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## Unregulated sales of fishing nets: Consequences and possible solutions in Brazil

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### Introduction

Nets are important gear for fishing that provides many people with both food and income; however, they have a variety of direct and indirect negative impacts on aquatic biodiversity (Gough et al. 2020; Piatt & Nettleship 1987, Read et al. 2006, Kelkar & Dey 2020; Ayaz et al. 2006, Blettler & Wantzen 2019; Vitorino et al. 2022). In Brazil the sale of nets is unregulated (Azevedo-Santos et al. 2022), with any buyer permitted to purchase any type of net, either from physical stores (Fig.1a) or through online suppliers. Only authorized fishermen and women are legally permitted to use fishing nets, but sales of these nets without control and the difficulty of enforcing restrictions on their use contribute to widespread illegal fishing in Brazil (Supplementary Appendix S1).



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38 **Fig. 1.** Events involving fishing nets in Brazil: (a) example of the free sale of fishing  
39 nets in a physical store; (b) example of fishes (orders Characiformes, Cichliformes, and  
40 Siluriformes) caught in a gill net; (c) a freshwater turtle captured in a gill net; and (d) a  
41 ghost net found with remains of fish in it.

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43 Despite studies showing the impacts of fishing nets on Brazilian biodiversity  
44 (e.g., Possatto et al. 2011, Santos et al. 2012, Iriarte & Marmontel 2013, Adedir-Alves et  
45 al. 2016, Azevedo-Santos et al. 2021, Gallardo et al. 2021), no empirical data on the  
46 free sales of nets are available and there have been no recommendations for regulating  
47 these sales. We examined advertisements for fishing nets and surveyed the mesh size  
48 and chemical composition of the gear offered for sale by two major online markets in  
49 Brazil: AliExpress and Mercado Livre. Here we discuss the ways that this unregulated  
50 commerce facilitates illegal fishing and impacts on biodiversity, and we provide  
51 suggestions for regulating the sale of fishing nets in Brazil.

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### 53 **Sales of fishing nets**

54 We searched the AliExpress (<https://best.aliexpress.com/>) and Mercado Livre  
55 (<https://www.mercadolivre.com.br/>) websites for the hypothetical purchase of fishing  
56 nets (Methods in Supplementary Appendix S2). We found a total of 72 advertisements  
57 for fishing nets (none requiring specific authorization to purchase); the nets comprised  
58 ‘cast nets’ (29.2%), ‘gill nets’ (52.8%), ‘trawl nets’ (8.3%), and ‘nets for fishing rods’  
59 (9.7%). The mesh sizes ranged from 2 cm to 24 cm (between opposite knots). Most nets  
60 found for sale were composed of nylon (59.7%) or unspecified plastic (1.4%). In 38.9%  
61 of the advertisements, the material from which the nets were made was either not  
62 provided or we were unable to find the information.

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### 64 **Consequences of free sales**

65 Our searches showed that people from any region of the country can get fishing  
66 nets (including those with small mesh) on both websites. In both physical (Fig.1a) and  
67 virtual commerce, the sellers are not required to ask for an attestation or authorization

68 certificate when fishing nets are purchased (Azevedo-Santos et al. 2022). In the specific  
69 case of AliExpress, the problem is exacerbated by the fact that the fishing gear is  
70 imported into the country and crosses the border without any environmental restrictions.

71 In Brazil, federal law restricts the use of fishing nets to professional fishers and  
72 to researchers; prior authorization is required in both cases (Brazil 2009). Restrictions  
73 on use include limits such as refraining from fishing during the spawning period. In  
74 general, professional fishers are required to be registered at a government-approved  
75 cooperative or similar entity. However, unregulated fishing is common in Brazil  
76 (Chagas et al. 2015), and nets are the principal type of equipment used. As these nets  
77 can be purchased without legal restrictions, inspection only applies to their use.  
78 Monitoring is hampered by the logistics of patrolling vast areas that are often  
79 inaccessible, especially in Amazonia. The recent examples (Supplementary Appendix  
80 S3) of the difficulty of inspecting illegal mining in or near Amazonian rivers illustrate  
81 this. The free access to fishing nets facilitates illegal fishing that is occurring (e.g.,  
82 Azevedo-Santos et al. 2022; see also Supplementary Appendix S1) — especially in  
83 Amazonia and in other parts of the country where inspection is difficult.

84 Fishing nets are efficient gear for catching fish (e.g., Ramos et al. 2021, Fig. 1b),  
85 but their use may also result in the accidental capture of other animals (Reeves et al.  
86 2013, Fig. 1c). Gillnets, when compared to other net types constitute a much larger  
87 problem for overfishing and bycatch due to the large areas they can cover and the long  
88 time they often remain in the ecosystem when compared to other net types (e.g., cast  
89 nets). Various studies have documented the accidental capture of animals in gillnets  
90 (e.g., Table 1). The free access to these nets, and consequent illegal use, contributes to  
91 overfishing and bycatch, both of which impact biodiversity.  
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**Tab. 1.** Examples of negative impacts on aquatic animals caused by different types of fishing nets.

Negative impact	Type of net	Animal group impacted	Reference
Overfishing	Gill nets	Crustaceans, fishes	Miranda et al. (2000); Mendonça & Bonfante (2011); Gallardo et al. (2021)
	Trawl nets	Crustaceans, fishes	Gallardo et al. (2021)
	Cast net	Crustaceans, fishes	Gallardo et al. (2021)
Bycatch	Gill nets	Crustaceans, fishes, birds, reptiles, mammals	Zerbini & Kotas (1998); Dagys & Žydelis (2002); Wallace et al. (2010); Gallardo et al. (2021)
	Trawl nets	Crustaceans, fishes, birds, reptiles	Silva et al. (2010); Wallace et al. (2010); Løkkeborg (2011); Gallardo et al. (2021)
	Cast net	Crustaceans, fishes	Gallardo et al. (2021)
Debris ingestion	Gill nets	Fishes, mammals	Jacobsen et al. (2010); Possatto et al. (2011)
	Trawl nets	ammals	Jacobsen et al. (2010)
	Not specified	Crustaceans, fishes, reptiles	Tomás et al. (2002); Murray & Cowie (2011); Jantz et al. (2013)
Ghost nets	Gill nets	Crustaceans, fishes, reptiles, mammals	Spirkovski et al. (2019); Azevedo-Santos et al. (2021); Azevedo-Santos et al. (2022)

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Pollution is also facilitated by unregulated sales of nets. Most nets are made of nylon (as shown by our survey), a material that is difficult to degrade (Link et al. 2019). After being abandoned, lost or otherwise discarded, the nets become a source of pollution in the ecosystems concerned (Azevedo-Santos et al. 2022). Ingestion of polyamide is a concern for both marine and freshwater fish (e.g., Zhu et al. 2019, Maaghlood et al. 2021), including those in Brazil (Pegado et al. 2018, Andrade et al. 2019, Neto et al. 2020). Fishing nets may be a prominent source of the polyamide and other compounds ingested by fish and other aquatic animals, including reptiles and large mammals (Table 1).

Free sale and illegal use also increase the number of nets left in the ecosystem, whether intentionally or not (Azevedo-Santos et al. 2022), resulting in ‘ghost nets’ (Barbosa-Filho et al. 2020; Vitorino et al. 2022; see also Fig. 1d), which chronically impact aquatic fauna ranging from invertebrates to fishes to large mammals (Table 1), including in Brazil (Barbosa-Filho et al. 2020, Azevedo-Santos et al. 2021, 2022).

### **The need for a law to regulate net sales**

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Although Brazil still has no federal regulation of fishing-net sales, in 2015 a bill (PL 206/2015) was presented to the federal legislature’s Chamber of Deputies, that would prohibit ‘the manufacture, sale and use, throughout the National Territory, of

116 fishing nets, with mesh smaller than 5 cm (...)’ (Brazil 2015). However, the bill was  
117 considered ‘too drastic’, and in 2019 it was shelved in the Chamber of Deputies.

118 A new bill is needed that could be approved and implemented without creating  
119 conflicts with authorized fishers and other groups. A clear example showing that this is  
120 possible is the Tocantins State Law 3249 of 24 July 2017, restricting the sale of nets to  
121 licensed fishers in that state (Diário Oficial de Tocantins 2017). Although this  
122 represents an advance in the state of Tocantins, its effect is undermined by the ease of  
123 purchasing nets in other states and via online sales. A law is needed at the federal level  
124 patterned on the law in Tocantins, however, we emphasize that the control of nets at the  
125 point-of-sale cannot replace the inspection and monitoring of their use.

126 Drafting a federal bill requires the participation of the fisheries sector in addition  
127 to researchers (Azevedo-Santos et al. 2017). This collaboration is needed to balance  
128 provisioning and regulating ecosystem services and to avoid interpretations that can  
129 harm professional fishermen and other sectors authorized to use fishing nets.

130

### 131 **Conclusions**

132 Sales of fishing nets in Brazil require no form of environmental authorization,  
133 yet the unregulated sale of these facilitates illegal fishing — which may contribute to  
134 overfishing, bycatch, pollution and ghost netting. The current scenario requires federal  
135 legislation (similar to an existing law in Tocantins State) regulating the sale of fishing  
136 nets throughout Brazil. However, this does not replace the need for strong inspection of  
137 fishing activities (legal or illegal) in the country’s waterbodies.

138

139 **Supplementary material.** Submitted separately.

140

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149

150 **Conflict of interest.** None.

151

152 **Ethical standards.** None.

153

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# Supplementary Appendix

## The environmental cost of fishing nets: A proposal for regulation at the point-of-sale in Brazil

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## **Supplementary Appendix S1**

News

<https://g1.globo.com/sp/bauru-marilia/noticia/2021/10/28/seis-pessoas-sao-detidas-por-pesca-ilegal-no-rio-tiete-em-barra-bonita.ghtml>

<https://agenciasertao.com/2022/01/19/ibama-ja-apreendeu-mais-de-33-mil-metros-de-redes-de-pesca-no-trecho-baiano-do-rio-sao-francisco-durante-piracema/amp/>

<https://g1.globo.com/mt/mato-grosso/noticia/2022/01/18/98-kg-de-pescado-irregular-e-materiais-de-pesca-predatoria-sao-apreendidos-em-caceres-mt.ghtml>

<https://pm.es.gov.br/Not%C3%ADcia/batalhao-ambiental-apreende-redes-de-pesca-durante-fiscalizacao-embarcada-em-regencia>

<https://www.aen.pr.gov.br/Noticia/Batalhao-Ambiental-aplicou-R-602-milhoes-em-multas-e-atendeu-14-mil-ocorrencias-em-2021>

<https://g1.globo.com/sp/vale-do-paraiba-regiao/noticia/2022/01/03/homem-e-multado-em-r-1-mil-por-pesca-ilegal-na-represa-do-funil-em-sao-jose-do-barreiro.ghtml>

<https://midiamax.uol.com.br/cotidiano/2022/pma-de-tres-lagoas-apreende-350-metros-de-redes-de-pesca-e-solta-7-kg-de-peixes-em-fiscalizacao-no-rio-sucuriu>

## **Supplementary Appendix S2**

Methods

We searched the AliExpress (<https://best.aliexpress.com/>) and Mercado Livre (<https://www.mercadolivre.com.br/>) sites for the hypothetical purchase of fishing nets. Access occurred between 25 September and 23 December 2021. For each website we evaluated the information on the mesh size, and the chemical composition of the material. To avoid repetition, on each page on the website we only considered the first two advertisements.

## **Supplementary Appendix S3**

News

<https://theintercept.com/2021/12/04/garimpo-ilegal-sai-cinza-para-amazonia/>

<https://www.brasildefato.com.br/2021/12/02/como-o-garimpo-ilegal-dominou-o-rio-madeira-e-por-que-e-tao-dificil-acabar-com-ele>

<https://g1.globo.com/mt/mato-grosso/noticia/2021/12/13/pf-fez-nove-operacoes-neste-ano-para-combater-garimpos-ilegais-em-terras-indigenas-de-mt.ghtml>

## **Supplementary Appendix S4**

News

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