RESEARCH ARTICLE　　　　　　　　　　　　　　　　　　　　　　　　　　**ARAŞTIRMA MAKALESİ**

Perception and demand for artificial reef by relevant local groups in Altınoluk (Turkey)

Altınoluk'ta ilgili grupların yapay resif algısı ve talebi

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Özet: Bu çalışmada, Türkiye Ulusal Yapay Resif Master Planı'nın pilot bölgesi olan Altınoluk'da yerleştirilmesi planlanan yapay resiflere olan talebin belirlenmesi amaçlanmaktadır. Çalışma kapsamında, Altınoluk'daki ticari balıkçılar, rekreasyonel balıkçılar ve yöre sakinleri ile yüz yüze görüşmeler gerçekleştirilmiştir. Veri toplama çalışmaları, yapay resif yerleştirmesi yapılmadan önce, Nisan, 2011'de tamamlanmıştır. Çalışma hedef gruplarının yapay resif algısı özel olarak tasarlanan 13 ifade Likert ölçeği yardımıyla analiz edilmiştir. Elde edilen sonuçlara göre, yapay resifler ile ilgili olumlu algı gözlenmiştir. Öte yandan, yapay resif yerleştirilmesi ile birlikte hem rekreasyonel balıkçılık (%158 artış) hem de ticari balıkçılık (31% artış) günlerinde artış tespit edilmiştir. Sonuç olarak, yapay resiflerle ilişkili grupların daha iyi anlaşılması ve yönetim süreçlerine dahil edilmesi yapay resiflerin etkinliği açısından önem taşımaktadır.

Anahtar kelimeler: Yapay resifler, algı, rekreasyonel ve ticari talep, yönetim.

Abstract: In this study, it is aimed to determine demand for the planned artificial reefs in Altınoluk where is the pilot site of the National Artificial Reefs Master Planof Turkey. Face to face interviews were conducted with commercial fishermen, recreational fishermen and local residents within the study. Data collection process was completed in April, 2011 before the artificial reefs deployment was launched. Artificial reef perception of the study target groups were analyzed by specially designed 13 statements with the aid of Likert scale. According to the results, positive perception regarding the artificial reefs was observed. Moreover, increases in both recreational fishing (158% increase) and commercial fishing (31% increase) days was determined with the deployment of artificial reefs. In conclusion, understanding artificial reef related groups and including them in management processes are crucial for the effectiveness of artificial reefs.

Keywords: Artificial reefs, perception, recreational and commercial demand, management

INTRODUCTION

Artificial habitats, deployed on the seafloor to conserve sensitive aquatic ecosystems or increase and contribute to the productivity of resources, have positive effects on commercial and recreational fishing (Seaman and Sprague, 1991). Artificial Reef (AR) deployments have recently become popular in Turkey where the first planned AR application dates back 20 years. Within the Master Plan of Turkish Artificial Reefs, a pilot project in Altınoluk (Edremit Bay) has been started to contribute to the marine life.

Deployments of ARs have many purposes including support to small-scale and traditional fisheries, to create new sites for recreational fishing and diving, to protect biodiversity, especially in the littoral zone, to protect fish-spawning and nursery areas from illegal trawling (Lök, 2012). Therefore, directly or indirectly, ARs constitute commercial and recreational demand which means an increased economic activity in the area where they were deployed. Hence,

deployment of ARs contributes to increase welfare locally and nationally (Ditton *et al.*, 2002; Morgana *et al.*, 2009; Oh *et al.*, 2008; Pendleton, 2004; Tunca, 2011; Tunca *et al.*, 2012).

Schug (1982) estimated total yearly expenditure of ARs users as 181,000-253,000 USD whereas, benefit – cost ratio of ARs was determined as over one. Study by Brock (1994) indicated both considerable positive effects of ARs: (1) Total yearly income by commercial (small scale) fishing was equal to 4% of one day diving charter to ARs, (2) Daily catch from ARs site was equal to yearly sustainable catch which means that the almost total catch was from the ARs site. The most comprehensive study was carried out by Bell *et al.* (1998) in the Northwest Florida.They demonstrated that there are 414 million USD contribution of ARs beside 8,136 new job opportunities and 84 million USD increase in salaries. In the Southwest Florida, ARs created 27,000 employments, beside 782 million USD increase in all incomes (Johns *et al.*, 2001).

ARs have been well-introduced as economy generator tools but the structure of multi-stakeholder (Commercial and recreational fishermen and SCUBA divers, etc.) (Milon, 1989a; 1989b) of ARs may cause conflicts because of the lack of management practices combined with **Integrated Coastal Zone Management** frameworks. Recent acts on management of ARs have already been begun to discuss (GFCM, 2012). In the management plans it is crucial to include constant social and economic monitoring of ARs.

This study primarily aims to measure the perception toward to ARs with specifically designed 13 statements covering biological, social and economic aspects. Secondly, it was aimed to calculate current and future estimated commercial and recreational demand of ARs. Finally it was aimed to provide information for decision makers about the demand framework of ARs.

Study site

The research was carried out in Altınoluk which is fishing and tourism district with the 13,800 population located innorthern Aegean coast of Turkey (Figure 1). Altınoluk County was found eligible for thepilot project of Turkish National AR Master Plan. Small-scale fishery dominates fishing activity in Altınoluk. 95% (55 commercial fishermen) of fishermen are organized under the Altınoluk Fishery Cooperative in the region. Altınoluk Fishery Cooperative was established in 2006 with the support and leadership of an extraordinary and innovator local fisher. The cooperative keeps seven employees permanently during the whole year and twenty employees temporarily during the summer time due to it also runs cafe, restaurant and aquarium (Ünal *et al.,* 2009). In this region, recreational fishing is another demanding activity on shore and/or by boat, and nearly 400 recreational fishermen attending this activity. Additionally, there is one diving charter in Altınoluk which only activates in the summer season.

Figure 1. Map of Turkish Aegean Sea coasts with the study area: Altınoluk

MATERIALS AND METHOD

Field studies were conducted to collect data from target survey groups via specifically designed questionnaire forms. Twenty commercial fishermen (CF) who are members of the Altınoluk Fishery Cooperative responded the questionnaires. Out of approximately four hundred recreational fishermen (RF) in the region, fifty five boat-based and shore-based RF were interviewed in fishing access points around Altınoluk fishing port. Lastly, for 13,800 local residents (LR) of Altınoluk, household survey was conducted through 67 LR. The sampling sizes for each group were determined by using the proportional sampling size formula in Equation 1.

$$n = \frac{Np(1-p)}{(N-1)\sigma_{px}^2 + p(1-p)}$$ (Equation 1)

Where *n* is the sample size, *N* is the population of each target group (CF, RF and LR), *p* is the contribution ratio to ARs (0.50 is used to reach the maximum sample size), and σ_{px}^2 is the variance. Representative sample size was calculated for each group according to 95% confidence interval and 50% error (Miran, 2003).

Additionally, basic descriptive statistics and parametric tests (analysis of variance, Kolmogorov-Smirnov and Tukey's Post Hoc Test) were used to better understand relations between socioeconomic dimensions and AR demand.

RESULTS

Demographics

A total of 55% of the CF were in the 26-45 age group, while 40% of them were in the 46-60 age group. Among the recreational fishers interviewed, members of the 26-45 age group composed the highest portion and secondly, the 46-60 age group, as in the case of the commercial fishers. Furthermore, it was determined that 6 RF were older than 61 years and 1 recreational fisherman were younger than 26 years. Among the household respondents who participated in the research, the 26-45 and 46-60 age groups had 53.7% and 31.3% of the respondents, respectively, whereas respondents were older than 61 years and younger than 26 years constituted minorities. The most common education levels of the CF were about eight years of secondary education. In contrast, RF have higher educational levels, with an average of 9.3 years. The mean period of education of the local people was 10.8 which are slightly higher than the general average for all of the respondents' education levels (9.9). The RF had the highest proportion of members with social security (89.7%). Following them, 80.6% of the local people and 60% of the CF had social security. A total of 34.5% of the RF were retired persons. Following those people, public servants and freely occupied individuals constituted the majority of this group. Among all of the respondents, retired persons composed the majority, with 40 individuals, while freely occupied persons, public servants, workers for a national company and fishermen almost homogeneously composed the majority of the rest of the individuals (105). The average monthly income of the CF was 1192.5 TL (1 TL: Turkish Liras=0.37 Euro, Spring-2011 TL/Euro Mean Ratio), while

75% of them were in the 501-1500 TL income group and 25% of them were in the 1501-3000 TL income group. 79% of the RF, were in the 501-1500 TL income group, although the mean monthly income was determined to be 1354.1 TL greater thanthe commercial fishers' monthly mean income. In contrast, the local people's monthly income was mostly in the 1501-3000 TL income group (mean 1360.5 TL). Moreover, for the local people, 30% had an income of 3001-5000 TL, and 15% was in the 5001-10000 TL income group. Overall, the 1501-3000 TL (66%) and 3001-5000 TL (24%) income group composed the majority. Additionally, the mean number of individuals that the CF were responsible for was nearly two and that of the average household population was three. These numbers were different for the RF, who were on average responsible for only one individual, and the total family population was three, as in the case of the CF. The local people were on average responsible for two individuals, and the mean household number was three. Generally, the mean number of individuals that all of the respondents were responsible for was approximately two, and the mean household population was about three.

To deeply investigate the relations among demand and socioeconomic variables, statistical tests were done. Firstly, normal distribution was determined by Kolmogorov-Smirnov Test for each commercial and recreational demand data sets of CF, RF and LR including the number of yearly current commercial or recreational fishing/diving/trip days in ARs site (p>0.05); the number of yearly current commercial recreational fishing/diving/trip fishing days (p>0.05) and future stated commercial fishing days in ARs site after the deployment (p>0.05).

Then, in the study, the possible effect of education (education levels in years: below 5; 5-8; 8-11; above 11) and income (Income levels: below 1000 TL; 1000-3000 TL; above 3000 TL) on commercial/recreational demand was analyzed for each group via analysis of variance (ANOVA) with an additional Tukey's Post-Hoc Test.The number of commercial fishing days each year in the ARs site (p>0.05), the number of total yearly commercial fishing days (p>0.05) and future stated commercial fishing days in the ARs site after deployment (p>0.05) was found not to have statistically significant relation with education level. The ANOVA analysis was also performed for the RF and the LR to present the effect of education level on demand (Present recreational fishing days in ARs site (p>0.05), total yearly recreational fishing days (p>0.05), future recreational fishing days in ARs site after deployment (p>0.05), but no statistically significant relation was found. For the LR, education and income has also no statistically significant effect on recreational trips done (p>0.05). Above found results proves the fact that education level and income levels have no effect on commercial and recreational demand of study groups.

Table 1.Descriptive statistics of commercial/recreational demand for education and income levels of each focus group.

			Current CF/RF Days[1]	Total Yearly Days[2]	Future CF/RF Days[3]
CF	Education	Below 5 years (N=6)	118±82.8	205±50.5	103±98.3
		5-8 years (N=7)	150±70.7	260±34.6	179±110.4
		8-11 years (N=5)	86±68.8	230±57	170±97.5
		Above 11 years (N=2)	50±70.7	250±70.7	150±70.7
		Total N=20	115±75.9	235±50.4	151±98.7
	Income	Below 1000 TL (N=13)	128±72.9	235±40.5	126±97.9
		1000-3000 TL (N=7)	90±80.8	236±7	197±88.8
		Total (N=20)	115±75.9	235±50.5	151±98.7
RF	Education	Below 5 years (N=14)	42±60.3	128±80.4	102±72.9
		5-8 years (N=13)	26±39.3	117±59.9	84±78.6
		8-11 years (N=19)	46±47.9	134±91.1	69±47.6
		Above 11 years (N=12)	37±42.9	113±68.9	110±74.7
		Total (N=58)	39±47.9	124±76.4	89±67.7
	Income	Below 1000 TL (N=30)	35±36.2	133±70.9	99±66.6
		1000-3000 TL (N=26)	46±59.3	118±82.3	79±68.7
		Above 3000 TL (N=2)	0	63±81.3	65±91.9
		Total (N=58)	39±47.9	124±76.4	89±67.7
LR	Education	Below 5 years (N=6)	23±38.3	38±57.8	8±11.6
		5-8 years (N=19)	34±68.5	50±75.7	30±14.5
		8-11 years (N=22)	37±55.2	52±65.1	15±19.5
		Above 11 years (N=20)	59±82.9	85±95.8	14±16.4
		Total (N=67)	41±67	60±78	18±22.7
	Income	Below 1000 TL (N=32)	35±58.5	54±67.9	22±27.6
		1000-3000 TL (N=32)	45±72.1	64±86.7	13±14.3
		Above 3000 TL (N=3)	110±127.3	120±113.1	23±31.8
		Total (N=67)	41±67	60±78	18±13.6

[1]The number of total yearly commercial/recreational fishing days on the AR site
[2]The number of total yearly commercial/recreational fishing days
[3]Future commercial/recreational fishing days onthe ARs site after deployment N: Number of Observations, SD: Standart Deviation

Table 2. Perception assessment through statements

Statements	CF	RF	LR	General
ARs increase biodiversity and quantity of living beings.	5	5	4.3	4.6
ARs increase the number of commercial and recreational fishing vessels.	4.5	4.5	3.6	4
ARs increase the number of commercial and RF.	4.4	4.4	4.1	4.2
ARs increase the number of diving clubs and their activities.	4.7	4.7	4.3	4.5
ARs protect some marine living species.	4.6	4.6	4.3	4.4
ARs help to put away conflicts rising among stakeholders related to use of marine zone.	2.5	2.5	3.4	3.4
ARs decrease pressure on natural reefs.	4	4	3.5	3.8
ARs play an important role on combating illegal fishing.	3.6	4.3	3.8	3.7
Constant control of ARs must be provided by a reef guard station and employees.	4.3	4.6	4.7	4.6
Constant control of ARs must be provided by fishery cooperatives, diving organizations or municipalities.	4.6	3.8	4.2	4.2
ARs increase fishing pressure on the marine zone where it has practiced.	3.8	2.9	3.9	4
ARs cause more fishing gear damage.	2.9	3.1	3.2	3.1
ARs cause conflicts among divers, commercial and RF concerning their use.	3.1	5	3	3.3

Likert Scale; 1: Strongly disagree, 2: Somewhat agree, 3: Moderately agree, 4: Quite agree, 5: Strongly agree

The statement *"ARs help to resolve conflicts rising among stakeholders related to use of marine zones"* received significantly lower agreement from the three groups, while the respondents strongly agreed with the statements *"ARs decrease pressure on natural reefs"* and *"ARs play an important role in combating illegal fishing"*. By comparing the responses to two statements *"Constant control of ARs must be provided by a reef-guard station and employees"* and *"Constant control of ARs must be provided by fishery cooperatives, diving organizations or municipalities"*, it is thought that a functional reef-guard station can be an acceptable and objective management and control tools for ARs.

Particularly, RF had slightly low agreement with management and control except for a reef-guard station of ministry. The statement *"ARs increase fishing pressure in the marine zone where the AR is placed"* was well accepted by the CF and LR, but RF only moderately agreed with this statement. Moderate agreement by all three of the groups was found for the statement *"ARs cause more fishing-gear damage"*. Finally, the statement *"ARs cause conflicts among divers, commercial and RF concerning their use"* received moderate agreement from the CF and LR, and the RF strongly agreed with that statement (Table 2).

AR Demand in the site: Use Types of AR Site

Commercial Fishing Use

Technical and economic dimensions of CF were assessed in this section. 95% of the CF indicated that they are active in terms of fishing in and/or around the predetermined pilot ARs site. In addition, 40% of the CF is attending 50 and below 50 commercial fishing days whereas, 35% of the CF stated that they are attending 101-200 commercial fishing days in a year. Then, half of the CF indicated that they are participating 201-

365 fishing days in ARs region and the other half is participating 101-200 days in a year (Figure 2).
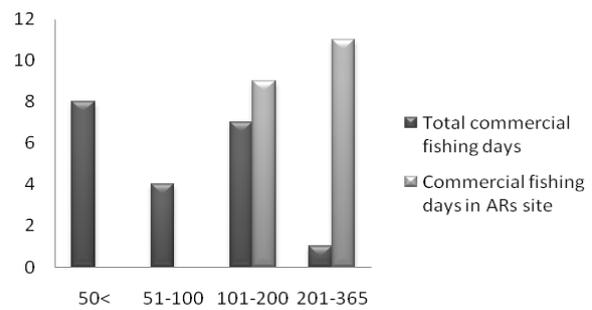

Figure 2. Total commercial fishing days and commercial fishing days in the ARs site.

Total yearly average commercial fishing days were determined as 235 whereas, present and future commercial fishing days in the ARs site were orderly determined as 115 and 151 (Table 3; Figure 3). With the attribution of present and future stated commercial fishing days to the total 55 CF who are member of the Altınoluk Fishery Cooperative, total yearly present and future demand were calculated as 6,325 and 8,305 commercial fishing days, respectively. Except small scale fishermen in Altınoluk, surrounding local fishermen and cooperatives constitute another potential commercial demand in the region.

Table 3. Descriptive statistics of total yearly commercial fishing days and commercial fishing days in the ARs site

	Mean	Min	Max	SD
Current CF days[1]	115	0	250	75.9
Total yearly CF days[2]	235	150	300	50.4
Future CF days[3]	151	10	200	4.4

[1]The number of total yearly commercial fishing days on the AR site
[2]The number of total yearly commercial fishing days
[3]Future commercial fishing days on the ARs site after deployment
Min: Minimum, Max: Maximum, SD: Standart Deviation

Moreover, there was a significant increase (31%) in the total number of commercial fishing days with the deployment of ARs were determined. 80% of the CF also indicated that they use the ARs site for other recreational purposes like diving and trips of which recreational trip activities came to be the first place with the percentage of 75.
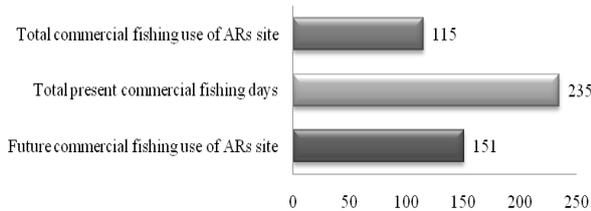
Figure 3. Present and future mean number of commercial fishing use in the ARs site.

Recreational fishing use

69% of the RF queried stated that they use the ARs site during their boat-based recreational fishing activities. Mean number of recreational fishing days by RF in the ARs site were determined as 34; however, this number were determined as 89 days after ARs deployment with the increase of 158%. Then, in the existence of 400 boat-based and shore-based RF, present and future demand of the ARs site were determined as 13,600 and 35,600 recreational fishing days, respectively. In addition, total yearly recreational fishing days were also determined as 124 (Table 4; Figure 4).

Table 4. Descriptive statistics of total yearly recreational fishing days, total yearly present and stated future recreational fishing days in the ARs site

	Mean	Min	Max	SD
Current RF days[1]	34	0	210	43.2
Total RF days[2]	124	5	350	76.4
Future RF days[3]	89	0	300	67.7

[1]The number of total yearly recreational fishing days on the AR site
[2]The number of total yearly recreational fishing days
[3]Future recreational fishing days on the ARs site after deployment
Min: Minimum, Max: Maximum, SD: Standart Deviation
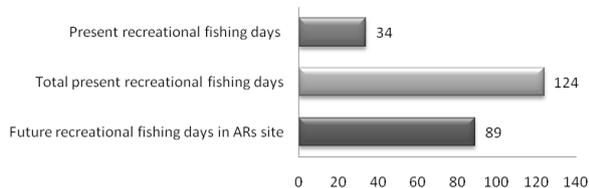
Figure 4. Present and future mean number of recreational fishing use in the ARs site.

It was found that 69% of the RF uses the proposed ARs site for other purposes including recreational diving and boat trips. Among these different types of uses, recreational diving and recreational boat trips and both recreational diving and boat trips got 44%, 28%, and 28% shares, respectively.

Local residents' use

Results of the household survey through Altınoluk residents showed that the ARs site in question is used by LR for especially, boat trips (63%), recreational fishing (14%) and recreational diving (9%). Total yearly mean number of recreational uses by LR including fishing, diving and boat trips was determined as 44 days. In addition, 75% of the LR have increased willingness to participate to a recreational activity in the ARs site after deployment compared to the present situation (52%) (Table 5).

Table 5. Recreational fishing and diving days of LR after deployment

	Mean	Min	Max	SD
Recreational fishing	19	0	90	16.8
Recreational diving	5	0	90	14.5

Min: Minimum, Max: Maximum, SD: Standart Deviation

Conclusion and Discussion

The respondents interviewed agree that ARs are useful materials that contribute to marine life positively. Based on the individual perception questions regarding the effects of ARs on user groups, it was determined that ARs contribute to the number of user groups and increase their activities, including diving, boat-based recreational fishing and other AR related recreational activities, by stating increased number of recreational activities which supports the hypothesis that ARs generate demand in local economy. There is also an optimistic perception on effects of ARs by local related groups. Apparently, the presence of ARs creates a significant increase in the number of future trips compared to past trips which is also contributing as an economic activity on a micro level.

The only local diving charter in Altınoluk which is only active in summer seasons may also become an important source of recreational demand. Additionally, with the deployment of ARs, there can be an increase in the diving demand, especially, targeting ARs which may also result in the establishment of new diving charters and increased economic activity.

In addition to the recreational activities, ARs are determined as an important tool to enhance commercial fishing demand. Therefore, increased willingness to participate a commercial fishing day was perceived as an increased commercial harvest by the CF. The future studies on increase in catch per unit effort of the CF can be calculated to put forward the actual commercial effect of ARs.

In conclusion, 158% increase in recreational fishing days and 31% increase in commercial fishing days in the ARs site are significant findings to find out the demand in the ARs site. To better analyze the social, economic and biological effects and effectiveness of deployed ARs, it is essential generate constant monitoring frameworks under management plans.

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