

## Maritime Connections and their Influence on Ancient Sea Trade:

Objects, People, Places

19/20/21 February 2024



## Reconstructing navigation in the northern Adriatic through the discovery of shipwrecks

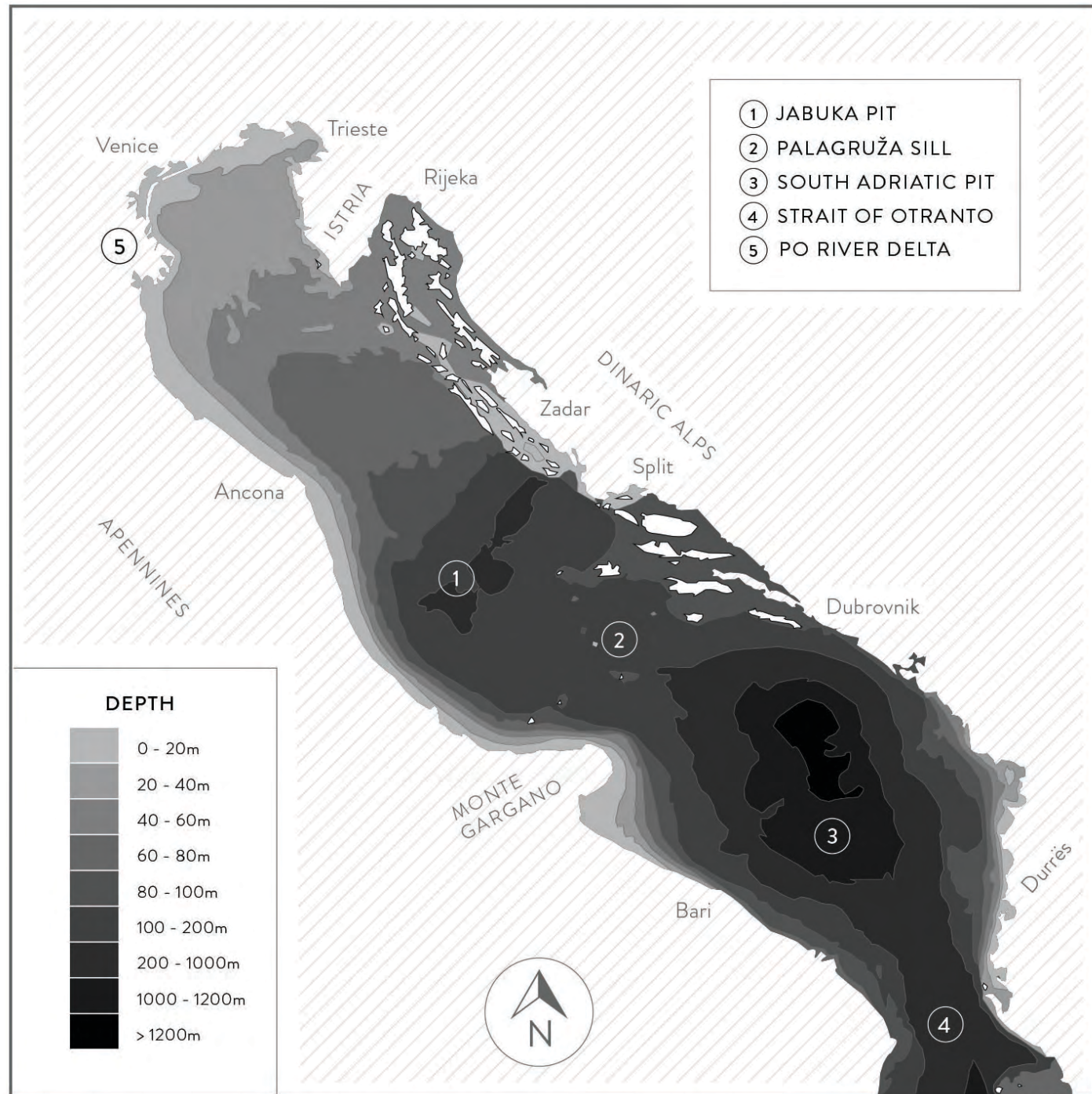
Giulia Boetto

*Centre Camille Jullian UMR 7299 (CNRS, Aix Marseille University)*

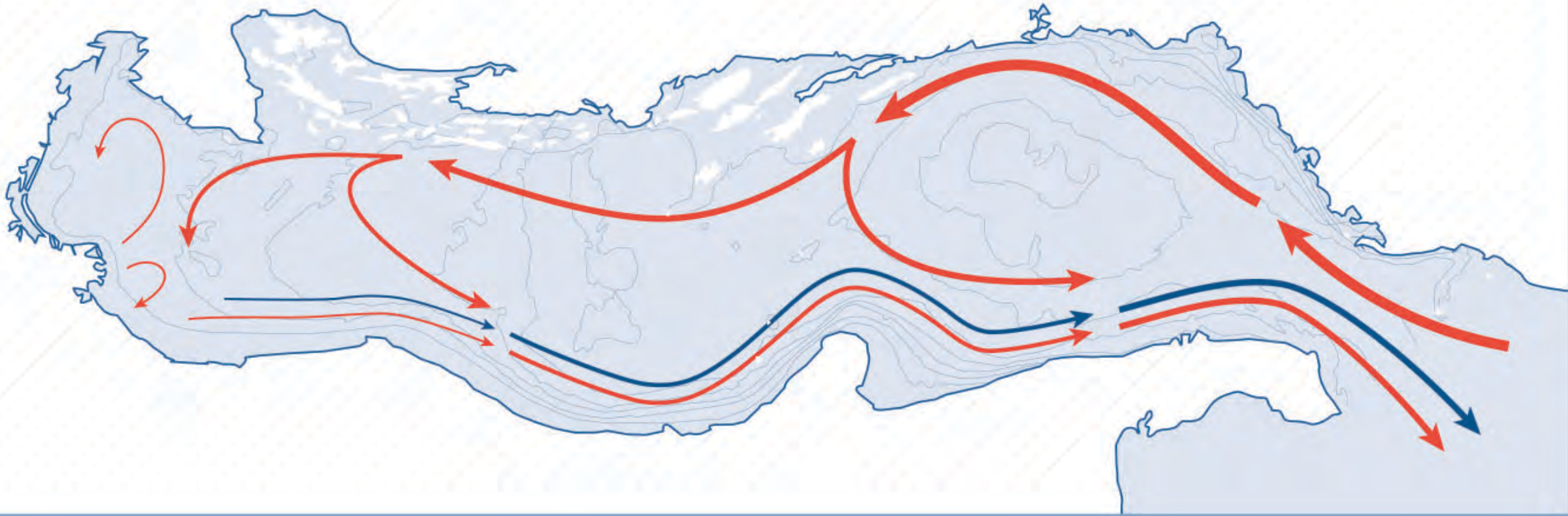




Palagruža

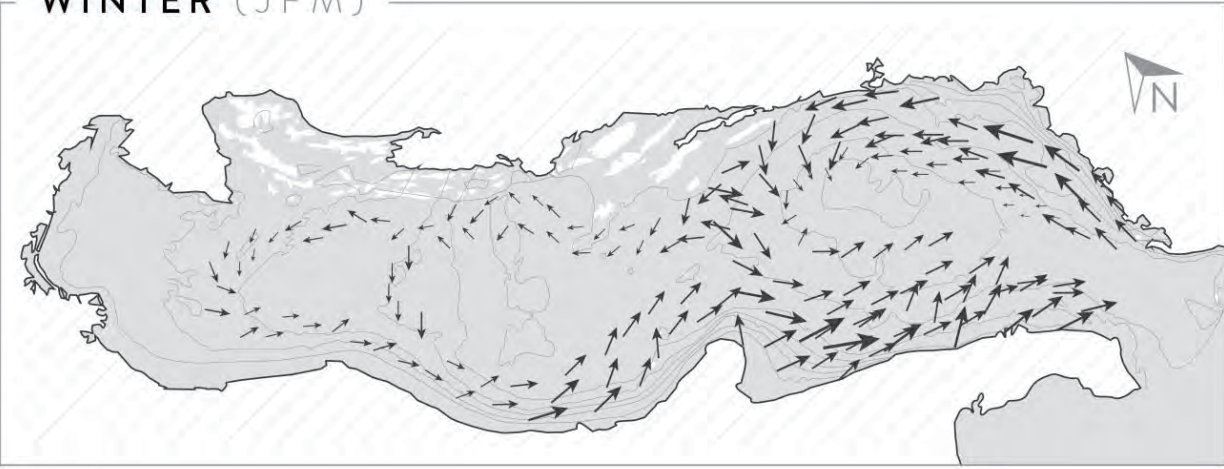


## East Adriatic Current (EAC)



## West Adriatic Current (WAC)

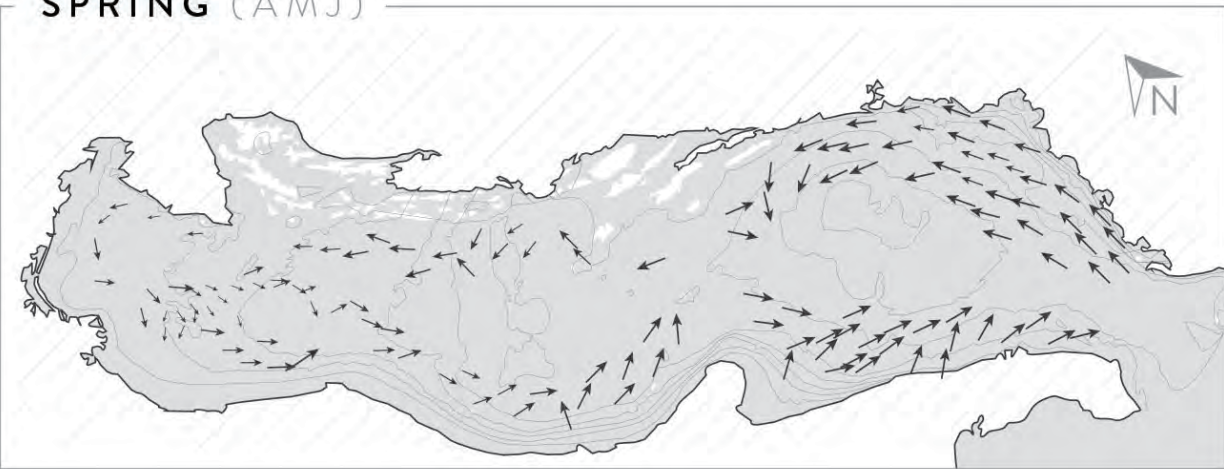
WINTER (JFM)



SUMMER (JAS)



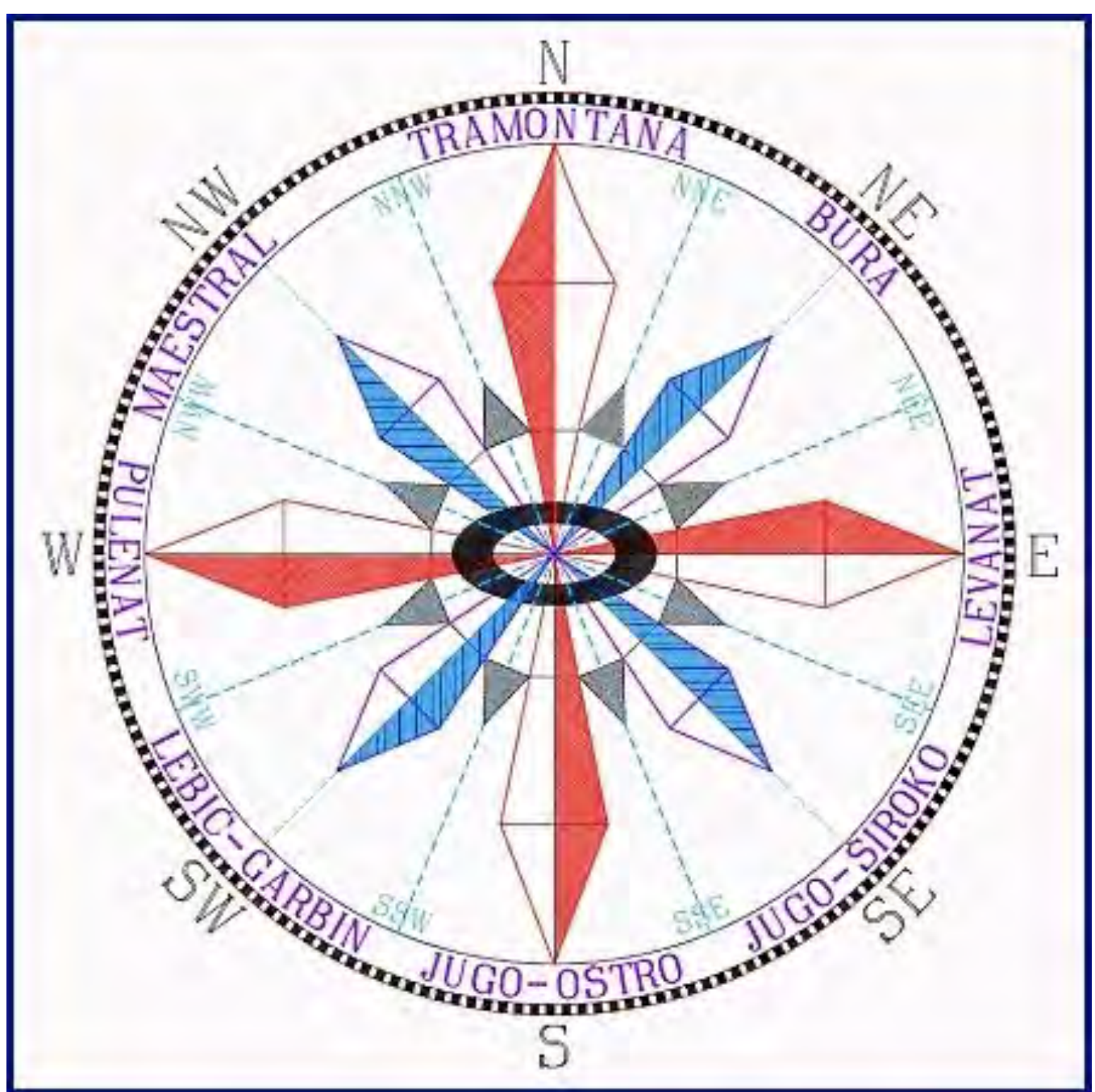
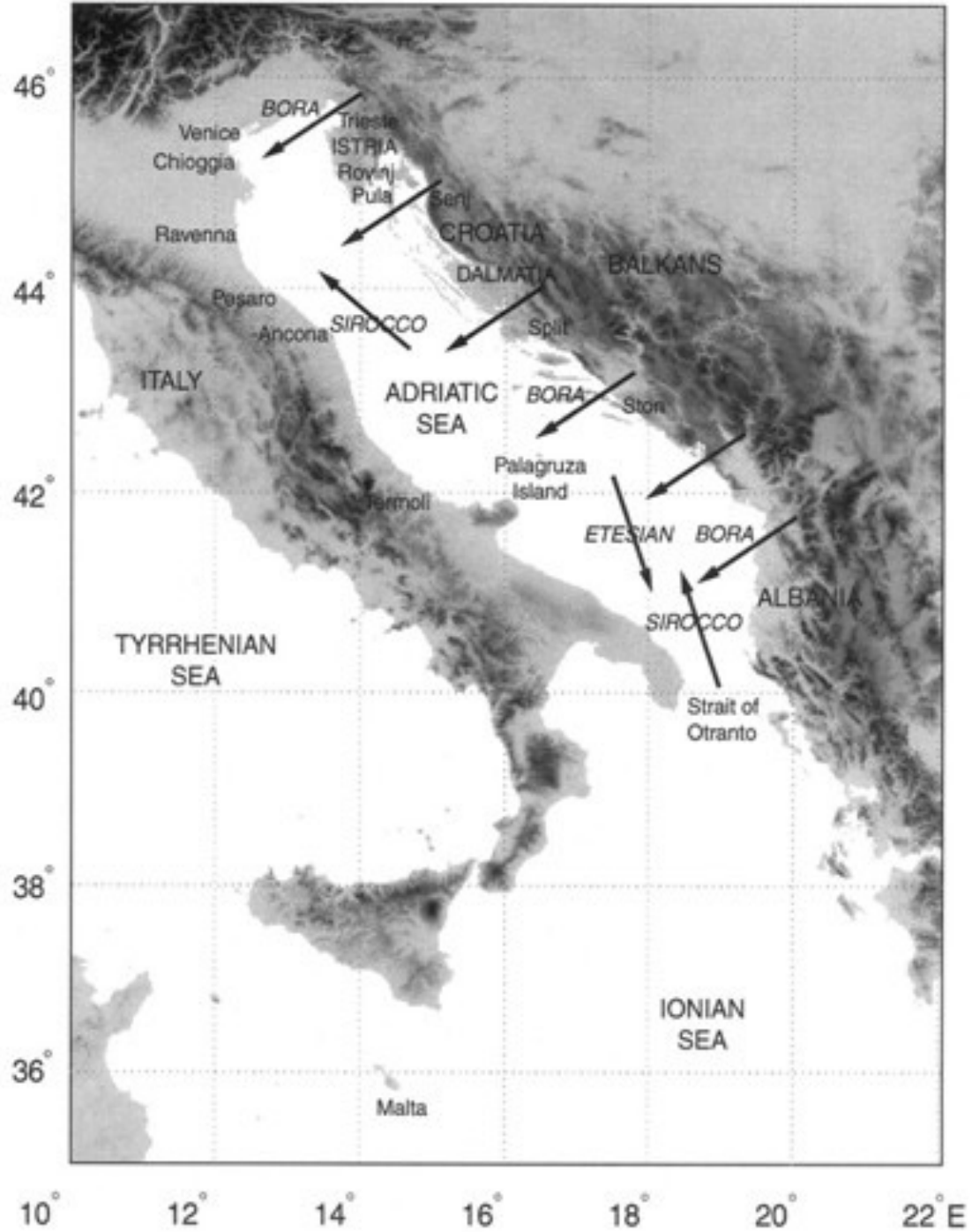
SPRING (AMJ)



FALL (OND)



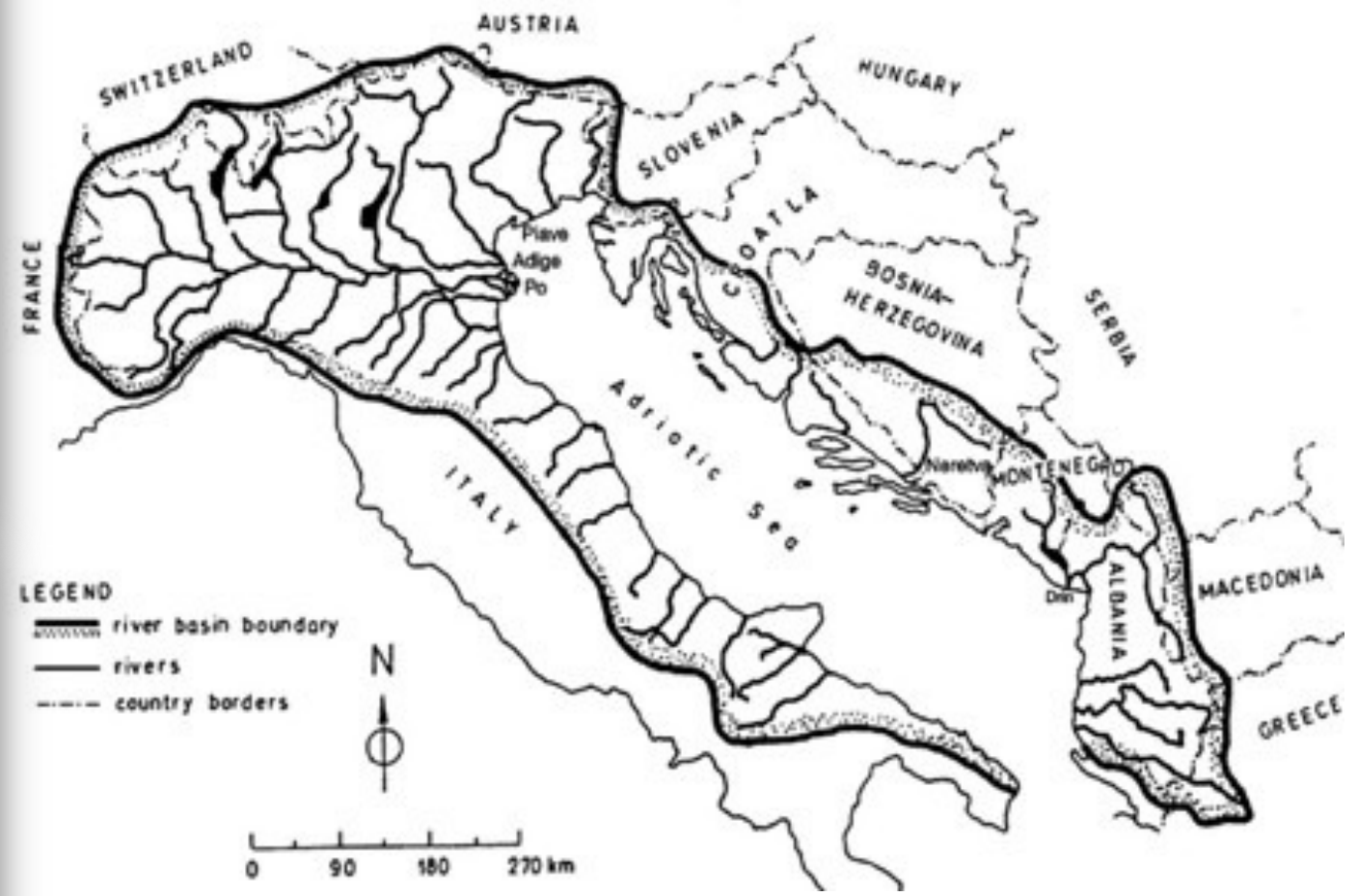
0 km 100      20 cm/s





*Velebit Channel*

*Pag Island*







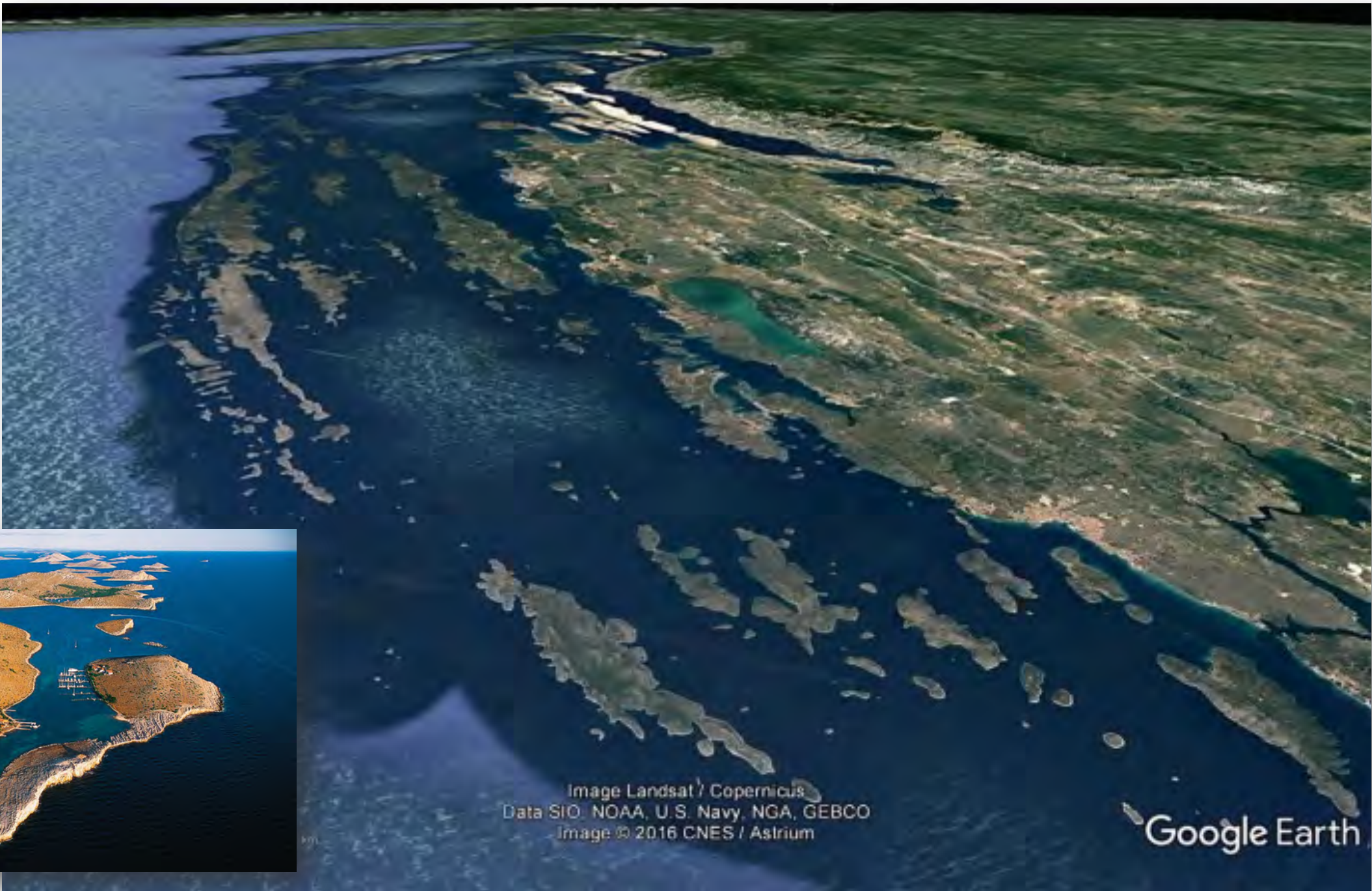
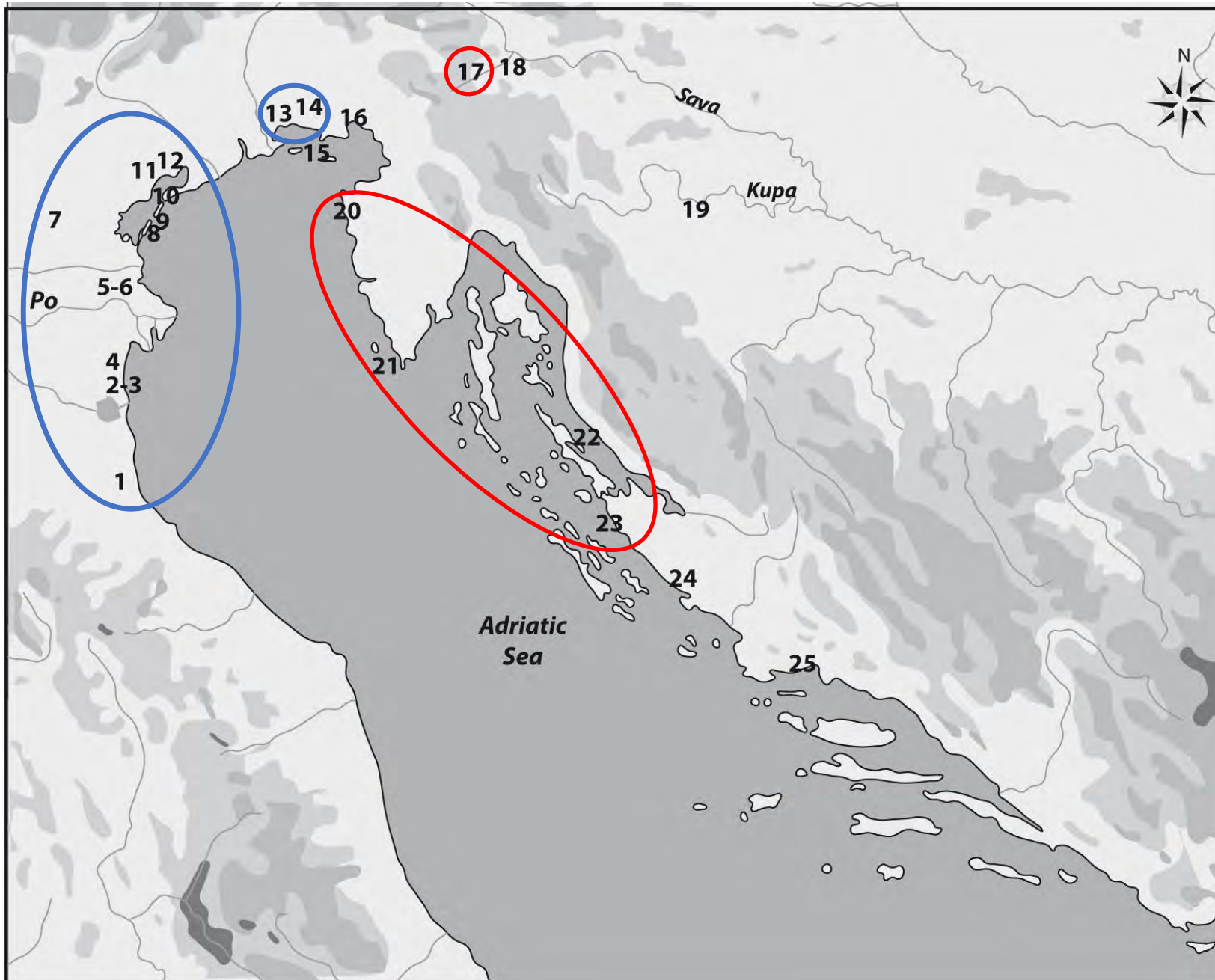




Image Landsat / Copernicus  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO  
Image © 2016 CNES / Airbus

Google Earth







## North-western Adriatic

espace de navigation fluvial	espace de navigation fluvio-maritime
<p>Stella, Corte Cavanella 1 et 2, Cavanella d'Adige</p>  <p>point croisé</p>	<p>Comacchio, Lido de Venise, Cervia, Pomposa</p>  <p>point croisé</p>

## North-eastern Adriatic

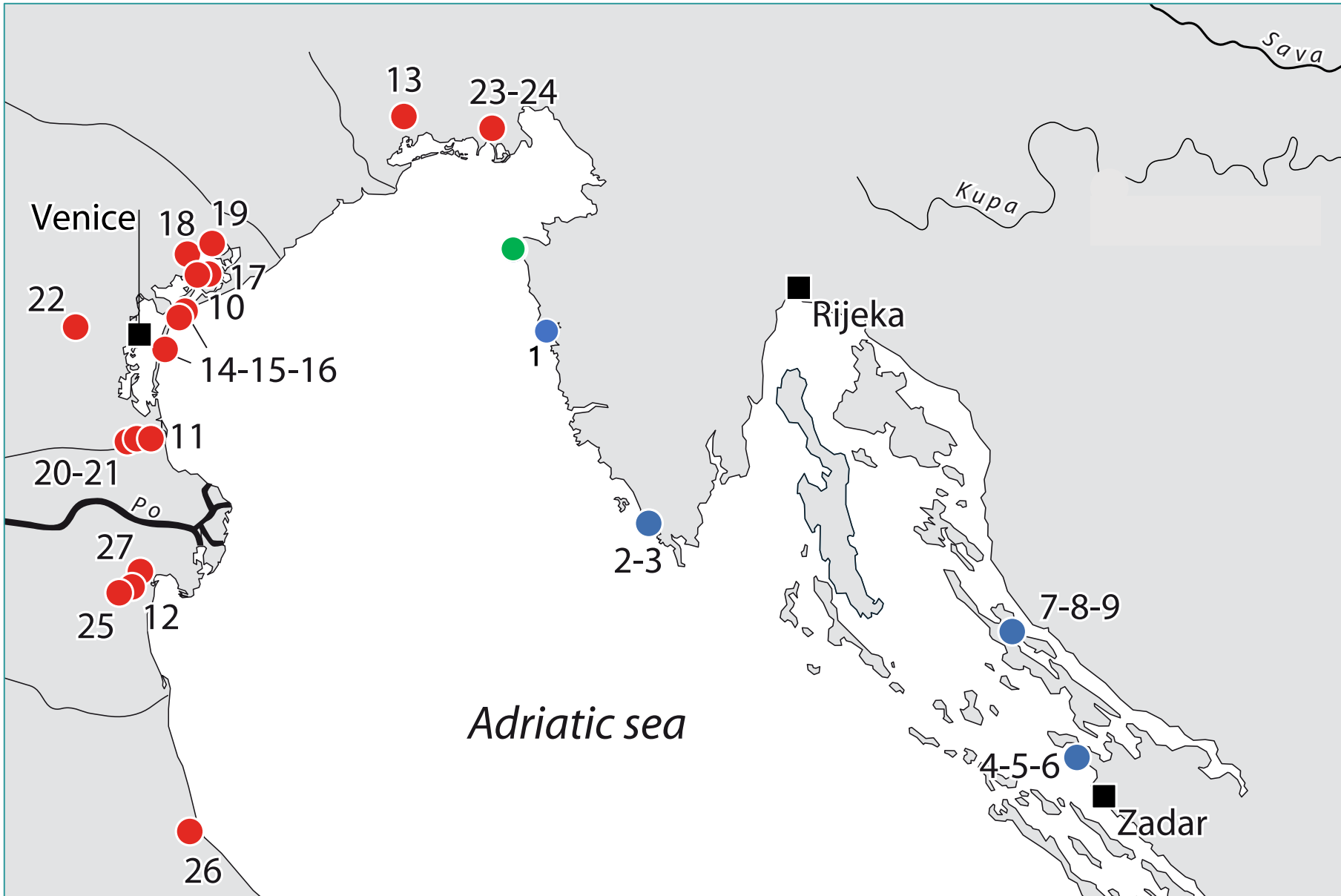
espace de navigation fluvial	espace de navigation maritime
<p>Lipe</p>  <p>point en zig-zag</p>	<p>Nin-Zaton, Caska, Zambrajia ?</p>  <p>point de surjet</p>



# ADRIBOATS – Navires et navigation en Adriatique orientale dans l'Antiquité



# Adriatic Sewn-Boats



## Zambratija

1, Poreč 1; 2-3, Pula 1 & 2;  
4-6, Zaton 1, 2 & 3; 7-9,  
Caska 1, 3 & 4

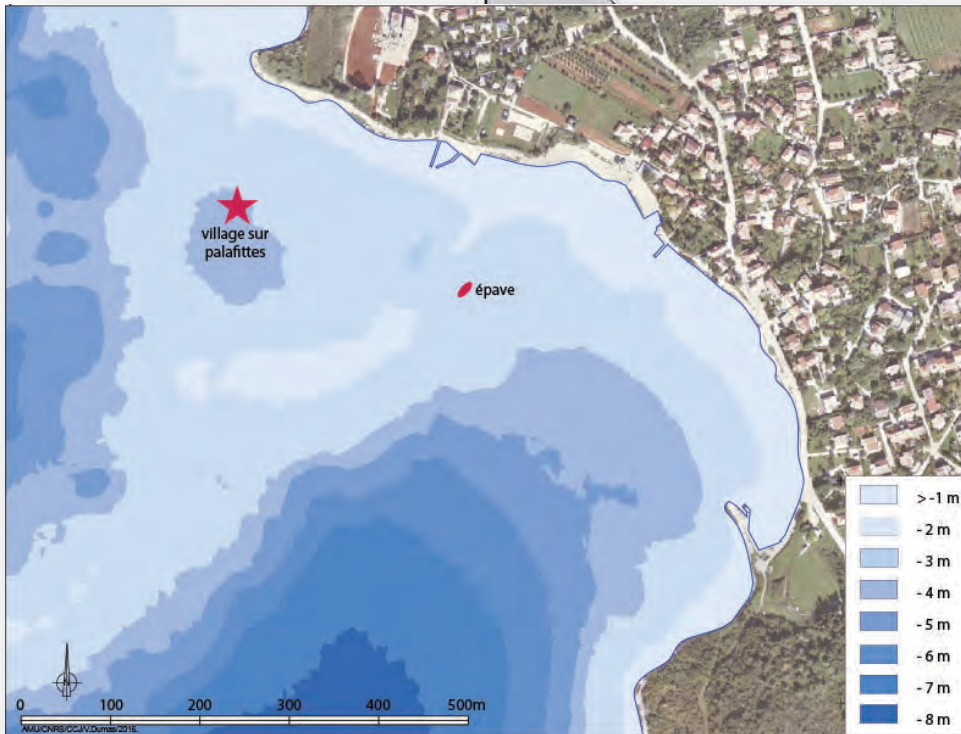
10, Barena del Vigno; 11,  
Cavanella d'Adige; 12,  
Comacchio; 13, Stella 1; 14-  
16, Lido di Venezia 1-3; 17,  
S. Francesco del Deserto;  
18, Marcon; 19, Meolo 1;  
20-21, Corte Cavanella 1 &  
2; 22, Padua; 23-24,  
Aquileia 1 & 2; 25, Santa  
Maria in Padovetere; 26,  
Cervia; 27, Pomposa

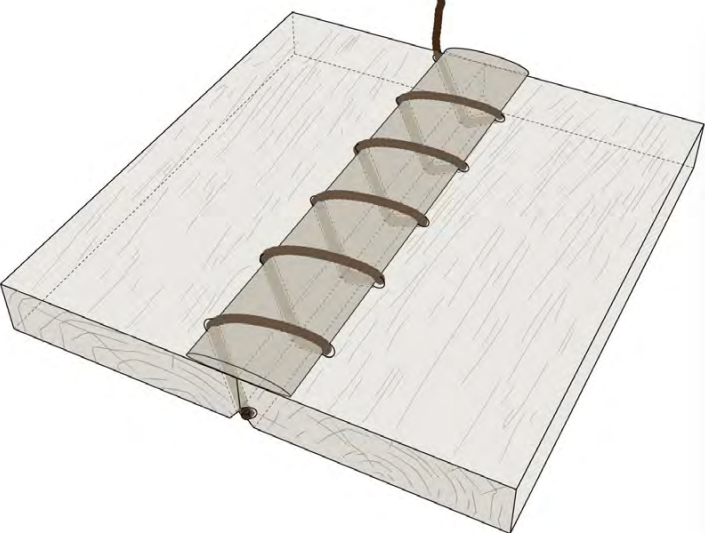
# Zambratija

## At the origin of the Adriatic Sewn-Boat tradition



# Zambratija (1120-930 BC)





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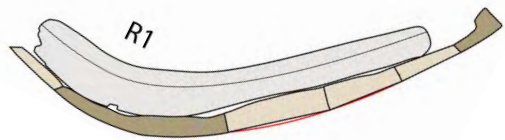
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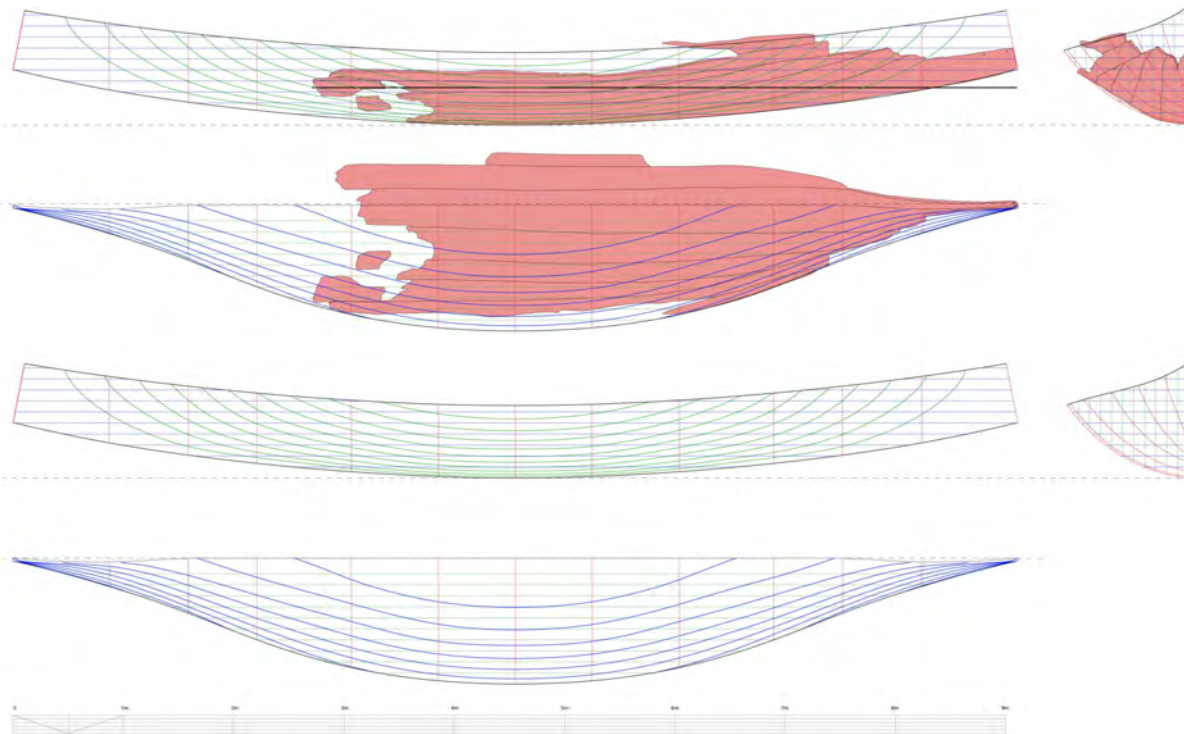
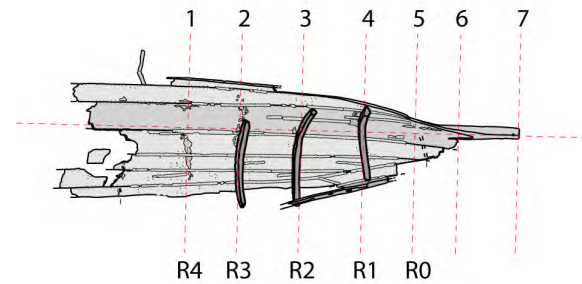
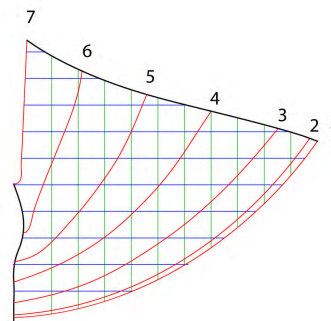
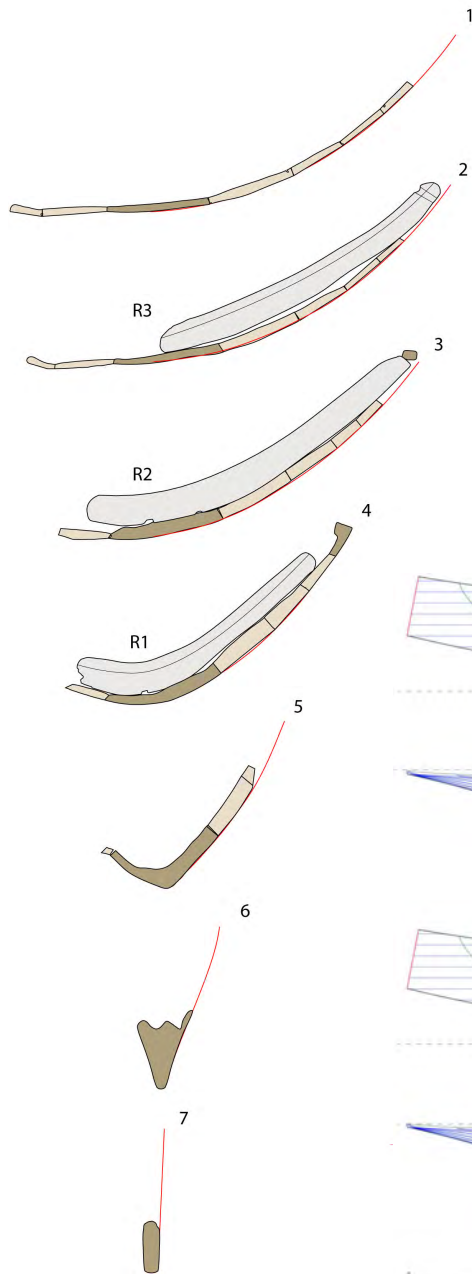
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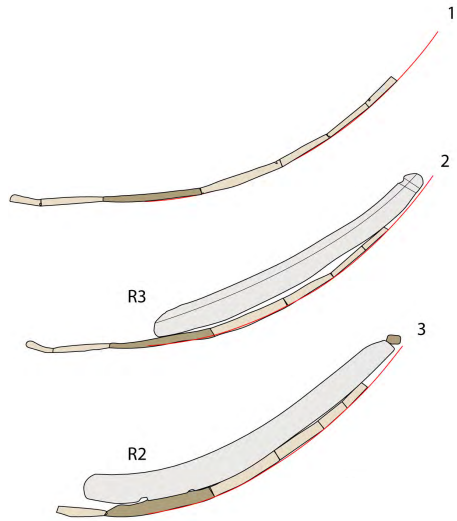


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?

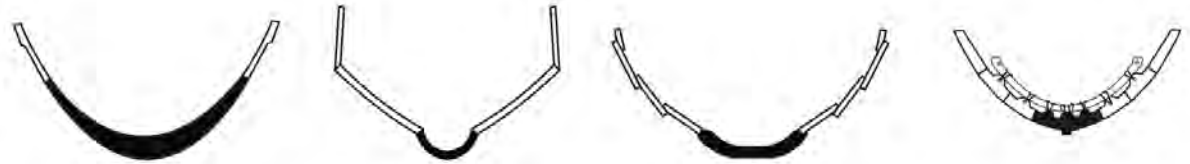
# 1. Structural system & reconstruction

?

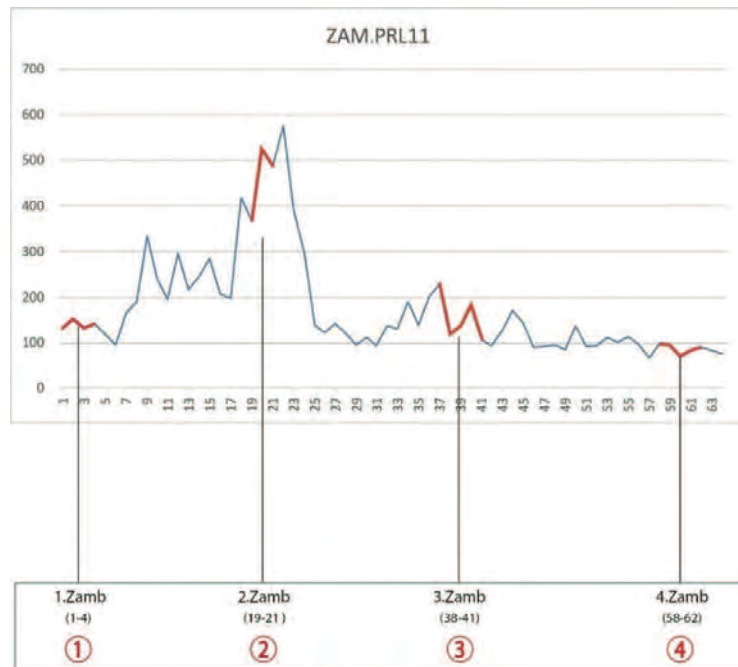
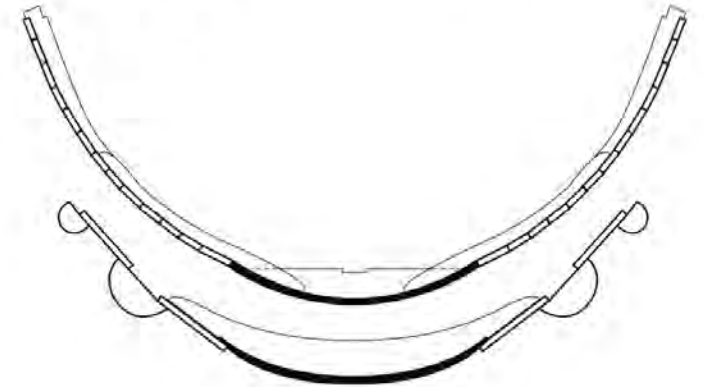
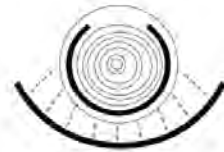
# 2. Waterproofing



2.1 surélévation simple



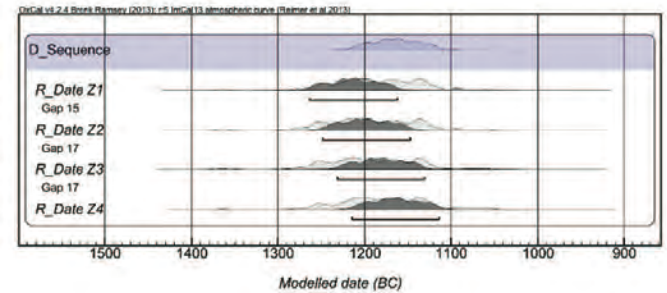
2.2 expansion (généralement complétée par une surélévation)

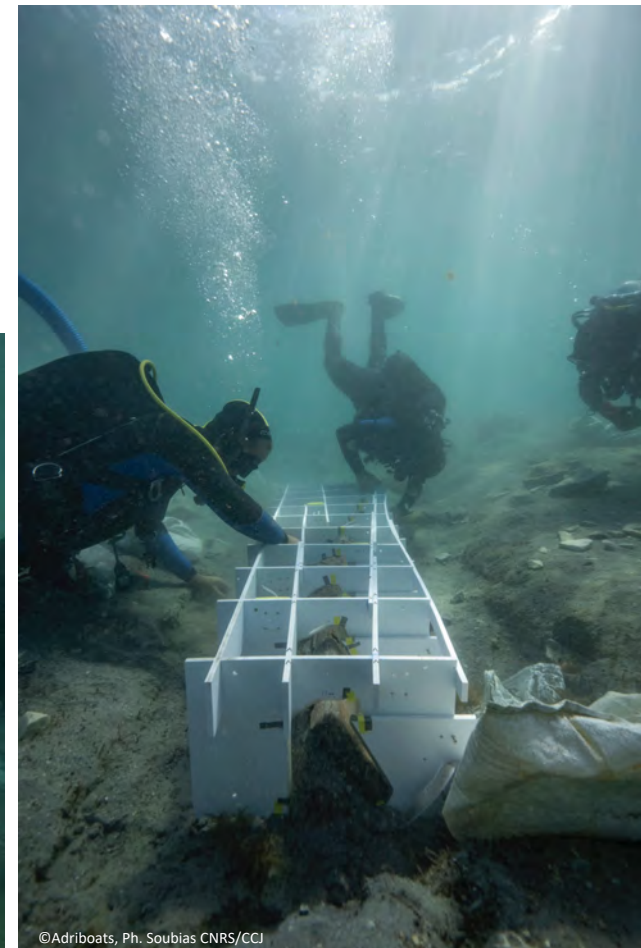
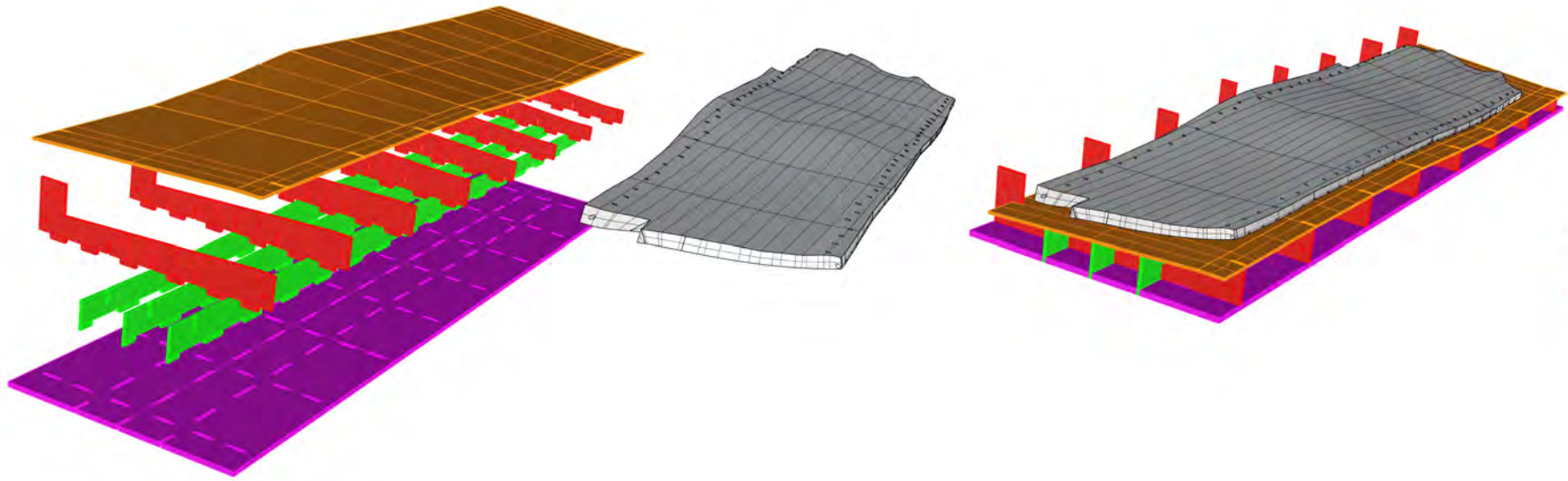


ZAM/PRL11

?

# 3. Dating







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## Structural system:

monoxylous base subtraction +  
simple elevation  
or  
monoxylous base subtraction &  
expansion + elevation



## Dating:

Dendrochronology (in progress)  
AMS dating + wiggle matching  
(coming in 2025)

# Waterproofing system



Interior face

Luting between planks



Exterior face



## Repairs

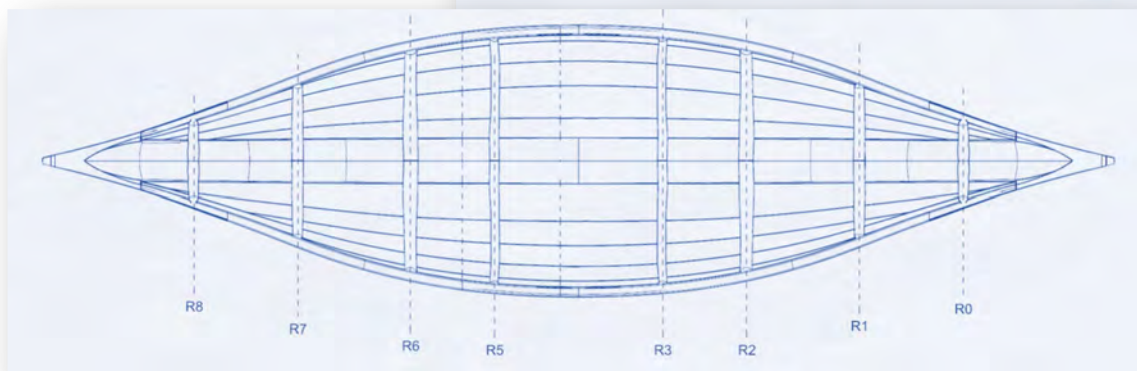
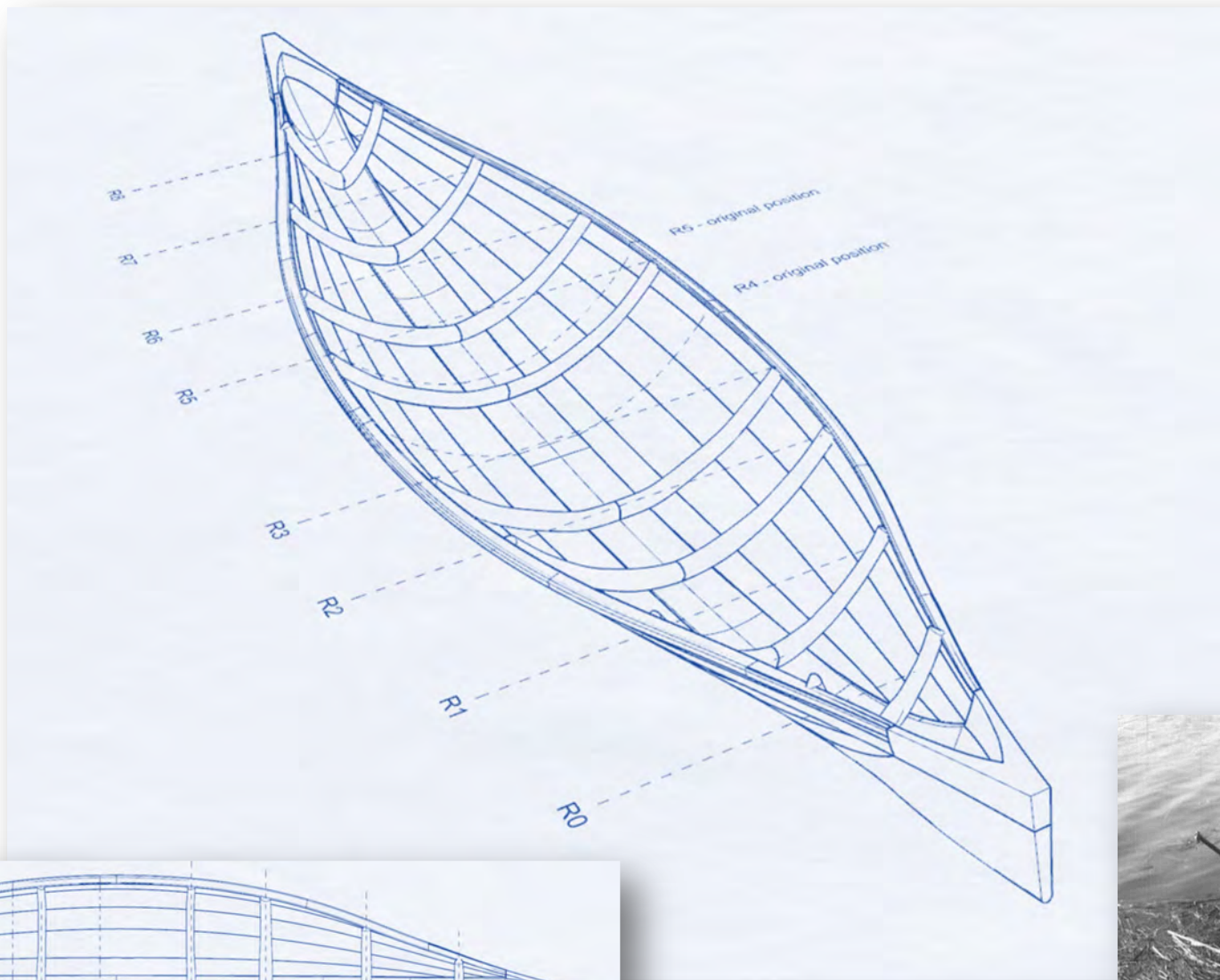


# Zambratija

Length: 9.11 m

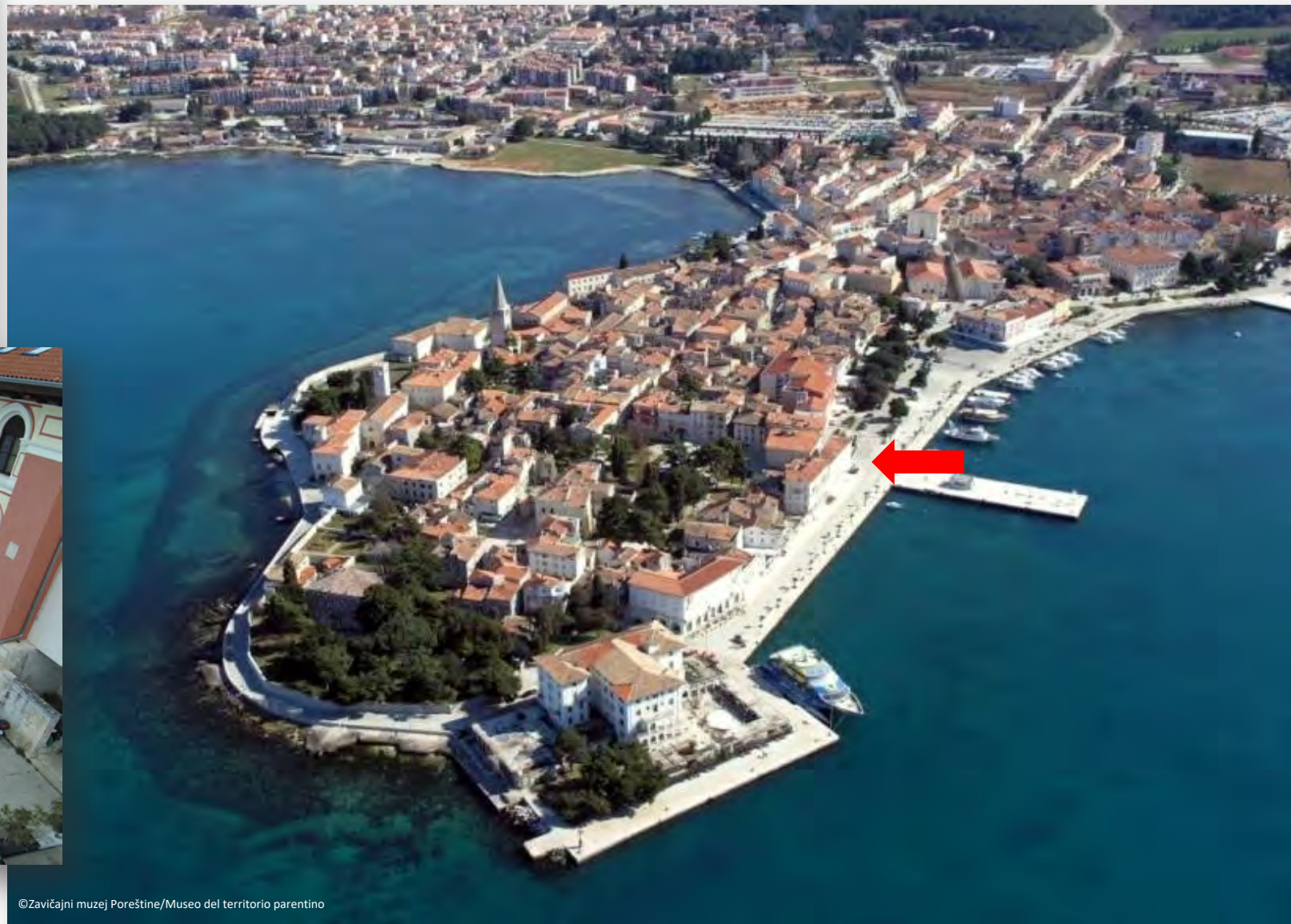
Width: 2.28 m

Depth: 0.66 m



Lađa, Neretva River

# Poreč, Istria



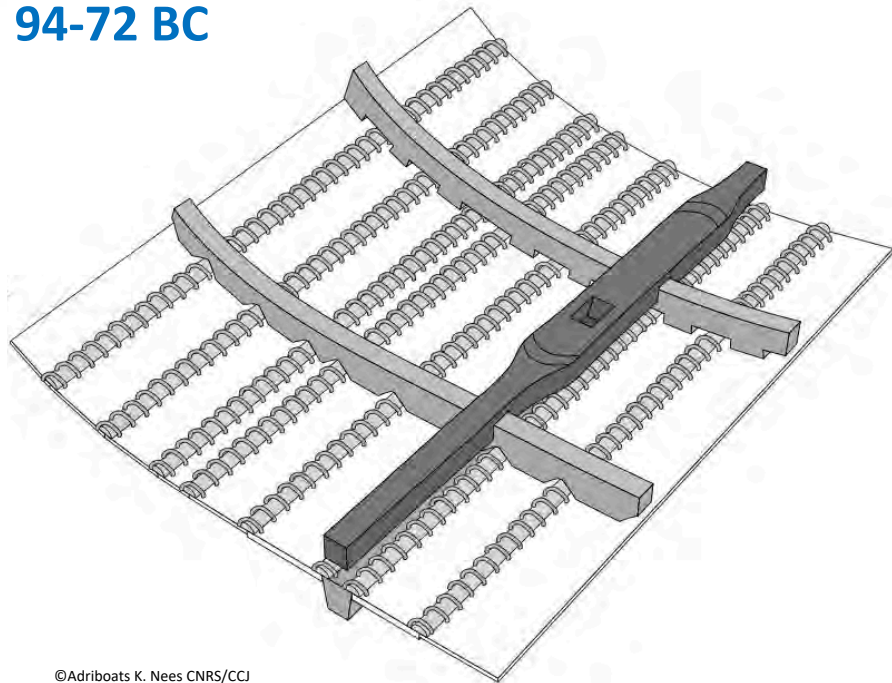
©Zavičajni muzej Poreštine/Museo del territorio parentino

©Zavičajni muzej Poreštine/Museo del territorio parentino

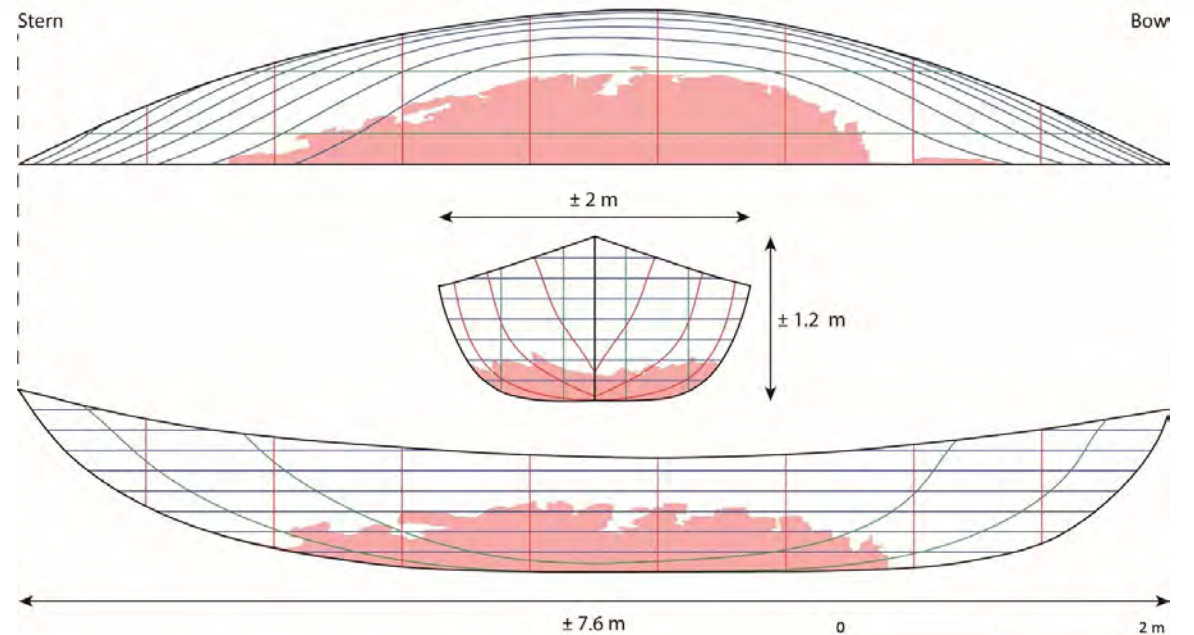




## Poreč 1, 94-72 BC

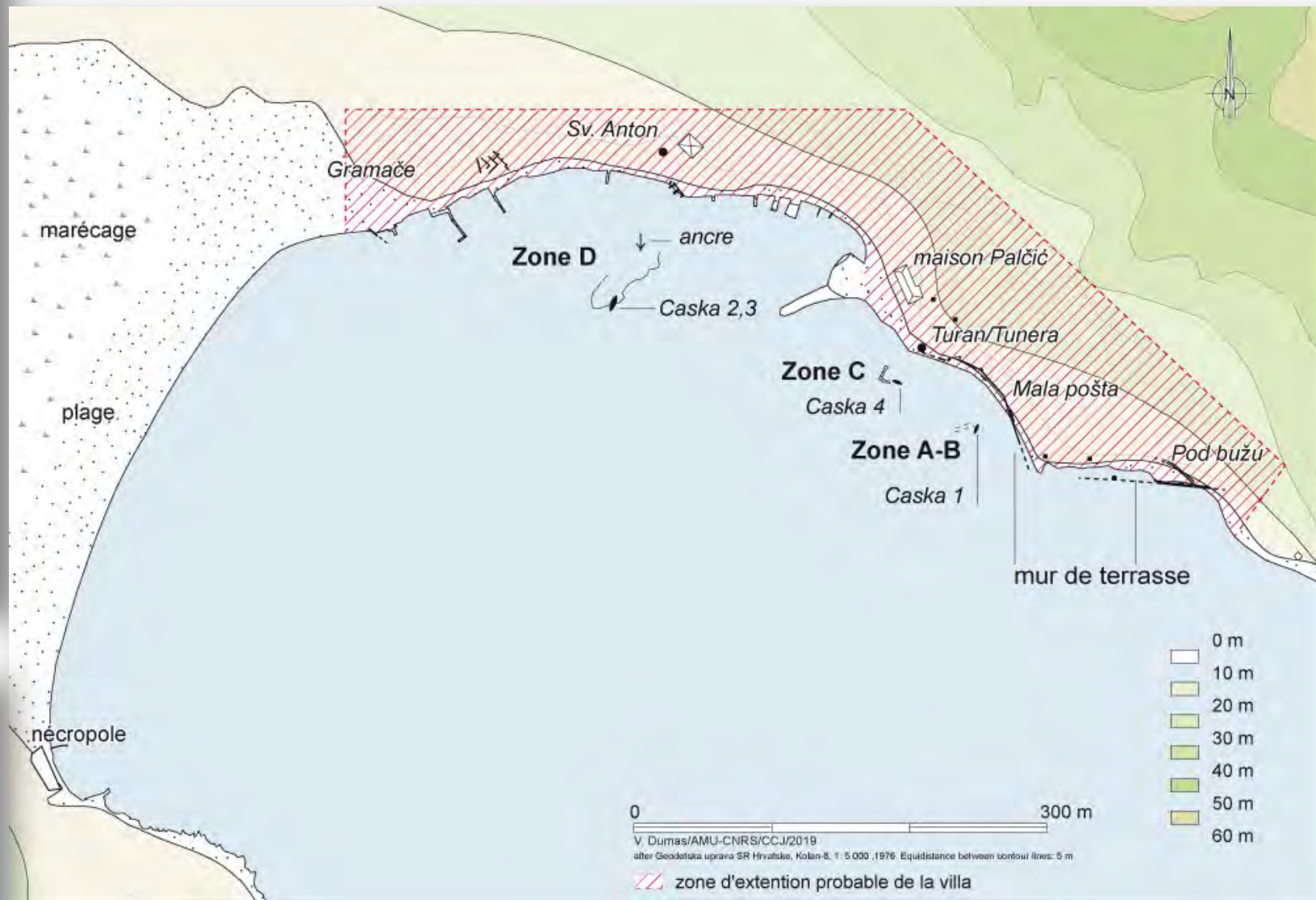


©Adriboats K. Nees CNRS/CCJ

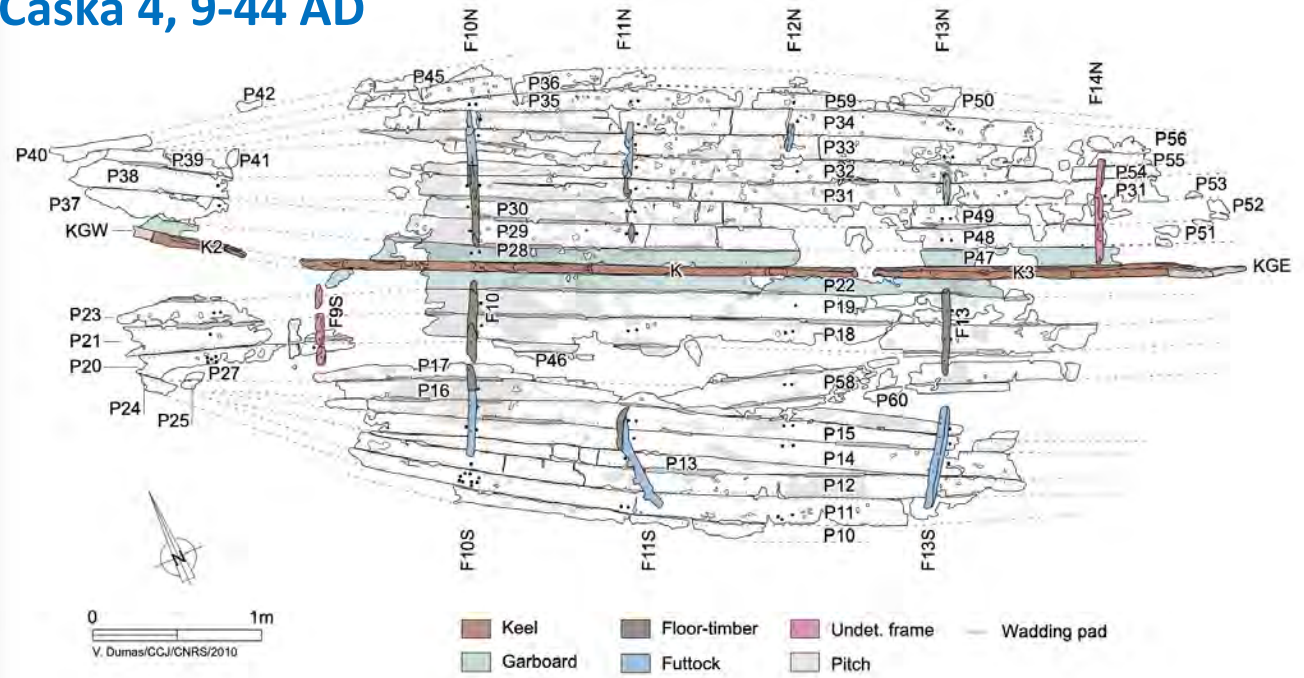


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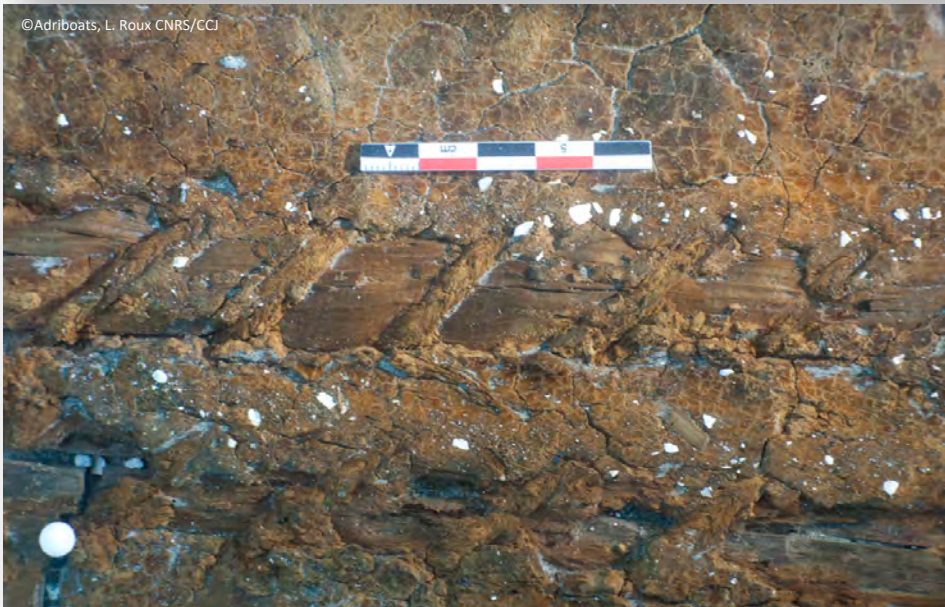
# Caska (Pag Island)



# Caska 4, 9-44 AD



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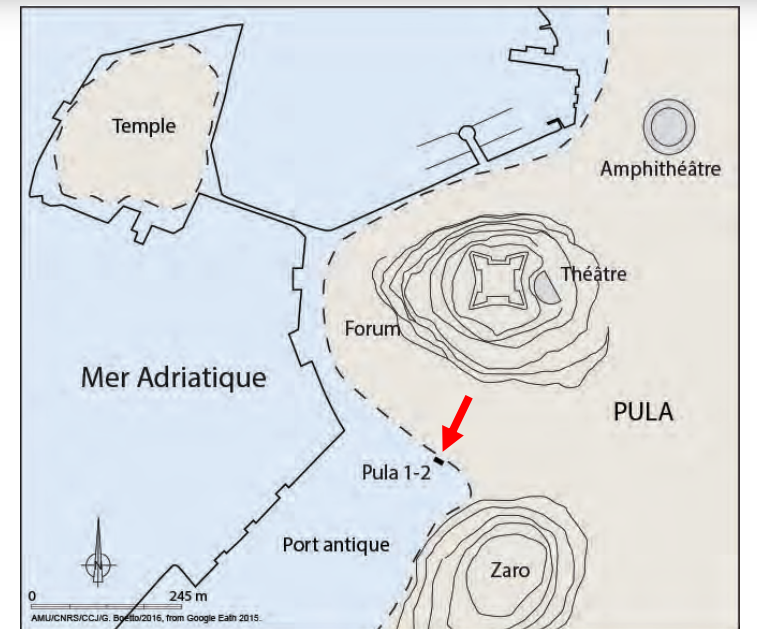


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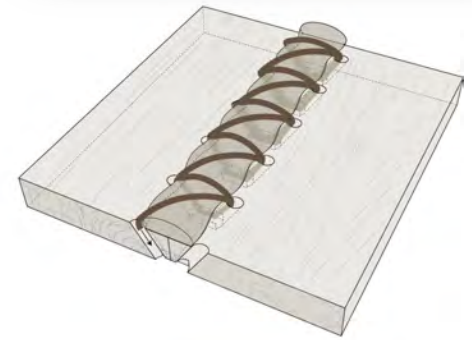


## Pula 1 103-155 AD



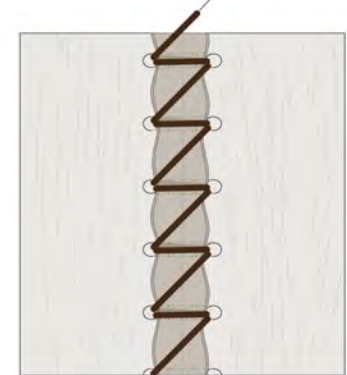
## Pula 2 103-172 AD



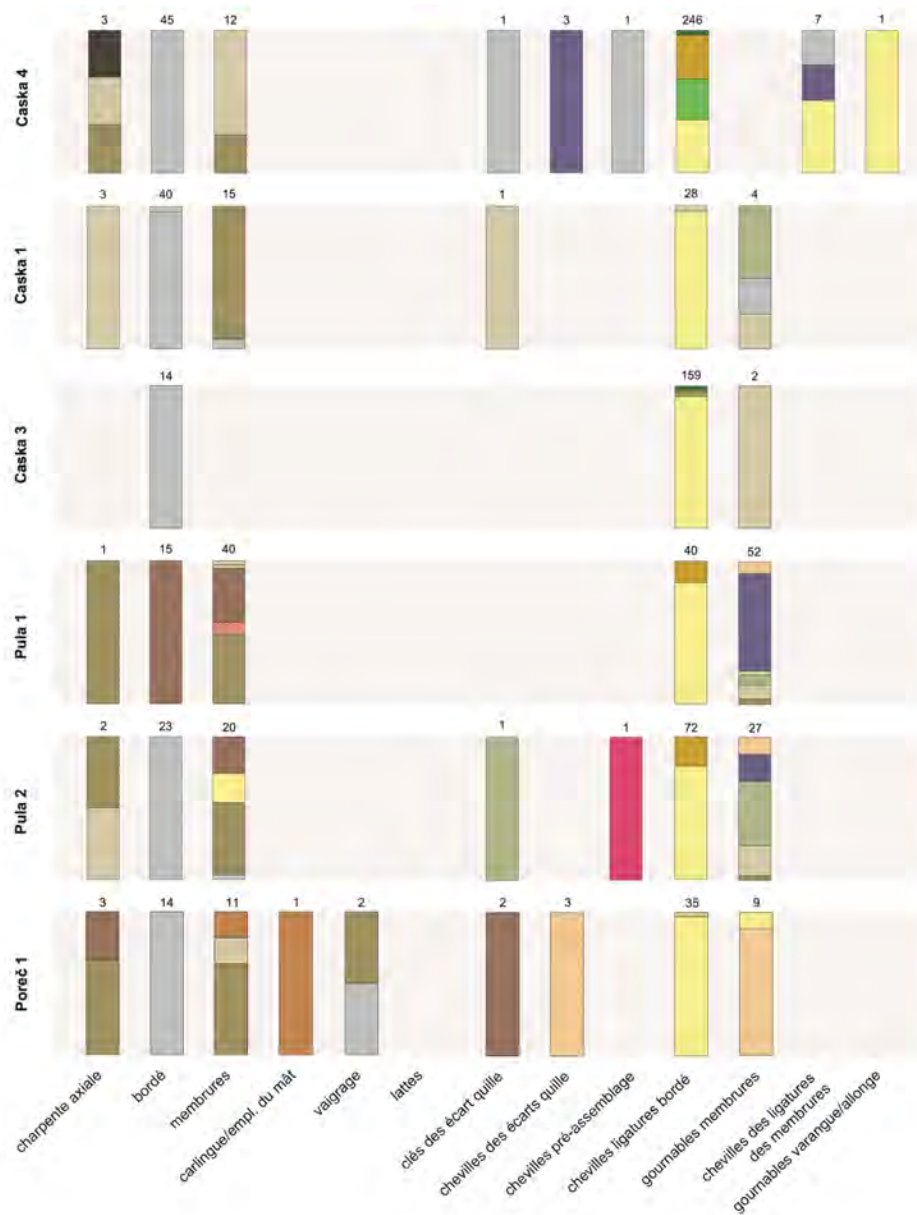


Pula 2

Pula 1



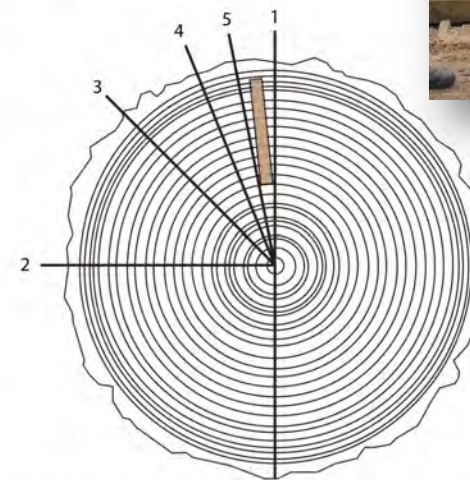
	POREC 1	CASKA 4	CASKA 1	CASKA 3	PULA 1	PULA 2
AMS & wiggle matching	94-72 BC	9-44 AD	42-104 AD	73-124 AD	103-155 AD	103-172 AD
Dendrochronology				79 AD		



- Fagus sylvatica* L.
- Quercus* sp.
- Quercus ilex* L.
- Acer* sp.
- Olea europaea* L.
- Cornus* sp.
- Ulmus* sp.
- Alnus* sp.
- Pinus communis* L.
- Populus* sp.
- Juglans* L.
- Rosaceae maloideae*
- Anacardiaceae*
- Fraxinus* sp.
- Abies* sp.
- Larix decidua* Mill.
- Picea abies* L.
- P. halepensis* Mill.-*P. pinea*-*P. brutia* Ten.
- Pinus leucodermis* L.
- Pinus* sp.



Caska 4, *Fagus sylvatica* L (A. Ferreira Dominguez)







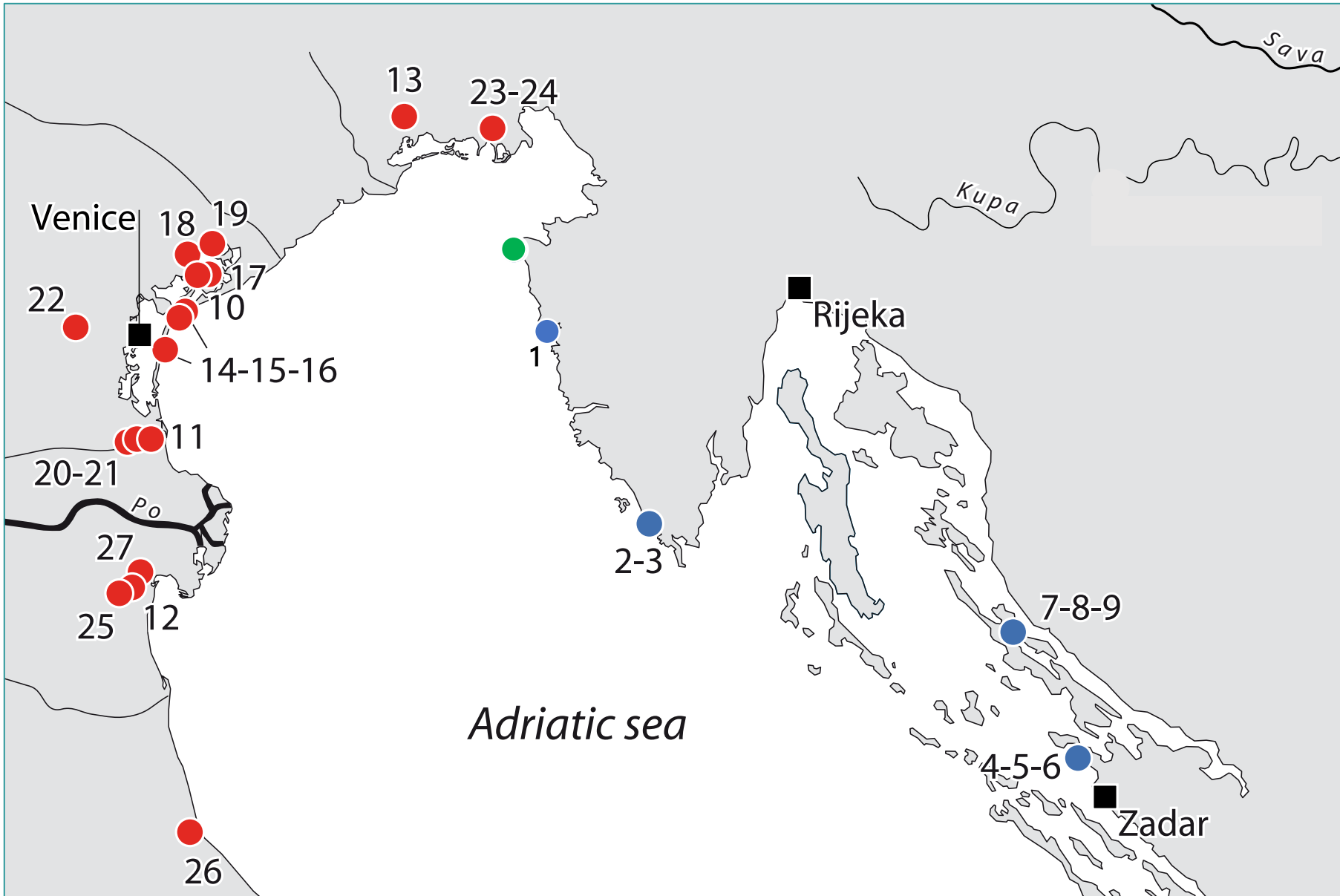
Gajeta, Kornati Islands

# Adriatic Sewn-Boats

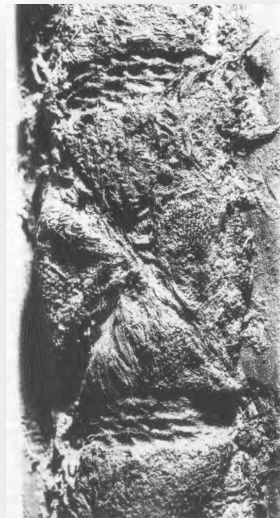
## Zambratija

1, Poreč 1; 2-3, Pula 1 & 2;  
4-6, Zaton 1, 2 & 3; 7-9,  
Caska 1, 3 & 4

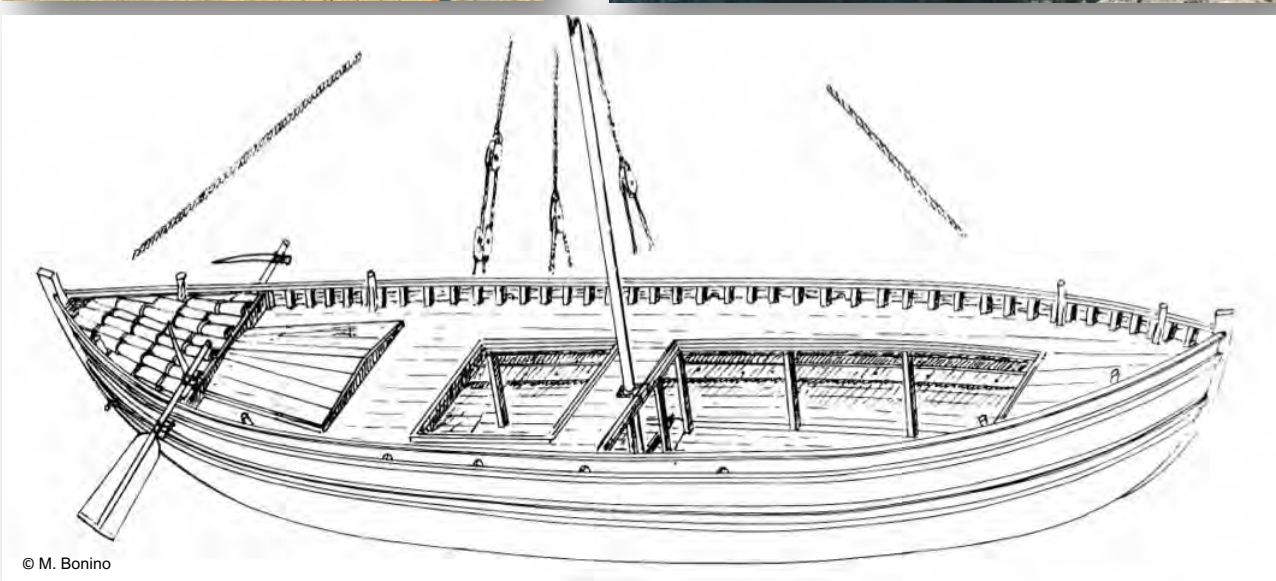
10, Barena del Vigno; 11,  
Cavanella d'Adige; 12,  
Comacchio; 13, Stella 1; 14-  
16, Lido di Venezia 1-3; 17,  
S. Francesco del Deserto;  
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2; 22, Padua; 23-24,  
Aquileia 1 & 2; 25, Santa  
Maria in Padovetere; 26,  
Cervia; 27, Pomposa



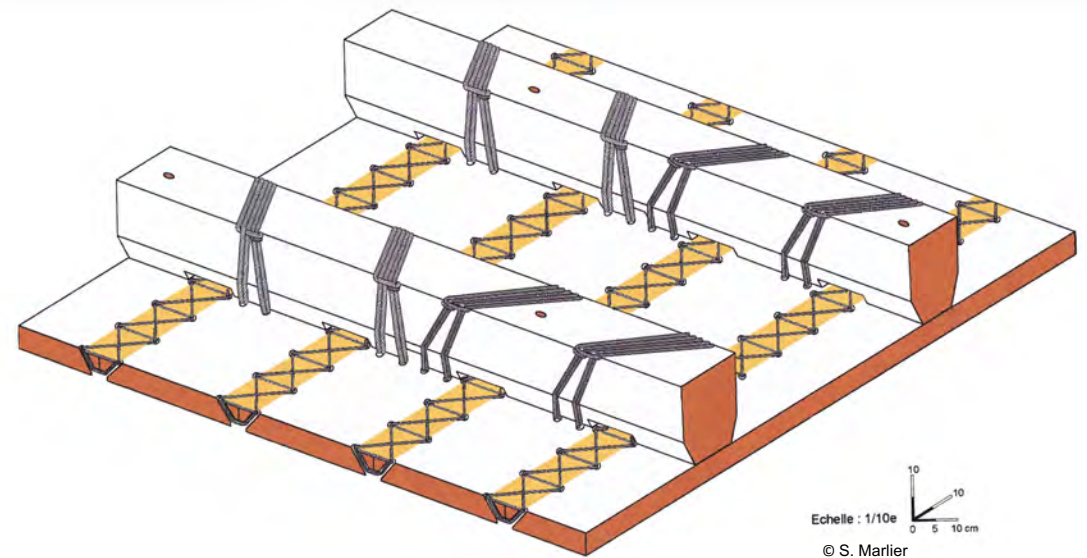
# Comacchio, end 1<sup>st</sup> c. BC



© F. Berti



© M. Bonino

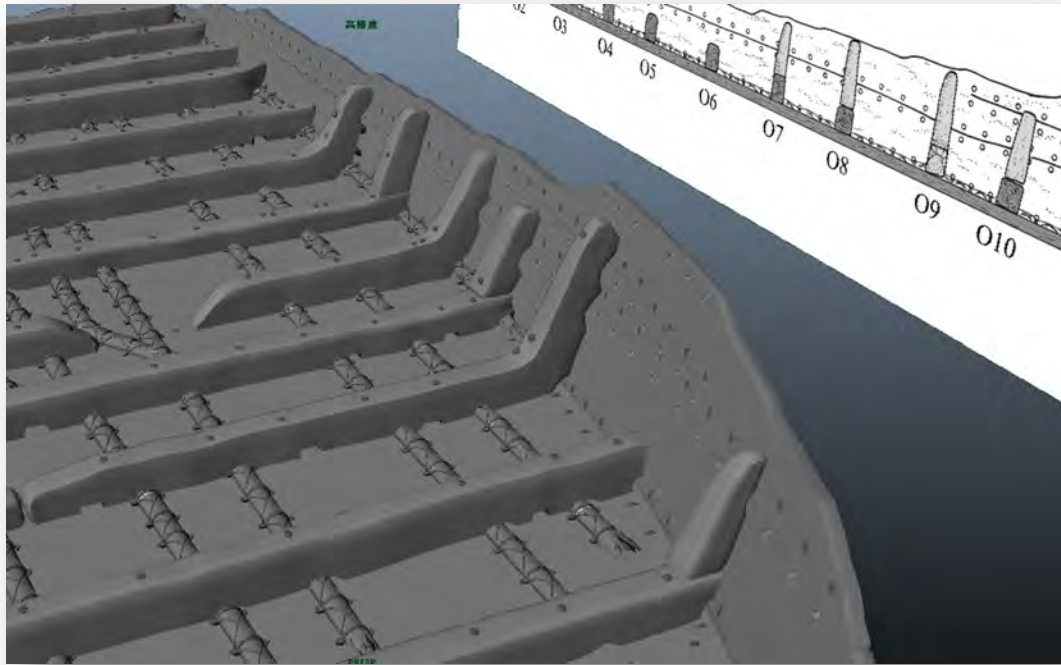


Echelle : 1/10e  
0 5 10 cm  
© S. Marlier

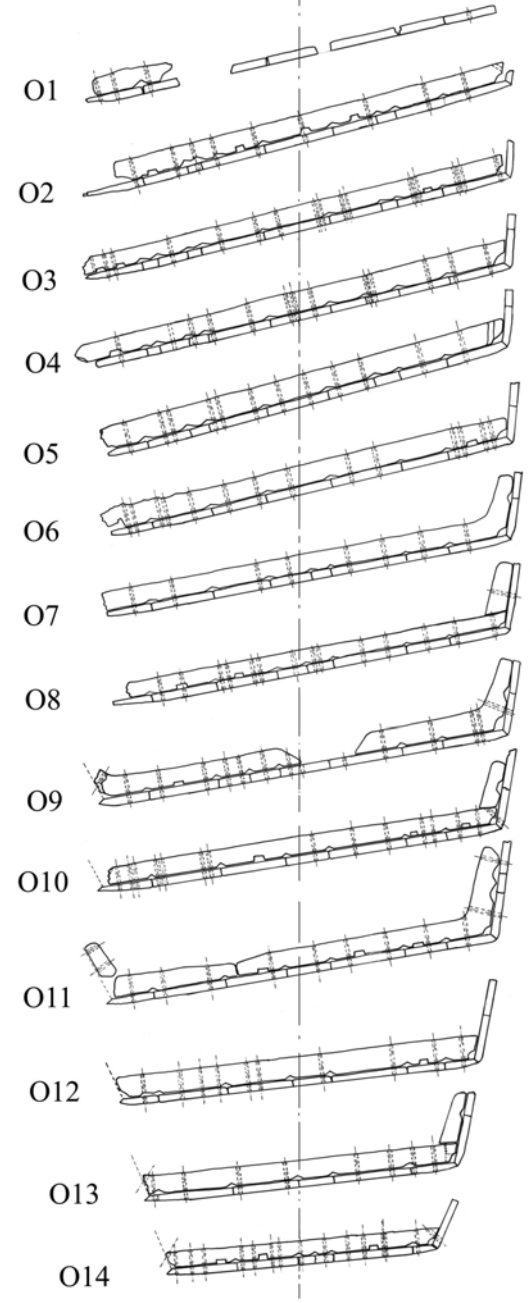
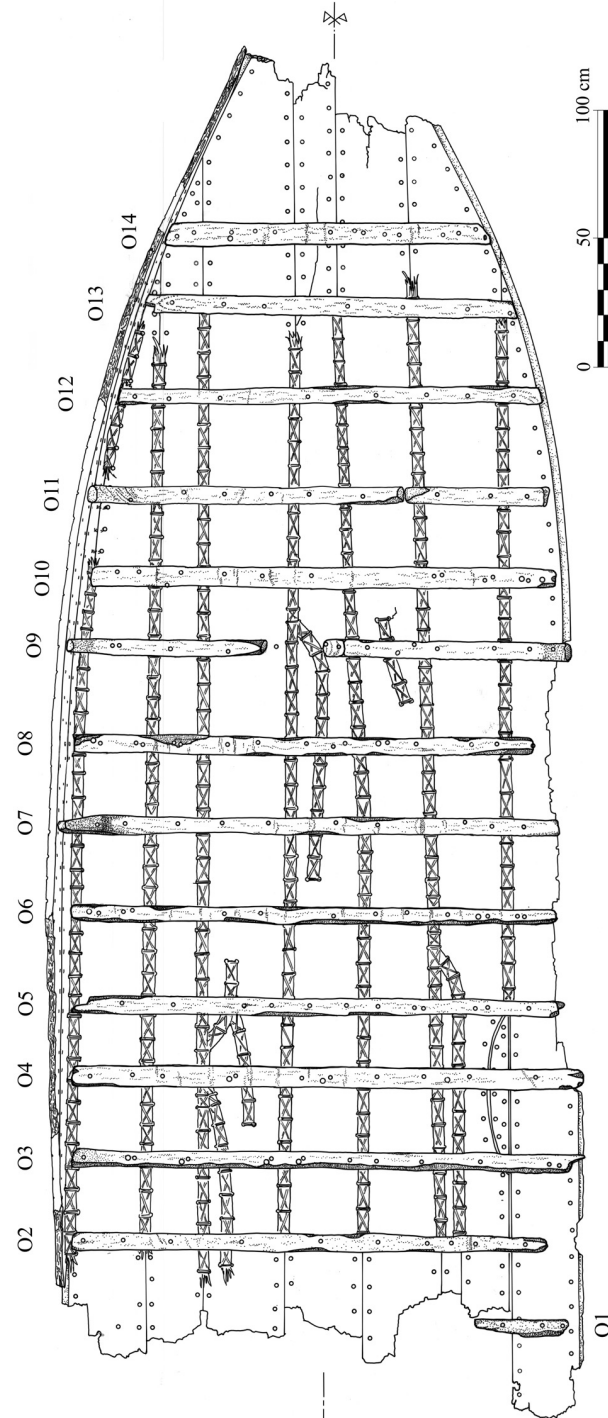
# Stella 1, beginning 1<sup>st</sup> c. AD



© F. Castro, M. Capulli



© F. Castro, M. Capulli



0 50 100 cm

© F. Castro, M. Capulli

# Santa Maria in Padovetere, 5<sup>th</sup> c. AD



© C.Beltrame, E. Costa



- Quercus sp.
- Ulmus campestris L. / Ulmus minor Mill
- Ferro



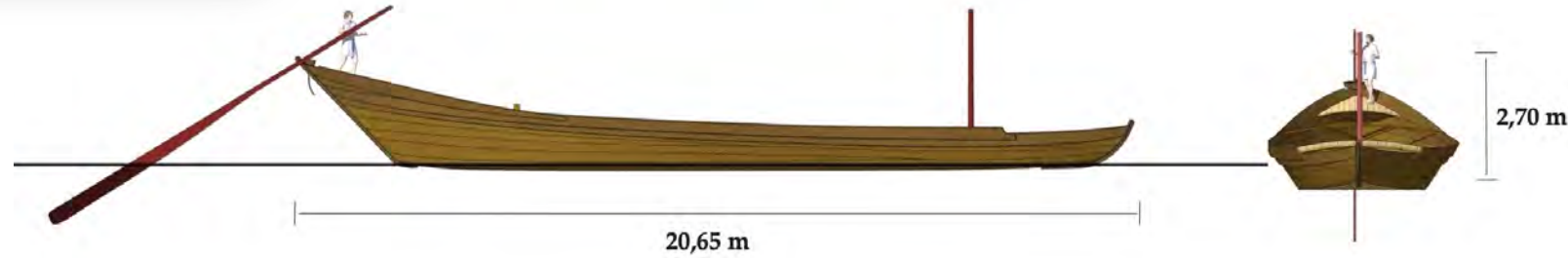
© C.Beltrame, E. Costa



4,90 m



© C.Beltrame, E. Costa



20,65 m

2,70 m



20,65 m

2,70 m



# Ilovik-Paržine, 2<sup>nd</sup> c. BC (170 BC)



REPUBLIKA HRVATSKA  
DRŽAVNA GEODETSKA UPRAVA





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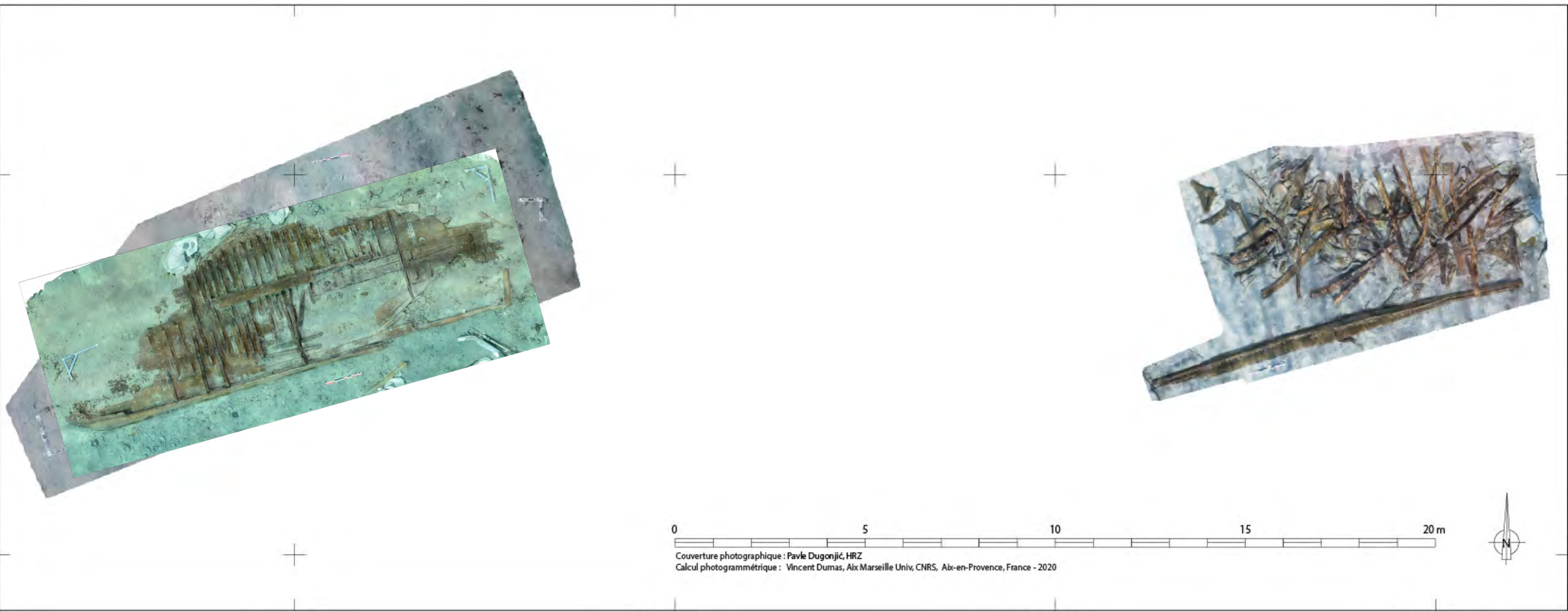


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2021  
70 m<sup>2</sup>

2018-2019  
58 m<sup>2</sup>



stern

distance ~ 20 m

prow

# LIFE ON BOARD

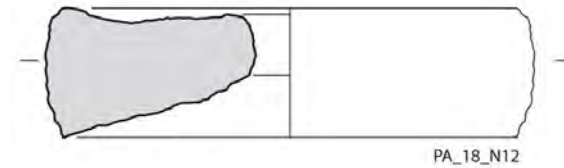
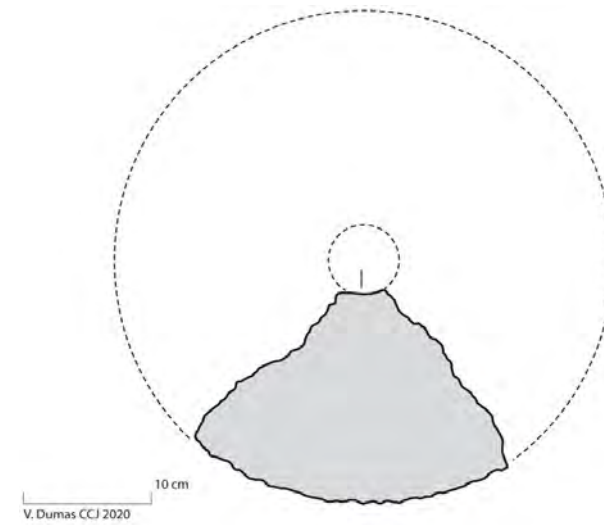
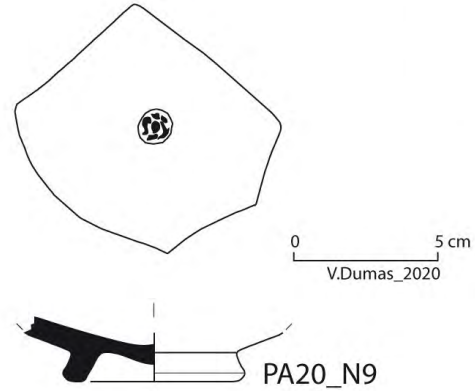
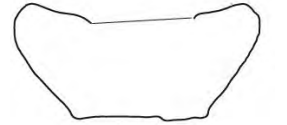
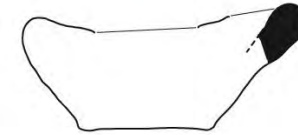
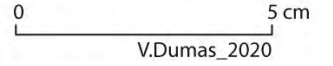
black-glazed  
& cooking  
ware



lamp



PA18\_N10



grinding stone





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**bronze statuette**  
**tutelary goddess**  
**on board**  
**(Isis-Fortuna)**

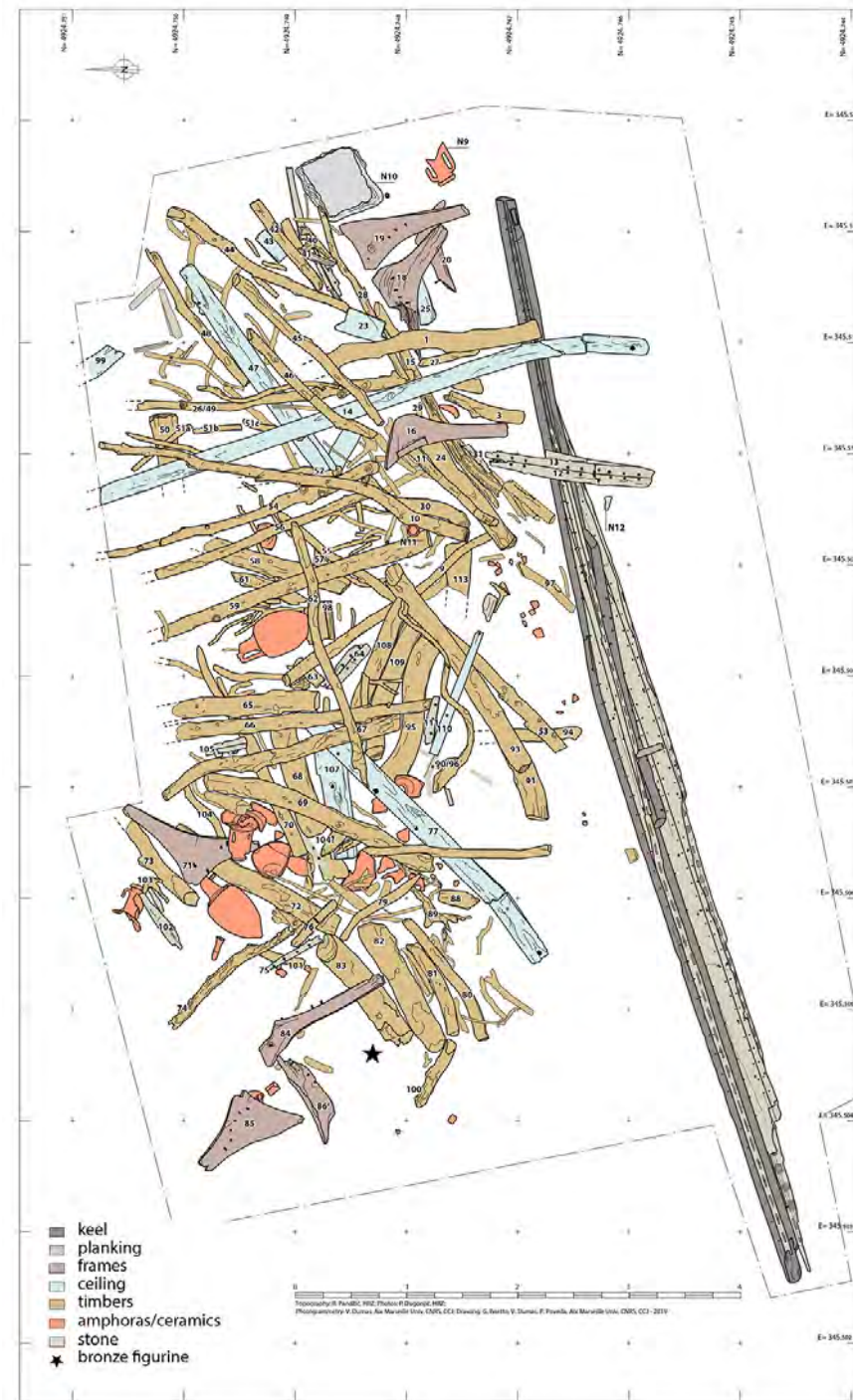
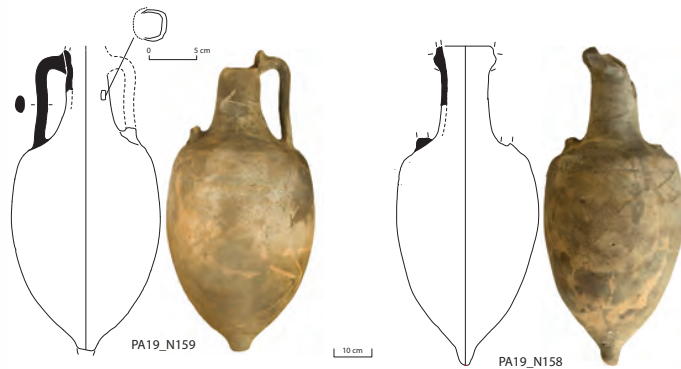
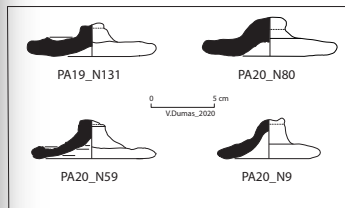
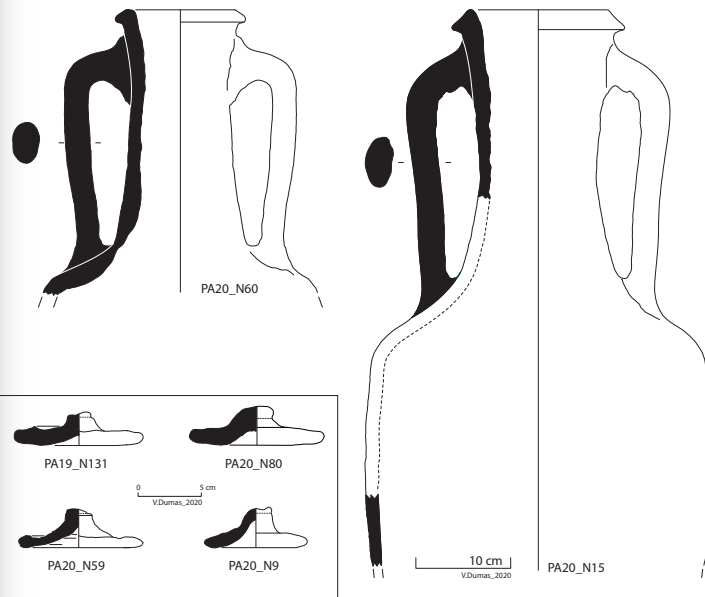


© P. Dugonjic HRZ

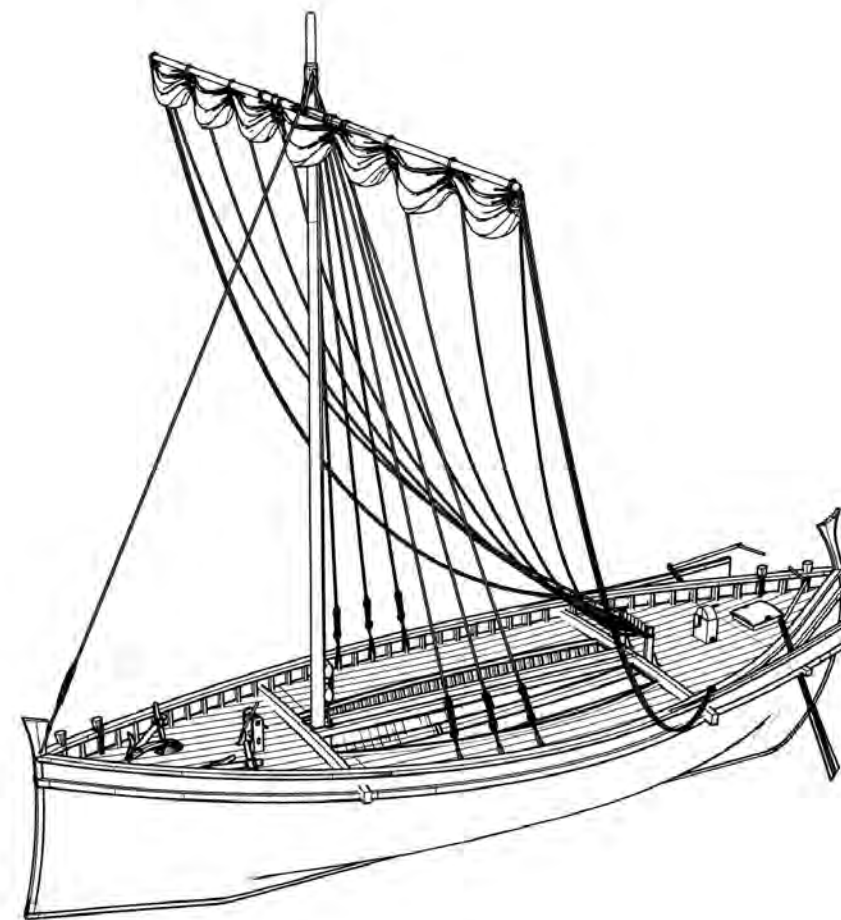
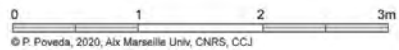
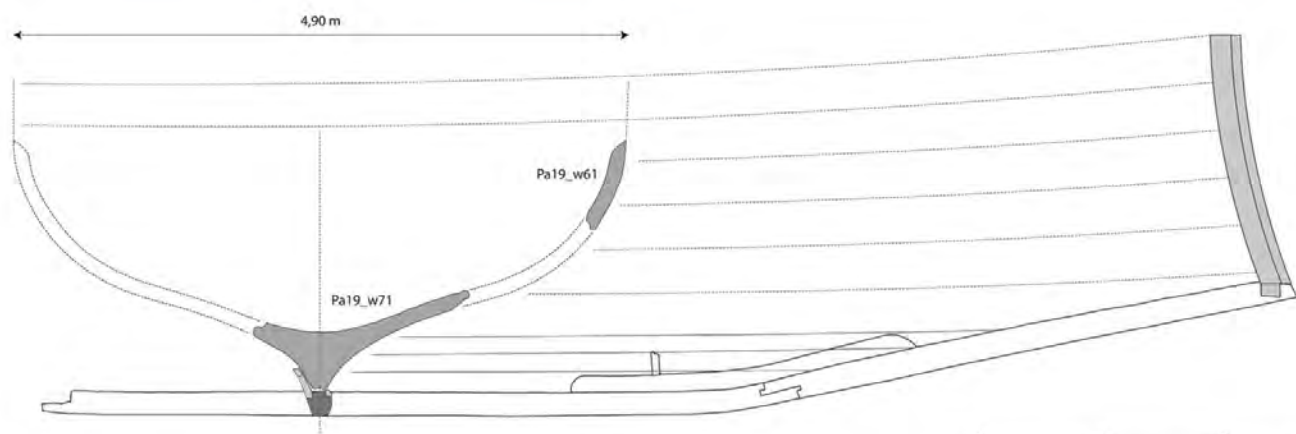
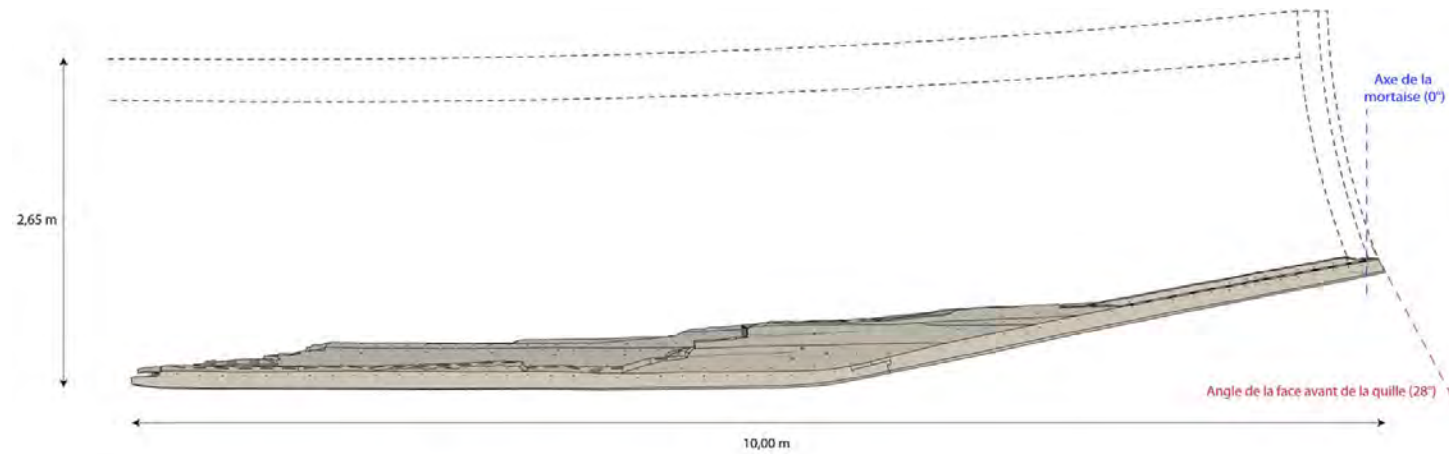




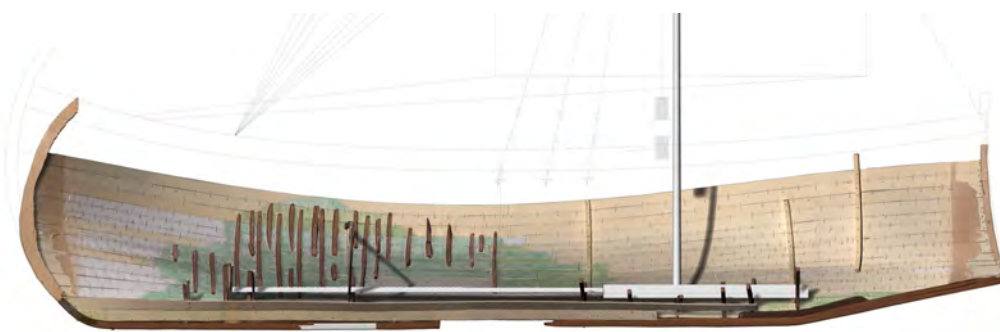
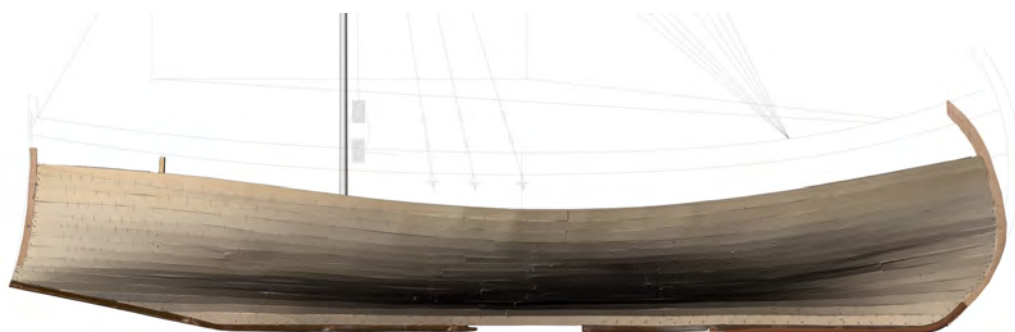
# Cargo: wine & wood







©A. Divic, Navarchos



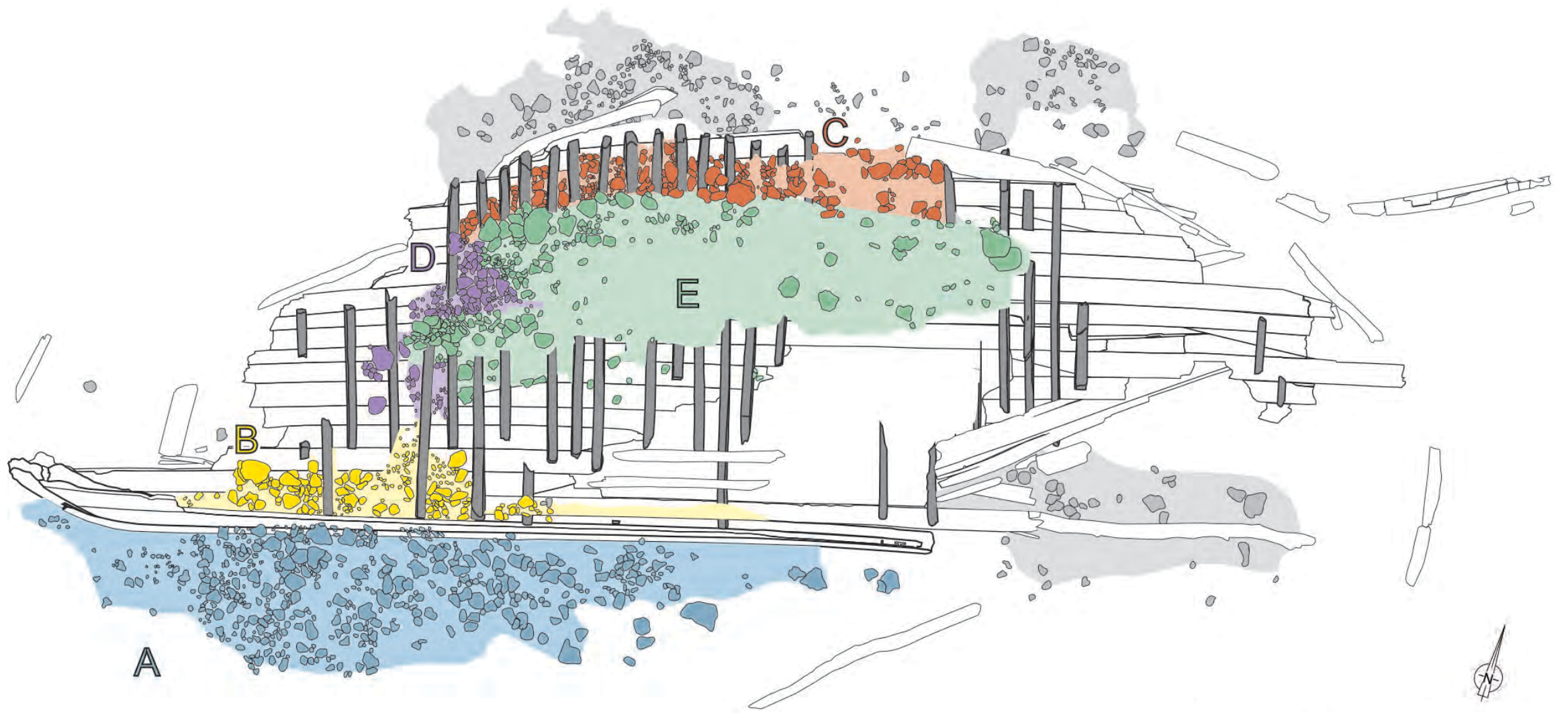
# BALLAST



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©Adriboats L. Damelet CNRS/CCI



ship remains  ballast sampled      ballast not sampled 

0 1 2 3 4 5 m  
 Couverture photographique : L. Damelet (CNRS, Aix Marseille Univ, CCI), P. Dugonjić (HRZ)  
 Calcul photogrammétrique et dessin : V. Dumas, CNRS, Aix Marseille Univ, CCI - 2021



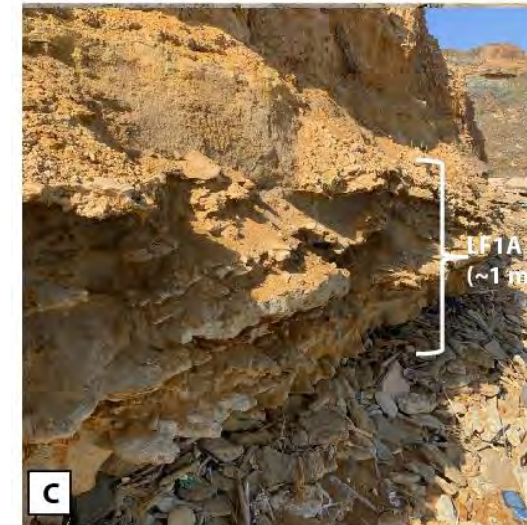
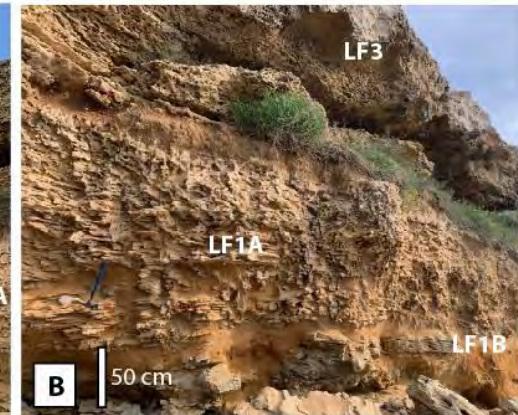
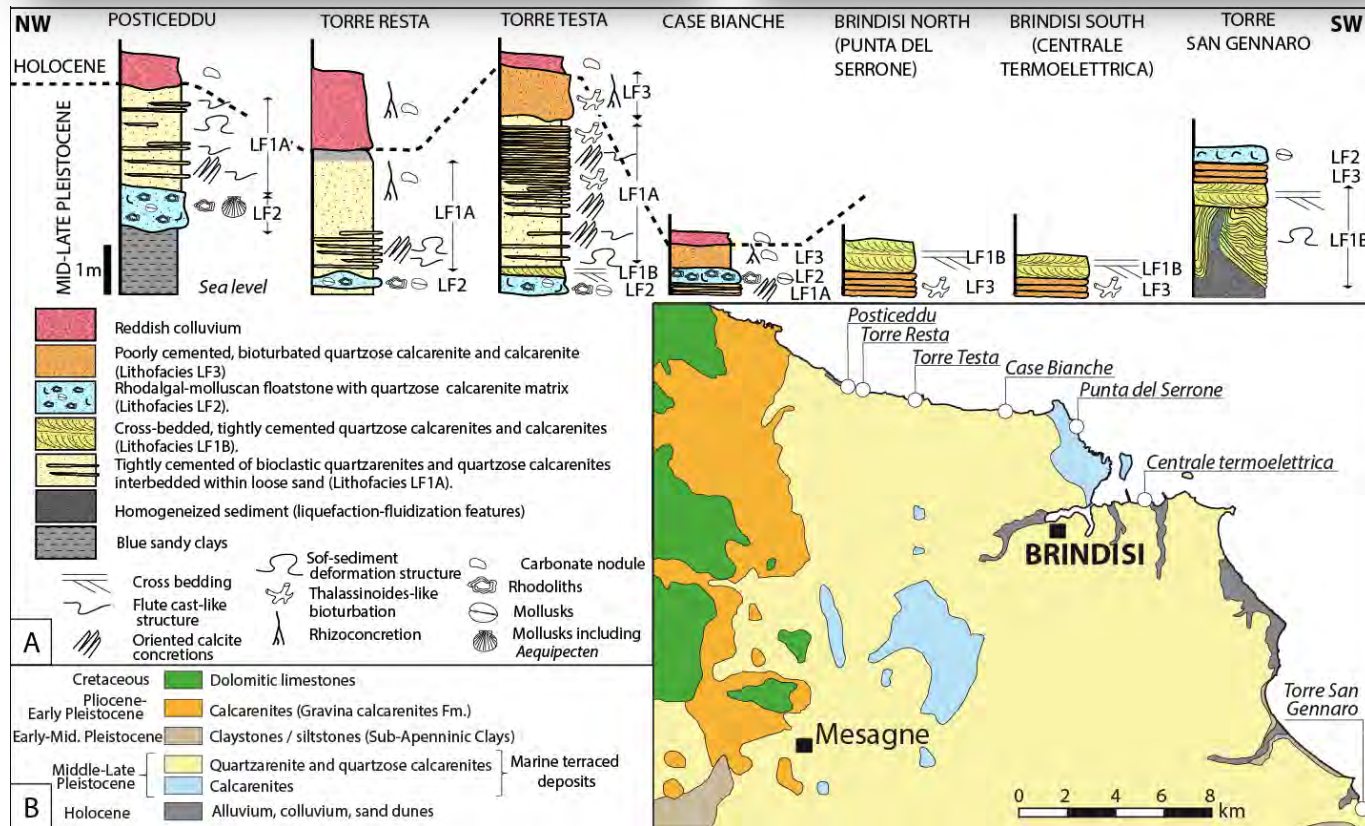


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Coastal outcrops from the Brindisi basin A-B: Torre Testa; C: Torre Resta; E: Torre San Gennaro



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The Brindisi basin: A: lithologic and sedimentologic log sections for selected coastal outcrops; B: Simplified geological map of the Brindisi basin (modified after Cotecchia, 2014; and Pastore et al., 2023).

# SHIPPING ROUTE

