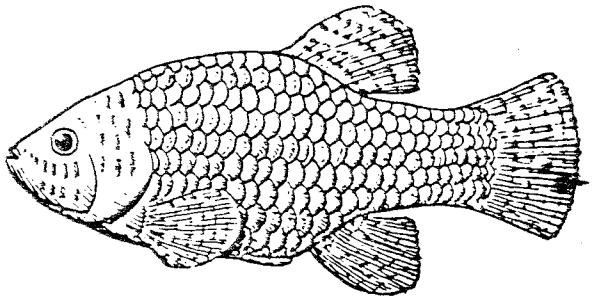
Desert Fishes Council



"Dedicated to the Preservation of America's Desert Fishes"

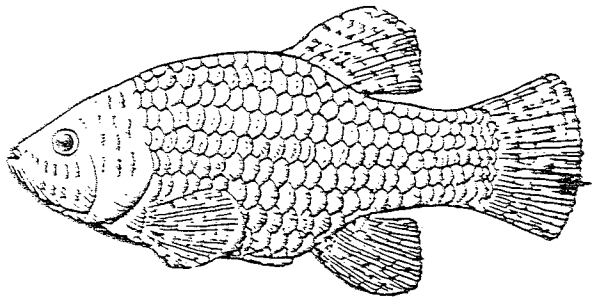
Proceedings of the Desert Fishes Council

VOLUME XIX

Edited by
Edwin P. Pister

The Nineteenth Annual Symposium

Desert Fishes Council



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The Nineteenth Annual Symposium

Produced in cooperation with the University of Nevada, Las Vegas

Desert Fishes Council
407 West Line Street
Bishop, California 93514

November, 1987

TABLE OF CONTENTS

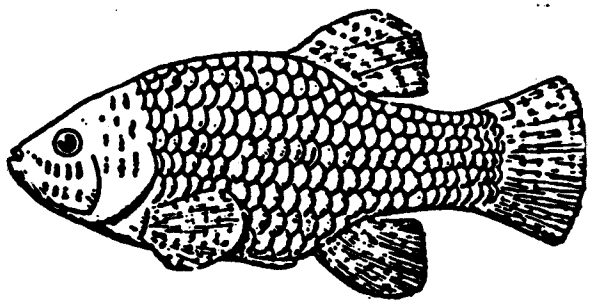
FOREWORD

For the third time since 1980, the Council met in México, this time at El Centro Ecológico de Sonora in Hermosillo. It was generally agreed that the Nineteenth Annual Symposium was the most successful in its history. Of 84 registrants, 28 were Mexican scientists or students, and of 27 universities and research institutions, 10 were from Mexico. Fifty technical papers were presented, and 17 were from Mexican students and researchers traveling from as far as Cancun in the Yucatan Peninsula, México City, Baja California, and Nuevo León. Both student paper awards were won by Mexican nationals. The Carl L. Hubbs Award, for the best student paper, was won by Francisco Abarca, a graduate student at Arizona State University. The Frances Hubbs Miller Award, for the best paper presented by a Mexican student, was awarded to Carlos Chávez Toledo of La Escuela Superior de Ecología, Hermosillo. Abstracts of both papers are included in these Proceedings. The formation of a Mexican Ichthyological Society in 1987, with its first meeting held in La Paz, B.C.S., in November, 1988, will do much to expedite ongoing efforts to preserve native fishes within Mexico.

Scientists from both nations work together toward a common goal of preserving aquatic ecosystems and their associated life forms throughout the North American Continent, with minimum emphasis placed on the political boundaries which our flora and fauna did very well without until Man's very recent appearance. It is upon this philosophical foundation that the Council continues to build as it approaches the end of its second decade.

Phil Pister
Bishop, California
10 November, 1988

EL CONSEJO DE LOS PECES DEL DESIERTO



"DEDICADO A LA PRESERVACION DE LOS PECES DE LOS DESIERTOS DE AMERICA"

DECIMONOVENO SIMPOSIO ANUAL

NINETEENTH ANNUAL SYMPOSIUM

HOLIDAY INN - HERMOSILLO

CENTRO ECOLOGICO DE SONORA
HERMOSILLO, SONORA, MEXICO
12-14 NOVIEMBRE, 1987

RESUMEN DEL PROGRAMA

JUEVES, 12 NOVIEMBRE. INTRODUCCION Y SIMPOSIO DEL DESIERTO SONORA

0800–1200	Registro
0900–0915	Introducción
0915–1000	Informes por representativos gubernativos
1000–1030	Trabajo 1
1030–1045	Intermisión
1045–1205	SIMPOSIO DEL DESIERTO SONORA
	Presidenta: Oc. Lourdes Juárez Romero, Centro Ecológico de Sonora
	Trabajos 2–5
1205–1330	Almuerzo
1330–1530	Trabajos 6–11
1530–1550	Intermisión
1550–1710	Trabajos 12–15
	Resumen y anuncios
1930	Banquete: Cafe Xochimilco
	Discurso de apertura: "Una aplicación poco común de la biología de conservación" - Phil Pister, California Departamento de Pesca y Caza y Secretario Ejecutivo del Consejo de los Peces del Desierto

VIERNES, 13 NOVIEMBRE. SIMPOSIO: EL CONTROLAR DEL HABITAT Y COMUNIDAD DE LOS PECES

Presidente: Dean Hendrickson, Arizona Departamento de Caza y Pesca

0800–1000	Trabajos 16–21
1000–1020	Intermisión
1020–1200	Trabajos 22–26
1200–1330	Almuerzo
1330–1450	Trabajos 27–30
1450–1510	Intermisión
1510–1600	Trabajos 31–32 y resumen
1600–1800	Trabajos variados
	Presidente: Salvador Contreras Balderas, Universidad Autónoma de Nuevo Le
	Trabajos 33–38
1800–2000	Comida
2000–2100	Sesión de negocios

SABADO, 14 NOVIEMBRE. TRABAJOS VARIADOS

Presidentes: Francisco Abarca y Mike Douglas, Universidad del Estado de Arizona, Tempe

0800-1000	Trabajos 39-44
1000-1020	Intermisión
1020-1140	Trabajos 45-48
1140-1200	Resumen del Simposio XIX
1200-1300	Almuerzo
1300	Excursion científica al Centro Ecológico de Sonora

NOTA PARA LOS PARTICIPANTES

Por los aspectos bilingues del simposio de éste año, es preciso que cada participante adhiera estrictamente a su tiempo: 20 minutos, incluyendo el período de discusión.

El manuscrito o resumen que remita va hacer usado como el original para reproducción. Con el interés de la uniformidad, por favor adhierase lo más cerca posible a la siguente guía: Usar una máquina de escribir Elite y una cinta nueva, el escrito se debe hacer en una hoja 8½ x 11, bond con los márgenes 1 1/8 pulgadas arriba y abajo, una pulgada del lado izquierdo, 7/8 de pulgada del lado derecho, espacio simple con doble espacio entre los párrafos; párrafos indentados 6 espacios. Por favor numere los hojas con lápiz. Las últimas hojas serán escritas después de que se manden a imprimir. Las fotografías no se aceptan actualmente, pero las gráficas y dibujos en negro y blanco pueden ser usadas sí se necesitan. La perfección del material que remite es su responsabilidad, revise su trabajo con cuidado; los resumenes deben estar en español e inglés.

Because of the bilingual aspects of the symposium this year, it is necessary that each participant adhere strictly to his time: 20 minutes, including the discussion period.

The manuscript or abstract you submit will be used as the original for reproduction. In the interest of uniformity, please adhere as closely as possible to the following guidelines: Use a typewriter with elite type and a new ribbon; typing to be done on 8½ x 11 bond paper with margins of 1 1/8 inches top and bottom, 1 inch on left side and 7/8 inch on right side; single spacing with double space between paragraphs; paragraphs indented 6 spaces. Please number pages in pencil. The final page numbers will be typed in after all papers are assembled for printing. Photographs are not acceptable, but graphs and drawings in black and white may be used. Perfection of the material you submit is your responsibility, so be sure to check your work carefully. Abstracts and papers are to be submitted in both English and Spanish.

Papeles, resumenes y consultas que conciernan al Desert Fishes Council y sus simposios y actividades deben ser dirigidas a:

Papers, abstracts, and inquiries concerning the Desert Fishes Council and its symposia and activities should be directed to:

E. P. Pister, Executive Secretary
Desert Fishes Council
407 West Line Street
Bishop, California 93514
Phone: (619) 872-1171

epp 11/22/75

Jueves, 12 Noviembre, 1000-1205

1. Public views on the conservation and protection of desert fishes, especially endangered species - a group discussion. Stephen R. Kellert, Yale School of Forestry and Environmental Studies, New Haven, Connecticut.

2. Seasonal and diel patterns of feeding in loach minnows (Tiaroga cobitis Girard). Francisco Abarca, Arizona State University, Tempe.

3. Notas sobre desarrollo larval del charalito Yaqui, Gila purpurea (Girard), en condiciónes de laboratorio. Alejandro Varela, Centro Ecológico de Sonora, Hermosillo.

4. Geographic variation in morphology of Sonoran Poeciliopsis o. occidentalis. M.E. Douglas, Arizona State University, Tempe; and R.C. Vrijenhoek, Rutgers University, Piscataway, N.J.

5. Status of the endangered (?) Gila topminnow (Poeciliopsis o. occidentalis) in North America. Lee H. Simons, Arizona Game and Fish Department, Phoenix.

Jueves, 12 Noviembre, 1330-1530

6. Interactions between Poeciliopsis occidentalis sonoriensis and Gambusia affinis at San Bernardino National Wildlife Refuge. David Galat, Arizona State University, Tempe; and Ben Robertson, U.S. Fish and Wildlife Service, San Bernardino National Wildlife Refuge.

7. Informe preliminar sobre estatus de la íctiofauna del Río Aros, subcuenca del Río Yaqui, Sonora. Jose Rafael Campoy, Lourdes Juárez Romero, y Alejandro Varela, Centro Ecológico de Sonora, Hermosillo; y Dean Hendrickson, Arizona Departamento de Caza y Pesca, Phoenix.

8. Reporte preliminar sobre los peces de la cuenca de los ríos Sonoyta y Bajo Colorado, con observaciónes sobre las poblaciónes del pupo del desierto (Cyprinodon macularius) en Sonora, México. Alejandro Varela, Lourdes Juarez Romero, y Jose Rafael Campoy, Centro Ecológico de Sonora, Hermosillo; y Dean Hendrickson, Arizona Departamento de Caza y Pesca, Phoenix.

9. Status of endangered fishes at Buenos Aires National Wildlife Refuge and Arizona State University Research Park, Arizona. Paul Marsh, Arizona State University, Tempe.

10. Trophic ecology of San Pedro Mártir trout (Parasalmo gairdneri nelsoni) relative to winter-spring conditions. Patricia Cota Serrano y Gorgonio Ruiz Campos, Escuela Superior de Ciencias, Universidad Autónoma de Baja California, Ensenada.

11. Aspects of age and growth of San Pedro Mártir trout (Parasalmo gairdneri nelsoni) populations from Baja California, Mexico. Javier Gomez Ramirez y Gorgonio Ruiz Campos, Facultad de Ciencias Marinas, Universidad Autónoma de Baja California, Ensenada.

Jueves, 12 Noviembre, 1550-1710

12. Recent studies of the San Pedro Mártir trout (Parasalmo gairdneri nelsoni) in Baja California. Gorgonio Ruiz Campos, Facultad de Ciencias Marinas, Universidad Autónoma de Baja California, Ensenada.

13. Avances del proyecto de investigación sobre la totoaba (Totoaba macdonaldi), pez endémico del Golfo de California. Lourdes Juárez Romero, J. Carlos Barrera, Adriana Zayas, y Marta Roman, Centro Ecológico de Sonora, Hermosillo.

14. Proyecto de investigación sobre la biología reproductiva de un pez marino del desierto en peligro de extinción, la totoaba (Totoaba macdonaldi). Lloyd Findley, Escuela de Ciencias Maritimas y Alimentarias, Instituto Tecnológico y de Estudios Superiores de Monterrey, Guaymas, Sonora.

15. Growth and survival of razorback suckers (Xyrauchen texanus) raised in ponds. Diana Papoulias, Arizona State University, Tempe.

16. Desert fish management in the year 2000 - where do we want it to be, and how will we get it there? Dean Hendrickson, Arizona Game and Fish Department, Phoenix.

17. Regional monitoring to minimize effects of introduced species. Donald W. Sada, University of Nevada, Reno.

Viernes, 13 Noviembre, 0800-1100

18. Monitoring exotic fish populations in desert aquatic ecosystems. Walter R. Courtenay, Jr., Florida Atlantic University, Boca Raton.

19. Deterministic and stochastic events affecting natural population changes in the Borax Lake chub, Gila boraxobius. Cathy Macdonald, The Nature Conservancy, Portland, Oregon; and Jack B. Williams, University of California, Davis.

20. Composition changes in fish communities in eastern Mexico. Reynaldo Perez Bernal, Salvador Contreras Balderas, y Lourdes Lozano Vilano, Universidad Autónoma de Nuevo León, Monterrey, N.L.

21. Monitoring of the Gila River Basin fish communities. David L. Propst, New Mexico Department of Game and Fish, Santa Fe; and Kevin R. Bestgen, University of New Mexico, Albuquerque.

22. Species introductions and changes in the fish fauna of the Pecos River, New Mexico. Kevin R. Bestgen and Steven P. Platania, University of New Mexico, Albuquerque; David L. Propst, New Mexico Department of Game and Fish, Santa Fe; and James E. Brooks, U.S. Fish and Wildlife Service, Dexter, N.M.

23. Evaluating instream flow needs of Colorado squawfish, Ptychocheilus lucius. Harold Tyus, U.S. Fish and Wildlife Service, Vernal, Utah.

Viernes, 1100-1200

24. Habitat suitability index curves for endangered fishes of Upper Colorado River Basin. Rich Valdez and Paul Holden, Bio/West, Logan, Utah.

25. Critique of biological aspects of instream flow incremental methodology. Eugene O. Maughan, University of Arizona, Tucson; and Paul Barrett, U.S. Fish and Wildlife Service, Phoenix.

26. Heritage methodology and its role in fish community and habitat monitoring. Darlene McGriff, California Department of Fish and Game, Sacramento.

Viernes, 13 Noviembre. 1330-1600

27. Monitoring contaminant residues in Southwestern aquatic habitats. William Kepner, U.S. Fish and Wildlife Service, Phoenix.

28. Peces cavernícolas en peligro de extinción en la península de Yucatan: problemas metodológicos para el estudio de su biología y ecología. Navarro-Mendoza M., Centro de Investigaciónes de Quintana Roo, Cancún, Q. Roo, Mexico.

29. Rise to the Future - the U.S.D.A. Forest Service National fisheries program. Glen Contreras, U.S.D.A. Forest Service, Washington, D.C.

30. Habitat preferences of several native Gila River cyprinids, using instream flow incremental methodology. Carl Couret, U.S. Fish and Wildlife Service, Albuquerque, N.M.

31. Recent invasion of red shiner (Notropis lutrensis) in the Virgin River, Utah, and its impact on the woundfin (Plagopterus argentissimus) and Virgin River chub (Gila robusta seminuda). Terry Hickman, St. George, Utah.

32. Physical habitat utilization in a Sonoran Desert stream, Aravaipa Creek. John N. Rinne, Forestry Science Laboratory, Arizona State University, Tempe.

Viernes, 13 Noviembre. 1600-1740

33. Aspectos distribucionales y ecológicos de los peces del Alto Lerma, subcuenca del Río Lerma (México). Carlos Chavez Toledo, Escuela Superior de Ecología, Hermosillo, Sonora, México.

34. Status of recovery efforts for Colorado River fishes. John Hamill, U.S. Fish and Wildlife Service, Denver, Colorado.

35. Effects of high temperature on reproductive behavior and physiology of Cyprinodon nevadensis amargosae. Robert Feldmeth, Joint Science Center, Claremont Colleges, Claremont, CA.

36. The illusion of technique and fisheries management. Robert Behnke, Colorado State University, Fort Collins.

37. Evolutionary relationships among inland pupfishes of the Cyprinodon variegatus complex. Tony and Alice Echelle, Oklahoma State University, Stillwater, and Dexter National Fish Hatchery, N.M.

38. Population size and future prospects for razorback sucker (Xyrauchen texanus) populations in the Green River Basin. Steve Lanigan and Harold Tyus, U.S. Fish and Wildlife Service, Vernal, Utah.

39. Fish fauna of lower Río Salado (Rio Bravo basin), northeastern Mexico. Maria Elena Limón Luna y Salvador Contreras Balderas, Universidad Autónoma de Nuevo León, Monterrey, N.L.

40. Status of the White Sands pupfish (Cyprinodon tularosa) in New Mexico. Paul Turner, New Mexico State University, Las Cruces.

41. Observations of Gila cypha on the Little Colorado River. C.O. Minckley, Flagstaff, Arizona.

42. Osteological comparison of Cyprinodon atrorus and Cyprinodon bifasciatus. II. Syncranium. Jesus Chavez Ortega, Salvador Contreras Balderas, y Lourdes Lozano Vilano, Universidad Autónoma de Nuevo León, Monterrey, N.L.

43. Fish fauna of Río Sabina (upper Río Salado and Río Bravo basin). Graciela P. Arocha Gomez y Salvador Contreras Balderas, Universidad Autónoma de Nuevo León, Monterrey, N.L.

44. Distribution and capture-recapture rates of the native suckers of the San Juan River, New Mexico. Stephen P. Platania and Kevin R. Bestgen, University of New Mexico, Albuquerque; David L. Propst, New Mexico Department of Game and Fish, Santa Fe; and James E. Brooks, U.S. Fish and Wildlife Service, Dexter, New Mexico.

45. Notas sobre los restos óseos de las ofrendas del Templo Mayor y algunos comentarios. Edmundo Teniente Nivon, Universidad Nacional Autónoma de México, México, D.F.

46. Variation in age, growth, and reproduction of Gila trout (Salmo gilae) in headwater streams of New Mexico. James Nankervis, Paul Turner, and Patrick Van Eimeren, New Mexico State University, Las Cruces.

47. Status of, and recovery actions for, the Railroad Valley springfish, Crenichthys nevadae. Randy McNatt, U.S. Fish and Wildlife Service, Reno, Nevada.

48. Fishes of the Río Conchos Basin of the Río Bravo. Hector Leal Sotelo y Salvador Contreras Balderas, Universidad Autónoma de Nuevo León, Monterrey, N.L.

DISCURSO DE INAUGURACION DE LOS TRABAJOS DEL XIX SIMPOSIO DE LOS PECES DEL DESIERTO.

REPRESENTANTE GUBERNAMENTAL:

ING. CESAR SILVA GOMEZ
SECRETARIO DE INFRAESTRUCTURA
Y DESARROLLO URBANO.

Hermosillo, Sonora, 12-14 de Noviembre de 1987.

SEÑORES CONVENCIONISTAS:

ANTES QUE NADA RECIBAN USTEDES UN AFECTUOSO SALUDO DEL SR. GOBERNADOR DEL ESTADO, ING. RODOLFO FELIX VALDES QUIEN ME ENCOMENDO ASISTIR EN SU NOMBRE A ESTE -- IMPORTANTE EVENTO QUE REUNEN A LOS ESTUDIOSOS DE LOS PECES EN GENERAL, Y DE MANERA PARTICULAR A AQUELLOS QUE HABITAN EN LOS DESIERTOS DEL MUNDO.

ME VOY A PERMITIR HACER, AUNQUE MUY SINTETICAMENTE, UNA REFLEXION SOBRE UN TEMA QUE USTEDES BIEN MANEJAN PERO QUE SIN EMBARGO, NUNCA ESTA DE MAS RECORDARLO, ME REFIERO CONCRETAMENTE A LA NECESIDAD DE CONSERVAR Y PROTEGER NUESTROS RECURSOS- NATURALES Y ESPECIFICAMENTE LOS RECURSOS BIOTICOS, NO SOLO POR LA IMPORTANCIA - QUE ESTOS REVISTEN EN EL DESARROLLO ECONOMICO, SINO TAMBIEN POR SU IMPORTANCIA- EN MANTENER EL EQUILIBRIO DE LA NATURALEZA Y COMO PARTE INTEGRANTE DEL PATRIMONIO NATURAL Y CULTURAL DEL MUNDO ENTERO. TODOS SABEMOS QUE LA BIOTA ES UN RECURSO NATURAL RENOVABLE, PERO TAMBIEN DEBEMOS ESTAR CONCIENTES QUE SU RENOVACION - SE DARA EN LA MEDIDA EN QUE EXISTAN LAS CONDICIONES NATURALES QUE GARANTICEN ESTE PROCESO REPRODUCTIVO; SIN EMBARGO SON ESTAS CONDICIONES NATURALES LAS QUE -- CONSTANTEMENTE SON OBJETO DE CAMBIOS DRASTICOS POR LA INFLUENCIA DE LA ACTIVI-- DAD HUMANA, LO QUE HA OCASIONADO LO QUE ACTUALMENTE CONOCEMOS POR "CRISIS ECOLOGICA" QUE SE EXPRESA FUNDAMENTALMENTE, POR UN LADO, EN GRAVES PROBLEMAS DE CONTAMINACION DE AIRE, AGUA, SUELO Y; POR EL OTRO, EN UNA PERDIDA PAULATINA DE RECURSOS GENETICOS ENCONTRANDOSE UN GRAN NUMERO DE ESPECIES VEGETALES Y ANIMALES- YA EXTINTOS, OTROS MAS QUE SON VULNERABLES O ESTAN SERIAMENTE AMENAZADOS PERO - AUN MAS PREOCUPANTE ES EL HECHO DE QUE DESCONOCEMOS EL ESTADO ACTUAL REAL Y TENDENCIAS DE LA INMENSA MAYORIA DE LAS POBLACIONES DE FLORA Y FAUNA SILVESTRES.

LAS CAUSAS TAMBIEN TODOS LAS CONOCEMOS...., LAS MODIFICACIONES DE LOS HABITAT - NATURALES Y TAMBIEN LA CONTAMINACION.

LAS ESPECIES DE AGUA DULCE Y DE MAR NO SON LA EXCEPCION A ESTAS TENDENCIAS. LAS PERTURBACIONES MATERIALES (-CONSTRUCCIONES HIDRAULICAS-) Y LA CONTAMINACION POR SALES, ACIDOS, PLAGUICIDAS Y OTROS QUIMICOS TOXICOS AFECTAN PROFUNDAMENTE LOS - ECOSISTEMAS DE AGUA DULCE EN TODO EL MUNDO.

ESTA SITUACION ES AUN MAS DRAMATICA EN RELACION A LA ICTIOFAUNA DE LOS DESIER-- TOS POR LA FRAGILIDAD QUE CARACTERIZA A ESTOS ECOSISTEMAS.

LA NECESIDAD DE REDOBLAR ESFUERZOS PARA DEFINIR ESTRATEGIAS QUE PERMITAN SALVAGUARDAR ESTOS RECURSOS NO SOLO POR RAZONES MERAMENTE ECONOMICAS, SINO TAMBIEN - POR LAS DE CARACTER CULTURAL, QUE PUEDEN SER AUN MAS IMPORTANTES, ES UNA PRIORIDAD DE PRIMER ORDEN QUE DEBE SER CONSIDERADA EN LA INSTRUMENTACION DE TODAS LAS ACCIONES DEL SECTOR PUBLICO. DEBIDO AL CARACTER MULTISECTORIAL DE LA ECOLOGIA.

SEÑORES CONVENCIONSITAS:
ESTE ES UN TEMA QUE USTEDES SEGURAMENTE DISCUTIRAN CON AMPLITUD Y PROFUNDIDAD Y SEGURAMENTE SUS CONCLUSIONES CONTRIBUIRAN EN LA DEFINICION DE MECANISMOS Y ESTRATEGIAS VIABLES QUE GARANTICEN LA CONSERVACION Y PRESERVACION DE LOS DIVERSOS ECOSISTEMAS EN GENERAL Y PARTICULARMENTE DE LOS RECURSOS BIOTICOS.
ESPERAMOS QUE LAS JORNADAS QUE HOY INICIAN SEAN FRUCTIFERAS Y CULMINEN CON EXITO. EN ESTE ORDEN, SIENDO LAS 9:30 HRS. DEL DIA 12 DE NOVIEMBRE DE 1987, ME PERMITO A NOMBRE DEL SR. GOBERNADOR DECLARAR INAUGURADOS LOS TRABAJOS DEL SIMPO-- SIO SOBRE LOS PECES DEL DESIERTO.

UNA APLICACION POCO COMUN DE BIOLOGIA DE CONSERVACION

E. P. Pister, Departamento de Pesca y Caza de California y
Secretario Ejecutivo del Concilio de Peces del Desierto

En 1931, a cambio de 25,000 huevos de trucha dorada (Salmo aguabonita), el Departamento de Pesca y Caza de California recibío de la División de Fauna Silvestre de Colorado 30,000 huevos de trucha garganta cortada (Salmo clarki pleuriticus). Estos peces fueron criados cuidadosamente y sembrados in tres lagunas esteriles entre 3,414 y 3,600 metros de altura en la parte sur de la Sierra Nevada en el este de California.

Ahora, Colorado duda la pureza genética de sus poblaciones de Salmo clarki pleuriticus. Por eso, en un trabajo conjunto entre División de Fauna Silvestre de Colorado, Servicio de Pesca y Fauna Silvestre de E.U., y Parque Nacional de Rocky Mountain, la cuenca de Bench Lake (Ptarmigan Creek) en Parque Nacional de Rocky Mountain fue preparado a recibir una población trasladado de trucha garganta cortada de California. Este trabajo describe el traslado llevado a cabo en Agosto de 1987. La colecta y transporte de los peces a Colorado fue por esfuerzo colaborativo entre Bosque Nacional Inyo, los Parques Nacionales de Sequoia y Kings Canyon, y el Departamento de Pesca y Caza de California. El Concilio de Peces del Desierto coordinó el proyecto, y participaron siete de sus miembros.

AN UNUSUAL APPLICATION OF CONSERVATION BIOLOGY

E. P. Pister, California Department of Fish and Game and Executive Secretary, Desert Fishes Council, Bishop, California 93514.

In 1931, in exchange for 25,000 eggs of the California golden trout (Salmo aguabonita), the California Department of Fish and Game received from the Colorado Division of Wildlife 30,000 eggs of the Colorado River cutthroat trout (Salmo clarki pleuriticus Cope). These fish were given special attention at the Mt. Whitney State Fish Hatchery and were planted in three isolated and barren lakes ranging in elevation from 3,414 to 3,600 meters in the southern Sierra Nevada. Because Colorado now questions the purity of certain of its native cutthroat trout stocks, plans were made to move a brood stock from California back into barren headwater areas of the Colorado River in Rocky Mountain National Park. This paper describes various aspects of this successful relocation, which occurred in August, 1987 and involved the cooperative efforts of several state and federal agencies and university researchers.

THE DEPARTAMENT OF HERPETOLOGY FROM CENTRO ECOLOGICO DE SONORA:

ITS OBJECTIVES AND ADVANCES:

María Cristina Meléndez T., Carlos Castillo S. y Guillermo Lara G.
Departamento de Herpetología del Centro Ecológico de Sonora, Apdo. Postal 1497, Hermosillo, Sonora, México.

ABSTRACT:

The Department of Herpetology within the Centro Ecologico - de Sonora, has on objectives of research and ecological concerning - Sonoran State reptiles and ambhibians.

In reference to education, there is a permanent exhibition - of live organisms representing the different ecosystems of the - - State. It shows, in diorama form, seventeen reptiles and eleven -- amphibian species. Also, the department mantains in open exhibi-- tion ten species of reptiles, including snakes, saurids and testudines.

The department mantains a facility for the acclimation of - organisms to captivity, which provides specimens either for - - -- research programs or for educational needs. The department has --- theree principal research proyects:

1) The inventory of reptiles and amphibians of Sonora- State,
2) Sinecological study of terrestrial ecosystem of San Esteban, Island, Sonora, and
3) Autoecology and population dynamics of the Desert - Tortoise (Gopherus agassizi).

Te department is forming the most complete regional Herpetological collection in Mexico, and to date maintains 991 specimens- of 109 species and 129 forms or subspecies.

EL DEPARTAMENTO DE HERPETOLOGIA DEL CENTRO ECOLOGICO DE SONORA:

SUS OBJETIVOS Y AVANCES:

María Cristina Meléndez T., Carlos Castillo S. y Guillermo Lara G.
Departamento de Herpetología del Centro Ecológico de Sonora, Apdo. Postal 1497, Hermosillo, Sonora, México.

R E S U M E N:

El Departamento de Herpetología tiene como objetivo, dentro del Centro Ecológico de Sonora, la investigación y educación ecológica respecto a los reptiles y anfibios del Estado de Sonora.

- En lo referente a educación, cuenta con una exhibición permanente de organismos vivos, representantes de los diferentes ecosistemas del Estado. Se exhiben en forma de dioramas a 17 especies de reptiles y 11 especies de anfibios. Además, se mantienen en exhibiciones a descubierto a 10 especies de reptiles incluyendo serpientes, saurios y testudinidos. El Departamento cuenta con un herpetario para la adecuación de organismos al cautiverio, el cual es infraestructura básica tanto para las funciones de investigación como de educación. Se tienen 3 proyectos principales que son:

1) Los reptiles y anfibios de Sonora,

2) Estudio Sinecológico del ecosistema terrestre de la Isla de San Esteban, Sonora, y

3) Autoecología y dinámica de población de la Tortuga del Desierto (Gopherus agassizi).

Se esta integrando la más completa colección herpetológica regional, en México, para las especies de reptiles y anfibios del Estado de Sonora, se cuenta con 991 ejemplares de 109 especies y 129 formas (especies y subespecies).

" DEPARTAMENTO DE HERPETOLOGIA DEL CENTRO ECOLOGICO DE SONORA"

SUS OBJETIVOS Y AVANCES

El Departamento de Herpetología fue creado con el propósito de estudiar los reptiles y anfibios del Estado de Sonora. Dentro del marco general del Centro Ecológico de Sonora se tienen dos -- objetivos principales que son: la investigación y la educación.

Para cubrir lo referente a educación, se cuenta con una exhibición permanente de organismos vivos, representantes de los diferentes ecosistemas del Estado de Sonora. Se exhiben, en forma dedioramas a 17 especies de reptiles y 11 especies de anfibios. Asimismo, se mantienen en exhibiciones a descubierto 10 especies de reptiles incluyendo serpientes, saurios y testudinidos. Cada exhibición representa el habitat o microhabitat particular de la especie y cuenta con información básica sobre aspectos biológicos y - ecológicos de los organismos exhibidos. Además, en coordinación - con el departamento de Difusión se elaboran trabajos divulgativos sobre los reptiles y anfibios del Estado, con el objeto de -- concientizar a la población sobre la importancia ecológica de dichos organismos.

El Departamento cuenta con un Herpetario para la adecuación de organismos al cautiverio con aproximadamente 200 ejemplares, - el cual es infraestructura para las funciones tanto de educación- como de investigación. Cuenta también con una área protegida para la reproducción e investigación de la tortuga del desierto, - - - Gopherus agassizi y la Iguana de la Isla de San Esteban, Sauromalus varius.

En lo que respecta a Investigación se tienen 3 proyectos estratégicos que son:

1) Los reptiles y anfibios del Estado de Sonora

2) Estudio Sinecológico sobre el ecosistema terrestre de la Isla San Esteban, Sonora, y

3) Autoecología y Dinámica de población de la tortuga del - desierto (Gopherus agassizi)

En el primer proyecto, Los Reptiles y Anfibios de Sonora, a largo plazo, el objetivo central es: Inventariar los recursos herpetofaunísticos del Estado de Sonora, para lo cual se dividió al- Estado en 3 regiones fisiográficamente precisas con características particulares. Estas regiones son: La Sierra Madre Occidental- y sus estribaciones, la planicie costera del Pacífico y el Golfo de California e islas.

Un avance muy importante de este proyecto es la formación de la colección científica herpetológica regional, única en su tipo - en México para las especies de Sonora, que empezó a integrar desde 1984, cuyo objetivo principal es: Representar taxonómicamente al - contingente de especies de reptiles y anfibios del Estado de Sonora (continental e insular) a través de organismos preservados, sus partes, estadíos ó restos orgánicos u otro tipo de materiales con- fines científicos de investigación.

Actualmente (Noviembre, 1987) la colección cuenta con 991 -- ejemplares de 109 especies y 129 formas (especies y subespecies) - estando representada principalmente por organismos en alcohol.Las- colecciones de larvas, huevos, embriones, esqueletos, pieles, exu- vias y excretas son aún muy incipientes.

De acuerdo a las últimas monografías herpetofaunísticas pu-- blicadas para el Estado de Sonora (Smith and Taylor, 1945, 1958 y- 1950), esta colección contiene el 93.26% de las especies y el - -- 95.55% de las subespecies. Sin embargo, de acuerdo a datos no pu-- blicados de diversos autores y a las apreciaciones de Lara (inédi- to) representa solamente el 57.67% de las especies y 48.49 de las- formas. (Tabla 1 y 2)

Dentro de este proyecto la colección científica representa - el avance más significativo que se ha logrado, debido a la falta - de presupuesto y recursos humanos. Sin embargo, se cuenta con una- lista preliminar de 8 localidades del Estado representantes de 4 - ecosistemas del mismo.

Los resultados de este proyecto se integrarán en una monografía científica para el Estado de Sonora y en otra de carácter divulga- tivo.

Se presentó en el IX Congreso Nacional de Zoología, en la -- Ciudad de Villahermosa, Tab. del 13 al 16 de Octubre del presente- año un trabajo titulado: Notas acerca de una colección Herpetológi ca del Estado de Sonora.

Con respecto al segundo proyecto denominado: Estudio Sineco- lógico sobre el ecosistema terrestre de la Isla de San Esteban, So nora, son prácticamente pocos los avances logrados a la fecha. El- objetivo de este estudio es evaluar el ecosistema terrestre de la- Isla de San Esteban en términos de la estructura, composición y di námica de la comunidad de vertebrados.

Este estudio es un proyecto interdisciplinario que pretende- conjuntar los esfuerzos de las áreas de Entomología, Botánica,Vete rinaria (Maztozoología) Ornitología y Herpetología en la evalua- - ción de un ecosistema Sonorense único.

El Departamento de Herpetología presentó la propuesta de ante proyecto ante la Sub-Dirección de Investigación del Centro Ecológico y se espera la aceptación del mismo. Sin embargo, se tienen avances en el subproyecto titulado Autoecología y dinámica de poblaciones de la Iguana pinta, Sauromalus varius de la Isla San Esteban. Subproyecto que dentro de sus metas contempla la adecuación y reproducción de la Iguana de San Esteban, Sauromalus varius, en condiciones de cautiverio, en donde se tienen avances en dos aspectos: a) Comportamiento y organización social, b) Dimorfismo sexual.

a) Comportamiento y organización social de Sauromalus varius (Dickerson) (Reptilla, Sauria, Iguanidae) en condiciones de cautiverio.

Desde 1985 se mantiene un pequeño grupo social de 6 organismos (actualmente 4) . Las observaciones sobre comportamiento se registran desde Marzo de 1987 en un observatorio escondido detrás del exhibidor a descubierto que mantenemos para la especie. Hasta la fecha se han efectuado aproximadamente 300 horas de observación y se han detectado 67 pautas de comportamiento que se pueden agrupar en 5 categorías:

1) Exclusivamente individual
2) Exclusivamente comportamiento reproductivo
3) Individual, social ó antipredatorio
4) Exclusivamente social y
5) Social o antipredatorio

que se integran en un etograma y sociograma de la especie. Se han registrado comportamiento termorregulatorio, de descanso, de forrageo, agonístico, de dominancia, territorial, de cortejo, de anidación y de cuidado del nido, entre otros.

Con respecto a su organización social en cautiverio, se observó una jerarquía de dominancia de dos niveles ó despotismo.

Los datos se integrarán en una publicación científica especializada y en una tesis de Licenciatura en Biología de uno de los investigadores del Departamento .

b) Dimorfismo sexual en la iguana de San Esteban, Sauromalus varius.

Los resultados obtenidos de este estudio fueron dados a conocer en el Joint Annual Meeting, celebrado en Mocambo, Veracruz, del 9 al 15 de Agosto de 1987 y fueron los siguientes:

A diferencia de otros géneros de iguanidos que presentan características dimorfico sexuales, Sauromalus varius carece de - -- ellos. En los machos de esta especie no existen crestas, pliegues, escamas o patrones de coloración dorsal o ventral que los distin-- gan de la hembras. En este estudio se evaluaron 7 mediciones y 14 proporciones corporales a través del análisis estadístico de t student y correlaciones con curvas de ajuste por el método de mínimos cuadrados. Se encontraron diferencias significativas para 4 medi-- ciones y 3 proporciones corporales. Con base en estos 7 parámetros y el grado de desarrollo de los poros femorales es posible identificar con gran seguridad ($p \geq 0.975$) a los sexos en individuos adultos.

Con respecto al tercer proyecto titulado: Autoecología y dinámica de la población de la tortuga del desierto (Gopherus agassizi) el avance es mínimo; se presentó la propuesta ante el Arizona-Game and Fish Department con el fin de obtener apoyo económico para la realización de dicho proyecto, el cual pretende evaluar la - situación de las poblaciones de esta tortuga en el Estado de Sonora (continental e insular), así como el proponer medidas para su - adecuado manejo y conservación.

Dentro de este proyecto se pretende realizar estudios en - - cautiverio para lo cual se cuenta con 44 ejemplares de los que se lleva registro de alimentación, datos de comportamiento y biológicos adicionales. Actualmente se realizan observaciones para el establecimiento de un programa de manejo y adecuación de Gopherus -- agassizi en cautiverio, el cual servirá como tesis para la Licen-- ciatura en Biología de uno de los investigadores del Departamento y los datos se integrarán en una publicación científica especializada.

SMITH TAYLOR 1945 - 1848 - 1950						COLECCION CIENTIFICA (C.E.S.)						
	REPTILES		T	ANFIBIOS		T	REPTILES		T	ANFIBIOS		T
	SERPIENTES	SAURIOS Y TESTUDINOS		CAUDATA	ANURA		SERPIENTES	SAURIOS Y TESTUDINOS		CAUDATA	ANURA	
ORDENES			2	1	1	ORDENES			2	1	1	2
FAMILIAS	5	12	17	6	6	FAMILIAS	5	10	15	1	6	7
GENEROS	28	28	56	10	10	GENEROS	24	22	46	1	12	13
ESPECIES	41	55	96	20	20	ESPECIES	37	48	85	2	22	24
SUBESPECIES	47	68	115	20	20	SUBESPECIES	46	59	105	2	22	24

95.6% de las familias registradas para Sonora (reptiles y anfibios) con base en los registros de Smith y Taylor - -- (1945, 1948, 1950)

89.39% de los géneros registrados para Sonora (reptiles y anfibios) con base en los registros de Smith y Taylor - -- (1945, 1948, 1950)

93.26% de las especies registradas para Sonora (reptiles y anfibios) con base en los registros de Smith y Taylor - - (1945, 1948, 1950)

95.55% de las subespecies registradas para Sonora (reptiles y anfibios) con base en los registros de Smith y Taylor- (1945, 1948, 1950)

Tabla 1.- Comparación de los taxa representados en la colección del Centro Ecológico de Sonora y los reportados por- Smith y Taylor 1945, 1948, 1950.

Referencia	No. de especies	No. de formas	Estimación del total probable
Bogert and Oliver (1945)	111	124	180
Smith and Taylor (1945,1948,1950)	117	135	-
Loomis (1956)	129	156	-
Smith and Taylor (1966)	-	149	-
Frost (1980)	166	224	238
Smith and Taylor (1976)	-	337	-
Lara (inédito) en preparación	189	266	266
Colección científica C.E.S.	109	129	-

Tabla 2.- Comparación entre el número de especies y formas reportadas por diversos autores y lo que existe en la colección científica herpetológica del C.E.S.

SEASONAL AND DIEL PATTERNS OF FEEDING IN LOACH MINNOW (Tiaroga cobitis Girard)

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ABSTRACT.- Seasonal feeding patterns of the loach minnow, Tiaroga cobitis were investigated from June 1966 to May 1967 at Aravaipa Creek, Arizona. This study is completed with diel chronologies carried out on July and August 1987. Ephemeroptera nymphs (56.4%) were the most important food in stomachs of this fish followed by Diptera larvae (20.7%). Baetis spp. (30.3%) was the main and constant component of its diet. Several differences between males and females on feeding patterns were found. There were seasonal trends in dominant foods organisms eaten, with mayfly nymphs making up 70% in spring and early summer and lower than 10% in late summer and autumn. There was diel peridicity in feeding intensity with a peak in early morning and late afternoon. Feeding activity is decreased drastically during the night. T. cobitis habitat selection shows a strong relationship with its feeding behavior and relatively restricted food preferences.

RESUMEN,- Los patrones alimenticios temporales del loach minnow, Tiaroga cobitis, fueron investigados desde Junio de 1966 a Mayo de 1967 en Aravaipa Creek, Arizona. Este estudio es completado con periodos de 24 horas llevados a cabo en Julio y Agosto de 1987. Las ninfas de Ephemeroptera (56.4 %) fueron el alimento más importante en los estómagos de este pez, seguidos por larvas de Diptera (20.7 %). Baetis spp. (30.3 %) fué el componente principal y constante en su dieta. Algunas diferencias entre los patrones alimenticios entre machos y hembras de esta especie, fueron encontradas. Existieron varias tendencias estacionales en los alimentos dominantes consumidos, teniendo a las ninfas de efemerópteros con un 70% en Primavera y en principios de verano y un 10% en finales del Verano y del Otoño. Esta especie se alimenta principalmente por la mañana y parte de la tarde. Su actividad alimenticia es disminuida durante la noche. La selección de habitat por T. cobitis muestra una fuerte relacción con su comportamiento alimenticio.

NOTAS SOBRE EL DESARROLLO LARVAL DEL CHARALITO YAQUI Gila purpurea (GIRARD) BAJO CONDICIONES DE LABORATORIO.

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R E S U M E N

Con reproductores del Charalito Yaqui G. purpurea colectados en la cuenca del Río Mátape (Loc. 28°52' N y 110°15' O) y mantenidos en el Acuario de Investigación del Departamento de Ictiología e Invertebrados Acuáticos del Centro Ecológico de Sonora se presentan los estadios larvales protolarva, mesolarva y metalarva asi como juveniles de acuerdo a Snyder (1976a). Se muestran además 22 datos morfométricos y conteo total de miomeros de los diferentes estadios larvales y juveniles del Charalito Yaqui.

NOTES ABOUT THE LARVAL DEVELOPMENT OF THE YAQUI CHUB Gila purpurea (GIRARD) UNDER LABORATORY CONDITIONS.

A B S T R A C T

A brood stock of Yaqui Chub G. purpurea collected in the Río Mátape Basin (Loc. 28°52' N and 110°15' W) is being mantained in the Investigation Aquarium of the Ichthiology and Invertebrate Aquatics Departament of the Ecological Center of Sonora. This study illustrates the larval stages protolarvae, mesolarvae and metalarvae, as well as juveniles (Snyder, 1976a) of that species. Data for 22 meristic characters, as well as total myomere counts, are presented for each stage in the development of Yaqui chub.

STATUS OF THE ENDANGERED (?) GILA TOPMINNOW IN NORTH AMERICA

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and

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ABSTRACT--The Gila topminnow (Poeciliopsis occidentalis occidentalis) was once abundant in southern Arizona and western New Mexico, but was listed as endangered in the United States in 1967. A Recovery Plan was adopted in 1983 which directed that natural populations be recovered and new populations established within historic range. After 1987, however, downlisting and delisting criteria set by the Plan rely solely on success of reintroduced populations. Prior to 1982 topminnows were introduced to 92 sites -- 6 of which persisted in 1987. During and after 1982 introductions were made to 99 sites -- 29 of which persisted in 1987. Enough reintroduced populations persisted in 1987 to satisfy criteria for downlisting from endangered to threatened status. Reclassification was proposed by the U.S. Fish and Wildlife Service in Fall 1987.

Despite this success, the topminnow recovery effort faces several problems. 1) The quality and reliability of reintroduced populations is questionable, 2) many natural topminnow populations continue to slip toward extinction, and 3) 33 of 35 reintroduced populations originate from a single natural population, hence providing no protection for other natural populations threatened with extinction.

Future recovery efforts for Gila topminnow should strive to: 1) establish additional reintroduced populations in quality habitats, and 2) protect genetic diversity within the species through reintroductions of broodstock from different natural populations. Extant natural topminnow populations cluster in four geographic areas: Bylas Spring (San Carlos Apache Indian Reservation), Upper Santa Cruz River (San Rafael Valley), Sonoita Creek, and Cienega Creek. Electrophoretic data indicates that genetic differences exist between at least some of these areas. More detailed analyses, such as morphological or mitochondrial DNA characterizations, should assess the efficacy of managing natural topminnow populations within a geographic area as single historic lineages.

SITUACION ACTUAL DEL GILA TOPMINNOW, EN PELIGRO DE EXTINCION (?) EN AMERICA DEL NORTE

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RESUMEN--Gila topminnow (Poeciliopsis occidentalis occidentalis) fue en otro tiempo abundante en el sur de Arizona y oeste de New Mexico, pero desde 1967 fue incluido en la lista de recursos en peligro de extinción de los Estados Unidos. Un Plan de Recuperación (estrategia para recuperar la especie) fue aceptado en 1983, estableciendo que, poblaciones naturales del topminnow deben ser recuperadas y nuevas poblaciones deben ser creadas dentro de los limites históricos de la especie. Sin embargo, después de 1987, el criterio descrito en el Plan de Recuperación para cambiar el estado legal del pez (con respecto a la lista de recursos en peligro de extinción), depende unicamente en el éxito de las poblaciones reintroducidas. Antes de 1982 topminnows fueron introducidos en 92 localidades -- 6 de esás persistieron hasta 1987. Durante y después de 1982 se efectuaron introducciones en 99 localidades, -- 29 de esás persistieron hasta 1987. Para 1987 suficientes poblaciones introducidas habian persistido hasta poder cumplir con el criterio para cambiar el estado legal del topminnow de en peligro a amenazado. Una reclasificación fue propuesta por el Servicio de Pesca y Fauna Silvestre estadounidense en el otoño de 1987.

A pesar del exito, existen varios problemas con el trabajo para recuperar el topminnow. 1) La calidad y seguridad de las poblaciones reintroducidas es cuestionable, 2) varias poblaciones naturales de topminnow estan llegando al borde de la extincion y 3) 33 de 35 poblaciones reintroducidas fueron originadas de una sola población natural, por lo tanto no hay protección para las demás poblaciones naturales en peligro de extinción.

En lo futuro los trabajos para recuperar el Gila topminnow deben ocuparse de: 1) establecer más poblaciones reintroducidas en habitats de buena calidad y 2) proteger la diversidad genetica dentro de las especies por reintroducciones de pie de cria proveniente de poblaciones naturales. Las poblaciones naturales existentes se agrupan en 4 áreas geograficas: Bylas Spring (San Carlos Apache Indian Reservation), Sonoita Creek, y Cienega Creek. Resultados de análisis electroforéticos indican que hay diferencias genéticas entre algunas de esás áreas. Un análisis más detallado, por ejemplo morfológico ó caracterización de DNA mitocondrial, deben ayudar para evaluar la validez del manejo de las poblaciones naturales, a manera de un linaje historico, dentro de un área geográfica.

GALAT, D. L. and B. ROBERTSON. Department of Zoology, Arizona State University and San Bernardino National Wildlife Refuge, U. S. Fish & Wildlife Service.
Interactions between Poeciliopsis occidentalis sonoriensis and Gambusia affinis in the Rio Yaqui drainage, Arizona.

Coexistence of the Yaqui topminnow, Poeciliopsis occidentalis sonoriensis, with introduced mosquitofish, Gambusia affinis was investigated in the Rio Yaqui drainage, southeastern Arizona, USA. We compared average fecundity of P. o. sonoriensis from Black Draw (San Bernardino Creek), San Bernardino National Wildlife Refuge (SBNWR) with P. o. occidentalis from Monkey Spring because earlier studies had suggested P. o. sonoriensis carried larger broods. There were no significant differences in brood size between the two subspecies, except for P. o. sonoriensis over 40 mm standard length (SL).

There were no differences in average SL of female P. o. sonoriensis in March 1987 within or among cienegas (Bunting, Cottonwood and West Border Springs) or stream habitats (Leslie Ck. and Black Draw), but females were smaller in SBNWR ponds (North, Tule). Only P. o. sonoriensis from thermal habitats (cienegas and Black Draw at its source) carried broods in March 1987. Moreover, fecundity was greater at the two sites (West Border Spring and Black Draw, source) where G. affinis was present.

Topminnow body and ovary weights and fecundity for March 1986, nine months after reintroduction to Black Draw, source, were compared with March 1987, 21 months after reintroduction, to evaluate effects of time since colonization. There was a 40% decrease in average wet body weight and a 70% decrease in wet ovary weight between March 1986 and March 1987. Furthermore, mean fecundity decreased by 75% over the same period, from 82 to 21 mature ova and embryos.

Poeciliopsis o. sonoriensis persists in Black Draw and West Border Spring at SBNWR where it is syntopic with G. affinis. During the first year following invasion of G. affinis in Black Draw, source, P. o. sonoriensis comprised between 50 to 95% of six collections. At Black Draw, Mexican border, relative abundance of P. o. sonoriensis declined steadily from January 1986 (70% of total numbers) until July 1987 (0%). Abundance of topminnows increased following a moderate flood in August 1987 to 30 % of total numbers in September. Yaqui topminnows are rare in West Border Spring, ranging between 2 and 12% of total numbers. However, they have been present in all nine collections made between May 1985 and September 1987.

Average SL and wet body weight of P. o. sonoriensis and G. affinis in Black Draw, source were not significantly different in March or June 1987. Nevertheless, fecundity of G. affinis was twice as great as P. o. sonoriensis in March and four times higher in June. Comparing fecundity within each species between March and June 1987 showed that fecundity of P. o. sonoriensis was higher in March than June while G. affinis brood size was larger in June.

From these results we make the following conclusions: There appears to be no difference in average fecundity between P. o. sonoriensis and P. o. occidentalis, except P. o. sonoriensis females greater than 40 mm SL exhibit higher average fecundity. Fecundity of G. affinis was generally higher than

observed in P. o. sonoriensis. Poeciliopsis o. sonoriensis has not been extirpated where syntopic with G. affinis at Black Draw or West Border Spring, SBNWR. The former is a complex stream habitat, subject to recurrent flooding and contains a spring source where P. o. sonoriensis appears to find refuge. Predation losses by G. affinis downstream can be replaced from this refugium, thereby maintaining coexistence. Other poecillids have persisted with G. affinis under similar conditions. In contrast, West Border Spring is a relatively simple habitat and, although P. o. sonoriensis is rare, it persists for reasons as yet unknown.

RESUMEN

Galat, D. L. and B. Robertson. Departemento de Zoologia, Universidad Estatal de Arizona y San Bernadino, Rufugio Nacional para Vida Silvestre, Servicio de Pesca y Vida Silvestre E.E.U.U. Interacciones entre Poeciliopsis occidentalis sonoriensis y Gambusia affinis en la cuenca del Rio Yaqui, Arizona.

La coexistencia del "Yaqui topminnow", Poeciliopsis occidentalis sonoriensis, con el introducido "mosquito fish", Gambusia affinis fue investigada en la cuenca del Rio Yaqui, Arizona sureste, E.E.U.U. Nosotros hemos comparado la fecundidad media de P. o. sonoriensis en "Black Draw" ("San Bernadino Creek"), San Bernadino Rufugio Nacional para Vida Silvestre (SBRNVS) con P. o. occidentalis de "Monkey Spring" debido a que investigaciones anteriores sugirieron que P. o. sonoriensis producia más crias. No existieron diferencias significativas entre tamaño de nidada entre las dos subespecies, con la excepción de P. o. sonoriensis mayores de 40 mm de longitud standard (LS).

No hubo diferencias en el promedio de LS de hembras P. o. sonoriensis en Marzo 1987 entre o dentro de ciénegas ("Bunting", "Cottonwood" y "West Border Springs") o arroyos ("Leslie Creek" y "Black Draw"), pero las hembras fueron más pequeñas en estanques del SBRNVS ("North" y "Tule"). Solo P. o. sonoriensis de hábitats termales (ciénegas y "Black Draw" en su punto de origen) tuvo nidadas durante Marzo 1987. Por lo demás, la fecundidad aumentó en los dos sitios ("West Border Spring" y "Black Draw" al punto de origen) donde estuvó presente G. affinis.

El peso corporal y el de los ovarios del "topminnow" y su fecundidad durante Marzo 1986, 9 meses después de reintroducción a "Black Draw" (al punto de origen), fue comparado con los de Marzo 1987, 21 meses después de la reintroducción, para evaluar el efecto del tiempo desde la colonización. Hubo una reducción de 40% en el promedio del peso corporal húmedo y una reducción de 70% en el peso del ovario húmedo entre Marzo 1986 y Marzo 1987. Además, la fecundidad media, disminuyó por 75% sobre el mismo periodo, de 82 a 21 huevecillos y embriones maduros.

Poeciliopsis o. sonoriensis persiste en "Black Draw" y "West Border Spring" a SBRNVS donde es sintopico con G. affinis. Durante el primer año después de la invasión de G. affinis en "Black Draw" (al punto de origen), P. o. sonoriensis consistió del 50 a 95% en 6 colecciones. En "Black Draw", en la línea entre México y los Estados Unidos, la abundancia relativa de P. o. sonoriensis bajó constantamente de Enero 1986 (70% del total de numeros) hasta Julio 1987 (0%). La abundancia de "topminnows" aumentó después de una inundación moderada durante Agosto 1987 a 30% del total en Septiembre. "Yaqui topminnows" son escasos en "West Border Spring", variaron del 2 a 12% del total. Sin embargo, han estado presentes en todos las 9 colecciones hechas entre Marzo 1985 y Septiembre 1987.

No hubo diferencias significas en Marzo o Junio 1987 de LS media y peso corporal húmedo entre P. o. sonoriensis y G. affinis en "Black Draw" (al punto

de origen). Sin embargo, fecundidad de G. affinis fue dos veces más alta que la de P. o. sonoriensis en Marzo y 4 veces más alta por Junio. La comparación de fecundidad dentro de cada especie entre Marzo y Junio 1987 demostró que fecundidad de P. o. sonoriensis fue más alta durante Marzo que Junio mientras que el tamaño de nidada de G. affinis fue más grande durante Junio.

Hacemos las siguentes concluciones de estos resultados: Parece que no hay diferencia en fecundidad media entre P. o. sonoriensis y P. o. occidentalis, con la excepción de hembras de P. o. sonoriensis de más de 40 mm LS las cuales tienen fecundidad media más alta. Fecundidad de G. affinis por lo general fue más alta que la de P. o. sonoriensis. Poeciliopsis o. sonoriensis no ha sido extirpado donde es sintopico con G. affinis a "Black Draw" o "West Border Spring", SBRNVS. "Black Draw" es un hábitat complejo, tiene indundaciones periodicas y contiene un manatial donde P. o. sonoriensis encuentra refugio. Los peces deprédadores por G. affinis río abajo, pueden ser resembrados de este refugio, así la coexistencia está mantenida. Otros poecílidos han persistido con G. affinis bajo condiciones parecidas. En contraste, "West Broder Spring" es un hábitat sencillo y, aunque P. o. sonoriensis es raro, persiste por razones hasta ahora desconocidas.

REPORTE PRELIMINAR SOBRE LA ICTIOFAUNA DEL RIO AROS, SUBCUENCA DEL RIO YAQUI, SONORA, MEXICO.

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R E S U M E N

Como parte del Estudio Ecológico de la Ictiofauna Dulceacuícola de Sonora que realiza el Centro Ecológico de Sonora, se reportan las colectas de peces realizadas en una localidad del Río Aros, 3 localidades selectas del Río Moctezuma y 1 del Río Bavispe. En El Río Aros se encontraron 11 especies de peces, 6 nativas y 5 exóticas; en el Río Moctezuma 3 nativas y 1 exótica y en la localidad del Río Bavispe 1 nativa y 2 exóticas. La presencia de especies exóticas tales como la Lobina, Mojarra Verde y Bagre Negro en el Río Aros, y el Pez Mosquito en las otras localidades muestreadas evidencia una mayor distribución dentro de la cuenca a la previamente conocida y se consideran una potencial amenaza para las poblaciones nativas que todavía no presentan respuestas a la modificación de habitats y sus estatus parecen permanecer estables.

A PRELIMINARY REPORT ON THE ICHTHYOFAUNA FROM RIO AROS, SUB-BASIN OF THE RIO YAQUI BASIN, SONORA, MEXICO.

A B S T R A C T

As a part of the ecological suvery of the Sonoran freshwater Ichthyofauna carried out by Centro Ecológico de Sonora, results of collections from one locality in the Río Aros, Sonora, 3 selected sites in the Río Moctezuma and 1 site in Río Bavispe are reported. In the R. Aros, 11 fish species were found, 6 native and 5 exotic in R. Moctezuma and 1 native and 2 exotic in R. Bavispe. The presence of exotic fishes as largemouth bass, Green Sunfish and Black Bullhead Catfish in R. Aros and Mosquito fish in the other localities sampled show evidence of a distribution of these species within the Río Yaqui Basin larger than was previously known. These species are considered a potencial threat to the Native populations, however, Native fish population apper no to have been greatly impacted yet by habitat modifications and their status seems relatively stable at this time.

REPORTE PRELIMINAR DE LA FAUNA ICTICA DE LOS RIOS SONOYTA Y COLORADO CON OBSERVACIONES SOBRE LAS POBLACIONES DEL PUPO DEL DESIERTO *Cyprinodon macularius* BAIRD AND GIRARD.

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R E S U M E N

El presente reporte forma parte de las prospecciones ictiológicas realizadas para el proyecto de Investigación Estudio Ecológico de la Ictiofauna Dulceacuícola del Estado de Sonora. De 23 colectas efectuadas se reportan 26 especies nativas y exóticas. En 8 colectas sobre el Río Sonoyta se reportan 2 especies nativas y 2 exóticas además de una exótica citada en la literatura y no encontrada en nuestras colectas. En el Río Colorado de 15 colectas efectuadas se registra la presencia de 23 especies, 13 nativas y 10 exóticas, siendo solo *Cyprinodon macularius* la única especie nativa de ambiente dulceacuícola. En ambas cuencas se observan poblaciones del Pupo del Desierto amenazadas por la presencia e incremento en el número de las especies exóticas y el uso y manejo del agua con fines agropecuarios.

A PRELIMINARY REPORT OF THE ICHTIC FAUNA FROM SONOYTA AN COLORADO RIVER, WITH OBSERVATIONS OF DESERT PUPFISH *Cyprinodon macularius* POPULATIONS.

A B S T R A C T

This study is part of Ichthiological studies being carried-out by the Ecological Center of Sonora under the project "Ecological Studies of freshwater Ichtyofauna of the State of Sonora". Twenty six native and exotic species were collected in 23 collections. From 8 collections in the Sonoyta River, 2 native and 2 exotic species are documented, an additional species reported in the literature was not found in this suvery. From 15 collections in the Colorado River Drainage, 23 species were documented of these, 13 are native and 10 exotic, but the only native freshwater fish found was *Cyprinodon macularius*. In both Drainage numerous populations of pupfish were found to be threatened by presence and in crease in numbers of exotics species and the use and management of water for agriculture.

DESERT FISHES COUNCIL SYMPOSIUM XIX, HERMOSILLO SONORA. NOV. 12-14, 1987

ECOLOGIA TROFICA DE LA TRUCHA DE SAN PEDRO MARTIR (Parasalmo gairdneri nelsoni) EN CONDICIONES DE INVIERNO-PRIMAVERA / TROPHIC ECOLOGY OF SAN PEDRO MARTIR TROUT (Parasalmo gairdneri nelsoni) RELATIVE TO WINTER-SPRING CONDITIONS.

POR/BY
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RESUMEN

Se analizó la ecología trófica de Parasalmo gairdneri nelsoni durante condiciones de Invierno-Primavera (1987) en el arroyo de San Rafael, noroeste de la Sierra San Pedro Mártir, B. C.

Se reconocieron un total de 41 rubros alimenticios para Invierno-Primavera, siendo las presas más importantes de acuerdo al Indice de Importancia Relativa, los tricópteros: Sericostomatidae (41.3 %), Leptoceridae (29.5 %) e Hydropsychidae (17.7 %), y el díptero Simuliidae (11.5 %).

Una marcada diferencia se encontró en la dieta de la trucha entre las estaciones de Invierno y Primavera. En Invierno se compone básicamente por los tricópteros Sericostomatidae (60.11 %) y Leptoceridae (29.5 %), en cambio para Primavera el díptero Simuliidae (41.8 %) y el tricóptero Hydropsychidae (26.2 %) fueron las presas más dominantes en la dieta.

Una correlación significativa entre el tamaño de presa y el tamaño de boca de la trucha, fue encontrada para aquellas presas más importantes en la dieta (Sericostomatidae r = 0.72, Leptoceridae r = 0.42 y Simuliidae r = 0.60).

Cuatro grupos talla fueron asignados con el método polimodal de frecuencias de tallas de Petersen. Donde una marcada diferencia en la composición de la dieta fue encontrada con la talla, siendo más evidente en los grupos extremos (35-55 mm y ⩾ 126 mm LP).

ABSTRACT

The tropic ecology of trout Parasalmo gairdneri nelsoni in winter-spring conditions, were studied in Arroyo San Rafael, North-West of Sierra San Pedro Martir, B.C.

Four size groups of trout were recognized according to Petersen Polimodal Method of length-frecuency. A notable difference in the diet composition was found between the size groups, principally between the size groups 35-55 mm and > 126 mm SL.

We recognized a total of 41 food items during winter-spring; the most important preys according to the Index of Relative Importance, were caddisflies: Sericostomatidae (41.3 %), Hidropsychidae (17.7 %) and Leptoceridae (29.5 %), and the Simuliidae flies (11.5 %).

A clear difference was found in the trout diet between the winter and spring seasons. During winter the diet is basically composed of caddisflies Sericostomatidae (60.11 %) and Leptoceridae (29.5 %), however during spring, the Simuliid flies (41.8 %) and the caddisflies Hydropsychidae (26.2 %) are the most important prey items in the trout diet.

A significant correlation between prey size and mouth size of trout, was found for those prey important in the trout diet (Sericostomatidae r = 0.72, Leptoceridae r = 0.42 and Simuliidae r = 0.60).

ASPECTOS DE EDAD Y CRECIMIENTO DE LA TRUCHA *Parasalmo gairdneri nelsoni* DE LA SIERRA SAN PEDRO MARTIR, B. C., MEXICO.

ASPECTS OF AGE AND GROWTH OF SAN PEDRO MARTIR TROUT (*Parasalmo gairdneri nelsoni*) POPULATIONS FROM BAJA CALIFORNIA, MEXICO.

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RESUMEN

Aspectos de la estructura poblacional y tasa de crecimiento individual fueron analizados en 2 poblaciones de la trucha de San Pedro Mártir, B.C. (poblacion Río Santo Domingo y Arroyo San Rafael). Se reconocieron 4 grupos tallas para el Arroyo San Rafael y 5 grupos tallas para el Río Santo Domingo, siendo el grupo talla más dominante el de 55-65 mm. LP. para el Arroyo San-Rafael, y el de 130-140 mm. LP. para el Río Santo Domingo. La población de-San Rafael se compone de 4 grupos de edades, con una mayor dominancia de -- los grupos 0 y 1 años, en contraste con la población del Santo Domingo donde predominan los grupos 2 y 3 años. La ecuación de la relación Longitud-Peso para la poblacion San Rafael es: $\text{Log } W = -2.67 + 1.95\ (LP)$ y para la del - Santo Domingo $\text{Log } W = -7.75 + 4{,}44\ (LP)$. El retrocalculo de tallas promedio-con la edad registra mayores tasas de crecimientos individual para la población del Río Santo Domingo. La ecuación de crecimiento de Von Bertalanffy - para la población de San Rafael es:

$$Lt = 285{,}63\ (1 - e^{-0.215\ (to - (-0.175))})$$

y

$$Lt = 262.90\ (1 - e^{-0.263\ (to - (-0.124))})$$

Para la población del Santo Domingo. Se obtuvo un mayor factor de condición (KLp) en Primavera-Verano y un menor de Invierno.

ABSTRACT

Aspects de population structure and individual growth rate were analized in two San Pedro Martir trout populations (Rio Santo Domingo and Arroyo-San Rafael population).

We recognized four trout size groups of Arroyo San Rafael and five size - groups for Rio Santo Domingo, where the most dominant size group was 55-65 mm SL for Arroyo San Rafael and of 130-140 mm SL for Rio Sahto Domingo.

San Rafael trout population its composed by four age groups, with a great predominance of 0 and 1 age groups; however the Santo Domingo populations is more represented by 2 and 3 age groups.

The equation of length-weight relation-ship of the San Rafael population is Log W= -2.6 + 1.95 (SL) and for Santo Domingo population is Log W= -7. 75 + 4.44 (SL).

The retrocalcuiated average lengths per each age gave a high individual growth rate for Rio Santo Domingo population.

The Von Bertalanffy growth equation for San Rafael population was L_t= 285. 639 (1 - e - 0.215 (t - (- 0.175)

AND $L_t = 262.905\ (I-e^{-0.263\ (t-\ (-0.124)}$

for Santo Domingo population. We found a high condition factor (K_{sl}) in spring-summer conditions and a low factor in winter- condition.

Proyecto de Investigación sobre la biología reproductiva de un pez marino - "del desierto" en peligro de extinción, la totoaba (Totoaba macdonaldi: Sciaenidae).

Por:

Juan Carlos Barrera Guevara[1y2] y

Lloyd T. Findley[2]

RESUMEN.

En este proyecto se están desarrollando las investigaciones básicas sobre la biología reproductiva de T. macdonaldi, durante la migración anual a la parte alta del Golfo de California, en la estación reproductiva (enero-mayo). Estudiando los cambios histológicos de las gónadas durante la maduración, para delimitar las fases de maduración que lo componen y también la determinación de la fecundidad potencial de las hembras en el período de desoves (marzo-abril). Durante la permanencia de los investigadores en el campo, la oportunidad se aprovechará para realizar la fertilización artificial de los gametos para producir larvas para el inicio del cultivo experimental en el laboratorio húmedo (CIDESON-CES) implementado en el Centro Ecológico de Sonora, en Hermosillo.

Los trabajos de campo exploratorios, hechos entre 1985-1987, muestran que aparentemente la totoaba realiza un tipo de comportamiento de "cortejo" que consiste en la segregación temporal de sexos en los cardúmenes predesovantes durante su permanencia en las áreas de "maduración" localizadas en la costa oeste en los campos de El Moreno y El Chinero, B.C. En los registros más al norte, en las aguas someras cercanas a los canales del delta del río Colorado en la zona del Golfo de Santa Clara, Sonora, todos los grupos colectados fueron mixtos, identificando estas áreas como las de mayor actividad reproductiva. La amplitud de las mareas, al menos en la zona de El Golfo de Santa Clara, Sonora, juega un papel importante en la localización de los reproductores. Las capturas ocurren principalmente durante las mareas vivas en los días de luna nueva o luna llena, por lo que es probable que los desoves ocurren en las mareas altas de marzo y abril.

El rápido incremento observado del peso de las gónadas, muestra que la maduración ocurre en su mayor parte durante la permanencia de los reproductores en los campos de maduración. El análisis microscópico de los tejidos del ovario de totoaba, muestran que la maduración del oocito es sincrónica, siendo posible encontrar oocitos en crecimiento, en reposo células germinales y ovogonias. La maduración sincrónica indica una alta probabilidad de que la

totoaba tenga desoves periódicos múltiples o por lotes. No conocemos aún la velocidad de maduración del oocito, por lo que no es posible determinar el intervalo de tiempo entre los desoves.

Para el estudio del ciclo histológico, las muestras son teñidas con Hematoxilina ds Harris-Eosina alcohólica y determinaremos la distribución de frecuencias de los diámetros de los oocitos para cada fase empleando la clasificación de (Robb, 1981), la cual emplea siete estados para los ovarios. Para la determinación de la fecundidad potencial de las hembras, los conteos de oocitos se harán por el método húmedo (diluciones) y seco, ambos basados en un índice de peso.

Los resultados al final del estudio, serán cruciales para hacer cálculos y predicciones sobre la dinámica de poblaciones de la totoaba, pudiendo estimar el tamaño del stock reproductivo y determinar su regulación futura al conocer el verdadero potencial reproductivo de las hembras. Si se obtienen larvas en su cultivo, se harán inicialmente estudios nutricionales para tratar de cultivarlas hasta la fase juvenil.

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ABSTRACT

SURVIVAL AND GRWOTH OF RAZORBACK SUCKER, (Xyrauchen texanus), IN PONDS

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Lake Mohave, a large Colorado River reservoir in northwestern Arizona, supports the largest reproducing population of the unique and endemic razorback sucker. It has been reported that the population in this lake is more than 30 years old with no evidence of recruitment. Explanation for apparent failure of razorback sucker year classes have included transport of larvae out of the reservoir system by sub-surface currents and egg and larval predation by non-native species.

Insufficient amounts or quality of food may also by considered a reasonable cause for recruitment failure. Little is known about the food and feeding requirements of larval razorback sucker. Objectives of this study were to compare survival and total biomass of razorback sucker larvae under quantified levels of food availability induced by 3 fertilization regimes. Growth and food selection by taxa and size are also described.

Densities of pond invertebrates averaged 39/L, 24/L and 12/L in high, medium and low treatments respectively and did not result in significant differences in larval survival among treatments. Average survival for the three treatments combined was ca. 78%. Biomass in high and medium treatments was greater than that in low treatments. Larvae in the latter treatment did grow more slowly than those larvae in ponds that were fertilized and had higher densities of invertebrates. Small larvae selected organisms .1 mm or less in body width, mainly rotifers and small chironomids, while larger larvae ate organisms .2 mm and .3 mm in size. Cladocerans and chironomids were in this size range.

Application of present data to the problem of recruitment failure in the Lake Mohave population of razorback sucker remains equivocal. Although Lake Mohave data are variable, there is evidence that zooplankton density is low and that a high percentage of larvae have empty stomachs. Insufficient food leading to mortality of larvae through direct starvation or indirectly through increased susceptibility to predation could explain year-class failure.

RESUMEN

SUPERVIVIENCIA Y CRECIMIENTO DE "RAZORBACK SUCKER" (Xyrauchen texanus) EN ESTANQUES

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Lago Mohave, un reservorio del Rio Colorado en el noreste de Arizona, tiene la poblacion reproductiva más grande de la especie única y endémica "razorback sucker", Xyrauchen texanus. Ha sido reportado que la población en dicho lago tiene más de 30 años de edad sin evidencia de reclutamiento. Posibles explicaciones sobre la falla de la población razorback sucker para renovarse serian: el transporte de sus larvas afuera del lago por corientes sub-superficias y la depredación sobre huevecillos o larvas por especies introducidas. También se considera la cantidad o la calidad de alimento como causa razonable para explicar esta falta de reclutamiento. Poco es lo que se conoce sobre los requisitos alimenticios de razorback sucker. Los objetivos del presente estudio fueron: comparar la supervivencia y la producción de biomasa de "razorback sucker" bajo diferentes densidades de alimentos cuantificables inducidas por 3 régimenes de fertilización. También el crecimiento y la selección de alimento por taxa y tamaño se describieron.

La densidad de invertebrados en los estanques tratados con fertilizante a niveles clasificados alto, mediano, y bajo tiene promedio de 39, 24 y 12 organismos por litro respectivamente y no existieron diferencias significativas en supervivencia entre los tratamientos. Supervivencia media para los 3 tratamientos juntos fue 78% aprox. La biomasa en tratamiento alto y mediano fue más grande que en el bajo. Las larvas en el ultimo tratamiento crecieron más despacio que en los demás tratamientos fertilizados y con densidad de invertebrados alta. Las larvas pequeñas escogieron organismos de .1 mm o menos de ancho corporal, principlemente rotiferos y chironomidos, mientras que las larvas más grandes elegieron organismos de .2 mm a .3 mm de tamaño. Cladoceros y chironomidos están en esta categoria.

La aplicación de los resultados de este estudio al problema de la falta de reclutamiento en la población de "razorback sucker" en el Lago Mohave permanece incierto. Sin embargo, los datos de la densidad de zooplancton en Lago Mohave son variables, y hay evidencia de que la densidad es baja y que un porcentaje alto de larvas tiene estómagos vacios. La falta de alimento conduce a mortalidades de larva por inanición directa o la depreación en la larva debilitada, y puede explicar la falta de reclutamiento.

DESERT FISH MANAGEMENT IN THE YEAR 2000 - WHERE DO WE WANT IT TO BE AND HOW WILL WE GET IT THERE?

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ABSTRACT--Long-term monitoring programs are proposed as a much needed approach to obtain empirical data required to provide accurate predictions of impacts and population and habitat status, as well as efficient evaluation of management practices or impacts. Such data are needed not only to further biological knowledge, but also to provide effectiveness in the legal arena. Many long-term data bases in biology and other fields have repeatedly demonstrated their value both to managers and theoreticians, yet there are few presently in existence, or being developed, for desert aquatic resources. Biotic data that do exist for these resources generally are from independent studies which are scattered, sporadic, and plagued by high levels of inter-study methodological variance and inadequate quantification. Such data are often entirely unsuitable for rigorous statistical analyses.

The great value of endangered resources and consequent high costs of errors, put a high priority on planner's and manager's abilities to make accurate predictions, a process often greatly facilitated by empirical data. Narrow-focus, short-term, experimental studies may complement data from empirical monitoring, but, due to the general complexity of natural systems, can not always be expected to control for all variables adequately to provide reliable predictions. Experimental designs addressing large numbers of variables become unmanageable and cost prohibitive, even in short-term studies. It has been clearly demonstrated that short-term ecological studies have explained unexpected outcomes by invoking "unusual events" with greatly unrealistic frequency. Long-term studies provide much more reliable perspectives of the frequency of truly unusual events and their importance.

While empirical monitoring may not always provide detailed insights into mechanisms of resource response to impacts, has an inherently delayed product, and presents funding and personnel problems, it offers numerous advantages over equal funding directed to numerous short-term studies of varied direction and focus. While ceratinly site specific, monitoring data have the advantage of frequently retaining considerable generality. Monitoring provides a relatively simple, cost-effective summarization of innumerably more variables than those actually monitored, and a more valid perspective of the system under study. Systematically gathered data are also far more amenable to rigorous statistical analyses than are those of numerous, varied-focus, independent, or loosely organized studies. They

are thus highly recommended as the means by which we should be trying to arrive at the high levels of predictive capability the future will surely demand from our field.

EL MANEJO DE LOS PECES DEL DESIERTO EN EL AÑO 2000 - DONDE QUISIERAMOS ESTAR Y COMO LLEGAREMOS

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RESUMEN--Se propone la necesidad de implementar muchos programas de evaluación sistemática (monitoreo) a largo plazo para obtener datos empíricos requiridos para la predición precisa de impactos y status de poblaciones y habitats, así como una evaluación eficiente de las prácticas de manejo e impactos. Se necesitan tales datos no solo para mejorar el conocimiento biológico, sino también para proveer efectividad en asuntos legales. Muchos bases de datos mantenidos a largo plazo en biología y otros campos han mostrado repetidamente su valor, tanto para los adimistradores como a los teóricos. Sin embargo actualmente existen, o estan en desarrollo, pocos bancos de datos sobre recursos acuáticos de desiertos. Datos bióticos que existen para estos recursos generalmente provienen de estudios independientes que estan difusos, espor'dicos y plagados de altos niveles de variación entre si mismos en cuanto a metodología y cuantificación. Tales datos son inútiles en análisis estadísticos rigurosos.

El gran valor de los recursos en peligro y los altos costos que representan los errores, imponen una gran responsabilidad en la habilidad de los programadores y administradores para producir prediciones precisas; un proceso frecuentemente facilitado por datos empíricos. Estudios experimentales de enfoque estrecho y de corto plazo pueden complementar datos de monitoreo, pero, debido al gran complejo de sistemas naturales, no se puede contar con ellos para controlar cada variable y producir siempre prediciones con mucha confianza. Diseños experimentales dirigiendose a un gran numero de variables son inmanejables y prohibitivamente caros, aún en estudios de corto plazo. Ha sido ampliamente demostrado que los estudios ecológicos a corto plazo han explicado con frecuencias estadisticamente grandes resultados inesperados al incluir "eventos raros". Estudios de largo plazo, resultan en perspectiva más realistas de la importancia y frecuencia de los eventos raros.

Mientras el monitoreo no provee siempre aseveraciones detalladas de los mecanismos por medio de los cuales responden los recursos a los impactos, presenta inherentemente un producto retrasado, y además problemas de apoyo financiero y de personal. El monitoreo ofrece ventajas sobre la aplicación de los mismos fondos a varios estudios de corto plazo y de dirección y enfoque variado. Aunque pueden ser especificos a ciertos sitios, los datos de monitoreo a menudo retienen bastante generalidad. También es un método relativamente sencillo y provee un resumen efectivo de muchas más variables que las actualmente evaluadas, y además proporciona una perspectiva más valida del sistema bajo estudio.

Datos tomados sistematicamente son mucho más aplicables en análisis estadísticos rigurosos que son recopilados de estudios independentes de enfoque variado. El monitoreo entonces es la estrategia recomendada por la cual debieramos estar intentando obtener altos niveles de capacidad de predición que en el futuro indudablemente demandará nuestro campo de estudio.

Desert Fishes Council, Annual Meeting.
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SPECIES COMPOSITION CHANGES IN FISH COMMUNITIES OF EASTERN MEXICO.

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ABSTRACT

Changes in fish community composition have been well documented in northern México, but are poorly known in its tropical areas. The objetives of this study are the monitoring of tropical and subtropical fish communities, evaluation of endengered species, recognition of exotic species if any, and the determination of some factors that may be affecting their aquatic environments. Eighteen localities were investigated. San Luis Potosí: Río Valles at Ciudad Valles changed from 18 to 11 native species, and 1 exotic was added, (38.9%); Río Gallinas at Rascón came from 11 to 5, (54.6/); Laguna de la Media Luna was reduced from 8 to 6 species, appearing 5 exotics, (25%). Tamaulipas: Río Pilón ar Garza Valdez, changed from 10 to 6 natives (-40%); Río Purificación at La Cruz, from 10 to 6 (-45.5%), and gained 2 introductions; Río Santa Engracia at Santa Engracia, descended from 8 to 4 (-50%); Río San Marcos at Ciudad Victoria, changed from 7 to 5 (-28.6%); Río Guayalejo at Forlón, lost 6 of 18 species (-33.3%), Veracruz: Río Sordo at Jalapa and Río Texolo at Xico are unchanged from their 2 and 1 natives; Río La Antigua at San Francisco came down from 17 to 13 (-23.6%); Lagunas north of Veracruz disappeared with 10 natives (-100%); Río Boca del Río at Boca del Río, lost and gained species, with total change from 21 to 17 (-19.1%), adding 1 exotic; Río Seco at Cuahtemoc, lost 2 of 6 natives (-33.3%); Río Blanco at Río Blanco changed from 4 to 2 (-50%); Río Otapa at Otapa lost 6 at 16 (-37.5%); Río Motzorongo at Motzorongo came down from 15 to 6 nstives (-60%) plus 1 exotic; and Río Tonto at Refugio, descended from 8 to 5 (-37.5%). Average loss at the 18 localities was (-37.6%). Factors recognized as possible causes are too general: oil welling and operation, damming, salinisation, industrial and urban residual discharges, high demograpgic growth and population, and fish introductions. It is recommended that this type or better monitoring be continued and increased in tropical México.

EVALUATING INSTREAM FLOW NEEDS OF COLORADO SQUAWFISH IN THE GREEN RIVER

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Abstract

Instream flow needs of different life history stages of Colorado squawfish, Ptychocheilus lucius, in the Green River, Utah, were evaluated by using physical habitat simulation model PHABSIM, aerial photographic mapping, and analysis of empirical field data. No one method was judged acceptable for all life stages of the fish, disagreement occurred between methods with respect to optimum flow requirements, and the field data did not support outputs of the modelling effort. Analytic models should be validated with empirical field data before their outputs are used to recommend instream flow scenarios for endangered fishes in large rivers.

EVALUACIÓN DE LAS NECESIDADES DE FLUJO DEL COLORADO SQUAWFISH IN DEL RIO GREEN

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Resúmen

Necesidades de flujo de diferentes edades del Colorado squawfish, Ptychocheilus lucius, en del Rio Green en el estado de Utah, fueron evaluadas por el modélo simulido de habitat física PHABSIM, fotografía aéreo, y analysis de datos de campo. Solamento ningun método fue aceptable para todos las edades del pez, disención ocurió entre los métodos, y observaciones del campo no soportaron el uso de modélos simulidos de habitat. Los modélos analyticos deben de cer probeados con datos actuales antes del uso en los rios grandes en los peces en peligro de extinción.

Critique of the biological aspects of instream flow incremental methodology. Dr. O. Eugene Maughan, Arizona Cooperative Fish and Wildlife Research Unit, Tucson, AZ and Paul J. Barrett, U.S. Fish and Wildlife Service, Phoenix, AZ.

Abstract: Instream Flow Incremental Methodology, a technique for determining the amount of water needed to sustain a river system, has received much criticism in recent years. Critics have charged that weighted usable area (WUA) does not equate to existing biomass, that the models are not predictive, and that insufficient factors are used to develop the models. All criticisms have some validity. However, innappropriate application of the technique and unrealistic expectations have greatly contributed to the controversy. Good biological judgement coupled with more field tests are needed to successfully use the method.

METODOLOGIA DEL PROGRAMA DE PATRIMONIO NATURAL (NATURAL HERITAGE): INFORMACION PARA LA PRESERVACION DE LA DIVERSIDAD BIOLOGICA

El personal del Programa de Patrimonio Natural (Natural Heritage) y de los Centros de Datos para la Conservación comprende las disciplinas de Zoología, Botánica, Ecología y Manejo de Datos contando con un miembro del grupo como Coordinador. La información de las bases (o bancos) de datos está contenida en archivos manuales, computarizados y en mapas. Generalmente, se usan microcomputadores PC AT para almacenar la información de los archivos computarizados, utilizando Dbase III Plus. El personal recolecta datos de fuentes secundarias y de nuevos trabajos de campo para finalmente procesarlos y añadirlos al sistema.

La red de los Centros de Datos cuenta con un alto grado de estandarización del sistema en lo referente a "hardware," "software," estructuración y operación metodológica. Un modelo del Manual de Operaciones, desarrollado por el Grupo de Procedimientos Operacionales, establece los parámetros para las actividades metodólogicas. Cada cuatro meses, este equipo se reúne para considerar temas que se refieren a la evolución dinámica del Manual. Los miembros de la red trabajan en coordinación para mantener la compatibilidad de datos, mientras que al mismo tiempo reúnen información específica necesaria sobre la diversidad natural en sus respectivos estados, regiones y países.

Los bancos de datos y la metodología operacional requieren mejoras contínuas en la adquisición de información computarizada, mayor rendimiento y aumento de usuarios. Sin embargo, la metodología no cambia las metas relacionadas con la adquisición, mantenimiento y distribución de información–a nivel de poderes de decisión–sobre los elementos de la diversidad biológica natural. Estos elementos consisten en especies de la fauna y la flora, comunidades naturales y otras entidades biológicas importantes que se saben ocurren dentro de la jurisdicción de los Centros de Datos.

El proceso de jerarquización relativa, que considera factores tales como la escasez de ocurrencia del elemento, vulnerabilidad, distribución, número de individuos, número de ocurrencia protegidas, amenazas y fragilidad ecólogica se usa para evaluar cada elemento desde una perspectiva global, nacional o local.

Los datos recolectados sobre los elementos de la diversidad biológica natural son registrados directamente y no desvirtuados por interpretaciones personales. Cada esfuerzo se hace teniendo en consideración "lo estrictamente real" y prevalece lo objetivamente neutral. Los datos son básicos y no se dejan llevar por connotaciones ni influencias de cierto punto de vista en particular. Por ejemplo, la información suministrada sobre la ocurrencia de una especie de planta incluye su localización exacta, datos concernientes a su número, habitat y la identicación de quienes saben más acerca de su ocurrencia. Esta información sobre ocurrencia, cuando va aparejada de la información que se tiene sobre otras ocurrencias conocidas de la misma especie junto a un patrón general de distribución (mantenida en la base de datos como RASTREO DEL ELEMENTO) constituye una poderosa herramienta para los planificadores y administradores.

Mientras que la información sobre las ocurrencias están contenidas en el REGISTRO DE OCURRENCIA DEL ELEMENTO, las fuentes de información se almacenan en el RESUMEN DE FUENTES. El RESUMEN DE AREAS DE MANEJO mantiene información de áreas administradas con un cierto grado de esfuerzo (criterio) conservacionista. Un grupo de bases de datos relacionados es aquel denominado RESUMEN DE CARACTERIZACION DE VERTEBRADOS que describe las especies de vertebrados e incluyen información sobre taxonomía, distribución, status, ecología, temporabilidad, habitat, fenología, hábitos alimenticios, reproducción, migración y referencias. Un resumen similar para plantas también se está desarrollando.

El desarrollo del sistema y la colección de datos continúa con una práctica sucesiva de aproximaciones. Ambas actividades crecen progresivamente a medida que nuevos programas de "software" se acoplan y se adquieren nuevos datos sobre ocurrencia, fuentes, sitios, áreas de manejos e información ecológica. Cuando un Centro de Datos para la Conservación llega a su etapa de madurez, los logros y productos de su trabajo comienzan a ser mas refinados, acertados y útiles. El paisaje natural está en evolución constante y el impacto del hombre en el mundo natural es también cambiante. En una tarea de colección y evaluación contínua y sostenida, se obtienen bases de datos dinámicas y en constante evolución.

Para mas información contactar el Programa Internacional de The Nature Conservancy, 1785 Massachusetts Avenue, Northwest, Washington, D.C. 20036.

PECES CAVERNICOLAS EN PELIGRO DE EXTINCION, EN LA PENINSULA DE YUCATAN: PROBLEMAS METODOLOGICOS PARA EL ESTUDIO DE SU BIOLOGIA Y ECOLOGIA

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Desde marzo de 1986 se vienen realizando muestreos mensuales en más de 20 cuerpos de agua epicontinentales (cenotes y lagunas) en el Estado de Quintana Roo, en la Costa Centro-oriental de la Peninsula de Yucatán, con el objeto de: a) Obtener un primer inventario y colección de referencia de la ictiofauna del área, b) Caracterizar los parámetros limnológicos principales de estos cuerpos de agua, y c) Estudiar la biologia y ecologia de las especies icticas que los habitan.
Al realizar estos estudios, se descubrió que los intrincados sistemas de cuevas inundadas que se comunican con los cenotes, eran habitados por especies de peces y crustáceos troglobíticos, cuya existencia era conocida únicamente para unas cuantas localidades del norte del Estado de Yucatán. Destacan entre las especies de peces, el brotúlido ***Typhliasina pearsei*** , el sinbránquido ***Ophisternon infernalis*** y algunas subespecies del bagre ***Rhamdia guatemalensis***. Con estos descubrimientos, además de haberse ampliado importantemente el área de distribución de estas especies, se tuvo la necesidad de modificar significativamente nuestros conceptos sobre su ecologia y biologia.
Las localidades Yucatecas y de Q. Roo, habitadas por estos organismos, son muy diferentes. Las yucatecas se caracterizan de manera general, por ser pequeños espejos de agua somera, que se encuentran en cavernas donde la luz no penetra y con condiciones fisicoquímicas totalmente constantes. Presentan el fondo cubierto por fango muy fino, con alta concentración de materia orgánica proveniente de las excretas de los murciélagos que pueblan las cavernas. No sufren presiones de predación y, según nuestras observaciones, no existe competencia interespecifica. Como contraparte, las localidades de Q. Roo son grandes cámaras completamente inundadas, de unos 3-25 metros de profundidad y hasta kilómetros de longitud, que conectan con los cenotes abiertos, ubicados en áreas cercanas a la costa. Los peces ciegos habitan estos sistemas desde áreas profundas, no determinadas aún, hasta la zona de penumbras de las cuevas, donde se unen con el cenote abierto. Sobre todo en esta zona de transición de ambientes, el aporte de materia orgánica proviene principalmente de la descomposición de material vegetal. Las caracteristicas ambientales son más variables por la influencia de los cambios en el cuerpo principal del cenote. Existe competencia interespecifica y predadores potenciales tales como ***R. guatemalensis*** y ***Anguilla rostrata***, entre otros. Después de todo, son más versátiles y adaptables de lo que se creia.
Estas diferencias, asi como sus caracteristicas poblacionales, plantean una serie de problemas metodológicos para su estudio que serán discutidos en detalle.

ASPECTOS DISTRIBUCIONALES Y ECOLOGICOS DE LOS PECES DEL ALTO LERMA, SUBCUENCA DEL RIO LERMA, MEXICO.[1]

Carlos Chávez-Toledo.[2]

Abstracto:

Habitan la subcuenca Alto Lerma 4 familias con 14 especies nativas, las mejor representadas son Goodeidae, Cyprinidae y Atherinidae. Con el fin de explorar la ocurrencia de cambios distribucionales y detectar sus causas y efectos, se compararon los datos y observaciones bibliográficas y de la Colección de Peces del Laboratorio de Cordados de la ENCB-IPN registrados hasta 1982, con los obtenidos de dos temporadas de muestreo (1985), y de la cuantificación de parámetros ambientales - (Proyecto DGI-851061).

De los resultados obtenidos, destacan la disminución de aproximadamente el 57% de la ictiofauna nativa, así como la restricción en su distribución, debido a alteraciones ecológicas fomentadas principalmente por la formación de núcleos urbanos e industriales. Tal es el caso, de Girardinichthys multiradiatus caracterizado como indicador biológico de toda la subcuenca (Romero, 1965), notándose que ahora restringe su distribución a las porciones más altas de la misma.

Los datos ecológicos obtenidos muestran que los factores que influyen directamente en la distribución específica son: altitud, temperatura y oxígeno. Se discuten la influencia de otras variables sobre la composición y distribución de los peces, se dá una caracterización ecológica específica y se revisan los límites de la subcuenca.

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ECOLOGICAL AND DISTRIBUTIONAL ASPECTS OF THE FISHES FROM ALTO LERMA SUB-BASIN, RIO LERMA, MEXICO.[1]

Carlos Chávez-Toledo.[2]

Abstract:

Four families including fourteen native species inhabit the "Alto Lerma" sub-basin, the most representative of which are Goodeidae, Cyprinidae and Atherinidae. In order to explore changes in the distribution and to detect the causes and effects, the data observations registered in the literature and the Fish Collection of the Laboratorio de Cordados de la Escuela Nacional de Ciencias Biológicas (ENCB)-Instituto Politécnico Nacional(IPN), are compared with the data obtained during two collection periods in 1985. In that year the quantification of environmental parameters was also completed (Proyecto DGI-851061).

Among the results obtained, it is worth mentioning the decrease of aproximately 57% of the native fish fauna and the restriction of their distribution due to ecological alterations developed mainly by the formation of urban and industrial centers. Such is the case of Girardinichthys multiradiatus characterized as an biological indicator of the whole sub-basin (Romero, 1965). It is noted here that its area distribution is now restricted in the uppermost portions of the sub-basin.

The ecological data obteined from the samples show that the factors directly influencing the distribution of species are altitude, temperature and oxygen. The influence of some other variables on distribution and composition of the fishes is discussed, an ecological characterization of the species is presented, and the limits of the sub-basin are reviewed.

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[1] Extracto de trabajo (Extract from): "Ictiofauna del Alto Lerma; Aspectos Sistemáticos, Zoogeográficos y Ecológicos". Chávez-Toledo, Carlos. 1987. Tesis Profesional Biólogo. Escuela Nacional de Ciencias Biológicas, IPN. México. D. F.

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THE ILLUSION OF TECHNIQUE AND FISHERIES MANAGEMENT

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I use the term illusion of technique in reference to the common phenomenon whereby the human mind is highly susceptible to indoctrination with a naive belief that chaotic systems of nature can be neatly ordered for predictive purposes if only modern technology, such as a computer simulation model, can be applied to a problem. This phenomenon leads to a naive faith that confuses objectivity, quantification, and sophistication with biological realities. The problem of erroneous predictions concerns the substitution of data for knowledge and the institutionalizing of ignorance under the guise of conflict resolution.

LIMITATIONS OF PREDICTIONS

If a regional farmer's almanac is consulted to observe times of sunrise, sunset, high tide and low tide for any given day, we would have a well-founded belief in the accuracy of these predictions. If this same almanac predicted the weather each day of the year, a year or more in advance, we might chuckle at the expected predictive accuracy of such long range weather forecasts. However, if we loosen the constraints for precision, we would have some confidence in a prediction that claims the maximum and minimum temperatures for any given day in July will be higher than for any given day in January in the Colorado-Wyoming area.

If one can comprehend the reasons why some natural phenomena can be accurately predicted and why some cannot, as illustrated in the above examples, then an understanding of the limitations for accurate predictions made on the basis of environmental or biological models should be apparent -- it concerns patterns of regularity in nature, and our interpretation of these patterns for making predictions.

To obtain consistently accurate predictions based on data from a natural system, the particular system must be stable, isolated (not subjected to external perturbations), and highly regular. Most biological systems do not meet these prerequisites. The law of gravity, the positions and motions of the sun and planets have patterns of regularities that justifies our faith in the accuracy of predictions regarding the times of sunrise, sunset, high tide and low tide. The value of empirical evidence can be demonstrated by considering the fact that accurate predictions are possible from accurate recording and interpretation of the data of regularity, even though the processes causing regularity are unknown. For example, ancient societies could have compiled the essential data on which accurate forecasts of sunrise, sunset, and tides could be made while accepting a theory that the earth is flat, stationary and the center of the universe. For long-range weather forecasts where a multiplicity of unpredictable, short-term influences act to create local conditions, a full understanding of all the processes of weather formation does little to improve

long-range predictive accuracy over mythological methodologies such as the degree of fuzz development on caterpillars.

The implication for fisheries management and environmental assessment in general, is that, unless a system is extremely regular and tight cause-and-effect relationships between a proposed action, such as change in flow regime, and the target species can be empirically demonstrated, do not expect predictive accuracy from any model -- the best that can be expected is to demonstrate trends; to be in the ballpark. For example, enrichment of a pond can be expected to result in a trend for increased fish production. The precise amount of increase in a target species such as bass or trout from a known percentage increase in nitrate and phosphate cannot be accurately predicted because of the multiplicity of unknown and unpredictable phenomena that can influence the transfer of energy from primary (or bacterial) production to the target species.

The limitations on predictive accuracy associating nutrient enrichment to fish production was neatly demonstrated by Bill McConnell and students of the Colorado Cooperative Fishery Unit and David Galat in replicated microcosm experiments. Under identical conditions, great variability in fish production was found, but consistent trends were apparent. Higher trophic level species, such as smallmouth bass, always had less production than lower trophic species, such as carp. Thus, a trend associated with trophic level can be predicted, but the actual amount of production cannot be predicted from nutrient levels.

A similar situation applies to other environmental variables as they affect fishes. A computer simulation model that produces precise habitat quantification such as habitat units expressed as weighted useable area (WUA) which display changes in relation to flow changes, has indoctrinated the minds of many naive biologists and administrators who confuse quantification, objectivity and sophistication with biological reality. Such people have assumed that changes in WUA accurately predict changes in fish populations -- they do not; the best that can be hoped for is that trends can be predicted. In recent years, many biologists and administrators have become vaguely aware of this fact, but the appeal for standardization of an assessment method is strong and arguments are developed concerning the relative merits of various methods in relation to negotiability, defensibility, holding up in court, etc. The only way I envision that quantified habitat units lacking valid representation of biological reality can be negotiated and defended is if a game of environmental assessment is created and all of the players agree to play by the rules, which would include treating habitat units as currency similar to play money in the game of Monopoly. If an irreconcilable conflict arose and a case ends up in court, I doubt that the judge and opposing attorneys would agree to the rules of the game.

CONCLUSIONS

What has been said above is only a matter of common sense thinking. Why is common sense so uncommon? The pioneers and leading practitioners of simulation modeling cannot be blamed for our problems with the illusion of technique. People such as MacArthur and Wilson (Island Biogeography) and Hollings (Adaptive Environmental Assessment), who popularized biological and environmental modeling, clearly sounded warnings and cautions concerning the limitations of predictions made from highly simplified and compartmentalized

abstracts of nature and emphasized the need to test and continually refine and fine-tune a model. The lure to administrators, however, of a "standard method" for conflict resolution, with or without biological reality, is great and difficult to resist. A negative aspect concerns the expenditure of considerable funds to obtain essentially meaningless data in relation to benefits to a target species when these funds might have been beneficially expended on constructive mitigation or enhancement measures if detailed knowledge of a species life history in a particular environment was used to resolve a conflict. That is, look for ways to reverse the illusion of technique by substituting human knowledge, expertise, and experience for "shotgun"-type of data and "rules".

During 1986 I was involved in an acrimonious legal action in Michigan over no-kill regulations for the Au Sable River. The backers of the no-kill regulation consistently cited a computer simulation model that "proved" a significant increase in larger trout would result from no-kill regulations, despite all empirical evidence to the contrary and a published word of warning from the creator of the model concerning its limitations for predictive accuracy. Highly trained and otherwise disciplined minds can be completely susceptible to the illusion of technique if it furthers their interests and supports a belief.

The Intermountain Region of the U.S. Forest Service published a small booklet entitled: "Macro What?". This booklet tells how analysis of aquatic invertebrates is used "to measure the effects of" such activities as hunting, fishing, camping, and livestock grazing. Are there people in the U.S. Forest Service who really believe that the best way to "measure effects" of hunting and fishing and livestock grazing is by indirectly analyzing the aquatic invertebrates rather than directly "analyzing" the hunters and fishermen or the direct livestock impact on riparian vegetation, bank stability, channel morphology, and fish population? Why not apply the "rule of parsimony" and look for the most simple and direct cause-and-effect relationship of a problem and "analyze" that rather than to instinctively "follow the rules" of a "standard method" when they are not applicable to particular situations?

Evidently, there are indeed such people, as Don Duff told us at our annual meeting, Forest Service administrators, after many years, finally agreed to institute revised grazing management on Silver King Creek, California, to enhance habitat conditions for the federally threatened Paiute cutthroat trout, after they were shown the evidence from aquatic invertebrate analysis. It must be assumed that these same administrators had been previously unconvinced by the direct evidence of cause-and-effect impact of livestock -- the barren, caved-in banks, erosion and actual trout population data -- until they were shown a "scientifically" derived metric of invertebrate diversity which "proved" the negative impact of livestock on the Paiute trout.

The moral of the story is that as long as we have to live and work with problems created by the illusion of technique, we might as well look for ways to use illusion in our favor. I would prefer, however, that in the future, we might have more knowledgeable administrators staffing resource agencies who are capable of exercising reflective judgement and a greater resistance to the illusion of technique -- but as I said, common sense is not common, and I doubt that it can be taught in school.

EVOLUTIONARY RELATIONSHIPS AMONG INLAND PUPFISHES OF THE CYPRINODON VARIEGATUS COMPLEX

A. A. Echelle and A. F. Echelle

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Electrophoretic analysis of 28 protein-coding genetic loci was used to examine the relationships among eight species of pupfish (Cyprinodontidae: Cyprinodon). For outgroup comparisons, representatives of two genera, Jordanella and Floridichthys, were included in the analysis. The analysis gave the following results: 1) Jordanella and Cyprinodon apparently represent a monophyletic group that excludes Floridichthys. 2) The wideranging coastal species, C. variegatus, appears ancestral to a group of four inland species from Oklahoma, New Mexico and Texas: C. bovinus, C. rubrofluviatilis, C. pecosensis, and C. tularosa. 3) Cyprinodon elegans, a highly distinctive species of previously undefined relationships, is more closely related to C. eximius and C. macularius than to the members of the C. variegatus complex. 4) Two allopatric forms of C. rubrofluviatilis were genetically more distinctive (Nei's identity = 0.85) than generally expected for members of the same species. Some aspects of the results of this analysis have important implications for the conservation of pupfishes, particularly the inland members of the C. variegatus complex. For example, in a recently discovered area of artificial contact, C. variegatus and C. pecosensis appear to behave as one species, yet those two species apparently are rather distantly-related members of the C. variegatus complex. This heightens concerns regarding the possible effects of further introductions of C. variegatus into habitat occupied by endemic pupfishes.

RELACIONES EVOLUTIVAS ENTRE PUPFISHES INTERIORES DEL COMPLÉJO *CYPRINODON VARIEGATUS*

A. A. Echelle y A. F. Echelle

Oklahoma State University y Dexter National Fish Hatchery

El análisis electroforético de 28 locus geneticos de proteínas ha sido usado para examinar las relaciones entre ocho especies de pupo (Cyprinodontidae: *Cyprinodon*). Para comparar grupos externos, fueron incluidos en el análisis representantes de dos géneros, *Jordanella* y *Floridichthys*. El análisis dio los siguientes resultados: 1) *Jordanella* y *Cyprinodon* aparentemente representan un grupo monofílico que excluye *Floridichthys*. 2) La especie costera mas ampliamente distribuida, *C. variegatus*, aparece como ancestro de un grupo de cuatro especies interiores de Oklahoma, New Mexico, y Texas: *C. bovinus*, *C. rubrofluviatilis*, *C. pecosensis* y *C. tularosa*. 3) *Cyprinodon elegans*, una especie altamente distintiva de previas relaciones indefinidas está más relacionada a *C. eximius* y *C. macularius* que a los miembros del complejo *C. variegatus*. 4) Dos formas alopatricas de *C. rubrofluviatilis* fueron genéticamente mas distintivas (identidad de Nei = 0.85) que lo generalmente esperado por miembros de las mismas especies. Algunos aspectos de los resultados de este análisis tienen importantes implicaciones para la conservación de pupos, particularmente para los miembros interiores del complejo *C. variegatus*. Por ejemplo en una recientemente descubierta área de contacto artificial, *C. variegatus* y *C. pecosensis* parecen comportarse como una sola especie a pesar de que esas dos especies aparentemente tienen una relación muy lejana dentro del complejo *C. variegatus*. Esto es de gran interes con respecto a los posibles efectos de fomentar introducciones de *C. variegatus* en el habitat ya ocupado por pupos endémicos.

Desert Fishes Council, Annual Meeting.
Hermosillo, Son., México., Nov. 12-13, 1987.

FISH FAUNA OF THE LOWER RIO SALADO, SUBBASIN OF RIO BRAVO, NE MEXICO.

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ABSTRACT

The fish fauna of the Río Salado, a major tributary of Río Bravo, is poorly known, so it was decided to carry on a survey. It consisted of 60 collections during ¿984-1985, resulting in 104,832 specimens, representing 38 species, 22 genera, and 13 families. Before this survey, 26 species were known in the area: Lepisosteus oculatus, L. osseus, Dórosoma cepedianum, Astyanax mexicana Cycleptus elongatus, Carpiodes carpio, Hybopsis aestivalis, Notropis amabilis. N. braytoni, N. jemezanus, N. lutrensis, N. saladonis, N. stramineus, N. sp., Pimephales vigilax, Ictalurus furcatus, I. cf. punctatus, Pylodictis olivaris, Gambusia affinis, G. marshi, Lepomis macrochirus, L. megalotis, Micropterus salmoides, Aplodinotus frunniens & Cichlasoma cyanoguttatum. Three species -- reported in literature, were not collected in this survey:Cycleptus elongatus Notropis amabilis, and N. saladonis. Twelve species are considered new records; six of them are native: Dorosoma petenense, Cyprinodon variegatus, Poecilia latipinna, P. mexicana, Menidia beryllina, and Lepomis cyanellus; except for the last, they may be considered recent invaders due to salinisation; six are new introductions: Cyprinus carpio, Lepomis gulosus, L. cf. microlophus, Pomoxis annularis, Morone chrysops, and Tilapia sp; ecologically, the native species are gruped in 20 primary, 8 secondary, and 4 perypheral; zoogeographically, they are 20 nearctic, and 6 neotropical, plus 6 other species, and the introductions.

STATUS OF THE WHITE SANDS PUPFISH, CYRINODON TULAROSA, IN THE TULAROSA BASIN OF NEW MEXICO

by Paul R. Turner, Department of Fishery and Wildlife Sciences, New Mexico State University, Las Cruces, New Mexico 88003.

Abstract

The White Sands pupfish is the only native fish species of the endorheic Tularosa Basin of south central New Mexico. Populations occur in Mound Springs (two adjacent limnocrenes) and Malpais Spring and its outflow. Both spring-fed habitats derive their water from archaic sources. The species also is abundant in suitable habitats of about 40 km of Salt Creek, the primary drainage of the upper basin. These three waters are on the U.S. Army's White Sands Missile Range. A fourth population occurs in about 5 km of Lost River on Holloman Air Force Base and White Sands National Monument. No other fish species occurs in the habitats occupied by C. tularosa, but several introduced populations of Gambusia affinis were found in isolated ponds on the missile range and air base. Populations of C. tularosa are found in waters with total dissolved solids ranging from 4,000 mg/L in the spring-fed habitats to over 100,000 mg/L in Lost River. We found no imminent threats to the four populations of C. tularosa. However, unauthorized introductions of non-native fishes or unregulated habitat alterations related to expanding military activities could impact existing populations. These potential threats have been identified and are recognized by the civilian environmental personnel of the military installations. Completion of and compliance with a cooperative pupfish management plan should reduce the likelihood for future problems and negate the need for federal listing of C. tularosa. In summary, increased concern by the military and the extensive distribution of C. tularosa in the diverse aquatic habitats of the Tularosa Basin should favor its long-term survival.

ESTADO DEL PEZ PUPO CYPINODON TULAROSA EN LA CUENCA DE TULAROSA EN EL ESTADO DE NUEVO MEXICO.

Por Paul R. Turner, Departamento de Pesca y Vida Silvestre, Universidad del estado de Nuevo Mexico, Las Cruces, New Mexico 88003.

Resumé

Pupo es la única especie nativa en la cuenca cerrada de Tularosa en la parte centro-sur del estado de Nuevo Mexico. Poblaciones de esta especie ocurren tanto en manantiales de la región conocida como Mound asi como en manantiales de la región llamada Malpais y sus derrames. Ambos manantiales son recargados por aguas intermitentes. Esta especie también es abundante en otras áreas similares a las anteriores abarcando 40 km de Salt Creek que es el principal drenaje de la parte alta de esta cuenca. Estos tres tipos de agua se localizan en la parte conocida como Arenas Blancas de la Armada de los Estados Unidos. Una cuarta población se encuentra en 5 km del río Perdido en la Base Aerea de Holloman y el Monumento Nacional de las Arenas Blancas. Ninguna otra especie de pez ocurre en el medio habitado por Cyprinodon tularosa, sin embargo, algunas especies introducidas de Gambusia affinis se encontraron en estanques aislados cerca del área de Arenas Blancas de la Armada de los Estados Unidos y la Base Aerea. Poblaciones de C. tularosa se encontraron en aguas con 4000 mg/L de sólidos totales en los manantiales asi como en aguas con mas de 100,000 mg/L en el área de Río Perdido. No se encontraron amenazas fuertes en éstas 4 áreas para C. tularosa. Es necesario mencionar que introducciones no autorizadas de peces no-nativos así como alteraciones del área debido a actividades militares podría impactar las poblaciones existentes. Estas amenazas potenciales han sido identificadas y son reconocidas por personal civil, expertos en problemas del ambiente, que se encuentran trabajando dentro de instalaciones militares. El establecimiento y cumplimiento de un plan de administración debe reducir la posibilidad de futuros problemas, además de evitar la extinsión de C. tularosa. En resumen, preocupación de los militares y la gran distribución de C. tularosa en la cuenca de Tularosa favorecen la supervivencia de esta especie en el largo plazo.

Desert Fishes Council, Annual Meeting.
Hermosillo, Son., México. Nov. 12-13:1987

OSTEOLOGY OF Cyprinodon atrorus AND C. bifasciatus. II. SYNCRANIUM. (PISCES:CYPRINODONTIDAE).

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ABSTRACT

An osteological comparison of the syncranium of the two Cuatro Ciénegas, Coahuila, México cyprinodontids, Cyprinodon atrorus and C. bifasciatus, is presented, based on 19 specimens, respectively 10 (25.6-39.2 mm SL) and 9 (30.4-47.4 mm SL): they were cleared and stained with the standar KOH alizarine red technique. Other material from several species, genera and related families was used for general reference. The syncranium is usually divided in seven regions: olfactory, orbital, otic, basicranial, oromandibular, hyoid, and branchial; a total of 64 structures was compared obtaining that 32 (51%) are in a divergent condition, and 30 (49%), are similar between the two species, plus two bones that were not found. When compared, the otic region is the more similar (37% different), while the orbital region shows more divergence (80% different). The sagitta is one of the more differentiated bones, and is characteristic for each species. Other good character is in the number of teeth or teeth-like structures. C. atrorus shows less teeth on premaxillary, dentary, gill rakers, pharyngobranchials, inferior pharingeals, and specially anterior end of the cerotobranchial-4, while C. bifasciatus shows more teeth/teeth-like structures in all of them, except they are absent in cerotobranchial-4.

VARIATION IN AGE, GROWTH AND REPRODUCTION OF GILA TROUT, SALMO GILAE IN HEADWATER STREAMS OF NEW MEXICO

by James Nankervis, Paul R. Turner, and Pat Van Eimeren, Department of Fishery and Wildlife Sciences, New Mexico State University, Las Cruces, New Mexico 88003.

Abstract

Transplants of Gila trout from the five original pure populations have been made into six additional streams. This increase in distribution has allowed the U.S. Fish and Wildlife Service to propose downlisting S. gilae from "endangered" to "threatened" status by 1988. Once this process is completed, the New Mexico Department of Game and Fish will be able to open suitable Gila trout streams to regulated sport fishing. Research indicates that the fishery potential of populations in headwater streams is highly variable. For example, S. gilae averaged only 113 mm (T.L.) at annulus 3 in a stunted population, but fish reached 242 mm at age 3 in an expanding introduced population at lower elevation. Female S. gilae first reach sexual maturity at age 4+ in the stunded population, but reach maturity at either age 2+ or 3+ in other streams. Spawning begins by March in a stream at 1900 m, but may not start until June in a stream at 2700 m. At higher elevations mean total length at annulus 1 is 35-60 mm, but S. gilae average 80-105 mm at age 1 in a lower elevation stream. Fecundity of S. gilae ranged from 68 mature ova in a 158-mm fish to 686 ova in a 274-mm fish. Standing crops of S. gilae were highly variable between and over time and ranged from 20-200 kg/hectare.

VARIACION EN EDAD, CRECIMIENTO Y REPRODUCCION DE LA TRUCHA SALMO GILAE EN CORRIENTES DE LA PARTE ALTA DEL RIO GILA EN EL ESTADO DE NUEVO MEXICO.

Resumé

Por James Nankervis, Paul R. Turner, y Pat Van Eimeren, Departamento de Pesca y Vida Silvestre, Universidad del estado de Nuevo Mexico, Las Cruces, New Mexico 88003.

Siembras de la trucha del Gila de 5 poblaciones puras han sido realizadas por agencias cooperativas dentro de 6 localidades adicionales. Este incremento en distribución ha permitido a el Departamento de Pesca y Servicio de Vida Silvestre salvar a la trucha del Gila de peligro de extinsión y llevarla dentro de niveles normales para 1988. Una vez que el proceso este completo, el Departamento de Pesca y Cacería del estado de Nuevo Mexico podra abrir y regular la pesca de esta importante especie en el Rio Gila. Investigación indica que el potencial de pesca de poblaciones en altas montanas es muy variable. Por ejemplo, la trucha del Gila promedió unicamente 113 mm (largo total) a la edad 3 en una población con prolbemas de crecimiento, pero la misma especie alcanzo 242 mm a la edad 3 en una población de introducción en bajas elevaciones. Las truchas hembras alcanzaron madurez sexual a la edad de 4+ en una población con problemas de crecimiento pero la misma especie maduró a la edad 2+ o 3+ en otras localidades. Desove empieza en Marzo a los 1900 m de altura, pero posiblement no empieze hasta junio a los 2700 m de altura. A mas altas elevaciones la media de el largo total a la edad 1 es 35-60 mm, sin embargo la trucha del Gila promedió 80-105 mm a la edad 1 en bajas altitudes. La fertilidad de Salmo gilae varió de 68 huevos maduros en truchas de 158 mm de largo, hasta 686 en truchas de 274 mm de largo. La cantidad total en peso de la trucha del Gila fue muy variable entre diversas localidades y diversas edades pero en general varió entre 20-200 kg/ha.

Status of, and Recovery Actions for, the Railroad Valley Springfish, *Crenichthys nevadae*

ABSTRACT: The Railroad Valley springfish, *Crenichthys nevadae*, was described in 1932 by Carl Hubbs from specimens collected at Duckwater in Railroad Valley, Nye County, Nevada. *C. nevadae* and *Gila bicolor* (tui chub) are the only two native fishes in the basin. Naturally-occurring populations of *C. nevadae* are known from two areas, Duckwater and Lockes Ranch, in the Railroad basin in a total of seven springs. In 1986, the species was listed as threatened with critical habitat. Threats to the species include effects of livestock overgrazing, modification of thermal spring habitats for agricultural purposes, groundwater pumping, and introduction of exotic species. Three introduced populations of *C. nevadae* are present, two of which are within the Railroad basin. At both Lockes Ranch and Duckwater, alteration of spring habitats has occurred. Additionally, exotic fishes were introduced at Duckwater, including channel catfish (*Ictalurus punctatus*) introduced for aquaculture. A recovery plan is presently being developed which emphasizes restoration and protection of the two native habitat areas, and establishment of a refugium population for each of these two areas.

Randy M. Scott

Estatos de, y Actiones de Recoperacion, del
Pez Manantial del Valle Ferrocaril, Crenichthys nevadae.
(Pez manantial del Valle Ferrocaril)

Resúmen:

El Railroad Valley springfish, Crenichthys nevadae, fue descrito en el año 1932 por Carl Hubbs de especimenes colectados en el sitio de Duckwater en el Valle del Ferrocaril en el estado de Nevada. C. nevadae ay Gila bicolor (el charalito tui) son las únicas dos peces nativas en la cuenca. Poblaciones de C. nevadae que ocuren naturalmente se conocen de dos áreas, Duckwater y el Rancho Locken, en la cuenca del Ferrocaril, en un total de 7 manantiales. En 1986, ele especie fue incluido en lista de peces en peligro de extinción con habitat crítica. Amenazas al especie incluyen efectos de sobre pastreo de ganado, modificación de habitats manantiales ternales para usos agrícolas, bombeo de aguas friáticas, y introducción de especies exóticas. Tres poblaciones introducidas de C. nevadae existen, dos dentro la Cuenca Ferrocaril. En los dos sitios, el Rancho Locken y Duckwater, cambios de habitats manantiales han ocurido. Adicionalmente, peces exóticos fueron introducidos en Duckwater, incluyendo pagres de canal (Ictalurus punctatus), introducidos para su cultura. Un Plan de Recoperación presentemente se está desarrollando, cuyo pone enfasis en la restoración y protección de los dos habitats nativos, y establecimiento de una población de refugio para cada de los dos áreas.

Randy McNatt

Desert Fishes Council, Annual Meeting.
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FISH FAUNA OF THE RIO CONCHOS, SUBBASIN OF RIO BRAVO, NORTH CENTRAL MEXICO

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ABSTRACT

The fish fauna of the Río Conchos, main tributary of Río Bravo in North - Central México, was studied on the basis of 78 collections, made at 62 — localities between 1964-1986. Until this study, 37 species were known from this river. Now, 43 native species, in 28 genera, and 11 families, 64,205 specimens. There are 4 native forms that seem to be new (Dionda ssp., Cyprinodon sp., Gambusia sp. A, and Gambusia sp. B.), and 2 new records (Dorosoma cepedianum and Notropis amabilis). To the 11 known introduced species, 4 are added, 3 new to the Conchos, (Fundulus zebrinus, Chirostoma consocium, and Chirostoma sp. indet.), and 1 new to México (Lepomis marginatus). Total species 58. The native species are predominantly nearctic 35 (29 primary, 5 secondary, and 1 perypheral). There are 8 neotropicals - (1 primary, and 7 secondary). Seven species recorded from literature, were not collected in this survey. Some species show differentiation within the basin, such as Codoma ornata, with high meristics in the Upper Conchos, and low ones in the Middle Conchos. The catfish is termed Ictalurus sp., pending publication of the punctatus/lupus study. Two Chirostoma sp. are considered, one from literature and one from our study, and they may or may not be the same. Gambusia hurtadoi was found in the Río Florido, at Jiménez, outside - its type locality Ojo Hacienda Dolores.

Implementing a Forest Service Fish Habitat Relationship Program Through GAWS

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ABSTRACT

The General Aquatic Wildlife System (GAWS, pronounced "JAWS") is the Intermountain Region's (R-4) Fish Habitat Relationships (FHR) Program. GAWS is a combined aquatic data base and information system. It contains a series of models which can be used separately or in combination. It provides a user-friendly storage and retrieval system for both fisheries habitat inventory data as well as an efficient analysis process to display resulting data outputs. Some of the GAWS models provide economic analysis for projects, angler days, and fish losses. The models in GAWS are speicfic to coldwater salmonid species, either resident or anadromous. GAWS is developed for use at the National Forest level on the Data General computer system and programs are written in either BASIC or FORTRAN 77. GAWS will be used to monitor land use ativities in Forest Plan implementation.

El GENERAL AQUATIC WILDLIFE SYSTEM (GAWS) es la Region Montanosa programma de. las relaciones de habitats de peces. GAWS es dato aquatico que es unido y una sistema de informacion. Se contiene una serie de modelos que se puede usar separadamente o en combinacion. Se da un almacen (user-friendly) y una sistema recuperable por el dato de inventario de la pesqueria habitat asi como un proceso de analisis eficaz para mostrar resultando salidas de dato. Algunos de los modelos de GAWS provide analisis economico para proyectos, dias del pescador, y perdidas de peces. os modelos en GAWS son specifico a los espepie de solmonid de agua fria, residental o los que van al mar. GAWS esta desarrollado por el uso en el nivel de la selva macional en el general dato del systema de computador y los programas estan escritos en BASIC o FORTRAN 77. GAWS sera usado para monitor actividades de los usos de la tierra en ejecucion del plan de la selva.

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The General Aquatic Wildlife System

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GAWS was developed for use at the National Forest level on the Data General computer system and follows Regional survey procedures contained in Forest Service Manual (FSM) R-4 Supplement 2609.23, March 1985, entitled "Fisheries Habitat Surveys Handbook." GAWS was originally developed for the Intermountain Region in the early 1960's, but has been refined in the 1970's and 1980's as a result of field testing new procedures and data. GAWS was introduced in Alaska (R-10) in 1977, R-2 in 1984, Regions 3, 8, and 9 in 1986, and Regions 5 and 6 in 1987. In 1983, GAWS was adopted as the standard interagency stream survey

and analysis procedure in Nevada by the Nevada Department of Wildlife, Forest Service, and the Bureau of Land Management.

GAWS contains the basic survey elements necessary to inventory, describe, monitor, and predict fisheries habitat condition and vulnerability from existing to potential land uses. With the completion of Forest Plans, GAWS will become a key tool in monitoring their implementation for fisheries habitat, biological water quality, and instream flow. GAWS will also provide the necessary aquatic data needed in the next update of RPA.

Included within the basic GAWS programs are procedural methods for conducting: (1) stream habitat surveys; (2) lake-reservoir habitat surveys; (3) aquatic macroinvertebrate surveys; and (4) instream flow quantifications. The stream and lake habitat survey procedure is divided into four conceptual levels. These levels are based on the assumption that different intensities of data collection are required to cope with varying levels of planning and management activities. Accomplishment of a Level 1 survey (office file data documentation) is required as a starting point in all survey planning efforts. With Level 1 as a foundation, the survey process can proceed to Level 2, a stream reach reconnaissance, extensive data collection level. From Level 2, the survey proceeds further into a project planning and/or monitoring Level 3, a site specific transect measurement level for designated stream reaches set apart by characteristics such as geomorphic land type associations, stream channel type, and valley bottom-riparian vegetative community types. A more intensive level of data collection for monitoring, research, and/or administrative studies is contained in a Level 4 survey process. A key component of the Level 2 and 3 survey is the Habitat Condition Index (HCI) which is a result of both streambank and channel component ratings, and relates to the existing (or measured) habitat condition of a specific (or in total) stream reach (or mainsteam). Key components of the HCI are pool/riffle ratio, pool quality class, streambottom material, streambank vegetative cover and stability, and streambank soil stability.

Since macroinvertebrates are a key management indicator species (MIS) for Forest Plan monitoring, GAWS contains a model designed to be used in monitoring the biological water quality of a stream. The data base for this model contains data collected from 1972 to present in over 700 streams containing in excess of 20,000 square foot bottom samples. Key parameters used in the model to analyze excellent to poor habitat conditions and species diversity and occurrence are channel gradient, streambank riparian cover, streambottom materials, and chemical parameters of sulfate, alkalinity, and specific conductance. Through identification analysis of stream samples, the Region 4 Aquatic Ecosystems Analysis Laboratory provides Forests with a Biotic Condition Index (BCI), a species diversity index useful in monitoring the relative health of aquatic ecosystems from land management activities.

Another important part of GAWS is the instream flow model. This model uses a methodology based on a habitat-discharge relationship evaluation to estimate a low streamflow in relation to habitat area and coldwater salmonid species and life stage use. Since any flow reduction or manipulation affects the aquatic habitat, the basic approach is to determine the discharge-habitat relationships and establish a reference point from which further flow reductions can be

related to retention or loss of aquatic habitat. This process has been used in Region 4 since 1975, and has maintained its credibility in instream flow quantifications and water rights adjudication court cases for fisheries habitat needs under the Multiple Use Sustained Yield Act. An important inclusion into this model is the U.S. Fish and Wildlife Service's habitat suitability indices for different salmonid species and life stages. The model's fish habitat report displays preferred habitat for these species and their life stages using depth, velocity, and substrate suitability curves. The report generates a display of habitat area utilized by each species' life stage for the index flow and each predicted level of discharge.

Other models contained within the GAWS program on the Data General and explained in the GAWS User Guide (October 1986) are very important in monitoring certain National Forest activities and in project evaluations. These models include:

. COWFISH - a spreadsheet program designed to assess livestock grazing use along low gradient meandering streams and associated impacts to habitat condition, fish production, loss, and economic value. There are several modifications to the basic COWFISH model which allows use of specific Region or National Forest fish production coefficients as well as associated economic values.

. Wyoming HQI - a program from Wyoming Game and Fish Department on habitat quality index to display estimated trout species standing crop in relation to physical and chemical stream habitat data is included within the GAWS.HIA program menu for habitat improvement analysis.

. GAWS.POP - a series of models to sort and analyze fish population and age/weight data collected from streams or lakes using electrofishing or other methods of fish capture. It includes population statistical models developed by the Wyoming Game and Fish Department and the Intermountain Forest and Range Experiment Station.

. FISHSED - a habitat suitability index (HSI) model capable of predicting the impacts to fish habitat from management derived sediment. It was developed to assist biologists in the use of the R-1/R-4 Guide for Predicting Salmonid Response to Sediment Yields in Idaho Batholith Watersheds (1983). This model uses information on spawning and rearing habitat changes, egg to fry survival, cobble imbeddedness and percent fine sediment by depth to predict existing, potential and cumulative effects to fish and critical habitat in response to management derived sediment.

. FISHBUCKS - a spreadsheet model to display anadromous fish project analysis (numbers and pounds of fish and values) using production, harvest, and production coefficients for summer steelhead and spring chinook in the Idaho area of the Columbia River basin.

. FISHCULVERT - a model designed to provide analysis of fish passage through culverts. Originally written for a TI-990, it is in the process of being converted to the Data General (DG) system for use in the GAWS menu in FY 1987.

. SALMON - an anadromous fish escapement data base model. It displays escapement data and population trends by stream reach within the Columbia River basin for anadromous fish species. It was developed for DG use by the USDI-FWS National Fisheries Research Center in Seattle and provided to Region 4 for GAWS use in anadromous fish project planning.

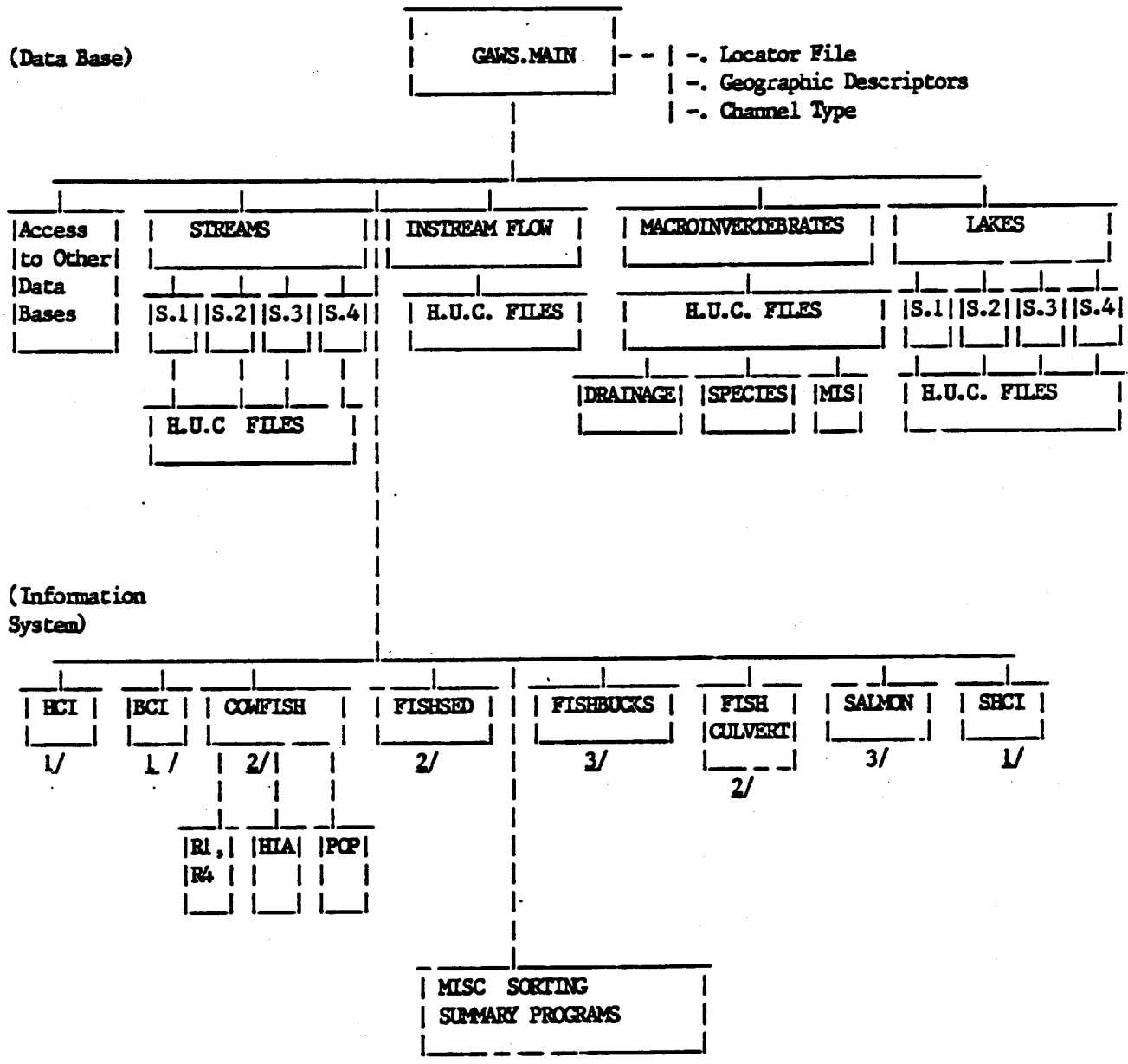
Other models scheduled for inclusion into GAWS, as soon as data analysis and programming is complete, include the HCI or habitat condition index, a model designed to relate salmonid habitat condition to fish numbers and biomass in order to display and predict existing and potential conditions related to Forest management activities; and SHCI a smolt habitat capability index model designed to display existing and potential anadromous fish smolt numbers within the Columbia River basin as a result of land management activities and/or basin-wide developments.

All of the above programs are designed and programmed for use on the Forest Service-wide Data General computer network. They are written in FORTRAN 77 or BASIC language for the DG and are contained in a GAWS User Guide dated October 1986. The current GAWS programs contain approximately 12,000 blocks of information. This figure would increase as Forests enter and store basic field survey data. Each National Forest will manage their specific GAWS data base files while the Regional Office will maintain existing programs and develop new models based on the field needs identified by the National Forests for the implementation and monitoring of Forest Plan activities.

Additional information on the GAWS programs can be obtained from any R-4 Forest Fisheries Biologist or the Regional Fisheries Program Manager (801) 625-5662.

R4 F & WL
USDA - Forest Service

"GAWS"
AQUATIC DATA BASE AND INFORMATION SYSTEM
ORGANIZATION



. stream reach summaries
. management classification
. misc. queries

1/ habitat capability models
2/ habitat evaluation models
3/ species evaluation models

H.U.C. = hydrologic unit code (USGS)

NATIVE FISHES AT BUENOS AIRES NATIONAL WILDLIFE REFUGE AND ARIZONA STATE UNIVERSITY RESEARCH PARK, ARIZONA: OPPORTUNITIES FOR MANAGEMENT, RESEARCH, AND PUBLIC EDUCATION ON ENDANGERED SPECIES

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ABSTRACT

Imperiled bonytail, Gila elegans, Colorado squawfish, Ptychocheilus lucius, or razorback sucker, Xyrauchen texanus, were stocked into ponds at Buenos Aires National Wildlife Refuge (NWR) or Arizona State University Research Park (ASU), Arizona, to evaluate efficacy of artificial habitats for grow-out (NWR), and examine growth where the natives were sympatric with various non-native fishes (ASU). Fish were stocked as juveniles in November 1986, and survival and growth of bonytail and razorback sucker in both places were exceptional; bonytail attained sizes to 370 mm long and razorback sucker reached 426 mm in length by autumn 1987. Ponds at NWR were clearly suitable for rearing fish to substantial size, attainment of which is considered desirable before fish are planted into open waters. There was no indication that presence of non-native fishes influenced growth at ASU, but substantial numbers of exotics were not present when natives were initially planted. Few squawfish have yet been captured at ASU, probably because their size precluded collection by methods used. Activities have focused considerable attention on these imperiled fishes, and thereby provided a mechanism to enhance public awareness of endangered species and programs being implemented toward their recovery.

ESPECIES NATIVAS EN EL REFUGIO NACIONAL DE VIDA SILVESTRE - BUENOS AIRES, ARIZONA, Y EN EL PARQUE DE INVESTIGACION DE LA UNIVERSIDAD ESTATAL DE ARIZONA; OPORTUNIDADES PARA EL MANEJO, INVESTIGACION Y EDUCACION PUBLICA SOBRE ESPECIES EN PELIGRO

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RESUMEN

Gila elegans ("bonytail"), Ptychocheilus lucius ("colorado squawfish") o Xyrauchen texanus ("razorback sucker"), fueron mantenidos dentro de estanques en el Refugio Nacional de Vida Silvestre - Buenos Aires, Arizona (NWR), para evaluar la eficacia de hábitats artificiales en su crecimiento; o en el Parque de Investigación de la Universidad Estatal de Arizona (ASU) para examinar su crecimiento, donde las especies nativas fueron simpátricas con varios peces no nativos. Los peces fueron mantenidos como juveniles en

Noviembre de 1986, observándose que la supervivencia y el crecimiento de "bonytail" y "razorback sucker" en ambos lugares, fueron excepcionales; "bonytail" obtuvo tamaños de 370 mm de largo y "razorback sucker" alcanzó 426 mm de longitud durante el Otoño de 1987. Los estanques en el "NWR" fueron claramente apropiados para criar estos peces hasta tamaños considerables, lo cual es ideal antes de implantarlos en otros lugares. No existió algún indicio de que la presencia de peces no-nativos influyera el crecimiento en los estanques en ASU, aunque números substanciales de especies exóticas no estuvieron presentes cuando los peces nativos fueron inicialmente implantados. Tan solo algunos "colorado squawfish" han sido aún capturados en ASU, probablemente debido a que su tamaño imposibilita su colecta por los métodos utilizados. Estas actividades han llamado la atención sobre estos peces en peligro, y por lo tanto proveyeron un mecanismo para acrecentar el conocimiento público de las especies en peligro y los programas implementados hacia su recuperación.

INTRODUCTION

Bonytail, Gila elegans, Colorado squawfish, Ptychocheilus lucius, and razorback sucker, Xyrauchen texanus, are among the endemic, big river fishes of southwestern North America's Colorado River system. All are imperiled because of habitat alteration or destruction, and interactions with non-native fishes, and are variously listed by the U.S. Fish and Wildlife Service and/or the states of Arizona, California, Colorado, Nevada, New Mexico, and Utah (Johnson 1987).

Many people consider bonytail the most critically endangered fish in the United States; its occurrance in nature has become so infrequent that its present recovery plan (USFWS 1987) calls for deposition in refugia of all wild individuals collected. Reintroductions of bonytail have been only into Lake Mohave, Arizona-Nevada, to augment a remnant, adult population. Razorback sucker adults are still abundant in Lake Mohave, but recruitment there is nil (Minckley 1983, McCarthy and Minckley 1987), despite annual production of substantial numbers of larvae (Marsh and Langhorst, in press). Populations of razorback sucker in the upper Colorado River basin are relatively small, and recruitment is low (Tyus 1987). Active razorback sucker reintroduction programs are underway in Arizona (Marsh, in press) and California (Ulmer 1985). Colorado squawfish has been extirpated from the lower Colorado River basin for decades (Minckley 1973), yet elsewhere fares considerably better than the other two species because reproducing populations still occupy portions of the upper Colorado River basin (Miller et al. 1982, Tyus 1986). Squawfish reintroductions to the Salt and Verde rivers, Arizona, began in 1985, shortly after designation of these stockings as nonessential experimental populations (USFWS 1985).

Studies of razorback sucker to evaluate post-stocking dispersal (Brooks and Marsh, unpubl. data) and predation by non-native ictalurid catfishes (Marsh and Brooks, in review), and of Colorado squawfish (Hendrickson and Brooks, unpubl. data), plus results of long-term monitoring for both species in Arizona, indicated that: (1) fish generally dispersed downstream en masse, usually in darkness, from stocking areas; (2) predation on at least juvenile razorback sucker was a potentially significant source of mortality; and (3) apparent long-term survival suggested by rates of recapture was low. Marsh and Brooks recommended that razorback suckers be captive-reared to two years of age before planting, by which time they could have acheived a size

years of age before planting, by which time they could have acheived a size that would make them relatively unavailable to a majority of predators. Bonytail and Colorado squawfish would likely benefit similarly from initial rearing to larger size.

Hatchery production of these species has been dependent on facilities at the U.S. Fish and Wildlife Service (FWS) National Fish Hatchery, Dexter, New Mexico. Space for grow-out is limited there, and some batches have been transfered to the Arizona Game and Fish Department (AZGFD) Page Springs State Fish Hatchery. However, space there also is limited. It thus was decided that additional facilities be identified and evaluated for grow-out before planting of native fishes. Ponds at the FWS Buenos Aires National Wildlife Refuge (NWR) were numerous, available, and apparently suitable on the basis of initial inspections for native fishes, so agreement was made within FWS Region II to enable plants of razorback sucker and bonytail to evaluate potentials of those ponds as supplemental production space.

Interactions among introduced and native fishes has long been implicated in declines of the latter (e.g., Miller 1961, Minckley and Deacon 1968), but seldom have there been opportunities to examine behavior and basic ecology of the two kinds where sympatric in the wild (but see, Meffe 1985). When "new" ponds at the Arizona State University Reseach Park (ASU) became available for use, they seemed ideal places to study effects of such interaction. These ponds were initially inhabited only by small populations of non-native fishes which were considered relatively innocuous to the big-river species. On the other hand, they were expected to eventually develop complex communities of fishes such as centrarchids, that are known to impact on natives (Marsh and Langhorst 1987, Brooks unpubl. data). Native fishes planted there would thus have a "head start", at least as regards growth, before establishment of exotics. In addition, native fishes at the ASU Park would have high public visibility, and thus represent an opportunity to provide awareness about these fishes, and imperiled species in general.

STUDY AREAS AND PRELIMINARY INVESTIGATIONS

Buenos Aries National Wildlife Refuge

Buenos Aires NWR occupies approximately 40,500 hectares (ha) of grasslands and rocky desert mountains in extreme southern Arizona, near the community of Sasabe, Arizona, and just east of the Baboquivari mountains. Most of the NWR is within headwaters of the north-flowing Altar Valley, a part of the Santa Cruz River system (Gila River drainage). To the extreme south, the refuge drains into Mexico via headwaters of the Rio Conception drainage. Aquatic habitats consist primarily of artificial cattle-watering ponds locally referred to as "tanks", which are dependent upon rainfall for maintenance as aquatic habitat. There is only one perennial stream on the refuge (Arivaca Creek, historically fishless), although substantial flows may occur when precipitation runoff floods normally-dry washes. The 100 or so tanks on the refuge range in size from <0.1 to >15 ha and have a variety of shoreline configurations and morphologies; most are circum-circular, shallow, mud-bottomed excavations or impounded desert washes. Many are ephemeral, while others have capability to hold water year-round. Emergent

and submergent vegetation, algae, and aquatic invertebrates and vertebrates vary substantially among ponds.

A preliminary inventory of aquatic habitats at Buenos Aires was conducted in early December 1985 by Lief Ahlm and Ben Roberton (FWS San Bernardino NWR). They sampled eight habitats (7 tanks and Arivaca Creek) with seines and gill nets, and collected only non-native fathead minnow (Pimephales promelas), largemouth bass (Micropterus salmoides), yellow bullhead (Ameiurus natalis), and mosquitofish (Gambusia affinis), plus tiger salamander (Ambystoma tigrinum, cf. mavortium) and ranid frogs (Rana spp.); one tank was considered fishless. A second inventory in mid-April 1986 by Minckley (ASU), J.E. Johnson (FWS), and others, resulted in sampling of 45 tanks, including 3 of those studied by Ahlm and Robertson. They found the same fish species, plus introduced black bullhead (A. melas), identified R. catesbeiana and R. pipiens among amphibians, and noted other aquatic or semi-aquatic vertebrates that might occur on or near the refuge. No native fishes were collected by either survey group. A third site visit was made in mid-October 1986 to re-examine tanks that appeared to have greatest probability for successful grow-out of native, big-river fishes. That effort resulted in specific stocking recommendations to FWS.

Selected, fishless tanks were stocked by AZGFD and FWS in November 1986. Approximately 3,000 juvenile razorback suckers, average 126 mm total length (TL) and 24 gm, were planted into Mormon Lake on 3 November, and on 4 November, bonytail averaging 76 mm TL and 6 gm were planted into King's (2,966), Big Bertha (2,502), and Road Camp (2,980) tanks. Additional stocking was accomplished on 31 March 1986 when razorback sucker fry (ca. 10 mm) were planted into Mormon Lake (40,000), and Rock (30,000) and Tequila (30,000) tanks.

Sampling after stocking was conducted opportunistically with seine, trammel, and gill nets of varying meshes and dimensions. On each site visit, specimens were measured (TL and standard length [SL]), weighed, evaluated for general health and condition, and a subsample was preserved for later laboratory analyses; others were released alive.

Arizona State University Research Park

The ASU Research Park is located in Tempe, south-central Arizona. Three lakes on the Park grounds were constructed in the early 1980s and filled with water in May 1985. Large-diameter pipes interconnect the lakes to maintain equal water levels, and these conduits allow free passage of fishes and other aquatic biota. Lakes are approximately 2 (North and South lakes) and 4 (Middle Lake) surface ha, have depths to ca. 6 m, and are continuously aereated. The Park grounds, totalling 130 ha, drain internally to the lakes; there are no outlets. They receive make-up water from the Salt River Project (SRP) canal system, which is then used for local irrigation.

Lakes were initially fishless, a situation that soon changed dramatically (Table 1). Stocking of approximately 1,000 redbelly tilapia (Tilapia zilli) on 28 May 1986 was authorized by the Park to control nuisance algae. Trammel netting and seining on 25-26 August indicated tilapia had reproduced successfully; young of year were abundant in all

lakes. Red shiner (Notropis lutrensis) was found in North Lake, presumably an invader from the SRP canals, where it was common (Marsh and Minckley 1982). The next collections were on 2 October 1986. Four taxa of tilapia (redbelly, blue [T.aurea], mouthbrooder [T. mossambica], and "Malacca" hybrid [produced by interbreeding two races of mouthbrooder]) were encountered, the last three presumably contaminants with the initial stocking. Redbelly tilapia made up more than 90% of about 3,900 fishes collected. Red shiner was generally distributed, and comprised about 4% of total fishes taken. Green sunfish (Lepomis cyanellus), bluegill (L. macrochirus), and mosquitofish, all invaders from SRP canals, were found sporadically in small numbers.

AZGFD and FWS planted 1,048 Colorado squawfish juveniles (ca. 76 mm TL) on 5 October 1986, followed on 3 November by 1,000 razorback suckers (80-200 mm TL) and 879 bonytail (76 mm). About half the total numbers of each species was planted in Middle Lake, and the remainder was equally divided between North and South lakes.

Lakes were periodically inspected thereafter, and sampled intensively with seines and trammel nets on 6-9 April and 8-9 September 1987 to assess status of target fishes, and the community as a whole.

RESULTS AND DISCUSSION

Buenos Aires National Wildlife Refuge

Tanks at Buenos Aires NWR were sampled on 31 January-1 February 1987, approximately 3 months after being stocked with native fishes. Sixteen razorback suckers were taken by seine and trammel nets in Mormon Lake; these averaged 166 mm long (range 106 to 222 mm) and 65 gm in weight (range 12 to 126 gm), and were in good condition.

Bonytail were found in all tanks into which they had been planted. Big Bertha produced 52 specimens, 91 were taken from King's, and 9 were collected in Road Camp tank. Total lengths and weights did not vary among tanks, overall averaging 101 mm (range 62 to 178) and 10 gm (range 3 to 52)

Next collections were 27-28 February, about 4 months after stocking, when 12 razorback averaging 172 mm TL (range 103 to 227) and 58 gm (range 12 to 105) were taken from Mormon Lake. Intensive seining in Big Bertha Tank produced one bonytail, King's Tank in contrast produced 37 individuals in a single haul, and 38 were collected in a 10-minute entanglement net set in Road Camp Tank. Bonytail (n = 72) averaged 130 mm TL (range 97 to 185) and 21 gm (range 5 to 53); fish size varied little among tanks. Fish were actively feeding at dusk. A rosy red color was pronounced at the base of anal and both paired fins, a characteristic reminiscent of breeding coloration in adult bonytail (Minckley 1973).

Samping on 15-16 August produced mixed results. Mormon Lake produced a total of 84 razroback suckers, which averaged 97 mm TL (range 71 to 122) and 9 gm (range 5 to 19). These all were derived from the second stocking (40,000 fry, ca. 10 mm, stocked 4 1/2 months earlier on 31 March); none that was attributable to the initial planting (November 1986) were recovered. However, additional collections with trammel nets on 31 August-1

September captured 9 razorback 268 to 311 mm TL (mean 290) and 200 to 400 gm (mean 278), all representatives of the initial planting. Survival and substantial growth over the 10-month period was thus confirmed.

Road Camp Tank produced 114 bonytail in a single seine haul on 15 August. Fish were 116 to 218 mm TL (mean 113) and 10 to 56 gm (mean 20), and exhibited no appreciable growth since February. Big Bertha and King's tanks, both reduced considerably in size compared to previous visits, were sampled intensively with seines; no bonytail were encountered and stocks there were considered extirpated. Cause(s) for extirpation remain unknown, but may include stress and mortality induced by deoxygenation (ponds had organic-rich substrates and substantial communities of phytoplankton and macro-algae, and were diminished to less than 0.2 m depth), and predation by piscivorous birds and mammals to which fish would have been highly vulnerable as water levels declined.

Rock and Tequila tanks, which had each received 30,000 razorback sucker fry in March were examined 31 August-1 September. The former produced 107 fish (58 to 172 mm TL, mean 113), and the latter yielded 102 razorbacks (73 to 176 mm TL, mean 96). Fish in both places were robust and in excellent condition after 5 months.

Selected tanks were sampled again on 20 October 1987. Bonytail in Road Camp Tank averaged 188 mm in length (range 145 to 285, n = 22) nearly a full year after planting. Razorback sucker among three places (Rock and Tequila tanks, and Mormon Lake) averaged 159 mm long (range 84 to 227, n = 162) about, 6 1/2 months after stocking.

Arizona State University Research Park

Lakes at the Park were visually examined during a cold-weather period on 26 January 1987. Large numbers (thousands) of tilapia in apparent cold torpor were aggregated in sunlit shallows. Many hundreds of small fish, primarily tilapia, were moribund on the bottom, and others were observed swimming erratically upside-down or sideways. These last were unresponsive to stimuli and could be readily captured by hand. Many dead fishes had been beheaded, presumably by crayfish, Procambarus clarki, which had invaded the system.

A single, 92-m trammel net set in Middle Lake overnight on 7-8 February produced one specimen each of threadfin shad, Dorosoma petenense, and bonytail. The bonytail had been partially consumed by scavengers; its estimated length was 120 mm.

Another visual inspection was accomplished 2 March when hundreds of dead tilapia (30 to 150 mm long) littered shorelines of all lakes. Three decomposing razorback suckers were recovered from South Lake. No other species of fish were found dead, and fewer than 10 individuals, all tilapia, were seen anywhere, including warm shallows where they had previously been abundant.

Trammel nets were deployed 6-8 April 1987. Razorback sucker predominated the catch (78% of 102 fishes collected), while other taxa

(goldfish, Carassius auratus; carp, Cyprinus carpio; bonytail, Sonora sucker, Catostomus insignis; mountain sucker, Pantosteus clarki; yellow bullhead, green sunfish, and largemouth bass) each was represented by at most 5 specimens. Razorback sucker were 165 to 325 mm TL (mean 255 mm, n = 77), and averaged 220 gm in weight. Razorback catch per trammel net unit effort (CPE, number per 100 m2 per 12-hr set) ranged narrowly among lakes from 7.2 to 9.2 fish, suggesting abundances were similar in all places. All razorback suckers were in excellent health and condition; none was infested with anchorworm, Lernaea cyprinacea, a common malady among wild (Minckley 1983), captive (Langhorst, pers. comm.), and reintroduced stocks (unpubl. data). Bonytail (n = 2) were 214 and 216 mm TL, and also appeared in good condition.

Seining operations were conducted on 9 April. Total CPE (number per haul) was 5.2 fish in North Lake, 0.9 in Middle Lake, and 0.5 in South Lake (overall mean of 2.6 fish), more variable and about 1/10 that recorded during the pre-stocking survey in October 1986 (above). Red shiner comprised 66% of 187 total fishes collected, followed by mosquitofish (13%) and "tilapia" (3%). Other species (bonytail, Colorado squawfish, razorback sucker, green sunfish, and bluegill) each was represented by 1 to 3 individuals. Bonytail (n = 2) were 83 and 104 mm TL, ca. 4 and 10 gm, respectively. Colorado squawfish (n = 2) were 85 and 102 mm TL, ca. 5 and 6 gm, and razorback sucker (n = 5) were 184 to 282 mm long (mean 228) and weighed 92 to 320 gm (mean 180). All fishes were in excellent condition.

A total of 18 species was found at the Park by April 1987, only four of which (bonytail, Colorado squawfish, razorback sucker, and redbelly tilapia) were intentionally stocked (Table 1). The remainder arrived as contaminants with redbelly tilapia (other "tilapias") or invaded from the canals. Status of bonytail and Colorado squawfish could not be quantitatively assessed because too few individuals were captured; however, that could have been attributed to sampling bias, which may not have adequately covered habitats occupied by these fishes, or to size-selectivity of entanglement nets that do not capture smaller individuals. Razorback sucker obviously were doing well: they comprised a remarkable 10% of trammel net catch, and substantial growth had occurred since stocking.

Lakes were next sampled on 8-9 September 1987. Trammel nets produced 11 species, including yellow bass, Morone mississippiensis, and black crappie, Pomoxis nigromaculatus; neither had previously been encountered. The bass was common in area canals, but the crappie had not been known from that system since 1969 (Marsh and Minckley 1982), although it inhabits some local lakes (unpubl. data). Total CPE was about double that of April, and similar among lakes: 16.8 (North), 15.0 (Middle) and 27.5 fish (South).

Razorback sucker was the most abundant fish, overall accounting for 50% of 124 total specimens. Redbelly tilapia (the only cichlid collected) was 28% of total fish, bonytail was 7%, and other species each comprised at most 3% of trammel net samples.

Razorback suckers were 305 to 426 mm TL (mean 363, n = 60), averaged 478 gm (n = 17), and had exhibited remarkable growth since previous sampling. Moreover, survival was apparently high because CPE of 9.3 fish was essentially unchanged from April (8.7).

Bonytail averaged 281 mm TL (n = 9, range 230 to 370 mm) and 155 gm (n = 6, range 88 to 345), and like razorback suckers had grown exceptionally well. These fish were free of external parasites and showed no indication of compromised health. Survival of bonytail could not be reliably interpreted because sampling may not reflect actual numbers present (due to behavioral avoidance of gears), or available to methods used (if smaller fish predominate the stock, these may not be vulnerable to relatively large meshes of trammel nets).

Status of Colorado squawfish at the Park is unknown. It seems likely that gear selectivity accounted for its absence from most collections: individuals remaining in autumn 1987 presumably were too large and agile to be captured with seines, yet too small to become entangled in trammel nets. Alternative techniques, such as electroshocking, may be required to assess squawfish until they attain larger sizes.

SUMMARY AND CONCLUSIONS

Survival and growth of bonytail and razorback sucker have been excellent in artificial habitats at Buenos Aires NWR and ASU Research Park. Growth of both species has met or exceeded that of wild populations in Lake Mohave, Arizona-Nevada (McCarthy and Minckley 1987) and of hatchery stocks at Dexter National Fish Hatchery, and Page Springs (Arizona) and Niland (California) state fish hatcheries (unpubl. data). Health and condition of planted fish also has been excellent compared with other stocks; in particular, anchorworm, which has been problematic at some facilities, has not been encountered among planted fish examined.

Efficacy of stock tanks for grow-out of imperiled fishes at Buenos Aires NWR has been clearly demonstrated. Survival of larval razorback suckers when other species were absent was expected on basis of reintroduction-monitoring and other results (also see Hamman 1987), and was reasonably extrapolated to bonytail. Fish attained sizes in periods of less than a year that should greatly enhance survival when reintroduced into historical, natural habitats. The last activity could be implemented immediately. Additional waters for receipt of native fishes have been identified at the NWR, and suitability of others is yet to be assessed; some will likely require reclamation to remove exotic species, as has already been acomplished in a few places. These should be stocked with bonytail and razorback sucker at earliest availability of fishes, and plans detailed for their later distribution to the wild.

Bonytail and razorback sucker at ASU Research Park demonstrated remarkable growth, despite co-occurrance with a suite of exotic fishes (Table 1) often implicated in declines of native forms. This result was possible because natives were planted at sizes beyond range of available predators; larval stockings would most likely have failed. While introduced fishes may have severe impacts on native populations, (e.g., predation on larvae may curtail recruitment), they have little apparent effect at least on growth of these two big-river fishes. In fact, abundant larval cichlids and other fishes may be important foods of both bonytail and razorback suckers at the Park (unpubl. data).

Both bonytail and razorback sucker now are approaching size and age at which sexual maturity is reached (Hamman 1985a, b). It will be fruitful to directly examine under controlled conditions the effect of exotic fishes on reproduction and recruitment by the natives, an opportunity not generally afforded among wild communities where such study is immensely difficult, if possible at all.

Fate of stocked Colorado squawfish at the Park remains unknown. Only future collections, enhanced by additional sampling methodologies, can determine their survival (if any) and growth. I am optimistic that fish are still plentiful, and positive results will be forthcoming.

Public awareness has been enhanced by recent print and broadcast media coverage on these native fish programs, as indicated by receipt of numerous telephone calls from persons requesting information. Interpretive signs at the ASU Park (Fig. 1) depict and describe the three big-river fishes, and educate the many recreationists who visit the facility daily. Thus, while biological data gathered as a result of these studies may be useful to the scientific community, as much benefit to these imperiled fishes may eventually be realized through an informed public, which supports endangered species recovery programs.

ACKNOWLEDGEMENTS

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LITERATURE CITED

Johnson, J.E. 1987. Protected fishes of the United States and Canada. American Fisheries Society, Bethesda, Maryland. 42 pages.

Hamman, R.L. 1985a. Induced spawning of hatchery-reared razorback sucker. Progressive Fish-Culturist 47:47-49.

Hamman, R.L. 1985b. Induced spawning of hatchery-reared bonytail. Progressive Fish-Culturist 47:239-240.

Hamman, R.L. 1987: Survival of razorback suckers cultured in earthen ponds. Progressive Fish-Culturist 49:138-140.

Marsh, P.C. in press. Razorback sucker management in Arizona. Proceedings of the Desert Fishes Council 17(1985).

Marsh, P.C. and J.E. Brooks. in review. Predation by ictalurid catfishes as a deterrent to re-establishment of hatchery-reared razorback suckers.

Marsh, P.C. and D.R. Langhorst. in press. Feeding and fate of wild larval razorback suckers. Environmental Biology of Fishes.

Marsh, P.C. and W.L. Minckley. 1982. Fishes of the Phoenix metropolitan area in central Arizona. North American Journal of Fisheries Management 2:395-402.

McCarthy, M.S. and W.L. Minckley. 1987. Age estimation for razorback sucker (Pisces: Catostomidae) from Lake Mohave, Arizona and Nevada. Journal of the Arizona-Nevada Academy of Science 21:87-97.

Meffe, G.K. 1985. Predation and species replacement in American Southwestern fishes: a case study. Southwestern Naturalist 30:173-187.

Miller, R.R. 1961. Man and the changing fish fauna of the American Southwest. Papers of the Michigan Academy of Science, Arts, and Letters 46:365-404.

Miller, W.H., J.J. Valentine, D.L. Archer, H.M. Tyus, R.A. Valdez and L. Kaeding. 1982. Colorado River Fishery Project. Final Report, Contract Number 9-07-40-L-1016, U.S. Fish and Wildlife Service and Bureau of Reclamation, Salt Lake City, Utah. 3 volumes; 42, 324, and 365 pages.

Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix. 293 pages.

Minckley, W.L. 1983. Status of the razorback sucker, Xyrauchen texanus (Abbott), in the lower Colorado River basin. Southwestern Naturalist 28:165-187.

Minckley, W.L. and J.E. Deacon. 1968. Southwestern fishes and the enigma of "endangered species". Science 159:1424-1432.

Tyus, H.M. 1986. Life strategies in the evolution of the Colorado squawfish (Ptychocheilus lucius). Great Basin Naturalist 46:656-661.

Tyus, H.M. 1987. Distribution, reproduction, and habitat use of the razorback sucker in the Green River, Utah, 1979-1986. Transactions of the American Fisheries Society 116:111-116.

Ulmer, L. 1985. Management plan for razorback sucker (Xyrauchen texanus) in California. California Department of Fish and Game Region 5 Informational Bulletin 0013-10-1985. 26 pages.

U.S. Fish and Wildlife Service. 1985. Endangered and threatened wildlife and plants; determination of experimental population status for certain introduced populations of Colorado squawfish and woundfin. Federal Register 50:30188-30195.

U.S. Fish and Wildlife Service. 1987. Technical review draft bonytail chub, Gila elegans recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado. 37 pages.

TABLE 1. List of fishes collected from lakes at Arizona State University Research Park, Tempe, Arizona, and known or suspected sources and dates of introduction, through September 1987. Voucher specimens of all taxa are deposited in the ASU Collection of Lower Vertebrates. Native species are indicated by an asterisk (*).

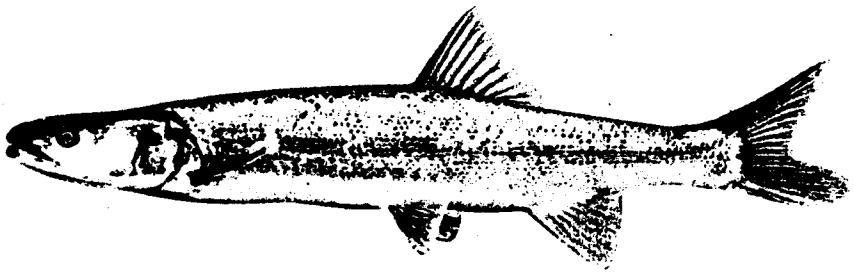
Scientific name	Common name	Source (date)[a]
Dorosoma petenense	Threadfin shad	SRP canal (2/87)
Carassius auratus	Goldfish	aquarium release ? (4/87)
Cyprinus carpio	Carp	SRP canal (4/87)
*Gila elegans	Bonytail	stocked by AZGFD[b] (11/86; 2/87)
Notropis lutrensis	Red shiner	SRP canal (8/86)
*Ptychocheilus lucius	Colorado squawfish	Stocked by AZGFD (11/86; 4/87)
*Catostomus insignis	Sonora sucker	SRP canal (4/87)
*Pantosteus clarki	Mountain sucker	SRP canal (4/87)
*Xyrauchen texanus	Razorback sucker	Stocked by AZGFD (11/86; 4/87)
Ameiurus natalis	Yellow bullhead	SRP canal (4/87)
Gambusia affinis	Mosquitofish	SRP canal (10/86)
Morone mississippiensis	Yellow bass	SRP canal (9/87)
Lepomis cyanellus	Green sunfish	SRP canal (10/86)
Lepomis macrochirus	Bluegill	SRP canal (10/86)
Micropterus salmoides	Largemouth bass	local resident[c] (4/87)
Pomoxis nigromaculatus	Black crappie	SRP canal (9/87)
Tilapia aurea	Blue tilapia	unknown[d] (5/86; 10/86)
Tilapia mossambica	Mouthbrooder	Stocked by Park (5/86; 10/86)
Tilapia zilli	Redbelly tilapia	Stocked by Park (5/86; 8/86)
Tilapia hybrid	"Malacca hybrid"	Stocked by Park (5/86; 10/86)

[a]Date of first collection record; where two dates are given, the first represents the stocking date, the second is the collection record.

[b]Stockings by AZGFD (Arizona Game and Fish Department) were in cooperation with U.S. Fish and Wildlife, Arizona State University, and the Park.

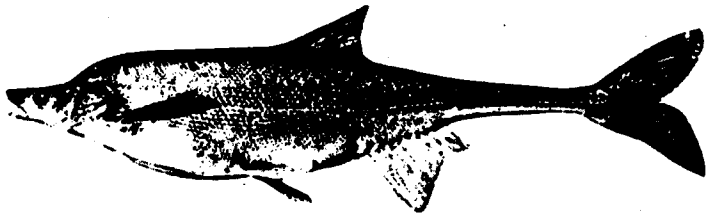
[c]Although present in the Salt River Porject (SRP) canal system, largemouth bass reportedly were planted by an unidentified local resident. Such unuathorized and thus undocumented activity should be discouraged. The Park stocked largemouth bass fingerlings, ca. 100 mm long, in May 1987.

[d]Presumably, only Tilapia zilli was to be stocked for control of nuisance algae; other species and the "Malacca" hybrid could have been contaminants inadvertantly planted along with T. zilli. T. aurea and T. mossambica both are rare in the SRP canal system and would not likely have been derived from that source. An unauthorized stock of T. aurea was held in tanks on the Park grounds until at least October 1986, after which they apparantly were destroyed or otherwise removed.



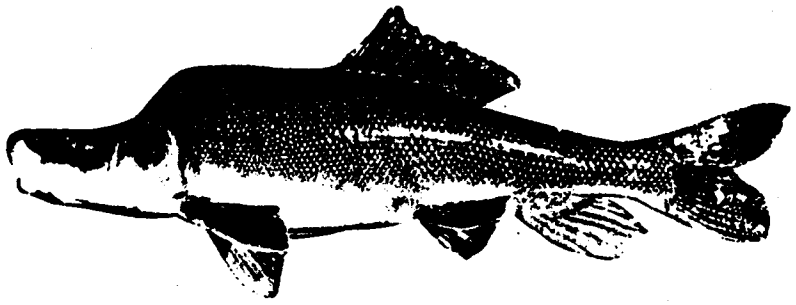
Colorado Squawfish *(Ptychocheilus lucius)*

Olive color, darker above; belly whitened.
Maximum adult size to 6 feet and nearly 100 pounds.



Bonytail Chub *(Gila elegans)*

Color dark olive above, light below.
Maximum adult size near 3 feet and more than 5 pounds.



Razorback Sucker *(Xyrauchen texanus)*

Color olive to brownish-black above, lighter (often yellow) below.
Maximum adult size more than 2 feet and 10 pounds.

These protected species have been stocked as part of research on imperiled Colorado River fishes. If you catch one RETURN IT TO THE WATER alive and notify the Arizona State University Center for Environmental Studies at 965-2977 or the Arizona Game and Fish Department Nongame Branch at 942-3000.

FIGURE 1. Interpretive sign (in part) posted at the Arizona State University Research Park to enhance public awareness of imperiled fishes. This publicity has resulted in numerous phone calls from persons interested in receiving additional information on these species.

ADVANCES IN TOTOABA RESEARCH PROJECT (*Totoaba macdonaldi*) ENDEMIC FISH OF THE GULF OF CALIFORNIA.

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A B S T R A C T

The totoaba, endemic fish of the Gulf of California was declared an endangered species in 1979. It is the largest scianid of great commercial value.

In 1983, due its endangered situation, the Consejo de Investigación y Desarrollo de la Totoaba (CIDET) was organized. This group concerned about the species conservation is attempting to improving research on bioecological aspects for this species, - through coordination with Federal and State Institutions. The - Centro de Investigación y Desarrollo de los Recursos Naturales- del Estado de Sonora (CIDESON) and the Centro Ecológico de Sonora (CES) are shearing those activities under agreement since -- 1987, following the recomendations of CIDET.

This paper, presents the results obtained in 1987, as a part of that agreement regarding the problematic situation of the totoaba *Totoaba macdonaldi* (Gilbert, 1890) in the Northern part of the upper Gulf. This paper discusses: The study of stomach con-- tents and food habits, inchthyoplancton and ichthyofauna sampling from January to September 1987, reproductive biology aspects and finally, the efforts to mantain individuals of different life -- stages in captivity.

AVANCES DEL PROYECTO DE INVESTIGACION DE LA TOTOABA (Totoaba macdonaldi), PEZ ENDEMICO DEL GOLFO DE CALIFORNIA.

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R E S U M E N

La totoaba, pez endémico del Golfo de California y declarado en peligro de extinción desde 1979, es el sciánido de mayor tamaño de importancia comercial cuya zona de reproducción es el Alto Golfo de California.

A raíz de su delicada situación se organizó en el año de 1983 el Consejo de Investigación y Desarrollo de la Totoaba (CIDET), preocupados por su conservación e impulsando la investigación de los aspectos bioecológicos de la especie, a través de instituciones federales y estatales. Dentro de estas destacan el Centro de Investigación y Desarrollo de los Recursos Naturales del Estado de Sonora (CIDESON) y el Centro Ecológico de Sonora (CES), quienes participan de estas actividades bajo un convenio de colaboración conjunto a partir de 1987, siguiendo los acuerdos del CIDET.

En este trabajo se presentan los avances obtenidos como resultado de dicho convenio, en cuánto a la problemática de la totoaba Totoaba macdonaldi, (Gilbert, 1890) en la parte Norte del Alto Golfo, en lo referente a: el estudio de los contenidos estomacales de adultos (durante la migración reproductiva anual) y juveniles; los muestreos ictioplanctónicos e ictiofaunísticos durante el período de Enero a Septiembre de 1987; aspectos sobre la Biología reproductiva y, los esfuerzos realizados para mantener especímenes en sus etapas juveniles en cautiverio.

I N T R O D U C C I O N

Es bien conocido por los investigadores y estudiosos del Mar de Cortés, la situación por la que atraviesa la totoaba Totoaba-macdonaldi (Gilbert, 1890), que es el sciánido de mayor tamaño - dentro de ese importante grupo de peces. Es una especie endémica del Golfo de California cuya amenaza de extinción es inminente - para el año 2000 de continuar como hasta ahora, los factores que contribuyen a ello, como lo es la pesca incidental y clandestina de juveniles y adultos de totoaba durante la temporada camaronera y en la época breve de reproducción, además de las alteraciones ecológicas ocurridas en la desembocadura del Río Colorado, por - mencionar solo algunas (Flanagan y Hendrickson, 1976).

Es innegable que el Gobierno Mexicano ha tratado de proteger a este pez y sus acciones datan de los años cincuentas en que algunos biológos se avocaron al estudio sobre aspectos biológicos- estableciendo la delicada situación de la especie. Es así que se decretó una temporada de veda y posteriormente se declaró una zona de reserva y refugio en le desembocadura del Colorado, hasta- llegar a la población total de su captura en 1975 (Dirección General de Pesca e Industrias Conexas, 1975) y que continua vigente- en nuestros días.

Gracias al esfuerzo y profundo interés y tezón de personas- como el Dr. John Hendrickson, quien ha contribuído enormemente - al conocimiento de la Biología de la especie, con el ánimo de -- conservar y salvar de las garras de la extinción a la totoaba; - ésta fué declarada en peligro de extinción por The National Marine Fisheries Service en 1979 (Federal Register 44 (9): 29478-29480).

Tal situación de la totoaba ha ocurrido por múltiples factores en donde se han combinado aspectos culturales, socioeconómicos, políticos escasez y desconocimiento de la información biológica necesaria, etc.; que ha conllevado a que cada vez sea más difícil su recuperación. No obstante, en 1983, en un esfuerzo - por conservar y proteger este importante recurso se creo el Consejo para la Investigación y Desarrollo de la Totoaba (CIDET), - en donde intervinieron diferentes instituciones federales y estatales vinculados al sector de recursos marinos, con el propósito de estructurar un plan maestro de investigación que enfocara -- los puntales básicos hacia la obtención de información bioecológica con el fin de buscar posibilidades reales para la conservación mediante el desarrollo de técnicas acuícolas para su cultivo en el largo plazo.

El Centro de Investigación y Desarrollo de los Recursos Naturales del Estado de Sonora (CIDESON) y el Centro Ecológico de Sonora (CES), participaron en dicho acuerdo, pero no es hasta 1987 que ambas instituciones estatales, establecen colaborar en forma conjunta bajo convenio, en el estudio de la Totoaba.

El objetivo principal, según los acuerdos de CIDET, es el realizar trabajos de investigación científica para incrementar la información bioecológica sobre este sciánido en su medio natural, así como bajo condiciones de laboratorio; para tratar de establecer las facetas iniciales de un cultivo a nivel experimental, que abra una luz hacia la conservación de la especie.

Como respaldo al convenio entre ambas instituciones se elaboró un plan de coordinación cuyos objetivos y estrategias estan plasmados en el cuadro 1.

El presente trabajo tiene la finalidad de dar a conocer los avances, producto de la coordinación, en cuanto a los aspectos de: análisis de contenidos estomacales y hábitos alimenticios de la totoaba, descripción de huevos y larvas de sciánidos en el Alto Golfo de California, Biología reproductiva y los esfuerzos realizados para la adaptación de larvas, juveniles y adultos de la Totoaba (Totoaba macdonaldi).

ACTIVIDADES DE CAMPO DURANTE 1 9 8 7

Se realizarón un total de 8 salidas de campo de Enero a Septiembre (excepto el mes de Julio) a la parte Alta del Golfo de California, en donde cada una de ellas atendió a un objetivo específico (cuadro 2). Las salidas durante el período Marzo-Abril, temporada reproductiva de la totoaba, fueron realizadas bajo permiso expedido por la Secretaría de Pesca a CIDESON con el Oficio No. 240287-222-01/0468. Los puntos de muestreos estuvieron en su mayoría localizados dentro de la zona de reserva sobre la costa de Sonora y en 3 ocasiones se muestreó sobre la costa de Baja California con el propósito de obtener muestras de ictioplancton.

A V A N C E S

ANALISIS DE CONTENIDOS ESTOMACALES Y HABITOS ALIMENTICIOS.

Un total de 52 estómagos de adultos de totoaba fueron revisados y se obtuvieron los datos de peso y volumen por desplazamiento de agua de estómagos vacíos y llenos del contenido estomacal y de cada uno de los grupos tróficos encontrados; aplicando el método volumétrico Frecuencia de Ocurrencia e Indice de Importancia Relativa. (Yañez-Arancibia et al., 1976).

Como parte del contenido estomacal de la totoaba se encontraron diez (10) especies y 2 identificados al nivel de familia (cuadro 3), donde según las pruebas aplicadas, se reporta que durante la época reproductiva, esta especie se alimenta principalmente de peces, donde la Frecuencia de Ocurrencia (F.O.) fué del 86.53%, el Volumen 66.77% y el Indice de Importancia Relativa de 38.54% (cuadro 4).

Los demás grupos que formaron parte del contenido estomacal presentaron los siguientes valores:

Para la materia digerida la F.O. fué de 38.46%, Volumen de- 22.42 e Indice de Importancia Relativa (I.I.R.) 10.93%.

Para los crustáceos la Frecuencia de Ocurrencia fué de 25%, el volumen 3.18% y un Indice de Importancia Relativa de 0.79%.- Por último, los moluscos presentaron una F.O. de 1.92%, un Vo-- lumen de 0.05% y un I.I.R. de 0.0009%.

Dentro de las especies presa de la totoaba se encontraron 4 nuevas especies: Callinectes arcuatus, Squilla bigelowi, Prionotus ruscarius y Peprilus ovatus. Además 2 familias de peces Aridae y Fistularidae.

Comparando las especies presa de la totoaba, mencionadas por otros autores (Berdegué, 1955; Arvizu y Chávez 1972; Flanagan y- Hendrickson, 1976 y Barrerea, 1985) se corrobora en el presente- estudio, que la totoaba es una especie carnívora en la etapa a-- dulto (1.33 a 1.70 m.), que se alimenta principalmente de peces. siendo estos el grupo de alimento primario dentro del cual la es pecie predominante fué Cetengraulis mysticetus (sardina bocona), especie catalogada como muy abundante en el Golfo de California- (Castro-Aguirre et al., 1970); por lo cual se puede considerar - accesible para ser consumida por la totoaba.

En lo que concierne a las demás especies de peces, todos que dan incluídos como grupos tróficos de importancia baja o acciden tal ya que los porcentajes de las pruebas aplicadas fueron meno- res al 10% (F.O., VOL. Y I.I.R.).

El grupo de los crustáceos quedó definido como un grupo de - alimento secundario y terciario ya que los valores para las prue bas antes mencionadas, fluctuaron entre el 10 y el 40% y menores al 10% respectivamente. En el caso de éste último grupo, todas - las especies que lo constituyen fueron consideradas como grupos- de alimento accidental, por el bajo valor porcentual alcanzado - (10%).

El resultado de las pruebas de análisis aplicados permiten - sugerir que la totoaba es una especie no selectiva ya que la mayo ría de las especies encontradas, en el contenido estomacal, queda ron incluidas dentro de los grupos tróficos circunstanciales o - accidentales, además, en el 56% de los estómagos analizados se en contraron combinaciones de 2 o más tipos de alimento; lo cuál su- giere la no selectividad de una especie en particular (Boothby y- Avault, 1971).

Actualmente se encuentra en proceso el análisis de los conte- nidos estómacales de una muestra de 64 ejemplares capturados en - arrastres camaroneros en Agosto de 1987. De éstos, se han procesa do hasta el momento 33 ejemplares.

DESCRIPCION DE HUEVOS Y LARVAS DE LOS SCIANIDOS DEL ICTIOPLANCTON DEMERSAL DEL DELTA DEL RIO COLORADO Y LA PARTE NORTE DEL ALTO GOLFO DE CALIFORNIA.

Las muestras se obtuvieron de arrastres de ictioplancton durante las mareas vivas de cada mes, utilizando una red de plancton tipo CalCOFI de luz de malla de 0.505 mm y un metro de diámetro. Los arrastres se realizaron a bordo de una panga de 7 m. de eslora con motor de 75 H.P. Se obtuvieron un total de 166 arrastres durante el período comprendido de Enero a Septiembre de 1987.

Los datos de colecta recabados fueron, número de muestra, localización de estación, profundidad, duración de arrastre (en minutos), temperatura del agua, salinidad y observaciones del estado del tiempo en general. Las muestras fueron debidamente etiquetadas y preservadas en formol 4% buffer. Una vez en el laboratorio se procedió a separar los huevos y larvas encontradas en cada muestra con la ayuda del microscopio estereoscópico. Después se transfirieron a frascos de 50 ml. para su posterior identificación. Durante la separación de las muestras, se estimó la abundancia de las demas especies utilizando la siguiente escala subjetiva: MA (Muy Abundante), A (Abundante), C (Común) y R (Raro).

Hasta el momento se ha procesado el 25% de las muestras, de las cuales se ha obtenido el registro de 21 géneros que corresponden a 16 familias (cuadro 5), de éstos, 3 géneros pertenecen a la familia Sciaenidae: Micropogonias spp, y Cynascion spp y Elattarchus spp.

La mayor abundancia de larvas de sciánidos encontrados pertenece a la zona de reserva (cuadro 6) y costa de Baja California, no teniendo registro, hasta el momento, para la Costa de Sonora. Aunque resulte prematuro decirlo, esto pudiera explicarse si se hace una relación entre las zonas de muestreos y el tipo de sustrato existente, de los lugares en donde se han encontrado larvas de sciánidos, ya que la composición de los sedimentos de dichos lugares es limo-arcilloso de fondo suave, que además se relaciona con la presencia de juveniles de sciánidos, como lo menciona Guevara-Escamilla et al. (1973), corroborado también por Flanagan y Hendrickson (1976), cuándo mencionan la captura de juveniles de totoaba de tallas menores a los 12 cm., en fondos de ese tipo.

Con respecto a la ictiofauna; se lleva procesado el 100% de las muestras obtenidas para 1987. Se encontraron un total de 11 familias, de las cuales la familia Atherinidae resultó la más abundante representando un 60.77% en forma global para el total de muestras analizadas.

La familia Sciaenidae en cambio solo alcanzó el 2.22%, con los géneros Atractoscion spp, Menticirrhus spp, Cynoscion spp, Umbrina spp, no existiéndo registro de totoaba en nuestros muestreos hasta el momento.

BIOLOGIA REPRODUCTIVA DE LA TOTOABA.

EL CIDESON, a través del M.C. Juan Carlos Barrera ha venido realizando investigaciones sobre estos aspectos de la Biología, de lo cual se esta elaborando un trabajo que será objeto de presentación en este Simposio donde se relatan los avances obtenidos a la fecha en cuanto madurez gonadal, fecundidad y comportamiento reproductivo durante la temporada de migración al Alto Golfo de California, (Barrera, comunicación personal).

ADAPTACION AL CAUTIVERIO DE LA TOTOABA.

Los esfuerzos realizados en este sentido para 1987, y a lo que se le dedicó 3 salidas especiales (Enero a Marzo), para la obtención de gametos maduros para intentar la fertilización artificial; resultaron infructuosos debido a dos causas principales: los adultos colectados durante Enero y Febrero se encontraban aún inmaduros para lograr la obtención de gametos. Durante la salida del mes de Marzo, no se pudo obtener ejemplar alguno adulto de totoaba a pesar del intenso esfuerzo de pesca aplicado a bordo de pangas totoaberas y con la experiencia y ayuda de los pescadores. Pensamos que este fenómeno pudiera deberse a las condiciones climáticas que prevalecieron durante este año, que difieren con respecto a los años anteriores, principalmente en cuanto a temperatura que se registró ligeramente más baja de lo normal. Sin embargo, se requiere de mayor profundidad en el estudio de este acontecimiento para poder afirmar a ciencia cierta sobre las causas reales del fenómeno observado. Los esfuerzos con respecto a la obtención de machorros (solamente una salida de campo), resultó de igual manera infructuosa durante 1987. Sin embargo se cuenta con la experiencia de haber mantenido en cautiverio un ejemplar juvenil durante un período de 6 meses, con la aceptación de alimento (camarón) congelado, en las instalaciones del C.E.S. de Septiembre de 1985 a Marzo de 1986.

FUENTES CONSULTADAS.

Arvizu, J. y H. Chávez. 1972. Fao Fish Synops., (108): pag. var. Sinopsis sobre la biología de la totoaba Cynoscion macdonaldi, Gilbert, 1980.

Barrera, J.C. 1985. La totoaba: Valioso recurso del NW de México, Sonora Investigación y Desarrollo Num 3: 2-4.

Berdegué, A.J. 1955. La pesuqería de la totoaba (Cynoscion macdonaldi) en San Felipe, Baja California Rev. Soc. Mex. - Hist. Nat. 16 (1-4): 45-78.

Boothby, R.N., and J.W. Avault Jr., 1971. Food Habitats Length-Weight, Relationlip and Condition factor of the Red Drum (Scianopus acellata) in South eastern Louisiana Trans -- Amer. Fish. Soc. (2): 290-295.

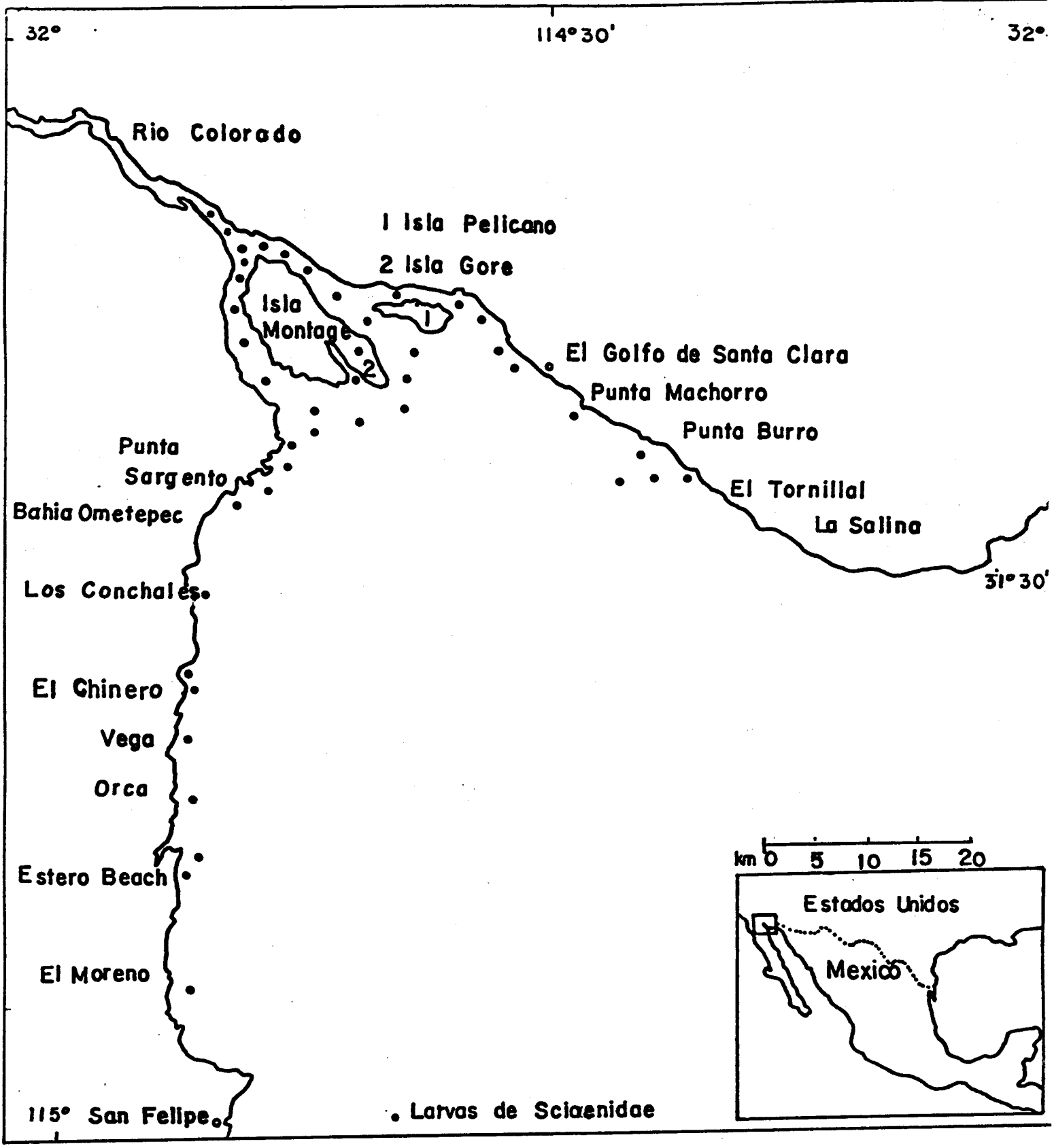
Castro-Aguirre, J.L., J. Arvizu M. y J. Páez. 1970. Contribución al conocimiento de los peces del Golfo de California Rev. Soc. Mex. Hist. Nat. 31:81-107.

Flanagan, C.A. and J.R. Hendrickson, 1976. Observation on the -- commercial fishery and reproductive biology of the totoaba Cynoscion macdonaldi in the northern Gulf of California, México. Fish. Bull. 74 (3): 531-544.

Guevara-Escamilla, S.H.A. Huerta Díaz, E. Felix Pico, B. Claudia Farfán y C. Matheius, 1973. Biología (Peces, contenidos - estómacales en peces, agrupaciones de fauna: Macro-invertebrados, biomasa de Zooplancton) En: Estudio Químico sobre la contaminación por insecticidas en la desembocadura del Río Colorado. Reporte final de la segunda etapa, a la Dirección de Acuacultura de la Secretaría de Recursos Hidráulicos., Universidad Autónoma de Baja California, Unidad de Ciencias Marinas, Tomo 11 Sec. IV 235-364 pp.

National Marine Fisheries Service, Office of Marine Mammals and-Endangered Species. 1979 Washington D.C. 20235.

Yañez-Arancibia, A., J. Curiel-Gómez y V.L. de Yañez 1976. Prospección Biológica y Ecológica de Bagre Marino Galleichthys caerulescens (Gunther) en el sistema lagunar costero de - Guerrero, México (Pisces: Ariidae), An. Centro Cienc. del Mar y Limnol. Universidad Nacional Autónoma de México 3 - (1): 125-180.



MAPA I

DISTRIBUCION DE ESTACIONES

ICTIOPLANCTON

PROYECTO: Ecología y Cultivo de la Totoaba

OBJETIVO: Información bio-ecologica de la Totoaba; Información bajo condiciones de cautiverio. → Conservación y Cultivo

ESTRATEGIA: 4 Subproyectos

Análisis de contenidos estomacales y hábitos alimenticios	Descripción de huevos y larvas en el Norte del Golfo de California	Biología reproductiva de la Totoaba	Adaptación de larvas, juveniles y adultos de Totoaba
Analizar cuali y cuantitativamente las especies consumidas; grupos preferenciales y hábitos alimenticios	Identificación, abundancia de huevos y larvas-determinación de parámetros para el desarrollo de los mismos.	Delimitar y describir el ciclo gonadal y la fecundidad, comportamiento y ecología reproductiva de la Totoaba	Adaptar al cautiverio ó domesticar larvas, juveniles y adultos de Totoaba

CUADRO 1. Diagrama de Flujo del Proyecto: "ECOLOGIA Y CULTIVO DE LA TOTOABA"

L U G A R	M E S	O B J E T I V O
El Golfo de Santa Clara, Son. y Zona de Reserva.	Enero.	Obtención de gametos de Totoaba y - - arrastres de Ictioplancton
El Golfo de Santa Clara, Son.	Febrero	Obtención de estómagos y gametos de - Totoaba, colecta de Ictiofauna.
El Golfo de Santa Clara, Son.	Marzo	Obtención de estómagos y gametos de - Totoaba, colecta de Ictiofauna
Alto Golfo de California y Zona de Reserva	Abril	Muestreos de Ictioplancton e Ictiofauna, Obtención de estómagos de Totoaba.
El Golfo de Santa Clara, Son. Zona de Reserva y Costa de Baja California	Mayo	Muestreos de Ictioplancton e Ictiofauna
Costa de Sonora y Costa de Baja California	Junio	Muestreos de Ictioplancton e Ictiofauna
Costa de Sonora, Costa de Baja California y Zona de Reserva	Agosto	Muestreos de Ictioplancton e Ictiofauna
Zona de Reserva	Septiembre	Muestreos de Ictioplancton y búsqueda de machorros.

CUADRO 2. Salidas de campo realizadas durante el período Enero-Septiembre de 1987.

PECES	CRUSTACEOS	MOLUSCOS
Gobionellus longicauda	Callinectes bellicosus	Loligo sp.
Gillichthys mirabilis	* Callinectes arcuatus	
Anchoa mundeloides	Squilla tiburonensis	
Mugil cephalus	* Squilla bigelowi	
Leuresthes sardina	* Sycionia penicillata	
* Micropogonias megalops	* Trachypenaeus sp.	
** Centengraulis mysticetus	Penaeus sp.	
* Ophistonema libertate	Post-larvas de camarones peneidos	
* Prionotus ruscarius		
* Peprilus ovatus		
* Syngnathus carinatus		
Syacium ovale		
Anchoa sp.		
Micropogon sp.		
Familia Ariidae		
Familia Fistularidae		

CUADRO 3. Grupos y especies de cada grupo que componen la dieta de la Totoaba en el Alto Golfo de California. (Berdegué, 1955; Flanagan y Hendrickson, 1976; Guevara- Escamilla et. al., 1973 y Barrera, 1985).

* Especies encontradas en el presente trabajo

** Especie más abundante encontrada en el presente trabajo.

GRUPO	FRECUENCIA DE OCURRENCIA	VOLUMEN %	IND. IMP. REL.
Peces	86.53	66.77	38.54
Materia digerida	38.46	22.42	10.93
Crustáceos	25.00	3.18	0.79
Moluscos	1.92	0.05	0.0009

CUADRO 4. Valores de frecuencia de Ocurrencia, Volumen e Indice de Importancia Relativa para cada uno de los grupos consumidos por T. macdonaldi -- durante los meses de Abril de 1986, Febrero y Abril de 1987 en la -- parte Norte del Alto Golfo de California.

C U A D R O 5

Familias de Peces encontradas en muestras de Ictioplancton durante el período Enero-Septiembre de 1987

1) Sciaenidae
2) Atherinidae
3) Engraulidae
4) Hemirhamphidae
5) Bothidae
6) Carangidae
7) Exocoetidae
8) Sygnathidae
9) Scombridae
10) Tetraodontidae
11) Mugilidae
12) Gobiidae
13) Pleuronectidae
14) Cynoglossidae
15) Sparidae
16) Albulidae

L O C A L I D A D	NO. LARVAS SCIAENIDAE
Entre el Bajo de la Isla Montague y Punta Sacatoza, B.C.	1
Frente a Punta Sacatoza, B.C.	3
Lado SW de Punta Sacatoza, B.C.	6
Lado SW de Punta Sacatoza, B.C.	2
Frente a "El Chinero", lado de las Salinas	5
Frente a "Estero Beach", B.C.	6
Desembocadura del Río Colorado, Lado de B.C.	115
Desembocadura del Río Colorado, lado de B.C.	5
Punta NW Isla Montague, B.C.	27
No. Total de Larvas.	170

CUADRO 6. Localidades con registro de larvas de Sciáenidos en el Alto Golfo de California.

F A M I L I A	NO. TOTAL DE ORGANISMOS.	ABUNDANCIA (%)
1) Atherinidae	1421	60.77
2) Albulidae	232	9.92
3) Gobiidae	196	8.38
4) Engraulidae	164	7.01
5) Carangidae	88	3.76
6) Clupeidae	84	3.59
7) Mugilidae	68	2.90
8) Sciaenidae	52	2.22
9) Pleuronectidae	29	1.24
10) Bothidae	3	0.128
11) Sygnathidae	1	0.0427

CUADRO 7.- Abundancia (%) por familia encontrada en muestras de ictiofauna de Abril, Mayo y Junio de 1987, en el Alto Golfo de California.

ASSIMILATION OF HABITAT UTILIZATION DATA FOR ENDANGERED FISHES OF THE UPPER COLORADO RIVER BASIN (A Case History)

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ABSTRACT

In 1984, the U.S. Fish and Wildlife Service (FWS) chose to implement the Instream Flow Incremental Methodology (IFIM) as a tool for evaluating the habitat requirements and flow needs of the endangered fishes of the Upper Colorado River Basin. One aspect of this methodology is the collection of habitat utilization data for developing habitat suitability index (HSI) curves. BIO/WEST, Inc. was contracted by FWS in 1986 to assimilate all existing data on the Colorado squawfish (Ptychocheilus lucius), humpback chub (Gila cypha), and razorback sucker (Xyrauchen texanus) in the upper basin and coordinate a panel of experts to develop appropriate HSI curves. This paper describes data collection and assimilation methods as well as problems recognized by species experts in applying IFIM to a large turbid riverine system such as the Green and Upper Colorado Rivers.

ASIMILACION DE DATOS DE HABITAT UTILIZADA POR LOS PECES EN PELIGRO DE EXTINCION DE LA CUENCA DEL RIO COLORADO

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RESUMEN

En 1984, el Servicio de Peces y Animales Silvestres de los Estado Unidos (FWS) decidio implemintar un metodo incremintal de flujo (IFIM) como instrumento para evaluar los requerimientos de habitat y nesesidades de flujo de los peces en peligro de extincion de la cuenca superior del Rio Colorado. Un aspecto de este metodo es la coleccion de datos de habitat utilizada por los peces para desarrollar funciones matematicas. BIO/WEST fue contratado por FWS en 1986 par asimilar todos los datos del Colorado squawfish (Ptychocheilus lucius), humpback chub (Gila cypha), y el razorback sucker (Xyrauchen texanus) de la cuenca superior y coordinar un grupo de expertos par desarrollar propias funciones matematicas. Esta presentacion describe metodos de coleccion y asimilacion de estos datos, iqualmente como las problemas reconosidas por los expertos en aplicar este metodo de IFIM en rios grandes y turbulentes como los Rios Verde y Colorado.

INTRODUCTION

The purpose of this project was to develop the best possible HSI curves for the Colorado squawfish (Ptychocheilus lucius), humpback chub (Gila cypha), and razorback sucker (Xyrauchen texanus). The parameters used were depth, velocity, substrate, cover, and temperature. To accomplish this goal, the following objectives were met:

1. Determine suitable data for use in HSI curves,
2. Analyze data and develop category 2 HSI curves,
3. Identify data gaps and develop category 1 or interim HSI curves where data are absent or sparse,
4. Attain consensus of species experts on all curve sets.

METHODS

The general format for the project involved having BIO/WEST assimilate and summarize all available data and then, during two workshops, develop a consensus of species experts on how the data would be analyzed for curve development.

The project was divided into the following six work tasks:

TASK A: Database Assimilation and summarization,
TASK B: Workshop #1 to convene species experts for data selection, stratification, pooling and analysis,
TASK C: Draft Report with preliminary HSI curves,
TASK D: Workshop #2 to obtain consensus on final HSI curves,
TASK E: Draft Final Report with HSI curves and documentation
TASK F: Final Report with HSI curves and documentation

TASK A: Database Assimilation

The data assimilated for this project were all preexisting field data that dated back to 1964. These data were assimilated, documented and summarized to provide a condensation of information for the species experts at Workshop #1.

Assimilate The Data

The database used was provided by FWS in computerized format. It consisted of about 100,000 records of information representing collections in the upper basin from 1964 through 1984. We identified a total of 99 different studies by 17 different principal investigators. BIO/WEST reduced this database to a working database of about 8,100 records containing just the quantitative habitat data on the three target fishes. The remaining data were not considered because of the lack of quantitative habitat measurements. It was noted that the database was devoid of cover data and contained little habitat-specific temperature measurements.

This assimilation of data revealed several problems inherent to assembling large databases. First, the large volume of data (100,000 records, each with up to 40 data fields) was difficult and cumbersome to sort using the proposed database management system dBASE III+. Instead, the BIO/WEST database manager worked with ASCI files and small programs tailored to meet the individual needs of data sorting or analysis.

The second problem encountered is that not all computerized data were received in a consistent format; data were stored under inconsistent field names, in different field widths, under various codes, and sometimes in different units of measure. Establishing a common format database with consistent codes and units of measure became a major task in this project. Since this project, FWS has developed and issued guidelines for data storage for all endangered fish collections in the upper Colorado River Basin (U.S. Fish and Wildlife Service 1987).

A third problem with the data was the large number of gear types employed. Over 50 different gears were identified, such as seines and gill nets of various dimensions and mesh sizes. Use of certain gear types may bias habitat measurements and render the data unusable.

A major problem with the database was that each study had specific and different objectives that did not often address collecting data for HSI curve development. To deal with this large variety of data, a system of decision points was established, based on nine biological criteria. This system is described briefly in the subsection on Workshop #1.

Summarize And Document Data Sets

A study narrative was developed for each study by an investigator for a given year (Exhibit 1). The narrative provided species experts with a brief description of study objectives, areas sampled, dates of collection, gear types, a summary of target fish by age category, and a list of related references.

Summary Tables

The data were further assimilated into summary tables by species and age category (Exhibit 2). These summary tables presented, by river strata or region, the total number of fish handled, and the number with associated habitat measurements. The number of fish observations were also presented by month and gear type. These summary tables were provided to the experts to enable them to assess data availability and distribution in preparation for Workshop #1.

Previous Studies

Six previous studies were identified through literature research which presented HSI curves for the target species. These were compared with the curves developed through the current project.

TASK B: Workshop #1

Workshop #1 was held in Salt Lake City in January 1987. It was attended by 17 people, including 3 BIO/WEST organizers, 5 species experts, and 9 participants. The objectives of the Workshop were to convene a panel of species experts and to:

1. Determine data to use for HSI curves,
2. Determine stratification, pooling and analysis.

Determine Data To Use

Workshop #1 was conducted by these BIO/WEST organizers; a chairman, a facilitator, and a database manager. The role of the chairman was to conduct the meeting, describe the database to the participants, and solicit input on data to be used. The facilitator moderated the workshop, insured equal input, and promoted consensus discussions. The database manager was responsible for insuring the complete database, and describing available analysis and curve development techniques. All workshop proceedings were documented on flip charts and reel-to-reel audio tape. These organizers did not have decision-making authority.

All decisions on data partitioning, pooling, and analysis were made by a panel of five species experts. The experts were selected and invited to the workshop by FWS, based on their professional expertise and working knowledge with the species. A decision by four of the five experts was considered a consensus.

The nine participants represented a cross-section of interests and were encouraged to contribute to workshop discussions, but they had no decision-making authority.

The decisions to use certain data were facilitated with the use of dendrograms for each species by age group (Exhibit 3). First, all data from all studies were grouped to remove the identity of the study and the investigator. By using a list of nine criteria as decisions points, the experts were asked whether data should be pooled as partitioned, i.e. pool or partition data by rivers. These nine criteria considered life stage, river, strata, year, gear type, time or year, time of day, sample design, and habitat parameters. At the bottom of each dendrogram, HSI curves and categories were identified for development. Category 1 curves were identified for life stages with little or no data; category 2 curves were identified for life stages with sufficient data.

Use of these dendrograms and decision criteria was very effective for this project. This approach enabled the species experts to consider all datasets equally and include or eliminate data from HSI curve development on the basis of data strengths and weaknesses rather than on individual or personal biases for particular investigators.

Stratify, Pool, Analyze Data

At the beginning of Workshop #1, the BIO/WEST chairman and database manager summarized the data to be considered for this HSI curve development project. At that time, the database manager presented to the species experts options for data stratification, pooling and analyses techniques, including appropriate statistical tests. This information was presented to the group to familiarize the experts with analyses options so that BIO/WEST could be provided with a specific direction and set of analyses in preparation for Workshop #2.

In some cases, the species experts decided, through biological rationale and by consensus, on the data for curve development. Where uncertain, BIO/WEST was asked to perform a 'test' or 'decision/test'. Where a 'test' was specified, the data were to be pooled if not significantly different. No pooling was to be performed under a 'decision/test', but the statistics were to be reported as a tool for decisions during Workshop #2.

To determine whether to pool data partitions, the Kolmogorov/Smirnov (K/S) cumulative frequency test was used to test between histograms of depth and velocity. Since the substrate data were in predetermined cells, a chi-square test was used instead of the K/S. Testing was done at the greatest level of resolution.

The system of consensus decisions by the five species experts worked very well. However, a sixth invited expert, that was unable to attend this first workshop, attended the second. This expert did not necessarily agree with or understand some of the decisions rendered at Workshop #1, and precious time was taken from Workshop #2 to explain the rationale of these decisions. A second species expert, able to attend only Workshop #2, sent an alternate to Workshop #1. This provided better continuity in understanding the rationale behind certain decisions. Nevertheless, any change in personnel composing the species experts should have been resisted, and such change is inadvisable in similar projects.

A second problem at Workshop #1 was a certain lack of commitment by the species experts to make decisions on data selection, partitioning, and pooling on the basis of biological rationale. There was a strong tendency by the experts to resist making a decision on certain data partitions without the benefit of statistical testing. Even in cases where a decision based on biological rationale seemed appropriate, they rendered the decision with much apprehension, or resisted making the decision without full statistical testing. This resulted in hundreds of statistical tests that BIO/WEST had to perform prior to Workshop #2. Presenting the results of these tests at Workshop #2 was complex and time consuming. Most of the test results supported the original biological intuition, initially resisted by the experts.

The experts recognized during Workshop #1 that an inherent problem in collecting microhabitat data from a turbid system like the Colorado River is the inability to observe fish in a recognized behavioral mode within a given microhabitat. Instead, the majority of available data

has been collected with conventional gears such as electrofishing, gill or trammel nets, and seines. Extensive use of these conventional gears has yielded a large volume of microhabitat data with questionable reliability, since it is not known if a fish was forced from a preferred habitat before capture by active gear (e.g. electrofishing), or captured in transit between habitats by passive gear (e.g. gill or trammel nets). The experts determined that seine data were appropriate for young and juvenile fishes, but that radiotelemetry data were preferred over data from conventional gears for adults. Unfortunately, radiotelemetry data were not available for all data partitions.

TASK C: Draft Report

A Draft Report was issued by BIO/WEST following Workshop #1. The purpose of this report was to:

1. Summarize the project to date
2. Describe methods used to pool data
3. Identify potential data sets to develop curves
4. Describe techniques used to develop HSI curves
5. Provide preliminary category 2 curves

Methods To Pool Data

In the month following Workshop #1, BIO/WEST followed the instruction provided by the species experts for pooling and analyzing the data. The Kolmogorov/Smirnov (K/S) cumulative frequency test was used to determine whether to pool data partitions of depth and velocity. Since the substrate data were in predetermined cells, a chi-square test was used instead of the K/S test. Testing was done at the greatest level of resolution.

Identify Datasets To Develop Curves

Following the partitioning and pooling established by the experts at Workshop #1, and the additional statistical analysis performed by BIO/WEST, a total of 56 preliminary curve sets resulted; 6 for razorback suckers, 12 for humpback chub, and 38 for Colorado squawfish. Each curve set was four histograms, one each for depth, velocity, substrate type, and habitat category, as well as accompanying documentation.

Techniques Used To Develop Curves

A mathematical approach was used to smooth each HSI curve to fit the raw data histogram for depth and velocity. Three curve models were used: exponential polynomial, exponential density, and generalized Poisson. These curve models were used instead of a least squares fit to force the curve to peak over the data mode and to reduce the influence of outlying data points.

Preliminary Category 2 Curves

The draft report issued by BIO/WEST following Workshop #1 provided the results of data partitioning and statistical tests specified by the experts at the workshop. This report also provided a set of "preliminary curves" that were developed from the data partitions decided at the first workshop. The draft report was sent to the species experts as well as to over 50 other "project participants" to prepare everyone for Workshop #2.

The problem with developing the draft report was dealing with the large number of data partitions and statistical test results created at Workshop #1. The draft report turned out to be a 100-plus page document that included the results of hundreds of statistical tests as well as 56 preliminary curve sets; 6 for razorback sucker, 12 for humpback chub, and 38 for Colorado squawfish. Each curve set was four histograms, one each for depth, velocity, substrate type, and habitat category, as well as accompanying documentation. The number of curve sets and statistical tests following Workshop #1 could have been reduced substantially with greater use of biological rationale and more discrete employment of statistics.

TASK D: Workshop #2

Workshop #2 was held in Fort Collins, Colorado, in late March 1987, and was attended by 16 people, including 4 BIO/WEST organizers, 6 species experts, and 6 participants. This week-long workshop was conducted in a similar manner to Workshop #1 in that all decisions were the result of expert consensus. The objectives of the Workshop were to reconvene the species experts to:

1. Obtain approval on category 2 curves.
2. Develop category 1 curves.

Approval Of Category 2 Curves

Workshop #2 generally went rather smoothly. One to two days was spent on each of the three target species, examining each set of preliminary curves and developing interim curves. Using copies of the draft report, transparencies of each curve set, and computer screen limelite projections, the results of further partitioning or pooling of data were shown to the participants at the time of these decisions. This enabled the experts to see the final results of their decisions rather than wait for the Draft Final Report. Each curve set consisted of a one-page description of the data partition, and four histograms with documentation; one each for depth, velocity, substrate, and habitat type (Exhibit 4).

The logistical procedure of showing each preliminary curve set and accompanying statistical tests was time-consuming, but did not present a major obstacle to finalizing the curves. But, as Workshop #2 progressed, it became more evident to the species experts that their decisions on data selection and even slight modifications to resultant

curve generation had major implications in assessing habitat and eventually flow needs of these endangered species. The experts recognized early in Workshop #2 that a third workshop was needed to examine the practicality of these curves by actually integrating them with PHABSIM (Physical Habitat Simulation Models), and generating values of weighted usable area. A third workshop was not a part of the original project description, and one was not scheduled following this revelation.

The ensuing discussions held during Workshop #2 were the most significant of this curve development project in that these revealed many insights into the application of IFIM to the fishes of the Upper Colorado River Basin. Participants and experts alike identified possible problems with each of the two major elements of IFIM; HSI curves and PHABSIM. However, there was insufficient time and opportunity to thoroughly discuss these issues in this workshop, and there remained many misconceptions and misunderstandings about the use of these curves in IFIM. These misconceptions brought about a concern by the experts for the hydraulic models that sometimes influenced their decisions in curve development. A limited discussion was held between the species experts (fisheries biologists) and a few hydrologists familiar with IFIM who participated in the workshop. Both biologists and hydrologists recognized problems in the application of IFIM to the Colorado River System because recent runs using preliminary HSI curves had yielded unlikely or unrealistic results of flow needs. A need was recognized for additional interaction between the disciplines to resolve the dilemma.

This uncertainty led to the development of a "General Habitat Constraint" by the species experts. Since it was recognized that certain riverine habitat types had not been described by current models, use of the HSI curves should be restricted. The experts specified in the documentation that curves containing 25 percent or more of data from backwaters, embayments, concavities, isolated pools, and gravel pits; or 50 percent or more of data from eddies; or 60 percent or more from a combination of these, were not to be used in IFIM using current PHABSIM models. The reason for this decision was that these habitats are either too small to be encompassed by the cross sections of a typical PHABSIM station, or they exhibit hydraulic phenomenon which is difficult to describe mathematically, i.e. upstream velocity in eddies. This general habitat constraint effectively eliminated 8 of the 18 final curve sets from use in current IFIM.

A problem that arose late in the workshop was confusion by the experts of the three categories of HSI curves, as described by Bovee (1986). The objective of the project was to develop category 2 curves from available data and category 1 curves, where data were insufficient or lacking. Category 2 curves were developed first. During this process, there was an effort to allow the curves to be defined by the data by using the best fit approach. As Workshop #2 progressed, the experts recognized that some data histograms did not necessarily reflect the perceived habitat used by the species, and some curves were modified to a more realistic curve. For example, the majority of data on humpback chub adults were from depths of less than 20 feet (Exhibit 4),

but the experts extended the utilization value of 1.0 to about 40 feet because such depths occur in the habitat of the fish but limit sampling efficiency. As a result of modifying some curves, the experts opted to eliminate use of the category concept to describe these curves.

Develop Category 1 Curves

Efforts to prompt the species experts to develop category 1 curves for those species and life stages where data were insufficient or lacking had limited success. Prior to Workshop #2, the species experts were sent available information and standard formats for developing category 1 curves for depth, velocity, and substrate for some life stages, and temperature and cover curves for all stages. This Delphi approach generally failed because the experts felt that so little is known about the habitat needs of some life stages of these endangered species, developing these category 1 curves would be a hazardous guess. Instead, the experts chose to apply the same or similar depth, velocity, and substrate curves previously developed from actual data for similar life stages. For example, a curve set similar to that developed for YOY Colorado squawfish was applied to YOY razorback sucker and humpback chub, where no data were available.

HSI curves for temperature and cover were not developed under category 2 because of lack of data, and these were not developed under category 1 because the experts felt that fish use of these parameters in the Colorado River System is not well understood. Temperature HSI curves were not developed because the experts felt that there was a lack of sufficient data to define temperature requirements of the various life stages, and there is a need to refine temperature models to the resolution needed to describe flow-temperature relationships. Efforts to develop HSI curves for cover were also not successful, although instream vertical rock structure was identified of possible importance to humpback chub. The experts resisted developing category 1 HSI curves for cover because they felt that the relationship of fish to instream cover was difficult to quantify under the turbid conditions of the Colorado River.

Tasks E and F: Draft and Final Reports

A Draft Final Report was issued following Workshop #2. This report contained the interim curves developed during Workshop #2, and a draft synopsis of the six project tasks. The report was reviewed by the 50 participants, and the reviews were assimilated by BIO/WEST into a Final Report (Valdez et al. 1987). There appeared to be insufficient time for the project participants to thoroughly review the document, and reflect on the use of these curves.

A major problem expressed by some potential users of these HSI curves is that they have been classified as "interim curves" by the species experts. This classification means that additional information is needed to further define the habitat used by all life stages of these three species, and use of these curves with current PHABSIM may yield unlikely or unrealistic results. For these reasons, the experts

recommended that use of these curves should be coordinated through FWS. A second problem expressed by users is that the general habitat constraint, imposed by the experts, effectively eliminated 44 percent of the curves from use; those with significant portions of data from backwaters, eddies, etc. These problems indicate that there are significant strides needed in data refinement and habitat modeling before IFIM can be effectively applied to the Upper Colorado River Basin.

FINDINGS

The following summarize the findings by the experts in the curve development project:

1. The curves developed are interim curves since ongoing programs are being conducted to refine them and develop new curves where none exist, i.e. winter habitat use.

2. For many curve sets, the quantity of data were judged insufficient and a need was identified for better data to refine the curves.

3. Data from radiotelemetered fish were observed to better represent adult habitat use, over data from conventional gear such as electrofishing, gill nets, and trammel nets.

4. The habitat requirements of very early life stages of these rare fish are not well known, but need to be described and their survival assessed in the wild.

5. A 'General Habitat Constraint' was developed since certain habitats (backwaters, eddies, embayments, concavities, isolated pools) have not been modeled to date, using current PHABSIM data.

6. No HSI curve were developed for temperature because of insufficient knowledge of the relationship between temperature and growth, survival and success of the species.

7. No HSI curves were developed for cover because little data were available and because cover may not manifest itself in a traditional sense of overhanging banks and streamside vegetation, but rather as turbidity, lateral rock structure, and instream sand ridges. HSI curves could be developed for these if data were available.

8. Other factors besides depth, velocity, and substrate are also recognized as important to the well-being of the species. The experts recognize that food availability, competition, predation, and diseases also affect the well-being of the native fishes.

LITERATURE CITED

Bovee, K.D. 1986. Development and evaluation of habitat suitability criteria for use in the Instream Flow Methodology. Instream Flow Information Paper 21. U.S. Fish Wildl. Serv. Biol. Rep. 86(7). 235 pp.

U.S. Fish and Wildlife Service. 1987. Upper Colorado River Basin Database, List of field names and data codes. U.S. Fish Wildl. Serv., Grand Junction, CO. Draft Report.

Valdez, R.A., P.B. Holden, T.B. Hardy, and R.J. Ryel. 1987. Habitat suitability index curves for endangered fishes of the Upper Colorado River Basin. HSI Curve Development Project, Contract No. 14-16-0006-86-055, performed by BIO/WEST, Inc. for U.S. Fish Wildlf. Serv., Region 6, Denver, CO. 173 pp.

EXAMPLE OF A STUDY NARRATIVE THAT DESCRIBES A SPECIFIC STUDY IN THE UPPER COLORADO RIVER BASIN THAT PROVIDED DATA FOR THE HSI CURVE DEVELOPMENT PROJECT.

STUDY: GR64VAN.DBF

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OBJECTIVES: Data collected in the Green and lower Yampa Rivers in 1964 as part of a doctoral dissertation to assess the impacts of Flaming Gorge Dam (impounded November 1, 1962) on fish populations. The major objectives of the study were:

1. To describe species composition, abundance, and distribution of Green River fishes at selected stations between Flaming Gorge Dam and the mouth of the White River, 1964-1966.

2. To compare present species compostion and distribution in the study are with that of pre-impoundment years.

3. To describe growth, reproduction, survival, and food habits of selected native species.

4. To determine the physical and biotic factors which limit the distribution and abundance of selected species.

5. To determine whether the environmental requirements of these species are being met in the section of the river studied.

Two native species were selected for intensive life-history study, the Colorado squawfish and "Colorado chub", Gila robusta. Life history and habitat use was compared between the roundtail chub (G. r. robusta) and the bonytail (G. r. elegans). Chubs shorter than 200 mm TL were grouped into one category because they could not be separated into subspecies. The humpback chub (G. cypha) was not collected in this study. Specific numbers of rare fish captured were not always available from original data sheets, but records are allocated in datafile to show that these fish were captured in respective samples. Contains some habitat designations and some depth, substrate measurements on Colorado squawfish and razorback suckers.

NUMBER OF RECORDS: 780

RIVER SAMPLED (RMI): GREEN RIVER (240.3 - 403.0)
YAMPA RIVER (0.0 - 0.5)
DUCHESNE RIVER (0.0)
WHITE RIVER (0.0)

DATAFILE: GR64VAN.DBF (continued)

DATES OF COLLECTION: 05/15/64 - 11/28/64

TIMES OF COLLECTION: 0600 - 1900

DATES OF COLLECTION CONTAINING TARGET SPECIES: 06/08/64 - 11/01/64

TIMES OF COLLECTION CONTAINING TARGET SPECIES: 0800 - 1830

GEAR TYPES:

Electrofishing	--	27 Records
Nets (Gill/Trammel)	--	17 Records
Seines	--	31 Records
All Other	--	0 Records

SUM OF RECORDS WITH TARGET SPECIES: 75

	NUMBER OF RECORDS				NUMBER COLLECTED			
SPECIES	LAR	YOY	JUV	ADU	LAR	YOY	JUV	ADU
Colorado Squawfish	0	1	0	2	0	8	0	2
Humpback Chub	0	0	0	0	0	0	0	0
Razorback Sucker	0	0	0	1	0	0	0	1
TOTALS	0	1	0	3	0	8	0	3

REFERENCES:

Vanicek, C.D. 1967. Ecological studies of native Green River fishes below Flaming Gorge Dam, 1964-1966. Doctoral Dissertation. Department of Wildlife Resources, Utah State University, Logan, UT. 124 pp.

Vanicek, C.D. and R.H. Kramer. 1969. Life history of the Colorado squawfish, Ptychocheilus lucius, and the Colorado chub, Gila robusta, in the Green River in Dinosaur National Monument, 1964-1966. Transactions of the American Fisheries Society 98(2):193-208.

Vanicek, C.D., R.H. Kramer, and D.R. Franklin. 1970. Distribution of Green River fishes in Utah and Colorado following closure of Flaming Gorge Dam. The Southwestern Naturalist 14(3):297-315.

Exhibit 2. Example of Summary Table.

COLORADO SQUAWFISH LIFE STAGE: Size 1

COLORADO RIVER 1982 - 1986

Strata	No. of Fish	Number of fish with following measurements: Depth	Velocity	Sub1	Sub2	Watertemp	Habitat
A	9	3	3	3	0	0	9
B	83	81	81	83	83	78	83
C	151	92	91	92	80	85	126
D	58	30	30	30	26	26	45
E	50	18	18	18	18	0	48
F	188	169	169	169	166	94	185
G	0	0	0	0	0	0	0
H	54	30	30	27	21	16	54
I	200	38	37	38	21	18	75
J	0	0	0	0	0	0	0
K	1	1	1	1	1	1	1
M	0	0	0	0	0	0	0
N	0	0	0	0	0	0	0
O	0	0	0	0	0	0	0
P	0	0	0	0	0	0	0
X	0	0	0	0	0	0	0
Y	0	0	0	0	0	0	0
Z	0	0	0	0	0	0	0
#	108	85	72	85	85	69	85
Total	902	547	532	546	501	387	711

Month	No. of Fish	Number of fish with following measurements: Depth	Velocity	Sub1	Sub2	Watertemp	Habitat
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	112	73	73	73	73	73	93
8	340	87	83	89	86	65	169
9	295	236	227	233	228	121	294
10	155	151	149	151	114	128	155
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
#	0	0	0	0	0	0	0
Total	902	547	532	546	501	387	711

Gear Type	No. of Fish	Number of fish with following measurements: Depth	Velocity	Sub1	Sub2	Watertemp	Habitat
Electro.	0	0	0	0	0	0	0
Nets(G/T)	0	0	0	0	0	0	0
Seines	547	547	532	544	499	387	547
Radio	0	0	0	0	0	0	0
Other	355	0	0	2	2	0	164
Total	902	547	532	546	501	387	711

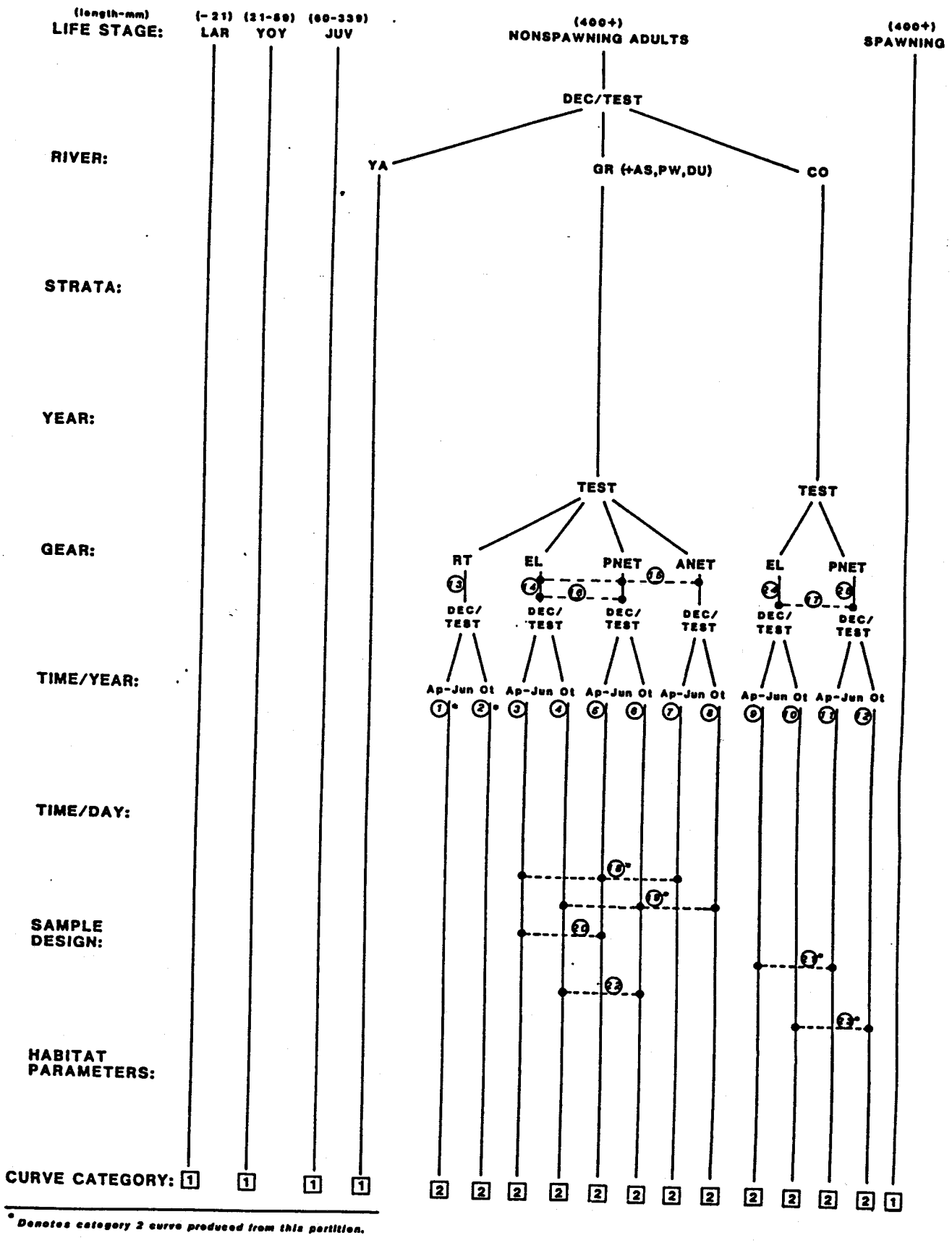

Exhibit 3. Dendrogram with data partitions for razorback sucker resulting from Workshop #1.

Exhibit 4.

CURVE SET: 16 - Humpback Chub Size 5 (260+ mm)

WHERE DATA COLLECTED: Colorado, Green, Yampa rivers.

WHERE CURVES APPLY: Upper Colorado River System occupied by humpback chub.

WHEN DATA COLLECTED: March - November

WHEN CURVES APPLY: March - November

HOW DATA COLLECTED: Radiotelemetry, electrofishing, nets, angling

PARAMETERS: Depth = total water column depth in feet at point of collection or triangulation.

Velocity = mean water column velocity in feet/second at point of collection or triangulation.

Substrate = see Table C-1.

Habitat = see Table C-2.

CONFIDENCE RATINGS: 'B' for depth, velocity, substrate, because, although sample size was adequate, the quality of the data was restricted by possible gear limitations from samling in the deep riverine regions occupried by the species.

CONSTRAINTS:

1. Apply only to Size 5 - Nonspawning Adults.
2. Use only in known or potential humpback chub habitat.

QUALIFIERS:

1. Taxonomic problems with Gila sp. lend problems to identification of adult fish afield.
2. Caution is advised in applying curves to times other than March-November, since all collections are from these months.
3. Data collected in specific humpback chub habitats only, i.e., Black Rocks, Westwater Canyon, Gray Canyon.
4. Use of "dominant" substrate not advised for future analyses, since "dominant" and "secondary" substrates should be considered.

DATA GAPS/NEEDS:

1. Gain ability to reliably identify adult humpback chubs afield.

RAW DATA USED: See Appendix D.

CURVE SET 16. HUMPBACK CHUB SIZE 5

PARAMETER: DEPTH (FT)
SAMPLE SIZE: 286.
MEAN = 10.33 VARIANCE = 65.24
MIN. = .00 MAX. = 40.10

CURVE COORDINATES

DEPTH	UTILIZATION
0.00	0.00
1.30	0.00
2.40	0.10
4.80	0.70
7.20	1.00
10.00	1.00
20.00	1.00
30.00	1.00
40.00	1.00
42.00	1.00
100.00	0.00

Model Format: GENERALIZED POISSON

F (X) = 1 AT A = 9.00
F (X) = 0 AT B = 40.10
SHAPE FACTOR C = 1.00
SHAPE FACTOR D = 20.00

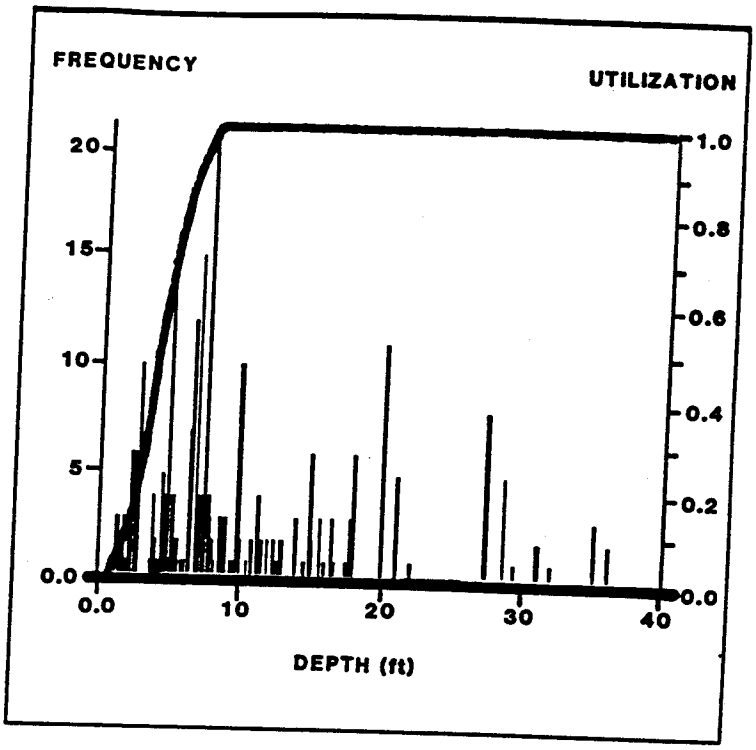

FIGURE 25A. DEPTH

PARAMETER: VELOCITY (FT/S)
SAMPLE SIZE: 274.
MEAN = .63 VARIANCE = .41
MIN. = .00 MAX. = 3.90

CURVE COORDINATES

VELOCITY	UTILIZATION
0.00	0.58
0.23	1.00
0.46	0.96
0.93	0.80
1.39	0.68
1.85	0.56
2.32	0.42
2.78	0.29
3.24	0.18
3.71	0.03
4.00	0.00

Model Format: GENERALIZED POISSON

F (X) = 1 AT A = .27
F (X) = 0 AT B = 3.90
SHAPE FACTOR C = 1.00
SHAPE FACTOR D = 60.00

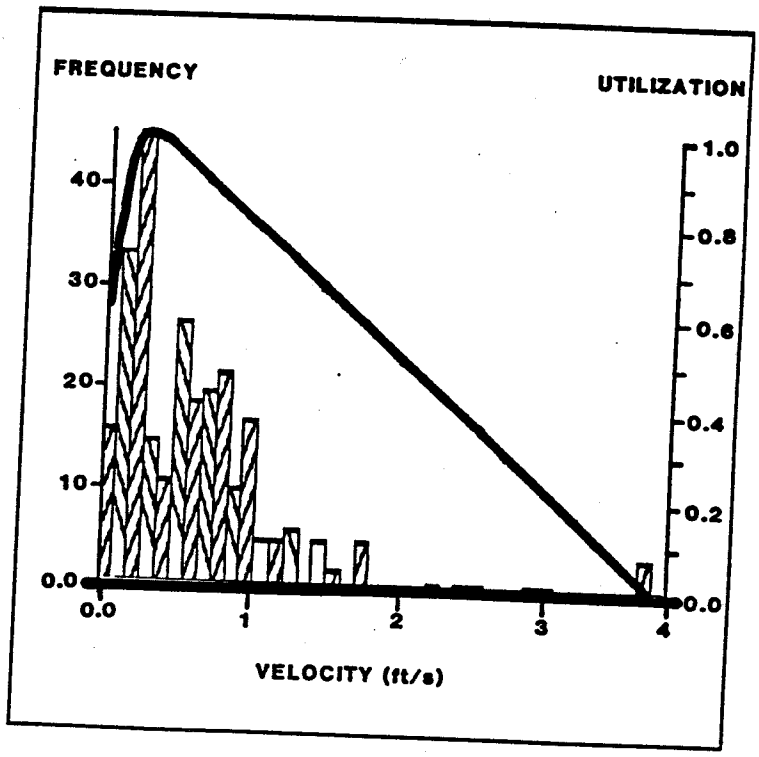

FIGURE 25B. VELOCITY

CURVE SET 16. (CONTINUED)

PARAMETER: SUBSTRATE
SAMLE SIZE: 297

CURVE COORDINATES

CATEGORY		UTILIZATION
CLAY	(CL)	.00
SILT	(SI)	.46
SAND	(SA)	.73
GRAVEL	(GR)	.01
RUBBLE	(RU)	.06
BOULDER	(BO)	1.00
BEDROCK	(BE)	.55
OTHER	(OT)	.00

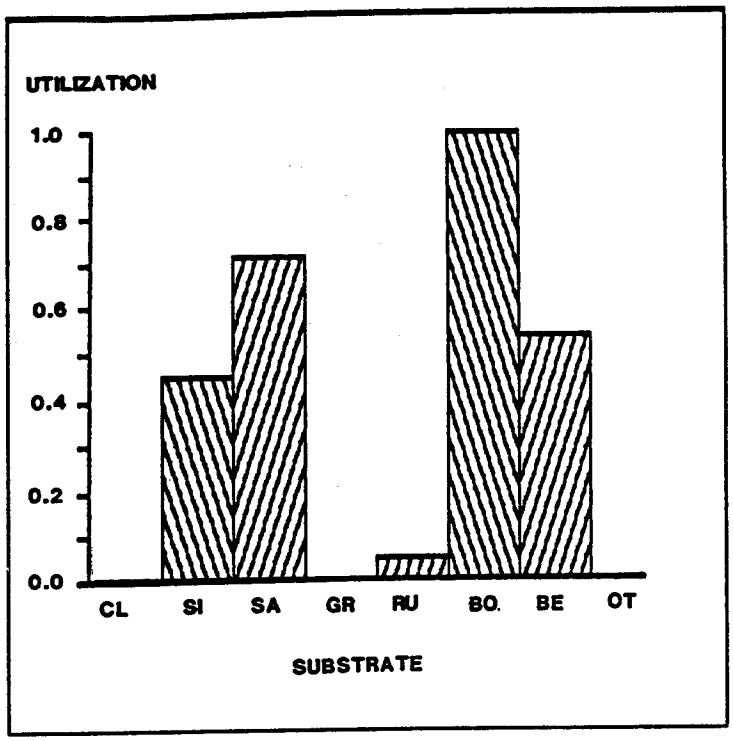

FIGURE 25C. SUBSTRATE

PARAMETER: HABITAT SAMPLED
SAMPLE SIZE: 272

CATEGORY		PERCENT
ISOLATED POOL	(IP)	.00
BACKWATER	(BA)	.74
EMBAYMENT	(EM)	.00
CONCAVITY	(CO)	.00
POOL	(PO)	9.93
EDDY	(ED)	39.71
SHORELINE	(SH)	12.87
RUN	(RU)	35.66
RIFFLE	(RI)	.37
RAPID	(RA)	.00
GRAVEL PIT	(GP)	.00
OTHER	(OT)	.74

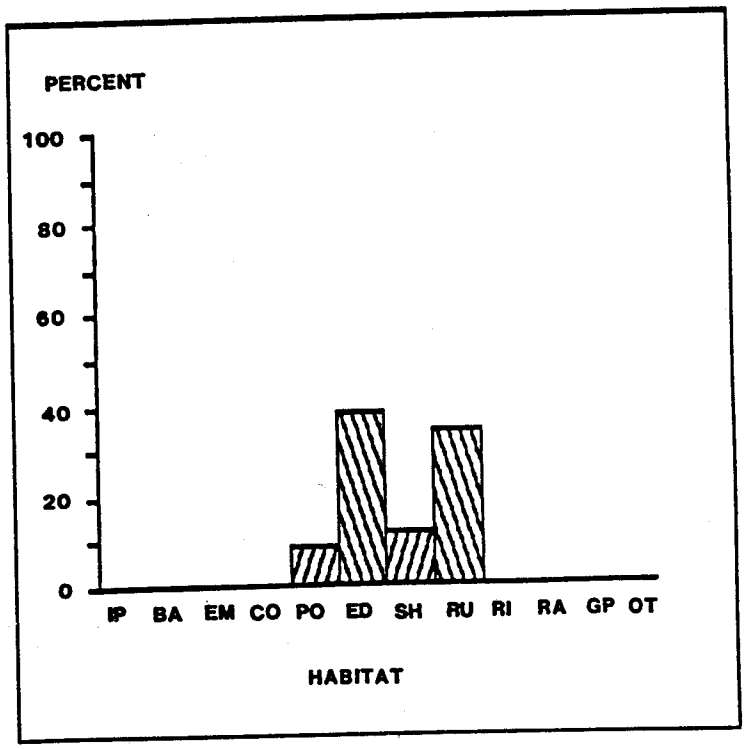

FIGURE 25D. HABITAT

MONITORING CONTAMINANT RESIDUES IN SOUTHWESTERN AQUATIC HABITATS[1]

William G. Kepner[2]

Abstract--The toxicity of certain agricultural chemicals to fish and wildlife resources and their persistence in the environment have been well documented throughout the literature. The National Contaminant Biomonitoring Program was one of the first monitoring studies to search for both geographical and temporal trends in pesticides and trace metals in biota throughout the United States. The contaminants program has since been expanded to include intensive surveys which examine complete watersheds or site specific problems. A variety of organisms have been utilized as bioindicators, however, fish provide the best index to habitat quality due to their propensity for biological uptake and their total exposure or immersion in the aquatic medium. This paper will summarize results and trends for fish tissue analysis on two Arizona watersheds (lower Gila and Colorado rivers). Future studies will also be discussed.

Resumen--La toxicidad de ciertas químicas agrícolas a recursos pesqueros y de fauna silvestre y su persistencia en el ambiente han sido reportado ampliamente en la literatura. El Programa Nacional de Control de Contaminantes fue uno de los primeros estudios que buscó tendencias geográficas y temporales en pesticidas y metales en biota por todo el E.U. Se ha ampliado el programa de contaminantes a incluir estudios intensivos que examinan cuencas enteras o problemas de sitios especificos. A pesar de que se ha utilizado como bioindicadores gran variedad de organismos, los peces proveen el mejor indice a calidad de habitat debido a su tendencia para acumulación biotica y su imersión en el medio acuático. Se presenta un resumen de los resultados y tendencias indicados por analises de tejidos de peces en dos cuencas de Arizona (partes bajas de los ríos Gila y Colorado). Se discutirán tambien los estudios futuros.

1 Paper presented at the Desert Fishes Council, Nineteenth Annual Symposium, 12-14 November 1987, Hermosillo, Mexico.

2 Environmental Contaminant Specialist, U.S. Fish and Wildlife Service, 3616 W. Thomas Road, Suite 6, Phoenix, Arizona 85019.

Introduction

In 1961, R. R. Miller published his classic account on Man and the Changing Fish Fauna of the American Southwest. In that paper he clearly outlined the deterioration of native ichthyofaunal assemblages in western North America due to modern mans modification of the environment. In his concluding remarks, Miller states

"Perhaps nowhere else in North America has the upset of natural conditions been more strikingly reflected by biotic change than in the arid Southwest, particularly southern Arizona. The deterioration of the native fish faunas can be attributed to construction of dams, water diversions, pollution, mining operations, use of toxic chemicals, depletion of ground water, and the introduction of alien species."

Although most depletions have been attributed to habitat elimination or interaction with introduced forms, little information is available regarding contaminant dispersal and impacts on Southwestern fishes.

Nationwide attention was focused on the problems associated with increasing use of persistent chemicals following the publication of Silent Spring by Rachel Carson in 1962. The National Pesticide Monitoring Program was established in the mid-1960s as a direct result of heightened public concern to monitor levels of organochlorine pesticides nationwide. The U.S. Fish and Wildlife Service was assigned the biotic portions of the program, i.e. starling, waterfowl, and freshwater fish networks. The program was later expanded to include industrial chemicals and trace metals and recently renamed the National Contaminant Biomonitoring Program (NCBP).

The purpose of the program is to examine geographical and temporal trends of selected contaminants throughout the United States. Areas where unusually high residues are detected are identified for more intensive study. The following is a summary of results from nationwide monitoring and site specific surveys conducted by the Fish and Wildlife Service on freshwater fishes in the Southwest.

Program Procedures

Chemical residues in freshwater fish have been monitored since 1967. Fish are sampled biennially at 112 stations nationwide. Sampling sites were selected to include all major river basins in the continental United States.

Fish are collected by non-chemical means in triplicate composite from each site. A composite sample consists of five fish of uniform size of the same species. Composites are divided into bottom-dwelling or predator species. Due to the universal distribution of certain introduced species, priority has been given to utilizing carp for bottom-dwelling composite samples and either

largemouth bass or rainbow trout as predator composites in warmwater or coldwater habitats, respectively.

Fish are weighed and measured upon capture. They are then wrapped individually in aluminum foil, grouped by composite, and quick-frozen on site. They are later transported frozen by air express to the designated laboratory where they are thawed, homogenized, and analyzed for trace metals and chlorinated organic contaminant residues.

Program Results

In general, organochlorine pesticide residues in fish have declined nationwide following their cancellation or restricted use. In contrast, due to their persistence in the environment, certain other organochlorine compounds have not changed appreciably and remain elevated. Total DDT for instance, is highest in the Southwest and Southeast, where application of the insecticide was greatest before the 1972 national ban, i.e. eighty percent of domestic DDT applications were formerly applied to cotton crops.

DDE, the ultimate degradation product of DDT, is detected more frequently and at higher concentrations than its parent compound. Thus reflecting the persistence of precancellation applications rather than illegal import and use. The national average for whole body wet weight DDE in fish tissue is 0.20 ppm (n=107).1/ Recently under separate study, DDE values in carp from southwest Arizona have ranged as high as 23 ppm. Previous results from both freshwater fish and starling networks have documented elevated organochlorine residues, particularly DDE, in whole body tissue samples collected from the lower Gila River. DDE residues in starlings collected at Goodyear for instance, were the highest among all sites collected nationwide in 1982 (n=129). DDE residues equaled 8.4 ppm wet weight at this location and far exceeded the national average of 0.15 ppm.

A contaminant study conducted on the lower Gila River during June - September 1985 revealed geographic trends in organochlorine contamination in selected fish and wildlife species and inferred possible sources of the contamination. Carp, channel catfish, red-winged blackbird, Gambel's quail, western whiptail lizard, and spiny softshell turtle were collected in triplicate whole body composites from several stations located on the Gila River between Phoenix and Yuma.

Sixteen of twenty-three organochlorines were detected in tissue samples from the lower Gila River. DDE and toxaphene were the most elevated residues of those detected. DDE for example, was detected in all sample categories, and with the exception of Gambel's quail, concentrations of DDE in biota exceeded the

1/. n equals the number of sampling locations

National Academy of Science 1.0 ppm criterion established for the protection of aquatic wildlife and fishes. As previously mentioned, geographic contamination trend was also particularly evident. All sample categories exhibited clear up- to downstream trends, i.e. stations at Painted Rock and above were 5 to 23 times more concentrated than those below. Levels below Painted Rock appear to diminish, frequently to nondetectable levels. Actual physical obstruction of surface flow by impoundments presumably facilitates sedimentation, results in the accumulation of contaminant residues on site, and creates localized conditions of "contaminant sinks" which are perpetuated by agricultural runoff.

Information derived from the NCBP has also identified selenium elevations in fish tissue throughout the western United States. For instance, selenium data determined for nine fish species at twelve different sites clearly demonstrate elevations at Colorado mainstream locations versus interior tributaries. The mean selenium value for Arizona fishes is 1.6 ppm wet weight (n=67) as compared to the national mean of 0.48 ppm (n=91).

A joint U.S. Fish and Wildlife Service and U.S. Geological Survey study conducted on the Colorado River in 1986 reconfirmed selenium elevations in fish tissue. Carp sampled throughout the lower Colorado River averaged 1.49 ppm wet weight (n=10). At two sites, Palo Verde Oxbow Lake and Imperial Oasis, fish values exceeded the 2.0 ppm guideline considered to be the "may effect" level for impairment of fish reproduction; the highest value detected was 4.0 ppm selenium. Some areas have already exhibited localized declines in fish populations, particularly with centrarchids which are considered to be the most chronically sensitive fish family to selenium exposure and biological uptake. Selenium values in carp from the Gila River, a major tributary to the lower Colorado, were lower than mainstream Colorado values and were consistent from site to site.

Irrigation drains do not appear to be the isolated source of selenium to the watershed as reported in other studies, e.g. Kesterson National Wildlife Refuge/San Luis Drain (California). The lowest selenium values for biotic and abiotic (water and sediment) samples were collected from within major agricultural drains or at their mouth. Selenium sources appear to be more of an upstream phenomenon and are apparently derived from weathering of Cretaceous shales, combustion of coal at power generating stations along the river, current or abandoned uranium extraction within the watershed, or perhaps agricultural practices in the upper basin. The system appears to be at a threshold where any further influx of selenium into the watershed could result in increased availability for biological uptake and elimination of certain components of the warmwater fishery.

Lastly, additional studies have been completed on the San Pedro River and San Bernardino National Wildlife Refuge which utilized native fish species for organochlorine and trace metal scans. Others are now scheduled for assessing impacts of uranium mining on populations of humpback chub at the mouth of the Little Colorado River and potential contaminant problems in diet items of desert nesting bald eagles on selected drainages in Arizona. Both studies are scheduled to use native and introduced fishes exclusively.

Summary

Monitoring programs and site-specific intensive surveys which utilize tissue samples provide important information that may not be available from other media. Although surface waters may be within drinking water standards for human consumption, they may still impose hazards to fish and wildlife due to their exposure via total immersion and their propensity for biological uptake and concentration. Biological samples, particularly fish tissues, represent the most significant tool available to assess contaminant effects on fish and wildlife resources and evaluate the hazards of ambient environmental conditions.

"SUBIR AL FUTURO"
EL PROGRAMA DE PESQUERIAS DEL SERVICIO FORESTAL DE LOS ESTADOS UNIDOS DE NORTE AMERICA

por RICHARD UBERUAGA*, GLEN CONTRERAS, Y MIKE DOMBECK

ABSTRACTO: Este manuscrito se trata los recursos de las pesquerias en los bosques naccionales de los Estados Unidos de Norte America. Se identifica las metas primarias de la agencia y describe un plan de accion para integrar el manejo de los habitatos en los usos y metas multiples del Servicio Forestal.

ABSTRACT: This manuscript describes the fisheries resources of the U.S. Forest Service along with the agency's principal goals and policies. A fisheries action plan to integrate fish habitat management into the Forest Service's overall multiple use goals is included.

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SUBIR AL FUTURO
EL PROGRAMA DE PESQUERIAS DEL SERVICIO FORESTAL DE LOS ESTADOS UNIDOS DE NORTE AMERICA

La demanda para las pesquerias deportivas y commerciales en los bosques naccionales de los estados unidos se anticipa creceria por noventa por ciento sobre las proximas cinco decadas. Pero, si el manejo de los aguas y las tierras de los bosques forestales no coninua a niveles presentes, la produccion de los recursos pesqueros podrian caer por viente por ciento. Los presupuestos recientes del servicio forestal han caido por dieciseis por ciento en los ultimos cinco anos. En 1985 la Sociedad Americana de Pesquerias hecho unas recomendaciones para assegurar la salud acquatica de los recursos pesqueros en las tierras y bosques nacionales. El Servicio Forestal formo un grupo de professionales para considerar y implementar estas recomendaciones. Esto resulto en la formacion de un plan de accion, approbado por el director del servicio forestal en 16 de Marzo, 1987. Este plan servira como un guia para implementar un programa de manejo cual resultara en un programa prospero y muy visible. Lo siguiente es un summario de los recursos pesqueros, metas primarias, y un plan de accion del Servicio Forestal:

La sistema de bosques naccionales contiene 193 millones de acres de tierra en 43 estados.Se calcula que 2.2 millones de acres de lagos y 128,000 millas de rios pintan el paisaje. Estos aguas sostienen la pesca deportiva y commercial y la industria de turismo. En los estados de California, Oregon, Idaho, y Washington se encuentra en los bosques naccionales mas que 50 por ciento de los habitatos requeridos por las truchas y salmones, cerca 15,000 millas de rios. En Alaska, cerca 30 por ciento de los habitatos se hallan en los bosques naccionales, o sea, 30,000 millas de rios. El interes en las pesca deportiva esta aumentando. La pesca deportiva es una actividad de recreacion al aire libre y en este ambiente es la segunda mas popular actividad en el pais. Mas que 53 millones de personas pescan annualmente. En el ano 1980 se realizo mas que 850 millon de dias de pesca y cerca 17.3 billon de dolares de valor economico. Se anticipa que la demanda de las pesca deportiva crecera 90 por ciento por el ano 2030. Ahora, en los bosques naccionales se realiza 46.5 millon dias de pesca annualmente, con un valor economico de 1.21 billon de dolares. Proteccion y mejoramiento de los habitatos acquaticos puede aumentar y sostener productividad y opportunidad. La meta principal del Servicio Forestal es el manejo responsable de las habitatos, manejando los recursos para los valores y usos multiples. Se requiere una consideracion balanceada durante formacion de los planes de manejo. Tambien, el Servicio Forestal esta manejando los habitatos para especies amenazadas y puesto en peligro. Este programa incluye 76 especies, 22 especies puesto en peligro, 16 especies amenazadas, y 38 especies propuestas. Las actividades de manejo,incluyendo los planes de assistencia, se anticipa cumpliran por implementacion de los planes forestales.

EL PLAN DE ACCION DEL PROGRAMA DE PESQUERIAS

El proposito de este plan de accion es la intergracion del manejo de los habitatos acquaticos en las metas de usos multiples de cada unidad del systema forestal.

1. REALZAR IDENTIFICACION DEL PROGRAMA DE MANEJO DE LOS HABITATOS PESQUEROS EN EL SERVICIO FORESTAL SI MISMO Y ENTRE NUESTROS COMPANEROS EN LAS OTRAS AGENCIAS

* Identificar claramente los resultados deseables a un nivel nacional, regional, y forestal.

* Assegurar que se incluya la palabra "pesquera" en cada titulo de personas con responsibilidades pesqueras.

* Assegurar que el manejo responsable de las especies amenezadas y en peligro este identificado a un nivel regional y forestal.

2. USAR LAS MEJORES TECHNOLOGIAS PARA MEJORAR MANEJO DE LOS HABITATOS

* Desarrollar, implementar, y refinar las analisis de effectos acumultivos para identificar los effectos positivos y negativos del manejo de tierra y como se affectan las pesquerias.

* Desarrollar y implementar classificaciones y inventarios acquaticos para mejorar los modelos predictivos y determinar inversiones de fondos.

* Identificar y determinar un nivel de inversion de fondos en los proyectos scientificos que se necessitan investigacion.

* Desarrollar y implementar estrategias de manejo que identifiquen los resultados de las mejores practicas de manejo en relacion a las especies sensitivas, amenezadas, y en peligro a un nivel forestal.

3. COMUNICAR LAS NECESSIDADES DE MEJORAMIENTO DE HABITATOS PESQUEROS Y ESTABLECER LA VENTA AGRESIVA DE LOS OPPORTUNIDADES PESQUEROS

* Publicar y distribuir materiales que distingan el programa de pesqueria y opportunidades para pescar en los bosques nacionales.

* Invitar a los periodistas y otras personas interesadas a ver proyectos pesqueros.

* Explicar al publico y la bureacracia las opportunidades, necessidades, y resultados del programa de pesqueria.

* Fomentar la participacion de las agencias estatales y grupos particulares en el mejoramiento de los habitatos que resulten en protecion y conservacion de especies amenezadas, sensitivas, y puesto en peligro.

4. FORMAR AMISTAD Y COOPERACION CON LAS AGENCIAS ESTATALES, OTRAS AGENCIAS FEDERALES, GRUPOS PARTICULARES, Y EL PUBLICO EN EL MANEJO DE LAS PESQUERIAS

* Revisar la memoranda de entendimiento con los estados para mejorar amistad y cooperacion con estos socios.

* Fomentar la participacion de voluntarios en proyectos que se traten especies sensitivas, amenezadas, y puesto en peligro.

5. USAR UNA VALIDA TECHNICA ECONOMICA EN LA DETERMINACION DE VALOR, DEMANDA, Y ABASTACIMIENTO PESQUERO EN EL PROCESO DE DECISIONES

* Publicar un sumario de los mejores metodos para determinar el valor economico de los recursos pesqueros.

* Requerir inclusion de los valores pesqueros con los valores de otros recurso en el proceso de decisiones.

6. MANTENER UN CADRE DE BIOLOGOS PESQUEROS QUE SEAN LIDERES PODEROSOS, CONTINUANDO A SU EDUCACION Y ENTRENAMIENTO, Y BUSCANDO DIVERSAS EXPERIENCIAS DE ADMINISTRAMIENTO DE RECURSOS NATURALES

* Utilizar programas de educacion y empleo cooperativa para dar estudiantes entrenamiento.

* Assegurar que los biologos sean calificados para diversas experiencias de administracion de recursos naturales.

* Assegurar que los biologos se den cuenta del programa de las especies sensitivas, amenezadas, y puesto en peligro. Se cumple esto por trabajo a todos niveles de administracion, desde la oficina regional al campo remoto.

7. IMPLEMENTAR UN PROGRAMA DE ACTIVIDADES Y DESARROLLAR EL NIVEL DE INVERSION DE FONDOS NECESSARIOS PARA ALCANZAR LAS METAS PESQUERAS

* Desarrollar un analysis de todo el trabajo pesquero y determinar en que area la organizacion se hace falta biologos.

* Incluir los proyectos pesqueros y el manejo de las especies sensitivas y amenezadas en un horario de implementacion y desarrollar un nivel de inversion de fondos annualmente y para un periodo de cinco anos.

USDA FOREST SERVICE
WILDLIFE AND FISHERIES

PROPOSED, ENDANGERED, THREATENED, AND CATEGORY SPECIES
OCCURRING ON LAND ADMINISTERED BY NFS

NATIONAL SUMMARY OF SPECIES
BY FEDERAL STATUS

FISH SPECIES ONLY

PROPOSED	1
ENDANGERED	21
THREATENED	16
CATEGORY 1	1
CATEGORY 2	35
CATEGORY 3	2
NATIONAL TOTAL	76

USDA FOREST SERVICE
WILDLIFE AND FISHERIES

PROPOSED, ENDANGERED, THREATENED AND CATEGORY SPECIES
OCCURRING ON LAND ADMINISTERED BY NFS

FISH SPECIES ONLY

REGION	COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS	FWS RECOVERY PLAN
02	TROUT, GREENBACK CUTTHROAT	Salmo clarki stomias	T	Y
03	CATFISH, YAQUI	Ictalurus pricei	E	N
	CHUB, BONYTAIL	Gila elegans	E	Y
	CHUB, CHIHUAHUA	Gila nigrescens	T	Y
	CHUB, GILA	Gila intermedia	C2	N
	CHUB, GILA ROUNDTAIL	Gila robusta grahami	C2	N
	CHUB, SONORA	Gila ditaenia	T	N
	CHUB, YAQUI	Gila purpurea	E	N
	MINNOW, LOACH	Tiaroga cobitis	T	N
	PUPFISH, DESERT	Cyprinodon macularius	E	N
	SHINER, BEAUTIFUL	Notropis formosus	E	N
	SHINER, RIO GRANDE BLUNTNOSE	Notropis simus simus	C2	N
	SPIKEDACE	Meda fulgida	T	N
	SPINEDACE, LITTLE COLORADO	Lepidomeda vittata	T	N
	SQUAWFISH, COLORADO RIVER	Ptychocheilus lucius	E	Y
	STONEROLLER, MEXICAN	Campostoma ornatum	C2	N
	SUCKER, RAZORBACK	Xyrauchen texanus	C2	N
	SUCKER, YAQUI	Catostomus bernardini	P	N
	SUCKER, ZUNI MOUNTAIN	Catostomus discobolus yarrowi	C2	N
	TOPMINNOW, GILA	Poeciliopsis occidentalis	E	Y
	TOPMINNOW, YAQUI	Poeciliopsis occidentalis sonoriensis	E	N
	TROUT, APACHE (ARIZONA)	Salmo apache	T	Y
	TROUT, GILA	Salmo gilae	E	Y
	WOUNDFIN	Plagopterus argentissimus	E	Y
04	CHUB, BONYTAIL	Gila elegans	E	Y
	CHUB, HUMPBACK	Gila cypha	E	Y
	DACE, KENDALL WARM SPRINGS	Rhinichthys osculus thermalis	E	Y
	SQUAWFISH, COLORADO RIVER	Ptychocheilus lucius	E	Y
	TROUT, COLORADO CUTTHROAT	Salmo clarkii pleuriticus	C2	N
	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	T	N
	TROUT, PAIUTE CUTTHROAT	Salmo clarki seleniris	T	Y
	WOUNDFIN	Plagopterus argentissimus	E	Y
05	CHUB, OWENS TUI	Gila bicolor snyderi	E	Y
	STICKLEBACK, UNARMORED 3-SPINE	Gasterosteus aculeatus williamsoni	E	Y
	SUCKER, MODOC	Catostomus microps	E	N
	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	T	N
	TROUT, LITTLE KERN GOLDEN	Salmo aquabonita whitei	T	N
	TROUT, PAIUTE CUTTHROAT	Salmo clarki seleniris	T	Y
06	CHUB, OREGON	Hybopsis crameri	C2	N
	CHUB, OREGON LAKES TUI	Gila bicolor oregonensis	C2	N
	MUDMINNOW, OLYMPIC	Novumbra hubbsi	C2	N

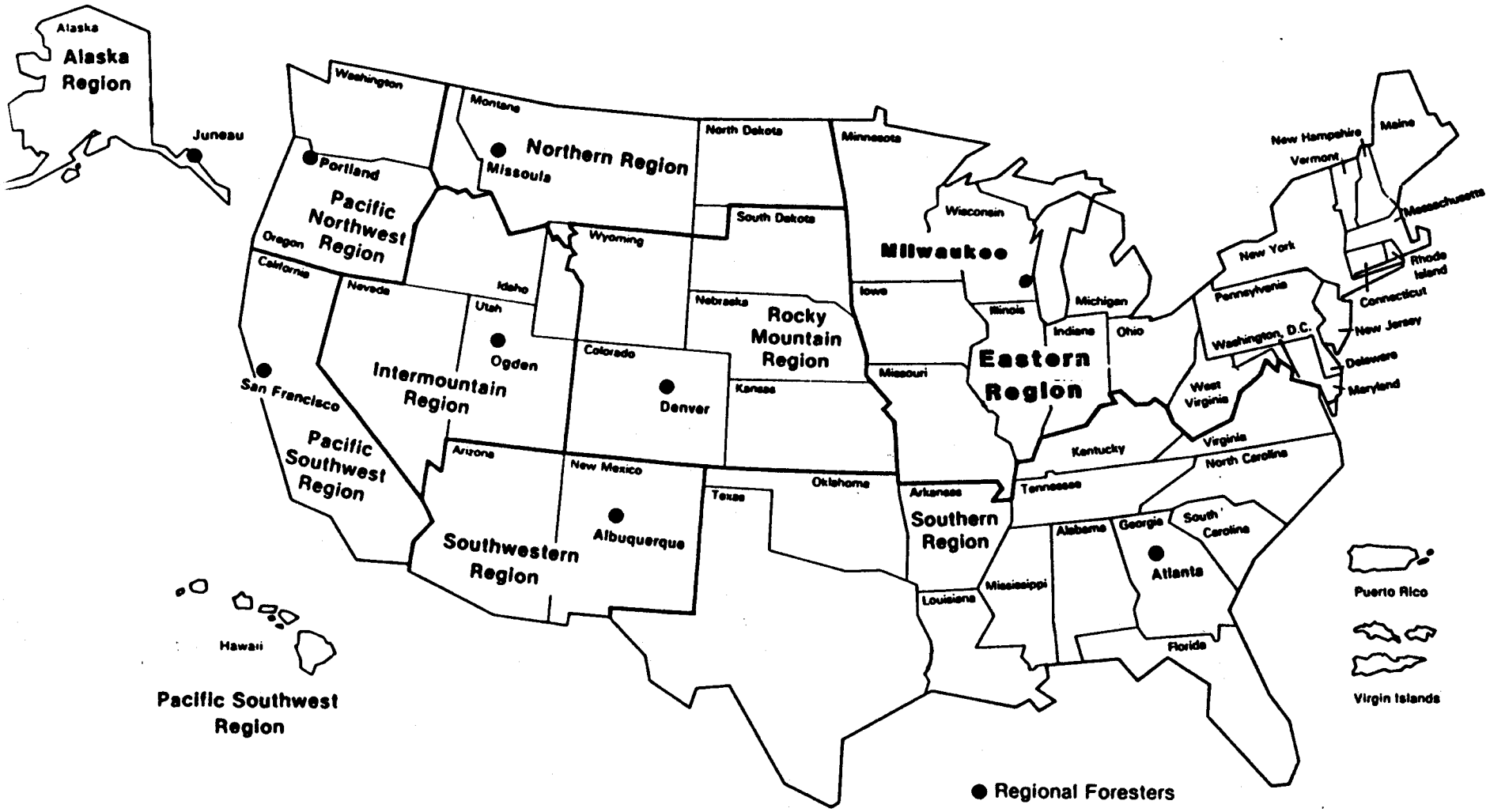
USDA FOREST SERVICE
WILDLIFE AND FISHERIES

PROPOSED, ENDANGERED, THREATENED AND CATEGORY SPECIES
OCCURRING ON LAND ADMINISTERED BY NFS

FISH SPECIES ONLY

REGION	COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS	FWS RECOVERY PLAN
06	SCULPIN, MALHEUR MOTTLED	Cottus bairdi spp.	C2	N
	SUCKER, GOOSE LAKE	Catostomus occidentalis lacusanserinus	C2	N
	SUCKER, KLAMATH LARGE-SCALE	Catostomus synderi	C2	N
	SUCKER, LOST RIVER	Deltistes luxatus	C2	N
	SUCKER, SHORTNOSE	Chasmistes brevirostris	C2	N
	TROUT, BULL	Salvelinus confluentus	C2	N
	TROUT, REDBAND	Salmo spp.		
08	CHUB, SLENDER	Hybopsis cahni	T	Y
	CHUB, SPOTFIN	Hybopsis monacha	T	Y
	DACE, BLACKSIDE	Phoxinus cumberlandensis	T	N
	DARTER, AMBER	Percina antesella	E	N
	DARTER, FRECKLED	Percina lenticula	C2	N
	DARTER, LEOPARD	Percina pantherina	T	Y
	DARTER, PALEBACK	Etheostoma pallididorsum	C3	N
	DARTER, SHARPHEAD	Etheostoma acuticeps	C2	N
	LOGPERCH, CONASAUGA	Percina jenkinsi	E	N
	MADTOM, CADDO	Noturus taylori	C2	N
	MADTOM, CAROLINA	Noturus furiosus	C2	N
	MADTOM, ORANGE-FIN	Noturus gilberti	C1	N
	MADTOM, OUACHITA	Noturus lachneri	C2	N
	MADTOM, SMOKY	Noturus baileyi	E	Y
	MADTOM, YELLOWFIN	Noturus flavipinnis	T	Y
	SHINER, BLUESTRIPE	Notropis callitaenia	C2	N
	SHINER, PEPPERED	Notropis perpallidus	C3	N
	STURGEON, GULF	Acipenser oxyrhynchus desotoi	C2	N
	STURGEON, SHORT-NOSE	Acipenser brevirostrum	E	N
09	CAVEFISH, NORTHERN	Amblyopsis speleae	C2	N
	CAVEFISH, OZARK	Amblyopsis rosae	T	N
	DARTER, BLUESTRIPE	Percina cymatotaenia	C2	N
	DARTER, CRYSTAL	Ammocrypta asprella	C2	N
	DARTER, FINESCALE SADDLED	Etheostomata osburni	C2	N
	DARTER, LONGHEAD	Percina macrocephala	C2	N
	DARTER, LONGNOSE	Percina nasuta	C2	N
	DARTER, MARYLAND	Etheostoma sellare	E	Y
	DARTER, STARGAZING	Percina uranidea	C2	N
	MADTOM, SCIOTO	Noturus trautmani	E	N
	MINNOW, CHEAT	Rhinichthys bowersi	C2	N
	MINNOW, KANAWHA	Phenacobius teretulus	C2	N
	STURGEON, LAKE	Acipenser fulvescens	C2	N
	SUCKER, BLUE	Cycleptus elongatus	C2	N

FOREST SERVICE REGIONAL OFFICE LOCATIONS



The location of each Forest Service Regional office and the states located within each Region is shown below:

Northern Region (1); ND, MT, Northern ID, N.West. SD. USDA Forest Service, Federal Building, P.O. Box 7669, Missoula, MT 59807. Commercial phone (406) 329-3288, FTS 8-585-3520.

Rocky Mountain Region (2); CO, KS, NE, SD, Eastern WY. USDA Forest Service, 11177 W. 8th Ave., Box 25127, Lakewood, CO 80225. Commercial phone (303) 236-9526, FTS 8-776-9526.

Southwestern Region (3); AR, NM. USDA Forest Service, Federal Building, 517 Gold Ave. S.W., Albuquerque, NM 87102. Commercial phone (505) 842-3260, FTS 8-476-3260.

Intermountain Region (4); So.ID, NV, UT, Western WY. USDA Forest Service, Federal Building, 324 25th St., Ogden, UT 84401. Commerical phone (801) 625-5666, FTS 8-586-5666.

Pacific Southwest Region (5); CA, HI, GU and Trust Territories of the Pacific Islands. USDA Forest Service, 630 Sansome St., San Francisco, CA 94111. Commercial phone (415) 556-8551, FTS 8-556-8551.

Pacific Northwest Region (6); OR, WA. USDA Forest Service, 319 S.W. Pine St., Box 3623, Portland, OR 97208. Commercial phone (503) 221-4091, FTS 8-423-4091.

Southern Region (8); AL, AR, FL, GA, KY, LA, MS, NC, OK, PR, SC, TN, TX, VI, VA. USDA Forest Service, 1720 Peachtree Road, N.W., Atlanta, GA 30367. Commercial phone (404) 347-4560. FTS 8-257-4560.

Eastern Region (9); IL, IN, IA, ME, MA, MI, MN, MO, NH, NJ, NY, OH, PA, VT, WV, WI. USDA Forest Service, 310 W. Wisconsin Ave., Rm. 500, Milwaukee, WI 53203. Commercial phone (414) 291-3612, FTS 8-362-3612.

Alaska Region (10); AK USDA Forest Service, Federal Office Building, Box 1628, Juneau, AK 99802. Commercial phone (907) 586-8752, FTS use commerical phone number.

EL PLAN DE ACCION DEL PROGRAMA DE PESQUERIAS
EL SERVICIO FORESTAL DE LOS ESTADOS UNIDOS DE NORTE AMERICA

El proposito de este plan de accion es la intergracion del manejo de los habitatos acquaticos en las metas de usos multiples de cada unidad del systema forestal.

1. REALZAR IDENTIFICACION DEL PROGRAMA DE MANEJO DE LOS HABITATOS PESQUEROS EN EL SERVICIO FORESTAL SI MISMO Y ENTRE NUESTROS COMPANEROS EN LAS OTRAS AGENCIAS

* Indentificar claramente los resultados deseables a un nivel nacional, regional, y forestal.

* Assegurar que se incluya la palabra "pesquera" en cada titulo de personas con responsibilidades pesqueras.

* Assegurar que el manejo responsable de las especies amenezadas y en peligro este identificado a un nivel regional y forestal.

2. USAR LAS MEJORES TECHNOLOGIAS PARA MEJORAR MANEJO DE LOS HABITATOS

* Desarrollar, implementar, y refinar las analisis de effectos cumultivos para identificar los effectos positivos y negativos del manejo de tierra y como se affectan las pesquerias.

* Desarrollar y implementar classificaciones y inventarios acquaticos para mejorar los modelos predictivos y determinar inversiones de fondos.

* Identificar y determinar un nivel de inversion de fondos en los proyectos scientificos que se necessitan investigacion.

* Desarrollar y implementar estrategias de manejo que identifiquen los resultados de las mejores practicas de manejo en relacion a las especies sensitivas, amenezadas, y en peligro a un nivel forestal.

3. COMUNICAR LAS NECESSIDADES DE MEJORAMIENTO DE HABITATOS PESQUEROS Y ESTABLECER LA VENTA AGRESIVA DE LOS OPPORTUNIDADES PESQUEROS

* Publicar y distribuir materiales que distingan el programa de pesqueria y opportunidades para pescar en los bosques nacionales.

* Invitar a los periodistas y otras personas interesadas a ver proyectos pesqueros.

* Explicar al publico y la bureacracia las opportunidades, necessidades, y resultados del programa de pesqueria.

* Fomentar la participacion de las agencias estatales y grupos particulares en el mejoramiento de los habitatos que resulten en protecion y conservacion de especies amenezadas, sensitivas, y puesto en peligro.

4. FORMAR AMISTAD Y COOPERACION CON LAS AGENCIAS ESTATALES, OTRAS AGENCIAS FEDERALES, GRUPOS PARTICULARES, Y EL PUBLICO EN EL MANEJO DE LAS PESQUERIAS

* Revisar la memoranda de entendimiento con los estados para mejorar amistad y cooperacion con estos socios.

* Encourage la participacion de voluntarios en proyectos que se traten especies sensitivas, amenezadas, y puesto en peligro.

5. USAR UNA VALIDA TECHNICA ECONOMICA EN LA DETERMINACION DE VALOR, DEMANDA, Y ABASTACIMIENTO PESQUERO EN EL PROCESO DE DECISIONES

* Publicar un sumario de los mejores metodos para determinar el valor exconomico de los recursos pesqueros.

* Requerir inclusion de los valores pesqueros con los valores de otros recurso en el proceso de decisiones.

6. MANTENER UN CADRE DE BIOLOGOS PESQUEROS QUE SEAN LIDERES PODEROSOS, CONTINUANDO A SU EDUCACION Y ENTRENAMIENTO, Y BUSCANDO DIVERSAS EXPERIENCIAS DE ADMINISTRAMIENTO DE RECURSOS NATURALES

* Utilizar programas de educacion y empleo cooperativa para dar estudiantes entrenamiento.

* Assegurar que los biologos sean calificados para diversas experiencias de administracion de recursos naturales.

* Assegurar que los biologos se den cuenta del programa de las especies sensitivas, amenezadas, y puesto en peligro. Se cumple esto por trabajo a todos niveles de administracion, desde la oficina regional al campo remoto.

7. IMPLEMENTAR UN PROGRAMA DE ACTIVIDADES Y DESARROLLAR EL NIVEL DE INVERSION DE FONDOS NECESSARIOS PARA ALCANZAR LAS METAS PESQUERAS

* Desarrollar un analyses de todo el trabajo pesquero y determinar en que area la organizacion se hace falta biologos.

* Incluir los proyectos pesqueros y el manejo de las especies sensitivas y amenezadas en un horario de implementacion y desarrollar un nivel de inversion de fondos annualmente y para un periodo de cinco anos.
s

EL PROGRAMA DE ESPECIES SENSITIVAS, AMENEZADAS, Y PUESTO EN PELIGRO

Este programa del Servicio Forestal de los Estados Unidos incluye 72 especies. Hay 21 especies puesto en peligro, 14 especies amenezadas, y 37 especies propuestas. Hay planes de assistencia para 22 especies. El programa esta trabajando en una manera agresiva y positiva solamente con una poca cantidad de especies de prioridad. Los presupuestos recientes estan a un nivel bajo. Demanda para el uso humano de los habitatos continuara en el futuro. Las actividades de manejo, incluyendo los planes de assistencia, se anticipa cumpliran por implementacion de los planes forestales. Lo siguiente es una lista de especies en nuestra programa de especies sensitivas, amenezadas, y puesto en peligro:

USDA FOREST SERVICE
WILDLIFE AND FISHERIES

THREATENED AND ENDANGERED SPECIES PROGRAM SUMMARY

The Forest Service Threatened and Endangered Species (TES) Program includes habitat management for proposed, endangered, threatened, category 1, category 2, category 3, and selected sensitive species. Management objectives and policy are presented in the Forest Service Manual. Proposed, endangered, threatened, and category species are so designated by the U.S. Fish and Wildlife Service, Office of Endangered Species (FWS), or the National Marine Fisheries Service (NMFS) under the auspices of the Endangered Species Act of 1973. The sensitive species are identified by Regional Foresters along with other agencies and cooperators as species for which population viability is a concern.

Approximately 148 threatened and endangered species are found on lands administered by the National Forest System. Our TES fish program includes 21 endangered, 16 threatened and 38 category species. Recovery plan have been approved for 23 fish species. The proposed 1988 program facilitates recovery and habitat management for these species. Attached is a species list and a map and addresses of Regional Offices where further information can be requested.

11/06/87
REPORT 26

USDA FOREST SERVICE
WILDLIFE AND FISHERIES

PROPOSED, ENDANGERED, THREATENED, AND CATEGORY SPECIES
OCCURRING ON LAND ADMINISTERED BY NFS

NATIONAL SUMMARY OF SPECIES
BY FEDERAL STATUS

FISH SPECIES ONLY

PROPOSED	1
ENDANGERED	21
THREATENED	16
CATEGORY 1	1
CATEGORY 2	35
CATEGORY 3	2
NATIONAL TOTAL	76

USDA FOREST SERVICE
WILDLIFE AND FISHERIES

PROPOSED, ENDANGERED, THREATENED AND CATEGORY SPECIES
OCCURRING ON LAND ADMINISTERED BY NFS

FISH SPECIES ONLY

REGION	COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS	FWS RECOVERY PLAN
02	TROUT, GREENBACK CUTTHROAT	Salmo clarki stomias	T	Y
03	CATFISH, YAQUI	Ictalurus pricei	E	N
	CHUB, BONYTAIL	Gila elegans	E	Y
	CHUB, CHIHUAHUA	Gila nigrescens	T	Y
	CHUB, GILA	Gila intermedia	C2	N
	CHUB, GILA ROUNDTAIL	Gila robusta grahami	C2	N
	CHUB, SONORA	Gila ditaenia	T	N
	CHUB, YAQUI	Gila purpurea	E	N
	MINNOW, LOACH	Tiaroga cobitis	T	N
	PUPFISH, DESERT	Cyprinodon macularius	E	N
	SHINER, BEAUTIFUL	Notropis formosus	E	N
	SHINER, RIO GRANDE BLUNTNOSE	Notropis simus simus	C2	N
	SPIKEDACE	Meda fulgida	T	N
	SPINEDACE, LITTLE COLORADO	Lepidomeda vittata	T	N
	SQUAWFISH, COLORADO RIVER	Ptychocheilus lucius	E	Y
	STONEROLLER, MEXICAN	Campostoma ornatum	C2	N
	SUCKER, RAZORBACK	Xyrauchen texanus	C2	N
	SUCKER, YAQUI	Catostomus bernardini	P	N
	SUCKER, ZUNI MOUNTAIN	Catostomus discobolus yarrowi	C2	N
	TOPMINNOW, GILA	Poeciliopsis occidentalis	E	Y
	TOPMINNOW, YAQUI	Poeciliopsis occidentalis sonoriensis	E	N
	TROUT, APACHE (ARIZONA)	Salmo apache	T	Y
	TROUT, GILA	Salmo gilae	E	Y
	WOUNDFIN	Plagopterus argentissimus	E	Y
04	CHUB, BONYTAIL	Gila elegans	E	Y
	CHUB, HUMPBACK	Gila cypha	E	Y
	DACE, KENDALL WARM SPRINGS	Rhinichthys osculus thermalis	E	Y
	SQUAWFISH, COLORADO RIVER	Ptychocheilus lucius	E	Y
	TROUT, COLORADO CUTTHROAT	Salmo clarkii pleuriticus	C2	N
	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	T	N
	TROUT, PAIUTE CUTTHROAT	Salmo clarki seleniris	T	Y
	WOUNDFIN	Plagopterus argentissimus	E	Y
05	CHUB, OWENS TUI	Gila bicolor snyderi	E	Y
	STICKLEBACK, UNARMORED 3-SPINE	Gasterosteus aculeatus williamsoni	E	Y
	SUCKER, MODOC	Catostomus microps	E	N
	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	T	N
	TROUT, LITTLE KERN GOLDEN	Salmo aquabonita whitei	T	N
	TROUT, PAIUTE CUTTHROAT	Salmo clarki seleniris	T	Y
06	CHUB, OREGON	Hybopsis crameri	C2	N
	CHUB, OREGON LAKES TUI	Gila bicolor oregonensis	C2	N
	MUDMINNOW, OLYMPIC	Novumbra hubbsi	C2	N

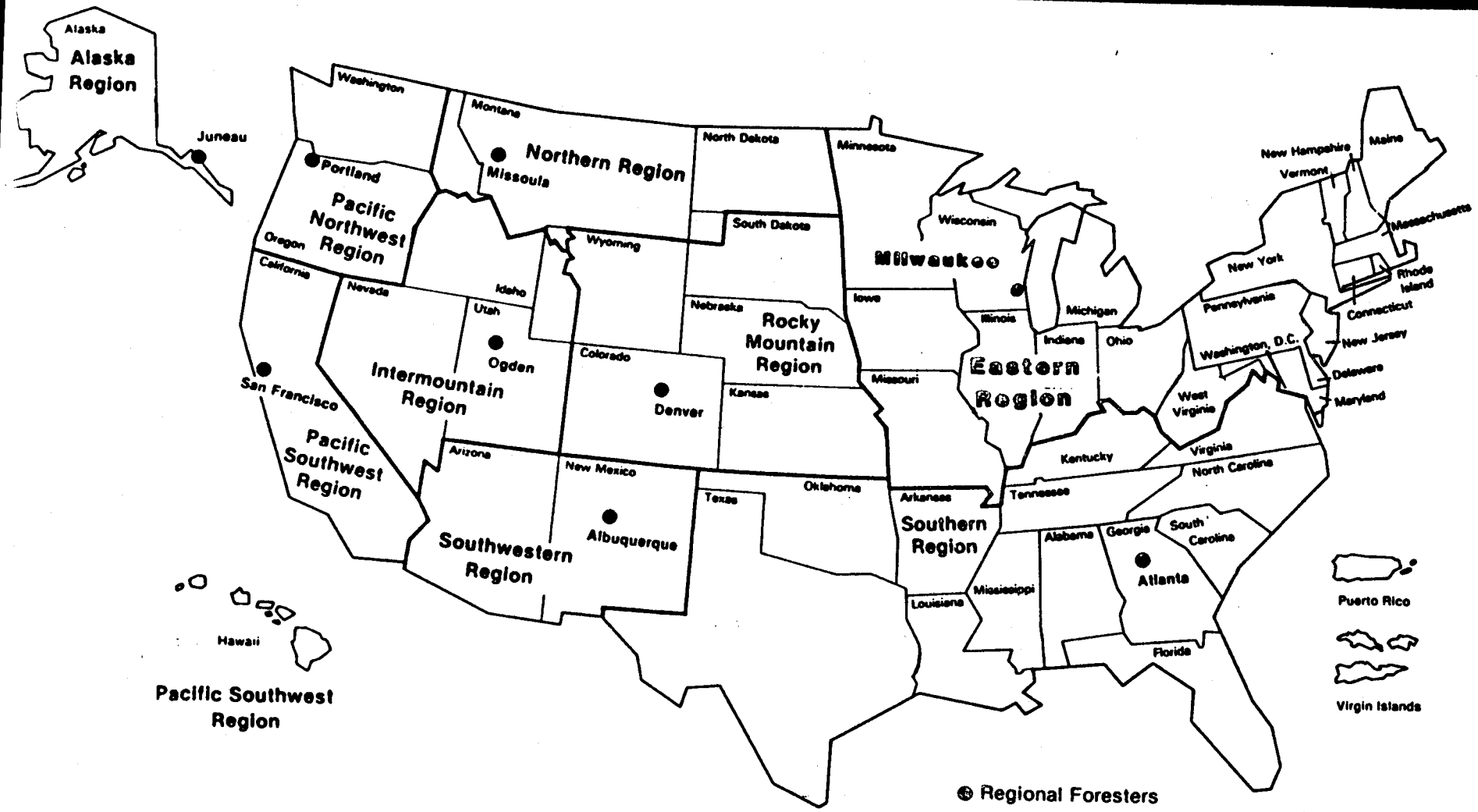
USDA FOREST SERVICE
WILDLIFE AND FISHERIES

PROPOSED, ENDANGERED, THREATENED AND CATEGORY SPECIES
OCCURRING ON LAND ADMINISTERED BY NFS

FISH SPECIES ONLY

REGION	COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS	FWS RECOVERY PLAN
06	SCULPIN, MALHEUR MOTTLED	Cottus bairdi spp.	C2	N
	SUCKER, GOOSE LAKE	Catostomus occidentalis lacusanserinus	C2	N
	SUCKER, KLAMATH LARGE-SCALE	Catostomus synderi	C2	N
	SUCKER, LOST RIVER	Deltistes luxatus	C2	N
	SUCKER, SHORTNOSE	Chasmistes brevirostris	C2	N
	TROUT, BULL	Salvelinus confluentus	C2	N
	TROUT, REDBAND	Salmo spp.	T	Y
08	CHUB, SLENDER	Hybopsis cahni	T	Y
	CHUB, SPOTFIN	Hybopsis monacha	T	N
	DACE, BLACKSIDE	Phoxinus cumberlandensis	E	N
	DARTER, AMBER	Percina antesella	C2	N
	DARTER, FRECKLED	Percina lenticula	T	Y
	DARTER, LEOPARD	Percina pantherina	C3	N
	DARTER, PALEBACK	Etheostoma pallididorsum	C2	N
	DARTER, SHARPHEAD	Etheostoma acuticeps	E	N
	LOGPERCH, CONASAUGA	Percina jenkinsi	C2	N
	MADTOM, CADDO	Noturus taylori	C2	N
	MADTOM, CAROLINA	Noturus furiosus	C1	N
	MADTOM, ORANGE-FIN	Noturus gilberti	C2	N
	MADTOM, OUACHITA	Noturus lachneri	E	Y
	MADTOM, SMOKY	Noturus baileyi	T	Y
	MADTOM, YELLOWFIN	Noturus flavipinnis	C2	N
	SHINER, BLUESTRIPE	Notropis callitaenia	C3	N
	SHINER, PEPPERED	Notropis perpallidus	C2	N
	STURGEON, GULF	Acipenser oxyrhynchus desotoi	E	N
	STURGEON, SHORT-NOSE	Acipenser brevirostrum	C2	N
09	CAVEFISH, NORTHERN	Amblyopsis speleae	T	N
	CAVEFISH, OZARK	Amblyopsis rosae	C2	N
	DARTER, BLUESTRIPE	Percina cymatotaenia	C2	N
	DARTER, CRYSTAL	Ammocrypta asprella	C2	N
	DARTER, FINESCALE SADDLED	Etheostomata osburni	C2	N
	DARTER, LONGHEAD	Percina macrocephala	C2	N
	DARTER, LONGNOSE	Percina nasuta	E	Y
	DARTER, MARYLAND	Etheostoma sellare	C2	N
	DARTER, STARGAZING	Percina uranidea	E	N
	MADTOM, SCIOTO	Noturus trautmani	C2	N
	MINNOW, CHEAT	Rhinichthys bowersi	C2	N
	MINNOW, KANAWHA	Phenacobius teretulus	C2	N
	STURGEON, LAKE	Acipenser fulvescens	C2	N
	SUCKER, BLUE	Cycleptus elongatus		

FOREST SERVICE REGIONAL OFFICE LOCATIONS



The location of each Forest Service Regional office and the states located within each Region is shown below:

Northern Region (1); ND, MT, Northern ID, N.West. SD. USDA Forest Service, Federal Building, P.O. Box 7669, Missoula, MT 59807. Commercial phone (406) 329-3288, FTS 8-585-3520.

Rocky Mountain Region (2); CO, KS, NE, SD, Eastern WY. USDA Forest Service, 11177 W. 8th Ave., Box 25127, Lakewood, CO 80225. Commercial phone (303) 236-9526, FTS 8-776-9526.

Southwestern Region (3); AR, NM. USDA Forest Service, Federal Building, 517 Gold Ave. S.W., Albuquerque, NM 87102. Commercial phone (505) 842-3260, FTS 8-476-3260.

Intermountain Region (4); So.ID, NV, UT, Western WY. USDA Forest Service, Federal Building, 324 25th St., Ogden, UT 84401. Commerical phone (801) 625-5666, FTS 8-586-5666.

Pacific Southwest Region (5); CA, HI, GU and Trust Territories of the Pacific Islands. USDA Forest Service, 630 Sansome St., San Francisco, CA 94111. Commercial phone (415) 556-8551, FTS 8-556-8551.

Pacific Northwest Region (6); OR, WA. USDA Forest Service, 319 S.W. Pine St., Box 3623, Portland, OR 97208. Commercial phone (503) 221-4091, FTS 8-423-4091.

Southern Region (8); AL, AR, FL, GA, KY, LA, MS, NC, OK, PR, SC, TN, TX, VI, VA. USDA Forest Service, 1720 Peachtree Road, N.W., Atlanta, GA 30367. Commercial phone (404) 347-4560. FTS 8-257-4560.

Eastern Region (9); IL, IN, IA, ME, MA, MI, MN, MO, NH, NJ, NY, OH, PA, VT, WV, WI. USDA Forest Service, 310 W. Wisconsin Ave., Rm. 500, Milwaukee, WI 53203. Commercial phone (414) 291-3612, FTS 8-362-3612.

Alaska Region (10); AK USDA Forest Service, Federal Office Building, Box 1628, Juneau, AK 99802. Commercial phone (907) 586-8752, FTS use commerical phone number.

Abundance, status, and rearing of razorback sucker (Xyrauchen texanus) in the Green River basin of Utah, USA

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Abstract. - The razorback sucker was rare in collections from the upper Green River basin, 1979 - 1987. The number of razorback sucker was estimated at 978 fish (95% C.I. = 746 - 1210), based on a total of 360 fish captured (50 recaptures). This low population size, and a lack of apparent recruitment, reflected the endangered status of this fish and indicates that immediate steps are needed to ensure its survival. Streamside stripping, artificial fertilization, and rearing of razorback suckers is currently under evaluation at an experimental rearing facility at Ouray National Wildlife Refuge, Utah. A total of 2987 razorback suckers, ranging in size from 49-205mm, were raised in 1987 from eggs stripped from wild fish. These young razorback suckers are being held for potential brood stock, and morphometric work.

Tamaño de población y prospectos futúros de razorback sucker (Xyrauchen texanus) en la Cuenca del Rio Green, Estados Unidos

Resumen. - La población de razorback sucker en la uenca superior del Rio Green, estimada a 978 peces con 95% confidencia de 746 - 1210 peces. Esta

población mínima, combinada con falta de recrutamiento, llama atención a la necesidad para medidas para asegurar la supervivercia de esta especie antes de su extinción. El éxito con natación de razorback sucker, en sitio, se esta evaluando en una creadora experimentál construida en el Refugio Nacional de Ouray, en el estado de Utah, en 1987. Un totál de 2,987 razorback suckers de 49 - 205mm de tamaño se han mantenído desde huevecios tomedos de peces capturados en el otoño de 1987. Los jovenes del año el mantienen para su potencia a reproducción, y para trabajo morfométrica.

Introduction

The razorback sucker (Xyrauchen texanus), endemic to the Colorado River basin (Minckley 1983), is now threatened with extinction (McAda and Wydoski 1980; Wick et al.1982; Tyus 1987; USFWS 1987). Seethaler et al. (1979) reported this species was once abundant and widely distributed, but its status has apparently declined in rivers of the upper Colorado River basin (UCRB). Today it is rare, and remains only in the mainstream and lower parts of tributaries of the Green and upper Colorado rivers (McAda and Wydoski 1980; Tyus et al. 1982). Razorback suckers are also found in mainstream reservoirs in the lower Colorado River, but those stocks appear to be relict subpopulations of very old individuals (Minckley 1983; McCarthy and Minkley 1987).

The precarious existence of the razorback sucker in the UCRB was indicated by McAda and Wydoski 1980; Wick et al. 1982; and Tyus 1987, but no attempts at estimating the size of razorback sucker subpopulations in rivers have been published. We evaluated the status of this rare species in the Green River, Utah, using capture-recapture data collected during 1980-1987.

Methods

Field Collections

U.S. Fish and Wildlife Service Colorado River Fish Project (CRFP) and Utah Division of Wildlife Resources (UDWR) personnel collected razorback suckers in the Green River basin. These fish were captured primarily by electrofishing, although a few were obtained in seine and trammel nets. Two CRFP electrofishing sampling programs were used: a basin-wide "standardized" program conducted from April to June 1980-1981, and a "spring" program conducted from April to June 1984-1987 (Tyus 1987). Sampling by UDWR personnel was done during April and May of 1986 and 1987 as part of a spring Colorado squawfish (Ptychocheilus lucius) monitoring program (USFWS 1986).

Population estimate assumptions

Geographic and demographic closure are important assumptions when using capture-recapture data to estimate population size (White et al. 1982). We assumed geographic closure for two subpopulations of razorback suckers: one in the upper Green River (RK 340 - 555) and one in the lower Green River (RK 0 - 211). An area of high gradiant, Desolation and Gray Canyons (RK 211 - 340), separates the upper and lower Green River. A review of collected data revealed that no razorback sucker movement occurred between the upper and lower Green River, nor between the lower Green and Colorado rivers. Therefore, we treated razorback suckers in the upper Green River and the lower Green River separately.

We also assumed demographic closure was met, even though several years of capture-recapture data were used. Spawning activities of the razorback sucker occurs, but do not result in successful recruitment. The presence of larval razorback suckers have been documented below suspected spawning sites

in the upper Green River (Tyus 1987) and ripe razorback suckers have been captured at several suspected spawning sites in the Green River basin (McAda and Wydoski 1980; Wick et al. 1982), but no razorback sucker juveniles (fish larger than 20mm but smaller than 400 mm) have ever been captured in the Green river during the past 9 years of sampling. Several authors (Behnke and Benson 1980, Miller 1961; Minckley and Deacon 1968; Minckley 1973; Tyus 1987) hypothesized that either large numbers of introduced predator species in the Green River prey on young razorback suckers to the extent they prevent their recruitment to the adult population, or that successful reproduction decreased after the impoundment of Flaming Gorge Dam in 1962, implicating habitat alteration as a major factor in reducing recruitment.

Adult mortality appears to be extremely low. Tyus (1987) reported the average age of Green River fish appears to be several years less than the ages of 24 to 44 years reported by McCarthy and Minkley (1987) for Lake Mohave fish. Assuming that razorback suckers in the Green river have a similar life span as Lake Mohave fish, the Green River fish are therefore likely to experience a low mortality rate due to their relatively young age. We therefore did not consider adult mortality a significant factor.

Computer program CAPTURE

Yearly capture-recapture data for razorback suckers for 1980 - 1987 were entered into the computer program CAPTURE (White et al. 1982) as a data matrix. This program tests capture probability assumptions by comparing the absolute and relative fits of eight different population estimation models to the data and selects the "best" estimator. The models are based on the three factors that can affect capture probabilities: time, behavioral response to capture, and innate heterogeneity (i.e., variations among individuals in

capture probabilities) (White et al. 1982). The maximum likelihood estimator of the estimated population size (N) under the selected model is computed by program CAPTURE using numerical methods (Otis et al. 1978).

We considered each year as a separate sampling occasion in the data matrix. We included only those fish captured by U.S. Fish and Wildlife Service Colorado River Fish Project or Utah Division of Wildlife personnel to ensure that fish were collected from a system-wide sampling effort that included the range of the fish. Recaptures of fish originally tagged by other people from point samples were considered as original captures in the data matrix. Fish whose tags were lost (i.e., a line was present where a tag was lost) were retagged and listed as an original capture. Fish removed from the population were deleted from the data matrix unless they were removed during the last year of sampling, 1987. No razorback hybrids are included in the data matrix.

Results and Discussion

Population Estimation

A total of 372 adult razorback suckers were caught from 1980 - 1987. These fish ranged in size from 426 to 608 mm, TL. Three fish caught in 1983 had lost their tags.

The model selection procedure of the CAPTURE program identified a model allowing time specific changes in probability of capture (M_t) as the most appropriate model to use for our data. This model assumed all fish had the same capture probability during a sampling occasion (t); the past capture history of a fish was not allowed to influence its current capture probability (White et al. 1982). The Petersen-Lincoln (for t = 2) and the

Schnabel (for t > 2) are familiar estimators that approximate the maximum likelihood estimator used in CAPTURE. Selection of M_t was expected in that sampling effort varied each year because of differences in river discharge, and to commitments to other sampling programs.

The total number of captures, recaptures, electrofishing effort, and catch per unit effort (CPUE) for the upper Green River (RK 340 - 555) and the lower Green River (RK 0 - 211) are listed in Table 1 for 1980 - 1987. Data from 1983 were not used as part of the population estimation data matrix because sampling effort was greatly curtailed that year due to flood conditions and no fish were caught in the upper Green River.

The population of razorback suckers in the upper Green River was estimated at 978 fish (SE = 118, 95% C.I. = 746 - 1210). The probability of capture (p) varied from .02 to .09 (Table 1). The coefficient of variation of N = 12.3 %, indicated good precision. White et al. (1982) suggested that reliable scientific studies require a coefficient of variation of N < 20%.

The number of captures of razorback suckers in the lower Green River was so small (12 fish captured from 1980-1987) that we felt it was impractical to estimate the population for this section of river. Catch-effort data (Table 1) indicated the razorback sucker population in the lower Green River is much smaller than in the upper Green River, and Tyus (1987) indicated that fish density in spring samples from strata in the lower Green River was about one order of magnitude less than the upper Green River. We consider the razorback sucker population in the lower river to be a remnant population, and too small to determine by capture-recapture methods.

Experimental razorback sucker facility

An experimental razorback sucker facility was established in 1986 at the Ouray National Wildlife Refuge (NWR) to: 1) determine if streamside stripping, artificial fertilization, and rearing of razorback suckers could be successful; 2) determine the logistics of rearing razorback suckers at a small facility using tanks and ponds; and 3) provide fish for experimental purposes, including an evaluation of the stock, and relative survivalship of different age classes of razorback suckers released into the Green River. The facility consists of three 1/10 acre ponds, a building which houses incubators and rearing tanks, and a well. Personnel from Vernal Colorado River Fish Project, Jones Hole National Fish Hatchery, Dexter National Fish Hatchery, Ouray NWR, and Arizona State University, Tempe contributed to the design, construction, and operation of this project.

Adult fish were collected from a razorback sucker spawning site in the Green River, Utah (RK 500) in April and May, 1987. Three female razorback suckers were stripped and eggs fertilized on the spawning grounds with 1 - 3 males in early collection efforts. Twenty four other adult razorback suckers (13 females, 11 males) were also taken to the Ouray NWR facility for hormone injection. Five attempts at spawning eleven females with 2 - 7 males each resulted in about 15,000 fertilized eggs. Unfortunately, a problem with fungus in the incubator (at low water temperatures of about 11 C) wiped out all but a few hundred eggs. Five females were subsequently spawned with 1 - 3 males, and this resulted in about 4500 fertilized eggs. These eggs were treated with the fungicide malachite green and moved to warmer ponds (16-21 C), where a good hatch occurred.

We stocked 2900 razorback sucker fry in pond 1 and 360 fry in pond 3 in early May, 1987. These ponds were seined during November, 1987 and produced 2725 fish from pond 1 (33 fish/lb), and 261 fish from pond 3 (12 fish/lb). The fish ranged in size from 49mm to 205mm. Differences in fish growth between the 2 ponds were presumably due to stocking densities (D. Toney, personnel communication).

Future plans for the Ouray NWR facility are not completed, but the facility is currently being expanded to include a new pond for holding future brood stock. Razorback suckers produced this year are being held for use as potential brood stock, stock evaluation, and potential release. If more are obtained in subsequent years, half of the captive fish would be released and new numbers added each year to increase diversity of the captive brood.

Results in 1987 indicated that our ability to take sex products in the field reduced the stress of holding wild fish. We believe future propagation efforts for razorback suckers will be necessary until the cause of reproductive failure is identified and corrected.

Acknowledgements

These studies were funded in part by the U.S. Bureau of Reclamation, the U.S. Fish and Wildlife Service, and the U.S. National Park Service. B.D. Burdick, W.B. Harned, J.J. Krakker, R.M. McNatt, and L.A. Trinca were principals among the many U.S. Fish and Wildlife Service employees who aided in gathering the data. R. Radant provided data collected by Utah Division of Wildlife Resources personnel under Section 7 of the Endangered Species Act. L. Mills and J. Hamill aided with planning. D. Toney was responsible for the culture work at the Ouray National Wildlife Refuge facility. Ouray National Wildlife Refuge personnel constructed the ponds and aided in maintenance.

J.J. Johnson was involved in all aspects of constructing and operating the razorback sucker facility. K.M. Paulin aided in data retrieval. D.L. Otis and D.R. Anderson provided the software for program CAPTURE and offered suggestions for its use.

References

Behnke, R.J., and D.E. Benson. 1980. Endangered and threatened fishes of the upper Colorado River basin. Extension Service Bulletin 503A, Colorado State University, Fort Collins.

McAda, C.W, and R.S. Wydoski. 1980. The razorback sucker, Xyrauchen texanus, in the upper Colorado River basin, 1974-1976. U.S. Fish and Wildlife Service Technical Paper 99, Washington, D.C.

McCarthy, M.S. 1986. Age determination for imperiled razorback sucker (Pisces:Catostomidae) from Lake Mohave, Arizona-Nevada. Masters Thesis, Arizona State University, Tempe.

Miller, R.R. 1961. Man and the changing fish fauna of the American Southwest. Paper of the Michigan Academy of Science, Arts, and Letters 24:686-687.

Minckley, W.L. 1983. Status of the razorback sucker, Xyrauchen texanus (Abbott), in the lower Colorado River basin. Southwestern Naturalist 28:165-187.

Minckley, W.L. and J.E. Deacon. 1968. Southwestern fishes and the enigma of "endangered species". Science 159:1424-1432.

Otis, D.L., K.P. Burnham, G.C. White, and D.R. Anderson. 1978. Statistical inference from capture data on closed animal populations. Wildlife Monographs No 62.

Seethaler, K.H., C.W. McAda, and R.S. Wydoski. 1979. Endangered and threatened

fish in the Yampa and Green rivers of Dinosaur National Monument. Pages 605-612 In R.M. Linn, editor. Proceedings of the first conference on scientific research in national parks. U.S. National Park Service, Washington, D.C.

Tyus, H.M. 1987. Distribution, reproduction, and habitat use of the razorback sucker in the Green River, Utah, 1979-1986. Transactions of the American Fisheries Society 116:111-116.

Tyus, H.M., B.D. Burdick, R.A. Valdez, C.M. Haynes, T.A. Lytle, and C.R. Berry. 1982. Fishes of the upper Colorado River basin: distribution, abundance, and status. Pages 12-70 In W.H. Miller, H.M. tyus, and C.A. Carlson, editors. fishes of the upper Colorado River system: Present and future. Western Division, American Fisheries Society, Bethesda, Maryland.

White, G.C., D.R. Anderson, K.P. Burnham, and D.L. Otis. 1982. Capture-recapture and removal methods for sampling closed populations. Los Alamos National Laboratory, LA-8787-NERP. Low Alamos, New Mexico.

Wick, E.J., C.W. McAda, and R.V. Bulkley. 1982. Life history and prospects for recovery of the razorback sucker. Pages 120-126 In W.H. Miller, H.M. Tyus, and C.A. Carlson, editors. Fishes of the upper Colorado River system: Present and future. Western Division, American Fisheries Society, Bethesda, Maryland.

USFWS (U.S. Fish and Wildlife Service). 1987. Recovery implementation program for endangered fish species in the upper Colorado River basin. Final Report. Region 6. Denver, Colorado

Table 1. Number of razorback suckers (Xyrauchen texanus) captured in the Green River, Utah by Vernal Colorado River Fish Project or Utah Division of Wildlife personnel from 1980-1987. Upper river is river kilometer (RK) 340 - 555, lower river is RK 0 - 211.

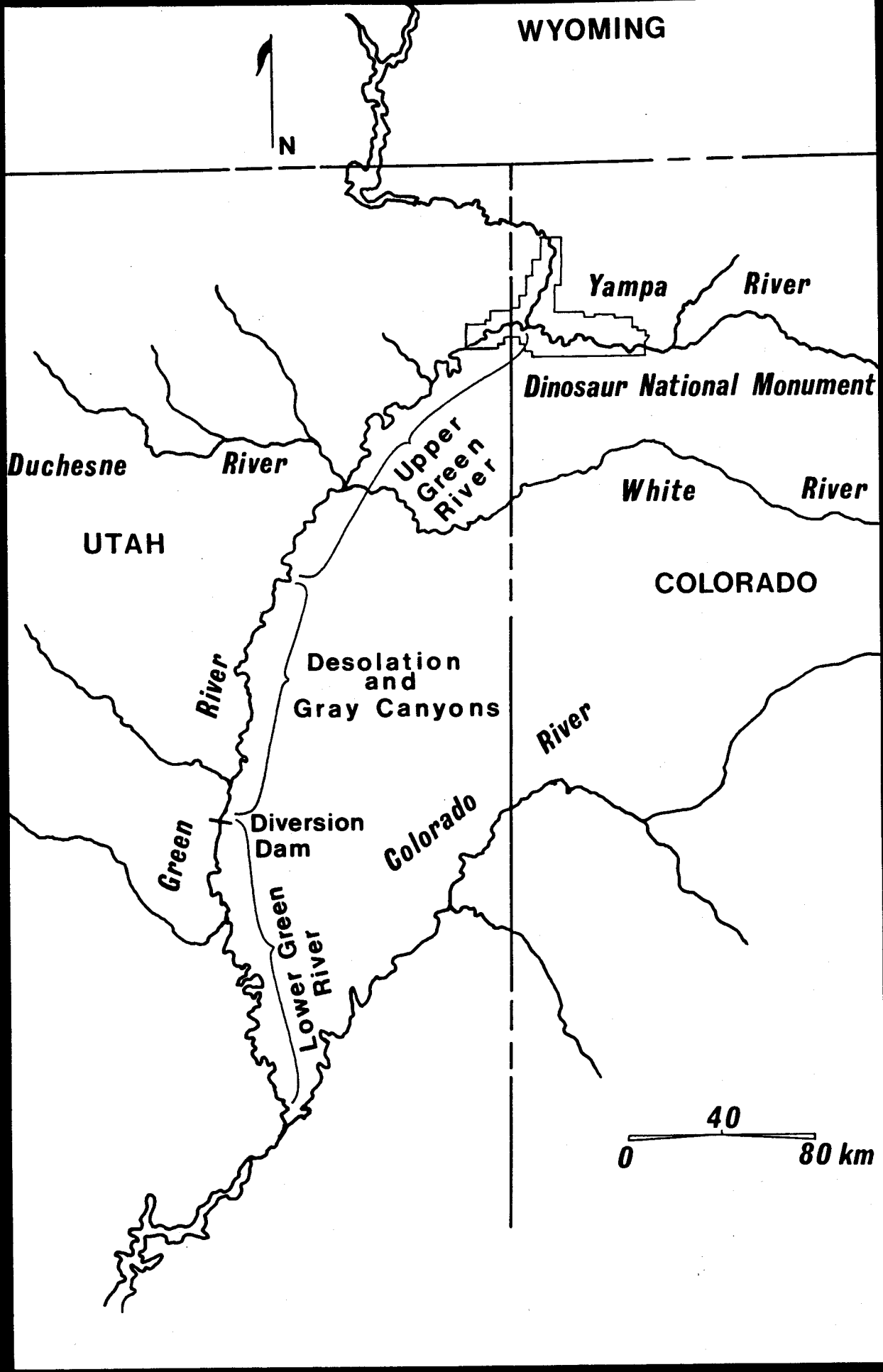
C = first time captures, R = recaptures, CPUE = catch per unit of fishing effort, p = probability of capture as determined by program CAPTURE. Effort is electrofishing hours.

Year	Upper River					Lower River			
	C	R	effort	CPUE	p	C	R	effort	CPUE
1980	17	0	140.2	0.12	0.02	1	0	24.1	0.04
1981	66[a]	0	75.0	0.88	0.07	0	0	-[b]	0.00
1982	33	1	30.2	1.13	0.03	0	0	0.0	0.00
1983	0	0	11.9	0.00	-	3	0	76.0	0.04
1984	78	6	101.2	0.83	0.09	2	0	32.3	0.06
1985	12	7	87.0	0.22	0.02	0	0	15.2	0.00
1986	59	20	93.5	0.87	0.08	0	0	18.4	0.00
1987	45	16	104.9	0.58	0.06	5	1	38.7	0.15
total	310	50				total 11	1		

[a]60 fish were caught electrofishing, 6 were caught by various nets or angling

[b]effort was not recorded

Figure 1. Location of Green River basin geographic sampling areas, 1980-1987.


WYOMING
N
Yampa River
Dinosaur National Monument
Duchesne River
Upper Green River
White River
UTAH
COLORADO
Desolation and Gray Canyons
River
River
Green
Diversion Dam
Colorado
Lower Green River
40
0
80 km

NOTES ABOUT FISH REMAINS FROM THE OFFERINGS OF THE "TEMPLO MAYOR" AND SOME COMMENTARIES.

EDMUNDO TENIENTE-NIVON
ESC. NAC. CIENCIAS BIOLOGICAS. I.P.N.

The material comes from the excavation of "Templo Mayor" which is located in the center of México city. These fish remains were founded in differents epochs of the construction of the Temple, the oldest construction is from the second epoch - in 1390, and the last one was made in the seventh in 1502.

This investigation tries to analyse the results of material from 26 offerings. In this research were founded 312 fish species(7 different types of sharks, stingrays and sawfishes and besides, 27 species of bony fishes). The main characteristic of these remains is the almost total absence of spines and vertebras, support elements, fish scales and denticles. The - jawbones, the operculars apparatus and the neurocraniums were the most abundants components, they comform a 70% of the material.

It is proposed the simmilitud Index X^2 to observe the relation between the offerings. This Index just takes in consideration the Presence-Absence of the identified species.

Are indicated the biological characteristics of some of recognised species. It is also identified the importance of - some of them mentioned in narrations and Codexs.

It is thought that these fish remains founded in the -- first epochs, were obteining by the commerce and that the quantity of the offeredfishes increased when many of the towns, near to the coast, were conquered.

Finally, none of the analised and identified remains is modified.

NOTAS SOBRE LOS RESTOS DE PECES DE LAS OFRENDAS DEL TEMPLO MAYOR Y ALGUNOS COMENTARIOS

Por: EDMUNDO TENIENTE NIVON

Casi en el total de las veces que se llevan a cabo excavaciones - arqueológicas es factible encontar restos óseos, usualmente fueron considerados tan solo como material de tipo orgánico. Descartando el posible valor informativo que en sí entrañaba, en la actualidad la identificación del material registrado conduce a análisis que van más allá del- contexto puramente biológico. Esos huesos a medida que son estudiados- en forma indirecta van informando sobre su historia, las artes de pesca de que se valieron para atraparlos, la fecha aproximada de la captura , los hábitos alimenticios de sus captores, la existencia de pesquerías , su comercio, su conservación y su transporte, idealmente se debería de- obtener el total de esa información pero es frecuente que queden lagu - nas.

Antes de que fueran descubiertas las ruinas del Templo Mayor en - el centro de la Ciudad de México, las únicas pruebas existentes de aquellos artículos que se traían como tributos o por el comercio, se tienen anotados graficamente en el Códice Mendocino y La Matrícula de Tributos además de aquellos escritos realizados en la época posterior a la con - quista que en ocasiones suelen ser vagos. Ahora con la información que se generó en el estudio del material identificado en cada una de las -- ofrendas se pueden complementar algunos pasajes de la historia narrados principalmente por cronistas de los siglos XVI y XVII.

METODOLOGIA

El material se recibió por separado en ofrendas, éstas a su vez -

se tienen fraccionadas en muestras más pequeñas que fueron obtenidas durante las excavaciones en base a su grado de asociación según el nivel en que se encontraron.

Se trabajó un total de 27 ofrendas divididas en 201 muestras, la identificación morfológica se hizo principalmente con el siguiente material bibliográfico; Gregory (1959), Díaz-Pardo (1982), Applegate (1965 1978) y Applegate et al (1979), y las publicaciones sobre el Templo Mayor de Matos-Moctezuma (1982-1984), además de aquellas que oportunamente se citan.

La determinación del número mínimo de individuos se efectúo de la siguiente forma, se llevó a cabo la cuenta de piezas impares que dan una impresión inicial de los ejemplares existentes, para este caso en particular el criterio que se siguio es la cuenta de neurocráneos, dimensiones y la cantidad de elementos correspondientes a cada lado.

La comparación de los restos se hizo con los esqueletos de la Colección Osteológica del Laboratorio de Cordados, Departamento de Zoología de la Escuela Nacional de Ciencias Biológicas, y el material ya identificado se depositó en el Instituto Nacional de Antropología e Historia.

RESULTADOS

El total de huesos identificados es de 1314 en las ofrendas revisadas, el porcentaje de aquellos elementos anatómicos mas abundantes es el siguiente; dentarios 25.64%; premaxilares 17.65%; preopérculos 9.58% opérculos 9.13%; neurocráneos 8.75%; los restantes componentes se encuentran en porcentajes menores al 5%.

Esos elementos corresponden a un total de 312 ejemplares que co - rresponden a 34 generos, pertenecientes a 21 familias, en la tabla No.1 se presentan por su abundancia y porcentaje.

TAXA	NUMERO DE JEMPLARES	%
Hemirhamphus sp.	61	19.55
Tylosurus acus.	55	17.62
Diodon sp.	30	9.61
Bodianus sp.	26	8.33
Pomacanthus of. paru	24	7.69
Pristis pectinatus	18	5.76
Lutjanus sp.	15	4.8
Carcharhinus sp. A	14	4.4
Epinephelus cf. analogus	11	3.52
Prionotus cf. evolans	7	2.24
Sphyraena barracuda	6	1.92
Balistes sp.	5	1.60
Haemulon cf. plumieri	4	1.28
Sparisoma sp.	4	1.28
Lactophrys sp.	4	1.28
Selene sp.	3	0.96
Conodon sp.	3	0.96
Carcharhinus sp. B	2	0.64
Caranx sp.	2	0.64
Scarus sp.	2	0.64
Scarus guacamaia	2	0.64
Batrachoides cf. gilberti cf. boulengeri	2	0.64

Galeocerdo cuvieri	1	0.32
Negrapion brevirostris	1	0.32
Dasyatis sp.	1	0.32
Dasyatis cf. americana	1	0.32
Fistularia sp.	1	0.32
Pomacanthus sp.	1	0.32
Trichiurus lepturus	1	0.32
Scorpaena plumieri	1	0.32
Balistes cf. carolinensis	1	0.32
Lagocephalus laevigatus	1	0.32
Sphoeroides sp.	1	0.32
Arothron sp.	1	0.32

Debido al número de ofrendas revisadas y a la cantidad de material reconocido, surgió la inquietud de valorar el grado de similitud que cada una de ellas mostró con las restantes, (es necesario aclarar que originalmente se hizo el tratamiento con relación a la etapa de construcción que se observa en el plano del Templo (figura 1), pero algunas de las ofrendas no corresponden a la etapa observada, esto se debe a que corresponden a planos superiores o inferiores de los templos dentro de la excavación, de todas maneras este metodo se espera que sea de utilidad cuando se conozcan con exactitud las fechas para cada ofrenda), los datos fueron representados en una matriz de Presencia-Ausencia (tabla 2) que permite aplicar en forma directa el Indice de Similitud - Complemento de X^2, que es presentado por Legendre y Legendre (1979), cuya representación es la siguiente:

$$S_{AB} = \frac{}{1/Yio\ (Yia/Yoa - Yib/Yob)^2}$$

Donde S_{AB}= Similitud de A con B

Yio= Suma del renglón "i" que se compara con la matríz de datos

Yia= Valor del renglón "i" comparado para la columna "a"

Yoa= Suma de la columna "a" que se está comparando

Yib= Valor del renglón "i" para la columna "b" que se está comparando.

Yob= Suma de la columna "b" que se está comparando

El resultado se presenta en forma de una matríz de similitud y los datos se interpretaron mediante un análisis de agrupamiento simple del que se obtuvo el siguiente dendrograma (figura 2), en este se separan cinco grupos, el primero con aquellas ofrendas que poseen únicamente a Pristis pectinatus.

El segundo grupo se encuentra formado por las ofrendas que cuentan con mayor grado de complejidad, debido al número y diversidad de peces que en ellas se reconocen, el centro de este conjunto de ofrendas lo constituye la número 23 que es la más diversa y rica, le siguen las 7, 61 y 62, que al parecer corresponden a las etapas constructivas en que el imperio tiene una mayor expansión hacia las costas del Golfo de México. (figura 3)

El tercer grupo lo forman las ofrendas que contienen los restos de Diodon sp., el cuarto grupo se forma con aquellas ofrendas que no guardan relación entre sí, pero que lo hacen con los grupos anteriores, en el último se aisla la ofrenda "L", por contener los restos de un ejemplar de Arothron sp.

El caso particular de la ofrenda 22 que no se considera en este

análisis, se debe a que tiene tan solo algunas vértebras de elasmobranquio, que podría darse el caso de que fueras restos de re-ofrendas aún cuando se pudo haber tratado de algún ofrecimiento con características muy específicas.

Se tienen además otros casos que en particular rompen con la armonía de las ofrendas, como situación relevante se tiene la existencia de vértebras que por su cantidad no resultan significativas, por ejemplo las ofrendas en que se encuentran dientes de tiburón usualmente -- también tienen algunas vértebras. En la ofrenda 13 en que se identificó a los peces pajarito Hemirhamphus sp. se encontraron numerosas vértebras, aquí se podría pensar que algunos de los pesecillos se depositaron íntegros; sin embargo no se tienen placas hipuricas ni elementos de las aletas pélvicas y pectorales.

De Diodon sp. el pez erizo se tiene una muestra con el total de las vértebras de un ejemplar, además de las espinas dérmicas y en la ofrenda número 13 se tienen los únicos restos con indicios de haber sido quemados, la cantidad de espinas dérmicas en cada muestra hacen suponer que siempre que se depositaron juntos la piel y el cráneo.

En la ofrenda 23 se tienen escamas de gran tamaño, redondeadas - al parecer de escarído, que en este caso pueden pertenecer de Sparisoma sp. en esta misma ofrenda se tiene un ejemplar casi completo del género Balistes sp.

Los fragmentos identificados de los peces cofre Lactophrys sp. , se encontraron junto con los componentes mandibulares y neurocraneales y algunas placas dérmicas, pero siempre en cantidades reducidas, otro-

detalle interesante en los restos identificados, se tiene en la existencia de los dos peces sapo del genero Batrachoides, ya que pueden corresponder a las especies B. gilberti ó B. boulengeri, el primero restringido a la cuenca del Usumacinta en Tabasco y Chiapas, y el segundo que se encuentra en el Caribe en Chetumal, Quintana Roo (Collete y Russo 1981) en caso de ser la segunda especie su orígen se puede explicar por el comercio entre los Pochtecas y sus homólogos los Ppolom, (figura 4) ya -- que como menciona Chapman (1959) estos comerciantes se ponian en contacto en la región conocida como Xicalanco, situada en el estado de Campeche.

Indudablemente la morfología que cada uno de estos peces presentan en vida, los hizo suceptibles a que los capturaran y a que la pesca de muchos de ellos condujera a estos hombres a los arrecifes y a islas cercanas a la costa, entre los peces que se destacan por su belleza se tienen los siguientes; Pomacanthus cf, paru conocidos como chabelas, -- los escaridos frecuentemente llamados guacamayas ó peces loro debido a la forma de sus mandíbulas en forma de pico y a lo vistoso de sus colores; los ostracidos que conocemos como peces cofre; el pez trompeta Fistularia sp.

La mayoría de los peces reconocidos habitan en los sistemas estuarino lagunares, otros de ellos invaden ocasionalmente las desembocaduras de los ríos, como suele suceder con algunos tiburones, las rayas y los peces sierra, aún cuando actualmente ya no es tan frecuente observar a estos últimos, otras formas a la fecha son fácil de encontrar en estuarios y rios entre ellos estan los agujones, los peces pajarito, -- los sables o machetes, los peces luna, los roncos, las boquillas, algu-

nos tetrodontiformes y cuando se incrementa considerablemente la salinidad en lagunas y estuarios se encuentra al pez erizo. (Castro-Aguirre - 1978)

Aún se puede hacer otra gran división del grupo de peces que se - han mencionado, entre los restos se reconocen a aquellos que son venenosos por la acumulación de toxínas en sus gonadas ó en otros tejidos, -- por ejemplo: Los tetrodontiformes Sphaeroides sp. y Arothron sp.; el - pez erizo Diodon sp.; el pez cofre Lacophrys sp. y en ocasiones la ba - rracuda (Hildebrand 1944) Sphyraena barracuda.

Aquellos que se consideran ponzoñosos que entran en esta catego - ría, debido a que inyectan algun tipo de sustancia venenosa por medio - de sus elementos de sosten o por otra estructura y son: El pez conocido como escorpión Scorpaena plumieri, las rayas Dasyatis sp. y D. cf. - americana; por último los dos peces sapo del género Batrachoides.

De aspecto poco común por presentar las mandibulas armadas con -- hileras de dientes agudos y cortantes, los tiburones de género Carcharhinus sp, la tintorera Galeocerdo cuvieri, el tiburón chato Negrapion - brevirostris, el pez sierra Pristis pectinatus, las barracudas y el pez sable Trichiurus lepturus, con formas esbeltas y colores agradables elmismo pez sable, los agujones y el pez trompeta que además posee escu - dos dérmicos que protegen su cuerpo en algunas áreas.

Se pueden seguir buscando características llamativas y cada pez - puede quedar incluído en una o en otra categoría quedaría tan solo pensar en la característica de ofrendas de tipo alimenticio, que al menospara mí se puede dejar parcialmente de lado.

Si se toman en cuenta solo aquellos peces que a la fecha se si -- guen consumiendo, el grupo se vería reducido a los siguientes; perros - colorados Bodianus sp, huachinangos Lutjanus sp., las cabrillas Epine - phelus cf, analogus, las boquillas Haemulon cf, plumieri, los peces luna Selene sp., los roncos Conodon sp. y los jureles Caranx sp., su porcentaje alcanza el 20% y si se consideran los tiburones y las barracudas que tienen mas bien un consumo reducido este porcentaje se eleva -- tan solo al 28.19%.

Cuando menciono que es poco probable que se trataran de ofrendas- del tipo alimenticio, se debe a varias razones; la primera de ellas es- el porcentaje reducido de peces comestibles, la segunda y más importante se debe a que solo se encontraron las regiones cefálicas de los peces, salvo las excepciones antes señaladas.

Y la tercera que es consecuencia de lo observado anteriormente y- que podría explicar el porqué de la falta de restos corporales, la existencia de huesos quemados en la ofrenda 13 es un fuerte índice de que - los cuerpos de algunos peces pudieron seguir la misma suerte.

Se sabe que en el período de máximo esplendor del imperio se po - dían llevar peces por medio de postas desde las costas de Veracruz a la capital en pocas horas, sin embargo si pensamos en las molestias de - - transportarlos desde lugares mucho más alejados y de clima tropical, -- con el inconveniente de que además se podían descomponer con facilidad, el transporte de éstos se pudo facilitar al llevar tan solo la cabeza - de los peces si los ejemplares eran de tallas muy grandes, lo más probable como se menciona en las crónicas es que pudieron haberlos llevado -

completos conservados en sal, ahumados, secos o aún como menciona Fray-Diego de Durán, preparados en barbacoa.

Hay que recordar que los pueblos costeros no se encontraron eximidos del pago de tributos que hacían en forma bianual (Soustelle 1977) y específicamente con productos obtenidos del mar (Torquemada).

El consumo de los peces era bastante común para este pueblo y diferenciaba a los dulceacuícolas o Michin de los de orígen marino que conocían como Tlacamichin, a los que definieron como "peces grandes que andan en el mar y que son buenos de comer" (Códice Florentino).

Al respecto en los escritos del siglo XVI de Sahagún presenta el nombre en Nahuatl del pez aguja o agujón Tylosurus, refiriéndose a el como Huitzilmichin (figura 5) o pez colibrí, al que llama Totomichin -- (figura 6), por las características de su descripción podría tratarse de algún tipo de escarido, mientras que Clavijero da los siguientes nombres; Tlateconi y Acipactli referidos al género Pristis, (figura 7) - - mientras a los tiburones los nombra Cipactli, las barracudas fueron conocidas como Tolmichin o Acuetzpalin.

Sobre su significado ritual es poco lo que se tiene investigado , en el Códice Florentino se pinta el sacrificio de una doncella con el espadarte de un pez sierra Pristis, (figura 8) aunque el texto dice que era utilizado tan solo para sujetar del cuello a la víctima, un espadarte aparece pintado en el Códice Borgia, y Eduardo Seler menciona sobre esta pintura lo siguiente: "representa un comerciante llevando un báculo por espadarte que además se encuentra armado en la punta por un cuchillo de piedra (figura 9).

El mismo autor al referirse a los tiburones, señala que mientras para algunos pueblos cercanos a la costa éste era conocido como Cipac - tli, para los habitantes del Valle de México éste representó un cocodrilo, cuando analiza el significado de estas figuras en los Códices Bor - gia, Fejervary Mayer y Vaticano, mencionan lo siguiente; El tiburón representa en la mitología de estos pueblos al pez con el cual se hizo la tierra, es además el primer símbolo de su calendario mágico ó Tonalmatl además de ser la representación del "Genio del Oeste" (Seler 1963), que habita en la región de Tamoanchan o casa del Nacimiento del agua (figuras 10 y 11).

Sobre el nacimiento de sus artes de pesca se escribió lo siguiente: "Al asentarce los mexicas en la laguna en el año de 1325, la supervivencia de este pueblo a lo largo de ocho años se debió a una intensa- actividad pesquera" (Chimalpain), hay que recordar que al establecerse- se trataba de un pueblo casi nómada y ellos mismos reconocían que sus - conocimientos en el arte de la pesca eran nulos, Clavijero en sus escritos habla de la existencia de un dios Opochtli que les proporciona los- instrumentos de pesca y les enseña la forma de utilizarlos, en la figura 12, se distingue a este dios y algunos hombres que llevan redes de - cuchara ó Chitlachtlis y fisgas con formas de tridentes conocidas como- Minacachallis (Sahagún), por último se presentas dos figuras que pescan con redes de cuchara y que son la representación simbólica del Occidente. (figuras 13 y 14)

C O N C L U S I O N E S

El haber encontrado restos de peces de orígen marino en las o -- frendas del Templo Mayor, es en sí mismo un hecho relevante, se destaca aún más si se toma en consideración que en el material estudiado no se presentan huesos de peces dulceacuícolas aún cuando la ciudad en -- que se localizó este Templo se hallaba rodeado por una gran laguna.

De acuerdo a los datos propuestos por Davies Nigel (1968-1973) , no es hasta 1440 que los Aztecas consiguen dominar el Valle de México, por lo que personalmente supongo que aquellas ofrendas que se localizan en las primeras etapas de construcción del Templo y que contienen- algunos elementos orgánicos de peces, éstos fueron obtenidos por medio del comercio, pues se sabe que existían líneas y puertos comerciales a todo lo largo de Mesoamérica que servían lo mismo para el intercambio- comercial, que para el cultural (Chapman 1959).

Después de controlar el Valle, los Mexicas inician el avance - - hacia la costa del Golfo de México, de esa forma las dificultados para adquirir alimentos y materiales costeros se desvanecen y ya controlada la costa, el tributo bianual de las poblaciones sojuzgadas permitió -- que aquellas ofrendas depositadas en las construcciones externas sean- más numerosas y que se incrementara la cantidad y la variedad de peces ofrendados con anterioridad.

Como ya se mencionó con anterioridad, existe la posibilidad de - que para los ceremoniales les entregaran peces recién capturados, pero del mismo modo pudo suceder, que les llevaran peces conservados en sal

sus regiones cefálicas ó partes de ellas, como pudo ocurrir con algu - nos espadartes de los peces sierra cuyos rostrales llegan a tener un - metro o más de longitud, lo cual implica que el pez mediría aproximada mente 5 metros de longitud total.

Nos podríamos inclinar hacia la primera situación, debido a que- se encontraron restos quemados, aún cuando sean tan solo de un pez, es to apoya fuertemente que los cuerpos de muchos de ellos pudieron ser - incinerados.

La importancia religiosa de algunos de estos peces marinos se re fleja en aquellas referencias hechas por los cronistas Novohispanos, - pero principalmente se observa en los contados registros que se guar - dan en códices y pinturas del periodo precortesiano y de los cuales se muestran algunos ejemplos en este trabajo.

Por último la presencia de los dos peces sapo (Batrachoides), -- vienen a ratificar la importancia del comercio realizado por los Poch- tecas, ya que de tratarse de la especie que se encuentra en el Grijal- va lo pudieron obtener por medio de la colonia que tenían establecida- en Xicalanco, y en caso de tratarse de la especie caribeña el intercam bio entre los primeros y sus homólogos los pplom, conduciría a los pe- ces a formar parte de las ofrendas, y como consecuencia final el trans porte de estos ejemplares ya sea desde Tabasco o de Quintana Roo tuvo- que hacerse en alguna de las formas antes señaladas.

Ofrendas.

	6	7	11	12	13	15	17	20	21	23	24	31	41	49	52	56	57	59	60	61	62	78	82	camara. A	L	III
Carcharhinus sp. A						*	*			*									*	*	*		*			
Carcharhinus sp. B										*																
Galeocerdo cuvieri																			*							
Negrapion brevirostris										*																
Pristis pectinatus	*	*	*	*	*	*	*	*	*	*	*	*				*	*		*				*			
Dasyatis sp.										*																
Dasyatis cf. americana							*																			
Tylosurus acus					*	*	*			*								*	*		*					
Hermirhamphus sp.	*				*		*			*									*	*			*			
Fistularia sp.																			*							
Sphyraena barracuda						*				*																
Epinephelus cf, analogus	*					*				*									*							
Caranx sp.																			*							
Selene sp.										*									*							
Lutjanus sp	*									*									*							
Conodon sp.	*									*																
Haemulon cf. plumieri										*									*							
Pomacanthus sp.																			*							
Pomacanthus cf. paru						*				*								*	*	*		*				
Bodianus sp	*					*				*										*	*					
Scarus sp.																			*	*						
Scarus guacamaia																			*						*	
Sparisoma sp.										*										*						
Trichiurus lepturus										*																
Scorpaena plumieri					*																					
Prionothus cf evolens					*					*									*				*			
Balistes sp.					*															*		*				
Balistes cf carolinensis										*																
Lactophrys sp.										*									*		*	*				
Lagocephalus laevigatus																			*							
Sphoeroides sp.										*																
Arothron sp.																									*	
Diodon sp.							*			*			*	*	*				*	*			*			
Batrachoides (+)		*								*																

TABLA 2. MATRIZ DE PRESENCIA-AUSENCIA.
(+) Las especies se encuentran referidas en el texto.

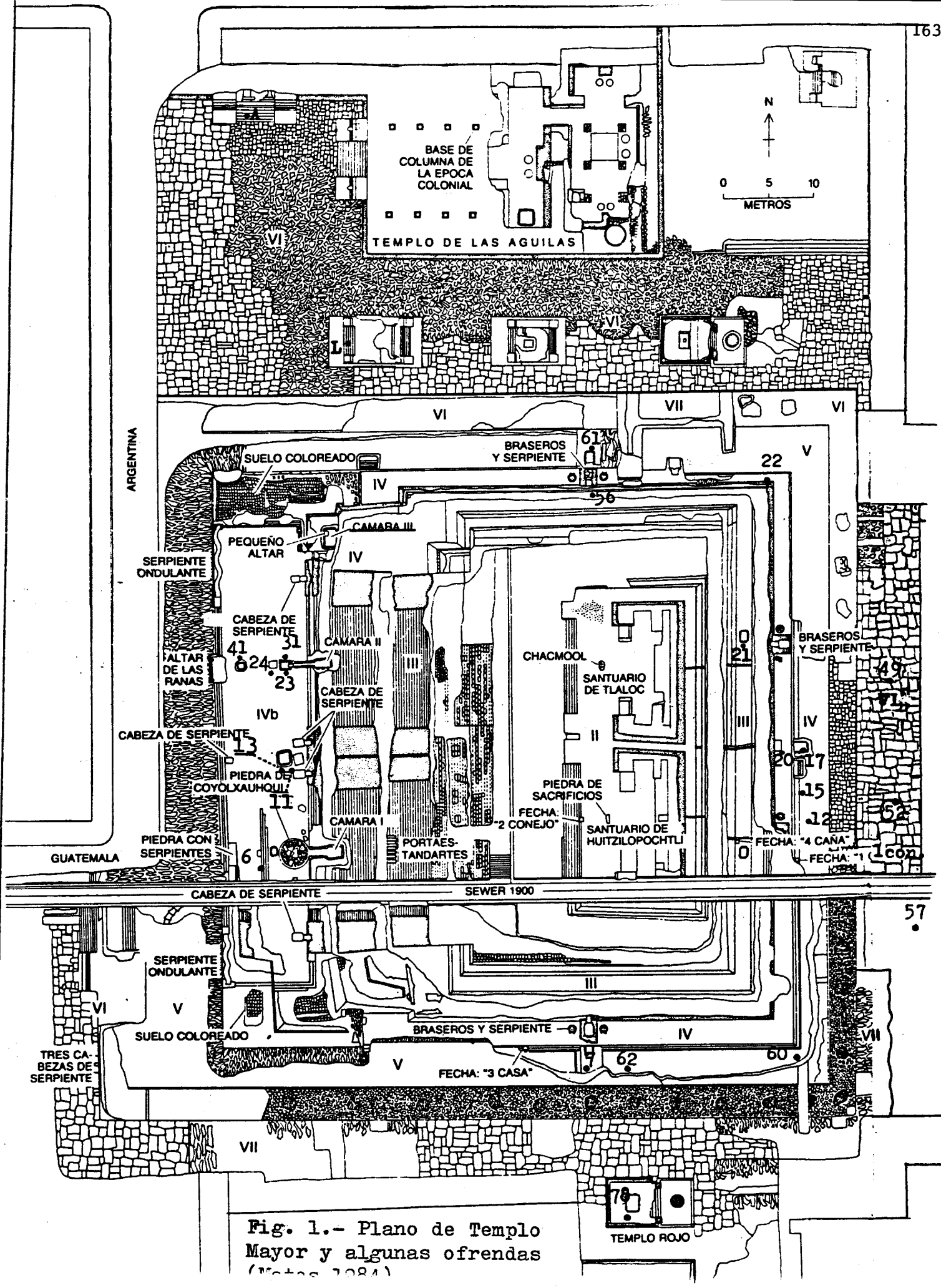


Fig. 1.- Plano de Templo Mayor y algunas ofrendas
(Matos 1984)

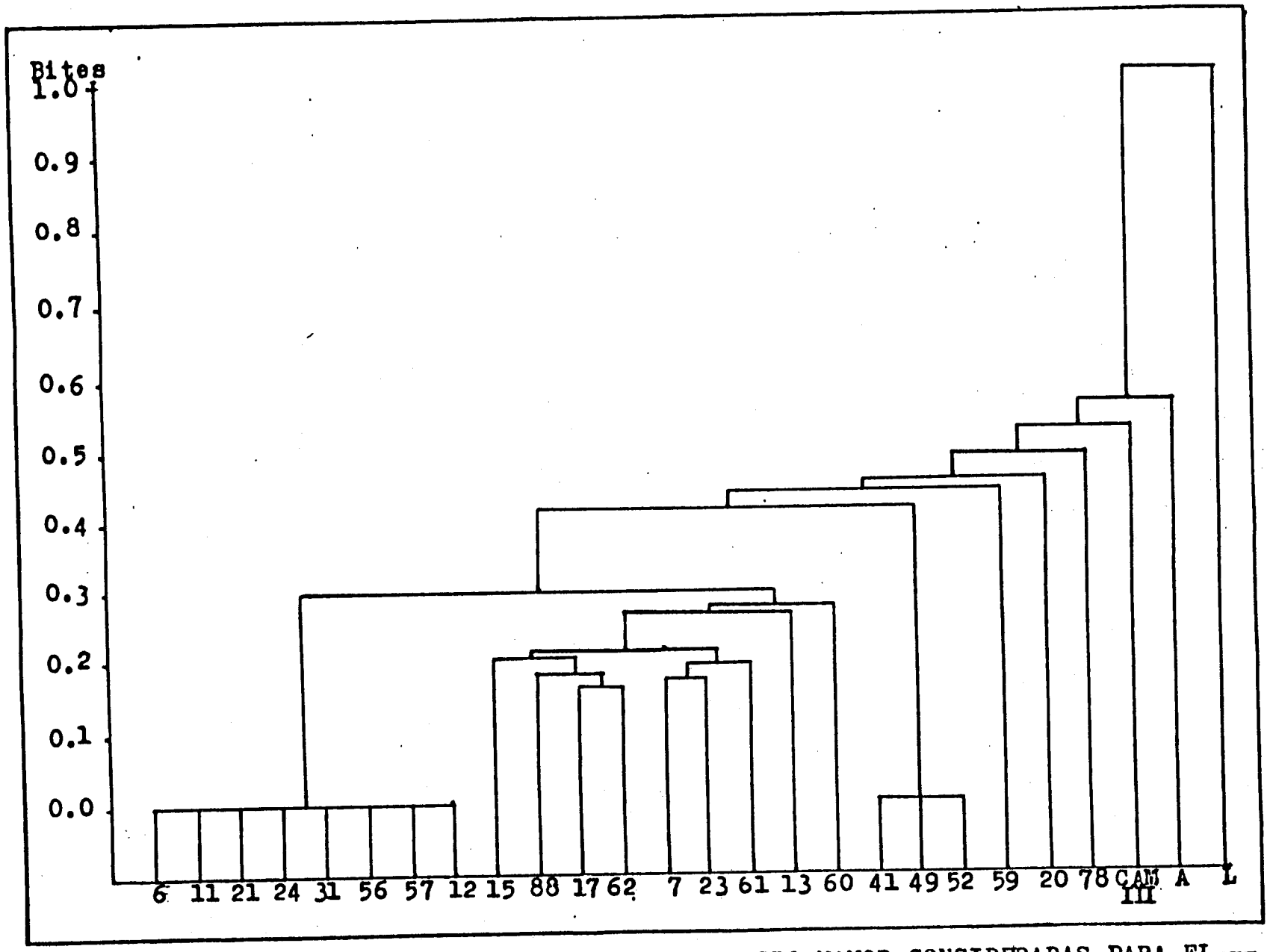
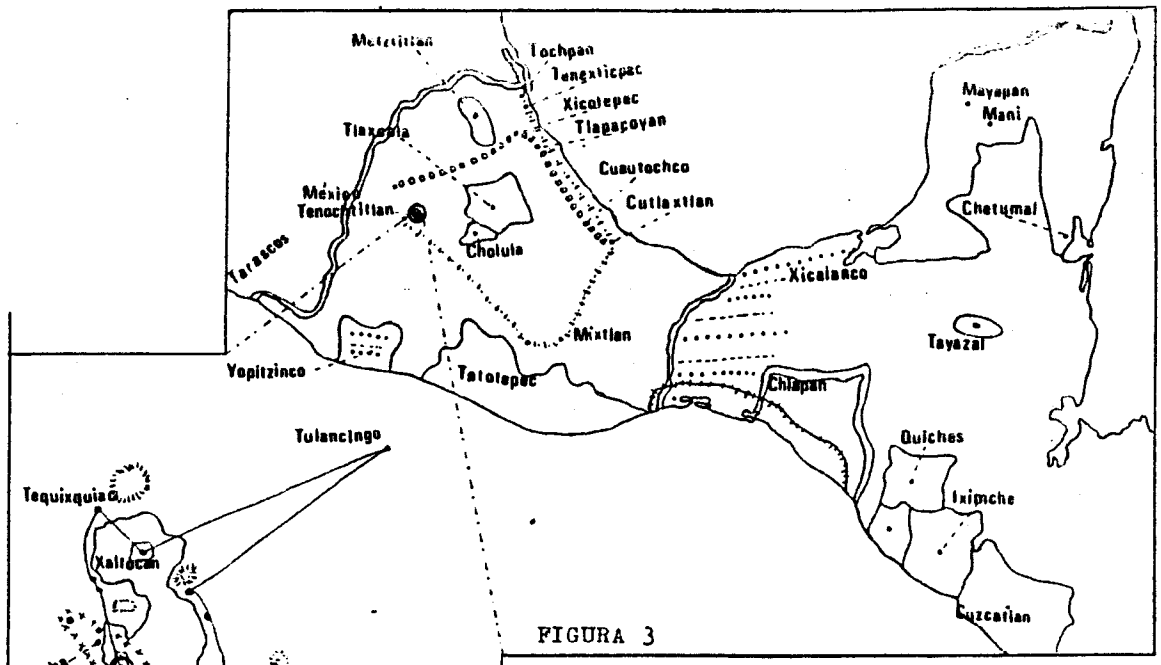


FIGURA 2.- DENDROGRAMA DE LAS 26 OFRENDAS DE TEMPLO MAYOR CONSIDERADAS PARA EL--- ANALISIS DEL INDICE DE SIMILITUD COMPLEMENTO DE X^2



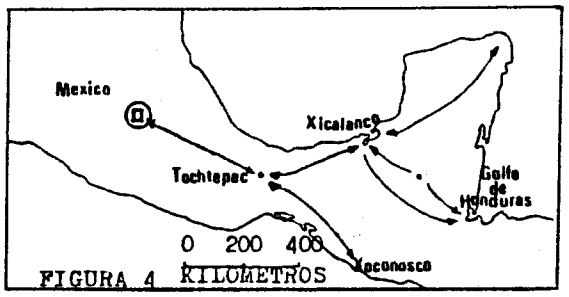


Fig. 3A.- A partir de 1427 (x), fecha asignada en que controlaron la zona aledaña al lago de Texcoco, el avance progresivo a la - costa de Veracruz se hizo cada vez más contundente.

Figura 3.- La extensión territorial contolada fué mayor, hacia el año de 1440 (o), habian dejado Metztitlan y Tlaxcala aisladas -- mientras que su avance casi los llevó a la costa.

En el período comprendido entre 1469-1481 (ı·ı), su control en el este fué un hecho, de 1486 a 1502 (///), invaden el Xoconusco y - con Yopitzinco, mantienen dominios en las costas del Pacífico.

Por último de 1502 a 1521 (═), sus fronteras se habian detenido en el norte y en el sur, pero tenian áreas de influencia comer-- cial en Xicalanco (:::).

Figura 4.- El establecimiento de puertos comerciales, permitio - que todo tipo de materias llegaran a lugares distantes, como se muestran en estas rutas.

Los datos utilizados para la elaboración de estos mapas corresponden a los siguientes autores.

Fig. 3A.- Gibson (1978); Códice Mendoza.

Fig. 3.- Códice Mendoza; Davies (1968; 1973); Haberland (1974)

Fig. 4.- Chapman (1959).

Figura 5.- Huitzitzilmichin es la representación de un belonido (Códice Florentino).

Figura 6.- Totomichin, por la descripción al parecer- de un escarido (Florentino).

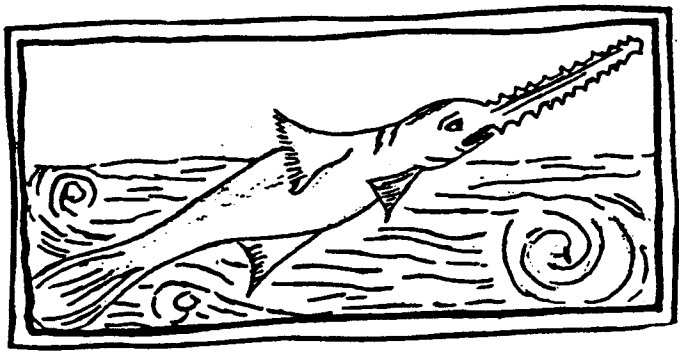


Figura 7.- Acipactli o Tlateconi, es la representación de Pristis

Fig. 8.- Sacrificio de una mujer con un espadarte de Pristis (Códice Florentino).

Figura 9.- Dios rojo de la noche, lleva por baculo una arma curva con el dibujo de Cipactli (Códice Borgia).

Figura 10.- Cipactli es el monstruo acuático y genio del oeste, representa a un tiburón.

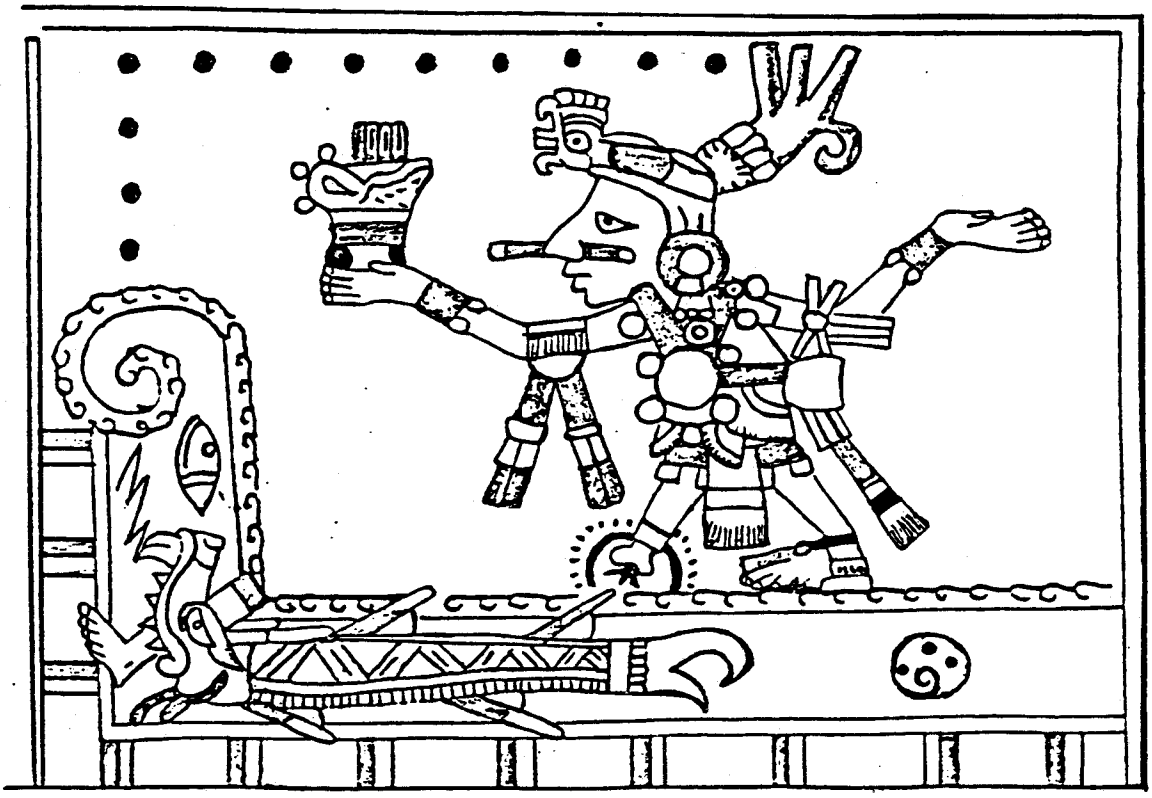


Figura 11.- Escena similar a la anterior, en que que un tiburón le arranca una pierna al dios Xochipilli. (Códice Fejervary Mayer).

Figura 12.-Ceremonia ante el dios de la pesca Opochtli (C. Florentino).

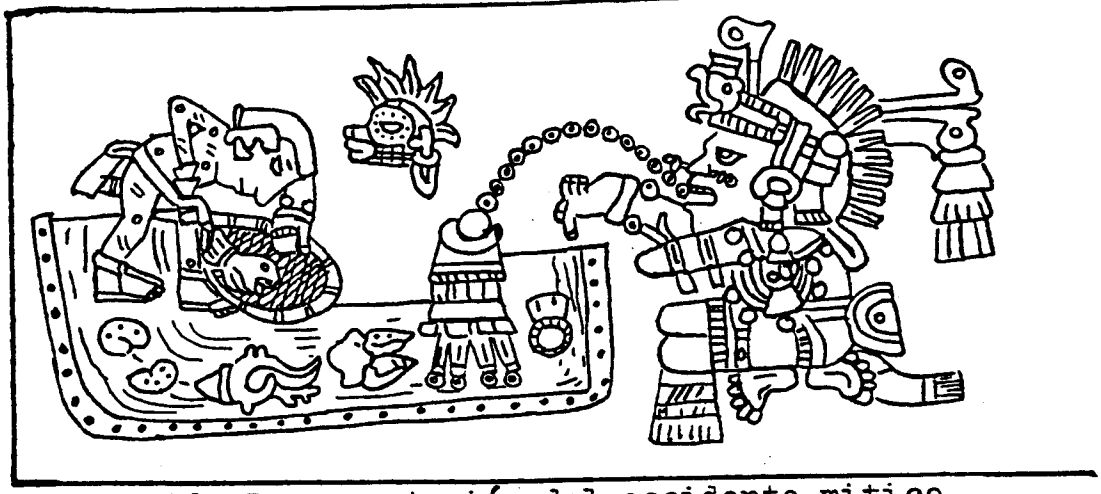


Figura 13.-Representación del occidente mitico, con el dios Xochipilli como personaje principal. (Códice Vaticano).

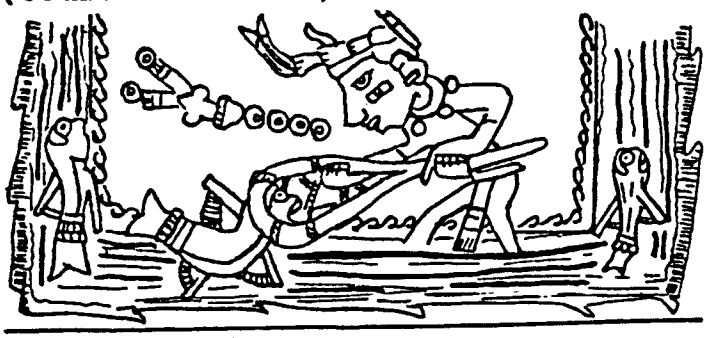


Figura 14.- La misma escena de pesca con una red de cuchara se presenta en el Códice Borgia.

B I B L I O G R A F I A

Applegate, S.P. 1965, Tooth terminology and variation in sharks with special reference to the sand sharks, Carcha - rias taurus Rafinesque. Los Angeles Country , Mus. Contrib. Sci. V, 86, pp 3-18

Applegate, S.P. L. Espinosa, L. Menchaca, F. Sotelo., 1979, Ti burones mexicanos. Subsria. Educ. Invest. Tec- nol. S.E.P. México, p 146

Castro Aguirre, J.L. 1978. Catálogo Sistemático de los peces marinos que- penetran a las aguas continentales de México.- Depto. pesca México., Serie Científica No. 19: 1-297.

Clavijero, F. J. Historia antigua de México, Editorial Porrua - 1982 Colección Sepan cuantos.

Códice Borgia II manoscritto messicano borgiano del Museo et nográfico della S. Congr. di Prop. Fide. Ripro dotto in fotocromografia a spese di S.E. il du ca di Loubat a cura della Bibl. Vaticana Roma, 1898.

Códice Florentino I, II, III, IV, V, VI, VII, VIII, IX, X, XI y- XII publicados por Dibble y Anderson; Florenti ne Codex, Santa Fe, New México, 1950-1959.

Códice Mendocino — The Mexican Manuscript know as the collection - of Mendoza and preserved in the bodleiaa library oxford edited and traslaten by James Cooper-Clark in three volumes Londres 1938.

Códice Borgia — Edicion facsimilar y comentarios de Eduardo Seler, 3 vols., Fondo de Cultura Económica, México 1963.

Codex Fejervary Mayer — Akademische Druck-u Verlagsantalt, Graz Austria 1971.

Codex Vaticanus 3773 — (b).´ II manoscritto messicano 3773, Riprodotto in fotocromografía a spece di S.E. il duca di - Loubat a cura della Bibl. Vaticana, Roma 1986.

Collete, B.B. and J.L Russo 1981. A revision of the scaly toad fishes-genus Batrachoides, with descriptions of two -- new species from eastern Pacific. Bull Sci. -- 31 (2): 197-233.

Chapman Anne 1959 — Puertos de intercambio en Mesoamérica Prehispánica. Serie Historia Número 3 INAH México.

Chimalpahin Cuauhtle huanitzin — Francisco de San Antón Muñon, Relaciones originales de Chalco Amaquemecan, versión de Silvia-Rendón, México- Fondo de Cultura Económica 1965

Davies, C.N.B. 1968 — Los señoríos independientes del imperio azteca-INAH. México.

1973, Los mexicas: primeros pasos hacia el imperio, - México, U.N.A.M.

Durán Fray Diego Historia de las Indias de la Nueva España, Editorial Porrúa, México 1967.

Díaz-Pardo E. 1982 Restos de peces procedentes de la ofrenda 7 In: El Templo Mayor excavaciones y estudios. INAH:- 151-160

Gibson, Ch. 1978 Los aztecas bajo el dominio español 1519-1810 - Siglo XXI América nuestra. Cuarta edición.

Gregory, W.K. 1959 Fish skulls, Astudy of the evolutión of natural mechanism. E. Laundberg, Fla. 469.

Haberland, W. 1974 Culturas de la América Indígena. Mesoamérica y- América Central. México FCE.

Hildebrand, S.F. 1944 Fishes, amphibians and reptiles, IN: Cold Blo - dded vertebrates. volume eigth of the Smithso - nian Scientific Series. 383 pp. 88 fig. 81 plates.

Matos, M.E. 1982 El Templo Mayor planos, cortes y perspectivas - INAH

1984 The Great Temple of Tenochtitlán. Scientific -- American Vol. 251, No. 2; 70-79.

Matrícula de Tributos (Códice Moctezuma) Introducción en Francés F. -

Bernard, Jaqueline de Durand-Forest. Austria: Alcademische Druck u. Verlagsanstalt, 1980 45p. lamns.

Sahagún, Fray Bernardino. Historia General de las cosas de la Nueva España. Editorial Porrúa. Colección "Sepan cuantos" México. 1975.

Soustelle, J. 1977 La vida cotidiana de los aztecas en visperas de la conquista. Fondo de Cultura Económica. Tercera reimpresión.

Torquemada, Fray Juan Monarquía Indiana. U.N.A.M. México 1978.

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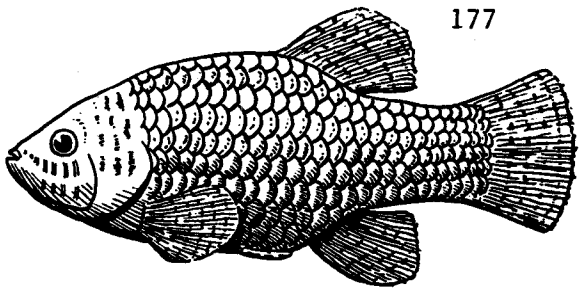
Desert Fishes Council



"Dedicated to the Preservation of America's Desert Fishes"
407 West Line Street
Bishop, California 93514
December 3, 1987

RESOLUTION 87-1

RELATIVE TO IMPROVING THE FISHERIES PROGRAM AND CAPABILITIES OF THE BUREAU OF LAND MANAGEMENT

WHEREAS the Bureau of Land Management is a manager of extensive land areas of the western United States, lands that include and influence important aquatic habitats, populations of listed and sensitive species, and waters important for many resource uses, and

WHEREAS in order to manage these aquatic resources, trained personnel are needed at all levels to enable the Bureau of Land Management to meet its various legal obligations and to plan, monitor, and manage its resources, and

WHEREAS at present the Bureau of Land Management lacks trained personnel in most State, District, and Area offices and little direction or support has been available for developing an aquatic program or maintaining staff expertise, now therefore be it

RESOLVED that the Desert Fishes Council supports with enthusiasm current efforts of the Bureau of Land Management Task Force to develop a long-term fisheries program, encourages its completion and implementation, and further encourages increased staffing to provide necessary expertise in aquatic biology at State, District, and Area offices, and be it further

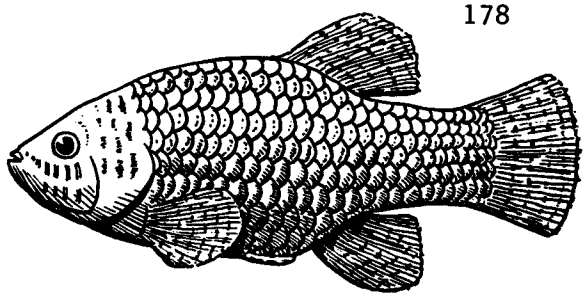
RESOLVED that the Desert Fishes Council offers its assistance in achieving these goals of the Bureau of Land Management.

PASSED WITHOUT DISSENTING VOTE

ATTEST:

Edwin P. Pister
Executive Secretary

Desert Fishes Council



"Dedicated to the Preservation of America's Desert Fishes"

407 West Line Street
Bishop, California 93514
December 3, 1987

RESOLUTION 87-2

RELATIVE TO THE RECOVERY OF THE GILA TROUT (SALMO GILAE)

WHEREAS the Gila Trout Recovery Plan called for the successful replication of the five surviving residual populations, and

WHEREAS this recovery objective was deemed essential to the downlisting of the Gila trout from endangered to threatened status, and

WHEREAS this objective has been achieved through cooperative efforts of the U.S. Forest Service, U.S. Fish and Wildlife Service, New Mexico Department of Game and Fish, and New Mexico State University, now therefore be it

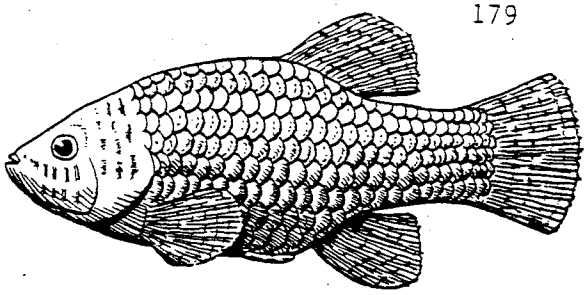
RESOLVED that the Desert Fishes Council commends these agencies for their concerted efforts to bring about the recovery of this valuable element of Southwestern aquatic ecosystems, and strongly urges these agencies to continue in their efforts to effect the full recovery and eventual delisting of the Gila trout.

PASSED WITHOUT DISSENTING VOTE

ATTEST:

Edwin P. Pister
Executive Secretary

Desert Fishes Council



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407 West Line Street
Bishop, California 93514
December 3, 1987

RESOLUTION 87-3

RELATIVE TO INSTREAM FLOW LEGISLATION WITHIN THE STATE OF NEW MEXICO

WHEREAS instream flow is a critical component of native fish habitat management in the western United States, and

WHEREAS protection of critical habitat conditions for a wide array of terrestrial and aquatic species will assist in survival of biotic communities associated with aquatic systems, and

WHEREAS low or zero flows are created by water management activities in many stream reaches, and

WHEREAS sufficient flows must be sustained to assure constant availability of suitable habitat for all components of these aquatic systems, now therefore be it

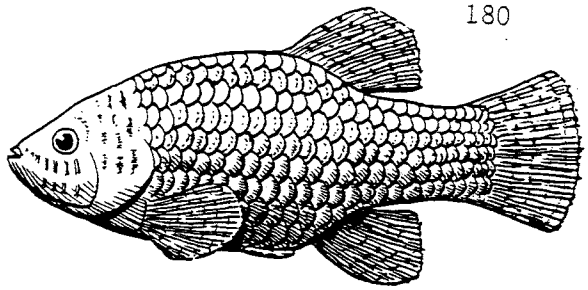
RESOLVED that the Desert Fishes Council strongly recommends that instream flow legislation be developed, presented to, and passed by the New Mexico Legislature.

PASSED WITHOUT DISSENTING VOTE

ATTEST:

Edwin P. Pister
Executive Secretary

Desert Fishes Council



"Dedicated to the Preservation of America's Desert Fishes"

407 West Line Street
Bishop, California 93514
December 3, 1987

RESOLUTION 87-4

RELATIVE TO THE CALIFORNIA DESERT PROTECTION ACT

WHEREAS Senate Bill 7, the California Desert Protection Act, would upgrade Death Valley National Monument to National Park status, and

WHEREAS unique life forms are found throughout Death Valley National Monument, and

WHEREAS Devils Hole, located in Ash Meadows, Nevada, is a disjunct portion of Death Valley National Monument, and

WHEREAS Devils Hole is the only natural habitat of the Devils Hole pupfish, Cyprinodon diabolis, and

WHEREAS Devils Hole is considered to be the world's most restricted environment for a vertebrate species, and

WHEREAS National Park status would increase funding for the protection of all life forms found within Death Valley National Monument, now therefore be it

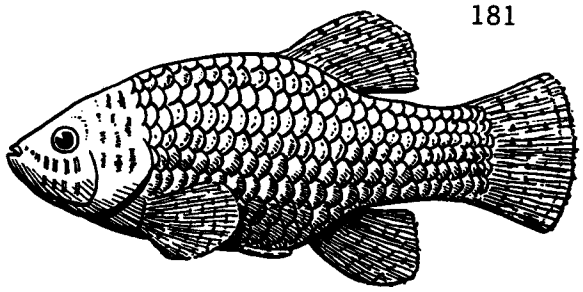
RESOLVED that the Desert Fishes Council strongly supports the passage of Senate Bill 7, or any other number this bill might be assigned in future sessions of the Congress.

PASSED WITHOUT DISSENTING VOTE

ATTEST:

Edwin P. Pister
Executive Secretary

Desert Fishes Council



"Dedicated to the Preservation of America's Desert Fishes"

407 West Line Street
Bishop, California 93514
September 7, 1988

Mr. Dave Livermore, Director
The Nature Conservancy
Great Basin Field Office
P.O. Box 11486
Salt Lake City, Ut 84147-0486

Dear Mr. Livermore:

The sensitive nature of many of Nevada's desert fishes is directly related to man's influence. Species have been lost or imperiled as man altered springs to suit his needs. Today, the majority of the desert's spring habitats are on private property. This fact often impedes the protection of the sensitive species existing in these aquatic environments. The opportunity has arisen for a conservation organization to purchase ranch property in south-eastern Nevada. This ranch includes a spring inhabited by a federal endangered species. The Desert Fishes Council urges The Nature Conservancy to explore the possibility of acquiring this property.

The Jay Wright Ranch is located in the center of Section 14, Township 4 South, Range 60 East, Lincoln County, Nevada. The boundaries of this 120± acre ranch encompass Hiko Spring, the home of the endangered Hiko White River springfish, Crenichthys baileyi grandis. The original outflow from this spring also supported the endangered Pahranagat roundtail chub, Gila robusta jordani. This outflow is now piped. The current situation at Hiko Spring is not typical of many other privately held springs. It has not been significantly altered and Mr. Wright has allowed unrestricted access for population monitoring. This may all change with a new owner.

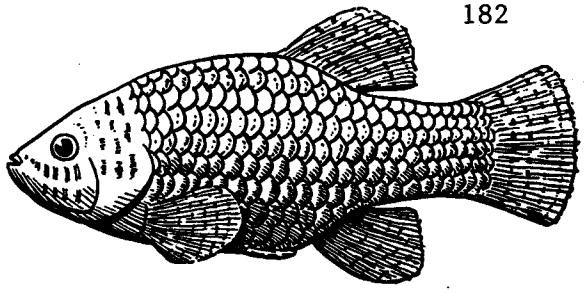
The purchase of this property by a conservation organization will secure this habitat for maintenance of the springfish population and possible reestablishment of the roundtail chub. An opportunity to provide long-term habitat protection for these endangered species must not be allowed to slip away.

Sincerely,

E. P. Pister
Executive Secretary

Attachment

Desert Fishes Council



"Dedicated to the Preservation of America's Desert Fishes"

407 West Line Street
Bishop, California 93514

September 7, 1988

Mr. Ron Weaver
Real Estate Division
U.S. Fish & Wildlife Service
Lloyd 500 Building
500 NE Multnomah Street
Portland, OR 97232

Dear Mr. Weaver:

The sensitive nature of many of Nevada's desert fishes is directly related to man's influence. Species have been lost or imperiled as man altered springs to suit his needs. Today, the majority of the desert's spring habitats are on private property. This fact often impedes the protection of the sensitive species existing in these aquatic environments. The opportunity has arisen for a conservation organization to purchase ranch property in south-eastern Nevada. This ranch includes a spring inhabited by a federal endangered species. The Desert Fishes Council urges the U.S. Fish and Wildlife Service to explore the possibility of acquiring this property.

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Sincerely,

E. P. Pister
Executive Secretary

Attachment