

Ghost fishing over the shipwrecks of Gallipoli Campaign (Çanakkale, Türkiye)

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Abstract

The phenomenon of ghost fishing, characterized by the persistent capture of marine organisms by lost or abandoned fishing gear, poses a significant threat to underwater cultural heritage, particularly around historic shipwrecks. This study focused on the ghost fishing and its impact on shipwrecks in the Gallipoli Campaign during World War I in Çanakkale, Türkiye. Underwater surveys were carried out between July and September 2023. The research explores the entanglement of fishing gear around these shipwrecks, assessing its ecological consequences on marine life and the structural integrity of the shipwrecks. The study also emphasizes the need for comprehensive documentation, monitoring, and management strategies to mitigate the adverse effects of ghost fishing on both biodiversity and historical artifacts. Recommendations include establishing monitoring programs, involving local communities, raising awareness, implementing regulations, and organizing underwater cleanup events.

Keywords: Ghost fishing, shipwrecks, underwater cultural heritage, marine conservation

Introduction

Ghost fishing, a term established by Breen (1990), is influenced by the introduction of highly durable fishing gear crafted from nonbiodegradable synthetic materials. This phenomenon, indirectly impacting fishing stocks, describes the persistence of lost or abandoned fishing gear that remains in a functional position (Angiolillo 2019). These gears may persistently capture and harm a broad spectrum of organisms over an extended period (Matsuoka *et al.* 2005; Brown and Macfadyen 2007; Galgani *et al.* 2015). While some prey might escape, those ensnared in these traps and pots face death by starvation or become bait, attracting new victims (Kühn *et al.* 2015). Many papers have reported that the lost fishing gear remained fishing for a while longer (Fowler 1987; Kaiser *et al.* 1996; Ayaz *et al.* 2004, 2006, 2010; Matsuoka *et al.* 2005;

Macfadyen *et al.* 2009; Uhlmann and Broadhurst 2015). The duration for which lost fishing gear continues to entangle organisms varies significantly, depending on location, gear size, and structure, increasing the risks of entanglement (Erzini 1997; Matsuoka *et al.* 2005; Erzini *et al.* 2008). Heavily colonized lost fishing gear undergoes alterations in weight, mesh size visibility, and catch efficiency (Erzini 1997). In deeper waters, ghost fishing appears to persist for longer periods, as fouling takes more time (Breen 1990). The extent of fouling may indicate the age of lost gear (Saldanha *et al.* 2003), with the most encrusted items presumed to be of older origin. However, debris may exhibit species-specific variations in fouling organism abundance, depending on material, geography, depth, and season (Saldanha *et al.* 2003). Due to the extremely slow degradation of nylon, lost gears may endure for a decade (Thompson *et al.* 2004; Barnes *et al.* 2009; Watters *et al.* 2010). During this time, they accumulate on the sea bottom, altering the surrounding benthic habitat, covering wide portions of settled communities, and impeding the recolonization of various large organisms (Saldanha *et al.* 2003; Galgani *et al.* 2015).

Ghost fishing gear encompasses fishing gear that has been abandoned, lost, or otherwise discarded, much of which frequently remains unnoticed. Ghost fishing gear stands out as the most lethal type of marine plastic due to its indiscriminate capture of wildlife, ensnaring marine mammals, seabirds, sea turtles, and sharks, leading them to a gradual and agonizing demise caused by exhaustion and suffocation. Furthermore, critical marine habitats like coral reefs suffer damage from ghost fishing gear. Moreover, it contributes to the depletion of economically significant fish populations, jeopardizing the overall sustainability of fisheries and impacting communities reliant on fish for sustenance and livelihoods.

Artificial reefs are deliberately positioned benthic structures, crafted from natural or man-made materials, with the aim of protecting, enhancing, or restoring components of marine ecosystems (Seaman and Lindberg 2009). Modern applications of artificial reefs encompass improving the effectiveness of artisanal, commercial, and recreational fisheries, generating new biomass in fisheries and aquaculture, enhancing opportunities for underwater recreation and ecotourism, preserving and rejuvenating coastal habitats and biodiversity, and advancing research. In recent decades, certain artisanal fishing communities have adopted more contemporary designs of artificial reefs, deploying them on larger scales. This response is, in part, a reaction to the damage inflicted on habitats and fisheries due to coastal land-use practices and more intensive fishing methods, such as trawling (Seaman and Lindberg 2009). Nevertheless, fishing equipment like gillnets and longlines employed in the vicinity of these shipwrecks gets shredded by the sharp metal structures of the ships, getting entangled and remaining stuck on the wrecks. Subsequently, these fishing tools persist in their activities around the shipwrecks.

As exploration and surveys in deep coastal waters expand, shipwreck sites are frequently discovered to be heavily entangled in fishing nets or broken and scattered by trawl doors and weights (Kingsley 2010; Brennan *et al.* 2012, 2013). Historic and ancient shipwrecks are both irreplaceable cultural sites and features of the modern seabed that serve as important artificial reef habitats (Walker *et al.* 2007). Efforts to protect such sites from mobile fishing gear activities have been minimal; even some of the marine protected areas (MPAs) that have been established still allow commercial fishing (U.S. Dept. of Commerce *et al.* 2010). One of the primary obstacles hindering proper assessment, protection, and management of these underwater cultural resources, however, is sparse documentation of the damage inflicted on wreck sites and the adjoining seabed. The problem is especially acute considering the limited accessibility of deep water to most researchers and resource managers (Brennan and Ballard 2014). The essential component lacking in this area of research is the thorough documentation of threatened and damaged sites by means of return visits and repeated surveys.

In addition to working toward appropriate management of underwater cultural heritage (UCH), a more comprehensive understanding of mobile fishing gear damage to shipwrecks is imperative for protecting sites targeted for their commercial value. The UNESCO Convention on the Protection of the Underwater Cultural Heritage of 2001 stipulates that in situ preservation of cultural sites should be considered as the first option for management (UNESCO 2001; Maarleveld 2011). However, the threat that trawl activities present to many shipwreck sites has been used by salvage companies, such as Odyssey Marine Exploration, to justify the commercial salvage and sale of valuable materials from wreck sites for profit (Kingsley 2010; Pringle 2013).

The destructive effects of mobile fishing gear towed along the seabed have long been a topic of concern for benthic ecologists (Jones 1992; Collie *et al.* 2000; National Research Council (NRC) 2002; Puig *et al.* 2012). However, in this chapter, we will focus on the ghost fishing over the shipwrecks sank during the Gallipoli Campaign of World War I (WWI).

Material and Methods

Study Area

The Gallipoli Historical Zone Administration, established in 2014, has a mission to safeguard the site of the Battle of Gallipoli and promote awareness of the battles for future generations (Anonymous 2023). Recognized as the best-preserved battle zone, it has been included in the UNESCO World Heritage Tentative List. The conservation efforts extend beyond land, as demonstrated by the Gallipoli Historical Underwater Park Project initiated in 2017. This project

aims to locate and unveil the sunken ships from the Battle of Gallipoli, making them accessible to visitors following protective measures. The project serves as an ongoing initiative to raise awareness about the Battles of Gallipoli. Simultaneously, advanced digital technologies have been employed to locate and document shipwrecks in the Çanakkale Strait and the Aegean Sea dating back to World War I. This comprehensive underwater research project is dedicated to preserving the shipwrecks from the Battle of Gallipoli for future generations. It also involves the identification and conservation of submerged ships from the Gallipoli Campaign, with the goal of enhancing awareness and accessibility to these historically significant sites. The project provides diving opportunities to explore 12 war wrecks and 2 natural reefs, offering a unique and immersive experience to witness the history of the war.

Shipwrecks Surveyed in the Study

Eight shipwrecks in the Gallipoli Historical Underwater Park were surveyed during the underwater surveys (Figure 1). The name, location and depth information of shipwrecks are given in Table 1.

Table 1. Shipwrecks surveyed in the study

Shipwrecks	Type	Location	Depth (m)
Louis	Destroyer	Suvla Bay	13
Lundy	Minesweeper	Suvla Bay	27
Küçükkemikli Barges	Barge	Küçükkemikli	30
Arıburnu Lighter	Lighter	Küçükkemikli	18
Arıburnu Barge	Barge	Anzak Cove	28.5
SS Milo	Steam-powered passenger ship	Anzak Cove	5-7
Helles Barges	Barge	Seddülbahir	25
HMS Majestic	Battleship	Seddülbahir	18-23

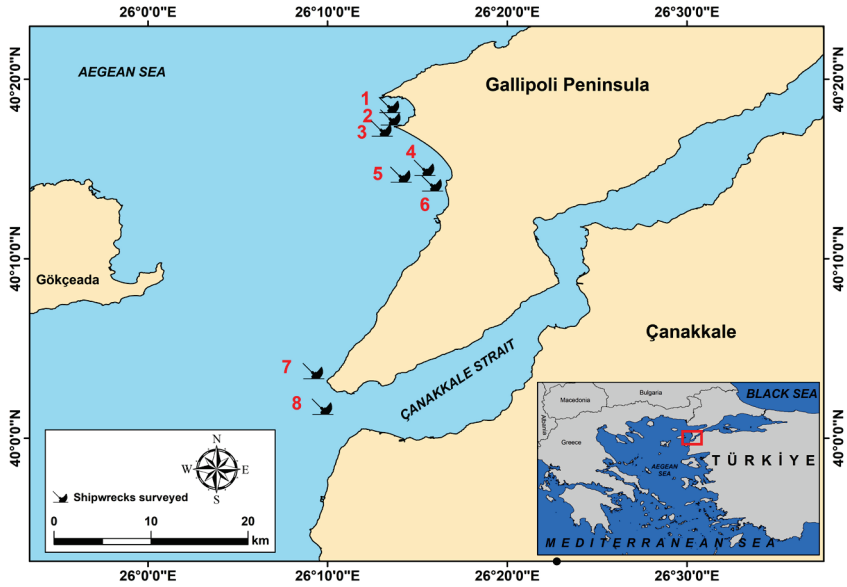


Figure 1. Location map of the shipwrecks in the study (1: HMS Louis, 2: Lundy, 3: Küçükkemikli Barges, 4: Arıburnu Lighter, 5: Arıburnu Barge, 6: SS Milo, 7: Helles Barges, 8: HMS Majestic)

Results and Discussion

Eight shipwrecks in the Gallipoli Historical Underwater Park were surveyed during the underwater surveys and ghost gears were recorded. During the underwater surveys, longlines were observed as ghost gears over ‘Lundy’ (Figure 2).

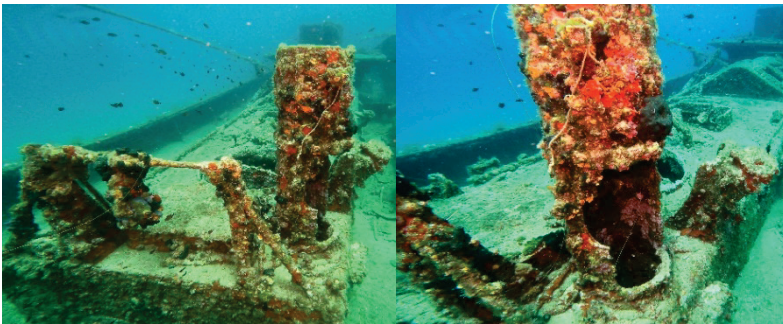


Figure 2. Longlines were observed as ghost gears over ‘Lundy’ shipwreck

In another survey, trawl nets and ropes were observed around the Arburnu Barge located at 28.5 m depth in Anzak Cove (Figure 3).

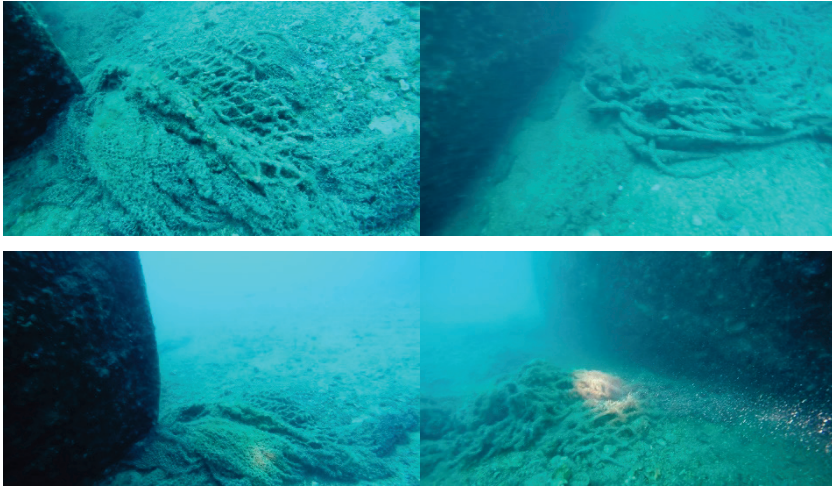


Figure 3. Trawl nets and ropes around the ‘Arburnu Barge’ shipwreck

Fishing lines and ropes were observed over the ‘Arburnu Lighter’ shipwreck in Küçükkemikli (Figure 4). Considering the citizen science and local knowledge, it is known that fishing lines, locally known as thick longlines, are used to catch *Dentex dentex*, *Sparus aurata*, *Scorpaena scrofa* species in the region. These species were observed during the SCUBA diving surveys (Figure 5). Shipwrecks serve as artificial reefs and enhance the biodiversity. As a matter of fact, the ghost gears observed during the underwater surveys continued to fish and increase the biodiversity around the shipwrecks.



Figure 4. Fishing lines and ropes over ‘Arburnu Lighter’ shipwreck

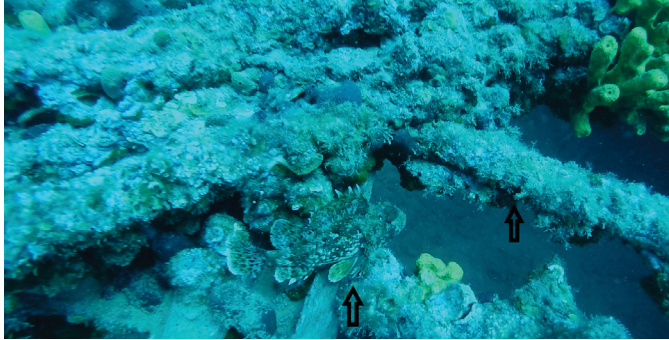


Figure 5. *Scorpaena maderensis* (left arrow) and ropes (right arrow) over the shipwrecks of ‘Küçükkemikli Cape Barges’

Although the broken/shattered ropes create a visually bad appearance around the shipwreck, it is noteworthy that the sponges settled on these ropes and created a new habitat (Figure 4, Figure 5). It is also recommended to make a plan for sessile organisms that settled on derelict fishing gear over the shipwrecks. Scientific researchers, decision-makers and policymakers should carry out joint studies and determine appropriate policies to protect or clean these organisms from shipwrecks, taking into account their ecological niches and ecological services.

Another important problem is the negative effects of the anchors and chains used to anchor diving boats carrying divers to be deployed close to the shipwrecks. This was encountered during underwater surveys while diving into the shipwreck SS Milo in Anzak Cove (Figure 6). During the underwater surveys carried out at different times, it was determined that a previously anchored chain was seen on the shipwreck and was subsequently removed from this area. Additionally, a broken mooring rope of a diving boat was observed on the shipwrecks. Therefore, making legal regulations on this issue is considered to be one of the most important issues.

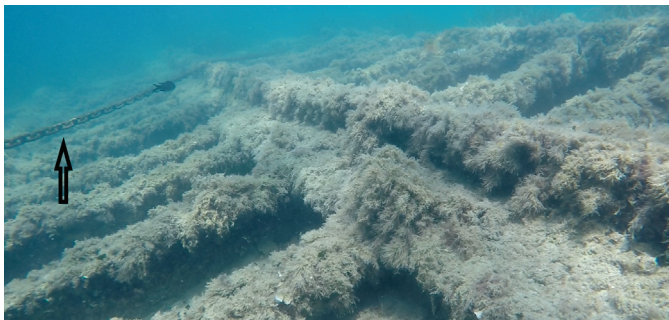


Figure 6. Anchoring chain over ‘SS Milo’ shipwreck



Figure 7. A broken mooring rope of a diving boat

This study reveals that although the areas where shipwrecks are located are known, shipwreck areas are actively used by small-scale fishermen and commercial fishermen. Since the shipwrecks serve as artificial reefs and attract commercially important fish species, fishermen's interest in these regions and shipwrecks increases. Therefore, collecting nets, fishing lines or other materials that cause ghost fishing from shipwreck sites will make significant contributions to the protection of biodiversity and will prevent divers diving in shipwrecks from getting caught or experiencing some negative accidents.

Abandoned, lost, and discarded fishing gear (ALDFG), often referred to as derelict fishing gear, has become an increasing issue, with significant amounts detected in oceans. This presents challenges for marine conservation and management (Gilman 2015; Gilman *et al.* 2021). Various forms of fishing gear persist in fishing activities even when abandoned, lost, or discarded (Do and Armstrong 2023). This phenomenon, known as ghost fishing, occurs with both passive and active fishing gear (Richardson *et al.* 2019, 2021). Evaluating the impact of ALDFG is complicated by the diverse exposure times and catch efficiencies associated with different types of fishing gear, such as nets, lines, traps, and pots. Moreover, it's important to note that not all ALDFG sustain fish capture, and there may be other significant adverse impacts that should not be disregarded (Macfadyen *et al.* 2009). Various factors contribute to the occurrence of ALDFG, with gear characteristics exerting a substantial influence on the likelihood of fishing gear loss (Wilcox *et al.* 2013). Additionally, adverse weather conditions, interactions with wildlife, defective or damaged gear, discards, or operator errors also play a role (Richardson *et al.* 2021). As fishing gear technology has advanced, fishing grounds have expanded, and traditional gears have shifted to synthetic materials offering greater resilience, reduced cost, increased breaking strength, and improved durability. Consequently, over time, the quantity, impacts, and distribution of ALDFG in the oceans have significantly risen (Macfadyen *et al.* 2009; Gilman 2015). The existence of ALDFG can lead to extensive plastic pollution in the marine trophic chain, adverse effects on marine

animal welfare and ecosystems, as well as negative influences on socioeconomic conditions (Wilcox *et al.* 2015; Gilman 2015).

Ghost fishing refers to the phenomenon where abandoned or lost fishing gear, such as nets and lines, continues to catch and kill marine life even when no fishermen are actively using the gear. This often occurs around shipwrecks, where fishing gear can become entangled with the submerged structures. The ghost fishing process begins when the fishing gear is lost or discarded and becomes ensnared on the sharp edges and protruding parts of the shipwrecks.

The impact of ghost fishing on shipwrecks is twofold. Firstly, the fishing gear, now unattended and entangled, continues to capture and entrap marine organisms. This results in unintended bycatch, including fish, crustaceans, and other marine species. The trapped animals face a grim fate, as they are unable to escape from the ensnared gear, leading to a cycle of death and further entanglement. This not only poses a threat to the affected marine life but also disrupts the natural balance of the underwater ecosystem surrounding the shipwrecks. Secondly, the persistence of ghost fishing around shipwrecks contributes to the deterioration of the wrecks themselves. The entangled fishing gear, often made of durable materials like nylon and plastics, can cause physical damage to the shipwrecks over time. The constant rubbing and tension from the ghost gear can corrode and weaken the submerged structures, accelerating their decay. This poses a threat to the historical and archaeological value of the shipwrecks, as well as the marine life that may have made the wrecks their habitat.

Efforts to mitigate the impact of ghost fishing around shipwrecks involve regular monitoring and removal of abandoned fishing gear. Divers and conservation organizations often engage in cleanup operations to free entangled marine life and remove the ghost gear. Additionally, raising awareness about the consequences of abandoned fishing gear and promoting responsible fishing practices are crucial steps in preventing ghost fishing and safeguarding both marine ecosystems and underwater cultural heritage.

Effective management of historic shipwrecks requires considering available management alternatives and selecting the alternative that will provide the highest net benefit to society. To make reasonable decisions, shipwreck managers must consider all current and potential uses (and non-uses) of historic shipwrecks (Kaoru and Hoagland 1994). Interaction between local fishermen and divers, and outreach programs will enhance efficiency and productivity of shipwreck.

Recommendations

The Gallipoli Campaign shipwrecks, like many other underwater sites, are faced with ghost fishing. Therefore, the decision makers and stakeholders may consider the following measures to mitigate the negative impacts:

- Establishing a monitoring program to regularly assess the condition of the shipwrecks
- Involving local communities and diving groups in monitoring efforts
- Raising awareness among fishermen, divers, and the general public about the impact of ghost fishing on marine ecosystems and historic shipwrecks
- Installing marker buoys around the shipwrecks to indicate their location to passing vessels
- Advocating for and support the implementation of regulations that address ghost fishing, such as proper disposal of fishing gear and penalties for illegal dumping.
- Developing strategies for the recovery and removal of ghost gear from the shipwrecks
- Designating specific areas around the shipwrecks as exclusion zones where fishing activities are prohibited
- Organizing regular underwater cleanup events involving trained divers to remove any ghost fishing gear found around the shipwrecks
- Investing in research and technology to develop innovative solutions for the detection and removal of ghost gear from underwater sites
- Collaborating with international organizations and neighbouring countries to address the issue of ghost fishing on a broader scale.

Successful mitigation of ghost fishing requires a combination of regulatory measures, community involvement, education, and ongoing monitoring and cleanup efforts. Implementing a holistic approach can help protect both the marine environment and the historical significance of shipwrecks like those from the Gallipoli Campaign.

In addition to the measures mentioned above, the measures specifically recommended to be taken by divers and the relevant public institutions/organizations are listed below:

- The rules to be followed regarding diving boats should be determined and implemented
- Diving boats should not be moored to shipwrecks in order to prevent them from drifting, shifting or deforming
- The diving boat should be allowed to anchor at least 10 m away from the wreck, and its anchors or ropes should be removed from shipwrecks
- Garbage should not be thrown into the sea from the diving boat

- Any living creature or material (belonging to the shipwreck) should not be allowed to be taken from the shipwrecks, and physical intervention should be avoided
- Foreign divers should be allowed to dive one-on-one with a diver guide
- All dives should be systematically monitored and divers should not be allowed to interfere with any shipwrecks
- Divers should be encouraged to stay away from ghost gears
- Precautions should be taken to avoid divers coming into physical contact with ghost gears and a comprehensive briefing on this matter should be conducted
- Ghost gears on shipwrecks should be cleaned systematically (every year, once a year, twice a year).

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