

Species Introduction in a Tropical Lake

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## Species Introduction in a Tropical Lake

A newly introduced piscivore can produce population changes in a wide range of trophic levels.

Thomas M. Zaret and R. T. Paine

By chance or by intention, man has often introduced new species to an ecosystem. The results have ranged from little or no effect to large-scale changes, often accompanied by catastrophic consequences (1). Although there have

been many such species introductions over the past century, there is little documentation of community effects other than some general information about vertebrate introductions (2) and some experimental studies concerning

the effects of herbivores on vegetation (3). Noticeably absent is the situation in which there has been sufficient qualitative or quantitative information concerning the preceding conditions of the ecosystem to permit a quantitative statement about changes resulting from the species introduction. Even in the field of biological control, where serious studies of this nature have been continuing for more than seven decades, accurate predictions of the effects of a new species on a given ecosystem are, even at the most basic level, not yet possible (4).

Historically, fish introduction (or culture) has provided a rich source of protein in many tropical areas. Introductions, however, are not without a

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potential ecological cost. As many governments in the tropics turn increasingly to freshwater fish as a source of animal protein, it seems important to be able to predict the long-term consequences of altering natural freshwater ecosystems. Further, if data on introductions of fish to tropical lakes were available, they would be valuable to the development of a general theory of freshwater community structure and organization.

For at least three centuries before 1958, Lake Atitlán, a large, tropical, and surely one of the world's most beautiful lakes, had sustained fisheries for small native fishes, probably *Poe-*

*cilia sphenops* and *Cichlasoma nigrofasciatum*, as well as a substantial crab-catching operation (5). The fish, which were smoke-cured, consumed, and, if there were any excess, sold in the market, and crabs (*Potamocarcinus guatemalensis*) provided the native Guatemalan Indian population with an important source of protein as well as a small extra cash income. In 1958, through the efforts of a well-meaning fish biologist, the game fish *Micropterus salmoides*, the largemouth bass, was introduced, along with *Pomoxis nigromaculatus*, the black crappie. *Micropterus* fed voraciously on the small native fishes, and the result, a totally unex-

pected one, is that now, some 15 years after the introduction, the local fish populations, along with the crabs, are gone, both decimated by *Micropterus*. The few large *Micropterus* in the lake are taken only by those individuals fortunate enough to own skin-diving equipment (and they do not include the local Indians). Gone is an accessible and, in this region of the world, critical source of protein, as well as the extra income once generated by the local fish populations. Clearly the ecological cost of this species introduction was great and the benefit slight.

## History of *Cichla*

In 1967, *Cichla ocellaris* (Bloch and Schneider) (6), a cichlid fish native to the Amazon River and its tributaries in northern South America, was introduced to Gatun Lake, a large (surface area of 42,315 hectares) body of fresh water in the Panama Canal Zone (7). This piscivore, bright yellow with black vertical bars, derives its pseudonym of "Peacock Bass" from its bass-like shape and, specifically, from the conspicuous ocellus (eyespot), black encircled by a gold ring, located at the base of the caudal peduncle (Fig. 1). *Cichla*, which commonly reaches 2 kilograms in weight and 50 centimeters TL (total length, from tip of snout to end of caudal fin) was thought to have been introduced as a boon to sportsmen because it has a reputation as a fine fighter, as well as being delicious (8). Owing to the success and popularity of this fish, a number of local residents have each taken credit for the "first introduction" of *Cichla*. In fact, in 1965, a local businessman, with the cooperation of the Panamanian government, arranged the transfer of approximately 100 fingerlings from rearing tanks in Buga, Colombia, to Panama. These fingerlings were put into a small impoundment with the hope of their eventually providing fish and fishing for the employees of his company and the residents of the neighboring community as well. During the rainy season, the waters of this impoundment, formed by damming the Quebrada Ancha creek, overflow and eventually reach the Rio Gatuncillo, a small tributary at the northern end of the Chagres River (Fig. 2). It is probable that by late 1966, during the rainy season, some of these fish entered this small tributary and spawned and that by 1967 *Cichla* had traveled the approximately 8 kilom-

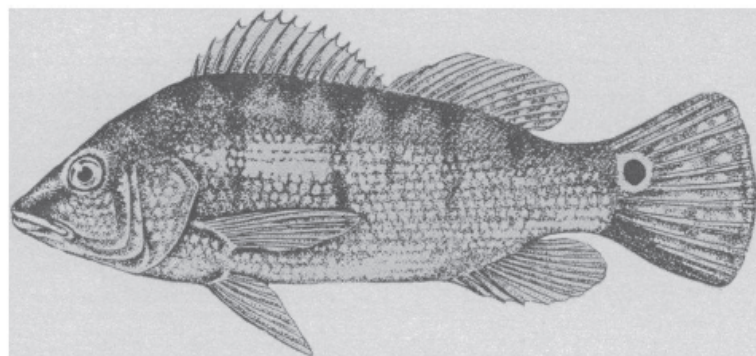


Fig. 1. *Cichla ocellaris* (Bloch and Schneider), showing ocellus (eyespot) at base of caudal peduncle [from Sterba (11), probably 1 year old, 24 to 32 cm TL].

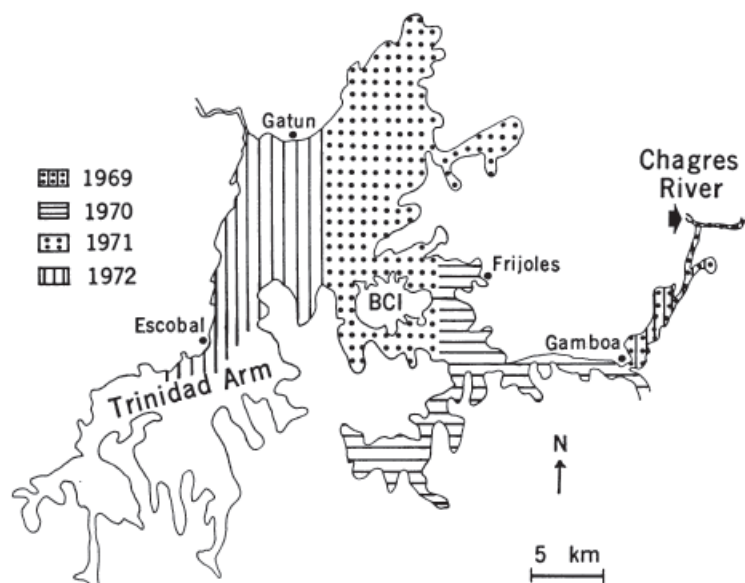


Fig. 2. Map of Chagres River and Gatun Lake, showing estimated extent of *Cichla* population by August of each year, 1969 through 1972. The extensive shoreline development is omitted from map outline. *Cichla* was first introduced in the upper Chagres (arrow), spread toward Barro Colorado Island (BCI), and, as of 1972, has not yet spread throughout the Trinidad Arm.