International Council for the
Exploration of the Sea

C.M. 1966
Comparative Fishing C.
F : 9

NOTE ON THE MEASUREMENT OF TARGET STRENGTH OF FISH AT SEA

by

L. Midttun
Institute of Marine Research, Bergen

When passing over a single fish with an echo sounder, echoes are received in a serie of transmissions as long as the fish is located within the acoustic beam. On a paper recorder these echoes together form a fish trace. A more precise measurement of the individual echoes and a closer examination of different fish traces are not possible by means of the paper recorder. Our two Norwegian research vessels "G.O.Sars" and "Johan Hjort" are, however, both equipped with the SIMRAD Research SONAR/Sounder including a calibrated oscilloscope by which it is possible to measure the target strength of fish.

Target strength, T, of a single fish measured at a distance, d, is expressed by

$$T = 10 \log \left(\frac{I_r}{I_s} d^4\right) \text{ (db)}$$

where I_s is the transmitted sound intensity at source (viz. a distance of 1 m from the oscillator) and I_r is the received sound intensity measured at the oscillator. In terms of decibels

$$T = E - S + 40 \log d$$

E is the echo level and S the source level, both reported in decibels above a standard value corresponding to a sound pressure of 1 dyn/cm^2. By means of a microphone both the source level S and the sensitivity of the receiving unit can be calibrated, the latter giving

$$E = M - F_e - F_s + U$$

where M is the found calibrated value of sound level required to give an oscilloscope reading of O (db) at maximum amplification of echo sounder and scope, F_e and F_s are the amplification (known) of sounder and scope during operation, and U is the finale echo reading of the oscilloscope. The transmission loss taken as 40 log d is also electronically compensated for on the SIMRAD equipment. Whitin a depth range of, say, 250 m a constant value of 96 db can be substituted. Then we have

$$T = (M - F_e - F_s - S + 40 \log d) + U$$

where the terms in the parenthesis all are known constants, which during the "G.O.Sars" run, described below, had the following values:

$M = -62$ db
$F_e = -12$ "
$F_s = -30$ "
$S = 118$ "
$40 \log d = 96$ "

thus giving

$$T = -41 + U \text{ db}$$

Resently a Bolex film camera was attached to the scope onboard the "G.O. Sars". The camera was trigged by the scope and single pictures of each echo signal received could therefore be obtained. On desperse consentrations of fish the same fish can be recognized from picture to picture, thus giving oportunity to examine the different fish traces. Figure 1 shows single fish recordings observed at about 200 m in the first trial run on the Malangen ground this winter.

The acoustic equipment onboard the "G.O.Sars" also includes an echo integrator (Dragesund and Olsen 1965) which can be arranged to record single fish traces presented in a decibel scale as target strength. Figure 2 shows recordings made on the integrator during the trial run on the Malangen ground referred to above. This device was not calibrated during the run and we were therefore not able to provide the figure with the decibel scale.

When used on pure consentrations of known fish species, valuable information about the target strength and trace patterns of different species can probably be obtained by means of the devices here described.

Reference

Dragesund, O. and Olsen, S. 1965. On the possibility of estimating yearclass strength by measuring echo abundance of 0-group fish. FiskDir. Skr. Ser. HavUnders., 13 (18).

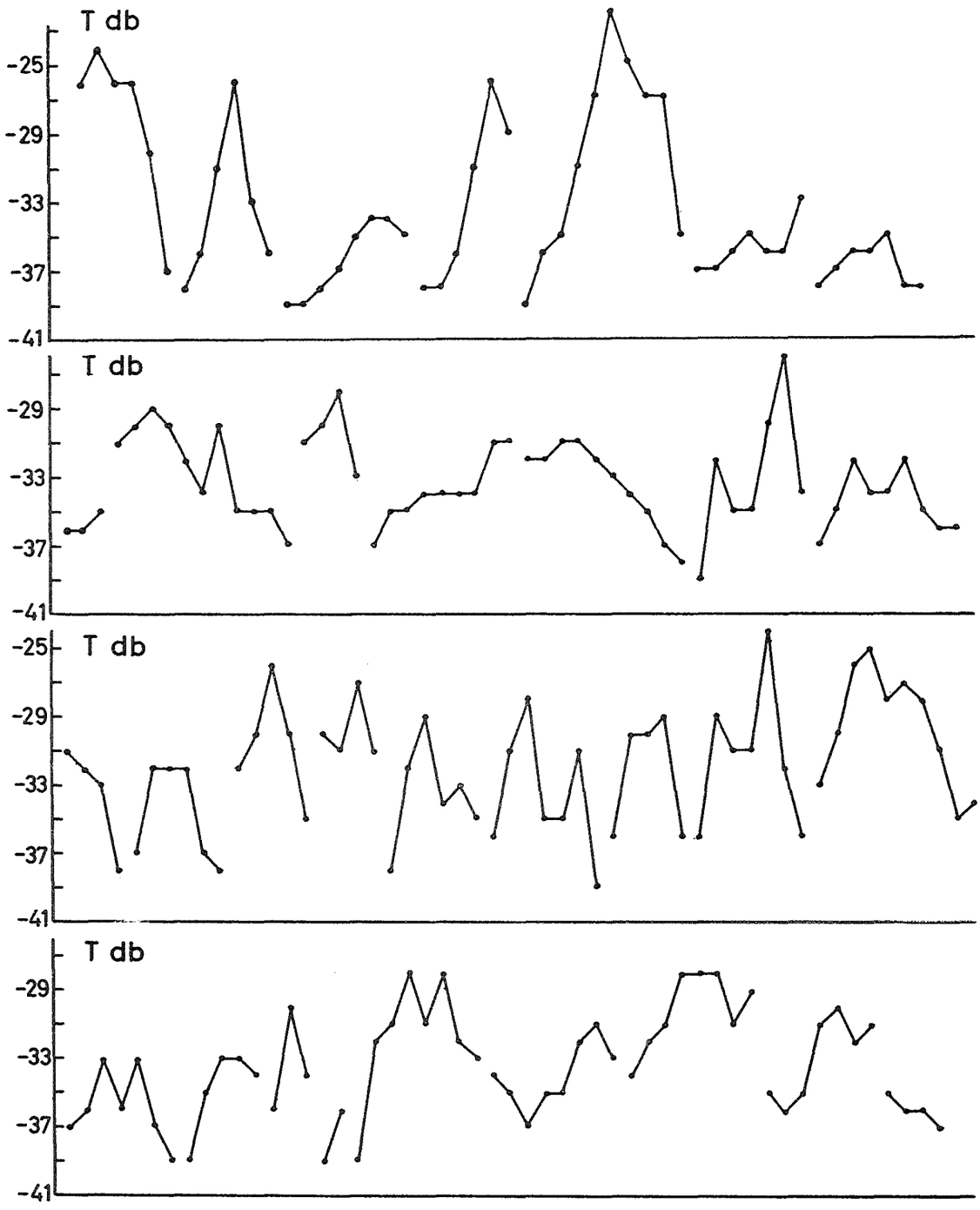

Fig. 1. Single fish traces based on scope recordings.
Target strength in decibels.
"G. O. Sars", Malangen, February 1966.

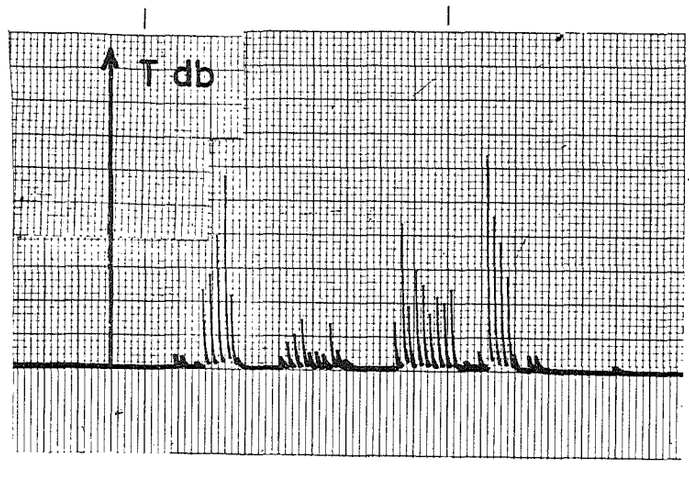

Fig. 2. Single fish traces from the integrator.
"G. O. Sars", Malangen, February 1966.