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Short Communication

Description of the IMR Standard Light Trap and the Vertical Distribution of Some Decapod Larvae (Homarus and Nephrops)

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Abstract— The construction of different versions of a cheap, robust, and easy to operate light trap for catching various aquatic organisms is shown. The trap can be used to > 300 m depth and meets a number of criteria. Small-scale vertical distribution of decapod larvae was investigated during trap trials. The traps (6-10) were set for 24 h at different depths, once a week, between 25 July and 28 September 2006, within the Kåvra lobster reserve at the Swedish west coast. This is an area with low salinity in the surface water during summer due to outflow of water from the Baltic Sea. The larvae of the European lobster *Homarus gammarus* (stage I) and Norway lobster *Nephrops norvegicus* (stages I-III) were found within and below the thermo- and haloclines. No larvae were found within the upper 2 m. This finding may have important bearings on the larval transport by currents and increase the possibility for retention of larvae, but was not tested in this study. The highest catches of both *H. gammarus* and *N. norveigicus* were obtained during August. The trap appears to be well suited for investigating small-scale vertical distribution during the dark period, and for collecting animals in good condition. However, the trap did not catch all larval stages, and the relation between light intensity (both natural and trap light) and catch ability is unknown.

INTRODUCTION

Aquatic light traps have advantages as well as disadvantages as they are selective devices and primarily catch animals that are attracted to light. Animals taken are not suited for strict quantitative estimates, or for feeding analyses as potential prey items inside the trap may have also been selectively attracted by light and are neither quantitatively nor qualitatively representative of the natural occurrence of prey. In addition, the predator-prey interaction is unlikely to be natural due to the light and the limited space. Different life stages or ages of a species may be selectively attracted. Some stages may avoid light or do not have the swimming capability required and current strength may affect different organism differently (Lindquist &Shaw, 2005). Water clarity may also affect the catch ability of the trap. Traps may not catch animals in the upper water layers during the day due to daylight influence. Trap catches from different depths may therefore not always be comparable.

Some advantages are that animals are often in good condition and therefore well suited for experiments and morphological and taxonomical work. Sorting animals is usually done within minutes. The traps can be set at very distinct depths and close to the bottom in areas where trawls and nets cannot be used, like coral reefs, shipwrecks, and rocky areas. They can be used in stormy

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weather and left out for several days, and set at great depths. In some cases, unusual animals, or animals seldom taken by other methods, can be caught. Many traps can be employed simultaneously and different habitats can be investigated, or small-scale vertical preferences identified, in a short time. This is particularly useful when investigating larval dispersal (Doherty, 1987).

Knowledge of the vertical distribution of planktonic organisms is crucial when modelling their dispersal, as well as for many other aspects of their life history. Larvae of the European lobster, *Homarus gammarus* have been found migrating to and from the neuston in European waters (Nichols & Lovewell, 1987, Tully & Ceidigh 1987). Knowledge of the vertical distribution of the Norwegian lobster, *Nephrops norvegicus* larvae exists from European waters (Nichols & Thompson,1988) but is absent for Swedish waters (Øresland, 1998). In the present study the small-scale vertical distribution of these decapod larvae was investigated during trap trials. The trap catches a number of other zooplankton like crab and fish larvae and polychaetes but those will not be reported here. The Swedish west coast water has distinct thermo-and haloclines during summer due to outflow of low saline surface water from the Baltic Sea. It is therefore hypothesized in this study that the decapod larvae are sparse above these clines off the Swedish west coast.

MATERIALS AND METHODS

Requirements and construction of the trap

Traps with high light power include the modified Quatrefoil trap (Hernandez & Shaw, 2003), the Stobutzki trap, and the Bucket trap (Watson *et al*., 2002). The trap presented here is a tube trap with low light power that has been constructed and tested at the Institute of Marine Research in Lysekil, Sweden. The trap meets the following criteria:

- Robust
- Inexpensive
- Easy and quick to operate at least 10 traps from a small boat
- Easy emptying and cleaning without loss of animals
- The trap opening size is easily adjustable
- Several traps can be mounted on a single anchored rope
- Wave actions are not affecting the trap (except for in the surface layer)
- Operational between the bottom (> 300 m depth) and the surface
- Allows sampling while drifting with the current
- The trap can be oriented in any vertical direction
- Allows 24 h sampling periods with negligible reduction in light intensity
- Allows for different light intensities and wavelengths
- Catches delicate organisms without harming them

Plate 1 (a) shows the trap, with an optional live animal collector, that can be used instead of the trap filter tube attached to the right side of the trap. A plastic bag inside the collector allows easy recovery of delicate animals without unnecessary handling. Both the filter tube and the funnel are kept in place by a rubber band placed inside a soft plastic tube for protection against abrasion. When emptying the trap the funnel is removed and the trap is flushed with seawater prior to the removal of the filter. Changing the length or position of the trap buoy ropes will change the vertical orientation of the trap. The trap buoy eliminates the effect of waves, except in the surface layers. The white nylon ring is attached to the anchor rope. A heavy, 1 m long chain is a practical and cheap anchor when many anchor ropes are in use and when working in sensitive areas such as coral reefs. A small depth recorder could be fastened to the trap since currents may make it difficult to estimate the trap depth just from the length of the anchor rope. In order to let the trap drift with the current a parachute (Øresland, 2000) can be attached to the anchor rope above the trap. A small weight should then be attached to the end of the rope instead of the anchor chain. The rope buoy in the surface should be as small as possible to avoid wind influence.

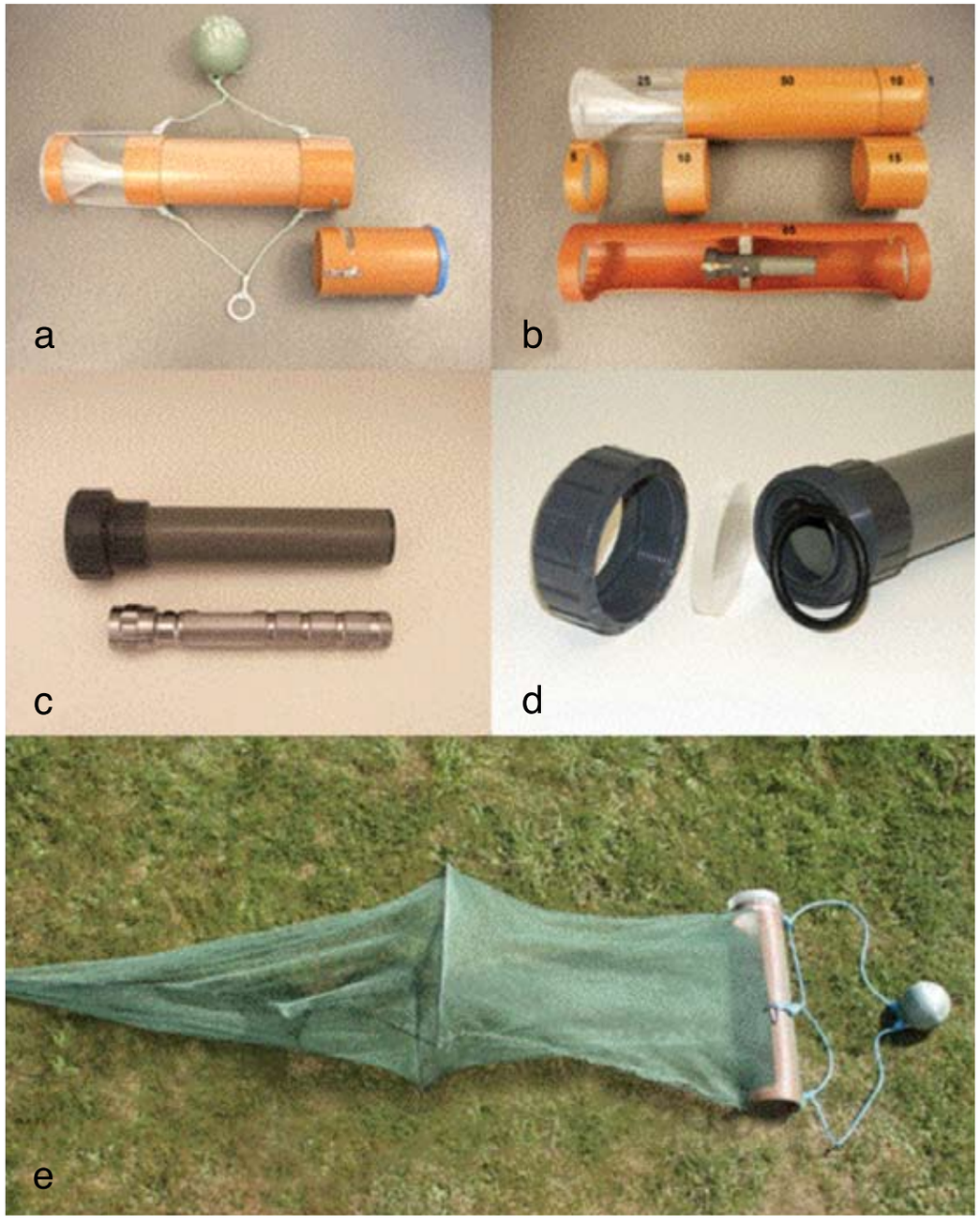

Plate 1. a) The IMR Standard Light Trap including an optional live animal collector. b) The different cut tube sections and a "fish and krill" version of the trap with the mounted torch. Numbers give the tube lengths in cm. c) The torch and its water proof tube casing. d) Details of the tube casing. e) The "fish and krill" version of the trap

Plate 1 (b) shows the lengths in cm of the different tube sections. The Plexiglas section can be omitted and the main section of the trap increased from 50 cm to 75 cm. This can be an option when small-scale vertical distribution is investigated and the light beam needs to be horizontal. The Plexiglas and the cut 10 and 15 cm sections are screwed to the main section and sealed with silicon caulk to prevent small organisms becoming trapped between the tube connections. The 5 cm section is screwed and glued to the Plexiglas. The right 10 cm section is the filter section, which into its right end the two 1 cm sections are inserted and glued with silicon glue with the filter between them. The tube is a standard PVC plumbing tube (200 x 5.9 mm). It is important to use a hard PVC so filter tube and live animal collector units remain rigidly attached. The 85 cm section is for a "fish and krill" version of the trap (see Plate 1 e). Note how the shape of the soft PVC used in this trap changed after cutting the section. The 7 cm long grey PVC tube, which holds the torch casing is mounted in the same way in both traps using aluminium parts. The white rubber rope with an aluminium hook keeps the torch casing in place inside the tube.

Plate 1 (c-d) show the torch and its casing made of glueable PVC HT ISO/B (50 x 3.2 mm). The right end is permanently closed with a piece of PVC that is turned 6 mm to fit into the tube, and cleaned with Tangit cleaner (Henkel) and glued with Tangit PVC-U special glue. The Plexiglas is 10 mm thick. The casing has remained waterproof to >300 m depth, but the tube broke when tested to 500 m depth. A thicker tube outside the casing tube would allow for sampling >300 m depth. The torch is 1 Watt LED torch Luxeon Star Model no ALX-713C with 25-30 lumen output. The torch weight is 382 g with three 1.5 V LR14 C alkaline batteries. The LED light allows > 24 h high light levels and > 5 days with reduced light. Rechargeable batteries are perhaps an option in large sampling programmes but the light will only last for a few hours. Different filters can be put in front of the torch if reduced light intensities or different wavelengths are required.

Plate 1 (e) shows the "fish and krill" version of the trap. The catch is taken out at the end of the net where a small weight (lead rope) keeps the net downwards. By tieing the buoy to the end of the net it will hang upwards and the trap can be placed at the bottom.

Testing the trap

The sampling programme was carried out within the Kåvra lobster protection area (N 58° 20´ E 11° 22´) on the Swedish west coast. The traps were connected to individual anchor ropes placed >10 m apart. The bottom substrate consists of sand and rocks and the bottom depth varied between 20-24 m where the traps were set out. Between 6 and 10 traps were set out simultaneously for 24 h once a week between 25 July and 28 September 2006. In total, 75 traps were set out of which 10 were set at 1-2 m, 14 were set at 8-10 m, and the remaining 51 traps were set (evenly spread) between >10 m-23 m. The reason for having a concentration of traps in the surface and at 10 m was to increase the chances of catching larvae if they occurred above the thermo- and halo clines.

On 6 September 10 traps were set out for 24 h between 8 – 19 m in order to test if the traps catch any zooplankton or fish without light. All traps were basically empty for animals except for one single *Nephrops norvegicus* larva. The larvae in this study were preserved in 4% formaldehyde in seawater, and identified and staged using Sars (1874), Appellöf (1909) and Jorgensen (1925). A CTD profile was obtained just prior to the traps being set out.

RESULTS AND DISCUSSION

Fig. 1 shows the temperature (T) and salinity (S) at trap depths. The temperature during the sampling period was unusually high, up to16 C° at the maximum trap depth at 23 m.

In total, 32 stage I and 2 stage II *Homarus gammarus* larvae were taken in the traps, but none were taken after 28 August. The two highest catches of *H. gammarus* were obtained 15 August (10) and 21 August (8). The absence of stages III and IV and only 2 individuals at stage II of *H. gammarus* may indicate that the light does not attract the larvae at later stages or that they were not present in the area.

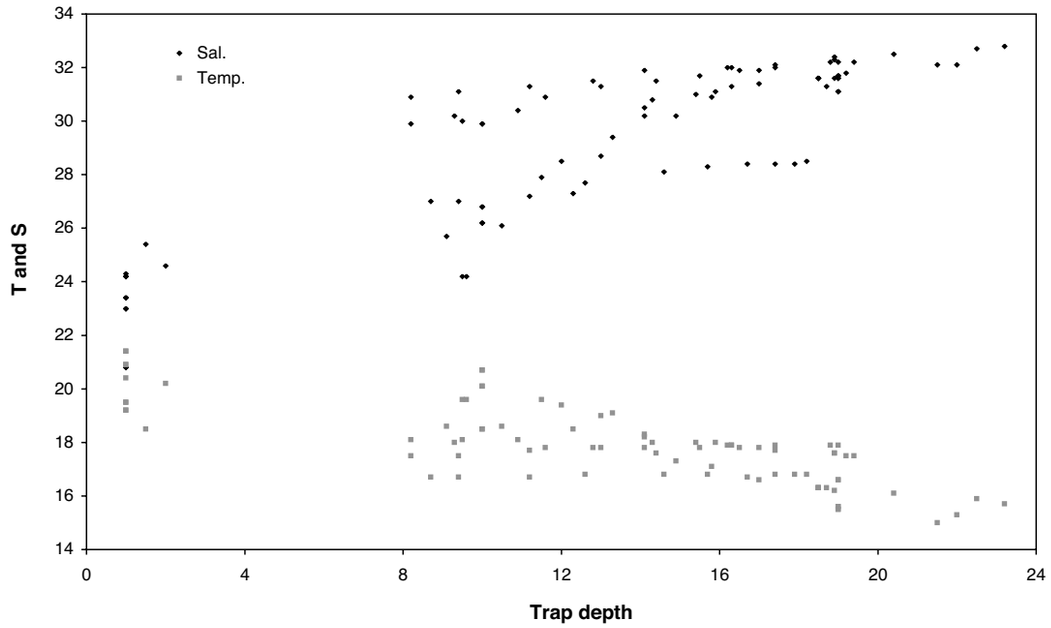

Fig. 1. Temperature and salinity at different trap depths

Nephrops norvegicus larvae were taken, with a total of 15 at stage I, 48 at stage II and 39 at stage III, but none were taken after 12 September. The two highest catches of *N. norvegicus* were obtained 28 August (n = 25 and 14). In contrast to *H. gammarus*, stages I-III of *N. norvegicus* were taken in the traps (but not stage IV).

The beginning of the larval periods was probably missed since larvae of both species were taken already during the first sampling 25 July. The fact that larvae were not taken during the last 1-2 weeks may indicate the end of the larval period of the stages taken by the traps. However, describing the larval periods was not a crucial part of this trap test study. Øresland (1998) reported low abundance of *N. norvegicus* larvae (all at stage I) in June but that the larvae increased considerably in abundance in July, when all three stages were present, off the Swedish west coast.

Fig. 2 shows peak abundances for *H. gammarus* at salinities between 29-32 ‰ that corresponded to depths between 16-19 m. Nichols & Lovewell (1987) found that the *H. gammarus* larvae in Bridlington Bay (the North Sea) had a diel vertical migration. They concluded that quantitative sampling of the larvae could not be confined to the neuston layer. *N. norvegicus* showed peak abundances at somewhat higher salinities between 30-33 ‰ and were generally found deeper than *H. gammarus*. The depth profile indicates that the larvae of *N. norvegicus* occur even deeper than the depths investigated in this study. No larvae of either species were found at 1-2 m depth. Daytime larval occurrence in water layers influenced by sunlight may not be detected using light traps. A more comprehensive trap study combined with net sampling at different times of the day might elucidate this potential problem.

In conclusion, the trap can be used for fine scale vertical sampling of decapod larvae. However, the trap does not catch all larval stages. There seems to be a strong preference for *H. gammarus* staying within and below thermo- and halocline and below these clines for the *N. norvegicus* larvae, at least among the larval stages captured. This could have important bearing on their dispersal with the possibility of retention of larvae that should be of interest for e.g. population dynamic and genetic studies.

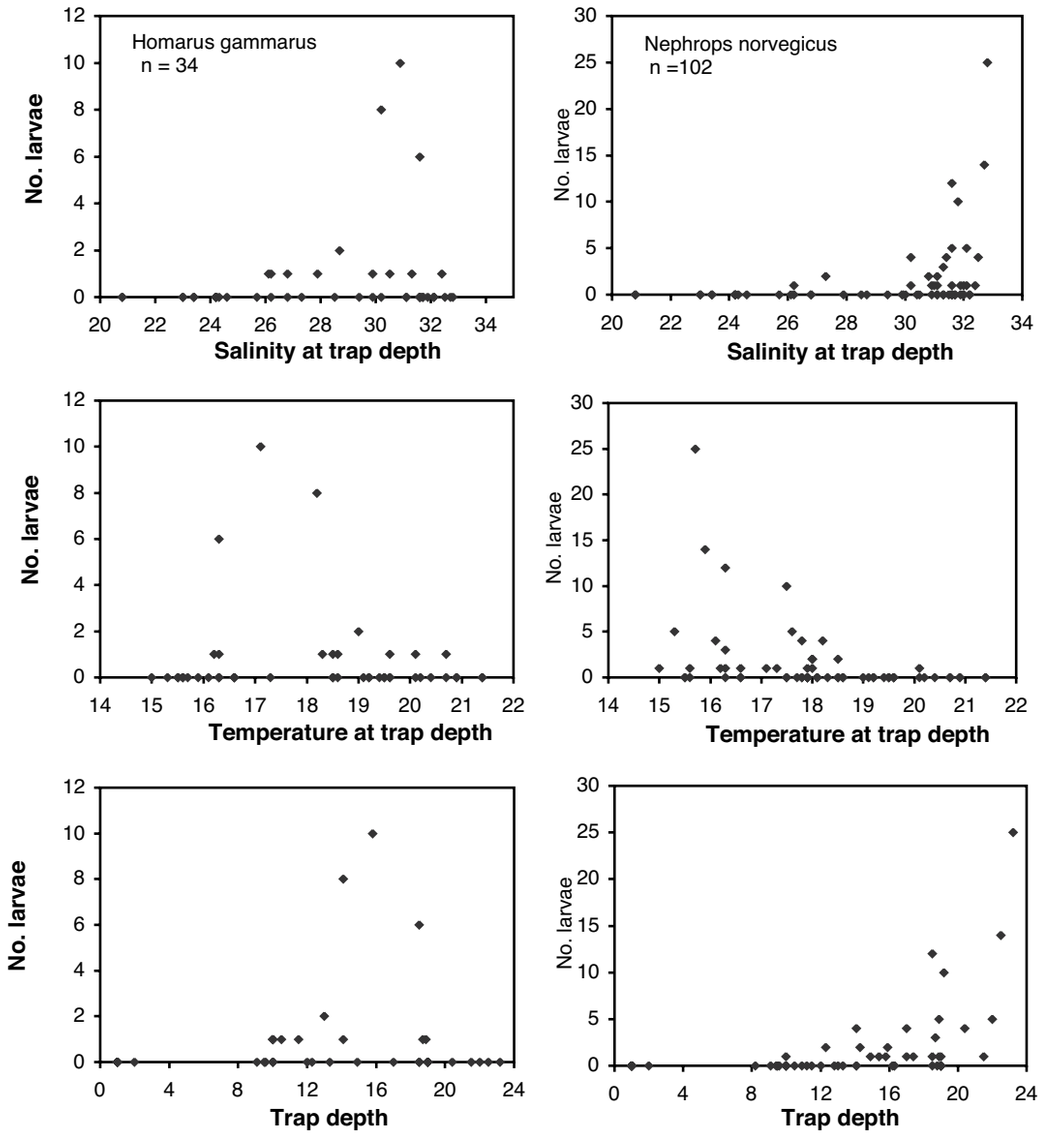

Fig. 2. The number of *H. gammarus* larvae taken until 28 August, and number of *N. norveigicus* taken until 12 September, and the salinity, temperature and depth at trap depths. Note that in the depth profiles the traps in the surface will not show separately since they caught no larvae

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