CEMARE Report 58

Future options for UK fish quota management

A Hatcher, S Pascoe, R Banks and R Arnason

Future Options for UK Fish Quota Management

A Report to the Department for the Environment, Food and Rural Affairs

Aaron Hatcher and Sean Pascoe
Centre for the Economics and Management
of Aquatic Resources (CEMARE)
University of Portsmouth

Richard Banks
Richard Banks Ltd

Ragnar Arnason
University of Iceland

June 2002

University of Portsmouth
Centre for the Economics
and Management
of Aquatic Resources
Locksway Road
Portsmouth PO4 8JF
United Kingdom

First published University of Portsmouth 2002

For bibliographic purposes this publication may be cited as:
Future options for UK fish quota management.
A. Hatcher, S. Pascoe, R. Banks and R. Arnason. *CEMARE Rep.* no.58. 2002, 122p.

ISBN 1 86137 274 4

Authors' note

Since this report was first submitted to DEFRA, there have, as anticipated, been some developments in the UK quota management system.

In October 2001, following a review of the operation of the FQA system to which POs and other industry bodies contributed, Fisheries Departments in the UK wrote to interested parties inviting comments on proposals for future quota management arrangements. The proposals were:

(i) that UK quotas should continue to be managed on a UK-wide basis;
(ii) that the FQA system should continue and should be further reviewed at the beginning of 2006;
(iii) that the separation of FQA units from fishing vessel licences should be permitted where (a) a vessel, along with its existing licence, was being transferred into new ownership but the current owner wished to retain the FQA units for the benefit of a replacement vessel, or (b) a licence entitlement was being cancelled or used to license another vessel;
(iv) that the owners of vessels of 10 metres and under in length should be permitted to acquire FQA units so that they could fish as part of the sector on the same terms as over 10 metre vessels.

Comments were also invited on whether special limitations should apply to the separation of FQA units from licences in respect of West of Scotland and Area VII *Nephrops*.

Separately from these proposals for future arrangements, the Fisheries Departments conducted an exercise to adjust the FQA units associated with fishing vessel licences to take account of permanent transfers of quota which fishermen entered into during the period 1 January 1999 to 8 October 2001. Some 900 such transfers were processed and were reflected in the quota allocations for 2002.

At the time of writing, Fisheries Departments are considering future arrangements in the light of the response to the consultation exercise and an announcement is expected to be made shortly.

AH/SP 06/02

Short summary

This report evaluates, from an economic perspective, the fish quota management arrangements adopted by the UK and considers options for the future, including the use of individual transferable quotas (ITQs).

Quotas have the potential to effectively and efficiently control fishery output and hence the potential to achieve both stock conservation and industry profitability objectives. Problems for fishery managers are created by the difficulty of enforcing compliance with quotas. For practical reasons enforcement is usually at the quayside, but this gives vessels the opportunity to discard fish at sea when there are incentives to do so. Quota-related incentives to discard arise where parts of the catch under quota differ in their market value, and also in multispecies fisheries where quotas are out of proportion to the mix of species on the grounds. We distinguish between *fixed* quotas and variable or *tradeable* quotas. If quotas are fixed (at least for the current period), as they are when managers decide how much quota each vessel receives, incentives to land over-quota fish and to discard are likely to be increased. Allowing the market to allocate quota among vessels helps to reduce incentives to land over-quota fish and for certain types of discarding, but also maximises the economic profits from quota use. Although strong enforcement of fixed quotas would result in some downward pressure on overcapacity in the fleet, quota trading should greatly assist a rationalisation of fleet capacity.

The UK's quota management system has strengths in that it has made a real attempt to allocate and enforce quotas at the individual vessel level and it has devolved a significant amount of management responsibility to the industry through the producers' organisations (POs). We argue that the effectiveness and efficiency of quota management in the UK would be increased, however, if existing impediments to freer quota trading were removed. Although there were sound reasons for the move from track record-based quota allocations to "Fixed Quota Allocations" (FQAs), the change has made permanent quota sales difficult and has resulted in an accumulating number of transactions for POs and Fisheries Departments to deal with. Also, many in the industry appear effectively to be excluded from the opportunity to adjust their quota holdings through trading.

In an appraisal of future quota management options, we note the dynamic nature of the system and suspect that current arrangements will not continue long without further change. In particular, we believe that the drive towards quota trading within the industry will continue and that Government should accept and encourage this. We therefore recommend that there should, at least, be an annual reconciliation of FQAs. We go on to suggest that the nature of the legal title to quota should be clarified and that the fishing rights conferred by FQAs be examined, in particular for the non-sector. We consider that a move to an ITQ system proper should be seriously contemplated, at least for the over 10m fleet. The POs could, and arguably should, play a key role in an ITQ system, organising and facilitating the quota trade and helping to ensure collective responsibility for compliance. With regard to the inshore (10m and under) sector, we suggest that they be gradually brought into the quota management system applied to the rest of the fleet. Finally, we emphasise the importance of strong *enforcement* to the success of any quota management system.

Executive summary

Introduction and objectives

1. This study, undertaken for the Department for the Environment, Food and Rural Affairs (DEFRA), presents an economic evaluation of the UK's current fish quota management arrangements and appraises various options for the future, including the possibility of moving towards a system of individual transferable quotas (ITQs).

2. Economic and biological data that would enable a rigorous empirical evaluation of the performance of the UK's quota management system in terms of stock conservation objectives and economic efficiency are simply unavailable. The primary approach adopted in this study is therefore to consider, based upon economic theory, the incentive structure created by the quota management system and to suggest how incentives for efficiency and stock conservation might be improved by making changes to the current arrangements.

3. The report firstly outlines the economic theory of fishery quotas in general and of ITQs in particular. It then examines the development and operation of the UK quota management system in some detail and evaluates the current arrangements in the light of economic theory.

4. We also report the results of a survey of the views of UK fishing vessel owners and their POs about the quota management system and the possibility of ITQs, and summarise a review of experiences with ITQ systems in other countries which was undertaken by Professor Ragnar Arnason of the University of Iceland (the full text is included as an Annex). A computer simulation of the possible effects on fleet size and employment if UK fishing capacity were completely rationalised through quota trading is then described.

5. Finally, we consider future quota management options for UK fisheries, including an ITQ system proper, at least for the over 10m fleet.

The economics of quota management in fisheries

6. Quotas, provided they can be enforced, enable fishery managers to control fishing mortality and hence achieve stock conservation objectives. However, the practical difficulty (cost) of enforcing quotas has two main consequences which can seriously confound these objectives. One is that in most fisheries quotas can only be enforced at the quayside, not at sea. The result is that if there are incentives for discarding, as in multispecies fisheries for example, vessels will have the opportunity to discard in order to remain within quota limits. The second is that if the expected penalty from landing over-quota fish is too low, because the probability of getting caught is small, and/or the expected fine if caught is relatively small, incentives to land over-quota fish will prevail. In either case fishing mortality will exceed target levels.

7. How quotas are allocated among individual fishing vessels in the fleet has important consequences, both for stock conservation objectives and for the economic performance of the industry. In our theoretical analysis we distinguish between quotas which are *fixed* for a period of time (such as non-transferable quotas or monthly catch limits) and quotas which are *variable* (tradeable).

8. If a fixed quota imposes a constraint on the optimal (efficient) output of a fishing vessel for the period in question, i.e., the feasible output which maximises profits, then clearly profits will be constrained. It follows that the vessel operator will have an economic incentive to exceed the quota limit. In general we would expect that the tighter the quota in relation to the capacity of the vessel, the greater the incentive to exceed the quota. While some vessel operators may nevertheless always respect quota limits, if we assume that the individual is indifferent to the act of cheating itself then the quota can only be enforced if the expected fine for all units of catch over and above the quota limit is at least as large as the additional expected profit.

9. In a multispecies fishery, fixed quotas can cause considerable discard problems, and these are likely to be exacerbated the more effective enforcement is at deterring over-quota landings. If the fixed quotas are not allocated to the vessel in the same proportion as the quota species occur in the vessel's catch, then it may be profitable to discard the most constrained species and carry on fishing for the other species. The more valuable the least constrained quota species are, the more likely it is that the most constrained quota species will be discarded.

10. Where different grades of fish command different market prices, there may be incentives to discard low-value grades in order to remain within quota limits. Such "highgrading" behaviour is more likely the greater is the difference in price between the least and most valuable parts of the catch. Again, the problem will be exacerbated by effective enforcement of quotas.

11. With variable or tradeable quotas, the vessel operator has the option of buying more quota instead of attempting to land over-quota fish. Assuming effective enforcement, in a fishery the short term (rental) price of quota will be set equal to the profit that can be earned from the last unit of quota each vessel buys. Hence the quota price reflects industry profitability. Also, in general the smaller the total supply of quota, the greater the quota price. The equilibrium allocation of quota (which will be an efficient allocation, i.e., the allocation that maximises industry profits) both determines and is determined by the quota price.

12. Variable quotas should reduce discard problems in multispecies fisheries compared to fixed quotas. The final distribution of quotas after trading will as closely as possible mirror each vessel's pattern of catches. However, where at the national level the supply of quota for some species is too low compared to the availability of species on the grounds, discard problems will persist.

13. Although the problem of highgrading is often specifically associated with ITQs, other things being equal incentives to highgrade are likely to be similar under fixed quotas. Highgrading is a general problem with individual vessel quotas and is not restricted to ITQs. In practice it is difficult to predict whether highgrading would increase in a move to greater quota tradeability.

14. The principal economic argument for ITQs is that the market will result in an *efficient* allocation of quota whereas other mechanisms for allocating quota are very unlikely to do so. The efficient allocation is the allocation which maximises industry profits given the total supply of quota. The report explains how this can be demonstrated using a simple economic model. Unless there are significant constraints on the quota market, the final (efficient) allocation is independent of the initial (first-round) allocation.

15. Under an ITQ system, because quota can be traded and acquires considerable value (according to the profits that can be earned from it) an adjustment of industry capacity to the overall availability of quota will be facilitated. Some vessels will increase their quota holdings in order to operate more efficiently while inefficient vessels are more likely to exit since they will be compensated to the value of the quota they sell. The extent and speed of capacity adjustment will however depend on factors such as the value of second-hand vessels and the strength of quota enforcement. While a strong enforcement system would also be expected to result in some rationalisation of industry capacity under a system of *fixed* (non-tradeable) quotas, at least to the extent that some vessels were operating with non-viable levels of quota, there would be greater financial pain for the industry.

16. Enforcement is in any case crucial to the performance of an ITQ system, in terms of both stock conservation and economic efficiency.

17. The economic profits generated under a tradeable quota system will be substantially reflected in the short run quota price and hence will become capitalised into the permanent sale value of quota. These profits can be left entirely within the industry or could be subjected to a "resource rental" tax in order to extract some benefit to society as a whole. This raises fundamental issues about who should benefit from national fishery resources, but also who should pay for fishery costs such as enforcement.

The UK approach to quota management

18. Since the inception of the TAC/quota system under the EC's Common Fisheries Policy, UK Fisheries Departments have progressively devolved a considerable amount of quota management responsibility to the fish producers' organisations (POs), of which there are now 20 established in the UK. In 2000 the POs represented nearly 70% of all UK fishing vessels over 10m in length, 85% in terms of nominal capacity measures. They were together responsible for managing over 90% by weight of UK quotas.

19. Until 1997 the allocations of quota to the POs were based each year on the recorded landings of individual member vessels over the previous three years (so-called landings "track records"). In 1998 quota allocations were based on the same track records as the 1997 allocations, in preparation for a fixing of quota allocations. In 1999 the same allocations were converted into 100kg quota "units", giving each vessel its Fixed Quota Allocation (FQA). Vessels' FQAs now remain the same each year, but the value of a quota unit depends upon the size of national quotas in relation to those set in 1999. One of the main reasons underlying the move to FQAs was to remove incentives to secure quota allocations by artificially inflating track records.

20. The POs have always been allowed to determine their own internal quota allocation methods. Some operate a common quota pool and set monthly landings limits which apply to all members. Others allocate individual quotas (IQs) to member vessels on the basis of each vessel's FQA. Some POs pool quotas for certain stocks and allocate IQs for others, or for some parts of the membership. Linked to an increase in quota trading (see below), in recent years more POs have implemented IQ systems while many which have traditionally operated quota pools now allow members to top up their pool allowances by buying in extra quota.

21. For the over 10m vessels which do not belong to a PO, a quota pool is reserved based on the sum of these vessels' FQAs. This is relatively small since many of these vessels target primarily shellfish stocks which are not subject to quotas. Their landings of quota stocks are regulated by means of monthly limits. Vessels of 10m or under in length, which make up some two-thirds of the fleet by number, do not have FQAs. The quota pool reserved for them is a very small part of the total UK quota, but for certain stocks, mainly in the English Channel, they account for a significant proportion of total landings. Their landings are mostly unregulated, although monthly limits are now routinely imposed for *Nephrops* (Norway lobster).

22. Since they were first introduced in their present form, UK restricted fishing licences have, to a greater or lesser extent, been privately tradeable. In 1995 landings track records became associated with licences rather than vessels and this gave the licences a greatly increased value because of the quota rights they now carried. Under the licence aggregation scheme, first introduced in 1990, vessels could now increase their quota allowances by combining licences from more than one vessel. In 1997 a number of track records were also permanently traded during the last decommissioning round, when owners of decommissioned vessels were permitted to sell rather than surrender their quota rights.

23. The main driving force behind an increase in quota trading, however, came from relaxed rules on the swapping of quota between POs, in particular the facility from 1996 for POs to make quota "gifts" (i.e., with no reciprocal transfer of quota, which had previously been required). This made it much easier for a vessel in one PO to lease or sell quota to a vessel in another PO. Deals were complex, involving the vessel owners and the PO officers, but under the track record-based allocation system a quota sale could be completed in three years. Within the POs operating IQs, of course, quota trading had always been possible.

24. The move to FQAs meant that trading of quota could not affect each vessel's basic quota allocation. This facilitated quota leasing but permanent sales of quota became effectively impossible, a quota "sale" becoming instead a long-term lease agreement. Nevertheless, quota trading has escalated in recent years, evidenced by an increase in the annual number of quota swaps between POs from 90 in 1994 to more than seven times that number in 2000.

25. The UK's quota management system has both strengths and weaknesses from an economic point of view. Its principal strength is that it has made a real attempt to allocate quotas at the individual vessel level and to enforce them (at least in the case of over 10m vessels), something which cannot be said of some other countries. The devolution of management responsibility to POs can also be seen as a strength, to the extent that the POs foster collective responsibility and so help to ensure that quotas are respected and that they are used as efficiently as possible.

26. In economic terms the main weaknesses of the UK system relate to the obstacles to greater freedom in quota trading and hence a more efficient allocation of quota between vessels. Vessels in the "non-sector" (those which do not belong to a PO), as well as many vessels in POs which pool quota, cannot participate in quota trading. The FQA system, which currently does not permit permanent transfers of quota, means that trading produces an increasing number of complex lease arrangements which are subject to considerable financial risk and uncertainty and place a significant administrative burden on both POs and Fisheries Departments.

27. We also have some concerns over the current strength of quota enforcement in general and over the apparent lack of any real control on landings by the inshore (10m and under) fleet.

28. Evaluating the various quota management approaches used by different POs is not straightforward, not only because of the lack of empirical data on economic and biological outcomes, but also because the objectives of the POs are not clear. Efficiency and effectiveness of quota management would suggest a market allocation of quota, and hence the use of IQs and full participation in quota trading, but it is possible that some PO memberships pool quota and subject all members to the same restrictions because they are prepared collectively to sacrifice profits for some notion of equality. This may not be very effective in reducing incentives to land or discard over-quota fish, however.

The views of the UK fishing industry

29. A telephone survey was undertaken to investigate opinions among the owners of just over 400 vessels, including more than 20% of the UK over 10m fleet, concerning existing management arrangements, the trading of quota, and the possibility of some sort of ITQ system for the UK industry.

30. Less than half of the "sector" as a whole (PO member vessels over 10m in length) were generally satisfied with the present management arrangements, although this may well have reflected a dislike of quotas as such more than the UK's quota management approach. Overall satisfaction was lower still among the non-sector and the 10m and under fleet.

31. Around 70% of the sector had supported the move to FQAs and considered that they represented an improvement on track record-based allocations, although nearly 80% were in favour of an annual reconciliation of quota trades. Overall, more than half thought that the amount of freedom to trade quota was about right while around a quarter wanted more freedom, in particular the pelagic vessels and the larger demersal trawlers. The majority wanted quota "ownership"restricted to active fishermen. Most of the non-sector and 10m and under boats did not support FQAs, but while two-thirds of the non-sector thought there was now too much freedom to trade quota, the same proportion of the inshore vessels were content with the current amount of quota trading.

32. The great majority of the sector appeared to be happy with their POs' quota management arrangements, although a significant number of demersal trawlers sought a move to IQs. More than half of all sector vessels had been involved in quota trading by some means or another, either by leasing or buying quota or acquiring additional track record/FQAs through licence transactions or from decommissioned vessels. The most quota trading activity was shown by the pelagic boats, the larger demersal trawlers and the North Sea beam trawlers, but in no segment were less than a quarter of vessels involved in quota trading.

33. Most of the non-sector vessels did not belong to a PO out of choice and had never been in a PO, but over a quarter had tried to join a PO and had been unsuccessful due to a poor track record/FQA. Just over half the sample expressed a desire to be able to have their FQA as an individual quota, although this increased to over two-thirds if they were also able to trade quota. More than half of the 10m and under vessel owners surveyed had previously owned an over 10m vessel and the great majority fished in the inshore sector out of choice. Nearly 90% did not want to be subject to the quota management arrangements applied to the over 10m vessels.

34. Nearly 80% of the sector thought that ITQs in the UK were inevitable and well over half were in favour of them. Support for ITQs was strongest among the demersal trawlers, the pelagic boats and the North Sea beam trawlers, and weakest among the *Nephrops* trawlers and the Area VII beam trawlers. Most thought they should apply at least to all finfish species under quota and to all vessels, even those of 10m and under. More than half of the sector thought that ITQs would reduce over-quota landings. The great majority thought that POs should continue to have a central role in the management system. Nearly three-quarters of the non-sector and 10m and under vessels sampled were against ITQs.

35. Concern about the possible effects of ITQs on the regional or sectoral concentration of UK fishing activity was expressed by around two-thirds of the sector with rather more concerned

about the possible implications for new entrants to the industry. Concern over the nature of the legal title to quota was expressed by nearly 70% of the sector.

36. Of the 18 POs who responded to the survey, only four were basically unsatisfied with the present quota management arrangements and just two did not think that FQAs were an improvement over track record-based allocations. All but two were in favour of an annual reconciliation of quota movements. Six POs thought there was now too much freedom to trade quota while three were in favour of more freedom for quota trading. On the other hand, five POs favoured trading between all over 10m vessels and seven thought that trading should in principle involve the inshore sector as well.

37. ITQs were considered inevitable by 15 POs although only 8 were in favour, in most cases for all stocks and for all vessels, at least those over 10m (including the existing non-sector). Most, but not all, were concerned about a possible concentration of ownership under ITQs and the cost of quota for new entrants to the industry. Seven POs were very concerned about the legal title to quota with a further nine were only slightly concerned about this.

ITQs in practice: an international review

38. A review of the experiences with ITQs in a number of other countries around the world was commissioned from Professor Ragnar Arnason of the University of Iceland. The full review is contained in an Annex, with only a summary included in the main body of the report.

39. The first ITQ systems were introduced in the 1970s. ITQs are now employed in a number of important fishing nations including Australia, New Zealand, the USA, Canada, Iceland and, within Europe, the Netherlands. Overall, the experience with ITQs has been positive. Fishing effort has generally decreased, depleted stocks have recovered, and the quality of the catch has often increased. In general, industry profitability has greatly increased.

40. When ITQs have been introduced, the initial allocation of quotas has normally been made on the basis of catch history. In all existing ITQ systems, quotas are defined in terms of percentage shares of the current TAC. Only rarely have institutions been set up by government in order to facilitate or manage the quota trade; generally the industry itself has created the necessary institutions for trading to take place efficiently. In almost all cases, however, governments have restricted the freedom to trade quota in some way or another. Typically quota ownership is limited to fishing firms. Firms may be restricted in the amount of quota they can own (as a proportion of the TAC). Often there are other restrictions. In all ITQ systems, however, quota can be both leased on a temporary basis and sold permanently.

41. In many ITQ fisheries governments have taken the opportunity to impose on quota holders a charge towards the costs of fishery management. Few governments, however, have attempted to

extract a resource rent from the industry (by imposing a charge greater than that necessary to cover management costs).

42. Enforcement of ITQs is essential to their successful operation. Generally, this relies upon self-reporting of landings backed up by an effective system of random checks, together with sanctions which have a real deterrent effect. Checks will involve inspections of landings but may also include the monitoring of buyers, processors etc., where a "paper trail" approach has been adopted.

43. ITQs generally result in increased industry profitability, which in most cases will reflect real increases in economic efficiency. Although fishing effort is likely to be significantly reduced under ITQs, the effect on capacity will depend upon factors such as the extent of overcapacity, the market for second-hand vessels and fishing opportunities for non-quota stocks. We would expect some reduction in capacity under ITQs, although this has varied greatly from country to country. Under ITQs stocks have generally improved in health, although this may reflect more the increased attention to controlling output effectively than the use of ITQs *per se*.

44. ITQs reduce incentives to discard in multispecies quota fisheries but create incentives to discard low value grades of fish. However, the incentives to discard low value fish under fixed individual quotas may be as great, while ITQs can encourage more selective fishing which will help to reduce discards. Although the empirical evidence is inconclusive, reports of significant changes in discarding behaviour point to reduced discards under ITQs.

45. ITQs may be associated with industrial concentration, in terms of quota ownership, geographical distribution of fishing activity and fleet make-up, but only to the extent that such concentration is a consequence of increased economic efficiency. Other factors are also making fisheries technologically more efficient, and ITQs will only alter the pace of change. While there is evidence of some concentration of ownership in many ITQ fisheries, this largely reflects the reduction in overall capacity. Overall, there is no clear pattern of geographical or sectoral change under ITQs, but in many cases there are restrictions on quota trade designed to limit such changes.

46. ITQs have been used extensively in multispecies fisheries and they generally reduce problems of quota mis-matches at the vessel level. Where problems persist despite quota trading they may reflect TACs which are not in proportion to the actual relative abundance of fish. Increased fishing selectivity and flexibility of quota rules can ameliorate the problem but only to a limited extent. Significant fluctuations in TACs are a problem for the industry under ITQs as they are under any quota system, but the operational flexibility provided by ITQs will give the industry more capacity to cope with TAC fluctuations than under other systems. To the extent that ITQ management is successful in rebuilding a fishery, however, future TACs should be more stable.

47. In all existing ITQ fisheries the nature of the property right inferred by quota "ownership" extends only to the permission to harvest a given share of the TAC. No ownership over the fish stocks themselves is established. The permission to harvest may be defined over some specified time period but in many cases the legal title to quota is rather vague in this and other respects.

Modelling the possible socio-economic impact of ITQs

48. A computer model was used to simulate the possible effects of liberalised quota trading across the entire UK over 10m fleet on fleet size, fishery profits and employment. The model is based on physical capacity: the FQAs of similar vessels are compared and those with the highest quota holdings are assumed to be the ones operating at full capacity. Vessels operating near full capacity utilisation are assumed to then buy quota from those operating with lower levels of capacity utilisation; trade takes place until a smaller fleet are all operating at full capacity defined in this way. Other simplifying assumptions include completely free and costless trading conditions and instantaneous exit of excess capacity (redundant vessels).

49. Various scenarios were investigated, including no restrictions on the transfer of quota, transfers restricted to vessels within the same fleet segment, transfers restricted to vessels within the same locality, and transfers restricted to vessels within the same region (Channel, Irish Sea, North Sea and West of Scotland). The analysis necessarily excluded 10m and under vessels. A version of the model was run without the shellfish boats, most of which have relatively small FQAs. Including these vessels overestimates the degree of fleet adjustment since it is possible that many vessels would increase their effort on non-quota stocks rather than exit the fishery.

50. Given the assumptions of the model, it was estimated that a *complete* rationalisation of the fleet through quota trading could reduce the pelagic and beam trawl fleets to just over 80% of their former size in terms of vessel numbers, while the demersal trawl segment could be reduced to around 65% of current vessel numbers. Smaller reductions would result if quota trading was restricted in some way.

51. Direct employment in fishing could be reduced by as much as 20-50% in some regions, depending on the region and whether restrictions on quota trading are applied, but again reductions of this magnitude assume that there is a complete rationalisation of capacity in the short term, which is unlikely in practice. Real reductions are likely to be significantly smaller.

52. It was estimated that a rationalisation of fleet capacity through quota trading could result in an increase in economic profits ranging from around 5% in the English Channel to as much as 20-25% in the North Sea. These sorts of economic gains would be reduced if quota trading was restricted in order to protect direct employment in fishing. The trade-off between potential economic profitability and fishing employment is straightforward, as the model illustrates.

Future management options for UK fisheries

53. From an economic perspective the main problem with existing arrangements is that there are significant obstacles to quota trading. In particular, many vessels are effectively excluded from the opportunity to trade quota while the transactions necessary in order to accomplish trades appear unnecessarily complex and cumbersome, with considerable risk associated with long term deals. We believe that economic efficiency and effective stock conservation are compromised by the existing impediments to a freer trade in quotas, both as sales and leases. Quota sales, in particular, have actually been made more difficult by the move to FQAs. It is considered that the accumulating number of quota deals between POs will begin to place real strains on both the POs and Fisheries Departments and that some changes to current arrangements are probably inevitable.

54. We note that among vessel owners and their POs there is considerable support for a routine annual reconciliation of quota trades onto vessels' FQAs. We would encourage Departments to agree to annual reconciliations in order to enable permanent transfers of quota under the current management system.

55. We suggest that the nature of the legal title to quota represented by FQAs should be clarified. We note that in many functioning ITQ systems the legal title to quota use rights is often not very clear, but in general the more secure "property" rights are the greater the economic efficiency of their use. Further to this, a clarification of the rights conferred by FQAs on individual vessels may then raise questions over the rights which should be enjoyed by vessels not in membership of a PO or in a PO which pools quota.

56. If individual vessels are able to fish against their own quota allocations, and are able to trade quota, then we effectively have an ITQ system. We argue that Government should seriously consider an ITQ system for the UK, at least for the over 10m fleet. We see no economic reason why any particular quota stocks or fleet segments should be excluded, and note that current trading does not appear to exclude any particular stocks or segments. We believe that an ITQ system would have benefits in terms of economic efficiency and stock conservation.

57. Restricting the transferability of quota, for example, by region or segment, in order to reduce employment impacts will impose economic costs in terms of the efficiency and effectiveness of quota management. Nevertheless, some restrictions on quota ownership may be necessary in order to avoid the emergence of market power and to deter speculation.

58. Although there may be employment impacts as a result of liberalised quota trading, these are unlikely to be of the scale predicted by our theoretical model. Nevertheless, some rationalisation of fleet capacity is an intended objective of an ITQ system and is necessary in order to achieve stock conservation and economic profitability objectives. If there is overcapacity, it is possible that some boats may need to exceed quotas in order to remain viable. Although we question the

usefulness of the MAGPs, they are likely to continue and so the UK will have to reduce its fleet size in any case.

59. An ITQ system would not mean an end to the role of the POs in quota management. As we have suggested, the POs could play an important role in facilitating quota trading, administering the quota management system and helping to ensure compliance with quotas. There are also ways in which a collective approach to quota management may be advantageous. For example, in a multispecies fishery it may be efficient for the PO to manage quota pools for non-target species while vessels fish against their ITQs for target species.

60. There is no economic reason why vessels of 10m and under targeting quota stocks should be excluded from the management system applied to the over 10m fleet. Problems are presented by the size of the inshore sector and the fact that vessels do not presently have any individual quota entitlements. Nevertheless, we suggest that the 10m and under fleet should be brought fully into quota management, perhaps gradually by reducing the lower length threshold over a number of years.

61. Finally, we emphasise again the importance of enforcement in quota management. Allowing vessels to exceed quotas will seriously compromise stock conservation objectives. Although we suspect that enforcement in the UK authorities may compare very favourably with some other countries, we would urge Departments to consider how enforcement of quotas could be strengthened. Increased enforcement effort can be costly and we suggest that Government should reconsider the possibility of an industry contribution to the costs of management.

Contents

1. Introduction and objectives

This study was commissioned by the Ministry of Agriculture, Fisheries and Food (MAFF), now the Department for the Environment, Food and Rural Affairs (DEFRA), in order to evaluate the UK's existing fish quota management arrangements and to appraise various options for the future, in particular whether the UK should consider moving towards a system of individual transferable quotas (ITQs). The detailed objectives of the study were set out by MAFF/DEFRA as follows:

> *Evaluation of current management arrangements and POs*
>
> *The evaluation will assess the role of POs within the overall system of quota management in the UK. In particular the evaluation will:*
> *(a) provide a short review of the development of the UK quota management arrangements and their current operation and incentives. In particular, the evaluation will assess to what extent current management arrangements (post-FQAs) are proving successful in conserving fish stocks for future generations and ensuring the biological and economic sustainability of the sea fishing industry.*
> *(b) present an overview of the development and current quota management practices of Producer Organisations;*
> *(c) consider the effectiveness of different approaches to management used by POs, having regard to effective conservation, sustainability and economic efficiency, highlighting areas of best practice;*
> *(d) consider in particular the advantages and disadvantages to fishermen, POs and Departments of transferable quota systems as operated internally by some POs. Account should also be taken of the requirements of fishermen in the non-sector and the under 10 metre fleet.*
>
> *Appraisal of future management options*
>
> *The research will then go on to assess how far the current overall UK quota management arrangements (post-FQAs) capture the main putative benefits of ITQ systems (as they might apply in the EU/UK context); and what scope may exist for additional net benefits from moving closer towards an ITQ system in the UK. Specifically, the research will:*
> *(a) provide an assessment of the current arrangements against the ITQ "benchmark" in order to consider the differential gains and losses associated with the current system against a fully-fledged ITQ system (of a type which would be expected to apply in the EU/UK context);*
> *(b) put forward options for improving quota management in the UK, assessing gains and losses against the following criteria: enforcement and compliance issues; economic resource use and profitability; implications for employment; fleet and quota*

concentration; discards and conservation;

(c) suggest means of alleviating any problems which might arise e.g. ring-fencing quota; different treatment for different sectors - pelagic, inshore etc.

In addressing the objectives of the study, our approach was necessarily determined to a great extent by the availability of suitable data. In order fully to evaluate the performance of the UK's quota management system and the quota allocation methods employed by the different POs, for example, we would require detailed data on the economic profitability of the fleet over a reasonable time period, which are not available in the UK, as well as reliable data on *actual* landings and on discards at sea, which are not available and would be extremely difficult to obtain in any case.

The question of whether UK quota management arrangements have resulted in the conservation of fish stocks is also complicated by the fact that nearly all the stocks exploited by UK fishermen are also exploited by fishermen from other countries. Clearly, the conservation of fishery resources for the future requires effective management measures to be implemented and enforced by *all* the countries with significant exploitation shares. It is clearly not possible for this study to evaluate the quota management systems of other countries (although in our analysis of the UK system presented in Chapter 3 we do suggest that the UK approach is probably superior in this respect to that of some other countries).

The basic approach adopted in this study is to consider, based upon economic theory, the *incentive structure* presented by a quota management system and then to evaluate the UK system in this light and suggest how the incentive structure might be improved by making changes to the current arrangements, including moving to an ITQ system. Some of what can be demonstrated about quota management using economic theory may seem intuitively obvious, but if this is the case then one might reasonably question why policy-makers in general (not necessarily UK policy-makers in particular) have not always appeared to take this into account when designing fisheries management systems. At the same time, we do recognise that in practice some aspects of policy design, ensuring an adequate enforcement system, for example, are not always as straightforward as economists may like to assume.

We incorporate into the study a detailed examination of how the UK quota management system has developed and how it currently operates in practice, and we have also undertaken a wide-ranging exploration of the opinions of UK fishermen about the quota management system in general and the possibility of ITQs in particular. A review of the experiences with ITQs of a number of countries world-wide has been compiled by Professor Ragnar Arnason of the University of Iceland. In addition, a computer simulation of the UK fleet under a perfectly transferable quota system demonstrates the possible effects on fleet size and employment if fleet capacity were to be completely rationalised.

The report is structured as follows. Chapter 2 presents an outline of the economic theory of quotas in a fishery and the principal economic arguments for ITQs. Chapter 3 traces the development of the UK quota management system and examines how it now functions, looking in particular at the quota allocation methods adopted by the UK producers' organisations (POs), and concluding with a critical appraisal of the system in the light of economic theory. Chapter 4 then presents the results of the survey of the views of UK fishermen and their POs. Chapter 5 summarises the review of ITQ systems in other countries, which is included in full as an Annex to this report. Chapter 6 contains the results of the computer modelling exercise for the UK fleet. Finally, Chapter 7 presents an overall assessment of the UK quota management approach and examines certain changes which could be made, including moving to an ITQ system proper.

2. The economics of quota management in fisheries

2.1 Introduction

A fundamental goal of most, if not all, fishery management regimes is to ensure conservation of the fishery resource into the future and hence the sustainability of fishery exploitation. Management measures are therefore imposed upon the industry in order, directly or indirectly, to control fishing mortality, i.e., the portion of the stock biomass that is removed by fishing within a given period.

Restrictions on the *output* of the fishery (as catches and/or landings) are intended to control fishing mortality directly. From estimates of stock biomass, recruitment etc., a Total Allowable Catch (TAC) is established for each species stock in the fishery, usually on an annual basis. In the case of a fishery involving more than one country (as is the general rule within the EU) the TACs are divided into national quotas.

Adherence to the TAC should, in theory at least, restrict fishing mortality to the target value on which the TAC is calculated, i.e., to the level desired by the management authority. In practice, however, ensuring adherence to the TAC is usually difficult (and therefore costly). Furthermore, the way in which the management authority attempts to ensure adherence potentially has profound economic implications for the fishery. At the very least, a quota management system will involve some allocation of quota at the *individual vessel* level, in order to avoid the economic wastage associated with a "race to fish" a global (aggregate) quota.

It is not technically impossible for a vessel's *catch* to be observed, but in most fisheries the cost of, say, a full-time observer on each and every vessel would be prohibitive. For this reason the first point of control in most fisheries is at the quayside where fish are landed. But even observing all landings is likely to be very costly, so practical fishery monitoring systems usually involve a rationing of inspections both quantitatively (a system of random inspections and/or targeted inspections) and qualitatively (cursory to thorough).

If all quota violations can be detected, the economics of the quota management problem is relatively straightforward, at least in theory. All the management authority has to do is to ensure that the penalty for landings in excess of a quota or quotas is in every case large enough to make *any* violation unprofitable and therefore unattractive to the vessel operator. Under a real-world enforcement system there is, however, uncertainty about whether a given violation will be detected or not. In this type of problem we therefore have to focus on *expected* penalties which depend on the probabilities of enforcement events occurring.

The general practical reliance on enforcing quota controls at the point of landing raises the issue of discarding. To a greater or lesser extent discarding is inevitable in all fisheries and in simple

terms will occur whenever the cost of retaining a particular part of the catch on board exceeds the benefit from landing it.[1] Discarding because of quota controls means that quotas (and therefore TACs) may be exceeded in terms of catch even if they are adhered to in terms of landings. Not only is discarding very difficult to observe, in many quota management systems it is implicitly condoned in order that vessels comply with quota regulations at the quayside.[2]

In this chapter we look at the economic incentives that arise when a fishing vessel, whose efficient operation is otherwise unconstrained, is subject to catch limits (quotas). In the context of this report we distinguish in particular between *fixed* quotas and *variable* (transferable or tradeable) quotas, i.e., between quotas which cannot be varied in the short run (such as periodic catch limits or non-transferable individual quotas) and quotas which, in principle, can be varied (and which may therefore effectively be considered as variable inputs). We then consider the theoretical underpinning to ITQ systems in more detail, focusing on the economic efficiency arguments for ITQs in addition to the effect on incentives to evade quotas or discard fish.

2.2 Fixed quotas

2.2.1 Fixed quotas in a single species fishery

Consider a fishing vessel which is capable, under normal conditions, of catching and landing an amount of fish q^* within a given period (say, a week, or a month). This is the level of catch, we will assume, which maximises vessel profits and is therefore the level of catch which the vessel operator (the skipper) will seek to achieve, other things being equal. For simplicity we will assume that there is a determinate relationship between fishing effort and catch, i.e., that the vessel can precisely choose its level of catch by adjusting its effort. This is not very realistic - in practice there is a lot of random variation in catches - but the assumption does not fundamentally alter the economics of the problem.[3]

If the vessel catches less than q^* then it can always expand its effort further and earn more profit by catching q^*. If the vessel tries to catch *more* than q^*, however, we assume that the cost of the additional effort needed is greater than the additional revenue obtained and so profits are less than at q^*. For a *profit-maximising* vessel operator, therefore, q^* is the optimal level of catch. It is also the level of catch which is most *efficient* for the vessel, i.e., which maximises the economic return on the capital invested in the boat and its gear.[4]

---

[1] See Pascoe (1997) for a review.

[2] UK licence conditions, for example, refer to the amounts of fish "which may be retained on board, landed or transshipped"

[3] We could think of q^* as the *average* catch over many periods.

[4] Note that here fishing "effort" refers to a bundle of inputs used per period. We assume that for any level of catch the vessel operator employs an efficient, i.e., cost-minimising, combination of inputs (gear, fuel, labour etc.).

If a management authority now imposes a fixed quota Q on the vessel for the period in question, then clearly if Q is greater than q^* the quota will not affect the efficient operation of the vessel at all. If, on the other hand, Q is *smaller* than q^* the vessel will be subject to a constraint on its efficient operation. In any given period the vessel will now earn smaller profits than it otherwise could (and would choose to in the absence of the constraint). It may be that Q is small enough that the corresponding level of profit is below the opportunity cost[5] of all the factors employed by the vessel. If this is the case then some factors (the capital invested in the boat, for example, or the owner's own labour) must receive less than their opportunity cost and the vessel will make a loss.[6]

In economics the effect of a constraint such as this can be represented by a "shadow price". The shadow price of the quota constraint, which we will denote by the Greek letter λ (lambda), represents the incremental addition to profit from a marginal relaxation of the quota, or, equivalently, the incremental loss in profit from a marginal tightening of the quota. Generally, the tighter the quota, the greater the shadow price.

We refer to λ as a *shadow* price because the price associated with the quota constraint may not actually exist in a market, but it *is* the maximum price that a vessel would be willing to pay for an additional unit of quota if a market for quota did exist. It is also theoretically equivalent to the charge that would have to exist on a unit of fish to produce the same effect as the constraint. If, for example, all catches were taxed at a rate of λ per unit, then the vessel operator would freely *choose* a level of catch equal to Q which would now be the optimal (profit-maximising) level of catch *given the tax*. Indeed, taxes are in theory an alternative way of attempting to regulate catches in a fishery.[7]

This is illustrated by the graph in Figure 2.1. The downward sloping line traces out the vessel's marginal profit as it increases its catch per period. By assumption, the cost of each additional unit of effort, and hence catch, is greater than the previous unit, while the market value of each unit of catch is the same. Hence the marginal profit, the additional profit from each successive unit of catch, decreases as catch increases. At a level of catch q^* the marginal profit is exactly zero and so this is the profit maximising level of catch per period; units of catch above q^* earn negative profit.

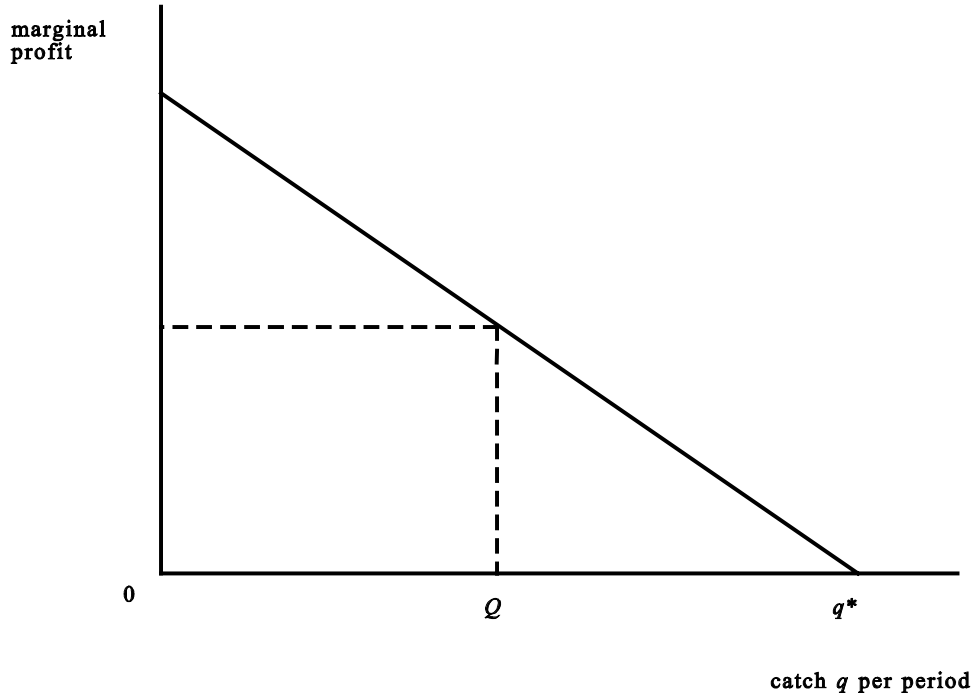
---

[5] The "opportunity cost" of a factor of production is the return that could be earned by using it in some best alternative activity. For example, the opportunity cost of capital may be taken as the return that could be expected from investing that capital in the best available alternative investment opportunity.

[6] A boat may make a financial profit but an economic loss, although this is unlikely if the capital invested in the boat is borrowed at a market interest rate. Also, while a skipper may appear to make an economic loss by using his own labour in fishing, he may be compensated by the "psychic" income derived from being a fisherman.

[7] In practice the taxation approach to fishery management has rarely been pursued, partly due to practical difficulties and partly due to the political unpopularity of taxes.

Figure 2.1: A constraining quota and the associated shadow price



Importantly, the shadow price is also equivalent to the *minimum* fine (per unit of catch) that the management authority would have to impose on the vessel for over-quota catches in order to ensure that a strictly rational and risk-neutral[8] vessel operator would not exceed the quota. Again, in general, the tighter the quota, the greater the shadow price and therefore the greater the fine needed to prevent a vessel from exceeding the quota.

In the real world, as we have already observed, the problem for the authority is monitoring catches (or, more strictly, landings) and hence detecting violations. Since in all practical cases the overall probability of inspection, detection, prosecution and sanction will be less than 100%, we need to model the problem in terms of the *expected* fine. The expected fine in this case is simply the fine the vessel would expect to incur if caught landing over-quota fish multiplied by the expected (subjective) probability of incurring that fine. If the expected fine was too small, either because the expected probability of getting caught and fined was very low, or the expected fine *if caught* was very low (or both), a (rational, risk-neutral) vessel operator would choose a level of catch and therefore landings *greater* than the quota limit.[9]

A relatively small "lump-sum" fine (i.e., a fine that is not directly related to the size of the quota violation) may not have any deterrent effect at all on a purely rational vessel operator. A very

[8] By "rational" we mean that the individual is indifferent between legal and illegal behaviour except with regard to the expected monetary outcomes. By "risk-neutral" we mean that the individual is indifferent between the expected pay-out from a gamble and the certain equivalent in money terms.

[9] As long as the expected fine is greater than zero, however (and is non-decreasing as the level of over-quota catch increases), the level of catch will still be less than it would be in the absence of any quota limit.

large lump-sum fine, on the other hand, as long as the expected probability of detection were reasonably high, could be expected to deter all quota infringements.

Notice that we have not so far considered the problem of discarding. Because in this simple case we have assumed that there is a determinate relationship between fishing effort and catches, and that there is only one species in the fishery, there will not be any incentive for the vessel to discard any of its catch.[10] If, however, there are price disparities between different grades of fish in the catch then we will need to consider discarding. We look at this case in Section 2.2.3 below.

2.2.2 Fixed quotas in a multispecies fishery

Now consider a vessel in a multispecies fishery. For simplicity we will assume that there are just two species for which there are two associated fixed quotas per period, Q_1 and Q_2. We will further assume that the two species are always caught in the same fixed proportion.

If the two quotas are allocated to the vessel in exactly the same proportion as the two species appear in the vessel's catch, then the problem is really just the same as in the single species case. Both quotas will always be filled at the same level of catch/effort and there will never be any incentive to catch more fish and then discard it.

If, however, the quotas are allocated to the vessel in a *different* proportion to that in which the species appear in the vessel's catch, then clearly one quota will be filled before the other. Now we do need to consider the problem of discarding. If the penalty (or, more strictly, the *expected* penalty) for landing over-quota fish is high enough to deter the vessel from doing so, then there will be an incentive to discard fish of the species for which the quota is filled. In simple terms, as long as the expected fine incurred from landing a unit of over-quota fish is greater than the market value of that unit of fish, then provided that it is profitable to expand effort further in order to catch more of the other species (for which the quota is yet unfilled) it will be optimal to discard the over-quota fish. In this case it is apparent that the TAC for the discarded species may be exceeded in practice even if it is observed to be adhered to at the quayside.

These observations can be extended to a fishery in which any number of quota species are caught together. Unless the quotas are in exact proportion to the species in the catch, there is a straightforward trade-off between enforcing fixed quotas in a multispecies fishery and discouraging discards. The more effectively the enforcement regime deters landings of over-quota fish, the greater the incentive for vessels to discard that fish if they have quota left for other species and can profitably increase effort in order to catch and retain those species alone. The only solution to this problem would be for the vessel to employ progressively more selective gear

[10] In this chapter we focus only on quota-related discarding. We therefore ignore discarding of non-target or non-marketable species, discarding of undersized fish, and discarding due to a limit on the space available in a vessel's hold or fish room. We also assume, implicitly, that discarding is a costless activity. For a full treatment of the economics of discarding see Arnason (1994).

and fishing methods as each quota is filled in order to avoid catching over-quota fish, but this may not be possible except to a very limited extent.

The more a vessel's overall parcel of quotas become filled, however, the greater the likelihood that, even if some quotas remain unfilled, it will no longer be profitable to continue to increase effort only to retain a small part of the catch. This is more likely if the market price of the species subject to the less constraining quotas are relatively low. If the market price of the species subject to the least constraining quota were very high, however, it might well be profitable to increase effort for that species even if all other quotas are filled (and so all other species are being discarded from the catch). In this case the enforcement system could only enforce the least constraining quota at sea, even if all quotas are being effectively enforced at the quayside.

2.2.3 "Highgrading" with fixed quotas

Suppose now that we have a single species fixed quota, but that there are different grades of fish of that species (different sizes perhaps) which command different prices. If the quota becomes filled, there may be an incentive to continue to increase effort and to discard the least valuable grades in the hold as long as the fine expected to be incurred from landing that fish is greater than their market value.

Note that for this type of discarding (often referred to as "highgrading") to be profitable, the revenue earned from an additional unit of catch (once the quota is filled), less the value of the discarded fish, must be greater than the cost of catching that additional unit. It would not be profitable to highgrade if the additional profit earned from an additional unit of catch were no greater than the market price of the fish thrown over the side in order to "make room" within the quota limit.[11]

It is not difficult to see that this is exactly analogous to the case of a "multispecies quota", i.e., a quota covering more than one species. The possibility for highgrading across species is one reason why multispecies quotas may not represent an attractive option in a multispecies fishery, even though it is the problem of quota-induced discarding which has led some to suggest this option. The difference between the incentives to discard fish of different species with single species quotas and with a multispecies quota is that with single species quotas there will never be incentives to discard species already in the hold, since quota cannot be substituted between species. With a multispecies quota there may be such incentives.

[11] When deciding whether or not to discard any part of the catch that is already on board, the value of that part of the catch represents pure profit, since the cost of catching it has already been incurred and cannot be recouped. A thorough treatment of highgrading can be found in Anderson (1994).

2.3 Variable quotas

2.3.1 Variable quotas in a single species fishery

In the previous section we assumed that the quota per period was fixed, so that the vessel could attempt to maximise its profits only by choosing its level of effort (and therefore catch) and, where appropriate, by also choosing whether or not to discard.

We now let the quota be variable, and we assume that it can be varied because quota is transferable privately and that there exists a market for it. We further assume that the market operates so efficiently that quota can be bought and sold in any quantity (subject to the TAC or national quota) and at any time. Because we are examining the short run behaviour of a fishing vessel we implicitly consider only the short run (lease) market for quota. Therefore by the quota price we mean the lease or rental price of quota for the period in question.

The implication of tradeable quotas is that, given an active market in quota, the vessel operator has a choice between landing a unit of fish illegally and purchasing a unit of quota in order to land the fish legally. Theoretically, with a constant (flat-rate) fine per unit of over-quota fish, a vessel operator who behaves strictly rationally will buy enough quota to cover all his landings (only) as long as the expected fine for over-quota landings is greater than the quota price. If the expected fine were less than the quota price, all the landings would be made illegally. However, it is more realistic to suppose that the expected penalty per unit of over-quota fish will, for one reason or another, *increase* as the volume of illegal landings increases. It can be shown that if the expected fine per unit of fish increases with the size of the illegal landings in this way, the proportion of landings for which the vessel owner will rationally buy quota will be somewhere between 0% and 100%, depending on the steepness of the expected penalty function.[12]

Assuming compliance (i.e., that the vessel operator chooses, freely or otherwise, to buy enough quota to cover his landings) the effect of the cost of quota for each unit of fish landed is that the optimal (profit-maximising) output for the vessel will be lower than in the absence of quotas. In its effect, the quota price is really the same as the hypothetical tax referred to in Section 2.2.1. Taking that particular case, if the quota price were equal to the shadow price λ then the vessel would maximise profits by producing an output equal to Q.[13]

2.3.2 Variable quotas in a multispecies fishery

Assuming, again, that the expected fine for landing over-quota fish is high enough to deter illegal landings, in a multispecies fishery the vessel operator will attempt to buy enough quota to cover the vessel's catches of all quota species. In theory the problem of quota combinations out of

[12] This assumes that the extent of cheating is not so widespread that the expected fine influences the quota price.

[13] The equilibrium quota price in a fishery will in fact be equal to the shadow price of the quota equalised across all vessels in the fishery (see Section 2.4).

proportion with the mix of species in the catch should not arise as long as there is active trading in all quotas and there are no supply constraints for particular quotas.

Given these conditions, as long as there are no different size grades in the catch for each species (see below) it will only be profitable to discard fish of a particular species if the quota price for that species is greater than the market price. While a quota price in excess of the market price is conceivable as a very short term phenomenon, or where the quota price is determined in a wider market and there is locally very weak demand for a particular species, in most circumstances it is unlikely.[14] Given a sufficient supply of quota, there should not be any incentives for quota-induced discarding.

If, however, there are supply constraints for some quotas, the sort of discard incentives expected with fixed quotas will appear. For example, where for some reason the TACs (or national quotas) for different species are not in proportion to the typical mix of species in the catch, it may become impossible for many if not all vessels in the fishery to purchase enough quota for some species to cover their catches of that species. Discards and/or illegal landings are then inevitable unless fishing practices can be adjusted to change the composition of the catch accordingly.

2.3.3 Highgrading with variable quotas

As before, suppose that we have a single species quota covering different grades of fish which command different prices, but now we let the quota be variable (tradeable). In this case there will be an incentive to discard any grade of fish for which the market price is less than the quota price, which is quite possible if there is a wide disparity between the market price for different grades of fish.[15]

With a fixed quota, we observed that for highgrading to be profitable, once the quota limit has been reached the revenue earned from an additional unit of catch, less the value of the discarded fish, must be greater than the cost of obtaining the extra catch. With tradeable quotas (assuming an expected penalty high enough to deter over-quota landings) the revenue earned from every unit of catch must always be greater than the cost of catching it *and* the cost of the quota required to land it. At the same time, once fish is caught it is only worth retaining it for landing if it is worth more than the cost of the required quota. Given this, assuming the quota price remains constant either *all* of the low value fish will be discarded or none of it will. As long as the market price of the fish retained on board is greater than the quota price, it will always be more profitable

[14] The quota price may, nevertheless, be proportionately higher for the least valuable species in the catch. Because it is likely to be potentially profitable to discard these low value fish while continuing to catch high value species, the quota price for the low value fish need not take account of the cost of catching them, only their market price. As a result, the quota price of by-catch species may be relatively higher (compared to the market price) than the quota price of target species.

[15] Note that since the quota price, in turn, reflects the market value of (and the cost of catching) the fish actually *landed*, there is a direct causal relationship between patterns of discards in the fishery and the equilibrium quota price.

to buy quota than to discard fish from the hold. If the quota supply for a particular species becomes constrained, then the discard incentives associated with fixed quotas will appear.

It is difficult to say whether, *all else equal*, in the short run we would expect more or less highgrading with tradeable quotas as compared to fixed quotas. In theory, with a distribution of fixed quotas among vessels that exactly mirrored the efficient equilibrium quota allocation we would expect a quota market to produce (see Section 2.4 below) we should end up with exactly analogous incentives for highgrading. In practice, the inefficient quota allocation we would expect under a system of fixed quotas will distort incentives to highgrade. It is certainly possible that under some conditions there may be more highgrading with tradeable quotas.

2.4 ITQs in theory

2.4.1 Economic efficiency

We have so far considered the incentives for landing over-quota fish and for discarding under fixed and variable quota systems. Given certain conditions, incentives for exceeding quotas and for some types of discarding are likely to be reduced with variable quotas. The principal economic argument for a fully variable individual transferable quota (ITQ) system, however, focuses on the *efficiency* of fishing operations.

We have so far assumed that the management authority is primarily interested in trying to ensure adherence to the TAC (or a national quota). This is not unreasonable, since domestic objectives and, in many cases, international obligations generally place considerable emphasis on resource conservation and hence on the enforcement of conservation policies. Given a TAC, however, we should perhaps also be interested in how that TAC might be allocated to the fishing industry in such a way that industry profits are maximised.

There are really only two ways in which quota can be allocated amongst fishing firms. Either an administrator decides how much quota each firm should get, either arbitrarily or according to some qualifying criterion such as recent catch history, or the (final) allocation could be left to the market, which is the idea behind ITQs. We can show that a market allocation necessarily produces an *efficient allocation*, i.e., an allocation which maximises economic benefits, whereas an administrative allocation will not (except by chance).

Suppose we have an industry composed of just two fishing firms (vessels). Let's call them vessel *i* and vessel *j*. Suppose that an administrator allocates an identical fixed quota *Q* to each vessel. Suppose, further, that vessels *i* and *j* are not identical in their capacity and efficiency, with the result that the fixed quota *Q* constrains each vessel's operation to a different extent. The quota will then have a different *shadow price*[16] for each vessel, i.e., λ_i does not equal λ_j.

[16] see Section 2.2.1

Assume that λ_i is greater than λ_j, as we depict in Figure 2.2a. This means that the quota constraint on vessel *i* is associated with a greater marginal increment to profit than the constraint on vessel *j*, and this means that a unit of quota is worth more to vessel *i* than to vessel *j*. If vessel *j* could sell a unit of quota to vessel *i* at a price somewhere between λ_i and λ_j (they could agree on a price by bargaining) then vessel *j* would gain more profit by selling a unit of quota than it would lose by reducing its output, while vessel *i* would increase its profit (by increasing its output) more than the cost of buying another unit of quota. Since the trade has been profitable for both vessels, *total* industry profits must have increased.

Figure 2.2a: Equal quota allocations - unequal shadow prices

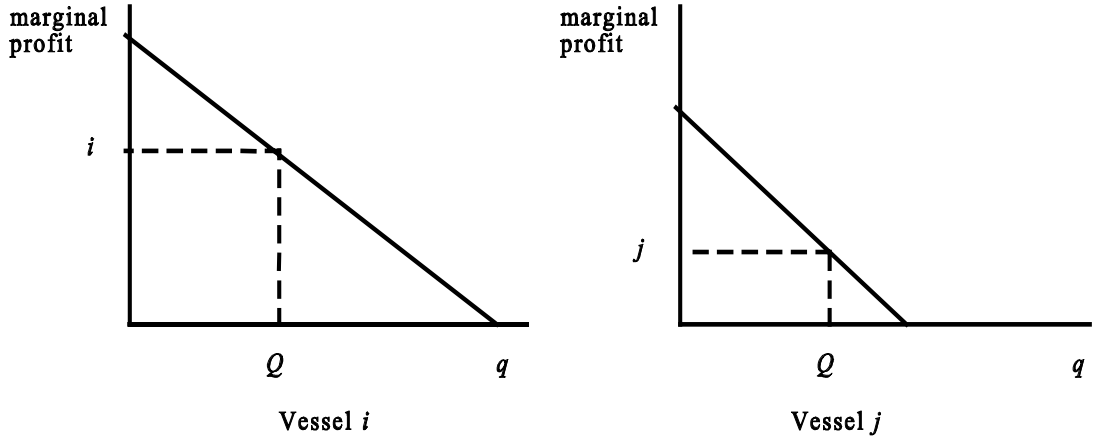
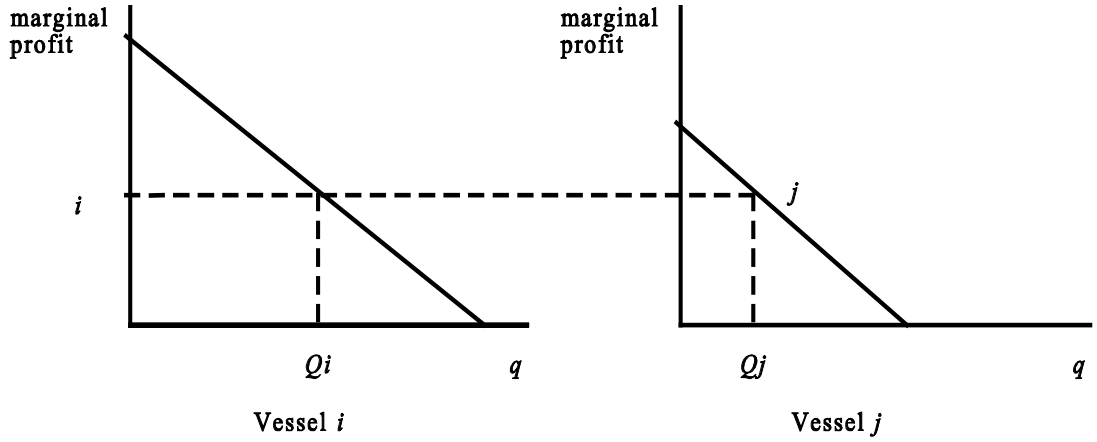


Figure 2.2b: Equalised shadow prices - unequal quota allocations



After this trade the shadow price of vessel *i*'s quota will have reduced and the shadow price on vessel *j*'s quota will have increased. If, after the trade, there was still a difference between λ_i and λ_j, then further trade would be mutually advantageous (by the same argument) and total industry profits would increase again as a result. It is not difficult to see that trading should take place until λ_i equals λ_j at which point industry profits are maximised. Because the two vessels are different in

their capacity, as a result of trading each now has a different quota allocation, Q_i and Q_j (although the TAC is the same). This result is shown in Figure 2.2b.

The equalisation of shadow prices across firms is the necessary and sufficient condition for maximising profits subject to the total quota constraint (the TAC). The shadow price will then be the equilibrium short-run price at which quota is traded among fishing firms.

It would be very difficult for an administrator to achieve this efficient quota allocation. To do this he would need extremely detailed information about the technical characteristics of each vessel, the day-to-day decisions of the skipper, and so on. He might closely approach such an allocation by using a "rule of thumb" performance-based criterion such as past catch history, but his allocation would almost certainly soon become rather inefficient as different vessels change their characteristics and become relatively more or less profitable with time. The argument for tradeable quotas, therefore, is that allowing the market to allocate quota among fishing firms ensures an efficient, i.e., profit maximising, allocation, both automatically and continuously.

In fact, no matter what the initial distribution of quota, the market will produce the same allocation after trade. Given significant variation within the industry in vessel capacity and efficiency, in the short term some vessels may find it profitable to purchase enough quota to operate at full capacity while other vessels may be so inefficient that they find it more profitable to sell *all* their quota and exit the industry. In a newly-introduced ITQ system, we would therefore expect some short term reduction in capacity, at least at the margins.

In the longer term all firms will have an incentive to reduce costs in order to increase profits. Some operators will do this by scaling down their capacity (or exiting the fishery) while others will be able to invest profitably in additional capacity and benefit from economies of scale. Overall, we would expect total industry capacity, over time, to align itself more efficiently to the size of the TAC(s) or national quota(s).[17] A better balance between capacity and quotas is likely to have the general effect of reducing overall incentives to land over-quota fish and to discard.

The value (price) of ITQs reflects the profits[18] that can be earned from their use, but also the total supply of quota relative to demand. Other things being equal, increased industry profitability will result in increased quota prices, but individual vessels (who cannot alone influence the quota price) will continue to have incentives to increase their own relative profitability. They can do this by reducing unit costs, or indeed by increasing revenues, for example by landing a higher quality product.

[17] The extent to which capacity will adjust, and how quickly, will depend upon a number of factors, including the degree of "capital malleability" (the ease with which excess capacity can be disposed of) and operators' differing expectations about future economic conditions in the fishery and future fish stock sizes (and hence the present value of quotas as *capital assets*). Adjustment will also depend, crucially, upon enforcement of quotas.

[18] Note that here we mean *economic* or "excess" profits, i.e., profits in excess of the normal return that could be expected on capital invested in a particular sector of the economy.

The foregoing assumes, importantly, that there is adequate enforcement of quotas. To the extent that vessels are able to land fish without quota, the potential short term and dynamic efficiency gains from an ITQ system will not be achieved in full. However, the value acquired by quotas may well produce a degree of "self-enforcement" within the industry to the extent that vessels who have paid for quota are not prepared to tolerate free-riding by others.

It is worth mentioning here that we would also expect capacity to adjust under a system of *fixed* quota allocations, *provided those allocations were fully enforced*. Vessels whose profits are significantly constrained will have an incentive to increase profits by scaling down their capacity and hence reducing their capital costs, while vessels forced to make a loss should exit the industry. ITQs, however, are generally assumed to facilitate capacity adjustment in the fishery since given an initial endowment of quota (see below) vessel owners exiting the industry are compensated to the value of the quota they sell to those remaining in the industry.

Useful references on the economics of ITQs include Arnason (1990) and Anderson (1995). Less technical accounts of ITQs in theory and practice can be found in Squires *et al* (1995), Grafton (1996) and Squires *et al* (1998).

2.4.2 Distribution of economic benefits

Policy makers are often interested not just in the size of economic gains but also in how those gains are distributed within society. Economic gains from an ITQ system will be reflected in the value of quota. Who in society benefits from these gains depends upon who is in a position to realise quota values.

If quotas were sold by the Government at the outset, say by auction or competitive tender (as rights over a reasonably long time period), then their value would be captured by Government on behalf of society as a whole. If, on the other hand, quotas were initially distributed free of charge to the industry (as often happens in practice) then the industry is in a position to obtain the value of the quotas. If the first round ITQ owners, i.e., the individuals or companies who initially receive free quota from Government, proceed to sell all or any of their quota (either outright or by renting it) they will realise the quota value as a windfall gain. Second round and subsequent owners of quota, however, will not receive any such windfall gain unless the value of quota appreciates while in their possession.

Once quotas have been freely given to the industry it is possible subsequently to recoup some of their value to the public purse, through taxes on quota holdings or profits for example, but any individuals or companies who have sold quota prior to the introduction of such measures will not forfeit any of their private gains and there is the possibility of a double charge on those who have acquired their quota on the open market.

Who should benefit from the economic value of a fishery is essentially a normative question. It could be argued that society as a whole should capture the benefits of what is known as the *resource rent* since fishery resources are owned by the nation state. This is the view that is usually taken with regard to other natural resources such as oil or gas. Some argue that allowing a significant part of economic profits to be retained by the industry ensures strong incentives for static and dynamic efficiency gains and may help assure compliance with quotas (i.e., respect for private property rights).[19]

2.5 Summary

A quota gives rise to a *shadow price* which is the marginal value (as marginal increments to or from profit) of the quota constraint. In general the greater the constraint on the vessel's profitability, the greater the shadow price. In order to enforce a quota, the management authority should ensure that the expected fine for exceeding the quota is at least as large as the shadow price. This can be assured with a sufficiently large fine per unit of over-quota landings or a large enough lump-sum fine for any violation.[20]

In a multispecies fishery, fixed quota allocations out of proportion to the species mix in the catch will result in discards of the most constrained species, unless the enforcement system is so weak that it is profitable to land over-quota fish. In either case the TACs for these species are likely to be exceeded.

Variable (tradeable) quotas allow vessels to purchase enough quota to operate profitably unless and until the total supply of quota becomes constraining. The ability for vessel operators to buy and sell quota, however, will assist the adjustment of capacity to the total quota supply. The equilibrium short run quota price represents the shadow price of quota equalised across all vessels in the fishery. The resulting market allocation of quota should be the efficient allocation, i.e., the allocation which maximises industry profits given the TAC.

Tradeable quotas should reduce problems of discarding in a multispecies fishery but cannot entirely resolve problems of relative quota deficits for some stocks at the national level. Highgrading, i.e., discarding low value fish in order to utilise quota to land fish of a higher unit value, is a possible cause of catch discarding under any quota system. Other things being equal, the problem of highgrading should not be significantly greater under a tradeable quota system, but it is difficult to predict in practice. Some highgrading is nevertheless possible wherever the market price of fish is lower than the quota price.

---

[19] There are a number of conceptual and design issues concerning rent capture; see, for example, Grafton (1995), Johnson (1995) and also Hatcher and Pascoe (1997).

[20] There are two conditions for effective enforcement. The *marginal* condition requires that the expected penalty for a marginal unit of violation is greater than the profit from that unit of violation. The *total* condition requires that the expected penalty for any single act of violation is greater than the total profit expected from the violation.

3. The UK approach to quota management

3.1 Introduction

As a Member State of the European Community (EC), the United Kingdom is bound in its fishery management decisions by international obligations under the EC's Common Fisheries Policy (CFP). Since 1983 the CFP has included a conservation and management system which provides for restrictions on the volume of catches from Community waters, with total allowable catches (TACs) distributed to Member States on the basis of "relative stability" of fishing activities.[21]

Member States have an obligation under EC law to put in place a system for the distribution and use of their quotas[22] and to monitor and enforce quota uptake by fishing vessels flying their flag.[23] Notwithstanding the stated objectives of the resource conservation and management system at the Community level, however, Member States are only required to ensure that their vessels do not land fish over and above the national quotas. They are not required to adopt any particular method for internal quota allocation,[24] so long as basic Community law is respected, or to allocate quota in such a way that any particular social or economic objective is fulfilled.

In addition, the Council Regulation which establishes TACs and quotas each year explicitly prohibits the retaining on board and landing by a Member State vessel of catches from a stock for which the Member State's quota is exhausted. Thus although limits are set in terms of catches, their practical implementation is prescribed in terms of landings. Discarding in order to remain within quota limits is therefore implicitly allowed for in Community law.

In this chapter we describe the arrangements which the UK Government has adopted in order to manage the uptake of national quotas by the UK fleet. We briefly trace the development of the "sectoral" quota management system since 1983 and then present an outline of the system as it operated in 2001, focusing in particular on the role of the UK fish producers' organisations (POs) to which a substantial degree of management responsibility is now devolved. Finally, we consider the strengths and weaknesses of quota management in the UK, particularly in the light of what economic theory tells us about the implications of different methods of quota.

---

[21] Article 8 of Council Regulation (EEC) No 3760/92 establishing a Community system for fisheries and aquaculture (*Official Journal of the European Communities*, No L 389, 31.12.1992, p.1). The TACs and national quotas for 2001 were set out in Council Regulation (EC) No 2848/2000 fixing for 2001 the fishing opportunities and associated conditions for certain fish stocks and groups of fish stocks, applicable in Community waters and, for Community vessels, in waters where limitations in catch are required (*Official Journal of the European Communities*, No L 334 , 30.12.2000, p.1), as amended.

[22] Article 9(2) of Regulation 3760/92.

[23] Articles 2, 21 and 31 of Council Regulation (EEC) No 2847/93 establishing a control system applicable to the common fisheries policy (*Official Journal of the European Communities*, No L 261, 20.10.1993, p.1).

[24] The basic EC marketing regulation, however, does suggest that producers' organisations be given some responsibility for quota management.

3.2 Development of the UK system

When the resource conservation component of the CFP was put in place in 1983, the UK Government already had a history of quota management arrangements for a number of stocks for which quotas had previously been agreed under the auspices of the North East Atlantic Fisheries Commission (NEAFC). UK vessels fishing for the Western mackerel stock and for the main herring stocks, for example, were subject to weekly or fortnightly landings limits set according to vessel length, while daily or weekly limits had from time to time been applied for cod, haddock and whiting stocks in ICES Areas IV and VI (generally set according to the size of a vessel's crew). In addition, since 1980 separate allocations from the quotas for mackerel and the main herring stocks had been reserved for the relatively small pelagic freezer trawler sector (these vessels, together with the big purse-seiners, were the only UK fleet sectors to come under restrictive licensing before 1984, when the "pressure stock" licensing system(25) was introduced).

In 1983 a much wider range of stocks became subject to quotas under the CFP. As fishing effort increased over the next few years by an industry which was still expanding in domestic waters, particularly in the Area VII demersal fisheries, weekly (later to become monthly) landings limits were extended to cover fishing for quota stocks by all vessels over 10 metres in length.

Early in 1984, however, the Shetland Fish Producers' Organisation (SFPO), one of 14 POs then established in the UK, successfully applied to the Government to be given its own annual allocations from the Area IV and VI haddock quotas to manage on behalf of its members. These allocations were based on the historic share of the UK's haddock catches landed by SFPO members. Later that year a number of other POs (as well as a few of the larger fishing firms) were given allocations from the Area IV and VI cod quotas on a similar basis, while in 1985 annual quotas were allocated to POs for Area IV/VI cod, haddock, whiting and saithe as well as Area IV herring. By the following year, most of the POs whose members were active in the North Sea and West of Scotland areas were receiving annual quota allocations for most of the stocks in these areas. Also from 1985, annual allocations from the main mackerel and herring quotas were granted to *individual* freezer trawlers and purse-seiners instead of parts of the quotas being reserved for these sectors as a whole.

The system of PO quota allocations was extended, at the industry's request, to cover quotas in the Irish Sea in 1990 and then the remainder of Area VII in 1991. By this time all the UK POs were managing quota allocations on behalf of their members. Annual allocations were now routinely based on the combined landings *track records* of each PO's over 10 metre vessel membership during the previous three years (calculated as a percentage of the total landings by UK vessels over the same reference period).(26) Fishing for quota stocks by vessels not belonging to a PO, as well as by PO member vessels whose PO had not requested an allocation for a particular stock,

[25] The development of the UK's restrictive licensing system, to which the quota management system is linked, is described in Appendix I.

[26] The reference period was two years in the case of some pelagic stocks.

continued to be regulated directly by the Government by means of (in most cases) monthly landings limits. The uptake of the quota shares reserved for the inshore (10 metre and under) sector was not regulated unless the level of estimated landings dictated an early fishery closure.[27]

Before 1995 the POs could more or less freely decide each year which quotas they wished to manage. Given the track record-based allocation system, this allowed for a degree of strategic behaviour. For example, it was possible for POs to "build up" relatively strong track records for particular stocks while fishing against the Government's monthly landings limits before requesting a sectoral allocation. Conversely, it was possible for a PO to decline an allocation if its catch performance in the preceding three years would result in stricter quota controls for its members than they would face fishing against anticipated non-sector monthly limits. In addition, vessels in some POs had allegedly been reporting catches as coming from areas in which the PO had not taken allocations instead of counting those catches against their sectoral quotas.

In 1995, in order to simplify the system and to press the POs into taking more management responsibility (and to reduce the possibilities for "ghost fishing" in order to inflate track records), the Government obliged the POs to accept allocations for *all* demersal species quotas (however small some of the allocations might be), although the management of the various pelagic quotas remained optional. From 1999, however, POs and other groups choosing to receive sectoral allocations for pelagic stocks were similarly obliged to take allocations for all pelagic stocks.

Under the sectoral quota system each of the POs were free to decide on the means by which they managed their quota allocations. Some chose to operate a common quota pool and set monthly landings limits for the membership, others allocated individual annual quotas to member vessels or companies for some or all stocks, normally based on each vessel's track record. The quota management approaches currently adopted by the various POs are examined in the following section. Individual vessel allocations were granted *directly* by the Government only to purse-seiners and freezer trawlers in respect of the main mackerel and herring stocks (where the vessels were not in membership of a PO taking a quota allocation for these stocks).

The POs were also able to undertake quota swaps between themselves at any time (as well as with the small number of companies which received allocations of pelagic quotas). To begin with, all such swaps had to balance in terms of "cod-equivalents"[28] but in 1993 this restriction was removed, although some exchange of fish still had to take place. In 1996 quota "gifting", i.e., one-way transfers of quota, was allowed for the first time. Any financial arrangements associated with these transactions, however, were left as a private matter for the POs and their members.

---

[27] More recently temporary stops, and lately monthly limits, have been imposed for a few stocks in an attempt to spread a fishery over 12 months.

[28] The notion of "cod-equivalents" was first used in the early 1980s during the negotiations over international TAC shares. Tonnages of species other than cod are inflated or deflated according to their average market price compared to that for cod.

In 1994 the Government introduced a provision to enable POs to retain the landings track records of any member vessel whose owner would agree to surrender his licence. In practice the PO would pay financial compensation to the owner for decommissioning his vessel. The PO could then arrange to "ring-fence" the additional landings track record, so that if any of the remaining member vessels subsequently left the PO, that proportion of their track record which was attributable to extra quota obtained in this way could be retained within the PO. This facility was used in a few cases, effectively enabling some POs to buy in additional quota, but apparently became relatively unattractive as the value of licences and track records grew following changes in the licensing system and an increasing demand for licences and quota allocations (see below).

As Appendix I describes, various types of licence have been freely traded since they were introduced, except where transferability between ownerships was explicitly restricted or prevented. Before 1995 individual landings track records were normally associated with the vessel rather the licence, except where a licence was transferred onto a new vessel (or at least a vessel new to a particular fishery) or where a licence aggregation was undertaken (in which case the track records of the previously licensed vessels were aggregated onto the new vessel). From 1995, however, track records were formally associated with licences. This move greatly increased the value of licences and facilitated licence trading.

The most significant advance in quota tradeability came not from developments in the licensing system, however, but from the changes in the rules governing quota swaps between POs. Once quota could be transferred more or less freely between POs, it could be traded between a member of one PO and a member of another PO, either permanently (a straight quota sale) or on an annual lease basis (see below). To begin with it was only the relatively small number of POs operating individual quota systems whose members could take advantage of this possibility, but recently more POs have introduced IQs for certain stocks and a number of the POs operating quota pools have permitted members to "top up" their allowances under a "pool-plus" system with quota bought or leased in from other vessels (see Section 3.3).

Under the track record quota allocation system based on the three-year rolling reference period, a (permanent) sale of 100 tonnes of quota from a vessel in PO *A* to a vessel in PO *B* would involve the transfer of 100 tonnes from PO *A* to PO *B* in year one, 67 tonnes in year two and 33 tonnes in year three. In year four the transaction would be complete, since PO *B* would now receive the entire extra 100 tonnes of quota in its allocation. For deals between vessels within the same PO, the same time would be needed for the track records to adjust. A one-off annual lease of 100 tonnes of quota from a vessel in PO *A* to one in PO *B* in year one would require PO *B* to transfer *back* 33 tonnes of quota to PO *A* in each of years two, three and four in order that track records would be completely readjusted by year five. Note that a one-off annual lease of 100 tonnes of quota from a vessel in PO *A* to one in PO *B* in year one with *no* subsequent transfers either way would eventually be reflected in an additional 50 tonnes of quota for PO *B* but this would take 7

years to work through the system (assuming that allocations were rounded to the nearest half tonne - trades in smaller amounts would be resolved more quickly).[29]

The Government implicitly recognised the reality of quota trading in 1996/7 when it allowed the track records of vessels removed from the fleet in the final round of the 1992-1997 decommissioning schemes to be retained or transferred onto another vessel. This almost certainly provided a stimulus to quota trading between individuals and led to a number of POs taking the opportunity to increase their quota pools or to move to a pool-plus system.

The system of rolling track-record based allocations was ended in 1999 following consultations between Government and industry over the previous two years. From 1999 quota allocations were formally fixed, although the allocations for both 1998 and 1999 had been based on track records over the period 1994-1996 which was the normal reference period for the 1997 allocations. This was done to avoid incentives to increase track records over a qualifying period leading up to the fixing of allocations; in effect, therefore, allocations had become fixed in 1997. The "Fixed Quota Allocations" (FQAs) attached to vessels' licences were denominated in quota units which were equivalent to 100kg shares of the 1999 allocation. For 2000 and 2001 the value of a unit was then inflated or deflated according to changes in the UK's national quota allocations.

The move to FQAs, in common with many of the developments in the UK quota management system, was to an extent industry-led, although by no means all sectors of the industry were in favour of the change.[30] Among the advantages cited for the new system in the 1997 Report of the Working Group on FQAs were:

- "greater year on year stability in managing quota allocations;"
- "less pressure on fishermen and their POs to maintain their track records by utilising their full quota allocations;"
- "a disincentive to 'paper fish' or 'ghost fishing'"
- "the ability to swap or gift quota without suffering a reduction in future quota allocations"
- "facilitating investment in the fleet by ensuring that track records were retained whilst vessels were being replaced or modernised"

During the move to FQAs the Government allowed all outstanding quota trades to be resolved with a once off reallocation of quota units. Each PO membership was allocated the number of units that reflected their current track records, but these units could be transferred to other POs or reallocated amongst the licences of the membership as appropriate. The Government insisted, however, that this did not set a precedent for future reallocations. The implications of this for quota trading are to simplify short term leases but to complicate deals to sell quota permanently

[29] These examples also assume no change in the relevant TAC.

[30] Of the responses received to a widely circulated 1998 consultation paper on FQAs, 5 out of 19 POs were against the move, along with 20 out of 24 Fishermens' Associations, 2 out of 18 fishing companies and 197 out of 215 individual vessel owners.

(apart from sales of units for aggregation on the licence market). A "permanent" transfer of quota from one vessel to another would now require the transfer of the same amount of quota between vessels (and their POs if the vessels are in different POs) in perpetuity. Particularly where TACs fluctuate significantly, the contractual terms of such deals are normally set out in quota units rather than tonnes of quota. Despite the increased risk associated with long term quota transfer deals, a large number have nonetheless been concluded since the introduction of FQAs in 1991, with around 900 such transfers being notified to Fisheries Departments in the context of the recent FQA adjustment exercise (see p.iii).

Particularly complex agreements can arise when a licence is put up for sale. Typically, transactions are arranged by licence brokers and may involve the "stripping" of units from the licence and their sale to one or even a number of purchasers. As far as Fisheries Departments are concerned, the units remain associated with the original licence, so in practice all sales must involve vessels in POs and wherever quota units are not to follow the licence the POs must agree to transfer the appropriate amounts of quota back each year.

Independent quantitative data on the total trade in quota that has taken place in the UK is not available, but from interviews with people directly involved (including licence and quota brokers) it was possible to gain an overall impression of how the quota trade has developed. It appears that quota trading to any significant extent began in 1995, following the association of track records with licences and an increased demand for both licences and track record. Quota leasing appears to have begun in earnest at around the same time, although one-way quota swaps between POs were not officially sanctioned until the following year.

Table 3.1: Total numbers of licence aggregations 1995-2001

Year	1995	1996	1997	1998	1999	2000	2001*
Donor licences	227	224	199	105	154	112	6
Recipient licences	110	91	94	49	83	67	4

Source: DEFRA. *as at 31.03.01

Recently the trade has been dominated by quota leasing, and the number of licence aggregations has decreased as Table 3.1 shows. One broker reported that the annual number of leases he handled had increased from around 20 in 1995-1998 to 60 in 2000 and nearly that figure during the first half of 2001. Anecdotal evidence suggests that much of the increase in leasing in recent years is due to demand by vessels in the North Sea demersal fisheries, in response to an increased enforcement effort by the authorities (and decreases in the UK cod quota in Area IV). The move to FQAs would be expected to have increased the proportion of leases, although one broker was of the opinion that FQAs *per se* had had no noticeable effect on trade. There was also a suggestion that leasing was now the dominant form of trade due to a shortage of available capital for outright purchases, but it also seems probable that leasing is simply the type of transaction that is optimal under the FQA system as it now operates.

A significant piece of circumstantial evidence for the increasing number of quota trades between vessels in different POs is provided by Fisheries Departments' records of the total number of swaps arranged between POs over recent years. As Table 3.2 shows, there has been a massive increase in the number of swaps undertaken annually between POs in the last five years and it seems likely that this trend reflects the increasing numbers of transfers needed to give effect to quota trades between PO vessels.[31]

Table 3.2: Total numbers of inter-PO swaps 1994-2000

Year	1994	1995	1996	1997	1998	1999	2000
Swaps	90	251	368	397	499	488	680

Source: DEFRA

Table 3.3: Observed sale prices for UK quota 1996-2000

	1996/1997	1997/1998	1998/1999	1999/2000*
Hake VI & VII	£1,600	£3,250	£3,000	£2,500
Monkfish VI	£2,500	£3,000	£3,000	£2,500
Monkfish VII	£3,000	£4,000	£5,000	£4,000
Megrim VI	£1,600	£3,000	£2,500	£1,100
Megrim VII	£1,600	£3,250	£2,750	£1,500
Cod IV	£900	£1,000	£1,000	£1,200
Cod VI	£900	£1,500	£1,350	£1,200
Cod VII	£900	£1,500	£1,350	£1,200
Haddock IV	£300	£300	£700	£500
Haddock VI	£800	£1,400	£1,700	£1,400
Haddock VII	£200	£200	£350	£300
Saithe IV	£300	£300	£400	£600
Saithe VII	£300	£300	£400	£300
Whiting IV	£200	£300	£300	£300
Whiting VI	£200	£200	£300	£300
Whiting VII	£200	£200	£300	£300
Plaice IV	£1,000	£1,200	£1,200	£1,000
Plaice VII	£1,000	£1,200	£1,200	£1,000
Sole IV	£3,000	£5,000	£9,000	£5,000
Sole VII	£3,000	£5,000	£9,000	£5,000
Pollock IV	£200	£200	£400	£300
Pollock VII	£200	£200	£400	£300
Nephrops IV	£1,000	£1,500	£1,700	£1,500
Nephrops VI	£900	£1,100	£1,450	£1,250

Prices are median nominal prices per tonne of quota/*per 10 quota units. Source: two (anonymous) licence/quota brokers.

[31] Note that the system cannot distinguish between swaps that give effect to private trades and those which, for example, are arranged by POs on behalf of the collective membership.

Table 3.3 shows the nominal prices (median values) per tonne of quota for sale or permanent transfer for a number of stocks, as observed by two important quota/licence brokers during 1996-2000. These figures are reproduced here simply to illustrate the level of quota prices in recent years and the number of stocks for which there has been trading.

Finally, it should be noted that the UK's quota management system has developed as an administrative arrangement between the Government and the fishing industry. Legislation requires fishermen to comply with the terms of their licences, issued by the Secretary of State at his (her) discretion under the provisions of the Sea Fish Conservation Act 1967 (as amended). Licence conditions include, in the case of non-sector vessels, restrictions on the amounts of fish which may be retained on board, but in the case of PO members the licence schedule simply requires observance of the quota management rules of the PO. Aside from this, the quota management system is not currently dependent on primary or secondary legislation.

3.3 Current management arrangements

3.3.1 Quota management rules

The principal features of the quota management arrangements as they operated in 2001 are set out below.[32] Firstly, the allocation mechanism can be summarised as follows:

- Quota allocations are made to POs in respect of the vessels over 10m in length in their membership[33] in proportion to the total number of units associated with those vessels' licences. POs opting to manage demersal species quotas or pelagic species quotas must accept allocations for *all* demersal stocks and *all* pelagic stocks respectively. In the case of pelagic stocks allocations can also be made to groups of vessels other than POs (currently this applies to just one fishing company).

- For each stock a "non-sector" allocation is reserved for those over 10m vessels not in membership of a PO, in proportion to the total number of units associated with those vessels' licences (but see below).

- Allocations are set aside for the 10m and under fleet on the basis of the total number of units assigned to this group (but see below).[34]

[32] Based on the *Rules for the management of the UK's fisheries quotas in Areas IV, VI and VII (and associated areas) for 2001* issued by the Fisheries Departments in the UK, November 2000.

[33] as at 1 January each year.

[34] Note that at the time of introduction of FQAs individual track records were not held by the inshore fleet, but a track record was established for the group as a whole for the period 1994-96.

The main exceptions to these general rules of allocation include the following:

- Specific allocations are also made for the South West mackerel handline fishery (as 0.83% of the Western mackerel quota or 1,750 tonnes, whichever is the greater) and the Mourne herring fishery, defined as the fishery involving vessels of 12.2m and less using drift nets in the Mourne area of the Irish Sea (annual allocation and management as agreed with the industry).

- The non-sector allocations for a number of stocks are subject to minimum shares based upon 1994 allocations to the "pure" non-sector (vessels not belonging to a PO). These floor levels, in contrast with the main allocation mechanism, are calculated each year according to the number of vessels with certain minimum qualifying landings track records. This is known as "underpinning" of allocations, introduced in 1995 in response to industry concerns over a (disproportionately) shrinking non-sector share for many stocks.

- Underpinning also applies with respect to a number of stocks in the allocations made to the 10m and under fleet. Underpinning for all stocks in Area VII is determined as a minimum percentage (from 34.8% for VIId sole to 0.7% for *Nephrops*); for those stocks concerned in Area IV some floors are defined in percentage terms, others as a fixed minimum tonnage, while in Area VI the floors for all the stocks affected except *Nephrops* are defined in tonnes.

As described in the previous section, in the case of over 10m vessels the FQAs (defined in quota units) are associated with each vessel's licence. The number of units is fixed, but units will be aggregated if licences are aggregated.[35] If a vessel moves from one PO to another, the respective number of units and hence the resultant quota allocations move as well.[36] Otherwise, as we have seen, POs can exchange quota in-year (either on behalf of individual members or the membership as a whole) but this will not affect their allocations in subsequent years.

3.3.2 Management of the non-sector and 10m and under vessels

The Government Fisheries Departments regulate the uptake of quota allocations by the non-sector and the 10m and under fleet by varying the amounts these vessels are allowed to catch and land by virtue of the conditions attached to their licences. In the case of the non-sector (over 10m vessels) landings for most stocks are restricted to monthly limits (or per trip limits in the case of some pelagic stocks) which are varied as necessary, in consultation with the industry. Although in the past limits were often set according to vessel length, the size and composition of the non-sector is now such that all limits are flat-rate, i.e., the same for all vessels. Landings by the 10m

[35] No penalty is applied to the resulting total, as it is to the number of vessel capacity units (VCUs) attached to the licence (see Appendix I).

[36] In the case of movements of vessels between POs during the course of the year (rather than at 1 January) the adjustment of quota allocations is a matter for agreement between all the parties concerned (the vessel owners, the POs and Fisheries Departments).

and under fleet have until recently generally been unrestricted although temporary fishery closures were sometimes imposed for certain species (notably sole and *Nephrops*). Towards the end of 1999, however, monthly catch limits were imposed for *Nephrops* in the North Sea and these were extended to other areas in 2000. For some specific fisheries such as the Mourne herring fishery there is an annual closed season. Note that these arrangements apply whether or not the 10m and under vessels belong to a PO.

Monitoring of landings by the non-sector is achieved by means of submitted logsheets and landings declarations backed up by inspections of landings. A rather *ad hoc* sampling-based approach is apparently used for estimating the total level of landings by the 10m and under fleet, including landings surveys, submission of logsheets on a voluntary basis by some boats and data collected from auctions and buyers.

Monitoring and enforcement is the responsibility of the Sea Fisheries Inspectorate (SFI) for England and Wales, the Fisheries Inspectorate of the Department of Agriculture and Rural Development in Northern Ireland, and the Scottish Fisheries Protection Agency (SFPA) for Scotland. Infringement of licence conditions is covered by Section 4 of the Sea Fish (Conservation) Act 1967 (as amended) and can result in a licence being suspended or revoked by the Secretary of State (which has happened on four occasions) and/or referral to the courts, where the maximum statutory penalty is currently £50,000.

3.3.3 Quota management by the POs

There are now 20 sea fishing POs established and officially recognised in the United Kingdom. As can be seen from Table 3.4, in 2001 their combined membership accounted for nearly 70% of the total number of over 10m vessels active in the UK fleet, but in terms of total physical capacity (measured in VCUs)[37] and aggregate engine power the figure was around 85%.

Table 3.4: PO membership in the UK fleet as at 1 January 2001

Fleet sector	number	total kW	total VCUs
Over 10m vessels	2,030	680,339	555,308
of which PO member vessels	1,409 (69%)	579,795 (85%)	469,085 (85%)
of which non-sector vessels	621 (31%)	100,544 (15%)	86,223 (15%)
10m & under vessels	5,235	257,491	219,580
All vessels	7,265	937,830	774,888

Source: DEFRA

[37] Total tonnage figures could not be calculated due to the incomplete transition from the "GRT" to the "GT" measure of vessel tonnage. VCUs are explained in Appendix I.

Table 3.5: Membership of individual POs in 2001

	No. vessels over 10m*	Mean length	Mean VCUs
Aberdeen Fish Producers' Organisation (AFPO)	44 (0)	23.7	352.6
Anglo-North Irish Fish Producers' Organisation (ANIFPO)	70 (10)	18.7	265.3
Anglo-Scottish Fish Producers' Organisation (ASFPO)	82 (8)	17.3	208.9
Cornish Fish Producers' Organisation (CFPO)	120 (75)	18.1	230.5
Fife Fish Producers' Organisation (FiFPO)	35 (0)	21.4	415.8
The Fish Producers' Organisation (FPO)	38 (0)	30.9	706.2
Fleetwood Fish Producers' Organisation (FFPO)	38 (3)	27.6	370.8
Grimsby Fish Producers' Organisation (GFPO)	50 (0)	17.2	206.3
Lowestoft Fish Producers' Organisation (LFPO)	9 (0)	38.1	913.8
North East of Scotland Fish Producers' Organisation (NESFO)	68 (0)	24.3	398.0
North Sea Fishermen's Organisation (NSFO)	39 (0)	32.5	676.4
Northern Producers' Organisation (NPO)	43 (0)	25.9	395.3
Northern Ireland Fish Producers' Organisation (NIFPO)	120 (26)	18.5	244.7
Orkney Fish Producers' Organisation (OFPO)	7 (0)	30.8	602.0
Scottish Fishermen's Organisation (SFO)	365 (0)	22.2	347.5
Shetland Fish Producers' Organisation (SFPO)	52 (2)	28.7	614.0
South Western Fish Producers' Organisation (SWFPO)	115 (15)	17.7	221.8
Wales and West Coast Fish Producers' Organisation (WWCFPO)	41 (0)	36.1	564.4
West of Scotland Fish Producers' Organisation (WSFPO)	49 (12)	14.7	160.7
Yorkshire and Anglia Fish Producers' Organisation (YAFPO)	20 (1)	15.6	192.7

*number of 10m and under member vessels shown in parentheses. Sources: DEFRA, POs

Table 3.5 lists all 20 POs and shows their individual membership of vessels under and over 10m in length as at 1 January 2001 , together with the average length and number of VCUs of the over 10m membership. It can be seen that the POs vary widely in size and composition. Few have many member vessels of 10m and under in length, the notable exception being the Cornish FPO, while a number have no inshore vessels at all in membership. This largely reflects the predominant quota management role of POs in the UK[38] and the fact that the POs can have no quota management responsibility for 10m and under vessels under the current system. Some, such as the SFO, the largest UK PO, have a very wide range of vessel sizes and types in membership. Others have a distinct sectoral identity. The CFPO, SWFPO, LFPO and NSFO between them

[38] As an institution of Community market policy, POs were originally designed specifically to organise the first-sale marketing of fishery products and to implement market support measures such as compensated withdrawals, carry-overs, etc. In contrast to other countries such as France, market support has been relatively little used in the UK in recent years.

contain most of the beam trawlers fishing in Areas VII and IV; the FPO and NPO represent many of the largest demersal trawlers (including those fishing in distant waters); the WSFPO is made up mostly of *Nephrops* trawlers on the Scottish west coast. The WWCFPO was set up some years ago by a number of the UK's Spanish-owned vessels and the FFPO and Northern FPO have more recently absorbed many of the others. The NSFO was set up by predominantly Dutch-owned boats but a number of Dutch-owned boats are also now in the Fife FPO. At one time the POs all tended to have fairly strong regional identities. While for the most part this is still the case, in recent years their divergent quota management approaches have resulted in many vessels choosing to belong to a particular PO because of the quota management arrangements on offer rather than because it is the local or regional organisation.

Table 3.6: Allocation of UK demersal quotas in 2000

Quota stock	UK quota (t)	% to POs	% to non-sector	% to 10m&under
Area IV				
Cod	34,149	95.3	1.3	3.4
Haddock	53,056	99.8	0.1	0.2
Whiting	19,470	99.1	0.3	0.6
Saithe	6,820	99.7	0.1	0.2
Plaice	26,520	98.4	1.2	0.4
Nephrops	14,862	91.6	3.7	4.7
Area VI				
Cod	3,530	100.0	0.0	0.0
Haddock	15,002	99.7	0.2	0.1
Whiting	2,875	100.0	0.0	0.0
Nephrops	12,305	79.0	9.8	11.3
Area VII				
Sole VIIa	206	91.1	1.5	7.5
Sole VIId	711	58.0	4.7	37.3
Sole VIIe	385	91.0	2.1	6.9
Sole VIIfg	291	93.0	0.6	6.4
Sole VIIhjk	151	100.0	0.0	0.0
Plaice VIIa	1,035	86.6	2.8	10.6
Plaice VIIde	1,797	70.8	5.4	23.8
Plaice VIIfg	175	86.6	1.6	11.8
Plaice VIIhjk	170	100.0	0.0	0.0
Cod VIIa	950	98.0	1.6	1.3
Cod VIIb-k	1,740	72.6	2.4	25.0
Whiting VIIa	1,220	98.0	0.6	1.4
Whiting VIIb-k	1,527	77.9	3.3	17.8
Anglerfish	3,990	93.8	2.0	4.2

Source: DEFRA

Tables 3.6 and 3.7 show the proportions of the main UK demersal and pelagic quotas for 2000 allocated to all the POs, to the non-sector and to the 10m and under fleet. The figures are those for the end of 2000 and therefore take account of all in-year international and sectoral swaps. Firstly, it is evident that for most stocks the majority of allocations are managed by the POs. Only

in the case of the *Nephrops* fisheries and the inshore demersal fisheries of the English Channel (Areas VIId & e) and the South West peninsular (Areas VIIf & g) are the non-sector and the 10m and under fleet responsible for fishing quota stocks in significant quantities. Except in a few small specialised inshore fisheries, non-sector vessels are almost entirely uninvolved in the pelagic fisheries.

Table 3.7: Allocation of UK pelagic quotas in 2000

Quota stock	UK quota (t)	% to POs	% to others*
Western mackerel	192,770	90.7	9.3
North Sea herring	40,570	91.7	8.3
West of Scotland herring	24,990	91.4	8.6

*mainly independent pelagic boats; in the case of mackerel the small allocation for the inshore handline fishery is included. Source: DEFRA

Table 3.8 shows the 2000 distribution of quota among the POs and other groups in terms of the total *value* of quota held. Because the relationship between the selling/lease prices of quota on the one hand and the quayside (market) fish price on the other for quota of different species is complex, and is likely to vary significantly both across species and across time, it is difficult to extrapolate from those species for which quota prices have been observed to those for which there has been little or no trading under the current arrangements. In order to compile this table, therefore, the quota values have been assumed to be determined in the same way for each species, and so the ratio of the quota price to the market fish price is assumed constant across species.[39]

It is apparent that the distribution of quota in terms of value is highly concentrated in one PO (the SFO). This PO holds some 31% of the total value of UK demersal quotas and 45% of the value of pelagic quota, nearly 32% of the total value overall. The SFPO holds 24% of the value of pelagic quota but less than 10% overall. Otherwise no single PO holds more than 10% of the total value of either demersal or pelagic quotas.

As part of the survey undertaken for this report (see Chapter 4), all the POs were asked to describe the quota management arrangements they adopted in 2000. Responses to these questions were received from all the POs except the SFO, NESFO and GFPO but the quota allocation methods used by these POs were commonly known within the industry. The basic approaches adopted by the various POs are summarised in Table 3.9, together with the number of (over 10m) vessels which operate under different management regimes as a result.[40]

[39] Effectively, therefore, the quota price is simply standardised to the market price.

[40] The quota management arrangements adopted by the POs in 1996 were reviewed by Hatcher (1997).

Table 3.8: Distribution of 2000 quotas by value

	% Demersal	% Pelagic	% Total
Aberdeen Fish Producers' Organisation (AFPO)	5.8	0.0	4.8
Anglo-North Irish Fish Producers' Organisation (ANIFPO)	2.5	3.4	2.6
Anglo-Scottish Fish Producers' Organisation (ASFPO)	4.4	0.0	3.6
Cornish Fish Producers' Organisation (CFPO)	3.4	0.0	2.8
Fife Fish Producers' Organisation (FiFPO)	3.8	0.0	3.1
The Fish Producers' Organisation (FPO)	2.0	9.2	5.8
Fleetwood Fish Producers' Organisation (FFPO)	1.5	0.0	1.2
Grimsby Fish Producers' Organisation (GFPO)	2.0	0.0	1.6
Lowestoft Fish Producers' Organisation (LFPO)	1.3	0.0	1.1
North East of Scotland Fish Producers' Organisation (NESFO)	9.9	1.0	8.3
North Sea Fishermen's Organisation (NSFO)	6.0	0.7	5.1
Northern Producers' Organisation (NPO)	3.4	0.2	3.2
Northern Ireland Fish Producers' Organisation (NIFPO)	4.3	6.9	4.5
Orkney Fish Producers' Organisation (OFPO)	1.7	0.0	1.4
Scottish Fishermen's Organisation (SFO)	30.6	44.7	31.7
Shetland Fish Producers' Organisation (SFPO)	4.7	24.1	7.4
South Western Fish Producers' Organisation (SWFPO)	3.0	0.0	2.5
Wales and West Coast Fish Producers' Organisation (WWCFPO)	2.9	0.0	2.4
West of Scotland Fish Producers' Organisation (WSFPO)	1.0	0.0	0.8
Yorkshire and Anglia Fish Producers' Organisation (YAFPO)	0.6	0.0	0.5
Independent pelagic vessels	0.0	9.0	1.3
Total all POs	94.8	99.2	95.7
Non-sector	1.8	0.3	1.5
10m & under	3.4	0.3	2.8

Table 3.9: POs' quota management approaches in 2000

Basic approach	POs	Number of POs	Number of vessels	% all PO vessels
"Pure" pool	--	0	0	0.0%
"Pool-plus"	ASFPO, CFPO, WSFPO	3	251	17.8%
Pool + IQs	AFPO, ANIFPO, FiFPO, FFPO, GFPO, NESFO, NIFPO, SFPO, SFO, SWFPO, WWCFPO, YAFPO	12	1,022	72.5%
IQs only	FPO, LFPO, NPO, NSFO, OFPO	5	136	9.7%

None of the POs now operate only with what might be called a "pure" pool system, i.e., one in which no individual member can enhance his allowance relative to other members. Three POs, the ASFPO, CFPO and WSFPO, do not allocate IQs as such for any stocks to any vessels, but within these POs individual members can lease in quota and fish against their own allocations once they have exhausted their monthly limits from the pool (the so-called "pool-plus" system).

Of the remaining POs, twelve allocate IQs, based on vessels' own FQAs, for at least some stocks and to at least some of the membership. Some of these POs, however, did operate a "pure" pool for the remaining stocks and/or members in 2000: these included the ANIFPO, the NIFPO (although here top-ups were to be permitted from 2001) and the SFPO. The two Northern Irish POs allocate IQs to their pelagic boats, as does (as far as we are aware) the SFO. The SFPO allocates IQs to its pelagic boats and to one of the larger demersal trawlers. The SWFPO allocates IQs to beam trawlers for sole, but the membership has decided these should be non-tradeable (although members can top up their quotas by leasing in from outside the PO). Some newer members of the SWFPO, however, have IQs for all stocks. The YAFPO also allocates IQs for some stocks only (in the North Sea) but allows some members (those with Area VII quota) to take IQs for all stocks. A number of the POs allocate monthly limits from a pool to part of the membership while giving IQs to others if they demand them. These include the AFPO and NESFO as well as the FiFPO and FFPO. Some respondents commented that the PO had to allocate IQs to members who wanted them or those vessels would simply move to another PO. Similarly, many POs apparently feel obliged to help their members lease in quota if they are asked to.

Five POs, the FPO, LFPO, NPO, NSFO and OFPO, allocate all quotas to member vessels or companies as IQs based on FQAs plus any quota leased in. In the case of the LFPO just one company now represents the entire membership.

Information obtained from the POs about their involvement in quota trading permitted an estimation of the extent to which the *final* year 2000 allocations to those POs (i.e., the allocations at the end of the year after all swaps and transfers) are the result of trading. This was quite significant for some stocks as Table 3.10 shows. Note that this does not include any data for the SFO or GFPO and that only trades between vessels in different POs, i.e., those trades requiring movements of fish between POs, are included.

Indications for some other stocks such as Area VII hake, megrim and monkfish are that there is a significant amount of trading between vessels within the same POs, if not between POs. Overall, however, the extent of trading within POs appeared to be more limited. From the POs for which information was available the volume of intra-PO trading was generally around a third of the total trade by the membership.

Table 3.10: Estimated contributions of trades to final PO allocations in 2000

Stock	% overall final allocation
IV whiting	25%
VI cod	19%
IV *Nephrops*	19%
IV cod	17%
IV haddock	15%
IV sole	15%
VI haddock	8%
IV plaice	4%

All but four of the POs hold quota units on one or more "dummy vessels".[41] These were created in 1998 when POs were allowed to reconcile quota trades by reallocating units between vessels. In some cases the units associated with the dummy vessel represent additional quota pools for the membership as a whole. These units may have derived only from the extra 2.5% allocation of units which was made to each group when FQAs were first introduced, but in a number of POs this was topped up with quota acquired by the PO from surrendered licences. Some POs arranged for member vessels to "park" units on a dummy vessel rather than associate them with their own vessel licence. This would enable a licence to be sold on at some later stage without taking the units with it. The four POs without units on dummy vessels POs moved all units onto members' licences in 1998.

Table 3.11 indicates the proportion of the POs' total allocations of units in 2000 that were held on one or more dummy vessels. The units have simply been summed across species, so the percentages do not represent overall percentages of quota in tonnes (although they would have done if TACs had remained unchanged since FQAs were introduced) but they nevertheless give an indication of the relative amounts of quota held "centrally" by the POs. A number of the POs held quite significant amounts (around a sixth to a quarter) of their total allocations of quota units on dummy vessels, while one had over 40% of its units on a dummy vessel. Information is not available on whether, in the case of this and a number of the other POs, this fish is held collectively for the PO membership as a whole (although it seem likely that in many cases it is), but for "IQ-oriented" POs the fish is almost certainly held for particular member vessels.

[41] Fisheries Departments associate the units with one or more dummy vessel registration numbers for each PO.

Table 3.11: PO quota units placed on "dummy vessels" in 2000

% total units on "dummy vessels"	Number of POs
0	4
0 – 10	11
10 – 20	2
more than 20	3

All the POs from which information was received monitor their members' uptake of quota allocations through routine checking of submitted copies of the vessels' logsheets, landings declarations and sales notes. These are checked against allowances (e.g., monthly limits or IQs). If detected, infringements, which represent violations of the rules of the PO,[42] are then dealt with in various ways ranging from a private warning to quota deductions, fines and ultimately the threat of expulsion from the PO for persistent offenders. As a general rule it appears that all the POs apply a penalty whether or not the PO as a whole is disadvantaged as a result, to the extent that quota available to other members is reduced in the current year or the PO suffers a quota deduction in the subsequent year.[43]

The schedules of penalties applied by the POs are broadly similar but differ in detail. Some POs apply fines plus deductions for all quota "overshoots", others apply deductions for first offences and then deductions plus fines for subsequent offences. Fines range from 10-20% of the gross market value of the overshoot to 2 or 3 times the value. In some cases deductions are applied at less than 100% of the overshoot, in others at 100% of the value, or even 200%. In at least one PO overshoots near the year end automatically result in deductions of twice the amount of the overshoot. Many of the POs require members to attempt to cover overshoots by leasing in quota, in which case the penalty is not usually applied. Some POs reported no problems with members exceeding their allocations while others admitted to dealing with between 6 and 56 overshoots during 2000. No POs appeared to have threatened any member with expulsion in recent years.

Apparently none of the POs themselves undertook inspections of members' landings in order to verify the accuracy of the paperwork submitted to the PO. Clearly any vessel deliberately seeking to land significant quantities of over-quota fish would falsify its documentation in order to appear in compliance with its PO's quota management rules and hence the ability of the POs independently to detect violations is necessarily rather limited. The task of enforcement of the requirements of Community control legislation for vessels to keep true logsheets and to submit

[42] All the POs are legally established as either mutuals or limited companies.

[43] The Fisheries Departments' quota management *Rules* provide for compensating deductions from a subsequent year's allocation if overfishing of a PO's allocation results in another group being prevented from landing its full allocation in that year.

accurate sales notes and landings declarations falls to officers of the Sea Fisheries Inspectorate (in England and Wales), the Fisheries Inspectorate of the Department of Agriculture and Rural Development for Northern Ireland and the Scottish Fishery Protection Agency. Offences may be referred to the Courts in which case the maximum fine is £50,000.(44)

3.4 A critical evaluation of the UK system

In Chapter 2 it was argued that fixed quotas, i.e., quotas which cannot be varied in the short run, will, relative to quotas which can be varied, tend to give rise to stronger incentives to land fish illegally and to discard fish in multispecies/multi-quota fisheries. The basic problem with fixed quotas, be they annual individual quotas or monthly quota limits, is that given a fixed total supply of quota for the industry as a whole, the allocation of quota to individual vessels is more or less arbitrary and will almost certainly be inefficient. In theory we could envisage a hypothetical arbitrary or administrative allocation of quota that produced exactly the allocation that a market in quota would produce, but in a non-static world even this allocation would very soon become inefficient and therefore the "perfect" allocation would need to be repeated continuously. A market in quota, it was argued, should, if the market functions well, produce an efficient allocation of quota automatically at all points in time. Recall that the efficient allocation is the allocation which maximises industry profits given the total quota constraint, and which should reduce the incidence of quota-induced discarding.

If quota can be traded between vessels then when trade takes place it is the result of units of quota being worth more to some vessels than to others (in which case it is implicitly the case that the initial allocation of quota was inefficient). That under these conditions trade will inevitably take place wherever it proves possible, even if trading is not particularly encouraged or easy to accomplish, is exemplified by the UK experience as the evidence in this and the next chapter clearly shows.

In an industry in which there is excess capacity in relation to the total supply of quota, quota trading should assist a rationalisation of capacity in the fleet. Holders of quota, if they scale down their capacity or exit the fishery altogether, will be compensated to the value of the quota they sell. If quotas are non-tradeable, operators can only realise the value of other assets such as the boat and its gear (and the licence if that is also a tradeable asset). In economic terms the *opportunity cost* of remaining in the fishery, at least with one's current level of operating capacity, is significantly increased if quota is a tradeable asset. As we have suggested, this was implicitly recognised by the Government when it sought to increase incentives to take up decommissioning grants under the last decommissioning round by allowing owners to retain their track records for private disposal.(45)

---

[44] The Sea Fishing (Enforcement of Community Control Measures) Order 2000; The Sea Fishing (Enforcement of Community Control Measures) (Scotland) Order 2000; The Sea Fish (Conservation) Act 1967 (as amended).

[45] The role of the market in rationalising capacity was also explicitly recognised back in 1990 when the "capacity aggregation" scheme was introduced. It may be remembered that at the time the scheme was envisaged as a precursor

Although it is often a neglected element in discussions about quota management in general and ITQ systems in particular, in Chapter 2 we sought to emphasise the importance of *enforcement* from the outset. Clearly, enforcement is crucial to achieving the management objectives which quotas are intended to achieve. We also noted that if there was overcapacity in the fleet, then perfect enforcement of *fixed* quotas would almost certainly result in some downward pressure on fleet capacity, at least to the extent that some vessels were operating with non-viable levels of quota. The corollary to this observation is that if enforcement is sufficiently weak that vessels are able to continue to operate with non-viable levels of quota, then overcapacity and hence, in turn, over-quota landings becomes an endemic problem. If, on the other hand, vessels with non-tradeable quota were forced to exit the fleet because of increased enforcement effort then, as we have observed, they would be compensated only to the value of their vessel and other tradeable assets.[46]

Enforcement is of course also necessary for the efficient functioning of a tradeable quota system. If a vessel can land fish profitably without paying for quota then it will certainly have an incentive to do so. The fact that, as in the UK, quota is observed to be traded at relatively high prices suggests that enforcement is sufficiently strong to provide significant incentives to hold quota, but this does not mean that at the margins there will be no over-quota landings. Data were not available to enable any analysis of the effectiveness of quota enforcement in the UK but there is ample anecdotal evidence of significant quantities of over-quota fish being landed in parts of the UK in the recent past. There have also been studies which have documented the extent to which landings over and above quota allowances occur almost routinely in at least some fisheries.[47]

The UK quota management system has both strengths and weaknesses from an economic perspective. To begin with, in terms of strengths it is not trivial to observe that in the UK there has been a real and commendable attempt to monitor and control the uptake of national quotas and to allocate quotas in some rational way to individual vessels within the fleet. This cannot be said of the fishery management regimes of some other countries.

Although the system of rolling track records has now been replaced by FQAs, since the initial FQA allocations derived directly from the 1997 track record-based allocations our evaluation begins by considering the track record system.

The logic underlying the track record-based system of allocation was appealing in that it offered a potential mechanism for allocating quota on the basis of capacity, which was taken to be revealed by a vessel's recent history of landings. A drawback of the system, however, was that there were incentives for vessels to over-declare their landings, up to permitted limits, in order to maintain quota shares (the practice known as "ghost fishing"). At the same time, if a vessel's track record-

---

to a (quota) "entitlement aggregation" scheme and ultimately some form of ITQ system for the UK.

[46] In a restricted entry fishery the resale value of many fishing vessels may be rather low.

[47] See, for example, Nautilus Consultants (1998) and Hatcher *et al* (2000).

based allocation was or became inadequate there would be incentives, as under any fixed quota system,[48] to land fish illegally and then to under-declare landings. Added to this, of course, was the problem that nominal quotas could not be secured to the extent that TACs and therefore national quotas fluctuated. While any system of fixed quotas makes it difficult to diversify, except into non-quota fisheries, the incentives to maintain quota shares under the track record-based system further discouraged diversification unless vessels were prepared to "ghost fish" their allowances at the same time.

There were positive aspects to the development of a PO-centred quota management system, however. By pooling their members' quota allocations, and by swapping quota of different species in and out of the PO, the POs had the potential to ameliorate the problems of fixed quotas by reallocating quota between the different POs and between vessels within each PO. But, while this system could plausibly help to mimic a market allocation of quota to some extent, the possibility for an efficient allocation through what was effectively a combination of barter and exchange and democratic decision-making was necessarily very limited. Within most of the POs, in the absence of price signals for quota, allocations were decided on simple equity grounds, hence flat-rate monthly allowances, or as equal shares according to some observable indicator of a "need" for quota, hence allowances scaled according to vessel length, crew size etc. The Government adopted a similar approach to allocating quota for the non-sector. Within one or two POs, however, quota was allocated according to the amount actually brought into the PO by individual vessels, as individual quotas (analogous to shareholdings in a company).

The essence of a market is that price signals enable an efficient allocation to be achieved without intervention. A good, such as a unit of quota, once it can be traded, is allocated according to the value people place on it. In the case of quota, that value is the profit that can be earned by using a unit of quota to catch a unit of fish. As we saw in Chapter 2, if someone else (another fishing vessel operator) can earn more from a unit of quota than you can, you are better off selling the quota than using it yourself, provided a price that is mutually beneficial can be agreed. If quota cannot be traded, but can only be given away for nothing or reallocated by mutual agreement, then it is not impossible for an efficient allocation to be achieved but it is very unlikely. The most likely result is an agreement for all to have equal shares from the outset, which is exactly what most of the POs decided, or in some cases, where a system of equal shares is patently a nonsense, there is an agreement for scaled allowances, or for each vessel to receive exactly what it brought with it, which was the case with one or two of the POs with relatively few, large and/or heterogeneous vessels in membership.

Under these conditions it is very difficult for any individual vessel operator to acquire additional quota in order to increase (legal) profitability (in some cases possibly to non-negative levels), and there are very weak incentives to relinquish quota that is surplus to requirements. It is therefore not surprising that trading in quota developed rather quickly once it became possible. POs and

[48] Note that here we use the term "fixed quotas" as distinct from "tradeable quotas". In order to avoid confusion we will use "FQA" to refer to the system of "Fixed Quota Allocations" introduced in 1999.

individuals began to buy licences for their quota allocations, and to lease or purchase quota both within POs and between POs, employing the facility for POs to engage in swaps and exchanges.

The implications of the move from track record-based allocations to FQAs for quota trading have already been mentioned. Fixing allocations made sense in many respects (ending incentives for "ghost fishing", for example) but fixed allocations that could not readily be traded actually made an efficient (or near-efficient) allocation *more* difficult than under the previous system. With track records it was at least possible for quota to move permanently from one vessel to another, despite necessitating rather complex deals over at least three years. With FQAs, as we observed, any transaction other than a one year lease (the one type of transaction that is made simpler by FQAs) involving vessels in different POs requires those POs to swap quota over a number of years (theoretically in perpetuity for a straight sale). This has two main consequences. One is that sales and long term lease agreements result in a *cumulatively increasing* number of deals which the POs must give effect to each year. Under the present system this might soon overload the capabilities of both PO officers and Fisheries Departments. The other is that sale transactions are subject to much greater risk, with the possibility of vessels changing hands (and the new owners then challenging existing quota agreements), moving into POs not bound by any agreement to swap quota, or becoming bankrupt, not to mention the problems caused by large reductions in TACs. It is likely that trading will become further dominated by one year leases which will be less efficient in allocating quota and rationalising capacity in the fleet. In essence, it is arguable that FQAs only really make sense in strengthening property rights that can be traded like any other property right.

Despite the potential problems of a democratic approach to quota allocation, there nevertheless continue to be good arguments for associating groups of quota-holding vessels in institutions such as the POs. The possibility for collective responsibility for monitoring and control of quota uptake is a strong one (although with a relatively weak Government enforcement system there is also the possibility of collective cheating rather than collective respect for legal rights and responsibilities). Another positive argument, as we have seen, is the possibility for the POs to play an active role in facilitating trade in quota and hence reducing the transaction costs associated with trades. In this context there may indeed be an argument for groups of individual quota holders pooling some of their quota if the costs of trade (balancing landings with quota holdings) are reduced by operating as a collective. In a multispecies fishery, for example, it may make sense for quotas for non-target species to be pooled and for the PO to manage the collective quota.

There is no economic argument of principle for excluding the smaller inshore vessels (who nevertheless target the same stocks) from the management system applied to the rest of the fleet. It is difficult to see why quotas should apply for an 11m trawler but not a 10m trawler in the same fishery (the 10m vessel may even have a greater catching capacity!). The only possible argument would be that the economic cost to society of enforcing quota controls on the (arbitrarily defined) inshore fleet exceeded the economic cost of leaving them free of quota restrictions, but this is not

very satisfactory for the governance of the fishery as a whole. There are also no real economic arguments for mechanisms such as "underpinning", which was introduced under the track record system in order primarily to protect inshore fisheries from losing track record when stocks failed to appear on inshore grounds. Ideally, the quota management system should be such that guaranteed shares are unnecessary because there is a more flexible allocation mechanism.

In summary, the positive aspects to the UK quota management system are that it allocates quota at the individual vessel level (notwithstanding the subsequent pooling of quota by many POs) and does so in some rational manner, it attempts to enforce quota controls at the individual vessel level, and by involving the POs in quota management it (potentially, at least) fosters collective responsibility for respecting quota limits.

Given the economic arguments for allocating quota *efficiently* amongst vessels, which we have suggested can only really be achieved with a relatively unconstrained market for quota, the limited tradeability of quota which the UK system permits is a positive aspect, but against a tradeable quota benchmark the obstacles to trade represent negative aspects to the system. These obstacles include the relatively complex administrative procedures necessary to accomplish trades, the impossibility of permanently transferring quota under the present FQA system (except by licence sales and aggregations) and the effective exclusion of many PO members and non-sector vessels from the opportunity to trade. Logically, this suggests that FQAs should be made truly tradeable by annually reconciling quota trades in the FQA allocations, and that every vessel owner should have the right to fish against his own FQA should he choose to do so.

Highlighting once again the importance of enforcement, it is apparent that any quota management system is only effective (in terms of stock conservation objectives) to the extent that the quota constraints imposed upon individual vessels are enforced. As we have said, comprehensive and reliable data that would enable an empirical evaluation of the effectiveness of enforcement of quotas in the UK is simply unavailable. At the same time, there exists no time series of data on the economic performance of fleets during the development of the quota management system and the move to FQAs. It is therefore difficult to evaluate in practice the success of the quota management in the UK and in particular the current system of FQAs. We suspect, though, that despite some reports of recent increases in enforcement effort, particularly on the east coast, the performance of the quota management system in terms of stock conservation and economic efficiency (including incentives for a rationalisation of capacity) would be greatly improved if the enforcement of quotas were considerably more rigorous than we believe is the case at present.

Finally, we were asked to evaluate in a comparative sense the quota management approaches adopted by different POs. This is somewhat problematic unless one makes quite clear assumptions about the collective objectives of each PO's membership. As economists we tend to adopt a normative stance which assumes the primary objective of efficiency (though not necessarily to the exclusion of other objectives which may conflict with the aim of maximising efficiency). Efficient use of quotas would suggest the ITQ model of PO management, but given

that the UK Government does not seek to capture the gains from efficient fishery exploitation through any sort of resource use charge or excess profits tax,[49] and arguably therefore does not *require* POs to maximise efficiency, we should perhaps allow for POs having objectives other than economic efficiency. If there is an objective of equity (distributive justice) which underlies the pooling and sharing of quota in a PO then implicitly the membership have decided, individually and collectively, to forgo some economic profits in that interest. This is a defensible approach, provided of course that vessels are adhering to quota limits. We might expect quota-related discarding to increase under a system of equal shares, with consequent effects upon stock conservation, but it is just possible that the PO may be effective enough in swapping quota with other POs that this problem is minimised, within the constraints of UK national quotas.

It is a little difficult to understand the rationale for the "pool-plus" approach, however. If the PO accepts the argument for a market in individual quota shares, then it is hard to see why it does not adopt an ITQ system, at least for the principal target stocks. It may be that this approach is mainly the result of a compromise between opposing views within the PO. We suspect, though, that within a PO vessels with larger than average FQAs going into the pool might be somewhat resentful at having then to lease in quota in order to increase their monthly quota allowances above the standard pool limits.

With regard to the performance of POs in terms of fish stock conservation, despite our general conclusion that tradeable quotas are likely to reduce over-quota landings and certain types of discarding, we simply do not have the data to evaluate the operation of the different POs in this respect. While, clearly, POs should do all they can to ensure that their members do not exceed their quota allocations, it is apparent that the extent to which they are in a position to do this is rather limited. We note, though, that all the POs who responded to our survey appeared to have proper disciplinary procedures.

[49] We referred to the issue of "rent capture" in Section 2.4.2.

4. The views of the UK fishing industry

4.1 Introduction

A key part of this study was to investigate the attitudes and perceptions of fishing vessel owners and their PO representatives about the existing management system and possible changes to the system, including the introduction of some form of ITQ regime for the UK.[50]

Structured questionnaires were used to elicit views on the move from track record-based quota allocations to fixed allocations (FQAs), the amount of quota trading now taking place and the possibility of more freedom to trade in quota. Views on management were sought from non-sector and 10m and under vessel owners as well as from the sector. Vessel owners belonging to POs were also asked about the quota management arrangements operated by their POs and about the extent of their own involvement in quota trading. All respondents, vessel owners and PO officers, were asked about their attitudes to and perceptions of ITQs as a management instrument and whether and to what extent they should be used in the UK.[51]

Section 4.2 below describes the survey of fishing vessel owners, while the results of the survey of POs are summarised in Section 4.3.

4.2 Survey of UK vessel owners

4.2.1 Survey methodology

In total 282 owners of UK fishing vessels were approached and telephone interviews were held with all but three of these individuals (who did not wish to participate in the survey). The 279 owners interviewed represented a total of 404 vessels which included more than 20% of the over 10m fleet. Around a fifth of those interviewed owned more than one vessel (predominantly in the demersal trawl and beam trawl groups). The aim was to include the views of the owners of a representative sample of vessels from the UK fleet. A decision had to be taken, therefore, about whether to duplicate the views of multiple vessel owners onto the vessel sample and the arguments for and against this were considered. In the event it was decided to base the results on the numbers of *vessels* in the UK fleet, and so in some sectors the results are weighted towards vessel ownership rather than vessel owners as individuals.

For sampling purposes the fleet was stratified, firstly by fishing method, and then where appropriate by area of operation and/or vessel length. The following sampling strata were identified:

[50] All survey work in this study was undertaken by Richard Banks, assisted by Carl James and Graeme Macfadyen.
[51] Copies of the questionnaires are available from the principal authors of the study.

(1) Demersal trawlers, sub-divided into
- demersal trawlers over 24m overall length (all areas)
- Area IV and VI demersal trawlers of 24m or under overall length
- Area VIId-k demersal trawlers of 24m or under overall length
- Area VIIa demersal trawlers of 24m or under overall length

(2) Pelagic vessels

(3) Beam trawlers, sub-divided into
- Area IV beam trawlers
- Area VII beam trawlers

(4) *Nephrops* trawlers,[52] sub-divided into
- Area IV *Nephrops* trawlers
- Area VI *Nephrops* trawlers
- Area VIIa *Nephrops* trawlers

(5) Gill netters & long liners (all areas)

(6) Non-sector vessels targeting quota species (mostly demersal trawlers)

(7) 10m & under vessels

The distribution of the sample by stratum is shown in Table 4.1. Just under half of the sample were vessels fishing predominantly in the North Sea (Area IV), a third were fishing to the West of Scotland (Area VI) and the remainder were mainly fishing in Area VII (the Channel, Irish Sea and Western Waters).

The results of the survey of fishing vessel owners are tabulated in full in Appendix II. Below we present a concise summary of the results, highlighting the main features of the survey responses. The overall results for the "sector" (i.e., PO member vessels over 10m in length) are presented as *weighted* averages across the sample strata, to take account of differences between the sample structure and that of the entire sector.

[52] defined as vessels whose catches comprised at least 45% *Nephrops*

Table 4.1: Vessel survey sample distribution

Sector	Population size*	Sample size	% sampled
Demersal trawlers (>10m)	*774*	*168*	*21.7*
> 24m (all areas)	219	50	22.8
≤ 24m Area IV/VI	395	74	18.7
≤ 24m Area VIId-k	78	26	33.3
≤ 24m Area VIIa	82	18	22.0
Pelagic vessels (>10m)	45	17	37.8
Beam trawlers (>10m)	*108*	*49*	*45.4*
Area IV	48	19	39.6
Area VII	60	30	50.0
Nephrops trawlers (>10m)	*329*	*82*	*24.9*
Area IV	76	26	34.2
Area VI	152	20	13.2
Area VIIa	101	36	35.6
Netters/liners (>10m)	130	20	15.4
Non-sector (>10m)	244	17	7.0
Total > 10m	*1,630*	*353*	*21.7*
10m and under	5,236	51	1.0
Total	*6,866*	*404*	*5.9*

*Source: DEFRA

4.2.2 General attitudes to the current management system

All respondents were asked:

How satisfied are you overall with the current quota management system?

Some 40% of the sector were quite satisfied but the rest were mostly either slightly unsatisfied or very unsatisfied. Only 4% were very satisfied. However, dissatisfaction appeared to relate more to quotas *per se* than the specific attributes of the UK system. Satisfaction was lowest among the beam trawlers as well as the smaller trawlers and prawn boats in the Irish Sea. Satisfaction was highest among the larger demersal trawlers, the netters/liners and the pelagic vessels. Overall there was generally a higher level of satisfaction with the system in Areas IV and VI than in Area VII.

Among the non-sector and 10m and under vessels satisfaction was low, with more than half in each case very unsatisfied with the system.

4.2.3 Attitudes to the FQA system

All respondents were asked:

Did you support the move from track record-based allocations to FQAs?

Now that FQAs have been introduced, do you consider that they represent an improvement on track record-based allocations?

Are you in favour of annual adjustments to vessels' FQAs to take account of quota movements between vessels?

Overall, just over 70% of the sector had supported the move to FQAs. Around the same number thought that they represented an improvement and nearly 80% were in favour of annual reconciliations of units. Support for FQAs was lowest among the smaller trawlers in Area VII and highest among the larger demersal trawlers and the pelagic boats. Only among the Area VII beam trawlers did a majority oppose the annual reconciliation of quota units, in other segments the great majority wanted annual adjustments, including all the over 24m trawlers in the sample.

The views of the non-sector and the 10m and under boats were in almost total opposition to those of the sector. The great majority opposed FQAs, did not think they were an improvement over track record-based allocations and did not wish to see annual quota reconciliations.

4.2.4 Freedom to trade in quota

All respondents were asked:

Do you think that under the current quota management system there is
(a) too much freedom to trade quota?
(b) about the right amount of freedom to trade quota?
(c) not enough freedom to trade quota?

Do you think that, in principle, quota trading in the UK should be allowed
(a) within POs, but not between POs?
(b) between POs, but not between individual vessels?
(c) only within, and between, POs?
(d) amongst any vessels over 10 metres?
(e) amongst any vessels, including those of 10 metres and under?
(f) or not at all?

If some form of quota trading is allowed, should it be possible for quota to be owned by
(a) anyone?
(b) only persons or companies actively engaged in fishing?

Just over half the sector thought the freedom to trade quota was about right while the remainder were more or less evenly divided as to whether there was too much freedom or not enough. A desire for greater freedom was most evident among the larger stern trawlers, the pelagic boats and the netters and liners. Among Area VI prawn boats the predominant view was that there was too much freedom to trade.

Nearly two-thirds of the sector thought that trade should be allowed between any over 10m vessels, with almost two-thirds of those in favour of including the 10m and under boats as well. The desire to restrict trade to PO members was most evident in the Irish Sea. Only around one tenth of the sector overall were against trade altogether, although around one quarter of the Area VI prawn boats and a third of the Area VII beamers were against. The great majority of the sector overall were in favour of restricting quota ownership to active fishermen, but a significant minority among the larger demersal trawlers and the netters/liners thought that anyone should be allowed to hold quota.

Some two-thirds of the non-sector thought there was now too much freedom to trade in quota. While more than half considered that there should be no trade, over a quarter thought that trading should be allowed between all vessels. Over two-thirds of the 10m and under boats were happy with the amount of freedom to trade (within the industry as a whole) while a quarter thought there was too much freedom. Most were in favour of trade between any over 10m vessels, with nearly 40% including their own inshore sector as well. All the non-sector and 10m and under respondents wanted quota ownership restricted to those actively engaged in fishing.

4.2.5 PO members' attitudes to PO management

PO members were asked:

Within your PO, does your vessel currently operate with
(a) individual vessel or company quotas (IQs)?
(b) monthly limits from a quota "pool"?
(c) monthly limits plus extra quota acquired by you ("pool-plus")?
(d) IQs for some stocks, monthly limits for others?
(e) other (please specify)?
How satisfied are you with these arrangements?

Given the choice, would you prefer your PO to operate different arrangements (under the existing quota management system)? If yes, which arrangements would you prefer?
(a) individual vessel or company quotas (IQs)?

(b) monthly limits?
(c) monthly limits plus extra quota acquired by you?
(d) IQs for some stocks, monthly limits for others?
(e) other (please specify)?

Overall, 40% of the weighted sector sample were operating with flat-rate monthly limits and 30% were under pool-plus arrangements. Nearly all the rest had IQs for all stocks, including all the pelagic boats, nearly half of the larger demersal trawlers and the netters and liners, as well as over 70% of the Area IV beam trawlers. In all, 84% were satisfied with these arrangements with only 24% wanting a change. Dissatisfaction with their POs' management arrangements was highest among the smaller Area VII trawlers and the Area VII beamers, although these were still a minority of respondents. Few of these wanted a change, however. In fact there was most desire for different arrangements among the other demersal trawlers, even though most of these were satisfied with present arrangements. Where a change was desired it was generally for IQs, although the smaller demersal trawlers in the Irish Sea favoured pool-plus arrangements.

4.2.6 PO members' involvement in quota trading

PO members were asked:

Have you ever enhanced your vessel's track record or FQA by
(a) purchase of a licence with track record/quota units?
(b) purchase of track record/quota units only?

Do you currently, or have you ever,
(a) leased quota from another vessel (in your own or another PO)?
(b) purchased quota from another vessel (in your own or another PO)?

Do you currently, or have you ever,
(a) leased quota to another vessel (in your own or another PO)?
(b) sold quota to another vessel (in your own or another PO)?

Can you estimate, at least roughly, the proportion of your current gross earnings which are attributable to
(a) extra units which have been added by acquiring licence(s)?
(b) extra quota which you have bought or currently lease from another vessel?

Overall, 16% of the sector had increased their quota allocations by licence aggregation, including 33% of the over 24m trawlers, 35% of the pelagic boats and over 40% of the Area VI prawn boats. A slightly greater number, 23% overall, had acquired extra quota off another licence, which had been possible during the last decommissioning round. This applied to 47% of the under 24m trawlers in the Irish Sea and 41% of pelagic vessels. Some groups were much more

likely to have acquired extra quota by licence purchases than by buying quota, while for others the opposite pattern was observed. For example, while 32% of the netters and liners had bought in quota, none had increased their allowances by licence aggregation. Just over 20% of the North Sea beam trawlers had bought in quota but none had aggregated licences, whereas the reverse was observed for the Area VII beam trawlers.

The responses to the questions concerning the leasing and purchasing of quota appeared to reflect some confusion over our distinction between leases and purchases.[53] We therefore focus only on the responses concerning leasing, which we take to cover leasing agreements for one or for a number of years. Some 32% of the sector overall had leased quota in, including around half of all beam trawlers and pelagic boats. Leasing-in quota was least observed among the smaller trawlers in Area VII and the Irish Sea and the North Sea and Irish Sea prawn boats. Slightly fewer (27%) in the sample were leasing out quota, but the overall pattern of leasing out among different groups was similar.

Estimated dependence on quota acquired through the licence market for the sector as a whole was between 10-25% for 12% of the weighted sample and between 25-50% for a further 17%. Overall, more than a third of vessels were dependent on quota acquired in this way for a least 10% of their gross earnings. Most dependent were the larger stern trawlers and the pelagic vessels. The estimated dependence on leased quota was rather less, with 18% dependent on leased quota for 10-25% of earnings and just 4% dependent for more than 25% of earnings. Most reliant on quota leasing were the pelagic boats, the smaller trawlers in Areas IV and VI, and the North Sea beam trawlers and prawn boats.

The responses to the questions about purchases and leasing of quota were cross-tabulated in order to identify those vessels which had been involved in quota trading at least to some extent and those which had had no such involvement. The results are summarised in Table 4.2.

The groups most involved in trading were the pelagic boats (100%), the over 24m demersal trawlers (88%) and the North Sea beamers (73%). More than half of the under 24m trawlers in Areas IV, VI and VIIa and the *Nephrops* boats in Area IV, together with almost half of the Area VII beamers, had been involved in trading. A little over one third of netters and liners and the smaller demersal trawlers in Area VIId-k had traded quota , together with rather less than a third of the *Nephrops* trawlers in Areas VI and VII. *In no sector, however, were less than a quarter of vessels trading*. For the sector overall, *more than half* had been involved in quota trading by some means or another.

[53] The intention in the survey was to distinguish between one-off annual leases and agreements to lease fish over a number of years ("purchases").

Table 4.2: Overall involvement in quota trading

	involved in trading	not involved in trading
Demersal trawlers		
> 24m (all areas)	88%	12%
≤ 24m Area IV/VI	57%	43%
≤ 24m Area VIId-k	36%	64%
≤ 24m Area VIIa	59%	41%
Pelagic vessels	100%	0%
Beam trawlers		
Area IV	73%	27%
Area VII	48%	52%
Nephrops trawlers		
Area IV	52%	48%
Area VI	29%	71%
Area VIIa	27%	73%
Netters/liners	39%	61%
Non-sector	--	--
Weighted total > 10m	**56%**	**44%**
10m and under	--	--

4.2.7 PO quota pools and "dummy" vessels

PO members were asked:

Does your PO hold any quota over and above the total of its members' FQAs, for example in the form of units attached to a "dummy vessel"?

If yes, do you receive additional quota allowances as a result?

Was the acquisition of this quota funded through
(a) a one-off contribution from the membership?
(b) an increased levy?
(c) other (please specify)?

Do you support the PO in acquiring quota in this way?
If yes, would you prefer the PO to be more pro-active in acquiring quota?

Overall, more than half of the sector reported that their PO had units held centrally on a dummy vessel and that they had extra allowances as a result. In most cases this extra fish was acquired with funds raised by increasing the PO levy. Only just over half supported their PO in this but of those nearly two-thirds thought the PO should be more pro-active in acquiring quota in this way. Support was weakest among the pelagic boats and the Area VI prawn boats, the smaller trawlers in Area VII and the netters and liners.

4.2.8 The non-sector

Non-sector (over 10m) vessels were asked:

Have you previously had this or another over 10 metre vessel in membership of a PO?

Do you (now) fish in the non-sector
(a) out of choice?
(b) because you have tried but failed to join a PO?
(c) for another reason (please specify)?

If you fish in the non-sector out of choice, is it
(a) because you target mainly non-quota stocks?
(b) because you have the flexibility to target a wider range of stocks?
(c) for another reason (please specify)?

If you have tried but failed to join a PO, was this
(a) because your track record or FQA was considered too poor?
(b) for another reason (please specify)?

If it were possible, would you prefer to have your vessel's current FQA as an individual (annual) quota?
(a) yes
(b) yes, but only if you were also able to trade quota with other vessels
(c) no

Only 17% of non-sector vessels in the sample had previously been in a PO. 72% were fishing in the non-sector out of choice while the remainder were in the non-sector because they had been unable to join a PO. All of these boats had failed to join a PO because their track record/FQA was considered too small. Most of the vessels choosing to be in the non-sector saw no advantage in belonging to a PO. None stated specifically that it was because they targeted mainly non-quota stocks or had more flexibility to target a wider range of stocks. Specific reasons cited by a number of respondents included a dislike of PO management structures and rules and the lack of a "local" PO. Over half (54%) stated that they would like to have their FQA as an individual allocation with only a further 13% making that desire conditional on being able to trade quota.

4.2.9 The 10m and under fleet

Respondents with 10m and under vessels (whether or not they belonged to a PO) were asked:

Have you previously owned an over 10m vessel?

Do you (now) fish in the 10m and under sector
(a) out of choice?
(b) because you cannot afford the price of a larger vessel?
(c) because you cannot afford the price of an over 10 metre licence and FQA?
(d) for another reason (please specify)?

If you fish in the 10m and under sector out of choice, is it
(a) because you are free from catch restrictions (for most stocks)?
(b) for another reason (please specify)?

Do you think the quota management arrangements applied to over 10m vessels should be extended to the 10m and under fleet, i.e., should it be possible for POs to manage quota on behalf of under 10m vessels?

Of the 10m and under vessels in the sample, 56% had previously owned an over 10m vessel. 82% fished in the 10m and under sector out of choice while just 10% said that they couldn't afford a larger vessel or an over 10m licence. Over half (54%) were in the inshore sector because of the relative freedom from restrictions, others cited a variety of reasons including preferences for operating on a small scale. The great majority, 88%, thought that the management arrangements applied to the over 10m vessels should *not* be extended to the 10m and under fleet.

4.2.10 Views on ITQs

All respondents were asked:

Do you consider that a move towards some form of ITQ system for the UK is now inevitable?

From your present understanding of ITQ systems, are you
(a) broadly in favour of ITQs, at least for some fisheries?
(b) broadly against ITQs?

If you are basically in favour of ITQs, do you think that ITQs might be appropriate for
(a) all stocks?
(b) pelagic stocks?
(c) whitefish stocks?
(d) Nephrops?

(e) other shellfish?
(f) don't know

...and for
(a) all UK vessels?
(b) over 10 metre vessels only?
(c) PO members only?
(d) other (please specify)?

Do you think that ITQs would tend to
(a) reduce or increase over-quota landings?
(b) reduce or increase discarding at sea?

If an ITQ system were to be introduced for the UK, do you think that the POs should be given a central role in the organisation of the system, for example handling quota sales and rentals on behalf of their members?

Again, if an official ITQ system were to be introduced, do you think that the Government should collect some sort of monetary levy or tax on the value of quota sales?

Overall, 78% of the sector thought that ITQs were now inevitable and nearly 60% were broadly in favour. Only among the West of Scotland and Irish Sea *Nephrops* trawlers did a majority think that ITQs were not now inevitable. Support for ITQs was strongest among the larger demersal trawlers, the North Sea beam trawlers and the pelagic boats, and weakest among the prawn boats and the Area VII beamers.

Most in the sector who were broadly in favour of ITQs considered them suitable for certain groups of species only rather than for all species. In total, around 70% thought ITQs suitable for pelagic and demersal species and just over half considered they should be applied to *Nephrops* (although the support for this was noticeably much lower among the prawn boats themselves). Nearly two-thirds thought ITQs should apply to all vessels, even those of 10m and under, while 80% supported ITQs for all over 10m vessels. Less than 10% would specifically restrict ITQs only to PO members.

Nearly 60% of the sector as a whole thought that ITQs would reduce the extent of over-quota landings, although more than 20% were unsure. Opinions concerning the effect on discards were more or less evenly divided, but many could not offer an opinion. The prawn trawlers and Irish Sea trawlers tended to think that discards would increase, while the pelagic boats and the netters and liners were most sure discards would decrease.

The great majority (84%) thought that the POs should retain a central role in management under an ITQ system. Only 20% overall were in favour of some type of quota tax, although more than half of the netters and liners thought there should in principal be a charge.

Of the non-sector sample, 78% thought ITQs were now inevitable and 72% were against their introduction. Of the one quarter or so in favour, most would like to see them either only for pelagic or only for demersal species. None would restrict ITQs to PO members and a few would include the under 10m boats. The majority of all respondents either did not know or thought over-quota landings and discards would increase. Nearly two-thirds supported a key role for POs in an ITQ system while all were against a tax on quota values.

Of the inshore (10m and under) boats, 86% were of the view that ITQs were inevitable with 72% against their introduction. Of those in favour there was little agreement over which species should be covered. While more than half would restrict ITQs to the over 10m boats, some did favour including the 10m and under vessels as well. Overall, most respondents could not say whether they thought over-quota landings and discards would increase under ITQs. Two-thirds favoured a continuing role for the POs. None supported a quota tax.

4.2.11 Concerns over the possible effects of ITQs

All respondents were asked:

Whether you are basically in favour of ITQs or against the idea, do you have concerns about
(a) the possibility of quota ending up in the hands of a few large companies?
(b) the possibility of quota moving to more prosperous regions?
(c) the possibility that high quota prices will discourage "new entrants" to the industry?
(d) uncertainty over the legal title to quota?
(e) other aspects (please specify)?

Overall, around two-thirds of the sector were concerned about a concentration of quota ownership into the hands of fewer companies or to particular regions, with some 40% very concerned. Least concerned were the larger stern trawlers and the North Sea beam trawlers. Nearly three-quarters were concerned about the possible impact on new entrants to the industry and nearly 70% were concerned about the legal title to quota. Again though, only around a third were very concerned in each case. Least concern about discouraging new entrants was expressed by the larger demersal trawlers, the Area IV beam trawlers and the pelagic boats, with the latter two groups also relatively unconcerned about the legal title to quota.

The non-sector and 10m and under vessels were generally more concerned than the sector about the possible impact of ITQs on sectoral and regional concentration and about the supposed problems for new entrants, but while few in the non-sector were concerned about the nature of the legal title to quota, a large minority of the 10m and under vessels said that they were concerned.

4.3 Survey of UK POs

4.3.1 Survey methodology

Questionnaires were distributed to all 20 of the sea fishing POs in the UK. Responses concerning views on current management arrangements, FQAs and ITQs were obtained from all except two of the POs, the *North East of Scotland Fish Producers' Organisation* (NESFO) and the *Scottish Fishermen's Organisation* (SFO). The responses given by the 18 POs who participated in the survey are summarised below.[54]

4.3.2 Views on current arrangements

None of the POs were very satisfied with the current quota management system. Fourteen were quite satisfied, three were slightly unsatisfied and one was very unsatisfied. Thirteen had supported the move to FQAs while five had not. However, 16 out of 18 now thought they represented an improvement on track records. The same number were in favour of an annual reconciliation of quota units.

Half of the 18 POs thought that the freedom to trade quota was about right, while 6, a third, thought that there was too much freedom. The fact that some of these POs were nevertheless in favour of annual reconciliations presumably reflects the administrative burden imposed by the increasing numbers of transfers required to give effect to quota trades under the existing arrangements. Only three POs said that there was not enough freedom for quota trading.

One PO was of the view that trading should take place between POs but not between individual PO members. Four considered that, as at present, trading should only be possible both within and between POs, but 5 thought trading should be possible between all over 10m vessels and 7 favoured trading across the whole fleet, under 10m vessels included. Just one PO would prefer to see no trading at all.

Fourteen of the 18 POs considered that quota ownership should be restricted to individuals or companies actively engaged in fishing.

Finally, the POs were asked what key changes they would like to see made to the existing system. Sixteen out of 18 reiterated that they wanted an annual reconciliation of units. Eight wanted an end to underpinning of non-sector and under 10m allocations, and the same number wanted to see the introduction of ITQs. Other changes specifically mentioned by just one or two of the POs

[54] The summary of views presented here is deliberately anonymous. The detailed views of *individual* POs about FQAs and quota trading are almost certainly well known to Fisheries Departments from responses to recent consultation exercises. Note that in all cases but one the questions were answered by the Chief Executive of the PO. It is assumed that the responses given reflected the views of at least a majority of the membership but the researchers were clearly not in a position to verify this.

were *no* reconciliations (2 POs), an end to "slipper skippers", i.e., fishermen who rent out all their quota (2), a formal clarification of the legal title to quota (2), an allocation of quotas according to the number of VCUs on a licence (1), an annual reallocation of unused quota (1) and an end to the split between quotas in Areas VIa and VIb.

4.3.3 Views on ITQs

Fifteen POs thought that ITQs were now inevitable while just 3 did not. However, only 8 of the 18 were in favour of ITQs, at least for some stocks. Of these eight, 6 thought ITQs would be suitable for all stocks, while one thought they should be restricted to finfish only (i.e., demersal and pelagic species) and one wanted ITQs for pelagic stocks only. Seven thought ITQs could apply to all UK vessels while one wanted them to apply to over 10m vessels only.

Thirteen POs thought that ITQs would reduce over-quota landings, two thought the opposite and 3 were uncertain or thought there would be no effect. Seven thought discards would decrease while 4 thought they would increase and another 7 thought there would be no real difference.

Sixteen of the 18 POs wanted to see POs retain a central role under an ITQ system while two did not. Just two of the POs were basically in favour of some sort of quota tax, 13 were against and three were unsure about the idea.

Most of the POs were either very concerned or quite concerned about a concentration of ownership and potential difficulties for new entrants, although a significant minority were not. Seven were unconcerned about any concentration into fewer hands, with rather less (3) unconcerned about regional effects and five unconcerned about high quota prices discouraging new entrants. Seven were very concerned about the issue of legal title to quota while 9 were slightly concerned. Just two were unconcerned about this.

5. ITQs in practice: an international review

5.1 Introduction

Since the general extension of national exclusive economic zones to 200 miles in the 1970s, there has been a trend towards the adoption of property rights-based fisheries management systems worldwide. Although there are some notable cases of territorial use rights and community fishing rights, the development has primarily been toward regimes of individual quotas (IQs) and individual transferable quotas (ITQs).

IQs are already quite common. They are widely used in Europe, Russia, Southern Africa, America and even Japan. An interesting aspect of IQs is that they tend to evolve over time into fully-fledged ITQs. Having secured valuable property rights in the form of IQs, the holders soon push for permission to trade these rights. After all, this possibility only enlarges their opportunities. This path of evolution has taken place for instance in Iceland, the Netherlands, Greenland and Namibia.

ITQs have now been implemented for the management of hundreds of fish stocks around the world. With the recent addition of Chile to the list of countries basing their fisheries management on ITQs, over 10% of the global ocean fish harvest is currently taken under ITQs.

The first ITQ systems were implemented in the 1970s. Currently, at least seven significant fishing nations - Australia, Canada, Chile, Iceland, Namibia, the Netherlands and New Zealand - employ ITQs as a major component of their fisheries management systems (OECD 1997, Arnason 1996a). Several others, including Mozambique, Greenland, Portugal, Mexico and the United States, use ITQs in some of their fisheries (OECD 1997). Important fishing nations such as Peru, Argentina and Morocco are preparing for the introduction of ITQs in some or all of their fisheries.

Thus ITQs can hardly be said to be experimental any longer. A great deal of experience with the system has been accumulated in numerous fisheries all over the world for the past 25 years.

The evidence cited in the Annex[55] to this report demonstrates that the experience with ITQs has generally been quite positive. Fishing effort has usually decreased and fishing fleets have contracted, depleted stocks have recovered and the quality of the landed catch has generally increased. In a number of cases, the increased emphasis on product value and quality has resulted in additional employment in the industry as a whole, offsetting the impact of reduced fleet sizes. Finally, economic rents have generally greatly increased. It seems that ITQs represent the only fisheries management system currently employed around the world that can claim this degree of

[55] This chapter and the accompanying Annex were prepared by Professor Ragnar Arnason of the University of Iceland.

general success. As a result, ITQ-managed fisheries are becoming more numerous every year.

This chapter summarizes the structure and experiences of some of the more important ITQ systems in the world focusing on the following key aspects of their implementation:

- ·the initial allocation of entitlements;
- the definition of entitlements;
- institutions to facilitate trading in quotas;
- restrictions on quota trades and quota holdings;
- the volume of quota trades;
- mechanisms for extracting resource rents and collecting management costs;
- the enforcement system;
- evidence of increased economic efficiency in the fishery;
- evidence of increased or reduced quota-induced discarding;
- evidence of an increased sense of resource stewardship by the fishing industry;
- the effect of quota tradeability on
    - concentration of quota ownership,
    - the geographical concentration of fleet activity and (hence), regional employment,
    - the concentration of quota towards particular fleet segments;
- the effect of restricted quota ownership and tradeability on the above;
- mechanisms to deal with problems associated with multispecies fisheries;
- how ITQ systems respond to significant fluctuations in TACs;
- the legal title to quota.

The summary is based on an extensive study of the experiences with ITQs in the seven major fishing nations that have already adopted ITQs as their main fisheries management system, namely Australia, Canada, Chile, Iceland, Namibia, the Netherlands, New Zealand and the USA. The detailed results of this study (together with sources and references) are to be found in the Annex to this report.

5.2 Initial allocation of entitlements

The initial allocation of ITQ rights in various fisheries around the world has been according to several criteria, the most important of which have been:

- historical catch shares;
- vessel harvesting and hold capacity;
- investment in vessels;
- equality, i.e., equal shares.

Of these criteria, the first is by far the most common. The reason is not difficult to fathom. Most often ITQs are introduced into an already established fishery. Moreover, quite often there is a need to constrain harvesting volumes from what they have been in the past. Under these

circumstances, it is socially and legally difficult to allocate the new more restrictive rights differently from what has been the case in the recent past.

There is a great variation in the length of catch history employed for the initial allocation of ITQ rights. Usually, the period in question is quite short : 3-4 years is quite common. However, there are cases of seven or more years being employed for the purpose. In many cases, the criteria for initial allocation of quota rights have not been strictly followed. It is quite common to set up appeals boards and similar institutions to consider allocation adjustments for those that feel they have been particularly unfairly treated by the straight-forward application of the allocation criteria. Thus, for allocation on the basis of the historical catch record, it is common to make allowances for years during which the vessel in question may not have been operating normally due to major repairs, not having entered the fishery and so on.

From the perspective of economic efficiency, it makes little difference how the initial allocation of quota rights is conducted provided the rights are subsequently freely transferable. With significantly limited transferability, however, the initial allocation of quota rights becomes more important in determining the economic outcome.

5.3 Definition of entitlements

The basic quota entitlement is usually a fraction of whatever TAC is set by the fisheries authorities every year. This entitlement then gives rise to an annual (seasonal) quota allocation equal to the multiple of this fraction and the TAC. This type of quota entitlement thus provides the quota holder with a certain share in the annual TAC. Hence it is often more strictly referred to as an individual transferable *share* quota (ITSQ).

Quota entitlements defined in terms of nominal volume of harvest have been used in the past but problems are created by the need in most fisheries to alter the TAC from one year to the next. When that happens, ITQ rights denominated in volume terms require the fisheries authorities to sell or buy quotas according to whether the TAC is increased or decreased relative to the initially allocated volume. These market operations by the fisheries authorities obviously create their own problems, not the least when funds have to be found to buy quotas back from the industry. As a results nations that have employed this method, notably New Zealand, have scrapped this method in favour of proportional or share quota entitlements.

Under the share quota system the ITQ is a lasting quota entitlement. Its duration (longevity) varies from one system to another. In certain systems (notably New Zealand) the ITQ is explicitly in perpetuity. In other systems (notably Namibia) the quota right is formally only for one year at a time but is generally automatically renewed. In other systems (e.g., Chile) the duration is for a specified number of years without a clear rule as to if and then how renewal is to occur. Often (as in Iceland and Australia) the duration of the ITQ right is simply left unspecified.

From a theoretical perspective share quotas have a clear advantage in terms of economic efficiency over volume quotas, not only because they are administratively easier but, more importantly, because they give the holder a greater vested interest in the welfare of the underlying fish stocks. For the same reason, "permanent" ITQs are economically superior to those of limited duration. Thus a limit on the duration of ITQs must be justified by other considerations.

5.4 Institutions to facilitate trade in quotas

Trading of quotas, both of the permanent and annual (lease) rights, results in their continuous reallocation to those able to make the best use of them in accordance with the principles of the market system. Hence quota trading is a crucial part of the economic efficiency of the ITQ system.

It is well known that for optimal results markets must work smoothly and market trades be as easily and inexpensively conducted as possible (that is, *transaction costs* should be minimised). If that is not the case, the economic efficiency of the ITQ system will be correspondingly reduced. In spite of this, official mechanisms or institutions to facilitate quota trades have generally not been set up in association with the major quota systems in the world. The only case of this that we have found is in Iceland, where there is a public quota exchange very much along the lines of a conventional stock exchange. This quota exchange, however, only trades in annual quota leases, not permanent ITQs. Moreover, its establishment was not at all motivated by the desire to facilitate quota trades. It was established as an official response to complaints by hired fishermen that their contractual share in the value of the catch was being eroded by artificially low quayside prices arranged as a part of quota trading deals between related parties.

In spite of this lack of official mechanisms to facilitate quota trades there is little evidence that quota trading has been hampered by market imperfections and high transaction costs. In many countries where the ITQ system has been in operation for some time (e.g., Iceland and New Zealand) quota traders or brokers have spontaneously emerged to assist the parties in trading quotas. In other cases, e.g., the Netherlands, Canada and USA, where the ITQ fisheries have generally had fewer participants and been more localized, quota trades have generally taken place directly between fishermen on the basis of personal contact.

5.5 Restrictions on quota trade and holdings

Restrictions on quota holdings and trades are common in the ITQ systems around the world. No system has no such restrictions. These restrictions take a wide variety of forms, and it is convenient to discuss restrictions on quota holdings and on quota trading separately.

Restrictions on quota holdings primarily take two forms: who can hold quota and how much they can hold. In almost all ITQ systems there are restrictions on who can hold quota. In the most free system in this respect, the New Zealand system, only New Zealand nationals can hold quota. In

most other systems the holding of quota is restricted to a much smaller set of the population. Typically only those with a fishing licence in the fishery in question can hold quota. In Iceland for instance, quotas must be associated with vessels, so only those with licenced fishing vessels can hold quota. In other countries, the holding of different species quotas is restricted to those with a licence for the particular fishery in question.

It is important to realise, however, that in practice it is usually easy to circumvent restrictions of this type. Those wanting to hold quotas can generally enter a contract with someone with the necessary qualifications to hold them on their behalf. How well such an arrangement would stand up in court would depend on the national legal framework and the particulars of each case.

In some ITQ systems there are also restrictions on the maximum allowable quota holdings. These, however, tend to be imposed at a later stage in the evolution of the ITQ system if large players start to emerge. Such restrictions vary greatly according to nation and fishery. Thus in New Zealand the maximum quota holding ranges from 10-45% depending on the fishery. In Iceland it ranges from 5-20%, again depending on the fishery.

Restrictions on quota trades are generally less severe than those on quota holdings. Note, however, that restrictions on quota holdings also imply an indirect restriction on quota trading. In many countries quotas, although tradeable, are often far from freely tradeable. This applies for instance to some USA and Canadian ITQ systems and the Namibian quota system in general. These restrictions take many forms. In some cases there are limitations on the volume of trades, elsewhere trades may only take place after a certain period, or trading may be restricted to a sub-group of those allowed to hold quotas. The purpose of these restrictions is generally to limit structural changes in the fishery and the fishing industry following the introduction of the ITQ system.

Despite such restrictions, all ITQ systems otherwise freely permit the transfer of property rights between fishing firms, that is, they allow the sale of permanent quota holdings as well as the leasing of quota for shorter periods.

5.6 Volume of quota trade

There is limited quantitative evidence on the extent of quota trades in the various ITQ systems around the world. A fairly complete picture of quota trades in Iceland and some more patchy data from other countries, however, indicates that quota trades are substantial. This applies to both annual trades (leases) and trades in permanent ITQs. In Iceland, trades in annual demersal quotas have in recent years been in the region of 80-90% of the year's total quota (Runolfsson 2000). Trade in annual quotas for other species such as pelagics and shellfish, where there are fewer players, is much less but still substantial relative to the total volume of quotas. Trade in permanent ITQs is generally less as a proportion of the total volume but still very substantial. Since 1971 ITQ trades for most species have been some 10-20% of total (outstanding) ITQs.

The incomplete quantitative evidence from other countries generally suggests somewhat smaller volumes of quota trades than in Iceland but still quite substantial compared to the outstanding volume of quota. In the Australian South-East trawl fishery, for example, (a multispecies fishery) annual quota trades have in recent years exceeded 30% of the TAC (Geen 2001). The qualitative evidence is very much along the same lines. In most ITQ fisheries for which data is available, it is reported that trades in quotas is substantial.

Theory suggests that the extent of quota trades depends on a number of factors, the most important of which are:

- the ease of trading;
- the size of the fishery;
- the number and diversity of vessels;
- variability (uncertainty) in the fishery;
- the state of the fishery in its adjustment towards equilibrium capacity.

It follows that there is little reason to expect much uniformity in the extent of quota trades across different fisheries: the larger and more diverse the fishery, the more variable it is, the further it is from its long run equilibrium and the easier it is to trade (the lower are the transaction costs), the more extensive the quota trades. The available evidence seems in reasonable agreement with these general principles.

5.7 Extraction of management costs and resource rents

In most advanced ocean fisheries the cost of management is quite substantial (Arnason *et al* 2000). This applies no less to ITQ-managed fisheries than to other fisheries. The difference is, however, that ITQ fisheries are capable of generating substantial economic profits to fishing companies that enable them to pay for these management services as well as generating net economic rents. Economic theory suggests that the collection of management costs from the recipients of these services may well enhance the efficiency of the both the industry and the management activity. Hence, the collection of fees for fisheries management services represents an attractive idea.

In most, but not all, ITQ fisheries there is some imposition of fees to pay for management costs. Nevertheless, in most fisheries the fees actually collected are substantially less than the total management costs incurred by the fishery authorities. On the other hand, management fees seem to be on the increase and many governments have announced their intention to collect repayment of all management costs from the fishing industry. In ITQ-managed fisheries the management charges range from virtually nothing to about 3-4% of the fishery's gross revenue. Total fisheries management costs, however, are usually well in excess of 3-4% of gross revenues. Thus in almost all cases the management fees collected are well under the actual management costs.

In very few ITQ-managed fisheries is there any attempt to extract resource rents from the fishery (i.e., fees in excess of management costs, designed to capture excess profits generated as a result of exclusive rights to the resource). Indeed, as already mentioned, in most ITQ fisheries the fees collected are generally well below management costs. The exception is in Namibia where the total fee collection from the fishery has for a number of years substantially exceeded the total management costs incurred by the government.

A number of fishing nations, including Australia, Chile and Namibia, have announced their intention to extract resource rents from the fishing industry under ITQs. Others have announced that they will not do so, for example the USA and New Zealand. In some countries, notably Iceland, Canada and the Netherlands, the issue is still unsettled.

5.8 Enforcement

The enforcement of an ITQ system involves two components: observation and control, and the sanctioning of violators.

The former is often referred to as MCS, a term coined by the UN FAO which stands for monitoring, control and surveillance. Its purpose is to observe the fishing activity, induce vessels to act in compliance with the rules, detect violations and report them to the sanctioning authority. The function of the second component of the enforcement system is to process alleged violations and, if appropriate, impose sanctions. In the fisheries management literature, this component is often referred to as the fisheries judicial system (FJS).

In ITQ systems the focus of the enforcement activity is naturally on the quota constraint, i.e., ensuring that quota holders do not exceed the landings stipulated by their quota. Under most ITQ systems existing MCS and FJS structures have initially been assigned to this particular function and, with the passage of time, have adapted and been modified to deal with the challenges posed by ITQs. Few ITQ enforcement systems have been designed from scratch, although the New Zealand system may be regarded as something of an exception in this respect.

There is a range of approaches for enforcing the quota constraint. These may be broadly divided into enforcement at sea and on land. While the logical method for enforcing the quota constraint is at sea where the harvesting takes place, practical considerations have forced all major ITQ nations to rely primarily on enforcement on land. There are essentially two means for monitoring catches and thus enforcing ITQs on land: monitoring at the landing site (quayside monitoring) and the collection of catch and landings reports from the industry.

Quayside monitoring involves the measurement of landings from fishing vessels. Clearly this is potentially very effective, but the problem can be the cost. While a range of techniques such as restrictions on the place and time of landings and the design of the monitoring system will reduce the cost, it will not be economical if there are too many small landing places. In many ocean

fisheries the landing places are sufficiently few and large to make this method economical. Otherwise inspections must be rationed in some way. In general, quayside monitoring, where it has been feasible, has been relatively successful.

Catch and landings reports must be backed up by a secondary monitoring activity, which can involve both spot checks and the "paper trail" approach. Spot checks are employed to verify that the reports given are accurate. Clearly this will not work for a low frequency of checks unless the penalties for violations are sufficiently heavy. The paper trail approach requires quantity reports not only from the vessel landing the catch but also the subsequent handlers and processors of the fish. Comparing these reports should reveal inconsistencies that may indicate violations. The problem, of course, is then to prove to the satisfaction of the officials of the FJS (often the courts) that a violation has actually occurred and who is the guilty party. Another fundamental problem with the paper trail method is that it seeks to uncover violations some time after they occur. To the extent that the probability of successful prosecution diminishes, this approach may therefore need to rely on heavier penalties than are socially acceptable and straightforward to implement.

5.9 Evidence of increased economic efficiency

The evidence concerning the impact of ITQs on economic efficiency is fairly unequivocal. Without exception, ITQs have been found to improve the profitability of the fishing industry, which is in accordance with theoretical predictions. With a reasonably undistorted price system, and in the absence of serious stock externalities,[56] profitability is a good measure of economic efficiency in a fishery. Therefore we can conclude that ITQs have improved the economic efficiency of the fisheries to which they have been applied.

Similarly, as a part of the increased profitability, ITQs have been generally been found to substantially reduce fishing effort in previously overexploited fisheries. The effect on fleet size, however, is often much less dramatic. While in many fisheries the number and size of vessels applied to a newly ITQ-managed fishery has been found to be dramatically reduced (e.g., in the US surf clam and ocean quahog fisheries, the Australian bluefin tuna fishery and the Icelandic purse seine fishery) the reduction in fleet size in some other fisheries (e.g., the Icelandic demersal fisheries and the Dutch flatfish fishery) has been quite slow. Given the reduction in fishing effort, however, this may be explained by a number of factors. First, due to the generally depressed price of fishing vessels in the world, the opportunity cost of retaining largely redundant vessels has been rather low. Second, many of these extra vessels have been assigned to fisheries outside the ITQ system, some of which have even been entirely new fisheries or fisheries on the high seas or both. Third, it seems that there are cases where fishing vessels made redundant by an ITQ fishery have actually been kept as an insurance in the case the ITQ system was to be scrapped in the near future.

[56] We assume that the industry is competitive and there are no public transfers (subsidies). We also assume that profitability is sustainable, i.e., there is no short term increase in profits at the expense of stock depletion.

The evidence about the effects of ITQs on fish stock biomass is also generally positive. In most cases the state of the stocks has improved and fish stock biomass has increased under ITQs. It is important to realize, however, that in principle an ITQ system as such does not have any particular effect on fish stock biomass. The ITQ system merely encourages the economically efficient fishing of whatever TAC is set by the fisheries authorities. Under ITQs, however, especially the permanent ITQ (individual transferable share quota) version, the quota holders should have a vested interest in the size and good condition of the fish stocks and their environment. Thus it is generally found that under ITQs the fishing industry is much more willing to accept reductions in the TACs to rebuild the fish stocks. Sometimes, it has even taken the initiative in this direction. Under ITQs bold stock rebuilding programs have been initiated. Moreover, it is generally found that under ITQs, it is much easier than under alternative fisheries management systems to enforce whatever TAC is imposed. This is also conducive to the proper biological management of stocks.

It should be noted in this context that while an ITQ system may be beneficial to the welfare of the stock(s) subject to ITQs, the effect on other stocks not subject to ITQs may be the opposite. The reason is that effort pushed out of the ITQ fishery for reasons of efficiency may be applied to these alternative fisheries which, as a result, sometimes become more overexploited than before. However, the same is true of any quota system, or indeed any management system which restricts access to some stocks and not others.

5.10 Evidence of increased or reduced quota-induced discarding

Compared to unmanaged fisheries (but not necessarily to other fisheries management systems) ITQs are known to generate additional incentives for discarding. These incentives arise only in the case of fisheries with different grades (often size) of the same species (Arnason 1994). Fishermen find it to their advantage to discard any fish whose landed value does not exceed the cost of actually catching and landing it. In the case of ITQs, the quota introduces an additional cost item associated with landing the fish. This is the value of the quota that is used up when the fish is landed. In valuable fisheries, this cost, i.e., the quota price, can be very substantial compared to the landed value of the fish.(57) Under these circumstances it will be economical for the fisherman to discard fish whose value does not exceed the cost of catching and landing it plus the corresponding quota value.

It is often claimed that discards will also arise through fishermen deciding to "save" quota for a later opportunity (in the expectation of higher prices). While there is indeed a stronger incentive to obtain the highest prices possible for the catch under an ITQ system, in order for it to be profitable to discard fish for this reason, the future price expected must effectively cover not only the cost of the quota, but also the revenue foregone through discarding, *and* the cost of catching the fish a second time! This is unlikely to be a profitable exercise in most circumstances.

[57] In the Icelandic and New Zealand demersal fisheries, for example, quota prices typically amount to 20-50% of the landed value of the catch.

It is important to realize that many other fisheries management systems also generate incentives for the discarding of fish. In particular, non-transferable quota systems (IQs) may generate an even greater incentive to discard than ITQ systems. One obvious reason is that since quota trades are impossible, fishermen in multispecies fisheries have no alternative but to discard all catches of species for which they have filled their quota in order to keep on fishing for other species.

It is similarly important to note that while ITQs generate an incentive for discarding, they also generate an additional incentive for more selective fishing (Arnason 1995). There are many reasons for this. One is that permanent ITQ holders have a vested interest in the welfare of the stocks and, as a result, are more willing to employ appropriate fishing methods. Another is that under an ITQ system, fishermen have a guaranteed share of the catch. Hence they have more opportunity for using selective fishing methods than under, say, competitive fishing, without having to worry about losing out in competition with other fishermen. Third, under ITQs there will often be an increase in fish stock sizes. Hence there will generally be a greater supply of large fish which is also often the highest value fish. Therefore concentrating on high value fish may be easier under ITQs than many alternative fisheries management systems.

Thus under ITQs we have two opposing forces as far as discarding is concerned. First, ITQs generate an incentive to discard lower grades of fish due to the ITQ price. On the other hand the ITQ system generates a tendency for more selective fishing methods. Hence there may be less low grade fish to discard. Therefore it is not possible to say *a priori* whether or not a shift to ITQs will result in increased or decreased volume of discards.

The available evidence on discarding in actual ITQ systems is quite mixed. There is some evidence of both increased and decreased discarding under the various ITQ systems, but overall there is little evidence of significantly increased discarding. In fact, where there is evidence of substantial changes in discarding following the introduction of ITQs, it is of reduced discarding (as in several of the USA fisheries).

5.11 Evidence of increased “resource stewardship”

Theory suggests that granting permanent, share-based, harvesting rights in the form of ITQs should generate an increased sense of resource stewardship. The reason is that quota holders have a vested interest in the welfare of the fish stocks and their environment. The better the condition of the fish stocks, the more valuable is the ITQ property. Note that this applies much less to non-transferable quotas (IQs) and to ITQs of very limited duration.

Reports from the various ITQ systems around the world tend to confirm these predictions. Although the evidence is mostly anecdotal, taken together it is compelling. It is generally reported that compliance, fishing selectivity, fish handling and quality, and the willingness of industry to rebuild fish stocks all improve under ITQs. Moreover, there are a number of cases of industry voluntarily funding research and enforcement activity under ITQ systems.

It should be noted, however, that there are certain organisational obstacles to a fragmented fishing industry being in position to harness individual "resource stewardship" incentives to the full. The reason is essentially the classic free-rider problem - it would pay every member of the industry to act irresponsibly if he knew that the others would act responsibly. Hence, it may be advisable for the fisheries authorities to assist the fishing industry in setting up the appropriate organisational structures that would encourage full member participation in initiatives of this nature.

5.12 Industrial concentration in the fishery

ITQs may affect concentration in the fishing industry in (at least) three different ways:

- concentration of quota ownership;
- geographical concentration of fleet activity and (hence) regional employment;
- concentration of quota towards particular fleet segments.

ITQs enable the fishing industry to become more economically efficient. Hence, under ITQs the industry will develop in whatever direction is in accordance with economic efficiency. This *may* imply more concentration in corporate structure (ownership), geographical location or fleet structure (vessel types). But it may just as well imply less concentration in these factors. It is only if concentration is more economically efficient under ITQs than under the previous fisheries management system that these developments will take place. Thus, as a matter of economic theory, ITQs are "concentration-neutral".[58] It is possible that the previous fisheries management system may well have been distortive with respect to the above dimensions of concentration.

In short, quota tradeability facilitates the development toward greater economic efficiency and to the extent that increased economic efficiency implies more concentration, quota tradeability will be a factor in that. Note, however, that even without tradeable quotas, e.g., in an IQ system, there will normally still be a substantial movement toward increased efficiency and, consequently, a similar kind of concentration. Even without quota tradeability there will typically still be ways to consolidate quotas (e.g., by company mergers or acquisitions) which are likely to be exploited if the economic gains are sufficiently high. Indeed, *restricted* quota tradeability might well lead to larger fishing companies than would otherwise be the case!

Note also that if ITQs (or, for that matter, IQs) lead to less fishing effort and a reduction in the fleet size (as would be expected) then that reduction by itself implies (given the imperfect divisibility of vessels and firms) concentration along the above dimensions, i.e., fewer firms, relatively more of certain types of vessels, etc.

Moreover, ITQs are not imposed on a static fishery. Inevitably, the fishery to which the ITQ system is applied is subject to various technological, social and market forces. Consequently, the

[58] The only inherent concentration effect of ITQs that has been suggested is that efficient quota trading requires large companies. This is somewhat doubtful in principle, but may well occur where trading is very restricted.

fishery, before the introduction of the ITQ system, is already responding to these various forces and evolving along the various dimensions of concentration. Thus any developments toward or away from concentration that may be observed under ITQs might equally well have occurred under an alternative fisheries management system.

The concentration experience under ITQ systems around the world is very much along the theoretical lines described above. Generally, when ITQs are imposed on mature fisheries some reduction in the number and an increase in the average relative size of fishing companies is observed. The few cases to the contrary of this, as in the Icelandic demersal fisheries, are due to exemptions of fleet segments from some or all of the ITQ restrictions.

The evidence on the geographical distribution of the fishing activity is somewhat less clear-cut. Obviously this depends very much on the spatial nature of the fishery in question, the technology involved, the impact of ITQs on the total level of harvest and other factors. Since, as already suggested, ITQs tend to encourage the development of new fisheries,[59] the overall geographical distribution of fishery-related activity may actually increase. Nevertheless, overall it seems that the evidence from ITQ systems around the world is rather in the direction of less geographical distribution of the fishing activity than before.

The influence of the ITQ system on sectoral concentration (or fleet homogeneity) is even less clear. As already stated, ITQs further economic efficiency. This may or may not imply fleet homogeneity. Given the heterogeneity of many fisheries with respect to fishing areas, fish behaviour, fish size and so on, not to mention fishery variability over time, it may well be that the optimal composition of the fishing fleet is quite heterogeneous. If so, the ITQ system will encourage that. In fact, taking it for granted that stocks will improve under ITQs, a wider distribution of age cohorts in the catch will, indeed, encourage fishing fleet heterogeneity compared to what would be the case in a fishery consisting of few cohorts.

The evidence available on the development of fleet composition under ITQs is simply too limited to allow us to draw any conclusions in this respect. In many fisheries, fishing vessels have become fewer and larger. This, however, is a result of technological improvements which have little to do with the ITQ system. Indeed there are fisheries that have been under ITQs for years (e.g., the Icelandic inshore shrimp fishery) where there has been very little change in the types of vessels employed.

[59] There are two reasons for this. First, because ITQ-holders retain their access rights to the fisheries for which they already own quota they do not run the risk of losing such rights by engaging in exploratory fishing trips. Second, in most ITQ fisheries initial quota allocations depend upon track records and there is therefore an economic incentive to establish a track record in a new fishery.

5.12.1 Fleet concentration and restricted quota tradeability

Restrictions on quota tradeability are often imposed with the intention of reducing concentration effects along the dimensions discussed above. One of the most pronounced cases of this is the ITQ system in the Alaskan halibut and sablefish fisheries where one of the main objectives is to avoid radical industrial and geographical restructuring of the fishery. Similar considerations motivated the Norwegian government to reject suggestions to move its IQ system toward ITQs. Many other cases of restricted transferability in ITQ systems for this express purpose can be mentioned. So the application of limited ownership and quota tradeability for the purpose of avoiding concentration is quite common. The question, however, is of the advisability and effectiveness of these measures.

First, these types of restrictions clearly subtract from the economic efficiency of the system. They are, in other words, costly. This cost has, of course, to be set against the benefits. Second, as regards effectiveness, there can be little doubt that these measures will delay whatever adjustment toward efficiency (and therefore also concentration) would otherwise have taken place. The long run effect is more doubtful. It may, for instance, be the case that in order to overcome the economic disadvantages of restricted tradeability, companies, through mergers and acquisitions, become even larger than they would have been under unrestricted tradeability in order to be able to move harvesting relatively freely across vessels and geographical areas.[60] It may also be the case that complete adjustments of this nature are impossible, even in the long run, and that restrictions on quota tradeability will have a long term discouraging impact on concentration. The empirical evidence provides little information on this issue.

5.13 Mechanisms to deal with problems associated with multispecies fisheries

Problems stem from a mis-match between the quotas for the various species and the actual catch rates of these species. This leads to a bycatch of the species for which the quota has been filled and, possibly, its discarding at sea. It is the discarding that is the problem for at least three reasons: it may represent an economic waste, it tends to distort the catch statistics and, hence, stock assessment, and it tends to undermine the legitimacy of the ITQ system. This problem, however, which has been used as an argument against using ITQs in multispecies fisheries, is actually far less serious than is often claimed.

First, transferable quotas reduce the problem greatly. If a vessel's quota for one species filled, it can buy additional quota for that species on the quota market. So, within the ITQ system, individual vessels' quota holdings can in principle be fitted to the vessel's pattern of fishing. Therefore, under the ITQ system the problem of quota/catch mismatch should not arise until a TAC is exhausted or close to being exhausted.

[60] This obviously assumes that quotas could freely be moved between vessels under the same ownership.

Second, the ratio of species in the catch is technically more flexible than is often acknowledged. By judicious selection of fishing gear (type, mesh size, hook size, etc.), fishing methods (i.e., how the fishing gear is employed), fishing areas and fishing times, it is possible in most multispecies fisheries to capture the various species in more or less the proportions desired. There is ample empirical evidence in support of this claim. In Iceland, for instance, vessels have not only generally solved the bycatch problem by altering their fishing methods, some of them can even select the size categories of fish that are sought.

However, the drawback is that increasing species selectivity is not necessarily costless. In many cases altering the species composition of the catch will reduce the overall catch rates even for the species that is being targeted. For this reason, fishermen may be reluctant to use more selective fishing methods and often claim inability to do so. Therefore the imposition and enforcement of appropriate regulations may be necessary to induce them to adopt more selective fishing methods.

Several nations, e.g., New Zealand, Australia, Iceland and Canada, have employed ITQs in their multispecies fisheries for years with good results. In this connection, it should be noted that the general experience is that under ITQs fishermen are much more willing to adopt selective fishing methods than under other fisheries management systems.

Nevertheless, to the extent that quota/catch mismatches are a problem in a multispecies fishery under ITQs, there are certain measures that can alleviate the problem and make it easier for fishermen to catch in the desired proportion. These include:

- attempting to set quotas in accordance with the actual abundance of fish;
- giving some flexibility by allowing the transfer of quota between species at specified conversion rates (although with sensitive species this should only be allowed at the margins);[61]
- allowing limited overages of quotas for one season to be made good during the next season (although, again, with sensitive species this should only be allowed at the margins);
- setting some quota aside each year (a "quota fund") that the authorities can use to supply the quota market as the quota prices increase in response to an expected exhaustion of the TAC or if for any other reason vessels cannot buy quota on the market;
- assisting the development and adoption of more selective gear and fishing practices.

5.14 Responding to significant fluctuations in TACs

Share-based ITQ systems (i.e., those in which the quota is a percentage of the TAC) are in many respects well-designed to cope with significant fluctuations in TACs. First, clearly the individual quota, being defined as a percentage of the TAC, is automatically adjusted to variations in the TAC. Second, the holders of ITQs for species subject to significantly fluctuating TACs are, or at

[61] This approach carries the danger of higher levels of over-quota catches than would have occurred with discarding and can reduce incentives to adopt more selective gear (Baulch and Pascoe 1992).

least should be, aware of the associated risk.[62] Hence they will (or should) already have taken this risk into their business calculations and adjusted to it. They could even insure against it, at least in principle. In any case, the market prices for such ITQs will reflect the market's general assessment of and attitude to the risk involved. Thus, to the extent that economic agents can cope with risk in general, there is every likelihood that appropriate measures will be taken within the ITQ system, i.e., the ITQ system is conducive to optimal risk management by the ITQ holders.

Note that we would expect industry profitability to increase under ITQs, and hence firms will be better able to cope with fluctuations in output due to TAC changes. Note also that permanent ITQ prices will tend to reflect long term expectations about stocks and will not fluctuate to the extent that TACs may year on year. Hence income variability will not be matched by the similar variability in asset values.

Essentially, there is no reason to add to the standard ITQ model any special provisions to deal with fluctuations in the TACs. In fact, it could be argued that such measures would be economically inappropriate as they would shield quota holders from the real variability in nature and thus prevent or reduce their appropriate adjustments to it.

Many ITQ fisheries are subject to large TAC fluctuations. One of the most dramatic examples is the Icelandic capelin fishery where during the past two decades the annual TAC has varied between zero and 1.2 million metric tonnes without causing any particular problems. There are many other cases of very substantial fluctuations in the TACs in the Icelandic, Namibian, New Zealand and Canadian ITQ fisheries. Nevertheless, at least in the Icelandic fisheries management legislation there are provisions for the fisheries authorities to compensate those subject to large TAC reductions with temporary quotas in other species. As these quotas have to be subtracted from someone else, this provision is highly controversial within the industry. To date it has only been used twice and then in a relatively minor way.

This is not to say that large fluctuations in TACs are not problematic for the industry. They are, and managers will seek to create more stable conditions in the fishery. Under an ITQ system, however, the industry is arguably in a better position than under, say, a system of fixed quotas where individual agents cannot alter their fishing opportunities. More positively, an ITQ regime underpinned by a strong enforcement system should be effective in controlling fishing effort, enabling a rebuilding of stocks and consequently more stable TACs from year to year.

5.15 Legal title to quota

In most ITQ systems the legal title to the quota is actually rather vague. ITQs represent property rights, not property rights in the fish stocks but rights to a certain share in the permissible harvest of fish from given stocks. This type of property right does not usually enjoy the same legal status

[62] This risk is actually very similar to that of derivative volatility in financial markets.

as more conventional property rights such as, say, the ownership of a house or company stock. Thus, in general ITQs do not enjoy constitutional protection as other property usually does. The exception to this rule is the New Zealand ITQ system where ITQs are explicitly defined as the permanent property of the holder and protected by the Constitution. In most other countries the legal status of the ITQs as property is much weaker. The duration of the ITQ is usually either explicitly limited or left unspecified. In many countries, the relevant legislation explicitly states that ITQs do not have the status of permanent property. In the USA and Canada ITQs are regarded legally as a *privilege* granted by the state that can be revoked at any time. In many cases the motivation seems to be to ensure that the ITQ system can be revoked in the future or the allocation of ITQs altered without the legal need to compensate ITQ holders.

Economic theory suggests that the more secure the property right, the more economically efficient the associated activity. Hence it may be expected that the relatively weak legal title to ITQs observed under most regimes will subtract to some degree from the efficiency of the fishery.

5.16 Summary

When ITQs have been introduced, the initial allocation of entitlements has normally been made on the basis of catch history (track record). In all existing ITQ systems quotas are defined in terms of percentage shares of the current TAC.

Only rarely have institutions been set up by governments in order to facilitate or manage the trading of quota. Generally the industry itself has created the necessary institutions for trade to take place efficiently. In almost all cases, however, governments have restricted the freedom to trade quota in some way or another. Typically quota ownership is limited to fishing firms. Firms may be restricted in the amount of quota they can own (as a proportion of the TAC). Often there are other quantitative and temporal restrictions. In all ITQ systems, however, quota can be both leased on a temporary basis and sold permanently.

In many ITQ fisheries governments have taken the opportunity to impose on quota holders a charge towards the costs of fishery management. Few governments, however, have attempted to extract a resource rent from the industry (by imposing a charge greater than that necessary to cover management costs).

Enforcement of ITQs is essential to their successful operation. Generally, enforcement relies upon self-reporting of landings backed up by an effective system of random checks, together with sanctions which have a real deterrent effect. Checks will involve inspections of landings but may also include the monitoring of buyers, processors etc where a “paper trail” approach has been adopted.

ITQs generally result in increased industry profitability, which in most cases will reflect real increases in economic efficiency. Although fishing effort is likely to be significantly reduced under ITQs, the effect on capacity will depend upon a number of factors such as the extent of overcapacity under the previous management regime, the market for second-hand vessels and fishing opportunities for non-quota stocks. We would usually expect some reduction in capacity under ITQs, although the evidence shows that this varies greatly from country to country. Under ITQs stocks have generally improved in health, although this may reflect more the increased attention to controlling output effectively than the use of ITQs *per se*.

ITQs will tend to reduce incentives to discard in multispecies quota fisheries but do create incentives to discard low value grades of fish. However, the incentives to discard low value fish under fixed individual quotas may be as great, while ITQs tend to encourage more selective fishing which will tend to reduce discards. The empirical evidence is inconclusive but reports of significant changes in discarding behaviour point to reduced discards under ITQs.

ITQs appear to foster a greater sense of resource stewardship in the fishing industry, although sound organisational structures may be needed to harness this effectively in improving stock conservation outcomes.

ITQs may be associated with industrial concentration, in terms of quota ownership, geographical distribution of fishing activity and fleet make-up, but only to the extent that such concentration follows from increased economic efficiency. Other factors are also making fisheries technologically more efficient, and ITQs will only alter the pace of change. While there is evidence of some concentration of ownership in many ITQ fisheries, this largely reflects the reduction in overall capacity. There is no clear pattern of geographical or sectoral change under ITQs, but in many cases there are restrictions on quota trade designed to limit such changes.

ITQs have been used extensively in multispecies fisheries and they generally reduce problems of quota mis-matches at the vessel level. Where problems persist despite quota trading they may reflect TACs which are not in proportion to the actual relative abundance of fish. Increased fishing selectivity and flexibility of quota rules can ameliorate the problem but only to a limited extent. Significant fluctuations in TACs are a problem for the industry under ITQs as they are under any quota system, but the operational flexibility provided by ITQs will give the industry more capacity to cope with TAC fluctuations than under other systems. To the extent that ITQ management is successful in rebuilding the fishery, however, future TACs should be more stable.

Finally, in all existing ITQ fisheries the nature of the property right inferred by quota "ownership" extends only to the permission to harvest a given share of the TAC. No ownership over the fish stocks themselves is established. The permission to harvest may be defined over some specified time period but in many cases the legal title to quota is rather vague in this and other respects.

6. Modelling the possible socio-economic impacts of ITQs

6.1 Introduction

Under a newly-introduced system of (well-enforced) tradeable fishing entitlements, such as ITQs, we would expect some vessels to purchase additional entitlements to improve the efficiency of their operation and others to sell their entitlements and exit the fishery. The reduction in the total level of inputs used in the fishery and the improved efficiency of the remaining vessels will lead to an overall increase in profits in the industry. However, any reduction in boat numbers will also result in a reduction in the level of direct employment in the industry.

In this chapter the potential impact of ITQs on the structure of the fishing fleet and the consequent impact on regional employment and profits is assessed using a computer model of the UK industry. The model assumes that boats that have FQAs that currently restrict them to operating at less than full capacity will either seek to purchase quota to enable them to operate at full capacity, or sell their quota and exit the fishery (or concentrate on non-quota species). This is consistent with the economic theory presented in Chapter 2, and has been observed in fisheries that have adopted an ITQ system (see, for example, Adulaja *et al* 1998).

6.2 Methodology and key assumptions

The analysis is run in two steps. First, the capacity utilisation of each boat is estimated relative to other boats with which it can trade. In the second stage, the model allocates quota to individual vessels based on their current level of capacity utilisation, with the quota of boats at low levels of capacity utilisation being allocated to boats with relatively higher levels of capacity utilisation. The model is used to estimate the minimum fleet size required to fill the quota for each and every species with all boats operating at or close to full capacity. The model is specified so that the boats with the lowest capacity utilisation are the first to leave, their quota being allocated to boats operating closer to full capacity. Full mathematical details of the model are given in Appendix III.

The level of capacity utilisation for each vessel is defined as the ratio of actual output (restricted by the FQAs) to the potential output, given the size and configuration of the vessel. As a result, it provides a measure of *technical* over-capacity, rather than economic over-capacity which would also take into account the costs of production (rather than just the potential output). Information on potential output is not available, but a proxy estimate for potential output given a set of inputs can be derived from examining the FQA holdings of the rest of the fleet: vessels that hold the greatest level of FQAs for a given boat size and type are assumed to be operating at full capacity.

An analytical method exists (see Appendix III) to identify which boats are operating at full capacity taking into account differences in physical input use (e.g., engine power and boat size) and catch composition (defined by the FQAs). Information on fleet characteristics and FQA holdings in 2001 was used in the analysis (such that any previous quota trades under the existing

quota management system had already been factored into the analysis, although quota leases are not considered).

As capacity utilisation is a relative measure, it will depend on the set of boats which can be compared. For the purposes of this analysis, this is the set of boats which can trade quota. A number of separate trading scenarios were examined, resulting in different measures of capacity utilisation for each vessel. There were as follows:

- complete transferability between all boats;
- transferability between boats within the same fleet segment;
- transferability between boats with the same administrative port;
- transferability between boats within the same region.

For the last scenario, four regions were defined (English Channel, Irish Sea, West of Scotland and North Sea). Boats were allocated to each of these regions according to their home port. While there are no economic reasons why trade should be restricted between vessels, it was assumed that concerns over employment implications may result in some restrictions on trade being imposed.

The analysis was limited to boats that currently hold quota in the form of FQAs. As a result, the 10m & under fleet are not included in the analysis, nor are any over 10m boats that target only non-quota species. While adjustment in the 10m & under fleet would also be likely to occur as a result of improved transferability of quota, this is presently not quantifiable. Previous bioeconomic modelling exercises in the English Channel that have incorporated the inshore boats have suggested that an economically optimal fleet might include no 10m & under boats all. However, a multi-objective optimal fleet (incorporating employment considerations) would involve between a zero and 50 per cent reduction in the 10m & under fleet depending on the relative importance attached to regional employment (Pascoe and Mardle 2001). Note, however, that the extent of any adjustment that might actually take place in the fishery is likely to be substantially less than the "optimal" amount, and will depend in part upon the degree of transferability permitted in the management system.

For the purposes of the analysis, it was assumed that vessels were fishing against their own FQAs only. While some vessels lease in additional quota, and others lease out quota, this will have little effect on the overall results. The capacity utilisation of an individual vessel will be underestimated if it leases in quota, and overestimated if it leases out quota, but these effects will cancel out when looking at the average of the overall fishery. Ignoring quota leasing would only have an impact if the vessels currently identified as operating at full capacity actually leased in quota as well. In such a case, the level of capacity utilisation in the fleet would be lower than estimated using the model, as the harvesting potential of these boats would be greater than suggested by their FQAs. As a result, the amount of fleet reduction following quota reallocation would be greater than estimated. However, this would only significantly affect the results if most

of the vessels identified as currently operating at full capacity leased in additional quota, and the additional quota substantially increased their total quota holdings.

As the analysis excludes non-quota species, vessels that hold quota but primarily target non-quota species, principally the shellfish boats, are likely to be considered as operating under-capacity when compared to all boats, but are not likely to be disadvantaged when compared with boats within the same gear segment. This catch is also not considered, so the capacity utilisation of this segment is likely to be underestimated, and the level of adjustment will be overestimated. To examine the effect of this, the analysis was undertaken both allowing shellfish boats to trade their quota and exit the fishery (the most extreme case), and also preventing shellfish boats from trading their quota, thereby forcing them to remain in the fishery. Depending on which assumption is made, the reduction in fleet size estimated using the model may overstate or perhaps understate the potential reduction.

A further assumption of the model is that boats are able to exit the fishery easily. However, low levels of profitability in many fleet segments and difficulties in raising finance may act as a constraint on adjustment, at least in the short to medium term. As a result, both the potential costs (in terms of employment loss) and benefits (in terms of increased profits) may be overestimated for all fleet segments.

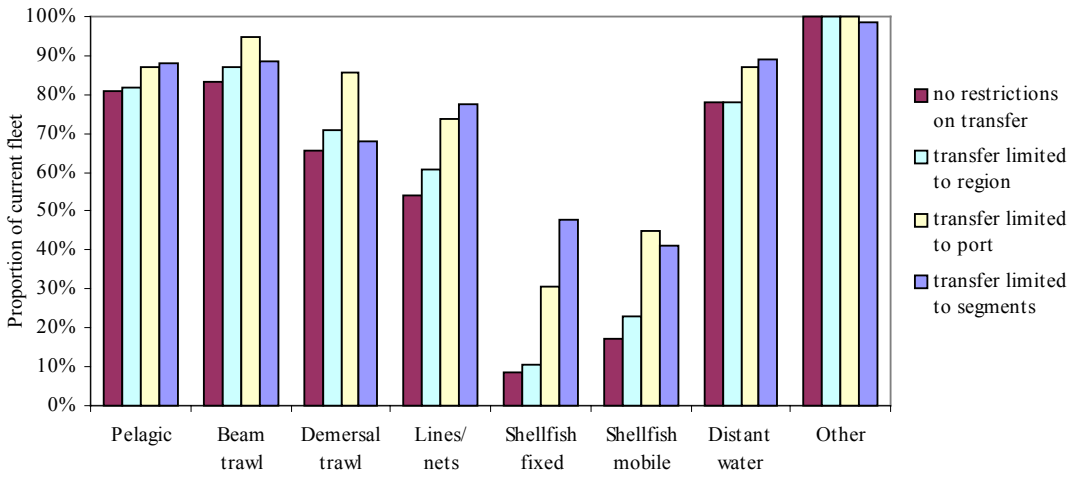
6.3 Estimated fleet structure after trade

The estimated proportion of the current fleet remaining after all potential trades have taken place is illustrated in Figure 6.1 by segment and in Figure 6.2 by region. These figures represent the number of *vessels* remaining (not the number of VCUs) after all quota has been reallocated. These should be considered as minimum figures, as they assume that all boats will be operating at full capacity as a result of quota trading. Transaction costs and imperfections in the quota market will no doubt prevent a "perfect" reallocation of quota, so many boats will not be able to purchase all the quota they require, and other boats that should have sold their quota (based on the model assumptions) will probably still remain in the fishery.

Generally, the greater the degree of transferability permitted, the greater the level of adjustment and the smaller the overall final fleet size. The fleet segments least likely to be reduced significantly are the pelagic boats, the beam trawlers and the distant water vessels. These segments were found to have a high degree of capacity utilisation on average (see Appendix III), so the number of boats needing to buy quota to fully utilise their capacity was relatively small. In contrast, in the model the shellfish boats are likely to experience the greatest reduction as a result of increased quota transferability. However, as noted above, the analysis does not take into consideration the non-quota species activity. While some adjustment in quota holdings is likely in this segment, the number of boats that exit the fishery would almost certainly be much fewer than is suggested in Figure 6.1. Instead, most of these boats will simply increase their activity on non-quota species. The reduction in the number of net and line boats is also likely to be overestimated

for the same reason, although many of these boats do target predominantly quota species. It is expected that some of these boats will also concentrate their activity on non-quota species rather than exit the fishery, although some will exit. Finally, the reduction in the distant water fleet segment is also over-estimated by the model as consideration is not given to the activity outside the UK quota management system.[63]

Figure 6.1: Minimum proportion of current over 10m fleet remaining after quota trade



To compensate for some of these effects, the analysis was also undertaken under the assumption that shellfish boats (both mobile and static) would not exit the fishery. The model was re-run given this assumption only for the case of unrestricted quota trade and for the case of regionally-restricted quota trade as these scenarios had the greatest impact on the estimated final fleet size.

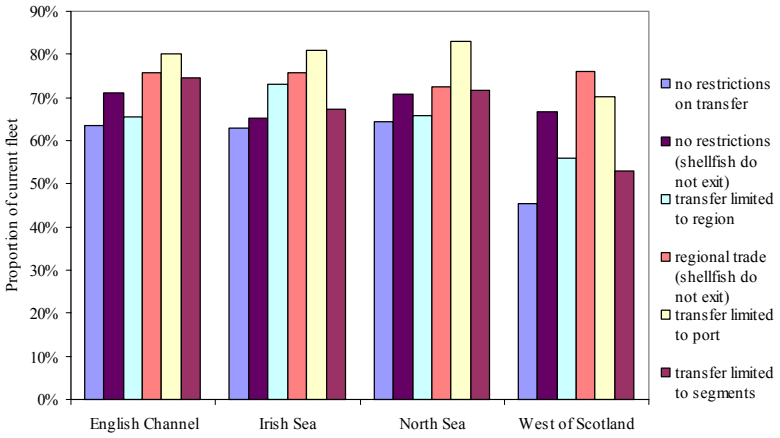
At the regional level (Figure 6.2), the impact is likely to be fairly evenly distributed between the Channel, Irish Sea and North Sea, although the West of Scotland may experience a greater proportional decrease in fleet size. As noted previously, the greater the degree of transferability, the greater the potential reduction in vessel numbers. As would be expected, assuming that shellfish boats would not exit the fishery has a substantial impact on the estimated minimum fleet size, particularly for the West of Scotland.

Recall that the estimated fleet reduction only refers to the over 10m fleet and to vessels that currently hold FQAs: boats targeting only non-quota species and those of 10m & under in length are excluded from the analysis. In some regions, particularly the English Channel, these groups may dominate the fleet. No doubt some of the inshore vessels would exit the fishery if included in an ITQ system. However, it is likely that the proportion of the total fleet remaining in each region

[63]The absolute number of boats in this segment is small, so a small change in vessel numbers will appear relatively large in percentage terms. Any adjustment through a consolidation of distant water quotas could not be considered in the analysis.

(when including the vessels not considered in the analysis) will be greater than indicated by the model.

Figure 6.2: Minimum proportion of current over 10m fleet by region



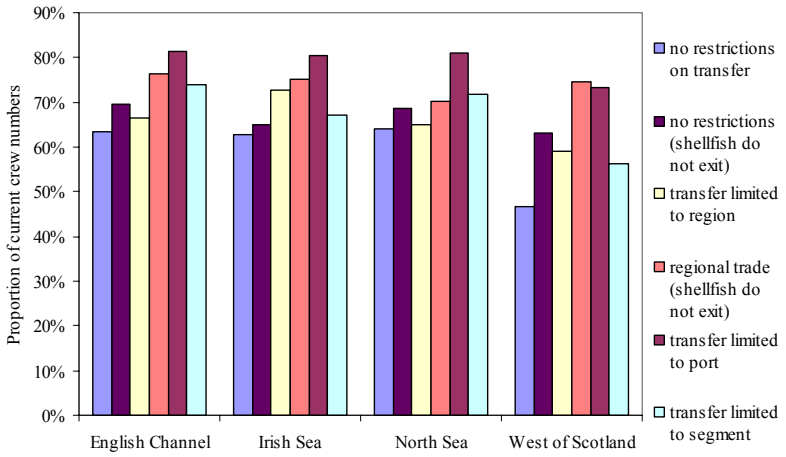
6.4 Socio-economic impact

Fleet reduction has two main effects on a region. First, the fleet reduction is associated with a reduction in the level of direct employment in the sector, with possible secondary effects on employment in sectors supplying the fishing industry. Second, the increased efficiency of the remaining vessels (now operating at full capacity) results in higher levels of profitability in the industry, while the increased catch per vessel results in higher incomes to the remaining crew members. The higher incomes and profits of the remaining boat owners and crews would result in increased consumption in the regions, as well as stimulating capital investment in the fishery. Further, the level of activity of the remaining boats will increase in order to fill their higher quota allocations, resulting in an increase in demand per vessel for many variable inputs (e.g., fuel). The extent to which these factors would offset the secondary effects created by fleet reduction is not quantifiable, however. Hence only the direct impacts will be considered here.

The estimated potential employment effects of an ITQ system are illustrated in Figure 6.3. These were derived using average employment figures for given boat types, and multiplying these by the number of boats that left the fishery of each type. Data on average crew numbers were available for some fleet segments by region (SFIA 2000).

The potential reduction in crew numbers as a result of the increased quota transferability mirrored the estimated reduction in fleet size. The greatest fleet size reduction, and hence employment reduction, was estimated to occur if no restrictions on transferability were imposed, whereas the smallest impact on employment was estimated to occur if trade were limited to administrative ports.

Figure 6.3: Minimum proportion of crew numbers by region (%)



If sufficient quota trade occurred to allow all remaining boats to achieve a quota holding equivalent to their full capacity, then it is possible that direct employment in the fleet segments examined might be reduced by around 53% in the West of Scotland, and by around 35% in the other regions. As noted above, however, such figures are the *maximum* potential reduction in employment. In practice, it is unlikely that sufficient boats would be willing or able to leave the fishery to provide the quota for the remainder to operate at full capacity even under an ITQ system. There are generally few alternative uses for the vessels outside fishing, and a limited demand for vessels within the industry (due to licence limitations). In some cases, the boats would not exit the industry but instead concentrate on non-quota species. In addition, changes in employment on vessels without FQAs are excluded. Where these vessels are prominent in a region, the reduction in employment will be less. Overall, it is likely that the fleet reduction and subsequent reduction in employment, at least in the short term, would be substantially less than suggested by the analysis.

As the total quotas, and hence revenues, are assumed to remain constant, the increase in economic profits generated as a result of improved transferability of quota can be estimated directly from the reduction in costs in the industry as boats exit. Not all costs are likely to reduce with the exit of boats from the fishery. Crew payments (which are linked to revenues and running costs) from the boats that exit the fishery are likely to be substantially transferred to the crews on the boats that remain. Similarly, the remaining boats will most likely have to increase their individual effort (and hence running costs) to take the higher levels of quota. As a result, the reduction in costs may be limited only to the reduction in annual fixed costs and capital costs.[64] The fixed and capital costs associated with the boats that exit the fishery were estimated based on the average cost per VCU of boats in that fleet segment and region, and the VCUs of the

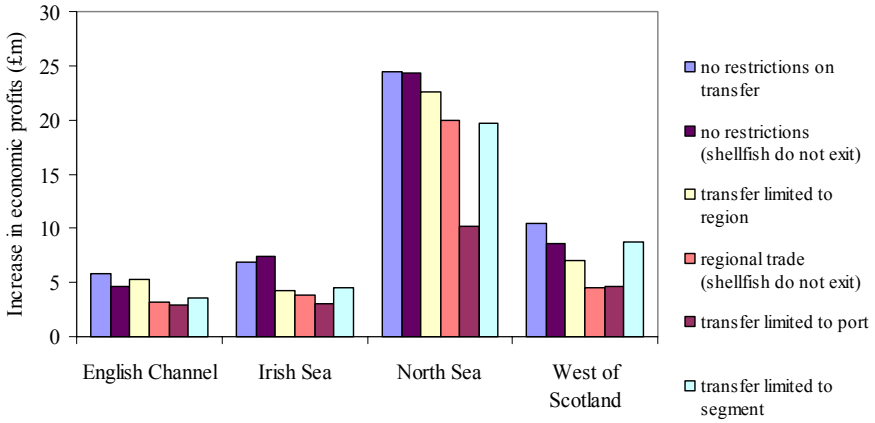
[64]There is actually no way of knowing by how much total variable costs may change. This will depend on the average variable costs of the remaining vessels and the level of effort required to fill the quota, which may be less than the current level of effort due to reduced crowding effects. By assuming there is no change in effort or variable costs, then the total gains are likely to be underestimated, giving a more conservative estimate.

individual boats assumed to exit the fishery. While cost data for Channel fisheries vessels were available for 1999-2000 (Cattermoul and Pascoe 2001), the latest available cost information for the other fleet segments were for the 1997-98 financial year (SFIA 2000). For consistency, the SFIA data were used for all fleet segments, so the increase in profitability is necessarily related to the levels of fixed and capital costs in 1997-98.

The increase in profitability was assumed to equal the reduction in annual fixed costs, plus an allowance for interest (i.e., the opportunity cost of capital, assumed to be 5%) and economic depreciation (assumed at 2.7% of the capital value, based on other economic studies).[65]

The estimated potential increase in economic profits by region (in 1997-98 values) is presented in Figure 6.4. These results are expressed in absolute terms rather than as a proportion of the current level of profitability of the fisheries, as the latter is not known (but is generally believed to be rather low). Again, the degree of transferability of quota affects the potential increase in economic profits. These figures therefore represent the maximum likely benefits, as not all boats will exit the fishery. In particular, as noted previously, shellfish boats (and many net and line boats) estimated to exit the fishery using the allocation model are more likely to increase concentration on non-quota species instead. Assuming that these boats remain in the fishery may reduce the estimated potential economic benefits that could be generated with an ITQ system.

Figure 6.4: Potential economic benefits of increased quota transferability

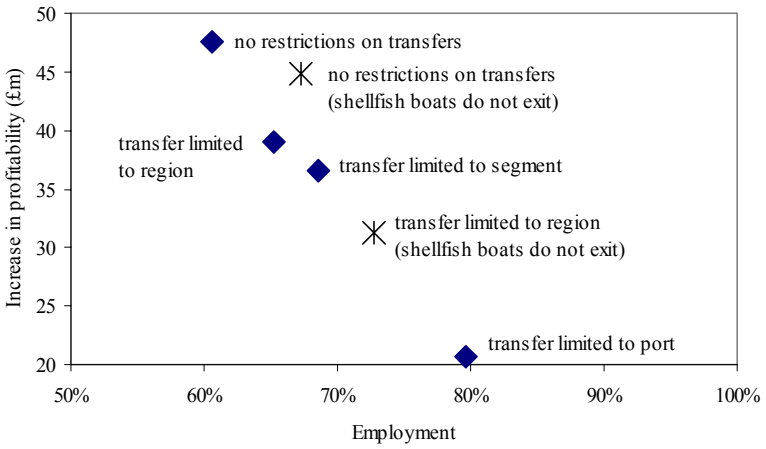


The greatest potential increase in profitability occurs if transferability of quota is unrestricted. However, this option was found to have the biggest impact on employment (see Figure 6.3). By contrast, the lowest potential economic benefits accrue by restricting quota trade to within fleet segments, although this was also found to have the smallest impact on employment. Note, once more, that the estimated benefits are likely to be the upper bounds on the economic benefits of

[65]Note that economic depreciation differs from financial depreciation, which is an accounting convention largely determined by the prevailing taxation legislation. Economic depreciation refers to the real loss in capital value through the use of the boat after the effects of repairs and maintenance have been taken into account.

quota trading, as it is not likely (at least in the short term) that complete adjustment will occur due to the lack of alternative uses for vessels.

Figure 6.5: Trade-off between employment (as % current employment) and increased economic profits (total UK)



The trade-off between employment and increased profits for the UK fleet as a whole is illustrated in Figure 6.5. As can be seen, the objectives of maintaining employment and increasing industry profitability are conflicting. On the other hand, a smaller, more profitable fleet is more likely to be economically sustainable over a wider range of economic and environmental conditions. This may have longer term economic benefits for local communities than a larger less profitable fleet which is more susceptible to fluctuations in prices and quotas, even though the short term consequences of fleet reduction are negative (i.e., reduced direct employment in fishing).

6.5 Discussion

As with any modelling exercise, the results of this analysis are indicative rather than predictive. Further declines in key stocks may result in the estimated fleet reductions being optimistic rather than pessimistic, while stock recovery in the longer term may result in a larger fleet being sustainable.

While the potential fleet reductions estimated using the model may not be achieved in the short term, it is possible that an ITQ system might well lead to fleet reductions of these magnitudes in the longer term. Although these reductions appear substantial (and have some negative socio-economic implications), reductions of these magnitudes are arguably necessary if the aim is to bring the harvesting capacity of the fleet in line with the reproductive capacity of the stock. Consequently, if ITQs are not imposed, some other form of fleet rationalisation will be required. In short, the sort of negative socio-economic impacts which may accompany ITQs will probably occur in any case, but at a potentially higher cost to the industry and the community as a whole.

Although a range of restrictions on quota trade was examined, there is no real *economic* rationale for imposing such restrictions. To an extent the current system of FQAs allows trade across all regions and ports. Indeed, as indicated by the model, restricting trade may reduce the effectiveness of the ITQ system as an industry rationalisation tool, necessitating the increased use of other, more costly, measures to achieve capacity reduction targets.

7. Future management options for UK fisheries

7.1 Introduction

In the light of our economic analysis of quota management in general and the current UK quota management system in particular, and taking account of the views and practices of UK fishermen and POs as well as the experience of ITQs in other countries, in this final chapter we examine several possible (and not all mutually exclusive) future options for quota management in the UK. These include: maintaining the management *status quo*; permitting an annual reconciliation of all traded quota units; clarifying the legal title to FQAs and the fishing rights they confer; introducing an ITQ system proper for the over 10m fleet; and finally, bringing the 10m and under fleet into the quota management system.

7.2 Maintenance of the *status quo*

What we imply here is that there are no changes to the current system as a result of this report. It is actually rather difficult to envisage what this might mean, however. As we have seen, the quota management arrangements have changed considerably in a number of respects since they were introduced in the early 1980s and it seems inconceivable that further changes will not take place. Indeed one or two of the (arguably not very radical) changes we discuss below might well occur "naturally" sooner or later in any case. Nevertheless, assuming for the sake of argument that the current system is now more or less frozen in time, we can take the critique presented in Section 3.4 as an initial appraisal of the *status quo* option.

The main problem with the system as it now stands is that the UK has moved very substantially toward transferability of quota but retains obstacles and constraints to trade without any apparent rational justification for these. A significant part of the industry clearly want to trade quota and many are already doing so to the extent that the system allows, but the obstacles to free and efficient trade appear to be considerable. For the vessels able to benefit from trading, which are those PO members with either individual quotas or the facility to top up their pool allowances, complex deals need to be arranged which involve not only the parties directly concerned but also their POs. Because FQAs remain fixed from year to year, permanent trading of quota is frustrated. Attempts to sell quota outright necessitate agreements involving a seemingly very high degree of risk with continual transfers of quota between as well as within POs.

Vessels in membership of a PO which discourages trading, for example by operating a pool and not permitting members to top up allowances, as well as vessels in the non-sector, are arguably at a disadvantage compared to other vessels in the fleet who can trade. Allied to this, quotas are (or have certainly become) valuable assets which have been given away free by the Government, and yet some vessels are able to realise the value of their assets while others are not. While it is true in principle that vessels are free to join the PO of their choosing, exercising this freedom may not

always be feasible in practice (even if only because of strong loyalty to a local PO). It is therefore arguable that the system is rather unfair in providing opportunities for quota trading. We suspect that the current complexities of trading together with uneven access to the quota market will soon result in unbearable strains on the system as it now stands and that this will force change.

As we discussed in Section 3.4, there are, nevertheless, positive aspects to the current quota management system. In particular, the organisation of vessels into POs with quota management responsibility is a very positive aspect, with potentially very significant benefits in terms of collective responsibility for compliance and facilitating trade in quota. As we suggested previously, and infer again below, we do not necessarily dismiss the "traditional" PO management model of pooling quota for the membership, but believe that in order for this model to be demonstrably beneficial, it should be seen to be adopted by a PO membership who have made an explicit decision to pool some or all of their individual quota rights in order to make both individual and collective gains in management effectiveness and efficiency. This does not even preclude sharing of quota on grounds of equity, for example, if a group of vessels of similar capacity explicitly chose to pool their allocations because of some idea of fairness (although in this case they might do better to trade quota as necessary and then share the resulting profits).

Lastly, even if no other changes are made to the management system we would reiterate the importance of adequate enforcement of quotas in order to (at least) ensure adherence to national quota limits.

7.3 Annual reconciliation of quota units

Given that quota trading is possible and does take place to a considerable extent under current arrangements, we can see no *economic* reason why Departments should not allow an annual reconciliation of units between licences. This would undoubtedly relieve the POs of a growing administrative burden since quota sales could now be completed in a single transaction.(66) It would also reduce the complexity, cost and riskiness of transactions for all concerned since deals would not need to cope with uncertainty over the future financial health of the private parties, or the future cooperation of their POs. In this context we note that 16 of the 18 POs surveyed were in favour of annual reconciliations, as were the overall majority of the PO membership. We are also aware of the strong opposition from some, including the largest UK PO, the SFO.

Merely undertaking annual reconciliations of FQAs would probably not make quota trading significantly more widespread, since as argued above many vessels are currently effectively excluded from trading. On the other hand, such a move might well increase demands from PO members to be allowed to participate in trading.

[66] The POs could presumably quite readily determine which quota movements were to be made permanent and which were not (i.e., those reflecting annual leases of quota, or simple inter-PO swaps on behalf of the membership).

7.4 Clarification of the "legal title" to quota

While annual reconciliations of FQAs would remove much of the current complexity and uncertainty surrounding quota trades, we note that there is widespread concern among both fishermen and their POs about the precise nature of the legal title to FQAs. Particular concerns exist where there might in future be claims against the value of FQAs, for example from banks and other creditors. In detail this issue is clearly a matter for legal, rather than economic, advice, but it is a general economic argument that efficiency in resource allocation depends upon the security and durability of property rights. Note that here the notion of "property rights" has to be interpreted in the widest sense. We are not talking about physical property as in the case of land or buildings, but rights to exploit a particular share of a national fishery quota. In fishery economics the term "use rights" is often used to make it clear that no actual ownership of the fishery resource itself is implied. It is also worth noting that the legal title to quota is actually rather vaguely defined in most ITQ systems around the world.

Notwithstanding this, we suggest that Departments should seek to clarify the nature of the rights which FQAs confer and to whom they apply. Under existing legislation FQAs are associated with licences which are issued at the discretion of the Secretary of State and it is only the (essentially informal) management arrangements agreed between Government and industry that enable certain vessels, principally those within POs that choose to reallocate quota to their members on the basis of their individual FQAs, that are in practice able to realise their FQAs as individual entitlements to catch and land a given share of national quotas, i.e., as I(T)Qs.

A (re-)definition of FQAs as such individual entitlements *independent* of the practice of particular POs, however, would raise a number of significant issues. Policy challenges would be presented by the status of FQAs in the non-sector, and indeed within POs that currently operate pooled quota systems of allocation. With individual rights to FQAs it would be difficult for the non-sector FQAs to remain entirely notional as they are at present unless, as is effectively the case now, FQAs could only be realised as individual quotas within membership of a PO. Each PO membership would then have to make the decision to pool quota if they considered that would be in their best interests. In reality this is not substantially different from the present position, but in effect the "default" internal PO allocation would now become IQs rather than a pool.

Note that if FQAs remained associated with licences then quota rights would remain conditional upon compliance with various rules and regulations and the Secretary of State would have the power to revoke quota rights along with a licence entitlement. At the same time, quota "ownership" would in principle be restricted to the owners of active fishing vessels or associations thereof.

7.5 ITQs for vessels of over 10 metres

It is apparent that if FQAs became quota use rights in the sense discussed above, which individual fishermen could exercise independently of their membership of a PO, then we would be very close to having an ITQ system for the over 10m fleet. Many in the industry consider that we are already very close to having ITQs and many, though by no means all, are broadly in favour of ITQs. An ITQ system proper, however, would require that all owners have the freedom to trade quota for sale or for lease in any quantity at any time (subject to necessary administrative restrictions, for example during a year-end reconciliation period).

We do not discuss whether ITQs might be introduced only for particular quota stocks or only for particular fleet segments because we can see no economic reason, nor indeed any apparent technical reason, why any quota stocks or fleet segments should be excluded. As we have seen, the market itself has not so far excluded any identifiable sectors or species from trading.

The arguments for ITQs in terms of the effectiveness of quota management and economic efficiency have been set out in this report, but there are evident concerns about the possible socio-economic impacts of a fully-transferable quota system. While these may be understandable concerns, it must be said that some rationalisation of capacity in the industry is inevitable with an ITQ system and indeed is essential to the full realisation of the long term management objectives which ITQs are designed to achieve.[67] Restricting the transferability of quota in various ways will impose costs to the extent that the economic benefits of an ITQ system are compromised as a result.

Nevertheless, there are sound economic arguments for rules to constrain market outcomes to some extent, in particular to prevent excessive concentration of ownership and hence the acquisition of market power in either or both of the quota and output markets. Thus there would be a case for limits on individual ownership (as, say, a maximum percentage of the national quota for a given stock) in order to prevent the possibility of excessive concentration.[68] There could also be some rule of forfeiture of unused quota over and above a given margin in order to deter speculation. Other constraints might be imposed in order to avoid the possibility of excessive socio-economic upheaval (in particular employment impacts) but while such constraints are common in ITQ systems the evidence for very significant structural changes in unconstrained ITQ markets is inconclusive. Although the theoretical model outlined in Chapter 6 predicts potentially very significant employment reductions in some fleet segments following a full rationalisation of quota allocations, it should be remembered that a modelling exercise of this type requires a number of working assumptions which are not wholly realistic. For example, the model assumes that excess vessel capacity can be readily disposed of, whereas in reality the

[67] As we have previously observed, it is also quite likely that if the existing quota system was better enforced there would be a rationalisation of capacity in any case (but at greater financial cost to the industry).

[68] In practice, however, such rules might be circumvented in various ways, for example by complex ownership structures or contractual arrangements between firms.

market for second-hand vessels may be relatively weak so that some over-capacity will remain, at least in the short term. In short, the scale of employment impacts are in practice unlikely to be as great as predicted by the model.

A related issue is the extent to which an ITQ system could be expected to result in the UK fleet meeting nominal capacity targets under the MAGPs (multiannual guidance programmes). In economic terms this is actually a trivial question. The implicit justification for the MAGPs is to make up for a collective failure of national fishery management policies adequately to control fishing effort. Under a well-enforced ITQ system fishing effort will not be excessive (to the extent that national quotas are respected) and therefore there can be no justification for having MAGP targets as well. As long as output targets (quotas) are not exceeded, normal market forces will determine the "right" level of capacity. Practical impediments to capacity adjustment may mean that the resulting level of capacity is not the economically optimal level, however, and there may be a case for some short term adjustment mechanism such as a decommissioning scheme.

Assuming that MAGPs continue to be implemented under the CFP, however (and the signs are that they will), similar arguments apply. ITQs will assist a reduction in fleet capacity but are unlikely to result in meeting MAGP targets exactly (the latter being based on some rather "rule of thumb" calculations[(69)]). If the equilibrium fleet size under ITQs is in excess of the MAGP target level, some intervention will be required. If the MAGP target figures are too low compared to the *optimal* equilibrium fleet size under ITQs, it might then be much more costly to induce additional capacity to exit the fleet.

While in most circumstances subsidies to the fishing industry tend to be damaging to the long term health of the fishery,[(70)] under an ITQ system where the overall level of exploitation is well controlled it is not impossible to make a case for public assistance in buying quota in order to secure fishing employment within a particular region.[(71)] Indeed, this type of assistance has already been seen in Shetland and Orkney. However, distorting the efficient market allocation of quota in this way has an economic cost (in this case, the full cost is borne directly by the local public authority) as would distorting the efficient allocation by "ring-fencing" a certain amount of quota within a particular region in order to achieve similar objectives. The former is arguably more transparent and the cost can be judged on a case-by-case basis. Ring-fencing quota within a region is an inflexible approach which may lead to increasing inefficiency over time (although this is not in essence any different from "ring-fencing" quota within particular EU countries by allocating national quotas).

[69] Hatcher (2000) gives a critique of the MAGP approach.

[70] Subsidies reduce the costs of fishing and therefore tend, under most management regimes, to increase levels of effort. See, for example, Hatcher and Robinson (1999).

[71] This is provided any such assistance were judged to be compatible with Community rules on State Aids to the fishing industry

As previously indicated, it is also possible to restrict quota ownership to active fishermen, for example by requiring quota holders to possess (and utilise) a fishing licence. It may be difficult, however, to prevent the establishment of contractual arrangements resulting in beneficial ownership by non-fishing entities.

As we have suggested, an ITQ system would not mean an end to the role of the POs in quota management. Indeed, despite our previous remarks about FQAs and individual entitlements, PO membership could in some way be made a *de facto* condition for holding ITQs, provided that Community rules on the free and voluntary membership of POs were not infringed.(72)

The POs could (and almost certainly should) play a key role in facilitating the trade in quota and in helping to ensure compliance with individual quota holdings (which is crucial). For example, in a highly multispecies fishery vessels might operate most efficiently by using their ITQs independently for some species while pooling their ITQs for others. For non-target species where the catch is very variable and therefore uncertain, the number of necessary trades and hence transaction costs could be reduced by pooling quota within the POs. In such a model, while vessels would manage their own ITQs for the target species they would draw on the PO pool for by-catch species, with the PO buying or leasing in quota as necessary on its members' behalf.

Lastly, we believe that enforcement would, if anything, be simplified under an ITQ system. Assuming that there is some administrative system in place for annually reconciling each vessel's recorded landings with its final quota allocations (as the total permanent quota holding plus quota leased in, less quota leased out) then the key is to ensure that logbooks and landings declarations are accurately completed. This requires an effective system of quayside checks backed up by penalties which have a real deterrent effect.

In the context of multispecies fisheries and the enforcement of multispecies quotas, the fact that quota can be traded at all will assist vessels in matching quotas with landings. In addition, a number of mechanisms have been proposed in order to aid vessel owners who for some reason are unable to match their quota holdings with their landings for the year.(73) To some extent the market itself would be expected naturally to evolve such mechanisms in response to the demands of ITQ holders. Also, vessel operators will normally be aware of what constitutes risky behaviour in a particular ITQ market; for example, a vessel owner would be ill-advised to wait until the last minute before attempting to secure quota to cover a significant quantity of additional landings over and above his initial quota holding. Nevertheless, possible institutional mechanisms include permitted marginal over-runs (with a corresponding deduction from the following year's quota); allowing marginal over-runs to be counted against quotas for other species (limited quota

[72] In the Netherlands, for example, ITQ holders are presented with strong incentives to belong to the PO-related quota management "Groups".

[73] In practice shorter periods for reconciling quotas and catches might be adopted, say 30 days after landing, depending partly on how the monitoring and enforcement system is structured.

substitution); a "clearing house" to organise the leasing of quota from those with unused quota at the year end; and the leasing of quota from a central Government reserve fund.[74]

7.6 Bringing in the 10m and under fleet

As we have said, there is in principle no economic reason why the inshore sector should operate under a different system to the over 10m fleet (this is now discussed in the context of ITQs, although the problems are really the same even if FQAs are retained for the over 10m fleet). Again, the only economic justification for excluding the inshore sector would be that the costs of the necessary additional administration and enforcement activity would exceed the social benefit of bringing this sector under the same management system. We are certainly aware of the potential problems. After all, the 10m and under sector includes over twice as many vessels as the over 10m sector and yet lands a very small overall proportion of the total catch. On the other hand, the inshore sector lands quite significant quantities of some quota stocks, including *Nephrops* and a number of the Area VII demersal stocks.

A move toward ITQs for the *over* 10m fleet is greatly facilitated by the fact that a more-or-less acceptable allocation has already been made at the individual vessel level. In other parts of the world one of the most problematic issues in introducing ITQ systems where there was no existing well-established quota management system has been deciding the initial allocation. In the UK this problem has largely already been overcome.

In the case of the great majority of the 10m and under fleet, however, there are no existing - even notional - individual allocations. Departments and industry would therefore need to agree on an acceptable first round allocation mechanism and this would not be easy or painless. Except for a small number of vessels which have voluntarily kept logbooks, there are no individual track records for the inshore vessels. Possible mechanisms might include a flat-rate allocation (perhaps scaled according to an estimated percentage reliance on quota stocks as opposed to shellfish) or an allocation based on some physical measure of capacity such as engine power or VCUs. It would probably be necessary to bring in the under 10m vessels gradually, by extending the lower threshold for full quota management by a small amount (say, one metre of vessel length) each year over a number of years. This would create incentives for reducing vessel length but in practice owners are unlikely to repeatedly shorten their vessels on an annual basis.

The 10m and under vessels could be encouraged to join POs or form their own POs. As we have suggested, POs or groups of vessels within POs would be able collectively to decide to pool quota if that was what they wanted to do. As an example of this we are aware of the case of a group of inshore vessels (in this case a little over 10m) who have their own pooled allocation within one of the POs which operates a system of individual quotas. There would be no reason to restrict trade in quota across the (arbitrary) 10m divide.

[74] For a review of mechanisms to deal with quota imbalances and associated discard problems see Pascoe (1997) and Squires *et al* (1998).

7.7 Conclusions

The UK quota management system has a number of strengths, as we have observed. In terms of restricting output at the individual vessel level, despite some concerns about the adequacy of enforcement we consider that the UK system has probably contributed more to the attainment of stock conservation objectives than have the arrangements adopted by some other countries. In terms of the economic efficiency of fishing operations, the UK system in the past undoubtedly resulted in a more efficient allocation of quota to the fleet than might have been achieved by a more arbitrary system, but a system of allocation now based upon fixed quotas can only become increasingly inefficient over time. Although we recognise that a number of problems which were created by the old rolling track record-based system were removed under FQAs, we do believe that there would be significant benefits in terms of stock conservation objectives and economic efficiency if quota trading were made considerably easier, *at least* by enabling firms to trade quota permanently as well as on an annual lease basis.

Fully-tradeable quotas should reduce incentives to land over-quota fish and for certain types of discarding, for example in multispecies fisheries. Tradeable quotas should also enable individual firms to operate more efficiently, while the exit of inefficient vessels is facilitated if quota can readily be sold. The limited tradeability of quota under the current system may go some way to achieving such conservation and efficiency objectives, but the impediments to free trading would appear to be considerable and must surely hamper progress in these respects.

Extending the allocation of IQs and the possibilities for freer quota trading to all vessels (at least those over 10m in length) would effectively result in an ITQ system for the UK and we believe that this possibility should be seriously considered. The experience with ITQs in other countries, which includes the Netherlands within the EU, is generally positive and where they have been introduced ITQs have in most cases proved popular with vessel owners.[75] As we have said, the POs could play a key role in an ITQ system and hence would retain their important management function.

While there are concerns over the possible effects of an ITQ system on fleet size and structure, and hence fishery employment, we would draw attention to the fact that if ITQs result in a smaller fleet, then it is implicitly the case that the previous fleet capacity was excessive. It might be argued that a fleet larger than is economically optimal can be justified if an explicit political trade-off is made between efficiency and employment, but if enforcement is much less than perfect the result is also likely to be significant levels of over-quota landings and hence a negative impact on stocks.

It is also the case that the UK will have to reduce its fleet size in any event, if only because of its MAGP commitments. The scale of fleet impacts predicted by our computer model, as we have

[75] A recent economic study of the introduction of ITQs in Nova Scotia in 1991 illustrates how successful ITQs can be in a multispecies fishery (Dupont and Grafton 2001).

said, are in practice somewhat unlikely, although to the extent that ITQs do not result in a sufficient reduction in capacity, external intervention may be required in the form of further decommissioning schemes.

Finally, we wish to emphasise once again the importance of enforcement in quota management. Allowing fleets to exceed output targets will seriously compromise stock conservation objectives and hence enforcement of quotas must be taken very seriously indeed. Although this observation is made in a general sense, and we suspect that enforcement by the UK authorities may compare very favourably with some other countries, we would urge Departments to consider how the enforcement side of the quota management system might be improved in order that compliance with UK quotas is assured. Increased enforcement effort can be costly, and in the context of the considerable value acquired by tradeable quota entitlements we do suggest that Government revisit the possibility of some industry contribution towards the costs of management.[76]

[76] This was the subject of a previous report to the Ministry (Hatcher and Pascoe 1998).

Appendix I: Development of the UK licensing system

Before 1983 fishing licences were a requirement for UK vessels operating in the main pelagic fisheries (mackerel and herring) and demersal fisheries (cod, haddock, whiting, sole and plaice) in all areas around the UK. However, in most cases they were only required by vessels of 40ft or over in length, and with the exception of licences for the large pelagic purse-seine and freezer vessels, they were quite freely available.

During 1983 licensing was extended to cover fishing for all the stocks subject to catch quotas (under the Community's new conservation and management system) by all vessels over 10m in length. To begin with, most licences continued to be freely available, but in 1984 the number of licences authorising fishing for those quota stocks considered to be under greatest pressure was restricted. The so-called "pressure stock licences" (PSLs) required were only issued to registered vessels which could demonstrate at least a 12-month record of fishing for one or more of the stocks concerned,[(77)] or which already held an appropriate licence. Although restricted in number, pressure stock licences were transferable. They could only be transferred between ownerships while they remained attached to a vessel, but within the same ownership they could be transferred from one vessel to another, the only restriction initially put in place being that licence transfers from under 40ft vessels to those of 40ft and over were not permitted.

For those vessels targeting other quota stocks, the required "non-pressure stock licences" (non-PSLs) continued to be issued freely to any fishing vessel on the UK register,[(78)] while vessels under 10m in length were still not required to have a licence.

The licensing scheme as it was introduced in 1984 was originally intended to run for a period of three years. However, because of the free availability of non-PSLs and the ease with which PSLs could be transferred to more powerful vessels (as well as the complete lack of control of the under 10m sector) the overall size and capacity of the UK fleet was allowed to expand. For this reason, a series of additional restrictions on the availability and transferability of licences were

---

[77] The "pressure stocks" originally designated in 1984 were as follows (species/area):

herring	*all quota stocks*	*cod*	*all except VII & VIII*
mackerel	*all quota stocks*	*haddock*	*all except VII & VIII*
saithe	*all quota stocks*	*whiting*	*IIa, IV, Vb, VI*
anglerfish	*all quota stocks*	*plaice*	*Vb, VI, VIIdefg*
hake	*IIa, IV*	*sole*	*VIIadefg*

The following stocks were also designated pressure stocks from 1986:

hake	*Vb, VI & VII*	*cod*	*VIIb-k, VIII, IX, X*
sole	*IIa, IV*	*haddock*	*VII, VIII, IX, X*
megrim	*VII*		

[78] From 1986, the list of "non-pressure stocks" was as follows:

plaice	*IIa, IV, VIIahjk*	*cod*	*VIIa*
sole	*VI, VIIhjk*	*megrim*	*Vb, VI*
whiting	*VII*	*sprat*	*VIIde*
pollack	*Vb, VI, VII*	*nephrops*	*Vb, VI, VII*

introduced during the next few years. Certain restrictions were designed in particular to try and control the expansion of the beam trawler sector fishing for sole and plaice in Area VII (the Channel and Western waters) and to impede the acquisition of licences by non-UK (predominantly Spanish) interests.(79)

In 1988, pending the implementation of new measures to reduce capacity (and with no decommissioning scheme in operation at the time), a temporary ban was placed on all transfers of licences between vessels except in cases where there was no resultant increase in either tonnage or engine power. Then in 1989 the Government indicated that it intended to employ a market-oriented approach, specifically by introducing flexible licence transfer arrangements which would also allow some measure of licence aggregation in order to "allow the fleet to modernise and adapt to changing conditions and to permit individuals to expand their enterprises while preventing any growth in the licensed fleet as a whole".(80)

In the following year licence requirements were extended to include fishing for all species in all areas by all vessels over 10m and a new "miscellaneous species" licence was introduced for those over 10m vessels (mainly shellfish boats) which had not previously required a licence. As all licences were now restricted, the free availability of non-pressure stock licences for vessels under 40ft and of licences for *Nephrops* was ended.

At the same time, transfers of licences between vessels were once again permitted under a new system of "vessel capacity units" (VCUs). Each licence was assigned a certain number of VCUs, calculated for the vessel to which the licence was attached according to a formula taking into account vessel size and power.(81) Licence transfers were now allowed more or less freely, provided that there was no increase in either vessel tonnage or engine power, or that there was a 10% decrease in VCUs for the recipient vessel. In addition, under the new "capacity aggregation" scheme, two or more licences (which had to be of a similar type) could be transferred onto a single larger or more powerful vessel provided that the capacity of that vessel measured in VCUs was no more than 90% of the combined capacity of the "donor" vessels.(82)

Since 1990 the VCU "penalties" for licence transfers and aggregations have been altered a number of times, while additional restrictions were again introduced in an attempt to make some

---

[79] In order to try and foil attempts by Spanish interests to gain access to various UK quotas in Area VII, the Government accompanied a restriction on the issue of non-PSLs in 1987 with a ban on transfers between ownerships. In addition, in the previous year a number of key stocks (including hake and megrim in Area VII) had been added to the list of pressure stocks. Vessels with non-PSLs having a record of fishing for the new pressure stocks were issued with special "limited pressure stock licences" which were also non-transferable between ownerships.

[80] MAFF News Release 445/89, 13 November 1989

[81] (overall length in metres x maximum breadth in metres) + (engine power in kW x 0.45)

[82] For the purposes of capacity aggregation the rule that a licence could only be transferred between ownerships while attached to a vessel was relaxed, so that licences from vessels in different ownerships could be aggregated onto another vessel, provided that the owners of the "donor" vessels were at least part-owners of the "recipient" vessel.

progress towards meeting the UK's MAGP targets for tonnage and engine power. In particular, the inshore (10m & under) sector was finally restricted in 1993 and in the previous year the number of beam trawlers licensed to fish in the North Sea (Area IV) was restricted (partly because of licence acquisitions by Dutch interests wishing to gain access to UK North Sea sole and plaice quotas).

In February 1996 it was announced that in addition to the existing VCU penalties, no licence transfers or aggregations would be allowed to result in any increase in either tonnage or engine power. On the other hand, since an overall revision of the licensing system in 1995 (when licence categories "A", "B" and "C" replaced the old PSLs, non-PSLs and MS licences) all licences were by now fully transferable independently of vessels.

More recently, most changes have involved tinkering with the capacity penalty rules in order to exert greater control over fleet capacity in relation to MAGP targets, and in particular the growth of the 10m and under fleet.[83] An overall review of the licensing system, reporting during 1999-2001, recommended substantially retaining the existing "ABC" arrangements.

The changes to the licensing system since 1983 are summarised in the Table below.

Year	Licence availability	Licence transfer restrictions
1983	all freely available (except for pursers/freezers); not required for non-quota stocks or under 10m vessels	none
1984	introduction of PSLs; non-PSLs still available; licences still not required for non-quota stocks or under 10m vessels	PSLs not transferable from vessels under 40ft to those over 40ft
1985	restriction on PSLs for beam trawlers in Area VII	Area VII beam trawl PSLs only transferable if no increase in length, tonnage or power; other PSLs not transferable onto beam trawlers in Area VII
1986		Area VII PSLs not transferable from vessels under 80ft to those over 80ft
1987	no new non-PSLs for vessels 40ft and over (except for *Nephrops* in Areas VI/VII)	no PSLs transferable across either 40ft or 80ft limits; non-PSLs not transferable across 40ft limit and now not transferable between ownerships
1988		temporary ban on all licence transfers except where no increase in tonnage or power would result

[83] New VCU penalties announced in 2001 were designed to stop the increase in capacity in the 8-10m band.

1990	introduction of miscellaneous species licence; licences now required for all vessels over 10m (no new licences of any category)	introduction of VCU system: transfers permitted with either no increase in tonnage or power or a 10% decrease in VCUs; aggregations (similar licences only) also required 10% cut in VCUs
1991		*Nephrops* licences now transferable between ownerships
1992	restriction on PSLs for beam trawlers in Area IV	no aggregation of PSLs onto beam trawlers in Areas IV or VI; VCU "penalty" for all transfers and aggregations increased to 20%
1993	licences now also required by 10m & under vessels (no new licences now available for any fishing vessels)	VCU penalty reduced to 10% for aggregations where increase in engine power limited to 15% and for all over 10m transfers; no penalty for 10m & under transfers (but no increase in VCUs); no transfers across 10m limit or aggregations combining under and over 10m licences; no more than two vessels in 10-17m band involved in aggregations
1995	new licence structure: cat. "A" for over 10m vessels (equivalent to old PSLs); cat. "A" for 10m & under vessels; cat. "B" (equivalent to old non-PSL/*Nephrops* licences), cat. "C" licences (old miscellaneous spp. licences)	all licences now transferable between vessels and between ownerships but still only similar licences can be aggregated: licences no longer have to be attached to a vessel when transferred between ownerships
1995		penalty for aggregation of 3 or more licences increased to 30% (except for purse-seiners/freezer trawlers); aggregations of more than 2 licences between 10-17m now permitted; Area IV/VI beam trawler licences can now be aggregated if resultant engine power does not exceed 1500kW
1996		no licence transfers or aggregations to increase either tonnage or power; no 10m & under aggregations to result in more than 100 VCUs
1998	introduction of cat. A pelagic trawler licences	zero penalties for transfers of pelagic freezer/purser licences and 10% penalty for aggregations
1998		exemption from capacity penalties for distant waters licences
1998		derogation for aggregating cat. A pelagic or demersal licences onto pelagic freezer/purser vessels until June 2001
1999	introduction of measures to verify maximum rated or permanently de-rated engine power declared on licences	aggregations needed to correct for underestimated VCUs (due to under-declared engine power) subject to 20% penalty only on additional VCUs (10% before 31/12/01)
1999	introduction of (over 10m) scallop licences	

1999	licensing review: upgrading of moratorium licences and single spp cat B licences to cat A	
1999		various changes to capacity rules for licence transactions: minor mismatches in tonnage, engine power or VCUs tolerated provided one measure is exactly met; 30% penalty on aggregations correcting for engine power if licences transferred from 18m or under vessels onto an over 18m vessel; other minor changes and provisions relating to change from GRT to GT measurements
2001		no aggregations of licences from under 8m vessels onto 8-10m vessels; limit of 70 VCUs applied to aggregations onto vessels under 8m
2001		in the case of engine up-rating or replacement capacity penalties applied to increase in VCUs only, as long as power does not increase by more than 35%: 20% (10% before 31/12/01) or 30% if licences transferred from 18m or under vessels onto an over 18m vessel
2001		announcement of a single capacity penalty to apply to tonnage, engine power and VCUs from 01/04/03.

Appendix II: Tables of responses to the survey of fishermen

General attitudes to the current management system

All respondents were asked:
How satisfied are you overall with the current quota management system?

	very unsatisfied	slightly unsatisfied	quite satisfied	very satisfied
Demersal trawlers				
> 24m (all areas)	10%	20%	70%	0%
≤ 24m Area IV/VI	22%	23%	51%	4%
≤ 24m Area VIId-k	28%	44%	28%	0%
≤ 24m Area VIIa	78%	17%	6%	0%
Pelagic vessels	24%	24%	41%	11%
Beam trawlers				
Area IV	26%	68%	5%	0%
Area VII	69%	28%	3%	0%
Nephrops trawlers				
Area IV	19%	33%	48%	0%
Area VI	5%	37%	58%	0%
Area VIIa	84%	10%	6%	0%
Netters/liners	15%	32%	32%	21%
Non-sector	62%	22%	16%	0%
Weighted total >10m	**31%**	**26%**	**39%**	**4%**
10m and under	52%	20%	13%	2%

Attitudes to the FQA system

All respondents were asked:
Did you support the move from track record-based allocations to FQAs?

	yes	no
Demersal trawlers		
> 24m (all areas)	90%	10%
≤ 24m Area IV/VI	78%	22%
≤ 24m Area VIId-k	40%	60%
≤ 24m Area VIIa	56%	44%
Pelagic vessels	83%	17%
Beam trawlers		
Area IV	75%	25%
Area VII	70%	30%
Nephrops trawlers		
Area IV	67%	33%
Area VI	60%	40%
Area VIIa	56%	44%
Netters/liners	79%	21%
Non-sector	12%	88%
Weighted total > 10m	**71%**	**29%**
10m and under	14%	86%

Now that FQAs have been introduced, do you consider that they represent an improvement on track record-based allocations?

	yes	no
Demersal trawlers		
> 24m (all areas)	90%	10%
≤ 24m Area IV/VI	66%	34%
≤ 24m Area VIId-k	36%	64%
≤ 24m Area VIIa	61%	39%
Pelagic vessels	93%	17%
Beam trawlers		
Area IV	83%	17%
Area VII	70%	30%
Nephrops trawlers		
Area IV	70%	30%
Area VI	76%	24%
Area VIIa	48%	52%
Netters/liners	79%	21%
Non-sector	18%	82%
Weighted total > 10m	**69%**	**31%**
10m and under	14%	86%

Are you in favour of annual adjustments to vessels' FQAs to take account of quota movements between vessels?

	yes	no
Demersal trawlers		
> 24m (all areas)	100%	0%
≤ 24m Area IV/VI	78%	22%
≤ 24m Area VIId-k	92%	8%
≤ 24m Area VIIa	88%	12%
Pelagic vessels	88%	12%
Beam trawlers		
Area IV	91%	9%
Area VII	40%	60%
Nephrops trawlers		
Area IV	74%	26%
Area VI	60%	40%
Area VIIa	78%	22%
Netters/liners	73%	27%
Non-sector	6%	94%
Weighted total > 10m	**79%**	**21%**
10m and under	22%	78%

Freedom to trade in quota

All respondents were asked:
Do you think that under the current quota management system there is (a) too much freedom to trade quota?; (b) about the right amount of freedom to trade quota?; (c) not enough freedom to trade quota?

	too much	right amount	not enough
Demersal trawlers			
> 24m (all areas)	2%	39%	59%
≤ 24m Area IV/VI	14%	69%	17%
≤ 24m Area VIId-k	16%	72%	12%
≤ 24m Area VIIa	33%	56%	11%
Pelagic vessels	24%	29%	47%
Beam trawlers			
Area IV	0%	71%	29%
Area VII	32%	44%	28%
Nephrops trawlers			
Area IV	37%	56%	7%
Area VI	58%	37%	5%
Area VIIa	27%	54%	19%
Netters/liners	26%	37%	37%
Non-sector	67%	22%	11%
Weighted total > 10m	**22%**	**53%**	**25%**
10m and under	26%	69%	5%

Do you think that, in principle, quota trading in the UK should be allowed (a) within POs, but not between POs? (b) between POs, but not between individual vessels? (c) only within, and between, POs? (d) amongst any vessels over 10 metres? (e) amongst any vessels, including those of 10 metres and under? (f) or not at all?

	(a)	(b)	(c)	(d)	(e)	(f)
Demersal trawlers						
> 24m (all areas)	2%	0%	8%	43%	43%	4%
≤ 24m Area IV/VI	3%	2%	5%	23%	53%	14%
≤ 24m Area VIId-k	16%	0%	16%	44%	8%	16%
≤ 24m Area VIIa	0%	0%	44%	17%	28%	11%
Pelagic vessels	0%	0%	29%	0%	71%	0%
Beam trawlers						
Area IV	0%	38%	4%	13%	54%	0%
Area VII	0%	0%	16%	12%	40%	32%
Nephrops trawlers						
Area IV	0%	7%	30%	15%	37%	11%
Area VI	5%	0%	17%	21%	32%	26%
Area VIIa	6%	0%	48%	25%	17%	4%
Netters/liners	5%	11%	16%	16%	47%	5%
Non-sector	0%	0%	0%	17%	28%	55%
Weighted total > 10m	**4%**	**4%**	**16%**	**24%**	**41%**	**11%**
10m and under	0%	0%	3%	43%	39%	15%

If some form of quota trading is allowed, should it be possible for quota to be owned by

(a) anyone?

(b) only persons or companies actively engaged in fishing?

	anyone	only those engaged in fishing
Demersal trawlers		
> 24m (all areas)	30%	70%
≤ 24m Area IV/VI	11%	89%
≤ 24m Area VIId-k	4%	96%
≤ 24m Area VIIa	0%	100%
Pelagic vessels	12%	88%
Beam trawlers		
Area IV	4%	96%
Area VII	24%	76%
Nephrops trawlers		
Area IV	4%	96%
Area VI	0%	100%
Area VIIa	0%	100%
Netters/liners	26%	74%
Non-sector	0%	100%
Weighted total > 10m	**11%**	**89%**
10m and under	0%	100%

PO members' attitudes to PO management

PO members (over 10m) were asked:
Within your PO, does your vessel currently operate with (a) individual vessel or company quotas (IQs)? (b) monthly limits from a quota "pool"? (c) monthly limits plus extra quota acquired by you ("pool-plus")? (d) IQs for some stocks, monthly limits for others?

	(a)	(b)	(c)	(d)
Demersal trawlers				
> 24m (all areas)	49%	28%	23%	0%
≤ 24m Area IV/VI	24%	23%	53%	0%
≤ 24m Area VIId-k	27%	50%	23%	0%
≤ 24m Area VIIa	0%	94%	6%	0%
Pelagic vessels	100%	0%	0%	0%
Beam trawlers				
Area IV	71%	4%	8%	16%
Area VII	0%	56%	2%	32%
Nephrops trawlers				
Area IV	13%	29%	58%	0%
Area VI	0%	63%	37%	0%
Area VIIa	0%	84%	16%	0%
Netters/liners	47%	42%	11%	0%
Non-sector	--	--	--	--
Weighted total > 10m	**27%**	**40%**	**30%**	**3%**
10m and under	--	--	--	--

How satisfied are you with these arrangements?

	satisfied	not satisfied
Demersal trawlers		
> 24m (all areas)	82%	18%
≤ 24m Area IV/VI	90%	10%
≤ 24m Area VIId-k	59%	41%
≤ 24m Area VIIa	89%	11%
Pelagic vessels	94%	6%
Beam trawlers		
Area IV	92%	8%
Area VII	64%	36%
Nephrops trawlers		
Area IV	92%	8%
Area VI	78%	22%
Area VIIa	96%	4%
Netters/liners	74%	26%
Non-sector	--	--
Weighted total > 10m	**84%**	**16%**
10m and under	--	--

Given the choice, would you prefer your PO to operate different arrangements (under the existing quota management system)?

	yes	no
Demersal trawlers		
> 24m (all areas)	37%	63%
≤ 24m Area IV/VI	34%	66%
≤ 24m Area VIId-k	5%	95%
≤ 24m Area VIIa	39%	61%
Pelagic vessels	10%	90%
Beam trawlers		
Area IV	8%	92%
Area VII	8%	92%
Nephrops trawlers		
Area IV	8%	92%
Area VI	5%	95%
Area VIIa	20%	80%
Netters/liners	26%	74%
Non-sector	--	--
Weighted total > 10m	**24%**	**76%**
10m and under	--	--

If yes, which arrangements would you prefer? (a) individual vessel or company quotas (IQs)? (b) monthly limits? (c) monthly limits plus extra quota acquired by you? (d) IQs for some stocks, monthly limits for others?

	(a)	(b)	(c)	(d)
Demersal trawlers				
> 24m (all areas)	27%	0%	10%	0%
≤ 24m Area IV/VI	28%	0%	10%	1%
≤ 24m Area VIId-k	5%	0%	0%	0%
≤ 24m Area VIIa	6%	0%	30%	0%
Pelagic vessels	0%	0%	0%	0%
Beam trawlers				
Area IV	4%	0%	4%	0%
Area VII	8%	0%	0%	0%
Nephrops trawlers				
Area IV	4%	0%	0%	4%
Area VI	0%	0%	0%	0%
Area VIIa	10%	0%	10%	0%
Netters/liners	16%	11%	0%	0%
Non-sector	--	--	--	--
Weighted total > 10m	**16%**	**1%**	**7%**	**1%**
10m and under	--	--	--	--

PO members' involvement in quota trading

PO members (over 10m) were asked:
Have you ever enhanced your vessel's track record or FQA by (a) purchase of a licence with track record/quota units? (b) purchase of track record/quota units only?

	licence plus quota	quota only
Demersal trawlers		
> 24m (all areas)	33%	31%
≤ 24m Area IV/VI	7%	27%
≤ 24m Area VIId-k	20%	12%
≤ 24m Area VIIa	12%	47%
Pelagic vessels	35%	41%
Beam trawlers		
Area IV	0%	21%
Area VII	12%	0%
Nephrops trawlers		
Area IV	43%	4%
Area VI	11%	0%
Area VIIa	19%	20%
Netters/liners	0%	32%
Non-sector	--	--
Weighted total > 10m	**16%**	**23%**
10m and under	--	--

Do you currently, or have you ever, (a) leased quota from another vessel (in your own or another PO)? (b) purchased quota from another vessel (in your own or another PO)?

	leased quota in	purchased quota
Demersal trawlers		
> 24m (all areas)	35%	0%
≤ 24m Area IV/VI	41%	0%
≤ 24m Area VIId-k	8%	0%
≤ 24m Area VIIa	6%	0%
Pelagic vessels	53%	0%
Beam trawlers		
Area IV	58%	0%
Area VII	44%	0%
Nephrops trawlers		
Area IV	11%	0%
Area VI	29%	0%
Area VIIa	17%	0%
Netters/liners	26%	0%
Non-sector	--	--
Weighted total > 10m	**32%**	**0%**
10m and under	--	--

Do you currently, or have you ever, (a) leased quota to another vessel (in your own or another PO)? (b) sold quota to another vessel (in your own or another PO)?

	leased quota out	sold quota
Demersal trawlers		
> 24m (all areas)	35%	2%
≤ 24m Area IV/VI	30%	0%
≤ 24m Area VIId-k	4%	0%
≤ 24m Area VIIa	18%	0%
Pelagic vessels	53%	0%
Beam trawlers		
Area IV	50%	0%
Area VII	8%	0%
Nephrops trawlers		
Area IV	7%	14%
Area VI	29%	0%
Area VIIa	9%	0%
Netters/liners	21%	0%
Non-sector	--	--
Weighted total > 10m	**27%**	**1%**
10m and under	--	--

Can you estimate, at least roughly, the proportion of your current gross earnings which are attributable to extra units which have been added by acquiring licence(s)?

	< 10%	10 - 25%	25 - 50%	> 50%
Demersal trawlers				
> 24m (all areas)	16%	8%	22%	24%
≤ 24m Area IV/VI	1%	8%	24%	11%
≤ 24m Area VIId-k	0%	0%	0%	0%
≤ 24m Area VIIa	0%	12%	6%	0%
Pelagic vessels	0%	0%	47%	41%
Beam trawlers				
Area IV	0%	0%	21%	0%
Area VII	0%	0%	0%	0%
Nephrops trawlers				
Area IV	0%	18%	21%	0%
Area VI	0%	35%	6%	0%
Area VIIa	2%	15%	9%	0%
Netters/liners	0%	16%	16%	0%
Non-sector	--	--	--	--
Weighted total > 10m	**3%**	**12%**	**17%**	**8%**
10m and under	--	--	--	--

Can you estimate, at least roughly, the proportion of your current gross earnings which are attributable to extra quota which you have bought or currently lease from another vessel?

	< 10%	10 - 25%	25 - 50%	> 50%
Demersal trawlers				
> 24m (all areas)	18%	8%	4%	0%
≤ 24m Area IV/VI	12%	36%	8%	1%
≤ 24m Area VIId-k	23%	0%	0%	4%
≤ 24m Area VIIa	6%	0%	6%	0%
Pelagic vessels	24%	53%	0%	0%
Beam trawlers				
Area IV	54%	25%	0%	0%
Area VII	56%	4%	0%	0%
Nephrops trawlers				
Area IV	11%	32%	0%	0%
Area VI	0%	0%	0%	0%
Area VIIa	0%	0%	0%	0%
Netters/liners	16%	16%	0%	0%
Non-sector	--	--	--	--
Weighted total > 10m	**15%**	**18%**	**3%**	**1%**
10m and under	–	--	--	--

PO quota pools and "dummy" vessels

PO members (over 10m) were asked:
Does your PO hold any quota over and above the total of its members' FQAs, for example in the form of units attached to a "dummy vessel"?

	yes	no
Demersal trawlers		
> 24m (all areas)	61%	39%
≤ 24m Area IV/VI	77%	23%
≤ 24m Area VIId-k	42%	58%
≤ 24m Area VIIa	81%	19%
Pelagic vessels	30%	70%
Beam trawlers		
Area IV	56%	44%
Area VII	52%	48%
Nephrops trawlers		
Area IV	75%	25%
Area VI	79%	21%
Area VIIa	76%	24%
Netters/liners	35%	65%
Non-sector	--	--
Weighted total > 10m	**56%**	**44%**
10m and under	--	--

If yes, do you receive additional quota allowances as a result?

	yes	no
Demersal trawlers		
> 24m (all areas)	61%	39%
≤ 24m Area IV/VI	77%	23%
≤ 24m Area VIId-k	36%	64%
≤ 24m Area VIIa	81%	19%
Pelagic vessels	0%	100%
Beam trawlers		
Area IV	56%	44%
Area VII	52%	48%
Nephrops trawlers		
Area IV	72%	28%
Area VI	79%	21%
Area VIIa	76%	24%
Netters/liners	35%	65%
Non-sector	--	--
Weighted total > 10m	**54%**	**46%**
10m and under	--	--

Was the acquisition of this quota funded through (a) a one-off contribution from the membership? (b) an increased levy? (c) other (please specify)?

	levy	PO funds	loan	2.5%	don't know	one-off
Demersal trawlers						
> 24m (all areas)	63%	23%	14%	0%	0%	0%
≤ 24m Area IV/VI	71%	8%	12%	0%	9%	0%
≤ 24m Area VIId-k	60%	0%	20%	0%	20%	0%
≤ 24m Area VIIa	100%	0%	0%	0%	0%	0%
Pelagic vessels	100%	0%	0%	0%	0%	0%
Beam trawlers						
Area IV	0%	21%	0%	15%	0%	64%
Area VII	45%	0%	13%	0%	42%	0%
Nephrops trawlers						
Area IV	38%	38%	0%	24%	0%	0%
Area VI	47%	0%	0%	53%	0%	0%
Area VIIa	100%	0%	0%	0%	0%	0%
Netters/liners	67%	0%	0%	33%	0%	0%
Non-sector	--	--	--	--	--	--
Weighted total > 10m	**56%**	**8%**	**6%**	**9%**	**5%**	**2%**
10m and under	--	--	--	--	--	--

Do you support the PO in acquiring quota in this way?

	yes	no
Demersal trawlers		
> 24m (all areas)	63%	37%
≤ 24m Area IV/VI	77%	23%
≤ 24m Area VIId-k	42%	58%
≤ 24m Area VIIa	88%	12%
Pelagic vessels	30%	70%
Beam trawlers		
Area IV	56%	44%
Area VII	48%	52%
Nephrops trawlers		
Area IV	57%	43%
Area VI	37%	63%
Area VIIa	80%	20%
Netters/liners	41%	59%
Non-sector	--	--
Weighted total > 10m	**52%**	**48%**
10m and under	--	--

If yes, would you prefer the PO to be more pro-active in acquiring quota?

	yes	no
Demersal trawlers		
> 24m (all areas)	73%	27%
≤ 24m Area IV/VI	59%	41%
≤ 24m Area VIId-k	77%	23%
≤ 24m Area VIIa	95%	5%
Pelagic vessels	30%	70%
Beam trawlers		
Area IV	43%	57%
Area VII	84%	16%
Nephrops trawlers		
Area IV	100%	0%
Area VI	93%	7%
Area VIIa	100%	0%
Netters/liners	100%	0%
Non-sector	--	--
Weighted total > 10m	**65%**	**35%**
10m and under	--	--

Views on ITQs

All respondents were asked:
Do you consider that a move towards some form of ITQ system for the UK is now inevitable?

	yes	no
Demersal trawlers		
> 24m (all areas)	88%	12%
≤ 24m Area IV/VI	91%	9%
≤ 24m Area VIId-k	81%	19%
≤ 24m Area VIIa	76%	24%
Pelagic vessels	94%	6%
Beam trawlers		
Area IV	100%	0%
Area VII	67%	33%
Nephrops trawlers		
Area IV	83%	17%
Area VI	37%	63%
Area VIIa	48%	52%
Netters/liners	79%	21%
Non-sector	78%	22%
Weighted total > 10m	**78%**	**22%**
10m and under	86%	14%

From your present understanding of ITQ systems, are you (a) broadly in favour of ITQs, at least for some fisheries? (b) broadly against ITQs?

	in favour	against
Demersal trawlers		
> 24m (all areas)	88%	12%
≤ 24m Area IV/VI	66%	34%
≤ 24m Area VIId-k	77%	23%
≤ 24m Area VIIa	59%	41%
Pelagic vessels	82%	18%
Beam trawlers		
Area IV	75%	25%
Area VII	36%	64%
Nephrops trawlers		
Area IV	21%	79%
Area VI	6%	94%
Area VIIa	58%	42%
Netters/liners	53%	47%
Non-sector	28%	72%
Weighted total > 10m	**59%**	**41%**
10m and under	28%	72%

If you are basically in favour of ITQs, do you think that ITQs might be appropriate for (a) all stocks? (b) pelagic stocks? (c) whitefish stocks? (d) *Nephrops*? (e) other shellfish? (f) don't know

	all	pelagic	whitefish	*Nephrops*	shellfish	don't know
Demersal trawlers						
> 24m (all areas)	29%	55%	59%	55%	0%	0%
≤ 24m Area IV/VI	34%	49%	46%	46%	0%	0%
≤ 24m Area VIId-k	42%	31%	27%	0%	0%	0%
≤ 24m Area VIIa	47%	18%	18%	6%	0%	0%
Pelagic vessels	24%	59%	11%	6%	0%	0%
Beam trawlers						
Area IV	34%	38%	38%	0%	0%	0%
Area VII	32%	8%	40%	0%	0%	8%
Nephrops trawlers						
Area IV	7%	59%	66%	14%	0%	0%
Area VI	0%	84%	63%	11%	6%	0%
Area VIIa	48%	8%	2%	0%	0%	6%
Netters/liners	16%	16%	47%	10%	0%	0%
Non-sector	11%	39%	39%	6%	0%	33%
Weighted total > 10m	**28%**	**44%**	**44%**	**25%**	**1%**	**1%**
10m and under	20%	22%	26%	2%	0%	34%

Again, if you are basically in favour of ITQs, do you think that ITQs might be appropriate for (a) all UK vessels? (b) over 10 metre vessels only?(c) PO members only? (e) other (please specify)?

	all vessels	>10m only	PO vessels only	other
Demersal trawlers				
> 24m (all areas)	66%	25%	9%	0%
≤ 24m Area IV/VI	73%	19%	4%	4%
≤ 24m Area VIId-k	31%	46%	8%	15%
≤ 24m Area VIIa	53%	18%	0%	29%
Pelagic vessels	64%	14%	8%	14%
Beam trawlers				
Area IV	38%	42%	4%	16%
Area VII	36%	8%	32%	24%
Nephrops trawlers				
Area IV	90%	0%	10%	0%
Area VI	47%	0%	6%	47%
Area VIIa	60%	32%	8%	0%
Netters/liners	53%	0%	16%	0%
Non-sector	44%	30%	0%	0%
Weighted total > 10m	**62%**	**18%**	**9%**	**11%**
10m and under	37%	63%	0%	0%

Do you think that ITQs would tend to reduce or increase over-quota landings?

	reduce	increase	don't know
Demersal trawlers			
> 24m (all areas)	88%	4%	8%
≤ 24m Area IV/VI	73%	5%	22%
≤ 24m Area VIId-k	23%	23%	54%
≤ 24m Area VIIa	18%	53%	29%
Pelagic vessels	65%	11%	24%
Beam trawlers			
Area IV	71%	4%	25%
Area VII	44%	12%	44%
Nephrops trawlers			
Area IV	59%	34%	17%
Area VI	21%	79%	0%
Area VIIa	32%	34%	38%
Netters/liners	79%	0%	21%
Non-sector	6%	28%	66%
Weighted total > 10m	**59%**	**20%**	**21%**
10m and under	10%	10%	80%

Do you think that ITQs would tend to reduce or increase discarding at sea?

	reduce	increase	don't know
Demersal trawlers			
> 24m (all areas)	47%	35%	18%
≤ 24m Area IV/VI	55%	26%	19%
≤ 24m Area VIId-k	8%	35%	58%
≤ 24m Area VIIa	12%	82%	6%
Pelagic vessels	65%	11%	24%
Beam trawlers			
Area IV	21%	0%	79%
Area VII	16%	4%	80%
Nephrops trawlers			
Area IV	17%	69%	14%
Area VI	11%	89%	0%
Area VIIa	24%	40%	36%
Netters/liners	74%	0%	26%
Non-sector	6%	44%	50%
Weighted total > 10m	**39%**	**37%**	**25%**
10m and under	6%	18%	76%

If an ITQ system were to be introduced for the UK, do you think that the POs should be given a central role in the organisation of the system, for example handling quota sales and rentals on behalf of their members?

	yes	no
Demersal trawlers		
> 24m (all areas)	69%	31%
≤ 24m Area IV/VI	85%	15%
≤ 24m Area VIId-k	92%	8%
≤ 24m Area VIIa	100%	0%
Pelagic vessels	76%	24%
Beam trawlers		
Area IV	100%	0%
Area VII	68%	32%
Nephrops trawlers		
Area IV	79%	21%
Area VI	79%	21%
Area VIIa	100%	0%
Netters/liners	84%	16%
Non-sector	39%	61%
Weighted total > 10m	**84%**	**16%**
10m and under	64%	36%

Again, if an official ITQ system were to be introduced, do you think that the Government should collect some sort of monetary levy or tax on the value of quota sales?

	yes	no
Demersal trawlers		
> 24m (all areas)	29%	71%
≤ 24m Area IV/VI	15%	85%
≤ 24m Area VIId-k	0%	100%
≤ 24m Area VIIa	0%	100%
Pelagic vessels	29%	71%
Beam trawlers		
Area IV	4%	96%
Area VII	0%	100%
Nephrops trawlers		
Area IV	3%	97%
Area VI	11%	89%
Area VIIa	0%	100%
Netters/liners	53%	47%
Non-sector	5%	95%
Weighted total > 10m	**20%**	**80%**
10m and under	0%	100%

Concerns over the effects of ITQs

All respondents were asked:
Whether you are basically in favour of ITQs or against the idea, do you have concerns (a) about the possibility of quota ending up in the hands of a few large companies?

	very concerned	slightly concerned	not concerned
Demersal trawlers			
> 24m (all areas)	18%	16%	66%
≤ 24m Area IV/VI	28%	23%	49%
≤ 24m Area VIId-k	42%	19%	39%
≤ 24m Area VIIa	76%	18%	6%
Pelagic vessels	35%	30%	35%
Beam trawlers			
Area IV	21%	12%	67%
Area VII	36%	28%	36%
Nephrops trawlers			
Area IV	41%	33%	26%
Area VI	37%	37%	26%
Area VIIa	76%	12%	12%
Netters/liners	16%	37%	47%
Non-sector	78%	11%	11%
Weighted total > 10m	**41%**	**22%**	**37%**
10m and under	74%	16%	8%

(b) about the possibility of quota moving to more prosperous regions?

	very concerned	slightly concerned	not concerned
Demersal trawlers			
> 24m (all areas)	18%	18%	64%
≤ 24m Area IV/VI	20%	30%	50%
≤ 24m Area VIId-k	35%	26%	39%
≤ 24m Area VIIa	70%	24%	6%
Pelagic vessels	0%	47%	53%
Beam trawlers			
Area IV	17%	12%	71%
Area VII	60%	28%	12%
Nephrops trawlers			
Area IV	48%	26%	26%
Area VI	58%	42%	0%
Area VIIa	72%	16%	12%
Netters/liners	21%	37%	42%
Non-sector	61%	27%	11%
Weighted total > 10m	**38%**	**28%**	**34%**
10m and under	56%	34%	8%

(c) about the possibility that high quota prices will discourage "new entrants" to the industry?

	very concerned	slightly concerned	not concerned
Demersal trawlers			
> 24m (all areas)	8%	42%	50%
≤ 24m Area IV/VI	32%	34%	34%
≤ 24m Area VIId-k	35%	30%	35%
≤ 24m Area VIIa	88%	6%	6%
Pelagic vessels	30%	5%	65%
Beam trawlers			
Area IV	25%	4%	71%
Area VII	56%	24%	20%
Nephrops trawlers			
Area IV	41%	55%	4%
Area VI	26%	74%	0%
Area VIIa	46%	44%	6%
Netters/liners	21%	47%	32%
Non-sector	50%	33%	17%
Weighted total > 10m	**35%**	**38%**	**27%**
10m and under	62%	28%	8%

(d) about uncertainty over the legal title to quota?

	very concerned	slightly concerned	not concerned
Demersal trawlers			
> 24m (all areas)	38%	54%	8%
≤ 24m Area IV/VI	34%	32%	34%
≤ 24m Area VIId-k	19%	57%	23%
≤ 24m Area VIIa	82%	12%	6%
Pelagic vessels	10%	47%	43%
Beam trawlers			
Area IV	12%	67%	21%
Area VII	40%	44%	16%
Nephrops trawlers			
Area IV	37%	53%	6%
Area VI	21%	53%	10%
Area VIIa	56%	26%	4%
Netters/liners	21%	42%	37%
Non-sector	11%	17%	61%
Weighted total > 10m	**31%**	**38%**	**27%**
10m and under	40%	10%	50%

Appendix III: Methodological appendix to Chapter 6

The method used to estimate the socio-economic impact of quota trade in the UK involved several steps. The first step required an estimation of the potential impact of quota trade on fleet structure by region. Given the different fleet structures under the different assumptions regarding restrictions on quota trade, the fixed costs and crew number associated with each vessel that was estimated to be removed from the fishery was estimated. The fixed cost per vessel was estimated using the average fixed cost per VCU (including an allowance for economic depreciation and interest, reflecting the opportunity cost of capital) for the different fleet segments. Where possible, region specific information was used. Similarly, average crew numbers per vessel (again, estimated for individual vessels based on their main gear type and region) were used to estimate the employment effects of the different restrictions on quota trading.

Average fixed cost per VCU and crew number information were derived from SFIA (2000). The data related to the 1997-98 financial year, these being the most recent data that were available on a consistent basis for the UK as a whole.[84]

Estimating the change in fleet structure

The analysis is run in two steps. First, the capacity utilisation of each boat is estimated relative to other boats with which it can trade. In the second stage, the fleet size required to fill the quota if all boats operated at full capacity was estimated using an allocation model.

Capacity utilisation (CU) can be defined in terms of the ratio of actual (current) to potential (capacity) output. CU is measured on a [0,1] scale, where a measure of $CU < 1$ implies that the same fleet, if fully utilised, could produce more than it is currently doing. Conversely, the same level of catch could have been taken by a smaller fleet if fully utilised. As a result, capacity under-utilisation is also an indicator of existence of excess capacity in a fishery, and the measure can be used to provide an indication of the extent of excess capacity.

In this study, it was assumed that the quota allocations (FQAs) reflected the output of each species, and hence capacity utilisation refers to the ratio of actual FQA holdings to potential holdings given the physical characteristics of the vessel. The latter potential FQA holdings are estimated on the basis of the FQA holdings and physical characteristics of the other vessels against which the vessel is compared (the reference set). In this case, the reference set of vessels is determined by the restrictions on quota trade.

[84] More recent data were available for certain regions. For example, economic data were available for the English Channel for the 1999-2000 financial year (Cattermoul and Pascoe 2001). However, for consistency, the SFIA (2000) data were used.

An analytical method exists (Data Envelopment Analysis) to identify which boats are operating at full capacity taking into account differences in physical input use (e.g. engine power, boat size) and catch composition (defined by the FQA which limits the catch of the quota species). Although the application of Data Envelopment Analysis (DEA) to fisheries is relatively new, this technique has become established as the preferred method employed to estimate capacity and capacity utilisation in fisheries (see, for example, Hsu, 1999; Kirkley, Färe *et al.,* 1999; Kirkley, Squires *et al.,* 1999; Vestergaard *et al.,* 1999; FAO, 2000; Pascoe *et al.,* 2001; Tingley *et al.,* 2001).

Information on fleet characteristics and FQA holdings in 2001 was used in the analysis (such that any previous quota trades under the existing quota management system had already been factored into the analysis, although quota leases are not considered).

Four different trade scenarios were examined:

- Complete transferability between all boats;
- Transferability between boats in the same fleet segment;
- Transferability between boats in the same administrative port; or
- Transferability between boats in the same region.

For the latter, for regions were defined (English Channel, Irish Sea, West of Scotland and North Sea). Boats were allocated to one of these regions based on their home port.

While there are no economic reasons why trade should be restricted between vessels, it was assumed that concerns over employment implications may result in some restrictions on trade being imposed.

The second stage of the analysis is an industry allocation model. The model estimates the minimum fleet size required to fill the quota of each and every species with all boats operating at or close to full capacity. The model is specified such that the boats that have the lowest capacity utilisation are the first to leave, with their quota being allocated to boats close to full capacity.

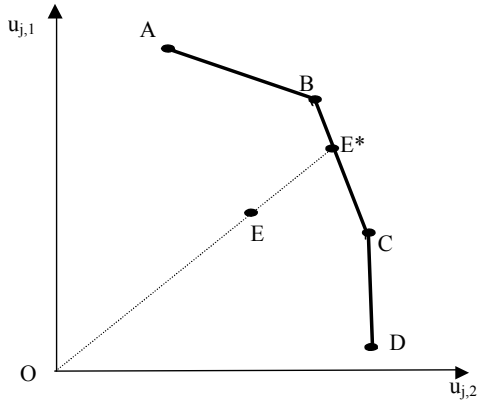
Description of the DEA technique

DEA is a non-parametric approach to the estimation of capacity and technical efficiency. An advantage of DEA is that it is able to incorporate multiple outputs directly in the analysis. Further, the technique does not require any pre-described structural relationship between the inputs and resultant outputs, which allows greater flexibility in the frontier estimation.

The technique can be illustrated using a simple example (Figure III.1), based on a set of five boats ($j = \{A,B,C,D,E\}$) catching two species ($m = \{1,2\}$). The catch per unit of fixed input, $u_{j,m}$, can be plotted to determine the production possibility frontier, defined by boats A, B C and D. As these boats lie on the frontier, they are assumed to be operating at full capacity. In contrast, boat E is producing less of both species relative to the frontier and is therefore assumed to be operating

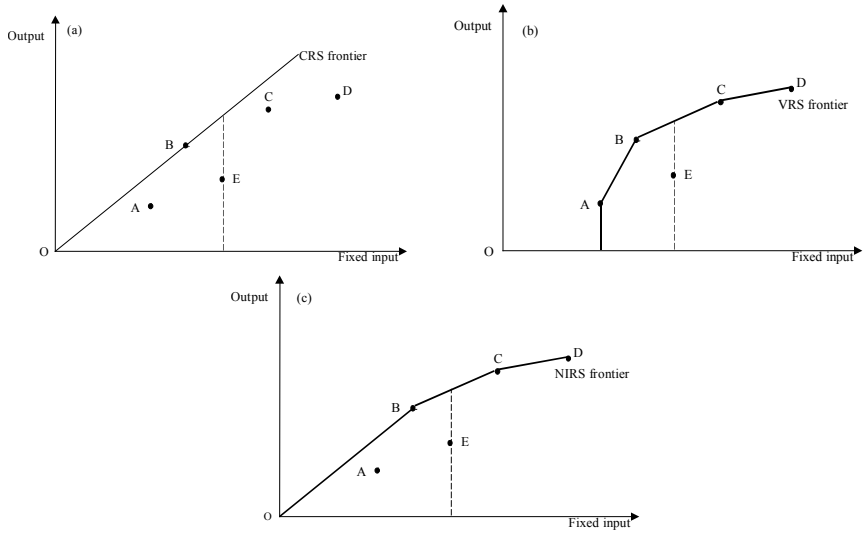
at less than full capacity. The production potential of boat E can be found by expanding the output of both species radially from the origin until it reaches the frontier (point E*). OE*/OE is the expansion factor (θ) by which output of boat E could be increased. Capacity utilisation of boat E is given by OE/OE* (i.e. 1/θ).

Figure III.1. Two output production possibility frontier



The shape of the frontier will differ depending on the scale assumptions that underlie the model (Figure III.2). Three scale assumptions may be incorporated into the analysis: constant returns to scale (CRS, defined by OB), variable returns to scale (VRS, defined by ABCD), and non-increasing returns to scale (NIRS, defined by OBCD). The VRS specification encompasses both increasing and decreasing returns to scale. There are generally *a priori* reasons to assume that fishing would be subject to non-constant returns, and in particular non-increasing returns to scale.

Figure III.2. CRS and VRS efficient frontiers



The NIRS DEA model is formulated as a linear programming (LP) model, where the value of θ for each vessel can be estimated from the set of available data. Following Färe *et al.* (1989, 1994), this DEA model of capacity output given current use of inputs is given as:

$$Max\ \theta$$

subject to

$$\begin{aligned} &\theta u_{0,m} \le \sum_j z_j u_{j,m} \quad \forall\ m \\ &\sum_j z_j x_{j,n} \le x_{0,n} \quad n \in \alpha \\ &\sum_j z_j \le 1 \\ &z_j \ge 0 \end{aligned} \tag{1}$$

where θ is a scalar denoting how much the output of the target boat (i.e. $j=0$) can be increased, $u_{j,m}$ is the output m produced by boat j, $x_{j,n}$ is the amount of input n ($n \in \alpha$, where α is the set of fixed inputs) used by boat j and z_j are the weights that relate the target vessel to the set of peers (i.e. the boats against which it is compared). The value of θ is estimated for each vessel separately (i.e. so effectively a set of θ_j are estimated), with the target vessel's outputs and inputs being denoted by $u_{0,m}$ and $x_{0,n}$ respectively. Inputs are restricted to fixed factors only (i.e. the set α). This is estimated in the model for each boat j and variable input $n \in \hat{\alpha}$ (Färe *et al.*, 1994). The restriction $\Sigma_j z_j \le 1$ allows for non-increasing returns to scale[85].

Capacity utilisation (*CU*) is defined as $CU=1/\theta$. The measure of CU ranges from zero to 1, with 1 being full capacity utilisation (i.e. 100 per cent of capacity). The capacity output of each vessel is determined by $u'_{j,m} = \theta u_{j,m}$ where $u_{j,m}$ is the FQA for each species m held by boat j and $u'_{j,m}$ is the full capacity quota holding of species m by boat j.

The DEA technique does not allow for trade-offs of one quota against another - to expand output of a species the boat must already have been catching the species, and catch of all species must increase by the same proportion. The linear programming technique effectively estimates 'virtual boats' based on the outputs and inputs of boats that are estimated as operating at full capacity. These 'virtual boats' have the same physical characteristics as the boat being examined, and the same catch composition, so the estimation of capacity utilisation is based on a like-for-like basis.

The allocation model

The allocation model adopted in the second stage of the analysis was based on industry allocation models developed by Färe et al. (1992) and Dervaux et al. (2000). The original versions of the

[85] In contrast, excluding this constraint implicitly imposes constant returns to scale while $\Sigma z_j=1$ imposes variable returns to scale (Färe *et al.,* 1989).

models were used to estimate the minimum inputs required at an industry level necessary to achieve the same level of outputs (Färe et al. 1992, Dervaux et al. 2000). The source of the inputs (i.e. which firms) was not included as a consideration. In this study, the model was modified to ensure that the boats that 'left' the industry in the model were those with the lowest capacity utilisation scores. This is more consistent with the economic theory presented in Chapter 2.

The model is given by

$$Min\ \lambda = \sum_j w_j \theta_j$$

subject to

$$\begin{aligned} &\sum_j w_j u'_{j,m} \geq TAC_m \quad \forall\ m \\ &\sum_j w_j x_{j,n} \leq \sum_j x_{j,n} \quad \forall\ n \\ &0 \leq w_j \leq 1 \end{aligned} \tag{2}$$

where θ_j are the expansion factors for each vessels j estimated in the first stage of the analysis (i.e. the inverse of the capacity utilisation scores), TAC_m is the total allowable catch of species m (estimated as the sum of the FQAs), and w_j are the weights associated with each boat j. As $\theta_j \geq 1$, the objective function is minimised by ensuring the constraints are satisfied by first utilising the boats already operating at full capacity (i.e. $\theta_j = 1$), and by discarding vessels with high values of θ_j (i.e. low levels of capacity utilisation). The first constraint is that the sum of the full capacity allocation of FQAs (i.e. $u'_{j,m} = \theta_j u_{j,m}$) held by the remaining boats (i.e. $w_j \geq 0$) must at least equal the TAC for the species. The second constraint equation relating to input use is largely superfluous, but is maintained in the analysis for completeness to ensure that final input use does not exceed current input use (which cannot happen in any case as $w_j \leq 1$).

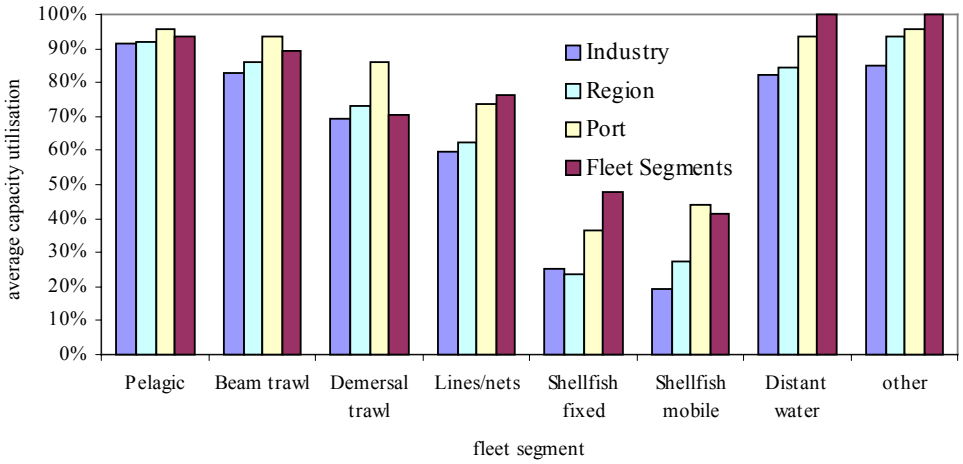
Estimated Capacity Utilisation (CU)

The average capacity utilisation of the existing fleet varies substantially by fleet segment (Figure III.3). Pelagic boats (which includes both trawlers and purse seiners) were estimated to average between 90 and 95 per cent capacity utilisation, depending on the degree of transferability, while the shellfish boats were estimated to average between 20 and 50 per cent. What this means is that pelagic boats would need to increase their quota holdings by about 5 to 10 per cent on average to operate at full capacity, whereas shellfish boats would need to more than double their quota holding to operate at full capacity on average. This last result is probably an overestimate, as it does not take into account the non-quota species that make up a large proportion of the shellfish boats' catch.

The estimated capacity utilisation increased as the number of potential trading partners decreased. When compared to boats in the same fleet segment, average capacity utilisation of the shellfish

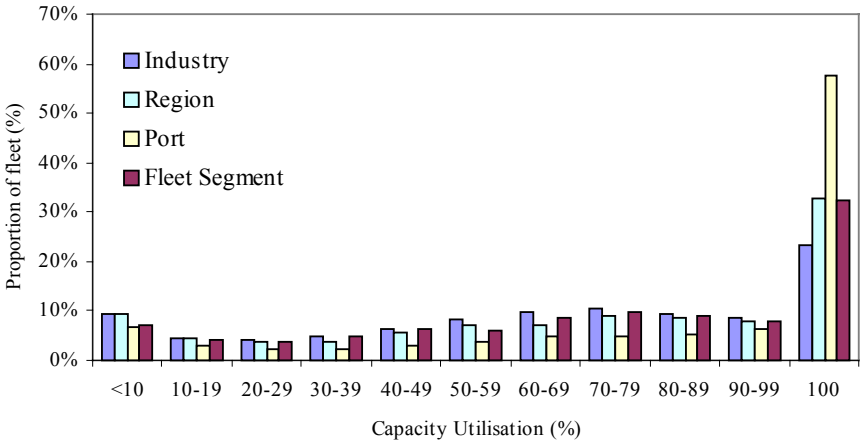
boats was still relatively low. This suggests that many of these boats would still need to increase their quota holdings to operate in the same fleet segment at full capacity.

Figure III.3. Average capacity utilisation by fleet segment (>10m), 2001



The estimated distribution of capacity utilisation (Figure III.4) suggests that only a limited number of boats are currently operating at full capacity. When all boats are compared (i.e. the industry analysis), only about 23 per cent of the fleet are operating at full capacity. In contrast, if trade is restricted to ports, nearly 60 per cent of the fleet are effectively operating at full capacity (i.e. these boats have no incentive to purchase additional quota from the available pool in the administrative port). By contrast, between 20 and 30 per cent of the fleet (depending on the assumptions regarding transferability) are operating at less than 50 per cent capacity utilisation. These boats are more likely to be willing to sell their quota and exit the fishery rather than purchase quota, provided the market price for quota is determined appropriately (as discussed in Chapter 2).

Figure III.4. Distribution of capacity utilisation over the fleet (>10m), 2001



References

Adulaja, A., McCay, B. and Menzo, J. (1998) Market share, capacity utilisation, resource conservation and tradeable quotas. *Marine Resource Economics*, 13(2): 115-134.

Anderson, L.G. (1994) An economic analysis of highgrading in ITQ fisheries regulation programs. *Marine Resource Economics*, 9(3): 209-226

Anderson, L.G. (1995) Privatising open access fisheries: individual transferable quotas. In: Bromley, D.W. (ed.), *The Handbook of Environmental Economics*. Oxford: Blackwell, 453-474.

Arnason, R. (1990) Minimum information management in fisheries. *Canadian Journal of Economics*, 23(3): 630-653.

Arnason, R. (1994) On catch discarding in fisheries. *Marine Resource Economics*, 9(3): 189-207.

Arnason, R. (1995) *The Icelandic Fisheries: Evolution and Management of a Fishing Industry*. Oxford: Fishing News Books.

Arnason, R. (1996) Property rights as an organisational framework in fisheries. In: Crowley, B.L. (ed.). *Taking Ownership: Property Rights and Fishery Management on the Atlantic Coast*. Halifax (N.S.): Atlantic Institute for Market Studies.

Arnason, R., Hannesson, R. and Schrank, W.E. (2000) Costs of fisheries management: the case of Iceland, Norway and Newfoundland. *Marine Policy*, 24: 233-243.

Baulch, K. and Pascoe, S. (1992) *Bycatch management options in the south east fishery*. ABARE Research Report 92/18. Canberra: ABARE.

Cattermoul, B. and Pascoe, S. (2001) *Economic and Financial Performance of the UK English Channel Fleet, 1995-96 to 1999-2000*. CEMARE Research Paper (forthcoming).

Dervaux, B., Kerstens, K. and Leleu, H. (2000) Remedying excess capacity in French surgery units by industry reallocations: the scope for short and long term improvements in plant capacity utilisation. In: J.L.T. Blank (ed.) *Public Provision and Performance: Contributions from Efficiency and Productivity Measurement*. Amsterdam: Elsevier, p121-146.

Dupont, D.P. and Grafton, R.Q. (2001) Multispecies individual transferable quotas: the Scotia-Fundy mobile gear groundfishery. *Marine Resource Economics*, 15: 205-220.

FAO (2000) *Report of the Technical Consultation on the Measurement of Fishing Capacity*. FAO Fisheries Report No. 615 FIPP/R615(En). Rome: FAO.

Färe, R., Grosskopf, S.and Kokkelenberg, E.C. (1989) Measuring plant capacity, utilization and technical change: a non-parametric approach. *International Economic Review*, 30(3): 655-666.

Färe, R., Grosskopf, S. and Li, S-K. (1992) Linear programming models for firm and industry performance. *Scandinavian Journal of Economics*, 94(4): 599-608.

Färe, R., Grosskopf, S. and Lovell, C.A.K. (1994) *Production Frontiers*. Cambridge: Cambridge University Press.

Geen, G. (2001) Bycatch management under ITQs in Australia. Paper given at the 3rd *Seminario Internacional Del Promaspe*, Buenos Aires.

Grafton, R.Q. (1995) Rent capture in a rights-based fishery. *Journal of Environmental Economics and Management*, 28: 48-67.

Grafton, R.Q. (1996) Individual transferable quotas: theory and practice. *Reviews in Fish Biology and Fisheries*, 6: 5-20.

Johnson, R.N. (1995) Implications of taxing quota value in an individual transferable quota fishery. *Marine Resource Economics*, 10: 327-340.

Hatcher, A. (1997) Producers' organizations and devolved fisheries management in the United Kingdom: collective and individual quota systems. *Marine Policy*, 21(6): 519-534.

Hatcher, A. (2000) Subsidies for European fishing fleets: the European Community's structural policy for fisheries 1971-1999. *Marine Policy*, 24(2): 129-140.

Hatcher, A., Jaffry, S., Thébaud, O. and Bennett, E. (2000) Normative and social influences affecting compliance with fishery regulations. *Land Economics*, 76(3): 448-461.

Hatcher, A. and Pascoe, S. (1998) *Charging the UK Fishing Industry*. A Report to the Ministry of Agriculture, Fisheries and Food. CEMARE Report No 49.

Hatcher, A. and Robinson, K., eds. (1999) *Overcapacity, Overcapitalisation and Subsidies in European Fisheries*. Proceedings of the first Concerted Action workshop on Economics and the Common Fisheries Policy, Portsmouth, UK, 28-30 October 1998. CEMARE Miscellaneous Publication No. 44.

Hsu, T., (1999) Simple capacity indicators for peak to peak and data envelopment analyses of fishing capacity. Presented at the *FAO Technical Consultation on the Management of Fishing Capacity*, Mexico City 29 November - 3 December 1999.

Kirkley, J.E. and Squires, D.E. (1999) Measuring capacity and capacity utilization in fisheries. In: Gréboval, D. (ed.) *Managing Fishing Capacity: Selected Papers on Underlying Concepts and Issues*. FAO Fisheries Technical Paper No.386. Rome: FAO.

Kirkley, J.E., Färe, R., Grosskopf, G., McConnell, K., Squires, D.E. and Strand, I. (1999) Assessing capacity and capacity utilization in fisheries when data are limited. Presented at the *FAO Technical Consultation on the Management of Fishing Capacity*, Mexico City, 29 November - 3 December 1999.

Kirkley, J.E., Squires, D.E., Alam, M.F. and Omar, I.H. (1999) Capacity and offshore fisheries development: the Malaysian purse seine fishery. Presented at the *FAO Technical Consultation on the Management of Fishing Capacity*, Mexico City, 29 November - 3 December 1999.

Nautilus Consultants (1998) *Costs and benefits of compliance with regulations in Northern EU fisheries*. Edinburgh: Nautilus Consultants.

OECD (1997) *Towards Sustainable Fisheries: Economic Aspects of the Management of Living Marine Resources*. Paris: Organisation for Economic Cooperation and Development.

Pascoe, S. (1997) *Bycatch management and the economics of discarding*. FAO Fisheries Technical Paper no.370. Rome: FAO.

Pascoe, S. and Mardle, S. (2001) Optimal fleet size in the English Channel: a multi-objective programming approach. *European Review of Agricultural Economics*, 28(2): 161-183.

Pascoe, S., Coglan, L. and Mardle, S. (2001) Physical versus harvest based measures of capacity: the case of the UK vessel capacity unit system. *ICES Journal of Marine Science*, 58. [in press]

Runolfsson, B. (2000) *The Quota Exchange: the fish price office and restrictions on transfers of quotas* (in Icelandic). Report to the Minister of Fisheries, Reykjavik.

Seafish Industry Authority (2000) *Fishermen's Handbook: costs and earnings of the United Kingdom fishing vessel fleet 1997/98*. Edinburgh: Seafish Industry Authority.

Squires, D., Kirkley, J. and Tisdell, C.A. (1995) Individual transferable quotas as a fisheries management tool. *Reviews in Fisheries Science*, 3(2): 141-169.

Squires, D., Campbell, H., Cunningham, S., Dewees, C., Grafton, R.Q., Herrick, S.F., Kirkley, J., Pascoe, S., Salvanes, K., Shallard, B., Turris, B. and Vestergaard, N. (1998) Individual transferable quotas in multispecies fisheries. *Marine Policy*, 22(2): 135-159.

Tingley, D., Pascoe, S. and Mardle, S. (2001) Trends in capacity utilisation in the English Channel. Paper presented at the *XIIIth Conference of the European Association of Fisheries Economists*, Salerno, Italy, 18-20 April 2001.

Vestergaard, N., Squires, D. and Kirkley, J.E. (1999) Measuring capacity and capacity utilization in fisheries: the case of the Danish gillnet fleet. Presented at the *FAO Technical Consultation on the Management of Fishing Capacity*, Mexico City, 29 November - 3 December 1999.