Available online at www.sciencedirect.com
SCIENCE DIRECT®
Fisheries Research 72 (2005) 1–12
FISHERIES RESEARCH
www.elsevier.com/locate/fishres

On electrical fishing for brown shrimp (*Crangon crangon*) I. Laboratory experiments

Hans Polet[a,*], Fernand Delanghe[a], Reinhart Verschoore[b,1]

[a] *CLO-Sea Fisheries Department, Ankerstraat 1, B-8400 Oostende, Belgium*
[b] *Department of Agricultural Engineering, Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen, Ghent University, Coupure Links 653, 9000 Ghent, Belgium*

Received 29 December 2003; received in revised form 7 September 2004; accepted 13 October 2004

Abstract

The fishery for brown shrimp (*Crangon crangon*) in the North Sea is carried out by more than 600 vessels with total annual brown shrimp landings of around 20,000 t. Due to the small mesh size used, the catches also contain large amounts of unwanted by-catch. To find ways of reducing this by-catch, experiments were carried out with electric pulses. The basic idea was to selectively invoke a startle response with shrimp without stimulating any by-catch species. A selective groundrope could then be used in combination with electric pulses to obtain catch separation.

As a preparation for sea trials, laboratory experiments were carried out. The pulse generators were tested for their basic characteristics. Experiments were carried out with fish and invertebrate species that are frequently caught in the brown shrimp fishery. The effect of pulse amplitude and frequency in relation to ambient parameters on the response of these animals was tested. To assess the effect of the pulses on these animals, survival experiments were carried out. The main conclusion was that shrimps react strongly to the pulses and most of the other species regularly caught in shrimp trawls do not, so selective electro-fishing has potential. The survival tests indicated that the pulses have no effect on the survival and general behaviour of the animals that have been in the electric field.

Keywords: Brown shrimp; Beam trawl; North Sea; Discard reduction; Electric pulses

1. Introduction

Most selectivity enhancing measures concentrate on the net part of the trawl (Walsh et al., 2000). These aim at catch separation or improved filtering of the catch, the disadvantage being that the animals are exposed to net meshes or other parts of the trawl before they can escape. Damage incurred by contact, or stress caused

DOI of original article:10.1016/j.fishres.2004.10.015
* Corresponding author. Tel.: +32 59 342253; fax: +32 59 330629.
E-mail addresses: hans.polet@dvz.be (H. Polet), reinhart.verschoore@ugent.be (R. Verschoore).
[1] Tel.: +32 9 264 61 29; fax: +32 9 264 62 35.

0165-7836/$ – see front matter © 2004 Elsevier B.V. All rights reserved.
doi:10.1016/j.fishres.2004.10.016

during the capture and escape process may lead to mortality amongst escapees. A better approach to improve selectivity, if at all possible, is to try to stop unwanted sizes and species from entering the net. To attain this goal, it is necessary to find alternative means of stimulation in the net mouth, i.e. to induce the desired reaction from the target species without stimulating unwanted animals.

The traditional way to stimulate brown shrimp in a trawl is mechanical, i.e. by the bobbin rope. In the case of the brown shrimp (*Crangon crangon*) fishery, it is mainly the turbulence in the water that causes brown shrimps to tail-flip (Berghahn et al., 1995). This stimulus, together with vibrations in the sediment and direct contact with the bobbins, indiscriminately stimulate all animals that come into contact with it and offer little opportunity to alter the selectivity of the net.

The idea of using electricity in fishing is very old. De Groot and Boonstra (1974) mentioned a reference to Job Baster, as early as 1765, stating that electricity might affect shrimps and that this should be investigated. Research on the application of electric pulse fields in shrimp trawling started in the late 1960s. De Groot and Boonstra published a first report on an electrified shrimp trawl in 1970. Some promising results were obtained, but after a disappointing trial in 1976, the work on shrimps was terminated. In the same period, electro-trawls for brown shrimps were tested in Belgium (Vanden Broucke, 1972), the UK (Stewart, 1978) and Germany (Horn, 1976) and most of the work pointed at good prospects for this type of fishery. The main objective of the work usually was to reduce fuel consumption and to increase the commercial catches with no or very little attention to by-catches. Some experiments, however, already pointed at possibilities for selective fishing with electricity (Stewart, 1975). Research on electric fishing continued into the 1980s but then stopped almost simultaneously in all North Sea countries. This was mainly caused by national bans on electric fishing driven by the fear of overfishing. In other parts of the world, however, interest in the fishing method, especially with an application for shrimps, was maintained. In 1987, experiments with brown shrimps in electric fields were reported in Lithuania (Burba and Petrauskiene, 1987). In the USA, a selective electrified shrimp trawl was developed (Holt, 1992), although commercial application was not reported. Also in India, experiments were carried out with electric fishing (Van Marlen, 1997). In 1997, Willy Versluys, a Belgian fishing vessel owner, visited China and reported that over 2000 fishing vessels were using electric pulses to catch penaeid shrimps. He brought a Chinese pulse generator back to Belgium. This renewed the interest in the method.

Pulse generators have been studied quite intensively in the past for application in sea fisheries. The main interest usually focused on increasing catching efficiency of the fishing gear. Electric pulses might also be used as an alternative stimulation to invoke selectively a reaction from shrimps without stimulating fish and other invertebrates. The basic idea was to raise the groundrope and stimulate shrimps to jump over this raised groundrope. Animals not stimulated could then escape underneath the net.

A project was set up which consisted of two phases: (1) laboratory experiments to study behaviour; (2) sea trials to test a preliminary design of an electro-shrimp trawl. The present report focuses on the laboratory experiments.

2. Materials and methods

2.1. Aquaria and instrumentation

We had access to seven aquaria with a total volume of 6000 l for storage, a Plexiglas tank of 210 cm L × 110 cm W × 60 cm H for the observation tests and a series of 18 aquaria of 80 cm L × 60 cm W × 32 cm H for the survival tests. The bottoms of the aquaria were covered with sand and the daylight was obscured to simulate natural conditions. Laboratory animals were collected in tidal waters or during short fishing operations at sea. The animals usually adapted well to the new environment and remained in good condition and feeding for a long time with very low mortality.

The pulse generators, available commercially, are produced in China for penaeid shrimp fishing. This type of apparatus was chosen because it had proved to work well in commercial conditions and because developing a new generator would be costly in time and money. Nothing was known though about the response of North Sea fish and invertebrates to the electric pulses of this apparatus. Four pulse generators were available