative threat anticipated to natural or cultural resources; (3) The use is consistent with management of existing Sacramento River Refuge lands and would contribute to achieving Refuge goals. In particular, existing Refuge regulations would not be compromised; (4) The newly acquired lands represent a meaningful unit within which to manage the activity; and (5) There are no anticipated conflicts with priority public uses.

When new lands are acquired by the Refuge, the Refuge would ensure, through the Stipulations presented herein and the terms and conditions in the Special Use Permit, that impacts would be similar to, if not less than, those described.

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the Draft CCP and Environmental Assessment for the Sacramento River Refuge (USFWS 2004).

Determination: This program as described is determined to be compatible. Potential impacts of research activities on Refuge resources will be minimized because sufficient restrictions and safeguards would be included in the Special Use Permit and research activities will be monitored by the Refuge manager and biologist. The Refuge manager and biologist would ensure that proposed monitoring and research investigations would contribute to the enhancement, protection, conservation, and management of native Refuge wildlife populations and their habitats thereby helping the Refuge fulfill the purposes for which it was established, the mission of the National Wildlife Refuge System, and the need to maintain ecological integrity, diversity, and environmental health.

_____Use is Not Compatible

__X__Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility: The criteria for evaluating a research proposal, outlined in the Description of Use section above, will be used when determining whether a proposed study will be approved on the Refuge. If proposed research methods are evaluated and determined to have potential adverse impacts on refuge wildlife or habitat, then the refuge would determine the utility and need of such research to conservation and management of refuge wildlife and habitat. If the need was demonstrated by the research permittee and accepted by the refuge, then measures to minimize potential impacts (e.g., reduce the numbers of researchers entering an area, restrict research in specified areas) would be developed and included as part of the study design and on the Special Use Permit. Special Use Permits will contain specific terms and conditions that the researcher(s) must follow relative to activity, location, duration, seasonality, etc. to ensure continued compatibility. All Refuge rules and regulations must be followed unless otherwise accepted in writing by Refuge management.

Extremely sensitive wildlife habitat areas would be avoided unless sufficient protection from research activities (i.e., disturbance, collection, capture and handling) is implemented to limit the area and/or wildlife potentially impacted by the proposed research. Where appropriate, some areas may be temporarily/seasonally closed so that research would be permitted when impacts to wildlife and habitat are no longer a concern. Research activities will be modified to avoid harm to sensitive wildlife and habitat when unforeseen impacts arise.

Refuge staff will monitor researcher activities for potential impacts to the refuge and for compliance with conditions on the Special Use Permit. The refuge manager may determine that previously approved research and special use permits be terminated due to observed impacts. The Refuge Manager will also have the ability to cancel a Special Use Permit if the researcher is out of compliance with the conditions of the SUP.

Justification: This program as described is determined to be compatible. Refuge monitoring and research will directly benefit and support refuge goals, objectives and management plans and activities. Fish, wildlife, plants and their habitat will improve through the application of knowledge gained from monitoring and research. Biological integrity, diversity and environmental health would benefit from scientific research conducted on natural resources at the refuge. The Big 6 wildlife-dependent, priority public uses (wildlife viewing and photography, environmental education and interpretation, fishing and hunting) would also benefit as a result of increased biodiversity and wildlife and native plant populations from improved restoration and management plans and activities associated with monitoring and research investigations which address specific restoration and management questions.

Mandatory Re-Evaluation Date (October 2014):

_____ Mandatory 15-year Re-Evaluation (for priority public uses)

__X__ Mandatory 10-year Re-Evaluation, Date will be provided in Final EIS/CCP (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

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COMPATIBILITY DETERMINATION
(June 2004)

Use: Camping and Recreational Boating

Refuge Name: Sacramento River National Wildlife Refuge, located in Tehama, Butte, Glenn and Colusa counties, California.

Establishing and Acquisition Authority(ies): Sacramento River National Wildlife Refuge (Refuge) was established in 1989. Approximately 11,000 acres of the approved 18,000 acres have been acquired. Legal authorities used for establishment of the Refuge include: the Endangered Species Act of 1973 as amended (16 U.S. Code 1531-1543: 87 Statute 884), the Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901(b) and the Fish and Wildlife Act of 1956 (16 U.S. Code 742).

Refuge Purpose(s): Sacramento River Refuge purposes include:

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. Sec. 1534 (Endangered Species Act of 1973)

".. the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..."16 U.S.C. 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. 742f (a) (4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. Sec. 742f (b) (1) (Fish and Wildlife Act of 1956)

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use: Camping and recreational boating are combined and evaluated together in this compatibility determination because access to camping on the refuge can only occur by boat. The Comprehensive Conservation Plan (CCP) Proposed Action would provide camping and associated recreational opportunities below the Ordinary High Water Mark with an emphasis on facilitating priority public uses, including hunting, fishing, wildlife observation, photography, environmental education, and interpretation (USFWS 2004). Fifteen of the twenty-three units proposed to be open for public use require refuge visitors to access by boat (Figure 27, Chapter 5, CCP). Those 15 units lack public or county roads and access through private farms is limited to refuge staff for

management and administrative purposes only. Restrictions on camping would be aimed at minimizing impacts to wildlife and habitat as well as conflicts with other users, and reducing the potential for wildfires. The Sacramento River is a navigable water within California and boating has been a traditional use. The jurisdiction of the Service regarding navigable waters within the Refuge is discussed in Chapter 1 of the CCP. Boating activities within the river are subject to existing State and Federal laws. No changes are proposed.

Recreational boating use addressed in this compatibility determination includes motorboats and non-motorized boats, including kayaks and canoes, in those waters under the jurisdiction of the Refuge (e.g. floodwater areas, isolated oxbows, and other floodplain wetlands). Motorboats include a variety of crafts powered by 2-cycle or 4-cycle engines. It does not include personal watercraft (jet ski) use

Camping has not previously been allowed on the Refuge. Historically, camping occurred on most gravel bars along the Sacramento River including those that were eventually acquired by the Refuge. Some demand occurs for camping on the Refuge from visitors wishing to conduct multiple day floats and visitors desiring to secure a hunting location on the Refuge. This demand is seasonal, with a majority of the camping activities occurring during the months of August and September. The anticipated peak use period weekend would be the annual opening of dove season in early September. Camping activity will be allowed to occur on designated Refuge gravel bars below the Ordinary High Water Mark (Figure 26, Chapter 5, CCP). No special facilities would be provided for this type of camping with the exception that a primitive group camping area may be designated at the gravel bar on the Dead Man's Reach Unit. The group site would be available by permit only to formal organizations with groups larger than 20 individuals (e.g., boy scout groups, youth groups, etc…). Access to all of the camping areas is by boat from the navigable waters of the Sacramento River (under State jurisdiction).

Availability of Resources: Development of specific a campground on the Dead Man's Reach Unit would require additional funding to build, maintain, and monitor. Currently, resources are stretched to maintain existing Refuge facilities and conduct law enforcement of existing public uses.

The following funding/annual costs (based on FY 2003 costs) would be required to administer and manage boating activities as described above:

	One-time Costs	**Annual Costs**
Administration	$2,000	$2,000
Law Enforcement		$10,000
Outreach, Education, and Monitoring		$5,000
Boundary surveys and posting	$15,000	$2,000
Camp Site Development and Maintenance	$25,000	$10,000
Signs	$3,000	$1,000
TOTAL	**$45,000**	**$30,000**

Additional funds would be required to construct, operate, and maintain visitor facilities and interpretive materials (see summary table above). Law enforcement staffing would also be needed. Funding would be sought through the Service budget process. Other sources will be sought through strengthened partnerships, grants, coordination with other law enforcement agencies, and additional Refuge operations funding to support a safe, quality public use program as described above.

No boat ramps or other boating related facilities are proposed to be developed within the Refuge.

Anticipated Impacts of Use: Camping and associated recreational boating have occurred for many years along the Sacramento River. Boating activity, both motorized and non-motorized, can alter distribution, reduce use of particular habitats or entire areas by waterbirds and other birds, alter feeding behavior and nutritional status, and cause premature departure from areas (Knight and Cole 1995). More sensitive species may find it difficult to secure adequate food or loafing sites as their preferred habitat becomes fragmented and recreation-related disturbances increase (Skagen et al. 1991; Pfister et al. 1992). Motorized boats generally have more impact on wildlife than non-motorized boats because motorboats produce a combination of movement and noise (Tuite et al. 1983, Knight and Cole 1995). For example, a significant decrease in the proportion of bald eagles feeding at a site was observed when motorized boating activity occurred within 200 meters of that area in the preceding 30 minutes (Skagen 1980). Motorized boats can also cover a larger area in a relatively short time, in comparison to non-motorized boats. Even canoes and kayaks can cause significant disturbance effects based on their ability to penetrate into shallower areas of the marsh (Speight 1973, Knight and Cole 1995). In the Ozark National Scenic Riverway, green-backed heron activity declined on survey routes when canoes and boat use increased on the main river channel (Kaiser and Fritzell 1984). Canoes or slow-moving boats have also been observed to disturb nesting great blue herons (Vos et al. 1985). Huffman (1999) found that non-motorized boats within 30 meters of the shoreline in south San Diego Bay caused all wintering waterfowl to flush between the craft and shore. However, compared to motorboats, canoes and kayaks appear to have less disturbance effects on most wildlife species (Jahn and Hunt 1964, Huffman 1999, DeLong 2002).

In Denmark, fast-moving boats were observed to have the greatest impact on red-breasted merganser broods (Kahlert 1994). The presence of fast-moving boats also caused the most significant modifications to the amount of time animals spent feeding and resting. In England, an increased rate of disturbance from boats partly caused a decline in roosting numbers of shorebird species (Burton et al. 1996). In addition, boaters have been observed to cause massive flights of diving ducks on the Mississippi River (Thornburg 1973). Motorized boats within 100 meters of shore caused all wintering waterfowl and shorebirds to flush between the craft and shore in south San Diego Bay, regardless of speed. However, disturbance to birds in general was reduced when boats traveled at or below the 5 mph speed limit (Huffman 1999).

Impacts of boating can occur even at low densities, given their noise, speed, and ability to cover extensive areas in a short amount of time. The total number of boats and people can be an inappropriate measure of recreational intensity because the presence of a single boat might be just as disturbing as that of many (Tuite et al. 1983, Knight and Knight 1984).

The habitat along the Sacramento River is a relatively narrow riparian corridor system that receives high use by a variety of Neotropical migratory birds, waterbirds, and raptors. Because boats in confined areas are generally closer to shorelines, waterbirds in sloughs and on the river may be exposed to more human activity than birds in other shoreline habitats (Bratton 1990). Even low levels of boating activity affect the duration and pattern of use by wildlife in this narrow system. In addition, disturbance to nesting birds is caused by boat activity. Active osprey nests occur along the river within and outside the Refuge. Nesting heron and egret colonies occur along the river in the Llano Seco, Flynn, and Moony Units. Nesting great blue herons are sensitive to a variety of human disturbances. Great blue herons were one of the most sensitive of 23 waterbird species, when measuring flush distances from motorized watercraft (Rodgers and Schwikert 2002).

Motorized boats introduce noise and pollution, in the form of gas and oil in water, and particulates in the air in the riverine habitats of the Refuge. However, please note that the majority of the boat access occurs on State waters outside the jurisdiction of the Refuge.

Camping is a high impact activity which can result in the degradation of Refuge habitat. Camping in itself can disturb and disperse wildlife. Human activity, generators, loud motors, music and dogs associated with some types of camping disturb wildlife and can detract from the outdoor experience of other Refuge users. Fires and firewood collection damage habitat. Use of detergent, soap, and toothpaste in or near rivers harm fish and other aquatic life. Human waste creates unsanitary conditions and litter. Campers sometimes leave garbage, litter, and other undesirable items. Creation of improvements (e.g., lean-tos, tables, rock walls, etc.) and alteration of the site can be byproducts of camping and may impact localized gravel bar vegetation.
Camping can result in inappropriate uses (e.g., littering, deposition of human waste), devalues vegetation and trampled and devalued wildlife habitats. Camping can degrade land, water, and wildlife by simplifying plant communities, increasing mortality, displacing and disturbing wildlife and distributing refuse (Boyle and Samson 1985). In addition, camping induced soil disturbance may provide conditions that favor weed infestations. Camping in riparian areas may also result in increased runoff into streams due in part to exposed soil and reduction in vegetation (Green 1998). Camping also requires additional law enforcement efforts that may have to be directed at a wide range of violations from those listed above to domestic disturbance/assaults.

In our opinion, the limited camping and associated boating will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Anticipated Impacts of Uses on future lands within the approved boundary: The following conditions must be met before allowing existing uses to occur on newly acquired lands: (1) There is no indirect, direct, or cumulative threat anticipated to human health or safety; (2) There is no indirect, direct, or cumulative threat anticipated to natural or cultural resources; (3) The use is consistent with management of existing Sacramento River Refuge lands and would contribute to achieving Refuge goals. In particular, existing Refuge regulations would not be compromised; (4) The newly acquired lands represent a meaningful unit within which to manage the activity; and (5) There are no anticipated conflicts with priority public uses.

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the Draft CCP and Environmental Assessment for the Sacramento River Refuge.

Determination:

_____Use is Not Compatible

__X__Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- No refuge lands other than gravel bars below Ordinary High Water Mark would be open to camping. Refuge informational signs will be located at the approximate Ordinary High Water Mark. Information will also be distributed in brochures and on the web-site.

- Monitoring of boating and camping activities and associated effects on habitat and wildlife will be conducted. Monitoring data will be used by the Refuge Manager in the periodic re-evaluation of this Compatibility Determination.

- Groups permitted to camp on Refuge lands for the purpose of completing specific projects or utilize a specific refuge unit must adhere to all conditions specified in a special use permit and Refuge regulations.

- Refuge staff will post seasonal camping closures on areas that contain sensitive wildlife species (e.g., active heron colony, osprey nest nearby, etc.)

- No person shall build or maintain fires except on gravel bars in portable gas stoves.

- Limited camping on gravel bars up to seven days is allowed. Camping on Refuge land, other than gravel bars, is prohibited.

- On Refuge lands, excluding gravel bars, entry and departure is restricted to one hour before sunrise to one hour after sunset.

Justification: Camping and associated boating are not considered wildlife-dependent recreation, but many wildlife-dependent recreational activities (fishing, hunting, environmental education, interpretation, wildlife observation and photography) along the river and within the Refuge are associated with boating. Providing opportunities for wildlife-dependent priority public uses would contribute toward fulfilling provisions under the National Wildlife Refuge System Administration Act as amended in 1997. Although boating has a potential to impact riparian wildlife, implementing the prescribed measures listed in the Stipulations section should reduce many of these impacts to acceptable levels. It is anticipated that an adequate amount of habitat would be available to the majority of migratory birds and other native wildlife because State boating regulations would be maintained and enforced. Thus, it is anticipated that migratory birds and other native wildlife will find sufficient food resources and resting places such that their abundance and use of the Refuge will not be measurably lessened, the physiological condition and production of migratory birds and other native wildlife will not be impaired, their behavior and normal activity patterns will not be altered dramatically, and their overall status will not be impaired. The Refuge will also implement a monitoring program to help assess disturbance effects on wildlife and habitat and discern adaptive management options. Improved outreach and educational information for Refuge visitors involved in activities associated with boating would also help to reduce the impacts associated with boating and riverside camping activities. In our opinion, camping and associated boating will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date (October 2014):

_____Mandatory 15-year Re-Evaluation, Date will be provided in Final EA/CCP (for priority public uses)

__X___Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

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COMPATIBILITY DETERMINATION
(*June 2004)*

Use: Cooperative Farming Program

Refuge Name: Sacramento River National Wildlife Refuge, located in Tehama, Butte, Glenn and Colusa counties, California.

Establishing and Acquisition Authority(ies): Sacramento River National Wildlife Refuge (Refuge) was established in 1989. Approximately 11,000 acres of the approved 18,000 acres have been acquired. Legal authorities used for establishment of the Refuge include: the Endangered Species Act of 1973 as amended (16 U.S. Code 1531-1543: 87 Statute 884), the Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901(b) and the Fish and Wildlife Act of 1956 (16 U.S. Code 742).

Refuge Purpose(s): Sacramento River Refuge purposes include:

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. Sec. 1534 (Endangered Species Act of 1973)

".. the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..."16 U.S.C. 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. 742f (a) (4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. Sec. 742f (b) (1) (Fish and Wildlife Act of 1956)

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use: For the past twelve years the Service has been acquiring parcels of land to establish the Sacramento River Refuge. The Service's goal is to purchase remnant forests, oxbow sloughs, and flood prone lands adjacent to or near the Sacramento River. These properties, along the riparian corridor, often include commercial farmland that includes English walnuts, *Juglans regia,* prunes, *Prunus domestica,* almonds, *Prunus amygdalus,* and various field crops. Currently the Refuge has 2,685 acres of agricultural land that includes; 1,529 acres of walnuts, 262 acres of almonds, 0 acres of prunes, 794 acres of row crops, and 100 acres of fallow fields**.** Transition farming activities occur on 7 of the 26 refuge units (La Barranca, Pine Creek, Capay, Dead Man's Reach, Hartley

Island, Codora, Drumheller Slough) (Chapter 3, CCP USFWS 2004). The long-term goal for these agricultural lands is restoration to riparian habitat. In the interim, crops are farmed under an existing Cooperative Land Management Agreement with nonprofit conservation groups that lease the property to local farmers (Refuge files, CLMA). The remaining refuge acreage consists mostly of mixed riparian forest, cottonwood riparian forest, herbland cover, riparian willow scrub, valley oak woodland and savannah, elderberry savannah, gravel bar, grasslands and the 3,204 acres that have been restored to native riparian communities.

General Orchard Management Practices

Orchard production within the Refuge requires progressive management to protect habitat and species while maintaining healthy, productive trees that avoid pest problems. Weeds and pests are controlled throughout the year using an integrated pest management (IPM) strategy (Cerus 2003). Methods include irrigation of the tree rows, domestic bee pollination, and the use of various types of pesticide spraying implements for application of Service approved pesticides. All pesticides are reviewed through the Fish and Wildlife Service National Pesticide Use Proposal Policy prior to authorizing use on the Refuge.

The understory vegetation in the majority of walnut orchards is a managed cover composed of nonnative annual winter weeds; and annual and perennial summer weeds usually Bermuda grass, *Cyanodon dactylon*. The orchards are part of the river floodplain and have a year round cover of resident vegetation which limits the run off of pest control materials. The surface vegetation is mowed during early spring and summer; the walnut orchard units are not disked (Cerus 2003).

General Row Crop Management Practices

Row crops grown on the refuge include corn, wheat, barley, safflower, and sunflower. Typical activities include: discing, planting, mowing to control weed growth, irrigation management, and Service approved herbicide sprays to control weeds. Row crop management activities occur between May and November. The row crop program helps to control weeds during the transition from orchard management to restoration activities.

Availability of Resources: The following funding/annual costs would be required to administer and manage research activities as described herein: The CLMA cooperator carries the major burden of administering the farming program.

	One-time Costs	**Annual Costs**
Administration		$10,000
Research	$25,000	$10,000
TOTAL	**$25,000**	**$20,000**

Anticipated Impacts of Use: The Refuge units, which contain managed walnut orchard production, use the most effective methods of pest control for codling moth, navel orange worm, mites, and walnut husk fly all of which may require a chemical control. All decisions to use a chemical control are based upon monitoring by licensed Pest Control Advisors and are used when cultural and biological methods have failed to control the pests below significantly damaging levels. Failure to treat the pests like codling moth and navel orangeworm, both of which have 3 or 4 generations, will result in population buildups that can impact neighboring walnut and almond orchards. This IPM Plan provides sufficient flexibility to keep the properties managed until further research and field experience with pest control methods can be evaluated and implemented.

It is important to keep the walnut crops managed by the tenant farmers who derive proceeds from the crop versus allowing the large units of walnuts to be unmanaged for years while funding is solicited for restoration. The phasing out of farming on Refuge lands, as opposed to immediate termination, offsets immediate impact to the local farming community and the county tax roles (Jones & Stokes 2002).

Effects to non-target organisms can be: interference with normal biological systems and functions, loss of biomass, loss of diversity, interference with normal ecological relationships, bioaccumulation, and other known and unknown effects. The mission of Refuge is to provide for the conservation of migratory birds, native anadromous fish, endangered and threatened species, native plants and other native animals and their habitats. There is concern that the walnut pest control treatments interfere with the Refuge's mission by reducing and contaminating existing food and water components of habitat. Rare insects or insects that may function as important pollinators for native plants, may also be impacted by walnut arthropod pest treatments. Significant bioaccumulation has not been associated with any of the approved chemical treatments referred to in this plan (Cerus 2003). Specific impacts to non-target species are addressed in the Orchard Integrated Pest Management Plan (Cerus 2003). Potential impacts from pesticides on anadromous fish, invertebrates, songbirds, and other wildlife are mitigated through restricted pesticide use, implementation of vegetative buffers, and seasonal restrictions on activities that may impact sensitive species.

Research Needs: There are many research needs regarding the effects of walnut management within the inner river area adjacent to the Refuge units. The role of biological control from the riparian forest as well as the role of bats, birds, and generalist predators is yet not clearly understood. Success with pheromone disruption in walnuts in northern California is being explored, but success has not been demonstrated on a large scale. Further research on the efficacy of pheromone disruption will be needed before this technology can be recommended for more than one third of the Refuge's walnuts.

Anticipated Impacts of Uses on future lands within the approved boundary: The following conditions must be met before allowing existing uses to occur on newly acquired lands: (1) There is no indirect, direct, or cumulative threat anticipated to human health or safety; (2) There is no indirect, direct, or cumulative threat anticipated to natural or cultural resources; (3) The use is consistent with management of existing Sacramento

River Refuge lands and would contribute to achieving Refuge goals. In particular, existing Refuge regulations would not be compromised; (4) The newly acquired lands represent a meaningful unit within which to manage the activity; and (5) There are no anticipated conflicts with priority public uses.

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the Draft CCP and Environmental Assessment for the Sacramento River Refuge.

Determination:

_____Use is Not Compatible

__X__Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

1. Compliance with annual Pesticide Use Proposal policy.
   - The use of buffers 300 feet or more between the walnut orchard pest control applications and blue elderberry plants should substantially help mitigate effect of applications of walnut pest control treatments on Valley elderberry longhorn beetle (VELB).
   - Wide unsprayed vegetated buffers (200 to 300 feet), reduced application rates (50 to 100 gallons per acre), low active ingredient concentrations, rapid degradation and soil binding, avoidance of applications during inversions or winds over 7mph, and the addition of drift control agents all reduce the opportunity for pesticides of concern to enter aquatic environments.
   - Despite the existence of buffer strips to prevent off site movement or drift of the pest control materials there is still concern that the use of Malathion may have either a transitory or cumulative effects on the reduction of non-target aerial or terrestrial insects, especially those that are rare or serve as pollinators for rare plant species. Inventories of at risk species should be undertaken based on their susceptibility to Malathion treatments. Further field research on the alternative for walnut husk fly control, the spinosad bait, should be accelerated (Cerus 2003).

2. Implementation of the IPM Plan for Walnut Production on the Sacramento River National Wildlife Refuge.
   - Conduct Best Management Practices for orchard farming
   - Experimentation with biological control methods for pest control
   - Monitoring potential impacts to non-target species

3. No public access will occur on farmlands
   - No spray buffers near areas open to the public
   - Notification/signing during periods of pesticide application

Research from other areas needs to continue to be evaluated for application to the Refuge. Furthermore, as new methods or products become available to control walnut pests, those that can provide adequate control with less negative impacts than the existing methods should be evaluated for use on the refuge walnut units if appropriate and feasible.

Justification: This program, as described, is determined to be compatible.
The Refuge Administration Act, 16 U.S.C. 715i, regarding administration of refuges, authorizes the Secretary to enter into agreements with public and private agencies and individuals. Such agreements are also approved under the Improvement Act (Public Law 105-57-Oct. 9, 1997).

Part 29.2 of Title 50, Code of Federal Regulations, entitled "Cooperative Land Management" provides: Cooperative agreements with persons for crop cultivation, haying, grazing, or the harvest of vegetative products, including plant life, growing with or without cultivation on wildlife refuge areas may be executed on a share-in-kind basis when such agreements are in aid or benefit to the wildlife management of the area.

Currently, there are not sufficient funds to restore the 2,685 acres of agricultural lands. The refuge cooperators provide resources to the Refuge to assist in other management activities including the Refuge's goal of riparian habitat restoration associated with these lands. The program provides a cost-effective and economical means for the Service to proceed with restoration projects (USFWS 1994 & 2002). Refuge cooperators combined with refuge personnel and resources working together will provide enhanced overall management of Sacramento River Refuge. Cooperative farmers and private nonprofit conservation organizations have shown a willingness to work with the Service and have the expertise and resources necessary to cooperatively assist in management of Sacramento River Refuge. The completion of defined land management activities by the cooperators will provide direct and substantial overall benefits to Refuge habitat and the associated wildlife.

PRBO has monitored bird populations in different habitat types on the Refuge for over ten years including orchards and fallow fields. Although species diversity and richness is lower in orchards than in riparian habitat, species diversity and richness is measurably higher in the orchards when compared fallow fields (Gilchirst et al. 2002). By eliminating the farming program, in-kind services provide by cooperators for riparian restoration would no longer be available, problems with agricultural pests and noxious weeds would result in poor habitat quality and a perception of irresponsible management of public lands (USFWS 1994).

In our opinion, implementing the Integrated Pest Management Plan, Cooperative Land Management Agreements, and associated stipulations will not conflict with the national policy to maintain the biological diversity, integrity, and environmental health of the refuge.

Mandatory Re-Evaluation Date (October 2014):

_____ Mandatory 15-year Re-Evaluation, Date will be provided in Final EA/CCP (for priority public uses)

___X___ Mandatory 10-year Re-Evaluation (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

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COMPATIBILITY DETERMINATION
(June 2004)

Use: Grazing

Refuge Name: Sacramento River National Wildlife Refuge, located in Tehama, Butte, Glenn and Colusa counties, California.

Establishing and Acquisition Authority(ies): Sacramento River National Wildlife Refuge (Refuge) was established in 1989. Approximately 11,000 acres of the approved 18,000 acres have been acquired. Legal authorities used for establishment of the Refuge include: the Endangered Species Act of 1973 as amended (16 U.S. Code 1531-1543: 87 Statute 884), the Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901(b) and the Fish and Wildlife Act of 1956 (16 U.S. Code 742).

Refuge Purpose(s): Sacramento River Refuge purposes include:

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. Sec. 1534 (Endangered Species Act of 1973)

".. the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..."16 U.S.C. 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. 742f (a) (4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. Sec. 742f (b) (1) (Fish and Wildlife Act of 1956)

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd et seq.]).

Description of Use: The natural and managed vegetation at the refuge provides habitat in the form of water, food, cover, breeding areas, rearing areas, and sanctuary for a variety of wildlife including endangered and threatened species, rare and endemic species, migratory birds, anadromous fish, and game animals, such as waterfowl and deer. Livestock grazing would be conducted annually for a specified period (i.e., seasonally) to manage vegetation for native plant and wildlife habitat. Grazing is administered with a livestock cooperator under a U.S. Fish and Wildlife Service Cooperative Land Management Agreement (CLMA). The CLMA states provisions for habitat objectives, expected wildlife benefits, shared staffing, facility maintenance, pest control damages,

remedies, operating rules and laws and reporting requirements. An annual grazing plan identifies the refuge tract to be grazed and specifies: vegetation and habitat type, grazing objective (primary target weed and/or primary native species or taxa), prescribed expected tract conditions (vegetation height), date by which expected conditions are to be met, livestock turn-in/turn-out dates and Animal Unit Months (AUM). The specific dates are determined by the refuge manager through consultation with the refuge biologist and cooperator to develop a strategy that meets target tract objectives. The grazing plan has built-in flexibility due to the uncertainties of annual and seasonal precipitation, flooding, and temperatures, and their consequent affect on vegetation growth. This is to insure that expected conditions are met and that refuge vegetation is neither over-grazed nor under-grazed—both conditions result in degraded habitat. Included in the annual grazing plan is a project plan, which also specifies by refuge tract: identified facilities and maintenance projects, materials, shared responsibilities, and special management problems and considerations.

Vegetation and wildlife habitat management occurs in grasslands, Valley oak and elderberry savanna, Valley oak woodlands, mixed-riparian forest, and freshwater marshes. Grazing is conducted periodically (seasonal) each year. The specified time is determined by the refuge and cooperator to meet target tract conditions. Currently Sacramento Refuge Complex has a CLMA for cattle grazing with Llano Seco Ranch, Butte County and Ohm Ranch, Tehama County. The Llano Seco CLMA covers all areas at the Llano Seco Unit, which includes annual grasslands/vernal pools, Valley oak/elderberry savanna, and managed freshwater marsh. The Ohm CLMA covers all areas at the Moony Unit and Ohm Unit, which includes annual grassland, Valley oak woodland/non-native hybridized California black walnut woodland, mixed-riparian forest, and willow-scrub.

Availability of Resources: The following funding/annual costs (based on FY 2003 costs) would be required to administer and manage research activities as described above:

	Annual Costs
Administration	$1,000
Facilities maintenance	$5,000
TOTAL	**$6,000**

Anticipated Impacts of Use: Grazing by native wildlife species has long occurred in the California landscape where it has shaped its botanical and zoological resources (Edwards 1992; Edwards 1996). Currently, livestock grazing is an important method of vegetation management (Barry 2003; Griggs 2000). Beneficial effects to refuge habitat, wildlife and native plants would occur as a result of a well managed livestock grazing program. Primary, benefits associated with the grazing program include: the reduction and accumulation of dead plant material; reduction in non-native invasive weeds (Thomsen et al. 1993); increases in native plants, including special status species, from reduced competition for sunlight, water and nutrients with non-native annual grasses (Coppoletta and Moritsch 2001; Davis and Sherman 1992; Menke 1992; Muir and Moseley 1994); increases primary production and resultant increases in plant biomass (McNaughton

1985); increases in flowering, with consequent increases in macro-invertebrate populations, including native pollinators of native plants, and prey items for refuge wildlife such as migratory birds and anadromous salmonids. Grazing would provide optimal shorebird foraging habitat (Colwell and Dodd 1995; Knopf and Rupert 1995) and also would provide short, nutritious grasses for grazing migratory waterfowl (Buchsbaum et al.. 1986), and local deer. Aquatic invertebrates, insects, and special status species would benefit from grazed herbaceous habitats (Bratton 1990; Bratton and Fryer 1990; Panzer 1988; Germano et al. 2001; Knopf). Primary burrowing mammals such as California ground squirrel would increase with grazing and this would result in increases of secondary burrowing animals such as burrowing owls and various snake taxa. Primary, long-term benefits include continued annual native plant production, non-native invasive plant species control, and annual, seasonal use of refuge habitat by migratory birds and resident deer herds. The condition of nesting cover would be maintained through increases in new plant biomass and removal of dense thatch layers. Secondary benefits of the program are the habitat and water system maintenance work done by the cooperator as specified in the CLMA. Periodic grazing can also be used to reduce thatch and mulch accumulation, lessening the threat of wildfire near rural structures and agricultural industrial facilities.

The grazing program would also impact refuge wildlife and habitat. Impacts to some nesting waterfowl, songbirds, would occur (Kirsch 1969; Krueper 1993), as well as Northern Harrier and American Bittern. Mammals, which burrow through thatch such as California meadow vole would likely decrease with grazing. However, these impacts would be short-term because the program would stipulate seasonal grazing. Songbirds, harriers and larger mammals, such as black-tailed jackrabbit, would move to other areas of the Refuge which would provide cover outside the grazed area. Seasonal grazing would improve plant species composition and structure so that short-term impacts to wildlife and habitat would be mitigated by long-term benefits to Refuge vegetation, native plants, and overall wildlife habitat quality. Therefore, the long-term benefits to habitat to migratory birds, resident deer herds, native plants, and nesting habitat condition would mitigate the short-term, localized impacts to local ground-nesting birds and some small mammals.

Anticipated Impacts of Uses on future lands within the approved boundary: The following conditions must be met before allowing existing uses to occur on newly acquired lands: (1) There is no indirect, direct, or cumulative threat anticipated to human health or safety; (2) There is no indirect, direct, or cumulative threat anticipated to natural or cultural resources; (3) The use is consistent with management of existing Sacramento River Refuge lands and would contribute to achieving Refuge goals. In particular, existing Refuge regulations would not be compromised; (4) The newly acquired lands represent a meaningful unit within which to manage the activity; and (5) There are no anticipated conflicts with priority public uses.

When new lands are acquired by the Refuge, the Refuge would ensure, through the Stipulations presented herein and the terms and conditions in the Special Use Permit, that impacts would be similar to, if not less than, those described.

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the Draft CCP and Environmental Assessment for the Sacramento River Refuge (USFWS 2004).

Determination: This program as described is determined to be compatible. Potential impacts of grazing activities on Refuge resources will be minimized because sufficient restrictions would be included as part of the annual grazing plan and grazing activities will be monitored by the Refuge manager and biologist. The Refuge manager and biologist would ensure the grazing plan and associated projects contribute to the enhancement, protection, conservation, and management of native Refuge wildlife populations and their habitats thereby helping the Refuge fulfill the purposes for which it was established, the mission of the National Wildlife Refuge System, and the need to maintain ecological integrity, diversity, and environmental health.

_____Use is Not Compatible

__X__Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

- The criteria for evaluating need for vegetation management, including grazing, are determined during the annual review of the refuge habitat management plan.

- Grazing is conducted in accordance with the CLMA. Any potential problems and impacts to refuge natural and cultural resources are identified during the annual review of the habitat management plan. These problems and impacts are also recorded in the annual grazing plan under associated projects. Measures to eliminate or reduce grazing impacts to refuge resources would be identified in both the CLMA and annual grazing plan and the refuge manger and biologist would monitor their outcome. If grazing impacts could not be eliminated or reduced to sufficiently protect natural and cultural resources, then other techniques for vegetation management would be considered. In addition to stipulations outlined above, in the CLMA, and annual grazing plan, all refuge rules and regulations must be followed by the livestock grazing cooperator unless otherwise accepted in writing by the refuge manager.

- Grazing would not be allowed in sensitive natural or cultural resource sites.

Justification: This program as described is determined to be compatible. Refuge livestock grazing will directly benefit and support refuge goals, objectives and management plans and activities. Fish, wildlife, plants and their habitat will improve through vegetation management which will result in short-term and long-term reductions of non-native invasive plant species, increases in native plants, increases in biomass, improved foraging conditions for migratory birds and local deer herds, and long-term improved nesting conditions. Consequently, the livestock grazing program would increase or maintain biological integrity, diversity and environmental health. The Big 6 wildlife-

dependent, priority public uses (wildlife viewing and photography, environmental education and interpretation, fishing and hunting) would also benefit as a result of increased biodiversity and wildlife and native plant populations from improved habitat conditions associated with the grazing program.

Mandatory Re-Evaluation Date (October 2014):

_____ Mandatory 15-year Re-Evaluation (for priority public uses)

___X___ Mandatory 10-year Re-Evaluation, Date will be provided in Final EA/CCP (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

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COMPATIBILITY DETERMINATION
(June 2004)

Use: Mosquito and Other Vector Control

Refuge Name: Sacramento River National Wildlife Refuge (NWR), located in Tehama, Butte, Glenn and Colusa counties, California.

Establishing and Acquisition Authorities: Sacramento River National Wildlife Refuge was established in 1989. Approximately 11,000 acres of the approved 18,000 acres have been acquired. Legal authorities used for establishment of the Refuge include: the Endangered Species Act of 1973 as amended (16 U.S. Code 1531-1543: 87 Statute 884), the Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901) and the Fish and Wildlife Act of 1956 (16 U.S. Code 742).

Refuge Purpose(s): Sacramento River NWR purposes include:

"... to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..." 16 U.S.C. Sec. 1534 (Endangered Species Act of 1973)

".. the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..."16 U.S.C. 3901(b) (Emergency Wetlands Resources Act of 1986)

"... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. 742f (a) (4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. Sec. 742f (b) (1) (Fish and Wildlife Act of 1956)

National Wildlife Refuge System Mission: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1996, as amended [16 U.S.C. 668dd et seq.]).

Description of Use: The proposed use is the implementation of mosquito monitoring and control activities requested and to be conducted by various Mosquito and Vector Control Districts (Districts) within the Sacramento River NWR including Tehama County Mosquito and Vector Control, Butte County Mosquito and Vector Control, Glenn County Mosquito and Vector Control, and Colusa Mosquito Abatement District. This is not a wildlife-dependent public use. There are five mosquito species of concern potentially produced or harbored on the refuge*: Ochlerotatus melanimon, Ochlerotatus nigromaculis, Aedes vexans, Culex tarsalis*, and *Anopheles freeborni*.

This represents an update of a compatibility determination approved in August 1994 (USFWS 1994). To our knowledge, no mosquito control activities have been conducted or are being conducted on the Sacramento River NWR even though this compatibility determination was approved. Mosquito monitoring and limited control activities have occurred within Sanctuary 1 and Sanctuary 2 of the Llano Seco Unit. This part of the Refuge was acquired for inclusion in the North Central Valley Wildlife Management Area, and is not included within the Sacramento River National Wildlife Refuge Draft Comprehensive Conservation Plan (CCP) and Environmental Assessment (EA) (USFWS 2004b). Riparian and agricultural habitats on the Refuge include sand and gravel bars, willow scrub, cottonwood forest, herblands, mixed riparian forest, valley oak woodlands and savannas, grasslands, freshwater wetlands, pastures, cover crops (i.e., winter wheat, safflower, corn, bell beans), almond and walnut orchards. There are no managed wetland units covered under the Draft CCP/EA.

The Districts have verbally informed the Refuge Manager of their desire to conduct mosquito monitoring and, if necessary, abatement activities in order to protect the public from any mosquito borne diseases. While mosquitoes are considered a nuisance because of their biting, many species are known vectors of serious diseases in California. Although 12 mosquito-borne viruses are known to occur in the state, based on current human health risks, the main disease of concern for mosquito abatement programs in northern California are Western Equine Encephalitis (WEE), St. Louis Encephalitis (SLE), California Encephalitis, West Nile Virus (WNV), and malaria (USFWS 2004). Only WEE and SLE have caused significant outbreaks of human disease (CA Dept. of Health Services 2003). California is also at risk for WNV which was first detected in the summer of 2003 in adult mosquitoes in Imperial County, and in crows in Orange County. WEE tends to be most serious in very young children, whereas elderly people are most at risk to SLE and WNV (CA Dept. of Heath Services 2003). WEE and WNV can cause serious diseases in horses and emus, and WNV kills a wide variety of endemic and imported birds.

Public concern over human health issues related to mosquito-borne disease has intensified on the west coast with the advance of WNV across the United States. To address mosquito management, a phased response strategy has been developed for implementation on refuges in the Pacific Region (USFWS 2003). This strategy encourages an integrated pest management approach that incorporates habitat and best management practices to reduce the need for and use of insecticides on refuges, while also ensuring that legitimate human, fish, and wildlife health concerns are addressed. To better address issues related to WNV, the current procedures for managing mosquitoes on this Refuge include this phased response program, which identifies thresholds for mosquito treatment and presents specific responses to various conditions encountered in the field (USFWS 2004a). Under this program, if mosquito population monitoring and disease surveillance (implemented by District vector control personnel) indicate that human health thresholds are exceeded, the use of larvicides, pupicides, and/or adulticides may become necessary. In some cases, emergency actions may be required that are not addressed by this compatibility determination.

The current procedures for implementing mosquito management on the Sacramento NWR Complex are covered under a Special Use Permit (SUP), which involves an annual meeting between District and Refuge staff to coordinate all necessary permitting and implementation planning required to conduct mosquito monitoring and control on the Complex for the upcoming year. When any District formally identifies that mosquito monitoring and control is needed on the Refuge, they will then be included in this process. Issues such as access points and pathways to be used by District personnel, appropriate hours of operation, and requirements for field coordination are discussed, agreed upon, and incorporated into the SUP. As part of this coordination process, District vector control personnel are provided with habitat management data generated by the Refuge biologist on listed species and other trust resources. District personnel share relevant data related to mosquito and disease monitoring in the vicinity of the Refuge. In addition, periodic meetings are conducted in the field with District field staff and the refuge staff to further coordinate activities. These meetings are scheduled throughout the season, when warranted, to ensure protection of endangered and threatened species and other wildlife.

The proposed use would apply the principles in the Draft Integrated Pesticide Management (IPM) Plan for Mosquito Control Activities on the Sacramento National Wildlife Refuge Complex (Complex) incorporated herein by reference (USFWS 2004a). The purposes of the IPM Plan are to: 1) identify mosquito control methods and materials currently approved for use on the Complex; 2) identify their use in an IPM program that is consistent with the goals of the Complex and minimizes public health risk from refuge-harbored mosquitoes; and 3) provide long-term planning to meet the Service's goal of reducing effects of pesticide use on Department of Interior (DOI) trust resources to the greatest extent possible. The IPM Plan outlines a risk-based, hierarchical approach to mosquito management (see attached IPM Figure 3). This approach uses an understanding of mosquito biology and ecology whereby intervention measures depend on continuous monitoring of mosquito populations. When unacceptable mosquito populations are reached, as determined by appropriate monitoring and thresholds, control measures could be implemented. Potential control measures include maintaining or restoring natural drainage channels through Refuge lands, burning, mowing, disking, mosquitofish, BTI, Methoprene, Golden Bear Oil, Adulticides (Pyrethrin, Malathion, Sumitrin, and Naled). For more information about the control measures see IPM Table 3 (attached) and the IPM Plan.

Monitoring mosquitoes on the Refuge is also facilitated by the same SUP, allowing District personnel to sample wetlands and other areas throughout the refuge on a weekly basis throughout the mosquito production season. Three types of monitoring may be conducted pre and post treatment: “dipper” samples for larvae; New Jersey Light Traps for relative abundance of adult *Culex tarsalis* and *Anopheles freeborni* mosquitoes; and landing counts for relative abundance of *Ochlerotatus* mosquitoes. Further details about these techniques can be found in the IPM Plan. District personnel conducting monitoring will be restricted to public access points on the Refuge. Specific locations and any sites that are within closed areas will be determined within the SUP process, if the need for mosquito control on the Refuge arises.

The Districts would use ground and/or aerial methods to apply larvicides, pupacides, and adulticides depending on the IPM Plan thresholds, Pesticide Use Proposal (PUP) requirements, Endangered Species Act - Section 7 compliance, and SUP conditions imposed by the Refuge. The decision making process would follow the IPM figure #3 (see attached).

Because the U.S. Fish and Wildlife Service uses insecticides, herbicides and fungicides on national wildlife refuges and fish hatcheries, a formal pesticide use review process is employed to ensure that all chemical pesticides approved for use on National Wildlife Refuges have been reviewed for their potential impacts to groundwater, surface water and terrestrial and aquatic non-target vegetation and wildlife, including threatened and endangered species. Pesticides approved for use must be shown to pose the lowest toxicity-related threat to non-target terrestrial and aquatic ecosystems, while addressing the specific pest control objectives. PUPs describe the target pest, crop, method of control, chemicals applied, rates of application, area being treated, sensitive habitats and best management practices are required. PUPs are reviewed and approved at the Refuge Manager, Regional Office, or Washington Office level, depending on the product.

Non-chemical preventative treatments will be used whenever possible. Among chemical treatments, adulticides are considered a last resort, used only after treatment thresholds have been met. Every attempt will be made to treat source areas in the riparian areas with mosquitofish or larvicides rather than adulticides. Other upland habitat blocks receive no treatments. Adulticide applications will not be made within 100 feet of wetlands, lakes, rivers or streams containing listed fish species, unless winds or inversions favor pesticide drift away from the water. Aerial application of adulticides is not anticipated to occur due to the threatened and endangered species that occur within the river and in the riparian areas on the Refuge.

Mosquito monitoring and control is discussed in the Draft EA (Table 1, Chapter 2) and in the Draft CCP (Chapter 6). It is also detailed in the Draft IPM Plan (which is included as Appendix P of the CCP).

Availability of Resources: The following funding/annual costs would be required to administer and manage activities as described above:

	ANNUAL COSTS
Administration (Evaluation of applications, permit compliance, and monitoring)	$5,000
TOTAL	**$5,000**

Refuge operational funds are currently available through the Service budget process to administer this program.

Anticipated Impacts of Use: One of the major objectives of the Refuge is to provide high quality feeding areas for migratory birds and other wildlife; there is concern that mosquito control treatments may be interfering with that objective by reducing the existing food base. Effects on non-target organisms (i.e., those other than mosquitoes) can be loss of biomass, loss of diversity, interference with normal ecological relationships, bioaccumulation, or other unknown effects. Another concern is that rare insects and/or insects that may function as important pollinators for rare plants may be impacted by mosquito control treatments. Use of non-native biological controls such as mosquitofish may alter ecological relationships of native species. Significant bioaccumulation has not been associated with any of the chemical treatments proposed in the IPM Plan. Moreover, in a study conducted on Colusa NWR and Sutter NWR, researchers found no reductions in total abundance or biomass of aquatic macro-invertebrates in the treated (i.e., application of pyrethrin, permethrin, or malathion) or control fields (Lawler et al. 1997). While this study provides encouraging information about adulticides use there are still some questions about their effects on refuge resources. This study focused on the effects of a single adulticide treatment. During most years, Colusa, Butte Sink, and Sutter NWRs receive multiple adulticide treatments, often weekly during the fall flood-up season. Effects of multiple applications may have cumulative effects not detected in the 1997 study. In addition, effects on smaller common invertebrates (i.e. cladocera, copepods) were not studied, but should be included in future research efforts, given their lower acute toxicity tolerances (Johnson and Finley 1980).

The following text in italics is the conclusion/summary section from the Environmental Effects of Mosquito Control "white paper" (USFWS 2004c) and serves to substantiate the importance of using the IPM approach.

Mosquitoes are a natural component of many aquatic and terrestrial ecosystems. Like other aquatic insects with terrestrial adult stages, mosquitoes provide a link between aquatic and terrestrial habitats. Predation is probably the largest source of mortality for both larval and adult mosquitoes and, although there are relatively few predators that specialize on mosquitoes, these insects are fed upon by a wide variety of invertebrate and vertebrate predators. The impact of greatly reducing mosquito populations in aquatic and terrestrial ecosystems has not been studied.

Virtually every pesticide currently used to manage mosquito populations has the potential to adversely impact nontarget species. Widely used larvicides such as Bti and methoprene have been demonstrated to kill susceptible chironomid midge larvae, with experimental evidence suggesting that such population-level impacts may result in community-level food web effects. All adulticides are broad-spectrum insecticides that can potentially impact a wide variety of invertebrates and some vertebrates. The degree to which non-target organisms or communities may be impacted by mosquito control pesticides is often difficult to predict because of differences in susceptibility among species, differences in toxicity of various formulated products, and basic knowledge gaps in toxicity data to certain species. An additional factor is the paucity of studies examining non-target impacts of mosquito control at large spatial and temporal scales.

Organized mosquito control most often occurs at a landscape level such as a county or parish. When pesticides are applied to manage mosquito populations, it is often at multiple locations over relatively large spatial scales. Furthermore, pesticides may be applied to any given area multiple times in a season, year after year. The majority of non-target mosquito control pesticide studies have examined impacts at much smaller temporal and spatial scales, such as one application in a single wetland. While these studies provide useful data, it is difficult to extrapolate the results of these small-scale experiments into predictions of impacts from much larger scale treatments.

Mosquito monitoring will include regular visits by District personnel to sample mosquito larvae (dip counts) and adults (landing counts) in wetlands and adjacent areas. Currently, there is no monitoring occurring on the Refuge and we would not expect them to occur more than once a week in the future. The Refuge will provide the Districts current habitat management maps which will include sensitive areas to avoid.

Larval treatment for mosquitoes does not involve a route, and may be applied on the ground. B.t.i. and methoprene may be applied aerially. Adulticide treatments will occur along a specific route, designated to minimize drift into sensitive areas. The Refuge will provide these maps to the Districts during the SUP process. Adulticide treatments will occur in evenings or early mornings when adult mosquitoes are active and Refuge personnel and visitors are not present. Their frequency will be determined by a combination of mosquito population levels exceeding treatment thresholds and the maximum allowable applications per site for a given season (approximately June 1 to October 31). Treatment thresholds are found in the IPM Plan.

For the purposes of using certain pesticides to control mosquitoes, a mosquito-borne public health emergency is defined as:

Actual or threatened, imminent outbreak of western equine encephalitis (WEE), St. Louis encephalitis (SLE), West Nile encephalitis (WNE), malaria, or other mosquito-borne public health disease. The presence of WEE, SLE, WNE, or malaria viral titers or mosquito pool titers in the mosquito population or in sentinel chickens (in accordance with test protocols developed by the California Department of Health Services, Environmental Management Branch, and the U.S. Department of Health and Human Services, Center for Disease Control) will confirm that a public health emergency exists or is imminent. This threshold will have been met when the mosquito abatement districts notifies the refuge manager of a laboratory test that is positive for any of the above viruses. The West Nile encephalitis is now also being monitored due to the discovery of its presence on the east coast in the vicinity of New York City and other locations in September 1999.

Mosquito monitoring will cause direct and indirect disturbance effects. Disturbance would include altering wildlife behavior, going off designated trails, and collecting water samples. However, most of these effects would be short-term because of the short duration of mosquito monitoring. The sampling interval is also spread out over time and would typically be once a week. Sampling locations will be restricted to areas already open

to the public (unless specifically designated in the SUP process), and therefore will not be in sensitive wildlife areas. Long-term effects would be eliminated/reduced because sufficient restrictions would be included as part of the SUP, and District activities would be monitored by Refuge staff. Refuge staff would ensure that mosquito monitoring does not detract from the Refuge purposes, the mission of the National Wildlife Refuge System, and the need to maintain ecological integrity. Additionally, SUP conditions would include conditions to further ensure that impacts to wildlife and habitats are avoided and minimized.

Mosquito control will have minimal impact to public use activities on the Refuge. Using the approach identified in this determination and the IPM Plan, mosquito control will utilize the least toxic and the least amount of insecticide is used at each level of the hierarchy. Adulticide treatments will occur in evenings or early mornings when adult mosquitoes are active and Refuge personnel and visitors are not present.

Following the IPM approach, including the implementation of adequate monitoring, will lessen potential short-term, long-term, and cumulative impacts of mosquito control activities to acceptable levels. As part of the IPM approach, the annual PUP and SUP processes would continue to be used by the Sacramento NWR Complex staff.

Anticipated Impacts of Uses on future lands within the approved boundary: The following conditions must be met before allowing existing uses to occur on newly acquired lands: (1) There is no indirect, direct, or cumulative threat anticipated to human health or safety; (2) There is no indirect, direct, or cumulative threat anticipated to natural or cultural resources; (3) The use is consistent with management of existing Sacramento River NWR lands and would contribute to achieving Refuge goals. In particular, existing Refuge regulations would not be compromised; (4) The newly acquired lands represent a meaningful unit within which to manage the activity; and (5) There are no anticipated conflicts with priority public uses.

Public Review and Comment: Public review and comments will be solicited in conjunction with distribution of the Draft Comprehensive Conservation Plan and Environmental Assessment for the Sacramento River NWR. The public review and comment period for these draft documents will be 45 days. Following this comment period, we will review all comments received, and incorporate and respond to them in the Final EA, as appropriate. Comments and our responses will be summarized here.

Determination:

_____Use is Not Compatible

__X__Use is Compatible with the Following Stipulations

Stipulations necessary to ensure compatibility:

1. All mosquito abatement activities will be evaluated and authorized via steps identified in the risk-based, hierarchical approach outlined in the IPM Plan (Figure 3).
2. The implementation of mosquito control measures will be conducted in accordance with approved PUPs. PUPs will require the use of Best Management Practices (BMPs) to ensure the least toxic and the least amount of insecticide is used at each level of the hierarchy. A list of BMPs can be found in the attached Appendix 2 from the IPM Plan.
3. The implementation of mosquito control measures will be conducted in accordance with Section 7 of the Endangered Species Act. The Refuge will provide a map of sensitive areas to avoid while monitoring or treating mosquitoes.
4. Mosquito control will be authorized on an annual basis by a SUP. The SUP will detail the justification for pesticide applications, identify the specific areas to be treated, and list any additional, necessary restrictions or conditions that must be followed before, during, or after treatment. District and Refuge staff will work together to agree upon issues related to access, methods of operation, and timing of access, as well as to exchange information related to listed species occurrences, permitting, and relevant agency policy.
5. The Refuge will monitor mosquito monitoring and control activities to ensure compliance with the Stipulations presented here and any additional restrictions or conditions specified in the SUP, as well as to ensure the impacts remain at an acceptable level.
6. Districts are required to notify the refuge manager prior to treatments or expected series of treatments. Treatments can occur after mosquito populations exceed treatment thresholds as documented by monitoring data. The refuge manager will be notified of any detection or virus activity in a sentinel flock or mosquito pools as soon as possible. This will establish the risk of a public health emergency.
7. While on the Refuge, District personnel must display a copy of the SUP on vehicle dashboards at all times. Speed limit on the Refuge is 25 miles per hour and gates are to be left as found.
8. An annual report summarizing the mosquito control activities will be provided to the refuge manager by December 31 each year. The report will include: 1) a brief narrative describing the season in general including whether or not a virus was detected, by which method it was detected, and what date; 2) identify any useful observations such as unusually high or low production areas that might help in future habitat management considerations to minimize mosquito populations; 3) summaries of dip count and light trap data by mosquito species; 4) summary of landing count data, including pre and post treatment evaluations; 5) a list of treatment dates, locations marked on Refuge map, material and amount used, and whether on an individual unit or a route.
9. Adulticide applications will also not be made within 100 feet of wetlands, lakes, rivers or streams containing listed fish species, unless winds or inversions favor pesticide drift away from the water.
10. Adulticide treatments will occur in evenings or early mornings when adult mosquitoes are active and Refuge personnel and visitors are not present.

Justification: Mosquito management activities controlled by a process that involves incorporating the National and Regional Mosquito Guidance, the local IPM Plan, annual PUPs and SUPs would contribute towards a compatible program consistent with refuge purposes and NWR System mission. Appropriate safeguards are incorporated into the planning efforts to ensure that the level of mosquito control is commensurate with the associated public health risk. In particular, the above stipulations and those within the PUPs and SUPs will help to alleviate or lessen any impacts to fish, wildlife, plants and their habitats along with the Refuge's ability to maintain the biological integrity, diversity, and environmental health of the Refuge. Any additional terms and conditions included in the SUP will be based, at least in part, on the results of monitoring efforts. If monitoring demonstrates an unacceptable impact to Refuge resources, this use will be reevaluated.

Although mosquito control has a potential to impact non-target wetland wildlife, implementing the prescribed measures listed in the Stipulations section should reduce many of these potential impacts. Mosquito-borne disease issues are a real threat in the northern Central Valley. Refuge staff has worked with local Districts on mosquito control at the other refuges within the Complex. The Refuges and the Districts have worked cooperatively to implement IPM and we anticipate doing the same for the Sacramento River NWR.

The Refuge in association with the Districts will implement a monitoring program to help assess disturbance effects on wildlife and habitat and to ensure those effects remain within acceptable levels. Monitoring will help to reduce impacts associated with mosquito management activities.

This compatibility determination may need to be reevaluated in the event that a national policy for management of mosquitoes on National Wildlife Refuges is finalized.

Mandatory Re-Evaluation Date (October 2014):

_____ Mandatory 15-year Re-Evaluation (for priority public uses)

__X__ Mandatory 10-year Re-Evaluation, Date will be provided in Final EA/CCP (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision (check one below):

_____ Categorical Exclusion without Environmental Action Statement

_____ Categorical Exclusion and Environmental Action Statement

_____ Environmental Assessment and Finding of No Significant Impact

_____ Environmental Impact Statement and Record of Decision

References

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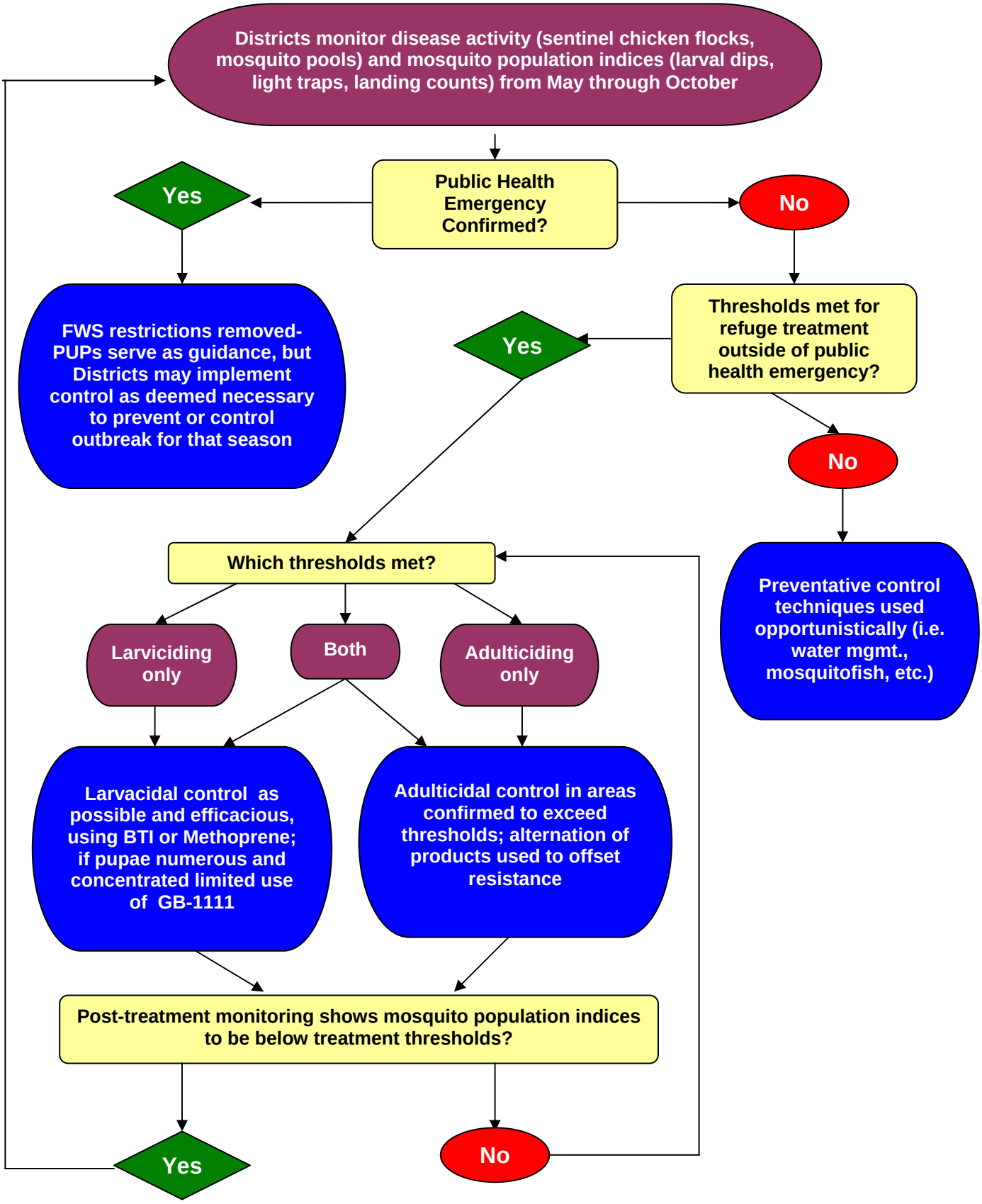

Figure 3. Decision-making process regarding mosquito control on an individual refuge at the Sacramento National Wildlife Refuge Complex.

Table 3. Comparison of mosquito control techniques and materials.				
Control Technique	**Mosquito Control Objectives**	**Usage**	**Advantages**	**Disadvantages**
Delayed Flooding	To delay initiation of major refuge mosquito production at the onset of fall floodup.	Preventative; can be optimized by refuge depending on historic/documented timing of wildlife use (i.e. migration patterns) and water availability.	Potentially reduces need for treatment during the late summer/early fall season.	None apparent at this time.
Rapid Floodup/ Irrigation	To minimize the number of cohorts of *Aedes* mosquitos hatching from individual units or blocks of units.	Preventative; used on 10-20% of wetlands, including spring/summer WPU irrigations and initial fall floodup of SFM units; large water control structures have been installed in these units for this purpose.	Potentially reduces number of additional treatments by helping to synchronize larval development and adult emergence.	Sacrifices slower flooding, which reduces amount of sustained "feather edge" habitat in SFM wetlands preferred by many migratory birds.
Mid-irrigation Drainage	To flush larvae into sub-optimal habitats, interrupting life cycle and minimizing subsequent adult emergence.	Opportunistic active management to control mosquitos; available for use infrequently and only on a very small percentage of habitat base; during irrigations on small units, when majority of larvae can be drained quickly (i.e. in one day).	Potentially eliminates or reduces need for additional control efforts.	Removes abundant food source for migratory birds; results in less efficient irrigation in terms of labor/water costs.
Irrigation Prior to Full Pond Drying	To avoid dry phase necessary for *Aedes* eggs to "ripen" prior re-flooding, resulting in reduced hatch and emergence.	Opportunistic/preventative; available for use only when weather conditions favor rapid plant growth and plants have achieved appropriate height prior to pond drying.	Potentially eliminates or reduces need for additional control efforts.	Requires more intensive monitoring of habitat conditions to achieve proper timing of irrigation.
Burning	Literature indicates potential to reduce mosquito populations by killing eggs and substrate beneficial to their life cycle.	Ancillary to mosquito control; used mainly for wetland habitat enhancement by reducing rank vegetation or undesirable species; typically does not occur on more than 5-10% of wetland habitats for a given refuge.	May be able to reduce need for additional control efforts; benefits habitat condition.	If used over large acreages, annual sacrifice of vegetative structure could be detrimental to many species of wildlife, including non-target invertebrates.
Mowing/ Disking	May have potential to reduce mosquito populations by killing eggs and substrate beneficial to their life cycle.	Ancillary to mosquito control; used mainly for wetland habitat enhancement by reducing undesirable species and providing openings for bird use, avian disease monitoring and wildlife viewing; typically annual use is $\leq$ 5% of wetland habitats per refuge.	May be able to reduce need for additional control efforts; periodic use benefits condition of some habitat types;	If used over large acreages, annual sacrifice of vegetative structure could be detrimental to many species of wildlife, including non-target invertebrates.

Table 3 (cont.). Comparison of mosquito control techniques and materials.				
Control Technique	**Mosquito Control Objectives**	**Usage**	**Advantages**	**Disadvantages**
Mosquitofish	To maintain a constant predation pressure on low to moderate mosquito larvae/pupae densities and minimize adult emergence.	Mostly preventative; typically stocked at 0.1 to 1.0 lbs./acre (roughly 1000 fish/pound) in SW and PP wetlands during summer and selected SFM wetlands during the fall.	Persistent in wetlands, often present without stocking.	Cannot effectively control *Aedes* densities that occur on most SFM;
BTI	To minimize adult emergence by reducing larvae populations.	For larvae control in discrete areas such as standing pools or small open units. Applied at 16-32 oz./acre depending on formulation.	Low toxicity, low persistence in environment; target-specific to dipterans; can effectively control mosquitoes in localized areas.	Questionable efficacy on heavy floodwater mosquito (*Oclhlerotatus*) densities; non-target mortality to some midge larvae.
Methoprene	To minimize adult emergence by preventing larvae from hatching.	For larvae control; growth regulator that prevents larvae from hatching; rates vary depending on formulation.	Low toxicity, low persistence in environment; target-specific to dipterans; can effectively control mosquitoes in localized areas; may leave larvae available as forage items.	Non-target impacts to dipterans other than mosquitoes.
Golden Bear Oil	To minimize adult emergence by reducing pupae populations.	For pupae control in discrete areas such as standing pools or windrowed concentrations. Applied at 3-5 gallons/acre.	Provides a method to control pupae.	Not target specific; can cause mortality to other air breathing invertebrates.
Adulticides – Pyrethrin, Malathion, Sumithrin, Naled	Reduction of adult mosquitoes to reduce public health risk or significant nuisance.	For active control of adult mosquitoes; applied with ULV fogger at dusk to treat extensive areas. Rates vary with product.	Method to control adult mosquitoes if necessary; not applied directly to water.	Not target specific; likely effects flying insects active at dusk; Efficacious use relies upon light wind and inversion conditions to treat standard 300-foot swath; insecticide resistance can develop without material rotation.

Appendix 2. Suggested "best management practices" for mosquito control efforts in managed wetlands (Source: Selected Tables from Central Valley Joint Venture. 2004. Best Management Practices for Mosquitoes in Managed Wetland Environments. in Draft, 33pp.

Water Management Practices to reduce mosquito production in managed wetlands.

Best Management Practice	Strategies	Mosquito Control Objective	Advantages	Disadvantages
Delayed fall flooding	Delay flooding of some wetland units until later in the fall. Target units with greatest historical mosquito production and/or closest to urban areas.	To delay initiation of floodwater mosquito production in seasonal wetlands by reducing the amount of mosquito habitat available during optimal breeding conditions (warm summer/early fall weather).	Depending on flood date, can reduce the need or amount of additional treatment. Delayed flooding can provide "new" food resources for wildlife later in the season.	Reduces the amount of habitat for early fall migrants and other wetland-dependent species, and may increase potential for waterfowl depredation on agricultural crops (especially rice). Flooding is often dictated by water availability or contractual dates for delivery. Delayed flooding may still produce mosquitoes in warm years. Private hunting clubs can't lease blinds that aren't flooded.
Rapid fall flooding	Flood wetland basin as fast as possible. Coordinate flooding with neighbors or water district to maximize flood-up rate.	To minimize number of mosquito cohorts hatching on a given area.	Reduces the need for multiple treatments needed by synchronizing larval development and adult emergence.-	Requires coordination & ability to flood quickly. Reduces slow, feather-edge flooding that is heavily utilized by waterbirds.
Flood & drain wetland	Flood wetland and hatch larvae in pond. Drain wetland to borrow or other ditch where larvae can be easily treated, drowned in moving water, or ~~be~~ consumed by predators. Immediately reflood wetland.	Hatches mosquito larvae and moves them to a smaller area for treatment before they can emerge into adults.	Can eliminate or reduce the need for additional mosquito control efforts.	Additional cost to purchase water to re-flood wetland. More labor intensive.

Best Management Practice	Strategies	Mosquito Control Objective	Advantages	Disadvantages
Early fall flood-up planning	Apply BMPs to wetlands identified for early flooding. To the extent possible, areas targeted for early fall flooding should not be near urban centers and should not have a history of heavy mosquito production.	To reduce the early season production of mosquitoes or to reduce their encroachment on urban areas.	Allows for the provision of early flooded habitat while minimizing mosquito production and conflicts with urban areas.	Some additional effort required to monitor and identify suitable areas and possible planning among multiple landowners.
Maintain stable water level	Ensure constant flow of water into pond to reduce water fluctuation due to evaporation, transpiration, outflow, and seepage.	To reduce conditions for additional floodwater mosquito production in summer and fall.	Provides a stable wetland environment for breeding wildlife during spring and summer. Discourages undesired excessive vegetative growth which could also become additional mosquito breeding substrate.	Requires regular monitoring and adjustments to water control structures. May be difficult if water availability is intermittent or unreliable. Reduces mudflat habitat that is attractive to shorebirds and waterfowl.
Water circulation	Provide a constant flow of water equal to discharge at drain structure.	To keep water fresh and moving to deter stagnant conditions for mosquito production; reduces water level fluctuation and potential production of floodwater mosquitoes.	Discourages warm water conditions associated with avian botulism outbreaks.	Requires landowner to purchase additional "maintenance" water. May be difficult if water availability is intermittent or unreliable
Rapid irrigation	7-10 day irrigation (from time water enters the pond to complete drawdown).	Shorten irrigation period to reduce time available for mosquitoes (especially *Culex tarsalis* and *Anopheles freeborni*) to complete lifecycle.	Provides some level of wetland irrigation while reducing the time available for mosquitoes to complete lifecycle.	Does not allow manager to use long duration irrigation for weed control. Requires ability to rapidly flood & drain wetland.
Reduced number of irrigations	Evaluate necessity of irrigation, especially multiple irrigations, based on spring habitat conditions and plant growth. Eliminate irrigations when feasible.	To eliminate unneeded additional irrigations which could provide potential habitat for mosquitoes.	Reduces potential need for additional mosquito control. Saves water and manpower costs. Discourages excessive growth of undesirable vegetation (i.e. joint and bermuda grass)	May reduce seed production or plant biomass with less irrigation.

Best Management Practice	Strategies	Mosquito Control Objective	Advantages	Disadvantages
Early spring drawdown and irrigation	Drawdown wetland in late March or early April. Irrigate in late April or early May when weather is cooler and mosquitoes are less of a problem.	To reduce need for irrigation in June, July, and August, when potential for mosquito production would be higher.	Wetland irrigation can be accomplished without creating potential mosquito problems. May allow moist-soil plants to take advantage of natural rainfall during the spring.	Reduces shallow wetland habitat for migratory shorebirds and waterfowl in April and May, during a major migration period. Newly germinated wetland plants may be impacted by cold weather conditions.
Don't let field completely dry and crack between spring drawdown and irrigation	Irrigate wetland before soil completely dries.	To eliminate necessary drying period for floodwater mosquito egg hatchability.	May reduce mosquitoes produced from irrigation	Requires close monitoring of soil conditions to prevent soil from drying before irrigation.
Subsurface irrigation	Maintain high ground water levels by keeping boat channels or deep swales permanently flooded.	To reduce amount of irrigation water during mosquito breeding season.	Reduce need for surface irrigation while maintaining soil moisture to promote moist-soil plant production.	Requires deep swales or boat channels to be effective. Requires additional pipes in channels for equipment access. May not produce intended irrigation result if water table is naturally low. Requires that water be maintained longer than normal in swales. May promote unwanted vegetation growth in swales or promote irrigation of non-target plants in wetland.
Utilize water sources with mosquito predators for flooding wetlands	Flood wetlands with water sources containing mosquito fish or other invertebrate predators such as permanent ponds to passively introduce mosquito predators	To inoculate newly flooded wetlands with mosquito predators.	May establish mosquito predators faster than natural colonization.	Requires source of water with already established sources of mosquito predators. Not applicable to wetlands flooded with well water.
Drain irrigation water into ditches or other water bodies with abundant mosquito predators	Drain irrigation water into locations with mosquito predators as opposed to adjacent seasonal wetland or dry fields.	To provide predators opportunities to consume mosquito larvae. To reduce chance of second hatch from draining water into adjacent seasonal wetland or dry field.	Already a common wetland management practice.	Must have ditch or water body with established predator population available to accept drain water. Does not allow for irrigation water to be reused in adjacent wetlands.

Vegetation management practices to reduce mosquito production in managed wetlands.

Best Management Practice	Strategies	Mosquito Control Objective	Advantages	Disadvantages
Mowing	Mow undesirable or overgrown vegetation that serves as mosquito breeding substrate prior to flooding.	To reduce standing vegetation that mosquitoes can use for egg laying and larval development. To create open water habitat that allows mosquito predators (fish, invertebrates, birds) better access to larvae and potentially more wave action to drown mosquito larvae.	Dual benefits of improving wildlife habitat and reducing mosquito breeding substrate.	Effects are largely temporary, so must be conducted annually. Overuse could be detrimental to some species of wildlife and non-target invertebrates. Mowed vegetation may float providing mosquito habitat and decomposition may affect water quality.
Burning	Controlled burn of undesirable or overgrown vegetation that may provide mosquito breeding substrate.	See mowing. Can also kill mosquito eggs.	See mowing.	Requires burn permit. Liability concerns. Most landowners are not adequately prepared to conduct a controlled burn. Special consideration should be taken around plastic pipes or water control structures. Overuse could be detrimental to some species of wildlife and non-target invertebrates.
Discing	Disc undesirable or overgrown vegetation that may provide mosquito breeding substrate.	See mowing.	See mowing. Can provide longer-term control of undesirable vegetation by itself or in conjunction with other management practices.	Creates walking problems for hunters. Overuse could be detrimental to some species of wildlife and non-target invertebrates.
Haying	Mow and bale undesirable or overgrown vegetation that may provide mosquito breeding substrate.	See mowing. Also removes vegetation after cutting.	Dual benefits of improving habitat and reducing mosquito breeding substrate. Removal of mowed vegetation further decreases mosquito breeding substrate and may improve water quality.	Overuse could be detrimental to some species of wildlife and non-target invertebrates. Removes seed that wintering waterfowl forage on. Expensive. Often difficult to find someone to bale and haul plant material.
Selective Grazing	Summer-Fall grazing. Short duration, high intensity grazing.	To reduce standing vegetation that provides habitat for mosquitoes.	Relatively inexpensive.	Irrigation for grass and/or livestock watering may exacerbate mosquito production. Livestock tend to forage on plants that produce seed for waterfowl. Livestock may damage levees or ditches.

Wetland infrastructure maintenance activities used to reduce mosquito production in managed wetlands.

Best Management Practice	Strategies	Mosquito Control Objective	Advantages	Disadvantages
Levee Inspection & Repair	Walk or drive levees, flag problem spots, repair as needed. Consider design elements to improve integrity of levee (see levee design).	To reduce mosquito habitat/production caused by seepage into adjacent fields or dry ponds.	Allows for early identification of problem spots. Helps conserve water and reduces growth of unwanted vegetation.	Requires annual monitoring and funding for repairs.
Water Control Structure Inspection, Repair, & Cleaning	Inspect structures and repair or replace as needed. Remove silt and vegetation build-up in front of structures. Adequately close, board or mud-up controls.	To reduce mosquito habitat/production caused by seepage into adjacent ponds or drainage ditches. Remove silt blockages that may trap water and impede drainage.	Enhances water management capabilities and limits unwanted vegetation or standing water.	Requires annual monitoring and funding for cleaning or repair.
Ditch Cleaning	Periodically remove silt or vegetation from ditches to maintain efficient water delivery and drainage.	To allow for rapid flooding/drainage & reduce vegetation substrate for breeding mosquitoes.	Enhances water management capabilities and limits unwanted vegetation or standing water.	Requires funding for ditch cleaning. Excessive vegetation removal on ditch banks can result in negative impacts to nesting birds and other wildlife.
Pump Tests & Repair	Test pump efficiency and make any necessary repairs to maximize output.	Could identify output problems and if corrected, allow managers to flood more rapidly.	May promote faster irrigation and flood-up if output can be improved.	Requires pump test. May be costly to repair or replace pump/well.

Wetland restoration and enhancement features to reduce production of mosquitoes in managed wetlands.

Best Management Practice	Strategies	Mosquito Control Objective	Advantages	Disadvantages
Independent water management	To the extent possible, design wetland projects to include independent inlets and outlets for each wetland unit.	To reduce the need to move water through multiple wetland units when flooding or irrigating target areas. This can reduce the number of mosquitoes produced per flood event.	Creates wetland units that are hydrologically distinct from one another allowing for diverse wetland management.	May require additional water control structures and ditches to be constructed and maintained. Increases restoration costs and complexity of management.
Adequately sized water control structures	Increase size and number of water control structures. When installing, set to proper grade to allow for complete drawdown.	To improve ability to implement rapid flooding/irrigation BMPs (Table 1).	See rapid flooding/irrigation BMPs (Table 1).	Increased size and number of water control structures will increase restoration costs and management complexity.
Swale construction (sloped from intake to drain)	Construct or enhance swales so they are sloped from inlet to outlet and allow the majority of the wetland to be drawndown.	To improve ability to implement rapid flooding/irrigation BMPs (Table 1). Creates a means to move water through wetlands without flooding entire wetland basin. Reduces mosquito habitat by allowing isolated sections of habitat to drain. Provides mosquito predators with access to all portions of wetland.	See rapid flooding and irrigation BMPs (Table 1). Provides habitat diversity and enhances capabilities to implement moist-soil management. Provides a more cost-effective and wildlife friendly alternative to laser-leveling to create drainage.	See rapid flooding and irrigation BMPs (Table 1). Reduces standing water in spring that is often used by foraging waterbirds. May result in additional expense to create swales. Shallow swales must be periodically re-cut if silt deposition or dense emergent vegetation is a problem. Could be a deep water hazard in hunting areas.
Wetland size considerations	Install cross-levees to facilitate more rapid irrigation and flood-up (Table 1). Build "underwater" levees that isolate irrigation water during the spring, but can be overtopped during fall and winter flooding.	To improve ability to implement rapid flooding/irrigation BMPs (Table 1).	Assists with faster flooding and drainage. Cross levees (checks) can provide loafing habitat for waterfowl and shorebirds.	Additional levees may result in decreased wildlife use and diversity. Expensive. Requires additional levee maintenance and water control structures.

Best Management Practice	Strategies	Mosquito Control Objective	Advantages	Disadvantages
*Ditch design (2:1 slopes & minimum 4 foot bottom)** **consider 3:1 slope or greater to discourage burrowing animal damage and potential seepage problems*	Construct or improve ditches to quality standard that prevents unwanted vegetation growth or unnecessary seepage.	Reduces likelihood of vegetation growing along ditch banks. Excessive vegetation slows water flow, traps silt, and can be used as substrate for mosquito eggs.	Improves water flow and decreases maintenance of vegetation that grows along canal banks.	May require re-designing some delivery ditches to meet specific design criteria. Could affect habitat for wildlife species such as giant garter snakes. Steeper slopes may erode more quickly and created a hazard for hunters.
*Levee design & compaction (≥3:1 slopes & >80% compaction)**	Construct or improve levees to quality standard that ensures stability and prevents unwanted seepage.	To reduce mosquito habitat caused by seepage into adjacent fields or dry ponds.	Properly constructed levees prevent seepage from erosion or rodent damage, and reduce need for annual maintenance.	Additional expense to repair or build levees on existing properties.
Deep channels or basins constructed in seasonal wetlands	Excavate deep channels or basins to maintain permanent water areas (> 2.5 feet deep) within a portion of seasonal wetlands. Provides year-round habitat for mosquito predators which can inoculate seasonal wetlands when they are irrigated or flooded.	To reduce mosquito larvae through predation.	Provides on-site source of mosquitofish and other mosquito predators to seasonal wetlands. Increases overall habitat diversity.	Expensive to excavate and maintain permanent water. Potential problems with emergent vegetation. May be a deep water hazard in hunting areas.
Permanent water reservoir that floods into seasonal wetlands	Maintain separate permanent water reservoir that conveys water to seasonal wetlands. Provides year-round habitat for mosquito predators which can inoculate seasonal wetlands when they are irrigated or flooded.	To reduce mosquito larvae through predation.	Provides on-site source of mosquitofish and other mosquito predators to seasonal wetlands. Increases overall habitat diversity.	Additional expense to construct reservoir that feeds water to seasonal wetlands and expensive to maintain permanent water.

Biological Controls

Best Management Practice	Strategies	Mosquito Control Objective	Advantages	Disadvantages
Mosquitofish	Stock managed wetlands with mosquitofish or encourage habitats for naturalized populations. Utilize water sources with mosquitofish to passively transport predators to newly flooded habitats.	To supplement mosquito predator population.	Provides a non-chemical control of mosquito larvae. Mosquito fish are often available free of charge to landowners from their local district.	May reduce non-target populations of invertebrates or other mosquito predators. Not appropriate for vernal pool habitats.
Encourage invertebrate predators	Maintain permanent or semi-permanent water where mosquito predators can develop and be maintained. Discourage use of broad spectrum pesticides.	To reduce mosquito populations through predation.	Provides biological control of mosquito larvae and adults.	None.
Swallow colonies	Do not discourage nesting swallows.	To reduce mosquito populations through predation.	Provides biological control of adult mosquitoes.	Guano.
Bats	Build bat boxes	To reduce mosquito populations through predation.	Provides biological control of adult mosquitoes.	Potential (or perceived potential) for transmission of rabies.

Suggested coordination activities between wetland managers and Mosquito and Vector Control Districts (MVCD).

Best Management Practice	Strategies	Mosquito Control Objective	Advantages	Disadvantages
Habitat management and flooding schedule coordination	Consult with MVCDs on Agency-sponsored habitat management plans on private lands (i.e. Presley Program). Consult with Districts on the timing of wetland flooding on public lands – urge private landowners to do the same.	Allows MVCDs the opportunity to provide input on habitat management and recommend BMPs to reduce mosquitoes.	Reduces potential conflicts between MVCDs, landowners, and Agencies/NGOs when managing or flooding wetlands. Provides information exchange.	Requires a commitment of time from MVCDs, landowners, and Agencies/NGOs to meet and coordinate activities.
Identify problem areas for mosquito production and target for implementation of BMPs	Local MVCDs identify problem locations for mosquito production and work with landowners and Agencies/NGO's to implement mosquito BMPs. Identify potential cost-share opportunities to implement BMPs.	Work to reduce mosquito production through BMPs on properties that are most problematic.	Allows limited resources from MVCDs and Agencies/NGO's to be targeted towards problem areas. Provides opportunities for monitoring the effectiveness of BMPs.	None
Wetland Habitat Restoration and enhancement project design & coordination	Consult with local MVCDs on the design of restoration and enhancement projects.	To determine where features to discourage mosquito production can be incorporated into wetland habitat restoration and enhancement projects where feasible.	Reduces potential conflicts between Districts, landowners, and Agencies/NGOs when restoring or enhancing wetlands. Provides a priori consultation for MVCDs on wetland projects.	Requires some flexibility from MVCDs, landowners, and Agencies/NGOs when designing projects. BMPs will likely increase the project cost.
Coordinate Monitoring Activities	Facilitate monitoring mosquito populations of larval and adult stages before and after implementation of BMPs.	Determine the effectiveness of BMPs to refine and prioritize their future use.	Provides a means to evaluate and document effectiveness of BMPs.	Requires time and resources to accomplish.

Appendix C. Sacramento River NWR Hunting Plan

I Introduction

Sacramento River National Wildlife Refuge (Refuge) is part of the Sacramento National Wildlife Refuge Complex (Complex) and is located in the Sacramento Valley of north-central California. The Valley is bordered by the Sierra Nevada Range and Cascade Range to the east and the North Coast Range to the west. The Refuge is composed of 26 properties (units) along a 77-mile stretch of the Sacramento River between the cities of Red Bluff and Princeton, 90 miles north of the metropolitan area of Sacramento. As of May 2004, the Refuge consists of approximately 10,141 acres of riparian habitat, wetlands, uplands, intensively managed walnut and almond orchards, and row crops in Tehama, Butte, and Glenn counties. Colusa County is within the approved refuge boundary, but the Refuge does not currently administer any properties along the river within the county.

The Valley is an extensive agricultural area, which historically included vast herds of pronghorn and tule elk and tens of millions of wintering ducks and geese. Lands that surround the Refuge are mostly orchards and irrigated rice lands with some dairying, safflower, barley, wheat, and alfalfa crops. Topography is flat with a gentle slope to the south. The predominant soil type is Columbia loam.

Riparian habitat along the Sacramento River has been identified as critically important for endangered and threatened species, anadromous salmonids, native resident fishes, migratory birds, native plants, and to the natural processes of the River. There has been a 98 percent reduction of riparian habitat along the Sacramento River. Habitat loss resulted from forest clearing, primarily for agriculture, dams for flood control and water storage on the main stem and tributaries, which attenuate and alter hydrology and geomorphology, and bank stabilization, such as levees and rip-rap, for flood control. The relatively small amount of remaining riparian woodland provides a strikingly disproportionate amount of habitat value for wildlife. The Refuge is managed to maintain, enhance and restore habitats for threatened and endangered species, migratory birds, anadromous fish, and native plants and vegetation. As much as possible, habitat is managed for natural diversity of indigenous flora and fauna. Riparian forests are being restored by converting flood-prone croplands along the Sacramento River in cooperation with The Nature Conservancy (TNC), Sacramento River Partners (SRP), and local farmers.

There are a variety of outdoor activities that occur on the Sacramento River and adjacent lands. Hunting, fishing, wildlife observation, environmental education, interpretation, tubing, and canoeing are some of the commonly known activities that occur during different times of the year on some private and public lands (Figure 24, Chapter 5, CCP, USFWS 2004). Hunting of birds and mammals is a traditional outdoor activity that is subject to the California Department of Fish and Game regulations.

The purpose of this hunting plan is to outline how the program will be operated within the Refuge. In addition, the hunting plan documents how the Refuge will provide safe and accessible hunting opportunities, while minimizing conflicts with other priority wildlife-dependent recreational uses.

II. Conformance with Statutory Authorities

National Wildlife Refuges are guided by the mission and goals of the Refuge System, purposes for which individual Refuges were established, Service policies, laws and international treaties. Relevant guidance includes the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act), the Refuge Recreation Act of 1962, and selected portions of the Code of Federal Regulations and Fish and Wildlife Service Manual. The Refuge Recreation Act of 1962, as amended, authorized the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use when such uses did not interfere with the areas primary purpose.

The Improvement Act identified a new mission statement for the Refuge System; established six priority public uses (hunting, fishing, wildlife observation and photography, environmental education and interpretation); emphasized conservation and enhancement of the quality and diversity of fish and wildlife habitat; stressed the importance of partnerships with Federal and State agencies, Tribes, organizations, industry, and the general public; mandated public involvement in decisions on the acquisition and management of refuges; and required, prior to acquisition of new refuge lands, identification of existing compatible wildlife-dependent uses that would be permitted to continue on an interim basis pending completion of comprehensive conservation planning.

The Improvement Act establishes the responsibilities of the Secretary of the Interior for managing and protecting the Refuge System; requires a CCP for each refuge by the year 2012; provides guidelines and directives for the administration and management of all areas in the Refuge System, including wildlife refuges, areas for the protection and conservation of fish and wildlife threatened with extinction, wildlife ranges, game ranges, wildlife management areas, or waterfowl production areas. The Improvement Act also establishes a formal process for determining compatibility of uses. Before any uses, including priority public uses, are allowed on refuges, Federal law requires that they be formally determined compatible. A compatible use is defined as a use that, in the sound professional judgment of the refuge manager, will not materially interfere with or detract from the fulfillment of the purposes of the refuge. Sound professional judgment is defined as a finding, determination, or decision that is consistent with the principles of sound fish and wildlife management and administration, available science and resources (funding, personnel, facilities, and other infrastructure), and applicable laws. The Service strives to provide priority public uses when compatible. If financial resources are not available to design, operate, and maintain a priority use, the Refuge manager will take reasonable steps to obtain outside assistance from the State and other conservation interests.

The Sacramento River Refuge was established in 1989 by the authority provided under the Endangered Species Act of 1973 and the Emergency Wetlands Resources Act of 1986, using monies made available through the Land and Water Conservation Fund Act of 1965. The Service proposed and Congress authorized the acquisition of 18,000 acres of land for establishment of the Sacramento River Refuge. The area considered for acquisition is located along the Sacramento River between Colusa and Red Bluff in Colusa, Glenn,

Butte, and Tehama counties. A combination of fee title and conservation easement acquisitions will be used to protect this habitat. The purpose of the Sacramento River Refuge is to preserve, restore, and enhance riparian habitat for threatened and endangered species, migratory birds, anadromous fish, native plants and vegetation. Draft compatibility determinations are included in Appendix B of the CCP.

III. Statement of Objectives

Hunting is identified in the Refuge Improvement Act as a priority use for refuges when it is compatible with other refuge purposes. The Refuge encourages dove, waterfowl, coot, common moorhen, pheasant, quail, snipe, turkey and deer hunting which are currently hunted species on public land along the Sacramento River. The hunting program will be conducted in a safe and cost-effective manner, and to the extent practicable, carried out in accordance with State regulations, see the Fish and Wildlife Service Manual 605 FW 2, Hunting. The Hunting Plan was developed to provide safe and accessible hunting opportunities, while minimizing conflicts with other priority wildlife-dependent recreational uses. The Refuge hunting program will comply with the Code of Federal Regulations Title 50, 32.1 and managed in accordance with Fish and Wildlife Service Manual Chapter 605 FW 2, Hunting.

Hunting will be permitted in accordance with State and Federal regulations and seasons to ensure that it will not interfere with the conservation of fish and wildlife and their habitats. Therefore, the sport hunting of migratory birds, upland game birds and deer on the Refuge is in compliance with State regulations and seasons, the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57), the National Wildlife Refuge System Administration Act of 1966 (1RM 5.4EE, Public Law 89-669), and the Refuge Recreation Act of 1962 (8RM 5.1, Public law 87-174).

IV. Assessment

a. *Will populations sustain hunting and still support other wildlife-dependent priority uses?*

Yes, the Refuge adopts harvest regulations set by the State, which uses concepts of density dependant compensatory mortality and adaptive harvest management to ensure sustained game species populations. The Refuge units are evaluated to determine the best public use strategy for providing high quality wildlife-dependent public use opportunities. Twenty-nine percent of the refuge lands are closed to hunting, while still providing opportunities for the other wildlife-dependent uses. Sixteen percent of the Refuge is closed to all public use and will provide areas of sanctuary that will function as a strong population base.

b. *Do target species and other wildlife compete for habitat?*

Possibly; while each species occupies a unique niche, there is only a finite amount of space available to satisfy various habitat requirements of water, food, cover, breeding, roosting, and fawning areas.

c. *Do target species prey on other species at unacceptable levels?*

No, target species (dove, waterfowl, coot, common moorhen, pheasant, quail, snipe, turkey and deer) generally do not prey on other species at unacceptable levels. Occasionally, in certain areas, deer browse of seedling valley oak is particularly heavy.

V. Description

a. *Areas of the Refuge that Support Populations of Target Species*

Target game species commonly occurring on the Refuge include waterfowl, coots, common moorhen, snipe, dove, quail, pheasant, turkey and deer. Descriptions of freshwater wetland and riparian habitats and their associated plant/wildlife species are described below and in further detail in Chapter 3 of the CCP. A list of animal and plant species occurring on the Refuge can be found in Appendix G of the CCP. An overview of hunted target wildlife species is also described below.

Habitats

Riparian Habitats and Vegetation

Refuge "riparian" habitats are referred to as: open water, gravel and sand bars, herbland cover, blackberry scrub, Great Valley riparian scrub, Great Valley cottonwood riparian forest, Great Valley mixed riparian forest, Valley oak, and Valley freshwater marsh (Geographic Information Center at California State University, Chico 2002). Distributions of these habitats on Refuge units can be seen in Figures 11-23 (Chapter 3, CCP).

Open water constitutes water, either standing or moving, and does not necessarily include vegetation. These areas support many fish species, including salmon, steelhead, and sturgeon, as well as avian species such as American white pelican, double-crested cormorant, osprey, kingfisher, and common merganser.

Gravel and sand bars appear as open, unvegetated areas in air photos, but ground inspection reveals several annual and short-lived perennial species of sun-loving herbs, grasses, and aromatic subshrubs. The vegetation cover is less than 50 percent. Species such as killdeer, spotted sandpiper, and lesser nighthawk commonly use these areas.

Herbland cover is composed of annual and perennial grasses and forbs, and is enclosed by other riparian vegetation or the stream channel. Species such as lazuli bunting, blue grosbeak, and common yellowthroat frequently nest in these areas.

Blackberry scrub is vegetation where 80 percent or more of the coverage is blackberry shrubs. Blackberry shrubs are important escape cover for California quail, and are used for perches by a variety of songbirds.

Great Valley riparian scrub forms from primary succession processes where vegetation becomes established in areas where erosion and sedimentation of deposits have occurred (Holland 1986; Holland and Roye 1989). Vegetation includes streamside thickets dominated by sandbar or gravelbar willows, or by other fast growing shrubs and vines. It is also commonly populated by cottonwood, California rose, Mexican tea, and wild grape. Typical inhabitants include the black-chinned hummingbird, willow flycatcher, western flycatcher, mourning dove, and black phoebe.

Great Valley cottonwood riparian forest consists of cottonwoods that are at least one year old and account for 80 percent or greater of the canopy coverage. Cottonwood forests are an early successional stage riparian vegetation type and consist of primarily mature Fremont cottonwood trees and sparse understory (Holland 1986; Holland and Roye 1989). They can also include one or more species of willows and have a dense understory of Oregon ash, box elder, wild grape, and various herbs and grasses. Species such as the bald eagle, yellow-billed cuckoo, and western flycatcher nest and forage in this habitat type.

Great Valley mixed riparian forest (MRF) is a forest vegetation type consisting of later successional species, such as valley oak (Holland 1986; Holland and Roye 1989). Valley oak accounts for less than 60 percent of the canopy coverage with black walnut, Oregon ash, and western sycamore also present. Willows and cottonwood may also be present in relatively low abundance. The dense understory often consists of Oregon ash, box elder, poison oak, and wild grape. Due to the dense canopy and understory, a large variety of Neotropical migrant bird species use this habitat, such as the yellow-billed cuckoo, yellow-rumped warbler, black-headed grosbeak, and spotted towhee. Since MRF frequently edges oxbows and sloughs, it attracts a large array of species that are "wetland-related", including the northwestern pond turtle, great blue heron, great egret, double-crested cormorant, wood duck, yellow-breasted chat, common yellowthroat, and song sparrow.

The valley oak riparian forest (VORF) consists of vegetation with at least 60 percent valley oak canopy. Restricted to the highest parts of the floodplain, VORF occurs in areas that are more distant from or higher than the active river channel. This habitat type is a medium-to-tall deciduous, closed-canopy forest dominated by valley oak and may include Oregon ash, black walnut, and western sycamore. The understory includes California pipevine, virgin's bower, California blackberry, California wildrose, poison oak, and blue wild-rye (Holland 1986). Common species found here include the red-shouldered hawk, great-horned owl, western screech-owl, acorn woodpecker, Bewick's wren, bushtit, and scrub-jay. Historically an extensive habitat, it has been greatly reduced by agriculture and firewood harvesting and is now only limited and scattered in occurrence.

Valley oak woodland (VOW) is found on deep, well-drained alluvial soils, far back from or high above the active river channel (Holland 1986). VOW is an open,

winter-deciduous savanna dominated by widely spaced oaks, blue elderberry, and coyote-brush, with an understory of grasses and forbs. VOW often intergrades with VORF. Due to its more open nature, VOW attracts different avian species than VORF, such as the Swainson's hawk, American kestrel, western kingbird, loggerhead shrike, yellow-billed magpie, and western meadowlark. VOW once occupied thousands of acres in the Great Central Valley. It occurred on the best agricultural soils (Columbia and Vina type) that covered thousands of acres in the Great Valley (Bureau of Soils 913; Holland 1986; Holmes et al. 1915; Watson et al. 1929). Consequently, valley oak woodlands are among the most reduced natural habitat type in California.

Valley freshwater marsh is dominated by perennial emergent monocots, a type of marsh vegetation. Cattails or tules usually are the dominants, often forming monotonous stands that are sparingly populated with additional species, such as rushes and sedges. Coverage may be very high, approaching 100 percent. Typical riparian areas that support freshwater marsh include the main channel, tributaries, sloughs, abandoned channel, oxbow lakes, and ponds. These areas attract an array of wetland-dependent species such as mallard, wood duck, black-crowned night-heron, great egret, great blue heron, American bittern, northwestern-pond turtle and giant garter snake.

Wetland Habitats

The Sacramento River, its tributaries, sloughs, abandoned channels, oxbow lakes, and ponds support freshwater wetlands. The river channel is dynamic: it varies with meander belt position from shallows near gravel bars to deep holes below steep cut banks. Depth and flow velocity also varies with seasonal differences in runoff and with flow releases from Keswick Dam. Generally, water in the channel is relatively fast moving and cold. Oxbow lakes occur on the middle Sacramento River floodplain. They form on meandering rivers when the channel breaches a narrow gap of land in the loop and a sand plug seals the upriver arm of the loop. They vary in depth depending on siltation. Water is calm and relatively warm compared to the main channel. Sloughs and swales convey and distribute water on the floodplain. They are usually wet only during high water and flood events. Gravel pits were excavated on the Sacramento River floodplain for private and public roads and an experimental artificial salmon-spawning project conducted by the Bureau of Reclamation. Gravel pits form wetlands when the bottom contacts the water table. Large portions of the Sacramento River floodplain become temporary wetlands when inundated with seasonal runoff from the tributaries and releases from Keswick Dam. A diversity of fish and wildlife use these various types of wetlands during portions of their life history, including nesting, migration, and wintering periods.

Target Species

Waterfowl

The primary waterfowl use of the Refuge is by migrating and wintering birds during the months of August through March. Peak populations occur during December, when several thousand ducks are present. A small percentage remains through spring and summer months to nest. Common wintering duck species include mallard, American widgeon, green-winged teal, northern shoveler, wood duck, ring-necked duck, common golden-eye, and common merganser. Wintering goose species consist mostly of western Canada goose, but occasionally white-fronted geese. The primary summer nesting species include mallard, wood duck, and common merganser, and lesser numbers of cinnamon teal and western Canada goose.

Waterfowl areas consist primarily of wetlands including the main river channel, tributaries, sloughs, swales, oxbow lakes, and freshwater marshes. When flooded by winter rains and releases from Keswick Dam, the sloughs, swales, and oxbow lakes become important winter habitat for waterfowl, especially ducks. A few species such as mallard, wood duck, common merganser, and Canada goose nest in herbaceous vegetation near the river and raise their broods at the wetlands and riparian area.

Upland Gamebirds

Gamebirds occupy various riparian habitats along the Sacramento River. The mourning dove commonly uses gravel bars and nest in riparian forests and orchards. California quail nest in the herbaceous layer of various riparian habitats and use blackberry and other thickets for escape cover. Wild turkey use large trees for roosts and nest in dense herbaceous vegetation. Ringed-neck pheasant nest in dense herbaceous vegetation and feed and roost in various riparian habitats.

Mammals

Black-tailed deer occupy various riparian habitats along the Sacramento River. Fawning areas are usually in dense riparian forest where deer find sanctuary from predators. Deer graze and browse on selected riparian plants and agricultural crops during their annual life history.

b. *Areas of the refuge to be opened to hunting*

The Refuge currently consists 10,141 acres of agricultural, wetland, grassland, and riparian habitats (Table 1, Chapter 1, CCP). Approximately 2,979 acres (29%) will be open by 2005 and an additional 2,592 acres (26%) within 2-10 years to total 5,571 acres (55%) open to hunting (Figure 27, Chapter 5, CCP). Current riparian restoration efforts provide excellent foraging, loafing, and nesting habitat for mourning doves, which tend to prefer the early succession stages of willow scrub and cottonwood forest. The more mature riparian habitats, especially Valley oak riparian forest and Valley oak savannah, provide excellent habitat for California quail, wild turkey and black-tailed deer. Waterfowl tend to use the oxbow lakes,

backwater sloughs and the Sacramento River. Any specific management actions relating to resident game animals are coordinated with the California Department of Fish and Game (CDFG).

c. *Species designated for hunting and hunting periods*

Hunting of waterfowl, coots, common moorhen, snipe, dove, quail, pheasant, turkey and deer will be allowed in accordance with State hunting regulations during the legal hunting seasons and shooting times (Table 9, Chapter 5, CCP).

In order to promote interest in hunting, the Sacramento River Refuge will continue to coordinate a Llano Seco Junior Pheasant Hunt with the Llano Seco Ranch, CDFG and California Waterfowl Association. This once-a-year hunt has occurred on private property adjacent to the Sacramento River Refuge.

d. *Justification for a permit system, if required*

Assess the need for turkey and deer hunting by permit only on Refuge lands during the 2005-7 hunting season.

e. *Consideration of user fees*

In order to be consistent with the Sacramento River State Wildlife Areas, managed by CDFG, hunters do not need to obtain a hunting permit or pay a special fee.

f. *Consultation and coordination procedures with States, including justification of refuge-specific regulations*

Attend the Sacramento Refuge Complex pre and post hunting meetings with the State managers and wardens. In addition, CDFG and the Refuge have a Memorandum of Understanding (MOU) that authorizes cooperative management efforts. Yearly coordination meetings are held in accordance with the MOU.

g. *Methods of control and enforcement*

- Boundary and public use signs depicting allowable uses will be placed and maintained above the approximate ordinary high water mark and at access points.
- California Department of Boating and Waterways boating guide that depicts the unit name and river mile location, a large laminated boating guide, and the Sacramento River Refuge brochure will be placed at public boat ramps and units accessible by vehicle.
- Gated roads to allow only pedestrian access from parking areas.
- Close landward boundaries to discourage trespass through adjacent private lands.
- Hunter comment drop box at Rio Vista
- Random, weekly hunter field checks by Refuge law enforcement officers to maintain compliance with regulations and assess species and number harvested.
- Law enforcement patrol by Refuge officers, special agents, game wardens, park rangers, and deputy sheriffs.

h. *Consideration of providing opportunities for hunters with disabilities*

- Construct a one-mile accessible trail on Sul Norte Unit.
- Make all parking areas and portable toilets fully accessible.

VI. Measures taken to avoid conflicts with other management activities

a. *Biological conflicts*

Biological conflicts will be minimized by the following:

- Proper zoning, regulations, and Refuge seasons will be designated to minimize negative impacts to wildlife.
- Due to difficult access to most units where hunting is allowed, (primarily by boat), it may limit the number of hunters and visits.
- Sanctuary units are located within separate reaches of the River, which distributes areas needed by wildlife for resting, feeding, nesting, and fawning.
- Density of the riparian forests provides additional sanctuary for wildlife species.
- Use of federally approved non-toxic shot for all hunting except deer will help minimize propensity of lead poisoning.
- No hunting during the breeding season (except turkey). Hunting will be allowed only during adopted seasons for waterfowl, upland game birds, and deer.
- Law enforcement presence to minimize excessive harvest and other infractions (illegal use of lead shot, take of non-game species, littering, etc.).
- No firearms permitted on the Refuge outside the designated hunting seasons and areas.

b. *Social Conflicts*

Conflicts between hunting and low impact activities and neighboring landowners will be minimized by the following:

- Provide 1,153 acres (11%) of the refuge for only non-hunting activities i.e. wildlife observation, photography, interpretation, environmental education and fishing activities by 2004 and an additional 1,754 acres (17%) within 2-10 year for a total of 2,907 acres (29%) which will separate the user groups spatially.
- Close landward boundaries to discourage trespass from and onto adjacent private lands.
- Hunting will not be allowed on Refuge units that are small in area and close in proximity to urban areas and private dwellings.
- Post all Refuge units with boundary signs and provide public use information signs
- Restrict entry and departure times on the refuge i.e. one hour before sunrise to one hour after sunset.
- Allow pedestrian traffic only.
- Provide coordinated law enforcement patrol by game wardens, park rangers, and Refuge officers.

VII. Hunt Specifics

a. *Refuge-specific regulations*

- Method of take: Federally approved non-toxic shot required for all species except, deer. Weapons or ammunition for take of deer include shotgun, 0 or 00 buckshot, shotgun slug, and archery. No shot shell larger than 12 gauge and no shot size larger than "T" is permitted. No rifles or pistols may be used or possessed.
- Method of transportation: pedestrian traffic only; bicycles not allowed.
- Alcohol: Use or possession of alcohol while hunting in the field is prohibited.
- Littering is unlawful.
- Fires: No person shall build or maintain fires except on gravel bars in portable gas stoves
- Camping: Limited camping on gravel bars up to seven days is allowed. Camping on Refuge land, other than gravel bars, is prohibited
- Day use hours are 1 hour before sunrise to 1 hour after sunset except on gravel bars.
- Dogs: All dogs must be kept on a leash, except while hunting with a licensed hunter.

b. *Outreach plan*

1. Issue

The Service intends to propose the opening of Sacramento River Refuge to hunting.

2. Basic facts about the issue

- Approximately 2,979 acres (29%) will be open by 2005 and an additional 2,592 acres (26%) within 2-10 years to total 5,571 acres (55%) open to hunting (Figure 27, Chapter 5, CCP).
- Hunting of waterfowl, coots, common moorhen, snipe, dove, quail, pheasant, turkey and deer will be allowed in accordance with State hunting regulations during the legal hunting seasons and shooting times
- Hunting will be permitted in accordance with State and Federal regulations and seasons to ensure that it will not interfere with the conservation of fish and wildlife and their habitats.
- Method of enforcement and control will take place through boundary and public use signs, information kiosks at boat ramps and routine patrol by CDFG wardens and Refuge officers.
- Biological conflicts will be addressed by use of federally approved non-toxic shot and providing sanctuary areas that are strategically dispersed and well distributed along the River.
- The density of the riparian forests and presence of poison oak, ticks, mosquitoes and periodic flooding will reduce or limit the amount of visitation on some areas.
- Hunting will not be allowed on Refuge units that are small in area and close in proximity to urban areas and private dwellings.

- Landward boundaries will be closed to discourage trespass from and onto adjacent private lands.
- Entry and departure times on the refuge will be restricted.
- The majority of the hunt area will be accessible by boat access only. This access will serve to limit the number of hunters using the refuge.

3. Communication goals
- Continue to solicit input from partners and keep lines of communication open
- Continue to attend pre and post hunt meetings with CDFG
- Continue to solicit input from Refuge Hunting Program and Disabled Access working groups.
- Continue to coordinate with the Sacramento River Conservation Area Forum.
- Ensure accurate public information and news stories

4. Message
A quality, compatible and safe hunting program can be implemented and maintained on the Sacramento River Refuge.

5. Interested parties
State fish and wildlife agencies; Tribes; nongovernmental organizations; conservation groups; hunting, fishing, and wildlife observation groups; educators; farmers and ranchers; other federal agencies; Members of Congress; state and county representatives; news media; and many members of the public.

6. Key date
October 2004

c. *Hunter application and registration procedures*
Non-applicable

d. *Description of hunter selection process, if needed*
Non-applicable

e. *Draft news release regarding the hunting program*
See Attached

f. *Description of hunter orientation, including pre hunt scouting opportunities*
Maps and hunting information will be provided on the Sacramento Refuge Complex website, in the California State hunting regulations, at public boat ramps, and entrance roads to refuge units. The refuge will be open year-round, therefore pre hunt scouting will be allowed.

g. *Hunter requirements*

(1) State determined age requirement

- Applicants for deer hunting must be at least 12 years old as stated in State regulations.
- Youth hunters, 15 year or younger, must be accompanied by adults 18 years or older.

(2) Allowable equipment

Method of take: Federally approved non-toxic shot required for all species except, deer. No shot shell larger than 12 gauge and no shot size larger than "T" is permitted. Weapons or ammunition for take of deer include shotgun, 0 or 00 buckshot, shotgun slug, and archery. No rifles or pistols may be used or possessed on the Refuge.

(3) Licensing and permits

- State hunting license is required for taking any bird or mammal. Hunters must carry licenses and be prepared to show them upon request.
- State and Federal duck stamps are required to take migratory waterfowl, an upland game bird stamp is required to take dove, pheasants, quail, and turkey; license tags are required for taking deer.
- Assess the need for turkey and deer hunting by permit only on Refuge lands during the 2005-7 hunting season.

(4) Reporting requirements

- Hunters must complete harvest report/comment report card at unit drop box on the Rio Vista Unit.
- Hunters must report take of deer according to State regulations.

(5) Hunter training and safety

Hunters are required to successfully complete a hunter education course in order to purchase a State hunting license.

(6) Other information (use of dogs, falconry, etc.)

- Bird hunting: trained retrieving dogs are allowed.
- Deer hunting: use of dogs to pursue, harass or take is not allowed.
- Falconry is not allowed.
- Dog trials not allowed.

VIII. Compatibility Determination

See Appendix B in CCP

IX. Appropriate NEPA Documents

See EA (Appendix A in CCP)

X. Evaluation

a. *Monitoring and reporting use levels and trends*

Use levels, trends, and needs will be evaluated through hunters' harvest report/comment report cards, report take of deer, auto counters, hunter contact in the field, comments during working group, agencies, and public meeting, e-mails and letters. The visitor use will be recorded annually in the Refuge Management and Information System.

b. *Surveying needs of the hunting visitor*

Universities will be contacted to develop a survey.

c. *Are we meeting program objectives?*

There is currently no hunting on the Sacramento River Refuge. The hunting program objective to, *"provide high quality hunting opportunities on 2,979 acres by 2005 and an additional 2,592 acres within 2-10 years",* will be meet through the CCP strategies.

d. *Do we need to resolve and conflicts?*

The hunting program and outreach plans are written to resolve and prevent future conflicts.

e. *Refuge/Regional Office review schedule*

NEWS RELEASE

U.S. FISH & WILDLIFE SERVICE - REGION 1

Sacramento NWR Complex
752 County Road 99 W
Willows, CA 95988

FOR IMMEDIATE RELEASE
Contact: Denise Dachner
530/934-2801
October 1, 2004

Sacramento River Refuge Lands
Open to Hunting

The Sacramento River National Wildlife Refuge (Refuge) is opening 2,979 acres between Red Bluff Diversion Dam to Princeton to hunting on _____. Take of deer, turkeys, quail, waterfowl, coots, snipe, dove and pheasants will be allowed in accordance with the State of California hunting regulations during the legal hunting seasons. Brochures available upon request and posted public use signs, including the River-mile for reference, will assist hunters in determining Refuge unit locations. For further information and Refuge specific hunting regulations see SacramentoValleyRefuges.fws.gov or call 530-934-2801.

The U.S. Fish and Wildlife Service is the principal federal agency responsible for conserving, protecting and enhancing fish, wildlife and plants and their habitats for the continuing benefit of the American people. The Service manages the 95-million-acre National Wildlife Refuge System, which encompasses 540 national wildlife refuges, thousands of small wetlands and other special management areas. It also operates 69 national fish hatcheries, 64 fishery resource offices and 81 ecological services field stations. The agency enforces federal wildlife laws, administers the Endangered Species Act, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, and helps foreign governments with their conservation efforts. It also oversees the Federal Aid program that distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state fish and wildlife agencies. 02/03

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Appendix D. Refuge Fishing Plan

I. Introduction

Sacramento River National Wildlife Refuge (Refuge) is part of the Sacramento National Wildlife Refuge Complex (Complex) and is located in the Sacramento Valley of north-central California. The Valley is bordered by the Sierra Nevada Range and Cascade Range to the east and the North Coast Range to the west. The Refuge is composed of 26 properties (units) along a 77-mile stretch of the Sacramento River between the cities of Red Bluff and Princeton, 90 miles north of the metropolitan area of Sacramento. As of May 2004, the Refuge consists of approximately 10,141 acres of riparian habitat, wetlands, uplands, intensively managed walnut and almond orchards, and row crops in Tehama, Butte, and Glenn counties. Colusa County is within the approved refuge boundary, but the Refuge does not currently administer any properties along the river within the county.

The Valley is an extensive agricultural area, which historically vast herds of pronghorn and tule elk and millions of wintering ducks and geese. Lands that surround the Refuge are mostly orchards and irrigated rice lands with some dairying, safflower, barley, wheat, and alfalfa crops. Topography is flat with a gentle slope to the south. Predominant soil type is Columbia loam.

Riparian habitat along the Sacramento River provides important habitat for endangered and threatened species, anadromous salmonids, native resident fishes, migratory birds, native plants, and to the natural processes of the River. There has been a 98 percent reduction of riparian habitat along the Sacramento River. Habitat loss resulted from forest clearing, primarily for agriculture, dams for flood control and water storage on the main stem and tributaries, which attenuate and alter hydrology and geomorphology, and bank stabilization, such as levees and rip-rap, for flood control. The relatively small amount of remaining riparian woodland provides a strikingly disproportionate amount of habitat value for wildlife. The Refuge is managed to maintain, enhance and restore habitats for threatened and endangered species, migratory birds, anadromous fish, and native plants and vegetation. As much as possible, habitat is managed for natural diversity of indigenous flora and fauna. Riparian forests are being restored by converting flood-prone croplands along the Sacramento River in cooperation with The Nature Conservancy (TNC), Sacramento River Partners (SRP), and local farmers.

II. Conformance with Statutory Authorities

National Wildlife Refuges are guided by the mission and goals of the Refuge System, purposes for which individual Refuges were established, Service policies, laws and international treaties. Relevant guidance includes the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act), Refuge Recreation Act of 1962, and selected portions of the Code of Federal Regulations and Fish and Wildlife Service Manual. The Refuge Recreation Act of 1962, as amended, authorized the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use when such uses did not interfere with the areas primary purpose.

The Improvement Act identified a new mission statement for the Refuge System; established six priority public uses (hunting, fishing, wildlife observation and

photography, environmental education and interpretation); emphasized conservation and enhancement of the quality and diversity of fish and wildlife habitat; stressed the importance of partnerships with Federal and State agencies, Tribes, organizations, industry, and the general public; mandated public involvement in decisions on the acquisition and management of refuges; and required, prior to acquisition of new refuge lands, identification of existing compatible wildlife-dependent uses that would be permitted to continue on an interim basis pending completion of comprehensive conservation planning.

The Improvement Act establishes the responsibilities of the Secretary of the Interior for managing and protecting the Refuge System; requires a CCP for each refuge by the year 2012; provides guidelines and directives for the administration and management of all areas in the Refuge System, including wildlife refuges, areas for the protection and conservation of fish and wildlife threatened with extinction, wildlife ranges, game ranges, wildlife management areas, or waterfowl production areas. The Improvement Act also establishes a formal process for determining compatibility of uses. Before any uses, including priority public uses, are allowed on refuges, Federal law requires that they be formally determined compatible. A compatible use is defined as a use that, in the sound professional judgment of the refuge manager, will not materially interfere with or detract from the fulfillment of the purposes of the refuge. Sound professional judgment is defined as a finding, determination, or decision that is consistent with the principles of sound fish and wildlife management and administration, available science and resources (funding, personnel, facilities, and other infrastructure), and applicable laws. The Service strives to provide priority public uses when compatible. If financial resources are not available to design, operate, and maintain a priority use, the Refuge manager will take reasonable steps to obtain outside assistance from the State and other conservation interests.

The Refuge was established in 1989 by the authority provided under the Endangered Species Act of 1973 and the Emergency Wetlands Resources Act of 1986, using monies made available through the Land and Water Conservation Fund Act of 1965. The Service proposed and Congress authorized the acquisition of 18,000 acres of land for establishment of the Sacramento River Refuge. The area considered for acquisition is located along the Sacramento River between Colusa and Red Bluff in Colusa, Glenn, Butte, and Tehama counties. A combination of fee title and conservation easement acquisitions will be used to protect this habitat. The purpose of the Sacramento River Refuge is to preserve, restore, and enhance riparian habitat for threatened and endangered species, migratory birds, anadromous fish, native plants and vegetation. Draft compatibility determinations are included in Appendix B of the CCP (USFWS 2004).

III. Statement of Objectives

Fishing is identified in the Refuge Improvement Act as a priority use for refuges when it is compatible with other refuge purposes. As a result the Refuge encourages fishing for legal take of freshwater game fish species. The fishing program will be of the highest quality, conducted in a safe and cost-effective manner, and to the extent practicable, carried out in accordance with State regulations, see 605 FW 3, Fishing. The Fishing Plan

was developed to provide safe and accessible fishing opportunities, while minimizing conflicts with other priority wildlife-dependent recreational uses. The Refuge fishing program will comply with the Fish and Game Code or from Title 14 of the California Code of Regulations as adopted by the Fish and Game Commission under authority of the Fish and Game Code and managed in accordance with Fish and Wildlife Service Manual Chapter 605 FW 3, Fishing.

Fishing will be permitted in accordance with State and Federal regulations and seasons to ensure that it will not interfere with the conservation of fish and wildlife and their habitats. Therefore, sport fishing on the Refuge is in compliance with State regulations and seasons, the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57), the National Wildlife Refuge System Administration Act of 1966 (1RM 5.4EE, Public Law 89-669), and the Refuge Recreation Act of 1962 (8RM 5.1, Public law 87-174).

IV. Assessment.
Evaluate the fishing resources on the refuge populations and habitat. Points to be discussed include, but are not limited to, the following:

a. *A biological evaluation.*

b. *Will populations sustain fishing and still support other wildlife-dependent priority uses?*

Yes, the Refuge adopts harvest regulations set by the State, which uses the best available population information. Sources of population data for Chinook salmon include the California Department of Fish and Game, the U.S. Fish and Wildlife Service (Fisheries Resources Offices and the National Oceanographic and Atmospheric Administration (Fisheries).

c. *Do fished species and other wildlife compete for habitat?*

Yes, non-native bass, bluegill, crappie, and sunfish compete for habitat with native species. Competition is especially severe in oxbows and sloughs, which provide relatively scarce still-water habitats, which are dominated by non-native fishes.

d. *Do fished species prey on other species at unacceptable levels?*

Yes, non-native bass prey on juvenile salmonids and other native species.

V. Description

a. *Areas of the refuge that support fished species.*

Game fish species occur in open water on the Refuge in the main River channel, sloughs, oxbow lakes, and on the inundated floodplain. Open water constitutes water, either standing or moving, and does not necessarily imply vegetation. Gravel and sand bars appear as open, unvegetated areas in air photos, but ground truthing reveals several annual and short-lived perennial species of sun-loving herbs, grasses and aromatic subshrubs. The vegetation cover is less than 50 percent. The above descriptions of open water, gravel and sand bar were developed

by the Geographic Information Center at California State University, Chico (2002) for mapping the riparian vegetation of the Sacramento River.

A diversity of game fish species use various types of wetlands during portions of their life history, including spawning, migration, and wintering periods. The Sacramento River, its tributaries, sloughs, abandoned channels, oxbow lakes, and ponds support freshwater wetlands. These wetland areas are described as follows.

The river channel is dynamic: it varies with meander belt position from shallows near gravel bars to deep holes below steep cut banks. Depth and flow velocity also varies with seasonal differences in runoff and with flow releases from Keswick Dam. Generally, water in the channel is relatively fast moving and cold. Oxbow lakes occur on the middle Sacramento River floodplain. They form on meandering rivers when the channel breaches a narrow gap of land in the loop and a sand plug seals the upriver arm of the loop. They vary in depth depending on siltation. Water is calm and relatively warm compared to the main channel. Sloughs and swales convey and distribute water on the floodplain. They are usually wet only during high water and flood events. Gravel pits were excavated on the Sacramento River floodplain for private and public roads and an experimental artificial salmon-spawning project conducted by the Bureau of Reclamation. Gravel pits form wetlands when the bottom contacts the water table. Large portions of the Sacramento River floodplain become temporary wetlands when inundated with seasonal runoff from the tributaries and releases from Keswick Dam.

b. *Areas of the refuge you intend to open to fishing.*

Gravel bars, sloughs, oxbow lakes, and the inundated floodplain on all Refuge units.

c. *Species for which you will allow fishing and fishing periods.*

Game fish species which will be allowed for legal take include all native and introduced species listed in the California regulations Freshwater Sport Fishing i.e. Pacific salmon, steelhead, trout, sturgeon, sunfish, shad, stripped bass, carp, catfish, bullhead, crappie, bass and spotted bass. Fishing will be permitted in accordance with State and Federal regulations and seasons to ensure that it will not interfere with the conservation of fish and wildlife and their habitats.

d. *Justification of permit system, if required.*

In order to be consistent with the State fishing regulations, anglers do not need obtain a refuge fishing permit.

e. *Consideration of user fees.*

In order to be consistent with the State fishing regulations, anglers do not need to pay a user fee.

f. *Consultation and coordination procedures with States and Tribes, including justification of refuge-specific regulations*.

- Continue to solicit input from partners and keep lines of communication open.
- Continue to attend the Sacramento River Area Forum meetings.
- Ensure accurate public information and news stories.

g. *Methods of control and enforcement*.

- Public use signs depicting allowable uses will be placed above the ordinary high water mark and at vehicle access points.
- California Department of Boating and Waterways boating guide that depicts the unit name and river mile location, a large laminated boating guide and the Sacramento River Refuge brochure will be placed at public boat ramps and units accessible by vehicle.
- Gated parking areas to allow pedestrian access only.
- Close landward boundaries to discourage trespass through adjacent private lands.
- LE patrol by game wardens, park rangers, Refuge officers.

h. *Consideration of providing opportunities for anglers with disabilities and youth anglers*.

- All parking areas and portable restrooms are fully accessible.
- Work with partners and public agencies to develop fishing opportunities on refuge units and partners' land.

VI. Measures Taken to Avoid Conflicts With Other Management Objectives.

a. *Biological conflicts*.

- Open only riverine areas, oxbow lakes and ponds to fishing; close seasonal marshes/canals.
- Maintain parking areas, roads, and access facilities to prevent erosion or habitat damage.
- Promote use of non-toxic sinkers, split shot, and lures.
- Monitor fishing activities to ensure facilities are adequate and wildlife disturbance is minimal.
- Include Section 7 consultation, and other measures proposed to minimize or eliminate conflicts with endangered species or non-target species.

b. *Social Conflicts*.

Reducing conflicts between fishing and hunting, non-consumptive uses, and neighboring landowners will be minimized by the following:

- Disseminate California Department of Boating & Waterways boating guide, which depicts Refuge units by river mile, at public boat ramps i.e. Red Bluff Diversion Dam, Woodson Bridge, Irvine Finch, Ord Bend, Butte City, and Sacramento River-Colusa State Park, by 2005.
- Place public use signs at the approximate ordinary high water mark on all units at access points.

- Construct information signs and place brochure holders at appropriate refuge units to provide fishing information.
- LE patrol by game wardens, park rangers, and Refuge officers.
- Close landward boundaries to discourage trespass through adjacent private lands.
- Restrict entry and departure times on the refuge.

VII. Program Specifics.

a. *Refuge-specific regulations*.
- Method of transportation: pedestrian traffic only.
- Littering is unlawful.
- Fires: No person shall build or maintain fires except on gravel bars in portable gas stoves.
- Camping: Limited camping on gravel bars up to seven days is allowed. Camping on Refuge land, other than gravel bars, is prohibited.
- Day use hours are 1 hour before sunrise to 1 hour after sunset except on gravel bars.

b. *Outreach plan*

1. Issue

The Service intends to propose the opening of Sacramento River Refuge to fishing.

2. Basic facts about the issue
- Gravel bars, sloughs, oxbow lakes, and the inundated floodplain are proposed to be opened on all Refuge units.
- Twenty-three river front miles and all seasonally submerged areas below the Ordinary High Water Mark will be opened for fishing by 2004.
- Fishing will be allowed in accordance with State fishing regulations during the legal fishing seasons and species.
- Fishing will be permitted in accordance with State and Federal regulations and seasons to ensure that it will not interfere with the conservation of fish and wildlife and their habitats.
- Method of enforcement and control will take place through boundary and public use signs, information kiosks at boat ramps and routine patrol by CDFG wardens and Refuge officers.
- Landward boundaries will be closed to discourage trespass through adjacent private lands.
- Entry and departure times on the refuge will be restricted.

3. Communication goals
- Continue to solicit input from partners and keep lines of communication open.
- Continue to attend the Sacramento River Area Forum meetings.
- Ensure accurate public information and news stories.
- Continue to solicit input from local/county Fish and Game Commissions.

4. Message
A quality, compatible and safe fishing program can be implemented and maintained on the Sacramento River Refuge.

5. Interested parties
State fish and wildlife agencies; Tribes; conservation groups; hunting, fishing, and wildlife observation groups; educators; farmers and ranchers; other federal agencies; Members of Congress; state and county representatives; news media; and many members of the public.

6. Key date
October 2004

c. *Angler application and registration procedures (if needed)*
Non-applicable

d. *Description of angler selection process (if needed)*
Non-applicable

e. *Draft news release regarding the fishing program*
See Attached

f. *Angler requirements by the California Department of Fish and Game (CDFG)*

(1) Age of angler
Anyone 16 years and older must have a State sport fishing license to take any kind of fish.
(2) Allowable equipment
All fish may be taken only by angling with one closely attended rod and line or one hand line with not more than three hooks nor more than three artificial lures attached thereto.
(3) Licensing and permits
Anyone 16 years and older must have a State fishing license to take any kind of fish. Every person, while engaged in taking any fish, shall display their valid sport fishing license by attaching it to their outer clothing at or above the waistline.
(4) Reporting requirements
There will be no reporting requirements of anglers unless required by CDFG.
(5) Angler training and safety
Anglers are not required to successfully complete a course in order to purchase a State sport fishing license.
(6) Other information (use of boats, motors, etc.)

VIII. Compatibility Determination.
See Appendix B in CCP

IX. Appropriate NEPA Documents

See EA (Appendix A, CCP)

X. Evaluation

a. *Monitoring and reporting use levels and trends.*

- Auto counters, angler contact in the field, comments during agency and public meetings, e-mails and letters are some of the methods used to evaluate visitor use levels, trends, and needs. The visitor use will be recorded annually in the Refuge Management and Information System.

b. *Surveying needs of the fishing visitor.*

Universities will be contacted to develop a survey

c. *Are we meeting program objectives?*

Yes, we are providing 23 river- front miles for fishing. Additionally, all seasonally submerged areas below the high water mark will be posted open to the public by 2004.

d. *Do we need to resolve and conflicts?*

The fishing program and outreach plans are written to resolve and prevent future conflicts.

e. *Refuge/Regional Office review schedule*

NEWS RELEASE

U.S. FISH & WILDLIFE SERVICE - REGION 1

Sacramento NWR Complex
752 County Road 99 W
Willows, CA 95988

FOR IMMEDIATE RELEASE
Contact: Denise Dachner
530/934-2801
December 1, 2003

Sacramento River Refuge Lands Open to Fishing

The Sacramento River National Wildlife Refuge (Refuge) has opened fishing for species that occur in the Refuge's sloughs, oxbow lakes, and inundated floodplain and fishing from its exposed sand and gravel bars between Red Bluff Diversion Dam to Princeton. Take of all native and introduced fish species will be allowed in accordance with the State of California freshwater sport fishing regulations during the legal fishing seasons. Brochures available at most public boat ramps and posted public use signs, including the River-mile for reference, will assist anglers in determining Refuge unit locations. For further information and refuge specific fishing regulations see SacramentoValleyRefuges.fws.gov or call 530-934-2801.

The U.S. Fish and Wildlife Service is the principal federal agency responsible for conserving, protecting and enhancing fish, wildlife and plants and their habitats for the continuing benefit of the American people. The Service manages the 95-million-acre National Wildlife Refuge System, which encompasses 540 national wildlife refuges, thousands of small wetlands and other special management areas. It also operates 69 national fish hatcheries, 64 fishery resource offices and 81 ecological services field stations. The agency enforces federal wildlife laws, administers the Endangered Species Act, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, and helps foreign governments with their conservation efforts. It also oversees the Federal Aid program that distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state fish and wildlife agencies. 02/03

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Appendix E. Fire Management Plan

The Department of the Interior (DOI) fire management policy requires that all refuges with vegetation that can sustain fire must have a Fire Management Plan that details fire management guidelines for operational procedures and values to be protected/enhanced. The Fire Management Plan (FMP) for the Sacramento River National Wildlife Refuge (NWR) provides guidance on preparedness, prescribed fire, wildland fire, and prevention. Values to be considered in the FMP include protection of Refuge resources and neighboring private properties, effects of burning on refuge habitats/biota, and firefighter safety. Refuge resources include properties, structures, cultural resources, trust species including Endangered, Threatened, and species of special concern, and their associated habitats. The FMP will be reviewed periodically to ensure that the fire program is conducted in accordance and evolves with the U.S. Fish and Wildlife Service (USFWS) mission and the Refuge's goals and objectives.

The FMP is written to provide guidelines for appropriate suppression and prescribed fire programs at Sacramento River NWR. Prescribed fires may be used to reduce hazard fuels, restore the natural processes and vitality of ecosystems, improve wildlife habitat, remove or reduce non-native species, and/or conduct research.

This plan will help achieve resource management objectives by enabling the Refuge to utilize prescribed fire, as one of several tools, to control non-native vegetation and reduce fire hazards in grassland and riparian habitats. It will be used in conjunction with other management tools that are currently applied on Refuge properties (i.e., grazing, mowing and herbicide applications) to meet resource objectives.

It is the intent of the USFWS to conduct wildland fire suppression and prescribed fire operations within the Sacramento River NWR.

Copies of the plan are available for review at the Sacramento National Wildlife Refuge Complex, 752 County Road 99W, Willows, California 95988. (530) 934-2801.

Copies are also available via the internet at the following address
http://sacramentovalleyrefuges.fws.gov

Appendix F. Compliance with Section 7 of the Endangered Species Act

An Intra-Service Section 7 Consultation has been initiated with the Sacramento Field Office and will be completed prior to the final approval of this CCP. In addition, a letter has been forward to NOAA – Fisheries requesting a review and concurrence with the CCP for species under their jurisdiction.

Appendix G. Wildlife and Plant Species at the Sacramento River National Wildlife Refuge and Vicinity (Red Bluff To Colusa)

APPENDIX G - Wildlife and Plant Species at the Sacramento River National Wildlife Refuge and Vicinity (Red Bluff to Colusa)

(* nonnative species)

ANIMALS

MAMMALS

COMMON NAME	SCIENTIFIC NAME
Marsupalia (opossums)	
Virginia opossum*	*Didelphis virginiana**
Insectivora (shrews and moles)	
Broad-footed mole	*Scapanus latimanus*
Chiroptera (bats)	
Yuma myotis	*Myotis yumanensis*
California myotis	*Myotis californicus*
Western pipistrelle	*Pipistrellus hesperus*
Big brown bat	*Eptesicus fuscus*
Red bat	*Lasiurus blossevilli*
Hoary bat	*Lasiurus cinereus*
Townsend's big-eared bat	*Pletocus townsendii*
Pallid bat	*Antrozous pallidus*
Brazilian free-tailed bat	*Tadarida brasiliensis*
Western mastiff bat	*Eumops perotis*
Silver-haired bat	*Lasionycteris noctivagans*
Lagomorpha (rabbits and hares)	
Brush rabbit	*Sylvilagus bachmani*
Desert cottontail	*Sylvilagus audubonii*
Black-tailed hare	*Lepus californicus*
Rodentia (rodents)	
California ground squirrel	*Spermophilus beecheyi*
Western gray squirrel	*Sciurus griseus*
Botta's pocket gopher	*Thomomys bottae*
California kangaroo rat	*Dipodomys californicus*
Beaver	*Castor canadensis*
Western harvest mouse	*Reithrodontomys megalotis*

Deer mouse	*Peromyscus maniculatus*
Brush mouse	*Peromyscus boylii*
Dusky-footed woodrat	*Neotoma fuscipes*
California vole	*Microtus californicus*
Muskrat	*Ondatra zibethicus*
Black rat*	*Rattus rattus**
Norway rat*	*Rattus norvegicus**
House mouse*	*Mus musculus**
Porcupine	*Erethizon dorsatum*
Carnivora (carnivores)	
Coyote	*Canis latrans*
Red fox*	*Vulpes vulpes**
Gray fox	*Urocyon cinereoargenteus*
Black Bear	*Ursus americanus*
Ringtail	*Bassariscus astutus*
Raccoon	*Procyon lotor*
Long-tailed weasel	*Mustela frenata*
Mink	*Mustela vison*
Badger	*Taxidea taxus*
Western spotted skunk	*Spilogale gracilis*
Striped skunk	*Mephitis mephitis*
River Otter	*Lutra canadensis*
Mountain lion	*Felis concolor*
Bobcat	*Linx rufis*
Feral house cat*	*Felis cattus**
Artiodactyla (hoofed mammals)	
Wild Pig*	*Sus scrofa**
Black-tailed deer	*Odocoileus hemionus*

AMPHIBIANS

Salientia (frogs and toads)

Western toad	*Bufo boreas*
Pacific tree frog	*Hyla regilla*
Bullfrog*	*Rana catesbeiana**

REPTILES

Emydidae (turtles)

Slider*	*Pseudemys scirpta**
Northwestern pond turtle	*Clemmys marmorata marmorata*

Iguanidae (iguanid lizards)

Western fence lizard	*Sceloporus occidentalis*

Scincidae (skinks)

Western skink	*Eumeces skiltonianus*

Teiidae (whiptail lizards)

Western whiptail	*Cnemidophorus tigris*

Anguidae (alligator lizards)

Southern alligator lizard	*Gerrhonotus multicarinatus*

Colubridae (Colubrid snakes)

Ringneck snake	*Diadophis punctatus*
Sharp-tailed snake	*Contia tenius*
Racer	*Coluber constrictor*
Coachwhip	*Masticophis flagellum*
California whipsnake	*Masticophis lateralis*
Gopher snake	*Pituophis melanoleucus*
Common kingsnake	*Lampropeltis getulus*
California mountain king	*Lampropeltis zonata*
Common garter snake	*Thamnophis sirtalis*
Western terrestrial garter snake	*Thamnophis elegans*
Western aquatic garter snake	*Thamnophis couchi*
Giant garter snake	*Thamnophis couchi gigas*
Night snake	*Hypsiglena torquata*

Viperidae (vipers)

Western rattlesnake	*Crotalis viridis*

BIRDS

Podicipediformes (grebes)

Pied-billed grebe	*Podilymbus podiceps*
Eared grebe	*Podiceps nigricollis*
Western grebe	*Aechmophorus occidentalis*
Clark's grebe	*Aechmophorus clarkii*

Pelicaniformes (pelicans and cormorants)

American white pelican	*Pelecanus erythrorhynchos*
Double-crested cormorant	*Phalacrocorax auritus*

Ciconiiformes (herons and egrets)

American bittern	*Botaurus lentiginosus*
Least bittern	*Ixobrychus exilis*
Great-blue heron	*Ardea herodias*
Great egret	*Casmerodius albus*
Snowy egret	*Egretta thula*
Cattle egret	*Bubulcus ibis*
Green-backed heron	*Butorides striatus*
Black-crowned night heron	*Nycticorax nycticorax*

Anseriformes (ducks, geese, and swans)

Greater white-fronted goose	*Anser albifrons*
Lesser snow goose	*Chen caerulescens*
Ross's goose	*Chen rossii*
Canada goose	*Branta canadensis*
Wood duck	*Aix sponsa*
Green-winged teal	*Anas crecca*
Mallard	*Anas platyrhyncos*
Northern pintail	*Anas acuta*
Blue-winged teal	*Anas discors*
Cinnamon teal	*Anas cyanoptera*
Northern shoveler	*Anas clypeata*

Gadwall	*Anas strepera*
Eurasian wigeon	*Anas penelope*
American wigeon	*Anas americana*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*
Ring-necked duck	*Aythya collaris*
Lesser scaup	*Aythya affinis*
Common goldeneye	*Bucephala clangula*
Barrow's goldeneye	*Bucephala islandica*
Bufflehead	*Bucephala albeola*
Hooded merganser	*Lophodytes cucullatus*
Common merganser	*Mergus merganser*
Ruddy duck	*Oxyura jamaicensis*

Falconiformes (vultures, hawks, eagles, and falcons)

Turkey vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
White-tailed kite	*Elanus leucurus*
Bald eagle	*Haliaeetus leucocephalus*
Golden eagle	*Aquila chrysaetos*
Northern harrier	*Circus cyaneus*
Sharp-shinned hawk	*Accipiter striatus*
Cooper's hawk	*Accipiter cooperii*
Red-shouldered hawk	*Buteo lineatus*
Swainson's hawk	*Buteo swainsoni*
Red-tailed hawk	*Buteo jamaicensis*
Rough-legged hawk	*Buteo lagopus*
American kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine falcon	*Falco peregrinus*

Galliformes (turkey, grouse, quail, and pheasants)

Ring-necked pheasant*	*Phasianus colchicus**
Wild turkey	*Meleagris gallopavo*
California quail	*Callipepla californica*

Gruiformes (cranes and rails)	
Virginia rail	*Rallus limicola*
Sora	*Porzana carolina*
Common moorhen	*Gallinula chloropus*
American coot	*Fulica americana*
Charadriiformes (shorebirds and gulls)	
Black-bellied plover	*Pluvialis squatarola*
Simipalmated Plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferus*
Greater yellowlegs	*Tringa melanoleuca*
Lesser yellowlegs	*Tringa flavipes*
Spotted sandpiper	*Actitis macularia*
Western sandpiper	*Calidris mauri*
Least sandpiper	*Calidris minutilla*
Semi-palmated sandpiper	*Calidris pusilla*
Dunlin	*Calidris alpina*
Long-billed dowitcher	*Limnodromus scolopaceus*
Short-billed dowitcher	*Limnodromus griseus*
Common snipe	*Gallinago gallinago*
Wilson's phalarope	*Phalaropus tricolor*
Red-necked phalarope	*Phalaropus lobatus*
Mew gull	*Larus canus*
Ring-billed gull	*Larus delawarensis*
California gull	*Larus californicus*
Herring gull	*Larus argentatus*
Forster's tern	*Sterna forsteri*
Columbiformes (pigeons and doves)	
Rock dove*	*Columba livia*
Band-tailed pigeon	*Columba fasciata*
Mourning dove	*Zenaida macroura*
Cuculiformes (cuckoos and roadrunners)	
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*

Strigiformes (owls)	
Barn owl	*Tyto alba*
Western screech owl	*Otus kennicottii*
Great horned owl	*Bubo virginianus*
Northern pygmy owl	*Glaucidium gnoma*
Long-eared owl	*Asio otus*
Caprimulgiformes (goatsuckers and nighthawks)	
Lesser nighthawk	*Chordeiles acutipennis*
Common nighthawk	*Chordeiles minor*
Common poorwill	*Phalaenoptilus nuttallii*
Apodiformes (swifts and hummingbirds)	
Vaux's swift	*Chaetura vauxi*
Black-chinned hummingbird	*Archilochus alexandri*
Anna's hummingbird	*Calypte anna*
Calliope hummingbird	*Stellula calliope*
Coraciiformes (kingfishers)	
Belted king fisher	*Ceryle alcyon*
Piciformes (woodpeckers)	
Lewis' woodpecker	*Melanerpes lewis*
Acorn woodpecker	*Melanerpes formicivorous*
Red-breasted sapsucker	*Sphyrapicus ruber*
Nuttall's woodpecker	*Picoides nuttallii*
Downy woodpecker	*Picoides pubescens*
Hairy woodpecker	*Picoides villosus*
Northern flicker	*Colaptes auratus*
Passeriformes	
Western wood pewee	*Contopus sordidulus*
Willow flycatcher	*Empidonax traillii*
Hammond's flycatcher	*Empidonax hammondii*
Dusky flycatcher	*Empidonax oberholseri*
Pacific-slope flycatcher	*Empidonax difficilis*
Black phoebe	*Sayornis nigricans*

Say's phoebe	*Sayornis saya*
Ash-throated flycatcher	*Myiarchus cinerascens*
Western kingbird	*Tyrannus verticalis*
Horned lark	*Eremophila alpestris*
Purple martin	*Progne subis*
Tree swallow	*Tachycineta bicolor*
Violet-green swallow	*Tachycineta thalassina*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Bank swallow	*Riparia riparia*
Cliff swallow	*Hirundo pyrrhonota*
Barn swallow	*Hirundo rustica*
Scrub jay	*Aphelocoma coerulescens*
Yellow-billed magpie	*Pica nuttalli*
American crow	*Corvus brachyrhynchos*
Common raven	*Corvus corax*
Wrentit	*Chamaea fasciata*
Oak titmouse	*Parus inornatus*
Bushtit	*Psaltriparus minimus*
Red-breasted nuthatch	*Sitta canadensis*
White-breasted nuthatch	*Sitta carolinensis*
Brown creeper	*Certhia americana*
Rock Wren	*Salpinctes obsoletus*
Bewick's wren	*Thryomanes bewickii*
House wren	*Troglodytes aedon*
Winter wren	*Troglodytes troglodytes*
Marsh wren	*Cistothorus palustris*
Golden-crowned kinglet	*Regulus satrapa*
Ruby-crowned kinglet	*Regulus calendula*
Blue-gray gnatcatcher	*Polioptila caerulea*
Western bluebird	*Sialia mexicana*
Mountain bluebird	*Sialia currucoides*
Swainson's trush	*Catharus ustulatus*
Hermit thrush	*Catharus guttatus*

American robin	*Turdus migratorius*
Varied thrush	*Ixoreus naevius*
Northern mockingbird	*Mimus polyglottos*
California thrasher	*Toxostoma redivivum*
American pipit	*Anthus rubescens*
Cedar waxwing	*Bombycilla cedrorum*
Northern shrike	*Lanius excubitor*
Loggerhead shrike	*Lanius ludovicianus*
European starling*	*Sturnus vulgaris**
Least Bell's vireo	*Vireo bellii pusillus*
Cassin's vireo	*Vireo cassinii*
Hutton's vireo	*Vireo huttoni*
Warbling vireo	*Vireo gilvus*
Orange-crowned warbler	*Vermicora celata*
Nashville warbler	*Vermivora ruficapilla*
Yellow warbler	*Dendroica petechia*
Yellow-rumped warbler	*Dendroica coronata*
Black-throated gray warbler	*Dendroica nigrescens*
Hermit warbler	*Dendroica occidentalis*
MacGillivray's warbler	*Oporornis tolmiei*
Common yellowthroat	*Geothlypis trichas*
Wilson's warbler	*Wilsonia pusilla*
Yellow-breasted chat	*Icteria virens*
Northern waterthrush	*Seiurus noveboracensis*
Western tanager	*Piranga ludoviciana*
Black-headed grosbeak	*Pheucticus melanocephalus*
Blue grosbeak	*Guiraca caerulea*
Lazuli bunting	*Passerina amoena*
Spotted towhee	*Pipilo maculatus*
California towhee	*Pipilo crissalis*
Chipping sparrow	*Spizella passerina*
Lark sparrow	*Chondestes grammacus*
Savannah sparrow	*Passerculus sandwichensis*

Fox sparrow	*Passerella iliaca*
Song sparrow	*Melospiza melodia*
Lincoln's sparrow	*Melospiza lincolnii*
Golden-crowned sparrow	*Zonotrichia atricapilla*
White-crowned sparrow	*Zonotrichia leucophrys*
Dark-eyed junco	*Junco hyemalis*
Red-winged blackbird	*Agelaius phoeniceus*
Tricolored blackbird	*Agelaius tricolor*
Western meadowlark	*Sturnells neglecta*
Yellow-headed blackbird	*Xantocephalus xanthocephalus*
Brewer's blackbird	*Euphagus cyanocephalus*
Brown-headed cowbird	*Molothurus ater*
Hooded oriole	*Icterus cucullatus*
Bullock's oriole	*Icterus bullockii*
Purple finch	*Carpodacus purpureus*
House finch	*Carpodacus mexicanus*
Pine siskin	*Carduelis pinus*
Lesser goldfinch	*Carduelis psaltria*
Lawrence's goldfinch	*Carduelis lawrencei*
American goldfinch	*Carduelis tristis*
Evening grosbeak	*Coccothraustes vespertinus*
House sparrow*	*Passer domesticus**

FISH

Petromyzontidae (lamprey)

Pacific lamprey	*Lampetra tridentata*
River lamprey	*Lampetra ayresi*
Western brook lamprey	*Lampetra richardsoni*

Acipenseridae (sturgeon)

White sturgeon	*Acipenser transmontanus*
Green sturgeon	*Acipenser medirostris*

Clupeidae (herring)

Threadfin shad*	*Dorosoma petenense**
American shad*	*Alosa sapidissima**
Salmonidae (salmon and trout)	
Chinook salmon, Central Valley fall- and late-fall-run ESU	*Oncorhynchus tshawytscha*
Chinnook salmon, Sacramento River winter-run ESU	*Oncorhynchus tshawytscha*
Chinook salmon, Central Valley spring-run ESU	*Oncorhynchus tshawytscha*
Coho salmon	*Oncorhynchus kisutch*
Sockeye salmon	*Oncorhynchus nerka*
Pink salmon	*Oncorhynchus gorbuscha*
Chum salmon	*Oncorhynchus keta*
Central Valley Steelhead ESU	*Oncorhynchus mykiss*
Rainbow Trout*	*Salmo gairdneri**
Brown trout*	*Salmo trutta**
Cyprinidae (minnow)	
Tui chub	*Gila bicolor*
Thicktail chub	*Gila crassicauda*
Lahontan redside	*Richardsonius egregius*
Hitch	*Lavinia exilicauda*
California roach	*Hesperoleucus symmetricus*
Sacramento Blackfish	*Orthodon microlepidotus*
Sacramento splittail	*Pogonichthys macrolepidotus*
Hardhead	*Mylopharodon conocephalus*
Sacramento squawfish	*Ptychocheilus grandis*
Speckled dace	*Rhinichthys osculus*
Golden shiner*	*Notemigonus crysoleucas**
Fathead minnow*	*Pimephales promelas**
Goldfish*	*Carassius auratus**
Carp*	*Cyprinus carpio**
Catostomidae (sucker)	
Sacramento sucker	*Catostomus occidentalis*
Ictaluridae (catfish)	
Black bullhead*	*Ictalurus melas**

Brown bullhead*	*Ictalurus nebulosus**
Yellow bullhead*	*Ictalurus natalis**
White catfish*	*Ictalurus catus**
Channel catfish*	*Ictalurus punctatus**
Poeciliidae (livebearer)	
Mosquitofish*	*Gambusia affinis**
Atherinidae (silverside)	
Mississippi silverside*	*Menidia audens**
Gasterosteidae (stickleback)	
Threespine stickleback*	*Gasterosteus aculeatus**
Percichthyidae (temperate basses)	
Striped bass*	*Morone saxatilis**
Centrarchidae (sunfish)	
Sacramento perch	*Archoplites interruptus*
Bluegill*	*Lepomis macrochirus**
Redear sunfish*	*Lepomis microlophus**
Pumpkinseed*	*Lepomis gibbosus**
Green sunfish*	*Lepomis cyanellus**
Warmouth*	*Lepomis gulosus**
White crappie*	*Pomoxis annularis**
Black crappie*	*Pomoxis nigromaculatus**
Largemouth bass*	*Micropterus salmoides**
Smallmouth bass*	*Micropterus dolomieui**
Spotted bass*	*Micropterus punctulatus**
Percidae (perch)	
Bigscale logperch*	*Percina macrolepida**
Embiotocidae (surfperch)	
Tule perch	*Hysterocarpus traski*
Cottidae (sculpin)	
Prickly sculpin	*Cottus asper*
Riffle sculpin	*Cottus gulosus*
Staghorn sculpin	*Leptocottus armatus*

VASCULAR PLANTS

FERN ALLIES

Equisetaceae (Horsetail Family)

Common horsetail	*Equisetum arvense*
Smooth scouring-rush	*Equisetum laevigatum*

CONIFERS

Pinaceae (Pine Family)

Gray pine	*Pinus sabiniana*

DICOT FLOWERING PLANTS

Aceraceae (Maple Family)

Box elder	*Acer negundo californicum*
Silver maple*	*Acer saccharinum**

Amaranthaceae (Amaranth Family)

Tumbleweed*	*Amaranthus albus**
Mat amaranth	*Amaranthus blitoides*
Red-rooted amaranth*	*Amaranthus retroflexus**

Anacardiaceae (Sumac Family)

Oriental pistachio*	*Pistacia chinensis**
Western poison-oak	*Toxicodendron diversilobum*

Apiaceae (Carrot Family)

Toothpick-weed*	*Ammi visnaga**
Bur-chervil	*Anthriscus caucalis*
Poison-hemlock*	*Conium maculatum**
Fennel*	*Foeniculum vulgare**
Kellog's yampah	*Perideridia kelloggii*
Shepherd's needle*	*Scandix pecten-veneris**
Common hedge-parsley	*Torilis arvensis*
Purple hedge-parsley*	*Torilis arvensis purpurea**
Knotted hedge-parsley*	*Torilis nodosa**

Aristolochiaceae (Pipevine Family)

California pipevine	*Aristolochia californica*

Asclepiadaceae (Milkweed Family)

Narrow-leaved milkweed	*Asclepias fascicularis*
Showy milkweed	*Asclepias speciosa*
Asteraceae (Sunflower Family)	
Blow-wives	*Achyrachaena mollis*
Annual agoseris	*Agoseris heterophylla*
Western ragweed	*Ambrosia psilostachya*
Mayweed*	*Anthemis cotula**
Mugwort	*Artemisia douglasiana*
California aster	*Aster chilensis*
Annual saltmarsh aster	*Aster subulatus*
Marsh Baccharis	*Baccharis douglasii*
Coyote-brush	*Baccharis pilularis*
Mule's fat	*Baccharis salicifolia*
Sticktight	*Bidens frondosa*
California brickellbush	*Brickellia californica*
Yellow star-thistle*	*Centaura solstitialis**
Valley pineapple-weed	*Chamomilla occidentalis*
Common pineapple-weed	*Chamomilla suaveolens*
Chicory*	*Cichorium intybus**
Bull thistle*	*Cirsium vulgare**
South American horseweed*	*Conyza bonariensis**
Canadian horseweed	*Conyza canadensis*
Many-flowered horseweed*	*Conyza floribunda**
Australian cotula*	*Cotula australis**
Western goldenrod	*Euthamia occidentalis*
Narrow-leaved filago*	*Filago gallica**
Weedy cudweed*	*Gnaphallium luteo-album**
Western marsh cudweed	*Gnaphallium palustre*
Rosilla	*Helenium puberulum*
Telegraph-weed	*Heterotheca grandiflora*
Oregon golden-aster	*Heterotheca oregona*
Smooth cat's ear*	*Hypochoeris glabra**
Willow-leaved lettuce*	*Lactuca saligna**

Prickly lettuce*	*Lactuca serriola**
Long-beaked hawkbit*	*Leontodon taraxacoides longirostris**
Douglas' microseris	*Microseris douglasii*
Dwarf wooly-marbles	*Psilocarphus brevissimus brevissimus*
Oregon woolly marbles	*Psilocarphus oregonus*
Old-man-in-the-spring*	*Senecio vulgaris**
Milk-thistle*	*Silybum marianum**
Spiny-leaved sow-thistle*	*Sonchus asper asper**
Common sow-thistle*	*Sonchus oleraceus**
Slender sow-thistle*	*Sonchus tenerrimus**
Spiny cocklebur	*Xanthium spinosum*
Cocklebur	*Xanthium strumarium*
Betulaceae (Birch Family)	
White alder	*Alnus rhombifolia*
Boraginaceae (Borage Family)	
Bugloss fiddleneck	*Amsinckia lycopsoides*
Common fiddleneck	*Amsinckia menziesii*
Wild heliotrope	*Heliotropium curassavicum*
Valley popcorn-flower	*Plagiobothrys canescens*
Brassicaceae (Mustrad Family)	
Black mustard*	*Brassica nigra**
Shepherd's purse*	*Capsella bursa-pastoris**
Lesser swinecress*	*Coronopus didymus**
Mediterranean hoary-mustard*	*Hirschfeldia incana**
Broad-leved mustard*	*Lepidium latifolium**
Shining pepper-grass	*Lepidium nitidum nitidum*
Upright pepper-grass	*Lepidium strictum*
Jointed charlock*	*Raphanus raphanistrum**
Radish*	*Raphanus sativus**
Western yellowcress	*Rorippa curvisiliqua occidentalis*
Virginia winged-rockcress	*Sibara virginica*
Callitrichaceae (Water-starwort Family)	

Variable-leaved water-starwort	*Callitriche heterophylla*
Caprifoliaceae (Honeysuckle Family)	
Blue elderberry	*Sambucus mexicana*
Capparaceae (Caper Family)	
Clammyweed	*Polanisia dodencandra trachysperma*
Caryophyllaceae (Pink Family)	
Sticky mouse-eared chickweed*	*Cerastium glomeratum**
Herniaria*	*Herniaria hirsuta hirsuta**
Boccone's sandspurry*	*Spergularia bocconei**
Common chickweed*	*Stellaria media**
Chenopodiaceae (Goosefoot Family)	
Lamb's-quarters*	*Chenopodium alnum**
Mexican tea*	*Chenopodium ambrosioides**
Jerusalem-oak*	*Chenopodium botrys**
Tasmanian goosefoot*	*Chenopodium pumilio**
Glaucous-leaved goosefoot*	*Chenopodium strictum glaucophyllum**
Winged-pigweed*	*Cycloloma atriplicifolium**
Russian thistle*	*Salsola tragus**
Convolvulaceae (Morning-glory Family)	
Bindweed*	*Convolvulus arvensis**
Cornaceae (Dogwood Family)	
Brown dogwood	*Cornus glabrata*
Crassulaceae (Stonecrop Family)	
Water pygmyweed	*Crassula aquatica*
Pygmyweed	*Crassula connata*
Cucurbitaceae (Gourd Family)	
California manroot	*Marah fabaceus agrestis*
Cuscutaceae (Dodder Family)	
Field dodder	*Cuscuta pentagona*
Elatinaceae (Waterwort Family)	
Variable-stamened waterwort	*Elatine heterandra*
Red waterwort	*Elatine rubella*

Euphorbiaceae (Spurge Family)	
Spotted spurge*	*Chamaesyce maculata**
Turkey-mullein	*Eremocarpus setigerus*
Fabaceae (Legume Family)	
American licorice	*Glycyrrhiza lepidota*
Angular-seeded pea*	*Lathyrus angulatus**
California pea	*Lathyrus jepsonii californicus*
Bird's-foot-trefoil	*Lotus corniculatus*
Spanish lotus	*Lotus purshianus purshianus*
Bicolored lupine	*Lupinus bicolor tridentatus*
Sky lupine	*Lupinus nanus*
Small-flowered lupine	*Lupinus polycarpus*
Spotted medick*	*Medicago arabica**
Common bur-clover*	*Medicago polymorpha**
Alfalfa*	*Medicago sativa**
White sweet-clover*	*Melilotus alba**
Indian sweet-clover*	*Melilotus indica**
Black locust*	*Robinia pseudoacacia**
Strawberry clover	*Trifolium fragiferum*
Rose clover*	*Trifolium hirtum**
Tomcat clover	*Trifolium willdenovii*
Red-flowered vetch*	*Vicia benghalensis**
Garden vetch*	*Vicia sativa sativa**
Winter vetch*	*Vicia villosa varia**
Fagaceae (Beech Family)	
Valley oak	*Quercus lobata*
Gentianaceae (Gentian Family)	
June centaury	*Centaurium muehlenbergii*
Geraniaceae (Geranium Family)	
Long-beaked stork's-bill*	*Erodium botrys**
Short-fruited stork's-bill*	*Erodium brachycarpum**
Red-stemmed filaree*	*Erodium cicutarium**
White-stemmed filaree*	*Erodium moschatum**

Cut-leaved geranium*	*Geranium dissectum**
Hippocastanaceae (Buckeye Family)	
California buckeye	*Aesculus californica*
Juglandaceae (Walnut Family)	
Northern California black walnut	*Juglans californica hindsii*
English walnut*	*Juglans regia**
Lamiaceae (Mint Family)	
Cut-leaved bugleweed	*Lycopus americanus*
Horehound*	*Marrubium vulgare**
Pennyroyal*	*Mentha pulegium**
Sonoma hedge-nettle	*Stachys stricta*
Loasaceae (Loasa Family)	
Giant blazingstar	*Mentzelia laevicaulis*
Lythraceae (Loosestrife Family)	
Valley redstem	*Ammannia coccinea*
Robust redstem	*Ammannia robusta*
Hyssop loosestrife*	*Lythrum hyssopifolium**
Lowland toothcup	*Rotala ramosior*
Malvaceae (Mallow Family)	
Velvetleaf*	*Abutilon theophrasti**
Rose mallow (California hibiscus)	*Hibiscus lasiocarpus*
Bull mallow*	*Malva nicaeensis**
Little mallow*	*Malva parviflora**
Martyniaceae (Unicorn-plant Family)	
Common unicorn-plant*	*Proboscidea louisianica louisinica**
Molluginaceae (Carpet-weed Family)	
Indian chickweed*	*Mollugo verticillata**
Moraceae (Mulberry Family)	
Edible fig*	*Ficus carica**
Oleaceae (Olive Family)	
Oregon ash	*Fraxinus latifolia*
Onagraceae (Evening-primrose Family)	
Tall annual willowherb	*Epilobium brachycarpum*

Fringed willowherb	*Epilobium ciliatum ciliatum*
Yellow waterweed	*Ludwigia peploides peploides*
Montevideo waterweed	*Ludwigia peploides montevidensis*
Hairy evening-primrose	*Oenothera elata hirsutissima*
Papaveraceae (Poppy Family)	
California poppy	*Esdhoscholzia californica*
Plantaginaceae (Plantain Family)	
Cut-leaved plantain*	*Plantago coronopus**
English plantain*	*Plantago lanceolata**
Common plantain*	*Plantago major**
Platanaceae (Sycamore Family)	
Western sycamore	*Platanus racemosa*
Polygonaceae (Buckwheat Family)	
Naked buckwheat	*Eriogonum nudum*
Wright's buckwheat	*Eriogonum wrightii trachygonum*
Swamp smartweed	*Polygonum amphibium emersum*
Common knotweed*	*Polygonum arenastrum**
Water-pepper*	*Polygonum hydropiper**
Mild water-pepper	*Polygonum hydropiperoides*
Willow-weed	*Polygonum lapathifolium*
Lady's thumb*	*Polygonum persicaria**
Dotted smartweed	*Polygonum punctatum*
Green dock*	*Rumex conglomeratus**
Curly dock*	*Rumex crispus**
Bitter dock*	*Rumex obtusifolius**
Fiddle dock*	*Rumex pulcher**
Portulacaceae (Purslane Family)	
Redmaids	*Calandrinia ciliata*
Common purslane*	*Portulaca oleracea**
Primulaceae (Primrose Family)	
Scarlet pimpernel	*Anagallis arvensis*

Ranunculaceae (Buttercup Family)	
Virgin's bower	*Clematis ligusticifolia*
Prickle-seeded buttercup*	*Ranunculus muricatus**
Rosaceae (Rose Family)	
Cherry plum*	*Prunus cerasifera**
California rose	*Rosa californica*
Himalayan blackberry*	*Rubus discolor**
California blackberry	*Rubus ursinus*
Rubiaceae (Madder Family)	
California button-willow	*Cephalanthus occidentalis californicus*
Cleavers	*Galium aparine*
Salicaceae (Willow Family)	
Fremont's cottonwood	*Populus fremontii*
Sandbar willow	*Salix exigua*
Goodding's black willow	*Salix gooddingii*
Arroyo willow	*Salix lasiolepis*
Scrophulariaceae (Figwort Family)	
Round-leved water-hyssop*	*Bacopa rotundifolia**
Valley-tassels	*Castilleja attenuata*
Sharp-leaved fluellin*	*Kickxia elatine**
False pimpernel	*Lindernia dubia*
Seep monkey-flower	*Mimulus guttatus*
Downy mimetanthe	*Mimulus pilosus*
Moth mullein*	*Verbascum blattaria**
Woolly mullein*	*Verbascum thapsus**
Water speedwell*	*Veronica anagallis-aquatica**
Purslane speedwell	*Veronica peregrina xalapensis*
Simaroubaceae (Quassia Family)	
Tree-of-heaven*	*Ailanthus altissima**
Solanaceae (Nightshade Family)	
Thorn-apple	*Datura wrightii*

Many-flowered tobacco*	*Nicotiana acuminata multiflora**
Tree tobacco*	*Nicotiana glauca**
Indian tobacco	*Nicotiana quadrivalvis*
Lance-leaved ground-cherry*	*Physalis lanceifolia**
American black nightshade	*Solanum americanum*
Tamaricaceae (Tamarisk Family)	
Small-flowered tamarisk*	*Tamarix parviflora**
Urticaceae (Nettle Family)	
Hoary creek nettle	*Urtica dioica holosericea*
Burning nettle*	*Urtica urens**
Verbenaceae (Vervain Family)	
Creeping lippia	*Phyla nodiflora nodiflora*
Rosy lippia*	*Phyla nodiflora rosea**
South American vervain*	*Verbena bonariensis**
Halberd-leaved vervain*	*Verbena hastata**
Western vervain	*Verbena lasiostachys scabrida*
Shore vervain	*Verbena litoralis*
Viscaceae (Mistletoe Family)	
Big-leaved mistletoe	*Phoradendron macrophyllum*
Vitaceae (Grape Family)	
California wild grape	*Vitis californica*
Zygophyllaceae (Caltrop Family)	
Puncture-vine*	*Tribulus terrestris**
MONOCOT FLOWERING PLANTS	
Alismataceae (Water-plantain Family)	
Water-plantain	*Alisma plantago-aquatica*
Fringed water-plantain	*Damasonium californicum*
Burhead	*Echinodorus berteroi*
Tule-potato	*Sagittaria latifolia*
Long-lobed arrowhead	*Sagittaria longiloba*
Montevideo arrowhead	*Sagittaria montevidensis calycina*

Cyperaceae (Sedge Family)

Santa Barbara sedge	*Carex barbarae*
Dense sedge	*Carex densa*
Clustered field sedge	*Carex praegracilis*
Torrent sedge	*Carex nudata*
Fox sedge	*Carex vulpinoidea*
Taper-tipped cyperus	*Cyperus acuminatus*
Small-flowered cyperus*	*Cyperus difformis**
Tall cyperus	*Cyperus eragrostis*
Yellow nutsedge	*Cyperus esculentus*
Red-rooted cyperus	*Cyperus erythrorhizos*
Black cyperus	*Cyperus nigra*
Purple nutsedge*	*Cyperus rotundus**
False nutsedge	*Cyperus strigosus*
Pale spike-rush	*Eleocharis macrostachya*
Engelmann's spike-rush	*Eleocharis obtusa engelmannii*
Four-angled spike-rush	*Eleocharis quadrangulata*
Hard-stemmed tule	*Scirpus acutus occidentalis*
River bulrush	*Scirpus fluvialtilis*
Saltmarsh bulrush	*Scirpus maritimus*
Rough-seeded bulrush*	*Scripus mucronatus**
Tuberous bulrush*	*Scirpus tuberosus**

Hydrocharitaceae (Waterweed Family)

Ricefield water-nymph*	*Najas graminea**
Common water-nymph	*Najas quadalupensis*

Juncaceae (Rush Family)

Sharp-fruited rush	*Juncus acuminatus*
Jointed rush	*Juncus articulatus*
Baltic Rush	*Juncus balticus balticus*
Common toad rush	*Juncus bufonius bufonius*
Congested toad rush	*Juncus bufonius congestus*
Pacific rush	*Juncus effusus pacificus*

Pointed rush	*Juncus oxymeris*
Iris-leaved rush	*Juncus xiphiodes*
Lemnaceae (Duckweed Family)	
Columbian watermeal	*Wolffia brasiliensis*
Liliaceae (Lily Family)	
Bluedicks	*Dichelostemma capitatum capitatum*
Ithuriel's spear	*Triteleia laxa*
Poaceae (Grass Family)	
Avnes bentgrass*	*Agrostis avenacea**
Short-awned foxtail	*Alopecurus aequalis*
Meadow foxtail	*Alopecurus pratensis*
Giant-reed*	*Arundo donax**
Wild oat*	*Avena fatua**
Ripgut brome*	*Bromus diandrus**
Soft chess*	*Bromus hordeaceus**
Red brome*	*Bromus madritensis rubens**
Smooth-flowered soft chess*	*Bromus racemosus**
Swamp pricklegrass*	*Crypsis schoenoides**
Bermuda grass*	*Cynodon dactylon**
Jungle-rice*	*Echinochloa colona**
Water-grass*	*Echinochloa crus-galli**
Blue wild-rye	*Elymus glaucus glaucus*
Creeping lovegrass	*Eragrostis hypnoides*
Purple lovegrass	*Eragrostis pectinacea pectinacea*
Tall fescue	*Festuca arundinacea*
Common velvetgrass*	*Holcus lanatus**
Meadow barley	*Hordeum brachyantherum brachyantherum*
Low barley	*Hordeum depressum*
Hare wall*	*Hordeum murinum leporinum**
Rice cutgrass	*Leersia oryzoides*
Bearded sprangletop*	*Leptochloa fascicularis**

Annual ryegrass*	*Lolium multiflorum**
Alkali ryegrass	*Leymus triticoides*
Deergrass	*Muhlenbergia rigens*
Smooth witchgrass*	*Panicum dichotomiflorum**
Dallisgrass*	*Paspalum dilatatum**
Knotgrass	*Paspalum distichum*
Harding-grass*	*Phalaris aquatica**
Lemmon's canarygrass	*Phalaris lemmonii*
Paradox canarygrass*	*Phalaris paradoxa**
Annual bluegrass*	*Poa annua**
Mediterranean beardgrass*	*Polypogon maritimus**
Annual beardgrass*	*Polypogon monspeliensi**
Yellow bristlegrass*	*Setaria pumil**
African bristlegrass*	*Setaria sphacelat**
Johnsongrass*	*Sorghum halepense**
Six-weeks fescue*	*Vulpia bromoide**
Foxtail fescue*	*Vulpia myuros hisuta**
Pontederiaceae (Pickerel-weed Family)	
Marsh mud-plantain*	*Heteranthera limosa**
Potamogetonaceae (Pondweed Family)	
Leafy pondweed	*Potamogeton foliosus*
Long-leaved pond weed	*Potamogeton nodosus*
Typhaceae (Cattail Family)	
Southern cattail	*Typha domingensis*
Broad-leaved cattail	*Typha latifolia*

Appendix H. Glossary

Abiotic Factors: The non-living parts of an ecosystem, such as light, temperature, water, oxygen, and other nutrients or gases.

Accumulation: The build-up of a chemical in an organism due to repeated exposure.

Adaptive Management: The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from refuge research and monitoring and evaluation of management actions to support or modify objectives and strategies at all planning levels (Service Manual 602 FW 1.6).

Alluvial Fan: Accumulation of sediment where a stream moves from a steep gradient to a flatter gradient and suddenly loses transporting power.

Alluvial: Pertaining to clay, silt, sand, gravel or other sedimentary matter deposited by flowing water, usually within a river valley.

Alternatives: Different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues. (1) A reasonable way to fix the identified problem or satisfy the stated need. (40 CFR 150.2) (2) Alternatives are different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues (Service Manual 602 FW 1.6).

Animal Unit Month (AUM): The amount of forage necessary to maintain one 1,000-pound animal for one month.

Appropriated Water: Surface water in an irrigation district that has been assigned or allocated to owners of water rights.

Appurtenant Land: The land base to which water rights legally pertain or belong.

Aquatic: Pertaining to water, in contrast to land. Living in or upon water.

Aquatic Habitat: The physical, chemical, and vegetative features that occur within the water of lakes, ponds, reservoirs, rivers, irrigation canals, and other bodies of water.

Artifact: An object made by humans; usually in reference to primitive tools, vessels, weapons, etc.

ATV: All Terrain Vehicle (either 3 or 4-wheeled vehicles).

Bank: The rising ground bordering a body of water or forming the edge of a cut or hollow.

Biodiversity (biological diversity): Refers to the full range of variability within and among biological communities, including genetic diversity, and the variety of living organisms, assemblages of living organisms, and biological processes. Diversity can be measured in terms of the number of different items (species, communities) and their relative abundance, and it can include horizontal and vertical variability. The variety of life, including the variety of living organisms, the genetic differences among them, and the communities in which they occur.

Biological Control: The use of organisms or viruses to control weeds or other pests.

Biological Integrity: Biotic composition, structure, and functioning at the genetic, organism, and community levels consistent with natural conditions, including the natural biological processes that shape genomes, organisms, and communities (Service Manual 602 FW 1.6).

Biota: The plant and animal life of a region.

Biotic Factors: All the living organisms -- fungi, protists, vertebrate, invertebrate, plants, etc. and their impacts on other living things within an ecosystem.

Bottom Land: Eligible land with a water duty of 3.5 AF/acre/year.

Categorical Exclusion (CE, CX, CATEX, CATX): A category of actions that do not individually or cumulatively have a significant effect on the human environment and have been found to have no such effect in procedures adopted by a Federal agency pursuant to the National Environmental Policy Act (40 CFR 1508.4).

CFR: Code of Federal Regulations.

Community: The combined populations of all organisms in a given area, and their interactions. For example, the frogs, fish, algae, cattails, and lily pads in a backyard pond make up a community.

Compatible Use: A proposed or existing wildlife-dependent recreational use or any other use of a national wildlife refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purposes of the national wildlife refuge (Service Manual 603 FW 2.6).

Compatibility Determination: A written determination signed and dated by the refuge manager and Regional Chief signifying that a proposed or existing use of a national wildlife refuge is a compatible use or is not a compatible use. The Director makes this delegation through the Regional Director (Service Manual 603 FW 2.6).

Comprehensive Conservation Plan (CCP): A document that describes the desired future conditions of the refuge or planning unit and provides long-range guidance and management direction to achieve the purposes of the refuge, helps fulfill the mission of the Refuge System; maintains and, where appropriate, restores the ecological integrity of each refuge and the Refuge System; helps achieve the goals of the National Wilderness Preservation System; and meets other mandates (Service Manual 602 FW 1.6).

Concern: See Issue.

Coordination Area: A wildlife management area made available to a State, by "(A) cooperative agreement between the United States Fish and Wildlife Service and the State fish and game agency pursuant to Section 4 of the Fish and Wildlife Coordination Act (16 U.S.C. 664); or (B) by long-term leases or agreements pursuant to the Bankhead-Jones Farm Tenant Act (50 Stat. 525; 7 U.S.C. 1010 et seq.)." States manage Coordination Areas, but they are part of the Refuge System. We do not require CCPs for Coordination Areas (Service Manual 602 FW 1.6).

Cultural Resource: The physical remains of human activity (artifacts, ruins, petroglyphs, etc.) and conceptual content or context of an area such as a traditional sacred site. It includes historically, archaeologically and architecturally significant resources.

Cultural Resource Inventory: A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4 (Service Manual 614 FW 1.7).

Cultural Resource Overview: A comprehensive document prepared for a field office that discusses, among other things, its prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement on how program objectives should be met and conflicts resolved. An overview should reference or incorporate information from a field offices background or literature search described in Section VIII of the Cultural Resource Management Handbook (Service Manual 614 FW 1.7).

Deposits: Material that is laid down through the actions of wind, water, ice, or other natural process.

Detritus: An accumulation of decomposing plant and animal remains.

Dissolved-Solids: Particles that are dissolved and suspended in water. See also total dissolved solids.

Diversion: A structure in a river or canal that diverts water from the river or canal to another water course.

Drain: A canal that collects and transports excess water from irrigated farmland.

Easement: A privilege or right that is held by one person or other entity in land owned by another.

Ecological Integrity: The integration of biological integrity, natural biological diversity, and environmental health; the replication of natural conditions (Service Manual 602 FW 1.6).

Ecology: The branch of biology that studies the interactions of organisms within an environment, either with other organisms (biotic factors) or with the non-living components (abiotic factors) of that ecosystem.

Ecosystem: The sum of all interacting parts of the environment and associated ecological communities within a particular area; an ecological system. Many levels of ecosystems have been recognized. Very few, if any ecosystems are self-contained; most influence, or are influenced by, components or forces outside the system. For administrative purposes, we have designated 53 ecosystems covering the United States and its possessions. These ecosystems generally correspond with watershed boundaries, and their sizes and ecological complexity vary.

Ecosystem Approach: Protecting or restoring the natural function (processes), structure (physical and biological patterns), and species composition of an ecosystem, recognizing that all components are interrelated.

Effect: A change in a resource, caused by a variety of events including project attributes acting on a resource attribute (direct), not directly acting on a resource attribute (indirect), another project attributes acting on a resource attribute (cumulative), and those caused by natural events (e.g., seasonal change).

Efficiency: With reference to an irrigation water delivery system, the proportion of the amount of water delivered for irrigation use compared to the total amount of water released to meet that delivery (i.e., amount of delivery divided by amount of release).

Effluent: Waste material discharged into the environment from a wastewater treatment facility.

Emergent Vegetation: Rooted, aquatic plants that have most of their vegetative (nonroot) parts above water.

Endemic Species: Plants or animals that occur naturally in a certain region and whose distribution is relatively limited to a particular locality.

Endangered Species: Any species that is in danger of extinction throughout all or a significant portion of its range and listed as such by the Secretary of the Interior in accordance with the Endangered Species Act of 1973. Endangered species are afforded protection under the Act as amended and under various State laws for State-listed species.

Entitlement: The annual maximum amount of water which can be delivered to a parcel of land, a product of eligible acres and water duty (expressed in acre-feet).

Environment: The sum total of all biological, chemical, and physical factors to which organisms are exposed; the surroundings of a plant or animal.

Environmental Assessment (EA): A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

Environmental Education: A process designed to develop a citizenry that has the awareness, concern, knowledge, attitudes, skills, motivation, and commitment to work toward solutions of current environmental problems and the prevention of new ones. Environmental education within the National Wildlife Refuge System incorporates materials, activities, programs, and products that address the citizen's course of study goals, the objectives of the refuge/field station, and the mission of the Refuge System.

Environmental Health: Abiotic composition, structure, and functioning of the environment consistent with natural conditions, including the natural abiotic processes that shape the environment (Service Manual 602 FW 1.6).

Environmental Impact Statement (EIS): A detailed written statement required by section 102(2) (C) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

Ephemeral: Pertains to streams, lakes and wetlands that exist temporarily each year.

Evapotranspiration: The collective processes by which water is transferred from the surface of the earth, including from the soil and the surface of water-bodies (through evaporation) and from plants (through transpiration).

Evolutionary Significant Unit (ESU): A sub-population of a species that is defined by substantial reproductive isolation from other conspecific units and represents an important component of the evolutionary legacy of the species.

Exotic and Invading Species. (Noxious Weeds): Plant species designated by Federal or State law as generally possessing one or more of the following characteristics: aggressive or difficult to manage; parasitic; a carrier or host of serious insects or disease; or nonnative, new, or not common to the United States, according to the Federal Noxious Weed Act (PL 93-639), a noxious weed is one that causes disease or has adverse effects on man or his environment and therefore is detrimental to the agriculture and commerce of the Unite States and to the public health.

Fallow: Allowing land that normally is used for crop production to lie idle.

Federal Trust Resources: A trust is something managed by one entity for another who holds the ownership. The Service holds in trust many natural resources for the people of the United States of America as a result of Federal Acts and treaties. Example are species listed under the Endangered Species Act, migratory birds protected by the Migratory Bird Treaty Act and other international treaties, and native plant or wildlife species found on the Refuge System.

Finding of No Significant Impact (FONSI): A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a Federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13).

Floodplain: The relatively flat area along the sides of a river which is naturally subjected to flooding.

Fluvial: Pertaining to a river.

Flyway: A route taken by migratory birds between their breeding grounds and their wintering grounds. Four primary migration routes have been identified for birds breeding in North America: the Pacific, Central, Mississippi, and Atlantic Flyways.

Foraging: The act of feeding; another word for feeding.

Forbs: Herbaceous dicotyledonous plants.

Fragmentation: The process of reducing the size and connectivity of habitat patches.

Friable Soil: Easily crumbled or pulverized soil.

GIS: Geographic Information System. Refers to such computer mapping programs as ArcView, ArcInfo, ERDAS, etc.

Goal: Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (Service Manual 620 FW 1.6).

Habitat: Suite of existing environmental conditions required by an organism for survival and reproduction. The place where an organism typically lives.

Habitat Restoration: Management emphasis designed to move ecosystems to desired conditions and processes, and/or to healthy forestlands, rangelands, and aquatic systems.

Hydrograph: The local pattern and magnitude of water flow influenced by season and dam releases.

Hydrologic Regime: The local pattern and magnitude of water flow influenced by season.

Hydrology: The science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere. The distribution and cycling of water in an area.

Impoundment: A body of water created by collection and confinement within a series of levees or dikes thus creating separate management units although not always independent of one another.

Impact: See effect.

Indigenous: Native to the area.

Inner River Zone: The estimated portion of river alluvium that has experienced river channel migration in the recent past and is likely to experience channel movement in the near future; the area includes the 100-year meanderbelt and areas of projected river bank erosion over the next 50 years.

Integrated Pest Management (IPM): Methods of managing undesirable species, such as weeds, including education; prevention, physical or mechanical methods or control; biological control; responsible chemical use; and cultural methods.

Interpretation: Interpretation can be an educational and recreational activity that is aimed at revealing relationships, examining systems, and exploring how the natural world and human activities are interconnected.

Invertebrate: Animals that do not have backbones. Included are insects, spiders, mollusks (clams, snails, etc.), and crustaceans (shrimp, crayfish, etc.).

Irrigation Drainwater: Ideally, subsurface water which flows from irrigated land and generally transports higher concentrations of dissolved salts than the water applied to the land.

Issue: Any unsettled matter that requires a management decision, e.g., an initiative, opportunity, resource management problem, threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition (Service Manual 602 FW 1.6).

Landowner: A person or entity indicated as the owner of property on the various ownership maps maintained by the Office of the County Assessor.

Landscape Ecology: A sub-discipline of ecology, which focuses on spatial relationships and interactions between patterns and processes. This emerging science integrates hydrology, geology, geomorphology, soil science, vegetation science, wildlife science, economics, sociology, law, engineering and land use planning to conserve, enhance, restore and protect the sustainability of ecosystems on the land.

Lease: A legal contract by which water rights are acquired for a specified period of time for a specified rent or compensation.

Levee: An embankment along the river to prevent water from overbank flooding.

Management Alternative: See Alternative.

Management Concern: See Issue.

Management Opportunity: See Issue.

Marsh: A periodically wet or continually flooded area where the water is shallow enough to allow the growth of emergent vegetation such as sedges, rushes, and cattails.

Marsh Habitat: Habitat that is characterized by shallow water and emergent vegetation. Unless otherwise specified, this term does not apply to similar habitat found in rivers, drains, or canals.

Meander: The bend of curve in a river or stream channel. Migration of the river or stream channel.

Meander Scar: The area of land marked by the earlier presence of a meandering river channel; the mark is usually identified by different soil texture and color.

Migration: The seasonal movement from one area to another and back.

Migratory Bird: A bird that seasonally moves between geographic areas. In reference to birds in the Great Basin, a bird that breeds in Great Basin and subsequently moves south of the Great Basin for the winter months. Birds that migrate south of Mexico for the winter are considered Neotropical migrants.

Mission Statement: Succinct statement of the unit's purpose and reason for being.

Mitigation: To avoid or minimize impacts of an action by limiting the degree or magnitude of the action; to rectify the impact by repairing, rehabilitating, or restoring the affected environment; to reduce or eliminate the impact by preservation and maintenance operations during the life of the action.

Model: A mathematical formula that expresses the actions and interactions of the elements of a system in such a manner that the system may be evaluated under any given set of conditions.

Moist-Soil: A process where water is drawn down intentionally or naturally to produce mudflats (i.e., moist soil) that is required for germination of many desirable plants.

Monitoring: Data collected and analyzed periodically for comparing trends in that which is being monitored. Monitoring is necessary to identify, track and analyze results of management actions at the refuge so that future management actions may be adapted to obtain the best benefits to wildlife and habitat (see adaptive management).

Mud Flat: Expanses of mud contiguous to a water body often covered and exposed by tides.

National Environmental Policy Act (NEPA): An act which encourages productive and enjoyable harmony between humans and their environment, to promote efforts that will prevent or eliminate damage to the environment and atmosphere, to stimulate the health and welfare of humans. The act also established the Council on Environmental Quality (CEQ). Requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making (from 40 CFR 1500).

National Wildlife Refuge (Refuge or NWR): A designated area of land or water or an interest in land or water within the system, including national wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas (except coordination areas) under the Service jurisdiction for the protection and conservation of fish and wildlife. A complete listing of all units of the Refuge System may be found in the current “Report of Lands Under Control of the U.S. Fish and Wildlife Service” (Service Manual 602 FW 1.6).

National Wildlife Refuge System, Refuge System, or System: Various categories of areas that are administered by the Secretary for the conservation of fish and wildlife, including species that are threatened with extinction; all lands, waters, and interest therein administered by the Secretary as wildlife refuges; areas for the protection and conservation of fish and wildlife that are threatened with extinction; wildlife ranges; game ranges; wildlife management or waterfowl production areas.

National Wildlife Refuge System Mission (mission): "The mission of the System is to administer a national network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (Service Manual 602 FW 1.6).

Natural Recruitment: Plant establishment through natural processes. In riparian systems these processes include: flooding, sediment deposition, erosion, and seed dispersal from local or upstream plant sources.

Native Species: Species that normally live and thrive in a particular ecosystem.

Neotropical Migratory Birds: Migratory birds that breed in North American and winter in Central and South America.

NEPA: National Environmental Policy Act of 1969.

Niche: An organism's "place," or role, in an ecosystem. This involves many components of the organism's life: where it lives (habitat), what it eats, by whom it is eaten, when it migrates or breeds, etc. All of these factors combine to determine the role of the organism in its ecosystem.

No Action Alternative: An alternative under which existing management would be continued.

Non-Priority Public Uses: Any use other than a compatible wildlife-dependent recreational use.

Notice of Intent (NOI): A notice that an environmental impact statement will be prepared and considered (40 CFR 1508.22). Published in the *Federal Register*.

NWR: National Wildlife Refuge.

Objective: A concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work. Objectives derive from goals and provide the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies. Make objectives attainable, time-specific, and measurable (Service Manual 602 FW 1.6).

One-hundred-year Floodplain: The relatively flat portion of the river channel that has a one percent chance of being inundated by flood water in any given year.

One-hundred-year Meanderbelt: The area of land over which a river channel has historically migrated over a 100-year period.

Operation and Maintenance (O&M) Costs: Charges paid by water users for delivery of water in the Newlands Project that are paid to the Newlands Project operator for reasonable and customary operation and maintenance of the delivery system.

Opportunities: Potential solutions to issues.

Ordinary High Water Mark: That line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Outreach: Outreach is two-way communication between the USFWS and the public to establish mutual understanding, promote involvement, and influence attitudes and actions, with goal of improving joint stewardship of our natural resources.

Overbank Flooding: River flows that exceed the boundaries of the existing river channel and flood the adjacent riparian areas and bottomlands.

Oxbow Lake: A horseshoe-shaped lake formed in an abandoned meander bend of a river.

Passerine Bird: A songbird or other perching bird that is in the order Passeriformes. Blackbirds, crows, warblers, sparrows, and wrens for example.

Perennial: In reference to a body of water, one that contains water year-to-year and that rarely goes dry.

Peak Flow: The maximum discharge of a stream during a specified period of time.

Permeability: The property or capacity of porous rock, sediment, or soil to transmit water.

Phenology: Life cycle of particular species.

Phreatophytes: Plants whose roots penetrate to the water table.

Physiographic: Physical geography of a particular region of the U.S.

PILT: Payment-in-Lieu-of-Taxes.

Planning Area: The area upon which the planning effort will focus. A planning area may include lands outside existing planning unit boundaries currently studied for inclusion in the Refuge System and/or partnership planning efforts. It also may include watersheds or ecosystems outside of our jurisdiction that affect the planning unit. At a minimum, the planning area includes all lands within the authorized boundary of the refuge (Service Manual 602 FW 1.6).

Planning Team: A team or group of persons working together to prepare a document. Planning teams are interdisciplinary in membership and function. Teams generally consist of a Planning Team Leader, Refuge Manager and staff biologists, a state natural resource agency representative, and other appropriate program specialists (e.g., social scientist, ecologist, recreation specialist). We also will ask other Federal and Tribal natural resource agencies to provide team members, as appropriate. The planning team prepares the CCP and appropriate NEPA documentation (Service Manual 602 FW 1.6).

Planning Team Leader: The Planning Team Leader typically is a professional planner or natural resource specialist knowledgeable of the requirements of NEPA and who has planning experience. The Planning Team Leader manages the refuge planning process and ensures compliance with applicable regulatory and policy requirements (Service Manual 602 FW 1.6).

Planning Unit: A single refuge, an ecologically or administratively related refuge complex, or distinct unit of a refuge. The planning unit also may include lands currently outside refuge boundaries (Service Manual 602 FW 1.6).

Plant Community: An assemblage of plant species of a particular composition. The term can also be used in reference to a group of one or more populations of plants in a particular area at a particular point in time; the plant community of an area can change over time due to disturbance (e.g., fire) and succession.

Pollutant: Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose.

Population: All the members of a single species coexisting in one ecosystem at a given time.

Preferred Alternative: This is the alternative determined (by the decision maker) to best achieve the Refuge purpose, vision, and goals; contributes to the Refuge System mission, addresses the significant issues; and is consistent with principles of sound fish and wildlife management. The Service's selected alternative at the Draft CCP stage.

Prescribed Fire: The skillful application of fire to natural fuels under conditions of weather, fuel moisture, soil moisture, etc., that allows confinement of the fire to a predetermined area and produces the intensity of heat and rate of spread to accomplish planned benefits to one or more objectives of habitat management, wildlife management, or hazard reduction.

Prime Farmland: Farmland in an area or region that is considered to be the most ideal farmland based on several criteria; usually soil types and land productivity of the land are two of the most important criteria.

Priority Public Uses: Compatible wildlife-dependent recreation uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation).

Proposed Action: The Service's proposed action for Comprehensive Conservation Plans is to prepare and implement the CCP.

Public: Individuals, organizations, and groups; officials of Federal, State, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in Service issues and those who do or do not realize that Service decisions may affect them.

Public Involvement: A process that offers impacted and interested individuals and organizations an opportunity to become informed about, and to express their opinions on Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for refuge management.

Public Involvement Plan: Broad long-term guidance for involving the public in the comprehensive planning process.

Public Scoping: See public involvement.

Purposes of the Refuge: "The purposes specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit." For refuges that encompass congressionally designated wilderness, the purposes of the Wilderness Act are additional purposes of the refuge (Service Manual 602 FW 1.6).

Purveyor: A private land owner or association that controls water rights for the ability to use the water.

Raptor: A bird of prey, such as a hawk, eagle, or owl.

Record of Decision (ROD): A concise public record of decision prepared by the Federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives considered, identification of the environmentally preferable alternative, a statement as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation (40 CFR 1505.2).

Recreation Day: A standard unit of use consisting of a visit by one individual to a recreation area for recreation purposes during any reasonable portion or all of a 24-hour period.

Recruitment: The annual increase in a population as determined by the proportion of surviving offspring produced during a specific period (usually expressed per year).

Refuge: Short of National Wildlife Refuge.

Refuge Goal: See goal.

Refuge Operating Needs System (RONS): The Refuge Operating Needs System is a national database that contains the unfunded operational needs of each refuge. We include projects required to implement approved plans and meet goals, objectives, and legal mandates (Service Manual 602 FW 1.6).

Refuge Purposes: See purposes of the Refuge.

Refuge Revenue Sharing Program or RRSP: Proves payments to counties in lieu of taxes using revenues derived from the sale of products from refuges.

Refuge Use: Any activity on a refuge, except administrative or law enforcement activity carried out by or under the direction of an authorized Service employee.

Restoration: The return of an ecosystem to an approximation of its former unimpaired condition.

Restoration, Cultural Restoration: Restoration that uses horticultural and agricultural techniques for plant establishment. Common practices of cultural restoration includes: propagating seeds, acorns and cuttings in a greenhouse; planting these propagules in rows so that irrigations systems may be installed and maintained and weeds can be sprayed and mowed. Specific human actions taken to reestablish the natural processes, vegetation and resultant habitat of an ecosystem.

Restoration, Passive Restoration: Restoration that relies on natural processes for plant establishment. These processes include: flooding, sediment deposition, erosion, and seed dispersal from local or upstream plant sources. Allowing an ecosystem to restore its natural processes, vegetation and resultant habitat without human actions.

Riparian Area: Riparian areas are transitional between terrestrial and aquatic ecosystems and are distinguished by gradients in biophysical conditions, ecological processes, and biota. They are areas through which surface and subsurface hydrology connect waterbodies with their adjacent uplands. They include those portions of terrestrial ecosystems that significantly influence exchanges of energy and matter with acquatic ecosystems (i.e., a zone of influence). Riparian areas are adjacent to perennial, intermittent, and ephemeral streams, lakes and estuarine-marine shorelines.

Riparian Habitat: Gravel bars, sand dunes, non-vegetated riverbanks, herbaceous, scrub and forested vegetation, which provides habitat for plants, macro-invertebrates, fish and wildlife.

Riverine: Pertaining to rivers and floodplains.

RMIS: Refuge Management Information System database

Secretary: Short of the Secretary of the Interior.

Sediment: Any material, carried in suspension by water, which ultimately settles to the bottom of water courses. Sediments may also settle on stream banks or flood plains during high water flow.

Service or USFWS: Short for U.S. Fish and Wildlife Service.

Shorebirds: Long-legged birds, also known as waders, belonging to the Order Charadriiformes that use shallow wetlands and mud flats for foraging and nesting.

Slough: A naturally occurring side or overflow channel that holds water.

Soil Erosion: The wearing away of the land's surface by water, wind, ice, or other physical process.

Sound Professional Judgment: A finding, determination, or decision that is consistent with principles of sound fish and wildlife management and administration, available science and resources, and adherence to the requirements of the Refuge Administration Act of 1966 (16 U.S.C. 668dd-668ee), and other applicable laws. Included in the finding, determination, or decision is a refuge manager's field experience and knowledge of the particular refuge's resources (Service Manual 603 FW 2.6).

Spatial Distribution: The pattern of frequency of a specific habitat type over a larger area.

Species: A distinctive kind of plant or animal having distinguishable characteristics, and that can interbreed and produce young. A category of biological classification.

Species Composition: A group of species that inhabit a specific habitat type in its healthy state. To enhance species composition is to ensure that all or as many species as possible inhabit the appropriate habitat by improving the quality of that habitat.

Step-Down Management Plan: A plan that provides specific guidance on management subjects (e.g., habitat, public use, fire, safety) or groups of related subjects. It describes strategies and implementation schedules for meeting CCP goals and objectives (Service Manual 602 FW 1.6).

Strategy: A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives (Service Manual 602 FW 1.6).

Submergent Vegetation: Plants that grows completely submerged except when flowering.

Succession: The replacement of one plant community by another over time.

Surface Water: A body of water that has its upper surface exposed to the atmosphere.

System or Refuge System: National Wildlife Refuge System.

Terminus: In reference to a stream or river, its end point; where it flows into a lake or other basin.

Threatened Species: Any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, and one that has been designated as a threatened species in the *Federal Register* by the Secretary of the Interior. Threatened species are afforded protection under the Endangered Species Act of 1973.

Tiering: The coverage of general matters in broader environmental impact statements with subsequent narrower statements of environmental analysis, incorporating by reference, the general discussions and concentrating on specific issues (40 CFR 1508.28).

Total Dissolved-Solids (TDS): The total concentration of solids (or salts) dissolved in water; specific conductance is a surrogate measure of dissolved solids. More specifically, total dissolved-solids is an aggregate of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, etc. of calcium, magnesium, manganese, sodium, potassium, and other cations that form salts.

Trace Elements: Metallic elements (with atomic number >21) generally occurring in trace amounts in water, including iron, manganese, copper, chromium, arsenic, mercury, and vanadium.

Transient Species: Animals that migrate through a locality without breeding or overwintering.

Trust Species: Species for which the U.S. Fish and Wildlife Service has primary responsibility, including, most federally listed threatened and endangered species, anadromous fishes once they enter inland U.S. waterways, migratory birds, and certain marine mammals.

Turbidity: Cloudiness of a water body caused by suspended silt, mud, pollutants, or algae.

Understory: Shrubs and herbaceous plants that typically grow beneath larger trees in a woodland.

Upland: An area where water normally does not collect and where water does not flow on an extended basis. Uplands are non-wetland areas.

USFWS or Service: Short for U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service Mission: Our mission is working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people (Service Manual 602 FW 1.6).

Vegetation: The composition plant species, their frequency of occurrence, density, and age classes at a specified scale.

Vegetation Community: See plant community.

Vegetation Type or Habitat Type: A land classification system based upon the concept of distinct plant associations.

Vernal Pool: Seasonally flooded depressions on soils with an impermeable layer such as a hardpan, claypan, volcanic basalt, or saturated alkali clays. The impermeable layer allows the pools to retain water much longer then the surrounding uplands; nonetheless, the pools are shallow enough to dry up each season. Vernal pools often fill and empty several times during the rainy season. Only plants and animals that are adapted to this cycle of wetting and drying can survive in vernal pools over time.

Vertebrate: An animal having a segmented backbone or vertebral column; includes mammals, birds, fish, amphibians, and reptiles.

Vision Statement: A concise statement of what the planning unit should be, or what we hope to do, based primarily upon the Refuge System mission and specific refuge purposes, and other mandates. We will tie the vision statement for the refuge to the mission of the Refuge System; the purpose(s) of the refuge; the maintenance or restoration of the ecological integrity of each refuge and the Refuge System; and other mandates (Service Manual 602 FW 1.6).

Water Year: That period of time between October 1 of one calendar year and September 30 of the next calendar year. Traditionally, hydrologic data (i.e., stream flows, precipitation, etc.) was summarized or totaled for this period of time.

Waterfowl: A group of birds that include ducks, geese, and swans (belonging to the order Anseriformes).

Water-righted Acreage: The land base for which there are water rights.

Water Rights: A grant, permit, decree, appropriation, or claim to the use of water for beneficial purposes, and subject to other rights of earlier date of use, called priority, or prior appropriation.

Watershed: The entire land area that collects and drains water into a river or river system.

Wetland: Land that is transitional between upland (terrestrial) and aquatic systems (greater than about 6-feet deep) where the water table is usually at or near the surface or the land is covered by shallow water... wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes (plants that require wet conditions); (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year (Cowardin and others, 1979).

Wetland Habitat: Habitat provided by shallow or deep water (but less than 6-feet deep), with or without emergent and aquatic vegetation in wetlands. Wetland habitat only exists when and where a wetland or portion of a wetland is covered with water (visible surface water). Consequently, the size and shape of "wetland habitat" will fluctuate from season-to-season and year-to-year while the size and shape of the "wetland" within which wetland habitat occurs will remain constant from season to season and from year to year. Wetlands only provide habitat for waterfowl, shorebirds, muskrats, aquatic insects, and other wetland-dependent wildlife when they contain surface water (i.e., when they provide wetland habitat).

Wildfire: A free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands (Service Manual 621 FW 1.7).

Wildland fire: A free burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands. Often referred to a wildfire.

Wildlife: All nondomesticated animal life; included are vertebrates and invertebrates.

Wildlife Corridor: A landscape feature that facilitates the biologically effective transport of animals between larger patches of habitat dedicated to conservation functions. Such corridors may facilitate several kinds of traffic, including frequent foraging movement, seasonal migration, or the once in a lifetime dispersal of juvenile animals. These are transition habitats and need not contain all the habitat elements required for long-term survival of reproduction of its migrants.

Wildlife-Dependent Recreational Use: "A use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation." These are the six priority public uses of the Refuge System as established in the National Wildlife Refuge System Administration Act, as amended. Wildlife-dependent recreational uses, other than the six priority public uses, are those that depend on the presence of wildlife. We also will consider these other uses in the preparation of refuge CCPs; however, the six priority public uses always will take precedence (Service Manual 602 FW 1.6).

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Appendix J. Consultation and Coordination with Others

Federal, State and County Elected Officials

Office of U.S. Senator Barbara Boxer
Office of U.S. Senator Dianne Feinstein
Office of U.S. Representative Wally Herger
Office of State Senator Sam Aanestad
Office of State Assemblyman Doug La Malfa
Office of State Assemblyman Rick Keene
Governor Arnold Schwarzenegger
Chairperson, Butte County Board of Supervisors
Chairperson, Colusa County Board of Supervisors
Chairperson, Glenn County Board of Supervisors
Chairperson, Tehama County Board of Supervisors

Federal Agencies

U.S. Department of Agriculture
- U.S. Forest Service
  - James Fenwood, Forest Supervisor
  - Randy Jero
- Natural Resource Conservation Service – Colusa, Willows, Chico
  - Dean Burkett
  - Jessica Groves
  - Dennis Nay, District Conservationist

U.S. Department of Commerce
- National Marine Fisheries Service
  - Mike Aceitano

U.S. Department of Defense
- U.S. Army Corps of Engineers
  - Art Champ, Chief, Regulatory Branch

U.S. Department of the Interior
- Bureau of Reclamation – Sacramento, Red Bluff
  - Regional Director, Mid Pacific Regional Office
  - Basia Trout
- Fish and Wildlife Service
  - Sacramento
    - Steve Thompson, California Nevada Operations Manager
    - Dave Paullin, Refuge Supervisor, California Nevada Office
    - Dan Walsworth, Refuge Supervisor, California Nevada Office
    - Robert Shaffer, CVHJV
    - Steve Dyer, Chief Sacramento Realty Office
    - Mark Pelz, Refuge Planning Office
    - Richard Smith, Refuge Planning Office
    - Bart Prose, Div. of Habitat Conservation

Wayne White, Field Supervisor, Sacramento FWO
Adam Zerrenner, Sacramento FWO

Stockton

Dan Castleberry, Central Valley Project Improvement Act
John Icanberry, Central Valley Project Improvement Act

Red Bluff

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Patricia Parker, Fisheries Biologist, Red Bluff FWO

Portland, OR

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Steve Moore, Chief Refuge Operations Support
James Roberts, Refuge Operations Support
Nell Fuller, Refuge Policy and Compliance
Chuck Houghten, Chief of Refuge Planning
Mike Marxen, Team Leader, Division of Refuge Planning
Kay KierHaggenjos, Div. of Refuge Planning
Ben Harrison, Chief of Land Protection Planning
Jean Harrison, Chief of Visitor Services & Comm.
Nathan Caldwell, T-21 Coordinator
Fred Paveglio, Branch of Refuge Biology
Sam Johnson, Branch of Refuge Biology
Tara Zimmerman, MBHP
Michael Green, MBHP
David Drescher, Branch Chief GIS/Mapping
Susan Saul, External Affairs
Anan Raymond, Chief of Cultural Resources
Nick Valentine, Cultural Resources
Paul Rauch, Div. of Engineering
Catherine Sheppard, Div. of Realty

Arlington, VA

Liz Bellantoni

National Conservation Training Center

Liz Fritsch
Ann Post Roy, Conservation Library

Bureau of Land Management, Redding

Glen R. Miller, Environmental Coordinator
Chuck Schultz, Area Manager

State Agencies

Department of Fish and Game – Sacramento, Redding, Rancho Cordova, Chico, Willows, Butte City

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Don Blake, Habitat Supervisor
Tom Blankenship
John Carlson, Wildlife and Inland Fisheries Division
Scott Clemons, Riparian Habitat Manager, Wildlife Conservation Board
Banky Curtis, Regional Manager, Region 2
Larry Eng
Paul Hofmann, Wildlife Biologist
Diana Jacobs, Deputy Director, Science Advisor
Don Koch, Regional Manager, Region 1
Henry Lamelli
Teresa Leblanc
Dan Odenweller, Central Valley Bay Delta Branch
Paul Ward, Associate Biologist, Marine Fisheries

Resources Agency

Felix Arteaga
Tim Ramirez
Rebecca Fawver

Department of Parks and Recreation

Daniel Abeyta, Office of Historic Preservation
Woody Elliott, Senior Resource Ecologist
Robert Foster, Supervisor
Trisha Tillotson, Hydraulics, District 3

Department of Water Resources – Sacramento, Red Bluff

Deputy Director, State Water Project
Annalene Bronson
Koll Buer
Stacy Cepello
James L. Martin, Wetlands Coordinator

Fish and Game Commission

Jim Kellogg, President

State Board of Reclamation

Betsy Marchand, President of the Reclamation Board
Peter Rabbon, General Manager

Local

Butte County Cooperative Extension
- Bill Olsen, Director

Butte County
- Bob Townsend, Public Works
- Jane Dolan, Supervisor
- Curt Josiassen, Board of Supervisors, Chairman
- Lynne Tillis, Department of Water Resources and Conservation
- J. Michael Madden, Butte County Emergency Services
- Jim Camy, Butte County Mosquito & Vector Control District

Colusa County
- Colusa County Fish and Game
- David B. Whitesell, Colusa Mosquito Abatement District
- David Womble, Board of Supervisors, Chairman

Glenn County
- Denny Bungarz, Board of Supervisors
- Forrest Sprague, Board of Supervisors
- Peter J. Boice, Fish, Game and Recreation Commission
- Jon Hays, Fish, Game and Recreation Commission
- John Benoit, Planning Department
- Christy Leighton, Planning Department
- Jack F. Cavier, Jr., Glenn County Mosquito & Vector Control

Tehama County
- Ernie Ohlin, Public Works
- William Borror, Board of Supervisors, District 5
- Barbara McIver, Board of Supervisors
- Tehama County Mosquito and Vector Control District, Red Bluff

Sacramento-Yolo County Mosquito and Vector Control District, Elk Grove
- David Brown

City of Tehama
- Ron Warner, Mayor

Public Libraries

Bayliss Library
Butte County Library – Chico Branch
Butte County Library – Oroville Branch
Colusa County Library – Colusa Branch
Colusa County Library – Princeton Branch
Corning Library
Orland City Library
Tehama County Library – Los Molinos Branch

Tehama County Library – Red Bluff Branch
Willows Public Library
Brent Miller, Head Librarian, Sacramento

Private Groups and Individuals
Assembly Committee on Water, Parks & Wildlife
Tim Adkins
Mark Adams, President, Chico Area Flyfishers
Don and Barbara Anderson
Animal Protection Institute
Jerry Arnoldy
Rel Atwood
Thad Baker
Ronald & Jeanette Barnes
Joe Becker, California Bowmen Hunters
Paul Biehn
Big Chico Creek Watershed Alliance
Serge Birk
Jay Bogiatto, Department of Biological Sciences, California State University, Chico
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Michael Bumgardner, EIP Associates
Burt Bundy, Sacramento River Conservation Area Forum
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Steve Carson
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Jim Clarkson, Raptor Rod Works
Walter Cook
George & Linda Colbin
Mark A. Corrie, Fisherman's Cove
John Cosby
Chuck Crain, Crain Walnut Shelling

Marci D'Arpino, Plan-Tech
Dan Davey
Kim Davis
Robert Davison, Wildlife Management Institute
Dave Dodds, United Outdoorsman
Edward F. Edgerton
Dan Efseaff, River Partners
Greg Elliott, Point Reyes Bird Observatory
Ruth Erwin
Tom Evans, Family Water Alliance
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Robert Fields, National Wildlife Refuge Association
Barney Flynn
Bernard Flynn
Brendon Flynn, Pacific Farms
Cecilia Flynn, Shasta View Farms Ruth Erwin
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Dan Gardner
Mike Gardner
Gene German
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Eric Ginney, Bidwell Environmental Institute, CSU/Chico
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Calvin Guin
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Heather Hacking
Scott Hartman, National Trappers Association
Edward Hay
Hilary R. Hedman
Bryan Henderson
Paul Hendricks, California Division of Forestry
Mark Hennelly, California Waterfowl Association
Les Heringer, M&T Ranch, Inc.
Karen Holl, University of California, Santa Cruz
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Bill Karr, Western Outdoor News

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Dr. Matt Kondolf, University of California, Berkeley
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Greg Treber
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Appendix K. List of Planning Team Members and Persons Responsible for Preparing this Document

U.S. Fish and Wildlife Service

Core Planning Team

Kevin Foerster	Project Leader, Sacramento NWRC
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Ramon Vega	Former Refuge Manager, Sacramento River NWR

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Perry Grissom	Fire Management Officer, Sacramento NWRC
Marilyn Gamette	Interpretive Specialist, Sacramento NWRC
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Appendix L. Rationale in Support of Public Use Determinations for the Units of Sacramento River Refuge

Big 6 – open to hunting, fishing, wildlife observation, photography, environmental education, and interpretation

Big 5 - open to fishing, wildlife observation, photography, environmental education, and interpretation

Sanctuary – closed to public use

Unit Name: Level of Public Use:

La Barranca – Big 6
- Makes large continuous area for hunting with Mooney and Todd Island Units
- Boat access only

Blackberry Island – Big 5
- Small acreage
- Private residence close proximity
- Good fishing from gravel bar
- Boat access only

Todd Island – Big 6
- Big 6 uses are consistent with current Bureau of Land Management (BLM) public use/contingency for transfer
- Adjacent to La Barranca and Mooney Units that will have Big 6 uses
- Boat access only

Mooney – Big 6
- Existing deeded hunting rights
- Makes large continuous area for hunting with La Barranca and Todd Island Units
- Boat access only

Ohm – Northeast portion is Big 6 and the remaining acres sanctuary
- South of existing unnamed slough closed to public due to grazing and sensitive resource areas
- Portion east of River open to Big 6 (below ordinary high water mark)
- Large tract of quality habitat on northern section of Refuge for wildlife sanctuary
- Boat access only

Flynn – Big 5
- Coyote Creek good natural separation between sanctuary to the north (Ohm Unit) and the Flynn Unit (see CCP chapter 3 unit descriptions for details)
- Good gravel bar for canoe/boat access
- Good wildlife viewing opportunities
- Boat access only

Heron Island – Big 6

- No sensitive resource issues
- Surrounded by agricultural lands
- Boat access only

Rio Vista – Northern portion Big 5, southern portion Big 6

- Northern portion closed to hunting due to proximity to Woodson Bridge State Park, Tehama county RV park, and private residences
- Northern portion has good vehicle access via South Avenue for Big 5 users
- Southern portion open to hunting via boat access
- Southern portion adjacent to California Department of Fish and Game (DFG, Merrill Landing Unit), that is also open to hunting via boat access

Foster Island – Big 6

- Big 6 uses consistent with current BLM public use/contingency for transfer
- Boat access only

McIntosh Landing North – Sanctuary

- Close proximity to private residences
- Small acreage
- Quality neotropical migrant bird breeding habitat
- Provides sanctuary on the middle section of the Refuge
- Lacks public vehicle access

McIntosh Landing South – Sanctuary

- Small acreage
- Steep eroding river bank makes boat access difficult
- Unsafe entrance/exit on Highway 45 for vehicles

Pine Creek – Big 5

- Good environmental education site due to close proximity to Chico
- Good wildlife viewing opportunities and habitat restoration sites
- Trails already exist
- Private residences on west side of unit
- Existing levee separates DFG (Pine Creek Unit) to the south that is currently open for hunting via boat access
- Proposed that State Parks The Nature Conservancy (TNC) property near bridge] may provide a parking and visitor facility area
- Good vehicle access on northwest corner via Highway 32

Capay – Big 6

- Historic hunting use
- Adjacent to DFG (Pine Creek Unit) to the north that is open to hunting
- Pedestrian access to River bank along existing road
- Good vehicle access via County Road 23

Phelan Island – Big 6

- Existing environmental education activities facilitated by Refuge partners
- Existing internal roads available for guided tours
- Good wildlife viewing and habitat restoration sites
- Historic hunting use
- Boat access only

Jacinto – Big 6

- Adjacent to DFG (Shannon Slough Unit) that is open to hunting
- Boat access only

Dead Man's Reach – Northwest portion Big 6, remainder Big 5

- Big 6 below ordinary high water mark, Big 5 above ordinary high water mark
- Deer grazing concerns by adjacent landowners
- Large gravel bar for easy boat access
- Boat access only

North Ord – Sanctuary

- Small acreage
- Provides sanctuary in the middle section of the Refuge
- Close proximity to private residences
- Lacks public vehicle access
- Steep river bank makes boat access difficult

Ord Bend – Big 5

- Adjacent to Ord Bend County Park
- Close proximity to Chico
- Private residences close proximity
- Small acreage
- Good vehicle access via Ord Bend county road

South Ord – Big 6

- Adjacent to DFG (Ord Bend Unit) that is open to hunting
- Boat access only

Llano Seco Island 1 – Big 6

- Adjacent to DFG (Jacinto Unit) that is open to hunting
- Boat access only

Llano Seco Island 2 – Big 6

- Historic hunting use
- Boat access only

Llano Seco Riparian Sanctuary – Sanctuary

- Original goal of Llano Seco property to be sanctuary
- Large tract of habitat for sanctuary for middle portion of Refuge
- Public access would potentially negatively impact private land easement sanctuaries
- Sensitive resource protection
- No vehicle access

Hartley Island – Big 6 western portion, Sanctuary eastern portion

- Adjacent to DFG (Oxbow Unit) that is open to hunting
- Large portion is below ordinary high water mark
- Eastern portion sanctuary due to no access (surrounded by private property)
- Boat access only

Sul Norte – Big 6, except for very southern portion Big 5

- Adjacent to DFG (Beehive Bend Unit) that is open to hunting
- South end closed to hunting as buffer to Highway 162 and the units to the south that are Big 5
- Good vehicle access and parking

Codora – Big 5

- Adjacent to Packer Unit which is currently open to fishing
- Good wildlife viewing opportunities

Packer – Big 5

- Currently open to fishing
- Close proximity to private residences
- Good vehicle access via Highway 45

Head Lama – Sanctuary and Big 6

- High quality habitat for sanctuary
- Provides sanctuary on southern portion of the Refuge
- Big 6 below ordinary high water mark
- Boat access only

Drumheller Slough – Big 6

- Historic hunting on surrounding properties
- Vehicle access by county road

Appendix M. Local Land Use Policies that relate to Refuge management

Appendix M. Summary of Local Land Use Policies that relate to Refuge Management.		
County	**Category**	**Land Use Policy**
Butte County General Plan (Butte County Planning Department 1991)	Agricultural and Crop Land	Policy b. Retain in an agricultural designation on the Land Use Map areas where location, natural conditions and water availability make lands well suited to orchard and field crop use, while considering for non-agricultural use areas where urban encroachment has made inroads into agricultural areas and where past official actions have planned areas for development.
Butte County General Plan (Butte County Planning Department 1991)	Biological Habitat	Policy b. Prevent development and site clearance other than river bank protection of marshes and significant riparian habitats. Policy d. Regulate development to facilitate survival of identified rare and endangered plants and animals.
Butte County General Plan (Butte County Planning Department 1991)	Natural Areas	Policy a. Encourage the creation and expansion of natural and wilderness areas.
Glenn County General Plan (QUAD Consultants 1993)	5.1.1 Agriculture/ Soils	As the most extensive land use in the county, agriculture constitutes a significant component of the local economy. Agricultural land also provides valuable open space and important wildlife habitat. It is important that the County take steps to preserve its agricultural land from both economic and environmental perspectives. ...Converting prime agricultural land to non-agricultural uses is considered an irreversible loss of resources. ...With the primary goal being that of preserving the county's valuable agricultural resources, a variety of preservation tools can be used.... Policy NRP-1. Maintain agriculture as a primary, extensive land use, not only in recognition of the economic importance of agriculture, but also in terms of agriculture's contribution to the preservation of open space and wildlife habitat.
Glenn County General Plan (QUAD Consultants 1993)	5.3.1 Land Use/Growth	Agriculture is the single most important component of the county's economic base, protection of agricultural land is of great importance. Land use patterns, goals and policies have been established which promote agricultural land preservation and protect these lands from urban encroachment. ...It is the intent of the County to promote orderly growth by directing new growth into areas where it can be accommodated and served adequately, and to avoid potential land use conflicts through the appropriate distribution and regulation of land uses. Only compatible uses will be encouraged in agricultural areas; compatible uses are defined as those uses capable of existing together without conflict or ill effect.
Glenn County General Plan (QUAD Consultants 1993)	6.7 Coordination with Wildlife and Land Management Agencies	For all projects, with the exception of those associated with sites low in wildlife value, early consultation with wildlife agencies should occur.

Appendix M. Summary of Local Land Use Policies that relate to Refuge Management.		
County	**Category**	**Land Use Policy**
Tehama County General Plan (Tehama County 1983)		Preservation of Tehama County's agricultural resources was identified as a key objective in the General Plan....The basic concept of the General Plan is the resolution of the inherent conflict between agricultural and non-agricultural uses....The Plan also contains other policies designed to prevent the piecemeal conversion of agricultural lands to other uses and to create a climate of public understanding in Tehama County which is supportive of agriculture.
Tehama County General Plan (Tehama County 1983)	Agricultural Preserve Lands	Objective AG-3. Protection of agricultural lands, whenever possible, from non-agricultural development through separation by natural buffers and land use transition areas that mitigate or prevent land use conflicts. Objective AG-4. Protection of agricultural lands from development pressures or uses which will adversely impact or hinder existing or foreseeable agricultural operations.
Tehama County General Plan (Tehama County 1983)	Wildlife Resources	Objective WR-1. Preserve environmentally sensitive and significant lands and water valuable for their plant and wildlife habitat, natural appearance and character. Objective WR-2. Afford. To the extent feasible, adequate protection to areas identified by the California Department of Fish and Game and the California Natural Diversity Data Base as critical riparian zones. Objective WR-3. Support and coordinate County plans with interjurisdictional programs for the proper management of riparian resources in the County.
Tehama County General Plan (Tehama County 1983)	Natural Resource Lands and Recreation	Objective NRR-1. Protection of resource lands for the continued benefit of agriculture, timber, grazing, recreation, wildlife habitat, and quality of life.
Integrated Resources Management Program for Flood Control in the Colusa Basin, (Colusa Basin Drainage District and U.S. Bureau of Reclamation 2000)		The unincorporated communities within Colusa County include Arbuckle, College City, Grimes, Maxwell, Princeton, and Stonyford. Incorporated cities in Colusa County include Colusa and Williams. The county also contains small settlement areas with permanent populations of less than 100 people. Land uses in Colusa County are typical of the rural counties of California. The eastern half of the county is dominated by large farms with much of the privately owned land following square-mile section lines. This portion of the county is relatively flat and use for the cultivation of rice, orchards, and row crops. The western half of the county contains the Coastal Range foothills, which are often used as rangeland.

Appendix M. Summary of Local Land Use Policies that relate to Refuge Management.		
County	**Category**	**Land Use Policy**
Colusa County General Plan (Colusa County 1989)		The majority of rangeland and general agriculture," "orchards," national wildlife refuge," and undeveloped bottomlands. The westernmost portion of the county contains areas of the Mendocino National Forest. In general, the eastern half of the county is designated "general agriculture" and the majority of the western half is designated either "national forest land" or "rangeland."
Colusa County Interim Farmland 1996" (California Department of Conservation 1998)		"Current land use within the eastern one-half of Colusa County is primarily "irrigated farmland" with small pockets of "non-irrigated farmland," "urban and built-up land", and "other land" (primarily wildlife preservation areas). The central area of the county consists primarily of "non-irrigated farmland" and the westernmost section of the county is primarily "other land" (i.e., Mendocino National Forest). Water bodies in the county include Funks Reservoir and East Park Reservoir, which are located in the northern and western centers respectively.

Appendix N. Referenced Tables from the Sacramento River Public Recreation Access Study (EDAW 2003).

Table 4.1-1. Study Area Counties

Local Area	Regional Area		
Local Counties	**Adjacent Counties**	**SACOG Area Counties**	**SF Bay/Delta Area Counties**
Butte	Lake	El Dorado	Alameda
Colusa	Mendocino	Placer	Contra Costa
Glenn	Plumas	Sacramento	Marin
Tehama	Shasta		Napa
	Sutter [1]		San Francisco
	Trinity		San Mateo
	Yolo [1]		Santa Clara
	Yuba [1]		Solano
			Sonoma

[1] Represents adjacent counties that are also part of the SACOG region.
Source: EDAW 2003

Table 4.1-2. Demographic Profile of the Study Area Residents

County	Population (2001) [1]	Population (2002) [1] (% growth)	Median Age (2000)[2]	M/F (2000) [2]	% White (2000) [3,4]	% Hispanic/ Latino (2000) [3,5]	Median HH Income (1999) [3]
Butte	205,400	207,000 (0.8%)	35.8	49.0 / 51.0	84.5	10.5	31,924
Colusa	19,150	19,450 (1.6%)	31.5	50.8 / 49.2	64.3	46.5	35,062
Glenn	26,800	26,800 (0.0%)	33.7	50.5 / 49.5	71.8	29.6	32,107
Tehama	56,100	56,900 (1.4%)	37.8	49.4 / 50.6	84.8	15.8	31,206
Local Sub-Total	307,450	310,150 (0.9%)	--	--	--	--	--
Alameda	1,462,900	1,486,600 (1.6%)	34.5	49.1 / 50.9	48.8	19.0	55,946
Contra Costa	965,100	981,600 (1.7%)	36.4	48.8 / 51.2	65.5	17.7	63,675
El Dorado	161,600	163,600 (1.2%)	39.4	49.9 / 50.1	89.7	9.3	51,484
Lake	59,500	60,300 (1.3%)	42.7	49.4 / 50.6	86.2	11.4	29,627
Marin	248,100	249,900 (0.7%)	41.3	49.5 / 50.5	84.0	11.1	71,306
Mendocino	87,100	87,700 (0.7%)	38.9	49.7 / 50.3	80.8	16.5	35,996
Napa	126,600	128,000 (1.1%)	38.3	49.9 / 50.1	80.0	23.7	51,738
Placer	254,900	264,900 (3.9%)	38.0	49.1 / 50.9	88.6	9.7	57,535
Plumas	20,850	21,000 (0.7%)	44.2	49.9 / 50.1	91.8	5.7	36,351
Sacramento	1,247,800	1,279,900 (2.6%)	33.8	49.0 / 51.0	64.0	16.0	43,816
San Francisco	785,700	793,600 (1.0%)	36.5	50.8 / 49.2	49.7	14.1	55,221
San Mateo	712,400	717,000 (0.6%)	36.8	49.4 / 50.6	59.5	21.9	70,819
Santa Clara	1,697,800	1,719,600 (1.3%)	34.0	50.7 / 49.3	53.8	24.0	74,335
Shasta	166,700	169,200 (1.5%)	38.9	48.7 / 51.3	89.3	5.5	34,335
Solano	398,600	405,800 (1.8%)	33.9	50.4 / 49.6	56.4	17.6	54,099
Sonoma	464,300	471,000 (1.4%)	37.5	49.2 / 50.8	81.6	17.3	53,076
Sutter	80,100	81,900 (2.2%)	34.1	49.5 / 50.5	67.5	22.2	38,375
Trinity	13,000	13,100 (0.8%)	44.6	51.0 / 49.0	88.9	4.0	27,711
Yolo	171,800	176,300 (2.6%)	29.5	48.9 / 51.1	67.7	25.9	40,769
Yuba	60,900	61,000 (0.2%)	31.4	50.4 / 49.6	70.6	17.4	30,460
Regional Sub-Total	9,185,750	9,332,000 (1.6%)	--	--	--	--	--
TOTAL	9,493,200	9,642,150 (1.6%)	--	--	--	--	--

[1] DOF – Table E-1 (rounded); as of January 1, 2001/2002

[2] DOF – Table E-5a (not rounded); as of January 2002

[3] 2000 Census Data, U.S. Census Bureau 2002

[4] Caucasian of any nationality. Therefore, a Caucasian born in a Latin American country may also be considered Latino and double counted by the Census Bureau in two categories.

[5] Represents individuals of Hispanic or Latino origin of any race; therefore, can include Caucasians, Asians, etc.

Source: EDAW 2003

Table 4.1-7. Population Projections for the Study Area Counties

	Year				
County	**2002 [1]**	**2005 [2]**	**2010 [2]**	**2015 [2]**	**2020 [2]**
Butte	207,000 (0.8%)	235,000 (4.3%)	259,800 (2.0%)	281,200 (1.6%)	308,900 (1.9%)
Colusa	19,450 (1.6%)	24,200 (7.5%)[3]	29,200 (3.8%)[3]	33,900 (3.0%)[3]	39,200 (2.9%)[3]
Glenn	26,800 (0.0%)	31,800 (5.8%)	36,700 (2.9%)	41,300 (2.4%)	46,500 (2.4%)
Tehama	56,900 (1.4%)	56,700 (-0.1%)	71,500 (4.7%)	78,200 (1.8%)	85,100 (1.7%)
Sub-Total	310,150	347,700 (3.9%)	397,200 (2.7%)	434,600 (1.8%)	479,700 (2.0%)
Alameda	1,486,600	1,580,200 (2.1%)	1,671,200 (1.1%)	1,735,800 (0.8%)	1,811,800 (0.9%)
Contra Costa	981,600	1,021,400 (1.3%)	1,071,400 (1.0%)	1,108,100 (0.7%)	1,152,900 (0.8%)
El Dorado	163,600	187,000 (4.6%)	212,000 (2.5%)	232,900 (1.9%)	252,900 (1.7%)
Lake	60,300	69,200 (4.7%)	77,600 (2.3%)	84,400 (1.7%)	93,000 (2.0%)
Marin	249,900	257,600 (1.0%)	263,500 (0.5%)	267,300 (0.3%)	273,800 (0.5%)
Mendocino	87,700	95,500 (2.9%)	103,200 (1.6%)	109,700 (1.2%)	116,700 (1.2%)
Napa	128,000	135,700 (2.0%)	143,900 (1.2%)	150,500 (0.9%)	158,400 (1.0%)
Placer	264,900	298,500 (4.1%)	339,300 (2.6%)	373,400 (1.9%)	406,900 (1.7%)
Plumas	21,000	21,900 (1.4%)	22,700 (0.7%)	23,100 (0.3%)	23,500 (0.3%)
Sacramento	1,279,900	1,368,500 (2.3%)	1,486,500 (1.7%)	1,591,100 (1.4%)	1,707,600 (1.4%)
San Francisco	793,600	793,500 (0.0%)	787,500 (-0.2%)	765,900 (-0.6%)	755,800 (-0.3%)
San Mateo	717,000	765,800 (2.2%)	794,600 (0.7%)	809,100 (0.4%)	834,500 (0.6%)
Santa Clara	1,719,600	1,867,400 (2.8%)	1,987,800 (1.3%)	2,063,000 (0.7%)	2,163,000 (1.0%)
Shasta	169,200	185,700 (3.2%)	203,500 (1.8%)	217,500 (1.3%)	231,000 (1.2%)
Solano	405,800	444,100 (3.1%)	485,500 (1.8%)	521,200 (1.4%)	559,500 (1.4%)
Sonoma	471,000	514,200 (3.0%)	557,300 (1.6%)	591,900 (1.2%)	628,400 (1.2%)
Sutter	81,900	90,400 (3.3%)	99,600 (2.0%)	107,200 (1.5%)	115,600 (1.5%)
Trinity	13,100	13,800 (1.8%)	14,400 (0.9%)	15,000 (0.8%)	15,400 (0.5%)
Yolo	176,300	188,600 (2.3%)	205,000 (1.7%)	219,500 (1.4%)	236,400 (1.5%)
Yuba	61,000	66,000 (2.7%)	71,400 (1.6%)	76,300 (1.3%)	81,900 (1.4%)
Sub-Total	9,332,000	9,965,000 (2.2%)	10,597,900 (1.2%)	11,062,900 (0.9%)	11,619,000 (1.0%)
TOTAL	9,642,150	10,312,700 (2.3%)	10,995,100 (1.3%)	11,497,500 (0.9%)	12,098,700 (1.0%)

[1] DOF - Table E-1 (rounded); as of January 1, 2001/2002

[2] DOF; Interim County Population Projections

[3] Figures in parenthesis show average annual compound growth rate from the previous period

Source: EDAW 2003

Table 4.1-3. Age Characteristics of Outdoor Recreators in the Study Area

Study Area	Age Group (percent)					
	Less than 26 years	26-30 years	31-40 years	41-50 years	51-64 years	65 + years
Local Area	9.3	5.6	31.5	29.6	18.5	5.6
Regional Area	12.2	11.3	30.1	22.3	16.1	8.0
TOTAL	12.0	10.8	30.3	22.9	16.3	7.8

Source: DPR 1998

Table 4.1-4. Education Level Characteristics of Outdoor Recreators in the Study Area

Study Area	Education Level (percent)				
	Less than high school	High school graduate	Some college/trade school	College/trade school grad	Graduate degree or some graduate level education
Local Area	12.7	15.9	42.9	15.9	12.7
Regional Area	4.8	16.6	30.8	31.8	16.0
TOTAL	5.5	16.5	31.8	30.5	15.8

Source: DPR 1997

Table 4.1-5. Race/Ethnic Background of Outdoor Recreators in the Study Area

Study Area	Ethnicity (percent)							
	Caucasian / White	Mexican-American	Other Hispanic	African-American	Asian	American Indian	Other	Mixed
Local Area	79.4	14.3	1.6	--	--	1.6	--	3.2
Regional Area	68.6	7.0	2.1	4.5	4.3	1.0	3.5	8.9
TOTAL	69.5	7.7	2.0	4.2	3.9	1.1	3.2	8.5

Source: CIC 1997

Table 4.1-6. Household Income Characteristics of Outdoor Recreators in the Study Area

Study Area	Income Level (percent)					
	Under $20,000	$20,000 to $29,999	$30,000 to $39,999	$40,000 to $49,999	$50,000 to $74,999	$75,000 or more
Local Area	30.2	20.8	18.9	13.2	13.2	3.8
Regional Area	16.5	11.5	13.3	13.1	21.7	24.0
TOTAL	17.6	12.3	13.7	13.1	20.9	22.3

Source: DPR 1997

Table 4.2-1. 1980 Study Participants Activity Participation Reports

Activities Reported in Survey	River Section in 1980 DWR Study			Total %
	Diversion Dam to Hamilton City Bridge %	Hamilton City Bridge to Chico Landing %	Chico Landing to Meridian Bridge %	
Relaxing	53	42	52	49
Fishing	46	45	50	47
Power boating	19	19	63	34
Camping	42	0	48	30
Canoeing	54	3	13	23
Tubing	27	15	24	22
Swimming/beach use	38	0	29	22
Picnicking	14	13	18	15
Special events	13	11	0	8
Sightseeing	0	0	12	4

Source: DWR 1982

Table 4.2-2. 1980 DWR Study Participants' Trip Characteristics

Trip Characteristics	River Section in 1980 DWR Study		
	Diversion Dam to Hamilton City Bridge %	Hamilton City Bridge to Chico Landing %	Chico Landing to Meridian Bridge %
Sacramento River is destination	77	90	81
On trip in route elsewhere	13	4	15
Staying nearby	20	6	4

Source: DWR 1982

Table 4.2-3. 1980 DWR Study – Overnight vs. Day Use

Overnight Stay vs. Day Use	River Section in 1980 DWR Study		
	Diversion Dam to Hamilton City Bridge %	Hamilton City Bridge to Chico Landing %	Chico Landing to Meridian Bridge %
Overnight	48	9	48
Day use	52	91	52

Source: DWR 1982

Table 4.2-4. 1980 DWR Study Participants' Reports of Length of Stay in Sacramento River Area

Length of Stay	River Section in 1980 DWR Study		
	Diversion Dam to Hamilton City Bridge	Hamilton City Bridge to Chico Landing	Chico Landing to Meridian Bridge
Average overnight stay (days)	3	4	3.7
Average length of day use (hours)	3.9	3.4	4.2

Source: DWR 1982

Table 4.2-5. Priority Public Uses in DPR 1997 Study

Activity	Percent Partic.	Rank	Activity	Percent Partic.	Rank
Walking (recreational)	90.1	1	**Power boating**	**24.7**	**22T**
Visiting museums, historic sites	81.5	2	Mountain biking (off paved surfaces)	22.4	24
Beach activities	75.5	3	Downhill skiing	21.9	25
Trail hiking	73.1	4	Golf	18.5	26
Driving for pleasure	72.1	5	Saltwater fishing	18.5	27
Picnicking at developed sites	**71.5**	**6**	Basketball	18.2	28
Use of open grass or turf areas	71.3	7	Water skiing	17.0	29
Visiting zoos and arboretums	70.7	8	Tennis	16.9	30
Attending outdoor cultural events	62.7	9	Skateboarding and rollerblading	14.8	31
Camping in developed sites (tent or RV)	**61.5**	**10**	4-Wheel drive use off paved roads	13.9	32
Swimming in lakes/rivers/ocean	**61.0**	**11**	Horseback riding	13.8	33
General nature study, wildlife viewing	**59.4**	**12**	Target shooting	13.8	34
Attending outdoor sports events	54.2	13	Mountain climbing	12.0	35
Swimming in outdoor pools	53.5	14	Soccer	11.4	36
Bicycling (on paved surfaces)	49.2	15	Cross-country skiing	9.9	37
Freshwater fishing	**39.8**	**16**	Football	8.6	38
Use of play equipment, tot-lots	37.2	17	**Hunting**	**8.0**	**39**
Camping–primitive areas & backpacking	**30.7**	**18**	Use of motorcycles, ATV's, off-road	7.7	40
Jogging and running	29.9	19	Sailboating and windsurfing	7.1	41
Softball and baseball	29.0	20	Surfing	4.0	42
Other non-mechanized winter sports	28.5	21	Snowmobiling	3.7	43
Kayaking, rowboating, canoeing	24.7	22T			

Bold type indicates a priority public use or closely associated activity.
T = Tie in ranking

Source: DPR 1998

Table 4.2-6. Level of Participation in Recreation Activities during the Previous 12 Months

Activity	Ave. # of days	Rank	Activity	Ave. # of days	Rank
Walking (recreational)	83.56	1	Attending outdoor cultural events	4.22	23
Driving for pleasure	29.65	2	Visiting zoos and arboretums	3.87	24
Bicycling (on paved surfaces)	23.38	3	Basketball	3.86	25
Use of open grass or turf areas	22.19	4	Horseback riding	3.05	26
Jogging and running	21.15	5	**Camping - primitive areas & backpacking**	**2.90**	**27**
General nature study, wildlife viewing	**19.35**	**6**	Soccer	2.78	28
Swimming outdoor pools	15.80	7	4-Wheel drive use off paved roads	2.67	29
Use of play equipment, tot-lots	15.31	8	Water skiing	2.26	30
Trail hiking	14.46	9	Target shooting	2.17	31
Beach activities	13.38	10	Saltwater fishing	2.04	32
Swimming in lakes/rivers/ocean	**9.11**	**11**	Downhill skiing	1.85	33
Visiting museums, historic sites	7.76	12	Other non-mechanized winter sports	1.80	34
Picnicking at developed sites	**7.57**	**13**	Kayaking, rowboating, canoeing	1.73	35
Camping developed sites	**7.28**	**14**	Use of motorcycles, ATVs, off-road	1.68	36
Attending outdoor sports events	7.19	15	Mountain climbing	1.46	37
Softball and baseball	6.59	16	**Hunting**	**1.35**	**38**
Freshwater fishing	**6.43**	**17**	Sailboating and windsurfing	0.74	39
Skateboarding and rollerblading	5.12	18	Cross-country skiing	0.63	40
Golf	4.99	19	Surfing	0.55	41
Mountain biking (off paved surfaces)	4.87	20	Football	0.51	42
Power boating	**4.51**	**21**	Snowmobiling	0.32	43
Tennis	4.25	22			

Bold type indicates a priority public use or closely associated activity.
Source: DPR 1998

Table 4.2-7. Comparison of Outdoor Recreators' Participation in Recreation Activities Across Geographic Sub-Areas

Recreation Activity	Percent of Participants				
	Local Area	Adjacent Counties	SACOG Region	SF Bay/ Delta	Total Study Area
Hunting	17.2	18.7	5.9	3.3	8.0
Freshwater Fishing	48.3	44.4	47.1	34.8	39.8
General Nature Study	62.1	59.7	52.9	60.8	59.4
Power Boating	44.8	30.2	17.6	21.5	24.7
Swimming (lakes/rivers/ocean)	72.4	66.1	58.8	58.0	61.0
Picnicking at Developed Sites	75.9	64.5	58.6	74.0	71.5
Camping at Developed Sites	65.5	61.3	56.9	62.2	61.5
Camping at Primitive Sites	31.0	31.7	33.3	29.4	30.7

Source: DPR 1998

Table 4.2-8. Study Area Survey Respondents Use of Outdoor Recreation Setting Types

Area Type	Level of Use by % of Respondents					
	Not At All	Once or Twice/ Year	Several Times/ Year	Once or Twice/ Month	Once Per Week	At Least 2-3 Times/ Week
Natural and undeveloped areas (large areas in a natural or nearly natural condition, with few developments)	7.4	27.9	37.4	13.8	7.4	6.1
Developed nature-oriented parks and recreation areas (with picnic areas, trails, information centers)	4.3	18.4	45.4	18.7	8.3	4.9
Highly developed parks and recreation areas in or near urban areas	7.6	20.8	27.5	21.7	14.4	8.0
Historical or cultural buildings, sites, or areas	8.6	37.1	39.6	11.3	1.2	2.1
Private outdoor recreation areas and facilities	20.9	29.8	24.5	9.8	8.0	7.1

Source: DPR 1998

Table 4.2-9. Factors Influencing Enjoyment of Most Important Activity

Factor	Percent of Responses		
	Not Important	Somewhat Important	Very Important
Being in the outdoors	2.5	10.1	87.4
Relaxing	2.8	19.9	77.3
Beauty of the area	2.5	20.8	76.7
Quality of the natural setting	3.2	21.5	75.4
Releasing or reducing tension	2.2	26.1	71.7
Being with family and friends	11.7	18.6	69.7
Having a change from the daily routine	6.6	25.6	67.7
Getting away from crowded situations	5.1	28.5	66.5
Keeping fit and healthy	9.5	25.7	64.8
Feeling in harmony with nature	10.2	26.0	63.8
Availability of facilities	8.2	29.7	62.0
Doing something your youth enjoyed	27.5	17.6	54.9
Achieving spiritual fulfillment	25.8	32.5	41.7
Experiencing challenge and excitement	25.1	33.6	41.4
Meeting new people	52.7	31.3	16.0

Source: DPR 1998

Table 4.2-10. Changes in Time Spent on Outdoor Activities by Study Area Residents (5 years ago)

Study Area	Amount of Time			
	More	Same	Less	Don't Know
Local Area	39.1	25.0	35.9	0.0
Regional Area	36.7	31.5	31.8	0.0
TOTAL	36.9	30.9	32.1	0.0

Source: DPR 1998

Table 4.2-11. Estimates of Participation and Projected Indexes of Change for Wildlife Related Activities, 1995-2040

Activity	Baseline	Projected Index of Change by Year				
	1995	2000	2010	2020	2030	2040
Fishing						
Days	119.10 [1]	1.05	1.16	1.25	1.33	1.40
Participation	7.50 [2]	1.05	1.12	1.20	1.23	1.30
Hunting						
Days	36.00 [1]	0.94	0.95	0.96	0.95	0.88
Participation	1.70 [2]	0.94	0.85	0.79	0.73	0.67
Nature Observation						
Days	838.50 [1]	1.10	1.33	1.58	1.82	2.01
Participation	16.70 [2]	1.08	1.23	1.37	1.52	1.65

[1] Millions of participant days.
[2] Millions of participating persons.
Source: Cordell, et al., 1999.

Table 4.3-1. Management Interview Categories

Category	Number of interviews
Federal land management agency	3
State land management agency	6
Non-profit land trust	2
Total	11

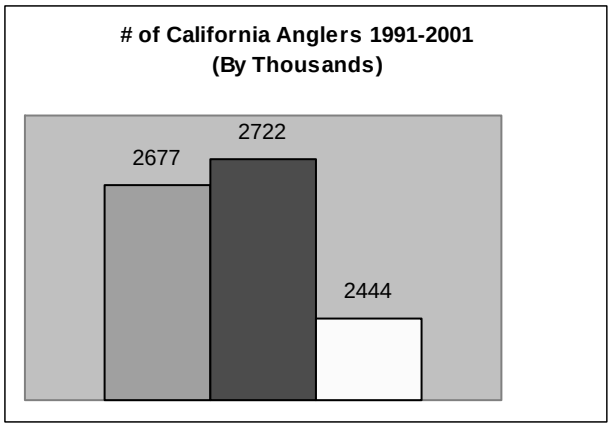
Source: EDAW 2003

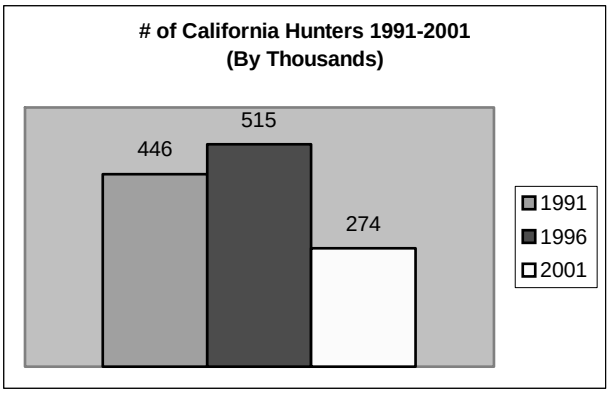
1991-2001 Survey Comparisons

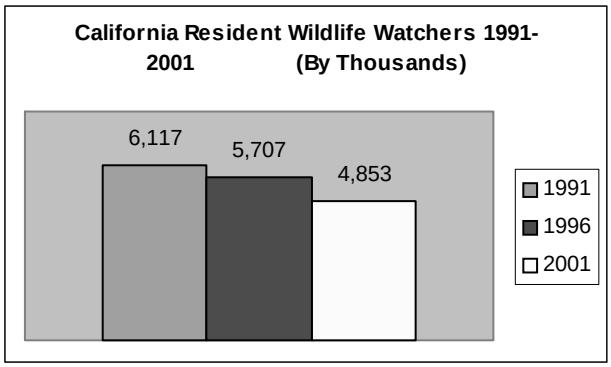
California 1991 and 2001 Comparison

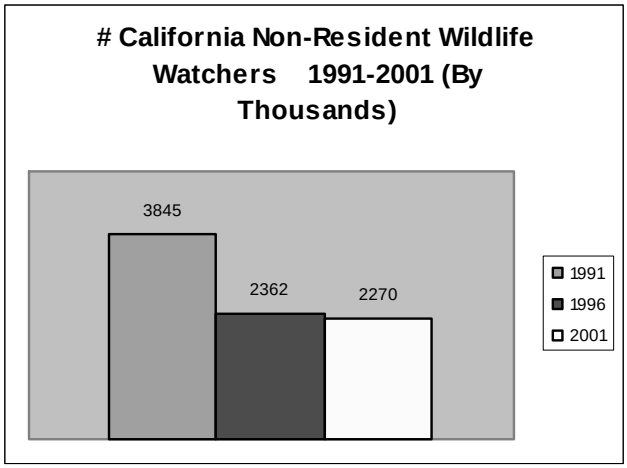
	1991	2001	Percent change
Fishing			
(Numbers in thousands)			
Anglers in-state	2,67	2,444 *	
Days in-state	23,994	27,663 *	
In-state trip-related expenditures	$1,078,873	$1,116,707 *	
State resident anglers	2,707	2,389	–12
Total expenditures by state residents	$2,334,734	$2,149,634 *	
Hunting			
(Numbers in thousands)			
Hunters in-	446	274	–39
Days in-state	5,211	3,426	–34
In-state trip-related expenditures	$140,249	$154,412 *	
State resident hunters	537	278	–48
Total expenditures by state residents	$836,095	$364,008	–56
Nonresidential Wildlife Watching			
(Numbers in thousands)			
Participants in-state	3,845	2,270	–41
Days in-state	42,353	23,807	–44
State resident participants	3,408	2,191	–36
Residential Wildlife Watching			
(Numbers in thousands)			
Total participants	6,117	4,853	–21
Observers	4,531	3,072	–32
Feeders	4,899	3,763	–23
Wildlife-Watching Expenditures			
(Numbers in thousands)			
Trip-related expenditures by state residents	$1,429,681	$832,531 *	
Total expenditures by state residents	$3,311,245	$2,234,350 *	

*No significant difference at the 0.10 level of significance.


# of California Anglers 1991-2001
(By Thousands)
2677
2722
2444


# of California Hunters 1991-2001
(By Thousands)
446
515
274
1991
1996
2001


California Resident Wildlife Watchers 1991-2001 (By Thousands)
6,117
5,707
4,853
1991
1996
2001


California Non-Resident Wildlife Watchers 1991-2001 (By Thousands)
3845
2362
2270
1991
1996
2001

California 1996 and 2001 Comparison

U.S. Fish & Wildlife Service—California

	1996	2001	Percent change
Fishing			
(Numbers in thousands)			
Anglers in-	2,722	2,444 *	
Days in-state	36,914	27,663	–25
In-state trip-related expenditures	$1,632,823	$1,116,707	–32
State resident anglers	2,721	2,389 *	
Total expenditures by state residents	$4,189,242	$2,149,634	–49
Hunting			
(Numbers in thousands)			
Hunters in-	515	274	–47
Days in-state	7,452	3,426	–54
In-state trip-related expenditures	$301,217	$154,412	–49
State resident hunters	578	278	–52
Total expenditures by state residents	$1,144,663	$364,008	–68
Nonresidential Wildlife Watching			
(Numbers in thousands)			
Participants in-state	2,362	2,270 *	
Days in-state	24,587	23,807 *	
State resident participants	2,391	2,191 *	
Residential Wildlife Watching			
(Numbers in thousands)			
Total participants	5,707	4,853	–15
Observers	4,306	3,072	–29
Feeders	4,336	3,763 *	
Wildlife-Watching Expenditures			
(Numbers in thousands)			
Trip-related expenditures by state residents	$1,529,728	$832,531	–46
Total expenditures by state residents	$2,880,151	$2,234,350 *	

*No significant difference at the .10 level of significance.

TABLE 2-1
FACILITIES AMENITIES MATRIX BY RIVER MILE

Subreach	River Mile #	SITE NAME	OWNER	AC.	ACCESS: Public Use Allowed	Mode of Access: Public Road	Mode of Access: River (RL)	Mode of Access: River (RR)	Facility Signage: Entrance	Facility Signage: Directional	Facility Signage: Facility Rules	Facility Signage: Services	Boating Facilities: Marina	Boating Facilities: Ramp(s)	Boating Facilities: Carry-in	Boating Facilities: Boat Dock/Landing	On-Site Parking: Asphalt Lot	On-Site Parking: Gravel Lot	On-Site Parking: Boat trailor Parking	On-Site Parking: Dirt Lot	Pedestrian Access: ADA Accessible	Pedestrian Access: Paved Walks	Pedestrian Access: Unpaved Walks/Trails	Overnighting (R=Reservable/ NR=Non-reservable): Tent sites	Overnighting: Tent/Trailer Sites	Overnighting: RV Sites	Overnighting: Group Camps	Overnighting: Cabins	Water: Potable Water	Water: Drinking Fountains	Picnic sites: Picnic Tables	Picnic sites: Picnic Shelters	Picnic sites: BBQ Grills/Pits	Picnic sites: Informal/Tree shaded	Toilet Facilities: Flush toilets & sinks	Toilet Facilities: Porta-potties	Toilet Facilities: None	Other Amenities: Showers	Other Amenities: Public Phones	Other Amenities: Store/Bar/Restaurant	Recreation Uses: Fishing	Recreation Uses: Hiking	Recreation Uses: Hunting	Recreation Uses: Wildlife Observation
Red Bluff/Los Molinos	243	Lake Red Bluff Recreation Area	USFS	~488	✓	✓		✓	✓	✓	✓			2				✓	✓		✓	✓	✓		30/NR		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓
	242	Altube Island	BOR					✓																													✓							
	239.5	Blackberry Island	USFWS	36																																								
	238	Todd Island	BLM	~125				✓																													✓							
	238	La Barranaca Unit	USFWS	1067																																								
	236	Mooney Unit	USFWS	344																																								
	235	Hunter's Resort	Private	~12	✓	✓	✓		✓				✓	✓		✓			✓						10				✓		✓				✓									✓
	234	Ohm Unit	USFWS	750																																								
	232	Flynn Unit	USFWS	552																																								
	231.5	North Mill Creek Fishing Access	Tehama Co.	3	✓	✓	✓													✓			✓														✓				✓			✓
	239.5	Blackberry Island	USFWS	40																																								
	229.7	Hidden Harbor Marina & RV Park	Private	8.86	✓	✓	✓		✓				✓	✓		✓			✓						31				✓		✓				✓					✓	✓			✓
	229.5	Mill Creek Park Launching Facility	Tehama Co.	51	✓	✓	✓		✓					✓			✓		✓										✓		✓	✓	✓		✓	✓								
	229.5	Driftwood RV Fishing Resort	Private	~6	✓	✓	✓		✓							✓		✓							30		✓		✓		✓				✓			✓			✓			✓
	229.5	River's Rest Resort	Private	~2	✓	✓	✓		✓							✓		✓							32			✓	✓		✓				✓						✓			✓
Woodson Bridge	228	Heron Island Unit	USFWS	116																																								
	221	Kopta Slough	SLC	700																																								
	218.5	Woodson Bridge SRA	DPR	325	✓	✓			✓	✓	✓						✓				✓		✓		35/R		✓		✓	✓	✓		✓	✓	✓			✓	✓		✓	✓		✓
	218	Tehama County River Park	Tehama Co.	14	✓	✓	✓		✓					✓			✓				✓	✓							✓	✓	✓	✓	✓	✓	✓						✓	✓		✓
	218	Woodson Bridge RV Park	DPR	~12	✓	✓	✓		✓							✓		✓	✓						120				✓		✓		✓		✓			✓		✓				✓
	217	Foster Island	BLM	222				✓																													✓							
	216.5	Rio Vista Unit	USFWS	1202																																								
	214	Merrill's Landing Unit	DFG	172	✓	✓	✓																														✓				✓	✓	✓	✓
	209	Dicus Slough Unit	DFG	1712	✓		✓																														✓				✓	✓	✓	✓
Chico Landing	203	Wilson's Landing Unit	DFG	285	✓			✓																													✓				✓	✓	✓	✓
	202	McIntosh Landing North	USFWS	60																																								
	201	McIntosh Landing South	USFWS	71																																								
	200	Irvine Finch River Access	DPR		✓	✓		✓	✓	✓	✓			✓			✓		✓		✓		✓		6/NR				✓	✓	✓		✓		✓						✓	✓		✓
	199	Harley	TNC	103		✓																																						
	199	Sunset Ranch	TNC	111		✓	✓																																					
	198.5	Pine Creek Unit	USFWS	435																																								
	198	Vereschagen	TNC	177		✓		✓																																				
	197	Bratten	TNC	83																																								
	197	Gunhill	TNC	64																																								
	197	Kaplan	TNC	102																																								
	196.5	Pine Creek Landing	DPR		✓	✓	✓		✓		✓			✓				✓	✓												✓			✓		✓					✓			✓
	196.5	Scotty's Boat Landing (lease)	Private	~2	✓	✓	✓		✓					✓					✓	✓				✓		✓			✓		✓				✓				✓	✓	✓			
	196	Site near Pine Creek Landing	RB	~50																																								
	196	Pine Creek Unit	DFG	1060	✓	✓	✓	✓																													✓				✓	✓	✓	✓
	195.5	Indian Fishery/Chico Landing	DPR		✓	✓	✓		✓		✓							✓			✓		✓	✓							✓			✓		✓					✓	✓		✓
	194	Rx Ranch	TNC	262		✓																																						
	193.5	Capay Unit	USFWS	666																																								
	193.2	Big Chico Creek Day-use Area	DPR	~260	✓	✓	✓		✓		✓				✓					✓			✓													✓					✓	✓		✓
	192.5	Site 32F (Instr. #960756)	RB	33.7																																					✓			
	191	Phelan Island	USFWS	308																																								
	191	Sacramento River Parcel	RB	33.3				✓																																	✓			✓
	190.5	Murphy's Slough/Golden State Is.	RB	659																																								
	190	Sam's Slough	RB	70.2																																								
	187	Shannon Slough Unit	DFG	150	✓	✓		✓																													✓				✓	✓	✓	✓
	186.5	Jacinto Unit	USFWS	82			✓																																		✓		✓	✓
	186	Dead Man's Reach	USFWS	632																																								
	185	North Ord Unit	USFWS	43																																								
	184	Ord Bend Unit	USFWS	118																																								
	184	Ordbend Park	Glenn Co.	12	✓	✓		✓	✓	✓	✓			✓			✓					✓								✓	✓		✓		✓						✓			✓
	182.5	Ord Bend Unit	DFG	112	✓			✓																													✓				✓	✓	✓	✓
	182	South Ord Unit	USFWS	122																																								
	180.5	Jacinto Unit	DFG	283	✓			✓																													✓				✓	✓	✓	✓
	178.2	Site 85F (B808 P72 S 43)	RB	73.3				✓																																	✓			
Beehive Bend	177	Llano Seco Unit	USFWS	907																																								
	174.5	Oxbow Unit	DFG	94	✓			✓																													✓				✓	✓	✓	✓
	172	Site 86F	RB	29				✓																																	✓			
	172	Site 78F (B795 P140 S 67)	RB	122				✓																																	✓			
	172	Site 79F (B807 P293 S67)	RB	36				✓																																	✓			
	170.5	Site 86F (B807 P293 S 67)	RB	29			✓																																		✓			
	170	Beehive Bend	DFG	216	✓																																✓				✓	✓	✓	✓
	170	Site 79F (B795 P135 S67)	RB	122				✓																																	✓			
	169	Sul Norte Unit	USFWS	600																																								
	169	Butte City Launch Facilities	Glenn Co.	2	✓	✓	✓		✓	✓	✓			✓			✓													✓	✓					✓					✓			
	168	Packer Lake Unit	USFWS	375	✓	✓		✓							✓					✓																					✓			✓
	168	Codora Unit	USFWS	394																																								
Colusa	164	Princeton Unit North	DFG	102	✓	✓		✓												✓																	✓				✓	✓	✓	✓
	163	Drumheller Slough	USFWS	200																																								
	163	Princeton Unit East	DFG	551	✓	✓	✓													✓																	✓				✓	✓	✓	✓
	162	Princeton Unit South	DFG	150	✓			✓																													✓				✓	✓	✓	✓
	159	Stegemen Unit	DFG	154	✓			✓																													✓				✓	✓	✓	✓
	156.7	Moulton Unit North	DFG	106	✓		✓																														✓				✓	✓	✓	✓
	155	Moulton Unit South	DFG	131	✓			✓																													✓				✓	✓	✓	✓
	146.5	Colusa Unit North	DFG	119	✓			✓																													✓				✓	✓	✓	✓
	146.2	Beach at SRWA Colusa Unit	RB	50				✓																																	✓			✓
	145.9	Cobb's Bend (island)	RB	35			✓																																		✓			✓
	145.5	Cruise n' Tarry Marina	RB	22.2	✓	✓	✓							✓						✓																					✓			✓
	145.5	Ward	TNC	238				✓																																				
	145	Colusa-Sacramento River SRA	DPR	67	✓	✓		✓	✓	✓	✓			1			✓		✓		✓	✓	✓		14/R		✓		✓	✓	✓		✓	✓	✓			✓	✓		✓	✓		✓
	145	Colusa Unit South	DFG	45	✓		✓																														✓				✓	✓	✓	✓
	144	Colusa Levee Scenic Park	Colusa City	2.19	✓	✓		✓	✓		✓											✓								✓	✓		✓	✓							✓			✓
	142	Bert's Steelhead Marina	Private	~1	✓	✓	✓		✓							✓	✓									✓			✓		✓				✓					✓	✓			

TABLE 2-2
FACILITIES AMENITIES MATRIX BY AGENCY/OWNER

River Mile #	SITE NAME	AC.	ACCESS			SITE AMENITIES & USES																																						SITE CHARACTERISTCS										
			Mode of Access			Facility Signage				Boating Facilities				On-Site Parking				Pedestrian Access			Overnighting (R=Reservable/ NR=Non-reservable)					Water		Picnic sites				Toilet Facilities				Other Amenities			Recreation Uses					Shore Characteristics							User Impacts			
			Public Use Allowed	Public Road	River	Entrance	Directional	Facility Rules	Services	Marina	Ramp(s)	Carry-in	Boat Dock/Landing	Asphalt Lot	Gravel Lot	Boat trailor Parking	Dirt Lot	ADA Accessible	Paved Walks	Unpaved Walks/Trails	Tent sites	Tent/Trailer Sites	RV Sites	Group Camps	Cabins	Potable Water	Drinking Fountains	Picnic Tables	Picnic Shelters	BBQ Grills/Pits	Informal/Tree shaded	Flush toilets & sinks	Pit/Chemical Toilets	Porta-potties	None	Showers	Public Phones	Store/Bar/Restaurant	Fishing	Hiking	Hunting	Passive Recreation	Wildlife Observation	Steep/Cut Embankment	Sandy Beach	Grassy/tule	Shrubby	Undercut	Overhanging Shrubs	Overhanging Trees	High	Moderate	Light	None Evident
	Federal Facilities																																																				
	BUREAU OF RECLAMATION																																																				
242	Altube Island				✓																													✓																			
	BUREAU OF LAND MGT																																																			
217	Foster Island	222			✓																													✓																			
238	Todd Island	~125			✓																													✓																			
	FISH & WILDLIFE SERVICE																																																			
	Sacramento River National Wildlife Refuge																																																				
239.5	*Blackberry Island*	36																																																		
193.5	*Capay Unit*	666																																																		
168	*Codora Unit*	394																																																		
186	*Dead Man's Reach*	632																																																		
163	*Drumheller Slough*	200																																																		
232	*Flynn Unit*	552																																																		
228	*Heron Island Unit*	116																																																		
186.5	*Jacinto Unit*	82																																																		
238	*La Barranaca Unit*	1067																																																		
177	*Llano Seco Unit*	907																																																		
202	*McIntosh Landing North*	60																																																		
201	*McIntosh Landing South*	71																																																		
236	*Mooney Unit*	344																																																		
184	*North Ord Unit*	43																																																		
234	*Ohm Unit*	750																																																		
184	*Ord Bend Unit*	118																																																		
168	*Packer Lake Unit*	375	✓	✓								✓					✓																					✓				✓				✓						✓	
191	*Phelan Island*	308																																																		
198.5	*Pine Creek Unit*	435																																																		
216.5	*Rio Vista Unit*	1202																																																		
182	*South Ord Unit*	122																																																		
169	*Sul Norte Unit*	600																																																		
	FOREST SERVICE																																																			
243	Lake Red Bluff Recreation Area	~488	✓	✓	✓	✓	✓	✓			✓				✓	✓		✓	✓	✓		30/NR		✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓		✓		✓		✓	✓							✓	✓		
	State Facilities																																																			
	DEPT. OF PARKS & RECREATION																																																			
	Bidwell-Sacramento River SRA	243																																																		
193.2	*Big Chico Creek Day-use Area*		✓	✓	✓	✓		✓				✓					✓			✓														✓					✓	✓			✓	✓	✓				✓	✓		✓		
195.5	*Indian Fishery/Chico Landing*		✓	✓	✓	✓		✓							✓			✓		✓									✓			✓			✓					✓	✓			✓	✓			✓					✓		
200	*Irvine Finch River Access*		✓	✓	✓	✓	✓	✓			✓			✓		✓		✓		✓		6/NR					✓	✓	✓		✓		✓							✓	✓			✓	✓			✓		✓	✓		✓		
196.5	*Pine Creek Landing*		✓	✓	✓	✓		✓			✓				✓	✓													✓			✓			✓					✓				✓	✓				✓				✓		
145	Colusa-Sacramento River SRA	67	✓	✓	✓	✓	✓	✓			✓			✓		✓		✓	✓	✓		14/R		✓		✓	✓	✓		✓	✓	✓				✓	✓		✓	✓			✓	✓								✓		
218.5	Woodson Bridge SRA	325	✓	✓	✓	✓	✓	✓						✓				✓		✓		35/R		✓		✓	✓	✓		✓	✓	✓				✓	✓		✓	✓			✓	✓								✓		
	DEPT. OF FISH & GAME																																																			
	Sacramento River Wildlife Area																																																			
170	*Beehive Bend*	216	✓																															✓				✓	✓	✓	✓	✓		✓									✓
146.5	*Colusa Unit North*	119	✓		✓																													✓				✓	✓	✓	✓	✓	✓	✓									
145	*Colusa Unit South*	45	✓		✓																													✓				✓	✓	✓	✓	✓	✓	✓									✓
209	*Dicus Slough Unit*	1712	✓		✓																													✓				✓	✓	✓	✓	✓		✓									
180.5	*Jacinto Unit*	283	✓		✓																													✓				✓	✓	✓	✓	✓	✓	✓									✓
214	*Merrill's Landing Unit*	172	✓	✓	✓																													✓				✓	✓	✓	✓	✓		✓									
156.7	*Moulton Unit North*	106	✓		✓																													✓				✓	✓	✓	✓	✓	✓										
155	*Moulton Unit South*	131	✓		✓																													✓				✓	✓	✓	✓	✓	✓	✓					✓				✓
182.5	*Ord Bend Unit*	112	✓		✓																													✓				✓	✓	✓	✓	✓		✓		✓						✓	
174.5	*Oxbow Unit*	94	✓		✓																													✓				✓	✓	✓	✓	✓	✓					✓	✓				✓
194-8	*Pine Creek Unit*	1060	✓	✓	✓																													✓				✓	✓	✓	✓	✓		✓								✓	
163	*Princeton Unit North*	102	✓	✓	✓												✓																	✓				✓	✓	✓	✓	✓	✓	✓								✓	
164	*Princeton Unit East*	551	✓	✓	✓																													✓				✓	✓	✓	✓	✓	✓									✓	
162	*Princeton Unit South*	150	✓		✓																													✓				✓	✓	✓	✓	✓	✓	✓									✓
187	*Shannon Slough Unit*	150	✓	✓	✓																													✓				✓	✓	✓	✓	✓	✓	✓				✓	✓				✓
159	*Stegemen Unit*	154	✓		✓																													✓				✓	✓	✓	✓	✓	✓	✓									✓
202-5	*Wilson's Landing Unit*	285	✓		✓																													✓				✓	✓	✓	✓	✓		✓		✓							✓
	RECLAMATION BOARD																																																			
146.2	Beach at SRWA Colusa Unit	50			✓																																	✓						✓									
145.9	Cobb's Bend (island)	35			✓																																	✓						✓									
145.5	Cruise n' Tarry Marina	22.2	✓	✓	✓						✓						✓																					✓					✓								✓		
190.5	Murphy's Slough/Golden State Is.	659																																																		
191	Sacramento River Parcel	33.3			✓																																						✓										
190	Sam's Slough	70.2																																				✓					✓										
196	Site near Pine Creek Landing	50			✓																																																✓
192.5	Site 32F (Instr. #960756)	33.7			✓																																	✓						✓									
178.2	Site 85F (B808 P72 S 43)	73.3			✓																																	✓					✓					✓	✓				✓
	Site 86F	29																																																		
172	Site 78F (B795 P140 S 67)	122			✓																																	✓						✓									✓
	Site 79F (B807 P293 S67)	36																																																		
170.5	Site 86F (B807 P293 S 67)	29			✓																																	✓						✓		✓							✓
170	Site 79F (B795 P135 S67)	122			✓																																	✓						✓									
	STATE LANDS COMMISSION																																																			
221	Kopta Slough	700																																																		
	County & City Public Facilities																																																			
	CITY OF COLUSA																																																			
144	Colusa Levee Scenic Park	2.19	✓	✓	✓	✓		✓											✓		✓						✓	✓		✓	✓								✓				✓	✓			✓				✓	✓		
	GLENN COUNTY																																																			
169	Butte City Launch Facilities	2	✓	✓		✓	✓	✓			✓			✓													✓	✓						✓					✓					✓			✓				✓	✓		
184	Ordbend Park	12	✓	✓	✓	✓	✓	✓			✓			✓					✓								✓	✓		✓		✓							✓				✓	✓			✓				✓			
	TEHAMA COUNTY																																																			
229.5	Mill Creek Park Launching Facility	51	✓	✓	✓	✓					✓			✓												✓	✓	✓				✓		✓																	✓	✓		
231.5	North Mill Creek Fishing Access	3	✓	✓	✓												✓			✓																			✓				✓										✓	
218	Tehama County River Park	14	✓	✓	✓	✓					✓			✓				✓	✓							✓	✓	✓	✓	✓	✓	✓													✓						✓			
	Private Facilities																																																			
	THE NATURE CONSERVANCY																																																			
197	Bratten	83																																																		✓
197	Gunhill	64																																									✓										✓
197	Kaplan	102																																									✓					✓	✓				✓
199	Harley	103		✓																																																	✓
194	Rx Ranch	262		✓																																																	✓
199	Sunset Ranch	111		✓	✓																																																✓
198	Vereschagen	177		✓	✓																																						✓										✓
145-6	Ward	238			✓																																						✓	✓									✓
	PRIVATE																																																			
142	Bert's Steelhead Marina	~1	✓	✓	✓	✓							✓	✓							✓		✓			✓		✓				✓						✓						✓			✓					✓		
229.5	Driftwood RV Fishing Resort	~6	✓	✓	✓	✓							✓		✓						✓		✓	✓		✓		✓				✓				✓							✓	✓			✓					✓		
229.7	Hidden Harbor Marina & RV Park	8.86	✓	✓	✓	✓				✓	✓		✓			✓					✓		✓			✓		✓				✓						✓					✓	✓			✓					✓		
235	Hunter's Resort	~12	✓	✓	✓	✓				✓	✓		✓			✓					✓		✓			✓		✓				✓											✓	✓			✓						✓	
229.5	River's Rest Resort	~2	✓	✓	✓	✓							✓		✓						✓		✓			✓		✓				✓											✓	✓			✓					✓		
196.5	Scotty's Boat Landing (lease)	~2	✓	✓	✓	✓					✓					✓	✓				✓		✓			✓		✓				✓					✓	✓						✓	✓						✓			
218	Woodson Bridge RV Park	~12	✓	✓	✓	✓							✓		✓	✓					✓	✓	✓			✓		✓		✓		✓				✓		✓					✓	✓	✓							✓		

Appendix O. Monitoring and Research Investigations at Sacramento River NWR and vicinity.

Project Title	Participants	Affiliation	Funding Source	Site Locations	Documents
Birds and Bird Predators	Geoff Geupel Stacy Small Joanne Gilchrist	PRBO PRBO-PhD student PRBO	Various	SRNWR	Proposals Reports Manuscripts
State transition modeling, Classification of Vegetation Communities, Red Bluff to Colusa Reach, Sacramento River, CA	Mehrey Vaghti Steven Greco Alex Fremier Jay Lee Truil	UCDavis-MS student UCDavis UCDavis-MS student UCDavis-MS student	DWR	Emphasis on river bends at Pine Creek and below Woodson Bridge; approx. 100 vegetation survey locations.	Proposals Master's Thesis
Recruitment of herbaceous species	Karen Holl Elizabeth Crone	UCSC U of Montana		Dave Jukkola has shape file	Proposals Report
Terrestrial Inverts	John Hunt	CSUC-MS student	CALFED 97-NO3	Rio Vista, plus WCB lands south, Pine creek & Phalen Island	Proposals Report
Ground water, soil development and nutrient cycling	David Brown David Wood Carey Wilder	CSUC CSUC CSUC-MS student	CSLFED 97-NO3	74387 (Brown, Wilder) 74388 (Wood, Hunt)	Proposals Reports
Salmonids, Salmonid Prey	Michael Marchetti Mike Limm	CSUC CSUC-MS student	CALFED Beehive Bend	N/A	Proposal Report
Stratigraphy, geomorphology & cottonwoods	Karin Hoover Walter Van Gronigen	CSUC CSU-MS student	CALFED Beehive Bend	Shaw Bar, RM 172 & RM 183, all on west side of river	Proposal
Evolution of backwater habitats	Matt Kondolf Herve Piegay Gundrun Bornette Ingrid Morken	UC Berkeley Nat'l Centr for Scientific Research, Lyon, FR; U Caude Bernard, Lyon, FR; UCB-MS student	TNC, DWR		Proposal
Isotopic Studies, Aquatic Food Web Dynamics, Bats	Mary Power Bruce Orr Frank Ligon Bill Rainey Dixie Pierson Sapna Khandwala	UC Berkeley Stillwater Sciences Stillwater Sciences UC Berkeley ? Stillwater Sciences	CALFED 97-NO3		Proposal Report

Project Title	Participants	Affiliation	Funding Source	Site Locations	Documents
Turtles	Dawn Wilson	CSUC	Various	Sam Slough, Murphy Slough, North of Pine Creek	Proposal Reports
Meander Migration Modeling	Eric Larsen	UC Davis	CALFED 97-NO2	RM 201-185	Proposal
Grassland Restoration	Jim Coleman Hall Cushman	Sonoma State U Sonoma State U	USFWS & Anderson Foundation	Llano Seco & Vermet Field	
Baseline Assessments of Future Restoration Sites	Jean Hubble David Wood John Hunt Matt Quinn Ryan Luster	CSUC CSUC CSUC-MS Student CSUC-MS Student TNC	TNC	Haleakala, Deadman's Reach, Capay, RX Ranch, Sunset Ranch	Proposal Reports
Grassland Restoration, Competition & Establishment	Matt Quinn Tom Griggs Dan Efseaff	CSUC CSUC	Sac River Partners	Llano Seco T4	Proposal Master's Thesis
Bird Food Identified Through Fecal Examination (feasibility study)	Scott Chamberlain Karen Holl Elizabeth Crone Aaron Gabbe Charles McClair	CSUC UCSC U of Montana UCSC UCSC	Research experience for undergraduate MSF (to Holl, Wood)	Sul Norte, Phalen Island	Proposal
Black Walnut Genetics	Paul Kirk Christina Schierenbeck	CSUC CSUC	CSUC Bio Dept		Proposal Master's Thesis
Soil Stratigraphy Mapping with Conductivity	Eileen Ernenwein Donald Sullivan	UDenver-PhD student UDenver			Proposal
Elderberry Associated Insects	Marcel Holyoak Teresa Talley	UCDavis UCDavis-post doc		Various riparian woodland sites with elderberry in the vicinity of Chico. Considered both natural and restored sites	Proposals
Pollinators	Neal Williams	Princeton U	TNC Smith Fellow		Proposal
How Management Scenarios Affect Rates of Floodplain Sedimentation, includes dating sediments with Lead-210	Michael Singer Tom Dunne	UC Berkeley UCSB	CALFED		Proposal PhD Dissertation Reports

Project Title	Participants	Affiliation	Funding Source	Site Locations	Documents
Species richness of medium-sized carnivores & riparian patch size	Earl Jeffrey Souza	CSUC	TNC	10 sites between Red Bluff & Colusa	Masters Thesis
Species-Area Relations of Breeding Birds on the Middle Sacramento River, CA	L. Breck McAlexander	CSUC			Report to TNC (1994) and Master's Thesis
Nest Site Selection & Nesting Success of the Western Wood Pewee (*Contopus sordidulus*) in the Sacramento Valley, CA	Carrie Bemis	CSUC-grad student		Sacramento River NWR, Flynn Unit & Woodson Bridge State Park	Masters Thesis Spring 1996
Fisheries Monitoring	Charles Brown David Grant	CDF&G CDF&G	CDF&G	Mouth of Stoney Creek at Phelen Island Unit	Brief Reports
Natural Process Restoration	Daryl Peterson Dave Wood	TNC CSUC	TNC	Sul Norte	Masters Thesis 2002
Survival & Growth of Valley Oaks at Restoration Sites	Tom Griggs Greg Golet	CSUC TNC	Some from TNC		Manuscript
Status of Yellow-Billed Cuckoo	Dave Gilmer Jim Snowden Steve Laymon Murrelet Halterman Gary Falxa	USGS-Dixon Kern River Research Ctr Kern River Research Ctr Kern River Research Ctr USFWS-Sacramento	USGS, USFWS	River wide	Report
Vegetation Dynamics at Restoration Sites & Remnant Riparian Sites	Dave Wood Greg Golet Ryan Luster Joe Silveira Brianna Borders Dylan Van Dyne Matt Brown	CSUC TNC TNC USFWS CSUC-MS Student CSUC-MS Student CSUC-MS Student	CALFED-Beehive Bend, TNC Fresh Water Initiative		Proposals
LaBarranca Gravel Pit Restoration Feasibility Study	Dan Efseaff Tom Griggs	CSUC Sac River Partners	AFRP grant to Sac River Partners		Proposal Report
Bank Swallow Surveys	Ron Schlorff Joe Silveira	CDF&G USFWS	CDF&G & USFWS		Annual Reports Publications

Project Title	Participants	Affiliation	Funding Source	Site Locations	Documents
Indicators of Hydrologic Alteration (IHA) Studies	Shawn Pike Stacy Cepello	DWR DWR			
Cottonwood Recruitment Pilot Study	Mike Roberts Stacy Cepello	TNC DWR	CALFED97-N02		Final Report
Current Status Report on Cottonwood Recruitment	Karin Hoover Sara Nash	CSUC CSUC	CALFED - Beehive Bend	RM 165-206 (30 sites)	Draft Report
Channel Cut-Off Investigation	Eric Larsen Laura?	UCDavis			
Sediment Mobility Study	Koll Buer	DWR	DWR		
Water Temperature Regime Study	Cindy Lowney				Ph D Dissertation
Refuge Wildlife Surveys	Joe Silveira	USFWS	USFWS		Reports Manuscripts
Soil Vegetation Associations at Llano Seco, Chico, CA	Joe Silveira Tom Griggs Dean Burkett	USFWS, SSRP, NRCS	USFWS, SRP, NRCS	Llano Seco Unit (USFWS), Llano Seco Ranch	Soils (1998)
Competitive Effects of Intercropping Alfalfa with Valley Oak & Blue Elderberry Seedlings	Jean Hubbell	CSUC		Kopta & Llano Seco	Master's Thesis
Influence of Riparian Vegetation on Water Temperature in the Sacramento River, CA	Cynthia L. Lowney	Water Resources			Report to USFWS
Sacramento River, Glenn, Butte & Tehama Counties: A Study of Vegetation, Deposition & Erosion and a Management Proposal	Thomas J. Kakremer	CSUC			Master's Thesis

Project Title	Participants	Affiliation	Funding Source	Site Locations	Documents
Monitoring Riparian Landscape Change & Modeling Habitat Dynamics of the Yellow-Billed Cuckoo on the Sacramento River, CA	Steven E. Greco	UCDavis			Ph D Dissertation
Riparian Vegetation Distribution Along the Middle Sacramento River in Relation to Flood Frequency	Stacy Cepello	CSUC			Master's Thesis
Leaf Litter Decomposition Rate	Brianna Borders David Wood James Pushnik Dave Brown	CSUC CSUC CSUC CSUC CSUC		Princeton Ferry, River Vista, Phelan Island, Pine Creek, Shaw Bar, Flynn	Master's Thesis
Sediment Transport	Koll Buer				
Bank Erosion and Meandering Studies	Koll Buer				
Human Effects on Geomorphic Processes	Koll Buer				
Effects of Dams & Diversion on the River	Koll Buer				
Hyporheic Zone (ground water, river water interactions)	Stacy Cepello Thomas Boullion				Proposal
Flows & Sediment Transport	Stillwater				
Cottonwood Root Growth Rates	Stillwater				
Processes that Create Off-Channel Habitats	Dietrich Kondolf				
Channel Substrate Comp and Permeability	Stillwater				
Frequency & Extent of Cottonwood Recruitment	USGS				

Project Title	Participants	Affiliation	Funding Source	Site Locations	Documents
Further Refinement of the Meander Migration Model	Eric Larsen				
Effects of Bank Protection on In-Channel Habitat	Kondolf				

Appendix P. Draft Integrated Pest Management Plan For Mosquito Control at the Sacramento National Wildlife Refuge Complex

The purposes of the Draft Integrated Pest Management Plan (IPM) for Mosquito Control at the Sacramento National Wildlife Refuge Complex (SNWRC) are to: 1) identify mosquito control methods and materials currently approved for use on the SNWRC; 2) identify their use in an IPM program that is consistent with the goals of the SNWRC and minimizes public health risk from refuge-harbored mosquitoes; and 3) provide long-term planning to meet the Service's goal of reducing effects of pesticide use on Department of Interior trust resources to the greatest extent possible.

Copies of the plan are available for review at the Sacramento National Wildlife Refuge Complex, 752 County Road 99W, Willows, California 95988. (530) 934-2801.

Copies are also available via the internet at the following address
http://sacramentovalleyrefuges.fws.gov

Appendix Q. Draft Integrated Pest Management Plan For Walnut Production On The Sacramento River National Wildlife Refuge

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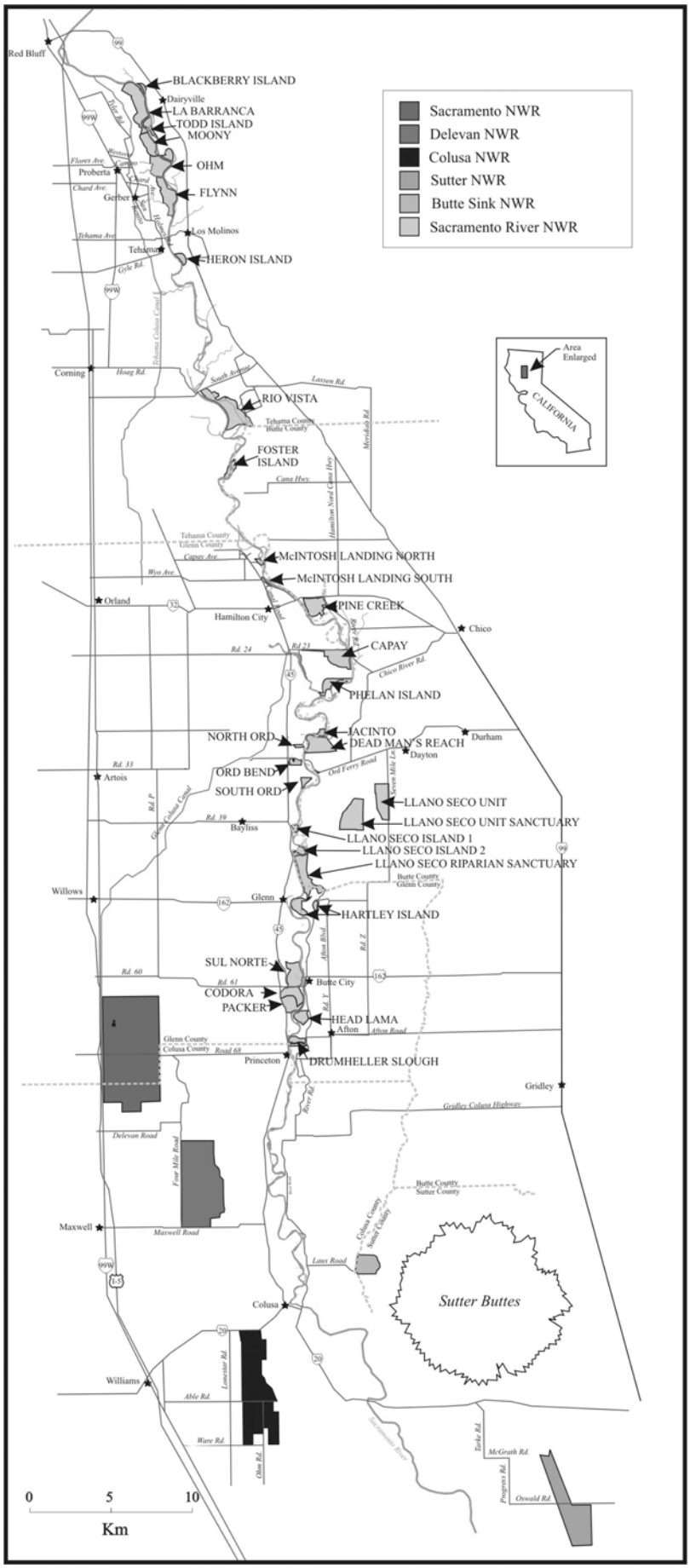
INTRODUCTION

The US Fish and Wildlife Service (Service) manages the Sacramento River National Wildlife Refuge (SRNWR), one of six national wildlife refuges in the Sacramento National Wildlife Refuge Complex (SNWRC) located within the Sacramento Valley of northern California (Figure 1). The primary objectives of the Sacramento River National Wildlife Refuge include: 1) provide habitat and manage for endangered, threatened, or sensitive species of concern; 2) protect and provide habitat for neotropical migratory land birds; 3) preserve a natural diversity and abundance of flora and fauna; 4) provide feeding and resting habitat for migrating and wintering waterfowl and other waterbirds; 5) provide opportunities for understanding and appreciation of wildlife ecology, the human role in the environment, and provide high-quality, wildlife dependent recreation and education; and 6) provide an area for compatible, management-oriented research. These objectives fall under a broader mission statement of the National Wildlife Refuge System, which is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

In 1989 Congress authorized formation of the Sacramento River National Wildlife Refuge (SRNWR) to preserve and restore riparian habitat along the Sacramento River between Red Bluff and Colusa. Since that authorization SNWRC has acquired 26 properties along the River towards a goal of 18,000 acres. Currently, those SRNWR properties consist of 10,141 acres including various riparian and agricultural lands of which 3,204 have been restored to native riparian species. While the Service did not wish to acquire or manage producing agricultural properties; most of the parcels offered by willing sellers included parts that were agricultural. The SRNWR currently has within its boundaries 1,529 acres of walnuts that are managed for wildlife habitat and commercial nut production. Through a partnership with The Nature Conservancy (TNC), walnut orchards are leased to farmers who commercially grow the walnut crop until the removal of the orchards.

SACRAMENTO NATIONAL WILDLIFE REFUGE COMPLEX



July 2003

Any net proceeds from the crop fund riparian restoration at SRNWR units. The two to five year goal is to eliminate these orchards and replace them with native riparian vegetation to provide habitat for indigenous aquatic and terrestrial species, some of which are threatened or endangered. In the interim the tenet farmers use Integrated Pest Management (IPM) for walnut production. Without immediate funds to restore the orchards to riparian habitat, it is important that the walnuts be managed rather than abandoned. While the Service is obligated to both fulfill its primary mission and refuge goals, failure to manage these walnut orchards would provide a habitat for pests, including insects, weeds, diseases, and vertebrates, to potentially cause off site impacts to neighboring walnut farmers along the River.

The purpose of this plan is to: 1) identify those walnut pest control methods/materials currently approved for use in the SRNWR; 2) incorporate their use into an IPM program consistent with the goals of the SRNWR; and 3) provide long-term planning to meet the Service's goal of reducing effects of pesticide use on Department of Interior (DOI) trust resources to the greatest extent possible.

REFUGE DESCRIPTION

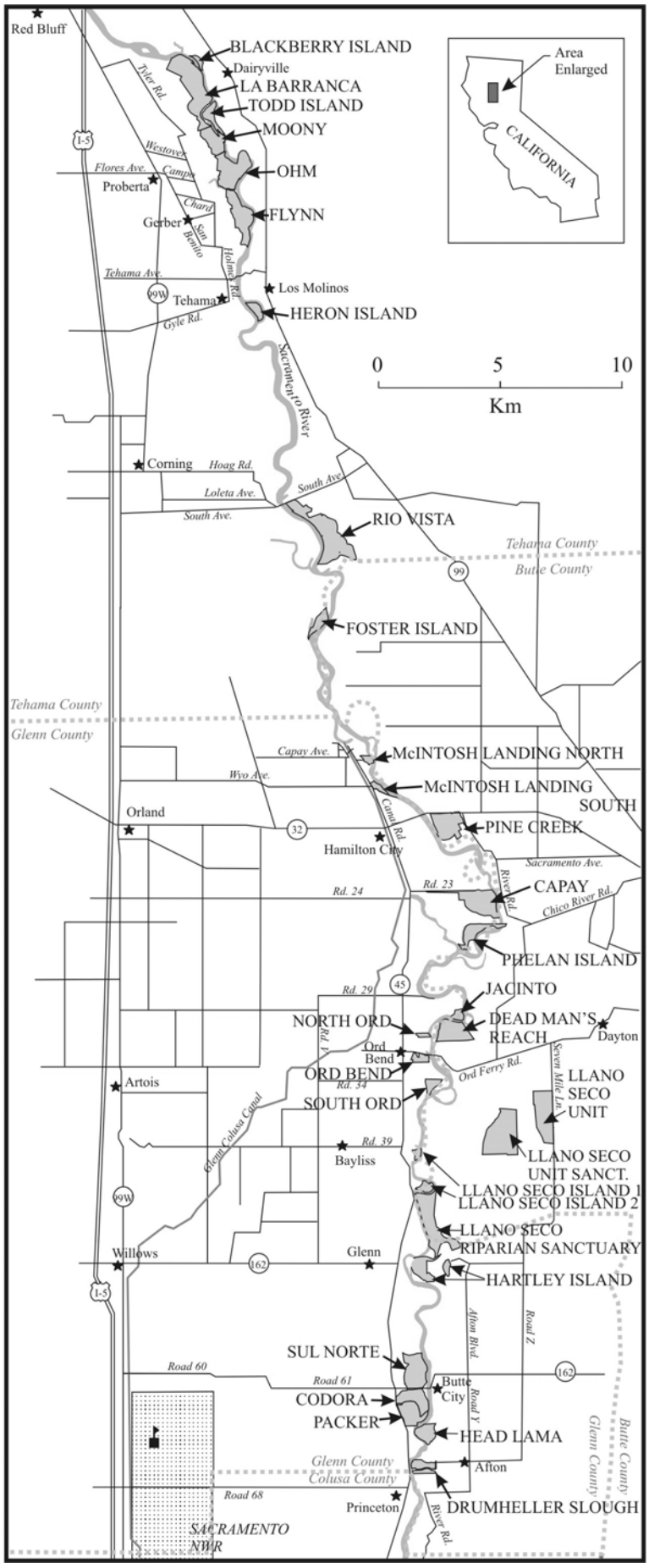
HISTORICAL

Vast acreage of natural wetlands was created when the Sacramento River flooded during annual winter storms. This cycle provided habitat for millions of waterfowl and other wildlife. In the early and mid-1900's levees were constructed along the rivers to reduce flood hazard to agricultural development. This reduced wetland habitat by approximately 95 percent in the Sacramento Valley. Due to loss of wetlands, crop depredation by waterfowl became a major problem. This problem and consideration for migratory bird conservation led to establishing a number of wildlife refuges, including those of the SNWRC during the period from 1937 to present. The SNWRC is composed of six refuges in the northern Sacramento Valley of California: Sacramento, Delevan, Colusa, Sutter, Butte Sink, and Sacramento River.

PHYSICAL

For the past twelve years the Service has been acquiring parcels of land to establish the Sacramento River National Wildlife Refuge (SRNWR) (Figure 2). The Service's goal is to purchase remnant forests and oxbow sloughs adjacent to or near the Sacramento River. These properties, along the riparian corridor, often include commercial farmland that includes English walnuts, *Juglans regia*, prunes, *Prunus domestica*, almonds, *Prunus amygdalus*, and various field crops. Currently the SRNWR has 2,685 acres of agricultural land that includes; 1,529 acres of walnuts (Table 1), 262 acres of almonds, no acres of prunes, and 100 acres of fallow fields. The remaining refuge acreage consists mostly of mixed riparian forest, cottonwood riparian forest, herbland cover, riparian willow scrub, valley oak woodland and savannah, elderberry savannah, gravel bar, grasslands and the 3,204 acres that have been restored to native riparian communities.

SACRAMENTO RIVER NATIONAL WILDLIFE REFUGE



June 2003

Soils on the SRNWR are primarily loamy to gravelly floodplain soils in an active meander belt. Slope on the SRNWR units range for 0-3 percent; elevation is 70–160 feet MSL; average rainfall is 17-24 inches. Maximum daily temperatures can exceed 90 degrees Fahrenheit from May into October.

The understory vegetation in the majority of walnut orchards is a managed cover composed of nonnative annual winter weeds; and annual and perennial summer weeds usually Bermudagrass, *Cyanodon dactylon.* The orchards are part of the river flood plain and have a year round cover of resident vegetation which limits the run off of pest control materials. The surface vegetation is mowed during the summer and winter; the walnut orchard units are not disked.

GENERAL WALNUT MANAGEMENT PRACTICES

Walnut production within the SRNWR requires progressive management to protect habitat and species while maintaining healthy, productive trees that avoid pest problems. Typical activities include: irrigation management to match tree-water use, mechanization for rapid walnut harvest, mechanized towers with hydraulic saws/clippers for pruning, mowing to control weed growth, herbicide "strip" sprays to control weeds on the bermed up tree rows, and ground driven "air blast" sprayers for pesticides, and occasionally aerial application of plant growth regulators.

The walnut orchards that are or may be acquired are primarily older orchards, 20 – 40 years of age. There are University Of California (UC) and privately selected cultivars (CV's) grown on these units including Ashley, Chico, Serr, Chandler, Hartley, Tehama, Vina, Blackmere, Franquette. The CV differences include maturity dates, height, and disease and insect susceptibility. Many of the orchard units are mixed with alternating CV's. While the shorter statured Vinas and Ashleys remain at 30 –40 feet many of the older blocks are more than 50 feet tall and fully canopied.

Table 1. Sacramento River National Wildlife Refuge Walnut Unit CV makeup.

Unit	**Acres**	**Varieties**	**Height (feet)**
La Barranca	404	Ashley, Chico, Serr, Hartley	35 – 50
McIntosh Landing South	28	Hartley	50
Pine Creek	65	Hartley	50
Jacinto	13	Hartley	50
Deadman's Reach	350	Hartley	35 – 50
Hartley Island	318	Ashley, Blackmere	40 – 50
Codora	285	Ashley, Chandler, Hartley, Tehama	40 - 50

PEST ABATEMENT ACTIVITIES

The University of California Integrated Pest Management Program (UC IPM) for Walnuts has been used as the guideline for management and monitoring decisions for the past eight years producing walnuts on the SRNWR properties. The objective of

controlling pests or avoiding their damage is favored by maintaining healthy, vigorous trees. Only tenet farmers who incorporate such practices as: pruning to keep an open canopy, adequate fertilization, optimal irrigation, and rapid harvest when using IPM practices can expect to realize sufficient revenues to avoid abandoning the walnut orchards.

There are many species that are considered pests in walnut production. For management decision making by the tenet farmers they are categorized into arthropods (insects and mites), diseases, weeds, and vertebrate pests. Because these orchard units will be removed and restored within two to five years some pest and disease problems will not be addressed, including Fall Webworm, *Hyphantria cunea*, Nematodes, *Pratylenchus vulnus* or *Macroposthonia xenoplax*, Blackline syndrome, Crown Rot, *Armillaria mellea*, or Deep Bark Canker, *Erwinia rubrifaciens*. The focus of the pest abatement activities will be on those programs that will reduce pests that could become a source of infestation to neighboring orchards outside the refuge or make commercial management unfeasible.

The primary pest Codling Moth, *Laspeyresia pomonella*, will be treated in depth because control of codling moth affects other pests and molds that make the crop unmarketable. The other significant pests; Navel Orange Worm, Web Spinning Mites, Walnut Husk Fly, San Jose Scale, Aphids, Walnut Blight, vertebrate pests and weeds will be addressed and control measures recommended.

PEST BIOLOGY FROM UC IPM WALNUT PEST MANAGEMENT

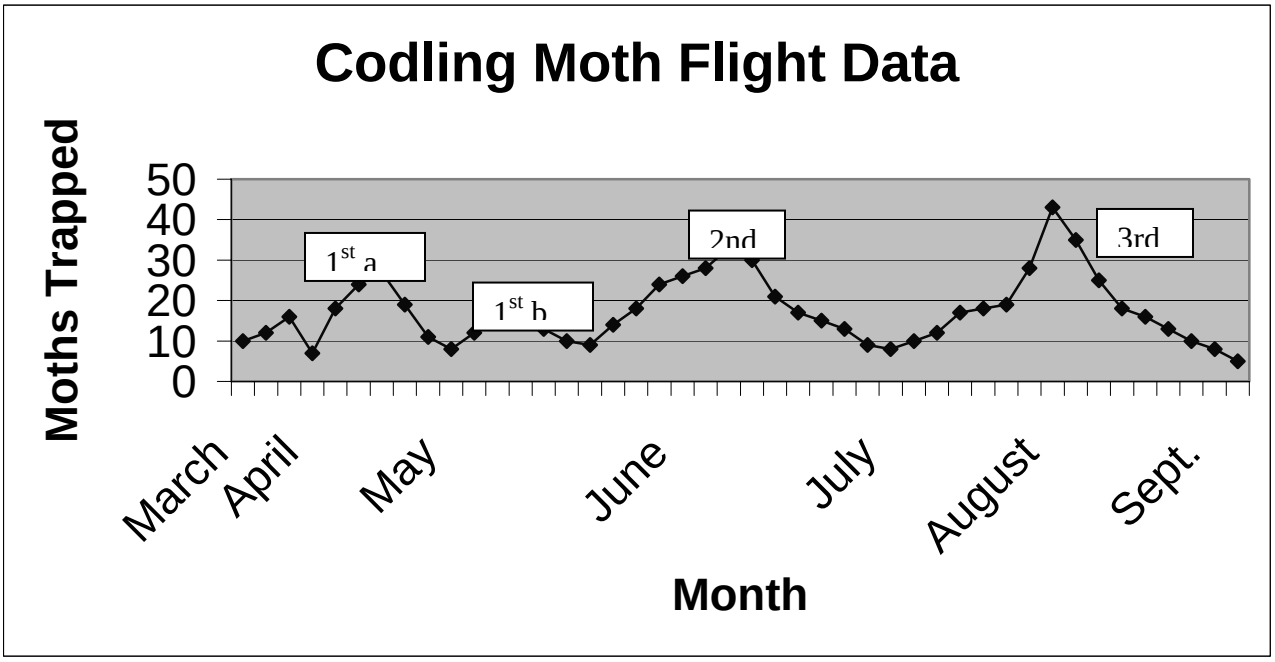
ARTHOROPOD PESTS

CODLING MOTH, *Laspeyresia pomonella*

Codling moth is the major pest of walnuts. Not only does it cause direct nut damage reducing a farmer's production and grade, but also its presence provides an entry point for secondary pests, such as the navel orangeworm. Further, extent and decision for types and timing of chemical treatment or other alternative management strategies required for its control, impacts the farmer's entire seasonal IPM program. There are several generations of codling moth:

Over-winter generation: Codling moth over-winters as mature larvae in a thick silken cocoon under loose scales of bark or in trash on the ground near the trunk. Adult emergence usually occurs in mid-late March just following budbreak of walnut CV's that leaf-out early in the season (e.g. Ashley, Chico, Serr). There are usually three complete subsequent generations and a partial fourth in Sacramento valley walnut orchards (see Fig. 3).

Figure 3. Codling moth seasonal populations.



1st generation: Adult codling moths emerging from the over-wintering population of mature larvae in mid – late March is referred to as the "first flight". When a sustained, 1st flight adult catch is obtained in pheromone traps, this is referred to as a "biofix" and developmental temperatures (50°F minimum and 88°F maximum) are recorded to determine and predict various life stages of this pest and best treatment times. The first flight of adult moths may have two distinct peaks of activity (peak 1a and peak 1b) and can last several months due to variable, often cool and rainy, spring weather. These moths begin to lay eggs when sunset temperatures reach 62°F that give rise to the "first generation" (Figure 3).

Each over-wintered female codling moth deposits about 30 eggs singly on leaves near nuts (later generations of females will lay an average 60 eggs on leaves or nuts). Duration of first generation codling moth egg laying is dependent on temperatures but typically lasts 4-6 weeks. The first eggs hatch after 5 to 20 days depending on the temperature but usually when the nuts reach a diameter of 3/8" – ½". Duration of egg hatch is important for timing sprays. In cool springs or cool locations, the flight of the over-wintering moths and subsequent egg laying lasts longer and may require two chemical treatments for adequate control.

The newly hatched larvae bore into nutlets through the blossom end. Most nuts damaged by 1st generation larvae drop to the ground, however nuts infested by larvae emerging late in the generation, as a result of flight peak 1b, remain in the tree.

2nd generation: Mature 1st generation larvae leave the nut after completing their development and pupate under loose bark on the tree. Adults of the first generation

begin to emerge from the end of May to as late as the last week of June depending on the season and location. Eggs laid by these 1st generation moths give rise to 2nd generation larvae. Because of higher temperatures at this time of year, eggs hatch and larvae develop faster than the 1st generation.
Newly hatched, second generation larvae enter the walnut husk anywhere on its surface but prefer the spot where two nuts touch. The larvae then proceed under the husk around the shell and enter the nut at the stem end, the weakest point of the shell seal. These larvae develop in the nuts, emerge and pupate under the tree bark, and emerge as adults by late July or the beginning of August. Nuts infested by this generation of larvae remain in the trees until harvest and thus have the potential to influence walnut quality and the farmer's grade sheet.

3rd and 4th generation: In the Sacramento Valley, 2nd generation adult codling moths produce a third generation of larvae in early August. This generation can cause significant damage at harvest by damaging kernels. Although these larvae leave the nuts when they are mature, only a few will pupate and then give rise to a 4th generation of larvae. The majority will spin cocoons and over-winter for the next year's population. Larvae developing as a fourth generation develop to late to cause economic damage to walnuts.

Occasionally some third generation codling moth larvae may be present in harvested nuts however most larvae found in nuts at harvest are the secondary pest, navel orangeworm that enters the nut through codling moth injury from late 1st, 2nd, or 3rd generation larval injury.

NAVEL ORANGEWORM, *Amyelois transitella*
Navel orangeworm (NOW) is the most common "worm" pest found in harvested walnuts and is usually regarded as the cause of worm damage and reason for reduced grade. However, it is a "secondary" pest. That is it cannot infest sound nuts (i.e. nuts that have not been previously injured) so its presence is often a direct result of nuts previously injured by codling moth, walnut blight, and/or sunburn. A grower's inability to manage these pests results in substantial NOW damage potential. NOW also infests nuts once hulls split prior to harvest so allowing nuts with split hulls to remain on trees past when they could be first harvested encourages infestation.

NOW over-winters as both larvae and pupae inside "mummy" nuts left in the tree following shaking and in trash nuts left on the ground, including those around hullers. Adult emergence begins in mid-March and may continue through early May – timing of adult emergence usually follows patterns of codling moth emergence closely. Female moths of the over-wintered generation lay their eggs singly on mummy nuts, current season's codling moth infested and/or blight infested nuts. The first generation, and most of the second, is completed in previous season's nuts or those infested with codling moth or infected with blight in the current season. In late summer, third generation larvae infest the crop as the husks begin to split. Females emerging at this time prefer to lay

eggs on the opened husk or on the exposed shell. Attention to mummy nut removal by dormant tree shaking and codling moth and blight control during the season minimizes the size of the generation that will infest nuts at harvest.

RED-HUMPED CATERPILLAR, *Schizura concinna*
Red-humped caterpillars damage walnut trees by feeding on leaves. Extensive feeding results in exposure of nuts and branches to sunburn, reducing both production and nut quality.

Three generations of red-humped caterpillars occur per year. The brown moths that give rise to first generation larvae emerge in early May. After mating, the females lay pearly white, spherical eggs in masses of 25 to 100 on the underside of leaves. The young larvae are quite gregarious and feed in large groups, quickly skeletonizing leaves. Once mature, they disperse and feed singly before falling to the ground to pupate. Additional generations occur in July and in September.
Usually red-humped caterpillar damage occurs before farmers or their Pest Control Advisors (PCAs) realize it; that is, it is too late for control as the "damage has been done". Because a number of natural enemies attack red-humped caterpillars, including two species of parasitic wasps, *Hyposoter fugitives* and *Apanteles* spp., and birds, they frequently do not recur preventing them from becoming a continually destructive pest in the orchard.

WALNUT HUSK FLY, *Rhagoletis completa*
Walnut husk fly (WHF) is a major pest of walnuts in the Sacramento valley. The fly oviposits in walnut husks during August and September prior to harvest. The maggots develop by feeding on husk tissue, which irreparably stains the walnut shell making it unsuitable for the in-shell trade. Nuts infested more than four weeks prior to harvest also sustain kernel color loss, reducing their grade. Black walnut, *Juglans hindsii*, which is found in the riparian areas, is the preferred host, but English walnut is also an excellent host for husk fly.

WHF has one generation per year. They over-winter as pupae in the soil and emerge as adults from late June until early September. Peak emergence is usually in mid-August. The female deposits eggs in groups of 15 below the surface of the husk. Eggs hatch into white maggots within 5 days. Older maggots are yellow with black mouthparts. After feeding on the husk for 3 to 5 weeks mature maggots drop to the ground and burrow several inches into the soil to pupate. Most emerge as adults the following summer but some remain in the soil for 2 years or longer. Some early maturing varieties, such as Ashley and Chico, can escape serious damage in most years simply because they harvest before serious damage occurs. Mid-late maturing varieties, such as Eureka, Chandler, and Hartley that have more exposure to WHF feeding before harvest are most susceptible to damage.

WEB-SPINNING SPIDER MITES

TWO-SPOTTED SPIDER MITE, *Tetranychus urticae*

PACIFIC MITE, *Tetranychus pacificus*

The web-spinning mites, Two-spot and Pacific, feed on the leaves causes stippling and leaf browning. Clusters of brown leaves are often the first sign of a mite population. Heavy populations produce copious webbing, and their feeding causes leaves to desiccate and drop. Defoliation early in the season will reduce nut yield and quality by shriveling kernels and increasing sunburn potential; defoliation late in the season will interfere with harvest. Early season infestations will also reduce subsequent crops as flower bud formation will likely be reduced.

Web-spinning mites over-winter as reddish orange, mature females in protected places on the tree, in the soil, and in trash on the ground. Eggs are spherical and translucent when first laid, becoming opaque soon before hatching. Immature mites molt three times before becoming adults. The first stage mites have six legs; later stages and adults have eight legs. During periods of active feeding the two-spotted mites have a dark spot on each side of the body, thus the name "two-spotted spider mite".

During warm weather in spring, over-wintered females begin feeding on walnut leaves and ground cover in the orchard. Colonies develop on the underside of leaves and also on the upper sides when heavy populations build up. These mites reproduce rapidly in hot weather and may become numerous in June or July. They produce many generations a year. If temperature and food supply are favorable, a generation can be completed in 7 days.

NON-WEB-SPINNING MITES

EUROPEAN RED MITE, *Panonychus ulmi*

The European Red Mite (ERM) populations develop in walnuts while weather is cool. While feeding by ERM does not result in leaf drop like web spinning mites, research has shown that when heavy populations are left un-treated for three years nut yield is reduced. In low numbers, that are by far the more common occurrence, the ERM can be beneficial by providing a food source for the western predatory mite, *Metaseiulus (Galendromus) occidentalis*, which can manage web spinning mite populations.

The ERM overwinters in the egg stage on twigs and branches. Eggs hatch in early spring when the walnuts leaf out. Immature mites are bright red; adult females have a brick red, globular body with four rows of long, curved hairs arising from white dorsal spots. Adult males are brownish and smaller than the females. ERM feeds on cell contents in leaf tissue. Initially, the feeding causes light leaf stippling. Prolonged feeding by a heavy population will gradually give leaves a bronzed appearance. They have multiple generations each season and do not produce webbing.

APHIDS

WALNUT APHID, *Chromaphis juglandicola*

Walnut aphid can be a serious pest of English walnut. Its feeding reduces tree vigor, nut size, yield, and quality. In addition to direct feeding damage, they excrete copious amounts of honey-dew that falls onto nuts, leaves and shoots. Honey-dew supports growth of the black sooty mold fungus. This fungus reduces light penetration to the leaf surface reducing its photosynthetic capacity. Being black, it also absorbs heat to predispose nuts to sunburn and subsequent kernel quality loss due to high temperatures. High populations of aphids may also cause leaf drop, exposing more nuts to sunburn. If heavy populations are allowed to develop (i.e. > 15 aphids per walnut leaflet) and remain for as little as 14 days uncontrolled, current seasons nut quality is reduced along with a substantial reduction in the following season's crop (Barnes, Sibbett, 1990.).
Walnut aphid over-winters in the egg stage on twigs. Eggs hatch as soon as leaf buds on early leafing CV's begin to open. These aphids settle on the leaflets (usually on the undersides of the leaf), mature, and reproduce without mating, giving birth to live nymphs. The aphids pass through many generations a year, depending upon temperature; hot temperatures seem to depress activity. In fall, wingless females mate with smaller, winged males and they lay the over-wintering eggs.

With the introduction of the wasp parasite, *Trioxys pallidus* by Robert Van Den Bosh in the early '70s, damaging populations of walnut aphid have generally disappeared statewide. Only in those cases where the parasite is killed with application of a broad-spectrum pesticide for control of another pest (e.g. codling moth) does walnut aphid become problematic.

DUSKY VEINED APHID, *Callaphis juglandis*)
The dusky veined aphid is a walnut pest that occurs mainly in the Sacramento valley. The life cycle of dusky veined aphid is similar to walnut aphid. It overwinters in the egg stage on twigs. Eggs hatch as soon as leaf buds on early cultivars begin to open where the young aphids settle on the leaflets, and they mature into larger, yellow aphids with dusky black spots, and reproduce without mating, giving birth to live nymphs. The aphids pass through many generations a year, depending upon temperature. In fall, wingless females mate with smaller, winged males and lay the overwinter eggs. In contrast to walnut aphid however, dusky veined aphids feed on the upper sides of leaves at the midrib. If 25% of a leaflet sample contains colonies of dusky veined aphids, economic quality damaged has been measured.

SCALE PESTS
Scales are insect pests that feed by extracting "plant sap" from limbs, branches, shoots, and leaves. When heavy infestations occur, substantial reduction and/or loss of tree growth occurs reducing production. Scales are classified as either "armored" or "un-armored". Armored scale adults have a hard, waxy coating that protects the insect from predation, parasitism, and, coincidently, chemical insecticides. Un-armored scales have no such protection, their body remains soft and exposed, and is more easily parasitized and controlled with insecticides.

ARMORED SCALES

SAN JOSE SCALE, *Quadraspidiotus perniciosus*

The San Jose Scale (SJS) produces three generations a year or more if warm weather extends into the fall. It overwinters mainly as first instar nymphs, a "black cap" stage. The wingless females molt twice and the winged males molt four times and mature at the same time as the females. San Jose Scale bear live young and these tiny "crawlers" begin emerging in May. The crawlers soon settle down, insert their feeding stylet, initiate feeding and secrete the white waxy cover that becomes the "armor". After two or three weeks these nymphs molt and complete their development. Heavy infestations of San Jose Scale kill scaffold limbs and branches within one to two years reducing production.

WALNUT SCALE, *Quadraspidotus juglansregiae*

The walnut scale is often tan or brown and the same color as the bark of the walnut tree, making it difficult to detect. The scale is found in daisy shaped groups formed by the male crawler. The walnut scale produces two generations a year. The second generation overwinters as second instar females and males. The young female crawlers are active in mid May after hatching, and another generation develops in Mid August. Similar to San Jose Scale, heavy infestations can cause bark and limbs to crack.

UN-ARMORED SCALES

FROSTED SCALE, *Lecanium pruinosum*

EUROPEAN FRUIT LECANIUM SCALE, *Lecanium corni*

These are two very similar un-armored (i.e. soft-bodied) scales. They suck plant juices from leaves and twigs and heavy populations reduce terminal growth and vigor, resulting in smaller nuts and poor kernel quality. The secreted honeydew may cover nuts and offering a substrate for growth of the sooty mold fungus, increasing the chances for sunburn damage.

They have one generation per season, over-wintering as nymphs on twigs and small branches. In the spring the nymphs grow rapidly, secreting large amounts of honeydew. Mating occurs in late spring and the females lay a large number of eggs, protected under her body, then dies. The newly hatched yellow crawlers, looking quite similar to walnut aphids, emerge from beneath the old female body and migrate to the underside of leaves where they feed much like aphids do. In fall the crawlers molt and move back to the maturing current season's shoots and permanently settle down to over-winter.

These soft scales are usually held in check by natural predators and parasites. It is only when the natural enemies have been eliminated, often through chemical upset, that these soft scales become a problem.

MICROBIAL PESTS

BACTERIAL DISEASES

WALNUT BLIGHT, *Xanthomonas campestris* pv. *juglandis*

Walnut blight is the only bacterial disease of walnut and infects leaves, flowers, and nuts. Economic loss occurs when nuts are infected. Nuts infected early in the season drop from the tree whereas those infected later, once shells begin to harden, have their kernels destroyed and provide a site for navel orangeworm infestation.

The walnut blight bacterium over-winters and survives either on or in dormant buds, catkins, and twig lesions from previous infections. When new tree growth resumes in spring the pathogen is moved to the new tissue in free moisture, usually rainfall. It enters the new plant tissue through natural openings such as the stomata. These primary infections produce more bacteria, which are spread to other sites in the tree, such as developing shoots, pistillate flowers, nuts and developing buds and catkins for the next season. Windblown raindrops or pollen can also carry walnut blight bacteria throughout the orchard. Thus, severity of blight each season depends upon amount of rainfall occurring during the primary infection period. Although all commercial walnut CV's are susceptible to blight, those that leaf out early in spring are most susceptible simply because of their coincident growth stage with highest probability for rain. Early leafing CV's such as Ashley, Payne, Vina, Sunland require major attention to blight whereas late leafing CV's such as Chandler require a minimal treatment regime. Interestingly, Serr, an early leafing CV, shows some field resistance to blight and is not severely infected even when conditions for infection occur.

VERTEBRATE PESTS

GROUND SQUIRRELS, *Spermophilus beecheyi*

Ground squirrels can live for five years and they emerge in February after winter hibernation from their burrows. The females have one litter of six to eight young in the spring. About six weeks after birth, the young emerge to feed above ground. The adults often go into a temporary state of inactivity (aestivation) for part of the hot summer and into hibernation in the winter. The young usually do not aestivate or hibernate during the first year.

Ground squirrels feed on young nuts and mature nuts on the ground or in the tree. They can climb trees and strip branches of large numbers of nuts. Ground squirrel burrows in the orchard can disrupt irrigation and cause erosion.

POCKET GOPHERS, *Thomoys* sp.

Gophers usually live alone, except for females with young or when breeding, in an underground burrow system that can cover 200 to 2,000 square feet. Gophers do not hibernate and may be active at any hour of the day. Gophers reach sexual maturity at about 1 year of age and can live up to 3 years. Litters of five or six gophers are produced by females up to three times per year. Gophers feed on roots and stems of weeds and occasionally they damage young walnut trees. They are a concern to walnut growers mainly because they dig burrows in the orchard, which interfere with mowing, harvesting operations, and irrigation.

WEED PESTS

Weeds cause many problems in walnut orchards if not well managed. Weeds: increase water use; enhance the potential for disease (e.g. crown rot) and rodent damage (meadow mice – *Microtis spp.)*; make it difficult to recover nuts from the orchard floor; and they increase management time, thus costs.

Weeds in areas between the tree rows, i.e. row middles, are allowed to grow and are mown 2-3 times annually. All of the orchards in the SRNWR area are mown and not disked as these orchards are on an active flood plain.

POTENTIAL CONTROL METHODS AND MATERIALS

CULTURAL CONTROLS

Good walnut cultural practices minimize pests and their control costs. Here are some examples:

Irrigation: Maintaining non-water stressed trees is one of the most important cultural practices farmers use to maximize yield and avoid pest problems. For example, allowing trees to stress from poor water management encourages spider mite infestations that would not occur in well-irrigated orchards. Nut sunburn readily occurs on stressed trees; sunburned nuts are predisposed to infestation by Navel orangeworm. Also, water stress predisposes walnut trees to infection by the deep bark canker bacterium and too much water encourages phytophthora infection. Water management is clearly a major component of an integrated pest management program.

Shaking "mummy" nuts and shredding: Old mummy nuts left in the trees following harvest are over-wintering sites for navel orangeworm (NOW). Dormant tree shaking to remove these nuts, then shredding them in the orchard destroys the over-wintering stages of this insect. The result is that there no longer is a resident population of NOW within the orchard to infest nuts injured in-season. This practice alone is a major part of any program to manage this insect pest.

Pruning: Dormant pruning complements other good cultural practices in a pest management program. It thins out wood within the tree, invigorates shoot growth and confines trees to their allotted space. As such, it is quite helpful in a pest management program, for example, encouraging tree vigor minimizes such diseases as branch wilt that infects via sunburn injuries and spider mites that often prefer non-vigorous trees; dense, shaded trees are often more prone to walnut blight due to higher humidity conditions within the orchard.

Mowing: Mowing is a direct weed control practice and a component of integrated pest management. Keeping weeds short minimizes problems weeds cause, such as, water use and rodent habitat. Although not well researched, mowing weeds or a cover crop also has

been suggested as a method of encouraging insect predators to move up into the tree-tops.

Harvesting: Prompt harvest and processing have long been shown to maximize kernel quality and minimize insect and mold damage. Once walnut hulls dehisce, the nut becomes a primary site for navel orangeworm infestation. Minimizing the opportunity time for infestation minimizes percent damage. Prompt harvest also minimizes damage from Walnut husk fly and kernel molds.

Rodex® Rodent Control: Recent development of a concussion device for control of pocket gophers and ground squirrels,Brand name "Rodex", has the ability to spot treat problem areas without use of anticoagulant baits, fumigants, or poisons. This method quickly exterminates existing pocket gophers and ground squirrels, collapsing the burrow system, and retarding re-colonization. The use of this method will be limited to less than 5% of the acreage selectively eliminating populations at pumps, levees, and neighboring farming and restoration borders where large populations cause damage.

Table 2. Cultural Control Methods for Walnut Pests

Control Technique	Objective	Usage	Advantage(s)	Disadvantage(s)
Irrigation	Create a healthier walnut tree to resist pests and to prevent sunburn.	100% - to produce healthy, productive walnut trees.	Reduces sunburn, secondary infestations of NOW, and maximizes production. Provides water for all species.	Minor expense
Shaking and shredding "mummy" nuts	To eliminate overwintering navel orangeworm from the orchard.	Preventative; tree shaking is occasionally used. All tenets mow the fallen walnuts by March 15 providing floodwaters allow.	Reduces NOW populations.	Tree shaking is expensive. Winter weather flooding often prevents t performance of this operation.
Pruning	To keep tree structure open and encourage air circulation to lessen impact of humidity on walnut blight. To provide conditions that minimizes spider mite infestations. A more open canopy allows more complete spray deposition when pest control measures must be applied.	Preventative; the use of pruning is primarily to increase production. Inadvertent pest control is obtained. Tenant farmers usually perform this operation up until the last two years of the orchard's life.	Reduces damage from walnut blight. Achieves better control of codling moth and other pests by ensuring conditions for optimal spray coverage.	Pruning is expensive and returns due to increased productivity are not realized for several years.
Mowing	Control weeds.	100% - Preventative.	Reduces need for herbicides.	Removes orchard vegetative structure, creates dust, may cause compaction.
Harvest	Prompt removal of the ripe walnuts.	Prevents damage from NOW, ants molds,	Prompt harvest minimizes pests and maximizes nut quality.	Not all walnut orchards can be harvested at one time. Some will be delayed due to infrastructure constraints.
Rodex® Rodent Control	Control pocket gophers, ground squirrels.	Selective control and preventative	Limits use of baits, fumigants, and poisons.	Equipment expense and labor.

BIOLOGICAL CONTROL

BIRDS, GENERAL

Codling moth: A USDA study in 1911 reported 36 bird species to be important codling moth predators (McAtee 1911). In California apple systems, a study funded by the Organic Farming Research Foundation showed up to 83 percent depredation of codling moth larvae by birds during the winter (Baumgartner 2000).

Currently few of the orchards in the SRNWR have high populations of codling moth, i.e. over 5 % from harvest "crack out" results conducted by The Nature Conservancy (CERUS Consulting 2000). Surveys conducted on SRNWR properties indicate that bird species richness was highest in riparian vegetation, followed by restoration sites, and grasslands with orchards being lowest (Small et al 1999). The bird diversity increases at the restoration sites with age (Small et al 2000). Although lacking solid research of birds' diets surveyed by Point Reyes Bird Observatory (PRBO), considering Baumgartner's research, it is believed birds in general; particularly; scrub jays, American robin, European starlings, Brewers blackbirds, and many woodpeckers have a substantial influence on suppressing the Codling Moth populations year round.

Rodents: For the pocket gopher, *Thomomys sp*., barn owls, *Tyto alba,* can represent a substantial biological control that can be manipulated with the placement of barn owl nest boxes around and in the orchard. Research work in California examined contents of barn owl nest boxes in the San Joaquin and Sacramento Valley around prunes, vines and pecans. Results showed pocket gophers represented over 50 percent of the barn owl diet representing an average of 215 gophers 'taken' during the breeding and nestling phase, the balance consisted of *Microtus sp*, 30 % and other birds 20 %. (Gallaway et al 1999).

It is doubtful this level of efficacy would be achieved in these walnut units where abundant habitat and alternate prey exist. Further, barn owls prefer to hunt away from their nests and in open areas. In tall dense walnut orchards, some predation in the more open areas may occur, but would be considerably less than in vineyards or prunes.

BATS

MEXICAN FREE-TAILED, *Tadarida brasiliensis*

YUMA MYOTIS BATS, *Myotis yumanensis*

Recent research in California indicates that the indigenous migratory bats, such as, Mexican free-tailed and Yuma myotis bats, may particularly play a large role in insect control. Research shows they consume a considerable quantity and diversity of insects after they have migrated to the Sacramento Valley in summer; from April through September 50% - 90% of the diet consisted of moths (Long 1998). Bats are also known to chase away moths with echolocation; moths, including cutworms, armyworms, and bollworms turn and dive to the ground up to 130 feet away from bats. While work has not been done on codling moth or navel orangeworm in walnuts or other crops, bats may be a

substantial natural predator of these pests and bat habitat and populations should be encouraged.

PARASITIC ARTHROPODS

Trichogramma platneri

The parasitic wasp was first isolated in Yuba County California attacking codling moth eggs in walnuts in 1986 (Bob Hanke, pers. comm.). Now, these egg parasites can be purchased from several insectaries for release in walnut orchards. Through testing by the University of California (Mills et al 1995) a suggested level of augmentive releases has been established for this pest. The University of California Pest Management guidelines (Mills and Pickel 1999) suggest releasing 200,000 *T. platneri* every week for four weeks during the egg laying period for second and third generations of codling moth. These guidelines suggest this augmentive release program has given 50-70 percent control of codling moth when populations are low to moderate.

Application of *T. platneri* egg cards to every tree in the orchard eight times a season is labor intensive and expensive. Aerial applications of *T. platneri* with 98 percent survival and recovery is possible (Stocker 2000). The expense of 5 applications eliminates this as an option.

Mastrus ridibundus, Liotryhon caudatus, Mastrus rufipes

Three parasitoid species on codling moth have been introduced: *M ridibundus*, *L. caudatus* (ichneumonids), and *M. rufipes* (a braconid). The two ichneumonid species are cocoon parasitoids and the braconid wasp is a larval parasitoid that attacks the mid-stage codling moth larvae inside fruit. These parasitoids typically cause 30 – 50 % parasitism of the codling moth in Kazakhstan apples (Mills 1997).

The two ichneumonid cocoon parasitoids were reared in the laboratory and there have been field releases of 41,000 *Liotryphon* and 95,500 *Mastrus* in walnut orchards throughout the Sacramento and San Joaquin Valleys between 1995 and 1997. In 1997 both species were recovered in walnut orchards outside of the release sites, indicating they had successfully overwintered. *M. rufipes* has failed to breed in captivity. As cocoon parasitoids the extent of these introductions on SRNWR walnuts has not been evaluated, but would be a very valuable research addition.

Trioxys pallidus

The parasitic wasp, *T. pallidus*, currently controls the walnut aphid. This wasp, introduced from France and Iran in the 1960's, has virtually eliminated walnut aphid as a pest in most orchards. Monitoring by TNC on properties farmed with existing IPM methodology for the past several years has confirmed an abundance of *T. pallidus* parasitized aphids exist indicating that the parasitoid is well established on the SRNWR walnut properties (CERUS Consulting 2000).

BACTERIAL AGENTS

B.t. (*Bacillus thuringiensis* var. kurstaki)

B.t. is a bacterium that has demonstrated selective larvacidal activity against all lepidopteran species including codling moth, navel orangeworm, and red-humped caterpillar. B.t. produces a crystalline protein (delta-endotoxin) that, when ingested by the susceptible insect, causes paralysis of cells in the gut, interfering with normal digestion and feeding. It must be applied prior to egg hatching and throughout the egg-hatching period. While the use of B.t. is common in apple orchards in Washington for codling moth control, it is relatively unused in walnut production in California. Several factors greatly reduce the efficacy of B.t. in walnut: tree height (often in excess of 40 to 50 feet tall), precludes the required thorough coverage, rapidly growing foliage during the first generation of codling moth would require frequent application for adequate control, and the protein has short term (5 day) effectiveness before it is degraded by sunlight. Because of the 5-8 applications per season this is an unused method for Codling Moth.

Table 3. Biological Controls of Walnut Pests.

Control Technique	Pest Control Objective	Usage	Advantages	Disadvantages
Birds, General	Encourage presence of general bird predators for control of codling moth, navelorange worm and other insect pests	Opportunistic and passive method of insect control.	Little supplemental expense.	A passive method of insect control that cannot be managed.
Barn Owl	Rodent control.	Opportunistic and passive.	Low cost.	Efficacy impaired in dense orchards. barn owls may not be active in densely canopied walnut orchards.
Bats	Encourage presence of general bat predators for the control of codling moth and navelorange worm.	Opportunistic and passive method of insect control.	Little supplemental expense.	A passive method of control but with abundance of habitat at refuge sites, it may not be worth time or labor to establish bat houses on these units.
Trichogramma platneri	Codling moth control.	Augmentive and opportunistic.	A control method using a California native parasitoid wasp. Does not impact secondary pests.	Expense. Cost of stapling *T. platneri* to tree leaves eight times a season is considerably more expensive than other control methods and is less effective than chemical control.
Mastrus ridibundus, Liotryhon caudatus, Mastrus rufipes	Codling moth control.	Opportunistic and passive.	Ease of establishment. These parasitic wasps may become established with little change in management.	None. Susceptibility to broad-spectrum insecticides unknown.
Trioxys pallidus	Control of walnut aphid.	Opportunistic and passive.	Currently well established in the units.	Susceptible to broad-spectrum insecticides.
Bacillus thuringiensis var. kurstaki	Control of red-humped caterpillar	Augmentive and active.	Does not impact secondary pests or wildlife.	Expense. The cost of labo and equipment to apply tl bacteria.

CHEMICAL CONTROLS

TEBUFENOZIDE (Confirm)
Tebufenozide is an Insect Growth Regulator (IGR), which acts by binding to the ecdysone receptor protein causing the molting process of codling moth larvae to become lethally accelerated. When applied at 200 to 250 degree days (hours of temperature over a threshold, i.e. 14° C since egg laying) from biofix and thorough coverage is obtained, including combinations of ground and/or aerial applications on large trees, good control is obtained. Tebufenozide is the primary IPM pesticide material used by tenet farmers for codling moth control. Since the SRNWR abandoned the use of synthetic pyrethroids in 2000, the use of tebufenozide has accounted for 95% of the control of codling moth on the SRNWR walnuts.

Tebufenozide has moderate aquatic toxicity by Service standards and will be mitigated by the buffer zones of 200 feet by ground and 300 feet by aerial applications.

PHEROMONE MIXTURE, MATING DISRUPTION (Isomate C+)
Considerable interest in using codling moth mating disruption technology has existed since development of Codlemone, a synthetic sex attractant pheromone. However, success similar to that of apples and pears using a pheromone dispenser technique in other parts of the United States was not realized for walnuts in early California trials; the size and volume of large trees has kept most growers from utilizing the technique. Growers with young walnuts have used the technique but often report partial failures.

Two recent walnut studies however have shown this to be an effective method, albeit time consuming, control of codling moth. A three-year Walnut Biologically Integrated Orchard Systems program (BIOS) in San Joaquin County, using Isomate C Plus had comparable damage levels to the conventionally managed blocks (Grant 2000). Because the dispensers need to be hung during a short, two week period of time in late March, this method has not been adopted by tenet farmers. The option on some blocks will remain within this IPM plan in the event that other methods should fail to be efficacious.

PHEROMONE MIXTURE, MATING DISRUPTION (CheckMate CM-F, 3M MEC-CM)
In addition to the potential use of Isomate C+, which has been approved by the Service, two new sprayable formulations of codlemone have been granted registration by EPA in 2002. Both products have been field tested by local PCAs and the Univerisity of California on properties adjacent to refuge properties. The results have been encouraging in controlling codling moth mating disruption, although with high risk CVs and high moth populations the disruption failed and tebufenozide was needed to control the 2nd or 3rd generations (Cliff Kitayama pers. comm.)

These sprayable formulations of the codlemone are easily applied by the tenet farmers, which facilitates their use and adoption of mating disruption. If the methodology can be

proven successful and cost effective, pheromone disruption will be strongly supported on refuge properties because of its low impact to wildlife and natural predators.

MALATHION and NU LURE BAIT
Malathion, developed in 1950, is one of the oldest organophosphate insecticides. Even though it is toxic to aquatic insect species it is rapidly biodegraded. Malathion has been the chemical recommended for control of walnut husk fly. The current and recommended method is to apply malathion with a food attractant, Nu-Lure Bait, to every third row, with a coarse spray to the lower half of the tree. This is the site where walnut husk flies live after emerging from the ground.

SPINOSAD (GF-120 NF Naturalyte)
In 2002 the use of spinosad with a bait attractant was approved by US EPA for use in walnuts for walnut husk fly. The active ingredient is produced from the aerobic fermentation of the naturally occurring actinomycete, *Saccharopolyspora spinosa*. This natural product, approved for organic production systems by OMRI, has a novel mode of action that affects the insect nervous system at the nicotinic acetylcholine receptors. It provides excel control through both contact and ingestion, yet is generally safe to beneficial insects. The product will be tested on walnut orchards in the area and if it is efficacious, will be an improved alternative in the control of walnut husk fly.

CLOFENTEZINE (Apollo)
In most years mites are controlled in walnuts by good cultural practices (e.g. water management) or natural enemies such as the western predatory mite, *Metaseiulus (Galendromus) occidentalis*. In some seasons, however, they require control. Clofentezine has been recommended in the past on Service units because it is relatively nontoxic to fish. Because the miticide interferes with the breathing tube of the egg stage of the mite, it must be applied before a truly threatening population level has been reached contrary to IPM practices. More tenet farmers will be encouraged to use narrow range oils and partial treatments with clofentezine in mite hot spots as part of the IPM program.

NARROW RANGE OIL
Agricultural oils will effectively control many insect pests by suffocation. Narrow range oils are recommended in the UC IPM Guidelines for mites. Most of the tenet farmers have not used narrow range oil in the past because they were both concerned about phytotoxicity and there were more effective materials available. Now that the number of available products for mite control has been reduced to clofentezine more tenet farmers will be encouraged to try oil as part of their mite control programs.

COPPER HYDROXIDE (Kocide 101)
Copper is a broad-spectrum fungicide/bacteriocide. Copper, in the form of copper hydroxide, has been used for control of walnut blight for many years. Regular applications for control of walnut blight are made based on temperature and rainfall

events or every 10 to 14 days through the leaf out and bloom period. Presently there is not an IPM control program for walnut blight and the application of copper as a preventative is the only option.

MANGANESE ETHYLENEBISDITHIOCARBAMATE (Manex)
Some orchards have developed copper resistant strains of walnut blight. It is suggested that where such strains exist, Manex be included with the copper to increase control. For the past six years the State of California has issued a Section 18 Emergency Exemption label for the use of Manex.

ETHEPHON (Ethrel)
The plant growth regulator ethephon is an important and integral part of the SRNWR IPM plan for walnut production. Ethephon acts by liberating ethylene gas resulting in an acceleration of hull dehiscence. This can advance harvest by 10 to 16 days. Ethephon is used by many of the tenet farmers because it eliminates additional inputs of pesticides, facilitates an earlier harvest, and delivers a superior quality product. The use of ethephon to hasten harvest avoids damage from 4th generation navel orange worms and from walnut husk fly.

GLYPHOSATE (Roundup Ultra®)
Glyphosate is used on all of the walnut units for weed control. The absence of weeds in the tree rows, around the walnut trunks, and around sprinklers facilitates management and harvest. As noted above under "Weeds", absence also reduces problems associated with trunk girdling by *Microtus* sp and by crown and phytophthora rot root. Walnut unit farmers do not control weeds outside the orchard edge because they wish to maintain a solid vegetative filter strip around the perimeters to reduce off site movement of water, soil, nutrients or chemicals.

WALNUT PEST CONTROL TREATMENT EFFECTS

EFFECTS ON WALNUT PESTS
The primary insect pest species, codling moth, can be controlled with tebufenozide, pheromone mating disruption, or the combination of both products during years of heavy codling moth pressure. *T. platneri* releases can 50 to 70 percent control according to research but have never been utilized by farmers regionally and fail to control the populations during high pressure years. Walnut tree height of 45 plus feet has made the use of the insect growth regulator tebufenozide challenging because it is difficult to get the required full coverage in the upper third of the tree. Adequate control of codling moth may require both ground and aerial application of tebufenozide.

There is not a specific pesticide treatment for navel orangeworm, and the farmer tenets use secondary methods such as: shaking and shredding of mummy nuts, avoiding codling

moth damage, keeping the walnuts well watered to avoid sunburn, treating for walnut blight, and accelerating harvest with the growth regulator ethephon.

The third primary pest, walnut husk fly, is easily controlled by monitoring known areas of the orchard that harbor the pest and treating. By monitoring for gravid females and treating with malathion or spinosad combined with an attractant bait the pest is controlled and damage is avoided.

Mites can be controlled by an early application of clofentezine and narrow range oils for spot treatments based upon monitoring, although no farmer tenets have used this treatment for over five years. All other potential arthropod pests are rarely an economic problem and are controlled by the abundance of beneficial insects, birds, and bats.

The crop disease, walnut blight, is controlled by the farmer tenets preventatively with 2 to 4 ground and aerial applications of fixed coppers and Manex every 10 to 14 days during the susceptible stages of spring growth. This practice is usually done in late March and April, except when the orchard may be inundated by high water. Controlling blight reduces secondary infestations by navel orangeworm.

Vertebrate pest control measures are preformed at several spot locations on less than 5 percent of the walnut acres. Edges and structures, particularly pumps, levees, buildings, and adjacent, bare fields undergoing restoration favor squirrels. Damage to irrigation systems by gophers and squirrels sometimes require the farmer tenets to spot treat these mammals with the Rodex® concussion device.

Farmer tenets treat weeds with herbicides, glyphosate only on the tree rows and around structures - up to three times per year. Except for some shady orchards, 80 % of the units are covered with vegetation and all perimeters of the orchards are 100 % vegetated to provide buffer vegetation. These vegetated buffer edges are encouraged to prevent the off site movement of pesticides.

EFFECTS ON NON-TARGET ORGANISMS

Effects to non-target organisms can be: interference with normal biological systems and functions, loss of biomass, loss of diversity, interference with normal ecological relationships, bioaccumulation, and other known and unknown effects. The mission of SNWRC is to provide for the conservation of migratory birds, native anadromous fish, endangered and threatened species, native plants and other native animals and their habitats. There is concern that walnut pest control treatments interfere by reducing and contaminating existing food and water components of habitat. Rare insects or insects that may function as important pollinators for native plants, may also be impacted by walnut arthropod pest treatments. Significant bioaccumulation has not been associated with any of the approved chemical treatments referred to in this plan.

INVERTEBRATES IN AQUATIC ENVIRONMENTS

From Service data, invertebrates in aquatic environments are impacted by tebufenozide, malathion, spinosad, fixed coppers, and manganese ethylenebisdithiocarbamate. Wide unsprayed vegetated buffers (200 to 300 feet), reduced application rates (50 to 100 gallons per acre), low active ingredient concentrations, rapid degradation and soil binding, avoidance of applications during inversions or winds over 7mph, and the addition of drift control agents all reduce the opportunity for pesticides of concern to enter aquatic environments.

INVERTEBRATES OUTSIDE AQUATIC ENVIRONMENTS

Application of several of the pesticides are more likely to impact invertebrates that exist in orchards when they visit from the surrounding forests. For example, applications of malathion, tebufenozide, clofentezine, or spinosad can have an impact on arthropods which are not the target of concern including pollinators, beneficial insects, and the parasitoids of codling moth and aphids. Through the combined efforts of the Service and farmer tenets the broad spectrum and long lasting pyrethroids (Asana®) and organophosphates (Diazinon®, Sevin®, Imidan®) have been eliminated on the SRNWR over the past eight years. Impacts on other invertebrates, such as earth worms, snails, and nematodes may be short lived in an active flood plain orchard. These questions represent an area of considerable unknowns and opportunities for research on farm property that is acquired for eventual restoration.

SENSITIVE SPECIES AND HABITATS

Federal and State listed endangered and threatened species and federal candidate species, which occur or potentially occur at SRNWR are listed in Table 4. Because general pesticide toxicity levels for vertebrate species such as reptiles, birds, and mammals are at least a magnitude greater than terrestrial insects, it is likely that toxicity impacts in wetland or riparian habitats are not great because pesticides are not applied in riparian areas.

Table 4. Federal and State-listed Endangered, Threatened, and Candidate Species occurring or potentially occurring at Sacramento River National Wildlife Refuge.

Name	**Scientific Name**	**Status**
Bald Eagle	*Haliaeetus leucocephalus*	FT, SE
Giant Garter Snake	*Thamnophis gigas*	FT
Chinook Salmon, Sacramento River winter-run ESU	*Oncorhynchus tshawytscha*	FE, SE
Chinook Salmon, Central Valley spring-run ESU	*Oncorhynchus tshawytscha*	FT, ST
Steelhead, Central Valley ESU	*Oncorhynchus mykiss*	FT
Valley Elderberry Longhorn Beetle	*Desmocerus californicus diamorphus*	FT
Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	FC, SE
Willow Flycatcher	*Empidonax trailii*	SE
Bank Swallow	*Riparia riparia*	ST
Chinook Salmon, Central Valley fall-run and late fall-run ESU	*Oncorhynchus tshawytscha*	FC

ESU – Evolutionary Significant Unit
FE – Federal-listed Endangered Species
FT – Federal-listed Threatened Species
FC – Federal Candidate Species
SE – California State-listed Endangered Species
ST – California State-listed Threatened Species

Fish have been the focus of Federal and State clean water research and enforcement during the past 20 years. Studies have shown that lethal and sublethal effects from pesticides have impacted fish in the Sacramento River. Additionally both mining and urban usage have contributed to the levels of metals in the Sacramento River. Numerous cleanups, restrictions on discharge, and impending Total Maximum Daily Loads (TMDLs) have and are being undertaken (Cooke & Connor 1998). The implications of the past research on pesticides led the Service to ban the use of Diazinon in 1998 and pyrethroids in 2000 on the walnut properties.

Much of the current concerns about fish include not mortality but sub lethal behavior modifications including the inability to smell predators, inability to respond to scent signals given off by female fish about to release their eggs, and the inability to find migration routes. Considering the current use along Sacramento River drainages includes over 300,000 lbs of organophosphates(OPs) still applied to the region the, continued use of the spot treatment product, malathion is small. As noted above, the Service has not allowed any other OPs since 1998. Three pesticides used on the walnut properties are listed in literature indicating that they could be of concern to fish: Copper Hydroxide, Malathion, and Manex.

Research studies of, *Oncorhynchus mykiss*, have shown bioaccumulation of Copper (Kamunde and Wood 2003) with some studies showing minor accumulation giving the fish the ability to enhance tolerance to other metals during the migration along the river (Clearwater et al 2002). The current use on the Refuge properties is not considered detrimental for this metabolic metal. The approximately 10,000 lbs of metallic copper used on the properties for walnut blight is small in comparison to the regional use of over 4,000,000 lbs of copper on rice, walnuts, and peaches.

Malathion, used for the control of Walnut Husk Fly, is the only OP that is still used on refuge properties. As of 2003 the US EPA has not made an effect determination for malathion, a popular home and mosquito vector control product. With a variety of fish species researched, some of the potential effects of malathion at high dosage include behavioral signs and chronic effects of altered metabolism on immune organs (Galloway and Handy 2003). With regard to species of concern, studies with *Oncorynchus mykiss*, indicated that malathion-exposed fish exhibited large decreases in distance and speed after 24 hours exposure, however even with 96 hours of continuous exposure they recovered fully 48 hours later (Brewer et al 2001). The current usage on refuge properties is approximately 400 lbs compared to a regional background of 20,000 lb in use for public health and walnuts. Malathion is closely controlled on the walnut orchards to a coarse baited spray every other row to draw the WHF to the malathion. Rapid degradation and extensive buffer strips prevent off site movement of the active ingredient.

The third chemical that is considered for use on the SRNWR that could be implicated in affecting fish is Manganese Ethylenebisdithiocarbamate (Manex®). In research, the chemical manex has been implicated in carcinogenic and mutagenic effects in rats (Deveci 1999). In studies conducted on *Oncorynchus mykiss* the early fry stage appeared the most critical period (Van Leeuwen et al 1985). Manex® is currently used on the refuge properties in April in combination with copper to control walnut blight. The level of application averages about 1,000 lb per season on the refuge with regional use of over 500,000 lb.

Other species of concern that feed primarily on aerial insects probably have the greatest probability of being temporarily impacted by effects of pest control treatments. Although bats are not listed in Table 4, they would be a good example of a species group that could potentially be impacted by the loss of prey when the pest control treatments reduce populations of the nocturnal lepidopteron species.

Of the insectivorous birds listed in Table 4, Western Yellow Billed Cuckoo (YBCU), Willow Flycatcher (WIFL), and Bank Swallow (BASW) may be impacted by pest control treatments because their aerial invertebrate food base would be reduced. Pesticide applications made during June and July would coincide with YBCU and BASW nesting possibly impacting food resources available to feed nestlings although an abundance of non pest species rapidly recolonizes the walnut orchards from the adjacent wildlife areas.

Recent surveys have indicated that YBCU breed at the SRNWR in riparian vegetation. Swainson's Hawk (SWHA) and Bald Eagle (BAEA) are not insectivorous but will typically nest and/or roost in tall trees near open fields (SWHA) and open water (BAEA), possibly in walnut trees. Valley Elderberry Longhorn Beetles (VELB) may be present at the SRNWR on any areas containing blue elderberry plants, *Sambucus mexicana.* The use of buffers 300 feet or more between the walnut orchard pest control applications and blue elderberry plants should substantially help mitigate effect of applications of walnut pest control treatments on VELB. For the past five years, the Service at the SRNWR has only allowed the lepidopteron specific products, tebufenozide and pheromone disruption for the majority of the pest control applications. The application of malathion and eventually spinosad applied as a low volume bait only onto every third row of the orchard in combination with the 300 foot buffers substantially reduces any effect on VELB. The Giant Garter Snake (GGS) is an aquatic snake that inhabits relatively warm slow moving or standing water. The GGS does not occur near orchards at the refuge.

Introduction of parasitoids such as *T. pallidus* and *M. ridibimdis* or augmentive releases of the native, *T. platneri* may have a detrimental effect on native Ichneumonid and related wasps by reduction or competition for food sources. For the past ten years there has not been any known augmentive releases on the SRNWR properties. Resident populations of these biological control agents do reside in some of the walnut orchards after spreading from the Univertisy of California regional release programs.

TREATMENT THRESHOLDS

Treatment for the various pests of walnuts include both preventative treatments as is the case of Isomate C Plus which is applied to orchards before the emergence of codling moth larvae or copper hydroxide which is applied to walnut blight to keep the bacteria from spreading during rainy weather. The other treatments for walnut pests are primarily active controls in response to monitoring thresholds, orchard history, and the previous years pest levels of codling moth or walnut husk fly. The following Walnut IPM Treatment Summary (Table 5) outlines the anticipated active and preventative treatments during a normal year of walnut production with the treatment threshold and rate of treatment when required.

Figure 5. Walnut IPM Treatment Summary of Active and Preventive Chemical Controls

Pest/ Disease	Treatment	When to Treat	Rate of Treatment
Codling Moth	Tebufenozide (Confirm®)	Treat at 200 to 250 degree days after biofix for the overwintering, 1st and 2nd generations	1 to 2 pts per acre in 100 gallons of water
Codling Moth	Isomate C Plus®	Place pheromone dispensers in the upper third of the tree canopy before the first moth emergence in mid-March	Place 400 dispensers per acre
Codling Moth	Pheromone Mixture, Mating Disruption (3M MEC-CM®)	Apply at Biofix in the first generation and every 30 days up to five applications per season	Apply at 7.5 fl. oz./acre per application
Codling Moth	Pheromone Mixture, Mating Disruption (CheckMate CM-F®)	Apply at Biofix in the first generation and every 30 days up to five applications per season	Apply at 7.5 fl. oz./acre per application.
Walnut Husk Fly	Malathion with NuLure Bait	Monitor for flys with ammonium carbonate charged yellow sticky traps in areas of infestation. When eggs can first be squeezed from gravid females treat within 1 week	Apply 1.5 to 3 pt/acre mixed with NuLure bait every third row with a coarse spray to the lower half of the walnut tree
Walnut Husk Fly	Spinosad (GF-120 NF Naturalyte)	Monitor for flys with ammonium carbonate charged yellow sticky traps in areas of infestation. When eggs can first be squeezed from gravid females begin treatment.	Apply 1-3 fl. oz/per tree of undiluted spray solution. Repeat applications every 7-14 days.
Two Spotted Mite European Red Mite	Clofentezine (Apollo®)	Monitor regularly and treat if brown clusters of leaves are present on 10 % of the trees and no predators are present	Apply 4 fl.oz/acre in 100 gallons of water
Walnut Blight	Copper Hydroxide (Kocide 101®)	Apply first treatment no later than first pistillate bloom, followed by additional treatments every 7 to 14 days depending on frequency of rainfall	Apply the equivalent of 4 lb of metallic copper per acre in 100 gallons of water
Walnut Blight	Manganese Ethylenebisdithiocarbamate (Manex®)	If registered in 2002 apply with each treatment of Kocide	Apply at 1.8 qts/acre of formulated product in 100 gallons of water
Weeds, General	Glyphosate (Roundup Ultra®)	Treat tree rows when weeds begin growing next to tree trunks or around buildings and irrigation structures	Apply 1 to 4 lb or a.i. per acre in 5 to 30 gallons of water

RESEARCH NEEDS

There are considerable areas to be researched regarding the effects of walnut management within the inner river area adjacent to the SRNWC units. The role of biological control from the riparian forest as well as the role of bats, birds, and generalist predators is yet not clearly understood. Success with pheromone disruption in walnuts in northern California is being explored but success has not been demonstrated on a large scale. Further research on the efficacy of pheromone disruption will be needed before this technology can be recommended for more than one third of the SRNWR walnuts.

Despite the existence of buffer strips to prevent off site movement or drift of the pest control materials there is still concern that the use of Malathion may have either a transitory or cumulative effects on the reduction of non-target aerial or terrestrial insects, especially those that are rare or serve as pollinators for rare plant species. Inventories of at risk species should be undertaken based on their susceptibility to Malathion treatments. Further field research on the alternative for walnut husk fly control, the spinosad bait, should be accelerated.

Research from other areas needs to continue to be evaluated for application to the SRNWR. Furthermore, as new methods or products become available to control walnut pests, those that can provide adequate control with less negative impacts than the existing methods should be evaluated for use on the refuge walnut units if appropriate and feasible.

SUMMARY

The SRNWR units, which contain managed walnut production units have in the past and are currently using the most efficacious methods of pest control for codling moth, navel orange worm, mites, and walnut husk fly all of which may require a chemical control. All decisions to use a chemical control are based upon monitoring by licensed Pest Control Advisors and are used when cultural and biological methods have failed to control the pests below significantly damaging levels. Failure to treat the pests codling moth and navel orangeworm, both of which have 3 or 4 generations, will result in population buildups that can impact neighboring walnut and almond orchards.

Failure to treat walnut husk fly or mites can cause a 10 to 20 % portion of the crop to be unmarketable due to sunburn and secondary infestations from molds. Other preventative treatments, such as, copper hydroxide for the bacteria walnut blight are standard industry treatments that are required to prevent a 20 to 50 % crop loss. It is important to keep the walnut crops managed by the tenet farmers who derive proceeds from the crop versus allowing the large units of walnuts to be unmanaged for years while funding is solicited for restoration. Currently there are not sufficient funds to restore the 1,529 acres of walnuts.

This IPM Plan will provide sufficient flexibility to keep the properties managed until further research and field experience with codling moth pheromone disruption and

spinosad bait can be evaluated and implemented. Until an acceptable pheromone disruption system is developed over the next three years, tebufenozide will be used as the primary codling moth control method on 95 percent of the acreage.

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