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Observation of Marine Areas (Çandarlı and Gökova Bays) and Their Biodiversity

Oğuz KURT*[1], Sevilay ÖZTÜRK[1]

Abstract

This study aimed to investigate to determine the number and biodiversity of species (especially seaweed populations) in the Çandarlı and Gökova Bays. Çandarlı and Gökova Bays are defined as "Special Environmental Protection Area (SEPA)" by the Ministry of Environment and Forestry of the Republic of Turkey, Special Environmental Protection Agency Presidency. For this purpose, in the study, i) description of habitats and facies in the studied areas, ii) determination of the number and diversity of species, iii) retrieval of underwater photo recordings, operations were carried out. The approach of collecting these data in such a way as to make comparisons and comments, especially for the future, has been followed. The literature shows that the existing ecological conditions and habitat characteristics of the areas restricted to SEPA and fisheries are studied. Thus, a comprehensive database is developed that will be extremely useful in terms of future works. On the other hand, the studies carried out are particularly inadequate for marine algae (macroalgae) in the related areas. As a result of the study, a total of 316 taxa were identified and observed, including 192 marine algae (20 Cyanobacteria, 54 Phaeophyceae, 93 Rhodophyta, 25 Chlorophyta), 3 seagrasses, 70 invertebrates (9 Porifera, 13 Cnidaria, 2 Annelida, 19 Mollusca, 16 Arthropoda, 10 Echinodermata, 2 Tunicata) and 51 fish (2 Chondrichthyes, 49 Osteichthyes).

Keywords: Çandarlı Bay, Gökova Bay, marine algae, marine organisms, monitoring

1. INTRODUCTION

Although the seas of Turkey differ in terms of ecological, geographical, geomorphological, meteorological, and similar features, they form a part of the Mediterranean water system. Among these seas, the Aegean Sea is richer in species diversity than the Mediterranean, Marmara, and Black Seas. Located between 41°-35° north latitude and 23°-27°/28° east longitude, the Aegean Sea has a length of approximately 660 km from north to south. It covers an area of approximately 214,000 km² within these borders. In terms of its morphological features, the Aegean Sea, which is divided into three different regions as North Aegean, Middle Aegean, and South Aegean, in terms of its morphological features, is a semi-enclosed sea with about 3,000 large and small islands/islets. At the same time, it forms a complementary front road of the straits connecting the Black Sea and the Mediterranean and a transition area between the Black Sea and

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the Mediterranean in terms of its biological and hydrological characteristics.

There are sub-activities carried out within the scope of the "Strengthening the System of Marine and Coastal Protected Areas of Turkey" Project in different coastal areas of our country by the Republic of Turkey Ministry of Environment and Forestry, Special Environmental Protection Agency Presidency. One of these; is a study titled "The Current Situation of Fishing in the Marine and Coastal Protected Areas in Five Special Environmental Protection Areas and Ayvalık Islands Nature Park and the Monitoring of Fishing Restricted Areas Determined in Gökova SEPA". Güçlüsoy [1] stated that a total of 8 MCPAs comprising 5 SEPAs, 2 NPs, and 1 NAP are located on the Turkish Aegean coasts. It also explains in detail all the features of the areas.

It is known that in this and similar monitoring studies, qualified scientific studies have been carried out, mostly evaluating the fish stocks and the status of fish populations in Fisheries Restricted Areas in SEPAs. In these studies, the bio-ecology of fish populations was studied, virtual population analyzes (length-based VPA) were made, and data were collected to make future comparisons and interpretations between restricted and free areas for fishing [2-6]. There are also a large number of similar studies on fish diversity and sea creatures on the coasts of Turkey [1, 7-15]. In addition to fish populations, natural habitats and facies of the studied areas and detailed habitat characteristics of fishery-restricted areas should be determined. For the realization of these determinations, SCUBA dives, photos, and video recordings should be taken underwater. In this context, there are few studies in detail on marine algae and seagrasses [16].

As it can be seen, although there are similar studies in the literature, there is no study in which all groups constituting the biodiversity of Çandarlı and Gökova SEPA areas are observed, and the macroalgae of these two ecosystems are determined in detail. The main objective of this study is to observe the Çandarlı and Gökova Bays, identify the habitats and facies in the studied areas in detail, determine the number/variety of species, and obtain underwater imaging records.

For this purpose, the approach followed in the study was as follows; a) compilation of qualified scientific studies on marine algae, seagrasses, invertebrates, and fishes up to now in Çandarlı and Gökova Bays, b) detection of the living group's populations in Çandarlı and Gökova Bays, c) observing and recording the marine life in the study areas.

2. MATERIALS AND METHODS

2.1. Sampling, Observing, and Recording

Sampling and observing were carried out monthly in 2017-2018 from stations determined on the shores of Çandarlı (38°55'39" N - 26°59'04" E) and Gökova (37°02'00" N - 28°17'01" E) Bays. Circalittoral, mediolittoral, and infralittoral zones were sampled, observed, and recorded in the sampling studies. Snorkeling was used from the shore to the deep, and scuba diving was also made with SCUBA dive equipment. The GoPro Hero 4 underwater action camera with special equipment was used for taking digital recordings and photographing species groups. Species that could be identified underwater were photographed in their natural habitats during dives and recorded digitally.

Algae and seagrasses species collected for identification were fixed by the species group. Collected algae and seagrasses samples were fixed in jars containing 2-4% formaldehyde-water, and the labels with the necessary information were affixed on them.

Also, macro biological diversity was tried to be determined by applying the Underwater Visual Observation/Counting (UVOC) technique, which is one of the different sampling techniques used to evaluate the macrofauna and flora diversity in the marine ecosystem, especially for invertebrates and fishes species [17]. These studies were carried out with direct observation and sampling methods during snorkeling and SCUBA dives. Dead individuals (Mollusca, Arthropoda, etc. shells) were also collected in the observed line, and those

whose identifiable characters were not lost were taken into consideration. During this period, imaging techniques (photo-video) were also applied.

2.2. Identification

Collected algae and seagrasses species were determined using stereo, light, and fluorescence microscopy, following procedures appropriate to species groups (taxonomic and systematic positions, and morphological structures of the samples, etc.), respectively. Most of the invertebrates and all fish species were identified in situ or from digital records. The methods determined suitable and valid for each species group by evaluating the necessary visual (internet, determination keys, CDs, etc.) and written (book, article, monograph) literature were used in performing these processes. Digital records were kept of the species photographed in their natural environment or the laboratory (for the algae and the seagrasses) during species identification.

Taxonomy and nomenclature follow Guiry and Guiry [18] for the marine algae and seagrasses, WoRMS Editorial Board [19] for the invertebrates and fishes.

3. RESULTS

This study was carried out for the main purpose of observing the Çandarlı and Gökova Bays, determining the number and diversity of species in the studied areas, and taking underwater photograph recordings. In particular, it is aimed to determine the marine algae populations. As a result of the study, a total of 316 species were identified and taken underwater photo records. The identified species as follows; 192 marine seaweeds (20 Cyanobacteria, 54 Phaeophyceae, 93 Rhodophyta, and 25 Chlorophyta), 3 seagrasses, 70 invertebrates (9 Porifera, 13 Cnidaria, 2 Annelida, 18 Mollusca, 16 Arthropoda, 10 Echinodermata, and 2 Tunicata), and 51 fishes (including 2 Chondrichthyes and 49 Osteichthyes). In this context, taxa determined from the marine algae groups are given in Table 1.

The main purpose of this study is to determine seaweed populations. However, as an observational study, seagrasses, invertebrates, and fish species observed in the Çandarlı and Gökova Bays were also tried to be determined and their underwater photographs were taken. The seagrasses, invertebrates, and fish species identified and observed in this context are given in Table 2.

Table 1 Distribution of the identified algae according to taxonomic categories

Classis	***Taxa***
Cyanophyceae	*Aphanocapsa litoralis* Hansgirg 1892
	A. marina Hansgirg in Foslie 1890
	Merismopedia mediterranea Nägeli 1849
	Gloeocapsa atrata Kützing 1843
	G. cf. *salina* Hansgirg 1893
	Chroococcus minutus (Kützing) Nägeli 1849
	C. varius A.Braun in Rabenhorst 1876
	Entophysalis deusta (Meneghini) F.E.Drouet & W.A.Daily 1948
	Xenococcus schousboei Thuret in Bornet & Thuret 1880
	Dermocarpa acervata (Setchell & Gardner) Pham-Hoàng Hô 1969
	Spirulina subsalsa Oersted ex Gomont 1892
	Leibleinia epiphytica (Hieronymus) Compère 1985
	Leptolyngbya fragilis (Gomont) Anagnostidis & Komárek 1988
	Phormidium litorale Golubic 1960
	Lyngbya confervoides C.Agardh ex Gomont 1892
	L. majuscula Harvey ex Gomont 1892
	L. salina Kützing ex Gomont 1892
	Calothrix aeruginea Thuret ex Bornet & Flahault 1886
	Dichothrix compacta Bornet & Flahault 1886
	Rivularia nitida C.Agardh ex Bornet & Flahault 1886
Phaeophyceae	*Ectocarpus fasciculatus* Harvey 1841

	E. siliculosus (Dillwyn) Lyngbye 1819
	Feldmannia irregularis (Kützing) Hamel 1939
	F. mitchelliae (Harvey) H.-S.Kim 2010
	F. padinae (Buffham) Hamel 1939
	Cladosiphon mediterraneus Kützing 1843
	Corynophlaea umbellata (C.Agardh) Kützing 1843
	Myriactula rivulariae (Suhr ex Areschoug) Feldmann 1937
	Myriotrichia clavaeformis Harvey 1834
	Hecatonema terminale (Kützing) Kylin 1937
	Punctaria latifolia Greville 1830
	Colpomenia sinuosa (Mertens ex Roth) Derbès & Solier in Castagne 1851
	Hydroclathrus clathratus (C.Agardh) M.Howe in N.L.Britton & C.F.Millspaugh 1920
	Petalonia fascia (O.F.Müller) Kuntze 1898
	Scytosiphon lomentaria (Lyngbye) Link 1833
	Nemacystus flexuosus var. *giraudyi* (J.Agardh) De Jong 1997
	Spermatochnus paradoxus (Roth) Kützing 1843
	Stilophora tenella (Esper) P.C.Silva in P.C.Silva, Basson & Moe 1996
	Pseudolithoderma adriaticum (Hauck) Verlaque 1988
	Hapalospongidion macrocarpum (Feldmann) León-Álvarez&González-González 1993
	Pseudoralfsia verrucosa (Areschoug) Parente, Fletcher & G.W.Saunders 2020
	Cutleria multifida (Turner) Greville 1830
	Zanardinia typus (Nardo) P.C.Silva in Greuter 2000
	Dictyopteris polypodioides (A.P.De Candolle) J.V.Lamouroux 1809
	Dictyota dichotoma (Hudson) J.V.Lamouroux 1809
	D. dichotoma var. *intricata* (C.Agardh) Greville 1830
	D. fasciola (Roth) J.V.Lamouroux 1809
	D. implexa (Desfontaines) J.V.Lamouroux 1809
	D. spiralis Montagne 1846
	Padina pavonica (Linnaeus) Thivy in W.R.Taylor 1960
	Stypopodium schimperi (Kützing) Verlaque & Boudouresque 1991
	Taonia atomaria (Woodward) J.Agardh 1848
	Cladostephus hirsutus (Linnaeus) Boudouresque & M.Perret-Boudouresque ex Heesch & al. 2020
	Sphacelaria cirrosa (Roth) C.Agardh 1824
	S. fusca (Hudson) S.F.Gray 1821
	S. rigidula Kützing 1843
	S. tribuloides Meneghini 1840
	Halopteris filicina (Grateloup) Kützing 1843
	H. scoparia (Linnaeus) Sauvageau 1904
	Cystoseira compressa (Esper) Gerloff & Nizamuddin 1975
	C. compressa f. *plana* (Ercegovic) Cormaci, G.Furnari, Giaccone, Scammanca & D.Serio 1992
	C. corniculata (Turner) Zanardini 1841
	C. foeniculacea (Linnaeus) Greville 1830
	C. foeniculacea f. *tenuiramosa* (Ercegovic) A.Gómez Garreta, M.C.Barceló, M.A.Ribera & J.Rull Lluch 2001
	C. humilis Schousboe ex Kützing 1860
	C. humilis var. *myriophylloides* (Sauvageau) J.H.Price & D.M.John in J.H.Price, D.M.John & G.W.Lawson 1978
	Ericaria crinita (Duby) Molinari & Guiry 2020
	E. mediterranea (Sauvageau) Molinari & Guiry 2020
	E. zosteroides (C.Agardh) Molinari & Guiry 2020
	Gongolaria barbata (Stackhouse) Kuntze 1891
	G. montagnei (J.Agardh) Kuntze 1891
	Sargassum acinarium (Linnaeus) Setchell 1933
	S. hornschuchii C.Agardh 1820
	S. vulgare C.Agardh 1820
Bangiophyceae	*Chroodactylon ornatum* (C.Agardh) Basson 1979
	Stylonema alsidii (Zanardini) K.M.Drew 1956
	Erythrotrichia carnea (Dillwyn) J.Agardh 1883
	Sahlingia subintegra (Rosenvinge) Kornmann 1989
	Bangia atropurpurea (Mertens ex Roth) C.Agardh 1824
	Neopyropia leucosticta (Thuret) L.-E.Yang & J.Brodie 2020
	Porphyra umbilicalis Kützing 1843

Florideophyceae	*Acrochaetium secundatum* (Lyngbye) Nägeli in Nägeli & Cramer 1858 *Colaconema daviesii* (Dillwyn) Stegenga 1985 *C. savianum* (Meneghini) R.Nielsen 1994 *Ganonema farinosum* (J.V.Lamouroux) K.C.Fan & Yung C.Wang 1974 *Gelidium serra* (S.G.Gmelin) E.Taskin & M.J.Wynne, nom. rejic. 2013 *G. spathulatum* (Kützing) Bornet 1892 *Huismaniella nigrescens* (Feldmann) G.Furnari, Cormaci, Alongi & Perrone 2018 *Millerella pannosa* (Feldmann) G.H.Boo & L.Le Gall 2016 *Asparagopsis armata* Harvey 1855 *Corallina officinalis* Linnaeus 1758 *Ellisolandia elongata* (J.Ellis & Solander) K.R.Hind & G.W.Saunders 2013 *Jania longifurca* Zanardini 1844 *J. rubens* (Linnaeus) J.V.Lamouroux 1816 *J. virgata* (Zanardini) Montagne 1846 *J. virgata var. attenuata* (Kützing) Taşkin 2019 *Amphiroa beauvoisii* J.V.Lamouroux 1816 *A. rigida* J.V.Lamouroux 1816 *A. cryptarthrodia* Zanardini 1843 *Lithophyllum stictiforme* (Areschoug) Hauck 1877 *L. corallinae* (P.Crouan & H.Crouan) Heydrich 1897 *L. cystoseirae* (Hauck) Heydrich 1897 *Titanoderma trochanter* (Bory) Benhissoune, Boudouresque, Perret-Boudouresque & Verlaque 2002 *Hydrolithon cruciatum* (Bressan) Y.M.Chamberlain 1994 *H. farinosum* (J.V.Lamouroux) Penrose & Y.M.Chamberlain 1993 *Neogoniolithon brassica-florida* (Harvey) Setchell & L.R.Mason 1943 *N. hauckii* (Rothpletz) R.A.Townsend & Huisman 2018 *Pneophyllum fragile* Kützing 1843 *Choreonema thuretii* (Bornet) F.Schmitz 1889 *Melobesia membranacea* (Esper) J.V.Lamouroux 1812 *Mesophyllum lichenoides* (J.Ellis) Me.Lemoine 1928 *M. philippii* (Foslie) Adey 1970 *Caulacanthus ustulatus* (Mertens ex Turner) Kützing 1843 *Chondracanthus acicularis* (Roth) Fredericq in Hommersand, Guiry, Fredericq & Leister 1993 *Hypnea musciformis* (Wulfen) J.V.Lamouroux 1813 *Peyssonnelia rubra* (Greville) J.Agardh 1851 *P. squamaria* (S.G.Gmelin) Decaisne ex J.Agardh 1842 *Gymnogongrus griffithsiae* (Turner) C.Martius 1833 *Botryocladia botryoides* (Wulfen) Feldmann 1941 *B. skottsbergii* (Børgesen) Levring 1941 *Callithamnion corymbosum* (Smith) Lyngbye 1819 *Centroceras clavulatum* (C.Agardh) Montagne 1846 *Ceramium brevizonatum* H.E.Petersen 1918 *C. cupulatum* Womersley 1978 *C. ciliatum* var. *robustum* (J.Agardh) Mazoyer 1938 *C. circinatum* (Kützing) J.Agardh 1851 *C. diaphanum* (Lightfoot) Roth 1806 *C. gaditanum* var. *mediterraneum* (Debray) Cremades in Cremades & Pérez-Cirera 1990 *C. siliquosum* var. *lophophorum* (Feldman-Mazoyer) Serio 1994 *Gayliella flaccida* (Harvey ex Kützing) T.O.Cho & L.J.McIvor 2008 *Corallophila cinnabarina* (Grateloup ex Bory) R.E.Norris 1993 *Crouania attenuata* (C.Agardh) J.Agardh 1842 *Griffithsia schousboei* Montagne in P.B.Webb 1840 *Ptilothamnion pluma* (Dillwyn) Thuret in Le Jolis 1863 *Spermothamnion repens* (Dillwyn) Magnus 1873 *Spyridia filamentosa* (Wulfen) Harvey in W.J.Hooker 1833 *Wrangelia penicillata* (C.Agardh) C.Agardh 1828 *Dasya rigidula* (Kützing) Ardissone 1878 *Heterosiphonia crispella* (C.Agardh) M.J.Wynne 1985 *Hypoglossum hypoglossoides* (Stackhouse) Collins & Hervey 1917 *Nitophyllum punctatum* (Stackhouse) Greville 1830 *Taenioma nanum* (Kützing) Papenfuss 1952 *Chondria capillaris* (Hudson) M.J.Wynne 1991

	C. dasyphylla (Woodward) C.Agardh 1817
	C. mairei G.Feldmann 1949
	Palisada patentiramea (Montagne) Cassano, Sentíes, Gil-Rodríguez & M.T.Fujii in Cassano *et al.* 2009
	P. perforata (Bory) K.W.Nam 2007
	P. thuyoides (Kützing) Cassano, Sentíes, Gil-Rodríguez & M.T.Fujii in Cassano *et al.*2009
	Digenea simplex (Wulfen) C.Agardh 1822
	Dipterosiphonia rigens (C.Agardh) Falkenberg 1901
	Halopithys incurva (Hudson) Batters 1902
	Herposiphonia secunda (C.Agardh) Ambronn 1880
	H. tenella (C.Agardh) Ambronn 1880
	Laurencia microcladia Kützing 1865
	L. obtusa (Hudson) J.V.Lamouroux 1813
	L. pyramidalis Bory ex Kützing 1849
	Osmundea pinnatifida (Hudson) Stackhouse 1809
	Lophosiphonia cristata Falkenberg 1901
	L. obscura (C.Agardh) Falkenberg in F.Schmitz & Falkenberg 1897
	Chondrophycus glandulifer (Kützing) Lipkin & P.C.Silva 2002
	Polysiphonia atra Zanardini 1847
	Carradoriella denudata (Dillwyn) Savoie & G.W.Saunders 2019
	C. elongata (Hudson) Savoie & G.W.Saunders 2019
	Vertebrata fruticulosa (Wulfen) Kuntze 1891
	V. fucoides (Hudson) Kuntze 1891
	Rytiphlaea tinctoria (Clemente) C.Agardh 1824
	Womersleyella setacea (Hollenberg) R.E.Norris 1992
Ulvophyceae	*Ulothrix implexa* (Kützing) Kützing 1849
	Ulva compressa Linnaeus 1753
	U. intestinalis Linnaeus 1753
	U. intestinalis f. *attenuata* (Ahlner) M.J.Wynne 2014
	U. lactuca Linnaeus 1753
	U. linza Linnaeus 1753
	Umbraulva dangeardii M.J.Wynne & G.Furnari 2014
	Anadyomene stellata (Wulfen) C.Agardh 1823
	Chaetomorpha aerea (Dillwyn) Kützing 1849
	Cladophora dalmatica Kützing 1843
	C. glomerata (Linnaeus) Kützing 1843
	C. prolifera (Roth) Kützing 1843
	Lychaete pellucida (Hudson) M.J.Wynne 2017
	Dasycladus vermicularis (Scopoli) Krasser in Beck & Zahlbruckner 1898
	Acetabularia acetabulum (Linnaeus) P.C.Silva 1952
Bryopsidophyceae	*Bryopsis corymbosa* J.Agardh 1842
	B. hypnoides J.V.Lamouroux 1809
	Pseudobryopsis myura (J.Agardh) Berthold in Oltmanns 1904
	Caulerpa prolifera (Forsskål) J.V.Lamouroux 1809
	C. racemosa (Forsskål) J.Agardh 1873
	C. cylindracea Sonder 1845
	Codium bursa (Linnaeus) C.Agardh 1817
	Derbesia tenuissima (Moris & De Notaris) P.Crouan & H.Crouan 1867
	Halimeda tuna (J.Ellis & Solander) J.V.Lamouroux 1816
	Flabellia petiolata (Turra) Nizamuddin 1987

Table 2 Distribution of the identified and observed seagrasses, invertebrates, and fish species according to taxonomic categories

Taxonomic group	***Taxa***
Tracheophyta	*Posidonia oceanica* (Linnaeus) Delile 1813
	Cymodocea nodosa (Ucria) Ascherson 1870
	Halophila stipulacea (Forsskål) Ascherson in Anon. 1867
Porifera	*Chondrosia reniformis* Nardo, 1847
	Axinella cannabina Esper, 1794
	A. verrucosa Esper, 1794
	Crambe crambe Schmidt, 1862

	Agelas oroides Schmidt, 1864
	Petrosia ficiformis Poiret, 1789
	Spongia agaricina Pallas, 1766
	Sarcotragus foetidus Schmidt, 1862
	Verongia aerophoba Nardo, 1833
Cnidaria	*Aurelia aurita* Linnaeus, 1758
	Nausithoae punctata Kölliker, 1853
	Penneria disticha Goldfuss, 1820
	Cladocora caespitosa Linnaeus, 1767
	Alcyonium acaule Marion, 1878
	Eunicella singularis Esper, 1791
	Actinia equina Linnaeus, 1758
	Anemonia viridis Forsskål, 1775
	Condylactis aurantiaca Delle Chiaje, 1825
	Cerianthus lloydii Gosse, 1859
	Parazoanthus axinella Schmidt, 1862
	Madracis pharensis Heller, 1868
	Balanophyllia europaea Risso, 1826
Annelida	*Hermodice carunculata* Pallas, 1766
	Sabella spallanzanii Gmelin, 1791
Mollusca	*Mytilus galloprovincialis* Lamarck, 1819
	Pinna nobilis Linnaeus, 1758
	P. rudis Linnaeus, 1758
	Venus verrucosa Linnaeus, 1758
	Tonna galea Linnaeus, 1758
	Bolinus brandaris Linnaeus, 1758
	Hexaplex trunculus Linnaeus, 1758
	Semicassis granulata Born, 1778
	Conomurex persicus Swainson, 1821
	Dendostrea frons Linnaeus, 1758
	Pinctada imbricata radiata Leach, 1814
	Cerithium vulgatum Bruguière, 1792
	Acanthocardia sp.
	Peltodoris atromaculata Bergh, 1880
	Flabellina affinis Gmelin, 1791
	Octopus vulgaris Cuvier, 1797
	O. macropus Risso, 1826
	Loligo vulgaris Lamarck, 1798
	Sepia officinalis Linnaeus, 1758
Arthropoda	*Melicertus hathor* Burkenroad, 1959
	Alpheus rapacida de Man, 1908
	Scyonia carinata Brünnich, 1768
	Penaeus japonicus Spence Bate, 1888
	Palaemon elegans Rathke, 1837
	Stenopus spinosus Risso, 1827
	Homarus gammarus Linnaeus, 1758
	Pagurus prideaux Leach, 1815
	Palinurus elaphas Fabricius, 1787
	Scyllarides latus Latreille, 1803
	Scyllarus arctus Linnaeus, 1758
	Calcinus tubularis Linnaeus, 1767
	Pachygrapsus marmoratus Fabricius, 1787
	Ilia nucleus Linnaeus, 1758
	Eriphia verrucosa Forskål, 1775
	Callinectes sapidus Rathbun, 1896
Echinodermata	*Antedon mediterranea* Lamarck, 1816
	Ophiomyxa pentagona Lamarck, 1816
	Marthasterias glacialis Linnaeus, 1758
	Astropecten platyacanthus Philippi, 1837
	Echinaster sepositus Retzius, 1783
	Paracentrotus lividus Lamarck, 1816
	Arbacia lixula Linnaeus, 1758
	Sphaerechinus granularis Lamarck, 1816
	Holothuria forskali Delle Chiaje, 1823

	H. tubulosa Gmelin, 1791
Tunicata	*Clavelina lepadiformis* Müller, 1776
	Halocynthia papillosa Linnaeus, 1767
Chondrichthyes	*Dasyatis pastinaca* Linnaeus, 1758
	Raja sp.
Osteichythyes	*Muraena helena* Linnaeus, 1758
	Apogon imberbis Linnaeus, 1758
	Merluccius merluccius Linnaeus, 1758
	Zeus faber Linnaeus, 1758
	Scopaena parcus Linnaeus, 1758
	S. scrofa Linnaeus, 1758
	Trigla lucerna Linnaeus, 1758
	Epinephelus aeneus Geoffroy Saint-Hilaire, 1817
	E. guaza Anonymous
	Serranus cabrilla Linnaeus, 1758
	S. scriba Linnaeus, 1758
	Gobius niger Linnaeus, 1758
	Echeneis naucrates Linnaeus, 1758
	Seriola dumerili Risso, 1810
	Trachinotus ovatus Linnaeus, 1758
	Trachurus mediterraneus Steindachner, 1868
	T. trachurus Linnaeus, 1758
	Xyrichtys novacula Linnaeus, 1758
	Coryphaena hippurus Linnaeus, 1758
	Boops boops Linnaeus, 1758
	Dentex dentex Linnaeus, 1758
	Diplodus annularis Linnaeus, 1758
	D. puntazzo Walbaum, 1792
	D. sargus sargus Linnaeus, 1758
	D. vulgaris Geoffroy Saint-Hilaire, 1817
	Lithognathus mormyrus Linnaeus, 1758
	Oblada melanura Linnaeus, 1758
	Pagellus erythrinus Linnaeus, 1758
	Pagrus pagrus Linnaeus, 1758
	Sarpa salpa Linnaeus, 1758
	Sparus aurata Linnaeus, 1758
	Umbrina cirrosa Linnaeus, 1758
	Sciaena umbra Linnaeus, 1758
	Mullus barbatus Linnaeus, 1758
	M. surmuletus Linnaeus, 1758
	Liza aurata Risso, 1810
	Mugil cephalus Linnaeus, 1758
	Sparisoma cretense Linnaeus, 1758
	Uranoscopus scaber Linnaeus, 1758
	Trachinus araneus Cuvier, 1829
	Sphyraena sphyraena Linnaeus, 1758
	Trichiurus lepturus Linnaeus, 1758
	Euthynnus alletteratus Rafinesque, 1810
	Scomber japonicas Houttuyn, 1782
	S. scombrus Linnaeus, 1758
	Spicara maena Linnaeus, 1758
	Solea solea Linnaeus, 1758
	Bothus podas Delaroche, 1809
	Balistes carolinensis Gmelin, 1789

4. DISCUSSION AND CONCLUSIONS

Considering that such diversity has not been determined in previous studies in research areas in the literature, the number and variety of species identified, observed, and recorded in this study are pretty remarkable. For example, Zeki [20] reported 75 taxa belonging to the south of the Gökova SEPA. While Rhodophyta took first place with 38 species, 20 Heterokontophyta, 15

Chlorophyta, and 2 Cyanophyta were determined. Canbolat et al. [6] reported 30 marine algae, 10 secondary aquatic plants (6 of which are freshwater forms distributed in Azmak Stream), 9 Invertebrates, and 58 Fish species in their study in Gökova Bay.

Güçlüsoy [1] reported that Gökova Bay is one of the most studied Marine and Coastal Protected Area in Turkey, and eleven marine and coastal projects on such as marine species inventory, ICM, fisheries, and management plan preparation were carried out between 2000 and 2012. Also, Okuş et al. [4] inventoried 723 macroscopic species comprising 79 flora and 644 fauna taxa. Since macroalgae are the primary goal in this study, a large surplus was determined in macroalgae diversity. As a natural consequence of this, fauna diversity remains lower.

Özaydın et al. [21] were determined a total of 60 fish species (including 11 Chondrichthyes and 49 Osteichthyes) in the Çandarlı Bay. Again, 54 Gastropod species distributed in Çandarlı Bay were identified by Aksoy [22]. Compared to these two studies, the diversity of fauna and flora observed in this study is greater.

In the literature, there are some checklists (as Review Articles) on the coasts of Turkey that represent a lot of species belonging to the related taxonomic categories; the marine fishes [14], Cnidaria and Ctenophora [15], the marine arthropods [23], Echinodermata [24], Tunicata [25].

Due to the open system of the study areas, fish and other invertebrates can be found in monthly or seasonal migration behaviors for both breeding and feeding purposes. In short-term studies, information can be obtained only about fish and invertebrate species belonging to the relevant period. Therefore, it was concluded that it is necessary to establish a long-term monitoring project.

When evaluated in terms of habitats, the relevant protection strategies should be determined by evaluating the relationship between the habitats determined in the regions and the ecological system in the region should be applied considering this differentiation.

On the other hand, not only marine environments but also terrestrial environments, which are in contact with the nature of the coastal area, should be carefully protected. Conservation activities in the region should continue not only in the marine but also in the coastal area.

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Authors' Contribution

The first author contributed 60%, the second author 40%.

The Declaration of Ethics Committee Approval

This study does not require ethics committee permission or any special permission.

The Declaration of Research and Publication Ethics

The authors of the paper declare that they comply with the scientific, ethical and quotation rules of SAUJS in all processes of the paper and that they do not make any falsification on the data collected. In addition, they declare that Sakarya

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