

NOTE

A pilot experiment of tagging the deep shrimp *Aristeus antennatus* (Risso, 1816)*

M. RELINI¹, P. MAIORANO², G. D'ONGHIA², L. ORSI RELINI¹, A. TURSI², M. PANZA²

¹Department of Territory and Resources, University of Genova, Via Balbi, 5, 16126 Genova, Italy.
Tel/fax: +3910 2099463. E-mail: largepel@unige.it

²Department of Zoology, University of Bari, Via Orabona, 4, 70125 Bari, Italy.
Tel.: +39 80 5442228; fax: +39 80 5443350. E-mail: g.donghia@uniba.biologia.it

SUMMARY: A tagging experiment of the blue and red shrimp, *Aristeus antennatus* was carried out in the Ionian Sea, off Roccella Jonica (RC). The experiment involved 45 shrimps, caught by trawling at night at about 100-150 m in depth. One month after tagging one specimen was recaptured at about 10 nautical miles from the releasing point. As the first case of tagged recaptured deep sea shrimp, this experiment brings important results about the feasibility of experimental studies on displacement and growth and gives the first direct proof of the migratory abilities *A. antennatus*.

Key words: *Aristeus antennatus*, tagging, displacement, Mediterranean

INTRODUCTION

The blue and red shrimp, *Aristeus antennatus* (Risso, 1816), which is generally fished by trawling at depths between 300 and 700 m, is one of the most important demersal resources in the Mediterranean. A remarkable quantity of work has been devoted to describing its fishery and biology (Orsi Relini and Relini, 1979; Sardà *et al.*, 1987; Cartes and Sardà, 1989; Matarrese *et al.*, 1992; Mura *et al.*, 1992; Spedicato *et al.*, 1995). However, some basic aspects remain obscure, such as the age of exploited shrimps and the movement of this species during its lifespan, i.e. as larvae, juveniles and adults. The distribution of larvae (Heldt, 1955) is practically unknown. Juveniles appear with different relative densities on various fishing grounds in the Mediter-

ranean: they seem most abundant at lower latitudes (Sardà and Demestre 1987; Mura *et al.*, 1997; D'Onghia *et al.*, 1997) while the largest, and probably the oldest, shrimps have been found in northern areas (Orsi Relini and Relini, 1979, 1998). Several fishing patterns suggest that shrimp may be capable of both vertical and horizontal displacement: 1) there is a unitary yield change with a daily periodicity, with a maximum in daylight conditions and minimum at night, suggesting a benthopelagic behaviour (Relini G., 1981; Bianchini *et al.*, 1998); 2) in some canyons fishing is productive in restricted areas, where several trawlers work for long periods (Orsi Relini *et al.*, 1986). The fact that the resource appears to be "resilient" means that shrimps come day after day to that particular fishing ground; 3) seasonal patterns of distribution of the trawling fleet and/or of the resource have been described (Sardà *et al.*, 1997); 4) In areas where the study of red shrimps

*Received September 30, 1999. Accepted February 17, 2000.

has lasted for several years sudden events of appearance and/or disappearance have been recorded (Relini and Orsi Relini, 1987; Orsi Relini and Relini, 1988).

Tagging techniques have been extensively used in the study of several important stocks of coastal peneids, especially in Australia (Dall *et al.*, 1990). These experimental approaches have revealed unsuspected migrations totaling 1000 Km or more (Montgomery, 1981). During such tagging experiments basic information about the growth and maturation of migrating shrimps has been collected. Similar studies have never been extended to species living in deep waters. As the application of tagging techniques to the study of red shrimps could be a means of obtaining direct information on displacement and growth, we have developed a simple method to tag and release *A. antennatus*. The first recovery of a tagged specimen in the Ionian Sea has prompted us to publish information about this experiment to underline the possibility of catching live specimens which can survive after the release back to deep waters; our aim is also to promote the extension of such tagging studies.

MATERIAL AND METHODS

The tagging experiment was carried out in the Ionian Sea, along the Calabrian coast, offshore from Roccella Jonica (RC) (Fig. 1). This area was chosen because vertical displacements of *A. antennatus* occur in the Roccella canyon during night hours (Matarrese *et al.*, 1995). Thus, *A. antennatus* was caught by trawling at only 100-150 m in depth. This small depth of catch reduced the traumatic effects of hauling on the survival of the specimens. The impact of trawling was also diminished by tows of short duration and by the fact that the tow was carried out at night when smaller thermic and light changes occur from water to air.

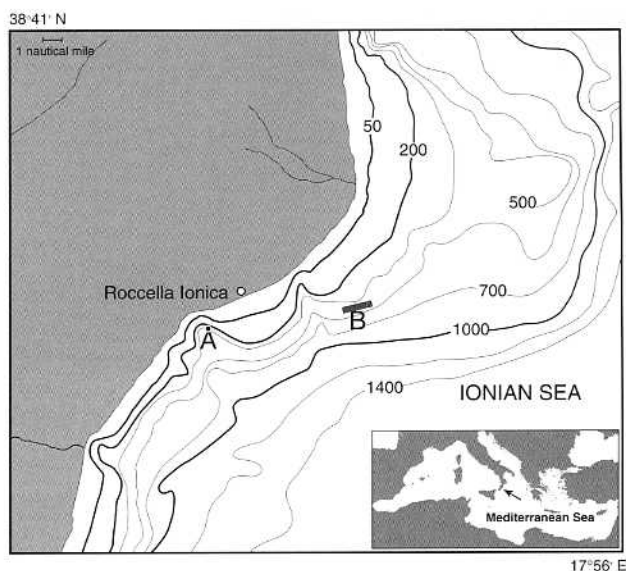


FIG. 1 – Map of the study area in the Ionian Sea with indication of the releasing point (A) and the recapture area (B) of a tagged specimen of *Aristeus antennatus*.

The sampling of *A. antennatus* specimens was conducted on 22 May 1998. A commercial vessel of 75 tons gross tonnage, with 360 Hp engine, was hired for two trawling operations. It was equipped with a nylon otter-trawl net with 40 mm stretched mesh (20 mm side) in the cod-end. The vessel speed, measured using GPS, was maintained at 2.5-2.8 knots. Two tows were carried out during the night in shelf waters close to the canyon: times, depth and geographical positions are reported in Table 1.

The catch was rapidly sorted and all the live specimens of *A. antennatus* were put in a tank containing cooled sea water (approximately 13°C). After half an hour in the tank, all swimming individuals were measured, sexed and tagged. The tag was a yellow streamer 95x4 mm, narrower in the middle (20x2 mm), placed through the pleon as shown in Figure 2. Each tagged specimen was replaced in the tank and left from half an hour to two hours to allow the vessel to reach the release site. This time lag was also useful to evaluate vitality after tagging. The tank was covered with a dark

TABLE 1 – Date, time, depth and geographical positions of two hauls carried out in the Ionian Sea during a tagging experiment on *Aristeus antennatus*.

Date	Haul		Time	Depth (m)	Geographical position	
					Latitude	Longitude
22.05.98	1	Starting point	21.45	198	38° 15.93 N	16° 24.34 E
22.05.98		Ending point	22.45	198	38° 17.33 N	16° 28.27 E
22.05.98	2	Starting point	23.55	149	38° 17.38 N	16° 28.00 E
23.05.98		Ending point	00.40	156	38° 16.07 N	16° 25.08 E

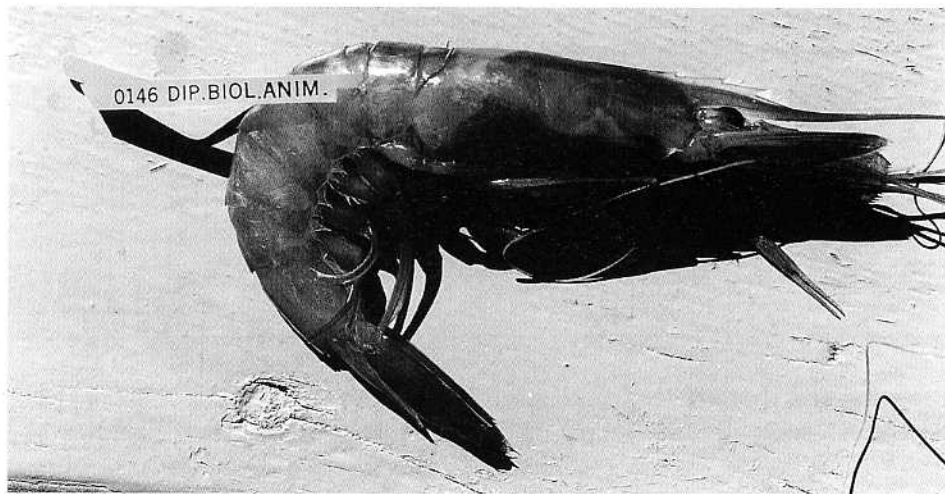


FIG. 2 – A tagged specimen of a female of *Aristeus antennatus*.

screen to reduce stress due to the lights of the vessel. Each tagged specimen was released from a segment of PVC tube (40 cm length and 10 cm in diameter) full of water, closed and ballasted at the lower end (Fig. 3). The tube was closed at the bottom using plastic or paper sheets, in order to investigate the durability and hence the ease of release using different materials. The cylinder was gently released overboard with the ballasted end down, so that it descended to the bottom in a vertical position and then lay down on it, allowing the shrimp to swim out if the basal plug was still in place. The total number of specimens tagged and released during the two hauls is reported in Table 2.

RESULTS AND DISCUSSION

The present pilot experiment involved only 45 shrimps. In commercial trawl catches the majority of shrimps come on board damaged or dead. For tagging purposes the duration of the trawl was reduced, but one-hour trawling is probably still too long as the dead shrimps outnumbered the others. Live specimens, when put in a provisional aquarium on board, seemed to survive well in this artificial environment, at least for the time necessary for the tagging and release operations: only 3 out of 45 specimens died. One month after tagging, the commercial vessel "Lucia madre" recaptured one specimen (104 tag number) on 26 June 1998 at 20:00, during a haul carried out at a depth of 506 m. During its month of free life, the tagged specimen, a female, covered at least 10 nautical miles, moving north-east and to greater depths (Fig. 1). It bore a spermatophore as at

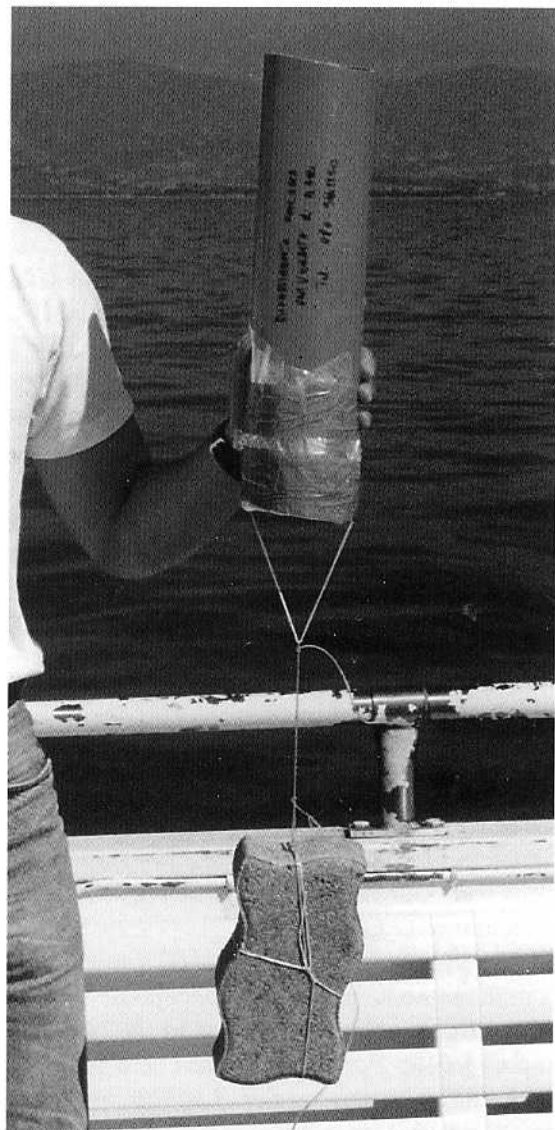


FIG. 3 – The PVC tube, 40 cm length and 10 cm in diameter, closed and ballasted at the lower end, employed for the release to deep waters.

TABLE 2 – Release data of 42 specimens of *Aristeus antennatus* with 1 recapture.

Releasing method	No. females	No. Males	CL range (mm)	Releasing point	Time	Recapture: time and area (central point)
PVC tube (plastic)	2	-	27-33	38°15.93 N 16°24.34 E	21.42	20.00
	24	1	23-50	38°14.70 N 16°23.90 E	23.25-02.15	38°21.00 N 16°34.00E
PVC tube (newspaper)	7	-	25-42	38°14.70N 16°23.90 E	23.25-02.15	
free on surface	1	-	32	38°15.93 N 16°24.34 E	21.42	
	7	-	33-53	38°14.70 N 16°23.90 E	23.25-02.15	

the moment of tagging and its carapace length was unchanged: therefore apparently no moult had occurred.

This report can be considered important from the technical point of view. Its main significance is to show the feasibility of tagging a deep-living species of Decapoda Natantia. Undoubtedly these species are more delicate than strictly benthic forms of Brachyuran Decapods, to which large-scale tagging has already been applied successfully (Melville-Smith, 1987). This first recapture also gives interesting indications about the displacement of the shrimp both in vertical and horizontal space, giving confirmation of the above-mentioned benthic-pelagic behaviour inferred from daily fluctuations in fishing yields and movements into and out of canyons, deduced both by persistent yields in limited areas such as in the Ligurian Sea and by seasonal variation of the productive fishing grounds such as along the Catalan coast (Sardà *et al.*, 1997).

A. antennatus has been monitored from a manned submarine (Campillo, 1994) and the shrimps were observed hovering on the sea bed at 1-2 m from the bottom. Their escape reaction involved moving up in the water column. These facts indicate strong swimming abilities that are probably favoured by a lighter body than in coastal species. In the latter the great distances recorded by tagging experiments have suggested speeds of up to 7 Km/day, which are unlikely to be achieved by walking and have therefore been assigned to swimming (Dall *et al.*, 1990).

It is well known that, even when few individuals are recaptured, tagging can give very important information both in terms of general knowledge and for management purposes. Decapoda Reptantia which were thought to be linked to the bottom like the spiny lobster *Palinurus elephas* or strictly benthic fish such as the angler *Lophius piscatorius*, showed unsuspected displacements which sometimes crossed hypothetical stock borders (Relini and Torchia, 1998; Pereda and Landa, 1997).

At present it is impossible to predict the recovery rate from a large-scale experiment on red shrimps, but perhaps even on the basis of the limited number of recoveries typical of migratory species, some basic questions about their life history (moult rate, growth per moult, displacements) could be answered.

REFERENCES

- Bianchini, M.L., L. Di Stefano and S. Ragonese. – 1998. Daylight vs night variations in the red shrimps catches of the Strait of Sicily. *Rapp. Comm. Int. Mer Médit.*, 35(2): 374-375.
- Campillo, A. – 1994. Bio-ecology of *Aristeus antennatus* in the French Mediterranean. Proc. Int. Workshop "Life cycles and fisheries of the deep-water red shrimps *Aristaeomorpha foliacea* and *Aristeus antennatus*", Mazara del Vallo 1994, M. L. Bianchini - S. Ragonese (Eds.), N.T.R.-I.T.P.P., special publication n. 3: 25-26.
- Cartes, J.E. and F. Sardà. – 1989. Feeding ecology of the deep-water aristeid crustacean *Aristeus antennatus*. *Mar. Ecol. Prog. Ser.*, 54: 229-238.
- Dall, W., B.J. Hill, P.C. Rothlisberg and D.J. Staples. – 1990. The biology of Penaeidae. *Adv. Mar. Biol.*, 27: 1-489.
- D'Onghia, G., A. Matarrese, P. Maiorano and M. Panza. – 1997. Recruitment pattern of *Aristeus antennatus* (Risso, 1816) from the north-western Ionian Sea. *Biol. Mar. Médit.*, 4(1): 244-253.
- Heldt, J.H. – 1955. Contribution à l'étude de la biologie des crevettes pénelides *Aristaeomorpha foliacea* (Risso) et *Aristeus antennatus* (Risso) (formes larvaires). *Bull. Soc. Sciences Nat. Tunisie*, 8 (1,2): 9-33, Tables 1-17.
- Matarrese, A., G. D'Onghia and A. Tursi. – 1992. Struttura e dinamica dello stock di *Aristeus antennatus* (Risso, 1816) (Crustacea, Decapoda) nel Mar Jonio. *Oebalia*, Suppl. 17: 61-66.
- Matarrese, A., G. D'Onghia, M. De Florio, M. Panza and G. Costantino. – 1995. Recenti acquisizioni sulla distribuzione batimetrica di *Aristaeomorpha foliacea* e *Aristeus antennatus* (Crustacea, Decapoda) nel Mar Jonio. *Biol. Mar. Médit.*, 2(2): 299-300.
- Melville-Smith, R. – 1987. Tagging study reveals interesting red crab (*Geryon maritae*) movements off Namibia (South West Africa). *J. Cons. int. Explor. Mer*, 43: 294-295.
- Montgomery, S. S. – 1981. Tagging studies on juvenile eastern king prawn reveal record migration. *Australian Fisheries*, 40(9): 1-13.
- Mura, M., S. Campisi and A. Cau. – 1992. Osservazioni sulla biologia riproduttiva negli Aristeidi demersali del Mediterraneo centro-occidentale. *Oebalia*, 17, Suppl.: 75-80.
- Mura, M., F. Orrù and A. Cau. – 1997. Osservazioni sull'accrescimento di individui in fase pre-riproduttiva di *Aristeus antennatus* e *Aristaeomorpha foliacea*. *Biol. Mar. Médit.*, 4 (1): 254-261.
- Orsi Relini, L. and G. Relini. – 1979. Pesca e riproduzione del gambero rosso *Aristeus antennatus* (Decapoda, Penaeidae) nel Mar

- Ligure. *Quad. Civ. Staz. Idrobiol.*, Milano, 7: 39-62.
- Orsi Relini, L., G. Relini and M. Semeria. – 1986. Displacements of shoals of *Aristeus antennatus* deduced by the fishing activity of west-Ligurian trawlers. *Rapp. Comm. int. Mer Médit.*, 30 (2): 1-12.
- Orsi Relini, L. and G. Relini. – 1988. An uncommon recruitment of *A. antennatus* (Risso) (Crustacea Decapoda Aristeidae) in the Gulf of Genoa. *Rapp. Comm. int. Mer Médit.*, 31(2): 1-10.
- Orsi Relini, L. and G. Relini. – 1998. Seventeen instars of adult life in females of *Aristeus antennatus* (Decapoda Aristeidae). A new interpretation of life span and growth. *J. Nat. History*, 32: 1719-1734.
- Pereda, P. and J. Landa. – 1997. Recuperación de dos ejemplares de rape *Lophius piscatorius* Linnaeus, 1758 en el stock norte (divisiones VIII a y b del CIEM) tras ser marcados en el stock sur (division VIII c). *Bol. Inst. Esp. Oceanogr.*, 13 (1 y 2): 75-78.
- Relini, G. – 1981. Campagna di pesca a strascico 1977 sui fondi batiali del Mar Ligure nell'ambito dei programmi finalizzati. *Quad. Lab. Tecnol. Pesca*, 3(1 suppl.): 111-122.
- Relini, G. and L. Orsi Relini. – 1987. The decline of red shrimps stocks in the Gulf of Genoa. *Inv. Pesq.*, 51(suppl. 1): 245-360.
- Relini, M. and G. Torchia. – 1998. Inaspettato percorso di un aragosta in Mar Ligure. *Biol. Mar. Medit.*, 5(1): 641-643.
- Sardà, F. and M. Demestre. – 1987. Estudio biológico de la gamba *Aristeus antennatus* (Risso, 1816) en el Mar Catalán (NE de España). *Inv. Pesq.*, 51(suppl. 1): 213-232.
- Sardà, F., F. Maynou and L. Tallò. – 1997. Seasonal and spatial mobility patterns of rose shrimp *Aristeus antennatus* in the Western Mediterranean: results of a long-term study. *Mar. Ecol. Prog. Ser.*, 159: 133-141.
- Spedicato, M.T., S. Greco, G. Lembo, F. Perdichizzi and P. Carbonara. – 1995. Prime valutazioni sulla struttura dello stock di *Aristeus antennatus* (Risso, 1816) nel Tirreno Centro-Meridionale. *Biol. Mar. Medit.*, 2(2): 239-244.

Scient. ed.: P. Abelló