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In situ Target Strength versus Fork Length Relations of *Trachurus japonicus* Extracted from a Set of Acoustic and Corresponding Length Surveys Data

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ABSTRACT

A constrained optimal searching method was developed in this study to estimate the logarithm-linear relations between *in situ* Target Strength (TS) and Fork Length (FL). This method needed only a set of properly matched data of two surveys, one on acoustic and a corresponding one on length. This paper demonstrated this method by coupling data of *in situ* TS survey by SIMRAD EK500 (38kHz) and the length survey, which were carried out concurrently on *Trachurus japonicus* caught by purse seine vessels in the same waters off NE Taiwan in July 1995. The relationship between *in situ* TS and FL of *T. japonicus* obtained by the optimal searching method was: TS = 112.7 × log (FL) – 205. The applicable range of FL for this species was from 17.8 cm to 24.6 cm, and the standard deviation of TS by individual fish was 3dB. Experiments on hooked alive individual *T. japonicus*, of which the size for each fish was known, were also carried out and the observed mean TS of these known fish were fell well in the relational prediction.

Key words: *In situ Target Strength Distribution, Fork Length Distribution, Trachurus japonicus.*

INTRODUCTION

The TS-FL relationships are constantly used to convert acoustic volume back-scattering strength into fish biomass (Burczynski, 1979; Johannesson *et al*., 1983; MacLennan, 1990). How one determines the precise Target Strength (TS) versus Fork Length (FL) relationship of the fish targets is one of the essential tasks for hydroacoustic fishery research.

Although observed TS can be classified as either ex situ or in situ (Foote, 1991; MacLennan *et al*., 1992), the in situ TS, which accounts for the environmental, biological and behavioral factors, is more applicable for echo integration. Yet the *in situ* TS, even obtained, it is very hard to identify its association with the size of the fish, and is very hard to estimate the TS-FL relationship by the regression methods. The usual approach to overcome this difficulty is to find the primary single-species aggregations of the target species that have a uni-modal FL distribution. Data are collected from as many aggregations as possible, and the resulting pairs of modal FL and modal TS are used in a regression to estimate the FL-TS relationship (Foote, 1987). Unfortunately, if there is no sufficient number of suitable aggregations, or the aggregations cannot be found over a wide enough range of FL modes, this kind of approach does not work well. To overcome this restriction, a non-linear and constrained optimal searching method was developed in this study. To estimate

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