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## Short Communication

# A cost effective light trap for sampling tropical fish and crustacean larvae

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**Abstract—**A simple and relatively cheap locally-assembled light trap was used to sample pre-settlement fish larvae in the Malindi Marine Park, Kenya, for two years. The trap was assembled locally using a water dispenser bottle, plastic bottle necks, buckets, 12V rechargeable alkaline batteries and a diver's dry box. The light unit consisted of a 12 V rechargeable alkaline Jacob's battery that powered a 12 volt energy saving fluorescent bulb of 11Watts. The catch potential and composition of fish larvae sampled using the trap is presented. The technical and functional problems encountered during the construction and operation of the light traps are presented, and improvements suggested. We compare the performance, costs and efficiency of this trap with light-traps used elsewhere in the world. In addition to fish larvae, the traps have potential use in qualitative sampling of crustacean larvae and ornamental fishes for the aquarium trade.

## INTRODUCTION

Light traps are effective devices for sampling pre-settlement larval stages of reef fishes (Doherty, 1987; Choat *et al.*, 1993). The traps, originally designed by Doherty (1987), have been modified to suit local situations in different studies. Light traps can selectively sample older larvae (Doherty, 1987; Choat *et al.*, 1993) and have proved valuable in assessing spatial and temporal patterns of recruitment. They are generally regarded as expensive research equipment, but have more practical applications such as collection of juvenile fish in the aquarium trade, stock enhancement and sampling decapod crustaceans (Doherty, 1994; Watson *et al.*, 2000; Øresland, 2007). The design originally popularized for reef fish by Doherty (1987) costs approximately US$ 3,000. Various cheaper designs have since been produced to sample both freshwater and marine habitats (Floyd *et al.*,1984; Ulrish, 1986; Faber, 1990; Secor *et al.*,1992; Ponton, 1994; Stobutzki and Bellwood, 1997; Watson *et al.*, 2002). In this article we describe how a low cost light trap was fabricated and used to sample pre-settlement fish larvae in coastal Kenya. The results presented here, give an insight of the design layout, sampling capabilities and cost comparisons with other light traps elsewhere.

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# MATERIALS AND METHODS

## Design

This trap is a modification of that described by Watson *et al.* (2002). The main body of the trap was made up of a 18.5 L transparent plastic water dispenser bottle supported by a three legged metal frame, measuring about 1.2 m in height (Plate1a). The frame had a support base on which a diver's dry box was tightly fastened using a rubber hose (Plate 1a). The water dispenser bottle was perforated to make eight uniform holes of about 10 cm diameter. Bottle necks (tapering to about 2 cm) cut from ordinary plastic drinking water bottles (1L) were then glued to the holes using araldite glue. These then formed entry windows for larvae to enter the bottle (Plate1a). A 1-litre collection bottle was initially secured at the bottom of the dispenser, however this was later replaced by a 10 L bucket (with a sieve of 1 mm mesh size as drainage panel) for more efficient collection of fish (Plate1b).

The light unit consisted of a water proof 11 Watt DC energy saving bulb (Plate 1a) bought from a local electrical shop for US$ 15 and powered by a Jacobs's lead-acid battery (12V 7Ah/20hr) which cost US$ 15 (Plate1a). The lamp terminals were connected by clips (+ve and –ve) which fitted easily and firmly onto the battery terminals. The battery was housed in a Seemann (Germany) diver's dry box which cost US$ 20. The dry box outside dimension measures 23 x 20 x 9 cm and comes with an O-ring seal which we coated in grease to ensure that no leakages occurred while underwater (Plate1a). The frame supporting the trap was tied to floaters using a 15 m nylon twine. The floats ensured that the location of the trap was known during retrieval, and the sinkers helped to hold the trap upright and anchor firmly at the bottom. In a later version, the metal frames were eliminated and instead floaters tied at the rim of the bottle by 1 m manila twine (Fig. 1). These provided the tension to keep the traps afloat about 1-2 m from the bottom.

## Deployment

The traps were deployed within Malindi Marine National Park, Kenya, to sample pre-settlement fish larvae. Traps were deployed at coral, seagrass and sandy habitats from a motorized boat every evening at 1800 hrs and recovered after about 12 hours (overnight). Deployment occurred during high tide, at depths varying between 10-18 m. On average three traps were deployed per site. During deployment, the lamp was lit by directly connecting the lamp terminals to the battery while aboard the boat. The use of switches proved difficult due to frequent malfunctioning. With the light on, the trap was lowered slowly using the surface floater rope until the sinker hit the bottom. The traps were then left overnight for retrieval at dawn the following day. All the trapped fish settled at the bottom of the collecting bucket and were removed and placed in labeled containers and fixed in 70% alcohol.

## Results

## Catch rates

Total catches expressed as number of fish caught per hour per trap was used to estimate larval abundance.The highest catch rates were observed during March-April of a two year study period. These catch rates, costs and comparisons with other traps are shown in Table 1.

The catch rates for the assembled light trap compare quite favourably with other internationally assembled light traps. Catch rates which ranged from 1.3 – 263 fish $hr^{-1}$ in March (peak season) were higher than that of Stobutzki and Bellwood trap (5.4 – 42.1 fish $hr^{-1}$) and the bucket trap (29.1 – 30.4 fish $hr^{-1}$) (Table 1). In terms of costs, the present light trap is cheaper (~US$ 70) when compared to the other traps which use relatively expensive materials either for the lighting system or the main body (mostly plexiglass) (Table 1). The

**Table 1. Catch rates and cost implications of different light trap designs**

| Light trap Designs | Catch rates (range) fish $hr^{-1}$ | Costs US$ |
|---|---|---|
| Stobutzki trap (Stobutzki and Bellwood, 1997) | 5.4 - 42.1 | 300 |
| Bucket trap (Watson *et al.*, 2002) | 29.1- 30.4 | 120 |
| Doherty trap (Doherty, 1987) | 293.2 | 3000 |
| Two chamber light trap (Brogan 1994) | 313.5 | - |
| Present Light trap | 1.3 - 263 | 70 |

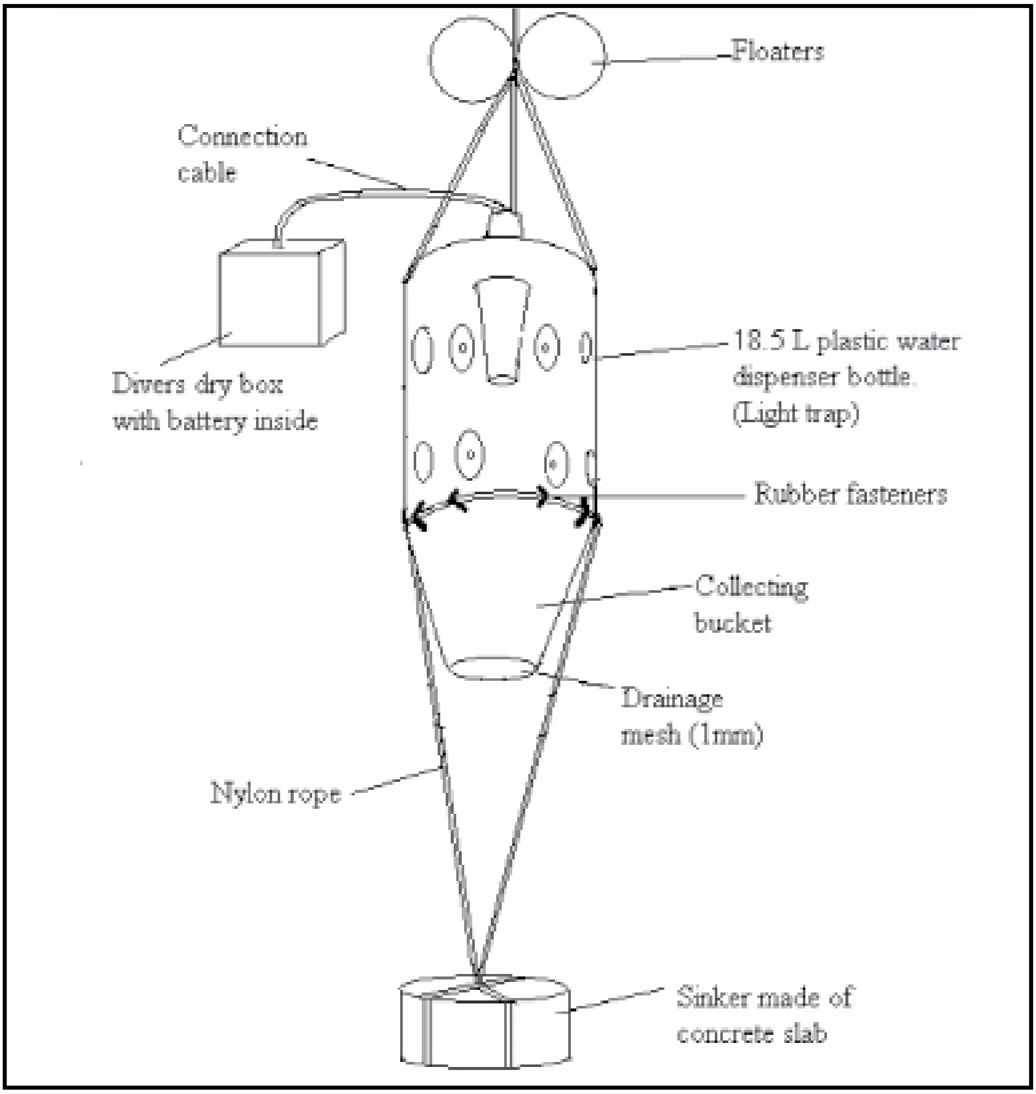


**Fig. 1. Diagram of light trap without iron frame ready for deployment mid water. Floaters and a sinker ensure upright positioning of the light trap at desired depth**

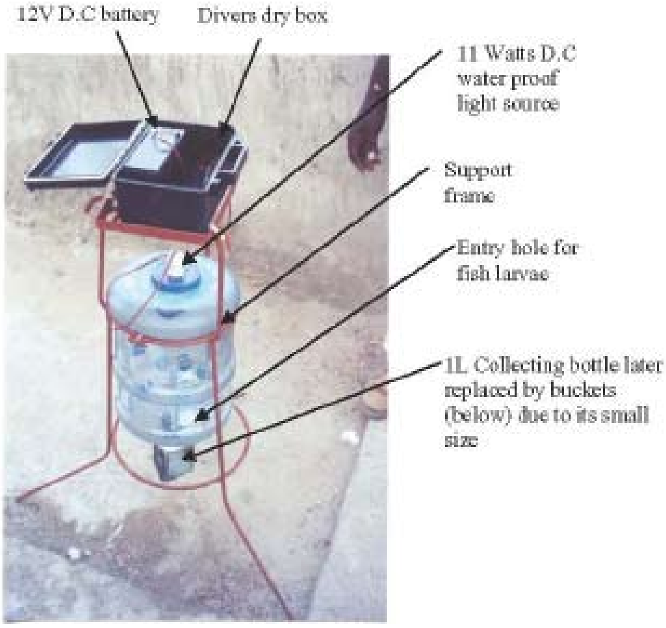


**Plate 1 a: The locally fabricated light trap (a) showing optional collection buckets with trapped fish**


**Plate 1 b: These replaced the 1L collecting bottle in order to accommodate larger amounts of fish**

**Table 2. Composition and size range of fish larvae collected by the light traps, March 2005-2007, Malindi Marine Park, Kenya**

| Family | Taxa | | Mean size (cm) ± S.D |
|---|---|---|---|
| Acanthuridae | Acanthurid 1 | | 3.4 |
| Apogonidae | *Apogon kallopterus* | | 7 |
| | *Apogon* sp. | * | 7.3 ± 1.0 |
| | *Apogon bandanensis* | | 6.5 |
| | *Archarmia furcata* | * | 6.7± 0.3 |
| | *Apogon sealei* | | 3.0 |
| | *Apogon cyanosoma* | * | 5.0 |
| | *Apogon fraenatus* | | 2.8 |
| | *Apogon angustatus* | | 3.2 ± 0.6 |
| | *Foa brachygramma* | | 1.5 |
| Balistidae | *Ostracion* sp. | | 1.2 |
| Blenniidae | Blenniid 1 | | 1.2 |
| Caesionidae | *Caesio* sp. | * | 5.4 ± 0.7 |
| | *Caesio caerulaurea* | ** | 5.5 ± 0.8 |
| | *Pterocaesio marri* | ** | 3.6 ± 0.8 |
| | *Pseudocaesio* sp. | | 3.9 ± 0.4 |
| | *Gymnocaesio gymnopterus* | ** | 3.4 ± 0.5 |
| | *Pterocaesio chrysozona* | | 3.2 ± 0.1 |
| | *Pterocaesio tile* | | 5 |
| Carangidae | *Megalapsis cordyla* | | 7.4 |
| | *Carangoides chrysophrys* | | 2.1 ± 1.1 |
| | *Carangoides gymnostethus* | | 2.6 ± 1.5 |
| | *Caranx* sp. | * | 3.1 ± 0.3 |
| | *Gnathanodon speciosus* | | 4.8 |
| Chaetodontidae | *Chaetodon mitratus* | | 3.5 |
| | *Chaetodon* sp. | | 1.3 ± 0.1 |
| Elopsidae | *Elops* sp. | | 3 |
| Labridae | *Thalassoma genivittatum* | | 4.8 |
| | *Ptereleotris evides* | | 12.2 |
| | *Oxycheilinus bimaculatus* | | 9.6 |
| Leiognathidae | *Secutor insidiator* | * * | 3.4 ± 0.5 |
| Lutjanidae | *Lutjanus kasmira* | * | 4.1 ± 0.1 |
| | *Lutjanus sebae* | | 1.7 ± 0.1 |
| | *Lutjanus lutjanus* | | 8.5 |
| | Lutjanid 1 | | 2.0 ± 0.1 |
| Monocanthidae | Monocanthid sp. | | 2.8 ± 0.2 |
| Mugilidae | *Mugil* sp. | | 7.8 |
| Mullidae | *Upeneus vigittatus* | | 3.5 |
| | *Parapeneus bifasciatus* | | 4 |
| Pempheridae | *Parapriacanthus guentheri* | | 2.4 ± 0.9 |
| Pomacentridae | *Chromis* sp. | | 3.0 |
| | *Chromis chrysura* | | 3.4 |
| | *Chromis lepidolepis* | | 3.3 |
| | *Abudefduf sexfasciatus* | | 2.3 ± 0.2 |
| | *Dascyllus reticulatus* | | 1.1 ± 0.2 |
| | Pomacentrid 1 | | 1.1 |
| Scombridae | Scombrid 1 | | 3.4 |
| | *Rastrelliger kanaguria* | | 9 |
| Scorpaenidae | *Taenianotus triacanthus* | | 4 |
| Serranidae | Serranid sp. | | 2.3 |
| Sphyraenidae | Sphyraena sp. | | 7.9 ± 0.6 |
| | *Sphyraena jello* | | 5.1 |
| | *Sphyraena barracuda* | | 6.9 ± 2.1 |
| Tetraodontidae | Tetradontid 1 | | 1.4 ± 0.1 |
| | *Canthigaster valentine* | | 3.3 |
| | *Canthigaster solandri* | | 6 |

*** most abundant ** moderately abundant * abundant advantage of designing a cheaper trap is the ease of replication especially in situations where funds are limited. The catches from the bottom (Plate 1 a) and suspended (Fig. 1) versions of the traps did not differ significantly perharps because of the shallow columns in the study area (< 10 m at high tide).

## Species composition

A total of 25 families and 65 species of fish larvae were caught using the light trap. Mean sizes and taxa sampled are summarized in Table 2. The dominant fish larvae caught were from families, Caesionidae, Tetraodontidae, Lutjanidae and Apogonidae in order of decreasing abundance. The traps also caught juveniles of pelagic fish species like the Engraulidae (*Stolophorus commersonii*), Pristigasteridae (*Pellona ditchella*) and other clupeidae (Table 2). Other organisms that were captured by the light traps included different groups of the crustaceans; Copepoda, Amphipoda, Ostracoda, Caridea (palaemonid larvae), Brachyura megalopa (Portunidae), Brachyura larvae, Stomatopoda, Mysiidacea, Polychaeta, Hydromedusae (jellyfish), Opisthobranchia (sea slugs), Pycnogonida, Syllaridae (lobster larvae) and Cephalopoda (squid larvae) among others.

## DISCUSSION AND CONCLUSIONS

The light trap catch composition in this study was comparable with that of other traps in tropical regions (Hickford and Schiel, 1999; Watson *et al.*, 2002; Watson and Munro, 2004) with a dominance of the Apogonidae and Caeasionidae. It is likely that the limited depth range of the study area excluded other species in the samples. Light-traps are useful tools for sampling pre-settlement fish larvae, however, most of them are expensive making them inaccessible to cash strapped projects. The light trap discussed in this paper is an attempt to overcome this problem by fabricating a low cost trap of comparable performance. The advantage with light traps is that they can be used to sample many different habitats, different depths and seasons. In this study, they were used to sample nearshore lagoonal reefs. A greater challenge would be to assess its performance and endurance in deeper offshore waters in the range of 50 m. The traps with appropriate modifications, can find applications in other habitats such as mangrove swamps, within creeks, estuaries and freshwater bodies like lakes. They can also be useful in sampling crustacean and juveniles of pelagic fishes for qualitative work apart from catching ornamental fish for aquarium fish trade.

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