

The fishery for, and local distribution of, *Aristeus antennatus* (Risso 1816) (Crustacea: Dendrobranchiata) off western Algeria

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This study presents data on the local distribution and yield of red shrimp *Aristeus antennatus* (Risso 1816) from a new deep-water fishery on the western Algerian slope obtained from commercial trawl fisheries at Oran and Arzew ports between 1999 and 2007. The fishing depth range was 350–750 m, with an average of 455 m. As in other fisheries in the western Mediterranean, the Algerian fishery shows seasonal variation in yields, with maxima during summer and autumn. Its average daily yields have been higher than those of other Mediterranean fisheries, which is attributed to the development of deepwater trawling that enabled the exploitation of stocks that were previously beyond reach. Since 2003 the annual landings have remained stable at around 25 tonnes and the CPUE at around 4 tonnes per boat per annum. It is possible that further exploratory trawling will result in an increase in the size of the fishery. Adaptive and precautionary management of this resource is advocated.

Keywords: Algerian slope, CPUE, landings, red shrimp, trawl fisheries, western Mediterranean

Introduction

The 'gamba' or red shrimp, *Aristeus antennatus* (Risso 1816), an important component of the deep-water ecosystem (Sardà *et al.* 2004a), is one of the most important traditionally exploited demersal species in the Mediterranean and eastern Atlantic (Udekem d'Acoz 1999). Described as a nekto-benthic species of moderate-to-high swimming mobility (Cartes and Sardà 1992, Maynou and Cartes 2000), it is distributed on the sea bottom in sloping areas to a depth of at least 300 m. The exploitation of red shrimp with bottom trawls to a depth of 1000 m is one of the most important fisheries in the western Mediterranean (Sardà *et al.* 2004b).

Previous studies on the biology, ecology, and fishery of red shrimp in the north-western Mediterranean — where the red shrimp fishery is well developed — include those on diet (Cartes 1994), spatio-temporal dynamics (Demestre and Martín 1993; Sardà *et al.* 1994, 1997, Tudela *et al.* 2003) and exploitation (Relini and Orsi Relini 1987, Demestre and Leonart 1993, Sardà and Maynou 1998, Carbonell and Azevedo 2003, García-Rodríguez 2003). Other studies focused on their general biology and fishery (e.g. Carbonell *et al.* 1999, García-Rodríguez and Esteban 1999). Studies undertaken in the central and eastern Mediterranean have covered both the highly exploited areas of the Straits of Sicily (Ragonese and Bianchini 1996) and the unexploited areas of the Ionian Sea (Papaconstantinou and Kaporis 2001, D'Onghia *et al.* 2005).

The knowledge of red shrimp off the central Mediterranean coast is still fragmentary, being limited to some comments on its ecology (Nouar 2001, Kherraz 2006, Mouffok *et al.* 2006) and exploitation (Yahiaoui *et al.* 1986) in Algerian

waters. The present study complements the limited information available. The study of this species is essential, since the fishery on the Algerian slope is not well developed and because the south-western Mediterranean has been identified as biogeographically distinct from the north-western basin (Grimes *et al.* 2004, Bouras 2006).

Study area

The study area extended along the western Algerian coast from Cape Ivi (36°37' N, 0°13' W) in the east to Cape Falcon (0°39' N, 35°43' W) in the west (Figure 1). It is characterised by a 6 km wide rocky continental shelf, with the 500 m isobath lying only 3 km from the coastline. The morphology of the continental slope comprises submarine canyons forming part of the drainage systems of the continental margins, which influence the environmental conditions in the deep sea ecosystems. These geomorphological structures can play an important role in the transport of sediment to great depths and they have been shown to be areas of high productivity (Bouras 2006).

The most important fishing activity in Algeria during the 1990s targeted small pelagic species, which represented 75% of the landings (FAO 2003). The geomorphological characteristics of the area, where it is estimated that only one third of the continental shelf is suitable for bottom trawling, has restricted the development of a demersal trawl fishery. The fishery was then mainly concentrated on the west coast, utilising small boats. In the absence of deep-water equipment, the fishery was not well developed, reaching to a depth of only 400 m. From 1988

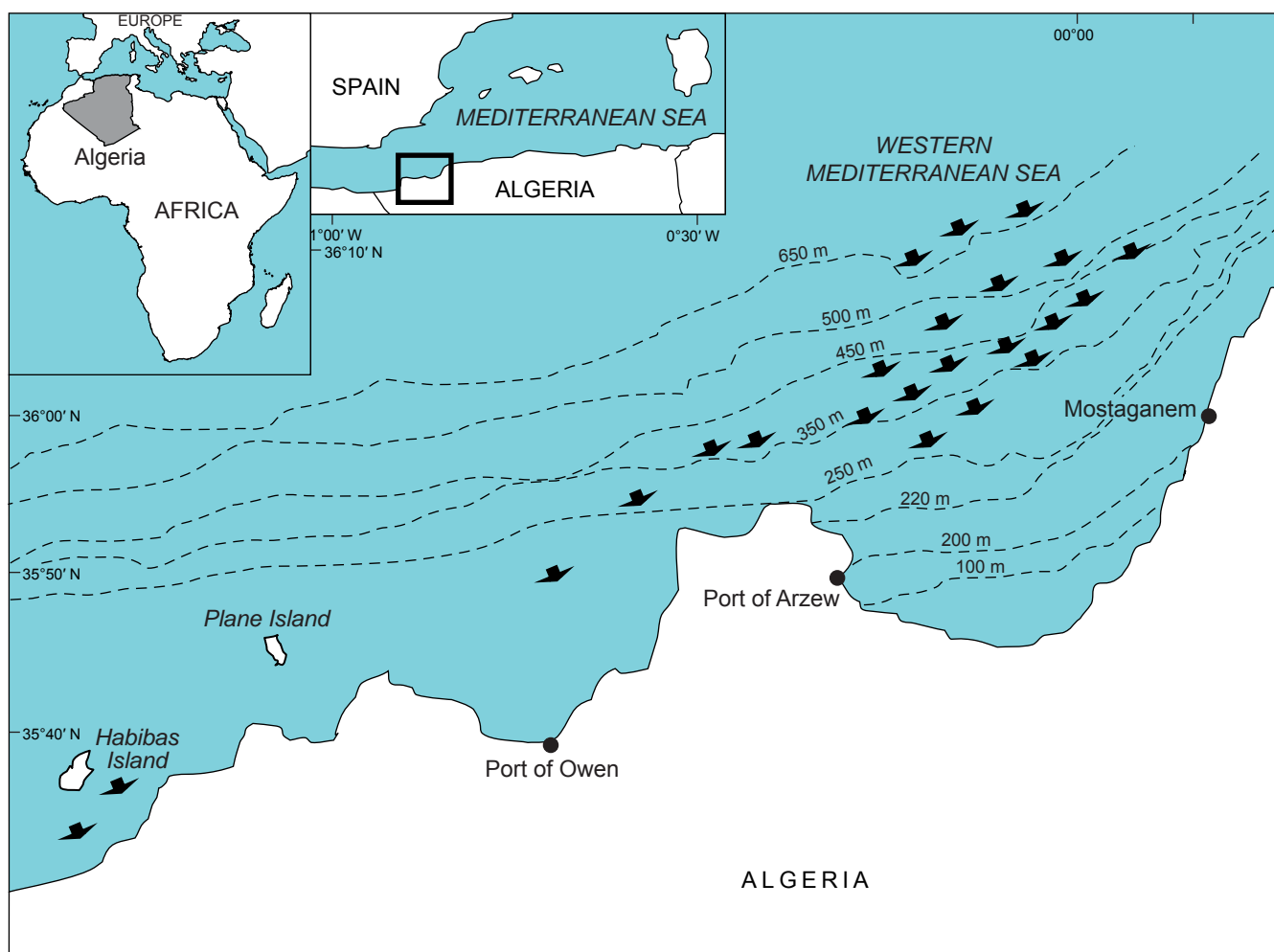


Figure 1: Map of the Oran-Azew coast showing fishing grounds (arrowed) and depths (after Mouffok et al. (2006))

to 1999 the annual landings of shrimp in Algeria, comprising mainly the deep-water decapods — pink shrimp, *Parapenaeus longirostris*, and red shrimp — were about 3 000 tonnes, which represented only 4% of the total landings (Nouar 2001).

Materials and Methods

Data on catch and fishing effort for red shrimp and on fishing vessel characteristics of fleets at the ports of Oran and Arzew for 1999–2007 were obtained from the Department of Fishing and Halieutic Resources. Landings per boat were used to derive annual values of catch per unit effort (CPUE) for the species. In addition, daily monitoring of landings was made for seven trawlers (four from Oran, three from Arzew) targeting red shrimp. From this data, total landings were estimated and fishing day CPUE values were derived.

To collect information on the density and spatial and bathymetric distribution of red shrimp, questionnaire returns from individual boat skippers on catches and fishing grounds for 126 trips in 2006 were analysed. The returns from experienced skippers yielded information on seabed morphology for well known as well as for newly explored fishing grounds.

Results

Aristeus antennatus was exploited regularly by Algerian trawlers from the ports of Oran and Arzew. The fishing grounds between these ports ranged in depth from 300 to 750 m (Table 1). The number of boats in the trawl fishery increased from 22 to 30 during the period 1999–2007 (Figure 2), these representing about 13% of the total fishing fleet based at these ports. At the same time the fishery's annual landings of red shrimp increased from 2.0 to 24.5 tonnes and CPUE increased from 0.4 to 4.1 tonnes/boat (Figure 3). The average standardised CPUE for the Arzew fleet was higher than that of the Oran fleet. Both ports' fleets showed similar trends for CPUE, with values in summer and autumn being higher than those in spring and winter (Figure 4).

Discussion

Aristeus antennatus, has only been fished on the Algerian west coast in recent years. According to Nouar (2001), the deep sea (>400 m) fishing grounds in which this species is distributed remained unexploited until the end of the last

Table 1. Fishing grounds where the trawl fleets from Oran and Arzew exploit red shrimp (after Mouffok *et al.* (2006))

Fishing ground	Latitude	Longitude	Minimum depth (m)	Maximum depth (m)
Oran				
O ₁	035°40' 174" N	001°10' 180" W	367	450
O ₂	035°42' 995" N	001°10' 757" W	350	420
O ₃	035°45' 975" N	001°37' 888" W	300	347
O ₄	035°46' 636" N	001°33' 385" W	360	550
O ₅	035°47' 007" N	001°32' 196" W	450	750
Arzew				
A ₁	036°03' 300" N	000°11' 767" W	420	480
A ₂	036°07' 406" N	000°03' 562" W	450	520
A ₃	036°01' 500" N	000°16' 500" W	500	550
A ₄	036°04' 603" N	000°08' 295" W	350	450
A ₅	036°12' 052" N	000°06' 314" E	400	500
A ₆	036°10' 280" N	000°02' 500" E	480	550
A ₇	036°08' 695" N	000°00' 137" W	450	500
A ₈	036°07' 465" N	000°02' 871" W	455	500
A ₉	036°05' 947" N	000°05' 674" W	450	490
A ₁₀	036°05' 054" N	000°07' 472" W	430	490
A ₁₁	036°10' 738" N	000°03' 540" E	500	550
A ₁₂	036°09' 423" N	000°00' 666" E	450	500
A ₁₃	036°05' 378" N	000°07' 627" W	500	550
A ₁₄	036°03' 566" N	000°11' 883" W	550	580
A ₁₅	036°02' 524" N	000°13' 538" W	475	500
A ₁₆	036°02' 193" N	000°14' 640" W	480	550
A ₁₇	036°02' 425" N	000°13' 600" W	400	450
A ₁₈	036°05' 315" N	000°07' 382" W	450	480
A ₁₉	036°02' 633" N	000°13' 531" W	420	480
A ₂₀	036°09' 430" N	000°00' 560" E	500	550
A ₂₁	036°09' 719" N	000°02' 350" E	420	450
A ₂₂	036°08' 752" N	000°00' 213" E	450	470
A ₂₃	036°07' 885" N	000°01' 749" W	450	500
A ₂₄	036°06' 957" N	000°03' 699" W	410	450
A ₂₅	036°06' 185" N	000°05' 056" W	400	480
A ₂₆	036°05' 140" N	000°07' 057" W	400	450

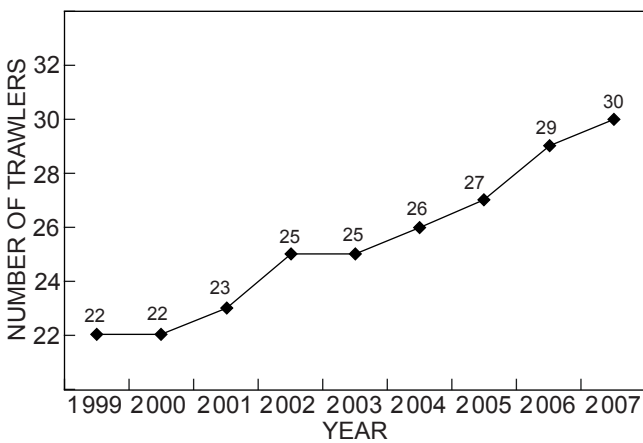


Figure 2: Number of trawlers at Oran and Arzew ports from 1999 to 2007 (after Mouffok *et al.* (2006))

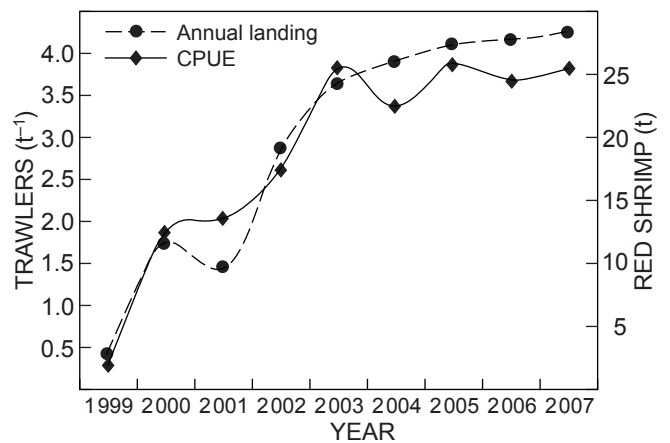


Figure 3: Annual landings and catches per unit effort (CPUE) of red shrimp at Oran and Arzew ports from 1999 to 2007 (after Mouffok *et al.* (2006))

century because of their distance from the ports, the journey being more dangerous during rough weather, and the lack

of suitable deep trawling equipment. Up until then the trawl fishery on the slope was limited to a depth range of 200–400 m,

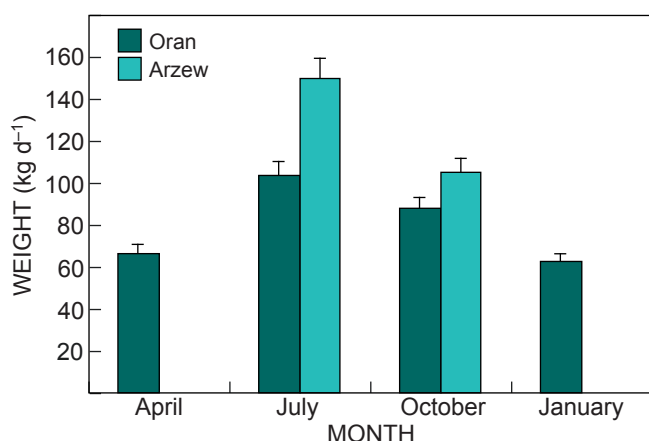


Figure 4: Average monthly standardised CPUE with standard error for Oran and Arzew ports (after Mouffok et al. (2006)).

and targeted pink shrimp, *Parapenaeus longirostris*. The present study shows a clear development of the deep water red shrimp fishery, with a continuous increase in the numbers of vessels in the trawl fleets and in the landings of this species.

The developing fishery of Algeria shows a seasonal trend in landings, as occurs in other red shrimp fisheries (Demestre and Martín 1993, Sardà et al. 1997, García-Rodríguez and Esteban 1999, Carbonell et al. 1999). Landings peaked during summer and autumn, which contrasts with fisheries in the north-western Mediterranean, where maximum landings have been reported during late spring and summer. According to Cartes (1998), during spring and summer the availability of food for decapod crustaceans is greater, which could explain why CPUE is highest and catches of some commercial species, such as red shrimp, are at a maximum. The differences in the periods of greatest CPUE could either be due to a different seasonal pattern in the availability of food resources for decapod crustaceans in Algerian waters, or to the different bathymetric range (400–800 m) of the grounds exploited in the other well developed fisheries.

The estimated monthly CPUE found in this study for Oran and Arzew is higher than that reported from other north-western Mediterranean fisheries (e.g. García-Rodríguez and Esteban 1999), possibly due to differences in fishing pressure. While the red shrimp populations are heavily exploited in the north-western sub-basin (Demestre and Martín 1993, Demestre and Lleonart 1993, García-Rodríguez and Esteban 1999), the fishery in Algerian waters is still developing. Similarly, in Arzew the fishery only operates during summer-autumn, whereas in Oran the species is exploited all year round. However, other factors such as environmental conditions may also play a role.

The main difference between the Algerian fishery and comparable fisheries in the other Mediterranean areas lies in the degree of development of the deep water red shrimp fishery. Red shrimp constitutes an important potential resource for the Algerian fishery. However, in order to avoid the mistakes made previously in other areas of the Mediterranean, returns need to be carefully monitored and

assessed as the fishery develops. A permanent data collection system, together with a strategy for regularly monitoring the fishery and the ecosystem being exploited, needs to be put in place (Lleonart and Maynou 2003). Moreover, an adaptive and precautionary fishery management strategy, which establishes close relationships between data gathering, assessment and management, and between administrators, fishermen and scientists, is needed.

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