Methods in Oceanography 9 (2014) 61–74

Contents lists available at ScienceDirect

Methods in Oceanography

journal homepage: www.elsevier.com/locate/mio

Full length article

Development of an oceanographic towing vehicle adapted for fishing craft: Prototype and protocol for use

José Faccin *, Dyegho M.C. Gama Cunha, Roberto Barddal, Charrid Resgalla Jr.

Universidade do Vale do Itajaí (Univali), Centro de Ciências Tecnológicas, da Terra e do Mar (CTTMar), Rua Uruguai, 458, CEP 88302-202, Cetro - Itajaí - Santa Catarina, Brazil

ARTICLE INFO

Article history:
Received 28 January 2014
Received in revised form
27 September 2014
Accepted 24 October 2014

Keywords:
Oceanographic sampler
High-speed vehicle
Ships of opportunity
Autonomy

ABSTRACT

Since the 1930s, the use of the Continuous Plankton Recorder (CPR) sampler has been considered one of the most important plankton collection methods using ships of opportunity, which make samples available on a wider spatial and temporal scale. With this advantage in mind, the objective of this work was to develop a device that uses a similar collection method as the CPR, but with lower construction costs, and to carry out changes in functioning that facilitate its use in fishing craft in the Southeast and South regions of Brazil, for use as a tool for generating oceanographic data applied to fisheries management. The new equipment, called the Oceanographic Towed Vehicle *(Veículo Oceanográfico de Reboque — VOR),* has mechanical improvements and construction alterations for combined use with a multiparameter probe. For the new design of the vehicle, the aim was to create the hydrodynamic shape of an Undulating Towed Vehicle (U-tow), but without the characteristic of undulating in the water column. Based on a prototype, three experimental trawls were carried out, to calibrate the mechanism and analyze the material collected, in a laboratory, through a stereoscopic microscope.

* Corresponding author.
E-mail address: josefaccin@gmail.com (J. Faccin).

http://dx.doi.org/10.1016/j.mio.2014.10.003
2211-1220/

1. Introduction

One of the means used to monitor the marine ecosystems is, without doubt, the use of planktonic indicators, as according to Batten and Burkill (2010), these can rapidly and directly reflect the state of the ecosystem. Plankton analysis can also detect oceanographic phenomena resulting from physical and chemical anomalies in the water, such as variations in the diversity of copepods, as occurred in the 1990s in the North Sea (Beaugrand, 2004). Alongside this, through monitoring programs using continuous methods, evidence of possible time variations can be obtained in the recruitment of some species of fish, as reported by Beaugrand (2004, 2005) for cod in the North Atlantic.

Sir Alister Hardy, in the 1920s, developed an innovative collection method for sampling plankton. This equipment, unlike conventional devices, was designed to solve a very common problem in sampling by the traditional method, which is the lack of precision due to irregular distribution of plankton during a tow (Hosie, 2004). The Continuous Plankton Recorder (CPR) is a sampler developed by Hardy (1936, 1939). It was originally designed for quantitative samplings of mesozooplankton, as well as giving an indication of phytoplankton "blooms" through the analysis of mesh color (Phytoplankton Colour Index—PCI) (Hardy, 1939; Batten et al., 2003; Head and Pepin, 2010). The equipment enables detailed study of various changes in abundance of different planktonic organisms (phyto- and zooplankton) along a continuous line of observation at sea. With this new equipment, it was possible to supplement conventional collection techniques such as towed nets (Hardy, 1936, 1939), with the use of "ships of opportunity", and it became possible to establish monitoring programs in oceanographic regions (Warner and Hays, 1994).

Over time, new devices have emerged to replace Hardy's model, such as the Video Plankton Recorder (VPR) (Davis et al., 1992). However, the complexity of their operation, associated with the need for specialized vessels and the cost of acquisition and maintenance, have limited their use on ships of opportunity (in this context, industrial fishing boats). A lower cost model of the equipment would therefore be useful, built using alternative materials such as fiberglass composite, and with fully mechanical functioning. This work therefore aims to develop an optimized model of the CPR for use on fishing vessels operating on the Brazilian coast, with the possibility of generating data that can be used in the management of this important economic sector.

2. Materials and methods

2.1. Setting up the prototype

Based on the works of Hardy (1926, 1936, 1939) and John and Reid (2009), adaptations and changes were made to the layout of the CPR aimed at making its operation more practical in ships of opportunity of the fishing fleet. The graphic project of the prototype was set up using the software CAD *Solidworks*®, after which it was separated into two working fronts; (1) defining the metal pieces, and milling these pieces at a local machine shop and (2) constructing the vehicle and other components, which was done on the premises of Universidade do Vale do Itajaí (Univali), at the Center for Technological Sea and Earth Sciences (CTTMar—Course in Naval Construction). The new equipment was named the Oceanographic Towing Vehicle (Veículo Oceanográfico de Reboque—VOR).

The adaptation of the new model in relation to the traditional CPR involved the proposal of a more modern concept, with a facilitated manufacturing process and lower cost due to the use of alternative materials (fiberglass composite). The final cost of the VOR was estimated at approximately U$8,000.00 (Fiberglass vehicle, cassette, roll of silk). Also, a 25% reduction in the size of the original cassette was proposed, and the cog system was modified in relation to the traction of the collection components and adjustment of mesh tension, facilitating its operation during use on board ships of opportunity.

Based on the same mechanical principles as the CPR, the layout of the vehicle was based on the Undulating towed vehicle described by Hays et al. (1998), Reid et al. (2003) and Mair and Fernandes (2004), but with changes to its structure and compartmentalization (multiparameter cassette and probe). Produced completely in fiberglass composite, the resulting equipment is resistant, lightweight, easy to handle, and low-cost, making it ideal for various types of ship of opportunity (Fig. 1).