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's-GRAVENHAGE

A Bio-economic study of the Dutch fisheries for flatfish

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Some preliminary results

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A BIO-ECONOMIC STUDY OF THE DUTCH FISHERIES FOR FLATFISH

Some preliminary results

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Contents

1. INTRODUCTION

1.1 The purpose of this paper is to outline a combined biological and economic approach to the problems of the Dutch near water fisheries and to arrive at a bio-economic advice for fishery management.
Until now the scientific basis for NEAFC-regulations was provided by biological advice exclusively. In our opinion these regulations are not meant to protect and conserve fish as a goal in itself, but to restore fishing into an economically feasible and even attractive activity. Therefore, policy-makers have to take into account economic data, apart from the biological advices.

1.2 The ultimate goal will be to attain an optimum economic sustainable yield level for the combination of species exploited by the fisheries concerned. From the economic point of view however it is not the ultimate goal alone that counts, but also the path along which this goal is to be reached.
In the case that species are heavily overfished and recruitment is in danger owing to low spawning stock level, biological considerations must have a high priority.
No economist would disagree that the collapse of stocks should be avoided. Consequently, hard and painful measures have to be taken to let the stock leave this perilous state. However if a species is outside the danger-zone there is no reason to spare fish to the detriment of fishermen. The existing fleets should not be disregarded when drawing up a policy as they greatly influence the economic results of the fishing industry on short run.
A reduction of fishing effort imposed by international regulations, makes a part of the fleets redundant, resulting in losses of capital and employment if no alternative fisheries can be developed.

1.3 In planning and taking regulatory measures the negative economic aspects should be minimised. Any room the biologic situation of the stock leaves can be utilised for that purpose. This could mean that a temporary overfishing of balanced stocks is allowed. Such a policy will not be popular amongst marine-biologists but it enables the fishermen to let dangerously overfished species restore, without completely losing their livelihood.
The problem remains of course that the danger limits can as yet hardly be defined. Therefore careful manoeuvring is needed.

But this should not restrain us from looking for possibilities to make the transition from the present overcapacity of fleets into a more optimal situation as gradual as the biological conditions of the stocks allow.

1.4 By exploring strategies for fisheries management our research gives administrators and industry an impression of the impact regulatory measures have on economic results in combination with the development of the fish stocks. This should provide both with a firmer basis for their management decisions (however uncertain the predictions still may be).
Besides, the construction of a bio-economic fishery model provides opportunities for analysis of the "fishery-mechanism" by measuring the effects of variations in the parameters. This could also contribute to the insight of policy-makers and industry.
All this is still confined to national fisheries, the economic contribution being in its first stages of development. We do hope, however, this may be the first step to an international project.

2. BIOLOGICAL FACTORS IN THE DUTCH NEAR WATER FISHERIES

2.1 General remarks

Dutch near water fisheries are mainly engaged in beam-trawling for flatfish in the North Sea. Part of the fleet is periodically switching to pair trawling or otter-trawling for herring or roundfish. Some vessels even never use beam-trawls, as they are specialised on roundfish.

In the Dutch flatfish-fishery sole and plaice are the predominant species. Turbot, brill, dab, cod, whiting, gurnards only make the by-catch.

The North Sea sole and the North Sea plaice are in different stages of exploitation. Whereas the sole is heavily overfished and has been exploited mainly by the Dutch fishermen, the plaice is near the biological optimum sustainable yield for the present exploitation pattern.

2.2 Assessment of the North Sea sole fisheries

2.2.1 Causes of catch-fluctuations

Three factors are responsible for the observed fluctuations in the total landings. They are :

a. Variations in year class success, resulting in short term fluctuations. For sole they may have a very pronounced influence.

b. Extra natural mortality. In severe winters extra natural mortality will have a short term effect on catch and stock. The level of recruitment may be influenced on medium term by increase or decrease of predators.

c. Fishery mortality, leading to medium-long term trends in catch and stock.

2.2.2 Landings, effort, catch per effort

Fig. 1 gives the international sole landings from 1903-1975. The general trend is an increase in catch level. The main reason is not a corresponding increase in stock level, but mainly a rapidly increasing total fishing effort, given in fig. 2 as equivalent otter-trawl hours. Beamtrawl hours have been modified in ottertrawl hours by means of converting factors based on comparison of the catch performance between both years. Fig. 3 gives the catch per effort as index of stock biomass. The figure demonstrates a very distinct decrease in catch per effort.

When comparing total landings with total effort for 1954-1975 (fig. 4) the influence of year class strength is apparent. The catches of 1961-1963 have been pushed to high values by the very strong 1958 year class. The severe winter 1962/63 caused a breakdown in the sole stock resulting in a low catch level in 1964 and 1965. The very strong year class 1963 on its turn lifted the catch to a very high level in 1966-1968. Since no very strong year class has occurred.

The present catch situation is beyond the optimum given by the adjusted parabola $Y = 9529 + 14.5 f - 0.003 f^2$ in which Y stands for yield and f for effort. Fig. 5 shows the catch per effort for the years 1954-1975. The present stock level is about one half of the level given by the effort at the optimum of the parabola.

Because of the pronounced year class influence in sole on the catches, it is better to calculate Beverton & Holt steady state yield per recruit and yield per effort per recruit curves (fig. 6) for F varying with age as deducted by virtual population analysis. The curves show that the present stock is about one half to one third of the stock corresponding with the optimum of the yield per recruit curve. The present maximal fishing mortality coefficient of the F-at-age array is 2.7 times the corresponding F at the optimum.

2.2.3 Stock-recruitment relationship

We may calculate the total sustainable yield by multiplying the values in fig. 6 by average recruitment (75 million 2 year old soles) disregarding any stock-recruitment relationship. Is this allowed at present?

Figure 7 gives the relationship between recruitment and stock size as given by the catch per effort (de Veen, 1975). At present both the mean and the variance of the abundance of the most recent year classes have decreased as compared with the pre-1964 year classes, which suggests that the stock has already entered the downward leg of a stock-recruitment relationship.

For that reason fishery regulation should no longer aim merely at stabilising the stock level at the present position, but reduce the fishing mortality by effort or catch reduction to such an extent that stock biomass will increase as quickly as possible.

2.3 Assessment of the North Sea plaice fisheries

2.3.1 Landings, effort, catch per effort

Total international landings of North Sea plaice rose in the course of the century (fig. 8). The increasing catches in the last decades are a reflection of an increased stock owing to increased recruitment. The decline in the herring, a predator on cod and plaice eggs may partly be responsible for this increased recruitment. The very strong year class 1963 also lifted the recruitment level temporary to a high level. At the moment the influence of this 1963 year class is not great any more. For that reason the catch level has decreased somewhat lately.

Fig. 9 shows the international effort in terms of British motor trawler effort in the post war years. For the most recent years no reliable index of effort is available, but fishing mortality has risen somewhat recently.

The catch per effort given in fig. 10 demonstrates a very marked increase from 1958-1970, owing to the above mentioned causes. In addition the overall decrease in fishing mortality after the war has resulted in an expected increase in catch and stock as compared with the situation in the thirties when plaice was overfished.

From 1971-present reliable catch per effort data are missing, but qualitative data show that the trend is downward but still at a high level.

Figure 11 gives the steady state yield per recruit and biomass per recruit against the maximal value of F on the F-at-age array (Anon, 1976). The present F is more or less the same as the F giving the optimum yield per recruit. Thus the present situation in the plaice fishery is very favourable.

2.3.2 Stock-recruitment relationship

The stock-recruitment relationship of plaice has been studied by Bannister (1975). Figure 12 shows that recruitment on average tends to decline with any decrease in the spawning stock. Compared with the situation of the sole, no immediate danger seems to be present in the plaice and a possible collapse of the stock owing to poor average recruitment seems to be only possible at much higher F values in a situation of heavy overfishing.

2.3.3 Temporary overfishing of plaice

In the following a temporary increase in fishing mortality of plaice will be proposed together with a considerable decrease in fishing mortality of sole.

Given the fact that the sole is in a dangerous situation as regards stock-recruitment relationship it seems reasonable from the multi-species point of view to allow a moderate overfishing on plaice for some years in order to let the fishing industry accept a severe reduction in sole catches.

The amount and duration of the period of overfishing on plaice should be kept within such limits that average plaice recruitment is not endangered.

2.4 Biological prognoses for fishery strategies

2.4.1 Short and longer term prognoses

The marine-biologists have much experience with catch prognoses. Before the start of quota regulations a forecast of Dutch sole-landings has been issued each year. Recently a prognosis on quarterly basis has been developed (de Veen and Panhorst, 1976) of which an example is given in fig. 13. This provides data for a subdivison of national quota within the year.

Catch-predictions require an approximation not only of the actual stock size but also of the recruiting year classes. The latter are available from several survey-programs. However, as sole and plaice recruit at 2 year-age, catch predictions based on estimated recruitments are possible for only two years ahead.

In planning a strategy for the middle-long term (until 1985) the prognosis has to be stretched beyond the first two years for which at least some data on recruitment are available. For later years we have to resort to an assumed level of recruitment, the average level probably giving the best estimate (as long as no stock-recruitment relationship applies).

The longer term prognosis thus gives the development of stock and catches proceeding from the last data on stock numbers over age, assuming constant (average) level of recruitment and constant natural mortality, and applying a chosen development of fishing effort. The basic data for our present research are in complete agreement with those used by the ICES Flatfish Working Group in preparing their advice for the 1977-quota.

2.4.2 Management strategies

In a first (trial) round the biological effects of a quartet of possible quota-strategies have been assessed. These strategies concern the combination of sole and plaice in the North Sea as practically all Dutch flatfish is caught in this area. This does not mean that when fishing effort on sole is reduced, the effort on plaice is reduced proportionally.

Strategy I leaves things as they were. Fishing effort remains at the level of last years, quota-regulations for 1976 are not effective. By adhering to the average recruitment level for sole the results for later years are rather optimistic.

Strategy II is to keep fishing effort at the level corresponding to quota for 1976. For sole this means a reduction in effort of about one third, while for plaice no reduction in effort is necessary.

Strategy III follows the recommendations of the Flatfish Working Group in aiming at a stock of soles twice the present one and at MSY for plaice. For this a reduction of effort on sole by 60% is necessary, while for plaice a reduction by 10% suffices (all to be realised after 1976 when the present quota apply).

By strategy IV it is tried to relief the impact of a considerable reduction of effort on sole by allowing a temporary increase of effort on plaice. By bringing back fishing effort on sole to 40% of the recent level during the three years following 1976 it is hoped the stock has been restored sufficiently to be able to sustain a slightly higher pressure, the effort being raised to 60% from then onwards. At the same time the effort on plaice is allowed to raise by 30% during three years and subsequently reduced to 90% of recent level.

Stocks and catches, resulting from these strategies are given in figs. 14-17.

3. ASSESSMENT OF ECONOMIC RESULTS

3.1 Economic fishery model

In sequence to the biologic assessment and prognosis model we have developed a model to estimate economic results of fisheries under certain stock management regimes. The model has been devised with regard to the Dutch situation, using our knowledge of market prices and exploitation costs of fishing vessels. Provided adequate data of these are available it might be applicable to foreign fisheries also.

In gross detail the economic model works as follows: from the total allowable catches of certain species given by the biologic prognosis the Dutch part is separated and subdivided into market sizes. Prices are calculated for each species and market size, taking into account the quantities landed. With addition of the by-catches the yearly total proceeds now can be estimated.

Costst are calculated in six items, comprising capacity-costs costs dependent on fishing effort and days at sea, landing costs (dependent on quantity and value landed) and remuneration of labour. Parameters are derived from annual costs and earnings studies of Dutch fisheries.

By subtraction of total costs from total proceeds yearly net-results are obtained. From the available data the net-value-added - the sum of remuneration of labour, interest on capital invested and net-result - can be derived also.

In order to make a comparison of the economic results of several runs with different parameters feasible they should be reduced to a common basis. This is done by a present value calculation by which future amounts are discounted to their value in a basis-year.(In this way the time-preference for money is taken into account, as people tend to prefer obtaining money to-day to obtaining the same amount in a rather uncertain future).

3.2 General suppositions and data for calculations

We are trying to assess the impact of flatfish quota strategies on the Dutch near-water fleet as a whole. Therefore the fisheries not directed on flatfish of this fleet have been included. Total landings are thought to consist of sole, plaice, by-catch of the flatfish fishery and catches from the additional fisheries.

Landings of by-catch vary greatly proportionally with combined fishing effort on plaice and sole. As long as sufficient fishing capacity is available for exerting the allowed effort on sole and plaice and practising the existing additional fisheries, landings from the latter are kept constant (at the 1975-level).

Whenever a shortage of capacity occurs the additional fishereis are thought to be reduced in favour of the flatfish fishery.

Total fishing effort of the Dutch near-water fleet was distributed among fisheries and species according to their share in the landed values. Roughly this results in 55% sole-fishing, 30% plaice-fishing and 15% additional fisheries. This is not only used to assess the required capacity, but also in the calculation of effort-dependent costs.

The market-prices for sole and plaice are derived from supply-price relations in recent years. The prices of other fish are kept constant at the 1975-level.

Data of costs are derived from costs and earnings studies over 1975. Supposing inflation affects market prices and costs to the same extent their 1975-level is adhered to throughout the calculations. So results are obtained in constant prices of 1975. This is also the basis-year for discounting the results to present value. A discount rate of 10% is taken, giving a present value of about 40% of nominal amounts received after 10 years from now.

The cost structure of the near-water fleet was as follows in 1975:

- capacity costs 1) : 40% of total costs
- variable costs of fishing and steaming: 24%
- costs of landing and conservation: 7%
- remuneration of labour (incl. skipper-owner) : 29%

Of course this structure will change over the years due to variation of the parameters.

Our computations are extending over a period of 10 years. In this time the effects of conservation should be apparent. Even thinking on this term is asking a lot from the fishing industry in its present predicament. Stretching the research beyond this period has no use either, as developments new unforeseen may have changed production conditions radically by then. In addition, the present fleet will be largely written off in 1985 which solves an important part of the fishery problem.

3.3 Improvement of economic results

In an attempt to improve results some changes of parameters, not being directly induced by the allowed levels of fishing effort on sole and plaice, have been introduced.

Restrictions of fishing effort lead to surplus capacity of the existing fleets. There are two ways to absorb at least part of this overcapacity. One is to try and find new alternative fisheries, the other is to dispose of the surplus fleet (by scrapping and selling). Both ways have been incorporated in our calculations. The former by

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1) Including depreciations based on replacement value of ships and gear.

(cautiously) supposing that one quarter of the available overcapacity could be put to use in alternative fisheries equivalent to the already existing additional fisheries. The latter by introducing a fleet reduction by 20% as intended by industry and administration.

Also the combined effect of both possibilities has been measured (a fleet reduction leaving less overcapacity to be spent in alternative fisheries).

3.4 Preliminary results

The results presented here are emphatically called preliminary, as in the first place cost parameters have not yet been estimated quite satisfactory and in the second place the strategies may be explored to a further extent. An adjustment of parameters may change the absolute values of the results (not leading however to a different order of magnitude), but relative position of the strategies will probably be little affected. A further exploration of strategies will also have influence on the relative positions.

Gross proceeds per year are given in fig. 18. It can be seen that in the non-restricting strategy I a generally higher value of landings will be obtained (provided recruitment will not be affected by this policy) than by restricting the effort on sole and plaice. In this free fishing situation according to data of recent years the Dutch part in total catches will be rather greater than the allocations of plaice and sole from NEAFC-agreements. Also landings and value of by-catches will be greater in this case.

Strategy II (quota in accordance with present TAC-levels) seems the next best, followed by strategy IV (allowing a temporary overfishing of plaice). Strategy III (interpreting the preferences of the biologists) seems the least attractive alternative, when only proceeds are considered.

By considering the net results in the original situation of fleet and additional fisheries as given in fig. 19 the picture changes quite a bit. In the outset strategy I is only slightly better than the others, but in the longer run it is lagging behind. All results being highly negative it is apparent that the present near-water fishery cannot be maintained without heavy outside support.

If compensating fisheries can be found, absorbing 25% of the overcapacity resulting from catch restrictions some improvement is obtained with strategies II, III and IV, a firmer restriction resulting in a greater improvement (fig.20). Policy I offers no opportunity for improvement as all capacity will be engaged.

Reduction of the fleet in two years to 80% of the present size has a far greater positive effect on net-results as appears from fig. 21. Strategy I being to keep fishing effort at the recent (high) level implies that in this case no reduction of the fleet can be introduced (how unrealistic this may be in view of the economic results).

A combination of fleet reduction and compensating fisheries would yield the best results (fig. 22). In 1976 adhering to the quota would not turn out worse (for the remaining fleet as a whole) 1) than neglecting them. But even assuming these combined ways to improvement no positive results emerge. Also it should be noted that with strategy II a fleet reduction by 20% leaves hardly any room for compensating fisheries, as practically all capacity is absorbed by the allowed effort for plaice and sole and the existing additional fisheries.

As was stated in 3.1 results of policies should be compared on basis of their present value. By this concept (generally accepted in economics) results in the near future are weighing heavier than those in later years. Fig. 23 offers the cumulative net present values over the period considered for the reduced fleet with compensating fisheries. It appears that there is no significant difference in economic net results between the conservation strategies worked out in these examples. There is a very marked improvement however on the "free fishing"-strategy (although the line given must be considered as being rather unrealistic).

Net-result is what remains to the owner from his enterprise after all production factors have been decently remunerated. The share-system almost generally practised in the Dutch near-water fisheries makes the crew more or less to co-entrepreneurs, as they bear part of the catching-risks ("no catch no pay"). So the share-system can be considered as a method of distribution of the total imcome produced by the fishing activity.

According to this philosophy the total income is a better measure of the success of these fisheries than the net-result. This total income is suitably represented by the net-value added. For comparison of the strategies on this basis fig. 24 gives the cumulative present values added. Differences between "free fishing" and "conservation" are much smaller than with net-results. (This gives an indication of a probably unmeant effect of quota regulations for these fisheries: a transfer of income from crew-members to owners). Differences between conservation strategies are a bit more pronounced though still not significant, quota at the level of effort now in force giving the best economic result.

4. CONCLUSIONS AND DISCUSSION

4.1 From the results of our calculations for the Dutch flatfish fisheries it is clear once more that a reduction in fishing effort on sole is inevitable, whether voluntary by accepting quota-regulations or forced by insustainable economic losses. Some fishermen seem to prefer the hard way, probably expecting they will outlast their fellow-fishermen. From the biological point of view this would be a very risky policy as the stock might be depleted to a level where restoration would be very slow and the remaining (few) fishermen could hardly make a living from it. Also from an economic and social point of vieuw quota-regulations offer better opportunities to conserve stock and fisheries.

4.2 A return to the very favourable economic circumstances of before the oil-crisis of 1973 may hardly be expected. Apart from the then available (remains of) strong year classes of sole 1) the economic production conditions were much more attractive than at present. The ratio between prices payed and prices received has become quite unfavourable, rendering a profitable exploitation of the fishery practically impossible if improvements stay out (as is implicity supposed in our examples).
There is however no reason why changes for the good should be excluded, although they cannot be predicted. One of these changes is an improvement in market-prices for fish of which the first signs could be noted last winter. Other improvements may be expected from development in the field of fishing techniques and rational vessel exploitation leading to economies. To this a contribution should be possible by an evolution of fisheries management techniques and strategies, as initiated by this paper.

4.3 The small differences between the results of the management strategies proposed here do not mean it doesn't matter which strategy is chosen. For the majority of fishing firms developments in the first couple of years will be dicisive for their opportunities to survive and to benefit by the more favourable years following. If this aspect is neglected, there would be little economic difference between the imposition of quota (in this case without regard of the fishermen) and the "starving-system" as described under 4.1

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1) Recruitment and stock of plaice were relatively stable then and now.

Very marked differences occur in the developments of the sole stock as appears from fig. 15 . Quota at the presently allowed level of fishing effort (II) only result in a consolidation of the present stock-size. A policy as proposed in strategy IV would result in a 25% enlagerment of the stock and strategy III gives a doubled stock as preferred by the flatfish working group.
Apparently the average recruitment level offers rather little opportunity for improvement. This is aggravated by the two small year classes expected in the first years. To maintain average recruitment over the whole period, one year class of 1969 strength should be inserted. Results would be very favourable influenced by an early appearance of such a year class.
The stock of plaice shows only slight variations from the present level, even in the case of overfishing. There is no biological argument to make a strict maintenance of the stock-size necessary, although a permanent diminutation should be avoided. Especially in the case of plaice-stocks it is therefore justified to devise a strategy which is based on economic as well as biological considerations.

4.4 The two opportunities for improvement of the economic results as proposed here besides quota: compensating alternative fisheries and fleet reduction, cannot be realised without problems.
The possibilities for compensating fisheries are questionable as practically all economically interesting species in the North Sea and adjacent waters are fully or overexploited. The roundfish and mackerel quota offer some room to the Dutch fleet but there are problems on the market side as well as on the catching side.
It will be clear that a 20% reduction of the Dutch cutter fleet cannot be effected without trouble, particularly if it is taken into account that already in 1975 some 100 vessels were withdrawn with help of the government (authorised by EEC). Even disregarding the personal and social problems such an operation evokes, it will have serious negative economic effects through annihilation of capital and loss of employment. As yet we have not been able to asses the amounts involved. With a modern fleet like the Dutch middle-water fleet - where just one third of the vessels (representing only about 22% of the fishing capacity) is older than ten years - and in a general situation of heavy unemployment, these effects may not be neglected.

4.5 Fisheries management is a short term as well as a long term question. But while fisherman tend to look at todays problems only, until recently biologists seem to have been taken up to much by steady state fishery models, which may only represent an average over a long range of years.

The management strategies introduced here are of a semi-dynamic nature and apply to the middle long term. This should be considered as a transition period in which a further decline of the stocks is prevented and room is created for a development to a more optimal exploitation of stocks. As the final goals are hardly defined yet and wide open for discussion, policies should be flexible and avoiding abrupt changes where possible. It is of prime importance that fishermen, if they are to benefit by the results of management, are spared as well as the fish. Every oppotunity should be taken to reach both goals. A multi-species model offers such opportunities by allowing temporary overfishing of some healthy stocks in favour of endangered other species, as e.g. in this case with plaice and sole. Another opportunity, although less controllable, lies in waiting for and taking advantage of occasional good year classes of more depleted stocks.

5. FIGURES 1 – 24

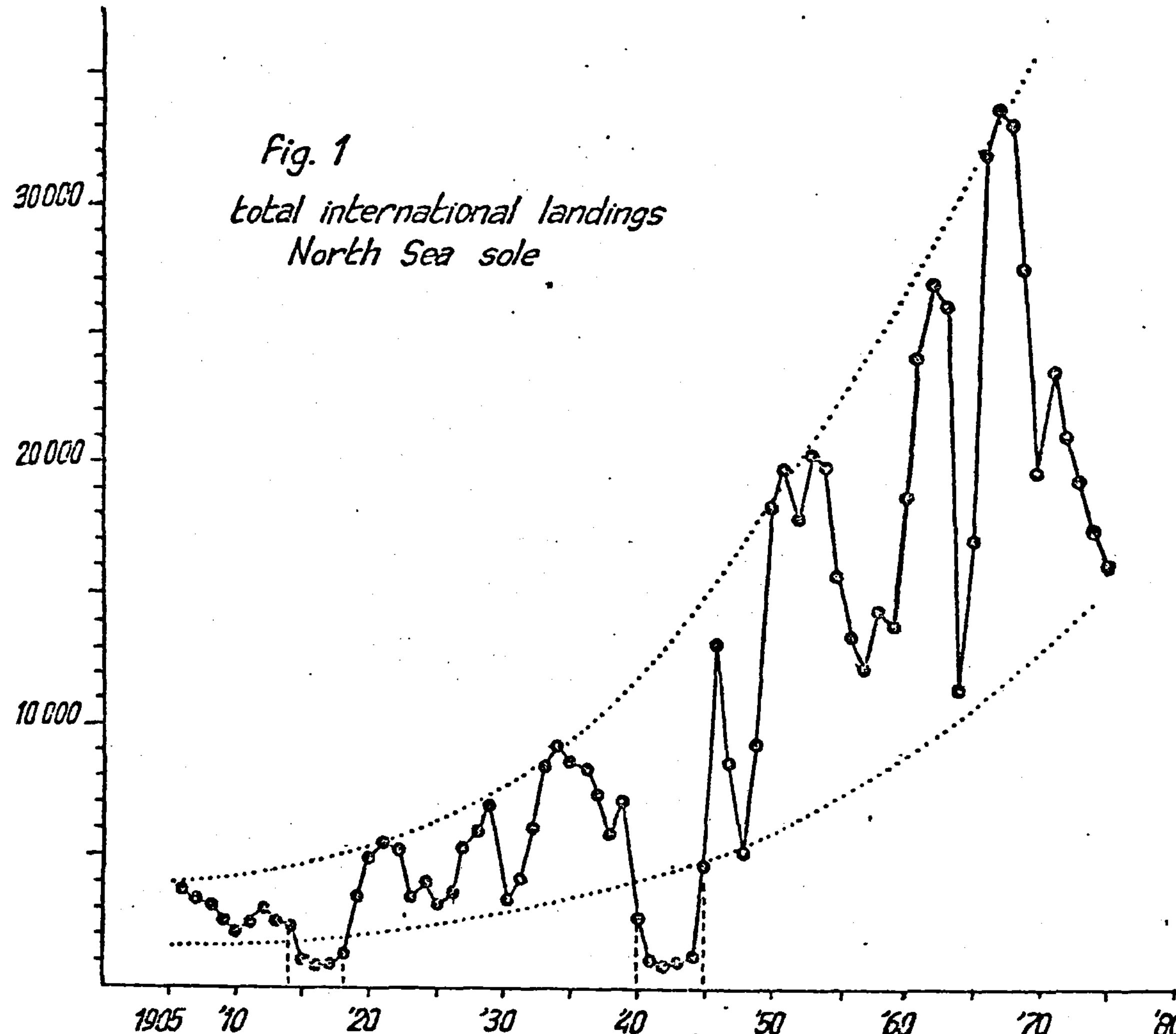
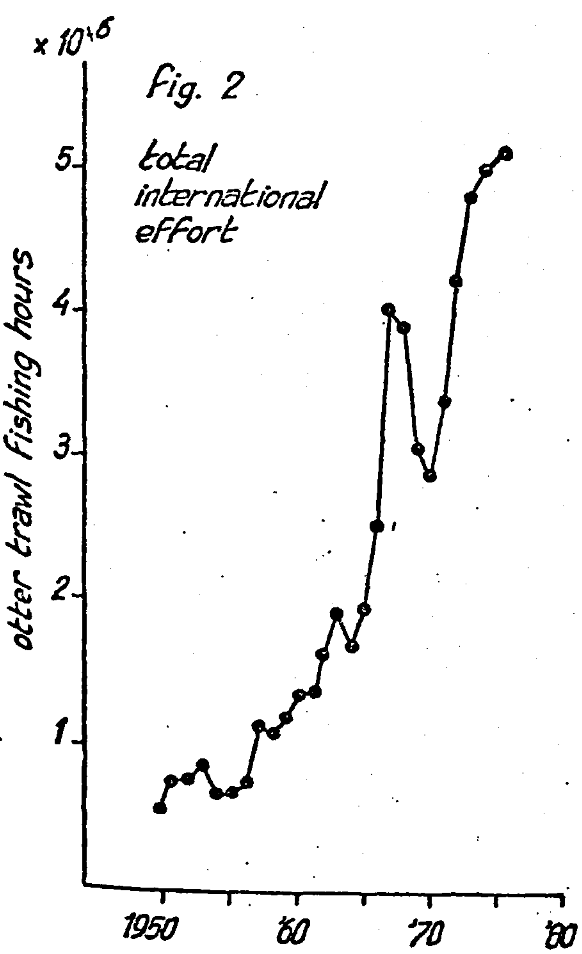


Fig. 1
total international landings
North Sea sole
30 000
20 000
10 000
1905
'10
'20
'30
'40
'50
'60
'70
'80


x 10^6
Fig. 2
total
international
effort
otter trawl fishing hours
5
4
3
2
1
1950
'60
'70
'80

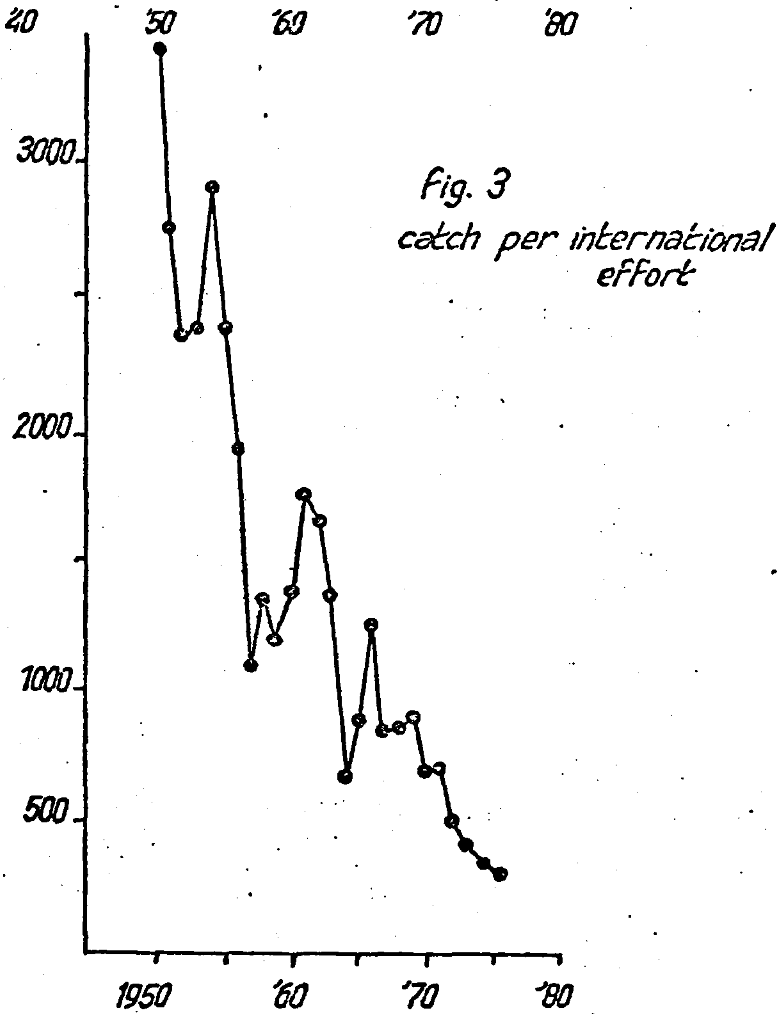


Fig. 3
catch per international
effort
3000
2000
1000
500
1950
'60
'70
'80

Figure 4 Catch North Sea sole

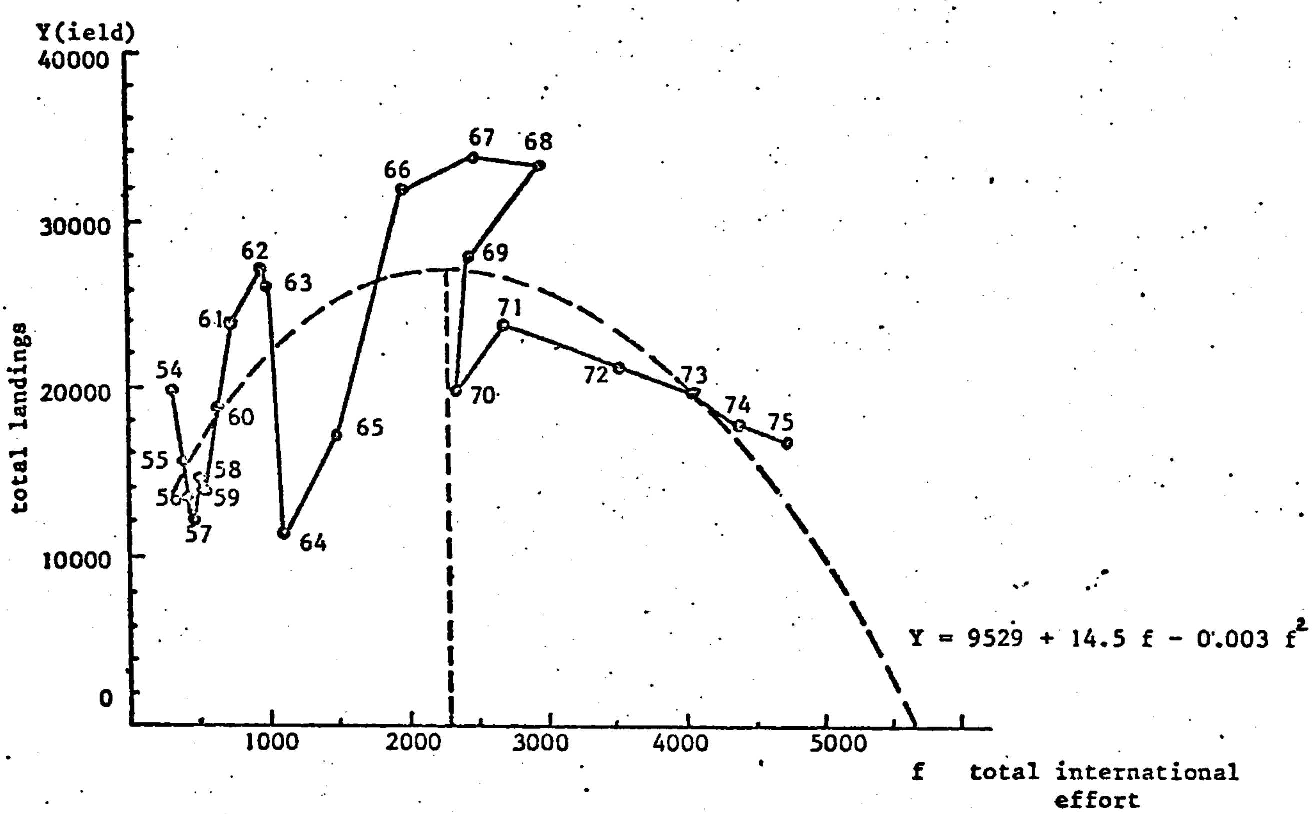


Figure 5 Catch per effort North Sea sole

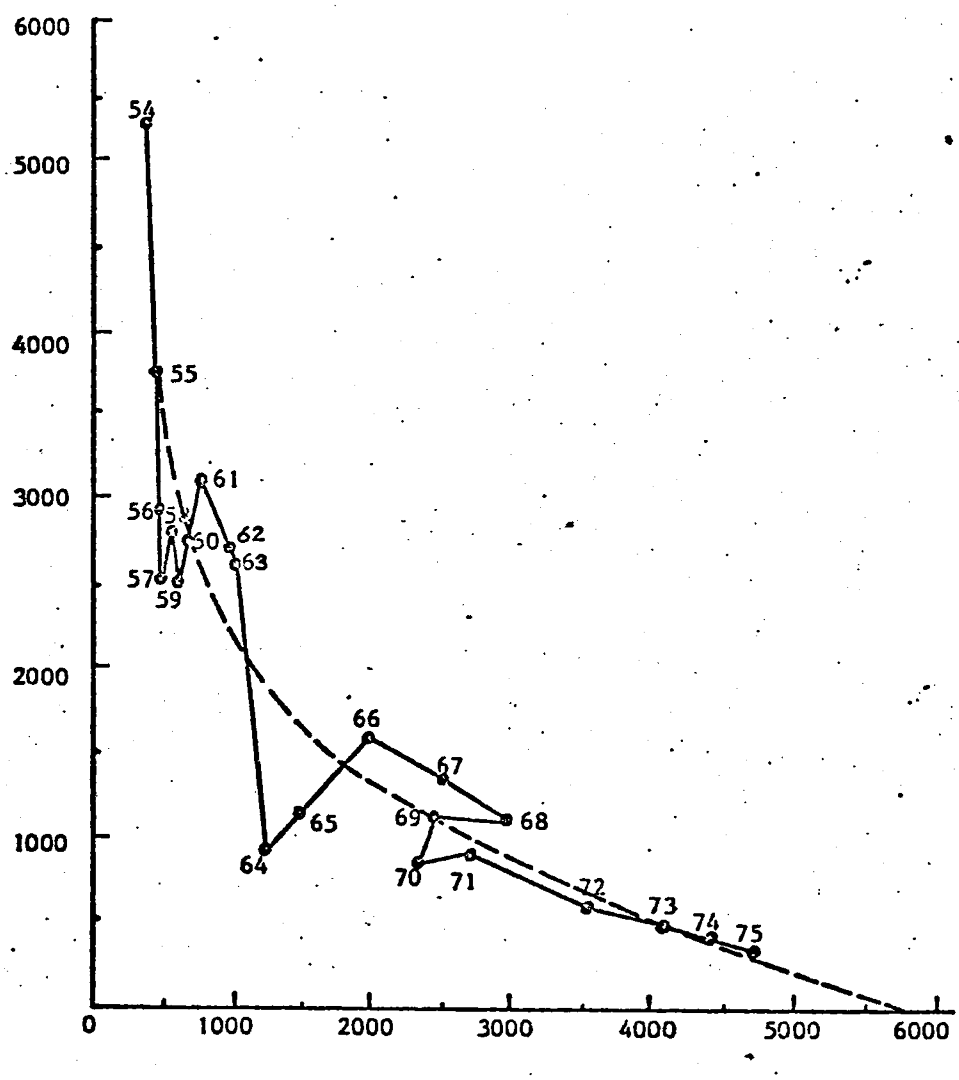


Figure 6 North Sea sole
Steady-state yield per recruit (Y/R)
and yield per effort per recruit (Y/R/f)

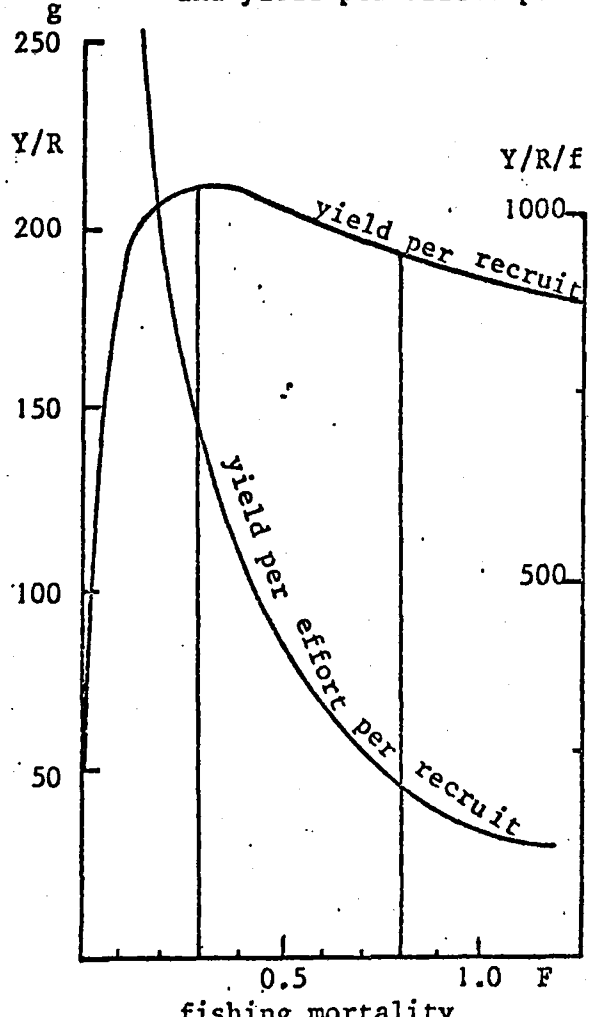


fig. 7 North Sea sole stock-recruitment relationship for post war year-classes

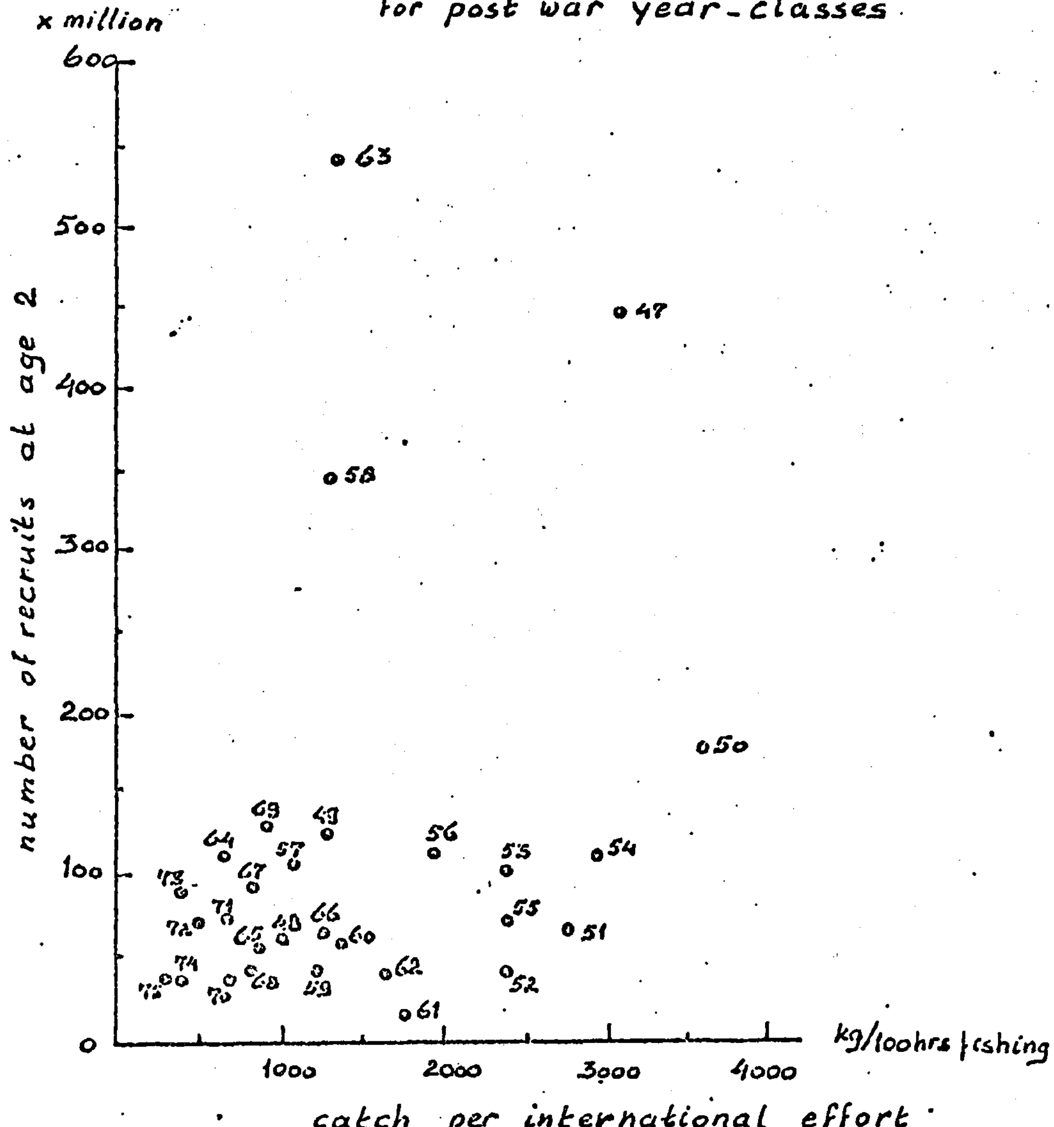


fig. 8 total landings of North Sea plaice (fresh weight)

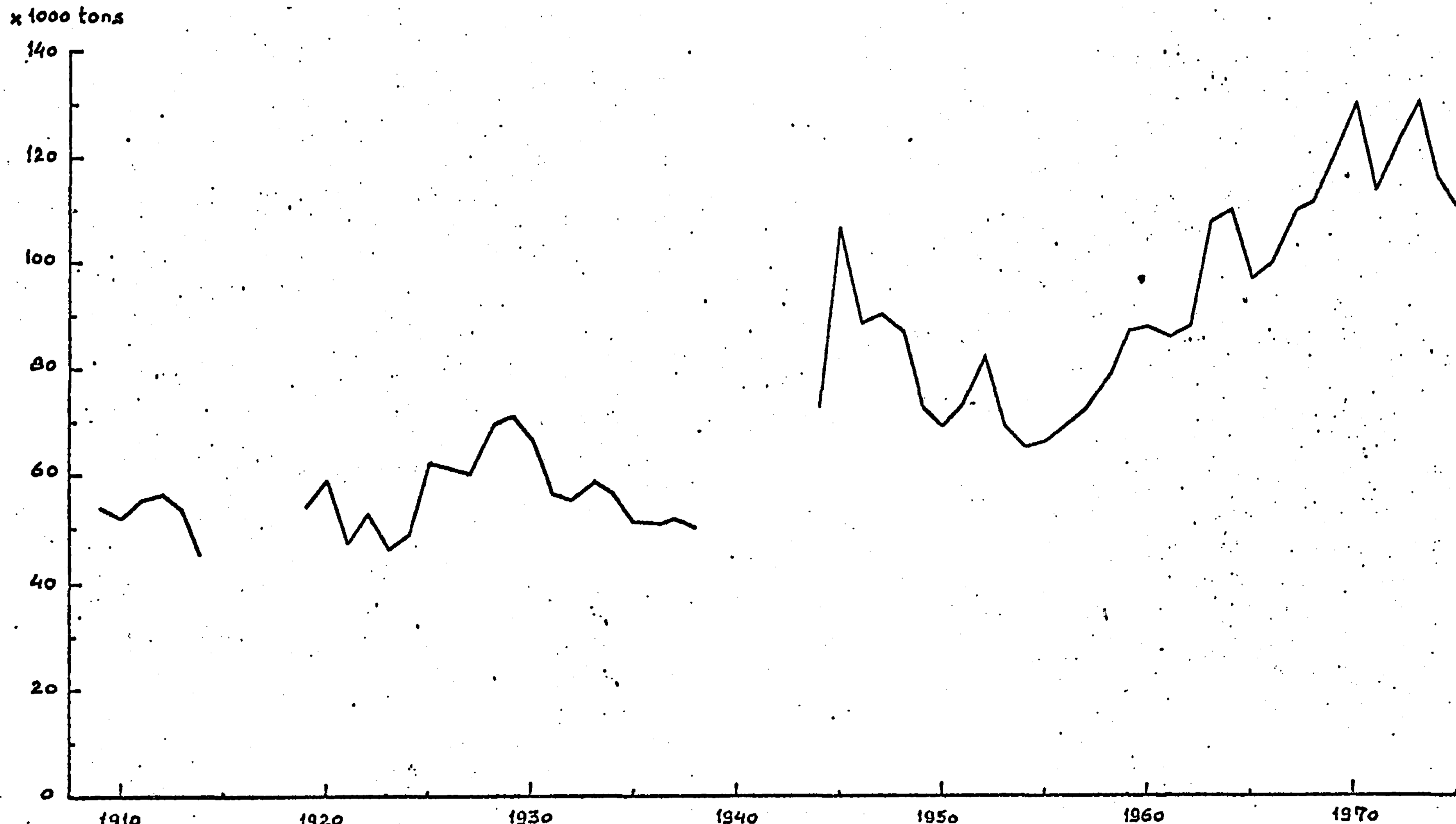


Figure 9 Total international effort on North Sea plaice in British motortrawl hours

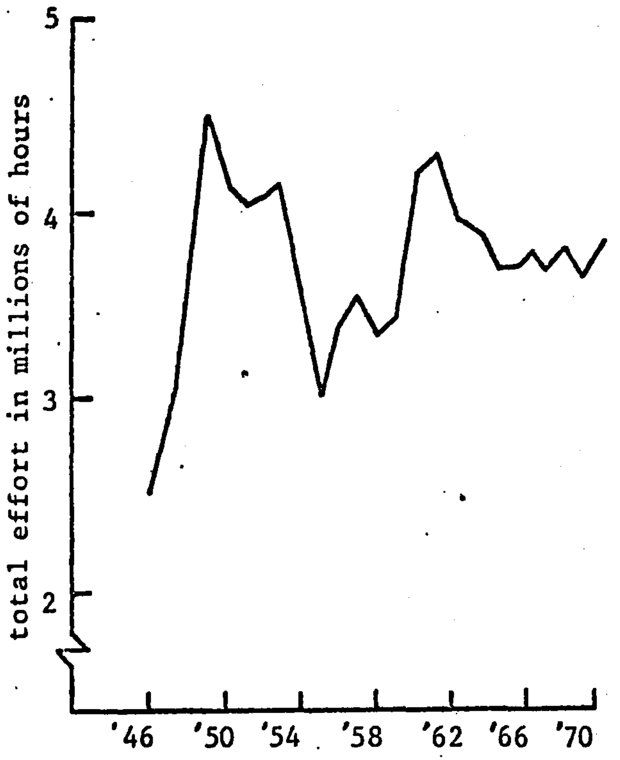


Figure 10 Total catch per 100 hours fishing North Sea plaice

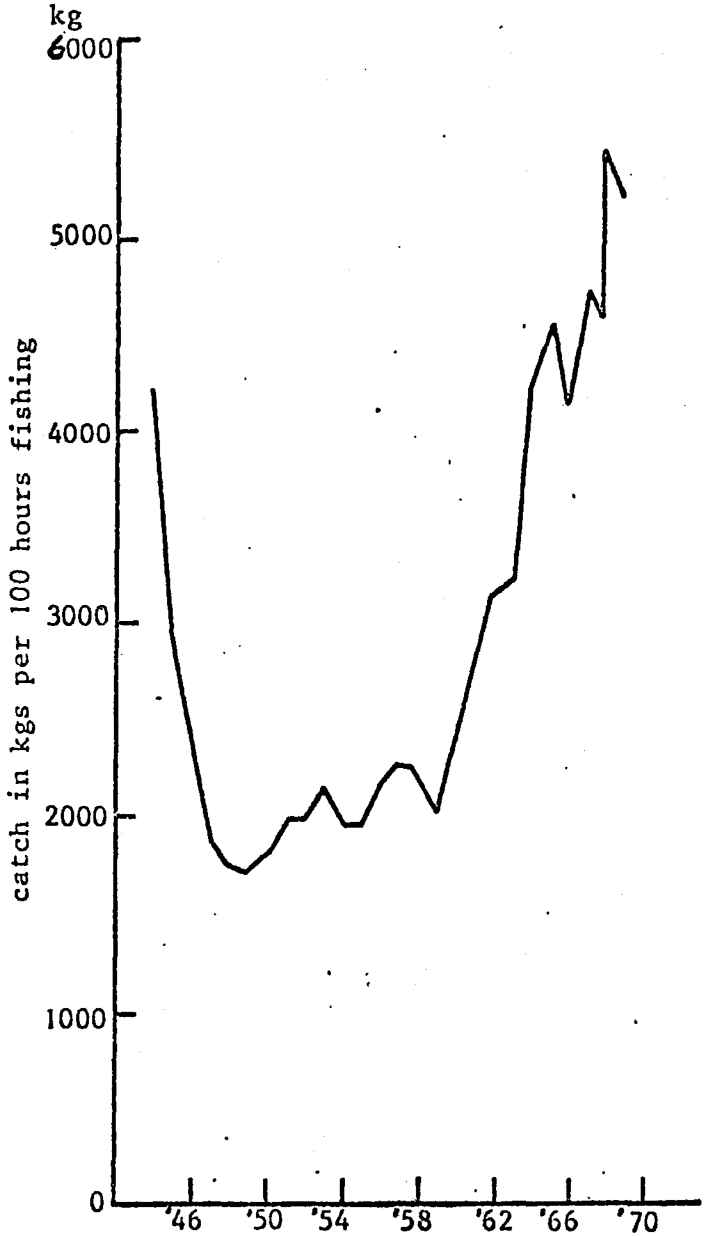


Figure 11 North Sea plaice
Steady-state yield per recruit (Y/R)
and yield per effort per recruit (Y/R/f)

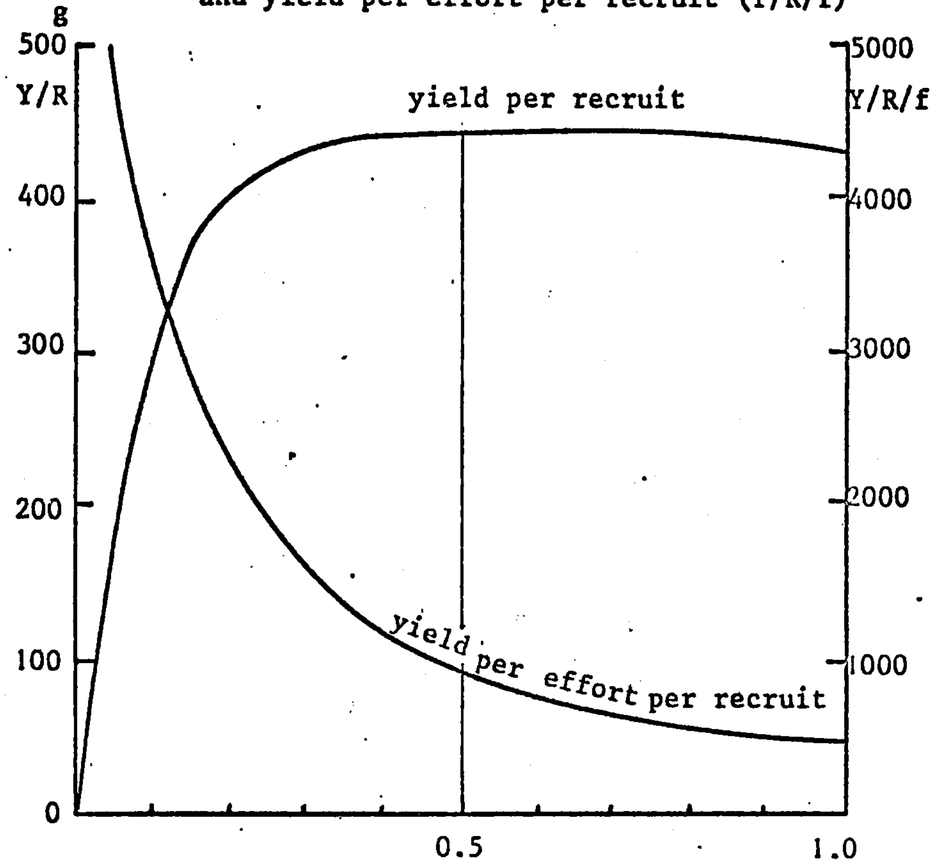


Figure 12 Stock-recruitment relationship North Sea plaice

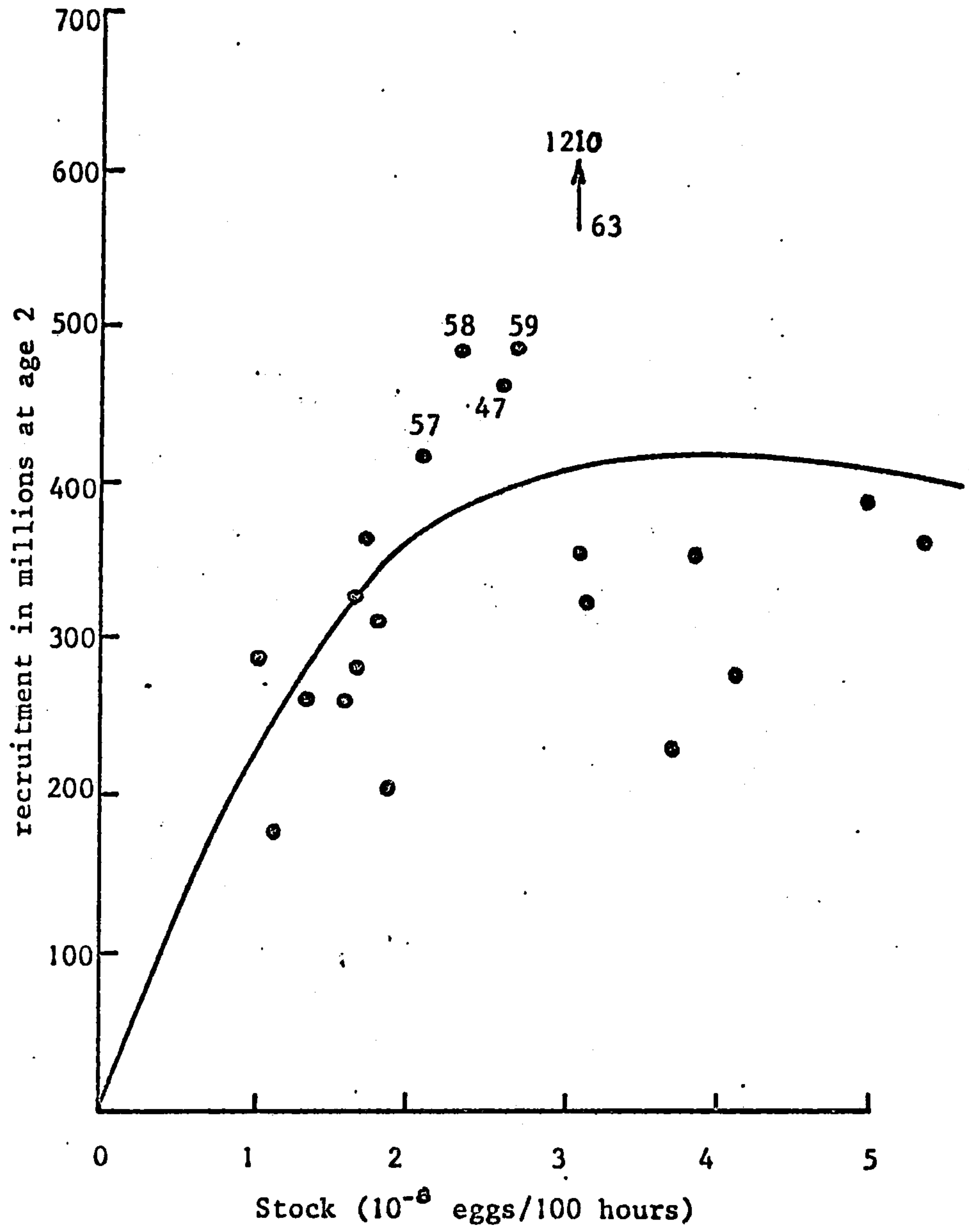
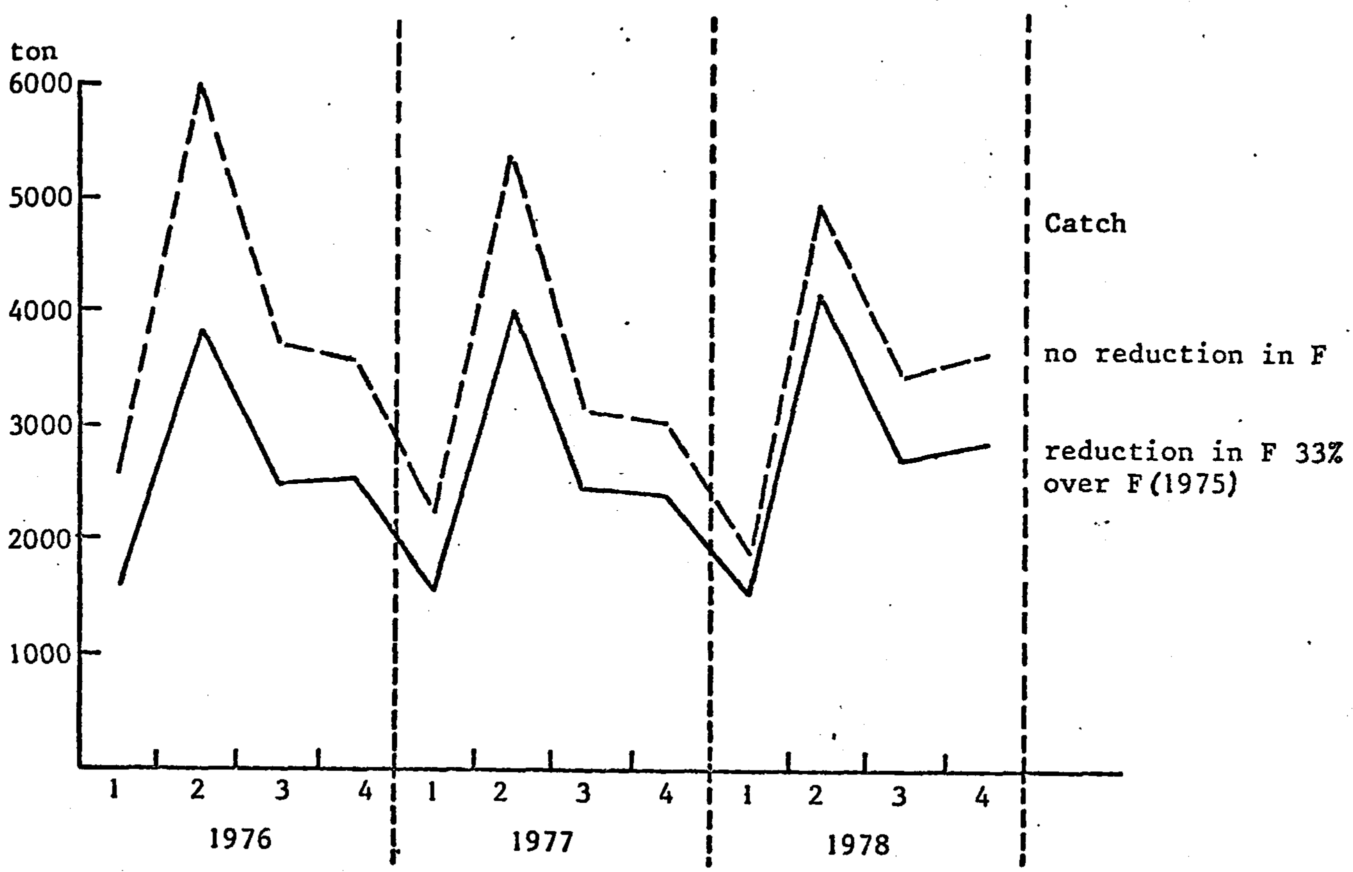


Figure 13 North Sea sole



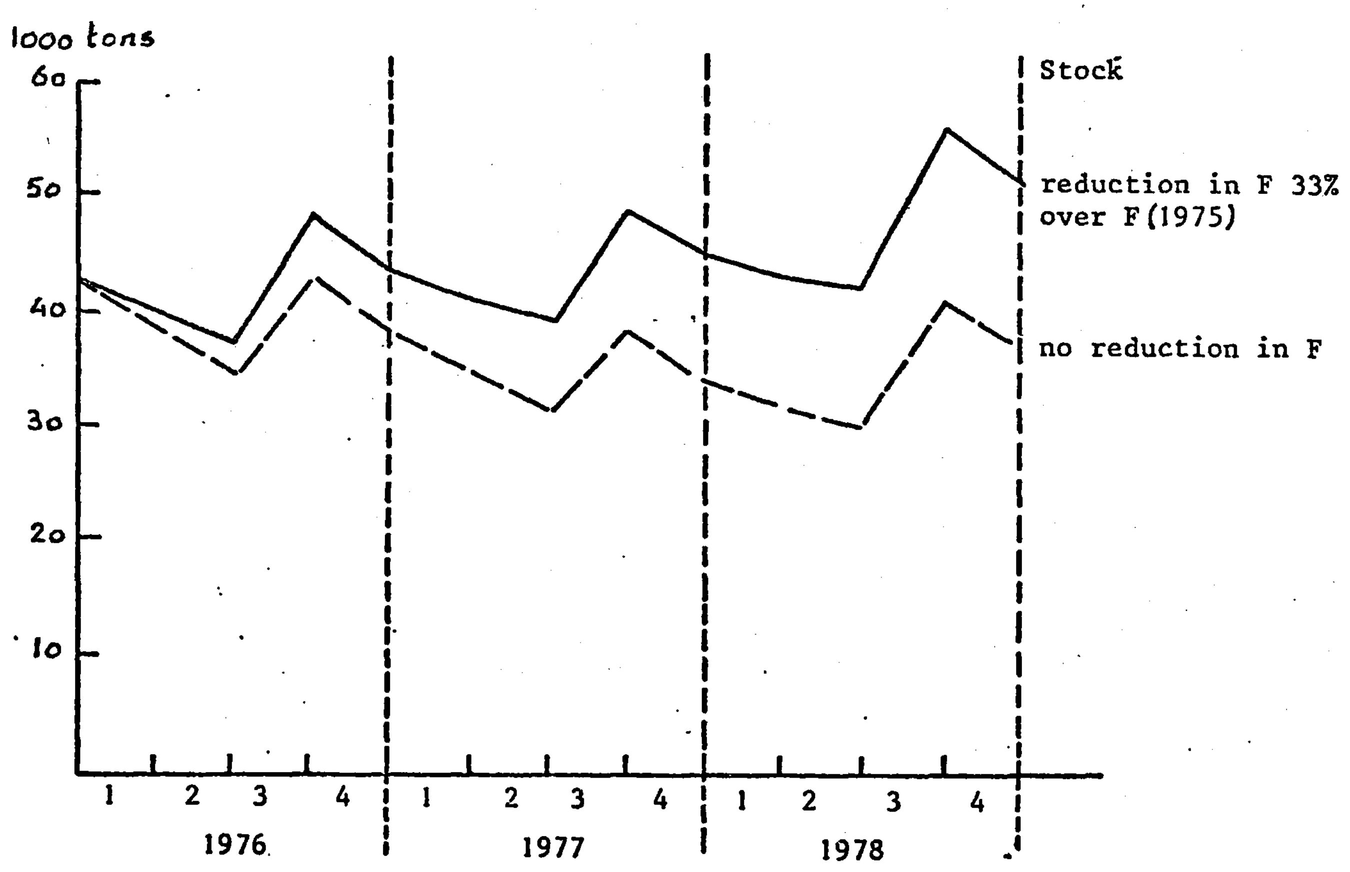


fig. 14 North Sea sole TAC-s for various strategies.

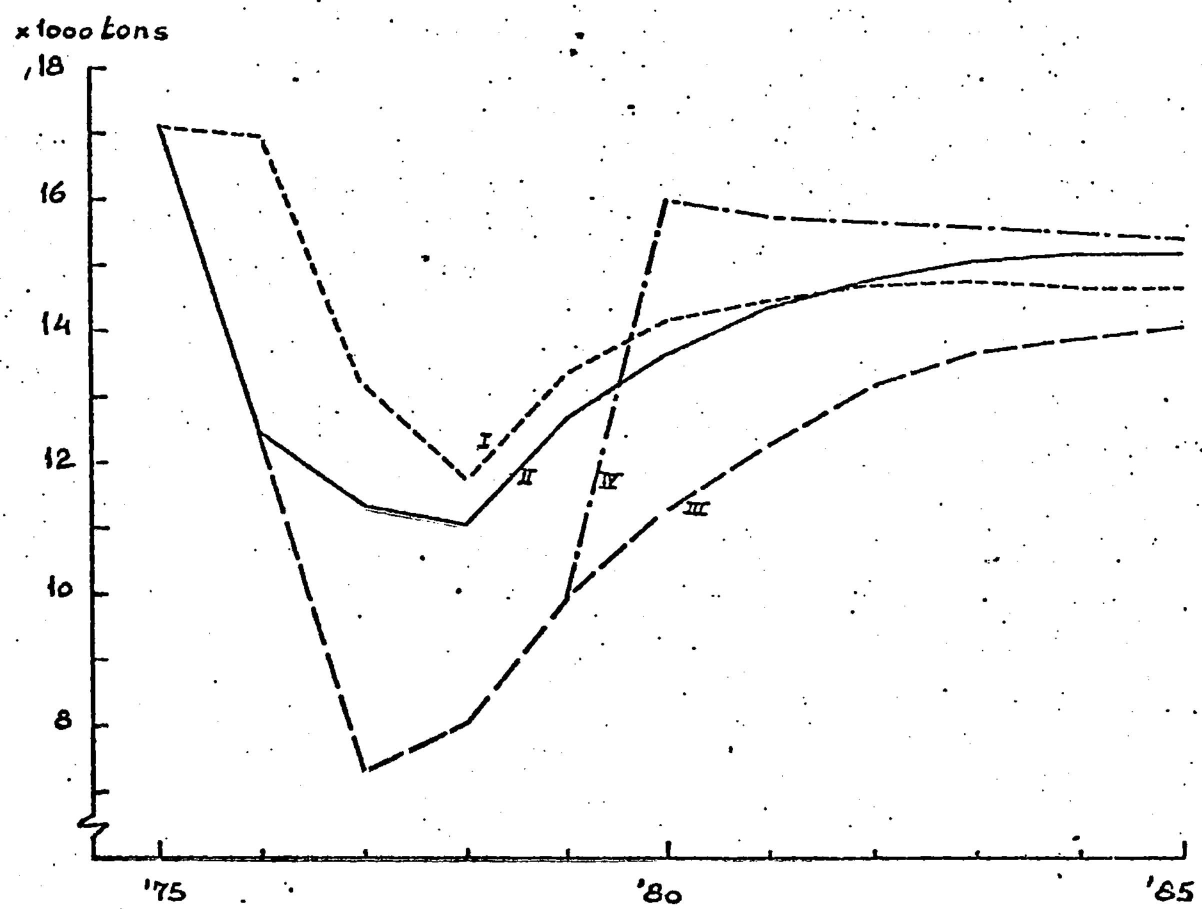


fig 15 North Sea sole stock biomass at beginning of year

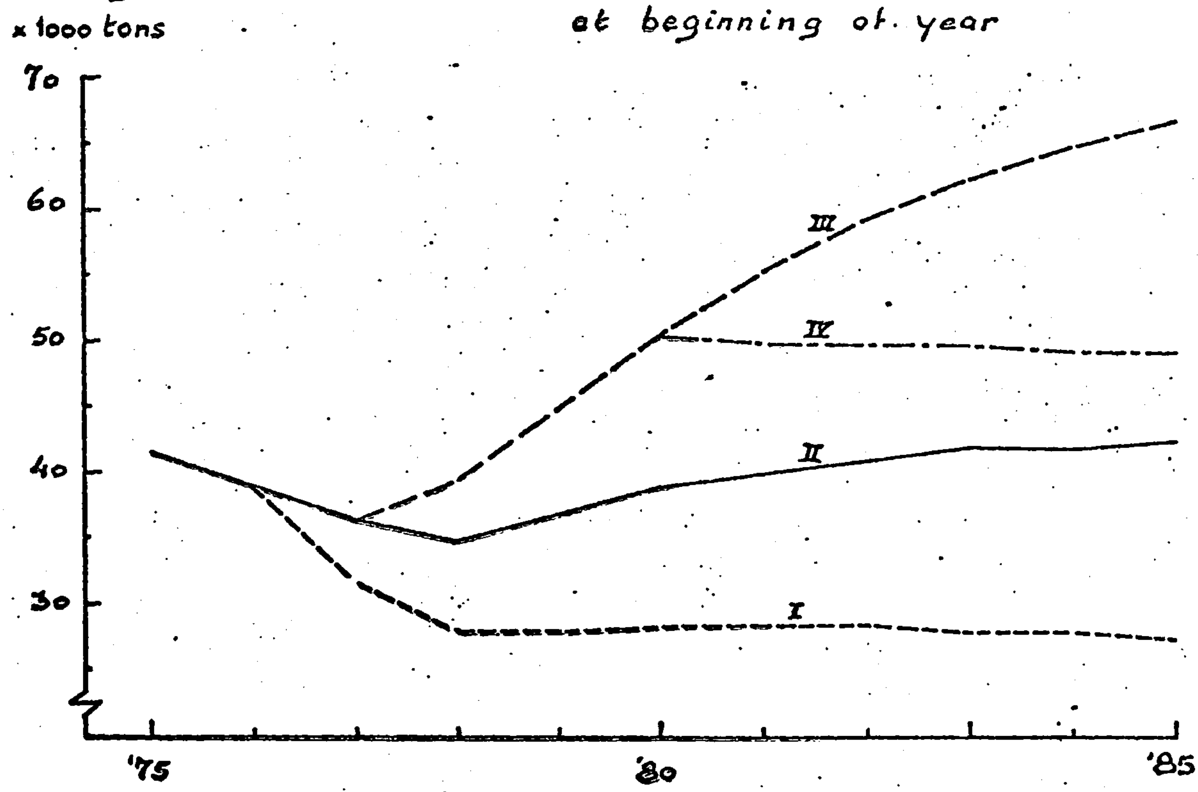


fig. 16 North Sea plaice TAC-s for various strategies

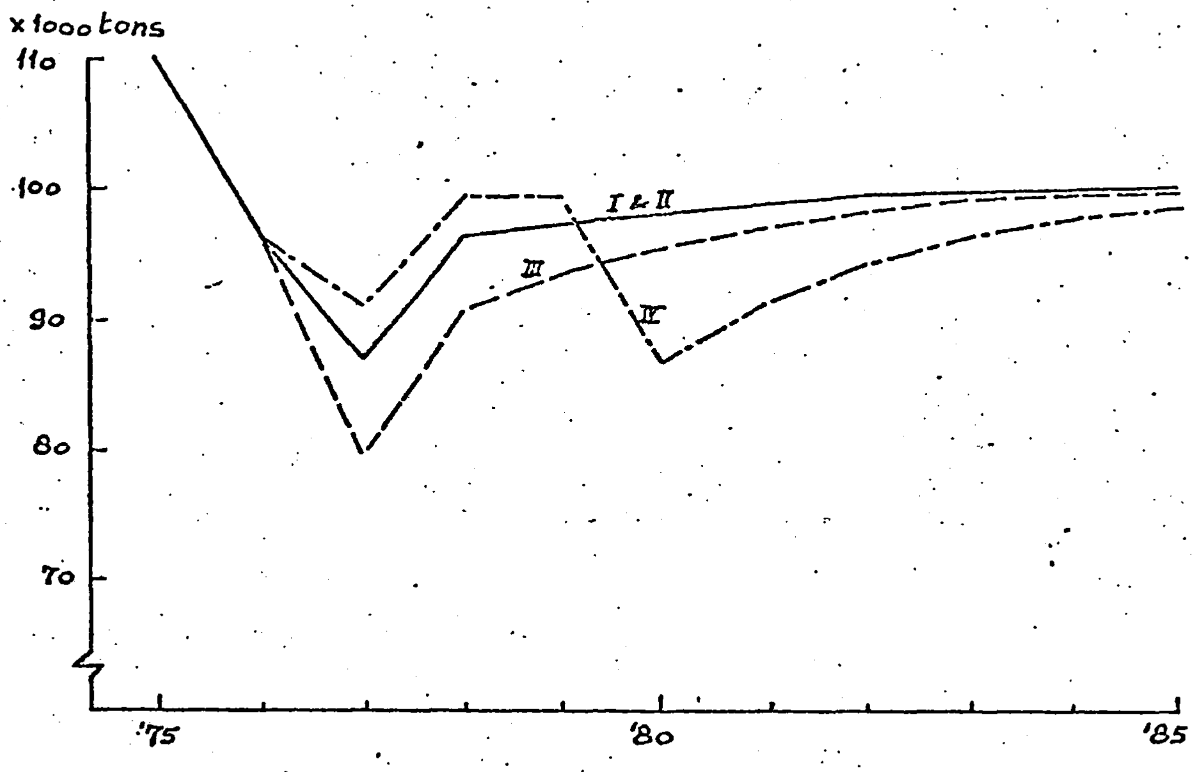


fig. 17 North Sea plaice stock biomass at beginning of year

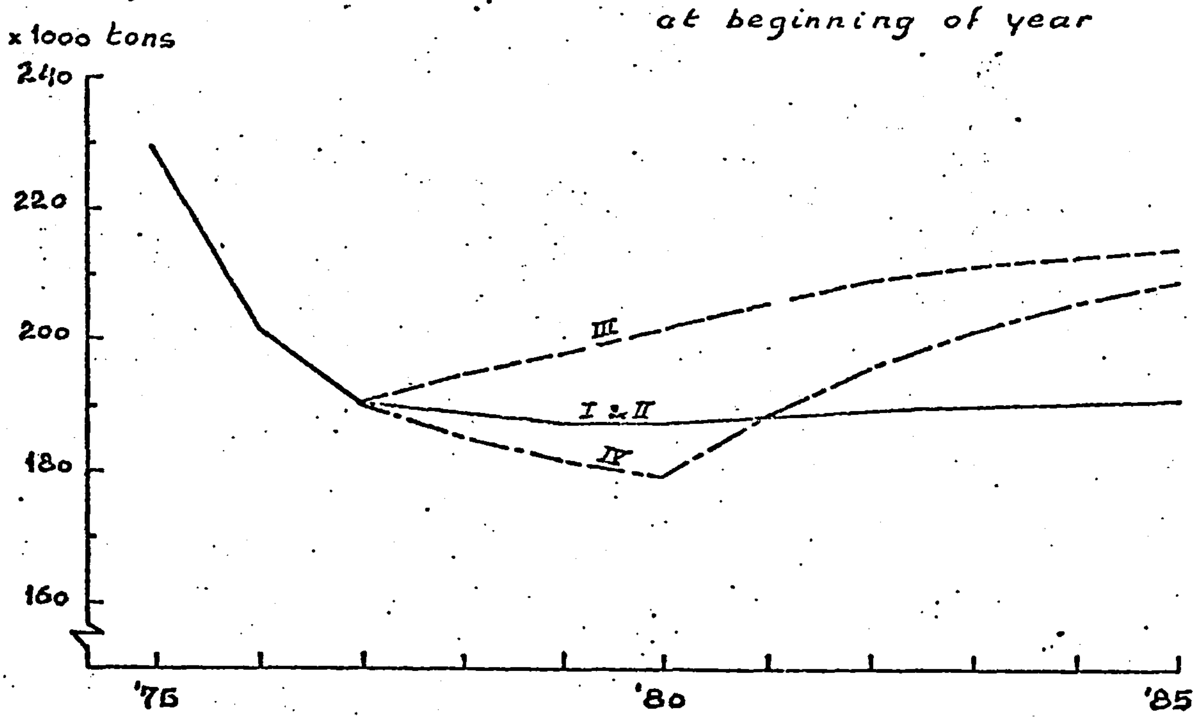


fig.18 gross proceeds of Dutch near-water fleet
- no fleet reduction
- no compensating fisheries

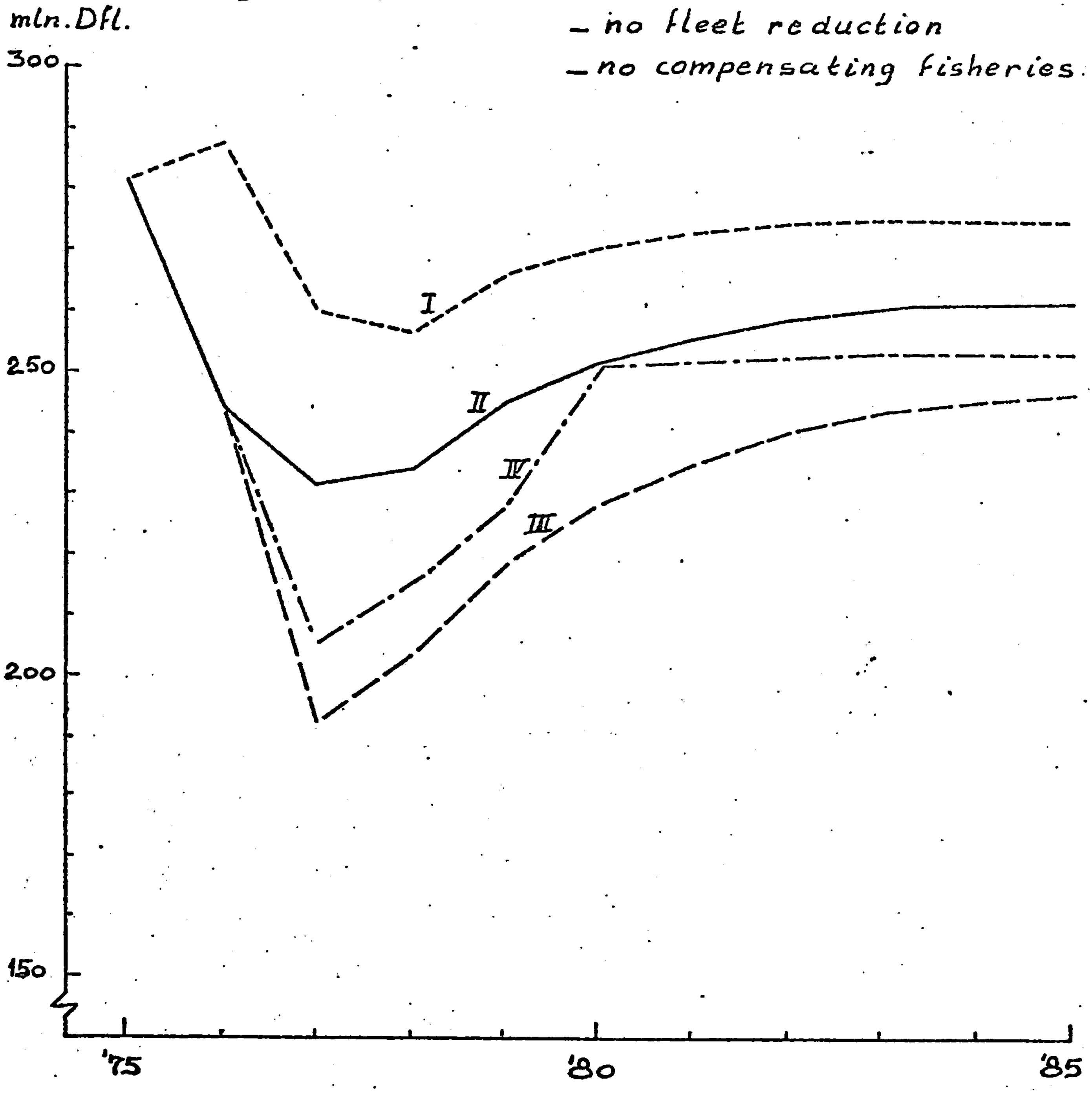


fig. 19 net-results of Dutch near-water fisheries
- no fleet reduction
- no compensating fisheries

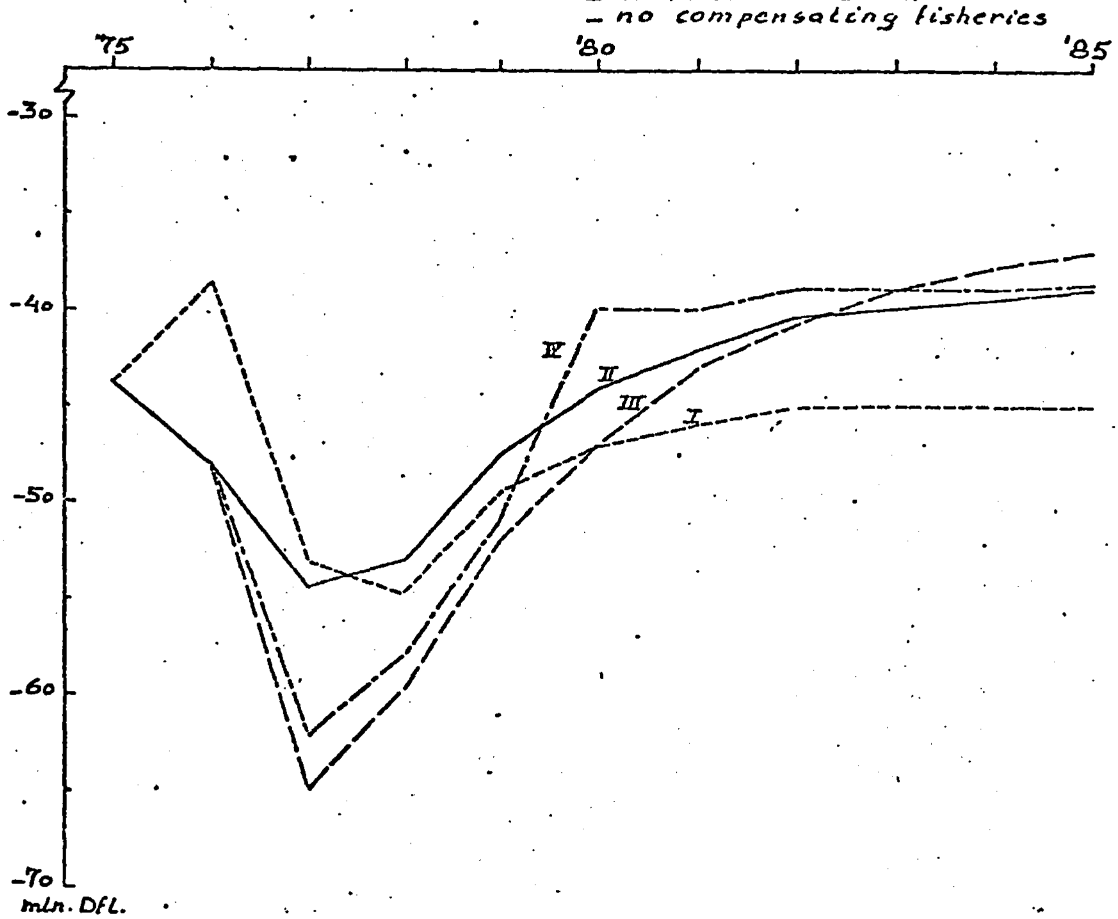


fig. 20 net-results of Dutch near-water fisheries
- no fleet reduction
- 25 % compensating fisheries

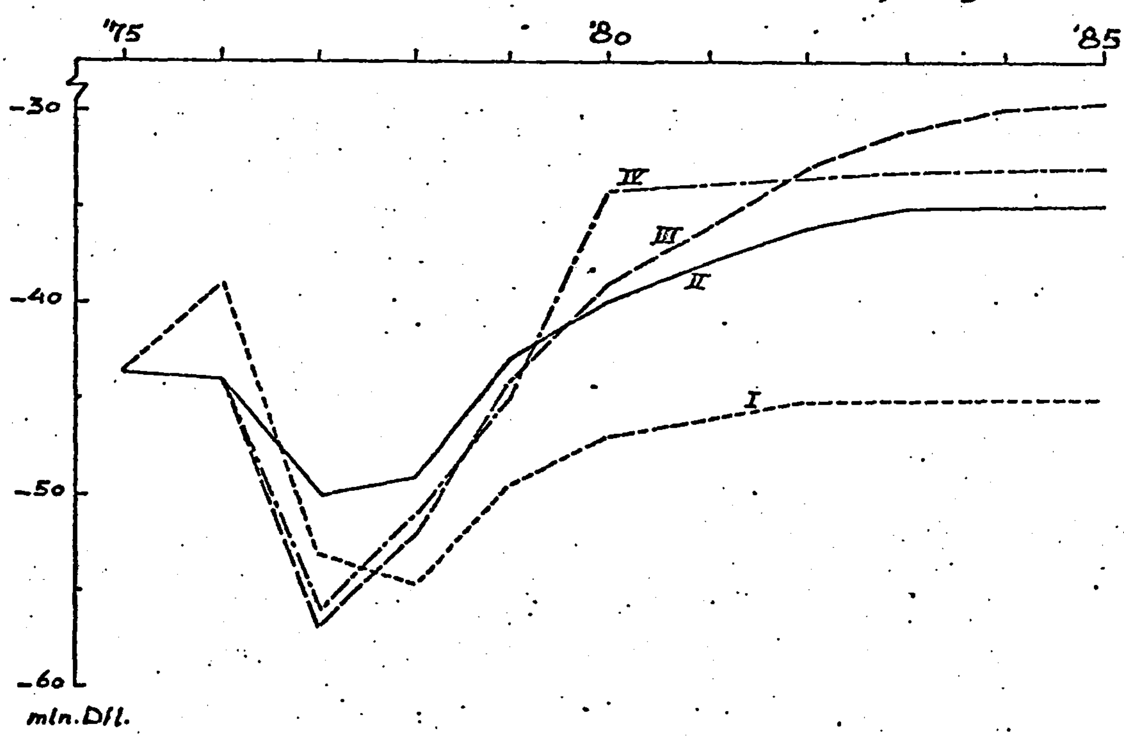


fig. 21 net-results of Dutch near-water fisheries
– 20 % fleet reduction
– no compensating fisheries

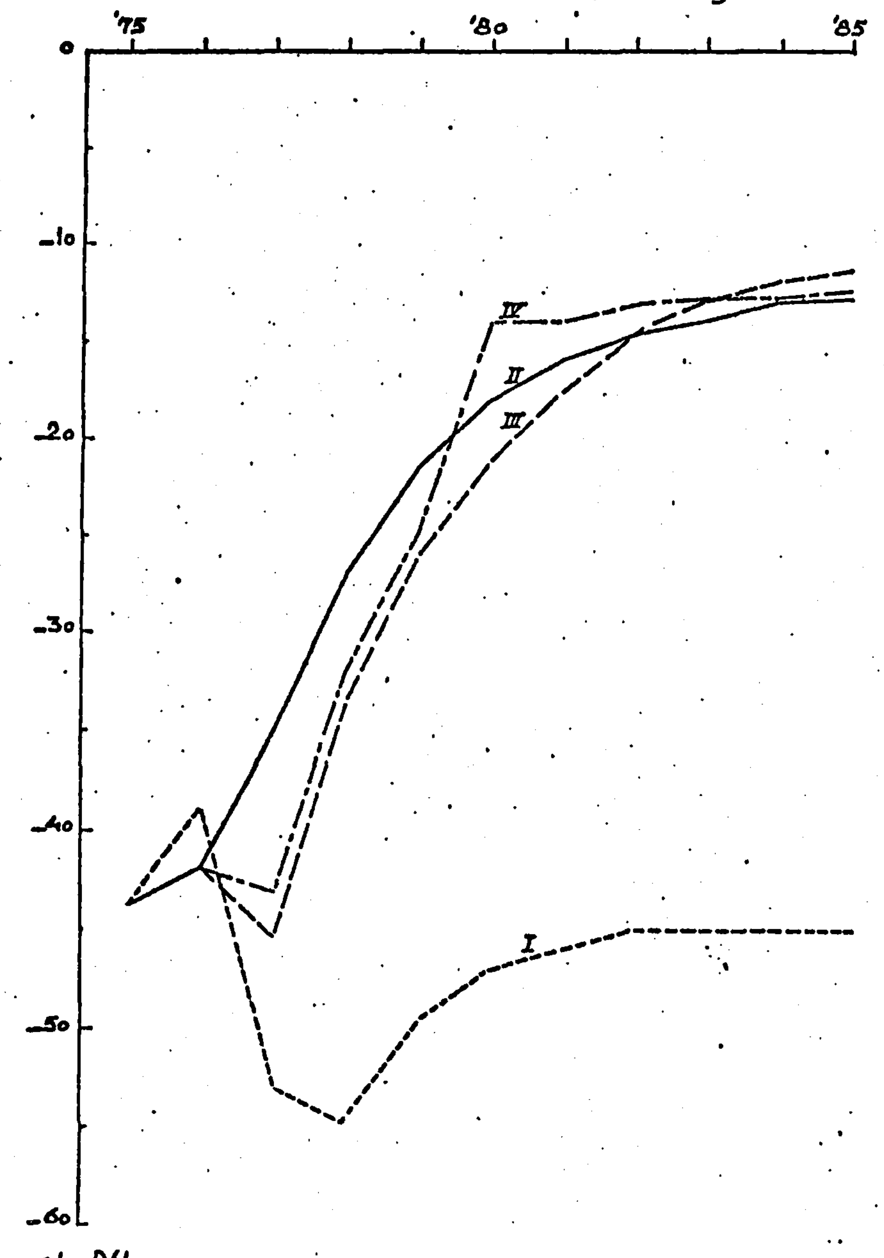


fig. 22 net-results of Dutch near-water fisheries
– 20 % fleet reduction
– 25 % compensating fisheries

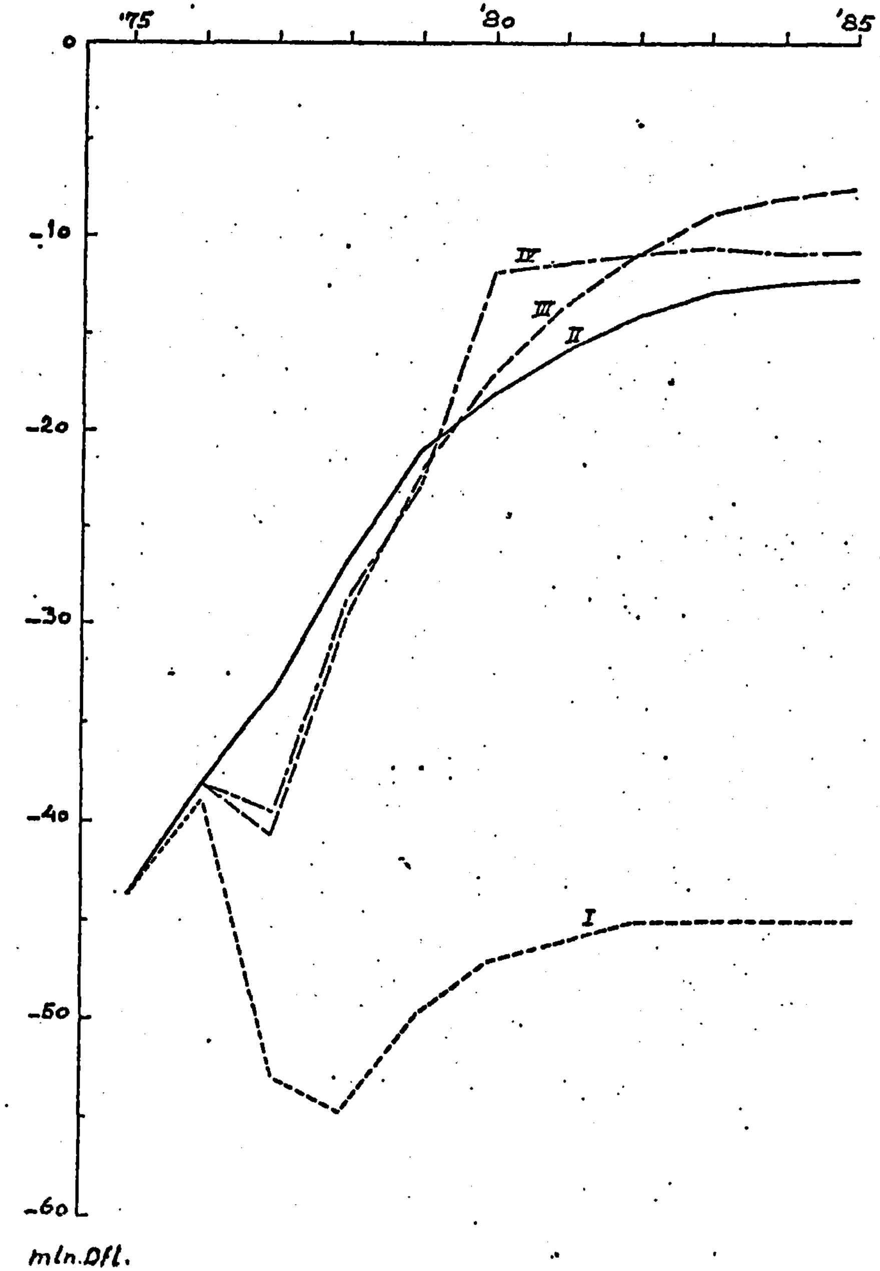


Figure 23 Cumulative net present value of Dutch near-water fisheries
- with fleet reduction
- with compensating fisheries

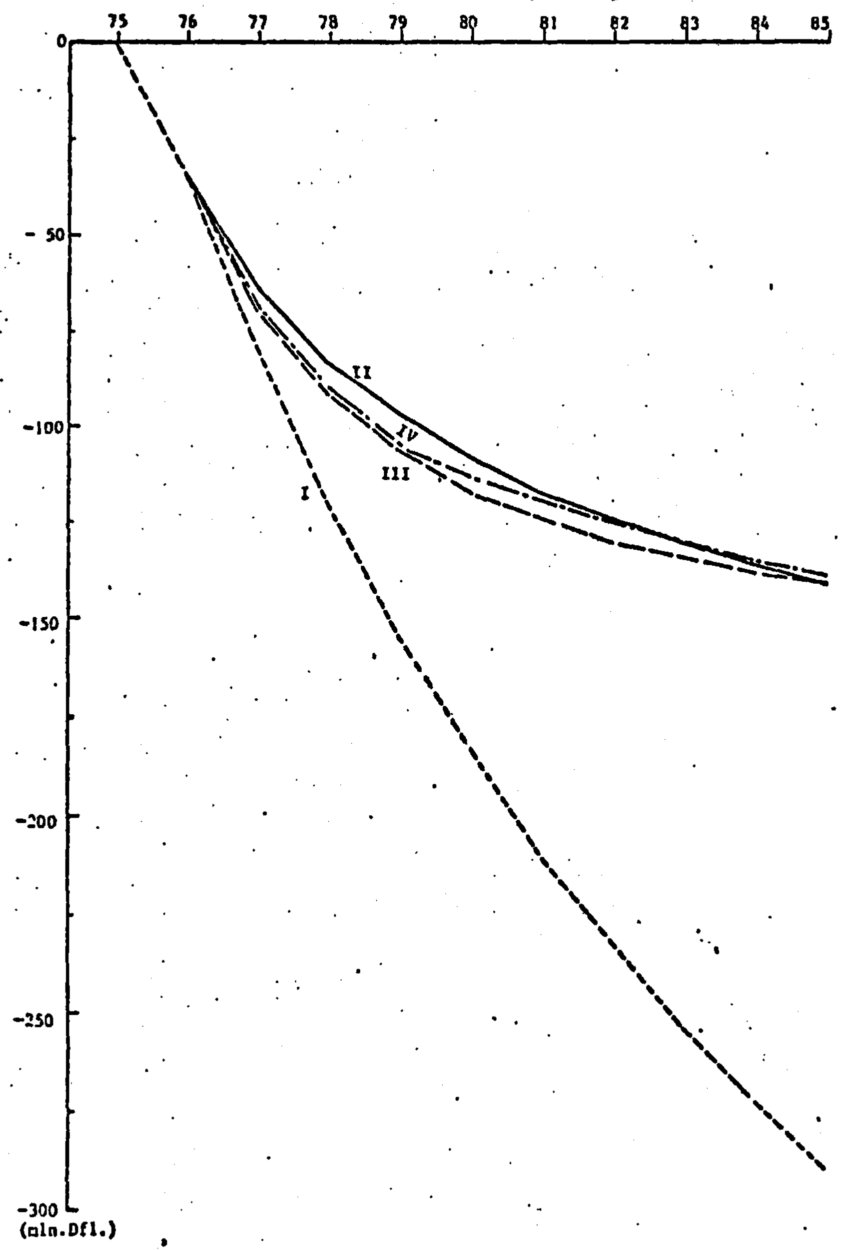


Figure 24 Cumulative present value added of Dutch near-water fisheries
- with fleet reduction
- with compensatory fisheries