Influence of Salinity Variations on Zooplankton Community in El-Mex Bay, Alexandria, Egypt

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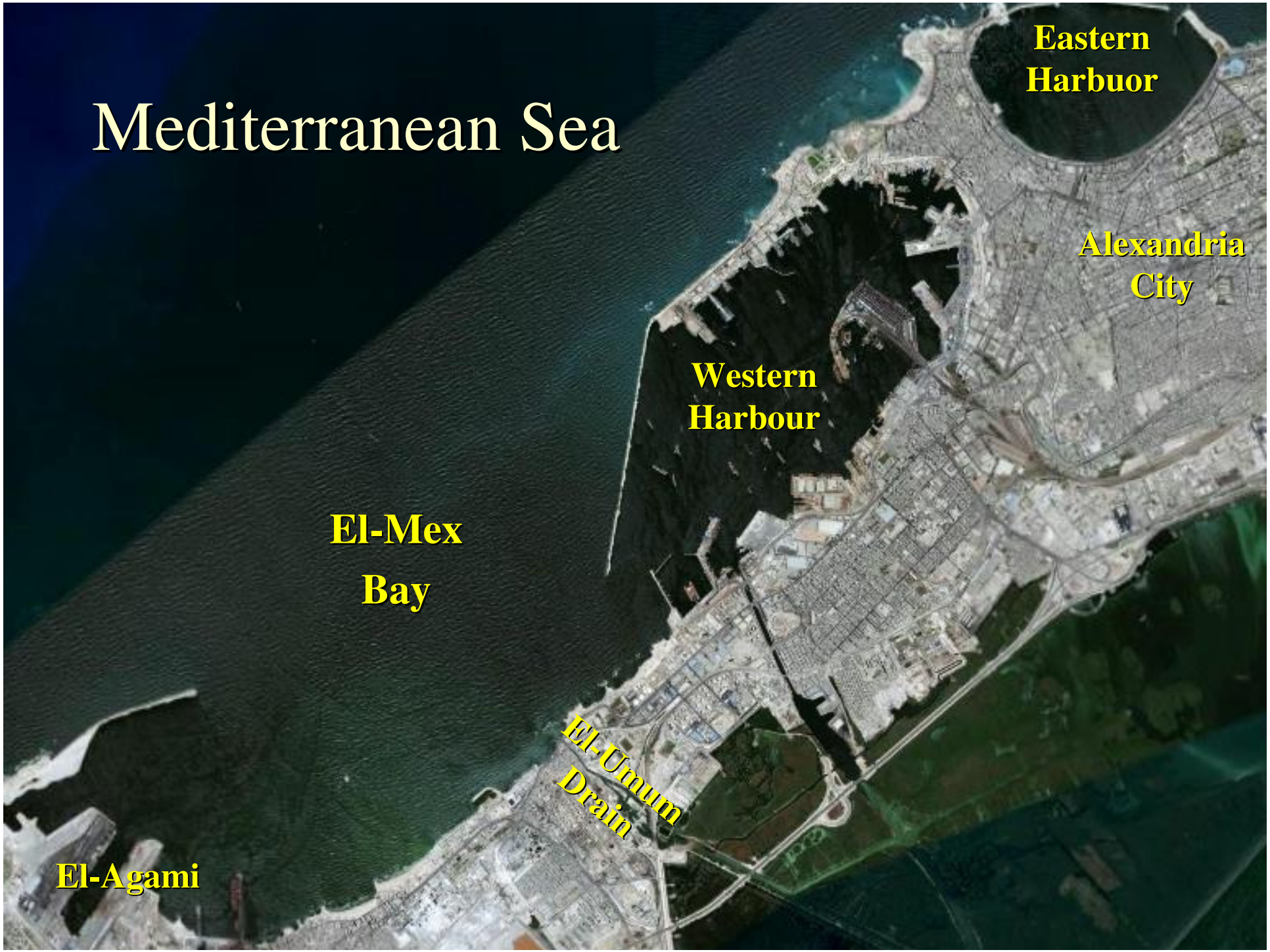
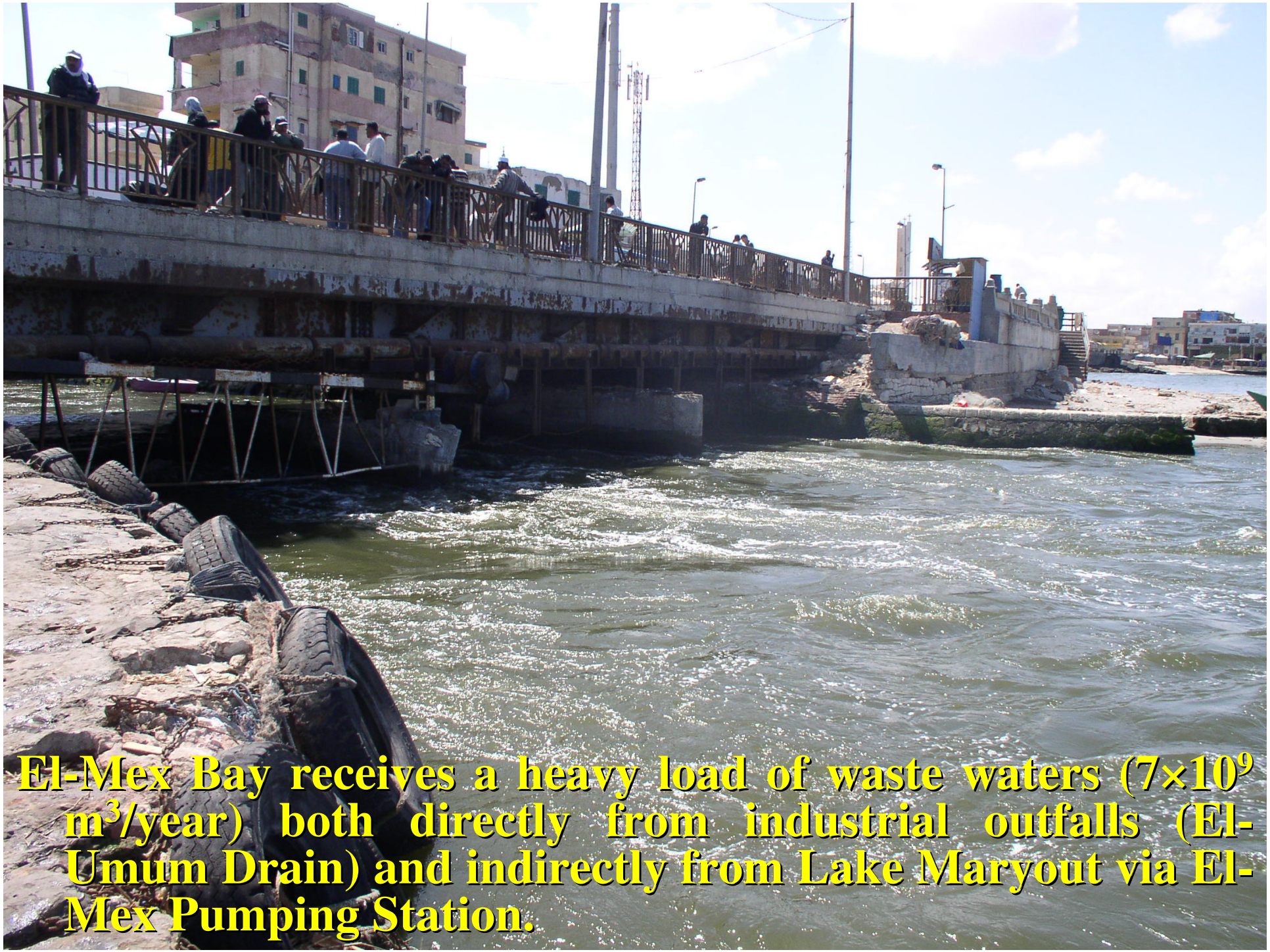

Mediterranean Sea
Eastern Harbuor
Alexandria City
Western Harbour
El-Mex Bay
El-Umum Drain
El-Agami


N
Umum Drain is a canal of 45.8Km long with a bottom width of 20m and average depth of 3.4m
Image © 2007 DigitalGlobe



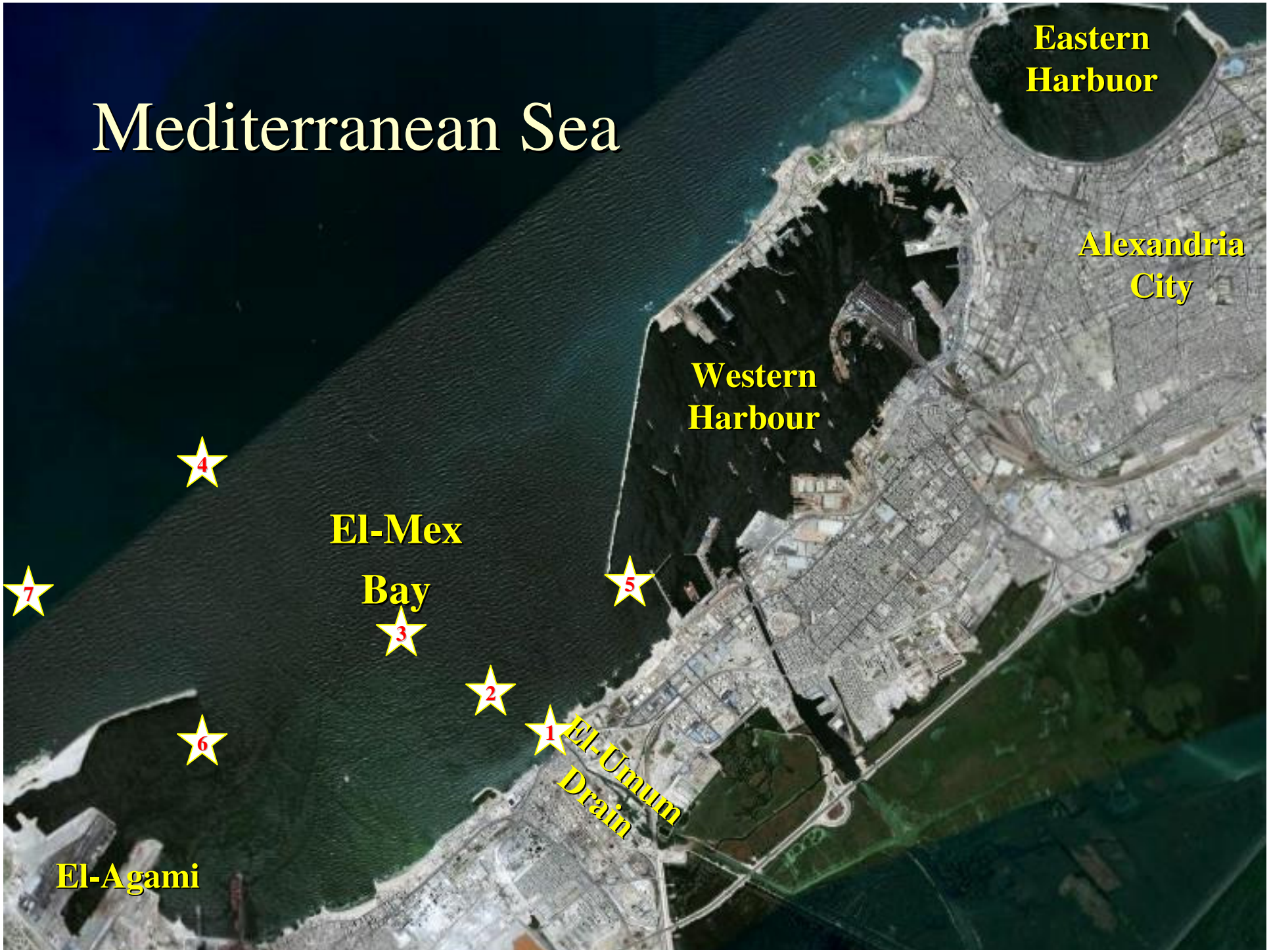
El-Mex Bay receives a heavy load of waste waters (7×10^9 m^3/year) both directly from industrial outfalls (El-Umum Drain) and indirectly from Lake Maryout via El-Mex Pumping Station.

Aim of the Study

The present work is an attempt to illustrate the influence of salinity variations on the abundance and community structure of zooplankton in El-Mex Bay waters

Materials and Methods of Analysis

- Quantitative and qualitative studies on zooplankton community were performed bimonthly in El-Mex Bay, from March 2005 to January 2006. Seven stations were selected to represent the different habitat in the Bay.
- Zooplankton samples were collected at each station by vertical hauls (from bottom to the surface) using standard plankton net of 55 µm mesh.
- Water temperature and salinity were also measured along with sampling.


Mediterranean Sea
Eastern Harbuor
Alexandria City
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El-Mex Bay
El-Umum Drain
El-Agami
1
2
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Results

(I) Water types characteristics

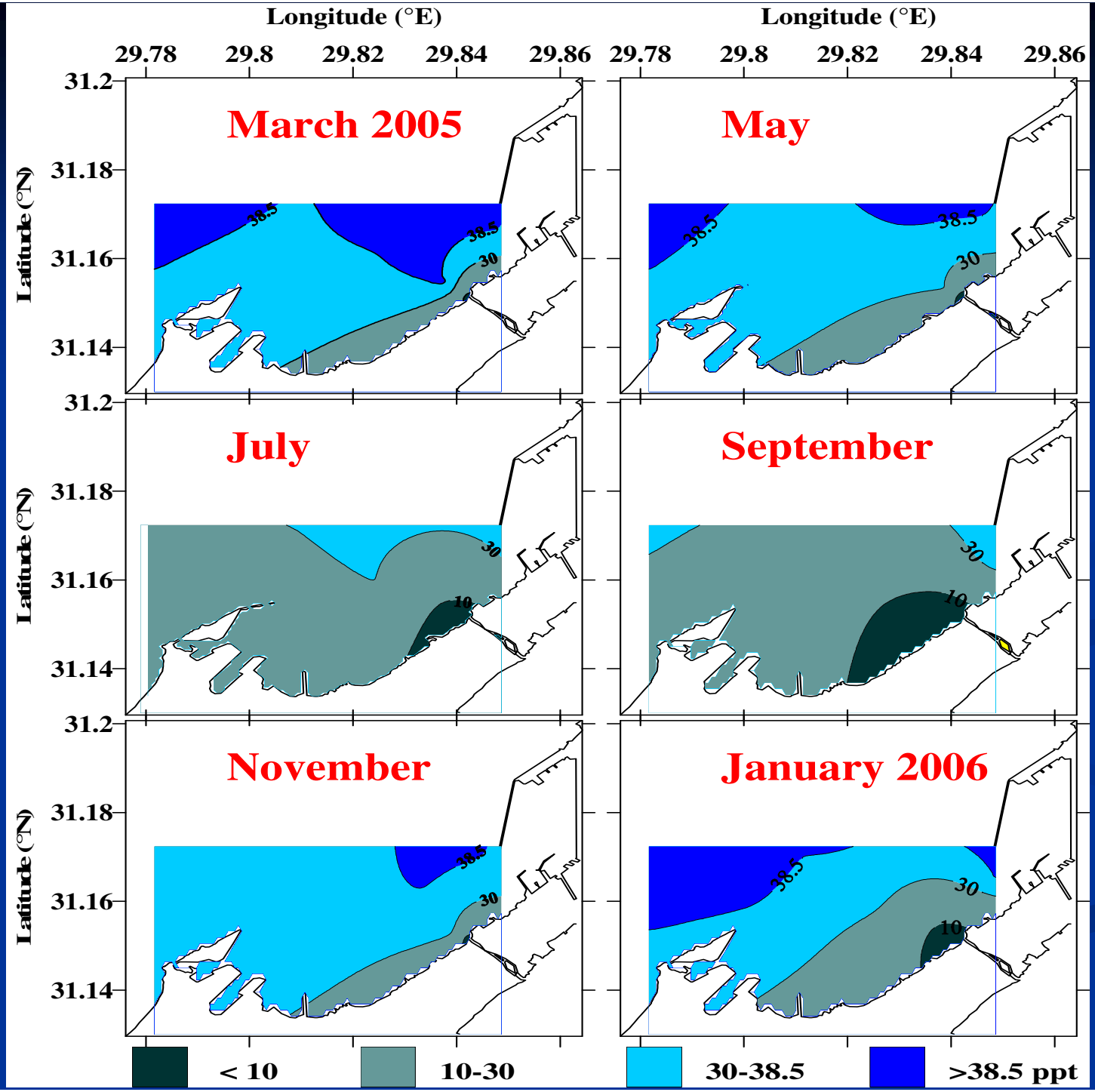
Based on the distribution of surface salinity in the investigated area, four types of water could be identified:

1- Mixed land drainage (L) with a salinity of < 10.00 ppt.

2- Mixed water (M) with a salinity range from 10.00 to 30.00 ppt.

3- Diluted sea water (D) with a salinity range from 30.00 to 38.50 ppt

4- Mediterranean Sea water (S) of salinity > 38.50 ppt.


Longitude (°E)
29.78
29.8
29.82
29.84
29.86
Latitude (°N)
31.2
31.18
31.16
31.14
March 2005
May
July
September
November
January 2006
38.5
30
10
< 10
10-30
30-38.5
>38.5 ppt

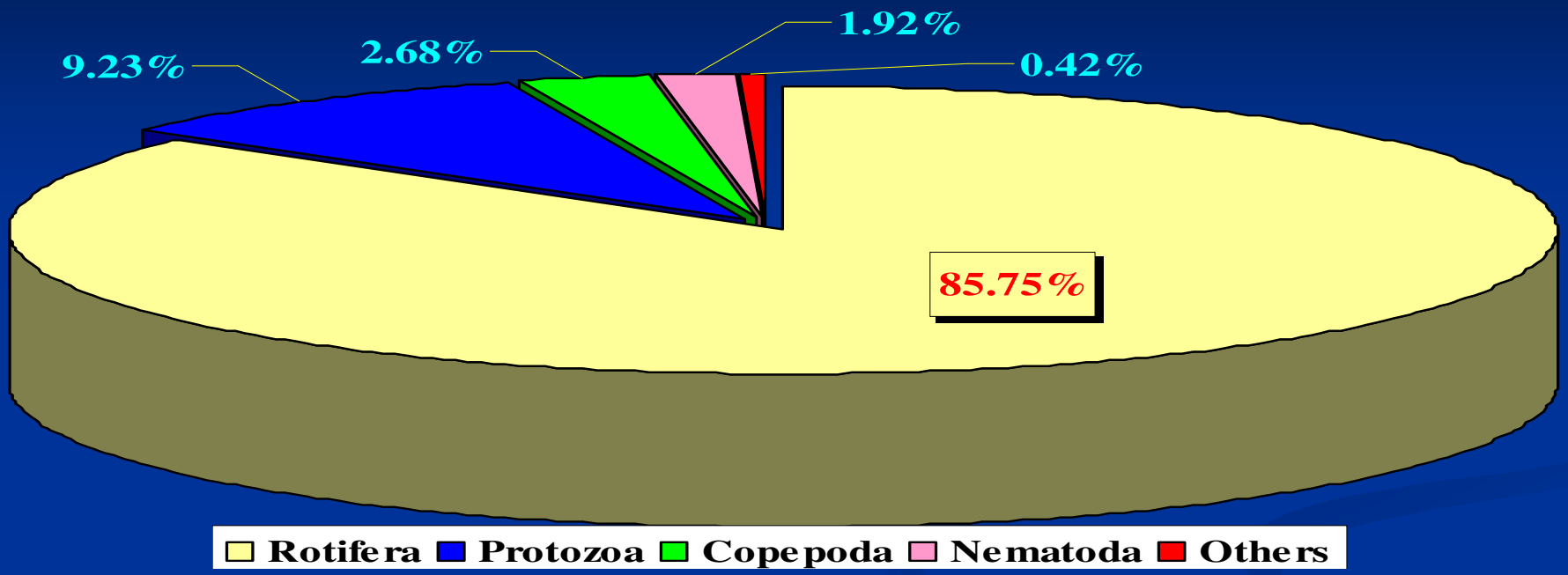
(II) Zooplankton community characteristics

(a) Mixed land drainage water type (L)

- Zooplankton community in the mixed land drainage water type (L) of salinity less than 10 ppt was represented by 47 taxa, out of them 25 protozoan species, 19 Rotifera and 3 species of Crustacea (2 Copepoda and one species of Cladocera). The water type (L) was characterized by highest number of species belonging to fresh water fauna (37 species).

(II) Zooplankton community characteristics

(a) Mixed land drainage water type (L)



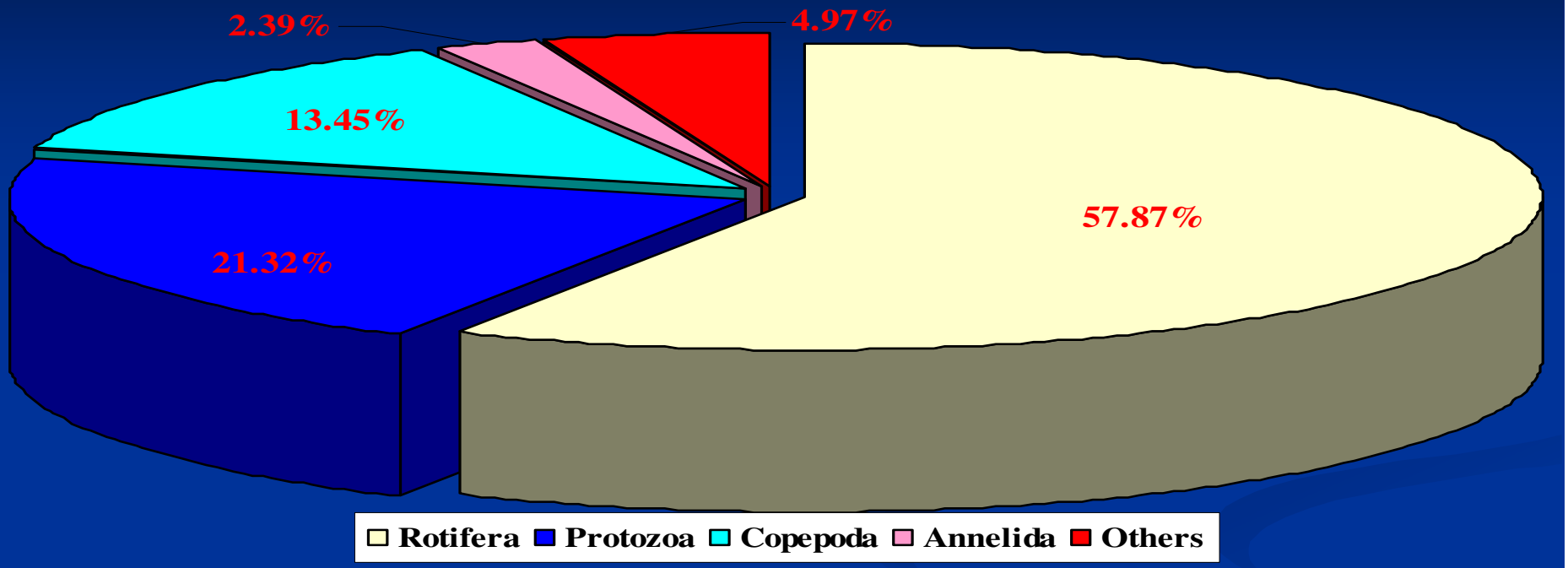
- Copepods and their larval stages occupied the third order of abundance, contributing 2.68% to the total zooplankton community. They were represented by 2 species, *Acanthocyclops americanus* and *Eucyclops agilis*. The nauplii predominated over the adults contributing 84.81% to the total copepods.
- Numerically, free living nematodes contributed 1.92% to the total zooplankton.
- Protozoa was the second important group contributing 9.23% to the total zooplankton crop. *Difflugia* sp. and *Paramecium caudatum* were the most dominant species forming 50.25% and 19.45% to the total protozoan population respectively.
- Other groups such as Nematoda and Cladocera as well as the meroplanktonic larvae of Annelida, Insecta and Mollusca were rarely represented and constituted collectively 0.42% to the total zooplankton community.
- Rotifers were the dominant group contributing 85.75% to the total zooplankton community. They were represented by 2 species, *Brachionus calyciflorus* and *B. plicatilis* were frequently recorded.

(II) Zooplankton community characteristics
(b) Mixed water type (M)

- *Zooplankton community in the mixed water type (M) of salinity 10-30 ppt was containing 65 taxa, out of them 27 protozoan species, 19 Rotifera and 14 species of Crustacea (7 Copepoda, 4 Cladocera, one species of Ostracoda and two decapods). Besides one species of Cnidaria and 4 species of Larvacea.*

(II) Zooplankton community characteristics

(b) Mixed water type (M)



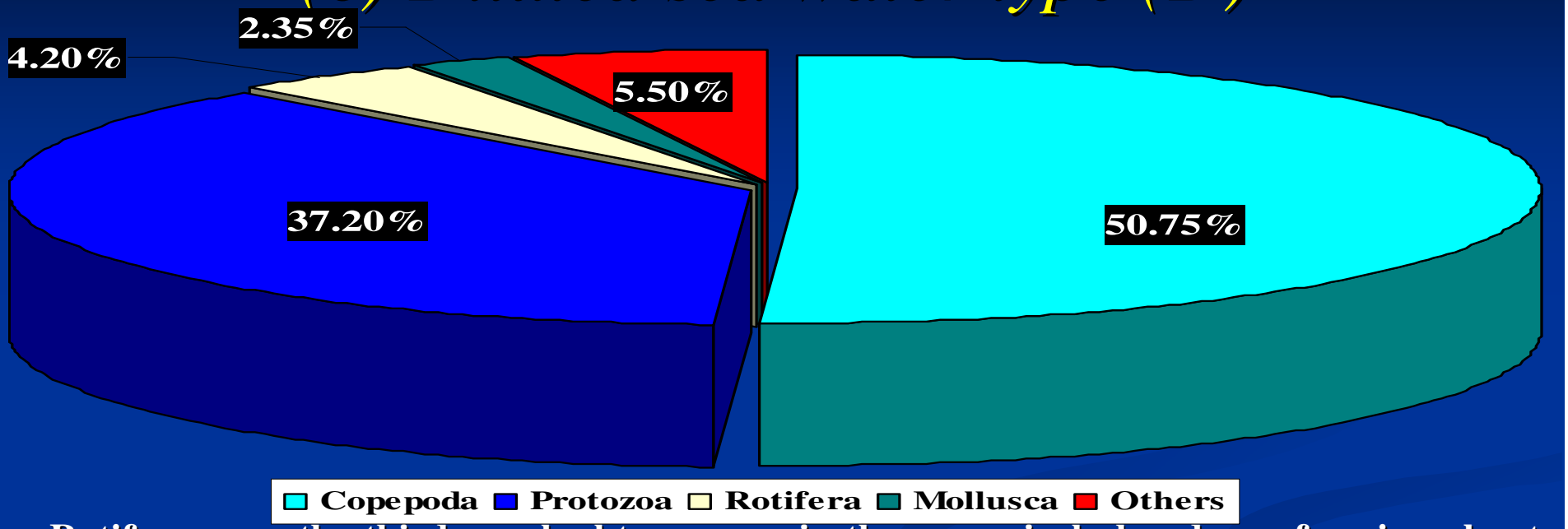
- Copepoda and their larval stages were numerically the third group, contributing 13.45% to the total zooplankton counts. They were represented by 7 species belonging to 7 genera, all of them belonging to marine forms. *Oithona nana* dominated copepod population in this water type. The copepod nauplii contributed 66.18% to the total copepod population.
- Rotifera was the most important zooplankton groups forming about 57.87% of the total zooplankton. They were represented by 19 species belonging to 9 genera. *Brachionus urceolaris* dominated the population (79.26% to the total Rotifera). *Ascomorpha* sp., *Brachionus plicatilis* and *B. calyciflorus* were represented with considerable numbers.
- Numerically, the meroplanktonic larvae of Annelida contributed 2.39% to the total zooplankton. Other groups such as Cnidaria, Nematoda, Cladocera, Ostracoda, Decapoda, Larvacea as well as the meroplanktonic larvae of Cirripedia, Mollusca, Echinodermata and Ascidiacea were rarely represented and constituted collectively 4.97% to the total zooplankton community.
- Protozoa ranked as the second dominant group constituting 21.32% of the total community. *Favella ehrenbergi* and *Difflugia* sp. were the most dominant protozoan species constituting 39.15% and 24.06% to the total population respectively.

(II) Zooplankton community characteristics (c) Diluted sea water type (D)

- **Zooplankton community in the diluted sea water type (D) of salinity 30-38.5 ppt was represented by 64 taxa, out of them 35 protozoan species, 12 Rotifera and 12 species of Crustacea (10 Copepoda, one species of Cladocera and one species of Ostracoda). Besides there were one species of Cnidaria, one species of Pteropoda and 3 species of Larvacea.**

(II) Zooplankton community characteristics

(c) Diluted sea water type (D)



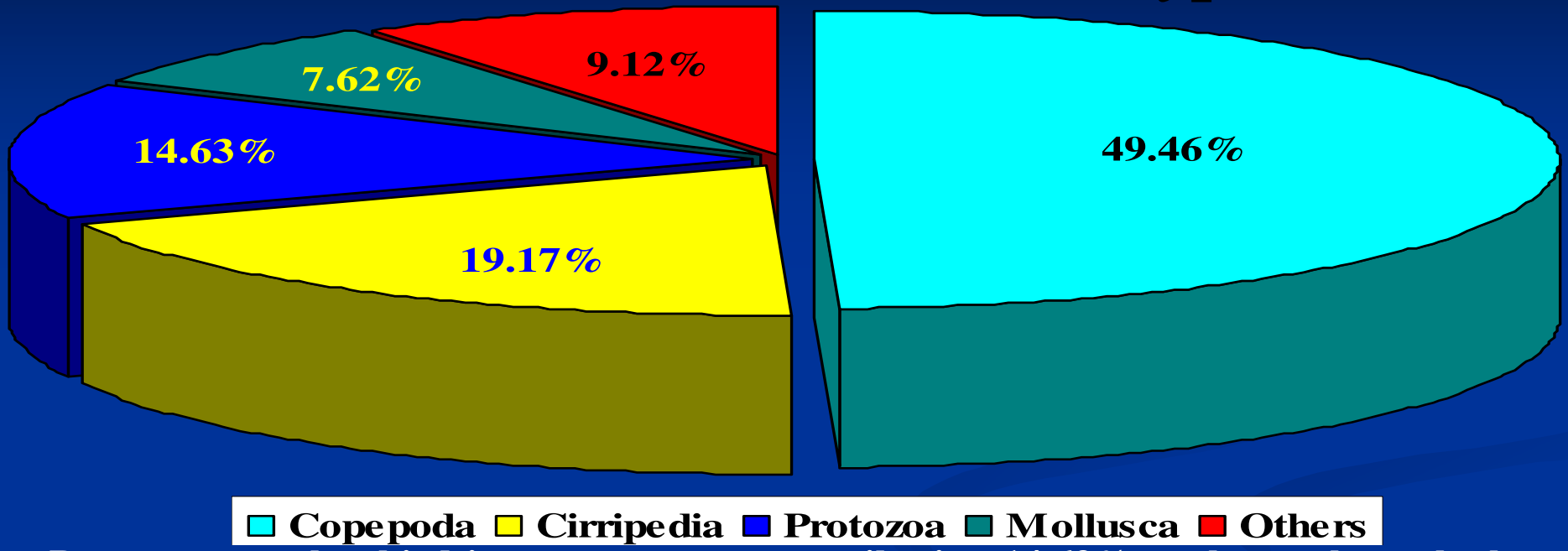
- Rotifera were the third zooplankton group in the numerical abundance forming about 4.20% of the total zooplankton. They were represented by 12 species belonging to 4 genera. *Synchaeta oka* dominated rotifer population forming 56.8% to the total Rotifera. *Brachionus plicatilis*, *Synchaeta oblonga* and *S. pectinata* were recorded with considerable numbers.
- Copepoda and their larval stages were the most dominant zooplankton groups constituting about 51% of the total zooplankton. They were represented by 10 species belonging to 8 genera, all of them belonging to marine forms. *Oithona nana* dominated copepod population in this water type. *Euterpina acutifrons*, *Eucalanus crassus* and *Paracalanus parvus* were rather frequent. The Copepod nauplii contributing about 65% to the total copepod population.
- Planktonic Mollusca contributed 2.35% to the total zooplankton. They were represented by 2 species; *Limacina inflata* as well as veliger larvae of lamellibranchs.
- Protozoa was the second important group constituting 37.20% to the total zooplankton crop. *Helicostomella fusiformis* and *Favella ehrenbergi* were the most dominant Protozoa species forming 38.19% and 28.47% to the total population respectively. *Petalotricha ampulla* and *Helicostomella subulata* were frequent.
- Other Hetrotrophic forms as Cnidaria, Cladocera, Ostracoda, Larvacea, all meroplanktonic larvae of Annelida, Cirripedia, Echinodermata and Ascidiacea constituted collectively 5.50% of the total zooplankton community.

(II) Zooplankton community characteristics

(d) Mediterranean Sea water type (S)

- Zooplankton community in the Mediterranean Sea water type (S) of salinity >38.5 ppt was represented by 41 taxa, including 23 protozoan species and 13 Crustacaea (12 Copepoda, and one species of Ostracoda) , 2 Rotifera as well as one species of Pteropoda, one species of Chaetognatha and one Larvacea species.

(II) Zooplankton community characteristics
(d) Mediterranean Sea water type (S)



- Protozoa was the third important group contributing 14.63% to the total zooplankton counts. *Globigerina* sp and *Textularia agglutinans* were the most dominant protozoan species forming 18.49% and 14.30% to the total protozoan population respectively. *Heliostomella fusiformis* and *Amphorellopsis tetragona* were rather frequent.
- Copepoda and their larvae were the most dominant zooplankton group contributing 49.46% to the total zooplankton. *Oithona nana*, *Acartia clausi* and *Paracalanus parvus* dominated copepod population in this water type. *Eucalanus attenuatus*, *Ctenocalanus vanus* and *Corycaeus clausi* were rare. The copepod nauplii contributed about 65% to the total copepod population.
- Planktonic Mollusca contributed 7.62% to the total zooplankton crop. They were represented by one pteropod species; *Limacina inflata* as well as the larvae of lamellibranchs. Rotifera contributed 2.02% to the total zooplankton community. They were represented by 2 species of genus *Synchaeta*; *Synchaeta okai* and *S. pectinata*.
- Cirriped larvae (nauplii and cypris) occupied the second order of abundance with a percentage frequency of 19.17% to the total zooplankton crop. Ostracoda, Chaetognatha and Larvacea contributed 1.33%, 0.05% and 1.87% to the total zooplankton population respectively. The larvae of Annelida and Echinodermata constituted 1.48% and 2.37% respectively.

Water types / Recorded species	L	M	D	S
Protozoa				
Tintinnida:				
Amphorellopsis tetragona (Jorg.)	13	120	85	83
Codonellopsis morchella (Cleve)	0	0	3	6
Coxliella ampla (Jorgensen)	0	0	5	0
Coxliella annulata (Daday)	0	12	39	0
Dadayiella ganymedes (Entz, Sr.)	0	0	34	37
Epiplocylis blanda (Jorgensen)	0	0	1	3
Epiplocylis undella (Ostenfeld & Schmidt)	0	2	0	0
Eutintinnus fraknoi (Daday)	30	85	148	24
Fevella adriatica (Imhof)	0	16	4	0
Fevella ehrenbergi (Claparede & Lachmann)	31	3836	2133	45
Helicostomella fusiformis (Meunier)	32	81	2861	85
Helicostomella subulata (Eherenberg)	13	540	663	20
Metacylis mediterranea (Mer.)	0	236	266	14
Metacylis vitreoides (Kofoid & Campbell)	0	2	0	0
Parundella aculeata (Jorgensen)	0	0	0	3
Parundella grandis (Kofoid & Campbell)	0	0	8	0
Parundella lachmanni (Daday)	0	158	35	0
Parundella sp.	0	0	0	19
Petalotricha ampulla (Fol)	21	495	834	0
Petalotricha major (Jorgensen)	0	7	24	0
Proplectella angustior (Jorgensen)	0	31	2	0
Proplectella ovata (Jorgensen)	0	0	1	6
Proplectella subcaudata (Jorgensen)	0	0	6	0
Rhabdonella spiralis (Fol)	0	0	0	3
Steenstrupiella steenstrupii (Claparede & Lachmann)	0	0	3	23
Stenosemella nivalis (Meunier)	0	0	7	11
Stenosemella ventricosa (Claparede & Lachmann)	0	7	1	30
Tintinnopsis beroidea (St.)	0	411	201	40
Tintinnopsis labiancoi (Dad.)	0	284	11	8
Undella hyalina (Daday)	0	1	3	0
Xystonella lohmanni (Brandt)	0	0	1	0

Water types / Recorded species	L	M	D	S
Ciliophora				
* *Ancyromonas controta* (Lemmermann)	70	0	0	0
* *Blepharisma lateritum* (Ehernberg)	177	0	0	0
* *Chilodontopsis depressa* (Perty)	76	0	0	0
* *Frontoniella camplanata* (Wetzel)	170	95	0	0
* *Paramecium aurelia* (Ehrenberg)	202	0	0	0
* *Paramecium bursaria* (Ehrenberg)	25	0	0	0
* *Paramecium caudatum* (Ehrenberg)	1915	232	0	0
* *Paramecium multimicronucleatum* (Powers & Mitchell)	50	0	0	0
* *Paramecium* sp.	1316	411	0	0
* *Stokesia vernalis* (wenrich)	126	21	0	0
* *Tetrahymena pyriformis* (Ehrenberg)	63	0	0	0
* *Vasicola ciliata* (Tatem)	44	0	0	0
Rhizopoda:				
* *Difflugia* sp.	4948	2357	17	0
Foraminifera:				
* *Ammonia baccarii* (Linneus)	69	0	7	0
* *Elphidium crispum* (L.)	72	0	0	0
Textularia agglutinans (Orb.)	57	33	16	123
Globigerina bulloides (Orb.)	13	0	2	3
Globigerina inflata (Orb.)	0	0	4	0
Globigerina sp.	232	138	16	159
Globorotalia truncatuloides (Orb.)	0	66	7	46
* *Quinqueloculina* sp.	79	121	36	0
Tretomphalus bulloides (Orb.)	0	0	8	69
Total	9844	9798	7492	860

Water types / Recorded species	L	M	D	S
Rotifera				
* *Ascomorpha saltans* (Beauchamp)	4852	1	0	0
* *Ascomorpha* sp.	31	2736	11	0
* *Brachionus angularis* (Gosse)	3318	42	17	0
* *Brachionus budapestiensis* (Daday)	129	358	0	0
* *Brachionus calyciflorus* (Pallas)	2358	547	14	0
* *Brachionus plicatilis* (O.F. Muller)	1954	894	98	0
* *Brachionus quadridentatus* (Hermann)	93	0	0	0
* *Brachionus urceolaris* (Muller)	62506	21082	26	0
* *Colurella adriatica* (Carlin)	803	53	0	0
* *Filinia longiseta* (Ehrenberg)	13375	46	0	0
* *Hexarthra mira* (Schmarda)	15	0	0	0
* *Keratella quadrata* (O.F. Muller)	74	52	0	0
* *Lecane luna* (O.F. Muller)	25	0	0	0
* *Lecane* sp.	29	0	0	0
* *Lepadella* sp.	0	21	0	0
* *Monommata grandis* (Tessin)	223	0	0	0
* *Monostyla bulla* (Gosse)	895	21	1	0
* *Monostyla closterocerca* (schmarda)	292	32	4	0
* *Monostyla lunaris* (Ehernberg)	201	3	0	0
* *Polyarthra vulgaris* (Carlin)	0	21	0	0
* *Synchaeta oblonga* (Ehrenberg)	0	146	74	0
* *Synchaeta okai* (Sudzuki)	0	303	480	24
* *Synchaeta pectinata* (Ehrenberg)	0	18	72	95
* *Synchaeta trenula* (O.F. Muller)	0	0	3	0
* *Synchaeta* sp.	230	224	45	0
Total	91403	26600	845	119

Water types / Recorded species	L	M	D	S
Copepoda				
Calanoida				
Acartia □lause (Giesbrecht)	0	92	19	160
Acartia latisetosa (Krieczaguin)	0	0	9	21
Acartia danne (Giesbrecht)	0	0	3	0
Centropages koryeri (Giesbrecht)	0	5	13	23
Ctenocalanus vanus (Giesbrecht)	0	0	15	10
Eucalanus attenuatus (Dana)	0	0	0	8
Eucalanus crassus (Giesbrecht)	0	81	198	43
Paracalanus parvus (Claus)	0	65	118	137
Cyclopoida				
* *Acanthocylops americanus* (March)	296	0	0	0
Corycaeus □lause (Dohl)	0	0	0	8
Corycaeus typicus (Kroyer)	0	0	0	35
Oithona nana (Giesbrecht)	0	1304	2328	261
Harpacticoida				
Euterpina acutifrons (Dana)	44	313	775	89
Microstella norvegica (Boeck)	0	32	10	27
Copepod nauplii	2424	4091	6641	1890
Copepodite stages	94	199	93	195
Total	2858	6182	10222	2907

CONCLUSIONS

- *Based on the salinity values, four water types could be observed in El-Mex Bay, namely; mixed land drainage (L), mixed water (M), diluted sea water (D) and Mediterranean water (S).*
- *The mixed land drainage water type (L) is slightly brackish and is characterized by very low salinity 3.295-6.779 ppt The highest zooplankton abundance (106.6×10^{3} $ind.m^{-3}$) was found in this water type (L). Rotifera was the leading group at this water type, constituted 85.75% to the total zooplankton community.*

CONCLUSIONS

- Mediterranean water type "S" differed greatly from water type "L". It represents pure Mediterranean water free from the effects of land drainage. Its salinity ranged between 38.608 and 39.325 ppt. The lowest zooplankton abundance (5.9×103 ind.m-3) was recorded at this water type and characterized by a great number of marine forms, constituting 95.12% to the total number of the recorded species. Copepoda and their larval stages were the most dominant group in this high salinity water type, contributing about 50% to the total zooplankton community.
- Water types (M) and (D) represent intermediate stages between water types (L) and (S). They are affected to a certain extent by land drainage water which is clearly observed in the water type (M) than in the water type (D)

Acknowledgement

- *The authors wish to acknowledge CIESM staff and UNESCO/IOC for their support to attend the Workshop.*
- *They also wish to express their thanks to the Organizing committee of the WGZE/CIESM Workshop.*


Thank you