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More of the same: new policies continue fostering the use of non-native fish in Brazil

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Incentives for farming non-native fish species in public waters have regained strength in Brazil (Charvet et al. 2021), and some states strive to boost the aquaculture market with the non-native striped catfish *Pangasianodon hypophthalmus* (Sauvage 1878). First authorized in the state of São Paulo, striped catfish farming has been allowed in other states (e.g., Rio Grande do Norte Decree N° 27.684/2018 and Tocantins Decree N° 3.825/2021). The national environmental licensing process has been simplified and inspections loosened from the permission process for farming non-native species (Dias et al. 2021). The direction of Brazilian national policies puts biodiversity at risk and encourages unsustainable practices that contrast with international agreements. Therefore, the increase in state authorizations for the farming of *P. hypophthalmus*, in addition to illegal farming that occurs in other states, can contribute to the spread of *P. hypophthalmus* throughout the country. This becomes even more worrying if other states also authorize or illegally farm the species, especially in those that share river networks with neighbouring countries (SAE 2013). Here, we aimed to register the legislation of the Brazilian states that authorize the farming of *P. hypophthalmus* and to warn about the risks of yet another imminent invasion of *P. hypophthalmus* in the country and in South America.

The rise of incentives

Powered by the agribusiness lobby, which dominates the Brazilian Congress, new setbacks are associated with incentives to farming non-native fish species in public waters such as rivers, reservoirs and adjacent areas (Charvet et al. 2021). The Neotropical freshwater fish fauna is the richest in the world, with more than 6200 species, the majority of them occurring in Brazilian territory (Albert et al. 2020). Nevertheless, some states strive to boost the aquaculture market with non-native fish species such as the Asian striped catfish *P. hypophthalmus* (Siluriformes, Pangasiidae), a species native to the Mekong, Chao Phraya and Maeklong river basins in Southeast Asia (Hill & Hill 1994). The main goal of cultivating the striped catfish in Brazil is self-sufficiency, reducing the current imports of nearly 60 000 tonnes per year from Vietnam (CNA 2019).

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First authorized in the state of São Paulo (State Decree N° 62.243 November 2016), striped catfish farming has been progressively allowed and encouraged in other states (Garcia et al. 2018). The state of Rio Grande do Norte changed its aquaculture regulation by adding the word ‘exotic’ in the first article of State Decree 23.379 April 2013 (Decree N° 27.684 January 2018). This alteration authorizes any farming of non-native fish in the state. Since then, several states in north-eastern Brazil have also allowed striped catfish farming, including Sergipe (Resolution number 17/2018), Pernambuco (Project Law N° 1.268/2020), Ceará (Decree N° 17.453 April 2021) and Paraíba (Project Law N° 2.386/2021). The striped catfish is also farmed in the states of Maranhão, Alagoas and Piauí and, in south-eastern Brazil, in the state of Minas Gerais. In northern Brazil, a law allows the farming of striped catfish in the state of Tocantins (Decree N° 3.825 September 2021). This entire state is located in the Tocantins–Araguaia Basin, where changes in environmental conditions have put its biodiversity and ecosystem services at risk (Pelicice et al. 2021). In addition to these state-level authorizations, the national environmental licensing process has been overly simplified and inspections loosened (e.g., bill N° 3.729/2004). The latter is evidenced by Decree N° 10.576/2020, in which President Jair Bolsonaro excluded the main supervisory agency, the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), from the permission process for farming non-native species in public waters (see Charvet et al. 2021, Dias et al. 2021). In the state of Pará, despite being prohibited for cultivation, the species is illegally farmed around the municipalities of Belém and Marabá (VLM Santos, personal observation 2021).

The introduction of *P. hypophthalmus* to Brazilian aquaculture is being supported by many decision-makers connected to the fish farming sector, such as Confederação da Agricultura e Pecuária do Brasil, Secretaria de Aquicultura e Pesca do Ministério da Agricultura, Pecuária e Abastecimento and Comissão Nacional de Aquicultura (CNA 2019). They argue that *P. hypophthalmus* farming will create new jobs and could boost Brazilian aquaculture. However, these claims rely on insufficient knowledge, non-scientific evidence and inadequate planning, resulting in unrealistic expectations. Hence, both illegal farming and increased authorizations and incentives for the farming of *P. hypophthalmus* can contribute to the spread of the species throughout Brazil and neighbouring countries, such as those that share river networks with Brazilian states (SAE 2013).

This is not the first time that aquaculture lobbyists and stakeholders have sponsored the introduction and/or authorization of a non-native ‘panacean’ species in Brazil. Previous disastrous introductions, such as the African catfish *Clarias gariepinus* (Burchell 1822) in the 1980s and the channel catfish *Ictalurus punctatus* (Rafinesque 1818) in the 1990s, were also based on expectations that they would boost the aquaculture industry. However, *C. gariepinus* and *I. punctatus* were never relevant to the Brazilian markets and failed in aquaculture. In addition, these two species escaped from confinement, having environmental impacts on the native aquatic biota of the Atlantic Forest (Weyl et al. 2016, Faria et al. 2019). Today, *C. gariepinus* may be found in several Brazilian ecosystems (Vitule et al. 2006, Weyl et al. 2016), and the same is expected in the case of *P. hypophthalmus* in the future. Currently, there is also a strong lobby calling from the expansion of the farming of non-native species in the country (Pelicice et al. 2014), despite the associated impacts (Attayde et al. 2011).

Introductions are already underway

In South America, *P. hypophthalmus* has already been recorded in the wild in the Magdalena river basin, Colombia (Valderrama et al. 2016). In Brazil, specimens of the striped catfish were recorded in the states of Ceará, Alagoas, Bahia (Ferraz et al. 2019, ALB Magalhães, unpublished data 2021), Espírito Santo (ALB Magalhães, unpublished data 2021) and Minas Gerais (TC Pessali, unpublished data 2021), indicating that introductions are already underway. In May 2021, a thin specimen measuring c. 30 cm was found dead on a marine beach (Ilha do Mel/state of Paraná) by fishermen, and this was the first record in an estuarine context (FL Rodrigues, unpublished data 2021). Fish are not constrained by geopolitical boundaries (Latini et al. 2021). Therefore, despite the limitations imposed by geographical barriers, the potential expansion of the striped catfish to other Brazilian states or even to other South American countries should not be underestimated.

The farming of striped catfish is concerning because of the high risk of escape (Zeena & Jameela Beevi 2013). Considering that the striped catfish displays migratory and omnivorous habits, it has a high capacity to alter water quality and to modify aquatic ecosystems (Singh & Lakra 2011). In Brazil, fish farming is mostly based on tanks and cage farm systems, both of which carry a high risk of escape during all stages of production (Pelicice et al. 2014, Casimiro et al. 2018). Environmental tolerance and resistance to extreme values of dissolved oxygen, salinity, pH and temperature (Ali et al. 2013) allow *P. hypophthalmus* to adapt to new environments. If fish farm escapes and releases by aquarists become more frequent, the chances of establishment of *P. hypophthalmus* will be greater. Thus, the propagule pressure of *P. hypophthalmus* may increase, as this consists of both the number of individuals introduced by events and the frequency of events (Lockwood et al. 2009). Because the striped catfish displays traits associated with high invasiveness (see Garcia et al. 2018), it is considered a potential threat to Neotropical ecosystems and native catfishes (Castellanos-Mejía et al. 2021). In addition, considering the species’ ability to survive in highly competitive environments in its native range, the biodiverse rivers of Brazil may not be a limitation to its spread and establishment (Fitzgerald et al. 2016).

Due to its migratory habits, the striped catfish may disperse further from the initial area of its introduction, especially in areas with free-flowing rivers and high connectivity. Its omnivorous diet, feeding upon zooplankton, insects, crustaceans, fish and fruits, can also interfere with and alter the food chain (Singh & Lakra 2011). If the striped catfish becomes established, there may be predation of the eggs and larvae of native species, bioturbation, transmission of pathogens and competition with species from similar trophic guilds and spawning areas (see Singh & Lakra 2012, Garcia et al. 2018).

Against environmental agreements

The recent direction of Brazilian national policies encourages unsustainable aquaculture practices and contrasts with international agreements such as the Convention on Biological Diversity (CDB) (Article 8(h)), which states, ‘Each Contracting Party shall, as far as possible and as appropriate, prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species.’ This approach also contrasts with the Convention on Wetlands (Ramsar Convention) Resolution VII.14 (invasive species and wetlands), Aichi Biodiversity Target

9 (control of non-native species; Lima-Junior et al. 2018), Sustainable Development Goal 15.8 (prevent the introduction of non-native species) of the 2030 Agenda for Sustainable Development of the United Nations and Principle 5D (prevent the introduction of non-native organisms) of the Earth Charter (Corcoran et al. 2015). Environmental Crimes Law N° 9.605/1998 clearly states that it is an environmental crime to 'introduce animal specimens into the country without a favorable official technical opinion and a license issued by a competent authority', as well as to disseminate 'disease or pests or species that may cause damage to agriculture, livestock, fauna, flora or ecosystems'. We therefore recommend that the farming of *P. hypophthalmus* should be prohibited in Brazil and that the laws and bills authorizing the farming of striped catfish be revoked and vetoed.

Final comments

We recognize that aquaculture, with or without native species, constitutes an impacting activity when carelessly practised in the natural environment because it removes riparian vegetation, causes siltation and dumps organic matter into freshwater ecosystems, accelerating eutrophication (Magalhães et al. 2020). Thus, prohibiting the farming of *P. hypophthalmus* in any region of Brazil is a decision that must be motivated not only based on the precautionary principle, but also because of the inevitability of escapes and the risks of the species becoming established in the wild. Therefore, Brazilian legislators must encourage and invest in technological developments to farm native species. Technological development can occur with research into species with potential for farming in each watershed. Furthermore, the adoption of recirculating aquaculture systems allows for the treatment of waste and increased biosecurity and control over water quality, in addition to a reduced risk of escapes and limited or no interaction with native biota (Martins et al. 2010, Nobile et al. 2019). Brazil hosts the most biodiverse freshwater fish fauna on the globe, and it makes no sense to invest in additional non-native fish under pretences of promoting economic growth and improving food sovereignty and security.

Supplementary material. To view supplementary material for this article, please visit <https://doi.org/10.1017/S0376892922000029>.

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Conflict of interest. The authors declare none.

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