


# Local reuse of damaged fishing nets as a preventive strategy against ghost gear formation and cetacean entanglement in central Ecuador

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## Abstract

Entanglement in abandoned, lost, or discarded fishing gear represents a significant threat to cetaceans worldwide, particularly in coastal regions dominated by artisanal fisheries. Preventive strategies that reduce the availability of damaged fishing gear before it enters the marine environment remain limited, especially in small-scale coastal communities. This study documents and analyzes a locally developed practice in Puerto Cayo, central Ecuador, consisting of the direct reuse of damaged nylon fishing nets as reinforcement material in cement-based plastering for bamboo wall structures. The nets, primarily monofilament nylon commonly used in artisanal fisheries, retain sufficient structural integrity to substitute conventional metallic mesh used in bamboo-based construction. Based on direct field observations, this practice is described as a low-cost, accessible, and context-specific solution that extends the functional lifespan of fishing nets on land. From a marine conservation perspective, this reuse reduces the likelihood that damaged nets become ghost gear, thereby indirectly lowering the risk of cetacean entanglement in adjacent coastal waters used seasonally by multiple species, including humpback whales (*Megaptera novaeangliae*). This practice is further interpreted within a biocultural framework, where local ecological knowledge, material reuse, and livelihood strategies intersect to produce adaptive, community-based responses to environmental challenges. Although no quantitative assessment of mechanical performance was conducted, this study highlights the potential of locally grounded preventive approaches to contribute to marine conservation, circular economy practices, and the recognition of community knowledge in data-poor contexts.

## Keywords

Artisanal fisheries, bamboo construction, cetacean entanglement, biocultural systems, community-based conservation, fishing net reuse

## Introduction

Entanglement in abandoned, lost, or discarded fishing gear represents one of the most significant anthropogenic threats to cetaceans worldwide (Brown and Niedzwecki, 2020; Mghili et al., 2023; Tulloch et al., 2020b). So-called ghost nets can remain active in the marine environment for prolonged periods, continuing to capture and entangle marine fauna, particularly large-bodied and highly mobile species such as cetaceans (Basran, 2021; Baulch and Perry, 2014; Dolman and Moore, 2017). Globally, entanglement has been documented as a major cause of injury and mortality across multiple cetacean taxa, posing serious challenges for conservation and management efforts (Dolman and Brakes, 2018; Tulloch et al., 2020b; Ulloa et al., 2024).

The central coast of Ecuador, particularly the area around Machalilla National Park and the Cantagallo Marine Reserve, constitutes an important seasonal habitat for cetaceans (Scheidat et al., 2004; Stafford et al., 2016). This region is especially known for the annual presence of humpback whales (*Megaptera novaeangliae*, stock G) (Denkinger et al., 2023; Félix and Haase, 2005; O'Hern et al., 2009), which migrate to these coastal waters for breeding and calving and represent a key species for marine tourism through whale-watching activities (Castro et al., 2022). In addition to humpback whales, several other coastal and oceanic cetacean species regularly use these waters (Félix et al., 2007; Félix et al., 2025; Orellana-Vásquez et al., 2025), increasing the overall exposure of cetaceans to the risk of entanglement associated with fishing activities (Castro and Van Waerebeek, 2019).

In response to entanglement events, the region has seen the development of rescue operations, disentanglement efforts, and environmental education initiatives aimed at reducing interactions between fishing gear and cetaceans (Alava et al., 2019; Villalba-Briones et al., 2021). While these actions are essential, they are often reactive in nature, require specialized training, involve considerable economic and human resources, and face operational limitations due to the unpredictable timing and location of entanglement events (Moore et al., 2001; Tulloch et al., 2020a). Consequently, there is growing recognition of the need to complement response-based approaches with preventive strategies that reduce the likelihood of damaged fishing gear entering or re-entering the marine environment (Hamilton and Baker, 2019; Tulloch et al., 2020a).

Some studies have explored the recycling of recovered fishing nets through industrial processes, such as shredding and incorporation into construction materials, fiber-reinforced composites, or eco-panels, contributing to circular economy frameworks and waste reduction (Bertelsen et al., 2016; Bertelsen and Ottosen, 2017; Zhou et al., 2017). However, these approaches typically require specialized infrastructure, technological processing, and financial investment, limiting their applicability in small-scale coastal communities. Moreover, such initiatives remain largely undocumented in Latin America, despite the region's extensive fishing activity and high biodiversity (Alava et al., 2019).

In coastal communities of central Ecuador, particularly those associated with artisanal fisheries, bamboo-based construction represents a widely used and economically accessible building practice (Bredenoord, 2024; Carpio et al., 2024; De Araujo et al., 2023; Martínez et al., 2025; Witte, 2019). These constructions commonly combine locally sourced bamboo with cement-based finishes to enhance durability and resistance, traditionally using metallic mesh as structural reinforcement (Di et al., 2025; Iuorio et al., 2025; Mite-Anastacio et al., 2022; Zea Escamilla et al., 2019; Zhao et al., 2012). Within this socio-environmental context, coastal communities develop adaptive practices that integrate ecological knowledge, resource availability, and socio-economic constraints (Gavin et al., 2018; Lloyd et al., 2013). Such practices can be understood as part of biocultural systems, where material reuse and resource efficiency are not only economic responses but also culturally embedded strategies shaped by long-standing interactions between human livelihoods and marine environments (Díaz et al., 2015; Maffi, 2007; Morante et al., 2025). In artisanal fishing contexts, these locally grounded solutions often emerge from experiential knowledge and reflect context-specific approaches to sustainability (Dei, 2024; Pelage et al., 2023; Prawira et al., 2025; Silva-Ávila et al., 2025).

Accordingly, the direct reuse of damaged fishing nets as a substitute for metallic mesh has been locally observed as an informal and undocumented practice based on material availability and practical knowledge. Documenting and systematizing such practices represents a critical step in recognizing and valuing community-based knowledge (Dei, 2024), transforming localized empirical solutions into transferable information with potential for adaptation and replication in other coastal settings facing similar socio-environmental challenges (Prawira et al., 2025).

This note documents and contextualizes this localized practice within a biocultural and conservation framework, presenting it as a potential primary prevention strategy against cetacean entanglement and as an example of how community-based innovations can contribute to marine conservation in data-limited coastal regions.

Importantly, within this context, the fishing nets considered in this study do not constitute ghost fishing gear *sensu stricto*, as they have not been lost or abandoned at sea. Instead, they represent damaged nets that, in the absence of alternative uses, would likely be discarded and could potentially become ghost gear.

## Methodology

### Study Area

The report was conducted in the marine-coastal line in Puerto Cayo parish, within the Jipijapa canton, Manabí Province, Ecuador, located in the central coastal region of the country, in the vicinity of Machalilla National Park and the Cantagallo Marine Reserve (Fig. 1) with a strong dependence on artisanal fisheries as a primary livelihood (GAD Puerto Cayo, 2026), as well as by the seasonal presence of multiple cetacean species, particularly humpback whales (*Megaptera novaeangliae*, stock G) (Castro et al., 2022; Félix and Haase, 2005).

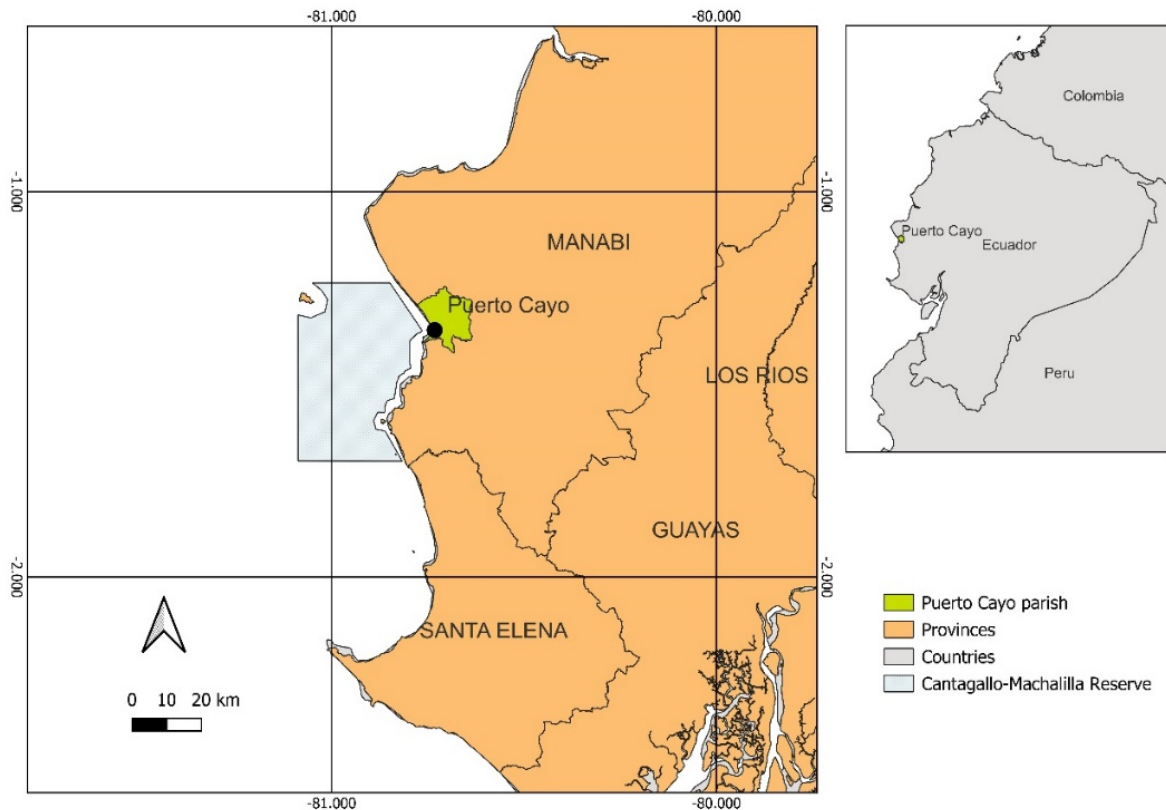


Fig 1. Location of the report area in Puerto Cayo, Jipijapa canton, Manabi Province, Ecuador. Source: Own elaboration based on publicly available geographic data.

## Methods

This report followed an exploratory, qualitative, and observational approach (Doresha et al., 2024; Hollstein, 2011; Roque et al., 2024; Sigfridsson and Sheehan, 2011) aimed at documenting a locally observed practice of damaged fishing net reuse within coastal construction activities. Information was collected through direct, informal conversations (Swain and King, 2022) with a local master builder "*maestro constructor*" experienced in masonry work and material reuse. The informant was not specialized in bamboo construction itself; however, they were directly responsible for the plastering and cement finishing of bamboo-based structures, where reinforcement materials are required. This positional role provided practical knowledge of alternative reinforcement techniques applied during the construction process.

Data collection was complemented by direct, non-participant observation (Denny and Weckesser, 2022) of the construction process during an on-site visit to a bamboo house under construction. The observation focused on the preparation, placement, and integration of damaged nylon fishing nets within the structure as reinforcement for cement-based plastering. Visual documentation was obtained through photographic records of the

materials and application stages to support qualitative and methodological description. No experimental manipulation or intervention was conducted. The observation was limited to documenting the technique as applied under real working conditions.

Additional contextual information regarding similar practices reportedly used by other local builders was obtained indirectly through the informant's accounts (Denny and Weckesser, 2022; Swain and King, 2022). No structured interviews, surveys, or systematic community-level assessments were conducted, and such accounts were not independently verified. Consequently, this information is treated as contextual background rather than representative or quantitative data.

The methodological scope of this study is intentionally descriptive and exploratory (Caggiano and Weber, 2023; Pownall, 2025), aiming to document a practice that has not been previously reported in the scientific literature.

## Results and discussion

The documented practice consists of the direct reuse of damaged nylon fishing net fragments as reinforcement material for cement-based plastering in bamboo wall structures within local construction activities. Although these nets are no longer functional for fishing purposes, they retain apparent tensile strength and structural integrity sufficient to be repurposed as construction reinforcement, replacing metallic mesh traditionally used in bamboo-based buildings (Chen et al., 2024). The nets observed were primarily monofilament nylon fishing nets with an approximate diameter of 0.30 mm and a mesh size of 3 inches, commonly used in artisanal fisheries targeting medium-sized fish for local consumption. In some cases, thicker nets associated with other fishing practices, including shrimp fisheries, were also reportedly reused, providing an apparently stronger structural support.

The observed application process is illustrated in Figure 2. Initially, damaged nylon fishing net fragments discarded from fishing activities were selected and prepared for reuse (Fig. 2A). Although damaged nets are commonly repaired or repurposed for secondary uses such as fences or poultry enclosures, the use of these materials as construction reinforcement represents a less documented application and constitutes the primary focus of this study. The net sections were then cut according to the dimensions of the wall surface and fixed to the bamboo structure using nails or clips at the edges and central points to ensure adequate tension and stability prior to plastering (Fig. 2B). Following the application of cement plaster, portions of the net remained visible along structural edges, such as window frames, clearly evidencing its incorporation as an internal reinforcement element (Fig. 2C). The final result consisted of a continuous and stable plastered surface comparable to outcomes achieved using conventional metallic mesh (Fig. 2D). A panoramic view of Puerto Cayo beach provides spatial context for the proximity between coastal construction practices, artisanal fishing activities, and marine environments used by cetaceans (Fig. 2E).



Fig 2. Reuse of damaged nylon fishing nets as reinforcement material in bamboo-based construction in Puerto Cayo, Ecuador. (A) Discarded and damaged nylon fishing net fragments prior to reuse. (B) Installation of the nylon net fixed to the bamboo wall structure before plastering. (C) Cement-plastered wall with portions of the nylon net visible along window edges, evidencing its incorporation as internal reinforcement. (D) Final plastered surface after completion of construction. (E) Panoramic view of Puerto Cayo beach, illustrating the coastal context where artisanal fishing activities and construction practices coexist. Source: Photographs by Hernán Orellana-Vásquez.

Local practitioners reported positive functional outcomes associated with this technique, including ease of application, rapid execution, and satisfactory performance under local environmental conditions (Cañadas-López et al., 2020). According to local perceptions, bamboo-based construction was more widespread in previous decades; however, its use has declined in favor of cement, block, or brick structures due to concerns about durability (Sánchez et al., 2018). Despite this trend, a limited number of practitioners continue to apply traditional bamboo techniques when opportunities arise, drawing on accumulated practical knowledge. Unlike metallic mesh, which is prone to corrosion and degradation in humid and saline coastal environments (Ebenezer et al., 2021; Martínez et al., 2025), nylon fishing nets showed resistance to these factors.

These observations reflect the persistence of locally grounded knowledge systems within coastal communities, where construction practices, material reuse, and resource management are shaped by accumulated experience and cultural transmission associated with artisanal livelihoods (Díaz et al., 2015; Maffi, 2007). In this context, the reuse of fishing nets can be understood not only as a technical solution but also as part of a broader set of adaptive strategies embedded in local coastal culture, linking everyday practices with resource use and environmental management (Dei, 2024).

Additionally, the use of damaged nets represents a low-cost alternative (Guest, 2003), as the material is locally available and would otherwise be discarded. Although no quantitative assessment of mechanical performance was conducted, the continued use of this technique by local builders suggests its practical viability within this context.

From a marine conservation perspective, the reuse of damaged fishing nets contributes to reducing the availability of materials that could otherwise become abandoned, lost, or discarded fishing gear in coastal and marine environments (Alava et al., 2019). By extending the functional lifespan of nylon nets on land, this practice indirectly decreases the potential for ghost net formation, thereby reducing the risk of entanglement for marine fauna. In the coastal waters adjacent to Puerto Cayo, which are seasonally used by multiple cetacean species, including humpback whales (*Megaptera novaeangliae*, stock G) (Alava et al., 2019; Castro and Van Waerebeek, 2019; Félix and Haase, 2005), such preventive measures may be particularly relevant.

Conservation actions in areas surrounding Machalilla National Park and the Cantagallo Marine Reserve have historically emphasized reactive responses to entanglement events, such as disentanglement operations and environmental education initiatives (Alava et al., 2005; Félix, 2021; Ortega-Pacheco et al., 2018; Villalba-Briones et al., 2021). While these efforts are essential, they often involve high economic and human costs and are constrained by the unpredictable timing and location of entanglement events (Moore et al., 2001). The practice documented here does not seek to replace these response-based strategies but rather to complement them through a primary prevention approach that addresses one of the structural drivers of the problem: the inappropriate disposal of damaged nylon fishing gear (Daniel and Thomas, 2023; Koziol et al., 2022; Li et al., 2023; Weißbach et al., 2022).

Importantly, this practice relies on the direct reuse of fishing nets without industrial processing, specialized infrastructure, or technological transformation, in contrast to other recycling experiences that rely on attainable or semi-industrial technologies (Bertelsen and Ottosen, 2017; Celauro et al., 2025; Movilla-Quesada et al., 2025). This characteristic is especially relevant in small coastal communities such as Puerto Cayo, where facilities for recycling or material processing are not available (Gutiérrez and Rodríguez, 2023). The application of locally accessible materials reflects an adaptive and context-specific solution aligned with principles of circular economy, waste reduction, and community-based conservation (Becker and Ghimire, 2003; Fiallo and Jacobson, 1995; Mestanza-Ramón et al., 2023).

Although humpback whales represent an emblematic species due to their visibility and tourism value (Castro et al., 2022), the potential benefits of reducing ghost net availability extend to other coastal and oceanic cetacean species present in the region (Alava et al., 2005). From a cost-effectiveness perspective, preventive strategies grounded in locally driven practices may reduce the long-term economic and logistical burden associated with entanglement response, while simultaneously supporting sustainable construction practices and local livelihoods (Rodríguez et al., 2018; Rodríguez Gómez et al., 2024). This localized experience should be regarded as an initial reference within a broader biocultural framework, where locally developed practices reflect the interaction between cultural knowledge, resource availability, and environmental challenges (Prawira et al., 2025). In this sense, the reuse of damaged fishing nets illustrates how community-based solutions can contribute to preventive marine conservation strategies by addressing the pathways through which fishing gear may become marine debris and, ultimately, a risk factor for cetacean entanglement.

Further research is required to assess the mechanical properties of reused fishing nets in construction, evaluate the prevalence of similar practices across coastal communities, and quantify potential reductions in ghost net occurrence (Brown and Macfadyen, 2007), particularly in data-poor contexts where formal waste management systems are absent.

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## Conflicts of interest

The authors have no conflicts of interest.

## Role of each author

Hernán Orellana-Vásquez conceived the study, conducted the fieldwork, and led the writing of the manuscript. Tirone Baque contributed to the development of the idea and compiled community-based information. Luna Barragán contributed to manuscript preparation and revision.

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