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ECOSYSTEMS

Ghost nets: A poorly known threat to Brazilian freshwater biodiversity

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Abstract: Ghost nets constitute a serious threat to aquatic biodiversity, because they entangle animals as long as they persist in the environment. However, scientific literature in Brazil is virtually silent about this issue in inland ecosystems. Concerned with this gap, we conducted searches on YouTube [BR] to gather information about ghost nets in Brazilian freshwaters. Through our search, we compiled 33 independent videos showing ghost nets in different aquatic environments. In several cases, we identified entangled animals (i.e., fishes, reptiles, and birds). In this work we also provide recommendations to better understand and mitigate this problem in Brazilian freshwater ecosystems.

Key words: Birds, entanglement, fish, fishing, nylon, reptiles.

INTRODUCTION

The continuous degradation of aquatic ecosystems is a growing concern (e.g., Pelicice et al. 2017, Albert et al. 2021). Pollution, in particular, has attracted mounting attention (e.g., Stelfox et al. 2016, Azevedo-Santos et al. 2019, Giarrizzo et al. 2019, Urbanski et al. 2020) because it has reached multiple aquatic environments and has caused substantial impacts on biodiversity. One important problem is the incorrect disposal or loss of fishing nets (Matsuoka et al. 2005), which creates ghost nets that continuously entangle aquatic animals in the environment (Smolowitz 1978, Iriarte & Marmontel 2013). Entangled individuals may die in the nets (Blettler & Wantzen 2019) or suffer injuries, infections, increased predation and reduced growth.

In Brazilian freshwaters, the presence of ghost nets and their effects have been poorly studied (Link et al. 2019). For instance, only one study reported the entanglement and death of animals; two cetaceans in the Amazon basin (Iriarte & Marmontel 2013). In contrast, several scientific works have been published for Brazilian estuarine and marine ecosystems (e.g., Adelir-Alves et al. 2016, Santos et al. 2012, Chaves 2021). Concerned with this gap, here we report some cases of ghost nets in Brazilian freshwaters based on data retrieved from the internet.

MATERIALS AND METHODS

Using YouTube [BR] (https://www.youtube.com/), we performed searches to find videos reporting ghost nets in Brazilian freshwaters. The searches occurred on 02 July 2020 and 24 September 2020, using the following keywords: “rede de pesca perdida” (“lost fishing net”), “rede de pesca abandonada” (“abandoned fishing net”), “redes fantasmas + rios” (ghost nets + rivers), “rede de pesca abandonada + rios” (“abandoned fishing net + rivers”), and “rede de pesca abandonada + sub” (“abandoned fishing net + sub”). Following methods in Ferraz et al. (2019), we watched all videos to identify animals entangled and the locality. Animals that were not identified at

taxonomic levels below class were not included in Table I. Those identifications that reached up to species level were performed based on Kullander & Ferreira (2006) and Ota et al. (2018).

RESULTS

We found 33 videos showing the presence of ghost nets in different waterbodies, from streams to reservoirs (see Supplementary Material). The identified entangled animals included fishes, reptiles, and birds (Table I). In addition, most records of entanglement were in the upper Paraná River system, southeastern Brazil (Table I).

DISCUSSION

In general, we found records of entanglement of freshwater fishes, reptiles, and birds. However, other aquatic animals are vulnerable to ghost nets, such as mammals (Iriarte & Marmontel 2013), amphibians and large reptiles. Our results support the idea that ghost nets constitute a relevant threat in inland waters. In addition, they reveal the importance of YouTube as a source of data about poorly investigated issues (El Bizri et al. 2015, Ferraz et al. 2019) — including pollution. These data are applicable to policies aimed at environmental issues, fishing regulations and social behavior.

Almost all cases of ghost nets occurred in the Upper Paraná system, probably because this basin incorporates one of the most highly populated regions in the country (i.e., São Paulo

Table I. Animal taxa found in ghost nets in Brazilian freshwater ecosystems (based on results in Supplementary Material).

Group	Taxa	Number	Watershed
Fish	*Plagioscion squamosissimus* (Heckel 1840)	1	Upper Paraná River
Fish	Pseudocrenilabrinae	2	Upper Paraná River
Fish	*Cichla kelberi* Kullander & Ferreira 2006	1	Grande River (Upper Paraná River)
Fish	Serrasalminae	3	Tietê River (Upper Paraná River)
Fish	*Cichla* sp.	1	Tietê River (Upper Paraná River)
Fish	*Cichla* sp.	1	Uninformed
Fish	*Hoplias* sp.	1	Tietê River (Upper Paraná River)
Fish	*Plagioscion squamosissimus* (Heckel 1840)	2	Tietê River (Upper Paraná River)
Fish	Cichlidae	22	Uninformed
Fish	Anostomoidea	1	São Marcos River (Upper Paraná River)
Fish	Characiformes	3	Uninformed
Fish	*Cichla kelberi* Kullander & Ferreira 2006	1	Uninformed
Fish	Loricariidae	1	Uninformed
Fish	*Serrasalmus* sp.	1	Uninformed
Fish	*Pimelodus maculatus* Lacepède 1803	1	Upper Paraná River
Reptile	Chelidae	1	Upper Paraná River
Reptile	*Hydromedusa* sp.	1	Tietê River (Upper Paraná River)
Reptile	*Hydromedusa* sp.	1	Uninformed
Reptile	Boidae	1	Lake (Upper Paraná River)
Bird	Anseriformes	1	Tietê River (Upper Paraná River)

State), where fishing activities (legal and illegal) are common. But this is not a problem restricted to that system. For instance, Iriarte & Marmontel (2013) found *Sotalia fluviatilis* Gervais & Deville, 1853 in a ghost net in the Japurá River, Amazon basin. Therefore, is very likely that other basins in the country (e.g., Doce, São Francisco, Paraíba do Sul) have been similarly affected by ghost nets where fishing activities are common, and inspections are limited (Agostinho et al. 2007).

Different factors may lead to ghost nets in Brazilian freshwater ecosystems, including entanglement and dislocation by large animals such as Capybara (*Hydrochoerus hydrochaeris* Linnaeus 1766) and Caimans (e.g., *Caiman* spp.), lost material during fishing trips, intentional abandonment (common during illegal fishing), floods, spates (especially in rivers), incorrect disposal near water bodies, among others. Fishing with nylon nets is an old activity in the country, dating back to the first half of the 20th century (Link et al. 2019). Considering that fishing activities have long been carried out regularly in inland ecosystems (e.g., Iriarte & Marmontel 2013, Agostinho et al. 2007), ghost nets likely constitute a common and invisible problem in freshwaters.

In addition to ghost fishing (as we showed herein), nets release synthetic polymers into freshwater ecosystems. As the nets degrade, animals may ingest plastic fragments (e.g., Ramos et al. 2012, in estuarine environments). Therefore, Brazilian authorities should care more about ghost nets and respond appropriately.

We have four recommendations regarding this issue. 1) Authorities, citizens and fishers must engage in removing ghost nets from the environment, including the implementation of collaborative projects, funds, and efforts to publicize the problem. Different techniques may be used to locate and remove nets (e.g., Spirkovski et al. 2019). 2) Access to fishing nets should be restricted. Currently, no authorization is required to buy fishing nets in Brazil. Nets are freely sold in stores and in the online market. 3) Education programs must be developed to inform stakeholders and the public about this problem. A public service television announcement could reach many citizens, as would pamphlets distributed to angling groups and sporting goods stores. 4) Researchers must devote attention to this issue and receive adequate funding to investigate the extent of the problem, i.e. quantity, distribution and effects of ghost nets.

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SUPPLEMENTARY MATERIAL

Results found on YouTube [BR]:

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Author contributions

VMAS collected data on the social media and elaborated the draft. RMH provided suggestions and helped with writing. FMP provided suggestions and helped with writing.

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