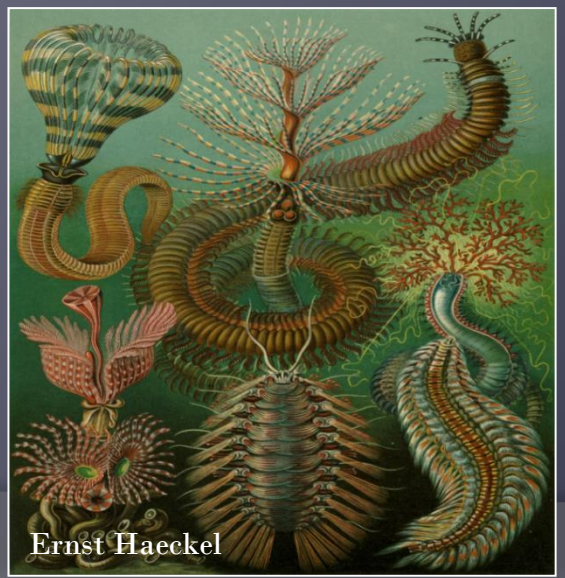
[1]Nasi F., [1]Auriemma R., [1]Cibic T., [1]Del Negro P., [2]Bonsdorff E., [2]Nordström M. C.

[1]Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Sezione Oceanografia, Trieste, Italy

[2]Åbo Akademi University, Environmental and Marine Biology, Turku. Finland

FUNCTIONAL BIODIVERSITY OF MARINE SOFT BOTTOM POLYCHETES IN TWO MEDITERRANEAN COASTAL AREAS


Ernst Haeckel

IPC12
Cardiff, 1st-5th,August 2016

ENVIRONMENTAL ISSUES

Anthropogenic pressures:

- multiple uses of the coast;
- large industrial infrastructures;
- intense maritime traffic.

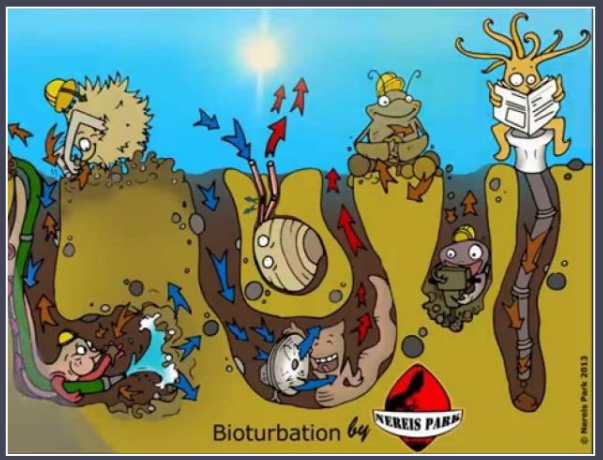
Environmental issues:

- hydrological modification;
- grain-size variation;
- organic matter enrichment and high concentration of contaminants.

Ecosystem functioning includes all the processes in a system and the **chemical, physical** and **biological components** involved[1].

In soft sediments, macrofauna are **key biological components** which drive important processes,[2] such as:

- sediments reworking;
- bio-irrigation;
- nutrient uptake;
- oxygen and dissolved matter transport.



Invertebrate biological features

-degree of mobility;
-borrowing activity;
-tube construction;
-feeding methods;

Functional traits

1]Bremmer J. (2008). Specie' trait and ecological functioning in marine conservation and management. J.Exp. Mar. Biol. Ecol.
2]Widdicombe S. et al. (2004). Importance of bioturbators of biodiversity maintenance: indirect effect of fish disturbance. Mar. Ecol. Progr. Ser.

Link between species, environmental and ecosystem processes: Biological Trait Analysis (BTA)

Functional diversity and Functional identity[3]

Functional diversity within a community may act as key driver in the explaining the magnitude of ecosystem processes[3].

Functional identity indicates the role of a single species in the ecosystem evaluating each its functional features.

3] Gagic V. et al. (2015). Functional identity and diversity of animals predict ecosystem functioning better than species-based indices.

AIMS OF THE STUDY

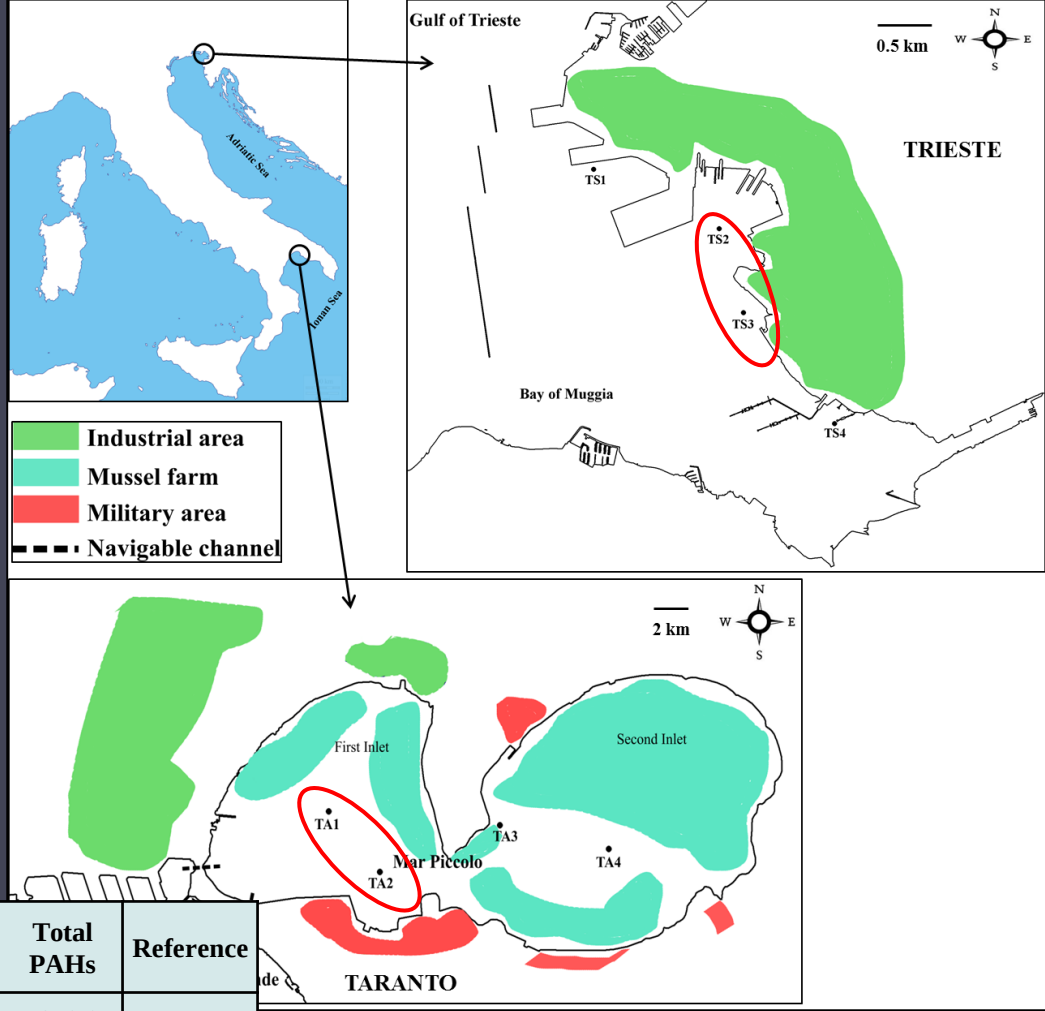
BTA was used to explore and characterize effects of contaminants on functional attributes of soft-bottom polychaete assemblages to predict alterations of ecosystem functioning.

1) Do the contaminated sediments affect functional biodiversity?

2) Which traits among the functional features may be affected by differently contaminated sediments?

STUDY AREAS

- 4 stations in each area;
- 2 sampling seasons (winter and spring).



Concentrations are expressed in mg kg^{-1} (sediment dry mass).

Area	Station	Depth (m)	Cu	Hg	Pb	Zn	Total PCBs	Total PAHs	Reference
Trieste	TS1	18.5	36.8	**3.4**	57.1	137.0	74.7	**4870.0**	Rogelja et al. submitted
	TS2	15.0	**112.0**	**4.4**	**388.0**	**770.0**	**907.0**	**19000.0**	
	TS3	13.0	28.7	0.5	73.9	**205.0**	50.8	**14950.0**	
	TS4	10.5	16.6	0.1	4.0	57.0	1.0	46.0	
Taranto	TA1	11.2	**180.3**	**0.9**	**80.0**	**231.0**	164.9	1755.0	Cibic et al. 2015 and Bellucci et al. 2016
	TA2	11.0	**100.5**	**1.6**	**152.0**	**319.0**	**1067.6**	1624.0	
	TA3	7.5	**64.9**	**0.6**	**74.0**	**222.0**	164.8	528.0	
	TA4	7.0	**55.2**	0.3	**51.0**	**189.0**	39.0	127.0	

Concentrations that exceed the legal limits are marked in bold.

BTA-Biological Traits Analysis

Traits	Categories	Abbrev.	Examples of potential relationships
Adult longevity	≤1 yr	Al1	Adult longevity increases the contact time with the contaminated sediments
	1-3 yrs	Al3	
	3-6 yrs	Al6	
	6-10 yrs	Al10	
Reproductive frequency	Semelparous	Sem	Riproductive frequency indicates role in comunity development
	Iteroparous	Iter	
	Semi-continous	Scon	
Mechanism development	Direct	Dir	Larval development is important to understand which type of feeding in relation
	Epitokia	Epit	
	Lecitotrophic	Flec	
	Planktotrophic	Fplan	
	Tube-builder	Tub	
	Burrower	Burw	
Adult feeding habit	Suspension feeder	Susp	Feeding habits indicates role in trophic pathway
	Surface deposit feeder	Sdep	
	Subsurface deposit	Ssdep	
	Herbivore	Herb	
	Predation	Pred	
	Scavanger	Scav	

-Review on polychaete feeding strategies by Jumars et al. 2015[5];

-Polytraits: a database on biological traits of polychaetes.

Fuzzy coding procedure:

-0 (blank) no affinity;

-1 low importance;

-2 moderately high importance;

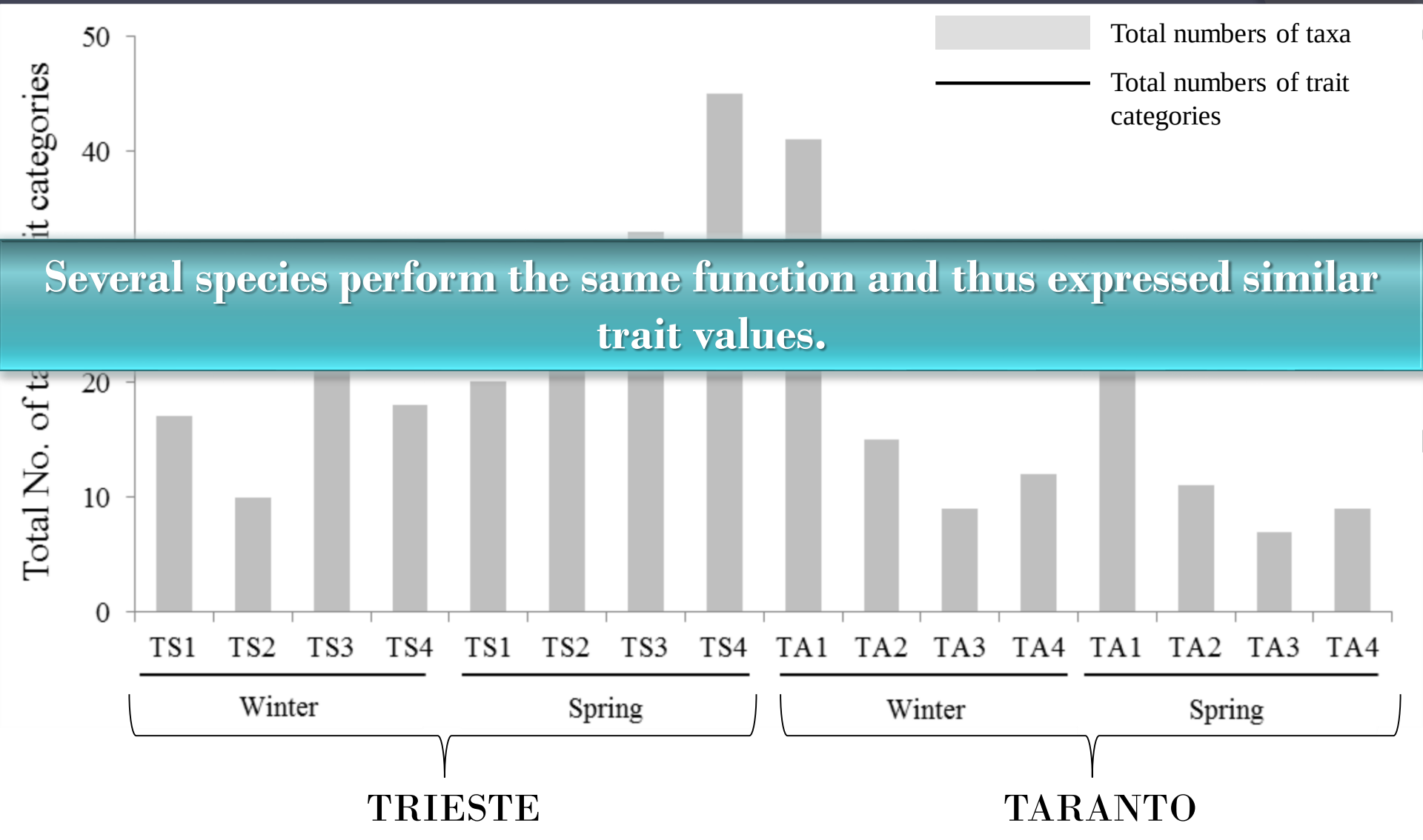
-3 dominant.

103 taxa of polychaetes

4] Jumars et al. (2015). Diet of worms emended: an update of polychaete feeding guilds. Annu. Rev. Mar. Sci.

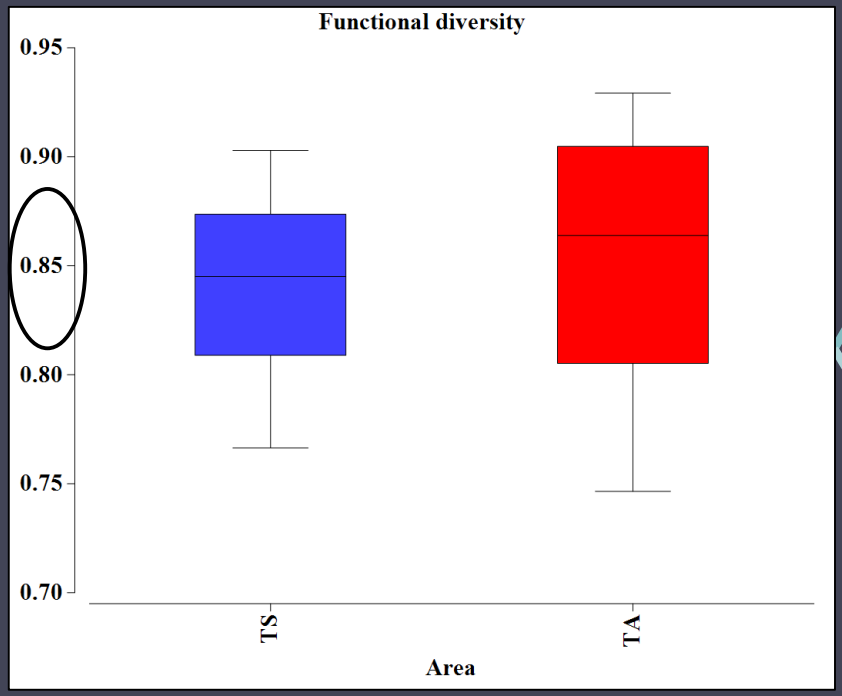
5] Faulwetter et al. (2014). Polytraits: a database on biological traits of polychaetes. Biodivers. Data J.

NUMBER OF TAXA *VS* TRAITS CATEGORIES

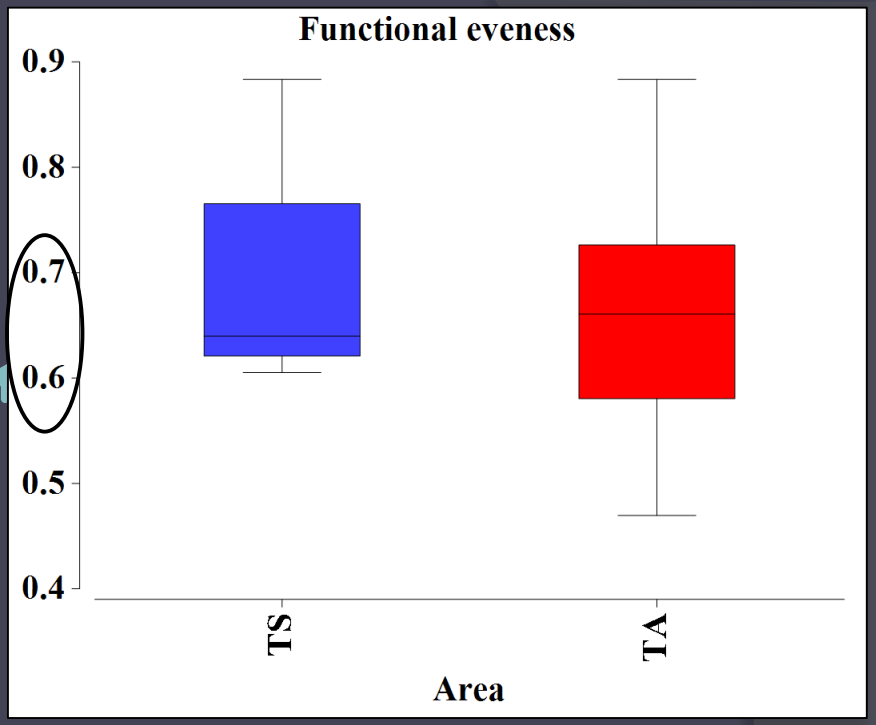


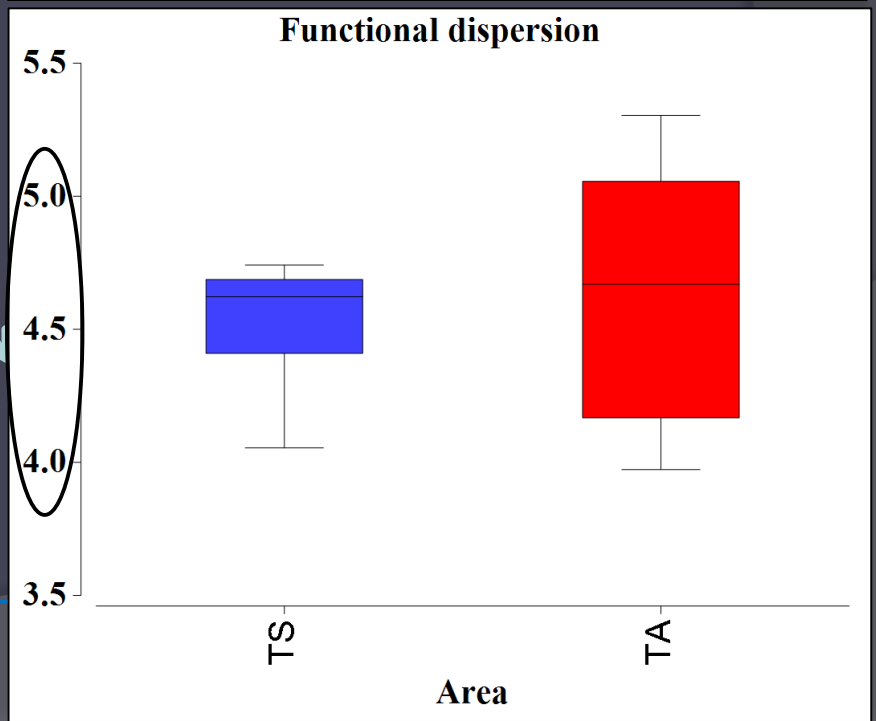
Several species perform the same function and thus expressed similar trait values.

FUNCTIONAL INDICES



FDiv average 0.65 ± 0.49 from Törnroos et al. 2014[4]





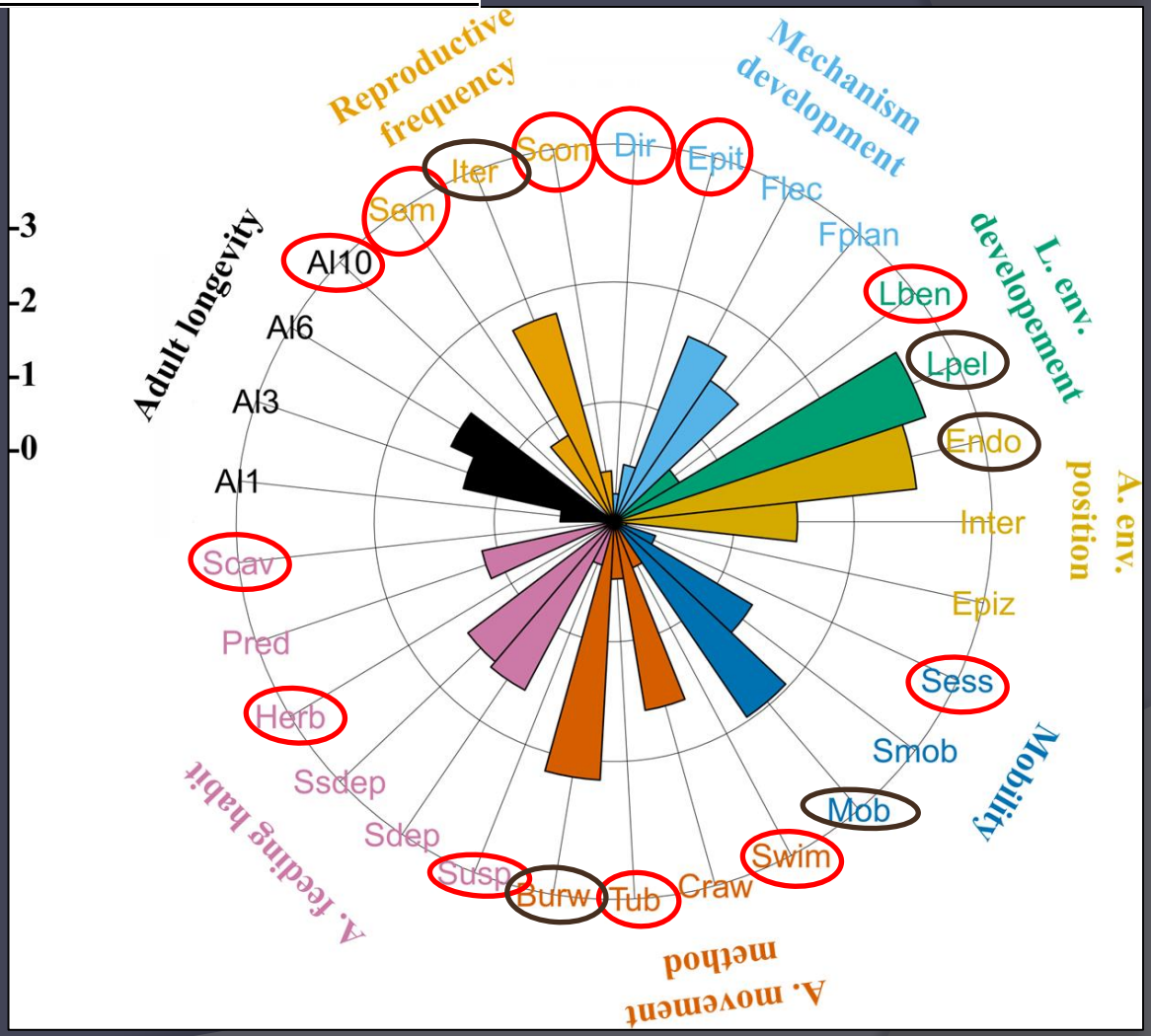
4] Törnroos et al. (2014). Marine benthic ecological functioning over decreasing taxonomic richness. Journal of Sea Research.

CWM[5] (COMMUNITY WEIGHTED MEANS-FUNCTIONAL IDENTITY)

Main-test PERMANOVA	Area		Season	
	t	P(perm)	t	P(perm)
Species composition	2.09	**0.01**	0.95	0.55
CWM	0.98	0.46	0.95	0.48

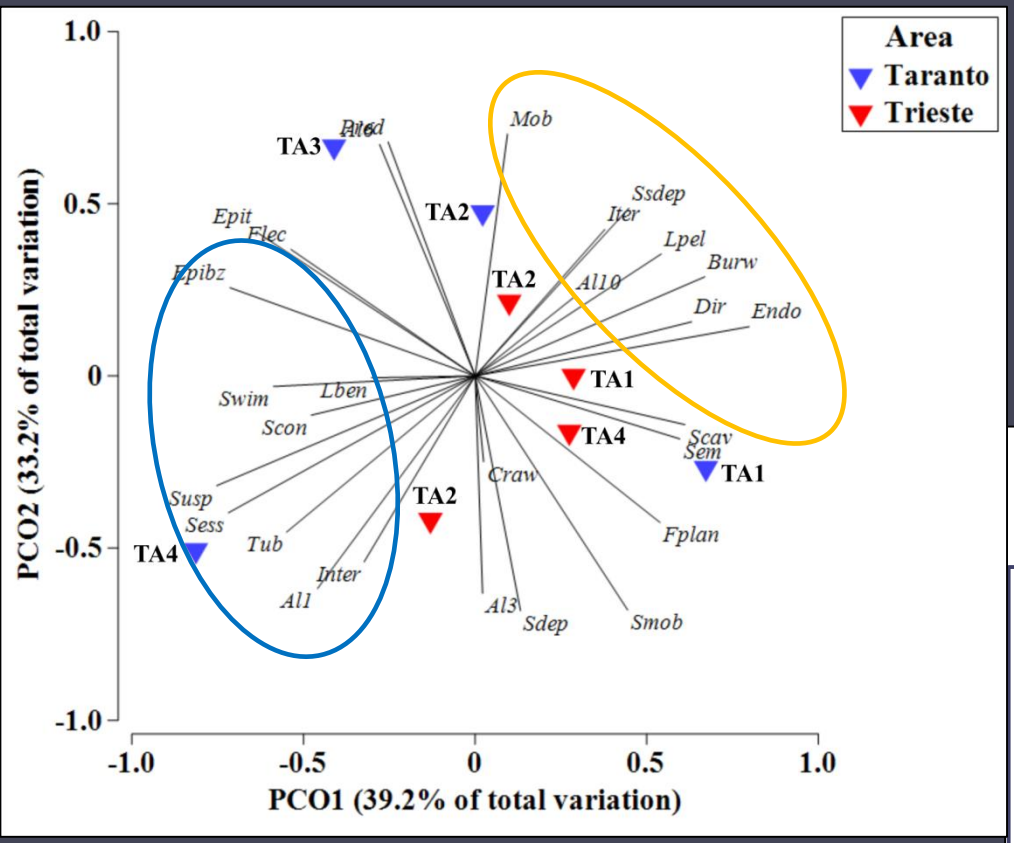
CWM > 1.8

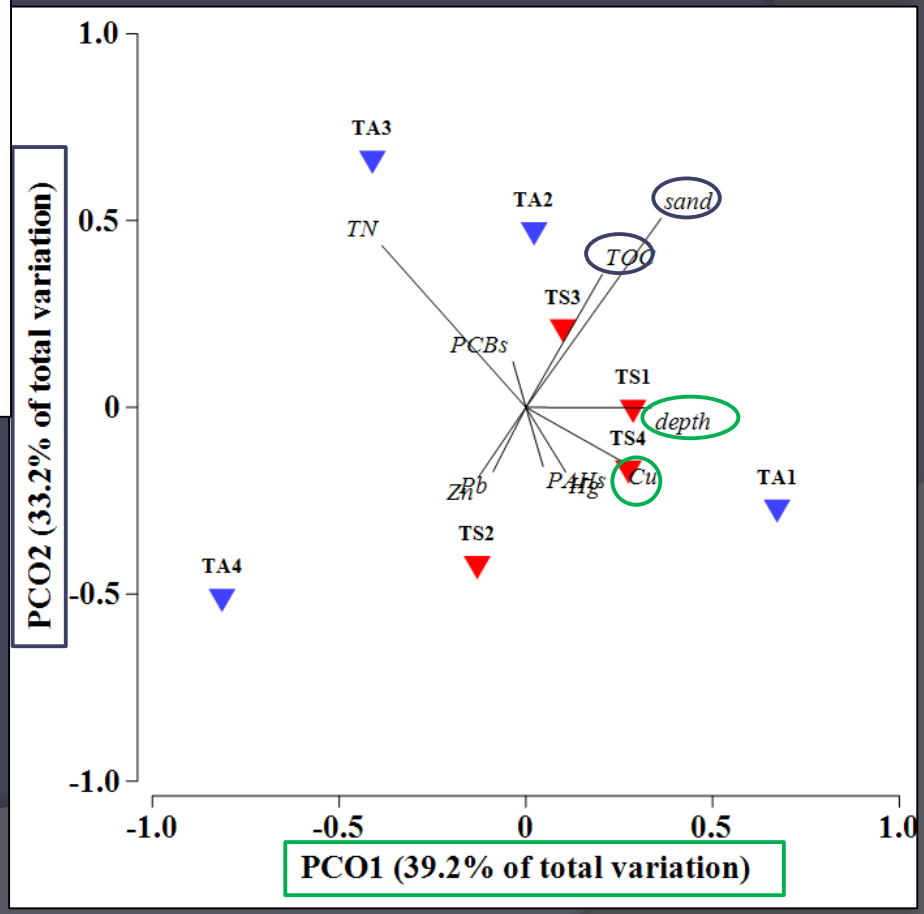
CWM <1



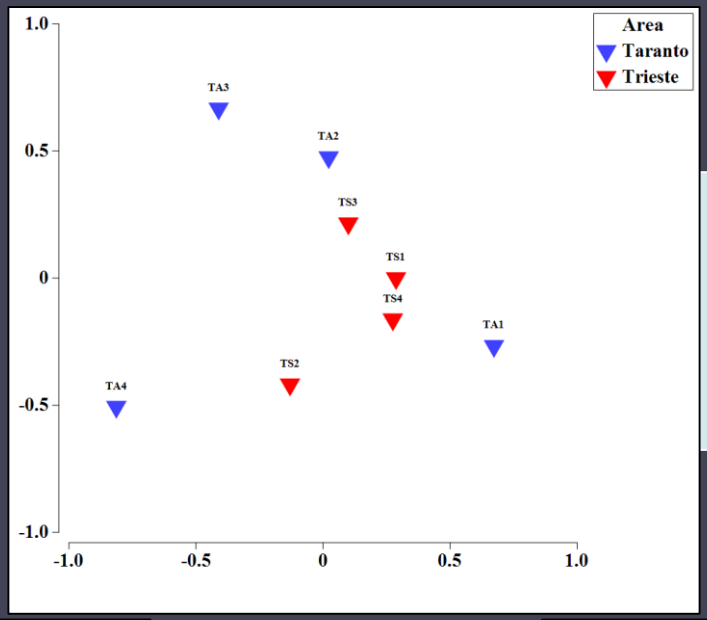
4] Laliberté et al. (2015). Measuring functional diversity (FD) from multiple traits, and other tools for functional ecology. FD package. R-software.

PRINCIPAL COORDINATES ANALYSIS (PCO)

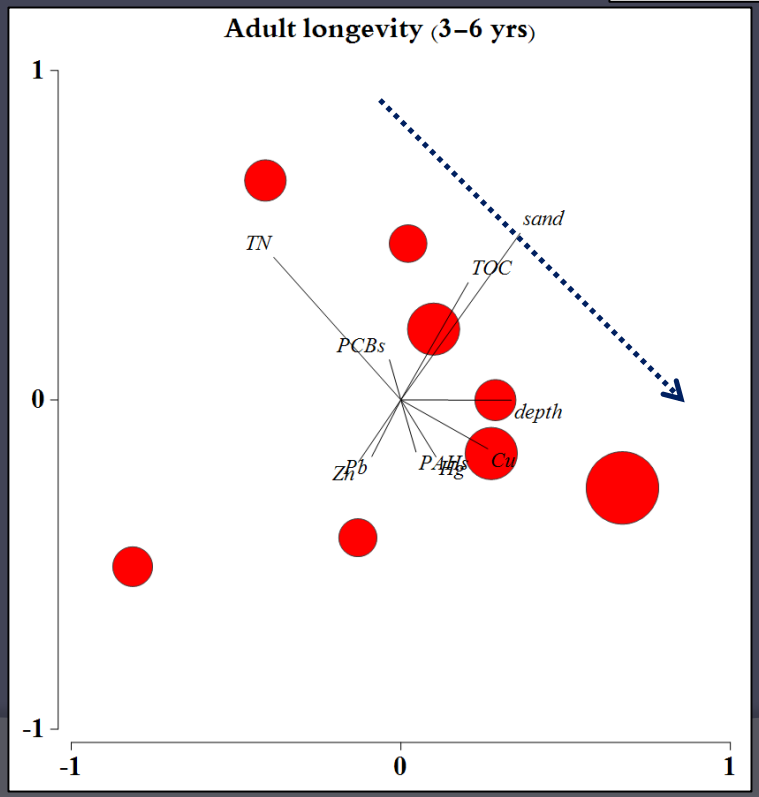


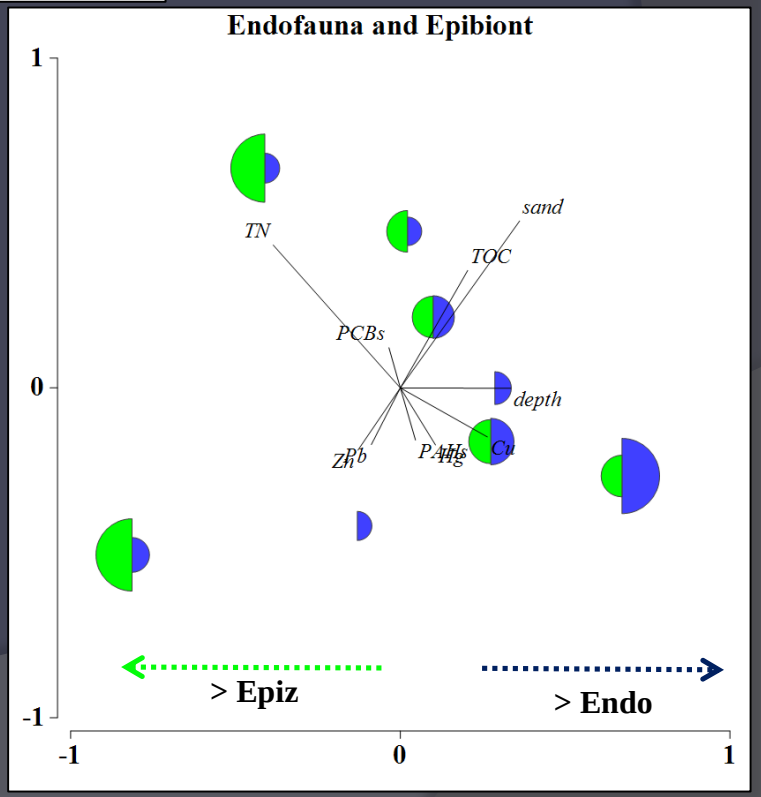


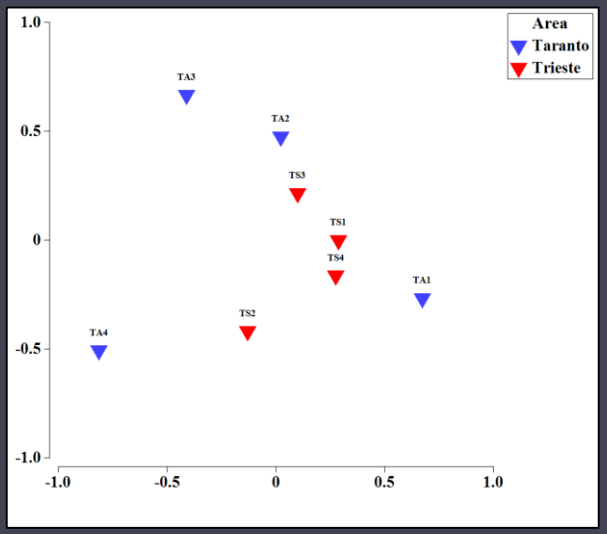
TRAITS CATEGORIES HIGHLY CORRELATED WITH PCO1 AND PCO2 (>± 0.80)

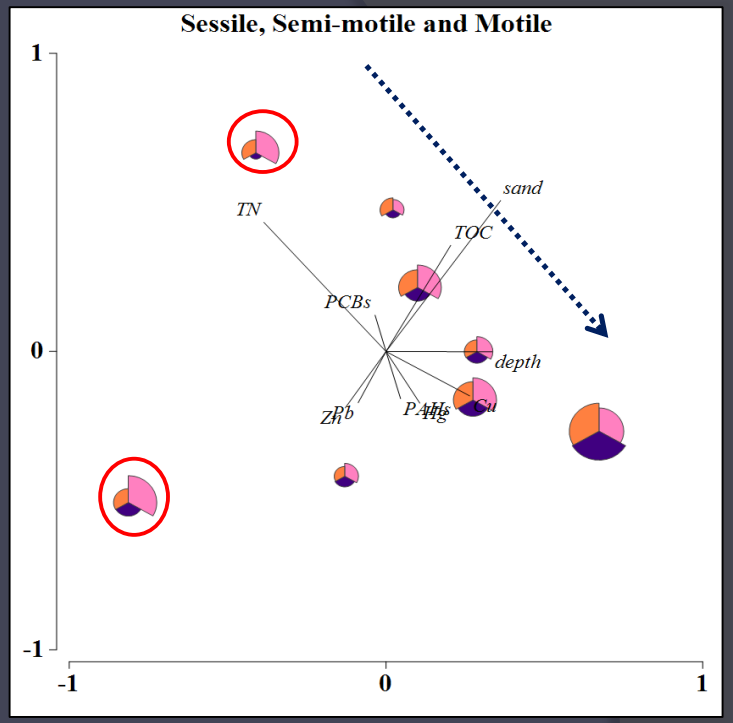


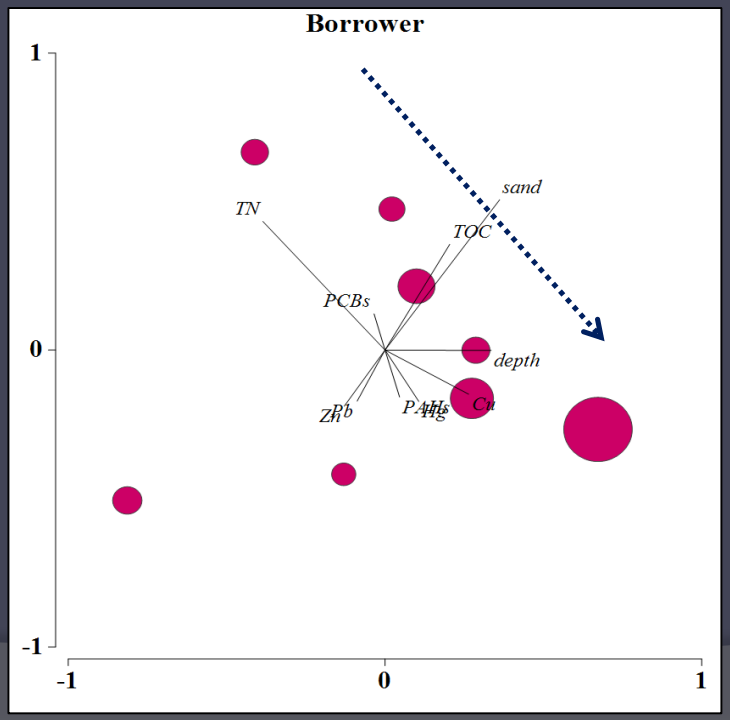
Bubbles sizes are scaled to represent the relative 'weighted' of the traits at each station.

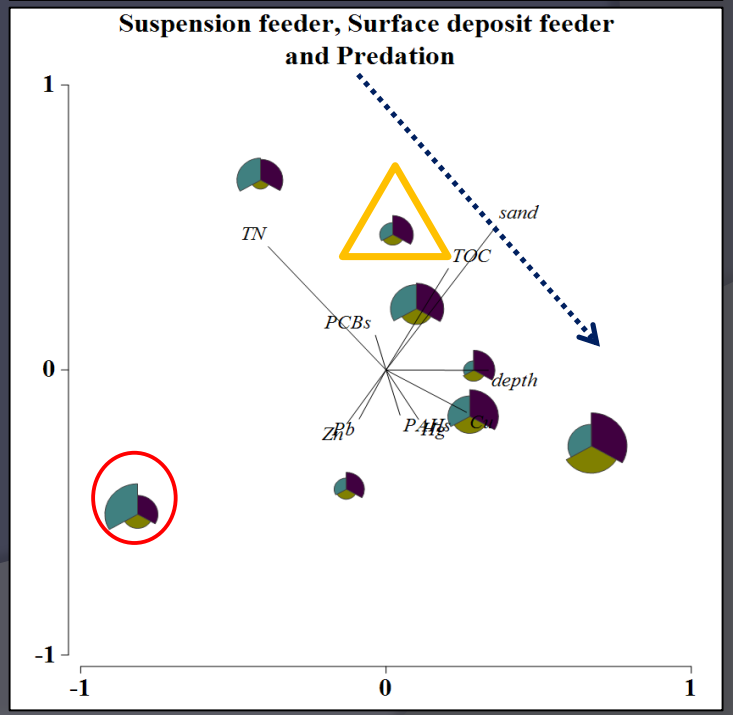





Area
Taranto
Trieste
TA3
TA2
TS3
TS1
TS4
TA1
TS2
TA4
1.0
0.5
0
-0.5
-1.0
-1.0
-0.5
0
0.5
1.0


Sessile, Semi-motile and Motile
sand
TN
TOC
PCBs
depth
Zn
Pb
Hg
Cu
1
0
-1
-1
0
1


Borrower
sand
TN
TOC
PCBs
depth
Zn
Pb
Hg
Cu
1
0
-1
-1
0
1


Suspension feeder, Surface deposit feeder and Predation
sand
TN
TOC
PCBs
depth
Zn
Pb
Hg
Cu
1
0
-1
-1
0
1

CONCLUSIONS

-The Functional Diversity in these areas seems not to be affected by contaminated sediments;

-There are patterns in Functional Identity, with prevalence or dominance of certain trait categories *iteroparous*, *endobenthic*, *mobile*, *borrower* and *predation*; whereas other trait categories were more rare in occurrence (in opposite to *sessile*, *tube builder*, and *suspension*). This could be linked to the ability to avoid hotspots of contaminants through their active movements;

-The long-term and continuous contamination in these areas might have adapted macrofaunal invertebrates to live in site with a persistent contamination.

THANK YOU!!

Ritmare

La ricerca italiana per il mare