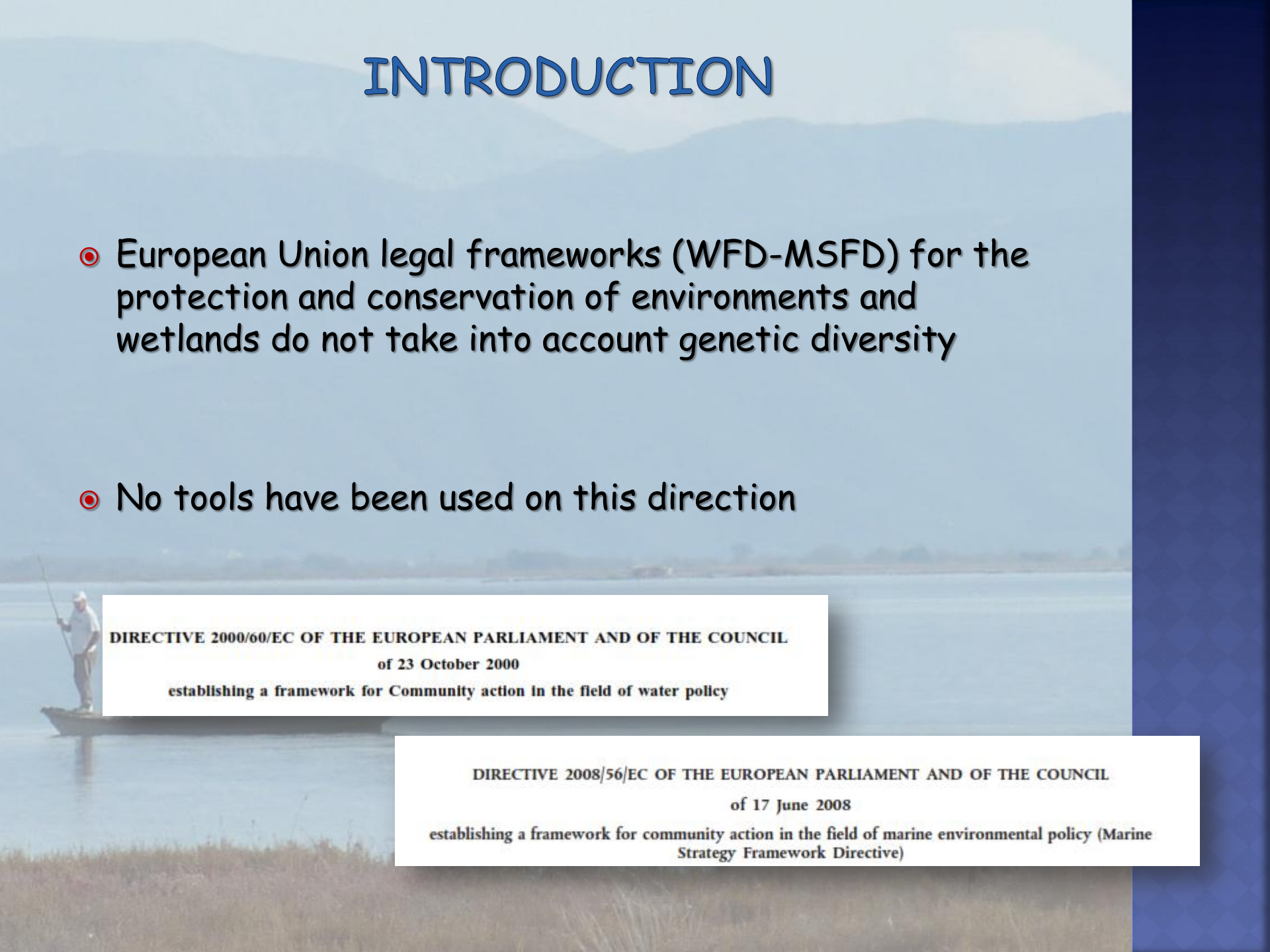


Genetic differentiation of *Hediste diversicolor* from the lagoons of Amvrakikos Gulf

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N. Fraggopoulou, G. Kotoulas, C. Arvanitidis

INTRODUCTION

- ◉ European Union legal frameworks (WFD-MSFD) for the protection and conservation of environments and wetlands do not take into account genetic diversity
- ◉ No tools have been used on this direction



DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 23 October 2000
establishing a framework for Community action in the field of water policy

DIRECTIVE 2008/56/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 17 June 2008
establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)

INTRODUCTION

- The factors affecting gene flow patterns between populations are not always easy to detect
- Genetic isolation possible scenarios:
 1. Isolation by distance
 2. Isolation by ecology
 3. Unrestricted gene flow
 4. Restricted gene flow due to historical events

Cognetti, 1992:

In stressful habitats, there are genotypes that dominate against all others, urging populations to react positively to the new environmental conditions and in cases, it is possible to lead in greater divergence from the original population.

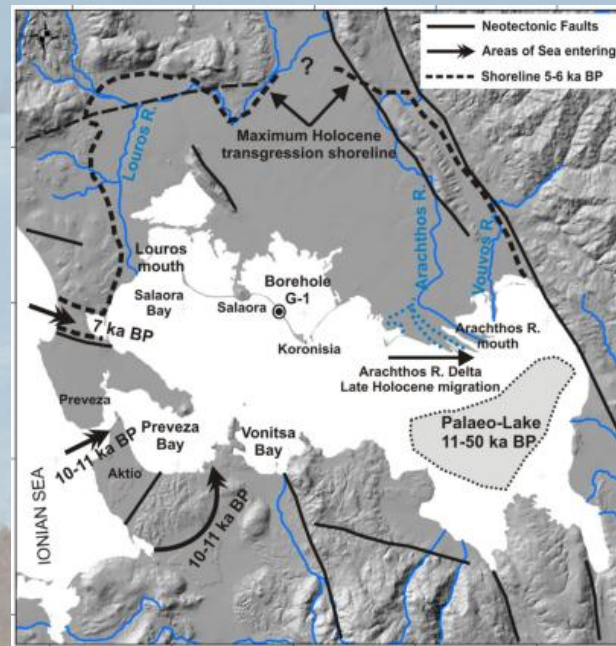
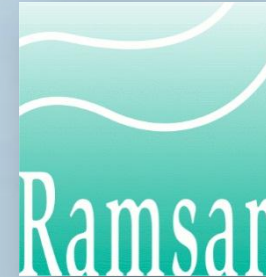
LAGOONS

- ◉ Shallow
- ◉ Spatial and temporal fluctuating conditions
- ◉ Dystrophic crises
- ◉ Human activities
- ◉ Small number of tolerant species



LAGOONS OF AMVRAKIKOS GULF

- ◉ Protected by Ramsar convention
- ◉ Aquaculture activities
- ◉ Dystrophic crisis events
- ◉ Formation history similar to the formation history of the Black Sea: connection to the Ionian was partial or completely interrupted several times.

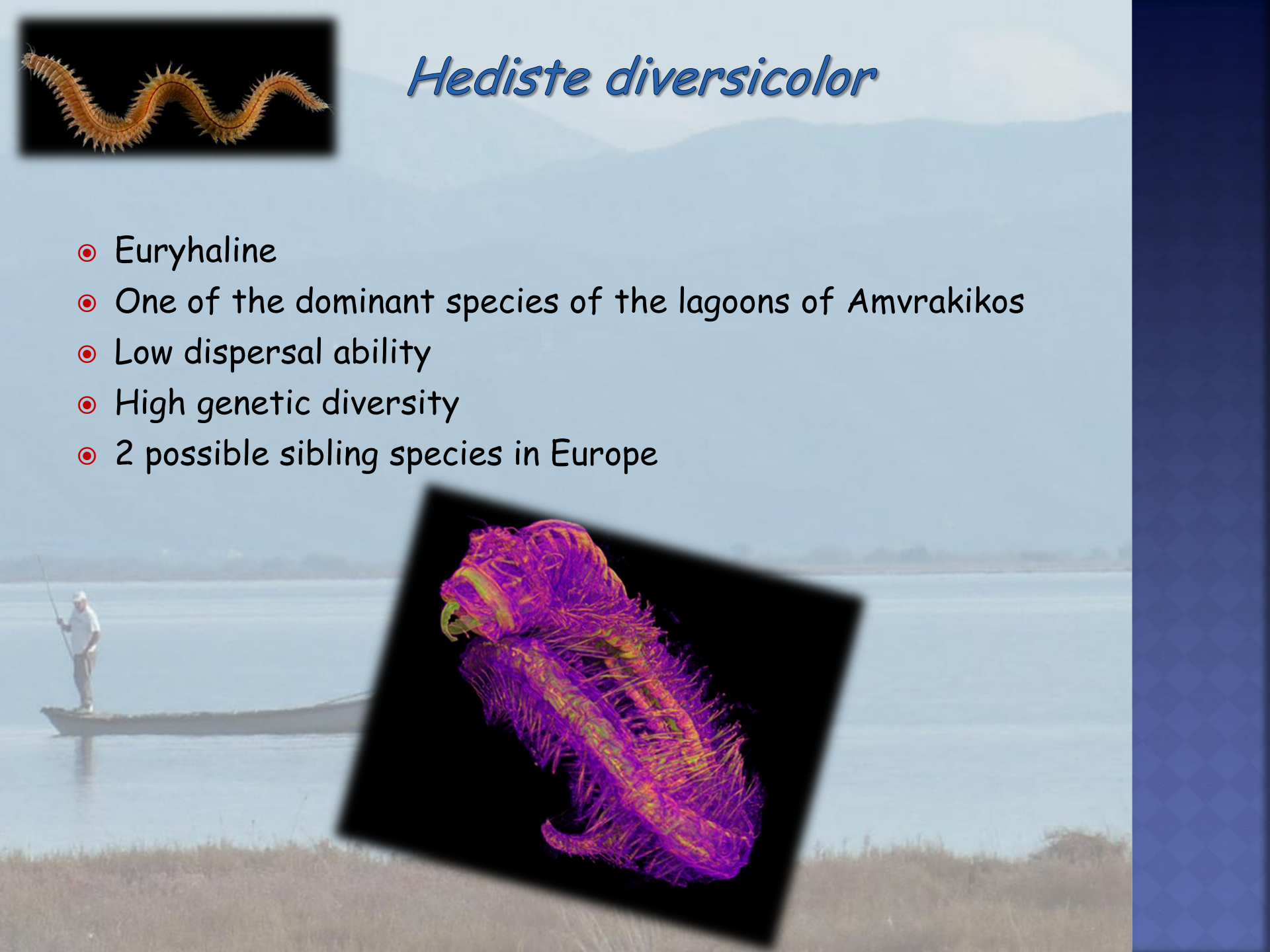
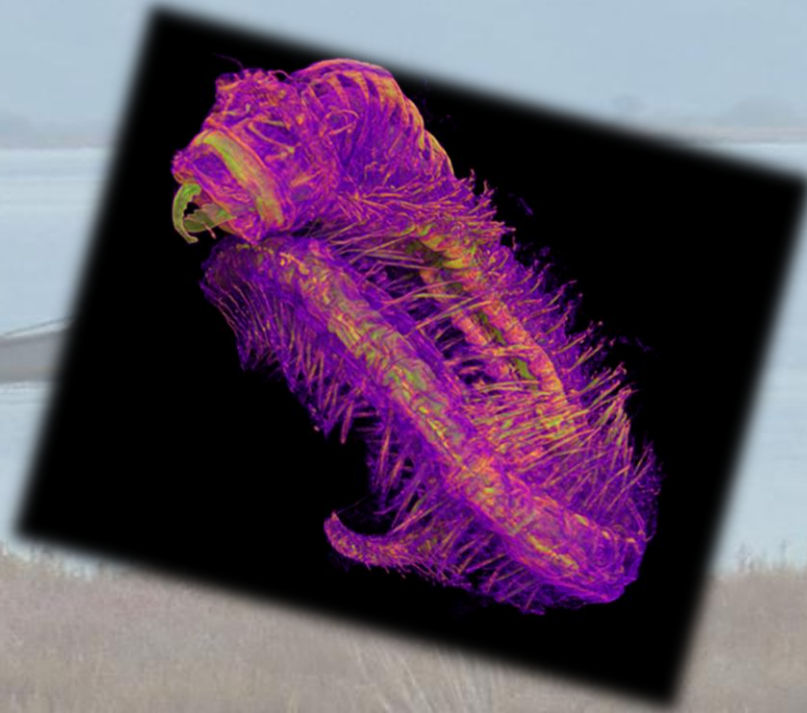


Avramidis et al., 2013



Hediste diversicolor

- ◉ Euryhaline
- ◉ One of the dominant species of the lagoons of Amvrakikos
- ◉ Low dispersal ability
- ◉ High genetic diversity
- ◉ 2 possible sibling species in Europe

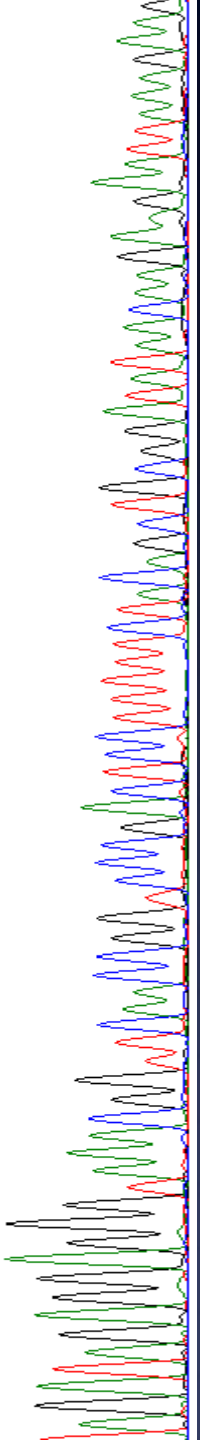


STUDY SITE

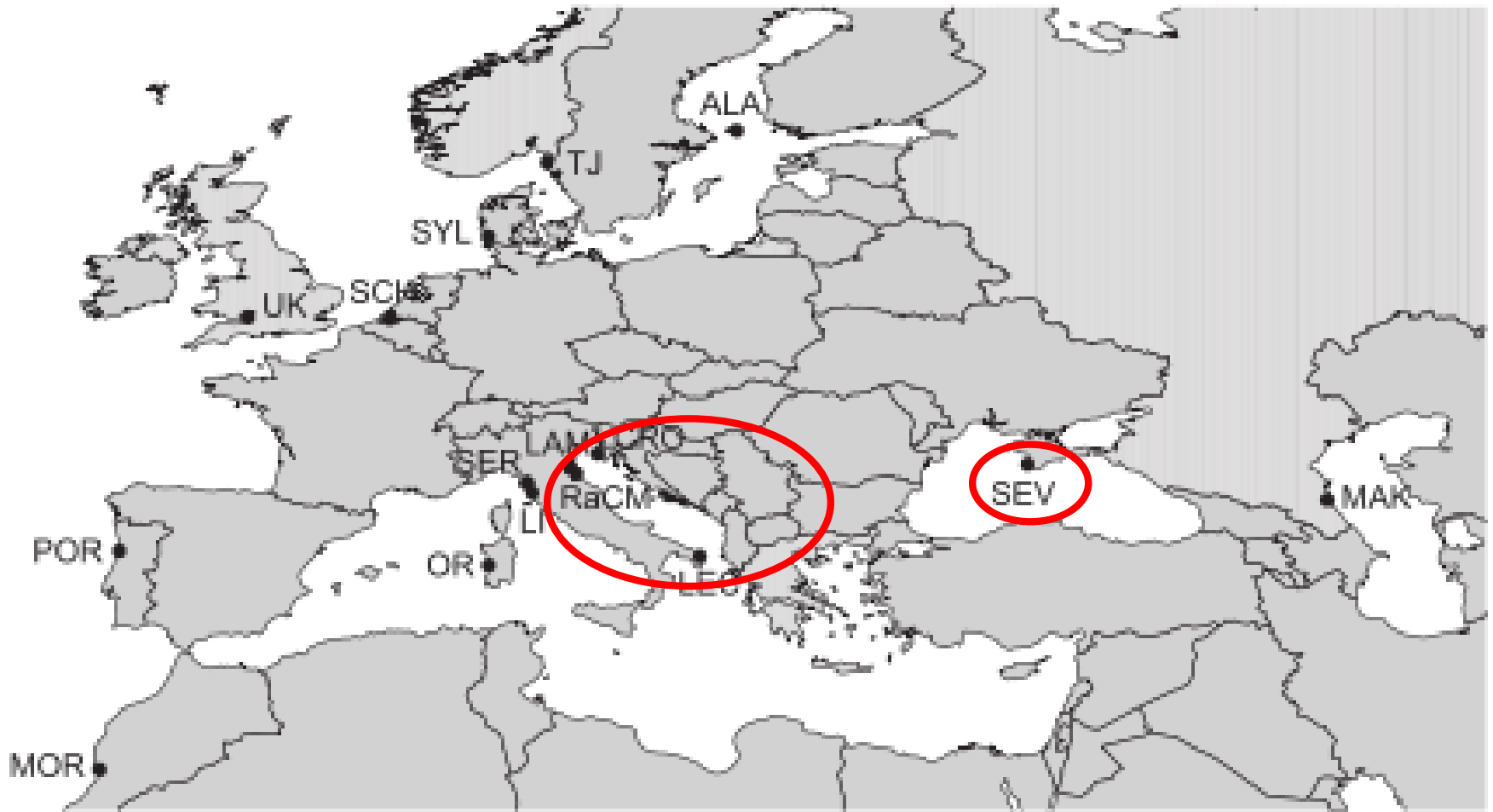


MATERIALS & METHODS

- ◉ Morphometric features (length, width, number of segments)
- ◉ Genomic DNA extraction and amplification of COI gene fragment (240 bp) with newly designed primer pair
- ◉ Bayesian analysis
- ◉ Phylogenetic networks
- ◉ Diversity indices
- ◉ AMOVA and pairwise F_{ST} s
- ◉ nMDS
- ◉ Sequences from GenBank



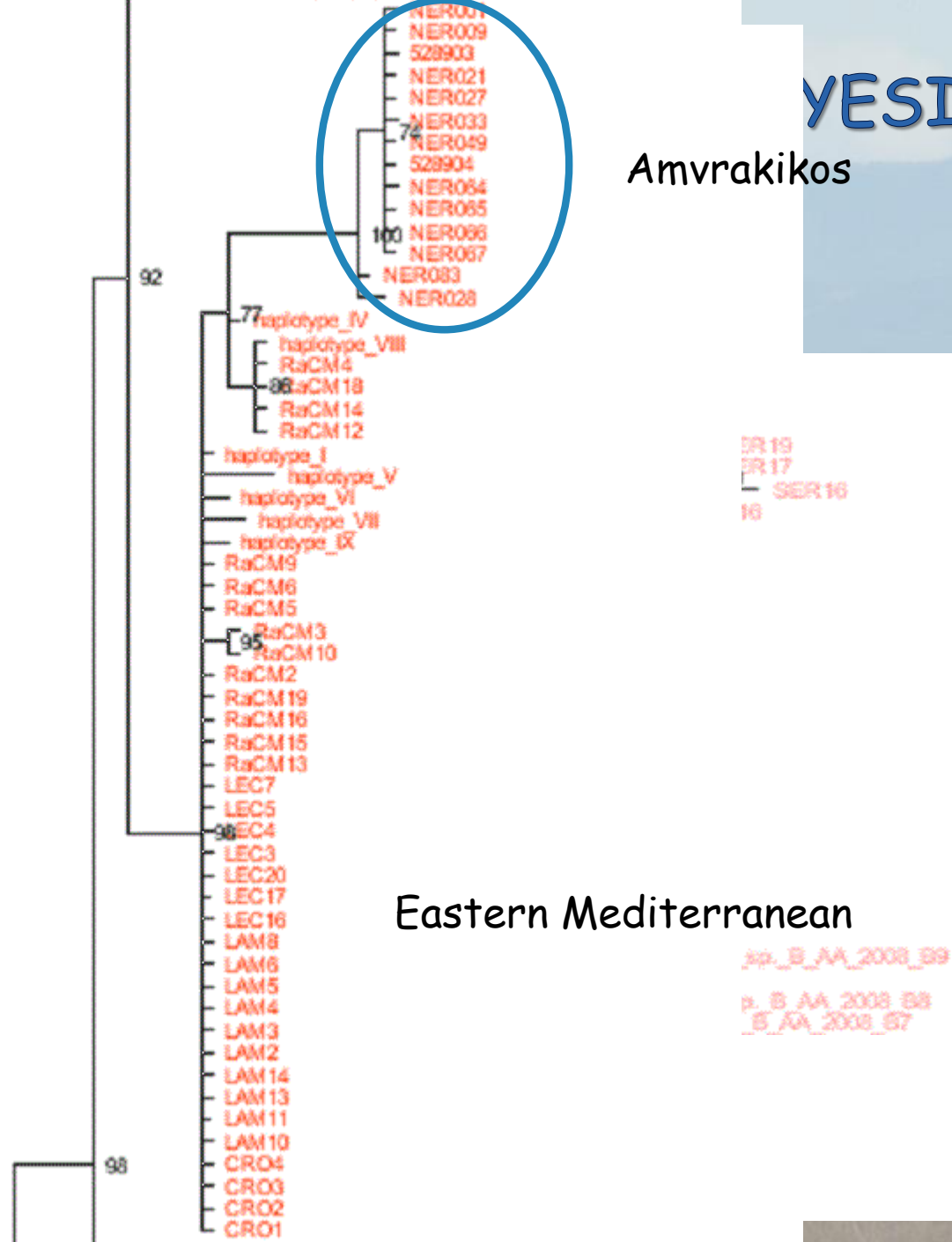
ΑΠΟΤΕΛΕΣΜΑΤΑ



Virgilio et al., 2009

YESIAN

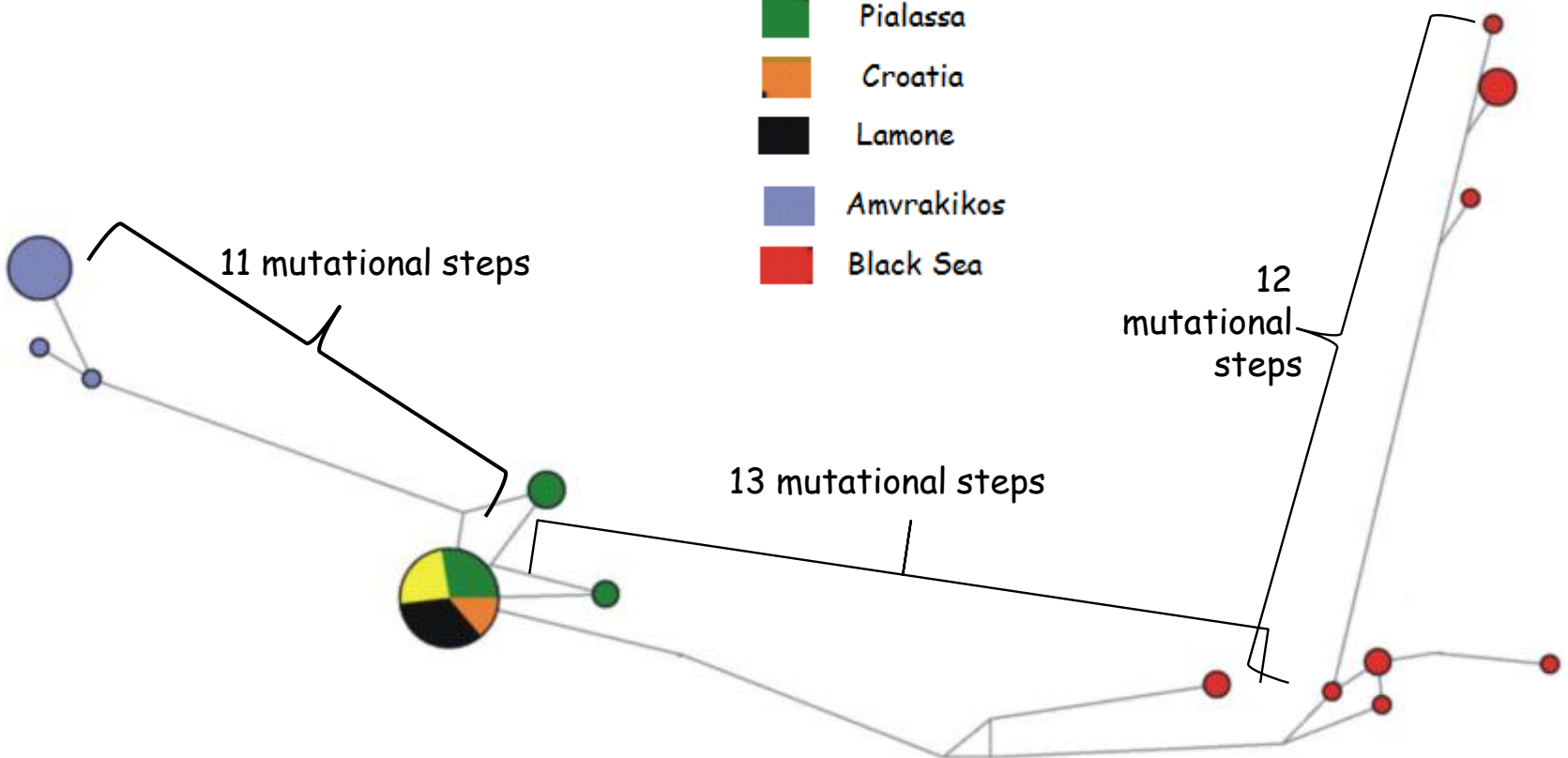
Amvrakikos



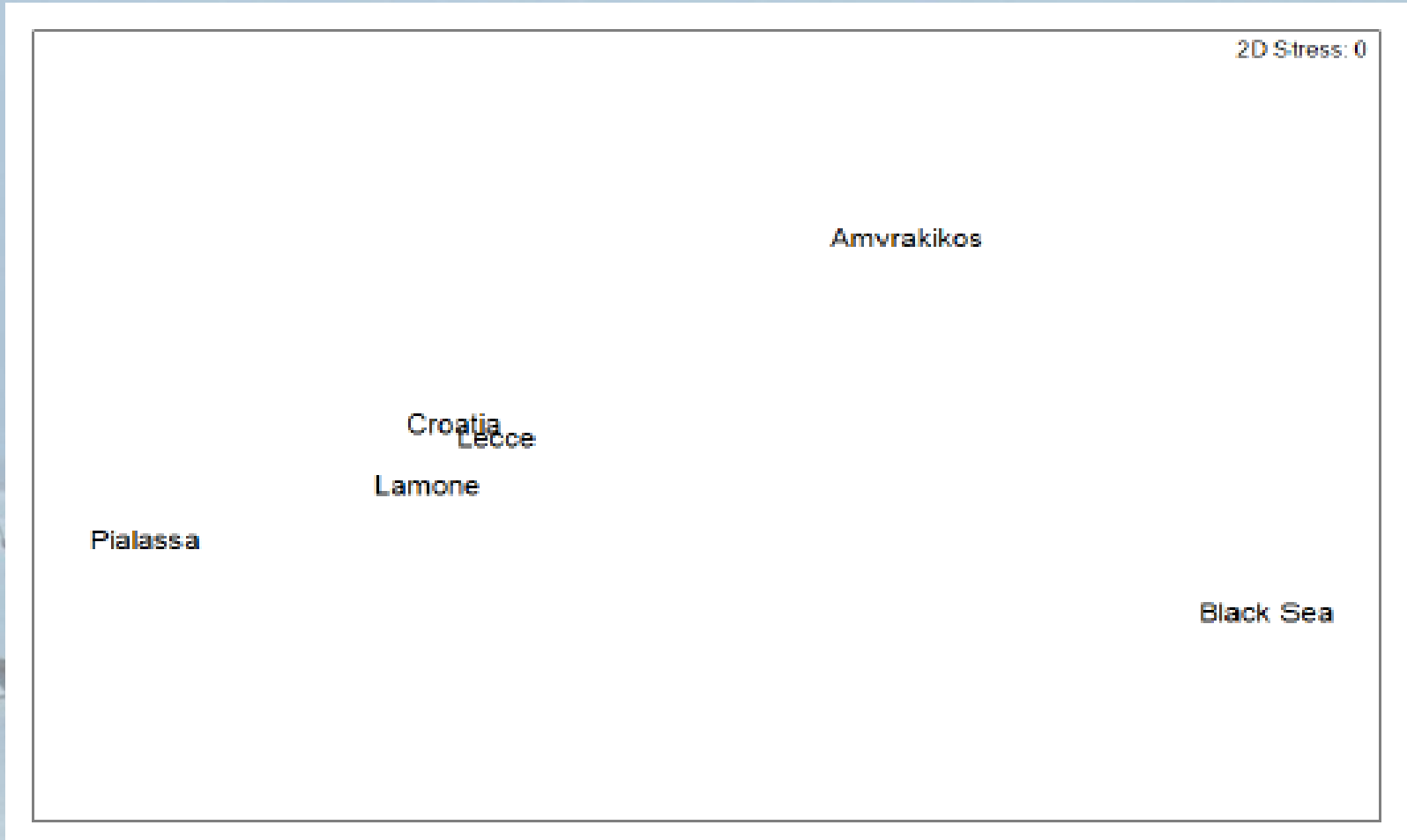
Eastern Mediterranean

PHYLOGENETIC NETWORKS

- Lecce
- Pialassa
- Croatia
- Lamone
- Amvrakikos
- Black Sea



nMDS PLOT



DIVERSITY INDICES

- ◉ Possible bottleneck for the Amvrakikos populations
- ◉ Suggesting stable populations in Pialassa and Black Sea

	n	Hd	π
Amvrakikos	14	0.275	0.0019
Black Sea	13	0.897	0.043
Pialassa	14	0.615	0.00499
Lecce	7	0	0
Lamone	10	0	0
Croatia	4	0	0

PAIRWISE F_{ST}

- ◉ High values for Amvrakikos
- ◉ Lower values for Adriatic populations

	Amvrakikos	Black Sea	Pialassa	Lecce	Lamone
Black Sea	0.78265				
Pialassa	0.91944	0.66386			
Lecce	0.96905	0.60148	0.16934		
Lamone	0.97318	0.64293	0.21532	0	
Croatia	0.96336	0.54251	0.09189	0	0

Values
were
significant

AMOVA

- ◉ 3 groups: Amvrakikos, Adriatic, Black Sea
- ◉ Highest variation among groups and within populations
- ◉ Low variation within groups

Source of variation	d.f.	SS	Variance components	Percentage of Variation	Fixation indices
Among groups	2	9.914	0.24917 Va	51.65	$F_{SC} : 0.07062$
Among populations within groups	3	1.057	0.01647 Vb	3.41	$F_{ST} : 0.55060$
Within populations	56	12.142	0.21682 Vc	44.94	$F_{CT} : 0.51646$
Total	61	23.113	0.49837		

DISCUSSION

- ◉ Populations from Amvrakikos are differentiated
- ◉ Diversity indices indicate bottleneck
- ◉ Amvrakikos was found to have limited gene flow also for other species: *Melicertus (Penaeus) kerathurus* (Pellerito et al., 2009), *Carcinus aestuarii* (Ragioneri & Schubart, 2013)
- ◉ Formation history of the Gulf and dystrophic crises events could be responsible for the differentiation of Amvrakikos haplotypes
- ◉ The populations in the Gulf are genetically differentiated from the rest of the eastern Mediterranean. That is another evidence for the necessity to include genetic diversity in the design of long-term successful management and conservation plans and legislation.

Acknowledgments

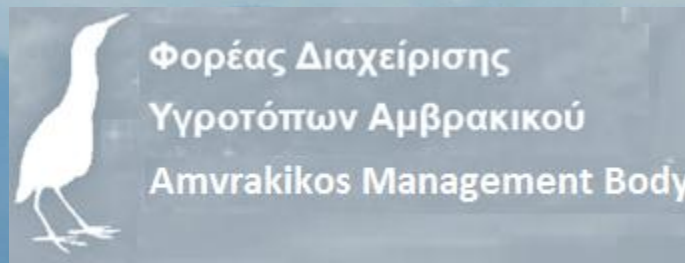
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