

UNITED STATES – MEXICO



**COLORADO RIVER
DELTA SYMPOSIUM**

Mexicali,
Baja California
September 11-12, 2001

ACKNOWLEDGMENTS

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The proceedings are the direct result of transcribed audio tape recordings from the event. Some of the presentations provided are verbatim (indicated) while all others are summarized and have been reviewed by the presenters.

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COLORADO
RIVER DELTA
BI-NATIONAL
SYMPOSIUM
PROCEEDINGS

ENGLISH

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MINUTE

INTERNATIONAL BOUNDARY AND WATER COMMISSION UNITED STATES AND MEXICO

El Paso, Texas
December 12, 2000

Minute No. 306

CONCEPTUAL FRAMEWORK FOR UNITED STATES - MEXICO STUDIES FOR FUTURE RECOMMENDATIONS CONCERNING THE RIPARIAN AND ESTUARINE ECOLOGY OF THE LIMITROPHE SECTION OF THE COLORADO RIVER AND ITS ASSOCIATED DELTA

The Commission met in the offices of the United States Section in El Paso, Texas, at 11:00 a.m. on December 12, 2000, to consider a conceptual framework for cooperation by the United States and Mexico through the development of studies and recommendations concerning the riparian and estuarine ecology of the Colorado River in its limitrophe section and its associated delta.

The Commissioners observed that studies are currently being performed by the Commission to improve the capacity of the Colorado River channel to convey normal and flood waters in the 24 mile (36 kilometer) limitrophe section of the Colorado River under the authority of Article 13 of the United States - Mexico Treaty for "Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande," signed February 3, 1944. Studies are also currently being performed by the Commission on the preservation of the channel of the Colorado River in its limitrophe section under the terms of Article IV of the United States - Mexico Treaty to Resolve Pending Boundary Differences and Maintain the Rio Grande and the Colorado River as the International Boundary, signed November 23, 1970.

The Commissioners referred to the Commission's binational technical task force (hereinafter binational technical task force) that was established to facilitate studies concerning the Colorado River delta in Mexico, as well as water flows to the Santa Clara Slough which are discharged to Mexico under IBWC Minute No. 242, entitled "Permanent and Definitive Solution to the International Problem of Salinity of the Colorado River," signed August 30, 1973. They made note of the United States - Mexico consultations concerning the proposed United States modification of its domestic surplus water guidelines, currently being conducted under the auspices of the Commission.

The Commissioners noted that each country has laws and regulations concerning the preservation of riparian and estuarine system habitat that are executed by authorities that are provided such responsibility in their respective country. The Commissioners recognized that collaboration is growing between those authorities as well as between scientific, academic and non-government organizations in the two countries which have an interest in preserving the Colorado River delta ecology. They observed that some studies conducted by these groups have provided some definition

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of the ecology affected by decreases in Colorado River flows in this reach and potential impacts to the habitat of fish, marine and wildlife species of concern to each country. The Commissioners observed that some entities in their respective countries may seek water and seek to ensure its use for ecological purposes in the Colorado River's limitrophe section and the Colorado River delta.

The Commissioners recognized that there was a need for the United States and Mexico to create a framework to formalize a process that will: 1) consider Colorado River delta restoration studies prepared by government, scientific, academic and non-government organizations in the two countries; 2) provide for development of additional studies through the binational technical task force; and 3) formulate recommendations for cooperative projects concerning the Colorado River delta in Mexico to be undertaken by the United States and Mexico based on the principle of an equitable distribution of resources. The Commissioners also recognized that there is a need to support the binational technical task force with a forum for the exchange of information and advice among government and non-government organizations with an interest in the affected areas.

Based on the above, the Commissioners submit the following recommendation for the approval of the two Governments:

1. That in recognition of their respective governments' interest in the preservation of the riparian and estuarine ecology of the Colorado River in its limitrophe section and its associated delta, the Commission shall establish a framework for cooperation by the United States and Mexico through the development of joint studies that include possible approaches to ensure use of water for ecological purposes in this reach and formulation of recommendations for cooperative projects, based on the principle of an equitable distribution of resources. The Commission may elicit the support and technical advice of the competent agencies of each Government.
2. That the Commission, through the binational technical task force, shall examine the effect of flows on the existing riparian and estuarine ecology of the Colorado River from its limitrophe section to its delta with a focus on defining the habitat needs of fish, and marine and wildlife species of concern to each country.
3. That the Commission shall support the binational technical task force by establishing a forum for the exchange of information and advice among government and non-government organizations with an interest in the affected area.

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4. That all activities undertaken pursuant to the provisions of this Minute shall be subject to the availability of funds, resources, and corresponding personnel as well as to applicable laws and standards in each country.
5. That this Minute shall enter into force upon notification of approval by the Government of the United States and the Government of the United Mexican States through the respective Sections of the Commission.

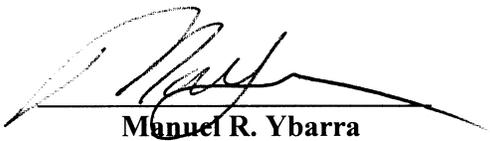
The meeting was adjourned.



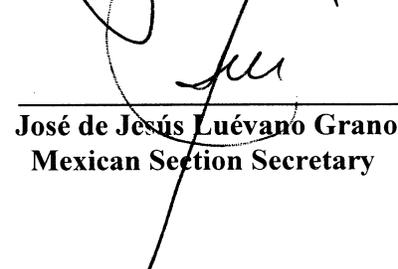
John M. Bernal
United States Commissioner



J. Arturo Herrera Solís
Mexican Commissioner



Manuel R. Ybarra
United States Section Secretary



José de Jesús Luévano Grano
Mexican Section Secretary

AGENDA



UNITED STATES – MEXICO COLORADO RIVER DELTA SYMPOSIUM

September 11-12, 2001

University Theatre of the Autonomous University of Baja California
Mexicali, Baja California

– TUESDAY, SEPTEMBER 11, 2001 –

OPENING SESSION

	Master of Ceremonies:	Teodoro Pérez V. (UABC)
8:00 a.m. - 8:55 a.m.	<i>Opening Remarks</i>	Víctor E. Beltrán Corona , Rector, Autonomous University of Baja California
	<i>Symposium Objective</i>	J. Arturo Herrera Solís , Mexican Commissioner, International Boundary and Water Commission, United States and Mexico Carlos Ramírez , United States Commissioner, International Boundary and Water Commission, United States and Mexico
	<i>United States Department of Interior message</i>	Bennett W. Raley , Assistant Secretary for Water and Science, Washington, D.C., United States
	<i>Mexican Secretariat of Environment and Natural Resources message</i>	Olga Ojeda Cárdenas , Head of International Affairs Coordinating Office
	<i>Secretariat of Foreign Relations message</i>	Alberto Székely , Advisor for the Secretary of Foreign Relations
	<i>Department of State message</i>	Dennis Linsky
	<i>Mexicali Mayor's Message</i>	Víctor Hermosillo Celada
	<i>Inauguration and message by the Governor of the State of Baja California</i>	Alejandro González Alcocer
	<i>Dignitaries' Departure</i>	Master of Ceremonies
	<i>Delta Overview Film</i>	States of Nevada and Baja California

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SYMPOSIUM ORIENTATION & LOGISTICS

General Coordinators: **Francisco Bernal Rodríguez**, IBWC Mexican Section
Robert M. Ybarra, IBWC U.S. Section

PANEL I – LEGAL & INSTITUTIONAL

Coordinators: **Dalia Bali Cohen / Jose Gutierrez**
David Getches / Jim Davenport

9:00 a.m. - 1:00 p.m. Moderators: Mexico – **Jaime Tinoco**, CNA Border Activities
United States – **David Getches**, University of Colorado
Jim Davenport, Colorado River Commission of
Nevada

9:15 a.m. - 10:45 a.m. **LAWS AND INTERNATIONAL INSTITUTIONS**

*Laws and International Institutions
United States and Mexico
Relative to the Colorado River*

José de Jesús Luevano Grano, Secretary
Mexican Section, IBWC
David van Hoogstraten, Department of State

*Laws and Multi-lateral Institutions For
the Use of Transboundary Waters and
Environmental Protection*

Jaime Palafox, Private Consultant, Washington D.C.

10:45 a.m. - 11:00 a.m. Break

11:00 a.m. - 1:00 p.m.

**LEGAL MATTERS OF MEXICO AND
UNITED STATES**

*Legal Aspects in the U.S. Relative to
the Upper Basin of the Colorado River*

Jim Lochhead, Brownstein, Hyatt and Farber, P.C.

*Legal Aspects in the U.S. Relative to
the Lower Basin of the Colorado River*

Gary Weatherford, Weatherford and Taaffe, LLP

*Legal Aspects in Mexico
Relative to Water Management*

Mario Alfonso Cantú Suárez,
National Water Commission, Mexico City, D.F.

1:00 a.m. - 2:00 p.m.

Lunch at Meeting Auditorium
hosted by U.S. Basin States

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PANEL II – CONVEYANCE SYSTEMS

	Coordinators:	Francisco A. Bernal and Lorri Gray
2:00a.m. - 6:00 p.m.	Moderators:	Mexico: Alfonso Andrés Cortéz Lara , COLEF United States: Bill Rinne , USBR Lower Colorado Region
2:00 a.m. - 3:45 p.m.		CONVEYANCE SYSTEMS AND INFRASTRUCTURE IN THE COLORADO RIVER BASIN IN THE UNITED STATES
	<i>Operations Aspects relative to Colorado River Water Management in the Upper Basin</i>	Tom Ryan , USBR Colorado River Upper Basin Salt Lake City, UT
	<i>Operations Aspects relative to Colorado River Water Management in the Lower Basin</i>	Jayne Harkins , USBR Colorado River Lower Basin Boulder City, NV
	<i>Plumbing in Yuma Area</i>	Jim Cherry , USBR, Yuma, AZ
	<i>Colorado River Water Deliveries Under the 1944 Water Treaty</i>	Carlos Marin , Principal Engineer, USBWC
3:45 a.m. - 4:00 p.m.		Break
4:00 a.m. - 5:45 p.m.		CONVEYANCE SYSTEMS AND INFRASTRUCTURE IN THE COLORADO RIVER BASIN IN MEXICO
	<i>Operations Aspects relative to Colorado River Water Management in Mexico</i>	Francisco A. Bernal Rodríguez , Mexican Section, IBWC. Mexicali Office Jose Trejo Alvarado , Director Mexicali Irrigation District
	<i>Assignment of Colorado River Water in Mexico for Urban use: Current Situation and Future Perspectives</i>	Luis López Moctezuma Torres , Private Consultant, Baja California
6:00 p.m.		Conclusion of Activities
7:30 p.m. - 10:00 p.m.		Reception offered by Mexicali Mayor's at Hotel Araiza Inn.

AGENDA

– WEDNESDAY, SEPTEMBER 12, 2001 –

PANEL III – ENVIRONMENTAL ISSUES AND TECHNICAL AND SCIENTIFIC STUDIES

	Coordinators:	Jose Campoy Favela, Michael Cohen
7:00 a.m. - 5:45 p.m.		Poster Session (See Annex).
8:00 a.m. - 10:30 a.m.		SPECIES AND HABITAT IN THE COLORADO RIVER DELTA AND UPPER GULF OF CALIFORNIA
	Moderator:	Exequiel Ezcurra , National Ecology Institute of Mexico
	<i>Delta Habitats</i>	Edward Glenn , University of Arizona, Environmental Research Laboratory
	<i>Upper Gulf of California</i>	Saúl Álvarez Borrego , Center for Higher Studies and Scientific Research – Ensenada
	<i>Habitat Response to Changes in Flow Regimes</i>	Francisco Zamora , Conservation International Gulf of California Program – Guaymas
	<i>Aquatic Birds and Mammals</i>	Eric Mellink , Center for Higher Studies and Scientific Research – Ensenada
	<i>Neotropical Migratory Species</i>	Charles Van Riper , USGS Science Center for Forest and Rangeland Ecosystems – Flagstaff
	<i>Upper Gulf Invertebrates</i>	Karl Flessa , University of Arizona Geo-Sciences Department
	<i>Water Quality</i>	Jaqueline García , Centro de Investigación en Alimentación y Desarrollo, A.C., CIAD, Guaymas
	<i>Wetlands and Estuarine Ecology</i>	Nicholas P. Yensen , NyPA International-Tucson
10:30 a.m. – 10:45 a.m.		Refreshment Break
10:45 a.m. - 1:00 p.m.		EXISTING RESTORATION PROJECTS
	Moderator:	Guillermo Torres Moye , Autonomous University of Baja California

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<i>Cottonwood and Willow Restoration</i>	Mark Briggs – Carlos Valdez
<i>Community Participation in Restoration Projects</i>	Elena Chavarría, Sonora
<i>Lower Colorado River Multi-Species Conservation Program</i>	Chris Harris, Colorado River Board of California- Glendale
<i>Purchase of Water Rights</i>	Michael Clinton, Michael Clinton Engineering – Las Vegas, NV
<i>River Restoration Experiences in Mexico</i>	Alberto Jaime Paredes, Mexico’s National Water Commission
<i>Restoration Projects and Community Participation in the Upper Gulf</i>	Peggy Turk-Boyer, Cultural Center for Desert and Ocean Studies (CEDO, A.C.)
<i>Administration of the Biosphere Reserve</i>	José Campoy Favela, Director-Upper Gulf of California & Colorado River Delta Biosphere Reserve
<i>Research Programs in the Delta/Upper Gulf</i>	Andrea Kaus, University of California-Riverside
1:00 p.m. - 3:00 p.m.	Lunch offered by Mexico’s National Water Commission and Poster Session
3:00 p.m. - 4:00 p.m.	Conclusions/Follow Up Actions/Close

Tuesday, September 11, 2001

OPENING SESSION

VICTOR EVERARDO BELTRAN CORONA DIRECTOR, AUTONOMOUS UNIVERSITY OF BAJA CALIFORNIA:

On behalf of the university, Mr. Beltran expressed his feelings of concern for the events of September 11 in the United States. He welcomed participants and attendees, stating the waters of the Colorado River had brought people together at the conference, providing an opportunity to reach agreements on the Colorado River Delta (Delta) that will benefit populations on both sides of the border. The river has given life and progress to both countries and to the cities and towns in the Imperial and Mexicali valleys.

The university has a goal of contributing to a democratic and equitable society, as well as the environment, by providing educated citizens that can address the problems facing the environment including the Delta and the Gulf of California. This is especially true when addressing the state of Baja California where one of the biggest challenges is water supply. Both nations recognize this ecosystem as a special resource that cannot be substituted with another resource. Taking the ecosystem into consideration, along with social and economic development, will require the efforts of the region's inhabitants, many of whom have lived there for a long period of time. For them, the Delta is a source of life.

The privilege of having the Delta as a resource makes the populations that use the Colorado River responsible for maintaining its sustainability. The Colorado River ecosystem extends from the Rocky Mountains to the Gulf, creating one of the most important habitats in nature, the Delta, where more than 200 species live in harmony in a combination of fresh water and sea water. We should feel proud of the life generated by these conditions but in this cen-

ture, the region also is facing unprecedented risks. There are still problems with water management, salinity and pollution.

Mexico's president, Vincente Fox, established in his administration that water is an element of national security and part of the strategic development for the country. Because restoring the Delta is such an important area requiring much effort, it is best to avoid conflict. Stopping the damage to the Delta is imperative before it is irreversible. It is essential to maintain a high quality of life for future generations.

J. ARTURO HERRERA SOLÍS MEXICAN COMMISSIONER, INTERNATIONAL BOUNDARY AND WATER COMMISSION (VERBATIM):

It gives me great pleasure to see several Mexican and US organizations coming together with one common goal: The conservation of the Colorado River Delta.

The effort undertaken by such organizations as the Mexican Department of the Environment and National Resources (SEMARNAT) and the National Water Commission (CNA), the Government of Baja California and the Municipality of Mexicali, the IBWC itself and the Department of the Interior of the United States, constitute a clear demonstration on the part of the administration of our President Fox and that of his counterpart, President Bush, that the issue of the Colorado River is one of the primary topics on the Mexico-United States border agenda.

I must mention the trend being experienced in this issue. By that I mean that the contributions made by non-governmental organizations and academic groups will be of great value for defining the courses of action demanded by this important body of water.

This is the reason why we have come together in the Auditorium of the Autonomous University of Baja California, one of the most important centers of higher education in the northwestern part of our country. We extend our most sincere appreciation to its distinguished Rector, Victor

Beltrán Corona, CPA, since without his support this event would not have been possible.

The Colorado River in the Mexican territory has a Delta that is unique in today's world, as the waters that gave it its original form have been used by both Mexico and by the United States primarily for urban and agricultural purposes, which has allowed the development of the states of Baja California, the northwest of Sonora, California, Arizona, Nevada, New Mexico, Colorado, Utah and Wyoming.

The cost of this development, whose benefits are enjoyed by tens of millions of people, is that the Delta of this river tends to be dry.

In this context, any changes made to the way the basin north of the Morelos Dam is managed, which would result in this body receiving even less water, are cause for permanent concern in Mexico

As a matter of fact, Mexico has already expressed through diplomatic channels its disagreement with any modifications in the operation or infrastructure of existing and future projects that affect the quality and availability of the water in Mexico, including the Colorado River Delta.

Therefore, it is of prime importance to quickly identify the means and actions that are needed for recovering this body of water, which reflects the relevance of this symposium.

During the following two days we will have the opportunity to take a detailed look at the legal aspects that have a bearing on the management of the flow, the operating conditions of the hydraulic infrastructure and the level of understanding with regard to the ecological needs of the Delta.

Consequently, this symposium will become one of the ways I have pointed out for identifying in the short term the actions necessary for protecting the ecological environment of this body of water.

Gentlemen, you have the floor and I wish you the greatest success in your presentations.

**CARLOS RAMIREZ
UNITED STATES COMMISSIONER,
INTERNATIONAL BOUNDARY AND WATER COMMISSION (VERBATIM):**

Good Morning. The International Boundary and Water Commission has the pleasure of joining with officials of the United States and Mexico in welcoming you to participate in the United States-Mexico Colorado River Delta Symposium.

We are especially pleased and honored to express our appreciation to the Autonomous University of Baja, California and the City of Mexicali for providing these facilities.

This Commission in partnership with the United States Department of the Interior and Mexico's Secretariat of Environment and National Resources entrusted the preparations for this symposium six months ago to our bi-national planning group. We appreciate the hard work and dedication to the task of convening this forum as a means of providing a technical information base to stakeholders in the two countries concerning this part of the Colorado River system.

This planning group, made up of government, academic and non-government organizations, did a remarkable job of establishing mutually acceptable terms of reference for this symposium. But most importantly, for the politically sensitive subject that is the Colorado River system, we take great pleasure in stating those terms in the form of the following symposium objectives.

In recognition of the respective governments interest in the preservation of the riparian and estuarine ecology of the Colorado River in the limitrophe section and its associated delta, the main objectives of the symposium are to improve the knowledge base of expert stakeholders and decision makers on institutional and legal matters, water conveyance and distribution matters, ecological scientific studies, and to identify Colorado River delta system needs and obstacles to meeting those needs.

We look forward to hearing from the various panels of Colorado River system experts in the next two days. There is much to learn. This symposium is not intended to provide immediate cooperative projects. We would expect that out of this symposium the United States and Mexico will have a group of stakeholders and decision makers that is more informed in these three disciplinary areas. Two days is a short time to cover all the details for many of the subjects discussed of this symposium.

The United States is, of course, aware of Mexico's concerns regarding developments in the United States of those waters that are reserved to the United States. These are matters that are being addressed by the two governments through appropriate consultative processes.

The United States supports this symposium to further the objective to provide expert stakeholders and decision makers in both countries a new level of knowledge in the areas of legal and institutional issues in the conveyance system issues and the environmental issues.

The decision makers in both countries, when you have more knowledge to help implement whatever technical summaries come from this meeting, this is itself a significant progress. There is significant amount of knowledge of a technical nature that is to be shared in these next two days. The United States invites and encourages participants to adhere to the symposium objective.

We are very pleased to know that this planning group considered that a key element of this symposium will be that of memorializing the proceedings in the form of a publication. We will make every effort possible in this process to have the proceedings available to the public by the end of the year.

Thank you and good luck in your endeavors.

BENNETT W. RALEY
ASSISTANT SECRETARY FOR
WATER AND SCIENCE, UNITED STATES
DEPARTMENT OF THE INTERIOR
(VERBATIM):

Thank you. I thank the Mayor, this fine city and the university for this opportunity. We all know that there have been tragic events in the United States, but our history teaches us that we cannot let events like that take us from the course of working together. Our nations have a shared destiny, and the issues that we deal with, the bonds that we have, the communications we will share are essential for those of us as free people to continue to do the work that our citizens would have us do regardless of outside forces. So it's with somewhat of a heavy heart but a resolve to stay the course, to focus on what can be done here because that has enduring importance.

I would like to offer some remarks on behalf of the Department of the Interior. I would particularly like to thank the Mexican Section of the International Boundary and Water Commission (IBWC) and the University for their hard work in putting this together.

Issues regarding the ecological status of the Colorado's Delta have emerged on both sides of our shared border in recent years. On behalf of Secretary Norton, I want to reaffirm and emphasize the commitment of the Department of the Interior to work together with all interested parties to seek out creative, cooperative solutions to conservation issues in the Delta through the IBWC process established under Minute 306, which was signed by the United States and the Republic of Mexico this past December.

The first step contemplated is this very important conference which provides an opportunity for discussion of important technological issues, including the law applicable to the Colorado River and the ecological status of the Delta region.

Secretary Norton and I both recognize that the Mexican Delta is an important ecological re-

source, and we support the process that is in place to identify the issues and to search for appropriate means to address them. We also believe that the goal of this conference, which is to establish a shared factual understanding of current conditions, is the appropriate starting point for any effort to address these issues. In fact, this conference grew, in part, out of a specific request for a greater understanding of the Delta region that emerged from discussions between the United States stakeholders and the federal government last year.

As we proceed with this conference and with Delta discussions, we believe that this effort should be guided by five fundamental principles. First, the Delta calls for a bi-national approach which fully respects the sovereignty of both nations. Second, sound science and detailed knowledge must be the foundation of every proposal for action. Third, the solution must fit within the existing framework. Fourth, the process should serve as a forum for the free exchange of information. And fifth, and perhaps most importantly, it is critical that we seek solutions that are positive for stakeholders on both sides of the border.

I want to emphasize this last point. The Colorado River, from its headwaters in the State of Colorado to its final destination in the Gulf of California, is a vital water lifeline for the most arid region of North America.

Within the United States, it's been called the River of Controversy, and the limited waters of the Colorado have indeed been the source of numerous, and at times bitter, domestic conflicts. Our Upper Basin states have struggled to protect their right to future development in light of the faster growing population centers in lower basin cities.

Arizona has repeatedly sought judicial help to protect its claims on the river. California has had to confront the limits of its entitlement even as its needs have grown dramatically, and the same is true for Nevada who has to deal with the explosive growth of the Las Vegas area.

Further, we know that our history, our common history, is that the United States and Mexico achieved a treaty in 1944 after decades of debate. We remain committed to honor and protect the compromise between our two nations which is embodied in the treaty and which has allowed the waters of the Colorado to be harnessed and fully utilized on both sides of the international border.

I mention this sensitive history to contrast it with the progress our basin states, the seven states within the United States of the Colorado River Basin, have made recently in fashioning consensual approaches to a number of difficult and long-standing problems.

Nevada and Arizona have negotiated an innovative method for storing water that can stretch the river's supply to meet Nevada's impending needs. In California, new proposals for conservation in agricultural use are facilitating transfers to meet metropolitan demand through voluntary agreements. Similarly, all basin states have come together to support a plan that will permit California to bring its Colorado River uses within its entitlement. All these efforts show the value of consensus-based negotiation. They also demonstrate how tightly allocated the Colorado River is within the available supply.

In moving forward with the next important agenda items for the Colorado, and particularly those involving the Colorado River Delta, we cannot jeopardize these innovative foundations that are essential to the future administration of the river.

In addition, the United States faces its own set of difficult issues with respect to the drainage bypass flows to the Cienega de Santa Clara which have been recognized as an important wetland habitat within the Delta region. The United States government, however, has a national obligation to replace the bypass flows for water users in the United States. We are hopeful that innovative solutions can be found which respect the interests of the water users in

the United States while recognizing and preserving this vital ecological habitat within the Delta.

In thinking about opportunities for protecting the ecological values in the Delta, we want to encourage and support exploration of programs in Mexico that can focus on innovative actions to effectively stretch existing supplies. Of course, any such actions would have to be accomplished consistent with the principles for this important effort that I mentioned a moment ago. I recognize and look forward to the fact that various approaches will be advanced in further bi-national technical discussions.

Working through the IBWC, our two nations can and should fashion a cooperative effort. Let me add, we will fashion a cooperative effort. We can and want to be helpful in a variety of ways, and scientific expertise is only one of the resources we can potentially contribute to such bi-national cooperative efforts.

The ecological values of the Delta are extraordinary, supporting hundreds of thousands of shore birds and waterfowl as well as providing habitat for a number of endangered species of animals, fish and plants. The Delta region also has great significance for indigenous people as a fishery and as an emerging destination for tourism.

We also recognize the pressing demands imposed by the growing population in the region, a trend that demands significant attention on both sides of our border. We are ready and willing to work together with the Mexican government and interested stakeholders to seek solutions that are right for the Delta in accord with our long-standing commitments, both national and international. Thank you.

ALBERTO SZEKELY
ADVISOR TO THE SECRETARY OF
FOREIGN RELATIONS (VERBATIM):

Because of several positions I have held, I have had to monitor the Colorado River Delta issue and I have always been concerned about the slowness with which the governments of

both countries have responded to the demands of an ecosystem that needs prompt attention. I count myself among those who responded to Act 306 of the IBWC with a certain degree of exasperation, when I felt that with said Act we were not able to get past the purely academic phase, because it needs to be understood that we need immediate and effective measures. Thus, my connection with this subject is through many of you who are participating in this Symposium and at the same time with those of you who come from different areas. This is why I am especially pleased to be able to state, in the name of the Department of Foreign Relations of Mexico, the resolve of our country to give an active push to our perception of the problem of the Colorado River Delta, and to begin acting in a pragmatic and immediate manner.

The defeat of the Harmon Doctrine – mentioned so often when talking about the International Law of international watercourses – has as an inevitable corollary in the shared responsibility of the states along any course of water and this is not only true with respect to the fair distribution and the different reasonable uses of the water of these international watercourses. Thanks to the advances in International Law, such as the one registered in 1995 in the United Nations Convention on the Rights of Use of International Watercourses for Purposes other than Navigation, the environment began to be seen as another user in the International Fluvial Law (the international rivers law), different in a way from the states along the watercourses and the traditional users. The dramatic unfolding – especially during the decades of the seventies and eighties – of Environmental International Law, started to influence the international standards of law of this new concept that resulted in Rio Conference: The Concept of Sustainability, which comes very much to mind now that we are discussing the Colorado River Delta. The way in which this Basin is being used has a lot to do with the possible solutions to the water requirements for the survival of the Colorado River Delta.

Up until now, there has been a feeling that this has been an issue primarily of interest in the United States. Ironically, we have to admit that this is an issue that was not been pursued on the Mexican side with the same intensity as compared to the United States, thanks mostly to the genuine interest of a significant number of scientists and non-governmental organizations on the American side. This has started to turn around. In Mexico there is a growing interest in assuming our fundamental responsibility over what is an essentially Mexican ecosystem and, fortunately, it is happening at the same time in the governmental and non-governmental sectors. The Mexican Government wants to move on to a new phase, leaving the academic phase, the phase of studies and discussions, and advance to the action phase. This is why this symposium is the fitting culmination of a phase of intense studies and investigations that will be laid out on the table of this meeting and from which we expect – and invite the participants to do the same – that specific practical proposals will be realized and become part of the negotiations that should start taking place very soon between both countries, i.e., the table of specific proposals, based on the best science and the best understanding of the requirements, not only scientific and technical, but also of the real possibilities to redirect the destiny of the Lower Basin toward a better future for the Colorado River Delta. This symposium must signal the conclusion of the discussion and study and research phase, and the start of the launching of actions on the part of the Governments.

As you well know, the new Government of Mexico approached the Government of the United States during January of this year with an important diplomatic note, stating its concern with regard to a series of matters related to the Colorado River, with the subject of the Delta as part of that diplomatic note. In said diplomatic note, we have already stated our concern with regard to some actions in the United States that could have consequences for the Colorado River Delta, which none of us wants. By means of this

diplomatic note, we invited the Government of the United States to start diplomatic talks concerning each of the issues that make up the bilateral agenda of the Colorado River. Everything that you come up with as a result of this symposium will undoubtedly have a direct impact on this negotiation, because you collectively represent a series of research efforts that were undertaken during the last decades and from which we should now extract practical consequences. In a Basin of this type, delivery of the agreed upon volumes of water does not exhaust our bilateral obligations. We have to enrich the legal framework of our cooperation to begin joining efforts and facing the challenges that now being identified, many of which are related to sustainability, which is the subject of the Colorado River.

This is the great responsibility of this symposium. I am sure that you will make a substantial contribution that will allow both governments to meet very soon and take immediate and practical measures. These are my fervent desires for all of you. Thank you very much.

DENNIS LINSKY
STATE DEPARTMENT, UNITED STATES
(VERBATIM):

Thank you for that very nice introduction. Members of the legal and institutional panel, distinguished guests, ladies and gentlemen, I'm struck by what a difference a week may make. The mood in Washington, as you can imagine right now, I'm sure is very somber. But last week it was one of the most jubilant periods I saw in Washington for a long time. Especially something that involved a foreign policy event. I think last week's visit by President Fox was a great success. I think it has established a new climate for U.S.-Mexican relations.

President Bush, several times, expressed the fact that Mexico is our most important bi-lateral issue. Now, we may have problems. We'll have disagreements, and we discussed honestly and openly, as friends, some of those issues in the meetings of last week. I think the tragic events

of today must temporarily shift our focus on one issue for awhile in the United States, but certainly our effort must be getting back to where our true interests are. I don't think our interest can be any stronger than they are with Mexico.

In this line, our undersecretary for global affairs, Paula Dobriowski, is the person within the State Department and within the U.S. government who has responsibility for all global or trans-boundary issues. She is in charge of the narcotic's policy and our environmental policies. Any real issue that doesn't effect a single state, which is cross-boundary nation, she has responsibility for it.

She asked me to read a statement for her. She can't be here today, but she's not here for a very good reason. Today she was to meet with a very senior delegation from Mexico for, I think two days, for some conversations on an international dolphin conservation program. So at least, if she cannot be here, we can take some comfort in knowing that she is working on a theme important to U.S.-Mexican relations. Let me just read undersecretariat Dobriowski's remarks. I'm putting words in her mouth, so let me just read from the text here.

"I regret that I cannot be here today in person, but I applaud the efforts of the sponsoring agencies, the International Boundary and Water Commission, U.S. Department of the Interior, and Mexico's Secretariat of Environment, Natural Resources and Fishery, in bringing together officials of both governments, representatives of the non-governed organizations, and the academic community, in an effort to share knowledge and to poll their respective resources. I hope this effort will help to clarify the scientific and legal framework that needs to be taken into account when considering management of the Colorado River system.

"By so doing, policy makers in both countries will be better able to make decisions relating to the preservation of the riparian and estuarine ecology of the Colorado River in its international region and in the Delta. As undersecretary for global affairs, I understand diplomacy's pivotal

role in reconciling competing interests and finding mutually beneficial solutions.

"I think earlier today someone said we must find some win-win solutions here. It's not an easy job; there very often aren't easy solutions. Nevertheless, we just have to keep working at it until we get it right. This is clearly the case with the Colorado River where state, municipal, tribal, agricultural and environmental interests converge, each competing for an increasingly scarce natural resource, competing and confronting the demands of growing populations on both sides of the border.

"Let me assure you that we take water issues very seriously. Secretary of State, Colin Powell, has launched an ambitious effort to promote better management and reduce the tensions associated with scarce water resources worldwide. In this regard, the Department of State is aware of Mexico's concerns that certain U.S. actions with respect to the management of the Colorado River system within the United States have failed to take into account the potential impacts on our neighbor Mexico. «However, the Department of State believes, nonetheless, that the United States carefully considered such transboundary impacts during a series of consultations held with Mexico under the auspices of International Boundary and Water Commission over the past year, as well as during the development of the Environmental Impact Statement called for by the United States National Environmental Policy Act.

"The Department of State also believes that in taking these actions the United States is acting in a manner that is consistent with the 1983 La Paz agreement. The United States concluded that adjustments to the management of the Colorado River system within the United States. Those adjustments which have occurred will not result in appreciable adverse impacts on Mexico.

"In closing, it's important to add that the United States intends to fulfill its treaty obligations to deliver to Mexico 1.5 million acre-feet of Colorado River water per year as provided for in the 1944 Water Treaty. And the United States

will continue to comply with its legal obligations concerning the salinity of those waters as provided under International Boundary Water Commission Minute 242.

“The United States gives its highest priority to fulfilling its international obligations and therefore it manages the system, the Colorado River, in a way that water is specifically allocated to assure deliveries to Mexico in accordance with the ‘44 Treaty.

“The State Department looks forward to continuing the currently ongoing extensive dialogues through the International Boundary and Water Commission and the bi-national technical groups it has established on Colorado River issues.

“It’s a good neighbor. The United States very much wants to cooperate with Mexico in every way that we can to improve the environment of the border region and to support collaborative efforts to improve the quality of the Colorado River water delivered to Mexico. The symposium is an important part of that process. I wish the participants of this symposium success, and I hope this experience will be a fruitful one for all concerned.”

And Undersecretary Dobrioski concludes that she looks forward to receiving a full report of the outcomes of these proceedings. Thank you.

**OLGA OJEDA CARDENAS
HEAD OF INTERNATIONAL AFFAIRS
COORDINATING OFFICE, MEXICAN
SECRETARIAT OF ENVIRONMENT AND
NATURAL RESOURCES (VERBATIM):**

Thank you, gentlemen. Thank you to the planning committee. We hope to have a lot of accomplishments after this symposium that will strengthen cooperation between the United States and Mexico around this topic, the Rio Colorado, the Colorado River. This was one of the richest ecosystems in the world and one that has been effected by multiple modifications in the Colorado basin due to the construction of big dams. The volume of the river in the past as it

came across the border was great enough to reach the Gulf of California. However, this has been deteriorating and it has had a negative effect on the Delta ecosystem.

During the last decade there has been a considerable volume of water released in the United States. This was one of the conditions that allowed restoration conditions to exist in the Delta. These conditions have resulted in increased fisheries and habitat in general. It is important to point out that the potential recuperation of fish that are endangered, the indigenous fish, depends on the restoration of the ecosystem. Mexico is doing conceptual actions to eliminate fisheries in the high basin, the Rio Colorado Delta and along the Colorado River. The complimentary measures to prevent the recuperation of this species are going to be difficult. The sustainable resources and water resources for maintenance of the ecological stability of our shared basins also are needed for the growth and development of productive activities that are critical for the region.

It also is a priority in Mexico to promote coordinated actions based on bilateral cooperation. Therefore, it is essential to prevent the implementation of unilateral actions that will affect the spirit of cooperation as well as equity to water access. I would like for us to establish, at this symposium, new parameters that will allow us to reach conclusions that both countries want to reach in the spirit of cooperation and that we have always had during the last years. This technical and scientific analysis is very important, but it also is important for us to emphasize the different decisions and political decisions that are in our hands to evaluate. Thank you very much.

**ERNEST RUSFFO APPEL
COMISIONADO PRESIDENCIAL PARA LA
FRONTERA NORTE (VERBATIM):**

First of all, I am very sorry. I want to express my feelings to the United States because of the things that occurred there this morning.

That said, I would now like to talk about what we can do together as two countries. This is the main reason Mr. Fox, President of Mexico, established a new commission to coordinate the federal government in northern Mexico and the six border states that have a boundary with the southwest United States. We are neighbors and as such share similar opportunities and problems. I have talked with different representatives from the United States government and the governors of the border states and have been able to add a vision that has evolved due to the growing trade between our two nations.

This region can grow very much. We know this growth has increased very rapidly but this promising future also has its limitations. One of them is real and natural and happens to be today's topic: water. I also am looking at the future with optimism. We should address these limitations in our region and try to see that we use our resources efficiently. The reasons are clear but there is a need for investment in order to continue implementing this vision. This calls for a lot of information sharing and understanding, both of which will be supported in what we are discussing today. Therefore, I see, in this spirit, the future of our region. We have to seek to work together to improve the water situation in both countries and eventually, this may mean we have to administer what is done with the water from a common hydrological basin. I wish you a lot of luck in your discussions and a fruitful day. Thank you.

**VICTOR HERMOSILLO CELADA
MAYOR OF MEXICALI:**

Mr. Hermosillo expressed his remorse over the events of September 11. He talked about the history of the region and how 150 years ago, the region had a small population and no border. The introduction of the border is man-made but that the geography has not changed and the Colorado River still flows from north to south. Up until the mid-20th Century, border issues were of little concern but times have since

changed. In the past, it was easier to make treaties because of smaller populations and less bureaucracy in both countries.

In 1944, the U.S. and Mexico signed a treaty granting water rights to Mexico, however, that treaty took a long time to implement. The water secured for these areas created great growth, as is evident by the populations in southern California and over the border. However with 35 million people dependent on the river, the impact these populations may have must be taken into account. We must try and address problems associated with the population and the river so that people can continue to live here. Given the numerous resources, both natural and intellectual, solutions to water issues at the border should be solved but not through short-sighted solutions. Instead, solutions should be long-term and win-win for stakeholders on both sides of the border.

Mr. Hermosillo echoed the sentiment of other speakers by advocating that good information combined with objectivity is essential to arrive at good conclusions. This is especially important given the number of parties involved on both sides of the border. Ecological situations cannot be solved without including or addressing regional development and the limitation of resources in both the U.S. and Mexico. Previous agreements, such as the 1944 Treaty, worked between the two countries and are good indicators of future potential for positive negotiations over the Delta.

**MIGUEL ANGEL GONZALEZ BARRIGA
REPRESENTATIVE FOR THE GOVERNOR
OF STATE OF BAJA, MEXICO:**

On behalf of the Governor of Baja, Mr. Gonzalez welcomed conference attendees. He stated that appropriate allocations of Colorado River water to provide adequate use and preservation of surroundings are a high priority for the Baja State government.

Mr. Gonzalez agreed with several other speakers' assertions that as the world population

grows, water is increasingly in demand. Historically human settlement was dependent on the availability of clean water and that a lack of preservation of this source led to the disappearance of different ethnic groups. It is for this reason that close attention must be paid in the 21st Century to water quality problems arising from pollution. People tend to take water for granted. However, there are agencies and individuals committed to solving problems through a joint vision without borders.

The Governor's office realizes its strengths and weaknesses but stressed that water problems are a high priority and will require addressing at federal, state and local levels. The State of Baja has invested substantial amounts of money to solve challenges surrounding drinking water, sewage and other water systems. But goodwill is not enough and there is no magic formula to solving problems. Instead, hard work and perseverance are needed to plan for the short, medium and long-term. This includes community participation. It is better to add than to subtract.

PANEL 1 – LEGAL & INSTITUTIONAL LAWS AND INTERNATIONAL INSTITUTIONS

JIM DAVENPORT COLORADO RIVER COMMISSION OF NEVADA:

Mr. Davenport began by discussing the three categories of law with which the conference should be concerned: national, bi-national and international. However, the jurisprudential foundations are different between those three, particularly with regard to the means and extent in which violations are sanctioned. National laws of the U.S. and Mexico can be enforced through the domestic judicial systems of the respective countries.

Using the 1944 U.S./Mexico Boundary and Water Treaty as an example, bi-national law can be enforced by courts in either nation in the locale where the persons or institutions against whom enforcement is intended reside. Such laws are more typically enforced through diplomatic or arbitrational means.

International law, or laws describing the accepted behavior of persons or institutions, notwithstanding national residence, exist as custom or international agreement, which are rare. Most are not enforceable except through diplomacy or in some instances, internationally agreed upon tribunals. Comity, or the courtesy and friendship of nations, is marked by mutual recognition of executive, legislative and judicial acts.

DAVID GETCHES
UNIVERSITY OF COLORADO:

Mr. Getches said the Colorado River is controlled by banks, dams and other means. However, the river also is controlled through a system of laws referred to as the Law of the River. The Law of the River controls the river in a variety of ways, including dams and river operations; water quality issues (including salinity problems as the river enters Mexico); and environmental issues.

Parts of the Law of the River intertwine the U.S. and Mexico and the first panel of the day includes those laws that deal with the two countries' relations regarding the Colorado River. The laws are evidence and inspiration that the two countries can cooperate in resolving problems of mutual concern regarding the Colorado River.

JAIME TINOCO
CNA BORDER ACTIVITIES, MEXICO:

Mr. Tinoco said that as an engineer, and like many engineers, he looks for problems with technical aspects of water problems. However the technical aspects are not necessarily the most relevant. The emphasis is shifting towards the social/political aspects of water and those are proving to be the most complicated. Sometimes technical solutions can fall into second place because although they can create solutions, they come at a high cost.

LUIS ANTONIO RASCÓN MENDOZA
INGENIERO PRINCIPAL, MEXICAN SECTION, INTERNATIONAL BOUNDARY AND WATER COMMISSION:

Mr. Rascón said his presentation deals with international boundary and water treaties.

He mentioned the principles of international law that are applied to continental international treaties, pointing out that territorial jurisdiction does not allow a country to take advantage of natural resources in a way that may affect a

neighboring country, such as diverting a river. Such actions require the consent of the other country. Countries also may not affect the water quality of international flows via wastewater discharges. Countries are not allowed to build structures that may alter the flow of a water source into another country. Countries that violate these principles will have to prevent or suspend their violating actions and pay for the damages.

In the 19th Century, the Guadalupe Hidalgo and Mesilla treaties established the border between the two countries. Rehabilitation of the international monuments took place under other treaties around 1880. The IBWC was created in 1889 by a treaty and continues to remain in effect today.

There were a number of treaties between the two countries in the 20th Century including the Banks Treaty of 1905 and the Rectification of the Rio Grande Treaty in 1933 that allowed work to begin on stabilizing the Rio Grande. The 1970 Boundary Treaty establishes criteria to solve issues regarding the boundaries between the two countries and established that the boundaries of the two countries would continue to be the Rio Grande and Rio Colorado, and that no country will lose territory from shift course of these rivers.

The 1944 Water Treaty is the most important of the water treaties between the two countries with reference to the Colorado River. It stipulates the Colorado River water rights of Mexico and gives certainty of a water supply to agriculture and other beneficial uses. The IBWC ensures treaty obligations are being met and is divided into two sections: The Mexican Section under the Foreign Affairs Secretariat of Mexico and the U.S. Section, under the U.S. State Department. The sections have the necessary personnel to meet the responsibilities assigned by the governments. Jurisdiction of the IBWC includes territorial boundaries, international crossings, water quality issues, water measurement and accounting, operation of international dams, and water distribution.

While volume and distribution of waters is described in the '44 Treaty, more details are needed to address specific projects or problems. Consequently, to cover these issues, there are minutes added as an addendum to the treaty. The minutes development process is divided into three stages: technical identification of the project and the way it is to develop (including the problem and solutions); a consulting and negotiation stage; and once consensus for a project has been achieved, formalization through minutes signed by Commissioners from each side of the border and approved by both governments.

There are a number of water projects connected to the Colorado River and to make alterations to any of them will affect other elements of the hydraulic cycle (including dams, drainage systems, groundwater, disposal areas, etc.). Different IBWC international agreements are related to these elements. There are a number of minutes related to the Morelos Dam involving its location, design, construction and operation, as well as complementary works. Likewise, minutes exist for issues of salinity, including Minute 242 which established a permanent salinity level for waters delivered by the U.S. and construction of the Mohawk drain which keeps the Cienega de Santa Clara slough with water. Minute 248 focuses specifically on operation of that drain.

Minute 291 deals with the accumulation of upstream silt affecting the delivery of water to Mexico.

Minute 287 allowed for the delivery of emergency water from the Colorado River using aqueducts in southern California to the city of Tijuana, B.C. Minute 301 agrees on a joint study between the two countries to explore alternatives for delivering water from the Colorado River to San Diego and Tijuana.

There are a number of minutes that deal with the New River. Minute 264, signed in 1960, establishes water quality standards for the New River when it crosses the international boundary. Minute 274, assists with updating pumping

facilities along the Mexicali wastewater system. Minute 288 is the long-term recovery plan for the river. Minute 294, signed in 1995, allocates IBWC resources to facility planning projects for the Mexicali wastewater systems, as well as to the construction of a pumping station, a force main and a treatment plant.

Minute 306, signed in 2000, pertains to the ecology of the Colorado River Delta. A work group, established under this minute, has coordinated activities between the two countries including information sharing, flow modeling, and pilot restoration projects. It is important to note that Minute 306 involve participation from academic and non-governmental groups.

MARY BRANDT U.S. DEPARTMENT OF STATE:

Ms. Brandt addressed two main themes: the relationship of the Department of State to the U.S. section of the IBWC and the international agreement process in the U.S. and how that relates to the adoption and entry into force of IBWC minutes.

The IBWC applies and exercises the rights of the United States and Mexico under the 1944 Water Treaty and settles any disputes that arise thereunder. It is composed of two sections: U.S. and Mexico. The U.S. Section is not technically under the Department of State but, in accordance with the '44 Treaty, operates under its foreign policy guidance. It receives its funding through the Department of State's budget. In essence, the U.S. Section, although an independent federal agency, is considered to be part of the foreign affairs family. The Department of State plays an oversight role with respect to the development and approval of IBWC Minutes since most IBWC Minutes constitute legally binding agreements between the United States and Mexico. These agreements are governed by international law.

The generally accepted customary international law on treaties is embodied in the 1970 Vienna Convention on Law of Treaties. This treaty was signed by the United States, but never

entered into force for it. It was developed to address the need to codify the rules applicable to treaties and enhance the stability of the treaty regime following the Second World War.

Under the Vienna Convention a treaty is defined as an international agreement between nation states, in written form, intended to be binding and governed by international law. The basic premise of treaty law is that treaties are binding upon their parties and must be performed by them in good faith. There is no international treaty police; disputes are generally settled through negotiation. The key that underscores all treaty rights and obligations is that just about anything is possible as long as both parties agree.

In U.S. practice there is a distinction between treaties and executive agreements; however, under international law all international agreements are considered treaties. In the U.S., treaties, such as the '44 Water Treaty, are those agreements requiring the advice and consent of the Senate. Executive agreements, are those agreements concluded under the executive power of the President as granted under the Constitution, or concluded pursuant to existing or subsequent legislation, or authorized by existing treaties. The President may conclude an international agreement on any subject within his constitutional authority so long as the agreement is not inconsistent with Congressional legislation.

A number of factors are considered when determining whether a particular agreement should be entered into for the United States as a treaty or executive agreement, such as the extent the commitments effect the nation as a whole, whether the agreement affects state laws, whether the agreement requires subsequent Congressional legislation, past U.S. practice, preferences of the Congress, degree of formality, duration, and general international practice.

Notwithstanding any other provision of U.S. law, conclusion of an international requires consultation with the Secretary of State. This legal requirement is implemented by what has

become known as the Circular 175 procedure. It allows for a coordinated review of the proposed agreement, ensures that all international agreements are fully consistent with U.S. foreign policy objectives. It determines when it is necessary or appropriate to have consultations with the Congress and whether the public should be given the opportunity to comment. It also provides for a thorough legal review to examine whether there is sufficient extant legal authority for the United States to enter into a proposed agreement and execute its terms and conditions. The Office of the Legal Adviser determines whether an arrangement constitutes a legally binding international agreement. For it to be legally binding there must be two or more parties to the agreement and each party must be a nation state or a federal government agency. The parties must intend that it be legally binding and governed by international law, as usually indicated by the specific language used. The significance must be such that it rises to the level of an international agreement. For example, the sale of one map to a foreign nation would not be considered an international agreement. However, an agreement to do mapping of a particular region, over a prolonged period of time, could be considered an international agreement. The language must reflect a certain level of specificity, including objective criteria for determining enforceability of performance.

All IBWC minutes are subject to this review process, at which time a determination is made as to whether the proposed minutes contain commitments clearly contemplated within the existing treaty structure, or whether they go beyond the scope of existing treaties and therefore constitute free-standing international agreements, such as those that govern wastewater treatment plants on the border or Minute 242 — the salinity Minute. IBWC Minutes are not considered amendments to the 1944 Waters Treaty; any amendment of the treaty, i.e. a modification of existing rights and obligations, would require that that agreement be submitted to the United States Senate for its advice and

consent. In most cases the authority to enter into and implement IBWC minutes is found within the 1944 treaty or other boundary treaties, which charge the IBWC with their execution, or within other existing U.S. statutory authorities.

Once authorized by the Department of State to do so, the U.S. IBWC finalizes the terms and conditions of the Minutes with its Mexican counterpart. Following signature the Minutes are forwarded to the Department of State and to the Mexican Secretariat of Foreign Affairs. They have traditionally entered into force as agreements between the United States and Mexico following the specific approval of both governments.

JAIME PALAFOX
PRIVATE CONSULTANT, WASHINGTON,
D.C.:

Mr. Palafox said he wanted to describe some of the institutional alternatives that exist on an international level that could aid in understanding concerns about the Delta and whether those concerns are warranted or need further study.

The technical side of the Delta must first be understood before talking about the legal side. A better understanding of the water flows and existing conditions in the Delta, as well as the overall health of the ecosystem, is needed. There are now environmental concerns that didn't exist when the 1944 Treaty was adopted and adopting Minute 306 is one avenue of addressing this change.

In 1983, existing treaties were considered insufficient to deal with erupting environmental problems. The La Paz Agreement, between Mexico and the U.S., is a border agreement that allows the countries to address environmental problems of joint concern. It includes local, state and federal institutions, including the IBWC and includes issues such as hazardous waste, air emissions and other issues. This is what existed prior to the North American Free Trade Agreement (NAFTA).

Within NAFTA what are known as the parallel agreements were signed. Under NAFTA,

the Environmental Cooperation Commission (ECC) was formed and designated NAFTA as having an obligation to environmental issues for the three countries (U.S., Mexico and Canada). The commission is available to study joint problems between the countries and develop action programs to analyze and improve environmental situations within the countries. The commission has a \$10 million annual budget and currently spends about \$7 million annually. The commission also has research capabilities that allow it to verify that countries are complying with their environmental regulations.

NAFTA promotes sustainable development including citizen involvement in environmental issues. If local governments do not comply with their own environmental regulations, citizens can make them comply through complaints. It also allows citizens, both within and outside of the country, the opportunity to present complaints if one country is not meeting its environmental obligations. This helps to maintain objectivity and also applies to transboundary environmental impacts. The ECC, by establishing agreements on transboundary environmental impacts, has shown desire to make the treatment of environmental issues more transboundary permeable. Ecosystems do not have borders. There should also be more compliance with regards to exchanging information.

The North American Development Bank, established under NAFTA, is designed to assist with the construction of environmental infrastructure in the U.S. and Mexico. They have \$10 million annually to spend on feasible projects. The bank is overseen by a board of directors that establishes priorities for use of the financing. These priorities are undergoing adjustments by President Fox who wants to use the funding in more efficient ways. Additional money will be budgeted by the National Water Commission and other Mexican institutions. The ECC works with the bank, other institutions and the community to analyze the projects and determine what is best. There fore, the bank and the ECC were created as two separate institutions in

order to keep the money out of the political spectrum.

All of this is important to the Delta because institutional alternatives exist and can serve as a conduit to providing better information on Delta and increase operational activity in this area. The institutions, such as the ECC and the North American Development Bank, have financial resources available to attend to the Delta. The La Paz Agreement is viable because it provides a greater scope of people interested in the problems of the Delta and the Colorado River, such as the Environmental Protection Agency/ SEMARNAT creation of the Border 21 program.

Q & A

(VERBATIM):

Q: JAIME PALAFOX: What legal or technical actions are implemented by United States government to control the water quality of the Colorado River?

A: LUIS ANTONIO RASCÓN MENDOZA: With regards to the actions implemented by the United States government to control the quality of the water in the Colorado River, and I'm going to comment on the actions that have been carried out by IBWC. Even though Minute 242 expresses the definite solution to the salinity of the Colorado River in the frame of this minute, we have been working in IBWC to look for a way in which we can improve the conditions of the water delivered in order to ensure the beneficial use on the Mexican side.

We have a work group in IBWC that analyzes the quality of water that has been delivered. We have had very specific actions related to problems, for example, with regards to the quality of certain peaks of water salinity, how can we attend to those problems.

The establishment of facilities to conduct or transfer the non-saline waters to the Mohawk Dam are cooperation measures. So, at IBWC,

we're always looking for cooperative measures to solve these problems.

Q: JAIME TINOCO: What are the legal limitations in the treaty of 1944 that IBWC has implemented to solve ecological problems that are being suffered by the Colorado River Delta?

A: LUIS ANTONIO RASCÓN MENDOZA: When the treaty was signed, both countries did not consider the environment. This is something that has had more importance recently. When the treaty was signed, the treaty was focused specifically on water distribution. These aspects that suffered later on, like water quality, salinity, and other issues, have been looked into with specific actions. The environmental aspect was not included.

Minute 306 takes a first step in that direction — the interest of considering the environment. Of course, right now, all the resources are distributed and we would have to explore options of how to consider the environment as part of all this hydraulic system

Q: JAIME TINOCO: Thank you. This is also to Mr. Rascon and this is related to expanding on the information on Minute 306, the objectives, the participation from different role players like local government, state government, etc.

A: LUIS ANTONIO RASCÓN MENDOZA: As was expressed during my presentation, we acknowledge the interest from both governments in the conservation of the Colorado River Delta. We acknowledge the effort already made to date. We acknowledge the activities that are being carried out by the fourth work group in the interest of working jointly and of working in cooperation to form work groups to have a better knowledge of the Colorado River Delta and to exchange information. I think that is, in general terms, the minutes generate or form work groups where we can identify problems and potential solutions.

Q: JIM DAVENPORT: I have two questions. Perhaps the three speakers can think about them both and respond to both of them. The first question relates to the hierarchy of legal significance of treaties, executive agreements, and statutorily authorized executive agreements as they were explained by Mary Brandt.

Would the three of you agree or disagree with the proposition that any agreement to alter the volumes of waters assigned to the respective nations by the 1944 Treaty would require congressional approval in the United States and national legislative approval of the Nation of Mexico? That's my first question.

My second question is, given your experience between the two nations, what have you found to be the most valuable and productive and workable: Is it the more formal agreement that requires a greater amount of approval by the national legislative bodies, or the less formal agreement, which perhaps is more easily altered and easily adapted to specific problems? Those are my two questions.

A: MARY BRANDT: I'll be happy to explain that. Under United States law, it would require an amendment to the 1944 Water Treaty to alter the water allocation. That would mean that we would have to do a treaty that would be subject to the advice and consent of the United States Senate.

I also should mention that the hierarchy that I explained of agreements, executive agreements, congressional agreements, they're all equal with statutes as the law of the land in the United States.

On your second question about which works better, I'm not sure that I understand the distinction between a formal agreement and an informal agreement. To me an agreement is either legally binding or it's not legally binding, and I think we find within the IBWC that we have legally binding agreements that work and that the IBWC is able to make this system work and work well.

Q: JIM DAVENPORT: Let me clarify. I would agree with you that all have the same legal effect. The question, I guess, is whether they are statutory or administrative type agreements, that is, more easily adaptable through an administrative or regulatory amendment process as opposed to strict statutory or treaty type amendment process.

A: MARY BRANDT: Well, do you want an agreement that's legally binding or do you want a political commitment of the two countries that does not have legal force, that would be the answer.

After spending 22 years working with treaties and agreements, I would have to come down on the side of a legally binding agreement, but that's because of my background. Anyone else want to comment?

A: JAIME PALAFOX: With regards to the Mexican side, if there are any adjustments, if the treaty has to be amended, that has to go through the Mexican Senate.

A: LUIS ANTONIO RASCÓN MENDOZA: I think that here we have different interpretations with regards to the concept that exists of reciprocal consulting. So, the commitment to do reciprocal consulting when there is going to be a change or a new water development between the two countries hasn't been interpreted the same by both parties.

A: MARY BRANDT: If we're talking about water quality, then we are probably talking outside the framework of the 1944 Water Treaty which deals primarily with quantity unless you look at the provisions in the treaty that talk to beneficial use. I'm not sure, but I suspect that we entered into Minute 241, the salinity minute, on the President's constitutional authority to conduct foreign affairs and not specifically the authority within the 1944 Water Treaty.

LEGAL MATTERS OF THE UNITED STATES AND MEXICO

JIM LOCHHEAD
BROWNSTEIN HYATT & FARBER, P.C.:

Since one theme of the conference is that hydrologic systems are interrelated, Mr. Lochhead said it is as important to have an understanding of the allocations and administration of water at the upper end of the Colorado River system – the Upper Basin – as it is of the Delta region.

Water rights in the Upper Basin were developed before statehood by irrigators and miners in the region, under a system known as “prior appropriation.” This is the law of first-in-time, first-in-right priority. The first water user to divert and use water from a stream has the first right to use that water as against subsequent appropriators on that stream.

Upon statehood, title to water and the bed and banks of navigable streams and rivers was removed from the public or federal domain and was vested in each state. As a result, each state owns, controls and manages the water resources within its borders, subject to prior appropriation by its citizens. Though states have individual water laws, there are elements of prior appropriation that are common. For example, water rights are based on a right of use, not ownership of the water itself. A water right is a property right to take water and use it for a beneficial purpose, at a particular locale and with a given priority. Water rights can be created for uses that are not yet vested. An unperfected right is a property right under state law. Individual states also can create in-stream flow rights for environmental and recreational purposes. States can approve changes in water rights to new points of diversion, places of use or types of use. Generally, changes are granted as long as they do not

injure other water rights.

Under the Compact Clause of the U.S. Constitution, states can apportion water amongst themselves. (The United States Congress and the U.S. Supreme Court also have the power to apportion water between states.) Since compacts are adopted by state legislatures and approved by Congress, they are both state and federal law. The first interstate equitable apportionment of water by a compact was the 1922 Colorado River Compact, which apportions the right to consumptively use the water of the Colorado River between the Upper Basin and the Lower Basin. A primary concept of the compact is the individual sovereignty of each state to own, regulate and manage only water apportioned to that state. Under the Compact, the Upper Division states (Colorado, Utah, Wyoming and New Mexico) must not deplete the flow at Lee’s Ferry, Arizona below 75 million acre-feet over a rolling 10-year average period. The Upper Basin also may not withhold water from the Lower Basin if the Upper Basin is not using it.

For the Upper Basin, the 1922 Compact serves as a defined apportionment of water to allow for future development and prevent the application of prior appropriation on an interstate basis. It also affirms individual states’ rights to control appropriation of water and water rights within their borders. Under the Compact, the Upper Division States may not sell, lease or transfer water to a Lower Division State.

The U.S. government has certain rights, both reserved rights and rights appropriated under state law, to water associated with federal land such as national forests and Bureau of Land Management (BLM) land. There are many issues associated with these rights, including how much water is needed to meet the purposes of the federal reservations.

Indian Tribes also have reserved water rights, many of which remain unquantified. Quantification is based on practicably irrigable acreage, the needs of the reservation and also on specific treaty requirements and obligations.

Under constitutional commerce and navigation powers, the federal government has constructed and operates large water projects for a number of purposes, including reservoirs to store and release water so as to allow the Upper Basin to meet Lower Basin obligations. The Secretary of the Interior has the authority to establish operating criteria for federal reservoirs, including how water is released and stored. The Secretary also has the power to declare surplus water within the Lower Basin. (This surplus is different than a surplus declared under the 1944 Mexican Treaty.) This has been a critical component of the interim surplus guidelines to help the State of California live within its Colorado River apportionment as established in Arizona v. California.

As a result of 1) appropriations under state law, 2) reserved rights for federal lands and Indian Reservations, 3) apportionments made to all of the states by interstate compact and in the 1928 Boulder Canyon Project Act as upheld in Arizona v. California, and 4) the delivery obligation of the United States to Mexico under the 1944 Treaty, all of the water in the Colorado River basin in the United States has been apportioned and is obligated. Major cities, industries and agricultural operations are dependent on those allocations, as are environmental and recreational interests and programs.

**GARY WEATHERFORD
WEATHERFORD AND TAAFFE, LLP:**

Mr. Weatherford said he would focus on the Lower Basin states and the allocation of Colorado River water within those states. Arizona, California and Nevada share a beneficial consumptive use right of 75 million acre-feet each successive 10-year period – about 7.5 million acre-feet annually. California receives 4.4 million acre-feet, Arizona 2.8 million acre-feet, and Nevada 300,000 acre-feet, determined under the 1928 Boulder Canyon Project Act and enforced by the 1964 *Arizona v. California* Decree.

The 1964 Decree allows the Secretary of the Interior to allocate the unused apportionment of one Lower Basin state to use in one or more of the other Lower Basin states. Historically, California has used the unused apportionments of Arizona and Nevada. However, surplus declarations by the Secretary have pushed consumptive uses of the Lower Basin states, but primarily by California, to 8.2 million acre-feet annually. California is expected to ramp down its use to the legal 4.4 million acre-feet by 2016.

When a surplus declaration is made, 50 percent of the surplus goes to California, 46 percent to Arizona and 3 percent to Nevada. However, in the case of the interim surplus guidelines, the normal numbers will be suspended.

Within Arizona, the largest of its allocation is pumped from Lake Havasu for the Central Arizona Project – about 1.42 million acre-feet in 2000. Other uses in Arizona include the Colorado River Indian Reservation, the Wellton-Mohawk Irrigation and Drainage District, the Yuma Mesa Irrigation and Drainage District and the Yuma County Water Users Associations.

California's apportionment is divided by the 1931 Seven Party Agreement. The priorities established by the agreement left Metropolitan Water District of Southern California's Colorado River Aqueduct less than half full. The top three agricultural priorities under the agreement total 3.85 million acre-feet of the 4.4 million acre-feet total apportionment and this has led to some squabbling among the parties. The pending quantification settlement is intended to help resolve some of those differences and includes a large ag-to-urban water transfer that would reduce the 3.85 apportionment to 3.47 by the year 2012.

For Nevada, the bulk of its 300,000 acre-feet apportionment is diverted through the Saddle Island diversion of the Robert B. Griffith Water Project to several Las Vegas Valley water purveyors who are members of the Southern Nevada Water Authority. Interstate water

banking will play a very important role for Nevada as the Las Vegas region continues to grow. Such banking is allowed due to flexibility of the Law of the River that allows the unused apportionment of one state to be used by another.

Water banking in Arizona is permitted under federal regulations adopted in 1999 and since then Nevada has negotiated a water banking agreement with the Arizona Water Bank. Under such agreements, water agencies in Nevada or California would pay Arizona to place part of unused apportionments in the ground. Later, when those water agencies request water, Arizona water users will pump the stored water for use and reduce diversions from the Colorado River – thus allowing water from the main-stream to be release to those water agencies that have built up credits in the water bank.

Major reservoir storage is an integral part of water supply for the Lower Basin. Hoover Dam holds back approximately 28 million acre-feet of water that forms Lake Mead. Generation from the turbines at the dam total about 4 billion kilowatt hours. Reservoir levels in Mead and upstream at Lake Powell are coordinated by the Bureau of Reclamation (Bureau) under the 1970 Long-Range Operating Criteria and the 1968 Colorado River Basin Project Act

A number of environmental issues impact the Lower Basin. Salinity, the most historic water quality issue on the Lower Colorado River, was addressed by Minute 242 which requires U.S. water deliveries to Mexico to not exceed 115 parts-per-million, plus or minus 30 parts-per-million, over the average salinity at Imperial Dam. Following the minute, the Colorado River Basin Salinity Control Forum was enacted and the 1974 Colorado River Basin Salinity Control Act was passed. Standards of the act are reviewed every three years.

The Salton Sea is another environmental issue in the Lower Basin and is located in Imperial and Riverside counties in California. The sea has a salt concentration 25 percent greater than the Pacific Ocean and continues to take on an

additional four to five million tons of salt annually. There are regular fish kills on the sea, which serves as a large bird habitat as well as a large sport fishery. The Salton Sea Authority and the Bureau are the lead agencies in preparing the environmental impact documents for the sea and currently salt removal is the primary target. Other potential problems exist for the sea as its primary supply of water is agricultural flow from the Coachella and Imperial valleys and pending water transfers and conservation efforts could reduce those flows to the sea.

There are a number of environmental undertakings along the mainstem of the Colorado River as well. Under guidelines of the 1973 Endangered Species Act and from determinations by the U.S. Fish and Wildlife Service and the National Marine Fishery Service, recovery programs have been established for a number of endangered species including the razorback sucker, the bonytail chub, the southerwestern willow flycatcher, the Yuma clapper rail and the flat-tailed horned lizard. The Bureau has established the Lower Colorado River Multi-Species Conservation Program, a regional, state, federal, tribal and private partnership aimed at recovering the aforementioned endangered species while not hindering river operations. A number of environmental groups have sued the Department of Interior and other agencies because of concerns over river operations on wildlife in Mexico which they feel should be covered by the ESA.

**MARIO ALFONSO CANTÚ SUÁREZ
NATIONAL WATER COMMISSION,
MEXICO CITY, D.F.:**

The National Water Commission has had a regulatory framework in place since the 1920s. The initial regulations dealt with irrigation laws and originated with the National Irrigation Commission. These were created to help promote agriculture in Mexico and help initiate construction of hydraulic infrastructure.

From 1947 to 1976, the Secretariat of Water really began to implement irrigation law. For the

first time, importance was placed on irrigation, focusing specifically on the irrigation districts, laws regulating water use and the regulation of national waters. All of this was integral to development of hydraulic resources and established the executive commissions within the main water basins in Mexico.

From 1976 to 1994 brought the advent of the Secretariat of Agriculture and this established much of the federal water law for Mexico. There were two sets of regulations: one that handled recuperation of infrastructure through federal financing contributions and the other that dealt with discharges to national waters or property.

In 1989, the National Water Commission was established and the focus of Mexico's water program changed from hydraulic infrastructure to more of an economic focus given that water is such a scarce commodity. However, its main role remains to administer and keep custody of national waters, manage the hydraulic system and to produce and promote social development.

With regards to international waters, the primary role of the commission is to: provide titles, concessions and permits; maintain a public registry of water rights; exercise fiscal aspects; and maintain the existing hydraulic program while continuing to develop new programs. This includes both the irrigation systems and the drinking water systems.

Legally, laws require a concession to use waters and as such, one must maintain certain water quality and quantity standards and to maintain an ecological equilibrium. This includes the preservation of the environment and the general health of the public. Such concession do have a termination period (though the definition of such is unclear) but can be extended.

A recent situation in Mexico has established that such concessions can be suspended, especially if customers do not pay for exploiting national waters, under federal water rights law. If aspects of the concession are not declared, such as place of use or amount of water to be

used, concessions can be suspended. Too little or too much water use can result in concession suspension. To transfer a permit from one user to another, permittees must request authorization from the commission if it will impact third-party users.

Protecting against water pollution is necessary. The commission determines the parameters of the discharges and treatment and was established under a 1996 regulation. Sanctions and fines can be levied against violators. If you use water, then you pay for it and the same holds true for discharges.

Agricultural water users have a variety of rules to uphold, depending on if the water is going to an irrigation district or directly to an agricultural field. There is water scarcity in northern Mexico that will make growth difficult and the result will likely be a shift in water from agriculture to other uses. Water projections for the future show we will not have enough water to go around. About 83 percent of water use goes towards agriculture, about 12 percent for public use and five percent for industrial use. Agriculture also suffers from low efficiency, contributing about 45 to 60 percent of water losses.

From central Mexico to the north, Mexico averages about 1,830 cubic meters of water per year. By contrast, the southern portion of the country sees around 15,000 cubic meters. Regions such as Sonora and Baja get under 1,000 cubic meters of water – a very low availability. The majority of Mexico's population, about 77 percent, lives in the northeast and central part of the country and produces the majority of the goods and services. It would make sense to move the population to the southern end of the country but to do such is nearly impossible.

Aquifers in the northern region of the country also are overdrafted. About two-thirds of the groundwater is used for urban uses and about one-third by agriculture. Some of the aquifers also suffer from water quality problems, such as pollution. In a 1999 sampling of 478 wells (about

54 percent of the total), about 19 percent were polluted.

Adequate drinking water and sewage disposal are of concern. About 13 million people lack adequate drinking water and sewage treatment and only about 24 percent of the water collected are treated. About 18 percent of the country's total water supply is untreated. In some areas of Mexico, the cultural norm is to not pay for such services.

The National Water Commission has the ability to issue permits for water and discharges and therefore can help to distribute water where it is needed. But part of the problem is a lack of resources to verify the water is used in the place and manner in which the government was told it would be. Consequently, it is a challenge to keep track of water users and uses. Sometimes, users just want to have a water reserve and are accumulating the water either for storage or to resell for profit.

Water marketing is another option to improve the water deficit, but it is a very expensive proposal for most water users. Water conservation is one method of increasing the supply, especially with regards to irrigation efficiency. This will require convincing water users that it is necessary to conserve in order to accommodate growth. The best instrument we have for increasing efficiency and conservation is to analyze and revise the water permits, but that will require a great deal of manpower and financial resources.

Q & A

(VERBATIM):

Q: JIM DAVENPORT: My question is whether a water right in Mexico which was based, which was a water right used for irrigation by an irrigation district, which right pre-dates the 1992 water law and is not registered or

confirmed as a concession by 2002, will that right continue as an effective water right?

A: MARIO ALFONSO CANTÚ SUÁREZ: This is a very important question because it is a problem throughout Mexico. There are about 6,000 water users registered in the agriculture sector where we have to apply the 1992 water law. The 6,000 became identified because we made an investigation with the electricity commission and we wanted to know which were using the subsidy. We wanted to know whether the water user was working on agriculture and they were complying with the law. When we made this cross investigation we discovered about 6,000. They came to us and they told us they were not able to do it [register their water rights as required by the 1992 water law] for this or that reason, and they are out now [their old irrigation rights are extinguished]. The only way to solve it [this problem] would be through a presidential decree where the president of Mexico would authorize them [the CNA] [under the terms of 1995 and 1996] so they [CNA] can issue another permit or concession [to the water user in the agricultural sector].

We have 99,000 users in the agriculture sector, and of these only 57,000 are registered with us [CNA]. The difference, we do not know where they are. The size of the problem can be as serious as having 42,000 left out, but we do not know if it's because of the electric power commission or not. So, we want to establish a new law so if they do not go to the water commission, then we are going to turn this over to the electric commission so we can regulate these people that have a permit and are using it. We are waiting for a determination by the president of Mexico.

But anyway, we have a very serious problem. Thank you.

PANEL II: CONVEYANCE SYSTEMS

CONVEYANCE SYSTEMS AND INFRASTRUCTURE IN THE COLORADO RIVER BASIN IN THE UNITED STATES

**TOM RYAN
U.S. BUREAU OF RECLAMATION,
UPPER COLORADO REGION:**

Mr. Ryan provided an overview of the water resources in the Upper Basin, including the natural hydrologic system.

The Upper Basin is about 113,000 square miles and slightly less in area than the Lower Basin. The region has a varied topography with elevations ranging from 1,000 meters at Lees Ferry to over 4,000 meters in the mountainous headwaters. The river originates in Rocky Mountain National Park and is fed by a number of tributaries throughout the Upper Basin including the largest, the Green River. Climates vary and some areas receive over 100 centimeters of rain while others receive less than 20. April through July is considered the runoff period, contributing about 70 percent of the annual runoff for the basin.

In the Colorado River basin there are, hydrologically speaking, both wet and dry periods. Based on flow measurements at Lees Ferry, it was abnormally wet the first part of the century, followed by a drying period in the '30s with a critical period starting in 1953 that brought the

12 driest consecutive years on record. The early to mid-'80s were wet followed by dry years in the late '80s and early '90s.

The current rate of depletion from the river that is taking place in the Upper Basin is approximately 4.7 million acre-feet including reservoir evaporation. There are about 50 Reclamation reservoirs – more than in the Lower Basin but smaller in size – with over 30 million acre-feet of water in storage. There are 1.6 million acres of irrigated land and most of the water in the Upper Basin is used towards agriculture. Many of the projects are relatively small and use water from Reclamation facilities that are operated by local water districts.

Water from the Upper Colorado River Basin also serves major cities such as Denver, Albuquerque and Salt Lake City.

The most significant project in the Upper Basin is the Colorado River Storage Project authorized in 1956 under the Colorado River Storage Project Act and operated by the Bureau. It authorized construction of Glen Canyon Dam, Flaming Gorge Dam, the Aspinall units – a series of three dams (Blue Mesa, Morrow Point and Crystal reservoirs) and Navajo Dam on the San Juan.

Lake Powell (behind Glen Canyon Dam) is operated consistent with the 1970 coordinated long-range operating criteria. Lake Powell serves as the pool of water at the end of the Upper Basin to assure deliveries required under the compact reach the Lower Basin. The operating criteria include 3 modes that govern releases from the dam. There is a minimum release of 8.23 million acre-feet to meet downstream demands. There are equalization releases to balance the amounts of water in Lake Powell and Lake Mead, though under certain conditions, equalization releases are not made. Additionally, spill avoidance is practiced whereby if high inflows are expected, water is released prematurely in order to create storage space.

There are endangered species recovery programs in place in the Colorado River and San

Juan River basins. The goal is to recover species while allowing water development to take place. Glen Canyon Dam also has an adaptive management program that integrates scientific information with dam operations. Operations at Glen Canyon Dam have been modified through the 1996 Record of Decision for the Glen Canyon Dam Environmental Impact Statement. Power plant ramp rates and daily fluctuations are now in place to protect downstream resources in the Grand Canyon. Experimental test releases have included beach habitat building flows that occurred in the spring of 1996, and a low, steady flow in the summer of 2000. A temperature control device at the dam may be implemented in the future for the benefit of humpback chub populations.

Upper Basin uses are expected to increase over the next 60 years and this will impact Lake Powell, leading to a greater number of 8.23 million acre-feet release years as opposed to the recent years where reservoir equalization/spill avoidance has been practiced.

**JAYNE HARKINS
U.S. BUREAU OF RECLAMATION,
LOWER COLORADO REGION:**

Ms. Harkins provided an overview of the Lower Colorado River Basin.

The average annual flow of the river is a little over 15 million acre-feet and there is a total storage capacity on the entire river of about 60 million acre-feet – so there is about four times the storage capacity of the river’s inflow. Current storage is about 47.2 million acre-feet – about 80 percent of the basin’s capacity.

There are tributaries to the Colorado River below Glen Canyon Dam though the main annual tributary inflow to the Lower Colorado River is less than one-and-a-half million acre-feet. Tributaries include the Gila River and the Bill Williams River, however, the primary source of water for the Lower Basin comes from Lake Powell.

Operation of Hoover Dam and Lake Mead is consistent with the 1970 Coordinated Long-Range Operating Criteria. Priorities from the Boulder Canyon Project Act are to provide flood control; improve navigation; regulate flows and provide water for consumptive use; and lastly, power generation. For Mead, there are essentially two types of operation: normal operation and flood control.

Normal operations are carried out to meet downstream demands that include U.S. and Mexico consumptive use schedules; downstream evaporation and transpiration losses; and reservoir regulation in lakes Mohave and Havasu.

Flood control regulations are authorized by the Corps of Engineers (Corps) and implemented through the Bureau. January through July, flood control releases are based on forecasts from the National Weather Service on the amount of inflow predicted to the system and the current available system space. From August 1st through January 1st, specific minimum space requirements – such as one-and-a-half million acre-feet in Lake Mead – are implemented. The net result of flood control operations is that there are releases in excess of downstream requirements.

Inflows to Lake Mead have varied due to low water years and the filling of Lake Powell in the early 80s. Flows below Hoover Dam also have varied depending on flood requirements and water use.

There are several facilities below Hoover Dam. Davis Dam, about 70 miles below Hoover Dam, is owned and operated by the Bureau as a way to re-regulate deliveries to Mexico. Lake elevations are kept within monthly targets throughout the year though such targets can be adjusted to meet short-term needs.

Parker Dam is about 150 miles downstream of Hoover Dam. It, too, is owned and operated by the Bureau and was built as a forebay for the pumping plants that carry water to California and Arizona. In normal operations, releases from

Parker are determined and then upstream reservoir releases are coordinated appropriately. During flood operations, Mead releases are determined first and then are coordinated downstream.

About 14 miles downstream from Parker is Headgate Rock Dam, operated by the Bureau of Indian Affairs as a diversion structure for Colorado River Indian Tribes and a hydro power plant. This is followed by Palo Verde Irrigation Dam which is about 60 miles downstream of Parker Dam and serves as a diversion structure for agriculture.

Imperial Dam, located 140 miles below Parker Dam, is owned by the Bureau and operated by the Imperial Irrigation District (IID). It serves as a diversion structure for IID, Coachella Valley Irrigation District, Yuma Valley, Yuma Mesa and the Wellton-Mohawk Irrigation District. Another diversion dam, Laguna Dam, is operated by IID and is located six miles below Imperial Dam.

On the Gila River, a major tributary of the Lower Colorado River, is Painted Rock Dam – owned and operated by the Corps. Operations on the mainstem Colorado River are conducted in conjunction with this flood control structure.

Water use in Arizona has been slowly increasing since the Central Arizona Project came on-line. The state has been using about 2.7 million acre-feet, however, use of their full allocation – 2.8 million acre-feet – is expected to take place in the near future with water needs exceeding 2.8 million acre-feet.

California use has fluctuated between 4.5 and 5.3 million acre-feet but in normal years, under the proposed plan, use would have to drop to their basic apportionment of 4.4 million acre-feet.

Nevada is using just above its 300,000 acre-foot apportionment this year. Nevada needs are expected to increase above their basic apportionment.

The Bureau has a water conservation program in 17 Western states. The Colorado River Basin has a \$4 million program with 18 employees and estimates it has conserved 350,000 acre-feet of

water between 1997 and 2001. The four components of the program include planning, education, demonstrations and implementation. Those water districts engaged in major contracts with the Bureau must have water conservation plans. About 60 percent of the districts have completed plans and submitted them. Assistance from the Bureau is given in the form of resource inventories, water budgets, technical evaluations, classroom education, financial assistance and grants for demonstration projects, research on soil salinity and low water use crops, improved flow measurements, and cost-sharing/funding to implement the projects.

JIM CHERRY
U.S. BUREAU OF RECLAMATION,
YUMA, AZ:

Mr. Cherry provided an overview of the water delivery infrastructure in the Yuma area, focusing on the flow of the Colorado River waters from Imperial Dam to Morelos Dam.

The area serviced by the Yuma Area Office is spread throughout three states, seven counties and 277 miles of the Colorado River. The Yuma area includes 12 irrigation districts, five Native American tribes and a number of towns and cities. Within the district, there are over 300 miles of laterals and canals and over 130 drainage wells. Issues affecting the region include sediment control, non-native invasive aquatic species, drainage issues and groundwater.

There are four primary programs principally operated by the Yuma Area office. These programs are primarily operation and maintenance (O&M). One such program encompasses the Yuma area and includes Laguna Dam, the boundary pumping plant and the number of canals, laterals and drains in the region. Another program includes salinity efforts such as Title I, desalting research, improving drainage water quality of the 242 well field, and O&M. The Colorado River Frontage and levy system covers controlling, improving and modifying the river. This can include straightening the river channel and conducting investigations where necessary.

The Yuma Area Office also covers water projections, river operations, river accounting, river gauging, and the Dam Safety programs.

Senator Wash Dam and reservoir is the last regulating reservoir on the Colorado River. It's about two miles upstream from Imperial Dam and since 1987, its use has been restricted by the amount of water that can be placed in it due to seepage. Releases from Parker Dam to Yuma take about three days but in the event of a thunderstorm that places additional water in the system below Parker Dam, Senator Wash allows those delivery waters to be stored. Without Senator Wash Dam at full capacity, a fair amount of water is passed along to Mexico during such events.

Laguna Dam, located 13 miles northeast of Yuma, was the first dam built on the Colorado River in 1905. Today the dam serves as a regulating structure for sluicing flows and downstream flow protection downstream of Imperial Dam.

Morelos Dam, constructed in 1950, was the last dam structure built on the Lower Colorado River and was constructed pursuant to the 1944 Treaty at the expense of Mexico. It is operated under the supervision of the International Boundary and Water Commission.

Agricultural irrigation is the primary use of water in the region. Irrigation water is applied through a number of methods including through sprinkler systems, flood irrigation and drip irrigation.

There are a number of challenges to operation and maintenance in the Yuma region. Sediment control, in particular bank line erosion, is one such challenge. Such erosion can clog diversion facilities and settling basins. Erosion also can diminish water quality and can pose threats to populations and facilities because of river meandering created by erosion. High tributary flow events, such as the 1993 flood on the Gila River, significantly contribute to this type of problem.

Another challenge is non-native invasive aquatic species, such as *Salvinia molesta*. This water fern has the potential to infest ponds,

lakes, streams and choke irrigation systems. A multi-agency effort to manage the problem is underway.

Groundwater management is an issue of binational concern. Currently, the Yuma Area Office and other water resources management groups have established a groundwater management awareness process. An emphasis is being placed on return flow quality standards as part of the ongoing drainage program. This also includes the disposal of saline flows in the U.S.

Maintaining water quality for international deliveries to Mexico is a priority. Near the Northern International Boundary (NIB), a desalting plant is maintained in a ready reserve status, however, there are daily and seasonal fluctuations in salinity at the NIB. The Yuma Desalting Plant, the world's largest reverse osmosis plant, was built to desalt drainage flows from the Wellton-Mohawk Irrigation and Drainage District, however, excess flows on the Gila and Colorado rivers have reduced salinity levels so that the plant has not been needed.

At the Southern International Boundary (SIB), there is an initiative that could help improve flow control and water quality. This initiative is considered part of the overall regional groundwater management plan. One portion will be to renovate the SIB pumping facility and install variable speed controls on one of the four pumps. Another portion is designed to improve water quality by constructing a bypass canal that could help to modulate saline flows during peak months.

**CARLOS MARIN
PRINCIPAL ENGINEER, U.S.
INTERNATIONAL BOUNDARY AND
WATER COMMISSION:**

Mr. Marin's presentation dealt primarily with water deliveries to Mexico under the 1944 Water Treaty and elements that impact the water quality of those deliveries.

The Limitrophe Section is defined as the reach of the Lower Colorado River serving as the international boundary between the U.S. and

Mexico. It is 23 miles long and begins at the NIB, located about a mile above Morelos Dam. At Morelos Dam, diversions are made through the Alamo Canal for deliveries to Mexico.

The time and frequency of deliveries to Mexico are based on the Bureau's annual operating plan – 1.5 million acre-feet are guaranteed to Mexico under the plan. The Secretary of Interior makes designations on the amount of water available in the system towards the end of the year. Under surplus declarations, Mexico can be granted an additional 200,000 acre-feet. Mexico informs the International Boundary and Water IBWC of their monthly delivery schedule for the upcoming year after the Secretary makes his designation and the IBWC, in turn, informs the Bureau of that schedule. Any changes to the schedule made by Mexico must be made at least 30 days in advance of the delivery.

Following the 1944 Treaty, Mexico constructed Morelos Dam in order to deliver water to the Mexicali and Sonora valleys. The first delivery from the dam began in 1950. IBWC, both the U.S. and Mexican sections, do the accounting for the deliveries. The accounting has never posed a problem and Mexico has always received its water.

Minute 242, effective on June 24, 1974, provides salinity values for waters diverted at Morelos Dam of no greater than 115 parts-per-million, plus or minus 30 parts-per-million. The number is based on annual flow weighted average and not daily values. Salinity values, however, are calculated monthly and sampling is done on both sides of the border. Some bi-national efforts are underway at the SIB to help meet salinity values. These include installing some variable speed pumps and construction of a conveyance channel that will help alleviate problems during the critical months of September, October, November and January.

Two major flood events on the Limitrophe Section in 1983 and 1993 created some sediment loading problems near Mexico's intake on the Alamo Canal. A program was hatched to remove 330,000 cubic yards of material just upstream of

the intake. However, it has had limited results because of the continuous volume of sediment from upstream. Another sediment removal program at Morelos Dam has removed over a million cubic yards of sediment.

Currently, the IBWC is undertaking an Environmental Impact Statement on the Limitrophe Section in order to preserve the river channel. Because of existing sediment and low volumes of water, vegetation has claimed much of the channel and reduced the 140,000 cubic-foot-per-second floodway conveyance capacity. This could create problems during a flood event and puts the Yuma Area at risk, as well as, populations on the Mexico side. The Corps of Engineers is studying remedying the situation while being cautious to meet environmental compliance.

The IBWC has established task forces to deal with issues on the river such as salinity, sediment, preservation of the Limitrophe Section, the Delta and the lining of the All American Canal. In addition to IBWC members from both sides of the border, the task forces also include individuals from the Bureau and Mexico's National Water Commission.

Q & A

(VERBATIM):

BILL RINNE: I'll read the first question. How many acre-feet of water per acre are used per year on Yuma area agricultural lands? And please answer with both average and high values. Do you want me to read that again?

JIM CHERRY: No, I understood the question. I don't have that information right with me. I'm thinking it's in the 417, but we have that information available but I do not have that right with me.

BILL RINNE: And I think it's true too, that depending on the particular district or the land types you had some variation in that.

JIM CHERRY: Absolutely. On the sandier soils on the Mesa, they of course are going to use more water than in the valley, and the type of irrigation system also is going to dictate. If it's flood irrigation on sandier soils, it's going to use quite a bit more than drip irrigation on the sandier soils. We do have those averages, but I don't have those with me right at this moment.

BILL RINNE: And the second question also, does the Bureau of Reclamation have any legal obligation to ensure reasonable use of Colorado River water?

JIM CHERRY: Through the part 417 of the ...

BILL RINNE: Yes, the beneficial use. The beneficial consumptive use part 417. You have another question. Okay.

JIM CHERRY: We do have a legal obligation to ensure that water is beneficially used and consumed, Colorado River water.

BILL RINNE: Thank you, Jim. We have a question for Jayne. Why don't you read it and then.

JAYNE HARKINS: The question is on February 5th, we researchers, a group from University of Baja, California, wrote a letter to you asking for the interim surplus water policy from 2001 to 2015 on the Colorado River water. And the question we ask you is related for which what will be the role of Mexico in this ... I'm not sure what that says, in the interim surplus criteria? And does the U.S. Government agree to share surplus water with Mexico?

The interim surplus criteria that we developed were for guidelines on how to deliver surplus water to the three lower basin states in excess of 7.5 million acre-feet. It did not include how Mexico would share in that surplus water. We do when we deliver flood control releases or we're projecting to deliver flood control releases, make available to Mexico additional water under the treaty.

And Carlos, I think the last question is for you. There's a number three there.

CARLOS MARIN: The question is how much water should be given to the Colorado River Delta to be sustainable ecological quota? I have no idea to tell you the truth, but the number that I have heard from other sources is about 30,000 acre-feet. I really have no idea what it would take to sustain the Delta area.

TOM RYAN: Here's the question. Are there any instances where environmental legislation have freed, forced plumbing operations in the Colorado River to change in order to preserve the ecosystem. I think in the Upper Basin the answer to that is the Endangered Species Act 1973. I don't know that we've changed the plumbing, but there's been a number of re-operations of facilities, most notably Flaming Gorge and Navajo, where in order to provide flows that are necessary to preserve and aid in the recovery of endangered species, we have changed the operation patterns at those reservoirs.

JAYNE HARKINS: For the Lower Basin, we do have some specific Endangered Species Act requirements on our Lake Mohave elevations which does impact Mohave releases and some of the releases from Hoover Dam. It doesn't change the amount of water we deliver past Parker Dam, but it does impact the releases and elevations at certain times of the year for razor-back suckers in Lake Mohave.

TOM RYAN: Just one other addition. I did think of an actual plumbing change. There's a fish ladder near the Redlands Diversion around the Gunnison River where the Redlands Diversion had limited the passage of Colorado pike minnows and so, that was specifically put in to allow for passage of endangered species.

PANEL II, CONVEYANCE SYSTEMS AND INFRASTRUCTURE IN THE COLORADO RIVER BASIN IN MEXICO:

FRANCISCO A. BERNAL RODRIGUEZ INTERNATIONAL BOUNDARY AND WATER COMMISSION, MEXICAN SECTION, MEXICALI OFFICE:

Mr. Bernal focused on the operational aspects of the IBWC from Mexico's perspective.

In relation to the rest of the Colorado River basin, the section of the river in Mexico is relatively short, however, it still serves as the water supply for the states of Baja and a portion of Sonora. The number of dams throughout the United States and Mexico provide a water supply for specific uses. However, water is not provided for the Gulf of Mexico.

The Mexican section of the IBWC is responsible for operating and maintaining Morelos Dam. This includes the water quality aspects that were mentioned by previous speakers.

When going into a water year, the National Water Commission sends to the Mexican section of the IBWC a calendar of desired water volumes for delivery which, in turn, will be turned into water use. Las derivaciones se hacen conforme lo establecen las reglas del Tratado de 1944 and then is delivered at the NIB or SIB and these deliveries have a right to increase or decrease in an amount not to exceed 20 percent. This is an important aspect to recognize because Mexico does not have a dam to store water. This flexibility allows Mexico to alter the delivery amounts if use fluctuates. Changes to delivery requests are reflected in the upcoming month's

deliveries so as not to impact operation too much. However, such alterations to the schedule do require close coordination between the agencies involved.

Changes to deliveries at the NIB will be reflected in balancing the deliveries made at the SIB. At the SIB, the water deliveries primarily consist of untreated effluent from Yuma and drainage flows and is used to irrigate lands in the San Luis area. Water received at the NIB is primarily for irrigation in Mexicali and the Tijuana aqueduct.

Volumes of Colorado River water over the border have varied throughout the 20th Century. Events such as the construction of Glen Canyon Dam reduced the amount of surplus waters delivered to Mexico. At times, surplus flows were quite heavy and this resulted in construction of infrastructure in Mexico that could handle such large volumes of water. In recent years, these surplus flows have benefited the Delta. In 1999, the surplus flows were not tremendous, but they were stable and continuous.

Though Minute 242 set a salinity standard at the NIB, it did not set a standard for the SIB and those flows have an average of 1,400 parts-per-million. The number, however, has decreased in the past year because pumping has increased from other sources in the Yuma Valley. In 1996, when surplus flows were minimal, the difference between Morelos and Imperial dams was 400 parts-per-million. From the Wellton-Mohawk drainage channel that feeds the Cienega de Santa Clara, salt loads currently measure about 2,500 parts-per-million.

Minute 291, passed in 1993, led to efforts to clean the Colorado River channel on both sides of the border that were impacted by sediment. During the past two years, a sedimentation basin was constructed on the Colorado River, 2.7 kilometers downstream from Morelos Dam (financed by the Bureau) that has been effective in decreasing sediment loading in the water.

Prior to the signing of Minute 306, a letter of intent was signed in 1997 between both govern-

ments to explore and exchange information regarding the Colorado River Delta. Environmental groups have been outspoken about implementation of the Lower Colorado River Multi-Species Conservation Program because it does not extend beyond the border.

Also that year, a joint work group (IV Work group) was started between the two sections of the IBWC, Bureau and Mexican agencies involved in these issues – the first phase of which was to use GPS geographic information to analyze vegetation in the Ciénega de Santa Clara. Technical meetings have been held to analyze the environmental impacts of upstream water projects on the Delta and how to make these projects more compatible with the Delta while not creating a direct impact on their operation. This bi-national work group has been identifying projects and updating an inventory of information, including scientific, governmental and academic information, for the public. Modeling also has been proposed to determine how flooding certain areas of the Delta would impact vegetation in the Delta. It is these meetings that led to the organization of the bi-national Delta symposium – an integral component to the management of the Delta.

**JOSE TREJO ALVARADO
DIRECTOR, MEXICALI IRRIGATION
DISTRICT, NATIONAL WATER
COMMISSION:**

Most of the years, the river below the border is dry. Most of the water diverted at Morelos Dam is used by the irrigation districts in the Mexicali Valley for beneficial uses. In total, including groundwater, there are about 2,740 million cubic meters of water available to the region annually.

The Mexicali Valley is located in the last part of the Colorado River Basin and is comprised of an irrigation basin of about 350,000 hectares with infrastructure to support about 250,000 hectares. However, because of public distribution, there are only about 208,000 irrigated hectares. About 26,600 of the hectares are located in San Rio

Colorado, Sonora and the rest, 181,000 hectares, in the state of Baja. The Colorado River is the only secure source of water for the whole state of Baja California.

Groundwater, about 197 million cubic meters annually, is used in the San Luis region (23 million) and for urban areas like San Luis Rio Colorado, Mexicali (82 million), Tecate (3.3 million), Ensenada (9 million) and Tijuana (80 million). Agriculture also uses groundwater – about 500 million cubic meters annually, 200 million of which are for private use. There are 725 wells, 432 of which are federal, 236 private and an additional 67 that are federal but that are used by the urban area in San Luis.

Over the past eight years, there has been some surplus water available. It is estimated that over the last eight years – which were heavier surplus water years – surplus flows have exceeded 800 million cubic meters. If enough warning is given about the possibility of surplus flows, such flows can be used to support a second harvest. Surplus flows also can be used in lieu of pumping groundwater.

The Delta serves as a means of managing flows to and from the irrigation districts. Four operational levels are used to accomplish this. First, the National Water Commission handles deliveries from Morelos Dam through the first 27 kilometers of the main river channel. Secondly, it is delivered to the myriad of irrigation canals, loosely controlled by an overseeing body. Thirdly, this body then delivers water to the 23 civil associations who fourthly, deliver it to the district for irrigation. The waters are delivered through a system comprised of 424 kilometers of main channels and 2,152 kilometers of secondary channels for irrigation districts, 2,350 of concrete channels and 2,376 kilometers of open air channels. To manage all the channels, there are 9,432 structures and 1,493 drains.

Soil types have made managing Colorado River flows a challenge. Most of the soil deposition in Mexico is the result of sedimentation from higher in the basin. Certain soil types have given rise to invasive plant species, such as salt

cedar. The impact from this invasive species has been reduced transport capacity in the river channel. Areas of the channel have been riprapped to help the river flow and discourage plant growth. In some cases, trouble areas of the river channel are bypassed to ensure higher quality water.

Along the Hardy River, there is irrigation infrastructure as well as pumping facilities. The pumping facilities operate on gravity, and permit distribution of agricultural runoff. Currently, about 89 million cubic meters of agricultural runoff are flushed through the system and into the river. The lower section of the river is more prone to sediment deposition because of sharp bends.

The Gila River, especially in 1993, produced strong flows that impacted hydrology south of the border. The result was large deposits of sedimentation – about 12 million cubic meters. Estimates are that all but about 5 million cubic meters could have stayed on the U.S. side if proper precautions had been taken. The work now being taken at Morelos Dam by the Bureau has helped to clean-up the large deposits of silt. However, about 2 million cubic meters of silt have created problems for the Mexicali water distribution system. The deposits are currently being removed.

**LUIS LÓPEZ MOCTEZUMA TORRES
PRIVATE CONSULTANT, BAJA
CALIFORNIA:**

Minute 306 defines the conceptual framework between Mexico and U.S. for the development of studies to provide recommendations about the Colorado River and the Delta. Specifically, it acknowledges the interest of the IBWC commissioners and their corresponding governments in conserving the ecology of the river and the Delta. This includes developing joint studies, recommendations for cooperative projects and the possibility of allocating water for environmental purposes based on the principal of equal distribution of resources.

Article 3 of the 1944 Treaty outlines water use of deliveries to Mexico in order of preference as follows: First, domestic and municipal uses; second, agriculture and stockraising; third, electric power; fourth, other industrial uses; fifth, navigation; and sixth, hunting fishing and hunting. The final preference is for any other beneficial use determined by the commission. Comments from a technical report on the treaty (reported by Mr. Orive de Alba, an executive member of the National Irrigation Committee) states that the priority established by the '44 Treaty are in correspondence with the 1972 federal decree that established federal water law. However, the '44 Treaty also states that federal executives can alter the order of the preferences (with the exception of the domestic uses) when of interest to the community.

Baja California Mexico has changed from a country with about 46 percent of its population in a rural setting in 1930 to only 9 percent of its population in a rural setting by the mid-1990s. In 1992, the National Water Law was developed further giving domestic uses preference in times of emergencies, scarcity, overuse or when there is surplus.

Mr. Orive de Alba's report states that the stretch of the Colorado River in Yuma, where the river serves as the boundary between the two countries, flows at 32,554 gallon-per-second (6,800 cubic meters-per-second). The maximum runoff in 43 years of observation occurred in 1940 with about 22,700,000 acre-feet (28,000 million cubic meters). Article 10, paragraph (a) says Mexico is guaranteed 1,500,000 acre-ft (1,850 million cubic meters) annually.

Urban centers in Baja California are expected to have a population of more than 4 million people by the year 2030. Given the growing population, water distribution systems have to be better lined to be more efficient and effluent will have to be adequately treated for reuse. Despite a number of wastewater treatment plants in Baja California, wastewater is not being reused in the major cities like Mexicali and Tijuana. Mexicali returns its effluent to the New

River, and Tijuana and Ensenada return their effluent to the sea.

Agriculture uses about 93.4 percent of the water; industry uses 3.8 percent; and municipalities use about 2.7 percent. However, agriculture loses about 70 percent of the water they use; industry 20 percent; and municipalities 10 percent.

How can riparian ecology be conserved in the Limitrophe Section? By ascribing a water supply to the Delta. From 1930 to 1935 Hoover Dam was constructed and Mexico protested construction of the dam because it altered the hydrology of the river and modified the agreement between the two countries. However, it was acknowledged that the Colorado River was a navigable waterway that would extend to the Gulf of California. However, in most years, the river does not reach to the Gulf. For the river to do such would require additional flows.

The amount of water needed every four years, in order to sustain flora and fauna in the Delta region, is estimated to be 353,500 acre-ft (436 million cubic meters). This breaks down to about 32,000 acre-ft (40 million cubic meters) a year and 256,000 acre-ft (316 million cubic meters) every fourth year. The total amount corresponds to be less than 0.5 percent of the Colorado River's total runoff for this same period of time – a total of about 71,340,000 acre-ft (88,000 million cubic meters).*

The solution would seem to be a reduction in the amount of wasted water on both sides of the border. Article 8 of the treaty says national executives can decree the reserves of national water for the minimum flow required to maintain stable flows for the environment. This includes the preservation of aquatic species and the restoration of aquatic ecosystems including marshes and lagoon, as well as aquatic ecosystems that have tourist or recreational value.

There is a pending task, not addressed by the '44 Treaty, to have a volume of Colorado River water permanently devoted to the river so that it can continue from its headwaters to the Gulf. We must agree to create a research center for the

Colorado River to examine the agencies in charge of water treatment and see what their water recycling requirements are required as well as research how such recycled water can be used. The water efficiency of these organizations must be examined and industrial water use must be improved.

*Defenders of Wildlife and Southwest Center for Biological Diversity.

Q & A (VERBATIM):

ALFONSO ANDRES CORTEZ LARA:

Thank you, Mr. Lopez Moctezuma. We are concluding with this presentation the presentations made by the panelists, and now we will begin with the session of questions and answers, comments, et cetera, complaints. And we have sufficient time according to the program, so if you have any questions in writing please could you send them to us. We haven't received any. I ask you to tell me who those questions are directed to and that would be easier to answer them.

Here is a question: Who is part of the fourth work group and what are the specific purposes of this group and the projects?

FRANCISCO BERNAL RODRIGUEZ:

I think that it's for me. The fourth work group is a technical bi-national group that was formed, as I mentioned during my presentation, in 1997. This group is made up of authorities from both governments.

On the Mexico side we have the participation of representatives of the National Commission of Natural Resources through the field office of the Colorado River Biosphere Reserve and Upper Gulf of California (Upper Gulf), and also people from the state government and the National Water Commission coordinated by IBWC.

On the U.S. side, the Bureau through the Boulder offices and Yuma, the Fish and Wildlife Service from the federal government, and some other agencies at state and local levels.

This group is coordinated through IBWC and the projects and objectives that they have are in general to carry out projects to review some of the impacts hydraulic projects have in the Colorado River. I mentioned three projects that we are carrying out in that group. The first one is to establish an inventory of the existing information. The second project is the hydraulic model that is being condensed, and we will carry it out through a specialized group through which people who create the model from the United States and Mexico with specialized groups, and the environmental side corresponds to the agencies that I already mentioned.

ALFONSO ANDRES CORTEZ LARA: The next question is also related to this. Maybe Bernal or the U.S. IBWC section can respond. It's four questions in one and refers to the fourth group. How can the inventory be concluded or available of this fourth work group, and if this inventory of documents would be available to the public, how? Another question, how do you define the area of the Delta restoration, and when can the information published be released?

FRANCISCO BERNAL RODRIGUEZ: Those are several questions. That would have to be another presentation, but I will try to give you a fast answer.

In some way I mentioned that these three projects are being carried out. However, we have made progress. The first project is establishing proposals. Maybe soon we can release this information. We're looking for a way in which this depository of information could be through a web page or maybe through a document that could be published. The most obvious is that it could be through a web page coordinated through certain groups, certain agencies.

What we have not been able to do or to determine to date is the site. If these documents exist physically, how can you have access to them? These documents are 500 to 1,000 pages long. We could give some feedback on these requests, but we have to look for a way in which we can, through abstracts or summaries or a literature guide, make them available as soon as possible. This is coordinated by Mr. Campoy with counterparts in the United States and the Mexican section in El Paso.

With regards to the model, one thing follows the other. If we don't have the model developed, we have not identified the habitat restoration areas. But we have made some proposals and some joint projects have been carried out through the reserves operated by the Department of Wildlife, together with the biosphere reserve, and they are proposing some sites.

For example, they are proposing an area below Morelos Dam to restore some trees, and we have to review in order not to have an impact on the operation of the Morelos Dam. There are other areas like the Hardy River and other areas that are considered flood zones. However, something that we have discussed during the meetings on the Mexican side is that as long as we don't have the possibility of sustaining these sites with water, it would be very difficult to implement them. This is the elemental, or the fundamental, part and as we solve this we would be trying to implement these types of practices.

ALFONSO ANDRES CORTEZ LARA: These questions are directed to CNA for Mr. Trejo Alvarado. This is a question regarding the basin boards, how are they integrated or organized, and are the basin boards operating right now?

JOSE TREJO ALVARADO: The basin boards or councils were carried out at a state level, but are grouped by region. The users are grouped in the case of areas where they are using underground water.

In the case of the Mexicali Valley in this area of the Rio Colorado, we have the Rio Colorado Council made up of all the different type of users. We have users from water companies, we have urban public customers, agriculture consumers, industrial users, and agencies that make up the state government, the municipalities. We have two states and two municipalities, the State of Sonora and the State Baja, California; the municipality of San Luis and the municipality of Mexicali.

This basin council was formed a little bit more than a year ago. It is working. It is being consolidated and we're gathering information. We're talking about having a web page. We're talking about having a bank of information or database. And it's working to capacity with all the data. It is working to full capacity with all its users integrated.

ALFONSO ANDRES CORTEZ LARA: I think that this question is for different institutions even though it's directed to IBWC U.S. section for the different actions carried out by the IBWC. How much do you consider the climactic variations, like for example the El Niño or La Niña phenomena, or how much do you integrate this into the actions that you carry out?

CARLOS MARIN: On this issue I think as far as IBWC is concerned, you know, we're I guess based on the treaty is the allocation of water to the communities or to the different countries. We do extensive water accounting both on the Colorado River and the Rio Grande, and I guess, it's synonymous of El Nino, La Nina, and stuff. It basically relates to the water that's made available to the different basins and, you know, for municipal and agriculture, industrial use. I don't think we put much emphasis on that on the phenomena but just on the water that they provide is a very important issue. Not related to the Colorado River, but the Rio Grande, we do have a severe drought in that area and, of course, it's a very delicate very serious issue that we're facing in that basin there.

ALFONSO ANDRES CORTEZ LARA: I think that this question is for Mr. Torres with regards to part of his presentation on the research center that you mentioned in the Rio Colorado. I think that this question is regarding expanding on this question. Who would be part of this institute or how would it be formed?

LUIS LÓPEZ MOCTEZUMA TORRES: There is the disposition because Minute 306 was signed. How can we carry out this research on the Delta of the Rio Colorado? Well, with experts on these areas.

I see and what I presented that in each water use we have a waste, sometimes greater, sometimes smaller, and I'll give you a very clear example. The reserved water. We take it 180 kilometers from here to over there, we move it 1,200 meters, we treat it and then we discharge to the sea.

With domestic water, we use more than normal and that is because of a lack of research. And in the agricultural area, that's more dramatic. The waste of water in the agricultural area, instead of making more beneficial use, we just waste it.

Who would form this institute? I would just leave it in the air. I don't know. I know who can participate, the ones that I mentioned. We need many areas, not only experts at a local level but at a national level as well.

I think these three questions have to do with the ecological use of the Rio Colorado Delta. This has to do with the question of is it possible to expand a Mexican official standard to define the environmental use of what is required for this area to be sustainable? And I think that everything is focused on the volumes required for the Delta.

Mexican official standards are drafted by the Mexican side and in some ways, there are some indication from research of a volume of water need to sustain the Delta. We continue working on that.

I think that the majority of these questions, up to a certain point, will be answered with the presentations that we are going to hear tomorrow. It would be important to make a link between the environmental side, the operational side and in some way the legal side, which is the legal frame that was discussed this morning. That is the reason we're here. And I think that as we search for the answers during the presentations, then we will satisfy those concerns we have.

ALFONSO ANDRES CORTEZ LARA: This is a question for Mr. Trejo. Can you expand on the information of how the underground flows move and how the aquifer in the Mexicali Valley is supplied? I think they are trying to determine how the All American Canal supplies water to the aquifer.

JOSE TREJO ALVARADO: The hydrological data from the Mexicali Valley using the flows that we have analyzed are more or less as follows. If you use your imagination, remember the maps that we saw of the north of the boundary line of the Rio Colorado, and then the part of the San Luis sandy area to be placed in the irrigation area of the Rio San Luis.

The aquifers that are exploited in the Mexicali Valley, partially come from the north of the Mexicali Valley. We're talking about the wells close to the area of Algodones. To the north they come to the Mexicali Valley in 100 million cubic meters. Where we have the boundary of the Colorado River with Arizona and Baja California, we have another contribution of 50 million cubic meters. And we have another contribution, a vertical contribution, in the same irrigation district area given by our own users.

We also have from the San Luis sandy area, another flow that comes from Arizona to Sonora to contribute what is supplied in that part. I'm talking from memory, and I would have to add up all these numbers to give you the total number of the volume I mentioned, but those are more or less the flows.

I'm appealing to the person who asked the question to remember the districts so you can obtain your answer.

ALFONSO ANDRES CORTEZ LARA: And here we conclude with these questions. All of them have to do with the same thing. These refer to Minute 242 and clarifying what it has to do with the water salinity, the differences between the water that we have in the Imperial Dam and the water that we have in Mexico and to expand on that aspect. Is there any program being considered to modify those great variations of salinity in the water that Mexico receives?

FRANCISCO BERNAL RODRIGUEZ: I mentioned in my presentation about desire to eliminate the variation as we have greater availability of water. This is an issue occurs in a natural way, or periodic way, when we have surpluses.

We have a measure to improve the conditions in the NIB. We're working on a limit for the SIB. Jim Cherry mentioned in his presentation the modification being proposed for the delivery area, the pumping area. They already have a concrete project to begin in the next weeks. In some way this implies modifying the systems to control the speed. And in the process, we'll be eliminating some of those saline peaks.

To eliminate the saline peaks, we are considering replacing certain waters that are supplied or delivered on that side with water from the wells that are being pumped in that area. Part of the more saline flows would be delivered through an interconnection channel with the Wellton-Mohawk channel. This is a project being carried out jointly with Yuma County Water Users Association and through the Bureau, in which Mexico and the United States are working to see what would be the U.S. requirements for Mexico to operate that diversion.

One of them is to increase the capacity of Sanchez Mejorada canal so that it can give us an average stability that is greater than what we are receiving right now.

In the case of the NIB, in a unilateral way, Mexico has been working since 1996/97 to implement equipment to measure salinity. These automatic systems would give us a measurement in real-time that would allow us at a given moment to be able to detect certain salinity peaks of the water that is coming into Mexico.

This is something that we have not agreed to under the commission. Such a proposal would give immediate knowledge of the salinity of the water that is coming into Mexico. We're talking about automatic measurement systems which we could monitor using the existing communication systems, allowing us to receive that information on a timely manner.

This proposal would require a certain investment and we are exploring this on the Mexican side from the perspective of having joint implementation between Mexico and the United States. That would help us to generate certain information that, at a given moment, would allow us to have more adequate management aspects for delivery with regards to salinity.

ALFONSO ANDRES CORTEZ LARA: This is a very interesting question that perhaps could be answered by both sides. It has to do with the interim surplus criteria in the Rio Colorado.

FRANCISCO BERNAL RODRIGUEZ: We have shared the surpluses of the Colorado River, and usually we have had damages on the Mexican side when we have had flooding. How can Mexico be integrated into the interim surplus criteria?

JAYNE HARKINS: I think I mentioned earlier that the interim surplus guidelines were for the delivery of surplus water to the three Lower Basin states. I think looking further, if we wanted to define how Mexico would become a part, we would have to work with Mexico and put some definitions on treaty surplus and change parts of that or put more definition to that part of what the surplus definitions are with regards to the treaty. I think that's where we'd

have to go to provide more water or share in more water.

CARLOS MARIN: In the 1944 Treaty, it states that Mexico will share in any surplus if there is no beneficial use in the United States. Again, like Jayne has mentioned, I think that would require a modification. If I understand right, even in this interim surplus criteria, there's probably around a 23/24 percent chance during the next 15 years that Mexico would get a surplus allocation. Of course, it all depends on the system and any inflows into the system. It's just an issue that I think time will tell if Mexico will be getting any surplus waters out of the Colorado River system.

Wednesday, September 12, 2001

PANEL III ENVIRONMENTAL ISSUES

TECHNICAL AND SCIENTIFIC STUDIES SPECIES AND HABITAT IN THE COLORADO RIVER DELTA AND UPPER GULF OF CALIFORNIA

**MODERATOR: EXEQUIEL EZCURRA
NATIONAL ECOLOGY INSTITUTE OF
MEXICO:**

Mr. Ezcurra informed the audience many representatives from the U.S. government were requested to return home due to the incidents on September 11 and that panels would be short. He mentioned that given the incidents in the U.S., the dimension of what was being discussed at the conference seems smaller than the current events unfolding in the U.S.

**DR. EDWARD GLENN
UNIVERSITY OF ARIZONA, ENVIRON-
MENTAL RESEARCH LABORATORY:**

Dr. Glenn began his talk by stressing the need for more research in the Delta. There also is a great deal of research that has already been conducted, including about 20 papers in the

September 2001 issue of the *Journal of Arid Environments* (Volume 49[1]). The U.C. Mexus program is funding ten new grants and there will be new investigators in the field in the upcoming years.

On the U.S. side of the border, there is plenty of water in the river channel next to the border, however, the water is contained within the channel and it has a very narrow flood plain. Most of the vegetation is dominated by shrub halophytic vegetation because there is no over-bank flooding to wash the salts from the soil and to germinate tree seedlings. Most likely, flooding will not occur in this river segment as there is property development along the river.

Agricultural return flows are a primary source of water for the Delta. Wellton Mohawk Irrigation District irrigation flows over the past 20 years have created the largest emergent wetland in the Sonoran Dessert – the Cienega de Santa Clara. The wetland now covers about 15,000 acres. In 1993, these flows were interrupted and the Cienega dried out. However, flows continued the following year and the habitat was revived – verifying these ecosystems are very resilient.

On the Mexican side of the border, past Morelos Dam, the river has the ability to spread out over a flood plain. This has created extensive cottonwood/willow habitat that require flood events to become established. They seem to continue their existence on subsurface water – about two meters beneath the river bed – even when there is no flow in the river. Flood flows remain the largest source of water for the Delta. About 20 percent of the total river flow in the past 20 years (since Lake Powell filled) have been flood flows and these typically come with El Niño events.

Over the past two years, remote sensing and ground studies have been conducted using ten cross river transects to measure the cottonwood/willow zone and then categorizing by species and plant type. Most of the trees are from the 1993 (about 70 percent of the vegetation) and 1997 floods in the area. This has shown the

differences between the U.S. side of the river versus the Mexico side as a result of the pulse flood flows. Most of the gallery forests that used to dominate other parts of the river have re-established in Mexico. There are now several thousand hectares of cottonwood and willow gallery forests in Mexico versus 98 hectares remaining on the U.S. side.

There is an effort to determine the minimum flows needed to support the Delta habitat. In January 1997, there was a release of approximately 250,000 acre-feet of water over a three-month period. This was enough water to inundate the flood plain, get water flowing into the Gulf and Laguna Salada, and resulted in vegetation response the following year. The water in the MODE canal will be needed to keep the Cienega alive – about 120,000 acre-feet of water annually.

For the rest of the Delta, it is estimated that a flood release is needed every three to four years in order to germinate new cottonwood and willow seedlings. Such trees can survive without water for three or four years as was shown by the trees established during the 1993 flows. Estimates for water needs in the Delta is about 102,000 acre-feet of water annually. The total is about .5 percent of the average annual flow of the Colorado River.

The estuary region of the Delta also is need of “freshening up.” Salinity measurements have indicated that flows of 200 cubic-meters-per-second – about 20 percent of the maximum releases done – decreases salt level in the estuary significantly in the northern Gulf. A correlation also has been shown between shrimp catches and flood events. To double the shrimp catch at San Felipe (estuary region of the Delta), it’s estimated an additional 50,000 acre-feet of water perennially is needed.

DR. SAÚL ÁLVAREZ BORREGO
CENTER FOR HIGHER STUDIES AND
SCIENTIFIC RESEARCH, ENSENADA:

Dr. Borrego said he would discuss the Upper Gulf of California, while focusing on two primary aspects: the impacts the lack of water in the Colorado River has had on salinity and the apparent lack of nutrients and that impact on the collapse of some fisheries.

There isn’t a lack of nutrients. The primary problem stems from the change in water quality in the Upper Gulf – from an estuary to an anti-estuary. There are plenty of nutrients from agricultural runoff, such as nitrate, but the effects of these on the estuary are still under study.

The University of Baja California began conducting research on water quality in the Upper Gulf in the 1970s. Though the Gulf of California is under the sovereignty of Mexico, it is a resource for both Mexico and the U.S. and ultimately, the world.

We can compare the Gulf of California and the Mediterranean. When the Nile River did not flow into the eastern Mediterranean, sardine and shrimp production collapsed due to the lack of nutrients, not unlike what is happening in the Gulf. While the Upper Gulf continues to be a productive fishery, in a certain way, shrimpers also are to blame for the reduction of marine biodiversity. They have continued to systematically harvest even when populations are small.

The Upper Gulf receives nutrients from several sources including coastal upwelling off Sonora during winter and nutrients from relatively deep waters that are brought to the surface by intense tidal mixing. This creates intense photosynthesis. Temperatures vary greatly from less than 10 degrees centigrade to more than 32 degrees centigrade with the warmer temperatures typically in the summer.

Progressing from the Upper Gulf into the internal extreme of the anti-estuary, nitrate levels increase and salinity levels decrease due to agricultural input. The 1993 flood flows pro-

duced more than two million acre-feet of fresh water to the Gulf. Southeastern portions of the Upper Gulf showed higher levels of salinity with the northeastern portion showing the lowest levels. Studies also have indicated that nitrate levels in the Upper Gulf tend to be higher during years in which there are not flood flows to the Gulf.

**FRANCISCO ZAMORA
CONSERVATION INTERNATIONAL GULF
OF CALIFORNIA PROGRAM, GUAYMAS:**

Mr. Zamora said he would focus on vegetation in the Delta from 1990 to 1999. This included discussion of how zones are defined in the Delta; how the percentage of vegetation coverage is determined; and finally, how that coverage is related to Colorado River flows.

The area of study is approximately 100 miles of the river from Morelos Dam on down – about 170,000 hectares. This is divided into eight zones based on vegetation and water sources found in each.

The first zone is Morelos Dam up to the crossing of the Colorado River on the highway. The second zone is from that crossing up to the railroad crossing – the San Luis Zone – and is about 4,000 hectares. The third zone is from the railroad crossing to the last willow trees found on the river – about 7,000 hectares. The next zone includes the Hardy River area. There also is the Hardy Colorado that includes 24,000 hectares. There is the Ejido Drain. Other parts include the Cienega de Santa Clara and the interim region as well.

The primary riparian areas include the Morelos, San Luis and Carranza zones – about 25 percent; the Hardy – which is about 5 percent; and the Hardy Colorado, which is the majority with 34 percent.

The percentage of vegetation for each of these areas was determined using satellite imagery. The vegetation index was estimated using a formula and analyzed images from several years including 1992 (a year following several years of drought), 1994 (a dry year following a wet year

in 1993), and wet years in 1997 and 1999. The images showed clear changes in the vegetation coverage of the area. In the studies, the images showed an increase of about 75,000 hectares of coverage between 1992 and 1999. Some areas showed increases to being covered 70 percent by vegetation.

Modeling was done to try and determine how the vegetative growth was related to water flows from the Colorado River and included examination of open water areas. Analysis indicated that the most important variable leading to greater vegetation was the number of days that contained flows greater than two cubic-meters-per-second.

The analysis is important because it shows that during a decade of alternating dry and wet years, vegetation in the Delta increased. The ecosystem is capable of supporting itself during dry periods and recovering during the wet periods. Certain conservation measures could be implemented in the Delta to maintain the currently existing habitat.

**ERIC MELLINK
CENTER FOR HIGHER STUDIES AND
SCIENTIFIC RESEARCH, ENSENADA:**

Many of the species once found in the Delta region are no longer there or have very reduced populations because much of the habitat historically there no longer exists. Data, however, are limited. This is the case of beavers and some birds. White egrets were nearly hunted to extinction early in the 20th century because of a demand for their feathers. Montague Island has become an important colony for these birds. Montague Island appears to be an important habitat for birds, however, the island faces periods of flooding and this can be devastating to the nesting species. There is the possibility that if Colorado River flows increase to the Delta, the flooding of Montague Island could increase and prove detrimental to the colonies. Conversely, increased flows will generate habitat elsewhere in the Delta for these species.

KARL FLESSA
UNIVERSITY OF ARIZONA,
DEPARTMENT OF GEOSCIENCES:

Mr. Flessa said he would discuss bivalve mollusks in the Northern Gulf of California, in particular, because they are an indicator of productivity and diversity of the Northern Gulf ecosystem in the vicinity of the Colorado River Delta.

Bivalve mollusks, after they die, leave behind a record of past environmental conditions in their shells. By dating the shells, a good indication can be given of what the Delta was like before the diversion of water from the river. Based on our data, we conclude that population sizes and diversity of bivalve mollusks were much greater in the past – in the era before the dams – than they are today. Other invertebrate populations (crabs, shrimps, snails, echinoderms, brachiopods, annelid worms, etc.) also were probably also more abundant – probably the result of a higher nutrient supply from the river. Populations of birds, fish, and marine mammals were probably also higher in the past because of the greater supply of invertebrates for food.

Mulinia coloradoensis, the Colorado Delta clam, was extremely abundant in the pre-dam era but is very rare today. It is found nowhere else than in the Delta. We believe that this species is endangered by the increase in salinity due to the diversion of fresh water. Oxygen isotopes in the clamshells indicate that this species prefers a mixture of fresh water and sea.

Islands and beaches in the marine zone of the Delta are composed entirely of shell material and extend for great distances – some up to 40 to 50 kilometers – from the mouth of the river towards San Felipe. This is a record of high biological productivity in the past. We estimate that more than two trillion shells compose the beaches and islands in the marine zone.

Radiocarbon and amino acid dating of these shells indicates they represent a thousand-year interval of time – most from before 1950; before

the major diversions of fresh water. Surveys of live mollusks indicate that current bivalve mollusk densities range from three to five per square meter. Estimates of past population densities – based on the number of shells, their age range, generation time and habitat area – range from 25 to 50 per square meter. This indicates a population crash of 34 to 95 percent since diversion of Colorado River water.

90 to 95 percent of the shells found are of one species – *Mulinia coloradoensis* – the Colorado Delta clam – endemic to the Delta. This indicates that the Colorado Delta clam was once the most abundant bivalve in the region. But this is no longer the case. Today, the genus *Chione* is the most common bivalve with *Mulinia* composing less than five percent of the fauna. The change in abundance is attributed to the decrease in nutrient input by the Colorado River while the change in species composition is the result of the increase in salinity. The *Chione* are more salt tolerant.

Although there is now a lot of information about environments of the Delta and Upper Gulf of California, I think that the scientific research needs to be better coordinated. Scientists often use different methods. We focus on different organisms. We work in different areas. We could coordinate our work with a series of baseline studies. Then, when the next flood flow in the Delta occurs, we could study the short-term and long-term effects of pulse flows of river water. Such a large, coordinated study could result in an integrated view of how the ecosystem responds to increased amounts of water. Scientists on both sides of the border are ready to do this necessary work; all we need is the financial support.

JAQUELINE GARCÍA HERNANDEZ
CENTRO DE INVESTIGACIÓN EN
ALIMENTACIÓN Y DESARROLLO, A.C.,
CIAD, GUAYMAS:

Ms. Garcia said she would discuss results of a water quality study in the Delta that took place

from 1996 to 2000. Those studies focused on the impact of contaminants on wildlife, in particular, the distribution of selenium, trace metals and concentrations of organochlorine pesticides in the sediment and biota of the different Delta wetlands.

Chemical contaminants are a great threat to both surface waters and groundwater. Such contaminants include heavy metals, asbestos, algae nutrients, organic contaminants, PCBs, pesticides, oil, sewage, pathogens, detergents, chemical carcinogens and sediment/salt.

Selenium is a semi-metal resulting from sedimentary rock exposure in the Colorado River drainage and though it is an essential micronutrient, concentrations of it may produce a toxic effect ranging from physical deformities during embryonic development to sterility and death. An example of such is the Kesterson Wildlife Refuge in California's San Joaquin Valley.

In the Delta, 41 samples of sediments were taken from different sites, as well as samples of fish, invertebrates, insects and amphibians from 12 locations in the Delta. Sediment values range from .6 up to 2.81 parts-per-million (ppm). Some of the higher concentrations are found in wetlands and these are believed to receive water from agricultural drains around Mexicali and San Luis and a geothermal plant.

The threshold for birth defects in fish and invertebrates is 3 ppm with 23 percent of the samples exceeding this guideline. El Mayor indicated a high level in sediment and fish. In Bocana, located high in the Gulf, shrimp were collected containing high levels of selenium. Other areas such as Cienega De Santa Clara, Mosqueda Camp and Campo Flores also indicated high levels of selenium.

When the same species of mosquito fish are compared between sites north of the border in the U.S. and south of the border in Mexico, concentrations are higher in the north – 9.5 ppm versus 2.6 ppm. A relationship was not found between selenium concentration in the sediment and that found in fauna.

With regards to pesticides, 86 percent of the samples taken contained DDE in a range of .01 to .34 ppm. Effects from toxicity can be seen between .15 and .3 ppm. 30 percent of the samples were above .15 ppm and none exceed 1 ppm. DDT was found in 26 percent of the samples ranging in concentration from .01 to .3 ppm. The range indicated DDT was used recently and often (but before the 1980s when it was banned).

Areas that received agricultural runoff but that had flushing mechanisms (such as tides) had lower concentrations of selenium. Areas that had mild reducing or oxidizing conditions, low organic carbon and high sand content were likely to result in high selenium levels in fish. Generally, these areas received agricultural runoff but had little or no outflow. These sites included the MODE canal, the El Mayor wetlands, the Cienega de Santa Clara and the El Indio wetlands.

The recommendations are to closely monitor the El Mayor wetlands because of high avian use and to monitor the reproductive success of the Yuma clapper rail in the Cienega de Santa Clara. Outflows from wetlands help to keep selenium concentrations to a minimum. Dredging in areas with little or no outflow should be avoided or, at least, such dredging should be coordinated after birds have nested to avoid creating high concentrations of selenium to the chicks. Where outflow is limited, periods of drying and flooding should be avoided. Overall, more research should be conducted, including on the effects of pesticides on wildlife; an analysis of groundwater for organic and inorganic compounds; and the impact of water quality from sewage, fertilizers and industrial discharges.

NICHOLAS P. YENSEN
NYPA INTERNATIONAL, TUCSON, AZ:

Mr. Yensen said his talk would focus on wetland and estuarine ecology, in particular, halophytes, found in the Delta. The Cocopah Indians used to harvest *Distichlis palmeri* and store it in baskets for the lean times of the year.

Once, the plant was thought to be extinct, however, it has since been found and studied.

Most halophytes (of which the *Distichlis palmeri* is one) require fresh water for germination. This has proven to be one of the problems in the Delta – a lack of fresh water has meant less germination for the halophytes. When water does flow, germination is tremendous. Halophytes increase growth with increased salinity to a certain point, however, it begins to drop after that point is reached. *Distichlis palmeri* grows well in inundated areas and has aerenchyma to assist in carrying oxygen to the roots. Consequently, it can grow well in anaerobic soils.

Distichlis palmeri only yields about one pound to the acre and has nutritional characteristics similar to whole wheat. By cross fertilizing, the yield was increased to about four tons to the hectare.

There are about 120 species of halophytes in the Gulf of California region. Worldwide, there are over 2000 species of plants that are salt tolerant. There are various projects being undertaken by companies to work with halophytes to remove salts from the soil. NyPa has a nursery in Arkansas experimenting with about 20 different species of plants endemic to the region.

It would take a very little amount of water to create a greenbelt in the Delta. This was could all be drainage water as there is quite an adequate supply if it were properly used.

Q & A

(VERBATIM):

EXEQUIEL EZCURRA: The question is about other species of *Mulinia* elsewhere in the Gulf of California, especially to the south, and to what extent they might have evidence for the influence of the Colorado River in the 20th century.

KARL FLESSA: The species *Mulinia coloradoensis* occurs only in the Delta. The other species of *Mulinia* that occurs in the Gulf of California is *Mulinia pallida*. *Mulinia pallida* is

principally known from the southern part of the Gulf near the mouth of the Gulf. We have looked at specimens of *Mulinia pallida* and we have examined the isotopic composition of shells from Nayarit and also from the area north of Guyamas. We have not found any evidence for fresh water influence in the shells of those specimens. It appears that *Mulinia coloradoensis* is the only species of *Mulinia* that shows the influence of the Colorado River.

EXEQUIEL EZCURRA: Ms. Hernandez, 2.5 selenium is considered in your study as the maximum concentration that causes abnormalities. Could you please tell me if the lagoons in Cerro Prieto are similar or different?

JAQUELINE GARCÍA HERNÁNDEZ: In Cerro Prieto, I only obtained two samples in the lagoon, which is the first inflow of water, because they use those lagoons for evaporation. I took the sample in a lagoon where the largest population of desert pupfish is found. I didn't take from all the lagoons because there's no life in the rest of them. In that lagoon, we found 1.6 parts-per-million of selenium in the sediment. So, they are below 2.5 that could cause abnormalities.

This element selenium is an element that is natural. There are certain organisms, the native organisms of this area, that could be accustomed to (or they evolved in order to have a greater tolerance for) the levels of selenium. That is why it's so important to make this study in birds, to see whether the levels that we found in fish and in sediment creating an impact.

EXEQUIEL EZCURRA: And then it says: How can you explain that the lagoons host the most active population of desert pupfish?

NICHOLAS P. YENSEN: This is why I told you they can sustain higher levels because of the fact that they have been here for a long period of time and selenium also is an element that has been here.

The mosquito fish, you made the distinction between the toxicology differences in the status of the fish. Your conclusion does not agree for the Cerro Prieto site and the pupfish. I hope those was clear, and if not you can ask me later.

I want to say something about selenium. In the Central Valley of California, I have found that there is bacteria that can tolerate selenium. Also, the salt grass can tolerate selenium and it transforms it. It can clean sites. It could be used for remediation. The wetlands clean or heal the body of the rivers and they can clean those toxic elements before they go into the Gulf.

EXEQUIEL EZCURRA: I have a question that says: Could you please explain a little bit more about the potential danger of solutions for the Salton Sea and the Upper Gulf of California?

JAQUELINE GARCÍA HERNANDEZ: Well, there is only one possible solution for Salton Sea that I was mentioning. I believe that about two years ago it was very clear that it would be very difficult to implement it and this is the solution that is called the exchange solution. This was an idea to pump water to the Upper Gulf and then to the Salton Sea and then to the Upper Gulf. Like I explained in my presentation, the danger is that this is a marsh with high salinity that would be very hot in summer and it has high concentrations of things like selenium and other toxins.

EXEQUIEL EZCURRA: There is another question here that says: Considering the importance of the supply of carbon and nitrogen in the high gulf of California, what is the opinion of the panelists to use waste water from urban areas, duly treated, for environmental restoration?

NICHOLAS P. YENSEN: It doesn't have an impact because we have an excess of nitrogen and carbon in sea water.

EXEQUIEL EZCURRA: There is a question whether the vegetation maps were available on the Internet.

SAÚL ÁLVAREZ BORREGO: They're not available on the Internet, but that's a good option. They will be initially available, at least on paper, in the publication published in September in the *Journal of Arid Environments*.

EXEQUIEL EZCURRA: There's a question for me. It says: What happened to species like the vaquita and jaguar?

FRANCISCO ZAMORA: The jaguar disappeared from the Delta. There were reports from the early 20th Century that jaguars had a large population. In reality, there were likely isolated individuals north of Sonora to the Gila River. There were reports of a very small local population but I don't really believe this. The fact is that the habitat has changed so much that I don't think they exist anymore, and if there are any, they would have killed them already. The fact is that you won't find any jaguars.

With regards to the vaquita. The vaquita is a species of the Delta and of the Upper Gulf. Somebody mentioned some weeks ago that I think there's about 600 individuals. It's a species that is very difficult to study and to determine population numbers. We're working with acoustic methods. They are endangered species under any standard.

One of the causes, or the basic reasons, of why vaquita are in this condition is because they can get tangled in fishing nets. In recent studies, people who were conducting the study said the mammal is very easily tangled. Some people say that the lack of fresh water has affected their reproduction. This is a point for discussion. There are people who do not say the same thing and lack enough information to be on one side or the other.

And taking advantage of this question, I would like to make a comment regarding other species. Yesterday we discussed waste waters. If

you see the images in the Mexicali Valley and Imperial Valley, they are very different because of the bushes that we have. This is very unique for different species and they have problems of conservation in southern California. There's some cotton rats and I think that we haven't found them but I think that California is in a similar condition.

EXEQUIEL EZCURRA: The specific question is: Can you explain, in detail, the statement that with the contribution of water from the Colorado River, the levels of nutrients are higher?

ERIC MELLINK: Well, objectively, this has been determined by the analysis carried out. They showed charts that in a wet year, April of 1993, the general nutrients of the gulf were higher than a dry year like April 1996. These studies were directed by Salvadore Galindo and published in *Coastal Science* stating that from '89 to '90 dry years, there were very high concentrations of nutrients up to 50 micrometers. So evidently this is something objective that results from analysis.

EXEQUIEL EZCURRA: The second part says: Can you expand on the characteristics of the Upper Gulf that make it more resistant to nutrient deprivation?

ERIC MELLINK: The main reason of the richness of the California Gulf is because of coastal movements due to the winds and the currents. This causes the nutrients that are rich go to the surface where they have sunlight. This is one reason. And the other one is the tides that keep the water very well mixed and there's always a high concentration of nutrients where there's light. And in the Mediterranean everything is very calm, the tide is 20 centimeters between the highest to the lowest compared to more than 7 meters in the Upper Gulf. The system doesn't have too much energy and if you don't have any nutrients from the Nile, then they don't have any nutrients.

EXEQUIEL EZCURRA: Another question: How many samples per year of shrimp do you take and for how many continuous years have you been sampling shrimp?

SAUL ALVAREZ BORREGO: Well, first like I said, I'm not the one that has sampled. I took it from a thesis for a bachelors degree that sampled in the 70's. The problem with these types of studies is that since we haven't had any money to sustain a research, these are studies that have been very fixed. The scope is changing because of a program with UC Mexus and the National Board of Science and Technology. We hope they will carry out this program for a few years. We cannot monitor this frequently. These shrimp boats were on loan to the university to carry out these samples. The other problem is that it's not easy to identify the juvenile shrimp. They're very small and you have to have some expertise to do it.

On the other side, based on research from the Marine Institute of the University of Baja California, we know totoaba can reproduce easily. On one hand, we don't have a sample where we need the water from the Rio Colorado, and on the other hand, we have a very clear picture that the shrimp nets capture totoaba fish by the hundreds, at least in this case.

EXEQUIEL EZCURRA: Can you predict any effects on the Yuma?

JAQUELINE GARCÍA HERNANDEZ: I think that the worst effect is to put in operation the marshes and not too much water with high salinity so the first thing that it would effect is the salinity and it would reduce the concentrations of salinity would be higher than what we have right now.

EXISTING RESTORATION PROJECTS

MARK BRIGGS

Mr. Briggs said he has been involved, on the community level, with restoration projects in the Delta. He said there are three primary projects he has been working on: the Moscela project, located along the Hardy River near the Cocopah Mountains; the El Indio wetlands restoration project, east of the Cienega de Santa Clara; and El Tapon – a small dam along the Hardy River just downstream of the Moscela project.

The three projects have the same five principal objectives: to improve local ecological conditions (carried out at the community level with a variety of people and organizations) by either manipulating or changing the flow in the river or through different revegetation efforts; to re-establish native seed sources; to bring benefit to local communities and make a connection between the ecology and livelihood of the people that live there; to raise awareness of the residents that live there, including understanding of regional issues; and to demonstrate the power of restoration and the power of communities through tangible improvements. Residents involved with the projects would like to use the sites and gain some economic benefit from the areas.

The Moscela site, along the Hardy River, is near an area known as Compo Moscela. The site, about ten hectares, was once heavily farmed but has been fallow for the past eight years. The idea is to take the site and re-establish cottonwood and willows, mesquite and some wetlands. This site, and the El Indio site, require water and soil samples to determine what types of vegetation can best grow there. The emergent wetland system will be supplied from several irrigation canals connected to the Hardy River and will include an aquaculture component. The project

has been funded and is expected to begin implementation in 2002.

The El Indio site, of the three, is the most in the design phase. The focus (similar to the Moscela site) will be on establishing and re-establishing emergent vegetation and includes an aquaculture component. The project is currently working to obtain funding.

The El Tapon project has been funded and implemented by a local organization called the ULIC. The primary purpose of the project is to establish a small dam on the Hardy River to elevate the water level and create more wetland areas. As with the other projects, the El Tapon project stresses community involvement in the restoration efforts which, in turn, leads to an improved Delta ecosystem

To create a greater ecological system in the Delta, several efforts need to happen. To change river management, water policy must be changed. And this requires a greater understanding of ecological conditions in the Delta. This includes a greater awareness for locals in this region, to restore these areas and to prevent further damage to the system.

Spot restoration efforts such as these, however, will not entirely restore the Delta. The total land area for the restoration projects is approximately 40 hectares. The idea is to gather community involvement and create the momentum necessary to create greater change. These projects examples of what needs to be done on a broader scale in the Delta.

ELENA CHAVARRÍA SONORA:

Ms. Chavarría began her presentation with the question: What does restoration of the Delta mean for the people that live there? Information can be obtained, regulations established and an international dialogue enacted but without the will of the people, progress will not be made.

Ten years ago when restoration efforts in the Delta began, the focus was on making progress in specific areas but without paying attention to

the local population. However, involvement has changed. It is no longer viewed as just a single person's effort, but as projects that involve communities. Ethics levels, while important to include the environment, also must consider the needs to the local communities.

Reassigning water from one use to another has been discussed as one possible solution for the Delta. However, there also needs to be a change in philosophy that recognizes community obligations as well because without it, efforts to create a long-standing contribution will be in vain.

**MICHAEL CLINTON
MICHAEL CLINTON ENGINEERING,
LAS VEGAS, NEVADA:**

Mr. Clinton said he would discuss the efforts of a team of professional from the U.S. and Mexico, funded by the David and Lucille Packard Foundation.

In 2001, about ten million acre-feet of water will be released from Hoover Dam to meet the needs of downstream users. None of that water is released for ecological purposes and instead is used to meet contracts, agreements and the 1944 Water Treaty. Ten million acre-feet is one million acre-feet more than was needed to be released five years ago. Uses in the U.S. continue to grow and the states continue to use more of their entitlements.

The basin is in its third year of a drought with runoff for 2001 – about 56 percent of normal. In the last three years, Colorado River Basin reservoirs have been drawn down about 12 million acre-feet and as such, the Bureau has done its best to end inadvertent deliveries to parties not entitled to them. Extra water released to help keep a dredge afloat near the City of Yuma has stopped.

In recent months, deliveries at Morelos Dam have exactly matched delivery requirements with no significant excess water deliveries. Under such tight releases, there will be very little excess water delivered to Mexico and in

particular, to the Delta ecosystem that has been sustained and restored over the past 20 years. The weather is unpredictable but if the Delta doesn't receive some near term water supplies by next summer, the ecosystem will begin to show signs of stress.

There are two potential approaches for bringing water to the Delta.

One involves bringing in water from the U.S. but this only is allowed during surplus conditions. However, an agreement in the 1970's under Minute 242 allows Wellton-Mohawk drainage water to be delivered past Morelos Dam and replaced with water from the Yuma desalting plant or with fresh water from other sources. There are currently large amounts of brackish water – agricultural drainage – in the south Gila Valley and the Yuma Valley being delivered as part of Mexico's Morelos Dam delivery entitlement. Due to legal constraints in the U.S., the only way to get water into the Delta ecosystem from the U.S. may be to move those resources away from being delivered in the river and into a bypass drain for delivery into Mexico for ecological purposes. By diverting those brackish water for use by the Delta ecosystem, this also could improve the water quality of the deliveries to the Mexicali and San Luis Rio Colorado valleys.

Another potential source of supply could be to lease or purchase water rights in the Mexicali and San Luis Rio Colorado valleys and transfer those fresh water resources from their current agricultural uses to ecological uses. Examination of CNA regulations and water law in Mexico shows that such an effort is viable.

There have been concerns over whether or not such waters acquired for the ecosystem would actually get to their intended purpose in Mexico. Analysis of CNA operations in District 14 in Mexico showed that accounting systems and the protection of water rights in the valley are as good or better than any place in the U.S. There are marginal farmlands located west of Mexicali and at the south end of the Mexicali Valley that could temporarily or permanently be taken out

of production. The water rights could be delivered to existing CNA canals into wetland areas that have been protected for over the last 15 to 20 years.

Currently, these are just ideas. The next step would be to implement the recommendations, leading to an interim (versus a permanent) water supply. Work needs to be done to develop a long-term water management strategy in the next three to five years. However, there is concern that the existing wetlands cannot survive in their current state if a solution is not enacted. A bi-national effort to bring water from both nations is the near-term is needed to sustain these resources – if only on an interim basis – as it is not know what is needed for a final solution. It would probably need to be a five-year period needed to sustain the Delta ecosystems for now.

ALBERTO JAIME PREDES MEXICO NATIONAL WATER COMMISSION:

Mr. Jaime said general Mexican environmental laws protect aquatic ecosystems. Citizen concern for riparian and aquatic ecosystems is growing because of the realized aesthetic values and impacts from loss of habitat. Some have said minimum flow requirements should be guaranteed for the protection, conservation and restoration of aquatic ecosystems including marshes and swamps. This should hold true for ecosystems that have historic value or display great biodiversity.

Under regulations of Mexican national water law, for water to be used for ecological purposes, there must be an understanding of the minimum amount of water needed to sustain the ecosystem. This is important to know for when supplies are scarce. Instream flows for ecological purposes are permissible as long as they do not interfere with the operation of the delivery infrastructure.

It also is necessary to know the other end of the spectrum: What are the maximum flows an ecosystem can tolerate? This includes not only

the volume of water, but the quality of the water as well. It also includes the organisms associated with these ecosystems, such as the vaquita refuge in a portion of the Colorado River.

In analyzing river flows, it is important not to think strictly about optimum flows but also about flows that sustain natural organism populations. Precautions must be taken when designating flow requirements to take into account adequate habitat for flora and fauna, acceptable water temperature and salt and oxygen levels appropriate to specific areas of the river. The flows also should include artificial flooding in order to scrub riverbanks and improve overall water quality. Some of the current flow regimens are based on historical flows as well as the results of hydraulic modeling designed to protect aquatic life.

There are fixed averages for current flows in order to meet downstream needs. Minimum flow criteria are based on historical flows. To establish ecological flows based on historical data, the demands of downstream users would have to be weighed with the ecological needs. A number of rivers around the U.S. have used different types of methods to determine ecological flows within existing flow frameworks, however, they vary from river to river because of the diversity of organisms found there.

Because flow studies to determine the best ecological flows could take many years, proposals have been made to contribute a certain percentage of the average monthly flows to the Delta. Such flows could occur 95 percent of the time in a natural setting. The Colorado River is not a small river and has daily flows of 650 cubic meters per second with a possible variation in flows of 60 cubic meters per second. During periods of heavy precipitation, flows can reach upwards of 15,000 cubic meters per second.

A bi-national group needs to be established to determine flow regimes to the Delta. This includes determining which zones in the Delta should receive what amounts of water to best recover the flora and fauna of the ecosystem. Alternatives for providing the water needed to

meet ecological needs should be determined. These could include recognizing the Delta as a legitimate user of Colorado River water; buying or giving water rights to the Delta; or using agricultural irrigation surplus from both sides of the border. Actions that would deteriorate the Delta further, such as the proposed interim surplus guidelines, should be prevented.

PEGGY TURK-BOYER
INTERCULTURAL CENTER FOR THE
STUDY OF DESERTS AND OCEANS:

Ms. Turk-Boyer said her talk would center on community participation and the management of fisheries resources in the Upper Gulf of California.

The northern Gulf of California estuary is famous for its abundance of fisheries resources. In the 1920's, fishermen came in dugout canoes from Sonora and Sinaloa to establish fishing communities in El Golfo Santa Clara, Puerto Peñasco and San Felipe.

The economy of the three communities still relies on fishing today (though tourism is of increasing importance). Over \$22 million in U.S. dollars directly enters the economies because of fishing.

There's been relatively little research done related to the fishery productivity and the flow of the Colorado River. Some recent work done by Ed Glenn and Salvador Galindo Beck show there's a relationship and that increased river flows have a logarithmic effect on shrimp production. Examining fisheries crises also might provide some insight about problems plaguing the Upper Gulf. The shrimping crisis at the end of the 1980's and into the beginning of the 1990's, resulted in a 50 percent reduction in shrimp catches. This crisis corresponded with the five consecutively driest years of Colorado flow to the Gulf. Likewise the collapse in the totoaba fishery in the early 1970's followed the opening of Glen Canyon Dam. Overfishing also was a factor in the collapse of the totoaba fishery which was banned in 1975, and juvenile popula-

tions continued to be devastated by trawling practices.

To better manage the fishery stocks, more attention needs to be paid to the life cycle of these species. It is imperative to understanding the factors that can impact the survival of the species at various life phases. Many of these species use the Upper Gulf estuary for various stages of their life cycle.

In 1993, during the wake of the shrimp crisis, the Upper Gulf of California and Colorado River Delta Biosphere Reserve was established, in part, to offer protection to endemic endangered species. The shrimp industry was behind the dedication of the reserve and has participated actively in the development of a management plan for the reserve. Small-scale fisherman became involved in 1996 and through a series of about 170 interviews, information was gathered about their fishing practices and published in a book called "Fishing between the Tides of the Upper Gulf of California." The book provides insight into the 13 major fisheries in the Upper Gulf, the species fished, a history of the fisheries, equipment used and most importantly, the fishermen's ideas for species management and overall management of the fisheries in the Upper Gulf. The final point is important and one of the conclusions of the study is that fishery management needs to involve fishermen, and because it is diverse and dynamic it should be managed by zones or by fishing sectors.

Interestingly, one of the high priorities for better management given by the small-scale fishermen, especially from San Felipe and El Golfo de Santa Clara, is the need for release of Colorado River water. The request for higher flows was found to be less in demand in the Puerto Peñasco community perhaps because they are less physically aware of the flow of the Colorado River due to the lack of flooding of surrounding lands. Also the influence of the river for the marine system in this region may be reduced. Establishing closed seasons and controlling trawling boats also were listed as

important to fishermen for managing the fisheries.

CEDO work has involved commercial divers in Puerto Peñasco who harvest a large number of benthic organisms including scallops, octopuses and the black murex snail. The group of divers is tightly knit – making them good candidates for the development of resource co-management. In particular, the divers are concerned about a decline in the snails (one of their most important fisheries) – they estimated the decline of snail from 600 tons in 1993 to 90 tons in 1999.

The snails were studied by Richard Cudney Bueno as part of his master's thesis at the University of Arizona and included diver input on better management. One proposal was a formalized closed season for harvesting the snails, including the establishment of a temporary "no take" zone for the creature at Isla San Jorge. The divers began implementing restrictions on their harvest without the government's formalization.

The crab fishery in Puerto Peñasco is of growing importance in the Upper Gulf as it is a sustainable high value industry with low incidental catch. The fishermen, in April 2001, began working with administrators in the crab industry to monitor crab size and reproductive state to determine the best season closure for the species. They also have been working with the government to formalize sub-commissions of fisheries to actively manage the resource for the long-term. These efforts are being promoted by the government, COBI at Kino Bay and CEDO at Puerto Peñasco.

Crabs, shrimp and other fisheries depend on healthy coastal wetlands. Local and large-scale threats to these habitats with changes in sedimentation due to dredging, nutrification and development may destroy these productive ecosystems. Citizens are joining together to discuss how to manage and plan for sustainable use of these wetlands. Pronatura Sonora and CEDO are working in the Puerto Peñasco region to bring interested parties together for monitor-

ing, protecting and using the wetlands of the region.

The following recommendations are made for restoring the productive Upper Gulf estuarine system: 1) Support growing community efforts for responsible fishing, reduced take, estero protection, 2) Study factors affecting survival of all life stages of commercial species, i.e. larval survival as a function of freshwater flow, nutrients, etc. 3) Make timing of water releases known to allow for such studies, 4) Maximize production potential of the Upper Gulf to balance fishermen's sacrifices and responsible behavior for management of resources, and 5) Appreciate that communities and people in Mexico depend on healthy fisheries.

JOSÉ CAMPOY FAVELA DIRECTOR, UPPER GULF OF CALIFORNIA AND COLORADO RIVER DELTA BIOSPHERE RESERVE:

Mr. Campoy said he would provide an overview of Biosphere Reserve.

The reserve was granted reserve status in 1993. It is a transition ecosystem located between the Delta and the coastal marine area, with the Sonoran Desert on both sides. It is shared by two states (Baja California and Sonora) and a number of coastal communities including Irrigation District #14 and the Cocopah Indian Tribe. Because of the diversity, both of the inhabitants, the ecosystems and the organisms, the biosphere reserve is a place that should be used for monitoring and research activities including restoration opportunities.

The ecosystems of the reserve are vast and varied, ranging from the dry Sonoran desert, to the estuaries, the Delta and the waters of the Upper Gulf. The goal of the reserve is to protect the biodiversity of the ecosystem and this includes priority species such as the vaquita, the endemic desert pupfish and other regional organisms.

This is the first biosphere reserve to have an official management program. Since 1985, what

is now the biosphere reserve was acknowledged as an important area for fisheries and for the protection and reproduction of marine species, such as the totoaba. Internationally, the vaquita was acknowledged in the 1980's and the importance of the Delta in the 1990's. The Mexican federal government, through the Secretariat of the Environment, began elaboration of the management program starting in 1996.

The biosphere reserve is known as a region of high fishing productivity, ecological diversity and increasing conservation. There are areas, within the reserve, that are of special importance to migrating bird species. The coastal environments, including portions of the Delta, are heavily used by neotropical migratory birds during both seasons of annual migration.

Business is important to the region with commercial fishing providing important employment and the economic benefits. Conflicts between the commercial fishing operations can be intense in some areas, but there has been acknowledgment that the reserve is largely a fishery reserve that needs to be managed. Tourism also is a growing economy around the reserve, particularly ecotourism in the Golfo Santa Clara, Pinasco, and the Ejidos of the Delta.

Issues for the reserve have included working to protect species such as the vaquita. This demands a great deal of collaboration, cooperation and paying attention to the needs of all parties involved. Fishing is a main activity in the reserve and the decrease in population because of this has created conflicts. There was the loss of biodiversity because of shrimping. Intensive ranching also is of concern and experimentation and collaborative work is underway to study the impact of cattle on flora.

Other potential areas of concern include the bioaccumulation of contaminants, especially high in the Gulf, which could have potential impacts on the ecosystem because of the lack of outflow from the Colorado River. There has been a loss of habitat, such as north of San Felipe, because of increased development to accommo-

date tourists. Work is being done with developers and land owners to minimize the loss of vegetation.

The most complicated problem may be the impact limited flows are having on biodiversity. Sufficient information, not only on species but on entire communities, has shown that a lack of flows to the Delta and the Upper Gulf has created some adverse effects.

In the past four years, the management program has progressed significantly. The reserve has supported all research projects in the region. The reserve has participated in the letter of intent that has allowed for joint work on the Delta, between colleagues on both sides of the border, to begin in earnest. In 1998, a consulting board was established for the reserve. There are a number of new ordinances that have been established since 1995, particularly with regards to fishing (in coordination with different fishing organizations), and these have been promoted at state, federal and international levels. This also has included work with non-governmental organizations and institutions to help present short-term strategies to preserve the vaquita and alternative projects to fishing for communities.

In 2002, the reserve will receive additional financing, giving it the opportunity to strengthen and handle the scope of conflicts and issues within the reserve and its area of influence. In particular, focus will be taken on the Indian agencies and indigent communities; a baseline will be established and coordinated with research institutions to design effective monitoring of priority species; and communication increased to the interior and exterior of the reserve.

Acknowledgment on state, federal and international levels that the reserve is a very important ecosystem is a call to Mexicans to establish a serious, well-planned, well-structured program to preserve and restore the Delta. This acknowledgment could potentially be tied to a Delta research center that would solidify a long-term water management program for the

Delta, including agricultural water. This also includes collaborating with the Salton Sea restoration program.

These efforts should be formalized in legal documents.

ANDREA KAUS
UNIVERSITY OF CALIFORNIA, INSTITUTE FOR MEXICO AND THE UNITED STATES

Ms. Kaus said she would report specifically on the research program generated by a previous meeting. One year ago, the Udall Center for Studies in Public Policy at The University of Arizona and the University of California Institute for Mexico and the United States (UC MEXUS) jointly convened the symposium and workshop, "To the Sea of Cortés: Nature, Water, Culture, and Livelihood in the Lower Colorado River Basin and Delta" in Riverside, California. The meeting represented the convergence of the border environment programs of both institutions and brought together U.S. and Mexican scientists and scholars with government officials, nongovernmental organizations, and indigenous and Native American representatives to examine critical problems regarding policy, management, and conservation in the region. The discussion not only reflected grave concern regarding the Delta's future, it also demonstrated a collective willingness and determination to seek creative binational options for the welfare of the region's environment and inhabitants.

One of the strong messages from the meeting was that viable solutions for the region required current and continuing research, including the development of human resources in terms of student and research training. As a result, a small meeting was held three weeks later at CICESE, the Centro de Investigación Científica y de Educación Superior de Ensenada, with CONACYT, Mexico's National Council for Science and Technology, to discuss the possibilities and parameters for a future binational research program in the area. A Memorandum of Understanding was subsequently established to

sponsor a joint grants program focused on the Delta and Upper Gulf with equal contributions from UC MEXUS and CONACYT and additional in-kind support from CICESE.

UC MEXUS, CONACYT, and CICESE together issued a special focused Call for Proposals last Spring to foster collaborative, academic and scientific ties between U.S. and Mexican researchers. The Call was based on the UC MEXUS-CONACYT annual grants program, which provides seed funding for starting projects that need to establish the initial data that allow researchers to apply for larger grants or long-term support from larger institutions.

The grants program for the Delta and Upper Gulf has two main goals. One is to support research that can inform water management and policy in the region. Second, the funded projects are expected to fit into and help to expand and strengthen the existing binational network of researchers and research institutions working on water issues in the region. The review process ended two weeks ago and nine projects were selected out of the proposals submitted. The projects are as follows:

Jay Barlow, Marine Life Research Group, Scripps Institution of Oceanography, UC San Diego, & Horacio de la Cueva Salcedo, Ecología, CICESE
*"Habitat Use of the Vaquita (*Phocoena sinus*): An Acoustic Approach"*

Tommy D. Dickey & Grace Chang, Geography, UC Santa Barbara, & Luis G. Alvarez Sánchez, Oceanografía, CICESE
"Suspended Sediment Concentration and Fluxes in the Tidal Flats of the Upper Gulf of California"

John A. Dracup, Civil & Environmental Engineering, UC Berkeley, & Silvia E. Ibarra-Obando, Ecología, CICESE
"The Effects of Hydrologic Variability on the Ecology, Hydrology and Geomorphology of the River Delta"

Milton S. Love, Marine Science Institute, UC Santa Barbara, & Oscar Sosa-Nishizaki, Ecología, CICESE
"Elasmobranchs Fisheries Biology in the Upper Gulf of California"

Leal A.K. Mertes, Geography, UC Santa Barbara, & Alejandro Hinojosa Corona, Geología, CICESE
"The Flood Plains of the Colorado River Delta Seen from Remote Sensing Perspective and Its Relation to the Water Flow Crossing the United States-Mexico Border"

Enric Sala, Center for Marine Biodiversity, Scripps Institution of Oceanography, UC San Diego, & Luis E. Calderon-Aguilera, Ecología, CICESE
"Ecosystem-based Conservation and Resource Management of the Upper Gulf of California and Colorado River Delta: A Mass Balance Approach"

Richard L. Snyder, Land, Air and Water Resources, UC Davis, & Jesús S. Ruiz, Ciencias Agrícolas, Universidad Autónoma de Baja California
"Extension of CIMIS to Baja California to Improve Irrigation Efficiency"

Drew M. Talley, Environmental Science and Policy, UC Davis, & Eric Mellink, Ecología, CICESE
"Trophic Structure of the Food Web Supporting Birds Nesting on Isla Montague, Delta of the Río Colorado"

Libe Washburn, Geography, UC Santa Barbara, & Miguel F. Lavin, Oceanografía Física, CICESE
"Circulation and Dispersion in the Upper Gulf of California"

Several other projects that focused on the Delta and Gulf of California were funded through other UC MEXUS grants programs in 2001, notable among them being a project developed by Daniel Schlenk (Environmental Sciences, UC Riverside) and Jaqueline García-Hernández (Centro de Investigación en Alimentación y Desarrollo – Unidad Guaymas), in conjunction with researchers at The University of Arizona, that is investigating the effects of contaminants in the Colorado River Delta on nest success of Yuma clapper rails and burrowing owls.

All together, this fledgling research program shows great promise. The projects present a good initial spread of research areas with excellent possibilities to integrate together. The research on the ecological and hydrological dynamics of the region has implications for other river basins as well. Future emphases for the program will be to cultivate more research in social sciences and public policy as well as to encourage more participation from additional

institutions. The goal from the very start was and still is to foster binational research and training that not only informs policy and management but that also joins with other such programs to form enough of a critical mass of researchers and institutions to be heard and understood when providing such information.

Q & A (VERBATIM):

GILLERMO TORRES MOYE: Thank you. Before continuing, this question is for Peggy: Are new fishing regulations helping to recover the vaquita?

PEGGY TURK-BOYER: That's a very good question. Considering the way in which they are fishing shrimp nowadays, I think that the answer would be no. The current fishing practices have a high incidental mortality of vaquita. In recent years the capturing of shrimp with gillnets has grown and we know that it has repercussions for the vaquita population. Trawlers also capture the vaquita, so it would be a matter of, and this is a concern of many, to look for alternatives or methods to capture the shrimp, that do not have this incidental catch in order for it to be sustainable. And also, I would like to say that maximizing productivity through adequate Colorado River flow, is an important part of making these fisheries sustainable.

JOSÉ CAMPOY FAVELA: Has anyone seen a vaquita in the reserve?

Many people have seen vaquita, at sea and also on nets and also on the beaches, stranded on the beaches. We have seen a series of photographs. There is a census which was carried out in 1998 where the largest schools of vaquita were seen, and that is where we had an estimate, the estimate in force of the population of vaquita, which is 700 individuals. There's a very good file of species in collections as well as in photographs of vaquita.

What is the best time to visit the reserve as a tourist?

August 15th at 2:00 o'clock in the afternoon, that is the best time. No, winter. Winter and spring. Remember that the reserve is located in one of the most arid and hot areas of the world, so I recommend to get in contact with the Sonoran Institute, they promote interesting field trips. This also is what we are promoting, along with all the local communities.

Vaquita also are impacted by fishing and the local culture. Harvesting shrimp is an industry that is very important at a world level. In countries like Equador, Panama, Costa Rico, Mexico, especially Mexico, this is a very important industry. The farms that are in the reserve, before the decree of the reserve, have been working for more than ten years to improve the industry.

And the impact that we have seen is relatively small. The mitigation is taking place as are the regulations with regards to the environment and the specific measures for those activities. It does have an impact because the landscape changed as they used water from the natural environment. They discharge waters. It's economically beneficial, it creates profits. It's a legal activity that could give economic alternatives to local populations.

What is the position of the reserve with regards to the nautical ladder?

As I mentioned in my presentation, Pinasco and San Felipe are considered within the nautical ladder. The position is not from the reserve as much. The position is from the Secretariat of Tourism, to make a sustainable project, ecologically and environmentally, not only in that region but in the Golfo California and Baja, California that would give benefits to the local communities.

Personally, and we're looking at this for the reserve, it could be a very important alternative for San Felipe and Pinasco in order to reduce and decrease the pressure with regards to the fisheries effort, especially for riparian fishing.

And we could promote sports fishing for the benefit of the communities.

We were part of the team of Mexican federal institutions that the United States consulted in this process of the Interim Surplus Guidelines. And there are written concerns with regards to the concerns of the potential impacts of implementing these guidelines.

It is important to emphasize that in the decree, the interim surplus guidelines, it is specifically emphasized in several paragraphs that the transboundary impact is not well-defined. They request and promote in that decree to continue with the consultation and the joint consulting work, for example this symposium, to define the potential impact and to establish mitigation measures in the times as the criteria is going to be implemented.

There are cases, like for example the lining of the All-American Canal, which will have another type of treatment and also a special group to deal with this lining aspect. But we have been working in consultation jointly with IBWC and IBWC has been consulting us and inviting us to the consultation meetings.

PEGGY TURK-BOYER: I have a few questions here, and the first question is directed to me and José: How would the halt of shrimping affect what is proposed by Dr. Alvarez Borrego?

As I mentioned in one of my slides, we have estimated that \$22 million U.S. dollars, or \$222 million pesos, goes to the local economy from shrimp fishing or other types of fisheries – the majority is shrimp. So, if shrimping were eliminated, it would reduce this amount of money as income to the communities and it would affect the population tremendously. Though it is important to note that the proposals that I have heard do not include the suspension of the fishing of shrimp completely. Outside of the reserve, there will be an increase in the effort and there would be income for that activity. And if there's a development of new methodolo-

gies, well, maybe they can continue fishing for shrimp.

Do you have any comments?

JOSÉ CAMPOY FAVELA: The industrial fishing of shrimp with larger ships is very important at a national level and we see it on both coasts. There are regulations established. What we're trying to promote is to have more precise regulations to protect the reserve, and that we could restrict, completely or partially, through consultation with the fishing authorities, especially those authorities that will give a judgment whether the restrictions that we are proposing are feasible. There are other restrictions, the excluding of turtles, the excluding of fishes. We are looking at times, efforts, quotas and specific volumes for the small fleet and the larger fleet.

This is very complicated work that has many sides, but the intention is that at least the dragging and the impact could be minimized in the near future within the reserve. But it's not our intention to prohibit it completely in the Gulf, but to ensure that in the buffer zone we have a sustainable fishing with the least impact possible.

ALBERTO JAIME PAREDES: I have several questions here. One says: Is it possible to ascribe water for ecological use and what would be the implications of doing so to international treaties of water allocation in the Rio Colorado Delta?

With regards to this, we have received several opinions that to make a rule for ecological use would be to commit ourselves because of the large diversity of regimens and the large number of rivers that we have in our country. In Mexico we have rivers that 363 days a year do not carry any water and two they do. In others, flows are permanent. But the majority have torrential use during rain that they don't have any sustained water flow, so it's not easy to have a Mexican official ecological standard with the high diversity of rivers.

I explained during my presentation that the ecological regime or the ecological use in rivers should be based on studies that tie the hydrology of the river to the riparian habitat.

What would be the implications if we had a standard like that?

Well, what are the implications in the United States to have a standard like this? If we would have this type of standard in the United States, they do it for every river, and I would ask the question also.

In a country, for example in Germany, where they were exporting cars that did not comply with a certain environmental law and they demanded it for their country, I would tell them, well, you can't do that. If you say that it's bad for your country to have these emissions, why are you sending automobiles to our country that do have those emissions? So in order to be equal, the consequence of ecological use that would be determined for the Colorado River should be shared by both countries. Basically, we should wait for an equal treatment in Mexican territory than what we would like to have in Mexican territory and visa-versa, that would be the implication, to have equal treatment in both countries.

And since all the people who spoke before me and everybody after me said that they were going to be very brief, I will also be very brief. I imagine that a representative from this group is asking: What is your opinion of the listing of the American Rivers Group that says that this river is endangered?

I apologize for my ignorance, but I don't know what the parameters are for this organization to declare an endangered river. I believe that the Colorado River is one of the most controlled rivers in the world, it has a very important control. There are many contradictory things. The Golden Group took geological centuries to form, and it's funny, the arms of the Hoover Dam are very important now for the people in the U.S. All the geological stage in which the river was formed completely to give way to the Delta, and the interaction with the Upper Gulf of

California is not very important. We have to defend the lake but not the upper part of the California Gulf.

I think that by stretches, the Colorado River is in excellent condition, and by stretches it's also in very bad condition. It depends on how we judge the river. In the last 100 years, human beings, all the users of the Colorado River, have changed the features of this river: the hydrology, the ecology, and the ecosystem. This is indubitable, but I don't know what we consider an endangered river. In danger of what?

We should see the Rio Colorado as what it is right now: a controlled river, very well controlled, and we have modified it substantially.

Now, to say that we can revert that, I think that that is an illusion. I do not agree that we can say we can promise environmental protection. Man should stop being the center of that judgment to carry out studies that would allow us to say, okay, we have to carry out these and these actions. If we don't have an anthropocentric vision of what is environmental protection, everything else is just a story because there's no other species in the world that sees that we have to protect the environment, and there's no species in the world that has the capability. The human being, if we protect the environment, then we will have a certain order. But if we alter that order, that's chaotic alteration of order and we will alter the Colorado River in a chaotic way.

This is 60,000 million cubic meters is equivalent to the main dams in Mexico. We're talking about very large volumes of water that were captured and that are not flowing. This is not only in Colorado, this is in the majority of the rivers in the world, in Europe and Asia and now in Africa and Mexico and in South America. So this is a problem.

I don't like the term endangered river. This is a very controlled river, and we have to mention it that way, but we cannot say that we will return the river to the way it was at the beginning of the relationship.

Then they ask Mike and myself: If there would be an ecological quota, where would we have to discharge it? And I think that Michael has something to say.

MIKE CLINTON: Maybe we would have to divide that ecological use into sections. My suggestion would be that we should always explore first to use the existing infrastructure.

The work we have done suggests that protecting the existing habitat resource in the main stem corridor below Morelos Dam, all the way down to the Cocopah complex, is a very important purpose here in the near term, while we seek knowledge to determine what is needed in a longer term.

Also, I see another purpose and reason for this work. We've talked this morning about the need for additional research to know how much water is needed, how different kinds of water quality can be used. I would propose and suggest that if we are able to build a consensus among the parties on both sides of the border that some interim water supplies should be provided for this period in the next three to five years, a part of that water resource ought to be used to validate the research work that's going on by people such as Mark Briggson habitat restoration and possibly on shrimp farming in the Delta.

A laboratory without any equipment is not very useful. The equipment for understanding how this Delta operates is water. During this next interim period, three, five years, I think the use of this water ought to be first to protect the existing habitats and secondly, to support the research work that's needed. This is a very high calling and very important to all of us.

CLOSING REMARKS

FRANCISCO BERNAL RODRÍGUEZ INTERNATIONAL BOUNDARY AND WATER COMMISSION, MEXICAN SECTION:

On behalf of the Mexican delegation, here is a summary of a document that outlines the actions developed by the delegation based on the presentations, poster content and questions asked by participants at the symposium.

The Delta and Upper Gulf have been acknowledged as important ecosystems due to their biodiversity and the presence of endemic species, some of which are in danger of extinction. Existing water treaties do not include the environment as a user of water from the Colorado River Basin. This should be taken into consideration during decision-making processes and during studies by the governments, scientists, academia and NGOs of both countries. Additional studies by the fourth bi-national technical group, to be coordinated by the IBWC should address the following:

- Implement specific restoration sites immediately;
- Identify measures in both countries to re-establish a water source to maintain and sustain riparian areas;
- Identify native vegetation in riparian areas and wetlands;
- Quantify the relations between fresh water flows in the Delta and the aquatic species in the Gulf;
- Explore opportunities for ecotourism;
- Explore creating a new research center related to aspects of the Lower Colorado River Basin and the Upper Gulf;
- Both governments would be committed to contributing volumes of water to protect and restore the Delta ecosystem;
- Promote conservation and efficient water use in the agricultural, urban and indus-

- trial sectors and apply some of the conserved water to environmental purposes;
- Promote the transfer of state-of-the-art technology, both countries would adapt principals with unilateral actions;
- Continue bi-national efforts to determine the use and quality of the water necessary, the scope of the region, and the engineering and operational aspects of supplying the water, needed to sustain the Delta ecosystem. This should include participation from scientists, academia and NGO's;
- Obtain a comprehensive view of environmental problems in the region;
- Promote the financial support, in both countries, of environmental studies of the Delta and include bilateral and trilateral institutions with expertise;
- Promote water recycling in urban areas and evaluate the possibility of channeling the water to Delta wetlands;
- Strengthen was quality monitoring and adopt legal water quality framework for water ascribed to the Delta;
- The potential for federal, state and local entities to work together to acquire water rights for environmental purposes;
- The Delta should be considered within the Interim Surplus Guidelines currently being implemented in the U.S.;
- Technically and financially support institutions and organizations currently working in the Delta;
- Finally, to increase public participation on both sides of the border through NGOs, academia and specifically, communities in the Delta and form a coalition of interested organizations.

BOBBY YBARRA INTERNATIONAL BOUNDARY AND WATER COMMISSION, U.S. SECTION:

With respect to the comments concerning community participation, it is a main stay of the work done in the U.S. and though not always to everyone's satisfaction, it is a main stay.

The symposium had objective developed through a six-month process that involved the agencies mentioned by Francisco Bernal. It involved non-governmental organizations and academic organizations. The idea was to provide information to expert stakeholders and decision-makers, concerning the Delta.

The intent was to educate as many of those far away from the border that have little knowledge of the Delta as possible so they would know the impacts on the Delta and what Delta restoration would be like. This is being done in the context of an international agreement that is a long-term process. The results will not be immediate but to create a framework of international cooperation is an important accomplishment.

I would like to thank everyone involved and to recite the objectives of why we are here and in recognition of the respective governments' interest in the preservation of the riparian ecology of the Delta:

- To improve the knowledge base of the expert stakeholders, decision-makers on institutional and legal matters (first panel), water conveyance and distribution (second panel), and as was seen today, ecological and scientific studies;
- And to identify the water needs for the Colorado River Delta and the obstacles in the way of meeting those needs.

On the U.S. side, the partnership will involve academics, the non-governmental community; the Department of Interior with all of its agencies – the Bureau, Fish and Wildlife – and others including the U.S. International Boundary and Water Commission and the Department of State.

To do this will require a great deal of consensus. As Under Secretary of Water Resource Bennett Raley said in his opening remarks that he would like this partnership to adhere to five principals – recognize the river as bi-national; have respect for the sovereignty of both countries; enhance community participation; and identify data gaps; and identify a solution based on solid science.

There are no immediate solutions. It takes time and work.

The planning group is invited to volunteer their efforts again to support the IBWC, Department of Interior, to help organize the next workshop on some of the more specific areas that need further identification.

GUILLERMO TORRES MOYE AUTONOMOUS UNIVERSITY OF BAJA CALIFORNIA:

When Francisco Bernal discussed the possibility that the Autonomous University of Baja California could be the headquarters for a symposium like this, for a meeting of great importance to the Delta, the president accepted. People of Baja California should become involved in these open, participative processes in order to re-establish healthy environmental conditions on the Colorado River.

Robert Ybarra and Francisco Bernal mentioned the objectives covered in this meeting and the manner in which to carry them out. Some issues were left in the air, but this is only the beginning.

The symposium opens doors so that Americans and Mexicans can start establishing the scientific arguments that can be used as elements for negotiations to restore a sustainable Colorado River Delta involving community participation.

The symposium, at 1:45 p.m. on September 12, 2001, is formally concluded. Congratulations to the organizers and thank you for coming. ■

ATTENDEE APPENDIX

Due to the events of September 11, 2001 in the United States, a complete and accurate attendee list from the symposium was not entirely possible. The following is the most thorough attendee list available.

The Hon. Wayne Allard

U.S. Senator
Washington, D.C.

Lloyd Allen

Board Member
Imperial Irrigation District
Calipatria, CA

D. Larry Anderson

Director
Utah Division of Water Resources
Salt Lake City, UT

Susan Anderson

The Nature Conservancy
Tucson, AZ

Lorenzo Arriago

Bureau of Reclamation
El Paso, TX

Joseph Babb

U.S. Embassy, Mexico City
Laredo, TX

Scott M. Balcomb

Balcomb & Greene, P.C.
Glenwood Springs, CO

Jack Barnett

Executive Director
Colorado River Basin Salinity Control Forum
Bountiful, UT

Doug A. Barnum

Salton Sea Science Office
La Quinta, CA

Mary Belardo

Chairwoman
Torres Martinez Desert Cahuilla Indians
Thermal, CA

The Hon. Robert Bennett

U.S. Senator
Washington D.C.

Mike Besson

Administrator
Wyoming Water Development Commission
Cheyenne, WY

Jane Bird

Assistant to Executive Director & General Council
Upper Colorado River Commission
Salt Lake City, UT

Sharon Blackwell

Deputy Commissioner, Bureau of Indian Affairs
Washington, D.C.

Charlie Blasingame

La Plata Conservancy District
La Plata, NM

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