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Productivity and fisheries monitoring in the Brazilian Amazon: insights from the Tocantins-Araguaia (State of Tocantins and Pará), Branco, and Jauaperi (State of Roraima) river basins

Adriano Prysthon[1], Sandro Loris Aquino Pereira[2] & Onivaldo da Rocha Mendes Filho[3]

[1]Embrapa Alimentos e Territórios, Maceió-AL, Brasil

[2] Embrapa Roraima, Boa Vista-RR, Brasil.

[3]Secretaria de Pesca e Aquicultura do Tocantins, Palmas-TO, Brasil.

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Abstract

Despite its significant socio-economic, cultural, and food security relevance, continental artisanal fishing in Brazil continues to face persistent, long-standing challenges, chief among them, the chronic lack of reliable data. This study aims to assess and compare fishing productivity in two Amazonian regions: the Tocantins-Araguaia basins (State of Tocantins and Pará) and the Branco and Jauaperi basins (State of Roraima). Through a participatory monitoring approach, more than 8,000 fishing landings were recorded between 2019 and 2021. Productivity was analyzed using Anova with Scott-Knott grouping (5% significance level) across variables including year, month, community, fishing gear, gender, expedition duration, and number of fishers. Results indicate that four-day expeditions involving two fishers yield the highest productivity. Although no evidence of overfishing was found, the study highlights the urgent need for an institutional agreement to establish permanent fish landing monitoring programs at local, regional, and national levels. Such initiatives are crucial to ensure the sustainability of artisanal fisheries and to protect the food security and livelihoods of Amazonian riverside communities.

Keywords: small-scale fisheries, participation, production, statistics.

Resumo - A produtividade e o monitoramento pesqueiro na Amazônia brasileira. A experiência nas bacias Tocantins-Araguaia (estados do Pará e Tocantins), Branco e Jauaperi (estado de Roraima)

Apesar da grande importância socioeconômica, cultural e segurança alimentar da pesca artesanal continental no Brasil, a atividade ainda padece de fragilidades crônicas históricas, sendo a falta de informação o principal desafio. Objetivou-se identificar e comparar a produtividade pesqueira em duas regiões amazônicas nas bacias Tocantins-Araguaia (Estados do Tocantins e Pará), Branco e Jauaperi- (Estado de Roraima). A metodologia envolveu o monitoramento participativo de mais de 8 mil desembarques entre 2019 e 2021. Foram comparadas as produtividades (*Anova- Scott knot 5%*) entre os anos, meses, comunidades, artes de pesca, gênero, duração das expedições e o número de pescadores. Os resultados indicaram que as expedições de quatro dias com dois pescadores são as mais produtivas. As conclusões destacam que não há indícios de sobrepesca. No entanto, há uma necessidade urgente de um pacto institucional para estabelecer programas de monitoramento de desembarques, como uma política pública permanente nas diferentes esferas (local, regional, nacional), sendo fundamental para garantir a sustentabilidade da atividade e a segurança alimentar das comunidades ribeirinhas, que dependem da pesca para sua socioeconomia e subsistência.

Palavras-chave: pesca artesanal, participação, produção, estatística.

Resumen - Monitoreo de la productividad y la pesca en la Amazonía brasileña. La experiencia en las cuencas Tocantins-Araguaia (estados de Pará y Tocantins), Branco y Jauaperi (estado de Roraima)

A pesar de su importante relevancia socioeconómica, cultural y de seguridad alimentaria, la pesca artesanal continental en Brasil sigue enfrentándose a desafíos persistentes y de larga data, el principal de ellos, la falta crónica de datos confiables. Este estudio tuvo como objetivo evaluar y comparar la productividad pesquera en

*Autor Correspondente: A. Prysthon, e-mail: adriano.prysthon@embrapa.br

dos regiones amazónicas: las cuencas de Tocantins-Araguaia (Estado de Tocantins y Pará), Branco y Jauaperi (Estado de Roraima). A través de un enfoque de monitoreo participativo, se registraron más de 8.000 desembarques pesqueros entre 2019 y 2021. La productividad se analizó mediante Anova con agrupamiento de Scott-Knott (nivel de significancia del 5%) en variables como año, mes, comunidad, arte de pesca, género, duración de la expedición y número de pescadores. Los resultados indican que las expediciones de cuatro días que involucran a dos pescadores producen la mayor productividad. Aunque no se encontró evidencia de sobrepesca, el estudio destaca la urgente necesidad de un acuerdo institucional para establecer programas permanentes de monitoreo de desembarques pesqueros a nivel local, regional y nacional. Estas iniciativas son cruciales para garantizar la sostenibilidad de la pesca artesanal y proteger la seguridad alimentaria y los medios de vida de las comunidades ribereñas de la Amazonía.

Palabras clave: pesca artesanal, participación, producción, estadística.

Introduction

Small-scale fisheries (SSF) play a vital role globally, particularly in developing countries, by supporting local economies, reducing poverty, ensuring food security, and promoting the sustainable management of fishery resources (FAO, 2022; Mancha-Cisneros et al., 2019; Béné et al., 2015). SSF are responsible for approximately 40% of global fish catches (World Bank 2010), and inland (continental) fisheries are predominantly composed of small-scale operations-accounting for 90% of the sector and involving around 61 million people, half of whom are women (Bartley et al., 2015). Beyond their economic and nutritional importance, SSF also help preserve cultural heritage and ancestral practices (Chuenpagdee and Jentoft 2019; Lynch et al., 2016). Most of their production is consumed, sold, or exchanged within local communities, reinforcing their central role in sustaining regional livelihoods (Funge-Smith, 2018).

Small-scale fisheries (SSF) are the primary source of animal protein in the Amazon region, generating approximately USD 800 million in annual revenue (Funge-Smith & Bennett 2019). The region also has the highest per capita fish consumption in the world (Isaac et al. 2015; Begossi et al. 2019). Despite their critical importance, SSF continue to face persistent, long-standing weaknesses, with the lack of reliable and up-to-date data being the most pressing challenge. When countries fail to report fisheries statistics to the Food and Agriculture Organization (FAO), production estimates must rely on outdated reports or unofficial sources (Bartley et al., 2015). Brazil ranks as the 25th largest fisheries producer globally, with an output of 758,000 tons (FAO, 2025), and 13th in inland fisheries with 226,000 tons (FAO, 2024). However, the country's last official national fisheries statistical bulletin was published in 2011, reporting a production of 1.43 million tons (Brasil, 2011a), underscoring a significant gap in data transparency and continuity.

Unfortunately, no updated data on national fishery production has been generated since then. As a result, attempts to compile fishery statistics in Brazil have relied on outdated averages, often more than a decade old or on repeated use of historical production figures (FAO, 2024). While Brazilian agriculture has consolidated its data and demonstrated growing socio-economic relevance, the fishing sector experienced a sharp decline in official reporting between 2009 and 2011. By 2012, the country lacked any official production data, and all national fisheries statistics programs had been dismantled. This situation remains unchanged, leaving the sector unable to demonstrate its economic importance through concrete indicators such as production volume, revenue, or employment figures (Canton et al., 2024). The lack of reliable fisheries information severely hinders the sector's development (World Bank, 2010), leading to inaccurate speculation about production levels and making effective decision-making increasingly difficult (Bartley et al., 2015).

In inland SSF, reliable estimation is even more challenging due to the absence of official monitoring programs and unified platforms that compile data across river basins. This contrasts with certain states such as São Paulo (IP-APTA-SP, 2024), Rio de Janeiro (FIPERJ, 2024), and Santa Catarina (Univali, 2024), which maintain robust and, crucially, publicly accessible fisheries statistics systems. However, data extrapolation methods are not suitable for inland fisheries, given the ecological complexity of these environments characterized by pronounced seasonal and interannual variability, or by a lack of reliable predictive indicators (FAO, 2023). Despite their socio-ecological importance and the remarkable diversity of freshwater fish species, inland fisheries remain largely overlooked in comparison to marine fisheries (Nagl et al., 2021).

It is estimated that, even in the absence of systematic monitoring and statistical reporting, the Brazilian Amazon produces around 600,000 tons of fish annually (Batista et al., 2012). The few monitoring programs that do exist are typically tied to environmental licensing requirements for hydroelectric plants (Doria et al., 2018; Mesquita et al., 2019), and their data is not publicly accessible.

Poor management, largely driven by a lack of reliable information, undermines the potential benefits that fisheries can offer to society, while disproportionately harming the most vulnerable riverine communities and exacerbating social inequality (Arthur et al., 2015). In this context, the absence of production data from inland SSF emerges as a key factor contributing to this situation. Collecting accurate and consistent monitoring data is therefore essential. At the same time, initiatives such as *Illuminating Hidden Harvests* (Bevitt et al., 2021) have played an important role in highlighting the benefits, interactions, and impacts of SSF in Brazil and globally. By informing policymakers at all levels, such efforts contribute to improved governance, increased productivity, and long-term sustainability (FAO, 2022).

This study aimed to generate data on the productivity of SSF through participatory monitoring of landings in riverside communities within the Tocantins-Araguaia and Lower Rio Branco/Jauaperi basins. The initiative seeks not only "Illuminating Hidden Harvests," but more importantly, to contribute to a virtuous cycle in which fishers develop a deeper understanding of their significance in food production, employment, and income generation thereby supporting the formulation of more effective and contextually appropriate public policies for the sector. Furthermore, this work aims to foster greater recognition of the SSF value chain among public administrators by promoting participatory fisheries monitoring as a policy instrument, incorporating traditional ecological knowledge, and addressing the persistent invisibility of a historically marginalized sector.

Methodology

Study Area

Two regions within the Legal Amazon were selected for this study: the middle portion of the Tocantins-Araguaia basin, located between the states of Pará and Tocantins, and the Lower Rio Branco/Jauaperi basin, situated in the state of Roraima. These areas were chosen due to Embrapa's ongoing engagement and research activities in these territories. In total, the study encompassed seventeen municipalities across the three states-five in Tocantins (Araguacema/arac, Araguatins/arat, Couto Magalhães/cma, Esperantina/esp, and Xambioá/xam), seven in Pará (Itupiranga/itu, Jacundá/jac, Marabá/mab, Nova Ipixuna/nip, Novo Repartimento/nre, São Geraldo do Araguaia/sga, and São João do Araguaia/sja), and five in Roraima (Caracaraí/car, Caroebe/cao, Rorainópolis/ror, São João da Baliza/sjb, and São Luiz/sao) (Figure 1). As the study involved the use of traditional knowledge provided by fishers, it was registered in the National System for the Management of Genetic Heritage and Associated Traditional Knowledge (SISGEN), under registration number A79139B.

Tocantins-Araguaia Basin

The Tocantins-Araguaia basin, the second largest in Brazil with a drainage area of approximately 767 000 km², constitutes the principal tributary of the Amazon basin located entirely within Brazilian territory. Its aquatic biodiversity is of particular significance due to its position as a transitional zone between the Amazon rainforest and the Cerrado biome, offering a range of habitats that support high levels of ichthyofaunal productivity (Latrubesse et al., 2019; Ferreira et al., 2011; Tejerina & Mérona 2010). This diversity serves as a vital fishing resource for riverine communities, among whom SSF represent the primary economic activity (Zacarkim et al., 2015).

The fishing fleet operating in the region has relatively low catching power compared to that of the broader Amazon basin and is primarily composed of small vessels powered by outboard and/or long-tail motors. Despite the general homogeneity in vessel characteristics, the exact number of boats remains uncertain. This lack of reliable data poses significant challenges for the development of effective public policies and undermines the implementation of appropriate socio-ecological management strategies for the whole basin (Silva & Farias, 2017).

The primary fishing techniques employed include gillnets, handlines/longlines, cast nets, and harpoons, with gillnets being the most widely used. Their application varies according to mesh size regulations, allowing for different capture strategies (Prysthon et al., 2022; Cashion et al., 2018; Ramírez-Amaro & Galván-Magaña, 2019). Although the Tocantins-Araguaia basin has the smallest number of artisanal fishers among Brazil's major river basins (Ruffino, 2016), SSF in the region are highly significant in terms of employment generation, support for the circular economy, and contributions to food security in riverine communities (Santos, 2022; Guimarães, 2024; da Rocha et al., 2021).

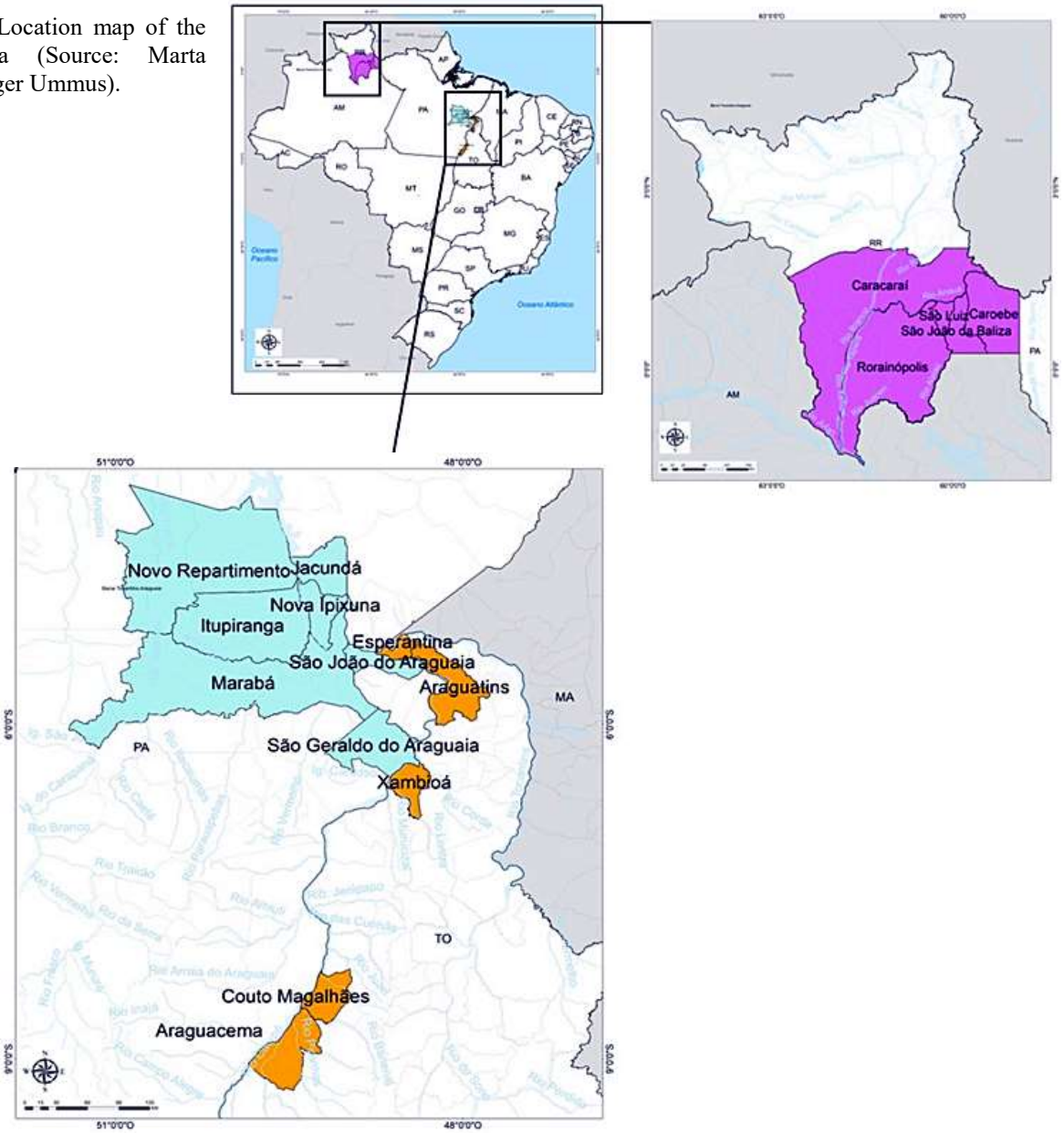

Figure 1. Location map of the study area (Source: Marta Eichemberger Ummus).

Branco and Jauaperi river basins

The Branco River basin, with a drainage area of approximately 187 540 km², is the largest river system in the state of Roraima and serves as the principal tributary of the Negro River (Campos, 2011). Around 12 000 km² of its headwaters originate in Guyanese territory (Carvalho & Morais, 2014), flowing across the Boa Vista sedimentary formation toward the lower Branco River before discharging into the Negro River (Naka et al., 2019). During the rainy season, the basin supports a diverse ichthyofauna, particularly within its floodplain habitats – a defining feature of the river's lower stretches (Ferreira et al., 2007; Cremon & Rosseti, 2011; Brasil, 2014; Schaefer et al., 2020). The Jauaperi River basin, encompassing a drainage area of 38 611 km², is located within the Guiana Shield, north of the Amazon Craton. It flows in a southeast-to-south direction, traversing four municipalities in the southern region of Roraima: São Luiz do Anauá, São João da Baliza, Caroebe, and Rorainópolis (Lemos et al., 2018).

The Jauaperi River is considered the second most important river in the state of Roraima. Its largest drainage area lies in the southeastern region, characterized by Quaternary sedimentary formations. The river spans low to mid-stretches within a zone of dense ombrophilous forests and served as a focal area for agrarian settlement projects during the 1970s and 1980s. These initiatives placed considerable pressure on aquatic ecosystems due to widespread deforestation and the removal of riparian vegetation to establish pasturelands and agricultural fields. Consequently, depending on the specific fishing locality, the river's diverse ichthyofauna becomes

accessible as a fishing resource for riverine communities. In these areas, SSF represent either the primary economic activity or coexist with subsistence farming and extractivist practices involving both plant and animal products (Barbosa, 2006).

The fishing fleet of the Lower Branco River primarily comprises small wooden boats ranging from six to eight meters in length. Some vessels are more structurally equipped known as mother boats and are essential for extended fishing expeditions (Castelo Branco et al., 2022). Most boats are powered by combustion engines and typically operated by two fishers. Due to the lack of onboard refrigeration systems, fish are stored on ice in support vessels. Catches are transported to Caracaraí or the village of Vista Alegre in the upper stretch, while in the lower stretch, they are sold in Caracaraí, Barcelos (AM), Manaus (AM), or Novo Airão (AM). Gillnets are the predominant fishing gear Lower Branco River, with variations in size and mesh tailored to the target species (Lopes & Souza, 2015; Castelo Branco et al., 2022). Other commonly used gears include longlines, handlines, harpoons, cast nets, short spears ("zagaias"), line tips, rods, and additional artisanal implements (Briglia-Ferreira et al., 2021).

Data Analysis

Landings were monitored in 2019, 2020, and 2021 as part of the project *Monitoring and Participatory Management of Artisanal Fisheries as a Tool for Sustainable Development in Amazon Region Communities (TO/PA/RR) - Propesca*. Data collection took place during the legally permitted fishing seasons: from March to October in the Tocantins-Araguaia basin (Brasil, 2011b; Brasil, 2011c), and from July to February in the Branco and Jauaperi river basins (Brasil, 2007). Additionally, some sampling was conducted during the closed season (March to June) to assess the occurrence of subsistence fishing activities.

In both basins, monitoring efforts were concentrated at the main landing sites located in municipal centers, as well as in more remote communities, such as those along the lower Branco River. Each landing event was documented by community agents using paper forms (Fishing Monitors) who were properly identified and trained by the technical team.

The unit of analysis was the fishing expedition (replica), defined as a complete round trip from and back to the port of origin. Random sampling was employed, whereby monitors recorded landings as they occurred, without targeting specific vessels or captains. Productivity was measured using Catch Per Unit Effort (CPUE), a widely recognized indicator for assessing fish stock status (Petrere et al., 2010; Quirijns et al., 2008). The sampling design followed a stratified random approach (Sparre & Venema, 1997), with strata based on production (kg) and categorized by year, month, municipality, fishing gear, gender, number of fishers, and number of fishing days.

The CPUE, in kg expedition^{-1}, was estimated as follows: $U1_{kpgndt} = \sum C_{kpgndt} / \sum F_{kpgndt}$, where: $U1_{kpgndt}$ is the CPUE1, in municipality *k*, gear *p*, gender *g*, number of fishermen *n*, fishing days *d*, at time *t* (month and year); C_{kpgndt} is the catch (in kg), in municipality *k*, gear *p*, gender *g*, number of fishermen *n*, fishing days *d*, at time *t* (month and year); F_{kpgndt} is the effort in municipality *k*, gear *p*, gender *g*, number of fishermen *n*, fishing days *d*, at time *t* (month and year).

To compare CPUE means, an analysis of variance (Anova) was conducted using a completely randomized design at a 5% significance level, followed by the Scott-Knott test to determine minimum significant differences. All statistical analyses were performed using the software *SisEAPRO - Sistema de Estatística Aplicada à Produção*, version 3.5 (SisEAPRO, 2024). For each CPUE variable, the number of replicates, mean, lower and upper confidence limits, and comparative statistics were evaluated. To minimize potential errors arising from field data collection, tabulation, or outliers, 5% of the metadata, specifically the lowest 2.5% and highest 2.5% of values were excluded from the analysis.

Results and Discussion

Number of Landings

A total of 8 143 fishing landings were recorded, with the highest proportion occurring in 2020 (55%), followed by 2019 (30%) and 2021 (15%). The reduced number of records in 2021 is attributed to the COVID-19 pandemic, which limited community mobility due to health-related restrictions and prevented the technical team from conducting fieldwork for most of 2020 and all of 2021. However, it is important to highlight that the lack of continuity in monitoring in 2021 may limit long-term inferences about productivity. In the Tocantins-Araguaia basin alone, 6 981 landings were monitored. The municipalities with the highest sampling frequencies were Esperantina (16.6%), Xambioá (14.2%), Couto Magalhães (14.0%), and Marabá (11.8%). In

contrast, Nova Ipixuna and Novo Repartimento accounted for the lowest proportions, with only 0.2% and 0.4% of total landings, respectively (Figure 2A).

In the Branco and Jauaperi River basins, a total of 1 025 fishing landings were recorded, with 47% occurring during the 2019/2020 season and 53% during the 2020/2021 season. Caracaraí including both the municipal center and communities along the Lower Branco River emerged as the primary fishing hub, accounting for 63.8% of all recorded landings, followed by the municipalities of Rorainópolis, São Luiz, São João da Baliza, and Caroebe (Figure 2B).

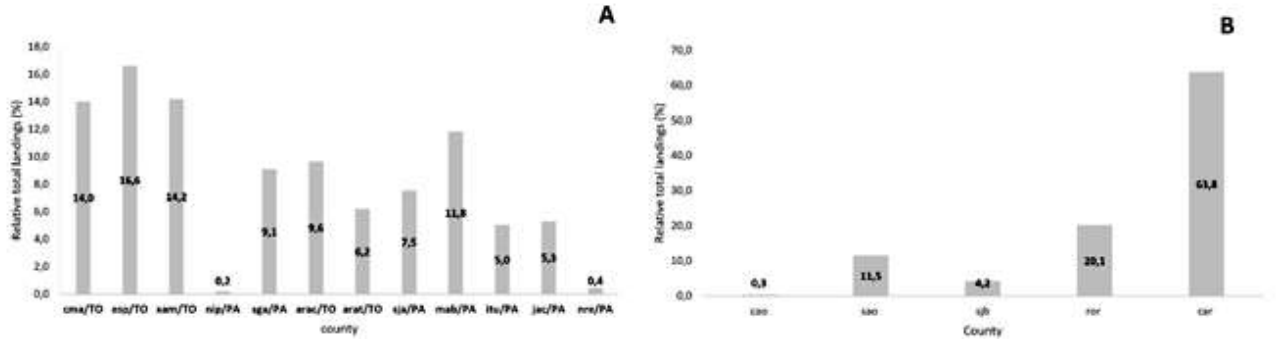

Figure 2. Relative total landings (%) by basin and municipality in the study area. *(A: Tocantins-Araguaia basin; B: Lower Branco/Jauaperi River basin).*

Productivity

The state of Pará recorded the highest productivity, with a CPUE of 92.3 kg expedition^{-1}, while the state of Tocantins registered 50.5 kg expedition^{-1} (Figure 3A). However, no significant differences ($p < 0.05$) in CPUE were observed between years (Figure 3B), months (Figure 3C), genders (Figure 3D), or fishing strategies (Figure 3E). Although the final three months of the series exhibited higher mean values, possibly indicating a harvest period the monthly averages were statistically similar, ranging from 58.5 kg to 75.2 kg expedition^{-1} (Figure 3C). The observed stability in fishing productivity across years and months suggests that current fishing effort remains compatible with stock availability. In other words, there is no evidence of overfishing in the SSF.

When comparing CPUE among municipalities in the Tocantins-Araguaia basin (Tocantins and Pará), three distinct productivity groups were identified (Figure 3E). Group 1 (G1, blue) included municipalities with productivity up to 50 kg expedition^{-1}, with no significant differences among them ($p < 0.05$). Group 2 (G2, green) encompassed municipalities with productivity between 50 kg and 110 kg expedition^{-1}, with the two highest, Marabá (mab/PA) and Itupiranga (itu/PA) being statistically similar. Group 3 (G3, red) comprised municipalities with productivity exceeding 150 kg expedition^{-1}. Notably, this group, along with Marabá and Itupiranga, is located near the Tucuruí Dam, an area characterized by increased fish abundance due to the presence of Tucuruí Lake. In the comparison of productivity across different fishing gears gillnets (gil), cast nets (cas), handlines (hoo), longlines (long), and others (oth) no statistically significant differences were found (Figure 3F).

Catch per unit effort (CPUE) values did not differ significantly for expeditions involving one, two, three, or five crew members (Figure 3G). However, higher productivity exceeding 100 kg per expedition was observed when crews consisted of four or six fishermen. These findings suggest that expeditions with only one or two crew members may be more economically efficient, given that CPUE remains statistically similar, operational costs are reduced, and the profits are shared among fewer individuals. It is worth mentioning that expeditions with one or two crew members represented 95% of all monitored fishing trips.

Regarding the number of days spent on board, the highest CPUE values were recorded during expeditions lasting six, seven, and nine days (Figure 3H). Most expeditions, however, occurred over one and four days, accounting for 48% of all trips. CPUE values for expeditions lasting three, four, five, six, nine, eleven, and twelve days were statistically similar, with the four-day expeditions yielding an average of 72.8 kg per expedition-more than twice the CPUE of one-day expeditions (33.6 kg expedition^{-1}). These results suggest that four-day expeditions represent the most productive duration within the observed effort patterns.

In Roraima, there was no significant difference ($p < 0.05$) in CPUEs between the years analyzed (Figure 4-A). However, meaningful variation was observed across fishing months, with March and September being the most productive, yielding 240.3 kg and 216.7 kg expedition^{-1}, respectively. Four distinct CPUE groups were identified based on seasonal productivity: Group 1 (orange) includes July, August, and December; Group 2 (red) comprises October, November, January, and February; Group 3 (green) includes March and September,

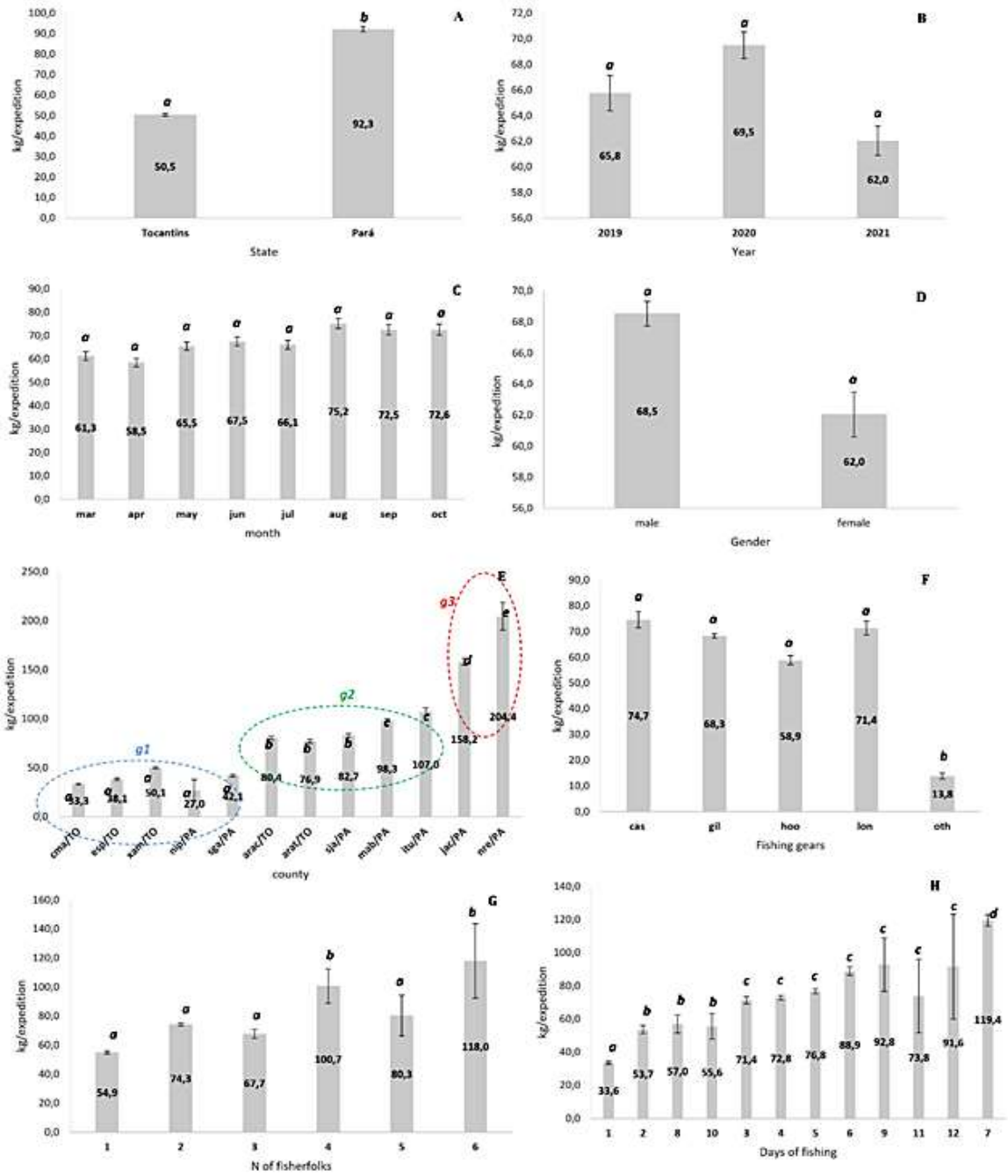

Figure 3. Comparison of CPUEs in the Tocantins-Araguaia Basin from 2019 to 2021. (A – State; B – Year; C – Month; D – Gender; E – Municipality; F – Fishing gear; G – Number of fishers; H – Fishing days). Treatments with different letters differ significantly (Anova – Scott-Knott test, 5%)

the most productive months; and Group 4 (blue) corresponds to the closed season months, during which productivity is naturally lower due to fishing being limited to subsistence purposes. March marks the beginning of the closed season (from March to June). However, fishers are permitted to complete and register their activities during the first 10 days of the month, which accounts for the high productivity observed during this period (Figure 4-B).

A significant difference in average CPUE was observed between men and women in Roraima, with values of 159.6 kg and 118.3 kg per dispatch, respectively (Figure 4-C), contrasting with the gender-based CPUE patterns observed in the Tocantins-Araguaia basin. CPUE also varied significantly among municipalities, with Caracaraí exhibiting the highest productivity, followed by Rorainópolis. In contrast, Caroebe had the lowest CPUE (Figure 4-D). The yields of São Luiz (89.1 kg expedition^{-1}) and São João da Baliza (84.4 kg/expedition) were statistically equivalent.

Regarding fishing gear, gillnets (gil) were the most productive, with CPUEs statistically equivalent to those in the "Other" (oth) category (Figure 4-E). The "Other" category includes various gear types used in specific

fisheries, most notably the *rede descaideira* a type of gillnet widely used in Roraima and culturally distinguished by fishers from the conventional *malhadeira* (Bastos et al., 2019). It also encompasses less commonly employed methods such as harpoons, short spears (zagaia), and bows and arrows. Longlines (lon) were the third most productive gear type, while cast nets (cas) and handlines (hoo) showed the lowest CPUE values.

Concerning the number of fishermen on board, productivity was highest during expeditions with four crew members, reaching an average of 267.1 kg expedition^{-1}. Catch per unit effort (CPUE) did not differ significantly among expeditions with two, three, or five fishermen (Figure 4-F), while the lowest CPUE was observed in expeditions with only one crew member. However, since the total catch is shared equally among the crew, expeditions with two fishermen proved more productive on a per-person basis. As for the number of fishing days, the highest CPUEs were recorded on trips lasting nine, six and eight days. The lowest CPUEs occurred on expeditions of just one or two days (Figure 4-G), suggesting that productivity is directly related to the duration of fishing activity.

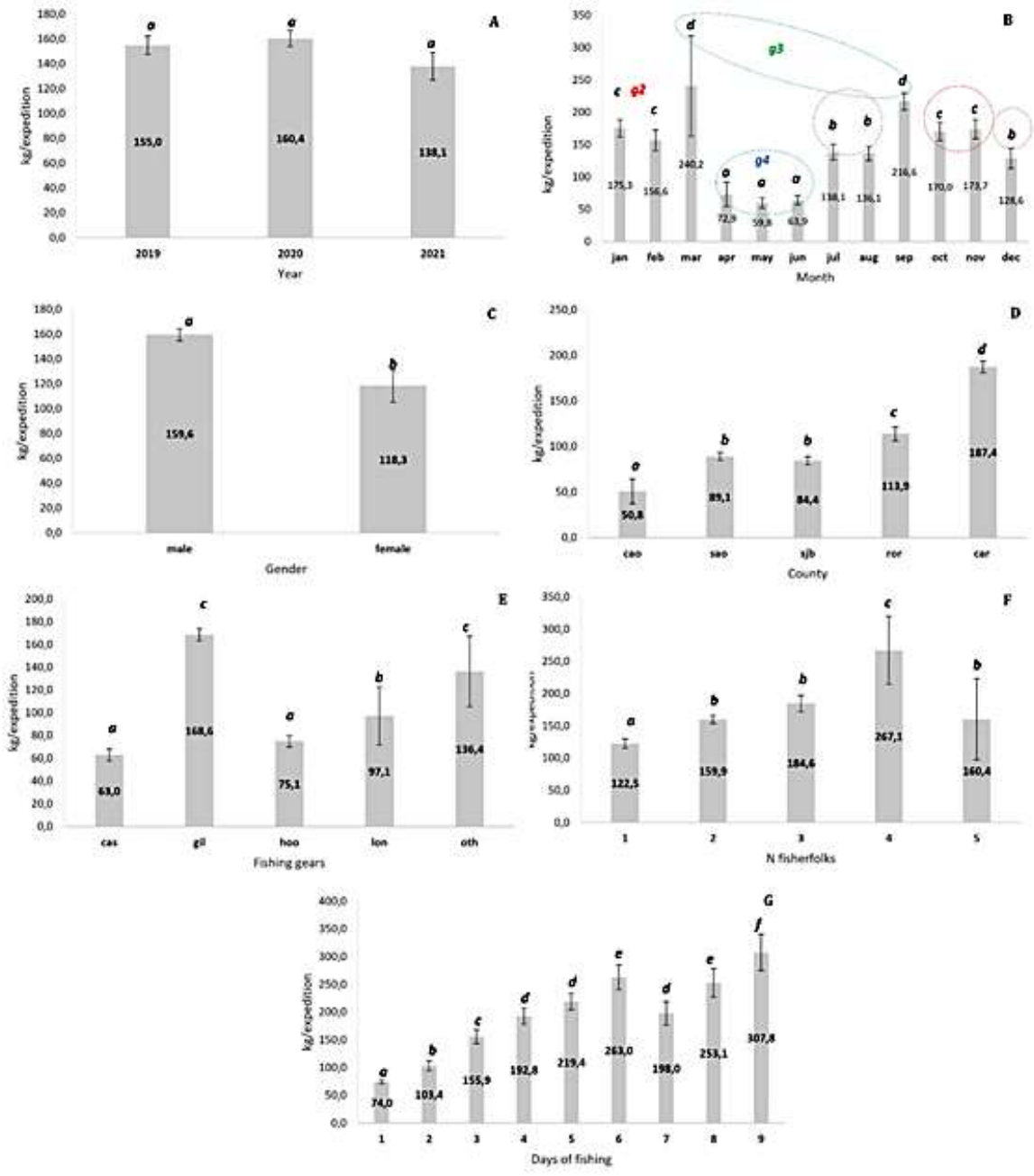

Figure 4. Comparison of CPUEs in the Lower Branco River and Jauaperi-Roraima basins from 2019 to 2021. (A - Year; B - Month; C - Gender; D - Municipality; E - Fishing gear; F - Number of fishers; G - Fishing days). Treatments with different letters differ significantly (Anova - Scott-Knott test, 5%).

Although there are similarities between SSF in Tocantins and Pará, communities in Pará tend to have higher CPUEs due to better access to more productive fishing areas, such as the Tucuruí Hydroelectric Reservoir (Cintra et al. 2007). While no significant differences are observed in the types of fishing gear used, gillnets are typically the most employed and preferred method, accounting for 77% of recorded landings. In addition to being widely used in inland freshwater environments (Baigun & Valbo-Jorgensen, 2023; Cashion et al. 2018), gillnets consistently yield higher CPUEs compared to other gear types in several rivers across the Amazon basin, including the Tapajós, Negro, and Madeira (Hallwass et al., 2023).

Regarding fishing expeditions, while crews of one or two fishers may yield higher individual returns, the complex dynamics of SSF leave little room for definitive conclusions. This complexity stems from their multi-species nature and their sensitivity to a wide range of environmental and social factors (Castilla & Defeo, 2005). Fishing performance is shaped by stock availability and distribution, effort levels, vessel technology, target species, fishers' traditional knowledge, and weather conditions (Dias & Prysthon, 2022). Furthermore, cultural characteristics unique to each region play a significant role, as catch data alone is insufficient for a comprehensive analysis. SSF is a multisectoral activity deeply intertwined with poverty reduction and food security efforts (Mancha-Cisneros et al., 2019).

Therefore, highlighting the productivity of SSF serves as a source of encouragement for riverside communities, as it contributes to the strengthening of social movements (Maarten et al., 2018) and the recognition of SSF as a sustainable and productive sector. Monitoring programs should become more adaptive to fostering greater social participation. In doing so, data collection can better integrate aspects of productivity, biology, and socio-ecology (Cunha & Sousa, 2024).

Although men's fishing yields were 10% higher than women's, productivity in Tocantins was statistically equivalent. This apparent difference in male productivity can be attributed to men's greater physical strength, allowing them to handle larger quantities of gear and fish, as well as their ability to access more remote fishing areas often carrying boats and ice boxes by hand through difficult terrain. While women participate in all aspects of fishing, they still face inequalities, particularly due to a clear division of labor between those who live with partners and those who are single (Araújo & Parente, 2016). In Roraima, women's roles are more diverse and tend to focus on complementary activities, such as food preparation and caregiving, as well as participation in social, economic, and cultural spheres (Cavalcante et al., 2020).

According to the Ministry of Fisheries and Aquaculture (Brazil, 2024), women comprise 42.7% of the SSF workforce in Tocantins, 48.5% in Pará, and 46.2% in Roraima. Gender-focused research in SSF is essential for understanding how women and men engage with and are affected by the sector, particularly in the face of recent changes and associated risks (Maneschy et al., 2012).

Despite stable productivity in terms of CPUE, the Tocantins-Araguaia basin has historically faced numerous setbacks resulting from unsustainable economic development, particularly due to the rapid expansion of human activities over the past decade (Pelicice et al., 2021). Contributing factors include the construction of hydroelectric power plants and the obstruction of tributaries, which disrupt the river's natural flow and impact its ecosystems (Akama, 2017); the rapid and unregulated growth of agribusiness (Scaramuzza et al., 2017); the expansion of cattle ranching, which has led to the loss of vast areas of tropical forest (Nepstad et al., 2014); and the widespread, uncontrolled use of pesticides (Martinelli et al., 2010).

Fisheries monitoring efforts in the Brazilian Amazon are valuable but remain largely isolated and poorly integrated into public policy, particularly regarding fisheries statistics (Alcântara et al., 2015). Many of these initiatives stem from academic research projects that often lack meaningful engagement with fishing communities and demonstrate limited coordination with public authorities. As a result, they fail to address the sector's real socio-economic needs. This disconnection contributes to the limited understanding of both fisheries and the ecosystems they rely on (World Bank, 2010).

The number of landings is significant in both basins, particularly given the absence of systematic data collection in these regions until now. Efforts in the Amazon biome underscore the urgent need for a robust monitoring system, emphasizing the role of institutional support and political will both essential for informed decision-making and effective fisheries management (Nolan, 2021). Building on the experience of *Propesca*, the government of Tocantins took a major step by issuing a Normative Instruction in 2024 that establishes permanent monitoring of fishing landings as part of its public policy (Tocantins, 2024).

The data derived from 6 981 recorded landings in the Tocantins-Araguaia basin challenge prevailing narratives regarding declining productivity due to fishing pressure and the current state of stock exploitation in the region. The historical lack of systematic data collection in the fisheries sector has contributed to conflicting perspectives, particularly in media discourse. On one hand, a decline in fish stocks is attributed to multiple uses and increasing threats to freshwater ecosystems. On the other, it is argued that the sector is in

fact expanding, with much of its production going unreported (Bartley et al., 2015). In Roraima, the monitoring of 1 025 landings marks the first structured effort to document key data on fishing productivity and stock exploitation. This information is essential for informing sustainable management practices and guiding the responsible use of aquatic resources in the basin (Briglia-Ferreira et al., 2021).

The Caracaraí fishing center is located within the Branco River basin, specifically in the stretch that exhibits the most prominent Amazonian features, including the presence of streams and lakes. This region is defined by a floodplain system, shaped by unique physical attributes and regulated by the Amazon basin's distinctive hydrological dynamic known as the flood pulse. These periodically inundated areas create environments rich in food resources and ecological niches, thereby supporting a more concentrated, intense, and productive commercial fishing activity (Brasil, 2014; Campos, 2011; Ferreira et al., 2007).

The fluctuation in the number of fishermen in Roraima is influenced by the seasonal dynamics of fishing resources. Fish schools migrate in accordance with the flood pulse and the availability of food and shelter, prompting a reorganization in the composition of fishing expeditions. This reorganization is shaped by the distances traveled, the various roles and specializations among fishermen, and the increased safety afforded by traveling in larger, familiar groups (Castelo Branco et al., 2022; Garcia et al., 2007). According to local fishers, expeditions lasting up to three days typically involve two participants; those lasting four to five days involve up to three; and expeditions of six or more days usually require at least four fishermen. The duration of these expeditions varies with the hydrological cycle and reflects the fishers' adaptation to the spatial and temporal distribution of aquatic resources (Castelo Branco et al., 2022). SSF in the region display a temporal dynamic that drives the use of different fishing gears. This variation is shaped by the life cycle characteristics of target species, the hydrological and climatic conditions of the system, as well as cultural preferences and the economic demands of the consumer market (Bentes et al., 2018).

Conclusions

The basins examined in this study hold significant national relevance and are major tributaries of the Amazon biome, particularly with respect to aquatic biodiversity and food production derived from artisanal fisheries. This production chain plays a critical role in sustaining local socioeconomic systems and ensuring food security. The results and methodologies presented herein can be replicated in other Amazonian regions, provided they are appropriately adapted to the distinct local and cultural contexts.

The collaborative effort of participatory monitoring across the three states, implemented on a pilot basis using a unified and participatory methodology, represents an unprecedented initiative in the region. It underscores the critical role of the SSF production chain in generating employment, income, and food security for thousands of families. This initiative highlights the pressing need for an institutional pact aimed at fostering fisheries development grounded in participatory approaches. In this context, it is pertinent to present a series of reflections to inform and support future fisheries management strategies.

The landings sampling methodology proved effective in capturing the distinct productive characteristics of the two basins under study. In the Tocantins-Araguaia basin, four-day expeditions with crews of one or two fishermen consistently yielded higher productivity, regardless of year, month, gender, or fishing gear used. In contrast, the most productive expeditions in the Branco/Jauaperi River basin were those lasting six days, involving two male fishermen, conducted in September (regardless of the year), using gillnets in the municipality of Caracaraí. The observed stability in catch per unit effort (CPUE) suggests that current fishing efforts remain compatible with available fish stocks. In other words, there is no evidence of overfishing within the context of SSF.

The analysis of over 8 000 fishing landings has significantly enhanced the visibility of the SSF production chain. Ensuring the continuity of this monitoring effort is essential and requires a formal agreement among public authorities, research institutions, the production sector, and organized civil society. The goal is to institutionalize landings monitoring as a permanent component of state public policy. In this context, the *Propesca* methodology played a key role in supporting and motivating the state of Tocantins to establish IN 07/2024, under the “Trilha da Pesca” program. This initiative aims to systematically monitor fishing landings across the state, replicating the *Propesca* methodology and generating a continuous, high-quality, state-managed database.

In Roraima, Propesca has fostered greater awareness among fishing organizations regarding the value of the data generated, prompting increased demands for stronger public sector engagement and more effective public policies for SSF. Additionally, several municipalities have expressed interest in establishing local fisheries monitoring programs.

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References

Akama, A. (2017). Impacts of the hydroelectric power generation over the fish fauna of the Tocantins river, Brazil: Marabá Dam, the final blow. *Oecologia Australis*, *21*(3):222–231.

Alcântara, N.C. & Gonçalves, G. S. (2015). Avaliação do desembarque pesqueiro (2009-2010) no município de Juruá, Amazonas, Brasil. *Biota Amazônia*, *5*, 37-42.

Araújo, S. H. D. A. M. & Parente, T. G. P. G. (2016). (In) visibilidade das mulheres na pesca artesanal: uma análise sobre as questões de gênero em Miracema do Tocantins-TO. *Revista brasileira de desenvolvimento regional*, *4*(2), 177-199.

Arthur, R., Friend, R. & Béné, C. (2015). Social benefits from inland fisheries: implications for a people-centred response to management and governance challenges. *Freshwater Fisheries Ecology*, 500-512.

Baigun, C. R. M. & Valbo-Jørgensen, J. (dirs.). (2023). *La situación y tendencia de las pesquerías continentales artesanales de América Latina y el Caribe.* FAO Documento Técnico de Pesca y Acuicultura N.º 677. Roma, FAO. https://doi.org/10.4060/cc3839es

Barbosa, R.P. (2006). *Apetrechos e Técnicas de pesca da bacia o rio Negro*. Manaus: EDUA.

Bartley, D. M.; De Graaf, G. J.; Valbo-Jørgensen, J.; Marmulla, G. 2015. Inland capture fisheries: Status and data issues. F*isheries Management and Ecology*, *22*(1), 71–77.

Bastos, R.G.P.; Pinto, S.S.; Coutinho-Mello, A.F.; Souza, R.F.C. 2019. A pesca com rede de emalhe à deriva "descaideira" no médio e baixo Rio Branco, Roraima, Brasil, Boletim Técnico e Científico/ Cepnor, *19* (1), 37-42. https://periodicos.ufra.edu.br/index.php/CEPNOR/article/view/23

Batista, VDS; Isaac, VJ; Fabré, NN; Alonso, JC; Almeida, OT; Rivero; et al 2012. *Peixes e pesca no Solimões-Amazonas: uma avaliação integrada*. Brasília: Ibama/ProVárzea.

Begossi, A.; Salivonchyk, S. V.; Hallwass, G.; Hanazaki, N.; Lopes, P. F. M.; Silvano, R. A. M.; Pittock, J. 2018. Fish consumption on the Amazon: a review of biodiversity, hydropower and food security issues. *Brazilian Journal of Biology*, *79*, 345-357.

Béné C; Barange, Rm; Subasinghe, P; Pinstrup-Andersen, G; Merino, G; Hemre, I; et al. 2015. Feeding 9 billion by 2050 – putting fish back on the menu. *Food security,* 7 261–274.

Bentes, K.L.S.; Oliveira, L.L.; Zacardi, D.M.; Barreto, N.J.C. 2018. The Relationship between Hydrologic Variation and Fishery Resources at the Lower Amazon, Santarém, Pará. *Revista Brasileira de Geografia Física*, 11 (4):1478-1489.

Bevitt, K.; Franz, N. 2021. Illuminating hidden harvests: The contribution of small-scale fisheries to sustainable development. https://agris.fao.org/search/en/providers/122443/ records/ 669fb0b24295623862506b5b

Brasil, (2011a). Boletim Estatístico de Pesca e Aquicultura. Ministério da Pesca e Aquicultura.https://bibliotecadigital.economia.gov.br/handle/123456789/191. Accessed on 12 Out 2024.

Brasil. Instrução Normativa Interministerial MPA/MMA. nº- 12, de 25 de outubro de 2011b. Estabelece normas gerais à pesca e no período de defeso para a bacia hidrográfica do rio Araguaia. *Diário Oficial, República Federativa do Brasil***,** Brasília, DF. Nº 206, 26 de out. 2011. Seção 1. p 124-126. https://www.icmbio.gov.br/cepsul/legislacao/instrucao-normativa/349-2011.html. Accessed on 13 Mar 2025.

Brasil. Instrução Normativa Interministerial MPA/MMA n° 13, de 25 de outubro de 2011c. Estabelece normas gerais à pesca para bacia hidrográfica do rio Tocantins e período de defeso para as bacias hidrográficas dos rios Tocantins e Gurupi. *Diário Oficial, República Federativa do Brasil***,** Brasília, DF. Nº 206, 26 de out

2011. Seção 1. pp. 127-129. https://www.icmbio.gov.br/cepsul/legislacao/instrucao-normativa/349-2011.html. Accessed on 13 Mar 2025

Brasil. Ministério da Pesca e Aquicultura. (2024). Painel unificado do RGP. Disponível em: https://encurtador.com.br/NHUXC Acessado em 23 out 2024. Accessed on 13 Jan 2025.

Brasil. Instituto Chico Mendes de Conservação da Biodiversidade. Plano de Manejo do Parque Nacional do Viruá. Brasília, 626 p., 2014. https://www.gov.br/icmbio/pt-br/assuntos/biodiversidade/unidade-de-conservacao/unidades-de-biomas/amazonia/lista-de-ucs/parna-do-virua. Accessed on 11 Fev 2025.

Brasil. (2007). Decreto nº 6.040. Institui A Política Nacional De Desenvolvimento Sustentável dos Povos e Comunidades Tradicionais. Disponível em: http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2007/decreto/d6040.htm. Accessed on 11 Fev 2025.

Briglia-Ferreira, S.R.; Aquino-Pereira, S.L.; Pequeno, P.A.C.L.; Barbosa, R.I. (2021). A Pesca artesanal na bacia do Rio Branco: Dos antecedentes históricos ao abandono das estatísticas pesqueiras em Roraima. *Ambiente: Gestão e Desenvolvimento*. 14(3):45-57.

Canton, L; Zamboni, A; Dias, M. *Auditoria da pesca: Brasil 2023*. 4ª edição. Oceana Brasil, (2024). https://brasil.oceana.org/relatorios/auditoria-da-pesca-brasil-2023/. Accessed on 14 Mar 2025.

Carvalho, T.M.; Morais, R.P. (2014). Aspectos hidrogeomorfológicos do sistema fluvial do baixo rio Uraricoera e alto rio Branco como subsídio à gestão de terras. *Geografias*, 10(2), 18-135.

Cashion, T., Al-Abdulrazzak, D., Belhabib, D., Derrick, B., Divovich, E. & Moutopoulos, D.K. (2018). Reconstructing global marine fishing gear use: Catches and landed values by gear type and sector. *Fisheries Research*, *206*, 57-64.

Castelo Branco, T.X., Araújo, M.B., Mendel, B. & Souza, A.O. (2022). Onde tá dando peixe, a gente tá: a dinâmica da pesca artesanal em uma vila amazônica brasileira. *Gaia Scientia*, 16(3): 22-42, 2022.

Castilla, J. C.; Defeo, O. (2005). Paradigm shifts needed for world fisheries. *Science*, *309*(5739), 1324-1325.

Cavalcante, M.M.A., Veras, A.T.R., Seabra, G.F., Silva, J.C., Silva, M.G.N. & Ribeiro, W. C. (2020). Amazônia: explorando o baixo Rio Branco – Roraima/Amazonas. *Revista Do Departamento De Geografia*, *40*, 203-217.

Chuenpagdee, R.; Jentoft, S. (2019). Transdisciplinarity for small-scale fisheries governance. *MARE Publication Series. Cham: Springer International Publishing. https://doi. org/10.1007/978-3-319-94938-3*. Accessed on 11 Fev 2025.

Cintra, I.H.A.; Juras A.A.; Andrade, J.A.C.; Ogawa, M. (2007). Caracterização dos desembarques pesqueiros na área de influência da usina hidrelétrica de Tucuruí, estado do Pará, Brasil. Bol. Téc. Cient. Cepnor, Belém, 7, n. 1, p. 135 –15.

Cremon, E.; Rossetti, D. (2011). Evolução do megaleque Demini (norte da Amazônia) no quaternário tardio com base na extração de corpos d'água. in: Simpósio Brasileiro de Sensoriamento Remoto, 15. https://www.academia.edu/download/28304141/edipo2011.pdf. Accessed on 11 Jan 2025.

Dias, C.R.G. & Prysthon, A. (2022) Avaliação Do Esforço Pesqueiro Em Comunidades Tradicionais Do Rio Araguaia, Tocantins, Brasil... In: Anais da RedeCT: III Congresso Científico Internacional da Rede de Pesquisadores sobre Povos Originários e Comunidades Tradicionais - RedeCT. Anais...Barra do Bugres (MT) UNEMAT, 2022. Disponível em: <https//www.even3.com.br/anais/3_CCI_RedeCT_2022/557628. Acessed on 03 Jan 2025.

Doria, C.R; Duponchelle, F. Lima, M.A.L; Garcia, A., Carvajal-Vallejos, F.M. & Méndez, C.C; (2018). Review of fisheries resource use and status in the Madeira River Basin (Brazil, Bolivia, and Peru) before hydroelectric dam completion. *Reviews in Fisheries Science & Aquaculture*, *26*(4), 494-514.

FAO. (2024). *The State of World Fisheries and Aquaculture 2024 – Blue Transformation in action*. Rome. https://openknowledge.fao.org/handle/20.500.14283/cd0683en. Accessed on 12 Fev 2025.

FAO, Duke University & WorldFish. (2023). Illuminating Hidden Harvests – The contributions of small-scale fisheries to sustainable development. Rome. https://openknowledge.fao.org/handle/20.500.14283/cc4576en. Accessed on 19 Fev 2025.

FAO, Duke University and WorldFish. (2022). Small-scale fisheries and sustainable development: Key findings from the Illuminating Hidden Harvests report. Rome, FAO; Durham, USA, Duke University; Penang, Malaysia, WorldFish. **https://www.fao.org/3/cc0386en/cc0386en.pdf**. Accessed on 20 Dez 2024.

Ferreira, E., Zuanon, J., Santos, G. D. & Amadio, S. (2011). A ictiofauna do Parque Estadual do Cantão, Estado do Tocantins, Brasil. *Biota Neotropica*, *11*, 277-284.Ferreira, E. J.G., Zuanon, J.A.S., Forsberg, B., Goulding, M. & Briglia-Ferreira, S.R. Rio Branco – Peixes, Ecologia e Conservação de Roraima. Lima: *Biblos*, 2007. 208p.

Fiperj. (2024). Estatística Pesqueira do Rio de Janeiro. Projeto de monitoramento da atividade pesqueira no Estado do Rio de Janeiro. Fundação Instituto de Pesca do Estado do Rio de Janeiro (FIPERJ). http://pescarj.fundepag.br/. Accessed on 18 Nov 2024.

Funge-Smith, S.; Bennett, A. (2019). A fresh look at inland fisheries and their role in food security and livelihoods. *Fish and Fisheries*, *20*(6), 1176-1195.

Funge-Smith, S. (2018). *Review of the state of the world fishery resources: Inland fisheries*. FAO Fisheries and Aquaculture Circular No. C942, Rome, FAO. https://openknowledge.fao.org/handle/20.500.14283/ca0388en. Accessed on 22 Nov 2024.

Garcia, N.M., Yunes, M.A.M., Chaves, P.F. & Santos, L.O. (2007). Educando meninos e meninas: transmissão geracional da pesca artesanal no ambiente familiar. *Psicologia da Educação,* 25(1):93-112.

Guimarães, M. V. F. A. (2024). Pesca artesanal: Saberes e desafios dos pescadores em Porto Nacional – Tocantins (1999 - 2022). Dissertação de Mestrado, Universidade Federal do Tocantins (UFT), Brasil. 90p. (https://repositorio.uft.edu.br/handle/11612/6904).Hallwass, G., Keppeler, F.W., Tomazoni-Silva, L.H., Alves, I.A; Isaac, V.J. & Almeida, M.C. (2023). Disentangling'the advantages from gillnets in freshwater small-scale fisheries in the Brazilian Amazon. *Reviews in Fish Biology and Fisheries*, *33*(3).

IP/APTA/SAA/SP. Estatística Pesqueira Marinha e Estuarina do Estado de São Paulo. Consulta On-line. Programa de Monitoramento da Atividade Pesqueira Marinha e Estuarina do Estado de São Paulo. Instituto de Pesca (IP), Agência Paulista de Tecnologia dos Agronegócios (APTA). Disponível em: http://www.propesq.pesca.sp.gov.br/. Accessed on 23 Out 2024.

Isaac, V. J., Almeida, M.C., Giarrizzo, T., Deus, C.P., Vale, R., Klein, G. & Begossi, A. (2015). Food consumption as an indicator of the conservation of natural resources in riverine communities of the Brazilian Amazon. *Anais da Academia Brasileira de Ciências*, *87*(4), 2229-2242.

Latrubesse, E.M., Arima E., Ferreira M.E., Nogueira, S.H.,Wittmann F. & Dias, M, (2019). Fostering water resource governance and conservation in the Brazilian Cerrado biome. *Conservation Science and Practice*, *1*(9), e77.

Lemos, C. E. F.; de Souza Vieira, M. I.; Ferraz, R. R. 2017. Compartimentação hidrográfica da bacia de drenagem do Rio Branco, estado de Roraima, Brasil por meio da base hidrográfica ottocodificada. *Acta Geográfica*, *11*(26), 35-53.

Lopes, P.L., Souza, J., (2015). Valor e categorias de uso dos apetrechos de pesca e das etnoepécies de peixes da comunidade de pescadores artesanais de Sacaí, Caracaraí-RR, Brasil. *Revista Brasileira de Agroecologia.* Vol. 10 (2).

Lynch, A.J., Cooke, S.J., Deines, A.M., Bower, S,D., Bunnell, D.B. & Cowx, I.G. (2016). The social, economic, and environmental importance of inland fish and fisheries. *Environmental reviews*, *24*(2), 115-121.

Maneschy, M.C., Siqueira, D. & Álvares, M.L.M. (2012). Pescadoras: subordinação de gênero e empoderamento. *Revista Estudos Feministas, 20*(03), 713-737.

Mancha-Cisneros, M.D.M., Basurto, X., Franz, N. & Funge-Smith, S. (2019). Illuminating hidden harvests: the global and local contributions and impacts of small-scale fisheries to sustainable development. https://encurtador.com.br/9BT6T. Accessed on 12/Jan 2025.

Martinelli, L.A., Naylor, R., Vitousek, P.M. & Moutinho, P. (2010). Agriculture in Brazil: impacts, costs, and opportunities for a sustainable future. *Current Opinion in Environmental Sustainability*, *2*(5-6), 431-438.

Mesquita, E. M. C.; Cruz, R. E. A.; Hallwass, G.; Isaac, V. J. 2019. Fishery parameters and population dynamics of silver croaker on the Xingu River, Brazilian Amazon. *Boletim do Instituto de Pesca*, *45*(2).

Naka, L.N., Laranjeiras, T.O., Lima, G,R., Plaskievicz, A.C., Mariz, D. & Costa, B.M. (2020). The Avifauna of the Rio Branco, an Amazonian evolutionary and ecological hotspot in peril. *Bird Conservation International*, *30*(1), 21-39.

Nagl, P., Hallwass, G., Tomazoni-Silva, L.H., Nitschke, P.P., Rowedder, A.R. & Romero-Martinez, A.T. (2021). Protected areas and frugivorous fish in tropical rivers: Small-scale fisheries, conservation and ecosystem services. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *31*(10), 2752-2771.

Nepstad, D., McGrath, D., Stickler, C., Alencar, A., Azevedo, A. & Swette, B. (2014). Slowing Amazon deforestation through public policy and interventions in beef and soy supply chains. *Science*, *344*(6188).

Nolan, K.S.S. (2021). A estatística do desembarque de pescado no Mercado Feira do Pescado, Santarém-PA. 2020. Indicações e reflexões para o período 2011-2020. Pro-reitoria de Cultura e extensão- PROCCE. Instituto de Ciência e tecnologia das Águas. Universidade Federal do Oeste do Pará. Doc interno. 24p.

Pelicice, F.M., Agostinho, A.A., Akama, A., Andrade Filho, J.D., Azevedo-Santos, V.M. & Barbosa, M.V.M. (2021). Large-scale degradation of the Tocantins-Araguaia River basin. *Environmental Management*, *68*, 445-452.

Petrere Jr., M., Giacomini, H.C. (2010). Catch-per-unit-effort: which estimator is best? *Brazilian Journal of Biology*, *70*, 483-491.

Prysthon, A., Ummus, M.E., Tardivo, T.F., Pedroza Filho, M.X., Chicrala, P.C.M.S., Kato, H.C.A., Dias, C.R.G. & Paz, L.R.S. (2022). A pesca artesanal no rio Araguaia, Tocantins, Brasil: aspectos tecnológicos e socioeconômicos. Editora e-Publicar, Rio de Janeiro. https://encurtador.com.br/00OVR. Accessed on 15 Ago 2024.

Quirijns, F.J., Poos, J.J., Rijnsdorp, A.D. (2008). Standardizing commercial CPUE data in monitoring stock dynamics: accounting for targeting behaviour in mixed fisheries. *Fisheries Research*, *89*(1), 1-8.

Ramírez-Amaro, S., Galván-Magaña, F. (2019). Effect of gillnet selectivity on elasmobranchs off the northwestern coast of Mexico. *Ocean & Coastal Management*, *172*, 105-116.

Rocha-Mendes, F.O., Figueiredo, E.S.A., Araújo Silva, K.C., Cintra, I.H.A. & Santos, M.A.S. (2021). O comportamento da pesca artesanal e soluções participativas para o uso sustentável dos recursos pesqueiros de Araguacema, Tocantins, Amazônia, Brasil. *Research, Society and Development*, *10*(12).

Ruffino, M.L. (2016). Situação dos estoques pesqueiros e suas relações ecológicas. Produto 1: Diagnóstico. Biologia e ecologia das espécies, dados sociais e econômicos relacionados às espécies alvo, acompanhantes e ameaçadas, por bacia hidrográfica sobre os períodos reprodutivos, épocas de safra e artes de pesca empregadas na captura. Relatório de Consultoria. Brasília: MMA/PNUD. https://encurtador.com.br/zrjLO Accessed on 01 Dec 2024

Santos, A.P.R. (2022). Pesca artesanal no Distrito de Peixelândia – Tocantins, Brasil. Dissertação de Mestrado, Universidade Federal do Tocantins (UFT), Brasil. 189p. (https://repositorio.uft.edu.br/handle/11612/7047).

Silva, A.P. & Farias, E.G.G. (2017). Caracterização participativa da frota pesqueira do Rio Araguaia-Tocantins, Brasil. *Magistra*, 29(1).

Scaramuzza, C.A.M., Sano, E.E., Adami, M., Bolfe, E.L., Coutinho, A.C. & Esquerdo, J.C.D.M. (2017). Land-use and land-cover mapping of the Brazilian Cerrado based mainly on Landsat-8 satellite images. *Revista Brasileira de Cartografia*, *69*(6).

Schaefer, C.E.G.R., Campos, P.V., Candido, H.G., Corrêa, G.R., Faria, R.M. & Vale Jr, J. F. (2020). Serras e pantanais arenosos: solos e geoambientes em unidade de conservação da Amazônia, Brasil. *Neotropical Biology and Conservation*, *15*(1), 43-69.

SisEAPRO. (Sistema de Estatística Aplicada à Produção). Versão 3.5. Recife/PE (Brasil). PPMendes, 2024. Disponível em: www.siseapro.com.br.

Sousa, C.C. (2011). Diversidade Socioambiental de Roraima: subsídios para debater o futuro sustentável da região. São Paulo: Instituto Socioambiental,. https://encurtador.com.br/0Qz5N. Accessed on 17 Fev 2025.

Sparre, P. & Venema S.C (1997). Introdução à avaliação de mananciais de peixes tropicais. Parte 1-Manual. FAO Documento Técnico sobre as pescas, Nº 306/1, Rev. 2. Roma: FAO. https://www.fao.org/4/w5449p/w5449p00.htm. Accessed on Apr 24.

Tejerina-Garro, F.L. & Mérona, B.D. (2010). Flow seasonality and fish assemblage in a tropical river, French Guiana, South America. *Neotropical Ichthyology*, *8*, 145-154.

Tocantins. (2024). Secretaria da Pesca e Aquicultura. Instrução Normativa Nº 07, de 10 de Outubro de 2024. Dispõe sobre o monitoramento de desembarque pesqueiro no âmbito do Programa Trilha da Pesca e

Aquicultura. Diário Oficial Nº 6675. Ano XXXVI - Estado do Tocantins, 57 Diário Oficial Nº 6675 sexta-feira, 11 de outubro de 2024. https://encurtador.com.br/9H65F. Accessed on 12 Oct 2025.

Univali/EMCT/Lema. Estatística Pesqueira de Santa Catarina. Consulta On-line. Projeto de Monitoramento da Atividade Pesqueira do Estado de Santa Catarina. Laboratório de Estudos Marinhos Aplicados (Lema), da Escola do Mar, Ciência e Tecnologia (EMCT) da Universidade do Vale do Itajaí (Univali). 2022. Disponível em: http://pmap-sc.acad.univali.br/. Accessed on 20 Nov 2025.

World Bank, FAO-WorldFish Center (2010) The Hidden Harvests. The Global Contribution of Capture Fisheries Agriculture and Rural Development Department Sustainable Development Network. Washington: World Bank, 62 pp. https://encurtador.com.br/9K6V8 Accessed on 15 Nov 2025.

Zacarkim, C.E., Piana, P.A., Baumgartner, G., Aranha, J.M.R. (2015). O panorama da pesca artesanal do Rio Araguaia, Brasil. *Fisheries Science*, *81*, 409-416.

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