Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Five-year Monitoring and Research Priorities for the Lower Colorado River Multi-species Conservation Program (2008–2012)

June 2008

Lower Colorado River Multi-Species Conservation Program Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
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City of Lake Havasu City
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Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState County Government Coalition
Desert Wildlife Unlimited

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Coachella Valley Water District
Colorado River Board of California
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Imperial Irrigation District
Los Angeles Department of Water and Power
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Nevada Participant Group

Colorado River Commission of Nevada
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Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
The Cocopah Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.

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Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
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Introduction

The Lower Colorado River Multi-Species Conservation Program (LCR MSCP) is a multi-stakeholder, federal and non-federal partnership responding to the need to balance the use of lower Colorado River (LCR) water resources and the conservation of native species and their habitats in compliance with the Endangered Species Act. This program is a long-term, 50-year plan to conserve at least 26 federal and state-listed candidate and sensitive species along the LCR, from Lake Mead to the Southerly International Boundary with Mexico, through the implementation of a Habitat Conservation Plan (HCP) (LCR MSCP 2004a). The Bureau of Reclamation (Reclamation) is the entity responsible for implementing the LCR MSCP. A Steering Committee, currently consisting of 54 entities, was formed as described in the *LCR MSCP Funding and Management Agreement* (FMA) (LCR MSCP 2004b) to provide input and oversight functions in support of LCR MSCP implementation.

The HCP conservation measures were designed to meet the biological needs for 26 covered species and potentially benefit 5 evaluation species included in the LCR MSCP. The HCP provides program-level guidance for ensuring that implementation of the conservation measures will be based on scientific information, methods, principles, and standards. Through utilization of adaptive management principles, new information obtained on species and their habitats can be used to implement biologically effective and cost-efficient conservation actions. The HCP acknowledged the need for implementing research and monitoring priorities within the first 20 years of the LCR MSCP period; implementation costs for monitoring, research, and adaptive management reflect these priorities (HCP Table 7-1).

A *Final Science Strategy* was drafted in August 2006 and finalized in October 2007, which outlines the adaptive management process (LCR MSCP 2006a). The Science Strategy describes a two-tier planning process to ensure effective implementation of research and monitoring actions: 1) a 5-year planning cycle, and 2) annual work plans. Every 5 years, a plan will be developed that describes the current knowledge for covered species and their habitats, priorities for research and monitoring to provide additional information needed over each ensuing 5-year period, and any potential challenges that may inhibit successful implementation of the scientifically sound conservation measures. An annual work plan that summarizes prior year accomplishments, describes current year ongoing activities, and outlines the proposed activities for the coming fiscal year is presented to the Steering Committee each year. These annual work plans enable adaptive management to occur in a timely manner, and ensure implementation of 5-year priorities.

A four-step process for identifying 5-year priorities is described in the Science Strategy:

- Identifying current knowledge and data gaps
- Initial ranking of data needs
- Review initial data ranking and propose priorities
- Determine final data need priorities

Annual priorities are established during the work plan process as described in the Science Strategy. First priority is the continuation of long-term research and monitoring projects identified and implemented during prior planning. Additional information obtained through these research and monitoring programs determine the need for additional data. These data are prioritized by balancing need with potential annual budgets, as described in Table 7-1 of the HCP (LCR MSCP 2004a). Priorities may shift as new information is obtained, opportunities are identified, and adaptive management recommendations are adopted. Five-year budgets for monitoring, research, and adaptive management are approximately $24,000,000 through FY10, increasing to $29,670,000 in FY11-FY16 (LCR MSCP 2004a).

The first 5-year planning cycle for LCR MSCP implementation covers fiscal years 2008 through 2012. This document establishes monitoring and research priorities for each implementation element described in the HCP: Fish Augmentation, Species Research, Created Habitat Research, System Monitoring, and Post-Development Monitoring. The document provides the 5-year research and monitoring priorities for individual covered species, species guilds, and/or their habitats needed to successfully implement conservation measures described in the HCP. Priorities have been established based on information outlined in the species accounts completed in 2007 (LCR MSCP 2007a).

Ongoing research and monitoring programs may continue into this 5-year planning cycle. New data accumulated from research and monitoring activities will be reviewed throughout the 5-year planning cycle. Results of research and monitoring activities outlined in this document will be evaluated during 2012 and new priorities will then be established for the next 5-year cycle (2013-2017). Some research and monitoring priorities that begin during this initial 5-year planning cycle are not anticipated to be completed until after 2012. The evaluation scheduled for 2012 will account for these long-term projects.

Research and Monitoring Activities Initiated Prior to 2008

Research and monitoring programs initiated prior to LCR MSCP establishment were continued during the first years of plan implementation. Several additional research and monitoring projects were initiated after the Record of Decision was signed in April 2005. Ongoing research and monitoring activities may continue as a high priority. Information obtained through these activities has led to additional research and monitoring priorities listed in this plan. The following is a brief discussion of the research and monitoring program initiated prior to 2008.

Fish Augmentation

Much of the current capability for fish augmentation stems from research and development at Willow Beach National Fish Hatchery, Achii Hanyo Rearing Facility, and Bubbling Ponds State Fish Hatchery between 1994 and 2005. Considerable work went into learning how to feed, grow, and treat these fishes. For example, razorback sucker were initially fed

a diet formulation designed for rainbow trout. During 1993 and 1994, larval razorback sucker were reared on brine shrimp and then put into lakeside ponds. They had no apparent skeletal deformities. In 1995, larvae were brought into the hatchery and, again, were initially fed brine shrimp. As they advanced in size and age, they were switched to a trout formulation. The fish began showing signs of skeletal deformities (lordosis and scoliosis). A new diet was worked out composed of brine shrimp flake, earthwork flake, and dried algae. This corrected the problem. By 1997, the program converted to a new razorback diet. During this first 5-year research and monitoring action, we will be developing a new diet formulation specifically for bonytail.

The current rearing program is benefiting from field observations made on juveniles in rearing ponds, adults on spawning grounds, and radio and sonic tracking activities, all accomplished by MSCP partners prior to signing the ROD.

Species Research

The most notable research actions for fish prior to 2008 have been for post-stocking survival. Unfortunately, the results are showing that survival of bonytail is almost zero, and that survival of razorback sucker is only slightly better. There are a number of factors that are being investigated with regards to poor survival of these fish. First, size and time of year the fish are stocked seems important. A strong correlation between size at time of release and first-year survival has yielded the current target size of 300 mm total length. Work on Lake Mohave is examining even larger fish, up to 500 mm total length.

Many species research projects were conducted on the life history of secretive marsh bird species over the 20 years prior to LCR MSCP implementation. Recent studies focused on survey protocol techniques or potential habitat management activities. In 2005, the University of Arizona conducted a study to determine whether multi-species marsh bird surveys could be conducted in place of the traditional single-species Yuma clapper rail surveys without compromising the data collected. The multi-species protocol was adopted in 2006. In 2005, the University of Arizona completed a 3-year study on the effects of fire on Yuma clapper rails and California black rails along the LCR (Conway et al. 2006). Information obtained during this study may be used to manage created marsh habitats in the future. Species research priorities listed in this plan were derived from data gaps identified in existing literature and through conversations with species experts.

Research and monitoring activities for riparian obligate birds were undertaken for federally listed threatened and endangered species prior to LCR MSCP implementation. Life history studies have been conducted on the southwestern willow flycatcher along the LCR since 1996, including studies on brown-headed cowbird parasitism completed in 2006. Information gathered during these studies has been used to create land cover types for southwestern willow flycatchers under the Secretarial Implementation Agreement (SIA) since 2006. Yellow-billed cuckoo life history studies along the LCR began in 2005. Other riparian obligate avian covered species have not been studied extensively along the LCR so priorities found within this plan emphasize life history studies to determine habitat requirements for these species.

Other LCR MSCP covered species have had little research conducted on them, especially on LCR populations. Information on covered and evaluation species of bats, small mammals, insects, and amphibians is extremely limited; thus, species research priorities detailed in this plan concentrate on life history and habitat requirements. Highest priority species research needs are for species with habitat creation goals as detailed in the HCP conservation measures.

Habitat Creation Research

Habitat creation, restoration, and enhancement projects have been conducted along the LCR for 30 years. Potential explanations for success and failure of past efforts have been documented (Pinkney 1992; Raulston 2003). Past riparian habitat restoration efforts were mainly small-scale projects, usually utilizing potted plants or poles. In anticipation of LCR MSCP implementation, studies were conducted on restoration techniques that could effectively and efficiently create large-scale habitat projects. Studies on mass transplanting seedlings and seed feasibility began in 2005 and are expected to be completed by 2009. Mass transplanting has already proven to be an effective and efficient method for creating large habitat blocks under agricultural conditions. High priority research detailed in this plan will investigate such issues as plant propagation to provide materials for mass transplanting, invasive species management, and developing optimal irrigation regimes.

Native fish habitat creation projects have focused on isolated aquatic environments that reduce or exclude nonnative fishes. Investigations on the application and effectiveness of fish screening technologies to isolate backwaters began in 2005 and will continue through 2008. These studies will evaluate screen hydraulic capabilities, biological exclusion effectiveness, and long-term maintenance applications.

System Monitoring

Much of the work under way for monitoring native fishes is a continuation of the various interagency fish roundups that began as early as 1987 on Lake Mohave. These actions provide a look at a large area over a short period of time. Each agency is assigned a portion of the lake to cover and results are shared between agencies so that everyone benefits by getting the results of a full lake-wide survey. Actions to develop “hands-off” monitoring also began on Lake Mohave, with the initiating of helicopter surveys to locate spawning groups in 1992.

Prior to LCR MSCP implementation, avian system monitoring efforts concentrated on federally listed threatened and endangered species. Yuma clapper rail surveys were conducted by various agencies along the LCR. In 2006, these surveys were expanded to include other secretive marsh bird species, including California black rail and least bittern, both LCR MSCP covered species. Riparian obligate bird presence/absence surveys were restricted to the southwestern willow flycatcher prior to LCR MSCP implementation. Southwestern willow flycatcher presence/absence surveys were initiated in 1996. In 2005, willow flycatcher habitat monitoring began on occupied sites between Parker and Imperial dams to meet conservation measures outlined in the SIA. Intensive, site-specific data for

all species were collected at MAPS sites beginning in 2000. Yellow-billed cuckoo system monitoring began in 2006 after protocols were established through studies initiated in 2005. In 2007, a system monitoring program for other riparian obligate covered species was designed using data collected from 2005 to 2006.

System monitoring has been initiated for other covered species and their habitats prior to development of this plan. System monitoring of bat species began in 2002 with the development of a survey protocol. MacNeill's sootywing skipper surveys were initiated in 2006 and are expected to be completed by 2009. Land cover types were delineated from the Grand Canyon to the Southerly International Boundary with Mexico using digital imagery obtained in 2004. Other system monitoring projects are being planned after protocols and studies have been completed, including small mammal surveys.

Post-development Monitoring

Monitoring has been conducted prior to development of designated habitat creation sites for targeted covered species. Post-development monitoring has been conducted on sites as habitat creation activities have commenced. Riparian restoration demonstration sites completed prior to LCR MSCP implementation were monitored for planting success, growth, and species utilization. Data collected during these monitoring activities have been used to design habitat creation sites conducted during LCR MSCP implementation.

Five-Year Monitoring and Research Priorities (2008-2012)

Fish Augmentation

The LCR MSCP Fish Augmentation Program will rear and stock 1.2 million native fish into the lower Colorado River (LCR MSCP 2006b). There are two focus areas for monitoring and research under the Fish Augmentation Program. These are fish propagation and fish distribution. Monitoring of these activities is accomplished through collection and tracking of production and distribution records kept at each facility, and these are summarized in annual/progress reports from each facility. For example, Willow Beach NFH records all of the larval razorback sucker it receives from the Lake Mohave Native Fish Work Group partners during the spring, tracks growth and survival of each year-class of fish kept on station, and tracks and records all fish leaving the station for transfer to another facility or for stocking into receiving waters. This monitoring is sufficient to assess effectiveness of the augmentation program.

As for research activities and priorities, it is important to note that RASU and BONY are rare fishes, and have only been in captivity for a few decades. Propagation and culturing techniques used for other fishes, such as rainbow trout and channel catfish, do not always work for these two native Colorado River species. During FY06 and FY07, research actions reviewed the procedures used by various facilities to rear RASU and BONY. A workshop is planned for the summer 2007 to present the findings of these reviews, and to develop a prioritized list of research questions for culturing each species. From this

priority list, study plans will be developed, and research will be initiated starting in 2008 to answer these questions. Research actions will continue through 2012 or until the priority list is exhausted.

Research will also be initiated to examine fish distribution techniques. Once the fish are reared, they must be marked and then stocked out. Research questions pertaining to the handling, marking, and distribution of these fishes are also expected to be generated during the summer 2007 workshop. Investigations to answer these questions will begin in 2008.

Species Research

General and species specific conservation measures are described in the HCP. The LCR MSCP is a habitat-based program that was designed, in part, to create and maintain habitat for covered species. Habitat creation acreage is expected to provide habitat requirements for multiple species at many sites along the LCR. To effectively and cost-efficiently create and manage habitats, habitat requirements for each species must be determined. Habitat creation projects will be designed to benefit the maximum number of covered species that are likely to use these sites based on knowledge of species habitat requirements at that time. Data collected during monitoring and research activities will provide additional information on habitat requirements throughout the LCR MSCP time period. These data will be used to manage existing sites through the adaptive management process and to design future habitat creation projects.

Other conservation measures have been designed to identify and alleviate potential limiting factors for covered species populations. Specific research projects may be developed to provide insight on limiting factors. Information obtained from these studies will be used to help manage covered species populations and habitats.

In 2006-07, species accounts were developed for LCR MSCP covered and evaluation species using information obtained from existing literature (LCR MSCP 2007a). The amount of existing data varied between species. For some species, such as the southwestern willow flycatcher, extensive monitoring and research programs have been conducted along the LCR and elsewhere in the range of the species. Other species, like the yellow-billed cuckoo, have been studied outside of the LCR MSCP area, but little is known about local populations. For some species, limited information is available for anywhere within their range. Research priorities have been determined by evaluating species or guilds that utilize each habitat described in the HCP.

Fish Species

The LCRMSCP will implement conservation measures for four native Colorado River fishes: humpback chub (HUCH), flannelmouth sucker (FLSU), razorback sucker (RASU) and bonytail (BONY). The species research actions for HUCH are limited to financial support of research needs within the Glen Canyon Adaptive Management Program, and no specific species research activities are planned. FLSU conservation measures call for supporting monitoring and research of FLSU populations in Reach 3 for a 5-year period. This work is currently underway and will be completed in 2010. An assessment of FLSU

management needs, along with recommended management strategies will be developed, based upon the results of this work. Any additional species research needs for FLSU beyond 2010 are expected to be identified in this report.

The LCRMSCP will rear and stock some 660,000 RASU and 620,000 BONY over the life of the program. Roughly 10% of these fish are to be released over a 5-year period to allow for extensive research and monitoring. These releases are presently targeted to begin in 2011 and run through 2016. The associated research and monitoring program will also commence in 2011; however, the studies may continue through 2019, if necessary. During the summer of 2007, Reclamation will develop a science advisory panel consisting of fishery scientists familiar with RASU and BONY life history and ecology. The panel will convene quarterly during 2008 and 2009 to develop and prioritize a multi-year research and monitoring program to coincide with these fish releases. During 2010, Reclamation will organize, coordinate, and finalize study plans and scopes of work necessary to start this research program in 2011 along with the accelerated native fish stockings.

Marsh Birds

Three secretive marsh birds have been listed as covered species under the LCR MSCP: Yuma clapper rail, least bittern, and California black rail. The Yuma clapper rail nests in dense, emergent vegetation from shallow water areas near shore to deep water (greater than 1 meter) in interior marsh habitat (Eddleman 1989; Conway et al. 1993). Foraging habitat is characterized by low emergent stem densities, moderate water depths, and high percent of open water (Eddleman 1989; Conway et al. 1993). Yuma clapper rails appear to be year-round residents, moving locally to interior marsh areas during the non-breeding season (Eddleman 1989; Conway 1990; Conway et al. 1993). Ideal habitat is a mosaic of different age and densities of emergent plants, interspersed with open water (Eddleman and Conway 1998). Home range varies from an estimated 6.7 hectares during breeding season to 24 hectares during the winter (Conway 1990). The least bittern nests in dense, tall emergent vegetation, interspersed with clumps of woody vegetation and open water (Gibbs et al. 1992). Nests have been found over water depths from 8-96 cm (Weller 1961; Gibbs et al. 1992). Patch size is unknown along the LCR. In Iowa, ideal habitat is described as 50% dense, emergent vegetation and 50% open water (Weller and Spatcher 1965 in Gibbs et al. 1992). It is unknown if similar conditions are required along the LCR. Some least bitterns may be year-round residents or individuals from other breeding populations may winter along the LCR. California black rail habitat is characteristically dense, emergent vegetation, with high canopy closure, near stand edges close to upland habitats (Flores and Eddleman 1995). Shallow, stable water depths (<3cm) appear to be an important habitat requisite (Flores and Eddleman 1995; Tecklin 1999 in Conway et al. 2002).

The HCP requires the creation of 512 acres of marsh habitat. All 512 acres must provide habitat requirements for the Yuma clapper rail and least bittern habitat, while 130 acres must also provide habitat requirements for the California black rail habitat within reaches 5 and 6 near existing occupied black rail habitat. Because created marsh acreage must provide habitat for all three secretive marsh birds, the ideal mosaic, incorporating each species habitat requirements, must be developed. Many habitat requirements for the Yuma

clapper rail, least bittern, and California black rail have been determined, although additional data are needed to effectively design, create, and manage these marsh habitats as a mosaic.

Species research priorities have been identified for marsh birds. Five-year priorities have been established based on immediate data needs and ability to accomplish these tasks. These 5-year species research priorities for the marsh birds include:

- Further define habitat requirements for least bittern, especially minimum patch size and percent vegetation/open water considered ideal for this species. Conservation measures list minimum patch size for Yuma clapper rail and California black rail (5 acres); however, no minimum patch size has been determined for least bittern. Patch size estimates have ranged from 0.4 hectares to greater than 5 hectares elsewhere in the range (Brown and Dinsmore 1986; Gibbs and Melvin 1990 in Gibbs et al. 1992).
- Design a habitat mosaic to provide the habitat requirements needed by all three marsh birds within one habitat block.

Additional species research needs have been identified for marsh birds. These data are important for future management of these species and their habitats. Future marsh bird species research needs include:

- Quantify the effects of water fluctuation on breeding Yuma clapper rails. Areas created to provide habitat for California black rails will be managed for stable water depths; however, areas created for clapper rails and least bitterns can have fluctuating water depths. Evaluating the effects of water fluctuation on known clapper rail populations may help determine possible management guidelines for habitat maintenance.
- Research population dynamics, such as migration, seasonal movements, seasonal habitat use, and dispersal distances, to help determine potential use of created habitats. These data may help with site selection and habitat maintenance activities.
- Evaluate the effects of selenium accumulation in backwaters and marsh habitats.

Secretive marsh birds, by nature, are difficult to study. Population numbers, especially California black rail populations, may limit the opportunity to complete some of these research priorities within the LCR MSCP area. Research conducted in other areas may not provide the necessary information for LCR MSCP populations. Existing population abundance and distribution needs to be determined to effectively conduct research on these species.

Riparian Birds

Nine avian covered species utilize riparian habitat for breeding, foraging, and migration. Some covered avian species are riparian obligates while others will utilize upland habitats. All nine species will utilize cottonwood-willow stands for breeding along the LCR, although many will also use honey mesquite for breeding, foraging, migration, or wintering habitat. Several species, such as summer tanager, require habitat characteristics

most readily found in mature cottonwood-willow stands, while others are more closely associated with early seral stages of cottonwood-willow stands.

The HCP requires the creation of 5,940 acres of cottonwood-willow habitat and 1,320 acres of honey mesquite habitat. Each riparian bird species has habitat creation acreage requirements listed by vegetation type and structure. By evaluating created acreage requirements and covered species habitat requirements, it is apparent that riparian habitat creation projects must be designed to provide habitat for multiple covered species at each site. Birds with similar habitat requirements will be managed as guilds. Specific habitat requirements for each species will be provided in appropriate habitat creation sites.

Early Seral Stage Cottonwood-Willow Habitat
Although southwestern willow flycatchers will utilize early seral to mature willow stands, they are most closely associated with dense riparian habitat above or near saturated soils or standing water (Sogge and Marshall 2000; USFWS 2002). High stem density, canopy closure, and foliage density appear to be important habitat characteristics (Sedgwick and Knopf 1992; Sogge and Marshall 2000; McKernan and Braden 2002; Allison et al. 2003; Stoleson and Finch 2003; Paradzick 2005; Koronkiewicz et al. 2006). Nests may be located in areas with fewer temperature extremes, higher relative humidity, and cooler diurnal temperatures than non-nest sites (Koronkiewicz et al. 2006). Territory size can range from 0.1 to 2.3 hectares (McCabe 1991). Adults show high site fidelity between years. Willow flycatchers will forage in adjacent habitats, including mesquite. The HCP requires the creation of 4,050 acres of cottonwood-willow I-IV for southwestern willow flycatchers, with at least 2,700 acres managed for both willow flycatchers and yellow-billed cuckoos. Minimum patch size must be at least 10 acres and surface water or saturated soils must be within 200 feet of nesting habitat. Habitat mosaics should include multiple structural classes, seral stages, and age cohorts to provide habitat for southwestern willow flycatchers and other associated covered species.

Yellow warbler habitat use mimics the southwestern willow flycatcher. Dense riparian habitat, either as early successional habitat or dense understory habitat within more mature cottonwood-willow stands, are ideal breeding habitats. Yellow warblers may also utilize honey mesquite for breeding, although mesquites may provide less quality breeding habitat than cottonwood-willow (Wise-Gervais 2005). Less information is available on yellow warbler micro-habitat requirements than for willow flycatchers. The HCP requires the creation of 4,050 acres of cottonwood-willow I-IV for yellow warblers. Habitat created for southwestern willow flycatchers and yellow-billed cuckoos are expected to provide the necessary habitat characteristics for yellow warblers.

Arizona Bell’s vireos breed in streamside willow and mesquite stands that have a well-developed shrub layer, dense understory, and moderately tall overstory. High quality habitat consists of early successional willows mixed with mesquite (Rosenburg et al. 1991; Serena 1986). Territories are often clumped within the habitat. The HCP calls for the creation of 2,983 acres of cottonwood-willow III-IV and honey mesquite III for Arizona Bell’s vireo habitat. Early successional riparian habitat developed for southwestern willow flycatcher should provide the necessary habitat requirements for Bell’s vireo.

Vermillion flycatchers breed in open cottonwood-willow and mesquite stands, usually associated with accessible water. In central Arizona and northern Mexico, vermillion flycatchers were not found in areas where cottonwoods formed a dense canopy and mesquites created a dense understory (Carothers 1974). Nest height ranges from 1 to 18 m. Vermillion flycatchers are resident birds along the LCR, often observed within open mesquite stands during the winter. Detailed habitat requirements have not been described along the LCR. The HCP requires the creation of 5,208 acres of cottonwood-willow I-IV and honey mesquite III for vermillion flycatchers. Habitat created for southwestern willow flycatcher and yellow-billed cuckoo is expected to provide the necessary habitat requirements for the vermillion flycatcher, although the vermillion flycatcher's preference for open stands will insure that a mosaic of different seral stages, densities, and age cohorts will need to be developed and managed.

Late Seral Stage Cottonwood-Willow Habitat

Yellow-billed cuckoos breed primarily in mature cottonwood-willow stands along the lower Colorado River, although they can occasional be found in isolated cottonwoods or willows mixed with tall mesquites or dense saltcedar stands (Rosenburg et al. 1991; Halterman 2001). Yellow-billed cuckoos nest primarily in willows and forage primarily in cottonwoods, mesquites, and saltcedar. High canopy closure, high foliage volume, intermediate basal area, and intermediate tree height provide ideal habitat along the Kern River (Laymon et al. 1997). Standing water may be an important breeding habitat characteristic. Patch size and habitat width appear to be limiting factors, with optimal stands greater than 80 hectares and wider than 600 meters (Laymon and Halterman 1989). Yellow-billed cuckoo population abundance fluctuates between years, possibly due to weak site fidelity and nomadic behavior caused by prey abundance. The HCP requires the creation of 4,050 acres of cottonwood-willow I-III for yellow-billed cuckoo, including at least 2,700 acres managed for yellow-billed cuckoo and southwestern willow flycatcher.

Summer tanagers require structurally well developed cottonwood-willow stands, although they will use mesquite and tamarisk at high elevations. Patch size (>9 hectares), tree height (>9 meters), and canopy closure may be important habitat characteristics for summer tanager breeding habitat (Rosenburg et al. 1991; Corman 2005). Brown-headed cowbird parasitism may have an affect on nest success, though existing data indicates that parasitism rates are low along the Kern River (Gallion in Robinson 1996). The larger bronzed cowbird has been recorded parasitizing summer tanager nests in Mexico (Unitt 2006). Conservation measure SUTA1 requires the creation of at least 602 acres of cottonwood-willow I-II for summer tanager. Habitat created for yellow-billed cuckoo and southwestern willow flycatcher will provide the habitat characteristics required by summer tanagers.

Three covered avian species nest in cavities found in mature saguaro cactus, mesquite, and/or cottonwood-willow stands. Elf owls are migratory, arriving along the LCR in March and leaving in September. Elf owls are secondary cavity nesters, relying on cavities excavated by Gila woodpeckers, gilded flickers, and ladder-backed woodpeckers along the LCR (Halterman et al. 1987). Home range size varies from 0.2 to 0.4 hectares, with up to 20% overlap between individuals (Ligon 1968). Breeding densities vary between habitat

types, with higher densities recorded in mature riparian woodlands. Distribution and abundance is unknown along the LCR. Gila woodpeckers and gilded flickers are resident throughout the year along the LCR. Both species breed from February into July, although most breeding occurs early in the season. Gila woodpecker territory size ranges from 4.4 to 10.0 hectares (Hensley 1954). Competition from other cavity nesters, including European starlings, may be a threat to all three species. The HCP requires the creation of 4,050 acres of cottonwood-willow I-III for gilded flickers, 1702 acres of cottonwood-willow I-IV within reaches 3-6 for Gila woodpeckers, and 1,784 acres of cottonwood-willow I-II and honey mesquite III for elf owls. Gila woodpecker acreage must have a minimum patch size of 50 acres.

Five-Year Research Priorities

Habitat creation projects must be managed for multiple species or guilds by providing a mosaic of vegetation community types and structures that fulfill habitat requirements for each specific species. Habitat requirements, threats, and limiting factors are known for several species; however, others have not been determined, especially along the LCR. These data must be acquired to effectively and efficiently create, manage, and maintain riparian habitat for covered avian species. Five-year research priorities have been determined for avian species that utilize riparian habitats, including:

- Conduct studies on water needs for riparian birds within created habitats. Southwestern willow flycatchers require standing water or moist soils during the breeding season (Sogge and Marshall 2000; USFWS 2002); however, it is unknown whether water is required throughout the entire habitat, what percent of the habitat must be wet to provide adequate habitat requirements for breeding, how long into the breeding season water is required, and when habitat needs to provide these moist soil characteristics to attract covered species. Some species, such as yellow-billed cuckoo, may benefit from moist soils; however, data are not currently known.
- Define habitat requirements and limiting factors for covered species and initiate studies to define habitat requirements where existing information is limited. Use these data to develop models to determine ideal habitat characteristics and habitat mosaics, at the site and landscape levels. Data gathered through existing monitoring and research will be used to develop initial habitat suitability index models for covered species. As additional data is accumulated, models will be re-evaluated. Specific habitat requirement data needs may include:
    - Acquire micro-habitat requirements data for breeding covered species so that threshold ranges can be estimated.
    - Delineate required breeding habitat conditions for yellow-billed cuckoo and Bell’s vireo along the LCR.
    - Research necessary breeding habitat requirements for vermillion flycatcher, including optimal tree density, shrub density, and herbaceous plant effects.
    - Research necessary breeding habitat requirements for summer tanager, including minimum patch size and canopy closure.

Additional species research projects may be needed to acquire information necessary for future habitat creation planning and management. These relationships will be addressed through analysis of information acquired through the monitoring program, as well as through directed research studies. Potential species research topics include:

- Study the effects of habitat fragmentation on southwestern willow flycatcher meta-population biology. These data are important in determining potential habitat creation sites through the site selection process.
- Acquire additional information on required habitat characteristics necessary to effectively and efficiently manage habitat creation sites for targeted covered species, including:
    - Year-round habitat requirements for resident species, including vermillion flycatcher, yellow warbler, gilded flicker, and Gila woodpecker.
    - Effects of predation and/or parasitism for susceptible species, including the southwestern willow flycatcher, yellow warbler, and Bell's vireo, and develop potential management actions.
    - Causes for population fluctuations between years for yellow-billed cuckoo, particularly the relationship between prey abundance and population size.
    - Relationship between water availability and insect diversity/abundance for covered avian species that rely on insects for prey.
- Conduct demographic studies, such as determining reproductive success, when these data are necessary for developing management actions at created habitat sites.

Specific habitat requirements for some covered species may be difficult to determine along the LCR due to limited population distribution and abundance. Assumptions may be made during initial habitat creation projects that will have to be tested through specific monitoring and research projects. Some specific research questions are dependent on certain habitat conditions that require time to reproduce, such as determining the effects of competition between European starlings and native cavity nesters. These studies may be conducted off site, if appropriate, or have been assigned a lower priority until habitat maturation can occur.

Bats

Two bat species are covered species under the LCR MSCP, the western red bat and the western yellow bat. Little is known about the life history requirements of either species, especially along the LCR. Both species will use riparian habitat, especially cottonwoods, for roosting and foraging habitat. Roosting and foraging habitat may be selected for patch size and prey abundance. Habitat use and migration may occur seasonally. Conservation measures listed in the HCP are similar for both species. Within reaches 3-5, 765 acres of cottonwood-willow I-II and mesquite III will be created for red and yellow bats. To accomplish these conservation measures, 5-year research priorities include:

- Initiate studies to categorize roosting habitat requirements, especially habitat level vegetation requirements such as patch size, canopy closure, species requirements, and mosaic. Data collected during monitoring activities may be used to help describe roosting requirements.

- Initiate studies to categorize foraging habitat requirements, including prey abundance.

Future species research projects may be initiated to provide the information necessary to effectively and efficiently manage habitat for targeted bat species, including:

- Investigate local or seasonal migration to determine whether local populations migrate within the LCR or elsewhere, especially during the winter.

Red and yellow bats are rare along the LCR. Some individuals have been detected along the main stem and tributaries such as the Bill Williams River and the Muddy River (Williams 2001; Brown 2006). These bats are not colonial, so population estimates are difficult to obtain. Surrogate species such as the hoary bat may be used to determine habitat requirements.

California leaf-nosed bat and pale Townsend's big-eared bat are evaluation species under the LCR MSCP. Research priorities have not been established for these species.

Small Mammals

The Colorado River cotton rat and Yuma hispid cotton rat are covered species under the LCR MSCP. The Colorado River cotton rat was believed to be primarily a marsh species; however, more recent studies have determined that dense grass also provides quality habitat (Andersen and Nelson 1998; Reclamation unpublished data). This species has been found in cattail/bulrush marsh, common reed, moderate to dense grass, and drier grasslands. It may be expanding into agricultural areas. The Yuma hispid cotton rat appears to be associated with dense grass within riparian habitats. Grass height and density may be important habitat requirements for this species (Cameron and Spencer 1981). The HCP requires the creation of 125 acres of marsh habitat within reaches 3 and 4 for the Colorado River cotton rat and 76 acres of cottonwood-willow within reaches 6 and 7 for the Yuma hispid cotton rat. Additional habitat may be provided for both species, especially the Colorado River cotton rat, by managing cottonwood-willow habitat for dense herbaceous cover. Five-year research priorities for small mammals include:

- Evaluate the genetic differences between Yuma hispid cotton rat and other hispid cotton rats found in southeastern Arizona. The Yuma hispid cotton rat may be a highly differentiated sub-species with unique life history and habitat characteristics from the main population of hispid cotton rats. Existing information from the southeastern Arizona sub-species, when combined with data acquired along the LCR, will provide for habitat creation and maintenance.
- Initiate research to describe habitat requirements for Colorado River cotton rat in both marsh and cottonwood-willow habitats, including limiting factors influencing habitat use or selection. Additional benefits for this species may be obtained by managing some cottonwood-willow habitat creation sites for dense herbaceous and grass cover.
- Initiate research to describe habitat requirements for Yuma hispid cotton rat, including limiting factors influencing habitat use or selection.

Little information exists on these two species along the LCR. Basic life history information, such as distribution and habitat preferences, are not entirely understood. Since these two species can not be readily distinguished from one another in the field, genetic samples need to be acquired through presence/absence surveys.

The desert pocket mouse is listed as an evaluation species under the LCR MSCP. Conservation measure requirements and existing life history studies conducted in Nevada preclude the need for priority research for this species.

Insects

The MacNeill's sootywing skipper is a covered species under the LCR MSCP. Dense quailbush is required for egg and larval stages while adult skippers require nectar producing plants for feeding. High leaf water content may be an important habitat characteristic. The HCP requires the creation of 222 acres of skipper habitat by creating a mosaic of honey mesquite III and quailbush. Five-year research priorities include:

- Acquire additional information on habitat requirements, including micro-habitat characteristics such as soil moisture, soil salinity, soil nitrogen, and plant water content.
- Design habitat mosaic including quailbush, nectar producing plants, and mesquite.

Reptiles and Amphibians

The desert tortoise, flat-tailed horned lizard, and relict leopard frog are covered species under the LCR MSCP; however, conservation measure requirements specifically target activities that utilize information from the Desert Tortoise Conservation Team, the Flat-tailed Horned Lizard Interagency Coordinating Committee, and the Relict Leopard Frog Conservation Team, respectively. Species research priorities have not been established for these species under the LCR MSCP. The Colorado River toad and the lowland leopard frog are listed as evaluation species. The Colorado River toad is a semi-aquatic species that breeds in permanent and seasonal pools or irrigation ditches in open desert, mesquite, and riparian woodland habitats (Stebbins 1985; Natureserve 2006; Brennen and Holycross 2006). The lowland leopard frog inhabits ponds and streams along water systems. Aquatic and terrestrial habitat heterogeneity appears to be an important habitat characteristic as different life cycles may require different habitat characteristics (Arizona Game and Fish Department 2001). Although created habitat goals do not require Colorado River toad or lowland leopard frog acreage, conservation measures do require life history studies on both of these evaluation species. Five-year priorities include:

- Initiate studies on the ecology of the Colorado River toad and the lowland leopard frog, including population biology, limiting factors, and potential factors for population declines.

Once additional information is acquired describing the ecology of the Colorado River toad and lowland leopard frog, studies will be initiated to determine the feasibility of establishing these species in unoccupied habitat, including the potential for captive

breeding and translocation within the LCR, as directed by the LCR MSCP HCP. These studies are not anticipated to begin within the first 5 years of the program.

Plants
Sticky buckwheat and threecorner milkvetch are endemic plant species in Clark County, Nevada, and northern Mohave County, Arizona. Both species are covered species under the LCR MSCP. Conservation measures are limited to providing funding to the Clark Count Multi-Species Habitat Conservation Plan Rare Plant Workgroup. Research priorities will not be set under the LCR MSCP.

Created Habitat Research

Habitat creation goals for the LCR MSCP include the establishment of 5,940 acres of cottonwood-willow, 1,320 acres of honey mesquite, 512 acres of marsh, and 360 acres of backwaters. To the extent practicable, cottonwood-willow, honey mesquite, marsh, and backwaters will be restored in proximity to other habitat types to create integrated mosaics of habitat that approximate the relationships among aquatic and terrestrial communities historically found along the LCR floodplain. During the first 5 years of the program, science and research is expected to focus on establishing land cover types. As more information is gathered through species research and species monitoring, the focus is expected to shift to the management and maintenance of created habitat.

During the first phase of the LCR MSCP, it is expected that little research on habitat creation techniques, in the classical sense, will be required to meet the goals for initially establishing LCR MSCP habitat. The techniques to efficiently and cost effectively create the needed habitat types are likely already in existence, and generally require implementing “best management practices” for construction. The primary short-term requirements for habitat creation research goals are to examine and experiment with existing techniques and their application to habitat creation goals. For example, mass transplanting is widely used for the establishment of crops such as broccoli. The mass transplanting demonstration (LCR MSCP 2007b, Work Task E7) attempts to establish large quantities of native plants using standard commercial practices. Native cottonwood and willow were collected, propagated, and mass transplanted. Survival after 2 years is greater than 95%. A seed feasibility study (LCR MSCP 2007b, Work Task E8) is documenting the collection, storage, and germination of numerous native plants. The 3-year study increases in scale from a greenhouse to a 20 acre experimental plot.

Wildlife Habitat
Research strategies for conservation areas being developed primarily as wildlife habitat (cottonwood-willow, honey mesquite, or marsh habitats) target improving vegetation growth and survival, testing alternate propagation and habitat establishment techniques, determining habitat creation potential at identified sites based on current ecological functions, and evaluation of technologies to assist in meeting specific habitat requirements. Short-term research to facilitate land cover establishment are expected to include:

- establishing methods for collection and storage of plant propagates from native plants
- identifying and evaluating techniques for propagating key plant species
- controlling invasive and/or exotic plant species
- minimizing water usage

Fish Habitat
Habitat creation for native fish is limited to backwater development. Implementation strategies range from making minor modifications to existing backwaters to major modifications such as the complete excavation of undeveloped land. Created habitat research for fish will focus on how to develop the physical, chemical, and biological characteristics of these backwater habitats to provide proper ecological function. Post-development monitoring will evaluate both the maturation of the site as it develops into covered species habitat and the use of the habitat by target species.

The focus area for the first 5-year planning cycle will be the recently developed Imperial Ponds on Imperial National Wildlife Refuge. These ponds were designed with various "fish friendly" features such as rip-rap shoreline, gravel spawning beds, increased depth, and vegetated hummocks, thought to contribute to the success of the ponds in supporting life-cycle completion by RASU and BONY. Extensive monitoring and research will be conducted to assess the relative effectiveness of these design features. However, the research will not be solely to assess backwater habitat development. The conservation measure for backwater habitat identifies that while the ultimate purpose of the habitat is to serve as refuges for these species, these backwaters can be used for fish production and species research during the life of the program. As there are six individual ponds on site, it is presently anticipated that at any given time during the first 5-year period, one or more ponds will be involved in fish production, one or more involved in species research, and one or more involved in created habitat research.

System Monitoring

System monitoring will be conducted to collect and analyze data on existing covered species populations and their habitats to determine status, distribution, trend, density, migration, productivity, and/or other important ecological parameters. Data obtained during system monitoring will provide information for habitat creation design and evaluation. System monitoring projects may utilize single species monitoring protocols, multi-species protocols, or habitat-based protocols. Initial 5-year priorities will determine status and distribution of covered and evaluation species, where appropriate to meet conservation measures detailed in the HCP.

Fish Species
System monitoring for fish species will be conducted to maintain an awareness of existing populations and their habitats, and to have these data available for use as long-term assessment tools in the adaptive management program. Only three of the four covered native fish species (RASU, BONY, and FLSU) will be monitored by the LCR MSCP at this time. The system monitoring actions for RASU and BONY gather information on the

status of these species by project reach. A status report will be developed annually, depicting the end-of-year status for distribution and abundance of both species. FLSU occur in Reach 3, primarily in the first 10 miles below Davis Dam. For the 2008-2010 project years, monitoring data for FLSU will be gleaned from ongoing research actions that began in 2006 and are scheduled to end in 2010. The LCR MSCP is required to review the results of this research and to develop fishery management recommendations for FLSU in this reach of the lower Colorado River. Monitoring recommendations for years beyond 2010 will be included in this report. The fourth species, HUCH, is essentially extirpated from the mainstem Colorado River below Grand Canyon.

With FY06 having been the first full year of LCR MSCP implementation, it is as yet unnecessary to change any part of the program. The current needs of the AMP are in the form of data collection and organization so that, when needed, the information can be readily accessed for use in the decision-making process. Data Management (G1) will fund the database management for the AMP. For native fishes, all stocking and tagging data developed by the LCR MSCP are provided to and maintained by Arizona State University (ASU) in an electronic database. Another aspect of the AMP that is needed early on is a tool box of evaluation techniques that can gauge the effectiveness of conservation measures as they are completed. Adaptive Management Research Projects (G3) will allow for the development of these tools. Funds allocated from G3 are being used to investigate non-intrusive survey techniques to assess relative abundance of RASU.

Marsh Birds

Yuma clapper rail surveys have been conducted along the lower Colorado River since the 1970s by an inter-agency group that includes federal, state, and tribal agencies. In anticipation of LCR MSCP implementation, a multi-species survey protocol was developed and tested. Implementation of the multi-species protocol began in 2006. The multi-species protocol includes Yuma clapper rail, least bittern, and California black rail and has been designed to include other species when appropriate. Five-year system monitoring priorities include:

- Continuing the inter-agency marsh bird surveys, using the current multi-species protocol, at survey points done historically
- Determine whether new sites should be included in the system monitoring effort
- Document black rail distribution in reaches 5-6
- Evaluate the current protocol to determine if the May survey period should be extended to increase least bittern detections
- Develop a protocol to monitor marsh habitats for covered species requirements such as prey abundance and selenium concentrations
- Convert existing and historical data into a digital database
- Provide training to new surveyors

Riparian Birds

System monitoring for riparian birds has been conducted using single species or multi-species protocols, depending on purpose and need. Southwestern willow flycatcher presence/absence surveys have been conducted on an annual basis since 1996, utilizing a

10-visit protocol adapted from the U.S. Fish and Wildlife Service-approved protocol by San Bernardino County Museum (McKernan and Braden 2001). In 2008, a new modified survey protocol will be conducted after input from species experts. In 2006, system monitoring for yellow-billed cuckoo was initiated using a presence/absence protocol developed jointly by USGS and Southern Sierra Research Station (Johnson et al. 2005). Species experts have provided input on the yellow-billed cuckoo protocol so that a standardized protocol will be in place by 2008.

Southwestern willow flycatcher and yellow-billed cuckoo surveys will help determine status and trend for these important umbrella species. System monitoring for the other covered avian species will be conducted using multi-species protocols (GBBO 2003, Bart 2007). Population status, distribution, and trend will be monitored for gilded flicker, Gila woodpecker, vermilion flycatcher, Arizona Bell's vireo, yellow warbler, and summer tanager. An additional methodology needs to be established for elf owl along the LCR as these birds are nocturnal.

Five-year system monitoring priorities are based on current knowledge of status, distribution, trend, and demography for each covered species. These 5-year priorities include:

- Monitor 372 acres of southwestern willow flycatcher habitat between Parker and Imperial dams to meet commitments in the SIA Biological Opinion
- Evaluate the protocol to determine the need for annual surveys at all sites for southwestern willow flycatcher and yellow-billed cuckoo
- Develop monitoring protocol for elf owls and determine population status and distribution within the LCR MSCP area
- Monitor population status and distribution for Gila woodpecker, gilded flicker, vermilion flycatcher, Arizona Bell's vireo, yellow warbler, and summer tanager within LCR MSCP area
- Develop habitat suitability index models for riparian obligate birds to quantify potential habitat
- Monitor winter habitat use for vermilion flycatcher

System monitoring for riparian birds will continue using existing or newly developed protocols. These protocols will be evaluated for their effectiveness in providing necessary data for habitat creation and maintenance through the adaptive management process. New information will be utilized, when available.

Bats

System monitoring for all bats species found along the LCR has been conducted using an established protocol (Brown 2006). Distribution and relative abundance will be measured throughout the year on a seasonal basis. Five-year system monitoring priorities include:

- Monitor distribution and abundance of red and yellow bats along the LCR
- Record all bat species during acoustical surveys so that possible surrogate species may be monitored for distribution and abundance

- Determine distance from urban areas and fan palm trees for any yellow bats detected

Small Mammals
Presence/absence surveys have been conducted on riparian restoration demonstration sites and at habitat creation sites along the LCR. Current distribution and range for the Colorado River cotton rat and Yuma hispid cotton rat are assumed from existing literature. It is unknown whether these two species' distributions overlap. Because these species can not be adequately determined in the field, genetic material will need to be taken from captured individuals to determine range restrictions. Five-year system monitoring priorities include:

- After genetic studies have been completed, delineate distribution and range for Colorado River cotton rat and Yuma hispid cotton rat
- Develop habitat suitability index model to quantify potential habitat, if practical

The southerly distribution limits for the desert pocket mouse are assumed to be near Laughlin, Nevada. Pocket mice caught near Needles will be sampled to test this assumption.

Insects
MacNeill's sootywing skipper utilizes dense quailbush and associated nectar-producing plant species as habitat. Quailbush has been mapped using digital imagery obtained in 2004. Potential skipper habitat will be visited to determine species distribution within the LCR MSCP area. Habitat creation sites targeting MacNeill's sootywing skipper should be located near existing skipper habitat.

Reptiles and Amphibians
Two evaluation species have system monitoring priorities under the LCR MSCP: the Colorado River toad and the lowland leopard frog. Conservation measures require the protection of occupied, unprotected habitat within the funding constraints of the LCR MSCP. To accomplish these conservation measures, the following 5-year priorities have been determined:

- Monitor the current distribution of Colorado River toad and lowland leopard frog
- Identify occupied Colorado River toad and lowland leopard frog habitat for possible protection

Other covered reptile and amphibian species do not require system monitoring efforts to accomplish listed conservation measures. Existing conservation efforts will adequately monitor these species at the landscape level.

Plants
Sticky buckwheat and threecorner milkvetch are endemic plant species in Clark County, Nevada, and northern Mohave County, Arizona. Both species are covered species under the LCR MSCP. Conservation measures are limited to providing funding to the Clark

Count Multi-Species Habitat Conservation Plan Rare Plant Workgroup. System monitoring priorities will not be set under the LCR MSCP.

Post-development Monitoring

Five-year priorities for monitoring habitat creation sites are similar for covered species that have conservation measures describing habitat creation goals. Prior to initiation of habitat creation projects, pre-development surveys will be conducted. After each habitat creation project or phase has been completed, post-development monitoring will occur for targeted covered species and their habitats. Species monitoring protocols will be similar to those used for system monitoring, whenever appropriate. Habitat models will be created and tested to more efficiently monitor pre- and post-development. Decision support tools will be developed for managing created habitats to ensure these habitats provide the required site characteristics for targeted covered species. Five-year post development monitoring priorities include:

- Evaluate protocols for monitoring covered species and their habitats at the site level
- Develop habitat suitability index models for agricultural areas and other potential pre-development situations
- Develop decision support tools for created habitats

Because the LCR MSCP is a habitat-based program, presence/absence of covered species is not a requirement for determining success. However, information gained from the presence of targeted covered species will increase our ability to provide habitat requirements for these species.

During this first 5-year period, the principal area of created fish habitat is the 80 acres of backwaters excavated on Imperial NWR. Use of these ponds to accomplish fish augmentation, species research, and created habitat research will take priority over their development and ultimate use as native fish refugia. Post-development monitoring activities will be incorporated into and combined with the monitoring and research being done to accomplish these other program purposes.

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