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An annotated checklist of dinoflagellates in the Black Sea

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Abstract

An annotated checklist of free-living dinoflagellates (Dinophyceae) of the Black Sea, based on literature records, is reported and compared to the Mediterranean Sea and world oceans. Toxic species and/or responsible of harmful algal blooms (HAB) are marked in the checklist. From the 267 species (54 genera) listed nearly all taxa can be considered as cosmopolitan and no species as endemic. Several typically Arctic-boreal species (non recorded from the Mediterranean Sea) are reported from the Black Sea. The taxonomy and the biogeography of the taxa are discussed.

Introduction

The Black Sea (∼41–46° N) is a semi-enclosed basin whose only connection to the world's oceans is through narrow straits (<110 m depth), the Dardanelles and the Bosphorus, both opening to the Marmara Sea. The fresher waters of the Black Sea (salinity ∼17) flow to the Mediterranean Sea by means of an upper layer flow; saltier Mediterranean waters (∼38.5) flow to the Black Sea in a lower current. A permanent halocline is maintained by colder low-salinity surface water averaging 17.5–19 overlying deep waters with salinity about 22. Low near-surface salinity is maintained by the influx of freshwater from rivers and decreases to <13 near the mouths of the Danube and Dnieper rivers (see references in Sorokin, 2002).

In the last decades the Black Sea basin has experienced huge changes in water quality caused by human interventions both on the hydraulic regime of the rivers and on the nutrient and pollutant discharge. Significant changes on phytoplankton, zooplankton, zoobenthos and fisheries have been reported (Bakan & Buyukgungor, 2000). The high nitrate and phosphate to silicate ratios as well as organic material provide competitive advantage for mixo- or heterotrophic dinoflagellates compared to autotrophic diatoms, with high dinoflagellates to diatoms ratio (Humborg et al., 1997). A change in dominant species was observed as well as an increase in red tide events (Bologa et al., 1995; Mihnea, 1997). The high degree of eutrophication in the Black Sea could favour invasive species (i.e., via ballast waters; Moncheva & Kamburska, 2002) to compete for niches. Among phytoplankton taxa, dinoflagellates with more than 200 potential toxic species (Sournia, 1995) require special attention.

Krakhmalny (1994) reported a list of 193 dinoflagellates (including infraespecific taxa) in the Black Sea. Other checklists are available from Georgian (Komakhidze & Mazmanidi, 1998), Ukrainian (Zaitsev & Alexandrov, 1998), Turkish (Ozturk, 1999; Turkoglu & Koray, 2000, 2002; Koray et al., 2000), Bulgarian (Konsulov, 1998; Velikova et al., 1999) and Romanian coasts (Skolka, 1977; Bodeanu, 1987–1988; Petranu, 1997).

Literature sources are compiled here and an annotated checklist is discussed. This study attempts to assess the biodiversity of dinoflagellates, here defined

as species richness, in the Black Sea and also to compare this richness to adjacent seas in order to establish the biogeographical affinities of the Black Sea dinoflagellates.

Material and methods

This study is based on literature records of dinoflagellates from the Black Sea (108 references). The species are arranged alphabetically and taxa are named with their nomenclatural authorities (Table 1). The nomenclature is updated and the synonyms are reported. The numbers following a species name in the checklist refer to the list of references. Exclusively freshwater taxa such as *Ceratium hirundinella* (O.F. Müller) Bergh, parasitic species such as *Paulsenella chaetoceratis* (Paulsen) Chatton or taxa insufficiently known or of doubtful validity such as the genera *Cystodinium* Klebs or *Hypnodinium* Klebs have been excluded. However the primarily freshwater species (see Popovský & Pfiester, 1990) that apparently are able to tolerate the salinity of the offshore waters of the Black Sea are listed, although not considered for biogeographical purposes.

The species included in what are considered to be valid or reliable records are reported in bold type. The records of insufficiently known or dubious species, requiring more precise taxonomical investigation, are presented in normal type. Most of these taxa mainly correspond to athecate dinoflagellates. It should be taken into account that the fixatives commonly used (Lugol, formaldehyde) do not sufficiently preserve them to allow species identification. Body shape and morphology often change during the process of fixation so that it is even difficult to determine the genus. In addition, some of the older descriptions are not sufficiently detailed or are inappropriate – as also occurred for some thecate species [i.e., *Protoperidinium sinaicum* (Matzenauer) Balech, *P. deficiens* (Meunier) Balech].

The taxa considered as Harmful Algal Bloom (HAB) species are based on the species listed by Faust & Gulledge (2002) and Hallegraeff (2002) as well as *Amphidinium operculatum* Claparède *et* Lachmann and *Heterocapsa triquetra* (Ehrenberg) Stein.

The Black Sea taxa have been compared to those in checklists from the Mediterranean and the adjacent seas. References concerning the presence of the taxa in the Mediterranean Sea are omitted due to space limitation, but can be found in Gómez (2003). Literary resources from other geographical areas are cited in the text where appropriate.

Results and discussion

The Black Sea dinoflagellates flora is represented by 267 species from 54 genera (Table 1), being about one half monotypic genera (30 genera). The most numerous genera were *Protoperidinium* Bergh *emend.* Balech (41 species), *Ceratium* Schrank (26 species) and *Dinophysis* Ehrenberg (20 species) as well as the primarily freshwater genera *Glenodinium* (Ehrenberg) Stein, *Peridinium* Ehrenberg (also *Glenodiniopsis* Woloszynska, *Peridiniopsis* Lemmermann) and species of *Gymnodinium* Stein (30 species) that are able to tolerate a wide range of salinity.

Concerning the geographical distribution, nearly all the Black Sea species can be considered as cosmopolitan with some exceptions as discussed below.

Species richness and biodiversity

About 1400–1800 species (115–131 genera) constitute marine living dinoflagellates in the world oceans (Sournia, 1995; Steidinger & Tangen, 1997). According to this non-updated value, the Black Sea comprises about 15% of the world species and about 40% of the dinoflagellate genera (54 genera).

This low species richness compared to the Mediterranean Sea (673 species, 104 genera; Gómez, 2003) is primarily attributable to the general low diversity in brackish waters, usually more stressed than marine waters. The low transparency and the toxic deep layer (most of the deeper waters are isolated from any source of oxygen, and have a high content of hydrogen sulphide) reduce the biotic layer. Consequently the oxygenic life is restricted to the upper waters, decreasing the number of niches available compared to oceanic waters [for example for the deep-living flora (Sournia, 1982)]. The contents of organic matter could favour a high species richness of heterotrophic dinoflagellates as Noctilucales and partially Gymnodiniales, the latter usually difficult to identify at species level. Stoyanova (1999) reported high abundance (85–170 cells l^{-1}) of the aberrant heterotrophic dinoflagellates *Spatulodinium pseudonoctiluca* (Pouchet) Cachon *et* Cachon *ex* Loeblich *et* Loeblich III, *Scaphodinium mirabile* Margalef and *Petalodinium porcelio* Cachon *et* Cachon. She suggested that the high abundance of these new records in the Black Sea is a consequence

Table 1. List of taxa. The species considered as valid records are reported in bold type. The records of insufficiently known, questionable or dubious species, requiring more precise taxonomical investigation, are presented in normal type. The numbers following a species name in the checklist refer to the list of references. HAB = Harmful Algal Bloom species; Cold = typical species from cold waters; Pacif. = apparently Indo-Pacific species.

	Achradina pulchra Lohmann [128]
HAB	***Akashiwo sanguinea*** (Hirasaka) G. Hansen *et* Moestrup [= *Gymnodinium sanguineum* Hirasaka, *G. splendens* Lebour, *G. nelsonii* Martin] [9,12,15,17–20,23,27,33,34,37,59,61,75,78,89,94,96,110,114,117,119,127,133–135,143]
HAB	*Alexandrium monilatum* (Howell) Balech [= *Gonyaulax monilata* Howell, *Gessnerium mochimaensis* Halim *ex* Halim, *G. monilata* (Howell) Loeblich, *Pyrodinium monilatum* (Howell) F.J.R. Taylor] [23,59,75,76,78,79,137,139]
HAB, cold	***Alexandrium ostenfeldii*** (Paulsen) Balech *et* Tangen [= *Goniodoma ostenfeldii* Paulsen, *Gonyaulax ostenfeldii* (Paulsen) Paulsen, *Protogonyaulax ostenfeldii* (Paulsen) Fraga *et* Sánchez, *Heteraulacus ostenfeldii* (Paulsen) Loeblich, *Gessnerium ostenfeldii* (Paulsen) Loeblich *et* Loeblich III, *Triadinium ostenfeldii* (Paulsen) Dodge] [61,96]
	Amphidinium acutissimum Schiller [= *A. acutum* Schiller, non *A. acutum* Lohmann] [132]
	Amphidinium amphidinioides (Geitler) Schiller [= *A. geitleri* Huber-Pestalozzi, *A. wigrense* Woloszynska, *A. bourrellyi* Wawrik, *Gymnodinium amphidinioides* Geitler] [61,132]
	Amphidinium conradii Schiller [= *Gymnodinium glaucum* Conrad] [61]
	Amphidinium crassum Lohmann [= *A. phaeocysticola* Lebour] [59,61,143]
Pacif.	*Amphidinium cucurbita* Kofoid *et* Swezy [61]
	Amphidinium curvatum Schiller [61]
	Amphidinium elenkinii Skvortsov [= *A. larvale* Lindemann, *A. hyalinum* Entz, *A. tatrae* Woloszynska, *A. tenagodes* Harris, *A. luteum* Skuja, *A. gyrinum* Harris, *A. turicense* Huber-Pestalozzi, *A. lohamari* Skuja, *A. skujae* Christen, *Gymnodinium rarum* Litvinenko] [132]
Cold	*Amphidinium extensum* Wulff [61,96,110,114,119]
	Amphidinium flagellans Schiller [61]
	Amphidinium globosum Schröder [61]
	Amphidinium lacustre Stein [= *A. lacustriforme* Schiller, *A. schroederi* Schiller] [132]
	Amphidinium lanceolatum Schröder [58,132]
Cold	*Amphidinium longum* Lohmann [= *A. acutum* Lohmann, non *A. acutum* Schiller] [59,61]
HAB	***Amphidinium operculatum*** Claparède *et* Lachmann [= *A. klebsii* Kofoid *et* Swezy, *A. massartii* Biecheler, *A. wislouchii* Hulburt, *A. hoefleri* Schiller *et* Diskus] [59,61]
	Amphidinium ovum Herdman [58,61]
	Amphisolenia bidentata Schröder [non *A. bidentata* Pavillard, non *A. bidentata* Okamura] [94]
Cold	*Amylax triacantha* (Jørgensen) Sournia [= *Gonyaulax triacantha* Jørgensen, *Amylax lata* Meunier] [61]
	Centrodinium intermedium Pavillard [1]
	Ceratium belone Cleve [= *C. pacificum* Schröder] [60,133,134]
	Ceratium buceros (Zacharias) Schiller [94]
	Ceratium candelabrum (Ehrenberg) Stein [8,61,94]
	Ceratium carriense Gourret [= *C. volans* Pavillard, *C. massiliense* Pavillard] [60,133,134]
	Ceratium compressum Gran [for synonymy with *C. platycorne*, see Balech (1988: 141)] [60,133,134]
	Ceratium declinatum (Karsten) Jørgensen [= *C. tripos declinatum* Karsten] [60,133,134]
	Ceratium extensum (Gourret) Cleve [= *C. strictum* (Okamura *et* Nishikawa) Kofoid, *C. biceps* Kofoid] [8,9,18,60,61,94,96,133,134]
	Ceratium falcatum (Kofoid) Jørgensen [= *C. pennatum* f. *falcata* Kofoid, *C. pennatum* var. *falcatum* Jørgensen] [61,94]
	Ceratium furca (Ehrenberg) Claparède *et* Lachmann [= *C. bipes* Claparède *et* Lachmann] [8,9,14,15,18–20, 33,34,46,59–61,74–76,79,90,94,96,107,109–111,114,119,125,132–135,143]
	Ceratium fusus (Ehrenberg) Dujardin [var. *fusus*, var. *seta* and var. *schuettii*] [2,8,9,18,27,33–35, 42,46,59–61,74,79,85,90,94,96,99,107,109,110–112,114,119,125,133–135,143,144]
	Ceratium hexacanthum Gourret [= *C. reticulatum* (Pouchet) Cleve] [60,61,94,133,134]
	Ceratium horridum (Cleve) Gran [= *C. tripos* var. *horridum* Cleve, *C. intermedium* (Jørgensen) Jørgensen, *C. claviger* Kofoid, *C. tenue* (Ostenfeld*et* Schmidt) Jørgensen, *C. inclinatum* Kofoid, *C. tenuissimum* Kofoid, *C. mollis* Kofoid, *C. batavum* Paulsen, *C. leptosomum* Jørgensen, *C. horridum* var. *denticulatum* Jørgensen] [60,94,133–135]
	Ceratium incisum (Karsten) Jørgensen [60,133,134]
	Ceratium inflatum (Kofoid) Jørgensen [8,60,61,94,114,133–135,
	Ceratium kofoidii Jørgensen [60,133,134]
	Ceratium lineatum (Ehrenberg) Cleve [60,61,133,134]

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Table 1. Continued.

Cold	***Ceratium longipes*** (Bailey) Gran [= *C. arcticum* var. *longipes* (Bailey) Graham *et* Bronikovsky] [61,94]
	Ceratium longirostrum Gourret [60,94,132–135]
	Ceratium macroceros (Ehrenberg) Cleve [8,61,94,114]
	Ceratium massiliense (Gourret) Karsten [also var. *armatum* (Karsten) Jørgensen] [60,61,133,134]
	Ceratium minutum Jørgensen [59,61]
	Ceratium pentagonum Gourret [46,61,94,135,]
	Ceratium pulchellum Schröder [= *C. tripos* var. *pulchellum* Peters] [60,94,133,134]
	Ceratium teres Kofoid [61,133,134]
	Ceratium tripos (O.F. Müller) Nitzsch [= *C. schroederi* Nie, *C. neglectum* Ostenfeld, *C. tripodioides* (Jørgensen) Steemann Nielsen] [8,9,18,31,33,34,42,46,58,60,61,74,79,90,94,96,99,107,109,110,114,119,125,133–135]
	Ceratium volans Cleve [= *C. carriense* var. *volans* (Cleve) Sournia, non *C. volans* Pavillard] [60,133,134]
	Cladopyxis brachiolata Stein [= *C. spinosa* (Kofoid) Schiller] [61]
	Cochlodinium adriaticum Schiller [= *Gyrodinium adriaticum* Schiller] [61,86,88]
	Cochlodinium brandtii Wulff [144]
	Cochlodinium citron Kofoid *et* Swezy [61,128,144]
	Cochlodinium geminatum (Schütt) Schütt [= *Gymnodinium geminatum* Schütt] [132]
	Cochlodinium helicoides Lebour [= *C. helix* Schütt pro parte, *C. helix* Kofoid *et* Swezy, reported as synonym *C. helix* (Pouchet) Lemmermann] [61,128]
	Cochlodinium lebourae Kofoid *et* Swezy [61]
	Cochlodinium pirum (Schütt) Lemmermann [= *Gymnodinium pirum* Schütt] [61]
	Corythodinium compressum (Kofoid) F.J.R. Taylor [= *Oxytoxum compressum* Kofoid] [133]
	Corythodinium diploconus (Stein) F.J.R. Taylor [= *Oxytoxum diploconus* Stein] [133]
HAB	***Dinophysis acuminata*** Claparède *et* Lachmann [= *D. ovum* var. *baltica* Paulsen, *D. arctica* sensu Woloszynska, *D. baltica* (Paulsen) Woloszynska, *D. cassubica* Woloszynska, *D. levanderi* Woloszynska, *D. paulsenii* Woloszynska, *D. boehmii* Paulsen, *D. borealis* Paulsen, *D. lachmannii* Paulsen, *D. skagii* Paulsen] [9,18,59–61,94,96,114,133–135,143]
HAB	***Dinophysis acuta*** Ehrenberg [= *D. dens* Pavillard, *D. groenlandica* (Schiller) Balech] [46,59–61,89,94,133,134]
Cold	*Dinophysis apiculata* Meunier [61]
Cold	*Dinophysis arctica* Mereschkowsky [= *D. laevis* (Bergh) Pouchet, *D. rotundata* Levander, *D. granulata* Cleve, non *D. laevis* Bergh, non *D. rotundata* Claparède *et* Lachmann, non *D. arctica* sensu Woloszynska] [61]
HAB	***Dinophysis caudata*** Saville-Kent [= *D. homunculus* Stein, *D. diegensis* Kofoid] [9,18,34,46,59–61,90,94,96,108,114,119,133–135,143]
	Dinophysis dentata Schiller [94]
HAB	***Dinophysis fortii*** Pavillard [= *D. laevis* Pouchet, *D. lapidistrigiliformis* Abé, *D. intermedia* Pavillard] [33,46,61,94,110,114,125,133–135,143]
HAB	***Dinophysis hastata*** Stein [non *Phalacroma hastatum* Pavillard, non *Ph. hastatum* Hensen] [9,18,34,59–61,94,96,110,114,133,134]
	Dinophysis meunieri Schiller [= *D. cuneiformis* Meunier, non *D. cuneiformis* Mangin] [34]
	Dinophysis minuta (Cleve) Balech [= *Phalacroma minutum* Cleve] [61]
HAB, cold	*Dinophysis norvegica* Claparède *et* Lachmann [= *D. debilior* (Paulsen) Paulsen, resembles to *D. acuta* Ehrenberg] [61,143]
	Dinophysis ovum Schütt [= *D. brevisulcus* Tai *et* Skogsberg pro parte, non *Phalacroma ovum* Schütt] [1,9,18,58,59,61,94,96,110,114,135,143]
	Dinophysis parva Schiller [= *D. infundibula* Schiller] [60,94,133,134]
	Dinophysis punctata Jørgensen [non *D. punctata* Balech] [60,94,133,134]
HAB	***Dinophysis sacculus*** Stein [= *D. acuminata* f. *reniformis* Pavillard, *D. reniformis* (Pavillard) Kofoid *et* Skogsberg, *D. pavillardii* Schröder, *D. ventrecta* Schiller, *D. phaseolus* Silva] [9,15,17–20,33,34,59–61,90,94,96,107–110,114,119,133–135,143]
	Dinophysis schilleri Sournia [= *Phalacroma sphaeroideum* Schiller] [59,61,96]
	Dinophysis schuettii Murray *et* Whitting [= *D. uracantha* Schütt, non *D. uracantha* Stein] [61]
	Dinophysis similis Kofoid *et* Skogsberg [= *D. sphaerica* Schütt, *D. simplex* Balech, *D. tai* Balech, non *D. simplex* Böhm] [94]
	Dinophysis sphaerica Stein [= *D. vanhoffenii* Ostenfeld] [61,94,96,143]
HAB	***Dinophysis tripos*** Gourret [= *D. caudata* var. *tripos* (Gourret) Gail] [61]
	Diplopelta bomba Stein *ex* Jørgensen [= *Diplosalis lenticula* Stein, *Peridiniopsis asymmetrica* Mangin, *Diplopelta asymmetrica* (Mangin) Lebour, *Diplopsalopsis asymmetricum* (Mangin) Abé, *Dissodium asymmetricum* (Mangin) Loeblich III] [94]

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Table 1. Continued.

	Diplopsalis lenticula Bergh [= *Glenodinium lenticula* (Bergh) Schiller, *Dissodium lenticulum* (Bergh) Loeblich III] [8,9,18,33,34,59–61,85,88,89,96,109–112,114,119,128,133,134,143]
	Diplopsalopsis orbicularis (Paulsen) Meunier [= *Peridinium orbiculare* Paulsen] [9,18,61,96,114,128,143]
	Glenodinium behningii (Lindemann) Kisselew [= *Diplopsalis behningii* Lindemann] [61,114,143]
	Glenodinium caspicum (Ostenfeld) Schiller [61,110,143]
	Glenodinium inflatum Meunier [18,61,96]
	Glenodinium obliquum Pouchet [61]
	Glenodinium paululum Lindemann [9,15,18–20,27,34,42,59,61,88,89,96,107,109,110,114,117,119,143]
	Glenodinium pilula (Ostenfeld) Schiller [= *Diplopsalis pilula* Ostenfeld, *Peridinium pilula* (Ostenfeld) Lemmermann] [9,14,15,18–20,34,58,59,61,96,114,143]
	Glenodinium pulvisculus (Ehrenberg) Stein [= *Peridinium pulvisculus* Ehrenberg] [61]
	Goniodoma acuminatum (Ehrenberg) Stein [= *Peridinium acuminatum* Ehrenberg, non *Peridinium polyedricum* Pouchet] [61,94]
	Goniodoma polyedricum (Pouchet) Jørgensen [= *Peridinium polyedricum* Pouchet, *Triadinium polyedricum* (Pouchet) Dodge, *Goniodoma acuminata* Stein pro parte, non *Peridinium acuminatum* Ehrenberg] [9,18,59,61,96,110,143]
	Gonyaulax africana Schiller [94,135]
	Gonyaulax apiculata (Pénard) Entz [= *G. apiculata* var. *clevei* Ostenfeld, *Peridinium apiculatum* Pénard, *G. clevei* Ostenfeld, *G. polonica* Woloszynska, *G. limmetica* Lindemann, *G. austriaca* Schiller] [8,33,34,59]
	Gonyaulax birostris Stein [= *Gonyaulax glyptorhynchus* Murray *et* Whitting, *G. highleyi* Murray *et* Whitting] [60,133,134]
Cold	***Gonyaulax cochlea*** Meunier [= *G. polygramma* Meunier] [9,18,22,25,58,59,61,94,96,114,117]
	Gonyaulax diegensis Kofoid [= *G. spinifera* sensu Schütt] [9,18,34,46,59–61,94,96,114,119,133,134,143]
	Gonyaulax digitalis (Pouchet) Kofoid [= *G. spinifera* Stein, *Protoperidinium digitale* Pouchet] [8,18,59,61,94,96,114,119]
	Gonyaulax elegans Rampi [94,135]
	Gonyaulax fragilis (Schütt) Kofoid [= *Steiniella fragilis* Schütt] [61]
	Gonyaulax gracilis Schiller [61]
	Gonyaulax minuta Kofoid *et* Michener [= *G. minima* Matzenauer] [58,59,61,89,131]
	Gonyaulax monacantha Pavillard [60,94,133,134]
	Gonyaulax monospina Rampi [94]
	Gonyaulax orientalis Lindemann [= *Goniodoma orientale* (Lindemann) Balech, *Triadinium orientale* (Lindemann) Dodge, *Gonyaulax lebourae* Balech pro parte, non *G. orientalis* sensu Lebour] [59,61]
HAB	***Gonyaulax polygramma*** Stein [= *G. schuettii* Lemmermann] [8–15,17,18,25–28,34,59–61,68,69,72,73,94,96,110,114,115,119,133,134,137,143]
	Gonyaulax scrippsae Kofoid [58,59,61,143]
	Gonyaulax spinifera (Claparède *et* Lachmann) Diesing [=*G. levanderi* (Lemmermann) Paulsen, non *G. spinifera* Stein] [8,9,18,46,59–61,89,94,96,109,114,131,133,134]
	Gonyaulax verior Sournia [= *G. diacantha* (Meunier) Schiller, *G. longispina* Lebour, *Amylax diacantha* Meunier] [46]
	Gymnodinium agile Kofoid *et* Swezy [non *G. agile* sensu Herdmann] [9,18,59,61,96,110,114,117]
	Gymnodinium agiliforme Schiller [58,61,89,96]
	Gymnodinium aeruginosum Stein [= *G. acidotum* Nygaard, *G. viride* Pénard, *G. campaniforme* Popovský] [132]
	Gymnodinium auratum Kofoid *et* Swezy [119]
	Gymnodinium biconicum Schiller [1,94]
	Gymnodinium conicum Kofoid *et* Swezy [= *G. viridis* Lebour] [59]
	Gymnodinium flavum Kofoid *et* Swezy [non *Gyrodinium flavum* Kofoid] [59]
	Gymnodinium fuscum (Ehrenberg) Stein [= *G. caudatum* Prescot, *Cystodinium gessneri* (Baumeister) Bourrelly] [9,18,96,119]
	Gymnodinium gracile Bergh [= *G. spirale* var. *nobilis* Pouchet, *G. roseum* Lohmann, *G. abbreviatum* Kofoid *et* Swezy, *G. lohmannii* Paulsen] [128]
	Gymnodinium helveticum Pénard [= *G. helveticum* var. *apiculata* (Zacharias) Utermöhl, *Glenodinium apiculatum* Zacharias *in* Schilling] [12,15,17,19,20,27,59,61,96,119,143]
	Gymnodinium galeaeforme Matzenauer [59]
	Gymnodinium gibbera Schiller [119]
	Gymnodinium grammaticum (Pouchet) Kofoid *et* Swezy [= *G. punctatum* var. *grammaticum* Pouchet] [61]
	Gymnodinium lachmannii Saville-Kent [59]

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Table 1. Continued.

	Gymnodinium marinum Saville-Kent [61]
	Gymnodinium minus Lebour [61]
	Gymnodinium najadeum Schiller [19–22,25,34,58,59,61,75,76,79,89,96,119,143]
	Gymnodinium neapolitanum Schiller [61,96,114,143]
	Gymnodinium paradoxum Schilling [27,96]
	Gymnodinium pygmaeum Lebour [possibly identical with *Gymnodinium aureolum* (Hulburt) G. Hansen] [61]
Pacif.	*Gymnodinium radiatum* Kofoid *et* Swezy [62]
	Gymnodinium rhomboides Schütt [9,12,14,15,17–20,33,34,58,59,61,90,96,110–112,114,119]
	Gymnodinium rotundatum Klebs [94]
	Gymnodinium semidivisum Schiller [61]
	Gymnodinium simplex (Lohmann) Kofoid *et* Swezy [= *Protodinium simplex* Lohmann] [1,61,94]
	Gymnodinium sphaericum (Calkins) Kofoid *et* Swezy [= *G. gracile* var. *sphaerica* Calkins] [117]
Pacif.	*Gymnodinium sulcatum* Kofoid *et* Swezy [61,143]
	Gymnodinium uberrimum (Allman) Kofoid *et* Swezy [= *G. mirabile* Pénard, *G. mirabile* var. *rufescens* Pénard, *G. rufescens* Lemmermann, *G. bogoriense* Klebs, *G. rotundatum* Klebs, *G. obesum* Schiller, *G. limneticum* Woloszynska, *G. poculiferum* Skuja, *G. limitatium* Skuja, *G. irregulare* Christen, *G. uberrimum* var. *rotundatum* Popovský, *Gyrodinium traunsteineri* Lindemann, *Melodinium uberrimum* Kent, *Peridinium uberrima* Allman] [23,75,76,132,139]
	Gymnodinium variabile Herdman [61]
Cold	*Gymnodinium wulffii* Schiller [non *Gyrodinium wulffii* Schiller] [58,59,61]
Cold	*Gyrodinium britannicum* Kofoid *et* Swezy [= *Spirodinium spirale* var. *acutum* Lebour] [61]
	Gyrodinium capsulatum Kofoid *et* Swezy [61]
	Gyrodinium cornutum (Pouchet) Kofoid *et* Swezy [= *Gymnodinium spirale* var. *cornutum* Pouchet] [85,86,132]
	Gyrodinium dorsum Kofoid *et* Swezy [61]
	Gyrodinium falcatum Kofoid *et* Swezy [= *Gymnodinium fusus* Schütt pro parte, *Pseliodinium vaubanii* Sournia] [9,14,15,18–20,34,61,96,110,119,143]
	Gyrodinium fissum (Levander) Kofoid *et* Swezy [= ?*G. fissoides* Elbrächter, ?*Gymnodinium fissum* Levander] [59,61,144]
	Gyrodinium fusus (Meunier) Akselman [= *Spirodinium fusus* Meunier, *G. fusiforme* Kofoid *et* Swezy] [9,18,26,27,29,33,34,42,59,61,79,94,96,107,114,117,119,128,143]
	Gyrodinium glaebum Hulburt [= *Gymnodinium mirabile* Pénard] [61]
	Gyrodinium lachryma (Meunier) Kofoid *et* Swezy [= *Spirodinium lachryma* Meunier] [9,18,27,33,34,59,61,94,96,114,117,119,128,135,143]
	Gyrodinium nasutum (Wulff) Schiller [= *Spirodinium nasutum* Wulff] [59,61,96,117,128,143]
	Gyrodinium pavillardii Biecheler [96]
	Gyrodinium pellucidum (Wulff) Schiller [= *Gymnodinium pellucidum* Wulff] [94]
	Gyrodinium pingue (Schütt) Kofoid *et* Swezy [= *Gymnodinium spirale* var. *pinguis* Schütt, *Spirodinium varians* Wulff] [9,18,59,61,96,112,114,143]
	Gyrodinium prunus (Wulff) Lebour [= *Spirodinium prunus* Wulff] [61]
	Gyrodinium pusillum (Schilling) Kofoid *et* Swezy [= *Spirodinium pusillum* (Schilling) Lemmermann, *Gymnodinium pusillum* Schilling] [94]
	Gyrodinium spirale (Bergh) Kofoid *et* Swezy [= *Gymnodinium spirale* Bergh] [59,61,128]
	Heterocapsa rotundata (Lohmann) G. Hansen [= *Amphidinium rotundatum* Lohmann, *A. pellucidum* Redeke, *Gymnodinium minutum* Lebour, *Katodinium rotundatum* (Lohmann) Fott, *K. minutum* (Lebour) Sournia, *Massartia rotundata* (Lohmann) Schiller] [61]
HAB	***Heterocapsa triquetra*** (Ehrenberg) Stein [= *Glenodinium triquetrum* Ehrenberg, *Peridinium triquetrum* (Ehrenberg) Lebour, *Properidinium heterocapsa* (Stein) Meunier] [9,18–23,25,27,28,34,41,58–61,70,75,76,78,85,86,88,89,94,96,97,110,132–135,137,139,143]
	Heterodinium murrayi Kofoid [94]
	Katodinium fungiforme (Anissimowa) Loeblich [= *Gymnodinium fungiforme* Anissimowa, *G. blax* Harris, *Massartia crassifilum* Schiller, *M. austriacum* Schiller, *Katodinium crassifilum* (Schiller) Loeblich III, *K. austriacum* (Schiller) Loeblich III] [59,132]
	Katodinium vorticella (Stein) Loeblich III [= *Gymnodinium vorticella* Stein, *Peridinium vorticella* Stein, *Massartia vorticella* (Stein) Schiller, *M. pratensis* Baumeister, *Katodinium viride* Christen, *K. vernale* Christen, *K. pratensis* (Baumeister) Loeblich III] [59,61]

Continued on p. 49

Table 1. Continued.

	Kolkwitziella acuta (Apstein) Elbrächter [= *Glenodinium acutum* Apstein, *Diplopsalis acuta* (Apstein) Entz, *Entzia acuta* (Apstein) Lebour, *Peridinium latum* Paulsen, *Kolkwitziella salebrosa* Lindemann, *K. gibbera* (Lindemann) Lindemann, *Apsteinia acuta* Abé] [61,96,119,143]
HAB	***Kryptoperidinium foliaceum*** (Stein) Lindemann [= *Glenodinium foliaceum* Stein] [18,59,61]
HAB	***Lingulodinium polyedra*** (Stein) Dodge [= *Gonyaulax polyedra* Stein] [8,9,14,15,17–20,23,25,33,46,58–61,72,75,76,78,85,86,89,90,94,96,110,111,114,118,119,132–135,139,143]
	Mesoporos perforatus (Gran) Lillick [= *Exuviella perforata* Gran, *Porella adriatica* Schiller, *P. bisimpressa* Schiller, *P. globulus* Schiller, *P. asymmetrica* Schiller, *Porotheca perforata* (Gran) Silva] [58,61,94]
HAB	***Noctiluca scintillans*** (Macartney) Kofoid [= *N. miliaris* Suriray *ex* Lamarck] [7,8,12,18,31,35,36,46,47,51,59–61,75,76,81,94,97,101,110,114,128,129,133–136,141,143]
	Oblea rotunda (Balech) Balech *ex* Sournia [= *Peridiniopsis rotunda* Lebour, *Glenodinium rotundum* (Lebour) Schiller, *Diplopsalis rotunda* (Lebour) Wood, *D. rotundata* Steidinger *et* Williams] [9,18,34,59,61,96,110,114]
	Oxyphysis oxytoxoides Kofoid [23,59,75,76,137,139]
	Oxyrrhis marina Dujardin [= *O. maritima* Van Meel, *O. tentaculifera* Conrad] [58,59,61,143]
	Oxytoxum adriaticum Schiller [133]
	Oxytoxum brunellii Rampi [133]
	Oxytoxum milneri Murray *et* Whitting [= *O. subulatum* Kofoid] [94]
	Oxytoxum mitra Stein [1,94]
	Oxytoxum parvum Schiller [= *O. tenuistriatum* Rampi, reported as '*O. parvulum*' Schiller] [61]
	Oxytoxum variabile Schiller [= *Oxytoxum gracile* Schiller] [61]
	Palaeophalacroma unicinctum Schiller [= *Heterodinium detonii* Rampi, *Epiperidinium michaelsarsi* Gaarder] [144]
Cold	***Peridiniella danica*** (Paulsen) Okolodkov *et* Dogde [= *Glenodinium danicum* Paulsen *ex* Braarud pro parte] [9,14,15,18–20,27,34,59,61,88,96,110,114]
	Peridiniopsis oculatum (Stein) Bourrelly [= *Glenodinium oculatum* Stein] [61]
	Peridiniopsis thompsonii (Thompson) Bourrelly [= *Glenodinium quadridens* (Stein) Schiller, *Peridinium quadridens* Stein] [96]
	Peridinium aciculiferum Lemmermann [= *P. umbonatum* var. *aciculiferum* Lemmernann, *P. stagnale* Meunier, *Glenodinium aciculiferum* (Lemmermann) Lindemann] [61,143]
	Peridinium bipes Stein [= *P. tabulatum* (Ehrenberg) Claparède *et* Lachmann, *Glenodinium tabulatum* Ehrenberg, *G. apiculatum* Ehrenberg] [34,58,61]
	Peridinium cinctum (O.F. Müller) Ehrenberg [= *Peridinium tabulatum* Pénard, *P. cinctum* var. *lemmermannii* West, var. *laesum* Lindemann, var. *regulatum* Lindemann, var. *irregulatum* Lindemann, var. *angulatum* Lindemann, var. *carinatum* Steinecke *et* Lindemann, non var. *gibbosum* Lefèvre, non var. *palustre* Lindemann. Also *P. cinctum* f. *regulatum* (Lindemann) Lefèvre, f. *angulatum* (Lindemann) Lefèvre, f. *ovoplanum* Lindemann, f. *meandricum* Lefèvre, f. *westii* (Lemmermann) Lefèvre, f. *tuberosum* (Meunier) Lefèvre, *P. germanicum* Lindemann, *P. eximium* Lindemann, *P. rhenanum* Lindemann] [9,18,61,84,94,96,143]
	Peridinium elpatiewskyi (Ostenfeld) Lemmermann [= *P. umbonatum* var. *elpatiewskyi* Ostenfeld, *P. pygmaeum* Lindemann, *Glenodinium elpatiewskyi* (Ostenfeld) Schiller, *Peridiniopsis elpatiewskyi* (Ostenfeld) Bourrelly] [61]
	Peridinium umbonatum Stein [= *Peridinium inconspicuum* Lemmermann, *P. pusillum* (Pénard) Lemmermann, *P. orrei* Huitfeld-Kaas, *P. umbonatum* var. *papilliferum* Lemmermann, *P. javanicum* Bernard, *P. umbonatum* var. *inaequale* Lemmermann, *P. inconspicuum* var. *armatum* Lemmermann, *P. marchicum* Lemmermann, *P. tabulatum* var. *caudatum* Playfair, *P. minimum* Woloszynska, *P. tatricum* Woloszynska, *P. tatricum* var. *spinulosa* Woloszynska, *P. linzium* Lindemann, *P. munusculum* Lindemann, *P. munusculum* f. *spiniferum* Lindemann, *P. caudatum* Playfair, *P. geminum* var. *angulosum* Playfair, *P. geminum* var. *elegans* Playfair, *P. geminum* var. *excavatum* Playfair, *P. marchicum* var. *keyense* Nygaard, *P. steinmannii* Woloszynska, *P. parvulum* Woloszynska, *P. ambiguum* Lindemann, *P. umbonatum* f. *spiniferum* (Lindemann) Lefèvre, *P. inconspicuum* var. *excavatum* (Playfair) Lefèvre, *P. inconspicuum* f. *armatum* (Lemmerman) Lefèvre, *P. inconspicuum* f. *spiniferum* (Lindemann) Lefèvre, *P. africanum* f. *tatricum* (Woloszynska) Lefèvre, *P. africanum* var. *spinulosum* (Woloszynska) Lefèvre, *P. inconspicuum* var. *balatonicum* Entz, *Glenodinium guildfordense* (Playfair) Lindemann, *G. geminum* (Playfair) Lindemann, *G. pusillum* Pénard, *G. lefevrei* Lindemann, *Gymnodinium oligoplacatum* Skuja. Also including *Peridinium umbonatum* var. *lubieniense* (Wolszynska) Popovský *et* Pfeister, *Peridinium lubieniense* Wolszynska, see also Elbrächter & Meyer (2001)] [59,61,143]
	Peridinium willei Huitfeld-Kaas [= *P. alatum* Garbini, *P. guestrowiense* Lindemann, *P. kincaidi* Wailes, *P. volzii* Lemmermann, *P. tabulatum* Playfair, *P. australe* Playfair, *P. hieroglyphicum* Playfair, *P. striolatum* Wailes, *P. vancouverense* Wailes, non *Peridinium tabulatum* (Ehrenberg) Claparède *et* Lachmann] [61,96]

Continued on p. 50

Table 1. Continued.

Petalodinium porcelio Cachon *et* Cachon [126]

Phalacroma acutum (Schütt) Pavillard [= *P. vastum* var. *acutum* Schütt, *Dinophysis acutoides* Balech, non *D. acutum* Ehrenberg] [61]

Phalacroma favus Kofoid *et* Michener [= *Dinophysis favus* (Kofoid *et* Michener) Abé vel Balech] [6,60]

Phalacroma ovatum (Claparède *et* Lachmann) Jørgensen [= *Dinophysis ovata* Claparède *et* Lachmann] [61,94,135]

Phalacroma parvulum (Schütt) Jørgensen [= *P. porodictyum* Stein var. *parvula* Schütt, *Dinophysis oviformis* Schiller; possible small cell of *D. rotundata* Claparède *et* Lachmann according to Reguera & González Gil (2001)] [60,94,133,134]

Phalacroma pulchellum Lebour [= *Dinophysis pulchella* (Lebour) Balech] [18,61,96,110]

HAB ***Phalacroma rotundatum*** (Claparède *et* Lachmann) Kofoid *et* Michener [= *Dinophysis rotundata* Claparède *et* Lachmann, *P. rudgei* Murray *et* Whitting, *D. whittingae* Balech] [9,15,17–19,20,27,33,34,46,59–61,90,94,96,110,114,119,129,133–135,143,144]

Plectodinium nucleovolvatum Biecheler [= *P. miniatum* (Kofoid *et* Swezy) F.J.R. Taylor, *Cochlodinium miniatum* Kofoid *et* Swezy] [94]

Podolampas elegans Schütt [94]

Podolampas spinifera Okamura [61]

Polykrikos kofoidii Chatton [= *P. schwarzii* Kofoid pro parte] [9,132]

Polykrikos schwartzii Bütschli [= *P. auricularia* Bergh] [8,18,42,59,61,94,96,110,114,118,129]

Preperidinium meunieri (Pavillard) Elbrächter [= *Diplopsalis lenticula* Bergh f. *minor* Paulsen, *Zygabikodinium lenticulatum* Loeblich *et* Loeblich III, *Peridinium lenticulum* Mangin, *Glenodinium lenticula* f. *minor* (Paulsen) Pavillard, *Diplopeltopsis minor* (Paulsen) Pavillard] [59,61]

Pronoctiluca acuta (Lohmann) Schiller [128]

Pronoctiluca pelagica Fabre-Domergue [= *Rhynchomonas marina* Lohmann, *Pelagorhynchus marinus* Pavillard] [74,94,128,144]

Pronoctiluca spinifera (Lohmann) Schiller [= *P. tentaculata* (Kofoid *et* Swezy) Fabre-Domergue] [94]

Prorocentrum aporum (Schiller) Dodge [= *P. antarcticum* (Hada) Balech, *Exuviella granii* Gaarder] [59,60,94,133–135]

HAB ***Prorocentrum balticum*** (Lohmann) Loeblich III [= *P. pomoideum* Bursa, *Exuviella baltica* Lohmann, *E. aequatorialis* Hasle] [18,46,60,61,75,76,94,96,110,114,133,134,143]

Prorocentrum compressum (Bailey) Abé *ex* Dodge [= *P. lebourae* Schiller, *Exuviella compressa* Bailey, *E. oblonga* Schiller, *E. lenticulata* Matzenauer, *E. elongata* Rampi] [8,9,14,15,18–20,33,34,46,58–61,63,90,94,96,107,110,114,119,127,133–135,143,144]

HAB ***Prorocentrum cordatum*** (Ostenfeld) Dodge [= *Exuviella cordata* Ostenfeld, *E. pyriformis* Schiller, *?P. minimum* (Pavillard) Schiller] [9–33,42,49,56,58,60,61,63,67–69,72,73,81–87,89,90,94,96–99,105–107,109–112,114–115,118,119,125,129,132–134,137,143]

Prorocentrum dentatum Stein [= *P. obtusidens* Schiller, *P. veloi* Osorio-Tafall, *P. monacense* Kufferath] [60,75,76,94,133,134]

HAB ***Prorocentrum lima*** (Ehrenberg) Dodge [= *Exuviella marina* Cienkowski, *E. caspica* Kisselew, *E. cincta* Schiller, *E. ostenfeldii* Schiller] [18,32,58,59,61,89,94,96,107,110]

Prorocentrum maximum (Gourret) Schiller [= *P. brochii* Schiller] [60,94,133,134,143]

HAB ***Prorocentrum micans*** Ehrenberg [= *P. schilleri* Böhm in Schiller, *P. levantoides* Bursa] [9,14,15,17–20,25–27,30,32,33,46,58–61,75,76,78,79,81,84–86,89,90,94,96,98,99,107,109–111,114,118,119,125,129,132–135,139,143]

HAB ***Prorocentrum minimum*** (Pavillard) Schiller [= *P. mariae-lebourae* (Parke *et* Ballantine) Loeblich III, *P. triangulatum* Martin, *P. cordiformis* Bursa, ?*P. cordatum* (Ostenfeld) Dodge] [2,46,59,60,75,76,78,79,94,133,134,138,139]

Prorocentrum obtusum Ostenfeld [9,18,34,61,89,96]

Prorocentrum ovum (Schiller) Dogde [= *Exuviella ovum* Schiller] [94]

Prorocentrum pusillum (Schiller) Loeblich [= *Exuviella pussilla* Schiller, non *P. nanum* Schiller] [58]

Prorocentrum rostratum Stein [= *Prorocentrum styliferum* Lohmann] [75,76]

Prorocentrum rotundatum Schiller [60,94,133–135]

Prorocentrum scutellum Schröder [= *P. sphaeroideum* Schiller, *P. robustum* Osorio-Tafall] [1,12,15,19,20–23,25,28,29,33,34,46,58,60,61,94,96,109,114,119,133–135]

Prorocentrum triestinum Schiller [= *P. redfieldii* Bursa, *P. pyrenoideum* Bursa] [60,133,134]

Prorocentrum vaginulum (Stein) Dodge [= *Dinopyxis vaginula* Stein, *Exuviella vaginula* (Stein) Schütt] [58,61]

Protoceratium areolatum Kofoid [59,60,94,133,134]

HAB ***Protoceratium reticulatum*** (Claparède *et* Lachmann) Bütschli [= *Gonyaulax grindleyi* Reinecke] [9,18,33,34,46,58,59,61,79,90,94,96,110,112,114,119,133,135]

Protoperidinium abei (Paulsen) Balech [= *Peridinium abei* Paulsen, *P. biconicum* Abé, non *P. biconicum* Dangeard] [58]

Protoperidinium achromaticum (Levander) Balech [= *P. finitimum* Balech, *Peridinium achromaticum* Levander] [58,59,61,128,143]

Continued on p. 51

Table 1. Continued.

	Protoperidinium bipes (Paulsen) Balech [= *Minuscula bipes* (Paulsen) Lebour, *Peridinium minusculum* Pavillard, *Glenodinium bipes* Paulsen, non *Peridinium bipes* Stein] [9,18,27,33,34,59,61,94,96,109,110,114,119,128,135,143,144]
	Protoperidinium brevipes (Paulsen) Balech [= *Peridinium brevipes* Paulsen, *P. varicans* Paulsen, *P. incurvum* Lindemann] [8,9,18,27,33,34,46,58,60,61,94,96,110,114,119,133–135]
	Protoperidinium brochii (Kofoid *et* Swezy) Balech [= *P. adriaticum* Broch, *P. divergens* var. *adriaticum* Schiller] [8,61,90,128]
	Protoperidinium claudicans (Paulsen) Balech [= *Peridinium claudicans* Paulsen] [8,60,128,133–135,143]
	Protoperidinium conicoides (Paulsen) Balech [= *Peridinium conicoides* Paulsen] [60,61,131,133,134]
	Protoperidinium conicum (Gran) Balech [= *Peridinium divergens* var. *conica* Gran] [8,42,59–61,94,128,133–135,143]
HAB	***Protoperidinium crassipes*** (Kofoid) Balech [see Balech (1988: 110) for synonymy with *P. curtipes*] [8,9,18,33–35,59,61,94,96,99,110,119,114,135,143]
	Protoperidinium curtipes (Jørgensen) Balech [= *Peridinium curtipes* Jørgensen, *P. crassipes* Paulsen, non Paulsen nec Schiller] [94,128,135]
	Protoperidinium curvipes (Ostenfeld) Balech [= *Peridinium curvipes* Ostenfeld] [46,94,135]
	Protoperidinium decipiens (Jørgensen) Parke *et* Dodge [= *Peridinium decipiens* Jørgensen] [9,18,58,61,96]
	Protoperidinium deficiens (Meunier) Balech [= *Peridinium deficiens* Meunier] [94]
	Protoperidinium depressum (Bailey) Balech [= *Peridinium depressum* Bailey] [8,9,18,33–35,46,60,61,94,96,110,113,114,119,128,133–135,143]
	Protoperidinium diabolus (Cleve) Balech [= *Peridinium diabolus* Cleve, including *P. longipes* (Karsten) Balech] [8,35,60,61,94,128,133,134,143]
	Protoperidinium divergens (Ehrenberg) Balech [= *Peridinium divergens* Ehrenberg] [8,9,18,34,35,46,59–61,94,96,107,114,119,128,133,134,143]
	Protoperidinium elegans (Cleve) Balech [= *P. fatulipes* (Kofoid) Balech, *Peridinium annulatum* Kofoid *et* Michener] [8,58,59,61]
	Protoperidinium excentricum (Paulsen) Balech [= *Peridinium excentricum* Paulsen, *P. perrieri* Fauré-Frémient] [58,59,61,94,143]
	Protoperidinium globulus (Stein) Balech [= *Peridinium ovatum* (Pouchet) Schütt, *P. globulus* var. *ovatum* (Pouchet) Schiller, also *P. globulus* var. *ovatum* (Pouchet) Krachmalny, *P. globulus* var. *quarnerense* (Schröder) Krachmalny] [8,9,18,37,59–61,94,96,114,117,119,128,133,134,143,144]
	Protoperidinium grande (Kofoid) Balech [= *P. truncatum* (Graham) Balech] [60,94,133,134]
	Protoperidinium granii (Ostenfeld) Balech [= *Peridinium granii* Ostenfeld *ex* Paulsen] [8,9,18,27,34,59–61,79,90,94,96,110,114,119,128,133–135,143]
	Protoperidinium inflatum (Okamura) Balech [= *Peridinium inflatum* Okamura, *P. crassum* Dangeard] [128]
Cold	*Protoperidinium knipowitschii* (Ussatschew) Balech [= *Peridinium knipowitschii* Ussatschew] [34,59,61,96,143]
	Protoperidinium leonis (Pavillard) Balech [= *Peridinium leonis* Pavillard, *P. conicum* Meunier, *P. saltans* Pavillard, *P. striatum* Böhm, *P. leonis* var. *concavilaterale* Kisselew] [8,61,94,128,135]
	Protoperidinium longispinum (Kofoid) Balech [= *Peridinium longispinum* Kofoid, *P. michaelis* Ehrenberg pro parte] [9,46,61,89]
	Protoperidinium marielebourae (Paulsen) Balech [= *Peridinium obtusum* (Karsten) Lebour, non *P. obtusum* (Karsten) Faure-Fremiet] [94,133]
	Protoperidinium minutum (Kofoid) Loeblich III [the synonymy with *P. monospinum* (Paulsen) Zonneveld *et* Dale is debatable] [18,61,96,143]
	Protoperidinium oblongum (Aurivillius) Parke *et* Dodge [= *Peridinium oblongum* Cleve, *P. divergens* var. *oblongum* Aurivillius, *P. oceanicum* var. *oblongum* Paulsen, *P. venustum* Matzenauer] [46,94]
	Protoperidinium oceanicum (Vanhöffen) Balech [= *Peridinium divergens* var. *oceanicum* Stein] [8,59,61,128,143]
	Protoperidinium pallidum (Ostenfeld) Balech [= *Peridinium pallidum* Ostenfeld] [8,9,18,34,46,59,61,94,96,114,128]
	Protoperidinium pedunculatum (Schütt) Balech [= *Peridinium pedunculatum* Schütt] [8,61,94,96,143]
	Protoperidinium pellucidum Bergh [= *Peridinium pellucidum* (Bergh) Schütt] [8,46,58–61,94,96,109,110,119,133–135,144,143]
	Protoperidinium pentagonum (Gran) Balech [= *Peridinium pentagonum* Gran, *P. sinuosum* Lemmermann] [8,33,59–61,94,114,119,128,131,133–135,143]
	Protoperidinium punctulatum (Paulsen) Balech [= *Peridinium subinerme* Paulsen var. *punctulatum* (Paulsen) Schiller] [60,94,133,134]
	Protoperidinium pyriforme (Paulsen) Balech [= *Peridinium steinii* var. *pyriformis* Paulsen, also *Peridinium breve* Paulsen] [59–61,94,96,119,133–135]
Pacif.	*Protoperidinium sinaicum* (Matzenauer) Balech [= *Peridinium sinaicum* Matzenauer] [8,61]

Continued on p. 52

Table 1. Continued.

	Protoperidinium solidicorne (Mangin) Balech [= *P. spiniferum* (Schiller) Balech, *P. spinosum* Schiller] [8,9,18,34,35,46,58,59,61,94,96,110,114,128,131,135,143]
	Protoperidinium steinii (Jørgensen) Balech [= *P. steinii* Jørgensen, *P. michaelis* Stein] [1,8,9,18,25,33,34,46,59–61,90,94,96,107,110,111,113,114,119,128,133,134,143,144]
	Protoperidinium subinerme (Paulsen) Loeblich III [= *Peridinium subinerme* Paulsen] [58–61,94,128,133–135]
	Protoperidinium thorianum (Paulsen) Balech [= *Peridinium thorianum* Meunier, *Glenodinium thorianum* Paulsen] [59]
	Ptychodiscus noctiluca Stein [= *P. inflatus* Pavillard, *P. carinatus* Kofoid] [59]
	Pyrocystis elegans Pavillard [60,133,134]
	Pyrocystis lunula (Schütt) Schütt [= *Gymnodinium lunula* Schütt] [8,61,81]
	Pyrophacus horologium Stein emend. Wall *et* Dale [9,18,59–61,94,96,110,114,119,133,134,143]
	Pyrophacus steinii (Schiller) Wall *et* Dale [= *P. horologicum* var. *steinii* Schiller] [94,135]
	Scaphodinium mirabile Margalef [= *Leptospathium navicula* Cachon *et* Cachon] [126]
HAB	***Scrippsiella trochoidea*** (Stein) Balech *ex* Loeblich III [= *Peridinium trochoideum* (Stein) Lemmermann, *P. faeroense* Paulsen, *Scrippsiella sweeneyae* Balech *ex* Loeblich III] [8,9,18,21–23,27,28,34,41,46,58–61,75,76,86,89,94,96,114,133–137,139,143]
	Spatulodinium pseudonoctiluca (Pouchet) Cachon *et* Cachon *ex* Loeblich *et* Loeblich III [= *Gymnodinium pseudonoctiluca* Pouchet] [126]
	Torodinium robustum Kofoid *et* Swezy [= *Gymnodinium teredo* Schütt pro parte] [61]
	Woloszynskia neglecta (Schilling) R.H. Thompson [= *Gymnodinium neglectum* (Schilling) Lindemann, *Glenodinium neglectum* Schilling] [59]

of the eutrophication. However it is likely that these species remained unnoticed in previous studies.

Cold waters species: Arctic-boreal affinities?

The low species richness could be associated with the low temperatures in the Black Sea (<4 °C in winter) that only favour cryophilic or eurythermal species. The Arctic Seas with 95 and 189 species listed in the Canadian and Russian waters, respectively (Hsiao, 1983; Okolodkov, 1998) also present low species richness compared to temperate or warm oceans.

Most of the freshwater taxa (from continental waters; Popovský & Pfiester, 1990) can be considered as cryophilic/eurithermal species, being here discarded for marine biogeography. Athecate species such as *Amphidinium longum* Lohmann (= *A. acutum* Lohmann), *A. extensum* Wulff, *A. ovum* Herdman (sand-living), *Gyrodinium britannicum* Kofoid *et* Swezy and also *Gymnodinium wulffii* Schiller are reported from the cold waters of the North Atlantic Ocean, but not or rarely reported in the Mediterranean waters (Gómez, 2003).

Okolodkov & Dodge (1996) reported only four Arctic-boreal species, *Alexandrium ostenfeldii* (Paulsen) Balech *et* Tangen, *Amylax triacantha* (Jörgensen) Sournia, *Ceratium arcticum* (Ehrenberg) Cleve, *Dinophysis norvegica* Claparède *et* Lachmann and the bi-polar *Dinophysis arctica* Meresch-kowsky, *Protoperidinium islandicum* (Paulsen) Balech, *P. saltans* (Meunier) Balech and *P. thulesense* Balech. All these species except *C. arcticum* and the last three are reported from the Black Sea. The records of Arctic-boreal species proposed by Okolodkov & Dodge (1996) are scarce and/or dubious in the Mediterranean Sea (Gómez, 2003).

Dinophysis arctica, *D. norvegica* and *D. apiculata* Meunier are not or rarely reported in the Mediterranean waters (Gómez, 2003). Similarities have been reported in the developmental stages of *D. acuminata*, *D. acuta* and *D. norvegica* (e.g., Reguera & González Gil, 2001). Genetic analyses showed that *D. acuminata* and *D. norvegica* were nearly identical (>99%) (Rehnstam-Holm et al., 2002). *D. apiculata*, reported only by Krakhmalny (1994) in the Black Sea, is according to Okolodkov (1998) related to *D. acuminata*. *Dinophysis apiculata* presented only one record in the Mediterranean Sea (Gómez, 2003).

Amylax triacantha only presents one dubious record in the Mediterranean Sea and *Alexandrinum ostenfeldii* is reported from the Egyptian waters (Gómez, 2003). Other thecate species that can be considered as cryophilic are *Gonyaulax cochlea* Meunier, *Protoperidinium knipowitschii* (Ussatchev) Balech, *Protoperidinium deficiens* and *Peridiniella danica* (Paulsen) Okolodkov *et* Dodge. *P. knipowitschii* is

rather similar in shape to the cosmopolitan species *Protoperidinium grande* (Kofoid) Balech [Taylor, 1976: 150] or to the bi-polar *P. saltans* (Meunier) Balech [Balech, 1974: 64] as well as *Peridinium fatulipes* Kofoid [Kisselew, 1950: 203]. *P. deficiens*, with one dubious record from the Mediterranean Sea (Gómez, 2003), could be considered a cold water species. *Peridiniella danica*, typically known from the North Atlantic Ocean (Okolodkov & Dodge, 1995), is reported from the North Adriatic Sea (Viličić et al., 2002) with additional, doubtful, records from the warm waters of the southern Mediterranean basin (Dowidar, 1974; Skolka et al., 1986). *Ceratium longipes* (Bailey) Gran (= *C. arcticum* var. *longipes* (Bailey) Graham *et* Bronikovsky) seems to be more common in cold waters (Okolodkov & Dodge, 1996).

Indo-Pacific species?

A reduced group of species not reported in the Atlantic Ocean to the best of our knowledge, but in the Indian and/or Pacific waters, includes dubious Indo-Pacific species such as *Amphidinim cucurbita* Kofoid *et* Swezy, *Gymnodinium radiatum* Kofoid *et* Swezy (recently reported by Krakhmalny, 2001) and *G. sulcatum* Kofoid *et* Swezy (Mediterranean; Gómez 2003). Among thecate dinoflagellates the only reports are of *Protoperidinium sinaicum*, which resembles to *Protoperidinium tuba* (Schiller) Balech, both doubtful or insufficiently known taxa (Taylor, 1976: 160).

Non-Mediterranean taxa and/or introduced species?

Nearly all the species reported from the Black Sea (Table 1) are also reported from the Mediterranean Sea. Several exceptions were *Amphidinium conradii* Schiller, *A. ovum* Herdman [both from the North Atlantic Ocean; Parke & Dodge (1976)], *Cochlodinium citron* Kofoid *et* Swezy [doubtful record by Skolka et al. (1986) in the Mediterranean Sea] as well as the Atlantic species *Cochlodinium pirum* (Schütt) Lemmermann. Excluding these dubious records only *Alexandrium monilatum* (Howell) Balech remains as a non-Mediterranean taxon, together with several Artic-boreal species and *A. cucurbita* and *G. radiatum* as artificially Indo-Pacific taxa.

Alexandrium monilatum, responsible for blooms in the Black Sea since 1991 (Moncheva et al., 2001a), is typically known from sub- and tropical regions of the Atlantic and Eastern Pacific Ocean, although it was also recorded in the cold waters of the Chesapeake Bay (Steidinger & Tangen, 1997: 499). Live cells of *A. monilatum* are easily identifiable compared to congeneric species, but difficult from fixed samples. A dubious record, as *Gessnerium mochimaensis* Halim *ex* Halim, is reported from the Suez Canal in the summer (El-Sherif & Ibrahim, 1993). It is unusual the proliferation of this taxon, an *a priori* thermophilic species, in the cold waters of the Black Sea.

The exchange of species, toxic or not, between the Mediterranean and Black Seas seems to be rare. Despite *A. monilatum* is being reported from Bulgarian waters close to the Bosphorus/Dardanelles Straits, the introduction to the Mediterranean Sea, favoured by the westward surface current system, is not reported. For example *Karenia brevis* (Davis) G. Hansen *et* Moestrup, a common toxic species in the Aegean Sea eutrophic waters (Gotsis-Skretas & Frigilos, 1990), is not reported in the Black Sea. Moncheva et al. (2001b) reported that despite the fact that the Aegean Sea, like the Black Sea, could be considered a eutrophic basin, the bloom-forming assemblages show a low taxonomic similarity. This has been attributed to both natural factors and dissimilarities and to the gradients in nutrient levels and their ratios (Moncheva et al., 2001b).

As non-indigenous plankton species (introduced species) from the Black Sea, Moncheva & Kamburska (2002) listed *Gymnodinium uberrimum* (Allman) Kofoid *et* Swezy, *Oxyphysis oxytoxoides* Kofoid, *Gymnodinium fuscum* (Ehrenberg) Stein, *Gyrodinium* cf. *aureolum* Hulburt, 'Gyrodinium simplex', *Spatulodinium pseudonoctiluca*, *Scaphodinium mirabile*, *Petalodinium porcelio* as well as *Alexandrium monilatum.*

Red tides by the freshwater species *Gymnodinium uberrimum* were reported from the western Black Sea since 1990's (Moncheva et al., 2001a). However this taxon presents a high number of related species or synonyms indicative of its difficult identification (Popovský & Pfiester, 1990: 117). As reported in Wyatt & Carlton (2002) *G. uberrimum* is a common bloom-forming species in European and North American lakes and its appearance in estuarine areas of the Black Sea is not unexpected.

Moncheva & Kamburska (2002) reported a possible origin of *Oxyphysis oxytoxoides* from Alaska/California. However this species was reported from the Mediterranean (Gómez, 2003), recently from the Marmara Sea (Balkis, 2000) and all major oceans (Sournia, 1986: 44). *Gymnodinium fuscum* is primarily a freshwater taxon of difficult identification, with dubious records in the Mediterranean Sea (Gómez,

2003). More uncertainties appear with *Gymnodinium aureolum* (Hulburt) G. Hansen related to the *Gymnodinium mikimotoi* complex (Hansen et al., 2000). *Gymnodinium simplex* (Lohmann) Kofoid *et* Swezy is also a species of complex identification frequently reported in the Mediterranean Sea (Gómez, 2003).

Stoyanova (1999) reported for the first time the noctilucaceans *Spatulodinium pseudonoctiluca*, *Scaphodinium mirabile* and *Petalodinium porcelio* in the Black Sea. *S. pseudonoctiluca* is reported from all major oceans (Sournia, 1986: 52). These three taxa, and especially the leptodiscaceans, *S. mirabile* and *P. porcelio*, strongly differ from the typical appearance of the dinoflagellates (Peridiniales) and that, together with the scarcity of available literature, is responsible for the under-estimation of these ubiquitous species, going unnoticed under routine microscopical analysis. For example *S. mirabile* is reported from the Mediterranean Sea (Gómez, 2003), Atlantic Ocean (Margalef, 1973) also recently from the Marmara Sea (Balkis, 2000). *S. mirabile* and *P. porcelio* can be found in the western Pacific Ocean (F. Gómez, unpublished results).

Exclusively Mediterranean–Black Sea species

Several species seem to be restricted to the Mediterranean–Black Sea waters such as several inappropriately described unarmored taxa: *Gymnodinium najadeum* Schiller, *G. neapolitanum* Schiller and *G. semidivisum* Schiller. The aberrant dinoflagellate *Petalodinium porcelio* Cachon *et* Cachon (Stoyanova, 1999) can be considered exclusively a Mediterranean–Black species, but probably this taxon remains unnoticed in the world's oceans. The citation of the thecate *Gonyaulax elegans* Rampi constitutes the only worldwide record of this dubious species never reported after the initial description in the Mediterranean Sea (Gómez, 2003). Many of the species of the genus *Gonyaulax* Diesing described by Rampi are considered as synonyms of other congeneric species (see Dodge & Saunders, 1985).

Endemic species?

The geologic evolution of the Ponto–Caspian basins involved a succession of separations/isolations and in more recent geologic time the reconnection to the ocean (Mediterranean Sea) (e.g., Mudie et al., 2002). These events resulted in the evolution of diverse modern organism assemblages of freshwater, brackish water, and marine taxa of mixed origins consisting of endemic (autochthonous) Ponto–Caspian species, Mediterranean–Atlantic immigrants, and Arctic Pleistocene glacial relicts. For macroscopic organisms, the autochthonous Ponto–Caspian species are characterized by wide adaptive capacities and constitute a significant portion of the invasive species currently spreading to regions in northern Europe and to the Great Lakes (Reid & Orlova, 2002). In the semi-enclosed Black Sea, with special hydrological, chemical and trophic conditions, a high endemism by Ponto–Caspian relict algal species could be expected.

A candidate could be *Prorocentrum caspicum* (Kisselew) Krakhmalny described from the Caspian Sea and further from the Arctic Sea (Kisselew, 1950). However this taxon is considered a synonym of *Prorocentrum lima* (Ehrenberg) Dodge (Dodge, 1975). *Prorocentrum cordatum* (Ostenfeld) Dodge originally described from the Caspian Sea is considered endemic and prominent in the Ponto–Caspian basins (Makarova, 1969), but the cosmopolitan *Prorocentrum minimum* (Pavillard) Schiller is considered to be synonym (Marasović et al., 1990; Velikova & Larsen, 1999). Several morphological varieties (infraespecific taxa) such as *Prorocentrum cordatum* var. *aralensis* (Kisselew) Krakhmalny or *Amphidinium klebsii* f. *ponticum* Rouchijajnen are reported (Kisselew, 1950; Krakhmalny, 1994). In conclusion, no taxa can be recognized as endemic species.

Final remarks

The extreme environmental conditions (high nutrient concentrations and modified nutrient ratios) are associated with low species richness and dominance of mono-specific blooms such as *Noctiluca scintillans*, *Prorocentrum cordatum*, *Heterocapsa triquetra*, *Scrippsiella trochoidea* (Stein) Balech *ex* Loeblich III, among others (Bologa et al., 1995; Mihnea, 1997; Velikova et al., 1999). Compared to the Mediterranean waters, several cold-water species appeared, indicative of the Arctic Seas affinities or the presence of glacial period relicts. Despite the strong environmental modifications that could favour invasive species in competition for niches, it is difficult to establish a tentative list of introduced species. The non-indigenous species list proposed by Moncheva & Kamburska (2002) is composed of doubtful taxa and species unnoticed in previous studies and/or taxa recently recognized at species level. More in deep taxonomical studies, with the application of recent taxonomical approaches, are

necessary to establish the species richness in the Black Sea waters.

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References

Aubert, M., P. Revillon, J. Aubert, G. Léger, C. Drai, A. Arnoux & C. Diana, 1990. Mers d'Europe: Études hydrobiologiques, chimiques et biologiques. Transfert de polluants entre la Mer Noire, la Mer de Marmara et la Mer Egée. Revue Internationale d'Océanographie Médicale 100: 1–44.

Aubrey, D., S. Moncheva, E. Demirov, V. Diaconu & A. Dimitrov, 1996. Environmental changes in the western Black Sea related to anthropogenic and natural conditions. Journal of Marine Systems 7: 411–425.

Bakan, G. & H. Buyukgungor, 2000. The Black Sea. Marine Pollution Bulletin 41: 24–43.

Balech, E., 1974. El género "*Protoperidinium*" Bergh, 1881 ("*Peridinium*" Ehrenberg, 1831 partim). Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" Hidrobiología 4: 1–79.

Balech, E., 1988. Los dinoflagelados del Atlántico Sudoccidental. Publicaciones Especiales del Instituto Español de Oceanografía, Madrid 1, 310 pp.

Balkis, N., 2000. Five dinoflagellate species new to Turkish Seas. Oebalia 26: 97–108.

Bityukov, E. P., 1969. Distribution and ecology of *Noctiluca miliaris* in the Black Sea. Biologiya Morya 7: 76–95.

Bityukov, E. P., P. V. Evstigneev & Yu. N. Tokarev, 1993. Luminescent dinoflagellata of the Black Sea as affected by anthropogenic factors. Hydrobiological Journal 29: 27–34.

Bodeanu, N., 1969. Cercetari asupra fitoplanctonului din zona de mica adancime de la litoralul romanesc al Marii Negre. Ecologie Marina 3: 65–147.

Bodeanu, N., 1983a. Modifications concernant le development quantitative et la structure du phytoplancton du littoral roumain de la mer Noire. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 28: 91–92.

Bodeanu, N., 1983b. Sur les phénomènes de floraison de l'eau du littoral roumain de la mer Noire. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 28: 93–95.

Bodeanu, N., 1984a. Modifications sous l'influence anthropique dans le développement quantitative et dans la structure du phytoplancton du secteur roumain de la mer Noire. Travaux du Muséum d'Historie Naturelle 'Grigore Antipa', Bucuresti 26: 69–83.

Bodeanu, N., 1984b. Le phytoplancton du littoral roumain de la mer Noire sous l'influence de l'eutrophisation. VII-es Journées Etudes de Pollution, Lucerne, Conseil international pour l'exploration de la Mer Méditerranée, Monaco: 745–752.

Bodeanu, N., 1984c. Données nouvelles concernant les developments massifs des espèces phytoplanctoniques et déroulement des phénomènes de floraison de l'eau du littoral roumain de la mer Noire. Cercetari Marine 17: 63–84.

Bodeanu, N., 1985. Caractéristiques du développement quantitatif et de la structure du phytoplancton de eaux du littoral roumain pendant la période 1983–1985. Cercetari Marine 18: 117–137.

Bodeanu, N., 1986. Evolution du développement quantitative du phytoplancton du littoral roumain de la mer Noire. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 30: 183.

Bodeanu, N., 1987a. Particularités du développement quantitative du phytoplancton du littoral roumain de la mer Noire pendant la période 1983–1986. Revue Roumanie de Biologie – série de Biologie Animal, Ed. Acad. RSR, Bucuresti 32: 139–147.

Bodeanu, N., 1987/1988. Structure and dynamics of unicellular algal flora in the Romanian littoral of the Black Sea. Cercetari Marine 20–21: 19–250.

Bodeanu, N., 1989. Algal blooms and development of the main phytoplanktonic species at the Romanian Black Sea littoral under eutrophication conditions. Cercetari Marine 22: 107–125.

Bodeanu, N., 1992. Algal blooms and development of the main phytoplanktonic species at the Romanian Black Sea littoral in conditions of intensification of the eutrophication process. In Vollenveider, R. A., R. Marchetti & R. Viviani (eds), Marine Coastal Eutrophication. Elsevier Science Publishers, Amsterdam: 891–906.

Bodeanu, N., 1993. Microalgal blooms in the Romanian area of the Black Sea and contemporary eutrophication conditions. In Smayda T. J. & Y. Shimizu (eds), Toxic Phytoplankton Blooms in the Sea. Elsevier Science Publishers, Amsterdam: 203–209.

Bodeanu, N., 1995. Algal blooms in Mamaia Bay (Romanian Black Sea coast). In Lassus, P., G. Arzul, E. Erard-Le Denn, P. Gentien & C. Marcaillou-Le Baut (eds), Harmful Marine Algal Blooms. Lavoisier Ltd., Nantes: 127–137.

Bodeanu, N., S. Moncheva, G. Ruta & L. Popa, 2000. Long term evolution of the algal blooms in Romanian and Bulgarian Black Sea waters. In Black Sea Ecosystem Processes and Forecasting/Operational Database Management System. METU Institute of Marine Science, Erdemli-Içel, Turkey, 20 pp.

Bodeanu, N. & A. Roban, 1975. Données concernant la floraison des eaux du littoral roumain de la mer Noire avec le péridinien *Exuviaella cordata* Ostf. Cercetari Marine 8: 43–62.

Bodeanu, N. & A. Roban, 1989. Les développements massifs du phytoplancton des eaux du littoral roumain de la mer Noire au cours de l'année 1989. Cercetari Marine 22: 127–146.

Bodeanu, N. & G. Ruta, 1994–1995. Phytoplankton structure and dynamics in the contingence zone between the waters of the Danube-Black Sea canal and the sea waters. Cercetari Marine 27–28: 81–99.

Bodeanu, N. & G. Ruta, 1998. Development of the planktonic algae in the Romanian Black Sea sector in 1981–1996. In Reguera, B., J. Blanco, M. L. Fernandez & T. Wyatt (eds), Harmful Algae. Proceedings of the VIII International Conference on Harmful Algae, Vigo, Spain 25–29 June 1997. Xunta de Galicia and I.O.C.: 188–191.

Bodeanu, N. & M. Usurelu, 1976. Prognoza influentei apelor dulci asupra fitoplanctonului marin in perspectiva deschiderii Canalului Dunare-Marea Neagra. Cercetari Marine 9: S89–105.

Bodeanu, N. & M. Usurelu, 1979. Dinoflagellate blooms in Romanian Black Sea coastal waters. In Taylor, D. L. & H. H. Seliger (eds), Toxic Dinoflagellate Blooms. Elsevier North Holland, Amsterdam: 151–154.

Bodeanu, N. & M. Usurelu, 1981. Particularités de la structure et de la repartition du phytoplankton de la zone sud du littoral roumain dans les conditions de predominance de la circulation atmosphérique de nord. Cercetari Marine 14: 129–144.

Bodeanu, N., A. Roban & M. Usurelu, 1985. Particularités de la structure et de la dynamique du phytoplankton du secteur Constanta (mer Noire) pendant la periode 1972–1983. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 29: 121–122.

Bologa, A. S., N. Bodeanu, A. Petranu, V. Tiganus & Y. P. Zaitsev, 1995. Major modifications of the Black Sea benthic and planktonic biota in the last three decades. Bulletin d'Institute Oceanographique de Monaco n. sp. 15: 85–110.

Bologa, A. S., H. V. Skolka & P. T. Frangopol, 1984. Annual cycle of planktonic primary productivity off the Romanian Black Sea coast. Marine Ecology Progress Series 19: 25–32.

Bologa, A. S., M. Usurelu & P. T. Frangopol, 1981. Planktonic primary productivity of the Romanian surface coastal waters (Black Sea) in 1979. Oceanologica Acta 4: 343–349.

Bryantseva, J. V., V. A. Bryanseva, A. Kovalchuk & Z. Samyshev, 1996. Long-term changes of diatomea and peridinea biomass in the Black Sea in connection with atmospheric transfers. Ecologiya Morya 45: 18–25.

Daskalov, G. M., 2002. Overfishing drives a trophic cascade in the Black Sea. Marine Ecology Progress Series 225: 53–63.

Devidze, M. 1998. Harmful algal events in Georgian waters. In Reguera, B., J. Blanco, M. L. Fernández & T. Wyatt (eds), Harmful Algae. Proceeding of the VIII International Conference on Harmful Algae, Vigo, Spain 25–29 June 1997. Xunta de Galicia and I.O.C.: 91.

Dodge, J. D., 1975. The Prorocentrales (Dinophyceae). II. Revision of the taxonomy within the genus *Prorocentrum*. Botanical Journal of the Linnaean Society 71: 103–125.

Dodge, J. D. & R. D. Saunders, 1985. A partial revision of the genus *Oxytoxum* (Dinophyceae) with aid of scanning electron microscopy. Botanica Marina 28: 99–122.

Dowidar, N. M., 1974. The phytoplankton of the Mediterranean waters of Egypt. I. A check list of the species recorded. Bulletin of National Institute of Oceanography Fisheries, Arab Republic Egypt 4: 319–344.

Eker, E., L. Georgieva, L. Senichkina & A. E. Kideys, 1999. Phytoplankton distribution in the western and eastern Black Sea in spring and autumn 1995. ICES Journal of Marine Science 56: S15–22.

Eker, E. & A. E. Kideys, 2003. Distribution of phytoplankton in the southern Black Sea in summer 1996, spring and autumn 1998. Journal of Marine Systems 39: 203–211.

Elbrächter, M. & B. Meyer, 2001. Plate pattern variability and plate overlap in a clonal culture of the freshwater dinoflagellate *Peridinium umbonatum* Stein species complex (Dinophyceae). Neues Jahrbuch für Geologie und Palaontologie-Abhandlungen 219: 221–227.

El-Sherif, Z. M. & A. M. Ibrahim, 1993. Phytoplankton production, diversity and chlorophyll-a in the Suez Canal (Egypt). Bulletin of National Institute of Oceanography Fisheries, Arabic Republic Egypt 19: 119–144.

Faust, M. A. & R. A. Gulledge, 2002. Identifying Harmful Marine Dinoflagellates. Contributions to the United States National Herbarium, Smithsonian Institution 42: 1–144.

Feyzioglu, M. & S. Tuncer, 1994. Seasonal changes at the net phytoplankton living Trabzon coasts of the eastern Black Sea. Turkish Journal of Biology 18: 161–171.

Finenko, G. A., Z. A. Romanova, G. I. Abolmasova, B. E. Anninsky, L. S. Svetlichny, E. S. Hubareva, L. Bat & A. E. Kideys, 2003. Population dynamics, ingestion, growth and reproduction rates of the invader *Beroe ovata* and its impact on plankton community in Sevastopol Bay, the Black Sea. Journal of Plankton Research 25: 539–549.

Gómez, F., 2003. Checklist of Mediterranean free-living dinoflagellates. Botanica Marina 46: 215–242.

Gomoiu, M. T., 1977. Les conséquences négatives de la "Floraison" des eaux a *Exuviella cordata* Ostenf. du littoral de la Mer Noir. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 24: 121–124.

Gotsis-Skretas, O. & N. Frigilos, 1990. Contribution to eutrophication and phytoplankton ecology in the Thermaikos Gulf. Thalassographica 13: 1–12.

Grese, V. N., 1979. On the bio-productive system of the Black Sea and its functional characteristics. Gidrobiologicheskiy Zhurnal 15: 3–9.

Hallegraeff, G. M., 2002. Aquaculturists' Guide to Harmful Australian Microalgae. University of Tasmania, Hobart, Australia, 136 pp.

Hansen, G., N. Daugbjerg & P. Henriksen, 2000. Comparative study of *Gymnodinium mikimotoi* and *Gymnodinium aureolum*, comb. nov. (= *Gyrodinium aureolum*) based on morphology, pigment composition, and molecular data. Journal of Phycology 36: 394–410.

Hsiao, S. I. C., 1983. A checklist of marine phytoplankton and sea ice microalgae recorded from Arctic Canada. Nova Hedwigia 37: 225–313.

Humborg, C., V. Ittekkot, A. Cociasu & B. V. Bodungen, 1997. Effect of Danube River dam on Black Sea biogeochemistry and ecosystem structure. Nature 386: 385–388.

Ionescu, A L. & V. H. Skolka, 1968. Notes sur la physiologie et l'écologie du dinoflagellé *Exuviaella cordata*. Travaux du Muséum d'Historie Naturelle "Grigore Antipa", Bucuresti 8: 207–215.

Kisselew, I. A., 1950. Pantsirnyye zhigutikonostsy (Dinoflagellata) morey i presnykh vod SSSR. Izd-vo AN SSSR, Moscow, Leningrad, 279 pp.

Komakhidze, A. & N. Mazmanidi, 1998. Black Sea Biological Diversity, Georgia. Black Sea Environmental Series, Vol. 8. United Nations Publications, New York, 167 pp.

Konsulov, A., 1998. Black Sea Biological diversity, Bulgaria. Black Sea Environmental Series, Vol. 5. United Nations Publications, New York, 131 pp.

Koray, T., Ş. Gökpinar, S. Polat, M. Türkoğlu, L. Yurga, F. Çolak, H. A. Benli & E. Sarihan, 2000. Türkiye Denizlerinin (Karadeniz, Ege Denizi Ve Kuzeydoğu Akdeniz) Mikroplankton (Bir Hücreliler) Topluluklarının Kalitatif Özelliklerinin Karşılaştırılması. Su Ürünleri Dergisi, Sayı: 3–4: 17: 275–291.

Krakhmalny, A. F., 1994. Dinophyta of the Black Sea (Brief history of investigations and species diversity). Algologiya 4: 99–107.

Krakhmalny, A. F., 2001. *Gymnodinium radiatum* Kofoid *et* Swezy (Gymnodiniales, Dinophyta): New species for Black Sea flora. Ukrayins'kyi Botanichnyi Zhurnal 58: 593–595.

Krupatkina, D. K., Z. Z. Finenko & A. A. Shalapyonok, 1991. Primary production and size-fractionated structure of the Black Sea phytoplankton in the winter-spring period. Marine Ecology Progress Series 73: 25–31.

Makarova, I. V., 1969. The formation and the affinities of the phytoplankton of the Black Sea, Sea of Azov and Caspian Bay. Botanicheskii Zhurnal Moscow 54: 389–398.

Marasović, I., T. Pucher-Petković & V. Petrova-Karadjova, 1990. *Prorocentrum minimum* (Dinophyceae) in the Adriatic and Black

Sea. Journal of the Marine Biological Association of United Kingdom 70: 473–476.

Margalef, R., 1973. Fitoplancton marino de la región de afloramiento del NW de África. Resultados de Expediciones Científicas del Buque Oceanográfico Cornide 2: 65–94.

Mihnea, P. E., 1979. Some specific features of dinoflagellate *Exuviaella cordata* Ostf. blooms in the Black Sea. In Taylor, D. L. & H. H. Seliger (eds), Toxic Dinoflagellate Blooms, Elsevier North Holland, New York, Amsterdam, Oxford: 77–82.

Mihnea, P. E., 1985. Effect of pollution on phytoplankton species. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 29: 85–88.

Mihnea, P. E., 1986. Phytoplankton diversity indices as eutrophication indicators of the Romanian inshore waters. Cercetari Marine 18: 139–155.

Mihnea, P. E., 1993. Blooms of Chrysophyta in the Black Sea. In Smayda, T. J. & Y. Shimizu (eds), Toxic Phytoplankton Blooms in the Sea. Elsevier Science Publishers, Amsterdam, The Netherlands: 293–297.

Mihnea, P. E., 1997. Major shifts in the phytoplankton community (1980–1994) in the Romanian Black Sea. Oceanologica Acta 20: 119–129.

Mihnea, P. E. & E. Cuingioglu, 1982. Particularités des phénomènes de "Floraison". Cercetari Marine 15: 27–57.

Mihnea, P. E., E. Cuingioglu & I. Bilal, 1980. Modifications des communautés phytoplanctoniques littoraux sous l'influence du phénomène de pollution. V-es Journées d'Etudes de Pollution, Cagliari, Conseil international pour l'exploration de la Mer Méditerranée, Monaco: 869–876.

Mikaelyan, A. S. & T. A. Zavyalova, 1999. Vertical distribution of heterotrophic phytoplankton in the Black Sea during the summer period. Oceanology 39: 813–821.

Moncheva, S., L. Doncheva & L. Kamburska, 2001a. On the long-tem response of harmful algal blooms to the evolution of eutrophication off the Bulgarian Black Sea coast: are recent changes a sign of recovery of the ecosystem -the uncertainties. In Hallegraeff, G. M., S. I. Blackburn, C. J. Bolch & R. J. Lewis (eds), Harmful Algal Blooms. Proceeding of the IX International Conference of Harmful Algal Blooms, UNESCO-IOC, Hobart, Australia: 177–181.

Moncheva, S., O. Gotsis-Skretas, K. Pagou & A. Krastev, 2001b. Phytoplankton blooms in Black Sea and Mediterranean coastal ecosystems subjected to anthropogenic eutrophication: similarities and differences. Estuarine, Coastal and Shelf Science 53: 281–295.

Moncheva, S. & L. Kamburska, 2002. Plankton stowaways in the Black Sea – Impacts on biodiversity and ecosystem health. In Briand, F. (ed.), Alien Marine Organisms Introduced by Ships in the Mediterranean and Black Seas. Conseil international pour l'exploration de la Mer Méditerranée, Workshop Monographs 20: 47–51.

Moncheva, S., V. Petrova-Karadjova & A. Palasov, 1995. Harmful algal blooms along the Bulgarian Black Sea coast and possible patterns of fish and zoobenthic mortalities. In Lassus, P., G. Arzul, E. Erard-Le Denn, P. Gentien & C. Marcaillou-Le Baut (eds), Harmful Marine Algal Blooms. Lavoisier Ltd., Nantes: 193–198.

Moncheva, S., G. Stereva, A. Krastev, N. Bodeanu, A. Kideys & S. Bayrakdar, 1998. Vertical distribution of summer phytoplankton in the western Black Sea during 1991–1995 with respect to some environmental factors. In Ivanov, L. & T. Oguz (eds), NATO TU-Black Sea Project: Ecosystem Modeling as a Management Tool for the Black Sea, Symposium on Scientific Results. Kluwer Academic Publishers, Dordrecht: 327–350.

Mudie, P. J., A. Rochon, A. E. Aksu & H. Gillespie, 2002. Dinoflagellate cysts, freshwater algae and fungal spores as salinity indicators in Late Quaternary cores from Marmara and Black Seas. Marine Geology 190: 203–231.

Narusevich, T. F., 1983. Phytoplankton structure of stratified waters of the Central Black Sea. Hydrobiological Journal 19: 1–9.

Nesterova, D. A., 1977. Development of phytoplankton of the northwest part of the Black Sea during spring, summer and autumn periods. Biologiya Morya 43: 17–23.

Nesterova, D. A., 1979. Development of the peridinian *Exuviella cordata* and "red tide" phenomenon in the northwestern part of the Black Sea. Soviet Journal of Marine Biology 5: 393–397.

Nesterova, D. A., 1982. On phytoplankton in the Egorlytsky and Tendrovsky Bays of the Black Sea. Ecologiya Morya 10: 39–42.

Nesterova, D. A., 1986. Size breakdown of summer phytoplankton in the western Black Sea. Oceanology 26: 351–355.

Nesterova, D. A., 1987. Characteristics of phytoplankton succession in the north-western Black Sea. Hydrobiological Journal 23: 16–21.

Nesterova, D. A., 1990. Study of the Black Sea phytoneuston. Ecologiya Morya 34: 1–8.

Nesterova, D. A., 2001. Zonation of the north-western Black Sea accordingly to species composition of phytoplankton. Oceanology 55: 23–27.

Nesterova, D. A. & L. S. Vasilenko, 1986. Phytoplankton and phytoneuston in the shallow-water Bays of the Black Sea. Ecologiya Morya 23: 24–30.

Nezlin, N. P., 1982. Seasonal species grouping of phytoplankton in the Black Sea littoral zone. Oceanology 22: 458–461.

Okolodkov, Y. B., 1998. A checklist of dinoflagellates recorded from the Russian Arctic Seas. Sarsia 83: 267–292.

Okolodkov, Y. B. & J. D. Dodge, 1995. Redescription of the planktonic dinoflagellate *Peridiniella danica* (Paulsen) comb. nov. and its distribution in the NE Atlantic. European Journal of Phycology 30: 299–306.

Okolodkov, Y. B. & J. D. Dodge, 1996. Biodiversity and biogeography of planktonic dinoflagellates in the Arctic Ocean. Journal of Experimental Marine Biology and Ecology 202: 19–27.

Ozturk, B., 1999. Black Sea Biological diversity, Turkey. Black Sea Environmental Series, Vol. 9. United Nations Publications, New York, 144 pp.

Parke, M. & J. D. Dodge, 1976. Dinophyta. Check-list of British Marine Algae. Third revision. Journal of the Marine Biological Association of United Kingdom 56: 527–594.

Petranu, A., 1997. Black Sea Biological Diversity, Romania. Black Sea Environmental Series, Vol. 4, United Nations Publication, New York, 314 pp.

Petranu, A., M. Apas, N. Bodeanu, A. Bologa, C. Dumitrache, M. Moldoveanu, G. Radu & V. Tiganus, 1999. Status and evolution of the Romanian Black Sea coastal ecosystem. In Besiktepe, S., U. Unluata & A. Bologa (eds), Environmental Degradation of the Black Sea: Challenges and Remedies. The Netherlands: 175–195.

Petrova, V. J., 1965. Sur le phytoplancton de la mer Noire devant le littoral bulgare. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 18: 357–361.

Petrova-Karadjova, V. J., 1986. Dynamique du phytoplancton du littoral bulgare de la mer Noire en conditions d'eutrophication. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 30: 187.

Popovský, J. & L. A. Pfiester, 1990. Dinophyta (Dinoflagellata). In Ettl, H., J. Gerloff, H. Heynig & D. Mollenhauer (eds),

Süβwasserflora von Mitteleuropa 6. G. Fischer Verlag, Stuttgart, New York, 272 pp.

Porumb, F., 1992. On the development of *Noctiluca scintillans* under eutrophication of Romanian Black Sea coastal waters. In Vollenweider, R. A., R. Marchetti & R. Viviani (eds), Marine Coastal Eutrophication: The Response of Marine Transitional Systems to Human Impact. Problems and Perspective for Restoration. Science of the Total Environment, S907–920.

Reguera, B. & S. González Gil, 2001. Small cell and intermediate cell formation in species of *Dinophysis* (Dinophyceae, Dinophysiales). Journal of Phycology 37: 318–333.

Rehnstam-Holm, A. S., A. Godhe & D. M. Anderson, 2002. Molecular studies of *Dinophysis* (Dinophyceae) species from Sweden and North America. Phycologia 41: 348–357.

Reid, D. F. & M. I. Orlova, 2002. Geological and evolutionary underpinnings for the success of Ponto–Caspian species invasions in the Baltic Sea and North American Great Lakes. Canadian Journal of Fisheries and Aquatic Sciences 59: 1144–1158.

Senicheva, M. I., 1980. Seasonal dynamics of the phytoplankton number, biomass and production in the Sevastopol Bay. Ecologiya Morya 1: 3–11.

Senicheva, M. I., 1983. Long-term dynamics of *Exuviella cordata* Ostenf. in Sevastopol Bay. In Polikarpov, G. G. (ed), State, Prospects for Development and Use of the Sea Ecological System in the Coastal Part of the Crimea. Sevastopol, Ukraine: 26–28.

Senicheva, M. I., 1990. Characteristics of phytoplankton as an object of nutrition for mussels *Mytilus galloprovincialis* Lam. in the region of the marine farm of the Laspi Bay. Ecologiya Morya 36: 7–16.

Senicheva, M. I., 1995. Algae of the genus *Dinophysis* (Ehrenberg) in the Black Sea. Hydrobiological Journal 31: 33–39.

Senicheva, M. I., 2000. Annual changes of phytoplankton community in the region of the Sevastopol oceanarium. Ecologiya Morya 53: 15–19.

Skolka, H. V., 1960. Espèces phytoplanctoniques des eaux roumaines de la mer Noire. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 15: 249–268.

Skolka, H. V., 1963. La dynamique du phytoplancton du littoral roumain de la mer Noire pendant l'année 1961. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 17: 467–477.

Skolka, H. V., 1965. Contribution a l'étude du phytoplancton de la partie Nord-Ouest de la Mer Noire. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 18: 363–366.

Skolka, H. V., 1968. Les pigments assimilateurs du phytoplancton du littoral roumain de la mer Noire. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 19: 567–570.

Skolka, H. V., 1977. Le phytoplancton des mers saumâtres pontocaspiennes notamment de la Mer Noire. In Pora, E. A. & M. C. Bacescu (eds), Biologie des eaux saumâtres de la Mer Noire. I.R.C.M., Constantza: 76–91.

Skolka, H. V. & N. Bodeanu, 1978. Fitoplanctonul de la litoralul romanesc si eutrofizarea marii. In Ionescu, A. L., I. Sion & M. Stanciu (eds), Protectia Ecosistemelor: 162–166.

Skolka, H. V., N. Bodeanu & A. Roban, 1986. Contributions à l'étude systématique du phytoplancton méditerranéen devant les côtes libyennes. Cercetari Marine 19: 23–54.

Skolka, H. V. & A. S. Bologa, 1990. L'eutrophisation et la production du phytoplancton des eaux de la mer Noire, devant la côte roumaine. Rapports et Procès-verbaux des réunions Conseil international pour l'exploration de la Mer Méditerranée, Monaco 32: 210.

Skolka, H. V. & I. Cautis, 1971. Floraison d'*Exuviaella cordata* Ostenf. et ses conséquences sur la pêche marine en Roumanie au cours de l'année 1969. Cercetari Marine 1: 59–82.

Skolka, H. V. & A. Roban, 1989. Répartition et dynamique du phytoplancton sur la plate-forme continentale roumaine au cours des années 1980–1981. Cercetari Marine 22: 147–171.

Sorokin, Y. I., 2002. The Black Sea: Ecology and Oceanography. Backhuys, Leiden, The Netherlands: 875 pp.

Sournia, A., 1982. Is there a shade flora in the marine plankton? Journal of Plankton Research 4: 391–399.

Sournia, A., 1986. Atlas du Phytoplancton Marin. Vol. I: Introduction, Cyanophycées, Dictyochophycées, Dinophycées et Raphidophycées. Editions du Centre National de la Recherche Scientifique, Paris, 219 pp.

Sournia, A., 1995. Red-tides and toxic marine phytoplankton of the world ocean: an inquiry into biodiversity. In Lassus, P., G. Arzul, E. Erard-Le Denn, P. Gentien & C. Marcaillou-Le Baut (eds), Harmful Marine Algal Blooms. Lavoisier Ltd., Nantes: 103–112.

Steidinger, K. A. & K. Tangen, 1997. Dinoflagellates. In Tomas, C. R. (ed.), Identifying Marine Phytoplankton. Academic Press, San Diego: 387–584.

Stolbova, N. G., V. I. Vedernikov & A. S. Mikaelyan, 1982. Diurnal cell-division rhythm of dinoflagellates from the Black Sea. Oceanology 22: 365–368.

Stoyanova, A. P., 1999. New representatives of Noctilucales in the Bulgarian Black Sea coastal water. Comptes Rendus de l'Académie Bulgare de Sciences 52: 119–122.

Sukhanova, I. N., 1992. *Exuviella compressa* bloom in the Gulf of Burgas in autumn 1990. Oceanology 32: 476–479.

Sukhanova, I. N. & A. Ye. Cheban, 1990. Heterotrophic phytoplankton of the Black Sea in the early spring development of the phytocenosis. Oceanology 30: 724–792.

Sukhanova, I. N., M. V. Flint, G. Hibaum, V. Karamfilov, A. I. Kopylov, E. Matveeva, T. N. Rat'hova & A. F. Sazhin, 1988. *Exuviella cordata* red tide in Bulgarian coastal waters (May to June 1986). Marine Biology 99: 1–8.

Taylor, F. J. R., 1976. Dinoflagellates from the International Indian Ocean Expedition. A report on material collected by R/V 'Anton Bruun' 1963–1964. Bibliotheca Botanica 132, 234 pp.

Terenko G. V., 2001. Phytoplankton species diversity from the Black Sea as a characteristic of ecosystem condition. Ecologiya Morya 58: 53–56.

Terenko, L. M. & G. V. Terenko, 2000. Species diversity of the plankton phytocenosis in the Odessa Bay of the Black Sea. Ecologiya Morya 52: 56–59.

Turkoglu, M. & T. Koray, 2000. Ecological and geographical distributions of the planktonic protista in the southern parts of the Black Sea (neritic waters of Sinop Peninsula, Turkey). Su Ürünleri Dergisi, Sayı: 1–2: 17: 161–178.

Turkoglu, M. & T. Koray, 2002. Phytoplankton species' succession and nutrients in the southern Black Sea (Bay of Sinop). Turkish Journal of Botany 26: 235–252.

Uysal, Z., 1993. A Preliminary study on some plankters along the Turkish Black Sea coast. Species composition and spatial distribution. Ph.D. The Middle East Technical University, Erdemli-Içel, Turkey, 148 pp.

Uysal, Z., 2001. On the formation of net phytoplankton patches in the southern Black Sea during the spring. Hydrobiologia 485: 173–182.

Velikova, V. N., 1998. Long-term study of red tides in the western Black Sea and their ecological modeling. In Reguera, B., J. Blanco, M. L. Fernández & T. Wyatt (eds), Harmful Algae.

Proceeding of the VIII International Conference on Harmful Algae, Vigo, Spain 25–29 June 1997. Xunta de Galicia and I.O.C.: 192–195.

Velikova, V. & J. Larsen, 1999. The *Prorocentrum cordatum*/*Prorocentrum minimum* taxonomic problem. Grana 38: 108–112.

Velikova, V., S. Moncheva, & D. Petrova, 1999. Phytoplankton dynamics and red tides (1987–1997) in the Bulgarian Black Sea. Water Science and Technology 39: 27–36.

Viličić, D., I. Marasović & D. Mioković, 2002. Check-list of phytoplankton in the eastern Adriatic Sea. Acta Botanica Croatica 61: 57–91.

Vinogradov, M. Ye & E. A. Shushkina, 1992. Temporal changes in community structure in the open Black Sea. Oceanology 32: 485–491.

Wyatt, T. & J. T. Carlton, 2002. Phytoplankton introductions in European coastal waters: why are so few invasions reported? In Briand, F. (ed.), Alien Marine Organisms Introduced by Ships in the Mediterranean and Black Seas. Conseil international pour l'exploration de la Mer Méditerranée, Workshop Monographs 20: 47–51.

Zaitsev, Y. P. & B. G. Alexandrov, 1998. Black Sea Biological Diversity, Ukraine. Black Sea Environmental Series, Vol. 7. United Nations Publications, New York, 351 pp.

Zav'yalova, T. A. & A. S. Mikaelyan, 1997. Heterotrophic phytoplankton of the Black Sea: Species composition and spatial distribution. Oceanology 37: 385–391.