

ミナミマグロ漁業におけるオーストラリア譲渡可能 個別漁獲割当と日本許可制度：漁獲努力抑制

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(要約)

本稿では漁業管理における一つの管理手法である漁獲努力コントロールについて、現在ミナミマグロ (SBT) 漁業管理に適用されているオーストラリアと日本の各システムの整理・分析を行い経済政策の方向性を探る。この SBT 漁業における両国の管理はオーストラリアでは譲渡可能個別漁獲割当 (ITCQ), 日本では許可制という代表的な2つの漁獲努力抑制手法を用いており、経済政策上の比較研究題材を提供している。

漁獲努力関連の抑制の狙いは、漁獲努力の有効的削減を促進させ目標とする資源量を持続させつつ経済効率を高めることにある。上記の各々のシステムはそれぞれの設定する漁獲努力を達成するための手法と考えられているが、経済効果またその結果などは漁獲努力量をどのように分配し、調整していくのかによって各々違ってくる。そもそもこの両手法における経済効果の相違は権利設定上の問題に起因していると考えられるが、それは許可制度では使用権、ITCQ では人工的な私的所有権を創り出している点に集約される。そこで、まず基本となる漁獲努力の定義を概観し、次に経済効率視点からオーストラリアの ITCQ 管理について分析するとともに独占化といったような ITCQ の問題点について検討を加える。さらに日本の許可制度について、その第一目標は漁獲努力削減にはなかった点を考慮に入れ長谷川モデルを使いながら経済理論的裏付けをする。また、他の漁獲努力抑制の一つの調整手法として、漁場距離に応じた最適漁船規模についても検討する。本稿ではこれらの実態および理論整理・分析を踏まえた上で、ミナミマグロ漁業国際管理について両国のシステムをまとめながら漁獲努力抑制関連の経済政策について検討している。

Australian Individual Transferable Catch-Quotas and the Japanese Licence System for Southern Bluefin Tuna Fishing: Controls on Fishing Effort

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1 Introduction

The objective of this paper is to elaborate further on the option of fishery management by regulating of fishing effort, particularly in relation to the current (1993) systems for Southern bluefin tuna (SBT) fisheries management by Australia and Japan. The introduction of controls on fishing effort could lead to improved economic efficiency within given quotas (i. e. within the combined total of national quotas). SBT fisheries provide examples of two schemes of fishing effort management: limiting fishing effort by means of individual transferable catch quotas (Australia); and limiting fishing effort by means of licence (Japan). These two schemes have been introduced as national policies under the voluntary national quota arrangement. The first priority of these regulations is the effective reduction of fishing effort in order to maintain the stock size at a particular target level. Although the desired level of fishing effort can be obtained by either of the above-mentioned schemes, the economic effects and consequences of each may differ, depending on how they allocate and adjust the fishing effort between the participating fisheries. This difference seems to originate from the creation of property rights (i. e. the licence scheme creates user rights or usufruct rights, and the individual transferable catch quota (ITCQ) system creates artificial private property rights).

The next section will review the definition of fishing effort in order to clarify its meaning in the context of economics. Section 3 will discuss the Australian individual transferable catch quota (ITCQ) management scheme from the perspective of economic efficiency, and will consider the problems associated with ITCQs, including the issue of monopolisation.

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In section 4, the Japanese licence scheme, including its origins, in which the reduction of fishing effort was not the primary objective, will be discussed. The licence system will be examined using the Hasegawa (1985) model. Adjustment of fishing effort by determining effective boat size, which would vary according to the distance of fishing grounds, will be discussed in section 5, while a global view of Southern bluefin tuna (SBT) fisheries management, as an example of the international management of a private good, will be discussed in the final section by summarising both systems of fishing effort management.

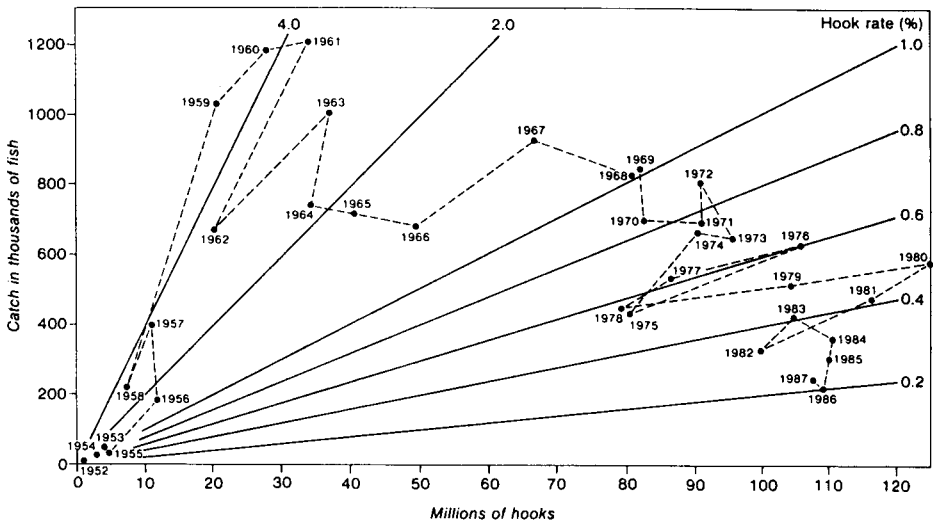
2 Fishing Effort

As noted in Anderson (1986), the concept of fishing effort is a complex one, and its exact definition depends upon the biological and economic characteristics of the fisheries. The term originated, however, as a technical term in population dynamics. The term 'fishing mortality coefficient' occurs in the fishing equations of Beverton and Holt (1957). According to Hasegawa (1985), there seem to be two reasons why this concept began to be employed in the field of population dynamics, although it could have been treated as just catch or fishing mortality as far as quantity is concerned. The first reason for the introduction of this concept relates to the overexploitation problem. It was felt that it was necessary to establish some connection between nature and human activity; thus, the concept of fishing effort was introduced. Secondly, the physical relationship between harvesting activity and the resulting catch could be used as the basis for estimating resource stock size. For example, catch per unit of effort (CPUE) is often used to represent the density of fish resources. In the case of tuna fisheries, particularly longliners, CPUE can be measured by the number of hooks used and the number of fish caught by the fishery. Figure 1 shows this relationship in the case of SBT fisheries. It clearly shows that despite increased fishing effort (number of hooks used) the SBT catch did not increase after the early 1960s; rather, Figure 1 shows a declining trend, which indicates overexploitation of the resource.

Although the concept of fishing effort seems to be straightforward, there appear to be several indices of fishing effort in the field of population dynamics. According to Kurita (1964), the FAO defined the technical terms used in population dynamics in 1960. In relation to fishing effort, the following indices were given:

F (fishing mortality coefficient): the instantaneous rate of reduction of resource by catch

X (fishing effort): this symbol shows adjusted statistical values, and should only be used



Source : Australian Fisheries, 48(8) : 13.

Figure 1 Historical Change in the Number of Hooks Used and Fish Caught by Japanese Fishery 1952–87

where it will not lead to confusion. It should be noted that there is a distinct difference between g , X , and f

f (effective overall fishing intensity): a proportional value to the fishing mortality coefficient; the average fish density of each unit of fishing ground by weight

g (fishing effort): uncorrected fishing effort

q (catchability coefficient): F/f , fishing mortality coefficient per unit of fishing intensity.

There seems to be a clear distinction between at least three of the above-mentioned indices: g , f , and X . It should be noted that uncorrected fishing effort (g) is a direct record of fishing effort. This implies that this index can only be used in cases where the same fishing gear is employed. Fishing effort (X) is a standardised index based on the use of certain fishing gear which indicates that the process of adjustment plays a key role. Catchability coefficient (q) needed to be created for analysis purposes in population dynamics, and is calculated from X via g . Moreover, the fishing mortality coefficient (F) is assumed to equal qX , but this hypothesis (i.e. $F=qX$) has yet to be proven (Tanaka, 1960). Therefore, the equation $F=qf$ which is used in population dynamics needs to be examined case by case.

1) The actual unit to be used would vary in different fisheries, and would include measures such as $\nearrow$

Although the term 'fishing effort' should be used carefully, it is clear that it represents conceptualised fishing activities. This implies some relationship to capital inputs, or costs, of the fisheries. In the case of Gordon's work (1954), fishing cost per unit of effort is fixed. Because there may be many possible relationships between fishing effort (e. g. f , g , and X) and fishing cost, Gordon's case seems to be a rather special one. There may be a scenario in which fishing effort increases without any increase in fishing cost; the poopsite case may also be possible. As noted in Hasegawa (1985), it is important to recognise a number of primary conditions in order to understand Gordon's assumption. These conditions are: a) no technological changes are relevant because it is a static model; b) a stable relationship is assumed between fish resources and fishing operations in order to realise $F = qf$ resource utilisation; and c) the same type of fishing gear and the same size boats are assumed in order to obtain a straight-line cost curve. If condition c) is not satisfied, fishing cost will not be proportional to fishing effort because it will vary according to the size of the fishing boat (Hasegawa 1985, p. 52).

In the case of SBT fisheries, most Japanese longliners are over 300 tonnes in size. Thus, it seems reasonable to assume that their fishing cost per unit of effort is proportional to their fishing effort, although this would only be a rough approximation of the real situation. It can therefore be concluded that a reduction in fishing effort would lead to an increase in the economic efficiency of Japanese longliners in SBT fishing, if the trend from the early 1960s to the early 1980s continues.²⁾

3 Australian Individual Transferable Catch Quotas

As discussed in general terms in section 1, the main aim of this measure is the reduction of the national fishing effort in order to obtain a sustainable target level of SBT stock and an improvement in the economic efficiency of SBT fisheries. This scheme give fishermen artificial private property rights to the resource, which should theoretically reduce fishing effort and generate economic rent.

There are several countries which have actually implemented individual quota systems, including Australia, New Zealand,³⁾ and the European Community (EC).⁴⁾ In Australia, SBT

↘ the number of hooks, the number of poles, the number of fishing trips, the number of trawlings and so on.

2) Before the early 1960s, the fisheries had not reached open-access equilibrium, and after the early 1980s the effects of Australian surface fisheries and international agreements would need to be considered.

3) ITCQs were introduced in NZ finfish fisheries for all significant commercial species in 1986. ↗

was the first fishery in which ITCQs were introduced in 1984. They were later introduced in the gemfish fishery in NSW⁵⁾. The introduction of this system is being considered for a number of species in the south-eastern trawl fishery and in the northern prawn fishery⁶⁾. Although there are many issues which could be considered in relation to the above-mentioned nations, this section will focus on the ITCQ system in Australian SBT fisheries.

On October 1st, 1984, the Australian Commonwealth Government introduced the ITCQ system in Australian SBT fisheries. This was because the Government recognised that the SBT resource was being overexploited and therefore its fisheries needed to be regulated. The ITCQ system hoped to achieve two basic objectives: more physically effective national resource utilisation and an improvement in the economic efficiency of SBT fisheries. Within an agreed national quota, ITCQs were allocated to both pole-and-line and purse-seine SBT fishing boats. The following formula was used to calculate the quota allocated to each boat (Wesney, 1989):

$$\text{Individual quota units} = \frac{\text{Best catch}}{\text{Best season total catch}} \times \frac{\text{weighting}}{\text{factor A}} \times \frac{\text{Current market value}}{\text{Total investment}} \times \frac{\text{weighting}}{\text{factor B}}.$$

The best individual catch was calculated over the preceding three years (1981–1983) and the best total catch was assumed to be 21,000 tonnes, based on the total Australian catch in 1982. Weighting factors A and B indicate the proportional market values of boats and gear in relation to SBT catch and investment, respectively. A ratio of A=75 and B=25 was used. Total investment in SBT fisheries was estimated to be A\$ 58 million. Then, each individual quota unit was converted to tonnes using the following formula:

$$\text{ITCQ} = \text{Individual quota units} \times \frac{\text{Australian quota}}{\text{Aggregate of individual units}}.$$

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- ↘ They allow indefinite tenure and almost unlimited transferability. (I. Clark, et al., 1989). However, SBT were excluded from the ITCQ system as SBT fisheries were at that time only in the early stages of development. Initially, NZ's ITCQs seemed to be successful; however, more recently this success seems to have been brought into question by several issues (Australian Fisheries, 1991, 50(8): 14–16).
- 4) It seems that the individual quota systems of these countries have also faced difficulties. According to Australian Fisheries (1991, 50(8): 14–16), the system of total allowable catches and quotas does not seem to have functioned effectively in the mixed species fisheries of EC waters.
 - 5) Although the system was introduced in the gemfish fishery in NSW, a zero quota was set in order to allow stocks to recover.
 - 6) Some studies on this subject in the economic literature include Wesney (1989) and Geen, Brown, and Pascoe (1990).

During the period between the 1984–85 and 1987–88 quota years, individual quota units totalled 5,347 units, and each ITCQ unit was equivalent to 2.712 tonnes.⁷⁾ A levy was imposed on each allocated unit to cover a share of the administration, policing, and monitoring costs. According to Wesney (1989), the levy was set at 38% of the attributable cost of management in 1985–86.⁸⁾

As discussed in Kuronuma (1992), it seems that the Australian ITCQ system has been achieving its basic objectives. The number of quota holders fell from 136 in 1984 to 63 in 1987, which is a total reduction of around 54% (see Kuronuma, 1992, section 3). During the same period, the number of individual quota holders has declined by around 66%; this decline has been particularly significant in WA (about 75%). Increasing concentration of catch can also be observed in SA (about 60% of the total Australian catch before the introduction of ITCQs, and about 92% afterwards). These results *seem* to indicate that an improvement in economic efficiency was able to be obtained by implementing of this scheme.⁹⁾

Geen and Nayar (1989-a, 1989-b) provided an empirical economic assessment of SBT fishing. They constructed a comprehensive model of SBT fisheries, and used this model to simulate different outcomes.¹⁰⁾ According to their analysis, the introduction of the ITCQ scheme led to major economic improvements. They drew this conclusion from their model by comparing three scenarios: the actual results of ITCQ implementation, and the hypothetical results of two alternative options (open-access and limited-entry fisheries with a global catch limit). One of their results showed that the fishery generated further economic rent under the ITCQ scheme, although the benefits were received by the initial quota holders.¹¹⁾ Another notable result was that the reduction in capital investment in fishing

7) National quota (14,500t)/Individual quota units (5,347)=2.71180101 tonnes. It should be noted that in 1986/87 and 1987/88 a total of 3,000 tonnes of the Australian quota was frozen. However, around A\$ 7.5 million of compensation was paid by the Japanese SBT industry for this frozen quota (Kuronuma, 1992).

8) According to a fisheries officer in Esperance, WA, the actual levy was A\$ 72 per unit, as of November 1987.

9) The findings of Kuronuma (1992) with regard to the Australian ITCQ system should be recalled here. That is, ITCQs did not provide perfectly efficient resource use from biological and economic standpoints, but rather partial improvements in production were achieved.

10) As noted by Copes (1989), there are several issues which need to be investigated further, including the question of the inclusion of intramarginal rents in the calculation of total net benefits, and different rates of natural mortality for cohorts of different ages, and so on. An evaluation of the Australian ITCQ system itself, however, is not an objective of this thesis, so it is assumed that Geen and Nayar's results are reliable. Furthermore, many relevant data are not available, although the author attempted to obtain such data in order to evaluate Geen and Nayar's model.

11) It seems that a quasi-rent type of return is generated after the creation of artificial property rights. See below in relation to the market price of quotas.

boats in the ITCQ scenario was greater than in the other two cases. In addition, Geen and Nayar (1989-a, 1989-b) estimated that the cost of managing the ITCQ system was around A\$ 600,000 for the 1986–87 season.¹²⁾ They also found that this cost could be paid from the gains generated within the SBT fishery by the regulation.

While the Australian domestic ITCQ policy for SBT fishery seems to have been successful in reducing fishing effort and thereby improving economic efficiency, there are particular factors which have contributed to its success. As noted by Copes (1989), the SBT fishery deals with a biologically discrete stock of a single long-lived species. In addition, there are relatively narrow marketing channels, and only two types of fishing gear are used in the SBT fishery in Australia. These conditions seem to have created a favourable climate for the introduction of such a scheme.

There is another factor which should be noted in relation to ITCQ prices. According to a WA fisheries officer¹³⁾ the price of SBT quotas was A\$ 600 to A\$ 1,000 per tonne in 1984, after the introduction of ITCQs. This price reflected the Australian domestic SBT market price for canning tuna, since most SBT were supplied to the domestic market at that time. However, the market price of quotas increased to between A\$ 6,000 and A\$ 7,000 per tonne¹⁴⁾ in 1987. This price reflected the price of Australian SBT products, including small frozen fish and small chilled fresh fish, in the Japanese sashimi market. As a result of this rapid increase in quota price, SBT quota holders could use their ITCQs as collateral for loans. This suggests that if the Japanese market had not existed, the effects of the introduction of the ITCQ system would have been different. The initial quota holders benefited because significant economic rent was generated by the introduction of the ITCQ system. Therefore, the existence of the Japanese market contributed to the success of the ITCQ system at the time of its introduction.

It seems from the above discussion that the ITCQ has been a fairly successful scheme. However, there are also some problems associated with the quota system as it applied to SBT fisheries in Australia. These include financial pressures on quota holders, a shortage of domestic tuna for the Australian canning industry, and the high proportion of the total catch which was accounted for by a small number of quota holders.

According to **Australian Fisheries** (1991, 50(8): 14–16), many operators needed to

12) According to Geen and Nayar (1989-a, 1989-b), only 44% of this amount was paid by SBT fishermen.

13) Fieldwork conducted in November 1987 by the author.

14) In December 1986, the price was A\$ 3,500; thus, there was a price increase of around 100% in 1987. Note that Wesley (1989) refers to the market price of quotas, but does not indicate the source of this data.

borrow money in order to purchase sufficiently large quotas to make their SBT operations economically viable. With the added pressure of a reduction in total allowable SBT catches, many tuna boat owners face financial problems as a result of the ITCQ system. As the market price of quotas increases, quota-holders may be able to borrow larger amounts of money against their quotas; however, not all of their catch is exported to the Japanese market where the quota price is reflected. Some of the catch is sold on the domestic market, and/or to the overseas canning industry. As a result, the economic returns to quota holders are less than they could have expected, and this may be causing them financial difficulties. Furthermore, many SBT companies in SA, where most Australian SBT are caught, own canneries. By exporting a large proportion of their catch in order to achieve better economic returns, they are creating a shortage of tuna for their canning industry.¹⁵⁾ While the market price of quotas based on the Japanese market initially led to an improvement in the economic efficiency of production, this artificial quota price has actually created new problems for the industry.

Although the issue of monopolistic practices has not yet arisen in Australian SBT fisheries, the large share of the total SBT catch (within the Australian national quota) which is accounted for by quota-holders in SA could lead to a classical problem of monopoly or oligopoly control in the future.¹⁶⁾ In other words, there is the potential for deadweight social loss and price discrimination in the SBT industry.¹⁷⁾ Around 92% of the Australian national quota was caught in SA in 1990. Most SA SBT fishing boats were built for tuna fishing, and seem to have few alternative fishing opportunities compared with WA and NSW tuna boats¹⁸⁾ (**Australian Fisheries**, 1990, 49(7): 26–29). Although some boats have been withdrawn from SA tuna fisheries¹⁹⁾ in order to adjust to the heavy reductions in national

15) Many of the factories in SA were using both SBT and other types of tuna from other states when the author conducted his preliminary fieldwork in December 1988.

16) At present (1993), it seems that SA fisheries are simply seeking ways to survive in the fishing industry. In this context, this is just a theoretical issue at this stage. In addition, it should be noted that at least two perspectives can be taken on the SBT monopoly issue: the Australian domestic perspective, and the international perspective. In this section, only domestic issues are discussed. However, further elaboration on these two views will be required in future research, including whether or not a monopoly-like front position would be a disadvantage for Australia in relation to the Japanese market, and whether or not a multinational duopoly or oligopoly would be an advantage for the world community in the future. At present, it is *not* apparent that a substantial monopoly exists in SA when both the Australian and Japanese catches are considered together.

17) Third price discrimination can be observed in the case of Hawaiian skipjack tuna (Hudgins, 1980).

18) WA and NSW boats are built as multi-purpose fishing boats.

19) For example, one SA-based company sold one of its boats to Solomon Taiyo Co. Ltd. in the Solomon Islands in late 1989, and that boat has been operating since 1990 in waters around the

quotas, SA operators are still major producers, which implies the possibility of monopolistic behaviour. Closer monitoring will be required in the future.

4 The Japanese Licence System

As discussed in general terms in the previous sections, the first priority of the introduction of licences was to achieve a rational reduction in fishing effort (limited entry) in order to achieve a sustainable target level of stock and an improvement in the economic efficiency of fisheries. Through the introduction of this scheme, fishermen and/or fishing boats were given artificial user rights (usufruct rights) to the resources. If licences were transferable under a total allowable catch scheme, they could theoretically provide an effective tool for a further reduction of fishing effort and the extraction of potential economic rent.

There are many countries which have introduced licence schemes, and Japan is one of them. Despite the above-mentioned general objectives of the policy, the licensing system was introduced to counter Japanese domestic problems, rather than to regulate fishing effort and/or manage tuna resources. In the coastal zone of Japan, fisheries policy was basically to create full employment opportunities and exclude efficient fisheries. The policy with regard to off-shore and long distance fisheries, on the other hand, was to transfer excess harvesting capacity from the coastal zones, and to rationalise the fisheries through effective production under open-access conditions. This indicates that the Japanese licencing policy for tuna fisheries was not introduced for purposes of resource management, but to bring about adjustments in employment. It should be noted that fishing licences are *not* legally transferable in Japan.

In order to understand this policy, we need to examine the concept of economic maximisation given the constraint of a fixed number of fishing vessels. The conventional fisheries economic theory outlined in the Gordon model (1953, 1954), assumes that fishing effort (or the number of fishing vessels) should be reduced under open-access equilibrium. In the real world, however, it may not occur. This is because a reduction in the number of vessels requires a reduction in fishing labour, which may lead to compensation and/or job transfer problems. Some fishermen may be strongly attached, both psychologically and culturally, to certain fisheries. In addition, optimal allocation of fishing vessels will differ from season to season, due to the changing pattern of abundance of the resource at different times. Under the given constraint of a fixed number of fishing vessels, one issue which should be addressed by economists is that of what allocation of fishing vessels between

fishing grounds will maximise producer surplus. This is likely to be a common problem.

One case study involving group ownership of a fish resource was outlined by Hasegawa (1985). It was based essentially on the experience of the Japanese coastal fishing industry. Hasegawa suggested that the optimum allocation of fishing vessels would be obtained when the marginal revenue product was equal for all fishing grounds. He assumed that there were four fishing grounds (**A**, **B**, **C**, **D**), including a marginal fishing ground **D**. He assumed first that fishing operations had reached an open-access equilibrium in each fishing ground. The question he then addressed was how fishing boats should be allocated between different fishing grounds in order to improve efficiency from an open-access perspective, given the constraint of a fixed number of fishing vessels. Figure 2, particularly Figure 2(c), shows Hasegawa's model. Costs are shown on the vertical axis, and the number of fishing vessels is shown on the horizontal axis. Subscripts indicate average revenue product (AR_1 , AR_2 , AR_3 , AR_4) and marginal revenue product (MR_1 , MR_2 , MR_3 , MR_4) for each of the fishing grounds. Although Hasegawa (1985) did not specify this, $MC(=AC)$ seems to be equal in all fishing grounds in his discussion.²⁰ Given this condition, it is clear that the total number of fishing vessels is $E_1 + E_2 + E_3$ in an open-access equilibrium situation where $AR=MC=AC$ for all fishing grounds (Figure 2(a)). MEY would be obtained where the total number of fishing vessels is $E_1' + E_2' + E_3'$ in the Gordon model (Figure 2(b)). Removal of some fishing vessels is a necessary condition to achieve MEY. Given the constraint of a fixed number of fishing vessels, Hasegawa (1985) suggested the relocation of some vessels from higher abundance grounds such as **A** and **B** to lower abundance grounds such as **C** and **D** (Figure 2(c)).

The number of fishing vessels to be allocated to **C** and **D** would be expressed as

$$(E_3'' - E_3) + E_4'' = (E_1 - E_1'') + (E_2 - E_2'').$$

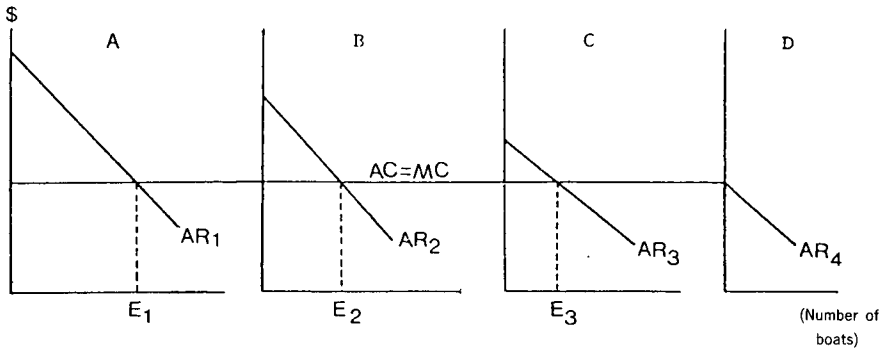
Then, the total revenue generated in this model would be

$$TR'' = \{(a_1 * E_1'') + (a_2 * E_2'') + (a_3 * E_3'') + (a_4 * E_4'')\}.$$

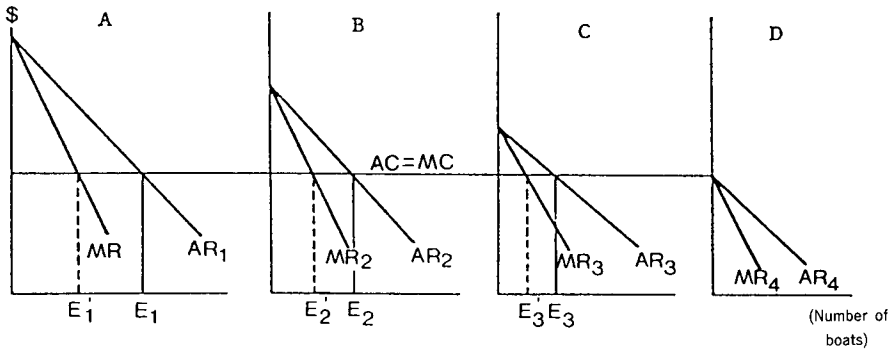
Hasegawa concluded that this would improve the open-access situation because

20) Although Hasegawa (1985) did not specify that $MC=AC$ should be equal in all fishing grounds, it seems that he assumed this in order to simplify the model; however, in practice, it need not be so.

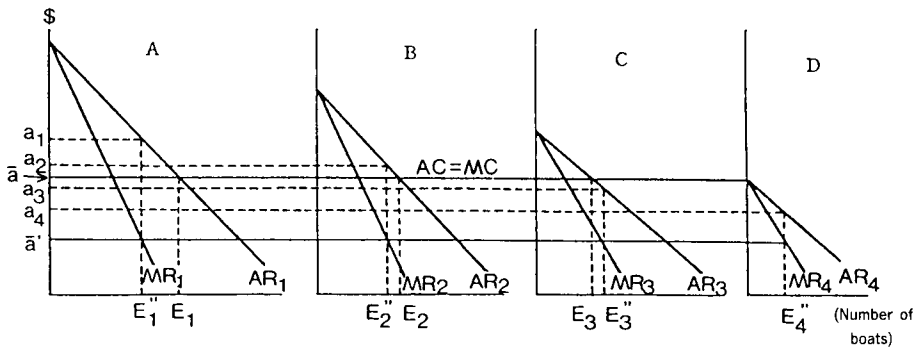
(a) Open-access case



(b) Gordon model (MEY)



(c) Hasegawa model



Adapted from Gordon, 1953, p. 452, and Hasegawa, 1985, pp. 160, 167 and 170.

Figure 2 Allocation of Fishing Vessels between Different Fishing Grounds with Known Resource Abundance

TR (total revenue of open access) $< TR''$ ($\leq TR'$: MEY)

i. e. $\bar{a}*(E_1 + E_2 + E_3) < \{(a_1 * E_1'') + (a_2 * E_2'') + (a_3 * E_3'') + (a_4 * E_4'')\}$.

Hasegawa's model aims to 'maximise' (or maintain) rent (subject to the total fishing effort being constant) by allocating a smaller proportion of fishing effort to the more resource-abundant fishing grounds, and by expansion of effort in the less resource-abundant grounds.²¹⁾ As a result, the same amount of labour (and possibly more) would be employed, with a better economic outcome than in the open-access equilibrium 'non-profit' situation. However, this would not be a desirable allocation of resources from the standpoint of individual fishermen, because it would lead to a different distribution of incomes. The economic returns from fishing operations in fishing grounds **C** and **D** would be negative in this case.

Although this method of allocation of fishing vessels has the above-mentioned disadvantage, it also has several advantages under group ownership of the resource:

- 1) the same number of fishing boats could be used as in an open-access equilibrium situation (i. e. the same number of fishermen could be employed) with better economic performance ($TR < TR''$);
- 2) the concentration of fishing boats in more resource-abundant fishing grounds would be avoided;
- 3) competition would be avoided within fishing grounds (this implies an improvement in working conditions, and secures fishermen's equity in their fishing grounds);
- 4) the marginal fishing grounds would be utilised, thus causing some expansion of other fishing grounds;
- 5) expansion of other types of fishing (or utilisation of other fishing resources) may be possible in order to utilise the excess capacity of fishing boats (This flexibility may be important in order to obtain different fish from different resource-abundant grounds according to the season and price fluctuations).

In order to overcome inequality of income distribution, the so-called 'common pool' method has been introduced by some Japanese fisheries. The basic idea of this 'common pool' method is that collective management allocates income in order to achieve the same income for all participants. Thus, close cooperation between participants is a necessity for the management of fishing operations as though they are being exploited by a single resource user. Several research reports can be found on this issue in Tokyo Suisan Shinkokai, ed.

21) It seems that Gordon (1953, 1954) has considered this case to some extent; however, he did not explore its full implications.

(1985). It should be stressed that Hasegawa's method may only apply in the case of group management as a single resource user. Again, the objective is the relevant economic 'maximisation' given a fixed amount of fishing effort, not the achievement of MEY in the sense of the Gordon-Schaefer model.

While the above-mentioned Japanese policy has been applied in Japan's coastal waters, the policy regarding off-shore and distant-water fishing has been to transfer excess harvesting capacity from coastal waters and to manage these by taking advantage of open access conditions, with the rationalisation of fisheries by encouraging productive fisheries. Thus, Japanese fisheries management involves two sets of policies depending upon whether the fisheries concerned are inshore, off-shore or distant-water fisheries. In other words, coastal policy has primarily aimed at maximising employment opportunities, while off-shore and distant-water fishing policy has aimed at encouraging productive fisheries.²²⁾ Distant-water fishing, including tuna fishing, is managed as open-access fishing, although licences have been introduced.²³⁾ SBT is one such case.

As discussed in Kuronuma (1988), by the early 1960s SBT resources were being fully exploited and the fishery had reached open-access equilibrium. Because of the lack of profitability in tuna fisheries as a whole, there was a conscious reduction of around 20 percent in the total number of long-line fishing vessels through cooperation between the fishing industry and the government in 1981 and 1982.

During the first oil crisis in 1973, Japanese firms in the tuna and skipjack fisheries were able to cope with the high costs of fuel oil primarily because of higher fish prices. This meant that fishing firms and the Government did not make any major adjustments to their operations. However, the second oil crisis in late 1978 and the introduction of 200 nm EEZs caused a significant decline in the profits of fisheries, so that output prices were not high enough to cover expenditure on fuel and other inputs (Kuronuma, 1983). The losses of firms in the tuna and skipjack fisheries grew as a result. There was therefore a need to initiate reforms in these industries in order to reduce costs and thereby increase profits.

For this reason there was a reduction of around 20 percent in the number of long-line fishing vessels. This was made possible by the joint efforts of the fishery industry and the

22) It should be noted, however, that the objective of maximisation of employment seems to have also heavily influenced Japanese distant-water fishing policy. This may be one of the reasons why Japan was strongly against the introduction of 200 nm EEZs at the series of United Nations Conference on the Law of the Sea III in the late 1970s in order to ensure employment opportunities in those waters.

23) It should be remembered that the creation of employment opportunities was the first priority for Japanese Government policy after World War II when this licencing system was introduced.

Government. The planned reductions were accomplished in two years (1981–1982), and as a result 169 distant-water tuna long-line fishing vessels were withdrawn from operation. This represents a reduction of 18.5% and 21% in the number of vessels and total gross tonnage respectively. According to Hirasawa (1982), the following procedure was followed:

- a) Priority for vessel removal was given to those firms with poorer performance and management compared with other applicants (at most one vessel per firm).
- b) Having selected the priority vessels from the said firms, their total tonnage was subtracted from the required tonnage reduction, which corresponded to 20 percent of the total tonnage in the industry. Any further tonnage reduction was achieved by withdrawing vessels belonging to other firms which had better performance than the priority firms.
- c) In the event that there were not enough applicants to achieve a 20 percent reduction in the number of vessels, other applications would be called for, mainly from those firms which wanted to transfer from long-line to purse-seine operation.

As there were more than enough applicants, the third step was not taken. The owners of the remaining operating vessels paid due compensation to the operators of the 169 tuna vessels withdrawn from the industry.²⁴⁾ These payments were made possible through the cooperation of government and private finance companies with the owners of the remaining vessels. Around 80% of the total amount of compensation was lent to the owners of the remaining vessels by the municipal treasury.²⁵⁾ The other 20% of the compensation was paid from the private capital of the remaining vessels' owners.²⁶⁾ (Kuronuma, 1983).

It seems that the reduction in fishing effort in 1981 and 1982 occurred because of action by the fishing industry, rather than because of the licence system. This indicates that the underlying philosophy seems to have been similar to that employed for coastal water fisheries. The industry tried to maximise its profits by reducing fishing effort, and compensated owners of tuna boats who left the industry. The difference between coastal-zone fisheries and tuna fisheries is that tuna operators do not use the 'common pool' method for their fishing operations. It may therefore be concluded that Japanese tuna fisheries are trying to achieve maximum economic returns within the constraint of a fixed number of fishing vessels which is formally allocated by the Japanese Government. This implies that tuna fisheries, including SBT fisheries, may still be operating under open-access conditions.

24) The standard was set at 150 million yen for 278 gross tonnes of fishing vessels, which comes to 540,000 yen (or A\$ 5,400 at the rate of ¥100 = A\$ 1) per gross tonne.

25) It was made payable over 15 years at 5% interest.

26) Most of the remaining owners borrowed from the Norinchuo Kinyu Kouko (The Norinchukin Bank) and the loans were repayable over 5 years at 8.5% interest.

Thus, the Japanese licence system has not provided a substantial solution to the management of SBT resources and fisheries, but rather has led to open-access problems.

5 Fishing Effort and Effective Boat Size

The preceding two sections have examined the actual policies of Australia and Japan for reducing SBT fishing effort. This section will consider a slightly different view of the regulation of fishing effort in relation to effective boat size. Although the simple estimation for multicohort fisheries in Kuronuma (1993) indicates that all Australian surface SBT fishery should be eliminated, it may be possible for Australian fisheries to remain in the industry because of their current joint venture with Japan, which may mean that technological transfer (of the long-line method) will be possible in the future. This indicates that it may be possible to reconsider resource allocation by utilising different fishing boat sizes. In this context, it is assumed that Australian surface fisheries (pole-and-line, and purse-seine) have been converted to small longliners (e.g. 30–100 tonne longliners), and therefore it is also assumed that Australian SBT fisheries harvest SBT resources in the same age group as those harvested by Japanese longliners. The question that then needs to be addressed is how to allocate SBT resources between the two classes of longliners (i.e. 30–100 tonne Australian longliners, and 200–500 tonne Japanese longliners).

Hasegawa (1974) established the relationship between the size of longliners and the abundance of fishing grounds in relation to Japanese tuna fisheries in 1968.²⁷⁾ He assumed that tuna longliners aimed to fill the carrying capacity of each participating vessel with their catch on each trip. Then, the relationship between length of return trip (days, X_t) an minimum daily average productivity of harvest (catch per number of hooks, M_e) can be given by the following equation:

$$M_e = \frac{kA}{n\{pk(1-B) - AX_t\}}$$

where $X_t \geq 0$, and

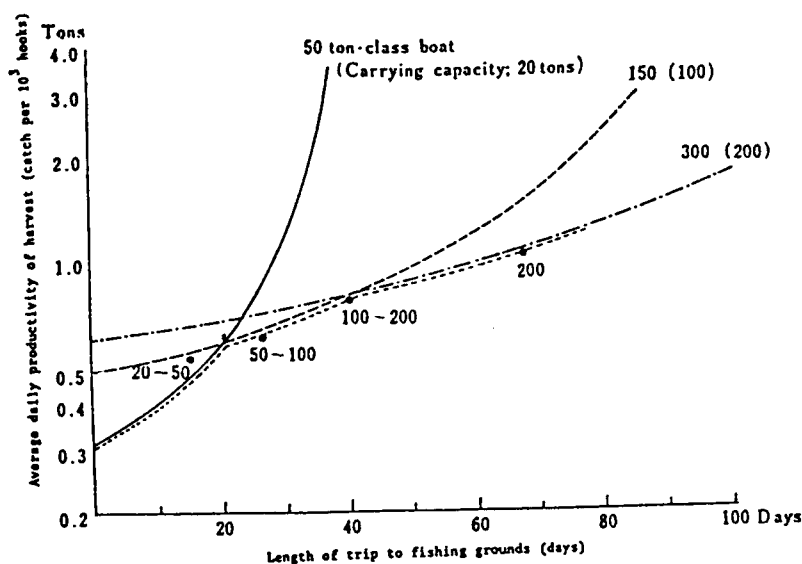
k: carrying capacity of tuna boat

A: ratio of cost to navigation days

B: ratio of cost to catch

p: fish price

27) There are several studies of the optimal scale of fishing business in Japanese fisheries economic literature. These include Yoneda (1968) and Tanba (1964).



Source : Hasegawa, 1974, p. 91.

Figure 3 Relationship between Length of Return Trip to Fishing Ground and Average Daily Productivity of Harvest

n: number of hooks per fishing day.

By substituting all relevant data from the three different classes of tuna boat in 1968 into this equation, Hasegawa (1974) obtained Figure 3. He therefore concluded that there was an optimum size of boat (tonnage) for each fishing ground, and that as the distance of fishing grounds increased, not only the optimum size of boat but also the average productivity of harvest would also increase.

As discussed in section 2, fishing cost per unit of effort would probably be proportional to fishing effort for each class of tuna fishing boat. Hasegawa's (1974) results therefore strongly indicate that if coastal states develop a long-line tuna fishery on a relatively small scale, their most economically efficient harvest is likely to be obtained in coastal and/or off-shore waters. This is likely to happen in Australia if a small-scale long-line method can be successfully adopted to their current SBT fisheries.

6 A Global View of the Issue and Concluding Remarks

The management of SBT fishery resources has historically been poor from both biological and economic perspectives. In Western countries, the basic objective of

fisheries resource management is usually considered to be the achievement of MEY for the fishing industry and/or welfare maximisation for society. In order to achieve this, Australia has effectively reduced its national SBT quota and fishing effort by introducing the ITCQ scheme, although several economic problems with the scheme have arisen. However, these were not necessarily the objectives of Japan's fisheries policy. Japanese fisheries basically involve group (or collective) management. Their major objectives were the maintenance of employment opportunities and the management of resources in order to optimise ('maximise') the incomes of fishermen. This concept of group management is exemplified by the number of Japanese fisheries' cooperative associations all over Japan. In the case of SBT fisheries, the Federation of Japan Tuna Fisheries Cooperative Association (JTF) is the principal organisation.²⁸⁾ The Japanese licence system is therefore not the typical licence system in general. The system may still create a classical open-access fisheries problem for distant-water tuna fisheries, despite a 20% reduction in fishing effort in the early 1980s.

The different backgrounds and objectives of the national fisheries of Australia and Japan have to be taken into account in SBT fisheries resource management at the international level. These factors make it difficult to find a single appropriate international solution for SBT management. However, as there are only relatively few countries involved, SBT management may be much simpler than the management of other types of highly migratory species. In order to reduce SBT fishing effort effectively, a key requirement would probably be the transferability of quotas (or fishing effort) under both ITCQ and licence schemes.²⁹⁾

The open-access problem still remains in SBT fisheries despite attempts at close cooperation in the past, at both international and domestic levels. This indicates that there is still a problem of excess fishing boat capacity in the SBT industry. At the 1988 scientific meeting in Wellington, scientists suggested a moratorium on SBT fisheries due to the considerable risk of reducing the parent stock size. Although it may not be applied in the same way as in the case of Japanese domestic fisheries, this moratorium proposal seems to suggest the further development of the Hasegawa model discussed in section 4 in order to find a solution for the survival of SBT fisheries other than that offered by the Gordon model. If it can be assumed that Australia owns the relatively small SBT fish resource and Japan owns

28) As discussed in section 4, their underlying philosophy seems to be the same as for their coastal policy, although the JTF does not follow the 'common-pool' form of management for tuna fisheries.

29) It seems, however, that the question of who should appropriate the rent requires further study.

the relatively large SBT fish resource, it would be possible to consider that SBT resources of each size are owned under conditions of sole ownership. The Hasegawa model may then be applied to each country in order to determine possible scenarios.

Another scenario considered in section 5 indicates that if Australian SBT fisheries could successfully adopt to a relatively small-scale long-line method, it might be necessary to reallocate SBT resources according to the economic effectiveness of different boat sizes relative to their productivities. That is, Australian SBT fisheries would possibly become dominant in Australia's coastal waters in terms of economic efficiency compared with the relatively large-scale Japanese longliners.

The two above-mentioned scenarios have different implications for the appropriate kind of institutional system and/or arrangements for the international management of SBT resources and fisheries. Which of the two options is chosen depends heavily on the value judgments of decision-makers, in this case those of Australian and Japanese decision-makers.

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