

FRESHWATER BIOLOGICAL RESEARCH IN MEXICO: A BRIEF HISTORICAL REVIEW

JAVIER ALCOCER-DURAND AND ELVA G. ESCOBAR-BRIONES

Environmental Conservation and Improvement Project, U.I.I.C.S.E.,
E.N.E.P.-Iztacala, U.N.A.M., A.P. 314 Tlalnepantla,
Estado de Mexico, 05490, Mexico.

(*Dr J. Alcocer-Durand, Calle 15 No. 51, San Pedro de los Pinos, Mexico 03800 D.F., Mexico City, Mexico and Dr E. C. Escobar-Briones, Benthic Ecology Laboratory, Institute of Marine Sciences and Limnology, U.N.A.M., A.P. 70-305, Ciudad Universitaria, 04510, Mexico.*)

The first notice of freshwater biological observations carried out in Mexico is contained in the ancient nahuatl codexes. In these, freshwater fishes, waterfowl and aquatic insects are depicted, showing capture methods, techniques and limnological observations such as changes in the water level of Lake Texcoco in 1519. All this information began with the arrival of the aztecs to the Valley of Mexico in 1245. An "aztec limnology" is defined by Deevey (1957) as all of the observations included in the codexes.

The aztecs acquired a deep knowledge of aquatic sciences because of their close relationship with the freshwater environment. They obtained water supplies, food, transportation and raw materials from the lakes. Within the Basin of Mexico a complex of six interconnected lakes existed. These were, from north to south and diminishing in altitude: Lake Zumpango, L. Xaltocan, L. Texcoco, L. Xochimilco, and L. Chalco. Now, only sparse remnants of that huge lacustrine complex remain.

Although there are a couple of early papers in which the Mexican axolotl, *Ambystoma tigrinum* (Amphibia; Ambystomidae) is recorded by Ximenez, in 1615, the development of freshwater biology as a science in Mexico began in the last century. Taxonomic studies were made especially on algae, aquatic insects, crustaceans, annelid worms and aquatic plants, notably by C. A. Agardh, A. Brulle, L. A. A. Chevrolat, C. G. Ehrenberg and A. F. A. Wiegmann in the 1920s and 1930s. In the following decades, many new species were described, notably by A. Bandelier, H. W. Clark, P. T. Cleve & J. D. Moller, H. A. Hagen, L. M. Jimenez, F. T. Kutzing, J. Leidy, G. Mendoza & A. Herrera, L. Rabenhorst, and H. Saussure.

Faunistic descriptions of the aquatic biota were the main objective in the early part of the 20th century, as well as the exploitation of lakes and ponds for aquaculture (Zipcy 1901). Zipcy's paper dealt with the rational exploitation of aquatic resources and had an immediate impact on the

economic plans of government at that time. It also stimulated more research on the biology of fresh waters. Most of the pioneer work was carried out by French, German and North American researchers in the northern, southern and south-eastern regions of Mexico (Juday 1916), including work on algae (J. E. Tilden), fish (G. A. Boulenger, D. S. Jordan &). O. Snyder, S. E. Meek) and plankton (H. W. Clark). In the first study of Lake Chapala, Cuesta-Terron (1925) studied the fish and molluscs.

The great impetus acquired by limnology in Europe and America in the first half of the 20th century stimulated foreign researchers to come and work in Mexico. As a result, in the 1920s and 1930s the freshwater biota was further documented by E. H. Ahlstrom, V. Brehm, E. P. Creaser, C. L. Hubbs, T. Jaczewski, W. G. van Name, and C. B. Wilson. During this period the Instituto de Biología, belonging to the Universidad Nacional Autónoma de México, was created in 1930. UNAM supported collaborative studies on limnology by Mexican and foreign staff. The Institute had a Section of Hydrobiology that contributed to the limnological characterization of Mexican lakes and ponds, and developed research on the biology of freshwater molluscs (F. Contreras), ciliated protozoa (D. Sokoloff), aquatic macrophytes (M. L. Blackaller, H. Bravo), algae (B. A. Samano, D. Sokoloff) and fish (E. Beltran, R. Martin del Campo).

Six years later, in 1936, the Estacion Limnológica de Patzcuaro (Patzcuaro Limnological Field Station), in Michoacan state, was created by the Departamento Autonomo Forestal y de Caza y Pesca (Forest, Game and Fish Department). The staff (F. Berriozaval, Y. Matsui, M. A. Quevedo, T. Yamashita) characterized the limnology of Lake Patzcuaro, in collaboration with I. Ancona, V. Brehm, M. Ueno and M. C. Zozaya from the Instituto de Biología. Others (E. H. Ahlstrom, V. Galvez, F. Orozco, C. D. Ramirez, B. A. Samano) studied the lakes of the Valley of Mexico.

Important contributions were made by Spanish refugees who arrived in the early 1940s. Of these, Fernando de Buen, from Nicolaita University in Spain, worked at the Patzcuaro Field Station and contributed much to the advancement of freshwater biology in Mexico. He studied the physico-chemical parameters of lakes (de Buen & Zozaya 1942) and their fauna (de Buen 1944a,1946), wrote historical reviews of the Mexican lakes (de Buen 1943), made a special study of Lake Patzcuaro (de Buen 1944b), and also worked on Lakes Chapala, Cuitzeo and Zirahuen. Osorio-Tafall was another prolific worker, studying phytoplankton and zooplankton, describing the trophic dynamics of fresh waters (Osario-Tafall 1944) and relating them, with Tamayo (1946), to the hydrology of the main basins of Mexico (Osorio-Tafall 1946). Enrique Rioja headed the Zoology Section of the Instituto de Biología

and promoted research on the fauna (Rioja 1940).

The Comision para el Fomento de la Piscicultura Rural (Council to Promote Rural Pisciculture) was formed in 1950. The main purpose of this Council was to characterize Mexican freshwaters from an aquacultural point of view and to promote their proper exploitation (CFPR 1951a, b, c).

During the 1950s, foreign scientists continued taxonomic work on the Mexican biota, focussing on zooplankton (Comita 1951; Schmitt 1954; Tressler 1954; Lindberg 1955) and on general limnology (Deevey 1957). The well-known limnologist, G. E. Hutchinson, worked on Lake Patzcuaro (Hutchinson et al. 1956).

Jose Alvarez del Villar, from the Escuela Nacional de Ciencias Biologicas of the Instituto Politecnico Nacional (IPN), widely promoted studies on the freshwater fauna from the mid-1940s onwards. Interested in pisciculture (Alvarez de Villar 1945, 1946, 1948), he described the development of ichthyology in Mexico (Alvarez del Villar 1972), produced identification keys (Alvarez del Villar 1950a, b, 1970; Alvarez del Villar & Navaror 1957), studied the effects of geomorphological changes on fish (Alvarez del Villar 1978), worked on Mexican fossil fishes (Alvarez del Villar 1974) and wrote a book on hydrobiology (Alvarez del Villar 1981).

In 1962, the Instituto Nacional de Investigaciones Biologico-Pesqueras (National Institute of Biology and Fisheries Research) was created to bring together the work of several institutes working on the native ichthyofauna, the introduction of new species, the restocking of natural and artificial reservoirs, and aquaculture. During the 1970s, many studies on lakes Chapala, Patzcuaro, Cuitzeo, Zirahuen and others were published by R. Bustamante & A. Sanchez, A. E. Chavez, T. Castellanos & M. S. Palacios, C. M. Gallardo, Q. L. Gonzalez, E. Herrera, T. R. Rivera, M. M. Rosas, and Y. L. Sasso. The first inventory of epicontinental water-bodies in Mexico was produced, catalogued by surface area (Cadena et al. 1979). The Mexican atherinid and cyprinid fishes were examined (Barbour 1973; Barbour & Miller 1978) and the paleolimnology of Lake Texoco was revealed (Bradbury 1970, 1971). In the early 1980s, lakes in the state of Michoacan were intensively studied by S. G. Lopez, M. Mazari, P. Ordonez, R. C. Tellez and others. Some results are summarized in unpublished reports and others have been published in the Annals of the Instituto de Biologia of the UNAM, the Escuela Nacional de Ciencias Biologicas of the IPN, and the Sociedad Mexicana de Historia Natural.

Mexico now has a number of Comisiones responsible for the administration of rivers used for irrigation, power generation etc., and numerous universities, state departments and institutes are involved in

research on scientific aspects of fresh waters. Urgent problems needing investigation are the rational exploitation of aquatic resources, the development of aquaculture of native and/or endemic species of economic importance, and the control of pollution from urban and industrial growth and tourism. To address these problems we need to produce a complete catalogue of the Mexican freshwater fauna and flora. A database of morphometric, physical, chemical and biological parameters is also needed to characterise each lake district, as an aid to the management of monitoring programmes for water quality and the establishment of biological reserves.

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