

Actions for Controlling and Eradicating Invasive Alien Species in the Cañon del Sumidero National Park

—

Marco Antonio Altamirano-González Ortega¹
biomarc2002@yahoo.com.mx
ORCID: 0000-0002-4794-2818

Irma de Jesús Serrano-Sánchez²
iserrano@conanp.gob.mx

1 DIRECTORATE OF THE SECRETARIAT OF ENVIRONMENT AND NATURAL
HISTORY NATURAL AREAS AND WILDLIFE, TUXTLA GUTIÉRREZ,
CHIAPAS. MÉXICO

2 NATIONAL COMMISSION OF PROTECTED NATURAL AREAS, NATIONAL
PARK CAÑON DEL SUMIDERO, TUXTLA GUTIÉRREZ, CHIAPAS, MÉXICO

To quote this article:

González Ortega, M. A. A., & Serrano Sánchez, I. de J. Acciones para el Control y Erradicación de Especies Exóticas Invasoras en el Parque Nacional Cañón del Sumidero. *Espacio I+D, Innovación más Desarrollo*, 14(42). <https://doi.org/10.31644/IMASD.42.2025.a01>

— Abstract—

Recently, in the Parque Nacional Cañón del Sumidero, activities have been undertaken to identify, control, and eradicate the invasive alien species present there. To date, activities have been intensified for the attention of jaragua grass (*Hyparrhenia rufa*), African nun orchid (*Oeceoclades maculata*), and mosquitoes of medical importance of the Culicidae family, devil fish (*Pterigoplychthys* sp.), red-eared turtle (*Trachemys scripta elegans*), and feral species (dogs and cats). The actions carried out by the Committee for the Attention of Invasive Alien Species of the Cañón del Sumidero National Park were analyzed from 2018 to date. Articles and internal documents generated from investigations on these species were reviewed. Advances are recognized in the prevention, dissemination, and awareness actions carried out, inside and outside the National Park, which will allow the proliferation and effects of invasive alien species to be contained.

Keywords:

Jaragua grass; African nun orchid; mosquitoes; devil fish; red-eared turtle; feral species.

Invasive Alien Species (IAS) are considered to be those originating from a non-native population, which is outside its natural range, that is able to survive, reproduce, and settle in natural habitats and ecosystems, which threaten native biological diversity, the economy, and public health (DOF, 2010). Invasive alien species affect ecosystems, environmental services, and, consequently, animal and human well-being (Espinosa-García & Villaseñor, 2017). IAS have a great capacity for adaptation since they generally have a generalist diet, reproduce rapidly, proliferate in progeny, and have a high tolerance to adverse climatic conditions (Martin et al., 2009). For this reason, they establish and appropriate sites where they reproduce and disperse without control, generate fertile offspring, and compete with native species, which causes damage to the environment, health, and economy (CONABIO, 2023). The introduction of IAS is considered among the first causes that threaten the extinction of biodiversity in the world (Clavero & García-Berthou, 2005).

The presence of IAS contributes to the degradation of aquatic and terrestrial environments and can cause the extinction of native populations and species, with greater effects on aquatic species, which are particularly sensitive, because their presence increases the transformation capacity of habitats and eutrophies (Gallardo et al., 2016). In the terrestrial environment, IAS affect 30% of birds, 11% of amphibians, and 8% of the world's mammals (CONABIO, 2023).

The greatest impact of IAS occurs in freshwater, due to the development of global aquaculture, based on the introduction of exotic species. In Mexico, this activity focuses almost entirely on seven introduced species: carp, tilapia, catfish, trout, prawn, Japanese oyster, and mussel (Mendoza, 2001). Other aquatic IAS have entered our territory due to aquarism, such as plecos and lionfish (Alfaro et al., 2014). It is estimated that around 798 IAS live in our country: 665 species from exotic plants, 77 from fish, 10 from amphibians and reptiles, 30 from birds, and 16 from mammals (CONABIO, 2023).

In Chiapas, information on the presence and effects of IAS is scarce. However, it is estimated that there are around 330 species in the state. In the Parque Nacional Cañon del Sumidero (PNCS), there are 68 IAS registered. The main causes of introduction are irregular settlements within the limits of the protected natural area, and even within it, as well as livestock activities, aquaculture, and tourism.

THE COMMITTEE FOR THE CARE OF INVASIVE ALIEN SPECIES OF THE PNCS

In September 2018, as a result of the problems detected in the PNCs regarding the presence of IAS, the Committee for the Care of Invasive Alien

Species (CAEEI) was created. The initiative is part of the national project, key GEF 00089333, named "Increase national capacities for the management of invasive alien species through the implementation of the National Strategy", which aimed to improve the integral management processes of IAS and train local actors in the National Park. As shown in Figure 1, this interdisciplinary body meets quarterly and aims to work and coordinate actions with different sectors, including academia, government, private initiative, the productive sector, the commercial sector, and local communities, to detect, control, and eradicate IAS from the protected natural area.



Note. Photo by Irma de Jesús Serrano-Sánchez, CONANP, Parque Nacional Cañon del Sumidero.

Figure 1. Committee for the Management of Invasive Alien Species of the PNCS

The CAEEI has three subcommittees: Research, Outreach, and Control and Management. The committee has developed a short-term, medium-term, and long-term work program with specific activities for each subcommittee, and it is part of the Advisory Council for the Protected Natural Area. Its creation and functions are based on the proposals outlined in the National Strategy on Invasive Alien Species in Mexico (CANEI, 2010) and the applicable regulations on the subject. It is based on the Political Constitution of the United Mexican States (Articles 1, 4, paragraph five, and 133), the provisions established by international treaties (Principle 10 of the 1992 Rio Declaration on Environment and Development), which establishes the Principle of Citizen Participation (Article 8, paragraph h) of the Convention on Biological Diversity, and Resolution No. VII/14 issued by the Scientific and Technical Review Panel (STRP) of the Convention on Wetlands of International Importance (Ramsar).

Among the national regulatory instruments for addressing IAS are Articles 72, section XIII, and 77, section I, of the Internal Regulations of

the Ministry of the Environment and Natural Resources; Articles 15, sections XII and XV, 47, 79, section I, and 80, section IV, of the General Law of Ecological Balance and Environmental Protection; Article 5, section III of the Regulations of the General Law of Ecological Balance and Environmental Protection on Protected Natural Areas; Articles 5, sections III and V, 10, section X, 15, and 27 Bis, last paragraph, of the General Wildlife Law; Article 21, section I, of the General Law of Sustainable Forest Development; the conservation objectives established in the Decree creating the Parque Nacional Cañon del Sumidero (PNCS), published in the Official Gazette of the Federation on December 8, 1980, and the National Strategy for the Eradication of Invasive Alien Species (EEI). Specifically, for the management of IAS detected in the PNCS, there is an Early Detection and Rapid Response Protocol that outlines the set of recommendations to be followed for their control and eradication, as proposed by the United Nations Development Program and the Commission for Protected Natural Areas (CONANP) (UNDP-CONANP, 2016).

METHOD

The actions carried out by the CAEEI of the Parque Nacional Cañon del Sumidero from 2018 to date were analyzed. Internal articles and documents generated from research conducted on IAS, considered priority areas for attention [jaragua grass (*Hypparrenia rufa*), African nun orchid (*Oeceoclades maculata*), medically important mosquitoes of the Culicidae family, devil fish (*Pterigoplychthys* sp.), the red-eared slider turtle (*Trachemys scripta elegans*), and feral species (dogs and cats)]. Finally, the general prevention, dissemination, and awareness-raising actions carried out by the CAEEI, both within and outside the protected natural area, were identified.

RESULTS

Research conducted

Jaragua grass (*H. rufa*). In 2019, actions were implemented in the PNCS to control and manage jaragua grass, as well as to protect and restore the habitat affected by this species. *H. rufa* is an invasive species that, during low water periods, is so resilient that it can take advantage of the stress on native vegetation and colonize new areas. This grass is gradually displacing native species, which are more sensitive to fire. Furthermore, it represents an adverse condition for the landscape in a scenario of exotic grasses spreading over well-preserved habitats, exacerbated by the advance of climate change (PNUD, 2023).

From 2019 to 2023, manual clearing (removal of rhizomes and stumps), prescribed burning, herbicide application, soil conservation works, reforestation with native species, and reforestation management were carried out on 15 hectares of the banks of the Rio Grijalva. Between 2020 and 2023, the management and control actions for *H. rufra* continued on 10 hectares along the banks of the Rio Grijalva and on 250 hectares of the Loma Larga property in Tuxtla Gutiérrez, where prescribed burns, firebreaks, fuel management, natural regeneration management, and reforestation with native species are carried out, as shown in Figure 2. CONANP reports that the development of *H. rufra* has been halted and its growth has been reduced by 70%; in contrast, the development of native plants has increased by 95%.



Note. Photo by Víctor Arturo Villatoro-Álvarez, CONANP, Parque Nacional Cañon del Sumidero.

Figure 2. Management for the control of Jaragua grass (*H. rufra*)

African nun orchid (*O. maculata*). Between 2021 and 2022, the Colegio de la Frontera Sur (ECOSUR) carried out the project "Initial detection of the African nun orchid (*O. maculata*) and control proposal in the PNCS," which aimed to assess its distribution and abundance within the protected natural area and describe the ecological effect on local populations of native orchids to contribute to the design of a control method. *O. maculata* is a terrestrial orchid with invasive behavior, broad tolerance to diverse environments, and high seed productivity that favors its reproduction (CABI, 2023).

For this project, 13 transects were established in the PNCS, where we detected 231 individuals of the following species: 71.4% vegetative and 28.6% reproductive, as shown in Figure 3. Based on observations made of other plant species present in the park, a list of native orchids with potential for impact was generated during the project.



Note. Edith Belén Jiménez Díaz, Naturalist, <https://www.naturalista.mx/observations/9958604>

Figure 3. Specimen of African nun orchid (*O. maculata*), at the PNCS

About *O. maculata*, it is noted that, after determining its distribution and abundance, supporting studies should be carried out to characterize the microenvironments where it thrives, its demography, reproductive strategies, and mycorrhizal associations, to provide an in-depth explanation of the invasive behavior of this terrestrial orchid and to be able to design efficient control strategies (Riverón-Giró et al., 2017).

Mosquitoes (Diptera: Culicidae). During the same period (2021-2022), the "Study on Mosquito Diversity (Diptera: Culicidae) of medical importance in the Parque Nacional Cañón del Sumidero" was conducted to determine the diversity and abundance of mosquitoes of the Culicidae family that affect human health. Culicidae belong to a family of dipterans colloquially known as mosquitoes, which includes 39 genera and 135 subgenera (Reinert, 2001).

The results identified 8 genera and 11 species present in the park, with the genus *Aedes* being the most abundant and the subspecies *Aedes aegypti* sumidero having the highest number of records. Species of this genus possess characteristics that give them adaptive advantages over others, making them successful invaders, as their eggs are more or less resistant to desiccation

and can be more easily transported by humans, achieving high effectiveness in transmitting diseases such as dengue fever by reproducing successfully (Rey & Lounibos, 2015).

Devilfish (*Pterigoplychthys sp.*). During the same period as the studies mentioned above, the project “Regional Strategy for the Management and Control of Devil Fish in the PNCS” was carried out by the Institute of Biological Sciences (ICBIOL) of the Universidad de Ciencias y Artes de Chiapas (UNICACH). The objective of this research was to develop a regional management and control strategy for the species. This research has identified sites where devilfish occur in the main channel of the Rio Grijalva, in the middle basin of the Cañón del Sumidero, where the presence of *Pterigoplychthys disjunctivus* (Velázquez et al., 2022) has been confirmed.

To date, biometric data has been collected from individuals captured in the Rio Grijalva, and workshops are planned with local PNCS fishermen to raise awareness about the problems caused by the species and about recording, capture, and measurement techniques. As a preventive measure, specimens of devilfish have been removed from the PNCS, as shown in Figure 4, and from the possible entry point, known as “Parque Joyyo Mayu,” on the western side of the city of Tuxtla Gutiérrez, Chiapas, which has direct storm drainage connections to the Grijalva River that runs through the PNCS.



Note. Picture by Javier Díaz- Náfate, CONANP, Parque Nacional Cañón del Sumidero.

Figure 4. Management for the control of the devilfish (*P. disjunctivus*)

Red-eared slider turtle (T. scripta elegans). The project "Presence of the Loggerhead Sea Turtle (*T. scripta elegans*) in the Central Depression of Chiapas," was developed by ECOSUR. The work is regional in nature, and it is assumed that the species is widely distributed in the Rio Grijalva and may be distributed in the PNCS (Reyes-Grajales, 2021). The presence of this species is considered one of the greatest threats to the diversity of aquatic flora and fauna in this region (ISSG, 2020).

This study indicates that the site with the highest number of sightings is Parque Joyyo Mayu, as shown in Figure 5, and, as is believed to be the case with the devilfish, this may be the route of entry for this species into the PNCS. Furthermore, it should be noted that the three localities registered for the municipality of Tuxtla Gutiérrez are interconnected by the Rio Sabinal, which flows into the Rio Grijalva, which in turn flows into the protected natural area. During the rainy season, these bodies of water tend to overflow considerably, causing the spread of red-eared sliders.



Note. Picture by Eduardo Reyes-Grajales, ECOSUR, Unidad San Cristóbal.

Figure 5. Sighting of a red-eared slider turtle (*T. scripta elegans*)

Preventive measures

The most frequent preventive actions have been carried out by institutions and associations allied with CAEEI, such as Kelam A.C., the Municipal Health Secretariat of Tuxtla Gutiérrez, through the Directorate of Protection against Health Risks, the Health Secretariat of the Government of the State of Chiapas, through the Directorate of Zoonoses, and the Universidad Autónoma de Chiapas, in coordination with the Faculty of Veterinary Medicine and Animal Husbandry. Activities have focused on preventing problems that directly affect the population surrounding the PNCS, such as

the introduction of domestic species that become feral within the protected natural area. These species consist of dogs and cats, which have been detected within the protected natural area, causing attacks on wildlife (e.g., white-tailed deer). The lack of attention to dogs and cats can become a health problem within the National Park, as they are potential carriers of diseases such as rabies and toxoplasmosis (Mayo, 2014). Controlling their birth rate is an important part of ecology and public health, as it can affect all known mammals, including humans (Castillo-Neyra, 2016; Murcia et al., 2023).

Between 2018 and 2023, rabies vaccinations were administered as a preventive measure, benefiting a population of 1,028 people in eight neighborhoods on the southern outskirts of the PNCS (Las Granjas, Delegación Granjas, Nueva Jerusalén, and Agua Azul). Likewise, between 2018 and 2023, 525 sterilizations were performed, benefiting 418 inhabitants of seven neighborhoods in the area of influence of the protected natural area. The participation of civil associations, together with government and academic institutions, has made it possible to expand the geographical coverage of vaccination and sterilization campaigns to other neighborhoods in the municipality of Tuxtla Gutiérrez (Los Ángeles) and in the municipality of Chiapa de Corzo, in the Julio Cesar Ruíz Ferro neighborhood, as can be seen in Figure 6.

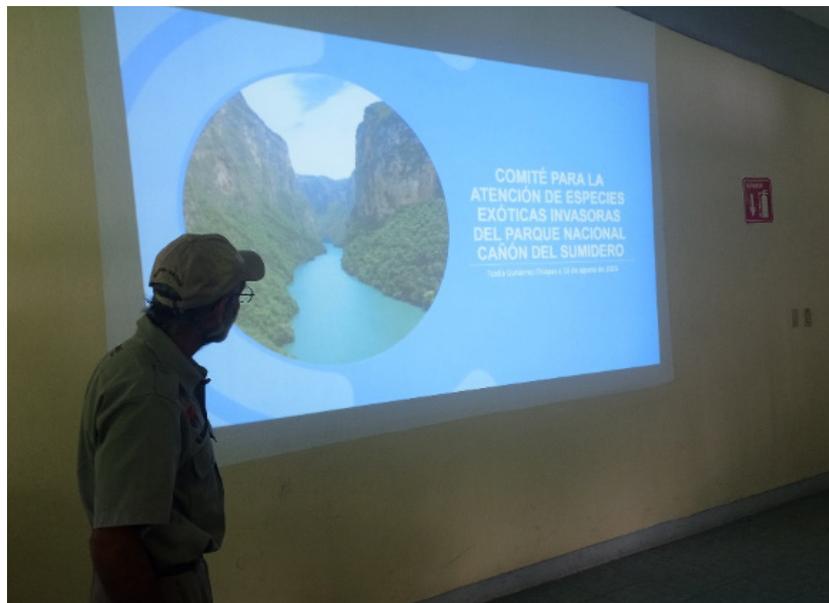


Note. Photo by Irma de Jesús Serrano-Sánchez, CONANP, Parque Nacional Cañón del Sumidero.

Figure 6. Vaccination and sterilization campaigns for dogs and cats

Outreach activities

The CAEEI was responsible for disseminating the actions carried out in various conservation and management forums, as shown in Figure 7. The results obtained from projects carried out by CAEEI for jaragua grass (CONANP, 2019), devilfish (Velázquez, 2022), and red-eared slider turtles (Reyes-Grajales, 2021) have also been published in scientific and popular science journals. In addition, information has been posted on a website (Facebook) with the aim of widely disseminating information to the people of Chiapas about the actions taken and the results obtained. The information presented there ranges from the CAEEI's creation, interviews, news, participation in events, regulations, and infographics on the species. In addition to being presented digitally and reaching a general audience, infographics are used in awareness workshops for local residents and service providers who have direct contact with IAS, such as boatmen and guides who serve tourists visiting the PNCS.



Note. Photo by Irma de Jesús Serrano-Sánchez, CONANP, Parque Nacional Cañón del Sumidero.

Figure 7. Dissemination of actions taken to eradicate invasive alien species

Awareness-raising activities

Another strategic line of action is to raise awareness among the population of the neighborhoods in the National Park's area of influence about responsible pet ownership (dogs and cats), as well as the negative effects that IAS have on wildlife, ecosystems, and human health, as shown in Figure 8. Awareness

talks have also been held for tourism service providers and fishermen in the municipalities of Chiapa de Corzo and Osumacinta on the negative effects of the devilfish (*Pterygoplichthys spp.*) on native fauna, ecosystems, and the local economy. These activities are carried out in coordination between the technical staff of the protected natural area and the Institute of Biological Sciences at UNICACH.

In total, between 2018 and 2023, 48 awareness talks were given to children and young people in the PNCS's area of influence, in eight neighborhoods. Likewise, awareness was raised among community brigades and young people doing social service in the protected natural area, fishermen, and tourism service providers. A total of 620 people were treated in this area, of whom 317 were men and 303 were women.



Note. Photo by Irma de Jesús Serrano-Sánchez, CONANP, Parque Nacional Cañón del Sumidero.

Figure 8. Awareness campaigns on the effects of invasive alien species.

FINAL THOUGHTS

Five years after implementing actions to control and eradicate IAS in the PNCS, encouraging results have been achieved toward their future removal from the protected natural area. The success achieved to date with the control of jaragua grass demonstrates the potential for achieving the same with other species. However, because the mechanisms used differ from one another, the results could be different.

The mechanism implemented by the CAEEI for research, prevention, dissemination, and awareness-raising appears to be the most appropriate

way to address the specific problems of each of the species selected and considered to be priorities for attention. Working together under this organizational structure has a significant impact on decisions regarding the management of the Reserve, as the Committee is part of the Park Advisory Council, which is the forum where the various stakeholders involved in the conservation and management of the Reserve agree on the actions to be taken. The CAEEI formalizes institutional commitments among its members, coordinates and cooperates in solidarity to achieve the objectives set out in the eradication of IAS, recognizes the strengths and limitations of social actors, and communicates institutional achievements in order to develop a plan toward achievable goals.

Controlling and eradicating IEDs in the PNCS is a difficult task that requires working and coordinating actions with different environmental and social sectors, including academia, government, private initiative, the productive sector, the commercial sector, and local human communities. Joint actions carried out from a committee perspective, based on scientific and precautionary principles and taking social participation into account, will be essential in order to continue the work carried out so far in the PNCS.

REFERENCES

- Alfaro, R. M.,** Ramírez-Martínez, C., González, C. A., y del Castillo, M. E. M. (2014). Principales vías de introducción de las especies exóticas. En R. Mendoza y P. Koleff (Coords.), *Especies acuáticas invasoras en México* (pp. 43–73). Comisión Nacional para el Conocimiento y Uso de la Biodiversidad.
- CABI.** (2023). *Oeceoclades maculata* (Rojas-Sandoval, J., y Acevedo-Rodríguez, P., Eds.). En *Invasive Species Compendium*. CABI International. <https://www.cabi.org/isc/datasheet/115853>
- CANEI** (Comité Asesor Nacional sobre Especies Invasoras). (2010). *Estrategia nacional sobre especies invasoras en México: Prevención, control y erradicación*. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad; Comisión Nacional de Áreas Naturales Protegidas; Secretaría de Medio Ambiente y Recursos Naturales.
- Castillo-Neyra, R.,** Levy, M. Z., y Náquira, C. (2016). Efecto del sacrificio de perros vagabundos en el control de la rabia canina. *Revista Peruana de Medicina Experimental y Salud Pública*, 33(4), 772–779. <https://doi.org/10.17843/rpmesp.2016.334.2564>
- Clavero, M.,** y García-Berthou, E. (2005). Invasive species are a leading cause of animal extinctions. *Trends in Ecology y Evolution*, 20(3), 110. <https://doi.org/10.1016/j.tree.2005.01.003>
- Comisión Nacional para el Conocimiento y Uso de la Biodiversidad** (CONABIO). (2023). *Sistema de Información sobre especies invasoras*. <https://www.biodiversidad.gob.mx/especies/Invasoras>
- Espinosa-García, F. J.,** y Villaseñor, J. L. (2017). Biodiversity, distribution, ecology and management of non-native weeds in Mexico: A review. *Revista Mexicana de Biodiversidad*, 88, 76–96. <https://doi.org/10.1016/j.rmb.2017.08.002>
- Gallardo, B.,** Clavero, M., Sánchez, M. I., y Vilà, M. (2016). Global ecological impacts of invasive species in aquatic ecosystems. *Global Change Biology*, 22(1), 151–163. <https://doi.org/10.1111/gcb.13004>
- Martin, P. H.,** Canham, C. D., y Marks, P. L. (2009). Why forests appear resistant to exotic plant invasions: Intentional introductions, stand dynamics, and the role of shade tolerance. *Frontiers in Ecology and the Environment*, 7(3), 142–149. <https://doi.org/10.1890/070096>
- Mayo, J. E. E.** (2014). Rabia: Una vieja enfermedad en el siglo XXI. *Anales de la Real Academia de Ciencias Veterinarias de Andalucía Oriental*, 27, 55–69.
- Mendoza, R.** (2001). Engaging the industry: Examples from aquaculture in Mexico. En *Preventing the introduction and spread of aquatic invasive species in North America: Workshop Proceedings*, 28–30 de marzo de 2001 (pp. 9–10). Commission for Environmental Cooperation of North America.

- Murcia Criollo, V., Sánchez Bonilla, M. P., y Meriño Olivella, S. E. (2023).** *Implicaciones de la rabia felina en la salud pública* [Tesis de pregrado, Universidad Cooperativa de Colombia]. Repositorio Institucional UCC. <https://repository.ucc.edu.co/handle/20.500.12494/52090>
- Programa de las Naciones Unidas para el Desarrollo (PNUD). (2023).** Erradican especie invasora en Parque Nacional Cañón del Sumidero. <https://www.undp.org/es/mexico/news/erradican-especie-invasora-en-parque-nacional-ca%C3%B1%C3%B3n-del-sumidero>
- Programa de las Naciones Unidas para el Desarrollo y Comisión Nacional de Áreas Naturales Protegidas (PNUD-CONANP). (2016).** *Protocolo de detección temprana y respuesta rápida para especies exóticas invasoras en el Parque Nacional Cañón del Sumidero* (101 pp.). Ciudad de México.
- Reinert, J. K. (2001).** Revised list of abbreviations for genera and subgenera of Culicidae (Diptera) and notes on generic and subgeneric changes. *Journal of the American Mosquito Control Association*, 17, 51–55.
- Riverón-Giró, F. B., Damon, A., García-González, A., Solís-Montero, L., Aguilar-Romero, O., Ramírez-Marcial, N., y Nieto, G. (2017).** Anatomy of the invasive orchid *Oeceoclades maculata*: Ecological implications. *Botanical Journal of the Linnean Society*, 184(1), 94–112. <https://doi.org/10.1093/botlinnean/box020>
- Rey, J. R., y Lounibos, P. (2015).** Ecología de *Aedes aegypti* y *Aedes albopictus* en América y transmisión enfermedades. *Biomédica*, 35(2), 177–185. <https://doi.org/10.7705/biomedica.v35i2.2530>
- Reyes-Grajales, E. (2021).** Presencia de la tortuga de orejas rojas (*Trachemys scripta elegans*) en la Depresión Central del estado de Chiapas, México. *Lum*, 2, 1–6.
- Velázquez-Velázquez, E., Anzueto-Calvo, M. J., Domínguez-Cisneros, S. E., Pineda Diez de Bonilla, E., y Serrano Sánchez, I. J. (2022).** Ocurrencia del pez diablo (*Pterygoplichthys disjunctivus*) (Siluriformes: Loricariidae), en el Parque Nacional Cañón del Sumidero, Chiapas, México. *Lacandonia*, 16(2), 63–68.