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Trophic structure and flows of energy in the Huizache–Caimanero lagoon complex on the Pacific coast of Mexico

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Abstract

The Huizache–Caimanero coastal lagoon complex on the Pacific coast of Mexico supports an important shrimp fishery and is one of the most productive systems in catch per unit area of this resource. Four other less important fish groups are also exploited. In this study, we integrated the available information of the system into a mass-balance trophic model to describe the ecosystem structure and flows of energy using the ECOPATH approach. The model includes 26 functional groups consisting of 15 fish groups, seven invertebrate groups, macrophytes, phytoplankton, and a detritus group. The resulting model was consistent as indicated by the output parameters. According to the overall pedigree index (0.75), which measures the quality of the input data on a scale from 0 to 1, it is a high quality model. Results indicate that zooplankton, microcrustaceans, and polychaetes are the principal link between trophic level (TL) one (primary producers and detritus) and consumers of higher TLs. Most production from macrophytes flows to detritus, and phytoplankton production is incorporated into the food web by zooplankton. Half of the flow from TL one to the next level come from detritus, which is an important energy source not only for several groups in the ecosystem but also for fisheries, as shown by mixed trophic impacts. The Huizache–Caimanero complex has the typical structure of tropical coastal lagoons and estuaries. The TL of consumers ranges from 2.0 to 3.6 because most groups are composed of juveniles, which use the lagoons as a nursery or protection area. Most energy flows were found in the lower part of the trophic web.

Keywords: Huizache–Caimanero; ECOPATH; trophic model; ecosystem structure; network analysis; Mexico

1. Introduction

Exploitation of penaeid shrimp is an important economic activity on the Pacific coast of Mexico. The Huizache–Caimanero coastal lagoons support an important shrimp fishery. Nearly 90% of the total shrimp catch consists of one species, *Litopenaeus vannamei* Boone 1931. Three other species of shrimp are also caught in the fishery; *Litopenaeus stylirostris* Stimpson 1874, *Farfantepenaeus californiensis* Holmes 1900, and *Farfantepenaeus brevirostris* Kignsley 1878. The catch is taken in tidal channels using artificial barriers locally known as 'tapos', which prevent the passage of shrimp during emigration. Until the 1980s, this system had important yields, up to 1500 t (de la Lanza & García, 1991) and was the ecosystem with the highest yields per unit area for shrimp fisheries in coastal lagoons of Mexico (Edwards, 1978a). During the last decade, yields notably decreased. Four fin-fish species are also exploited by local fishermen using beach seine and cast nets. During the 1970s, extensive studies were made because of the economical importance of this area. Several were focused on shrimp biology, ecology, and fishery (Edwards, 1978a; Edwards & Bowers, 1974; Menz & Blake, 1980; Menz & Bowers, 1980; Sepúlveda, 1976, 1981). Other biological components of the system were also studied (Amezcua-Linares, 1977; Edwards, 1978b; Gómez-Aguirrre, Licea-Durán, & Flores-Coto, 1974; Paul, 1981; Warburton, 1978, 1979). The need to integrate the available information was recognized by Edwards (1978b), but little progress,

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