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RESEÑA SOBRE LOS ESTUDIOS DE LOS PECES DE LAS AGUAS CONTINENTALES EN BAJA CALIFORNIA, CON ESPECIAL REFERENCIA EN LA TRUCHA DE SAN PEDRO MARTIR (*Salmo nelsoni*, Everman, 1908).

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RESUMEN :

Se da a conocer en forma cronológica los estudios recientes de los peces de las aguas continentales de Baja California realizados por instituciones nacionales, en el período de 1970-1982.

Se hace enfasis en la problemática taxonómica y el desconocimiento general sobre la biología y la pesquería de la trucha de San Pedro Mártir (Salmo nelsoni, Everman, 1908), tema que ha sido abordado recientemente.

Por separado, se somete una propuesta de investigación, con el objetivo de resolver dichas interrogantes, como también, se externa la necesidad del establecimiento de un programa de intercambio y de cooperación mutua entre nosotros.

ABSTRACT

Briefly, and in chronological sequence, recent studies (1970-82) on fishes from the inland waters of Baja California are described. Special reference is given to taxonomic contradictions and need for additional research concerning the biology of the San Pedro Mártir trout (Salmo nelsoni Evermann). In addition, a joint research program designed to provide additional information concerning the San Pedro Mártir trout, possible aquacultural techniques for the species, and the desirability of a technical exchange and cooperative program between scientists from Mexico and the United States are proposed.

INTRODUCCION :

Baja California, es un Estado de contrastes, por un lado tiene valles y desiertos que la cubren en su totalidad, al igual de que cuenta con dos zonas boscosas, que datan desde la era cuaternaria y mismos que semejan dos islas, donde las condiciones de vida, resaltan por lo majestuoso e impresionante de su vegetación (Nishikawa, Com. Pers.).

La fisionomía geográfica y su extensión horizontal longitudinal, hacen que su climatología esté expuesta a dos celdas metereológicas; la tropical y la templada con una zona intermedia de convección ascedente con calmas. En el extremo noreste, es notoria la influencia de los frentes fríos de invierno que ocasionan la lluvia de la estación, y en el extremo sureste; las lluvias de verano y otoño, son determinadas por los vientos alisos y ciclones tropicales.

En el extremo noroeste; el clima es templado lluvioso, con lluvia en invierno en que la temperatura media del mes más cálido es mayor a 18° C (Csa) o es menor de 18° C (Csb). La región con este tipo, y sus dos subtipos, corresponden a las dos sierras septentrionales y a la llanura situada entre ésta y la costa del Océano Pacífico.

En el extremo sur el clima es lluvioso de humedad moderada, templado en las montañas y tropical en parte de las llanuras con lluvias en otoño (Cw'a y Aw'). El resto de la península presenta clima seco (BS).- (Bol. Soc. Mex. de Geo. y Esta., 1975; Fig 1)

Esta comarca de aparente sequía, se ve matizada por los mares que bañan sus litorales, creando con ello, una zona de diversidad biotica de gran interés científico; es por esto que se han establecido en nuestra entidad, varios centros educativos y públicos que se dedican a su estudio y evaluación , haciendo que nuestro desarrollo económico se vea orientado hacia la agricultura, la ganadería,la pesca y la industrialización (indicadores socioeconómicos, 1977).

Como consecuencia de lo anterior y por su prioridad económica, recientemente se han implementado programas para evaluar nuestro potencial pesquero y acuacultural en los frentes marinos, reelegando, a un segundo plano, a las aguas continentales, cuyo uso fundamental ha sido, urbano y agrícola (Tabla N° 1).

No obstante, en una zona como la nuestra, es prioritario instituir políticas que normen su preservación y uso integral, mediante la aplicación de programas y medidas que presenten solución a su problemática.

A continuación, detallo por zonas y en forma cronológica, aquellos estudios cuya naturaleza y contenido, aportan solo algunos datos sobre la ictiofauna, pesquería y potencial acuacultural,en las aguas continentales del Estado; primer paso para la diversificación del uso de nuestros recursos Hidrológicos.

Período 1976- 1978

PROGRAMA: Evaluación de las aguas interiores de Baja California.

Como parte de sus actividades académicas de la Unidad de Ciencias Marinas (UCM) y el Instituto de Investigación Oceanológicas (I.I.O.) de la Universidad Autonoma de Baja California, llevan a cabo un programa de evaluación de las aguas, localizando zonas con potencial pesquero y acuacultural.

Se construye el primer laboratorio didáctico para prácticas de piscicultura y se habilita una poza de 1/4 Ha. en la Delegación de Maneadero, Munp. Ensenada, para llevar a cabo demostraciones y prácticas de campo. Actualmente las instalaciones del IIO-UCM están siendo remodeladas y ampliadas para otros proyectos acuaculturales, a causa de lo anterior los programas de piscicultura, han sido postergados a futuro.

Período 1978- 1982.

PROGRAMA: Extensión piscícola.

Se instituye este programa para dar orientación a grupos interesados en piscicultura. Se celebra con el California Fish and Game, un acuerdo de cooperación y donación de especies, para ser introducidas a Baja California, auspiciado por la Comisión de las Californias.

Actualmente la Dirección de Pesca (Residencia del Golfo) y la Secretaría de Pesca ejecutan coordinadamente este programa en el Estado.

Período 1980

PROGRAMA: Introducción de la carpa hervíbora (Ctenopharyngodon idella) en la región de Ensenada,B.C.

Este proyecto experimental patrocinado por la Unidad de Ciencias Marinas(UCM) y el Instituto de Investigación Oceanológicas, basado en el " Primer Plan Ciprinícola Nacional", tiene como objetivo, demostrar la sobreviviencia de la carpa amura en el municipio de Ensenada, como también, presentar una solución al problema de la proliferación de la maleza acuática dentro de las pozas de riego, usando a la carpa como control biológico (Almanza E. y Almanza J.A., 1980).

El proyecto refleja el desconocimiento de los autores en cuanto a las consecuencias de la introducción incontrolada de peces exóticos a nuestras aguas. Sin embargo proyectos de esta naturaleza y asumiendo las protecciones biológicas adecuadas, como podría ser la extracción quirúrgica de sus organos reproductores, la utilización de hibridos u organismos de un solo sexo etc., pueden ofrecer solución tanto al problema alimentario como al de la proliferación de malezas dentro de algunos cuerpos de agua encontrados en nuestro Estado. Las tablas N°. 2;2.1 y Fig. 2;2.1, detallan los resultados más sobresalientes del proyecto.

Período 1980.

PROYECTO: Semicultivo de trucha arco iris (*Salmo giardnerii*).

Proyecto llevado a cabo por la Dirección de Pesca en Sierra de Juárez, donde se demuestra que las aguas y condiciones ambientales son aptas para un semicultivo de trucha arco iris.

Utilizando alimento balanceado (3% diario/ biomasa total) se obtiene una media mensual de crecimiento de 2.85 cm. y de 16.75 gr. de peso. El proyecto se interrumpe a los nueve meses, debido a los daños causados por las precipitaciones registradas en el Estado, mismas que causan la aniquilación del grupo de peces. (Yruretagoyena y Baylón, en prensa).

1981. PROYECTO: Estudio preliminar de la pesquería de la Laguna Salada. (Compeán, et. al., Ms.)

Con este estudio llevado a cabo por el Departamento de Pesca (Secretaría de Pesca), se obtiene una visión general de la Laguna Salada, - su medio físico, la pesquería comercial y la composición ictiofaunistica.

De acuerdo al censo efectuado, se observa que la mayoría de las especies proceden muy probablemente de las introducciones efectuadas en el alto Río Colorado incluídas las efectuadas en el sistema de riego del Valle Imperial.

También se detecta, que nunca ha existido un estudio biológico de las especies capturadas, así como tampoco estimaciones correctas de la captura y el esfuerzo. Como una consecuencia de lo anterior se propone que se efectúen muestreos del rendimiento de las redes en diferentes partes del vaso de la laguna y canal alimentador, así como llevar a cabo, censos aereos del número de embarcaciones y/o redes que operan en la laguna. Fig. 3 Tabla 3.

Los señores Compeán y Baylón, daran una explicación en más detalle de su trabajo y conclusiones.

1982. PROGRAMA: Extensionismo piscícola.

PROYECTO: La trucha de San Pedro Mártir; su revisión taxonómica, evaluación pesquera y desarrollo de una técnica acuacultural para su cultivo.

Proyecto que tiene como finalidad definir la situación taxonómica, la pesquería y el desarrollo de una técnica acuacultural para su cultivo.

ANTECEDENTES HISTORICOS :

En 1905, el Sr. W.W. Nelson, del U.S. Bureau of Biological Survey, en comisión de trabajo captura en el río de San Ramón unos especímenes - pertenecientes a la familia de los salmonidos; posterior a ello, el - Dr. Everman los identifica como una especie nueva, Salmo nelsoni . (Everman, 1908).

En dicho trabajo, Everman (1908) da una descripción detallada de las características del Río de San Ramón según le fué proporcionada por Nelson. Después, Otterbein (1926) realiza otra expedición de colecta patrocinada por el Museo de Zoología de vertebrados de California, para colectar estos salmonidos de Baja California, y concluyen que - unicamente en el Río de Santo Domingo se encuentran las truchas descritas por Everman y que en véz de ser una especie nueva, ellos consideran que se trata del género Salmo gairdnerii aislado geográficamente, por un proceso geológico.

Otterbein (1926), también señala un error que Everman tuvo en su conteo de las escamas laterales, mismo que influyó en su conclusión de - nombrar a la trucha de San Pedro Mártir, como una especie nueva. Además y para aclarar la situación, se hizo una comparación automática - lineal de caractéres entre otras truchas y las de Baja California, - llegando a la conclusión que no existían suficientes diferencias para avalar lo concluído por Everman.

Posteriormente Needham (1937) realiza otra expedición al Santo Domingo con la intención de capturar y preservar vivos a estos salmonidos. - Posterior a ello, son introducidos en la estación de Forest Home. Nueve meses después el proyecto se da por terminado ya que una interrupción - del sistema de agua, líquida a todas las truchas que estaban en la granja de cultivos , Needham, observa que debido a su localización geográfica estas truchas posiblemente desovan en los meses de febrero ó marzo, y que su mayor abundancia fué detectada en las cercanías del rancho de San Antonio en el arroyo de Santa Cruz.

Tanto en la expedición de Nelson como en la de Snider, se capturan las truchas en casi el mismo lugar como así lo hace notar Needham (1937).

Sin embaro en nuestra expedición efectuada en 1982, se llevó a cabo un recorrido más amplio y se consultó tanto planos del Departamento de - Estudios del Territorio Nacional como fotos de satélite, para localizar los afluentes prospectados, por los autores antes mencionados, se platicó extensamente con moradores del lugar y muy en particular con los - señores Aída Meling y Andres Meling; este último participó en los viajes del Sr. E.C. Utt, donde introdujo truchas a los arroyos de San Isidoro, la Misión de San Pedro, La Grulla, La Zanja, La Tasajera, La Canoa San Rafael, y de San José, durante los años de 1938 a 1941.

Nuestra información recabada nos indica que Nelson se equivocó al nombrar al San Ramón como el río que él prospectó, ya que los arroyos de la zona, en dirección NS-SE son: El San Rafael y el San Antonio (conocido también como Santo Domingo), Fig. 5 Fig. 6.

De nuestras cartas geográficas y de la observación aerea concluimos lo siguiente:

El río San Rafael nace en San Pedro Mártir de tres afluentes que son el arroyo La Fresa (que nace en Venado Blanco), arroyo Vallecitos (que - nace en Vallecitos y sale en el área del cerro de la Botella Azul entroncándose al San Rafael) y el arroyo de Agua Zarca o de Agua Blanca que nace al oeste de vallecitos, pasa por el aserradero y se entronca al San Rafael.

De aquî el San Rafael pasa por el Rancho del Mikes Sky, llega a Colonet, para finalmente desembocar al Océano Pacîfico en Bahía Colonet.

Durante una expedición anterior llevada a cabo en septiembre de 1982 se capturaron 16 ejemplares de trucha en la zona de Mikes. Desafortunadamente estas fueron descartadas, por efectos de descomposición avanzada al no tomarse las precauciones adecuadas en su preservación.

Resultados del trabajo de campo:

Durante esta expedición se capturaron 16 ejemplares de trucha en la zona de La Grulla (Longitud 30° 57' 51" Lat. 115° 30' 47"), y se confirmó la presencia de otros salmonidos en la zona de la Vîbora (Longitud 30° 52' 48", lat 115° 30' 11"), desafortunadamente y como después se constató probablemente debido a que estaban en proceso de desove fué imposible capturarlos en esta última localidad, tanto con línea , anzuelo,como con chinchorro.

Se realizó tambien una colecta para identificación de algas e insectos a la véz que se llevó a cabo un análisis fisicoquímico de las aguas del arroyo. A las muestras ícticas se les harán análisis de pesticidas y otros contaminantes mismos que estarán a cargo del Dr. Katsuo Nishikawa del Centro de Investigación Científica y de Estudios Superiores de Ensenada, se hará también un estudio biométrico y de análisis proteico para determinar y definir la situación taxonómica de la trucha de San Pedro Mártir.

Beneficios inmediatos obtenidos:

Se obtiene con nuestro recorrido una corrección al nombre del arroyo citado por Nelson en su 1ra. expedición (1903) de colecta a Baja California.

El poder contar con especimenes vivos y aplicar técnicas acuaculturales para su cultivo asegurará su producción e introducción en los arroyos del sistema montañoso de Baja California. A la véz la obtención de la información biológica básica, nos proporcionará los suficientes conocimientos para aplicar una regulación adecuada de la pesquería.

Avances del proyecto:

De acuerdo a nuestro calendario de actividades planteadas se han logrado los siguientes avances:

1).- Completa recopilación de material (Bibliográfico necesario para el estudio.- Sin embargo se estima conveniente poder contar con copias de la correspondencia, que el Sr. Utt. dirigió al Dr. - Humbbs, Dr. Miller y Dr. Bencke. (Anexo 1).

2).- Localización y prospección de las zonas. Se recorrió la zona de la Tasajera, la Grulla- La Víbora al igual que la zona del Mikes casi en un (60%). Se capturaron ejemplares para su estudio. Quedó pendiente la zona de San Antonio- Valladares, mismo que se realizará, durante octubre-noviembre ó hasta marzo-abril del - próximo año (1983).

3).- Revisión taxonómica.- El Dr. David Graham Gall,de la Universidad de Davis, y personal adscrito a CICESE llevarán a cabo un estudio simultáneo para evaluar las características morfológicas más distintivas y compararlas con aquellas descritas por Evermann (1908), a la véz el Dr. Graham Gall, hará análisis de electro --- foresis proteica y una examinación de carotipos para así poder aclarar difinitivamente la posición taxonómica de la trucha de San Pedro Mártir.- De resultar diferente la evaluación, se podrá definir la situación taxonómica de la trucha de San Pedro Mártir.

4).- Determinación de la zoogeografía del recurso:

Se detectó la presencia en zonas tan distantes al Santo Domingo; como la zona de Mikes- La Grulla y la Víbora. El recorrido realizado por nosotros a lo largo del cauce de los arroyos del Santo Domingo y del San Rafael nos inclinan a suponer que estas fueron introducidas y quizá sean las decendientes, de las truchas que originalmente transplantó el Sr. Utt y los hermanos Meling. Esta suposición la apoyamos fuertemente, ya que se detectaron barreras geográficas como cascadas, caidas y rocas, que resultan casi imposible - de ser sorteadas por una trucha.

AGRADECIMIENTOS:

Agradezco la ayuda que la Sra. Aida Meling ha prestado, patrocinándonos con hospedaje, animales de carga y equipo de campo a igual que al Ing. Abelardo Rodríguez, R., que ha sido tan gentil siempre, en donar su tiempo y vehículo de transporte, tanto terrestre como aéreo. Al - Ing. Humberto Palomares, que siempre ha sido un excelente compañero de campo y entusiasta colaborador, y por último al Sr. Phill Pister, que compartió con nosotros tan interesante experiencia de campo.

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RELACION DE TABLAS

TABLA N° 1 RELACION DE CUERPOS DE AGUA EXISTENTES EN EL ESTADO DE BAJA CALIFORNIA Y ESPECIES SUSCEPTIBLES A CULTIVAR.

EMBALSES	UBICACION	MUNICIPIO	SUPERFICIE (HAS)	TEMPORAL	PERMANTE	ESPECIES SUSCEPTIBLES DE CULTIVAR.
*ABELARDO RODRIGUEZ	Entrada a Tijuana por la carret. Tijuana - Tecate.	TIJUANA	509.6		X	Lobina, Bagre, Tilipia Carpa.
*EL CARRIZO	A 30 Km. de la carret. Tecate- Tijuana.	TECATE	238		X	Lobina, Bagre, Carpa.
*EMILIO LOPEZ ZAMORA		ENSENADA	62.62		X	Lobina, Carpa.
*LAGUNA HANSEN	Parque Nacional Constitución 1847 Sierra de Juárez.	ENSENADA	20		X	Trucha.
*BORDOS CONSTRUIDOS POR LA SARH,EN LA ZONA COSTA.						
LOS ALAMOS	Ej. Jacume	TECATE	6-20-00	X		Se recomienda el cultivo de especies de rápido - crecimiento dada la temporalidad de estos cuerpos de agua, como Tilipia Carpa, Bagre y Trucha en los bordos localizados en la Sierra de Juárez y San Pedro Mártir.
LA MISION	Ej. La Misión	ENSENADA	6-64-89	X		
EL HORNO	Ej. La Misión	ENSENADA	4-76-58	X		
EL MEXQUITAL	Ej. Heroes de la Ind.	ENSENADA	31-89-70	X		
SAN JOSE	Col. Indíg. San Jóse	ENSENADA	1-33-40	X		
EL RINCON	Ej. Heroes de la Ind.	ENSENADA	72-38-20	X		
EL RODEO	Ej. Leyes de Reforma	ENSENADA	39-10-08	X		
LAS PAREDES	Ej. El Porvenir	ENSENADA	7-44-05	X		
LA POZA	Ej. 18 de Marzo	ENSENADA	31-01-00	X		

NOMBRE	UBICACION	MUNICIPIO	SUPERFICIE (HAS)	TEMPORAL	PERMANENTE	ESPECIES SUCEPTIBLES DE CULTIVAR.
RIO COLORADO	Sección localizado entre los paralelos 32° 01' 40" y 32° 04' 30" Latitud norte y 115° 11' 50" y 15° 13' 00" Longitud Oeste en el Valle de Mexicali.	MEXICALI			X	
		- Existe una sección de aproximadamente 10 Km. del Rio Colorado, en donde se puden implantar cultivos de peces en jaulas flotantes y encierros para engordar de lisa en los brazos del mismo rio.				Lisa, Bagre, Bocon,Carpa Tilapia.
*** LAGUNA SALADA	Km. 25 Carret. Fed. N° 2 Mexicali- Tijuana	MEXICALI	40,700	X		Lisa, Bagre, Bocon, Carpa, Tilapia.

* Fuente: Guión de actualización para el diagnostico de la Acuacultura en el Estado de Baja California.

** S.A.R.H. Relación y características de bordos construídos en la Entidad.

*** S.A.R.H. Obras de rehabilitación y complementarias interconexión de pozos Dístrito de Riego No. 14, Baja California y Sonora.

**** Compeán, Baylón, Robles y Aranda (1980), Estudio preliminar de la Pesquería de la Laguna Salada, Baja California. Delegación Federal de Pesca, B.C.

1/ Con estos canales se puede manejar normalmente un costo de 150 m^3 / SEG. y hasta un extraordinario de 230 m^3/ SEG.

NOMBRE	UBICACION	MUNICIPIO	SUPERFICIE (HAS)	TEMPORAL	PERMANENTE	ESPECIES SUSCEPTIBLES DE CULTIVAR
LA MINA	Ej. La Misión	ENSENADA	1-98-80	X		
EL CHOPO	Ej. La Misión	ENSENADA	2-04-20	X		
LA VINATA	Com. Indíg. Sta.Catalina	ENSENADA	1-82-35	X		
LA CAMPANA	Com. Indíg. Sta.Catalina	ENSENADA	5-02-34	X		
SAN ANTONIO	Poblado Villa Juárez	ENSENADA	6-35-90	X		
LAS PINTAS	Ej. López Rayón	ENSENADA	1-14-05	X		
LA COCINA	Ej. San Jacinto	ENSENADA	4-20-50	X		
LOMA LINDA	Ej. 27 de Enero	ENSENADA	3-68-00	X		
MESA ALTA	Ej. Heroes de Chapultepec	ENSENADA	2-93-20	X		
CAPRICORNIO	Ej. Capricornio	ENSENADA	1-58-80	X		
*** CANALES Y DRENES DEL DISTRITO DE RIEGO # 14 1/	Valle de Mexicali -Existe en el Valle de Mexicali una red de distribución de 1880 Kms. de canales de riego, 330 Kms. corresponden a canales principales y 1550 Kms a canales laterales y secundarios. De los cuales se pueden utilizar para el fomento de la Acuicultura mediante el cultivo de peces en jaulas flotantes 440 Kms., de canales revestidos, sin revestir y laterales. Siempre y cuando no se afecte la función principal que tiene esta red de distribución.	MEXICALI			X	Bagre, Tilapia, Carpa.

TABLA I. 1 DESCRIPCION DE CARACTERISTICAS FISICAS DE ALGUNAS PRESAS DE BAJA CALIFORNIA.

* PRESA ABELARDO L. RODRIGUEZ TIJUANA

Presa tipo " Ambursen" de machones de concreto.

Capacidad cresta vertedor	92'370,000 M^3
Capacidad adicional compuertas	44'630,000 M^3
Capacidad total	137'000,000 M^3
Altura máxima	57 M
Area de la cuenca	2,430 Km^2
Inundación máxima vaso	541 Ha.
Long. de la cortina	579 M.

ESPECIES: Lobina, Tilapia, Agalla azul, Bagre.

AFLUENTE: PRECIPITACION - LAS CALABAZAS CUENCA DE GUADALUPE.

* PRESA EMILIANO ZAMORA ENSENADA

Capacidad útil	2'800,000 M^3	
Capacidad de azolve	200,000 M^3	
Capacidad de regulación	3'720,000 M^3	
Capacidad total	6'720,000 M^3	
Altura máxima	33 M.	
Area de la cuenca	150 Km^2	153 Km^2
Inund. máxima vaso	90.96 Ha.	
Long. de la cortina	260 M.	

ESPECIES A CAPTURAR : Bagre, Tilapia, Mojarra, Lobina.

* PRESA EL CARRIZO. TECATE

Distancia Presa Ciudad Tecate, aproximada a 25/30 Km.

Capacidad de azolve	5'240,000 M^3
Capacidad total	43'500,000 M^3
Altura máxima	42.8 M
Area de la cuenca	100 Km^2 (estimado)
Inund. máxima vaso	238 Ha.
Long. de la cortina	305 M.

ESPECIES A CAPTURAR: Bagre, Lobina, Rana, Agalla azul, Tilapia, Carpa.

NOMBRE : PRESA MATAMOROS SUPERFICIE DE INUNDACION: 17,500 Ha.

MUNICIPIO: MEXICALI, B.C.

VOLUMEN DE CAPACIDAD : 400037 M^3

ESPECIES SUJETAS A CAPTURAS:

Todas las descritas por Compeán, et. ali. 1981.

AFUENTE : RIO COLORADO.

TABLA N°. 2 RELACION DE DATOS BIOMETRICOS, GRUPO LIBRES; MEDICIONES DE LONGITUD TOTAL Y PESO HUMEDO; DONDE: N = TAMAÑO DE LA MUESTRA, @ = VARIANZA DE LA MUESTRA, d = DESVIACION ESTANDAR DE LA MUESTRA, i = INTERVALO DE CONFIANZA AL 95 % Y SOBREVIVIENCIA, $\bar{x}$ = MEDIA DE LA MUESTRA.

(Almanza y Almanza 1980).

		Longitud cms.				Peso grs.				
Fecha	N	$\bar{X}$	@	d	i $\pm$	$\bar{X}$	@	d	i $\pm$	Sobrevivencia = 98%
01 X 78	30	11.4	1.4	1.2	0.4	14.2	15.7	4.0	1.5	
04 XI 78	27	14.1	4.9	2.2	0.9	38.3	247.2	16.0	6.2	
20 V 79	51	23.1	10.0	3.2	0.9	219.3	6626.9	82.2	22.9	
28 VII 79	80	32.4	10.2	3.2	0.7	463.1	18134.1	135.5	29.9	

TABLA N°. 2.1 RELACION DE DATOS BIOMETRICOS, GRUPO JAULA BLANCA; MEDICIONES DE LONGITUD TOTAL Y PESO HUMEDO; DONDE : N = TAMAÑO DE LA MUESTRA, $\bar{x}$ = MEDIDA DE LA MUESTRA, @ = VARIANCIA DE LA MUESTRA, d = DESVIACION ESTANDAR DE LA MUESTRA, i = INTERVALO DE CONFIANZA AL 95 % Y SOBREVIVENCIA.

(Almanza y Almanza 1980).

		Longitud cms.				Peso grs.				
Fecha	N	$\bar{X}$	@	d	i ±	$\bar{X}$	@	d	i ±	
03 IX 78	30	9.4	1.6	1.4	0.5	8.8	12.6	3.6	1.3	Sobrevivencia = 93 %
01 X 78	30	10.1	2.4	1.6	0.6	10.4	18.9	4.4	1.6	
05 XI 78	30	9.9	3.2	1.8	0.7	12.7	31.4	5.7	2.1	
02 XII 78	30	10.2	3.0	1.8	0.6	12.8	34.4	6.0	2.2	
14 I 79	30	10.8	3.2	1.8	0.7	12.8	39.8	6.4	2.4	
11 II 79	30	10.9	3.2	1.8	0.7	12.9	37.6	6.2	2.3	
07 IV 79	29	11.4	3.8	2.0	0.7	15.5	58.7	7.8	2.9	
09 V 79	29	13.0	4.1	2.1	0.8	26.4	174.7	13.5	5.0	
29 VII 79	28	14.7	8.2	2.9	1.0	44.8	532.5	23.5	28.0	

TABLA N°3

RELACION DE ESPECIES PRESENTES EN LA LAGUNA SALADA
(COMPEAN et. ali, 1982)

FAMILIA	ESPECIE	NOMBRE COMUN	AREA DE CAPTURA		DULCEACUICOLA		MARINO
			CANAL ALIMENTADOR.	VASO DE LA LAGUNA SALADA.	NATIVA	EXOTICA	EURIHALINO.
ELOPIDAE	Elops affinnes (Regan)	Chiro, Joton	X				X
CLUPEIDAE	Dorosoma petenense (Gunther)	Sardina plateada	X	X		X	
CYPRINIDAE	Cyprinus carpio (Linneo)	Carpa común	X	X		X	
ICTALURIDAE	Ictalurus punctatus	Bagre	X			X	
	Pylodictis olivaris						
POECILIDAE	Poecilia velifera (Regan)	Bagre	0			0	
CENTRARCHIDAE	Lepomis macrochirus (Rafinesque)	Mojarra Agalla azul		X		X	
	Micropterus salmoides	Lobina, bocón	X			X	
CICHLIDAE	Tilapia nilotica (Linnaeus)	Mojarra	X	X		X	
	T. zillii (Dumeril).	Mojarra	X	X		X	
	Sarotherodon masambicus (Peters)	Mojarra	X	X		X	
MUGILIDAE	Mugil cephalus (Linnaeus)	Lisa		X			X
PENEIDAE	Penaeus stylirrostris (Stimpson)	Camarón azul	X	X			X
PALAEOMONIDAE	Palaeomonetes, sp	Camarón cristal		X		X	

NOTA: X Especies capturadas durante el muestreo del 16 y 17 de Septiembre de 1981.

0 Especies colectadas el 19 de Marzo de 1981 en el Km. 29+400 del Canal Alimentador a la Laguna Salada.

* lg

RELACION DE FIGURAS.

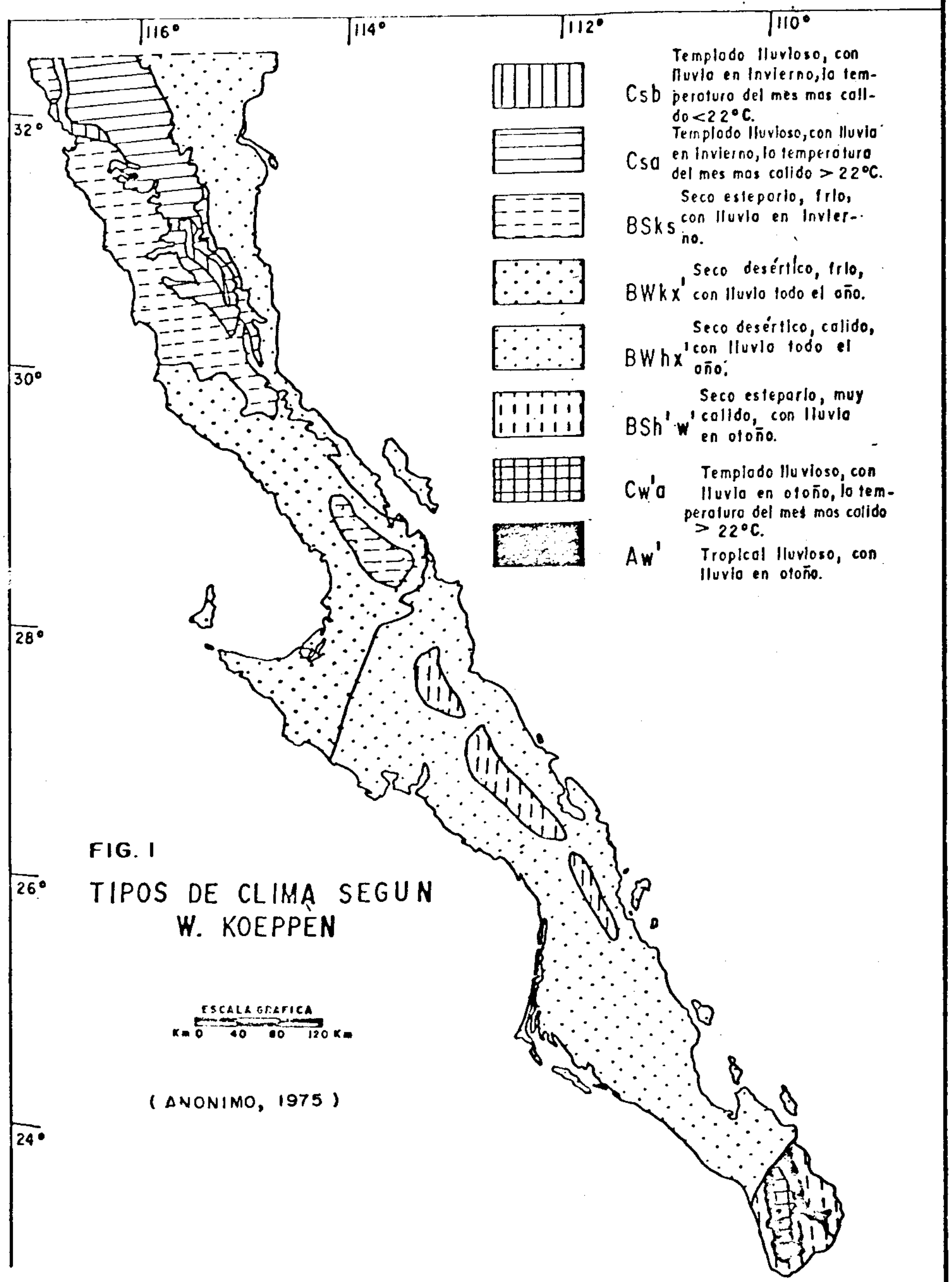

FIG. I

TIPOS DE CLIMA SEGUN W. KOEPPEN

(ANONIMO, 1975)

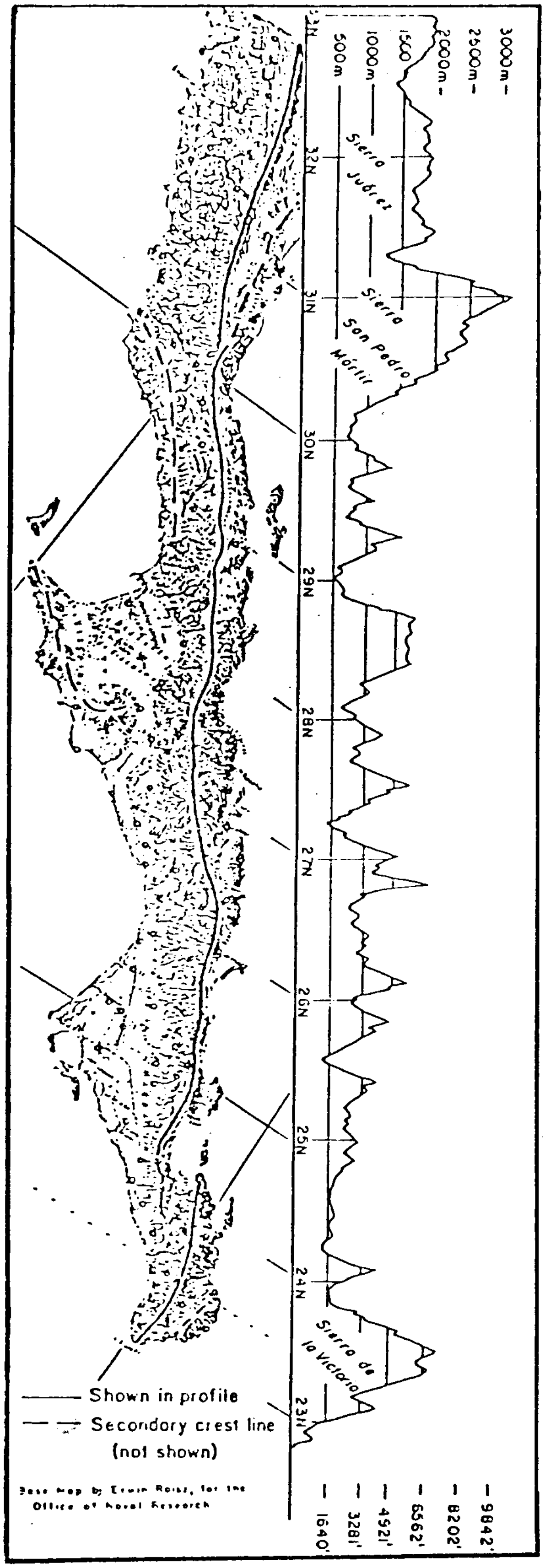

FIG. I·I FISIOGRAFIA DE BAJA CALIFORNIA

(Markham , 1972)

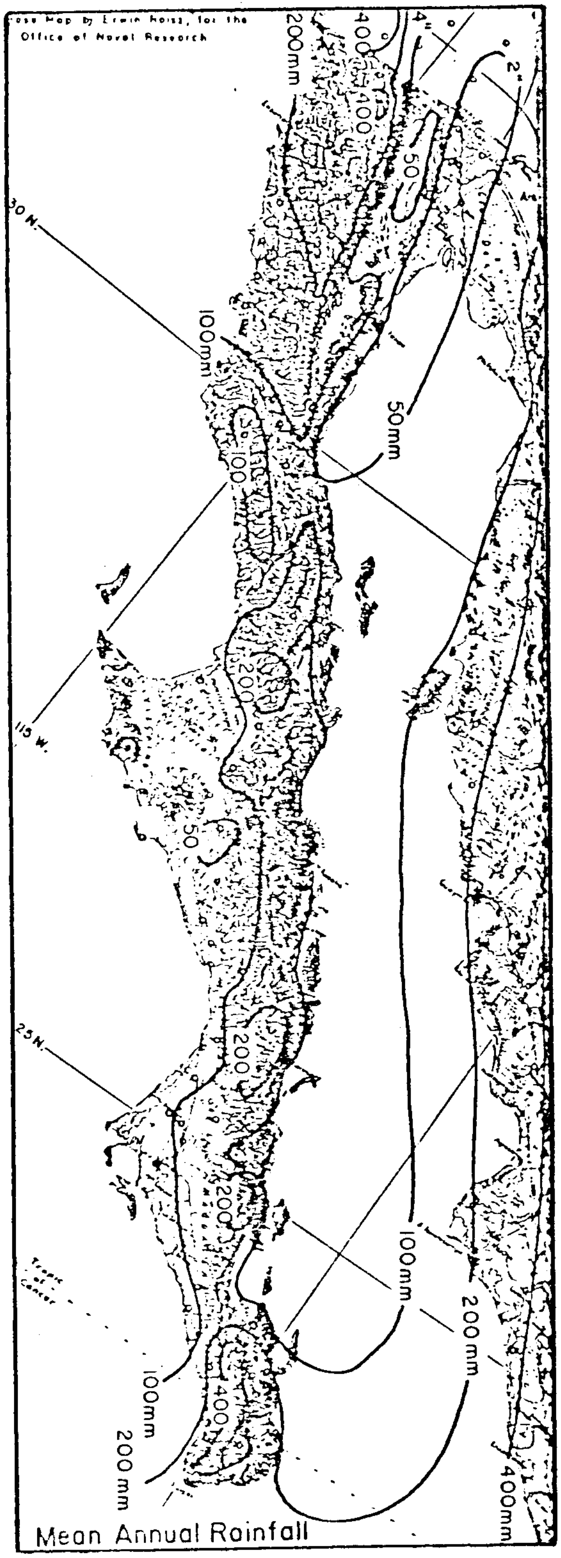

FIG. I·2 PRECIPITACION MEDIA ANUAL
(Morkham, 1972)

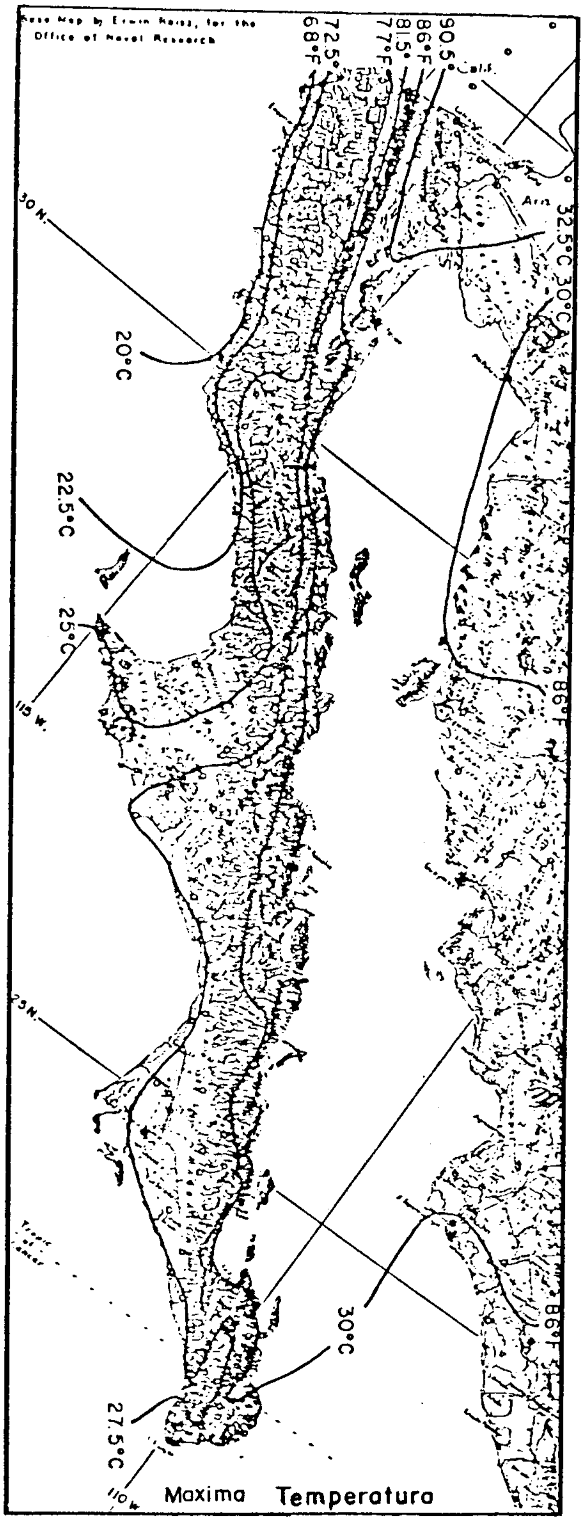

FIG. I-3 MEDIA ANUAL TEMPERATURA MAXIMA.

(Markham 1972)

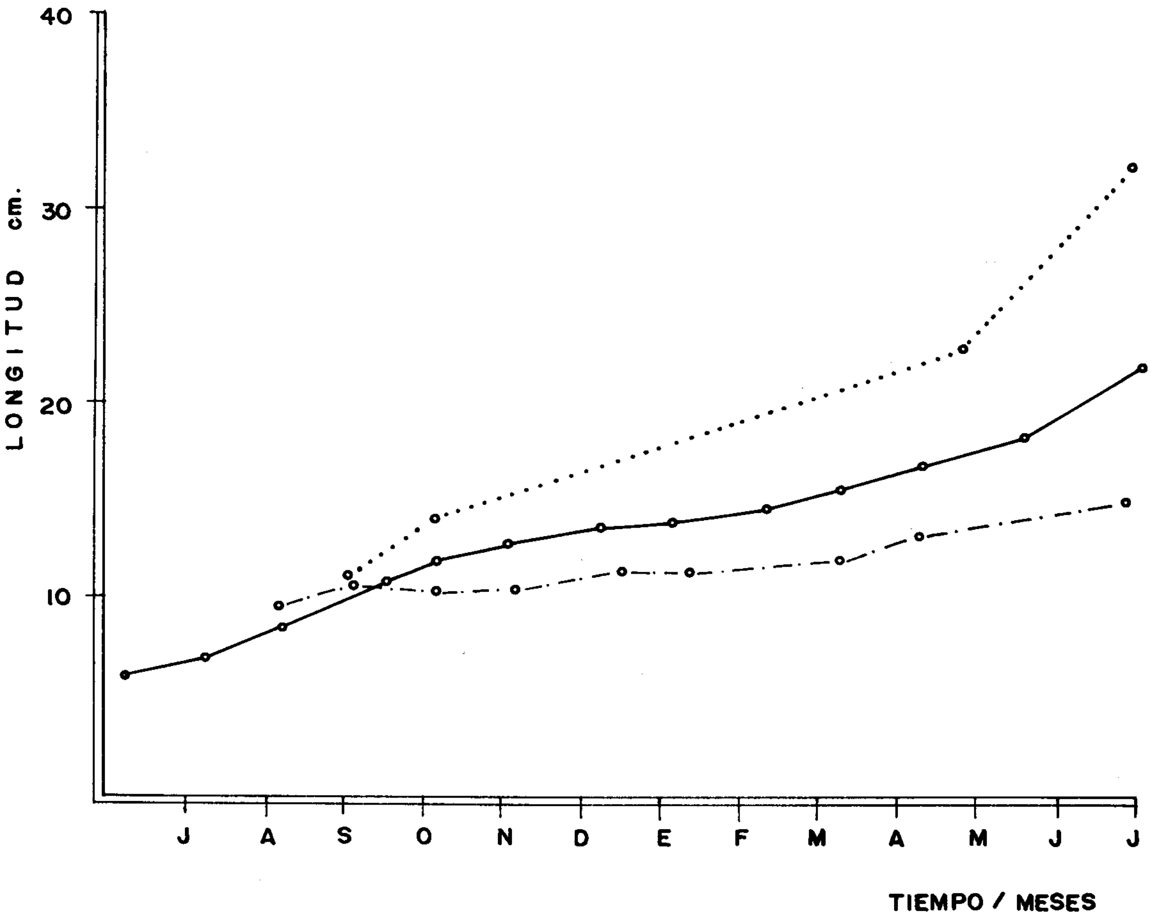

FIG. 2 CRECIMIENTO COMPARATIVO OBTENIDO, EXPERIMENTO CARPA HERBIVORA C. idella .

Grupo Libres (..........), Laboratorio (————) ,

Jaula Verde (·——·——·——); Longitud Total vs.

Tiempo en Meses .

(Almanza y Almanza, 1980)

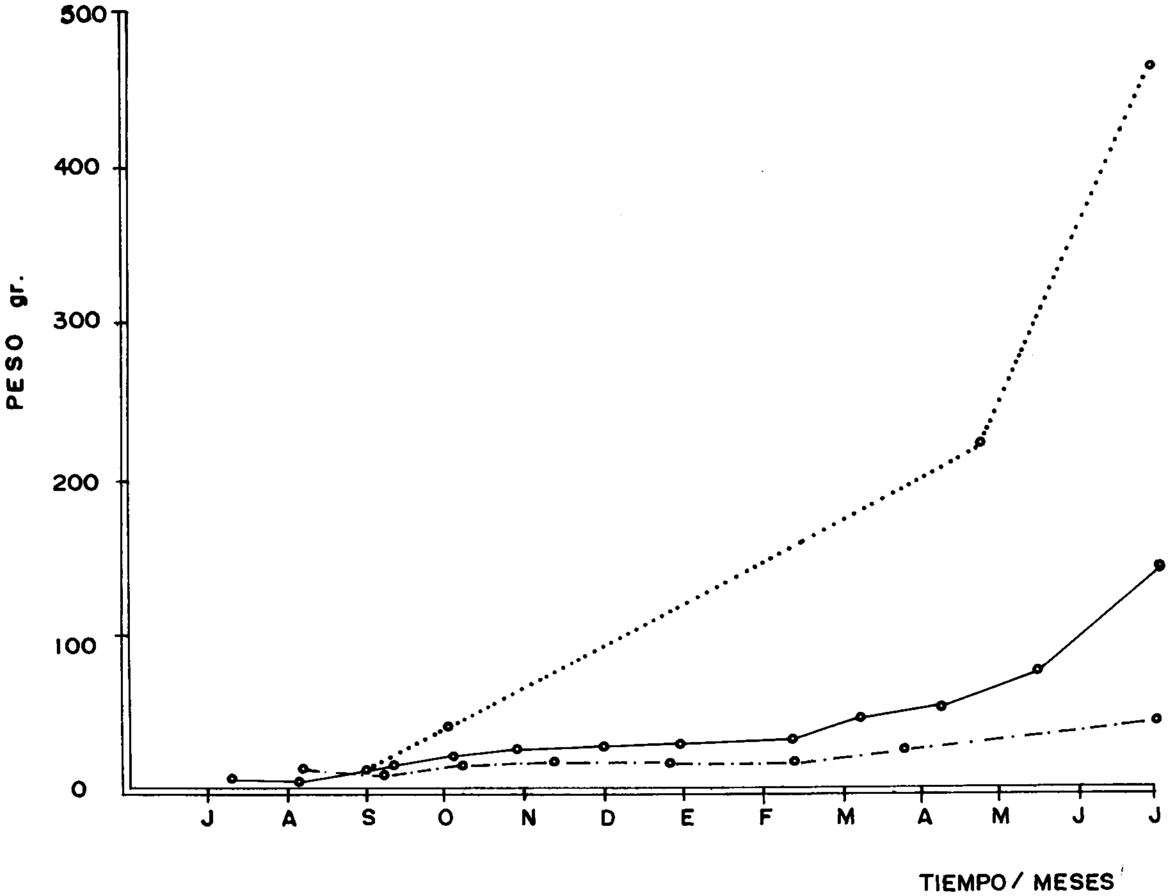

FIG. 2.1 PESO COMPARATIVO OBTENIDO, EXPERIMENTO CARPA HERBIVORA C. idella.

Grupos Libres (......), Laboratorio (———), Jaula Verde (—·—·—); Peso Humedo vs. Tiempo en Meses.

(Almanza y Almanza, 1980)

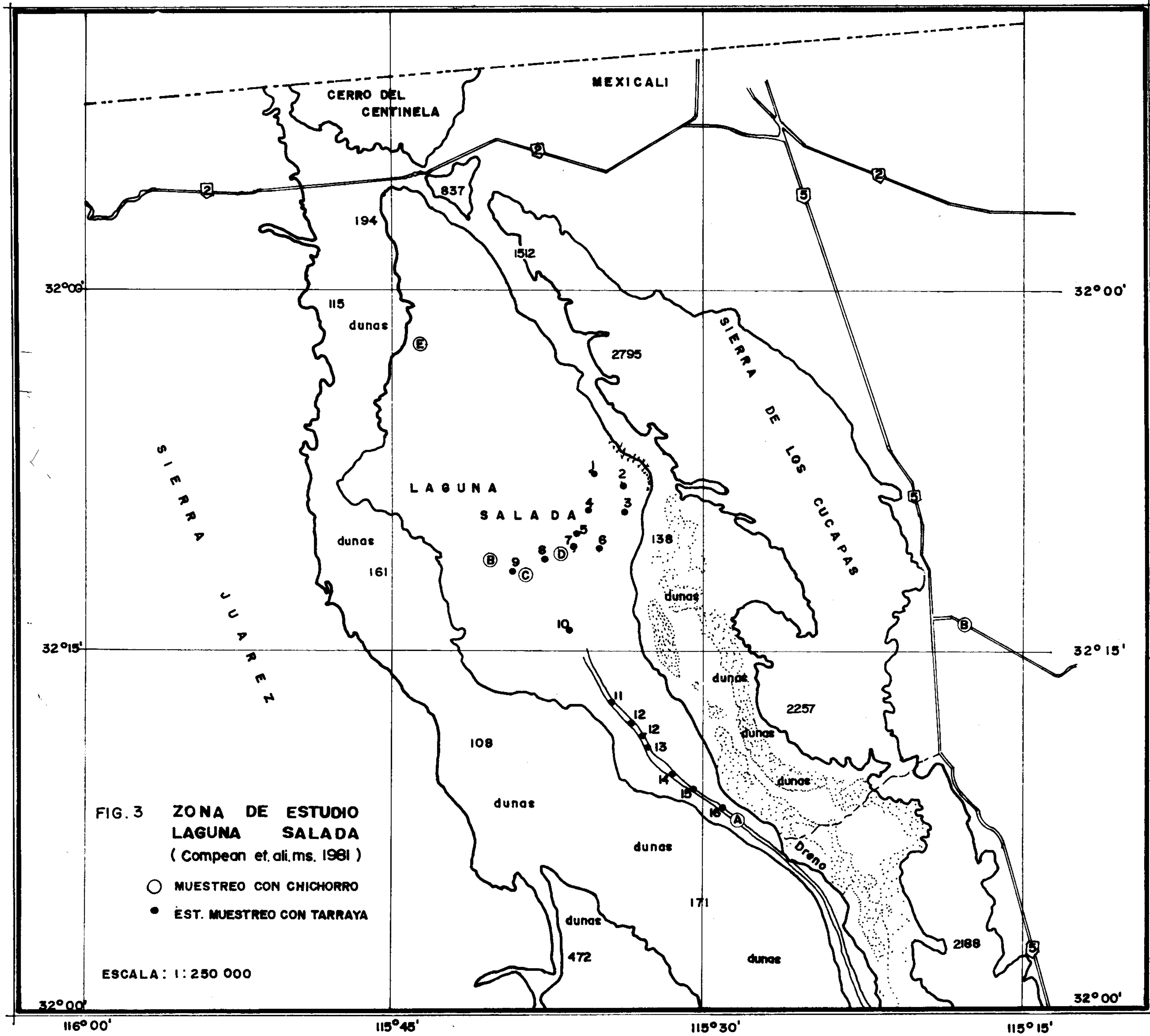

FIG. 3 **ZONA DE ESTUDIO LAGUNA SALADA**
(Compean et. ali. ms. 1981)

○ MUESTREO CON CHICHORRO
• EST. MUESTREO CON TARRAYA

ESCALA : 1 : 250 000

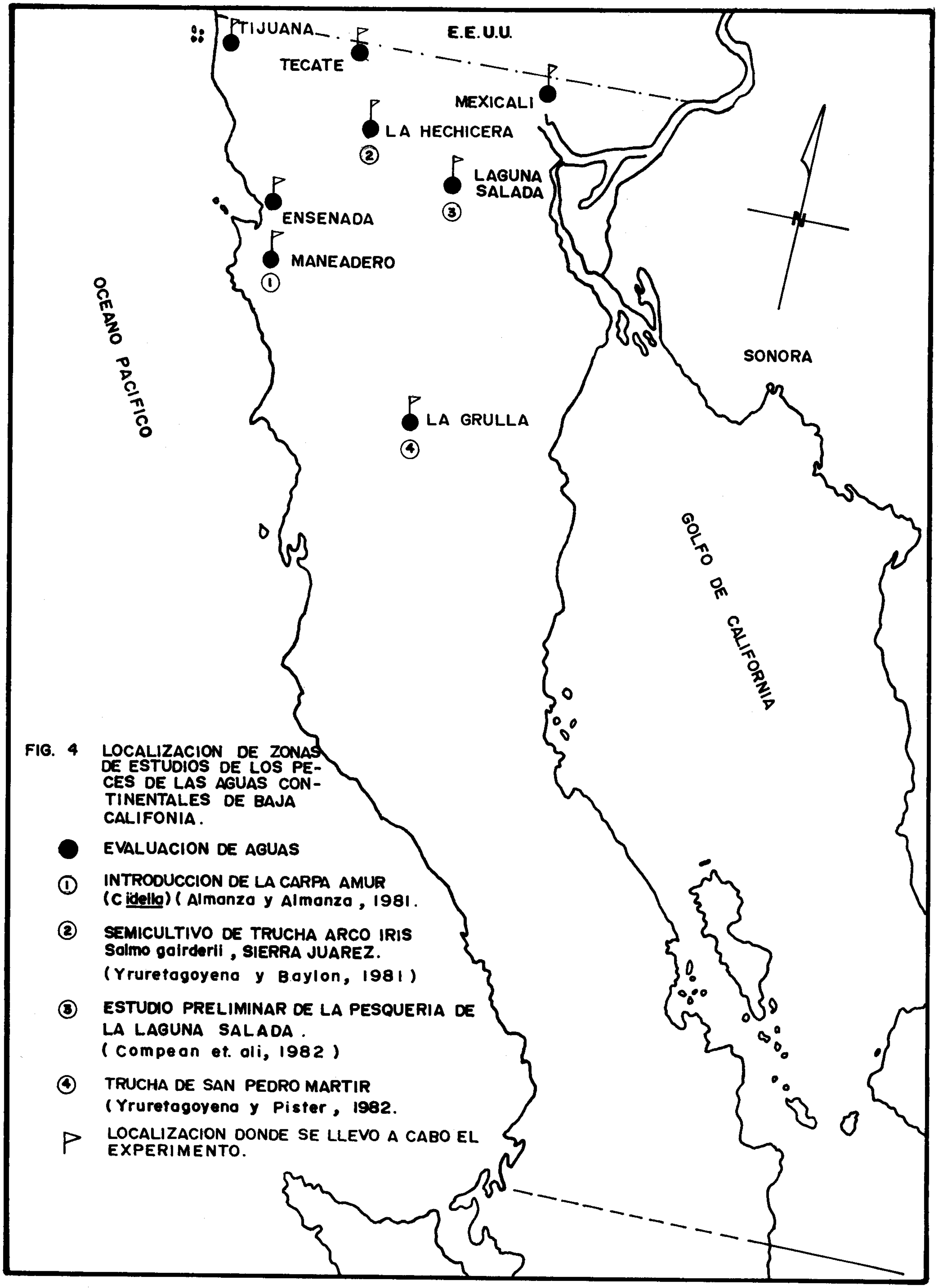

FIG. 4 LOCALIZACION DE ZONAS DE ESTUDIOS DE LOS PECES DE LAS AGUAS CONTINENTALES DE BAJA CALIFONIA.

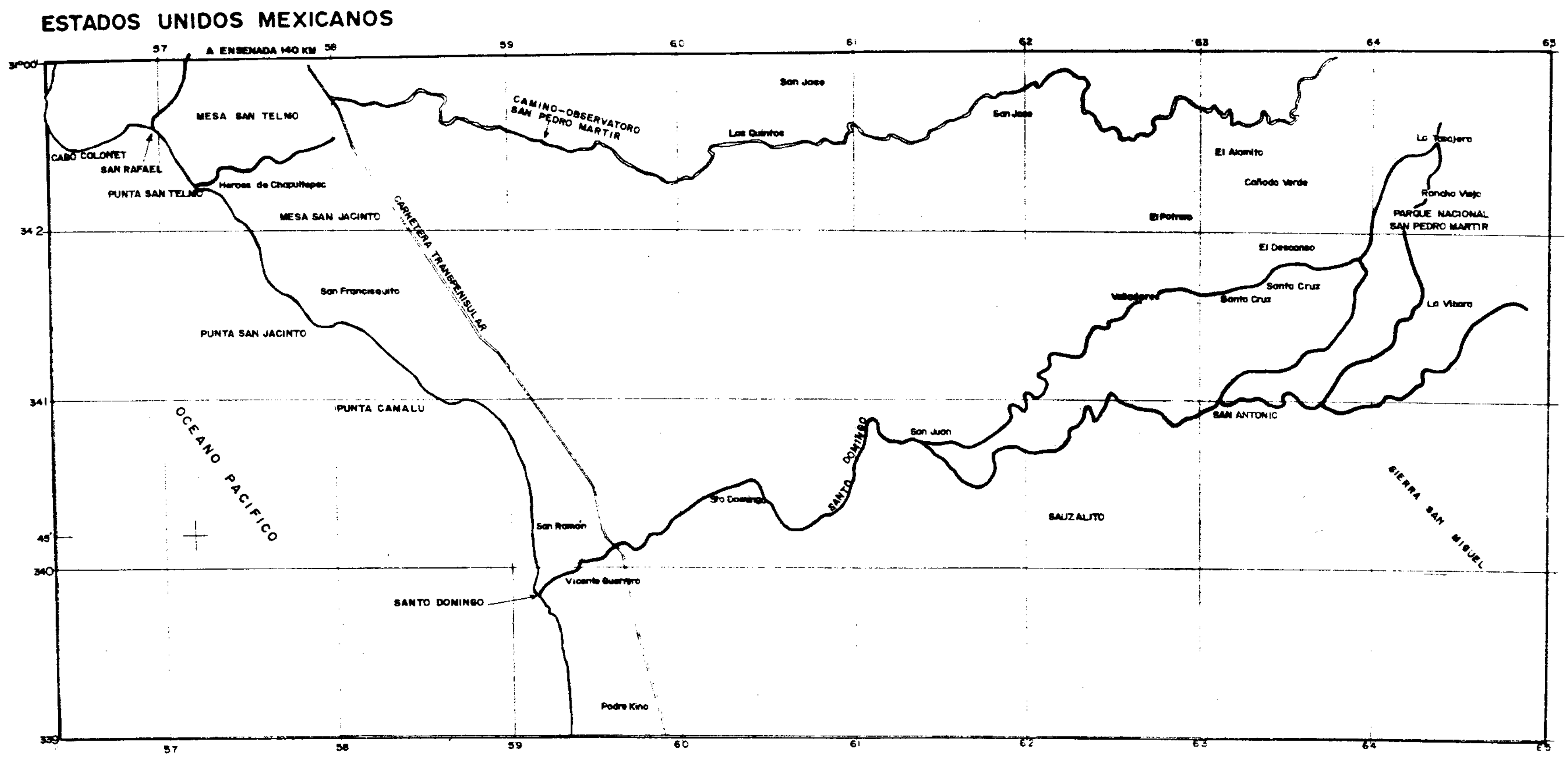

FIG. 5 NACIMIENTO DE ALGUNOS ARROYOS DEL SISTEMA SIERRA DE SAN PEDRO MARTIR, B.C. (Manantiales).

ESC. 1:250 000

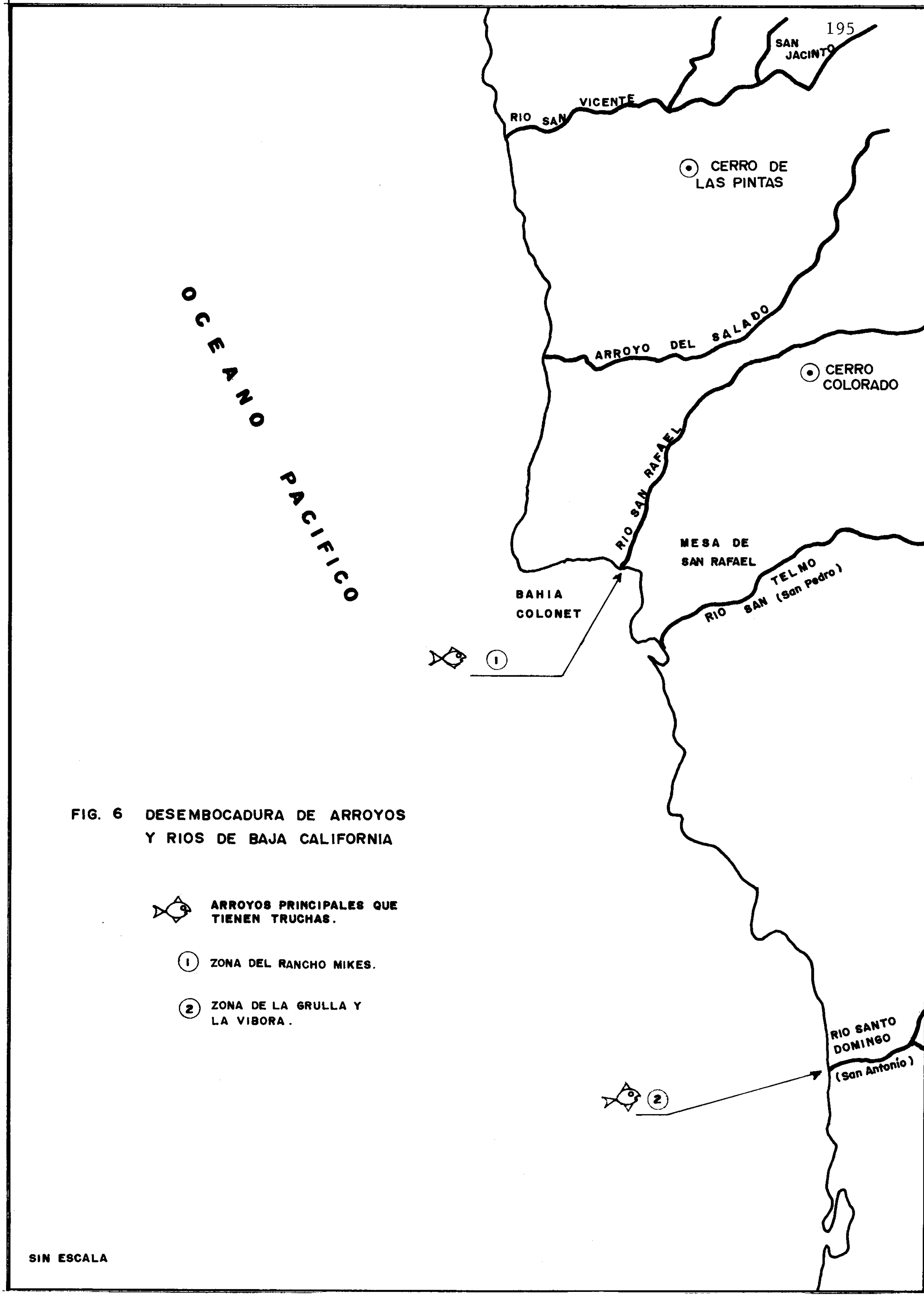

FIG. 6 DESEMBOCADURA DE ARROYOS Y RIOS DE BAJA CALIFORNIA

ANEXO I

UNIVERSITY OF CALIFORNIA, SAN DIEGO

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SCRIPPS INSTITUTION OF OCEANOGRAPHY LA JOLLA, CALIFORNIA 92093

Mex. Carlos Yruretagoyena

SEP 8 1977
CARL L. HUBBS

September 2, 1977

Carlos Yruretagoyena U.
Escuela Superior de Ciencias Marinus
Dept. de Biología
Apartodo Postal 453
Ensenado, B.C.
México

Dear Sr. Yruretagoyena:

I have received your letter making inquiry about research on the rainbow trout in Baja California. One of the main sources of information on them is the following:

Needham, Paul R., and Richard Gard. 1959. Rainbow trout in Mexico and California.Univ. California Publications in Zoology, Vol. 67, No. 1, 124 pp.

The publication is entered as No. 57078 in my large library, now in the new Marine Biology Building at Scripps -- in the south-west corner of the 2nd floor (or you may have this at Ensenada).

I do not know of any very significant studies of the rainbow trout in Baja California. The name Nelson Rainbow Trout or Salmo irideus nelsoni (or just Salmo nelsoni) is a misnomer; the reason being that there are no valid species or subspecies of trout in the Peninsula. The trout that inhabitat mountain streams in the vicinity of the Melling Ranch were wrongly treated, first by Barton Warren Evermann, as Salmo nelsoni (named after a famous explorer in Mexico). Instead, as I learned several years ago, the trout there are the offspring of some trout that were illegally caught near San Simeon, California, on the Hearst Ranch and were released near Melling Ranch. Conditions were good in the mountain streams there, and the species (Salmo gairdnerii) has thrived in the new home. The man's name was Utt and he wrote me a long letter telling the story.

Rainbown trout do occur in the ocean as far south as Rosarito, and in high water swim up streams.

There are some native trout in the west-coast streams of mainland Mexico - notably the very beautiful, largely yellow, species *Salmo chrysogaster* trout (described in Copeia, 1964, no. 1, pp. 169-173, 1 fig.). It occupies the mountain portions of the Rio Fuerte system, and in some places, appears to have hybridized with the widely introduced rainbow trout (*gairdnerii*).

A study of the trout in Baja California could be very interesting, along the lines that you mention. If such a study is undertaken, I hope it will include research on the effects that trout may exert on the survival of the few small native freshwater forms of *Fundulus* that live in a few springs and seem to be in danger of extinction.

Very sincerely,

Carl L. Hubbs

Carl L. Hubbs
Professor of Biology Emeritus

CLH:ks

cc: Dr. Robert Rush Miller

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THE UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN, U.S.A. 48109

MUSEUM OF ZOOLOGY

12 September 1977

Dr. Carl L. Hubbs
Scripps Institution of Oceanography
Box 109
La Jolla, CA 92093

Dear Carl:

I was just getting ready to write Carlos Yruretagoyena regarding the Baja California trout when the copy of your letter to him (IX:2:77) arrived.

In reading over my copies of C.E. Utt's letter to you (VI:15:1945) and his report, I do not get the impression that the trout he brought down from San Simeon survived. At least the trout Dick Croker caught from Rio San Rafael in April, 1973, looked just like the original specimens of Salmo "nelsoni", with interesting spotting, etc. You looked at these fish here and agreed that the problem of the B.C. trout needed further study.

Since the stream conditions (low water at times and above average trout temperatures) for the B.C. trout are rather extreme, it seems unlikely that a northern form introduced there would survive. See Utt's letter, in which he found none after 3 transplants.

See also the enclosed copy of a letter (6/17/77) written by the Director of the Cal. F. & G. Dept., which refers to likely unique adaptations of this trout, as mentioned above. Perhaps you will wish to write again to Carlos; I will be doing so before long.

Cordially,

Bob

Robert R. Miller
Curator of Fishes

Enc.

RRM:hw

SEP 15 1977

THE UNIVERSITY OF MICHIGAN
ANN ARBOR, MICHIGAN, U.S.A. 48109

MUSEUM OF ZOOLOGY

13 September 1977

Sr. Carlos Yruretagoyena U.
Escuela Superior de Ciencias Marinas
Departamento de Biologia
Ado. Postal 453
Ensenada Baja California
Mexico

Dear Sr. Yruretagoyena:

This will supplement the letter to you from Carl L. Hubbs.

The native trout of Baja California may well be a unique genotype, adapted to the warmer than usual temperatures and often low-water flows of this southerly habitat. I do not believe that any of the introductions of California rainbow trout (referred to by Dr. Hubbs) survived. Specimens of B.C. trout that I saw from Rio San Rafael, collected in 1973, looked very much like the good drawing of this trout that appears in Evermann's (1908) article (cited by Needham and Gard).

No comprehensive studies of the Baja California trout have been made. A popular account of collecting in 1937 for culture in California is given by Paul R. Needham in Pacific Discovery (1955, vol.8, no.4, pp.18-24). The introductions to California failed because of negligence.

Studies of the general biology of this trout (spawning, behavior, growth, variation in taxonomic characters, karyotype) need to be made so that it can be compared with more northerly rainbow trout. The original designation by Evermann as a full species was due to an error in counting scales (he said the holotype has 170 scales in lateral series; actually it has about 130). See also a paper by Snyder entitled "The trout of the Sierra San Pedro Martir, Lower California" (1926, Univ. Calif. Publ. Zool., 21(17):419-426). Snyder showed that Evermann's scale count was wrong.

Good color photographs of spawning fish would be desirable to have.

This trout has presumably been largely isolated from contact with other rainbows for a long period, perhaps as much as 10,000 years. If so, it is likely that it has developed distinctive traits adapting it to its rather extreme habitat.

Sincerely yours,

Robert R. Miller

Robert R. Miller
Curator of Fishes

ESTUDIO PRELIMINAR DE LA PESQUERIA DE LA LAGUNA SALADA, BAJA CALIFORNIA

DR. GUILLERMO COMPEAN JIMENEZ
Centro de Investigación Pesquera.
Delegación Federal de Pesca en el
Estado de Baja California
Ensenada, B. C.

P. BIOL. OSCAR BAYLON GRECCO
Delegación Federal de Pesca en el
Estado de Baja California
Ensenada, B. C.

RESUMEN

La Laguna Salada es una cuenca cerrada que forma parte del delta del Río Colorado, se encuentra localizada dentro del municipio de Mexicali, B. C. México. En el período en que se realizó el presente trabajo, tenía un área inundada de 40,700 hectáreas, con un volúmen captado de 738 millones de metros^3. Sin embargo la Laguna Salada es un cuerpo de agua somera con volúmenes variables que dependen de los aportes provenientes del Río Colorado.

La vegetación de la laguna está compuesta principalmente por dos especies: Pino Salado (*Tamarix petandra*) y Tule (*Typha latifolia*).

Existe una pesquería comercial, de tipo artesanal, que se efectúa tanto en la zona del canal alimentador como en el vaso de la laguna. Las especies principales que se capturan comercialmente son: lisa (*Mugil cephalus*), bagre (*Ictalurus sp.*), bocón (*Micropterus salmoides*), y camarón (*Peneaus stylirrostris*). Las capturas se realizan con redes agalleras que son tendidas por medio de pequeñas embarcaciones de motor fuera de borda.

En base a un muestreo de la pesca comercial y a las capturas obtenidas de una pesca experimental con atarraya, en septiembre de 1981, se pudo constatar la presencia de 7 familias de peces y 2 familias de crustáceos, con un total de 13 especies identificadas, la mayoría exóticas provenientes muy probablemente de las introducciones efectuadas en Estados Unidos de América. Algunas especies también son de orígen eurihalino.

La evaluación y manejo del recurso pesquero de la Laguna Salada, presenta muchas dificultades debido a las características propias de la laguna y a la dificultad para evaluar las capturas y el esfuerzo. Debido a lo anterior se recomienda una serie de acciones que permitan reorientar la pesquería así como aumentar el conocimiento sobre la biología de las especies presentes.

ABSTRACT

The Laguna Salada, located in the Mexicali Valley, State of Baja California, is a close basin, thats part of the Colorado Delta. During the time of our study it had a surface of 40,700 ha. area covered with 738 million m^3 of water. However, the lagoon is a shallow body of water with a fluctuating total volume, that is dependent on the water sheds from the Colorado River.

Its vegetation is mainly represented by the salt cedar (Pino Salado (*Tamarix petandra*) and cattails (Tule *Typha latifolia*).

In this basin and in its principal inlet canal there is a small artisan-commercial established fishery, the principal captured species are: mullet (Lisa, Mugil cephalus), cat fish (bagre, Ictalurus sp.) bass (bocon-robalo Micropterus salmoides) and shrimp (camarón, Penaeus stylirrostris). Captures are mainly done with gill nets fixed by small outboard engine boats.

Based on the results obtained from the commercial catch and the ones obtained from an experimental catch, using a hand net (atarraya), during the month of september of 1981, we were able to confirm the presence of 7 families of fishes and 2 families of crustaceams, obtainning a total of 13 identified species, where exotic organisms are majority, probably came from the introductions made in the upper Colorado River in the U.S.A.; some are eurialine.

The evaluation and management of the fishery resources of the Laguna Salada, presents many problems, mainly because of the lagoon's general caracteristics and its difficulty to accurately evaluate the total capture and effort of its fishery. Therefore it is recommended that a series of actions be implemented to reorient the fishery as well as to increase the general biological knowledge of the fishes present.

INTRODUCCION

La Laguna Salada se encuentra localizada dentro del municipio de Mexicali, B.C., México, entre los paralelos 32° 00' 00" y 32° 33' 50" latitud norte, y los 115° 22' 00" y 115° 47' 00" longitud oeste del meridiano de Greenwich. Limita al norte con el cerro El Centinela, al sureste con el extremo norte de la Sierra Las Pintas, al este con las Sierras Cucapa y El Mayor, y al oeste con la Sierra de Juárez. (fig. 1).

El clima para esta localidad de acuerdo a la clasificación de Köppen (1948) modificada por García (1973); para las condiciones de México es del tipo BW (h') hw (x') (e), que corresponde al cálido seco, semicálido con invierto fresco y régimen de lluvias en verano e invierno. La precipitación media anual es de 5 mm. y la evaporación media anual es de 170 mm. La temperatura máxima es de 49°C, y la temperatura mínima es de 12°C (Pérez, B.D. 1981).

En lo que respecta a la vegetación circundante a la Laguna Salada, ésta se encuentra tipificada por especies propias de las zonas áridas y semiáridas, agrupándose estas bajo el rubro de matorral xerófilo.

Esta zona, antes de la construcción de la carretera federal No. 5 Mexicali-San Felipe, se veía influenciada por las mareas extraordinarias del Golfo, que ocasionalmente rebosaban e inundaban las partes bajas de la cuenca, nor malmente seca. Fué hasta 1974 cuando la laguna empezó a recibir los primeros aportes de agua provenientes de los drenes de descarga de la vertiente sur del distrito de riego No. 14, (dren de descarga al Rio Hardy, dren Plan de Ayala y dren Colector Sur), a través del canal alimentador que comunica al Río Colorado con la Laguna Salada. La construcción de este canal se inició en septiembre de 1973 y empezó a operar a partir del mes de febrero de 1974; mide 37.5 km. de longitud, tiene una plantilla de 25 mts. y la profundidad física oscila entre 2.5 y 3 mts., su capacidad de aporte original fué de 6.24 m^3/seg.

A principios de 1979, E.U.A., envió los primeros volúmenes excedentes del Río Colorado, por lo que la Secretaría de Agricultura y Recursos Hidráulicos inició la construcción de una serie de obras decontrol y defensa para evitar inundaciones en las áreas de cultivo colindantes al cauce principal del río, y sobre todo las localizadas en la parte sur del Distrito de Riego, en donde ya se observaban algunos desbordamientos, debido a que el cauce original que desembocaba en el Golfo estaba prácticamente seco, es así como se iniciaron las obras de ampliación del canal alimentador para mandar los excedentes del Río Colorado hacia la Laguna Salada.

En septiembre de 1981, fecha en que se realizó este estudio, la Laguna Salada tenía un área inundada de 40,700 has. con un volúmen captado de 730 millones de m^3. La profundidad en el vaso era de 20 cm. en las partes someras y de 4 mts. en las partes más profundas.

La evaporación promedio anual es de 2,420.63 mm. y el volúmen de evaporación anual es de 13,967.79 m^3/Ha. Por lo que para asegurar la existencia de la Laguna Salada es necesario tener un aporte contínuo de agua durante todo el año, que contrarreste las pérdidas ocasionadas por la transminación y evaporación. Con un gasto de 6 m^3/seg. es factible mantener un área aproximada de inundación de 7,604 Ha. para el mes de junio y con un máximo de 31,984 Ha. para el mes de diciembre (información proporcionada por la S.A.R.H.)

En lo que respecta a la pesca del Bajo Río Colorado en Baja California, México; desde 1969, existen registros de capturas comerciales, de especies dulceacuícolas en la Oficina de Pesca de Mexicali, B. C. aunque unicamente del Río Colorado y sus afluentes y es sólo a partir de 1977 que empezaron a registrarse capturas procedentes de la Laguna Salada. Sin embargo hasta esta fecha se carecía de estudios que evaluaran el potencial pesquero, razón por la cual la Delegación Federal de Pesca en B. C. incluyó dentro de sus actividades de 1981 un estudio preliminar de la pesquería de la Laguna Salada, con el fín de establecer las políticas de explotación que deberían seguirse.

MATERIAL Y METODOS

El material procede de la pesca comercial y experimental efectuada en septiembre de 1981 en 20 estaciones situadas a lo largo del canal alimentador y el vaso de la Laguna Salada.

Para la pesca experimental que se efectuó durante la comisión, se utilizaron dos tipos de artes, una red agallera de 60 mts. de longitud y una atarraya de 3.20 mts. de diámetro.

Con la red agallera de luz de malla de 8.25 cm. se efectuaron 2 lances (ver fig. I) uno nocturno en el canal alimentador (Lance A) y el otro diurno dentro del vaso de la laguna.

Con la atarraya que tenía luz de malla de 3.17 cm., 3.81 cm. y 4.44 cm., se efectuaron 18 lances dobles tanto a lo largo del canal como dentro de la laguna. Además se muestrearon otros dos lances comerciales efectuados en el vaso de la laguna (lance B y E).

Los datos hidrológicos proceden de mediciones efectuadas en los meses de septiembre, octubre y noviembre de 1981. Unas estaciones fueron monitoreadas por el personal de la Secretaría de Pesca y otras por personal de la Secretaría de Agricultura y Recursos Hidráulicos (Tabla I).

El rendimiento de las redes, con un fín meramente comparativo, fué calculado de acuerdo a la fórmula:

$$R = \frac{a}{b} \cdot \frac{c}{d} = R \cdot n$$

Donde:

R = rendimiento
1/ a = 500 mts.
b = longitud de la red
1/ c = 12 horas
d = tiempo utilizado
n = No. de individuos

RESULTADOS

En general la Laguna Salada es un cuerpo de agua somera con volúmenes variables que dependen de los aportes provenientes del Río Colorado, con temperaturas elevadas que descienden en los meses de diciembre, enero y febrero: y niveles de O_2 variables, y en cuanto a los demás parámetros fisicoquímicos, éstos se mantienen estables en toda el área de la laguna, (tabla I). El fondo es predominantemente fangoso y con características topográficas irregulares.

En lo que respecta a la flota podemos observar que existe una zonación bien marcada en cuando a la distribución de las 2 especies. Principalmente el pino salado (*Tamarix petandra*) lo encontramos en los márgenes del canal alimentador y de la laguna, y la zona de tulares (*Typha latifolia*) que está lo

---

1/ se compara el rendimiento en 500 mts. de red agallera en 12 horas.

calizada a partir de donde se ramifica el canal alimentador, para desembocar en lo que propiamente es el vaso de la Laguna Salada, extendiéndose - por las partes poco profundas hacia el interior del mismo en dirección noroeste, a lo largo del cauce principal, formando densas áreas de vegetación que dificultan su acceso. El esquema de distribución antes mencionado, responde a un gradiente con respecto a la profundidad.

PESCA COMERCIAL

La pesca comercial se efectúa tanto en la zona del canal alimentador como en el vaso de la laguna, esta es de tipo artesanal y se realiza por medio de lanchas de aproximadamente 3 metros de longitud construídas en fibra de vidrio o madera, todas cuentan con motor fuera de borda de 40 hp. la actividad dentro del vaso de la laguna ó en el canal dependen del interés de - cada uno de los pescadores, sin embargo aparentemente es mucho más importante en el canal alimentador, en donde se observaron la mayor parte de - las redes, algunas de las cuales estaban formadas por la unión de varias - redes de 60 mts. de longitud, éstas generalmente son tendidas a lo largo - de la orilla de tulares ó atravesadas en el canal.

En el vaso de la laguna al contrario, la actividad parece ser menor y las redes son colocadas en las zonas de poca profundidad. Sin embargo es necesario señalar que no se realizó un recorrido exhaustivo del área que corresponde al vaso de la Laguna Salada. En lo que respecta a las artes de pesca son muy homogeneas y no presentan grandes diferencias a pesar de que estan hechas para la captura de diferentes especies (Fig. 2). En general estan construídas con paños "Nylon" poliamida (P.A.) multifilamento y paños "Nylon" poliamida monofilamento, estos paños varían en dimensión, luz de malla, material y diámetro del hilo; de las redes revisadas se encontró luz de malla de 7.62 cm., 8.25 cm., 13.33 cm.; y 15.87 cm.

Las especies que se capturan comercialmente son: lisa, bagre, carpa, bocón, ó lobina, tilapia ó mojarra y algo de camarón además existe captura occidental de chiro ó jotón.

PESCA EXPERIMENTAL

Con la red agallera en el primer lance que fué nocturno en el canal alimentador la captura fué en su totalidad de chiro o jotón, aproximadamente 100 kg. y 6 camarones; en el segundo que fué diurno (dentro del vaso) la red - permaneció durante dos horas tendida en el agua y la captura fué principalmente de lisa, carpa y mojarra (tilapia), los resultados han sido comparados entre sí y con un lance comercial (dentro de la laguna) para obtener el rendimiento en 500 m/12 hrs. (tabla II); con la atarraya la captura - fué principalmente de mojarra (tilapia) (fig. 3 y 4) tanto a lo largo del canal como dentro de la laguna.

De las capturas comerciales y experimentales realizadas dentro del canal alimentador y en el vaso de la laguna, se encontraron representadas 7 familias de peces y 2 familias de crustáceos, así mismo se incluye en este informe a un representante del genero Poecilia, que probablemente se trate de la especie P.latipinna, colectada en otra comisión, dando un total de 13 especies (tabla III).

INFORMACION BIOLOGICA

Las especies que se capturan comercialmente y las que fueron capturadas durante la pesca experimental son en su mayoría especies exóticas y no forman parte de la fauna original de la cuenca del Río Colorado, la mayor parte proviene probablemente de las introducciones que se realizaron en territorio norteamericano. Algunas otras son de origen eurihalino, de las especies que tenemos algunos datos son los siguientes:

Camarón

Esta especie se capturó solo experimentalmente ya que en la fecha de la comisión aún estaba vigente la veda, sólo se capturaron 6 ejemplares con la red agallera de 5.08 cm. de luz de malla en pesca nocturna, esta red fué colocada en el canal alimentador (estación A) todos los ejemplares adultos con gónadas inmaduras, no se capturaron juveniles en ninguna de las estaciones, es poco probable que esta especies se reproduzca dentro de la laguna ó en el canal alimentador, los ejemplares que se capturan provienen muy probablemente de los que entraron durante el último período en que hubo comunicación con el mar.

Lisa

Se capturó en gran cantidad; especie eurihalina, es muy común dentro de la laguna y menos abundante en el canal alimentador; como el esfuerzo de pesca es muy alto dentro del canal y esta especie sigue siendo la base de la pesca comercial, es muy probable entonces que la pesquería del canal se efectúe sobre peces que migran del interior del vaso. No se observó ningún individuo con gónadas maduras ó recién desovadas, solo estadíos I y II. Se capturó una amplia gama de tallas (Fig. 5 y 6), esta especie junto con el camarón son las más apreciadas desde el punto de vista económico, por lo que está soportando la mayor parte del esfuerzo.

Mojarra (tilapia)

Las mojarras estan representadas cuando menos por tres especies muy abundantes presentes en todos los niveles tróficos, se captura comercialmente tanto dentro del vaso de la laguna como en el canal alimentador.

Carpa

Las especies de carpa son abundantes en el vaso de la laguna y en el canal alimentador, existe una gran variedad de tallas en las capturas comerciales y en la captura experimental. De los ejemplares examinados ninguno tenía las gónadas sexualmente maduras ó recién desovadas.

Chiro (jotón)

Esta especie eurihalina ha sido reportada como invasora del Río Colorado (Miller, 1958), se captura en gran cantidad dentro del canal alimentador; durante la pesca experimental obtuvimos un gran rendimiento (tabla II, estación A), pero está ausencte en las capturas efectuadas dentro del vaso de la laguna actualmente es poco aprovechado ya que no hay una demanda comercial, a pesar de su gran abundancia.

Robalo (lobina)

Actualmente se le pesca comercialmente y es muy apreciada en el mercado, sin embargo la captura que obtuvimos fué mínima.

Bagre

El bagre probablemente está representado por más de una especie pero no ha sido posible comprobarlo, es muy abundante y se capturan varias tallas, está presente principalmente en la zona del canal alimentador.

Sardina plateada

Esta especie es muy abundante tanto en el vaso de la laguna como en el canal alimentador, es la especie forraje y junto con las mojarras de agallas azules (*Lepomis macrochirus*) son las presas del bocón.

DISCUSION

La pesquería de la Laguna Salada presenta muchas dificultades para la evaluación del recurso. Algunas de éllas se deben a las características propias de la Laguna como son la gran variedad en los aportes de agua los cuales repercuten en grandes fluctuaciones de la superficie inundada.

Otras dificultades son de órden biológico, pues es probable la existencia de una gran migración de peces entre el vaso de la laguna y al canal alimentador así como con el Golfo de California (Peces y camarón) cuando existe comunicación con el mar. A las dificultades ya mencionadas hay que -

agregar que el esfuerzo pesquero incontrolado está muy disperso y debe presentar variaciones estacionales más ó menos importantes relacionadas con los aportes de agua a la laguna y con las disposiciones administrativas como las vedas.

Por otro lado no se cuenta con estadísticas correctas sobre las capturas de la laguna ya que estan mezcladas probablemente con capturas del Río Hardy y del Puerto de San Felipe, B. C. A todo lo anterior hay que agregar que no se cuenta con el personal que efectúe muestreos periódicos y análisis de los datos.

Además sabemos que existe un aumento en el esfuerzo de pesca y que éste es muy difícil de cuantificar por ser principalmente pesca incontrolada. Durante la comisión efectuada a la laguna hemos podido constatar que el número de artes registradas por los permisionarios es inferior a los que se encontraban trabajando en el canal y vaso de la laguna, ésto a pesar que el recorrido del vaso de la laguna no fué exhaustivo y por consiguiente no se revisó toda el área inundada.

En lo que respecta a las especies, como se observa en la tabla IV ninguna de las especies de peces dulceacuícolas son nativas de la cuenca del Río Colorado y su actual distribución en el Valle de Mexicali, B. C., es probablemente el resultado de las introducciones hechas en los diferentes cuerpos de agua del Estado de California, U.S.A. Al no existir barreras ecológicas que las mantuvieran aisladas, éstas se establecieron y adaptaron satisfactoriamente en las aguas del Río Colorado y sus ramales.

La presencia de especies de origen marino dentro de la Laguna Salada, se debe a que el Río Colorado originalmente desembocaba en el mar, aunque ésta situación se ha modificado y no existe comunicación permanente, en 1979 el río desembocó de nuevo en el Golfo de California y esta comunicación duró hasta febrero de 1981. Lo anterior permitió que especies como el camarón, la lisa y el chiro o jotón, remontaran las aguas del Río Colorado hasta llegar a colonizar la Laguna Salada, en donde encontraron las condiciones propicias para desarrollarse.

Actualmente como los hemos mencionado, ya no existe comunicación entre el río y el mar, lo que evita que el camarón complete su ciclo biológico. Por lo que respecta a la lisa, hay la posibilidad de que desove en agua dulce, ya que los registros de captura que datan desde 1967 para el Valle de Mexicali, B. C., nos hace pensar sobre un reclutamiento contínuo en las poblaciones de lisa, descartando la posibilidad de que los juveniles provengan del mar.

CONCLUSIONES Y RECOMENDACIONES

La evaluación y el buen manejo de los recursos de la Laguna Salada como lo hemos mencionado anteriormente va ha depender de una serie de actividades que en su conjunto nos permitan conocer como se está comportando el recurso bajo la presión de una pesquería comercial, algunas de estas actividades las expondremos enseguida.

La estimación del esfuerzo, es una información fundamental para poder preveer el efecto de la pesca sobre el recurso, solo que las estimaciones de ésta variable no es tarea fácil a causa de la falta de personal y lo intensivo de la pesca incontrolada, sin embargo una solución posible es realizar censos aéreos sobre el vaso de la laguna para conocer el número de redes/hectáreas y un censo a lo largo del canal, desde embarcaciones para determinar el número de redes/kilómetro, éste último sería idéntico al que hemos realizado durante esta comisión. Dichos censos para ser efectivos deberán realizarse cuando menos cuatro veces por año, aunque lo ideal sería mensual ó bimestral.

Las capturas estan subestimadas y son muy difíciles de corregir con los datos de la Oficina de Pesca de Mexicali, B. C., pero una solución es realizar muestreos del rendimiento de las redes en diferentes zonas de la laguna (vaso, canal y zona de tulares), esta actividad debe efectuarse paralelamente con la estimación del esfuerzo. Los datos así obtenidos pueden extrapolarse para estimar el total de capturas de cada una de las especies comerciales, corrigiendo de esta manera los datos proporcionados por la Oficina de Pesca.

Al mismo tiempo que el muestreo de capturas para la estimación del rendimiento, es conveniente realizar muestreos biológicos (gónadas y talla) para determinar el ciclo gonádico de las especies de agua dulce, en el caso de la lisa podremos comprobar si se reproduce dentro de la laguna.

En lo que respecta a la pesquería de camarón, hay que esperar que ésta tienda a disminuír, ya que no existe comunicación con el mar y una siembra de larvas no sería recomendable ya que la población de mojarra (tilapia) es muy grande y esta especie puede alimentarse de larvas de camarón, podría pensarse unicamente en encierros bien controlados en zonas más idóneas como la del Yurimuri.

De la misma manera pueden iniciarse los estudios para determinar la viabilidad de un cultivo de lisa, ya que existe la posibilidad que la hipótesis de que se reproduzca dentro de la laguna sea falsa. Actualmente las técnicas de inducción del desove en lisa adaptada al agua dulce, estan bien desarrolladas y solo sería necesario adaptarlas a las condiciones técnicas de la región.

En lo que respecta a la pesquería que se está efectuando, sería recomendable que esta se desarrolle más hacia el interior del vaso de la laguna, pues ya hemos mencionado que el esfuerzo es muy alto dentro del canal, también la colocación de las redes de una orilla a la otra del canal debe ser evitada ya que desconocemos los movimientos de las especies entre el canal y el vaso de la laguna ó viceversa.

Finalmente todas las consideraciones de carácter biológico pesquero que hemos mencionado, deben estar supeditadas a un estudio profundo de la presencia de contaminantes en la Laguna Salada y en las especies que ahí se explotan, pues no hay que olvidar que se trata de una cuenca cerrada, con gran evaporación, la cual se alimenta con las aguas que proceden de una zona agrícola bien desarrollada, que utiliza gran cantidad de pesticidas, herbicidas e insecticidas así como gran cantidad de fertilizantes, ésto sólo será posible en la medida en que conozcan el destino y las cantidades exactas de capturas que proceden de la Laguna Salada.

AGRADECIMIENTOS

Esta comisión ha podido realizarse con éxito, en gran parte gracias a la cooperación de los miembros de la Unidad de Producción Pesquera Cucapa, de los Oceanólogos Norberto Castro C. y Benito Nava C., del Instituto Nacional Indigenista, y a la participación en el trabajo de campo al Ing. Pesq. Humberto Robles y el Oceanólogo Enrique Aranda de la Secretaría de Pesca.

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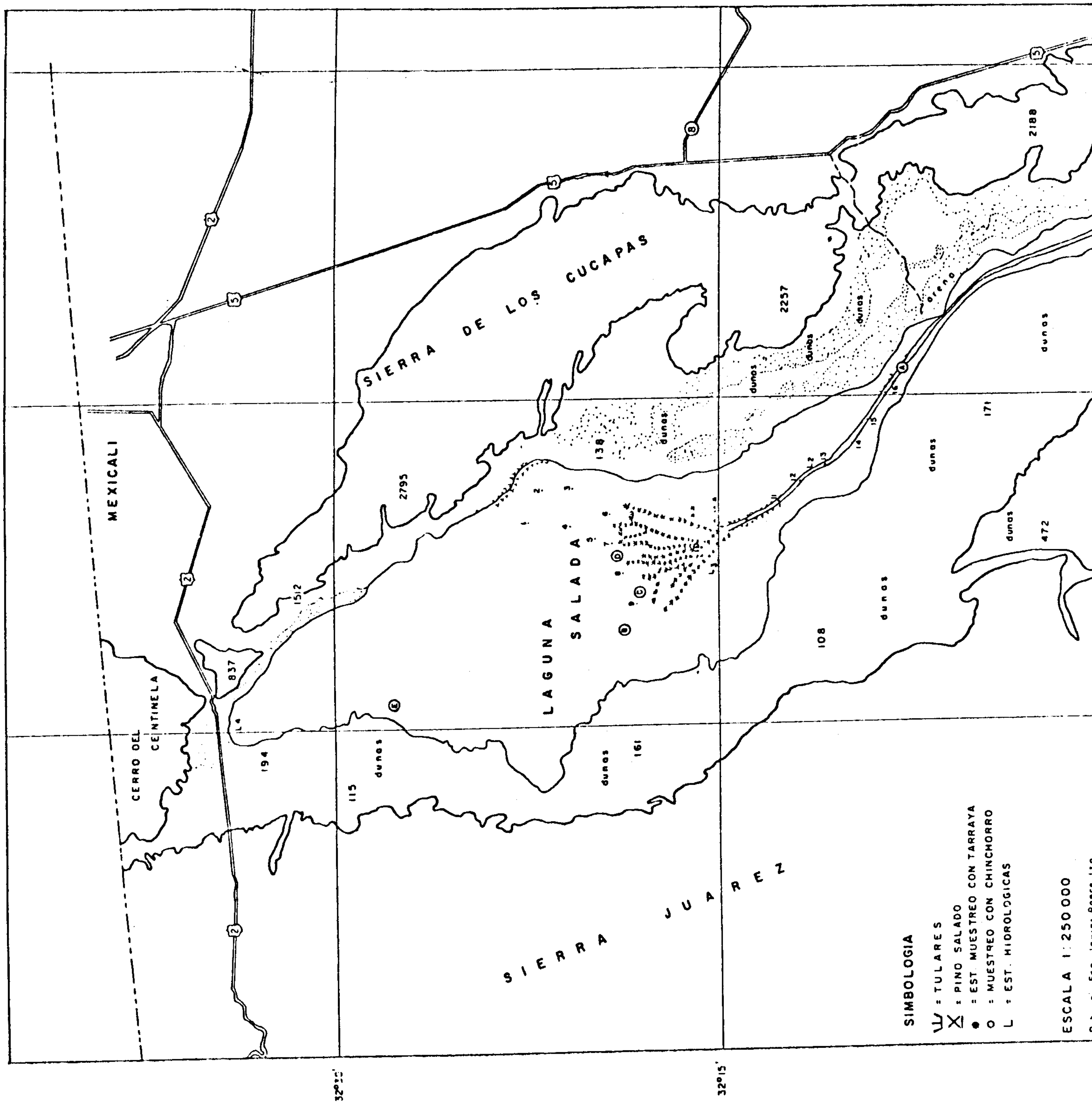
SIERRA DE LOS CUCAPAS
MEXICALI
CERRO DEL CENTINELA
LAGUNA SALADA
SIERRA JUAREZ
dunas
arena
2188
2257
2795
138
171
472
108
1512
837
194
115
161
SIMBOLOGIA
: TULARES
: PINO SALADO
: EST. MUESTREO CON TARRAYA
: MUESTREO CON CHINCHORRO
: EST. HIDROLOGICAS
ESCALA 1: 250 000
32°15'

FIGURA Nº 1

PARAMETROS FISICO-QUIMICOS DE LA LAGUNA SALADA

PARAMETRO	Est.L_1	Est. L_4	Est. L_1	Est.L_2	Est. L_1	Est.L_3
TEMPERATURA AMB °C	- . -	40.0	- . -	30.0	- . -	28.0
TEMPERATURA Agua °C	31.5	36.0	22.5	22.0	18.0	22.0
0_2 SUPERFICIE ppm	8.0	- . -	9.71	10.2	10.3	9.2
0_2 FONDO ppm	- . -	16	- . -	6.8	- . -	9.0
Co_2 mg/lts.	- . -	6.5	- . -	3	- . -	2
NH_3 mg/lts.	.50	- . -	.14	0.854	0	0.793
NH_4 mg/lts.	- . -	- . -	- . -	0.903	- . -	0.838
NO_2 mg/lts.	- . -	- . -	- . -	0.059	- . -	6.6
NO_3 mg/lts.	.18	- . -	.13	14.08	.11	11.0
DUREZA ($caCo_3$) mg/lts.	355	3000	368.5	343	379	360
SALINIDAD 0/00	- . -	8.0	- . -	1	- . -	0
pH	8.35	7.80	8.20	7.80	8.33	8.3
TURBIDEZ Mts.	- . -	.60	- . -	0.38	- . -	0.25
PROFUNDIDAD Mts.	- . -	.60	- . -	2.80	- . -	0.85
FECHA	Sept.	Sept.	Oct.	Oct.	Nov.	Nov.

Est.L_1 = Canal Alimentador (Datos Monitoreados por S.A.R.H.)
Est.L_2 = Canal Alimentador (Datos Monitoreados por el Departamento de Pesca).
Est.L_3 = Vaso Laguna Salada (Datos Monitoreados por el Departamento de Pesca).
Est.L_4 = Zona del Oasis (Datos Monitoreados por el Departamento de Pesca).

*abs.

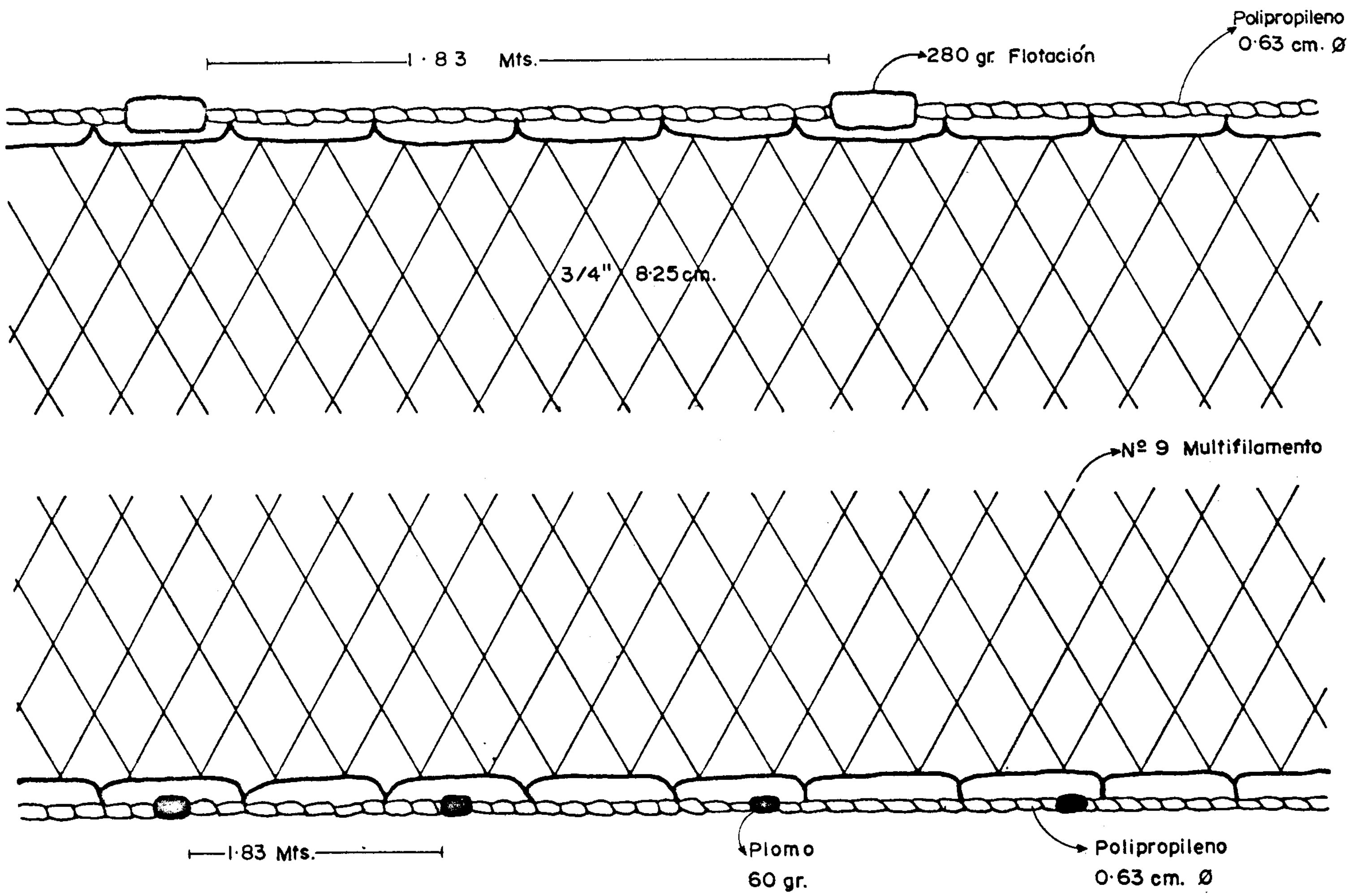

FIGURA Nº 2
RED TIPO AGALLERA

TABLA: II

RESULTADOS DE LA CAPTURA DE PECES POR ESTACION Y CON RED AGALLERA EN EL CANAL ALIMENTADOR Y LAGUNA SALADA, MUNICIPIO DE MEXICALI, B.CFA.

ESTACION	FECHA	LONG(m)	TIEMPO (HRS.)	No.DE INDIVIDUOS CAPTS.	RENDIMIENTO EN 500 m/12 hr.	MALLA (cm).
A	16/sept.	50	11:00	187	2040	7.0
C	17/sept.	150	16:00	70	87.4	9.0
D	17/sept.	50	3:30	35	1200	7.0
TOTAL 3	2 días	250	30:30	292	3327.4	
PROM.		83.33	10:10	97.33	1109.1	

$$\text{Rendimiento} = \frac{a}{b} \times \frac{c}{d} = f \times n$$

Donde
*a = 500 mts.
b = long.de la red.
*c = 12 hrs.
d = Tiempo utilizado
n = No.de individuos

* Se compara el rendimiento en 500 m de agallera en 12 horas.

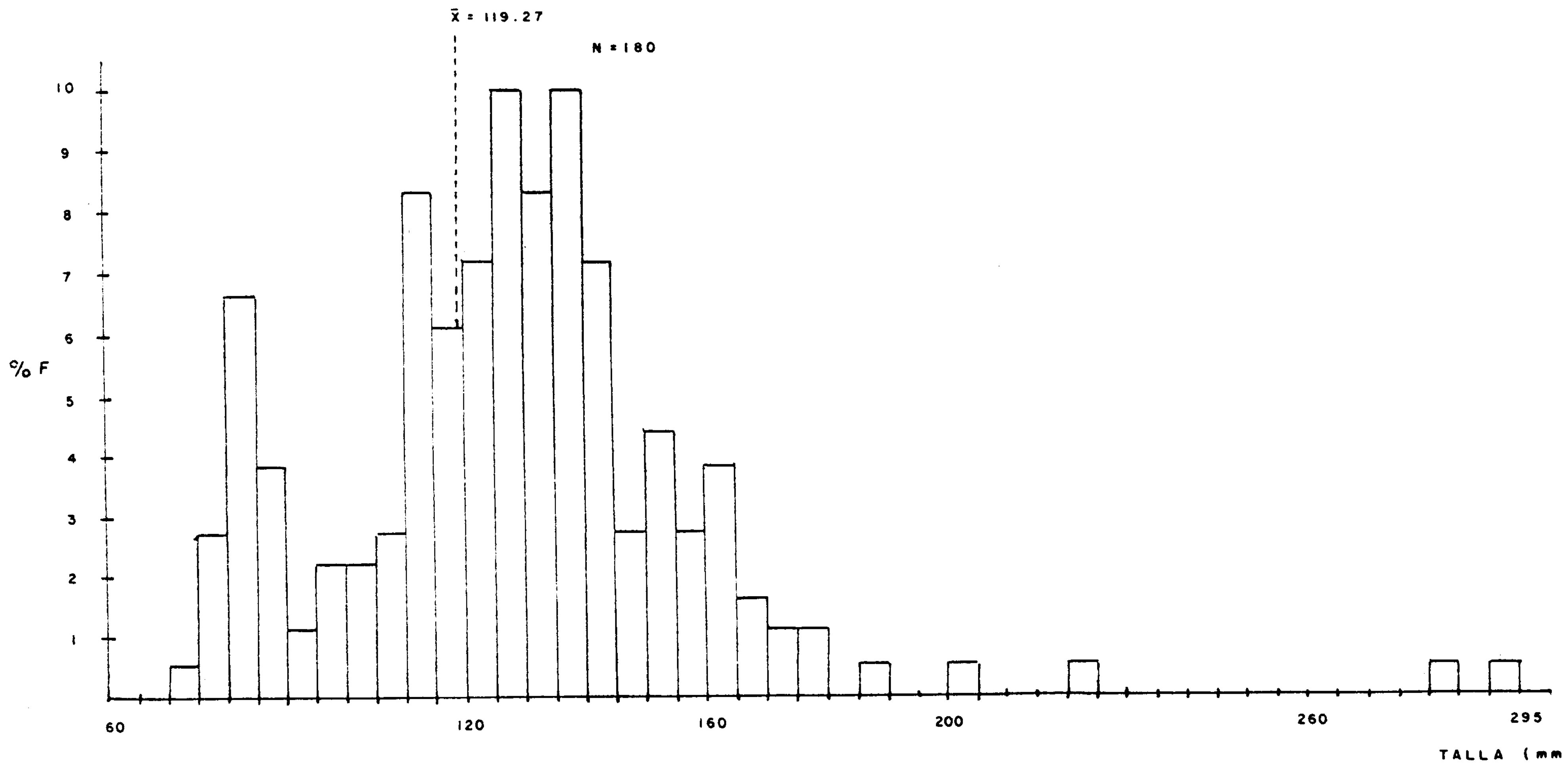

FIG. Nº 3 . RESULTADO DE LA CAPTURA TOTAL DE <u>TILAPIA SP.</u> CON ATARRAYA , % DE LA FRECUENCIA DE TALLAS .

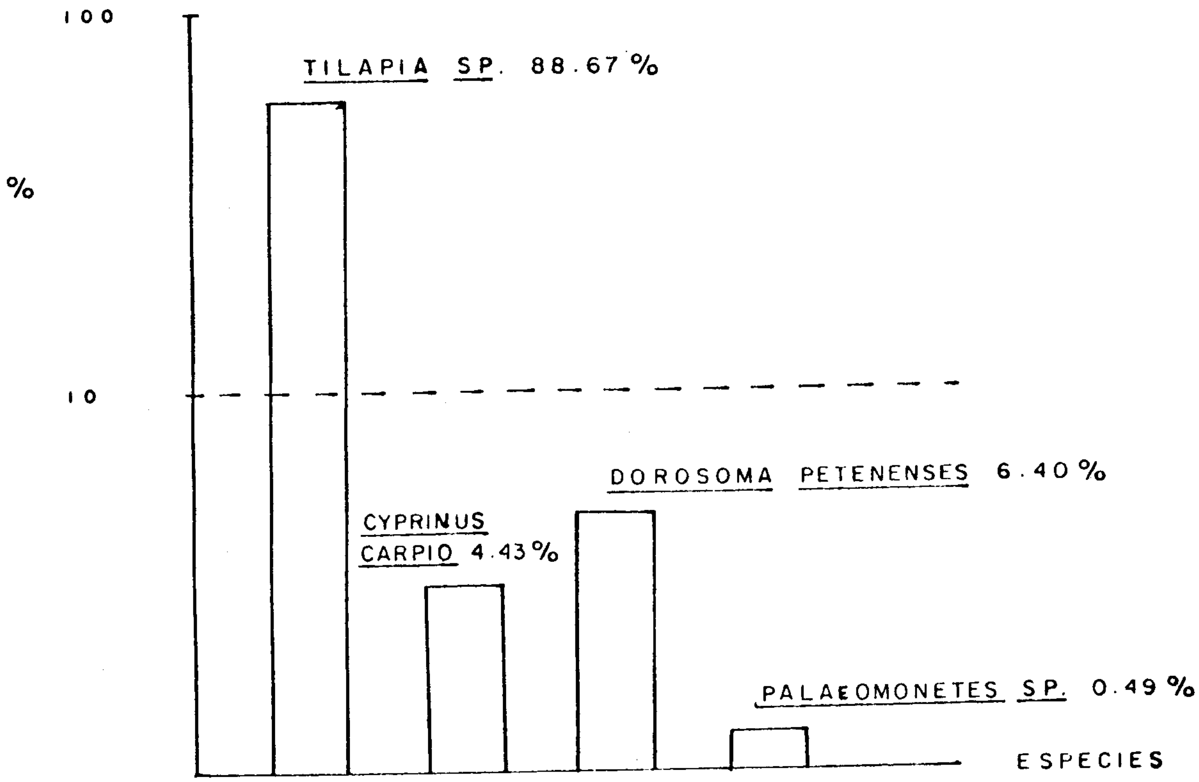

FIG. Nº 4 . ESPECIES CAPTURADAS CON ATARRAYA .
% DE LA CAPTURA TOTAL .

TABLA III

RELACION DE ESPECIES PRESENTES EN LA LAGUNA SALADA

FAMILIA	ESPECIE	NOMBRE COMUN	AREA DE CAPTURA		DULCEACUICOLA		MARINO
			CANAL ALIMENTADOR.	VASO DE LA LAGUNA SALADA.	NATIVA	EXOTICA	EURIHALINO.
ELOPIDAE	Elops affinnes (Regan)	Chiro, Joton	X				X
CLUPEIDAE	Dorosoma petenense (Gunther)	Sardina plateada	X	X		X	
CYPRINIDAE	Cyprinus carpio (Linneo)	Carpa común	X	X		X	
ICTALURIDAE	Ictalurus punctatus	Bagre	X			X	
	Pylodictis olivaris						
POECILIDAE	Poecilia sp		0			0	
CENTRARCHIDAE	Lepomis macrochirus (Rafinesque)	Mojarra Agalla azul		X		X	
	Micropterus salmoides	Lobina, bocón	X			X	
CICHLIDAE	Tilapia nilotica (Linnaeus)	Mojarra	X	X		X	
	T. zillii (Dumeril)	Mojarra	X	X		X	
	Sarotherodon masambicus (Peters)	Mojarra	X	X		X	
MUGILIDAE	Mugil cephalus (Linnaeus)	Lisa		X			X
PENEIDAE	Peneaus stylirrostris (Stimpson)	Camarón azul	X	X			X
PALAEOMONIDAE	Palaeomonetes, sp	Camarón cristal		X		X	

NOTA: X Especies capturadas durante el muestreo del 16 y 17 de Septiembre de 1981.

0 Especies colectadas el 19 de Marzo de 1981 en el Km. 29+400 del Canal Alimentador a la Laguna Salada.

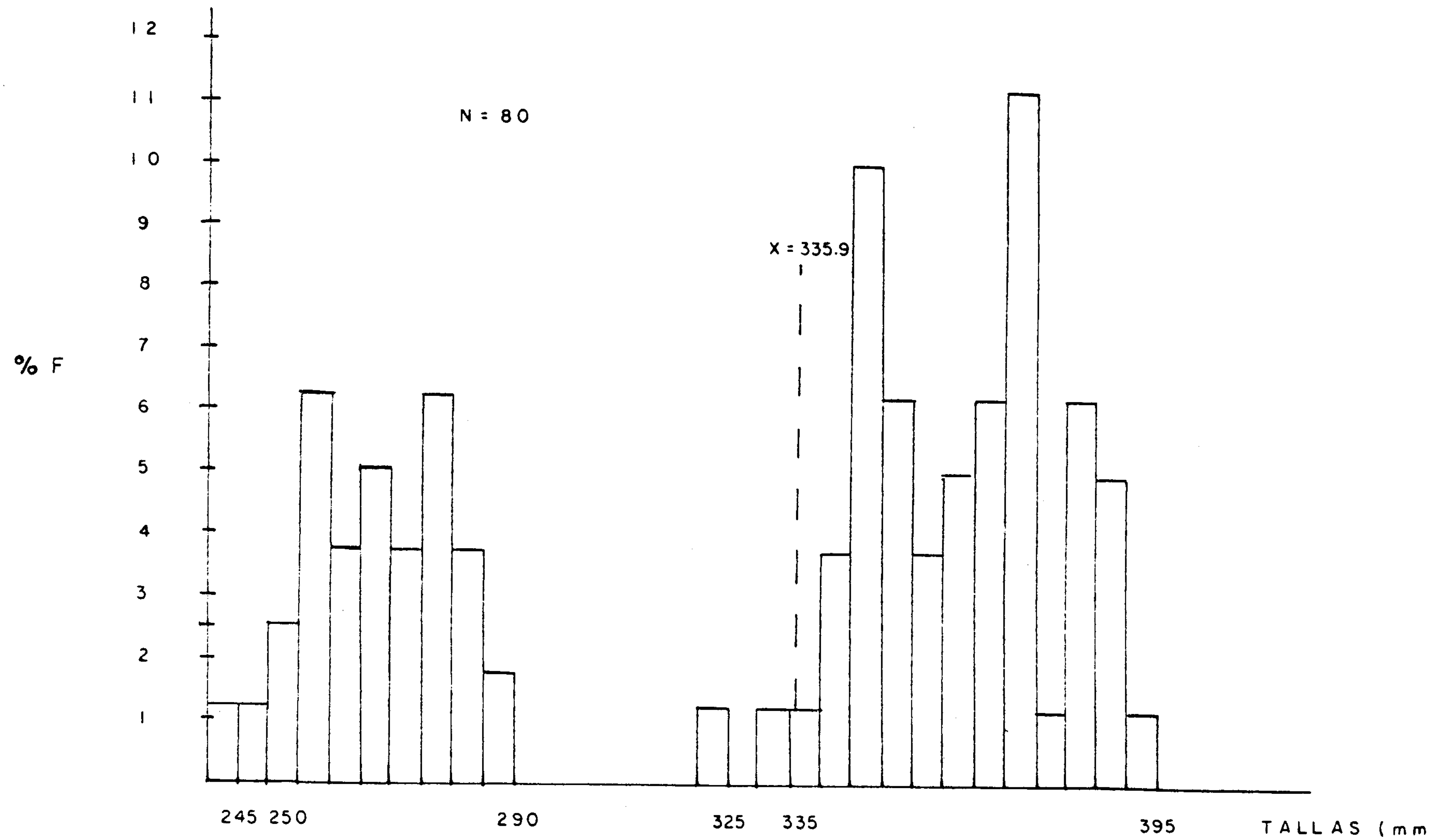

FIG. Nº 5 . % DE LA FRECUENCIA DE TALLAS DE <u>MUGIL CEPHALUS</u> . CAPTURA TOTAL REALIZADA CON RED AGALLERA .

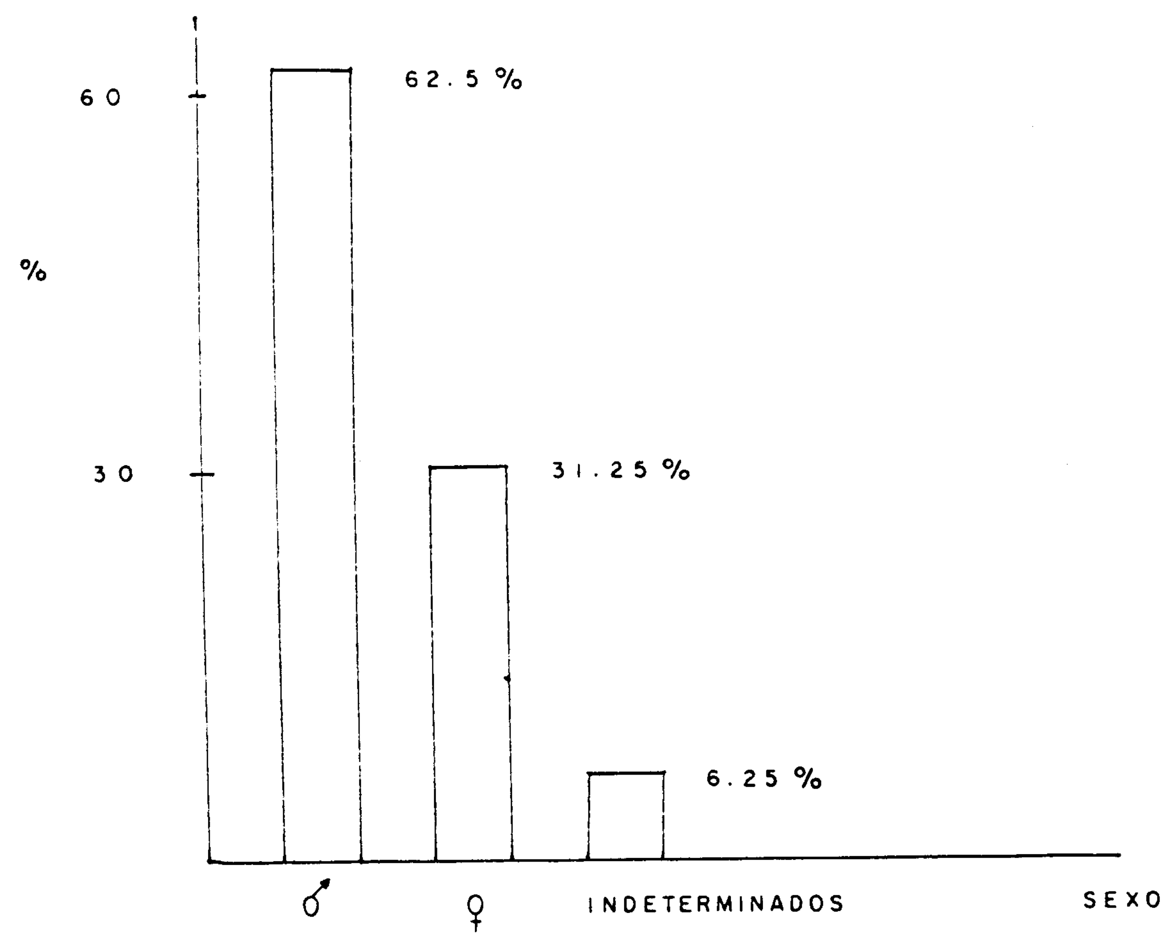

FIG. Nº 6. % DE LA DISTRIBUCION DE SEXOS DE MUGIL CEPHALUS, CAPTURADA CON RED AGALLERA. TOTAL DE LA CAPTURA DE LAS ESTACIONES A, B, C, D, Y E.

PROYECTO DE INVESTIGACION

ANALISIS DE LA COMPOSICION ICTIOFAUNISTICA DEL BAJO RIO COLORADO EN BAJA CALIFORNIA, MEXICO.

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Delegación Federal de Pesca en Baja California.
Ensenada,B.C.

RESUMEN

Hasta la fecha, existen pocos estudios sobre la Ictiofauna del - bajo Rio Colorado en Baja California, México, que nos permite - conocer su composición y algunos otros aspectos de la biología - de las especies.

A partir de la década de los años 30, se inició la construcción de varias presas a lo largo del Río Colorado en los Estados Unidos; y en México se creó el Distrito de Riego N° 14 del Valle - de Mexicali. Estas obras hidraulicas ocasionaron cambios en - las condiciones del cauce del Río, y por consiguiente se modificó el habitat natural de muchas especies Icticas.

Estudios hechos sobre los peces del bajo Río Colorado, muestran que ha existido un incremento en el número de especies exóticas introducidas con respecto al registro elaborado por Gilbert y - Scofield en 1898 (Snyder, 1915; Everman, 1916; Dill 1944; Follet, 1961; Johnson, 1978; Compeán, et. at. 1981).

Con basé a lo anterior, los objetivos que se pretenden lograr - son:

- Realizar un inventario de especies de la Ictiofauna del Bajo Río Colorado, en Baja California.
- Realizar una compración Ictiofaunatica en diferentes estaciones de muestreo en base a la variación que presenten las comunidades a lo largo del Río Colorado.
- Contribuír con algunos datos biológicos al conocimiento de las especies de peces del bajo Río Colorado.

ABSTRACT.

Until now, theres only a few published articles related to the - fishes of the Lower Colorado River, of Baja California, México, - that could give us a general idea as to it's composition or that of other basic biological aspects.

In the beginning of the 1930's, the U.S. Fed. Goverment, started in the Colorado River, the construction of several dams that - eventualy have affected the natural habitat of many organisms and in particular of the fish communities.

With respect to the estudies of Gilbert and Scofield (1898), - recent studies on such communities and especially, on the lower - parts of the Colorado, indicate the presence and increase of - exotic species.

The study objectives are:

1.- Make an inventory of species in comprising the Ichthyofauna of the Lower Colorado in Baja California.

2.- Make an Ichthyofauna comparison at different sampling stations, basing them fish communities variation along the Lower Colorado.

3.- Contribute, by way of various biological data, to better - Knowledge of fishes of the Lower Colorado River.

Sexual Dimorphism in Utah Chubs (*Gila atraria*)

by

Arcadio Valdez-Gonzalez and Rex C. Herron

Sexual dimorphism in Utah chubs (*Gila atraria*) was investigated to determine if reliable characteristics could be identified that would enable fishery managers and culturists to sex fish easily and rapidly under field or laboratory conditions during any season regardless of temporary morphological differences during spawning periods. Twenty external characteristics of 61 Utah chubs (32 females and 29 males) were measured, either as length, width, or depth, and expressed as percent of standard length. Means were calculated for each variable and a T-test was used to compare differences in means for male versus female fish. All variables measured were significantly different (alpha = 0.05) between male and female chubs except for diameter of eye, distance from tip of snout to pelvic fins, width of base of pelvic fins, length of head, and length of opercular slit.

A linear regression was calculated for each variable as a function of standard length. All variables were highly correlated with standard length with r^2 values ranging from 0.916 to 0.997 for females and from 0.876 to 0.998 for males. Discriminant function analyses performed on the chub data discriminated fish by sex with minor overlap occurring when only one variable was used, but completely separated fish by sex when two or more variables were used in the analyses.

Differences in most external characteristics between sexes of Utah chubs were significant and measurable. The most obvious differences that could be discerned with a cursory examination were the length of the pelvic fins and the width of the bases of pectoral fins versus width of the bases of pelvic fins. Generally, the pelvic fins of male Utah chubs overlapped the anus, whereas, pelvic fins of females did not, and the bases of the pectoral fins were wider in males than in females. There was no significant difference between width of pelvic fin bases in males and females.

The investigators correctly identified the sex of 95% of 123 Utah chubs with only a superficial examination. This method of sex determination seems to be rapid and reliable.

Dimorfismo sexual en la sardina gorda de Utah
"The Utah chub" Gila atraria (Girard).

Arcadio Valdes-Gonzalez, y Rex C. Herron

Se analizó el dimorfismo sexual en Gila atraria para determinar la presencia de alguna caracteristica confiable que pudiera ser utilizada para identificar el sexo de ésta especie, en condiciones de campo o de laboratoria durante cualquier estación del año independientemente de las diferencias morfologicas temporales relacionadas a la epoca de reproducción. Veinte características corporales externas de 61 peces (32 hembras y 29 machos) fueron analizadas; medidas tales como longitud, anchura y profundidad del cuerpo, y expresadas como porcentaje de la longitud estandard. Se calculó la media estadistica para cada una de las variables y se examinaron mediante un análisis-T para comprobar las diferencias entre machos y hembras de la especie. Todas las variables observadas fueron estadísticamente diferentes (Alfa = 0.05) a excepcion de: diámetro ocular, distancia prepelvica, base de las aletas pelvicas, longitud de la cabeza, y la longitud de la abertura opercular.

Se calculó la regresion linear para cada una de las variables en funcion de la longitud estandard. Todas las variables mostraron una correlacion excelente en relación con la longitud estandard, y los valores de r^2 mostraron un rango de 0.916-0.977 en las hembras y de 0.876-0.998 en los machos. El analisis de funcion discriminativa segregó los sexos con una excepción cuando una sola característica se tomó en cuenta, mientras que el mismo análisis segrego perfectamente los sexos de esta especie cuando dos o mas características se analizaron.

Diferencias entre los sexos de esta especie en la mayoria de las caracteristicas observadas son medibles y altamente significativas. Las diferencias más obvias que se pueden distinguir en un análisis cursorio son: la longitud de las aletas pélvicas, y la amplitud de la base de las aletas pectorales comparadas con la amplitud de la base de las aletas pélvicas. En general las aletas pélvicas de los machos alcanza o sobrepasan la region anal, en tanto que esto no sucede en las hembras; y la base de las aletas pectorales son mayores en los machos que en las hembras. No hubo diferencia significativa entre la amplitud de la base de las aletas pélvicas entre machos y hembras.

Los autores correctamente identificaron el sexo de 95% de 123 sardinas gordas de Utah, usando unicamente observacion directa. Este método para determinar el sexo en ésta especie es directo, rapido y confiable.

LIVESTOCK AND RIPARIAN HABITAT MANAGEMENT - WHY NOT?

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ABSTRACT

Since the introduction of livestock into the western ecosystems, the once abundant riparian habitat and herbaceous forage have continued to deteriorate. After a hundred years, livestock mismanagement still appears to be the rule rather than the exception. On many grazing allotments, it continues to be a livestock and livestock mismanagment or a livestock or riparian habitat management choice with riparian habitat and its associated wildlife species the losers. There are solutions to the problem that may permit resource managers the opportunity to add the option of livestock and riparian habitat management.

INTRODUCTION

When livestock was first introduced to the Southwest by Coronado in 1540 (Wagoner, 1952), little did he know that this was the first of many domestic animals that later would be overstocked and mismanaged on the western rangelands. This lack of proper livestock management has led to significant reductions in range productivity and has had adverse impacts on wildlife and wildlife habitat including the productive and once abundant riparian habitat.

The problem caused by livestock mismanagement was identified a century ago, but still continues today as the predominant condition. The question in the title, "Livestock and Riparian Habitat Management - Why Not?" implies that this does not have to be the case.

LIVESTOCK AND LIVESTOCK MISMANAGEMENT

It is amazing that in our world of scientific enlightenment, the problems of livestock overstocking and mismanagement and habitat destruction continue. These conditions persist although volumes of data are available that describe the range and riparian habitat resources of the past, the unacceptable conditions of the present, and solutions for improving the situation.

Some view range mismanagement with a "business as usual" attitude hoping that the problem will eventually disappear or correct itself. It is important that resource managers stay atuned to the problem and remain aware of the past if there is to be hope for proper resource management for the future. This can be done by reviewing available data describing past resource conditions and conparing it with the present conditions.

Rusby (1889) described the area in Northern Arizona stating, "Everywhere through the forest we encountered beautiful open parks from a few acres to several square miles in area. Here the grasses are taller, often nearly two yards high and of different species."

Over eighty years ago, Griffiths (1901) wrote:

> "The free range system has led to the ruthless destruction of the native grasses which once covered the magnificent pasture lands of the west, and the time has now come when active measures need to be adopted to remedy the evils that have resulted from overstocking and mismanagement. It is evident that laws for the proper control and preservation of the ranges are not only essential to the stock interests, but also to the general welfare of the country."

Griffiths documented reports made in December 1900 by ranchers, H.C. Hooker proprietor of the Sierra Bonito Ranch, and C.H. Bayless of Oracle, Arizona.

H. C. Hooker described the range condition of the San Pedro Valley in 1870 as having an abundance of willow, cottonwood, sycamore, and mesquite timber with large beds of saccaton and grama grasses. The river bed was shallow and grassy with its banks beautiful with luxuriant growth of vegetation. In December of 1900 he said that the river had cut 10 to 40 feet below its banks with its trees and underbrush gone, and the mesas grazed by thousands of horses and cattle.

C. H. Bayless described the same valley as very fertile lands with beaver dams which checked the flow of water. Trappers exterminated the beavers and less grass on the hillside permitted greater erosion until within four or five years, channels depths to 20 feet were cut almost the entire length of the river. "The valley is a sandy waste from bluff to bluff and so little remains of the rich grama grasses that no account could be taken of them. The very roots were trampled out by the hungry herds that constantly wandered to and fro in search of enough food." "Vegetation does not thrive as it once did, not because of drought, but because the seed is gone, the roots are gone, the soil is gone. Object lessons of this kind will prove conclusively that overstocking not drought, has made our country a desert."

In 1926, Fred Cruxon[1] described the range on the Tonto National Forest by interviewing the original settlers still living on the land.

> Florance A. Packard, probably the oldest living man to settle in Tonto Basin, came from California to the Salt River Valley in 1874, where he was told of the Greenback Valley by an army officer. He came to Greenback, liked it and settled there in 1875. He came as a professional lion

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[1]Presented by Senior Forest Ranger, Fred W. Croxen, at the Tonto Grazing Conference in Phoenix, Arizona, November 4 - 5, 1926. On file at Supervisor's Office. Memeographed report, 11 pages.

hunter, for the territory paid a bounty of $20.00 at that time, and was a keen observer. He told of Blackfoot and Crowfoot Grama grass that touched one's stirrups when riding through it, where no grama grass grows at present. The Pine Bunch grass grew all over the Sierra Anchas in the pine type and lower down than the pine timber on the north slopes. There were perennial grasses on the mesas along Tonto Creek where only brush grows at the present time. Mr. Packard says that Tonto Creek was timbered with the local creek bottom type of timber from bluff to bluff, the water seeped rather than flowed down through a series of sloughs and fish over a foot in length could be caught with little trouble. Today, this same creek bottom is little more than a gravel bar from bluff to bluff. Most of the old trees are gone, some have been cut for fuel, many others cut down for the cattle during drouths and the winters when the feed was scarce on the range, and many have been washed away during the floods that have rushed down this stream nearly every year since the range started to deplete. The same condition applies to practically every stream of any size on the Tonto. The first real flood to come down the Tonto Creek was in 1891 after it had rained steadily for twelve days and nights. At this time the country was fully stocked, the ground had been trampled hard, much of the grass was short, or gone, gullies had started and the water came rushing down. This flood took a good deal of the agricultural land from the ranches along the creek and was so high that it filled the gorge where it entered Salt river at the present site of the Roosevelt Dam and backed a house up Salt River about a mile.

E. M. (Chub) Watkins, whose father, Captain W. C. Watkins, settled on Tonto Creek in 1882 at what is now known as the H4 Ranch, tells about the same story of early conditions as Mr. Packard. He says Curley Mesquite grass covered the foothills but did not extend to so low an elevation as at present, these lower elevations having been covered by grama and other grasses now gone. His people came from Indian Territory and brought the finest horses that ever came to this part of the state, if not the entire state, owned a bunch of greyhounds as well, and used to run jack rabbits all over the mesas along Tonto Creek from the box to the mouth. There were no washes at all in those days, where at present arroyos many feet deep are found and at places cannot be crossed.

Cliff C. Griffin, the present owner of the 76 Quarter Circle Ranch on Tonto at the mouth of the Wild Rye Creek, came to Salt River and settled in 1884 on some of the part now covered by the Roosevelt Reservoir. He says the principle grass was Black Grama and a species of Sage. The Black Grama used to cover the slopes on each side of the river. In those days this came up in bunches, approximately five inches at the base, grew to a height of two to two and one-half feet with a sheaf-like spread of two to two and one-half feet. This was very nutritious, making the finest kind of feed for cattle. He says in early days, the settlers used to chop this grass for hay, using heavy hoes for chopping and with a hoe, rake and fork he could fill a wagon in two hours with this grass.

Volumes of data are replete with descriptions of the resources and the conditions that were. The indicated resource abuse is so drastic and dramatic that some find it difficult to comprehend. But data supporting past and continuing livestock mismanagement is not limited to the turn of the century.

A comparison made of three relict (ungrazed) areas with adjacent grazed sites on the Kaibab and Tonto National Forests indicated that the ungrazed sites had a significantly greater species composition and forage production though the soils were shallow. Forage production on the ungrazed areas was 15 times greater and the species composition of cool season grasses was 31%, 60% and 34% on the Winters, Devil Dog Winter, and Tule Grazing Allotments versus 2%, 1%, and 24% on the grazed portions of the same allotments (Table 1).[2]

Table 1. Comparison of three relict areas and adjacent grazed sites on the Kaibab and Tonto National Forests.

	GRAZING ALLOTMENT					
	Winters		Devil Dog Winter		Tule	
	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed	Grazed
Condition Class	Good	Poor	Good	V.Poor	Fair	Poor
Forage/Acre (lbs)	860	75	1200	50	500	50
Bare Ground (%)	13	52	8	65	7	
No. Species	24	8	19	10	17	10
Cool Season Grasses (%)	31	2	60	1	34	24
Decreasers (%)	72	12	65	3	59	9

The same or similar species of grasses were present on the Winters and Devil Dog Winter relict areas, although these areas were approximately 160 air-miles apart. Many of the same plant species were absent from the grazed areas of the allotments although they were separated by great distances and had been subjected to different administrative influences.

Glimpses of the past range resources represented by grasses in the ungrazed areas helps to develop a sensitivity for what was, and should be.

[2]Davis, J.W., 1981, Southwest Habitater Volume 2 Number 2, USFS, Albuquerque, New Mexico.

The same grazing influences that have altered the herbaceous forage have altered the riparian habitat as well. In most cases, this deterioration has not been rapid or dramatically obvious. It happened one bite at a time until the reproduction was gone and the mature trees died or were washed away by the resulting floods. Without reproduction, the riparian habitat that once was is no longer in a productive desireable condition.

LIVESTOCK OR RIPARIAN HABITAT MANAGEMENT

Although the problems of riparian habitat decline has been recognized for a century, not enough has been done to insure its restoration and continued existance in a healthy self perpetuating condition.

Many managers recognizing the problem and desiring to implement a solution have met with frustration. Pressure from livestock interests, the instability and illogics of politics, and constraints on personnel, funds, and travel have acted to discourage, reduce, or negate proper resource management efforts.

In an effort to do something under these circumstances, the logical solution was to exclude livestock from the areas to be protected and restored. Protective fencing has been commonly used to provide the desired control. This leads to a choice of livestock <u>or</u> riparian habitat. Fencing is relatively successful and has been used to protect natural and transplanted regeneration along streams and around springs and seeps. Such token efforts, however, are expensive to construct and maintain. Although successful, they must be recognized as treating the symptoms rather than the problem. As a result, the problem remains everpresent. When watergaps are washed out or vandals cut the fences, livestock can destroy in a short period of time, the habitat gained over months of protection.

Associated with protective fencing, some sites require drip irrigation to improve seedling survival where down-cutting, water pumping, or other factors have caused inadequate and unpredictable moisture (Davis, 1981). Browse-resistant cottonwood poles have also been planted on grazing allotments that are not under proper stocking and management. This concept was described by Leopold (1924) and is successful even without protective fencing.

Fencing is not the only situation where the option is a choice between livestock or riparin habitat. Livestock non-use, whether for permittee convenience or for resource protection, can provide some of the rest needed to initiate some resource response. When in the elementary stages of resource recovery, and an optimistic objective is to get some regeneration above the reach of livestock, the resource rest provided by non-use may be a start.

When given the choice of livestock or riparian habitat management, riparian habitat management tokenism is the most common but not always the selected alternative by land managers or the public. In some cases, grazing allotments have been and are being closed for resource protection. This is authorized under Regulation 36 C.F.R. 222.4(v)(5) which gives the Chief of the Forest Service the authority to "Cancel or suspend the permit if the permit holder is convicted for failing to comply with Federal laws or regulations or State laws relating to protection of air, water, soil and vegetation; fish and wildlife, and other environmental values when exercising the grazing use authorized by the permit" (USDA 1980). But usually when the resource has deteriorated to the level to justify allotment closure, the resource and everyone involved loses.

The choice of livestock or riparian habitat management can be used to benefit riparian habitat recovery. This may not however, be the most desireable alternative because of construction and maintenance costs, vandalism, and political influences, but should continue to be used when necessary.

LIVESTOCK AND RIPARIAN HABITAT MANAGEMENT - WHY NOT?

The question asked in the title of this paper could be conceived from two different aspects.

The first implies the question, why can't livestock and riparian habitat be managed simultaneously under a management system? This contrasts the prevalent condition of livestock and livestock mismanagement and the either/or choice of livestock or riparian habitat management.

The Tonto National Forest has 103 grazing allotments totalling almost three million acres. Its resource managers not only recognize that a problem exists, but are taking positive steps to solve the problem.

The situation and condition of each allotment varies, therefore, a multifacited approach has been initiated.

In an effort to protect the resources and restore the riparian habitat, the Tonto National Forest has used protective fencing, resource protection non-use, allotment closure, and proper stocking and management. All of these efforts have been successful to varying degrees in re-establishing riparian habitat regeneration.

On several grazing allotments, a four-pasture rest-rotation system accompanied by proper stocking and management has been successful in establishing cottonwood and willow regereration. This approach provides high-intensity, short duration livestock grazing with each pasture receiving spring-summer rest, back to back, two years out of three.

In 1978, the Sedow Allotment on the Globe Ranger District was placed under this system after the permitted 11,125 animal unit month (AUM's) were reduced to 5,800 AUM's (Davis (1981). When the system was initiated, the Walnut Spring area of the Storm Canyon pasture did not have cottonwood or willow between .1 and 10.2 cm. in diameter. Today after rest and even livestock use, the area supports 650 cottonwoods and 2,275 willows per hectare in this size class (see Table 1).

Table 1. Riparian Habitat Response, Storm Canyon Pasture, Sedow Grazing Allotment, Tonto National Forest.

	Tree/Hectare					
	Cottonwood			Willow		
Tree Diameter Class (cm.)	1978	1980	1982	1978	1980	1982
> 50.0	21	21	21	0	0	0
10.3 - 15.2	24	24	24	66	66	66
5.1 - 10.2	0	138	175	0	220	250
.1 - 5.0	0	537	475	0	1,914	2,025

Other grazing allotments placed under proper stocking and management using a four pasture system have shown encouraging results.

The success of this system depends upon the combination of proper livestock stocking and a management system that incorporates adequate resource rest. All of these aspects are important for success.

At this point in time, I cannot tell you that this system will restore all aspects of the riparian habitat, but it has provided the re-establishment of cottonwood and willow regeneration. This re-establishment provides hope for a productive riparian habitat for the future which has not existed in the past.

The second aspect of the question is asking why aren't we as professional resource managers doing more to make proper livestock and riparian habitat management a reality? Many riparian habitats have lost, and others are rapidly approaching the loss of their natural seed source and reproductive capability. This is eliminating the hope of a natural, relatively economical restoration.

If all that was necessary for solution implementation was a vote of need or a consensus of opinion from the scientific world, then it would be well on its way to recovery. This, however, will not solve the problem and the riparian habitat continues to decline at an alarming rate. To permit the perpetuation of such conditions is stupid, unethical, and illegal.

Resource managers must redevelop and sensitize their resource ethic. When resource managers lose their enthusiasm for the proper management of the resource and fail to become excited when the resource is being mismanaged, they are worthless to themselves, their profession and the resource.

CONCLUSION

The overgrazing and mismanagement of livestock continues to have adverse impacts on the riparian habitat although solutions to the problem exists.

In the past, resource managers have had the choices of livestock and livestock mismanagement, and livestock or riparian habitat management. The critical element in any solution is livestock control and resource restoration.

The Tonto National Forest has been successful in improving the riparian habitat using protective fencing, resource protection and permittee convenience non-use, allotment closure, planting of cottonwood poles, seedling planting and drip irrigation, and a rest-rotation grazing system. All of these efforts have been successful in improving the riparian habitat.

The use of a four pasture rest-rotation system with proper stocking and mnagement, however, appears to be the most successful for the economic restoration of the riparian habitat as well as other resources values. This provides resource managers an additional choice of livestock and riparian habitat management and should be considered as another means of achieving riparian habitat restoration.

The answer to the question "Livestock and Riparian Habitat Management - Why Not?" could be that you do not want riparian habitat bad enough.

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Evolutionary Genetics of the Chihuahuan Desert Species of Gambusia.

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Electrophoresis of 20 proteins was used to examine genetic divergences and genetic structure of the 10 species of Gambusia in the Chihuahuan Desert. Seven of these (G. nobilis, G. geiseri, G. georgei, G. hurtadoi, G. alvarezi, G. longispinis, G. krumbolzi) occur in isolated spring systems and may be considered endangered or theatened due to restricted habitat. Three species (G. affinis, G. marshi, G. senilis) are more wide-ranging river dwellers and occur outside the Chihuahuan Desert as well. The seven spring-dwellers and G. senilis belong to the G. nobilis species group as recognized by some workers. In addition to the Chihuahuan Desert species, two other members of the nobilis group (G. heterochir, G. atrora) and several species of other species groups were examined.

UPGMA cluster analysis based on overall genetic similarity suggests that the nobilis group is polyphyletic. However, one cluster of species (G. senilis, G. alvarezi, G. hurtadoi, G. gaigei) with a center of distribution in the Conchos River area appears monophyletic on the basis of shared alleles not present in any other species. G. marshi, which occurs in Cuatro Cienegas, shows genetic affinity with a group of species (G. panuco, G. atrora, G. vittata) centered to the south in Gulf Coast rivers of Mexico. G. affinis and all spring-dwellers from the Rio Grande and northward form a third cluster. G. longispinis shows high genetic divergence from all species, possibly as a result of a long history of isolation in Cuatro Cienegas. Data presented here show that genetic divergence between G. gaigei, G. alvarezi, and G. hurtadoi, and between the four isolated populations of G. nobilis is comparable to that expected of different populationc ff a single species. G. alvarezi and G. senilis occur together and show evidence of reproductive isolation. Genetic divergences between G. geiseri populations are consistent with the hypothesis that this species recently was introduced into the Chihuahuan Desert from a parent population on the east side of the Edwards Plateau.

Comparación genética evolucionaria de especies
del genero *Gambusia* del Desierto Chihuahuense

Se utilizarón electroforesis de 20 proteinas para comparar la divergencia y estructura genética de 10 species de *Gambusia* del Desierto Chihuahuense. Siete especies (*G. nobilis*, *G. geiseri*, *G. gaigei*, *G. hurtadoi*, *G. alvarezi*, *G. longispinis*, *G. krumbolzi*) ocurren en fuentes de aguas aislados y son considerados amenazados porque sus medios son tan restringidos. Tres especies que son habitantes de rios y con distribuciones mas extensivas ocurren afuera del Desierto Chihuahuense. Algunas investigadores incluyen las siete especies de fuentes y *G. senilis* en el grupo de especies representado por *G. nobilis*. Ademas de las especies del Desierto Chihuahuense, se examinarón dos otros miembros del grupo *nobilis* (*G. heterochir* and *G. atrora*) y varios especies de otros grupos de especies.

Similaridad total del racimo UPGMA indica que el grupo *nobilis* es polifiletico. Sin embargo, un grupo de especies (*G. senilis*, *G. alvarezi*, *G. hurtadoi*, *G. gaigei*,) con su centro de distribución en el Rio Conchos aparentemente es monofiletico basado en alleles no presentes en otras especies. *G. marshi*, que ocurre en Cuatro Cienegas, muestra afinidad genética con el grupo de especies (*G. panuco*, *G. atrora*, *G. vittata*) centrado al sur en rios que desembocan en el Golfo de Mexico. *G. affinis* y todos los habitantes de fuentes del Rio Bravo del Norte y mas al norte forman un tercero racimo. *G. longispinis* muestra mucha divergencia genética de todas especies, posiblemente como resultado de una historia larga de aislamiento en Cuatro Cienegas. Los datos indican que divergencia genética entre *G. gaigei*, *G. alvarezi*, y *G. hurtadoi* y entre los cuatro poblaciones aislados de *G. nobilis* es comparable con la divergencia genetica esperado de poblaciones distintas de una sola especie. *G. alvarezi* y *G. senilis* ocurren juntos y muestran evidencia de aislación reproductiva. Divergencia genética entre poblaciones de *G. geiseri* es consistente con el hipótesis que esta especie fue recien introducida al Desierto Chihuahuense desde una población del lado este del Edwards Plateau en Texas.

STATUS OF THE FISHES OF THE RIO SONOYTA BASIN, ARIZONA AND SONORA, MEXICO

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ABSTRACT

Two native (Cyprinodon macularius and Agosia chrysogaster) and two exotic (Gambusia affinis and Poeciliopsis occidentalis) fishes occur in the Rio Sonoyta drainage basin. All four species co-occur in the (Mexican) Rio Sonoyta, but in Quitobaquito Springs only Cyprinodon is present. The population of the desert pupfish from the (Mexican) Rio Sonoyta and that from Quitobaquito Springs appear to be two distinct subspecies of C. macularius.

Groundwater depletion, pesticide use, and the spread of exotic fish seriously threaten the survival of the native fishes in the basin. Pesticides have been detected in pupfish from Quitobaquito. We have observed a drastic decline in the pupfish population in the Rio Sonoyta within the last six months. Gambusia numbers increased markedly during this same period and their increase is thought to be the cause of the decline of the pupfish. A detailed survey of the basin to locate surviving populations of pupfish and to locate and establish suitable refuge sites is needed to insure the continued survival of the native fishes of the Rio Sonoyta.

RESUMEN

Dos especies indígenas de peces (Cyprinodon macularius y Agosia chrysogaster), y dos introducidas (Gambusia affinis y Poeciliopsis occidentalis) habitan la cuenca del Río Sonoyta. Los cuatro especies coexisten en la porcíon mexicana del Río Sonoyta pero en los manantiales de Quitobaquito, Arizona, solamente se encuentra Cyprinodon. Las poblaciones de C. macularius del Río Sonoyta y las de Quitobaquito aparentemente pertenecen a subespecies distintas.

La disminución del nivel freâtico, el uso de pesticidas, y la dispersión de peces introducidos amenazan un seriamente la sobreviviencia de las especies indígenas en la cuenca. Se ha detectado la presencia de pesticidas en especimenes de C. macularius procedentes de Quitobaquito. También se ha observado un drástica reducción en la población de C. macularius correlativa con el notable incremento de G. affinis durante los ultimos seis meses, y es posible que el incremento de G. affinis sea la causa de la merma en la población de C. macularius. La sobreviviencia de las especies de peces nativos del Río Sonoyta depende del reconocimiento de la cuenca del Río Sonoyta para la busqueda y establecimiento de refugios adecuados para las poblaciones de C. macularius.

Agricultural activities and exotic fish have been and continue to be a major factor in the decline and extirpation of desert fishes (Miller 1961; Deacon and Bunnell 1970; Minckley 1973; Black 1980; Smith 1980). This paper concerns the current status of the native fishes inhabiting the Rio Sonoyta basin and the problems accompanying the increasing agricultural development and spread of exotic fish presently occurring in the area. The following account is based on visits to the basin by Miller in 1950, by McMahon in 1976-77 with B. Kynard and by one or both of the authors in May and November 1982.

The Rio Sonoyta drainage basin (Fig. 1) lies along the U.S.-Mexico boundary, draining 3,360 Km^2 in the very arid region of southwestern Arizona and northwestern Sonora (Bryan 1925; Tamayo and West 1964). Climate is of the monsoon type, characterized by torrential summer rains and subsequent river flooding (Ives 1936). Based on fish and physiographic evidence, the Rio Sonoyta is considered to be a disrupted segment of the Colorado River system; its former Pluvial connection with the Colorado was diverted southward to Bahía de San Jorge, Golfo de California, by the great Pleistocene Pinacate lava flows (Ives 1936, 1964; Hubbs and Miller 1948). The Rio Sonoyta is an interrupted desert stream with only short stretches of permanent surface water (Bryan 1925). Based on observations or maps by Hornaday (1908), Lumholtz (1912), Bryan (1925), Ives (1936), and us, segments of permanent surface water occur from several kilometers east of the town of Sonoyta, Sonora, to the Agua Dulce-Aqua Salada area, 32-40 km west of Sonoyta and east of the Pinacates (Fig. 1). Water is reported to occur in stream channels in the upper basin above Sonoyta only during rainy periods (Bryan 1925); however this region is largely unexplored and some permanent water may exist there. Water flow south of Agua Salada and connection with the Gulf has only been observed in recent times during periods of heavy flooding (Hornaday 1908; Lumholtz 1912; Ives 1936).

Aquatic habitats in permanent sections of the Rio Sonoyta consist chiefly of slow, shallow runs coursing through wide sandy arroyos (Ives 1936: Fig. 1; pers. obser.). At one segment we visited south of Quitobaquito Springs (Station A, Fig. 1), the stream channel is narrower, the current swifter and the stream bordered by dense stands of salt cedar (*Tamarix chinensis*) and cattails (*Typha angustifolia*). In the town of Sonoyta at the bridge crossing over the stream, the stream was a murky green, of an unknown depth, and what appeared to be mosquitofish (*Gambusia affinis*) were observed swimming at the surface. At least up until 1950, this segment of the river supported pupfish and longfin dace (Miller, pers. obser.).

The only other natural existing water source in the Rio Sonoyta drainage containing fish is Quitobaquito Springs, located in Organ Pipe Cactus National Monument just within the U.S. border and 18.5 km west of Sonoyta (Bryan 1925; Cole and Whiteside 1965). Quitobaquito is the result of two warm springs emerging from a granite outcrop and draining into a marshy area that has been impounded and dredged to form a pond (see Status Section). Based on temperature, chemistry, geology and elevation of the springs, Bryan (1925) concluded that water from the springs originates primarily from a deep fissure within the earth's crust rather than from groundwater in the

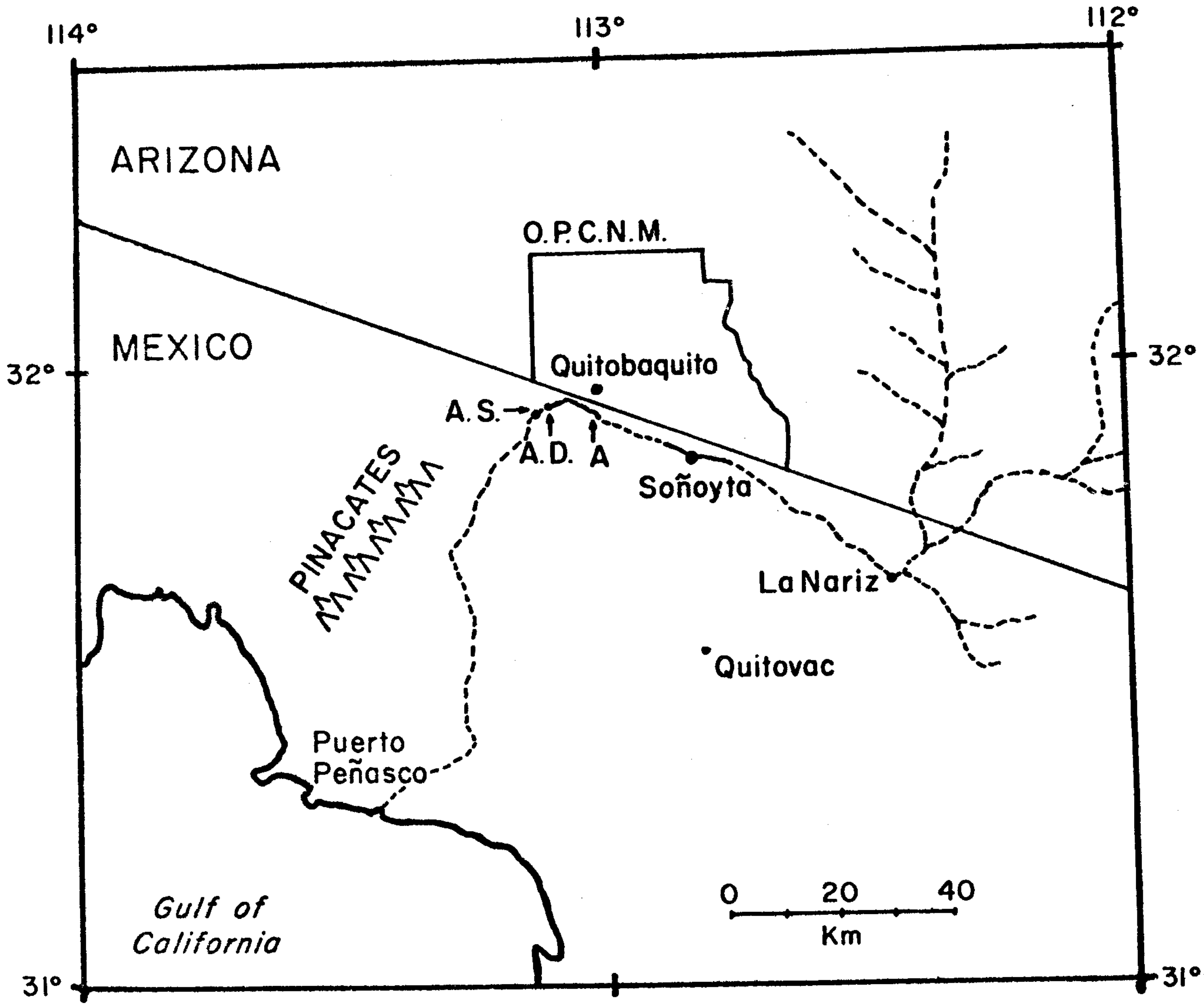

Figure 1. Rio Sonoyta drainage basin.
Solid lines indicate presence of permanent water.
Abbreviations: A = Station A, site of sampling in May and November 1982.
AD = Agua Dulce
AS = Agua Salada

Sonoyta Valley. Quitobaquito, 30 m higher and 1.5 km north of the Rio Sonoyta, presently has no connection with that stream. Lumholtz (1912:199) and Ives (1936:351) inferred that a connection between the two may have existed as recently as the turn of the century but the topography of the area and the degree of differentiation of the desert pupfish in the two locations suggests a longer separation.

Fishes of the Rio Sonoyta Basin

Two fish species are native to the Rio Sonoyta basin, the longfin dace, *Agosia chrysogaster*, and the desert pupfish, *Cyprinodon macularius* (Snyder 1915; Miller 1943; Hubbs and Miller 1948). *Agosia* and *Cyprinodon* co-occur in the (Mexican) Rio Sonoyta, but in Quitobaquito only *Cyprinodon* is present (Lumholtz 1912; Huey 1942; Minckley 1973).

The taxonomic relationships of the pupfish inhabiting the disjunct Rio Sonoyta drainage have not as yet been completely established. Based on meristic and morphological differences in pupfish collected from the (Mexican) Rio Sonoyta as compared to *C. macularius* populations from other areas, Miller (1943) and Hubbs and Miller (1948) recognized this long-isolated population as a distinct (but un-named) subspecies. *C. macularius* from Quitobaquito has long been thought to represent the same undescribed subspecies as that inhabiting the Rio Sonoyta (e.g., Cole and Whiteside 1965; Minckley 1973), but Miller (unpub. data) has found surprising differences between the Quitobaquito and Rio Sonoyta populations on the order of magnitude that have been employed to separate pupfish taxa below the species level. Furthermore, recent electrophoretic studies have revealed fixed allelic differences between the Quitobaquito pupfish and those from the Salton Sea area sufficient to support the proposal that the Quitobaquito pupfish deserves recognition at the subspecific level (Turner in press). Electrophoretic studies of the (Mexican) Rio Sonoyta pupfish are currently planned by Bruce Turner (Virginia Polytechnic Institute and State University). This will be coupled with a comprehensive morphological and meristic analysis of populations of *Cyprinodon macularius* in Arizona, Mexico, and California, by Miller and W.L. Minckley, to establish the relationship of the Rio Sonoyta and Quitobaquito populations as well as their relationship with populations of the species in other desert areas. At present, it appears that pupfish from the (Mexican) Rio Sonoyta and from Quitobaquito represent two distinct subspecies of *C. macularius*.

Two additional fish species now occur in the (Mexican) Rio Sonoyta — mosquitofish and Gila topminnow, *Poeciliopsis occidentalis*. These two species were first collected in the stream at Agua Salada by Larry May (1979) in the 1970's. Our recent surveys indicate that mosquitofish have now become abundant, but no Gila topminnows were collected (sample deposited at Museum of Zoology, University of Michigan). Gila topminnow were once common in the adjoining Gila River drainage (Minckley 1973), but it is probably not native to the Rio Sonoyta. It was absent from the several previous collections in the Rio Sonoyta made throughout the 1900's, including those at Agua Salada in the 1930's (collections listed in Miller 1943; Miller 1950 unpub. data). Also, this species has been stocked elsewhere as an exotic (Miller 1961:393).

Present Status of Native Fishes

Water from the Rio Sonoyta has been used for many years to irrigate crops in the valley (Hornaday 1908; Lumholtz 1912). However, agricultural activities in Mexico have greatly expanded since the 1970's as part of a government-sponsored land settlement program. Large tracts of land have been cleared and groundwater pumps installed on ejidos (cooperative farms) throughout the Sonoyta Valley (T.J. Cox, 4 Dec. 1975 letter to Miller; Anonymous 1978; L. May, National Park Service, Washington, D.C., pers. comm. to McMahon). The magnitude of groundwater pumping in the Sonoyta Valley is unknown. The National Park Service (NPS), through contract to the U.S. Geological Survey, has begun a program to monitor groundwater levels in wells in Organ Pipe Cactus National Monument (B. Werrell NPS hydrologist, San Francisco). Deep alluvial groundwater exists in large quantities in the Sonoyta Valley (Harshberger and Associates 1979) but information on the extent and recharge characteristics of the aquifer is insufficient to predict the effects pumping will have on the availability of water in the Rio Sonoyta or its effects on Quitobaquito Springs (B. Werrell, pers. comm.).

Although the present extent of groundwater depletion is uncertain, observations we have made in the last six months indicate that some dewatering of the Rio Sonoyta may have already occurred. For example, water and native fishes were present in the stream near Ejido Santo Domingo in 1975-1977 (Cox 1975, op. cit.; McMahon, pers. observ., 1976-1977), but wells and groundwater pumps have been installed in this same area and the stream is now dry and appears to have been dry for some time. Based on these observations and on the amount of land cleared for agriculture, continuing and increasing use of groundwater for crop irrigation and subsequent habitat loss is evident, and the potential for extirpation of the native fish fauna is very high. A more imminent threat, however, appears to be the spread of the exotic mosquitofish. At Station A last May, pupfish and dace were common and mosquitofish were present in shaded side-pools. On 2 November 1982, dace were still common but mosquitofish numbers had skyrocketed, no pupfish were observed and only one was collected in two hours of seining along a .5 km section of stream (temperature 22° C). Previous studies have shown rapid replacement of desert pupfish and other native fishes by mosquitofish (Miller 1961; Myers 1965; Schoenherr 1981), and it appears likely that this is the cause for the rapid decline of the pupfish in the Rio Sonoyta.

Quitobaquito Springs has a long history of man-induced impacts. As one of the few reliable water sources for thousands of square kilometers of desert, the springs have been impounded for use in farming and ranching for hundreds of years (Lumholtz 1912; Bryan 1925). Prior to the 1960's Quitobaquito consisted of a spring-fed marshy pond with water depths < 26 cm and contained an abundant population of pupfish (Miller 1950, pers. obser.). In 1962, the marsh was drained and excavated and pipes were installed to carry water from the springs to the impoundment (Cole and Whiteside 1965; Cox 1966). Quitobaquito is now a .22 ha steep-sided pond with a mostly uniform depth of 1 to 1.5 m. *Scirpus* forms a thick margin surrounding the pond and dense beds of *Potamogeton* and *Chara* cover most of the bottom (Cole and Whiteside 1965). Dredging Quitobaquito reduced the amount of suitable habitat available to the pupfish by removing a substantial portion of shallow, open spawning habitat, but the population still numbers several thousand (Kynard and Garrett 1979). Quitobaquito received additional impacts in the late 1960's by the introduction and subsequent eradication of the exotic golden shiner, Notemigonus crysoleucas (Minckley 1973). Present-day groundwater pumping and the drift of pesticide spray from nearby agricultural fields are considered a threat to the survival of the pupfish and to the unique and critical ecosystem values of Quitobaquito. As a result, the Park Service has initiated a program of monitoring water quality, flow rates, pupfish population size, and pesticide levels at Quitobaquito (Anonymous 1977). No noticeable decline in the flow rate of the springs or in the pupfish population has been observed as yet, but 2 ppb of an organophosphate pesticide have been detected in the tissues of the pupfish (P. Bennett, Cooperative National Park Studies Unit, Tucson, pers. comm). Several small refugia have been established for Quitobaquito pupfish in the Monument (R. Hall, former Resource Manager, Organ Pipe Cactus National Monument, pers. comm.) and elsewhere in Arizona (Minckley 1973; Kynard 1979) as insurance against their extirpation in Quitobaquito.

DISCUSSION

The Rio Sonoyta and Quitobaquito Springs are among the very few localities where the once wide-ranging but now endangered desert pupfish still persists (Miller 1979). Information presented in this report provides additional documentation in support of Desert Fishes Council Resolution 79-8 (1979 Desert Fishes Council Proceedings 11:137) urging the U.S. Fish and Wildlife Service to officially designate the desert pupfish as an endangered species in the United States and Mexico. The pupfish and aquatic habitat in the Rio Sonoyta are declining and the potential is high for extirpation of the native fish fauna in the near future from a combination of replacement by mosquitofish, habitat loss from groundwater depletion, and pesticide usage. While the survival of the Quitobaquito pupfish may also be threatend by agricultural practices in the Sonoyta Valley, at the present time its status appears more secure. Unlike the pupfish and dace populations from the Rio Sonoyta, refugia populations have been established for the Quitobaquito pupfish and a program established by the Park Service is monitoring the effects of agricultural activities on the pupfish and their habitat at Quitobaquito. Further study of the hydrology of the springs and adjacent lands is needed to determine if the water source for the springs at Quitobaquito is indeed independent of groundwater in the adjoining Sonoyta Valley as suggested by Bryan (1925) and by Anderson and Laney (1978).

We are not optimistic about the continued survival of pupfish and dace in the (Mexican) Rio Sonoyta if groundwater pumping and the spread of mosquitofish continue and increase as present conditions indicate. To assure the perpetuation of these native fishes, we recommend that the following steps be taken: (1) initiation of a joint program by the U.S. and Mexico to monitor the status of the fish populations in the Rio Sonoyta; (2) further exploration in Mexico and Arizona of the basin upstream of Sonoyta, Sonora, in an attempt to locate and establish suitable refugia; and (3) if possible, a stock of Rio Sonoyta fishes be secured and maintained at Dexter National Fish Hatchery or other suitable location to serve as a reservoir for continuation and future re-establishment of the species should they be extirpated in Mexico.

ACKNOWLEDGMENTS

We thank P. Bennett, R. Johnson and especially B. Brown, Cooperative National Park Studies Unit, Tucson, for their cooperation and assistance in the preparation of this report. W.W. Dudley and J.A. Camp, U.S. Geological Survey, provided a copy of an administrative report on groundwater by permission of G.S. Witucki, National Park Service. J. Burton, D. Hendrickson, and L. May generously shared their knowledge of the area. S. Holanov and M. Kunzman willingly assisted in the field work. Funds for typing (by E. Ayers) and illustrations were provided by the Arizona Cooperative Fishery Research Unit. Victor Torres and M.L. Smith kindly provided the Spanish translation.

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ADDENDUM

In April 1983 we surveyed the section of the Rio Sonoyta upstream from the town of Sonoyta (Fig. 1) where, to our knowledge, no previous collections had been reported. Permanent surface water extended approximately 1.5 km east from Sonoyta. Habitat in this upper section was of poor quality for dace or pupfish. The water was murky green and the bottom heavily-silted. Much of the surrounding watershed has been cleared for agriculture and a local farmer reported seeing fish kills in the stream after heavy pesticide usage. No pupfish or dace were seen or collected, but mosquitofish were common in sidepools and other areas of slow current. A small reservoir just east of town contained black bullheads (*Ictalurus melas*) and several juveniles were collected downstream near Station A (Fig. 1).

Additional surveys of the Station A area in 1983 suggest that pupfish are still surviving in the Rio Sonoyta but at low numbers. Dace remained abundant and mosquitofish locally common in our April survey, but no pupfish were observed in seining approximately 5 km of the stream, although this section appeared to be ideal pupfish habitat. Pupfish also were absent during visits to the area by P. Bennett and M. Kunzman (National Park Service, Tucson) in May and November, but pupfish were present in low numbers in July. The 1983 surveys further substantiate the need for continued monitoring of the Rio Sonoyta pupfish population and for obtaining a stock for insurance against their extirpation from one of the last streams in which they still survive.

We thank Fernando Lizarraga T., Administrador, Parque Nacional Sierra del Pinacate (Sonoyta, Sonora), for his generous assistance and hospitality.

Area Cladograms for Western North American Fish Faunas
by
Dean A. Hendrickson and W. L. Minckley
Departamento de Zoología, Universidad Estatal de Arizona

Based on a survey of recent geological literature, cladograms depicting historic relationships of present hydrographic basins have been developed. Following principles of vicariance biogeography, if such hypothesized area relationships are valid, phylogenetic analyses of fish relationships in these areas should produce congruent cladograms. Development of fish phylogenies with which to test these geological hypotheses is encouraged. Application of vicariance biogeography theory to freshwater fish relationships and distributions in the area is discussed.

Cladogramos de Areas para Faunas Icticas del Occidente de Norte America
por

Dean A. Hendrickson y W. L. Minckley
Departamento de Zoología
Universidad Estatal de Arizona

Basado en un examen de la literatura geológica reciente, se han desarrollado cladogramos que describen relaciones históricas de cuencas hidrográficas presentes. Segun principios de biogeografía "vicariance" sí tales relaciones hipotéticos son válidos, analise filogenéticos de las relaciones de peces en estos areas producirán cladogramos congruentes. Se espero animar el desarrollo de filogenías para peces con que se puede comprobar estos hipôteses geológicos. Se discuta aplicación de la teoría de biogeografía "vicariance" a la fauna ictica de agua dulce en este area.

Ciénegas - Endangered Habitats of the Southwest

by

W. L. Minckley and Dean A. Hendrickson
Department of Zoology, Arizona State University

Desert stream marshlands (ciénegas) were formely much more numerous and extensive in the desert grasslands of southeastern Arizona, and provided a fish habitat type which is now rapidly disappearing. A survey of historical accounts of the region, supported by U.S. Fish and Wildlife Service, allowed us to document former extent of ciénegas and suggested a longitudinal gradient of marshland communities along major drainages. Ecological factors determining such a cline are hypothesized. The role of ciénegas in determining fish distributions and influencing hydrologic regimes is discussed. A controversy surrounding causation of a century-old cycle of arroyo cutting which led to demise of ciénegas is briefly reviewed and prospects for renovation of these systems discussed.

Ciénegas - Habitatos amenazados en el Suroeste de E. U.

por

W. L. Minckley y Dean A. Hendrickson
Departamento de Zoología, Universidad Estatal de Arizona

Ciénegas eran mucho mas numerosas y extensivas en los pastorales desérticos de Arizona, y proveian un tipo de habitato para peces que se está desapareciendo rapidamente. Un examen de relatos históricos de la región, apoyodo por U. S. Fish and Wildlife Service, nos permitió documentar la extensión histórica de ciénegas y sugerió un gradiente de communidades a lo largo de cauces mayores. Se formulan hipóteses sobre factores ecologicos que determinen tales gradientes. Se discuten el papel de ciénegas en determinar las distribuciones de peces y en influir el régimen hidrológico. Se repasa aspectos de una disputa sobre la causación de un ciclo de erosión que empezó hace un siglo y que resultó en la destrucción de ciénegas. Se discutan perspectivas para la renovación de estas sistemas.

Desert Fishes Council

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

407 West Line Street
Bishop, California 93514
January 11, 1983

RESOLUTION 82-1

IN COMMENDATION OF SENATOR PAUL LAXALT OF NEVADA

WHEREAS the Ash Meadows area of Nye County, Nevada harbors over 20 unique plants and animals, and

WHEREAS four fishes found in Ash Meadows are considered to be endangered by the Government of the United States, and

WHEREAS similar designation is given these fishes by the State of Nevada, and

WHEREAS several plants within Ash Meadows are also considered endangered by the State of Nevada, and

WHEREAS Ash Meadows has been of interest to the Nevada Department of Wildlife as a potential waterfowl refuge for many years, and

WHEREAS the major private landowner in Ash Meadows, Preferred Equities Corp., has indicated an interest in divesting itself of all holdings, and

WHEREAS a land exchange with the Bureau of Land Management has been requested by Preferred Equities Corp., and

WHEREAS it would be in the best interests of the State of Nevada and the United States for this exchange to be consummated at the earliest possible date, and

WHEREAS Senator Paul Laxalt has supported protective measures instituted for Ash Meadows by the Federal Government over the past year and has supported the proposed land exchange, now therefore be it

RESOLVED that the Desert Fishes Council, meeting for its Fourteenth Annual Symposium at Arizona State University, Tempe, does hereby express its appreciation to Senator Laxalt for his active intesest in favorably resolving the problems inherent within Ash Meadows and does urge him to continue his efforts to preserve this invaluable part of Nevada's heritage.

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
January 11, 1983

RESOLUTION 82-2

RELATIVE TO THE PRESERVATION OF ASH MEADOWS, NYE COUNTY, NEVADA,
AND A REQUEST TO FINALIZE THE ENDANGERED LISTING OF TWO ASH MEADOWS FISHES

WHEREAS Ash Meadows is an unique desert oasis with a larger number of endemic plants and animals than any other local area in the United States, and

WHEREAS each of the more than 30 endemic organisms is likely to become extinct because of habitat alterations anticipated during development of Ash Meadows into a recreational, residential, and agricultural community, and

WHEREAS the U.S. Fish and Wildlife Service recognized the consequences of these threats by listing the Ash Meadows pupfish and Ash Meadows speckled dace as endangered by emergency rule on May 10, 1982, and

WHEREAS the emergency protection afforded these fishes by that ruling was scheduled to expire on January 5, 1983, and

WHEREAS the proposed development of Ash Meadows will proceed without any program to conserve these fishes should this listing not be finalized, now therefore be it

RESOLVED that the Desert Fishes Council hereby petitions the U.S. Fish and Wildlife Service to utilize the biological data within their files to finalize the endangered listing of the Ash Meadows pupfish and Ash Meadows speckled dace at the earliest possible date, and be it further

RESOLVED that this resolution be sent to the Secretary of the Interior; the Director of the U.S. Fish and Wildlife Service; the Director of the Nevada Department of Wildlife; Senator Paul Laxalt; and Senator Chick Hecht.

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
January 12, 1983

RESOLUTION 82-3

RELATIVE TO THE ACQUISITION OF ASH MEADOWS,
NYE COUNTY, NEVADA, BY MEANS OF A LAND EXCHANGE

WHEREAS Ash Meadows is an unique desert oasis with a larger number of endemic plants and animals than any other local area in the United States, and

WHEREAS each of the more than 30 endemic organisms is likely to become extinct because of habitat alterations anticipated during development of Ash Meadows into a recreational, residential, and agricultural community by Preferred Equities Corporation, and

WHEREAS Ash Meadows is habitat for four fishes currently listed as endangered by the U.S. Fish and Wildlife Service, with in excess of 20 species of plants and animals being considered for future listing, and

WHEREAS Preferred Equities Corporation has stated its desire to trade its entire holdings in Ash Meadows for public lands located near Las Vegas, Nevada, and

WHEREAS this trade would promote the preservation and conservation of all species endemic to Ash Meadows and do so to the satisfaction of this Council and Preferred Equities Corporation, now therefore be it

RESOLVED that the Desert Fishes Council strongly endorses this exchange and urges the Bureau of Land Management to take immediate action toward this end, and be it further

RESOLVED that this resolution be sent to the Secretary of the Interior; Director, Bureau of Land Management; Nevada State Director, Bureau of Land Management; Director, Nevada Department of Wildlife; Senator Paul Laxalt; Senator Chick Hecht; Representative Barbara Vucanovich; and Representative Harry Reid.

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

January 12, 1983

RESOLUTION 82-4

RELATIVE TO THE CONSTRUCTION OF A NATIONAL FISHERY RESEARCH LABORATORY

WHEREAS introductions of exotic fishes have often had negative impacts on native biota and habitat, and

WHEREAS the fragile aquatic ecosystems of American deserts are particularly susceptible to negative impacts from introduced exotic fishes, and

WHEREAS many native species and subspecies of fishes are already threatened by man and his technology, and

WHEREAS there are presently at least 40 species of exotic fishes, most introduced within the past three decades, reproducing within the open waters of North America, and

WHEREAS the likelihood of future introductions of exotic fishes into open waters is great, and

WHEREAS the Desert Fishes Council is dedicated to the preservation of America's desert fishes, now therefore be it

RESOLVED that the Desert Fishes Council, meeting at its Fourteenth Annual Symposium in Tempe, Arizona on November 18-20, 1982, does hereby urge funding for construction of the National Fishery Research Laboratory, U.S. Fish and Wildlife Service, Gainesville, Florida, a laboratory whose mission would be the study of distribution and impacts of introduced fishes, and the research of exotic fishes proposed for importation for purposeful release or use in aquaculture, to assure maximum protection of native biota and habitat from harmful effects of such fishes, and be it further

RESOLVED that this resolution be forwarded to the Director of the U.S. Fish and Wildlife Service; to the Chairmen of the House and Senate Interior Subcommittees as appropriate, and to the Chairmen of the House and Senate Appropriations Committees.

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
January 11, 1983

The Honorable Richard Bryan, Governor
State of Nevada
Carson City, Nevada 89701

Sir:

The Desert Fishes Council is an organization numbering in excess of 300 persons and comprising a nationwide and international representation of federal, state, and university scientists and resource specialists, members of conservation organizations, and individuals concerned with the long term conservation of natural values throughout the southwestern United States. We are proud to count many Nevadans as members of the Council.

At the Council's Fourteenth Annual Symposium, held on November 18-20, 1982 at Arizona State University, Tempe, the item of greatest concern to be discussed by the assembled membership involved the threat of development destroying the magnificent ecosystem represented by Ash Meadows, Nye County, Nevada.

We greatly appreciate the interest you have shown in Ash Meadows through your efforts in requesting a compilation of information regarding the status and future of the area. We urge you to do all within your power to remove the threat of development from Ash Meadows by endorsing a land exchange within that area. We urge you to make such a suggestion to the Director of the Bureau of Land Management. Such an action would be not only in the best long-term interests of the people of Nevada, but to all citizens of the United States.

Sincerely,

Edwin P. Pister
Executive Secretary
(619) 872-1171

Desert Fishes Council

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

407 West Line Street
Bishop, California 93514
January 11, 1983

Mr. William D. Blair, Jr., President
The Nature Conservancy
1800 Kent Street
Arlington, Virginia 22209

Dear Mr. Blair:

The Desert Fishes Council is an organization numbering in excess of 300 persons and comprising a nationwide and international representation of federal, state, and university scientists and resource specialists, members of conservation organizations, and individuals concerned with long-term environmental values. In 1982, as we met at our Fourteenth Annual Symposium held this year at Arizona State University, Tempe, perhaps the item of greatest concern to be discussed by the membership involved the threat of development destroying the magnificent ecosystem represented by Ash Meadows, Nye County, Nevada. As you are no doubt aware, The Nature Conservancy has been one of our strongest allies in the effort to acquire Ash Meadows.

The purpose of this letter is to express the Council's appreciation for the past involvement of the Conservancy and to encourage your continuing efforts. We consider the acquisition and preservation of Ash Meadows to be a conservation project of the highest national priority.

It now appears that the major private land owner, Preferred Equities, is willing to sell all or part of their Ash Meadows property in the event that a land exchange with B.L.M. is not completed in a timely manner. We feel that this opportunity should be exploited to the fullest by the Conservancy and that any and all such properties made available should be purchased.

We also encourage the continuing efforts of the Conservancy to identify and acquire other private inholdings within Ash Meadows, and we offer our assistance to the best of our ability to achieve this goal.

Sincerely,

Edwin P. Pister
Executive Secretary
(619) 872-1171

Fourteenth Annual Symposium Attendance List

Name	Affiliation	Address
Jim Johnson	USFW	P.O. Box 1306, Albuquerque, NM 87103
Fran Miller	Fish Div, Univ. Michigan	Ann Arbor, MI 48109
Jim Williams	Fish & Wildlife Serv.	Washington, D.C. 20240
Bob Miller	Museum of Zoology, U of Mich	Ann Arbor, MI 48109
Mike Hatch	NM Dept Game & Fish	Santa Fe, NM 87501
Beula Edmiston		814 W. Marklane Dr, Monterey Park, CA
Tasker Edmiston		814 W. Marklane Dr, Monterey Park, CA
Jim Deacon	Biology, UNLV	Las Vegas, NV 89154
Jerry Stefferud	Forest Service	517 Gold Ave. SW, Albuquerque, NM 87102
Sally Stefferud		1109 Calle del Sol, NE, Albuquerque, NM
C.O. Minckley		2820 N 1st St., Flagstaff, AZ
Bill Kepner	BLM	10613 N. 33rd Ave., Phx, AZ 85029
Kauren Kepner	AGFD	10613 N. 33rd Ave., Phx, AZ 85029
K. Bruce Jones	BLM	3523 W. Cinnabar, Phx, AZ 85021
Cheryl Gast		1085 E. Campus Dr, Tempe, AZ 85282
Cheryl Mollohan	AGFD	1245 E. Vine, Mesa, AZ 85204
Peter Bennett	NPS	Box 41058, Tucson, AZ 85717
Marty Jakle	Bureau of Reclamation	632 N. Hobson St., Mesa, AZ 85203
Tom Gatz	USBR	5701 S. Rural Rd, Tempe, AZ 85283
Jim Burton	AGFD	4423 W. Griswold Ave, Glendale, AZ 8530
Arcadio Valdes		1465 W. 200 N, Logan, UT 84321
Salvador Contreras	UANL	Monterrey, NL
Gary Scoppettone	USFWS	4600 Kietzke Ln, Reno, NV
Steve Vigg	Desert Research Inst.	11491 Sitka St, Reno, NV
Jim Cooper	Desert Research Inst.	10054 Hornblende St, Reno, NV
Tom Strekal	Bureau of Reclamation	P.O. Box 640, Carson City, NV 89702
Larry Zuckerman	CSU	Fort Collins, CO 80523
Ron Piette	ASU	2211 N 202nd, Buckeye, AZ 85326
Phil Hines	ASU	1434 W. 5th St, Mesa, AZ 85201
Dave Soltz	CSULA, Biology	Los Angeles, CA 90032
Paul Helden	BIO/West, Inc.	P.O. Box 3226, Logan, UT 84321
John Rinne	USFS	Tempe, AZ 85287
Glenn Clemmer	Fish & Wildlife Serv.	1300 Blue Spruce Dr, Ft. Collins, CO
Jim Warnecke	AZ Game & Fish	6330 E. Main, Mesa, AZ 85205
Paul Turner	NMSU	Box 4901, Las Cruces, NM 88003
Mike Busdosh	Woodward-Clyde	WCC 3489 Kurtz St, San Diego, CA 92110
Rod Rish		532 S. Valencia, Mesa, AZ 85202
Francis Lundin	Santa Maria High School	751 Fairmont Ave, Santa Maria, CA
David Galat	CSU	Ft. Collins, CO 80523
John Irwin	CSU, LA Biology	
Jim Bennett	Colo. Div. Wildlife	6060 Broadway, Denver, CO 80216
Tom McMahon	Univ. of Arizona	210 Bio. Sci. E, Tucson, AZ 85721
Bob Behnke	CSU	Ft. Collins, CO 80523
Bob Love	Nature Conservatory	P.O. Box 1006, Yorba Linda, CA 92686
Jerry Burton	USFWS	P.O. Box 1306, Albuquerque, NM
Bob Hershler		20 Ward St, Floral Pk, NY 11001
Jerry Landye	BIO-GEO SW	3465 N Jamison Blvd, Flagstaff, AZ
Joy Shrode		P.O. Box 24714, Tempe, AZ 85282
Bill Gallagher	Thomas Reid Assoc.	1600 Begen Ave., Mtn. View, CA 94040
Neil Armantrout	BLM	Bx 10582, Eugene, OR 97440
David Bowman	USFWS	1317 Wilmoore SE, Albuquerque, NM
Scott J. Reger	AZ Game & Fish	2222 W Greenway Rd, Phx, AZ 85023
Loti Calliga	CA Fish and Game	1416 9th St, Sacramento, CA 95814
Sheryl Vaughan	ASU, B of R	2039 E Boradway #148, Tempe, AZ

Paul Barrett	ASU, Dept. of Zoology	Tempe, AZ 85287
Walter R. Courtenay, Jr	Florida Atlantic Univ.	1040 SW 3rd St, Boca Raton, FL 33432
Bruce MeMarais	ASU, Zoology	Tempe, AZ 85281
Paul Schumann	Env. Sci. & Engineering	3677 Geology, UCLA, LA, CA 90024
Karl Rodenbaugh	UCLA	3677 Geology, UCLA, LA, CA 90024
Erick G. Campbell	BLM	425 E 4th St, Safford, AZ 85546
Al Bammann	BLM	425 E 4th St, Safford, AZ 85546
Mike Mathis	BLM	425 E 4th St, Safford, AZ 85546
Nadine Kanim	UNLV, Biology	Las Vegas, NV 89154
Mark Roeder	SBCM	211 Mesa Dr, Costa Mesa, CA 92627
Dean Hendrickson	ASU, Zoology	Tempe, AZ 85287
Ken Hanks	AZ Game & Fish	2222 W. Greenway Rd, Phx, AZ
Debbie Youngs	UNLV, Biology	Las Vegas, NV 89154
Ganise Satterwhite	NV Dept. Wildlife	Las Vegas, NV
Valerie Sheppe	UNLV, Biology	Las Vegas, NV 89154
Marian Smith	USFWS	447 E. Main, Suite #4, Vernal, UT
Gary Meffe	ASU, Zoology	Tempe, AZ 85287
Peter Lawson	ISU, Biology	Pocatello, ID 83209
Jack/Cindy Williams	USFWS	7550 Verdugo Way, Sacramento, CA 9584
Gene Wilde	UNLV, Biology	Las Vegas, NV 89154
Terry J. Hickman	USFWS	9473 S. Hunts End Dr, Sandy, UT 84092
Don, Barb & Abby Sada		1805 Van Ness, Reno, NV 89503
Jerry W. Davis	USFWS	8649 E McDonald Dr, Scottsdale, AZ
Phil Pister	Calif. Fish & Game	407 W. Line St, Bishop, CA 93514
Roger C. Cogan	Phoenix Zoo	6236 S 10th St., Phoenix, AZ
Ed Lorentzen	US Fish & Wildlife Serv.	1230 "N" St, Sacramento, CA
Ellen Gleason	Calif. Dept. Fish & Game	1416 Ninth St, Sacramento, CA
Robert Feldmuh		727 W 11th St, Claremont, CA 91711
A Marchley	ASU	Tempe, AZ 85282
Nancy Grimm	ASU	Tempe, AZ 85282
Bruce Taubert	AGFD	
Roger Sorenson		2211 Cornville, AZ 86325
Jim Brooks	AGFD	
Terry B. Johnson		30 N Tucson Blvd, Tucson, AZ 85716
Tom Grahl		5503 W Alice, Glendale, AZ 85302
Michael McCarthy		4602 E Cypress, Phoenix AZ 85008
Rosemary Thompson		4634 Mint Ln, Santa Barbara, CA 9311(
Bob Furtek		2621 Bello Dr, No. Las Vegas, NV 890(
Darrell Wong	Calif. Fish and Game	407 W. Line, Biship CA 93514
Karen Austin		927 J St. #53, Davis, CA 95616
Steve Nicola		927 J St. #53, Davis, CA 94616
Jerry Tash		8765 E Harborag Dr, Tucson, AZ 85710
Carl Hubbs		5719 Marilyn Dr, Austin, TX 78731
Tony/Aline Echelle		2223 W. Admiral, Stillwater, OK 7407
Karl Seethaler		98 E. 5th S, Providence, UT 84332
Paul C. Marsh	ASU	Tempe, AZ 85287
Charles Haynes		317 W. Prospect, Ft. Collins, CO 805
Ken Jarvis		3523 W. Cinnabar, Phoenix, AZ 85021
Tom Baugh	UNLV, Biology	Las Vegas, NV 89154
Bob Edwards	Pan American Univ, Biology	Edinburg, TX 78539
Thom Hardy	UNLV, Biology	Las Vegas, NV 89154
Paul Schumann	UCLA	3677 Geology, Los Angeles, CA 90024
Ted Cordery		4321 N 31 Dr., Phoenix, AZ 85017
Gordon Mueller		1332 Pinto, Boulder City, NV 89005

Robert Smith		PO.O Box 927, Palisade, CO 81526
Marc Dahlberg		5532 W. Barbara, Glendale, AZ 85302
Patrick Sollberger	UNLV, Biology	Las Vegas, NV 89154
Randy McNatt		2891 W 1500 N, Vernal, UT 84078
David Miller	CSU, Dept. Fish/Wildlife	Ft. CO 80523
Kevin Bestgen	CSU	Ft. Collins, CO 80523
David Propst	NMGF	Santa Fe, NM 87501
Gary Bell	Coconino Natl. Forest	Flagstaff, AZ 86001
Ken Byford	Tonto Natl. Forest	Phoenix, AZ 85038
Shelby Gerking	ASU, Zoology	Tempe, AZ 85282
Sue Morgensen		2828 W. Coolidge, Phoenix, AZ 85017
Larry/Sherrell Paulson	UNLC,Biology	Las Vegas, NV 89154
W. Linn Montgomery	No. Ariz. Univ., Biology	Flagstaff, AZ 86011
Frank Baucom		5605 S. Spinnaker Rd, Tempe, AZ 85283
Behrooz Dehdashti	NAU	315 Campus Heights, Flagstaff, AZ 86001
Nancy Sanders	NAU, Biology	Flagstaff, AZ 86011
John Meyer		27117 Langside Ave, Canyon Country, CA
Robert Clarkson		1801 W. Tuckey Ln. #1, Phoenix, AZ
Michael Bozek	UNLV, Biology	Las Vegas, NV 89154

Desert Fishes Council

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

FIFTEENTH ANNUAL SYMPOSIUM

Death Valley National Monument Headquarters

Furnace Creek, California

November 17-19, 1983

PROGRAM

Thursday, November 17.

8:00 a.m. until noon - registration.

8:30 a.m. Welcome to Death Valley.

Ed Rothfuss, Superintendent, Death Valley National Monument.

Announcements and introductions.

Phil Pister, California Department of Fish and Game, Program Chairman.

SESSION I - REPORTS FROM AREA COORDINATORS, RECOVERY TEAM LEADERS, AND AGENCIES.

Chairman: Salvador Contreras-Balderas, Universidad Autónoma de Nuevo León and Chairman, Desert Fishes Council.

AREAS	GOVERNMENTAL AGENCIES, ET AL.
Bonneville	México
Interbasin	United States
Death Valley	Bureau of Land Management
Oregon Lakes	National Park Service
Lahontan	Bureau of Reclamation
Sonoran Desert - México	Forest Service
Sonoran Desert - United States	Fish and Wildlife Service
Chihuahuan Desert - México	State Fish and Wildlife Agencies
Chihuahuan Desert - United States	Nevada, Utah
Chihuahuan Desert - Isolated Basins	Colorado, Arizona
Upper Colorado	California, New Mexico
Lower Colorado	The Nature Conservancy
Baja California	Southeastern Fishes Council

SESSION II - STATUS OF GREAT BASIN FAUNA. 1:30 p.m.

Chairman: Jim LaBounty, Bureau of Reclamation, Denver.

- A status review of the June sucker, *Chasmistes liorus mictus*.

  Terry Hickman, Fish and Wildlife Service, Salt Lake City, Utah; and Randy Radant, Utah Division of Wildlife Resources, Salt Lake City, Utah.

- Conservation status of the Mezquital pupfish, *Cyprinodon meeki*, from Durango, México.

  Robert Rush Miller, University of Michigan, Ann Arbor.

- Status and management of the Lahontan cutthroat trout, *Salmo clarki henshawi*.

  Eric Gerstung, California Department of Fish and Game, Sacramento.

- Status of *Cyprinodon macularius* ~~in~~ Arizona.

  W. L. Minckley, Arizona ~~State~~ University, Tempe.

SESSION II (continued).

- Status of fishes along the course of the pluvial White River, Nevada.

  Walt Courtenay, Florida Atlantic University, Boca Raton; Jim Deacon, University of Nevada, Las Vegas; Don Sada, Fish and Wildlife Service, Reno; and Gary Vinyard, University of Nevada, Reno.

- Fishes of the San Luis closed basin and upper Rio Grande, Colorado.

  Larry Zuckerman, Colorado State University, Fort Collins.

- The Amargosa toad, 1983: distribution and habitat.

  John A. Maciolek, Fish and Wildlife Service, Reno, Nevada.

- Introduction of Gila topminnow and desert pupfish on public lands in Arizona.

  Bill Kepner, Bureau of Land Management, Phoenix; and Jim Brooks, Arizona Game and Fish Department, Phoenix.

- Gila trout restoration - at the crossroads.

  Paul R. Turner, New Mexico State University, Las Cruces.

SESSION III - COMMUNITY STRUCTURE (GROUP DISCUSSION). 4:30 p.m.

- Structure of the fish community of a Lahontan drainage stream.

  Peter B. Moyle, University of California, Davis.

SESSION IV - BARBECUE AND RANDOM DISCUSSIONS. 7:00 p.m.

Chairman: Don Sada, Fish and Wildlife Service, Reno. Assisted by Barbara Kelley, Ash Meadows Preservation Committee; Jerry Stefferud, Forest Service, Albuquerque, N.M.; Sally Stefferud, Fish and Wildlife Service, Albuquerqu N.M.; and John Turner, Ellen Gleason, Gary Smith, and Jim Schuler, California Department of Fish and Game, Sacramento.

Friday, November 18. 8:00 a.m.

SESSION V - RESEARCH.

Chairman: Jack Williams, Fish and Wildlife Service, Sacramento.

- Reproduction of Colorado squawfish, Yampa River, Colorado.

  Charles Haynes, Colorado Division of Wildlife, Fort Collins; and Robert Muth, Colorado State University, Fort Collins.

- Age and growth of Mohave tui chubs at Fort Soda (Lake Tuendae), California.

  Tom Taylor, California Department of Parks and Recreation, Sacramento; and Darlene McGriff, California Department of Fish and Game, Sacramento.

- Evidence for homing in Colorado squawfish.

  Harold Tyus, Fish and Wildlife Service, Vernal, Utah.

- Habitat size and fish diversity in Cuatro Ciénegas, México.

  W. L. Minckley, Arizona State University, Tempe.

- Longevity of the Cui-ui.

  Gary Scoppettone, Fish and Wildlife Service, Reno.

- Relationships between habitat, flow and larval fishes in the upper Colorado River.

  John Carter, Ecosystem Research Institute, Logan, Utah.

- Biology of the leatherside chub, Gila copei.

  Clay Speas, Brigham Young University, Provo, Utah.

- Predation on, and food availability for, threatened and endangered larval fishes in the lower Colorado River.

  Mike Busdosh, Affinis, Inc., San Diego, California.

- Gill raker differentiation of the tui chub in remnant Lahontan waters.

  Steven Vigg, Desert Research Institute, Reno, Nevada.

- Drift of larval fishes in the upper Colorado River.

  R. Valdez, J. Carter, and R. Ryel, Ecosystem Research Institute, Logan, Utah.

- Feeding ecology of the endemic Bonneville cisco of Bear Lake, Utah-Idaho.

  D. Lentz and V. Lamarra, Ecosystem Research Institute, Logan, Utah.

SESSION VI - GENETIC CONSIDERATIONS (GROUP DISCUSSION). 1:30 p.m.

Chairman: Gary Meffe, Arizona State University, Tempe.

- Conservation genetics of an endangered species, Poeciliopsis occidentalis, in Arizona.

  Bob Vrijenhoek, Rutgers University, Piscataway, N.J.; and Michael E. Douglas, Oklahoma State University, Stillwater.

- Genetic considerations in management of endangered fishes.

  Gary Meffe.

SESSION VII - ECOSYSTEM RESEARCH AND MANAGEMENT. 3:00 p.m.

Chairman: Phil Pister, California Department of Fish and Game, Bishop.

- The climatology of Sierra San Pedro Mártir.

  Manuel Alvarez, Instituto de Astronomía, U.N.A.M.

- The limnology of San Pedro Mártir streams: preliminary results.

  Katsuo Nishikawa, Victor Camacho, Diogenes Herrera and Socorro Posada, Centro de Investigación Científica y de Educación Superior de Ensenada; Carlos Yruretagoyena, Dirección de Pesca, Ensenada, B.C.; and E. P. Pister, California Department of Fish and Game, Bishop.

- An update on trout research in the Sierra San Pedro Mártir.

  Carlos Yruretagoyena, Dirección de Pesca, Ensenada, B.C.

- The fishes of Durango.

  Salvador Contreras-Balderas and Leticia Macias, Universidad Autónoma de Nuevo León, Monterrey, N.L.

- A review of Mexican presentations at the 1983 meeting of the Western Division, American Fisheries Society.

  Salvador Contreras-Balderas, Universidad Autónoma de Nuevo León, Monterrey, N.

- Endangered aquatic ecosystems in North American deserts - final report.

  Jack Williams, Fish and Wildlife Service, Sacramento; Dave Bowman, Fish and Wildlife Service, Albuquerque; Jim Brooks, Arizona Game and Fish Department, Phoenix; Tony Echelle, Oklahoma State University, Stillwater; Dean Hendrickson Arizona State University, Tempe; Bob Edwards, Pan American University, Edinburg, Texas; and Jerry Landye, Bio-Geo Southwest, Inc., Flagstaff, Arizona

- Desert phyllopods, an underknown resource.

  Larry Eng, California Department of Fish and Game, Sacramento.

- Management of riparian systems.

  Rick Warner, Field Studies Center, Davis, California.

- Empirical evidence and inference as a provisional basis for the prediction and management of upper Colorado River basin fishes.

  Bob Behnke, Colorado State University, Fort Collins.

- Western North American sub-plate tectonism and fish distributions.

  Dean Hendrickson, Arizona State University, Tempe.

- Natural resources of the Lark Seep system (China Lake, CA), with special emphasis on the Mohave chub (Gila bicolor mohavensis).

  Bob Feldmeth, Claremont Colleges, Pomona, California; Dave Soltz, California State University, Los Angeles; Lon McClanahan, California State University, Fullerton; Jeffrey Jones, Saddleback College, Mission Viejo, California; John Irwin, Bishop Amat High School, La Puente, California; and Beverly Kohfield, Naval Weapons Center, China Lake, California.

Saturday, November 19, 8:00 a.m.

SESSION VIII - BUSINESS MEETING.

Chairmen: Salvador Contreras-Balderas, Chairman, Desert Fishes Council; and W. L. Minckley, Chairman-elect, Desert Fishes Council.

a) Old and new business.

b) Constitution and bylaws.

c) Resolutions.

d) Treasurer's report.

e) Proceedings update.

SESSION IX - FIELD TRIPS. 10:00 a.m.

Field trips are tentatively planned to Ash Meadows and possibly other locations in the Death Valley area. Further details will be announced early in the symposium.

NOTE TO PARTICIPANTS

It is absolutely mandatory that each participant adhere strictly to his allotted time of 20 minutes, including discussion period. Reports from agency representatives, area coordinators, and recovery team leaders should be held to 15 minutes. Please do not dig into the next speaker's time, because he is probably hoping that you will finish early. If you feel that you cannot make an effective presentation within the designated time, please contact me prior to your session and we will see if an adjustment may be made.

All presentations will be timed with an electronic timer. When you hear the bell, you will have one additional minute. If you are still speaking at that time, you run the very real risk of being abruptly removed from the speaker's stand by your session chairman, who will release trained Dobermans to do the job for him. Remember that slides invariably take much longer during a formal presentation than during a brief review. Slides greatly enhance a presentation if prudently used. Conversely, they may just as effectively detract from a presentation if too many are used, or if they are poorly arranged. If possible, bring your slides to the symposium "ready to go" in a Kodak Carousel magazine. The National Park Service will provide Kodak Carousel 35 mm. projectors as the standard projection equipment, with remote controls to enable you to change slides from the speaker's stand.

The manuscript or abstract you submit will be used as the original for reproduction. In the interest of uniformity, please adhere 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 currently acceptable, but graphs and drawings in black and white may be submitted. Perfection of the material you submit is your responsibility, so be sure to check your work carefully. Nothing reflects upon an individual more than a poor manuscript. Abstracts and papers are to be submitted in both English and Spanish. If manuscript preparation in a second language poses a problem for you, please let me know. Assistance is available for this purpose.

DEADLINE FOR MANUSCRIPT AND ABSTRACT SUBMISSION IS DECEMBER 31, 1983. Material submitted after this date will be published in a special section of the 1984 proceedings.

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

E. P. Pister, Executive Secretary
Desert Fishes Council
407 West Line Street
Bishop, CA 93514

Phone: (619) 872-1171

epp 10/21/83

Bonneville Basin Report to the Desert Fishes Council, 1983

by

Terry J. Hickman
U. S. Fish and Wildlife Service
Salt Lake City, Utah
and
Don Duff
U. S. Forest Service
Ogden, Utah

The Bonneville Basin, comprises 34 million acres in portions of Utah, eastern Nevada, southeastern Idaho, and southwestern Wyoming. Major fisheries activities within the Bonneville Basin during 1983 involved work with the following fish:

1. June sucker (Chasmistes liorus):

   The Utah Division of Wildlife Resources (UDWR) conducted a study, which was partially funded by the U. S. Bureau of Reclamation, to define spawning habitat selection in the Provo River. Results from this study will make it possible to establish flow recommendations for June sucker spawning in the Provo River.

   The U. S. Fish and Wildlife Service (FWS) is presently preparing a proposal to list this fish as an endangered species. This proposal is expected to be completed by March or April 1984.

   Randy Radant and Terry Hickman will present a paper at this meeting on the status of June sucker.

2. Least chub (Iotichthys phlegethontis):

   The UDWR is developing a program to duplicate much of the previous sampling work on the least chub. They intend to revisit the sites and determine the status of these populations and establish an annual monitoring program.

   UDWR is also trying to locate and identify areas in the Bonneville Basin without least chub, prioritize these areas and introduce the species into them. They are also analysing the potential of the least chub for mosquito control.

3. Bonneville cutthroat trout (Salmo clarki utah):

   During 1983 several populations were impacted by spring flooding, hybridization and energy developments. The threat of new impacts, and recent degredation of habitat and numbers has prompted the FWS to prepare a proposal to list the Bonneville cutthroat as a threatened species. This proposal is expected to be completed by early 1984. During 1981 the FWS made a determination after consulting with several State, Federal and private organizations, to postpone listing action with the hope of developing various management agreements intended to increase habitat and numbers. However, to date this has proven unsuccessful and listing now appears to be warranted.

The U. S. Forest Service (USFS) has estimated that over 6 million dollars worth of damage has occurred to stream habitats in the Bonneville Basin as a result of the 1983 floods. Streams containing the Bonneville cutthroat were impacted during 1983 and unless habitat rehabilitation is scheduled the species will continue a declining trend.

The following impacts occurred to various streams containing Bonneville cutthroat trout during 1983:

Goshute Creek (Nevada) - Spring flooding on U. S. Bureau of Land Management (BLM) land wiped out the lower gabion structure and destroyed much of the habitat resulting in a loss of a considerable number of trout.

Pine Creek (Nevada) - Spring flooding on the Humboldt National Forest forced this stream from its normal channel resulting in a loss of habitat and fish.

Hendrys Creek (Nevada) - Spring flooding on the Humboldt National Forest caused extreme habitat damage resulting in a loss of all of the artifical habitat structures. The natural stream channel changed in several sections and a loss of fish occured.

Hampton Creek (Nevada) - Spring flooding on the Humboldt National Forest resulted in a loss of some habitat and fish.

Trout Creek (Utah) - During 1977 the lower two thirds of this stream was treated to eradicate rainbow and cutthroat-rainbow hybrids. The upper section, containing the only pure Bonneville cutthroat on the Deep Creek mountains, was left to repopulate the lower sections. Sampling during September, October and November 1983 located rainbow trout throughout the stream. In November 1983, 60 cutthroat trout were taken from the upper end of Trout Creek to a hatchery in Logan, Utah. These fish will be used in propagation work as well as provide security for the Bonneville cutthroat from the Deep Creek Mountains. Spring flooding resulted in a loss of some habitat and several artifical habitat structures.

Birch Creek (Utah) - This stream was treated in October 1978 to eliminate rainbow and rainbow-cutthroat trout hybrids. Fish from upper Trout Creek were stocked into Birch Creek during November 1978. Although no rainbow trout have been found in Birch Creek to date, access is available for rainbow to move from Trout to Birch Creek. Spring flooding resulted in a loss of some habitat and the natural stream channel changed in several sections.

Red Butte Canyon (Utah) - This stream was treated by the UDWR and USFS (Wasatch-Cache National Forest) during June 1983 to eradicate all non-native trout. It is anticipated that Bonneville cutthroat trout will be stocked into this stream within the next year or two.

Salt Creek (Wyoming) - Spring flooding caused extreme habitat damage but existing stream habitat improvements constructed by the USFS and Wyoming Game and Fish Department survived and helped maintain some important habitat. More habitat improvement and maintenance is planned.

Raymond Creek (Wyoming) - Spring flooding caused extreme habitat damage. Several habitat improvement structures were destroyed and some fish loss occured. The stream left its natural channel in some locations.

Coantog Creek (Wyoming) - A reservoir is proposed for the Smith Fork River drainage. Significant impacts to the Bonneville cutthroat trout in Coantag Creek could occur as a result of this reservoir. Exact reservoir design, location, and operation have not yet been developed.

4. Lahontan cutthroat trout (*Salmo clarki henshawi*):

During April 1983 a meeting was held between personnel from the UDWR, FWS and BLM to discuss the management of the Lahontan cutthroat in Donner and Bettridge Creek, Utah. General agreement was reached that the low population level in Donner Creek and the slow establishment of these trout in nearby Bettridge Creek will preclude any rapid activity in establishing this fish in other waters. Building up populations in Donner and Bettridge Creeks is the highest priority. UDWR will continue to look for suitable transplant sites, hopefully a pond can be located to aid in the propagation of this trout.

Donner Creek (Utah) - This stream survived the heavy spring runoffs without any major habitat damage. Personnel from UDWR, BLM and FWS surveyed the lower section of Donner Creek during September 1983. A total of 20 fish were collected and stocked into Bettridge Creek. Although, over 100 fish have been taken from Donner Creek (since 1977) for scientific purposes and stocking into Bettridge Creek, the population density appears to be about the same as it was in 1977.

Bettridge Creek (Utah) - This stream survived the heavy spring runoffs without any major habitat damage. The stream was treated in the fall of 1979 and the winter of 1980 to eradicate the rainbow trout. Since May 1980 a total of 68 Lahontan cutthroat trout were collected from Donner Creek and stocked into Bettridge Creek. A survey of Bettridge Creek during September 1983 located 4 cutthroat trout. This represents the first indication of survival of the introduced trout in Bettridge Creek.

Nevada Streams - The Nevada Division of Wildlife (NDOW), BLM and USFS have implemented an interagency agreement to jointly survey all Lahontan cutthroat streams. A schedule for surveying based on priority and year has been established. Implementation depends on agency funding levels. The NDOW, BLM, USFS and FWS have recently implemented a "Lahontan cutthroat trout fishery management plan for the Humboldt River drainage basin." It will cover those populations which may exist in the Bonneville Basin area of Nevada.

5. Endemic Fish of Bear Lake

Bear Lake (Utah-Idaho) contains at least five fish species that are endemic to Bear Lake. They are: Bonneville cisco (Prosopium gemmiferum), Bear Lake whitefish (Prosopium abyssicola), Bonneville whitefish (Prosopium spilontus), spotted whitefish (Prosopium nannomaculatum), and Bear Lake Sculpin (Cottus extensus). Presently a group from Utah State University is trying to obtain funding from the FWS, UDWR and an NSF grant, to study the life history and habitat requirements of these five endemic species. Funding would also be used to study the possibility that a fourth endemic whitefish occurs in Bear Lake.

During 1983 the UDWR introduced 10 million Bonneville cisco fry and 25 thousand Bear Lake sculpins into Flaming Gorge reservoir (Utah-Wyoming) as forage for the trout. UDWR is experimenting with species that occur within the state of Utah rather than introduce additional non-native fish into the state for forage purposes.

Desert Fishes Council

"Dedicated to the Preservation of America's Desert Fishes"
407 West Line Street
Bishop, California 93514
April 11, 1983

To: All Persons and Agencies Concerned

From: Chairman, Death Valley Area Committee

Subject: **Ninth and Tenth** Annual Meetings, Death Valley Area Committee

Subject meetings were held in the National Park Service Auditorium, Furnace Creek, on February 27, 1982 and February 25, 1983. For a variety of reasons the meetings are being summarized together.

1. 1981-82 symposia review.

   The symposia held in 1981 and 82 were reviewed, as were the resolutions which were passed during the business meetings. All such resolutions were formalized and distributed as directed. They will be printed in the proceedings in their entirety.

2. Eastern Mohave Desert Recovery Team.

   The Eastern Mohave Desert Fishes Recovery Team met on January 26, 1982 with team members Bill Rinne, Don Sada, Cal Allan, Pete Sanchez, and Jim Deacon in attendance, as were several guests. The meeting dealt primarily with the status of individual species, and this information will be presented during the species discussions to follow.

3. Ash Meadows land acquisition.

   The acquisition of Ash Meadows remains one of the Council's major objectives. Negotiations are continuing, and purchase of the land seems more feasible than acquisition through land exchange. Negotiations in this respect are now being led by the Nature Conservancy, but legislative support is needed (probably through Land and Water Conservation funds) to allow government ownership. The Council's activities are being headed by Barbara Kelley of Reno, who maintains close contact with the problem and is enlisting as much support as possible from private individuals and conservation groups.

   Although the renewal of the listings for the Ash Meadows speckled dace and Ash Meadows pupfish is in progress, there is strong reason to question the designation of such small critical habitat areas, other than that they may provide temporary protection during the land acquisition process. Although we have been eminently unsuccessful to date, I hope that we may ultimately prove to the leadership of the Fish and Wildlife Service that the only feasible means of protecting a species is by providing complete protection for its habitat. No doubt the temporary security furnished by the Supreme Court's Devils Hole decision in 1976 was in a sense one of the worst things that could have happened to us in the acquisition of Ash Meadows. It provided an excuse for not acquiring the entirety of Ash Meadows when it was offered for sale shortly thereafter.

4. Duckwater catfish farm.

The Duckwater catfish farm in Railroad Valley is going full swing, and catfish are known to be in the springhole. The operation will produce 1,000 pounds of catfish per week. There is communication between Jack Dieringer (Nevada's Chief of Fisheries) and David Koch, the consulting biologist for the project. The Council still strongly opposes projects of this type, which are invariably detrimental to the native fish fauna.

5. Darwin Falls Creek.

The Anaconda Copper Co. owns a large quantity of silver tailings at its Darwin (Inyo Co.,Calif.) operation and needs water from Darwin Falls Creek to run its milling operation. Water is in very short supply in this area (a tributary to Panamint Valley) and **a water use** application was protested by both the California Department of Fish and Game and B.L.M. Dismissal terms for the protest involved a study, to be funded by Anaconda, of the entire Darwin Falls ecosystem as a basis for evaluating and predicting any destructive change. Initial studies were made by a Las Vegas biological consultant, but a drop in silver prices brought the entire matter to a standstill about a year ago. where it remains as of this writing.

6. Desert Fishes Council's endangered species committee.

The Desert Fishes Council's Endangered Species Committee remains a viable group, meeting as necessary to provide the best possible input for decisions as to listings, etc. The most recent function of the committee was a letter to the Fish and Wildlife Service criticizing the Service's failure to list 17 desert fishes that qualify in every way for the protection that listing would provide.

7. Small hydro update.

Small stream ecosystems throughout the Great Basin are threatened by the development of hydroelectric plants which would further deplete the flows of systems that are already 'water short' because of the precipitation patterns that sustain them. The Council has worked with the California Water Resources Control Board in furthering the concept of cumulative environmental impact assessments of many projects planned for the east slope of the Sierra Nevada. The Board plans to endorse such studies during 1983.

8. By Day Creek Ecological Reserve.

By Day Creek is located five miles northwest of Bridgeport, CA and contains the only known native population of Walker River strain Lahontan cutthroat trout (Salmo clarki henshawi). This strain will be used extensively in the renovation of numerous streams within California to native cutthroat trout. The majority of the cutthroat trout population occurs within two private inholdings on Toiyabe National Forest lands. The Department of Fish and Game has submitted an Environmental Protection Program land acquisition proposal to obtain a 160 acre parcel which contains approximately half of the cutthroat habitat. The acquisition of this property appears likely and, if successful, will result in the creation of a By Day Creek Ecological Reserve to protect this unique population from over-exploitation and habitat degradation.

9. H. R. 2475, the Fish Slough (Mono Co., Calif.) land exchange bill.

On December 19 Congress passed H.R. 2475, the Fish Slough Land Exchange Bill, which clears the way for the acquisition of 202 acres of privately held land within a mile of the type locality of the Owens pupfish, which is endangered under both federal and state (California) listings. The related land exchange is currently in progress. When completed, the Fish Slough area will be managed as an ecological study area under the joint auspices of the B.L.M., University of California, Los Angeles Department of Water and Power, and California Department of Fish and Game. This will do much to assure the eventual delisting of the pupfish, and to strengthen the status of other native fishes protected within refugia established at Fish Slough.

10. Future symposia.

The 1983 symposium will be held during the period of November 17-19 at Furnace Creek, Death Valley National Monument. A likely location for the 1984 symposium is San Luis Potosí, located in the State of San Luis Potosí, central México. This would allow a field trip to the superb area of La Media Luna, another example of the endemism which has come to typify many areas of southwestern North America. A final decision in this respect will be made during the 1983 symposium at Death Valley.

11. Proceedings.

The compendium covering from 1971-77 has been produced in draft form on Bio/West's (Paul Holden's) word processor, and the manuscript is now being edited prior to being turned over to U.N.L.V. for printing. As soon as this is completed, the 1981 and 1982 proceedings will be printed. The manuscripts are ready at at this time.

12. California nongame tax checkoff.

Assembly bill 384, by Assemblyman Campbell of the California legislature, is now being kicked around in committee. This is a tax checkoff bill which could provide as much as $2 million annually for California's nongame and endangered species programs. Cindy Williams, who works on Assemblyman Campbell's staff, is keeping us informed in this respect. The Council has written to various legislators in support of this bill.

13. Chihuahuan desert symposium.

The Second Chihuahuan Desert symposium will be held on October 20-21, 1983 at Alpine, Texas. Inquiries should be directed to Dennie Miller, CDRI, Box 1334, Alpine, Tx 79830.

14. Public trust doctrine.

In February 1983 the California Supreme Court ruled that the State Water Resources Control Board must consider the Public Trust Doctrine in ruling on water use applications. The decision was made in relation to the Mono Lake problem, but is all inclusive and may be applied to all water rights decisions, past, present and future. It gives much new hope for Mono Lake and other aquatic habitats within California.

15. Status of Death Valley Area fishes.

a. Pahrump killifish, Empetrichthys latos.

The populations at Corn Creek and Shoshone Ponds continue to be in good condition. Additional transplant sites are being investigated. The species (and genus) is in no immediate danger. It is still vivid in my memory that about a decade ago the entire world population of Empetrichthys existed in a small horse trough at Corn Creek. Part of the current program involves an exchange of fish between Corn Creek and Shoshone Ponds in order to prevent genetic isolation of either population.

b. Devils Hole pupfish, Cyprinodon diabolis.

The water level within Devils Hole remains between 2.0 and 2.5, and the population in Devils Hole appears to be in good condition and is being monitored regularly. Additional research is being planned for the species, including a comparison of the present Hoover Dam population with that which existed when the refugium was established in 1971. In addition, the Council has received a formal request from Bob Miller at Michigan to coordinate efforts to obtain material for a biochemical comparison (using electrophoresis) of the Devils Hole pupfish with its transplanted stock at Hoover Dam Refugium. The purpose of the study is to determine whether there has been a significant change in genetic diversity in the transplant, which was established from a relatively small stock. This work would be done by Bruce Turner at V.P.I., Blacksburg, VA. The Council is now in the process of working out the politically sensitive issue of getting the necessary material for Dr. Turner.

c. Ash Meadows speckled dace, Rhinichthys osculus nevadensis and Ash Meadows pupfish, Cyprinodon nevadensis mionectes.

The emergency listing on these two fishes was extended, giving some protection for Ash Meadows during the negotiations for its acquisition. Both fishes are reasonably secure under the status quo. Water rights to Jackrabbit Spring (1.5 cfs) have been successfully transferred from BLM to the Nevada Department of Wildlife.

d. Warm Spring pupfish, Cyprinodon nevadensis pectoralis.

The major refugium for this fish (School Spring) is being rehabilitated using prison labor. Status is presently secure.

e. Owens chub Gila bicolor snyderi.

Dr. Robert R. Miller has examined collections of chubs from the headsprings of Hot Creek hatchery in Mono County and believes they are pure Owens chubs. The several hundred chubs inhabiting these springs will provide ample numbers for transplants to the Owens Valley Native Fishes Sanctuary. Adequate numbers of Owens chubs are not available from the subspecies' only other known habitat, the Owens River Gorge below Crowley Lake, to make transplants feasible from that source. A visual survey is planned to insure that no exotic species are present in the upper pond of the OVNFS prior to transplants planned for early Spring of 1983.

f. Owens dace, Rhinichthys osculus subsp.

Continuing electroshocking surveys of Owens Valley waters have not revealed any expansion of the known distribution. Owens dace are only found in lower Pine Creek, lower Horton Creek, and in "A" drain within Bishop city limits. The Pine Creek population is subject to frequent habitat alterations due to L.A.

Department of Water and Power activities, and is threatened by a potential deterioration of water quality due to an upstream mining operation and proposed small hydroelectric project. The establishment of Owens dace populations in other suitable waters is a management goal for 1983.

g. Rhinichthys osculus subsp., Amargosa R. near Beatty, Nevada
" " ", Amargosa Gorge below Tecopa, California

No further work has been done on the differential taxonomy of these fishes. Their habitat remains relatively secure, although proposed geothermal leasing in the Tecopa area poses a long-term threat to the lower population. We hope that BLM will recognize the unique biological value of the Amargosa Gorge ecosystem and provide adequate protection, should leases be issued.

h. Mohave chub, Gila bicolor mohavensis.

A good population exists at Lark Seep Lagoon on the Naval Weapons Center, and Dave Soltz of Cal. State Los Angeles is under contract to the Navy to conduct a survey of native wildlife and vegetation, with special emphasis on the chub, following which we will have a much better understanding of the Lark Seep refugium in the role of the preservation of the subspecies.

In addition, Mike Havelka continues with his research at the Desert Research Station near Barstow. The status of the Mohave chubs at ZZYZX Spring appears unchanged. The population has recovered following a major die-off which occurred there over a year ago. The die-off was attributed primarily to decaying vegetation.

The Mohave chub recovery plan is nearing completion.

i. Owens pupfish, Cyprinodon radiosus.

See 9. above. In addition, California Fish and Game personnel will soon be involved in eradicating largemouth black bass from the lower refugium of the Owens Valley Native Fish Sanctuary. This remains a major problem in the recovery of the species and serves as an object lesson of the difficulty of having easily accessible refugia near populated areas. It is hoped that this concept can be made clear to those who feel the Ash Meadows problem can be worked out with half the area as a refugium and the other half populated by people.

j. Cottonball Marsh pupfish, Cyprinodon milleri.

No problem. The population (and habitat) remain in good condition and are given further protection under current wilderness management procedures by the National Park Service.

k. Saratoga Springs pupfish, Cyprinodon nevadensis nevadensis.

Both habitat and population are in good condition.

l. Amargosa pupfish, Cyprinodon nevadensis amargosae.
See g. above. Population currently adequate.

m. Salt Creek pupfish, Cyprinodon salinus.

Both habitat and population in good condition. The "boardwalk" at Salt Creek has been a major help in preserving habitat integrity.

n. Owens sucker, Catostomus fumeiventris.

Large numbers of the species exist in the stable habitats of the Crowley Lake area of the upper Owens River.

o. Desert pupfish, Cyprinodon macularius.

In a circus which is beginning to rival the trauma of Ash Meadows, efforts are still being made to acquire the critical areas of San Sebastian Marsh/San Felipe Creek. The private land owners reportedly are discussing selling their holdings to a group of Israeli investors interested in desert agriculture experiments. Keith Moore of Cal Fish and Game (619 356-5947) is willing to entertain any reasonable suggestion.

Probably a good way to end this report is by stating the obvious: No one ever promised us that preserving aquatic species in the southwest during the latter part of the twentieth century would be any bed of roses. The entire matter seems to be reflected in the problems we are now trying to overcome in Ash Meadows.

E. P. Pister
Chairman

DEATH VALLEY HYDROGRAPHIC AREA COMMITTEE

Desert Fishes Council

February 25, 1983

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DEATH VALLEY AREA COMMITTEE - DESERT FISHES COUNCIL

FURNACE CREEK, DEATH VALLEY NAT. MON.

February 26, 1982

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STATUS OF THE JUNE SUCKER (*Chasmistes liorus*)

Randy D. Radant
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and

Terry J. Hickman
U. S. Fish and Wildlife Service
Salt Lake City, Utah

Introduction

Suckers in the genus *Chasmistes* are lake dwelling midwater planktivores characterized by their numerous dendritic gill rakers and terminal mouth. Fossil records indicate that at one time these suckers occurred throughout much of the west. Today, only three species of *Chasmistes* are known to survive, the June sucker (*Chasmistes liorus*) in the Bonneville Basin in Utah, the cu-ui sucker (*Chasmistes cujus*) in the Lahontan Basin in Nevada, and the shortnose sucker (*Chasmistes brevirostris*) in the Klamath River Basin in Oregon and California (Miller and Smith 1981). Of the three species still remaining, the cu-ui sucker is federally listed as endangered and the other two are being considered for listing.

The June sucker is endemic to Utah Lake, Utah, a 38,000 ha remanent of ancient Lake Bonneville. Utah Lake is slightly saline, turbid, and highly eutrophic. When full the lake has an average depth of 2.9 m and a maximum depth of 4.2 m (Fuhriman et al. 1974). The Provo and Spanish Fork rivers are its largest tributaries while the Jordan River forms its only natural outflow.

Population Status

When pioneers first arrived in 1848 they described Utah Lake as abounding with cutthroat trout (*Salmo clarki utah*), chub (*Gila atraria*), and suckers. Fish from Utah Lake provided a critical food source during early settlement of the state (Carter 1969). Cutthroat trout were extirpated by 1936, Utah chub are considered extirpated, and suckers occur in extremely small numbers. Commercial fishing, irrigation, degradation of water quality, and introduction of nonnative fishes have contributed to the decline of native fish populations. Today, the predominant fish species in Utah Lake are carp (*Cyprinus carpio*), white bass (*Morones chrysops*), walleye (*Stizostedion vitreum vitreum*), and channel catfish (*Ictalurus punctatus*) (Radant and Sakaguchi 1981).

In 1889, Jordan (1891) reported that millions of suckers existed in Utah Lake and he subsequently proclaimed it "the greatest sucker pond in the Universe." In the late 1800's an estimated 1,361 metric ton (t) of spawning sucker were killed in about 3.3 km of the Provo River when it was dewatered (Carter 1969). Soon after 1923, 2.3 t of sucker were removed from a dewatered irrigation ditch. During the 1932-35 drought hundreds of tons of suckers were lost from crowding and freezing when irrigation use nearly drained Utah Lake dry (Tanner 1936).

Utah Lake suckers were an important component in commercial fish harvest until their numbers became too low. Between 1901 and 1905, an average of 162 t of sucker were harvested annually (Carter 1969). In 1951 as many as 1,350 could still be taken in a single day of commercial seining (Lowder 1951).

The decline of sucker numbers to present levels appears to correspond largely with the introduction and population expansion of white bass and walleye in the mid-1950's. Fish population studies in 1959 produced gillnet catch rates of 0.16 suckers per net hour (Arnold 1959). By 1970 similar netting efforts captured only 0.01 suckers per net hour (White and Dabb 1970). Gill netting in 1978-79 produced no suckers. An intensive inventory of the Utah Lake fishery during 1978-79 using a variety of sampling gear resulted in 2,097 separate net collections which captured 34,292 adult fish. Only 102 or 0.3% of the total catch were identified as June sucker (Radant and Sakaguchi 1981). Eighteen were identified as Utah sucker. No young-of-the-year suckers were taken during the study.

Taxonomy

Much confusion has existed over the systematics of Utah Lake suckers. It has been reported that three species of suckers occurred in Utah Lake (Stubbs 1966, Lowder 1951, and Jordan 1878). However, recent information presented by Miller and Smith (1981) suggests that only two species, the Utah sucker (*Catostomus ardens*) and June sucker occurred in Utah Lake. June sucker are readily distinguished from Utah sucker by their subterminal mouth, relatively smooth divided lips, broad skull and greater number of gill rakers. June sucker spawn in June while Utah sucker spawn in early April.

Recent taxonomic evaluation of the June sucker by Miller and Smith (1981) concludes that specimens present today are different from specimens collected in the 1880's. They hypothesize that hybridization between Utah and June sucker occurred during the 1932-35 drought when fish populations were stressed. As June sucker returned to abundance, the new genes were incorporated into the population and have become normal characteristics. They have assigned *C. liorus liorus* to specimens collected in the 1880's and *C. liorus mictus* to specimens collected after 1939.

Biology

Biological information for the June sucker was nonexistent prior to 1978 and remains generally lacking. Because of their rarity in the lake, little biological data were collected for them during 1978-79 Utah Lake fisheries investigations. Much of the work and subsequent information for June sucker relates to their spawning in the Provo River. Sucker spawning is restricted mostly to the Provo River, with limited spawning probably also occurring in the Spanish Fork River (Radant and Sakaguchi 1981).

June sucker generally begin spawning during the second or third week of June, with most spawning completed within five to eight days. They will travel over 6 km upstream to a diversion barrier; however, few fish actually reach the diversion structure. While in the river June sucker congregate in groups over suitable spawning habitat. The same areas of the river appear to be selected from year to year. The spawning process is typical for river spawning catostomid species. The female maintains her position with two males on each side, parallel to her. Periodically, in a few seconds of intense activity the female releases her eggs and the males release their milt. They rest a few minutes before the spawning process is repeated (Radant and Sakaguchi 1981).

Water velocities where spawning occurred averaged 0.37 m/sec on the bottom and ranged from 0.06 m/sec to 0.98 m/sec. Water depth at the spawning site ranged from 0.30 m to 0.86 m with a mean of 0.51 m. Substrate selected for spawning was a mixture of predominately coarse gravel to small cobble-sized particles (Shirley 1982). Mean river temperatures during spawning ranged from 11 to 15 C (Radant and Sakaguchi 1981).

Larval development and hatching periods have been described by Shirley (1982). June sucker eggs are pale yellow, demersal, and weakly adhesive. They hatch in four days at 21.1 C and ten days at 10.6 C. Larvae remain quiescent on the bottom for ten days after hatching.

After swim-up occurs larvae seek shallow backwater areas with little or no current. They are frequently observed in large groups in the quiet water areas. Most of the young sucker remain in the river through August with numbers declining in September. By October the majority of the young sucker have disappeared from the river; however, a few will remain in the river until the following spring.

Management

The Utah Division of Wildlife Resources (UDWR) has listed the June sucker as a protected species. A study partially supported by the U. S. Bureau of Reclamation is being conducted by the UDWR to define June sucker spawning and nursery habitat selection in the Provo River so flow recommendations can be established.

An attempt will be made to establish June sucker in Mona Reservoir, a 526 ha body of water approximately 19 km south of Utah Lake. The purpose of the introduction is to provide a safety measure for the species and to establish suitable numbers of sucker for additional research.

Listing Status Chronology

During September and October 1982 the Salt Lake City field office of the U. S. Fish and Wildlife Service (FWS) recommended to its regional office in Denver that a proposal to list the June sucker be prepared. A 30 December 1982 Federal Register (FR) published by the FWS included the June sucker among a list of vertebrate species currently under review for listing as endangered or threatened. The notice indicated substantial information was available to support the biological appropriateness of proposing to list the species as endangered or threatened. In March 1983 a recommendation was forwarded to the FWS Washington Office to prepare a proposal to list the June sucker as an endangered species.

On 12 April 1983 the FWS received a petition from the Desert Fishes Council (DFC) to list the June sucker as an endangered species. On 14 June 1983 the FWS published in the FR a notice of finding on the DFC petition to list the June sucker. It was determined that the petition provided substantial information indicating that action may be warranted to list the June sucker. The FWS has one year from the date the petition was received to publish its finding in the FR.

The FWS is presently preparing a proposal to list the June sucker as an endangered species. This proposal is expected to be published in the FR by March or April 1984. Once the listing proposal is published in the FR the FWS will have up to one year to decide whether to complete the listing process.

Outlook for Recovery

Recovery of the June sucker will be very difficult and will involve considerable time and money. Very little information exists regarding life history requirements of this species in Utah Lake. Only adults have been collected and no survival of young-of-the-year June sucker has been recorded in Utah Lake in recent years. During the past 80 years several nonnative fish have been stocked in Utah Lake (bass, walleye, catfish, carp, etc.), which may be out competing the June sucker for food and habitat as well as preying on young June sucker.

Major impacts to the June sucker in the immediate future will be competition and predation by nonnative species and development of the Central Utah Project (CUP). Addressing both these issues will be a major aspect of the recovery program.

Competition and predation by nonnative species is a very complex problem due to sport fishery demands in Utah. Several species have been introduced into Utah Lake in an attempt to develop a sport fishery. There is considerable pressure on the DWR to improve the quality of the sport fishery in Utah Lake. The solution to this problem will involve coordinating with sport fishery management programs in Utah Lake to minimize species conflict and increase June sucker recruitment. It is recognized that little can be done about the nonnative fishes already present in the lake; however, future introduction of nonnative species into the lake should be fully evaluated.

The CUP, costing several billion dollars, will reduce and change flows in the Provo River (the major spawning area) and affect portions of Utah Lake, mainly with various dikes that will isolate sections of the lake from the main lake body. Successful recovery activities will require coordination and input into the design and operation of the CUP. It will be necessary to maintain adequate flows in the Provo River to insure successful sucker spawning, and to minimize negative impacts of the project on June sucker habitat in Utah Lake. It is anticipated that CUP impacts to the Provo River and Utah Lake could occur as early as 1984 or 1985.

Recovery of the June sucker will probably include the following items:

1. Obtain information on June sucker life history (preferred lake habitat, food, competition and predation by nonnative fishes, etc.).

2. Coordination of Utah Lake fisheries management to minimize competition and predation by nonnative species.

3. Develop a hatchery program (similar to that used to recover the cui-ui sucker) to increase size and numbers of June sucker entering Utah Lake. Additionally, it may be necessary to locate another lake in the area for propagation and security.

4. Rehabilitate the Spanish Fork River to enable June sucker to spawn successfully in this Utah Lake tributary.

5. Monitor project developments (such as the CUP) and resolve negative impacts to the June sucker to insure that recovery efforts are not hampered.

There appears to be many similarities between the cui-ui sucker of Pyramid Lake, Nevada, and the June sucker (both are endemic to a single lake, they spawn in tributary streams, they appear to have similar life history characteristics, etc.). Several years of study have been devoted to developing propagation techniques and collecting life history information for the cui-ui sucker. Knowledge gained by these studies will be helpful in the recovery of the June sucker.

It is doubtful that June sucker in Utah Lake will ever be present in the numbers that existed during the 1880's. Many of the factors that are thought to have contributed to their decline (change in water quality, lake level fluctuation, degraded spawning habitat, and competition and predation by nonnative species) will be difficult to change. However, if this species is to be saved from extinction, an intense coordinated effort by state, federal and private entities must be made in the next several years to reverse the trend of declining numbers.

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The Status and Management of the Lahontan Cutthroat Trout (*Salmo clarki henshawi*, Snyder)

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ABSTRACT

Lahontan cutthroat trout, *Salmo clarki henshawi*, are endemic to the Pleistocene Lake Lahontan which occupied most of north and west central Nevada during maximum levels some 25,000 years ago. Lake Lahontan fluctuated widely throughout the centuries in response to climatic changes. Following a long drying trend final desiccation occurred about 8,000 years ago. Pyramid and Walker lakes are remnants. Four major stream systems including the Truckee, Carson, Walker, and Humboldt rivers also remain.

When settlers first arrived in the Lahontan drainage over a century ago, *S. c. henshawi* were reported to have existed in waters throughout the basin. It is suspected that Lahontan cutthroat trout occurred in most of the cooler, perennial streams downstream from impassable falls. At least 6100 km of stream habitat fall into this category. In addition, *S. c. henshawi* are known to have occurred in 11 lakes with a combined surface area exceeding 135,000 ha. The majority of *S. c. henshawi* habitat existed in five major subbasins: those of the Truckee, Carson, Walker and Humboldt rivers and the subbasin encompassing the Smoke Creek and Black Rock deserts. Lahontan cutthroat trout also likely occurred in the Honey Lake subbasin during historic times.

Adult cutthroat trout within Lahontan Basin waters probably numbered in the millions during the early part of the last century. Some lake populations such as those in Lake Tahoe and Pyramid and Walker lakes were large enough to support thriving commercial fisheries. In exceptional years the combined commercial catch exceeded 120,000 kg.

Pure self-sustaining stocks of Lahontan cutthroat today are limited to headwater streams within the Humboldt River drainage, to Summit and Independence lakes, and to several small tributaries of the Truckee, Carson and Walker rivers. In 1982 Lahontan cutthroat trout were known to occur in 87 streams with 400 km of occupied habitat and two lakes with 524 ha of habitat. This amounts to about 7% of the historic stream habitat and 0.4% of the historic lake habitat. These waters supported an estimated 25,000 adult Lahontan cutthroat trout in 1982. Populations in Walker and Pyramid lakes which are artificially maintained are not included in the above figures. A small number of additional populations, 15 as of 1982, have been established outside the Lahontan basin in both California and Nevada by transplants and stocked hatchery reared fish by each of these states. These waters supported over 2000 adult trout in 1982.

Present Lahontan cutthroat trout populations are probably less than 1% of historic levels. The drastic decline in the abundance of Lahontan cuttrhoat trout prompted the U. S. Fish and Wildlife Service to list it as an endangered species in 1970. It was reclassified as threatened in 1975 to facilitate management and allow angling.

Obstruction of spawning migrations and streamflow depletion following the construction of dams and diversions on Truckee and Walker rivers are primarily responsible for the elimination of naturally produced trout from Pyramid, Winnimucca, and Walker lakes. Introduction of nonnative trout and resulting hybridization and competition are thought to be largely responsible for the elimination of cutthroat trout from other lakes and streams within the drainages of the Truckee, Carson, and Walker rivers. A combination of factors including displacement by nonnative trout, stream flow depletion below diversions and stream habitat degradation resulting from livestock grazing have reduced the range of endemic cutthroat trout in the drainages of the Humboldt and Quinn rivers.

Stream surveys have been completed for 72 cutthroat trout waters within the Lahontan basin. In the Humboldt River drainage 46 streams, 72% of those surveyed, were in only fair to poor condition. In the western portion of the drainage two streams, 22% of those surveyed, were in fair to poor condition. Within the Humboldt River drainage, nonnative trout were mixed with cutthroat trout populations in 24 streams (37%) of those surveyed. Within the western portion of the Lahontan basin, two waters (22%) of those surveyed contained mixed populations.

Both California and Nevada have developed programs for reestablishing the Lahontan cutthroat trout in former habitat. Management plans also recommend additional stream inventories, population monitoring, habitat protection and improvement, and special regulations for controlling angling mortality. State programs will be incorporated into a recovery plan now being prepared by the U. S. Fish and Wildlife Service.

California and Nevada management plans recommend restoration of endemic races of cutthroat trout in 15 to 30 streams within the Lahontan drainage. Since 1970, six new populations occupying 28 km of habitat have been established in Lahontan basin streams. Habitat improvement projects involving livestock exclosures and installation of pool and cover producing structures have been initiated on eight streams. Special regulations and angling closures existed on eleven waters in 1982. Additional special regulations will be enacted as needed and additional habitat improvement is proposed.

In order to improve sportfishing, hatchery reared cutthroat trout are stocked annually in several dozen coldwater reservoirs and lakes in California and Nevada, including Walker and Pyramid lakes. Lahontan cutthroat, because of their tolerance to highly alkaline waters and their ability to utilize nongame fish as forage to reach trophy size, are expected to play an increasingly significant role in fisheries management in California and Nevada.

Present efforts to maintain and expand Lahontan cutthroat trout populations will hopefully prevent extinction of the subspecies.

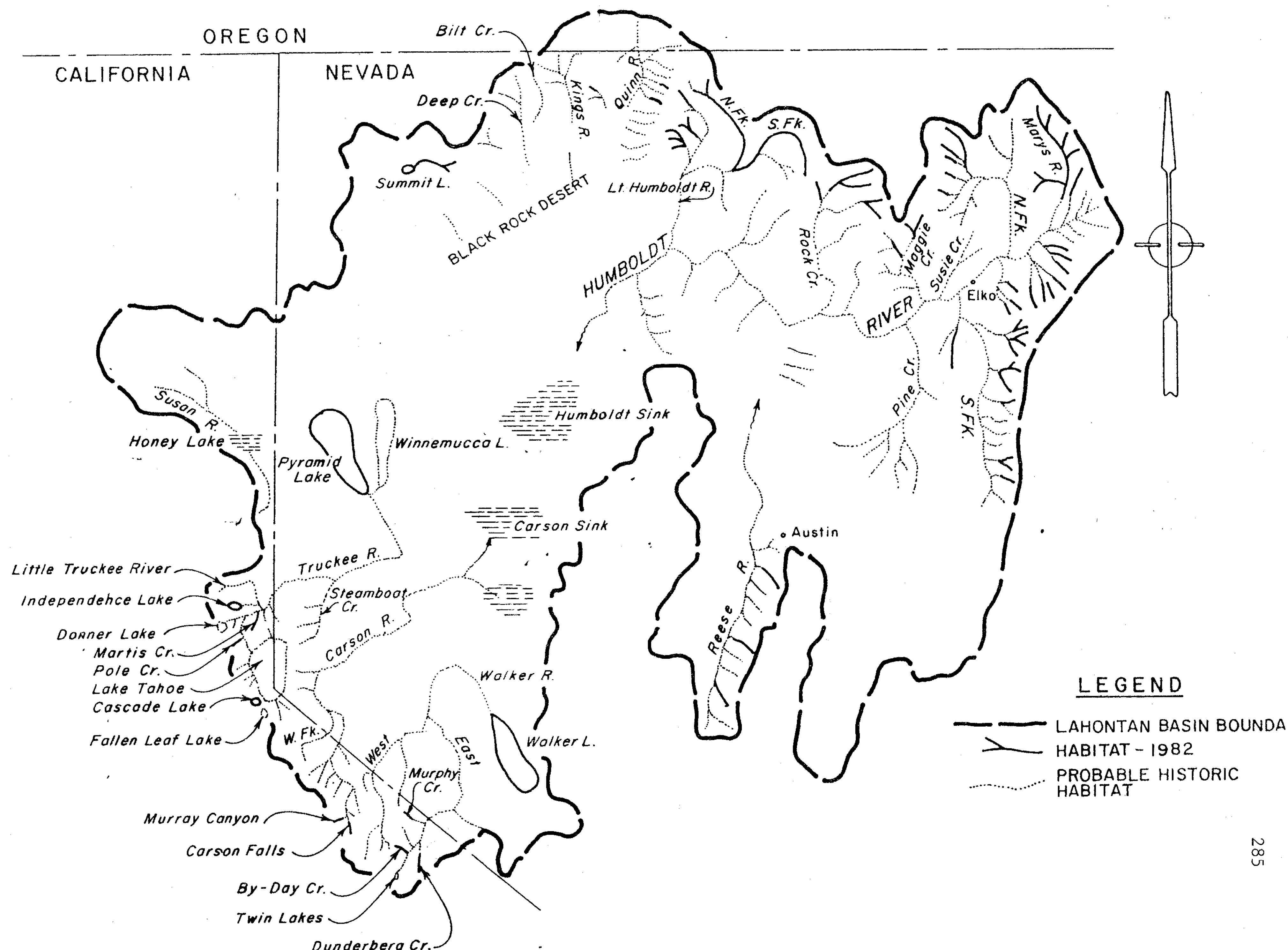
OREGON
CALIFORNIA
NEVADA
Bilt Cr.
Deep Cr.
Summit L.
Kings R.
Quinn R.
N.Fk.
S.Fk.
Lt. Humboldt R.
BLACK ROCK DESERT
HUMBOLDT
RIVER
Rock Cr.
Maggie Cr.
Susie Cr.
Elko
N.Fk.
Marys R.
Pine Cr.
S.FK.
Susan R.
Honey Lake
Pyramid Lake
Winnemucca L.
Humboldt Sink
Carson Sink
Austin
Reese R.
Truckee R.
Steamboat Cr.
Carson R.
Walker R.
Walker L.
W. Fk.
West
East
Murphy Cr.
Little Truckee River
Independehce Lake
Donner Lake
Martis Cr.
Pole Cr.
Lake Tahoe
Cascade Lake
Fallen Leaf Lake
Murray Canyon
Carson Falls
By-Day Cr.
Twin Lakes
Dunderberg Cr.
LEGEND
LAHONTAN BASIN BOUNDA
HABITAT - 1982
PROBABLE HISTORIC HABITAT

TABLE 1. Probable Historic Lahontan Cutthroat Trout Waters and Habitat Currently Supporting Self-sustaining Populations.

	Historic Habitat		Known Occupied Habitat (1982) Self-sustained		Known Occupied Habitat (1982) Artificially Maintained	Estimated Self-Sustained Population (fish >150 mm FL) 198
	Stream (km)	Lake (ha)	Stream (km)	Lake (ha)	Lake (ha)	
Honey Lake Drainage	250	None	None	None	None	None
Truckee System	600	115,000	5	284b/	45,000	200
Carson System	500	None	17	None	None	700
Walker System	600	20,000	6	None	15,000	500
Humboldt System	3,500	None	374	None	None	23,000
Black Rock Desert System (including Quinn River)	640	None	17	None	None	Few
Summit Lake Drainage	10	240	10	240	None	2,000d/
Total	6,100	135,240a/	429	524	60,000c/	26,400

a/Includes Walker, Pyramid, Winnemucca, Tahoe, Independence, Donner, Cascade, Fallen Leaf, Upper Twin and Lower Twin lakes in addition to Summit Lake.

b/Independence Lake.

c/Pyramid and Walker lakes.

d/Natural reproduction at Summit Lake is responsible for about 2,000 spawners. Additional spawners (1,000-3,000) are produced by stocking.

TABLE 2. Known Populations of Pure *S. clarki henshawi*

Name of stream	Occupied habitat (km)	Other salmonids present[e]	Habitat quality[d]	1981 Est. pop. of CTL >150 mm[f]	Test section pop. density CTL >150 mm/km
TRUCKEE RIVER BASIN					
Independence Creek	1.6	BT,KOK	Good	NA	c/
Pole Creek	2.4a/	None	Good	100	50
CARSON RIVER BASIN					
East Fork Carson River	8.0b/	None	Good	400	50
Golden Canyon Creek	2.0a/	None	Good	20	10
Murray Canyon Creek	4.0b/	None	Excellent	200	50
Poison Flat Creek	1.6b/	None	Good	100	60
Raymond Meadows Creek	1.6a/	None	Fair	Stocked 1982	-
WALKER RIVER BASIN					
By-Day Creek	3.2	None	Fair	300	100
Murphy Creek	3.0b/	None	Fair	200	200
Total	27.4			1,320	

a/ Established by recent stocking.

b/ Established by transplants or stocking prior to 1940.

c/ Occupied by adults only during spawning period (Mean of about 60 spawners annually).

d/ These ratings are based on an analysis of bank stability, bank cover, pool-riffle ratio, pool quality, and substrate quality.

e/ BT=brook trout, KOK=kokanee salmon.

f/ Genetic purity of all listed populations have been confirmed by electrophoresis.

TABLE 3. Known Populations of *S. clarki henshawi* Within the Nevada Portion of the Lahontan Basin[a]

Water	Occupied habitat (km)	Other salmonids[e]	Habitat quality[b]	Test section pop. density CTL >150 mm/km
HUMBOLDT RIVER SYSTEM				
ROCK CREEK SUBBASIN - 100% surveyed.				
Rock Creek	16.0	None	Poor	80[f]
Lewis Creek	6.1	None	Fair	20
Frazier Creek	2.4	None	Poor	140[f]
Nelson Creek	4.0	None	Fair	30
Toejam Creek	9.6	None	Poor	20
Willow Creek	1.6	RT, BT	Fair	Obs.
MAGGIE CREEK SUBBASIN - 100% surveyed				
Maggie Creek	6.4	BN	Poor	50
Coyote Creek	7.7	None	Fair	140[f]
Beaver Creek	4.5	None	Fair	160
William Canyon Creek	1.6	None	Poor	Obs.
NORTH FORK HUMBOLDT RIVER SUBBASIN - 100% surveyed				
North Fork Humboldt	32.0	BT	Good	80[f]
Gance Creek	6.4	None	Poor	30[f]
Mahala Creek	4.8	None	Poor	Few
Jim Creek	0.4	None	Poor	Obs.
Foreman Creek	20.8	None	Poor	Few
California Creek	1.6	None	Fair	30[f]
Cole Canyon Creek	1.6	None	Good	30
MARYS RIVER SUBBASIN - 100% surveyed				
Marys River	40.0	BT	Poor	5[f]
West Fork Marys River	6.4	None	Good	20
Marys River Basin Creek	4.0	None	Fair	30
Gaws Creek	0.1	None	Excellent	40
Cutt Creek	8.0	None	Poor	10
Williams Basin Creek	0.4	None	Fair	20
Chimney Creek	3.2	None	Poor	50
Tea (T) Creek	5.1	None	Poor	20[f]
Anderson Creek (Lower T)	3.2	None	Poor	Obs.
Draw Creek	2.4	None	Fair	Obs.
Wildcat Creek	1.6	BT	Good	50

a/ From Coffin 1981.
b/ These ratings are based on an analysis of bank stability, bank cover, poor-riffle ratio, pool quality, and substrate quality.
c/ Established by recent transplant.
d/ Genetic purity of populations in Quinn River tributaries remains to be confirmed by electrophoresis.
e/ RT=rainbow trout, BT=brook trout, BN=brown trout, Int.=introgressed population, NA=not available, and Obs.=observed.
f/ Purity confirmed by electrophoresis.

TABLE 3 (Cont.)

Water	Occupied habitat (km)	Other salmonids[e]	Habitat quality[b]	Test section pop. density CTL >150 mm/km
MARYS RIVER SUBBASIN - (Cont.)				
Conners Creek	1.6	None	Good	50
Hanks Creek	22.4	None	Fair	20
Camp Draw Creek	0.3	None	Excellent	150
Basin Creek	0.8	None	Poor	Obs.
Current Creek	2.4	RT, BT, Int.	Poor	Few
LITTLE HUMBOLDT RIVER SUBBASIN - Mostly unsurveyed				
South Fork Little Humboldt	22.0	None	Poor	80[f]
Sheep Creek	1.9	None	Fair	20
Secret Creek	2.4	None	Poor	20
Pole Creek	NA	None	NA	Obs.
North Fork Little Humboldt	NA	BN, RT	Good	Obs.[f]
Solid Silver Creek	NA	NA	Fair	Obs.
Mullinex Creek	NA	BT	Good	Obs.
North Fork Indian Creek	NA	NA	Good	Obs.
South Fork Indian Creek	NA	NA	NA	Obs.
Road Creek	NA	NA	NA	Obs.
Lye Creek	NA	BT	NA	Obs.
Big Cottonwood Creek	NA	NA	NA	Obs.
Little Cottonwood Creek	1.0	BT	Good	Obs.
SOUTH FORK HUMBOLDT RIVER SUBBASIN - 68% surveyed				
Carville Creek	2.0	None	Fair	170
North Fork Green Mountain Cr.	6.1	BT	Fair	20[f]
McCutcheon Creek	4.0	BT	Fair	30
Middle Fork Smith Creek	9.6	None	Fair	30
North Fork Smith Creek	3.7	BT	Good	50
Smith Creek	3.7	BT, BN	Poor	40[f]
Gennette Creek	4.8	BT	Good	120
Rattlesnake Creek	2.0	BT	Excellent	30
Long Canyon Creek	4.8	RT, BT	Good	40[f]
Segunda Creek	1.6	None	Fair	210
Mahogany Creek	NA	None	NA	High
Mitchell Creek	2.0	None	Good	96
North Fork Mitchell Creek	0.4	None	Good	40
Pearl Creek	0.4	BT	Good	Low
Dixie Creek	11.2	None	Poor	167
Cottonwood Creek	0.4	None	NA	Low
EAST FORK HUMBOLDT RIVER SUBBASIN - Mostly unsurveyed				
Fourth Boulder Creek	6.2	None	Fair	High
North Fork Cold Creek	2.8	BT	Fair	Low
Conrad Creek	0.2	None	Fair	Low[f]

Water	Occupied habitat (km)	Other salmonids[e]	Habitat quality[b]	Test section pop. density CTL >150 mm/km
REESE RIVER SUBBASIN - 39% surveyed				
Marysville Creek	8.0	BT	Fair	Med.[f]
Tierney Creek	12.0	BT	Fair	Med.[f]
Crane Canyon Creek	1.6	None	Excellent	High[f]
Cottonwood Creek	3.2	RT, BT, BN	Good	High
Washington Creek	11.2[c]	None	Fair	High[f]
Mohawk Creek	4.8	None	Good	Few
Stewart Creek	1.6	RT, BT, BN	Good	Obs.
PINE CREEK SUBBASIN - 19% surveyed				
Trout Creek	3.2	RT	Poor	Low
ELKO REACH - 100% surveyed				
Sherman Creek	3.2[c]	None	Fair	Low
WINNEMUCCA REACH - 100% surveyed				
Rock Creek (Sonoma Range)	3.0	BT	Poor	Low
BLACK ROCK DESERT SYSTEM				
SUMMIT LAKE SUBBASIN				
Mahogany Creek	5.7	None	Good	--
Summer Camp Creek	2.4	None	Fair	--
QUINN RIVER SUBBASIN[d]				
Washburn Creek	3.8	None	Poor	Med.
Riser Creek	2.0	None	Poor	Med.
Flat Creek	1.0	BT, RT	NA	Low
Eightmile Creek	1.0	None	NA	Low
Crowley Creek	4.0	None	NA	Low
Threemile Creek	3.0	None	Poor	Med.
Willow Creek	1.8	BT, RT	Good	Med.
Rebel Creek	0.1	BT, RT	Poor	Low

Probable Lahontan Cutthroat Trout Streams Without Current Inventories

Stream	Drainage
Stoddard Creek	South Fork Humboldt River
North Furlong Creek	" " " "
Kleckner Creek	" " " "
Box Canyon Creek	" " " "
Echo Canyon Creek	" " " "
Snell Creek	Lamoille Creek
Talbot Creek	" "
Thorpe Creek	" "
Little Thorpe Creek	" "
McConnel Creek	Quinn River

Stream	Drainage
Andorna Creek	Quinn River
Falls Creek	" "
Horse Creek	" "
Cabin Creek	Little Humboldt River
Abel Creek	" " "
Long Canyon Creek	" " "
Dutch John Creek	" " "
Martin Creek	" " "
Elder Creek	Interior drainage
Hill Creek	Reese River
Decker Creek	Big Smokey Valley
Illipah Creek	Jakes Valley
Edwards Creek	Edwards Valley
Marshall Canyon Creek	North Fork Mokelumne River

Introgressed Populations in California and Nevada

Dunderberg Creek (Dog Creek)	Walker River
Desert Creek	Walker River
Trout Creek	Pine Creek
Currant Creek (lower)	Marys River
North Fork Humboldt River (lower)	Humboldt River
Kings River	Quinn River
Bilk Creek	Quinn River
Kings River	Quinn River
Martis Creek	Truckee River

California and Nevada Streams Recently
Stocked with Lahontan Cutthroat Trout

Stream	River System	Year Stocked
Jacks Valley Creek	Carson	1983
West Fork Grey Creek	Truckee	1983
Bodie Creek	Walker	1983
Pete Hansen Creek	Pine Valley	1983

Artificially Maintained Lake Populations
in California and Nevada

Water	Occupied Habitat (ha)
Heenan Lake	52
Martis Lake	28
Marlette Lake	154
Pyramid Lake	44,670
Walker Lake	15,000
Miscellaneous small lakes	

TABLE 4. Known Populations of *S. clarki henshawi* in California and Nevada Outside the Lahontan Basin.

Name of Stream	Occupied Habitat (km)	Other Salmonids Present	Habitat Quality[b]	1982 Est. Pop. of CTL 150 mm[d]	Test Sect. Pop. Density CTL 150 mm per km
YUBA RIVER SYSTEM					
Macklin Creek	1.6	None	Excellent	500	300
East Fork Creek	0.8	None	Good	50	40
Trib. to East Fork Cr.	1.1	None	Fair	50	100
STANISLAUS RIVER SYSTEM					
Disaster Creek	3.2	None	Excellent	300	100
SAN JOAQUIN RIVER SYSTEM					
Portuguese Creek	2.4	None	Good	100	60
Cow Creek	3.2	None	Fair	150	100
OWENS RIVER SYSTEM					
O'Harrel Canyon Creek	1.3	None	Fair	100	100
SNAKE RIVER SYSTEM					
West Fork Deer Creek	4.0[c]	BT, RT	Good	Low	Low
NEVADA INTERIOR DRAINAGES					
Decker Creek	NA	None	NA	NA	NA
Mosquito Creek	NA[c]	None	NA	NA	NA
Shoshone Creek	4.8	None	Excellent	500	100
Santa Fe Creek	4.8	None	Excellent	500	100
Donner Creek	3.2[a]	None	NA	80	25
Bettridge Creek	4.0[a]	None	NA	Few	Few
Total	34.4			2,330	

a/ Situated in Bonnieville Drainage partially in Utah. Cutthroat trout from Pilot Creek were transplanted to Bettridge Creek in 1979.

b/ These ratings are based on an analysis of bank stability, bank cover, pool-riffle ratio, pool quality, and substrate quality.

c/ Recently established population.

d/ Genetic purity of Santa Fe Creek population and all listed California populations have been confirmed by electrophoresis.

THE AMARGOSA TOAD, 1983: DISTRIBUTION AND HABITAT. John A. Maciolek, Natl. Fishery Research Center, Bldg. 204 - Naval Station, Seattle, WA 98115

Abstract

The Amargosa toad, now recognized as a distinct species (Bufo nelsoni Stejneger 1893), is endemic to the upper Amargosa River Basin, Nevada. Historically, it was reported from at least seven sites. Because the toad was found at only two sites in recent years, an extensive survey of known and potential habitats was made from July to November, 1983. The species was found at 13 sites in Oasis Valley and adjacent springs, and residents indicated its presence at nine additional sites. The toad apparently exists in moderate abundance as five subpopulations between Beatty and the upper limits of Oasis Valley.

The most important component of the toad's habitat is open ponds or pools for breeding, oviposition, and larval development. Another component needed is terrestrial subsurface shelter (in rodent burrows, under rocks, etc.). Although some original toad habitat has obviously been degraded or lost following human settlement of the area, other habitat has been created or enhanced at homes and ranches by development of protected ponds and marshy pastures. Results of this survey suggest that the Amargosa toad is an adaptable species whose existence is not presently threatened.

Introduction of Gila topminnow and desert pupfish on public lands in Arizona

William G. Kepner[1] and James E. Brooks[2]

Abstract--The Phoenix District Office of the Bureau of Land Management and the Arizona Game and Fish Department have evaluated potential introduction sites for Gila topminnow (*Poeciliopsis o. occidentalis*) to mitigate the recent loss of the Cocio Wash population. Additional sites were evaluated for desert pupfish (*Cyprinodon m. macularius*) introduction under existing interagency agreements. Introduction of endangered species is now authorized under the Endangered Species Act as amended by Public Law 97-304, Sec. 10j (Experimental Populations), 13 October 1982. Introduction of topminnow and pupfish into suitable sites is intended to reestablish self-sustaining populations of both species within a significant portion of their historic range, result in their eventual recovery leading to delisting, and is consistent with the U.S. Fish and Wildlife Service (Region 2) Topminnow Draft Recovery Plan. Topminnow and pupfish introductions are not anticipated to interrupt existing land uses or restrict future management options.

Resumen--La oficina del distrito de Phoenix de la Agencia de Manejo de Terrenos (Bureau of Land Management) y el Departamento de Caza y Pesca de Arizona (Arizona Game and Fish Department) han evaluado sitios potenciales para la introducción del Gila topminnow (*Poeciliopsis o. occidentalis*) para mitigar la perdida reciente de la población de Cocio Wash. Además, se evaluaron sitios adicionales para la introducción de desert pupfish (*Cyprinodon m. macularius*) bajo acuerdos existentes entre agencias. Ya se autoriza la introducción de especies enpeligradas bajo el Acto de Especies Enpeligradas como fue amendado por la Ley Publica 97-304, Sec. 10j (Poblaciones Experimentales) del 13 de Octubre, 1982. La introducción del topminnow y pupfish a los sitios apropiados se hace con intento a restablecer poblaciones de ambas especies sobre una parte significante de sus extensos históricos que se sostendrán por sus propios recursos, hecho que puede resultar en sus recuperaciones eventuales a niveles que se permitirán quitarlas de la lista de especies enpeligradas. Esto está de acuerdo con el Plan Propuesto para Recuperación del Topminnow del Servicio de Pesca y Fauna Silvestre de Los Estados Unidos. No se espera que las introducciones vayan a interrumpir usos existentes de los terrenos ni limitar alternativas futuras de manejo.

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ABSTRACT

STRUCTURE OF THE FISH COMMUNITY OF A SMALL LAHONTAN DRAINAGE STREAM

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A small but morphologically diverse fish assemblage of Martis Creek, a tributary to the Truckee River in California, was examined to see if it fit an equilibrium model of community structure. The persistence and resilience of the assemblage was examined in four stream sections over five years. During the fourth year, resource utilization by habitat, microhabitat and diet was measured. Species composition in each section proved to be persistent and resilient, although there were differences in composition among sections reflecting differences in physical characteristics. The six most abundant species were strongly segregated by habitat, microhabitat, and/or diet. In most species young-of-year were ecologically segregated from the adults as well, increasing the functional complexity of the assemblage. The fish assemblage observed in Martis Creek has the characteristics of an equilibrium community and its structure is probably characteristic of the cold water streams of North America that contain the same or similar species. This study demonstrates that the waters of arid western basins are excellent sites for studies of community ecology as they are typically small in size, comparatively low in species richness, and often subject to environmental perturbations that can be regarded as natural experiments.

ESTRUCTURA DE LA COMUNIDAD PESQUERA DE UN PEQUENO ARROYO DEL RIACHUELO DE DRENAJE LAHONTAN

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Se examinó un pequeno agrupamiento pesquero, de morfologí́a variada en el Arroyo Martis. Dicho arroyo es un tributario de Río Truckee en California. El agrupamiento pesquero fué examinado para determinar si se acomodaba a un modelo de equilibrio de estructura comunitaria. La persistence y resilience de dicho agrupamiento fueron examinados en cuatro secciones del arroyo por un término de 5 años. Durante el cuarto año, se midió la utilizatión de recursos de la habitación, la micro-habitación, y la dieta.

Se comprobó que la composición de las especies en cada sección es (persistente y resilience aunque se observaron algunas diferencias en la compósición de las secciones que reflejan las diferencias en las caracteristicas físicas de dichas secciones. Las séis (6) especies mas abundantes estaban fuertemente divididas por medio de la habitación, la micro-habitación y/o la dieta. En la mayoría de las especies hasta los <u>recien nacidos</u> estaban ecológicamente segregados de los adultos, lo que contribuyó al aumento de la complejidad funcional del agrupamiento.

El agrupamiento pesquero que se estudió en el Arroyo Martis tiene las caracteristicas propias de una comunidad en equilibrio y su estructura es probablemente típica de la de los arroyos de agua fría de Norte America que contienen las especies similares.

Este estudio demuestra que las aguas de las cuencas occidentales son sitios apropiados para el estudio de ecología de comunidades debido a que son típicamente pequenos en numero, de un índice bajo en cuanto a variedad de especies, y, a menudo, sujetos a perturbaciones del medioambiente que pueden ser consideradas como experimentos naturales.

REPRODUCTION OF COLORADO SQUAWFISH, PTYCHOCHEILUS LUCIUS, IN THE YAMPA RIVER, COLORADO (1980-83)

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Abstract. Small mesh (1.6 mm) seine collections of Colorado squawfish (Cyprinidae: Ptychocheilus lucius Girard) young-of-the-year (YOY) were made in the lower 145-km reach of the Yampa River (Moffat Co., Colo.) during 1980-83. Downstream transport (drift) was also investigated in 1983 using 0.5-m^2, 560 μ, plankton nets at 2 sites in Dinosaur National Monument. Young-of-the-year were collected by seine as early as 24 July (1981) and as late as 25 August (1980 and 1982). Total length varied from 8.6 to 29.3 mm in 1983 and 1980, respectively. Young were collected in the lower 28.8 km exclusively and were typically associated with low-velocity ($\leq$ 0.3 m/sec), shallow (0.06 - 0.3 m) shoreline habitats (i.e. embayments, concavities, backwaters and isolated backwater pools). Temperatures ranged from 19 to 28 C at specific collection points. Capture-per-unit-effort (C/f) varied from 0.19/100 m^2 (1982) to 6.02/100 m^2 (1983). Young were collected in drift nets from 20 July through 20 August with maximum density (27.1/1000 m^3) in a midnight sample from a downstream locality just above the Green River confluence. Size of drift specimens ranged from 7.3 to 9.3 mm TL on 7 July and 8-9 Aug., respectively. A single YOY collected at the upstream net location (20 July) indicated that spawning occurred to some unknown extent somewhere above km 28.8 in 1983. Assuming equal densities of drifting squawfish across the channel and at all depths, the Yampa River could have contributed 35 thousand-2.8 million YOY to the Green River in 1983. Peak spawning in 1983 (28 July - 6 Aug.), based upon estimates of YOY ages, coincided with rapidly declining flows and warming temperatures. The 1983 year-class, based upon comparative C/f, was far stronger than 1980-82. Similarly, discharge in 1983 was substantially greater than in 1980-82.

LA PROCREACION DEL SQUAWFISH, (PTYCHOCHEILUS LUCIUS,) EN EL RIO YAMPA DE COLORADO (1980-83)

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Resumen. Una malla pequeña (1,6 mm) colecciones de jábega de 'Colorado squawfish' (Cyprinidae: Ptychochielus lucius Girard) el joven del año (YOY) eran contruidas en la extensión 145-km más baja del Río Yampa (El condado de Moffat. Colorado) durante los años 1980-83. El transporte más abajo (amontonado) era examinado en el año 1983 usando 0,5-m^2, 560 μ las mallas de planctón a 2 lugares en el Dinosaur National Monument. El joven del año eran acumulado por jabega tan temprano como el 24 de julio (1981) y tan tarde como el 25 de agosto (1980 y 1982). El largo total variaba de 8,6 a 29,3 mm en el año 1983 y 1980, respectivamente. El joven era acumulado en 28,8 km mas bajo unicamente y era típicamente asociado con la velocidad baja ($\leq$ 0,3 m/s), bajo (0,06-0,3 m) habitat de la línea de la playa (esto es: abras, concavidades, remansos, y remansos aislados del brazo de río estuncado). Las temperaturas iban de 19 a 28C a lugares de colección específicos. El esfuerzo de captura por unidad (C/f) variaba de 0,19/100 m^2 (1982) a 6,02/100 m^2 (1983). El joven era acumulado en mallas de amontonar del 20 de julio hasta el 20 de agosto con la densidad máxima (127,1/1000 m^3) en una muestra del medianoche de una localidad más abajo a punto arriba de la confluencia del Green River. Las dimensiones de los especimenes de amontonamiento se extendían de 7,3 a 9,3 mm LT el 7 de julio y el 8-9 de agosto, respectivamente. Un YOY acumulado a la malla colocada a aguas arriba (el 20 de julio) indicó que la freza ocuría hasta cierto punto bastante desconocido en alguna parte arriba km 28,8 en el año 1983. Tomando desidades iquales de 'squawfish' amontonado a traves el cauce y a todas las profundidades, el Río Yampa habría contribuido a 35 mil-2,8 millones YOY al Green River en el año 1983. La máxima freza en el año 1983 (el 28 de julio - el 6 de agosto), basado en estimaciones de los edades del YOY coinciden con corrientes declinando rápidamente y temperaturas calentándose. La clase del año de 1983, basado en C/f comparativo, era más fuerte que el de 1980-82. De un modo parecido, la descarga en el año 1983 era sustancialmente más grande que la de los años 1980-82.

Age and Growth of Mohave Tui Chub *Gila bicolor mohavensis* from Two Ponds at Ft. Soda

by

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The endangered Mohave tui chub (*Gila bicolor mohavensis*) is found in two pond habitats at Fort Soda, near Baker in San Bernardino County, California. These fish, once native to the Mojave River were eliminated from it through hybridization and introgression with the Arroyo chub, *Gila orcutti*, introduced from the Los Angeles Basin. The Fort Soda habitats contain the only remaining Mohave tui chubs in the Mojave River drainage. These populations have provided stock for two successful introductions outside the Mojave River drainage.

The land manager (Bureau of Land Management) contracted with the Department of Fish and Game for a study of these habitats and the tui chub populations at Fort Soda. A portion of this study was an age and growth analysis to determine if differences exist between the two tui chub populations at Fort Soda.

The two pond habitats are of similar size but show important differences in water quality. Lake Tuendae has a surface area of 0.47 hectares (1.2 acres). Water is pumped into the lake from the well at Fort Soda. Water loss is by seepage and evaporation. Three Bats Pond has a surface area of 0.4 hectares (1.0 acres) and a surface elevation about one meter lower than Lake Tuendae.

Three Bats Pond operates as a sink. It is filled by ground water and water loss is by evaporation only. Consequently, summer conductivites and salinities are 2 to 3 times higher than those in the lake.

Tui chubs were captured using minnow traps baited with bread. Scale samples were taken from 200 fish captured in Lake Tuendae April 14, 1982, and 170 fish captured in Three Bats Pond April 15, 1982. Standard length was recorded for each fish.

Scales were read on a Bell and Howell ABR-610 microfiche projector at 48X by two independent readers. Total scale radius and radius at each annulus was recorded. The relationship of total scale radius to fish standard length is linear.

The lake population contained age groups 0+ to 4+ whereas the pond population was represented by only one fish in the 0+ age group and the remainder in age groups 1+ to 3+. The size at capture, by age are:

	Lake Tuendae			Three Bats Pond		
	$\bar{X}$ SL	SD	N	$\bar{X}$ SL	SD	N
0+	48.3	5.65	35	57.0	-	1
1+	63.8	6.05	95	65.2	3.85	71
2+	82.2	8.60	55	78.3	6.36	94
3+	103.8	8.30	11	108.0	11.77	4
4+	109.5	9.19	2	-	-	-

The backcalculated sizes at each age are:

	Lake Tuendae	Three Bats Pond
Age	$\bar{X}$ SL	$\bar{X}$ SL
1	49.1	46.9
2	72.8	64.7
3	97.9	97.4
4	103.4	-

The only significant difference in backcalculated size at age between the pond and the lake populations (Student's T-test $p < 0.05$) occurs at age 2, with the pond population having smaller fish. This does not necessarily imply that the pond is a less suitable environment for the Mohave tui chub, however.

During November 1982, a water quality problem developed in the pond that resulted in a substantial die-off of Mohave tui chubs. Observers estimated the kill at 90% or more of the tui chub population in Three Bats Pond. No absolute cause for the die-off was ever identified. This fish kill reduced the population of tui chubs >40 mm SL in the pond from an October 1981 level of 4,458 (95% CI, 2,873-9,941) to a February 1982 level of 2,177 (95% CI, 1,789-2,778) (Taylor 1982). However, Lake Tuendae, which did not experience a noticeable die-off showed a similar reduction in population size; from an October 1981 level of 5,588 (95% CI, 4.314-7,929) to a February 1982 level of 1,450 (95% CI, 1,251-1,725) (Taylor 1982).

The die-off in the pond altered the population structure by nearly eliminating all fish less than 50 mm SL. It may also have resulted in premature annulus formation.

Two other important aspects of Mohave tui chub growth were discovered from information gathered during the study. It was found that Mohave tui chubs grow very little, if at all between August and April. This phenomenon was discovered when sizes and ages from August 1981 samples from Ft. Soda (Taylor 1982) were compared to the April 1982 samples. This is probably the result of the energetic costs associated with living in a warm, saline environment during the summer and fall. Mohave tui chubs have been documented to actually loose weight between August and October in their habitat at Hinckley, California (Havelka et al. 1982).

Mohave tui chubs observed at Fort Soda in the 1981-1982 study were smaller than those studied at Fort Soda in 1970 (Vickers 1973). Few large individuals were seen during the current study and only one large (220 mm SL) individual was captured. Vickers noted that tui chubs were being fed table scraps by patrons of the Zzyzx Mineral Springs Resort. These scraps may have been a significant food source that contributed to the population's growth. The resort is no longer in operation and the chubs must now rely solely on food produced within their habitat.

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Evidence for homing in Colorado squawfish, *Ptychocheilus lucius*

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Abstract--Spawning migration of 23 radiotelemetered Colorado squawfish to two sites in the Yampa and Green rivers, 1981-1983 suggested homing behavior. Movement patterns of these fish displayed similarities to migrating salmonids, indicating olfaction as a possible mechanism used in navigation. Recaptures of Colorado squawfish indicated a year-to-year fidelity to the spawning grounds.

Colorado squawfish were reported in many early accounts (Sigler and Miller 1963) and documentary proof was obtained by Fish and Wildlife Service workers in 1981 (Tyus et al. 1981). Since that time two spawning areas have been identified in the Green River Basin of Colorado and Utah, and Colorado squawfish have been radiotracked round trip distances of 400 km in their travel to them (Miller et al. 1983, Wick et al. 1983). Movement patterns obtained from these fish display both upstream and downstream potamodromous migrations (Myers, 1949) and suggest a homing ability for which no mechanism has been identified. This paper presents evidence for the development of a homing hypothesis based on the results of Fish and Wildlife Service studies in the Green River Basin of Colorado and Utah, 1980-1983. This evidence is contrasted with hypotheses developed by others for salmon and other fish species.

METHODS

Colorado squawfish were collected primarily by electrofishing but some were also collected by seining and trammel netting. Collections were made early in the year so fish might have time to recover from surgery before the mid-summer spawning season, and to reduce the risk of secondary infection.

After their capture, the Colorado squawfish were placed into a 200 mg/L solution of tricaine methylsulfonate. When the fish were anesthesized, they were surgically implanted with radiotransmitter modules using a procedure similar to that of Bidgood (1980). Sutures were individual (usually five) rather than the continuous suture used by Bidgood, and the incision was made laterally, immediately anterior and slightly dorsal to the insertion of the right pelvic fin. Implanted fish were held five days in 1980 in order to determine the results of the surgery. Thereafter, the fish were released after implanting them in order to reduce stress associated with holding them (Hart and Summerfelt 1975).

Surgical implantation was completed with AVM company and Smith-Root Company fish transmitter modules dipped in melted beeswax. Four different modules were used that varied in weight from 10 to 23 g in air and about 3.5 to 6 g in water. The units are powered by mercury batteries and had a life from 6 to 18 months, depending on the model used. All units transmitted in the 40.660-40.700 MHz frequency range. Each transmitter had a unique signal (frequency vs pulse rate) so that individual fish could be identified. Radio receiver sets used were Smith-Root RF-40 and SR-40 models. The RF type enabled the investigator to identify any particular frequency transmitted at 40 MHz. The SR receiver was a "search" type and received all emitted frequencies in the frequency range.

Omnidirectional and pin-pointing type (bidirectional) antennas were employed. A Larson-Kulrod whip antenna was used to search for implanted fish. This antenna was mounted on a 20 cm square steel plate elevated about 4 m above the water when mounted on a boat, or mounted directly to an airplane, or helicopter strut. A Smith-Root loop antenna (directional) was used only to triangulate fish location, from boat or shore.

RESULTS AND DISCUSSION

Two spawning migrations were identified in the Green River Basin by tracking 23 radioimplanted Colorado squawfish. One migration, identified in 1981 (Figure 1) was reconfirmed in 1983 (Figure 2). A total of 14 Colorado squawfish migrated downstream and two migrated upstream to spawn in the lower 30 km of Yampa Canyon. Another migration, suspected in 1981 was confirmed by 1983 after 7 Colorado squawfish were followed to the same general area in Gray Canyon of the Green River (Figure 3). Collections made at the Yampa site in 1983 produced two Colorado squawfish tagged there in 1981 and 1982, demonstrating a fidelity to the spawning grounds.

Potamodromous migrations (Myers 1949) of North American riverine fishes have received little study in comparison with the information developed for anadromous forms. Until now, homing - a regular movement

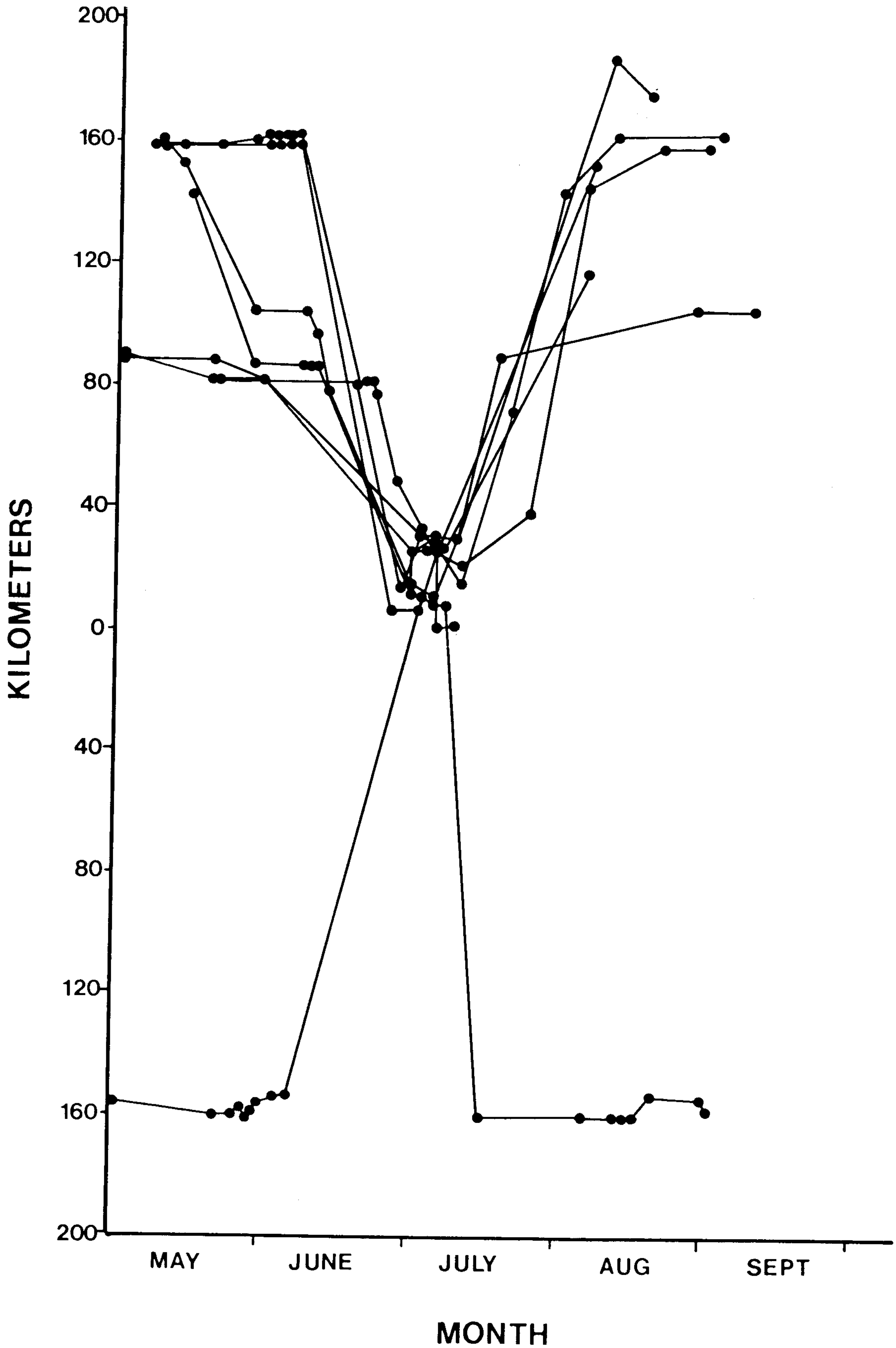

Figure 1. Migration of 8 Colorado squawfish, Yampa River, 1981.

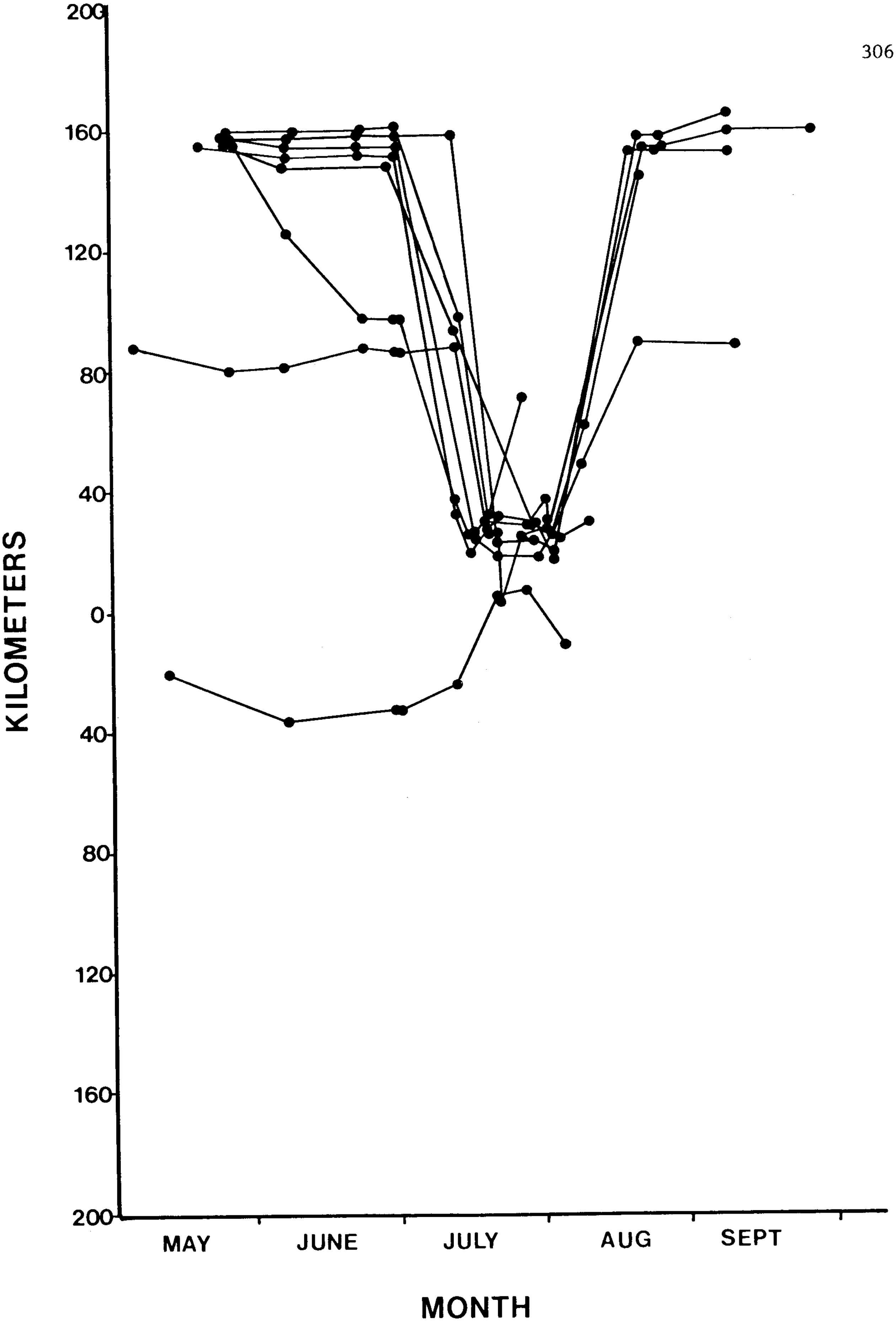

Figure 2. Migration of 8 Colorado squawfish, Yampa River, 1983.

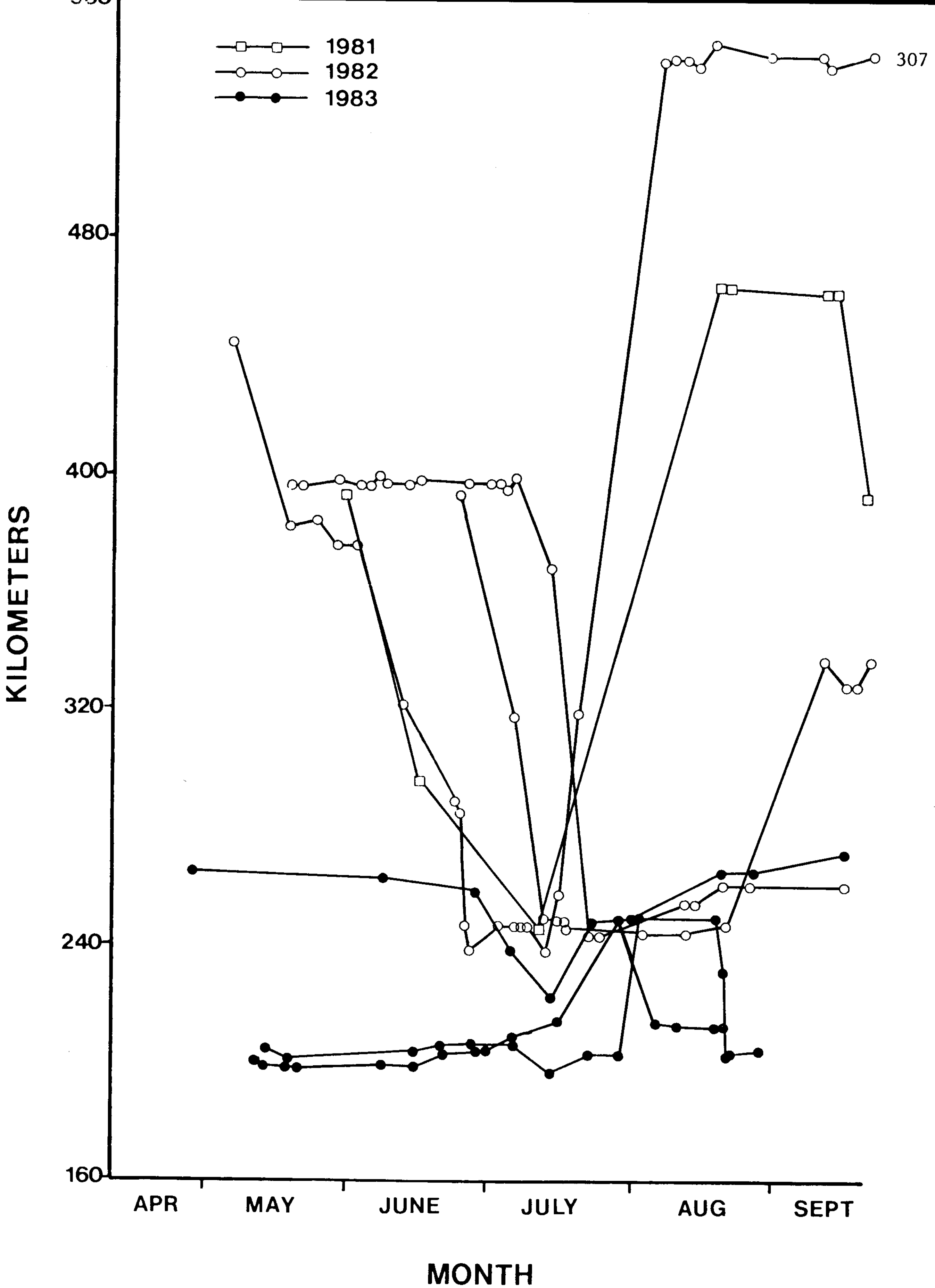

Figure 3. Migration of 7 Colorado squawfish , Green River, 1981-1983.

to a specific site (Gerking 1959) - has been most dramatically demonstrated in salmonids (Harden-Jones 1981) and most studies of potamodromous species only document short distance movements of a few kilometers. The movement patterns of Colorado squawfish (Figure 1-3) demonstrate long distance homing and their behavior is similar in many ways to that observed in migrating salmonids, including positive and negative rheotaxis in orienting to spawning grounds (Harden-Jones 1968, Hasler and Scholz 1983) and "overshooting and backtracking" (Delacy et al. 1969, Hasler and Scholz 1983).

Olfaction appears to be commonly used by fish species for navigational purposes and is more widespread than formerly believed (Leggett 1977). The initiation of spawning appears to hasten the arrival of other Colorado squawfish to the spawning area, and collections of ripe Colorado squawfish coincide very well with the location of radiotelemetered squawfish even though the fish move freely within an area of several miles. These observations are in agreement with those by Hasler and Scholz (1983) that conspecific odors act as generalized attractants and they found that salmon responded more strongly to odors of other salmon at the end of spawning season than they did to imprinting odors. Although there is no experimental evidence to date that confirms or disproves the existence of an olfactory imprinting mechanism (Hasler and Scholz 1983) to explain the migration patterns observed for Colorado squawfish, conditions at the two spawning grounds suggest that such a mechanism could be in use. Field observations of the two known spawning grounds in the Green River basin indicate these canyon areas are geohydrologically different from those upstream, and Colorado squawfish spawn in river canyons that receive freshwater input flowing from sandstone/limestone seeps. The fish may use the input of groundwater in these locations as a means of orientation, and I suggest the Groundwater Seepage Hypothesis, proposed by Harden-Jones (1980), be considered as a possible mechanism. If such a mechanism is operating, the larval squawfish would have to be imprinted at an early stage, since they drift downstream soon after hatching.

The Colorado squawfish may provide new insights into the homing mechanism of fishes, and several mechanisms (Leggett 1977) may be implicated in its ability to home to specific sites. The use of olfaction, genetic memory (Nordeng 1977) and learning should be further investigated. There is a danger, however, that this endangered fish is continuing to decline and may be extirpated from its remaining range before such investigations can be made. It appears that the strong homing behavior observed thus far in the Green River Basin is restricted to only a few sites of relatively undisturbed spawning habitat that lie upstream from productive nursery areas. This behavior may be weak or lacking in other areas of occupied Colorado squawfish range where spawning habitat has been cut off by dams, where nursery areas are poor, or where river management has degraded habitat and fostered exotic fish competitors. Because optimal reproduction may be dependent on long distance migration, obstructions to stream passage should be viewed as particularly threatening. Larval Colorado squawfish may imprint at an early age, stocking of hatchery reared squawfish that would compete with residents for food and space but which may not have the ability to home to suitable habitat and successfully reproduce, should be deferred until more information can be obtained.

ACKNOWLEDGEMENTS

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REPRODUCTIVE LIFE HISTORY OF THE LEATHERSIDE CHUB, *GILA COPEI*, IN MAIN CREEK, UTAH

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Abstract--The Leatherside chub (*Gila copei*) is a cyprinid native to parts of the Bonneville Basin and the Snake River Drainage in Idaho. *Gila copei* were collected from Main Creek, Wasatch County, Utah, between August 1978 and September 1979. The gonad index, fecundity, and condition factor all indicate that spawning occurred between late May and late June of 1979, but no fish were collected in April. Fish were mature at two years of age with the majority of the spawning fish in 1979 being from the 1977 cohort. The condition factor coincides with the peak gonad index. While fecundity alone could be used to determine spawning onset, both the gonad index and condition factor are simpler and lead to the identical conclusion that spawning occurred during the above mentioned months.

La Historia de la Vida Reproductiva del Leatherside Chub, *Gila copei*, del Arroyo Main, el Estado de Utah, Estados Unidos

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Extracto--El Leatherside chub (*Gila copei*) es un ciprínido nativo de algunos lugares de la cuenca de Bonneville y de la arroyada del río Snake del estado de Idaho. Los especímenos de *Gila copei* fueron tomados del arroyo Main, condado de Wasatch, el estado de Utah, de agosto 1978 hasta septiembre 1979. El índece de los gonados, el estado de fecundidad, y el factor de la condición corporal juntos indican que el desovar ocurrió alguna vez en la temporado de fines de mayo hasta de fines de junio pero especímenos no fueron tomadosos en el mes de abril. Los peces estaban moduros a los dos años de edad. La mayoría de los que desovaron en 1979 fueron de la cohorte de 1977. El factor de la condición corporal coincide con el apageo del índece de los gonados. Aunque se puede usar sólamente el estado de fecundidad para determinar el comienzo del desovar, ambos el índece de los gonados y el factor de la condición corporal se pueden emplear más fácilmente y resultan en la misma conclusión que el desovar ocurrió durante los meses ya indicados.

Gill-Raker Differentiation of the Tui Chub in Remnant Lahontan Waters

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Gill-raker counts have been used to distinguish between two forms of tui chub, *Gila bicolor* (Girard), which occur in remnant waters of the Lahontan basin. The forms are ecologically distinct. *G.b. obesa* is a fluvial-benthic morph with 8-19 coarse gill-rakers and an omnivorous diet. *G.b. pectinifer* is a planktivorous lacustrine-limnetic fish with 27-42 fine gill-rakers. The taxonomy of these tui chub has been quite confused: J. O. Snyder considered *obesa* and *pectinifer* to represent separate genera; Hopkirk and Behnke believe them to be specifically distinct; Hubbs and Miller call the forms separate subspecies; and LaRivers grouped both morphs together as a single subspecies.

I present gill-raker frequency distributions of tui chub from Pyramid Lake, Walker Lake, and Lake Tahoe in relation to fluvial populations (Figure 1). The inshore benthic population of Pyramid Lake is bimodal--both *obesa* and *pectinifer* are represented. The offshore-surface tui chubs have a very abundant *pectinifer* mode with a small proportion in the intermediate (20-26 raker) range. The Walker Lake population is very similar to the limnetic Pyramid one; it is represented primarily by *pectinifer* with a remnant intermediate sub-mode. Lake Tahoe tui chubs exhibit two modes; however, discrete samples indicate that schools of chubs in the intermediate range exist. Taylor Creek, a tributary to Tahoe has a unimodal *obesa* population. Likewise Long Valley Creek, which flows into the intermittant Honey Lake, has a single mode primarily in the *obesa* range.

I hypothesize that the observed patterns of tui chub gill-raker frequency distributions are associated with differential regimes of filling and desiccation of aquatic habitats within the Lahontan system over the past 10-100 thousand years. Pyramid and Tahoe Lakes essentially represent a continuity with Lake Lahontan, i.e., a stable lake and river system which never completely desiccated--thus both morphs persist. In contrast Walker Lake had an unstable river system which periodically shifted, via the Adrian Valley, to the Carson River. As a result it may have had less of a fluvial *obesa* input. At the other extreme, Honey Lake represents an unstable playa - lake which periodically desiccates, and a relatively stable fluvial system; these conditions would select for *obesa*.

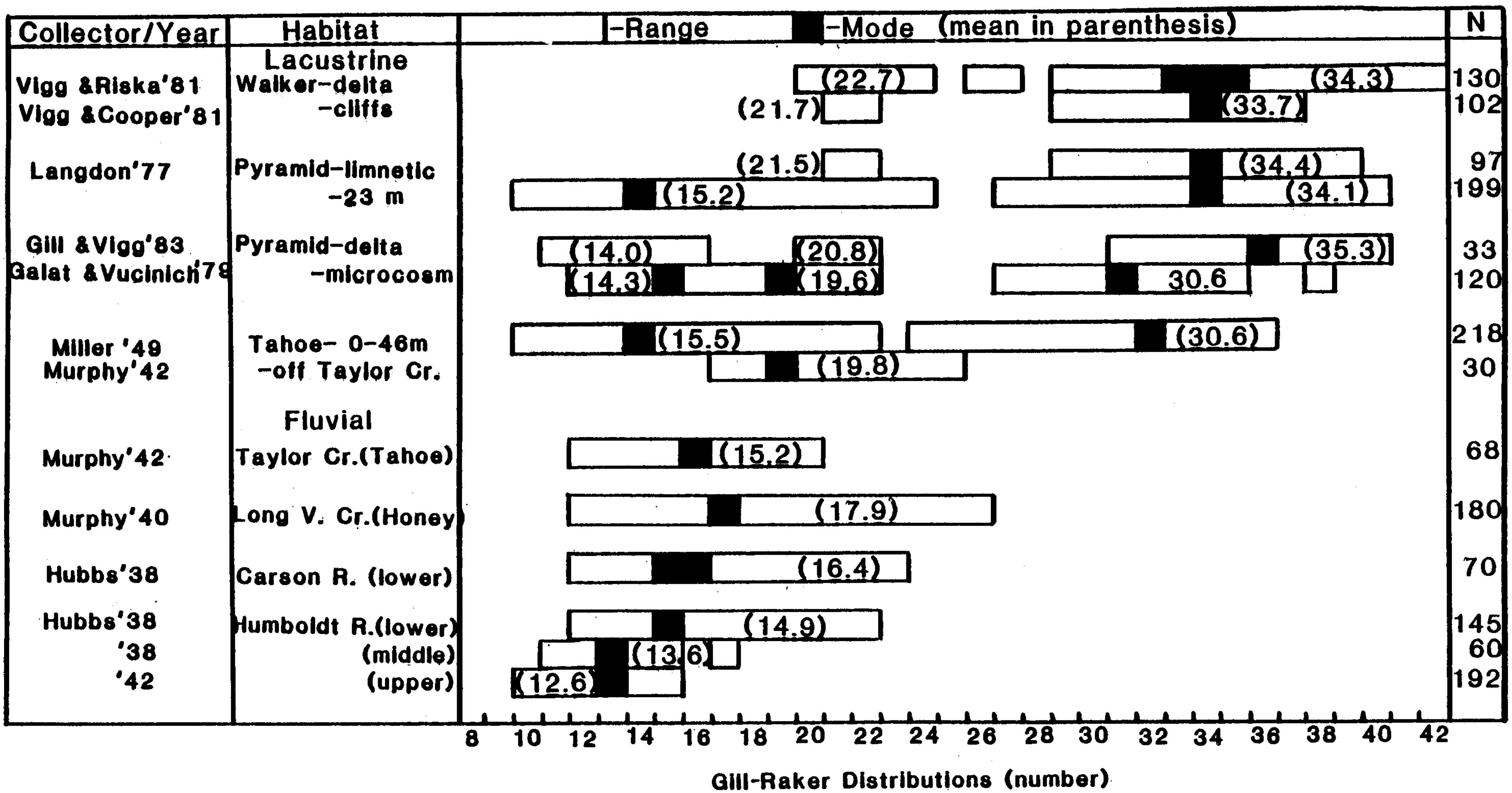

FIGURE 1. Range, mode, and mean of gill-raker frequency distributions of various lacustrine and fluvial populations of tui chub (*Gila bicolor*) within the Lahontan basin.

ASPECTS OF THE FEEDING ECOLOGY OF THE ENDEMIC BONNEVILLE CISCO OF BEAR LAKE, UTAH-IDAHO

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ABSTRACT

The Bonneville cisco (*Prosopium gemmiferum*) is one of four endemic fishes in Bear Lake. The cisco is extremely important to the trophic structure of Bear Lake because it is the principle source of forage for the native cutthroat trout and the introduced lake trout. In addition, the cisco plays a key role in converting zooplankton to fish biomass, being the only planktivore utilizing the limnetic zone of the lake. The Bonneville cisco is probably the most numerous fish in Bear Lake.

Fishery managers are also interested in the cisco for its value as a coldwater forage species. Current efforts are being made to introduce it in Flaming Gorge Reservoir, Utah-Wyoming. Also, the cisco provides a sport fishery during its January spawning run in the shallow, rocky zones of Bear Lake.

Our studies focus on the role of the cisco in the trophic structure of Bear Lake. In this paper, we look at the Bear Lake environment, aspects of the cisco's zooplankton prey, diet composition, and prey selection for the adult and subadult cisco in the metalimnion of the lake.

Bear Lake is a large, old lake located on the Utah-Idaho border. It is oval-shaped with a shoreline of 81 km, length of 34 km and width of 14 km. Physical characteristics of the lake are presented in Table 1. For an estimated 8000 years BP, Bear Lake was a closed basin lake (Robertson 1978). After 1912, the Bear River was diverted through a marsh, into Bear Lake for the purpose of water storage, irrigation and power generation.

Thousands of years of isolation produced unusual chemical characteristics in Bear Lake as noted in early limnological studies (Kemmerer et al. 1923). Those original characteristics have been altered by diversion of the Bear River and by changing land uses with increased development in the lake's watershed. Some current physical, chemical and biological parameters of Bear Lake are summarized in Table 2.

Specific habitat requirements and environmental preferences of the Bonneville cisco are not well known. During summer stratification the cisco apparently avoid the epilimnion with temperatures greater than 15°C. During

Table 1. Physical and morphometric characteristics of Bear Lake.

Surface area	282 km^2
Mean depth	30 m
Maximum depth	63.4 m
Volume	7.98×10^9 m^3
Mean Hydraulic Retention Time	48 years

1981, cisco schools were located with echo sounding equipment and in almost all cases, found in the metalimnion at depths greater than 15 m. The metalimnion of Bear Lake in 1981 was characterized by a chlorophyll a peak below 20 m and a metalimnetic maximum of oxygen (Figure 1).

The zooplankton community of Bear Lake is dominated by a large calanoid copepod, *Epischura nevadensis*, and a colonial rotifer, *Conochilus* (Figure 2). *Epischura* is the principle food item of Bonneville cisco as determined by early studies at Bear Lake (Perry 1943). Since these previous studies, additional zooplankters such as, *Diaphanosoma* have entered the community and are utilized by cisco as food. Several cladocerans (*Daphnia*, *Ceriodaphnia*, *Bosmina*, *Chydorus*) and a number of rotifers comprise the remainder of the limnetic zooplankton.

Changes in the composition of the cisco's prey from Perry's (1943) investigation were noticed during five months in 1981 (Figure 3). For example, *Diaphanosoma*, which was not present in 1943, became abundant in late summer 1981 and was utilized by cisco, providing a significant portion of the diet (Figures 2 and 3). *Daphnia* became available in December, after fall overturn, and were consumed by cisco in greater proportion than their abundance in the plankton. The rotifer *Conochilus* was available to cisco because of its colonial form. Mean colony diameter was about 1 mm and mean number of individuals per colony about 24. *Epischura*, the dominant cisco food item, had a significantly larger mean length in cisco stomachs than in the plankton. Size selection by cisco was apparent for nearly all prey species.

Recent investigations indicate that the environment in which Bear Lake endemic fishes evolved is changing (Lamarra et al. 1983). There is evidence that nutrient levels and nutrient loading in the lake are increasing the lake's trophic state. The zooplankton community in Bear Lake has also changed with the addition of several new species. With many aspects of the ecology and life

Table 2. Summary of physical, chemical, and biological parameters of Bear Lake, 1981-1982.

	YEAR					
	1981 (4-24-81 to 12-3-81)			1982 (1-19-82 to 6-22-82)		
Parameter	N	x ± S.E.	range	N	x ± S.E.	range
temperature(°C)	75	9.4 ± 0.5	2.8-21.5	48	5.2 ± 0.5	0-15.7
Secchi disc(m)	13	4.91 ± 0.34	2.9-6.6	8	4.35 ± 0.36	2.8-6.1
oxygen (mg/l)	70	8.1 ± 0.2	3.8-12.2	48	10.8 ± 0.2	9.3-14.4
pH(units)	84	8.5 ± 0.1	8.4-8.8	55	8.68 ± 0.1	8.3-9.0
total alkalinity ($mgCaCO_3/l$)	97	271 ± 1	243-338	56	262 ± 2	244-348
turbidity(NTU)	72	2.8 ± 0.4	0.7-18.0	56	1.9 ± 0.1	0.1-5.7
suspended solids(mg/l)	74	7.3 ± 1.5	0.0-56.0	55	3.07 ± .83	0-6.4
PO_4-P(ug P/l)	85	3 ± 0.3	0.0-17	55	2 ± 0.2	0-5
total P(ug P/l)	77	11 ± .6	2.0-30	55	11 ± 1.3	2-50
NH_3-N(ug N/l)	78	35 ± 3	6-146	55	16 ± 1	5-33
NO_3-N(mg N/l)	82	0.10 ± .04	<.04-.360	56	.031 ± .003	0-.097
NO_2-N(ug N/l)	77	3 ± 0.1	0-104	56	2 ± .01	0-4
total nitrogen(mg N/l)	75	0.51 ± .08	.09-2.63	56	.23 ± .007	0.13-0.43
conductivity (umhos/cm)	27	593 ± 15	490-703	45	420 ± 8	367-600
TOC(mg/l)	54	4.18 ± .24	1.9-11.80	54	3.91 ± 0.11	2.1-6.90
chlorophyll *a* * (ug/l)	34	0.59 ± .09	0.18-2.67	36	0.70 ± .04	0.18-1.61

* Surface, 10, 20, and 30 meter depth stations only

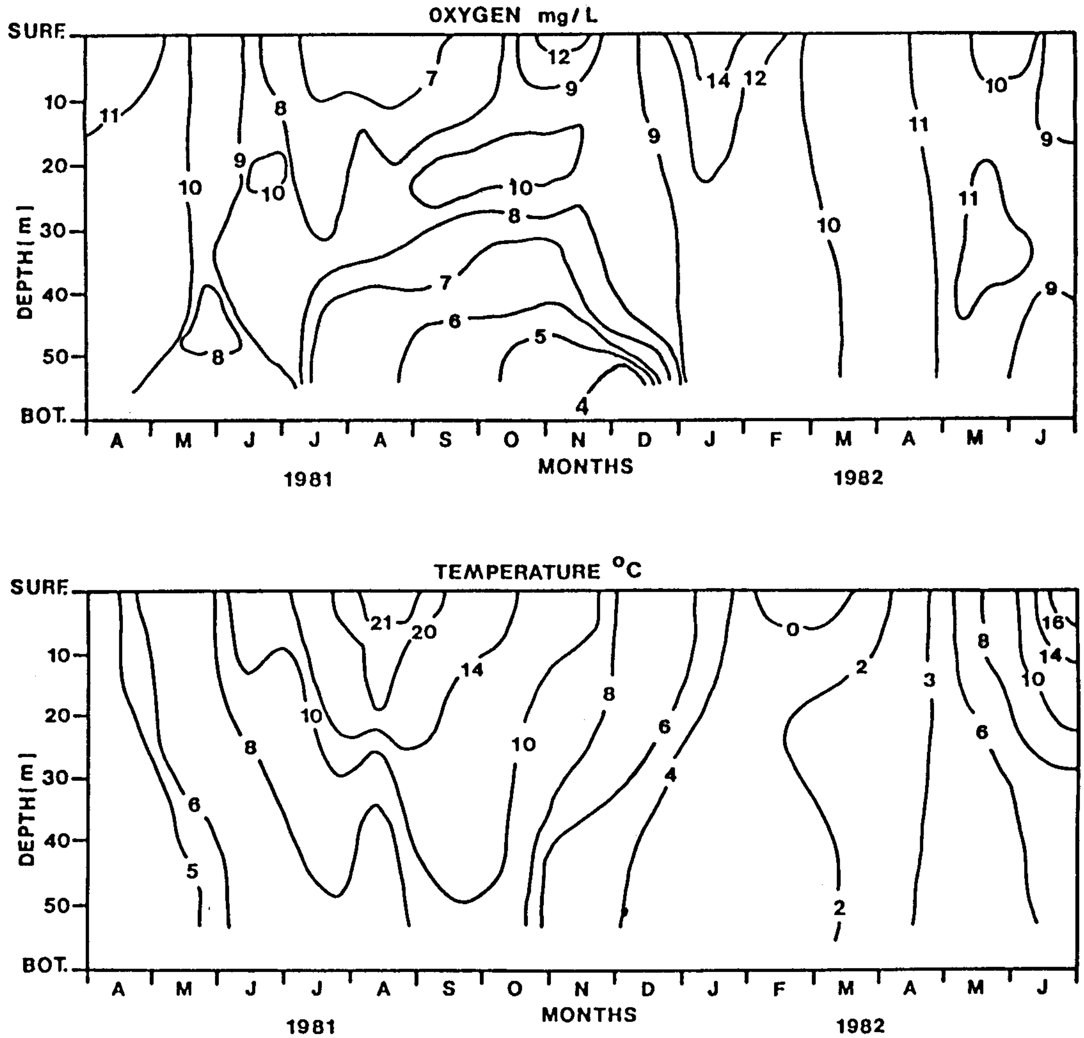

Figure 1. Temperature (°C) and oxygen (mg O_2/l) isopleths for Bear Lake, 1981-1982.

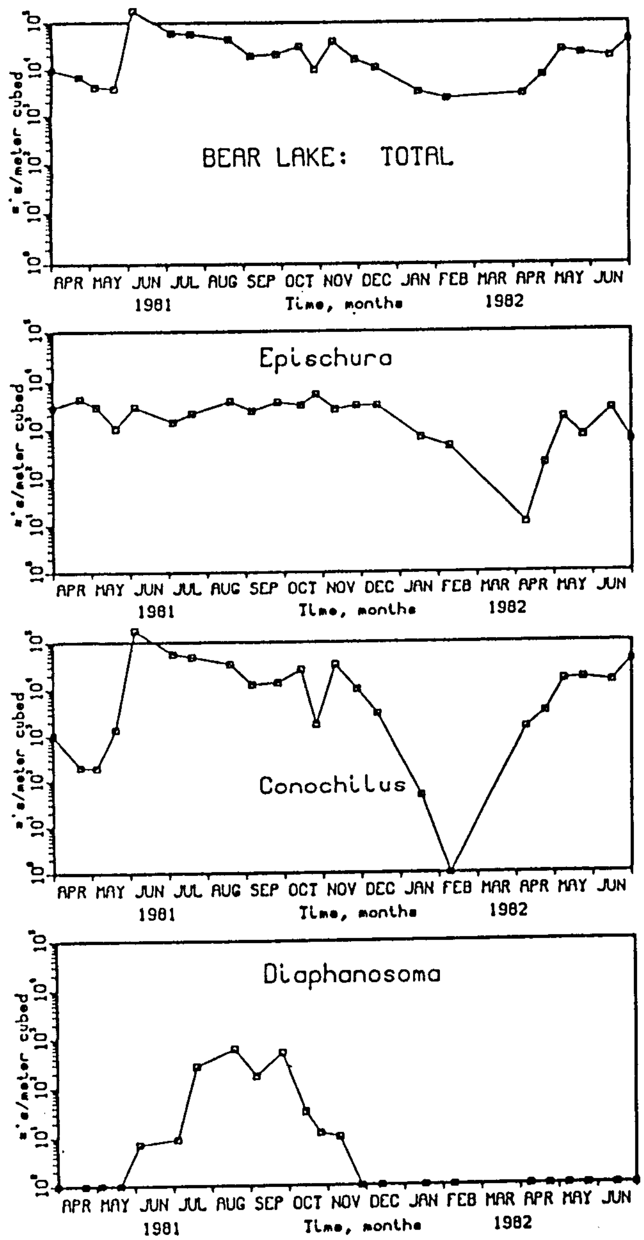

Figure 2. Density (numbers/m^3) of the Bear Lake zooplankton community during 1981 and 1982. Total community numbers are presented in top graph and plots of three important community members are presented below.

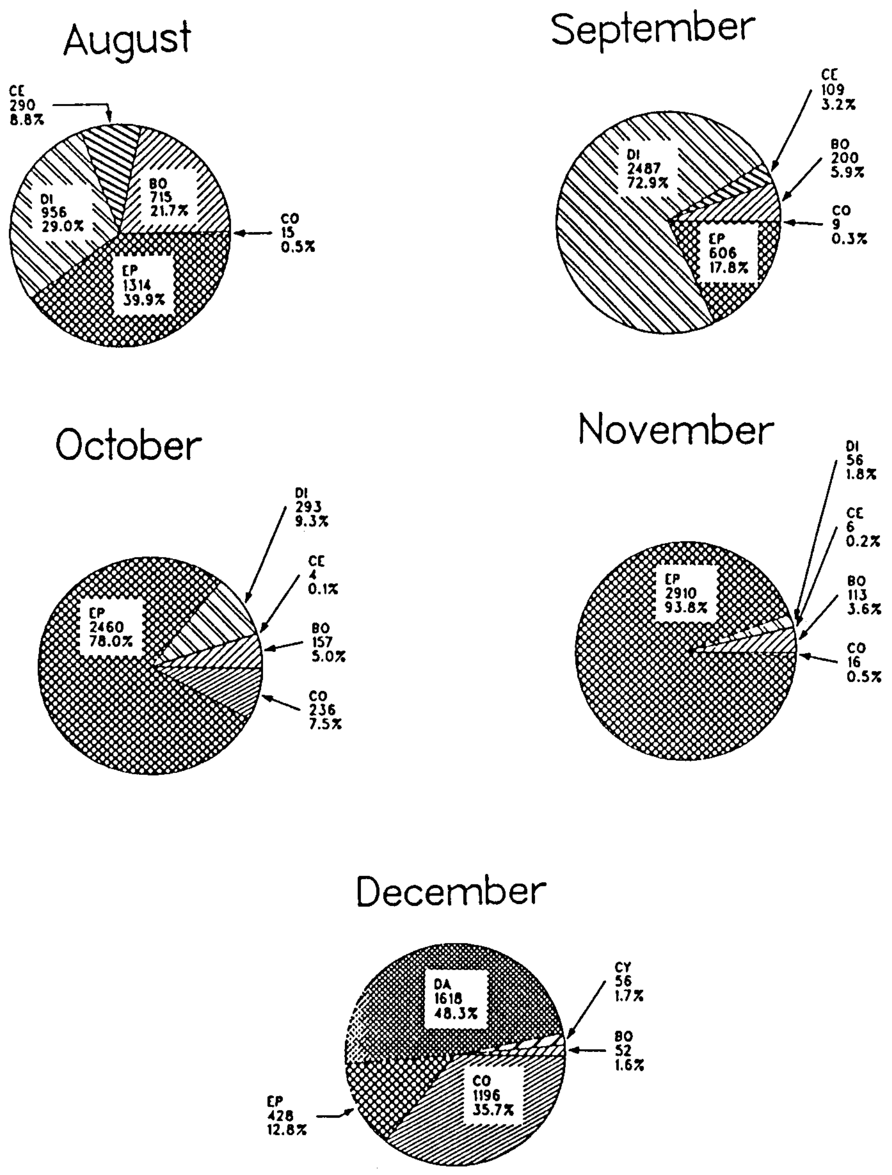

Figure 3. Cisco prey composition for five months during 1981. Pie charts represent percent composition of individual prey species from all cisco stomachs combined. (KEY: BO = *Bosmina*; CE = *Ceriodaphnia*; CO = *Conochilus* colonies; CY = *Cyclops*; DA = *Daphnia*; DI = *Diaphanosoma*; EP = *Epischura*)

history of the Bonneville cisco and the other endemic fishes largely unstudied, we wonder: What will happen to this valuable, unique ecosystem in the face of environmental change?

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ASPECTOS DE LA ECOLOGIA ALIMENTICIA DEL ENDEMICO PEZ BONNEVILLE CISCO DE BEAR LAKE, UTAH-IDAHO

por
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ABSTRACTO

El Bonneville cisco (Prosopium gemmiferum) es uno de cuatro peces endémicos de Bear Lake. El cisco es muy importante para la estructura trófica de Bear Lake porque es el manantial principio de forraje para la trucha nativa y la trucha laguna introducida. Además, el cisco representa importancia en convertiendo plancton a monton de pez, y es el único consumidor de plancton que utilisa la zona limnética del lago. El Bonneville cisco probablemente es el pez mas numeroso de Bear Lake.

Manejadores de peces tambien tienen interés en el cisco para su valor como especie forrajero de aqua fría. Esfuersos corrientes tratan de introducir lo a la Presa Flaming Gorge, Utah-Wyoming. Tambien, el cisco provée una pesca deportiva durante su corrida reproductiva de Enero en las profundas zonas piedregosos de Bear Lake.

Nuestros estudios enfocan en la parte que representa el cisco en la estructura trófica de Bear Lake. En este ensayo, examinamos el ambiente de Bear Lake, aspectos de la rapiña plancton del cisco, y selección rapiña para los ciscos adultos y subadultos en la zona media limnética del lago.

Bear Lake es un lago grande y antiguo localizado en la frontera de los estados de Utah y Idaho. Toma forma ovalada con playas de 81 km de distancia, longitud de 34 km y anchura de 14 km. Característicos físicos del lago se presentan en Tabla 1. Para aproximadamente 8,000 años BP, Bear Lake fue cuenca cerada (Robertson 1978). Despues de 1912, el Bear River fue divertido por una ciénaga a Bear Lake a propósito de almacenar aqua, riego, y producíon de potencia eléctrica.

Tabla 1. Características físicas y morfométricas de Bear Lake.

Área Superficie	282 km^2
Profundidad Promedia	30 m
Máxima Profundidad	63.4 m
Volumen	7.98×10^9 m^3
Promedio Tiempo De Retención Hidráulico	48 años

Miles de años de aislamiento producieron características químicas estraordinarias en Bear Lake como notado en pasados estudios limnológicos (Kemmerer et al. 1923). Esas características originales han sido cambiadas por diversion del Bear River y por cambios de usos de terreno con aumentación del desarollo de la cuenca. Algunos aspectos corrientes físicos, químicos y biológicos de Bear Lake son resumidos en Tabla 2.

Specíficos requerimientos de habitat y preferencias ambientales del Bonneville cisco no son bien conosidas. Durante estratificación veraniego, el cisco aparentemente evita la zona superficie limnética con temperaturas mas de 15°C. Durante el año 1981, escuelas de cisco fueron localizadas con equipo de eco sondear y en casi todos casos, se hallaron en la zona media limnética a profundidades mas de 15 m. La zona media limnética de Bear Lake en 1981 fue caracterizada por punto máximo de chlorophyl a bajo de 20 m y un máximo de oxígeno en la zona media limnética (Figura 1).

La comunidad zooplancton de Bear Lake se domina por una copepoda calanoida grande, Epischura nevadensis, y un rotífero colonial, Conochilus (Figura 2). Epischura es el artículo principal alimenticio del Bonneville cisco como determinado por estudios pasados en Bear Lake (Perry 1943). Desde estos estudios previos, zooplancton adicionales como Diaphanosoma han entrado a la comunidad y son utilizados por el cisco como alimento. Algunos cladocerans (Daphnia, Ceriodaphnia, Bosmina, Chydorus) y numerosos rotíferos comprenden el resto del zooplancton de la zona limnética.

Cambios en la composición del alimento del cisco de las investigaciones de Perry (1943) fueron notadas durante cinco meses en 1981 (Figura 3). Por ejemplo, Diaphanosoma, que no era presente en 1943, se hizo abundante en el verano de 1981, y fue utilizado por el cisco, proveniendo una parte significante de la dieta (Figuras 2 y 3). Daphnia se hizo disponible en Deciembre, despues del desvielto de otoño, y fueron consumidos por cisco en parte mayor que su abundancia en la comunidad plancton. El rotífero Conochilus fue disponible al cisco por su forma colonial. El diámetro promedio de la colonia fue aproximadamente 1 mm y numero promedio de individos por colonia aproximadamente 24. Epischura, el alimento dominante del cisco, ocurió, significatívamente, mas grande en su longitud promedia en estómagos de cisco que en la comunidad plancton. Selección de tamaño por el cisco fue aparente para casi todos los especies alimenticios.

Investigaciones recientes indican que el ambiente en que evolucionaron los peces endémicos de Bear Lake está cambiando (Lamarra et al. 1983). Hay evidencia que los niveles de nutrientes y su carga en el lago están aumentando la condición trófica. La comunidad de zooplancton en Bear Lake tambien ha cambiado con la adición de varios especies nuevos. Con muchos aspectós de la ecología y vida natural del Bonneville cisco y otros peces endémicos que quedan sin estudio, maravillamos: ¿Que pasará a este valioso, único systema ecológico en presente de cambios ambientales?

Tabla 2. Sumario de parámetros físicos, químicos, y biológicos de Bear Lake, 1981-1982.

	YEAR					
	1981 (4-24-81 to 12-3-81)			1982 (1-19-82 to 6-22-82)		
Parameter	N	$\bar{x} \pm$ S.E.	range	N	$\bar{x} \pm$ S.E.	range
temperature(°C)	75	9.4 ± 0.5	2.8-21.5	48	5.2 ± 0.5	0-15.7
Secchi disc(m)	13	4.91 ± 0.34	2.9-6.6	8	4.35 ± 0.36	2.8-6.1
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* Surface, 10, 20, and 30 meter depth stations only

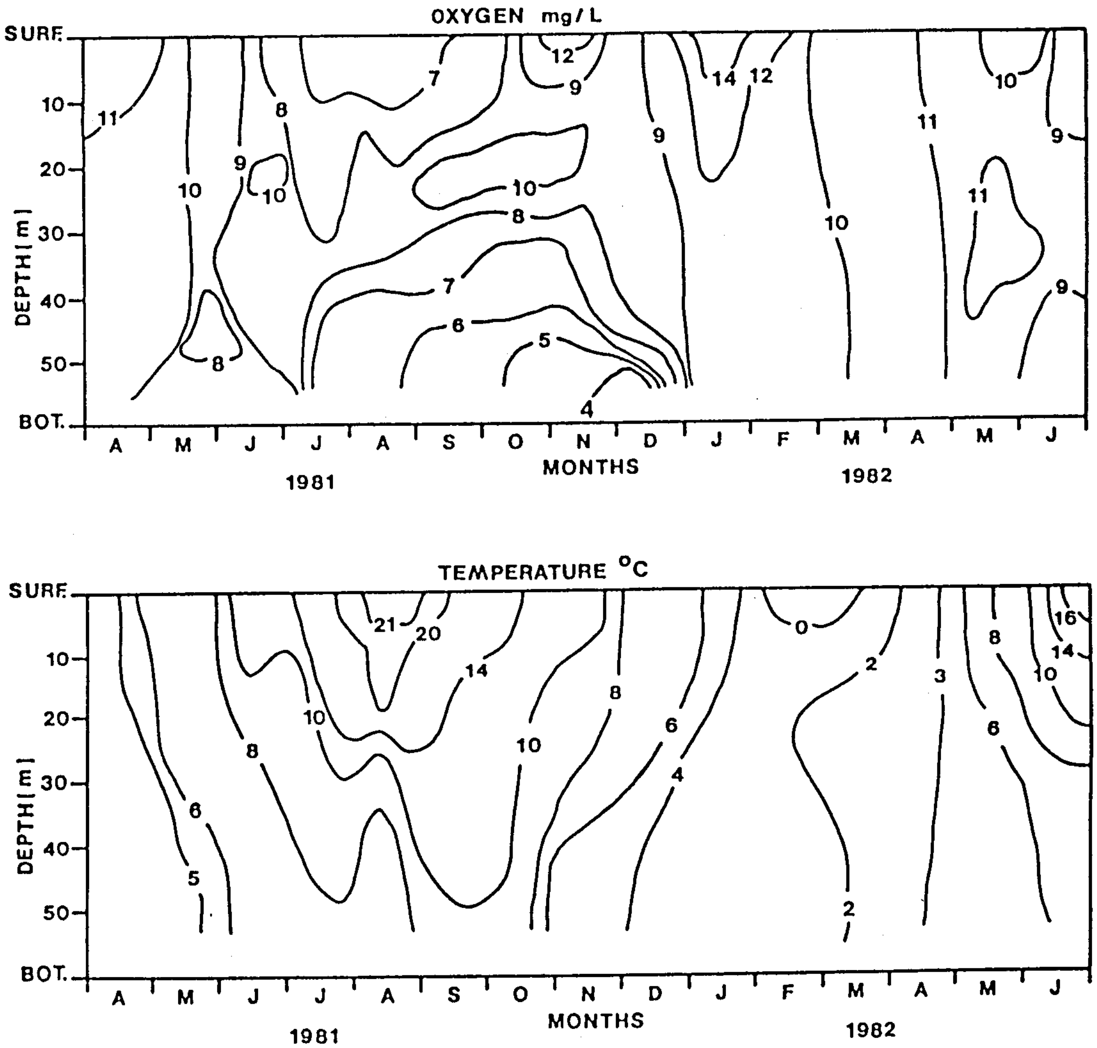

Figura 1. Curvas de temperatura y oxígeno de Bear Lake, 1981-1982.

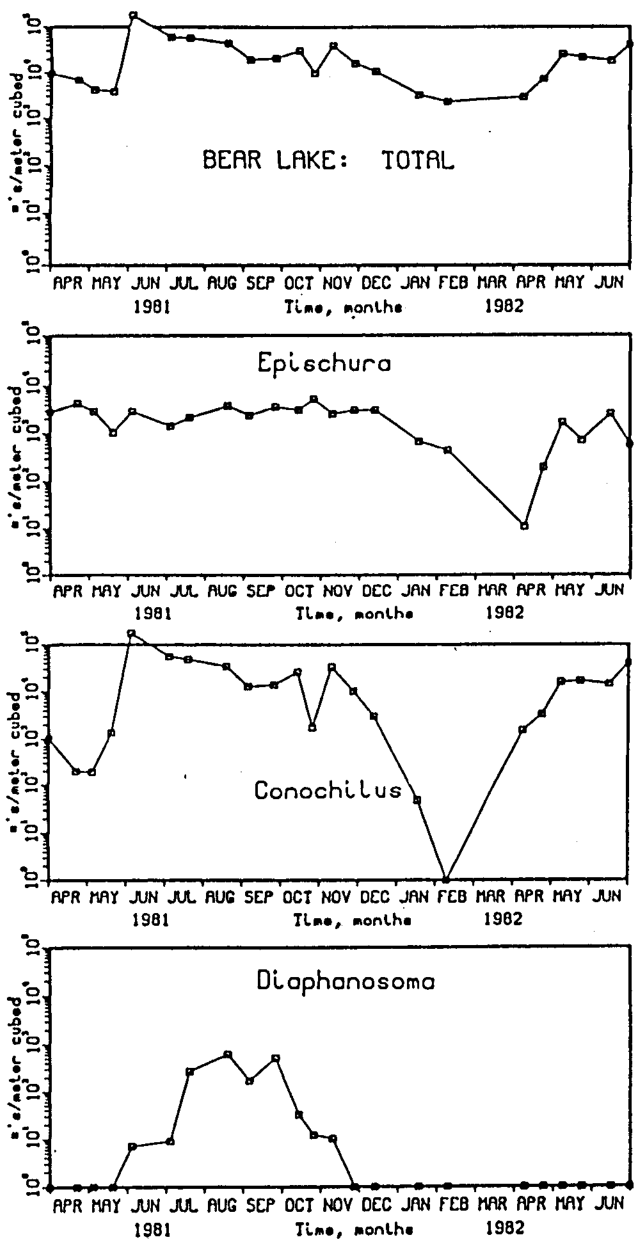

Figura 2. Densidad (numero/m^3) de la comunidad de planktíferos en Bear Lake durante 1981 y 1982. Numeros totales de comunidad se presentan en el gráfico de arriba y diagramas de tres miembros comunidades de importancia se presentan abajo.

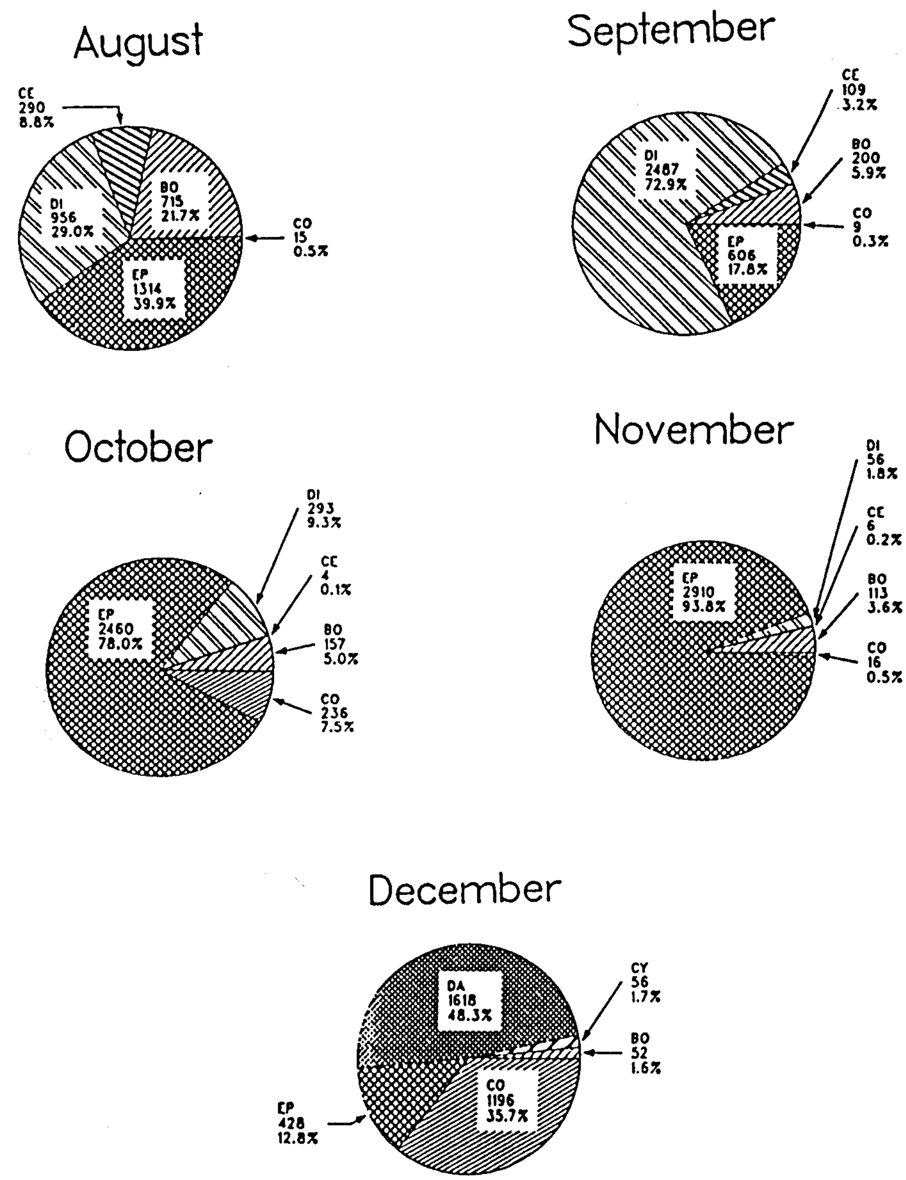

Figura 3. Composición de rapiña de cisco par cinco meses durante 1981. Gráficas representan composición en por ciento de individos especies de rapiña de todos estómagos de cisco combinados. (CLAVE: BO = *Bosmina*; CE = *Ceriodaphnia*; CO = colonias de *Conochilus*; CY = *Cyclops*; DA = *Daphnia*; DI = *Diaphanosoma*; EP = *Epischura*)

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GENETIC CONSIDERATIONS IN MANAGEMENT OF ENDANGERED FISHES

Although declining populations of endangered fishes are at present being intensively managed, species recovery plans have included little emphasis on long term genetic health of rare fishes. Genetic management of small populations is imperitive since inappropriate actions early in a recovery program can have harmful and irreparable long range effects on the species. Consequently, I call the attention of managers to potential genetic problems in managing small populations of endangered fishes (with particular emphasis on captive propagation) and offer initial and basic measures to aviod these pitfalls. All management actions should be consistent with the three goals of conservation genetics: avoidance of extinction, maintenance of the capacity of the species to adapt to changing environments, and maintenance of the capacity for continued speciation.

The central problem in genetics of endangered fishes is loss of genetic variation, both within and among populations, resulting in erosion of evolutionary flexibility. Appropriate concerns regarding loss of variation are: the genetically effective population size (a function of sex ratio, progeny distribution, and population fluctuations), genetic bottlenecks, genetic drift, inbreeding depression, artificial selection in captivity, and divergence (uniqueness) of separate populations. The manager can minimize genetic deterioration, and maximize evolutionary flexibility through the following: 1) monitor the genetics of field and captive populations to characterize the genetic structure of the species and detect long or short term genetic change; 2) maintain the largest feasible genetically effective population size in captive breeding programs via 50:50 sex ratios, culling of excess offspring to ensure even progeny distribution, and avoidance of population crashes; 3) if only small populations are available for recovery, avoid inbreeding through selective mating programs; 4) minimize time in hatchery environments to reduce artificial slection, domestication, and chances of bottlenecks, inbreeding, and catastrophic losses; and 5) maintain separate stocks of distinct populations to maximize among population variance.

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CONSIDERACIONES GENÉTICAS EN EL MANEJO DE ESPECIES EN PELIGRO DE EXTINGUIRSE

A pesar de que hoy día se estan manejando intensivamente poblaciones reducidas de peces en peligro de extinguirse, programas de recuperación de especies han incluido poca énfasis de la salud genética a plazo largo de peces raros. El manejo genético de poblaciones pequeñas es imperativo como acciones inapropiadas a principiar un programa de recuperación pueden causar daños irreparables a la especies. Por lo tanto, yo llamo la atención de administradores a problemas genéticos potenciales en el manejo de poblaciones pequeños de peces (con énfasis en cria en cautivo) y ofresco métodos iniciales y básicos para evitarlos. Toda acción de manejo debe conformarse a trés metas de conservación genética: evitación de la extinción, sostenimiento de la capacidad de la especie a adaptarse a ambientes inconstantes, y sostenimiento de la capacidad para especiación.

El problema central en genética de peces arriesgados es la perdida de variación genética, ambos dentro como entre poblaciones. Esto resulta en la erosión de la flexibilidad evolucionaria. Asuntos de interés al respecto a la perdida de variación son: el censo efectivo de la población (esto siendo función de proporciónes de los sexos, distribución de descendencias, y oscilaciones del numero en el censo), estrechuras genéticas, procesos fortuitos, depresión por endogamia, selección artificial en cautivo y divergencia (singularidad) de poblaciones. El manejador puede reducir al mínimo la deterioración genética, y llevar hasta el máximo la flexibilidad evolucionaria por lo siguiente: 1) amonestar la genética de poblaciones silvestres y cautivas para determinar la estructura genética de la especie y hallar cambios a largo ó corto plazo; 2) mantener el censo efectivo de la población a lo mas grande posible en programas de cria en cautivo por mantener proporciones de los sexos a 50:50, entresacar cria sobrante para asegurar distribución iqual de reproducción entre individuos, y evitar decrementos catastróficos en poblaciones; 3) en caso que solo se disponen poblaciones pequenos para recuperación, evite endogamia por programas de apareamiento selectivo; 4) reducir al mínimo el tiempo en cautivo para evitar la selección artificial, la domesticación y chance de estrechuras, endogamia, y pérdidas catostróficas; 5) mantener apartes varias poblaciones representantes de distintas poblaciones silvestres para llevar hasta el máximo la variación entre poblaciones.

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CLIMATOLOGIA DE LA SIERRA DE SAN PEDRO MARTIR.

Presentado en el 15o. Simposio Anual del
DESERT FISHES COUNCIL. Noviembre 1983.

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RESUMEN.

Damos una descripción de la Sierra de San Pedro Mártir y un reporte de algunas medidas climatológicas que hemos hecho en el lugar donde se encuentra el Observatorio Astronómico Nacional.

INTRODUCCION

Las montañas de San Pedro Mártir albergan al Observatorio Astronómico Nacional desde el año de 1967 cuando después de efectuar un estudio con fotografías infrarrojas de satélite, se encontró que en la parte norte de la península de Baja California, existe una zona con una gran proporción de tiempo despejado. (Mendoza E. et al. 1972, ver también Mendoza E. 1971, 1973). Después de varias visitas a la región, se decidió construir una estación con el objeto de efectuar mediciones in-situ de los principales parámetros con el objeto de verificar la calidad del lugar como posible observatorio astronómico.

En colaboración con el Instituto de Geofísica de la Universidad Nacional Autónoma de México (U.N.A.M.), el Instituto de Astronomía instaló varios instrumentos meteorológicos con el objeto de registrar la temperatura, humedad relativa, velocidad y dirección del viento y otros parámetros de interés astronómico como cielos despejados, transparencia de la atmósfera en varias longitudes de onda, calidad de la imágen estelar o "seeing", etc. Alvarez y Maisterrena (1977), siguiendo los trabajos de García y Mosiño (1968), clasifican el clima del observatorio como Cs(b´)e, sub-húmedo con precipitación invernal, semifrío con temperatura anual promedio de 7.3 C y un rango promedio de temperatura de 10.3 C.

DESCRIPCION GENERAL.

La sierra está formada por los picos mas altos de la península de Baja California. Dentro de ella se encuentran "El Picacho del Diablo", también llamado "La Encantada" de 3,100 mt. de altura como un pico aislado y majestuoso en el lado este de la cordillera. El lado este es una cadena de montañas que sigue la orientación NW-SE de la península. Esta cadena tiene varios picos de 2,800 mt. de altura y en uno de ellos se localiza el observatorio a 2,830 mt. de altitud. (Flores D. y García de León A., 1983). Nuestra figura 1 es una carta topográfica del "Parque Nacional de San Pedro Mártir" que muestra algunos aspectos de la montaña.

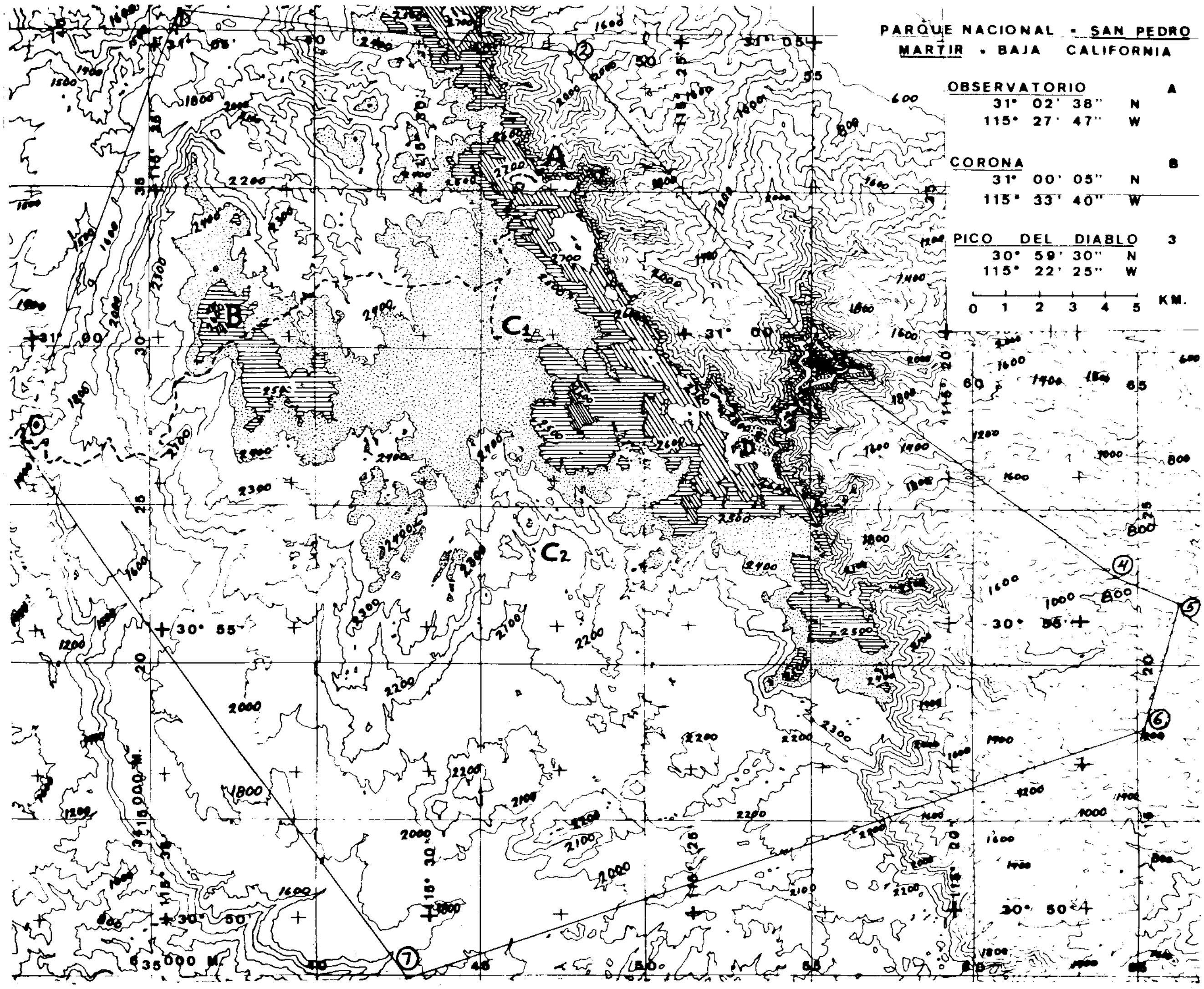

FIGURA 1. Mapa Topográfico del "Parque Nacional de San Pedro Mártir" adaptado de las cartas topográficas H11B45, H11B46, H11B55 Y H11B56 de CETENAL (1974). El PUNTO 3 es el "Picacho del Diablo", también llamado "La Encantada" de 3,100 mt. de altura es el punto mas alto de la península. El PUNTO A muestra al Observatorio Astronómico Nacional a 2,830 mt. de altura. El PUNTO B es llamado La Corona con 2,600 mt. de alto. Los límites del parque nacional fueron tomados gráficamente a partir de datos reportados en 1953 por la Dirección General Forestal y de Caza.

El lado este desciende abruptamente al desierto de San Felipe de sólo 400 mt. de altura y alcanza el Golfo de California. Del lado oeste del observatorio, la montaña desciende a una meseta de altura de 2,400 mt. de altitud, sube nuevamente a un pico de 2,600 mt. llamada "La Corona" para caer nuevamente al área del rancho Meling (800 mt. de altura), al valle de San Telmo (600 mt.) para alcanzar finalmente el Oceano Pacífico. La figura 2 muestra un corte de la sierra a través del observatorio (Punto A) y de La Corona" (Punto B).

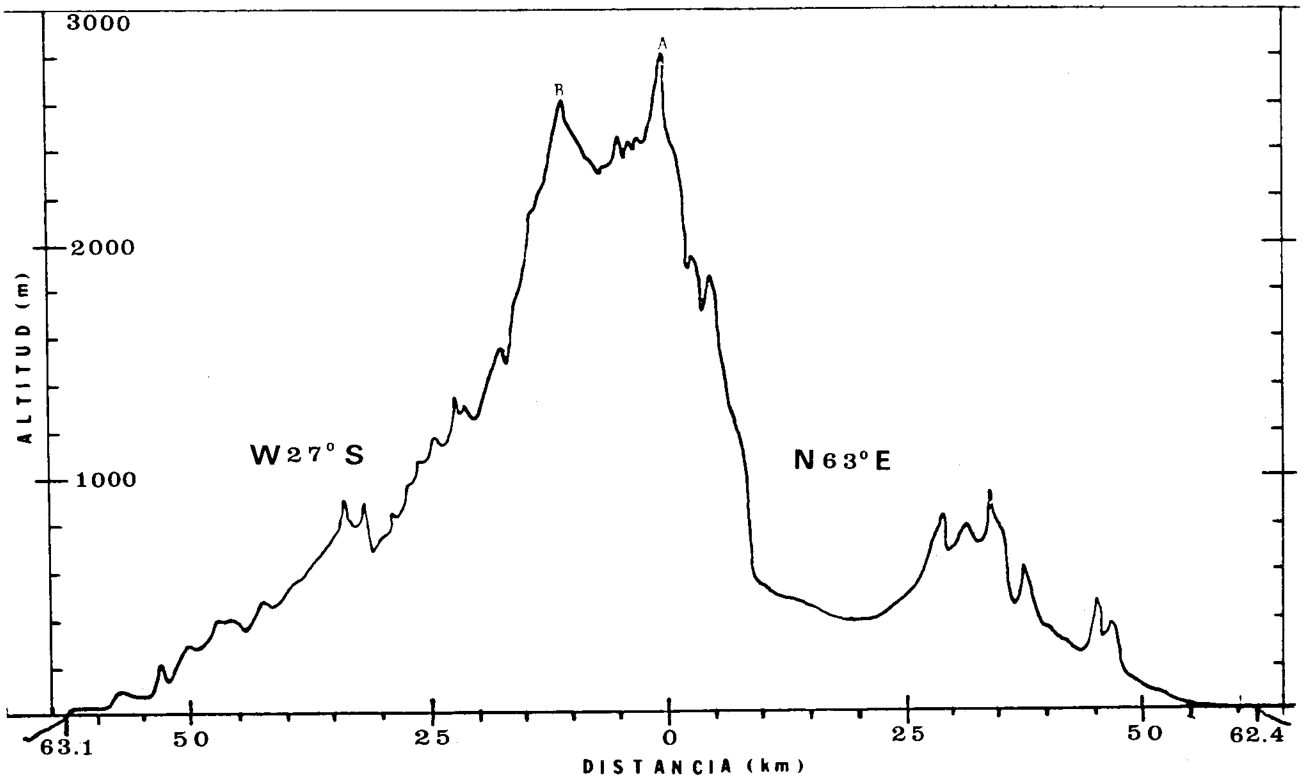

FIGURA 2. Corte transversal de la Sierra de San Pedro Mártir a través de los PUNTOS A donde se encuentra el observatorio astronómico y el PUNTO B llamado "La Corona". Este es el punto mas alto en el lado oeste de la sierra. El eje horizontal está marcado en km. a partir del observatorio astronómico. El eje vertical en metros a partir del nivel del mar.

La alta meseta de mas de 1,800 mt. de altitud se extiende por mas de 15 km. en la dirección E-W y corre por mas de 50 km. en la dirección NW-SE uniéndose en el norte con el Valle de la Trinidad y la Sierra de Juárez. Se extiende hacia el sur hasta la abandonada "Misión de San Pedro Mártir" a 1,600 mt. de alto. La sierra de San Pedro Mártir, junto con la sierra de Juárez, dividen a la península en dos zonas climáticas muy diferentes. Como ha sido señalado por el Dr. Nishikawa y sus colaboradores (1984), esta meseta es rica en su flora y fauna y es una importante zona ecológica que merece adecuada atención.

EL CLIMA DE LA PENINSULA.

La parte norte de la península de Baja California, dentro de la latitud 28 N y 32.5 N pertenece a la zona subtropical donde se localizan la mayoría de las zonas desérticas. Esta región se caracteriza por la existencia de dos regímenes meteorológicos principales que dividen al clima en un clima cálido y seco durante la primavera, verano y principios del otoño y un invierno relativamente húmedo y ligeramente frío. La corriente oceánica de California, siendo una corriente fría, modifica y controla el regímen meteorológico general, sobre todo a bajas altitudes aumentando la zona de subsidencia atmosférica que inhibe la formación de las nubes de tipo convectivo sobre todo en las cercanías de la costa del Pacífico. Alvarez y Maisterrena (1977), que llamaremos en lo sucesivo Trabajo I, muestran la existencia de una capa de inversión localizada alrededor de los 1,000 mt. de altitud (vease su figura 1 tomada de su trabajo y que hemos reproducido aquí como nuestra figura 3-a). Esta capa de inversión está presente durante todo el año. El lado este de la península hacia el Golfo de California no presenta esta capa de inversión como lo podemos apreciar de nuestra figura 3-b. Las dos gráficas muestran en el eje horizontal, la temperatura mensual promedio de diferentes estaciones climatológicas alrededor del observatorio dentro de un radio de menos de 100 km. El eje vertical es la altitud de la estación. Incluimos en estas gráficas nuestras mediciones efectuadas en el observatorio de S.P.M.

García E, y Mosiño, P.A. (1968), en su estudio de los climas de Baja California, dividen a la península en tres provincias climáticas: a.-) la PROVINCIA DEL NOROESTE que se extiende desde la frontera internacional (32.5 N) hasta la latitud 25.5 N y desde la costa del Pacífico hasta la división montañosa. b.-) la PROVINCIA CENTRAL va desde el sur del Rio Colorado hasta la latitud de 26 N en el lado oeste de las montañas, cruzando al Oceano Pacífico hasta la latitud de 25 N en donde comienza c.-) la PROVINCIA DEL SURESTE que se extiende hasta La Paz y Cabo San Lucas.

La sierra de San Pedro Mártir es parte de la provincia del Noroeste. Cada una de estas provincias climáticas se caracteriza por tener diferente regímen de precipitación y distribución de temperatura. La PROVINCIA DEL NOROESTE tiene un rango de temperaturas del órden de 10-15 C y una escasa precipitación pluvial que ocurre durante los meses del invierno. La PROVINCIA CENTRAL tiene un rango de temperatura mucho mas grande (mas de 20 C) y su regímen de precipitación pluvial aunque muy pequeño está concentrado en los meses del otoño. Finalmente, la PROVINCIA DEL SURESTE tiene un clima mas moderado con un rango de temperaturas menor que 10 C. y fuertes lluvias concentradas en el otoño e invierno. Esta precipitación pluvial se debe sobre todo al efecto de los ciclones tropicales.

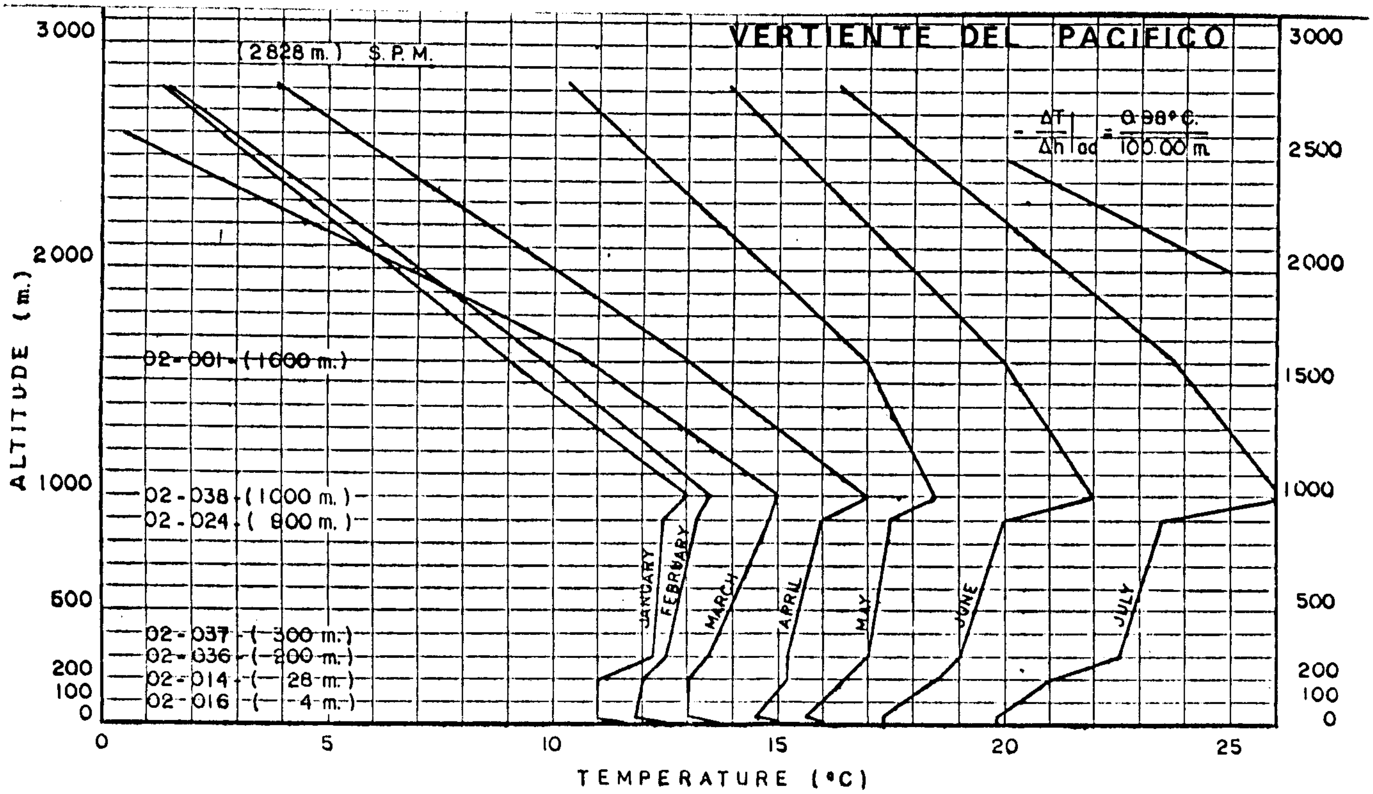

FIGURE 3-a. (de Alvarez y Maisterrena, 1977). Gradiente vertical de la temperatura promedio mensual en varias estaciones climatológicas de la vertiente del Pacífico alrededor del Observatorio Astronómico Nacional en la Provincia Climatológica del Noroeste . El eje horizontal es la temperatura promedio de la estación para cada mes y el eje vertical es la altitud de la estación. Incluimos nuestras mediciones de temperatura para los años 1969 a 1974.

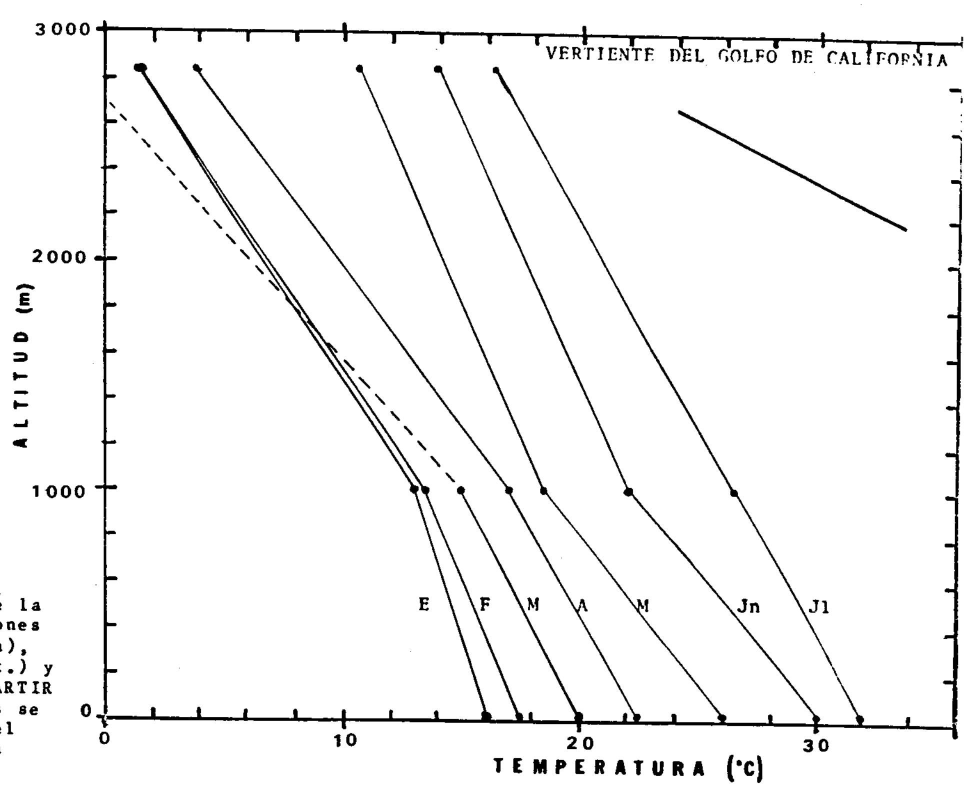

FIGURA 3-b. Igual que la Figura 3-a para las estaciones 032 SAN FELIPE (20 mt.altura), 038 SANTA CATARINA (1,000 mt.) y OBSERVATORIO DE SAN PEDRO MARTIR (2830 mt.). Estas estaciones se localizan en el lado este del observatorio en la Provincia Climatológica Central.

EL CLIMA DE LA SIERRA DE SAN PEDRO MARTIR.

A.-) TEMPERATURA. En el año de 1968, iniciamos una campaña para probar el lugar como posible observatorio astronómico. Esta campaña incluyó mediciones meteorológicas junto a observaciones astronómicas para probar la calidad astronómica del lugar. En el Trabajo I, Alvarez y Maisterrena reportan la temperatura promedio para los años 1969-1974. En nuestra TABLA 1, damos los promedios mensuales para cada uno de esos años. La pequeña diferencia que existe entre los valores promedios para cada mes y los valores reportados en el Trabajo I se debe a la inhomogeneidad de la muestra y a la técnica para promediar utilizada. En algunos meses tenemos sólamente unos pocos días de medición. El <RANGO> se ha calculado a partir de los promedios semanales de temperatura máxima y mínima.

TABLA 1.

TEMPERATURA PROMEDIO MENSUAL. - AVERAGE MEAN TEMPERATURE.

	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC
1969	5.6	-1.8*	-	7.5*	10.1	15.0	15.6	16.3	13.5	8.4	2.7	3.8
1970	1.9	0.5	-0.1	1.9	11.0	13.8	15.0	13.5	12.2	7.3	-	-
1971	-	-	-	-	-	-	-	-	16.5	8.2	4.6	-0.5
1972	2.6	5.0	-1.0	8.0	11.1	12.2	18.6	14.2	12.8	7.2	4.3	1.2
1973	-1.4	0.1	-4.0	2.1	8.1	13.8	16.1	13.3*	13.2*	8.7	-1.7	2.8
1974	-1.0	-0.8	1.1	3.7	7.8	-	-	-	-	-	5.3	3.2
PROMEDIO	1.5	0.6	-1.0	4.6	9.6	13.7	16.3	14.3	13.6	8.0	3.0	2.1
<RANGO>	15.2	16.3	16.4	17.1	16.7	14.1	12.2	11.8	13.5	14.9	17.5	15.5

(*) La muestra es muy pequeña - Sample is very small.

En la figura 4, graficamos los promedios mensuales de temperatura para intervalos de seis horas. Estos valores son ´promedios corridos´ calculados cada siete días. El punto indica el promedio mensual de la temperatura. Podemos apreciar el cambio diario de la temperatura, así como la tendencia mensual general.

En la figura 5 hemos graficado los valores promedio semanales de la temperatura máxima y mínima, así como el promedio mensual de la temperatura. De estas mediciones podemos ver que el mes de Marzo es el mes más frío con <T> = -1.0 C. Los valores extremos observados para este mes son -19 C. y +16 C. La temperatura promedio mas baja de -19 C. fué registrada en diciembre de 1971 y marzo de 1974. El mes mas caliente es julio con <T> = 16.3 C. Los valores extremos para este mes son +27.7 C. (julio 1972) y + 9 C. (julio 1973). La temperatura promedio mas caliente de +29.7 C. fué registrada en Agosto de 1971. Como podemos ver de esta figura y de la TABLA 1, el rango promedio de temperaturas está entre +11.8 C. en agosto y +17.5 C. en noviembre.

En la figura 2 del Trabajo I, podemos ver que existe una capa de inversión local muy definida.

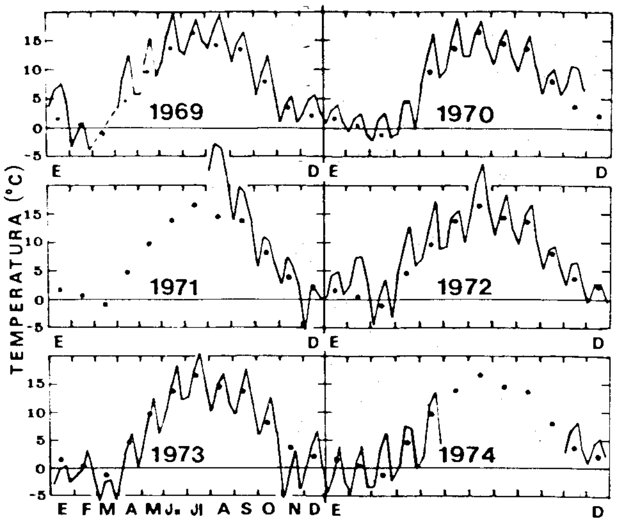

FIGURA 4. Temperatura promedio mensual para los años de 1969 a 1974. Promedios corridos de la temperatura cada seis horas calculados cada siete días. Podemos apreciar el cambio diario de la temperatura. El punto indica el valor promedio de la temperatura mensual.

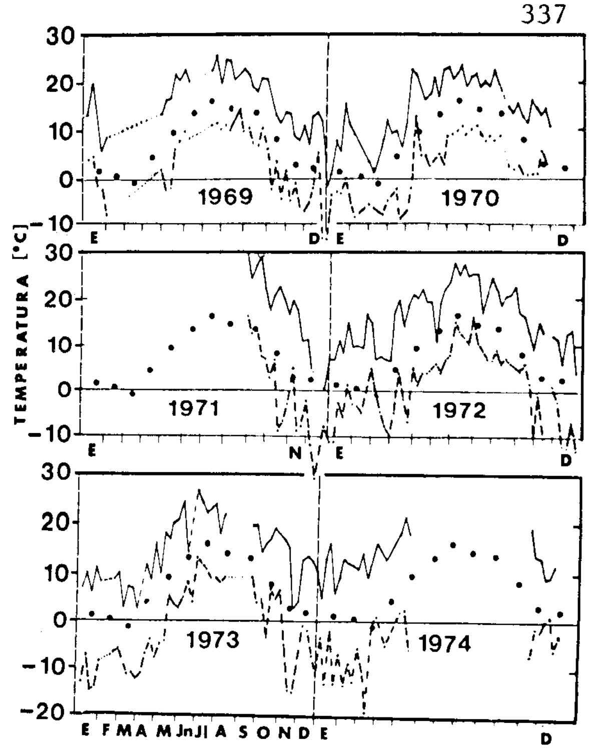

FIGURA 5. Temperatura semanal promedio de los valores máximos y mínimos para los años de 1969 a 1974.

En esa figura tenemos los promedios de temperatura máxima y mínima para el año de 1969 para dos estaciones con una diferencia de 400 mt. entre ellas. Encontramos que durante la noche, la estación más baja llamada "VALLECITOS" (2,420 mt.) es mas fría (en promedio cerca de -5 C.) que la estación llamada "CUPULA" (2,830 mt.) donde se encuentra instalado el observatorio astronómico. Durante el día, debido a la turbulencia forzada, esta capa de inversión se destruye, teniendo temperaturas máximas mayores en el Valle que en la Cúpula. Este efecto depende también de la dirección y de la velocidad del viento tanto durante la noche como durante el día.

B.-) VELOCIDAD Y DIRECCION DEL VIENTO. Nuestras propias medidas de la dirección y velocidad del viento para el año de 1969 han sido reportadas por Alvarez (1982) y son reproducidas aquí. En la TABLA 2 tenemos los promedios mensuales de la dirección y de la velocidad del viento para intervalos de seis horas.

La figura 6 muestra la velocidad promedio y como se espera de la circulación general, los vientos mas fuertes ocurren durante el invierno con velocidades promedio de 21.4 km/h (5.94 m/s.) en diciembre, 31.5 km/h (8.75 m/s.) en enero y 27.0 km/h (7.5 m/s.) en febrero. Durante la noche, los valores promedio alcanzan 35.2 km/h (9.78 m/s.) mientras que durante el día el valor promedio es de 18.0 km/h (5 m/s.).

TABLA 2

VELOCIDAD Y DIRECCION DE VIENTO

PROMEDIOS MENSUALES (1969)

(Velocidad en km/h)

		0-6 hs	6-12 hs	12-18 hs	18-24 hs	Promedio Mensual
Enero (28 días)	V	35.2	29.8	28.0	33.1	31.5
	D	186°	142°	169°	178°	169°
Febrero (6 días)	V	31.1	26.7	22.6	27.5	27.0
	D	139°	139°	142°	157°	144°
Marzo (5 días)	V	8.8	7.5	10.3	9.9	9.1
	D	315°	282°	289°	302°	297°
Abril (30 días)	V	30.5	20.4	18.5	26.8	24.1
	D	165°	165°	181°	175°	172°
Mayo (28 días)	V	15.3	8.4	8.5	13.6	11.5
	D	188°	225°	254°	193°	215°
Junio (10 días)	V	25.9	19.1	11.1	16.1	18.0
	D	136°	141°	219°	147°	161°
Julio (18 días)	V	13.0	9.7	8.9	11.0	10.7
	D	89°	101°	127°	90°	102°
Agosto (13 días)	V	10.5	6.0	6.4	7.8	7.7
	D	79°	83°	65°	61°	72°
Septiembre (20 días)	V	10.8	9.9	10.4	11.8	10.7
	D	111°	115°	105°	153°	121°
Octubre (24 días)	V	23.0	18.6	14.4	21.2	19.3
	D	231°	231°	203°	198°	216°
Noviembre (26 días)	V	22.2	20.3	6.2	19.8	19.5
	D	111°	127°	151°	124°	128°
Diciembre (19 días)	V	23.8	21.2	18.0	22.6	21.4
	D	171°	182°	182°	148°	171°

Velocidad Promedio Anual 17.5 km/h.

Rango Promedio Anual 23.8 km/h.

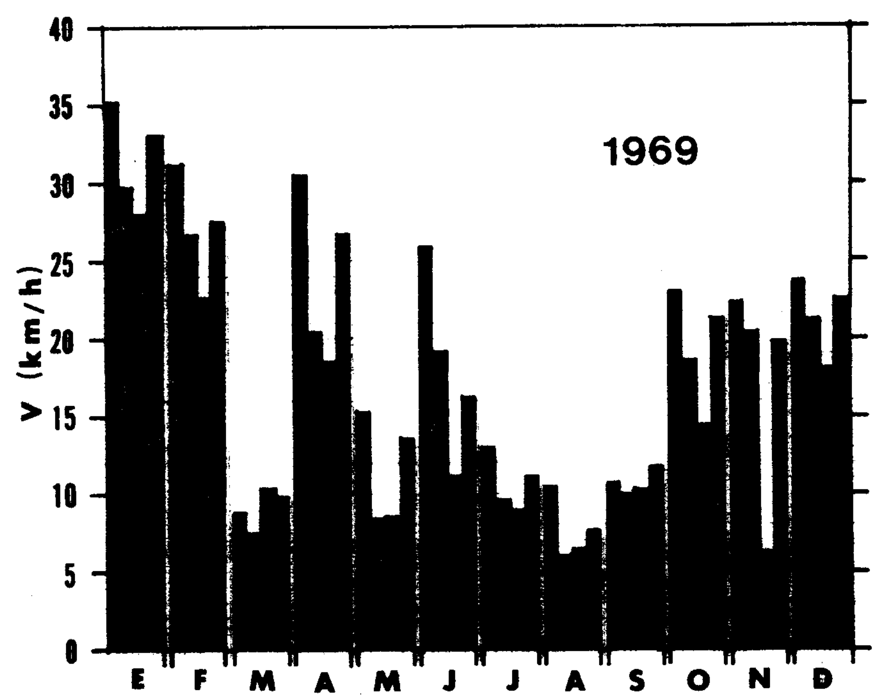

Fig. 6. Velocidad mensual promedio (km/h.) agrupada en períodos de 6 horas.

Los valores promedios máximos, reportados también en la TABLA 3 de Alvarez (1982) para los promedios corridos cada 3 horas alcanzan 101.9 km/h (28.3 m/s.) el mes de enero. Se observó una velocidad de 108 km/h (30 m/s.) en octubre y 114 km/h (31.7 m/s.) durante el mes de marzo de 1969. Esta TABLA 3 tiene también los valores extremos de la temperatura para el año de 1969.

La figura 7 es un diagrama vectorial que muestra la velocidad y la dirección de viento cada mes. De acuerdo a estas medidas, hay una componente SE de la dirección del viento que parece prevalecer en la montaña. Sin embargo, las observaciones efectuadas in-situ muestran claramente una componente dominante del oeste o del suroeste. Existen dos explicaciones probables para esta diferencia que deben ser exploradas. El hecho experimental: esto es que el anemógrafo fué instalado con la orientación aquivocada o bien que por efectos de la orografía, estamos midiendo la dirección del viento influenciada fuertemente por los intensos vientos ascendentes que vienen del desierto de San Felipe que se encuentra al este del instrumento. Estos dos efectos deben ser considerados y los resultados de este estudio será reportado en otra ocasión.

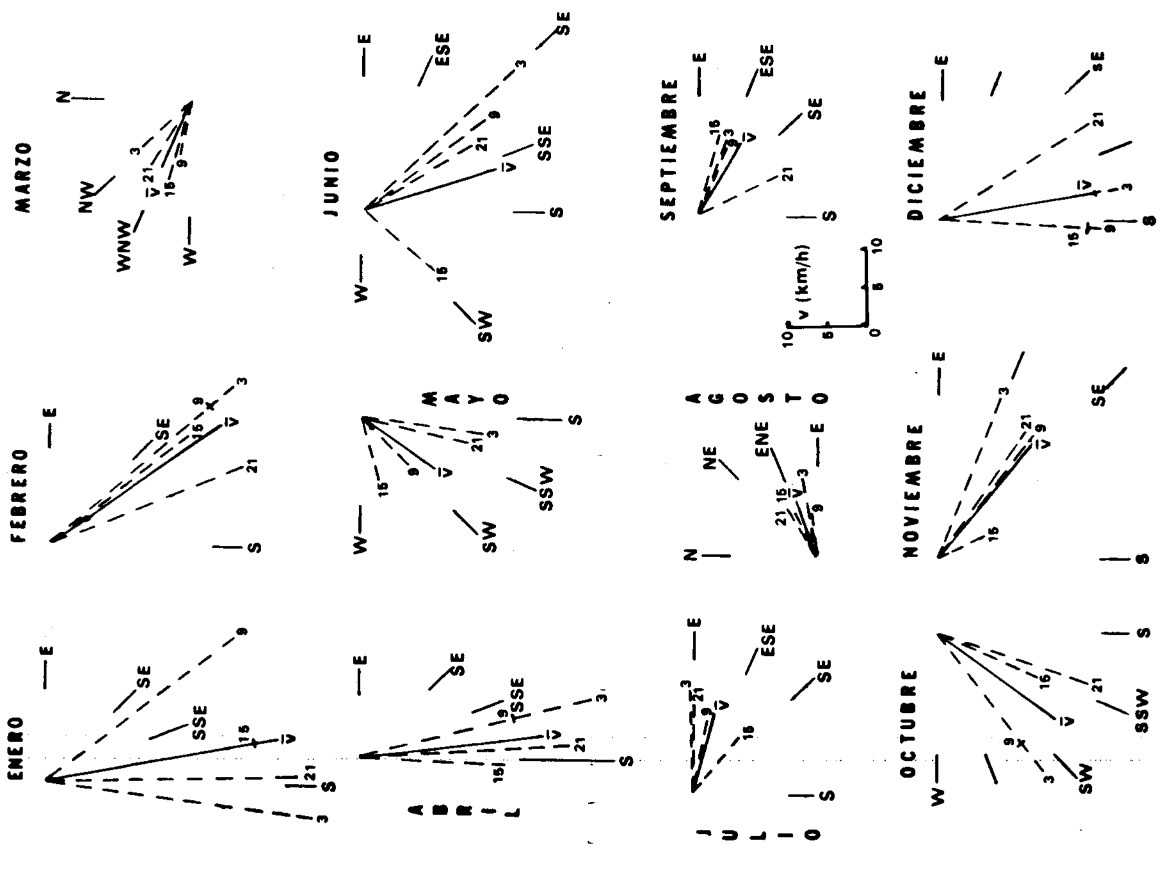

Fig. 7. Diagrama vectorial de la velocidad y dirección de viento promedio para cada uno de los meses del año, agrupados en períodos de 6 horas. Para cada diagrama (3) de 0-6 hs., (9) de 6-12 hs., (15) de 12-18 hs., (21) de 18-24 hs. La línea sólida corresponde a la dirección y velocidad de viento promedio del mes.

TABLA 3

VALORES EXTREMOS DE TEMPERATURA AMBIENTE,
VELOCIDAD Y DIRECCION DE VIENTO
(PROMEDIOS SUPERPUESTOS CADA 3 HORAS)

Semana	Fecha 1969		T min (°C)	T max (°C)	V max (km/h)
1	Enero	1-5	4.0	13.3	19.8
2		6-12	4.7	20.0	54.0
3		13-19	-1.7	11.7	49.3
4		20-26	-2.7	6.0	101.9
5		27-2	-8.0	8.7	54.0
6	Febrero	3-9	-	-	72.0
7		10-16	-	-	-
8		17-23	-	-	-
9		24-2	-	-	-
10	Marzo	3-9	-	-	-
11		10-16	-	-	-
12		17-23	-	-	-
13		24-30	-	-	19.2
14		31-6	-	-	72.0
15	Abril	7-13	-	-	114.0
16		14-20	-	-	66.0
17		21-27	2.0	13.7	54.0
18		28-4	-2.3	16.3	54.0
19	Mayo	5-11	-2.0	16.7	22.8
20		12-18	6.0	22.0	25.2
21		19-25	8.0	21.0	25.8
22		26-1	10.0	23.0	24.6
23	Junio	2-8	8.7	20.3	-
24		9-15	-	-	-
25		16-22	-	-	46.8
26		23-29	-	-	54.0
27		30-6	-	-	40.8

Tabla 3 (Continúa)

Semana	Fecha 1969		T min (°C)	T max (°C)	V max (km/h)
28	Julio	7-13	10.0	20.3	36.0
29		14-20	11.7	25.7	18.6
30		21-27	10.3	21.7	13.8
31		28-3	11.3	25.0	-
32	Agosto	4-10	10.3	25.0	-
33		11-17	12.3	20.7	10.8
34		18-24	14.3	22.0	16.2
35		25-31	10.0	23.0	24.0
36	Septiembre	1-7	10.7	22.0	28.8
37		8-14	7.7	19.3	15.9
38		15-21	7.0	18.3	42.0
39		22-28	10.3	21.3	45.0
40		29-5	6.3	21.3	54.0
41	Octubre	6-12	-2.3	17.7	42.0
42		13-19	3.7	13.0	108.0
43		20-26	-4.3	11.5	30.6
44		27-2	1.7	13.7	25.2
45	Noviembre	3-9	-4.7	13.3	48.0
46		10-16	-1.0	8.7	66.0
47		17-23	-6.0	8.0	48.0
48		24-30	-7.0	11.0	32.4
49	Diciembre	1-7	-5.0	7.3	34.8
50		8-14	-2.0	13.0	60.0
51		15-21	5.7	13.7	54.0
52		22-31	-13.7	11.7	66.0

C.-) INSOLACION. Otro parámetro climatológico de mucha importancia en astronomía es la medida de los cielos despejados. En el Trabajo I, se reportan los resultados obtenidos en el lugar del observatorio durante el período de agosto de 1968 a junio de 1969.

De las figuras 3 y 4 del Trabajo I podemos ver que mas del 50% del tiempo es tiempo despejado, alcanzando mas del 70% de horas de sol en los meses de abril, mayo, junio, septiembre y octubre. Este hecho confirma las medidas reportadas en el Trabajo I que da valores bajos de la humedad relativa especialmente durante los meses del otoño. (ver la Tabla 6 del Trabajo I).

Nuestra experiencia en el observatorio nos ha mostrado que la mayor parte del tiempo, debido al enfriamiento radiativo durante la noche, las nubes de tipo convectivo que se forman en las primeras horas de la tarde, desaparecen al anochecer. Este hecho también fué medido desde julio de 1971 hasta junio de 1972 y reportado en el Trabajo I como medida del ruido del cielo en 10 . Es posible ver esta ligera tendencia de su figura 5 y Tabla 4 en donde además podemos apreciar un fuerte efecto estacional.

D.-) PRECIPITACION PLUVIAL. La mayor parte del agua que corre en los arroyos y corrientes de la península cae en altas altitudes y desafortunadamente no existen medidas continuas de la precipitación pluvial en el sitio del observatorio. Este parámetro es de gran importancia y podemos solamente hacer hacer una estimación muy cruda de la cantidad de precipitación pluvial que esperamos tener en este lugar a partir de las medidas efectuadas a altitudes menores. En la figura 8, tenemos la precipitación anual de las estaciones climatológicas que rodean al observatorio, tanto en la vertiente del Pacífico como en la del Golfo de California.

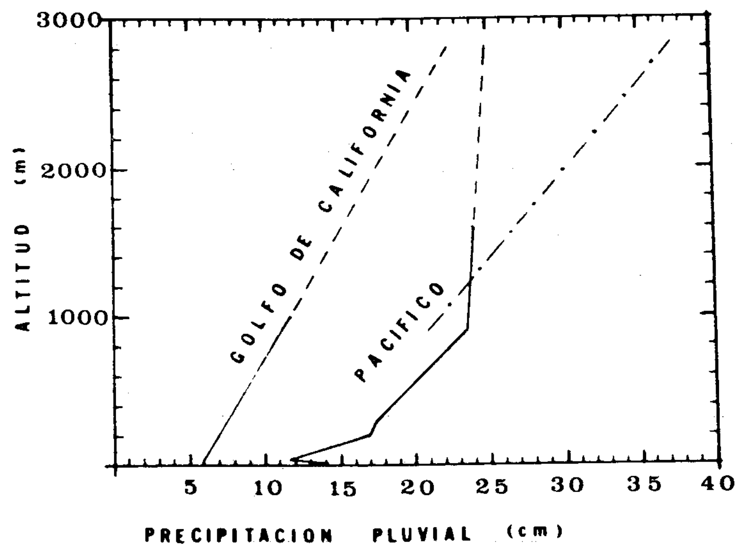

FIGURA 8. Precipitación pluvial anual para las estaciones climatológicas que rodean al observatorio astronómico. En el lugar del observatorio no existen mediciones de precipitación pluvial.

Podemos fácilmente ver que hay un continuo aumento en la precipitación con la altura y podemos esperar una precipitación anual en el sitio del observatorio que va desde 250 mm. hasta más de 500 mm. de agua sea en forma de lluvia o de nieve.

CONCLUSIONES.

La presencia del Observatorio Astronómico Nacional en las montañas de San Pedro Mártir, ha permitido efectuar algunas mediciones para determinar el clima de una región muy importante de la península de Baja California. Sin embargo, un esfuerzo contínuo debe de llevarse a cabo con el objeto de tener un mejor conocimiento del lugar para lograr su preservación y conservar el bosque y la región útiles para los fines científicos para los que fué dedicado cuando el Instituto de Astronomía de la Universidad Nacional Autónoma de México decidió instalar el observatorio astronómico, buscando un balance adecuado entre el uso del bosque y su cuidado y mantenimiento.

El autor desea agradecer al personal técnico del observatorio astronómico que con su trabajo hicieron posible adquirir los datos que aquí se reportan. En especial quisiera reconocer y agradecer las facilidades recibidas por los organizadores del DESERT FISHES COUNCIL para la asistencia al simposio y la presentación de este trabajo.

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CLIMATOLOGY OF SAN PEDRO MARTIR SIERRA.

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ABSTRACT.

We give a description of the San Pedro Mártir Sierra and a report of some of the climatological measurements made at the site of the Mexican National Astronomical Observatory.

INTRODUCTION

San Pedro Mártir mountains houses the Mexican National Astronomical Observatory since 1967 in which after a photographic search with the infrared satellite pictures, it was found that in the northern part of the peninsula of Baja California there is a zone with a very large proportion of cloudless skies. (Mendoza E. et al. 1972, see also Mendoza E. 1971, 1973). After several visits to the region, it was decided to build a small station to do in-situ measurements of the main parameters to be sure of the quality of the place as a possible astronomical observatory.

With colaboration of the Institute of Geophysics of the Mexican National University (U.N.A.M.), the Institute of Astronomy installed several climatological instruments to record the temperature, relative humidity, wind speed and direction and some other parameters of astronomical interest like cloudless skies, transparency of the atmosphere at several wavelengths, quality of the stellar images or "seeing", etc. Alvarez and Maisterrena (1977), following García and Mosiño (1968), classified the climate of the observatory as Cs(b´)e , sub-humid with winter precipitation, semicold with annual mean temperature of 7.3 C and mean temperature range of 10.3 C.

GENERAL DESCRIPTION.

The sierra is formed by the highest peaks in the peninsula of Baja California. It includes the "Picacho del Diablo" or "Devil´s Peak", also called "La Encantada" of 3,100 mt. altitude as an isolated and majestic peak to the east of it. The east side is a chain of mountains following the NW-SE orientation of the peninsula. This chain has several peaks of 2,800 mt. altitude in one of which the observatory is located at 2,830 mt. high. (Flores D. and García de Leon A., 1983). Our figure 1 is a topographical chart of the "San Pedro Mártir National Park" showing some of these features. The east side drops to the San Felipe Desert of only 400 mt. high and to the Gulf of California. To the west side of the observatory, the mountain drops to a high plateau of 2,400 mt. high and climbs again to a high peak of 2,600 mt. altitude called "La Corona", then drops again to Meling´s area (800 mt. high) and San Telmo Valley (600 mt.) to finally reach the Pacific Ocean. Our figure 2 shows a cross section of the sierra through the observatory (point A) and the Corona (point B).

This high plateau of more than 1,800 mt. altitude extends for more than 15 km. in the E-W direction and runs for more than 50 km. in the NW-SE direction joining to the north with the Valle de la Trinidad and Sierra de Juárez. It extends to the south to the abandoned "San Pedro Mártir Mission" at 1,600 mt. altitude. The San Pedro Mártir Sierra together with Sierra de Juárez divides the peninsula into two very different climatic zones. As is pointed out by Dr. Nishikawa and colaborators (1984), this plateau is rich in flora and fauna and it is an important ecological zone.

THE CLIMATE OF THE PENINSULA.

Northern Baja California, within the 28 N and 32.5 N latitude belongs to the subtropical zone where most of the desertic areas are located. This area is characterized by the existence of two mayor meteorological patterns that divides the weather into a hot and dry weather during the spring, summer and earlier autumn and a mildly cold and relatively humid winter. The cold California ocean current modifies and controls the general weather pattern, mostly at low altitudes enhancing the subsidence atmospheric zone that inhibits most of the convective type clouds near the Pacific coast. Alvarez and Maisterrena (1977), in the following called Paper I, show the presence of an inversion layer located at around 1,000 mt. altitude (see figure 1 taken from their work and reproduced here in our figure 3-a). This inversion layer is present during the whole year. The east side of the peninsula towards the Gulf of California does not have this inversion layer as is shown in our figure 3-b. The two graphs show the average monthly temperature of different climatological stations surrounding the observatory within a radius of less than 100 km. versus the altitude of the station. We include our measurements made at the S.P.M. observatory.

García E. and Mosiño P.A. (1968), in their study of the climates of Baja California divide the peninsula in three climatic regions. a.-) The NORWEST PROVINCE goes from the international border (32.5 N) to latitude 25.5 N and from the Pacific coast to was dripping into the coals, making the fire in the grills even hotter. Soon everyone was in line, going past the grills for steak. I think the cooks were thankful that a lot of people (including me) like very rare steaks! Anyway, after about ten sodas and one steak. we left. As soon as we got home I fell asleep. At last! Some sleep!

The next morning I just moped around until lunch. Then my dad came out and we had lunch. Then my mom announced that we were going to the Amargosa Opera House that evening. Just my luck! Ughh!

(Typists note: That afternoon Noah attended the session of the Desert Fishes Council in which I gave a half-hour talk followed by a half-hour of questions. He sat through it all very patiently but at the end his only question was "Gee, dad, is it hard to talk that long?)

When we got to the opera house, we went to a nearby Mexican restaurant for dinner. It was a weird place. The people who owned it had painted fake cracks in the walls, making it look run-down. After a delicious meal, we went to the opera house. The show wasn't too bad but I fell asleep during the best part. I also fell asleep in the car on the way back I was so tired! Since it was our last day, we all got packed up that night.

The next morning we left Furnace Creek Ranch and drove to the sand dunes. It was pretty fun playing on them and looking for tracks. The tracks we saw were: tarantula, kangaroo rat, birds, and human. After two hours we left, back to Davis.

THE END*

*It wasn't the end,actually. As it took us two days to get back to Davis because of heavy snow, which forced us to spend an extra night in front of a color T.V. in a motel near Lake Tahoe.

Desert Fishes Council

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

407 West Line Street
Bishop, California 93514

November 19, 1983

RESOLUTION 83-1

STATEMENT OF ENDORSEMENT

The Desert Fishes Council at its 15th Annual Meeting at Furnace Creek, Death Valley National Monument, California, hereby expresses its strong approval of recent efforts by fisheries officials of the Federal Republic of Mexico and the State of Sonora to conserve the totoaba (*Cynoscion macdonaldi*). Inasmuch as it is most appropriate to have development of fish culture activities of endangered fishes within or adjacent to their native range, the Council expresses special approval of the effort to ensure **survival of a captive population** of the totoaba in cultural facilities adjacent to the Gulf of California or the Pacific Ocean.

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
November 19, 1983

RESOLUTION 83-2

STATEMENT OF CONCERN

The Desert Fishes Council at its 15th Annual Meeting at Furnace Creek, Death Valley National Monument, California, hereby expresses its deep concern over the desirability of culturing the totoaba (Cynoscion macdonaldi) in Texas waters. The Council feels it is most appropriate to develop fish cultural facilities in the proximity of the natural range of fish species in order to maximize similarities with natural regimes. The Council is especially concerned over the possibility of releases into any waters that may connect with the Gulf of Mexico.

If the totoaba should become established in the waters of the Gulf of Mexico it could deplete the natural stocks of shrimp and compete with native sport and commercial fishes such as spotted seatrout (Cynoscion nebulosus) and red drum (Sciaenops ocellatus).

The Council vigorously opposes any fish cultural activities that might result in the release of totoaba into waters outside of its natural range.

The Council is likewise opposed to the issuance of a permit to obtain totoaba brood stocks which could lead to cultural activities outside the Gulf of California or Pacific Ocean.

PASSED WITHOUT DISSENTING VOTE

ATTEST:

Edwin P. Pister

Edwin P. Pister
Executive Secretary

Desert Fishes Council

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

407 West Line Street
Bishop, California 93514

November 19, 1983

RESOLUTION 83-3

RELATIVE TO COMMENDATION OF THE NATURE CONSERVANCY FOR ACTIVITIES INVOLVING THE ACQUISITION OF ASH MEADOWS, NYE COUNTY, NEVADA

WHEREAS Ash Meadows is an unique oasis in the Mohave Desert that provides habitat for a larger number of endemic plants and animals than any other local area in the United States, and

WHEREAS protection of this area has been one of the highest priorities of the Desert Fishes Council since its formation in 1969, and

WHEREAS this goal is becoming a reality largely because of the efforts of The Nature Conservancy and, in particular, its Great Basin Coordinator, David Livermore, and its California Field Representative, Steven McCormick, now therefore be it

RESOLVED that the Desert Fishes Council, meeting at Death Valley National Monument on November 17-19, 1983, for its Fifteenth Annual Symposium, does hereby commend The Nature Conservancy and Steven McCormick, and especially David Livermore for his tireless efforts in behalf of Ash Meadows, and be it further

RESOLVED that copies of this resolution be sent to Mr. William D. Blair, President, The Nature Conservancy; Mr. John Nutter, Western Regional Director, The Nature Conservancy; Mr. Will Molini, Director, Nevada Department of Wildlife; and Mr. Richard Myshak, Regional Director, U.S. Fish and Wildlife Service.

PASSED WITHOUT DISSENTING VOTE

ATTEST:

Edwin P. Pister

Edwin P. Pister
Executive Secretary

Desert Fishes Council

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

407 West Line Street
Bishop, California 93514
November 19, 1983

RESOLUTION 83-4

RELATIVE TO ACQUISITION OF LAND IN THE MOAPA VALLEY, CLARK COUNTY, NEVADA FOR PROTECTION OF THE ENDANGERED MOAPA DACE

WHEREAS the Moapa dace (Moapa coriacea) is recognized as an endangered species by the U.S. Fish and Wildlife Service and Nevada Department of Wildlife, and

WHEREAS the Moapa dace is restricted to the headwater springs of the Moapa River, Nevada, and

WHEREAS the U.S. Fish and Wildlife Service has approved a recovery plan that identifies the habitats requiring protection in order to conserve the species and allow its removal from the Federal list of endangered species, and

WHEREAS the U.S. Fish and Wildlife Service has also prepared a draft Land Protection Plan that proposes that these important habitats be acquired by the purchase of conservation easements and/or fee acquisition, now therefore be it

RESOLVED that the Desert Fishes Council supports the proposed acquisition program presented in the draft Land Protection Plan, and be it further

RESOLVED that the Desert Fishes Council requests that this program be implemented immediately, and be it further

RESOLVED that this resolution be sent to Richard Myshak, Regional Director, U.S. Fish and Wildlife Service; Robert Gilmore, Assistant Director, U.S. Fish and Wildlife Service; and U.S. Senator Paul Laxalt.

PASSED WITHOUT DISSENTING VOTE

ATTEST:

Edwin P. Pister

Edwin P. Pister
Executive Secretary

Fifteenth Annual Symposium Attendance List

Name	Affiliation	Address
Phil Pister	Calif. Dept. Fish and Game	407 W. Line St., Bishop, CA 93514
Mignon Shranway	Calif. Dept. Fish and Game	407 W. Line St., Bishop, CA 93514
Robert Rush Miller	Univ. Mich. Mus. Zool.	Ann Arbor, MI 48109
Frances H. Miller	Univ. Mich. Mus. Zool.	Ann Arbor, MI 48109
Laura Hubbs		La Jolla, CA
Frances N. Clark		La Jolla, CA
W.L. Minckley	A.S.O.	Tempe, AZ 85287
Robert P. Smith	US Fish & Wildlife Serv.	Grand Junction, CO
Terry Hickman	US Fish & Wildlife Serv.	Salt Lake City, Utah
Randy Radant	Utah Wildlife Resources	Salt Lake City, Utah
Jim Williams	FWS/Endangered Sp. Off.	Washinton, D.C.
Jim Johnson	FWS/Endangerd Species	Albuquerque, NM
Butch Padilla	Nevada Dept. of Wildlife	Las Vegas, NV
Ganise Satterwhite	UNLV	Las Vegas, NV
Valerie Sheppe	UNLV	Las Vegas, NV
John Hutchings	Nevada Dept. of Wildlife	Las Vegas, NV
Mike Burrell	Nevada Dept. of Wildlife	Las Vegas, NV
Bruce DeMarais	ASU	Tempe, AZ 85287
Mike McCarthy	ASU	Tempe, AZ 85287
Beverly Kohfield	Naval Weapons Ceter	Environmental Br., China Lake, CA
Larry Eng	Calif. Dept. Fish & Game	Sacramento, CA 95814
Clark Hubbs	Dept. Zoology, Univ. Texas	Austin, TX 78712
Bob & Deb Edwards	Pan American Univ.	Edinburg, TX 78539
Bob Feldmeth	Claremont College	Claremont, CA 91711
Dave Soltz	Calif. St. Univ. Los Angeles	Los Angeles, CA 90032
Bill London	Calif. Fish & Game	Rancho Cordova, CA
Melanie Wilson	Calif. Fish & Game	Rancho Cordova, CA
Dennis McEwan	Calif. Fish & Game	Rancho Cordova, CA
Robert Clarkson	Ariz. Game & Fish	2222 W. Greenway Rd, Phoenix, AZ
Linda Ulmer	Calif. Fish & Game	PO Box BD, Blythe, CA 92225
Judy Hohman	Bureau of Reclamation	PO Box 12487, Yuma, AZ 85365
Bruce Jones	BLM	5050 N. 19th Ave, Phoenix, AZ 85015
William Kepner	US Bureau of Land Mgt.	2929 W. Clarendon, Phoenix, AZ 85017
Lauren Porzer Kepner	AZ Game & Fish	2222 W. Greenway Rd, Phoenix, AZ 85023
Randy McNatt	US Fish & Wildlife Serv.	4600 Kietzke Ln, Reno, NV 89502
David Buck	NV Dept. of Wildlife	St. Mail Rm. Complex, Las Vegas, NV
Randy Benthin	Calif. Fish & Game	407 W. Line St, Bishop, CA 93414
Nadine Kanim	UNLV, Biology	Las Vegas, NV 89154
Michael Parker	UNLV, Biology	Las Vegas, NV 89154
Patrick Coffin	Nev. Dept. of Wildlife	1100 Valley Rd, Reno. NV 89520
Jerry Landye	AZ Game & Fish	3465 N Jamison, Flagstaff, AZ
Jim LaBounty	Bureau of Reclamation	PO Box 25007, Denver, CO 80225
Mike Busdosh	Affinis	10140 Gayuba Ln, San Diego, CA 92124
Jerry Stefferud	US Forest Serv.	517 Gold Ave. SW, Albuquerque, NM 87102
Sally Stefferud	US Fish & Wildlife Serv.	Albuquerque, NM 87103
Donald W. Sada	US Fish & Wildlife Serv.	4600 Kietzke Ln, Reno, NV 89502
Rosemary Thompson	HDR Systems	804 Anacapa St, Santa Barbara, CA 93101
Cal Allan	NDW (retired)	5412 Longride Ave, Las Vegas, NV 89102
Mike Kunzmann	National Park Service	PO Box 41622, Tucson, AZ 85717
Peter Bennett	National Park Service	PO Box 41058, Tucson, AZ 85717

Linn Montgomery	No. Arizona Univ., Bio.	Flagstaff, AZ 86011
Bob Minckley	ITS	2601 E. 4th, Tucson, AZ 85716
Nicholas Dye	Arizona Sonora Desert Mus.	Rt. 9, Box 900, Tucson, AZ 85743
Tom & Doreen McMahon	Univ. of Arizona	210 Biological Sciences E, Tucson, A
Peter B. Moyle	Univ. Calif., Davis	Davis, CA 95616
Martin R. Brittan	Calif. State Univ., Bio.	Sacramento, CA 95819
Carl E. Bond	Ore. St. Univ., Fish/Wild.	Corvallis, OR 97331
Neil B. Armantrout	BLM	Bx 10502, Eugene, OR 97440
Nancy Norton	PO Box 31100	Dallas, TX 75231
John Irwin	Cal. St. Univ., Bio.	Los Angeles, CA 90032
Paul R. Turner	New Mexico St. Univ, F/W	Las Cruces, NM 88003
Jack E. Williams	US Fish & Wildlife Ser.	1230 N St, Sacramento, CA 95814
Austin E. Williams		7550 Verdugo Way, Sacramento, CA 958
Gail C. Kobetich	USFWS	1230 N St., Sacramento, CA 95814
Paul Holden	Bio/West, Inc	PO Box 3226, Logan, UT 84321
Larry Crist	Bio/West, Inc.	PO Box 3226, Logan, UT 84321
Jim Brooks	Ariz. Game & Fish	2222 W. Greenway, Phoenix, AZ 85023
Osborne Casey	BLM	Box 12000, Reno, NV 89520
Dave Tacoechea	BLM	Box 12000, Reno, NV 89520
Chas. M. Haynes	CO Div. Wildlife	317 W. Prospect, Ft. Collins, CO
Robt. T. Muth	CO St. Univ, F/W Bio.	Ft. Collins, CO
Ted Nado	BLM, Barstow Res. Area Off.	831 Barstow Rd, Barstow, CA 92311
Bob Love	TNC-Ash Meadows	PO Box 1006 Yorba Linda, C
Larry Zuckerman	Colo. St. Univ, F/W, Bio.	Ft. Collins, CO 80523
David L. Propst		PO Box 2131, Silver City, NM 99061
Wm & Margaret Sigler	WF Sigler & Assoc, Inc.	PO Box 1350, Logan, UT 84322
Bob Behnke	CSU	Ft. Collins, CO
Eric Gerstung	CDFG	1701 Nimbus Rd., Ranco Cordova, CA
Milton C. Kolipinski	Natl. Park Service	4500 Golden Gate Ave, San Francisco,
John Boehmke	USBR	PO Box 25007, Lakewood, CO 80225
Glen Gould	USBR	PO Box 12487, Yuma, AZ 85365
Paul Marsh	AZ St. Univ. Ctr. Envir. St.	Tempe, AZ 85287
Tom Burke	Bureau of Reclamation	Box 427, Boulder City, NV 89005
Frank Hoover	Cal. Dept. Fish & Game	15378 Bird Farm Rd, Chino, CA 91710
Alan McCready		4529 Marble Way, Carmichael, CA 9560
Betsy Chessher	CDFG	1416 9th St, Rm 1225, Sacramento, CA
Darlene McGriff	Calif. Fish & Game	1701 Nimbus Rd, Rancho Cordova, CA
Cay Colette Goude	US Army Corps of Engineers	10685 Jackson Rd, Sacramento, CA 958
Ellen Gleason	CA. Dept. Fish & Game	1416 Ninth St, Sacramento, CA 95814
Ed Lorentzen	US Fish & Wildlife Service	1230 N St, Sacramento, CA 95814
Gary Vinyard	UNR, Biology	Reno, NV 89557
Pat Minckley	ASU, Zoology	Tempe, AZ 85282
Steven Vigg	Desert Research Inst.	Reno, NV 89506
Dean Hendrickson	ASU, Zoology	Tempe, AZ 85287
Mark G. Baxter	BYU, Zoology	Provo, UT 84602
Clay Speas	BYU, Zoology	Provo, UT 84602
Allen Kimball	BYU, Zoology	Provo, UT 84602
Dennis Shiozawa	BYU, Zoology	Provo, UT 84602
Elisabeth Milstead		PO Box 1316, Niland, CA 92257
Glen Sibbald	HSU/CDFG	28883 W. Barragan St, Agoura, CA 9130
Jim Deacon	UNLV, Biology	Las Vegas, NV 89154
Gene Wilde	UNLV, Biology	Las Vegas, NV 89154
Don Archer	USFWS	150 S. State St, Salt Lake City, UT 8
Bob Vryenhoek	Rutgers Univ.	New Brunswick, MJ 08903
Gary Meffe	ASU, Zoology	Tempe, AZ 85287

Ed Kinney		807 17th St. SW, Massillon, OH 44646
Kevin Bestgen	Contractor/NMGF/CSU	Box 2131, Silver City, NM 88062
David L. Miller	CSU, Fish/Wildlife Biology	
Michael L. Johnson	CF & G	2201 Garden Rd, Monterey, CA 93940
Paul Barrett	ASU	1010 W 17th St, Tempe, AZ 85281
Gary Scoppettone	USFWS	4600 Kietzke Ln, Reno, NV 89502
Howard Burge	USFWS	PO Box 205, Moapa, NV 89025
Julie West	CA Fish & Game	407 W Line, Bishop, CA
Dennis M. Rubly	AZ State	401 W. Pebble Beach, Tempe, AZ 85282
Thomas L. Taylor	Parks & Recreation	PO Box 2390, Sacramento, CA 95411
George Renwick	TNC	1800 N Kent St, Arlington, VA 22207
Susan Cochrane	CDFG	1416 9th St, Sacramento, CA 95814
Michael Havelka	Desert Research Station	Barstow, CA 92311
Calvin Rowland	Desert Research Station	Barstow, CA 92311
Jason Lamoreawx	Desert Research Station	Barstow, CA 92311
Jon Bolden	Desert Research Station	Barstow, CA 92311
Chuck McAda	US Fish & Wildlife Service	Box 3442, Grand Junction, CO 81501
Gary Smith	CDFG	1416 9th St, Sacramento, CA 95814
Katsuo Nishikawa	CICESE	
Carlos Yruretagoyena	Direccior de Pesca	
Manuel Alvarez	UNAM	
Victor Camacho	UABC	
Salvador Contreras	UANL	

Using roughly estimated and rounded figures, future depletions up to an additional 500,000 acre feet per year can be viewed as follows. The long-term virgin flow from the Colorado River at State Line probably averaged about 6.5 million acre feet per year. Present depletions have reduced the virgin flow by about 25% or to an average of slightly less than 5 million acre feet per year. An additional 500,000 acre feet depletion would reduce flows to 65-70% of the virgin flows, or to about 4.5 million acre feet per year.

An average annual flow in the range of 60 to 70% of the virgin flow offers considerable opportunity to maintain optimum habitat for fishes with proper structuring of the annual hydrograph. A starting point for the resolution of the present conflict between endangered species and state water rights would consider that, given an annual flow of about 4.5 million acre feet, how would an annual hydrograph be structured (if complete regulation of river were possible) to create the most favorable regime for meeting all life history needs of squawfish and humpback chub?

I recognize the complexities and innumerable "ifs" and "buts" involved in this oversimplified scenario, and that additional storage for transport of water out of the state would be required, but the important point is that FWS personnel and state water user groups should initiate communication and dialogue on the matter to examine the feasibility of such an approach to resolve the present conflicts in the upper basin. This matter is all the more urgent because the present recommended flows given in the FWS Draft Conservation Plan are not based on hard biological or hydrological data clearly relating direct cause and effect between squawfish and/or humpback chub "needs" and flows. As such they would be difficult to defend if seriously challenged.

WESTERN NORTH AMERICAN SUBPLATE TECTONISM AND FISH DISTRIBUTIONS

Dean A. Hendrickson (Department of Zoology, Arizona State University, Tempe, AZ 85281 U.S.A.)

Abstract --

Recently documented histories of tectonic displacements and rotations of sub-plates within Western North America are relevant to biogeographic history of the region and its fauna. Major sub-plates of the region are aseismic and bounded by zones of seismicity. These large aseismic areas correspond to areas of fish fauna endemicity. Rotation of the Klamath-Cascade-Coast Range block, westward displacement of the Sierra Nevada, extension, shearing and block faulting in the Great Basin and Southern Basin and Range and rotation and uplift of the Colorado Plateau are reviewed. Restoration of these displacements to Miocene paleopositions is demonstrated to condense presently allopatric ranges of many congeneric species into probable paleosympatry. Phylogenies and distributions seen today may thus, at least in part, result from tectonic displacements which fragmented broad ancestral distributions into allopatric sub-divisions in which subsequent diversification occurred. The vicariance biogeography methodology of analysis is applied using an area cladogram (branching diagram depicting area relationships) based on pre-Pleistocene geologic evidence. Area relationships are highly congruent with the two fish phylogenies available (*Chasmistes*-Miller and Smith 1981; *Catostomus* Smith and Koehn 1971) indicating that the vicariance methodology is applicable within continents and that speciation has been predominately allopatric as the result of vicariance rather than dispersal. Greatest congruence of the *Catostomus* phylogeny with area relationships is obtained by hypothesizing earlier divergence of the *Pantosteus* (including *Catostomus* (*P.*) *columbianus*) lineage than indicated by Smith and Koehn (1971). It is predicted that reanalysis of relationships in the genus will indicate that *Pantosteus* and a lineage now represented by *C. occidentalis*, *C. rimiculus* and *C. tahoensis* are sister groups which diverged in late Oligocene after their common ancestor diverged from the other *Catostomus* clade of Smith and Koehn (1971) which includes *C. commersoni*, *C. insignas* et al. It is expected that phylogenies of other organisms in the region will similarly comply with these patterns. Production of more phylogenies is encouraged for further testing of the model.

TECTONISMO DE SUB-PLACAS DEL ORIENTE DE NORTE AMERICA Y SU RELACION A DISTRIBUCIONES Y FILOGENIAS DE PECES

Dean A. Hendrickson (Departamento de Zoología, Universidad del Estado de Arizona, Tempe, AZ. 85281, EE.UU.)

Resumen --

Historias documentadas recientemente de desplazamientos tectónicos de sub-placas dentro del Oriente de Norte America son pertinentes a la historia biogeográfica de la región y su biota. Sub-placas mayores son asismicas bordadas por zonas de sismicidad. Areas asisimicos corresponden a areas de endemicidad fauntistica. Se revisan aqui datos sobre rotación del bloque Klamath-Cascade-Coast Range, desplazamiento al oriente de la Sierra Nevada, extensión, deslizamiento y quebrados de bloques en el Valle Grande y Región de Valles y Sierras del Sur y la rotación y levantamiento del Altiplano del Colorado. La restauración de estos deplazamientos a sus paleoposiciones en Mioceno se demostra tener efecto de condensar las extensiones de especies congenericas que hoy día estan alopátricas a condición de paleosimpatria. Así, distribuciones y filogenias que vemos hoy día pueden ser, por lo menos en parte, atribuidas a desplazamientos tectónicos que quebraron distribuciones amplias de antepasados, así produciendo sub-poblaciones alopátricas que diferenciaron subsecuentemente. Se aplica el método de biogeografía por vicario, utilizando un cladogramo de áreas (arbol de bifurcaciones que representa relaciones de áreas) basado en datos geológicos de eventos de edades mayores que Pleistoceno. Un nivel alto de congruencia de relaciones de áreas a las dos filogenias de peces que se encuentran en la literatura (Chasmistes - Miller y Smith 1981; Catostomus-Smith y Koehn 1971) indica que el método de biogeografía por vicario puede tener aplicación dentro de continentes y que la especiación alopátrica producida por eventos vicarios ha predominado. Mayor conformidad de la filogenia de Catostomus con las relaciones de áreas de obtiene si se permite que la separación del linaje de Pantosteus es mucho mas viejo que la indicada por Smith y Koehn (1971). Se predice que la reanálisis de relaciones dentro del género se vaya indicar que Pantosteus y el grupo de Catostomus que consiste de C. occidentalis, C. rimiculus y C. tahoensis son grupos hermanos que separaron tarde en Oligoceno despues de que su antepasado común separó del otro linaje que incluye C. commersoni, C. insignis y otros. Se espera que filogenias de otros organismos en la región conformarán tambien al arbol de relaciones de áreas. Se solicita aquí la producción de mas filogenias para proveer mas ensayos del modelo.

NATURAL RESOURCES OF THE LARK SEEP SYSTEM (CHINA LAKE, CA) WITH SPECIAL EMPHASIS ON THE MOHAVE CHUB (Gila bicolor mohavensis)

by
Robert Feldmeth, David Soltz, Lon McClanahan, Jeffrey Jones and John Irwin

The Claremont Colleges, California State University, Los Anggles and California State University, Fullerton

ABSTRACT

In 1971 Mohave chub were introduced into the lagoon at Lark Seep, a small marsh formed by leakage from the sewage treatment ponds on the China Lake Naval Weapons Center. Since the introduction the Lark Seep marsh system has become enlarged due to increases in the capacity of the sewage system.

In order to access the present chub population and its habitat the U.S. Navy sponsored a natural resources survey of the entire aquatic ecosystem at Lark Seep with a special emphasis on the Mohave chub (a species listed as endangered by the U.S. Fish and Wildlife Service and the State of California).

A field survey of the Lark Seep System was conducted during 1983 with major sampling periods in March, May, late June and late August. Sampling included water chemistry, primary production, plankton, benthic invertebrates and fishes.

Another purpose of the study was to determine habitat requirements for the Mohave chub in order to predict what affects alteration of the existing habitats would have upon this endangered species.

Field investigation of the chubs included studies in distribution, feeding, reproduction and parasites. Also physiological measurements such as thermal tolerance, osmoreglatory ability and energy metabolism were conducted.

FISHERIES STUDIES

The general habitat at Lark Seep consists of a main channel through which water flows to the lagoon-marsh system. The lagoon is approximately 10 acres in size and is relatively shallow (less than 50 cm). Water drains from the marsh and flows into a long channel which leads out onto the China Lake playa.

Distribution

Although the transplant was made into the lagoon the fish appear to prefer the deeper water of the channels. During mid and late summer, fish occurred throughout the entire channel system.

In 1982 the channels were dredged to remove emergent vegetation and the fish quickly colonized these newly enlarged habitats so that the majority of the population (greater than 90 percent) now live in the channels.

The population was censused in spring as well as early, mid and late summmer using baited traps, umbrella nets and minnow seines. In March and May chubs were readily seined and trapped from the channel which flows into the marsh but they were not observed or captured from the channel flowing toward the playa. In the mid and late summer sampling periods the fish were found to be numerous and distributed throughout the channel system, although the presence of cover (cattails and bulrushes) appeared to be important. Some chubs including young of the year, were present in the mid and late summer samples from the lagoon.

Reproduction

Gonosomatic indices indicate that spawning occurred between May and June. Fish were found to be ripe in May and were spent by late June. Large numbers of juvenile chubs (25-50 mm) were observed in several habitats during the latter sampling period. Recruitment of young of the year fish in the August sample substantiate this early summer spawning.

Food Habits

Gut analyses indicated that the Mohave chub population at Lark Seep is an opportunistic omnivore with stomach contents which include detritus, vascular plants, *Spirogyra* and animals. The latter categories included fish (young chub), *Daphnia*, chironomids, amphipods and trichopteran cases.

Plankton samples taken from the lagoon and the channels yielded low numbers of zooplankton. Benthic samples (Ekman grab) produced numerous aquatic invertebrates (insects and amphipods) especially in areas vegetated with *Ruppia*.

Parasites

In the samples of fish taken from the lagoon in late August the incidence of parasitism exceeded 75 percent. The parasite (a nematode) was located in the body cavity and was present mainly in young of the year fish. Parasitism of fish of the same age class from the flowing channel environments was much lower, while the frequency among all adult fish was even lower (less than 9 percent). The latter finding suggests that the nematode could be an important source of mortality for the lagoon population.

PHYSIOLOGICAL STUDIES

In order to determine specific habitat requirements related to water temperature and salinity extremes, various laboratory experiments were conducted.

Thermal Tolerance

Using standard techniques to measure thermal tolerance, critical thermal maxima and critical thermal minima were found to be dependent upon on thermal acclimation. Fish acclimated to 18C had a CTMax of 33.5C, while those acclimated to 30C had a CTMax of 36.2C. CTMin ranged from 2.8C for fish acclimated to 18C while CTMin rose to 7.2C when the acclimation temperature was elevated to 30C.

Salinity Tolerance

The Mohave chub was able to tolerate salinities up to 7.5 ppt without an increase in blood osmolarity. When acclimated to a salinity of 10 ppt, a significant rise (17 percent) in blood osmolarity occurred. In 12.6 ppt, blood salt concentration increased another 7 percent and fish became listless and began to lose equilibrium. In the latter concentration, body water decreased which is another indication that this species is unable to osmoregulate in salinities greater than 10 ppt.

Energy Metabolism

When placed in a water tunnel-respirometer Mohave chub demonstrated the ability to swim in currents up to 87 cm/sec. Metabolic rate at rest was temperature dependent rising from 0.03 to 0.07 ml/g/hr in test temperatures ranging from 18-30C. When exercised, oxygen consumption rose to 0.1 ml/g/hr and was temperature independent, indicating maximum energy expenditure.

At 18C the maximum swimming speed was 45 cm/sec and in temperatures below 18C some fish were unable to swim. The maximum speed of 87 cm/sec was reached in 30C.

Significance of Present Study (Habitat Requirements)

Chubs were found over a wide range of habitats in both channels and lagoon areas. Food requirements are very general but plant material was predominate in gut samples. The fish appear to prefer deeper channel habitats and thermal tolerance experiments indicate that this species has a considerably lower CTMax than other fish inhabiting desert habitats (eg. *Cyprinodon*). The inability of chub to swim in a water tunnel at temperatures lower than 18C probably explains our difficulty in trapping or seining fish from the channels below the lagoon in March. In cooler temperatures common in much of the habitat at Lark Seep during the winter months chubs must remain relatively inactive.

Salinity tolerance data indicate the chub are capable of tolerating slight elevations in salt concentration in their environment such as would occur in a pool or playa lake during dry summer periods. Salinities greater than 10 ppt (30 percent sea water) probably can only be tolerated for short periods of time.

Habitat requirements for this endangered species would thus appear to include the need of some emergent vegetation for cover, water of low salinity and pond or channel configurations which allow cooler waters to be present during the hot summer months. Small, shallow ponds without vegetation or circulation would appear to be unsatisifactory refugia for Mohave chub.

Phil —
Thought you might enjoy Noah's account of what really went on at DFC meeting!
Bob

MY TRIP TO DEATH VALLEY

November 16-20,1983

John Noah Moyle

I woke up feeling strange. Where was I? Then I remembered. I was at Furnace Creek Ranch in Death Valley! I quickly got up and got dressed. Then I woke up my Mom and Dad and we had breakfast. Then my Dad (who is an ichthyologist) had togo over to his meeting so my mom and I were left alone. We both decided to walk over to the Visitor's Center and go on the date palm hike. We walked over and seated ourselves on a metal bench where everyone was gathering. At 10:00 the ranger, Tom, walked over to us.

We soon learned that date palms have to be fertilized and that the ones that aren't turn a bright orange and turn bad. The easiest way' to fertilize them,and the quickest way, is to hand pollinate them by cutting off the flower of a male and spreading the pollen on the female flower. This way is more reliable and,besides, you need only one or two male palms for a whole orchard of female date palms.

Then we learned about the different kinds of date palms like the Washingtonian, which is named after George Washington. If its leaves aren't cut when they die, they make a "skirt" around the tree. Tom went on to say that since it's been transplanted to Hawaii, they' have been calling it the "Hula Hula" and the "Hula Skirt" palm. They still tend the dates in Death Valley, but they don't really ship the dates anywhere.

After we had walked through the orchard and bought some dried dates we went back to our cabin to wait for my dad to come back for lunch. We proceeded to have lunch with some of our friends. Then my mom and I went back to our cabin to take a nap.

I nagged my mom into letting me have two dollars for a bicycle you could rent at a nearby gas station. She let me have the money & I went and rented a dirt bike. There were lots of nice bike paths so I went on a few of them , though I didn't go to the Borax Works because I wanted to go there with my mom on a tandem bicycle.

After I had parked my bicycle,I woke up Mom and we rented a tandem bicycle and bicycled down to the Borax Works. The Borax Works is the remains of an old company that mined borax, called the Twenty Mule Team (which is what they used to transport borax). Borax is a mineral which is very common in Death Valley and has a number of uses. It can be used as a detergent, which is the main use, or it can be used as an ornament because it has nice crystals.

By the time we came back, it was almost time for my dad's meeting to end. We walked over to the Visitor's Center where the conference was being held and looked through the museum there. We walked over to a scene of some me looking at a wagon under some glass. We pressed the button and the voice said: "It was 1803 when William Manley and another man went out to find some food for a stranded wagon in Death Valley. After travelling over 200 miles for supplies, they made it back to the wagon. They saw no signs of life until a man came out from under a wagon and said "It's them!" Then a boy and a woman came out and welcomed them with all the strength they had. Then, after a refreshing dinner, they set out and by the next evening they were looking down at Death Valley, the danger of starvation past. One of the women looked back and said "Good-bye Death Valley." " Then the voice clicked off and I think that is supposed to be the reason that people call Death Valley Death Valley!

At about 8:00 my dad finished with the meeting and we decided to go to the ranch cafe. I didn't eat much because the food was terrible but I managed to eat a few bites. After dinner, my mom decided to call my sister who was staying at her friend Garyth's house. After depositing about five dollars we got her. Meanwhile, I was feeling around the coin return of another phone. I found 55 cents! By then I was so tired that all I wanted to do was to go to sleep. I stumbled back to our cabin with my mom and dad. Soon after I fell asleep.

The next morning I woke up and looked around at the end of my bed. My dad was sitting there reading a <u>Science</u> magazine. I quickly got up and he made breakfast. Then my mom woke up and my dad left. My mom wanted to go on the Artist's Drive but I didn't. She made me go anyway.

Our first stop was Mushroom Rock! Wind and sand had carved out a volcanic rock into a mushroom shape. Later on, these natural forces caused a large portion of it to fall off, making it look like a sliced mushroom. It was really interesting, especially since it was carved by nature. Then we moved on to the real Artists Drive. We drove down a narrow dirt road to the Artist's Palette. It was a cliff where different metals had made the cliff turn several different colors. I wasn't too impressed but my mom was dazzled. She took about a thousand photos while I waited. Then, on the way back, we took a hike through Golden Canyon. Was I tired! It was a boring mile long waste of time. But my mom didn't think so. She was in a daze. Finally, two thousand snap shots later, we left.

When we got back to our cabin I took a rest and read my book. I really needed that rest too, because there was going to be a bar-b-que! Arghghgh!

It was time to leave for the cookout too soon. It started at seven and it was taking place by a drained swimming pool so we had to leave at about 6:30. When we got there, the party was already in full swing. There was a trashcan full of soda, so I grabbed a Sunkist. Then I went over to the grills. The two men there were trying to keep the steaks from burning, but it wasn't enough. The fat from the steaks the mountain divide. b.) The CENTRAL PROVINCE goes from the Colorado River south to the 26 N latitude running in the eastern side of the mountains. Then crosses to the Pacific Ocean until the 25 N latitude where starts c.-) THE SOUTHEASTERN PROVINCE that extends south to La Paz and Cabo San Lucas.

San Pedro Mártir sierra is part of the Northwestern climatic province. Each of this climatic regions is characterized by different precipitation regimes and temperature distributions. The NORTHWESTERN PROVINCE has a temperature range of the order of 10-15 C and a scarce winter precipitacion regime. The CENTRAL PROVINCE has a much larger temperature range (more than 20 C) and the precipitacion regime although very small is concentrated in the autumn months. Finally, the SOUTHEASTERN PROVINCE has a milder climate with a temperature range smaller than 10 C and heavy rains concentrated also in autumn and winter. This precipitation regime is mostly due to the effect of the tropical cyclons.

CLIMATE OF SAN PEDRO MARTIR SIERRA.

A.-) TEMPERATURE. In 1968 we started a site testing campaign that included climatological measurements together with astronomical observations in order to test the astronomical quality of the place. In Paper I, Alvarez and Maisterrena report the average monthly temperature for the years 1969-1974. In our TABLE 1, we give the monthly average values for each of these years. The difference between the mean values for each month with respect to the values reported in Paper I is due to the inhomogeneity of the sample and the averaging technique used in that paper. In several months we have only a few days of measurement. The <RANGE> is computed from the weakly mean values of maximum and minimum temperatures.

In Figure 4 we plot the monthly average values of temperature at 6 hour intervals. These are running averages computed every seven days. The small dot indicates the mean value for each month. We can see the daily change in temperature plus the monthly temperature trend.

In Figure 5 we plot the weakly mean values of maximum and minimum temperature. The monthly mean value of the temperature is also plotted. From these measurements we find that March is the coldest month with <T> = -1.0 C. The extreme values observed for this month are -19 C. and +16 C. The coldest average temperature of -19 C. was recorded on December 1971 and March 1974. The warmest month is July with <T> = 16.3 C. The extreme values for this month are +27.7 C. (July 1972) and + 9.0 C. (July 1973) The warmest average temperature of +29.7 C. was recorded on August 1971. As we can see from this figure and TABLE 1, the average range of temperatures lies between +11.8 C in August to +17.5 C. in November.

In figure 2 of Paper I, we can see the existence of a very well defined local inversion layer. In that figure we have the monthly mean of maximum and minimum temperatures for the year 1969 for two stations with an altitude difference of 400 m. between them. We find that at night, the lower station called "VALLECITOS" (2,420 mt.) is colder (about -5 C.) than the station called "CUPULA" (2,830 mt.) where the astronomical observatory is located. During the day, by forced turbulence, this inversion layer is destroyed. It also depends on wind direction and speed both at night and in the daytime.

B.-) WIND DIRECTION AND SPEED. Our own measurements of wind direction and speed for the year 1969 have been reported by Alvarez (1982) and are reproduced here. In TABLE 2 we have the monthly averages of wind direction and speed at 6 hr. intervals.

Figure 6 shows the average speed and as expected from the global circulation pattern, the strongest wind speed occurs at winter time with average values of 21.4 km/h. (5.94 m/s.) in December, 31.5 km/h (8.75 m/s.) in January and 27.0 km/h. (7.5 m/s.) in February. At night, the average values reach 35.2 km/h. (9.78 m/s.) while during the day the average value is of 18.0 km/h. (5 m/s.).

The maximum average values, reported also in TABLE 3 from Alvarez (1982) for the 3 hr. running averages reach 101.9 km/h. (28.31 m/s.) in January. It was observed a wind speed of 108 km/h. (30 m/s.) in October and 114 km/h. (31.67 m/s.) during the month of March 1969. This TABLE 3 has also the extreme values of temperature for the year 1969.

Figure 7 is a vectorial diagram showing the wind direction and speed for each month. According to these measurements, there is a SE wind that prevails in the mountain. However, the in-situ observations shows very clearly a westerly or south-westerly dominant component of wind direction. There are two probable explanations to this discrepancy that must be explored. The instrumental one: it is that the anemograph was installed with the wrong orientation or that by orography effects we are measuring the wind direction affected by the strong updraft winds comming from the San Felipe Dessert to the east of the instrument. These two effects will be considered and the results reported elsewhere.

C.-) INSOLATION. Another climatological parameter of upmost importance in astronomy is the measure of clear skies. In Paper I, they report the results obtained at the site of the observatory during the period from August 1968 to June 1970.

From their figures 3 and 4 we can see that there is more than 50 % of the time of cloudless skies reaching more than 70 % of sunshine hours in April, May, June, September and October. This fact confirms the measurements reported also in Paper I that give low values of the relative humidity especially during the spring and autumn months, (see Table 6 of Paper I).

Our experience in the observatory have shown us that most of the time, by radiative cooling at night, the afternoon convective type clouds usually dissapear. This fact was also measured from July 1971 to June 1972 and reported in Paper I as a measure of the infrared sky noise at 10 . It is possible to see this trend from their figure 5 and Table 4 were we can also see a strong seasonal effect.

D.-) WATER PRECIPITATION. Most of the water that goes into the streams of the peninsula falls at high altitudes and unfortunately there are no continuous measurements of water precipitation at the site of the observatory. This parameter is of great importance and we can only make a very crude estimate of the amount of water precipitation that we expect to have at this place from measurements made at lower altitudes. In Figure 8, we have the annual precipitation of the climatological stations surrounding the observatory, both from the Pacific slope and from the Gulf of California. We can easily see that there is a continuous increase of water precipitation with altitude and we may expect an annual precipitation at the site of the observatory that goes from 250 mm. to more than 500 mm. of water either as rain or snow.

CONCLUSIONS.

The presence of the National Astronomical Observatory at the San Pedro Mártir mountains has allowed to make some measurements to determine the climate of a very important region of the peninsula of Baja California. However, a more continuous effort has to be made to have a better knowledge of this place to preserve it and to keep the forest and the region usefull for the scientific purposes to wich it was devoted when the Institute of Astronomy of the National University of México decided to install the astronomical observatory. We must keep a balance between the use of the natural resources, without destroying them.

The author wishes to thank the technical personnel of the astronomical observatory that trough their effort was possible the elaboration of this report. Special thanks are given to the organizers of the DESERT FISH COUNCIL for the facilities received during the meeting.

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FIGURE CAPTIONS.

FIGURE 1.- Topographical chart of the "San Pedro Mârtir National Park", adapted from the topographical charts H11B45, H11B46, H11B55 and H11B56 from CETENAL (1974). POINT 3, the highest peak of the peninsula is the "Picacho del Diablo" also called "La Encantada" of 3,100 mt. altitude. POINT A shows the Mexican National Observatory at 2,830 mt. altitude. POINT B is the point called "La Corona" of 2,600 mt. high. The limits of the National Park were taken graphically from data taken in 1953 by the Dirección General Forestal y de Caza.

FIGURE 2. Cross section of the San Pedro Martir sierra through the POINTS A were the National Astronomical Observatory is located and POINT B called "La Corona". This point is the highest in the western side of the sierra. The horizontal axis is labeled in km. starting from the astronomical observatory. The vertical axis is labeled in meters from sea level.

FIGURE 3-a. (From Alvarez and Maisterrena, 1977). Vertical gradient of monthly mean temperature at several climatological stations situated around the Mexican Astronomical Observatory in the Northwestern Climatological Province of the peninsula. The horizontal axis is the mean temperature of the station for each month and the vertical axis is the altitude of the station. We include our own measurements of temperature from 1969 to 1974.

FIGURE 3-b. Same as Figure 3-a for the stations 032 SAN FELIPE (20 mt.), 038 SANTA CATARINA (1,000 mt. high) and SAN PEDRO MARTIR ASTRONOMICAL OBSERVATORY (2,830 mt. high). These stations are located to the east side of the observatory in the Central Climatological Province.

FIGURE 4. Monthly Average Values of Temperature for the years 1969 to 1974. Running averages of temperature at six hour intervals computed every seven days. We can see the daily change in temperature. The dot indicates the mean value for each month.

FIGURE 5. Weakly mean values of maximum and minimum temperature for the years 1969 to 1974.

FIGURE 6. Monthly average speed at six hour intervals for the year 1969.

FIGURE 7. Vectorial diagram of average wind direction and speed at six hour intervals for the year 1969. For each diagram, (3) stands for the period from 0 - 6 hs., (9) from 6 - 12 hs., (15) from 12 -18 hs., (21) from 18 24 hs. Solid line corresponds to the monthly mean wind direction and speed.

FIGURE 8. Annual water precipitation of the climatological stations surrounding the observatory. At the site of the observatory there are no water precipitation measurements.

EMPIRICAL EVIDENCE AND INFERENCE AS A PROVISIONAL BASIS FOR PREDICTION AND MANAGEMENT OF UPPER COLORADO RIVER BASIN FISHES

Robert J. Behnke

ABSTRACT

When the present lull in energy development in the upper basin reignites with its demands for water, serious problems are foreseen in regards to maintaining an adequate flow regime for endangered species. This is due to the emotional and politically sensitive issue of state water rights and to the fact that there is no solid evidence on which to base flow recommendations for endangered fishes. Ideally, a high level federal-state commission should develop a "water budget" for the Colorado River that takes fishery values into consideration. To arrive at some provisional flow recommendations insight is provided from analysis of USGS historical flow and temperature records and a review of convergent life history strategies evolved by large cyprinids in big rivers.

A STEP TOWARD RESOLVING ENDANGERED SPECIES CONFLICTS IN UPPER COLORADO RIVER BASIN

R. J. Behnke

The following is a brief summary of a talk given at the meeting of the Desert Fishes Council, November 16, 1983, in Death Valley, California.

My main thesis is that, in the long run, the Endangered Species Act will not triumph over state water rights by preventing the upper basin states from utilizing their presently unused share of water guaranteed under the Colorado River Compact -- this is a politically reality that must be faced and planned for.

The example used was Colorado which has about 700,000 acre feet of additional annual depletion that the State is entitled to under the Compact. The drainages from which this future depletion can be obtained are the Yampa, White, mainstem Colorado, Dolores, and San Juan river drainages. It is obvious that most (ca. 500,000 a.f.) will come from the mainstem Colorado.

A series of slides was shown to illustrate changes in historical hydrographs, and tables and graphs depicting how U.S.G.S. data can be interpreted in relation to planning flows for fisheries.

I discussed the relative values of various river drainages in relation to squawfish, pointing out that the Yampa River has the highest priority for squawfish because it is the greatest known spawning area for the species. In relation to future compromises and trade-offs that may be necessary to resolve endangered species conflicts and state water rights, I suggested that emphasis might be given to maintaining as much of the virgin flow in the Yampa as possible. I then suggested that FWS initiate contact with Colorado water users to explore the possibility of an agreement to partition future depletions by river drainage. For example, no more than about 150,000 additional acre feet to be depleted from the Yampa, with most of the remaining 550,000 acre feet of future depletion to be partitioned among other drainages, mainly from the mainstem Colorado.