Bull. Inst. Oceanogr. & Fish. ARE., 12, 1986: 103 - 113.

CATCH PER UNIT EFFORT IN THE NORTHERN EGYPTIAN DELTA LAKES.

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ABSTRACT

Catch per effort statistical analysis has been adopted on Egyptian northern Delta Lakes in order to study the relation between the catch of unit effort (CPUE), effort and the corresponding commercial catch from each lake during 1962 - 1983 period.

Fish catch from each lake has been found to be positively correlated with the catch per unit effort (fisherman, boat). On the contrary, numbers of fishermen and fishing boats at any of these lake were not significantly correlated with the annual commercial catch. Fish catch was determined in the northern lakes by fish density and not by fishing effort.

INTRODUCTION

Several authors has revealed that structure and size of commercial fish catch reflect, sufficiently well, state of fish stock in water biomass. The productivity of unit effort (CPUE) is an index of effectiveness of exploitation, which is considered a satisfactory measure of the density of fish in a given biomass (2,4,5).

Long-term studies has revealed that there exist statistically measurable and calculable relationships between total intensity of exploitation, i.e., total effort, total catch and index of effectiveness of exploitation, i.e., (CPUE), (5,6).

The object of this study is to correlate the effect of the catch per unit effort (CPUE) and effort with fish catches in Egyption northern lakes, namely, Manzala, Burullus, Edku, and Mariut which constitute about 2.9% of the total water area of the Egyptian fisheries, and contribute about 40% from the annual total catch in the country during 1962 - 1981 period (8).

MATERIAL AND METHODS

Statistical analysis of correlation and regression has been performed on size of fish catch (y) from each lake, productivity of unit of effort expressed in catch per fisherman (x_1), and catch per fishing boat (x_2), and total fishing effort expressed in number of fishermen (x_3), and number of fishing boats (x_4). The analysis embrace a period of 22 years from 1962 - 1983.

The coefficient of linear correlation (r) is obtained from the following equation (7):

$$rxy = n\Sigma xy - \Sigma x \Sigma y \; / \; \sqrt{[\, n\Sigma x^2 - (\Sigma x)^2 \,]\,[\, n\Sigma y^2 - (\Sigma y)^2 \,]},$$

where, y and x (x_1, x_2, x_3, x_4) are variables under study and n is number of years.

Influence of one variable upon the other is determined from the coefficient of determination (r^2), which is calculated from the following equation (7):-

$$r^2 x\, y = (n\Sigma xy - \Sigma xy)^2 \; / \; [\, n\Sigma x^2 - (\Sigma x)^2 \,]\,[\, n\Sigma y^2 - (\Sigma y)^2 \,].$$

Significance of the coefficient of correlation has been checked using statistical tables.

Regression coefficient (b) is used to study the range of variation induced in one variable by the variation (change) of the other variable by one standard unit. It is calculated from the following equation (7):

$$b = n\Sigma xy - \Sigma x \Sigma y \,/\, n\Sigma x^2 - (\Sigma x)^2.$$

Index number (I. N.) calculates the evolution of a given variable. It is achieved as following:

$$I.N = [\text{ Variable in each year / Variable in basic year }] \times 100,$$

assuming that 1962 is the basic year.

RESULTS AND DISCUSSION

As it is seen from Table (1-4), and as illustrated by Fig.(1- 8), fish catch in the northern Egyption lakes is possitivelly correlated during the period of study with catch per unit effort (catch per fisherman, catch per fishing boat).

Table (1)

Evolution of fish catch and fishing effort
in Lake Manzala in 1962-1983.

Years	Fish Catch	No. of Fishermen	No. of Fishing Boats	C P U E	
				Fisherman	Fishing Boat
1962	19.0	9.2	2.7	2.1	7.0
1963	19.5	9.4	2.8	2.1	7.0
1964	21.0	9.1	2.7	2.3	7.8
1965	20.6	8.3	2.5	2.5	8.2
1966	23.8	9.2	2.8	2.6	8.5
1967	26.7	9.0	2.7	3.0	9.9
1968	24.7	7.3	2.2	3.4	11.2
1969	22.5	8.0	2.4	2.8	9.4
1970	21.3	8.2	2.5	2.6	8.5
1971	21.3	8.1	2.5	2.6	8.5
1972	21.0	8.9	2.7	2.4	7.8
1973	22.1	7.6	2.4	2.9	9.2
1974	27.9	8.9	2.7	3.1	10.3
1975	29.2	8.7	2.7	3.5	10.8
1976	23.0	8.3	2.7	2.8	8.5
1977	23.4	8.3	2.7	2.8	8.7
1978	23.6	8.4	2.8	2.8	8.4
1979	25.2	8.3	2.8	3.0	9.0
1980	23.3	8.4	2.8	2.8	8.3
1981	26.3	8.4	2.8	3.1	9.4
1982	30.9	7.3	2.7	4.3	11.4
1983	31.2	8.1	2.7	3.8	11.6

Source : Fish catch statistics in ARE, Central Agency of Public Mobilization and Statistics, 1962 - 1983, Cairo.

Table (2)
Evolution of fish catch and fishing effort in Lake Burullus
in 1962 - 1983.

Years	Fish Catch	No. of Fishermen	No. of Fishing Boats	C P U E	
				Fisherman	Fishing Boat
1962	7.5	9.0	2.4	0.8	3.1
1963	7.7	9.0	2.4	0.9	3.2
1964	7.5	9.0	2.5	0.8	3.0
1965	7.0	9.0	2.5	0.9	2.8
1966	8.0	9.0	2.5	0.9	3.2
1967	7.6	7.0	2.3	1.1	3.3
1968	7.3	8.0	2.6	0.3	2.8
1969	8.9	8.0	2.6	1.1	3.4
1970	8.1	9.0	2.7	0.9	3.0
1971	7.6	9.0	2.6	0.9	2.9
1972	7.5	8.0	2.7	0.9	2.8
1973	4.6	9.0	2.9	0.5	1.6
1974	4.9	9.0	2.9	0.6	1.7
1975	5.5	8.0	2.8	0.7	2.0
1976	6.6	8.0	2.8	0.8	2.4
1977	6.6	9.0	2.8	0.8	2.4
1978	6.5	9.0	2.8	0.8	2.3
1979	7.0	9.0	2.8	0.8	2.5
1980	7.1	8.0	2.8	0.8	2.5
1981	6.1	8.0	2.8	0.8	2.4
1982	7.3	8.0	2.8	1.0	2.6
1983	8.2	8.0	2.8	1.0	2.9

Source: Fish catch statistics in ARE, Central Agency of Public Mobilization and Statistics, 1962-1983, Cairo.

Table (3)
Evolution of fish catch and fishing effort
in Lake Edku in 1962 - 1983.

Years	Fish Catch	No. ofg Fishermen	No. of Fishing Boats	C P U E	
				Fisherman	Fishing Boat
1962	4.4	4.1	1.4	1.1	3.1
1963	4.4	4.8	1.3	1.1	3.4
1964	4.9	3.9	1.3	1.2	3.6
1965	4.6	4.0	1.3	1.2	3.5
1966	3.5	4.0	1.3	0.9	2.7
1967	2.3	4.0	1.3	0.6	1.8
1968	1.5	4.0	1.3	0.4	1.2
1969	1.3	4.0	1.3	0.3	1.0
1970	1.1	4.0	1.3	0.3	0.8
1971	0.8	3.9	1.3	0.2	0.6
1972	0.8	4.0	1.3	0.2	0.6
1973	0.9	3.9	1.3	0.2	0.7
1974	1.1	3.9	1.3	0.3	0.8
1975	1.1	3.8	1.3	0.3	0.8
1976	0.9	3.9	1.3	0.2	0.7
1977	1.3	4.3	1.4	0.3	0.9
1978	0.6	3.9	1.3	0.2	0.5
1979	0.8	3.9	1.3	0.2	0.6
1980	0.8	3.9	1.3	0.2	0.6
1981	0.4	3.9	1.3	0.1	0.3
1982	0.4	3.4	1.2	0.1	0.3
1983	0.2	3.8	1.3	0.1	0.2

Source : Fish catch statistics in ARE, Central Agency of Public Mobilization and Statistics, 1962 - 1983, Cairo.

Table (4)
Evolution of fish catch and fishing effort
in Lake Mariut from 1962 - 1983.

Years	Fish Catch	No. of Fishermen	No. of Fishing Boats	C P U E	
				Fisherman	Fishing Boat
1962	7.8	4.0	1.3	2.0	6.0
1962	8.7	3.3	1.1	2.6	7.9
1964	8.3	3.3	1.1	2.5	7.5
1965	6.8	3.2	1.0	2.1	6.8
1966	4.7	3.2	1.0	1.5	4.7
1967	2.3	3.1	1.0	0.7	2.3
1968	1.4	2.5	0.8	0.6	1.8
1969	1.5	2.3	0.8	0.6	1.9
1970	2.1	2.7	0.9	0.8	2.3
1971	2.6	2.4	0.8	1.1	3.3
1972	3.8	3.0	1.0	1.2	3.8
1973	10.7	3.0	1.0	3.5	10.7
1974	17.4	3.1	1.0	5.6	17.3
1975	17.1	3.1	1.0	5.5	17.1
1976	10.8	3.0	1.0	3.6	10.8
1977	13.2	3.0	1.0	4.4	13.2
1978	14.0	3.1	1.1	4.5	12.7
1979	13.6	3.4	1.1	3.9	12.4
1980	14.1	3.2	1.1	4.4	12.8
1981	11.4	3.2	1.1	3.6	10.4
1982	11.3	3.6	1.1	3.1	10.3
1983	8.1	3.2	1.1	2.7	7.9

Source : Fish catch statistics in ARE, Central Agency of Public Mobilization and statistics, 1962-1983, Cairo.

The coefficient of correlation (r) between fish catch and catch per fisherman being 0.6676 in Lake Manzala, 0.4321 in Lake Burullus, 0.7595 in Lake Edku, and 0.9912 in Lake Mariut (Table 5).

Catch per fisherman explains about 45% of the variability in total catch in Lake Manzala (P = 0.001), 19% in Lake Burullus (P = 0.05), 58% in Lake Edku (P = 0.001), and 98% in Lake Mariut (P = 0.001), (Table 5).

According to the above relationship, an increase or decrease of catch per fisherman by one standerd unit (kg / fisherman), is closely associated with an increase or decrease of total fish catch by 4.4 tons, 2.7 tons, 1.9 tons, and 2.7 tons consequently in Lakes Manzala, Burullus, Edku, and Mariut during the period of investigation, (Table 5).

Table (5)
Relationship between fish catch and catch per unit effort in Northern Lakes, (1962 - 1983).

Lakes		Correlation Coefficient (r)	Coefficient of Determination (r^2)	Coefficient of Regression (b)	Probability (P)
Manzala	(1)	0.6675	0.4451	4.3875	0.001
	(2)	0.3571	0.1275	-	-
	(3)	0.8981	0.8066	2.3562	-
	(4)	0.1834	0.0331	-	0.001
Burullus	(1)	0.4321	0.1884	2.6923	0.05
	(2)	0.1871	0.0353	-	-
	(3)	0.9432	0.8896	1.9939	0.001
	(4)	-0.5760	0.3318	-	-
Edku	(1)	0.7595	0.5762	1.9262	0.001
	(2)	0.2706	0.0732	-	-
	(3)	0.9432	0.8896	1.9938	0.001
	(4)	-0.5760	0.3318	-	-
Mariut	(1)	0.9912	0.9827	2.6591	0.001
	(2)	0.2402	0.0576	-	-
	(3)	0.9769	0.9543	1.0557	0.001
	(4)	-0.5339	0.2850	-	-

(1) Catch per fisherman.. (2) Number of fishermen.
(3) Catch per fishing boat. (4) Number of fishing boats.

On the other hand, the coefficient of correlation (r) between fish catch and catch per fishing boat bieng 0.8981 in Lake Manzala, 0.9432 in Lake Burullus, 0.9432 in Lake Edku, and 0.9769 in Lake Mariut, (Tab. 5).

Catch per fishing boat explains about 81% of the variability in total fish catch in Lake Manzala (P = 0.001), 89% in Lake Burullus and in Lake Edku (P = 0.001), and 95% in Lake Mariut (P = 0.001), (Table 5).

Consequently and according to the above relationships catch per unit effort represented by cath per fishing boat is highly significant than catch per fisherman in northern lakes. However, as the coefficient of correlation (r) gives a better approximation, it can be said that an increase or decrease of catch per fishing boat by one standard unit (Kg. fishing boat), is strictly and positively correlated with an increase or decrease of total fish catch by 2.4 tons, 1.9 tons, 2.0 tons and 1.1 tons consequently in Lakes Manzala, Burullus, Edku, and Mariut during the period of investigation, (Table 5).

Contrarily to the above, correlation between fish catch and numbers of fishermen, fishing boats is almost insignificant, (Tab. 5). Since the number of fishermen and the number of fishing boats can be treated as a rough measures of the fishing effort, whereas the catch per fisherman, and the catch per fishing boat may constitute a measure of fish density in northern lakes, it can be concluded that level of fish catch was essentially determined by the fish density in these lakes and not by the fishing effort used.

In view of this, it can be estimated from the coefficient of determination (r^2), that fish catches in northern lakes were determined in over 88.5% by fish density estimated by catch per boat, 55.0% by catch per fisherman (Tab. 5), while the fishing effort (numbers of fishermen, fishing boats), explained variability of the fish catch in only 24.5% estimated by number of fishing boats, 7.0% by number of fishermen (Tab. 5). This statement comply with earlier conclusions that variations in fish catches from lake Mariut is attributed to changes in the fish density induced by environmental factors and not by changes in the fishing effort (3).

It must be, However,underlined that these measures of the fish density in northern lakes (catch per unit effort for fisherman and fishing boat), or any other index will not be fully effective without improvements of the environmental conditions in these lakes. As illustrated by catch per fisherman, and catch per fishing boat, since 1968 in lake Manzala, 1969 in lake Burullus, 1964 in lake Edku, and 1974 in lake Mariut where fish density in these lakes decreases gradually. In view of this, an increase of the number of fishermen or the number of fishing boats will not improve the catch, but rather may lead to overfishing.

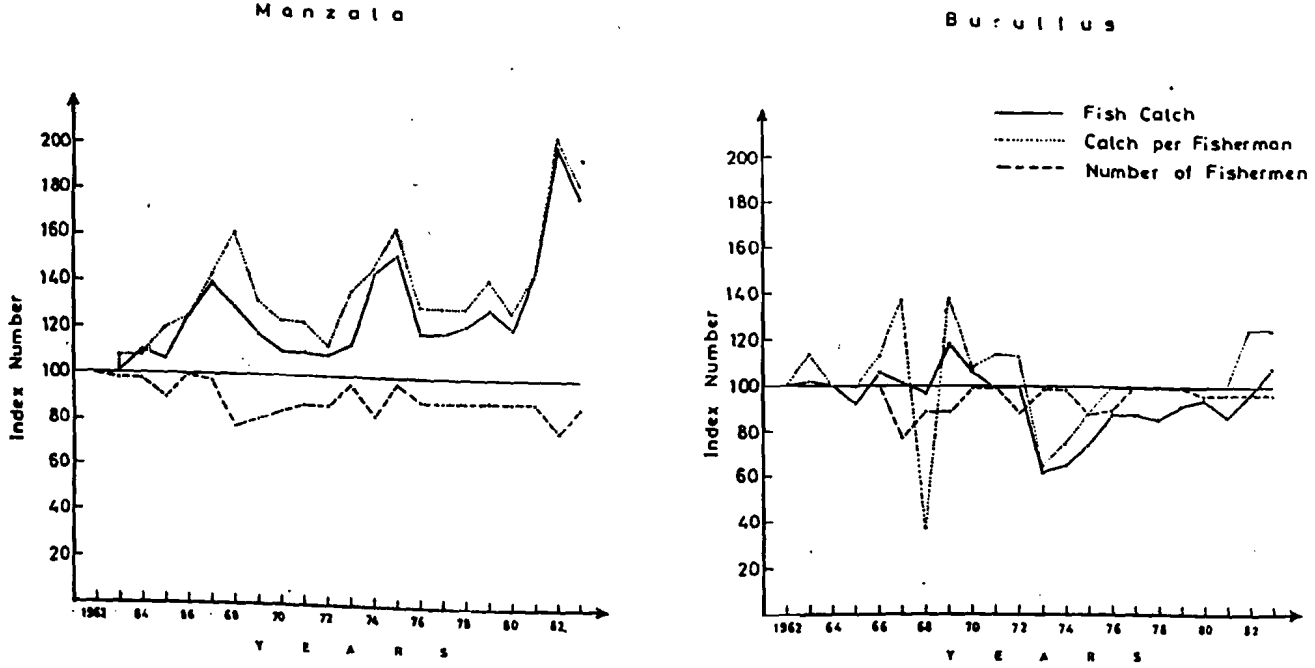

Fig. (1 - 2)
The relation between fish catch, catch per fisherman and number of fishermen in Northern Lakes, (1962-1983).

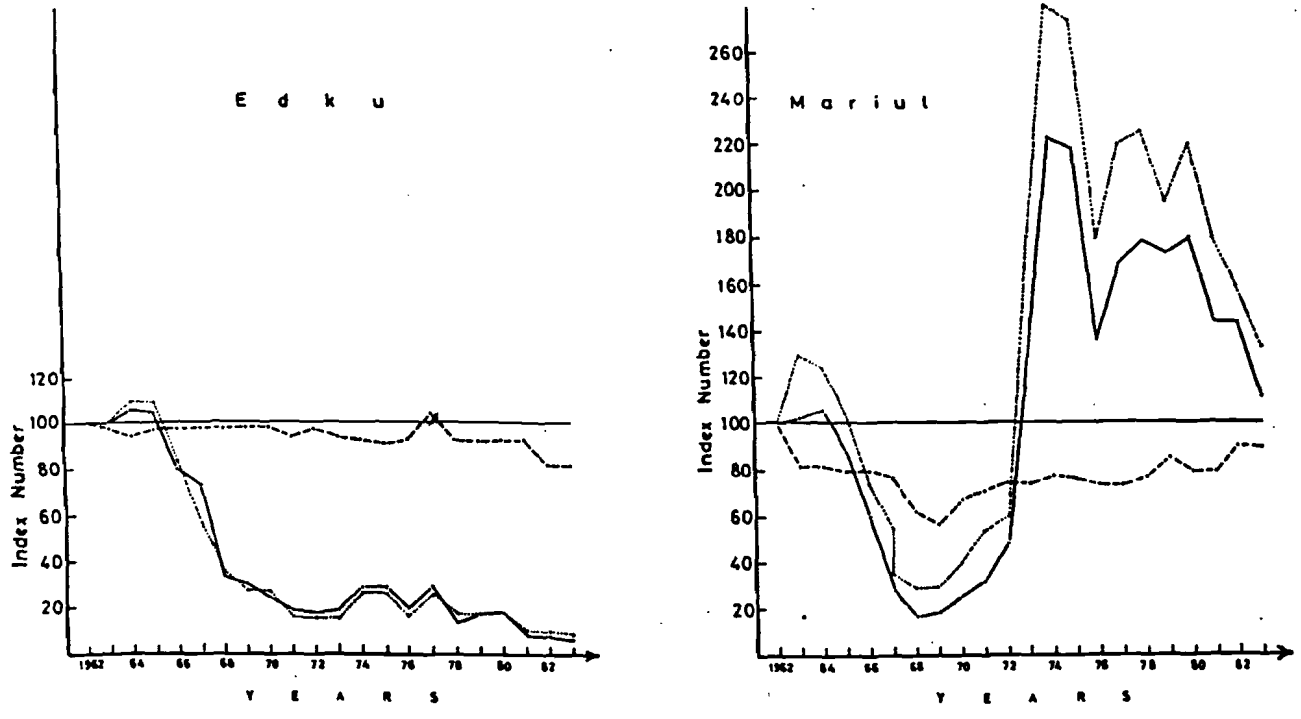

Fig. (3 - 4)
The relation between fish catch, catch per fisherman and number of fishermen in Northern Lakes, (1962-1983).

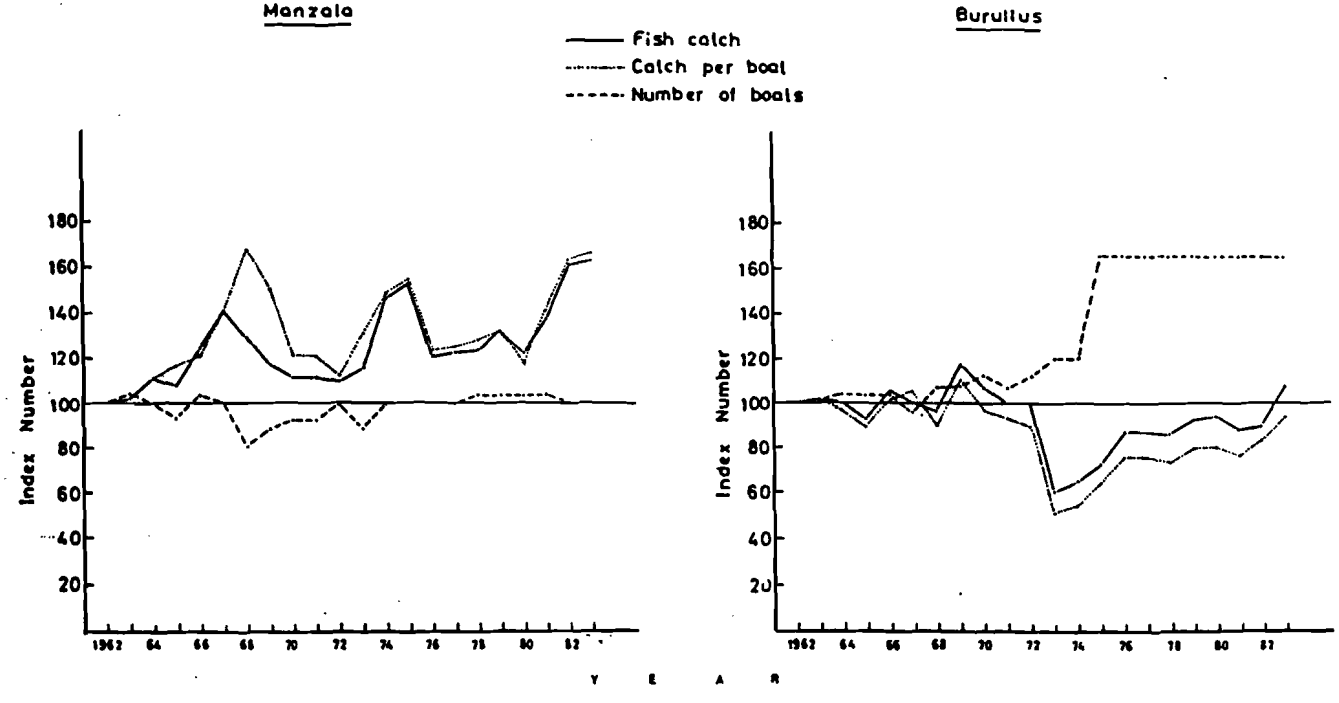

Fig. (5 - 6)
The relation between fish catch, catch per boat and number of boats in Northern Lakes, (1962-1983).

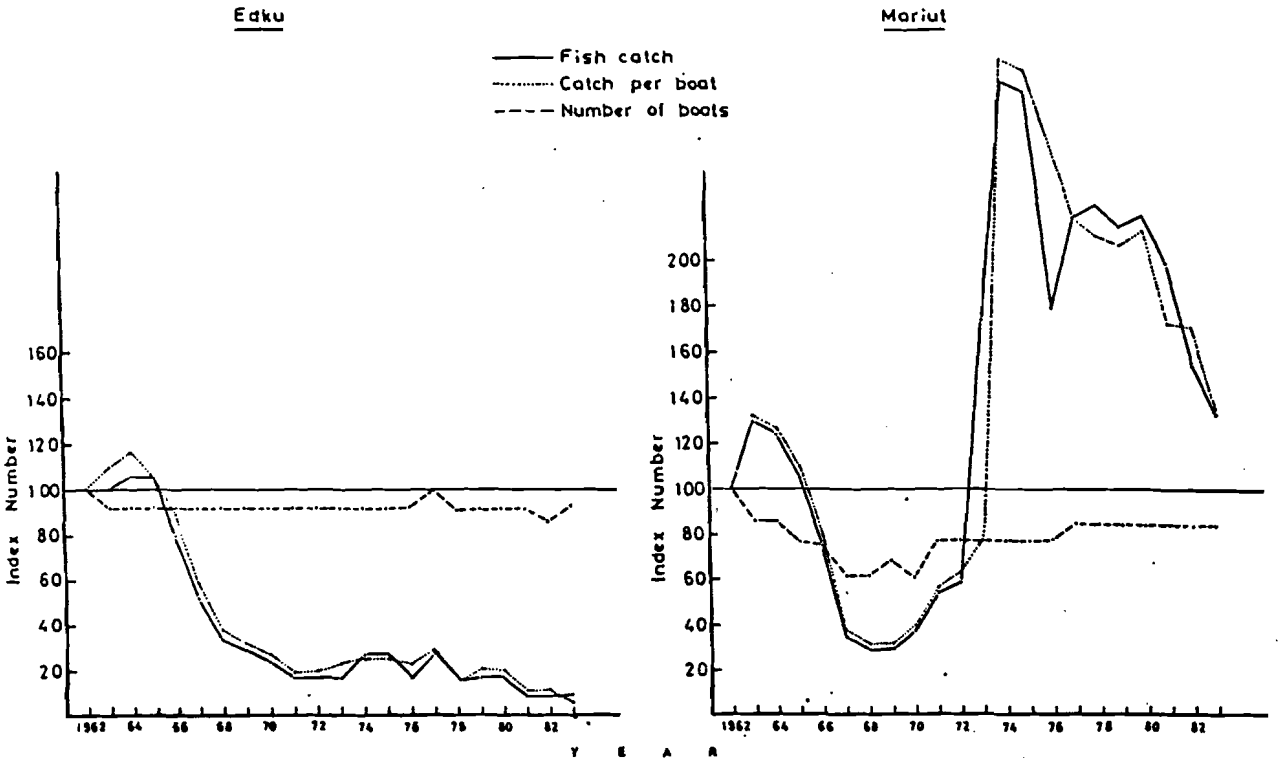

Fig. (7 - 8)
The relation between fish catch, catch per boat and number of boats in Northern Lakes, (1962-1983).

Obviously, it can be assumed that the only way to increase the productivity for the units of effort in northern lakes is to improve the environmental conditions. These improvements can be achieved by fishery management at these lakes. Selection of appropriate method of management depends on the character of trophic relations in the ecosystem, on the character of the given water body, and the existing of socioeconomic relations.

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