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Preliminary results from an exploratory translocation study at the Natural Marine Reserve of Miramare (Trieste, Italy)

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Abstract

One of the conservation precautionary measures applicable to overexploited species is to implement protected population through translocation of exogenous individuals. The European lobster (*Homarus gammmarus* L. 1758) and the brown meagre (*Sciaena umbra* L. 1758) are species under strong fishing pressure. In summers 2001 and 2002 we released four translocated lobsters and two translocated brown meagres inside the Natural Marine Reserve of Miramare, where the species are naturally present. The spatial behaviour of the released animals was monitored using two different acoustic tracking systems (Track28 and VR1 receivers; Vemco Ldt). On the base both of bibliography and of our preliminary experimental outcomes, the lobsters were tagged by gluing the pinger to the dorsal surface of the cephalothorax and the brown meagres were tagged by implanting the pinger in the peritoneal cavity. All the animals, both lobsters and brown meagres, disappeared from the detection range of the hydrophones after a variable number of days (2-16 days of continuous monitoring). We suppose that they did not colonize the site, leaving the protected area. From the methodological point of view, VR1 mode proved to be a suitable tool to evaluate the colonisation of an area by transferred animals.

Introduction

One of the objectives of the Natural Marine Reserve of Miramare (Trieste, Italy) is to protect the local breeding populations from exploitation, maximising its density up to the extent permitted by local keystone resources. This is particularly relevant and precautionary for overexploited species and represents a buffer against mismanagement. In addition to protective measures, a management option for achieving this goal is to restock the local natural population with additional wild individuals, caught elsewhere, to increase the population's size and gene pool ('augmentation program'; Primack, 1993). This action assumes, however, that the released individuals will settle in the new area and avoid conflicts that are a potential hazard. A successful programme needs to consider the spatial behaviour of the released animals and therefore close monitoring is required.

In order to assess whether the reserve aided in restocking overfished species, the purpose of this preliminary project was (1) to monitor the behaviour of animals translocated into the protected area and (2) to evaluate the effectiveness of acoustic tracking methods as a tool for achieving the first goal. The target species were a crustacean, i.e. the European lobster (*Homarus gammarus* L.) and a teleost fish, i.e. the brown meagre (*Sciaena umbra* L.), which are naturally present in the reserve and are under strong fishing pressure outside the protected area. The small size of the marketed *H. gammarus* individuals throughout the Mediterranean Sea suggests that it is over-exploited (Relini *et al*., 1999). On the other side, the brown meagre, a soniferous fish, is included in the UNEP annex 3 of RAC-SPA protocol, i.e. the list of species whose exploitation has to be regulated (RAC-SPA Barcelona Convention, 1995, ratified in Italy in 1999; AA. VV., 1995).

Materials and methods

We monitored the spatial behaviour of four translocated lobsters and two translocated brown meagres in the Natural Marine Reserve of Miramare. The reserve is located about 8 km from Trieste at 45°42'08'' latitude and 13°42'42'' longitude (Fig. 1) and it extends for 1700 m coastline and for 121 hectares at sea. The area is divided in a core and in a buffer zone and the maximum depth reaches 18 m.

The animals were caught close to Pirano (Slovenia), at a coastal site facing the Trieste Gulf, tagged with acoustic transmitters and then released in the Reserve about 15 days later.

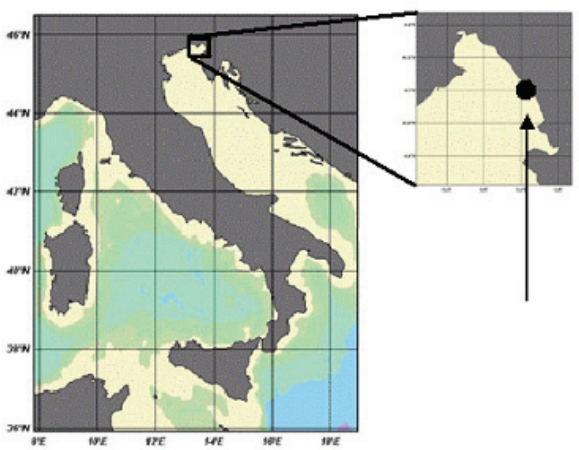


Fig. 1 – The Natural Marine Reserve of Miramare.

The tagging procedure was relatively easy for lobsters: the tag was glued to the dorsal surface of the cephalothorax with quick-setting epoxy resin after drying the carapace with alcohol (Van der Meeren, 1997). Four lobsters of different size (from 17 to 27 cm total length) were tagged with dummy transmitters and released in aquaria (3 m long, 3 m wide, 1 m deep) with ten blocks as shelters (50 cm long, 30 cm wide, 9-13 cm high). They were monitored over a period of 3 months and none of them lost its pinger throughout that time.

Tagging procedures for the fish were more difficult (for a review see Bridger and Booth, 2003). In aquaria, we tagged six brown meagres externally (423±28 gr body weight) i.e. securing a dummy transmitter onto one side of the fish by nylon wires inserted through the dorsal musculature (Baras and Lagardère, 1995). Other four brown meagres were tagged internally, two (441 gr and 443 gr) by forced ingestion of the dummy transmitter into the stomach (Hawkins and Urquhart, 1983) and two (424 gr and 380 gr) by surgical intra-peritoneal implantation (Thoreau and Baras, 1997). The transmitters never exceeded 2% of the body weight in water of the tagged fish. Four of the externally tagged fish shed their pingers within 24 hours and the other two kept pingers for about five days; all brown meagres showed wounds and infections on the skin around the pinger. Both fish regurgitated the transmitters located in the stomach within 48 hours, whereas the transmitters implanted in the peritoneal cavity were retained longer than 20 days. The latter brown meagres recovered within 24 hours from the operation, showing normal feeding and swimming behaviour. Buoyancy was also not noticeably affected by tagging. After 20 days of observations, the animals, in perfect health condition and still carrying the transmitter, were moved to a different, non-experimental tank, due to lack of space. Considering these preliminary outcomes, we concluded that intraperitoneal implantation was the best tagging procedure for our study.

In the field, the animals were tracked using two different acoustic systems: a four channel ultrasonic receiver, connected to a four element hydrophone array located under the research vessel (Track28, Vemco Ldt.) and four submerged automated acoustic receivers (VR1, Vemco Ldt.). The receivers VR1 were moored 1.5 m above the seafloor in proximity of two artificial rocky reefs of the reserve, where the target species are abundant. Mooring units consisted of a concrete filled box used as an anchor, a stainless steel bar and a sub-surface float providing positive buoyancy. The detection radius of each receiver ranged from 70 to 300 m, depending on bottom topography, but dropped to 15-20 meters from the source, when the pinger was located under the rocks.

The pinger used for the lobsters (8x38 mm, 5 gr in water) were the V8-1L continuous transmitters (©Vemco Ldt.), emitting one signal per second at

76.8 kHz (battery life 35 days) and the V8-2L-R256 coded transmitters (©Vemco Ldt.), emitting a train of six pings every 40-60 seconds at 69 kHz frequency (battery life 320 days).
The pingers used for brown meagres (5.5x30 mm, 3.3 gr in water) were the V8SC-6L continuous transmitters (©Vemco Ldt.), emitting one signal per second at 76.8 kHz (battery life 20 days) and the V8SC-6L coded transmitters (©Vemco Ldt.), emitting every 15-45 seconds at 69 kHz frequency (battery life 96 days).

Results

Tracking at sea: lobsters movements
On 16 May 2001 and 13 July 2001 two tagged lobsters (lobsters A and B; 17 and 32 cm TL, respectively) were released in different locations of the Reserve (Fig 2). The releases occurred at about mid-day at a depth of about 8 meters and the lobsters were then tracked continuously by means of the VR28 Tracking System. In both cases, even if shelters were present at the site, the animals moved away from the release point. They roamed around for the subsequent ten (A) and five (B) hours before settling inside (A) and outside (B) the core zone of the Reserve, respectively at 150 m and at 1100 m away from the release point. These sites had beach rocks present. Visual inspection by divers confirmed their positions. They remained at the same location for the following 26 hours (A) and 72 hours (B) respectively, alternating between sporadic short strolls and long residence in their shelter. After which time, the signal emitted by the transmitters was no longer detectable by the tracking system, even if visual inspections (17, 19 and 22 May 2001) revealed the presence of the lobster A at the same position previously defined acoustically. Lobster A found its shelter under a big rock of 1.5x3x0.5 m in size. Unfortunately after 22 May, the animal was no longer detected at its shelter nor at other locations inside the Reserve. A total of 130 and 150 hours of active search was carried out after the last received signal before ending the acoustic tracking session.

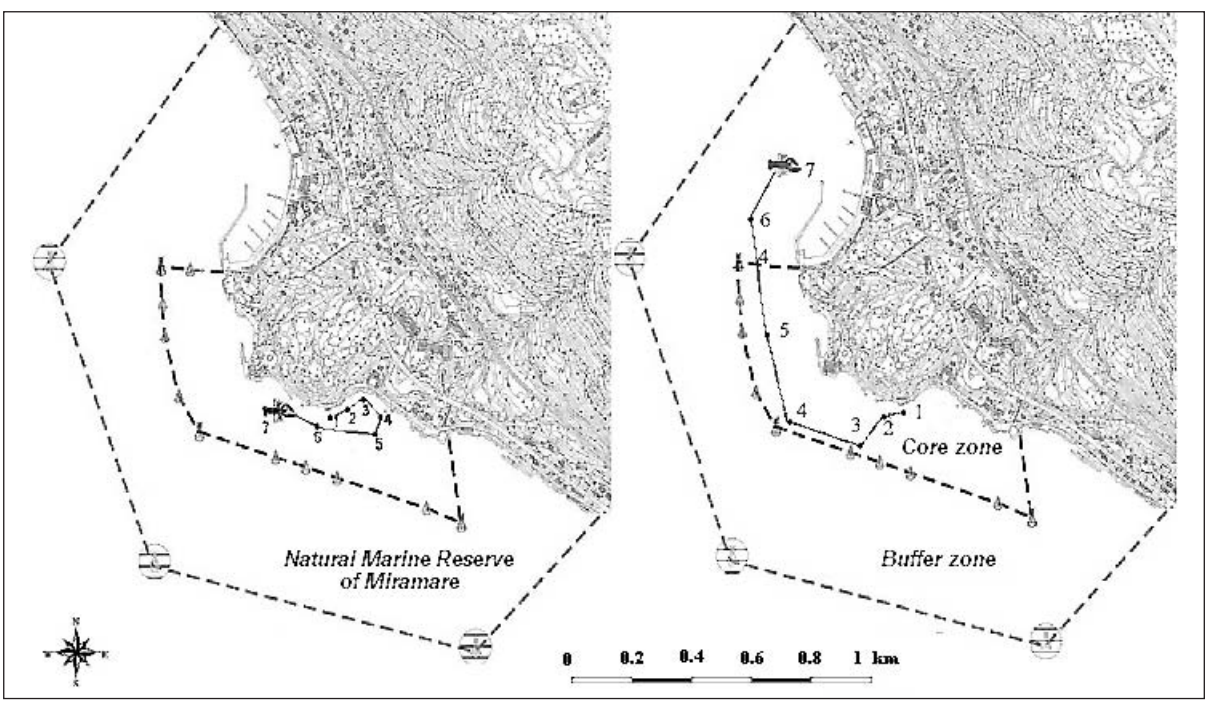


Fig. 2 – Movements of lobsters A (left) and lobsters B (right) at the Natural Marine Reserve of Miramare (number 1 represents the releasing point).

Two lobsters (lobsters C and D; 28 and 20 cm TL, respectively) were released on 13 May and 23 May 2002, respectively, at the rocky reef of Miramare (at 4 meters depth). Their presence was automatically detected by means of the VR1 Tracking System. Lobster C was also fitted with a V8-2L-R256 transmitter and it was therefore simultaneously monitored by both the VR28 and VR1 tracking systems. VR1 receivers demonstrated to be more effective in detecting the acoustic signals than the VR28, recording the presence of the animal also when the VR28 System did not reveal this. Visual observations showed that the individuals were detectable only when the lobsters projected themselves, or most of their body, out of the rocks, or when they moved to the muddy grounds facing the rocky reef. The animal was thus detectable only when the transmitter was clear from obstructions.

Lobsters remained inside the Reserve for the periods from 13 to 29 May (lobster C) and from 23 to 28 May 2002 (lobster D). Contrary to observations from 2001, lobsters C and D remained at the release point for one day after translocation. Subsequently, lobster C settled itself along the reef, building its burrow 150 m away from the release point (visual inspection confirmed the location of this shelter). Lobster D moved along the entire rocky reef for five days, stopping at different positions but never settling anywhere. A total of 7038 signals were detected by the four VR1 receivers (Fig 3): 1645 signals originated from lobster C and 5393 originated from lobster D.

In two cases, i.e. on 26 May from 01:00 to 04:00 and from 20:00 to 23:00 and on 27 May from 02:00 to 03:00, a large number of signals originating alternatively from lobsters C and D were detected by the same VR1 receiver, with an inter-pulses delay of 2–3 seconds. It is possible that the lobsters interacted with one another during these two periods, after which the animals disappeared permanently from the detection range of the hydrophones, one 20 hours after the other one.

Tracking at sea: brown meagre movements

On 31 July 2002, a brown meagre (individual a, 512 gr of weight) was released around midday at the rocky reef of Miramare at a depth of about 8 m. The animal was monitored by means of the VR28

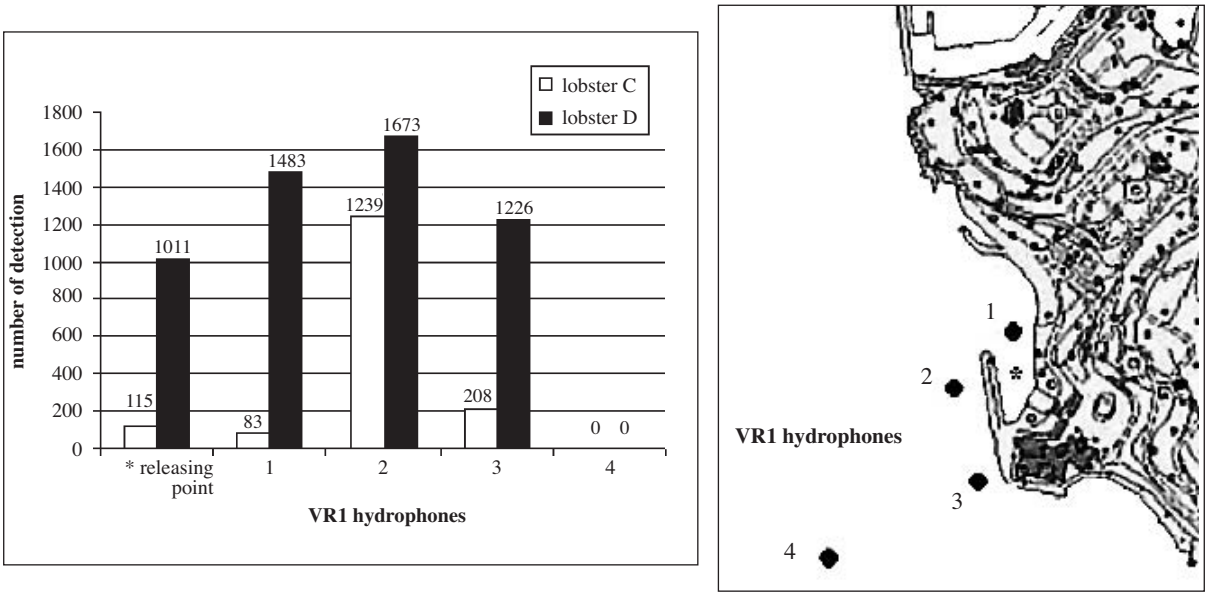
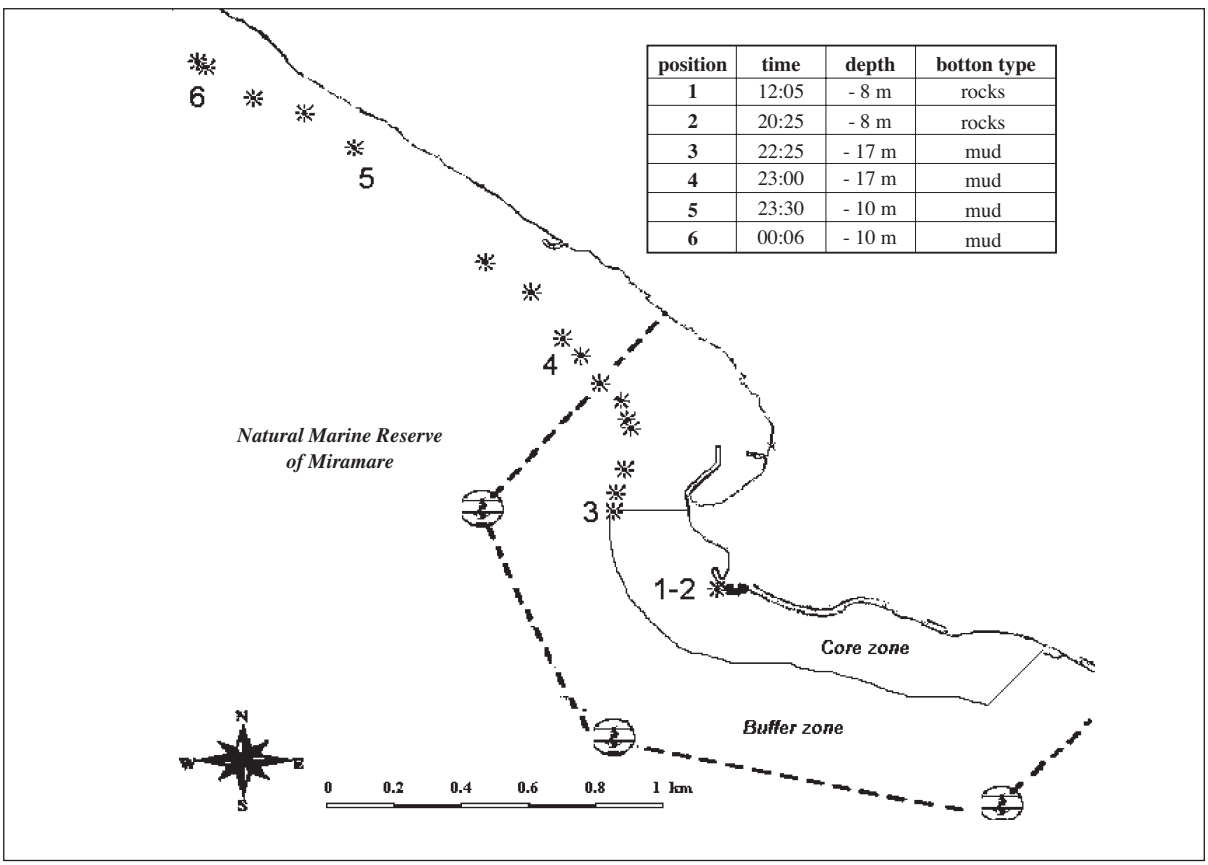


Fig. 3 – Number of detections of each VR1 hydrophones (on the left) – Position of the four VR1 hydrophones in the core area of the Natural Marine Reserve of Miramare (on the right).

Tracking System and, whenever possible, by visual inspection. Just after release, the animal hid in the rocky shelters present at the site, where it remained for the subsequent ten hours (till 22:20). That night, the fish moved away from the reef, leaving the protected area at about 23:00. At the same time, i.e. from about 19:00 till 00:20, acoustic emissions of *S. umbra* were recorded in the area facing the reef, indicating reproductive and agonistic activity within the local population detectable in the area (2500 meters from releasing point) at 05:00 the following day. A total of 30 hours of active search was carried out in the following 15 days after the last received signal.

Another brown meagre (individual b, 424 gr of weight) was released at the rocky reef of Miramare and its presence was detected by means of the VR1 Tracking System from 31 July to 7 November 2002. Out of the total of 2997 signals detected by the hydrophones, 638 signals were



position	time	depth	botton type
1	12:05	- 8 m	rocks
2	20:25	- 8 m	rocks
3	22:25	- 17 m	mud
4	23:00	- 17 m	mud
5	23:30	- 10 m	mud
6	00:06	- 10 m	mud

Fig. 4 – Movements of the released brown meagre (individual a) in the gulf of Trieste.

(Bonacito, 2000; Bonacito *et al*., 2001). The released brown meagre swam along the coast with a north bearing (Fig 4) at a maximum recorded speed of 1.5 kmh^{-1}. The animal was detected until 00:06, when the monitoring was stopped due to bad weather conditions. The fish was no longer received almost simultaneously by different receivers (inter-pulses delay <1 sec) and allowed a better localization of the fish. Table 1 reports the first and the last signal recorded per day by the VR1 hydrophones (no signals were detected in between the reported recordings).

Table 1 – The first and the last signal from the brown meagre (individual b) detected per day by the VR1 hydrophones located in the Natural Marine Reserve of Miramare (the number of the VR1 refers to their position – see Figure 3).

	First detection of the day		Last detection of the day	
DATE	TIME	VR1 hydrophone	TIME	VR1 hydrophone
31 July	11:50	release point		
31 July			11:53	3
1 August	00:44	1		
1 August			21:17	4
2 August	04:32	4		
2 August			04:51	1
5 August	01:26	1		
5 August			21:18	4
30 August	20:34	4		
30 August			20:46	1
9 September	14:02	4		
9 September			14:22	4
7 November	07:10	4		
7 November			16:51	4

Discussion

The acoustic tracking systems proved to be an effective way to monitor movement and activity of individual animals without the need of direct observations. In our case, the active tracking system (VR28) was not ideal for tracking lobsters because the varied bottom structure and the shelter-seeking behaviour of this species did not allow the hydrophones to detect the signals originated by the pingers. Active tracking of brown meagres, however, was limited by time and overall weather constraints. We conclude that VR28 System is suitable only for very short-term studies, that require precise positioning (i.e. monitoring movement of translocated animals until their settlement). The automatic static monitoring system (VR1) provided continuous monitoring of many individuals simultaneously in the study-area, although the use of four hydrophones did not provide a complete coverage of the protected area of Miramare. It allowed for monitoring the two local rocky reefs (where most of the animals are usually located) with a degree of overlap between the ranges of the four hydrophones that permitted a rough triangulation. The spatial resolution obtained by the VR1 system was not amenable to analysis of fine-scale movements but daily activity and site fidelity patterns could be calculated by the VR1-data, provided the animal remains within the range of the receivers. We believe that VR1 mode is ideal for long-term monitoring of animal movements in a MPA and we consider it a suitable tool to evaluate the colonisation of an area by transferred animals.

The disappearance of the released animals, both lobsters and brown meagres, from the detection range of the hydrophones seems to indicate that they did not colonize the site, leaving the protected area after a variable number of days. This is particularly probable in the case of *S. umbra*: the data from the VR28 system showed clearly the departure of the tagged animal "a" from the reserve ten hours after the release; likewise, the erratic detections from the VR1 hydrophones suggest that brown meagre "b" did not establish at the reserve. On the other side, the fish seems to have been settled not very far from it, since its presence was recorded sporadically for about one month after the release and, interestingly, also three months later on. The translocated animal may have found a suitable habitat outside the MPA, where the brown meagre is distributed (Bonacito *et al*., 2002).

The disappearance of *H. gammarus* is more difficult to interpret. We cannot exclude they lost their pinger, whereas it is rather difficult they have been preyed upon, because predators are not present in the area (except poachers). Out of four, only in one case (lobster "C"), the tagged animal seemed to start establishing itself at the reserve: data from VR1 indicated that for 13 days the animal movements were spatially restricted around an area, where a new burrow has been visually detected. Nevertheless, the animal disappeared later on.

Concluding, this study should be considered a very preliminary one; increasing sample size and additional research on the behaviour of both translocated and resident animals are necessary to better clarify these aspects.

Acknowledgements

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