CONSTRUCTION CHARACTERISTICS OF A BEAM TRAWL FOR CATCHING YOUNG SHRIMPS IN ESTUARIES

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Abstract - Faced with the difficulty of catching young shrimp individuals in estuaries, a beam trawl was developed and tested. It was effective in catching shrimps measuring between 2.7 and 11.5 mm in length and crabs of 5.99 to 6.64 mm in length. The equipment is resistant to corrosion and can be maneuvered by one person. The net fastening system is easy to operate, allowing its removal after every trawl, thus avoiding possible sample losses with onboard handling. The ideal trawling time was around 3 minutes and use of a ballast system gave better results during the catching operation, although without any statistical difference.

Keywords: sampling, trawl, dredge, estuary, post-larva.

ASPECTOS CONSTRUTIVOS DA DRAGA TIPO *BEAM TRAWL* PARA PROSPECÇÃO DE CAMARÕES JOVENS EM ESTUÁRIOS

Resumo - Diante da dificuldade de se prospectar indivíduos jovens de camarões no estuário, uma draga do tipo “beam trawl” foi desenvolvida e testada. O modelo utilizado se mostrou eficiente, capturando camarões com comprimento entre 2,7 e 11,5 mm, além de caranguejos entre 5,99 e 6,64 mm. O equipamento é resistente à corrosão podendo ser manuseado por apenas uma pessoa, além de possuir um sistema de fixação das redes de fácil operação, que possibilita a retirada da mesma após cada arrasto, evitando, assim, possíveis perdas de exemplares com o manuseio a bordo. O tempo ideal de arrasto ficou ao redor de 3 minutos e o sistema de lastro, embora sem diferença estatística, se mostrou mais expressivo na captura.

Palavras-chave: amostragem, arrasto, draga, estuário, pós-larva.

INTRODUCTION

Estuaries are considered to be areas of extreme importance for many species of fish, crustaceans and other organisms, especially for shrimps of the Peneidae family, which life cycle depends on estuarine waters (Anderson, King & Lindner, 1949; Dura, 1985, Coelho & Santos, 1994; Coelho & Santos, 1995; Costa, Fransozo & Castilho, 2007, Santos, Severino-Rodrigues & Vaz-dos-Santos, 2008; Vasconcelos et al., 2009).

Some species of shrimps represent important fishery resources, both for hand-operated and for industrial fishing (D'Incao, Valentini & Rodrigues, 2002; Santos, Severino-Rodrigues & Vaz-dos-Santos, 2008). Within estuaries, exploiting shrimps is a very ancient practice and is done with rudimentary equipment, supporting a fragile productive chain (Brito & Silva, 2003).

Sampling of these shrimps, starting from the first phases of their cycle in the estuary (post-larva), demands a differentiated sampling effort. Most of the existing studies used adaptations of commercial fishing equipment as sampling apparatus for evaluating this resource, but such methods are inefficient for catching post-larval shrimps (Coelho & Santos, 1994; Coelho & Santos, 1995; Santos, Severino-Rodrigues & Vaz-dos-Santos, 2008; Correa & Martinelli, 2009).

In studies on the recruitment of some species, plankton nets and "picaré", a type of beach trawl manually pulled by the fishermen, were used (Sarmento, Sampaio & Moura, 2001; Costa, Fransozo & Castilho, 2007; Fausto, Fontoura & Würdig, 2007).

Beam trawling has been used and described in different studies involving young individuals of fish and post-larval shrimps in estuarine environments (Abookire & Rose, 2005; Guest, Connolly & Loneragan, 2003; Loneragan, 1995; Rotherham, Broadhurst, Gray & Johnson, 2008). In Brazil, there are few records describing the use of this type of equipment in estuarine environments. Garcia & Vieira (1997), for instance, used beam trawling to evaluate the abundance and diversity of fish in grassbeds of the Patos Lagoon estuary (RS).

The difficulties in capturing young shrimp individuals during their estuarine phase and the need for data that is independent from fisheries motivated the objective of this study, which was to develop a prototype to catch these specimens in estuaries and evaluate its operational capacity.

MATERIAL AND METHODS

The development of the prototype followed the model presented by Nomura (1981), used in the north of Japan to operate in muddy bottoms for gathering shells. Three types of materials were assessed for constructing the structure: aluminum, galvanized iron and stainless steel (316-L). Stainless steel was chosen because of its high resistance to localized corrosion.

The dimensions were predefined according to the availability of standardized stainless steel tubes on the market, which are 6070 mm in length, 2.0 mm in thickness and 31.8 mm in diameter. This tube was divided into eight parts (4x88 mm; 2x97 mm, 2x29 mm) and welded using the TIG (Tungsten Inert Gas) system. Two of these tubes were bent at an angle of 135°, without heating, using a manual device. At the base of the structure, two expanded polyvinyl chloride (PVC) skates of 3.0 mm in thickness, 120 mm in width and 400 mm in total length were attached using a system of stainless steel bolts, washers and nuts. At the front, two stainless steel shackles of 6.4 mm in diameter and 18 mm in opening were welded on, to hold the cable (Figure 1).

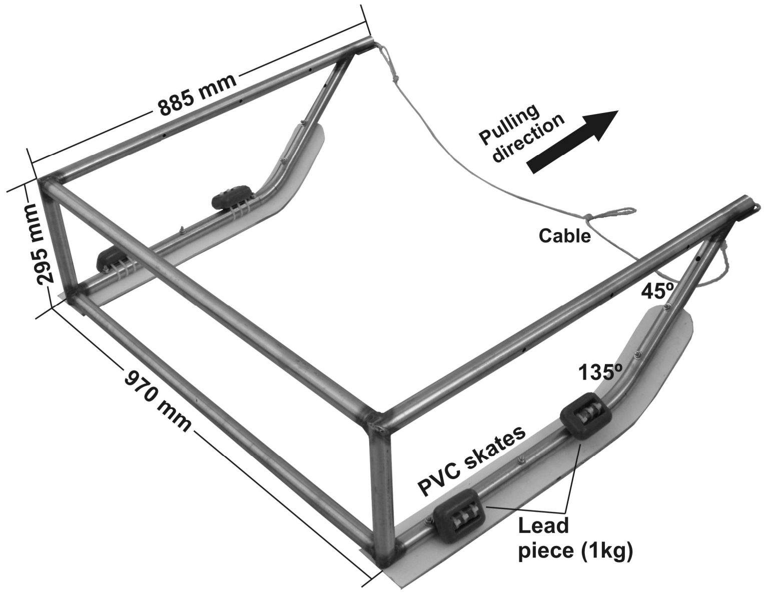

Figure 1. Prototype developed to catch young shrimps in estuaries.

For the operational assessment, an unknotted net consisting of a square mesh, with 2.0 mm of size, was used. This net was made of blue-colored multifilament polyester, of 210/6 denier (23/6 tex). The net was produced from a piece of fabric measuring 2.0 m in length by 1.30 m in width, which was folded in half along its length and sewn together at the sides using monofilament polyamide thread of 0.20 mm in diameter. The opening of the bag was reinforced with a plastic belt of 50.0 mm in width and a safety cable made of polyamide, of 2.0 mm in diameter (Figure 2).

To attach the net to the prototype, polyethylene clamps were used. These were passed through each of the 17 holes with metallic eyelets that were spaced every 100 mm on average along the reinforcement belt. The dimensions of the net used were: 0.23 m of vertical opening, 0.92 m of horizontal opening, total length of 1.0 m and capacity for 211.6 L (Figure 3).

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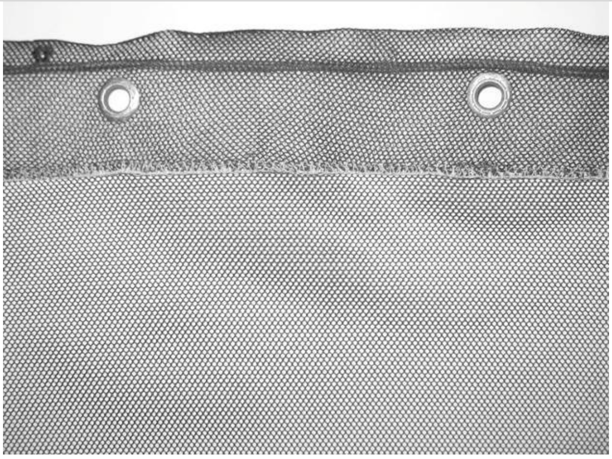

Figure 2. Detail of the net used in the prototype.

Figure 3. Detail of the attachment system for the net on the prototype.

The tests were carried out in an estuarine environment, observing the performance with regard to possible adjustments to the length of the trawling cable and the stability and positioning of the localization and recovery equipment. The capture efficiency was related to the adjustment of the ballast system. With the purpose of detecting differences in the composition of the catch and their relationship with the ballast system, an ANOVA test was carried out with two factors (Sokal & Rohlf, 1995).

RESULTS AND DISCUSSION

In April 2009, six trawls were performed at a point in the interior of Santos estuary, in a shallow area (0.5 m). The prototype was pulled by an aluminum boat equipped with a 15 HP outboard motor. The equipment was firstly connected to the pulling cable and then lowered over the side of the boat. After it had submerged, the boat started to pull it (Figure 4).

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Figure 4. Method used in the field during the trawling procedure. In sequence: lowering the equipment over the side of the boat, pulling it and retrieving it.

The prototype was easy to operate and could be maneuvered by one person alone. To make full use of all the biological material caught, it was essential to replace the net for each trawl.

The trawls lasted for an average of 3 min 15 s, with a trawled area of 111.25 m^2 at a speed of 2.03 $km.h^{-1}$. The material caught consisted of annelids, bivalves, shrimps, crabs, gastropods, Mysidacea species and fish, totaling 655 specimens. The most representative group was the shrimps with 315 specimens (48.1%), followed by fish (33.6%), annelids (9.3%) and Mysidacea species (5%).

The correlation between the effort and the total biomass demonstrated that the longer the trawl, the smaller the biomass retained in the equipment was, thus presenting a tendency towards a negative correlation (Table 1).

Studies carried out by Rotherham, Broadhurst, Gray & Johnson (2008) showed that shorter trawling periods with a beam trawl are more efficient for surveying local diversity. During the test, it was seen that longer trawls produced return circulation that could allow some organisms to escape. Thus, for this environment, the ideal trawl duration was up to 3 minutes.

Table 1. Results for the coefficients a (intercept) and b (slope) and the correlation, fitted using the linear relation (y = a + bx) between different effort measurements and the total sampled biomass.

Correlation	a	b	r^2
Trawling time (h) x biomass (g)	250.57	-43.62	0.35
Distance (m) x biomass (g)	142.97	-0.30	0.24
Speed (km.h-1) x biomass (g)	143.64	-16.96	0.18

Variations in the ballast system of the prototype showed that there was greater relative capture of $individuals.m^{-2}$ when ballast was used, although this difference was not significant (t test: $p = 0.10$). For the shrimp group, there was also no statistically significant difference (t test: $p = 0.18$). However, considering that the relative capture was greater with a ballast system (1.97

individuals.m^2) than without it (1.37 individuals.m^2), it was defined that using a ballast system would be the standard.

Within the shrimp group, four families were identified (Alpheidae 0.7%, Ogyrididae 12.5%, Penaeidae 82.4% and Palaemonidae 4.4%) totaling 272 individuals. Some shrimps could not be identified because of the conditions under which these organisms were found.

The specimens of the Penaeidae family were the most abundant (224 individuals) in relation to the total sample and most of them were found at the post-larval phase, thus confirming the efficiency of the prototype (Figure 5) to catch this life stage. Fish were also frequent, with 220 individuals caught.

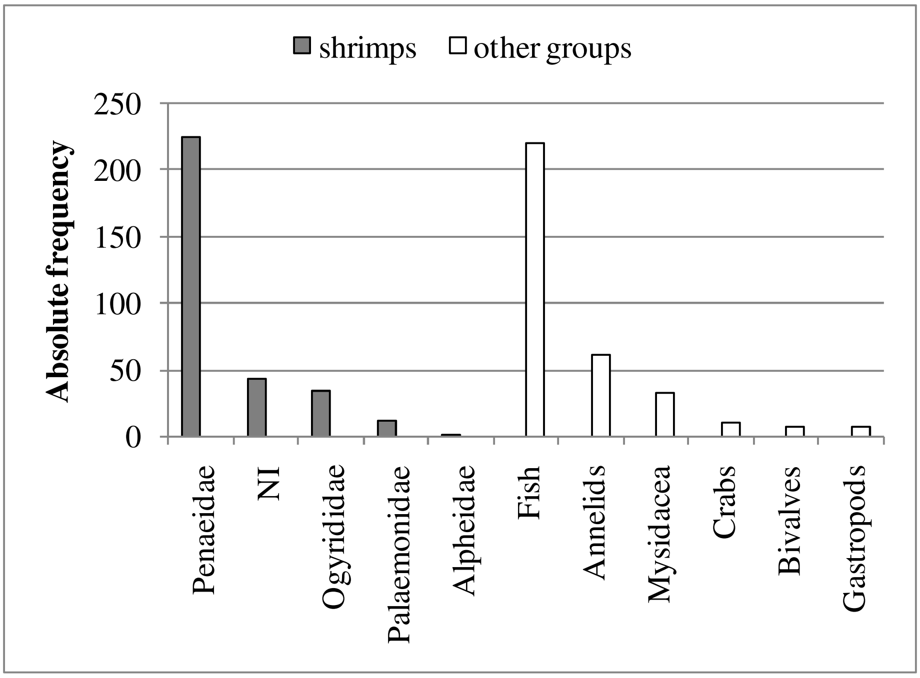

Figure 5. Absolute frequency of the different groups and families that were sampled during the prototype tests

In Santos estuary, various studies have been conducted in relation to the crustacean fauna, using traditional fishing methods as sampling tools. Santos, Severino-Rodrigues & Vaz-dos-Santos (2008) evaluated the population structure of the white shrimp (*Litopenaeus schmitti*), belonging to the Penaeidae family, and caught individuals of at least 7 mm in carapace length and especially in the range between 13 and 19 mm. Severino-Rodrigues, Pita & Graça-Lopes (2001) evaluated crabs captured by hand-operated fishery, with lengths ranging from 27 to 106 mm in carapace width.

The carapace length of the shrimps caught in the present study ranged from 2.7 to 11.5 mm, while the carapace width of the crabs ranged from 5.99 to 6.64 mm (Table 2). In the case of finfish, their total length ranged from 13 to 32 mm. These results demonstrate that the prototype is an important sampling tool for fractions of small size specimens for these three groups.

When evaluating the population dynamics of a given species, it is important to obtain information which is independent from commercial fisheries (Rotherham, Underwood, Chapman & Gray, 2007). Thus, using the prototype to sample smaller specimens, as an addition to traditional fishing methods, which catch larger-sized fractions of the populations, may provide complementary information for understanding the life cycle of certain species, especially of the Penaeidae family.

Table 2. Description of the lengths of the different groups sampled through capture during the prototype test.

Group	Family	Measurement	N	Mean	Standard deviation	Minimum	Maximum
Shrimps	Alpheidae	Cl	1	3.36	-	3.36	3.36
	Penaeidae	Cl	122	3.24	1.67	1.56	11.5
	Ogyrididae	Cl	32	2.70	0.83	1.28	4.53
	Palaemonidae	Cl	12	3.82	1.76	2.38	8.66
Crabs	-	Cw	6	5.99	0.55	5.38	6.64
Mysidacea	-	Cl	19	2.22	1.81	1.43	9.57
Fish	-	Tl	43	13.81	5.79	8.69	32.9

N = number of individuals measured; Cl = carapace length (mm); Cw = carapace width (mm); Tl = total length (mm)

CONCLUSÕES

The prototype that was developed is practical for operations in estuarine regions, and it attained the proposed objective.

The lengths of the shrimps that were caught were smaller than those sampled in previous studies. Among these, the specimens of the Penaeidae family were mostly in the post-larval phase. The prototype was also effective in catching small fish and crabs.

It is suggested that to evaluate certain groups, sampling with a beam trawl and traditional fishing methods are probably the best strategy, since it would ensure that specimens at different stages of their life cycle and with a greater range of lengths are caught.

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