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RESEARCH ARTICLE **ARAŞTIRMA MAKALESİ**

Investigation of harmful algae in İzmir Bay for the 30 years

İzmir körfezindeki zararlı alglerin 30 yıllık incelenmesi

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Abstract: Marine pollution, which has been seen for the recent years in cities with a coast that industrializes day by day, was also seen in İzmir, the third most populous city of Turkey. After the destruction of Ragıp Paşa jetty and especially the completion of the Grand Canal Project, the improvement in the gulf is increasing day by day. In İzmir Bay, which is one of the most fertile areas of the Aegean Sea, excessive algae growth is occasionally observed. In this study, 360 quantitative and 1080 qualitative samples were obtained during the monitoring projects carried out jointly by İzmir Metropolitan Municipality, Dokuz Eylül University Marine Sciences and Technology Institute and Ege University Faculty of Fisheries between 1990-2016 were examined. The distribution of the 2 dominant major classes Dinophyceae and Bacillariophyceae were investigated. In addition to the species that produce toxins such as DSP, ASP and PSP into the marine environment, species that do not contain any toxins but cause adverse conditions in the environment by mass-formation were investigated.

Keywords: Harmful species, toxic, dinoflagellate, diatom, DSP, ASP, PSP

Öz: Son yıllarda endüstrileşme ve artan sanayi faaliyetleri nedeniyle denize kıyısı olan şehirlerde görülen deniz kirliliği, Türkiye'nin üçüncü en kalabalık kenti olan İzmir'de de görülmekteydi. Ege Denizinin en verimli alanlarından birisi olan "İzmir Körfezi'nde başlatılan büyük kanal projesi ve yıkılan Ragıp Paşa Dalyanı sayesinde körfez akıntısında düzelme ve kirlilikte azalma olmasına rağmen; dönem dönem gözlenen alg patlamaları, denizdeki canlıları olduğu kadar insan sağlığını da tehdit etmektedir. Bu çalışmada 1990-2016 yılları arasında İzmir Büyük Şehir Belediyesi, Dokuz Eylül Üniversitesi Deniz Bilimleri ve Teknolojisi Enstitüsü ve Ege Üniversitesi Su Ürünleri Fakültesinin ortaklaşa yürüttüğü izleme projeleri sırasında elde edilen 360 kantitatif ve 1080 kalitatif örnek incelenerek; hem körfezde geçen süre boyunca gözlenen zararlı alg patlamaları hem de baskın 2 büyük sınıfı olan Dinophyceae ve Bacillariophyceae türlerinin dağılımları incelenmiştir. DSP, ASP ve PSP gibi toksinler üreten türler yanında, herhangi bir toksin içermeyen fakat aşırı üreyerek ortamda olumsuz koşulları oluşturan türler incelenmiştir.

Anahtar kelimeler: Zararlı türler, toksik, dinoflagellat, diyatom, DSP, ASP, PSP

INTRODUCTION

Over the last 30 years, excessive algal blooms have been increasingly reported around the world, both negatively affecting interactions between species and reducing the populations of other aquatic organisms. Sustainability of the ecosystem affects important economic areas such as tourism and seafood farming, as well as human health (Shumway, 1990; Landsberg, 2002; Wells et al., 2015, Lin et al., 1994). Massive blooms are particularly affect filter-feeding bivalves (oysters, mussels, scallops, clams), crustaceans, and finfish. When the overgrowth, which we call bloom, the color of sea changes, this event named according to the color of the pigment contained in the species that reproduces and the density of the species (red-tide, green-tide, brown-tide, etc.) (Hallegraeff, 1995; Lindahl, 1998). Only 2% of the approximately 5000 phytoplankton species are harmful. However, the effect of these mass blooming species, whether toxic or not, is significant on the ecosystem (Landsberg, 2002). Excessive algal blooms, which are discussed in this study, are called Harmful Algal Blooms (HABs), which have a significant impact on the food chain and human health in the seas by releasing various toxins into the environment, especially Dinoflagellates (Hallegraeff et al., 2004). Dinoflagellates are also excellent indicators of the environment, especially water temperature, salinity and eutrophication in the seas (Graham, 1942; Wood, 1954).

The study by German researcher Wilhelm Nümann, who was in our country for a short time between 1954-1955 and conducted research, in 1955 is the first study on excessive algae blooms in Izmir Bay (1955). Various newspapers of that period attributed the mass fish deaths observed in İzmir Bay to 'excessive chlorine gas increase in seawater, gas plant wastes, oil spilled from ships and tectonic movements on the seabed'. He stated that the causative organisms, especially dinoflagellates, in the environment were responsible for fish deaths. The amount of oxygen detected as 9.3 mg/liter on the surface was measured as 2.8 mg/liter in the inner bay bottom water taken from 10 meters. The water samples taken in August were sent to the Humboldt University in Berlin. The samples were analyzed by Prof. Dr. Alfred Heilbronn and observed many cells abundantly belonging to the genus *Gymnodinium*. According to Heilbronn, in the shallow regions, where water mixing are constantly observed, the oxygen in

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the water reaches a normal level despite the mixing, only after the aforementioned dinoflagellate species starts to decrease in the environment. According to the results of the research, the fish died first by poisoning massively on the surface because of the dinoflagellate toxin, and then the still-living ones drowned due to the decomposition of the dead dinoflagellates at the bottom and the oxygen depletion caused by the oxidation of organic materials (Nümann, 1955).

The study conducted by Yurga (1992) in the areas selected from muddy sea coasts that are polluted by industrial and domestic wastewater in the Inner Bay of İzmir, showed that while diatoms and dinoflagellates were never found in samples taken from heavily polluted areas throughout the year, some tintinnids were adapted to live in these polluted areas. In the study, it was observed that tintinnids were found only in the surface of muddy seawater in the inner gulf coasts, where there is no oxygen and there is intense pollution, and no harmful algae growth has been reported.

Non-native species that transported to the bay by ballast waters of ship and currents (Oligotrichea class (*Leptotintinnus nordqvisti* Brandt, 1906 and *Rhizodomus tagatzi* Strelkow & Wiketis, 1950 (=*Tintinnopsis corniger*)) did not show any excessive reproduction, they were rarely observed and reported seasonally. The same two alien species, Balkıs and Koray's study in 2014 were detected and reported in the Marmara and Aegean Seas, these species were rarely encountered throughout the year, and any excessive reproduction was not recorded (Balkıs and Koray (2014).

The amount of harmful and poisonous algae species that show excessive reproduction in the phytoplankton groups distributed in the seas of our country is only about 10%, and it is known that only 5% of these affect the ecosystem, especially mass fish deaths, by synthesizing neuro-toxins Koray (2001), Bargu et al., (2002), Koray (2002a), Koray (2002b), Koray and Cihangir (2002), Koray and Çolak-Sabancı (2003), Çolak-Sabancı and Koray (2005), Koray and Çolak-Sabancı, (2007).

MATERIAL AND METHODS

To determine the qualitative distributions of the phytoplanktonic organism groups that form the first food chain in the İzmir Bay, between 1990 and 2016, in Outer Bay (Station 1), Middle (Station 2), and Inner Bay (Station 3) (Figure 1), samples were collected with a standard plankton net with 55 µm mesh size seasonally from stations 1, 2 and 3, with the horizontal method at speed 2 mils for 10 minutes and fixed with formaldehyde at a resulting concentration of 4%. 5-liter samples collected from selected stations as surface (0.5 meters), middle (5.0 meters), and bottom water (10.0-20.0 meters) were fixed with acidic Lugol to be used in quantitative studies. The samplings between 2017-2020 were made during the excessive algal blooms in the bay.

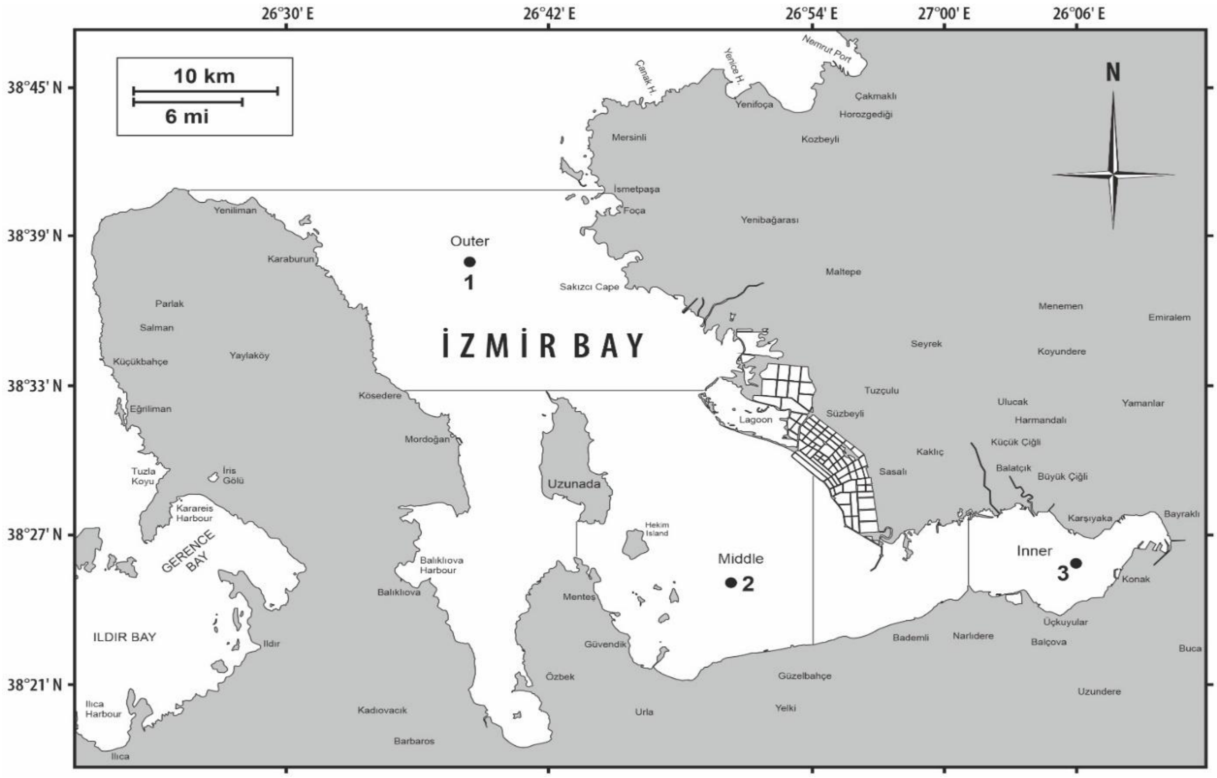

Figure 1. Sampling stations in İzmir Bay

Seawater temperature, pH, salinity, and oxygen values were measured in situ and recorded seasonally. Brought quantitative samples bottles were transferred to 250 cc measuring glass cylinders in the laboratory by removing excess seawater after 1 week of sedimentation and kept for the second sedimentation for another week. After removing excess seawater, the remaining samples were transferred to standard glass tubes and labeled and the concentrations of the species belonging to the planktonic organism groups per liter were counted and determined using the one-drop method, phase-contrast Olympus BX-50 and Olympus CX-31 research microscopes at 15x20 and 14x40 magnifications for 3 times for each sample. To determine the amount of the species per liter, the cell and individuals count results were calculated separately for each sample and converted into cell/liter and individual/liter. In each sampling period, quantitative samples were taken from 3 depths and a plankton net was used for each station. 12 samples obtained per expedition is 48 per year and 1440 samples in 20 years. In qualitative studies, 360 tubes and 1080 bottles of quantitative samples were examined. Seasonal quantitative plankton data were regularly transferred to spreadsheet software in each sampling period and the seasonal and annual distribution of the research stations's class, family, and species was obtained. The seasonal qualitative and quantitative data obtained as a result of the examination of the samples were transferred to a spreadsheet software periodically, the frequency of species and the concentrations per liter of the bay, which changed depending on the years, were obtained eventually. Class, family, and species distributions in the content of 120 seasonal qualitative lists in spreadsheet software covering the years 1990-2020 were converted into annual lists jointly with the calculation formula. The data in the lists were gathered together to be used in this study. Toxic species detected using standardized methods (Hallegraef, 2003) by UNESCO-IOC/HAB bureau were marked seasonally in spreadsheet software and their distribution over 30 years was determined qualitatively and quantitatively. In the determination of the species belonging to the diatom and dinoflagellate classes, Anderson et al., (1995), Balech (1988), Cupp (1943), Delgado and Fortuno (1991), Dodge (1982), Hasle and Syvertsen (1997), Hendey (1964), Koray *et. al.,* (2007), Lebour (1930), Marshall (1969a), Rampi and Bernhard (1978, 1980), Ricard (1987), Steidinger and Williams (1970), Steidinger and Tangen (1997), Sournia (1968, 1976, 1986), Taylor (1976), Tomas (1997), Tregouboff and Rose (1957), and Wood(1954); for Ciliophora species; Boltovskoy (1981), Isamu (1982), Lee, J.B. and Kim (2010), Margalef (1963), Marshall (1969b) and Pierce and Turner (1993); for HAB species, the works of Anderson et al., (1995) and Landsberg (2002) were used for the identification of the diatom and dinoflagellates. The names of the authors of the designated species and the current status of the scientific names of the species were periodically checked and rearranged on the websites of AlgaeBase. Samples were used to determine the distribution of phytoplankton groups have been collected using "The Physical, Chemical, Biological, and Microbiological Effects and Microbiological Effects of the DBTE-180, DBTE-199 Grand Canal Projects on the Marine Environment of the İzmir Bay", jointly organized by Dokuz Eylul University, Institute of Marine Sciences and Technology and İzmir Metropolitan Municipality between 1990-2016. During the seasonal research, expeditions were carried out by the R/V. K. Piri Reis. Ege University Faculty of Fisheries, Department of Hydrobiology carried out the preservation, storage, and evaluation of the collected all samples.

RESULTS AND DISCUSSION

Considering the distribution of the species belonging to the large groups in the bay over a 30-year period, it was determined that the dominant class in the bay was Bacillariophyceae with 42.8%, followed by Dinophyceae with 38.6% (Figure 2).

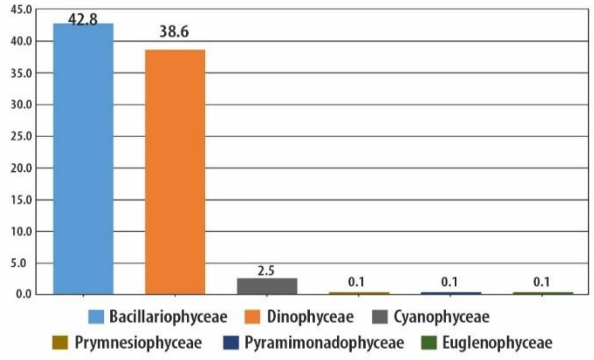

Figure 2. Percentage distribution of major classes in the bay

It was seen that the distribution of the frequency of occurrence of planktonic HAB classes in Izmir Bay, the most dominant class was the dinoflagellate (Dinophyceae) class (14.8%). Percentage distributions of 6 orders belonging to the class Dinophysales 5.9%; Gonyaulacales 3.0%; Prorocentrales 2.6%; Gymnodiniales 1.3%; Noctilucales are 0.3% and Peridiniales 1.6%. The percentage distributions of the detected Cyanophyceae, Prymnesiophyceae, Pyramimonadophyceae and Euglenophyceae classes were determined as 0.3% (Figure 3).

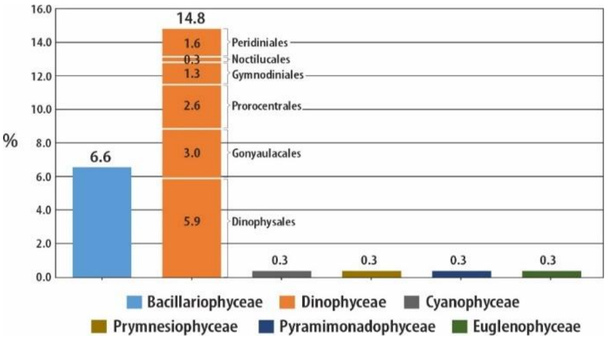

Figure 3. Percentage distribution of major HAB classes in the bay

It has been observed that species that release toxins such as DSP, PSP, ASP occasionally cause blooms in the bay. *Alexandrium minutum* Halim 1960, *Alexandrium tamarense* (Lebour) Balech 1995, *Gymnodinium catenatum* H. W. Graham 1943, *Lingulodinium polyedra* (F. Stein) J. D. Dodge 1989, *Prorocentrum lima* (Ehrenberg) F. Stein, 1878 and *Prorocentrum minimum* (Pavillard) J. Schiller 1933 species that cause PSP (Paralytic shellfish poisoning or PST (Paralytic shellfish toxins) in the bay. The secretions of these species contain Saxitoxin, Neosaxitoxin and Gonyatoxin. DSP (Diarrhetic Shellfish Poisoning) species containing Okadaic acid and Dinophysis toxin: *Dinophysis acuminata* Claparède & Lachmann, *Dinophysis acuta* Ehrenberg, *Dinophysis caudata* Saville-Kent, 1881, *Dinophysis fortii* Pavillard, *Dinophysis mitra* (F. Schütt) T.H. Abé, *Dinophysis rotundata* Claparède & Lachmann, *Dinophysis sacculus* F. Stein, *Dinophysis tripos* Gourret, *Gonyaulax grindleyi* Reinecke, 1967 and *Prorocentrum cassubicum* (Woloszynska) Dodge, 1975. The two species that cause ASP (Amnesic Shellfish Poisoning) by releasing domoic acid into the marine environment are *Pseudo-nitzschia delicatissima* (Cleve) Heiden, 1928 and *Pseudo-nitzschia pseudodelicatissima* (Hasle) Hasle, 1993 species from the diatom class. It is a type of *Gymnodinium breve* dinoflagellate that causes NSP (Neurotoxic Shellfish Poisoning by releasing Brevetoxin into the environment.

Species of poisoning by AZP (Azaspiracid shellfish poisoning), (CFP) Ciguatera fish poisoning and VSP (Venerupin shellfish poisoning) toxins seen in other seas were not encountered in the bay during this period. Although it has been reported in other studies that dinoflagellate species *P. minimum* causes VSP, there was no evidence of an overgrowth of this species observed throughout the year in the bay. As a result of combining the species lists obtained from the studies in the bay, when the frequencies of the species detected in the 30-year period are examined, it is seen that the dominant class of the bay, which reproduces excessively, is Dinophyceae with 45 species (14.8%). 5 species (1.6%) producing PSP belonging to this class; It was observed that there were 11 species (3.6%) producing DSP and 3 (1.0%) producing ASP. In 67 species, 48 of them, which reproduce excessively from time to time and do not release any neurotoxin to the environment, were detected in the bay, and these species were found at seasonally varying rates (Table 1).

Table 1. Distribution of classes of toxin-producing and non-toxin-producing species

	CLASSES							TOXIC						
	CY	DI	PR	BA	EU	PM	OL	PP	DP	AP	NP	NT	Mu	Color and type
Achnanthes brevipes C. Agardh, 1824				●								●		
Alexandrium minutum Halim		●						●						Reddish brown
Alexandrium tamarense (Lebour) Balech 1995		●						●						
Anabaena variabilis Kützing ex Bornet & Flahault	●											●		Reddish brown, HT
Ceratium furca (Ehrenberg) Claparède & Lachmann		●										●		Orange, HAO, AO
Ceratium fusus var. *fusus* (Ehrenberg) Dujardin, 1841		●										●		Orange, HAO, AO
Ceratium tripos var. *atlanticum* (Ostenfeld) Paulsen, 1908		●										●		
Chaetoceros danicus Cleve, 1889				●								●		
Chaetoceros densus (Cleve) Cleve, 1899				●								●		
Coscinodiscus granii Gough, 1905				●								●		
Cyclophora tenuis Castracane, 1878				●								●		Greenish brown, HAO, AO
Cylindrotheca closterium (Ehrenberg) Reimann & J.C. Lewin, 1964				●								●	●	
Dinophysis acuminata Claparède & Lachmann		●							●					Pale brown
Dinophysis acuta Ehrenberg		●							●					Orange
Dinophysis caudata Saville-Kent, 1881		●							●					Orange
Dinophysis fortii Pavillard		●							●					Orange
Dinophysis infundibulum J. Schiller		●										●		Orange
Dinophysis mitra (F. Schütt) T.H. Abé		●							●					

Table 1. Continued

	CLASSES							TOXIC						
	CY	DI	PR	BA	EU	PM	OL	PP	DP	AP	NP	NT	Mu	Color and type
Dinophysis odiosa (Pavillard) Tai & Skogsberg		●										●		Orange
Dinophysis ovata Claparéde & Lachmann, 1859		●										●		
Dinophysis ovum (F. Schütt) T.H. Abé		●							●					
Dinophysis rotundata Claparède & Lachmann		●							●					
Dinophysis rudgei (G. Murray & F.G. Whitting) T.H. Abé		●										●		Orange
Dinophysis sacculus F. Stein		●							●					
Dinophysis tripos Gourret		●							●					Orange
Diplopsalis lenticula Bergh		●										●		Orange
Emiliania huxleyi (Lohmann) W.W. Hay & H.P. Mohler			●									●		
Eutreptiella gymnastica Throndsen, 1969					●							●		Milky
Gonyaulax grindleyi Reinecke, 1967		●						●						Green Anoxia, hyperoxia
Gonyaulax polygramma Stein, 1883		●										●		Orange
Gonyaulax spinifera (Claparède & Lachmann) Diesing, 1866		●										●		
Gymnodinium breve C.C. Davis 1948		●									●			Reddish brown
Gymnodinium catenatum H.W. Graham 1943		●						●						
Gymnodinium simplex (Lohmann) Kofoid & Swezy		●										●		
Gyrodinium spirale (Bergh) Kofoid & Swezy 1921		●										●		Orange
Heterocapsa triquetra (Ehrenberg) F. Stein		●										●		
Lingulodinium polyedra (F. Stein) J.D. Dodge		●						●						Reddish brown
Mesodinium rubrum (Lohmann, 1908)							●					●		
Noctiluca scintillans (Macartney) Kofoid & Swezy		●										●	●	Pink, NH3
Ornithocercus magnificus F. Stein, 1883		●										●		
Ornithocercus quadratus Schütt, 1900		●										●		
Ornithocercus steinii Schütt, 1900		●										●		
Oxytoxum scolopax F. Stein		●										●		Pale orange
Phaeodactylum tricornutum Bohlin				●								●		Pale brown
Phalacroma mitra		●		●								●		
Phalacroma rotundatum (Claparéde & Lachmann) Kofoid & J.R. Michener 1911		●		●					●					
Prorocentrum aporum (Schiller) Dodge, 1975		●										●		
Prorocentrum balticum (Lohmann) Loeblich, 1970		●										●		
Prorocentrum cassubicum (Woloszynska) Dodge, 1975		●										●		Pale orange, HAO, AO
Prorocentrum dentatum Stein, 1883		●										●		Orange, HAO, AO
Prorocentrum lima (Ehrenberg) F. Stein, 1878		●							●					Orange

Table 1. Continued

	CLASSES							TOXIC						
	CY	DI	PR	BA	EU	PM	OL	PP	DP	AP	NP	NT	Mu	Color and type
Prorocentrum micans Ehrenberg, 1834		●										●		Orange, HAO, AO
Prorocentrum minimum (Pavillard) J. Schiller		●										●		Pale brown
Prorocentrum triestinum J. Schiller, 1918		●										●		Orange, HAO, AO
Protoperidinium longipes Balech, 1974		●										●		Orange
Protoperidinium steinii (Jörgensen, 1899) Balech, 1974		●										●		Orange
Pseudo-nitzschia delicatissima (Cleve) Heiden, 1928				●						●				Milky
Pseudo-nitzschia pseudodelicatissima (Hasle) Hasle, 1993				●						●				Milky
Pseudo-nitzschia pungens (Grunow ex Cleve) G.R. Hasle, 1993				●						●				Pale green
Pseudosolenia calcar-avis (Schultze) B.G. Sundström, 1986				●								●		
Pyramimonas propulsa Moestrup & Hill, 1991						●						●		Green
Rhizosolenia setigera Brightwell, 1858				●								●		
Scrippsiella trochoidea (Stein) Loeblich III, 1976				●								●		Brown
Skeletonema costatum (Greville) Cleve, 1873				●								●	●	Greenish orange, HO, AO
Thalassiosira allenii H. Takano 1965				●								●		Pale Green, HAO, AO
Thalassiosira angustelineata (A.W.F. Schmidt) G. Fryxell & Hasle				●								●		
Thalassiosira rotula Meunier				●								●		PUA, Greenish orange, HO, AO

(CY: Cyanobacteria, DI: Dinophyceae, PR: Prymnesiophyceae, BA: BacillariophyceaE, EU: Euglenophceae, PM: Pyramimonadophyceae, OL: Oligotrichea, PP: Paralytic Shellfish Poison, DP: Diarrhetic Shellfish Poison, AP: Amnesic Shellfish Poison, NT: Non toxic blooms, Mu: Mucilage secretion, HO: Hyperoxia, AO: Anoxia, HT: Hepatotoxic, NH3: Ammoniac, PUA: Polyunsaturated short chain aldehydes.

When we review the history of algal blooms in the bay, it is seen that the Cyanophyceae, Dinophyceae and Bacillariophyceae classes are responsible for. Cyanophyceae class started to decrease gradually after the Grand Canal Project came into operation after 2000, and it was determined in 1994 as the most abundant throughout the period. This group was observed at all stations in 1994, increased depending on the depth at station 1, 6000 cells l^{-1} at 15 meters, 17000 cells l^{-1} at 15 meters at station 2 and all levels at station 3 in the inner bay. It was determined as 60000 cells l^{-1} in the water column in Spring. In the summer of 1994, it was found at a concentration of 6500 cells l^{-1} at station 6, 8000 cells l^{-1} at station 2, increasing depending on the depth at station 3, and 80000 cells l^{-1} "on the surface, station 3. In the autumn of 1994, this class was the highest in the outer bay surface water at a concentration of 40000 cells l^{-1} at station 6, 50000 cells l^{-1} at station 2, and 400000 cells l^{-1} in the entire water column at station 3 reached high density.

Pseudo-nitzschia pungens (Grunow ex Cleve) G.R. Hasle, 1993 and *Ceratium fusus* var. *seta* (Ehrenberg) Sournia was observed in all stations in March 2000, *P. pungens* was detected at a concentration of 8370 cells l^{-1} at 5 meters in the inner bay, and *Ceratium fusus* var. *seta* (Ehrenberg) Sournia at a concentration of 8056 cells l^{-1} at 5 meters.

In May 2006, *L. polyedra* bloomed at a concentration of 4630 cells l^{-1} on the surface in the middle bay, making the color of the sea brownish-red. *C. furca var. furca* was detected at a concentration of 8624 cells l^{-1} per liter at station 3 in July 2008. In February 2009*, R. setigera* was detected at all depths by blooming massively in the entire bay, most abundantly at station 2, at a concentration of 53280 cells l^{-1} at 5 meters, and changed the color of the sea in coastal areas in Güzelbahçe and İnciraltı. *G. spinifera* species, which bloomed excessively in Urla, Güzelbahçe and Foça in September 2010, turned the seawater in these regions brownish-red. *P. pungens* changed the color of the sea to pale green in February 2011 and was observed at all stations, especially at a concentration of 7611 cells l^{-1} at 5 meters at station 2, and 7437 cells l^{-1} at 10 meters in the inner bay. The same species was detected in January 2020 and again at all stations, with the most abundant concentration of 6556 cells l^{-1} at 5 meters at station 2. In November 2018, green water color was observed on the sea surface on the shores of Karşıyaka, and it was determined that the species showing excessive proliferation was diatom *T. allenii* at a concentration of 6228 cells l^{-1} at 5 meters at station 2. *P. triestinum* dinoflagellate species was detected in March 2014 at a concentration of 67203 cells l^{-1} on the surface, 28296 cells l^{-1} at 5 meters and 81351 cells l^{-1} at 10 meters by causing excessive proliferation in the inner bay and turned the color of seawater orange. The same species was intensely observed in the inner bay 3 months later in June, with a concentration of 67203 cells l^{-1} on the surface and 28296 cells l^{-1} at 5 meters. The diatom species *L. minimus*, belonging to the class Coscinodiscophyceae, which causes mass fish kills, was detected only at station 3 in March 2014 at all depths, changing the color of the sea from light brownish to dark green at 106111 cells l^{-1} concentration on the surface. It was detected at a concentration of 24759 cells l^{-1} and 45981 cells l^{-1} at 10 meters. In April 2018, *G. spinifera* showed excessive bloom and was detected at a concentration of 9760 cells l^{-1} at station 2 and 10880 cells l^{-1} at station 3, and turned the color of the sea in red color on the Konak and Narlıdere shores.

A species known to cause anoxic and hypoxic conditions in water with excessive growth, *P. micans* made a mass blooming in February 2020 and changed the color of the sea to orange, 8772 cells l^{-1} at 5 meters of station 2 and 9360 cells l^{-1} at 5 meters of station 3. It was determined most intensely at the concentration of 10030 cells l^{-1}.

The massively blooming classes are mostly diatom and dinoflagellate and cases where ciliates blooms are rarely encountered in the bay. *H. subulata*, a tintinnid from the Oligotrichea class, was observed in all stations in July 2010, it was most intensely detected at station 24 at a concentration of 49648 individuals/l^{-1}, and the same species was detected in a very small amount in winter. It is known that the genus *Helicostomella* is widely distributed in neritic waters (Pierce and Turner, 1993).

When the phytoplanktonic organisms included in the mucilage formation, the environmental disaster that started to be seen in the Adriatic (Rinaldi and Vollenweider, 1995) and the Tyrrhenian Bay in 1991 (Innamorati et al., 1998) in the summer of 1988 is examined, the important species detected are *Dinophysis caudata* Saville-Kent, 1881; *Ceratium fusus* var. *fusus* (Ehrenberg) Dujardin, 1841 from the Dinophyceae class; *Ceratium tripos* var. *atlanticum* (Ostenfeld) Paulsen, 1908; *Prorocentrum micans* Ehrenberg, 1834; *Coscinodiscus radiatus* Ehrenberg, 1840; *Cylindrotheca closterium* (Ehrenberg) Reimann & J.C.Lewin, 1964*; Dactyliosolen fragilissimus* (Bergon) Hasle, 1996; *Gonyaulax fragilis* (Schütt) Kofoid, 1911; *Grammatophora marina* (Lyngbye) Kützing, 1844; *Leptocylindrus danicus* Cleve, 1889; *Licmophora abbreviata* C. Agardh, 1831; *Nitzschia longissima* (Brébisson) Ralfs, 1861; *Pleurosigma elongatum* W. Smith; *P. delicatissima*, *Pseudo-nitzschia pseudodelicatissima* (Hasle) Hasle, 1993 and *Pseudo-nitzschia pungens* (Grunow ex Cleve) G.R. Hasle, 1993, *Pseudosolenia calcar-avis* (Schultze) B.G.Sundström, 1986; *Rhizosolenia setigera* Brightwell, 1858; *Skeletonema costatum* (Greville) Cleve, 1873; *Striatella unipunctata* (Lyngbye) C. Agardh, 1832*; Synedra undulata* (J.W. Bailey) Gregory, 1857; *Thalassiosira pseudonana* Hasle & Heimdal, 1970; *Thalassiosira rotula* Meunier; *Thalassiothrix frauenfeldii* (Grunow) Grunow from Bacillariophyceae class and *Eutreptiella gymnastica* Throndsen, 1969 from the class Euglenophyceae have been reported by the above researchers. The first observation of mucilage formation in the Turkish Seas was made by Aktan in the fall of 2007 in the Marmara Sea, and the *G. fragilis* seen in the Tyrrhenian Sea and Adriatic was also reported for the first time in Marmara. Aktan detected *G. fragilis* at a density of $3.9x10^6$ l^{-1} in the study. (Aktan et al., 2008). With the exception of the dinoflagellate *Gonyaulax fragilis* (Schütt) Kofoid 1911, which has the ability to produce mucilage (Pistocchi et al., 2005), all of the species found in the mucilage structure are also present in İzmir Bay, according to the species lists of all periods in our study. Although diatom species *Cylindrotheca closterium* (Ehrenberg) Reimann & J.C. Lewin, 1964; *Skeletonema costatum* (Greville) Cleve, 1873 and dinoflagellate speices *Noctiluca scintillans* (Macartney) Kofoid & Swezy which are capable of producing mucilage substances, reproduce from time to time in the bay, it has not been observed that they cause any mucilage formation other than changing the color of the sea.

As a result of the observations in İzmir Bay, considering the species belonging to all classes in the Bay, the rate of harmless species that do not reproduce excessively is 77.6%, the rate of blooming species whether toxic or not is 22.4%, the rate of non-toxic species that worsen the marine environment by excessive reproduction is 16.1%. and the rate of both toxic and overproducing species was determined as 6.3% (Figure 4).

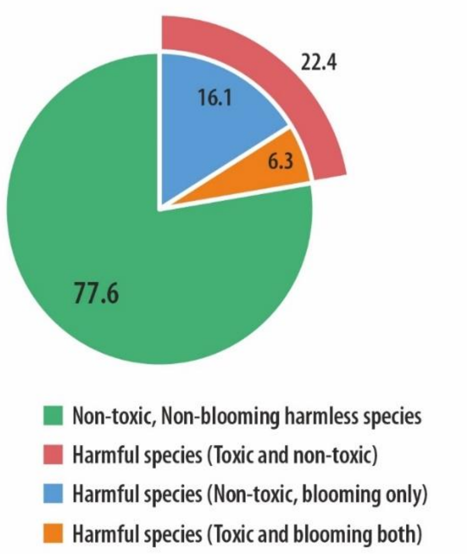

Figure 4. Percentage of HAB species and Non-toxic, Non-blooming harmless species

When 67 planktonic organism species that cause harmful algae overgrowth are examined in the bay (Table 1), the ratio of the species in the bay that affect the other organisms by releasing DSP, PSP, ASP and NSP toxins into the sea is given in Figure 5. Among the 67 species with harmful increase the most producing common toxin is DSP with 16.4% (Figure 5).

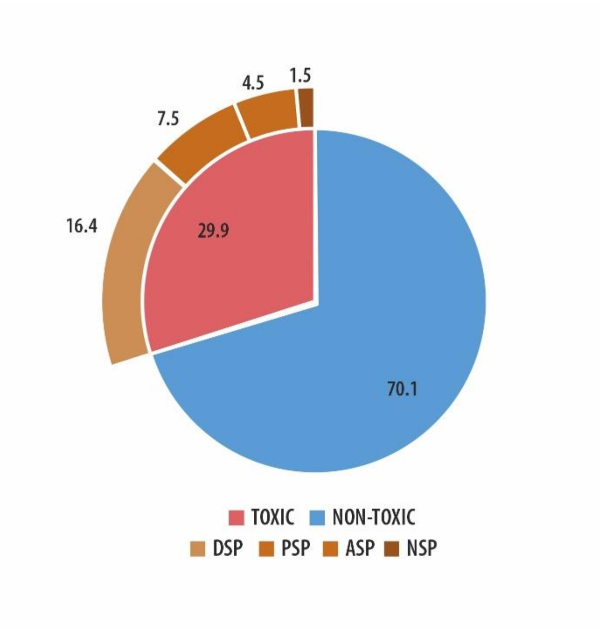

Figure 5. Percentage of algal bloom forming species and toxin producers

Successful commissioning of the İzmir Grand Canal Project has made an substantial improvement in diversity. The seasonal excessive algal blooms in the Izmir Bay, which has an extremely dynamic structure, should be continuously monitored.

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