YUMA CLAPPER RAIL RECOVERY PLAN

(*Rallus longirostris yumanensis*)

DRAFT FIRST REVISION

Original Approval: February 4, 1983

Southwest Region
U.S. Fish and Wildlife Service
Albuquerque, New Mexico

Draft

Approved: ________________________________ Date: ________________
Regional Director, U.S. Fish and Wildlife Service,
Region 2

Draft

Concurrence: ________________________________ Date: ________________
Regional Director, U.S. Fish and Wildlife Service,
Region 8

Draft

Concurrence: ________________________________ Date: ________________
Director, Arizona Game and Fish Department

DISCLAIMER

Recovery plans delineate actions which the best available science indicates are required to recover and protect listed species. Plans are published by the U.S. Fish and Wildlife Service (USFWS), and are sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Nothing in this plan should be construed as a commitment or requirement that any Federal agency obligate or pay funds in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation. Recovery plans do not necessarily represent the views or the official positions or approval of any individuals or agencies involved in the plan formulation, other than the USFWS. They represent the official position of USFWS only after they have been signed by the Regional Director. Approved recovery plans are subject to modification as dictated by new information, changes in species status, and the completion of recovery actions. Please check for updates or revisions at the website below before using.

Literature citation of this document should read as follows:

U.S. Fish and Wildlife Service. 2009. Yuma Clapper Rail (*Rallus longirostris yumanensis*) Recovery Plan. Draft First Revision. U.S. Fish and Wildlife Service, Southwest Region, Albuquerque, New Mexico.

Additional copies may be obtained from:

U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021
602-242-0210
On-line: http://www.fws.gov/southwest/es/arizona

Or

U.S. Fish and Wildlife Service
Southwest Region
500 Gold Avenue, S.W.
Albuquerque, New Mexico 87102
On-line: http://www.fws.gov/endangered/

ACKNOWLEDGEMENTS

The U.S. Fish and Wildlife Service (USFWS) gratefully acknowledge the commitment and efforts of the following individuals to the development of this revised recovery plan for the Yuma clapper rail. Without their assistance, this revision would not have been possible.

Arizona Game and Fish Department
- Mr. William Burger
- Mr. Troy Corman
- Mr. Linden Piest

USGS: Arizona Cooperative Fish and Wildlife Research Unit
- Dr. Courtney Conway

The Arizona Ecological Services Field Office (AESFO) would also like to thank the following agencies for their participation in annual surveys for the Yuma clapper rail. Surveys were initiated on the Colorado River and Mexico in 1969 and over the ensuing years personnel from these agencies made time in their often over-full schedules to complete the survey routes set up in the early 1970s. Our knowledge of Yuma clapper rail populations over time would not have been possible without their efforts.

Arizona Game and Fish Department
- Mesa Regional Office
- Yuma Regional Office

California Department of Fish and Game
- Colorado River Office
- Imperial State Wildlife Area: Wister Unit

Nevada Division of Wildlife
- Las Vegas Regional Office

USDI Bureau of Land Management
- Lake Havasu Field Office
- Yuma Field Office

USDI Bureau of Reclamation
- Lower Colorado River Multi-Species Conservation Program
- Arizona Projects Office

USDI Fish and Wildlife Service
- Bill Williams River National Wildlife Refuge
- Cibola National Wildlife Refuge
- Havasu National Wildlife Refuge
- Imperial National Wildlife Refuge
- Sonny Bono Salton Sea National Wildlife Refuge

EXECUTIVE SUMMARY

Current Status: The Yuma clapper rail is federally listed as endangered without critical habitat. The species is only listed in the United States (U.S.) although the majority of the population is found in Mexico. The species' recovery priority number is 6, which indicates a subspecies with a high degree of threat and low recovery potential from loss of habitat due to lack of natural river processes that create and maintain marshes, and lack of security relative to the protection of existing habitats in the U.S. and Mexico. The Yuma clapper rail occurs along the lower Colorado River (LCR) and tributaries (Virgin River, Bill Williams River, lower Gila River [LGR]) in Arizona, California, Nevada, and Utah; the Salton Sea in California; and the Cienega de Santa Clara and Colorado River Delta in Mexico.

Habitat Requirements and Limiting Factors: The Yuma clapper rail is the only subspecies of clapper rail found in freshwater marshes. Historically, cattail/bulrush marshes in the Colorado River Delta were the likely stronghold for the species. The virtual elimination of freshwater flows down the LCR to the Delta due to diversions from the river for agriculture and municipal uses destroyed that habitat. Existing habitats are primarily either human-made, as are the managed ponds at Salton Sea or the effluent-supported marshes at the Cienega de Santa Clara, or formed behind dams and diversions on the LCR at the time those structures were created. This entire habitat is subject to natural successional processes that reduce habitat value over time without also being subject to natural restorative events generated by a natural hydrograph. The greatest threat to the Yuma clapper rail is that without active management and protection of water sources supporting the habitat, these habitat areas will be permanently lost. Other threats to this species include continuing land use changes in floodplains, human activities, environmental contaminants (particularly increases in selenium levels), and reductions in connectivity between core habitat areas.

Recovery Strategy: To achieve recovery, the Yuma clapper rail must reach and maintain a viable population level and have sufficient protected and managed marsh habitat to provide for long-term persistence of populations in the three major core areas (LCR, Salton Sea, and Cienega de Santa Clara) and movement corridors between them. The focus of the strategy is providing long-term management and protection for a sufficient amount of core and other habitats to support a viable population of Yuma clapper rails, monitoring of populations and habitats, research to provide effective conservation and recovery, and application of research results and monitoring through adaptive management.

Implementation of the recovery strategy will be conducted as a collaborative effort among technical experts, State and Federal agencies in the U.S. and Mexico, and other interested participants including Native American Tribes. Implementation of the recovery actions and the status of the species will be tracked via monitoring and annual reporting to the recovery implementation team (RIT). Research recommended in the recovery plan will be refined by the RIT as needed and proposals developed for funding. Revisions and updates to this recovery plan will be recommended by the RIT to the USFWS as appropriate.

Recovery Goal: To achieve population stability and habitat protection sufficient to downlist and/or delist the Yuma clapper rail.

Recovery Objectives:

1. Documentation of a stable or increasing trend for numbers of rails in the U.S. as shown through annual rail surveys based on maintaining a statistically secure minimum population size determined by research and modeling (as exemplified in Fleischer et al. 1995).

2. Protection of sufficient breeding and wintering habitat to support the desired minimum population size from identified threats and allow for connectivity of habitat.

3. Development of management plans for all important Federal and State-owned habitat areas in the U.S. and for the Cienega de Santa Clara in Mexico that provide for habitat development, maintenance of suitable habitat conditions, and protection from human disturbances.

4. Completion of an assessment of the degree of threat from existing and predicted selenium levels to adult rails and recruitment of young rails and, if necessary, implementation of management actions to control this threat in rail habitats.

5. Evaluation of potential migration pathways between the LCR, Salton Sea, and Mexican core habitat areas that provide for connectivity that supports population viability and, if appropriate, development of management plans to protect stop-over habitats.

6. Completion of efforts to protect and secure for the long-term an adequate water supply to support rail habitat at current levels at the Salton Sea and in the Cienega de Santa Clara.

Recovery Criteria: The Yuma clapper rail will be considered for downlisting when the following criteria are met:

1. Annual rail surveys document a stable or increasing trend in population based on a minimum of 824 rails in the U.S. for at least 5 consecutive years.

2. Management plans for all important Federal and State-owned habitat areas are developed. For the LCR, these areas are: Havasu National Wildlife Refuge, Bill Williams National Wildlife Refuge, Cibola National Wildlife Refuge, Imperial National Wildlife Refuge, Mittry Lake State Wildlife Area, Imperial Division lands of the Bureau of Land Management; for the Salton Sea: Sonny Bono Salton Sea National Wildlife Refuge and Imperial State Wildlife Area.

3. Long-term contracts providing for a quality and quantity of water to support the Yuma clapper rail habitats at the Salton Sea are in place. The amount and quality of the water supply should be sufficient to maintain healthy cattail marsh habitat at Sonny Bono Salton Sea NWR and Imperial State Wildlife Area.

The Yuma clapper rail will be considered for delisting when the downlisting criteria and the following additional criteria have been met.

4. Annual rail surveys document a stable or increasing trend in population based on a desired population of 824 individuals (or a higher minimum population size established through research and modeling) in the U.S. for at least 5 years beyond that needed for downlisting.

5. The amount of habitat needed to support a minimum population size (as determined in #4 above) is established, protected, and managed to ensure adequate breeding and wintering habitat in the U.S.

6. An assessment of the degree of threat from existing and predicted selenium levels to adult rails and recruitment of young rails is completed, and, if necessary, management actions to control this threat in rail habitats are implemented.

7. An evaluation is completed of potential migration pathways between the LCR, Salton Sea, and Mexican core habitat areas that provide for connectivity that supports population viability and, if appropriate, management plans are developed to protect stopover habitats.

8. A water supply of sufficient quality to assure the continuation of current levels of rail habitat, in terms of both quantity and quality has been secured for the long-term for the Cienega de Santa Clara. This water supply can be of the current quantity (approximately 100,000 acre-feet per year), and quality (averaging less than 2,660 parts per million [ppm]) or that needed to maintain salinities in the Cienega below that needed for cattail growth [5,000-6,000 ppm]) over the long-term.

Progress toward achieving recovery criteria will be measured via research, monitoring, and completion of management plans for core habitat areas. In addition, regulatory mechanisms and land-management commitments must be implemented to provide adequate protection of the Yuma clapper rail and its habitats. These commitments and mechanisms should address habitat protection and maintenance, environmental contaminants, and public outreach.

Actions Needed:

1. Determine the minimum number of breeding birds in the U.S. that provides for a statistically and genetically secure population.

2. Provide for coordinated annual surveys of populations in core habitat areas in the U.S. with expansion to other habitats as appropriate.

3. Cooperate with agencies in Mexico to survey populations there.

4. Refine knowledge of physical factors that provide for suitable habitat to contribute to management actions and creation of new habitat areas.

5. Refine knowledge of habitat use to ensure protection and management of sufficient habitat to support desired U.S. population levels.

6. Determine the level of risk to Yuma clapper rail from existing and potential levels of selenium in occupied habitats.

7. Identify migration pathways between the three core populations to assess metapopulation status and contribute to determinations on minimum population size and habitat necessary to support that population.

8. Ensure that existing core habitat areas and newly created habitats are protected and managed for long-term habitat suitability.

9. Through the RIT, collaborate on research and monitoring to effectively implement the plan and address issues affecting the species in Mexico.

10. Work with all potential partners to develop cooperative conservation efforts to support the implementation of the plan and recovery of the species.

11. Use adaptive management to update and revise the plan or tasks as pertinent new information becomes available.

Total Cost of Recovery (minimum):

Fiscal Year	Minimum Costs (in thousands of dollars)
2010	208
2011	104
2012	155
2013	305
2014	111
2015	
2016	
2017	
2018	
2019	
Total	883

Date of Recovery: If recovery actions are promptly and successfully implemented, and recovery criteria are met, we estimate downlisting could be initiated by 2014 and delisting could be initiated by 2020.

TABLE OF CONTENTS

PART I. BACKGROUND

The Endangered Species Act (ESA) requires, with some exceptions, the development of recovery plans for listed species to guide implementation of actions that will lead to recovery of the species such that the protections of the ESA are no longer needed. Recovery plans are advisory documents that contain a set of recommended actions intended to resolve the threats to the species, thus ensuring the maintenance of self-sustaining populations in the wild. The recommended actions are developed using information on the species and its habitat needs and an understanding of the threats that have adversely affected the species over time. Thus, a recovery plan must present information on the species and its threats to formulate the recovery recommendations presented therein.

Regulatory History

The Yuma clapper rail (*Rallus longirostris yumanensis*) was listed as an endangered species on March 11, 1967, pursuant to the Endangered Species Preservation Act of 1966 (32 FR 4001). Very little information was available on the Yuma clapper rail at that time. Dr. John W. Aldrich of the USFWS was the scientist charged with reviewing the bird species nominated for listing. He relied heavily on his personal knowledge and that of Mr. Gale Monson, a noted ornithologist who was also refuge manager at Imperial National Wildlife Refuge on the LCR north of Yuma, Arizona (USFWS 1983). The 1966 legislation only recognized species in the U.S. for listing, so the Yuma clapper rail populations in Mexico were not included in the designation. In 1969, the Endangered Species Conservation Act created a list of foreign species considered endangered or threatened. The Yuma clapper rail was not included on that list. With the passage of the ESA in 1973, the domestic list from 1966 and foreign list from 1969 were merged to form the complete list covered under the new legislation. Because the Yuma clapper rail population in Mexico was not included on the 1969 list of foreign species, only the U.S. population is designated as endangered under the ESA. There is no designated critical habitat.

The Yuma clapper rail was listed as an endangered species under the California Endangered Species Act of 1970 in 1971, and as a Group 3 species (equivalent to threatened on the Federal list) by the Arizona Game and Fish Commission in 1978 (USFWS 1983). The Yuma clapper rail is listed as a threatened species under Mexico's Environmental Regulations on Endangered Species (Hinojosa-Huerta et al. 2004).

A recovery team (team) was established for the Yuma clapper rail in 1972. The team established survey protocols for the U.S. and Mexico and initiated biological research. The Yuma Clapper Rail Recovery Plan (USFWS 1983) was developed based on survey and biological information gathered between 1969 and 1981 by biologists associated with the team, including staff from USFWS, U.S. Bureau of Reclamation (USBR), Arizona Game and Fish Department (AGFD), and California Department of Fish and Game (CDFG). The recovery plan was finalized in 1983 and portions of the action plan were initiated over the ensuing years. After 1985, the recovery team became inactive except for coordination of annual surveys. Annual surveys are accomplished with volunteer partners from State and Federal agencies. Survey records are maintained at the Arizona Ecological Services Field Office (AESFO) of the USFWS in Phoenix, Arizona.

In 2006, the USFWS completed a 5-year review (review) for the Yuma clapper rail (USFWS 2006) to examine information on the species and its status since listing. The 5-year review concluded that no change to endangered status was warranted at the time due to continuing threats. However, the review included five recommendations for future actions to move recovery of the species forward. Briefly, these are:

1. Revise the action plan in the 1983 recovery plan to reflect being completed.

2. Identify any new tasks to achieve recovery.

3. The USFWS should be involved in the Bypass Flow Restoration or Replacement Program to work toward a secure, dedicated water source for the Cienega de Santa Clara in Mexico. The Cienega supports the majority of the Yuma clapper rail population in Mexico.

4. Implement new survey protocol and training for all cooperating agency personnel.

5. Develop management plans on Federal and State lands supporting significant populations of breeding Yuma clapper rails.

6. Develop information on the effects of selenium on Yuma clapper rail habitats and reproduction.

The USFWS initiated efforts to implement these recommendations in 2007. With the significant passage of time since the original recovery plan was completed, the USFWS determined it was appropriate to revise the entire recovery plan to incorporate new information on the Yuma clapper rail obtained since 1981 (the last year of data used in the 1983 recovery plan) and changes in structure of recovery plans that increases their usefulness in documenting the recovery needs of listed species.

Taxonomy

The clapper rail, *Rallus longirostris*, is a large marsh bird generally found in salt- to brackish-water marshes, mangrove swamps, and other tidal wetlands on the Atlantic, Caribbean, and Pacific coasts of North, Central, and northern South America (Eddleman and Conway 1998). There are a number of recognized subspecies of clapper rails within this larger range, largely distinguished by differences in size and coloration of individuals (Eddleman and Conway 1998).

The first documentation of a clapper rail on the LCR was a specimen taken in 1902 from Yuma, Arizona. This specimen was described as *Rallus levipes*, the light-footed clapper rail of the southern California coastal marshes by Herbert Brown (Banks and Tomlinson 1974). This description was used in the 1910 American Ornithologists Union checklist and by other authors to report an accidental occurrence of this coastal California species.

In 1923, the Yuma clapper rail was described as a full species, *Rallus yumanensis*, from specimens taken in 1921 from near Bard, Imperial County, California on the LCR (Dickey 1923 cited in Banks and Tomlinson 1974). Dickey included in his discussion the 1902 specimen from Yuma, Arizona described by Herbert Brown. Dickey believed Brown's Yuma specimen was probably also *R. yumanensis* based on the proximity of the two sites (Bard is across the LCR from Yuma). Dickey described *R. yumanensis* by comparing the Bard specimens to the descriptions of the two geographically closest clapper rails; *R. levipes* and *R. obsoletus* (California clapper rail). The Bard specimens were most similar to *R. levipes*, differing in minor coloration and more slender tarsus and bill. These differences were not strongly marked, and Dickey also noted the "unique ecological niche" of the Yuma clapper rail, in that unlike the two California rails it was found in fresh water, as part of the justification for determining it to be a full species under *Rallus* (Banks and Tomlinson 1974).

Later taxonomic work described the Yuma clapper rail to be a subspecies of *R. obsoletus* (van Rossem 1929 cited in Wilbur and Tomlinson 1976), then as a subspecies of *R. longirostris* (Oberholser 1937 cited in Wilbur and Tomlinson 1976). The validity of the subspecies *R. l. yumanensis* was verified from specimens taken from the LCR and coastal areas of the Gulf of California in Mexico (Banks and Tomlinson 1974). Banks and Tomlinson (1974) verified three subspecies of *R. longirostris* based on plumage and wing configurations and distribution patterns. Currently, the Yuma clapper rail is placed in the *obsoletus* group of subspecies of the clapper rail *R. longirostris*. This group includes the California clapper rail (*R. l. obsoletus*) of the San Francisco Bay area and the light-footed clapper rail (*R. l. levipes*) of the Pacific coast of southern California through Baja California, Mexico (Eddleman and Conway 1998). The *obsoletus* group also includes clapper rails along the Baja California, Sonora, Sinaloa, and Nayarit coasts of the Sea of Cortez in Mexico (Figure 1). The number of subspecies found in Mexico is uncertain, with up to four potential subspecies identified in the literature (Banks and Tomlinson 1974, Wilbur and Tomlinson 1976, USFWS 1983, Todd 1986, Eddleman and Conway 1998).

There has not been a comprehensive study of genetic relationships between the Yuma clapper rail and the California or light-footed clapper rails. Microsatellite and RAPD DNA analysis on four light-footed clapper rail populations and the Salton Sea Yuma clapper rail population indicate that the two subspecies have highly significant differences in variability, and based on neighbor-joining trees, the Yuma individuals cluster together somewhat distantly from the light-footed individuals (Fleischer et al. 1995). The authors concluded that the two subspecies shared a common ancestor within the last 50,000 years; however, gene exchange between them is low.

Species Description

The Yuma clapper rail is one of the smaller subspecies of clapper rail, with adult males standing 20-23 centimeters (cm) (eight inches [in]) tall and weighing 266.8 grams (g) (9.3 ounces [oz]) on average (Todd 1986). Females are slightly smaller, averaging between 226.2 g (eight oz) (Todd 1986) and 193.0 g (seven oz) (Eddleman 1989). Sexes can be differentiated based on use of several external measurements (Eddleman 1989).

Adult Yuma clapper rails of both sexes are similar in plumage; they possess a long, slender slightly de-curved bill, a laterally compressed body, and relatively long legs and toes compared to body size. The upper mandible is dark grey, fading to orange at the base and the tip. The head and scapular area are grey, with browns and oranges appearing on the sides of the neck and under the head. The chin and upper throat are white, and there is a light eyebrow stripe extending from above the eye to the upper mandible. The breast is tawny- or burnt-orange in the male, and a brick-orange in breeding females. The upper body is light grey to dark brown, becoming blotchy and dominant on the rump and distally on the wings. The underside and flanks forward of the legs are dark grey with vertical white stripes. The tail is dark brown above and white below. Legs are unfeathered and orange-flesh in color (Todd 1986). Adult rails have a basic pre-body molt in May-August, with flightless birds found between mid-July and the end of September. A second, pre-alternate molt occurs from September to December and does not involve the flight or tail feathers (Eddleman 1989).

Hatchlings are downy black, with many having some white downy feathers on their anterior abdominal region (Weatherbee and Meanley 1965, cited in AGFD 2006). The young retain their black down for about a month then achieve juvenile plumage. Some resemble the eastern races of clapper rail; others have black feathering on the sides and flanks (Ridgeway and Friedman 1941 cited in Eddleman 1989). The second body molt takes six to seven weeks, with the juveniles obtaining the buffy adult ventral plumage. Juveniles are difficult to distinguish from adults after September (Eddleman 1989).

Distribution

Historical

The pre-1900 distribution of the Yuma clapper rail in the U.S. is unclear. Because clapper rails are residents of salt- or brackish-water marshes along the coasts of North America, biologists of the time would not have expected to find one in the fresh-water portions of the LCR. The clapper rail taken at Yuma in 1902 was assumed to be a light-footed clapper rail from the Pacific coast that had somehow ended up on the LCR (Todd 1986). However, the calls of all subspecies of clapper rails are similar enough that if one was heard on the LCR, it likely would have been recognized by these biologists and none had been recorded.

The LCR was a free-running river subject to both very high and very low flows within a single year. Marsh development could occur around backwaters and swales within the floodplain, with the longevity of individual marsh areas dependent on maintaining a connection to river flows during high water while avoiding the erosive effects of flood events that would eliminate the shallow marshes. In his review of historical vegetation communities along the LCR, Ohmart (1982) quoted from written reports of explorers and travelers that described the vegetation communities they observed along the river. Marshes and backwaters were not often mentioned; however, areas of grasses and tules and “rich bottomlands” were often mentioned separately from discussions of riparian forests. Grinnell (1914) noted that during his intensive biological survey between Needles and Yuma, there was very little marsh vegetation present along the river corridor, hypothesizing that the high evaporation rate dried out backwaters and sloughs, reducing the extent of potential marshes. The removal or deposition of silts and sands during high flows that either filled in or eroded out marsh sites was also hypothesized to reduce the potential for significant marsh development. Grinnell was very familiar with the light-footed clapper rail, and would have recognized the calls of clapper rails. He did not record hearing or seeing any rails during the journey.

With the limited amount of dedicated survey work prior to the listing of the Yuma clapper rail in 1966, it is difficult to confirm if the present distribution of the species along the LCR reflects the true historical picture, or if the changes in the LCR caused by the creation and operation of the small diversion dams (Laguna, Imperial, Palo Verde, and Headgate Rock) and the large water storage dams (Parker, Davis, and Hoover) are responsible for the hypothesized “expansion” of the distribution of Yuma clapper rails upriver during the 1930s to the present. The hypothesis is that the presence of the large dams controlled the floods once common to the LCR, and the small dams provided a constant water level that promoted deposition of sediments that promoted the growth of marshes in their upstream pools. Examples of this are seen above Laguna and Imperial Dams. The timing of the upstream spread of Yuma clapper rail coincides with dam construction, as sediment deposition in the still water behind the dams created conditions suitable for marsh habitats in as little as 10-15 years after dam creation, dependent on the local sediment load and the height of the dam (Ohmart and Smith 1973, USFWS 1983).

The capture of Yuma clapper rails at Laguna Dam in 1921 was 13 years after the dam was constructed. Monson documented Yuma clapper rails at Headgate Rock Dam in 1946, four years after the dam was created. The creation of Parker Dam in1938 allowed for sediment deposition at the Bill Williams River inflow to Lake Havasu. Monson had visited the new delta in previous years; however, he did not record Yuma clapper rails there until 1954. Similar situations existed for Topock Marsh and the upper end of Lake Havasu, where Yuma clapper rails were not found until 1966 (USFWS 1983).

Todd (1986) compiled all survey information available prior to 1985 and the following discussion (including citations) is taken from his work. The calls of what may have been clapper rails were noted along the LCR in the Mohawk Valley near Ft. Mohave by Dr. J.G. Cooper in 1884. In his intensive survey of the LCR between Needles and Yuma, Grinnell (1914) did not record the vocalizations of any clapper rails and he was on the river during the breeding season.

The next documented specimens for the LCR were taken in 1921 near Laguna Dam on the LCR by Huey and Canfield and included females in breeding condition (cited in Dickey 1923). Additional birds were seen in 1924 north of Laguna Dam by Huey and Canfield. There was speculation that there was a population of clapper rails inhabiting the LCR from Yuma south through the Colorado River delta in Mexico; however, there were no records or sightings to confirm this until reports from Charles Lamb (Grinnell 1928 cited in Todd 1986) documented the presence of large rails in the delta. There were no other reports from that area for several years. The Imperial Valley/Salton Sea Yuma clapper rail populations were discovered in 1931 (Moffitt 1932 cited in Todd 1986). It is unclear if anyone was looking for clapper rails on the LCR between the 1920s and 1940s, but none were reported. Grinnell and Miller (1944 cited in Todd 1986) described the distribution of the Yuma clapper rail as along the LCR between Laguna Dam and Yuma, and at the Salton Sea.

In 1948, Mr. Gale Monson, a trained ornithologist, began to report of Yuma clapper rails north of Laguna Dam, first at Headgate Rock Dam near Parker in 1946, then in 1954 at the Bill Williams River delta 24 km north of Parker. Gale Monson also documented Yuma clapper rails between Laguna Dam and the Cibola Valley in the 1950s (Phillips et al. 1964).

The listing of the Yuma clapper rail under the 1966 legislation spurred interest in determining the range and population status of the species. In 1966, the Yuma clapper rail was documented at Topock Marsh, Havasu National Wildlife Refuge. In 1982 a pair was documented north of Needles, California, in the Mohave Valley. Initial dedicated surveys in 1968-1970 by Roy Tomlinson and Dick Todd documented Yuma clapper rails on the LCR between Topock Marsh and the Southerly International Boundary with Mexico (Tomlinson and Todd 1973). Yuma clapper rails were confirmed on the lower Gila River (LGR) upstream as far as the Phoenix metropolitan area during the late 1960s and 1970s (Todd 1986). Since 1986, Yuma clapper rails were found on Lake Mead in Las Vegas Wash and the Virgin River above Lake Mead beginning in 1998 (Garnett et al. 2004).

In Mexico, the delta of the LCR supported vast areas of riparian and marsh vegetative communities (Hinojosa-Huerta et al. 2004). As discussed earlier, the delta was believed to support a population of Yuma clapper rails, although the documentation for the size and extent of the marsh habitat and the attendant rails was limited.

<u>Present</u>

The present range of the Yuma clapper rail in the U.S. includes portions of Arizona, California, and Nevada (Figure 2). Occupied habitats exist in the LCR from the Southerly International Boundary with Mexico to the upper end of Lake Mead at the Grand Canyon, the Virgin River (a tributary to Lake Mead) in Nevada, the LGR from its confluence with the LCR to the vicinity of the Phoenix metropolitan area in Arizona, and the Imperial Valley/Salton Sea area in California. The most recent estimate of potentially suitable Yuma clapper rail habitat currently present on the LCR is 3,653 hectares (ha) (9,041 acres [ac]) with 1,083 ha (4,457 ac) of that on four National Wildlife Refuges (NWR) (Havasu, Bill Williams River, Cibola, and Imperial) (USBR

2007). For the Salton Sea, a total of approximately 607 ha (1,500 ac) is on the Sonny Bono Salton Sea NWR and the Imperial Wildlife Area (IWA) (USFWS 2006). The amount of habitat on the LGR from the Phoenix metropolitan area to the confluence with the LCR is unknown, as is the amount of habitat upstream of Lake Mead. However, neither of these sites contains large amounts of habitat. In Mexico, the changes in water flows reaching the LCR delta due to upstream diversions also resulted in the loss of considerable acreage of marsh and riparian vegetation communities within the delta itself (Glenn et al. 1996, Hinojosa-Huerta et al. 2000). In 1975-76, the Cienega de Santa Clara was a 120 to 814 hectare (ha) (518 to 2,011 acre [ac]) marsh isolated from the delta and fed by brackish seeps and local agricultural drainage. In 1977, the USBR began to send 90,000 to 100,000 acre-feet (af) of saline groundwater from the Wellton-Mohawk Irrigation and Drainage District to the Cienega de Santa Clara. The salinity of this water had an adverse effect on the salinity of the LCR water provided to Mexico under the 1944 Treaty, and thus could not be put into the river. This water significantly increased the size of the wetland at the Cienega to 4,187 ha (10,346 ac) in 2000 (Sanchez et al. 2000). Cattail-dominated marsh lands in Mexico were estimated at 6,300 ha (15,567 ac) (Cienega de Santa Clara, El Doctor, and Laguna Indio wetlands isolated from the LCR Delta), and 1,200 ha (2,965 ac) at the Rio Hardy/Rio Colorado in the Delta (Hinojosa-Huerta et al. 2004).

Population Size

U.S. Populations

Yuma clapper rail surveys in U.S. were initiated in 1969 with distributional-level coverage of the LCR from near Needles to the Southerly International Boundary (approximately 386 kilometers [km] [240 miles {mi}]). All potential habitat sites were surveyed; however, at larger sites, surveys were stopped when rails were detected, so the complete habitat area was not surveyed (Tomlinson and Todd 1973). In 1973 and 1974, surveys (described as a “census”) were completed to define the minimum number of rails in the census areas (Gould 1975). This effort did not assume there would be 100 percent response to the taped calls, so the minimum number does not imply a total population. These two surveys also delineated the areas of suitable habitat to be surveyed in the future. There is no definite information on the percentage of available habitat that was included in the survey areas; however, an assumption can be made that the survey routes encompassed most of the identified habitat area.

Between 1975 and 1978, surveys were limited and incomplete. In 1981, another comprehensive survey was done, looking at all habitat areas on the LCR between Needles and the Southerly International Boundary. It also included the Imperial Wildlife Area at the Salton Sea, the Salt/Gila Rivers in central Arizona, and a portion of the LCR in the Colorado River Delta. Coverage of available habitat ranged from 60 to 100 percent in the U.S. and a considerable portion of the Delta (Tomlinson 1981, Burton 1982). A similar effort was made in 1983, but several important habitats were not surveyed. According to the report, those that were surveyed had 90 to 100 percent coverage. The exceptions were Topock Marsh at 50 percent and IWA at 25 percent (Busch and Gomez 1983). It is not clear if the coverage data reflects the entire habitat or the area along transects. Funding was provided to set up a statistically valid survey protocol to obtain trend data at the most important rail habitats (Ohmart and Anderson 1978); however, there is no evidence that this plan was implemented.

Standardized surveys were included in the 1983 recovery plan for sites on the LCR and Salton Sea generally using the routes identified in the pre-1981 surveys. Additional routes were added over time. The concept for the annual surveys continued to be a "census" covering as much habitat as possible to obtain a count of the minimum number of rails present (the report recorded the maximum number of rails detected, which corresponds to the minimum number of rails present). During 1983-1999, at least one, and more likely two, different call broadcast tapes were used (one with continuous calls and one with calls and silence alternating every two minutes). In 2000, a broadcast tape and associated play-back protocol was developed to standardize the survey effort. This was used from 2000-2005. Beginning in 2006, survey data were collected using the USFWS National Marsh Bird Survey Protocol (Conway 2005) for four species of interest on the LCR (additional species are the California black rail [*Laterallus jamaicensis coturniculus*], western least bittern [*Ixobrychus exilis hesperis*], and Virginia rail [*Rallus limicola*]). The National Marsh Bird Survey Protocol will be used for the foreseeable future. The one constant over the 1969-2008 periods of rail surveys is that the annual report has always reflected the minimum number of rails present in the habitat. Table 1 shows the rail survey data from 1969-2008.

Incidental reports of Yuma clapper rails above Lake Mead date to the late 1990s (Garnett et al. 2004) and surveys were initiated in 2000 by Southern Nevada Water Authority for the Virgin and Muddy Rivers. Surveys above Lake Mead are not done according to the National Marsh Bird Protocol; however, inclusion of these surveys to be part of the official survey is under discussion. Data collected from past years will be appended to the official survey reports.

Comparisons between years of reported minimum number of rails present in the U.S. should be done carefully. Surveys were done during different months (ranging from March to September), and under different protocols, varying surveyor experience, and completeness of the survey effort. New or modified routes were included. Furthermore, dynamic habitat conditions changed the quality of the habitat on the routes that affects rail use of those areas (Eddleman and Conway 1994). Some of these differences can be teased out of the data, particularly time of year, number of routes, and extent of routes completed. Others cannot easily be defined, particularly the effects of different protocols and changes in habitat quality. It is possible to compare data at each site over a period when all surveys were using the same protocol and transects did not change during the period. These should only be considered as trend data, because use of the minimum number of rails present to create a population estimate is also complicated by the uncertain percentage of birds present that respond to the call-back tape.

Different protocols of recorded call-playback methods for surveying Yuma clapper rails vary in effectiveness at detecting birds (Gibbs and Melvin 1993, Conway and Gibbs 2005). The relative amounts of passive (no calls broadcast) and active (calls broadcast) periods vary between protocols, and response by individual birds to the protocol vary. Several different recorded call-playback protocols were used in the U.S. over the 1969-2008 survey periods, and there is no way to compare the response rates to each protocol to standardize the data.

In the literature, various authors have assumed a percentage of birds present that respond to call-playback surveys in making population estimates. Smith (1975), Bennett and Ohmart (1978), and Todd (1986) assumed 70-95 percent of birds on the survey route responded to the calls. Eddleman (1989), using birds with radio transmitters, was able to determine a maximum response rate of 42 percent during the early breeding season (March-April) and 20 percent during the late breeding season (May-July). Eddleman's birds were repeatedly exposed to call-playback and may have become habituated, resulting in a lower response rate than assumed by other authors (Eddleman and Conway 1998). Definitive data on response rates within or between core areas and other habitats is not available.

Mexico Populations

Surveys in portions of Mexico were initiated in 1973 at the Colorado River Delta habitats (primarily at the Rio Hardy-Colorado River confluence area). Surveys are intermittent, although several efforts in the late 1970s and early 1980s were made by the recovery team to get official permission from the government of Mexico to conduct surveys. The Cienega de Santa Clara did not form until after 1977, so all surveys before that date are for the main stem of the river.

Surveys in Mexico were redone in 1998 (Piest and Campoy 1998) and have continued through 2006 (Hinojosa-Huerta et al. 2000, 2003, 2007). Actual numbers of rails heard during surveys at the Cienega de Santa Clara and other sites in Mexico from 1998 through 2006 ranged from 164 to 382. The 2006 population estimate for the Cienega was 5,974 (95% CI 4,698-7,482) (Hinojosa-Huerta et al. 2008)

Surveys in Mexico after 1999 were done with a specific protocol and according to a stratified design to enable density and population estimates to be made. An assumption of a 60 percent response rate (instead of the documented U.S. response of 20-42 percent [Eddleman 1989]) is based on the presence of high densities of rails at the Cienega which may increase response rates (Zembal and Massey 1981). Assuming a response rate of 60 percent, the 2006 estimate was 9,956 individuals (95percent confidence interval 7,830-12,470) with 5,800 ha (14,332 ac) assumed habitat (Hinojosa-Huerta 2007). It is not clear from the report what actual percentage of the habitat was surveyed to assess the densities for the entire marsh.

Rangewide Population Distribution

The amount of Yuma clapper rail habitat in the U.S. totals 4,260 ha (10,551 ac) compared to 7,500 ha (18,532 ac) in Mexico. The difference in the amount of habitat between the U.S. and Mexico is perhaps better evaluated by the amount of habitat in the U.S that is on Federal and State wildlife areas, which comprise the majority of the habitat included in the annual population surveys. That figure is approximately 1,912 ha (4,724 ac)[1] which is 25 percent of the amount of habitat available in Mexico. In 2006, the number of Yuma clapper rails detected in the U.S. in these habitats was 707. This is only 12 percent of the estimated number in Mexico for the same year (5,974). This figure should be viewed with caution, because the amount of the habitat actually surveyed in the U.S. and the density of birds in those habitats is not known.

The importance of the larger Yuma clapper rail population in Mexico to the status of the species as a whole is unclear. Prior to the development of the Cienega, the amount of rail habitat on the LCR Delta was significantly reduced by lack of flows from the LCR, and may have been less than the amount of newly developed habitats in the U.S. Yuma clapper rails could easily move up from the Delta along the LCR to reach these new habitat areas. The Delta habitats are not protected, and are subject to elimination by flood flows, drought, and water management (Burton 1982, Hinojosa-Huerta et al. 2001). The Cienega is by far the largest rail habitat, and, by being a contiguous habitat area, is not subject to habitat quality constraints resulting from small habitat size and edge effects.

As described previously, the survey results for the Yuma clapper rail in the U.S. indicate a minimum number of rails present. Over the 2000-2008 period, the numbers have fluctuated between 503 and 890 (Table 1), reaching the minimum recovery population size of over 700 (USFWS 1983) in 5 of those 9 years. If the federally listed U.S. population alone is sufficiently robust to survive over the long-term without consideration of the unlisted Mexican populations, then for recovery purposes, preservation of the populations and habitat in Mexico is less important. That is not to say efforts to ensure the future of rail populations in Mexico should not be undertaken now and in the foreseeable future. Unless efforts are made within the next few years, it may be impossible to initiate actions to preserve the Cienega (particularly to ensure a water supply to maintain the habitat). Before any decision can be made, there are also several important points about the value of the Mexico populations that require additional evaluation:

- The selection of 700-1,000 individual birds in the U.S. as the population size sufficient to achieve recovery was not based on any viability analysis. The number appears to have come from the results of surveys in the U.S. between 1969 and 1982. This level reflects what was seen as the number of birds that could be supported by the amount of habitat present at that time (USFWS 1983). The validity of that population level has not been confirmed by additional work, except for some preliminary efforts by Fleischer et al. (1995), who estimated a population of 824 birds was sufficient for persistence.

- The amount of habitat present before 1983 that supported rails was considerably less than that present now, yet the number of rails detected has not increased in proportion to the

[1] This figure assumes 1083 ha (4,457 ac) on the LCR Federal refuges, 607 ha (1,500 ac) combined at the Federal and State wildlife areas at Salton Sea, 122 ha (301 ac) at Mittry State Wildlife Area on the LCR, and 100 ha (247 ac) on Bureau of Land Management lands in the Imperial Division of the LCR. This comprises at least 90-95 percent of the annually surveyed habitat in the U.S.

additional habitat. The important habitat areas included in early surveys did not include the Sonny Bono Salton Sea NWR, or the current full area of IWA.

- The assumptions on the quantity and quality of habitat needed to support the 700-1,000 rails need to be evaluated. The productivity of various habitats, particularly relative to source or sink status, is unknown. Birds found at some areas may be newcomers each year, or are part of a sustained local population. The amount of habitat needed to support a minimum population in the U.S. is also unclear. Information on the densities of Yuma clapper rails occupying various habitats are not easily comparable owing to different assessments of density that use different assumptions for responses to taped calls, and size, quality, and configuration of habitat areas surveyed. Additional research is needed to evaluate habitat area needs to provide for the population segments in each of the core areas. Information from the Cienega shows that Yuma clapper rails will move within the larger habitat area to find more suitable areas. Changes in water flow patterns and a large fire resulted in significant changes to the distribution of Yuma clapper rails (Hinojosa-Huerta et al. 2008) that are relevant to evaluating the size of habitats needed to support the desired population.

- The movement patterns of rails between core habitat areas are unclear. There is evidence of movements within habitats (Smith 1975, Bennett and Ohmart 1978, Conway 1990), and the presumed spread of rails northward along the LCR requires a degree of dispersal that has not been documented. Eddleman (1989) documented that most rails do not migrate, but remain in the habitat all year. There may be a migratory or dispersal component of the population that requires connectivity between core habitat areas on the LCR, Salton Sea, and the Cienega. However, we do not know the extent of this exchange, or if it is comprised of dispersing juveniles or migrating adults. This measure of connectivity between known core areas is also important to an understanding of how many birds are needed in each site to achieve genetic stability. If there is limited interchange, the number of breeding adults per core area will need to be larger to support genetic diversity than if the three core areas have sufficient exchange to maintain diversity.

- There is limited information on the genetic structure of the Yuma clapper rail. The amount of movement between present population areas now, and in the recent past is unknown and likely affects the structure of the genome. While the apparently recent expansion of the rail in the last 100 years indicates that separation of local populations is too recent to show any genetic divergence, the characterization of the representative founder populations that moved into the U.S. from Mexico, as compared to the current Mexico populations, is unknown. Important alleles may be present in one but not all core areas.

Life History

Behavior

Yuma clapper rails are secretive birds that are more often heard than seen. Their bodies are laterally compressed, and they can steer right and left, which enables them to move efficiently through cattails and other emergent vegetation. Yuma clapper rails under cover or in the open walk upright with a deliberate step, and may twitch their tails. When alarmed, they will run into vegetative cover with their bodies held horizontal (Todd 1986). Yuma clapper rails do not usually perch above the ground; however, an individual may climb into a shrub or tree.

Despite a lack of webs between their toes, adult Yuma clapper rails are good swimmers, sitting high in the water with the head held up. The swimming motion is slightly jerky, likely due to the continued "walking" motion of the legs used for propulsion. Individuals are known to dive underwater, and may hold onto submerged vegetation to stay down in response to threats, or use its wings to "swim" through the water (Todd 1986, Ripley 1977 cited in Eddleman and Conway 1998). Todd (1986) noted that Yuma clapper rails do not swim for long distances; he rarely saw an individual swim channels more than 30 meters (m) (100 feet [ft]).

In short flights within or between habitat areas, Yuma clapper rails appear to be inadequate fliers, with a slow, weak, and fluttering flight, the legs dangling with the head held high (Todd 1986). However, clapper rails in general are successful fliers over longer distances, as would be assumed for a species that migrates. This type of flight is more duck-like, with the head, tail, and legs held in a straight line and steady, rapid wing beats (Meanley 1985 cited in Todd 1986, Eddleman and Conway 1998).

Yuma clapper rails have a series of vocalizations that are used by one or both sexes. The "kek" is the primary advertising call for males, while the "kek-burr" is the equivalent female call. Pairs will "clapper or clatter" as a means of communication between the pair or in response to loud noises or the other bird vocalizations. Individuals of either sex may use the "kek-hurrah" call. There is a seasonal peak to use of vocalizations, with the breeding season being the period of highest use (Bennett and Ohmart 1978, Todd 1986, Conway et al. 1993, Eddleman and Conway 1998).

Yuma clapper rails are active most of the daylight hours, with little to no activity after dark (Eddleman 1989). Daily movement was lowest during the late breeding period (May-July) and highest during the late winter (January-February) (Conway et al. 1993). Juvenile dispersal, movements by unpaired males during the breeding season and by both sexes post-breeding, and relocations in response to changing water levels are also documented (Eddleman 1989). Eddleman (1989) postulated that the types of movements he documented would enable Yuma clapper rails to quickly locate areas of new habitat. Movements of Yuma clapper rails out of areas of unsuitable habitat have also been documented (Smith 1975).

Initially, Yuma clapper rails on the LCR were believed to be migratory because there was limited response to taped calls outside of the breeding season (Tomlinson and Todd 1973, Smith 1975, Bennett and Ohmart 1978, Todd 1986), and it was believed that they wintered in brackish marshes along the eastern shore of the Sea of Cortez (Gulf of California) (Banks and Tomlinson 1974). Small numbers of Yuma clapper rails were documented on the LCR outside of the breeding season (Smith 1975, Anderson and Ohmart 1985). Data from the Salton Sea also indicated that most birds migrated for the winter (Bennett and Ohmart 1978, Montgomery 1990). Telemetry data from Eddleman (1989) indicated that many more birds than anticipated were present during the winter; however, vocalizations were significantly reduced. This lack of response to taped calls in the winter was a significant factor in the assumption that the Yuma clapper rail was migratory. He estimated that only 30 percent of telemetered birds may have migrated. The loss of signal from these birds had a number of other potential causes (for example, radio failure or mortality of the bird without relocating the transmitter). Eddleman (1989) also suggested that the increasing amount of suitable habitat with a stable food source (crayfish) may be influencing the need to migrate. Similar considerations were also voiced by Ohmart for the LCR (Personal communication cited in Bailey et al. 1983) and may also apply to conditions at the Salton Sea. Conway (1990) also noted a change in seasonal habitat preference that may alter the likelihood of locating Yuma clapper rails in the winter without the aid of telemetry. Based on these conclusions, we now assume that most of the LCR and Salton Sea Yuma clapper rail populations are not migratory, but remain in the area all year. There is some indication that the population near Phoenix on the Gila River may be more migratory than the other populations (Corman and Wise-Gervais 2005), as individuals are seemingly not present outside of the breeding season.

Food Habits

The diet of Yuma clapper rails is dominated by crayfish, with small fish, tadpoles, clams, and other aquatic invertebrates also utilized (Ohmart and Tomlinson 1977, Anderson and Ohmart 1985, Todd 1986, Eddleman 1989, Conway 1990). Crayfish (*Procamberus clarki* and *Orconectes virilis*) are not native to the LCR basin and were introduced to the basin for aquatic weed control and to provide forage for sport fish (Inman et al. 1998). The spread of crayfish in the LCR may have been pivotal to the expansion of Yuma clapper rail, as crayfish provided a more abundant and secure food supply (Ohmart and Tomlinson 1977). The abundance of crayfish in different areas appears to vary; with most abundance in moderately dense cattail and bulrush (Smith 1975) or in very dense cattails (Bennett and Ohmart 1978). The seasonal abundance of crayfish at Salton Sea is highest in late April to mid-May and lowest during the winter (Bennett and Ohmart 1978). On the LCR, highest levels were found in the early breeding through post-breeding periods (March through October) depending on location (Eddleman 1989). Crayfish and freshwater prawn (*Palaemonetes paludosus*) numbers also vary significantly depending on microhabitat, with crayfish more abundant in the denser interior marsh vegetation and prawns at the vegetation/open water interface (Eddleman 1989). This seasonal availability of crayfish corresponds to shifts in habitat use by Yuma clapper rails (Bennett and Ohmart 1978, Eddleman 1989, Conway et al. 1993).

Yuma clapper rails are sight-feeders with an excellent sense of smell (Eddleman and Conway 1998). Prey items are taken by surface gleaning or shallow probing on open mudflats, shallow (7.5 cm [3 in]) open waters, vegetated areas with low emergent stem densities, and the water/emergent vegetation interface (Todd 1986, Eddleman 1989). During periods of low prey availability, daily foraging movements are over a larger home range (Conway et al. 1993)

Breeding

Along the LCR, male Yuma clapper rails begin advertising with "kek" calls in February and pair bonding occurs shortly thereafter. The pair bond lasts for the breeding season, and it is unknown if the same birds bond in subsequent years (Eddleman and Conway 1998). Nesting begins in March with a peak in mid-May on the LCR (Eddleman 1989) and from May to June at Salton Sea (Abbot 1940, Bennett and Ohmart 1978). Along the Gila River in Maricopa County, the first birds do not begin to call until mid-to late-March (Mr. William Burger, personal communication). Clutch size is from 5 to 10 (Bennett and Ohmart 1978, Eddleman 1989). Incubation ranges from 23-28 days with the males generally incubating at night and females during the day (Eddleman 1989). In other rail species, eggs may hatch over several days, with one adult taking charge of the chicks while the other remains at the nest. It is unknown if this is true of the Yuma clapper rail. Hatching success may be high; however, chick mortality is also high, with perhaps two young fledging per pair (Bennett and Ohmart 1978). Initially, it was not believed that Yuma clapper rail adults would re-nest (Eddleman1989), but clapper rails in general are known to re-nest (Conway and Eddleman 2000 cited in USBR 2009). More information on re-nesting by the Yuma clapper rail would be helpful in evaluating nesting success for demographic modeling. Adults remain with the chicks, protecting them at night in brooding nests and accompanying them on foraging trips for approximately six weeks post-hatching (Eddleman and Conway 1998).

Nests are constructed on stable substrates (bases of emergent plant clumps or trees, on or in deep mats of residual vegetation) and may be near-shore in shallow water or in the interior of marshes over deeper water (Abbot 1940, Bennett and Ohmart 1978). Males may build multiple nests that can be used for incubation if predators or high water disturb the primary nest (Conway and Eddleman 2000 cited in USBR 2009) and adults are capable of moving the eggs from one nest to another. Placement of nests on sites slightly higher than the surrounding marsh, elevating them several centimeters by building on vegetation above the normal water level, or placement on the thick residual vegetation helps protect nests from water level fluctuations (Smith 1975, Todd 1986, Eddleman 1989). Elevated nests over deep water may have access ramps (Bennett and Ohmart 1978, Todd 1986). The cattail stems provide overhead cover for nests, and generally additional tree or shrub cover is not needed (Eddleman 1989).

Mortality

Yuma clapper rails are subject to predation by coyotes (*Canis latrans*), raccoons (*Procyon lotor*), great horned owls (*Bubo virginianus*), northern harriers (*Circus cyanus*), and Harris hawks (*Parabuteo unicinctus*) (Eddleman 1989). Based on losses of adult telemetered birds, predation rates were highest in late summer and mid-winter. Factors involved in this increase may include movements by predators into the marshes and increases in wintering raptors, increased movements by Yuma clapper rails as they alter their habitat use seasonally, changes in water levels that result in use of more open areas for foraging, or detrimental effects of the telemetry harness (Eddleman 1989). There is no information on survival rates for chicks or fledglings, which are subject to a variety of potential avian and mammalian predators (AGFD 2006).

Diseases and parasites may affect Yuma clapper rail survival; however there are no extant studies for this subspecies. For clapper rails in the eastern U.S., worms, flukes, tapeworms, and nematodes are recorded at various levels (summarized in Todd 1986). One case of hepatitis is documented for the Yuma clapper rail (Eddleman 1989). Like other water birds, they may be subject to other avian diseases.

Eddleman (1989) identified selenium as a potential threat to the survival and recovery of the rail. High levels of selenium can result in acute toxicity, chronic poisoning, tissue damage, and reproductive impairment (developmental abnormalities, embryo mortality, and reduced survival or growth of young). The adverse effects of selenium have been well documented in the years since the problem was identified at Kesterson NWR in the San Joaquin Valley of central California. The LCR (including the Salton Sea and Mexico) does not contain local sources of selenium that contribute to selenium levels in the biological environment. However, the Colorado River in the Upper Basin (Utah, Wyoming, and Colorado) picks up selenium from the seliniferous soils of the Mancos shale formations (return flows of irrigation water are the primary vector) and transports it to the LCR, where evaporation concentrates the selenium in the water and it is deposited into the sediments, vegetation, invertebrates, and fish. Rails become contaminated through their diet of crayfish, other invertebrates, and fish. Levels of selenium in LCR-supported clapper rail habitats in the U.S. and Mexico may have increased (significant historical data on pre-development selenium levels is not available) over the last 10-15 years due to effects of water use for agriculture and high evaporation rates. Several studies of selenium core areas mostly using measurements from sediment, vegetation, invertebrates, fish, and surrogate bird species to stand in for direct measurements from Yuma clapper rails were completed (Rusk 1991, Andrews et al. 1997, King et al. 2000, and Garcia-Hernández et al. 2001). Selenium levels in those studies were high enough to indicate the potential for exposure and adverse effects to Yuma clapper rails. Roberts (1996) did have some data from eggs, chicks, and adult Yuma clapper rails at the Salton Sea. The levels in the eggs (4.98 and 7.75 µg/gram dry weight) approached the lower threshold (8.0 µg/gram dry weight) for peripheral teratogenic effects (Skorupa and Ohlendorf 1991). One liver was found to have a concentration of 11.78µg/gram dry weight which is near a level associated with reproductive impairment in females (12-15µg/gram dry weight) (Lemly 1993). Preliminary information from a joint USFWS-USGS study on selenium in Yuma clapper rails at Salton Sea and the LCR shows that concentrations in eggs were well above suggested “No Effect Concentrations” at 3.30 to 12.0 µg/g and in blood and feathers 15.0 and 20.0 µg/gram respectively (Dr. Kevin Reynolds, USFWS, personal communication 2009).

While the available information suggests a potentially significant effect of selenium on Yuma clapper rails, there is no documented evidence of reproductive impairment; however, the cryptic nature of the species and difficulty in locating nests and young birds make casual observation of these effects extremely unlikely. Survey data have not shown a definitive decline in Yuma clapper rail numbers over time, but as noted earlier, the data are not robust. The numbers of birds located varies within sites from year to year, sometimes with significant declines (see Table 1) that may be the result of changes to habitat, efficiency of surveyor, and local weather conditions. Further, chemical and biological conditions at sites in the core areas may result in exposure to selenium varying between sites. One advantage of the highly-reducing soils at the Cienega is that a considerable amount of the selenium is sequestered in the sediments, and it is unlikely that there would be a change to the basic water chemistry that would enable its release (Garcia-Hernandez et al. 2001). We do not have a complete picture of the degree of threat posed to the Yuma clapper rail by selenium; however, based on the available data, we do identify it as a long-term threat to survival and recovery.

Habitat Description

The Yuma clapper rail lives in freshwater marshes dominated by cattail (*Typha* sp.) and bulrush (*Scirpus* ssp.) with a mix of riparian tree and shrub species (*Salix exigua*, *S. gooddingii*, *Tamarix* sp., *Tessaria serica*, and *Baccaris* sp.) along the shoreline of the marsh (Gould 1975, Smith 1975, Anderson and Ohmart 1985, Todd 1986, Eddleman 1989). Along the LCR, such habitats are generally found in backwaters or in the impoundments behind small dams. At the Salton Sea, marsh habitats are created in fields or cells with managed water levels. Along the lower Gila, Virgin, and Muddy Rivers, marshes are found along the margins of the river and wetted floodplain. At the Cienega de Santa Clara, the marsh is large and dense with vegetated areas interspersed with shallow open water areas (Hinojosa-Huerta et al. 2000). The specific physical conditions in each of these habitat areas are different and likely define the quality of the habitat available at each site relative to desirable patch size and configuration.

Information from the literature suggests that optimum Yuma clapper rail habitat consists of a mosaic of emergent vegetation averaging greater than 2 m (6 ft) high (Anderson and Ohmart 1985, Eddleman 1989), shallow (less than 30 cm [12 in]) open water areas either as channels or pools with minimal daily water fluctuation (Tomlinson and Todd 1973, Gould 1975), open dry ground (slightly higher than the water level) between water, vegetation, or marsh edge for foraging and movement (Gould 1975, Anderson and Ohmart 1985, Eddleman 1989, Conway et al. 1993), and a band of riparian vegetation on the higher ground along the fringes of the marsh that provides cover and buffer areas that may be used seasonally (Eddleman 1989).

Habitat quality is a factor in the densities of rails per unit habitat area. Several studies have included information on the density of rails located within the surveyed habitats; however, the variances in survey methods, assumptions about the percent of rails present that actually are counted, and incorporation of habitat quality data into calculations complicates comparisons of data from these different studies. This lack of consistent data contributes to the uncertainty in defining the amount of habitat needed to support the population size that will indicate recovery of the species.

Home Range and Activity Areas

Yuma clapper rails exhibit seasonal changes in habitat selection and home range size. Depending on the season, adult Yuma clapper rails select microhabitats based on a number of physical factors (Table 2 from Conway et al. 1993). These changes may be in response to prey availability, predator avoidance, ease of movements by chicks, or other factors (Smith 1975, Conway et al. 1993). The availability of a continuum of habitat values in the mosaic may be a determining factor in home range size and density of Yuma clapper rails at a site.

Stem density of emergent vegetation is one physical habitat feature that varies significantly between seasons. Generally, low stem densities and low residual vegetation coverage are indicative of suitable habitat (Conway et al 1993). Overall, areas with lower stem densities (less than 75-80 stems/m^2) had significantly more rails during the breeding seasons (Smith 1975, Bennett and Ohmart 1978). Yuma clapper rails use areas with higher stem densities during the late summer and fall (Anderson and Ohmart 1985, Eddleman 1989). Other features with significant changes in seasonal use included distance to the adjacent uplands and vegetative edge and percent residual basal coverage. While vegetation mats (the residual vegetation formed by previous years cattail growth) is of importance to provide movement corridors particularly over deep water, excessive amounts of this material clogs the spaces between living stems and hinders Yuma clapper rail use of those areas (Conway et al. 1993). Rail use of habitats with excessive amounts of residual vegetation declines (Conway and Nadeau 2005). Active management actions, largely through use of prescribed burning, eliminate the residual vegetation and restore the appropriate stem densities (Conway and Nadeau 2005). Additional work is needed to define the proper cycle of burns and identify when rails return to burned habitats.

Home ranges are generally smallest during the early and late breeding seasons (March through July) at 7 to 8 ha (17- 20 ac) and largest in the post breeding (August through October) at 15 ha (37 ac) and late winter (January through February) at 24 ha (59 ac) periods (Conway et al. 1993). Both sexes have similar home range sizes except in the post breeding season, when females averaged about 21 ha (51 ac) and males 9 ha (22 ac) (Eddleman 1989). These figures are significantly larger than those in previous studies, which ranged from 0.12 to 3.59 ha (0.29 to 9.5 ac) (Tomlinson and Todd 1973, Smith 1975, Bennett and Ohmart 1978, Todd 1986). These earlier studies were conducted during the breeding season, and are not representative of year-round use. The figures from Eddleman (1989) and Conway et al. (1993) are for year-round home ranges.

The wide range of home range and activity area sizes indicates that Yuma clapper rails can successfully inhabit a range of marsh sizes. However, the mosaic of habitat features must be met within the area. Eddleman (1989) recognized the value of the small habitats but stressed that larger blocks of habitat provided more opportunities to maintain the mosaic. He suggested areas of 150 ha (370 ac), the approximate size of his study areas, would provide suitable large-scale management units. Todd (1986) discussed the sizes of suitable areas relative to their habitat quality, assuming a minimum of eight pairs per site. Wet sloughs, for example Mittry Lake, could support 8 pairs in 5 ha (12 ac), sandbar-marshes on rivers or reservoirs would require 80 ha (197 ac), and open-lake marshes may require up to 150 ha (370 ac). These figures have not been documented by experimental design. Surveys by Gould (1975) indicated that 68 percent of rails detected were in habitat areas at least 8 ha (20 ac) in size. No minimum patch size for creation of Yuma clapper rail habitat is established; however, Bailey et al. (1983) suggested a minimum of 8 ha (20 ac) for habitat creation at Salton Sea.

Reason for Listing/Threats

Five Factor Analysis

Threats to the Yuma clapper rail are classified according to the five factors identified in section 4(a)(1) of the ESA for consideration in listing, delisting, and reclassification decisions. These five factors are as follows:

A. The present or threatened destruction, modification, or curtailment of habitat or range;
B. Overutilization for commercial, recreational, scientific, or educational purposes;
C. Disease or predation;
D. Inadequacy of existing regulatory mechanisms; and
E. Other natural or man-made factors affecting the continued existence of a species.

The five listing factors and their application to the Yuma clapper rail are discussed below.

Factor A: The present or threatened destruction, modification, or curtailment of its habitat or range.

The most recent estimate of potentially suitable habitat for the LCR and Salton Sea totals 4,260 ha (10,511 ac) with approximately 1,912 ha (4,724 ac) on Federal and State lands. The amount of habitat on the LGR in the vicinity of the Phoenix metropolitan area and the lowest portion of the river near the confluence with the LCR have not been determined, nor has the amount of habitat upstream of Lake Mead along the Virgin River. Those areas do not comprise a significant amount of habitat compared to that compiled for the rest of the U.S. Mexico contains 7,500 ha (18,532 ac) in the Cienega and the Delta.

There are several sources of threat to rail habitats that apply to Factor A. The discussion of these threats is divided below based on the areas with significant populations of breeding rails in the U.S.

Water Management: Rivers

Marshes in the desert southwest are associated with rivers that maintain permanent or mostly permanent flow. Natural hydrological cycles determine the flow patterns that create and destroy marshes in the floodplains of the rivers (Ohmart et al. 1975). Marshes would form along backwaters and oxbows and in the wetter areas of the floodplain. Moderate flows would sustain these areas, and high flood flows would scour out existing marshes or bury them in sediment while at the same time providing new locations for marsh development. The entire system was extremely dynamic in the amount and location of marsh habitats available year-to-year.

Beginning in 1905 on the LCR and later on the LGR, a series of small and large dams began to disrupt the natural hydrograph. Associated diversions from the LCR in particular reduced flows incrementally downstream. Since completion of dams and diversions, water is only released from Hoover Dam on the LCR in response to water requirements by agricultural and municipal users. Flows on the LGR are supported by wastewater releases in the Phoenix area and agricultural runoff from the Wellton-Mohawk Irrigation and Drainage District in the lowest reaches. While both rivers experience flood flows due to upstream precipitation, these floods are not comparable with the usual range of historical annual floods, being generally of the extreme (100 to 500-year frequency) range. These types of flood destroy more acres of marsh than they help establish.

The destructive nature of the floods must also be considered in concert with actions taken to channelize the LCR and portions of the LGR to provide for flood protection and improved water conveyance. Channelization and bank stabilization detach the floodplain and backwaters from the main channel, eliminate marsh and riparian vegetation from the banks and shallow water areas that are dredged, and often result in lower water tables that dry up adjacent marshes. With this management, the cycle of creation and destruction of marsh habitats was significantly altered.

Where habitat remains along the channel and floodplain of the LGR, it is created and destroyed by floods that occur largely as the result of heavy winter rainfall that fills the upstream reservoirs and requires flood releases from the Gila, Salt, and Verde Rivers. These events are sporadic and habitat recovers between their occurrences as it would under natural conditions. Restoration of the complete hydrograph is not likely possible as it would require removal of the upstream dams. The result is that this threat, while not removable, still allows for some natural cycling of habitats.

In one respect, current water management on the LCR has provided for more permanent marshes than may have existed historically. Construction and operation of large and small dams and diversions provided opportunity for establishment of new marshes at the inflow into large reservoirs, and behind the small dams where water is now permanently impounded, water level fluctuations are minimal, and shallow conditions exist for cattail establishment. This has occurred above Imperial and Parker Dams, and at the created Topock Marsh on the LCR. Unfortunately, because these formation events were one-time-only and controls on water flows are maintained, natural cycling to vegetation maturity is the only process operating. In the absence of active management (e.g. prescribed fire) the accumulation of residual vegetation as described earlier reduces the value of the habitat for Yuma clapper rails, and over time, dead plant material builds up the sediments and water depths become shallower, with the eventual loss of marsh acreage at the site.

This aging without regeneration of marshes has profound effects on the entire population of rails on the LCR and has occurred over the last 70 years and continues to occur in the marshes that remain on the rivers. Without active management, existing marshes would degrade and disappear, affecting rail distribution, numbers, and ability to reproduce successfully. The effects of river management are long-term in that they do not relax, and in some cases have a permanent effect. While the original changes in river management occurred in the past, these changes will continue into the future and continue to affect the natural cycling of marsh habitats.

Water Management: Created Marshes

The Salton Sea has, over thousands of years, been periodically filled from the LCR and subsequently dried. The most recent event was in 1905-1907, when the LCR burst through the levee near Laguna Dam and spilled down into the Salton Sea via the irrigation canal that led to the Imperial Valley. As that water evaporated, thousands of acres of agricultural lands were created in the Imperial and Coachella Valleys adjacent to the Salton Sea using water from the LCR delivered through the All-American Canal, which provided a new source of inflow to the Salton Sea through drain water moving from the fields. The Salton Sea marshes at Sonny Bono Salton Sea NWR and IWA were created and are under active management to retain their quality for rails as well as to support other shorebirds and waterfowl. Both Sonny Bono Salton Sea NWR and IWA must purchase water for the marsh habitats from the Imperial Irrigation District (IID). While water for these wildlife areas is considered to be high priority, the future cost (prices have increased 14 percent in the last 4 years) and availability is not guaranteed. The LCR allocation for the IID was recently quantified at 3.1 million acre-feet per year, an actual reduction from the up to 3.3 million acre-feet per year historically used. As water use and demands change in the valley, costs may increase significantly, and priorities for the available water may shift. The IID is currently evaluating the amount of water each category of user in the Imperial Valley will get to not overdraw the LCR allotment. For Sonny Bono Salton Sea NWR, that amount is based on historical use from 1996-2005. However, since 2004 the refuge has used considerably more water than “average” to flush salts from the wetlands ponds. The currently degraded conditions of the Salton Sea are also likely to be factors in future water use, availability, and the potential for contamination of wildlife habitats.

Water for the Cienega de Santa Clara

There is no regulatory protection for the LCR water currently supporting the marsh habitat for the rail at the Cienega de Santa Clara. The land base of the Cienega is included in the core area of the Upper Gulf of California and Colorado River Delta Biosphere Reserve in Baja California and Sonora, Mexico. The Biosphere Reserve concept was a United Nations initiative to protect world-class ecosystems while encouraging sustainable economic activity in surrounding buffer areas. The Mexican government designated this biosphere reserve under authority of the General Law of Ecological Equilibrium and Environmental Protection (Luecke et al. 1999). This law enables designations of protected areas that are at least 10,000 ha [25,000 acres] that contain endemic, threatened, or endangered species. The Biosphere Reserve Management Plan identifies environmental threats, biological resource values, management and research needs, monitoring, and allowed consumptive uses that will contribute to protection of the reserve. In addition to the biosphere management plan, management and enhancement of the wildlife value of the Cienega is included in the recent Bird Conservation Plan for the Colorado River Delta, Baja California, and Sonora, Mexico (Hinojosa-Huerta et al. 2004).

With the recent seven-year drought lowering the water levels in Lake Mead and potential shortage conditions that would affect Arizona's 2.8 million acre-feet allocation of LCR water, there is considerable interest from Arizona water users to reduce the amount of Arizona's potential return flow credit water that began delivery to the Cienega in 1977 via the Main Outlet Drain Extension to the Bypass Canal[2]. The primary option to reduce the amount of water that is diverted to the Cienega is the operation of the Yuma Desalting Plant to desalinate the drain water. This would significantly reduce the amount of water reaching the Cienega, and, if the reject brine was conveyed to the Cienega for disposal, significantly increase the salinity and eventually eliminate the fresh-water marsh that supports the rails. The U.S. has no responsibility to maintain the Cienega; however, a group of individuals, acting outside of their respective agencies, has prepared a white paper that examines ways to provide the water savings desired while not adversely impacting the Cienega. That paper has been included in materials provided for preliminary scoping meetings for the Bypass Flow Restoration or Replacement Program and is an important step in a united effort to preserve this important habitat. However, there is no guarantee that a permanent water supply for the Cienega can be obtained. Future discussions on provision of water for the Cienega should include potential partners in Mexico as well as from the U.S.

[2] The water for the Cienega is saline agricultural return flows that were prevented from returning to the LCR to protect water quality for Mexico's LCR allocation under the terms of Minute 242 (Permanent and Definitive Solution to the International Problem of Salinity in the Colorado River) and the Colorado River Basin Salinity Control Act of 1974 to meet requirements of the Mexican Water Treaty of 1944. The saline flows are contained in a lined canal that extends from Yuma into Mexico and empties into the Cienega. The average flow from the canal into the Cienega is 109,100 acre-feet per year (data from 1994-2003) at a salinity of approximately 2.8 parts per thousand. Under the Law of the Colorado River, Arizona cannot claim those flows as return flows to the LCR; instead they are counted as consumptive use against their 2.8 million acre-feet of LCR allocation, which reduces the opportunity for Arizona to re-use this water under its allocation. This issue is also relevant to Factor D: Inadequacy of existing regulatory mechanisms.

Land Use Changes

Much of the former floodplain of the LCR and LGR that contained marsh habitats associated with backwaters and riparian areas has been disconnected from the river through channelization, bank stabilization, levee construction, and control of water flows. The remaining floodplain along the LCR now has considerable agricultural development. Additional floodplain development may result in the loss of additional marsh habitats. Any action that requires Clean Water Act section 404 permits would also be required to replace lost wetland values. However, replacement may be on off-site and thus, habitat fragmentation may be increased.

Environmental Contaminants

As described previously, the current levels of selenium at the Salton Sea, LCR, and the Cienega de Santa Clara are a source of concern for the Yuma clapper rail populations in those important habitats. These levels may, or may not, be a threat to the Yuma clapper rail. Ongoing and future proposed research looking at selenium levels in adults and eggs at the Salton Sea and LCR will assist in determining the amount of risk posed to the Yuma clapper rail from selenium to assess if this is a threat that requires action be taken. Other contaminants, including heavy metals and pesticides have not been identified as significant threats.

Factor B: Overutilization for commercial, scientific, or educational purposes.

This factor has not been identified as a threat to the Yuma clapper rail.

Factor C: Disease or predation.

This factor has not been identified as a threat to the Yuma clapper rail except in the context of selenium contamination discussed under Factor A.

Factor D: Inadequacy of existing regulatory mechanisms.

In the U.S., the largest areas of Yuma clapper rail habitat are in areas managed for wildlife. Effects to all rail habitats on the LCR and LGR from activities covered under the Clean Water Act section 404 permit programs are subject to section 7 consultations under the Endangered Species Act and mitigation required by section 404 for loss of wetlands.

In California, the Yuma clapper rail is listed as a State endangered species under the California Endangered Species Act and activities that may result in take require the issuance of a 2081 permit by CDFG for activities in California. There is a similar system in Nevada; however, the Yuma clapper rail is not listed by the State as endangered there. Arizona does not have a State endangered species act that provides a similar level of protection for the Yuma clapper rail.

Restoration Potential for Natural Hydrograph

Restoration of normal river flows on the LCR to provide natural cycles of development for Yuma clapper rail habitats is not possible under the suite of laws governing water management. Similarly, no responsibility to maintain marshes created by past water management was provided by those laws. However, because USBR manages the LCR, their actions are subject to section 7 consultations, and under the recently completed Lower Colorado River Multi-Species Conservation Program (LCR MSCP), USBR has committed to provide funding for the maintenance of existing marsh habitats on the LCR (LCR MSCP 2004). The result is that this threat, while not removable, has been addressed to the extent practicable.

Factor E: Other natural or man-made factors affecting its continued existence.

Human Activities

Human activities result in disturbances that can take several forms and primarily affect the behavior of individual birds; however, the quality of habitat can be degraded by chronic disturbances to the extent that an area may no longer support rails. Noise from vehicles (including cars, trucks, boats, and jet skis), radios and human voices, and other sounds may disturb rails in their habitats. The threshold for noise disturbance that results in behavioral disturbance or abandonment of the area is unknown and some areas with significant noise sources maintain healthy rail populations. The degree of risk of abandonment likely varies significantly based on size of the habitat area, volume and frequency of the noise, and the pattern of the noise (continuous, intermittent, occasional, or sporadic).

We have no information on the effects of artificial lights on rail behavior or habitat use. However, information for other animal species indicates that artificial lighting that shines into a habitat area may alter normal behavior patterns (foraging, vocalizations), increase the risk of predation by nocturnal predators, and affect nest-site selection (Rich and Longcore 2006).

Human presence in association with facilities development is also an issue that is of unknown significance. Presence of people and facilities may or may not elicit adverse behavioral responses or abandonment of an area. The threshold level is unknown; however, rails are found in areas where there are roads, launch ramps, recreation sites, and other similar facilities nearby or adjacent. Acclimation is likely an important component for the acceptance of these disturbances near habitat areas.

Extensive development for residential, recreational (recreational vehicle parks and riverfront concessions offering permanent or seasonal spaces), commercial, or similar purposes where human presence is continuous may be more of an adverse effect through changes in riparian vegetation components, shoreline use by residents or visitors, run-off from streets, and additional predation risks from pets. The size of the habitat area is likely an important consideration, with smaller areas that do not provide for refuge sites away from the source of disturbance more likely to be abandoned.

Overgrown marshes with their abundance of fuels from the dead cattail leaves and stalks are at significant risk from wildfires, whether resulting from lightning or the result of human activity (recreational fires, fireworks, arson). This habitat loss can be temporary, because cattails grow back quickly after a fire if their underground rhizomes are not harmed. Fires also clear marshes of accumulated dead vegetation, which acts as a restorative event for the marsh habitat that improves rail habitat characteristics. Prescribed burns during the late fall and winter are a documented management tool to address the marsh degradation that results from water management and land clearing-channelization (USFWS 2006). The seasonality of the fire is the critical component to avoiding death or injury to resident rails. Fire can also eliminate the adjacent riparian vegetation component. That loss may also be temporary depending on the speed of re-sprouting of surviving plants and if conditions are suitable to allow for re-colonization by desirable plant species. The effects of wildfires are difficult to manage because they are unpredictable; however, because effects to habitat are temporary, the important consideration is the connectivity between occupied habitats that allows for re-colonization of the burned area.

Connectivity

Yuma clapper rail populations are separated in three core habitat areas that cover several hundred miles of river and, in the case of the Salton Sea and the Cienega, are also isolated from each other by extensive deserts. The extent of migration or dispersal between the populations is not known. It is assumed that most of the LCR birds do not seasonally migrate, but rates or extent of dispersal is unknown. It is also unclear if some areas are “sinks” where birds dispersing from other areas appear to maintain a population, when in fact there is limited or no recruitment from that site. With the degree of separation between sites, the ability of Yuma clapper rails at one core area to disperse to another area is unclear. Identification of potential migratory pathways will assist in defining metapopulation status for the core areas and identify any stopover habitats that may need protection. Connectivity between the three core areas is also a factor in determining the minimum population size for recovery and the amount of suitable habitat per core area needed to support that area’s portion of the total population.

Climate Change

According to the Intergovernmental Panel on Climate Change (IPCC) (2007) “Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.” Average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1,300 years (IPCC 2007). It is very likely that over the past 50 years cold days, cold nights, and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent (IPCC 2007). It is likely that heat waves have become more frequent over most land areas, and the frequency of heavy precipitation events has increased over most areas (IPCC 2007). To date, these changes do not appear to have had a negative impact on the Yuma clapper rail.

The IPCC (2007) predicts that changes in the global climate system during the 21st century are very likely be larger than those observed during the 20th century. For the next two decades a warming of about 0.2°C (0.4°F) per decade is projected (IPCC 2007). Afterwards, temperature projections increasingly depend on specific emission scenarios (IPCC 2007). Various emissions scenarios suggest that by the end of the 21st century, average global temperatures are expected to increase 0.6°C to 4.0°C (1.1°F to 7.2°F) with the greatest warming expected over land (IPCC 2007). Localized projections suggest the southwest may experience the greatest temperature increase of any area in the lower 48 States (IPCC 2007). The IPCC says it is very likely that hot extremes, heat waves, and heavy precipitation will increase in frequency (IPCC 2007). There is also high confidence that many semi-arid areas like the western United States will suffer a decrease in water resources due to climate change (IPCC 2007). Milly et al. (2005) project a 10 to 30 percent decrease in precipitation in mid-latitude western North America by the year 2050 based on an ensemble of 12 climate models.

Therefore, while it appears reasonable to assume that Yuma clapper rails may be affected, we lack sufficient certainty to know how climate change will affect the subspecies. We believe the effects would likely be related to water availability to support the three core habitat areas. All three rely on water from the Colorado River, and shortages resulting from climate change would be felt in all core areas. We do not know if the extent of water shortages would result in reduced habitat, or if new habitat at different locations, particularly along the LCR, could be created.

Previous and Ongoing Conservation Measures

<u>Factor A: The present or threatened destruction, modification, or curtailment of its habitat or range.</u>

For the LCR habitats, the recently approved LCR MSCP (LCR MSCP 2004) will provide substantial conservation benefit. The LCR MSCP is a 50-year, comprehensive Habitat Conservation Plan that addresses the effects of water use and hydropower generation on the LCR on 26 species, including the Yuma clapper rail. The plan provides for 512 acres of habitat for the rail to be created (a net gain of 269 acres over that presumed to be lost due to covered actions) and managed to maintain habitat quality in addition to species monitoring and research efforts, and funding to maintain existing habitats along the LCR (particularly on the NWRs and Mittry Lake State Wildlife Area) that are threatened with elimination over time by natural aging processes (LCR MSCP 2004). This rail habitat will be created in a landscape mosaic on lands along the LCR corridor and in adjacent areas (LGR, Virgin River) near areas where rails are known to occur.

Under another program at the Salton Sea, the USBR and California partners will create a minimum of 190 and potentially up to 652 acres of new marsh habitat (location to be determined) to offset losses to IID drain habitats from reduced water flows and increases in selenium levels due to water transfers (USFWS 2002, CDFG 2006)) from the IID to California coastal cities. Additional conservation would be required for future transfers that would result in similar effects. In addition, the ongoing programs to protect and restore the avian and aquatic habitats present at the Salton Sea include the commitment to maintain the existing important wildlife habitats, specifically including rail habitat on the Sonny Bono Salton Sea NWR and IWA. We anticipate that water for the refuge and wildlife areas will continue to be purchased from IID (availability and funding constraints may exist in the future and affect the amount and quality of the water provided) and will be canal-delivered LCR water, not drain water with its higher salinity and selenium levels; although, consideration of use of some drain water may be needed if fresh supplies from the canal are inadequate. If only canal water is used, it will not prevent future increases of selenium in the habitats, as this accumulation is already occurring, but would avoid the faster increase in levels that would result from use of the higher selenium drain water.

In 2005, the Torres Martinez Desert Cahuilla Indians began development of a Pilot Wetlands Project at the northern end of the Salton Sea. The initial project has 85 acres of native riparian and wetland habitats and future expansion of the pilot to create 2,000 to 8,000 acres of native riparian and wetlands is anticipated. The development of a Safe Harbor Agreement to facilitate the expansion of the project is underway with the Carlsbad Fish and Wildlife Office of the USFWS.

Prescribed fire has been used at the Salton Sea on Sonny Bono Salton Sea NWR and IWA, and information on areas burned is provided during annual survey reports to the USFWS. Prescribed fire is also in use along the LCR on Mittry Lake Wildlife Area and Havasu and Imperial NWRs as part of a study on the effects of fire on clapper rails with the intent to restore habitat quality in overgrown cattail marshes. In the Cienega, maintenance of existing habitats has already been identified, and funding for a prescribed burn in 2005 was provided through the Sonoran Joint Venture (Hinojosa-Huerta et al. 2007). Because questions remain about the efficacy of prescribed fire and the appropriate periodicity of its application in Yuma clapper rail habitat, an ongoing study on the effects of prescribed fire for cattail re-growth is underway. Preliminary results of post-burn monitoring are showing that the technique has promise for habitat management (Conway and Nadeau 2005). More information on the appropriate schedule to use this technique, and the benefits and risks of this management will be available with the completion of this work.

The Yuma clapper rail was recently downlisted from endangered to threatened under the Mexican endangered species laws as a result of protections afforded its habitat area in the Upper Gulf of California and Colorado River Delta Biosphere Reserve. Plans for the management and enhancement of the wildlife value of the Cienega are included in the management of the Reserve and through the recent Bird Conservation Plan (Hinojosa-Huerta et al. 2004). Efforts in the U.S. and Mexico to secure a long-term water supply for the Cienega are continuing.

Factor D: Inadequacy of existing regulatory mechanisms.

There are regulator mechanisms that exist through the U.S. Endangered Species Act, California Endangered Species Act, and Mexican Endangered Species Act. Also, the Clean Water Act 404 program works to protect marshes.

Factor E: Other natural or man-made factors affecting its continued existence.

Efforts to evaluate effects of human activity and connectivity have not been initiated.

Biological Constraints and Needs

Marshes are dynamic ecosystems that require periodic disturbances to maintain the mix of vegetation and open water that provides habitat for the Yuma clapper rail. The natural aging process of marshes to terrestrial habitats requires that a mosaic of uneven-age stands be maintained across the landscape to ensure that adequate areas of suitable habitat are present at all times. The lack of a natural hydrograph for the LCR and the intrinsic need for management at the created Salton Sea and Cienega de Santa Clara marshes require that active management will be required as part of any recovery scenario for the Yuma clapper rail.

PART II. RECOVERY

Recovery Strategy

Achieving recovery for the Yuma clapper rail is primarily focused on the need to actively manage existing and created habitats throughout the range of the species to ensure that a sufficient amount of habitat of suitable quality exists on a landscape scale to support the U.S. and Mexican populations and that allows for movement of individuals between habitat areas. It must be noted that the major threats to the Yuma clapper rail--water management in rivers (restoration of the natural hydrograph), land use changes, and selenium levels in the LCR--cannot be eliminated. The existing developed structure of the LCR, LGR, and Salton Sea preclude any return to historical conditions. However, these habitats can be manipulated to maintain or restore physical habitat parameters needed by Yuma clapper rails over the long-term and achieve recovery.

While we have considerable information on the physical components of Yuma clapper rail habitat and life history, there are several areas where additional information is needed to complete a comprehensive program that supports recovery and post-delisting management needs. These areas include refinement to habitat parameters including patch size and distribution of habitat areas across the local and regional landscape, total amount of habitat needed to support the desired population in the U.S., seasonal migration and dispersal movements of rails between habitats, and threats from environmental contaminants such as selenium. Recovery actions are included in this plan to address these data gaps.

Recovery Goal

The goal of this recovery plan is to recover the Yuma clapper rail to the point where it is no longer in need of protection under the ESA. Our intermediate goal is to downlist the species to threatened. Because Yuma clapper rail habitat will require long-term active management to maintain in suitable condition, delisting of the species will require core Federal and State-owned and managed habitats to have plans and implementation in place to manage rail habitat over the long-term.

Recovery Objectives

Recovery objectives are discrete components or parameters of the recovery goal that describe the conditions needed to meet the goal. Objectives may be demographic in nature, address specific threats or management needs, and once met, contribute to the recognition that the recovery goal has been met. To meet the recovery (delisting) goal, the following objectives must be met:

1. Documentation of a stable or increasing trend for numbers of rails in the U.S. as shown through annual rail surveys based on maintaining a statistically secure minimum population size determined by research and modeling (as exemplified in Fleischer et al. 1995[3]);

2. Protection of sufficient breeding and wintering habitat to support the desired minimum population size from identified threats and allow for connectivity of habitat;

3. Development of management plans for all important Federal and State-owned habitat areas that provide for habitat development, maintenance of suitable habitat conditions, monitoring, and protection from human disturbances;

4. Completion of an assessment of the degree of threat from existing and predicted selenium levels to adult rails and recruitment of young rails, and if necessary, implementation of management actions to control this threat in rail habitats;

---

[3] The population size requirement for the clapper rail used in the 1983 Recovery Plan was a breeding population of 700-1000 birds in the United States. Until the analysis under section 1.1.2 of the Recovery Actions can be completed the Downlisting criteria will use 824 birds, as derived in Fleischer et al. 1995.

5. An evaluation is completed of potential migration pathways between the LCR, Salton Sea, and Mexican core habitat areas that provide for connectivity that supports population viability and, if appropriate, management plans developed to protect stop-over habitats.

6. Completion of efforts to protect and secure for the long-term an adequate water supply to support rail habitat at current levels at the Salton Sea and in the Cienega de Santa Clara[4].

Recovery Criteria

Recovery criteria are objective, measurable guidelines to assist the USFWS in determining when an endangered species has recovered to the point that it may be downlisted to threatened, or that the protections afforded by the Endangered Species Act are no longer necessary and the species may be delisted. The rulemaking for a reclassification (downlisting or delisting) is based on the analysis of the same five factors used in the listing of the species. The recovery criteria presented here are listed under the appropriate listing factor and represent the best assessment of conditions that would likely result in a determination that a reclassification is warranted.

Downlisting of the Yuma clapper rail to threatened status may be considered when all of the following conditions have been met.

Listing/Recovery Factor A: The present or threatened destruction, modification, or curtailment of its habitat or range.

1. Annual rail surveys document a stable or increasing trend in population based on a minimum of 824 rails (or a higher minimum population size established through research and modeling) in the U.S. for at least 5 consecutive years.

2. Habitat Management Plans for all important Federal and State-owned habitat areas are developed. For the LCR, these areas are: Havasu National Wildlife Refuge, Bill Williams National Wildlife Refuge, Cibola National Wildlife Refuge, Imperial National Wildlife Refuge, Mittry Lake Wildlife Area, Imperial Division lands of the Bureau of Land Management; for the Salton Sea: Sonny Bono Salton Sea National Wildlife Refuge and Imperial State Wildlife Area.

3. Long-term contracts providing for a quality and quantity of water to support the Yuma clapper rail habitats at the Salton Sea are in place. The amount and quality of the water

[4] Although there is no requirement under the U.S. Endangered Species Act to provide for the rail populations in Mexico, the estimated population size of rails there is several times higher than in the United States, and the available habitat is roughly equal to that in the United States. We do not know the true difference in size between the two areas, however, without the Mexican populations, the status of the rail would be much more precarious, and we believe that maintenance of a stable and secure population in Mexico is an essential component of delisting in the U.S.

supply should be sufficient to maintain healthy cattail marsh habitat at Sonny Bono Salton Sea NWR and Imperial Wildlife Area.

Delisting of the Yuma clapper rail may be considered once downlisting criteria and the following additional criteria have been met.

Listing/Recovery Factor A: The present or threatened destruction, modification, or curtailment of its habitat or range.

4. Annual rail surveys document a stable or increasing trend in population based on a desired population of 824 individuals in the U.S. for at least 5 additional years beyond that needed for downlisting.

5. The amount of habitat needed to support a minimum population size as determined in #4 above is established, protected, and managed to ensure adequate breeding and wintering habitat in the U.S.

6. An assessment of the degree of threat from existing and predicted selenium levels to adult rails and recruitment of young rails is completed and, if necessary, management actions to control this threat in rail habitats are implemented.

7. A water supply of sufficient quality to assure the continuation of current levels of rail habitat, in terms of both quantity and quality has been secured for the long-term for the Cienega de Santa Clara. This water supply can be of the current quantity (approximately 100,000 acre-feet per year), and quality (averaging less than 2,660 parts per million [ppm]) or that needed to maintain salinities in the Cienega below that needed for cattail growth [5,000-6,000 ppm]) over the long-term.

Listing/Recovery Factor E: Other natural or man-made factors affecting its continued existence.

8. An evaluation is completed of potential migration pathways between the LCR, Salton Sea, and Mexican core habitat areas that provide for connectivity that supports population viability and, if appropriate, management plans are developed to protect stopover habitats.

Recovery Actions Narrative

The following specific actions are needed to meet the recovery objectives and criteria for downlisting and delisting. Table 3 contains information on how each primary action (1, 2, and 3) relates to the threats identified under the listing factors and the relevant recovery criteria.

1: Define the minimum population size that must be maintained for the Yuma clapper rail in the U.S. to achieve recovery and document progress toward meeting that population size.

1.1 Determine the number of breeding birds in the U.S. that provides for a statistically and genetically secure population. The existence of a minimum population of breeding individuals in the U.S. provides for maintenance of genetic variation and survival after stochastic events in one or more core habitats. This effort will require one or more sequential steps depending on the results of each step.

1.1.1 Evaluate the existing minimum population size of 700-1,000 breeding birds in the U.S. included in the 1983 recovery plan. The 1983 Yuma Clapper Rail Recovery Plan considered a breeding population of 700-1,000 birds in the U.S. as sufficient to achieve delisting. This figure represented the estimated number of rails present between 1973 and 1981 as determined by surveys. There is no information in the records that indicates this minimum population size was based on other biological or genetic information. If the review of this minimum number indicates that the figure of 700-1,000 birds is appropriate to use as a recovery criterion, this number can be used as the figure to meet in criteria 1 and 4. If the review indicates this number is not appropriate, a new minimum population figure is needed.

1.1.2 Depending on the results from task 1.1.1, determine the minimum number of breeding birds in the U.S. needed for down- and delisting using conservation biology principles and/or data on the rail or on surrogate species. If the existing minimum population level is not appropriate, a new minimum population level will be developed. The intensity of the analysis needed to determine the appropriate minimum population size is not known, however, information gathered under the following specific actions will be used to make this determination.

1.1.2.1 Review existing biological information for data to support development of a minimum viable population level. The existing data on the rail, including known information on population dynamics, dispersal and migration between breeding groups in core areas, and existing levels of genetic diversity will be summarized and evaluated to identify any gaps in the existing data that would require additional research to address. A refinement of the current taxonomy of the rail subspecies along the Sea of Cortez may also be appropriate to include.

1.1.2.2 Identify specific research tasks needed to address data gaps from 1.1.2.1. The extent and costs of these research tasks cannot be identified until the review is completed. Once this information

1.2 Conduct coordinated surveys for Yuma clapper rails in the U.S. to document when minimum viable population levels are met.

1.2.1 Continue official annual surveys in the U.S. at all important Federal and State-owned core habitat areas as listed under delisting criterion #2. Cooperating agencies initiated rail surveys in designated habitats beginning in the early 1970s. Continuation of this effort documents the number of rails detected to assess population trends and if recovery criteria are being met.

1.2.1.1 Complete a review of existing survey routes and make revisions/additions to ensure important habitats in the core areas are adequately surveyed. Some survey routes have been in existence for 30 years and habitat may have expanded outside of the routes. This review identifies those areas where adjustments are needed to include important patches in the survey.

1.2.2 Continue surveys on lands outside of core areas and expand as appropriate to the size and potential importance of the area to sustain Yuma clapper rails. Areas outside of the core areas on the LCR and Salton Sea are important for understanding the overall species' status within the range of the rail. These areas should be added to the official survey effort as appropriate. Surveys in some of these areas were established in the 1990s or earlier; others are more recent. Documentation of rails and their habitats in these areas contributes to the range-wide stability needed for recovery.

1.2.2.1 Complete a review of potential habitat areas within the U.S. range of the species and establish survey routes. Areas to be considered under this action include: un-surveyed areas of the LCR, LGR, Bill Williams River, Imperial Valley in California including the northern end of the Salton Sea, the Virgin and Muddy Rivers in Nevada and Utah, and Las Vegas Wash, Overton State Wildlife Area and other sites in southern Nevada that may support rail habitats.

1.2.3 Provide for coordination of all official surveys in core habitats and other areas. Acquisition of good data to use in the documentation of minimum viable population levels requires that annual surveys are done consistently with a standard protocol and qualified surveyors. The official surveys use the National Marsh Bird Protocol (Conway 2005) as established for the LCR in 2006. Minor modifications to this standard protocol to include other marsh bird species of concern to cooperating agencies, minor procedural adjustments, and the addition of new survey routes are implemented as needed. The AESFO, with the eventual cooperation of the Recovery Implementation Team (RIT), continues to be the lead for coordinating annual surveys, including development of the annual report.

1.2.3.1 All personnel participating in the coordinated annual surveys must have sufficient experience in audio-playback survey methods for secretive marsh birds sufficient to qualify for a Federal 10(a)(1)(A) permit and the equivalent State game and fish permit as applicable, or be under the supervision of personnel possessing such permits. There is a level of turn-over of agency staff that may have, in the past, affected the quality of annual survey data. Experience sufficient to gain a permit can be obtained from past field work on marsh birds, training with a permitted surveyor, or training organized or provided by cooperating agencies.

1.2.3.2 Initiate revision to annual report to include estimated population size. Currently, the annual report presents the maximum number of birds contacted during the official survey. Based on existing information that not all rails respond to audio calls, the actual minimum population size documented by the surveys is higher than the survey numbers would indicate. Using existing research or development of new information on call-response rates, area covered during a survey route and other relevant information, a metric that represents the percentage of rails that do respond to audio calls can be developed and used to create reliable trend estimate or, if sufficient information can be gathered, population estimates.

1.2.4 Provide standardization for clearance surveys needed as part of Endangered Species Act requirements for Federal actions and private actions with a Federal nexus. There are two regions of the USFWS that provide permits to contractors or agency personnel to undertake project clearance surveys. Coordination between regions on these permits is needed.

1.2.4.1 Provide a standard survey protocol for clearance surveys. The multi-species survey protocol is not needed for clearance surveys where only the Yuma clapper rail is the listed species of concern. A standard protocol will clarify survey requirements for contractors and agencies.

1.2.4.2 Standardize qualification requirements for potential surveyors applying for Federal and State research permits. At the present time, there is no standard of competency for issuance of permits to consulting firms or individuals who wish to perform Yuma clapper rail surveys for Federal or private actions. Such consistency is desirable to ensure accuracy in these surveys.

1.2.4.3 Determine if development of a training program for potential surveyors outside of the cooperating agencies is needed and develop such training if appropriate. Such programs exist for other species and are required prior to issuance of a Federal permit. A considerable demand for this training is known to exist.

2: Define the physical parameters of and document the amount of Yuma clapper rail habitat in the U.S. needed to support the minimum viable population size needed to achieve recovery. Once the size of the minimum viable population of rails in the U.S. is determined, the amount of habitat needed to support that population in the core habitats and other identified breeding areas must be determined. Additional habitat acreage over that minimum is beneficial to provide refuge during periods when other habitat is not available due to stochastic events or management actions, as well as to provide for connectivity between major breeding groups for dispersal and, in some cases, migratory paths to wintering habitats.

2.1 Refine knowledge of physical factors that provide for suitable habitat conditions. Research conducted in the 1970s-1980s provided much of our current knowledge of the physical parameters that provide suitable rail habitat. Some information has been gathered in the intervening years, both from research in rail habitats and marsh development protocols. Because management of existing habitat to maintain these parameters is crucial to the recovery of the rail, an examination of our current knowledge and identification of data gaps in that knowledge enables identification of when habitat is degrading, the development and use of efficient and successful management actions to restore habitat, and design criteria for habitat creation. This effort first requires an initial review of existing information, then if needed, subsequent research and monitoring efforts.

2.1.1 Refine definition of suitable habitat parameters, including differences between bird densities, breeding and wintering habitat, and home range sizes in different size and quality of habitats. We have several completed research studies that describe the parameters that create suitable habitat; however, there has not been a synthesis of this information or an evaluation if the value of the parameter changes depending on the type of habitat (actively created marsh versus riverine created marsh).

2.1.2 **Information on selenium concentrations in habitat, prey base, and individuals.** We have baseline data from surrogates in core habitat areas for selenium levels, but limited data on exposure in Yuma clapper rail. Information from research on the subspecies is needed, and will be used to determine if selenium levels are a current or potential threat to Yuma clapper rails. If identified as a threat, management actions would be identified to address the threat.

2.1.3 **Identification of other potential contaminants issues.** A review of existing data on environmental contaminants should be accomplished to provide baseline data. Additional research and monitoring may be required.

2.1.4 **Assess effects of human activities on habitat.** Human developments are often adjacent to occupied rail habitats. In some cases, rails remain in these habitats; however, the habitat quality may be adversely affected by increases in light, noise, human presence, trash dumping, predation by pets, or increased risk of wildfire. Determination of appropriate buffer areas between human development and high quality rail habitat is part of this effort.

2.2 **Refine knowledge of rail use of habitats that support determination of the total amount of habitat needed in the U.S.** Research in the 1970s-1980s provided our existing data on how rails use habitat areas, the density of rails related to habitat conditions in several habitat areas, and optimum patch size and configuration across the landscape. How rails use habitat is a factor in determining how much habitat is needed, as is the relationship between habitat parameters and rail density in that habitat. The spatial placements of habitats in large and small patches across the occupied range influences how well rails can reach other significant breeding areas or locate migration paths. We have limited information on the movements of rails either for juvenile dispersal, winter migration, and movements between adjacent breeding and wintering habitats or between core areas. The degree of connectivity is not known between the three core areas. Without this information, identifying a reduction in connectivity between core areas or adjacent habitats that could be a threat to local population success and gene flow is not possible. This effort first requires a review of existing information, then if needed, subsequent research and monitoring efforts.

2.2.1 **Evaluation of patch size and physical configuration of habitat for both large contiguous habitats and smaller areas.** This information is

2.2.2 Determine a range or other measurement of density for rails under various habitat conditions. The number of rails using a habitat is a reflection of its habitat quality. When rail numbers increase or decline over several years, it may be an indication of a change in habitat quality that requires a management action. Success or failure of that action is reflected in subsequent monitoring of the population.

2.2.3 Evaluation of rail dispersal and movement between and within core habitat areas that may affect potential for use of these habitats. Our information on dispersal or seasonal movements within or between habitats or core areas is very limited. Understanding how rails move between areas is important to overall landscape design for habitats, and to ensure connectivity between the large core habitats.

2.3 Develop techniques for managing habitats to maintain suitable conditions for rails. This task is especially important to rail recovery because all core habitats must be actively managed to offset vegetation maturity or other degradation. Current research on the role of prescribed fire is included here, and additional work in that area may be needed. Other management actions for maintaining water quality, preventing selenium accumulation or remediation of such accumulations, addressing invasive species, and other issues are likely to be needed. Monitoring and adaptive management are expected to assist in identification of technical management needs.

2.4 Complete an assessment of the amount and location of Yuma clapper rail habitat in the U.S. every five years. This action is necessary to ensure that the amount of habitat identified in 2.1 as needed for recovery continues to exist and needed management to ensure its suitability is in place. Identification of new issues that may alter the long-term suitability of habitat is an equally important component to the documentation, because habitat quality or its availability may be compromised and past adverse conditions rectified. Survey efforts under task 1.2 may be modified as a result of this assessment.

3: Ensure existing and new habitats for Yuma clapper rail are protected and managed for long-term habitat suitability. Because extensive creation of new habitats by natural processes is largely precluded by existing water management, the future recovery of the rail must focus on maintaining the extent and quality of existing habitats and ones newly created under conservation programs.

3.1 Develop and implement management plans for all important Federal and State-owned core areas to maintain suitable habitat conditions. On the LCR and Salton

Sea, all but one of the important core areas is located on NWRs or State wildlife areas. Management of these areas for wildlife involves various planning documents, a part of which may suffice as a rail management plan. The rail plan can be an appendix or other attachment to existing planning; however, the critical point is that the implementation of the rail plan is given suitable priority with other resources to ensure successful maintenance of rails and their habitats. The existence of written plans also provides continuity between personnel changes and short-term changes in management needs.

3.2 Ensure all core areas in the U.S. have secure water sources that provide for a quantity and quality of water sufficient to manage existing and newly created rail habitat. Without water, marshes cannot be maintained in suitable conditions for rails. Core areas on the LCR at NWRs and State wildlife areas have established LCR water rights. These rights are subject to reduction in accordance with their priority during times of shortage; however, these rights are not in the first rank of rights subject to shortage and are considered secure. Documentation of extant water rights and their use to provide rail habitat is part of the management plan for that area.

3.2.1 Acquire a secure source of water of sufficient quantity and quality to provide for management of existing levels of rail habitat on Sonny Bono Salton Sea NWR for the long-term. As noted previously, the refuge buys water from IID and there is an issue of decreasing source and increasing price. The amount of water needed annually for normal maintenance is less than that needed for occasional habitat management such as flushing salts from the ponds. There is a risk that in the future, sufficient water may not be available without an agreement or contract.

3.2.2 Acquire a secure source of water of sufficient quantity and quality to provide for management of existing levels of rail habitat on the IWA at Salton Sea. The IWA is in the same position as the Refuge in 3.2.1.

3.3 As possible, provide protection for other habitat areas supporting breeding rails through management plans associated with easements, mitigation associated with Federal actions, Habitat Conservation Plans, Safe Harbor Agreements, the Partners for Fish and Wildlife Program, Tribal cooperation, and other options. Habitat areas on the LGR, in Nevada, and in other areas of the LCR are not insignificant to rail recovery; however, the ability to provide management may be limited by multiple landowners, existing and future human development, and lack of knowledge of conservation options. This activity will direct efforts to these other areas to identify and develop these opportunities. Management plans subsequently developed should have similar provisions as those for significant habitat areas in action 3.1.

4: Provide a mechanism for coordination and implementation of recovery actions. Recovery of the Yuma clapper rail requires efforts in two countries and four U.S. States. Landowners include Federal, State, Tribal, and private entities. Water management is both a Federal and State responsibility. Opportunity exists for cooperators from research institutions and national or bi-national conservation groups to participate in implementing the recovery actions. A Recovery Implementation Team (RIT) that incorporates cooperators from the defunct recovery team and interested cooperators is an effective option to provide this mechanism. It is also hoped that participation from Pronatura Noroeste, Dirección de Conservación Sonora in the RIT will enable coordination with Mexican researchers and managers. There may be subgroups formed within the overall RIT focusing on specific areas of interest, particularly reflecting the responsibilities listed below. Some of these responsibilities tie back to recovery actions identified previously in this outline.

4.1 Establish a Recovery Implementation Team with responsibilities for implementing recovery activities, with emphasis on tasks relating to survey management, research, and development of partnerships. The function of the RIT is to assist the USFWS in implementing the annual surveys, identifying research and monitoring needs, developing public outreach materials, and formulating recommendations for new or modified recovery actions. Cooperating parties would fund their own costs for meetings. The RIT would be chartered as appropriate to meet Federal Advisory Committee Act (FACA) rules.

4.1.1 Explore partnerships with other entities to manage or create habitat in concert with their land use plans, conservation programs, or mitigation needs for Federal actions in the U.S. These partnerships can be with Native American Tribes, Federal agencies with conservation funding sources such as the Natural Resources Conservation Service, the Sonoran Joint Venture, State wildlife programs, non-governmental organizations, conservation programs, and private landowners.

4.2 Cooperate with partners in Mexico on issues related to long-term survival of Yuma clapper rail. As previously discussed, the recovery of the rail in the U.S. is linked to its long-term stability in Mexico. The international effort to provide conservation for rails and their habitat in Mexico supports the range-wide recovery for the species.

4.2.1 Work with agencies and cooperators in Mexico to coordinate and continue surveys and trans-boundary research at the Cienega de Santa Clara and along the Colorado River Delta. Survey information to document the status of rails in Mexico is important for documenting the overall species' status. Additional research on rail movements between Mexico and the U.S. should be conducted.

4.2.2 Work with agencies and cooperators in the U.S. and Mexico to protect habitats in Mexico. Because the majority of the Yuma clapper rails are seemingly found in Mexico, protecting their habitats is critical to maintaining genetic variability and long-term population stability.

4.2.2.1 Cienega de Santa Clara. The following tasks are needed to ensure the habitat at the Cienega de Santa Clara is protected and maintained: (1) provide a secure, long-term source of water in sufficient quantity and quality to support existing habitat and provide for maintenance of that habitat, (2) establish a baseline for habitat conditions, including selenium concentrations, and (3) identify funding sources and cooperators to monitor conditions at the Cienega and develop and implement management plans. Of these, the most critical need is to secure the water source.

4.2.2.2 Colorado River Delta. The following tasks are needed to ensure the habitat at the Colorado River Delta is protected and maintained: (1) evaluate existing water sources that create habitat and identify options to protect these sources, (2) establish a baseline for habitat conditions, including selenium concentrations, and (3) identify funding sources and cooperators to monitor conditions and implement management plans.

Minimization of threats to the Yuma clapper rail through implementation of recovery actions

The primary threats to the Yuma clapper rail are habitat-related. The maintenance of suitable habitat conditions in existing habitats relies on the implementation of active management programs by the Federal and State landowners. As noted earlier, there is little to no opportunity to address the changes in water management or restoration of the natural hydrograph that led to the current conditions. However, by managing the existing habitats, including the guarantee of a stable water source on the LCR, Salton Sea, and the Cienega de Santa Clara, habitat quality and quantity can be provided for the species over the long-term. Creation of new, managed habitats on the LCR and Salton Sea through the LCR MSCP and IID conservation programs enhances the existing conditions and provides additional opportunities for research into habitat parameters and how Yuma clapper rails use their habitats.

The managed habitats can also provide areas for survival of Yuma clapper rails that may be displaced by continuing land use changes and human activities. Research into Yuma clapper rail movements between core habitat areas will help define movement corridors and identify smaller habitat areas that may be at risk from land use changes and human activities. Management actions can then be implemented to protect those areas.

The threat posed by selenium contamination will be difficult to address, because there is limited effective control of the source inputs or the magnification of levels due to evaporation and accumulation in the sediments and biota. Remediation, if it becomes necessary, is likely to be costly. Monitoring of selenium levels over time will identify when, or if, remediation is needed at the earliest stages before significant damage is done to the habitat and the resident population.

PART III. IMPLEMENTATION SCHEDULE

The implementation schedule outlines actions and estimated costs for the recovery program for the Yuma clapper rail as set forth in this recovery plan. It is a guide for meeting the recovery goals outlined in this plan. The schedule indicates action priorities, action numbers, action descriptions, duration of actions, the parties responsible for actions (either funding or carrying out), and estimated costs. Parties with authority, responsibility, or expressed interest in carrying out a specific recovery action are identified. Where more than one party has been identified, the proposed lead party is indicated by an asterisk (*). The listing of a party under a specific recovery action does not require the indicated party implement or secure funding for the implementation of that action.

The implementation schedule for this revision covers the period 2009-2018 based on the need to document stable or increasing populations for a 10-year period. Costs are estimated, and may not reflect actual expenditures, particularly in terms of additional research that may be needed to inform recovery decisions.

The implementation schedule does not list all recovery actions by number, only those where specific efforts are needed as identified in the narrative outline. Further partitioning of costs and efforts by cooperators was not practicable.

The RIT is listed in the table under responsible parties for numerous actions. As discussed in the narrative outline, the function of the RIT is to provide a means to encourage all stakeholders and interested parties to participate in the recovery of the Yuma clapper rail. Because for any specific recovery action the members of the RIT who would be actively involved are unknown, the responsible party is only identified as the RIT.

Similarly, there are several USFWS regions, programs, and offices with responsibility to provide for the recovery of the rail. The AESFO in Region 2 is the lead office for the recovery of the rail and will provide overall coordination. The USFWS offices in Region 8 from Ecological Services and National Wildlife Refuges and Region 2 National Wildlife Refuges should be members of the RIT.

The Priority Number in the table reflects the following determinations based on the importance to recovery of the rail of the particular action. The priority numbers are:

Priority 1: Actions necessary to prevent extinction or irreversible decline in rail populations in the foreseeable future.

Priority 2: Actions necessary to prevent a significant decline in rail populations or habitat quality, or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to meet recovery objectives.

Priority Number	Action Number	Action Description	Recovery Criteria	Action Duration In years	Responsibility		Cost Estimate by Fiscal Year ($1,000.00's)						Comments
					Parties	Is FWS lead?	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Total Cost	
3	1.1.1	Assess rationale for setting recovery goal of 700-1,000 breeding birds in the 1983 recovery plan.	1,6	1	RIT	Y	21	0	0	0	0	21	If completion of this task validates the existing number, no work under task 1.1.2 would occur.
3	1.1.2	Determine the minimum number of breeding birds in the U.S. needed for recovery.	1,6	2	RIT	Y	0	0	0	0	0	0	Decision made based on information provided in 1.1.2.1 and 1.1.2.2
3	1.1.2.1	Review existing biological information for data to support determination of minimum viable population.	1,6	1	RIT	Y	0	0	0	0	0	0	This review is part of 1.1.1 and may provide sufficient information to make a reasonable estimate for minimum population size. If not, additional work under 1.1.2.2 would be needed.
3	1.1.2.2	Identify and implement research to fill data gaps from task 1.1.2.1.	1,6	1 to 5	RIT	Y						TBD	Because the extent of this research is unknown at this time, the amount of effort and costs cannot be estimated.
3	1.2.1	Continue annual surveys on Federal and State core habitat areas.	1,6	On-going	RIT	Y	25	25	25	25	25	225	Each cooperating agency including FWS will provide funds for staff field work.

Priority Number	Action Number	Action Description	Recovery Criteria	Action Duration In years	Responsibility		Cost Estimate by Fiscal Year ($1,000.00's)						Comments
					Parties	Is FWS lead?	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Total Cost	
3	1.2.1.1	Review existing survey routes to ensure 90% of core areas are covered during survey.	1,6	2	AGFD CDFG BLM USFWS	Y	3	0	0	0	0	3	Review of existing routes against new marsh habitat maps to determine if routes should be adjusted.
3	1.2.2	Continue or implement official surveys in other occupied habitat areas outside the core areas.	1,6	On-going	AGFD CDFG NDOW UDW USFWS	N	10	10	10	10	10	100	This will enable these non-core routes to be added to the official survey.
3	1.2.2.1	Complete a review of potential habitat areas within the U.S. and establish survey routes.	1,6	1	AGFD CDFG NDOW UDW USFWS	Y	0	24	0	0	0	24	Ensure all significant areas of suitable habitat are identified and included in the official survey.
3	1.2.3	Coordination of annual survey effort and modifications to routes, protocols, and reporting.	1,6	On-going	USFWS RIT	Y	2	2	2	2	2	20	AESFO will continue to coordinate surveys and distribute results to cooperators.
3	1.2.3.1	Provide survey training for personnel from official survey cooperating agencies.	1,6	On-going	RIT	N	6	6	6	6	6	60	USGS-Arizona Cooperative Fish and Wildlife Research Unit has provided this training for agency cooperators in the past.

Priority Number	Action Number	Action Description	Recovery Criteria	Action Duration In years	Responsibility: Parties	Responsibility: Is FWS lead?	Cost Estimate by Fiscal Year ($1,000.00's): FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Total Cost	Comments
3	1.2.3.2	Initiate revision to annual report to include estimated population size.	1,6	2	USFWS	Y	0	0	2	0	0	2	Will require research into rail densities and response rates to calls in habitat types included in annual surveys.
3	1.2.4	Provide standardized section 10(a)(1)(A) permits for compliance surveys for section 7 requirements.	1,6	1	USFWS	Y	1	0	0	0	0	1	Includes actions under 1.2.4.1, 1.2.4.2, and 1.2.4.3 to be completed.
2	2.1	Review existing data on physical habitat elements.	2,3, 7,8	1	RIT	Y	2	0	0	0	0	2	The data gaps identified during this review would be addressed in subsequent tasks 2.1.1 through 2.1.4
2	2.1.1	Refine suitable habitat parameters for summer, winter, and relation to home range sizes.	2,3, 7,8	1	RIT	Y	6	0	0	0	0	6	Rails are known to use habitats differently over the course of a year.
2	2.1.2	Obtain additional information on selenium concentrations in habitat, prey base, and individuals.	3,7	2-4	RIT	Y	0	0	18	0	21	57	This builds off existing information and results from study in 2006-2009. Research may take 2-4 additional years.
2	2.1.3	Obtain information on other potential contaminants and invasive species.	6	1	RIT	Y	0	7	0	0	0	7	The spread of giant salvinia, quagga mussels, and other invasives may affect habitat.

Priority Number	Action Number	Action Description	Recovery Criteria	Action Duration In years	Responsibility		Cost Estimate by Fiscal Year ($1,000.00's)						Comments
					Parties	Is FWS lead?	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Total Cost	
2	2.1.4	Assess effects of human activities on habitat.	2,6	1-2	RIT	Y	0	0	0	20	0	20	Habitat adjacent to development may be degraded.
2	2.2	Review existing data on how rails use habitats.	2,3, 7,8	2-5	RIT	Y	0	3	0	0	0	3	The data gaps identified during this review would be addressed in subsequent tasks 2.2.1 through 2.2.3
2	2.2.1	Evaluation of patch size and physical configuration of habitats.	2,3, 7,8, 9	2	RIT	Y	85	0	0	0	0	85	Funded by Showing Success Grant from USFWS.
2	2.2.2	Determine normal range of rail density for occupied habitat types.	2,3, 7,8, 9	TBD	RIT	Y	0	0	65	65	10	140	Will require multi-year and location tracking of rail populations.
2	2.2.3	Evaluation of rail dispersal and seasonal movements between habitats.	9	2	RIT	Y	0	0	0	140	10	150	This will determine importance of core areas and dispersal patterns.
2	2.3	Develop techniques for management actions to maintain rail habitats in suitable conditions.	2,6	1-5	RIT	Y	0	0	0	10	0	10	This may require several research and monitoring efforts to accomplish. As tasks are developed, they will be tracked individually under this task.

Priority Number	Action Number	Action Description	Recovery Criteria	Action Duration In years	Responsibility		Cost Estimate by Fiscal Year ($1,000.00's)						Comments
					Parties	Is FWS lead?	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Total Cost	
3	2.4	Complete an assessment of the amount of rail habitat in the U.S. every five years.	7,8, 9	2	AGFD BLM CDFG NDOW, NPS	Y	18	0	0	0	0	36	Initial year 2009.
1	3.1	Develop and implement management plans on Federal and State-owned core habitat areas.	2,4	On-going	AFGD, CDFG BLM, USFWS	Y	3	3	3	3	3	30	Costs are primarily for development of plans and projects. Implementation costs are unknown.
2	3.2	Document water rights for core habitats on the LCR.	2,6	1	USFWS	Y	2	0	0	0	0	2	Ensure adequate water is available to provide for suitable habitat.
1	3.2.1	Acquire secure water rights for Sonny Bono Salton Sea NWR.	2,6	1-5	USFWS	Y						TBD	Will require extensive negotiation and development of agreements with the final costs unknown.
1	3.2.2	Acquire secure water rights for IWA at Salton Sea.	2,6	1-5	CDFG USFWS	N						TBD	Same as 3.2.1
2	3.3	Provide protection for other breeding habitats and movement corridors in the U.S.	2,4	10	AGFD, CDFG, NDOW UDW	N						TBD	Same as 3.2.1. Likely to be part of second five year implementation schedule.

Priority Number	Action Number	Action Description	Recovery Criteria	Action Duration In years	Responsibility		Cost Estimate by Fiscal Year ($1,000.00's)						Comments
					Parties	Is FWS lead?	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Total Cost	
3	4.1	Create and support a Recovery Implementation Team.	All	10	USFWS	Y	1	1	1	1	1	10	RIT will guide implementation of recovery plan.
3	4.1.1	RIT meetings to address survey management, research and monitoring, and changes to the recovery plan.	All	10	RIT	Y	3	3	3	3	3	30	Organize annual meeting by AESFO. Cooperating agencies will pay own staff costs.
3	4.1.2	RIT efforts to explore partnerships with potential cooperators in the U.S. to create and manage rail habitats.	2,6	10	RIT	N	5	5	5	5	5	50	These are meeting and plan development costs. Implementation of any plans would require additional funding.
2	4.2.1	Work with agencies and cooperators in Mexico to coordinate surveys and research.	5,9	10	RIT	N	5	5	5	5	5	50	These are meeting and plan development costs. Providing funding or survey assistance would require additional funding.
1	4.2.2.1	Protect habitat at the Cienega de Santa Clara.	8	10	USBR USFWS ADWR CAWCD IBWC Mexico	N	5	5	5	5	5	50	The most important issue here is the acquisition of a secure water source for the Cienega. These are meeting and planning costs. The implementation costs are unknown.

Priority Number	Action Number	Action Description	Recovery Criteria	Action Duration In years	Responsibility		Cost Estimate by Fiscal Year ($1,000.00's)						Comments
					Parties	Is FWS lead?	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	Total Cost	
2	4.4.2.2	Protect habitat at the Colorado River Delta.	8	10	USBR USFWS ADWR CAWCD IBWC Mexico	N	5	5	5	5	5	50	Same as 4.2.2.1

PART IV. LITERATURE CITED

Abbot, C.G. 1940. Notes from the Salton Sea, California. Condor 42(5): 264.

Anderson, B.W. and R.D. Ohmart. 1985. Habitat use by clapper rails in the Lower Colorado River Valley. Condor 87(1): 116-126.

Andrews, B.J., K.A. King, and D.L. Baker. 1997. Environmental contaminants in fish and wildlife of Havasu National Wildlife Refuge, Arizona. USFWS-Arizona Ecological Services Office-Contaminants Program. Phoenix, Arizona. 63 pp.

Arizona Game and Fish Department. 2006. Yuma clapper rail. Unpublished abstract compiled and edited by the Heritage Data Management System. Phoenix. 11 pp.

Banks, R.C. and R.E. Tomlinson. 1974. Taxonomic status of certain Clapper rails of southwestern United States and northwestern Mexico. Wilson Bulletin 86: 325-335.

Bailey, D.A., K.H. Rodenbaaugh, V.M.J. Ryden, P.B. Schumann, P.M Merifield, and W.D. Dritschilo. 1983. Enhancement of habitats for the Yuma clapper rail and desert pupfish, in the vicinity of the Salton Sea, California. Report ESE 83-52. Prepared for Southern California Edison. Environmental Science and Engineering, University of California, Los Angeles. 107 pp.

Bennett, W.W. and R.D. Ohmart. 1978. Habitat requirements and population characteristics of the clapper rail (*Rallus longirostris yumanensis*) in the Imperial Valley of California. University of California, Lawrence Livermore Laboratory, Livermore. 55 pp.

Burton, G.L. 1982. Memorandum to Assistant Regional Director, Endangered Species, Region 2, U.S. Fish and Wildlife Service. February 16, 1982. From Arizona Area Office, Endangered Species, Phoenix. 1 p.

Busch, D. and A. Gomez. 1983. Colorado River Yuma Clapper Rail Survey-1983. U.S. Bureau of Reclamation, Yuma, Arizona. 5 pp.

California Department of Fish and Game. 2006. Comments on draft 5-year review for the Yuma clapper rail. Letter to Arizona Ecological Services Office, Phoenix, Arizona, from California Department of Fish and Game, Sacramento. 3 pp.

Conway, C.J. 1990. Seasonal changes in movements and habitat use by three sympatric species of rails. M.S. Thesis, University of Wyoming, Laramie. 58 pp.

__________ and W.R. Eddleman. 2000. Yuma Clapper Rail. Greenwood Press. *Cited in*: U.S. Bureau of Reclamation. 2009. Appendix C in Draft Environmental Assessment for the Yuma Desalting Plant Pilot Run. Yuma Area Office, Yuma, Arizona. 27pp.

__________. 2005. Standardized North American Marsh Bird Monitoring Protocols. Wildlife Research Report #205-04. USGS- Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, Tucson. 26 pp.

__________, W.R. Eddleman, S.H. Anderson, and L.R. Hanebury. 1993. Seasonal changes in Yuma clapper rail vocalization rate and habitat use. Journal of Wildlife Management 57(2): 282-290.

__________ and J.P. Gibbs. 2005. Effectiveness of call-broadcast surveys for monitoring marsh birds. Auk 122(1): 26-35.

__________ and C.P. Nadeau. 2005. Effects of fire on Yuma clapper rails and California black rails. 2004 Annual Report. Wildlife Research Report #2005-01. USGS-Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, Tucson. 16 pp.

Corman, T.E. and C. Wise-Gervais. 2005. Arizona Breeding Bird Atlas. University of New Mexico Press, Albuquerque. 636 pp.

Dickey, D.R. 1923. Description of a new clapper rail from the Colorado River Valley. Auk 40(1): 90-94. *Cited in* Banks, R.C. and R.E. Tomlinson. 1974. Taxonomic status of certain clapper rails of southwestern United States and northwestern Mexico. Wilson Bulletin 86: 325-335.

Eddleman, W.R. 1989. Biology of the Yuma clapper rail in the southwestern U.S. and northwestern Mexico. Final Report to Bureau of Reclamation, Yuma Projects Office and Fish and Wildlife Service, Region 2. Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming. 127 pp.

_____________ and C.J. Conway. 1994. Clapper Rail. *In* T.C. Tacha and C.E. Braun *eds.* Management of migratory shore and upland game birds in North America. International Association of Fish and Wildlife Agencies, Washington, D.C. pp 167-179.

____________________________. 1998. Clapper rail (*Rallus longirostris*). *In* The Birds of North America, No. 340 (A. Poole and F. Gill, eds). The Birds of North America, Inc. Philadelphia, Pennsylvania. 31 pp.

Fleischer, R.C., G. Fuller, and D.B. Ledig. 1995. Genetic structure of endangered clapper rail (*Rallus longirostris*) populations in southern California. Conservation Biology 9: 1234-1243.

Garcia-Hernández, J., K.A. King, A.L. Velasco, E. Shumilin, M. A. Mora, and E.P. Glenn. 2001. Selenium, selected inorganic elements, and organochloride pesticides in bottom material and biota from the Colorado River Delta. Journal of Arid Environments (2001) 49: 65-89.

Garnett, M.C., J. Kahl, J. Swett, and E.M. Ammon. 2004. Status of the Yuma clapper rail (*Rallus longirostris yumanensis*) in the northern Mojave Desert compared with other parts of its range. Great Basin Birds 7: 6-15.

Gibbs, J.P. and S.M. Melvin. 1993. Call-response surveys for monitoring breeding waterbirds. Journal of Wildlife Management 57(1): 27-34

Glenn, E.P., C. Lee, R. Felger, and S. Zengel. 1996. Effects of water management in the wetlands of the Colorado River Delta, Mexico. Conservation Biology 10: 1175-1186.

Gould, G. 1975. Yuma clapper rail study-censuses and distribution. California Department of Fish and Game, Wildlife Management Report 75-2. Sacramento. 12 pp.

Grinnell, J. 1914. An Account of the Mammals and Birds of the Lower Colorado River Valley. University of California Publications in Zoology. Volume 12: 51-294.

________. 1928. A distributional summation of the ornithology of lower California. University of California Publications in Zoology 32(1): 1-300. *Cited in* Todd, R.L. 1986. A Saltwater Marsh Hen in Arizona. A History of the Yuma Clapper Rail (*Rallus longirostris yumanensis*). Completion Report Federal Aid Project W-95-R. Arizona Game and Fish Department, Phoenix. 290 pp.

________ and A.H. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna, Number 27. Cooper Ornithological Club, Berkeley, California. 608 pp. *Cited in* Todd, R.L. 1986. A Saltwater Marsh Hen in Arizona. A History of the Yuma Clapper Rail (*Rallus longirostris yumanensis*). Completion Report Federal Aid Project W-95-R. Arizona Game and Fish Department, Phoenix. 290 pp.

Hinojosa-Huerta, O., S. DeStefano, and W.W. Shaw. 2000. Abundance, distribution, and habitat use of the Yuma clapper rail (*Rallus longirostris yumanensis*) in the Colorado River Delta, Mexico. Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, Tucson. 78 pp.

________________, S. DeStefano, and W. Shaw. 2001. Abundance and distribution of the Yuma clapper rail (*Rallus longirostris yumanensis*) in the Colorado River delta, Mexico. Journal of Arid Land Environments 49:171-182.

________________, H. Iturribarría-Rojas, and E. Zamora-Hernández. 2003. Status of the Yuma clapper rail and California black rail in the Colorado River Delta. Report to Sonoran Joint Venture by Pronatura Sonora. 10 pp.

______________, H. Iturribarría-Rojas, Y. Carrillo-Guerrero, M. de la Garza-Treviño, and E. Zamora-Hernández. 2004. Bird conservation plan for the Colorado River Delta. Pronatura Noroeste, Dirección de Conservación Sonora. San Luis Rio de Colorado, Sonora, Mexico. 70 pp.

______________, J.J. Rivera Diaz, A.C. Fonseca, M. Gomez, and E. Soto. 2007. Habitat enhancement for endangered rails at the Cienega de Santa Clara. Final Report to Sonoran Joint Venture. Pro Natura Noroeste, Dirección de Conservación Sonora. 15 pp.

______________, J.J. Rivera-Diaz, H. Iturribarría-Rojas, A. Calvo-Fonseca. 2008. Population trends of Yuma clapper rails in the Colorado River Delta, Mexico. Studies in Avian Biology 37:69-73.

Inman, T.C., P.C. Marsh, B.E. Bagley, and C.A. Pacey. 1998. Survey of crayfishes of the Gila River Basin, Arizona, and New Mexico, with notes on occurrences in other Arizona drainages and adjoining States. Report for Contract 5-FG-32-00470 to Bureau of Reclamation, Phoenix, AZ by Arizona State University, Tempe. 46 pp.

Intergovernmental Panel on Climate Change. 2007. Fourth Assessment Report. Climate Change 2007: Synthesis Report Summary for Policymakers. Released on 17 November 2007. Available at: http://www.ipcc.ch/pd/assessment-report/ar4/syr/ar4/syr/spm.pdf

King, K.A., A.L. Velasco, J. Garcia-Hernandez, B.J. Zaun, J. Record, and J. Wesley. 2000. Contaminants in potential prey of the Yuma clapper rail: Arizona and California, USA, and Sonora and Baja, Mexico, 1998-1999. USFWS-Arizona. Ecological Services Office-Contaminants Program. Phoenix, Arizona. 21 pp.

Lower Colorado River Multi-Species Conservation Program. 2004. Volume II: Habitat Conservation Plan. December 17, 2004. Jones & Stokes Inc. Sacramento, California. 378 pp. plus appendices.

Luecke, D.F., J. Pitt, C. Congdon, E. Glenn, C. Valdes-Casillas, and M. Briggs. 1999. A delta once more: restoring riparian and wetland habitat in the Colorado River Delta. Environmental Defense Fund. Washington, D.C. 88 pp.

Lemly, A.D. 1993. Guidelines for evaluating selenium data from aquatic monitoring and assessment studies. Environmental Monitoring and Assessment 28:83-100.

Meanley, B. 1985. The marsh hen: a natural history of the clapper rail if the Atlantic coast salt marsh. Tidewater Publications, Centreville, Maryland. 123 pp. *Cited in* Todd, R.L. 1986. A saltwater marsh hen in Arizona. A history of the Yuma Clapper Rail (*Rallus longirostris yumanensis*). Completion Report Federal Aid Project W-95-R. Arizona Game and Fish Department, Phoenix. 290 pp.

Milly, P.C.D., K.A. Dunne and A.V. Vecchia. 2005. Global pattern of trends in streamflow and water availability in a changing climate. Nature. The Nature Publishing group. Vol. 438. November 17, 2005. pp. 347-350.

Moffitt, J. 1932. Clapper rails occur on marshes of Salton Sea, California. Condor 34(3): 137. *Cited in* Todd, R.L. 1986. A saltwater marsh hen in Arizona. A history of the Yuma Clapper Rail (*Rallus longirostris yumanensis*). Completion Report Federal Aid Project W-95-R. Arizona Game and Fish Department, Phoenix. 290 pp.

Montgomery, S.J. 1990. Year-end report of activities regarding a 1989 study of Yuma rail at the Wister Unit, Salton Sea, California. Report to U.S. Fish and Wildlife Service, Albuquerque, New Mexico. SJM Consultants, Solana Beach, California. 6 pp.

Oberholser, H.C. 1937. A revision of the clapper rails (*Rallus longirostris*) Boddaert. Proceedings of the U.S. National Museum. 84(3018): 313-354). *Cited in* S.R. Wilbur and R.E. Tomlinson. 1976. The literature of the western clapper rails. Special Scientific Report-Wildlife Number 194. U.S. Fish and Wildlife Service, Washington, D.C. 31 pp.

Ohmart, R.D. 1982. Past and present biotic communities of the Lower Colorado River Mainstem and selected tributaries: Davis Dam to Mexican Border. Bureau of Reclamation, Boulder City, Nevada. 238 pp.

___________ and R.W. Smith. 1973. North American clapper rail (*Rallus longirostris*) Literature Survey with Special Consideration Being Given to the Past and Current Status of *yumanensis*. Report to Bureau of Reclamation. Contract 14-06-300-2409. 45 pp.

__________, W.O. Deason, and S.J. Freeland. 1975. Dynamics of marsh land formation and succession along the lower Colorado River and their importance and management problems as related to wildlife in the arid Southwest. Transactions of the 40th North American Wildlife and Natural Resources Conference, Wildlife Management Institute, Washington, D.C. pp 240-251.

__________ and R.E. Tomlinson. 1977. Foods of western clapper rails. Wilson Bulletin 89: 332-336.

__________ and B.W. Anderson. 1978. Recommended transects for clapper rail population trends on the Lower Colorado River. Contract 14-16-022-78-061.

Report submitted to U.S. Fish and Wildlife Service. Arizona State University, Tempe. 14 pp.

Phillips, A., J. Marshall, and G. Monson. 1964. The Birds of Arizona. University of Arizona Press, Tucson. 211 pp.

Piest, L., and J. Campoy. 1998. Report of Yuma clapper rail surveys at Ciénega de Santa Clara, Sonora. Arizona Game and Fish Department and SEMARNAP. 9 pp.

Rich, C. and T. Longcore. eds. 2006. Ecological Consequences of Artificial Night Lighting. Island Press, Washington, D.C. 458 pp.

Ridgeway, R., and H. Friedman. 1941. The birds of North and Middle America. Part IX. U.S National Museum Bulletin 50. 254 pp. *Cited in* Eddleman, W.R. 1989. Biology of the Yuma clapper rail in the southwestern U.S. and northwestern Mexico. Final Report to Bureau of Reclamation, Yuma Projects Office and Fish and Wildlife Service, Region 2. Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming. 127 pp.

Ripley, S.D. 1977. Rails of the world. David R. Godine Publishers. Boston, Massachusetts. *Cited in* Eddleman, W.R. and C.J. Conway. 1998. Clapper rail (*Rallus longirostris*). *In* The Birds of North America, No. 340 (A. Poole and F. Gill, eds). The Birds of North America, Inc. Philadelphia, Pennsylvania. 31 pp.

Roberts, C.A. 1996. Trace elements and organochlorine contamination in prey and habitat of the Yuma Clapper Rail in the Imperial Valley, California. U.S. Fish and Wildlife Service-Carlsbad Fish and Wildlife Office-Division of Environmental Contaminants. Carlsbad, California. 24 pp.

Rusk, M.K. 1991. Selenium risk to Yuma clapper rails and other marsh birds of the Lower Colorado River. Research Report. Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, Tucson. 75 pp.

Sanchez, R.D., E. Burnett, and F. Croxen. 2000. Mapping *Typha domingensis* in the Cienega de Santa Clara using satellite images, global positioning system, and spectrometry. Open File Report 00-314. U.S. Geological Survey. Reston, Virginia. 18 pp.

Skorupa, J.P. and H.M. Ohlendorf. 1991. Contaminants in drainage water and avian risk thresholds. Pages 347-368. *In:* The Economics and Management of Water and Drainage in Agriculture. A. Dinar and D. Zilberman, eds. Kluwer Academic Publishers, New York.

Smith, P.M. 1975. Habitat requirements and observations on the clapper rail, *Rallus longirostris yumanensis*. M.S. Thesis. Arizona State University, Tempe. 35 pp.

Todd, R.L. 1986. A saltwater marsh hen in Arizona. A history of the Yuma clapper rail (*Rallus longirostris yumanensis*). Completion Report Federal Aid Project W-95-R. Arizona Game and Fish Department, Phoenix. 290 pp.

Tomlinson, R.E. 1981. 1981 Yuma clapper rail survey results. Report to U.S. Fish and Wildlife Service, Region 2, Albuquerque, New Mexico. 6 pp.

______________ and R.L. Todd. 1973. Distribution of two western clapper rail races as determined by responses to taped calls. Condor 75: 177-183.

U.S. Bureau of Reclamation. 2007. Distribution of marsh habitats on the lower Colorado River, Davis Dam to the southerly International Boundary. Lower Colorado Regional Office, Boulder City, Nevada.

________________________. 2009. Cienega de Santa Clara Literature Review. Appendix C to Environmental Assessment for Yuma Desalting Plant Pilot Run. Yuma Projects Office, Yuma, Arizona.

U.S. Fish and Wildlife Service. 1983. Yuma Clapper Rail Recovery Plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 51 pp.

__________________________. 2002. Biological opinion in the Bureau of Reclamation's voluntary fish and wildlife conservation measures and associated conservation agreements with the California water agencies. USFWS Carlsbad Fish and Wildlife Office, Carlsbad, California.

__________________________. 2006. Five-Year Review: Yuma Clapper Rail (*Rallus longirostris yumanensis*). Arizona Ecological Services Office, Phoenix. 48 pp.

van Rossem, A.J. 1929. The status of some Pacific coast clapper rails. Condor 31(5): 213-215. *Cited in* Todd, R.L. 1986. A saltwater marsh hen in Arizona. A history of the Yuma clapper rail (*Rallus longirostris yumanensis*). Completion Report Federal Aid Project W-95-R. Arizona Game and Fish Department, Phoenix. 290 pp.

Weatherbee, D.K. and B. Meanley. 1965. Natal plumage characteristics in rails. Auk 82(3): 500-501. *Cited in* Arizona Game and Fish Department. 2006. Yuma clapper rail. Unpublished abstract compiled and edited by the Heritage Data Management System. Phoenix. 11 pp.

Wilbur, S.R. and R.E. Tomlinson. 1976. The literature of the western clapper rails. Special Scientific Report-Wildlife Number 194. U.S. Fish and Wildlife Service, Washington, D.C. 31 pp.

Zembal, R. and B.W. Massey. 1981. A census of the light-footed clapper rail in California. Western Birds 12: 87-99.

PART V. APPENDICES

Appendix A: List of acronyms

AESFO	Arizona Ecological Services Field Office
AGFD	Arizona Game and Fish Department
CDFG	California Department of Fish and Game
ESA	Endangered Species Act
IID	Imperial Irrigation District
IWA	Imperial State Wildlife Area
LCR	Lower Colorado River
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
LGR	Lower Gila River
NDOW	Nevada Department of Wildlife
NPS	National Park Service
NWR	National Wildlife Refuge
RIT	Recovery Implementation Team
USBR	U.S. Bureau of Reclamation
USFWS	U.S. Fish and Wildlife Service

PART VI. FIGURES

Figure 1: Subspecies ranges of clapper rails in the western U.S. and Mexico.

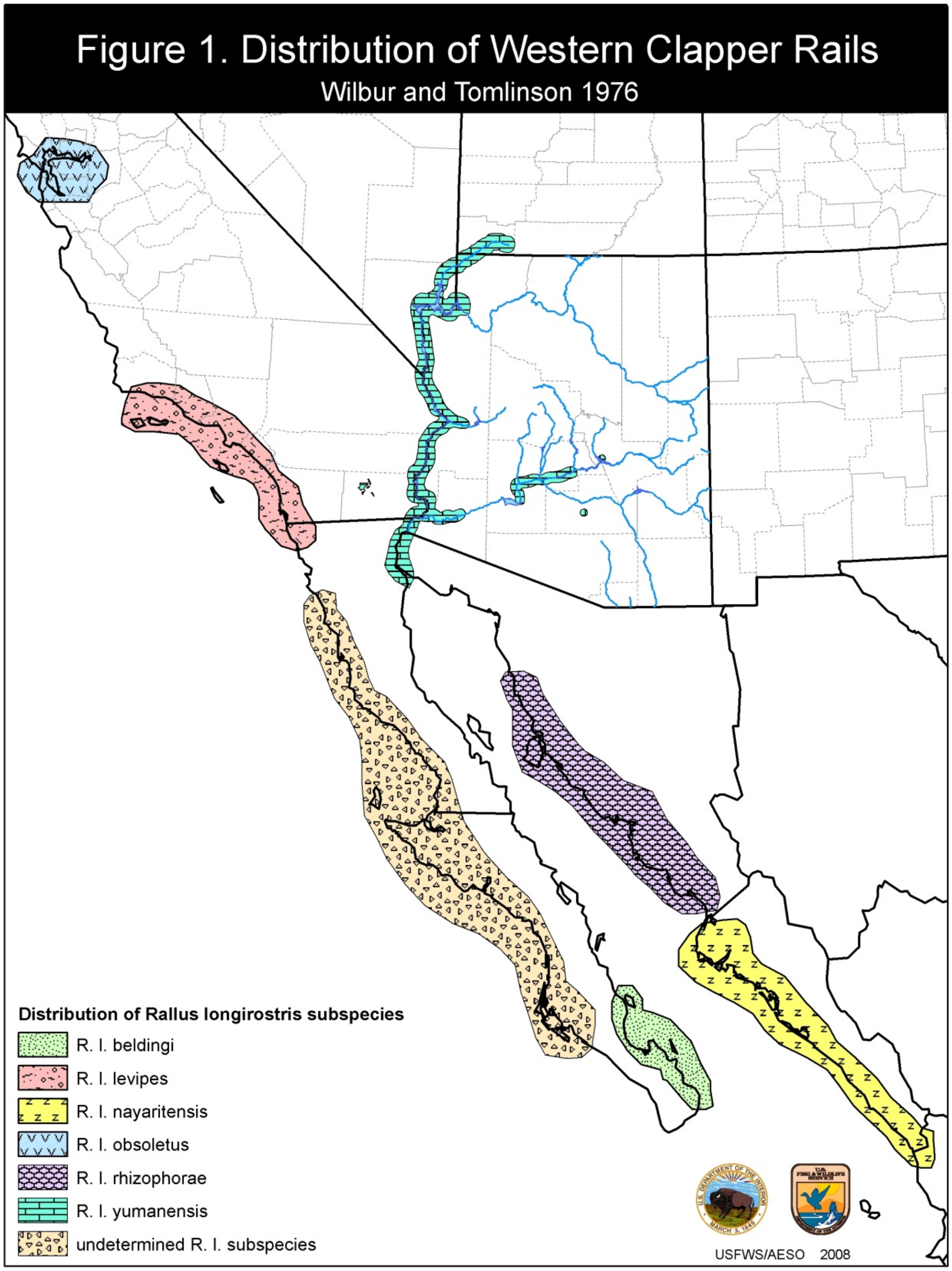
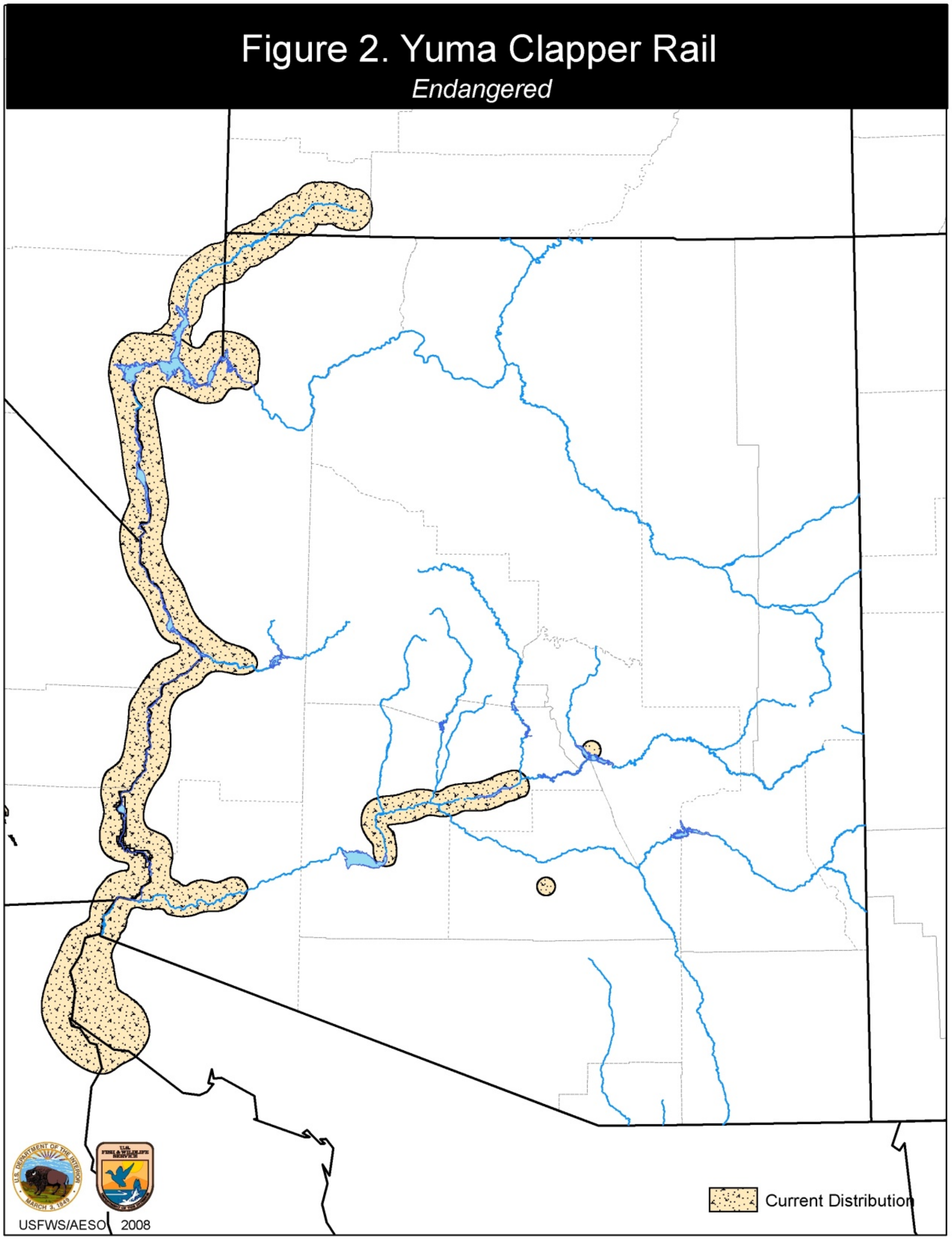


Figure 2: Distribution of the Yuma clapper rail.



PART VII. TABLES

Table 1: Compiled survey data for 1969-2007 for Yuma clapper rail (actual counts of rails recorded on survey routes). Except where indicated, all data from files held at AESFO.

Year	Lower Colorado River	Salton Sea	Lower Gila River	Central Arizona	U.S. Total	Above Lake Mead[5]	Mexico[6]
1969-70	157				157		
1971							
1972	182				182		
1973	684		14		698		145
1974	687	134	18		839		104
1975	604	21	7	7	639		
1976	59				59		700
1977	50				50		
1978	289		29		318		
1979	456	1			457		
1980	523	12			535		
1981	554	54-56	27	4	639-641		41
1982	444				444		
1983	483	14	39		536		
1984	358	42			400		
1985	511	45			556		
1986	406	60			466		
1987	274	89			363		
1988	241	73	5	10	329		
1989	239	93		12	344		
1990	478	110	11	11	610		
1991	496	289	NS	52	837		
1992	560	377	28	47	1012		
1993	599	414	17	46	1076		
1994	495	413	11	50	969		
1995	445	419	5	31	900		
1996	427	365	9	33	834		
1997	404	381	7	22	814		
1998	269	300	0	10	579	1	240
1999	301	226	1	15	543	3	364
2000	257	234	1	11	503	24	382

[5] Data taken from McKernan and Braden 2001, McKernan and Carter 2002, Rathbun and Braden 2003, Garnett et al. 2004, Braden et al. 2005, Miller et al. 2005, Miller et al. 2006, and Braden et al. 2007

[6] Data from Hinojosa-Huerta et al. 2007

Year	Lower Colorado River	Salton Sea	Lower Gila River	Central Arizona	U.S. Total	Above Lake Mead[5]	Mexico[6]
2001	217	255	17	44	533	15	164
2002	252	330	NS	57	639	9	162
2003	359	463	3	35	851	5	337
2004	303	444	64	52	863	6	341
2005	326	523	13	28	890	0	326
2006	300	407	23	23	753	2	370
2007	272	500	13	37	822		
2008	239	353	23	26	641		

Table 2: Comparisons of habitat variables at random sites and those heavily used by Yuma clapper rails during each of five seasons in the lower Colorado River Valley, Arizona, 1986-1987.

Habitat Variable	Random sites (n = 240)	Heavy Use Sites (Z- values)^				
		Late winter N = 18	Early breeding N = 17	Late breeding N = 51	Post breeding N = 41	Early winter N = 15
Stem density (stems/0.25 m^2)	49	-3.8*	-1.3	-0.7	-4.2*	-4.0*
Percent residual basal coverage	13	-2.4	-3.7*	-4.3*	-6.1*	-4.2*
Percent overhead cover	58	-3.7*	-2.5	-1.9	-3.9*	2.9*
Distance to vegetative edge (m)	34	2.5	-1.5	-4.4*	-5.3*	8.1*
Distance to upland (m)	168	-2.9*	0.0	2.6*	7.9*	5.1*
Percent ground coverage	32	0.2	-0.6	0.9	1.1	-4.9*
Percent water coverage	54	0.2	2.4	2.2	2.0	6.4*
Water depth (cm)	9	-0.1	1.1	-1.8	-2.7*	3.3*
Mean emergent height (cm)	212	-1.2	-2.3	-0.8	1.6	4.3*
Distance to open water (m)	37	-1.7	-3.3*	0.5	1.1	-5.2*
Distance to dry ground (m)	103	-1.1	0.1	-3.1*	0.0	5.5*
Percent emergent basal coverage	6	1.6	1.0	-0.9	-4.2*	-2.0

^ Compared with random sites using normal approximation to the Mann-Whitney *U*-test
* Differs from random ($P < 0.01$)

Taken from Conway et al. 1993

Table 3: Relationship between threats, recovery criteria, and recovery actions for the Yuma clapper rail.

Factor	Threat to the species	Recovery criteria	Recovery actions that address the threat
A	Water management: rivers	1, 2,	1, 2
	Water management: created marshes	1, 2, 3, 7,	1, 2, 3
	Water for the Cienega de Santa Clara	7	2, 3
	Land use changes	2, 4, 5	2, 3
	Environmental Contaminants	6	1, 2, 3
B	Threat factor has been analyzed and no known threats exist. Therefore, no criteria or actions to address the threat are needed.		
C	Threat factor has been analyzed and no known threats exist. Therefore, no criteria or actions to address the threat are needed.		
D	Natural hydrology[7]	2	2
E	Maintain connectivity	2,4,5, 6, 8	1, 2, 3
	Human activities	1, 2, 6, 8	2, 3

[7] While the lack of natural hydrology to support most populations of the Yuma clapper rail remains an ongoing threat, there are no identified means of restoring natural river flows to create natural habitat development processes. What is needed to offset this threat is the commitment to artificially maintain existing habitats and create new ones, which is included in the concept of managing important habitats under recovery action 2.