Studies in Avian Biology No. 37:69–73

POPULATION TRENDS OF YUMA CLAPPER RAILS IN THE COLORADO RIVER DELTA, MEXICO

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Abstract. The Yuma Clapper Rail (*Rallus longirostris yumanensis*) is a binationally protected marsh bird in northwestern Mexico and southwestern US. We monitored the population of Yuma Clapper Rails in the Colorado River delta, Mexico from 1999–2006. The monitoring program consists of call-response surveys at 15 transects (five point counts each) randomly located in the Ciénega de Santa Clara, northwestern Sonora. The population of Yuma Clapper Rails at the Ciénega declined 55% during the period of 1999–2002 (95% CI = 33.53–76.45; $P < 0.001$, $\beta = 0.99$). However, from 1999–2006 we found no change in the population of Clapper Rails ($P = 0.43$, $\beta = 0.12$). The Ciénega de Santa Clara maintains the largest known population of the subspecies, with an estimate of 5,974 individuals (95% CI = 4,698–7,482) for 2006. The short-term population fluctuations of Clapper Rails are likely associated with changes in the direction of water flows and the occurrence of wildfires in emergent vegetation. In the long-term, the conservation of the Yuma Clapper Rail requires binational collaboration to secure water for key wetland areas and the implementation of management strategies to maintain vegetation dynamics.

Key Words: Ciénega de Santa Clara, marshbirds, monitoring, *Rallus longirostris yumanensis*, Upper Gulf of California and Colorado River Delta Biosphere Reserve.

TENDENCIAS POBLACIONALES DEL PALMOTEADOR DE YUMA EN EL DELTA DEL RÍO COLORADO, MÉXICO.

Resumen. El Palmoteador de Yuma (*Rallus longirostris yumanensis*) es un ave de marisma protegida a nivel binacional en el suroeste de Estados Unidos y el noroeste México. Monitoreamos la población de *R. l. yumanensis* en el delta del Río Colorado, México, de 1999 al 2006. El programa consistió en conteos por llamado-respuesta en 15 transectos (con 5 puntos de conteo cada uno) localizados aleatoriamente en la Ciénega de Santa Clara, en el noroeste de Sonora. La población de la subespecie en la Ciénega de Santa Clara disminuyó 54.99% durante el periodo de 1999-2006 (I.C. 95%. 33.53–76.45; $P < 0.001$, $\beta = 0.99$). Sin embargo, de 1999 al 2006 no detectamos cambios en la población de *R. l. yumanensis* ($P = 0.43$, $\beta = 0.12$). La Ciénega de Santa Clara mantiene a la población conocida más grande de la subespecie, con un estimado de 5,974 individuos (95% I.C. 4,698–7,482) en 2006. Las fluctuaciones poblacionales de corto plazo probablemente se encuentren vinculadas con cambios en la dirección de los flujos de agua y con los patrones de incendios de la vegetación emergente. En el largo plazo, la conservación del Palmoteador de Yuma requiere de colaboración binacional para garantizar las fuentes de agua para los humedales y la implementación de estrategias de manejo para mantener el dinamismo de la vegetación.

Long-term monitoring programs can provide critical information on changes in bird populations that can guide conservation efforts and provide feedback for adaptive management plans (Ralph et al. 1993). In the Colorado River delta, recent pulse floods and agricultural drainage water have restored wetland and riparian areas (Glenn et al. 2001, Nagler et al. 2005). With effective management, these areas and their water sources can maintain critical habitat for hundreds of bird species, many of which are of special concern (Hinojosa-Huerta et al. 2004, 2007).

The Yuma Clapper Rail (*Rallus longirostris yumanensis*) is a marsh bird classified as Threatened in Mexico and Endangered in the US (Eddleman and Conway 1998, Diario Oficial de la Federación 2002). The subspecies is distributed in the Lower Colorado Basin, from Topock Marsh, California, to the Colorado River delta in Mexico, and in mangrove marshes along the coast of Sonora (Eddleman and Conway 1998). The subspecies' population has declined due to habitat degradation and loss caused by water management practices in the Lower Colorado Basin (Eddleman and Conway 1998). In the Colorado River delta, Clapper Rails inhabit remnant wetlands (Hinojosa-Huerta et al. 2001), in particular the Ciénega de Santa Clara, which is estimated to support one of the largest populations of the subspecies with over 3,000 pairs (Hinojosa-Huerta et al. 2001).

The Ciénega de Santa Clara is located in the southeastern section of the Colorado River delta in Sonora, Mexico, within the Upper Gulf of California and Colorado River delta Biosphere

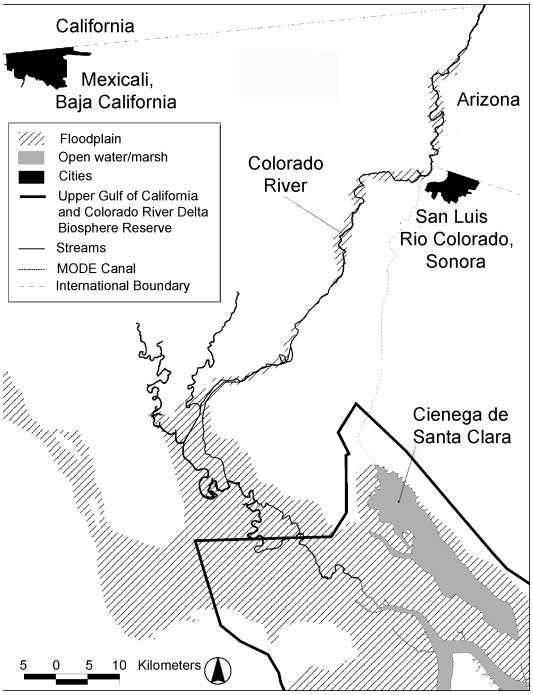

FIGURE 1. Map of the Colorado River delta, Baja California, and Sonora, Mexico.

Reserve (UGCCRDBR; Fig. 1). This 5,800 ha wetland, dominated by cattail (*Typha domingensis*), was accidentally restored in the late 1970s when brackish agricultural drainage from the Wellton and Mohawk Valleys in Arizona started to reach the area (Glenn et al. 1996). The drainage reaches the Ciénega through the Main Outlet Drain Extension (MODE) canal, as part of a temporary solution implemented by the US in the 1970s to control the salinity of Colorado River water deliveries into Mexico (Zengel et al. 1995). As such, the flow into the Ciénega is not permanently secured, emphasizing the importance of a program to monitor the ecological health of this wetland.

The criteria to establish the UGCCRDBR included protection of the Yuma Clapper Rail. Specific objectives for the management of the natural protected area include the preservation of Yuma Clapper Rail populations and its habitat, as well as maintenance of a monitoring program for the subspecies. Several efforts have been carried out to determine the status of the population in the Ciénega de Santa Clara, including initial assessments carried out in 1989 (Eddleman 1989) and 1993 (Abarca et al. 1993), and a pilot binational monitoring program in 1998 (L. Piest and J. Campoy, unpubl. data).

As a follow-up and as part of the management activities of the biosphere reserve, we designed and implemented a long-term program to monitor the population of Yuma Clapper Rails in the Ciénega de Santa Clara (Hinojosa-Huerta 2000). The general objectives of the program are to monitor ecosystem health, determine whether habitat requirements are being met for the protection of the subspecies, and guide management actions in the natural protected area. Here we present the results of the monitoring program from 1999 to 2006, including the population trends and latest population estimates of Yuma Clapper Rails at the Ciénega de Santa Clara, Sonora, México.

METHODS

We conducted surveys during the breeding seasons of 1999–2006 at 15 transects randomly located in the Ciénega de Santa Clara. These transects are a subset of the transect surveys conducted in 1999 and 2000 to determine the status of the Yuma Clapper Rail at the Ciénega (Hinojosa-Huerta et al. 2001). With the 1999 and 2000 survey data, we designed a long-term monitoring plan using the program MONITOR 6.2 (Gibbs 1995), with the objective of detecting population changes <3% per year, with a significance level of 95% and a statistical power of 90% (Hinojosa-Huerta 2000).

Our survey procedures were based on the protocol established by the USDI Fish and Wildlife Service for Yuma Clapper Rail surveys (USDI Fish and Wildlife Service 2000). The protocol consists of call-response surveys, in which taped vocalizations are broadcasted to elicit the response of the target species (Conway and Gibbs 2005). At each survey point, the surveyors recorded the number of Yuma Clapper Rails during a 2-min passive period prior to broadcasting recorded calls, and during two periods in which pre-recorded vocalizations of Yuma Clapper Rails were broadcast for 2 min, followed by 2 min of silence. Survey stations were variable distance circular plots located 200 m apart, and grouped in transects (five stations per transect). Surveys started at sunrise and continued until no later than 1030 H. Transects were either on the edge between marsh and upland or on the edge between marsh and open water. Following recommendations from standardized protocols (Conway 2002) and pilot studies in the Ciénega de Santa Clara (Hinojosa-Huerta 2000), we did not establish transects through cattail patches.

We visited each station once during early breeding season (March), and once during late breeding season (May). In addition to rails, we

also recorded vegetation and water depth characteristics at each transect, as well as effects on habitat features by disturbance events such as wildfires and hydrological fluctuations.

We entered all the data in a relational database and conducted the statistical analyses using JMP IN 3.2 (Sall and Lehman 1996). Individual birds detected at several survey points were only counted at the initial detection site. To estimate population trends, we used the number of Clapper Rails detected per point, using the average for each point of the early and late breeding season counts. With this data set we ran a linear regression of detections of Clapper Rails against year, from 1999 to 2006.

We used the program DISTANCE (Thomas et al. 2002) and the May 2006 survey data to estimate Clapper Rail densities. We selected the distance models using a combination of goodness of fit test and the coefficient of variation in the parameter estimates. Estimates of abundance were based on the area of the Ciénega de Santa Clara (5,800 ha; Glenn et al. 2001), and the 95% confidence intervals of the density estimates from DISTANCE. This estimate assumes a 100% response rate from Clapper Rails to the call-response surveys. We also calculated a less conservative estimate, using a fixed 60% response rate based on L. Piest and J. Campoy (unpubl. data).

To examine changes of Yuma Clapper Rail densities at the Ciénega de Santa Clara, we generated density maps of Clapper Rails for 1999, 2002, and 2006. We used ARC/VIEW 3.1 to interpolate density polygons for the whole Ciénega, using the data from rails detected at the survey stations, a cell size of 50 m, and interpolation of data using the closest 10 survey stations to each cell. The datum for each cell is an estimate, but allows for a general observation of the patterns of Clapper Rail distribution at the Ciénega throughout the study.

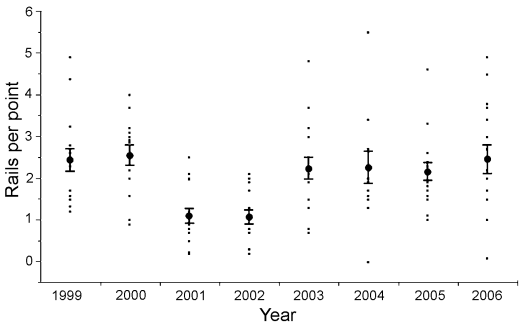

FIGURE 2. Detections of Yuma Clapper Rails by year and transect, at the Ciénega de Santa Clara, Sonora, Mexico.

RESULTS

The average number of detections of Yuma Clapper Rails per year at the Ciénega de Santa Clara was 305.70 (SE = 31.82). The minimum number of detections was 162, which occurred during 2002, and the maximum was 370, during 2006. Overall, from 1999–2006 we found no change in detections of Yuma Clapper Rails (average change per year = 3% ± 4%, $P = 0.43$, $\beta = 0.12$). However, the number of Yuma Clapper Rails at the Ciénega declined 55% during the period of 1999–2002 (95% CI = 33.53–76.45; $P < 0.001$, $\beta = 0.99$), with detections decreasing from 364 in 1999 to 162 in 2002 (Fig. 2). The decrease in detections occurred mostly at the central lagoons, with 83% fewer detections (Fig. 3). In comparison, count numbers increased 47% in 2003–2006 (95% CI = 22–71, $P < 0.001$; Fig. 2). However, there was a shift

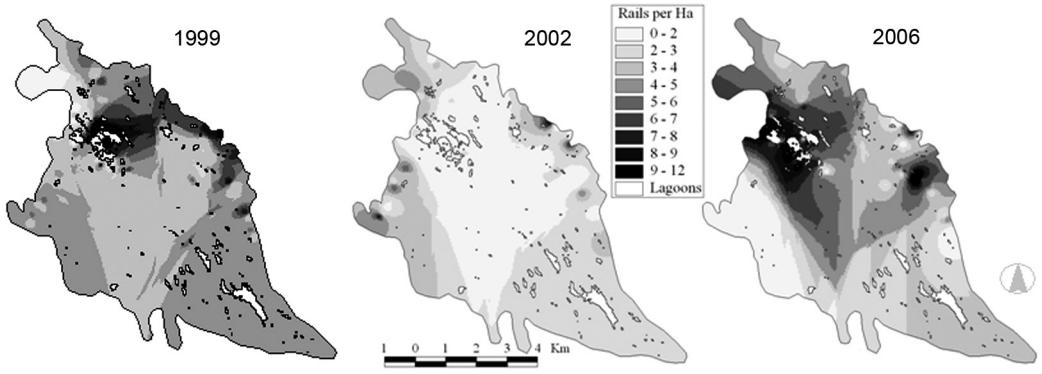

FIGURE 3. Densities of Yuma Clapper Rails per hectare at the Ciénega de Santa Clara, Sonora, Mexico, for 1999, 2002, and 2006. ARC/VIEW 3.1 was used to interpolate the density polygons from rails detected at the survey stations.

in distribution of Clapper Rails through this period, with an increase at the central lagoons and northwestern edge of the Ciénega (52% overall increase) and a decrease at the southwestern and eastern edges (34% decrease).

The estimated density of Yuma Clapper Rails at the Ciénega de Santa Clara during the May 2006 survey was 1.03 rails/ha (95% CI = 0.81–1.29, 267 detections, $\chi^2 = 0.368$, df = 1 and 82), with an estimated detection radius of 105.02 m (95% CI = 97.70–112.87). Assuming a conservative estimate of 100% response rate and a wetland area of 5,800 ha for the Ciénega, the population estimate of Yuma Clapper Rails for 2006 was 5,974 individuals (95% CI = 4,698–7,482). Assuming a fixed response rate of 60%, the population estimate was 9,956 individuals (95% CI = 7,830–12,470).

DISCUSSION

A level of uncertainty is associated with the abundance estimation of Yuma Clapper Rails in the Ciénega de Santa Clara due to the lack of a precise estimate of response rate of birds to the pre-recorded vocalizations (Conway and Gibbs 2005). However, using a conservative estimate of 100% response rate, population estimates are close to 6,000 individuals, the largest known population for the subspecies in its entire range (Eddleman and Conway 1998).

Despite fluctuations and some significant decreases during the first half of the study period, the population of Yuma Clapper Rails at the Ciénega has been stable during the last eight years and does not show a downward trend. With the information generated through the monitoring program, we conclude that the estimated number of Clapper Rails meets the conservation objectives for the subspecies in Mexico and for the UGCCRDBR (CONANP 2007).

From 1999 throughout 2006 fluctuations occurred in abundance and changes in the distribution of Clapper Rail densities at the Ciénega. These variations were likely associated with marsh habitat dynamics (Conway and Nadeau 2005). The eastern and northern parts of the Ciénega burned in 1998, just before the beginning of the monitoring program, which promoted the growth of young stands of cattail. In the following years, cattail stands became too dense and senescent, probably reducing the density of rails they could support (Conway and Nadeau 2005). This was evident during 2001 and 2002 at the central, more stable lagoons of the Ciénega, where the stand density and senescence reduced the quality of habitat for Yuma Clapper Rails.

In 2003, changes in the direction of the flow that reaches the Ciénega promoted the growth of young cattail stands at new sites, in particular in the northwestern edge. This triggered the population increase and shift in distribution observed in 2003–2005. In early 2006, another wildfire at the Ciénega burned nearly 2,000 ha, primarily in the central portion. By late spring 2006, the cattail stands grew back, and detections of Yuma Clapper Rails increased throughout the burned area (O. Hinojosa-Huerta, unpubl. data).

With the monitoring program we have been able to track the fluctuations of Yuma Clapper Rail abundance at the Ciénega and provide feedback for the management of the Biosphere Reserve. In particular, we learned that the conservation of the subspecies requires not only the maintenance of water flows, but also the maintenance of successional stages in wetlands throughout the region. This should be based upon the implementation of various management strategies, including the restoration, at a smaller scale, of the natural hydrologic regime of the Colorado River delta, with periodic pulse floods, and the implementation of prescribed fires. The actions should maintain a mosaic of large cattail patches of mixed ages interspersed with shallow lagoons, deter the invasion of the exotic saltcedar (*Tamarix ramosissima*), and prevent the senescence of the emergent vegetation (Eddleman 1989, Hinojosa-Huerta 2000, Conway and Nadeau 2005).

Despite their fairly high numbers, Yuma Clapper Rails are still threatened in Mexico, due to water management actions and the destruction of wetlands that could drastically reduce their population. The extended drought throughout the Colorado River basin has increased the pressure to improve water efficiency, resulting in less water for wetlands and wildlife (Zamora-Arroyo et al. 2006). In particular, there is increasing pressure to operate the Yuma Desalting Plant (U.S. Bureau of Reclamation 2005). This would divert the water from the MODE canal to the Yuma Desalting Plant in Arizona, and the resulting freshwater would be allocated to consumptive uses. The concentrated brine exiting the plant would be directed to the Ciénega, which would almost certainly result in the disappearance of emergent vegetation and Yuma Clapper Rails at this wetland (García-Hernández et al. 1999).

However, environmental organizations and government agencies are working together to find solutions to the water requirements in the US while maintaining the ecological values of the Ciénega de Santa Clara in Mexico (Yuma Desalting Plant/Ciénega de Santa Clara

Workgroup 2005). This approach provides a sounder framework for negotiation with clearer opportunities for reducing the risk of shortage in the basin while establishing measures to protect the Ciénega. Considering the dynamics of water management in the region and across the border, a robust monitoring program, implemented in the framework of adaptive management and providing guidelines for water use, is an essential tool to guarantee the long-term conservation of the Yuma Clapper Rail and its habitat in the United States and Mexico.

ACKNOWLEDGMENTS

This program has been funded and supported by the Sonoran Joint Venture, USDI Fish and Wildlife Service, CONANP, National Fish and Wildlife Foundation, CEDES, AEURHYC, Ejido Luis Encinas Johnson, University of Arizona, PRBO Conservation Science, and Pronatura. We thank José Campoy, Martha Gómez, Eduardo Soto, Ramsés Rodríguez and all the personnel at the Upper Gulf of California and Colorado River Delta Biosphere Reserve who have provided support for the implementation of this program. We also thank the field technicians and volunteers that have participated in the surveys, in particular Juan Butrón, José Juan Butrón, Enrique Zamora, Ricardo Olachea, Yamilett Carrillo, Robert Mesta, Pablo Valle, and Jaqueline García. We thank Courtney Conway for the helpful comments and support to improve the monitoring program for marshbirds in the Colorado River delta, as well as Lin Piest, Eduardo Palacios, and Tim Brush for their invaluable editorial feedback.