SURVIVAL STATUS OF THE SANDIA AND POTOSI VALLEYS ENDEMIC PUPFISHES AND CRAYFISHES FROM THE MEXICAN PLATEAU IN NUEVO LEON, MEXICO, WITH COMMENTS ON ASSOCIATE EXTINCT SNAILS.

Salvador Contreras-Balderas & Maria de Lourdes Lozano-Vilano[2].

[1] Bioconservación, A.C., AP 504, San Nicolás, N.L., Mexico.

[2] Laboratorio de Ictiología. Facultad de Ciencias Biológicas, UANL. A.P. 425. San Nicolás de los Garza, Nuevo Leon, Méx. 66450

ABSTRACT. Exploration of the arid SW Nuevo León, Mexico has rendered a number of recently described new species of living pupfishes and crayfishes, and extinct snails from isolated springs, as follows: Charco Palma: Cyprinodon longidorsalis, discovered 1984, extinct, 1994. La Trinidad: C. inmemoriam and crayfish, discovered 1984, extinct 1986. Charco Azul: C. veronicae and crayfish, discovered 1984, surviving in 1994; the snails Valvata beltrani and Valvata sp. were dead when discovered. La Presa: C. ceruliae and crayfish, discovered 1988, extinct 1990. Potosí: Megupsilon aporus and Cyprinodon alvarezi discovered between 1948 and 1961, almost extinct 1994. Extinction has resulted soon due to depleted aquifers for agricultural needs, irrational, not sustainable, and illegal. Conservation of this biodiversity, and the agriculture, needs regional management of the geohydrological basins.

RESUMEN. Las exploraciones del árido SW de Nuevo Leon, Mexico, han resultado en un n mero de especies reciéntemente descritos, de peces cachorritos y acociles vivientes, y caracoles extintos, de manantiales aislados, como sigue: Charco Palma: Cyprinodon longidorsalis, descubrimiento 1984, extinción 1994. La Trinidad: C. inmemoriam y acocil, descubrimiento 1984, extinción 1986. Charco Azul: C. veronicae y acocil, descripción 1984, sobreviviendo en 1994; los caracoles Valvata beltrani y Valvata sp. fueron descubiertos como conchas secas. La Presa: C. ceciliae y acocil, descubrimiento 1988, extinción 1990. Potosí: Megupsilon aporus and Cyprinodon alvarezi descubrimientos de '948 a 1961, casi extintos 1994. Las extinciones han sido rápidas a consecuencia de un abatimiento creciente de mantos acuíferos para fines agrícolas, irracional, no sustentable e ilegal. La conservación de ésta biodiversidad, y de la agricultura, requiere de manejo regional integral de las cuencas geohidrológicas.

Contreras & Lozano

The arid lands of southwestern Nuevo Leon, Mexico, were considered devoid of aquatic fauna until in 1948 a sample of cambarellid crayfish and pupfish from the large isolated spring of Potosí was obtained. They were described as new as Cambarellus alvarezi Villalobos (1952), and the fish as Cyprinqdon alvarezi Miller (1976). In 1961 a second pupfish, dwarfed, was collected by R.R. Miller and party, and described as Megupsilon aporus Miller & Walters (1972). One of us (SCB) recognized, from a commercial flight in 1983. a pluvial lake, with large springs, in the uplands of Nuevo León, Mexico, and the area was explored in 1994, when three endemic pupfishes were discovered in them, with a closely related group of 2 endemic crayfishes, one each per spring, except the smaller one that had only the pupfish. The first collecting produced a good sample. In subsequent visits the fish and crayfish were found in good shape, except the Trinidad forms, that were not found alive as the spring had fouled and almost dried before the second collection. While working a dissertation on the group, a third spring was found and explored which gave another pupfish and crayfish; simultaneously, it was recognized that all of them were endangered. The pupfishes were described by Lozano-V. & Contreras-B. (1993). The crayfishes are being studied and remain undescribed. Later on several new species of snails were detected, one has been described and another in the review process. A number of snail shells representing several new species was also collected and is being studied by Alberto Contreras-Arquieta (1993, In Press).

CHARCO LA PALMA

Cyprinodon longidorsalis was described from this spring. It was first collected by A.J. Contreras-B. and party in march 17, 1984. A visit by one of us (SCB) shortly after produced a good series of the pupfish and some crayfish. The springhead was 4 to 4.5 m^2 and 1.4 m deep in a sort of slanted hole on one side, 0.5 m in other parts; it was fenced around, having a small outlet and little running water that formed a small pool around 6 m^2 amd 0.1 m deep downwards. The spring water was used for human consumption and for irrigation of a small orchard, while the outlet pool was used for cattle. The water was clear and had plenty of aquatic plants at the time of several collecting urips: SCB & party (April 20, 1985), MLLV & party (June 17, 1988), SCB & party (October 31, 1987), MLLV & party (March 13, 1988 & June 17, 1988) (Fig. la). Population was around 50 to 70 individuals, mostly half grown or smaller. They were perhaps the smallest population and habitat ever known for any vertebrate species. Later visits were for monitoring of the statu only. In 1985 it was noticed that the water was 10 cm lower and the outlet pool was dry, by 1989 we found the water level had dropped another 10 cm and few fishes were on sight, situation that worsened by June 5, 1990 (Fig. lb). In November 5, 1994 the spring was found very low, shallow as if sides had collapsed and the deeper

parts filled in and leveled. Only plentyful mosquito larvae were found, and almost no vegetation. The species survived 10 years, 1984 to 1994, after discovery.

OJO LA TRINIDAD.

This spring was the type locality for C. inmemoriam L & C. One mature male was sampled first by A.J. Contreras-B. & party in March 17, 1984. Water was murky and had already lowered from an original 1 ha to a half dried spring covering only 0.5 ha; in a second visit in april 20, 1984, population was not estimated, but was in such bad condition that collecting was not attempted to reduce the endangerment of the species; the water was more than 1 meter below original level, and the area less than 1/10 ha. A visit in october 25, 1985 discovered that the water was murky brown and stinky, with no sign of the pupfish (Fig. 2a); only 2 female crayfish were so covered by fungus that they were misericordiously put in alcohol immediately. Both species have not been seen again; the spring was completely dryed thereafter (Fig. 2b), flowing again only one rainy season ever since, always without sign of aquatic fauna. We described the new species of pupfish on the basis of that single mature male specimen only. This species dissappeared less than 2 years after its discovery.

Contreras & Lozano

OJO DE AGUA CHARCO AZUL (= BARRENO).

Type locality of the brilliant and extremely pugnacious cyprinodontid fish C. veronicae L & C, and the extinct valvatid snails Valvata beltrani Contreras-A. (1993) and Valvata sp. n. Contreras-A. (In Pre s); he spring was first explored in February 26, 1984, subsequent visits by SCB & parties in April 20, 1985, October 25, 1985, and November 27, 1985, MLLV & party in March 13, 1988, and SCB & party in June 5, 1990. There were signs that the site was larger in the recent past, as well as in geological time. At the time of first collecting the fish and crayfish populations were around 10,000 to 12 000 each. This extensive spring complex (Fig. 3a) had beautifully clear water and a surface of 1.5 ha, with several pools 2 to 4 m deep, giving rise to a small creek. This condition was fairly stable except for a drop in water level that stoped flow in the creek since 1985. The springs kept clear water until abatement of the water table in 1988 increased by more than 1 m. An inpection showed that in the peak of the dry season, the water depth had diminished to around 0.3 m in October 1993 (Fig. 3b), and then to 0.2 m November 5, 1994. On these dates, the remaining water was in 3 and 1 pool only, respectively. In both these visits we observed the pupfish but not the crayfish. This is the only extant local pupfish population that has survived longer after discovery, 1984 to 1994 at least. It is difficult to accept that the species will not survive much longer.

Contreras & Lozano

OJO DE AGUA LA PRESA.

Type locality of C. ceciliae L & C, this sl.ring was not reached and explored until March 13, 1988, and again in June 17, 1988, finding the pupfish and 1 form of crayfish. The spring area was around 0.8 ha, with several spring pools 1 to 2 m deep, and an outlet creek with depth around 0.6 m on the first collection (Fig. 4a), lowering 50% by the second visit. An inspection in June 5, 1990, showed a drop in water level of more than 1.5 m (Fig. 4b), 2 stinky little pools remaining, no fishes and a few crayfish. The pring dryed completely in 1991, showed partial recovery of water level a couple of times, without reappearance of the fauna. Time elapsed between discovery and extinction of this species was less than 2 years also, 1988 o 1990.

OJO DE POTOSI.

This is the type locality of 3 aquatic species: 2 pupfishes, M. aporus Miller & Walters (1972), and Cyprinodon alvarezi Miller (1976), and 1 crayfish, Cambarellus alvarezi Villalobos (1952). No habitat description was available when the crayfish was collected (1948). The endemic genus of dwarf pupfish (Megupsilon) was first collected in 1961 together with carp. One of us (SCB) collected in this locality in 1968, finding all 3 endemic species abundant, 10,000 to 12,000 in ividuals for each of two endemics, common

pupfish and crayfish, and around 5 to 6,000 for the dwarf pupfish. The spring covered 1 ha (Fig. 5a) from 1968 to 1983, with maximum depth >2.5 m, abundant vegetation of Ceratophyllum, Najas, Lemna, Nasturtium, Utricularta, and sparse clumps of Typha and Scirpus, as described by Smith (1980). The original spring must have been smaller and was expanded by means of an earthen and rock dam at some time, one piece of cement had a date inscribed at August, 1924. Below the dam there were several secondary springs or seeps from the main spring, running down distributaries for 1 to 1.5 km;, they contained plenty of aquatic fauna except for Megupsilon . This ecosystem and its endemics have been subject to a series of threats throughout the years. Sometime before 1961 unknown people introduced goldfish (Carassius auratus), bred consistently but with little success, keeping always a low population. In 1974 one of us (SCB) collected largemouth bass (Micropterus salmoides), young being common in shallows and some adults, up to 0.3 m TL, mostly in the deep central pool; at the time only one Megupsilon was collected (to Miller in litt. 1976). The larger specimens of the endemics were gone, and the different populations were decimated. The habitat remained more or less stable from 1968 to 1983 (Fig 5a), with water level fluctuating 0.2 to 0.3 m, and loosing some 10% of aquatic area, then dropped nearly 1.5 m by 1984 reducing the pool surface 90% (Fig. 5b), another 0.3 by October 26, 1985 (Fig. 5c), and the rest next summer, when no pool or reservoir remained with water, with only a triffle of water running down the

distributaries, and has remained since (Fig. 5d); afterwards there has been a slight recovery in both, the pool and downstream. An inspection in November 8, 1994 disclosed very few specimens of the endemics, mostly the larger local pupfish, few dwarf pupfish, and negligible numbers of crayfish, down the remaining sidespring.

CAUSES OF ENDANGERMENT OF SANDIA AND POTOSI FISH ENDEMICS.

The first Mexican report of the causes behind the threats to fish species in Mexico is that of Contreras-B. (1975), where environmental impacts of hydraulic works were analyzed in general, and the Mexican waters in particular, with a list of threatened fish species. More recently, the water availability in Mexico has been summarized (Vázquez-G., 1993), and the relationship between water availability, fish diversity, and sustainable development were correlated (Contreras.B. & Lozano-V., 1994). All together, Northern Mexico water is overexploited, either surface or underground. Rivers have decreased flow and some have ceased it completely. Aquifers are polluted, usually saline (12 of 36 cases), overexploited (35 of 36), and aquifers were being depleted in 33 of 36 areas an average of 1 m/year in 1981 (Plan Nacional Hidráulico, 1981; Vázquez-G., 1993) with no later information. fhe same source reports the poor quality of all known surface waters (24 out of 37 regions, 4 unknown quality). Most of the endangered or threatened Mexican fish are from the arid and semiarid zone (Contreras-B. &

Lozano-V., 1994), 115 out of 135 in an unpublished paper (Contreras-B. & Almada, MS), encompassing 6 out of its 11 known fish extinctions until 1989 (Miller, 1989), rising to 10 out of 15 in 1994 (Contreras-B. & Lozano-V., MS). This data can not be considered as separate issues anymore. Preliminary reports have been presented at annual meetings of the Desert Fishes Council since 1984, American Asociation of Ichthyologists & Herpetologists (New York, 1992), American Fisheries Society Western Division (Flagstaff, 1994), and others.

CONSERVATION ACTIONS.

The General Environmental Mexican Law was promulgated in 1988, and did not result in protection of this fishes, or regulation, of the water use. The recent Federal listing of threatened and endangered species (Periódico Oficial, 1993), included only the Potosi forms, and came to late to benefit them.

Only the most initial conservation steps have been taken to protect the fish species from Potosí; among others, they have been repeatedly reported as under threat or danger by Contreras-B. (1975; 1978; 1984); such reports have been the basis for inclusion of the species in the endangered fish lists by Deacon, Kobetich, Williams, & Contreras-. (1979), with the addition of the Sandia endemics in Williams et al. (1989) and others. These reports

or.ginated also the recent list of Normas Oficiales Mexicanas (Official Mexican Norms, equivalent to listing in the USA) dated June, 1994, where endangerment of the Potosí endemics is recognized, but not the Sandia forms. This norms require all citizens and authorities to protect and enforce protection of species listed. Although appropiately decreed, this norms, their meaning, or the strategies for application have not been properly informed nor enforced, so they are relatively meaningless and have almost no standing for the authorities concerned.

Active actions for conserving the species have been the following: In 1974 one of us (SCB) moved numerous dwarf pupfish to the side springs, where no bass had been collected, trying to assure survival of the endemics. An observation in 1975 (Contreras-B. to Miller, in litt, 1976), a small population of the dwarf pupfish was observed in one of the small springs, in dense vegetation; it seems this action resulted in the dwarf pupfish becoming common in the creek, as observed in 1980 and latter.

In 1976 a team leaded by Armando J. Contreras-B. started an attempt to erradicate the bass by gillnetting, collecting bimonthly for 1 year; the bass population was depleted after removing 286 individuals; in February, 1977, many fry and only 1 subadult black bass was collected, although others were seen. The operation was h lted for lack of reasonable success. Field operations were

Contreras & Lozano

supported by a grant from Fauna Preservation Society (London) thanks to the efforts of Robert R. Miller.

PROBLEMS.

Until 1983, agricultural fields around Potosí were naturally irrigated by distributaries of the spring. At a somewhat earlier time, a wide area around this valley were open to agriculture, then the next valleys south, Sandia Valley one of them. Several hundred water pumps, some 12", were put to service in a few years, and is increasing. The resulting overexploitation is depleting the aquifers, and already has dryed some springs, or has stopped most flow in the others. Such continued depletion is irrational, unsustainable, and against actual Mexican laws and reason.

CONCLUSIONS

A diverse but restricted fauna from the Mexican highland plateau in Nuevo León, Mexico, is being lost rapidly: 3 species extinct and 3 more nearly extinct that may dissappear at any moment, visibly because of overexploitation of the phreatic water, in spite of a number of regulations. It is clear that a system of environmental laws, listing of threatened species, and locality protection in the arid and semiarid zones is not enough. To protects this biodiversity and human interests the region should be regulated

regionally usina the geohydrological basins as the uni , and the springs with their aquatic biota should be kept steady as a signal that the agricultural system would be sustainable.

AKCNOWLEDGEMENTS.

Numerous persons (colleagues, students, friends) assisted in field work, so as to make impractical listing them. This paper is a byproduct of research on the fishes of Mexico, done under grants from Comisión Nacional Consultiva de Pesca (1967-68), Consejo Nacional de Ciencia y Tecnología (to S. Contreras-B., (198), and contracts from Dirección General de la Investigación Científica y Apoyo Académico, Secretaría de Educación Pública Mexico, to M. L. Lozano-V. in 1987 (P-UANL-DGICSA-C87-08-0199), and 1988-89 (C88-08-0128). To all of them our sincere appreciation.

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8

Fig. 1. Spring Charco La Palma (24°04'N & 100°05.3'W), Aramberri, Nuevo Leon, Mexico. Type locality of the cyprinodontid fish Cyprinodon lnngidorsalis Lozano-V. & Contreras-B. (1993). A. April 20, 1985. B. June 5, 1990. Photos S. Contreras-B.


A
B

Fig. 2. Spring La Trinidad (24°06.3' N & 100 03 3 W), Aramberri, Nuevo Leon, Mexico. Type locality of the cyprinodontid fish Cyprinodon inmemoriam Lozano-V. & Contreras-B. (1993). A. November 25, 1985. B. June 5, 1990. Photos S. Contreras-B.


A
B

Fig. 3. Main pool of Spring Charco Azul (24°09.8' N & 100 03.7' W), Aramberri, Nuevo Leon, Mexico. Type locality of the cyprinodontid fish Cyprinodonveronicae Lozano-V. & Contreras-B. (1993), and the valvatid snails Valvata beltrani Contreras-A. (1994) and V. new species being described by Contreras-B. (1995). A. November 25, 1985. B. June 5, 1990. Photos S. Contreras-B.


A
B

Fig. 4. Main pool of Spring La Presa (24°11.87' N & 100 04.34' W), Aramberri, Nuevo Leon, Mexico. Type locality of the cyprinodontid fish Cyprinodon ceciliae Lozano-V. & Contreras-B. A. March 13, 1988. B. June 5, 1990. Photos: A. S. Contreras-B., B. A.J. Contreras-B.


A
B
C
D

Fig. 5. Main Spring El Potosí (24°52.9' N & 100°32.3' W), Galeana, Nuevo Leon, Mexico. Type locality of the cyprinodontid fishes Cyprinodon alvarezi Miller (1976), Megupsilon aporus Miller & Walters (1972), the cambarellid crayfish Cambarellus alvarezi Villalobos (1952), and the Valvatid snails Valvata beltrani Contreras-A. (1993) and. sp. Contreras-A. (In Press). A. August 3, 1979. B. November 8, 1984. C. October 26, 1985. D. September 4, 1987. Photos S. Contreras-B.

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Dr. Maurice Kottelat
Route de Fregiécourt 96c
Case postale 57
2952 Cornol, Switzerland
Tel./Fax (41) (66) 72 22 59
E-mail:
Maurice.Kottelat@bota.Unine.Ch

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Ms # **213** Date: 4/10/95

Author(s): **Contreras & Lozano-V.**

Title : Survival status of the Sandia and Potosi valleys endemic pupfishes and crayfishes from the Mexican plateau in N:!evo Leon, Mexico, with comments on associate extinct snails

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10 April 1995

Dr. Maurice Kottelat
Route de Fregiecourt 96c
Case Postale 57
2952 Comol, Switzerland

Dear Dr. Kottelat:

At the onset I apologize for the delay in responding to you request for a review. I am swamped with other responsibilities, as most of us seem to be.

Enclosed is an unmarked copy of Contreras-B and Lozano-V.'s manuscript on the imperiled aquatic fauna in San Luis Potosi, Mexico. I am quite familiar with the area and situation, and with the authors, and thus have some suggestions for you to consider.

The paper is clearly a timely contribution reporting a sad and unfortunate situation but at the same time important in alerting the ichthyological world to a national problem in Mexico (and in many other developing nations). The Sandia-Potosi valleys situation is not uncommon in the region; it seems likely that far more than half of the fish fauna in desert and semi-desert areas of Mexico may be lost in the next decade. This may also occur in comparable areas of the United States, and for almost the same reasons. Thus, it is important that this paper be published as soon as possible. First, however, I consider the paper as now constituted, as a series of notes, neither well integrated nor cohesive. Thus, although the subject is important and the data are clearly pertinent to conservation in the region and worthy of publication, the summarization has not been carefully thought out or carefully presented.

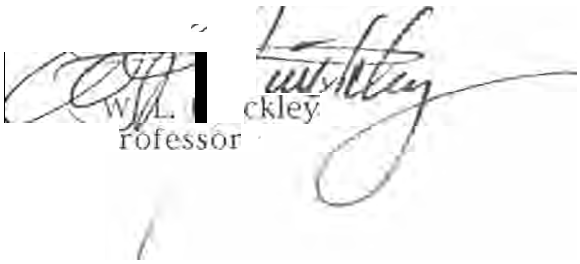
My second comment is that the literal translation by the authors to English (although clear enough in most cases) be refined to an easier and less colloquial style by an editor or individual asked to do just that. Both authors, although relatively fluent in English, have had and still have difficulties in written communication. The paper can be made far more readable and the authors will receive considerably more attention if this is done. I am willing to do such a substantial (suggested) revision anonymously if the review can be delayed until sometime in May, but cannot take it on right now.

Thirdly, if the option to revise is acceptable to the authors, the paper could easily be expanded, only slightly, to place greater emphasis on the plight of aquatic systems and organisms in northern Mexican desert/semi-desert habitats by citing just a few more pertinent papers. The Cuatro Cienegas area in the Mexican State of Coahuila (immediately northwest of San Luis Potosi) has a long history of research and efforts for conservation (some citations attached), and was just set aside as a biological reserve (which may not prevent its destruction by water development, but is at least a step in that direction). Both authors are knowledgeable of that area, but must have chosen not to cite works in that area despite its proximity to

their study site. I cannot understand why this is the case. A recent book by Ramamoorthy et al (1993) might also appropriately be cited. In other words, I recommend that they use the specific and tragic example of Sandia-Potosi in a conservation context that urges broader involvement by Mexican and other scientists in sorely needed conservation efforts.

Please advise me relative to the second question. And, if you decide to accept the paper in an expanded version relative to the third suggestion, please allow me the opportunity to review the revised manuscript. An alternative might also be to suggest that the authors submit additional information on other such places and biotas in Mexico and see how they respond. I know that such "presumptuous" suggestions may not be considered by some to be in the bailiwick of an editor. But in this instance, a basically valuable paper can be made more valuable with a bit of help and a little expansion in thinking. Forgive me if you do not agree.

Anyway, thank you for the opportunity to act as a reviewer for your journal. Although I have not personally subscribed, I read it regularly and feel that it fills a critical gap in ichthyological communication.



Some citations:

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