TD/SP/4

December 1983

CATCH-EFFORT ANALYSIS BASED ON TOTAL CATCH AND CPUE OF STANDARD GEAR

(A Microcomputer Program)

Shigeaki Shindo

Training Department
Southeast Asian Fisheries Development Center

Special Publication No.4
December 1983

CATCH-EFFORT ANALYSIS
BASED ON
TOTAL CATCH AND CPUE OF STANDARD GEAR

(A Microcomputer Program)

Shigeaki Shindo

Training Department
Southeast Asian Fisheries Development Center

CONTENTS

1. INTRODUCTION

The present paper is a sequel to "*Catch-effort Analysis* using a microcomputer program" which was published by the SEAFDEC Training Department as the Special Publication No.1 (TD/SP/1) in May 1983. In the present paper, the author introduces another program for the microcomputer which can be applied to analyze the status of fish stocks as well as its annual changes, using the total catch by various gears and CPUE of standard gear. With this program, several important factors of fishing operation and parameters of fish stock can be calculated and tabulated, and seven graphs are generated for quick and easy understanding of the situation under study.

The theoretical background and the meaning of each parameter, such as the stock density/size indexes, effective effort and effectiveness of effort, etc., have already been explained in the above-mentioned publication (TD/SP/1), and will not be explained again here.

The difference between the earlier programs (600-A and 600-B) and the program 610 introduced here, is that the former deal with each gear separately, whereas the latter handles the problem of the total catch by various gears and the status of stocks not in relation to individual gears, but in the aggregate.

2. MATHEMATICAL FORMULAE

(1) Total catch (in metric tons) ..... $C = \Sigma Ci$
where, Ci denotes catch in Area i. In the present case, total catch denotes the entire catch by various gears (the sum of catches by all gears).

(2) Total effort (in days) ..... $X = \Sigma Xi$
where, Xi denotes effort in Area i. Effort here means not the effort actually expended, but the estimated effort obtained by using the formula EFFORT = CATCH/standard CPUE (by respective Areas). In order to avoid confusion of terms, the following symbols for effort have been used in tables generated by computer;

X1 ..... total effort of respective gears (in the earlier paper TD/SP/1).

X2 ..... effective effort of respective gears (in TD/SP/1).

X3 ..... effort of standard gear by area (in the present paper).

X4 ..... total effort estimated above-mentioned formulae (in the present paper).

X5 ..... effective effort of overal gears using X4 (in the present paper).

(3) Simple CPUE[1] ..... $\Sigma Ci/\Sigma Xi$

(4) Stock density index[2] ..... $\phi = \{\Sigma(Ci/\Sigma Xi)\cdot Ai\}/A$
where Ai is the extent of area i, $A = \Sigma Ai$

(5) Stock size index ..... $N = \Sigma(Ci/\Sigma Xi)\cdot Ai$

(6) Effectiveness of effort ..... $r = \text{CPUE}/\phi$

(7) Effective effort ..... $\tilde{X} = X\cdot r$

---

[1] (d) in computer-generated tables.

[2] (phi) in computer-generated tables.

3. COMPUTER PROGRAM No.610

3.1 Outline

The microcomputer used here is a SHARP-1500 with accessories of 8K RAM Module (CE-155) and Print/Cassette Interface (CE-152).

The program line number 10 (see 3.6 Program list on page 20) displays the title of the present program on the screen within a few seconds. Lines 20 to 40 show the initial year and the number of years of data. The size of each area (in square kilometers) as well as the catch and CPUE data are given in lines 50 to 100. Lines 104 to 140 are the statements which generate year columns attached to Tables 1 and 2. Similarly, lines 150 to 240 contain statements which make Table 1, and 250 to 480 are those for Table 2. After line number 500, the computer generates seven graphs as shown in 3.3 Printout on page 12.

A sub-program (sub-routine) with computations of maximum value of curves in graphs and graduations attached to Y-axes of graphs occupies line numbers from 510 to 1020. This includes a sub-sub-routine program from 1000 to 1020. The total number of bytes of the program is 4570.

3.2 Key operation procedure

STEP	KEYSTROKE	DISPLAY (Screen)
0	ON	>
1	DEF A	* CATCH-EFFORT by ST. CPUE * PEN SELECT (0 - 3) = ?_
2	2 ENTER	No. of YEARs (6 - 10) =?_
3	6	Initial YEAR = ?_
4	1976	No. of AREAs (6 - 10) = ?_
5	6	No. of YEAR Columns =?_
6	3	KM^2 AREA (1) = ?_
7	63500 (Repeat)	KM^2 AREA (2) = ?_ (Repeat)

	Remarks
	Make sure that the prompt charactor ">" is on the screen; this means that the computer is ready for operation.
	Beep. The program title is displayed on the screen for about five seconds. The four small boxes for pen selection are printed out on paper. After that, the computer requests the required pen number.
	If you select pen number 2, press 2 and key marked ENTER (N.B. : the ENTER key must be pressed after every step in operation. This instruction will therefore be omitted from now on). The computer asks number of years in your data. Input it by keystroke. The number of years should be between six and ten.
	Beep. The computer asks the initial year of your data. If the initial year is 1976, type 1976.
	Beep. The computer asks the number of statistical areas. If the number of areas is six, press 6. The number of areas should be between six and ten.
	Beep. The computer asks the number of YEAR columns. (ref. Tables 1 and 2). If you want to have three columns, press 3. (The number of columns depends on the layout of the tables).
	Beep. The computer asks the area (in square kilometers) of AREA 1. (^ indicates the exponent, so KM^2 means km^2). If the size of AREA 1 is 63,500 km^2, type 63500.
	Beep. The computer requests the size of AREA 2. The same procedure is repeated until AREA 6. After that, the computer calculates the total area and prints out "TOTAL AREA (SQ.KM) = 593806" on the paper.

STEP	KEYSTROKE	DISPLAY (Screen)
8 and 9	1 (or 2)	AREA ADJUST. (Yes = 1 : NO = 2) = ? T. AREA (Yr. 1) = ? (Repeat)
10	93682 1103.7 (Repeat)	CATCH (Yr 1, Ae 1) CPUE (Yr 1, Ae 1) (Repeat)
/	PRINTING (Tables)	
11		MAX/10^? = INT (Dig. 1-3) : = ?_

	Remarks
	If there is no fishing effort (i.e. no fishing operation) in some AREA, subtract this AREA from the total area (in km^2) which was printed out on paper in step 7, and input the remainder (figure in km^2) for the first year. The same procedure has to be repeated up to the last year. To indicate that an adjustment is necessary, press 1 (adjustment is necessary, that is, Yes = 1). If fishing operation covers all AREAs, and adjustment is not necessary, press 2 (adjustment is not necessary, that is, NO = 2).
	After step 9, the computer plays a tune (sound); the input catch (in M/T) and standard CPUE (in kg) data, according to the instructions, are displayed on the screen. For example, (Yr 1, Ae 1) denotes first year and AREA 1. A beep is inserted "between years" and a different sound (beep) is also inserted "between AREAs" in order to avoid key-in mistakes. The same procedure is to be repeated up to the last year and the last AREA. Then, a sound (beep) from the computer indicates that all data have been input.
	After several seconds, the computer start to print out YEAR columns and tables.
	Beep. The computer prints out "TOTAL CATCH IN M/T" in small size characters (CSIZE 1) and figure of maximum total (annual) catch during the period under study (1976 to 1981) as shown on page 12 that is, 1167280. Then, the computer displays "MAX/10^ ? = INT (Dig. 1-3) : = ? " on the screen. The integer part (INT) of the figure should be less than 3 digits in the graph, so, the figure should be devided by 10^4 = 10,000 or 10^5 = 100,000. In our example on page 12, the figure 1167280 was devided by 100,000 which was typed in. The result is 11.6728 which is also printed out as shown on the same page. (A more detailed explanation can be found in S. Shindo:"Catch-Effort Analysis Using a Microcomputer" published by TD/SEAFDEC, May 1983. See pp. 12-13, step 14 and 15).

STEP	KEYSTROKE	DISPLAY (Screen)
12	100000	Interval of Y-axis = ?_
13	2	MAX/10^? = INT (Dig. 1-3) : = ?_
14		>

	Remarks
	The computer requests interval of Y-axis. Now the figure is 11.6728. Carefully consider interval of Y-axis, that is, the number of horizontal dotted lines in the graph. (In our example, 2 is selected and key marked 2 is pressed).
	The computer generates the first graph. After beep, the computer prints out "EST. EFFORT in Days" and figure (maximum) 1305506 for the second graph. The same procedure of steps 11 and 12 will be repeated until the final graph.
	After all figures have been generated, "---- End ----" is printed out on the paper and the prompt mark ">" is also displayed on the left-hand side of the screen. This means that the computer work is finished (and ready for the next operation of this program).

3.3 Printout

□□□□

TOTAL AREA (SQ.KM)
= 593806

YEAR	
1	1976
2	1977
3	1978
4	1979
5	1980
6	1981
SUM/MEAN	

AREA 1

CATCH (C)	EFFORT (X3)
93682	84880
81717	64726
107709	127617
111012	137989
121145	140997
107709	127617
622974	683826

(63500 SQ.KM)

CPUE (d)	S.SIZE (d x A)
1103.7	70085
1262.5	80169
844.0	53594
804.5	51086
859.2	54559
844.0	53594
952.9	60514

AREA 2

CATCH (C)	EFFORT (X3)
244182	204713
189984	148379
0	0
369812	307894
369802	453968
350803	407721
1524583	1522675

(336245 SQ.KM)

CPUE (d)	S.SIZE (d x A)
1192.8	401073
1280.4	430528
0.0	0
1201.1	403864
814.6	273905
860.4	289305
891.5	299779

AREA 3

CATCH (C)	EFFORT (X3)
150049	349683
277149	655819
154197	249227
200372	247893
172828	206337
130520	167076
1085115	1876035

(46928 SQ.KM)

CPUE (d)	S.SIZE (d x A)
429.1	20137
422.6	19832
618.7	29034
808.3	37932
837.6	39307
781.2	36660
649.5	30483

AREA 4

CATCH (C)	EFFORT (X3)
194068	179178
0	0
0	0
158988	189226
153131	188075
152630	178140
658817	734619

(70315 SQ.KM)

CPUE (d)	S.SIZE (d x A)
1083.1	76158
0.0	0
0.0	0
840.2	59079
814.2	57250
856.8	60246
599.0	42122

AREA 5

CATCH (C)	EFFORT (X3)
112396	97676
144482	113213
96838	85132
106631	127595
103071	126903
120453	139948
683871	690467

(46618 SQ.KM)

CPUE (d)	S.SIZE (d x A)
1150.7	53643
1276.2	59494
1137.5	53028
835.7	38959
812.2	37863
860.7	40124
1012.1	47185

AREA 6

CATCH (C)	EFFORT (X3)
194065	179093
198713	156356
0	0
220465	194140
158988	189226
188099	231051
960330	949866

(30200 SQ.KM)

CPUE (d)	S.SIZE (d x A)
1083.6	32725
1270.9	38381
0.0	0
1135.6	34295
840.2	25374
814.1	24586
857.4	25893

TOTAL CATCH (C)	ESTIM. EFFORT (X4)
988442	1095223
892045	1138493
358744	461976
1167280	1204737
1078965	1305506
1050214	1251553
5535690	6457488

EFFECT EFFORT (X5)	SIZE INDEX (N)
897712	653821
842932	628404
1570324	135656
1108641	625214
1312205	488259
1236084	504515
6967898	505978

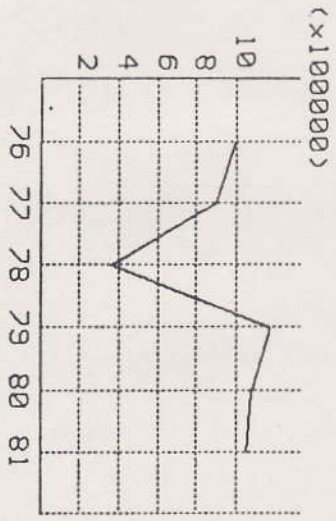
SIMPLE CPUE (d)	DENSITY INDEX (Phi)
902.5	1101.0
783.5	1058.2
776.5	228.4
968.9	1052.8
826.4	822.2
839.1	849.6
849.5	852.0

EFFECT IVNESS (r)
0.81
0.74
3.39
0.92
1.00
0.98

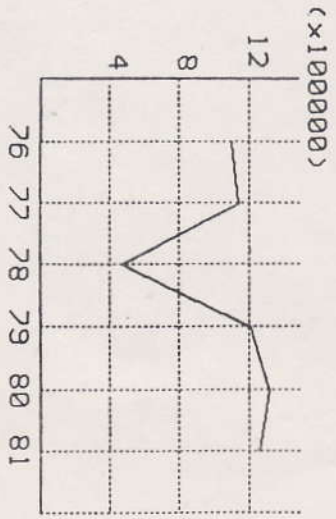
1.31

------GRAPH------

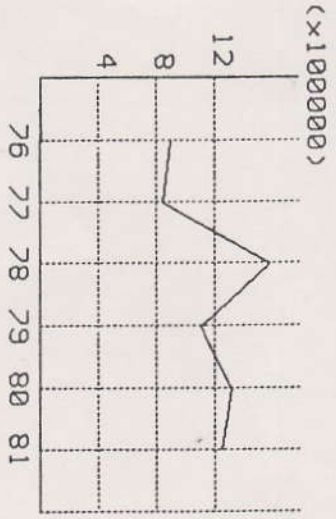
TOTAL CATCH IN M/T 1167280
11.6728



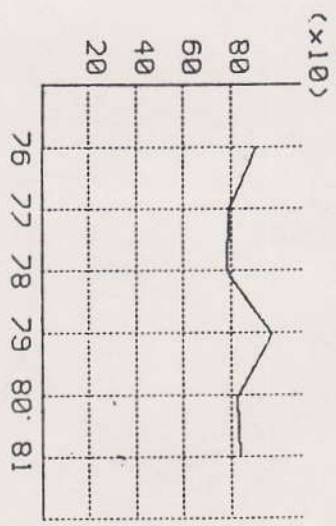
EST.EFFORT In Days 1305506
13.05506



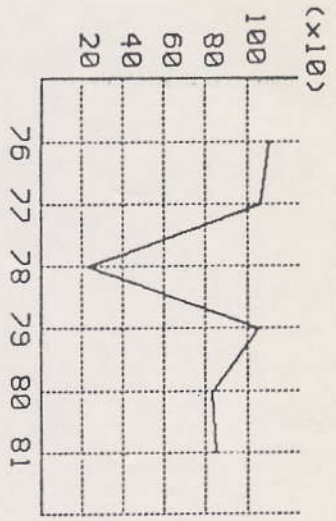
EFCT.EFF. 1570323.64
15.7032364



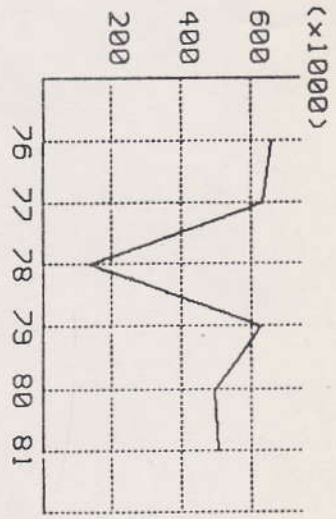
SIMPLE CPUE 968.9085668
96.89085668



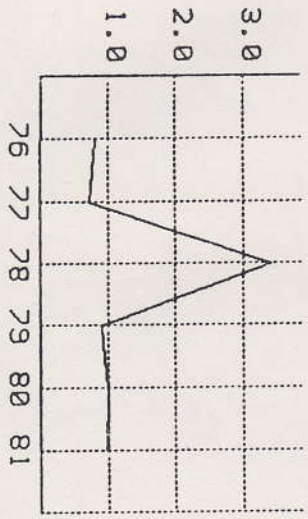
DENS.INDEX 1101.068396
110.1068396



SIZE INDEX 653821.0199
653.8210199



EFFECTIVENESS 3.399145496



--------End-------

3.4 Layout of tables and diagrams

Table 1. Table of seven parameters (1976-81)

	YEAR	TOTAL CATCH (C)	ESTIM. EFFORT (X4)	EFFECT. EFFORT (X5)	SIZE INDEX (N)	SIMPLE CPUE (d)	DENSITY INDEX (Phi)	EFFECTIVENESS (r)
1	1976	988442	1095223	897712	653821	902.5	1101.0	0.81
2	1977	892045	1138493	842932	628404	783.5	1058.2	0.74
3	1978	358744	461976	1570324	135656	776.5	228.4	3.39
4	1979	1167280	1204737	1108641	625214	968.9	1052.8	0.92
5	1980	1078965	1305506	1312205	488259	826.4	822.2	1.00
6	1981	1050214	1251553	1236084	504515	839.1	849.6	0.98
SUM/MEAN		5535690	6457488	6967898	505978	849.5	852.0	1.31

Table 2. Table of four parameters in each Area (1976-81)

	AREA 1 (63500 SQ.KM)				AREA 2 (336245 SQ.KM)				AREA 3 (46928 SQ.KM)			
YEAR	CATCH (C)	EFFORT (X3)	CPUE (d)	S.SIZE (d x A)	CATCH (C)	EFFORT (X3)	CPUE (d)	S.SIZE (d x A)	CATCH (C)	EFFORT (X3)	CPUE (d)	S.SIZE (d x A)
1 1976	93682	84880	1103.7	70085	244182	204713	1192.8	401073	150049	349683	429.1	20137
2 1977	81717	64726	1262.5	80169	189984	148379	1280.4	430528	277149	655819	422.6	19832
3 1978	107709	127617	844.0	53594	0	0	0.0	0	154197	249227	618.7	29034
4 1979	111012	137989	804.5	51086	369812	307894	1201.1	403864	200372	247893	808.3	37932
5 1980	121145	140997	859.2	54559	369802	453968	814.6	273905	172828	206337	837.6	39307
6 1981	107709	127617	844.0	53594	350803	407721	860.4	289305	130520	167076	781.2	36660
SUM/MEAN	622974	683826	952.9	60514	1524583	1522675	891.5	299779	1085115	1876035	649.5	30483

	AREA 4 (70315 SQ.KM)				AREA 5 (46618 SQ.KM)				AREA 6 (30200 SQ.KM)			
YEAR	CATCH (C)	EFFORT (X3)	CPUE (d)	S.SIZE (d x A)	CATCH (C)	EFFORT (X3)	CPUE (d)	S.SIZE (d x A)	CATCH (C)	EFFORT (X3)	CPUE (d)	S.SIZE (d x A)
1 1976	194068	179178	1083.1	76158	112396	97676	1150.7	53643	194065	179093	1083.6	32725
2 1977	0	0	0.0	0	144482	113213	1276.2	59494	198713	156356	1270.9	38381
3 1978	0	0	0.0	0	96838	85132	1137.5	53028	0	0	0.0	0
4 1979	158988	189226	840.2	59079	106631	127595	835.7	38959	220465	194140	1135.6	34295
5 1980	153131	188075	814.2	57250	103071	126903	812.2	37863	158988	189226	840.2	25374
6 1981	152630	178140	856.8	60246	120453	139948	860.7	40124	188099	231051	814.1	24586
SUM/MEAN	658817	734619	599.0	42122	683871	690467	1012.1	47135	960330	949866	857.4	25893

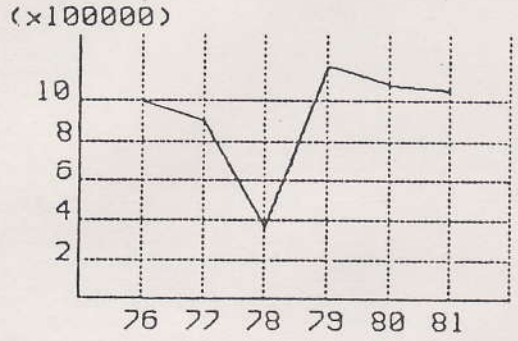


Fig. 1. Annual changes of total catch in metric tons.

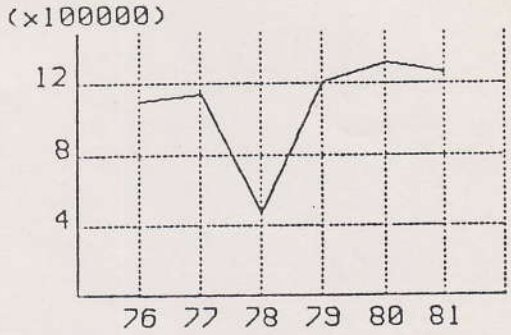


Fig. 2. Annual changes of estimated effort in days.

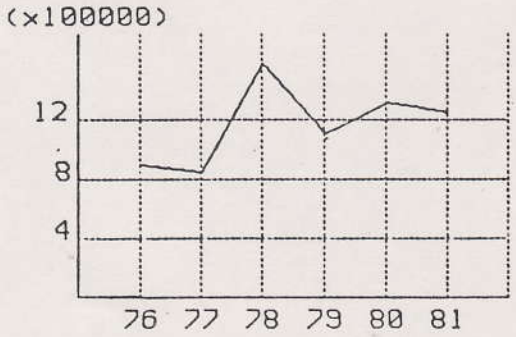


Fig. 3. Annual changes of effective effort in days

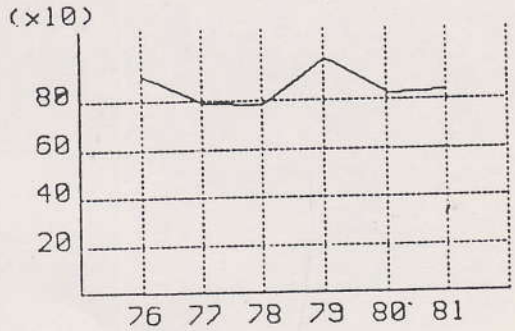


Fig. 4. Annual changes of simple CPUE in kilograms.

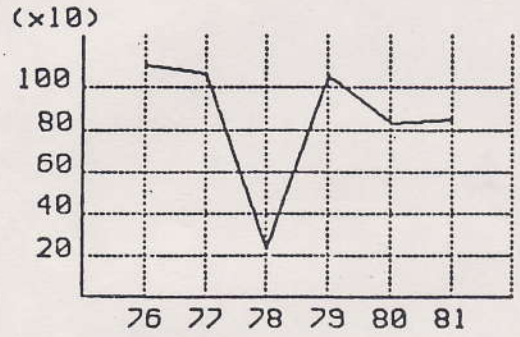


Fig. 5. Annual changes of stock density index in kilograms.

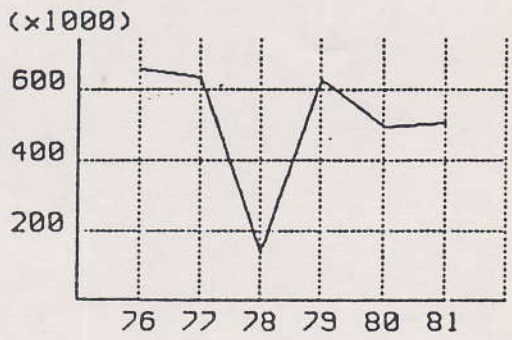


Fig. 6. Annual changes of stock size index in kilograms.

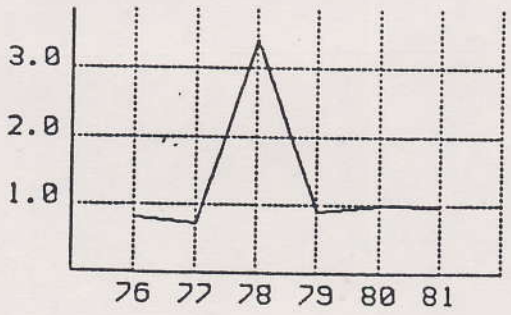


Fig. 7. Annual changes of effectiveness of fishing effort.

3.5 Memory contents

A	Number of years.	A$	KM^2 AREA (1 to D)
B	Initial year.	B$	CATCH (Yr 1 to A, Ae 1 to D).
C	Pen number.	C$	CPUE (Yr 1 to A, Ae 1 to D).
D	Number of Areas.	G$	T. AREA (1 to A).
E	Number of year columns.	L$	"(X" in the top of each graph.
G	Graduations of MAX in graphs.	M$	"R" in the top of each graph.
I	(Loop for AREAs)	N$	") " in the top of each graph.
J	(Loop for YEARs)	O$	L$ + M$ + N$
L	(Position of X-axis in graphs)	T$	"AREA" in the top line of Table 2.
N	(Loop related curves in graphs)	U$	Area number in the top line of Table 2.
Q	B-1901	V$	T$ + U$
R	Reduction factor of MAX in graphs	W$	X$ + Y$ + Z$
S	Sum of parameters, such as effective effort and size index throughout whole years.	X$	" (" in the top line of Table 2.
U	Years in year columns, Interval of graduation in Y-axis in graphs.	Y$	Area (in square kilometers) in the top line of Table 2.
V	(Position of X-axis in graphs.	Z$	" SQ KM) " in the top line of Table 2.
W	Year number in year columns and (Loop for years)		
Z	(Loop for keep, etc.)		

C(I)	Area in square kilometers of each Area.
TA	ΣC(I) = total area in square kilometers.
OO	Decision for adjustment of total area.
TA(I)	Adjusted total area.
A(I,J)	Catch data.
B(I,J)	CPUE data.
AA	SUM/MEAN in the bottom line of the Table 2.
BB	SUM/MEAN in the bottom line of the Table 2.
S1	Sum of parameters (total catch) of all years.
S2	Sum of parameters (estimated effort) of all years.
D(J)	S1
E(J)	S2
F(J)	S for Table 1. (effective effort)
G(J)	S for Table 1. (size index)
M(W)	Estimation of MAX in Y-axis in graphs.
MAX	Maximum graduation in Y-axis in graphs.
X(W)	Vertical position (X-axis) of graduations attached to Y-axis in graphs.

3.6 Program list

```
 3:REM  PROG.-610
 5:REM **********
   *CATCH-EFFORT*
   * ANALYSIS by*
   *STANDARD-CPUE
   **************
10:"A":CLEAR :
   BEEP 5,50:WAIT
   10:PRINT "* CA
   TCH-EFFORT by
   ST.CPUE*":BEEP
   3
20:TEST :INPUT "P
   EN SELECT(0-3)
   =?";C:COLOR C:
   BEEP 5
30:INPUT "No.of Y
   EARs(6-10)=?";
   A:BEEP 5:INPUT
   "Initial YEAR=
   ?";B:BEEP 5
40:INPUT "No.of A
   REAs(6-10)=?";
   D:BEEP 5:INPUT
   "No.of YEAR Co
   lumns=?";E
45:DIM A(D-1,A-1)
   ,B(D-1,A-1),C(
   D-1),D(A-1),E(
   A-1),F(A-1),G(
   A-1),M(A-1),X(
   15)
46:DIM TA(D-1)
50:BEEP 5:FOR I=0
   TO D-1:CLS :A$
   ="":CLS :A$="K
   M^2 AREA ("+
   STR$ (I+1)+")=
   ":PRINT A$;
55:INPUT C(I):
   PRINT C(I):
   BEEP 3:NEXT I
60:TA=0:FOR I=0TO
   D-1:TA=TA+C(I)
   :NEXT I:LPRINT
   "TOTAL AREA (S
   Q.KM)":LPRINT
   "=":LF -1:
   LPRINT TAB 1;T
   A
61:OO=0:LF 2:WAIT
   0:INPUT "AREA
   ADJUST(Yes=1:N
   o=2)=?";OO
63:IF OO=2GOTO 68
65:FOR I=0TO D-1:
   CLS :G$="":CLS
   :G$="T.AREA (Y
   r."+STR$ (I+1)
   +")=":PRINT G$
   ;
66:INPUT TA(I):
   PRINT TA(I):
   BEEP 4:NEXT I:
   GOTO 69
68:FOR I=0TO D-1:
   TA(I)=TA:NEXT
   I
69:FOR Z=50TO 1
   STEP -5:BEEP 1
   ,Z:NEXT Z:Z=0
70:WAIT 0:FOR I=0
   TO D-1:FOR J=0
   TO A-1
80:B$="":CLS :B$=
   "CATCH(Yr"+
   STR$ (J+1)+",A
   e"+STR$ (I+1)+
   ")="
83:PRINT B$;
85:INPUT A(I,J):
   CLS :PRINT A(I
   ,J)
90:C$="":CLS :C$=
   "CPUE(Yr"+STR$
   (J+1)+",Ar"+
   STR$ (I+1)+")=
   "
92:PRINT C$;
93:INPUT B(I,J):
   CLS
95:PRINT B(I,J):
   CLS :BEEP 3
100:NEXT J:BEEP 4:
   NEXT I:BEEP 6
102:REM **Yr Col**
104:FOR I=0TO D-1:
   FOR J=0TO A-1
105:IF B(I,J)=0LET
   B(I,J)=0.00000
   0000000001
106:NEXT J:NEXT I
110:FOR Z=0TO E-1:
   LPRINT "     Y
   EAR":LF 2:W=0:
   U=B-1
120:FOR J=0TO A-1:
   W=W+1:U=U+1:
   LPRINT TAB 2;W
   :LF -1:LPRINT
   TAB 5;U
130:IF J=4LF 1
135:IF J=8LPRINT
   TAB 1;W+1:LF -
   1:LPRINT TAB 5
   ;U+1:GOTO 140
137:NEXT J
140:W=0:U=B-1:LF 1
   :LPRINT "  SUM
   /MEAN":LF 3:
   NEXT Z
144:LPRINT "  ----
   ----------":
   LF 3
150:FOR I=0TO D-1
153:T$="
   AREA ":U$=STR$
   (I+1):U$=T$+U$
155:LPRINT U$:LF 1
160:LPRINT "   CAT
   CH    EFFORT":
   LPRINT "    (C
   )      (X3)":
   LF 1
170:FOR J=0TO A-1:
   USING "########
   #":LPRINT TAB
   1;A(I,J):LF -1
   :LPRINT TAB 9;
   INT (A(I,J)/B(
   I,J)*1000+0.5)
180:IF J=4LF 1
190:AA=AA+A(I,J):B
   B=BB+INT (A(I,
   J)/B(I,J)*1000
   +0.5):NEXT J:
   LF 1
192:LPRINT TAB 1;A
```

```
    A:LF -1:LPRINT
    TAB 9;BB:USING
    :LF 3:AA=0:BB=
    0
193:X$="  (":Y$=
    STR$ (C(I)):Z$
    =" SQ.KM)":W$=
    X$+Y$+Z$
195:LPRINT W$:LF 1
200:LPRINT "   CPU
    E     S.SIZE":
    LPRINT "    (d
    )    (d x A)":
    LF 1
205:FOR J=0TO A-1
210:USING "#######.
    #":LPRINT TAB
    1;B(I,J):LF -1
    :USING "#######
    ##":LPRINT INT
    (B(I,J)*C(I)/1
    000+0.5)
220:IF J=4LF 1
225:AA=AA+B(I,J):B
    B=BB+INT (B(I,
    J)*C(I)/1000+0
    .5)
227:NEXT J:LF 1
230:USING "#######.
    #":LPRINT TAB
    1;AA/A:LF -1:
    USING "########
    #":LPRINT BB/A
    :LF 3:AA=0:BB=
    0
240:NEXT I
250:LF 2:LPRINT "
     ------------
    ---  ":LF 1
260:LPRINT "   TOT
    AL    ESTIM.":
    LPRINT "   CAT
    CH    EFFORT":
    LPRINT "    (C
    )      (X4)":
    LF 1
270:FOR J=0TO A-1:
    FOR I=0TO D-1
280:S1=S1+A(I,J):D
    (J)=S1:S2=S2+
    INT ((A(I,J)/B
    (I,J)*1000+0.5
    )):E(J)=S2
285:NEXT I
290:USING "########
    #":LPRINT TAB
    1;D(J):LF -1:
    LPRINT TAB 9;E
    (J)
295:AA=AA+D(J):BB=
    BB+E(J)
300:IF J=4LF 1
305:S1=0:S2=0
310:NEXT J:LF 1
320:LPRINT TAB 1;A
    A:LF -1:LPRINT
    TAB 9;BB:AA=0:
    BB=0:LF 3
330:LPRINT "  EFFE
    CT.    SIZE":
    LPRINT "  EFFO
    RT    INDEX":
    LPRINT "   (X5
    )      (N)":LF
    1
340:FOR J=0TO A-1:
    FOR I=0TO D-1
350:S=S+B(I,J)*C(I
    )/TA(I):F(J)=S
    :NEXT I:S=0:
    NEXT J
360:FOR J=0TO A-1:
    FOR I=0TO D-1
370:S=S+B(I,J)*C(I
    )/1000:G(J)=S:
    NEXT I:S=0:
    NEXT J
380:FOR J=0TO A-1
385:IF J=5LF 1
390:CLS :USING "##
    ######":LPRINT
    TAB 1;INT ((D(
    J)/F(J)*1000+0
    .5)):LF -1:
    LPRINT TAB 9;
    INT (G(J)+0.5)
393:AA=AA+D(J)/F(J
    )*1000:BB=BB+G
    (J)
395:NEXT J:LF 1
400:LPRINT TAB 1;A
    A:LF -1:LPRINT
    TAB 9;BB/A:AA=
    0:BB=0:LF 3
410:LPRINT "   SIM
    PLE  DENSITY":
    LPRINT "    CP
    UE    INDEX":
    LPRINT "    (d
    )     (Phi)":
    LF 1
420:FOR J=0TO A-1
425:IF J=5LF 1
430:USING "#######.
    #":LPRINT TAB
    1;D(J)/E(J)*10
    00:LF -1:
    LPRINT TAB 9;F
    (J)
435:AA=AA+D(J)/E(J
    )*1000:BB=BB+F
    (J)
440:NEXT J:LF 1:
    LPRINT TAB 1;A
    A/A:LF -1:
    LPRINT TAB 9;B
    B/A:AA=0:BB=0:
    LF 3
450:LPRINT "  EFFE
    CT":LPRINT "
    IVNESS":LPRINT
    "    (r)":LF 1
455:FOR J=0TO A-1
456:IF J=5LF 1
460:USING "###.##"
    :LPRINT TAB 1;
    D(J)/E(J)*1000
    /F(J)
465:AA=AA+D(J)/E(J
    )*1000/F(J)
470:NEXT J:LF 1
480:LPRINT TAB 1;A
    A/A:AA=0:LF 3
500:LPRINT "------
    GRAPH------":
    LF 2:BEEP 10:
    USING
```

```
510:FOR W=0TO A-1:
    M(W)=D(W):NEXT
    W
515:BEEP 5:CSIZE 1
    :LPRINT "TOTAL
     CATCH IN M/T"
    :GOSUB 900
520:FOR W=0TO A-1:
    M(W)=E(W):NEXT
    W:USING
525:BEEP 5:CSIZE 1
    :LPRINT "EST.E
    FFORT in Days"
    :GOSUB 900
530:FOR W=0TO A-1:
    M(W)=D(W)/F(W)
    *1000:NEXT W:
    USING
535:BEEP 5:CSIZE 1
    :LPRINT "EFCT.
    EFF.":GOSUB 90
    0
540:FOR W=0TO A-1:
    M(W)=D(W)/E(W)
    *1000:NEXT W:
    USING
545:BEEP 5:CSIZE 1
    :LPRINT "SIMPL
    E CPUE":GOSUB
    900
550:FOR W=0TO A-1:
    M(W)=F(W):NEXT
    W:USING
555:BEEP 5:CSIZE 1
    :LPRINT "DENS.
    INDEX":GOSUB 9
    00
560:FOR W=0TO A-1:
    M(W)=G(W):NEXT
    W:USING
565:BEEP 5:CSIZE 1
    :LPRINT "SIZE
    INDEX":GOSUB 9
    00
570:FOR W=0TO A-1:
    M(W)=D(W)/E(W)
    *1000/F(W):
    NEXT W:USING
575:BEEP 5:CSIZE 1
    :LPRINT "EFFEC
    TIVENESS":
    GOSUB 900
580:LF 2:LPRINT "-
    -------End----
    ---":LF 4
590:END
900:FOR I=0TO D-1
902:IF MAX<=M(I)
    LET MAX=M(I)
904:NEXT I:CSIZE 2
    :LPRINT MAX
905:IF MAX<10LF 4:
    GOTO 920
906:INPUT "MAX/10^
    ?=INT(Dig.1-3)
    :?=";R:BEEP 3
908:FOR I=0TO D-1:
    M(I)=M(I)/R:
    NEXT I
910:L$="  (x":M$=
    STR$ R:N$=")":
    O$=L$+M$+N$
915:LPRINT MAX/R:
    LF 4
920:INPUT "Interva
    i of Y-axis=?"
    ;U
925:GRAPH :
    GLCURSOR (25,0
    ):SORGN :
    ROTATE 1
926:IF MAX<10LET R
    =1:GOTO 930
927:GLCURSOR (175,
    70):LPRINT O$
930:G=INT (MAX/R/U
    ):FOR W=1TO G:
    X(W-1)=30/MAX*
    W*U*5*R
932:IF MAX<10
    GLCURSOR (X(W-
    1),54):USING "
    ##.#":LPRINT U
    *W:USING :GOTO
    950
935:IF U*W<9
    GLCURSOR (X(W-
    1),26):USING "
    ##":LPRINT U*W
    :USING :GOTO 9
    50
940:IF U*W<99
    GLCURSOR (X(W-
    1),40):USING "
    ###":LPRINT U*
    W:USING :GOTO
    950
945:IF U*W<999
    GLCURSOR (X(W-
    1),54):USING "
    ####":LPRINT U
    *W:USING :GOTO
    950
950:NEXT W
955:LINE (0,0)-(17
    0,0),0,C:Y=0
959:Q=B-1901
960:FOR W=0TO A:
    LINE (0,Y)-(0,
    (Y-40)),0,C:
    LINE (0,(Y-40)
    )-(170,(Y-40))
    ,1,C
970:GOSUB 1000
975:IF W=AGOTO 995
980:IF W<>0LINE (U
    ,Y)-(L,(Y-40))
    ,0,C
985:GLCURSOR (-20,
    (Y-18)):Q=Q+1
986:LPRINT Q
987:Y=Y-40:U=L
990:NEXT W
995:TEXT :MAX=0:LF
    3:RETURN
 1000:FOR N=1TO G:
      LINE (X(N-1)
      ,Y)-(X(N-1),
      Y-40),1,C:
      NEXT N
 1005:IF W>=AGOTO
      1020
 1010:L=30/MAX*M(W
      )*5*R
 1020:RETURN
65279:END

STATUS (1)
                4570
```