http://dx.doi.org/10.18623/rvd.v18i41.1990

ANALYSIS OF THE EFFECTS OF CURRENT LEGISLATION ON ALIEN SPECIES IN THE BRAZILIAN LEGAL AMAZON

Lariesssa Moura de Araújo Soares[1]
Universidade Federal de Rondônia (UNIR)

Neiva Araujo[2]
Universidade Federal de Rondônia (UNIR)

Jean Ricardo Simões Vitule[3]
Universidade Federal do Paraná (UFPR)

Carolina Rodrigues da Costa Doria[4]
Universidade Federal de Rondônia (UNIR)

ABSTRACT

The present study analyzed the norms for breeding exotic species, their relationship with the advance of pressure from propagules and with Goal 15 of the Sustainable Development Agenda of the United Nations. The main objectives of this research were to concatenate and relate: (1) the legislation in force in the states of the Legal Amazon and the federal legislation; (2) data on the production of Oreochromis niloticus, as a proxy for the pressure of propagules. State regulations diverge from each other

1 Doctoral student in Biodiversity and Conservation at the Laboratory of Ichthyology and Fisheries of the Rede Bionorte Post-Graduate Program at UNIR. Master's Degree in Animal Production from the Centro Universitário Autônomo do Brasil (UNIBRASIL). Bachelor's Degree in Animal Science from the Universidade Federal do Mato Grosso (UFMT). Laboratory of Ichthyology and Fisheries at UNIR. ORCID: https://orcid.org/0000-0001-8461-6862/ e-mail: lariessa@gmail.com

2 Doctoral Degree in Regional Development & Environment from UNIR. Master's Degree in Law from the Universidade de Santa Cruz do SUL (UNISC). Specialist in Public Law from the Faculdade IDC. Bachelor's Degree in Law from UNISC. Professor at UNIR. Leader of the Law, Territory & Amazon Research Group (DITERRA). Member of the Amazon Dams Network ORCID: https://orcid.org/0000-0003-3252-4514 / e-mail: neiva.araujo@unir.br

3 Postdoctoral and Doctoral Degrees in Zoology from the Universidade Federal do Paraná (UFPR). Master's Degree in Zoology from UFPR. Bachelor's Degree in Biological Sciences from the Pontifícia Universidade Católica do Paraná (PUC-PR). Professor at the Department of Environmental Engineering at UFPR. Resident Researcher at The Rockefeller Foundation. ORCID: https://orcid.org/000000016543-7439 / e-mail: biovitule@gmail.com

4 Post-doctoral Degree in Fisheries Management at the University of Florida (UF). Doctoral Degree in Sustainable Development in the Humid Tropics from the Universidade Federal do Pará (UFPA). Master's Degree in Ecology of Continental Aquatic Environments from the Universidade Estadual de Maringá (UEM). Bachelor's Degree in Biological Sciences from the Universidade Estadual de Londrina (UEL). Associate IV at UNIR. Professor at the Department of Biology of the Postgraduate Program in Regional Development and Environment at Rede Bionorte. *Visiting faculty* at the Center for Latin American Studies of University of Florida. Member of the Guaporé Ecological Action (ECOPORÉ – NGO). ORCID: https://orcid.org/0000-0003-1638-0063 / e-mail: carolinarcdoria@unir.br

and conflict with federal guidelines and international treaties. This, associated with the lack of inspection, seems to promote the disorderly advance of aquaculture of exotic species without adequate containment to prevent the escape of these and their pathogens. This poses great risk to adjacent ecosystems. This scenario highlights the lack of dialogue between the legislative sectors at different levels and these with the executive bodies and aquaculture. A plausible solution inexorably involves the replacement of exotic species by species, phenotypes and genotypes native to the river basin or sub-basins where the cultivar is located; and strict adherence to the Ecological Monitoring System (i.e. Plan, Do, Verify, Act), which is a series of practices aimed at reducing environmental impacts of human activities.

Keywords: biological invasions, environmental legislation, non-native species, sustainable development goals (SDG).

ANÁLISE DOS EFEITOS DA LEGISLAÇÃO VIGENTE SOBRE ESPÉCIES EXÓTICAS NA AMAZÔNIA LEGAL BRASILEIRA

RESUMO

O presente estudo analisou as normas para criação das espécies exóticas, sua relação com o avanço da pressão de propágulos e com o Objetivo 15 da Agenda de Desenvolvimento Sustentável das Nações Unidas. Os objetivos focais desta pesquisa foram concatenar e relacionar: (1) as legislações vigentes dos estados da Amazônia Legal e a legislação federal; (2) os dados da produção de Oreochromis niloticus, como proxy da pressão de propágulos. As normativas estaduais divergem umas das outras e destoam das diretrizes federais e de tratados internacionais. Esse fato, associado com a necessidade de fiscalização nesse tema, parece promover o avanço desordenado da aquicultura de espécies exóticas sem a contenção adequada para evitar seus escapes e de seus patógenos, o que constitui grande risco para os ecossistemas adjacentes. Esse cenário evidencia a necessidade de diálogo entre os setores do legislativo, em diferentes níveis, e destes com os órgãos executivos e os aquicultores. Uma solução plausível passa, inexoravelmente, pela substituição de espécies exóticas por espécies, fenótipos e genótipos nativos da bacia do rio ou sub-bacias em que

há o cultivar e aderência estrita ao Sistema de Monitoramento Ecológico (i.e., planejar, fazer, verificar, agir), que é uma série de práticas direcionadas para reduzir impactos ambientais de atividades humanas.

Palavras-chave: *espécies exóticas invasoras; invasões biológicas; legislação ambiental; pressão de propágulos; objetivos de desenvolvimento sustentável (ODS).*

INTRODUCTION

In Brazil, Law no. 11,959/2009 deals with the National Policy for the Sustainable Development of Aquaculture and Fisheries, but there is no detail regarding the farming of alien species in public continental waters. However, there are more than 70 normative acts related to invasive alien species (State Laws, CONABIO and CONAMA Resolutions, MMA Ordinances) that deal with the subject and regulate it. The Convention on Biological Diversity (CBD), of which Brazil was the first signatory, is considered a general guide to measures adopted at the national level. The CBD is focused on three pillars: the conservation of biological diversity, the sustainable use of biodiversity, and the fair and equitable sharing of benefits arising from the use of genetic resources.

Gaps in the regulation on the farming of alien species favor increased propagule pressure, which can overwhelm the biotic resistance of natural ecosystems, increasing the risk of invasion of these species and their parasites/pathogens in natural or semi-natural aquatic compartments, jeopardizing water security and the conservation of biodiversity and fisheries resources in regions with high diversity, such as the Legal Amazon. Accordingly, this study aimed to analyze the influence of legislations in force in the Legal Amazon states on the advancement of the farming of invasive alien species in the region, focusing on *Oreochromis niloticus* (Linnaeus 1758) and on the aquatic environment as a whole, in addition to elucidating conflicts related to fish farming legislation in the Legal Amazon, promote discussions on good practices and sustainable alternatives. In this context, the analysis encompasses the comprehension of the subject in a holistic way, based on the Sustainable Development Goals (SDGs), federal legislation and state regulations, in order to examine the execution of the

goals considering the challenges as to prevention in managing invasive alien species and to national water security.

1 METHODOLOGY

The research considered as data sources:

- The Brazilian Pisciculture Yearbook of the Brazilian Association of Pisciculture (ABP, 2020) to obtain the production of *O. niloticus*, in tons, by state.
- The 2017 Agricultural Census, from the Brazilian Institute of Geography and Statistics (IBGE, 2017), to obtain the total number of fish farms and the number of *O. niloticus* fish farms.
- The legal regulations in force are available on the publication websites *of the Official Gazette* of the states of Acre, Amapá, Amazonas, Roraima, Rondônia, Mato Grosso, Maranhão, Tocantins and Pará, in addition to federal legislation and websites of competent environmental agencies.

After collecting data, we carried out a descriptive analysis (focusing on alien species) of the legislations in force in the states that constitute the Legal Amazon, and we evaluated their adequacy to comply with target 15.8 of the SDGs: "By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems" (UN, 2020).

2 RESULTS AND DISCUSSION

In the Legal Amazon, all Federation Units permit, by law, the farming of alien species; however they differ in some aspects. The permit/license for the farming of alien species is a common point, but the modes for obtaining the permission differ between states; the legal permissiveness is inconsistent with Brazil's commitment to comply with SDG 15.8[5], since it does not create legal barriers to the introduction of alien species of high invasive potential and with a long history of ecological impacts, as is the case of *O. niloticus* (e.g., CHARVET *et al*. 2021, OCCHI *et al*., 2021).

5 SDG 15 aims to protect, recover and promote the sustainable use of land ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt the loss of biodiversity. SDG 15.8 By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species.

Table 1 – Current legislations, total number of fish farms, and number of fish farms and production of *O. niloticus* among the states of the Legal Amazon

State	**Current legislation**	**Permits the farming of alien species**	**Total number of fish farms***	**Production of *O. niloticus* (in tons)****	**Number of *O. niloticus* fish farms***
Acre	Law no. 1,117/1994 and Law no. 1,235/1997	YES	10,195	64	834
Amapá	Law no. 898/2005	YES	477	84	97
Amazonas	Law no. 4,330/2016	YES	4,555	0	146
Maranhão	Law no. 5,405/1992	YES	22,229	4,019	2,693
Mato Grosso	Law no. 10,669/2018	YES	11,973	3,100	695
Pará	Law no. 6,713/2005	YES	17,170	383	3,089
Rondônia	Law no. 3,437/2014	YES	11,033	0	1,279
Roraima	Law no. 007/1994	YES	1,592	0	189
Tocantins	Law no. 13/1997	YES	2,334	35	151
Total	-	-	**81,558**	**7,685**	**9,173**

* IBGE (2017).

** ABP (2020).

2.1 Federal legislation

Law no. 11,959/009, which provides the National Policy for the Sustainable Development of Aquaculture and Fisheries, only mentions the farming of alien species in its art. 22: "[…] the farming of alien species, it is the responsibility of the aquaculturist to ensure the containment of the specimens in the scope of captivity, preventing their access to the drainage waters of the Brazilian water basin" (BRASIL, 2009a).

The need to control and eradicate alien species that threaten ecosystems, habitats or species is addressed in the Convention on Biological Diversity (BRASIL, 2009b), a multilateral international treaty that addresses the protection and use of biological diversity in each signatory country. Brazil ratified this treaty and addressed the issue in the National Biodiversity Policy (Decree no. 4,339/2002, which institutes principles and directives for the implementation of the National Biodiversity Policy), in Decree no. 4,703/2002 (which provides the National Biological Diversity Program – PRONABIO and the National Biodiversity Commission), in Federal Law no. 13,123/2015 (which addresses the access to genetic heritage, protection and access to associated traditional knowledge, and the sharing of benefits for the conservation and sustainable use of biodiversity) and Decree no. 10,235/2020 (which amends Decree no. 4,703/2003).

In addition, CONABIO Resolution 05 of Oct 21, 2009 addresses the National Strategy on Invasive Alien Species, emphasizing the need for protective actions in order to:

> Prevent and mitigate the negative impacts of invasive alien species on the human population, productive sectors, environment and biodiversity, through planning and execution of actions to prevent, eradicate, contain or control invasive alien species with coordination between Federal, State and Municipal Government bodies and civil society, including international cooperation (BRASIL, 2009b).

As for environmental licensing at the federal level, Resolution no. 413, of July 26, 2009, of the National Council for the Environment (CONAMA), establishes that: "Aquaculture activity will only be permitted when there is the use of autochthonous or native species, or, in the case of allochthonous or alien species, when it appears in a specific federal normative act that authorizes their use" (CONAMA, 2009); this wording was changed by Resolution no. 459/2013 of CONAMA, which, in its art. 9, authorizes the use of allochthonous or alien species, provided that mitigation measures for potential impacts are presented, in order to obtain a single environmental

license. This resolution describes measures that are necessary so the impacts are mitigated, such as: which handling and equipment will be used to prevent escapes into the natural environment at all stages of breeding; techniques that prevent individuals from reproducing in case of escape; containment measures for parasites and pathogens referring to the bred species; activity monitoring and actions to reverse or compensate for the environmental impacts that may occur, caused by the species (CONAMA, 2013).

Ordinance no. 3, of August 16, 2018 (BRASIL, 2018), instituted the Plan for Implementation of the National Strategy for Invasive Alien Species, which delimited the operation for the execution of the strategy, with a duration of 12 years. The main objective is "to guide the implementation of measures to prevent the introduction and dispersion and significantly reduce the impact of invasive alien species on the Brazilian biodiversity and ecosystem services, control or eradicate invasive alien species".

In the scope of the strategy, important actions were defined for the prevention, eradication, control and monitoring of invasive alien species, using participatory management instruments, in which the monitoring was carried out by networks of collaborators, for prior detection before their establishment and/or invasion (BRASIL, 2018).

The importance of the issue is also shown with the creation of the Permanent Technical Chamber on Invasive Alien Species (CTPEEI), linked to the National Biodiversity Commission (CONABIO Deliberation no. 49, of August 30, 2006). This Chamber is composed of various bodies at the federal and state levels, aiming to disseminate information on the impacts and consequences arising from these invasions; integrate different public and private sectors; protect ecosystems; control or eradicate alien species that threaten ecosystems, habitats or species; and, most importantly, regulate the management of the use of invasive alien species in the country, generating Resolution instruments within the scope of CONABIO and CONAMA, since, once supervised and regulated, the authorizations for the introduction of alien species can be monitored by the competent agencies (BRASIL, [nd]).

2.2 State legislations

2.2.1 State of Acre

In Acre, Laws no. 1,117, of Jan 26, 1994, and no. 1,235, of Jul 9, 1997 prohibit the introduction of alien species into public domain water bodies

in the state, as well as in any water bodies connected with them of alien species of aquatic fauna and flora, without prior authorization from the environmental agency, which is responsible for controlling and preventing the introduction of alien species in the state territory (ACRE, 1994; ACRE, 1997).

However, despite current laws prohibiting the introduction of alien species, the State Council for the Environment, Science and Technology of Acre (CEMACT) prepared Resolution 03, of Aug 17, 2010, authorizing the farming of the species *O. niloticus* in Acre, for aquaculture purposes; to this end, specific tanks are required, and farming in natural aquatic environments is prohibited, including in dams in watercourses (ACRE, 2010).

2.2.2 State of Amapá

Law no. 898, of Jun 14, 2005 (art. 26) and Complementary Law no. 5, of Aug 18, 1994 (art. 76) prohibit, without prior authorization from the responsible Environmental Agency, the introduction of any alien or allochthonous fish species, at any stage of development in Amapá (AMAPÁ, 2005; AMAPÁ 1994).

Law no. 898, of Jun 14, 2005 defines as alien species individuals of the ichthyofauna that do not have genetic origin in the water basin in which the enterprise is located. Art. 8 prohibits the use of alien species (those that do not have genetic origin in the enterprise's water basin) and allochthonous species for population and repopulation purposes. However, fish farming depends on environmental licensing, with the Institute for the Environment and Territorial Planning of Amapá (IMAP) being the body responsible for the procedure (AMAPÁ, 2005).

The aforementioned Law considers the environmental impact resulting from aquaculture, the introduction of alien – animal or plant – species that may change the natural frequency of occurrence of populations or the possibilities of survival of any native species, as well as the introduction of alien species that may alter the genetic nature of native species, which is called "genetic contamination". However, this provision excludes aquaculture producers that farm and sell species that, although alien, are intended for ornamentation and aquarium hobby (fish breeding in aquariums) and/or export, provided that the facilities constitute a closed system (not part of watercourses) (AMAPÁ, 2005).

2.2.3 State of Amazonas

The state of Amazonas regulates the farming of alien species through Law no. 4,330, of May 30, 2016, which defines an alien or allochthonous species as one that does not or did not occur naturally in a given water basin, at any stage of development (AMAZONAS, 2016).

This law also considers environmental irregularities in aquaculture activities, the introduction of undetected alien species in the water basin, without prior authorization from the competent state environmental agency (AMAZONAS, 2016). This authorization is given after evaluating the degree of risk of escape, the installed containment systems, and the level of risk that the species represents to the environment (AMAZONAS, 2016).

2.2.4 State of Maranhão

In Maranhão, state Law no. 5,405, of Apr 8, 1992 concerns environmental protection, prohibits the introduction, in state water bodies, of alien species of aquatic fauna and flora, without prior authorization from the competent environmental agency (MARANHÃO, 1992).

Fish farms are licensed by the Department of the Environment (SEMA); the parameters are regulated by Ordinance no. 10, of Jan 17, 2013, and the provisions deal with the waiver of licensing (MARANHÃO, 2013).

According to Ordinance no. 10, of Jan 17, 2013, enterprises in up to two hectares of water depth may be exempted from environmental licensing upon request in the aforementioned agency by filling out a specific form. This form includes *O. niloticus*, among other alien species. It also defines allochthonous species as those that do not occur naturally in a given water basin (MARANHÃO, 2013), with no mention of alien species.

In turn, state Law no. 10,535, of Dec 7, 2016 deals specifically with alien wildlife, defining it as "individuals belonging to species whose original geographic distribution does not include the Brazilian territory, or which were introduced therein by man or spontaneously, in a natural environment, including wild species, with the exception of native species" (MARANHÃO, 2016).

It is clear that the environmental agency must grant authorization for the farming of these individuals, but Ordinance no. 10, of Jan 17, 2013 grants exemption from licensing up to hectares; in turn, Law no. 10,535,

of Dec 7, 2016 determines that the environmental licensing of up to 50 specimens in the herd will be simplified, with the other cases being conventionally licensed.

2.2.5 State of Mato Grosso

The state of Mato Grosso provides, in Law no. 10,669, of Jan 16, 2018 (MATO GROSSO, 2018), that, when fish farming aims at the production of hybrid fish and fingerlings, of alien, native and allochthonous species, it must be carried out in excavated ponds, dams, net tanks and closed systems. In turn, Law no. 11,129, of May 13, 2020 (MATO GROSSO, 2020) highlights that alien and allochthonous species do not fall under the simplified environmental licensing.

Decree no. 337, of Dec 23, 2019 (MATO GROSSO, 2019) defines allochthonous or alien species as those that do not occur or did not occur naturally, and they may have their farming authorized (for example, *O. niloticus*) upon application in the environmental agency. Decrees on licensing related to fish farming: Decree no. 8,149/2006, which was amended by Decree no. 1,190/2017. For conventional licensing, there are prerequisites such as:

> […] protection mechanisms against the escape of aquatic organisms, built with materials resistant to corrosion, traction and mechanical action of predators, in order to prevent their breakage, and special care must be taken during their transport, repair and handling, in order to ensure the non-escape of these species at their different stages of development.

As for environmental licensing, only some alien species are authorized, such as: grass carp (*Ctenopharyngodon idella*), Nile tilapia (*O. niloticus*), Pacific white shrimp (*Litopenaeus vannamei*), among others, being necessary, in addition to the environmental agency, opinion of the Institute of Agricultural Defense of the State of Mato Grosso (INDEA/MT) (MATO GROSSO, 2019).

2.2.6 State of Pará

As for the protection of wild fauna, Law no. 5,977, of 1996 prohibits the introduction of alien species in public domain locations, that is, in water courses for collective use, without prior and express authorization and control by a state environmental agency (PARÁ, 1996). This legislation specifies only the aforementioned locations.

Fishing and aquaculture are regulated by Law no. 6,713, of Jan 25, 2005 (PARÁ, 2005), being illegal to farm alien species in open systems (which are connected to watercourses), with no specification on other systems, based on federal regulations for regularization of fish farms that raise alien species in other systems (BRABO, 2017). Normative instruction no. 004/2013 complements and defines that the farming of alien species cannot be exempted from environmental licensing and aquaculture enterprises, even small ones, that carry out this farming must obtain conventional licensing (PARÁ, 2013).

COEMA Resolution no. 143/2018 deals directly with the farming of alien species in the state of Pará. As for the farming criteria, the following applies: it must be conducted in closed systems; obtaining and producing fish with certified sexual reversion; protection to avoid predatory birds and proper disposal of effluents, expanding to partially closed systems if the licensing establishes that there will be containment of the species farmed (PARÁ, 2018).

2.2.7 State of Rondônia

In Rondônia, Law no. 3,437, of Sep 9, 2014 deals with the rules for aquaculture, including for the farming of alien species (RONDÔNIA, 2014). According to the aforementioned Law, the farming of alien, allochthonous and hybrid species

> […] will be the full responsibility of the aquaculturist, who is responsible for ensuring efficient containment, which can only occur in excavated ponds, in systems that prevent the access of specimens, at any stage of development, to the drainage waters of the Rondônia water basins. The aquaculturist is also responsible for installing physical, biological or chemical barriers to prevent fish from escaping (RONDÔNIA, 2014).

The applicant, in this mode, must submit an Environmental Control Plan, given the high impact of the activity. Farming hybrid fish (originating from crosses between species) of allochthonous and alien species is prohibited in Permanent Preservation Areas (APP), where release in water bodies is also prohibited (RONDÔNIA, 2014). Art. 38, of Law no. 3,437/2014, also provides fines for those who import or export any aquatic species, regardless of the stage of evolution, stipulating the mandatory licensing of the environmental agency for the introduction of native or alien species in state waters (RONDÔNIA, 2014).

2.2.8 State of Roraima

Roraima addresses the issue of alien species in Complementary Law no. 7, of Aug 26, 1994. There is a prohibition on the introduction of alien species of aquatic fauna and flora, without prior authorization from the competent environmental agency (RORAIMA, 1994). In a more recent regulation, Law no. 516, of Jan 10, 2006, art. 23, prohibits the production, raising and fattening of alien species and species that do not originate in the corresponding water basin, without authorization from the State Foundation for the Environment, Science and Technology (FEMACT) (RORAIMA, 2006).

However, Resolution 01, of Apr 2, 2018, of the State Council for the Environment, Science and Technology of Roraima (CEMACT-RR), regulates the farming, providing the exemption of environmental license for flooded areas of up to five hectares, not specifying the species (RORAIMA, 2018).

2.2.9 State of Tocantins

In Tocantins, the regulation of fishing, aquaculture and pisciculture activities is governed by Law no. 13, of Jul 18, 1997, which prohibits the breeding and introduction of exotic species without prior licensing from the Instituto Natureza do Tocantins (NATURATINS) (TOCANTINS, 1997). The state considers as an alien species that which, in addition to not occurring in the region, presents extravagant and distinct characteristics from the other species (TOCANTINS, 1997).

The Resolution of the State Environmental Council of the State of Tocantins (COEMA/TO) deals directly with environmental licensing in the state, citing the alien species Nile Tilapia (*O. niloticus*) as the only one permitted; for licensing, information must be provided as to the methods to control the spread of alien and allochthonous species to be used during cultivation (TOCANTINS, 2018).

The same Resolution requires mitigating measures for the implementation of the enterprise, such as:

> Description of handling procedures aiming to prevent species from escaping from the farms, including the stages of transport, raising and handling in the stages, with special attention to the classification by size and handling of juveniles, containing the corresponding implementation strategies (TOCANTINS, 2018).

The activity of farming alien species, specifically *O. niloticus*, is permitted in the Tocantins basin in different modes: net tank in reservoir, diversion and accumulation dams, fee-fishing, excavated pond/tank and suspended elevated tank (TOCANTINS, 2018).

2.3 State Legislation and compliance with SDG 15

Compliance with SDG 15, especially target 15.8, involves the development of an early warning and detection system for invasive alien species, with, among other actions, the "consolidation of a national list of invasive alien species and the preparation and application of of risk analysis protocols for importing species", as well as the "registration of products based on biological and microbiological control agents", which are the reasons why there was no change in the wording of target 15.8 (IPEA, 2020).

In Brazil, Law no. 11,959/2009, which deals with the National Policy for the Sustainable Development of Aquaculture and Fisheries, in its art. 22, deals with alien species, but there is no detail regarding the farming of alien species in continental public waters (BRASIL, 2009a). However, there are documents that deal with the subject and regulate it. The CBD is considered a guide to measures adopted at the national level, which is focused on the three pillars mentioned above.

At the national level, Decree no. 4,339 and the CBD establish the principles and guidelines for the implementation of the National Biodiversity Policy (BRASIL, 2002). Law no. 9,605, 1998, mentions the criminal sanctions for the introduction of animal species in Brazil, without a favorable official technical opinion and a license issued by a competent authority (IBAMA, 1998), not instituting parameters on authorizations at the federal level. As shown, many states are not consistent with federal directives.

Current legislation in Rondônia permits the farming of alien species, provided the property is licensed and complies with minimum handling rules (physical, biological or chemical barriers) that prevent escape into the natural environment (RONDÔNIA, 2014). However, until 2018 there were no records, in the environmental agency, of properties with farming of alien species, although there are records of such production in the state in other agencies (IBGE, 2017). Oral reports of the occurrence in natural environments in the state of invasive species, such as Pirarucu, *Araiapama gigas* (CATÂNEO, 2019), and *O. niloticus* suggest that there were failures in the record, as this is an alien species to breed without authorizations for farming in the state (SOARES *et al.*, 2020).

Current legislations, both at the federal and state levels, have many loopholes, with permission for farming and limited requirements in licensing, such as the requirement of barriers to prevent escapes into watercourses. In Amapá, the use of alien and allochthonous species for population and repopulation purposes and their introduction of high environmental impact is prohibited (AMAPÁ, 2005)**.** In Pará, there is a waiver of environmental licensing for small businesses (PARÁ, 2013).

In Roraima (RORAIMA, 2018) and Maranhão (MARANHÃO, 2016), as mentioned above, authorization from the environmental agency is required for farming. Acre has a specific resolution, which authorizes the farming of *O. niloticus* in closed systems, as long as it is licensed (ACRE, 2010). In Tocantins, the farming of alien species requires authorization/licensing from the environmental agency (TOCANTINS, 1997). In Amazonas, authorization is based on the degree of risk of escape (AMAZONAS, 2016). In Mato Grosso, in addition to the environmental agency, the agricultural defense agency also issues opinion in the procedural instruction (MATO GROSSO, 2019).

The result of this mix of different legislations is that, currently, in the Legal Amazon, about 10% of the existing fish farms (9,173) produce *O. niloticus* (IBGE, 2017) (Table 1). These values may still be underestimated, according to Latini (2016) and Soares *et al.* (2020), which is concerning, as *O. niloticus* is a highly invasive fish with great potential for impact, which affects a variety of ecosystems, particularly those located in the tropics (ISSG, 2008; CHARVET *et al*., 2021; OCCHI *et al*., 2021).

The occurrence of *O. niloticus* in the Amazon in natural environments was recorded by Guarido (2014) and Soares *et al.* (2019), who found that the species is established in anthropized watercourses, with low environmental quality (water, biotic and abiotic factors). The impact of alien species, such as *O. niloticus,* on the Amazon biome can lead to major changes in the local ichthyofauna, introduce parasites and diseases, and threaten water security as a whole, since, through its establishment, native ichthyofauna can be replaced with the invasive species, which represents a decrease in local fish diversity (BITTENCOURT *et al.*, 2014).

Although federal legislation indicates the prohibition of the farming of alien species, the Amazon states prohibit in some points, but leave loopholes, such as breeding in net tanks, permission for some species with high invasive power, exemption from licensing per area, without specifying species, in dams in watercourses, among others . Legislations along these

lines are not consistent with the Aichi biodiversity targets[6] (the proposals are all aimed at reducing the loss of biodiversity worldwide), of which Brazil is a signatory, as they generate unsustainable policies, do not promote best practices, and do not follow sustainability principles (LIMA JÚNIOR, 2018), in addition to contributing negatively to changes in fish diversity (NOBILE *et al*., 2020).

In addition to gaps and loopholes in the legislation, existing flaws in the enforcement of legislation, such as the mandatory licensing of properties with fish farms, make monitoring and control difficult. States such as Amazonas, Rondônia and Roraima, for example, do not have official records of *O. niloticus* production (ABP, 2020), diverging from the data presented by the IBGE and PEIXEBR Census, which indicate the existence of fish farms of *O. niloticus* in those mentioned states (IBGE, 2017; PEIXEBR, 2019).

This difference in figures between agencies responsible for monitoring and inspection is a concern shown by Soares *et al*. (2020) as to Rondônia, since nine points of occurrence of *O. niloticus* in natural environments have already been observed in the state, possibly resulting from failures in the application of current legislations regarding the registration of aquaculture activities on the properties and the use of adequate handling practices that prevent the escape of specimens (DORIA *et al.*, 2021).

Effective compliance with the current legislation on aquaculture and its processes, such as environmental licensing, authorizations and the breeding system itself, in addition to legislations on biological invasions and international cooperation treaties, is essential for the maintenance of biodiversity (VITULE, 2009).

CONCLUSION

The different legislations are inconsistent with federal directives regarding the preservation of local biodiversity and influence the advancement of the farming of alien species, which, associated with non-focused inspection and inadequate application of legislation, can facilitate the occurrence of biological invasions in the region of the Legal Amazon.

This situation is in contrast to what is established in target 15.8 of SDG 15, according to which it would be a priority to introduce measures

6 During the Tenth Meeting of the Conference of the Parties to the Convention on Biological Diversity (COP-10), held in Nagoya (Aichi Province, Japan), in 2010, member countries set 20 targets to safeguard the planet's biodiversity: the Aichi Targets.

to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems, since current legislations do not support the achievement of the target, due to the lack of joint direction in actions, especially with regard to containing the advance of alien species in natural environments.

Considering the possible threats arising from the invasion of *O. niloticus* in the region, it is suggested that the states of the Legal Amazon, as they share the same water resources, discuss together the legislations and actions relevant to alien species and increase the inspection of their execution, in order to avoid new irregular invasions in the aquatic environments of the northern region of the country.

Finally, it should be noted that truly sustainable aquaculture in the Amazon requires massive investment in replacing alien species with native species, phenotypes and genotypes (i.e., native to the river basin or sub-basins where the cultivar is located) and strict adherence to the Ecological Monitoring System and good practices as to planning, actions and constant inspection (NOBILE *et al*., 2020), which consist of a series of practices aimed at reducing environmental impacts from human activities (e.g*.,* EPA, 2017. At: https://www.epa.gov/ems). Furthermore, fisheries and/or aquaculture committees need to act in an integrated and consistent manner, throughout the Amazon biome, for the execution of SDG 15, meeting Brazil's commitment to comply with it.

REFERENCES

ABP – ASSOCIAÇÃO BRASILEIRA DA PISCICULTURA. *Anuário Brasileiro da Piscicultura – Peixe BR/2020.* São Paulo: ABP, 2020.

ACRE. Assembleia Legislativa do Estado do Acre. Lei n. 1.117, de 26 de janeiro de 1994. Dispõe sobre a política ambiental do Estado do Acre, e dá outras providências. *Diário Oficial do Estado do Acre,* Rio Branco, 26 jan. 1994.

ACRE. Assembleia Legislativa do Estado do Acre. *Lei n. 1.235, de 9 de julho de 1997*. Dispõe sobre os instrumentos de controle do acesso aos recursos genéticos do Estado do Acre e dá outras providências. Rio Branco: Assembleia Legislativa do Estado do Acre, 1997.

ACRE. Conselho Estadual de Meio Ambiente, Ciência e Tecnologia do Acre. Resolução n. 3, de 17 de agosto de 2010. Autoriza o cultivo da

espécie Tilápia-do-Nilo (*Oreochromis niloticus*) e recomenda a adoção das normativas federais para licenciamento de seu cultivo. *Diário Oficial do Estado do Acre,* Rio Branco, 13 set. 2010.

AMAPÁ. Assembleia Legislativa do Estado do Amapá. Lei Complementar n. 5, de 18 de agosto de 1994. Institui o Código de Proteção ao Meio Ambiente do Estado do Amapá e dá outras providências. *Diário Oficial do Estado do Amapá,* Boa Vista, n. 0896, 19 ago. 1994.

AMAPÁ. Assembleia Legislativa do Estado do Amapá. Lei n. 0898, de 14 de junho de 2005**.** Define e disciplina a Aquicultura no Estado do Amapá e dá outras providências. *Diário Oficial do Estado do Amapá*, Boa Vista, n. 3540, 15 jun. 2005.

AMAPÁ. Conselho Estadual de Meio Ambiente, Ciência e Tecnologia do Amapá. Resolução n. 1, de 2 de abril de 2018. Dispõe sobre o Licenciamento Ambiental Simplificado e dá outras providências. *Diário Oficial do Estado de Roraima,* Boa Vista, 10 abr. 2018.

AMAZONAS. Assembleia Legislativa do Estado do Amazonas. Lei n. 4330, de 30 de maio de 2016. Disciplina a atividade de aquicultura no Estado do Amazonas e dá outras providências. *Diário Oficial do Estado do Amazonas,* Manaus, 30 maio 2016.

BITTENCOURT, L. S. *et al*. Impact of the invasion from Nile *O. niloticus* on natives Cichlidae species in tributary of Amazonas River, Brazil. *BiotAmazônia,* Macapá/AP. v. 4, n. 3, p. 88-94, 2014.

BRASIL. Congresso Nacional. Decreto Legislativo n. 2, de 1994. Aprova o texto da Convenção sobre Diversidade Biológica, assinada durante a Conferência das Nações Unidas sobre Meio Ambiente e Desenvolvimento, realizada na Cidade do Rio de Janeiro, no período de 5 a 14 de junho de 1992. *Diário Oficial da União:* seção 1, Brasília, DF, p. 1693, 4 fev. 1994.

BRASIL. Presidência da República. Casa Civil. Subchefia para Assuntos Jurídicos. Decreto n. 4.339, de 22 de agosto de 2002. Institui princípios e diretrizes para a implementação da Política Nacional da Biodiversidade. *Diário Oficial da União:* seção 1, Brasília, DF, p. 2, 23 ago. 2002.

BRASIL. Presidência da República. Casa Civil. Subchefia para Assuntos Jurídicos. Lei n. 11.959, de 29 de junho de 2009. Dispõe sobre a Política Nacional de Desenvolvimento Sustentável da Aquicultura e da Pesca,

regula as atividades pesqueiras, revoga a Lei n. 7.679, de 23 de novembro de 1988, e dispositivos do Decreto-Lei n. 221, de 28 de fevereiro de 1967, e dá outras providências. *Diário Oficial da União:* seção 1, Brasília, DF, p. 1, 30 jun. 2009.

BRASIL. Ministério do Meio Ambiente. *Resolução CONABIO n. 05, de 21 de outubro de 2009*. Estratégia Nacional sobre Espécies Exóticas Invasoras. Brasília, DF: CONABIO, 2009b. Available from: http://www.mma.gov.br/biodiversidade/biosseguranca/especies-exoticas-invasoras/estrategia-nacional. Access on: Apr. 17, 2018.

BRASIL. Ministério do Meio Ambiente. Secretaria de Biodiversidade. Portaria n. 3, de 16 de agosto de 2018. Plano de Implementação da Estratégia Nacional para Espécies Exóticas Invasoras. *Diário Oficial da União:* seção 1, Brasília, DF, p. 75, 17 ago. 2018.

BRASIL. Ministério do Meio Ambiente. Espécies exóticas invasoras. Brasília, DF: MMA, [s.d.]. Available from: https://antigo.mma.gov.br/calendario/item/7501-espécies-exóticas-invasoras.html. Access on: Jul. 30, 2021.

CATÂNEO, D. T. B. S. *A invasão do pirarucu Arapaima gigas Schinz, 1822 na bacia do rio Madeira:* histórico de introdução, determinação genética e manejo. Dissertação (Mestrado) – Programa de Pós-Graduação em Desenvolvimento Regional e Meio Ambiente. Universidade Federal de Rondônia, Porto Velho, 2019.

CHARVET, P. *et al*. Tilapia farming threatens Brazil's waters. *Science*, v. 371, n. 6527, p 356, jan. 2021.

CONAMA – CONSELHO NACIONAL DO MEIO AMBIENTE, 2009. Resolução n. 413, de 26 de julho de 2009. *Diário Oficial da União:* seção 1, Brasília, DF, p. 126-129, 30 jun. 2009.

CONAMA – CONSELHO NACIONAL DO MEIO AMBIENTE, 2013. Resolução n. 459, de 07 de outubro de 2013. *Diário Oficial da União:* seção 1, Brasília, DF, p. 75, 7 out. 2013.

GUARIDO, P. C. P. *Degradação ambiental e presença de espécies de peixes não nativas em pequenos igarapés de terra firme de Manaus*. Dissertação (Mestrado) – Instituto Nacional de Pesquisas da Amazônia, Manaus, 2014.

IBGE – INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. *Censo Agropecuário 2017.* Rio de Janeiro: IBGE, 2017.

IBAMA – INSTITUTO BRASILEIRO DO MEIO AMBIENTE E DOS RECURSOS NATURAIS RENOVÁVEIS. *Portaria n. 145-N, de 29 de outubro de 1998*. Estabelece normas para a introdução, reintrodução e transferência de peixes, crustáceos, moluscos, e macrófitas aquáticas para fins de aqüicultura, excluindo-se as espécies animais ornamentais. Brasília, DF: IBAMA,1998.

IPEA – INSTITUTO PESQUISA ECONÔMICA APLICADA. *Objetivos de desenvolvimento sustentável.* Brasília, DF: IPEA, 2020. Available from: https://www.ipea.gov.br/ods/ods15.html. Access on: Sep. 28, 2020.

ISSG – INVASIVE SPECIES SPECIALIST GROUP. *Oreochromis niloticus*. *Global Invasive Species Database,* 27 mar. 2008. Available from: http://www.iucngisd.org/gisd/speciesname/Oreochromis+niloticus. Access on: Apr. 16, 2018.

LIMA JUNIOR, D. P. *et al*. Aquaculture expansion in Brazilian freshwaters against the Aichi Biodiversity Targets. *Ambio,* v. 47, n. 4, p. 427-440, 2018.

MARANHÃO. Secretaria de Estado de Meio Ambiente e Recursos Hídricos. *Lei estadual n. 5.405*, de 8 de abril de 1992. Institui o Código de Proteção de Meio Ambiente e dispõe sobre o Sistema Estadual de Meio Ambiente e o uso adequado dos recursos naturais do Estado do Maranhão. São Luís: SEMA, 1992.

MARANHÃO. Secretaria de Estado de Meio Ambiente e Recursos Naturais. Portaria SEMA n. 10, de 17 de janeiro de 2013. Institui o processo de simplificação ou dispensa do Licenciamento Ambiental de empreendimentos de piscicultura de pequeno porte para produtores familiares enquadrados no PRONAF e Programas afins. *Diário Oficial do Estado do Maranhão*, São Luís, 22 jan. 2013.

MARANHÃO. Governo do Estado do Maranhão. Lei n. 10.535, de 7 de dezembro de 2016. Dispõe sobre a gestão da fauna silvestre brasileira e exótica no âmbito do Estado e estabelece outras providências. *Diário Oficial do Estado do Maranhão*, São Luís, 7 dez. 2016.

MATO GROSSO. Decreto n. 1.119, de 15 de setembro de 2017. Altera e

acrescenta dispositivo ao Decreto n. 8.149, de 27 de setembro de 2006, e dá outras providências. *Diário Oficial do Estado do Mato Grosso,* Cuiabá, 15 set. 2017.

MATO GROSSO. Lei n. 10.669, de 16 de janeiro de 2018. Altera e revoga dispositivos da Lei n. 8.464, de 04 de abril de 2006, altera dispositivo da Lei n. 9.408, de 01 de julho de 2010, e dá outras providências. *Diário Oficial do Estado do Mato Grosso,* Cuiabá, 16 jan. 2018.

MATO GROSSO. Decreto n. 337, de 23 de dezembro de 2019. Disciplina o procedimento de licenciamento ambiental para cultivo de espécies aquícolas alóctones, híbridas e exóticas no âmbito do Estado de Mato Grosso e dá outras providências. *Diário Oficial do Estado do Mato Grosso,* Cuiabá, n. 27658, 26 dez. 2019.

MATO GROSSO. Lei n. 11.129, de 13 de maio de 2020. Altera e revoga dispositivos da Lei n. 8.464, de 04 de abril de 2006 e altera dispositivo da Lei n. 9.408, de 01 de julho de 2010, e dá outras providências. *Diário Oficial do Estado do Mato Grosso,* Cuiabá, 14 maio 2020.

NOBILE, A. B. *et al*. Status and recommendations for sustainable freshwater aquaculture in Brazil. *Reviews in Aquaculture,* v. 12, n. 3, p. 1495-1517, ago. 2020.

OCCHI, T. V. T. *et al*. Nile Tilapia impacts reference list LEC-UFPR. *Figshare Dataset*, 2021. Available from: https://figshare.com/articles/dataset/Nile_Tilapia_impacts_reference_list_/14551275/9. Access on: Jul. 30, 2021.

ONU – ORGANIZAÇÃO DAS NAÇÕES UNIDAS NO BRASIL. *Objetivos de desenvolvimento sustentável 15:* vida terrestre. Available from: https://brasil.un.org/pt-br/sdgs/15. Access on: Oct. 13, 2020.

PARÁ. Lei n. 5.977, de 10 de julho de 1996. Dispõe sobre a proteção à fauna silvestre no Estado do Pará. *Diário Oficial do Estado do Pará,* Belém, 12 jul. 1996.

PARÁ. Assembleia Legislativa do Estado do Pará. Lei n. 6.713, de 25 de janeiro de 2005. Dispõe sobre a política pesqueira e aquícola no estado do Pará, regulando as atividades de fomento, desenvolvimento e gestão ambiental dos recursos pesqueiros e da aquicultura e dá outras providências. *Diário Oficial do Estado do Pará,* Belém, 2005.

PARÁ. Secretaria de Estado de Meio Ambiente. Instrução Normativa n. 004/2013. Dispõe sobre o licenciamento ambiental de empreendimentos e atividades aquícolas no Estado do Pará e dá outras providências. *Diário Oficial do Estado do Pará*, Belém, 10 maio 2013.

PARÁ. Secretaria de Estado de Meio Ambiente. Conselho Estadual De Meio Ambiente. Resolução COEMA n. 143, de 20 de dezembro de 2018. Dispõe sobre diretrizes para o cultivo de espécies exóticas em empreendimentos aquícolas do Estado do Pará e dá outras providências. *Diário Oficial do Estado do Pará*, Belém, 18 mar. 2018.

RONDÔNIA. Lei n. 3.437, de 9 de setembro de 2014. Dispõe sobre a aquicultura no estado de Rondônia e dá outras providências. *Diário Oficial do Estado de Rondônia,* Porto Velho, 9 set. 2014.

RORAIMA. Lei Complementar n. 07, de 26 de agosto de 1994. Institui o Código de Proteção ao Meio Ambiente para a Administração da Qualidade Ambiental, Proteção, Controle e Desenvolvimento do Meio Ambiente e uso adequado dos Recursos Naturais do Estado de Roraima. *Diário Oficial do Estado de Roraima,* Boa Vista, 29 ago. 1994.

RORAIMA. Assembleia Legislativa do Estado de Roraima. Lei n. 516, de 10 de janeiro de 2006. Dispõe sobre a pesca no Estado de Roraima, estabelecendo medidas de proteção à ictiofauna, e dá outras providências. *Diário Oficial do Estado de Roraima,* Boa Vista, 11 jan. 2006.

RORAIMA. Conselho Estadual de Meio Ambiente, Ciência e Tecnologia de Roraima. Resolução CEMACT n. 1, de 02/04/2018. Dispõe sobre o Licenciamento Ambiental Simplificado e dá outras providências. *Diário Oficial do Estado de Roraima*, Boa Vista, 10 abr. 2018.

SOARES, L. M. A. *et al*. A criação de tilápias (*Oreochromis niloticu*s) como fonte de invasoras nas bacias hidrográficas de Rondônia. *In:* III SEMINÁRIO DO PPG BIONORTE-RO: DA BIODIVERSIDADE À BIOTECNOLOGIA, AVANÇANDO AS FRONTEIRAS DO CONHECIMENTO, 3., 2019, São Luís. *Anais [...]*. São Luís: Bionorte, 2019.

SOARES, L. M. A. *et al*. Ciência cidadã como forma de identificação de ocorrência de espécies não nativas na Amazônia. *SAJEBTT*, Rio Branco, v. 7 n. 2, p. 145-159, 2020.

TOCANTINS. Assembleia Legislativa do Estado do Tocantins. Lei

Complementar n. 13, de 18 de julho de 1997. Dispõe sobre regulamentação das atividades de pesca, aquicultura, piscicultura, da proteção da fauna aquática e dá outras providências. *Diário Oficial do Estado do Tocantins*, Palmas, 18 jul. 1997.

TOCANTINS. Conselho Estadual do Meio Ambiente o Estado do Tocantins. Resolução COEMA/TO n. 88, de 05/12/2018. Dispõe sobre o Licenciamento Ambiental da Aquicultura no Estado do Tocantins. *Diário Oficial do Estado do Tocantins*, Palmas, 7 dez. 2018.

VITULE, J. R. S. Introdução de peixes em ecossistemas continentais brasileiros: revisão, comentários e sugestões de ações contra o inimigo quase invisível. *Neotropical Biology and Conservation*, São Leopoldo, v. 4, n. 2, p. 111-122, 2009.

Article received on: 10/21/2020.
Article accepted on: 08/25/2021.

How to cite this article (ABNT):
SOARES, L. M. A. *et al*. Analysis of the effects of current legislation on alien species in the Brazilian Legal Amazon. *Veredas do Direito*, Belo Horizonte, v. 18, n. 41, p. 271-292, may/aug. 2021. Available from: http://www.domhelder.edu.br/revista/index.php/veredas/article/view/1990. Access on: Month. day, year.