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# A method for assessing the fishing potential of the Nephrops stock at Iceland

by

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## Abstract

The author tries in this paper to make an assessment of the fishing potential of Nephrops at Iceland, based on the relation between abundance in one year and the average fishing effort over that year and the two preceding years. This relation was first used by Gulland (1961) for a few species of fish at Iceland.

Most of the material relating to catch and effort was obtained from compulsory catch reports made by skippers of Nephrops boats. Catch per trawling hour is used as the best measure of abundance available.

According to the relation between abundance and average fishing effort/3 yrs, the estimated fishing potential of Nephrops at Iceland amounts to an annual sustained yield of approx. 3.600 metric tons at a maintained effort of some 78 thousand trawling hours, or approx. 46 kgs/hour. This is considerably higher catch/effort than that of the more recent years, since fishing effort has exceeded the optimal.

A study of the relationship between catch per effort in one year and the average annual catch of that year and the two preceding years shows distinct phases of the fishery in as much as average catches above max. sustained yield are followed by a drop in catch/effort and vice versa. Therefore it is suggested that the catch/effort could be raised and somewhat stabilized by means of seasonal catch quotas which were introduced for the 1973 and 1974 seasons. Apart from catch quotas being the easiest means of stock conservation, from fishery management point of view, the raising of the catch per effort was considered necessary as the low catch/effort in recent years has been endangering the profitability of the Nephrops fishery in many areas at Iceland.

Catch limitations are expected to pay off in the long run in the form of larger individuals caught and thus a more valuable catch.

## Introduction

Gulland (1961) discussed the relation between the abundance of cod, haddock and plaice in one year and the average fishing effort over that year and the two preceding years. His study was mostly based on English measures of abundance and fishing effort over the period 1908-1958 at Iceland.

Similarly Skúladóttir (1967) studied this relation for the Pandalus and Nephrops fisheries at Iceland over the period 1960-1966.

This paper is intended to give an estimate of the fishing potential of the Nephrops stock at Iceland, based on the relation between abundance and average fishing effort during the period 1960-1973. It is hoped that this estimate may prove useful in the absence of other valuable data such as mortality rates and reliable estimates of annual recruitment.

## Material and methods

Most of the material relating to catch and effort has been obtained from compulsory catch reports filled out by skippers of Nephrops boats. Also catch per trawling hour has been used as the best measure

of abundance available.

It has been shown previously that increasing fishing effort over the years on the Nephrops grounds at Iceland, has resulted in a very considerable drop in catch per trawling hour (Eiríksson 1968 and 1970). In a Nephrops fishery, which at any time is based on a number of year-classes, the abundance can be expected to be dependant on a number of years' fishing effort and is therefore likely to be most closely related to the average effort over the past so many years. Ideally the average effort should be based on the average time during which the Nephrops are exposed to fishing. This in itself, however, will depend on the amount of fishing. As the latter is a constantly varying factor the period used for calculating average effort has to be chosen somewhat arbitrarily, although some deviation from the best value will not matter a great deal. In this paper the relation between abundance in each year and the average fishing effort of that and the two preceding years is used, i.e. average effort/3 yrs. However, the difference observed when using average effort/6 yrs only amounted to approx. 15%, the latter giving lower values.

When plotting abundance against average fishing effort a straight line can be fitted to the points, giving the relation:

$$Y/f = a + bf \qquad (1)$$

Hence $$Y = af + bf^2 \qquad (2)$$

where $Y$ = catch and

$f$ = effort (Gulland, 1961)

It should be pointed out, however, that a curvilinear relation is possible, although there is no evidence to it being a more correct one in this case. From the relation between catch/effort and average effort (equation (1)), the relation between catch and effort in a steady state can be obtained (equation (2)), giving the catch obtained if the effort was maintained at the same level for several years.

## Estimate of fishing potential

In Figure 1 the catch/effort in each year has been plotted against the average effort of that and the preceding two years, i.e. average effort/3 yrs. A straight line (A) has been fitted to the points, giving the relation between catch per unit effort and average effort in a steady

state. From this relation the curve (B) has been plotted, giving the sustained yield if the effort was maintained at the same level for several years. This relation indicates an annual sustained yield of approx. 3.600 metric tons at an effort of some 78 thousand trawling hours, or approx. 46 kgs/hour. This is considerably higher catch/effort than that of most recent years since fishing effort has exceeded the optimal.

Figure 2 shows the relationship between catch per effort in each year and the average annual catch of that and the two preceding years, i.e. average catch/3 yrs. Here distinct phases of the fishery can be observed in as much as average catches above max. sustainable yield are followed by a drop in catch/effort and vice versa. A fairly clear relationship is therefore seen between the two indicating that the catch/effort could be raised and somewhat stabilized by means of total catch quotas per season, which in any case is the easiest method of stock conservation from a fishery management point of view.

The present and possible future state of the fishery

Figure 3 A-C shows the annual catches of Nephrops at Iceland over the period 1950-1973 and the Icelandic fishing effort and catch per effort during 1960-1973. A general rise is seen in fishing effort until 1973 when catch limitations were introduced. However, the increase in landings has not been relative to increasing effort owing to lesser catch per effort. Moreover considerable fluctuations are seen, partly due to annual catches having surpassed the max. sustained yield with a resulting fall in catch/effort, as mentioned previously in the paper. The max. sustained yield and effort and optimal catch per effort, as estimated by the relation of average effort/3 yrs - catch/effort, are indicated by arrows in Fig. 3.

There is no denying that the low catch per effort in the more recent years has been endangering the profitability of the Nephrops fishery in many areas at Iceland. As it was quite evident in 1972, that the Nephrops fishery was entering a phase of decreasing catch per effort accompanied by smaller mean size of Nephrops than ever before, a decision was made to introduce a total catch quota of 3.000 metric tons for the 1973 season. Although catch per effort continued to drop in 1973, the

latest figures for the 1974 season, which has a quota of 2.000 metric tons, show a very considerable improvement. The success in bringing about a more stable fishery, based on the before-mentioned estimate of fishing potential has, however, to await the outcome of forthcoming years.

The temporary economic loss due to catch limitations is expected to pay off in the long run in the form of larger individuals caught and thus a more valuable catch, as Iceland's largest buyer of Nephrops, the U.S.A. market, relies to a great extent upon the larger and more expensive Nephrops.

References:

Eiríksson, H., 1968: The effect of fishing on catch per effort, size and sex-ratio of the Norway lobster (Nephrops norvegicus L.) in Icelandic waters during the years 1962-1967. ICES, Doc., C.M. 1968/K:4 (mimeo).

Eiríksson, H., 1970: The Nephrops Fishery of Iceland 1958-1969. ICES, Doc., C.M. 1970/K:5 (mimeo).

Gulland, J.A., 1961: Fishing and the Stocks of Fish at Iceland. Fish. Invest. Lond. Ser. 2, 23 (4).

Skúladóttir, U., 1967: Krabbadýr og skeldýr. Vinnsla sjávarafla: 13-23.

Figure 1. The relation between abundance of Nephrops in one year and the average fishing effort in that year and in the two preceding years, over the period 1960-1973 (line A). The relation between sustained yield and effort in the steady state (curve B), as deduced from relation A.

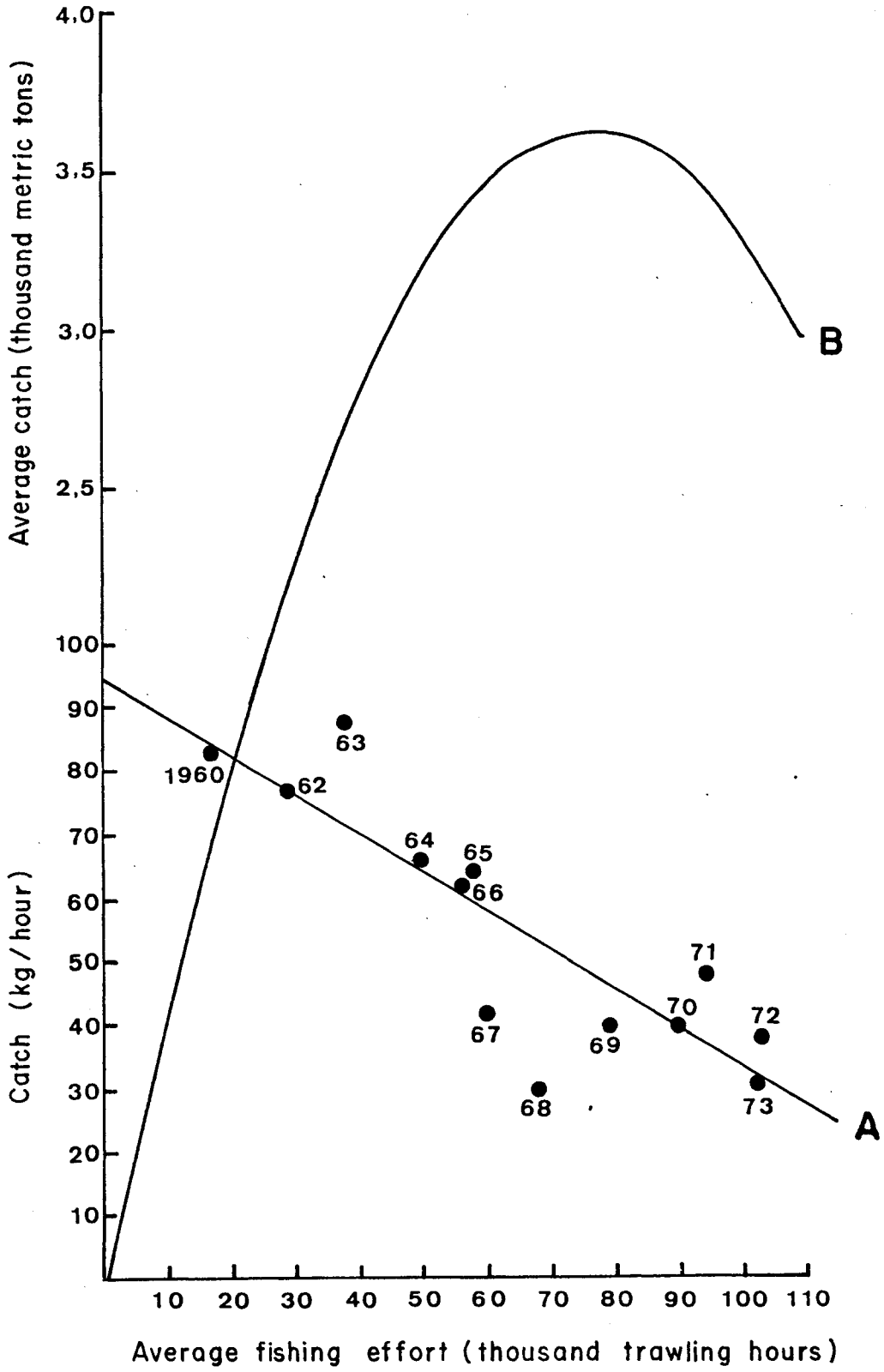

Figure 2. The relationship between catch per effort in each year (broken line) and the average annual catch in that year and in the preceding two years (solid line). Arrows indicate max. sustained yield and optimal catch per effort, as deduced from the relations in Figure 1.

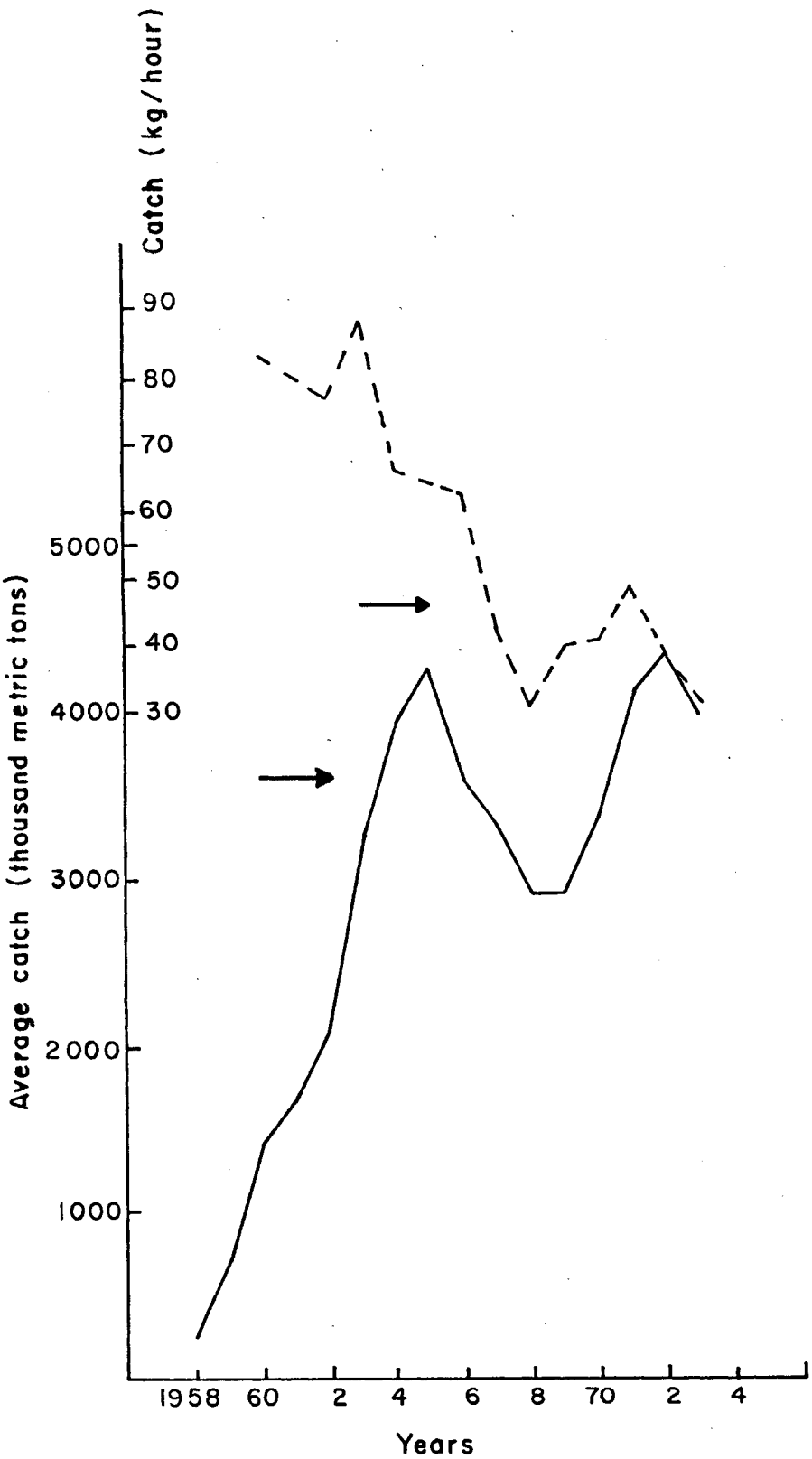

Figure 3. A - The Nephrops fishery at Iceland showing the total landings (solid line) and Icelandic landings (broken line).
B - Catch per unit effort in the Icelandic fishery.
C - Total effort on the Nephrops stock in the Icelandic fishery.
Arrows indicate the max. sustained yield and effort and optimal catch/effort, as deduced from the relations in Figure 1.