Effect of summer eutrophication on the coastal zooplankton community composition along the Iberian Alborán Sea

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Aims

Mediterranean Marine Pollution Assessment and Control Programme (MED POL), derived from the Convention of Barcelona.

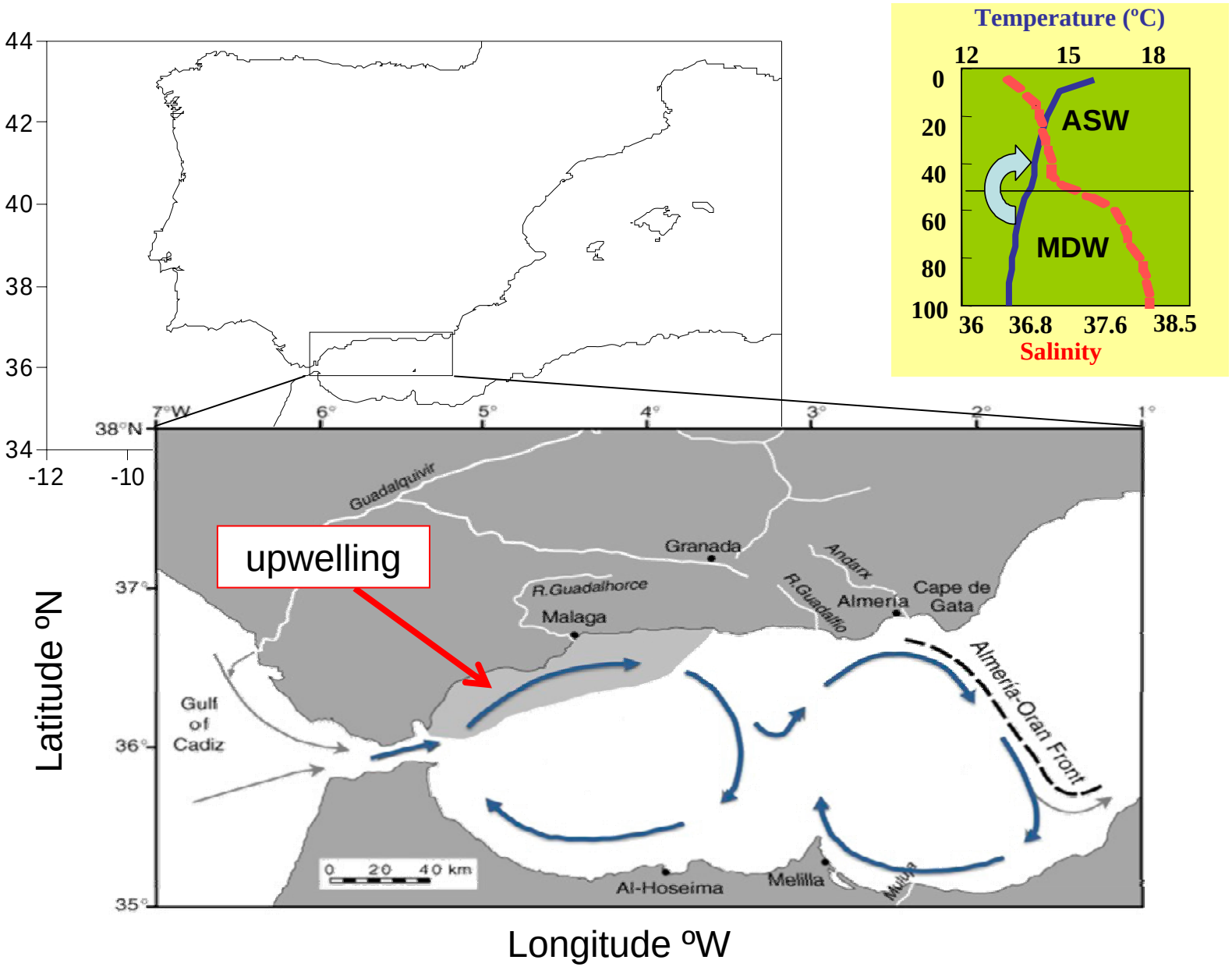
"Eutrophication Monitoring Strategy of MED POL" (UNEP(DEC) WG.231/14. Phase IV: ecosystem approach.

Evaluation of the eutrophication status on the Iberian coastal Mediterranean: Spatial distribution and temporary tendencies of eutrophication indicators.

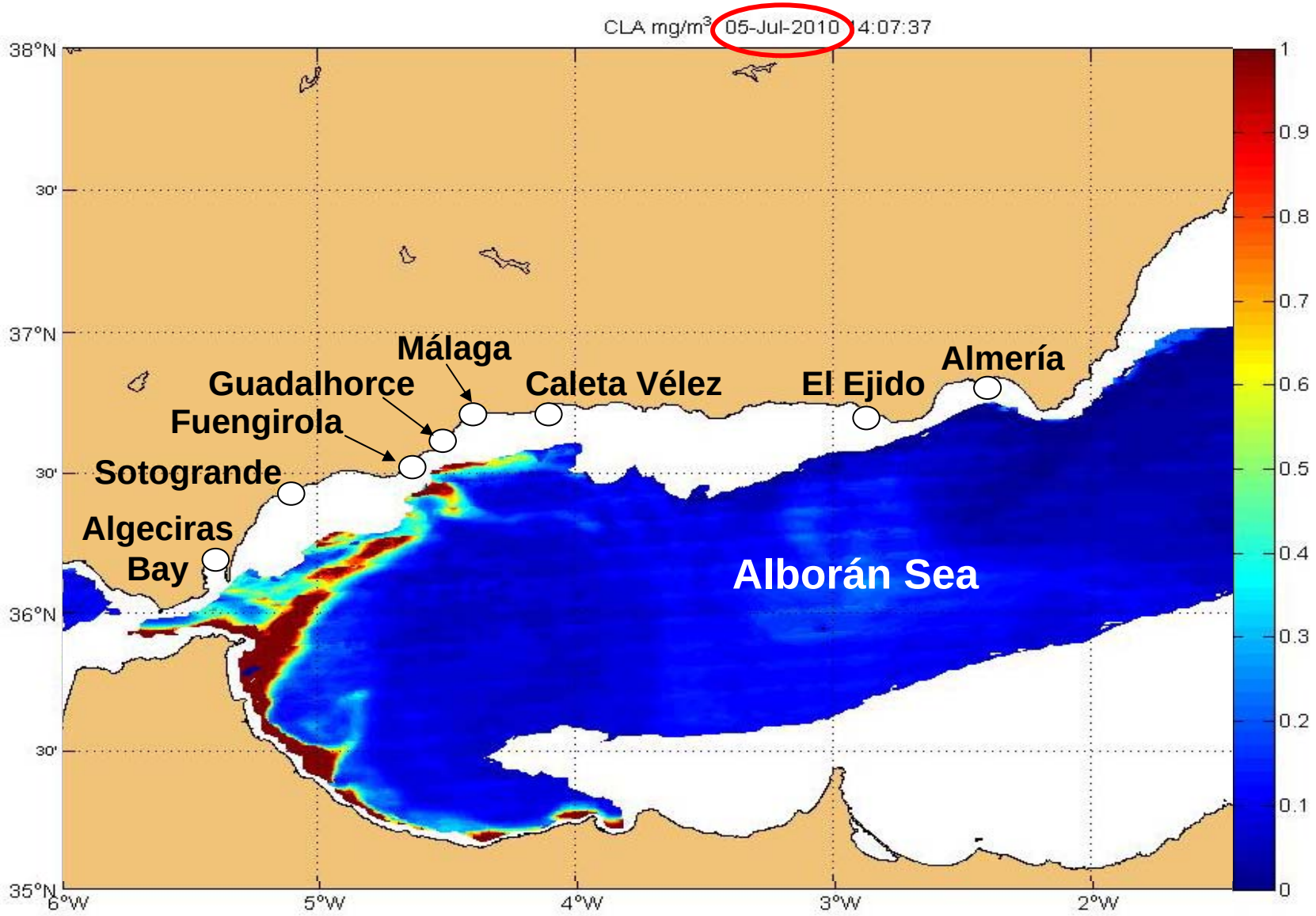
- Identify areas affected by eutrophication

- Start a monitoring program of the quality of selected coastal hotspots

Study Area

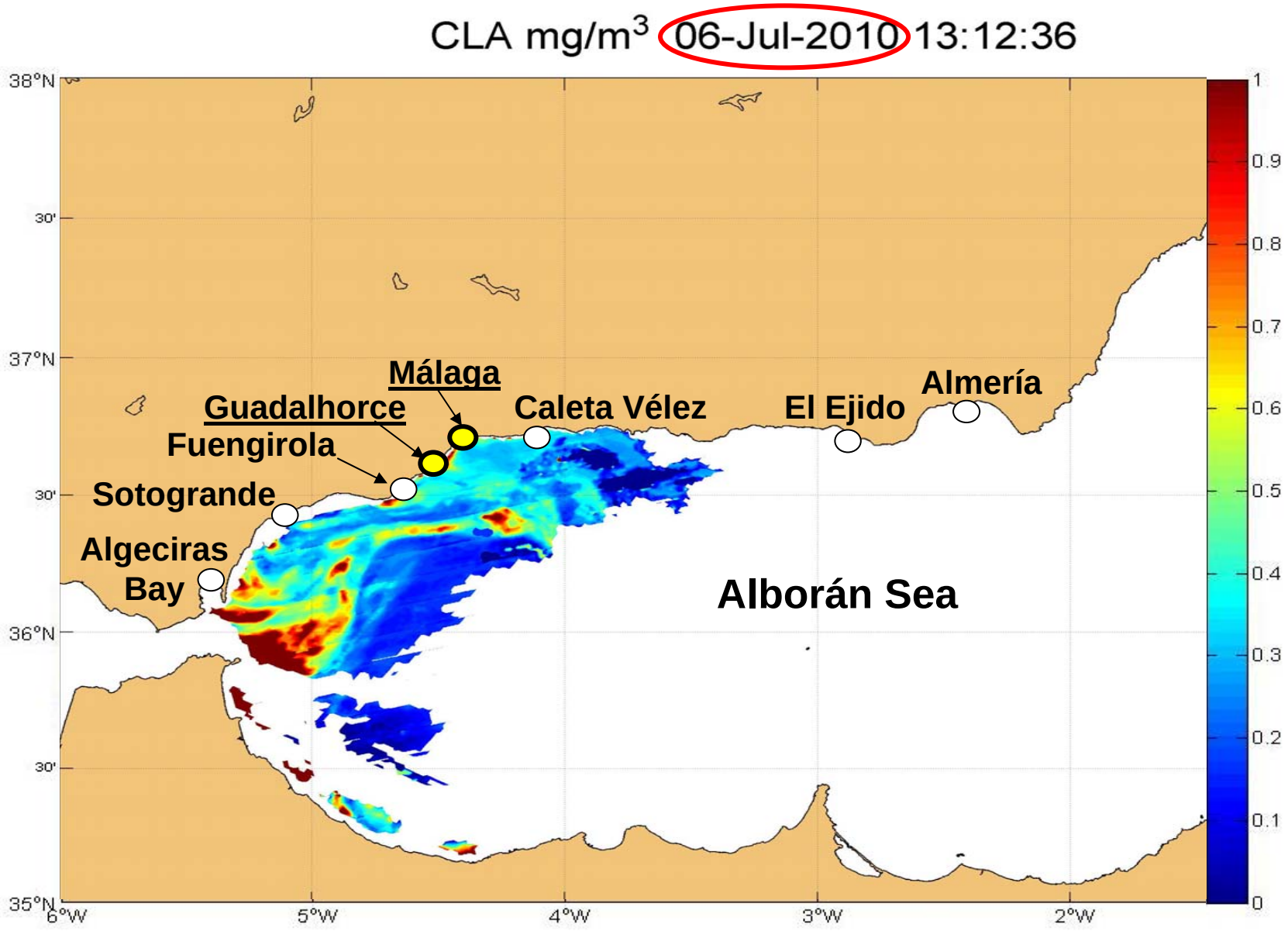

Temperature (ºC)
12
15
18
0
20
40
60
80
100
ASW
MDW
36
36.8
37.6
38.5
Salinity
44
42
40
38
36
34
-12
-10
7ºW
6º
5º
4º
3º
2º
1º
38ºN
37º
36º
35º
upwelling
Guadalquivir
Granada
Andarx
R.Guadalhorce
Malaga
R.Guadalfeo
Almería
Cape de Gata
Almería-Oran Front
Gulf of Cadiz
0 20 40 km
Al-Hoseima
Melilla
Latitude ºN
Longitude ºW

Hydrography



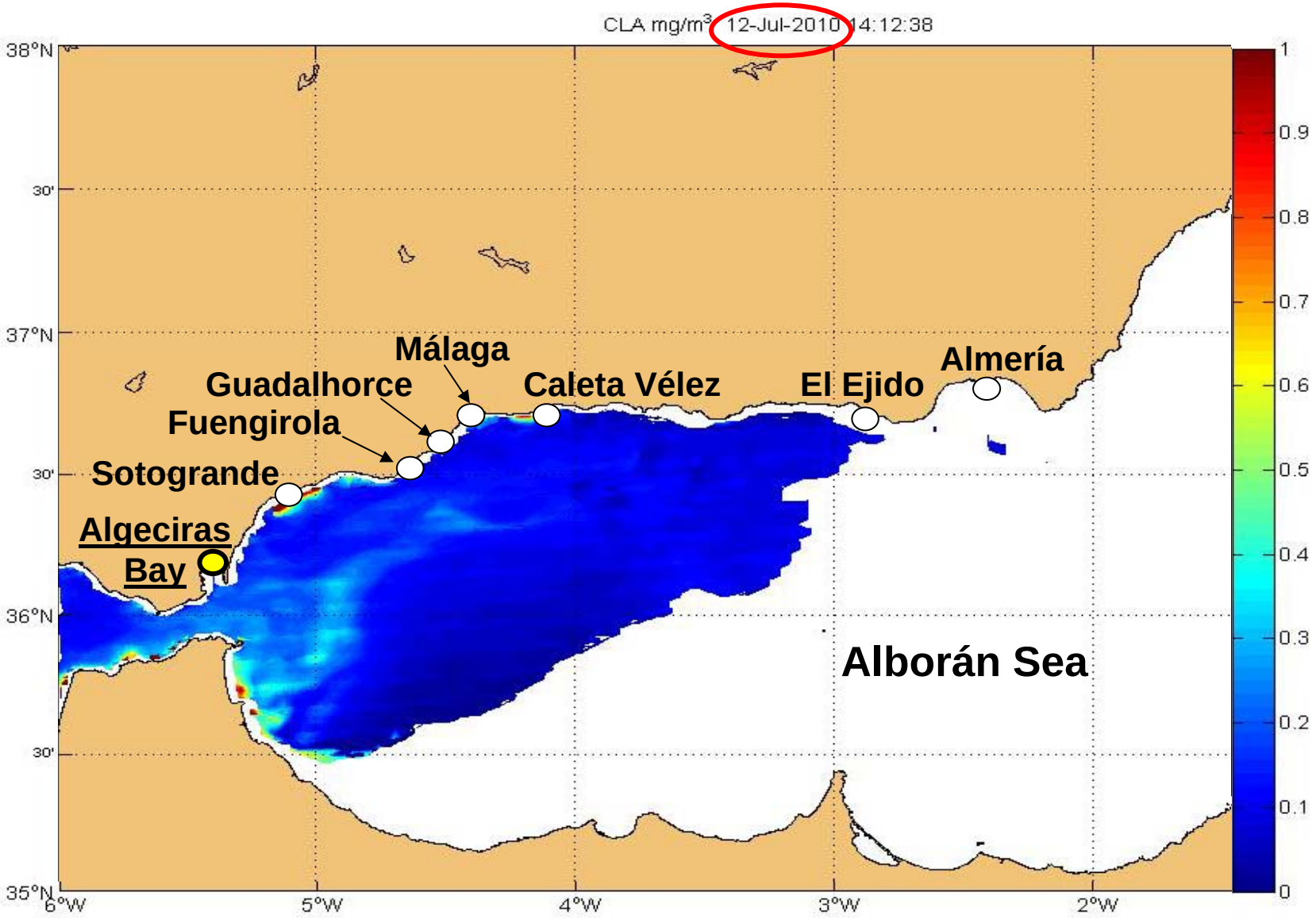
1 day before the cruise

Hydrography



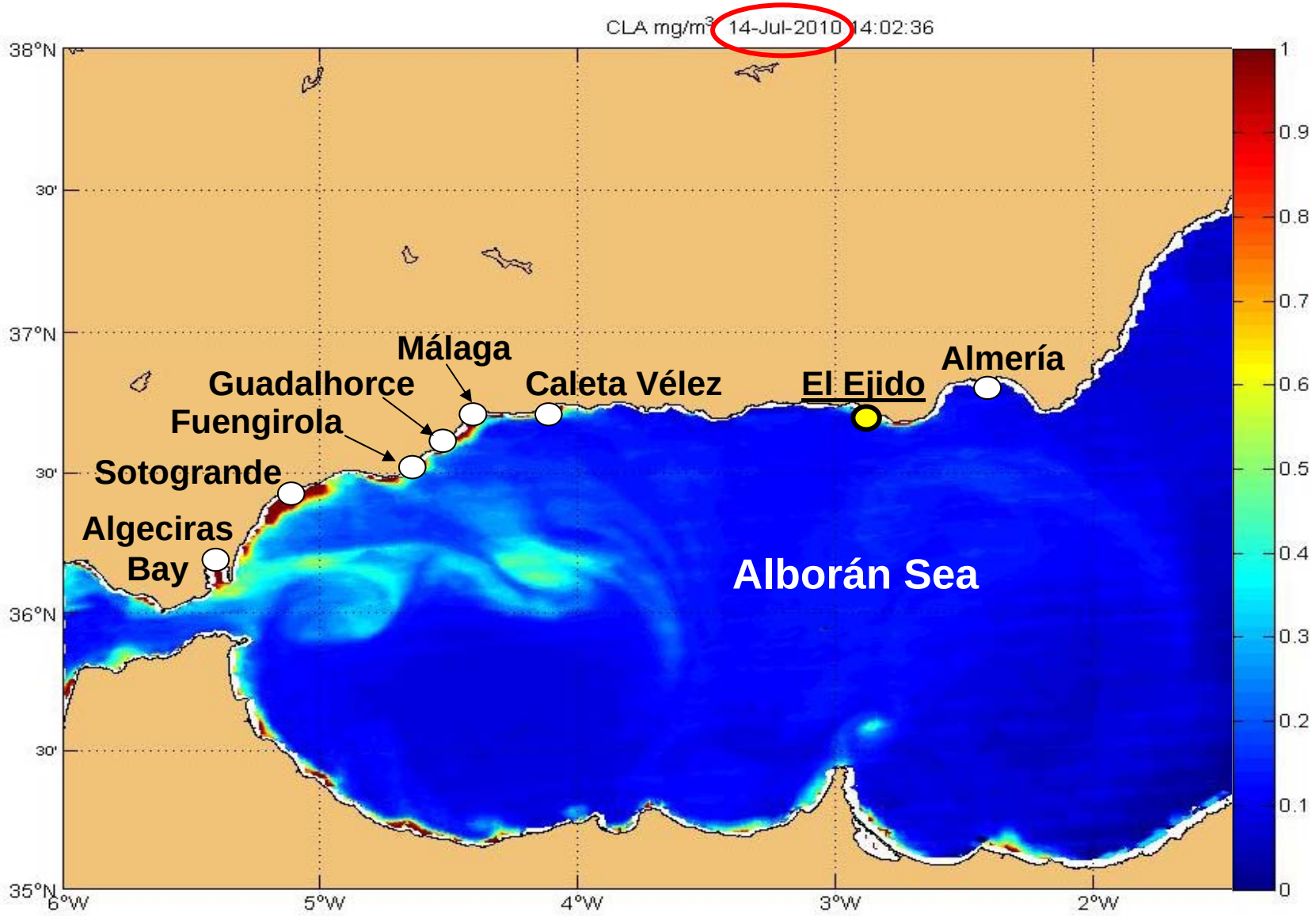
1st day of the cruise

Hydrography



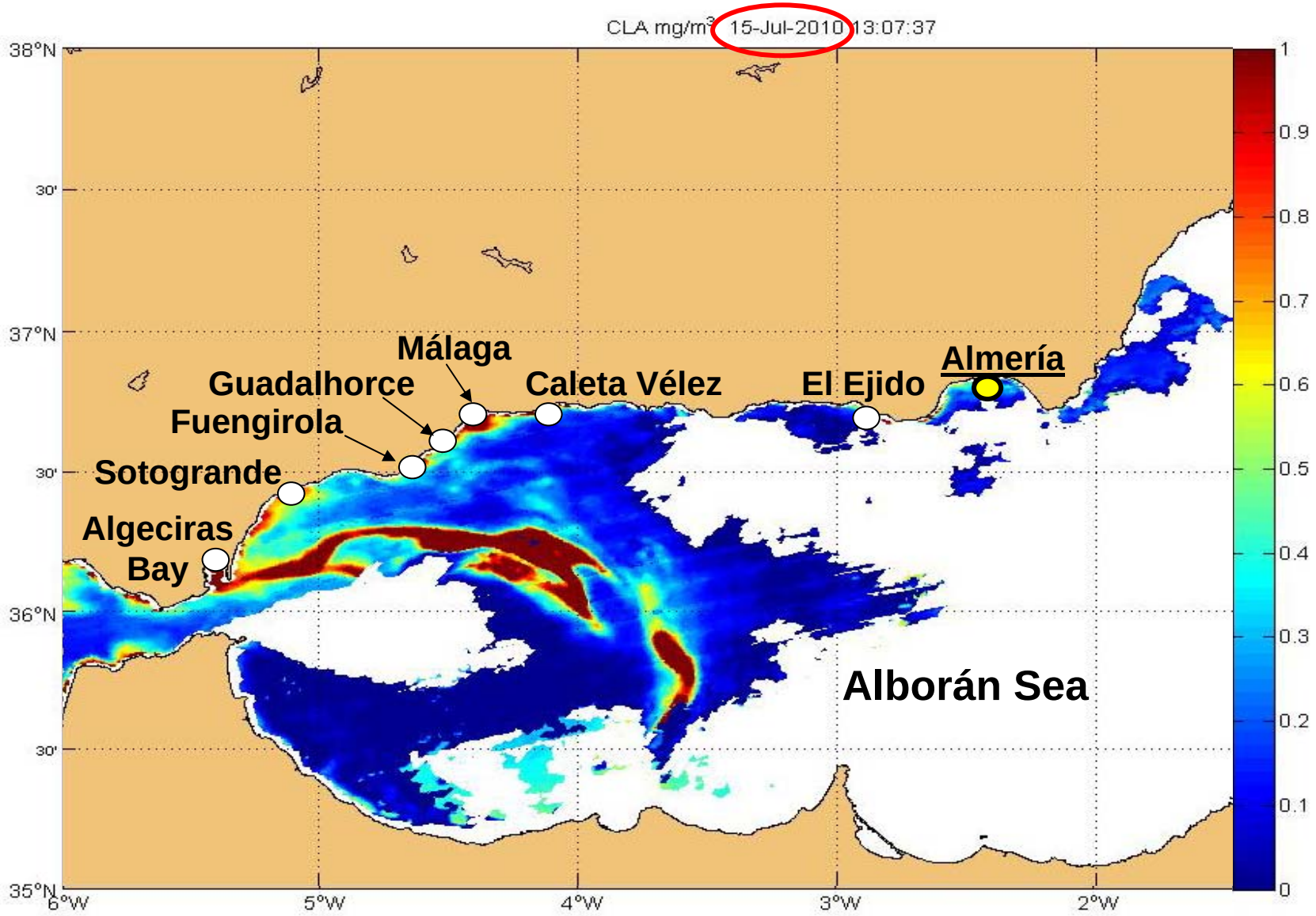
+6 days later

Hydrography



+2 days later

Hydrography



+1 day later

Eutrophication (MED POL)

TRIX index (Volleinder et al. 1998):

Deviation of normal values of nutrients, O_2 and Chl as index of eutrophication.

$$TRIX = k/n \sum_{i=n} (M - L)/(U - L)$$

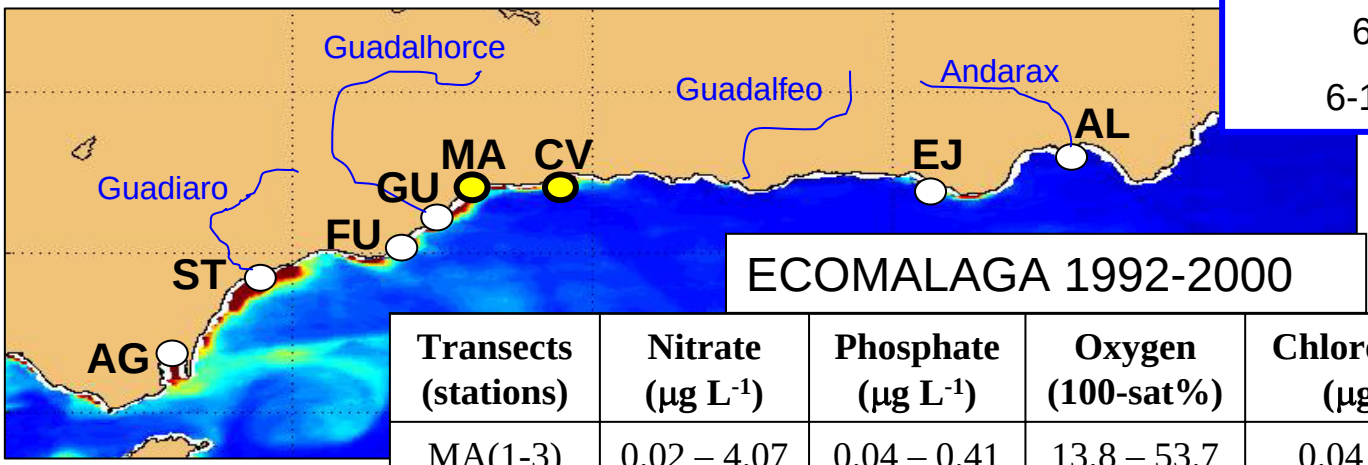
Environmental quality

0-4 high

4-5 good

6 moderate

6-10 degraded

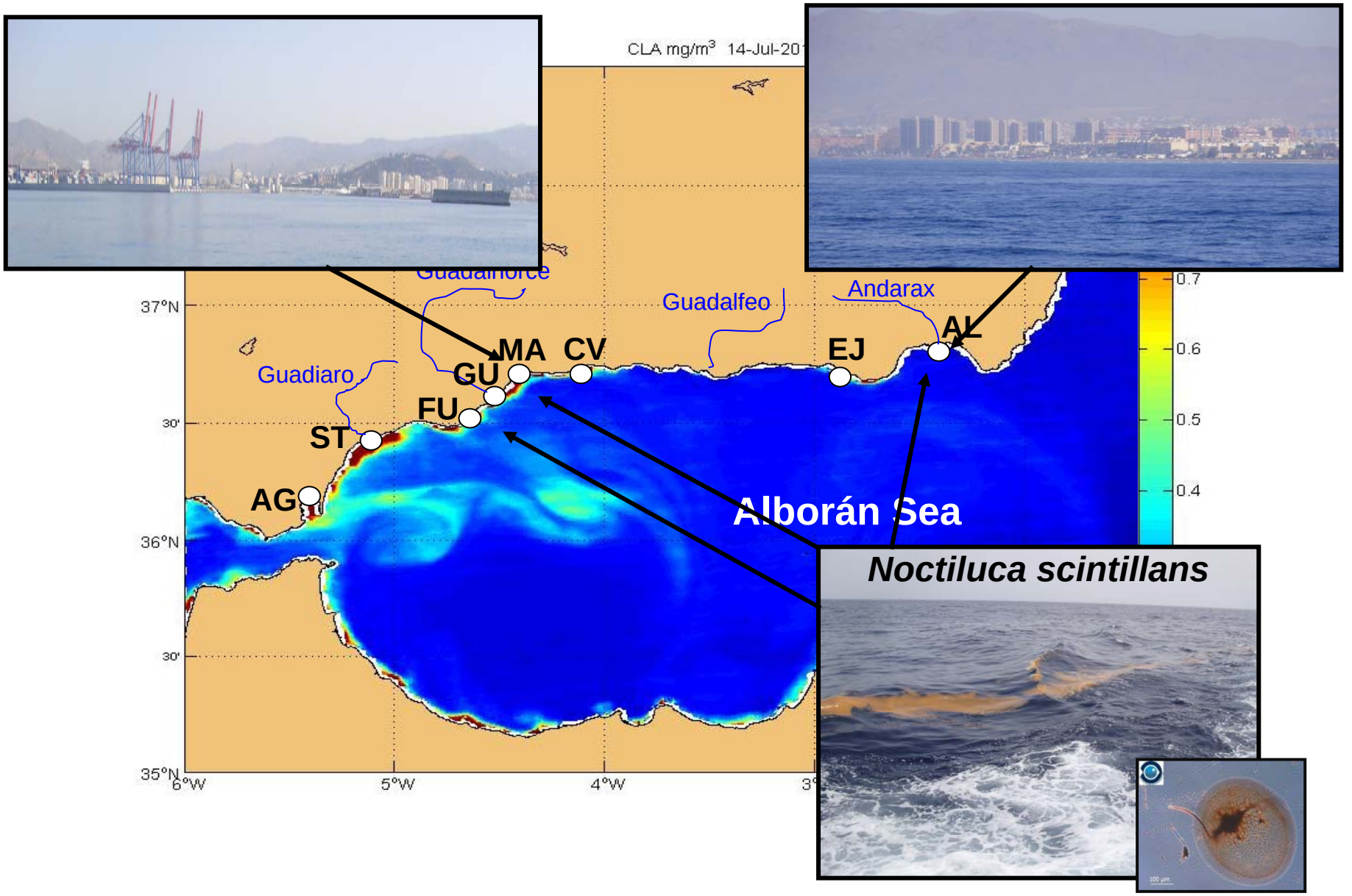


ECOMALAGA 1992-2000

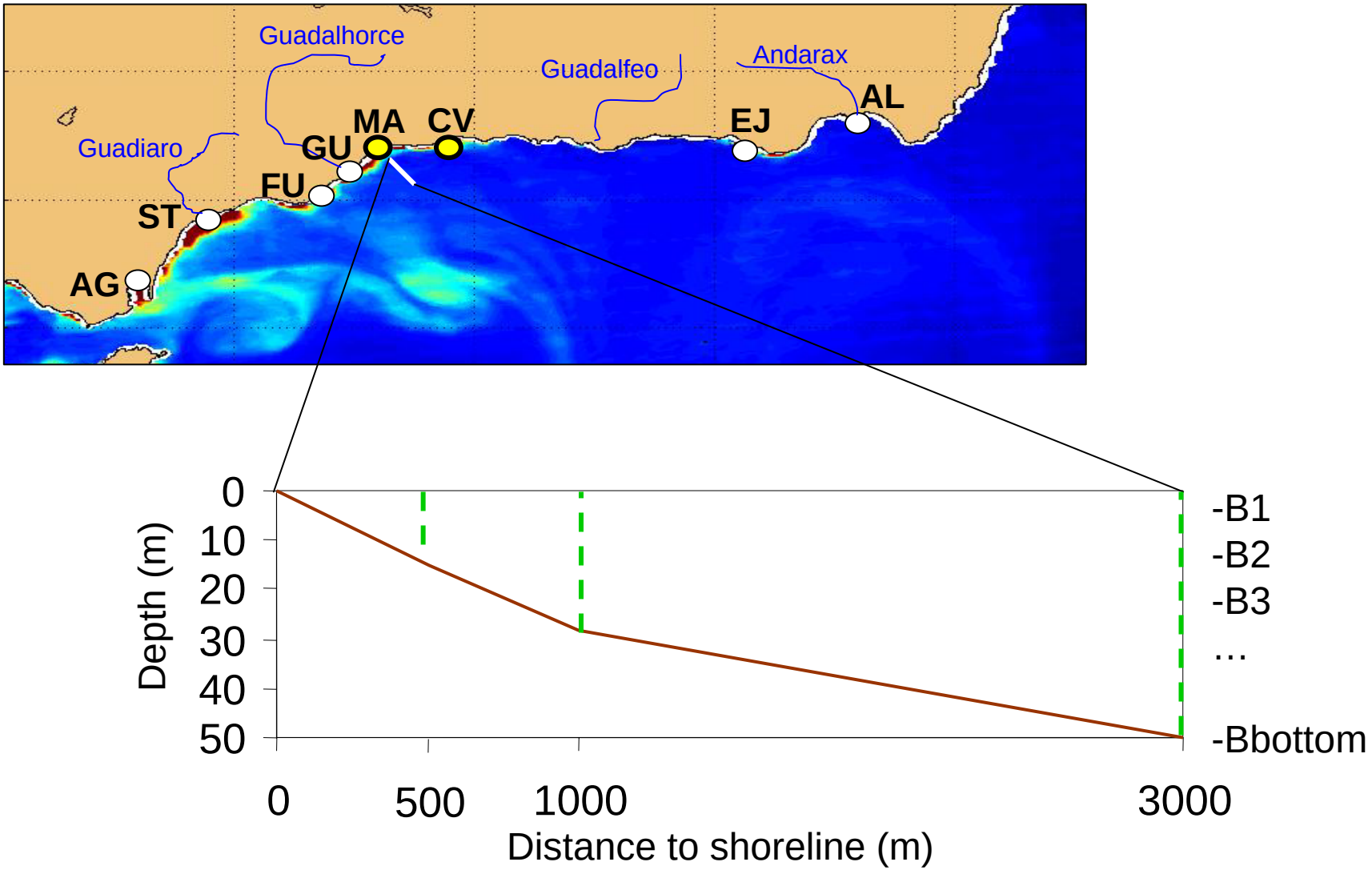
Transects (stations)	Nitrate (μg L^{-1})	Phosphate (μg L^{-1})	Oxygen (100-sat%)	Chlorophyll *a* (μg L^{-1})	TRIX
MA(1-3)	0.02 – 4.07	0.04 – 0.41	13.8 – 53.7	0.04 – 7.94	**5-6 (9.9)**
CV(1-3)	0.02 – 5.49	0.04 – 0.45	10.9 - 64.6	0.05 – 7.08	**4-5 (0.3)**

In the rest of the study area the “normal values” are unkown.

Coastal environment



Sampling design (MED POL)



Variables analysed

CTD, LICOR, Secchi disc

Temperature, salinity, fluorescence, PAR, turbidity, transparency & dissolved Oxygen

Niskin bottles (10L)

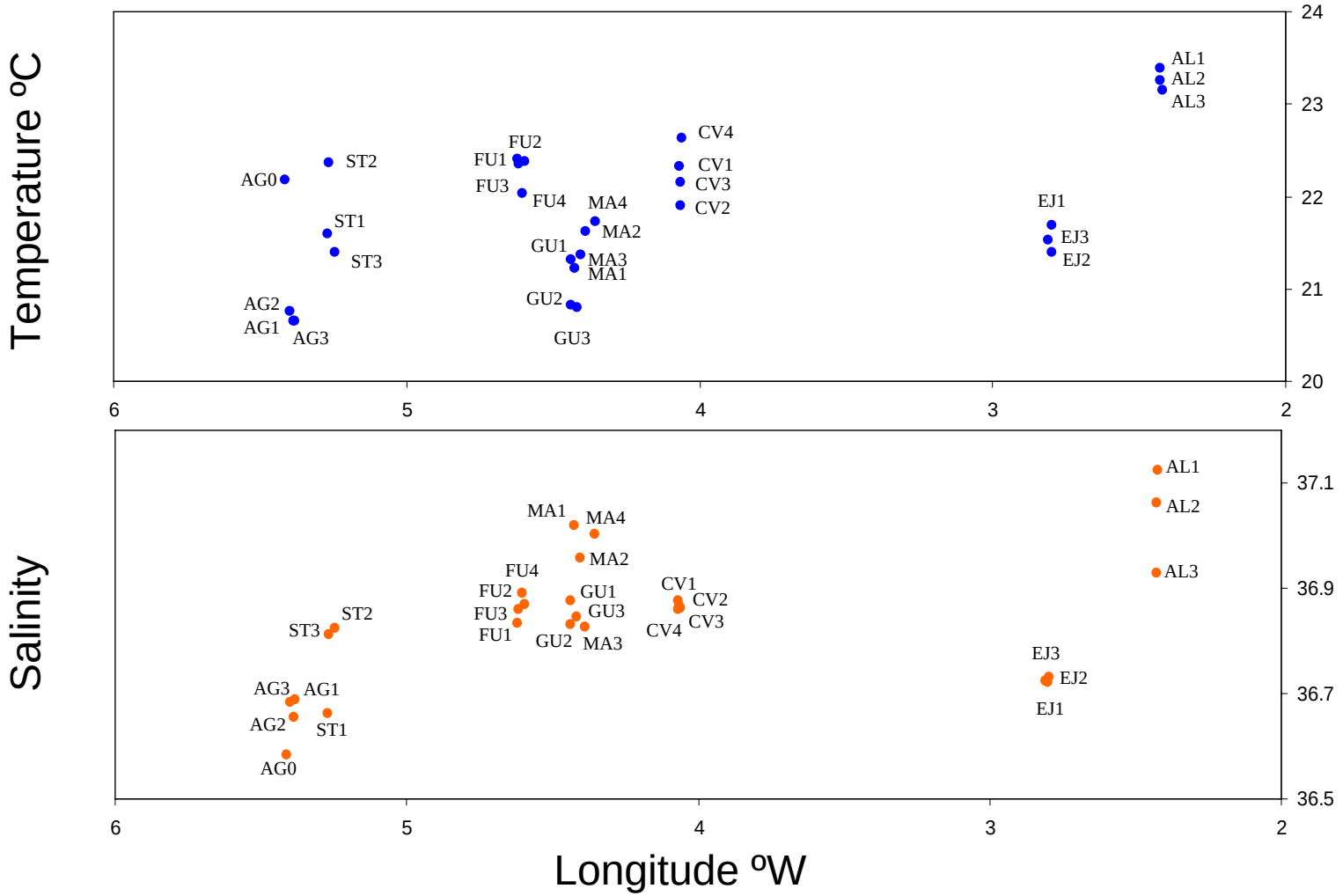
Nutrients (phosphate, nitrate, nitrite, silicate, ammonia, total N & P)
Chlorophyll *a* (total & fractionated)
Particulate Organic Carbon & Nitrogen
Dissolved Oxygen (Winkler & WTW electrode)
pH (WTW electrode)
Abundance of pico- & nanoplankton
Abundance & taxonomic composition of micro- & phytoplankton

Bongo vertical tows (200µm mesh)

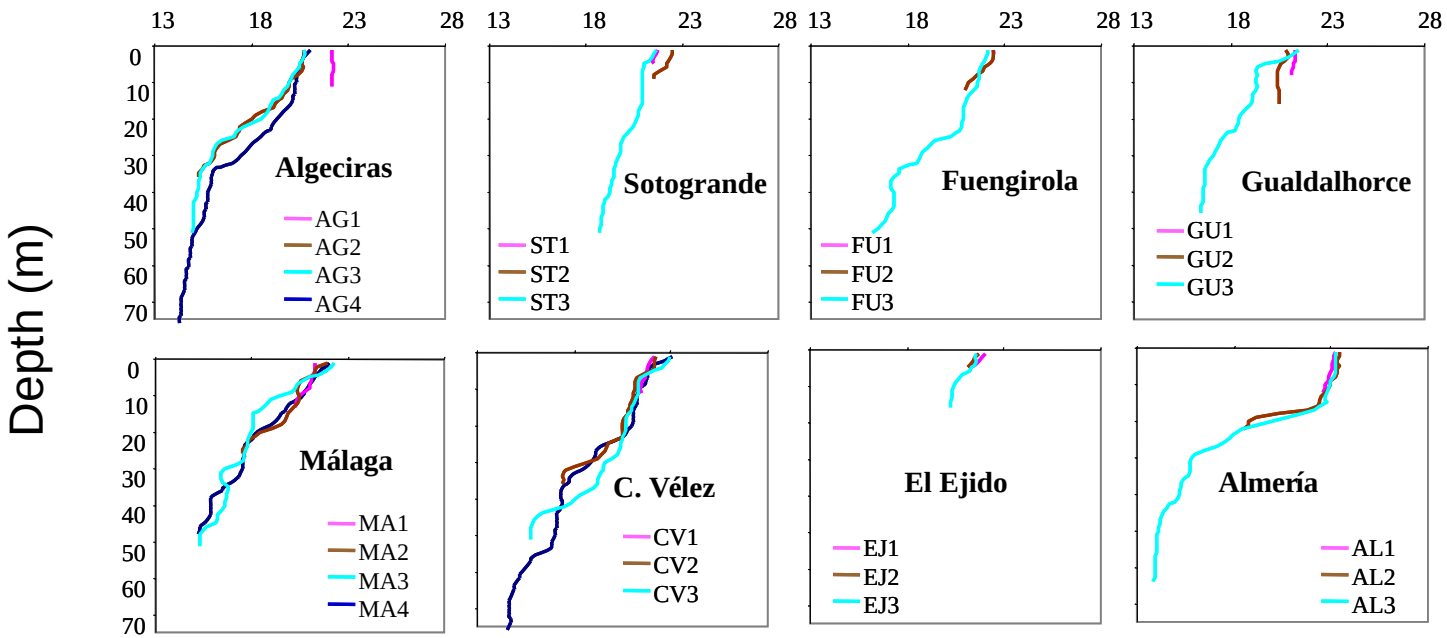
Abundance & taxonomic composition of mesozooplankton

MED POL: mandatory variables to evaluate eutrophication

West-East T-S gradient



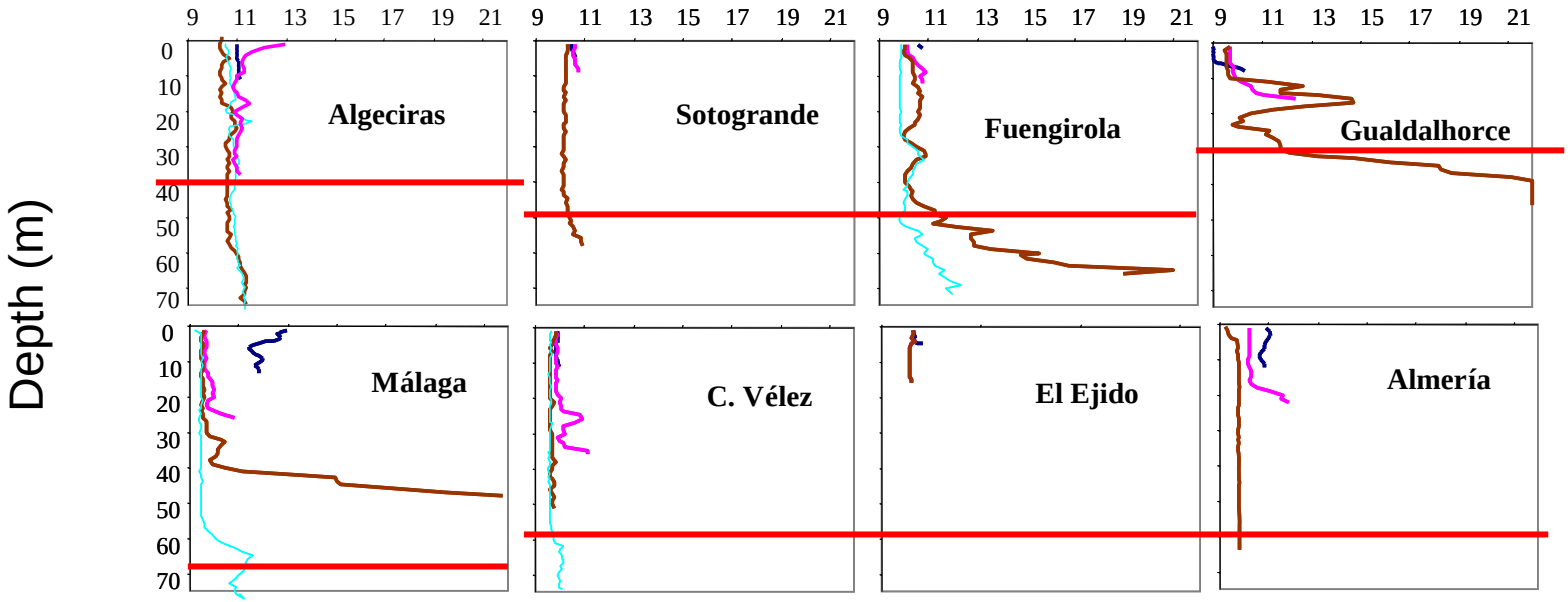
Temperature (°C)



- Marked thermocline and halocline
- Stratified water column - Absence of winds

Turbidity (ftu)

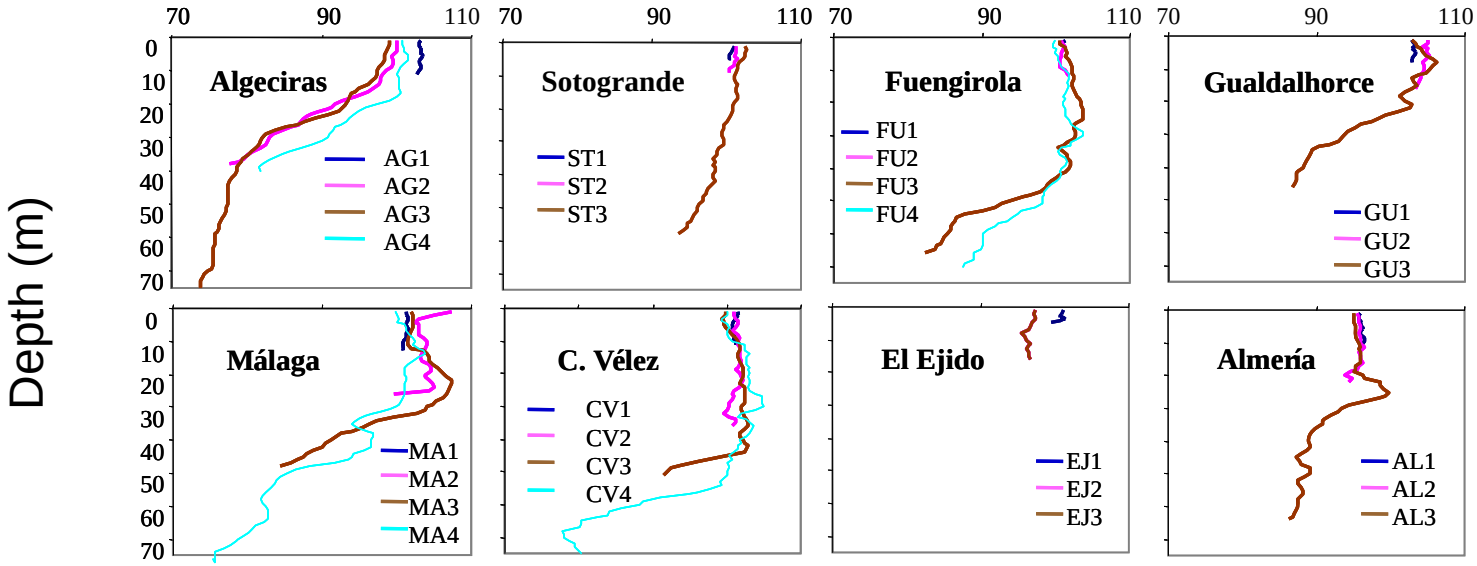
euphotic layer



AG: highest surface turbidity, lowest transparency: pigmented particles

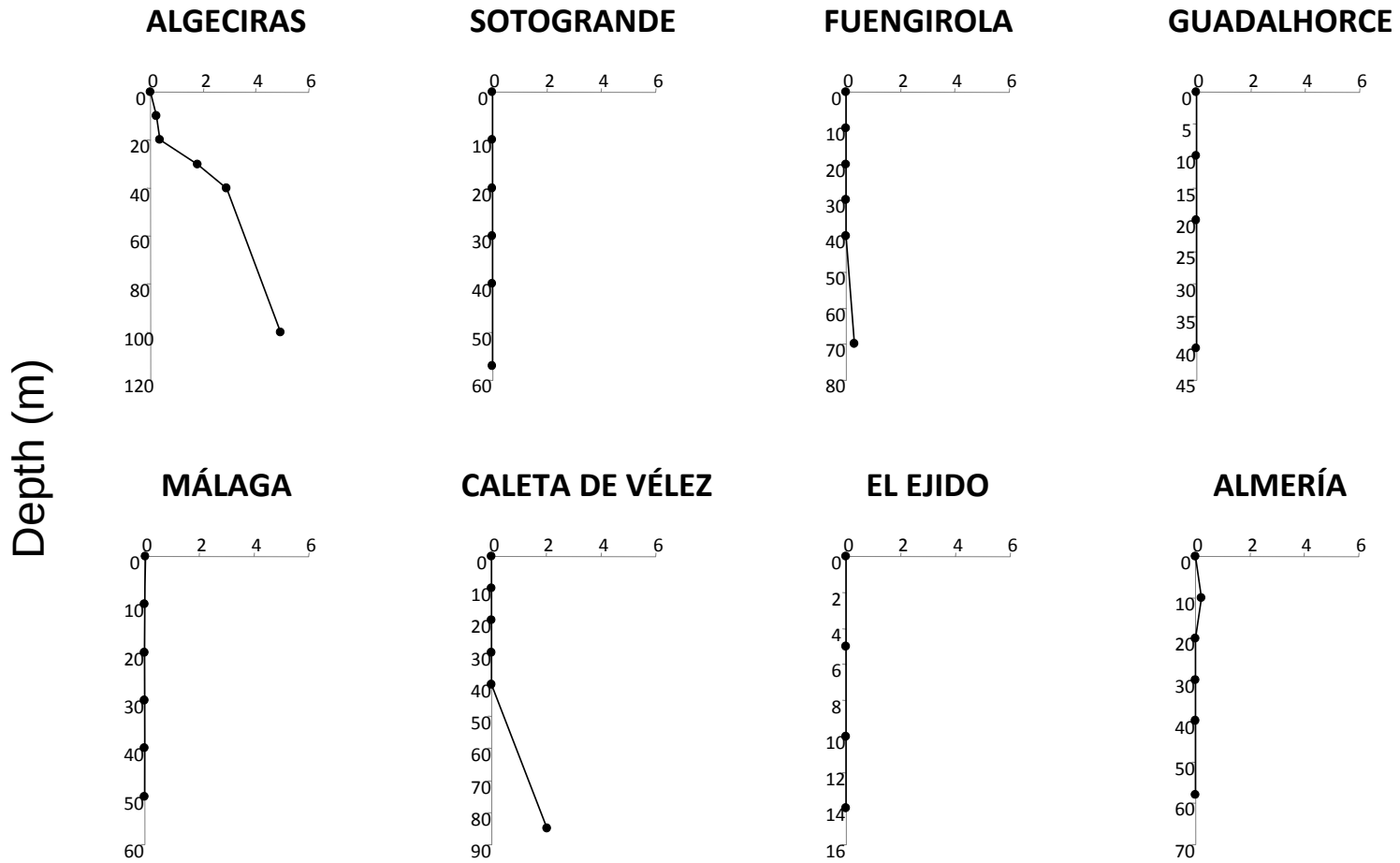
FU-MA: maximum turbidity at depth (high concentration of suspended particles) but not low transparency: non-pigmented particles or dead phytoplankton

Dissolved Oxygen (%)



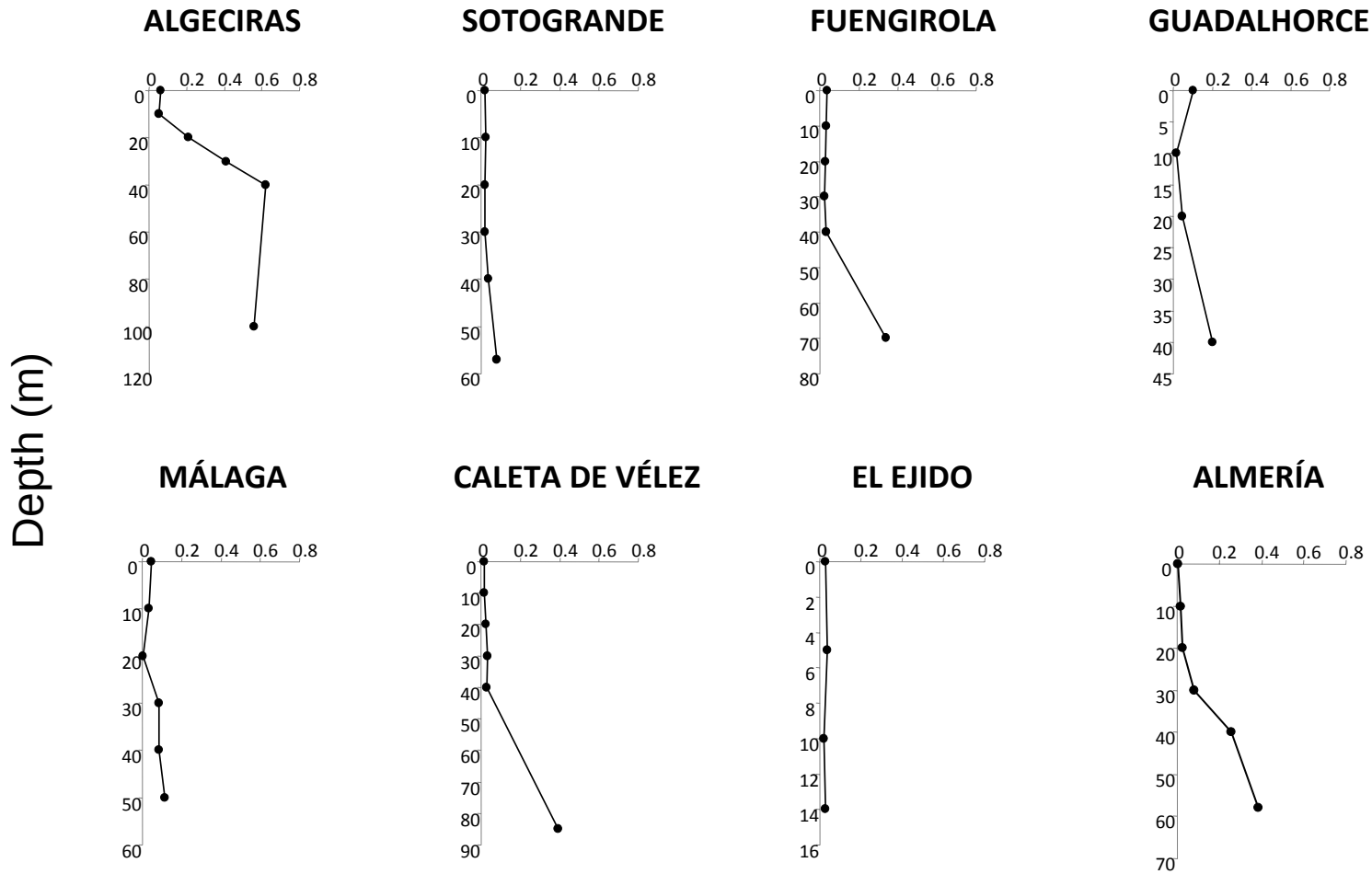
- Oxygen deficit at depth in AG, and FU-CV
- High respiration related to accumulation of organic matter (sinking of *Noctiluca* bloom?)

Nitrate (NO_3^-, µmol/L)



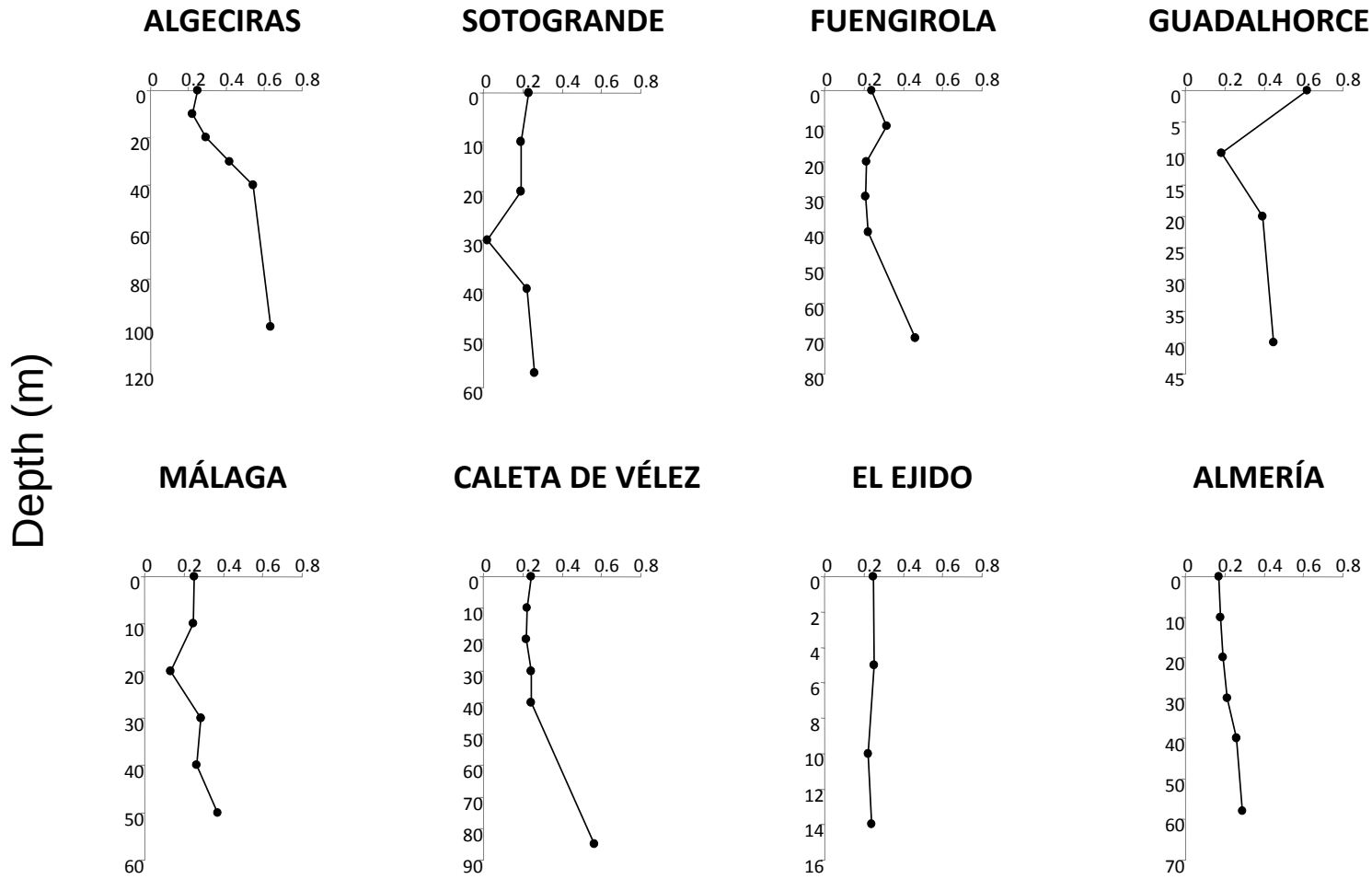
- **Levels below detection limit: summer stratification**
- **ECOMALAGA time-series range: 0.02 – 4.07**

Nitrite (NO_2^-, µmol/L)



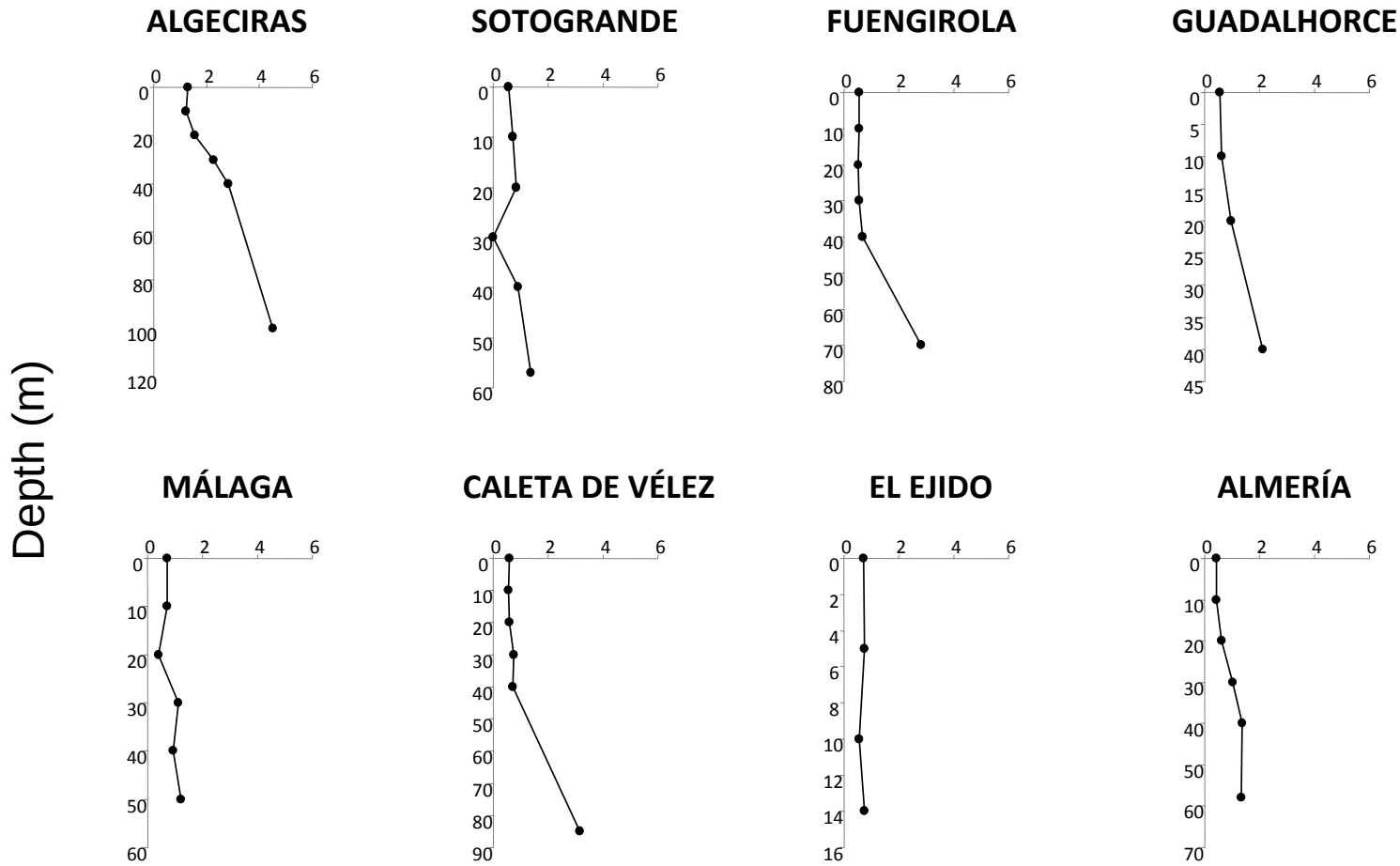
- Higher values below 40 m depth
- NO_2 higher than NO_3 indicates mineralization
  - post bloom situation

Phosphate (PO_4^-, µmol/L)



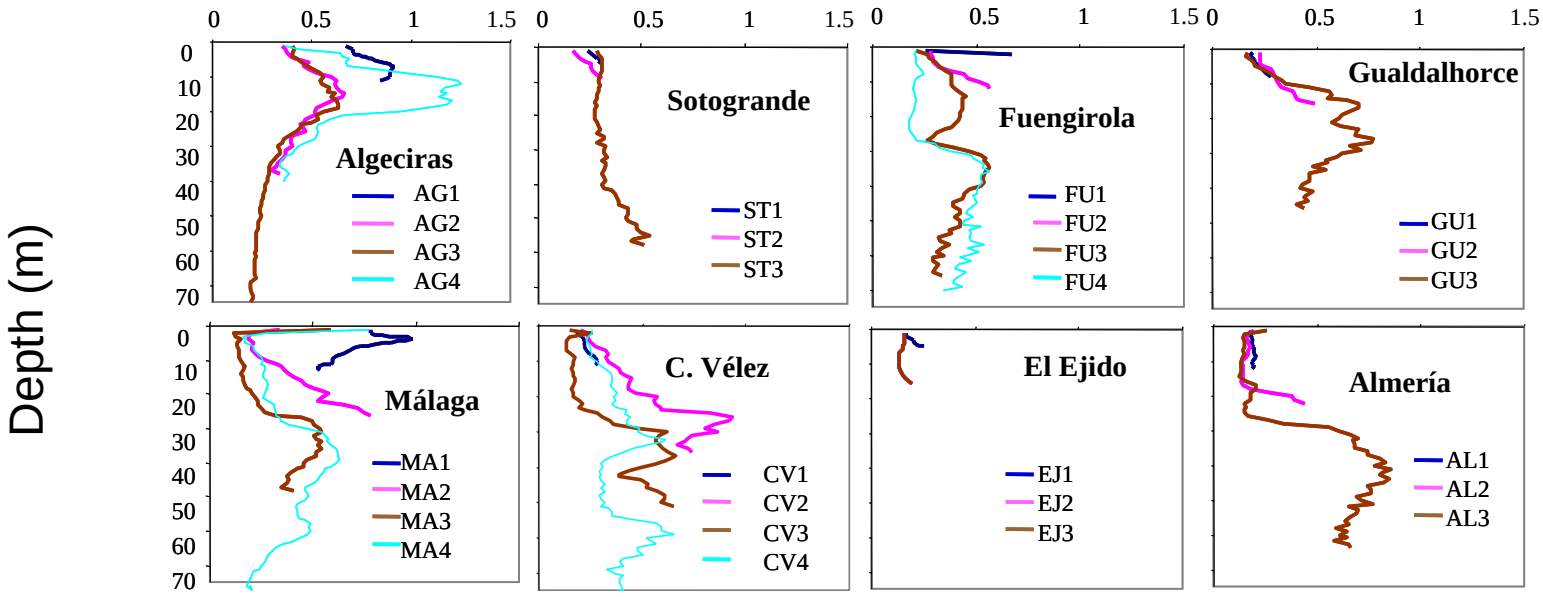
- **Homogeneous distribution within transects**
- **ECOMALAGA time-series range: 0.04 – 0.41**

Silicate (SiO_4^-, µmol/L)



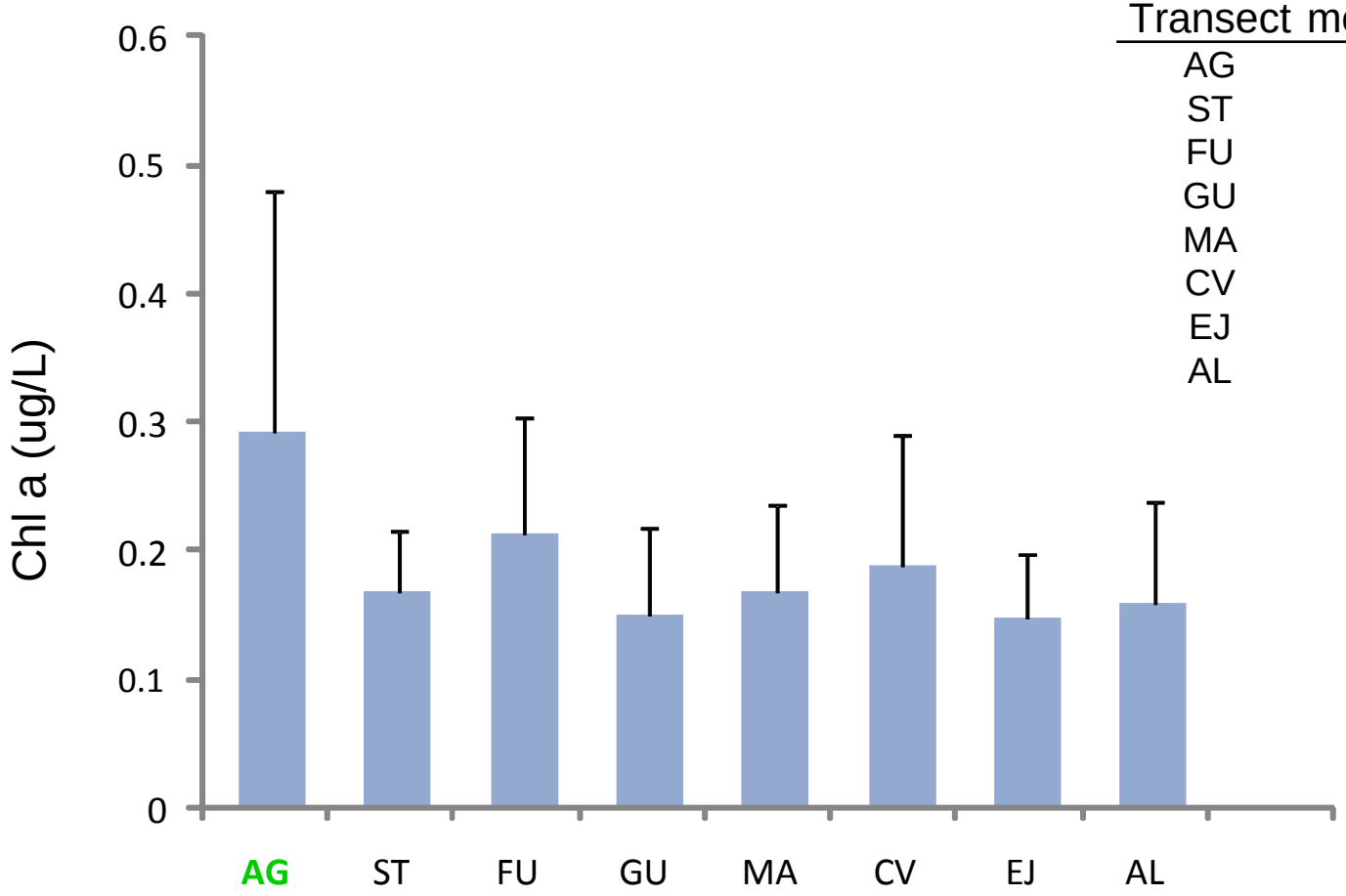
- **Similar to phosphate distribution**
- **Increases with depth at western stations**

Fluorescence



- Maximum surface values in AG, and FU-MA
- Depth of subsurface maximum variable

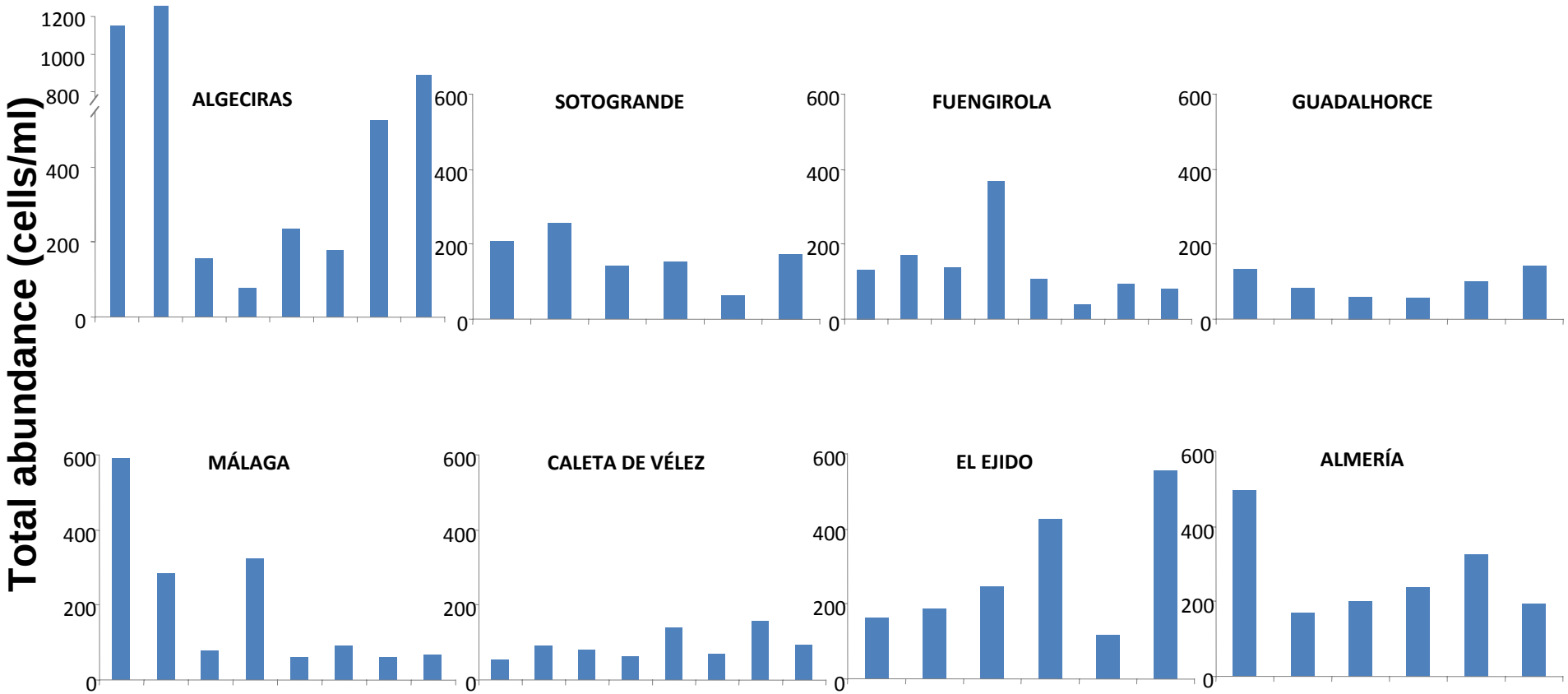
Chlorophyll *a* (ug/L)



Transect mean Chl *a*	
AG	0.293
ST	0.169
FU	0.213
GU	0.150
MA	0.168
CV	0.189
EJ	0.147
AL	0.160

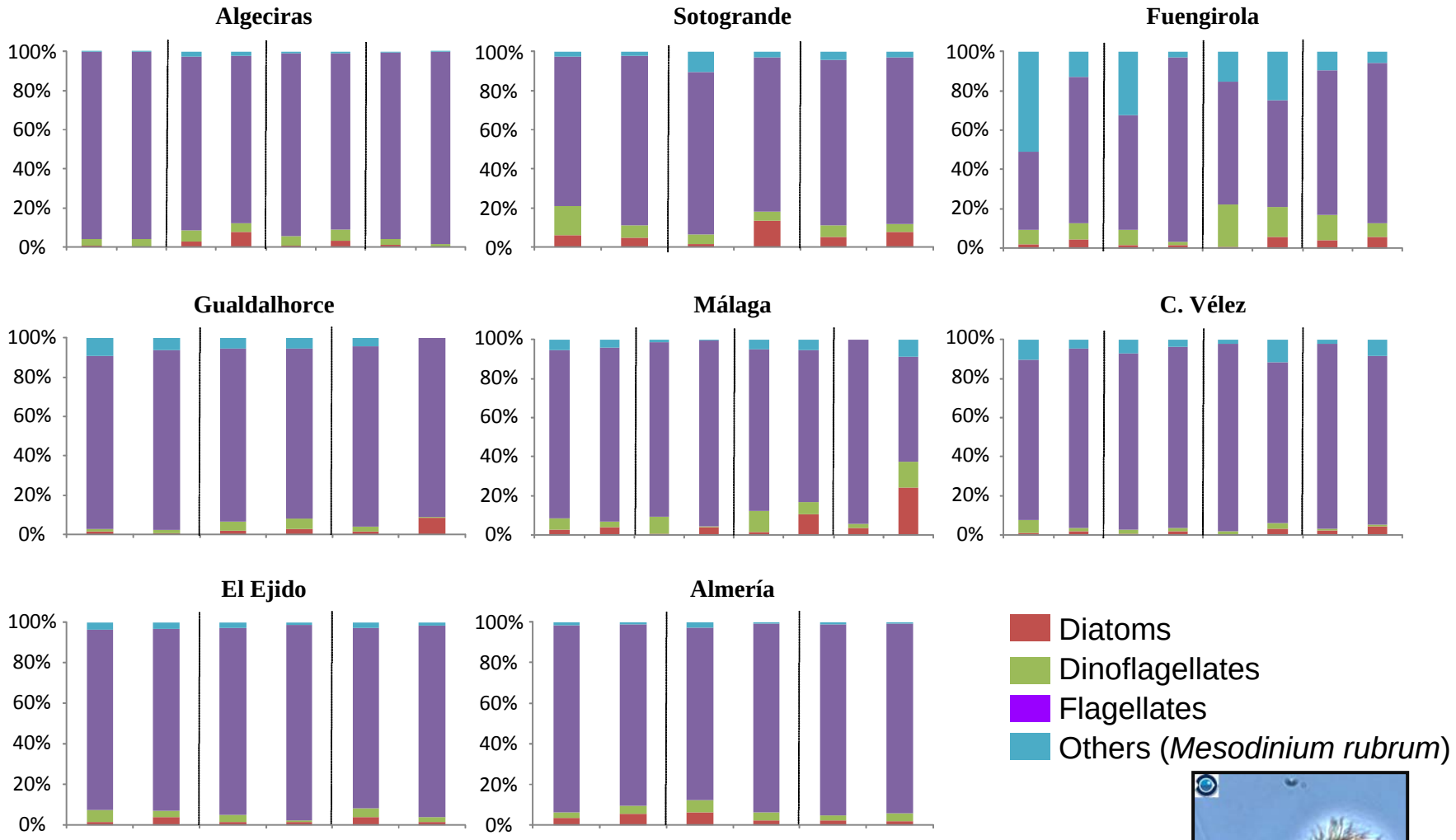
- ECOMALAGA time-series range: 0.04 – 7.94
- Summer avg. Chl *a* at MA is 0.80 (Mercado et al. 2007)
- NO_3 limiting phytoplankton growth, not PO_4

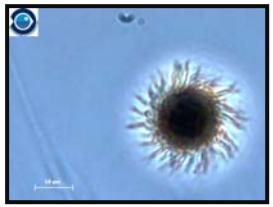
Phytoplankton abundance (cells/ml)



- Diatom abundance was only 1-31 cells/ml
- Mean summer abundance at MA is 234 cells/ml (50% diatoms, Mercado et al. 2005)

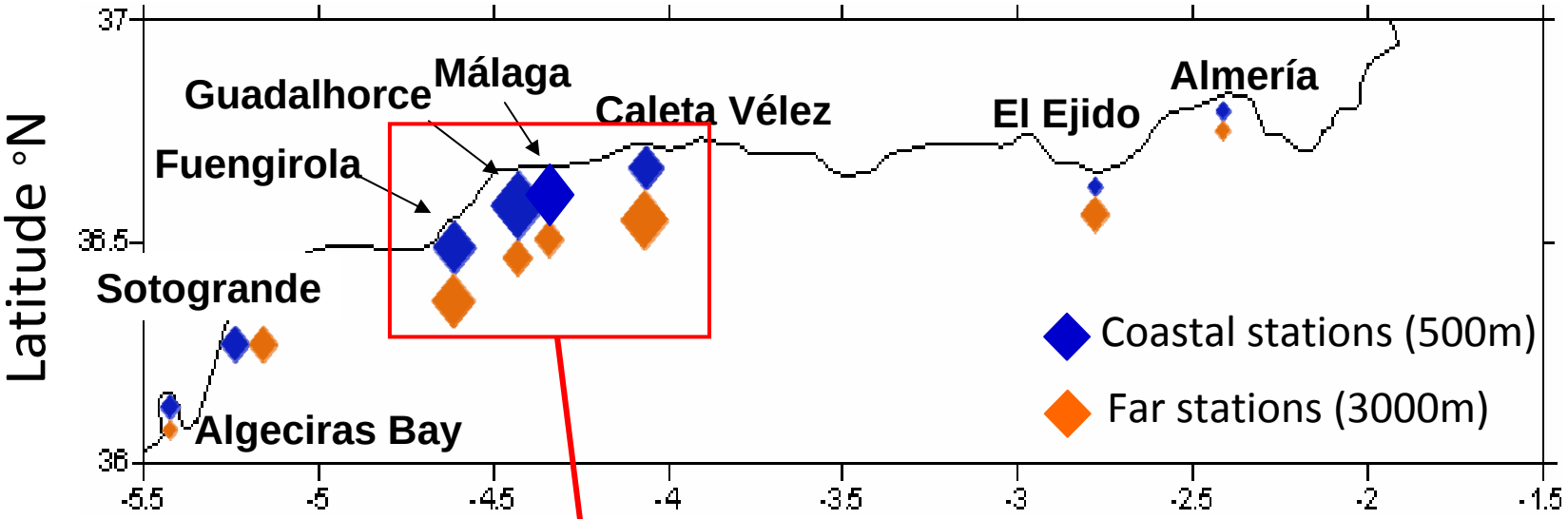
Phyto/microplankton composition

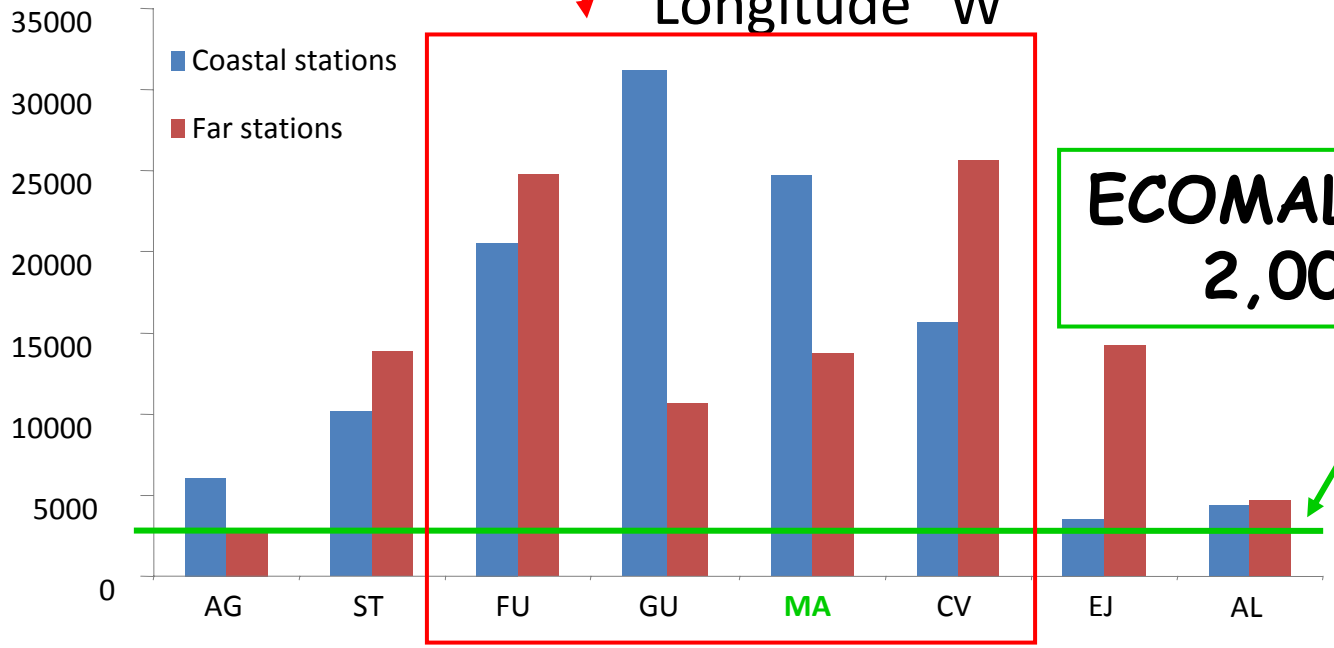




- Flagellates dominated all sites
- Few dinoflagellates and less diatoms
- Ciliates bloom at FU

Zooplankton abundance (ind/m^3)





ECOMALAGA summer 2,000 ind/m^{-3}

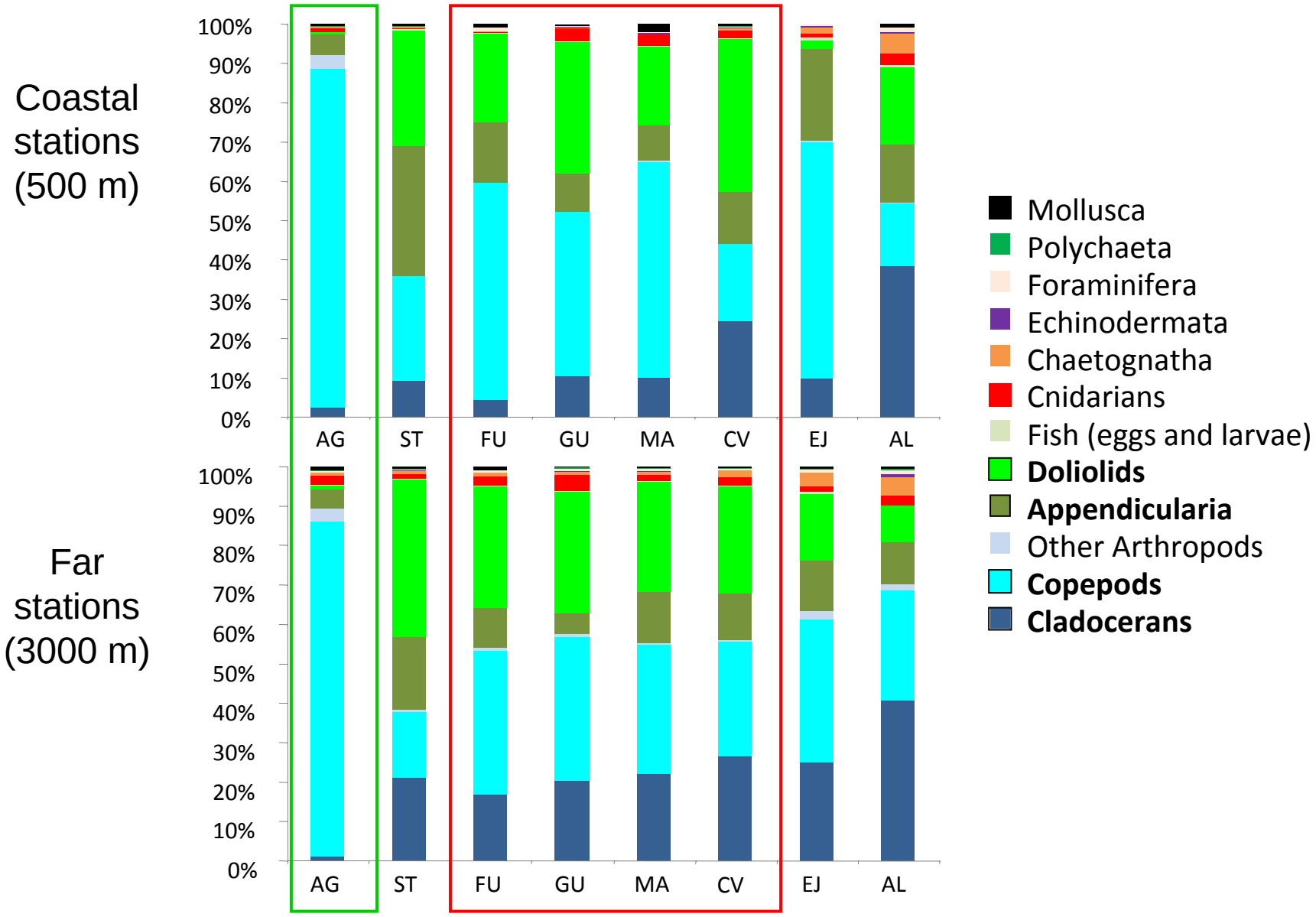
Zooplankton taxonomic composition

	AG	ST	FU	GU	MA	CV	EJ	AL
Cladocerans	89	1930	2539	2690	2751	5280	1918	1738
Copepods	3743	2502	10134	8453	9009	5191	3581	975
Other Arthropods	146	51	96	48	100	58	159	35
Appendicularia	222	2933	2773	1784	1962	2516	1293	563
Doliolids	33	4255	6145	6870	4418	6476	1216	626
Fish (eggs & larvae)	1	17	30	20	16	20	46	20
Cnidarians	64	114	323	724	462	446	109	115
Chaetognatha	22	63	132	76	79	239	275	221
Echinodermata	0	11	15	40	41	35	9	22
Foraminifera	3	20	133	83	59	78	65	41
Polychaeta	10	17	19	9	22	17	5	11
Mollusca	23	59	187	64	261	77	33	29
Total	4356	11972	22527	20862	19181	20431	8709	4396

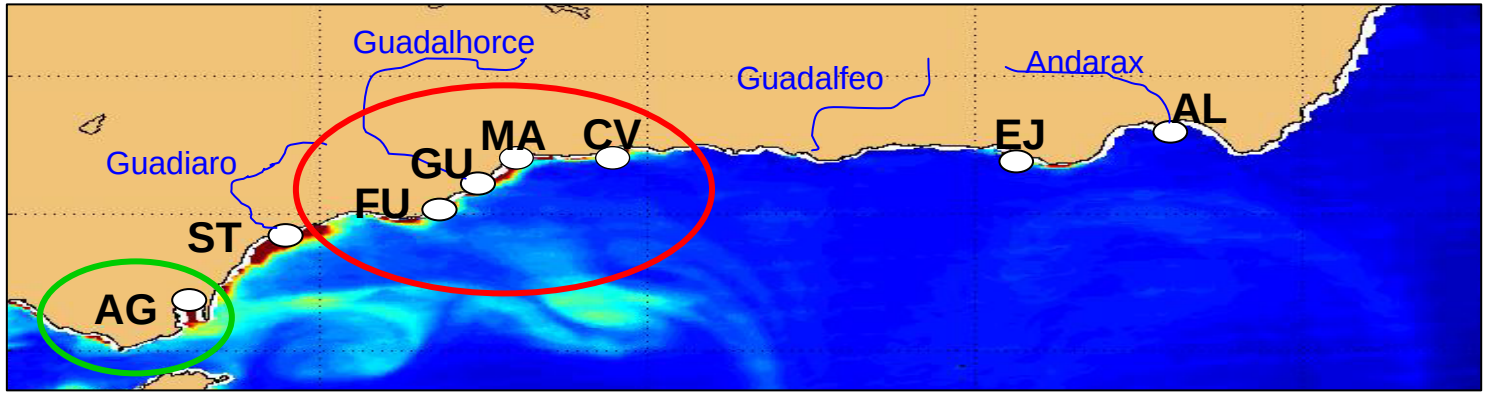
Mean zooplankton groups abundance (ind·m^{-3})

- **Dominant groups: copepods and doliolids**

Zooplankton taxonomic composition



Conclusions so far



High hydrographic variability - West-East T & S gradient
Atypical stratified water column - Absence of winds

AG: maximum nut & Chl – 90% flagellates
– low ZP abundance (90% copepods)

FU-CV: phytoplankton NO_3 limited – post dinoflagellate bloom – *high bacteria abundance?* - ongoing ciliates bloom at FU
- high ZP abundance (40-60% copepods & cladocerans, 25-50% doliolids & appendicularia)


Thank you
Gracias