The Economics of Boat Size in the Barbados Pelagic Fishery

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ABSTRACT

La pesquerías de peces pelagicos en Barbados esta siendo por "botes-dia" (lanchas de 7 a 12 metros con motores dentro de borda de 22 a 120 caballos de fuerza), que regresan al mercado diariamente, y "botes-hielo" (12-18m, 80-225 h.p.) que permanecen en el mar por cerca de una semana. Los "botes-hielo" fueron introducidos alrededor del 1980; y 50 estan registrados para pescar en la temporada de 1986. La introducción de los "botes-hielo" ha incrementado significativamente los desembarcos anuales en estas pesquerias. Las ventajas de los "botes-hielo" incluyen: capturas anuales por bote (25 toneladas métricas en 15 viajes) es mayor que la de los "botes-dia" (10 toneladas métricas en 125 viajes); capturas por toneladas de combustible consumido 2 1/2 veces mayor que los "botes-dia"; el ingreso por capita an y tripulación es substancialmente mayor en los "botes-hielo." Este último factor es principalmente responsable por la presente transición rápida a "botes-hielo." Desventajas en los "botes-hielo" incluyen: ellos causan aglutinamiento en el mercado, lo cual baja el precio del pescado y el margen de ganancia para ambos "botes-hielo" y "botes-dia"; al presente pescan en aguas territoriales de paises vecinos; emplean la mitad de los pescadores por tonelada-de-peces-capturados que los "botes-dia"; las tasas altas de capturas de la flota en expansión de "botes-hielo" podria causar una desestabilisación del abasto pesquero (stock). Se sugiere que la tasa de expansión de la flota de "botes-hielo" sea reducida y que se mantenga una flota mezclando "botes-hielo" con "botes-dia." Esta, tal vez sea la estrategia mas prudente para esta pesqueria en Barbados.

INTRODUCTION

The oceanic pelagic fishery has historically been the most important fishery in Barbados, and today pelagic species account for about 90% of the total weight landed annually. Fishing effort is seasonal (November to June) as it tracks the availability of the migratory oceanic pelagics (Hunte and Mahon, 1982).

The pelagic fleet originally consisted of open sailing boats around 6 m in length with oars as an alternative power source. Following extensive damage to the fleet by hurricane "Janet" in 1955, and provision of credit facilities, the sailing boats were replaced by motorised launches (Wiles, 1959). By 1956 the ratio of motor launches to sail boats was 157 to 232 and by 1959 the ratio was 451 to 4 (Brown, 1967). The early motorised launches were partially covered wooden launches, around 7 m in length, powered by 10 to 22 HP inboard diesel engines and they made daily fishing trips. This change from sail to engine was the first of two major transitions in the structure of the Barbados pelagic fleet.

In the 1970s, larger day boats (10—12 m) with more powerful diesel engines (80—120 HP) were added to the fleet such that the average size of boats in the fleet increased steadily (Figure 1). These motorised launches caught more fish per day trip than the smaller boats, but had higher operating costs.

Between 1978 and 1980 two long-range vessels (ice-boats) of 8 to 10 ton capacity were introduced into the Barbados pelagic fleet, and by 1984 there were 34 in operation. Fifty nine ice-boats are presently fishing and 75 are registered for the 1986/1987 fishing season. The ice-boats are between 12 and 18 m in length, with 5 to 12 ton capacity ice-holds. Many of the boats are converted day-boats; 70% being wooden and 30% fiberglass. The majority are powered by single inboard diesel engines from 80 to 225 HP, and remain at sea from 4 to 14 days, storing the catch on ice. These ice-boats employ the same fishing techniques for catching large pelagics and flyingfish as the day-boats, but often fish 24 hours a day and fish further afield; primarily in the triangle between Tobago, Grenada, and Barbados. This current change from day-boats to ice-boats represents the second major structural transition undergone by the Barbados pelagic fleet. The gradual increase in landings in the pelagic fishery which accompanied the gradual increase in average day-boat size in the 1970's, and the sudden increase in landings accompanying the introduction of ice-boats is shown in Figure 2.

Most countries in the eastern Caribbean are presently expanding or intend to expand their oceanic pelagic fishing fleets, primarily by increasing fleet size but also by changing boat type (Hunte, 1985). Thus the fisheries are moving from"small scale artisanal" towards "large scale commercial" operations, with considerably more capital being invested in the fleets than in the past. Large scale commercial fisheries catch more fish, but they do so at a price. Compared with small scale artisanal fisheries, they employ far fewer fishermen, the capital cost of each job on a fishing vessel is far greater, considerably more fuel is consumed overall, and typically, fewer fish are harvested per ton of fuel consumed (Thomson, 1980).

In this study we compare capital investment, catch rates, and operating costs of day-boats with ice-boats in the Barbados pelagic fleet to comment on the advantages and disadvantages of the two approaches to harvesting oceanic pelagics in the eastern Caribbean.

METHODS

Day-boat catch and effort records were obtained from the Fisheries Division of the Ministry of Agriculture, Food, and Consumer Affairs. Data on fuel, food, and maintenance costs for day-boats were obtained through interviews with fishermen, boat owners, and Fisheries Division staff. Ice-boat catch is unloaded directly to processors or consumers at unmonitored landing sites, and is therefore largely unrecorded by the Fisheries Division. We obtained these catch records directly from a sub-sample of the vessels' log books and from records kept by a local fish processor. Fuel, ice, and food expenses were obtained from the log books, from interviews with ice-boat fishermen and boat owners, and from local suppliers. Maintenance costs were quantified through interviews with boat owners and builders.

Catch value was calculated using figures provided by the Fisheries Division who have been monitoring market prices since 1981. Insurance costs of both

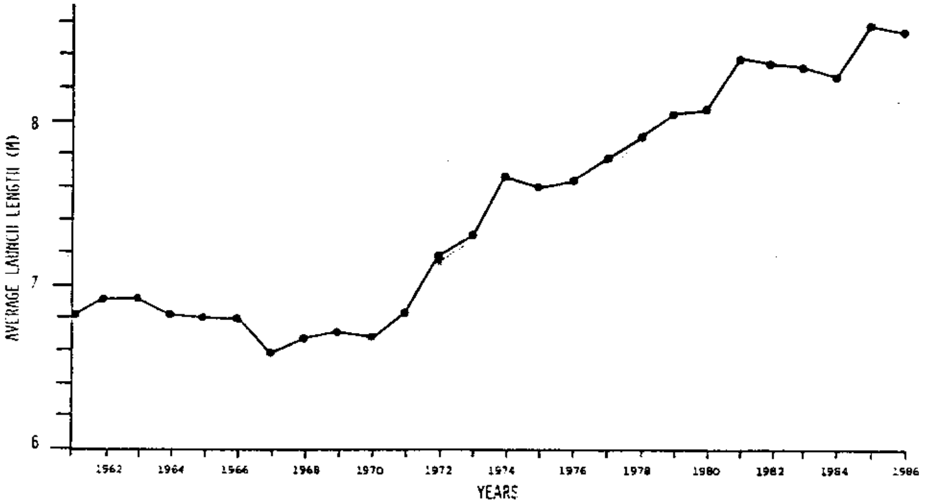

Figure 1. Average length of registered fishing boats in the pelagic fleet at Oistins, Barbados.

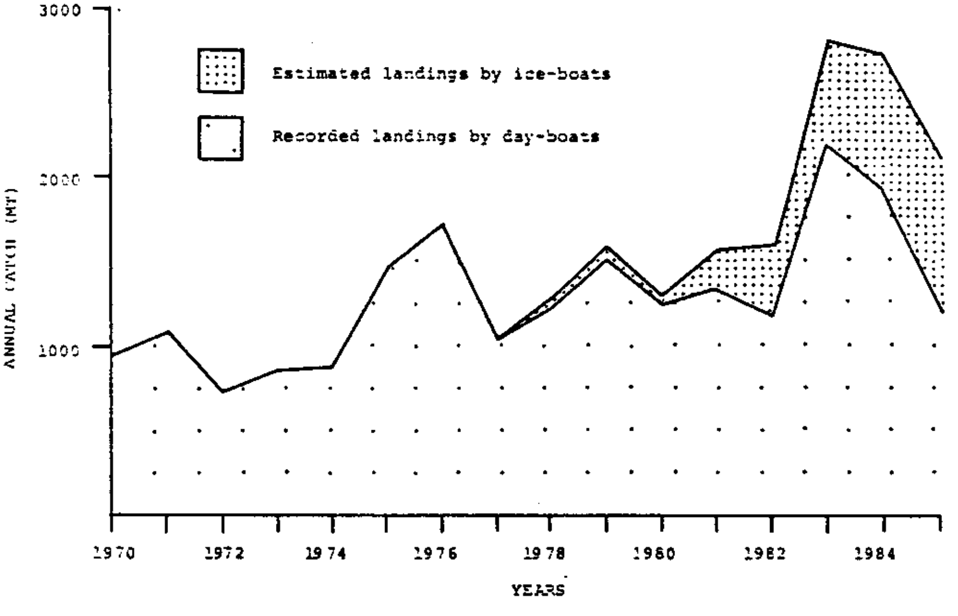

Figure 2. Annual recorded landings of pelagic fish by day-boats at Oistins Market, Barbados and estimated landings for ice-boats.

types of vessel were obtained from local marine insurance companies, and information on loan structure was obtained from the Barbados Development Bank.

RESULTS

Capital Costs

The current cost of a fully-equipped day-boat ranges from around US$20,000 to US$35,000 depending on the hull size and engine power. The average cost was taken as approximately US$22,500. Ice-boats converted from day-boats are worth about US$50,000 including gear and equipment. A typical ice-boat built in Barbados costs around US$125,000 when fully equipped with navigational, safety, and fishing gear. The average cost of a typical ice-boat was therefore taken as approximately US$100,000. A bank loan for up to 70% of the boat value may be obtained for the purchase of a fishing boat, at an annual interest rate of 13%. For a typical day-boat (estimated cost US$22,500), in a situation in which the potential owner must take out the maximum loan to which he is entitled, the loan required is US$15,750. The time allowed for repayment is typically 7 years. Repaid evenly over the 7 years, the annual repayment cost to the principle would be US$2,250. Annual interest costs at 13% would be US$2,048, US$1,755, US$1,463, US$1,170, US$868, US$585, US$293 in years 1 to 7 respectively. The average annual interest cost per year is therefore aproximately US$1,170. Hence the total smoothed cost of servicing the loan is US$3,420 annually.

For a typical ice-boat (estimated cost US$100,000), in a situation where the potential owner must take out the maximum loan to which he is entitled, the loan required is US$70,000. The time allowed for repayment is typically 10 years. Repaid evenly over this period, the annual repayment cost to the principle would be US$7,000. Annual interest costs at 13% would be US$9,100, US$8,190, US$7,280, US$6,370, US$5,460, US$4,550, US$3,640, US$2,730, US$1,820, US$910 in years 1 to 10 respectively. Distributed evenly over the 10 years the average annual interest cost becomes approximately US$5,000. Hence, the total smoothed cost of servicing the loan is US$12,000 annually.

Boat insurance costs average about US$1,500 per year for a typical day-boat and US$3,750 per year for a typical ice-boat.

The life of a fishing vessel was taken as 15 years for a typical day-boat and 25 years for a typical ice-boat. This is probably reasonable for the hull but may be lenient for the engine. Depreciation costs smoothed over the life of the boat are therefore around US$1,500 a year for a day-boat and US$4,000 for an ice-boat.

Operating Costs

Maintenance costs show considerable variation between years for any boat. However, for day-boats the estimated average annual cost of hull and engine maintenance is around US$1,000, and of gear maintenance and/or replacement is around US$688. An overall maintenance cost for day boats is thus estimated to be approximately US$1,688 annually. The average cost of hull maintenance for ice-boats is approximately US$2,250 annually, and for maintenance and/or replacement of gear about US$1,000. Thus, an average maintenance cost for ice-boats is approximately US$3,250 annually.

Fuel costs for day-boats vary from US$20 to US$35 per trip. A reasonable average is around US$25. A typical day-boat makes an average of 125 fishing trips a year and hence the annual cost of fuel is approximately US$3,125. At 35c a litre this represents a total annual fuel consumption of approximately 8.9 MT. Fuel costs for ice-boats vary between US$200 and US$300 per trip. A reasonable average is around US$250. The average number of trips made per year by an ice-boat is 14.5, and hence the annual cost of fuel for a typical ice-boat is about US$3,625. This represents a total annual fuel consumption of 10.4 MT.

The cost of ice for ice-boats ranges between US$200 and US$300 per trip; a reasonable average being US$250. Hence the annual cost of ice is around US$3,625. There is no equivalent cost for day-boats.

Food supplies for the crew are minimal for day boats, being US$2.50 per trip. The annual cost of crew supplies is therefore about US$313. Ice-boat crew supplies range from US$100 to US$200 per trip. A reasonable average is US$125, such that the annual cost is around US$1,813.

There is a government market toll of 2c per kg of flyingfish and 5c per kg of large oceanic pelagics landed. A typical day-boat lands an average of 10 MT of fish per year of which an estimated 65% is flyingfish and 35% large pelagics. This generates an annual market toll of US$305. A typical ice-boat lands an average of 26.2 MT of fish per year, with a similar ratio of flyingfish to large pelagics. The annual market toll for a typical ice-boat is therefore around US$800.

Landings and Revenue

Catch rates vary annually, presumably reflecting variation in fish abundance. However, the average annual fish catch per vessel is 10 MT for a typical day-boat and 26.2 MT for a typical ice-boat. This gives a catch per metric ton of fuel consumed of 1.12 MT of fish for a day-boat, and 2.52 MT of fish for an ice-boat. The latter is a considerably more favourable yield and as such ice-boats are more productive and more efficient than day-boats in terms of catch and fuel consumption. Thus compared with day-boats, ice-boats are not only more productive (greater total catch), but are also more efficient in terms of catch per unit of fuel consumed.

The average market value of the catch was taken as 88c per kg for flyingfish, and $3.30 per kg for large pelagics. These prices fluctuate widely with season and with the occurrence of market gluts on any day. This makes the estimation of average prices difficult. If anything, our estimates may be slightly generous, particularly for ice-boats selling in bulk to processors. A typical day-boat catches 6.5 MT flyingfish and 3.5 MT large pelagics per year. This produces a gross revenue of US$5,720 from flyingfish and US$11,550 from large pelagics, or a total gross revenue of around US$17,270 per annum for a typical day-boat. A typical ice-boat catches 17 MT flyingfish worth US$14,960, and 9.2 MT large pelagics worth US$30,360. This gives a total gross revenue of US$45,320.

Total annual expenses (obtained by summing insurance costs, loan interest and repayment costs, maintenance costs, depreciation cost, operating costs, and market toll) are approximately US$11,851 for a typical day-boat and US$32,863 for a typical ice-boat. Total annual expenses subtracted from gross revenue provides a net annual revenue of US$5,421 for a day-boat and US$12,458 for an ice-boat. Expressed as profit per unit of fishing pressure on the resource, this represents an average profit factor for day-boats of US$542 for every ton of fish caught and for ice-boats of US$475 for every ton of fish caught. In this resource sense, ice-boat fishing is less efficient than day-boat fishing.

For purposes of estimating fishermen revenue, we will consider only the situation in which the boat owner is also the captain (typical in ice-boats; common in day-boats); and only the most commonly used system of dividing revenue. Captain and crew wages are paid at the end of each fishing trip. For day-boats the revenue from the catch, less fuel, food, and market toll expenses, is typically divided such that 75% goes to the captain/owner, 25% to the single crew. This is a gross annual income of US$10,146 for the captain/owner and US$3,382 for the crew. However, the captain/owner must pay the additional expenses (US$6,608 for insurance, loan interest and repayment, and maintenance). This gives the captain/owner a net annual profit of US$3,538 (US$2,038 if depreciation is considered). For ice boats, the revenue from the catch, less fuel, ice, food, and market toll expenses, is typically divided such that the captain/owner receives 70% and the crew 15% each. This gives the captain/owner a gross annual income of US$24,821, and each crew an average annual wage of US$5,319. However, the captain/owner must pay additional expenses of US$19,000, giving him a net annual profit of approximately US$5,820 (US$1,820 if depreciation is considered).

A summary of the costs is presented in Table 1 and a summary of the landings, revenues and profits in Table 2.

DISCUSSION

The Barbados pelagic fishing fleet is presently in a rapid expansion phase with a sharp increase in the number of ice-boats. There are several advantages of ice-boat or long-range fishing. An ice-boat catches more fish per annum, it catches more fish per unit of fuel consumed, and it provides higher wages for captain and crew than does a day-boat. This latter factor has been the primary driving force behind the present rapid conversion of day- boats to ice-boats.

The potential disadvantages of ice-boats are more subtle. The larger capacity of ice-boats ensures that they presently cause market gluts which drop fish prices and so decrease profit margins for both ice-boats and day-boats. Hence, with existing market conditions, every expansion of the ice-boat fleet decreases the profit margin of all boats in the fleet. This reduction in fish price with increase in fish volume landed may largely explain why ice-boats are already tending to return to market when they have caught only about 55% of their fish holding capacity. Note that although the addition of each ice-boat decreases the profit margin, ice-boats retain their profit advantage over day-boats. Hence, the incentive remains to convert to ice-boats in spite of the conversion accelerating the reduction in profit margin for all.

Given that all neighbouring countries in the eastern Caribbean plan to increase their exploitation of oceanic pelagics (Hunte, 1985), countries may become increasingly sensitive to neighbours fishing in their territorial waters. This would have more serious repercussions for ice-boat fishing than for day-boat fishing.

Considering the greater fishing power of ice-boats, an expanding ice-boat fleet will approach fishing levels that increase the probability of stock collapse more rapidly than will an expanding day-boat fleet. Since neighbouring

Table 1. Summary of estimated average costs (US$) of a typical day-boat and a typical ice-boat in the Barbados pelagic fishing fleet.

Costs	Day-Boat	Ice-Boat
Capital: average total	22,500	100,000
Loan:		
maximum loan (% value)	70	70
max. repayment time (yrs)	7	10
interest rate (%)	13	13
average annual repayment	3,420	12,000
Insurance: annual premium	1,500	3,750
Depreciation: annual	1,500	4,000
Maintenance:		
hull and engine (annual)	1,000	2,250
gear (annual)	688	1,000
Operational:		
fuel (per trip)	25	250
fuel (annual)	3,125	3,625
ice (per trip)	-	250
ice (annual)	-	3,625
food (per trip)	2.5	125
food (annual)	313	1,813
market toll (annual)	305	800
ANNUAL TOTAL:	11,851	32,863

Table 2. Landings (metric tons) and revenue (US$) estimated for a typical day-boat and a typical ice-boat in the Barbados pelagic fishing fleet.

Landings & Revenue	Day-Boat	Ice-Boat
Landings: annual (MT)	10	26.2
per metric ton of fuel (MT)	1.12	2.52
Revenue: gross annual (from flyingfish)	5,720	14,960
(from large pelagics)	11,550	30,360
Net annual	5,421	12,458
Profit/MT fish	542	475
Earnings: annual (captain/owner)	3,538	5,820
(crew)	3,382	5,319

Note: calculated earnings for captain/owner omit depreciation costs.

countries are probably exploiting the same stocks, at least for the larger pelagics (Hunte, 1985; Oxenford and Hunte, 1986), the above will be aggravated by fisheries expansion by neighbouring countries. Note that although annual abundance has apparently not decreased for oceanic pelagics over the last five years, the year to year variation in abundance has been increasing in the 1980s (Hunte, 1985; Mahon *et al.*, 1986; Oxenford and Hunte, 1987). For annual species, this may indicate the begining of stock destabilisation (Saville, 1979; Hunte, 1986).

Ice-boats have a lower profit margin than day-boats per ton of fish harvested or per unit of fishing pressure put on the resource (Table 2). Therefore, if the fleet was continously expanded until the point where it was obtaining a maximum sustainable yield (MSY), and the relative fee structures remained the same, the profit margin at MSY for the fleet as a whole would be greater for a day-boat fleet than for an ice-boat fleet. Also, since day-boats employ almost twice as many fishermen per ton of fish harvested as do ice-boats, the number of fishermen employed at MSY by a day-boat fleet would be nearly double that by an ice-boat fleet.

Given the above, it may be unwise to continue expanding the Barbados ice-boat fleet at current rates. A development policy of deliberately maintaining a mixed fleet may presently be most prudent. Given that certain of the oceanic pelagics show natural five year cycles of abundance (Storey, 1983; Oxenford and Hunte, 1987), one approach may be to consider expansion of the fishing fleet in five year pulses. The period between expansion pulses would allow marketing facilities to improve and hence profit margins to rise; would allow time to ascertain that fish stocks were still returning to their typical abundance peaks; and may allow time to ascertain how close current levels of fishing effort are to levels that may initiate stock collapse. Given the different characteristics of ice-boat and day-boat fishing, the ratio of boat types ultimately used would depend on national objectives set for the fishery. Such objectives may vary between countries. However, given the shared nature of the stocks, attaining national objectives will probably require both the will and the mechanism for structured regional collaboration.

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