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RESEARCH ARTICLE ARAŞTIRMA MAKALESİ

Determination of marine environmental awareness level of Turkish SCUBA divers

Türk aletli dalıcıların denizel çevre bilinç düzeylerinin belirlenmesi

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Abstract: Human beings have been benefiting from ecosystem services for a long time. Recreational diving, as a Cultural Ecosystem Service, engages millions of divers worldwide. Because divers have a strong motivation to support biodiversity conservation, they have been involving in ecosystem assessment studies. In this study, an online survey was conducted to investigate on the marine environment awareness of people who actively dive on the coast of Türkiye. The collected responses of the divers were evaluated according to the participants' demographic characteristics and diving experiences. The questionnaire was conducted with 111 people, 32% of them were female divers. Divers' certificates vary from 1 star (1*) diver to 3 star (3*) instructor diver. On the questionnaire, we presented photographs of 13 fish species that are frequently encountered at diving areas and/or have ecological importance in our country's waters were asked to identify the species with their Turkish names. It was determined that there was no significant difference between genders, ages and the levels of education in species identification ($p>0.01$). However, there was a significant relationship between the identification of *Coris julis*, *Epinephelus marginatus* and *Chromis chromis* and the level of diving ($p<0.01$). Participants were asked which of the 13 fish species given in the survey is completely prohibited to catch in our country's waters. More than half (61%) of divers know that fishing for dusky grouper is prohibited in the coasts of Türkiye. Within the scope of this study, divers were asked "What tools do you use to get to know marine life better?". Thirty-five percent of the divers responded by watching documentaries and 33% by following some social media accounts. It is very important for divers to obtain accurate information about marine life and disseminate it to society with appropriate tools for the protection, planning and management of our seas.

Keywords: Recreational diving, SCUBA, cultural ecosystem service, environmental consciousness, awareness, Türkiye

Öz: İnsanoğlu uzun zamandır ekosistem hizmetlerinden faydalanmaktadır. Kültürel Ekosistem Hizmeti olan rekreasyonel dalış, dünya çapında milyonlarca insanı cezbetmektedir. Dalıcılar biyoçeşitliliği korumada güçlü bir motivasyona sahip olduklarından, ekosistem değerlendirme çalışmalarının bir parçası olmuşlardır. Bu çalışmada, Türkiye kıyılarında aktif olarak dalış yapan kişilerin denizel çevre bilinçlerini araştırmak için çevrimiçi bir anket çalışması yürütülmüştür. Dalıcılardan toplanan yanıtlar, demografik yapıları ve dalış tecrübelerine göre değerlendirilmiştir. Anket 111 kişi ile yürütülmüştür, katılımcıların %32'si kadın dalıcılardan oluşmaktadır. Dalıcıların bröveleri 1 yıldız (1*) dalıcıdan 3 yıldız (3*) eğitmen dalıcıya kadar çeşitlilik göstermektedir. Ankette, ülkemiz sularındaki dalış alanlarında sıklıkla karşılaşılan ve/veya ekolojik öneme sahip olan 13 balık türünün fotoğrafı gösterilmiş ve dalıcılardan bu türleri Türkçe isimleri ile tanımlamaları istenmiştir. Dalıcıların cinsiyetlerine, yaşlarına ve eğitim seviyelerine göre tür tanımlamada önemli bir farkın olmadığı belirlenmiştir ($p>0.01$). Ancak *Coris julis*, *Epinephelus marginatus* and *Chromis chromis* türlerini tanımlama ve dalış brövesi arasında önemli bir ilişki vardır ($p<0.01$). Katılımcılara, ülkemiz sularında 13 balık türü içinden hangisinin avcılığının tamamen yasak olduğu sorulmuştur. Dalıcıların yarısından fazlası (%61) Türkiye sularında orfoz balığının avcılığının yasak olduğunu bilmektedir. Bu çalışma kapsamında, dalıcılara "Denizel yaşamı daha iyi tanımak için hangi araçları kullanıyorsunuz?" sorusu sorulmuştur. Dalıcıların %35'i belgesel izleyerek ve %33'ü bazı sosyal medya hesaplarını takip ederek cevabını vermiştir. Denizlerimizin korunması, planlanması ve yönetimi açısından dalgıçların deniz canlıları hakkında doğru bilgilere ulaşmaları ve bunu uygun araçlarla topluma yaymaları büyük önem taşımaktadır.

Anahtar kelimeler: Rekreasyonel dalış, aletli dalış, kültürel ekosistem hizmeti, çevre bilinci, farkındalık, Türkiye

INTRODUCTION

Ecosystem Services (ES) are "the benefits that people obtain from nature." In broader terms, they can be thought of as resources and conditions provided by nature that enhance human well-being, ranging from water resources, food, and materials to opportunities for enjoyment or exercise in a recreational area (M.E.A. A Report of the, 2005).

Humanity has long benefited from ecosystem services. These services are necessary to ensure human health, maintain social stability, promote economic growth, and support human well-being (Costanza et al., 1997). Millennium Ecosystem Assessment (MEA) categorized the ES in four principal types as provisioning, regulating, supporting, and cultural services. Cultural Ecosystem Service (CES), encompasses a society's values, needs, and habits, considering its socio-political, economic, and environmental dimensions. With CES, people provide benefits from the ecosystem and which directly influence their quality of life (M.E.A. A Report of the, 2005). Assessing cultural ecosystem services is essential for effectively planning and managing an ecosystem, and being aware of the diversity within the environment (Gee et al., 2017).

As an important Cultural Ecosystem Service, recreational diving involves millions of divers (De Brauwer et al., 2017; Huveneers et al., 2017; Arcos-Aguilar et al., 2021). In marine

tourism activities, PADI (Professional Association of Diving Instructors) reported that each year, more than one million newly certified divers engage in this association. (PADI, 2019). According to PADI 2019 Worldwide Corporate Statistics, more than 28 million people in the world have received diving certification since 1967. The United States Sports and Fitness Industry Association reported that 3.1 million Americans engaged in diving at least once in 2013 (Denoble, 2016). According to the President of the Turkish Underwater Sports Federation, there are approximately 150 thousand certified active divers in Türkiye (Ş. Özen, personal interview, 2018). There is no comprehensive official statistic on the number of divers and dives worldwide. However, Schuhbauer et al. (2023) have estimated every year, 8.9–13.6 million divers and snorkelers participate in marine dive tourism activities worldwide. Several studies have been conducted to estimate the value of ecosystem services related to recreational diving (Ruiz-Frau et al., 2013; Failler et al., 2015; Rees et al., 2015; Zunino et al., 2020), focusing particularly on evaluating nature-based solutions such as habitats, species, and marine protected areas.

SCUBA (Self-Contained Underwater Breathing Apparatus) diving contributes to the economic growth of coastal regions (Ha et al., 2020). Its economic contribution to in establishing a Blue Economy make it an important sector (Schuhbauer et al., 2023). Furthermore, diving industry has an important role in the enhancement of biodiversity awareness (Oliveira et al., 2018). Also, divers are progressively participating in marine conservation efforts, often integrating these activities into their recreational pursuits (Hammerton et al., 2012).

To understand the relationship between our daily lives and a healthy coastal environment is important for the development of coastal communities (Fletcher and Potts, 2007). To understand this relationship requires increasing awareness of marine environmental problems. It is also very important to understand the role of personal behaviour in creating and solving marine environmental problems (McKinley and Fletcher, 2012).

In the current study, we were interested in examining the level of marine environmental awareness of individuals who actively dive on the coast of Türkiye. The collected responses of the divers within the scope of the study were evaluated according to the participants' demographic characteristics and diving experiences. We presented photographs of 13 fish species on the questionnaire. We compared the participants' responses on ecological issues of these fishes, such as correctly identifying them and whether there were any fishing bans on them, according to their diving experiences and demographic characteristics.

MATERIALS AND METHODS

A questionnaire (QA) survey accompanied by Google Forms was conducted with divers at different levels from different cities in Türkiye in April and May 2024. To access more respondents, the survey was shared through the social media accounts of some of the diving centers, which are hosted by many divers, on the coast of the country and student communities of universities from different cities such as İzmir, Antalya, Muğla, İstanbul and Kocaeli.

The QA gathered information which contains demographic attribute, diving experiences and ecological knowledge (species identification, fishing bans, etc.). In the ecological knowledge section, photographs of 13 fish species were presented, considering fishes that divers may frequently encounter in the regions where they dive (Figure 1). In the survey, divers were asked the names of these fishes in Turkish. In the last part of the QA, divers were asked about the tools they use to satisfy their curiosity about marine life (such as documentaries, social media accounts, popular science magazines, etc.). The full questionnaire can be found in the Supplementary Material section.

The data from the multiple-choice questions in the survey were analysed using the Statistical Package for the Social Sciences (SPSS, Version 25) software. Chi-square and sign tests were applied to categorical variables to assess differences in responses to ecological knowledge questions.

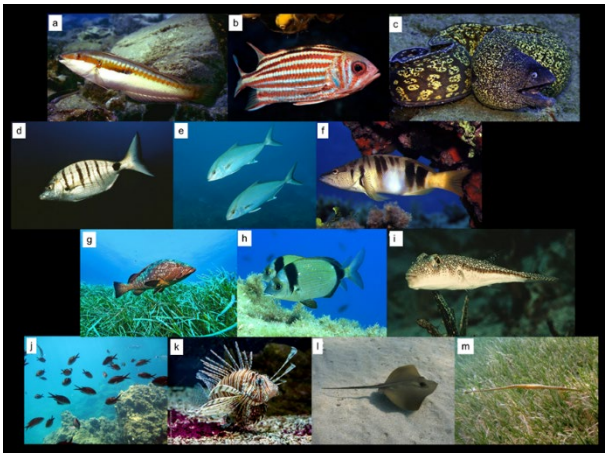

Figure 1. Fish species frequently encountered in diving areas off the Turkish coast: (a) *Coris julis* (Linnaeus, 1758) (gün balığı) (b) *Sargocentron rubrum* (Forsskål, 1775) (asker balığı), (c) *Muraena helena* Linnaeus, 1758 (müren), (d) *Diplodus puntazzo* (Walbaum, 1792) (sivriburun karagöz), (e) *Seriola dumerili* (Risso, 1810) (akya), (f) *Serranus scriba* (Linnaeus, 1758) (hani balığı), (g) *Epinephelus marginatus* (Lowe, 1834) (orfoz), (h) *Diplodus vulgaris* (Geoffroy Saint-Hilaire, 1817) (karagöz), (i) *Torquigener hypelogeneion* (Bleeker, 1852) (balon balığı), (j) *Chromis chromis* (Linnaeus, 1758) (papaz balığı), (k) *Pterois miles* (Bennett, 1828) (aslan balığı), (l) *Dasyatis pastinaca* (Linnaeus, 1758) (vatoz), (m) *Syngnathus typhle* Linnaeus, 1758 (deniz iğnesi)

RESULTS

The survey was conducted with 111 divers, all of whom were suitable for further analysis. The majority of divers participating in the survey were from Izmir (44%), followed by participants from Muğla (24%) and Antalya (16%). The

proportion of female participants was smaller (32%). The majority of the respondents (66%) were in their 30s and 40s. Only 4 divers (all male) were over 60 years old. The participants' education level revealed that 87% held a higher education degree with 47% having bachelor's degree, and 23% and 17% having completed a master's degree and doctoral degree, respectively. More than half of the participants (52%) were private sector workers, and 32% were employed in the public sector. Only two percent of the participants were unemployed. Only 2 participants reported having no income, while the biggest proportion of the participants (37%) reported an income ranging from 1072 to 1607 US$ (Reference average exchange rate of April and May 2024: US$ 1 = 31.74 TL) (TCMB, 2024). Table 1 presents the demographic variables and the divers' career.

Table 1. Divers' sociodemographic characteristics and diving background (n = 111)

Sociodemographic characteristics	No. of divers		Dive experience	No. of divers	
Age	Female	Male	***Level of certification***	Female	Male
20s	8	10	1* diver	6	10
30s	18	23	2* diver training	1	2
40s	7	25	2* diver	7	13
50s	2	14	3* training	0	1
>60	0	4	3* diver	12	14
Level of education			Guide diver	0	2
Middle school	1	0	1* instructor	5	14
High school	1	8	2* instructor	2	12
Undergraduate school	0	5	3* instructor	0	3
Bachelor degree	16	36	Other	2	5
Master degree	11	14	***Years diving***		
Doctoral degree	6	13	0	1	1
Occupation			1-10	19	28
Student	1	3	11-20	14	29
Unemployed	1	2	>21	1	18
Civil servant	11	25	***Annual number of dives***		
Private sector	22	36	1-20	13	26
Retired	0	10	21-40	11	11
***Monthly income* (US$)**			41-60	4	5
0	0	2	61-80	3	5
<536	1	4	>81	4	29
537-1071	6	9	***Experience level***		
1072-1607	15	26	Inexperienced	14	25
1608-2143	8	15	Experienced	21	51
>2144	5	20			

All participants in the study have diver certificates obtained from different diving organizations (PADI, SSI, CMAS etc.). The divers' certification levels ranged from beginner [CMAS 1 star (1*)] to master instructor [CMAS 3 star (3*) instructor]. While the participants hold various diving certifications, 3* (equal to dive master in PADI), 2* (equal to advanced open water in PADI) and 1* instructor (equal to open water diver instructor in PADI) divers account for 23%, 18%, and, 17% respectively. The experience duration of certified divers ranged from below 1 year (2%) and above 21 years (17%). Thirty-five percent of participations reported the number of dives per year as below 20, while 30% of divers stated having above 81 logged dives. In this study, recreational divers were at the various diving levels, therefore they were categorized into two groups, namely "experienced" and "inexperienced" for better analysis. Inexperienced divers included 1* and 2* divers and divers who were in training for 2* level (N=39), while experienced divers included 3* divers, dive masters, and instructors (N=72).

In this study, 111 divers were shown photographs of 13 fish species commonly encountered and/or of ecological importance at Turkish Seas, and they were asked to identify the species by their Turkish names (Table 2). Majority of divers identified fish species correctly except for *Diplodus puntazzo* and *Sygnathus typhle*. *Diplodus puntazzo* was identified by only 14% of female and %29 of male divers, and *Sygnathus typhle* was identified by 29% of female and 41% of male divers. Regardless of the fish species, there were no significant differences in fish species identification according to divers' socio-demographic characteristics (gender, age and level of education) and diving location of them ($p>0.01$).

As diving experience increases, it is expected that marine life will become better known. As expected, experienced divers accurately identified fish species more than inexperienced divers in this study. Lionfish (*Pterois miles*) and puffer fish (*Torquigener hypelogeneion*) were the most known fishes for divers. The level of diving certificate, the length of dive career, and the number of annual logged dives have no affect to know these two fish species ($p>0.01$). A significant relationship between the diving experience of divers and species identification was found the identification of *Coris julis*, *Epinephelus marginatus*, and *Chromis chromis* according to the diving level ($p<0.01$). These three fish species were identified significantly more by experienced divers than inexperienced divers (Table 2). The duration of diving experience and the number of logged dives per year reflect the divers' experience (Stolk et al., 2005). Additionally, the number of dives shows how are divers active in scuba diving. In this study, except identify *C. chromis and C. julis*, there is no significant relationship between fish species identification and divers' experience. While the length of dive career enlarged, the rate of divers who identified the damsel fish increased significantly ($p<0.01$). Similar with former finding, while the number of annual logged dives increase, the rate of divers who identified *C. julis* increased significantly.

In the survey, there were three exotic fish species (*Sargocentron rubrum*, *Torquigener hypelogeneion*, *Pterois miles*) among 13 fishes. Most divers (63%) identified pufferfish and lionfish as exotic fish, while 24% identified these three fish correctly. A significant relationship was not found between the dive level category and identify exotic fishes. Both experienced and inexperienced divers identify exotic fishes at the same rate (~24%, $p>0.01$). Besides the ecological knowledge question, we asked the fishing regulation question to divers. More than half of divers (61%) stated that "fishing of *E. marginatus* is prohibited in the coasts of Türkiye". The knowledge about fishing regulations on fishes was not changed according to dive level category either. More than half of experienced (67%) and inexperienced (51%) divers have correct knowledge of the fishing regulations ($p>0.01$).

Table 2. Percentages of divers on fish species identification according to dive experience

Fish species	Diving levels		Length of diving career (year)				The number of annual logged dives				
	Inexp. (n=39)	Exp. (n=72)	0 (n=2)	1-10 (n=47)	11-20 (n=43)	>21 (n=19)	1-20 (n=39)	21-40 (n=22)	41-60 (n=9)	61-80 (n=8)	>81 (n=33)
C. julis	41	69	50	49	60	84	41	50	89	63	79
S. rubrum	59	72	100	60	77	63	62	68	78	75	70
M. helena	92	100	100	96	98	100	92	100	100	100	100
D. puntazzo	15	29	0	15	23	53	23	36	11	0	27
S. dumerili	77	88	100	79	81	100	72	86	78	100	94
S. scriba	51	74	100	55	65	89	51	59	67	63	88
E. marginatus	77	99	100	83	95	100	82	91	89	100	100
D. vulgaris	74	82	100	68	84	95	69	86	89	50	91
T. hypelogeneion	90	94	100	89	93	100	90	95	89	88	97
C. chromis	44	72	100	45	67	89	51	50	56	88	79
P. miles	92	99	100	96	95	100	95	95	100	88	100
D. pastinaca	97	97	100	98	98	95	95	100	100	100	97
S. typhle	33	39	0	26	42	58	31	41	44	25	42

To learn more information about marine life, 35% of the respondents watch documentaries, and 33% follow regarding social media accounts. Both groups use their mobile phones to obtain the information. To identify a species to which respondents encountered it, 42% use “search engine", and almost half of the divers ask the species to a person (instructor; 24%, dive buddy; 25%) in their social surroundings.

DISCUSSION

This study was conducted with recreational divers who dive in the waters of our country and possess various levels of diving certifications. The percentage of female divers (32%) is aligned with the finding from previous research on recreational divers (Musa et al., 2006; Edney and Spennemann, 2015; Şensurat-Genç et al., 2022). The age of the divers in the study is younger than in previous studies (Ditton et al., 2002; Shani et al., 2012; Kirkbridge-Smith et al., 2013).

The majority of participants (86%) have completed high levels of education. The study’s respondents have higher education level than previous studies (Ditton et al., 2002; Stolk et al., 2005; Edney, 2012; Polak and Shashar, 2013; Edney and Spenneman, 2014). Consistent with previous study findings, the majority of recreational divers have incomes above the minimum wage (Stolk et al., 2005; Shani et al., 2012; Edney and Spenneman, 2014; Şensurat-Genç et al., 2022). Eighty percent of the divers surveyed have monthly incomes exceeding 30.000 TL. This amount is higher than the approximately 7.000 TL (US$221), which is the annual average disposable income per capita for households (TÜİK, 2023). While two participants reported no income, five individuals have monthly incomes less than the minimum wage (US$536). In this study, results consistent with previous studies conducted with recreational divers were found, suggesting that our sample properly reflects the diving community of Türkiye.

Participants presented a wide range of certification levels, from 1* divers to 3* instructors. The largest dive group was 3* divers accounting for 23%, followed by 2* divers at 18%. In previous studies conducted with recreational divers, 2* divers were the most numerous certification level (Stolk et al., 2005; Shani et al., 2012; Polak and Shashar, 2013). To analyze the responses such as species identification, ecological knowledge, divers were categorized into two groups as experienced and inexperienced.

Recreational diving, by definition, makes the diver a part of the marine ecosystem. The presence of a diver underwater impacts ecosystem directly and/or indirectly. These impacts can be either positive or negative. The main negative impact is that diver contact with corals and cause damage (Hawkins et al., 1999). To reduce this effect, some solutions have been implemented such as giving brief information to divers before diving (Camp and Fraser, 2012; Webler and Jakubowski, 2016; Giglio et al., 2018), providing better negative buoyancy dive training (Hammerton, 2017), limiting the number of dives and creating closed areas.

"The exact information" is crucial for the preservation of the marine ecosystem and all living creatures in it. The most important requirement for the protection of a species is for the diver to identify the species who encounters and to know its ecological and economic importance. It is especially important for instructor-level divers (herein experienced) to have known well of the common species and habitats in their region. Research on the motivations of SCUBA divers shows that when diving development improves, the level of environmental concern, or ethic increases (Todd et al., 2002). In this study, our hypothesis was that experienced divers (N: 72) would be able to identify all the thirteen species who frequently encounter in their regions. The experienced divers identified moray eels (100%), dusky groupers (98%), lionfish (98%) and pufferfish (94%) at high rates, while the other 9 species were identified by professionals better than the inexperienced divers, but not at the high rates we expected. Among 13 species, only 24% and 67% of experienced divers were able to identify exotic species and fishing prohibited species, respectively.

“Pufferfish and lionfish” were chosen by divers as exotic species in this study (63%). These two species, which are in

the news, talked about, and given information about their ecology and even biology in many broadcasting channels and social media in Türkiye, However, 24% of all divers stated that "squirrel fish, pufferfish and lionfish" are not native species. So, they completely answered the exotic species question in the QA. Additionally, in this study, it was found that to "better understand marine life" and "research a species they couldn't identify underwater" the divers mostly utilized the internet. While 33% of divers follow social media accounts to "better understand marine life," 42% of them research online to "research a species they couldn't identify underwater". It's already known that people today use social media to support environmental campaigns and to bring people together on small and large environmental issues locally and globally (Mallick and Bajpai, 2019).

CONCLUSION

"What was that fish?" is one of the most common question heard after a dive. The training systems of diving organizations are more or less the same. There is no special section in basic diver training programs that introduces the marine environment and/or fish species. Organizations give speciality courses named as Environment Specialty Programs, Fish Identification, Coral Identification etc. We believe that instead of such speciality courses, short briefings before and after diving will be a more useful and cheaper way to get to know the marine environment and raise awareness on related issues. Social media has become a part of today's lifestyle. It is also used as a tool to reach people's awareness about current environmental issues to a wider audience much faster and in a very short time. In this study, it is noted that the majority of divers surveyed are aware that lionfish and pufferfish are exotic species. It is believed that the extensive coverage of these species in social and mainstream media may have had a significant impact. In this context, it is thought that informative posts with plenty of photos from the social media accounts of environmental organizations, relevant university faculties, and/or related academics could make a difference in creating environmental awareness and consciousness.

Today, as one of the fastest tools for sharing information, social media needs to be used for a healthy marine environment and its effects need to be evaluated in the future.

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AUTHOR CONTRIBUTIONS

Tuğçe Şensurat-Genç: Conceptualization, Data analysis, Methodology, Writing-Review and Editing; Kaan Kırşan: Investigation, Formal analysis, Writing Original Draft

CONFLICTS OF INTEREST

The authors declare that there are no financial interests or personal relationships that could have appeared to influence the work reported in this paper.

ETHICS APPROVAL

The ethical approval of this study was received from the Board of Scientific Research and Publishing Ethics of İzmir Katip Çelebi University.

DATA AVAILABILITY

For any questions, both authors should be contacted.

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