SUPPLEMENTAL
BIOLOGICAL ASSESSMENT ON TRANSBOUNDARY EFFECTS IN MEXICO
FOR
PROPOSED INTERIM SURPLUS CRITERIA

January 9, 2001

INTRODUCTION

This consultation is conducted to consider the impacts on species in Mexico listed as endangered or threatened in the U.S. under Section 7 (a)(1) of the Endangered Species Act of 1967, as amended. This document addresses impacts in Mexico and supplements the Biological Assessment (BA) on the Interim Surplus Criteria (ISC) and Secretarial Implementation Agreements (SIA) (U.S. Bureau of Reclamation, 2000a) which is incorporated by reference. Project descriptions and background for the SIA are found in the main body of the BA. Project descriptions and background for the ISC are found in the Final EIS, Colorado River Interim Surplus Criteria EIS (U.S. Bureau of Reclamation, 2000b)

This consultation does not reflect any conclusion on Reclamation's part that consultation is required, as a matter of law or regulation, on any possible impact the adoption of interim surplus criteria may have on U.S. listed species in Mexico. Rather, consultation on these effects has proceeded with the express understanding that it may exceed what is required under applicable Federal law and regulations and does not establish a legal or policy precedent.

Several interim surplus criteria (ISC) have been proposed and are described in the EIS. For the purposes of this analysis, however, the criteria selected are known as the Basin States Alternative, which is presently proposed for use by Reclamation for the Preferred Alternative in the EIS. The Basin States Alternative specifies ranges of Lake Mead water surface elevations to be used through 2015 for determining the availability of surplus water through 2016. The elevation ranges are coupled with specific amounts of surplus water in such a way that, if Lake Mead's surface elevation were to decline, the amount of surplus water would be reduced. Surplus water would be available only to holders of valid contracts for surplus water delivery. The interim criteria would be reviewed at five-year intervals with the Long-Range Operating Criteria and as needed based upon actual operational experience. This plan is described further in Appendix A of this document. This alternative was developed with input and consensus from the seven Colorado River Basin states.

This document discusses the potential effects that extend across the international border below the Northerly International Boundary (NIB). Reclamation distinguishes between impacts resulting from the ISC and the SIA. Reclamation does not believe the SIA has any potential effect on any U.S. listed species in Mexico. Potential effects on resources could occur from potential changes in flows to Mexico as a result of adoption of ISC. The potential changes in flow to Mexico as a result of the ISC are discussed in this document. Details of how the changes in flow were derived are further detailed in the EIS and are also incorporated by reference.

U.S. Federally Endangered Species analyzed in this assessment include the desert pupfish (*Cyprinodon macularius*), vaquita (*Phocaena sinus*), totoaba (*Totoaba macdonaldi*), southwestern willow flycatcher (*Empidonax traillii extimus*), and the Yuma clapper rail (*Rallus longirostris yumanensis*).

METHODOLOGY

The analytical approach used to evaluate potential impacts below the NIB is the same as that used for other resources and is fully consistent with the other documents pertaining to this subject. The incremental hydrological change between the baseline conditions and the Basin States Alternative was determined by modeling the Colorado River system. Environmental baseline conditions are those expected to result from the full development of the U.S. waters reserved by treaty. This includes the full development of the water allocated to the lower Colorado River Basin and up to 5.9 maf development of the upper Colorado River Basin allocation as recognized by the Colorado River Compact.

The potential effects on Mexico's resources cannot be specifically determined due to the uncertainty of water use once it flows across the NIB into Mexico. The waters of the Colorado River, once delivered to Mexico, as agreed upon in the Mexican Water Treaty of 1944, are under the jurisdiction of Mexico. This treaty contains no provisions requiring Mexico to provide water for environmental protection, nor any requirements relating to Mexico's use of that water. It is reasonably foreseeable that Mexico will continue to maximize consumptive use of its Colorado River water apportionment for agricultural, municipal and industrial purposes.

For Clarification it is necessary to distinguish between Mexico's receipt of up to 200,000 acre feet (af) of scheduled surplus water from that of additional water, which this analysis refers to as "excess flows." The 200,000 af of flood control surplus to Mexico is in addition to the amount necessary to supply uses in the United States and the more assured quantity of 1.5 maf to Mexico. This 200,000 af is scheduled by Mexico and is spread over the entire year as outlined in Article 15

of the Treaty of 1944, and are not related to the surplus water that will be generated from the Basin States Alternative implementation under the surplus criteria. Excess flows result from flood control operations, unanticipated contributions from events such as flooding along the Gila River and/or other factors resulting in canceled water orders by water users below Parker Dam. The change in probability of these excess flows is the subject of this analysis. Mexico has complete autonomy as to how they choose to manage apportioned (scheduled surplus water) and excess Colorado River flows.

AFFECTED ENVIRONMENT

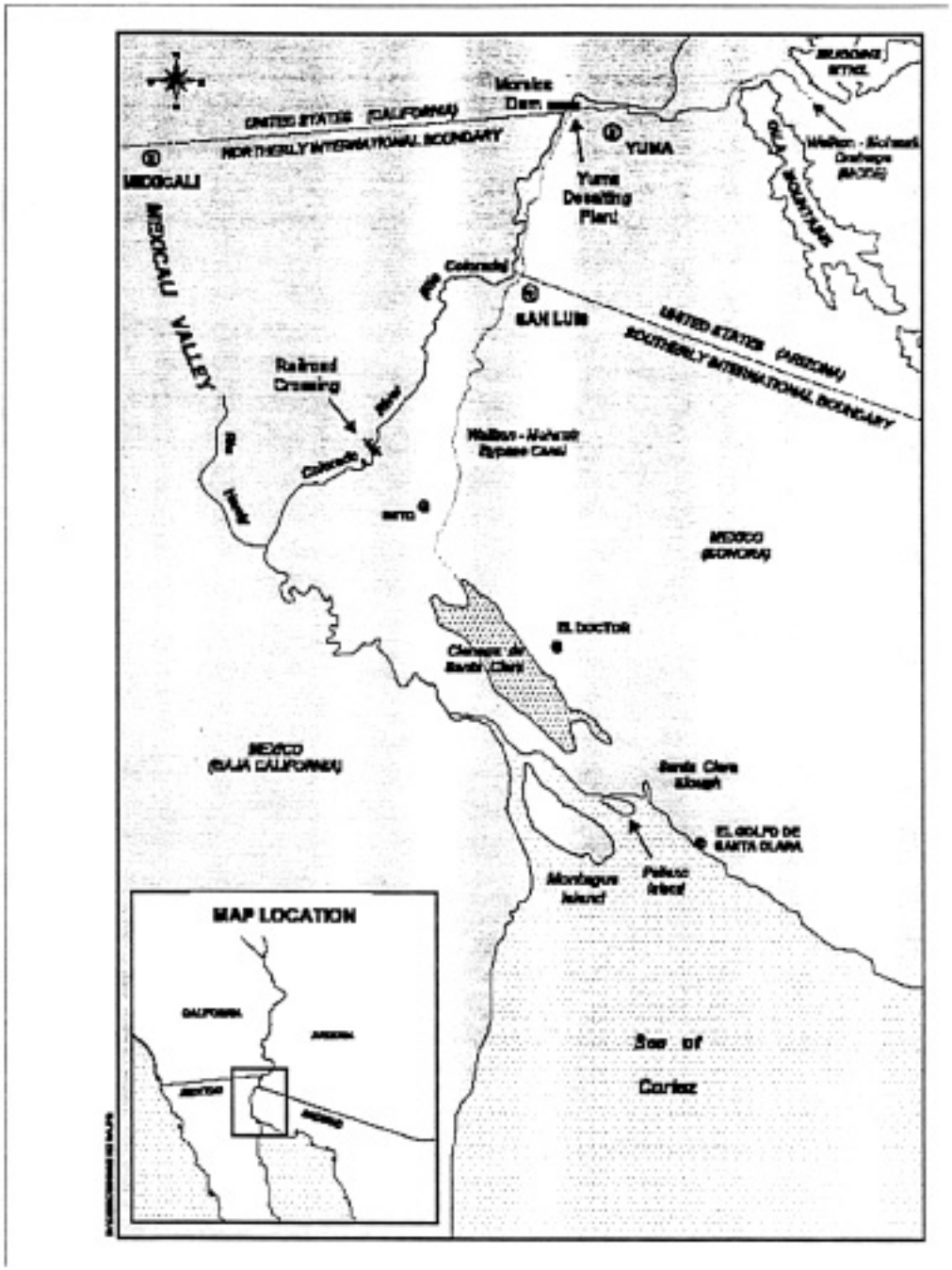
HISTORICAL COLORADO RIVER BETWEEN THE NORTHERLY INTERNATIONAL BOUNDARY AND THE GULF OF CALIFORNIA

Historically, the Colorado River flowed approximately 1,440 miles from its headwaters in the Rocky Mountains to its mouth at the Gulf of California. Although the section of the river between the Southerly International Boundary (SIB) with Mexico and the Sea of Cortez is less than 50 air miles in length, the river meandered as much as 175 miles through this stretch (Browne, 1869; Rudkin, 1953). This section of the river from the SIB to the Sea of Cortez could be divided into two reaches: the upper reach, which was influenced mainly by flood events; and the lower reach, which was influenced mainly by tidal fluctuations in the Gulf of California. A third reach of the river, stretching from the NIB to the SIB, is analyzed in this section that acts as the east-west boundary between Baja California and the State of Arizona. This section of the river is known as the Limitrophe Division. Map 1 illustrates the Colorado River location in Mexico.

The upper reach of the Colorado River in Mexico between the NIB, including the Limitrophe Division, and the Gulf of California, extends from the international boundary to approximately the confluence of the Rio Hardy and the Colorado (Mearns, 1907). The plant community found in this reach of the Colorado was similar to that found in the Yuma Valley. Large cottonwoods and dense willow thickets lined the river channel and oxbows within the floodplain (Johnson, 1869; Mearns, 1907) Honey and screwbean mesquites formed large dense thickets in areas that were subject to occasional overbank flooding (Bolton, 1930; Thwaites, 1905). Dense stands of arrowweed were noted in many historical journals throughout this reach of the river (Bolton, 1930; Mearns, 1907). Unlike the portion of the Colorado River that lies within the United States, large marshes were common within this stretch of the river. Several journals note expanses of cattails, rushes, and cane (Thwaites, 1905; Mearns, 1907; Bolton, 1930). Large grass savannas were present within the floodplain that supported a cattle industry from the late 1800's through the early 1900's (Mearns, 1907; Kniffen, 1929 *in* Ohmart, 1982; Bolton, 1930).

The ecosystem found in the lower reach of the Colorado River, below the mouth of the Rio Hardy to the Gulf of California, was heavily influenced by tidal fluctuations in the Gulf of California and by heavy soil deposition from annual flood events. As the river meandered south of its confluence with the Rio Hardy, cottonwoods became scarce. Dense thickets of mesquite and arrowweed were still recorded on the upper terraces within this reach of the river. Dense stands of willows formed on newly deposited sediments. Large marshes, comprised mainly of cattails, rushes, and cane, dominated this stretch of the river (United States War Department, 1852; Mearns, 1907). Saltgrass became prevalent at the mouth of the river (Kniffen, 1929 *in* Ohmart, 1982).

Map 1
Colorado River Location In Mexico



Present Status of the Colorado River in Mexico

Human activities have significantly changed the lower Colorado River ecosystem since the early 1900's. The most current information available on the vegetation composition present along the upper reach of the Colorado River floodplain between the SIB and the Rio Hardy comes from a 1999 study conducted by the University of Monterrey (Guaymas), the University of Arizona, the Environmental Defense Fund, and the Sonoran Institute (Glenn, unpub. data and Luecke et al, 1999). Aerial and remote sensing methods, combined with ground surveys to check accuracy, were used to estimate acreages of each habitat type. Habitat types were separated into two broad categories: (1) areas where Fremont cottonwood and Goodding willow comprised greater than 10 percent of the stand (determined by measuring percent vegetation cover by using remote sensing techniques); and (2) areas where Fremont cottonwood and Goodding willow comprised less than 10 percent of the stand. In stands where cottonwoods and willows comprised greater than 10 percent of the vegetative cover, the stands were further subdivided by height class and density (Open Gallery Forest, Closed Gallery Forest, and Shrub Dominated). In stands where cottonwoods and willows comprised less than 10 percent of the vegetative cover, the stands were further divided by species composition (saltcedar/arrowweed and saltcedar/mesquite).

The University of Monterrey study estimated approximately 9,545 acres of >10 percent cottonwood-willow habitat, 4,492 acres classified as open gallery forest and 5,053 acres classified as shrub dominated. Analysis of tree ring data indicated that the majority of these cottonwood-willow stands had been regenerated during high flow events over the past twenty years, including the high flows from 1983-1985 and the 1993 Gila River flood event along with the high flows in the Gila River during 1997. This study also identified 25,829 acres of saltcedar/arrowweed habitat. Although the study does not specify, it is likely that these stands were actually monotypic saltcedar and monotypic arrowweed stands or clumps as arrowweed does not usually grow as a mixed stand with other vegetation types. Interestingly, this study did not identify any saltcedar/mesquite acreage within the entire study area (E. Glenn, University of Arizona, Tucson, unpub. report; CH2MHill, 1997).

In December, 1998, biologists from the Bureau of Reclamation, San Bernardino County Museum, and the Upper Gulf of California and Colorado River Delta Biosphere Preserve conducted an aerial survey of the Rio Hardy and the Colorado River to determine potentially suitable Southwestern willow flycatcher breeding habitat. This survey noted the vegetation at the confluence of the Rio Hardy and Colorado River was mostly narrow, dry stands of saltcedar. Northeast of the town of Venustiano Carranza, patches of Goodding willow and Fremont cottonwood were evident. Approximately 5 kilometers north of the Mexican Railroad crossing

of the Colorado River, the river contained long, linear stands of Goodding willow with a few cottonwoods also present. Approximately 15 kilometers south of San Luis, Sonora, the Colorado River begins to broaden out and, from this point north to the NIB, a variety of habitats believed to be suitable breeding habitat for Southwestern willow flycatcher were present (McKernan, pers. comm.). The majority of those latter habitats occurs in the Limitrophe Division between Morelos Dam and San Luis.

SEA OF CORTEZ ESTUARY

The lower Colorado River supported a large estuary at its mouth in the Sea of Cortez. The historic lower Colorado River exhibited the typical annual fluctuations in flow with the peak flows generally occurring in the spring to early summer. These flows carried nutrients and sediments into the estuary, creating the conditions suited for various phases of the life history of the endemic species.

The current condition of the upper end of the Sea is remarkably changed due to the lack of annual inflow from the lower Colorado River, following the construction of dams and water diversions upstream. In recent years there have been only three events of note that have resulted in large quantities of water reaching this estuary from the lower Colorado River. High flows were experienced on the lower Colorado River during flood control operations from 1983 through 1987, and flows from the Gila River through the lower Colorado River reached the estuary in 1993. There were space building flows in the fall of 1997 and fall of 1998, and flood control releases in January 1998. All but the flows of 1983-85 and 1993 probably had little effect on the Sea of Cortez. Therefore, the hydrology of the estuary is primarily dominated by tidal processes, and sediment contribution to the estuary is a result of erosion of the delta itself (Carriquiry and Sanchez, 1999).

In spite of the reduced inflow from the lower Colorado River the estuary is extremely rich in nutrients, with the corresponding richness of plankton, leading to rich amounts of organisms on up the food chain. High chlorophyll values are found in the estuary typical of very rich coastal waters (Santamaria-Del-Angel, et. al. (1994). Zooplankton biomass values are similar to those of the rich central Sea of Cortez, and the values for the channels around Montague Island at the mouth of the Colorado River are as high as those of estuaries and coastal lagoons (Farfan and Alvarez-Borrego, 1992). The nutrient inflow is primarily a result of agricultural drainage into the Rio Hardy, which joins the lower Colorado River immediately above the Sea.

FLOWS IN MEXICO

Currently, water can flow past Morelos Dam under three circumstances; (1) as a result of canceled water orders that Mexico is unable to divert at Morelos Dam; (2) during a Gila River flood event; and (3) during flood control releases along the mainstream Colorado River.

Water released from Parker Dam to meet U.S. orders from irrigation districts in Imperial Valley, Coachella Valley, and the lower Colorado River Valley, normally takes up to three days to reach its point of diversion. Occasionally, unforeseen events, such as localized precipitation, result in irrigation districts canceling these water delivery orders after the water has been released at Parker Dam. Usually, the water is diverted at Morelos Dam for use in Mexico; however, some of this water may flow past Morelos Dam. The volume of water passing by Morelos Dam due to cancelled water orders by contract users is rarely enough to have much effect on species and habitat in Mexico below the NIB. Mexico has the capability to divert up to 200 kaf monthly over its normal water order. Adoption of interim surplus criteria will not affect water that flows past the NIB as a result of canceled water orders.

As stated earlier in the discussion on the upper end of the Sea of Cortez there have been only three events of note in recent years that have resulted in large quantities of excess water reaching Mexico. Gila River flood events are extremely rare. Only once has flow been recorded over 4000 cfs at the Dome, Arizona, gaging station since 1941. In 1993, up to 27,500 cfs flowed past the Dome gaging station as a result of the 1993 Gila River flood. The 1993 flood created much of the riparian habitat presently found along the Gila River and Colorado River below its confluence with the Gila (Glenn, per. comm.).

BASELINE CONDITION

Excess flows below Morelos Dam are almost entirely due to flood control releases originating at Hoover Dam. These flood control releases are dictated by the flood control criteria established for Lake Mead and Hoover Dam and are dependent upon hydrologic conditions. Mexico can schedule up to 200 kaf annually during years when flood control releases occur; however, it is important to remember that water which flows beyond the NIB are managed by Mexico and may be used for beneficial human uses and therefore, may not reach the affected areas. As flood flows arrive at Morelos Dam, Mexico has the discretion to divert more water than their water order, or allow all the additional flows to flow downstream of Morelos Dam. In the past, Mexico has generally chosen to increase their diversion for use in agriculture for increased crop production and soil salinity improvement, or for

diluting flows delivered at the Southerly International Boundary, municipal and industrial uses, or to recharge groundwater aquifers in the Mexicali Valley.

Both the frequency and magnitude of excess flows are important factors in restoring and maintaining riparian and estuary habitat below Morelos Dam and the Sea and are analyzed in more detail in this section. It should be emphasized that Mexico's management decisions at and below Morelos Dam are not modeled. This is due to the uncertainty of what Mexico chooses to do with excess water; therefore, the hydrologic analyses assume that any water in excess of Mexico's scheduled normal or surplus deliveries are those flows that would occur below Morelos Dam.

The potential for future excess flows of any magnitude to Mexico is shown in Figure 1. The frequency of occurrence is computed by counting the number of modeled traces for each year that have excess annual flows and dividing by the total number of traces (85). As shown in Figure 1, under baseline conditions, the probability is a maximum of 35 percent in 2007 and then follows a gradually declining trend. The gradual decline in the trend can be attributed to increasing Upper Basin depletions. Under baseline conditions, the frequency of occurrence of any magnitude of flows declines to about 16 percent in 2050.

Predicting what magnitudes of flows could be expected from 2002 until 2050 is problematic at best. One way is to examine the probability of occurrence of flows greater than specified volumes. It is generally believed that periodic flows of 250 kaf or greater are necessary for maintaining the health of the Colorado River corridor in Mexico and the upper end of the Sea of Cortez (Leuke et al, 1999). Figure 4 shows the potential for excess flows of 250 kaf or greater to Mexico under baseline conditions. As illustrated, the probability of excess flows exceeding 250 kaf is a maximum of 32% in 2007 and gradually declining to about 13% in 2050. Similarly, Figure 5 shows the probability of excess flows of 1000 kaf or greater.

Alternatively, one can examine the probability of occurrence versus the magnitude of the flows for specified years. Figures 2 and 3 present the cumulative distribution of the annual flows for years 2016 and 2050. Figure 6, shows the probability of magnitude of excess flows at the 75th and 90th percentile levels. The probability magnitude of excess flows at the 50th percentile level is essentially zero.

Figure 1. Frequency of Excess Flows to Mexico