

The Use of Artificial Reefs for Recreational Diving

Yapay Resiflerin Rekreatif Dalış için Kullanımı

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ABSTRACT

Scuba diving has become a burgeoning branch of the tourism service. Various activities of recreational diving do not especially necessitate natural reefs-any varied vehicle such as ship, plane and other large structures may be adequately attractive. Coastal groups are turning to these structures by the way of supplying new locations for scuba diving tourists. Despite the lack of a global database, our literature review indicated extensive use of artificial reefs for recreation in the United States, currently viewed as the pioneering puissance and professional in the field. Moreover, the Canadian and Australian governments have both promoted several "ships to reef" programs focused on

recreation. However, the used of three-dimensional structures (ships, planes etc.) as artificial reefs in sensitive ecosystems such as the Mediterranean and Red Sea is not a common practice. Although scuba divers are interested in such type of structures, ships to reef is a matter of debate especially in the Mediterranean region. In Turkey, a National Artificial Reef Program was drafted in 2008, however there is no regulation at present about intentionally sinking a ship for the creation of recreational diving destinations. The aim of this review was to investigate the use of man-made structures as artificial reefs for recreational diving around the world.

Keywords: Ships to reef, diving tourism, artificial reef, Mediterranean Sea, Turkey.

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ÖZET

Aletli dalış, turizm sektörünün gelişen bir kolu haline gelmiştir. Çoğu rekreasyonel dalış aktivitesi özellikle doğal resiflere gereksinim göstermemekte, gemi, uçak ve diğer büyük yapılar da dalış için yeterince cazip olabilmektedir. Kıyasal alan kullanıcıları dalış yapan turistlere yeni yerler sağlamak için bu yapılara yönelmektedirler. Küresel bir veri tabanı olmamasına rağmen, literatür incelememiz günümüzde bu alanda öncü ve uzman olarak görülen ABD'nin rekreasyonel dalış için yapay resifleri yaygın şekilde kullandığını göstermiştir. Ayrıca Kanada ve Avustralya hükümetleri rekreasyon üzerine odaklanan "gemi resifi" programlarını geliştirmişlerdir. Ancak Akdeniz ve Kızıldeniz gibi hassas ekosistemlerde üç boyutlu yapıların (gemi, uçak vb.) yapay resif olarak kullanılması yaygın bir uygulama değildir. Her ne kadar dalğışlar bu tür yapılara ilgi duyuyor olsalar da, gemi resifleri özellikle Akdeniz'de tartışma konusudur. Türkiye'de bir "Ulusal Yapay Resif Programı" 2008 yılında hazırlanmıştır, fakat programda rekreasyonel dalış alanları oluşturmak için kasten gemi batırma hakkında bir düzenleme bulunmamaktadır. Bu derlemenin amacı, dünya çapında rekreasyonel dalış için insan yapımı yapıların yapay resif olarak kullanımını araştırmaktır.

Anahtar sözcükler: Gemi resifi, dalış turizmi, yapay resif, Akdeniz, Türkiye

1. INTRODUCTION

The nautical environment do the honours a series of tourism and a recreational pursuit represented by a variety of activities including angling, surfing, marine viewing, snorkeling and scuba diving (Dimmock, 2007; Musa and Dimmock, 2013). Recreational scuba divers have soaked up the marine environment since the mid-1940s when secure and dependable equipment became commercially convenient (Dimmock, 2009). During 1980s and 1990s recreational scuba diving was one of the world's fastest growing recreational activities, and carries on to be an important and favorable business (Edney and Spennemann, 2015), with an estimated number between 3 (Lew, 2013) and 28 million (Garrod and Gossling, 2008) worldwide active divers present. Many components play a role in the fast development of this sport, particularly; transportation to distant diving sites,

technological developments in equipment, a raise in spare time as well as an increasing of social attention in nature protection and environmental mindfulness (Garrod and Wilson, 2003; Musa and Dimmock, 2013).

There is a direct correlation between growing numbers of divers and the environmental pressure on diving areas. Keep on development in reef-based tourism connected with an increasing request for suitable diving areas may disagree with the environmental values of various coastal regions inducing reef deterioration (Kirkbride-Smith, 2014). Higher effects on the marine ecosystem are mostly based to poor buoyancy control and common diver inexperience (Harrioult *et al.*, 1997; Barker and Roberts, 2004; Hawkins *et al.*, 2005; Shackleton, 2010).

An artificial reef (AR) is a submerged (or partially exposed to tides) formation purposely placed on the sea floor to imitate certain properties of a natural reef, such as

defending, regenerating, gathering and/or augmenting populations of living marine resources. This involves the conservation and regeneration of environments. It will service as habitat that function as partial of the nature while doing 'no harm'. Artificial reefs are used in seas around the world for many purposes, eg. conservating fragile habitats from fishing activities, renovating depleted regions, reducing habitat loss, increasing biodiversity, enhancing populations of aquatic organisms by providing shelter for all species during sensitive life stages, giving new substratum for algae and mollusc, improving professional and recreational fisheries, making satisfactory areas for diving, providing a mean to manage coastal activities and decrease disagreements, promoting research and educational studies, creating potential networks of marine protected areas (MPAs) to manage the life cycles of fish and connectivity (Fabi *et al.*, 2015).

At present for purposes of shoreline protection, habitat creation for fish and marine life, and attraction of recreational diving tourism, a number of ships, planes and other large man-made structures have been intentionally sank in the seabed along North American, European, Australian and other coasts (Pendleton, 2005). These structures are placed deliberately as a recreational source, such as angling, surfing or diving and for other aims worldwide (Edney and Spennemann, 2015). The use of vessels as recreational artificial reefs for divers is supportive in habitats where natural reefs are missing, to decrease the human being pressure on natural, fragile areas. As a rising apply, the utilize of artificial reefs is being progressively identified as an efficient administration plan to support minimise user pressure on natural fragile environments (Van Treeck and Schuhmacher, 1999; Zakai and Chadwick-Furman, 2002; Hasler and Ott, 2008; Van Treeck and Eisinger, 2008; Polak and Shashar, 2012). ARs have been largely utilized to serve diving activities in

numerous areas around the world and are their use is growing (Johns *et al.*, 2003; Pendleton, 2005). Artificial habitats also stand for a potentially large financial source, even in sites where many users are probable to live close by. Native users make use of the advantages provided by the recreational chances of ARs (Pendleton, 2005). Additionally, these reefs might be thought to give shipwreck diver occasions for instruction and expertise progress than ancient wrecks, as many of recreational artificial reefs are adapted and pre-cleaned to their sinking to make them safer for divers and the marine environment (Edney and Spennemann, 2015). Recreational diving is a quickly developing business and more artificial habitats are being fixed, submerged and serviced for the recreational scuba diving.

In this paper we have reviewed that use of ships-to-reefs for the creation of new diving sites around the world and will compare with practices of Turkey and other Mediterranean countries' artificial reefs for diving tourism.

1.1. Ships-to-Reef for Diving Tourism Worldwide

Deployment and investigation of operation seems to have been focused on waters of Florida, Texas and Louisiana, where structures are used by growing recreational quests such as surfing, diving (Leeworthy *et al.*, 2006) and fishing. Besides America, the Canadian and Australian governments have both backed up a number of successful "ships to reef" programs aimed at recreational activities (Jones and Welsford, 1997; Dowling and Nichol, 2001; Schaffer and Lawley, 2007).

The first governmental efforts to provide ships as artificial reefs began with the Liberty ship program in U.S.A. Federal and state government participation in the procurement of steel vessels for use as artificial reefs. The project started with Alabama's initiative to secure Liberty ships from the U.S. Maritime Administration's

(MARAD) Reserve fleet in the Alabama River. There were 36 Liberty ships available in Texas, Alabama, Virginia and California. The majority of the ships were sunk between 1974-1978, with 26 of 36 Liberty ships available in 1972 sunk off four Gulf coast sites, including Alabama with five, Texas with 12, Mississippi with five, and Florida Gulf coast with four. During the period 1986-95, in Florida alone, 28 projects have involved vessel procurement, cleaning and sinking (Lukens, 1997). To date, over 700 ships serve as artificial reefs in the waters off the continental U.S. coastline. The majority of these ships are found off the coast of Florida (380), New Jersey (129), South Carolina (100), and New York (65) (Pendleton, 2005). In the Mediterranean Sea, There are applications of recreational artificial reefs in Albania, Cyprus, Israel, Malta and Turkey. A diving survey performed in the last decade showed that there was large potential for diving tourism in the Karaburuni peninsula in Albania (Fig. 1a). The immersion of several ex-naval vessels was predicted within the Pilot Fishery Development Project (Government of Albania and World Bank, 2006). In 2010, five decommissioned Albanian Navy ships were intentionally submerged in the

Ksamil Bay with the help of the United States Navy vessel Grapple. Malta has occasionally used ships for scuba diver since the late 1980s (Jensen, 2002). In U.K., there are interests in creating reefs for diving tourism. The first scuba diving reef was licensed in 2001 close to the port of Plymouth. In Turkey, the Bodrum peninsula is one of the most impressive touristic and recreational areas for scuba diving in Turkey. In 2007, two old vessels and one plane was sunk as artificial reefs in the south of Karaada (Fig. 1b), After the immersion of them, half of the 400 000 dives transfered to these ARs. Therefore, half of the diving pressure and stress on natural environments were moved away thanks to the artificial reefs. Although Turkey has the National Artificial Reef Program, there is no regulation about using ships to create artificial reefs for diving destinations and a lot of vessels (often using decommissioned military ships and airplanes), which are sunk by the collaboration of municipalities, coast guard and associations without any procedure, have been sunk almost in the last decade in all Turkish Seas. A list of vessels used as artificial reef in Turkey are summarized in Table 1.

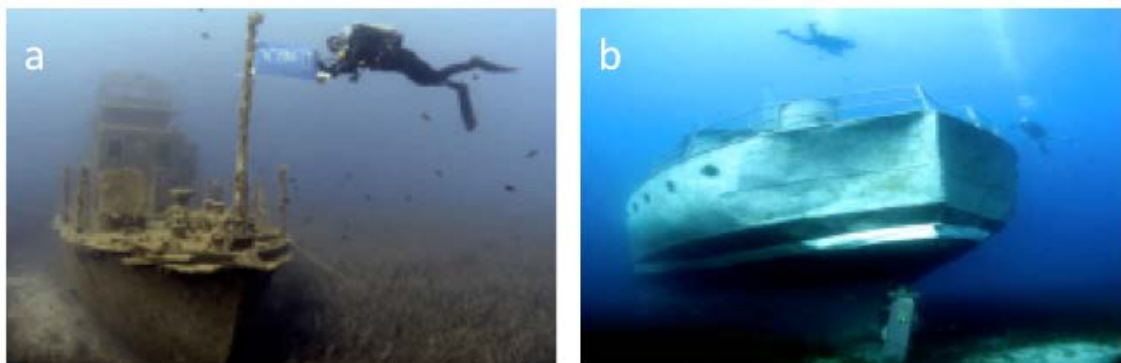


Figure 1. (a) Ship wreck submerged as artificial reefs for diving in Kamil Bay, Albania (courtesy of the Albanian Center for Marine Research), (b) Ship wreck sunk as artificial reefs in south of Karaada, Turkey.

Table 1. Ships and vessel wrecks used as artificial reefs for recreational diving in Turkey.

Location	Date	Design	Number	Depth (m)
İzmir inner Bay	1989	trolleybus	10	16-20
Alanya, Damlataş Beach	June, 2006	ship	1	26
Bodrum, Karaada	May, 2007	ship	2	18-30
Kemer, Üçadalar	May, 2007	ship	1	18-20
Bodrum, Paçoz Bright	July, 2008	airplane (C47)	1	16-33
Düzce, Akçakoca	June, 2009	airplane (C47)	1	29
Kaş, İnceboğaz	June, 2009	airplane (C47)	1	18-22
Seferihisar, Sığacık	Sep, 2010	ship	1	20
Mordoğan	May, 2011	airplane	1	18
Kaş, Çukurbağ Peninsula	June, 2011	ship	1	18
Didim	Oct, 2011	ship	1	20
Fethiye	Apr, 2012	ship	1	28
Samsun, Kurupelit	Dec, 2012	ship	1	20
Kemer, Üçadalar	Sept, 2013	airplane (C47)	1	23-31
Edirne, Saros Bay	Sept, 2014	ship	1	-
Mersin, Silifke	Jan, 2015	ship	1	-
Karaburun	Apr, 2016	ship	1	25-35
Dikili, Beylikçeşmesi	May, 2016	ship	1	35
Karaburun	May, 2016	ship	1	25-35
Kuşadası	June, 2016	airplane (Airbus)	1	-

1.2. Legislations of Ships-to-Reef

Artificial reef deployment is an activity covered by several international legal instruments, including those on the protection of the sea. The “London Convention” is one of the first worldwide conventions concerning the protection of marine environmental from human activities. The Barcelona Convention replaced the 1975 United Nations Environmental Programme Mediterranean Action Plan of the Barcelona Convention, a regional cooperative effort launched in 1975 involving the European Community and 21 countries bordering the Mediterranean Sea (Fabi *et al.*, 2015). The structures used, which are most commonly used for artificial reef construction, are vessels. In such cases, the vessel must be cleaned prior to placement. The London Convention and Protocol Specific Guidelines for Assessment of Vessels serve as a useful starting point for this process. In the U.S. artificial reefs have been utilized for recreational purposes. In the Mediterranean, by contrast, governments

have used artificial reefs more as a conservation and restoration tool.

1.3. Economic Values of Ships-to-Reef

Producing an artificial reef can be costly. The cost to get ready a ship for reefing can range from \$ 56 000 to \$ 2.4 million, depending on the size of the vessel (Pendleton, 2005). Johns *et al.* (2003) and Milon (1998) evaluate values for recreational diving in Florida ranging from \$ 5.45 to \$46.76 per person-day. Artificial reefs also represent a potentially large economic. Native users, especially local divers, benefit from the recreational possibilities provided by artificial reefs.

2. CONCLUSIONS AND OUTLOOK

Recent projects to sink ships as artificial reefs have taken up to twenty years with the growth in popularity of artificial reef wrecks. The right site location for artificial reef creation is vital to their ecological, physical and economic success. The location chosen for the reefs placement

(from a biological perspective), is important since natural reef habitat can provide an important source of transient fishes and juvenile fish to the recruitment of artificial reefs. Additionally, following vessel deployment, artificial reefs provide ecological benefits to the surrounding natural reefs. Yet, initially its cleanup standards still are not well defined worldwide. These standards should be reasonable, environmentally sound, and repeatable and have quantifiable methods especially in vulnerable ecosystems such as the Mediterranean.

Although many countries comply to the London Convention and Protocol in Mediterranean, while especially Italy, France and Greece, which have a lot of sanctuary areas as compared to Turkey, avoid sinking vessels as artificial reefs for diving tourism, Turkey continue to sink ships and airplanes particularly during the last years.

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