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Hydroid and serpulid recruitment patterns using a new laser microtopography technique

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ABSTRACT

The early settlement process is difficult to assess, due to the small size of the early settlers. Early recruitment counts generally concern individuals that have succeeded in taking the first step in this process, between the first larval contact with the substrate and the early growth of settled individuals. In this paper, a non-destructive technique is used to obtain information at organism level on the location and growth of freshly settled individuals. Settlement plates were collected every week for 2 months then replaced at sea. A video survey was combined with laser beam 3D surface analysis to obtain information on the individual location and size of settlers colonizing settlement panels immersed at two depths in western Mediterranean waters. Settling *Pomatoceros* (serpulid polychaete) were isolated with image analysis. Within hydroid colonies *Clytia* polyps were identified individually and their position stored on a database. Micro-topography was used to geo-localize settlers over time and thus identify inter-specific constraints during the settlement phase. *Clytia* colonies were seen to have a negative effect on the recruitment rate of *Pomatoceros*.

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1. Introduction

Many benthic invertebrates with a pelagic larval phase rely heavily on early recruitment phases to establish and maintain population levels. Knowledge of the early processes when larvae have to adapt to a new substrate after metamorphosis is a pre-requisite to understanding recruitment success. Interactions between different species that modify the substrate may lead to a drastic elimination of settling larvae or they may have a repellent effect and prevent any settlement (Grosberg, 1981; Russ, 1982). Early competition within the first few days after benthic settlement may strongly influence densities of these invertebrate populations (Keough, 1998; Sams and Keough, 2007). A good knowledge of the early growth of benthic settlers is somehow masked by the fast dynamics of many of these events. When settlement plates are recovered every week they can provide a summary of all the individual events that occur in the colonizing species during a time step. A non-linear relationship between larval supply and settlement has been reviewed (Pineda et al., 2010). There are many factors that may interact during the settlement period: presence of recruitment windows (Pineda et al., 2006), larval behavior (Grosberg, 1982), current speed and turbulence (Guizien et al., 2006), sediment or substrate quality and heterogeneity (Qian et al., 2000), chemical cues (Qian, 1999), presence of existing fauna (Dahms et al., 2004; Hamer et al., 2001; Harder et al., 2002; Keough, 1998; Keough and Raimondi, 1996; Todd and Keough, 1994).

Counting new settlers on a recruitment plate is usually considered a good indicator of the recruitment process. By using non-destructive sampling, the settlement panels can be returned to the field several times (Hills et al., 1999; Schoener and Greene, 1981). In this paper we investigate a non-destructive technique to provide information at organism level by geo-localizing the settlers across time to identify inter-specific negative interactions during the settlement phase. Relationships between species with different dynamics, i.e. colonial organisms versus tubicolous organisms, were examined on recruitment plates immersed in Mediterranean waters. A colony of *Clytia hemisphaerica* (Linnaeus, 1767) (Hydrozoa, Leptothecata, Campanulariidae) starts from a single planula larva, which originated from a planktonic leptomedusa. Larvae may reach about 400 μm in size (Houliston et al., 2010). From this single larva, a colony develops and spreads across the recruitment plates, thus modifying the surface texture and physical properties. Larval settlement by *Pomatoceros triqueter*, (a serpulid polychaete) was examined on the same plates in relation to the coverage of hydroid colonies. We estimated colony growth and the effect of the substrate coverage on the recruitment of serpulid polychaete *Pomatoceros* using video techniques and 3D laser scanning of the panels to obtain information on the position and size of the early settlers.

2. Material and methods

Recruitment structures were immersed in the bay of Banyuls, in the Western Mediterranean Sea, close to the SOLA station (42°29′30″N, 3°08′70″E, a point in the SOMLIT network, recording marine environmental parameters every week). A 2-month survey of recruitment

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patterns was carried out between early March and early May 2008, with a sample being taken every week. Ten plates were immersed at two different depths (3 m and 25 m below the surface, the deeper structure being 3 m above the sediment surface) on 5 March and recovered for a 12-hour study once a week (t1 = March 19, t2 = March 27, t3 = April 2, t4 = April 9, t5 = April 16, t6 = April 23, t7 = April 29, t8 = May 6). Information on hydrology was obtained from the SOLA station (temperature, salinity profiles).

2.1. Recruitment plates

Recruitment structures were made from three metacrylate plates cemented together. The central plate was longer than the external ones and was used to attach the structure to buoys moored in Banyuls Bay at two different depths. The external plates measured 140 × 140 × 5 mm. This type of plate was used in the MarPace project (Marine Propagation Along the Coasts of Europe), undertaken within the MarBEF EU Network of Excellence to analyze recruitment patterns along European shores by 15 European marine institutes. The MarPace plates initially had 4 holes, but in our case these have been filled.

The upper and lower parts of the central plate were drilled with 2 holes for holders so that the diver could position and collect the plates hanging vertically under the buoys.

Using a container, up to 10 plates could be recovered during each sampling (Fig. 1 A,B). The container was inserted in a closed cool box filled with sea water to transport the plates from the buoys to the laboratory. In the laboratory, the cool box was placed in a controlled temperature room in dark conditions, with cooled running water (sea temperature, between 11.8 °C for the first March measurement and 13.3 °C for the last measurement in May, salinity range between 37.75 and 38.2‰). Some plates were used only for species analysis after 1 month and 2 months.

2.2. Recording conditions

An aquarium was built to hold 3 structures in a row. They were placed horizontally on lateral raised blocks, with the lower part of the plates 2 cm from the bottom of the aquarium (Fig. 1 D). Every structure was analyzed on both sides. The plates remained in sea water while measurements were taken and were replaced in the container after analysis. The container was then taken back to the sea and divers returned the recruitment structures to their original location.

This measurement phase lasted about 14 h and for practical reasons recruitment structures remained in the laboratory for 24 h in controlled conditions (temperature, light, non-filtered running sea water), spending the rest of the week at sea. During the measurement phase a non-destructive photographic survey was made under microscope (high resolution pictures) to obtain information on all the species present at any time on the plates.

2.3. Measuring device

The aquarium was placed under a set of motorized cross tables (401XR Parker Hannifin precision linear positioners with 5 mm ball screw) connected to ViX500 Microstepper Indexer Drives with XL-PSU power supplies. The tables were controlled by a set of specially written programs and drivers (written in Microsoft C# by J.C. Duchêne, MTOPO program, for MicroTOPOgraphic program) which allowed for precise positioning (1.5 μm). A multi-instrumented stage attached to the lower Y tables was equipped with measuring and control devices (Fig. 1 C). These included a laser telemeter (Sick OD80), a video control camera (JAI S3200) connected to an IDS Falcon grabber, a Canon EOS 400 still camera and various lights which moved with the recording devices. Sensors and lights were switched by a static relay board (Digimetrie DPCITOR48) controlled by the program. Every sensor was connected to drivers controlled by the MTOPO program, so that operations were simultaneous: (1) low resolution images (800 × 600 pixels) for positioning and video recording, (2) high resolution pictures (3888 × 2592 pixels) for identification, (3) automated light switching, and (4) laser beam scan of the surfaces to compute microtopography. 3D data were obtained by connecting the telemeter to the computer. The telemeter signal was sent to an Analog Device acquisition board (PCI-6220 with NiDaq driver), converted to voltage and processed by the MTOPO program to convert this voltage into a relative height obtained from a calibration curve. Digital data were produced by the control software and stored in proprietary format for processing later. The MTOPO program controlled the process (switching the various lights on or off, switching the telemeter on, positioning the motorized tables, grabbing images, scanning the target area, converting incoming

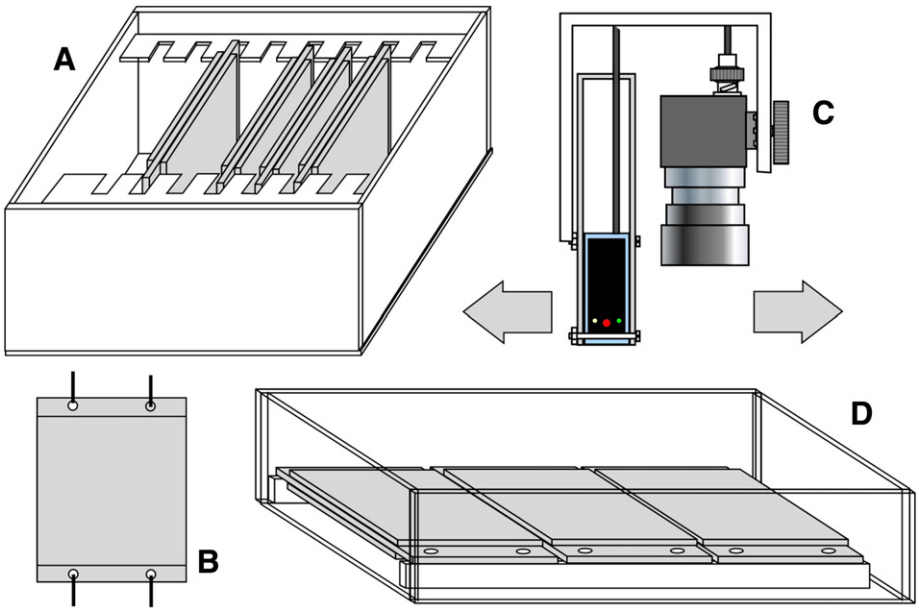

Fig. 1. Recruitment plate 140 × 140 mm. Carrying tank (A) to transport plates to and from the laboratory. Plate with holders (B). Stage with video and laser telemetry sensors on motorized cross tables (C). Measuring aquarium (D) for photographic survey and microtopography.

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