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International Journal of Zoology and Animal Biology
ISSN: 2639-216X

New Records for the Fluvial Ichthyofauna in Varadero, Cuba

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Research Article
Volume 4 Issue 4
Received Date: August 07, 2021
Published Date: August 19, 2021
DOI: 10.23880/izab-16000319

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Abstract

Millions of people suffer from infections transmitted by arthropod vectors. Among them, culicidae are undoubtedly those of greatest hygienic-sanitary importance, especially in tropical and subtropical regions, so biological control, as an alternative to confront vector organisms, is becoming increasingly necessary due to the development of resistance to insecticides. With the objective of knowing the fish species that inhabit the fluvial ecosystems of Varadero, Matanzas province, Cuba, the following research was carried out, which covered the health areas of Santa Marta and Varadero, for which eight fluvial ecosystems were sampled, during January 24 and 25, 2020. The sampling unit used was the jamb, with the following dimensions (70x50x50 cm), with 150 cm of handle. Six fish species grouped into six genera and three families were identified. *Gambusia puncticulata* and *Limia vittata* turned out to be the best represented and distributed species; in the case of the first species, it was present in all the sampled reservoirs and even in brackish water reservoirs. The best represented family in the study was the *Poeciliidae*, present in 100% of the river ecosystems sampled, while, of all the fish species identified, those with the best bioregulatory potential on mosquito larvae were *G. puncticulata* and *L. vittata*.

Keywords: Fluvial Ecosystems; *Gambusia Puncticulata*; Fluvial Ichthyofauna; Limia Vittata; Varadero

Introduction

Millions of people suffer from infections transmitted by arthropod vectors [1-3]. Among them, culicidae are undoubtedly of the greatest hygienic-sanitary importance, especially in tropical and subtropical regions, since they are responsible for the maintenance and transmission of pathogens that cause Dengue, Yellow Fever, Malaria, Lymphatic Filariosis, among other deadly and debilitating infections [3-5]. This problem is now compounded by global warming and the intensification of extreme meteorological disturbances, which has brought with it changes in the behavior of diseases and their transmitters, with the establishment of vector species in places never recorded before [6-9]. All this has brought with it major environmental problems that humanity faces today, the genesis of which lies in the human pretension to maximize production and economic profits without respecting the laws that regulate the functioning of nature [10-12].

Cuba, due to its geographical location and climatological characteristics, has a wide fauna of culicidae; many of them are important from the epidemiological point of view because of the diseases, both endemic and exotic, that they can transmit to the human and animal population [13-15]. Efforts to control such diseases have been hampered, in part, by the development of drug-resistant etiologic agents, insecticide-resistant mosquitoes, environmental contamination, residual effect of chemicals, high market prices, and other operational difficulties [16-19]. Consequently, there is a growing need to develop other strategies for disease control, which can complement existing methods, such strategies consist of the implementation of biological methods to control mosquito populations [20,21]. The main biological agents that have been successfully employed are predators, particularly larvivorous fish and copepods, as well as entomopathogenic agents, such as sporogenous bacteria: Bacillus thuringiensis (Bti) and Bacillus sphaericus (Bs) that attack the larval stages of mosquitoes [22-24]. Taking into account the above, we proposed to make known the fish species that inhabit the fluvial ecosystems of Varadero.

Materials and Methods

Study Area

The research was carried out in eight fluvial ecosystems of the health areas, Santa Marta and Varadero, both belonging to the Varadero municipality, Matanzas province, Cuba, including the Hicacos peninsula, where most of the hotel facilities are located. The distribution of the sampled reservoirs was as follows: ditches (4), lagoons (3) and estuary/mangrove (1).

Geographical Location of Varadero

The Hicacos Peninsula is located in the central region of Cuba, bordered to the north by the Atlantic Ocean (Gulf of Mexico, the Florida Strait and the Old Bahamas Channel), to the south by the provinces of Cienfuegos and Sancti Spiritus, to the east, southeast and southwest, and to the west by Matanzas (Figure 1).

Figure 1: Political-administrative map of Varadero. **Fuente**: Google Maps.

The relief is flat and not very dissected, its heights do not exceed 30 meters above sea level. The average height is 10 meters and the maximum is 27 meters (Chapelin and Frances). Curious rocks formed by sands with crossed stratification also rise. The peninsula, when beaten by the waves, has formed cliffs with caves of marine origin.

The coastline has been, in part, modified by complex biological processes (corals and mangroves), erosive and depositional, and cumulative abrasive processes: the mangroves form a mesh with their roots that fixes the accumulations of mud and sand moved by the marine currents, giving rise to cays and mangroves. There is a tendency for the northern coast to rise and the southern coast to fall.

From the point of view of its geological structure, the peninsula is located in the region of development of tertiary rocks, mainly calcarenites.

The Hicacos Peninsula has six beaches that stand out for their wide strip of fine white sand, the smooth profile of their bathing area and the extraordinary transparency and intense turquoise color of their waters, which have earned them the title of “Cuba’s blue beach”. Separated by low rocky cliffs, the widest beaches are Varadero (10.8 km), Rincon Frances (3.5

km) and La Alameda (4.5 km). Three other smaller beaches (together they total 1.6 km) are located between the San Bernardino Rock, on which the famous Xanadu Mansion is located, and the Pirate Caves, in the Chapelin Ecological Reserve. Playa Coral is another interesting beach for diving.

Aerial view of the Hicacos Peninsula. In the foreground, Varadero Beach, the longest of the six beaches located on its coastline and after which the resort is named. As a curiosity, this beach would be interrupted in its southern portion with the construction of the Paso Malo lagoon channel. Its vegetation is very similar to that existing in the Cuban keys, characterized by the presence of coastal mangrove, xeromorphic scrub and microphyllous and mangrove forests, with some species endemic to the western region of Cuba. Particularly relevant are the Hicacos (*Chrysabalanus*), which give the peninsula its name, and the cacti (*Pilosocereus robinii* and *Dendrocereus nudiflorus*) with specimens such as "The Patriarch", a giant arboreal cactus that has become an attractive natural monument, estimated to be nearly half a millennium old.

Varadero has a territorial extension of 8 662.4 km^2, a population density of 96.2 inhabitants per km^2 and approximately 833 424 inhabitants.

Fish Collection

For the sampling and collection of fish in the different ecosystems, a jamb with a 1.5 mm diameter mesh size and the following dimensions (70x50x50 cm), with a 150 cm handle was used (Figure 2). Samplings was carried out on January 24 and 25, 2020.

Figure 2: Jamb used for sampling.

Three sets were made with the jamb at a distance of 2.5 m between sets (in the area with the greatest visible presence of fish). The samples obtained were deposited in 2% formalin, most of them in glass bottles, while the rest were transferred in nylon bags (5 and 10 L capacity), with water from the reservoirs themselves in 25 L plastic buckets to the laboratory of the Centro de Vigilancia, Monitoreo y Control de Culicidos de Varadero, where studies were carried out for the identification of each specimen collected, supported by different keys for such purposes [25-27].

Results

A total of six species were identified, distributed in an equal number of genera, and grouped into three families (Table 1).

Species	Status	Family
Gambusia puncticulata Poey, 1854	N	Poeciliidae
Limia vittata (Guichenot, 1853)	E	Poeciliidae
Cyprinodon variegatus Poey, 1860	N	Cyprinodontidae
Cyprinus carpio (Linnaeus, 1758)	I	Cyprinodontidae
Tilapia rendalli (Boulenger, 1897)	I	Cichlidae
Oreochromis mossambicus (Peters, 1852)	I	Cichlidae

Legend: E: Endemic; I: Introduced; N: Naturalized.

Table1: Fluvial Ichthyofauna identified by species, condition and family.

Regarding the distribution of specimens collected by species (Table 2), *G. puncticulata* (385) and *L. vittata* (92) were the best represented and distributed species.

Species	Total specimens	%
G. puncticulata	385	66,3
L. vittata	92	15,8
C. variegatus	51	8,7
C. carpio	11	1,8
T. rendalli	32	5,5
O. mossambicus	9	1,5
Total	580	100

Table 2: Species distribution of collected specimens.

Discussion

Of the three families identified, *Poeciliidae* was the best represented and distributed, being present in 100 % of the sampled reservoirs, while of the total number of fish species identified, those with the best bioregulatory potential on mosquito larvae were *G. puncticulata* and *L. vittata*, which is equivalent to 33.3 % of the total number of species identified [20,28,29]. In relation to the total number of species identified, the greatest number corresponded to endemic and naturalized species (528), which coincides with the ichthyofauna of South America and the Caribbean Islands, and corroborates the theory of Iturralde & MacPhee, et al. [30] in relation to the origin of the Cuban flora and fauna, and which has also been demonstrated by other authors for South America, especially in Venezuela and Peru [31,32].

G. puncticulata was the best distributed and distributed species in the sampled reservoirs, followed by L. vittata, which agrees with the results obtained by Morejon, et al. [33], for Sancti Spiritus province, and Garcia, et al. [34] for Cuba, which may be due to various factors, such as the substantial increase in the levels of contamination of the river ecosystems of Varadero (domestic activity, tourism, agriculture and industries), as well as the intensification of interspecific competition, mainly with exotic species that have been introduced into these river ecosystems, mainly T. rendalli, C. carpio and Clarias gariepinus, which have greater ecological plasticity and adaptive capacity than endemic and naturalized species [35-38].

Conclusion

The updating of the fluvial ichthyologic record of any locality is of vital importance in the surveillance, monitoring and control of culicidae larval populations.

Conflict of Interest Statement

The authors declare that they have no conflict of interest.

Contribution

All the authors contributed substantially to the concrescence of the manuscript

Financing

No funding was available.

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