

pediculus, *Cocconeis pediculus*, *C. placentula*, *Navicula cryptocephala*, *Nitzschia palea*, *Anabaena sedowii*, *Aphanizomenon flos-aqua* and *Oscillatoria*. A rich algal flora consisted of typical epiphytic and epilithic diatom species. Full lists of phytoplankton, zooplankton, macrophyte species are given in Annex 1 - Tables 1, 2 and 3 respectively.

The first studies of marine macroscopic algae were conducted by Handel-Mazetti (1907). 14 algae species were recorded on the Turkish Black Sea coast. Güner (1986) found 82 macroscopic algae species, including 56 Rhodophyta, 15 Pheophyta, nine Chlorophyta and two Charophyta species. Güven *et al.* (1991) reviewed algal studies in the Black Sea between 1898 and 1990.

There have been a small number of studies of the benthic algae population in the Sinop Inceburun zone of the Turkish Black Sea. Cirik and Cihangir (1987) reported 31 species, of which 20 species were Rhodophyta, six Chlorophyta, four Pheophyta and one marine phaeograme. The Rhodophyta species included: *Gelidium crinale*, *Gelidium latifolium*, *Lithothamnium lenormandi*, *Pseudolithophyllum orbiculatum*, *Corallina elongata*, *Corallina granifera*, *Jania rubens*, *Peyssonnelia squamaria*, *P. rubra*, *Glacilaria verrucosa*, *Hypnea musciformis*, *Phyllophora nervosa*, *Antithamnion cruciatum*, *Ceramium diaphanum*, *C. rubrum*, *C. ciliatum*, *Nitophyllum punctatum*, *Laurencia paniculata*, *Polysiphonia denudata* and *Herposiphonia tenelle*. The Pheophyta algae comprised: *Sphecelaria cirossa*, *Cladostephos verticillatus*, *Cystoseira barbata* and *C. sp.* The chlorophyta algae included: *lactuca*, *Enteromorpha intestinalis*, *E. linza*, *Cladophora coelothrix*, *C. glomerata* and *C. sp.* However, *Zostera noltii* was the only sea grass found in the area.

II. Review of Studies of Turkish Black Sea Coastal Benthic Communities

Deveciyan (1926) reported several fish and invertebrate species from the Turkish Black Sea. Later Kocataş and Katagan (1980) reported 41 Amphipoda species from 14 families along the Turkish Black Sea coast, including: one Ampeliscidae, three Amphithoidae, two Aoridae, two Calliopidae, six Corophiidae, one Dexamidae, one Eupliantidae, four Gammaridae, one Haustoriidae, three Ischyroceridae, one Oedicerotidae, one Stenothoidea, nine Talitridae and six Caprellidae.

Bacescu (1959) and Zenkevich (1963) reported more than 60 Mediterranean benthic forms in the Bosphorus region of the Black Sea at depths of 38-94 m and included: two Cnidaria, eight Echinodermata, 11 molluscs, six Annelidae and seven crustacea.

Rullier (1963) reported 118 Polychaeta species in the Bosphorus and 170 in the Black Sea, namely: 11 Aphroditidae, 18 Synidae, 11 Nereidae, eight Nephtidae, 22 Eunicidae, 10 Spionidae, six Cirratulidae, eight Maldanidae, 11 Capitellidae and 12 Terebellidae.

Caspers (1968) investigated the benthic macrofauna in the Bosphorus and 12 stations off the Bosphorus junction of the Black Sea, recording two mollusc species, one echinoderm,

eight annelids and one amphipod at a station at a depth of 145 m and one echinoderm and two annelid species at the deep station (205 m).

Bacescu *et al.* (1970) also studied benthic forms in the Bosphorus region, finding 13 species of Porifera, five Hydrozoa, three Anthozoa, 32 Turbellaria, 13 Nemertina, two Nematoda, 66 Annelida (65 Polychaetae and one Oligochaetae), 49 molluscs (23 Gastropoda and 26 Bivalvia), 48 Crustacea (13 Ostracoda, 19 Amphipoda, three Isopoda, two Cumacea, three Decapoda, two Halacarida and one Pantopoda) and five Bryzoa. The Food and Agriculture Organization (FAO) manual reported 69 benthic species, including 21 phythobenthos macrophytes.

Kocataş (1981) found 17 species of decapod crustaceans in the Turkish Black Sea, of which seven were Natantia, two Anomura and eight Brachyura.

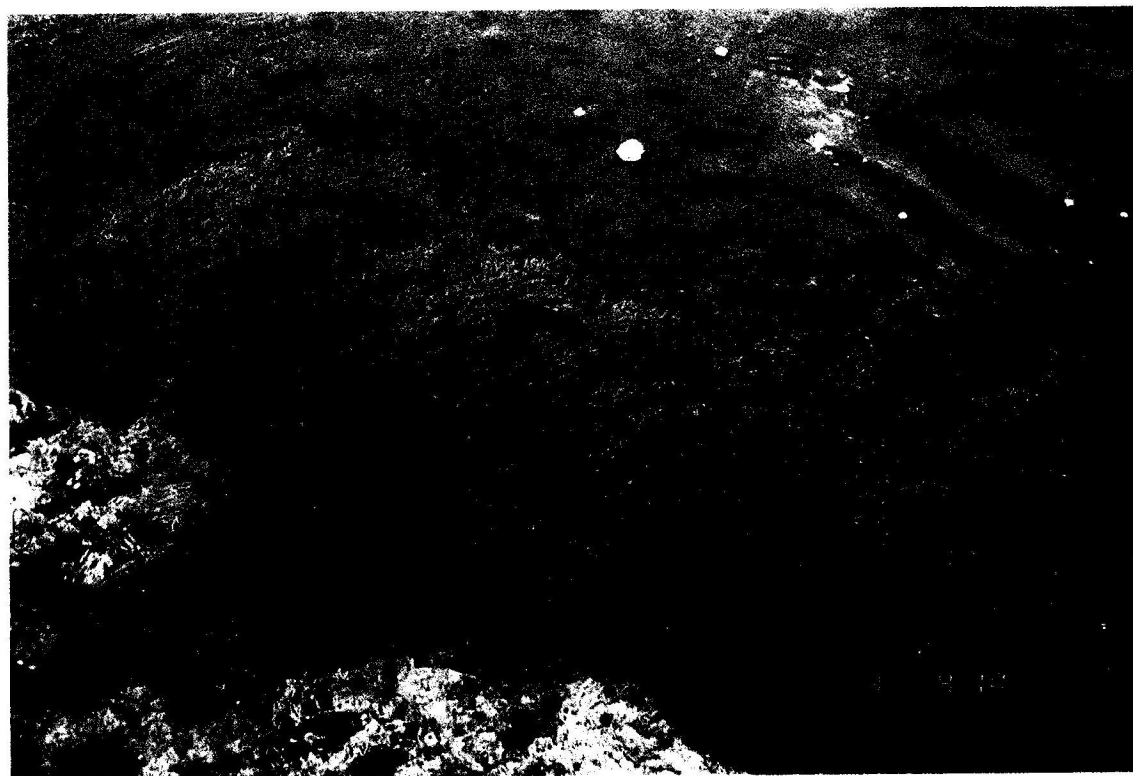
Fisher *et al.* (1987) studied the marine invertebrates of the Black Sea and Mediterranean Sea, identifying 21 species of benthic macrophytes, 10 decapods, 37 molluscs (25 bivalvia and 12 gastropods) and one species of echionoderm along the Turkish Black Sea coast.

A study by Aysel *et al.* (1990) identified 55 taxa of benthic algae from 21 families of Cyanophyta, Chlorophyta, Phaeophyta and Rhodophyta along the Black Sea coast near Trabzon, including the first record of the alga *Polysioptionia vidovichii* in the Turkish Black Sea. Erdoğan *et al.* (1995) found 88 taxa of marine algae from 29 families living in the upper infralittoral zone between Rize and Sarp, including the first record of *Xenococcus cladophora* on the Turkish Black Sea coast.

A review of surveys of 13 Turkish Black Sea cities between 1823 and 1994 (Aysel and Erdoğan, 1995) found 258 species, of which nine taxa (*Adouinella saviana*, *A. secundata*, *A. virgatula*, *Peyssonellia dubyi*, *Nitophyllum punctatum f. ocellatum*, *Streblonema sphaericum*, *Myrionema orbiculare*, *Dilophus repens* and *Ulvella lens*) were new to the Turkish Black Sea. Aysel *et al.* (1996) studied the species composition of marine algae inhabiting the upper infralittoral zone off the Turkish Black Sea city of Bartın and found 210 taxa, of which 10 were new to Turkey, namely: *Adouinella leptonema*, *Phyllophora brodiaei f. ligulata*, *Lithothamnion corticiforme*, *Ceramium arborescens*, *Streblonema oligosporum*, *Compsonema secundum f. secundum*, *C. secundum f. terminale*, *Stilophora tuberculosa*, *Cystoseirae barbata f. aurentia* and *C. crinata f. bosporica*.

Recent studies of benthic macro molluscs and crustacea along the Turkish Black Sea coast recorded 37 species of mollusc (11 gastropod and 26 bivalvia; Mutlu *et al.*, 1993; Mutlu, 1994) and 40 species of crustacea (19 amphipod, 10 cumacea, five ostracod, two cirriped, two isopod, one anisopod and one decapod (Mutlu *et al.*, 1992). A new cumacean species was discovered (Mutlu, 1990) and confirmed by Bacescu.

A list of benthic fauna and flora is given in Annex 1 - Table 4. However, further studies are needed in order to assess the impact of pollution on fauna and flora, mainly in the pre-Bosphorus area.



Cystoseira barbata is one of the key species in the Turkish Black Sea.

There have been dramatic changes in the Black Sea recipient ecosystem. These include the loss of extensive areas of seagrass meadows, a virtual collapse of the benthos over broad regions of the shelf area and mass mortalities due to hypoxia.

The harvesting of the bivalve *Ruditapes decussatus* by dredging the mediolittoral zone of the sea is very damaging to the benthic community and is destroying flatfish habitats, particularly *Solea* sp. In addition, mollusc and crustacean communities, such as *Donax* sp., *Turiletta* sp. and *Macra* sp., are coming under threat. Isopod and amphipod species are also affected by coastal degradation and destruction. The dredging of sand from the sea is also destroying the habitats of marine biota along the Turkish Black Sea coast.

III. Review of Turkish Black Sea Coastal Fish Fauna

The tectonic evolution of the Black Sea has resulted in four distinct groups of fish fauna each of a different origin, namely: warm water fish; moderately cold water fish; brackish water fish; and anadromus fish (Rass, 1992).

The warm water marine fish, which account for the largest number of species, originated in the Mediterranean and moved through the Bosphorus during the post-glacial period. This group includes the Black Sea anchovy *Engraulis encrasicolus*, *Mugil cephalus*, *Mullus barbatus*, *Belone belone euxini*, *Dasyatis pastinaca* and all the members of the Sparidae and Sciaenidae families. Other members of this group (such as *Trachurus mediterraneus*, *Sarda sarda*, *Scomber japonicus*, *Scomber scombrus*, *Thunnus thynnus thynnus* and *Pomatomus saltator*) are migratory, spending the warmer months in the Black Sea and wintering in the Marmara Sea and the northern Aegean (Rass, 1992).

The moderately cold-water species are relicts from the glacial period during which the Mediterranean and its adjacent seas experienced a fall in temperature. Examples of this group include *Sprattus sprattus*, *Merlangius merlangus euxinus*, *Platichthys flesus*, *Gymnammodytes eiccerelus*, *Raja clavata* and *Squalus acanthias*.

The brackish water species, such as *Clupeonella cultriventris*, are Ponto Caspian relicts (Ross, 1992). Most are confined to the northwestern shelf and the Azov Sea, where a significant amount of fresh water is discharged into the basin via major rivers, such as the Danube, Dniestr, Dniepr and Kuban. They are therefore very rare along the Turkish Black Sea coast.

The anadromus species breed in rivers flowing into the Black Sea but spend most of their adult life in the sea itself, such as sturgeons Acipenseridae diminishing in the Turkish Black Sea coast (Figure 5).

Deknik (1979) recorded 165 fish species in the entire Black Sea, of which 119 were exclusively marine, 24 anadromus or semi-anadromus and 22 fresh water species. A total of