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DATA SOURCES AND STATISTICAL METHODS USED TO EVALUATE THE EASTERN HARBOUR FISHING ACTIVITIES IN ALEXANDRIA, EGYPT.

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ABSTRACT

According to the recorded data which were collected by total enumeration and data of sampling method about boats landed at the Eastern-harbour, the annual fish catch of about 5000 ton was estimated in 1993 by the former in comparison to about 7000 tons obtained by the later.

From both the general and special raising factor nearly the same catch of about 660 tons/month from this center is obtained, but depending on the special factors more accurate figure is obtained. Classification of boats according to their fishing method, and from the mean catch (Y_i) of each category (method 2) monthly catch of about 660 tons was estimated (C.V. 15 %), while from the mean monthly catch (R) of all boats (method 3), the same catch of 660 tons is obtained with the highest degree of precision (C.V. 4%). Using the proportional size of boats (P_i) in different groups (method 4), gives the catch of 456 tons with the lowest degree of precision (C.V. 20 %). Sampling method of data collection, with the method of special raising factor or method 2, are recommended to be the acceptable for the Eastern-harbour fish catch estimate

INTRODUCTION

Reliable data about fishing craft, tackle and manpower, disposal of catch, market prices and data for studying catch effort relationship represent an essential basis for the Egyptian fisheries efficient exploitation and development. These data are used by the government and policy makers for long-term planning, also help fishery administrators, economists, statisticians and research workers for better recognition of these fisheries potentialities.

Data covering all aspects of the Egyptian fisheries are published by three official authorities, namely; National Institute of Oceanography and Fisheries (NIOF), General Authority of Fishery Resources Development (GAFRD) and Central Agency of Public Mobilization and Statistics (CAPMS).

According to the statistical method of stratified random sampling which had been adopted by Panse and Sastry 1957 the Egyptian national fish catch by NIOF was estimated. This catch by GAFRD was obtained, based on data of tax collectors using total enumeration method. The estimated figure of the country catch given by CAPMS mostly dependent on the previously mentioned two methods, however sometimes it gives for the country catch an estimates of its own.

Some years ago, three different figures for the Egyptian fish yield had been given in fishery reports published by these authorities. This is because each has its own method of data collection and depend on different methods to estimate this catch.

It is aimed in the present study to evaluate methods used to collect basic statistical data about boats landed at Alexandria Eastern-harbour and to compare efficiency of some suggested methods to estimate its catch.

MATERIAL AND METHODS

Alexandria Eastern-harbour was chosen to carry out this study. Its annual production in 1993 was estimated by one method while data used were collected from two different sources. Some methods for this center catch estimation are suggested, and compared to recommend the suitable one with acceptable degree of precision.

I : Effect of data collection methods of the estimated catch :

Two days are randomly selected each week for visiting this center. Data needed are collected from the fishermen, boats owners by our personal observation and direct contact also from registered data of GAFRD surveyors of total enumeration.

These data are :

1- Number of landed boats
2- Fishing methods
3- Motor powers (horse).
4- Average number of fishing trips/year/boat.
5- Mean catch per fishing trip/boat.
6- Length of fishing trip (days).
7- Fishermen per boat/trip.
8- Total monthly landed boats of different fishing methods and boats of different power.

According to their motor powers Boats are classified into:-

Group I : With motor power of less than 50 horse.
Group II : of motor power from 50-100 horse.
Group III : with motor power of 100-150 horse.
Group IV : with motor power of 150-200 horse.
Group V : with motor power more than 200 horse.

For each groups, annual catch was estimated separately based on mean catch per fishing trip/boat multiplied by the annual fishing trips obtained for these groups. (N.B. annual fishing trips = annual landed boats X average fishing trips/year).

Annual catch for the Eastern-harbour in 1993 was estimated by the two types of collected data from :

$$\hat{Y}_{est} = \hat{Y}_{I} + \hat{Y}_{II} + \ldots\ldots\ldots\ldots + \hat{Y}_{IV}$$

II : Efficiency of some statistical methods of catch estimation:

Four methods are used to estimate monthly catch of this center. The month of June 1993 where boats of different fishing methods are represented with a considerable number was chosen for this purpose.

According to fishing methods, boats landed on sampling days are classified into five groups of trawling, purse-seining, Sardine gill net, trammel net and long-lining boats. For each group, data of monthly landed boats (N_i), boats landed on sampling days (n_i) and their catch (Y) were collected. From which monthly catch of the Eastern-harbour was estimated by the following methods:

Method 1: Estimated catch by two different raising factors :

Monthly Catch of each category was monthly estimated from the formula of :

$$\hat{Y}_i = \bar{Y}_i \cdot R$$

where:

$\hat{Y}_i$ = The estimated monthly catch of i^{th} group.
$\bar{Y}_i$ = Recorded catch of landed boat of i^{th} boats group at sampling days.
R = Catch estimation raising factor, obtained by :

A : General Raising Factor (R) :

It is calculated as a ratio, all monthly landed boats (Σ N), and boats at selected sampling days (Σn) of all categories i.e. $R = \Sigma N / \Sigma n$

B : Special Raising Factor (R_i):

For each group, a special raising factors (R_i) was obtained from monthly landed boats (N_i) and boats of sampling days (n_i) i.e. $R_i = N_i / n_i$ for i^{th} group.

Monthly total was obtained from catch of these groups based on the two raising factors where

$$\hat{Y}_{est} = \sum_i \hat{Y}_i$$

Method 2 : Catch estimation based on boat groups mean catch :

From number of landed boats on sampling days (n_i) and their catch (Y_i), the mean catch ($\bar{Y}_i$) was obtained ($\bar{Y}_i = Y_i / n_i$). By this mean and according to monthly landed boat of each group (N_i), monthly catch for each was estimated as $\hat{Y}_i = \bar{Y} n_i$ while the monthly catch was given by :

$$\hat{Y}_{est} = \sum_i^n \hat{Y}i = \sum N_i \cdot \bar{Y}_i$$

The efficiency of this method was calculated from :

i : Variance of the estimated catch :

$$\hat{V}(Y_{est}) = \sum_{I}^{n} N_i^2 (1/ni - 1/Ni) Si^2$$

$$Si^2 = 1/ni \{ \sum_{i}^{n} Yi^2 - Yi^2/ni \}$$

ii : Standard error :

$$\hat{S}(Y_{est}) = \sqrt{\hat{V}(Y_{est})}$$

iii : Coefficient of variation of the estimated catch :

$$\hat{C.V.}(Y_{est}) = \hat{S}(Y_{est}) / \hat{(Y_{est})}$$

Method 3 : <u>Catch estimation using the mean catch calculated for all boats landed at sampling days</u> :

Using number of boats of all categories landed at the selected sampling days ($\sum X$) and their catch ($\sum Y$), the general mean catch R was obtained. From the monthly total landed boats (N) and by this R mean value, monthly catch of this center was estimated by :

$$\hat{Y}_{est} = N . R$$

It is important to mention that by this method, monthly catch could be estimated using time stratification, where boats are presented by their number and catch recorded on sampling days. No consideration has given to their fishing methods. Also, to obtain the coefficient of variation for the estimated catch the correlation coefficient (r) value between landed boats (x) and their catch (Y) was given from :

$$r = S^2 x y / SX^2 * Sy^2$$

the coefficient of variation of the catch estimated by this method was obtained as follow :

i : Variance of the estimated catch: (caddy and Bazigos 1985)

$$V(\hat{Y}_{est}) = [Sy^2 + R2 \quad Sx^2 - 2R\, S_x\, S_y\, r]$$

ii : Standard error of the estimated catch:

$$S(\hat{Y}_{est}) = V \sqrt{(\hat{Y}_{est})}$$

iii : Coefficient of variation :

$$C.V.(\hat{Y}est) = S(\hat{Y}_{est}) / (\hat{Y}_{est})$$

Method 4: Catch estimated based on the proportional size of boats in different groups:

Depending on number of landed boats, grouped by their fishing methods or days of landing (X_i) their proportional size (P_i) in relation to monthly landed boats (N) are obtained as $P_i = X_i / N$.

From (Pi) values and data of their catch (Y_i) a relative catch (t) for each was calculated from $t_i = Y_i / P_i$. Monthly catch for the investigated center is estimated as an average from

$$Y_{est} = \sum_{+}^{n} ti/n$$

Coefficient of variation of the estimated catch by this method was given from.

i : Variance of the estimated catch:

$$V(\hat{Y}est) = 1/(n-1)\,[ti^2 - (\sum ti)^2 / n]$$

ii : Standard error :

$$S(\hat{Y}_{est}) = \sqrt{V(Y_{est})}$$

iii : Coefficient of variation :

$$C.V.(\hat{Y}_{est}) = S(\hat{Y}_{est}) / \hat{Y}_{est})$$

RESULTS AND DISCUSSION

I : <u>Effect of data collection method on the estimated catch</u> :

The control of marine fisheries is exercised by coast guard units located at various point along the coast, which are divided into section forming the jurisdiction of each unit. Fishermen are required to land their catches at certain specified landing centers. Soldiers on duty at these centers are responsible for issuing permits to every out-going fishing boat, they maintain a record which shows the data and time of arrival of every incoming boat and of departure of each out-going boat. (Panse and Sastry 1967).

From this department registration, accurate statistics of total monthly landed boats, number of fishermen, boats motor power, length of fishing trip, and average fishing trips per boat are collected. Two different figures about number of landed boats, their mean catch per fishing trip and average fishing trip per boat/year are obtained in this study depending on methods used for these data collection as shown in table (1). According to total enumeration data, the mean numbers of 66 trips/y, 70 trips/y, 54 trips/y, 52 trips/y and 50 trips/y are collected for boats in groups I, II, III, IV and V respectively, which give the annual fishing trips of 25212/y, 2590/y. 1350/y, 1040/y and 2200/y based on annual landed boats. The mean catches of 42 kg/trip, 715 kg/trip, 510 kg/trip. 548 kg/trip and 644 kg/trips for groups I, II, III, IV and V respectively are obtained to give on base of these groups annual trips the catches of 1059 tons, 1593 tons, 689 tons, 570 tons and 1417 tons, from which the total annual catch of 5027 tons was estimated for the Eastern-harbour in 1993.

From data collected at sampling days, the higher average of 78 trips/y, 86 trips/y, 59 trips/y, 56 trips/y and 55 trips/y were obtained to give for boats in group I, II, III, IV and V the annual fishing trips of 29796, 2992, 1475, 1420 and 2420 respectively. For these groups, the mean catches of 60 kg/trip, 525 kg/trip, 615 kg/trip 675 kg/trip and 850 kg/trip are obtained, gives on base of the annual fishing trips, catches of 1788 tons/y, 1571 tons/y, 716 tons/y, 959 tons/y and 2057 tons/y, from which annual catch of 7190 tons for the Eastern-harbour was obtained.

Table (1): Annual Fish Catch (tons) of the Eastern-harbour in 1993 estimated from data of sampling and total enumeration methods.

Groups	Boats Motor powers (horse)	Boats numbers	Fishermen per boats	Average length of trip (days)	Method of data collection	Mean fishing trips/ year	Annual fishing trips	Mean Catch per trip (Kg)	Annual estimated catch	
									Method I	Method II
I	< 50	382	5	2	I	66	25212	42	1058	
					II	78	29796	60		1787.8
II	50-100	37	20	3	I	70	2590	715	1592.9	
					II	86	2992	252		1570.8
III	100-150	25	20	3	I	54	1350	510	688.5	
					II	59	1475	615		815.7
IV	150-200	20	20	3	I	52	1040	548	569.9	
					II	56	1420	675		958.5
V	> 200	4	20	5	I	50	2200	644	1416.8	
					II	55	2420	850		2057.0
Total Catch									5027.0	7190.0

I : Total enumeration. II : Sampling method.

Easter-harbour was considered to represent one of the major fish landing center along the Egyptian Mediterranean Sea coast which is characterized by its high fishing activities, received daily a considerable number of boats. Data about these boats are collected by a limited number of surveyors, carrying out their work without regular supervision or field forces in addition to insufficient attention given by them to this statistical work. So data by them are collected through total enumeration not cover all landed boats and for the surveyed ones low figures for their production are recorded.

In comparison, due to the operational convenience of which sampling method provides to insure reliability of the collected data, as it has the properties to provide an adequate chance to collect the necessary data covering all units landed on days of sampling with a considerable degree of accuracy, also it gives facilities for field work organization and supervision regulation.

II : Efficiency of some statistical methods of catch estimation :

Method 1: Catch estimation based on two different raising factors :

As shown in table (2), from the monthly landed units (N=469) and those recorded at sampling days (n=111), a general raising factor with the value of 4.2 was obtained. Based on the monthly catches of about 391 tons, 227 tons, 16 tons and 8 tons are estimated for trawling, purse seining, sardine gill net, trammel net and longlining boat groups respectively that finally gives the total of 656 tons in June 1993.

On the other side, for the previously mentioned groups, the special raising factors of 3.711, 5.039, 5.273, 3.056 and 5.273 are obtained. Based on, the catches of 345.1 tons, 271.8 tons, 17.5 tons, 11.9 tons and 10.4 tons are monthly estimated for trawling, purse-seining, sardine gill net trammel net and long-lining boat groups respectively. The estimated figures given by these special raising factor are noticed to be different from those of the general one, but nearly the same catch of about 657 tons by both in June 1993 was obtained. By the special raising factors which represent an actual ratio between landed units and those recorded on sampling days for the given categories, a considerable more accurate catches for these groups are estimated.

Method 2 : Estimated catch based on boat groups mean catch :-

As shown in Table (3), based on landed boat numbers (n_i) and the catch (Y) recorded for trawling, purse-seining, sardine gill net, trammel net and long-lining groups, a monthly mean catch (Y_i) of 2.07 tons, 2.0 tons, 0.3 tons, 0.22 tons and 0.18

Table (2) : Estimated monthly fish catch based on two raising factors.

Fishing	Monthly landed boats	Sampling boats		Monthly estimated catch			
	N	n	y (tonns)	$\overset{*}{Ri}$ G.R.F	$\hat{Y}$	$\overset{*}{R2}$ G.R.F	$\hat{Y}$
Trawling	167	45	92.99	4.2	390.558	3.711	345.096
Persesining	131	26	53.95	4.2	226.590	5.039	271.827
Trammel net	58	11	3.32	4.2	13.944	5.273	17.505
Sardine gill net	55	18	3.89	4.2	16.398	3.056	11.886
Long-lining	58	11	1.98	4.2	8.316	5.273	10.440
	469	111	156.13		655.746		656.754

R_1 : General Raising Factor = N/n. R_2 : Specific Raising Factor = Nl/nl.

Table (3): Estimated monthly catch obtained by method 2, based on mean monthly catch of different boat groups.

Fishing Boats	Monthly landed boats	Boats in sampling days			Estimated Catch (tons)	$S_i^2 = N_i^2(1/n_i - 1/N_i^2)$	$N_i^2 = (1/n_i - 1/N_i) S_i^2$	
		Number	Catch	Mean Catch				
	N_i	n_i	Y_i	$\bar{Y}_i$	N, Y (Y)			
Trawling	167	45	92.99	2.07	345.69	46.10	3.35	154.30
Persesining	131	26	53.95	2.08	272.48	214.32	46.68	10004.01
Trammel net	58	11	3.32	0.30	17.40	0.10	235.48	23.55
Sardine gill net	55	18	3.89	0.22	12.10	0.12	121.00	14.52
Long-lining	58	11	1.98	0.18	10.44	0.25	235.48	58.57
	469	111	156.13		658.11			10255.25

$\hat{V}(\bar{Y}_{est}) = 10255.25$ $\hat{S}(\bar{Y}_{est}) = 101.268$ $\hat{C.V}(\bar{Y}_{est}) = 0.15$

tons are respectively obtained. Depending on these means ($\bar{Y}_i$) and monthly landed boats of each (N_i), catches of 345.69 tons, 272.48 tons, 17.4 tons, 12.1 tons and 10.44 tons trawling, purse-seining, sardine gill net, trammel net and long-lining boat groups are respectively obtained to gives finally the catch of 658 tons in June 1993 with the coefficient of variation value of 15 %.

Method 3 : Estimated catch based on the mean catch (R) extracted generally from all monthly landed boats :

As given in table (4), from the catch of 156.13 tons ($\sum Y_i$) recorded for the landed N_i=111 units on sampling days, the monthly mean catch (R) of 1.14 tons/boat was obtained. It is used in this method with the total monthly landed boat (N) of 469 units to estimate catch of the Eastern-harbour in June 1993 by the formula ($\hat{Y} = R.N$) to give the catch of 660 tons with coefficient of variation value of 4 %.

Using this method, but depending on boats presentation according to their numbers on sampling days (table 5) and follow the above computational method the catch of 660 tons was obtained but with less coefficient of variation value of 19 %.

Classification of boats according to their fishing method give the higher correlation coefficient (r) value of 0.89 between boat of these groups and their catch, while the less (r) value of 0.22 was obtained when fishing methods are neglected.

Method 4 : Estimation Catch based on the proportional size of boats in different groups :

Table (6), showed that from trawling, purse-seining, sardine gill net, trammel net and long-lining groups the units (n_i) of 45, 26, 11,18 and 11 are landed at the selected sampling days. They found to represent respectively according to the total (N_i) of 469 units the proportion (P_i) of 0.096, 0.055, 0.023, 0.038 and 0.023 where ($P_i = n_i/N$). From these groups catch (Y_i) and the proportional size of each (P_i), the relative catch (t_i) are obtained to give the total ($\sum t_i$) of about 2283.367 tons ($t_i = Y_i/P_i$), which is divided on these groups numbers ($n_i = 5$) to give the catch of 456.67 tons/month with coefficient of variation value of about 20 %.

Presentation of boats according to their number landed on sampling days (7 days) reduced the proportional size of each as illustrated in table (7), consequently the higher relative total catch of 4732.99 tons was obtained, that found to give for the Eastern-harbour the monthly higher catch of 676.14 tons in June 1993 with the lowest coefficient of variation value of 23 %.

Table (4): Estimated monthly catch by method 3, based on the general mean catch (R) calculated from the recorded sampled boats.

Fishing Boats	Recorded landing boats		X^2	Y^2	X Y
	Number X	Catch (tonns) Y			
Trawling	45	92.99	2025	8647.14	4184.55
Persesining	26	53.95	676	2910.60	1662.70
Trammel net	11	3.32	121	11.02	36.52
Sardine gill net	18	3.89	324	15.13	70.02
Long-lining	11	1.98	121	3.92	21.78
	111	156.13	3267	11587.81	5775.57

$\hat{N}$ = 469 R = 156.13/111 = 1.407 $\hat{Y}$ = N R = 659.68 tonns r = 0.86

$\hat{V}(Y_{est})$ = 853.027 $St(\hat{Y}_{est})$ = 29.20 C.V ($\hat{Y}$) = 0.04

Table (5): Estimated monthly catch by method 3, and boats are presented according to their number at sampling days.

Sampling days	Landed Boats		X^2	Y^2	X Y
	Number X	Catch (tonns) Y			
1	16	24.83	256	616.53	397.28
2	12	11.46	144	131.33	137.52
3	9	11.7	81	138.06	105.75
4	16	17.31	256	299.64	276.96
5	20	29.27	400	856.73	585.40
6	15	45.73	225	2091.23	685.95
7	23	15.75	529	248.06	362.25
	111	156.13	1891	4381.587	2551.11

$\hat{N}$ = 469 $\hat{R}$ = 1.406 $\hat{Y}$ = N R = 659.68 tonns $\hat{r}$ = 0.22

$\hat{V}(Y)$ = 15515.9 $St(\hat{Y})$ = 124.56 C.V ($\hat{Y}$) = 0.19

Table (6): Eastimated monthly catch by method 4, using proportional size of boats in different groups.

Fishing Boats	Sampled Boats		$P_i = X_i/n$	$t_i = y_i/p_i$	t_i^2
	Number X_i	Catch (tonns) Y_i	N=469	N=469	
Trawling	45	92.99	0.0959	969.655	940232.548
Persesining	26	53.95	0.0550	980.909	962182.645
Trammel net	11	3.32	0.0230	144.348	20836.295
Sardine gill net	18	3.89	0.0380	102.368	10479.294
Long-lining	11	1.98	0.0230	86.087	7410.964
	111			2283.367	1941139.808

$Y = (1/n) * t_i = 2283.367/5 = 456.67$ tons V (Y) = 8093.575

St.er. (Y) = 89.964 C.V (Y) = 0.197 = 0.02

Table (7): Estimated monthly catch by method 4, based on proportional size of boats presented according to sampling days.

Fishing Days	Sampled Boats		$P_i = X_i/n$	$t_i = y_i/p_i$	t_i^2
	Number X_i	Catch (tonns) Y_i	N=469		
1	16	24.83	0.0341	728.152	53006.052
2	12	11.46	0.0256	447.656	200396.118
3	9	11.7	0.0192	611.979	374518.500
4	16	17.31	0.0341	507.625	257682.768
5	20	29.27	0.0426	687.089	472091.571
6	15	45.73	0.0320	1429.063	2042219.628
7	23	15.75	0.0490	321.429	103316.327
	111	156.13		4732.993	39980430.964

$\hat{Y} = (1/n) * t_i = 42732.993/7 = 676.14$ $\hat{V}$ (Y) = 2169.558

St.er. (Y) = 158.65 C.V (Y) = 0.23

classification of boats into seven groups according to sampling days instead of five, reduce the proportional size and so increase the relative catch of groups and finally the estimated catch, but decreased the coefficient of variation values.

CONCLUSION

Data about the Egyptian marine fisheries are collected by total enumeration as well as by sampling method, however each have not able to compile any reliable detailed information about their potentialities.

Results of the present study showed that due to manpower limitation lack of supervision and field forces in addition to insufficient attention given by some data collector, it is so difficult to collect the necessary data covering all fisheries aspects of landed boats by total enumeration method.

Underestimated catch for the investigated center by these data is obtained in comparison to that from data collected by our personal observation on a selected sampling days.

Due to the operational characteristics of sampling technique, which provide an adequate chance for field work organization and supervision regulation in addition it provides the limited number of data collector with the advantages to collect data only on the selected sampling days, so from our view this method could be successfully used, but for these collectors, training, field forces, equipments and financial encouragement are important.

Dealing with the compared methods of catch estimation it is clearly found that depending on both general and special raising factors, the same monthly catch for the investigated center was obtained. But it is reasonable to depend on the special factors to estimate this catch which represent the actual figure of different boats categories. About the other three methods it is clearly noticed that by method 2 where catch was estimated based on the mean catch obtained for each group of boats and method 3 by which the catch is obtained from the general monthly mean catch from all landed boats the same monthly catch was obtained. However, the coefficient of variation values estimated for these two methods (15 % for method 2) and (4 % for method 3) gives a clear indication that method 3 being more efficient than method 2. But from the fisheries and economical point of view due to the valuable information gathered for each group of boat categories by method 2 it is preferable to depend.

Among the four methods of catch estimation used in this work method 4 which depend on the proportional size of landed boats is the less efficient one, showed under or over estimated catch based on boats classification but with a reduced degrees of precision (C.V. 20 % and C.V. 23 %).

REFERENCES

Caddy, J.F. and Bazigos, G.P., 1985. "Practical guideline for statistical monitoring of fisheries in manpower limited situation" FAO. Fish. Tech. Paper 257, Rome, 1985.

El-Feky, A., 1986. "A review of Egyptian Medi. Fisheries". Report of technical consultation of stock assessment in the Eastern Med. FAO, Rome FIPL, R. 361.

Panse, V.G. and Sastry, K.V.R., 1962. "Sample survey for fishery stat. techn. rep. to the gov. of U.A.R.", Rome, No. 1247.

Thomas, G.H., 1988. "A comparative study between statistical design of catch estimation" Bull. High. Inst. of P.H. Vol. XVIII. No. 5.

Thomas, G.H., 1989. "Monthly estimated catch by class I boats in relation to sampling days and type of landed boats" Bull. High. Inst. P.H. Vol. XIX, No. 2.