Canadian Manuscript Report of
Fisheries and Aquatic Sciences 1705

April 1983

COMPUTER PROGRAMS FOR ANALYSIS OF LOBSTER (*HOMARUS AMERICANUS*) MOVEMENTS FROM TAG RELEASE-RECAPTURE DATA

by

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Cat. No. Fs 97-4/1705 ISSN 0706-6473

Correct citation for this publication:

Campbell, A., S. E. Bellis, G. E. Fawkes, C. Hastey. 1983. Computer programs for analysis of lobster (*Homarus americanus*) movements from tag release-recapture data. Can. MS. Rep. Fish. Aquat. Sci. 1705: iv + 22 p.

TABLE OF CONTENTS

ABSTRACT

Campbell, A., S. E. Bellis, G. E. Fawkes, C. Hastey. 1983. Computer programs for analysis of lobster (Homarus americanus) movements from tag release-recapture data. Can. MS Rep. Fish. Aquat. Sci. 1705: iv + 22 p.

Two computer programs are listed in FORTRAN IV with input instructions and samples of printout provided. The first program (LOCSEL) requires input on tag release-recapture information such as tag number, date, latitude and longitude, depth, size, sex, egg development stage, gear and/or person type retrieving tagged lobsters. Tag release-recapture data can be sorted by each of 23 possible categories (e.g. sex, depth of recapture, distance or direction moved, or growth). Output includes listing of all information for each tag sorted according to categories required in ascending order and statistical summaries (e.g. mean, SE, minimum and maximum) for depth ranges, straight-line distance and direction (degrees from north) moved, days at liberty, and growth between tag release and recapture.

The second program (STATLOC) requires input on straight-line distance and direction (degrees) traveled and days at liberty between tag release and recapture. The output provides statistical summary (e.g. mean, SE) on number of days at liberty and distance traveled, and direction such as the mean square dispersion coefficient, mean vector angle, and Rayleigh test for randomness about a circle of unit radius.

Although the programs are written for use on a HP3000 computer system, the programs can be adapted to other computer systems.

Key words: tagging, movements, computer program

RÉSUMÉ

Campbell, A., S. E. Bellis, G. E. Fawkes, C. Hastey. 1983. Computer programs for analysis of lobster (Homarus americanus) movements from tag release-recapture data. Can. MS Rep. Fish. Aquat. Sci. 1705: iv + 22 p.

Deux programmes informatiques sont listés dans le FORTRAN IV avec des instructions d'entrée et des exemples de sortie sur imprimante. Le premier programme (LOCSEL) nécessite l'entrée d'informations sur la libération et la recapture après marquage comme le numéro de marquage, la date, la latitude et la longitude, la profondeur, la taille, le sexe, le stade de développement des oeufs, le type d'instrument et de personne ayant récupéré les homards marqués. Les données sur la libération et la recapture après marquage peuvent être classées dans 23 catégories (par exemple le sexe, la profondeur à laquelle la recapture a eu lieu, la distance parcourue ou la direction du déplacement, ou la croissance). Les résultats comprennent une liste imprimée, en ordre croissant, de toutes les informations obtenues sur chaque marquage classifié selon les catégories requises et des résumés statistiques (par exemple la moyenne, le SE, le minimum et le maximum) sur l'éventail des profondeurs, la distance parcourue en ligne droite et la direction du déplacement (en degrés à partir du nord), les jours de liberté et la croissance entre la libération après marquage et la recapture.

Le deuxième programme (STATLOC) exige l'entrée de données sur la distance parcourue en ligne droite, la direction du déplacement (en degrés) et les jours de liberté entre la libération après marquage et la recapture. Les résultats fournissent un résumé statistique (par exemple la moyenne, le SE) sur le nombre de jours de liberté, la distance parcourue et la direction du déplacement, comme le coefficient de dispersion quadratique moyen, l'angle vectoriel moyen et l'essai de Rayleigh sur le caractère aléatoire autour d'un cercle de rayon unitaire.

Bien que les programmes soient conçus pour être utilisés sur un système informatique HP 3000, ils peuvent s'adapter à d'autres systèmes informatiques.

INTRODUCTION

Large quantities of tag release-recapture data require the use of computer programs for rapid sorting and statistical summarization. Two computer programs are presented in this paper which are adapted to analyze lobster (Homarus americanus) movements from tag release-recapture information. The programs are applicable to other crustaceans in which the direction and distance traveled are calculated from release and recapture positions.

The first program (LOCSEL) requires input data for each individual on tag release and recapture information including tag number, date, latitude and longitude, depth, size (e.g. carapace length in mm), sex, egg development stage, gear and/or person type retrieving tag. The program can sort the input data on up to 23 different categories (e.g. sex, size and for distance moved) at a time and prints in ascending order all information for each tag according to the categories required. Statistical summaries are also provided. There is an option to create data files for use in the second program (STATLOC). LOCSEL calls two function subprograms (RDIFF1) to calculate the degree change from true north and distance (nautical miles or kilometers) traveled from latitude-longitude data and (IDIFF2) to calculate the number of days at liberty between the tag release and recapture dates.

The second program (STATLOC) requires input on straight-line distance (e.g. nautical miles or kilometers) and directon (degrees from true north) traveled and days at liberty between tag release and recapture. This program is set up to receive a data file with distance, direction, and time at liberty information that has been created by the program LOCSEL. The output provides statistical summaries of the number of days at liberty and distance and direction traveled.

Also, for an evaluation of the directional components of movement, the following test statistics are computed according to Jones (1959) and Saila and Flowers (1968):

Mean square dispersion coefficient (km^2/day)

$$a^2 = \frac{1}{n}\left[\sum \frac{r^2}{t} - \frac{(\Sigma r \cos \theta)^2}{\Sigma t}\right]$$

North-south directional component (km/day)

$$V = \frac{\Sigma r \cos \theta}{\Sigma t}$$

East-west directional component (km/day)

$$V' = \frac{\Sigma r \sin \theta}{\Sigma t}$$

Mean vector angle

$$\theta = \arctan\left[\frac{\Sigma r \sin \theta}{\Sigma r \cos \theta}\right]$$

Rayleigh test $Z = R^2/n$

where n = number of individual tag returns;

$R = \sqrt{(\Sigma \sin \theta)^2 + (\Sigma \cos \theta)^2}$;

r = apparent "straight line" distance traveled (km) from release to recapture point;

θ = direction of travel from an arbitrary reference point;

t = time (days) from release to recapture.

All angles (θ) are presented as deviations of true north. The Rayleigh test is a statistical test for randomness or uniform distribution of points about a circle of unit radius (Batschalet 1965). The mean square dispersion coefficient is dependent on both the rate of travel and mean distance traveled and is a measure of undirected or random movement based on physical theories of diffusion and heat conduction (Skellam 1951; Jones 1959). The parameters V and V' indicate the mean rate of directed (non-random) movement of a group of tagged lobsters in the north-south and east-west direction, respectively. Care should be used in interpreting the summary directional statistics and the user should be aware of the assumptions involved (Batschalet 1965).

Although the two programs are written in FORTRAN IV for use on an HP3000 computer system, the programs can be adapted to other computer systems.

ACKNOWLEDGMENTS

We thank H. J. MacNichol for technical assistance and G. Black and T. Deveau for helpful comments on this paper.

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INSTRUCTIONS FOR PROGRAM USE

LOCSEL PROGRAM

PROGRAM ACCEPTS "08I" DATA RECORDS.

FORMAT OF INPUT DATA RECORD "08I" IS:

FIELD	NO. OF CHARACTERS	FORMAT	ITEM
1-3	3	I3	STATION
4-8	5	I5	TAG NO.
9	1	I1	TAG TYPE
10-15	6	3I2	DATE RELEASE,D/MO/YR.
16-19	4	2I2	LATITUDE AT RELEASE,DEG.,MIN.
20-23	4	2I2	LONGITUDE AT RELEASE,DEG.,MIN.
24-26	3	I3	SIZE AT RELEASE,CARAPACE LENGTH,MM.
27	1	I1	SEX AT RELEASE,1=MALE,2=FEMALE, 3=BERRIED
28-33	6	3I2	DATE RECAPTURED,D/MO/YR.
34-37	4	2I2	LATITUDE AT RECAPTURE,DEG.,MIN.
38-41	4	2I2	LONGITUDE AT RECAPTURE,DEG.,MIN.
42	1	I1	RELEASE=1
43	1	I1	RECAPTURE=1
44-47	4	4X	SKIP
48	1	I1	EGG STAGE 1=NEW EGG,2=OLD EGG,3=REMNANTS
49-52	4	4X	SKIP
53	1	I1	FOUND,1=FISHERMAN,2=PLANT
54	1	I1	GEAR TYPE,1=INSHORE,2=OFFSHORE, 3=SCALLOP DRAG
55-57	3	I3	SIZE AT RECAPTURE,CARAPACE LENGTH,MM.
58	1	I1	SEX AT RECAPTURE,1=MALE,2=FEMALE, 3=BERRIED
59	1	1X	SKIP
60-62	3	I3	DEPTH AT RELEASE
63-65	3	I3	DEPTH AT RECAPTURE
66-77	12	12X	SKIP
78-80	3	A3	"08I" RECORD ID.

USE THE FOLLOWING EXAMPLE TO SET UP STREAM FILE:

```
!JOB INV.GROUP
!PURGE TAGD80
!PURGE LOC1
!BUILD LOC1;REC=-80,,F,ASCII;DISC=5000
!FILE FTN01=TAGD80,NEW;SAVE;DISC=1000,16,1;REC=-27,,F,ASCII
!FILE FTN02=LOC1,OLD
!FILE FTN07=DATAFILE,OLD
!FILE FTN08=MALE08I,OLD
!FILE FTN09=FEMB08I,OLD
!RUN LOCSEL

CONTROL RECORDS(3)
!EOJ
```

<u>CONTROL RECORDS</u> (FREE FORMAT)

THERE ARE THREE CONTROL RECORDS:

1. THE FIRST CONTROL RECORD HAS TWO FIELDS:

   OPT1,OPT2

   SUPPLY THE OPTION VALUE-IF OPT1=1,THE DATA FILE LOC1 WILL BE PRODUCED FOR THE USE OF STATLOC PROGRAM.
   IF OPT1=2,IT DOES NOT.
   IF OPT2=1,CHANGE NAUTICAL MILES TO KILOMETERS.

   IF OPT2 IS ANY OTHER NUMBER THAN 1,THEN VALUES ARE IN NAUTICAL MILES.

2. THE SECOND CONTROL RECORD HAS ONE FIELD:

   TITLE(MAX.80 CHARACTERS)

3. THE THIRD CONTROL RECORD HAS ELEVEN FIELDS:

FROM DATE,TO DATE,GROWTH LIMIT,BASE TIME,INPUT FILE NUMBER,NUMBER OF KEYS,KEYS,NUMBER OF EXCLUSIONS,EXCLUSIONS,EXCLUSIONS,EXCLUSIONS.

FROM DATE-ONLY DATA RECAPTURED AFTER THIS DATE WILL BE PROCESSED. SEE "TO DATE" ALSO. YR/MO/D IN FORMAT 3I2

TO DATE-ONLY DATA RECAPTURED ON OR BEFORE THIS DATE WILL BE PROCESSED. SEE "FROM DATE" ALSO. YR/MO/D IN FORMAT 3I2

GROWTH LIMIT-WOULD EXCLUDE ANY DATA WITH A SIZE DIFFERENCE LESS THAN THIS GIVEN VALUE. E.G IF THE VALUE GIVEN WAS 5 (I.E. 2,3,4,2.5) WOULD BE EXCLUDED FROM SUMMARY TABLE BUT IS SHOWN IN OUTPUT WITH ASTERISK AT FAR RIGHT.

BASE TIME-THIS VALUE IS EXPRESSED IN DAYS. WOULD EXCLUDE ANY DATA WHICH HAD BEEN OUT LESS THAN THE GIVEN NUMBER OF DAYS. E.G. IF THE VALUE WAS 50,ANYTHING LESS THAN 50 DAYS,(I.E 25,30,10)WOULD BE EXCLUDED FROM THE LISTING AND DATA SUMMARY TABLES.

INPUT FILE NUMBER=7

NUMBER OF KEYS-THE NUMBER OF FIELDS TO BE SORTED. DEFAULT IS 1.

KEYS-A KEY NUMBER TO DESCRIBE WHICH FIELDS ARE TO BE SORTED. THE FOLLOWING IS A LIST OF KEY NUMBERS AND THEIR DESCRIPTIONS:

1-TAG NUMBER
2-DATE RELEASED
3-LONGITUDE AND LATITUDE(RELEASED)
4-DEPTH AT RELEASE
5-SIZE AT RELEASE
6-SEX AT RELEASE
7-DATE RECAPTURED
8-LONGITUDE AND LATITUDE(RECAPTURED)
9-DEPTH AT RECAPTURE
10-SIZE AT RECAPTURE
11-SEX AT RECAPTURE
12-GROWTH
13-PERCENTAGE GROWTH
14-CHANGE IN DEPTH
15-DISTANCE MOVED
16-DEGREES
17-DAYS OUT
18-TAG TYPE
19-FOUND
20-GEAR
21-FLAG
22-STATION
23-EGG STAGE

DEFAULT IS 1,SORTED BY TAG NUMBER IN ASCENDING ORDER.

NUMBER OF EXCLUSIONS-THE NUMBER OF FIELDS HAVING EXCLUSIONS. THIS VALUE CAN BE SPECIFIED AS "0" FOR NO EXCLUSIONS.

EXCLUSIONS-ANY NUMBER OF GROUPS CONTAINING THREE NUMBERS EACH FIRST BEING A KEY NUMBER TO DESCRIBE THE FIELD HAVING EXCLUSIONS;THE SECOND AND THIRD GIVING THE RANGE OF VALUES TO BE INCLUDED IN THE FIELD. IF THE NUMBER OF EXCLUSIONS IS 0,THIS FIELD WILL BE IGNORED. MAXIMUM EXCLUSIONS IS THREE.

EXAMPLE OF CONTROL RECORDS:

```
1,1
AREA A,1977-78 RELEASES
000000, 999999,-1,0,7,1,15,1,5,95,999
```

EXPLANATION OF OUTPUT OF LOCSEL

PROGRAM PRODUCES A TABLE LISTING INFORMATION READ FROM DATA FILE;DIFFERENCES IN SIZE,DEPTH,LATITUDE,AND DEGREES;% CHANGE IN GROWTH AND THE NUMBER OF DAYS OUT FOR EACH LOBSTER BETWEEN RELEASE AND RECAPTURE.

A SUMMARY IS PRODUCED LISTING RELEASES,RECAPTURES,AND % OF RELEASES WHICH WERE RECAPTURED FOR MALES,FEMALES,BERRIED,TOTAL FEMALES AND TOTAL. A TABLE LISTING MEAN,S.E.,S.D.,MIN.,MAX., RANGE,NUM.,AND SUM FOR DEPTH CHANGE,DISTANCE MOVED,DAYS RELEASED, GROWTH AT RECAPTURE,REL. SIZE AT RECAPTURE,RELEASE DEPTH,AND RECAPTURE DEPTH.

INPUT RELEASE INFORMATION WITHOUT RECAPTURE DATA CAN ALSO BE USED. THE PROGRAM WILL IGNORE RELEASE INFORMATION ONLY WHERE BOTH RELEASE AND RECAPTURE DATA SUMMARIES CALCULATIONS ARE REQUIRED FOR SUMMARY INFORMATION.

IN THE OUTPUT TABLE OF DATA LISTING THE HEADING CATEGORIES ARE:

REL S/E=RELEASE SEX (S) AND EGG STAGE (E):
TT=TAG TYPE;
F=THE FOUND BY CATEGORY:
G= GEAR TYPE:
CODES=RECORD TYPE:
E= RELEASE CODE. IF THERE IS AN ASTERISK BESIDE THIS COLUMM, THE DATA IN THE RAW ARE EXCLUDED FROM THE SUMMARY TABLES BECAUSE SOMETHING IS WRONG WITH THE RELEASE-RECAPTURE DATA, E.G. NO SEX GIVEN AT RELEASE.

A NEGATIVE VALUE UNDER "GTH MM" AND "GRTH %" (PERCENT GROWTH) INDICATES THAT THE RECOVERY LENGTH (REC SIZ) IS PROBABLY MISSING. A NEGATIVE VALUE UNDER DEPTH CHANGE (DEP CHG) COULD INDICATE THAT THE RECOVERY DEPTH (REC DEP) IS MISSING. EXAMPLE INPUT' OUTPUT AFTER PROGRAM LISTING.

STATLOC PROGRAM

INPUT

INITIAL DATA MUST BE RUN THROUGH THE LOCSEL PROGRAM WHICH CREATES A DATA FILE "LOC1". THE MAIN INPUT DATA REQUIRES STRAIGHT LINE DISTANCE MOVED(KM OR NAUT. MILES), DIRECTION MOVED, (IN DEGREES FROM TRUE NORTH) AND DAYS OUT BETWEEN RELEASE AND RECAPTURE.

FORMAT OF INPUT DATA RECORD IS:

FIELD	NO. OF CHARACTERS	FORMAT	ITEM
1-5	5	I5	TAG NUMBER
6-7	2		SPACE
8-12	5	F5.1	DISTANCE TRAVELLED
11-13	2		SPACE
14-18	5	F5.1	DIRECTION IN DEGREES
19-20	2		SPACE
21-24	4	I4	DAYS OUT BETWEEN RELEASE AND RECAPTURE
25-26	2		SPACE
27-28	2	I2	FLAG FOR KM (1) OR NAUT. MILES (2)

USE THE FOLLOWING EXAMPLE TO SET UP STREAM FILE TO RUN PROGRAM.

```
!JOB INV.GROUP
!FILE FTN02=LOC1,OLD
!RUN STATLOC
  TITLE RECORD
!EOJ
```

TO USE INTERACTIVELY:

```
:FILE FTN02=LOC1,OLD
:FILE FTN06;DEV=LP(THIS FILE DECLARATION SENDS THE OUTPUT TO THE
                   LINEPRINTER. IF THE OUTPUT IS REQUESTED ON THE
                   TERMINAL BEING USED,LEAVE THIS OUT.)
:RUN STATLOC
            CURSOR WILL PROMPT YOU TO TYPE IN TITLE,AND THEN PRESS
            CARRIAGE RETURN.
 (IF MORE THAN ONE RUN IS TO BE DONE INTERACTIVELY,THE FILES ONLY
 HAVE TO BE DECLARED ONCE. TO ERASE THE PREVIOUS FILE DECLARATIONS
 TYPE "RESET @".
```

EXPLANATION OF OUTPUT OF STATLOC.

PROGRAM USES THE DATA FILE LOC1(OBTAINED FROM RUNNING LOCSEL FIRST) TO PRODUCE VALUES FOR THE MEAN SQUARE DISPERSIONS COEFFICIENT, NORTH-SOUTH DIRECTIONAL COMPONENT,EAST-WEST DIRECTIONAL COMPONENT, MEAN VECTOR ANGLE,RAYLEIGH TEST,RAYLEIGH TEST STATISTICS,AND THE COMPONENT OF THE RAYLEIGH TEST IN THE DIRECTION OF THE THEORETICAL ANGLE,THE NUMBER OF INDIVIDUALS,SUM,MINIMUM VALUE,MAXIMUM VALUE, RANGE,MEAN,STANDARD DEVIATION,AND STANDARD ERROR ARE ALSO GIVEN FOR DAYS OUT AND DISTANCES MOVED. EXAMPLE INPUT AND OUTPUT FOLLOWS PROGRAM LISTINGS.

```
C     SOURCE LISTING OF PROGRAM LOCSEL.
C
      PROGRAM LOCSEL
C     SAVED IN EDITOR AS QLOCSEL
C     MODIFIED TO PRINT ONLY RECAPTURE INFO WHEN SAME LOBSTER
C     RECAPTURED. ALSO TO REMOVE UNKNOWN VALUES FOR DIST.,DEG.,TIME
C     JAN 20/83--G.FAWKES
C     FIELD DECLARATORS
      INTEGER*4 TAG,ITM,IDIFF2,TABLE(5,8,2),NXTR,RC,FDTE,DATE1
      INTEGER*4 RLT,RCT,RLM,RCM,RLF,RCF,RLB,RCB,RECS,TDTE,IDTE
      INTEGER*4 RCFCB,TLFLB
      REAL DGS,FIELD,V(11),DST,RDIFF1,E(3,23)
      INTEGER DRLD,DRLM,DRLY,LT1D,LT1M,LN1D,LN1M,LT2D,LT2M,LN2D,LN2M
      INTEGER DRCD,DRCM,DRCY,TYP,SZ1,SZ2,SX1,SX2,FND,GR,DP1,DP2,C1,OPT1
      LOGICAL LR(6),LAOP,LFOP,LK(99),LREC(65),FAIL,SUSP,LC(40),FLAG
      INTEGER DATA4,OPT2
      REAL DATA2,DATA3
      INTEGER AOP,FOP,KY(99),FNUM,KYS(23),KFD1(2,23)
      CHARACTER FLG*1,TITLE*80,DATEL*27,CMD*80,REC*12,C2*3,FL*18
      CHARACTER CREC*129
      CHARACTER ST1*8(5),ST2*14(8),REC1*129,TF*9,KFD*5(23),SRTNME*17
      CHARACTER TREC*6
      CHARACTER ST3*14,ST4*14
      EQUIVALENCE (REC,LR),(LFOP,FOP),(LAOP,AOP),(LK,KY),(LREC,REC1)
      EQUIVALENCE (LC,CMD)
      SYSTEM INTRINSIC COMMAND,FOPEN,FCLOSE,FREADDIR,FWRITEDIR
      SYSTEM INTRINSIC FGETINFO
      SYSTEM INTRINSIC DBINARY,CREATE,ACTIVATE,FREAD,FWRITE
C      FOR A DESCRIPTION OF SYSTEM INTRINSICS REFER TO:
C      HP 3000
C      MPE INTRINSICS
C      REFERENCE MANUAL
C      PART NO 30000-90010
C      AVAILABLE FROM:
C      HEWLETT-PACKARD COMPANY
C      COMPUTER SYSTEM DIVISION
C      MPE DOCUMENTATION
C      19447 PRUNERIDGE AVENUE
C      CUPERTINO,CAL.  95014
C
      DATA ST1/"MALE    ","FEMALE  ","BERRIED ","TOTAL   ","TOT FEM "/
      DATA ST2/"DEPTH CHANGE  ","DISTANCE MOVED","DAYS RELEASED ",
     1 "GRTH AT RECAP ","REL SIZ OF REC","RELEASE DEPTH ","RECAPTURE DEP
     2.","RELEASE SIZE  "/
      DATA ST3/"(NAUT. MILES )"/,ST4/"(KILOMETERS  )"/
      DATA KFD/"02,05","09,08","19,09","29,03","33,03","38,01",
     1"43,08","53,09","63,03","67,03","72,01","73,05","78,07",
     2"86,05","92,05","98,05","105,4","111,1","114,1","116,1","127,1",
     3"118,3","40,01"/
      DATA KFD1/2,5,9,8,19,9,29,3,33,3,38,1,43,8,53,9,63,3,67,3,
     172,1,73,5,78,7,86,5,92,5,98,5,105,4,111,1,114,1,116,1,127,1,118,3,
     240,1/
C     PROGRAM INITIALIZATION
      CALL UNITCONTROL(8,1)
      CALL UNITCONTROL(9,1)
      CALL UNITCONTROL(8,8)
      CALL UNITCONTROL(9,8)
      RLT=0
      RLM=0
      RLF=0
```

```
      RLB=0
      RCM=0
      RCF=0
      RCB=0
      RCFCB=0
      TLFLB=0
      RCT=0
      TREC[1:5]="      "
      AOP=%405
      FOP=%4
      WRITE(CMD,7000)
 7000 FORMAT("PURGE LOCWRK",%15C)
      CALL COMMAND(CMD,IERR,IPRM)
      WRITE(CMD,7001)
 7001 FORMAT("BUILD LOCWRK;DISC=6000;REC=65,1,F,ASCII",%15C)
      CALL COMMAND(CMD,IERR,IPRM)
      FL="LOCWRK.PUB.GROUP  "
      ILW=FOPEN(FL,%3L,%505L,65,,,,1,1)
      IF(.CC.) 901,2,901
  901 CALL PRINTFILEINFO(ILW)
      STOP 1
    2 IFL=FOPEN(,LFOP,LAOP,6,"002",,,1,1,50000J,32,1)
      IF(.CC.) 900,1,900
  900 CALL PRINTFILEINFO(IFL)
      STOP
    1 CALL DATELINE(DATEL)
C     READ CONTROL CARDS.THE FIRST CARD CONTAINS THE OPTION. THE
C     SECOND CONTAINS THE TITLE. THE THIRD CONTAINS THE RANGE OF
C     DATES TO BE PROCESSED,GROWTH LIMIT,BASE TIME IN DAYS,DATA
C     INPUT FILE NUMBER,NUMBER OF FIELDS TO BE SORTED,THE FIELDS TO
C     BE SORTED,THE NUMBER OF FIELDS TO HAVE EXCLUSIONS, AND THE
C     FIELD TO BE SORTED WITH THE RANGE OF VALUES TO BE EXCLUDED.
C
C     CONTROL RECORDS ARE FREE FORMAT.
C
      READ(5,*)opt1,opt2
      READ(5,*) TITLE
      READ(5,*)FDTE,TDTE,GL,IBT,INF,NKY,(KYS(I),I=1,NKY),NEX,((E(I,J),
     1I=1,3),J=1,NEX)
      IF(NKY.NE.0) GOTO 10
      NKY=1
      KYS(1)=1
C     READ DATA FROM CARDS.
   10 READ(INF,5000,END=61)C1,TAG,TYP,DRLD,DRLM,DRLY,LT1D,LT1M,LN1D,
     1LN1M, SZ1,SX1,DRCD,DRCM,DRCY,LT2D,LT2M,LN2D,LN2M,IRL,IRC,IEG,FND,
     2GR,sz2,SX2,DP1,DP2,C2
 5000 FORMAT(I3,I5,I1,7I2,I3,I1,7I2,2I1,4X,A1,4X,2I1,I3,I1,1X,2I3,
     112X,A3)
C
C     DISTANCE TRAVELLED AND DEGREES.
C
       DST=RDIFF1(LT1D,LT1M,LN1D,LN1M,LT2D,LT2M,LN2D,LN2M,DGS)
C     CHANGE NAUT. MILES TO KM.
      IF(OPT2.EQ.1) DST=DST*1.8532
      ITM=IDIFF2(DRLD,DRLM,DRLY,DRCD,DRCM,DRCY)
      IF(ITM.LT.IBT) GOTO 10
      IDTE=DRCY
      IDTE=IDTE*10000+DRCM*100+DRCD
      IF(IDTE.LT.FDTE.OR.IDTE.GT.TDTE) GOTO 10
      DEPTH=FLOAT(DP2-DP1)
```

```
      FLG=" "
      GRTH=FLOAT(SZ2-SZ1)
      PCGTH=0
      IF(SZ1.NE.0) PCGTH=GRTH/FLOAT(SZ1)*100.0
C
C     CHECK TO SEE WHETHER ERRORS WERE MADE IN DETERMINING THE SEX,
C     EITHER BEFORE RELEASE OR AFTER RECAPTURE.
C
      IF((SX1.EQ.1.AND.SX2.GT.1).OR.(SX2.EQ.1.AND.SX1.NE.1)) FLG="*"
      IF((SX1.LT.1.OR.SX1.GT.3)) FLG="*"
      IF(ITM.LT.0) FLG="*"
      WRITE(REC1,6001) TAG,DRLY,DRLM,DRLD,LT1D,LT1M,LN1D,LN1M,DP1,SZ1,
     1SX1,IEG,DRCY,DRCM,DRCD,LT2D,LT2M,LN2D,LN2M,DP2,SZ2,SX2,GRTH,PCGTH,
     2DEPTH,DST,DGS,ITM,TYP,FND,GR,C1,C2,FLG,IRC
      IF(NEX.LT.1) GOTO 7
      DO 6 I=1,NEX
      TF="          "
      TF[9-KFD1(2,IFIX(E(1,I)))+1:KFD1(2,IFIX(E(1,I)))]=
     1REC1[KFD1(1,IFIX(E(1,I))):KFD1(2,IFIX(E(1,I)))]
      VAL=RNUM(TF)
      IF(E(2,I).EQ.0.0.AND.E(3,I).EQ.0.0.AND.VAL.LE.E(2,I)) GOTO 10
      IF(E(2,I).EQ.0.0.AND.E(3,I).EQ.0.0) GOTO 6
      IF(VAL.LT.E(2,I).OR.VAL.GT.E(3,I)) GOTO 10
    6 CONTINUE
    7 RLT=RLT+1
C
C     TOTAL THE NUMBER OF MALES AND FEMALES FOR RELEASES AND
C     RECAPTURES.
C
      IF(SX1.EQ.1) RLM=RLM+1
      IF(SX1.EQ.2) RLF=RLF+1
      IF(SX1.EQ.3) RLB=RLB+1
      IF(IRC.EQ.0) GOTO 3
      RCT=RCT+1
      IF(SX2.EQ.1) RCM=RCM+1
      IF(SX2.EQ.2) RCF=RCF+1
      IF(SX2.EQ.3) RCB=RCB+1
      IF(SX2.EQ.0.AND.SX1.EQ.1) RCM=RCM+1
      IF(SX2.EQ.0.AND.SX1.EQ.2) RCF=RCF+1
      IF(SX2.EQ.0.AND.SX1.EQ.3)RCB=RCB+1
C
C      FILE FTN08 IS THE MALE PLOTTING OUTPUT
C      FILE FTN09 IS THE FEMALE + BERRIED PLOTTING OUTPUT
C      THEY CONTAIN: RELEASE SIZE, DISTANCE MOVED, TIME OUT (IN DAYS)
C
      IF(SX1.LT.1.OR.SX1.GT.4) GOTO 3
      IF(IRC.NE.1) GOTO 3
      IF(LT1D.LT.1.OR.LN1D.LT.1.OR.LT2D.LT.1.OR.LN2D.LT.1) GOTO 3
      IF(DRLY.LT.1.OR.DRCY.LT.1) GOTO 3
      IF(SZ1.LT.20.OR.SZ1.GT.300) GOTO 3
      IF(SX1.NE.1) GOTO 200
      WRITE(8,201) SZ1,DST,ITM
  201 FORMAT(F4.0,F8.2,F5.0)
      GOTO 3
  200 WRITE(9,201) SZ1,DST,ITM
    3 CALL FWRITE(ILW,LREC,65,%0L)
      IF(.CC.) 90,10,90
   90 CALL PRINTFILEINFO(ILW)
      STOP 20
   61 WRITE(CMD,7002)
```

```
7002 FORMAT("PURGE STDIN",%15C)
     CALL COMMAND(CMD,IERR,IPRM)
     CALL UNITCONTROL(8,8)
     CALL UNITCONTROL(9,8)
     WRITE(CMD,7010)
7010 FORMAT("PURGE LOCWRK1",%15C)
     CALL COMMAND(CMD,IERR,IPRM)
     WRITE(CMD,7003)
7003 FORMAT("BUILD STDIN;DISC=10;REC=40,1,F,ASCII",%15C)
     CALL COMMAND(CMD,IERR,IPRM)
     WRITE(CMD,7009)
7009 FORMAT("FILE STDIN=STDIN.PUB.GROUP,OLD",%15C)
     CALL COMMAND(CMD,IERR,IPRM)
     FL="STDIN.PUB.GROUP   "
     ISC=FOPEN(FL,%3L,%505L,40,,,,1,1)
     IF(.CC.) 902,4,902
 902 CALL PRINTFILEINFO(ISC)
     STOP 3
   4 CONTINUE
     WRITE(CMD,7006)
7006 FORMAT("INPUT LOCWRK")
     CALL FWRITE(ISC,LC,40,%0L)
     IF(.CC.) 903,5,903
 903 CALL PRINTFILEINFO(ISC)
     STOP 4
   5 CONTINUE
     CMD[1:1]=" "
     CMD[2:79]=CMD[1:79]
     CMD[1:5]="KEY  "
     DO 62 I=1,NKY
     CMD[I*6:5]=KFD(KYS(I))
     IF(I.GE.NKY) GOTO 62
     CMD[I*6+5:1]=";"
  62 CONTINUE
     CALL FWRITE(ISC,LC,40,%0L)
     WRITE(CMD,7007)
7007 FORMAT("OUTPUT LOCWRK1")
     CALL FWRITE(ISC,LC,40,%0L)
     WRITE(CMD,7008)
7008 FORMAT("END")
     CALL FWRITE(ISC,LC,40,%0L)
     CALL FCLOSE(ILW,1,0)
     CALL FCLOSE(ISC,1,0)
     SRTNME="SUPRSORT.PUB.SYS "
     SUSP=%2L
     FLAG=%1L
     CALL CREATE(SRTNME,,IPN,,FLAG)
     IF(.CC.) 63,64,64
  63 STOP 96
  64 CALL ACTIVATE(IPN,SUSP)
     WRITE(CMD,7004)
7004 FORMAT("PURGE LOCWRK",%15C)
     CALL COMMAND(CMD,IERR,IPRM)
     WRITE(CMD,7005)
7005 FORMAT("PURGE STDIN",%15C)
     CALL COMMAND(CMD,IERR,IPRM)
     FL="LOCWRK1.PUB.GROUP "
     ILW=FOPEN(FL,%3L,%505L,65,,,,1,1)
     IF(.CC.) 904,60,904
 904 CALL PRINTFILEINFO(ILW)
```

```
      STOP 5
   60 ICNT=FREAD(ILW,LREC,65)
      IF(.CC.) 66,67,500
   66 CALL PRINTFILEINFO(ILW)
      STOP 30
   67 IF(LNS.GT.0) GOTO 20
C
C     DATA TABLE WILL BE PRINTED WITH FOLLOWING LABELS.
C
      WRITE(6,6000) TITLE,DATEL
 6000 FORMAT("1",A80,18X,A27,/,/,2X,"TAG     DATE     REL  REL REL ",
     1"REL REL     DATE     REC  REC REC REC REC GTH   GRTH  DEP  DIST
     2  TRUE   DAYS  T  F G  CODES   E",/,3X,"#    RELEASED   LAT  LON
     3DEP SIZ S/E  RECAPTURED  LAT  LON DEP SIZ SEX  MM     %",3X,"CHG
     4MOVD   DIRC   OUT  T")
      IF(OPT2-1)7050,7051,7050
 7050 WRITE(6,7080)
 7080 FORMAT(91X,'N.MI.'/)
      GO TO 7090
 7051 WRITE(6,7081)
 7081 FORMAT(91X,'KM.'/)
 7090 LNS=74
   20 IF(REC1[2:5].NE.TREC[2:5]) GO TO 7060
      CREC[1:129]=REC1[1:129]
      WRITE(6,7061)CREC[43:86]
      GO TO 7062
 7060 WRITE(6,6101) REC1
      TREC[2:5]=REC1[2:5]
 7061 FORMAT(42X,A86)
 7062 IF(OPT1.NE.1)GO TO 100
      READ(REC1,102)DATA1,IYR,IMO,IDY,LAT1,LAT2,DATA2,DATA3,DATA4
  102 FORMAT(1X,I5,36X,I2,2(1X,I2),2X,I2,3X,I2,32X,F5.1,1X,F5.1,2X,I4)
      IF(IMO.EQ.0)DATA4=-99
      IF(LAT1.EQ.0.OR.LAT2.EQ.0)DATA2=999
      IF(LAT1.EQ.0.OR.LAT2.EQ.0)DATA3=999
      WRITE(2,101)DATA1,DATA2,DATA3,DATA4,OPT2
 101  FORMAT(I5,2X,F5.1,2X,F5.1,2X,I4,2X,I2)
 100  CONTINUE
 6101 FORMAT(A128)
 6001 FORMAT(1X,I5,2X,I2,"/",I2,"/",I2,2X,2I2,1X,2I2,1X,I3,1X,I3,2X,
     1I1,1X,A1,2X,I2,"/",I2,"/",I2,2X,2I2,1X,2I2,1X,I3,1X,I3,2X,I1,F5.0,
     2F7.2,1X,F5.0,1X,F5.1,1X,F5.1,2X,I4,2X,I1,2X,I1,1X,I1,1X,I3,"/",A3,
     32X,A1,I1)
      LNS=LNS-1
      READ(REC1,6102)TAG,DRLY,LT1D,LT1M,LN1D,LN1M,DP1,SZ1,SX1,DRCY,DRCM,
     1DRCD,LT2D,LT2M,LN2D,LN2M,DP2,SZ2,SX2,GRTH,DEPTH,DST,ITM,FLG,IRC
 6102 FORMAT(1X,I5,2X,I2,8X,2I2,1X,2I2,1X,I3,1X,I3,2X,I1,4X,I2,
     11X,I2,1X,I2,2X,2I2,1X,2I2,1X,I3,1X,I3,2X,I1,F5.0,8X,F5.0,
     21X,F5.1,8X,I4,18X,A1,I1)
      WRITE(1,1900) TAG,LT1D,LT1M,LN1D,LN1M,DRCD,DRCM,DRCY,
     1LT2D,LT2M,LN2D,LN2M
 1900 FORMAT(I5,11I2)
      IF(FLG.NE." ") GOTO 60
C
C     SEPARATE THE FIELD BY MALE, FEMALE, BERRIED, AND TOTAL.
C
      DO 25 I=1,5
      IF(I.EQ.1.AND.SX1.EQ.1) GOTO 50
      IF(I.EQ.1.AND.SX1.EQ.2) I=2
      IF(I.EQ.1.AND.SX1.EQ.3)I=3
```

```
      IF(I.EQ.2.AND.SX1.EQ.1) I=4
      IF(I.EQ.3.AND.SX1.EQ.2)I=4
      IF(I.EQ.4.AND.SX1.EQ.3) I=4
      IF(I.EQ.5.AND.SX1.EQ.1) GO TO 25
      IF(I.EQ.5.AND.SX1.EQ.2) I=5
      IF(I.EQ.5.AND.SX1.EQ.3) I=5
   50 CONTINUE
C
C     USE CONTROL INFORMATION TO EXCLUDE UNNECESSARY DATA FROM
C     SPECIFIED FIELDS.
C
      DO 24 J=1,8
      GOTO (41,42,43,44,45,46,47,48),J
   28 IF(TABLE(I,J,1).EQ.0) GOTO 30
      CALL FREADDIR(IFL,LR,6,TABLE(I,J,2))
      IF(.CC.) 905,26,905
  905 CALL PRINTFILEINFO(IFL)
      STOP 70
   26 READ(REC,1001) FIELD1,NXTR
      RC=RC+1
      WRITE(REC,1001) FIELD1,RC
      CALL FWRITEDIR(IFL,LR,6,TABLE(I,J,2))
      IF(.CC.) 906,27,906
  906 CALL PRINTFILEINFO(IFL)
      STOP 71
   27 WRITE(REC,1001) FIELD,0
 1001 FORMAT(F6.1,I6)
      CALL FWRITEDIR(IFL,LR,6,RC)
      IF(.CC.) 907,29,908
  907 DISPLAY RC,REC
      CALL PRINTFILEINFO(IFL)
      STOP 72
  908 CALL PRINTFILEINFO(IFL)
       STOP 74
   29 TABLE(I,J,2)=RC
   24 CONTINUE
   25 CONTINUE
      GOTO 60
   30 RC=RC+1
      TABLE(I,J,1)=RC
      GOTO 27
   41 FIELD=ABS(DEPTH)
      IF(DP1.EQ.0.OR.DP2.EQ.0.OR.IRC.EQ.0) GOTO 24
      GOTO 28
   42 FIELD=DST
      IF(LT1D.EQ.0.OR.LT2D.EQ.0) GOTO 24
      GOTO 28
   43 FIELD=FLOATJ(ITM)
      IF(DRLY.EQ.0.OR.DRCY.EQ.0) GOTO 24
      GOTO 28
   44 FIELD=GRTH
      IF(SZ1.EQ.0.OR.SZ2.EQ.0) GOTO 24
      IF(GRTH-GL)24,28,28
   45 FIELD=FLOAT(SZ1)
      IF(SZ1.EQ.0.OR.IRC.EQ.0) GOTO 24
      GOTO 28
   46 IF(DP1.EQ.0) GOTO 24
      FIELD=FLOAT(DP1)
      GOTO 28
   47 IF(DP2.EQ.0.OR.IRC.EQ.0) GOTO 24
```

```
      FIELD=FLOAT(DP2)
      GOTO 28
   48 IF(SZ1.EQ.0) GOTO 24
      FIELD=FLOAT(SZ1)
      GOTO 28
C
C     PRINT TABLE GIVING SUMMARY OF MALES, FEMALES, AND TOTALS FOR
C     RELEASES, RECAPTURES, AND THE % OF RELEASES RECAPTURED.
C
  500 WRITE(6,6002)
 6002 FORMAT("1",34("*"),3X,"SUMMARY",3X,34("*"),/,1X,34("*"),
     11X,"INFORMATION ",34("*"),/,/,14X,"TOTAL   MALE  FEMALE BERRIED",
     22X,"ALL FEMALES"/)
      TLFLB=RLF+RLB
      WRITE(6,6003) RLT,RLM,RLF,RLB,TLFLB
 6003 FORMAT(1X,"RELEASED     ",5(I5,2X),/)
      RCFCB=RCF+RCB
      WRITE(6,6004) RCT,RCM,RCF,RCB,RCFCB
 6004 FORMAT(1X,"RECAPTURED   ",5(I5,2X),/)
      IF(RLT.NE.0) RCPC=FLOATJ(RCT)/FLOATJ(RLT)*100.0
      IF(RLM.NE.0) RCMPC=FLOATJ(RCM)/FLOATJ(RLM)*100.0
      IF(RLF.NE.0) RCFPC=FLOATJ(RCF)/FLOATJ(RLF)*100.0
      IF(RLB.NE.0)RCBPC=FLOATJ(RCB)/FLOATJ(RLB)*100.0
      IF(TLFLB.NE.0)RCPPC=(FLOATJ(RCFCB)/FLOATJ(TLFLB))*100.0
      WRITE(6,6005) RCPC,RCMPC,RCFPC,RCBPC,RCPPC
 6005 FORMAT(1X,"RECAP % REL ",5(F6.2,1X),/)
      LNS=68
      DO 550 I=1,8
      DO 520 K=1,5
      IF(TABLE(K,I,1).NE.0) GOTO 530
  520 CONTINUE
      GOTO 550
  530 CONTINUE
C
C     PRINT SEVEN TABLES WITH EACH GIVING THE MEAN, S.E., S.D.,
C    MIN., MAX., RANGE, NUM, AND SUM OF MALES, FEMALES, BERRIED, AND A
C     TOTAL FOR DEPTH CHANGE, DISTANCE MOVED, DAYS RELEASED, GRTH AT
C     RECAPTURE, REL.SIZE OF RECAPTURE, RELEASE DEPTH, RECAPTURE
C     DEPTH, AND RELEASE SIZE.
C
      IF(I.NE.2) GO TO 6070
      WRITE(6,6067) ST2(I)
 6067 FORMAT(/,1X,A14,7X,"MEAN",5X,"S.E.",5X,"S.D.",4X,
     1"MIN    MAX  RANGE   NUM          SUM")
      IF(OPT2-1) 6068,6069,6068
 6069 WRITE(6,6066) ST4
      GO TO 6080
 6068 WRITE(6,6066) ST3
 6066 FORMAT(1X,A14/)
      GO TO 6080
 6070 WRITE(6,6006) ST2(I)
 6006 FORMAT(/,1X,A14,7X,"MEAN",5X,"S.E.",5X,"S.D.",4X,
     1"MIN    MAX  RANGE   NUM          SUM",/)
 6080 DO 540 J=1,5
      RC=TABLE(J,I,1)
      IF(RC.EQ.0) GOTO 540
      C=0.0
      TDATA=0.0
      TD2=0.0
      V(8)=99999999.0
```

```
      V(9)=-9999999.0
  510 CALL FREADDIR(IFL,LR,6,RC)
      IF(.CC.) 900,511,900
  511 READ(REC,1001) FIELD,RC
      C=C+1
      TDATA=TDATA+FIELD
      TD2=TD2+FIELD**2
      IF(FIELD.LT.V(8)) V(8)=FIELD
      IF(FIELD.GT.V(9)) V(9)=FIELD
      IF(RC.NE.0) GOTO 510
      V(2)=C
      V(1)=TDATA/C
      SSQ=TD2-TDATA**2/C
      IF(C.GT.1.0) V(3)=SSQ/(C-1.0)
      IF(C.LE.1.0) V(3)=0.0
      IF(V(3).NE.0.0) V(4)=SQRT(V(3))
      IF(V(3).EQ.0.0) V(4)=0.0
      V(5)=V(4)/SQRT(C)
      V(10)=V(9)-V(8)
      WRITE(6,6007) ST1(J),V(1),V(5),V(4),V(8),V(9),V(10),V(2),V(1)*V(2)
 6007 FORMAT(1X,A8,11X,F6.1,2X,F7.1,2X,F7.1,1X,3(F6.1,1X),1X,F6.0,
     12X,F9.1,/)
  540 CONTINUE
      LNS=LNS-13
      IF(LNS.GT.0) GOTO 550
      WRITE(6,6010)
 6010 FORMAT("1")
      LNS=80
  550 CONTINUE
      CALL FCLOSE(IFL,0,0)
      CALL FCLOSE(ILW,%11,0)
      STOP
      END
C
$CONTROL INIT,LIST
C     REAL FUNCTION SUBPROGRAM RDIFF1 TO CALCULATE THE DEGREE
C     CHANGE IN LATITUDE AND LONGITUDE AND DISTANCE TRAVELLED.
C
      REAL FUNCTION RDIFF1(LT1D,LT1M,LN1D,LN1M,LT2D,LT2M,LN2D,LN2M,DGS)
      DGS=0
      IF(LT1D.EQ.0.OR.LT2D.EQ.0) RDIFF1=0.0
      IF(LT1D.EQ.0.OR.LT2D.EQ.0) RETURN
C     CONVERT LATITUDE AND LONGITUDE FROM DEGREES TO MINUTES.
      ALT=FLOAT(LT1D*60+LT1M)
      ALN=FLOAT(LN1D*60+LN1M)
      BLT=FLOAT(LT2D*60+LT2M)
      BLN=FLOAT(LN2D*60+LN2M)
      DLAT=BLT-ALT
      DLON=COS(((ALT+BLT)/2.0)/60.0*(3.1415926/180.0))*(BLN-ALN)
C
C     DISTANCE TRAVELLED IN NAUTICAL MILES.
C
      RDIFF1=FLOATJ(JFIX((SQRT(ABS(DLAT)**2+ABS(DLON)**2)+0.05)*10.0))
     1/10.0
      CON=180/3.1415927
      IF(ABS(DLON).EQ.0.AND.ABS(DLAT).EQ.0) GOTO 8
      IF(DLAT.EQ.0.AND.DLON.GT.0) GOTO 1
      IF(DLAT.EQ.0.AND.DLON.LT.0) GOTO 2
      IF(DLON.EQ.0.AND.DLAT.GT.0) GOTO 3
      IF(DLON.EQ.0.AND.DLAT.LT.0) GOTO 4
```

```
      IF(DLAT.LT.0.AND.DLON.GT.0) GOTO 5
      IF(DLAT.GT.0.AND.DLON.GT.0) GOTO 6
      IF(DLAT.LT.0.AND.DLON.LT.0) GOTO 7
C
C     DEGREE CHANGE
C
      DGS=ATAN(ABS(DLON)/ABS(DLAT))*CON
      GOTO 8
    1 DGS=270
      GOTO 8
    2 DGS=90
      GOTO 8
    3 DGS=360
      GOTO 8
    4 DGS=180
      GOTO 8
    5 DGS=ATAN(ABS(DLON)/ABS(DLAT))*CON+180
      GOTO 8
    6 DGS=ATAN(ABS(DLAT)/ABS(DLON))*CON+270
      GOTO 8
    7 DGS=ATAN(ABS(DLAT)/ABS(DLON))*CON+90
    8 CONTINUE
      RETURN
      END
C
$CONTROL INIT,LIST
C     INTEGER FUNCTION SUBPROGRAM IDIFF2 TO CALCULATE THE NUMBER
C     OF DAYS OUT.
      INTEGER*4 FUNCTION IDIFF2(ID1,IM1,IY1,ID2,IM2,IY2)
      INTEGER MTHT(12)
      DATA MTHT/31,59,90,120,151,181,212,243,273,304,334,365/
      IDIFF2=1
      IF(IM1.LT.1.OR.IM1.GT.12.OR.IM2.LT.1.OR.IM2.GT.12) IDIFF2=0
      IF(IY1.EQ.0.OR.IY2.EQ.0) IDIFF2=0
      IF(IDIFF2.LT.1) RETURN
C     CONVERT YEARS INTO DAYS.
      YR1=FLOAT(IFIX(FLOAT(IY1-1)*365.25))
      YR2=FLOAT(IFIX(FLOAT(IY2-1)*365.25))
C     DETERMINE IF THE YEAR INVOLVED IS A LEAP YEAR.
      IF(IY1/4.EQ.FLOAT(IY1)/4.0.AND.IM1.GT.2) YR1=YR1+1
      IF(IY2/4.EQ.FLOAT(IY2)/4.0.AND.IM2.GT.2) YR2=YR2+1
C     SUM THE DAYS, MONTHS, AND YEAR TO EXPRESS THE DATE IN DAYS.
      YR1=YR1+ID1+MTHT(IM1)
      YR2=YR2+ID2+MTHT(IM2)
C     FIND IDIFF2 (DAYS OUT) BY SUBTRACTING THE DATES.
      IDIFF2=IFIX(YR2-YR1)
      RETURN
      END
```

```
C
C   SOURCE LISTING FOR PROGRAM STATLOC
C
C
C
      PROGRAM STATLOC
C
C     SAVED AS QSTATLOC IN QEDIT
C COMPILED AS STATLOC
C MODIFIED TO ELIMINATE UNKNOWN VALUES JAN 20/83 G.FAWKES
C UNKNOWN OR INVALID VALUES FOR DEGREES,DAYS OUT AND DISTANCE
C ARE FLAGGED IN THE PROGRAM LOCSEL.
      CHARACTER TITLE*80,NAUT*12,KILO*12
      REAL DATA1,DATA4,TAG(3000),DAYS(3000),TIME,I
      REAL RSQT,ASQUARED,VEE,VEEPRIME,ARCVALUE,THETA,BEFORARE
      REAL ARE,DATA2,DATA3,DIST(3000),DEG(3000),SINE,COSINE
      REAL RSINE,RCOSINE,ZED,CHI,PI,COUNT
      REAL MINMILES,MAXMILES,AVMILES,MINTIME,MAXTIME,AVTIME,MILES
      REAL MILES2,TMILES2,SDMILE1,SDMILE,SDMILE2,SEMILE,RANGMILE
      REAL TIME2,TTIME2,SDTIME1,SDTIME,SDTIME2,SETIME,RANGTIME
      INTEGER OPT2
      ON REAL DIV 0 CALL DVZR
      ON REAL UNDERFLOW CALL UNDR
      I=0.0
      PI=22.0/7.0
      READ(5,11)TITLE
 11   FORMAT(A80)
 2    CONTINUE
      READ(2,100,END=10)DATA1,DATA2,DATA3,DATA4,OPT2
 100  FORMAT(I5,2X,F5.1,2X,F5.1,2X,I4,2X,I2)
      IF(DATA2.EQ.0.AND.DATA3.EQ.0.AND.DATA4.EQ.0) GO TO 2
      IF (DATA2.EQ.999.OR.DATA3.EQ.999.OR.DATA4.EQ.-99)GO TO 2
      I=I+1.0
C TAG NO
      TAG(I)=DATA1
C STRAIGHT LINE DISTANCE TRAVELLED(KM. OR NAUT. MILES
C BETWEEN RELEASE AND RECAPTURE.
      DIST(I)=DATA2
C DIRECTION MOVED DEGREES FROM TRUE NORTH.
      DEG(I)=DATA3
C DAYS OUT BETWEEN RELEASE AND RECAPTURE.
      DAYS(I)=DATA4
      GO TO 2
 10   TIME=0.0
      TIME2=0.0
      MILES2=0.0
      MILES=0.0
      SINE=0.0
      COSINE=0.0
      RSINE=0.0
      RCOSINE=0.0
      RSQT=0.0
      TIM=0
      NAUT="(NAUT. MILES"
      KILO="(KILOMETERS "
      MINMILES=5000.0
      MAXMILES=0.0
      MINTIME=5000.0
      MAXTIME=0.0
      DO 20 J=1,I
```

```
      MILES2=MILES2+DIST(J)**2
      MILES=MILES+DIST(J)
      IF(DIST(J).GT.MAXMILES) MAXMILES=DIST(J)
      IF(DIST(J).LT.MINMILES) MINMILES=DIST(J)
      TIME=TIME+DAYS(J)
      TIME2=TIME2+DAYS(J)**2
      IF(DAYS(J).GT.MAXTIME) MAXTIME=DAYS(J)
      IF(DAYS(J).LT.MINTIME) MINTIME=DAYS(J)
      DEG(J)=DEG(J)*PI/180.0
      SINE=SINE+SIN(DEG(J))
      COSINE=COSINE+COS(DEG(J))
      RSINE=RSINE+DIST(J)*SIN(DEG(J))
      RCOSINE=RCOSINE+DIST(J)*COS(DEG(J))
      RSQT=RSQT+DIST(J)**2/DAYS(J)
      TIM=TIM+DAYS(J)
20    CONTINUE
      TMILES2=MILES**2
      TTIME2=TIME**2
      SDTIME1=TIME2-(TTIME2/I)
      SDMILE1=MILES2-(TMILES2/I)
      IF(I.GT.1.0)SDTIME2=SDTIME1/(I-1.0)
      IF(I.LE.1.0)SDTIME2=0.0
      IF(I.LE.1.0)SDMILE2=0.0
      IF(I.GT.1.0)SDMILE2=SDMILE1/(I-1.0)
      IF(I.GT.1.0)SDTIME=SQRT(SDTIME2)
      IF(I.LE.1.0)SDTIME=0.0
      IF(I.GT.1.0)SDMILE=SQRT(SDMILE2)
      IF(I.LE.1.0)SDMILE=0.0
      SETIME=SDTIME/SQRT(I)
      SEMILE=SDMILE/SQRT(I)
      RANGTIME=MAXTIME-MINTIME
      RANGMILE=MAXMILES-MINMILES
      AVTIME=TIME/I
      AVMILES=MILES/I
      ASQUARED=(RSQT-RCOSINE**2/TIM)/I
      VEE=RCOSINE/TIM
      VEEPRIME=RSINE/TIM
      ARCVALUE=RSINE/RCOSINE
      OLDTHETA=ATAN(ARCVALUE)
      THETA=OLDTHETA*180.0/PI
      BEFORARE=SINE**2+COSINE**2
      ARE=SQRT(BEFORARE)
      ZED=ARE**2/I
      IF(VEE.GE.0.AND.VEEPRIME.GE.0) GO TO 205
      IF(VEE.LT.0.AND.VEEPRIME.GE.0) THETA=THETA+180.0
      IF(VEE.GE.0.AND.VEEPRIME.LT.0) THETA=THETA+360.0
      IF(VEE.LT.0.AND.VEEPRIME.LT.0) THETA=THETA+180.0
 205  WRITE(6,108)TITLE
      WRITE(6,109)
      WRITE(6,110)I,TIME,MINTIME,MAXTIME,RANGTIME
      WRITE(6,112)AVTIME,SDTIME,SETIME
      WRITE(6,111)
      WRITE(6,110)I,MILES,MINMILES,MAXMILES,RANGMILE
      WRITE(6,112)AVMILES,SDMILE,SEMILE
      IF(OPT2.EQ.1) GO TO 200
      WRITE(6,101) NAUT,ASQUARED
      WRITE(6,102) NAUT,VEE
      WRITE(6,103) NAUT,VEEPRIME
      GO TO 201
 200  WRITE(6,101) KILO,ASQUARED
```

```
      WRITE(6,102) KILO,VEE
      WRITE(6,103) KILO,VEEPRIME
  201 WRITE(6,104)THETA
      WRITE(6,105)ARE
      WRITE(6,106)ZED
  101 FORMAT(1X,"MEAN SQUARE DISPERSION COEFFICIENT ",A12,"**2/DAY)",
     12X,3(".  "),F11.5)
  102 FORMAT(1X,"NORTH-SOUTH DIRECTIONAL COMPONENT ",A12," /DAY)",
     12X,4(".  "),F11.5)
  103 FORMAT(1X,"EAST-WEST DIRECTIONAL COMPONENT ",A12," /DAY)",
     11X,5(".  "),F11.5)
  104 FORMAT(1X,"MEAN VECTOR ANGLE",1X,16(".  "),F11.5)
  105 FORMAT(1X,"RAYLEIGH TEST",2X,17(".  "),F11.5)
  106 FORMAT(1X,"RAYLEIGH TEST STATISTICS (R**2/N)",11(".  "),F11.5)
  108 FORMAT(1X,A80,//)
  109 FORMAT(9X,"*******STATISTICAL INFORMATION FOR DAYS OUT*******")
  111 FORMAT(9X,"*****STATISTICAL INFORMATION FOR DISTANCE MOVED*****")
  110 FORMAT(/,11X,"NUMBER OF INDIVIDUALS",6(".  "),F8.2,
     1/,11X,"SUM",11(".  "),".",F10.2,
     2/,11X,"MINIMUM",2X,10(".  "),F8.2,
     3/,11X,"MAXIMUM",2X,10(".  "),F8.2,
     4/,11X,"RANGE",1X,11(".  "),F8.2)
  112 FORMAT(11X,"MEAN",2X,11(".  "),F8.2,
     1/,11X,"STANDARD DEVIATION",7(".  "),F8.2,
     2/,11X,"STANDARD ERROR",1X,8(".  "),F8.2,//)
      STOP
      END
C
      SUBROUTINE UNDR(RL)
      RL=0
      RETURN
      END
C
      SUBROUTINE DVZR(RR)
      RR=0
      RETURN
      END
```

EXAMPLE OF INPUT TO LOCSEL

```
0086711008774442663 9     150480          11          2       053
0225312311774447664 0    31704804439663711    1    111553 053090
0226912311774447664011831904804138682711    1    11    3 053105
0025411207774442663914032104804439663711    2    111652 053090
0043712007774441664116010505804439663711         111861 018090
0100711508774447664013230505804439663711    2    111552 053100
0148310309774441664111030505804439663711    3    111452 018100
0041212007774442663912820605804439663711         111433 053090
0026211207774442663914511505804321663011         11     053075
0051412307774445664512511505804506663311         11     018018
0057612307774447664014511505804351692911         11     053
0234512511774447664012031505804507661811    1    11     053020
0091611008774441664113021905804437664411         111443 018090
0088411008774442663914532105804439663711    2    111572 053090
0011811207774445664513022605804437664411         111473 018090
0019211207774447664013513105804503662811         111711 053020
0096711008774447664013011006804437664411         111581 053090
0219112111774442663910531106804439663711    1    111273 053070
0038612007774442663910021206804437664411         111193 053090
0097911008774447664009021206804437664411         11     053
0056012307774447664014211606804503662811         111741 053018
0033211607774441664 1     21806804444664311      111392 018045
0036511607774447664013511806804439663711         111641 053090
0070012707774445664511511806804444664311         111381 018055
0211611811774445664511531806804441664111    1    111343 018040
0229312511774442663 9     31806804439663711    1    11     053070
0024811207774442663910532306804439663711    2    111342 053090
0070912707774445664511012306804441664111         111411 018045
0158210609774445664511022306804437664411         111222 018070
0241612811774447664 0     32306804441664111    1    111313 053040
0085811008774442663 9     12406804439663711         111831 053090
0393013107784447664011830104814439663711    2    111402 053090
0380512807784447664015311204814439663711         11     053
0379412807784447664014821504814438663511         11     053095
0395613107784445664516312504814243704411         131881 018
0524512508784447664012231105814439663711    3    11     053070
0391313107784447664014410106814140695411         11     053
0480011508784447664016330306814439663711    2    111842 053090
0636912209784445664511531106814439663711    3    111212 018090
0395213107784445664511821506814439663711         11     018085
0512712308784438665408821506 81          11      2      018
```

EXAMPLE OF OUTPUT FROM LOCSEL

AREA A 1977-78 RELEASES

TAG #	DATE RELEASED	REL LAT	REL LON	REL DEP	REL SIZ	REL S/E	DATE RECAPTURED	REC LAT	REC LON	REC DEP	REC SIZ	REC SEX	GTH MM	GRTH %	DEP CHG	DIST MOVD KM.	TRUE DIRC	DAYS OUT	T T	F	G	CODES	E
700	77/ 7/27	4445	6645	18	115	1	80/ 6/18	4444	6643	55	138	1	23.	20.00	37.	3.2	125.1	1056	1	1	1	0/08I	1
254	77/ 7/12	4442	6639	53	140	3 2	80/ 4/21	4439	6637	90	165	2	25.	17.86	37.	6.1	154.6	1013	1	1	1	0/08I	1
412	77/ 7/20	4442	6639	53	128	2	80/ 5/ 6	4439	6637	90	143	3	15.	11.72	37.	6.1	154.6	1021	1	1	1	0/08I	1
884	77/ 8/10	4442	6639	53	145	3 2	80/ 5/21	4439	6637	90	157	2	12.	8.28	37.	6.1	154.6	1015	1	1	1	0/08I	1
2191	77/11/21	4442	6639	53	105	3 1	80/ 6/11	4439	6637	70	127	3	22.	20.95	17.	6.1	154.6	933	1	1	1	0/08I	1
248	77/ 7/12	4442	6639	53	105	3 2	80/ 6/23	4439	6637	90	134	2	29.	27.62	37.	6.1	154.6	1076	1	1	1	0/08I	1
437	77/ 7/20	4441	6641	18	160	1	80/ 5/ 5	4439	6637	90	186	1	26.	16.25	72.	6.5	125.1	1020	1	1	1	0/08I	1
1483	77/ 9/ 3	4441	6641	18	110	3 3	80/ 5/ 5	4439	6637	100	145	2	35.	31.82	82.	6.5	125.1	976	1	1	1	0/08I	1
916	77/ 8/10	4441	6641	18	130	2	80/ 5/19	4437	6644	90	144	3	14.	10.77	72.	8.3	208.1	1013	1	1	1	0/08I	1
2116	77/11/18	4445	6645	18	115	3 1	80/ 6/18	4441	6641	40	134	3	19.	16.52	22.	9.1	144.6	943	1	1	1	0/08I	1
709	77/ 7/27	4445	6645	18	110	1	80/ 6/23	4441	6641	45	141	1	31.	28.18	27.	9.1	144.6	1061	1	1	1	0/08I	1
386	77/ 7/20	4442	6639	53	100	2	80/ 6/12	4437	6644	90	119	3	19.	19.00	37.	11.3	215.4	1057	1	1	1	0/08I	1
118	77/ 7/12	4445	6645	18	130	2	80/ 5/26	4437	6644	90	147	3	17.	13.08	72.	14.8	174.9	1049	1	1	1	0/08I	1
1582	77/ 9/ 6	4445	6645	18	110	2	80/ 6/23	4437	6644	70	122	2	12.	10.91	52.	14.8	174.9	1021	1	1	1	0/08I	1
1007	77/ 8/15	4447	6640	53	132	3 2	80/ 5/ 5	4439	6637	100	155	2	23.	17.42	47.	15.4	165.1	994	1	1	1	0/08I	1
365	77/ 7/16	4447	6640	53	135	1	80/ 6/18	4439	6637	90	164	1	29.	21.48	37.	15.4	165.1	1067	1	1	1	0/08I	1
3930	78/ 7/31	4447	6640	53	118	3 2	81/ 4/ 1	4439	6637	90	140	2	22.	18.64	37.	15.4	165.1	974	1	1	1	0/08I	1
3805	78/ 7/28	4447	6640	53	153	1	81/ 4/12	4439	6637	0	0	0	-153.	-100.00	-53.	15.4	165.1	988	1	1	1	0/08I	1
5245	78/ 8/25	4447	6640	53	122	3 3	81/ 5/11	4439	6637	70	0	0	-122.	-100.00	17.	15.4	165.1	990	1	1	1	0/08I	1
4800	78/ 8/15	4447	6640	53	163	3 2	81/ 6/ 3	4439	6637	90	184	2	21.	12.88	37.	15.4	165.1	1022	1	1	1	0/08I	1
6369	78/ 9/22	4445	6645	18	115	3 3	81/ 6/11	4439	6637	90	121	2	6.	5.22	72.	15.4	136.5	993	1	1	1	0/08I	1
3952	78/ 7/31	4445	6645	18	118	2	81/ 6/15	4439	6637	85	0	0	-118.	-100.00	67.	15.4	136.5	1049	1	1	1	0/08I	1
3794	78/ 7/28	4447	6640	53	148	2	81/ 4/15	4438	6635	95	0	0	-148.	-100.00	42.	18.0	158.5	991	1	1	1	0/08I	1
967	77/ 8/10	4447	6640	53	130	1	80/ 6/10	4437	6644	90	158	1	28.	21.54	37.	19.3	195.9	1034	1	1	1	0/08I	1
192	77/ 7/12	4447	6640	53	135	1	80/ 5/31	45 3	6628	20	171	1	36.	26.67	-33.	33.5	28.0	1054	1	1	1	0/08I	1
560	77/ 7/23	4447	6640	53	142	1	80/ 6/16	45 3	6628	18	174	1	32.	22.54	-35.	33.5	28.0	1058	1	1	1	0/08I	1
514	77/ 7/23	4445	6645	18	125	1	80/ 5/15	45 6	6633	18	0	0	-125.	-100.00	0.	42.1	22.0	1027	1	1	1	0/08I	1
2345	77/11/25	4447	6640	53	120	3 1	80/ 5/15	45 7	6618	20	0	0	-120.	-100.00	-33.	46.9	37.9	903	1	1	1	0/08I	1
262	77/ 7/12	4442	6639	53	145	1	80/ 5/15	4321	6630	75	0	0	-145.	-100.00	22.	150.7	175.4	1038	1	1	1	0/08I	1
576	77/ 7/23	4447	6640	53	145	1	80/ 5/15	4351	6929	0	0	0	-145.	-100.00	-53.	247.0	245.1	1027	1	1	1	0/08I	1
2269	77/11/23	4447	6640	53	118	3 1	80/ 4/19	4138	6827	105	0	3	-118.	-100.00	52.	379.0	202.4	878	1	1	1	0/08I	1
3956	78/ 7/31	4445	6645	18	163	1	81/ 4/25	4243	7044	0	188	1	25.	15.34	-18.	391.8	234.8	998	1	1	3	0/08I	1
3913	78/ 7/31	4447	6640	53	144	1	81/ 6/ 1	4140	6954	0	0	0	-144.	-100.00	-53.	434.4	217.1	1035	1	1	1	0/08I	1

EXAMPLE OF LOCSEL OUTPUT (CONTINUED)

********** SUMMARY **********
********** INFORMATION **********

	TOTAL	MALE	FEMALE	BERRIED	ALL FEMALES
RELEASED	33	13	7	13	20
RECAPTURED	33	13	11	9	20
RECAP % REL	100.00	100.00	157.14	69.23	100.00

DEPTH CHANGE	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM
MALE	33.3	6.3	18.8	.0	72.0	72.0	9.	300.0
FEMALE	54.1	6.1	16.0	37.0	72.0	35.0	7.	379.0
BERRIED	40.5	5.3	19.3	17.0	82.0	65.0	13.	527.0
TOTAL	41.6	3.6	19.4	.0	82.0	82.0	29.	1206.0
TOT FEM	45.3	4.2	19.0	17.0	82.0	65.0	20.	906.0

DISTANCE MOVED (KILOMETERS)	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM
MALE	107.8	42.3	152.7	3.2	434.4	431.2	13.	1401.9
FEMALE	12.7	1.6	4.3	6.1	18.0	11.9	7.	88.7
BERRIED	41.8	28.3	101.9	6.1	379.0	372.9	13.	542.9
TOTAL	61.6	20.7	119.1	3.2	434.4	431.2	33.	2033.5
TOT FEM	31.6	18.4	82.3	6.1	379.0	372.9	20.	631.6

DAYS RELEASED	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM
MALE	1035.6	6.7	24.1	988.0	1067.0	79.0	13.	13463.0
FEMALE	1028.7	9.0	23.8	991.0	1057.0	66.0	7.	7201.0
BERRIED	977.7	14.7	53.0	878.0	1076.0	198.0	13.	12710.0
TOTAL	1011.3	8.1	46.3	878.0	1076.0	198.0	33.	33374.0
TOT FEM	995.6	11.3	50.7	878.0	1076.0	198.0	20.	19911.0

GRTH AT RECAP	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM
MALE	28.8	1.5	4.2	23.0	36.0	13.0	8.	230.0
FEMALE	15.4	1.2	2.7	12.0	19.0	7.0	5.	77.0
BERRIED	21.4	2.6	8.1	6.0	35.0	29.0	10.	214.0
TOTAL	22.7	1.6	7.7	6.0	36.0	30.0	23.	521.0
TOT FEM	19.4	1.9	7.3	6.0	35.0	29.0	15.	291.0

EXAMPLE OF LOCSEL OUTPUT (CONTINUED)

REL SIZ OF REC	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM
MALE	138.6	4.4	15.9	110.0	163.0	53.0	13.	1802.0
FEMALE	123.4	5.9	15.7	100.0	148.0	48.0	7.	864.0
BERRIED	123.7	4.7	17.0	105.0	163.0	58.0	13.	1608.0
TOTAL	129.5	3.0	17.4	100.0	163.0	63.0	33.	4274.0
TOT FEM	123.6	3.6	16.1	100.0	163.0	63.0	20.	2472.0

RELEASE DEPTH	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM
MALE	39.5	4.9	17.7	18.0	53.0	35.0	13.	514.0
FEMALE	33.0	7.1	18.7	18.0	53.0	35.0	7.	231.0
BERRIED	44.9	4.3	15.3	18.0	53.0	35.0	13.	584.0
TOTAL	40.3	3.0	17.1	18.0	53.0	35.0	33.	1329.0
TOT FEM	40.8	3.8	17.1	18.0	53.0	35.0	20.	815.0

RECAPTURE DEP.	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM
MALE	55.7	10.6	31.9	18.0	90.0	72.0	9.	501.0
FEMALE	87.1	3.1	8.1	70.0	95.0	25.0	7.	610.0
BERRIED	80.4	6.9	24.9	20.0	105.0	85.0	13.	1045.0
TOTAL	74.3	5.1	27.2	18.0	105.0	87.0	29.	2156.0
TOT FEM	82.8	4.6	20.6	20.0	105.0	85.0	20.	1655.0

RELEASE SIZE	MEAN	S.E.	S.D.	MIN	MAX	RANGE	NUM	SUM
MALE	138.6	4.4	15.9	110.0	163.0	53.0	13.	1802.0
FEMALE	123.4	5.9	15.7	100.0	148.0	48.0	7.	864.0
BERRIED	123.7	4.7	17.0	105.0	163.0	58.0	13.	1608.0
TOTAL	129.5	3.0	17.4	100.0	163.0	63.0	33.	4274.0
TOT FEM	123.6	3.6	16.1	100.0	163.0	63.0	20.	2472.0

EXAMPLE OF OUTPUT FROM STATLOC

```
*******STATISTICAL INFORMATION FOR DAYS OUT*******

  NUMBER OF INDIVIDUALS. . . . . .     33.00
  SUM. . . . . . . . . . . . . . . . 33374.00
  MINIMUM . . . . . . . . . . . . .   878.00
  MAXIMUM . . . . . . . . . . . . .  1076.00
  RANGE . . . . . . . . . . . . . .   198.00
  MEAN . . . . . . . . . . . . . . .  1011.33
  STANDARD DEVIATION. . . . . . . .    46.28
  STANDARD ERROR . . . . . . . . . .    8.06

****STATISTICAL INFORMATION FOR DISTANCE MOVED****

  NUMBER OF INDIVIDUALS. . . . . .     33.00
  SUM. . . . . . . . . . . . . . . . 2033.50
  MINIMUM . . . . . . . . . . . . .     3.20
  MAXIMUM . . . . . . . . . . . . .   434.40
  RANGE . . . . . . . . . . . . . .   431.20
  MEAN . . . . . . . . . . . . . . .   61.62
  STANDARD DEVIATION. . . . . . . .   119.13
  STANDARD ERROR . . . . . . . . . .   20.74

MEAN SQUARE DISPERSION COEFFICIENT (KILOMETERS **2/DAY) . . .    16.40784
NORTH-SOUTH DIRECTIONAL COMPONENT (KILOMETERS  /DAY) . . . .     -.03850
EAST-WEST DIRECTIONAL COMPONENT (KILOMETERS  /DAY) . . . . .     -.02365
MEAN VECTOR ANGLE . . . . . . . . . . . . . . . . . . . . .    211.54541
RAYLEIGH TEST . . . . . . . . . . . . . . . . . . . . . . .     22.13327
RAYLEIGH TEST STATISTICS (R**2/N). . . . . . . . . . . . .     14.84489
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