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INTERSPECIFIC DIFFERENCES IN BEAK SHAPE AND TROPHIC NICHE IN SIX CEPHALOPOD SPECIES INHABITING THE NORTH-WESTERN MEDITERRANEAN SEA

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INTRODUCTION

Cephalopods play a key role in marine ecosystems, acting as a link between lower and upper trophic levels in marine food webs (Coll et al., 2013). They occupy a wide range of trophic levels, from medium to top trophic positions (Coll et al, 2013; Navarro et al., 2013). Scenarios of coexistence and interspecific competition might have resulted in divergences in certain morphological characters.

OBJECTIVE

To **analyze** the **beak shape** and **trophic niche** of six cephalopod species inhabiting the north-western Mediterranean Sea.

MATERIAL AND METHODS

Morphological analysis

- Digital standardized pictures of the beaks were obtained (Figure 1).
- Landmarks were defined using the pictures. 10 for the upper beak and 8 for the lower beak (Figure 2).
- All landmarks configurations were compared applying a generalized Procustres analysis (GPA). It allows the obtention of a consensus configuration (Figure 3) and the uniforms components of shape variation for each individual or relative warps (Figure 4).

Stable isotopes analysis

- The beaks were dried for 48 hours and powdered.
- Between 0.3 to 0.4 mg of beak sample were packed into tin capsules.
- The packed samples were sent to the Laboratory of Stable Isotopes of the Estación Biológica de Doñana, where isotopic analysis were performed.

Morphological analysis process

Fig. 1. *Upper (left) and lower (right) beak pictures.*

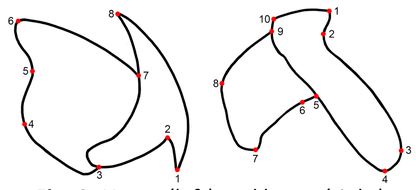


Fig. 2. *Upper (left) and lower (right) beak landmark definitions.*

GPA

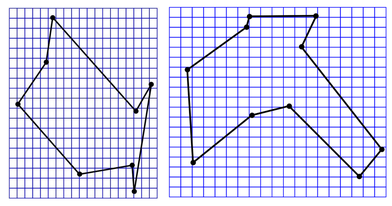


Fig. 3. *Upper (left) and lower (right) beak consensus shape.*

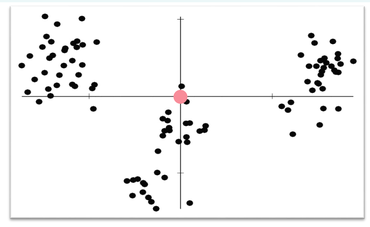


Fig. 4. *Graphical representation of the relative warps.*

RESULTS AND DISCUSSION

Morphological analysis results

Upper beak

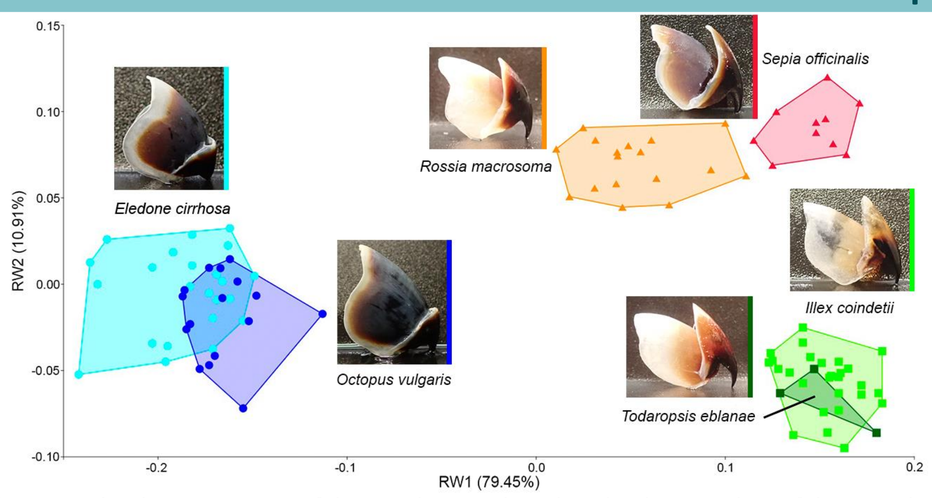
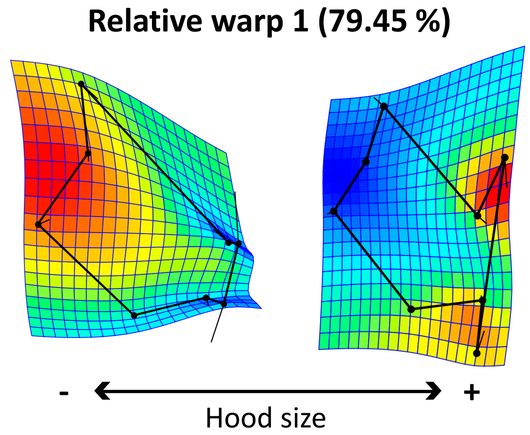


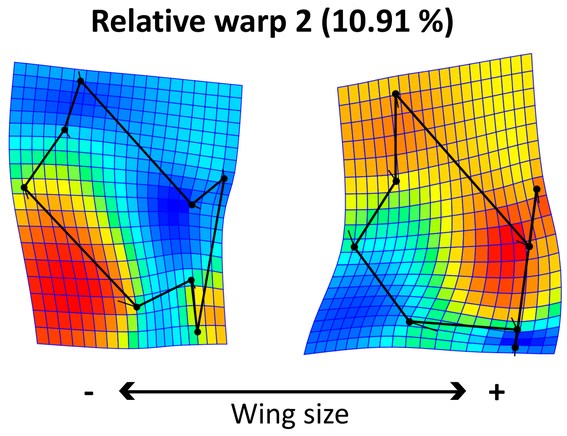
Fig. 5. *Graphical representation of the morphospace based on the shape analysis of the upper beak.*

Relative warp 1 (79.45 %)



\- Hood size
Lateral wall size +

Relative warp 2 (10.91 %)



\- Wing size
Crest size
Hood proportions +

Lower beak

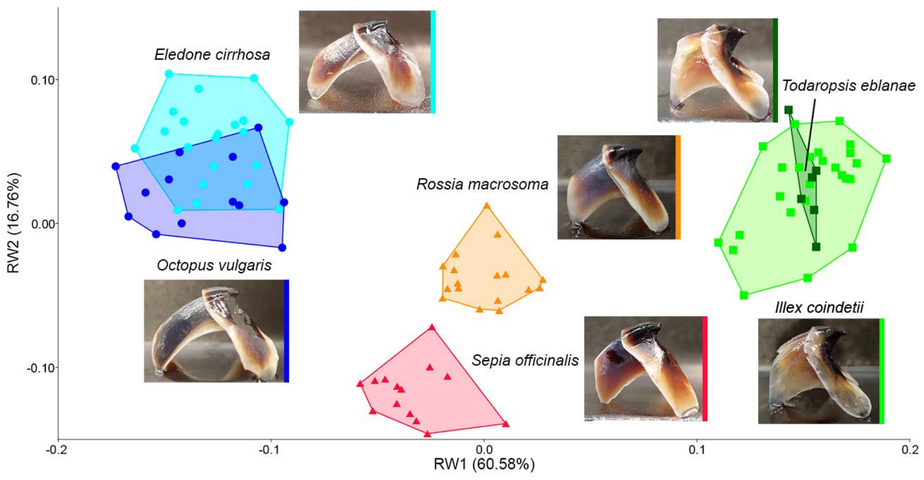
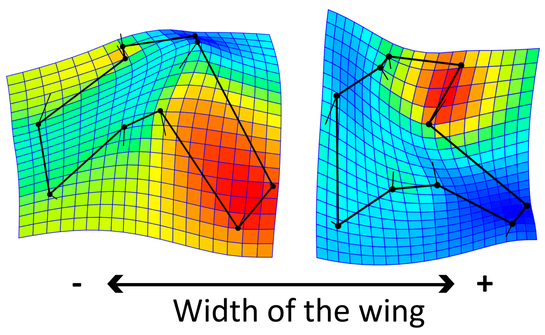


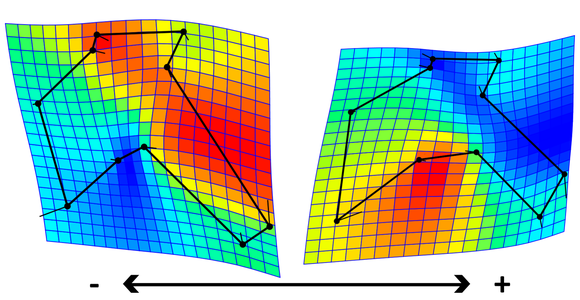
Fig. 6. *Graphical representation of the morphospace based on the shape analysis of the lower beak.*

Relative warp 1 (60.58 %)



\- Width of the wing
Lateral wall shape
Distance between rostrum and jaw angle +

Relative warp 2 (16.76 %)



\- Width of the lateral wall
Distance between hood and wing tip. +

Stable isotopic results

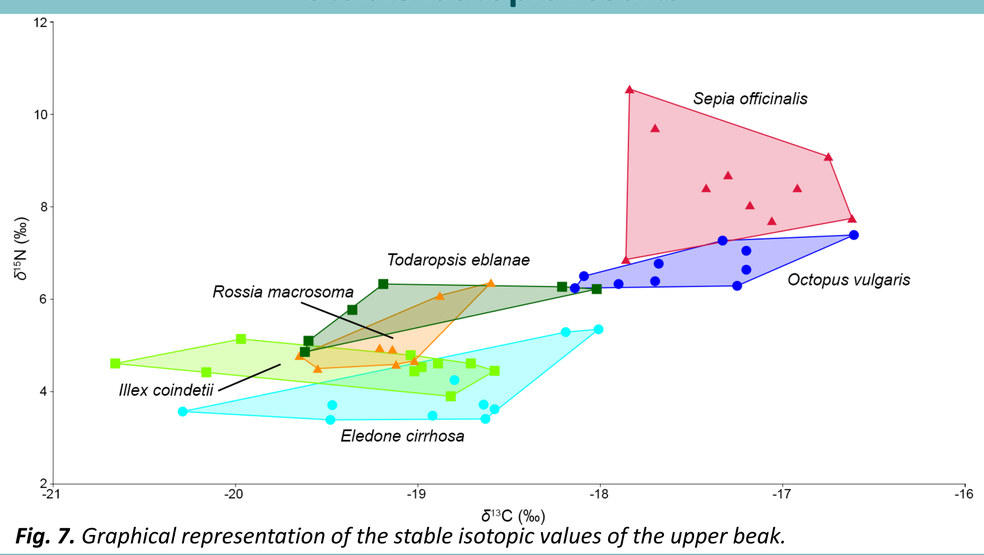


Fig. 7. *Graphical representation of the stable isotopic values of the upper beak.*

CONCLUSIONS

- **Landmark-based geometric morphometric** methods and associated **stable isotopes analyses** were **useful** in order to **differentiate** cephalopod species based on their morphological variability, habitat distribution and diet habits.
- **Beak shape** is strongly affected by **phylogeny** and illustrates the species ability to exploit certain prey.
- The combination of **both isotopic values** helped to ascertain differences in **prey selection** or **habitat differentiation**.
- Both methodologies **helped** independently to the comprehension of cephalopod **ecological segregation** and allowed for a more in depth knowledge of its **dietary habits** related to **beak shape**.

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References:
Coll, M., Navarro, J., Olson, R. J. & Christensen, V. (2013). Assessing the trophic position and ecological role of squids in marine ecosystems by means of food-web models. *Deep-Sea Research II*, 95, 21-36.
Navarro, J., Coll, M., Somes, C. J., & Olson, R. J. (2013). Trophic niche of squids: Insights from isotopic data in marine systems worldwide. *Deep Sea Research Part II: Topical Studies in Oceanography*, 95, 93-102.