Can brush parks aggregate species in lagoon systems? A case of Homa Lagoon, Aegean Sea, Turkey

Deniz Acarlı*, Semih Kale, Ali Kara

ABSTRACT

This study aimed to investigate the species aggregating performance of brush parks in Homa Lagoon, Aegean Sea, Turkey. The study was conducted in 100 m² area between June 2004 and January 2005 in Homa Lagoon. Alternative fishing gears (produced from Polyvinyl chloride (PVC) and sacks filled with bush bundles) were investigated for the first time by the present study besides commonly used fishing gears (fyke net, basket trap, and circled lift net) in traditional fisheries in lagoon systems in Turkey. The species composition was determined for each fishing gears for brush park fisheries. A total of 1855 individuals were caught and the highest yield was obtained from the basket traps (1018 individuals) followed by the sacks filled with bush bundles traps (324 individuals), PVC materials (313 individuals), and the circled lift nets (200 individuals). This study revealed that brush park fisheries can attract the species in lagoon systems. Therefore, socioeconomic assessment and appropriate fisheries management approaches for brush park fisheries and lagoon fisheries should be carried out and applied for sustainable use of fisheries resources in lagoon systems.

Introduction

Fish aggregating (or attracting) devices (FADs) as the form of man-made floating objects have been used worldwide by commercial, artisanal and recreational fishers for catching mainly pelagic fish species (Dempster and Taquet, 2004). FADs increase the catchability of fish species with regard to free swimming fish species (Guillotreaua et al., 2011). Moreover, they increase recruitment, sustainability and habitat of fish species (Kingsford, 1999). Brush park is a kind of FADs which make possible the aggregation and attraction of fish. Brush parks are underwater constructions made up of wooden materials that are usually fixed to the bottom of a shallow water body (COFAD, 2002). Brush parks provide substrate for the growth of periphyton and suitable habitats and shelter areas for several fish species. Therefore, brush parks have high level of nutrients (Welcomme, 2005). They also significantly increase the efficacy of fishing operations (Béné and Obirih-Opareh, 2009). Brush parks are commonly used in western part of Africa (Benin, Ghana, Ivory Coast, Nigeria, and Togo) where they are known as acadjas (Lalèyè, 2000), samrah in Cambodia (Ho, 1999), and katha in Bangladesh (Ahmed and Akther, 2008; Uddin et al., 2015).

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Homa Lagoon is one of the most significant lagoons in the coasts of Aegean Sea of Turkey and it is a biodiversity hotspot (Çolak-Sabancı, 2012). Homa Lagoon was included within the list of wetlands of international importance (Ramsar Site) in Gediz Delta Ramsar Site. Homa Lagoon serves as a natural habitat and provides living space, protection from predators for many aquatic species that have high economic value and more than 200 bird species (Acarlı, 2007). Fish and birds prefer these areas for breeding, feeding, living, nursery, and growth (Alpbaz, 1990; Akyol, 1999; Elbek et al., 2003; Deveciyan, 2006; Acarlı, 2007).

Some studies have been carried out in Homa Lagoon. These studies include different aspects, for instance, limnologic characteristics such as physicochemical characteristics (Ünsal et al., 2000), zooplankton (Pulat and Özel, 2003), algology (Çolak Sabancı and Koray, 2010; Çolak Sabancı et al., 2011; Çolak Sabancı, 2012), growth and survival rates of *Tapes decussatus* (Serdar et al., 2007) *Anadara inaequivalvis* (Acarlı et al., 2012), *Ostrea edulis* (Lok et al., 2005), reproductive activity of *O. edulis* (Acarlı et al., 2015), catch efficiency and catch composition of species (Acarlı et al., 2009), length-weight relationships of fish species (Acarlı et al., 2014) of Homa Lagoon. Heavy metal and pesticide concentrations in fish, molluscs, polychaete species were also studied by some authors (Atılgan and Egemen, 2001; Taş et al., 2009; Bilgin and Uluturhan Suzer, 2015, 2017; Sevgi and Uluturhan Suzer, 2019; Uluturhan et al., 2019). Moreover, fisheries management (Tosunoğlu and Ünal, 2012; Tosunoğlu et al., 2013) and some socioeconomic aspects of fisheries in Homa Lagoon were examined (Köken et al., 2019). Traditional fishing gears such as fences trap, trammel net, veranda net, and fyke net are commonly used in Homa Lagoon where the most caught species have been Mugilid species including *Mugil cephalus, Liza saliens, Liza ramada, Liza aurata, Chelon labrosus*. Apart from these species, fishing efforts are also performing for *Sparus aurata, Dicentrarchus labrax, Solea solea,* and *Anguilla anguilla* species.

Several fishing gears are used in the lagoon fisheries. However, there is no study on the assessment of fish aggregating performance of brush parks in Homa Lagoon. In addition, there is a lack of information on the utilization of polyvinyl chloride (PVC) pipe materials as alternative fishing gears for brush park fisheries in Homa Lagoon. Therefore, the aim of this study was to investigate the species aggregating potential of brush parks in Homa Lagoon. PVC pipe materials and sacks filled with bush bundles were used for the first time as fishing gears in the present study.

**Material and Methods**

Homa Lagoon (Figure 1) covers 1852 ha area (Acarlı, 2007) and maximum depth of the lagoon is 1.8 m while average depth ranges between 0.5 m and 1.0 m (Acarlı, 2007). The study area is an active lagoon and spawning season for fish species is between June and October in this lagoon (Acarlı, 2007). At the end of the spawning period, fence traps are closed and fish are introduced into the lagoon voluntarily but prevented from leaving. In autumn season, high salinity is observed due to rainfall and evaporation (Çolak Sabancı, 2012).

**Figure 1.** The location of the study area in Homa Lagoon
Brush parks were established on 100 m² area in the Homa Lagoon. Piles having 10m×10m and 8m×8m were fixed in the lagoon. FAO (2007) reported that many species live around these traps. Similarly, several authors also documented that these traps attracted animals (Buffe, 1958; Costa and Wijeyaratne, 1994; Welcomme, 2002). Hence, fyke nets, basket traps and polyvinyl chloride (PVC) materials were used and placed around brush parks. Two types of PVC materials were investigated in the study. The first one had 100 cm length and 8 cm diameter (named as PVC 100) while the other one had 300 cm length and 11 cm diameter (named as PVC 300). One of the entries of PVC materials was covered by nets. In addition, PVC materials were interconnected with each other by No.5 surface rope such as longline. The technical measurements and characteristics of fyke nets are given in Figure 2 while the characteristics of basket traps are presented in Table 1. Four different basket traps models were used in the study. The model#1 had blue colour and foldable characteristic in the shape of rectangular prism while model#2 was circle and foldable. The model#3 and model#4 had circular shape whereas the length of the model#3 was higher than model#4. The characteristics of basket traps are also summarized in Table 1. The sacks filled with bush bundles were used for the first time by the present study to investigate the fish attracting performance in the lagoon systems. The circled lift nets were placed around the brush parks. European pilchard (Sardina pilchardus) and the Mediterranean mussel (Mytilus galloprovincialis) were used as baits for the circled lift nets. The diameter was 50 cm and mesh size was 12 mm (210D/18N) for the circle of the lift net (Figure 3).

**Results**

Four different fishing traps were placed around the brush parks and 1855 individuals were caught by brush park fisheries. The highest yield was obtained with the model#1 basket trap. The most caught species was Carcinus aestuarii (741 individuals). In addition, 157 gastropod individuals (belonging to
15 different species including Cerithium vulgatum, Nassarius incrassatus, Turritella communis, Epitonium commune, Osilinus sp., Pirenella conica, Nassarius mutabilis, Nassarius pyrgmaeus, Gibbula albida, Nassarius reticulatus, Bittium reticulatum, Gibbula adensonii adensonii, Cyclopes neritea, Bittium brandaris, Hexaplex trunculus, Crustacean species Paguristes syrtensis, although their small areas compared with the total surface areas of water bodies where they are hosted (Béné and Obirih-Opareh, 2009). Sugunan et al. (2007) indicated that well-managed brush parks can even be equivalent to intensive or semi-intensive aquaculture operations with regard to annual per-unit-area harvesting rates. Therefore, brush park fisheries can considerably contribute to the increase of water productivity.

Welcomme (2002) indicated that the detrimental or beneficial status of brush parks for natural fish stocks depends to a great range on the ecology of the fish species existing in the water body. Some fish species are attracted for their shelter and food needs while others for reproduction (Anis et al., 2015). If brush parks were used by fish species for breeding, they could serve as a shelter for young fish species and improve the growth and survival of the species. Thus, brush parks have a positive impact on the growth and survival rate of the natural fish stocks. Furthermore, opportunistic predators are attracted to brush parks as stated by Malone et al. (2011). Gammanpila et al. (2017) have revealed that ecomorphology of the fish species in the brush parks is associated with diet. Knowledge on feeding ecology of the fish species in a fish assemblage makes the understanding of trophic interactions possible (Gammanpila et al., 2019a). The understanding of these interactions has a great importance for fisheries managers to decide on ecosystem based management (Pikitch et al., 2004).

In Turkey, lagoon fishermen have been using fishing materials and methods such as trammel nets, fyke nets, longlines, nets (seine or etc.) and fences since many years (Deveciyan, 2006). The fences traps (“kuzuluk” in Turkish) are the most basic fishing gear types for the whole operational lagoons in the coasts of Aegean Sea (Kaykaç and Tosunoğlu, 2015). On the other hand, despite brush parks were used in numerous countries such as Bangladesh (Kapetsky, 1979; Wahab and Kibria, 1994; Ahmed and Hambrey, 1999; Ahmed and Akther, 2008; Uddin et al., 2014, 2015), Benin (Buffe, 1958; Laléyé 2000; Niyonkuru and Laléyé 2010), Cambodia (Fily, 1966; Ho, 1999; Lamberts, Table 1. The characteristics of the basket traps used in the study

<table>
<thead>
<tr>
<th>Traps</th>
<th>Height (cm)</th>
<th>Width (cm)</th>
<th>Length (cm)</th>
<th>Entry Diameter (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model#1</td>
<td>65</td>
<td>36</td>
<td>116</td>
<td>7</td>
</tr>
<tr>
<td>Model#2</td>
<td>40</td>
<td>70</td>
<td>193</td>
<td>10</td>
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<tr>
<td>Model#3</td>
<td>30</td>
<td>70</td>
<td>225</td>
<td>15</td>
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<tr>
<td>Model#4</td>
<td>25</td>
<td>55</td>
<td>169</td>
<td>11</td>
</tr>
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</table>

PVC materials caught 313 individuals belonging to 21 different species. PVC 100 aggregated Palaemon sp. (71 specimens), gastropods (63 specimens), Carcinus aesturariai (32 specimens), and G. niger while PVC 300 intensely collected Palaemon sp. (119 specimens) beside gastropods (15 specimens), C. aestuarii (2 specimens), Blennius ocellaris (7 specimens) and G. niger (2 specimens).

The sacks filled with bush bundle traps attracted commonly Palaemon sp. (324 individuals) in addition to Crustacean species C. aestuarii (87 individuals).

The circled lift nets were used for the first time in Homa Lagoon in the present study and they caught 200 individuals belong to 20 different species including gastropods (186 individuals from 15 different species), Palaemon sp. (11 individuals) and Zosterisessor ophiocephalus (2 individuals) and G. niger (1 individual).

Discussion

The lagoon fishery production have several activities: traditional fishing on lagoon canals and water areas, valley fishing; farm fishing (aquaculture) mussel farming and clam fishing (Rosetto, 2001). Brush parks in lagoon systems can improve fisheries production considerably
References


An investigation of brush park fishing in Lagos lagoon of Nigeria has been carried out by Solarin and Udolisa (1993). Positive correlations were found between the fish caught in the brush park and the period of establishment (Solarin, 1998) and between the fish and density of establishment (Solarin and Kusemiju, 2003). Abdul et al. (2004) reported that brush park fisheries presented a respectable catch to the fisherman in Iwopin Lagoon area, Nigeria. In addition, brush park fishing was found profitable and it had supported to development of fisheries and had reduced the poverty among the Nigerian rural inhabitants. Gammanpila et al. (2016b) reported that the optimal time period for fishing was about 30 days after the establishment to reach maximum yield in brush park fisheries.

Atar et al. (2002) have investigated the catching efficiency and catch rates of three different traps in Beymelek Lagoon of Turkey. They reported that traps were particularly effective in crustacean fisheries and that the most caught species was Carcinus aestuarii. In addition, they documented that Lyngbya majuscuta, blue-green algae, caused the closure of traps and circled lift net meshes. Thus, it allows the intensive fishing of crustacean and gastropod species. The results of the present study are similar to the findings of Atar et al. (2002).

Different species have been observed around the brush parks. The adherence of macroalgae to the piles by the currents might be possible providing a feeding and sheltering area for species. Hence, animals were attracted to the piles. Moreover, thigmotropism behaviour of animals (the attraction of animals to a solid object) was efficiently and effectively monitored in brush park fisheries. Therefore, fish behaviour mechanisms should also be investigated for species observed in lagoon system in future researches.

Brush parks have been accepted to be a comparatively effective fishing method to improve the productivity of fisheries. They could efficiently contribute to the improved food productivity in the rural areas where they are established. Thus, brush parks can play an important role in fisheries productivity ensuring the food availability, rural development, and poverty alleviation.

An appropriate management of brush park fisheries can be used as a potential tool to ensure the sustainability of fisheries resources in lagoon systems. Establishment of brush parks may possibly help to develop biodiversity and habitats in Homa Lagoon. Fish population can get benefits of food and shelter in the brush parks throughout the dry season. Furthermore, the fish population can gain sexual maturity for spawning in the next breeding season which is clearly vital for the sustainability of fisheries resources to the next generations.

Conclusion

The present study revealed that brush park can aggregate and attract species in lagoon systems. Brush park fisheries contribute to sustainable fisheries and ecosystem approach to fisheries management by using less harmful fishing gears for habitat and fish stock.

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