Morphological, sediment and soil chemical characteristics of dry tropical shallow reservoirs in the Southern Mexican Highlands

Guillermo ALDAMA-ROJAS1,2, Jesús Trinidad PONCE-PALAFOX3,2*, Delfino MADRIGAL-URIBE1,4, José MONROY-GAYTAN4,5, Luis Fernando CRUZ-GARCIA6,7 and José Luis ARREDONDO-FIGUEROA8

1Posgrado en Ciencias Ambientales, Universidad Autónoma del Estado de México, Paseo Tollocan Isidro Fabela, Toluca de Lerdo, México C.P. 50170
2Laboratorio de Bioingeniería Acuícola, Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Morelos, Av. Universidad No. 1001 Col. Chamilpa, Cuernavaca, Morelos, México C.P. 62209
3Centro Nayarita de Innovación y Desarrollo Tecnológico (CENITT), Universidad Autónoma de Nayarit-Posgrado CBAP, Cda. de la Cultura Amado Nervo, Col. Menchaca Tepic, Nayarit, México C.P. 63150
5Universidad Autónoma Metropolitana Iztapalapa. División de CBS, Departamento de Hidrobiología, Planta Experimental de Producción Acuícola, Av. San Rafael Atlixco No. 186, Col. Vicentina C.P. 09340 Del. Iztapalapa, México D.F.
6e-mail corresponding author; jesus.ponce@uaemex.edu.mx

ABSTRACT

The morphometry, sediment and soil chemical characteristics of eleven dry tropical shallow reservoirs situated in Southern Mexican Highlands were studied. The reservoirs are located at 1104 to 1183 meters above sea level in a sedimentary area. Seventeen morphometric and eight sediment and soil chemical parameters were measured. The results of the morphometric parameters showed that these reservoirs presented a soft and roughness bottom, with an ellipsoidal form and a concave depression that permit the mix up of water and sediments, causing turbidity and broken thermal gradients: their slight slopes allowed the colonization of submerged macrophyte and halophyte plants and improved the incidence of sunlight on water surface increasing evaporation and primary productivity. Dry tropical shallow reservoirs have fluctuations in area, and volume according to the amount of rainfall, the effect of evaporation, temperature, lost volume for irrigation, and other causes. The sand-clay was the most important sediment texture and their values fluctuated with the flooded periods. The concentration-dilution cycle showed a direct relationship in the percentage of organic matter as well as with pH, soil nitrogen and phosphorus. El Tilzate, El Candelerio and El Movi were related by the shore development and high concentrations of organic matter and nitrogen in the soil. Finally, we emphasize the importance of this study, in relation to possible future changes in morphometrical parameters as a consequence of human impact.

Key words: Morphometry, bathymetry, soil chemical characteristics, tropical shallow reservoirs, Southern Mexican Highlands

1. INTRODUCTION

A limnological description of dry tropical shallow reservoirs is a necessary step in the research of the aquatic ecosystem (Håkanson 1981). The morphology of shallow reservoir basin exerts a major control over a wide range of processes and features in a lacustrine ecosystem and reflects a series of actions closely related to its origin, operation and use.

One of the oldest limnological principles is that basin morphometry influences lake metabolism (Thienemann 1925; Neumann 1932), as a consequence, many studies have demonstrated how tropical shallow reservoirs morphometry affects the rate of certain limnological processes and the distribution of physical, chemical and biological parameters (Ponce-Palafoux et al. 1998), phytoplankton and submerged macrophyte abundance, structure and production (Schindler 1971; Duarte & Kalff 1988; Pinel-Alloul et al. 1990), loading, dilution and recycling of nutrients (Pick & Lean 1987), ratio of nitrogen to phosphorus (Smith 1982), light in surface layer (Sterner 1990), sediment focusing (Blais & Kalff 1995), thermal structure (Robertson & Ragotzkie 1990), and phytoplankton structure (Eloranta 1986). In this sense Guiral & Pérez (1980) pointed out the importance of the cartography and morphometry of lake ecosystems as a first step in any kind of limnological research.

The majority of the morphometric analyses carry out on tropical shallow reservoirs have been based on measures of surface dimensions in different basins (Ponce-Palafoux et al. 1998), but this type of study is insufficient to establish a good relationship between physico-chemical and biological parameters, and for elaboration of a good integrated management plan. It would be necessary to include a more detailed analysis of morphometrical parameters of both, surface and subsurface dimensions. In dry tropical shallow reservoirs of Latin America there are few studies on morphometric parameters. This research aim contributes to this type of knowledge