

Biological control with fish.

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The basic premise of biological control is to control agricultural pests and disease-transmitting insects using their natural enemies, which can be other beneficial insects, predators, parasitoids, and microorganisms, such as fungi, viruses, and bacteria.

January and February 2024, Brazil has one million cases of arboviruses. Use of fish in biological mosquito control.

The *Aedes aegypti* (Linnaeus, 1762), mosquito can breed in different types of breeding sites and correlate the occurrence of vector infestation foci with the population's water storage and management habits. Therefore, human activity, guided by incorrect habits of using water resources and managing waste, increases the incidence of mosquitoes in urban areas. Small artificial deposits and large water reservoirs are important for *A. aegypti* infestation [1-4].

The Municipal Health Department of the City of Monte Carmelo, in Minas Gerais, has been using fish of the *Poecilia* Bloch & Schneider, 1801 species since 2007 *reticulata* in large and small water reservoirs. Still through the same program, the population received fish and appropriate guidelines for carrying out biological control of *A. aegypti* larvae in the domestic environment [1-4].

Gúpi, guppy, barrigudinho, and guaru *Poecilia reticulata* Peters, 1859 (Cyprinodontiformes: Poeciliidae).

Natural species from Antigua and Barbuda, Barbados, Trinidad and Tobago, and Venezuela. It was widely introduced in several regions of the world as an attempt to control mosquitoes, with little success in combating it. Body covered in scales, elongated, and laterally compressed. Males colored in different patterns with modification of the anal fin into a copulatory organ (gonopodium). Larger, brown females. Maximum total length: 3.5 centimeters [4-6].

Reproduces all year round. Fertilization is internal and females are often found pregnant. Insemination occurs through contact between the male's gonopodium and the female's urogenital pore. It has a detritivore/planktophage feeding habit it feeds on insect larvae. This species is highly appreciated in aquariums, having undergone several modifications through artificial selection, mainly to diversify the color and increase the size of the fins. Nowadays there are several strains of *P. reticulata* in captivity around the world. Fish are used in the biological control of mosquito larvae that transmit arboviruses (Figure 1) [4-6].



Figure 1. *Poecilia reticulata* Peters, 1859 (Cyprinodontiformes: Poeciliidae).

Source: https://www.researchgate.net/figure/Guppy-Poecilia-reticulata-found-in-the-Fitzroy-Basin_fig2_330913489.

Males are half the size of females and have a long and colorful caudal fin, the anal fin is modified into a gonopodium for internal fertilization of the female. Females are larger and plumper and typically have monotonous coloring. Biotope: Occurs in various biotopes, ranging from highly turbid water to crystal clear water in lagoons, canals, and ditches, among others, normally amidst dense aquatic vegetation. Some populations are found in brackish water conditions [4-6].

Easily found in rivers in southeastern Brazil, even polluted rivers. In its wild form, it has a gray tone and is rarely sold. Wild specimens tend to have little or no striking coloration where predators are present, while specimens that do not have to deal with this problem have more exuberant colors. Introduced in several countries to control mosquitoes and larvae, making it a potential threat due to its easy adaptation to different environments and rapid proliferation [4-6].

Two-Spotted lambasty *Astyanax bimaculatus* (Linnaeus, 1758).

The genus *Astyanax* Baird & Girard 1854 is the most diverse and common of the family Characidae, covering the region of South America, from the Panama basin to the Amazon basin, bringing together hundreds of species that are widely distributed and abundant in the Brazilian river basins. Such characteristics indicate that this genus probably has great ecological importance and enormous adaptive plasticity (Figure 2) [7-14].



Figure 2. Two-Spotted lambast *Astyanax bimaculatus* (Linnaeus, 1758) (Characiformes: Characidae).

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The yellow-tailed piaba *A. bimaculatus*, a species native to the São Francisco River basin, is being used for biological control of the larvae of the *A. aegypti*, mosquito, which causes diseases such as dengue, chikungunya, zika, and yellow fever. *A. bimaculatus*, popularly known as yellow-tailed piaba, is a species native to South America, very common in streams, creeks, rivers, lakes, and reservoirs throughout Brazil [7-14].

It is a small fish with scales, silvery in color, and fins varying between yellow, red, and black. Its body is elongated and somewhat compressed. It has two spots, one close to the pectoral fin, with an oval shape and horizontal position, and the other in the shape of a club, running from the caudal peduncle to the median portion of the body. Its average size is between 10 and 15 centimeters in length. These piabas are omnivorous and feed on fruits, vegetables, aquatic invertebrates, eggs, larvae of other fish, and even organic matter and other debris [7-14].

Oviparous. In the early hours of the day, the male will lead the female to release the non-adhesive eggs onto plants that will be fertilized. Most eggs will fall to the bottom or may float. They hatch within 2 days and the larvae will be free-swimming within 48 hours. Parents do not exhibit parental care. Studies indicate that this species is quite opportunistic and is always one of the first to discover and enjoy a type of new food. There is evidence of specimens that lived for up to 19 years [7-14].

The use of fish as natural controllers is more interesting than the use of conventional larvicides, as it can reduce infestation rates without the need to use components. chemicals in the environment. The Municipal Health Department of the City of Goiânia, Goiás, in Brazil, is using fish *A. bimaculatus* in 2024 for the biological control of *A. aegypti* [7-14].

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