

A biogeographical analysis using artisanal dredging fisheries discards of the northern Alboran Sea

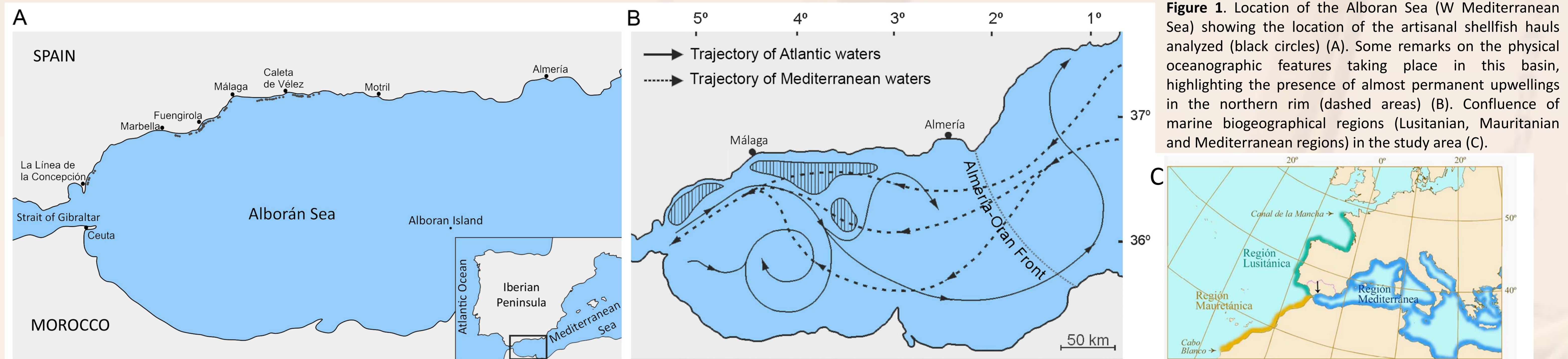
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INTRODUCTION

Discards are defined as the portion of the total catch brought on board and then returned to the sea for whatever reason (e.g. unmarketable species, individuals below minimum legal size, etc.). Its analysis is considered of importance for fisheries management, allowing to improve the knowledge on the composition of benthic communities harboring living resources that are included in several European Directives. Besides, it provides a baseline for biodiversity conservation purposes, with the monitoring of rare and singular species, which is of interest in the Alboran Sea as it represents a biodiversity hotspot within the Atlantic-Mediterranean marine transition region (Fig. 1) (Templado 2011).



MATERIAL AND METHODS

A total of 278 discard samples (standardized weight of 5 kg) were collected between March 2013 and March 2014 from the catches obtained with nine artisanal fishing vessels with similar characteristics operating from La Línea de la Concepción to Caleta de Vélez (90 nautical miles apart) (Fig. 1, 2), and targeting the most demanded commercial bivalves in the area (the wedge clam *Donax trunculus*, the striped venus clam *Chamelea gallina* and the smooth clam *Callista chione*). In the laboratory, every specimen was separated, identified to species level, quantified (abundance and biomass), and characterized according to their biogeographical distribution (Fig. 3).

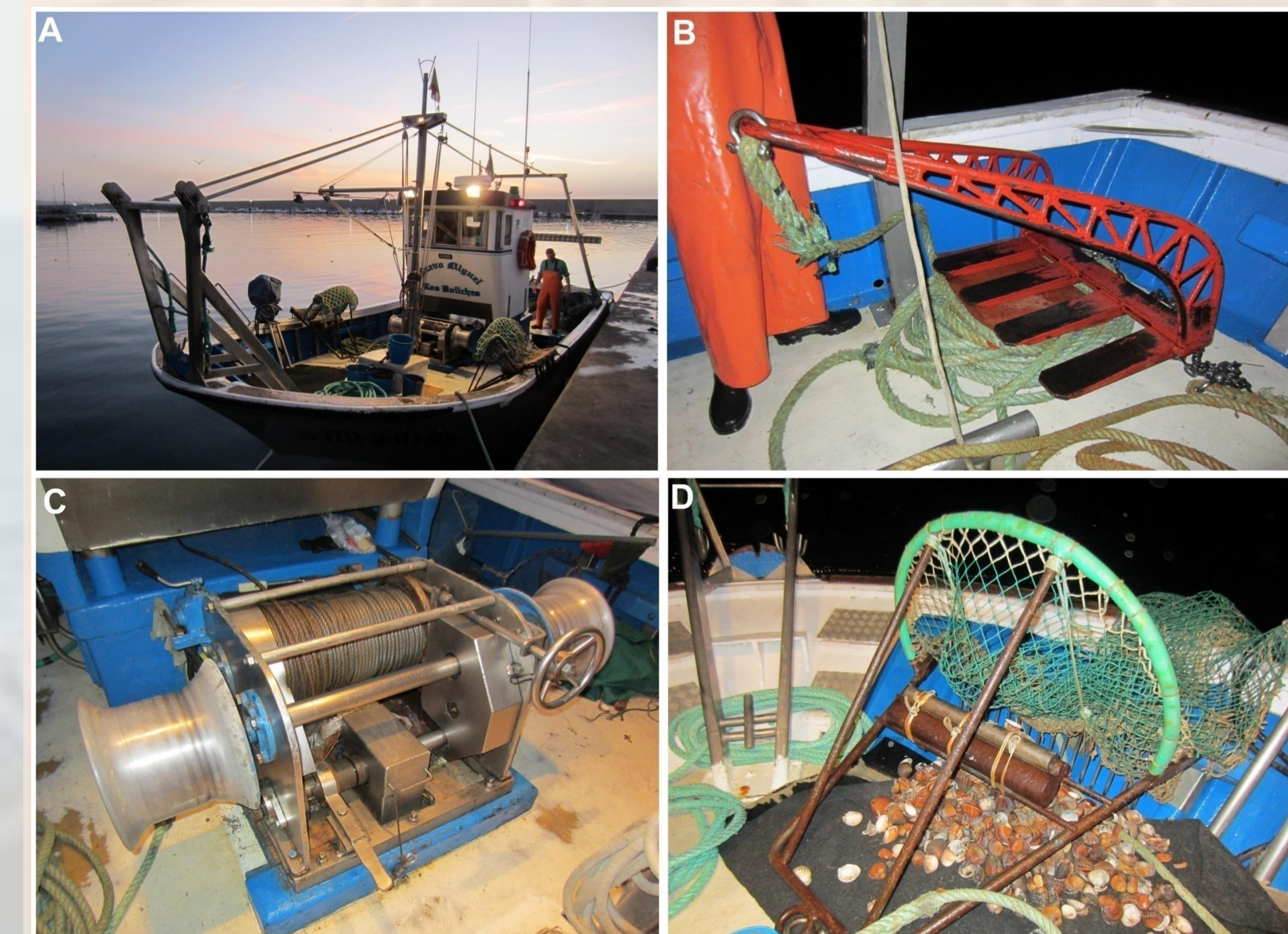


Figure 2. Example of an artisanal fishing vessel operating in the northern Alboran Sea (A). The fishing equipment used in this activity includes a gavián anchor (B), a winch driven by a hydraulic pump fitted on the vessel's main engine (C) and dredges consisting of a rigid iron frame (1 m length) with a number of iron teeth that rake the seabed and a plastic or metallic grid to hold the catch.



An artisanal fishing vessel operating off Fuengirola



Figure 3. Discard sample from the smooth clam mechanized dredging fisheries of the northern Alboran Sea (A); sample processing included the separation and identification of individuals (B), their quantification (C) and conservation in the invertebrate reference collection of the Centro Oceanográfico de Málaga from the Instituto Español de Oceanografía (IEO, Spain).

RESULTS

The discards generated by shellfish fisheries in the northern Alboran Sea showed a high biodiversity (134 spp., of which 5 are of commercial interest), with the dominant species corresponding to components of the “Sables Fins Bien Calibrés” biocoenosis (well-sorted fine sands) defined for the Mediterranean Sea (Fig. 4, 5). The analysis has showed that most species, including the top abundant ones, have a wide biogeographical distribution along the north and western European and Mediterranean coasts, whereas strictly Mediterranean species represent a minority group.

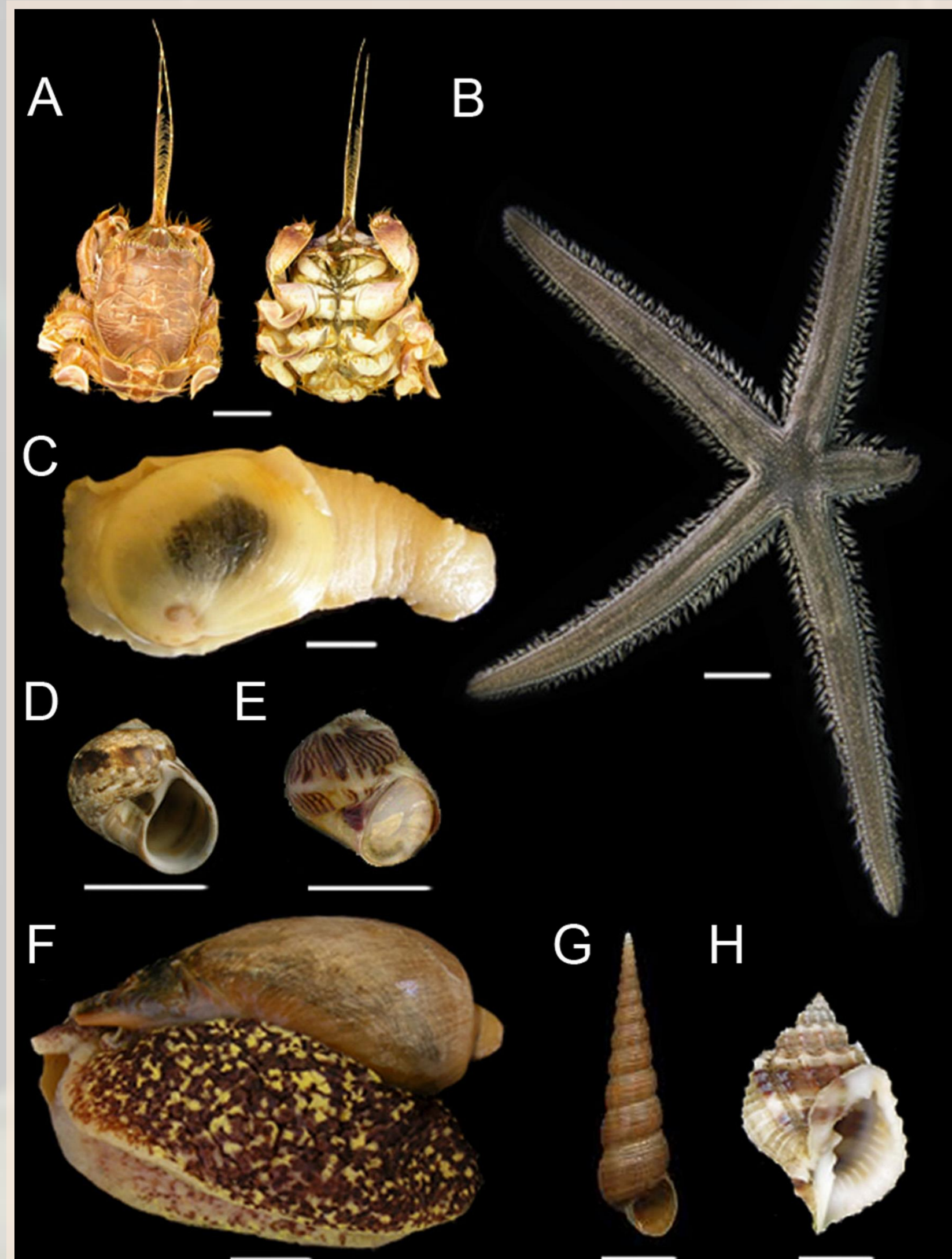


Figure 6. Subtropical marine species found in the studied soft bottoms of the northern Alboran Sea. Scale bars: 1 cm.

Interestingly, a total of eight species with tropical West African affinity (at least south to Senegal) were detected and included the decapod crustacean *Albunea carabus* (Fig. 6A), the starfish *Luidia atlantidea* (Fig. 6B), the gastropod molluscs *Sinum bifasciatum* (Fig. 6C), *Natica vittata* (Fig. 6D), *Tectonatica sagraiana* (Fig. 6E), *Cymbium olla* (Fig. 6F), *Mesalia varia* (Fig. 6G) and *Bivetiella cancellata* (Fig. 6H).

CONCLUSIONS

The analysis of discards represents a useful complementary tool for improving the distribution range of benthic species and for monitoring benthic biodiversity components in a hotspot as the Alboran Sea, including exotic range-expanding species in the area that could be collected and assessed with the help of these coastal monitoring programs.

All of the subtropical marine species found in this study are considered native as persistent populations have been observed during the last decades in the Alboran Sea.

These species seem to be self-introduced by active dispersal (planktonic larval development) promoted by the flux of Atlantic surficial waters through the Strait of Gibraltar (Fig. 1B).

Areas located at “biogeographical crossroads” usually support high species richness and beta diversity, and should be considered a conservation priority (Spector 2002). This could be applied on a large scale to the southern coasts of Spain and the Alboran Sea, which have called attention to their faunistic singularities (e.g. Maldonado and Uriz 1995; Gofas et al. 2011).

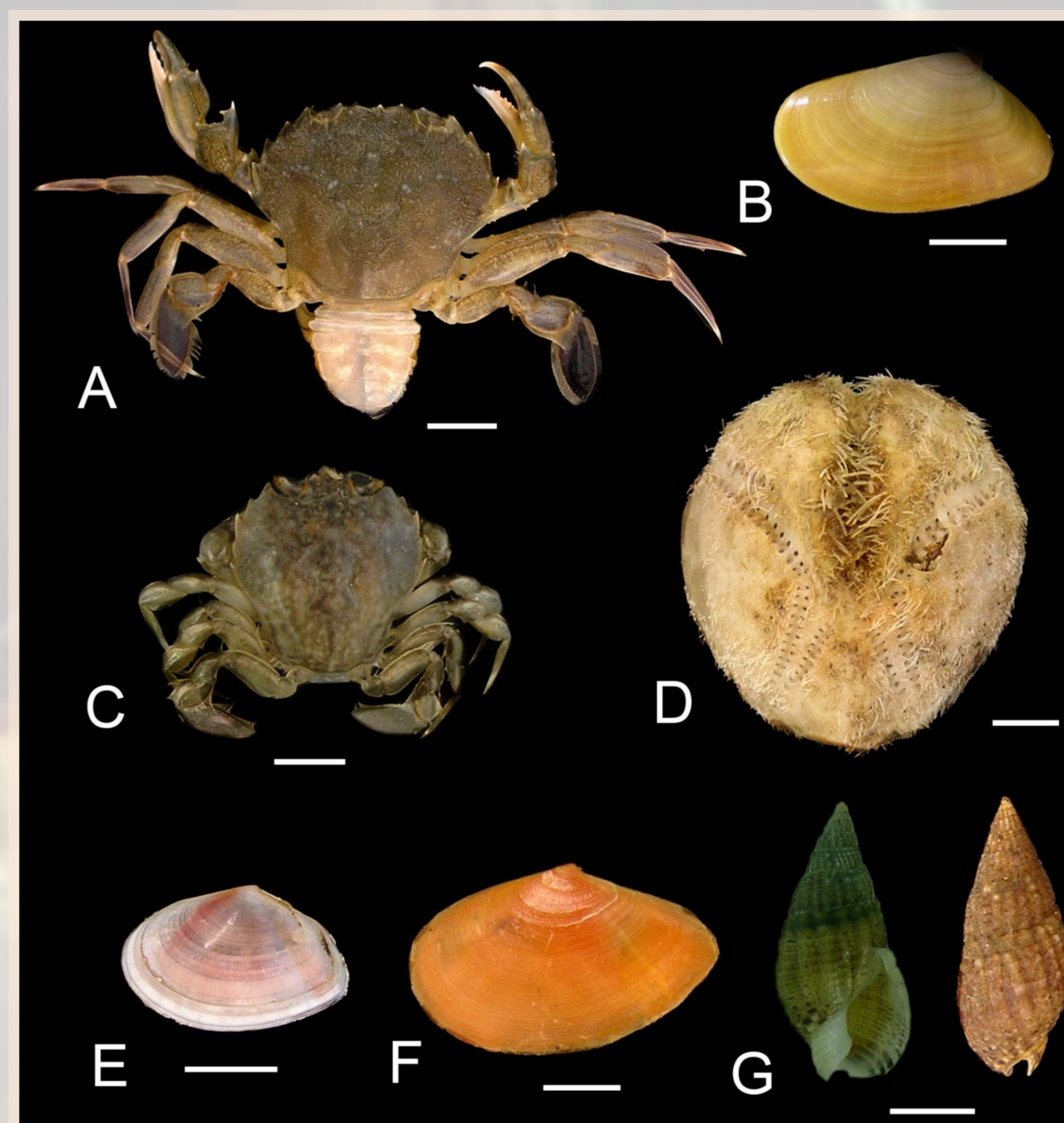


Figure 4. Characteristic discarded species in the wedge clam mechanized dredging fisheries of the northern Alboran Sea: A: *Liocarcinus vernalis*; B: *Donax trunculus*; C: *Portunus latipes*; D: *Echinocardium cf. mediterraneum*; E: *Tellina tenuis*; F: *Tellina incarnata*; G: *Nassarius reticulatus*. Scale bars: 1 cm.

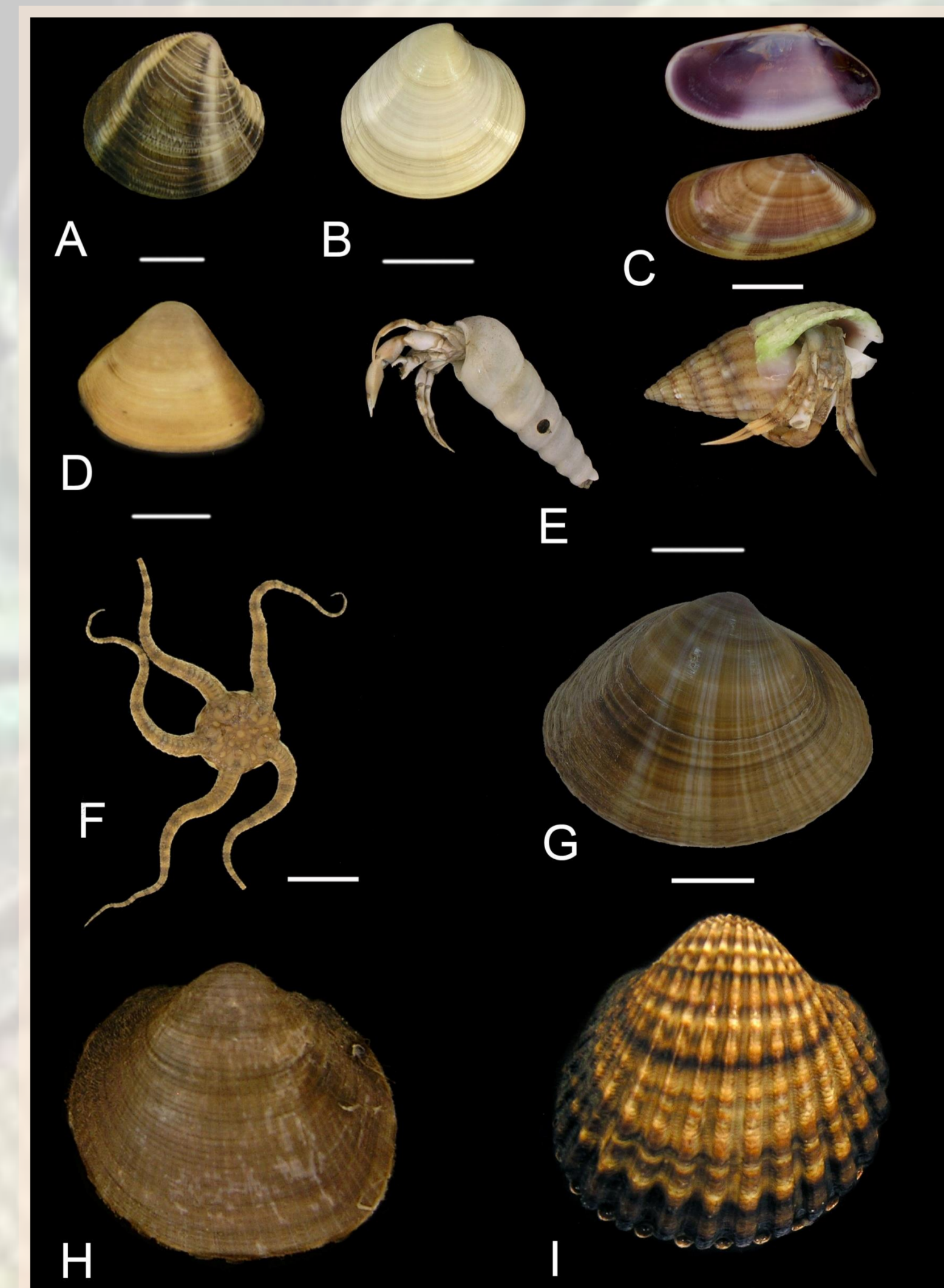


Figure 5. Characteristic discarded species in the striped venus clam mechanized dredging fisheries of the northern Alboran Sea: A: *Chamelea gallina*; B: *Dosinia lupinus*; C: *Donax venustus*; D: *Spisula subtruncata*; E: *Paguroidea*; F: *Ophiura ophiura*; G: *Mactra stultorum*; H: *Glycymeris nummaria*; I: *Acanthocardia tuberculata*.

ACKNOWLEDGEMENTS

This study was developed under the collaboration agreement between Junta de Andalucía (Spain) and Instituto Español de Oceanografía (Contract 126/2012-SEN), within the framework of the research project REMAN-REMARAN. This project was funded by the European Fisheries Fund.

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