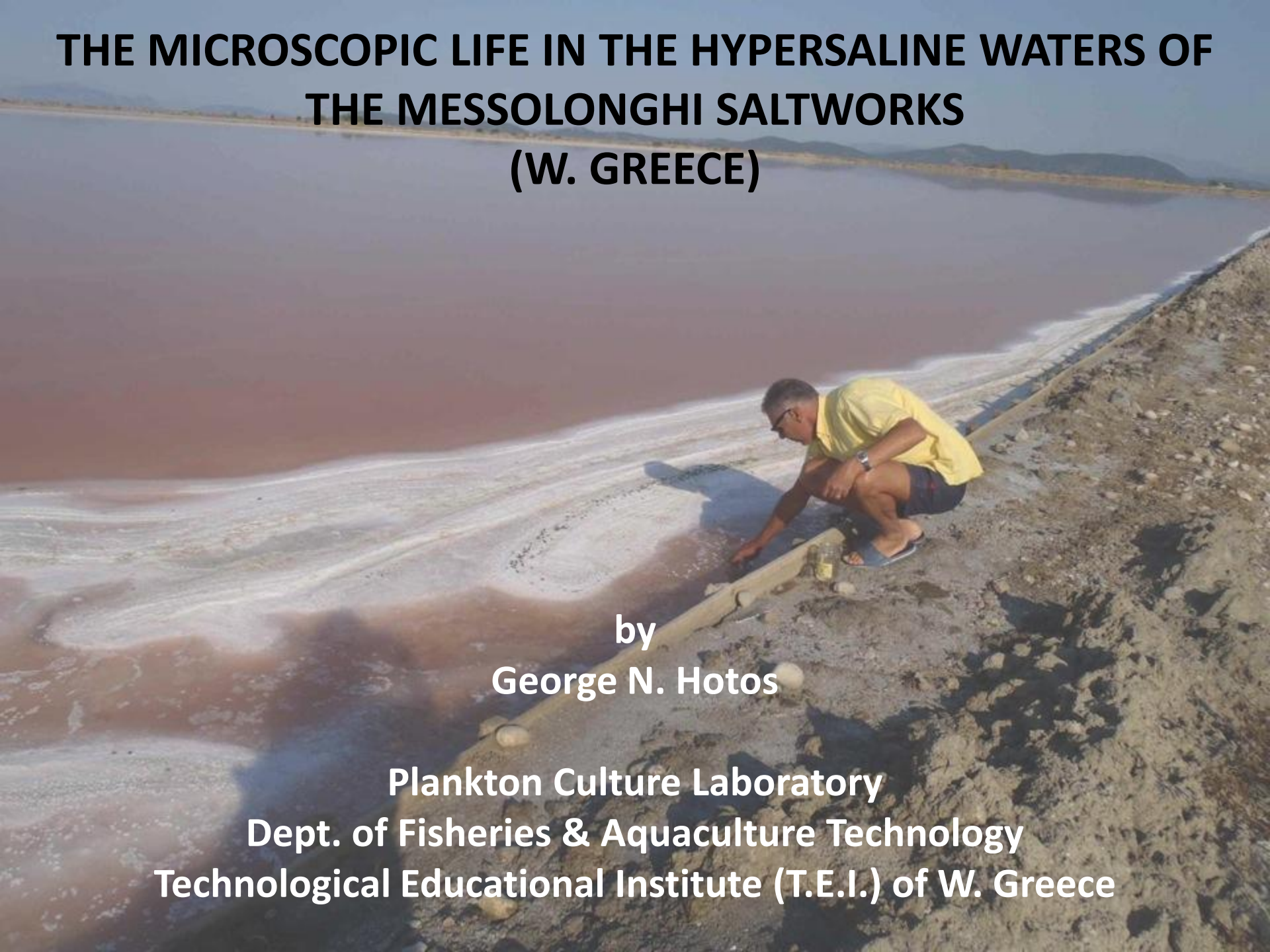
THE MICROSCOPIC LIFE IN THE HYPERSALINE WATERS OF THE MESSOLONGHI SALTWORKS (W. GREECE)



by

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MESSOLONGHI SALTWORKS
STUDY AREA – SAMPLING POINTS

Duration of survey: 6 months (Apr. – Sept. 2015)

Salinity range of samples: 50 – 210 ppt

Categories of organisms found: 3 Kingdoms (Monera, Protista, Animals)

Kingdom Monera: Cyanobacteria 22 species

Kingdom Protista: Chlorophyta 5 species, Dinoflagellata 1 species, Diatoms 27 species, Protozoa 51 species

Kingdom Animals: Rotifera 9 species, Copepoda 1 species, Anostraca 1 species, Nematoda 1 species

<u>TOTAL NUMBER OF SPECIES FOUND: 118</u>

Due to:

changing salinity | intense light | shallow ponds | low oxygen

It is logical to expect scarcity of species

But because of:

The exclusion of large predators

An astonishing richness of species exists

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CONSIDERING

THE DRY-FLOODED ANNUAL STATE OF SALTERN PONDS

THE WATER SUPPLY FROM THE LAGOON ONLY

THE ONLY ONE CENTURY HISTORY OF THE SALTERN

SOME BASIC QUESTIONS ARISE

HOW MANY OF THESE SPECIES ARE ENDEMIC?
IF NOT ENDEMIC WHERE DO THEY COME FROM?

ANSWER 1
IF THEY ARE ENDEMIC THEN A BRIGHT BIOLOGICAL FIELD AWAITS
ANSWER 2
LOGICALLY THE WATER OF THE LAGOON OF MESSOLONGHI BRINGS THEM IN

A BROAD SPECTRUM THOROUGH AND LONG LASTING STUDY OF BOTH THE LAGOON AND THE SALTERN CAN ELUCIDATE THE SITUATION

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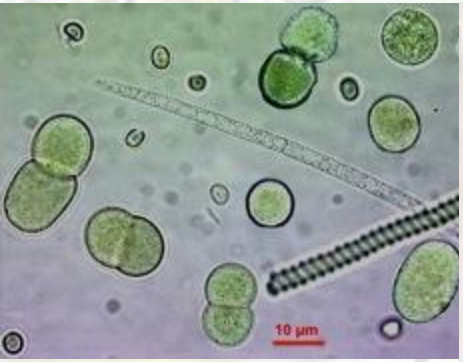
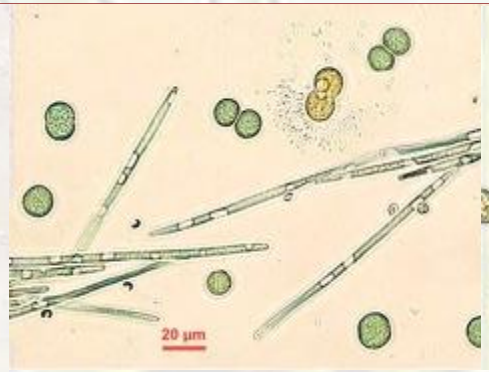
COCCOID CYANOBACTERIA
PLANKTONIC

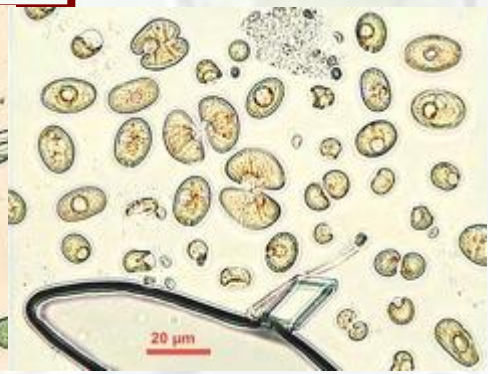


Cyanothece sp.

Synechococcus sp.

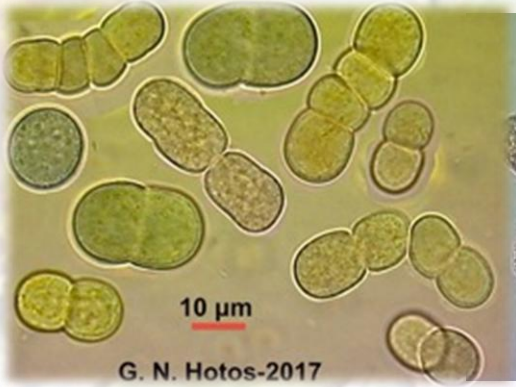


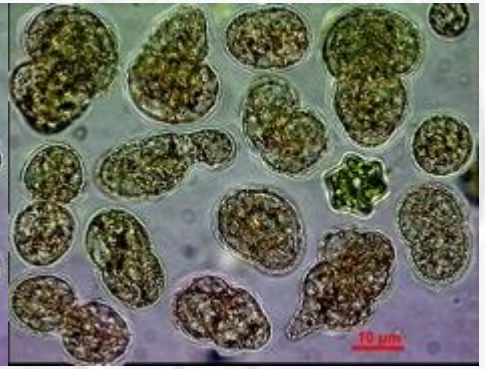
Aphanothece sp.



Unidentified

Synechococcus various forms





The most numerous photosynthetic planktonic entities in all salinities

Great variation in cell sizes and forms

Many unidentified species

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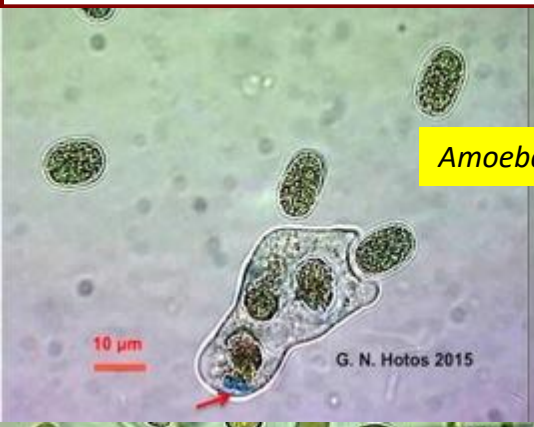
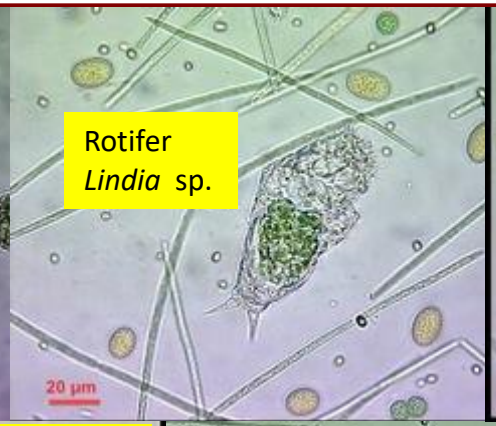
-COCCOID PLANKTONIC CYANOBACTERIA-
THEY ARE FOOD ITEMS FOR VARIOUS HETEROTROPHS

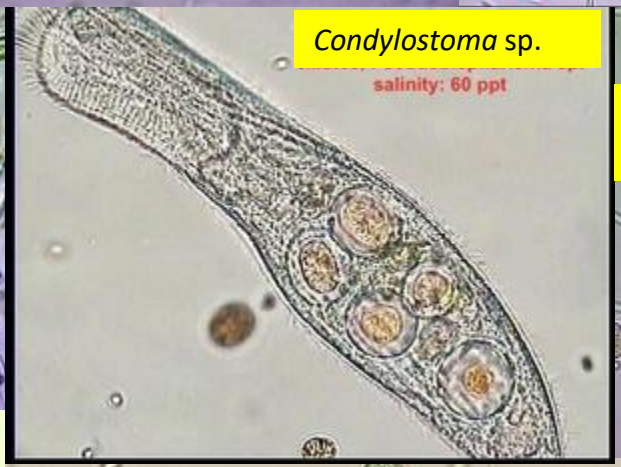


Amoeba sp.

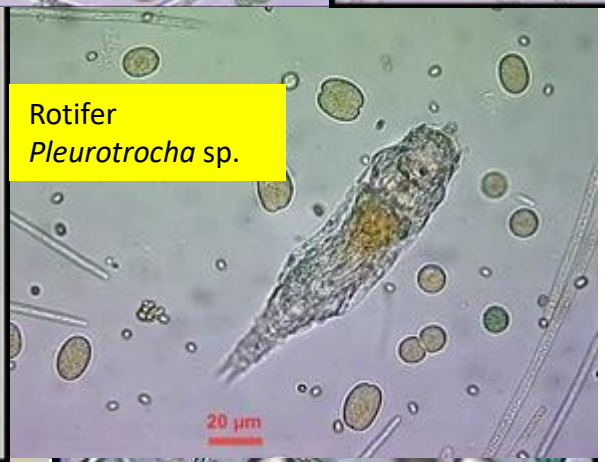


Rotifer
Lindia sp.

Frontonia sp.

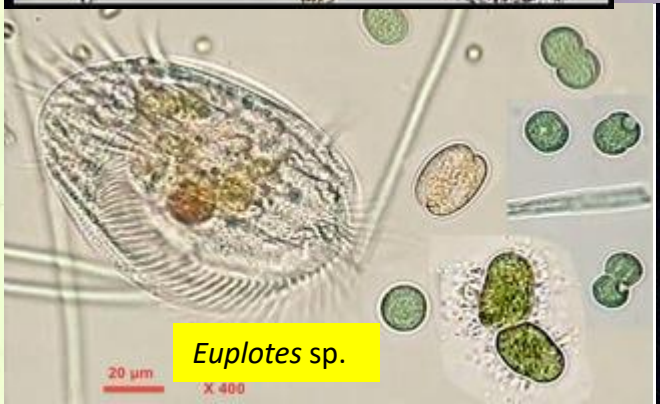


Condylostoma sp.



Rotifer
Pleurotrocha sp.

Climacostomum sp.?



Euplotes sp.

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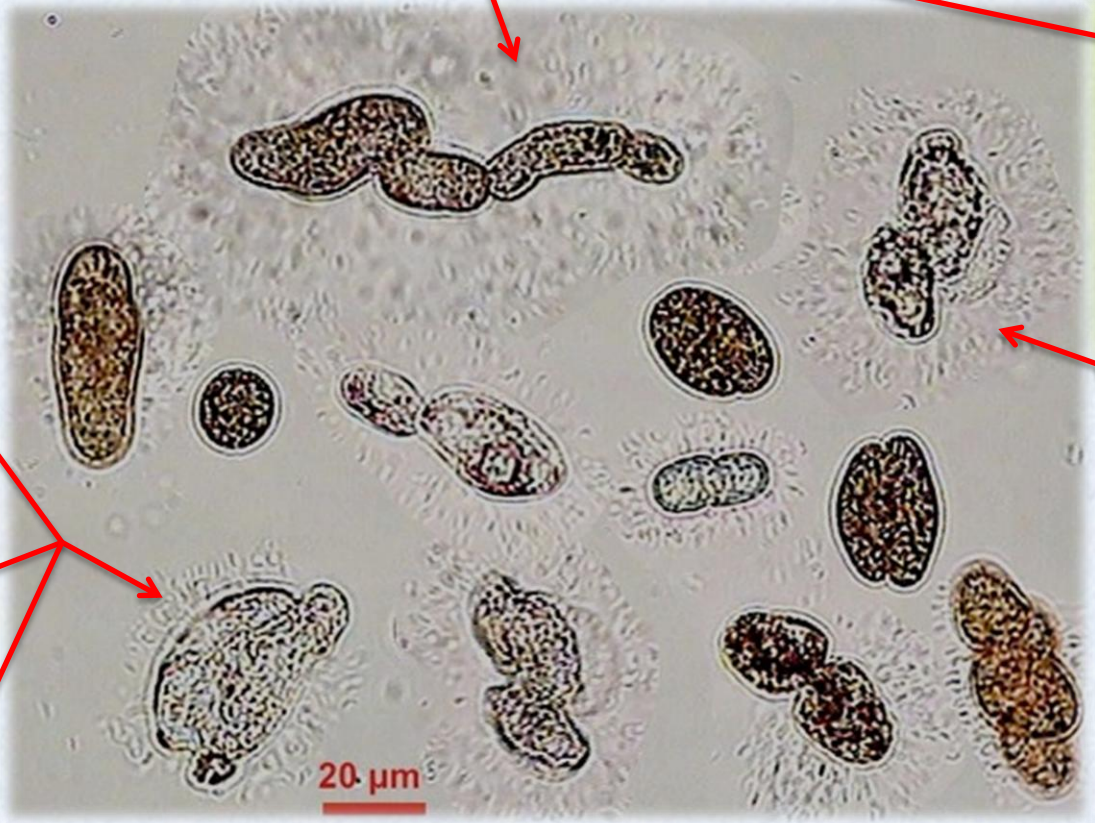
COCCOID PLANKTONIC CYANOBACTERIA PRODUCE AND SECRETE MUCILAGINOUS MATERIAL
THIS IS EVIDENT AS A SLIME "CLOUD" AROUND THE CELL



SLIME PLAYS A BIOLOGICAL ROLE IN CYANOBACTERIAL LIFE (PROBABLY BENEFICIAL) BUT **IT IS NOT GOOD** FOR THE PRODUCTION OF GOOD QUALITY SALT

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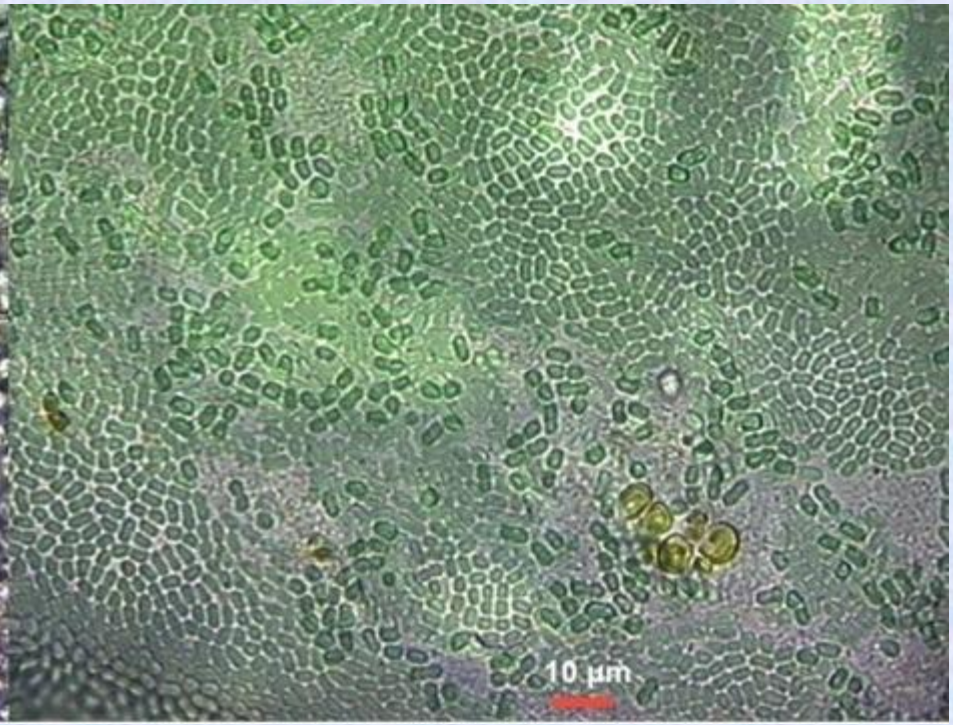
THE OTHER FORM OF UNICELLULAR COCCOID CYANOBACTERIA IS IN COLONIAL AGGREGATIONS

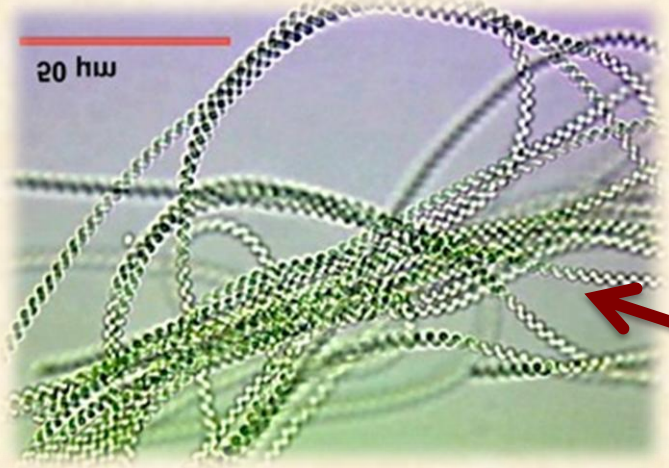
IN HYPERSALINITY THERE WERE NOT FOUND COLONIES EMBEDDED IN MUCILAGE

Microcystis sp.



Synechocystis sp.

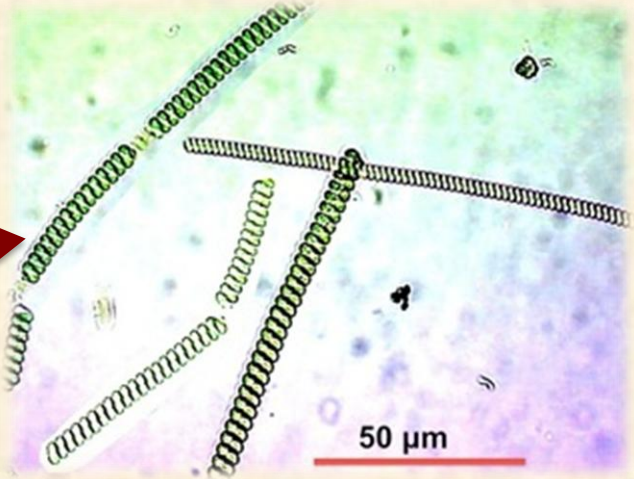
AN IMPRESSIVE NUMBER OF FILAMENTOUS CYANOBACTERIA WAS ALSO RECORDED IN PLANKTONIC CONDITION



***Arthrospira* (*Spirulina*) was of the most abundant genera**

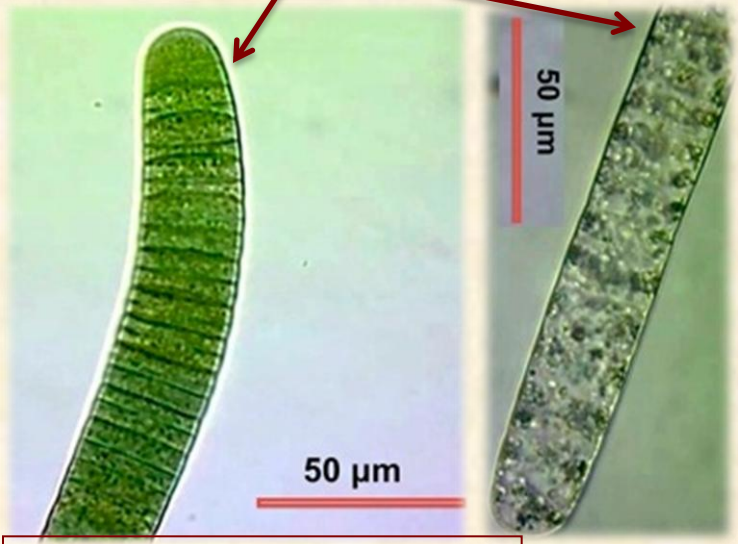
Spirulina major

Spirulina sabsalsa

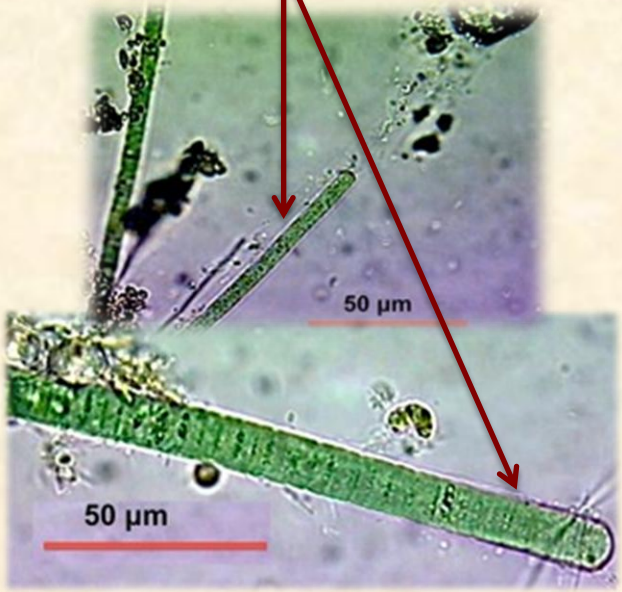


followed in abundance by:

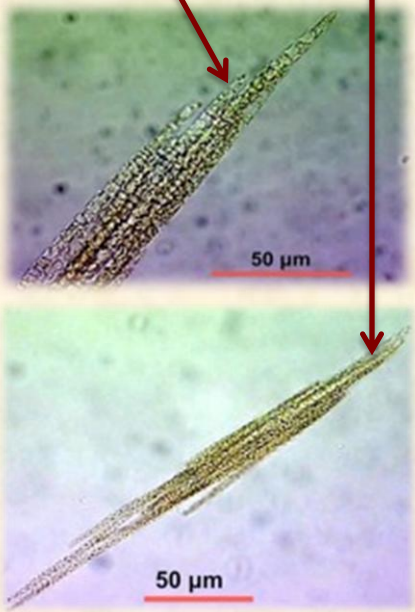
Oscillatoria



Lyngbya



Aphanizomenon



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EUCARYOTIC MICROALGAE WERE PROFOUNDLY REPRESENTED BY THE EXTREMELY HALOTOLERANT CHLOROPHYTES:

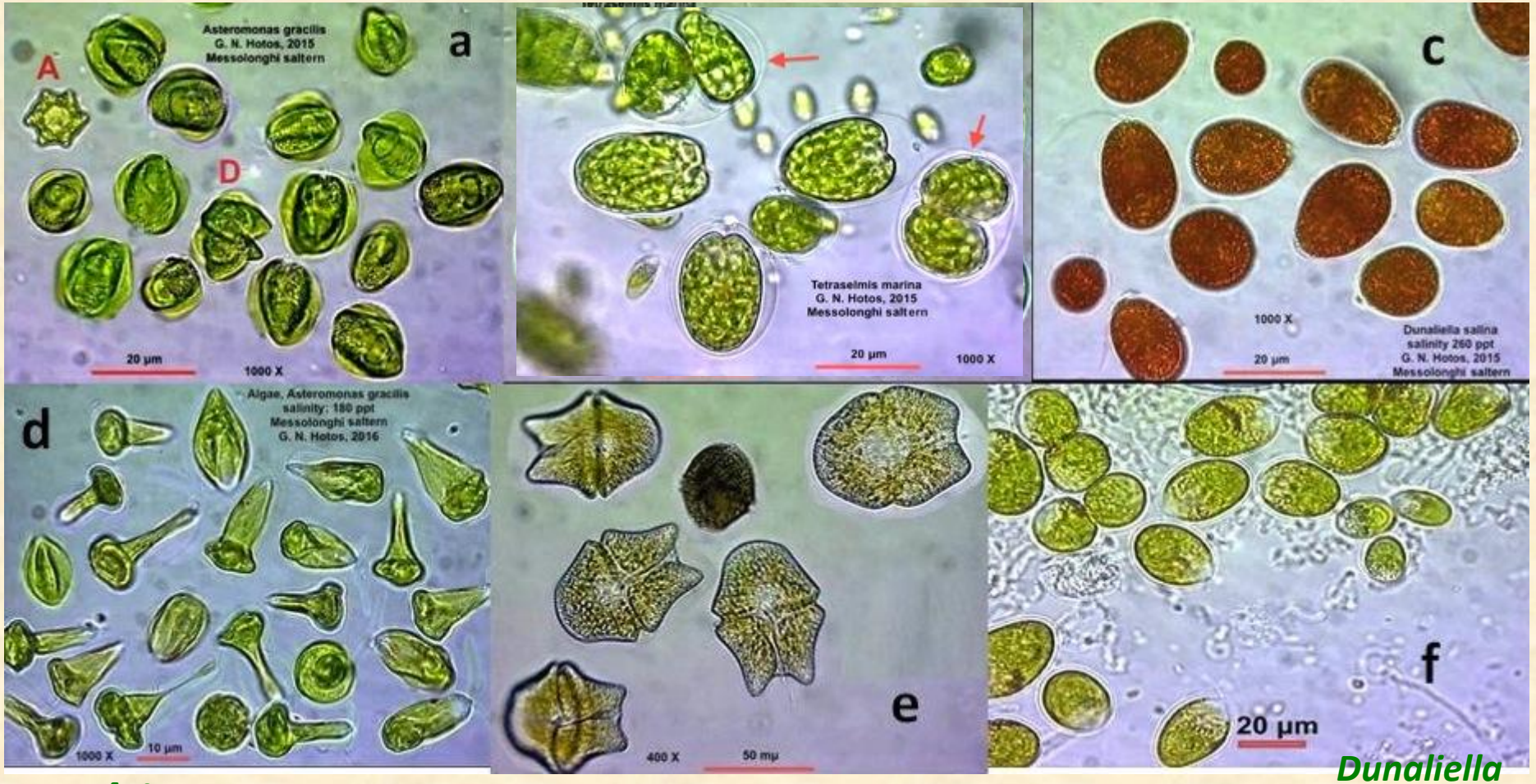
Dunaliella salina, *Asteromonas gracilis* & *Tetraselmis marina*

and the dinoflagellate *Gymnodinium* sp

Asteromonas

Tetraselmis

Dunaliella



Asteromonas

Gymnodinium

Dunaliella

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Dunaliella, *Asteromonas* & *Tetraselmis* CAN ENDURE HARSH CONDITIONS BY FORMING CYSTS FROM WHICH FLAGELLATED CELLS EMERGE AGAIN

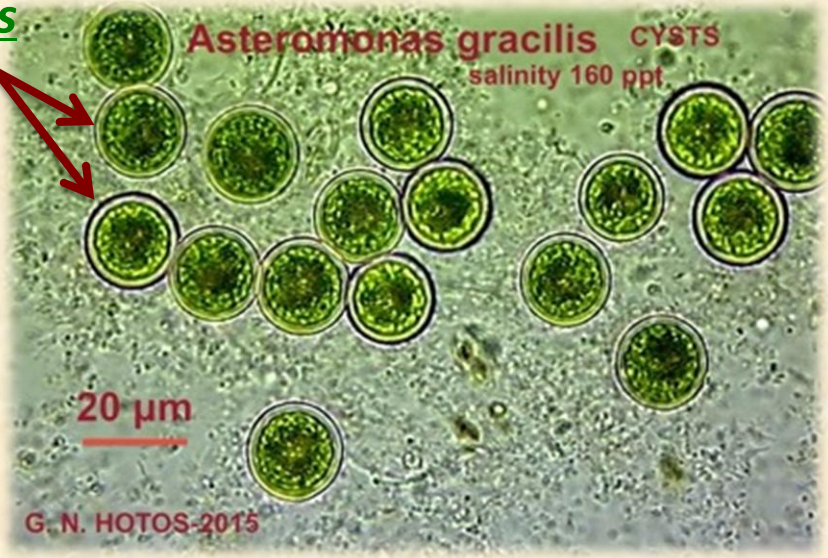
Dunaliella salina

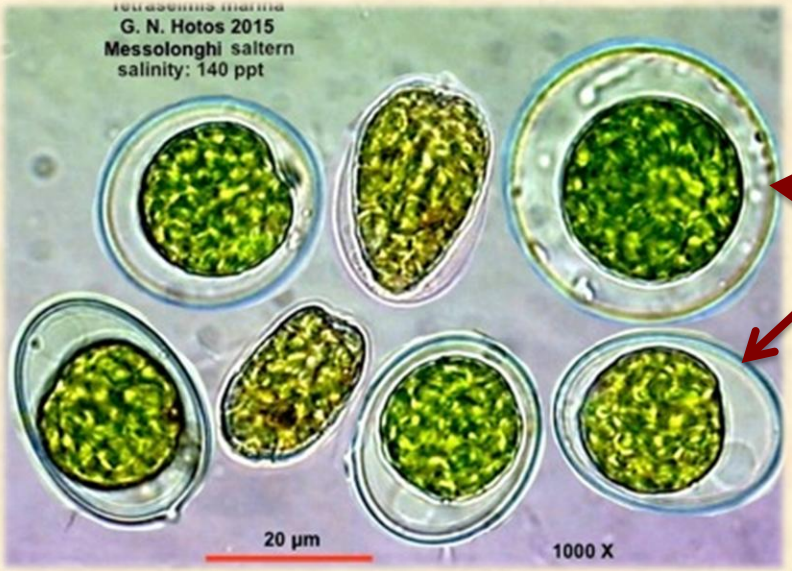
cysts

vegetative cells

Asteromonas gracilis

cysts





Tetraselmis marina

palmelloid cysts

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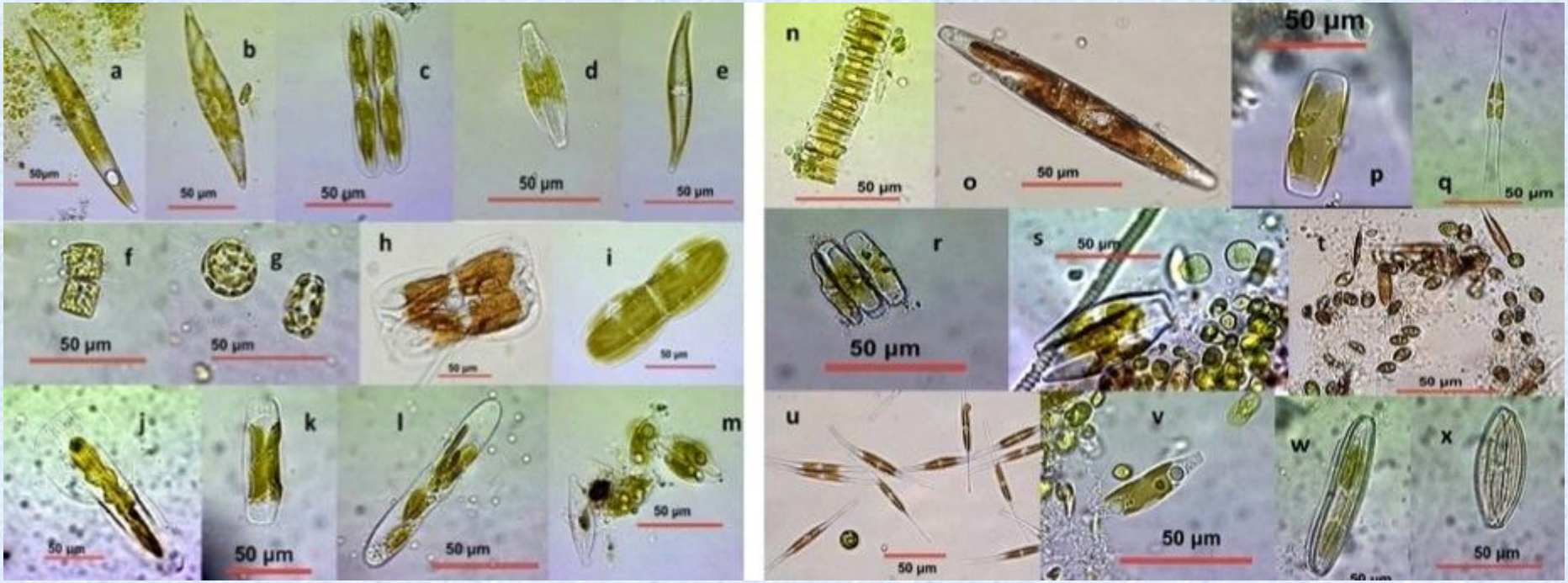
DIATOMS (PROTISTA: BACILLARIOPHYTA) WERE NEXT IN ABUNDANCE OF PHOTOSYNTHETIC SPECIES. ONLY PENNATE DIATOMS AND NOT CENTRIC WERE FOUND

MOST OF THE DIATOMS WERE BENTHIC BUT WERE PRESENT ALSO IN THE PLANKTON

BASED ON THEIR MORPHOLOGY THERE ARE PROBABLY MANY ENDEMIC STRAINS

AN EXTENDED STUDY SHOULD BE MADE FOR THE DIATOMS IN HYPERSALINITY



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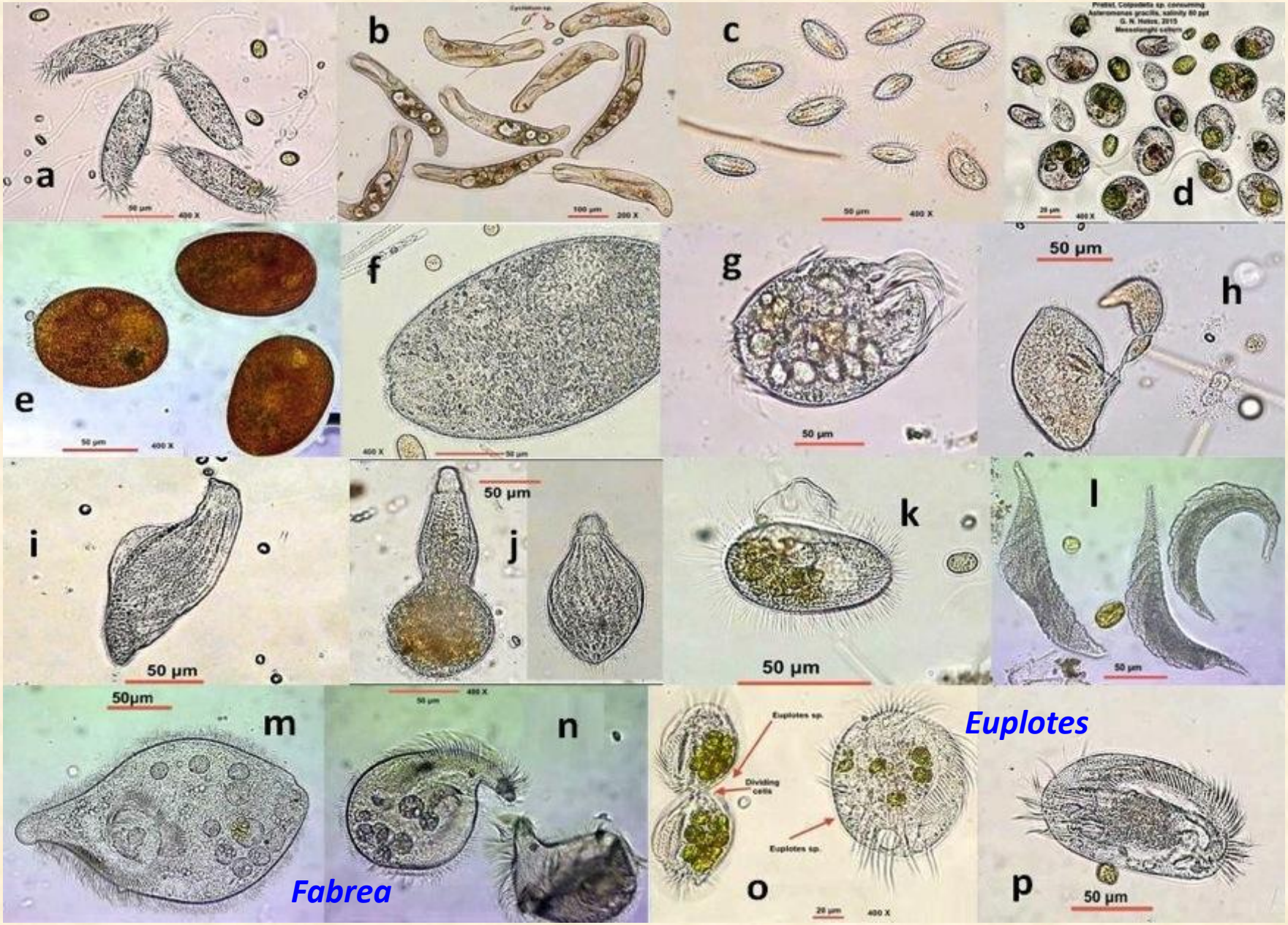
CILIATE PROTOZOA WERE PRESENT IN ABUNDANCE AND SPECIES RICHNESS FOUND IN ALL SALINITIES – MOST ABUNDANT *Euplotes* sp & *Fabrea salina*



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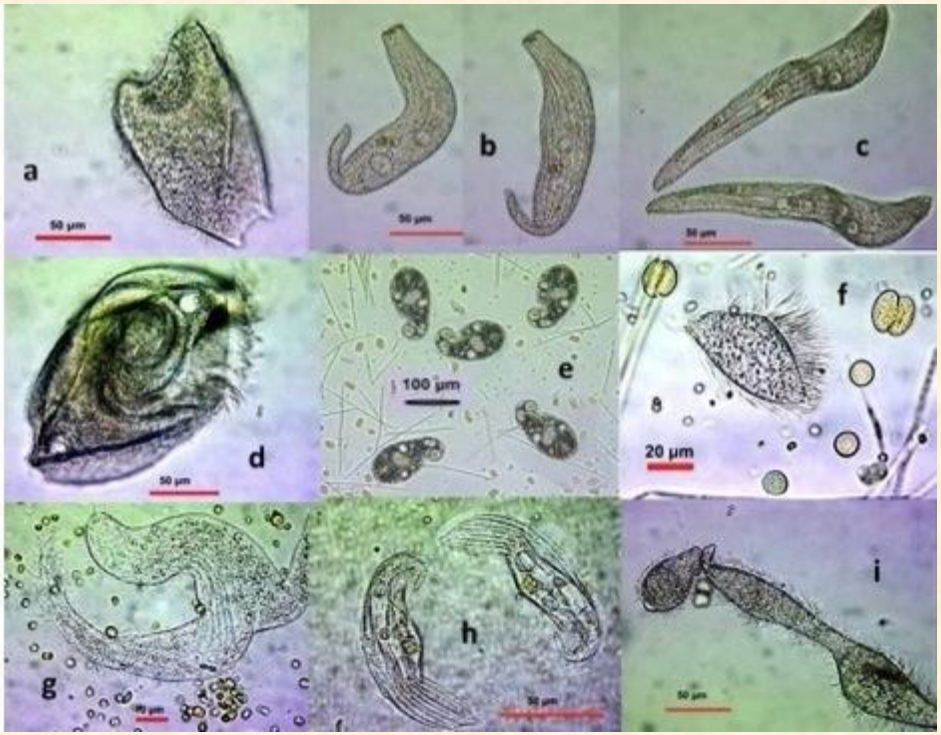
FROM THE COLLECTED PROTISTS, MANY SPECIMENS WERE TOTALLY UNMATCHED TO THE EXISTED IMAGES FOUND IN THE LITERATURE

IT IS PROBABLE THAT NEW SPECIES CAN BE DESIGNATED AFTER SPECIAL STUDIES



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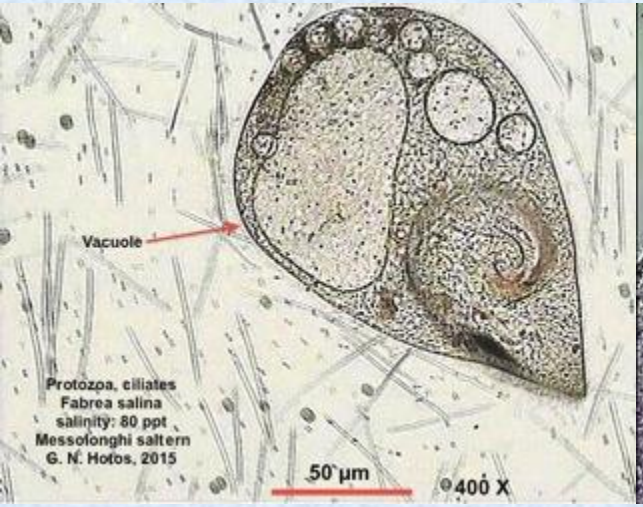
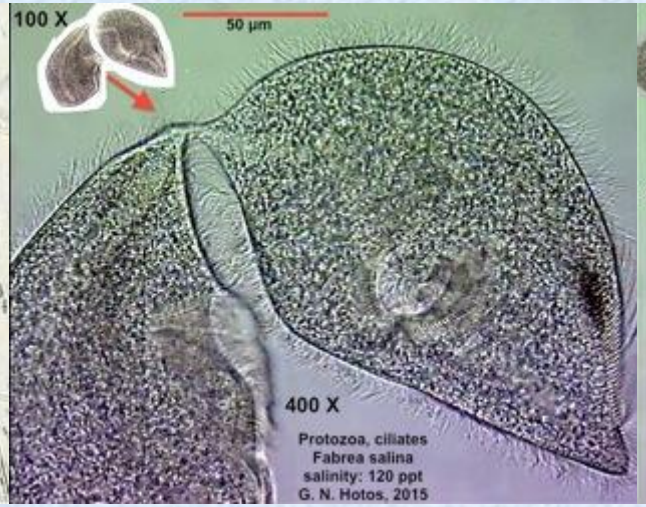
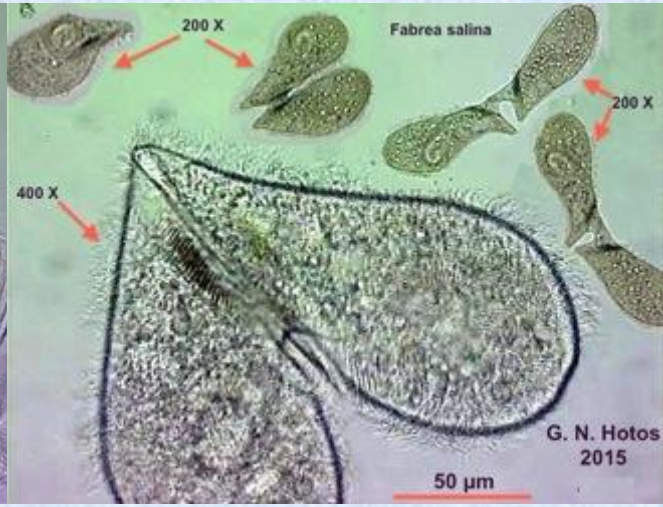
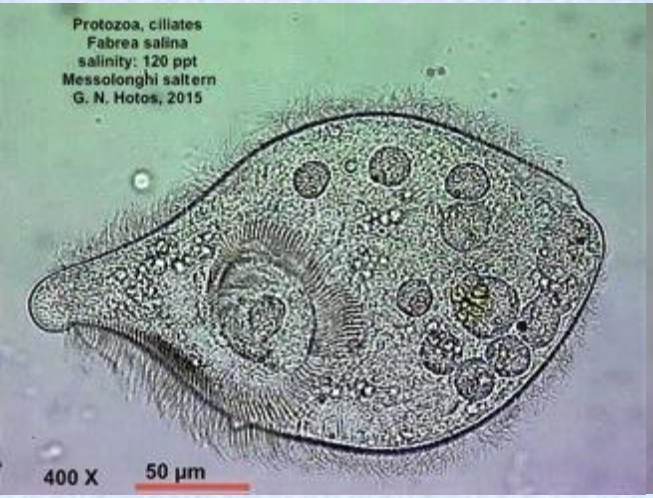
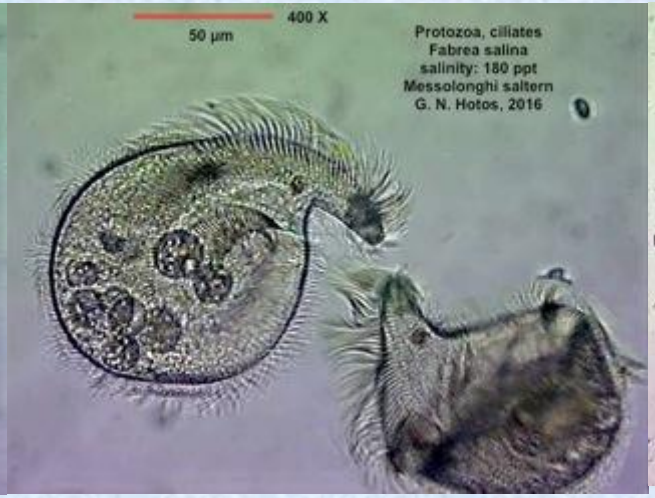
AMONG CILIATES *Fabrea salina* IS THE DOMINANT SPECIES FOUND EVEN AT 200 ppt SALINITIES
IT'S A BIG CILIATE 200-300 µm
CAN BE USED AS LIVE FOOD IN MARINE FISH HATCHERIES

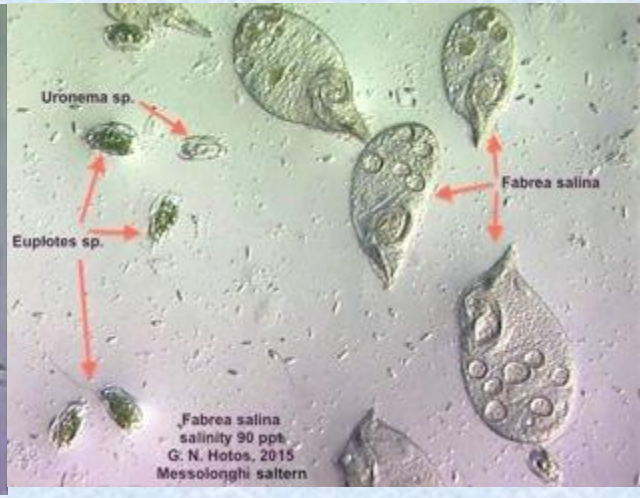












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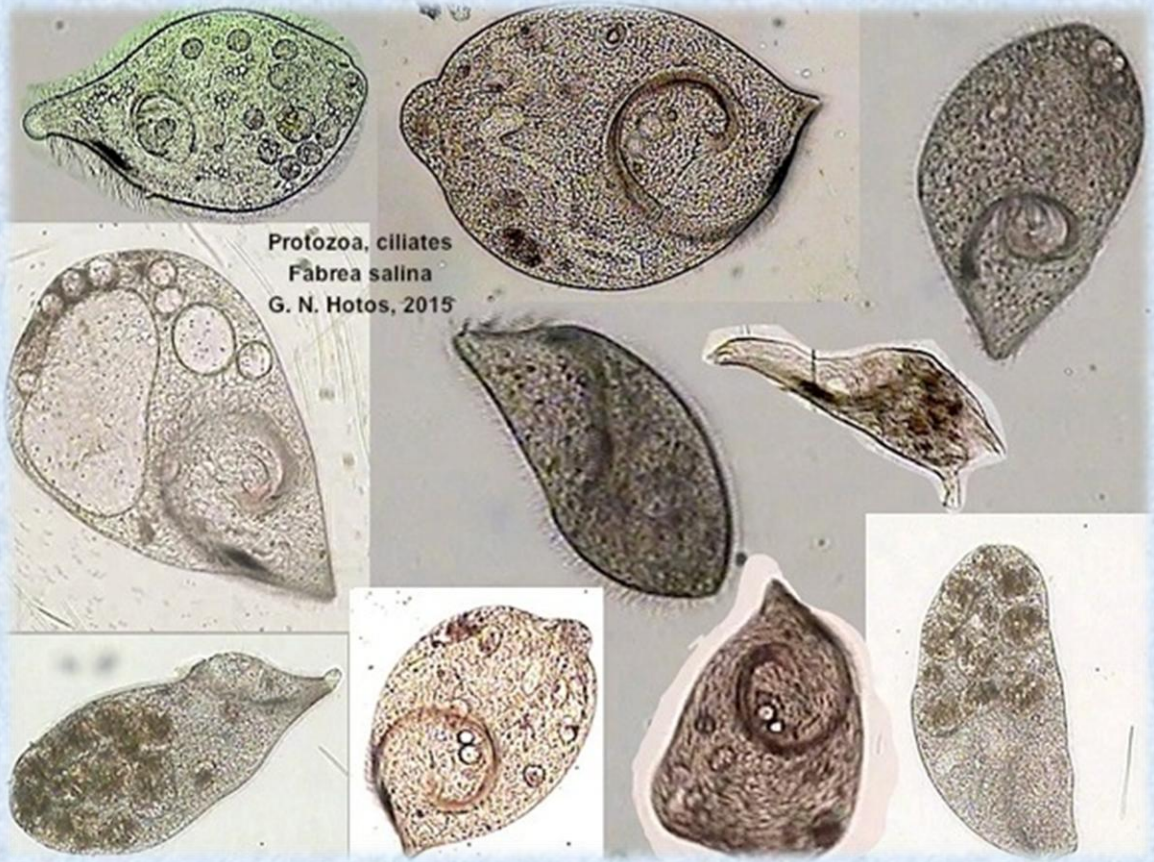
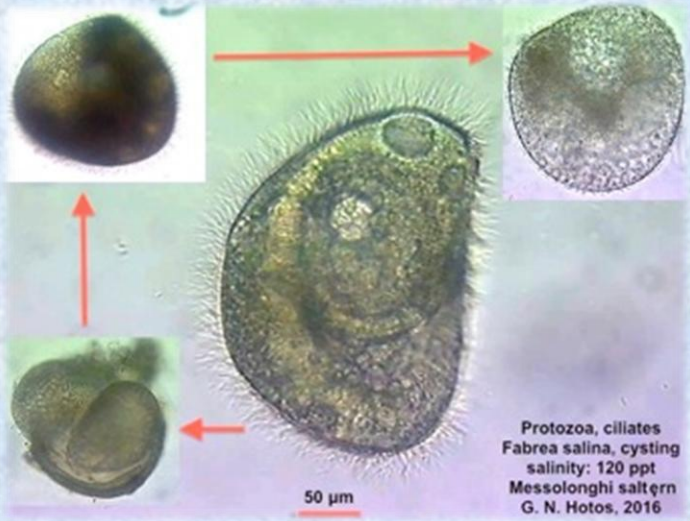
Fabrea salina **EXHIBITS AN AMAZING PLASTICITY IN CELL MORPHOLOGY**

THE REASON FOR THAT REMAINS UNKNOWN

IT IS PROBABLY A RESULT OF ITS OSMOREGULATION





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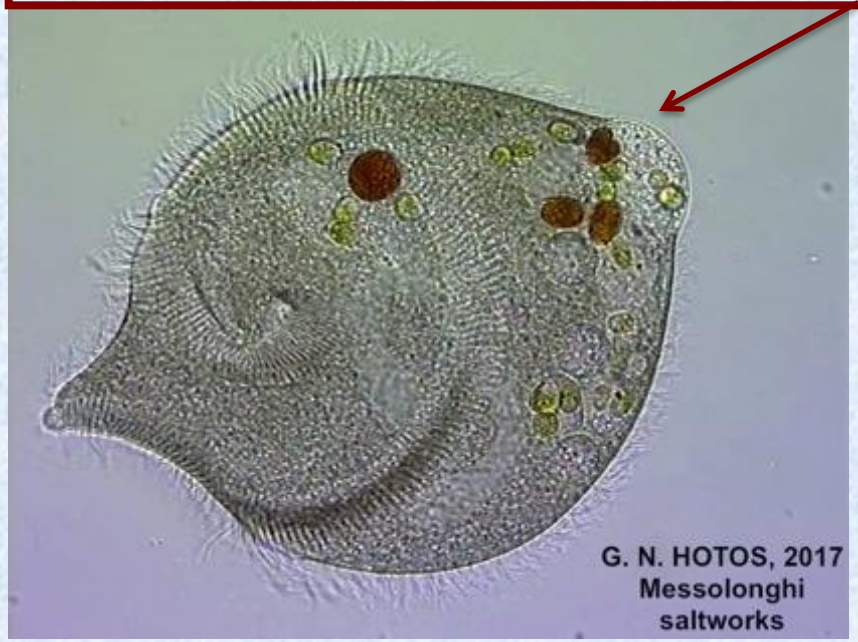
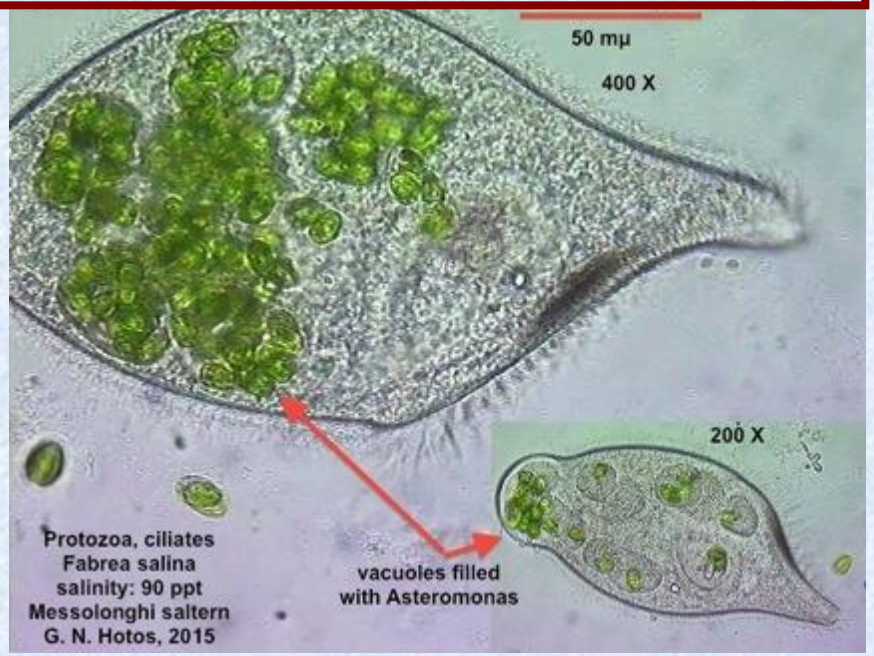
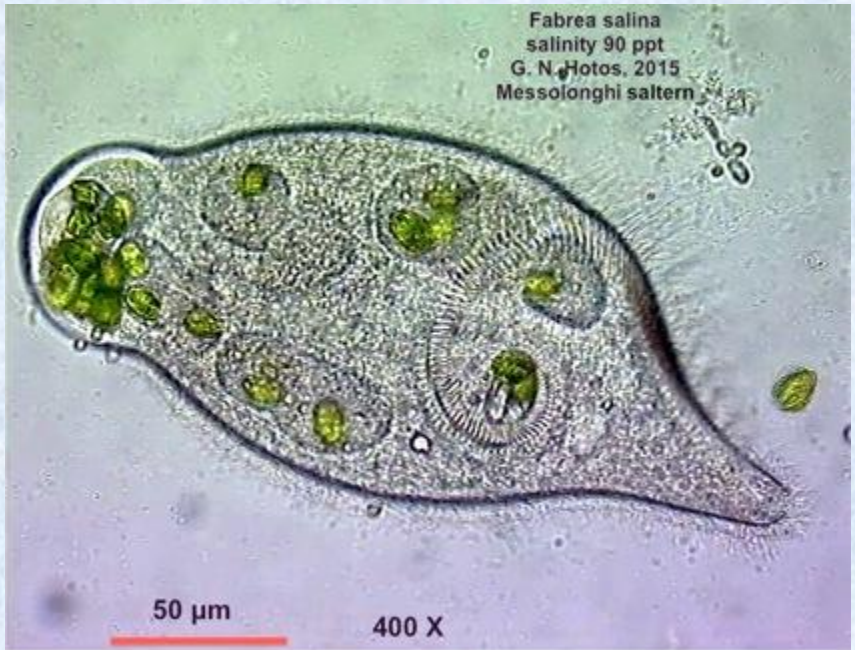
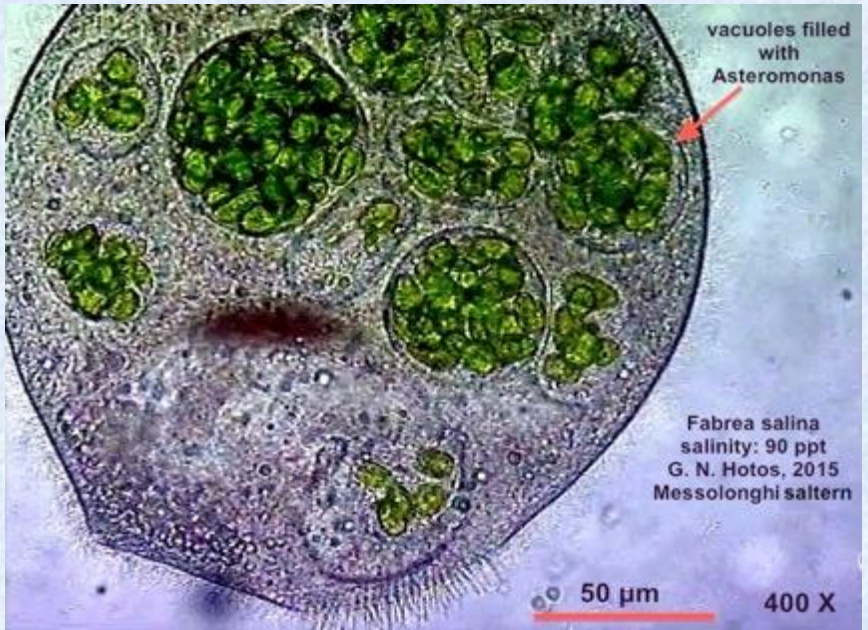
Fabrea salina IS A VORACIOUS CONSUMER OF MICROALGAE INCLUDING *Dunaliella salina*









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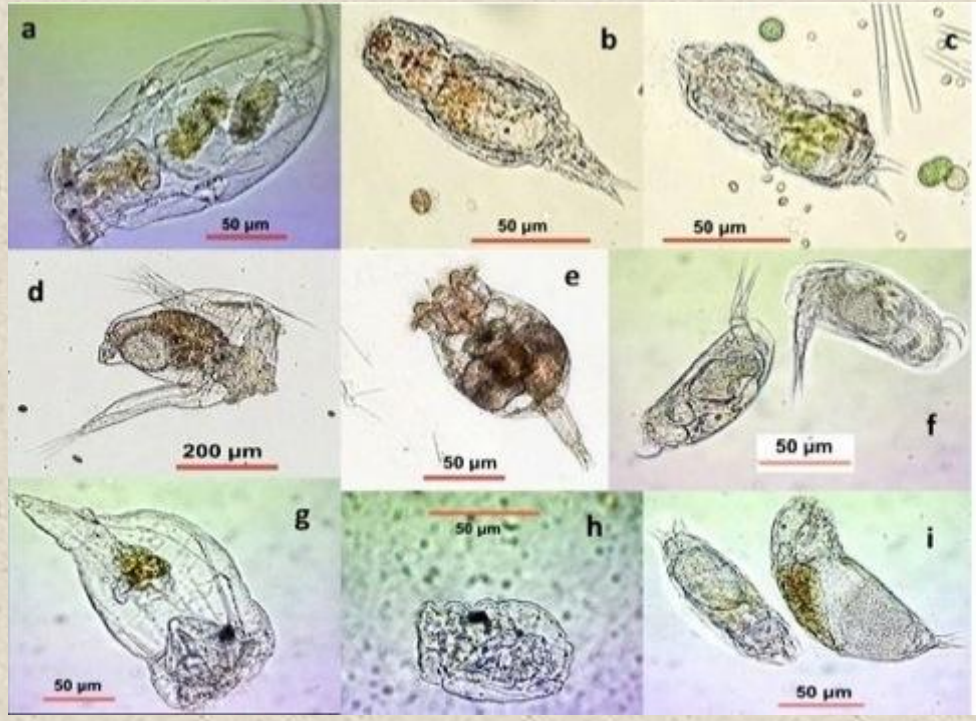
A LOT OF METAZOANS MAINLY ROTIFERS, COPEPODS AND OF COURSE ARTEMIA WERE FOUND IN HYPERSALINITY

EXCEPT FOR ARTEMIA, THEIR BIOLOGICAL ROLE IN PRODUCTIVITY OF THE SALTERNS IS TO BE ELUCIDATED – THEY ALL CAN BE USED AS LIVE FOOD IN HATCHERIES

ROTI



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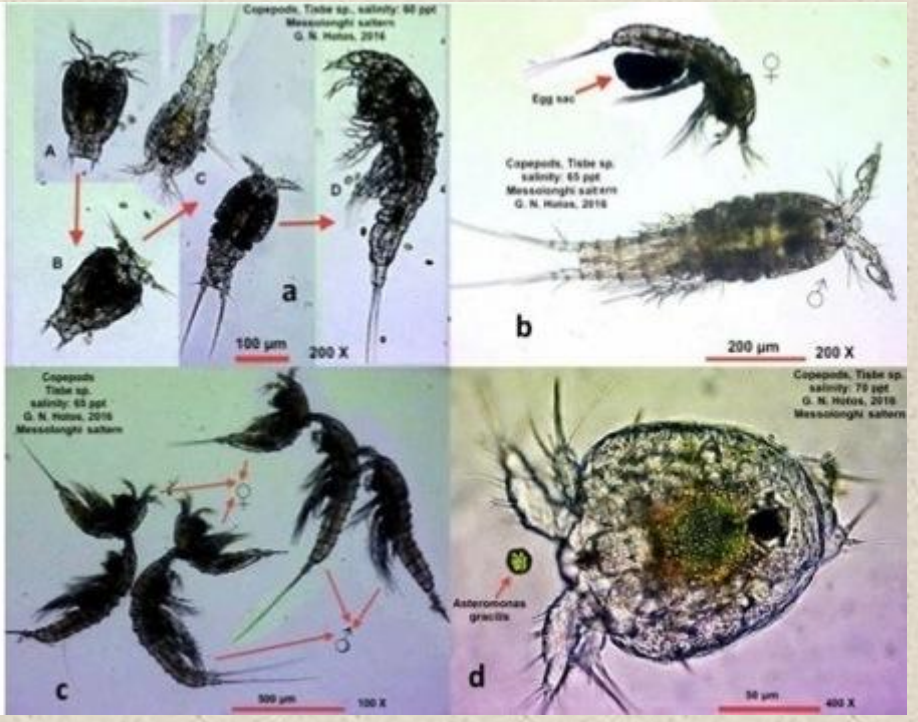
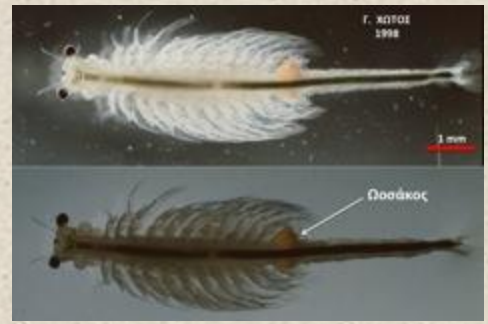


ARTE



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MANY ORGANISMS IN HYPERSALINITY CAN REMAIN FOR LONG PERIOD IN THE SEDIMENT IN CRYPTOBIOSIS BY MEANS OF ENCYSTMENT OR RESTING EGGS

THIS IS THEIR MODE OF SURVIVAL CONFRONTING DESICCATION