DOCUMENTATION FOR MATHEMATICAL
MODELS OF THE HUDSON RIVER
STRIPED BASS POPULATION

VOLUME I: TRANSPORT MODEL

July 1974

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INTRODUCTION

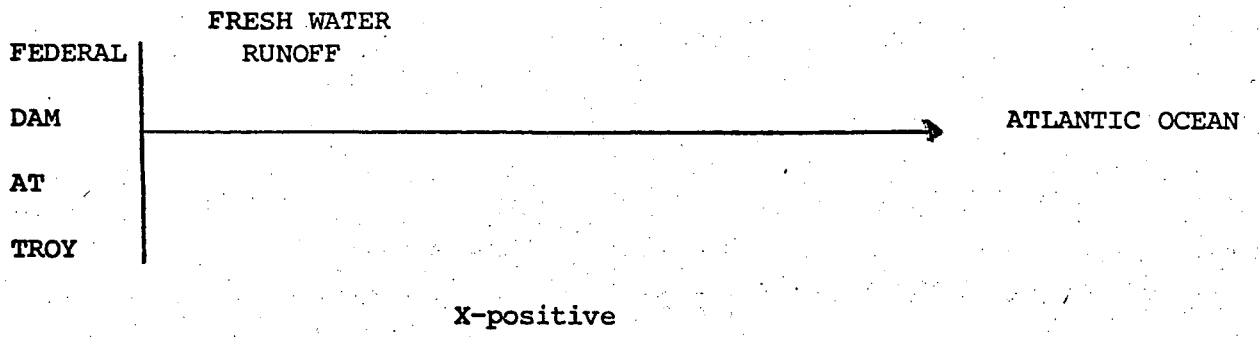
Two mathematical models of the Hudson River striped bass population are documented in this two volume set. Both of these models were used in preparing testimony concerning the possible impact of Con Edison's nuclear power plants at Indian Point on the Hudson River striped bass population.

Volume I contains the analysis, program flowcharts and listings for the transport model of the striped bass population. This model includes the hydrodynamic performance of the Hudson River on a tidal average time scale. The transport model is described in detail in the October 30, 1972 testimony of Dr. John P. Lawler on the "Effect of Entrainment and Impingement at Indian Point on the Population of the Hudson River Striped Bass".

The completely mixed model documented in Volume II is described in Dr. John P. Lawler's testimony of April 5, 1972 on the same issue.

Derivation of transport model:

The development commences with the segmentation of the estuary into "n" compartments or segments. Segment numbering is in ascending order from upstream to downstream.



We write the material balance equation for eggs and larval stages -- both stages have same balance. The balance is performed for segment k.

IN-OUT + PRODUCTION-LOSS-TRANSFER=ACCUMULATION

Each term in this equation is evaluated in terms of mass or numbers per unit volume with associated rate of decay coefficients (1/unit time).

Let us consider the rate of mass or energy input to a specific segment. Input to a segment consists of two terms. Advection which is the contribution to a segment due to the fresh water run-off. The mass contribution per unit volume to a segment is the fresh water run-off multiplied by the computed upstream boundary average concentration. Concentration is numbers per unit volume. The other term which accounts for input to a segment is the longitudinal mixing or dispersion. Dispersion is the transport of mass or energy above that transported into the segment via the net flow. This additional contribution physically represents

salinity-induced circulation, tidal mixing, etc.

The advective input to segment k is:

$$Q_{k-1,k} \quad C_{k-1,k}$$

where

$Q_{k-1,k}$ = the net flow at the boundary between segments k-1 and k. (volume/time).

$C_{k-1,k}$ = the area averaged, tidal-smoothed concentration of the unknown egg or larval entity at the boundary between segments k-1 and k. (mass/volume).

The dispersion of eggs or larvae from segment k-1 into segment k is:

$$-E_{k-1,k} \quad AX_{k-1,k} \quad \frac{dC}{dx}_{k-1,k}$$

where

$E_{k-1,k}$ = the longitudinal dispersion coefficient at the boundary of segments k-1 and k. (length^2/time).

$AX_{k-1,k}$ = The cross-sectional area at the same boundary. (length^2)

$\frac{dC}{dx}_{k-1,k}$ = The rate of change of concentration with respect to distance. (MASS/VOLUME/LENGTH).

Dispersive transport always moves in the direction of decreasing concentration. If the concentration is assumed to be decreasing in the downstream direction, dispersive transport at the upstream boundary of the segment should appear as input to the segment, i.e., its numerical value should be positive. Since the

gradient $\frac{dC}{cx}$ is negative in this case, the entire term will be positive as required with the inclusion of the minus sign in front of $E_{k-1,k}$. On the other hand, if the concentration of eggs and larvae is increasing in the downstream direction at the boundary between segments k-1 and k, dispersive transport should be out of segment k into segment k-1. The gradient is positive (dC/dx) but the minus in front of $E_{k-1,k}$ makes the entire term negative as required, i.e. dispersive transport is out of segment k into k-1.

Advective and dispersive output or output from segment k to segment k+1 is written similarly as above:

$$Q_{k,k+1} \quad C_{k,k+1} \quad - \quad E_{k,k+1} \quad AX_{k,k+1} \quad \frac{dC}{dx}_{k,k+1}$$

The rate of production for segment k is:

$$\int_{o}^{\Delta t} \overline{P_k \ (t) \ dt} = P_k \ (t) \ \Delta t$$

Where:

$P_k \ (t)$ is the average numbers of eggs produced in segment k for time period Δt. (NUMBERS), (DAYS)

The loss to segment k is

$$\int^{V_k} K'_E \ C_k \ dV$$

where:

$$K'_E = K_E + (K_E - K_o) * \left(\frac{C_k - C_s}{C_s}\right)^3$$

K_E = unit rate of decay (1/day); first order decay rate

K_o = minimum rate of decay (1/day)

C_s = carrying capacity of segment k (MASS/VOLUME)

C_k = total concentration in segment k (MASS/VOLUME)

V_k = volume of segment k.

Since we have used the age group approach within an early stage, we assume

Transfer = o;

so that when an end of an age group is attained, we apply similar equations to it but subject to a different mortality; that is, a different life cycle. We assume K'_E is fixed and evaluate the C_k term, without loss of generality.

Whereas, the accumulation of organisms within a given segment is the time rate of increase within that segment. This is written

$$\frac{d}{dt}\left\{ \int_0^{V_k} C_k \, dV \right\}$$

where:

t = time from some initial condition

$\int_0^{V_k} C_k \, dV$ = mass of organisms, C_k, in segment k.

This completes the evaluation of each term as presented in the material balance equation. Hence, we have:

$$\left[Q_{k-1,k} \cdot C_{k-1,k} - E_{k-1,k} \, AX_{k-1,k} \left[\frac{dC}{dx}\right]_{k-1,k}\right]$$

$$- \left\{ Q_{k,k+1} \cdot C_{k,k+1} - E_{k,k+1} \, AX_{k,k+1} \left[\frac{dC}{dx}\right]_{k,k+1} \right\} + \overline{P_k(t)} \Delta t$$

$$- K_e' \int_0^{V_k} C_k dV$$

$$= \frac{d}{dt} \left\{ \int_0^{V_k} C_k dV \right\} \qquad [1]$$

We assume that the variation of the concentration of organisms is linear between segment midpoints. This permits evaluation of the integrals and space deviations shown above. Thus, the "n" equations reduce to a set of first order ordinary differential equations. This set of equations may then be solved via the fourth order Runge - Kutta numerical technique on a digital computer.

This linear approximation simply requires that the segment length must be chosen sufficiently small, so that the actual concentration variation between segment midpoints can be represented by a straight line variation. We now evaluate each of the terms in the above equation.

The segment boundary concentrations, $C_{k-1,k}$ and $C_{k,k+1}$ are readily obtained when the variation between successive midpoint concentrations C_{k-1}, C_k, and C_{k+1} is linear. Using ratios of similar triangles, we get:

$$C_{k-1,k} = C_{k-1}\left(\frac{L_k}{L_{k-1} + L_k}\right) + C_k\left(1 - \frac{L_k}{L_{k-1} + L_k}\right)$$

Let $$EP_k = \frac{L_k}{L_{k-1} + L_k}$$

where:

L_k is the length of segment k.

Hence we rewrite this equation as:

$$C_{k-1,k} = EP_k \cdot C_{k-1} + (1-EP_k) \cdot C_k$$

In a similar manner the downstream boundary condition is written:

$$C_{k,k+1} = EP_{k+1} \cdot C_k + (1-EP_{k+1}) \cdot C_{k+1}$$

where:

$$EP_{k+1} = \frac{L_{k+1}}{L_k + L_{k+1}}$$

The linear assumption requires that the gradient $[dC/dx]_{k-1,k}$ be constant

between segment midpoints. This quantity is computed as follows:

$$\left[\frac{dC}{dx}\right]_{k-1,k} = \frac{C_k - C_{k-1}}{X_k - X_{k-1}}$$

where:

X_k, X_{k-1} are at the midpoint of segments k and k-1, respectively and therefore are representable as being at distance $\frac{L_k}{2}$ and $\frac{L_{k-1}}{2}$ from the coincident boundary.

Hence $X_k - X_{k-1} = \frac{L_k + L_{k-1}}{2}$

and $\left[\frac{dC}{dx}\right]_{k-1,k} = 2 \cdot \frac{[C_k - C_{k-1}]}{L_k + L_{k-1}}$ for upstream boundary of segment k.

Similarly, for the downstream boundary concentration between segments k and k+1, we find for the gradient

$$\left[\frac{dC}{dx}\right]_{k,\ k+1} = 2 \cdot \frac{[C_{k+1} - C_k]}{L_k + L_{k+1}}$$

To evaluate the decay term, this is accomplished by evaluating the linear profile for C between each boundary and the segment midpoint, and then performing the required integral evaluation. Begin by splitting the integral about the midpoint, since the profile is discontinuous at this point.

$$\int_0^{L_k} C\ dx = \int_0^{L_k/2} C_1\ dx + \int_{\frac{L_k}{2}}^{L_k} C_2 dx$$

where:

$$C_1 = \frac{[C_k - C_{k-1,k}]}{\left(\frac{L_k}{2}\right)} \cdot X + C_{k-1,k}$$

and

$$C_2 = \left[\frac{C_{k+1,k} - C_k}{L_k/2}\right]\left(X - L/2\right) + C_k$$

Substitution of these results for an evaluation of the integration of C_1 and C_2 yields:

$$\int_0^{L_k} C\,dx = (C_{k-1,k} + 2C_k + C_{k+1,k})\,\frac{L_k}{4}$$

Using the results for segment boundary conditions in the above equation, we obtain:

$$\int_0^{L_k} C\,dx = \frac{L_k}{4}\left\{EP_k \cdot C_{k-1} + (3 + EP_{k+1} - EP_k)\,C_k + (1 - EP_{k+1})\,C_{k+1}\right\}$$

Recall that in the evaluation of the decay term, we extracted K_E' from under the integral. Had we left K_E' under the integral our results above would have contained concentrations raised to the fourth power. This would mean more involved computer time later. The results of these computations will not yield that much more accuracy than if we treat K_E' as a constant. Especially if we are taking small time steps, the change in concentration will not be that significant from one time step to the next. Hence, the effect to the decay term due to carrying capacity will not be tremendously affected by using this simplification.

Similarly, if we compute the accumulation term in equation (1), we get:

$$\frac{d}{dt}\int_0^{V_k} C\,dv = \frac{d}{dt}\left\{\frac{V_k}{4}\,[EP_k \cdot C_{k-1} + (3 + EP_{k+1} - EP_k)C_k + (1-EP_{k+1})C_{k+1}]\right\}$$

To simplify the equations, let us introduce some new terminology. Let

$$D_{k-1,k} = 2\left[\frac{E_{k-1,k} \cdot AX_{k-1,k}}{L_{k-1} + L_k}\right]$$

and

$$D_{k,k+1} = 2 \cdot \frac{E_{k,k+1} \cdot AX_{k,k+1}}{L_k + L_{k+1}}$$

which are called the exchange coefficients between segments k-1, k, and k+1, respectively. They are called this since they represent the rate of volume transfer from one segment to another and back again.

Let:

$$a_{k,k-1} = \frac{1}{4} EP_k$$

$$a_{k,k} = \frac{1}{4} (3 + EP_{k+1} - EP_k)$$

$$a_{k,k+1} = \frac{1}{4} (1 - EP_{k+1})$$

These terms represent the relationship of midpoint concentrations in segments k-1 and k+1 to segment k midpoint concentrations.

Rewriting equation [1], we obtain

$$Q_{k-1,k} \left\{ EP_k \, C_{k-1} + (1-EP_k) \, C_k \right\} - D_{k-1,k} \, (C_k - C_{k-1})$$

$$- \left\{ Q_{k,k+1} \left(EP_{k+1} \cdot C_k + (1 - EP_{k+1}) \, C_{k+1} \right) - D_{k,k+1} \, (C_{k+1} - C_k) \right\}$$

$$+ \overline{P_k(t)} \Delta t - K_{E_k}' V_k \left\{ a_{k,k-1} \, C_{k-1} + a_{k,k} \, C_k + a_{k,k+1} \, C_{k+1} \right\}$$

$$= a_{k,k-1} \, V_k \frac{dC_{k-1}}{dt} + a_{k,k} \, V_k \frac{dC_k}{dt} + a_{k,k+1} \, V_k \frac{dC_{k+1}}{dt} \qquad [2]$$

To further simplify equation [2], divide by V_k and group terms as follows; and subtracting from segment k the plant withdrawal of $f_{E_k} Q_{p_m}/V_k$;

f_{E_k} = entrainment

Q_{p_k} = plant intake

$$A_{k,k-1} = [Q_{k-1,k}\ EP_k + D_{k-1,k}]/V_k$$

$$A_{k,k} = [Q_{k-1,k}\ (1-EP_k) - D_{k-1,k} - Q_{k,k+1} \cdot EP_{k+1} - D_{k,k+1}]/V_k$$
$$- f_{E_k} Q p_k / V_k$$

$$A_{k,k+1} = -[Q_{k,k+1}\ (1-EP_{k+1}) - D_{k,k+1}]/V_k$$

Rewriting equation [2], we have

$$A_{k,k-1}\ C_{k-1} + A_{k,k}\ C_k + A_{k,k+1}\ C_{k+1}$$

$$- \quad K'_{E_{k-1}}\ A_{k,k-1}\ C_{k-1} - K'_{E_k} \cdot a_{k,k}\ C_k - K'_{E_{k+1}}\ a_{k,k+1}\ C_{k+1}$$

$$+ \quad \overline{P_k(t)}\,\Delta t/V_k = a_{k,k-1}\ \frac{dC_{k-1}}{dt} + a_{k,k}\ \frac{dC_k}{dt} + a_{k,k+1}\ \frac{dC_{k+1}}{dt}$$

Now, if we assume that no organisms enter the estuary at the upstream boundary of segment 1 and leave the estuary at the downstream boundary of segment n, we arrive at the following set of equations in matrix form:

$$\begin{bmatrix} A_{11} & A_{12} & 0 & \cdots & & & & \\ A_{21} & A_{22} & A_{23} & 0 & & & \bigcirc & \\ 0 & A_{32} & A_{33} & A_{34} & 0 & & & \\ & 0 & \cdot & \cdot & \cdot & 0 & & \\ & & 0 & \cdot & \cdot & \cdot & 0 & \\ & & & 0 & \cdot & \cdot & \cdot & 0 \\ & \bigcirc & & & 0 & A_{n-1,n-2} & A_{n-1,n-1} & A_{n-1,n} \\ & & & & & 0 & A_{n,n-1} & A_{n,n} \end{bmatrix} \begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ C_n \end{bmatrix}$$

$$
-\begin{bmatrix}
K'_{E_1} a_{11} & K'_{E_2} a_{12} & 0 & & & & \\
K'_{E_1} a_{21} & K'_{E_2} a_{22} & K'_{E_3} a_{23} & 0 & & \bigcirc & \\
0 & \cdot & \cdot & \cdot & 0 & & \\
 & 0 & \cdot & \cdot & \cdot & 0 & \\
 & \bigcirc & 0 & \cdot & \cdot & \cdot & \\
 & & & 0 & K'_{E_{n-1}} a_{n,n-1} & K'_{E_n} a_{n,n}
\end{bmatrix}
\begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ \cdot \\ \cdot \\ C_n \end{bmatrix}
$$

$$
+\begin{bmatrix}
\dfrac{\overline{P_1(t)}\,\Delta t}{V_1} \\
\dfrac{\overline{P_2(t)}\,\Delta t}{V_2} \\
\cdot \\
\cdot \\
\cdot \\
\dfrac{\overline{P_n(t)}\,\Delta t}{V_n}
\end{bmatrix}
$$

$$
=\begin{bmatrix}
a_{11} & a_{12} & 0 & & & & \\
a_{21} & a_{22} & a_{23} & 0 & & \bigcirc & \\
0 & a_{32} & a_{33} & a_{34} & 0 & & \\
 & 0 & \cdot & \cdot & \cdot & 0 & \\
 & \bigcirc & 0 & \cdot & \cdot & \cdot & 0 \\
 & & & 0 & a_{n-1,n-2} & a_{n-1,n-1} & a_{n-1,n} \\
 & & & & 0 & a_{n,n-1} & a_{n,n}
\end{bmatrix}
\begin{bmatrix} C_1' \\ C_2' \\ C_3' \\ \cdot \\ \cdot \\ \cdot \\ C_n' \end{bmatrix}
$$

We can rewrite this matrix set of equations as

$$AC - DC + P = EC' \qquad [4]$$

where

A = the occurrence of advection and dispersion throughout the estuary

D = the decay mechanism of organic matter throughout the estuary

P = the occurrence of the rate of production throughout the estuary

E = the relationship of midpoint concentration change throughout the estuary

C = current concentrations at midpoint of segments

C' = change in current midpoint segment concentrations.

Equation [4] is solved as follows:

[5] $P = EC'$

This represents the generation of the first age group within either the egg or larval stage.

[6] $AC - DC = EC'$

This represents the progression of age groups within a particular early life stage to maturity and entrance into the next life cycle.

Whence, for equation (5), we get

$$C_{\Delta t} = C_o + E^{-1}P \qquad [7]$$

and for equation [6]

$$C' = [E^{-1}A]C - [E^{-1}D]C \qquad [8]$$

Co represents the initial concentration of age group 1 at time zero.

$C_{\Delta t}$ represents the age group concentration at time Δt. This is input into equation [8] to determine successive age group concentrations.

The inverse of matrix E, (the procedure) is illustrated in the section TMXINV. Matrix multiplication is illustrated in section MXMUL. The numerical technique to resolve equation [8] is illustrated in section RKUTTA. The computational procedure for the decay matrix is illustrated in Section DECAY.

This completes the methodology employed to resolve transport, decay, and plant effect to the egg and larval stages, respectively.

To properly represent the phenomena of migration and decay and plant withdrawal for the juvenile I through juvenile III stages, we proceed as follows.

We assume migration between segments takes place from upstream to downstream. If no migration occurs into or out of a specific segment the resulting concentration is affected exclusively by decay.

Let $[MIG]_i$ = migration preference for segment i

$$= \frac{(\text{Observed fraction - computed fraction})}{(\text{Time at end of stage - current time})} \times (\text{total numbers})$$

$[SA]_i$ = specific age group within a stage to the total numbers in the stage

then:

$[MP]_i = [MIG]_i \times [SA]_i$ is the migration preference of $[SA]_i$ for segment i.

If $[MIG]_i = 0$, no migration is affected. If $[MIG]_i < 0$, migration occurs in the upstream direction. If $[MIG]_i > 0$, migration is downstream. Since no migration is assumed to occur outside the estuary, let:

$$Y_1 = [MP]_{11}/V_1, \text{ migration is downstream at segment 1}$$

$$Y_n = 0, \text{ no migration out of segment n}$$

and between segment

$$Y_i = ([MP]_{i-1} - [MP]_i)/V_i$$

where V_i is the volume of segment i and Y_i is the concentration in segment i. Hence the change in concentration due to migration and decay is:

$$\vec{Y}' = E^{-1}\vec{Y} - D\vec{Y}$$

if no migration is assumed then

$$\vec{Y}' = -D\vec{Y}.$$

Cycling:

The number of juvenile III's remaining at the end of year are the recruits to adult 1 (assuming compensation to be operative or non-operative) say A_1. Let S_1 be the survival rate of A_1 to A_2, then

$$A_2 = A_1 S_1$$

In general

$$A_n = A_{n-1} S_{n-1}.$$

In this fashion, we generate an adult population when no plants are operative. The so-called "equibilrium" (relative) or base population.

The total egg production, E, is

$$E = \sum_i A_i M_i S_i F_i$$

where:

M_i = maturation of ith age group (class)

S_i = females of ith age group to total number in i age class

F_i = fecundity of females in i^{th} age class.

This egg production is used for the forthcoming years when the plant is assumed to be operative. Cycling through the transport equation could then be effected, but would be quite expensive. To reduce costs, a ratio of the results produced by the transport and completely mixed models for the base year and one year's operation of the plant(s) has been introduced to force the completely mixed model to behave like the transport model.

the reduction of cost in run time since the totally mixed model runs in a fraction of the time required by the transport model.

Internal switches:

K is set equal to IMODEL and is passed in the argument list to either HISTG or TMODEL and used internally by those routines.

Equations: None

Subroutines called:

TMODEL - Transport model

HISTG - Totally mixed model

DMODEL:

Functional description: DMODEL is the main program that selects either the transport model (TMODEL) if IMODEL =1, the totally mixed models (in this specific order) if IMODEL = 3. DMODEL requires input to determine if any of the early life cycles survival is to be random. This is accomplished by setting a switch to zero which indicates no random survival or to one which does. The array is M(5) where M(1), M(2), M(3), M(4), and M(5) respectively refer to the egg, larval, juvenile I, juvenile II, juvenile III life stages.

Inputs:

IMODEL = Model to be selected;

1 implies the transport model

2 implies the totally mixed model

3 implies both

M(1:5) = ϕ - no
1 - yes
random survival

External switches:

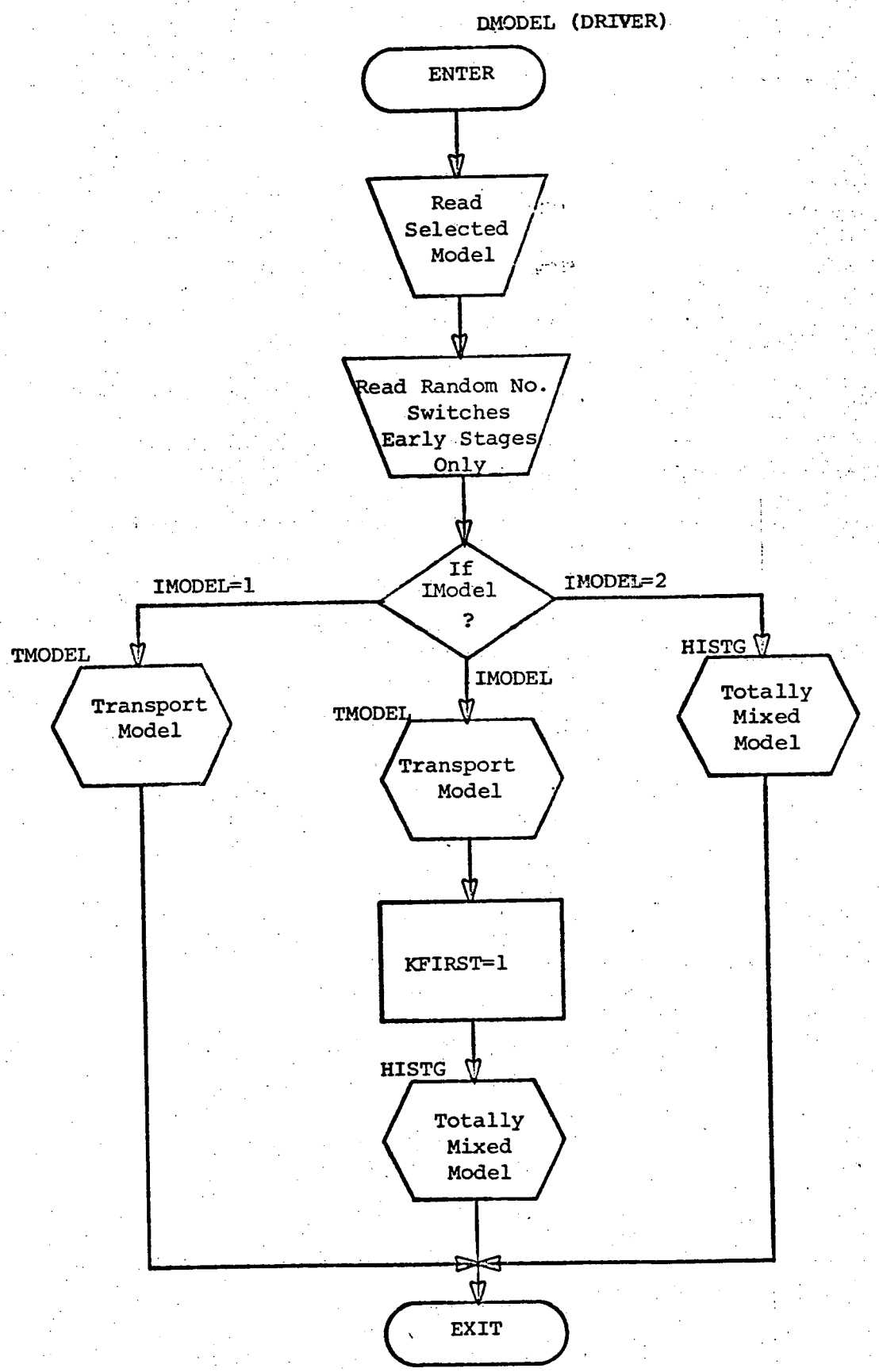
KFIRST = ϕ - no
1 - yes - designates if the equilibrium condition for year zero has been computed.

ITY = specifies the number of internal adult 1 age classes which have been stored. Used in the computation of the adult 1 modifier in the completely (totally) mixed model to either scale down or up the number of recruits to this age class. Functionally, this forces the totally mixed model to behave as the transport model for specified run parameters. This enables

Required Argument Name List

position	variable name	description
1	ADULT (1:20)	NUMBER ADULTS/ADULT CLASS
2	FR (1:20)	Sex ratio FEMALE: TOTAL ADULTS
3	FM (1:20)	Female Maturation
4	FEC (1:20)	AVERAGE FECUNDITY/FEMALE
5	SVA (1:20)	ADULT FIRST ORDER DECAY RATE
6	SVAO (1:20)	MINIMUM ADULT MORTALITY
7	KFIRST	= 0 no 1 yes equilibrium case
8	ADULTS (1:20)	ADULT CARRYING CAPACITY
9	SVU (1:20)	COMPENSATORY DECAY RATE FOR ADULTS
10	RMF (1:20)	product of items 2,3, & 4
11	K	IMODEL
12	M (1:5)	RANDOM SURVIVAL 0 = no 1 = yes
13	EAD (1:ITY)	ADULT 1 recruits for years 1:ITY
14	ITY	number of EAD

Outputs: None


DMODEL (DRIVER)
ENTER
Read Selected Model
Read Random No. Switches Early Stages Only
If IModel ?
IMODEL=1
IMODEL=2
IMODEL
TMODEL
Transport Model
TMODEL
Transport Model
HISTG
Totally Mixed Model
KFIRST=1
HISTG
Totally Mixed Model
EXIT

DMODEL-PNC/LIBS CREATE:02/01/73,11:27:53 FREQ:11 SIZE:1 BACKUP:02/02/73,
C[illegible]21:30 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE ON:SPN

```
C......DRIVER PROGRAM. DETERMINES WHICH MODEL IS TO BE USED.
        DIMENSION ADULT(20),FR(20),FM(20),FEC(20),SVA(25),SVAO(25)
       DIMENSION ADULTS(20),SVU(25),RMF(20),M(5),EAD(20)
      READ(5,10)IMODEL,(M(J),J=1,5)
   10 FORMAT( )
C......IMODEL=1, USE TRANSPORT MODEL.
C......IMODEL=2, USE TOTALLY MIXED MODEL.
C......IMODEL=3, USE TRANSPORT MODEL AND THE TOTALLY MIXED MODEL.
      ITY=0
      K=IMODEL
      IF(K-2)100,200,300
C......CALL TRANSPORT MODEL.
  100 CALL TMODEL(ADULT,FR,FM,FEC,SVA,SVAO,KFIRST,ADULTS,SVU,RMF,K,M,
     *EAD,ITY)
      GO TO 500
  200 KFIRST=0
C......CALL TOTALLY MIXED MODEL.
      CALL HISTG(ADULT,FR,FM,FEC,SVA,SVAO,KFIRST,ADULTS,SVU,RMF,K,M,
     *EAD,ITY)
      GO TO 500
  300 CALL TMODEL(ADULT,FR,FM,FEC,SVA,SVAO,KFIRST,ADULTS,SVU,RMF,K,M,
     *EAD,ITY)
      KFIRST=1
      CALL HISTG(ADULT,FR,FM,FEC,SVA,SVAO,KFIRST,ADULTS,SVU,RMF,K,M,
     *EAD,ITY)
  500 STOP
      END
```

IQ

TMODEL:

Functional description

TMODEL permits the tracing of the life stages of the striped bass due to advection, dispersion, decay, and migration. Briefly, it performs those calculations pertaining to transport phenomena.

Initially TMODEL calls the subroutine INPUT which initiates a reading in of all required input parameters. INITIAL then initializes key input parameters. Depending upon the value of IOPT the input parameters are either displayed or not displayed. The computation of the inverse of the E-matrix, which relates the changes in midpoint concentrations, is computed for the run. Plant entrainment rates for the egg stage are calculated. If random egg survival is desired, a gross random decay rate is computed for the egg stage to be used throughout the year. Total eggs produced in each segment and assumed to yield estuary total is calculated for time step Δt. This set of values is used to compute the change in midpoint concentration. If required for current time a computation for exchange coefficients, the matrix of advection and dispersive coefficients are made. These values are used to compute the matrix $E^{-1}A$ which is used to compute changes in midpoint concentrations. However, decay mechanisms must be included. These values acquired we next compute the change in midpoint concentrations advancing all age groups after decay, advection, and dispersion one time step forward. This process is continued to the end of the stage. Note that at the end of the egg stage, the next age group represents production into the lavval stage. Δt_E days of the egg stage, our larval production table is complete for the next cycle.

A similar procedure is followed thru the larval cycle thereby generating a production table of juvenile I's.

In the juvenile I thru III cycle instead of computing changes in midpoint concentration due to advection and dispersion, this change is computed due to migration preferences.

In all life cycles of the early stages, calculations are performed which measure rates of entrainment for the egg and larval stage and rates of impingement for the juvenile I thru III cycle. These rates and totals entrained and impinged are displayed. Furthermore, errors introduced in the numerical computations which advance age groups on a pertime step basis are corrected at each time step by treating each segment as a completely mixed tank in which nothing leaves or enters. Decay acts on the current age group concentrations in each segment. Total numbers are computed for each segment in the estuary and summed to yield the estuary total. This total is assumed correct. The results of the numerical technique are utilized to compute the distribution of organisms throughout the estuary. This distribution is assumed correct and is used to redistribute the total number of organisms computed via the completely mixed notion. The resulting total numbers in each segment thus being corrected are converted back to midpoint concentrations and used to compute the next age group in the above manner outlined.

At the end of the juvenile III stage, the total number of survivors represents the recruits to adult year class I. If an adult population exists, it is decayed one year forward and the previous adult I year class is superceded with the recruits. Total population is then computed. If no adult population exists, the routine 2 EQUAL is called in order to generate decay rates which satisfy the equilibrium condition. These decay rates are used to compute

the adults in each succeeding year class and then totalled to yield total adults in estuary. The first year recruits and each succeeding set of first year recruits are saved as input to the completely mixed model in order to compute the TRT, which is the modifier that makes the completely mixed model resemble the transport model for the cycling of adults.

The transport model cycles until completion and then transfers control to the calling routine DMODELS.

Inputs:

See DMODEL

INPUT see sample data input section.

Equations: see analysis

Outputs: See report section generated. SAMPLE OUTPUT section

Referenced by: DMODEL

Subroutines called:

INTIAL

AWGHT

MTIME

GROSSK

FACTOR

INPUT

PARSUM

TMXINV

MXMUL

DICAL

AMACAL

RKUTTA

MIGN

WEIGHT

PATCHI

PATCH2

TNUM

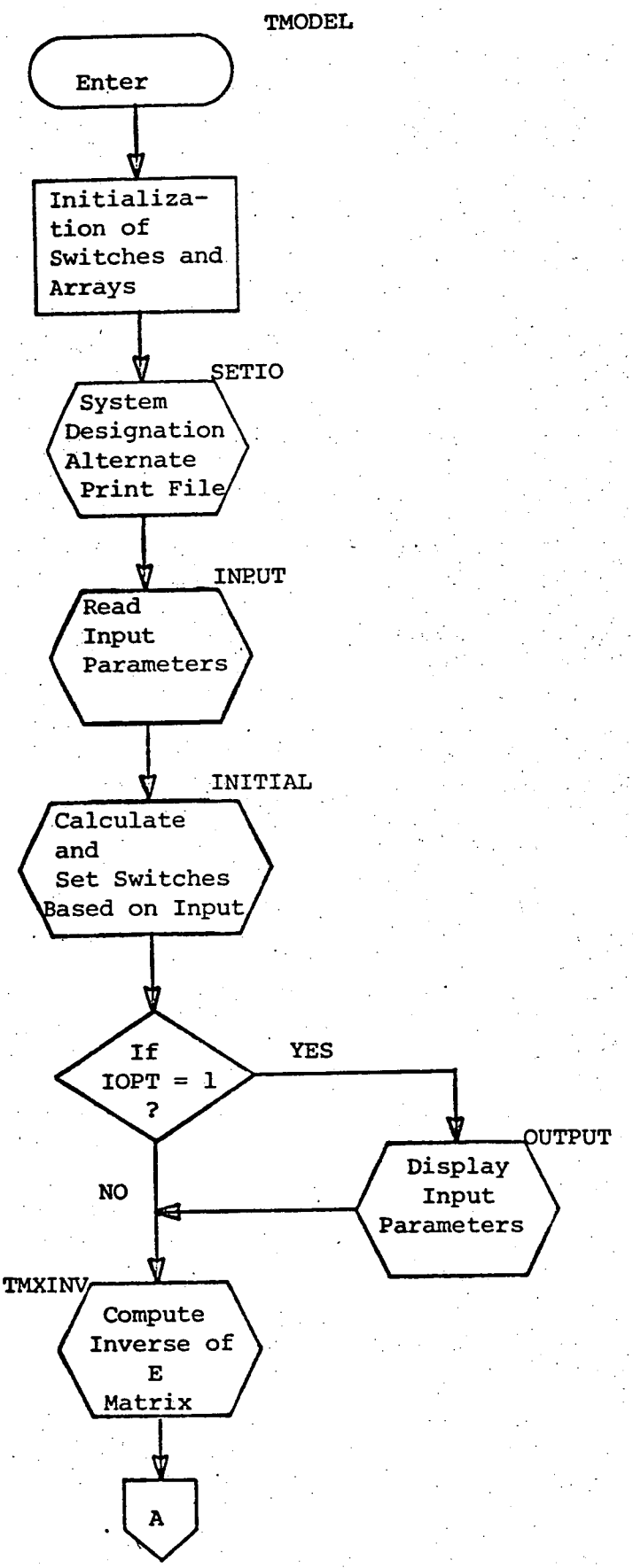
DECAY

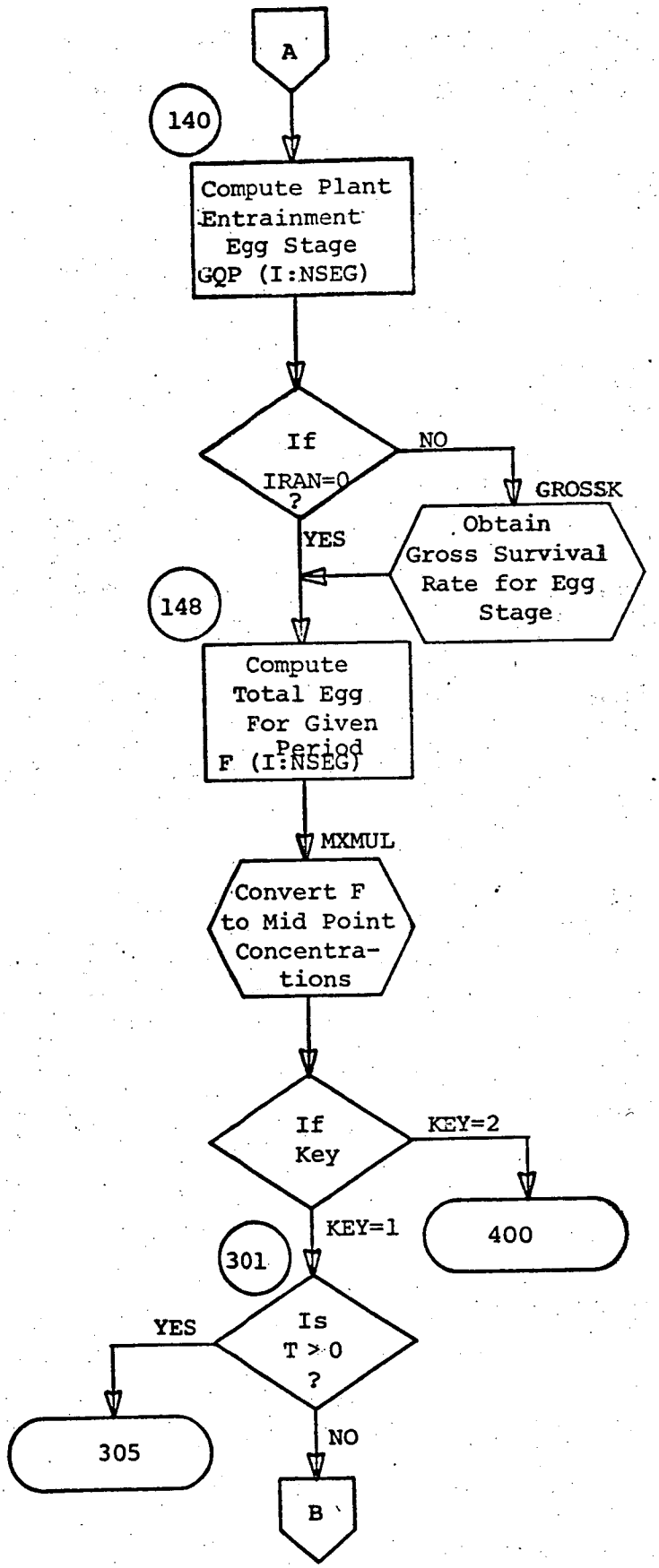
COMPUT

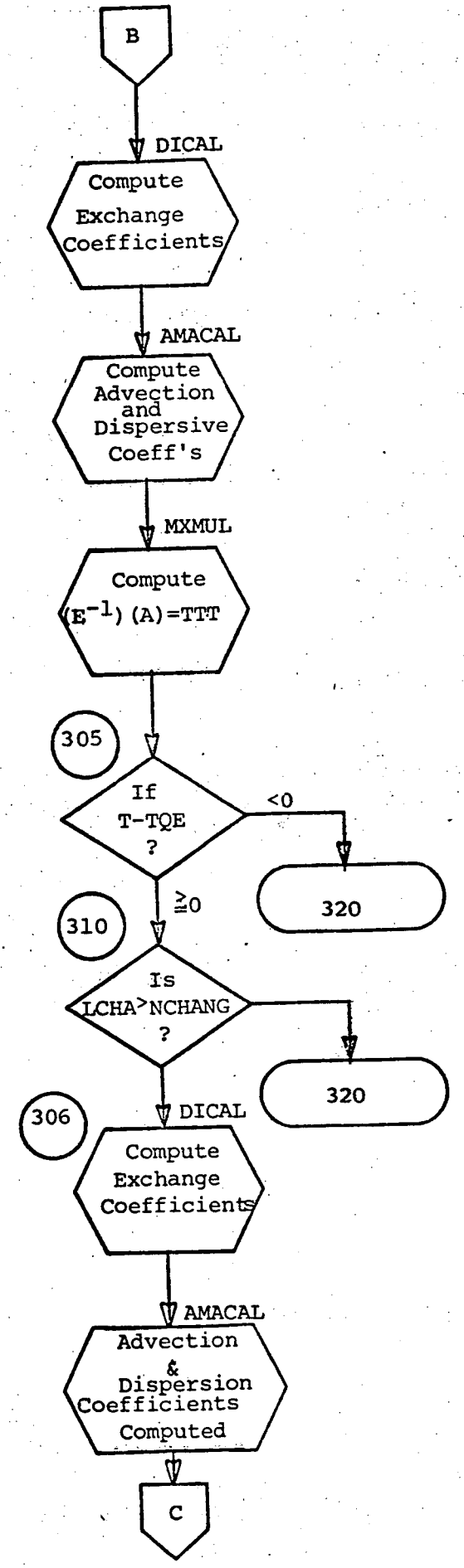
OUTPUT

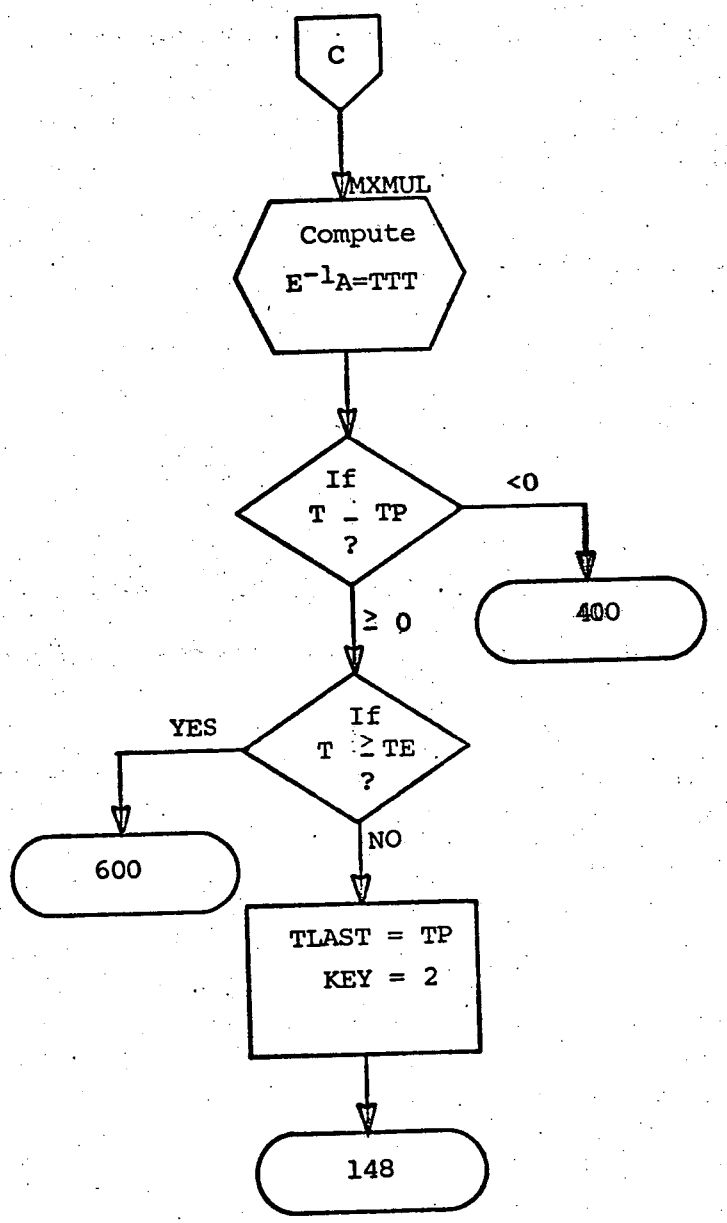
RANDN

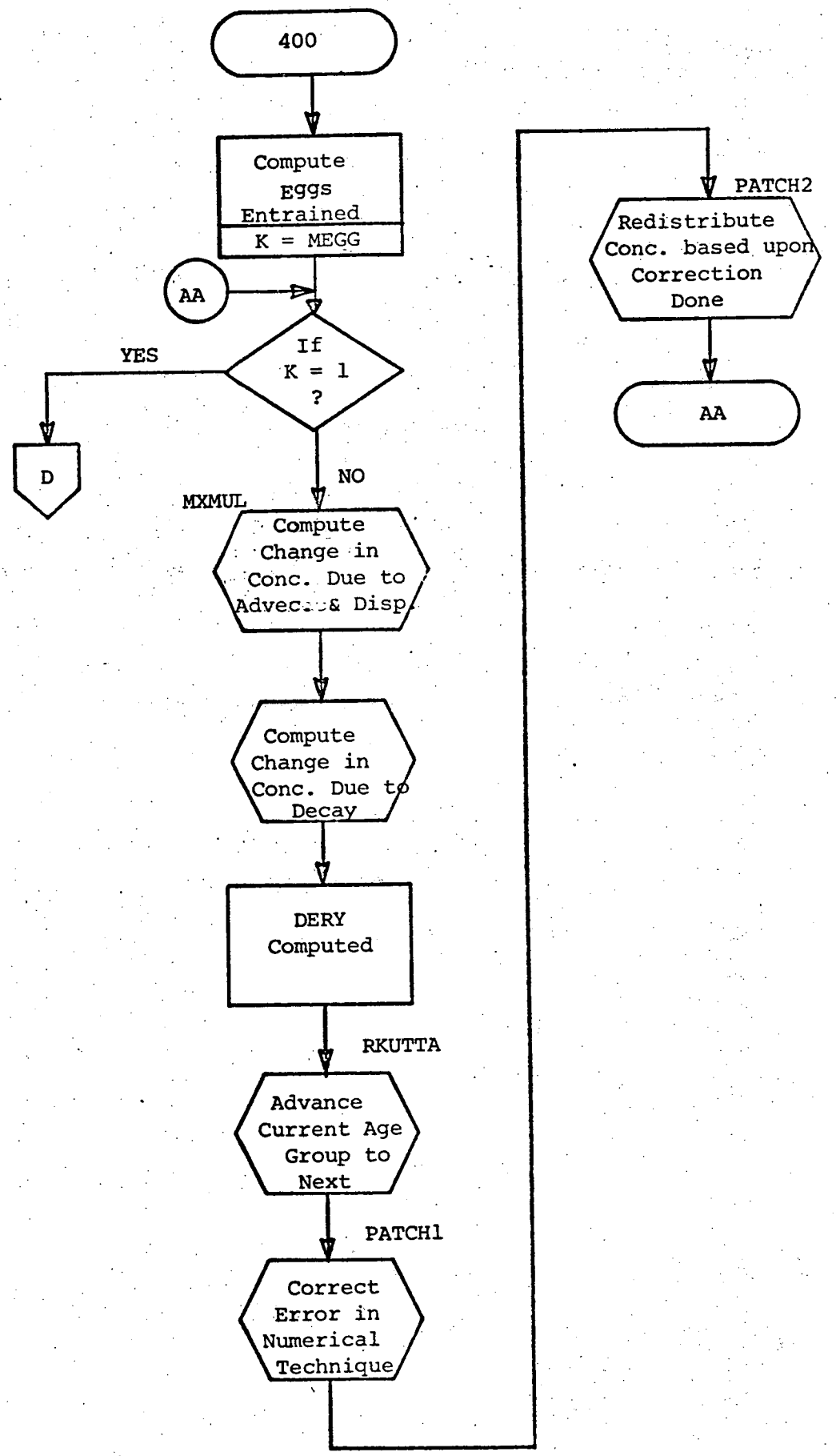
EQUAL

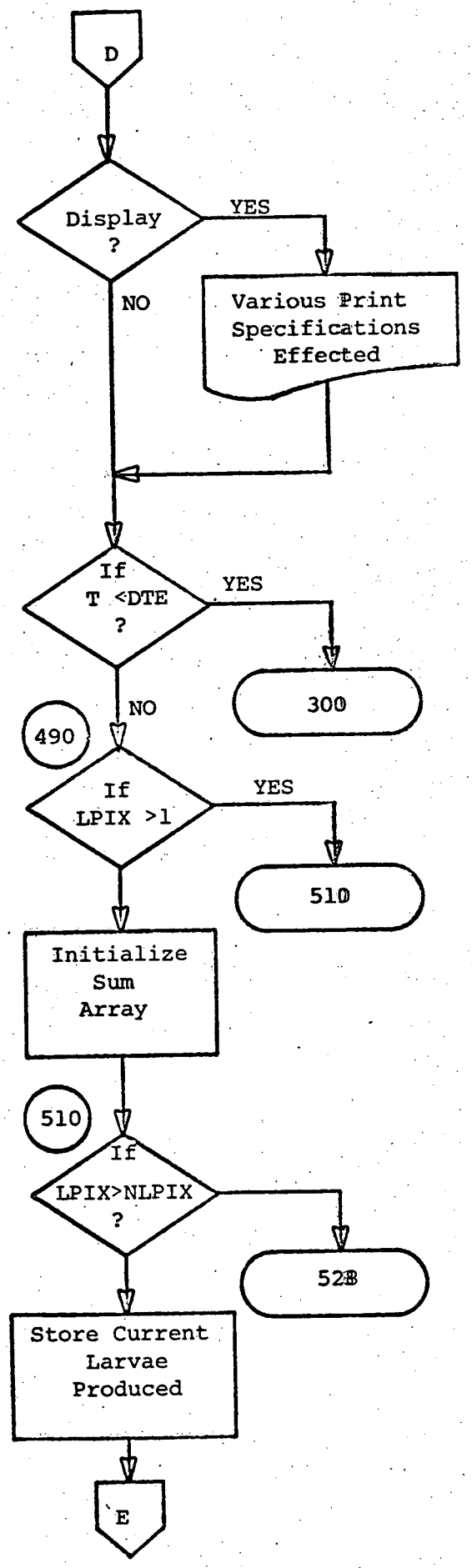

TMODEL
Enter
Initializa-
tion of
Switches and
Arrays
SETIO
System
Designation
Alternate
Print File
INPUT
Read
Input
Parameters
INITIAL
Calculate
and
Set Switches
Based on Input
If
IOPT = 1
?
YES
OUTPUT
Display
Input
Parameters
NO
TMXINV
Compute
Inverse of
E
Matrix
A

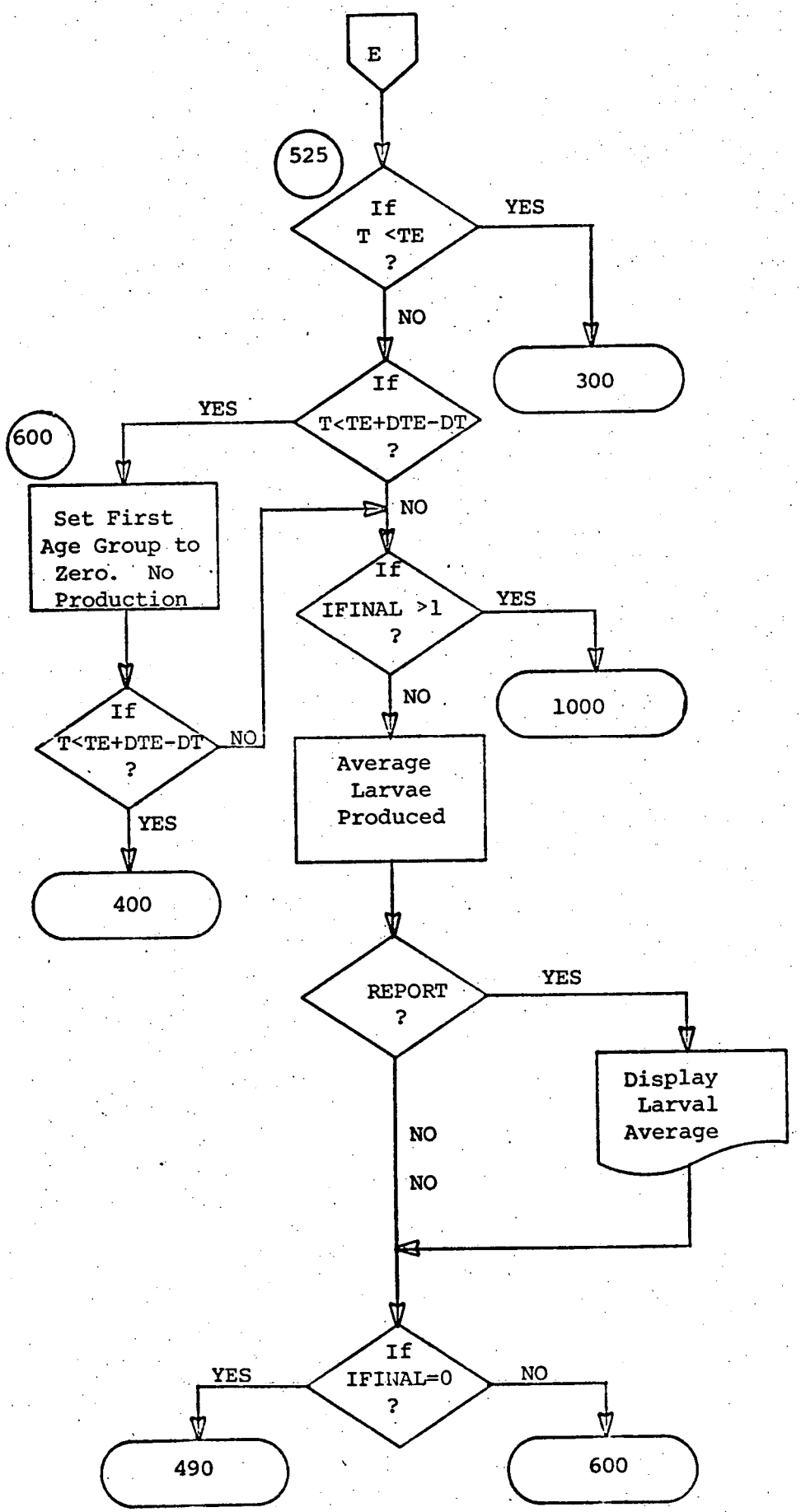

A
140
Compute Plant Entrainment Egg Stage GQP (I:NSEG)
If IRAN=0 ?
NO
GROSSK
Obtain Gross Survival Rate for Egg Stage
YES
148
Compute Total Egg For Given Period F (I:NSEG)
MXMUL
Convert F to Mid Point Concentra- tions
If Key
KEY=2
400
KEY=1
301
Is T > 0 ?
YES
305
NO
B

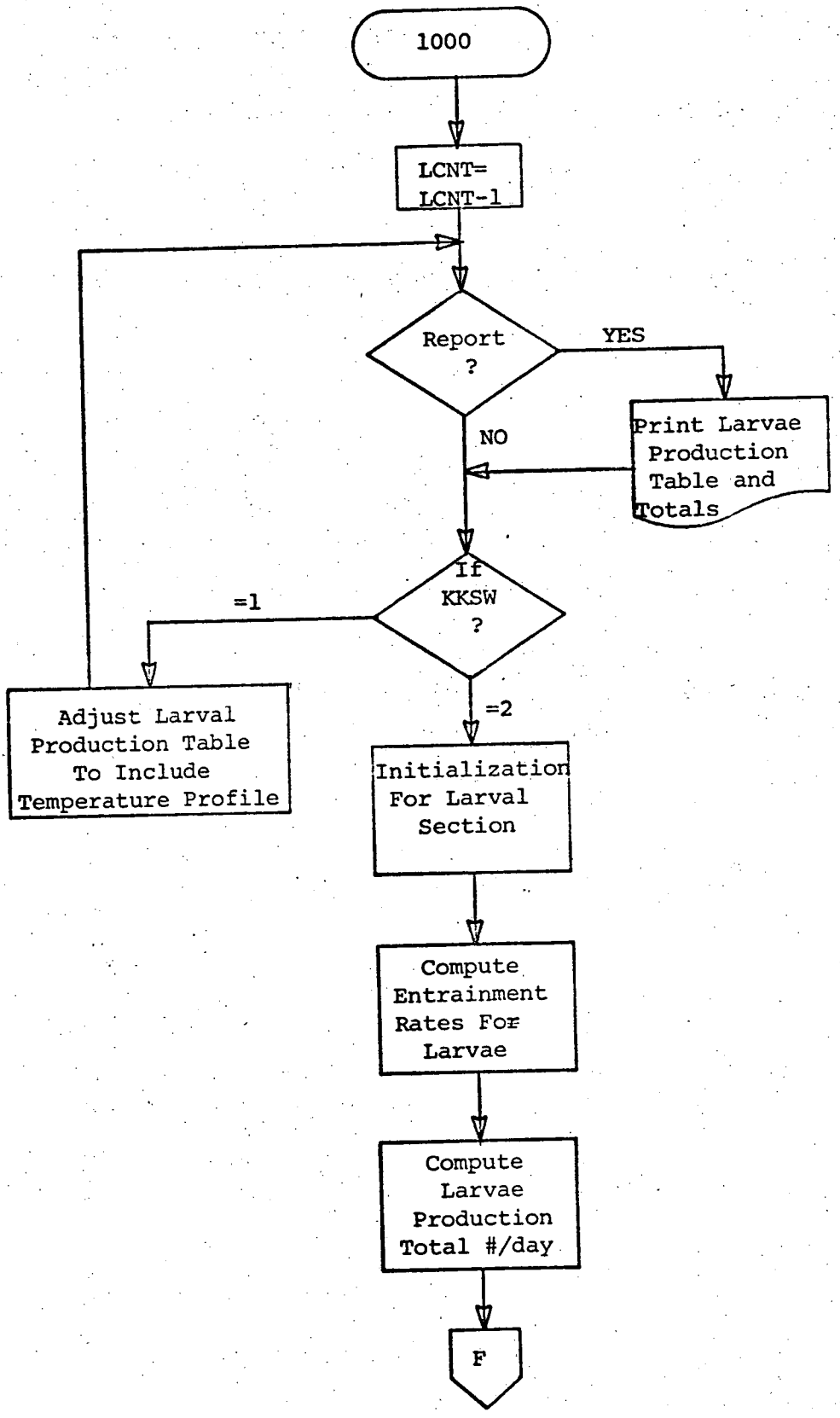

B
DICAL
Compute Exchange Coefficients
AMACAL
Compute Advection and Dispersive Coeff's
MXMUL
Compute $(E^{-1})(A)=TTT$
305
If T-TQE ?
<0
320
≧0
310
Is LCHA>NCHANG ?
320
306
DICAL
Compute Exchange Coefficients
AMACAL
Advection & Dispersion Coefficients Computed
C

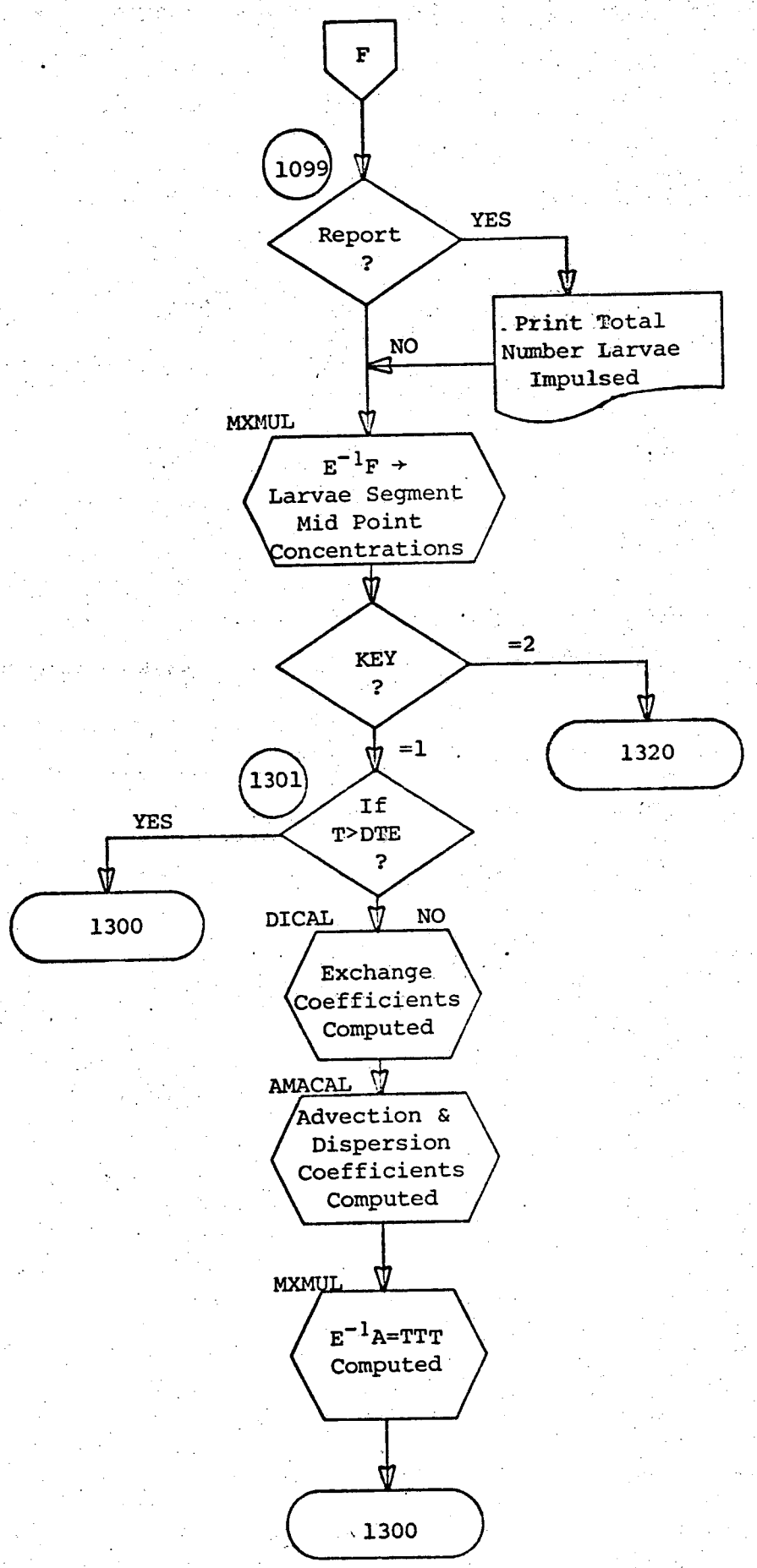

C
MXMUL
Compute
$E^{-1}A=TTT$
If
T - TP
?
<0
400
≥ 0
If
T ≥ TE
?
YES
600
NO
TLAST = TP
KEY = 2
148

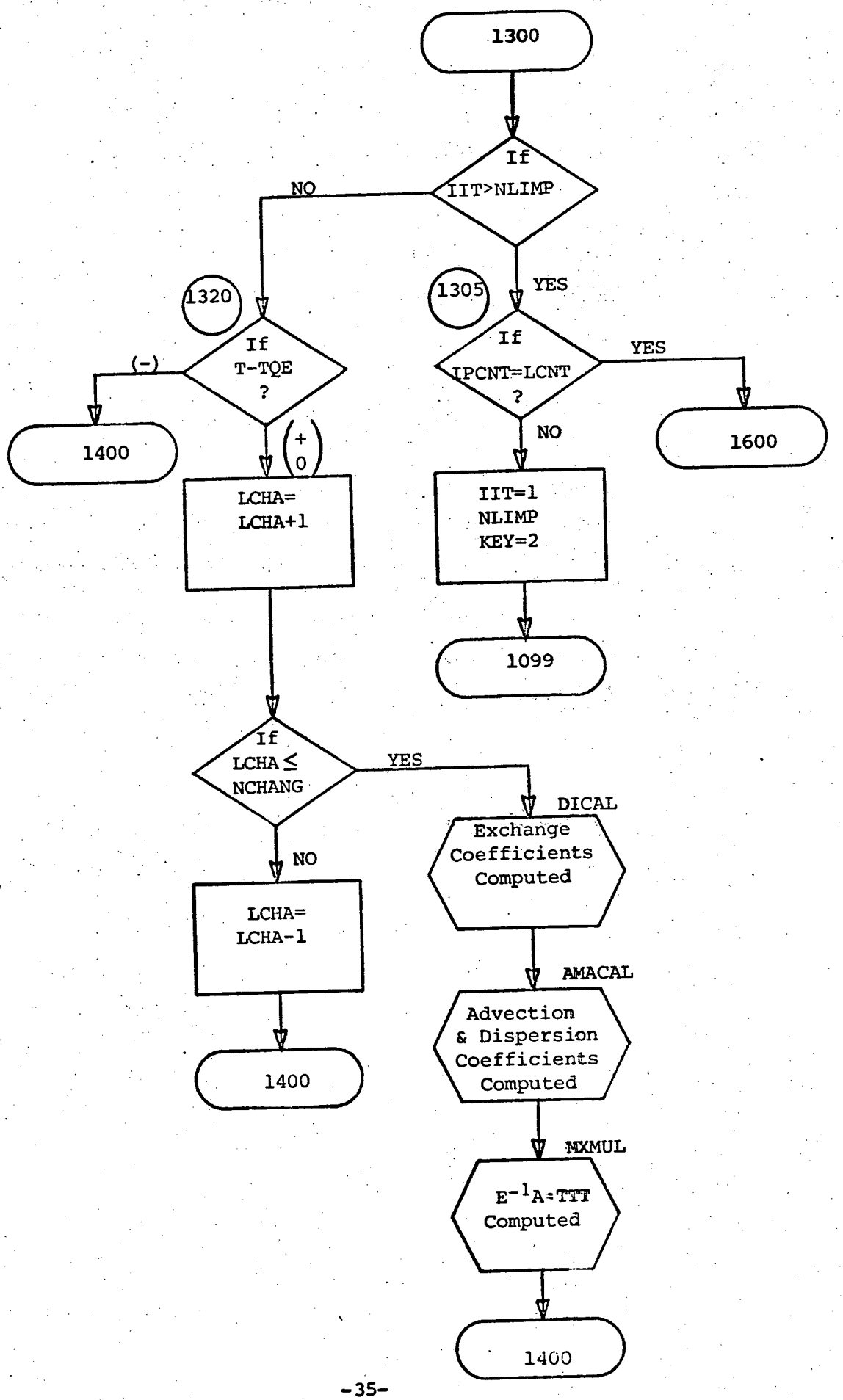

400
Compute Eggs Entrained
K = MEGG
AA
If K = 1 ?
YES
D
NO
MXMUL
Compute Change in Conc. Due to Advec.& Disp.
Compute Change in Conc. Due to Decay
DERY Computed
RKUTTA
Advance Current Age Group to Next
PATCH1
Correct Error in Numerical Technique
PATCH2
Redistribute Conc. based upon Correction Done
AA

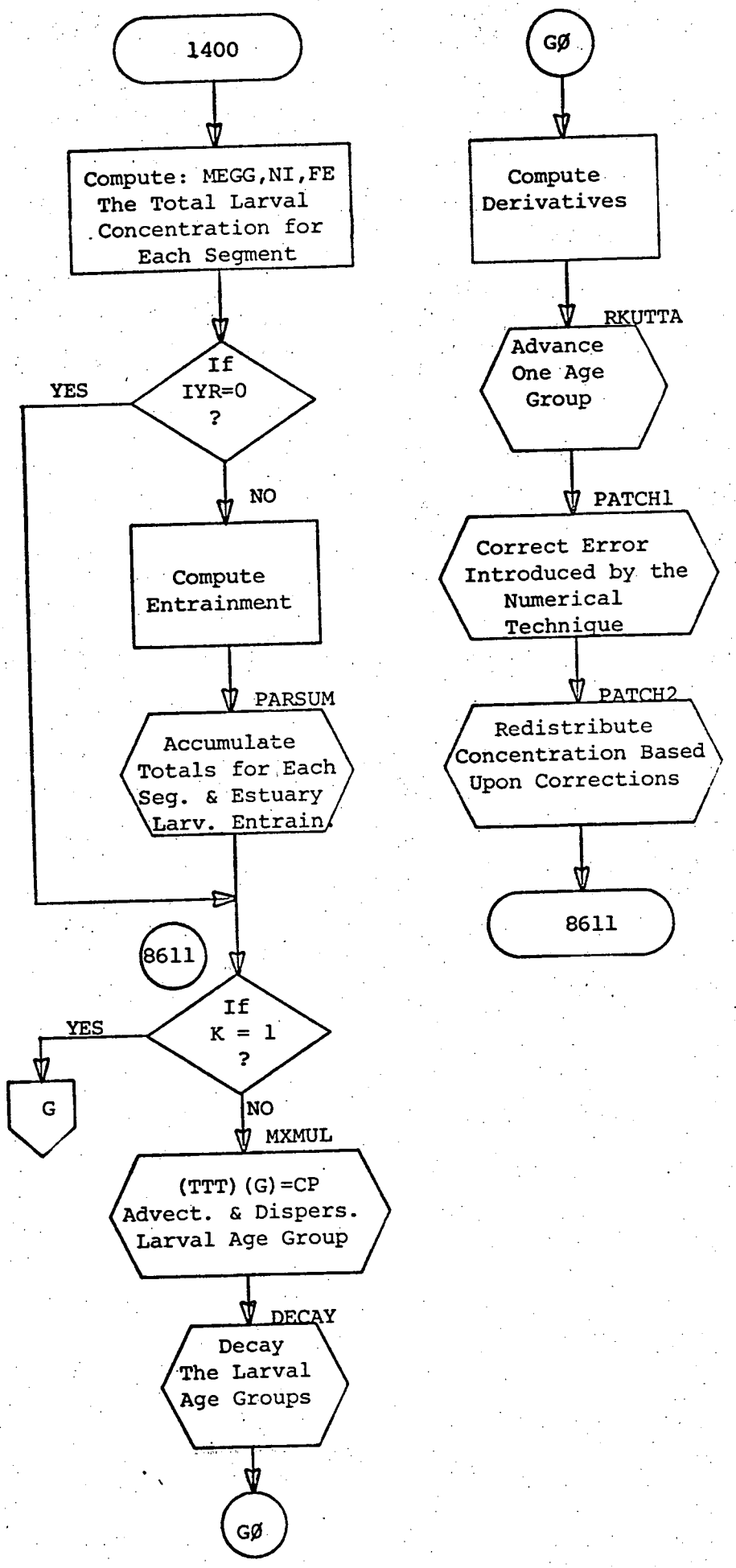

D
Display ?
YES
NO
Various Print Specifications Effected
If T <DTE ?
YES
300
NO
490
If LPIX >1
YES
510
Initialize Sum Array
510
If LPIX>NLPIX ?
520
Store Current Larvae Produced
E

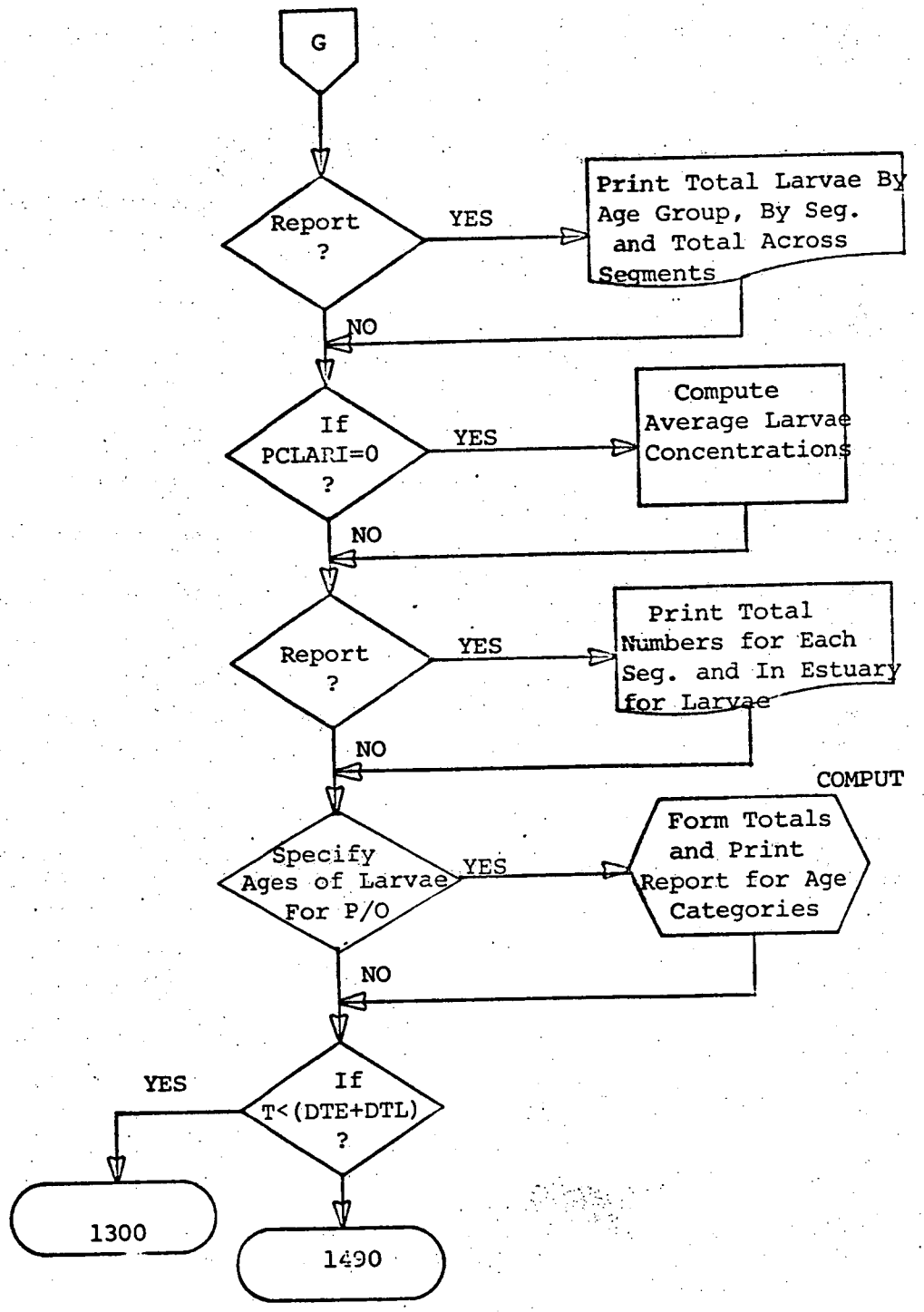

E
525
If
T <TE
?
YES
300
NO
If
T<TE+DTE-DT
?
YES
600
Set First
Age Group to
Zero. No
Production
NO
If
IFINAL >1
?
YES
1000
NO
If
T<TE+DTE-DT
?
NO
YES
400
Average
Larvae
Produced
REPORT
?
YES
Display
Larval
Average
NO
NO
If
IFINAL=0
?
YES
NO
490
600

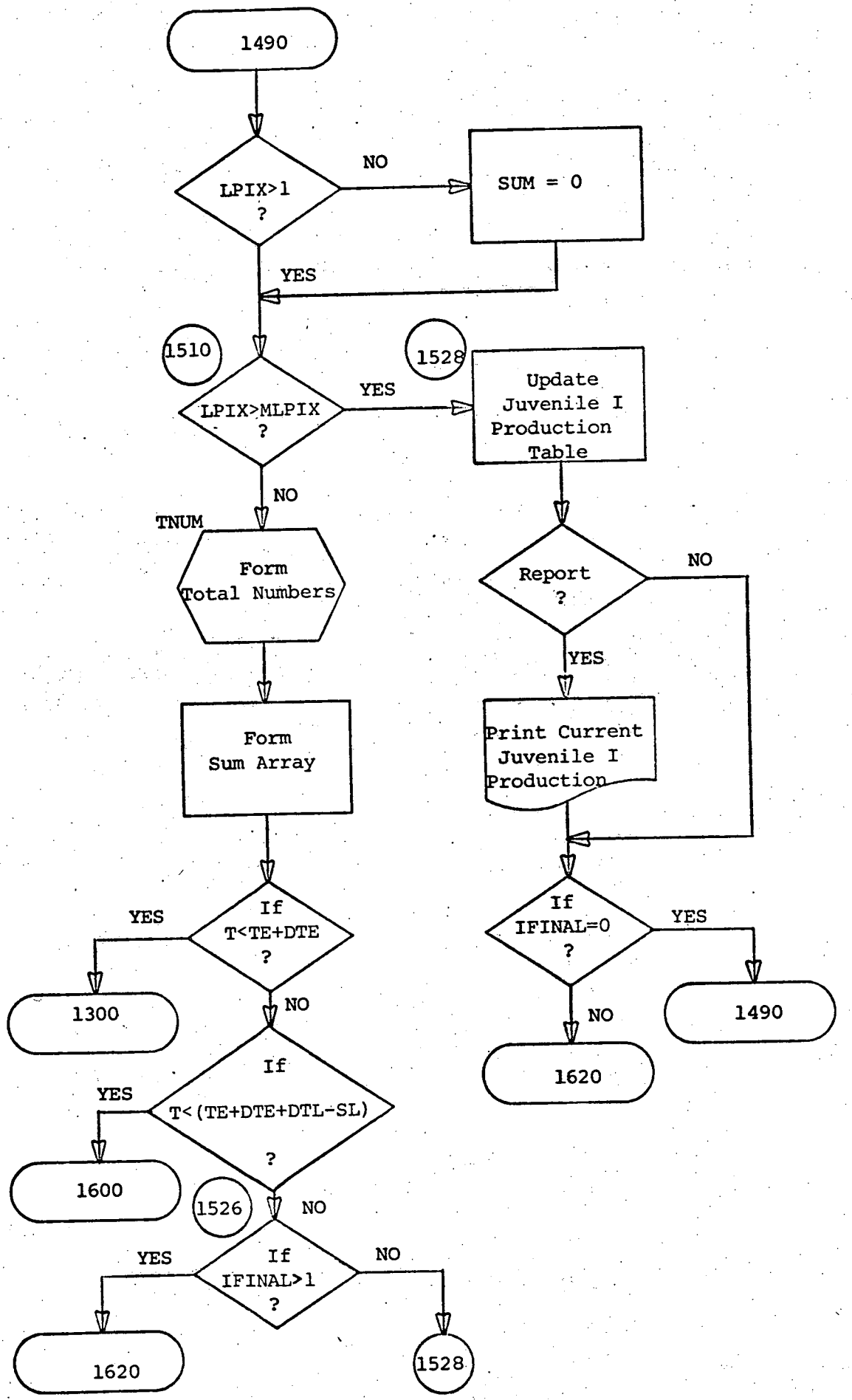

1000
LCNT=
LCNT-1
Report
?
YES
NO
Print Larvae
Production
Table and
Totals
If
KKSW
?
=1
=2
Adjust Larval
Production Table
To Include
Temperature Profile
Initialization
For Larval
Section
Compute
Entrainment
Rates For
Larvae
Compute
Larvae
Production
Total #/day
F

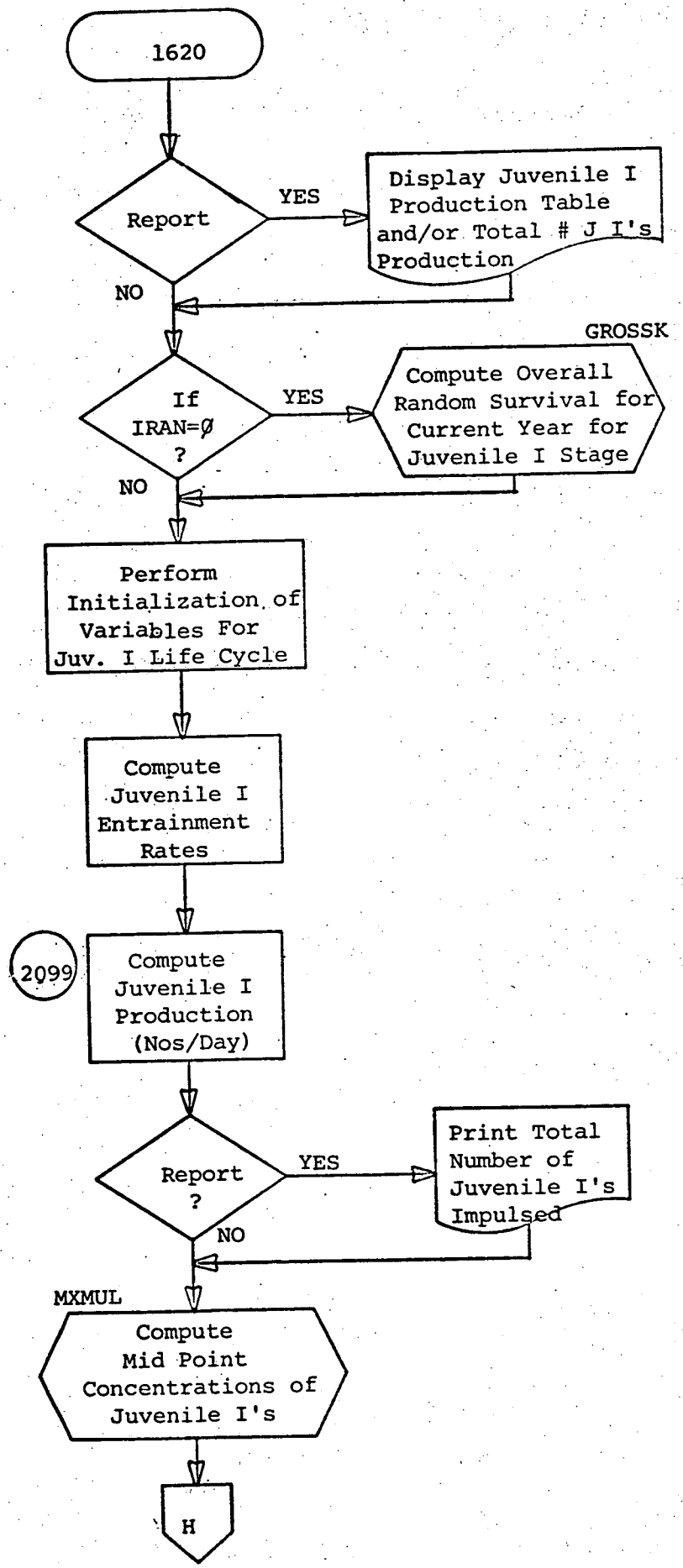

F
1099
Report ?
YES
Print Total Number Larvae Impulsed
NO
MXMUL
$E^{-1}F \rightarrow$ Larvae Segment Mid Point Concentrations
KEY ?
=2
1320
=1
1301
If T>DTE ?
YES
1300
DICAL
NO
Exchange Coefficients Computed
AMACAL
Advection & Dispersion Coefficients Computed
MXMUL
$E^{-1}A$=TTT Computed
1300

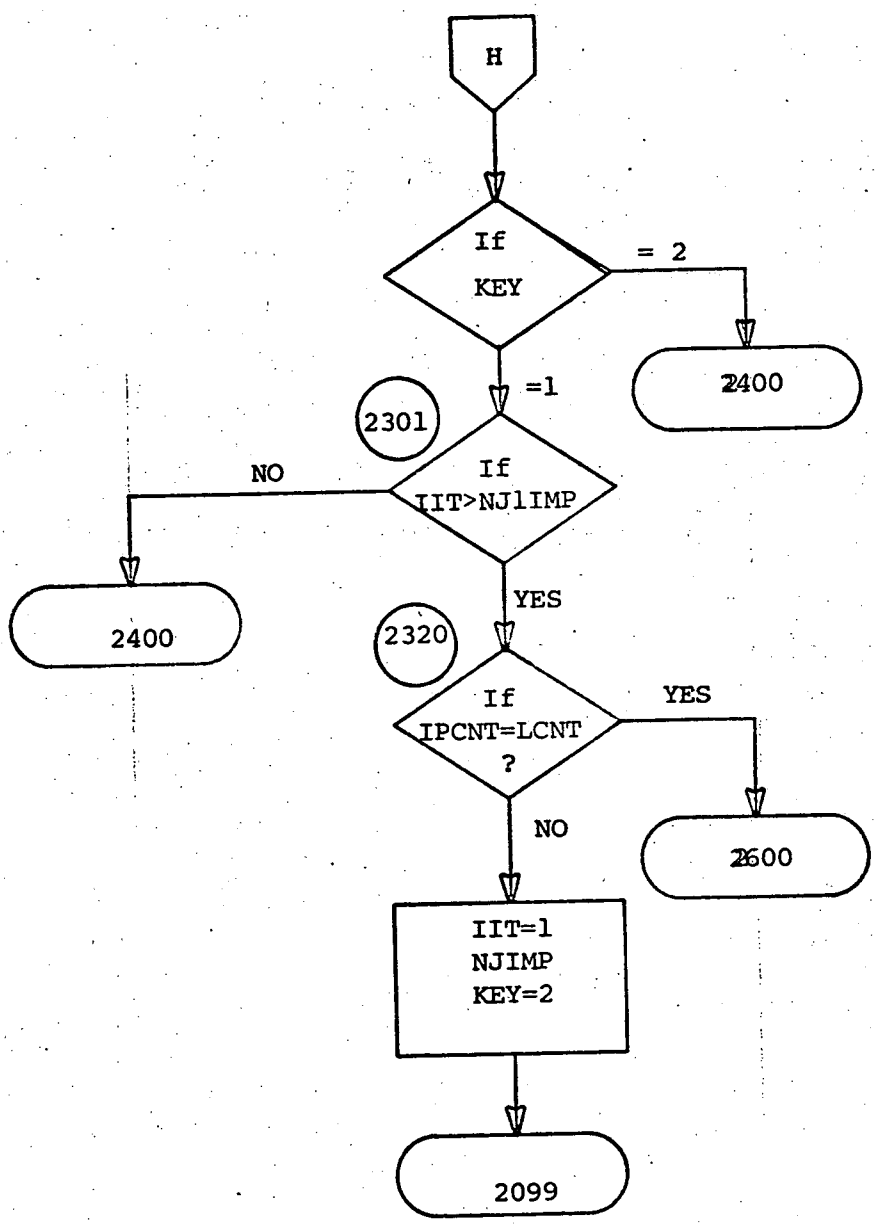

1300
If
IIT>NLIMP
NO
YES
1320
1305
If
T-TQE
?
(-)
(+
0)
1400
If
IPCNT=LCNT
?
YES
NO
1600
LCHA=
LCHA+1
IIT=1
NLIMP
KEY=2
1099
If
LCHA ≤
NCHANG
YES
NO
DICAL
Exchange
Coefficients
Computed
LCHA=
LCHA-1
1400
AMACAL
Advection
& Dispersion
Coefficients
Computed
MXMUL
E-1A=TTT
Computed
1400

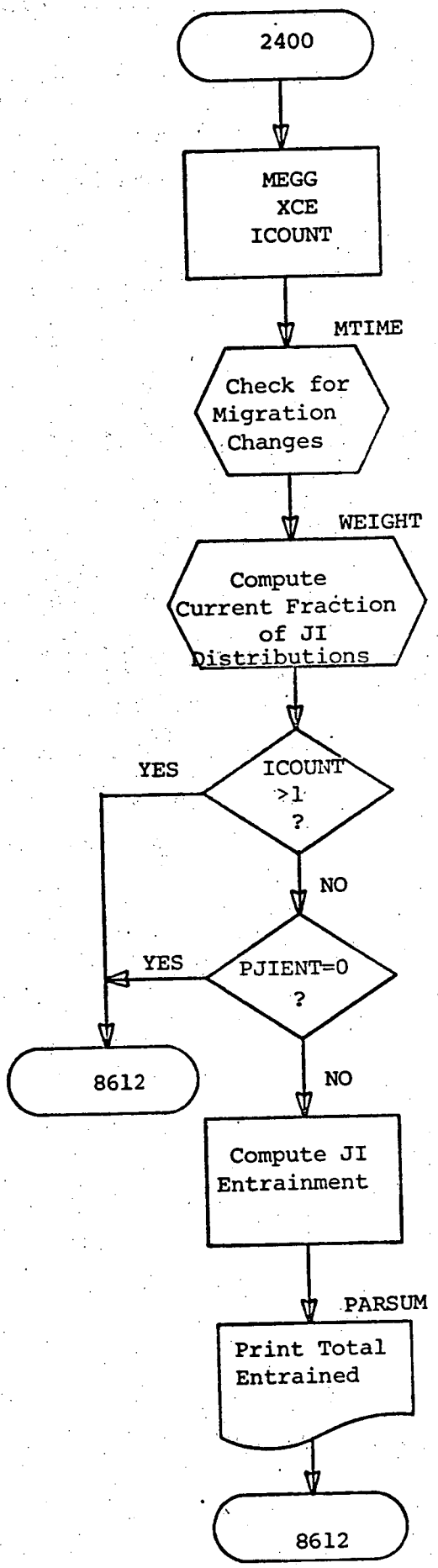

1400
Compute: MEGG,NI,FE The Total Larval Concentration for Each Segment
If IYR=0 ?
YES
NO
Compute Entrainment
PARSUM
Accumulate Totals for Each Seg. & Estuary Larv. Entrain.
8611
If K = 1 ?
YES
G
NO
MXMUL
(TTT)(G)=CP Advect. & Dispers. Larval Age Group
DECAY
Decay The Larval Age Groups
GØ
GØ
Compute Derivatives
RKUTTA
Advance One Age Group
PATCH1
Correct Error Introduced by the Numerical Technique
PATCH2
Redistribute Concentration Based Upon Corrections
8611

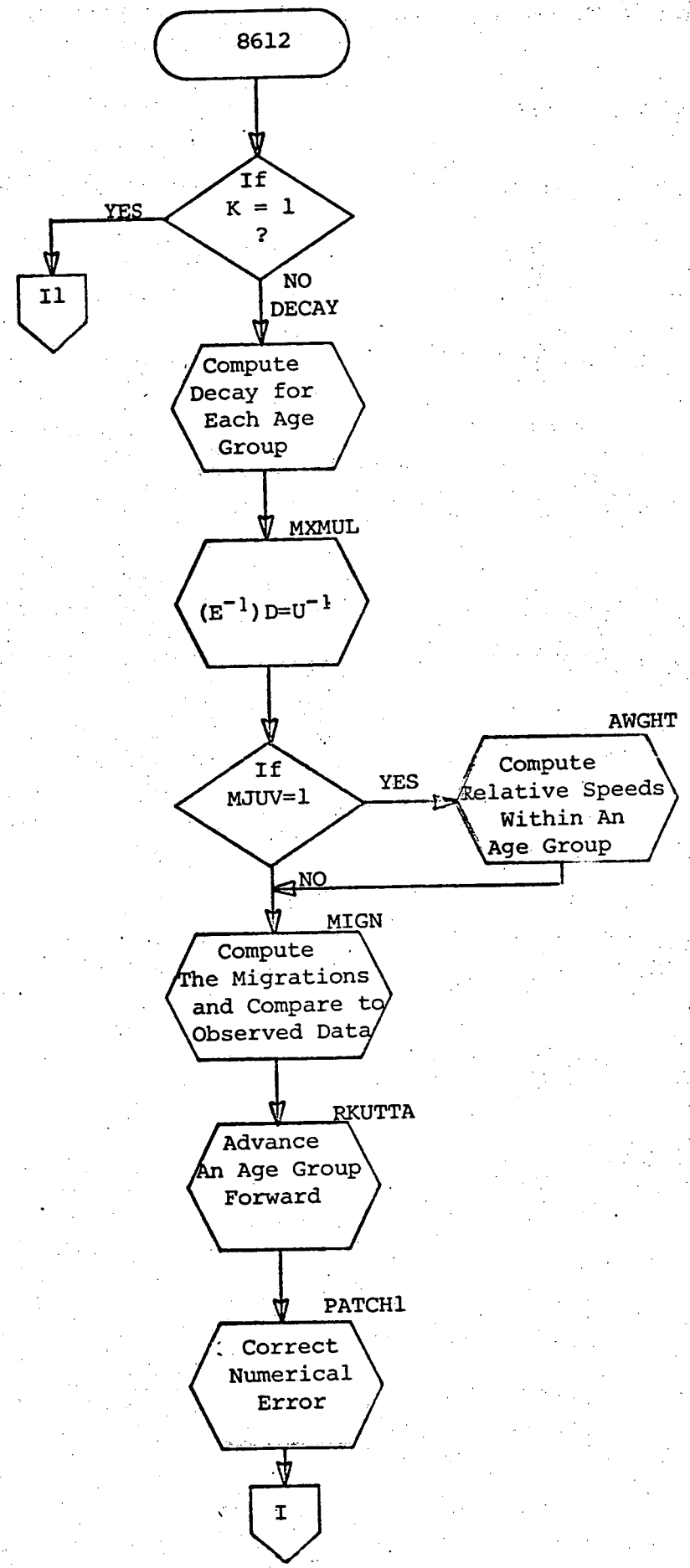

G
Report ?
YES
Print Total Larvae By Age Group, By Seg. and Total Across Segments
NO
If PCLARI=0 ?
YES
Compute Average Larvae Concentrations
NO
Report ?
YES
Print Total Numbers for Each Seg. and In Estuary for Larvae
NO
COMPUT
Specify Ages of Larvae For P/O
YES
Form Totals and Print Report for Age Categories
NO
If T<(DTE+DTL) ?
YES
1300
1490

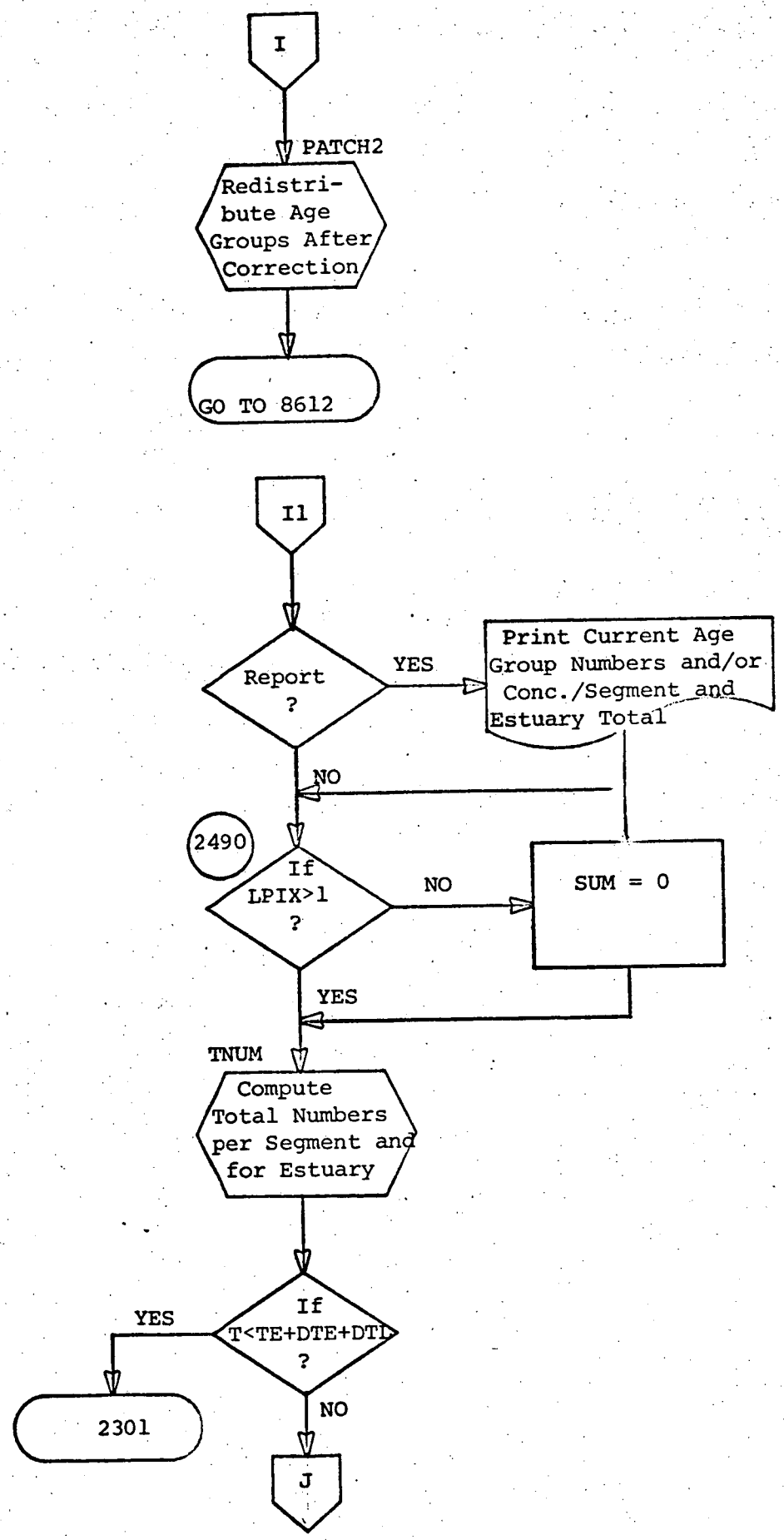

1490
LPIX>1 ?
NO
SUM = 0
YES
1510
1528
LPIX>MLPIX ?
YES
Update Juvenile I Production Table
NO
TNUM
Form Total Numbers
Report ?
NO
YES
Form Sum Array
Print Current Juvenile I Production
If T<TE+DTE ?
YES
1300
NO
If IFINAL=0 ?
YES
1490
NO
1620
If T<(TE+DTE+DTL-SL) ?
YES
1600
1526
NO
If IFINAL>1 ?
YES
NO
1620
1528

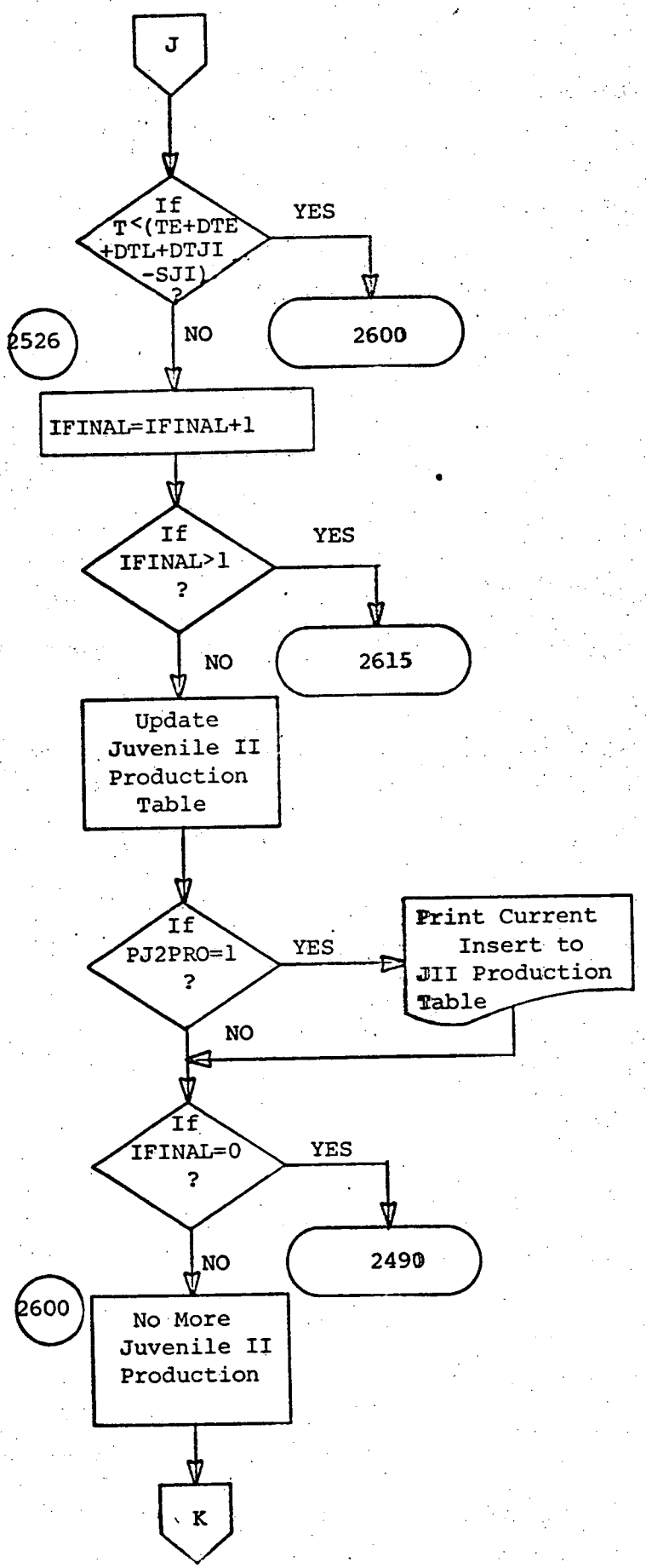

1620
Report
YES
Display Juvenile I Production Table and/or Total # J I's Production
NO
GROSSK
If IRAN=Ø ?
YES
Compute Overall Random Survival for Current Year for Juvenile I Stage
NO
Perform Initialization of Variables For Juv. I Life Cycle
Compute Juvenile I Entrainment Rates
2099
Compute Juvenile I Production (Nos/Day)
Report ?
YES
Print Total Number of Juvenile I's Impulsed
NO
MXMUL
Compute Mid Point Concentrations of Juvenile I's
H

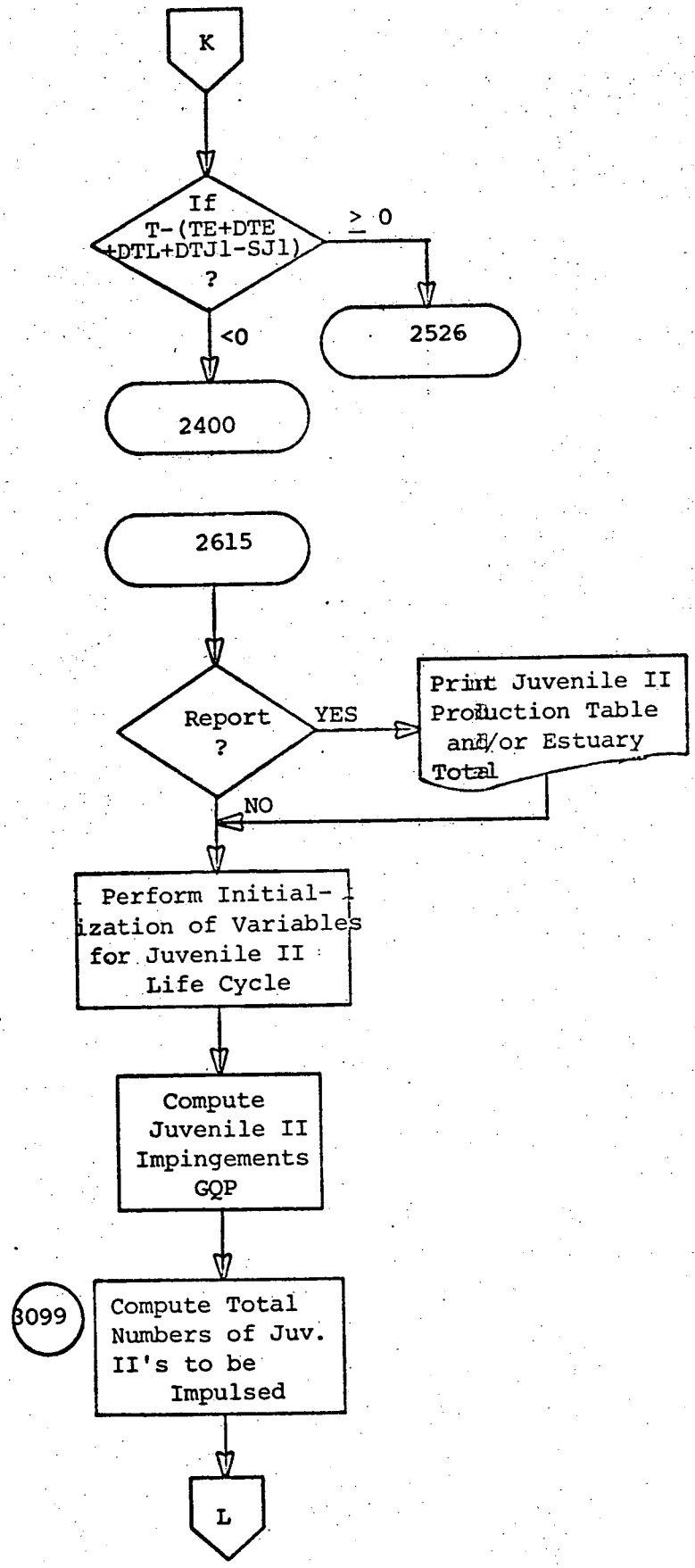

H
If
KEY
= 2
2400
=1
2301
If
IIT>NJ1IMP
NO
2400
YES
2320
If
IPCNT=LCNT
?
YES
2600
NO
IIT=1
NJIMP
KEY=2
2099

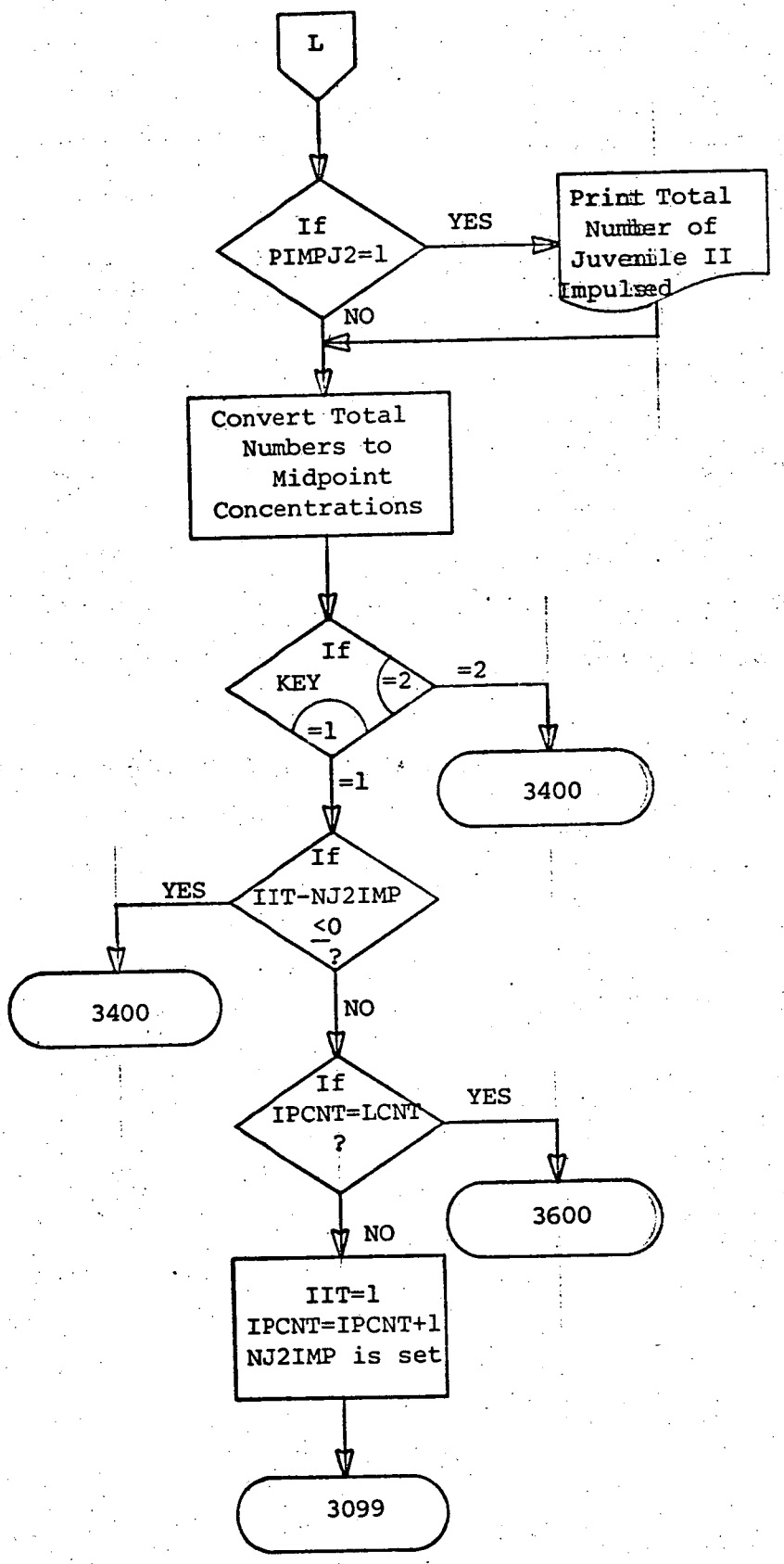

2400
MEGG
XCE
ICOUNT
MTIME
Check for Migration Changes
WEIGHT
Compute Current Fraction of JI Distributions
ICOUNT >1 ?
YES
NO
PJIENT=0 ?
YES
8612
NO
Compute JI Entrainment
PARSUM
Print Total Entrained
8612

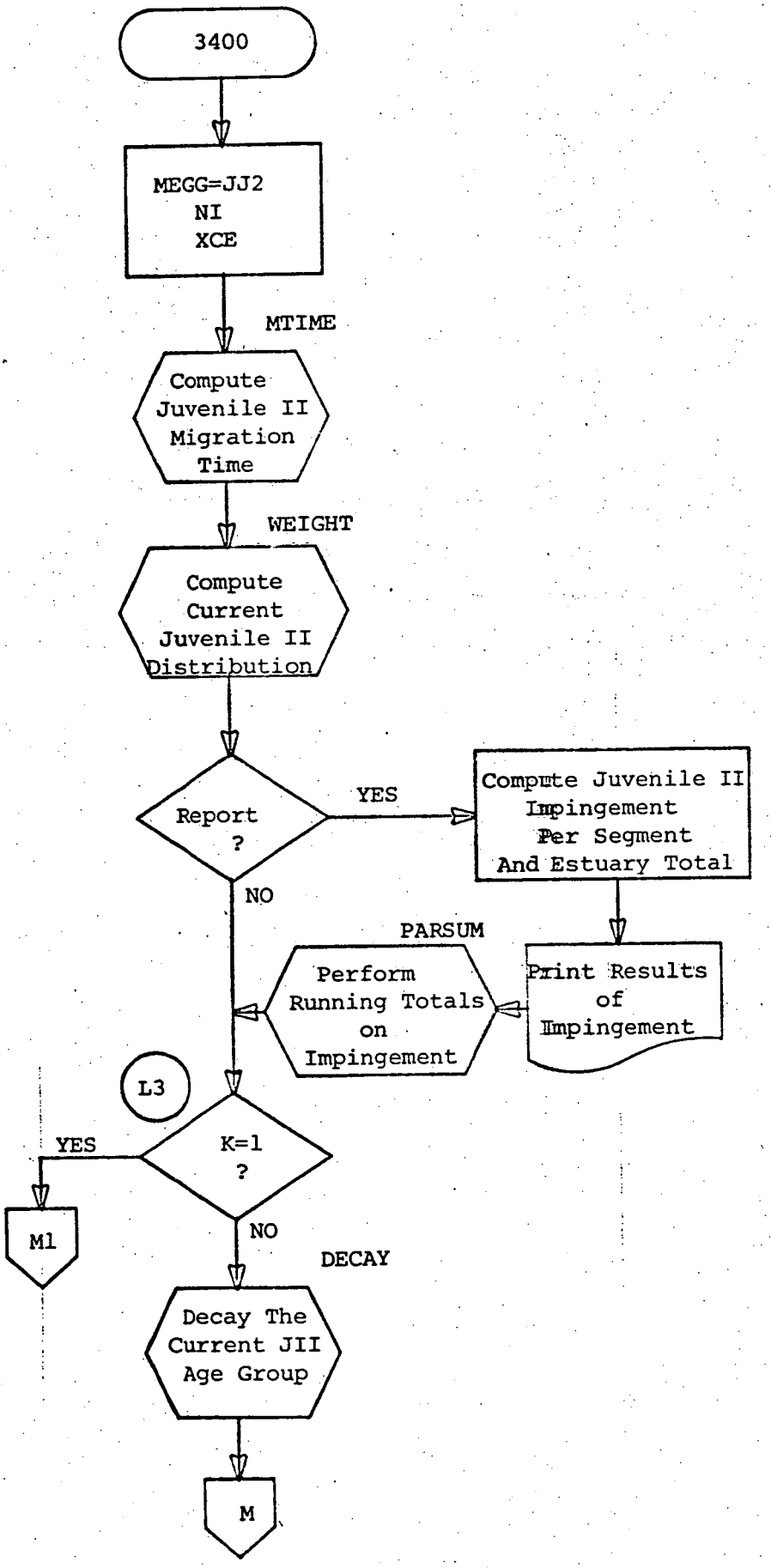

8612
If K = 1 ?
YES
I1
NO DECAY
Compute Decay for Each Age Group
MXMUL
$(E^{-1})D=U^{-1}$
If MJUV=1
YES
AWGHT
Compute Relative Speeds Within An Age Group
NO
MIGN
Compute The Migrations and Compare to Observed Data
RKUTTA
Advance An Age Group Forward
PATCH1
Correct Numerical Error
I

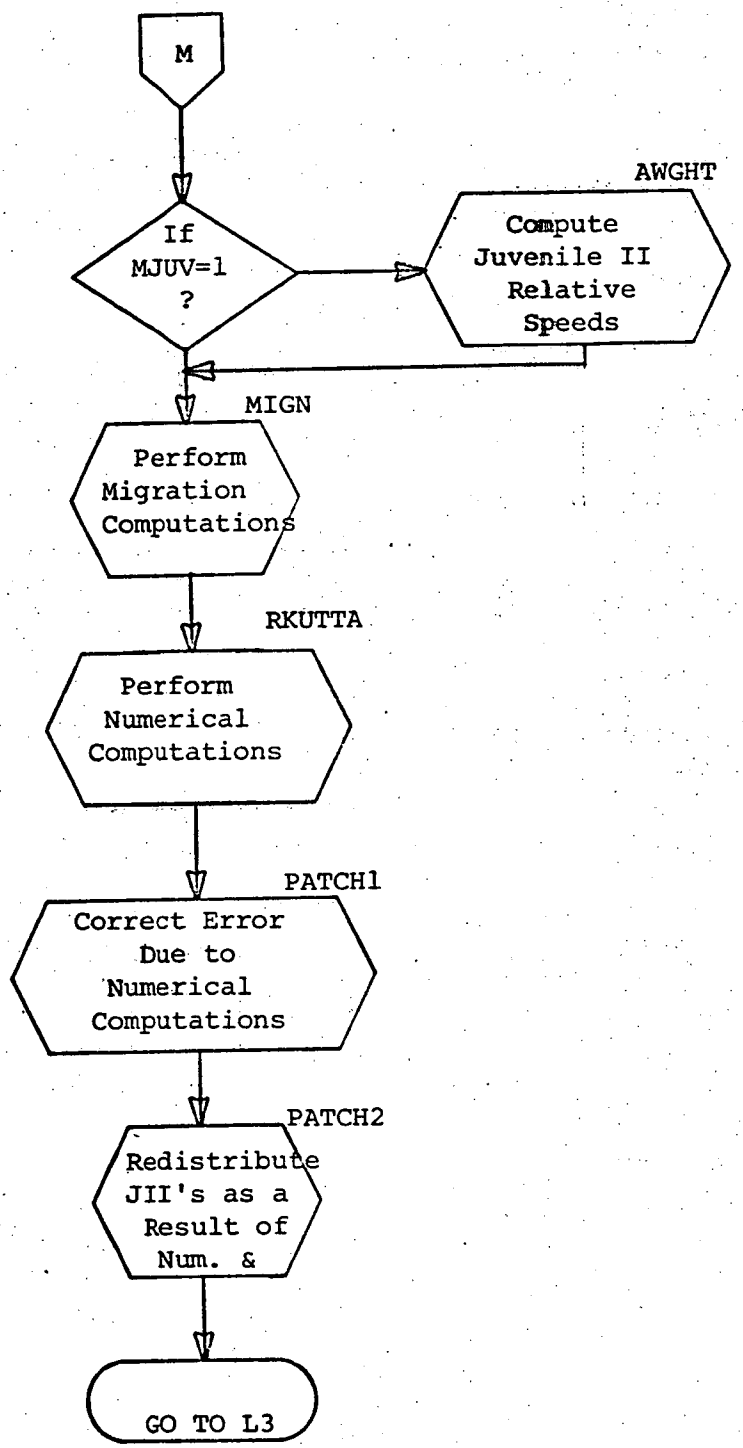

I
PATCH2
Redistri-
bute Age
Groups After
Correction
GO TO 8612
I1
Report
?
YES
Print Current Age
Group Numbers and/or
Conc./Segment and
Estuary Total
NO
2490
If
LPIX>1
?
NO
SUM = 0
YES
TNUM
Compute
Total Numbers
per Segment and
for Estuary
If
T<TE+DTE+DTI
?
YES
2301
NO
J

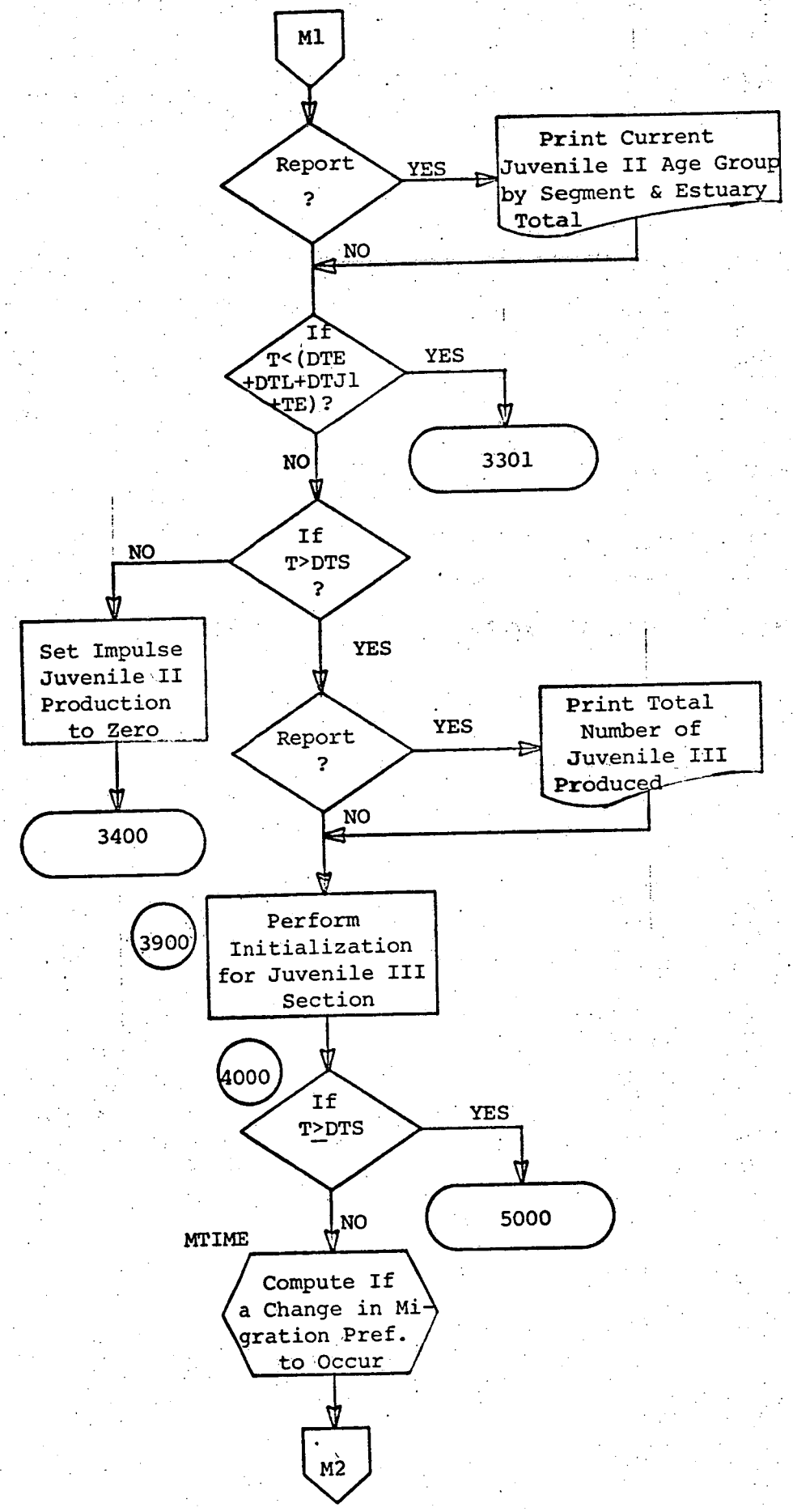

J
If T<(TE+DTE +DTL+DTJI -SJI) ?
YES
2600
2526
NO
IFINAL=IFINAL+1
If IFINAL>1 ?
YES
2615
NO
Update Juvenile II Production Table
If PJ2PRO=1 ?
YES
Print Current Insert to JII Production Table
NO
If IFINAL=0 ?
YES
2490
NO
2600
No More Juvenile II Production
K

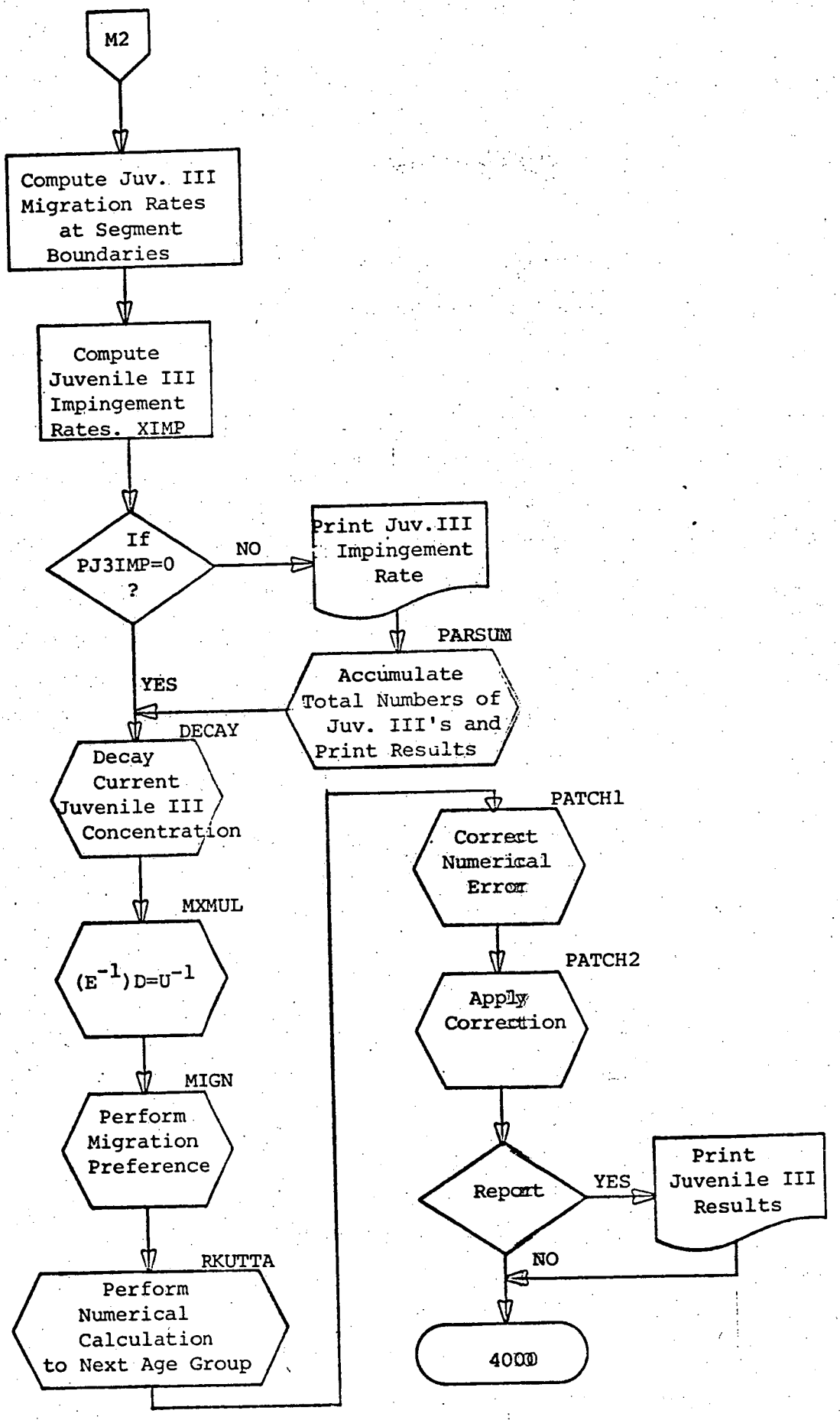

K
If T-(TE+DTE +DTL+DTJ1-SJ1) ?
≥ 0
2526
<0
2400
2615
Report ?
YES
Print Juvenile II Production Table and/or Estuary Total
NO
Perform Initialization of Variables for Juvenile II Life Cycle
Compute Juvenile II Impingements GQP
3099
Compute Total Numbers of Juv. II's to be Impulsed
L

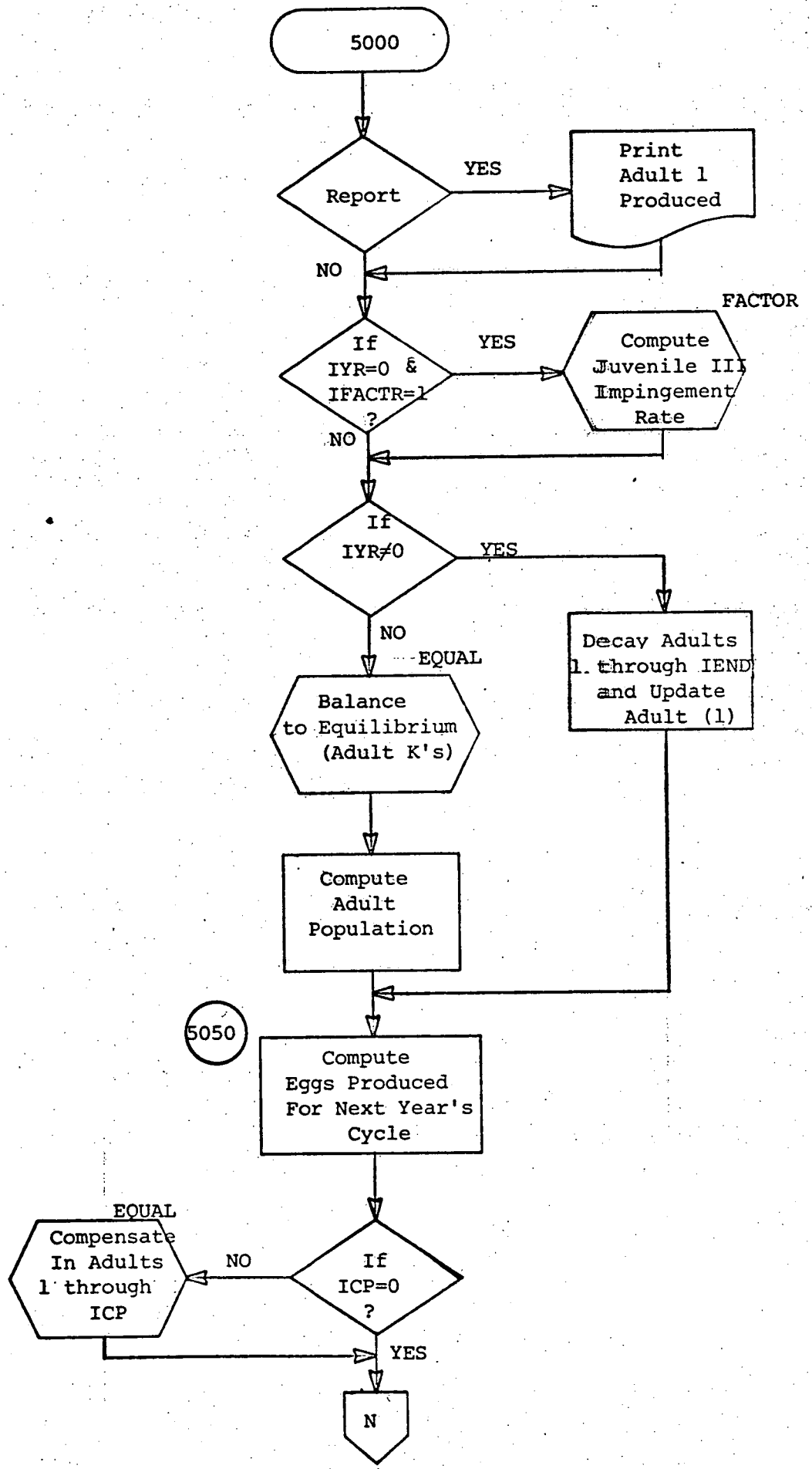

L
If PIMPJ2=1
YES
Print Total Number of Juvenile II Impulsed
NO
Convert Total Numbers to Midpoint Concentrations
If KEY
=2
=1
=2
3400
=1
If IIT-NJ2IMP ≤0 ?
YES
3400
NO
If IPCNT=LCNT ?
YES
3600
NO
IIT=1
IPCNT=IPCNT+1
NJ2IMP is set
3099

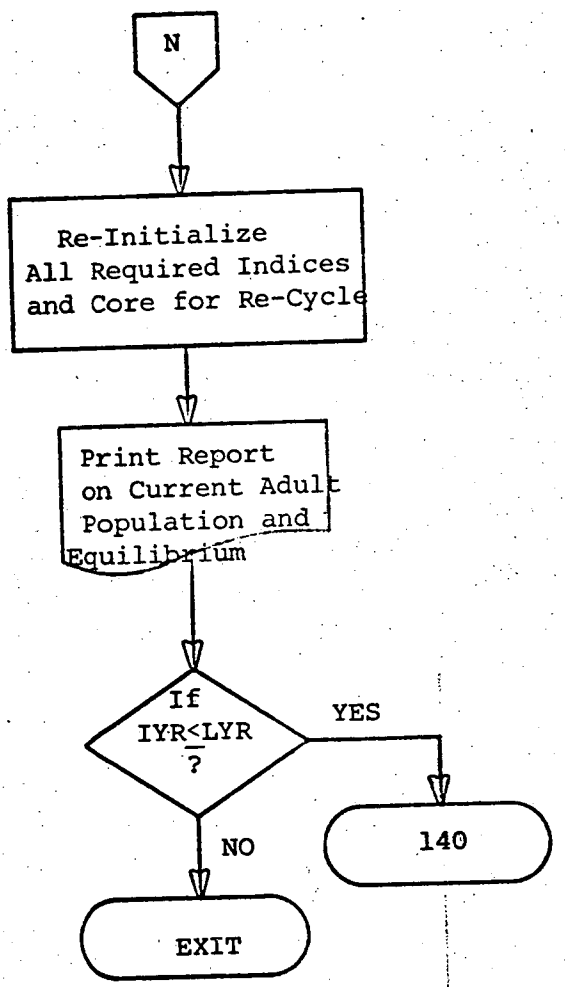

3400
MEGG=JJ2
NI
XCE
MTIME
Compute Juvenile II Migration Time
WEIGHT
Compute Current Juvenile II Distribution
Report ?
YES
Compute Juvenile II Impingement Per Segment And Estuary Total
NO
PARSUM
Perform Running Totals on Impingement
Print Results of Impingement
L3
K=1 ?
YES
M1
NO
DECAY
Decay The Current JII Age Group
M


M
If MJUV=1 ?
AWGHT
Compute Juvenile II Relative Speeds
MIGN
Perform Migration Computations
RKUTTA
Perform Numerical Computations
PATCH1
Correct Error Due to Numerical Computations
PATCH2
Redistribute JII's as a Result of Num. &
GO TO L3


M1
Report ?
YES
Print Current Juvenile II Age Group by Segment & Estuary Total
NO
If T<(DTE +DTL+DTJ1 +TE)?
YES
3301
NO
If T>DTS ?
NO
Set Impulse Juvenile II Production to Zero
3400
YES
Report ?
YES
Print Total Number of Juvenile III Produced
NO
3900
Perform Initialization for Juvenile III Section
4000
If T≥DTS
YES
5000
NO
MTIME
Compute If a Change in Migration Pref. to Occur
M2


M2
Compute Juv. III Migration Rates at Segment Boundaries
Compute Juvenile III Impingement Rates. XIMP
If PJ3IMP=0 ?
NO
Print Juv.III Impingement Rate
PARSUM
Accumulate Total Numbers of Juv. III's and Print Results
YES
DECAY
Decay Current Juvenile III Concentration
MXMUL
$(E^{-1})D=U^{-1}$
MIGN
Perform Migration Preference
RKUTTA
Perform Numerical Calculation to Next Age Group
PATCH1
Correct Numerical Error
PATCH2
Apply Correction
Report
YES
Print Juvenile III Results
NO
4000


5000
Report
YES
Print Adult 1 Produced
NO
If IYR=0 & IFACTR=1 ?
YES
FACTOR
Compute Juvenile III Impingement Rate
NO
If IYR≠0
YES
Decay Adults 1 through IEND and Update Adult (1)
NO
EQUAL
Balance to Equilibrium (Adult K's)
Compute Adult Population
5050
Compute Eggs Produced For Next Year's Cycle
If ICP=0 ?
NO
EQUAL
Compensate In Adults 1 through ICP
YES
N


N
Re-Initialize
All Required Indices
and Core for Re-Cycle
Print Report
on Current Adult
Population and
Equilibrium
If
IYR≤LYR
?
YES
NO
140
EXIT

```
MODE-PNC/LIB$ CREATE:02/01/73,14:15:05 FREQ:14 SIZE:31 BACKUP:02/02/73,
05:21:31 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE ON:SPN
IL
      SUBROUTINE TMODEL(ADULT,PRAT,PMAT,PEC,PSA,PSAO,KFIRST,ADULTS,
     1SVU,RMF,IMODEL,IRA,EAD,ITY)
C     TRANSPORT MODEL OF LIFE STAGES OF STRIPED BASS
C     SUBJECT TO PLANT INTAKE AT INDIAN POINT.
C
      INTEGER PIMPE,PNEGG1,PCEGG1,PNEGG2,PCEGG2,PLPROD,PLPTB1,PLPTB2
      INTEGER PIMPL,PNLAR1,PCLAR1,PNLAR2,PCLAR2,PJ1PRO,PJ1PT1,PJ1PT2
      INTEGER PIMPJ1,PNJ11,PCJ11,PNJ12,PCJ12,PJ2PRO,PJ2PT1,PJ2PT2
      INTEGER PIMPJ2,PNJ21,PCJ21,PNJ22,PCJ22,PJ3PTN,PJ3PTC
      INTEGER PEENT,PNEEN,PLENT,PNLEN,PJ1ENT,PNJ1EN
      INTEGER PJ2IMP,PNJ2IM,PJ3IMP,PNJ3IM
      INTEGER PNJ32,PCJ32,PA1PTN,PA1PTC,CONENT,CONIMP
      DIMENSION XCE(25),TEMP1(25),TNUMBR(25),SUM1(25,1),EAD(20)
      DIMENSION GQP(25),XENT(25),XIMP(25),SQP(25),SJ2I(25)
      DIMENSION ADULTS(20),SVU(20),RMF(20),PRAT(1),PMAT(1),PEC(1)
C
      COMMON/MLIFE/SVE(25),SVO(25),FVE(25),TCE(25),SVL(25),SVLO(25),
     1FVL(25),TCL(25),SVJ1(25),SVJ1O(25),FVJ1(25),TCJ1(25),SVJ2(25),
     2SVJ2O(25),FVJ2(25),TCJ2(25),SVJ3(25),SVJ3O(25),FVJ3(25),TCJ3(25
     3NEGG,AEP,DTE,DTL,DTJ1,DTJ2,DTJ3,DTA,TE,WI(25,10),TP(10),PP(10),
     4DT,ICP,IEND,SVA(20),FEC(20),FRAT(20),FMAT(20),SVAO(20),IFACTR
     1,TJJ3,TSPW
      COMMON/PLANT/LYR,LPYR(25),QP(25),KPLANT(25),KKSW,IOPT
C     ESTURARY CHARACTERISTICS FOLLOWS,
C
      COMMON/MCHAR/NSEG,NCHANG,VI(25),AX(25),SLEN(25),
     *QI(25,10),EP(26),EI(25,10),TQE(10),DI(25)
      COMMON/INITAL/LEGG,LCHA,T,KNOW,JEGG,JLARV,JJ1,JJ2,JJ3,
     *LPIX,NLPIX,IDAY,IFINAL,PRMT(5),AUX(16,25),TEMPER(26,55),NTEMP,
     *T1967P,TCUT(25)
      DIMENSION TTT(25,25),CP(25,1),G(25,1),PSA(1),PSAO(1),IRA(5)
      DIMENSION F(25,1),EINV(25,25),CE(25,500),A1(25),A2(25),A3(25)
      DIMENSION AMAT(25,25),Y(25),SUM(25,10),PRTAB(25,60),
     *FE(500),ADULT(20),DECY(25,25),SLINV(25,25),UINV(25,25)
      COMMON/MWGHT/GG(25),AL(25),KAGE,MJUV
      COMMON/MIGRT/TMIG(10,3),NCJ1,NCJ2,NCJ3,YJ1(25,10),YJ2(25,10),
     1YJ3(25,10)
      COMMON/COMPRT/NCOMR,IAGE(10),IEAGE(10)
      DIMENSION DERY(25),TEMPT1(25),TEMPT2(25)
      COMMON/IDSTEP/IDTE,IDTL,IDTJ1,IDTJ2,IDTJ3,IYR
      COMMON/EGIND/NESP,PIMPE,PNEGG1,PNEGG2,PLPROD,PLPTB1,
     *PLPTB2,PCEGG1,PCEGG2,PEAVG
      COMMON/LVIND/NLSP,PIMPL,PNLAR1,PNLAR2,PJ1PRO,PJIPT1,PJ1PT2,
     *PCLAR1,PCLAR2,PLAVG
      COMMON/J1IND/NJ1SP,PIMPJ1,PNJ11,PNJ12,PCJ11,PCJ12,
     *PJ2PRO,PJ2PT1,PJ2PT2,MJUVI,PJ1AVG
      COMMON/J2IND/NJ2SP,PIMPJ2,PNJ21,PNJ22,PCJ21,PCJ22,
     *PJ3PTN,PJ3PTC,MJUV2,PJ2AVG
      COMMON/J3IND/NJ3SP,PNJ32,PCJ32,PA1PTN,PA1PTC,MJUV3
      COMMON/EIMP/CONENT,CONIMP,PEENT,PNEEN,PLENT,PNLEN,
     *PJ1ENT,PNJ1EN,PJ2IMP,PNJ2IM,PJ3IMP,PNJ3IM
```

```
1500          COMMON/TIMSTP/SL,SJ1,SJ2,SJ3
1505          COMMON/RANDV/IRAN,DYY(25),SDYY(25)
1510          KFIRST=0
1530          INCJ1=1
1540          INCJ2=1
1550          INCJ3=1
1560          NDT=0
1570          TLAST=0.
1580          CONST1=1000./(5280.**3)      mi³/ft³      mi³/1000 m³ = 1/(4.1683×10
1590    C
1600          IPP=0
1610          TOTLP=0.
1620          TOTJ1P=0.
1630          TOTJ2P=0.
1640          DO 2 J=1,13
1650        2 ADULT(J)=0.
1660          DO 3 J=1,NSEG
1670          DO 3 L=1,60
1680        3 PRTAB(J,L)=0.
1690          CALL INPUT
1691          DO 888 J=1,IEND
1692          PEC(J)=FEC(J)
1693          PRAT(J)=FRAT(J)
1694          PMAT(J)=FMAT(J)
1695      888 CONTINUE
1696          DO 621 J=1,NSEG
1697          PSA(J)=SVA(J)
1698          PSAO(J)=SVAO(J)
1699      621 CONTINUE
1700          CALL INTIAL(NSEG,NEGG,DTE,DTL,DTJ1,DTJ2,DT)
1705          SE=DT
1710          PEQUAL=AEP
1720          IF(IOPT.EQ.1)CALLOUTPUT
1730          CONST2=0.
1740          DO 5 I=1,NSEG
1741          SJ2I(I)=0.
1742          IF(IFACTR.EQ.1)SJ2I(I)=FVJ2(I)
1750          TEMP1(I)=0.
1760        5 CONST2=CONST2+VI(I)      CONST2 = Total Volume
1770          DO 4 J=1,NSEG
1780          DO 4 L=1,JEGG
1790        4 CE(J,L)=0.
1795          DO 911 J=1,NSEG
1800          TCE(J)=TCE(J)/CONST1
1810          TCL(J)=TCL(J)/CONST1
1820          TCJ1(J)=TCJ1(J)/CONST1
1830          TCJ2(J)=TCJ2(J)/CONST1
1840          TCJ3(J)=TCJ3(J)/CONST1
1845      911 CONTINUE
1850          MSEG=NSEG-1
1860    C
1870    C     RI IS NUMBER OF EGG AGE-GROUPS/DAY
1880          RI=PEAVG/DT
1890    C
```

```
1900      C       AUX(15,1) IS A SWITCH USED IN THE RUNGE-KUTTA TO DETERMINE
1910      C       IF MIGRATION (AUX(15,1)=99.) OR ADVECTION AND DISPERSION
1920      C       (AUX(15,1)=0.) IS TO OCCUR.
1930      C
1940              AUX(15,1)=0.
1950      C
1960      C       PERFORM COMPUTATION FOR EGG STAGE ONLY
1970      C       COMPUTE EPSILON-EP
1980      C
1990              DO 100 J=1,MSEG
2000              TEMP=SLEN(J)+SLEN(J+1)
2010          100 EP(J+1)=SLEN(J+1)/TEMP
2020              EP(1)=0.
2030              EP(NSEG+1)=1.0
2040      C
2050      C       COMPUTATION OF EMATRIX, WHICH REFLECT CHANGES IN MIDPOINT CONC
2060      C       LOWER DIAGNOL IS A1
2070      C
2080              DO 125 I=2,NSEG
2090          125 A1(I)=.25*EP(I)
2100      C
2110      C       MAIN DIAGNOL IS A2
2120      C
2130              DO 130 I=1,NSEG
2140          130 A2(I)=.25*(3.+EP(I+1)-EP(I))
2150      C
2160      C       UPPER DIAGNOL IS A3
2170      C
2180              DO 135 I=1,MSEG
2190          135 A3(I)=.25*(1.-EP(I+1))
2200              A3(NSEG)=0.
2210      C
2220      C       COMPUTE THE INVERSE OF THE EMATRIX
2230      C
2240              CALL TMXINV(A1,A2,A3,NSEG,EINV,AL,GG,SLINV,UINV)
2250      C
2260              DO 136 J=1,NSEG
2270              SQP(J)=QP(J)
2280              IF(IYR.GT.0)GO TO 136
2282              QP(J)=0.
2284          136 CONTINUE
2290          140 DO 141 J=1,NSEG
2300          141 GQP(J)=FVE(J)*FLOAT(KPLANT(J))*QP(J)/VI(J)
2310      C
2320      C       COMPUTE PRODUCTION VECTOR F
2330      C
2335              ISW=0
2336              TB=0.
2340              NLPIX=PLAVG/DT+.0001
2350              KEY=1
2360      C************ E G  G  S E C T I O N **********************
2361              IRAN=IRA(1)
2362              IF(IRAN.NE.0)CALL GROSSK(DYY,SDYY,DTE,NSEG,SVE)
2370              WRITE(6,12)
```

```
   12 FORMAT(1H1,40X,'BEGIN EGG PRODUCTION"//)
  148 TOT1=0.
  150 DO 200 J=1,NSEG
      F(J,1)=DT*AEP*PP(LEGG)*WI(J,LEGG)/(TP(LEGG)-TLAST)
      TOT1=TOT1+F(J,1)
  200 CONTINUE
C
C      WRITE OUT NUMBERS IMPULSED BY SEGMENT
C
      IF(PIMPE.EQ.1)WRITE(6,251)TOT1,(F(J,1),J=1,NSEG)
  251 FORMAT(1H ,14HEGGS IMPULSED=,F15.0,8(1X,F10.0))
      DO 206 J=1,NSEG
  206 F(J,1)=F(J,1)/VI(J)
C
C      COMPUTE INCREASE IN MIDPOINT CONC.(CP) DUE TO IMPULSE
C
      CALL MXMUL(EINV,F,NSEG,1,CP)
C
C      RESET FIRST AGE GROUP CONCENTRATION
C
      DO 210 JN=1,NSEG
  210 CE(JN,1)=CP(JN,1)
  250 FORMAT(1X,F5.1,'-',F5.1,1X,'AN=',9(1X,F10.0))
      GO TO(301,400),KEY
C
C      CALCULATE E INVERSE * A.
C      COMPUTE THE EXCHANGE COEFFICIENTS BETWEEN SEGMENTS.
C
  301 IF(T.GT.0.)GO TO 305
      CALL DICAL(DI,EI,AX,SLEN,NSEG,LCHA)
C
C      COMPUTE ADVECTION AND DISPERSIVE COEFFICIENTS IN MATRIX A,AMAT
C
      CALL AMACAL(AMAT,LCHA)
C
C      COMPUTE E INVERSE * A AND STORE IN MATRIX TTT.
C
      CALL MXMUL(EINV,AMAT,NSEG,NSEG,TTT)
  300 CONTINUE
C
C      CHECK CURRENT TIME, T, WITH TIME TQE FOR NEXT CHANGE IN FLOWS,
C      AND DISPERSIONS, EI.
C
  305 IF(T+.0001-TQE(LCHA)) 320,310,310
C
C      USE NEXT PAIR OF QI AND EI
C
  310 LCHA=LCHA+1
      IF(LCHA.GT.NCHANG)GO TO 320
C      RE-CALCULATE E INVERSE * A IN MATRIX TTT.
C      NCHANG IS THE MAXIMUM NUMBER OF CHANGES
C      PERMITTED IN FLOW AND DISPERSION ARRAYS,
C      QI AND EI, RESPECTIVELY.
C      DICAL COMPUTES THE EXCHANGE COEFFICIENT (OF BOUNDARY CONC.)
```

```
C        BETWEEN SEGMENTS BASED UPON THE MIDPOINT CONC.
C
  306 CALL DICAL(DI,EI,AX,SLEN,NSEG,LCHA)
C
C        AMACAL COMPUTES THE MATRIX OF COEFFICIENTS WHICH DESCRIBES
C        THE ADVECTION AND DISPERSION OF CONC. IN EACH SEGMENT.
C
      CALL AMACAL(AMAT,LCHA)
C
C        COMPUTE E INVERSE * A = MATRIX TTT WHICH IS N X N.
C
      CALL MXMUL(EINV,AMAT,NSEG,NSEG,TTT)
C
C        USE PRESENT VALUES FOR QI AND EI,
C        CHECK CURRENT TIME, T, WITH TIME TP FOR NEXT CHANGE IN EGG
C        PRODUCTION.
C
  320 IF(T+.0001-TP(LEGG))400,330,330
  330 LEGG=LEGG+1
C
C        CHECK CURRENT TIME WITH LENGTH OF SPAWNING, TE, TO DETERMINE
C        IF SPAWNING IS CONCLUDED BY THE ABOVE TEST
C        WHERE TP(1:NEGG)=TIME AT WHICH PRODUCTION IS TO CHANGE.
C
      IF((T+.0001) .GE. TE) GO TO 600
      TLAST=TP(LEGG-1)
      KEY=2
      GO TO 148
C
C        SET MEGG TO THE NUMBER OF EGG STAGES STORED IN JEGG.
C
  400 MEGG=JEGG
C
C        SET NI TO CURRENT NUMBER OF EGG STAGES
C
      NI=RI*(T+DT)+.0001
C
C        LIMIT FOR EGG STAGES IS IN JEGG
C
      IF(NI .LT. MEGG) MEGG=NI
      DO 437 J=1,NSEG
  437 XCE(J)=CE(J,1)
      ICOUNT=1
  431 CONTINUE
C
C        COMPUTE TOTAL EGG CONC
C        PER SEGMENT AND STORE IN THE ARRAY FE.
C
      DO 432 J=1,NSEG
      FE(J)=0.
      DO 432 L=1,MEGG
  432 FE(J)=FE(J)+CE(J,L)
      IF(ICOUNT.GT.1)GO TO 8610
      IF(PEENT.EQ.0)GO TO 8610
```

```
      SK2=0.
      K1=MOD(NDT,PNEEN)
      IF(K1.NE.0)GO TO 8610
      IF(IYR.EQ.0)GO TO 8610
      DO 921 J=1,NSEG
      XENT(J)=FVE(J)*QP(J)*FLOAT(KPLANT(J))*CONENT*FE(J)
  921 SK2=SK2+XENT(J)
      WRITE(12,8615)T,SK2,(XENT(J),J=1,NSEG)
      CALL PARSUM(XENT,TB,T,NSEG,ISW)
 8615 FORMAT('@@@T=',F10.2,' EGG ENTRAINED=',F15.0,'*****'//
     18(1X,F10.0))
 8610 CONTINUE
      DO 435 K=MEGG,1,-1
      DO 433 J=1,NSEG
C
C       SET THE ARRAYS Y AND G TO CURRENT AGE GROUP CONC.
C
      G(J,1)=CE(J,K)
  433 Y(J)=CE(J,K)
C
C       COMPUTE THE CHANGE IN CONC. DUE TO ADVECTION AND DISPERSION
C       WITHOUT DECAY.
C
      CALL MXMUL(TTT,G,NSEG,1,CP)
      CALL DECAY(SVE,SVO,FE,TCE,DECY,VI,NSEG,A1,A2,A3,GQP)
      DO 1460 J=1,NSEG
 1460 DERY(J)=CP(J,1)
      CALL MXMUL(EINV,DECY,NSEG,NSEG,UINV)
      CALL MXMUL(UINV,G,NSEG,1,CP)
      DO 1465 J=1,NSEG
 1465 DERY(J)=DERY(J)-CP(J,1)
C
C       PERFORM RUNGE KUTTA
C
      STEP=DT/FLOAT(IDTE)
      CALL RKUTTA(STEP,Y,DERY,UINV,AUX,NSEG,TTT,G,CP,VI)
      CALLPATCH1(G,CE,K,A1,A2,A3,VI,TOTAL,NSEG,0,STEP,DECY,GQP)
C
C       SET LL INDEX TO STORE AGE GROUP AT TIME T+DT.
C
      LL=K
      IF(ICOUNT.EQ.IDTE)LL=K+1
      DO 1505 JN=1,NSEG
C
C       IF ANY AGE GROUP IN ANY SEGMENT IS NEGATIVE
C       PRINT TIME,SEGMENT,AGE GROUP, AND AGE GROUP VALUE.
C
  244 FORMAT(' T=',F6.1,1X,'SEG=',I2,1X,'AGE GRP=',I3,1X,
     *'NEG CONC=',F15.0)
C
C       SET NEG AGE GROUP TO ZERO
C       TO AVOID INSTABILITY IN FUTURE RUNGE-KUTTA CALCULATIONS.
C
      IF(Y(JN).LT.0.)Y(JN)=0.
```

```
 1505 CE(JN,LL)=Y(JN)
C
      CALLPATCH2(G,CE,LL,A1,A2,A3,VI,TOTAL1,TOTAL,NSEG,
     *EINV,CP,TNUMBR)
  435 CONTINUE
      ICOUNT=ICOUNT+1
      IF(ICOUNT.LE.IDTE)GO TO 431
      DO 438 J=1,NSEG
  438 CE(J,1)=XCE(J)
      NDT=NDT+1
C
C      UPDATE CURRENT TIME.
C
      T=FLOAT(NDT)*DT
C
C     IPP IS NO. OF TIME STEPS(DT) SINCE LAST PRINTOUT
C
      IPP=IPP+1
C
C      MGM IS THE INDEX WHICH POINTS TO THE LAST AGE GROUP CALCULATED
C      THE RUNGE KUTTA CALCULATIONS FOR TIME T+DT.
C
      MGM=MEGG+1
C
C     COMPARE IPP TO NESP TO DETERMINE WHEN PRINTOUT IS TO OCCUR.
C
      IF(IPP.NE.NESP)GO TO 487
      WRITE(6,255)T
      IPP=0
      TOT2=0.
      DO 481 LL=2,MGM
      A4=FLOAT(LL-2)*DT
      A5=FLOAT(LL-1)*DT
C     CHANGE CURRENT AGE GROUP CONC., LL, TO TOTAL NOS.
C      CE IS THE ARRAY IN WHICH ALL AGE GROUP CONC. ARE STORED BY SEG
C      LL IS THE CURRENT AGE GROUP CONC. TO BE CHANGED TO TOTAL NOS.
C     SEGMENT AND STORED IN THE ARRAY G.
C      A1, A2,A3 ARE DEFINED ABOVE IN THE E MATRIX.
C      VI IS THE VOLUME PER SEGMENT.
C     TOT1 IS THE TOTAL NUMBER OF ORGANISMS IN THE AGE GROUP LL.
C      NSEG IS THE NUMBER OF SEGMENTS THAT THE ESTUARY HAS BEEN
C      SUBDIVIDED INTO.
C     TNUM EFFECTS THESE CALCULATIONS.
C
      CALL TNUM(G,CE,LL,A1,A2,A3,VI,TOT1,NSEG)
      IF(PNEGG1.EQ.1)WRITE(6,250)A4,A5,TOT1,(G(JJ,1),JJ=1,NSEG)
  255 FORMAT(1H ,5H*****,4HT = ,F8.2,6H DAYS )
      IF(PCEGG2.EQ.0 .AND. PNEGG2.EQ.0)GO TO 9301
C
C      FORM TOT NUMBERS(ALL AGE GROUPS) BY SEGMENT
C
      DO 9302 JJ=1,NSEG
 9302 TEMP1(JJ)=TEMP1(JJ)+G(JJ,1)
 9301 IF(PCEGG1.EQ.0)GO TO 9310
```

```
C
C       COMPUTE AVERAGE EGG CONCENTRATIONS
C
        DO 9304 JJ=1,NSEG
 9304   G(JJ,1)=G(JJ,1)*CONST1/VI(JJ)
        TOT3=TOT1*CONST1/CONST2— Total Estuary Volume
        WRITE(6,9001)A4,A5,TOT3,(G(JJ,1),JJ=1,NSEG)
 9001   FORMAT(1X,F5.1,'-',F5.1,1X,'AC=',9(1X,F10.4))
 9310   CONTINUE
C
C       TOT2 IS THE TOTAL OF TOT1.
C
        TOT2=TOT2+TOT1
  481   CONTINUE
        IF(PNEGG2.EQ.1)WRITE(6,488)TOT2,(TEMP1(JJ),JJ=1,NSEG)
  488   FORMAT(1H ,18HTOTAL NO.(EGGS) = ,9(1X,F10.0))
        IF(PCEGG2.EQ.0)GO TO 9320
        DO 9312 JJ=1,NSEG
        G(JJ,1)=TEMP1(JJ)*CONST1/VI(JJ)
 9312   CONTINUE
        TOT2=TOT2*CONST1/CONST2
        WRITE(6,9002)TOT2,(G(JJ,1),JJ=1,NSEG)
 9002   FORMAT(1X,10HEGG CONC.=,1X,'TC=',9(1X,F10.4))
 9320   CONTINUE
        DO 9313 JJ=1,NSEG
 9313   TEMP1(JJ)=0.
  487   CONTINUE
        IF((T+.0001) .LT. DTE)GO TO 300
C
C        COMPUTE LARVAL PRODUCED
C
  490   IF(LPIX .GT. 1) GO TO 510
        DO 500 J=1,NSEG
        DO 495 L=1,NLPIX
  495   SUM(J,L)=0.
  500   CONTINUE
C
C        COMPUTE TOTAL PRODUCTION FOR DAY IF EQUALITY HOLDS
C
  510   IF(LPIX .GT. NLPIX) GO TO 528
        CALL TNUM(G,CE,MGM,A1,A2,A3,VI,TOT1,NSEG)
C
C        TOTLP IS THE TOTAL NUMBER OF LARVAE PRODUCED.
C
        TOTLP=TOTLP+TOT1
C
C        CUMULATIVE FOR ALL TOTALS TAKEN AT THE END OF A DAY FOR EACH
C
C        STORED IN TOTLP.
  515   DO 520 J=1,NSEG
  520   SUM(J,LPIX)=G(J,1)
        LPIX=LPIX+1
C
C        IF SPAWNING IS NOT THRU, CONTINUE CALC'S AT STATEMENT 300.
```

```
5050        C
5060      525 IF((T+.0001) .LT. TE) GO TO 300
5070        C
5080        C       SPAWNING IS COMPLETE, SET IMPULSE EGG PROD TO ZERO, AND
5090        C       CONTINUE COMPUTING LARVAL PROD. DUE TO REMAINING EGG CONC.
5100        C
5110              IF((T+.0001) .LT. (TE+DTE-DT))GO TO 600
5120      526 IFINAL=IFINAL+1
5130              IF(IFINAL.GT.1)GO TO 1000
5140        C
5150        C       LARVAL PRODUCTION TABLE (NO. LARVAE/DAY)
5160        C
5170      528 DO 540 J=1,NSEG
5180              DO 530 L=1,NLPIX
5190        C
5200        C       EACH ROW IS AVERAGE FOR NLPIX*DT DAYS
5210        C
5220      530 PRTAB(J,IDAY)=PRTAB(J,IDAY)+SUM(J,L)
5230      540 PRTAB(J,IDAY)=PRTAB(J,IDAY)/((LPIX-1)*DT)
5240              PRTAB(NSEG+1,IDAY)=(LPIX-1)*DT
5250              IF(PLPROD.EQ.1)WRITE(6,596)IDAY,TOTLP,(PRTAB(J,IDAY),J=1,NSEG)
5260      596 FORMAT(' DAY=',I5,' TLP=',F12.0,8(1X,F10.0))
5270              LPIX=1
5280              TOTLP=0.
5290              IDAY=IDAY+1
5300        C
5310        C       IFINAL = 1, MEANS THE COMPLETE END OF THE EGG STAGE CYCLE
5320        C       HAS OCCURRED.
5330        C
5340              IF(IFINAL.EQ.0) GO TO 490
5350              LCNT=IDAY-1
5360        C
5370        C       NO MORE IMPULSE EGG PRODUCTION OCCURS.
5380        C
5390      600 DO 610 J=1,NSEG
5400      610 CE(J,1)=0.
5410              IF((T+.0001)-(TE+DTE-DT))400,526,526
5420     1000 LCNT=IDAY-1
5430        C     PATCH FOR TEMPERATURE MODIFICATION OF LARVAL PRODUCTION*****
5440              GO TO 9797
5450     9796 T1=DTE
5460              DO 9790 K=1,LCNT
5470              T2=T1+PRTAB(NSEG+1,K)
5480              DO 9791 J=1,NTEMP
5490              KK=J-1
5500              IF(TEMPER(NSEG+1,J).GT.T1)GO TO 9792
5510     9791 CONTINUE
5520     9792 DO 9793 J=1,NTEMP
5530              KKK=J-1
5540              IF(TEMPER(NSEG+1,J).GT.T2)GO TO 9794
5550     9793 CONTINUE
5560     9794 DO 9795 J=1,NSEG
5570              TEMPT1(J)=TEMPER(J,KK+1)-TEMPER(J,KK)
5580              TEMPT1(J)=TEMPT1(J)*(T1-TEMPER(NSEG+1,KK))/(TEMPER(NSEG+1,KK+1
```

```
     *-TEMPER(NSEG+1,KK))+TEMPER(J,KK)
      TEMPT2(J)=TEMPER(J,KKK+1)-TEMPER(J,KKK)
      TEMPT2(J)=TEMPT2(J)*(T2-TEMPER(NSEG+1,KKK))/
     *(TEMPER(NSEG+1,KKK+1)-TEMPER(NSEG+1,KKK))+TEMPER(J,KKK)
      TEMPT2(J)=.5*(TEMPT1(J)+TEMPT2(J))
      IF(TEMPT2(J).LT.TCUT(J))PRTAB(J,K)=0.
 9795 CONTINUE
      T1=T2
 9790 CONTINUE
      KKSW=2
C
C       PRINTOUT DAILY LARVAL PRODUCTION PER DAY BY SEGMENT AND
C       TOTAL DAILY PRODUCTION (ALL SEGMENTS)
 9797 CONTINUE
      IF(PLPTB1.EQ.1 .OR. PLPTB2.EQ.1)WRITE(6,9101)
      S12=0.
      DO 9705 J=1,NSEG
 9705 TEMPT1(J)=0.
      DO 8000 JK=1,LCNT
      S11=0.
      DO 8005 J=1,NSEG
      TEMPT1(J)=TEMPT1(J)+PRTAB(J,JK)*PRTAB(NSEG+1,JK)
 8005 S11=S11+PRTAB(J,JK)
      S12=S12+S11*PRTAB(NSEG+1,JK)
      IF(PLPTB1.EQ.1)WRITE(6,8010)S11,(PRTAB(J,JK),J=1,NSEG)
 8010 FORMAT(' PTABLE ',F12.0,1X,8(1X,F12.0))
 9101 FORMAT(1H ,10H**********,23HLARVAE PRODUCTION TABLE,
     *10H**********///)
 8000 CONTINUE
C
C       PRINTOUT TOTAL NUMBERS PRODUCED
C
      IF(PLPTB2.EQ.1)WRITE(6,489)S12,(TEMPT1(J),J=1,NSEG)
  489 FORMAT(1H ,18HTOTAL NO.(LARV) = ,F15.0,8(1X,F10.0))
      GO TO(9796,1001),KKSW
 1001 CONTINUE
C
C******************* L A R V A L  S E C T I O N *********
C
C       RE-INITIALIZE CONCENTRATION, PRODUCTION AND TEMPORARY ARRAYS.
C
      IRAN=IRA(2)
      IF(IRAN.NE.0)CALL GROSSK(DYY,SDYY,DTL,NSEG,SVL)
      DO 1010 J=1,NSEG
      CP(J,1)=0.
      TEMP1(J)=0.
      F(J,1)=0.
      G(J,1)=0.
      DO 1005 L=1,500
      FE(L)=0.
 1005 CE(J,L)=0.
 1010 CONTINUE
C
C       LCHA INDICATES THE CURRENT FLOW AND DISPERSION COEFFICIENTS
```

NSEG?

```
6110        C       BEING USED.
6120        C
6130                LCHA=1
6140                NDT=0
6150                T=DTE
6155                ISW=0
6156                TB=T
6160        C
6170        C       IDAY IS AN INDICATOR WHICH IS USED TO OVERLAY A PREVICUS
6180        C       PRODUCTION IN THE PROD. TABLE - PRTAB.
6190        C
6200                IDAY=1
6210                LPIX=1
6220                IFINAL=0
6230        C
6240        C       IPCNT IS AN INDICATOR WHICH IS TO POINT TO THE CURRENT PRODUCT
6250        C       BEING USED.
6260        C
6270                IPCNT=1
6280        C
6290        C       RI IS THE NUMBER OF LARVAL AGE-GROUPS/DAY
6300        C
6310                RI=PLAVG/SL
6320        C
6330        C       NLIMP=NUMBER OF LARVAL IMPULSES BEFORE ADVANCING TO
6340        C       THE NEXT COLUMN OF THE PRODUCTION TABLE.
6350        C
6360                NLIMP=PRTAB(NSEG+1,IPCNT)*RI+.0001
6370        C
6380        C       NLPIX IS MAXIMUM NUMBER OF AGE GROUPS TO BE AVERAGED INTO THE
6390        C       STAGE.
6400        C
6410                NLPIX=PJIAVG/SL+.0001
6420                TOTJ1P=0.
6430        C
6440        C       JLARV=MAXIMUM NUMBER OF LARVAL AGE GROUPS
6450        C
6460                JLARV=DTL/SL+.0001          DTL= 28
6470        C
6480        C       IIT IS AN INDICATOR WHICH DETERMINES WHEN PRODUCTION IS TO BE
6490        C
6500                IIT=0
6510        C
6520        C       COMPUTE RATE AT WHICH LARVAL ORGANISMS IN IOP SEGMENT ARE TO BE
6530        C       WITHDRAWN BY THE PLANT.
6540        C
6550                DO 1096 J=1,NSEG
6560         1096   GOP(J)=FVL(J)*FLOAT(KPLANT(J))*OP(J)/VI(J)
6570                KEY=1
6580                IPP=0
6590        C
6600        C       COMPUTE LARVAL PRODUCTION
6610        C
6620                WRITE(6,1097)
```

```
 1097 FORMAT(1HI,40X,'LARVAL SECTION'///)
 1099 TOT1=0.
      DO 1100 J=1,NSEG
C
C       F CONTAINS CURRENT LARVAL PRODUCTION PER SEGMENT (TOT NO./DAY)
C
      F(J,1)=SL*PRTAB(J,IPCNT)
C
C       TOT1 IS THE TOTAL LARVE PRODUCED IN ALL SEGMENTS.
C
      TOT1=TOT1+F(J,1)
 1100 CONTINUE
      IF(PIMPL.EQ.1)WRITE(6,252)TOT1,(F(J,1),J=1,NSEG)
  252 FORMAT(1H ,14HLARV IMPULSED=,F15.0,8(1X,F10.0))
      DO 1150 J=1,NSEG
C
C       F NOW CONTAINS CURRENT AVERAGE LARVAL IMPULSE CONC. PER SEGMEN
C
 1150 F(J,1)=F(J,1)/VI(J)
C
C       COMPUTE E INVERSE * F = CP, THE IMPULSE AGE GROUP CONC.
C
      CALL MXMUL(EINV,F,NSEG,1,CP)
C
C       CE(J,1) CONTAINS THE IMPULSE LARVAL CONC. AT THE MIDPOINT
C       OF EACH SEGMENT (WHERE J=1,...,N REFERS TO THE SEGMENT).
C
      DO 1175 J=1,NSEG
 1175 CE(J,1)=CP(J,1)
C
C       KEY=1 FOR FIRST PRODUCTION AND KEY=2 FOR ALL OTHER PROD.'S.
C
      GO TO (1301,1320),KEY
C
C       COMPUTE EXCHANGE COEFFICIENTS.
C
 1301 IF(T.GT.DTE)GO TO 1300
      CALL DICAL(DI,EI,AX,SLEN,NSEG,LCHA)
C
C       COMPUTE ADVECTION AND DISPERSION COEFFICIENTS AND STORE IN MA
C
      CALL AMACAL(AMAT,LCHA)
C
C       COMPUTE E INVERSE * A MATRIX AND STORE IN MATRIX TTT.
C
      CALL MXMUL(EINV,AMAT,NSEG,NSEG,TTT)
 1300 CONTINUE
C
C       INCREMENT COUNTER IIT
C
      IIT=IIT+1
C
C       IF IIT IS GREATER THAN NLIMP CHANGE PRODUCTION.
C
```

```
      IF(IIT-NLIMP) 1320,1320,1305
C
C     IF IPCNT IS LESS THAN LCNT - INCREMENT IPCNT TO OBTAIN NEXT
C     PRODUCTION IN TABLE PRTAB.  IF IPCNT=LCNT, THERE IS NO MORE
C     PRODUCTION.
C
 1305 IF(IPCNT.EQ.LCNT)GO TO 1600
      IPCNT=IPCNT+1
      IIT=1
      NLIMP=PRTAB(NSEG+I,IPCNT)*RI+.0001
      KEY=2
      GO TO 1099
C
C     CHECK CURRENT TIME , T, WITH TIME TQE TO DETERMINE IF NEW
C     EXCHANGE COEFFICIENTS AND 'A MATRIX' AND MATRIX TTT =
C     E INVERSE * A ARE TO BE COMPUTED DUE TO THE INTRODUCTION
C     OF NEW FLOW AND DISPERSION VALUES.
C
 1320 IF(T+.0001-TQE(LCHA)) 1400,1330,1330
 1330 LCHA=LCHA+1
      IF(LCHA.LE.NCHANG)GO TO 1306
      LCHA=LCHA-1
      GO TO 1400
C
 1306 CALL DICAL(DI,EI,AX,SLEN,NSEG,LCHA)
      CALL AMACAL(AMAT,LCHA)
      CALL MXMUL(EINV,AMAT,NSEG,NSEG,TTT)
C
C
C     MEGG EQUALS MAXIMUM NO. OF LARVAL AGE GROUPS PERMITTED.
C
 1400 MEGG=JLARV
C
C     NI EQUALS PRESENT NO. OF LARVAL AGE GROUPS.
C
      NI=RI*(T+SL-DTE)+.0001
      IF(NI .LT. MEGG) MEGG=NI
      DO 1437 J=1,NSEG
 1437 XCE(J)=CE(J,1)
      ICOUNT=1
 1431 CONTINUE
C
C     COMPUTE TOTAL LARVAL CONC FOR EACH SEGMENT WHICH IS TO BE
C     USED IN THE COMPUTATION OF THIRD ORDER DECAY RATE.
C
      DO 1432 J=1,NSEG
      FE(J)=0.
      DO 1432 L=1,MEGG
 1432 FE(J)=FE(J)+CE(J,L)
      IF(ICOUNT.GT.1)GO TO 8611
      IF(PLENT.EQ.0)GO TO 8611
      K1=MOD(NDT,PNLEN)
      IF(K1.NE.0)GO TO 8611
      SK2=0.
```

```
      IF(IYR.EQ.0)GO TO 8611
      DO  933 J=1,NSEG
      XENT(J)=FVL(J)*QP(J)*FLOAT(KPLANT(J))*CONENT*FE(J)
  933 SK2=SK2+XENT(J)
      WRITE(12,8616)T,SK2,(XENT(J),J=1,NSEG)
      CALL PARSUM(XENT,TB,T,NSEG,ISW)
 8616 FORMAT('@@@T=',F10.2,' LARVAL ENTRAINED='F15.0,'*****'//
     18(1X,F10.0))
 8611 CONTINUE
      DO 1435 K=MEGG,1,-1
      DO 1433 J=1,NSEG
C
C       G AND Y ARRAYS CONTAIN THE CURRENT LARVAL AGE GROUP CONC
C       PER SEGMENT.
C
      G(J,1)=CE(J,K)
 1433 Y(J)=CE(J,K)
C
C       ADVECT AND DISPERSE LARVAL AGE GROUPS AND STORE IN CP ARRAY.
C
      CALL MXMUL(TTT,G,NSEG,1,CP)
      CALL DECAY(SVL,SVLO,FE,TCL,DECY,VI,NSEG,A1,A2,A3,GQP)
      DO 1450 J=1,NSEG
 1450 DERY(J)=CP(J,1)
      CALL MXMUL(EINV,DECY,NSEG,NSEG,UINV)
      CALL MXMUL(UINV,G,NSEG,1,CP)
      DO 1455 J=1,NSEG
 1455 DERY(J)=DERY(J)-CP(J,1)
      STEP=SL/FLOAT(IDTL)
C
C       PERFORM RUNGE KUTTA CALCULATIONS.
C       STEP IS THE CURRENT TIME STEP TO BE USED IN RUNGE KUTTA.
C       Y IS THE CURRENT CONC. OF THE KTH AGE GROUP AT TIME T.
C       DERY IS THE DERIVATIVE OF Y.
C       DEC      IS AN ARRAY DESCRIBING THE DECAY RATE OF THE KTH AGE
C       GROUP AT TIME T.
C       AUX IS AN AUXILLIARY ARRAY USED BY THE RUNGE-KUTTA.
C
      CALL RKUTTA(STEP,Y,DERY,UINV,AUX,NSEG,TTT,G,CP,VI)
C
      CALLPATCH1(G,CE,K,A1,A2,A3,VI,TOTAL,NSEG,0,STEP,DECY,GQP)
C
      LL=K
      IF(ICOUNT.EQ.IDTL)LL=K+1
C
C       STORE AGE GROUP FOR TIME T+SL IN CE ARRAY.
C
      DO 1444 JN=1,NSEG
      IF(Y(JN).LT.0.)Y(JN)=0.
 1444 CE(JN,LL)=Y(JN)
C
      CALLPATCH2(G,CE,LL,A1,A2,A3,VI,TOTAL1,TOTAL,NSEG,
     *EINV,CP,TNUMBR)
C
```

```
 1435 CONTINUE
      ICOUNT=ICOUNT+1
      IF(ICOUNT.LE.IDTL)GO TO 1431
      DO  438 J=1,NSEG
 1438 CE(J,1)=XCE(J)
      NDT=NDT+1
      T=FLOAT(NDT)*SL + DTE
      IPP=IPP+1
      MGM=MEGG+1
C
C      IF IPP = NLSP PRINT OUT TOAL NUMBERS OF LARVAE BY AGE GROUP
C      AND BY SEGMENT AND TOTAL ACROSS SEGMENTS.
C
      IF(IPP.NE.NLSP)GO TO 1487
      WRITE(6,255)T
      IPP=0
      TOT2=0.
      DO 1481 LL=2,MGM
      A4=FLOAT(LL-2)*SL
      A5=FLOAT(LL-1)*SL
C
C      CONVERT AGE GROUP CONC. IN EACH SEGMENT TO TOTAL NOS. AND STOR
C      RESULTS IN THE G ARRAY.
C      THIS IS ACCOMPLISHED BY THE ROUTINE TNUM.
C
      CALL TNUM(G,CE,LL,A1,A2,A3,VI,TOT1,NSEG)
      IF(PNLAR1.EQ.1)WRITE(6,250)A4,A5,TOT1,(G(JJ,1),JJ=1,NSEG)
      IF(PCLAR2.EQ.0 .AND. PNLAR2.EQ.0)GO TO 9401
C
C      FORM TOT NUMBERS(ALL AGE GROUPS) BY SEGMENT
C
      DO 9402 JJ=1,NSEG
 9402 TEMP1(JJ)=TEMP1(JJ)+G(JJ,1)
 9401 IF(PCLAR1.EQ.0)GO TO 9410
C
C      COMPUTE AVERAGE LARVAE CONCENTRATIONS
C
      DO 9404 JJ=1,NSEG
 9404 G(JJ,1)=G(JJ,1)*CONST1/VI(JJ)
      TOT3=TOT1*CONST1/CONST2
      WRITE(6,9100)A4,A5,TOT3,(G(JJ,1),JJ=1,NSEG)
 9100 FORMAT(1X,F5.1,'-',F5.1,1X,'AC=',9(1X,F10.4))
 9410 CONTINUE
      TOT2=TOT2+TOT1
 1481 CONTINUE
      IF(PNLAR2.EQ.1)WRITE(6,489)TOT2,(TEMP1(JJ),JJ=1,NSEG)
      IF(PCLAR2.EQ.0)GO TO 9420
      DO 9412 JJ=1,NSEG
      G(JJ,1)=TEMP1(JJ)*CONST1/VI(JJ)
 9412 CONTINUE
      TOT2=TOT2*CONST1/CONST2
      WRITE(6,9102)TOT2,(G(JJ,1),JJ=1,NSEG)
 9102 FORMAT(1X,10HLAR.CONC.=,1X,'TC=',9(1X,F10.4))
 9420 CONTINUE
```

```
      DO 9413 JJ=1,NSEG
 9413 TEMP1(JJ)=0.
C.....IST IS THE START OF THE AGE GROUP
C.....IENST IS THE END OF THE AGE GROUP CATEGORY SELECTED.
      IF(NCOMR.EQ.0)GO TO 1487
      DO 1485 KK=1,NCOMR
      IST=IAGE(KK)
      IENST=IEAGE(KK)
      CALL COMPUT(T,MGM,CE,NSEG,VI,A1,A2,A3,G,
     IIST,1000,IENST,SL,CONST1,CONST2)
 1485 CONTINUE
 1487 CONTINUE
C     IS JUVENILE 1 PRODUCTION TO BEGIN-ONLY IF T=DTE=DTL.
C
      IF((T+.0001) .LT. (DTE+DTL)) GO TO 1300
C
C      COMPUTE JUVENILE 1 PRODUCED
C
C
 1490 IF(LPIX .GT. 1) GO TO 1510
      DO 1500 J=1,NSEG
      DO 1495 L=1,NLPIX
 1495 SUM(J,L)=0.
 1500 CONTINUE
 1510 IF(LPIX .GT. NLPIX) GO TO 1528
C
C      CONVERT JUV 1 PRODUCED TO TOTAL NOS. AND STORE IN G ARRAY.
C
      CALL TNUM(G,CE,MGM,A1,A2,A3,VI,TOT1,NSEG)
      TOTJ1P=TOTJ1P+TOT1
 1515 DO 1520 J=1,NSEG
 1520 SUM(J,LPIX)=G(J,1)
      LPIX=LPIX+1
C
C      IS LARVAL PRODUCTION TO CEASE - T=TE+DTE FOR THIS TO OCCUR
C
 1525 IF((T+.0001) .LT. (TE+DTE)) GO TO 1300
C
C      IS JUV 1 IMPULSE PROD TO STOP.
C
      IF((T+.0001).LT.(TE+DTE+DTL-SL))GO TO 1600
C
C      CEASE JUV 1 PROD.
C
 1526 IFINAL=IFINAL+1
      IF(IFINAL.GT.1)GO TO 1620
C
C      COMPUTE JUVENILE 1 PROD TABLE (NO J1/DAY)
C
 1528 DO 1540 J=1,NSEG
      PRTAB(J,IDAY)=0.
      DO 1530 L=1,NLPIX
 1530 PRTAB(J,IDAY)=PRTAB(J,IDAY)+SUM(J,L)
 1540 PRTAB(J,IDAY)=PRTAB(J,IDAY)/((LPIX-1)*SL)
```

```
      PRTAB(NSEG+1,IDAY)=(LPIX-1)*SL
      LPIX=1
C
C     PRINT OUT CURRENT JUV 1 PRODUCTION.
C     TOTAL NOS. FOR EACH SEGMENT
C
      IF(PJ1PRO.EQ.1)WRITE(6,1596)IDAY,TOTJ1P,(PRTAB(J,IDAY),J=1,NSEG)
 1596 FORMAT(' IDAY=',I5,' TJ1P=',F12.0,8(1X,F10.0))
      IDAY=IDAY+1
      TOTJ1P=0.
C     IF IFINAL NOT 1 RESET SUM ARRAY TO ZERO AND STORE
C
C     CURRENT CE(J,MGM) CONC. DISTRIBUTION.
C
      IF(IFINAL.EQ.0) GO TO 1490
      LCNT=IDAY-1
 1600 DO 1610 J=1,NSEG
 1610 CE(J,1)=0.
      IF((T+.0001)-(TE+DTE+DTL-SL)) 1400,1526,1526
 1620 LCNT=IDAY-1
      S12=0.
      IF(PJ1PT1.EQ.1 .OR. PJ1PT2.EQ.1)WRITE(6,9201)
      DO 1635 J=1,NSEG
 1635 TEMPT1(J)=0.
      DO 1700 JK=1,LCNT
      S11=0.
C
C     PRINTOUT JUV 1 PROD TABLE (NOS./DAY) PER SEGMENT.
C
      DO 1750 J=1,NSEG
      TEMPT1(J)=TEMPT1(J)+PRTAB(J,JK)*PRTAB(NSEG+1,JK)
 1750 S11=S11+PRTAB(J,JK)
      S12=S12+S11*PRTAB(NSEG+1,JK)
      IF(PJ1PT1.EQ.1)WRITE(6,8010)S11,(PRTAB(J,JK),J=1,NSEG)
 9201 FORMAT(1H1,10H**********,23HJUV. 1 PRODUCTION TABLE,
     *10H**********///)
 1700 CONTINUE
C
C     PRINT OUT TOTAL JUVENILE 1 PRODUCTION.
C
      IF(PJ1PT2.EQ.1)WRITE(6,491)S12,(TEMPT1(J),J=1,NSEG)
  491 FORMAT(1H ,20HTOTAL NO.(JUV. 1) = ,F14.0,8(1X,F10.0))
 2001 CONTINUE
C
C**************** J U V E N I L E  1  S T A G E **************
      IRAN=IRA(3)
      IF(IRAN.NE.0)CALL GROSSK(DYY,SDYY,DTJ1,NSEG,SVJ1)
      WRITE(6,1797)
 1797 FORMAT(1H1,40X,'JUVENILE 1 SECTION'///)
C
C     RI IS THE NUMBER OF JUVENILE 1 AGE-ROUPS/DAY
C
      MJUV=MJUV1
      RI=PJ1AVG/SJ1
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```
9820      C
9830      C       NLPIX INDICATES HOW JUV 2 PROD IS TO BE AVERAGED.
9840      C
9850            NLPIX=PJ2AVG/SJ1+.0001
9860      C
9870      C       SJ1 IS THE JUV 1 TIME STEP TO BE USED.
9880      C
9890      C
9900      C       TOTJ2P IS THE TOTAL JUV 2 PRODUCED.
9910      C
9920            TOTJ2P=0.
9930            NDT=0
9940      C
9950      C       RE-INITIALIZE PRODUCTION, CONCENTRATION AND TEMPORARY ARRAYS.
9960      C
9970       2000 DO 2010 J=1,NSEG
9980            CP(J,1)=0.
9990            F(J,1)=0.
10000           G(J,1)=0.
10010           TEMP1(J)=0.
10020      2010 CONTINUE
10030     C
10040     C       OFFSET CURRENT TIME, T, BY DTE AND DTL TO POINT TO THE
10050     C       BEGINNING OF JUVENILE 1 PRODUCTION.
10060     C
10070           T=DTE+DTL
10075           ISW=0
10076           TB=T
10080     C
10090     C       DTS IS THE TIME UP TO  WHICH JUV 1'S EXIST.
10100     C
10110           DTS=T+TE+DTJ1
10120           IDAY=1
10130           LPIX=1
10140           IFINAL=0
10150           IPCNT=1
10160           IIT=0
10170           JJ1=DTJ1/SJ1+.0001
10180           NJ1IMP=PRTAB(NSEG+1,IPCNT)*RI+.0001
10190     C
10200     C       GQP IS THE RATE AT WHICH JUV 1'S IN SEG IQP ARE WITHDRAWN
10210     C       BY THE PLANT.
10220     C
10230           DO 2051 J=1,NSEG
10240      2051 GQP(J)=FVJ1(J)*FLOAT(KPLANT(J))*QP(J)/VI(J)
10250           KEY=1
10260           IPP=0
10270           AUX(15,1)=99.
10280      2099 TOT1=0.
10290           DO 2100 J=1,NSEG
10300     C
10310     C       COMPUTE JUV 1 PRODUCTION (NOS/DAY)
10320     C
10330           F(J,1)=SJ1*PRTAB(J,IPCNT)
```

```
10340      C
10350      C       TOT1 IS TOTAL NO. JUV 1 PRODUCED IN THE ESTUARY.
10360      C
10370            TOT1=TOT1+F(J,1)
10380       2100 CONTINUE
10390            IF(PIMPJ1.EQ.1)WRITE(6,9501)TOT1,(F(J,1),J=1,NSEG)
10400       9501 FORMAT(1H ,I4HJUV1 IMPULSED=,F15.0,8(1X,F10.0))
10410            DO 2150 J=1,NSEG
10420      C
10430      C       F CONTAINS JUV 1 CONC.
10440      C
10450       2150 F(J,1)=F(J,1)/VI(J)
10460      C
10470      C       COMPUTE MIDPOINT CONCENTRATION IN ARRAY CP.
10480      C
10490            CALL MXMUL(EINV,F,NSEG,1,CP)
10500      C
10510      C       CP CONTAINS JUV 1 CONC. AT THE SEG MIDPOINT.
10520      C
10530            DO 2175 J=1,NSEG
10540      C
10550      C       SET CE(1:NSEG,1) TO THE IMPULSE PRODUCTION OF JUVENILE 1'S.
10560      C
10570       2175 CE(J,1)=CP(J,1)
10580            GO TO (2301,2400),KEY
10590       2301 CONTINUE
10600            IIT=IIT+1
10610      C
10620      C       IF IIT=NJ1IMP, WE CHECK TO SEE IF THERE ARE ANY MORE IMPULSE P
10630      C
10640            IF(IIT-NJ1IMP) 2400,2400,2320
10650      C
10660      C       IF IPCNT IS LESS THAN LCNT, USE NEW IMPULSE PRODUCTION.
10670      C       OTHERWISE, NO MORE IMPULSE PRODUCTION.  SET IMPULSE PRODUCTIO
10680      C       ZERO.
10690      C
10700       2320 IF(IPCNT.EQ.LCNT)GO TO 2600
10710            IPCNT=IPCNT+1
10720            IIT=1
10730            NJ1IMP=PRTAB(NSEG+1,IPCNT)*RI+.0001
10740            KEY=2
10750            GO TO 2099
10760      C
10770      C       MEGG IS MAX. NO. OF JUV 1 AGE GROUP CONC.'S.
10780      C
10790       2400 MEGG=JJ1
10800      C
10810      C       NI IS THE MIN NO. OF JUV 1 AGE GROUPS.
10820      C
10830            NI=RI*(T+SJ1-DTE-DTL)+.0001
10840            IF(NI.LT.MEGG)MEGG=NI
10850      C
10860      C       WEIGHT COMPUTES THE TOTAL NUMBER OF JUVENILE 1'S IN THE ESTUA
10870      C       THE FRACTIONAL PERCENT OF JUVENILE 1'S IN EACH SEGMENT COMPA
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C       TO THE DESIRED FRACTIONAL PERCENT BASED ON EMPIRICAL DATA,AND
C        THE RATE (GG(1:NSEG)) AT WHICH JUVENILE 1'S MIGRATE AT THE
C        BOUNDARIES.  THE DIRECTION OF MIGRATION IS ASSUMED TO BE FROM
C       UPSTREAM TO DOWNSTREAM.  HENCE, THE APPROPRIATE CHOICE OF
C        A NEGATIVE SIGN IS USED IN THE MATRIX EQUATIONS.
C
        DO 2437 J=1,NSEG
 2437   XCE(J)=CE(J,1)
        ICOUNT=1
 2431   CONTINUE
        CALL MTIME(TMIG,NCJ1,INCJ1,T,1)
        CALL WEIGHT(GG,CE,YJ1,INCJ1,SUM1,G,A1,A2,A3,VI,DI,EP,
       *TOTNUM,MEGG,NSEG,DTS,T)
        IF(ICOUNT.GT.0)GO TO 8612
        IF(PJ1ENT.EQ.0)GO TO 8612
        KI=MOD(NDT,PNJ1EN)
        IF(K1.NE.0)GO TO 8612
        SK1=0.
        IF(IYR.EQ.0) GO TO 8612
        DO 8605 J=1,NSEG
        XENT(J)=FVJ1(J)*QP(J)*FLOAT(KPLANT(J))*CONENT*SUM1(J,1)
 8605   SK1=SK1+XENT(J)
        WRITE(12,8617)T,SK1,(XENT(J),J=1,NSEG)
        CALL PARSUM(XENT,TB,T,NSEG,ISW)
 8617   FORMAT(1X,'@@@T=',F10.2,' JI ENT =',F15.0,'*****'//
       18(1X,F10.0))
 8612   CONTINUE
        DO 2435 K=MEGG,1,-1
        DO 2433 J=1,NSEG
        FE(J)=SUM1(J,1)
 2433   Y(J)=CE(J,K)
        KAGE=K
        CALL DECAY(SVJ1,SVJ1C,FE,TCJ1,DECY,VI,NSEG,A1,A2,A3,GQP)
        CALL MXMUL(EINV,DECY,NSEG,NSEG,UINV)
C        COMPUTE THE MIGRATION RATE AND THE CHANGE IN CONC. DERY WITH
C        DECAY DUE TO MIGRATION.
C
        IF(MJUV.EQ.1)CALL AWGHT(CE,A1,A2,A3)
        CALL MIGN(EINV,CP,G,NSEG,Y,DERY,UINV,VI)
        STEP=SJ1/FLOAT(IDTJI)
C
C        ADVANCE THE CURRENT AGE GROUP CONC. VIA THE RUNGE-KUTTA
C        FROM TIME T TO TIME T+STEP.
C
        CALL RKUTTA(STEP,Y,DERY,UINV,AUX,NSEG,EINV,G,CP,VI)
C
        CALLPATCH1(G,CE,K,A1,A2,A3,VI,TOTAL,NSEG,1,STEP,DECY,GQP)
C
        LL=K
        IF(ICOUNT.EQ.IDTJI)LL=K+1
        DO 2444 JN=1,NSEG
        IF(Y(JN).LT.0.)Y(JN)=0.
 2444   CE(JN,LL)=Y(JN)
C
```

```
11400          CALLPATCH2(G,CE,LL,A1,A2,A3,VI,TOTAL1,TOTAL,NSEG,
11410         *EINV,CP,TNUMBR)
11420    C
11430     2435 CONTINUE
11440          ICOUNT=ICOUNT+1
11450          IF(ICOUNT.LE.IDTJ1)GO TO 2431
11460          DO 2438 J=1,NSEG
11470     2438 CE(J,1)=XCE(J)
11480          NDT=NDT+1
11490    C
11500    C      COMPUTE CURRENT TIME T AND OFFSET BY STAGE LENGHTS DTE AND DTL.
11510    C
11520          T=FLOAT(NDT)*SJ1+DTE+DTL
11530          IPP=IPP+1
11540          MGM=MEGG+1
11550          IF(IPP.NE.NJ1SP)GO TO 2487
11560          WRITE(6,255)T
11570          IPP=0
11580          TOT2=0.
11590          DO 2481  LL=2,MGM
11600          A4=FLOAT(LL-2)*SJ1
11610          A5=FLOAT(LL-1)*SJ1
11620    C      COMPUTE TOTAL NUMBER OF ORGANISMS IN THE LL AGE GROUP IN THE
11630    C      ESTUARY AND BY SEGMENT VIA THE ROUTINE TNUM.
11640    C
11650          CALL TNUM(G,CE,LL,A1,A2,A3,VI,TOT1,NSEG)
11660          IF(PNJ11.EQ.1)WRITE(6,250)A4,A5,TOT1,(G(JJ,1),JJ=1,NSEG)
11670          IF(PCJ12.EQ.0 .AND. PNJ12.EQ.0)GO TO 9601
11680    C
11690    C      FORM TOT NUMBERS(ALL AGE GROUPS) BY SEGMENT
11700    C
11710          DO 9602 JJ=1,NSEG
11720     9602 TEMP1(JJ)=TEMP1(JJ)+G(JJ,1)
11730     9601 IF(PCJ11.EQ.0)GO TO 9610
11740    C
11750    C      COMPUTE AVERAGE JUVENILE 1 CONCENTRATIONS
11760    C
11770          DO 9604 JJ=1,NSEG
11780     9604 G(JJ,1)=G(JJ,1)*CONST1/VI(JJ)
11790          TOT3=TOT1*CONST1/CONST2
11800          WRITE(6,9100)A4,A5,TOT3,(G(JJ,1),JJ=1,NSEG)
11810     9610 CONTINUE
11820     9488 FORMAT(1H ,18HTOTAL NO.(J 1 ) = ,9(1X,F10.0))
11830          TOT2=TOT2+TOT1
11840     2481 CONTINUE
11850          IF(PNJ12.EQ.1)WRITE(6,9488)TOT2,(TEMP1(JJ),JJ=1,NSEG)
11860          IF(PCJ12.EQ.0)GO TO 9620
11870          DO 9612 JJ=1,NSEG
11880          G(JJ,1)=TEMP1(JJ)*CONST1/VI(JJ)
11890     9612 CONTINUE
11900          TOT2=TOT2*CONST1/CONST2
11910          WRITE(6,9303)TOT2,(G(JJ,1),JJ=1,NSEG)
11920     9303 FORMAT(1X,10HJ1  CONC.=,1X,3HTC=,9(1X,F10.4))
11930     9620 CONTINUE
```

```
      DO 9613 JJ=1,NSEG
 9613 TEMP1(JJ)=0.
 2487 CONTINUE
C
C       HAS PRODUCTION OF JUVENILE 2'S BEGUN?
C       YES  IF THE TIME TEST BELOW FAILS.
C
      IF((T+.0001).LT.(DTE+DTL+DTJ1))GO TO 2301
C
C       COMPUTE JUVENILE 2 PRODUCTION
C
 2490 IF(LPIX .GT. 1) GO TO 2510
      DO 2500 J=1,NSEG
      DO 2495 L=1,NLPIX
 2495 SUM(J,L)=0.
 2500 CONTINUE
 2510 IF(LPIX .GT. NLPIX) GO TO 2528
C
C       C       COMPUTE TOTAL NUMBER TO BE USED IN JUVENILE 2 IMPULSE P
C       (TOT1) AND FOR EACH SEGMENT (G(1:NSEG,1)).
C
      CALL TNUM(G,CE,MGM,A1,A2,A3,VI,TOT1,NSEG)
      TOTJ2P=TOTJ2P+TOT1
 2515 DO 2520 J=1,NSEG
 2520 SUM(J,LPIX)=G(J,1)
      LPIX=LPIX+1
C
C       IF TEST FAILS THERE IS NO MORE JUVENILE 1 PRODUCTION.
C
 2525 IF ((T+.0001).LT. (TE+DTE+DTL))GO TO 2301
C
C       IF TEST FAILS ALL JUVENILE 1'S THAT WERE IN ESTUARY HAVE TRANS
C       TO JUVENILE 2 IMPULSE PRODUCTION.
C
      IF((T+.0001).LT.(TE+DTE+DTL+DTJ1-SJ1))GO TO 2600
 2526 IFINAL=IFINAL+1
      IF(IFINAL.GT.1)GO TO 2615
C
C       COMPUTE TOTAL NO. JUVENILE 2'S PRODUCED FOR (LPIX-1)*SJ1 DAYS.
C
 2528 DO 2540 J=1,NSEG
      PRTAB(J,IDAY)=0.
      DO 2530 L=1,NLPIX
 2530 PRTAB(J,IDAY)=PRTAB(J,IDAY)+SUM(J,L)
 2540 PRTAB(J,IDAY)=PRTAB(J,IDAY)/((LPIX-1)*SJ1)
      PRTAB(NSEG+1,IDAY)=(LPIX-1)*SJ1
      LPIX=1
C
C       PRINT THE IDAY IMPULSE PRODUCTION, THE TOTAL NUMBER PRODUCED
C       ESTUARY, TOTJ2P, AND THE TOTAL NUMBER OF LARVAE (#'S PER DAY)
C       IN EACH SEGMENT (G(1:NSEG)).
C
      IF(PJ2PRO.EQ.1)WRITE(6,9596)IDAY,TOTJ2P,(PRTAB(J,IDAY),J=1,NSE
 9596 FORMAT(6H IDAY=,I5,6H TJ2P=,F12.0,8(1X,F10.0))
```

```
      TOTJ2P=0.
      IDAY=IDAY+1
C
C      IFINAL = 1, MEANS THERE IS NO MORE TRANSFER OF JUVENILE 1'S TO
C      THE JUVENILE 2 PRODUCTION TABLE.
C
      IF(IFINAL.EQ.0) GO TO 2490
      LCNT=IDAY-1
C
C      SET THE JUVENILE 1 IMPULSE PRODUCTION TO ZERO.  NO MORE
C      IMPULSE PRODUCTION.
C
 2600 DO 2610 J=1,NSEG
 2610 CE(J,1)=0.
      IF((T+.0001)-(TE+DTE+DTL+DTJ1-SJ1)) 2400,2526,2526
 2615 LCNT=IDAY-1
      IF(PJ2PT1.EQ.1 .OR. PJ2PT2.EQ.1)WRITE(6,9306)
 9306 FORMAT(1H1,10H**********,23HJUV. 2 PRODUCTION TABLE,
     *10H**********///)
      S12=0.
      DO 9393 J=1,NSEG
 9393 TEMPT1(J)=0.
      DO 8300 JK=I,LCNT
      S11=0.
      DO 8350 J=1,NSEG
      TEMPT1(J)=TEMPT1(J)+PRTAB(J,JK)*PRTAB(NSEG+1,JK)
 8350 S11=S11+PRTAB(J,JK)
      S12=S12+S11*PRTAB(NSEG+1,JK)
      IF(PJ2PT1.EQ.1)WRITE(6,8010)S11,(PRTAB(J,JK),J=1,NSEG)
 8300 CONTINUE
C
C      S12 IS THE TOTAL NUMBER OF JUVENILE 2 PRODUCTION.
C
      IF(PJ2PT2.EQ.1)WRITE(6,9391)S12,(TEMPTI(J),J=1,NSEG)
 9391 FORMAT(1H ,20HTOTAL NO.(JUV. 2) = ,F14.0,8(1X,F10.0))
 3001 CONTINUE
C
C*****************J U V E N I L E  2  S E C T I O N***************
      WRITE(6,2097)
 2097 FORMAT(1H1,40X,'JUVENILE 2 SECTION'///)
      R1=PJ2AVG/SJ2
      MJUV=MJUV2
C
C      RE-INITIALIZE CONCENTRATION,PRODUCTION AND TEMPORAY ARRAYS.
C
      TOTJ3P=0.
      NDT=0
 3000 DO 3010 J=1,NSEG
      CP(J,1)=0.
      TEMP1(J)=0.
      F(J,1)=0.
      G(J,1)=0.
 3010 CONTINUE
C
```

```
13020      C        SET CURRENT TIME TO THE TIME WHEN JUVENILE 2'S FIRST BEGIN TO
13030      C        APPEAR; THAT IS, THE SUM OF ALL PREVIOUS STAGE LENGHTS.
13040      C
13050               T=DTE+DTL+DTJ1
13055               ISW=0
13056               TB=T
13060               DTS=TJJ3-TSPW
13070               DTJ2=DTS-T
13071               IRAN=IRA(4)
13072               IF(IRAN.NE.0)CALL GROSSK(DYY,SDYY,DTJ2,NSEG,SVJ2)
13080               IDAY=1
13090               LPIX=1
13100               IFINAL=0
13110               IPCNT=1
13120               IIT=0
13130               KEY=1
13140               NJ2IMP=PRTAB(NSEG+1,IPCNT)*RI+.0001
13150      C
13160      C        COMPUTE RATE AT WHICH JUVENILE 2'S ARE WITHDRAWN BY THE
13170      C        PLANT.
13180      C
13190               DO 3015 J=1,NSEG
13200       3015 GQP(J)=FVJ2(J)*FLOAT(KPLANT(J))*QP(J)/VI(J)
13210               IPP=0
13220               JJ2=DTJ2/SJ2+.0001
13230               AUX(15,1)=99.
13240      C
13250      C        COMPUTE TOTAL NUMBER OF JUVENILE 2'S TO BE IMPULSED.
13260      C
13270       3099 TOT1=0.
13280               DO 3100 J=1,NSEG
13290               F(J,1)=SJ2*PRTAB(J,IPCNT)
13300               TOT1=TOT1+F(J,1)
13310       3100 CONTINUE
13320      C
13330      C        PRINT OUT TOTAL NUMBER OF JUVENILES IMPULSED IN ESTUARY, TOT1,
13340      C        (NO/DAY) AND IN EACH SEGMENT (F(1:NSEG,1)).
13350      C
13360               IF(PIMPJ2.EQ.1)WRITE(6,253)TOT1,(F(J,1),J=1,NSEG)
13370        253 FORMAT(1H ,14HJUV2 IMPULSED=,F15.0,8(1X,F10.0))
13380      C
13390      C        CONVERT TOTAL NUMBERS TO CONCENTRATIONS BY DIVING BY THE
13400      C        APPROPRIATE VOLUMES, VI, AND STORING THE RESULTS IN F(1:NSEG,1
13410      C
13420               DO 3150 J=1,NSEG
13430       3150 F(J,1)=F(J,1)/VI(J)
13440      C
13450      C        COMPUTE CHANGE IN CONC. IN EACH SEGMENT BASED UPON THE
13460      C        MIDPOINT CONC.
13470      C
13480               CALL MXMUL(EINV,F,NSEG,1,CP)
13490      C
13500      C        SET CE(1:NSEG,1) TO THE IMPULSE PROD. CONC.
13510      C
```

```
      DO 3175 J=1,NSEG
 3175 CE(J,1)=CP(J,1)
      GO TO (3301,3400),KEY
 3301 CONTINUE
      IIT=IIT+1
C
C  IF IIT=NJ2IMP,CHANGE IMPULSE PROD CONC IF FOLLOWING TEST IS
C     SATISFIED.
C
      IF(IIT-NJ2IMP) 3400,3400,3320
 3320 IF(IPCNT.EQ.LCNT)GO TO 3600
      IIT=1
      KEY=2
      NJ2IMP=PRTAB(NSEG+1,IPCNT)*RI+.0001
      IPCNT=IPCNT+1
      GO TO 3099
C
C     MEGG EQUALS THE MAXIMUM NUMBER OF JUVENILE 2 AGE GROUPS.
C
 3400 MEGG=JJ2
      NI=RI*(T+SJ2-DTE-DTL-DTJ1)+.0001
C
C     NI EQUALS THE MINIMUM NUMBER OF JUVENILE 2 AGE GROUPS.
C
      IF(NI.LT.MEGG)MEGG=NI
C
C     WEIGHT COMPUTES THE TOTAL NO. OF JUVENILE 2'S IN THE ESTUARY,
C     THE FRACTIONAL PERCENT OF JUVENILE 2'S IN EACH SEGMENT
C     COMPARED TO THE DESIRED FRACTIONAL PERCENT BASED UPON
C     EMPIRICAL DATA, YJ2, AND THE RATE TO BE USED IN MIGRATING
C     BOUNDARY CONCENTRATIONS (GG(1:NSEG)).
C
      DO 3437 J=1,NSEG
 3437 XCE(J)=CE(J,1)
      ICOUNT=1
 3431 CONTINUE
      CALL MTIME(TMIG,NCJ2,INCJ2,T,2)
      CALL WEIGHT(GG,CE,YJ2,INCJ2,SUM1,G,A1,A2,A3,VI,DI,EP,
     *TOTNUM,MEGG,NSEG,DTS,T)
      IF(ICOUNT.GT.1)GO TO 8613
      IF(PJ2IMP.EQ.0)GO TO 8613
      K1=MOD(NDT,PNJ2IM)
      IF(K1.NE.0)GO TO 8613
      SK1=0.
      IF(IYR.EQ.0) GO TO 8613
      DO 8621 J=1,NSEG
      XIMP(J)=FVJ2(J)*QP(J)*FLOAT(KPLANT(J))*CONIMP*SUM1(J,1)
 8621 SK1=SK1+XIMP(J)
      WRITE(12,8618)T,SK1,(XIMP(J),J=1,NSEG)
      CALL PARSUM(XIMP,TB,T,NSEG,ISW)
 8618 FORMAT(1X,'@@@T=',F10.2,' J2 IMPING.='F15.0,'*****'//
     18(1X,F10.0))
 8613 CONTINUE
      DO 3435 K=MEGG,1,-1
```

```
      DO 3433 J=1,NSEG
      FE(J)=SUMI(J,1)
 3433 Y(J)=CE(J,K)
      KAGE=K
      CALL DECAY(SVJ2,SVJ20,FE,TCJ2,DECY,VI,NSEG,A1,A2,A3,GQP)
      CALL MXMUL(EINV,DECY,NSEG,NSEG,UINV)
C      MIGRATE THE CURRENT JUVENILE 2 AGE GROUP WITH DECAY TO OBTAIN
C      THE DERY AT THE CURRENT TIME.
C
      IF(MJUV.EQ.1)CALL AWGHT(CE,A1,A2,A3)
      CALL MIGN(EINV,CP,G,NSEG,Y,DERY,UINV,VI)
      STEP=SJ2/FLOAT(IDTJ2)
C
C      COMPUTE THE CONC. FOR THE (K+1)TH AGE GROUP VIA THE RUNGE-
C      KUTTA CALCULATIONS FOR TIME T+STEP.
C
      CALL RKUTTA(STEP,Y,DERY,UINV,AUX,NSEG,EINV,G,CP,VI)
C
      CALLPATCH1(G,CE,K,A1,A2,A3,VI,TOTAL,NSEG,1,STEP,DECY,GQP)
C
      LL=K
      IF(ICOUNT.EQ.IDTJ2)LL=K+1
      DO 3444 JN=1,NSEG
C
C      IF AN AGE GROUP CONTAINS NEGATIVE CONC., PRINT RESULTS
C      AND THEN ZERO THE AGE GROUP.
C
      IF(Y(JN).LT.0.)Y(JN)=0.
 3444 CE(JN,LL)=Y(JN)
C
      CALLPATCH2(G,CE,LL,A1,A2,A3,VI,TOTAL1,TOTAL,NSEG,
     *EINV,CP,TNUMBR)
C
 3435 CONTINUE
      ICOUNT=ICOUNT+1
      IF(ICOUNT.LE.IDTJ2)GO TO 3431
      DO 3438 J=1,NSEG
 3438 CE(J,1)=XCE(J)
      NDT=NDT+1
C
C      T IS THE CURRENT TIME OFFSET BY THE STAGE LENGHTS DTE,DTL, & D
C
      T=FLOAT(NDT)*SJ2+DTE+DTL+DTJ1
      IPP=IPP+1
      MGM=MEGG+1
      IF(IPP.NE.NJ2SP)GO TO 3487
       WRITE(6,255)T
      IPP=0
      TOT2=0.
      DO 3481 LL=2,MGM
      A4=FLOAT(LL-2)*SJ2
      A5=FLOAT(LL-1)*SJ2
C
C      COMPUTE TOTAL NUMBERS IN ESTUARY (TOT1) AND IN EACH SEGMENT
```

```
C       G(1:NSEG,1) VIA THE ROUTINE TNUM.
C
        CALL TNUM(G,CE,LL,A1,A2,A3,VI,TOT1,NSEG)
        IF(PNJ21.EQ.1)WRITE(6,250)A4,A5,TOT1,(G(JJ,1),JJ=1,NSEG)
        IF(PCJ12.EQ.0 .AND. PNJ12.EQ.0)GO TO 9701
C
C       FORM TOTAL NUMBERS (ALL AGE-GROUPS) BY SEGMENT
C
        DO 9702 JJ=1,NSEG
 9702   TEMP1(JJ)=TEMP1(JJ)+G(JJ,1)
 9701   IF(PCJ21.EQ.0)GO TO 9710
C
C       COMPUTE AVERAGE JUVENILE 2 CONCENTRATION
C
        DO 9704 JJ=1,NSEG
 9704   G(JJ,1)=G(JJ,1)*CONST1/VI(JJ)
        TOT3=TOT1*CONST1/CONST2
        WRITE(6,9100)A4,A5,TOT3,(G(JJ,1),JJ=1,NSEG)
 9710   CONTINUE
        TOT2=TOT2+TOT1
 3481   CONTINUE
 9489   FORMAT(1H ,18HTOTAL NO.(J 2 ) = ,9(1X,F10.0))
        IF(PNJ22.EQ.1)WRITE(6,9489)TOT2,(TEMP1(JJ),JJ=1,NSEG)
        IF(PCJ22.EQ.0)GO TO 9720
        DO 9712 JJ=1,NSEG
        G(JJ,1)=TEMP1(JJ)*CONST1/VI(JJ)
 9712   CONTINUE
        TOT2=TOT2*CONST1/CONST2
        WRITE(6,9703)TOT2,(G(JJ,1),JJ=1,NSEG)
 9703   FORMAT(1X,10HJ2  CONC.=,1X,3HTC=,9(1X,F10.4))
 9720   CONTINUE
        DO 9713 JJ=1,NSEG
 9713   TEMP1(JJ)=0.
 3487   CONTINUE
C
C       DOES JUVENILE 2 IMPULSE PRODUCTION CEASE?
C       IF YES, THE TEST BELOW FAILS.
C
        IF((T+.0001).LT.(DTE+DTL+DTJ1+TE))GO TO 3301
C
C       IS CURRENT TIME EQUAL TO TIME TJJ3, THE TIME AT WHICH ALL
C       JUVENILE 2'S  ARE RECLASSIFIED AS JUVENILE 3'S.
C
        IF((T+.0001) .GE. DTS) GO TO 3900
C
C       SET JUVENILE 2 IMPULSE PRODUCTION TO ZERO.
C
 3600   DO 3500 J=1,NSEG
 3500   CE(J,1)=0.
        GO TO 3400
C
C       SUM UP ALL JUVENILE 2 MIDPOINT AGE GROUP CONCENTRATIONS BY SE
C       AT THE MIDPOINT CONC. FOR RECLASSIFYING AS JUVENILE 3'S.
C
```

```
15120      3900 S12=0.
15130           IF(PJ3PTN.EQ.1 .OR. PJ3PTC.EQ.1)WRITE(6,9725)
15140      9725 FORMAT(1H1,10H**********,27HJUVENILE 3 PRODUCTION TABLE,
15150          *10H**********///)
15160      3800 DO 3850 J=1,NSEG
15170           CP(J,1)=0.
15180           DO 3825 L=2,MGM
15190      3825 CP(J,1)=CP(J,1)+CE(J,L)
15200      3850 CONTINUE
15210      C
15220      C       COMPUTE TOTAL NUMBER OF JUVENILE 3'S IN THE ESTUARY (TOTNUM),
15230      C       AND IN EACH SEGMENT G(1:NSEG,1).
15240      C
15250           CALL TNUM(G,CP,1,A1,A2,A3,VI,TOTNUM,NSEG)
15260           IF(PJ3PTN.EQ.1 )WRITE(6,9726)TOTNUM,
15270          *(G(JJ,1),JJ=1,NSEG)
15280           DO 3855 J=1,NSEG
15290      3855 TEMPT2(J)=G(J,1)
15300           IF(IFACTR.EQ.1.AND.(IYR.EQ.0))CALL FACTOR(FVJ2,TEMPT1,
15310          1TEMPT2,DTJ2,SOP,VI,NSEG,FTJ2)
15320      9726 FORMAT(1H ,14HTOT JUV3 PROD=,F15.0,8(1X,F10.0))
15330           IF(PJ3PTC.EQ.0)GO TO 9730
15340           DO 9727 JJ=1,NSEG
15350      9727 SUM1(JJ,1)=G(JJ,1)*CONST1/VI(JJ)
15360           TOT3=TOTNUM*CONST1/CONST2
15370           WRITE(6,9728)TOT3,(SUM1(JJ,1),JJ=1,NSEG)
15380      9728 FORMAT(1H ,14HTOT JUV3 CONC=,9(1X,F10.4))
15390      9730 CONTINUE
15400      C
15410      C**********J U V E N I L E -3- S E C T I O N*******************
15420      C
15430      C       SET CURRENT TIME TO TJJ3, THE TIME THE JUVENILE 3 STAGE BEGINS
15440      C
15450           AUX(15,1)=99.
15460           DO 3097 J=1,NSEG  ?
15470           TNUMBR(J)=G(JJ,1)
15480           CE(J,1)=CP(J,1)
15490      3097 AL(J)=1.
15500           T=TJJ3-TSPW
15505           ISW=0
15506           TB=T
15510           DTJ3=365.-T
15511           IRAN=IRA(5)
15512           IF(IRAN.NE.0)CALL GROSSK(DYY,SDYY,DTJ3,NSEG,SVJ3)
15520           DTS=365.
15530           NDT=0
15540           MJUV=MJUV3   IF (IYR.EQ.0)
15550           TOTAL=TOTNUM
15560           WRITE(6,3098)
15570      3098 FORMAT(1H1,40X,'JUVENILE 3 SECTION'///)
15580           DO  989 J=1,NSEG
15590       989 GOP(J)=FVJ3(J)*FLOAT(KPLANT(J))*QP(J)/VI(J)
15610           IPP=0
15620      4000 IF((T+.0001) .GE. DTS) GO TO 5000
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```
15630   C
15640   C       COMPUTE THE FRACTIONAL PERCENT OF JUVENILE 3'S IN EACH SEGMENT
15650   C       TO THE TOTAL NUMBER IN THE ESTUARY, G(J,1)/TOTNUM.
15660   C
15670           TEMP=TOTAL/(DTS-T)
15680           CALL MTIME(TMIG,NCJ3,INCJ3,T,3)
15690           DO 4200 J=1,NSEG
15700           GG(J)=TNUMBR(J)/TOTAL
15710           Y(J)=CE(J,1)
15720   C
15730   C       COMPUTE THE RATE AT WHICH JUVENILE 3'S MIGRATE TO SATISFY
15740   C       THE REQUIRED FRATIONAL PERCENT,YJ3, OF JUVENILE 3 TO
15750   C       APPEAR IN EACH SEGMENT  GG(1:NSEG,1).
15760   C
15770    4200 GG(J)=(YJ3(J,INCJ3)-GG(J))*TEMP
15780   C
15790   C       COMPUTE MIGRATION RATE AT SEGMENT BOUNDARIES
15800   C
15810           GG(1)=-GG(1)
15820           DO 4201 J=2,MSEG
15830    4201   GG(J)=GG(J-1)-GG(J)
15840           GG(NSEG)=0.
15850           DO 4202 J=1,NSEG
15860    4202   TEMPT1(J)=0.
15870           IF(PJ3IMP.EQ.0)GO TO 8614
15880           K1=MOD(NDT,PNJ3IM)
15890           IF(K1.NE.0)GO TO 8614
15900           SK1=0.
15905           IF(IYR.EQ.0)GO TO 8614
15910           DO 4205 J=1,NSEG
15920           XIMP(J)=FVJ3(J)*QP(J)*FLOAT(KPLANT(J))*CONIMP*Y(J)
15930    4205   SK1=SK1+XIMP(J)
15940           WRITE(12,8619)T,SK1,(XIMP(J),J=1,NSEG)
15945           CALL PARSUM(XIMP,TB,T,NSEG,ISW)
15950    8619   FORMAT(' @@@T=',F10.2,' J3 IMPING.=',F15.0,'******'//
15960          18(1X,F10.0))
15970    8614   CONTINUE
15980           CALL DECAY(SVJ3,SVJ3C,Y,TCJ3,DECY,VI,NSEG,A1,A2,A3,GQP)
15990           KAGE=0
16000           CALL MXMUL(EINV,DECY,NSEG,NSEG,UINV)
16010   C        MIGRATE THE JUVENILE 3'S AND COMPUTE DERY.
16020   C
16030           CALL MIGN(EINV,CP,G,NSEG,Y,DERY,UINV,VI)
16040           STEP=SJ3
16050   C
16060   C ADVANCE THE CURRENT CONC OF JUVENILE 3'S VIA THE RUNGE KUTTA
16070   C        TO TIME STEP T+SJ3.
16080   C
16090           CALL RKUTTA(STEP,Y,DERY,UINV,AUX,NSEG,EINV,G,CP,VI)
16100           CALLPATCHI(G,CE,1,A1,A2,A3,VI,TOTAL,NSEG,1,STEP,DECY,GQP)
16110   C
16120           DO 4220 J=1,NSEG
16130           IF(Y(J).LT.0)Y(J)=0.
16140    4220   CE(J,1)=Y(J)
```

```
16150      C
16160            CALLPATCH2(G,CE,1,A1,A2,A3,VI,TOTAL1,TOTAL,NSEG,
16170           *EINV,CP,TNUMBR)
16200            NDT=NDT+I
16210            T=(TJJ3-TSPW)+FLOAT(NDT)*SJ3
16220            IPP=IPP+1
16230            IF(IPP.NE.NJ3SP)GO TO 4000
16240            IPP=0
16250            WRITE(6,255)T
16260            IF(PNJ32.EQ.1)WRITE(6,4206)TOTAL,(TNUMBR(J),J=1,NSEG)
16270       4206 FORMAT(1H ,18HTOTAL NO.(J 3 ) = ,9(1X,F10.0))
16280            IF(PCJ32.EQ.0)GO TO 4000
16290            TOT2=TOTAL*CONST1/CONST2
16300            DO 4392 J=1,NSEG
16310       4392 CP(J,1)=TNUMBR(J)*CONST1/VI(J)
16320            WRITE(6,4207)TOT2,(CP(J,1),J=1,NSEG)
16330       4207 FORMAT(1H ,10HJ3 CONC.= ,1X,3HTC=,9(1X,F10.4))
16340            GO TO 4000
16350      C
16360      C     COMPUTE THE CURRENT ADULT POPULATION BY YEAR CLASS.
16370      C
16380       5000 IF(PA1PTN.EQ.1 .OR. PA1PTC.EQ.1)WRITE(6,4209)
16390       4209 FORMAT(1H ,10H**********,24HADULT 1 PRODUCTION TABLE,
16400           *10H**********//)
16410            IF(PA1PTN.EQ.1)WRITE(6,4206)TOTAL,(TNUMBR(J),J=1,NSEG)
16420            IF(PA1PTC.EQ.0)GO TO 5001
16430            TOT2=TOTAL*CONST1/CONST2
16440            DO 4393 J=1,NSEG
16450       4393 CP(J,1)=TNUMBR(J)*CONST1/VI(J)
16460            WRITE(6,4207)TOT2,(CP(J,1),J=1,NSEG)
16470       5001 CONTINUE
16471            DO 4111 J=1,NSEG
16472            TEMPT2(J)=TEMPT2(J)-SJ2I(J)
16473       4111 SJ2I(J)=0.
16480            AUX(15,1)=0.
16490            WRITE(6,4098)
16500       4098 FORMAT(1H1,40X,'ADULT SECTION')
16501            IF(IFACTR.EQ.1.AND.(IYR.EQ.0))CALL FACTOR(FVJ3,TEMPT2,
16502           *TNUMBR,DTJ3,SQP,VI,NSEG)
16510            IF(IYR .NE. 0) GO TO 5030
16520            ADULT(1)=0.
16530      C
16540      C     IF IYR=0, THEN SUM UP ALL JUVENILE 3'S REMAINING AND RENAME AS
16550      C     THE FIRST YEAR CLASS OF ADULTS.  THEN  GENERATE ALL YEAR CLASS
16560      C     BASED UPON THE FIRST ADULT YEAR CLASS.
16570      C
16580       5002 DO 5010 J=1,NSEG
16590            QP(J)=SQP(J)
16600       5010 ADULT(1)=ADULT(1)+TNUMBR(J)
16610            IF(KFIRST .NE. 0) GO TO 5050
16620            RECRUT=ADULT(1)
16630            CALL EQUAL(ADULT,ADULTS,SVU,SVAO,SVA,FEC,FMAT,FRAT,RECRUT,
16640           1ICP,IEND,PEQUAL,KFIRST,RMF,RO)
16645            KFIRST=1
```

```
16650          SPE=ADULT(1)
16660          DO 5020 J=2,IEND
16670          ADULT(J)=ADULT(J-1)*EXP(-365.*SVU(J-1))
16680     5020 SPE=SPE+ADULT(J)
16685          SPTN=SPE
16690          GO TO 5050
16700     5030 DO 5040 J=13,2,-1   IEND
16710     5040 ADULT(J)=ADULT(J-1)*EXP(-365.*SVU(J-1))
16715          ADULT(1)=0.
16720          GO TO 5002
16730     5050 AEP=0.
16731          SPTN=0.
16732          DO 5055 J=1,IEND
16733     5055 SPTN=SPTN+ADULT(J)
16740     C
16750     C     COMPUTE THE TOTAL PRODUCTION FOR THE NEXT SPAWNING PERIOD AS
16760     C     FOLLOWS BELOW.
16770     C
16780          DO 5060 J=1,13   IEND
16790     C
16800     C     FEC      IS THE FECUNDITY OF EACH ADULT YEAR CLASS.
16810     C     FMAT IS THE MATURITY OF EACH ADULT YEAR CLASS.
16820     C     FRAT IS THE SEX RATIO OF FEMALES TO MALES FOR EACH ADULT CLASS.
16830     C     AEP IS THE TOTAL EGG PRODUCTION FOR TE THE SPAWNING PERIOD.
16840     C
16850     5060 AEP=AEP+FEC(J)*FMAT(J)*FRAT(J)*ADULT(J)
16860          RECRUT=ADULT(1)
16865          IF(ICP.EQ.0)GO TO 5065
16870          CALL EQUAL(ADULT,ADULTS,SVU,SVAO,SVA,FEC,FMAT,FRAT,RECRUT,
16880         1ICP,IEND,AEP,KFIRST,RMF,RO)
16890     C
16900     5065 CONTINUE
16910          NDT=0
16930     C
16940     C     IYR IS THE CURRENT YEAR - LPYR IS THE NUMBER OF YEARS THE PLAN
16950     C     OPERATES.
16960     C
16965          DO 979 J=1,NSEG
16970          IF(IYR .GT. LPYR(J)) KPLANT(J)=0
16975      979 CONTINUE
16980     C
16990     C     REINTIALIZE INDICES.
16991          DT=SE
16992          RI=PEAVG/DT
16993          INCJ1=1
16994          INCJ2=1
16995          INCJ3=1
16996          TOTLP=0.
16997          TOTJ1P=0.
16998          TOTJ2P=0.
17000          TLAST=0.
17002          NDT=0
17004          IPP=0
17010          LEGG=1
```

```
17011          DO 5080 J=1,NSEG
17012          TEMP1(J)=0.
17013          DO 5079 L=1,500
17014          IF(L.LE.60)PRTAB(J,L)=0.
17015     5079 CE(J,L)=0.
17016     5080 CONTINUE
17017          DO 5085 J=1,16
17018          DO 5085 I=1,25
17019     5085 AUX(J,I)=0.
17020          LCHA=1
17030          T=0.
17040          KNOW=1
17050          LPIX=1
17060          IDAY=1
17070          IFINAL=0
17080          WRITE(6,5070)IYR,SPTN,AEP
17090     5070 FORMAT(1X,' CURRENT YEAR ',I3/
17100         1' TOTAL ADULTS =',F15.0/
17110         2' TOTAL EGGS IN ESTUARY =',F20.0///
17120         35(15H AGE NUMBERS        )/)
17130          WRITE(6,6000)(J,ADULT(J),J=1,IEND)
17140     6000 FORMAT(5(1X,I3,F10.0))
17150          E2=1
17160          SUMA=0.
17170          DO 6010 J=1,NSEG
17180          IF(J.NE.1)E2=E2*EXP(-SVU(J-1)*365.)
17190     6010 SUMA=SUMA+E2*RMF(J)
17200          SMEQ=SUMA*(RECRUT/PEQUAL)
17210          WRITE(6,6020)SMEQ
17220     6020 FORMAT(' EQUILIBRIUM (1.0) =',E15.7/)
17230          DO 6030 J=1,NSEG
17240          IF(IYR.EQ.LPYR(J))QP(J)=0.
17250     6030 CONTINUE
17255          IYR=IYR+1
17256          EAD(IYR)=ADULT(1)
17260          ITY=IYR
17270          IF(IYR.LE.LYR)GO TO 140
17275     9999 RETURN
17280          END
IQ
```

0

IEND

INTIAL

Functional description:

INTIAL effects the initialization and computation of key variables used in the transport model.

Inputs:

Calling sequence

1.	NSEG	# segments in estuary
2.	NEGG	number of items in temporal egg distribution
3.	DTE	egg duration (days)
4.	DTL	larval duration (days)
5.	DTJ1	juvenile I duration (days)
6.	DTJ2	juvenile II duration (days)
7.	DT	time step used throughout egg stage

NAMED COMMON BLOCK INTIAL

see description of named common in the subroutine INPUT.

Equations:

$$JEGG = \frac{DTE}{DT} = \text{number of age groups in the egg state (life cycle)}$$

$$J\ LARV = \frac{DTL}{DT} = \text{number of age groups in the larval stage}$$

$JJ1 = \frac{DTJ1}{DT}$ = Age groups in juvenile I cycle,

$JJ2 = \frac{JTJ2}{DT}$ = Age groups in juvenile II cycle.

NLPIX = 1.ϕ/DT = number of age groups averaged

Variables initialized:

LEGG = 1 = current temporal egg distribution

LCHA = 1 = current advection and dispersion values used

LPIX = 1 = current value in age group from which averaging process will start.

IDAY = 1 = current position in production table to larval stage.

T = ϕ = current time set to zero

IFINAL = ϕ key which indicates when last averaging for egg cycle is to commence.

AUX (1:16, 1:25) = 0 = auxiliary array used by numerical technique.

KNOW = 1 = a switch used in TMODEL.

Keys:

T1967° = 1 use 1967 temperature profile.

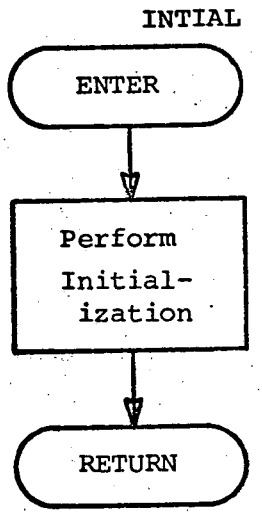
Referenced by:

TMODEL - transport model

Subroutines called:

TP1967 - date arrays for 1967 temperature profile by time and space

Output: None


INTIAL
ENTER
Perform
Initial-
ization
RETURN

```
NTAL1-PNC/LIB$  CREATE:02/01/73,11:27:33 FREQ:11 SIZE:1 BACKUP:02/02/73,
05:21:40 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
1000          SUBROUTINE INTIAL(NSEG,NEGG,DTE,DTL,DTJ1,DTJ2,DT)
1010          COMMON/INITAL/LEGG,LCHA,T,KNOW,JEGG,JLARV,JJ1,JJ2,JJ3,
1020         *LPIX,NLPIX,IDAY,IFINAL,PRMT(5),AUX(16,25),TEMPER(26,55),NTEMP
1021         *TI967P,TCUT(25)
1030      C THIS ROUTINE INITIALIZES THE FOLLOWING INDICES
1040      C AND ARRAYS WHICH ARE DEFINED ELSEWHERE IN THE CALLING
1050      C PROGRAM.
1060          LEGG=1
1070          LCHA=1
1080          T=0.
1090          KNOW=1
1100          JEGG=.0001+DTE/DT
1110          JLARV=.0001+DTL/DT
1120          LPIX=1
1130          NLPIX=.0001+1.0/DT
1140          IDAY=1
1150          IFINAL=0
1160          DO 10 J=1,16
1170          DO 5 I=1,25
1180        5 AUX(J,I)=0.
1190       10 CONTINUE
1200          JJ1=.0001+DTJ1/DT
1210          JJ2=.0001+DTJ2/DT
1211          IF(TI967P.EQ.1)CALL TP1967
1220          RETURN
1230          END
IQ
```

AWGHT

Functional description:

AWGHT computes the fraction of a specific age group at the downstream boundary of a segment. AWGHT can be expanded to attribute relative swimming speeds to this concentration.

Inputs: CE, A1, A2, A3

CE - concentration

A1, A2, A3 - elements of A matrix; (description given in the analysis)

Named common arrays;

MWGHT - specifics in MIGN section.

MCHAR - specifics in INPUT section.

Equations: None

Outputs: AL (1:NSEG) - fractional age group concentration at downstream boundaries.

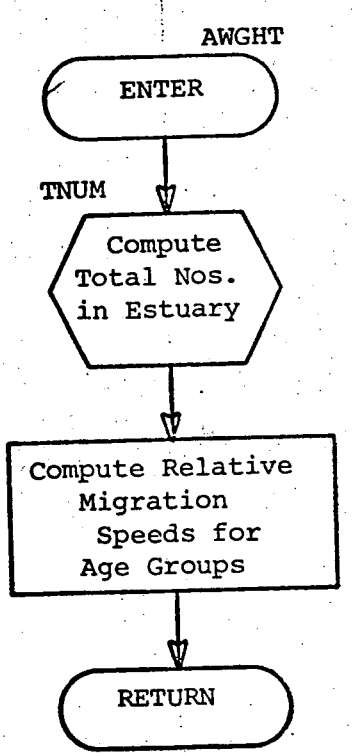
Subroutines called:

TNUM - computes total numbers of a specified early stage in the estuary.

Referenced by:

MIGN - performs migration function

TMODEL - Transport model.


AWGHT
ENTER
TNUM
Compute Total Nos. in Estuary
Compute Relative Migration Speeds for Age Groups
RETURN

```
AWGHT-PNC/LIB$  CREATE:02/01/73,11:27:35 FREQ:11 SIZE:1 BACKUP:02/02/73,
05:21:39 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
1000            SUBROUTINE AWGHT(CE,A1,A2,A3)
1010            DIMENSION CE(25,1),G(25,1)
1015            DIMENSION A1(1),A2(1),A3(1)
1020            COMMON/MWGHT/GG(25),AL(25),KAGE
1030      C ESTURARY CHARACTERISTICS FOLLOWS,
1040            COMMON/MCHAR/NSEG,NCHANG,VI(25),AX(25),SLEN(25),
1050           *QI(25,10),EP(26),EI(25,10),TQE(10),DI(25)
1060      C THIS ROUTINE COMPUTES THE RELATIVE SPEEDS FOR WHICH THE KAGE AGE
1070      C GROUP OF A GIVEN CONCENTRATION AT THE BOUNDARY OF A SEGMENT WILL
1080      C THESE WEIGHTS ARE LATER USED IN THE ROUTINE MIGN TO COMPUTE
1090      C THE MIGRATION RATES.
1160      C AGR IS THE WEIGHT FOR THE SPEED OF THE PREVAILING AGE GROUP AND
1170      C AL(1:NSEG) IS THE RELATION BETWEEN SEGMENTS.
1180      C THIS WEIGHT IS BASED ON THE POPULATION WITHIN A GIVEN SEGMENT.
1199      C
1200      C       AL(J) IS FRACTION OF KAGE IN SEG J
1201      C
1210            CALL TNUM(G,CE,KAGE,A1,A2,A3,VI,TOT1,NSEG)
1215            DO 5 J=1,NSEG
1220          5 AL(J)=G(J,1)/DI(J)
1230            RETURN
1240            END
IQ
```

MTIME:

Functional description:

MTIME compares current time with the time specified for a change in migration preferences. If current time is greater than or equal to the time for a change in migration preferences, MTIME updates the index for the next migration preference provided there is a next migration preference. If there is not a next migration preference the current one remains in effect.

Inputs:

1.	TMIG	Current migration time (days)
2.	NCJ	# migrations input
3.	M J	Current migration input utilized.
4.	T	Current time
5.	J	Current juvenile stage
		(1 = juvenile I)
		(2 = juvenile II)
		(3 = juvenile III).

Equations

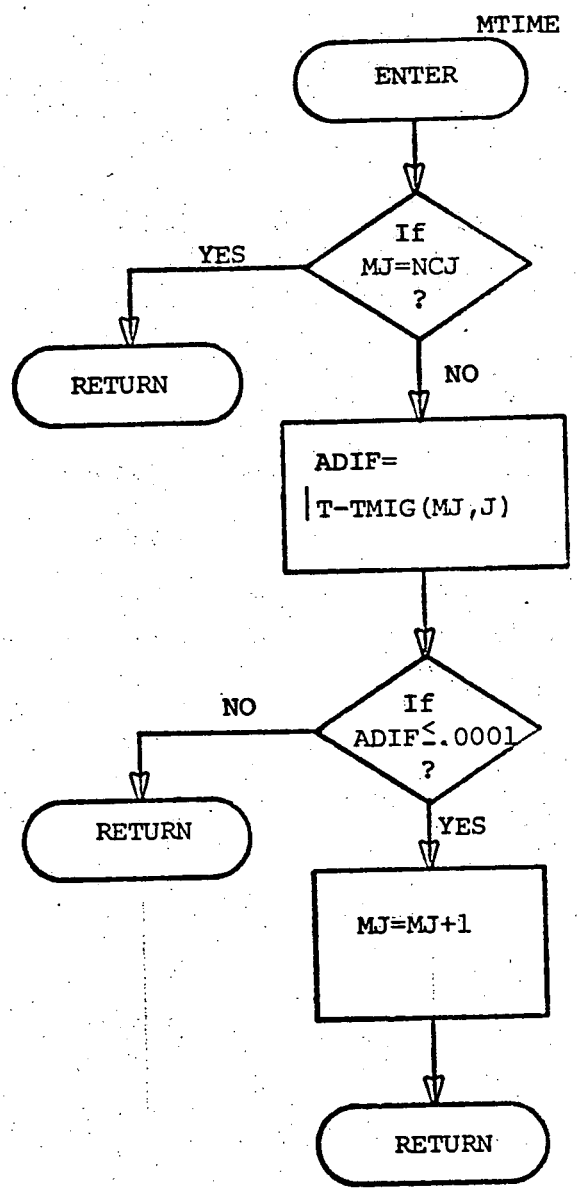
ADIF = T - TMIG (MJ, J) determines if current migration preferences are to be updated based upon the difference comparison of the two times.

Outputs:

Updated MJ.

Subroutines called: None

Referenced by: TMODEL - transport model.


MTIME
ENTER
If
MJ=NCJ
?
YES
RETURN
NO
ADIF=
|T-TMIG(MJ,J)
If
ADIF≤.0001
?
NO
RETURN
YES
MJ=MJ+1
RETURN

```
MTIME-PNC/LIB$  CREATE:02/01/73,11:27:37 FREQ:11 SIZE:1 BACKUP:02/02/73,
05:21:38 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
   10          SUBROUTINE MTIME(TMIG,NCJ,MJ,T,J)
   20          DIMENSION TMIG(10,3)
   30          IF(MJ.EQ.NCJ)RETURN
   40          ADIF=ABS(T-TMIG(MJ,J))
   50          IF(ADIF.LE..0001)MJ=MJ+1
   60          RETURN
   70          END
IQ
```

GROSSK:

Functional description:

GROSSK, in the case of random survival, computes the gross first order decay rate for the specific stage which is utilized as the new first order decay for this stage's development (applies to early stages only).

Inputs: calling sequence

DYY	output first order decay rate
SDYY	standard deviation
SDUR	stage duration
NSEG	number of river sections
DEQ	input first order decay rate.

Equations:

STDEV = .5 x DEQ(J)

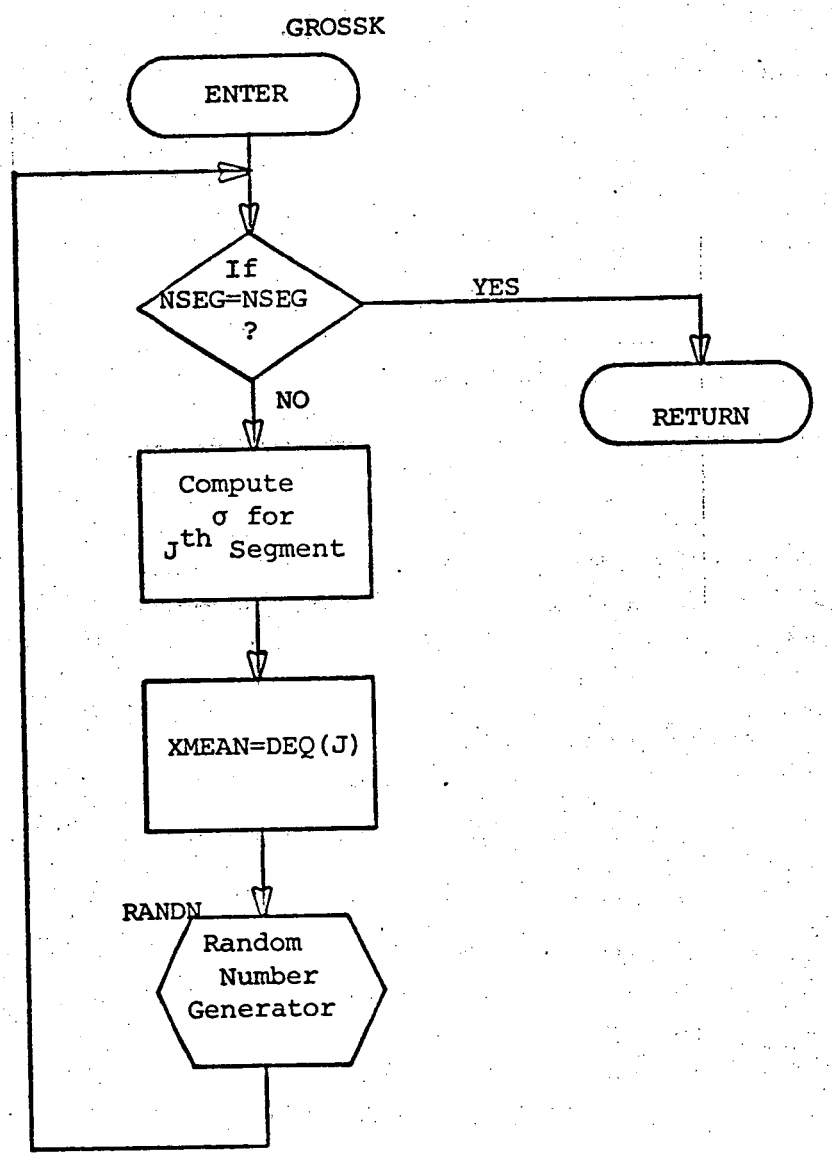
Output: DYY

Subroutines called:

RANDN - random number generator (based on normal distribution)

References by:

TMODEL - transport model.


GROSSK
ENTER
If
NSEG=NSEG
?
YES
NO
RETURN
Compute
σ for
Jth Segment
XMEAN=DEQ(J)
RANDN
Random
Number
Generator

```
GROSSK-PNC/LIB$  CREATE:02/08/73,08:31:55 FREQ:8 SIZE:1 KIND:DISK KEY:1 LIFE:
PERM ACCESS:UPDATE
IL
  100          SUBROUTINE GROSSK(DYY,SDYY,SDUR,NSEG,DEQ)
  110          DIMENSION DYY(25),SDYY(25),DEQ(1)
  120          DO 10 J=1,NSEG
  130          SDYY(J)=DEQ(J)
  131        5 STDEV=.5*DEQ(J)
  132          IF(STDEV.GT.1.0)GO TO 5 ---> 133  XMEAN = DEQ(J)
  170          CALL RANDN(X,XMEAN,STDEV)
  180          DYY(J)=X
  190       10 CONTINUE
  200          RETURN
  210          END
IQ
```

FACTOR:

Functional description:

FACTOR computes the impingement rates for the juvenile II and III stages.

Inputs: calling sequence

F	Total numbers impinged in each segment
TOTS	Total numbers at beginning of a stage
TOTE	Total numbers at end of stage
TIME	Stage duration (or persistency)
SQP	Plant intake flows for each segment
VI	Volume of each segment

Equations:

$$AVG = \frac{TOTS + TOTE}{2} \quad \frac{(TIME)(SQP)}{(VI)}$$

$$F \text{ (Impingement rate)} = \frac{F \text{ (TOTAL NOS.)}}{AVG.}$$

Outputs:

.F impingement rates for each segment

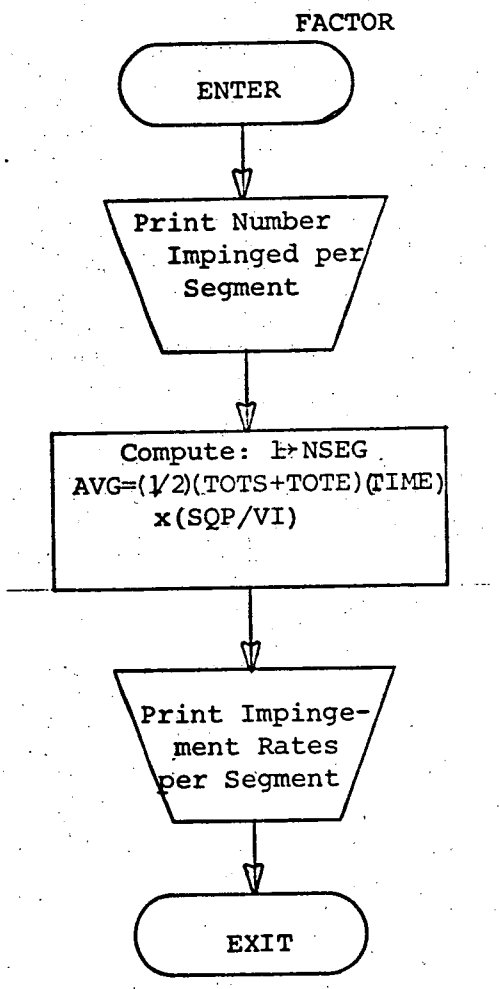
.Display of input impingement totals

.Display of computed impingement rates.

Subroutines called: None

Referenced by:

TMODEL - transport model.


FACTOR
ENTER
Print Number Impinged per Segment
Compute: I→NSEG
AVG=(1/2)(TOTS+TOTE)(TIME)
x(SQP/VI)
Print Impinge-ment Rates per Segment
EXIT

```
FACTOR-PNC/LIB$  CREATE:02/01/73,11:27:42 FREQ:11 SIZE:1 BACKUP:02/02/73,
05:21:36 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE ON:SPN
IL
      SUBROUTINE FACTOR(F,TOTS,TOTE,TIME,SQP,VI,NSEG)
      DIMENSION F(1),TOTS(1),TOTE(1),SQP(1),VI(1)
      WRITE(6,3)(F(J),J=1,NSEG)
    3 FORMAT(' FACTOR',5X,8(F10.0,1X))
SUM=0 DO 10 J=1,NSEG
F=0    AVG=0.5*(TOTS(J)+TOTE(J))*TIME*SQP(J)/VI(J)
      IF(F(J).EQ.0.)GO TO 10
      F(J)=F(J)/AVG
   10 CONTINUE
      WRITE(6,16)(F(J),J=1,NSEG)
   16 FORMAT(' FACTOR',5X,8F10.5/)
      RETURN
      END
IQ
```

NSEG

on a per segment basis

SUM = SUM + AVG

F = F + F(J)

FTOT = F / SUM

INPUT:

Functional description:

INPUT reads into the core locations the data specified in the following pages. The first six data items are read by DMODEL.

Inputs: description given in following pages and input is in free format.

Equations: None

Outputs: None

Indicators:

T1967P if new temperature profile is to be input

Subroutines called: - None

Referenced by: TMODEL - transport mode.

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
IMODEL	I			Determines which model is to be selected. 1 → Transport; 2 → Totally mixed; 3 → Both
IRA	I	(1:5)		Specifies if random variation of a decay rate is to occur for a given early stage. 0 → off; 1 → on. NOTE: IRA(1)=1 implies random survival for egg cycle.
				IMODEL=1, or 3 requires following input
NSEG	I	MAX. 25		Segmentation of estuary.
NEGG	I	MAX. 10		The number of different weights used to compute the average rate (#'s/day) at which eggs are produced.
NCHANG	I	MAX. 10		The number of sets of flows and dispersions to be input.
IEND	I	MAX. 20		Number of adult classes
LYR	I	NONE		Number of years the model will simulate.
ICP	I	MAX. 3		Specifies if adult compensation is to occur. 0 implies none; 1 through 3 implies for adults 1 through 3 with 3 as a cut-off.
IOPT	I			Display input parameters 0 → no; 1 → yes
NCJ1	I	MAX. 10		Number of juveniles 1 migration preferences input.
NCJ2	I	MAX. 10		Number of juveniles 2 migrations preferences input.
NCJ3	I	MAX. 10		Number of juveniles 3 migrations preferences input.

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
KKSW	I			Use 1967 Temperature profile if KKSW=1 and TP1967=2. If KKSW=1 and TP1967≠2, a new temperature profile is given. If KKSW=2, no temperature profile is to be used.
NCOMR	I	MAX.10		Specifies the number of different larval age group numbers and concentrations to be printed. If none, NCOMR=0.
IFACTR	I			Specifies if impingement rates for juvenile II and III are input (IFACTR=0) or are to be computed from total number. (IFACTR=1).
				The following variables are input in groups of 4, one group per segment.
SVE	R	1:NSEG	K_E	First order decay rate(1/day)EGG
SVO	R	1:NSEG	K_o	Minimum decay rate(1/day)-EGGS
FVE	R	1:NSEG	f_e	EGG entrainment rate
TCE	R	1:NSEG	C_S	Carrying capacity of the ith segment for egg concentration (#'s/TCF).
				The following variables are input in groups of 4, one group per segment.
SVL	R	1:NSEG	K_L	Larval first order decay rate (1/day)
SVLO	R	1:NSEG	K_{LO}	Larval minimum decay rate(1/day)
FVL	R	1:NSEG	f_L	Larval entrainment rate
TCL	R	1:NSEG	C_S	Larval carrying capacity(#'s/TCF)
				The following variables are input in groups of 4, one group per segment.
SVJI	R	1:NSEG	K_{JI}	Juvenile I first order decay rate (1/day)
SVJ10	R	1:NSEG	K_{J10}	Juvenile I minimum decay rate (1/day)

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
FVJ1	R	1:NSEG	F_{J_I}	Juvenile I entrainment rate
TCJ1	R	1:NSEG	C_J	Juvenile I carrying capacity (#'s/1000 cu. ft.).
				The following variables are input in groups of 4, one group of 4 per segment
SVJ2	R	1:NSEG	K_{JII}	Juvenile II first order decay rate (1/day)
SVJ20	R	1:NSEG	K_{JII_o}	Juvenile II minimum decay rate (1/day)
FVJ2	R	1:NSEG	F_{JII}	Juvenile II impingement rate or numbers
TCJ2	R	1:NSEG	C_s	Juvenile II carrying capacity per segment
				The following variables are input in groups of 4, one group of 4 per segment.
SVJ3	R	1:NSEG	K_{JIII}	Juvenile III first order decay rate (1/day)
SVJ30	R	1:NSEG	K_{JIII_o}	Juvenile III minimum decay rate (1/day)
FVJ3	R	1:NSEG	F_{JIII}	Juvenile III impingement rate or numbers
TCJ3	R	1:NSEG	C_s	Juvenile III carrying capacity per segment
SVA	R	1:3	K_A	Adult 1-3 first order decay rate (1/day)
SVAO	R	1:3	K_{Ao}	Adult 1-3 minimum decay rate (1/day) (given if ICP=1)
DTE	R		Δt_E	Duration of egg stage (days)
DTL	R		Δt_L	Duration of larval stage (days)
DTJ1	R		Δt_{JI}	Duration of juvenile I stage (days)
DTJ2	R		Δt_{JII}	Duration of juvenile II stage (days)

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
TJ33	R		T_{END}	The time (in days) at which all juvenile II's are reclassified as Juvenile III's (reference from day 0)
DTA	R			Duration of adult stage (365 days for non leap year).
DT	R		Δt	Time step through egg cycle. Number of age groups in egg cycle is $\Delta t_E/\Delta t$
TE	R		T_E	Duration of Spawn period (days).
TSPW	R		T_{start}	Start of spawning referenced from day 0 (Julian days).
AEP	R		E	Total eggs produced in T_E.
QP	R	1:NSEG	Q_p	Plant withdrawal per segment $\left(\frac{\text{cubic mile}}{\text{day}}\right)$
KPLANT	I	1:NSEG		=1 if plant is on; =0 if off.
LPYR	I	1:NSEG		The number of years the plant in the ith segment will operate if it is on.
IAGE	I	1:NCOMR		Begin of larval age group to be accumulated.
IEAGE	I	1:NCOMR		End of larval age group to be accumulated NOTE: Read in pairs; printout displays total numbers from IAGE to IEAGE.
QI	R	2:NSEG 1:NCHANG	Q_i	Fresh water flow (advection) at the boundary of segment i for a specific time. (cu miles/day)
EI	R	2:NSEG 1:NCHANG	E_i	Dispersion coefficient at the boundary of ith segment for a specific time (square miles/day).

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
SLEN	R	1:NSEG	L_i	Length in miles of the ith segment.
AX	R	1:NSEG	AX_i	Cross sectional area at the downstream boundary of the ith segment.
VI	R	1:NSEG	V_i	Volume of the ith segment (cubic miles)
TQE	R	1:NCHANG		Specific time (days) for which the advection and dispersion pair is to change.
TP	R	1:NEGG		Specific time at which egg distribution is to change (days)
TMIG	R	1:NCJ1 1		Specific time at which Juvenile I migration preferences change.
TMIG	R	1:NCJ2 2		Specific time at which Juvenile II migration preferences change (days)
TMIG	R	1:NCJ3 3		Specific time at which Juvenile III migration preferences change (days)
YJ1	R	1:NSEG 1:NCJ1		Migration preferences per segment for juvenile I's for a specific time
YJ2	R	1:NSEG 1:NCJ2		Migration preference per segment for juvenile II's for a specific time.
YJ3	R	1:NSEG 1:NCJ3		Migration preference per segment for Juvenile III's for a specific time.

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
WI	R	1:NSEG 1:NEGG		Spatial distribution of total eggs produced per segment for specific time slots(days).
PP	R	1:NEGG		Temporal distribution of total eggs produced for given time slots (days)
FEC	R	1:IEND		Average number of eggs produced by females in a specific adult class.
FMAT	R	1:IEND		Maturation of Females in a specific age class.
FRAT	R	1:IEND		The ratio FEMALES: TOTAL NUMBERS for a specific age class. NOTE: read as (FEC, FMAT, FRAT) pair
IDTE	I			number of iterations to go thru Egg Cycle for 1 time step of the numerical technique (1 is suggested)
IDTL	I			Number of iterations to go thru larval cycle for 1 time step of the numerical technique (1 is suggested).
IDTJ1	I			Number of intentions to go thru Juvenile I cycle for 1 time step of the numerical technique (1 is suggested).
IDTJ2	I			Number of iterations to go thru juvenile II cycle for 1 time step of the numerical technique (1 is suggested).
IDTJ3	I			Number of iterations to go thru juvenile III cycle for 1 time step of the numerical technique (1 is suggested).

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
IYR	I			Starting year at which model will commence to simulate effects to fish (striped bass) population.
NESP	I			Number of time steps between success printouts in the egg cycle. (use 10)
PIMPE	I			Request printout of impulse egg production for each segment and for estuary {0 → off, 1 → on}
PNEGG1	I			Display all current age (EGG) groups {0 → off, 1 → on}
PNEGG2	I			Display age (EGG) group total numbers {0 → off, 1 → on}
PLPROD	I			Display larval production as occurs {0 → off, 1 → on}
PLPTB1	I			Display larval production table {0 → off, 1 → on}
PLPTB2	I			Display larval production for estuary only {0 → off, 1 → on}
PCEGG1	I			{0 →off, 1 →on} display egg group concentrations.
PCEGG2				{0 →off, 1 →on} display egg conc. for estuary

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
PEAVG	R			Number of days for which transfer from eggs to larvae will be averaged. $\frac{PEAVG}{DTE}$
NLSP	I			Number of steps between successive printouts in the larval cycle
PIMPL	I			{0 = off {1 = on · write impulse larval production
PNLAR1	I			{0 = off {1 = on Write larval age group numbers for estuary and segments.
PNLAR2	I			{0 = off {1 = on Write total larval numbers for estuary and segments.
PJIPRO	I			{0 = off {1 = on Print Juvenile I production table for estuary and segments as it occurs.
PJIPT1	I			{0 = off {1 = on Prints Juvenile I production numbers for estuary and segments.
PJIPT2	I			{0 = off {1 = on Print total Juvenile I for estuary total.
PCLAR1	I			{0 = off {1 = on Display larval age group concentration for estuary and segments.
PCLAR2	I			{0 = off {1 = on Display total larval concentrations.
PLAVG	R			The number of days for which transfer from eggs to larvae will be averaged. $\frac{PLAVG}{SL}$

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
NJISP	I			Number of steps between successive printouts in the Juvenile I stage.
PIMPJ1	I			{0 = off 1 = on print number of Juvenile I's impulsed.
PNJ11	I			{0 = off 1 = on print total number Juvenile I's by age group for the estuary and segments.
PNJ12	I			{0 = off 1 = on print Juvenile I total numbers.
PCJ11	I			{0 = off 1 = on print Juvenile I concentration for each age group.
PCJ12	I			{0 = off 1 = on print total Juvenile I concentration.
PJ2PRO	I			{0 = off 1 = on print Juvenile II production calculations as they are computed.
PJ2PT1	I			{0 = off 1 = on print the results stored in the Juvenile II production table.
PJ2PT2	I			{0 = off 1 = on print only the total number of Juvenile II's produced in the estuary.
MJUV1	I			{0 = off 1 = on Indicates that juvenile I migration preferences are input.
PJ1AVG	R			The number of days over which transfer from larvalto juvenile I stage will be averaged. $\frac{PJIAVG}{SJI}$
NJ2SP	I			The number of time steps between successive printouts in the Juvenile II stage.

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
PIMPJ2	I			{0 = off 1 = on print number of Juvenile II's impulsed.
PNJ21	I			{0 = off 1 = on print total numbers in Juvenile II age groups.
PNJ22	I			{0 = off 1 = on print total number of juvenile II's
PCJ21	I			{0 = off 1 = on print total concentrations of Juvenile II age groups.
PCJ22	I			{0 = off 1 = on print total concentration of Juvenile II's.
PJ3PTN	I			{0 = off 1 = on print Juvenile III production table.
PJ3PTC	I			{0 = off 1 = on print total Juvenile III's produced in estuary.
MJUV2	I			{0 = off 1 = on Specifies if Juvenile II migration preferences are given.
PJ2AVG	R			The number of days for which transfer from Juvenile I to Juvenile II will be averaged. $\frac{PJ2AVG}{SJ2}$
NJ3SP	I			The number of time steps between successive printouts in the Juvenile III stage.
PNJ32	I			{0 = off 1 = on print the total number of Juvenile III's in the estuary.
PCJ32	I			{0 = off 1 = on display concentration of Juvenile III's in the estuary.

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
PAIPTN	I			{0 = off 1 = on print total number of adult 1's recruited.
PAIPTC	I			{0 = off 1 = on print total concentration of adult 1's recruited.
MJUV3	I			0 = off 1 = on Specifies if Juvenile III migration preferences are given.
CONENT	I			{0 = off 1 = on compute entrainment.
CONIMP	I			{0 = off 1 = on compute impingement.
PEENT	I			{0 = off 1 = on display egg entrainment rate.
PNEEN	I			The intervals at which plant entrainment of eggs is to be computed (time steps).
PLENT	I			{0 = off 1 = on print larval entrainment rate (numbers/day).
PNLEN	I			The interval (number of time steps) at which larval plant entrainment is to be printed.
PJ1ENT	I			{0 = off 1 = on display Juvenile I entrainment.
PNJ1EN	I			The interval (number of time steps) at which Juvenile I entrainment rate (numbers/day) is to be displayed.
PJ2IMP	I			{0 = off 1 = on print Juvenile II impingement rates.

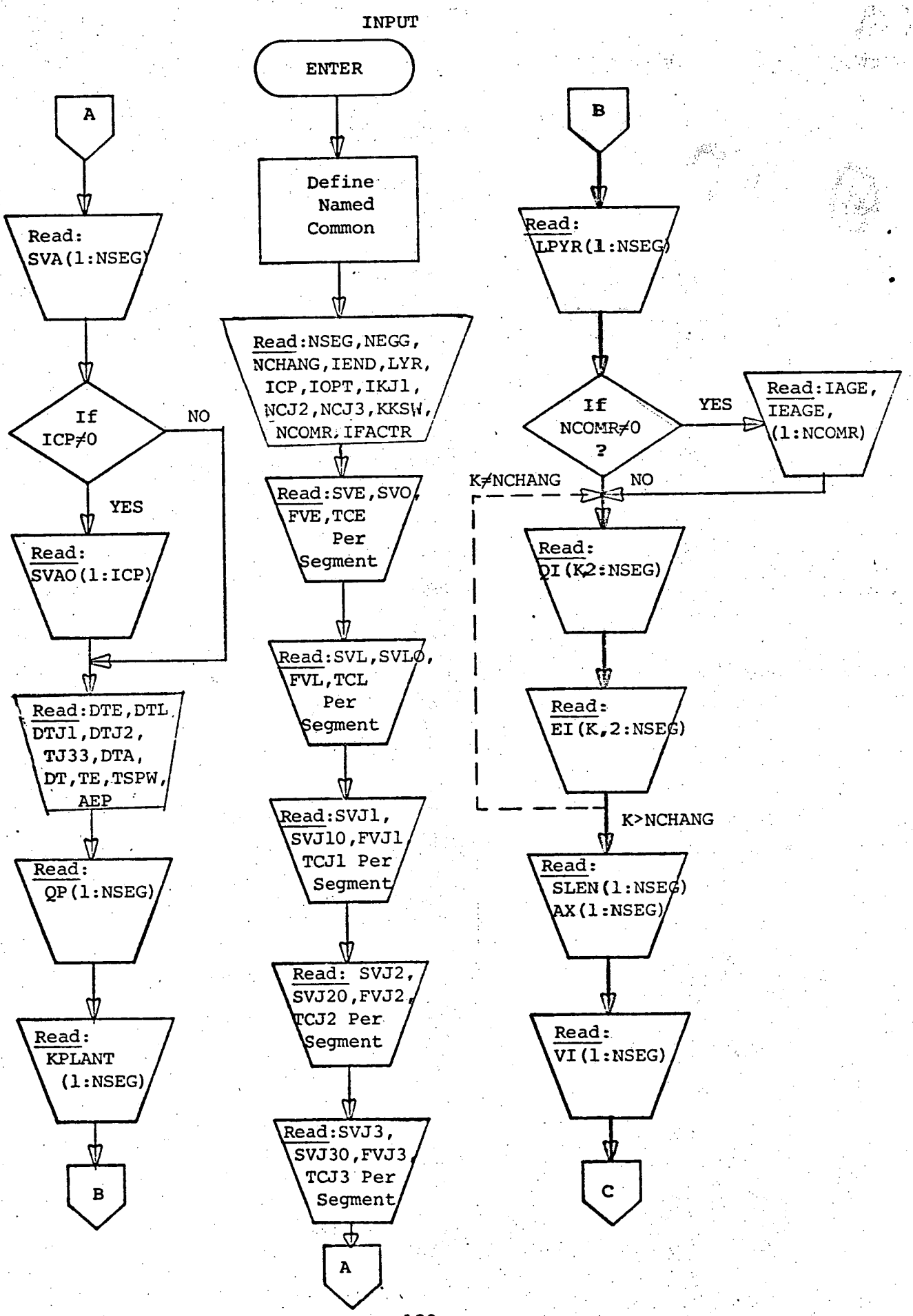
VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
PNJ2IM	I			The interval at which Juvenile II impingement rate is to be displayed.
PJ3IMP	I			{0 = off {1 = on print impingement rates for Juvenile III's.
PNJ3IM	I			The interval at which Juvenile III impingement is to be displayed.
				NOTE: # OF AGE GROUPS = STAGE LENGTH / TIME STEP FOR EACH EARLY LIFE CYCLE.
SL	R			Δt in larval stage (days).
SJ1	R			Δt in juvenile I stage (days).
SJ2	R			Δt in juvenile II stage (days).
SJ3	R			Δt in juvenile III stage (days).
T1967P	R			= 0, no temperature profile = 1, use 1967 temperature profile = 2, read in new temperature profile.
NTEMP	I			Number of input values in the temperature profile for each segment. (= 0 of T1967P = 0).
TEMPER*	R	1:NSEG 1:NTEMP		If T1967P = 2, input temperature/segment/time (°F).
TEMPER*	R	NSEG + 1 1:NTEMP		Days (reference from day zero) at which temperature profiles are to be initiated.
TCUT*	R	1:NSEG		The critical temperature below which eggs die for each segment (°F).
				* These values are input only if T1967P = 2.

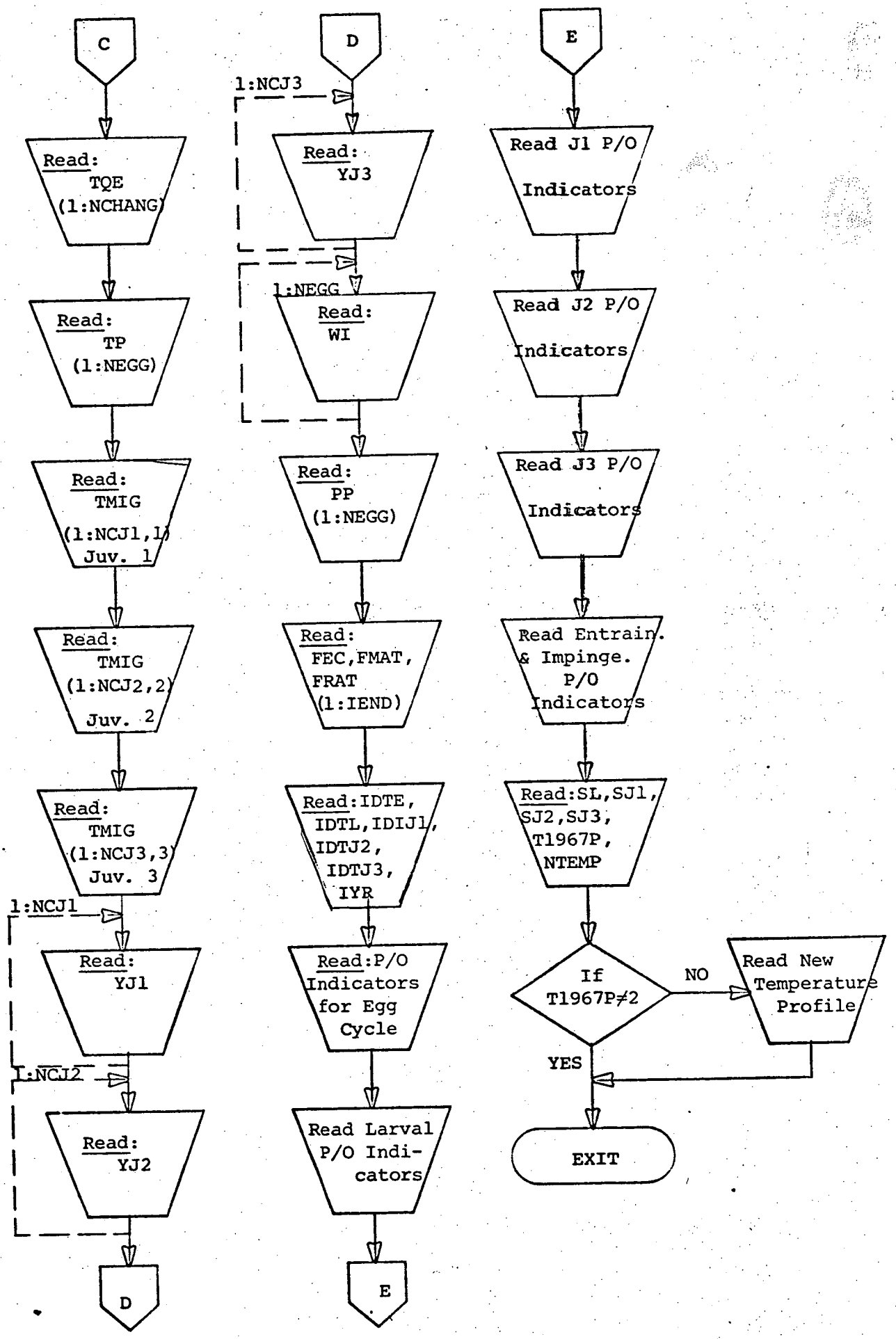
VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
				If IMODEL = 2 or 3 the following inputs are required.
ISW	I			{0 = off 1 = on plant operation.
IEND	I			Number of adult year classes.
LYR	I			Number of years the model is to simulate.
KSTP	I			Number of steps between printouts in early life stages.
TCUT	R			Time at which temperature cut-off occurs.
TSTART	R			Start of spawning (Julian day).
TEND	R			Time at which Juvenile II's are reclassified as Juvenile III's.
PJ2	R	$0 \leq PJ2 \leq 1.0$		Specified Juvenile II fractional survival.
IKX	I			{0 = off 1 = on compute Juvenile II decay rate.
ICP	I			Number of adult classes for which compensation is to occur $\begin{pmatrix} 0 \\ \neq 0 \end{pmatrix}$.
ISKP	I			{0 = off 1 = on permit printouts to occur in early stage computations.
IST	I			Starting year at which adult printouts will occur up to.
IK	I			The "year" step or multiple at which adult printouts will occur.
IEN	I			Starting year at which adult printouts will occur until the last year that the model simulates.

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
TRT	R			Input if IMODEL = 2, computed in TMODEL if IMODEL = 3. This is the ratio of adult 1's in the transport to the totally mixed model. Used to make the totally mixed resemble the transport model.
NN	I			{0 = off {1 = on print input parameters
LQP	I			Number of plant input intake flows (year by year basis).
INCPOP	I			{0 = off {1 = on if increasing population is desired.
PINC	R			Population percentage increase to use (input as a fraction).
				<u>If ISW = 1, input the following:</u>
QQ	R	1:LQP		Yearly gross plant withdrawals (cubic miles/day).
V	R			Estuary volume (cubic miles).
FKILL	R	1:5		Gross entrainment and impingement factors for estuary.
IPL	I			Number of years plant will operate.
P	R			Total eggs produced during spawning in the estuary.
DE	R	1:5		Δt for eggs, larvae, juvenile I through III, respectively (days).
NSPAN	I			Number of weights + 1 in the egg time distribution.
TIM	R	2:NSPAN		Day at which production weights are to be superseded.
TIMW	R	1:NSPAN-1		Temporal distribution for egg production rate computations.

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
TIMT	R	1:NSPAN-1		If a temperature cut-off time is specified (TCUT), the weights at which eggs survive to the larwal stage (based on time TIM) are to be input. Set to 1.0 whem TCUT = 0.
				If IMODEL = 2, the following is required:
DCY	R	1:3		First order decay rates for adult 1 through 3, respectively (1/day).
DCYO	R	1:3		If ICP = 0 and = 3, DCYO is input; otherwise, no input required. DCYO is the minimum decay rates for adult 1 through 3, respectively (day-1).
SRAT	R	1:IEND		Ratio of females to total adults per age class.
SMAT	R	1:IEND		Maturation of females within an age class.
FEC	R	1:IEND		Average fecundity of females within an age class.
PNDAY	R	1:4		Number of days over which transfer from stage to stage (early stages) will be averaged. PNDAY (1:4) DE(1:4)
				A set of the following is to be input for each of the early stages in the format that follows:
CHAR	R	1:6		Description of early stage.
IMPUS	I			{0 = off, 1 = on} impulse.
MULT	I			{0 = off, 1 = on} multiplicity.

VARIABLE NAME	TYPE R=REAL I=INTEGER	CONSTRAINTS OR ARRAY SIZE	SYMBOL	DESCRIPTION
KX	R			First order decay rate (1/day).
KXØ	R			Minimum decay rate (1/day).
YS	R			Carrying capacity (#'s).
DTE	R			Stage duration (days).
TE	R			Spawn period (not specified for Juvenile III).
				If IMODEL = 3, specify inputs according to IMODEL = 1 first; then, specify inputs according to IMODEL = 2, noting exceptions.


INPUT
ENTER
Define Named Common
Read:NSEG,NEGG, NCHANG,IEND,LYR, ICP,IOPT,IKJ1, NCJ2,NCJ3,KKSW, NCOMR,IFACTR
Read:SVE,SVO, FVE,TCE Per Segment
Read:SVL,SVLO, FVL,TCL Per Segment
Read:SVJ1, SVJ10,FVJ1 TCJ1 Per Segment
Read: SVJ2, SVJ20,FVJ2, TCJ2 Per Segment
Read:SVJ3, SVJ30,FVJ3 TCJ3 Per Segment
A
Read: SVA(1:NSEG)
If ICP≠0
NO
YES
Read: SVAO(1:ICP)
Read:DTE,DTL, DTJ1,DTJ2, TJ33,DTA, DT,TE,TSPW, AEP
Read: QP(1:NSEG)
Read: KPLANT (1:NSEG)
B
B
Read: LPYR(1:NSEG)
If NCOMR≠0 ?
YES
Read:IAGE, IEAGE, (1:NCOMR)
NO
K≠NCHANG
Read: QI(K,2:NSEG)
Read: EI(K,2:NSEG)
K>NCHANG
Read: SLEN(1:NSEG) AX(1:NSEG)
Read: VI(1:NSEG)
C


C
Read: TQE (1:NCHANG)
Read: TP (1:NEGG)
Read: TMIG (1:NCJ1,1) Juv. 1
Read: TMIG (1:NCJ2,2) Juv. 2
Read: TMIG (1:NCJ3,3) Juv. 3
1:NCJ1
Read: YJ1
1:NCJ2
Read: YJ2
D
D
1:NCJ3
Read: YJ3
1:NEGG
Read: WI
Read: PP (1:NEGG)
Read: FEC,FMAT, FRAT (1:IEND)
Read:IDTE, IDTL,IDIJ1, IDTJ2, IDTJ3, IYR
Read:P/O Indicators for Egg Cycle
Read Larval P/O Indicators
E
E
Read J1 P/O Indicators
Read J2 P/O Indicators
Read J3 P/O Indicators
Read Entrain. & Impinge. P/O Indicators
Read:SL,SJ1, SJ2,SJ3, T1967P, NTEMP
If T1967P≠2
NO
Read New Temperature Profile
YES
EXIT

```
INPUT2-PNC/LIB$  CREATE:02/01/73,11:27:37 FREQ:11 SIZE:5 BACKUP:02/02/73,
05:21:38 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
      SUBROUTINE INPUT
      INTEGER PIMPE,PNEGG1,PCEGG1,PNEGG2,PCEGG2,PLPROD,PLPTB1,PLPT
      INTEGER PIMPL,PNLAR1,PCLAR1,PNLAR2,PCLAR2,PJ1PRO,PJ1PT1,PJ1P
      INTEGER PIMPJ1,PNJ11,PCJ11,PNJ12,PCJ12,PJ2PRO,PJ2PT1,PJ2PT2
      INTEGER PIMPJ2,PNJ21,PCJ21,PNJ22,PCJ22,PJ3PTN,PJ3PTC
      INTEGER PEENT,PNEEN,PLENT,PNLEN,PJ1ENT,PNJ1EN
      INTEGER PJ2IMP,PNJ2IM,PJ3IMP,PNJ3IM
      INTEGER PNJ32,PCJ32,PA1PTN,PA1PTC,CONENT,CONIMP
      COMMON/MLIFE/SVE(25),SVO(25),FVE(25),TCE(25),SVL(25),SVLO(25
     1FVL(25),TCL(25),SVJ1(25),SVJ1O(25),FVJ1(25),TCJ1(25),SVJ2(25
     2SVJ2O(25),FVJ2(25),TCJ2(25),SVJ3(25),SVJ3O(25),FVJ3(25),TCJ3
     3NEGG,AEP,DTE,DTL,DTJ1,DTJ2,DTJ3,DTA,TE,WI(25,10),TP(10),PP(1
     4DT,ICP,IEND,SVA(20),FEC(20),FRAT(20),FMAT(20),SVAO(20),IFACT
     5,TJ33,TSPW
      COMMON/PLANT/LYR,LPYR(25),QP(25),KPLANT(25),KKSW,IDPT
      COMMON/MCHAR/NSEG,NCHANG,VI(25),AX(25),SLEN(25),
     *QI(25,10),EP(26),EI(25,10),TGE(10),DI(25)
      COMMON/MIGRT/TMIG(10,3),NCJ1,NCJ2,NCJ3,YJ1(25,10),YJ2(25,10)
     IYJ3(25,10)
      COMMON/COMPRT/NCOMR,IAGE(10),IEAGE(10)
      COMMON/INITAL/LEGG,LCHA,T,KNOW,JEGG,JLARV,JJ1,JJ2,JJ3,
     *LPIX,NLPIX,IDAY,IFINAL,PRMT(5),AUX(16,25),TEMPER(26,55),NTE
     *T1967P,TCUT(25)
      COMMON/IDSTEP/IDTE,IDTL,IDTJ1,IDTJ2,IDTJ3,IYR
      COMMON/EGIND/NESP,PIMPE,PNEGG1,PNEGG2,PLPROD,PLPTB1,
     *PLPTB2,PCEGG1,PCEGG2,PEAVG
      COMMON/LVIND/NLSP,PIMPL,PNLAR1,PNLAR2,PJ1PRO,PJ1PT1,PJ1PT2,
     *PCLAR1,PCLAR2,PLAVG
      COMMON/J1IND/NJ1SP,PIMPJ1,PNJ11,PNJ12,PCJ11,PCJ12,
     *PJ2PRO,PJ2PT1,PJ2PT2,MJUV1,PJ1AVG
      COMMON/J2IND/NJ2SP,PIMPJ2,PNJ21,PNJ22,PCJ21,PCJ22,
     *PJ3PTN,PJ3PTC,MJUV2,PJ2AVG
      COMMON/J3IND/NJ3SP,PNJ32,PCJ32,PA1PTN,PA1PTC,MJUV3
      COMMON/EIMP/CONENT,CONIMP,PEENT,PNEEN,PLENT,PNLEN,
     *PJ1ENT,PNJ1EN,PJ2IMP,PNJ2IM,PJ3IMP,PNJ3IM
      COMMON/TIMSTP/SL,SJ1,SJ2,SJ3
   10 FORMAT( )
C READ INPUT DECAY RATES FOR THE EQUILIBRIUM CONDITION AND FOR
C THE CASE WHEN THE CURRENT CONC. IS EXTINCT OR AT THE BOTTOM OF
C LOGISTIC CURVE.
C THE DECAY RATES FOR THE EQUILIBRIUM STATE FOR EGGS, LARVAE, JUV
C THRU JUVENILE 3 AND FOR THE ADULT STAGES ARE SVE,SVL,SVJ1,SVJ2,
C AND SVA(1:13 ADULT YEAR CLASSES), RESPECTIVELY.
C THE DECAY RATES FOR WHEN THE POPULATION IS TO BECOME EXTINCT FO
C EGGS, LARVAE,JUVENILE 1 THRU JUVENIL3 ARE SVO,SVLO,SVJ1O,SVJ2O,
C SVJ3O, RESPECTIVELY.
      READ(5,10)NSEG,NEGG,NCHANG,IEND,LYR,ICP,IDPT,NCJ1,NCJ2,NCJ3
     1KKSW,NCOMR,IFACTR
      READ(5,10)(SVE(J),SVO(J),FVE(J),TCE(J),J=1,NSEG)
      READ(5,10)(SVL(J),SVLO(J),FVL(J),TCL(J),J=1,NSEG)
      READ(5,10)(SVJ1(J),SVJ1O(J),FVJ1(J),TCJ1(J),J=1,NSEG)
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```
1435          READ(5,10)(SVJ2(J),SVJ20(J),FVJ2(J),TCJ2(J),J=1,NSEG)
1440          READ(5,10)(SVJ3(J),SVJ30(J),FVJ3(J),TCJ3(J),J=1,NSEG)
1445          READ(5,10)(SVA(J),J=1,3)
1450          IF(ICP.NE.0)READ(5,10)(SVAC(J),J=1,3)
1540     C THE LENGHT IN DAYS OF THE STAGES EGG, LARVAE, JUVENILE 1 THRU
1550     C JUVENILE 3 IS GIVEN BY DTE,DTL,DTJ1,DTJ2,DTJ3, RESPECTIVELY.
1560     C FOR ADULTS THE STAGE LENGHT IS DTA (IN DAYS).  THE TIME AT WHICH
1570     C IT IS ASSUMED THAT ALL JUVENILE 2'S BECOME JUVENILE 3'S IS GIVEN
1580     C TJ33.  TE IS THE LENGHT IN DAYS OF THE SPAWNING PERIOD.
1590     C DT IS THE INPUT TIME STEP TO BE USED DURING THE RUNGE KUTTA
1600     C CALCULATIONS IN THE EGG STAGE.
1610     C TSPW IS THE TIME REFERENCED FROM DAY ZERO THAT SPAWNING IS TO BE
1620     C AEP IS THE INPUT AVERAGE EGG PRODUCTION IN THE ESTUARY (EGGS/DAY
1630          READ(5,10) DTE,DTL,DTJ1,DTJ2,TJ33,DTA,DT,TE,TSPW,AEP
1640          READ(5,10)(QP(J),J=1,NSEG)
1642          READ(5,10)(KPLANT(J),J=1,NSEG)
1644          READ(5,10)(LPYR(J),J=1,NSEG)
1650          IF(NCOMR.NE.0)READ(5,10)(IAGE(J),DEAGE(J),J=1,NCOMR)
1730     C QI (1:NSEG,1:NCHANG) IS THE FLOW IN SEGMENT L AT TIME J.
1740     C EI(1:NSEG,1:NCHANG) IS THE DISPERSION COEFFICIENTS AT THE
1750     C BOUNDARY BETWEEN SEGMENTS AND FOR TIME NCHANG.
1760          DO 20 J=1,NCHANG
1770          READ(5,10) (QI(L,J),L=2,NSEG)
1780          READ(5,10) (EI(L,J),L=2,NSEG)
1790       20 CONTINUE
1800     C SLEN(1:NSEG) IS THE SEGMENT LENGHTS.
1810     C AX(1:NSEG) IS THE CROSS SECTIONAL AREA FOR EACH SEGMENT AT THE
1820     C DOWNTSTREAM BOUNDARIES.
1830     C EGG PRODUCTION RATE 1:NEGG OVER THE ESTUARY.
1840     C PP(1:NEGG) IS THE FRACTION OF THE AEP WHICH WILL OCCUR IN THE
1850     C WEEKS OF PRODUCTION 1:NEGG.
1860          READ(5,10) (SLEN(J),J=1,NSEG),(AX(J),J=1,NSEG)
1870     C VI(1:NSEG) IS THE VOLUME OF EACH SEGMENT (CU. MI.)
1880          READ(5,10)(VI(J),J=1,NSEG)
1890     C
1900     C READ TIME FOR FLOW CHANGES AND EGG PRODUCTION CHANGES,
1910     C MIGRATION TERMS
1920     C TQE(1:NCHANG) IS THE TIME REFERENCED FROM DAY ZERO FOR WHICH
1930     C FLOWS QI AND DISPERSIONS EI WILL CHANGE.
1940          READ(5,10) (TQE(J),J=1,NCHANG)
1950     C TP(1:NEGG) IS THE TIME REFERENCED FROM TIME ZERO FOR WHICH THE
1960     C EGG PRODUCTION RATES WILL CHANGE.
1970          READ(5,10) (TP(J),J=1,NEGG)
1980     C YJ1,YJ2 AND YJ3 IS THE DESIRED FRACTIONAL PERCENT OF JUVENILE 1
1990     C JUVENILE 3'S, RESPECTIVELY THAT ARE TO APPEAR IN SEGMENTS 1:NSE
1991          READ(5,10)(TMIG(J,1),J=1,NCJ1)
1992          READ(5,10)(TMIG(J,2),J=1,NCJ2)
1993          READ(5,10)(TMIG(J,3),J=1,NCJ3)
1999          DO 25 JK=1,NCJ1
2000       25 READ(5,10)(YJ1(J,JK),J=1,NSEG)
2001          DO 26 JK=1,NCJ2
2010       26 READ(5,10)(YJ2(J,JK),J=1,NSEG)
2011          DO 27 JK=1,NCJ3
2020       27 READ(5,10)(YJ3(J,JK),J=1,NSEG)
```

```
C WI(1:NSEG,1:NEGG) ARE THE WEIGHTS APPLIED TO AEP TO DETERMINE
C THE APPROPRIATE EGG PRODUCTION RATE PER SEGMENT FOR THE GIVEN
      DO 30 J=1,NEGG
   30 READ(5,10)(WI(L,J),L=1,NSEG)
      READ(5,10)(PP(J),J=1,NEGG)
C DTJ3 IS THE COMPUTED STAGE LENGHT OF THE JUVENILE 3 LIFE STAGE.
      DTJ3=365.-TJ33+TSPW
C FEC IS THE FECUNDITY OF FEMALES IN EACH ADULT AGE CLASS.
C FMAT IS MATURITY OF FEMALES CAPABLE OF SPAWNING.
C FRAT IS THE SEX RATIO OF FEMALES TO MALES WITHIN AN ADULT AGE CL
      READ(5,10) (FEC(J),FMAT(J),FRAT(J),J=1,IEND)
C......READ COUNTERS FOR THE NUMBER OF TIMES THE RUNGE-KUTTA
C......WILL BE EXECUTED TO GO FROM AGE GROUP TO AGE GROUP WITHIN
C...... A SINGLE ITERATION FOR EACH EARLY LIFE STAGE
      READ(5,10)IDTE,IDTL,IDTJ1,IDTJ2,IDTJ3,IYR
C......READ PRINTOUT INDICATORS FOR THE EGG STAGE.
      READ(5,10)NESP,PIMPE,PNEGG1,PNEGG2,PLPROD,PLPTB1,
     *PLPTB2,PCEGG1,PCEGG2,PEAVG
C......READ LARVAL PRINTOUT INDICATORS.
      READ(5,10)NLSP,PIMPL,PNLAR1,PNLAR2,PJ1PRO,PJ1PT1,
     *PJ1PT2,PCLAR1,PCLAR2,PLAVG
C......READ JUVENILE 1 PRINTOUT INDICATORS.
      READ(5,10)NJ1SP,PIMPJ1,PNJ11,PNJ12,PCJ11,PCJ12,PJ2PRO,
     *PJ2PT1,PJ2PT2,MJUV1,PJ1AVG
C......READ JUVENILE 2 INDICATORS.
      READ(5,10)NJ2SP,PIMPJ2,PNJ21,PNJ22,PCJ21,PCJ22,
     *PJ3PTN,PJ3PTC,MJUV2,PJ2AVG
C......READ JUVENILE 3 PRINTOUT INDICATORS.
      READ(5,10)NJ3SP,PNJ32,PCJ32,PA1PTN,PA1PTC,MJUV3
C......READ ENTRAINMENT AND IMPINGEMENT PRINTOUT INDICATORS.
      READ(5,10)CONENT,CONIMP,PEENT,PNEEN,PLENT,PNLEN,
     *PJ1ENT,PNJ1EN,PJ2IMP,PNJ2IM,PJ3IMP,PNJ3IM
C......READ TIME STEPS TO BE USED IN THE RUNGE-KUTTA FOR THE
C......EARLY LIFE STAGES - LARVAE,J1 THRU J3
      READ(5,10)SL,SJ1,SJ2,SJ3,T1967P,NTEMP
C......CHECK IF A NEW TEMPERATURE PROFILE IS TO BE INPUT.
C......IF T1967P=2,READ NEW TEMPERATURE PROFILES,
      IF(T1967P.NE.2)RETURN
C......A NEW TEMPERATURE PROFILE IS TO BE INPUT ON A PER
C......SEMENT BASIS.
      NN=NSEG+1
      DO 40 J=1,NN
   40 READ(5,10)(TEMPER(J,K),K=1,NTEMP)
C......READ THE CRITICAL TEMPERATURE VALUES FOR EACH SEGMENT
      READ(5,10)(TCUT(J),J=1,NSEG)
      RETURN
      END
```

IQ

TP1967:

Functional description:

TP1967 establishes the 1967 temperature profile for the given run.

Inputs: none

Equations: none

Outputs: see output arrays

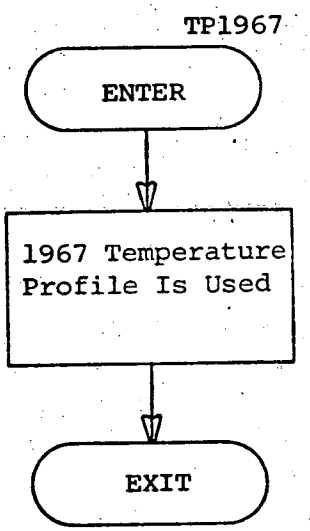
TEMPER

TCUT

Subroutines called: none

Referenced by:

INTIAL - initialization routine


TP1967
ENTER
1967 Temperature Profile Is Used
EXIT

```
IL
      SUBROUTINE TP1967
      COMMON/INITAL/LEGG,LCHA,T,KNOW,JEGG,JLARV,JJ1,JJ2,JJ3,
     *LPIX,NLPIX,IDAY,IFINAL,PRMT(5),AUX(16,25),TEMPER(26,55),NTEMP,
     *T1967P,TCUT(25)
      DATA (TEMPER(1,J),J=1,55)/52.,52.,52.,52.,52.5,53.,53.3,
     *53.7,54.,54.3,54.7,55.,55.5,56.1,56.6,57.2,57.8,58.4,58.9,
     *59.4,60.,60.8,61.7,62.5,63.4,64.2,65.,66.1,67.3,68.4,69.6,
     *70.8,72.,72.5,73.,73.5,74.,74.5,75.,75.2,75.4,75.7,75.9,
     *76.1,76.4,76.6,76.8,77.0,77.2,77.4,77.5,77.6,77.8,78.,78.2/
      DATA (TEMPER(2,J),J=1,55)/51.,51.,51.,51.,51.2,51.5,51.8,
     *52.,52.2,52.5,52.8,53.,53.5,54.,54.5,55.,55.5,56.,56.3,56.7,
     *57.,57.3,57.7,58.,58.7,59.3,60.,61.7,63.3,65.,67.,69.,71.,
     *72.,73.,74.,74.3,74.7,75.,74.8,74.6,74.5,74.3,74.1,74.,74.1,
     *74.3,74.5,74.7,74.9,75.,75.3,75.7,76.,76.3/
      DATA(TEMPER(3,J),J=1,55)/50.,50.,50.,50.,50.,50.,
     *50.6,51.3,52.,52.3,52.7,53.,53.3,53.7,54.,54.8,55.7,
     *56.5,57.4,58.2,59.,59.3,59.7,60.,60.8,61.7,62.5,63.4,
     *64.2,65.,65.8,66.7,67.5,68.4,69.2,70.,70.7,71.3,72.,72.3,
     *72.7,73.,73.1,73.3,73.5,73.7,73.9,74.,74.1,74.3,74.5,
     *74.6,74.8,75.,75./
      DATA (TEMPER(4,J),J=1,55)/53.,53.,53.,53.,53.,53.,
     *53.,53.,53.,53.,53.,53.,53.7,54.3,55.,55.6,56.2,56.7,
     *57.3,57.9,58.4,59.,59.5,60.,60.7,61.4,62.1,62.8,63.5,
     *64.3,65.,65.6,66.2,66.9,67.5,68.1,68.8,69.4,70.,70.4,
     *70.8,71.3,71.7,72.1,72.6,73.,73.4,73.9,74.3,74.7,75.,
     *75.3,75.7,76.,76.3/
      DATA (TEMPER(5,J),J=1,55)/52.,52.,52.,52.,52.,52.,52.7,
     *53.3,53.,53.,53.,53.,53.3,53.7,54.,54.3,54.7,55.,55.8,
     *56.6,57.5,58.3,59.2,60.,60.5,61.1,61.6,62.2,62.7,63.3,
     *63.8,64.4,65.,65.7,66.3,67.,67.6,68.3,69.,69.5,70.,70.5,
     *71.,71.5,72.,72.5,73.,73.5,74.,74.5,75.,75.3,75.7,76.,
     *76.5/
      DATA (TEMPER(6,J),J=1,55)/52.,52.,52.,52.,52.,52.,
     *52.3,52.7,53.,53.3,53.7,54.,54.3,54.7,55.,55.7,56.3,
     *57.,57.3,57.7,58.,58.,58.,58.,58.3,58.7,59.,59.3,59.7,
     *60.,60.8,61.7,62.5,63.4,64.2,65.,65.4,65.8,66.3,66.7,67.1,
     *67.6,68.,68.4,68.8,69.2,69.6,70.,70.3,70.7,71.,
     *71.3,71.7,72.,72.3/
      DATA (TEMPER(7,J),J=1,55)/51.,51.,51.,51.,51.,51.,
     *51.3,51.7,52.,52.5,53.,53.5,54.,54.5,55.,55.3,55.7,
     *56.,56.3,56.7,57.,57.3,57.7,58.,58.3,58.7,59.,59.3,
     *59.7,60.,60.8,61.7,62.5,63.4,64.2,65.,65.3,65.6,66.,
     *66.3,66.6,67.,67.3,67.6,68.,68.3,68.6,69.,69.3,69.6,
     *70.,70.3,70.7,71.,71.3/
      DATA (TEMPER(8,J),J=1,55)/50.,50.,50.,50.,50.5,51.,51.6,
     *52.3,52.9,53.6,54.3,55.,55.3,55.7,56.,56.3,56.7,57.,57.3,
     *57.7,58.,58.3,58.7,59.,59.3,59.7,60.,60.8,61.7,62.5,63.4,
     *64.2,65.,65.8,66.7,67.5,68.4,69.2,70.,70.3,70.5,70.8,71.,
     *71.3,71.5,71.8,72.,72.3,72.5,72.8,73.,73.4,73.8,74.3,74.7/
      DATA (TEMPER(9,J),J=1,55)/0.,1.,2.,3.,4.,5.,6.,7.,8.,9.,
     *10.,11.,12.,13.,14.,15.,16.,17.,18.,19.,20.,21.,22.,23.,24.,
     *25.,26.,27.,28.,29.,30.,31.,32.,33.,34.,35.,36.,37.,38.,39.,
     *40.,41.,42.,43.,44.,45.,46.,47.,48.,49.,50.,51.,52.,53.,54./
      DATA(TCUT(J),J=1,8)/70.,70.,70.,65.,4*60./
      NTEMP=55
      RETURN
      END
10
```

PARSUM:

Functional Description:

PARSUM computes the total number entrained or impinged for the current early stage considered on a per segment basis. These numbers are summed to yield the total entrained or impinged in the estuary.

Inputs:

XVAL - current numbers entrained or impinged

TB - begin time of interval

TE - end time of interval

NSEG - number of segments in estuary

ISW - $\begin{cases} 0 \text{ - perform initialization} \\ 1 \text{ - bypass stage initialization} \end{cases}$

Equations: Using trapezoidal rule.

$$\text{total nos.} \begin{Bmatrix} \text{entrained} \\ \text{or} \\ \text{impinged} \end{Bmatrix} = \left(\frac{TE - TB}{2}\right)\left(NOS_{TE} + NOS_{TB}\right)$$

where:

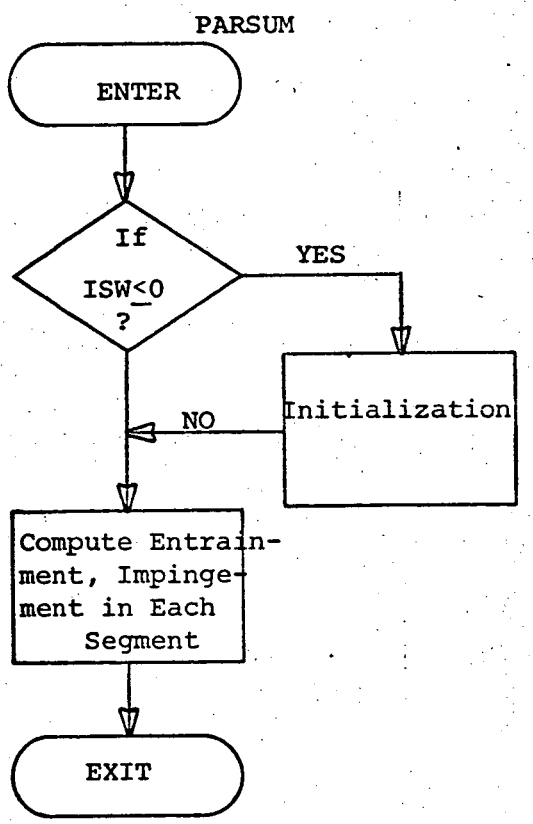
NOS_{TE} = numbers entrained or impinged at TE

NOS_{TB} = numbers entrained or impinged at TB.

Output: Report on cumulative total numbers entrained or impinged in each segment and in the estuary for the current stage considered.

Referenced by: TMODEL

Subroutines called: None.


PARSUM
ENTER
If
ISW≤0
?
YES
NO
Initialization
Compute Entrain-
ment, Impinge-
ment in Each
Segment
EXIT

```
PARSUM-PNC/LIB$  CREATE:02/01/73,11:27:35 FREQ:11 SIZE:1 BACKUP:02/02/73,
05:21:39 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE ON:SPN
IL
100          SUBROUTINE PARSUM(XVAL,TB,TE,NSEG,ISW)
110          DIMENSION XVAL(1),XTVAL(25),SKT(25)
120          IF(ISW)10,10,20
130       10 SKT1=0.
140          DO 15 J=1,NSEG
150          SKT(J)=0.
160       15 XTVAL(J)=0.
170          ISW=1
180       20 DT=(TE-TB)*0.5
190          DO 30 K=1,NSEG
200          XTVAL(K)=DT*(XTVAL(K)+XVAL(K))
210          SKT(K)=SKT(K)+XTVAL(K)
220       30 SKT1=SKT1+XTVAL(K)
230          WRITE(12,40)SKT1,(SKT(L),L=1,NSEG)
240       40 FORMAT(1X,'TOTAL #=',F8.0,8(1X,F8.0))
250          DO 50 K=1,NSEG
260       50 XTVAL(K)=XVAL(K)
270          TB=TE
280          RETURN
290          END
IQ
```

TMXINV:

Functional description:

TMXINV separates the A-matrix discussed in the section on the analysis into a strictly lower and upper triangular matrix. It then proceeds to obtain the inverse of both matrixes such that A^{-1} is obtained.

NOTE: $A = LU$

$A^{-1} = U^{-1}L^{-1}$

Inputs: calling sequence

B	lower diagonal of A-matrix
A	main diagonal of A-matrix
C	upper diagonal of A-matrix
NSEG	number of segments in estuary
BINV	output matrix A^{-1}
AL	elements of lower triangular matrix
G	elements of upper triangular matrix
SLINV	inverse of lower triangular matrix
UINV	inverse of upper triangular matrix.

Equations:

Let A =
$$\begin{pmatrix} a_1 & c_1 & 0 & & & & & \\ b_2 & a_2 & c_2 & 0 & & & \bigcirc & \\ 0 & b_3 & a_3 & c_3 & 0 & & & \\ & 0 & \cdot & \cdot & \cdot & 0 & & \\ & & 0 & \cdot & \cdot & \cdot & 0 & \\ & \bigcirc & & 0 & b_{n-1} & a_{n-1} & c_{n-1} & 0 \\ & & & & 0 & b_n & a_n & c_n \end{pmatrix}$$

Derive L and U such that:

$$A = LU$$

where:

$$L = \begin{pmatrix} \alpha_1 & 0 & & & & & & \\ b_2 & \alpha_2 & 0 & & & & \bigcirc & \\ 0 & b_3 & \alpha_3 & 0 & & & & \\ & 0 & b_4 & \alpha_4 & 0 & & & \\ & & 0 & \cdot & \cdot & 0 & & \\ & \bigcirc & & 0 & \cdot & \cdot & 0 & \\ & & & & 0 & b_n & \alpha_n & 0 \end{pmatrix}$$

and

$$U = \begin{pmatrix} 1 & \gamma_1 & 0 & & & & & \\ 0 & 1 & \gamma_2 & 0 & & & \bigcirc & \\ & 0 & 1 & \gamma_3 & 0 & & & \\ & & 0 & \cdot & \cdot & 0 & & \\ & \bigcirc & & 0 & \cdot & \cdot & 0 & \\ & & & & 0 & 1 & \gamma_{n-1} & \\ & & & & & 0 & 1 & \end{pmatrix}$$

The elements of L and U are:

$$\alpha_1 = a_1$$

$$\gamma_1 = C_1/\alpha_1$$

$$\alpha_i = a_i - b_i\gamma_{i-1} \qquad \text{for } i = 2, \ldots, n.$$

$$\gamma_i = c_i/\alpha_i \qquad \text{for } i = 1, 2, \ldots, n-1.$$

<u>Note</u>: $A^{-1} = U^{-1} L^{-1}$

The elements of U^{-1} are:

$$U_{ij} = \begin{cases} 0 & \text{for } j < i \\ 1 & \text{for } j = i \\ (-1)^{i+j} \prod_{l=i}^{j-1} \gamma_l & \text{for } j > i. \end{cases}$$

The elements of L^{-1} are:

$$l_{ij} = \begin{cases} \dfrac{1}{\alpha_i} & \text{for } i = j \\ 0 & \text{for } j > i \\ \dfrac{(-1)^{i+j} \prod_{i=j+1}^{j-i} b_l}{\prod_{n=j}^{i} \alpha_n} & \text{for } j < i \end{cases}$$

Output:

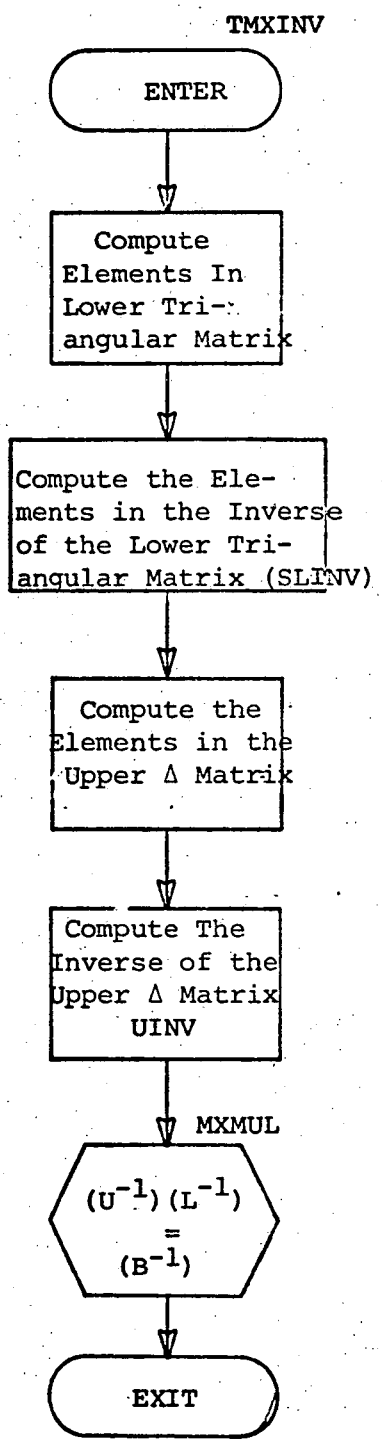
BINV - Inverse of matrix A.

Subroutines called:

MXMUL - matrix multiply

Referenced by:

TMODEL - transport model.


TMXINV
ENTER
Compute Elements In Lower Tri-angular Matrix
Compute the Ele-ments in the Inverse of the Lower Tri-angular Matrix (SLINV)
Compute the Elements in the Upper Δ Matrix
Compute The Inverse of the Upper Δ Matrix UINV
MXMUL
$(U^{-1})(L^{-1}) = (B^{-1})$
EXIT

PRINTF TMXINV FORTRAN

```
      SUBROUTINE TMXINV(B,A,C,NSEG,BINV,AL,G,SLINV,UINV)
      DIMENSION B(1),A(1),C(1),BINV(25,1),AL(1),G(I)
      DIMENSION SLINV(25,1),UINV(25,1)
C EMAT=LTRI*UTRI; BINV=UINV*LINV
C COMPUTE THE ELEMENTS OF THE LOWER TRIANGULAR MATRIX IN
C ARRAYS B AND AL,
C COMPUTE THE ELEMENTS OF THE UPPER TRIANGULAR MATRIX IN ARRAY G
C
      AL(1)=A(1)
      G(1)=C(1)/AL(1)
      DO 10 I=2,NSEG
      AL(I)=A(I)-B(I)*G(I-1)
   10 G(I)=C(I)/AL(I)
C COMPUTE LINV STORE IN SLINV
      DO 50 I=1,NSEG
      DO 40 J=1,NSEG
      IF(I-J) 15,20,25
   15 SLINV(I,J)=0.
      GO TO 40
   20 SLINV(I,J)=1.0/AL(I)
      GO TO 40
   25 DENOM=1.
      SNUM=1.
      K=J+1
      DO 30 L=J,I
   30 DENOM=DENOM*AL(L)
      DO 35 L=K,I
   35 SNUM=SNUM*B(L)
      SLINV(I,J)=(-1.0)**(I+J)*(SNUM/DENOM)
   40 CONTINUE
   50 CONTINUE
C COMPUTE UINV, STORE IN UINV
C
      DO 100 I=1,NSEG
      DO 90 J=1,NSEG
      IF(I-J) 70,65,60
   60 UINV(I,J)=0.
      GO TO 90
   65 UINV(I,J)=1.
      GO TO 90
   70 K=J-1
      PROD=1.
      DO 75 L=I,K
   75 PROD=PROD*G(L)
      UINV(I,J)=(-1.)**(I+J)*PROD
   90 CONTINUE
  100 CONTINUE
C COMPUTE BINV=UINV*LINV
      CALL MXMUL(UINV,SLINV,NSEG,NSEG,BINV)
      RETURN
      END
```

12.22.25 >

MXMUL:

Functional Description:

MXMUL computes the product of any two n x n matrices or an n x m and m x n_o matrices.

Input:

$A = (a_{ij})$

$B = (b_{ij})$

NROW - number of rows in A

NCOL - number of columns in A and number of rows in B.

Equations:

$$AB = \left(\sum_{i,j} a_{ij} b_{ji} \right)$$

Outputs:

AB - the product matrix.

Subroutines called: None

Referenced by:

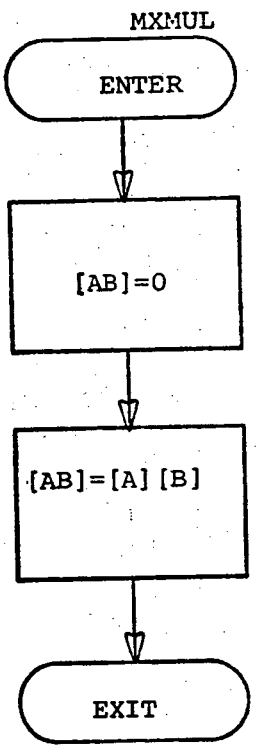
TMODEL

TMXINV

FCT

MIGN

PATCH2


MXMUL
ENTER
[AB]=0
[AB]=[A] [B]
EXIT

```
MXMUL-PNC/LIB$  CREATE:02/01/73,11:27:32 FREQ:11 SIZE:1 BACKUP:02/02/73,
05:21:41 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
1000          SUBROUTINE MXMUL(A,B,NROW,NCOL,AB)
1010          DIMENSION A(25,1),B(25,1),AB(25,1)
1020      C
1030      C INITIALIZE THE RESULTANT PRODUCT MATRIX AB(NROW,NCOL) TO ZERO.
1040      C NROW IS THE NUMBER OF ROWS AND COLUMNS IN THE MATRIX A.  NROW
1050      C IS THE NUMBER OF ROWS IN MATRIX B AND NCOL IS ITS' NUMBER OF
1060      C COLUMNS.
1070      C
1080          DO 20 I=1,NROW
1090          DO 10 J=1,NCOL
1100          AB(I,J)=0.
1110       10 CONTINUE
1120       20 CONTINUE
1130      C
1140      C MATRIX B IS MULTIPLIED BY MATRIX A YIELDING MATRIX AB.
1150      C
1160          DO 50 I=1,NROW
1170          DO 40 J=1,NCOL
1180          DO 30 L=1,NROW
1190          AB(I,J)=AB(I,J)+A(I,L)*B(L,J)
1200       30 CONTINUE
1210       40 CONTINUE
1220       50 CONTINUE
1230          RETURN
1240          END
IQ
```

DICAL:

Functional description:

DICAL functionally performs the computation of the exchange coefficients at the downstream boundaries of each segment of the estuary.

Inputs: calling sequence

DI	output exchange coefficients
EI	dispersion coefficient at boundary
AX	cross sectional area at boundary
SLEN	segment length
NSEG	number of segments
LCHA	indicates which dispersion coefficient set to use.

Equations:

$$D_{i-1,i} = 2 \cdot \left\{ \frac{E_{i-1,i} \cdot A_{i-1,i}}{L_{i-1} + L_i} \right\}$$

$$D_{i,i+1} = 2 \cdot \left\{ \frac{E_{i,i+1} \cdot A_{i,i+1}}{L_i + L_{i+1}} \right\}$$

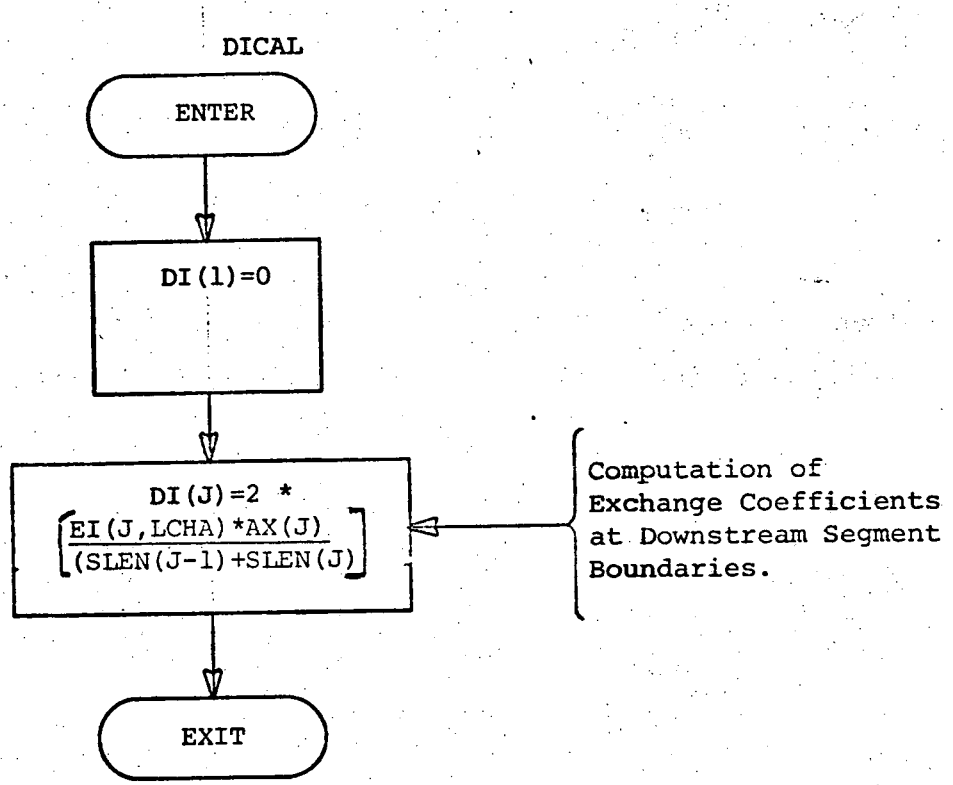
Output:

D_i - Exchange coefficients

Subroutines called: None

Referenced by:

TMODEL - transport model.


DICAL
ENTER
DI(1)=0
DI(J)=2 *
[EI(J,LCHA)*AX(J) / (SLEN(J-1)+SLEN(J))]
Computation of Exchange Coefficients at Downstream Segment Boundaries.
EXIT

DICAL-PNC/LIB$ CREATE:02/01/73,11:27:52 FREQ:11 SIZE:1 BACKUP:02/02/73,
05:21:30 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE

```
IL
1000          SUBROUTINE DICAL(DI,EI,AX,SLEN,NSEG,LCHA)
1010      C THIS ROUTINE COMPUTES THE EXCHANGE COEFFICIENTS AT THE BOUNDARIES
1020      C OF EACH SEGMENT IN DI(1:NSEG). DI(1) IS SET TO ZERO SINCE WE DO
1030      C NOT PERMIT ANY MATTER TO LEAVE THE ESTUARY IN THE UPSTREAM
1040      C BOUNDARY OF SEGMENT 1.
1050            DIMENSION DI(1),EI(25,1),AX(1),SLEN(1)
1060            DI(1)=0.
1070            DO 10 J=2,NSEG
1080            DI(J)=2.*(EI(J,LCHA)*AX(J))/(SLEN(J-1)+SLEN(J))
1090         10 CONTINUE
1100            RETURN
1110            END
IQ
```

$$a_{J,J-1} = \left[QI(J,LCHA) \cdot EP(J) + DI(J)\right]/VI(J)$$

for J = 2,...,NSEG

$$a_{J,J+1} = \left[-QI(J+1,LCHA) \cdot (1-EP(J+1)) + DI(J+1)\right] /VI(J)$$

for J = 1,...,NSEG-1.

where:

QI	= advection
DI	= exchange coefficient at boundary
VI	= volume of segment
EP(J+1)	= SLEN(J+1)/[SLEN(J) + SLEN(J+1)]
SLEN	= segment length
NSEG	= number of segments

<u>Output</u>: AMAT - (a_{ii})

<u>Subroutines called</u>: None

<u>Referenced by</u>:

TMODEL - transport model.

AMACAL:

Functional Description:

AMACAL functionally computes the A matrix of coefficients that depict the manner which advection and dispersion will occur in the estuary.

Inputs:

.AMAT - output A matrix [NSEG×NSEG]

.LCHA - indicates which pair of flows and dispersive values are to be used.

.MCHAR - common name for several variables. See INPUT section for a description of variables.

Equations:

$$a_{11} = [-QI\ (2,LCHA) \cdot EP(2) - DI(2)]/VI(1)$$

Since it is assumed no organisms leave at the boundary of segment 1 and at the downstream boundary of segment N, we get:

$$A_{nn} = \{QI(NSEG,LCHA) \cdot [1 - EP(NSEG)] - DI(NSEG)\}/VI(NSEG)$$

In general,

$$a_{J,J} = [QI(J,LCHA) \cdot (1-EP(J)) + DI(J) - QI(J+1,LCHA) \cdot EP(J+1) - DI(J+1)]/VI(J)$$

for J = 2, ..., NSEG-1.

AMACAL:

Functional description:

AMACAL functionally computes the A matrix of coefficients that depict the manner which advection and dispersion will occur in the estuary.

Inputs: calling sequence

.AMAT - output A matrix [NSEGXNSEG]

.LCHA - indicates which pair of flows and dispersive values are to be used.

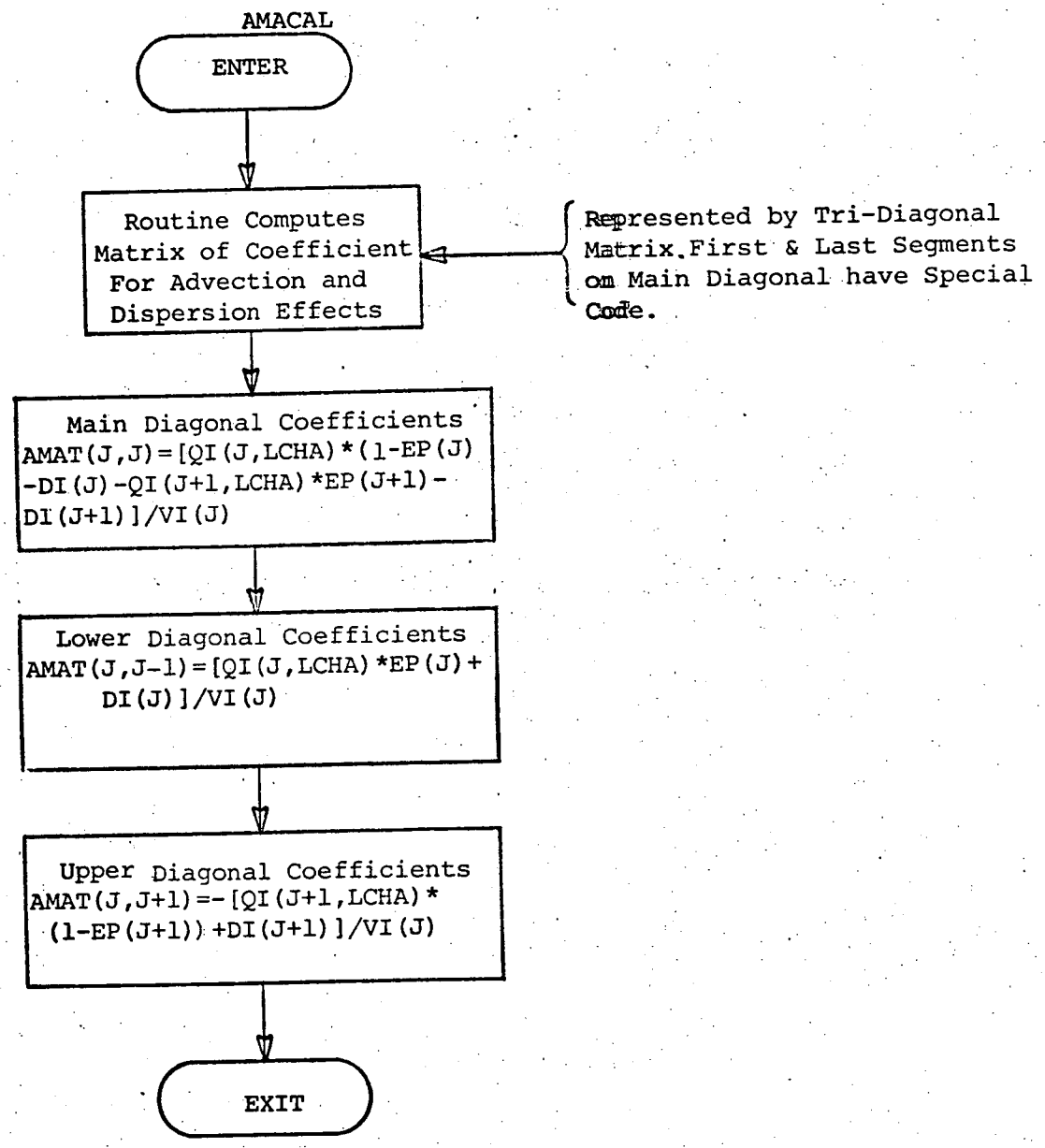
.MCHAR - named common see INPUT section for a description of variables.

Equations:

$$a_{11} = \left[-QI(2, LCHA) * EP(2) - DI(2) \right] / VI(1)$$

since, it is assumed no organisms leave at the upstream segment 1 boundary. Also, it is assumed no organisms leave at the downstream segment N boundary, we get

$$a_{nn} = \left(QI(NSEG, LCHA) * (1 - EP(NSEG)) - DI(NSEG) \right) / VI(NSEG)$$


AMACAL
ENTER
Routine Computes Matrix of Coefficient For Advection and Dispersion Effects
Represented by Tri-Diagonal Matrix. First & Last Segments on Main Diagonal have Special Code.
Main Diagonal Coefficients
AMAT(J,J)=[QI(J,LCHA)*(1-EP(J)-DI(J)-QI(J+1,LCHA)*EP(J+1)-DI(J+1)]/VI(J)
Lower Diagonal Coefficients
AMAT(J,J-1)=[QI(J,LCHA)*EP(J)+DI(J)]/VI(J)
Upper Diagonal Coefficients
AMAT(J,J+1)=-[QI(J+1,LCHA)*(1-EP(J+1))+DI(J+1)]/VI(J)
EXIT

```
      SUBROUTINE AMACAL(A1,A2,A3,LC)
C
      COMMON/MCHAR/NSEG,NCHANG,VI(25),AX(25),SLEN(25),QI(25,10),
     1EP(25),EI(25,10),TOE(10),DI(25)
      COMMON/ACHAR1/QO(10),AO,EO(10),DL(25),SLPI(25)
      DIMENSION A1(25),A2(25),A3(25),DQA(25),ED(25),DEI(25),QA(25)
      DO 100 J=1,NSEG
100   ED(J)=DL(J)/SLPI(J)
      NSEG1 = NSEG + 1
      QAO = QO(LC)/AO
      DO 1 J=1,NSEG1
    1 QA(J)=QI(J,LC)/AX(J)
C
C     NUMBER OF UNKNOWNS= NSEG
      DQA(1) = (1 - ED(1))* (QA(1)- QAO)/DL(1) + ED(1)*(QA(2)-QA(1))
     1        /DL(2)
      DO 2 J=2,NSEG
    2 DQA(J) = (1 - ED(J))*(QA(J)- QA(J-1))/DL(J)  + ED(J)*(QA(J+1) -
     1          QA(J))/ DL(J+1)
C
      DEI(1) = (1 - ED(1))*(EI(1,LC) - EO(LC))/DL(1) +ED(1)*(EI(2,LC)
     1           -EI(1,LC))/ DL(2)
C
      DO 3 J=2,NSEG
    3 DEI(J) = (1 - ED(J))*(EI(J,LC)- EI(J-1,LC))/DL(J) + ED(J)*
     1          (EI(J+1,LC)- EI(J,LC))/DL(J+1)
C
C
      DO 4 J = 1,NSEG
    4 A1(J) = (2* EI(J,LC) + QA(J) * DL(J+1) - DEI(J)*DL(J+1))/(SLPI(J)*
     1          DL(J))
C
      DO 5 J = 1,NSEG
    5 A3(J) = (2*EI(J,LC) - QA(J)* DL(J) + DEI(J)* DL(J))/(SLPI(J)*
     1          DL(J+1))
C
C
C
      DO 6 J = 1,NSEG
    6 A2(J) = -DQA(J) + ((DEI(J) - QA(J))*(DL(J+1)-DL(J))- 2*EI(J,LC))
     1        / (DL(J+1)* DL(J))
C
      A2(1) = A1(1)  + A2(1)
C
      A2(NSEG) = A3(NSEG) + A2(NSEG)
C
C
      RETURN
      END
```

```
IAC NC/LIB$  CREATE:02/01/73,11:27:54 FREQ:11 SIZE:1 BACKUP:02/02/73,05:21:29
.IND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE

      SUBROUTINE AMACAL(AMAT,LCHA)
      DIMENSION AMAT(25,25)
      COMMON/MCHAR/NSEG,NCHANG,VI(25),AX(25),SLEN(25),
     *QI(25,10),EP(26),EI(25,10),TQE(10),DI(25)
C THIS ROUTINE COMPUTES THE MATRIX OF COEFFICIENTS WHICH
C ADVECT, DISPERSE AND EFFECT THE PLANT WITHDRAWAL FOR A GIVEN
C AGE GROUP CONCENTRATION WITHIN A PARTICULAR STAGE LIFE CYCLE.
C
C MAIN DIAGNOL, A2I
C
      DO 100 I=1,NSEG
      DO 100 J=1,NSEG
  100 AMAT(I,J)=0.
      MSEG=NSEG-1
      AMAT(1,1)=(-QI(2,LCHA)*EP(2)-DI(2))/VI(1)
      AMAT(NSEG,NSEG)=(QI(NSEG,LCHA)*(1.-EP(NSEG))-DI(NSEG)
     *)/VI(NSEG)
      DO 10 J=2,MSEG
      AMAT(J,J)=(QI(J,LCHA)*(1.-EP(J))-DI(J)-QI(J+1,LCHA)*
     *EP(J+1)-DI(J+1))/VI(J)
   10 CONTINUE
C
C LOWER DIAGNOL, A1I
C
      DO 15 J=2,NSEG
   15 AMAT(J,J-1)=(QI(J,LCHA)*EP(J)+DI(J))/VI(J)
C
C UPPER DIAGNOL, A3I
C
      DO 20 J=1,MSEG
   20 AMAT(J,J+1)=(-QI(J+1,LCHA)*(1.-EP(J+1))+DI(J+1))/VI(J)
      RETURN
      END
```

RKUTTA:

Functional description:

RKUTTA performs the Runge-Kutta computations using either the equations describing advection, and dispersion or migration to advance one (1) time step.

Inputs: calling sequence

H	time step
Y	current concentration
DERY	change in concentration
DECY	decay matrix
AUX	auxiliary array
NDIM	number of segments
SMATX	$E^{-1}A$ or $E^{-1}M$
CC	temporary array
CP	output of either FCT or MIGN
VI	volume of a specific segment.

Equations:

$$k_0 = h\ f(x, y_n)$$

$$k_1 = h\ f(x + .4h, y_n + .4k_0)$$

$$k_2 = h\ f(x + .45573726h, y_n + .2969776k_0 + .15875966k_1)$$

$$k_3 = h\ f(x + h, y_n + .21810038k_0 - 3.0509647k_1 + 3.832865k_2)$$

$$y_{n+1} = y_n + .17476028k_0 - .55148053k_1 + 1.20553547k_2 + .17118478hk_3$$

Output:

Y - concentration for each segment (updated).

Subroutines called:

FCT - routine performs advection and decay

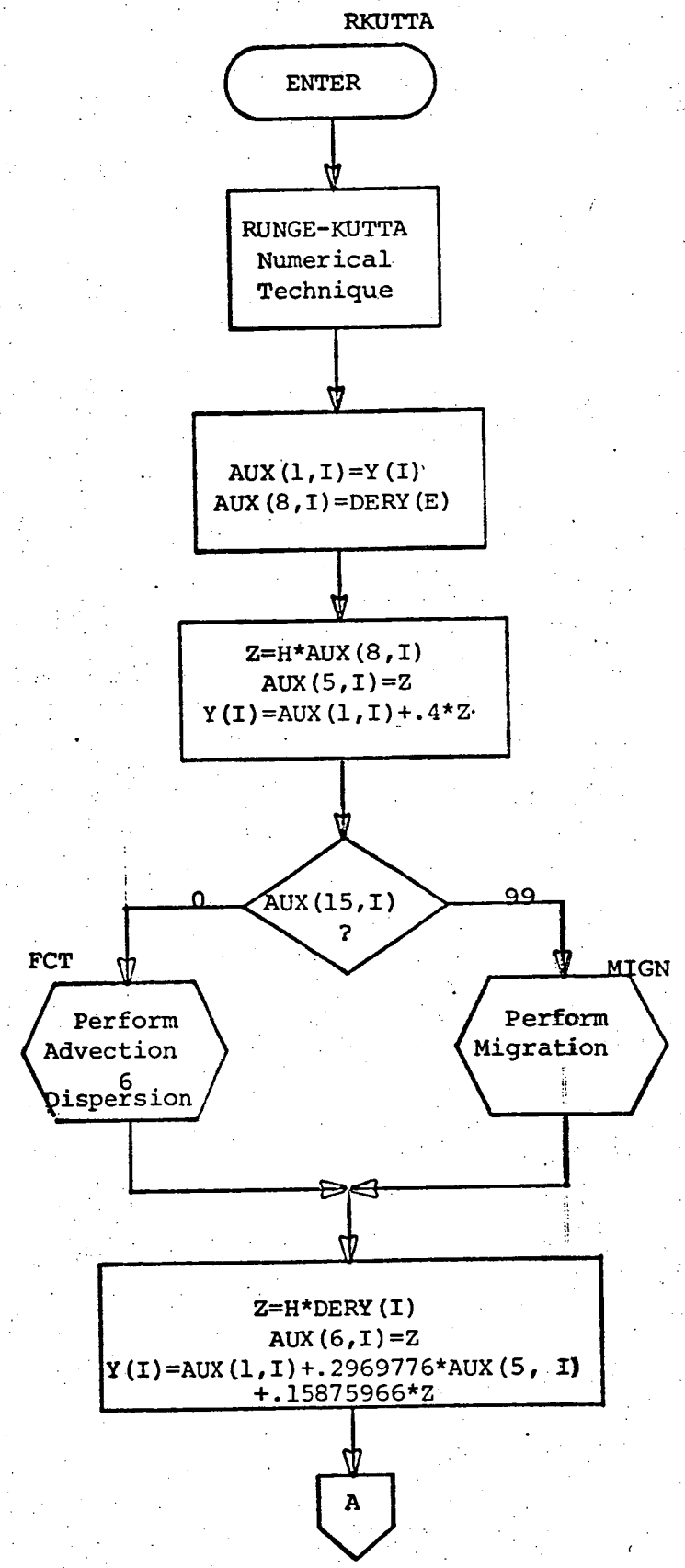
MIGN - routine performs migration function.

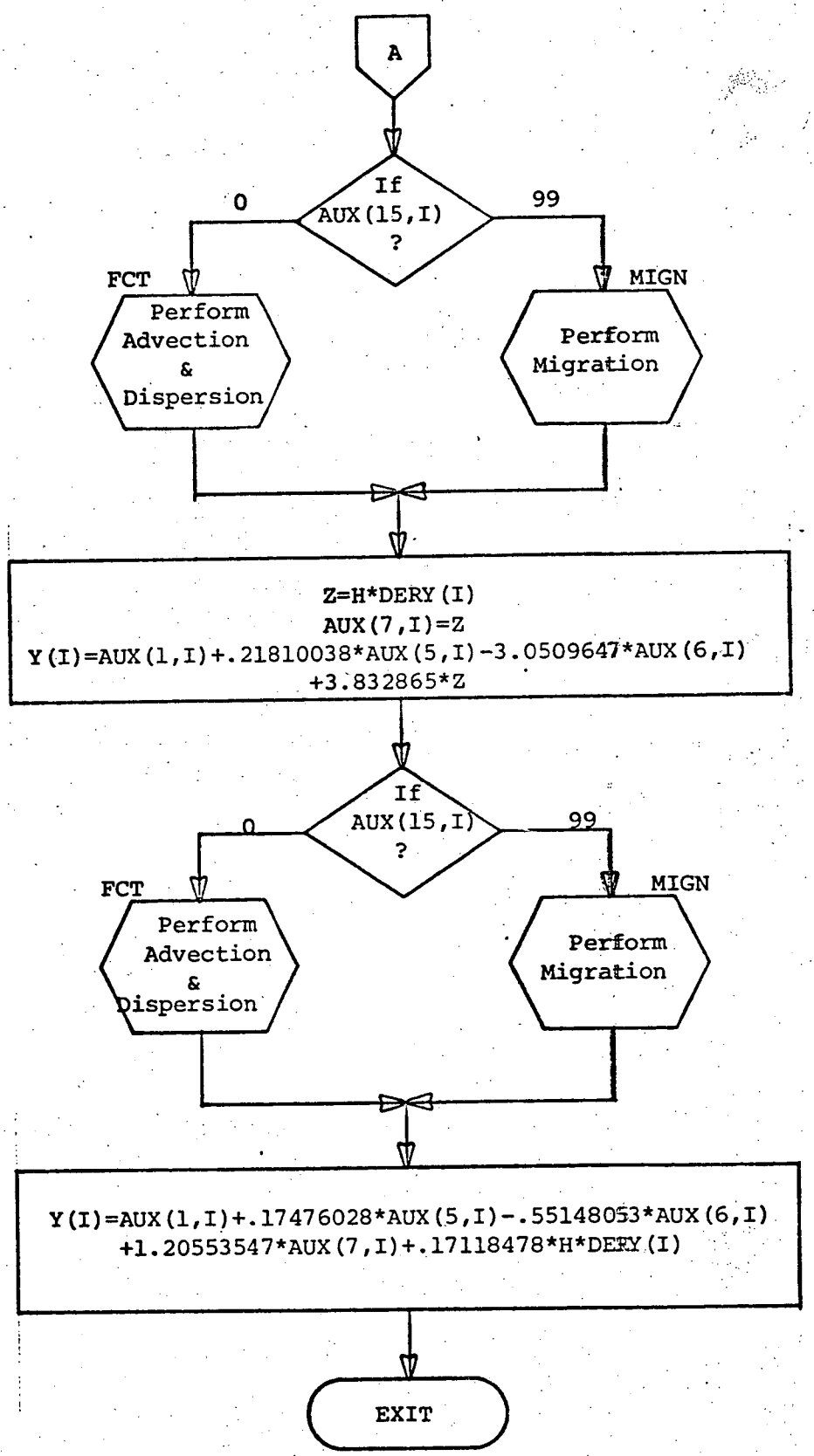
Referenced by:

TMODEL = transport model

Special considerations:

AUX (15,1) = 0 call FCT
99 call MIGN


RKUTTA
ENTER
RUNGE-KUTTA Numerical Technique
AUX(1,I)=Y(I)
AUX(8,I)=DERY(E)
Z=H*AUX(8,I)
AUX(5,I)=Z
Y(I)=AUX(1,I)+.4*Z
AUX(15,I) ?
0
99
FCT
MIGN
Perform Advection & Dispersion
Perform Migration
Z=H*DERY(I)
AUX(6,I)=Z
Y(I)=AUX(1,I)+.2969776*AUX(5, I) +.15875966*Z
A


A
If
AUX(15,I)
?
0
99
FCT
MIGN
Perform
Advection
&
Dispersion
Perform
Migration
Z=H*DERY(I)
AUX(7,I)=Z
Y(I)=AUX(1,I)+.21810038*AUX(5,I)-3.0509647*AUX(6,I)
+3.832865*Z
If
AUX(15,I)
?
0
99
FCT
MIGN
Perform
Advection
&
Dispersion
Perform
Migration
Y(I)=AUX(1,I)+.17476028*AUX(5,I)-.55148053*AUX(6,I)
+1.20553547*AUX(7,I)+.17118478*H*DERY(I)
EXIT

```
RKUT-PNC/LIB$  CREATE:02/01/73,11:27:43 FREQ:11 SIZE:1 BACKUP:02/02/73,05:21:35
 MEND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
1000          SUBROUTINE RKUTTA(H,Y,DERY,DECY,AUX,NDIM,SMATX,CC,CP,VI)
1010          DIMENSION Y(1),DERY(1),AUX(16,1),VI(1),DECY(25,25)
1020          DIMENSION SMATX(25,1),CC(25,1),CP(25,1)
1030    C THIS ROUTINE PERFORMS THE RUNGE KUTTA CALCULATIONS.
1040    C MIGN IS THE ROUTINE WHICH PERFORMS MIGRATION.
1050    C FCT IS THE ROUTINE WHICH PERFORMS ADVECTION AND DISPERSION.
1060          DO 7 I=1,NDIM
1070          AUX(1,I)=Y(I)
1080        7 AUX(8,I)=DERY(I)
1090        8 CONTINUE
1100    C RUNGE-KUTTA EQUATIONS FOLLOW
1110      100 DO 101 I=1,NDIM
1120          Z=H*AUX(8,I)
1130          AUX(5,I)=Z
1140          Y(I)=AUX(1,I)+.4*Z
1160      101 CONTINUE
1170    C     Z=X+.4*H
1180          IF(AUX(15,1).GT.98.)CALL MIGN(SMATX,CP,CC,NDIM,Y,DERY,DECY,VI)
1190          IF(AUX(15,1).EQ.0)CALL FCT(DECY,Y,DERY,NDIM,SMATX,CC,CP)
1200          DO 102 I=1,NDIM
1210          Z=H*DERY(I)
1220          AUX(6,I)=Z
1230          Y(I)=AUX(1,I)+.2969776*AUX(5,I)+.15875966*Z
1250      102 CONTINUE
1260    C
1270    C     Z=X+.45573726*H
1280          IF(AUX(15,1).GT.98.)CALL MIGN(SMATX,CP,CC,NDIM,Y,DERY,DECY,VI)
1290          IF(AUX(15,1).EQ.0)CALL FCT(DECY,Y,DERY,NDIM,SMATX,CC,CP)
1300          DO 103 I=1,NDIM
1310          Z=H*DERY(I)
1320          AUX(7,I)=Z
1330          Y(I)=AUX(1,I)+.21810038*AUX(5,I)-3.0509647*AUX(6,I)
1340         *     +3.832865*Z
1360      103 CONTINUE
1370    C     Z=X+H
1380          IF(AUX(15,1).EQ.0)CALL FCT(DECY,Y,DERY,NDIM,SMATX,CC,CP)
1390          IF(AUX(15,1).GT.98.)CALL MIGN(SMATX,CP,CC,NDIM,Y,DERY,DECY,VI)
1400          DO 104 I=1,NDIM
1410          Y(I)=AUX(1,I)+.17476028*AUX(5,I)-.55148053*AUX(6,I)
1420         *     +1.20553547*AUX(7,I)+.17118478*H*DERY(I)
1440      104 CONTINUE
1450      150 RETURN
1460          END
IQ
```

FCT:

Functional description:

FCT computes the change in concentration for each segment due to advection, dispersion, and decay.

Input:	calling sequence
DECY	decay matrix
Y	current concentration
DERY	change in concentration
NDIM	number of segments
SMAT	$E^{-1}A$
CC	temporary array
CP	temporary array

Equation:

$$\vec{y}' = E^{-1}A\,\vec{y} - Dy$$

Output:

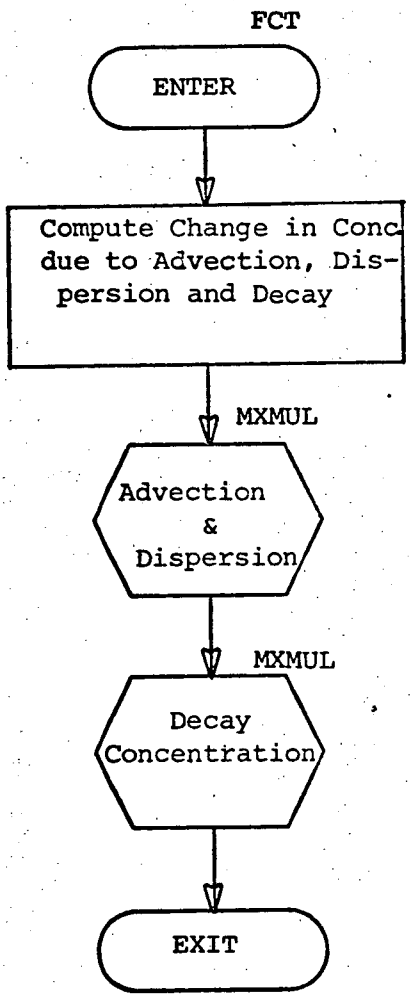
DERY - change in midpoint concentration for each segment.

Subroutines called:

MXMUL - matrix multiplication

Referenced by:

RKUTTA - Runge-Kutta subroutine


FCT
ENTER
Compute Change in Conc due to Advection, Dispersion and Decay
MXMUL
Advection & Dispersion
MXMUL
Decay Concentration
EXIT

```
FE-PNC/LIB$  CREATE:02/01/73,11:27:44 FREQ:11 SIZE:1 BACKUP:02/02/73,05:21:35
KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
1000          SUBROUTINE FCT(DECY,Y,DERY,NDIM,SMAT,CC,CP)
1010      C THIS ROUTINE COMPUTES THE CHANGE IN CONC., DERY, GIVEN THE CONC.,
1020      C ,Y, AND THE DECAY RATE, DECY, FOR EACH SEGMENT, RESPECTIVELY.
1030      C IT PERFORMS THE MATRIX FUNCTION OF ADVECTING, DISPERSING AND
1040      C DECAYING THE CONC. Y(1:NSEG) GIVEN THE CURRENT AGE GROUP
1050      C MIDPOINT CONC..
1060          DIMENSION Y(1),DERY(1),SMAT(25,1),CC(25,1),CP(25,1),DECY(25,25)
1070          DO 10 J=1,NDIM
1080       10 CC(J,1)=Y(J)
1090      C COMPUTE E INVERSE * A * Y(1:NSEG) GIVING CP(1:NSEG,1).
1100          CALL MXMUL(SMAT,CC,NDIM,1,CP)
1110          DO 20 J=1,NDIM
1111       20 DERY(J)=CP(J,1)
1120          CALL MXMUL(DECY,CC,NDIM,1,CP)
1125          DO 30 J=1,NDIM
1130       30 DERY(J)=DERY(J)-CP(J,1)
1140          RETURN
1150          END
IQ
```

MIGN:

Functional description:

MIGN computes the change in concentration of juvenile (I through III) organisms in each segment resulting from inter-segment migration and decay. Migratory direction is assumed to be downstream. If no migration occurs for a stage then the resulting output is the change in concentration due to decay.

Inputs:

.calling sequence

EINV - E^{-1}, this matrix is used to compute the change in the midpoint concentration

CP - computed migration direction

G - E^{-1} (CX), change in concentration due to migration based upon midpoint concentrations

NDIM - number of segments in the estuary

Y - current input juvenile concentration for each segment

DERY - computed change in concentration due to migration and decay or to just decay if no migration

DECY - the decay matrix coefficients

VI - volume given for each segment in the estuary.

.Named common block MWGHT

GG - migration preference for each segment

AL - fraction of total stage that the current age group (a subdivision of a stage) represents.

KAGE - Index which points to current age group within the juvenile stage being investigated.

MJUV - Indicator = ϕ no migration only decay

1 migration

Equations:

If GG is (-), then GG(J)*AL(J+1), migration is upstream.

CP = If GG is (o), then ϕ, no migration for this segment.

If GG is (+), then GG(J)*AL(J), migration is downstream.

CX (NDIM,1) = ϕ, no migration permitted outside of estuary (the Nth segment)

CX (1,1) = CP (1,1)/VI(1), no migration outside of segment 1 upstream boundary. Migration is assumed at downstream boundary as indicated by leading negative sense.

In general,

CX(J,1) = (CP(J-1, 1) - CP(J,1) /VI(J)

represents the change in concentrations based upon midpoint concentrations and decay.

DERY = E^{-1}[CX] - D[CX]

or

DERY = -D[Y] if no migration

Output:

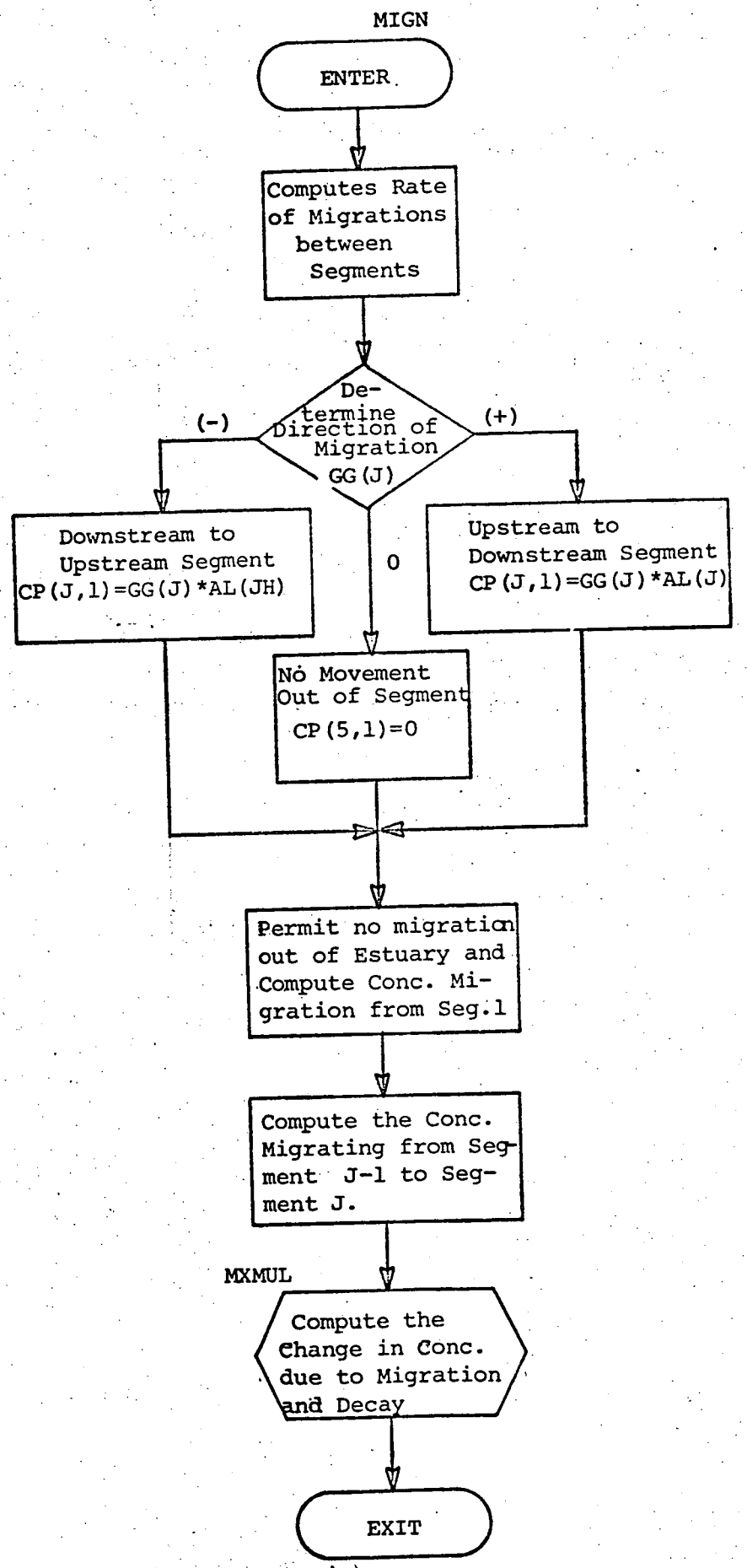
DERY - change in concentration due to decay and/or migrations

Subroutines called:

MXMUL - matrix multiply

Referenced by:

TMODEL - transport model


MIGN
ENTER
Computes Rate of Migrations between Segments
De-termine Direction of Migration GG(J)
(-)
(+)
0
Downstream to Upstream Segment CP(J,1)=GG(J)*AL(JH)
Upstream to Downstream Segment CP(J,1)=GG(J)*AL(J)
No Movement Out of Segment CP(5,1)=0
Permit no migration out of Estuary and Compute Conc. Mi-gration from Seg.1
Compute the Conc. Migrating from Seg-ment J-1 to Seg-ment J.
MXMUL
Compute the Change in Conc. due to Migration and Decay
EXIT

A3	upper diagonal of A-matrix
VI	volume for a given segment
DI	total number of all age groups in a segment
EP	$= l_{i+1}/(l_i+l_{i+1}) - L+1$
TOTNUM	total number organisms in estuary
MEGG	number of age groups
NSEG	number of segments
DTS	effective end time of observed migration
T	current time

Equations:

Concentration in segment j is computed as:

$$C_j = \sum_{i=1}^{MEGG} A_{ji}$$

where A_{ji} = age group i concentration.

Total numbers is computed via routine TNUM.

See equations in TNUM section. Let G_j equal total numbers in segment j.

Then:

$$GG_j = G_j/TOTNUM$$

is the fraction of organisms in segment j.

Note:

$$1 = \sum_{j=1}^{NSEG} GG_j$$

Let

$$Temp = \frac{TOTNUM}{DTS-T}, \text{ numbers per time}$$

then

$$M = [YJ-GG] * TEMP$$

indicates the direction these numbers will move. If a downstream movement is assumed then

$$GG(1) = - GG(1)$$

$$GG(NSEG) = o \quad \text{(no organisms leave).}$$

and

$$GG\ (J) = GG(J-1) - GG(J),\ J-2,\ldots,NSEG-1.$$

represents migration rate.

Output:

GG - migration rate (numbers/time)

Subroutines called:

TNUM - computes total number of organisms in estuary.

Referenced by:

TMODEL - transport model

WEIGHT:

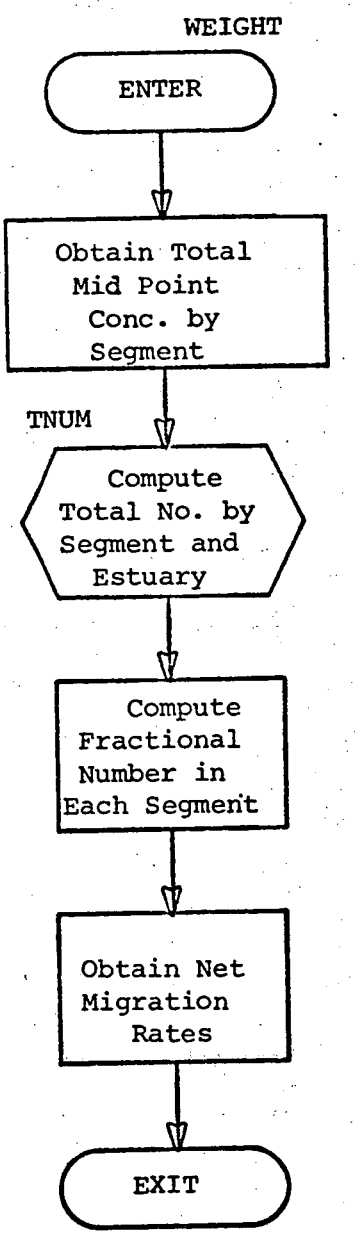
Functional description:

WEIGHT computes the total midpoint concentration for each segment. It uses this information to compute total numbers in each segment and in the estuary. Then it uses the fraction in each segment (current migration preference), obtained by dividing total numbers in a given segment by total numbers in the estuary; by comparing this computed fraction to the observed fraction (migration preference) computed from observed data to compute a migration rate.

Inputs:

.calling sequence

GG	(1) (current migration preference)	(2) - migration rate
CE	Concentrations in each segment (midpt.)	
YJ	Observed migration on preference	
MJ	indicates a juvenile stage (I-III).	
SUM	used to contain total midpoint conc/seg.	
G	total number in each segment	
A1	lower diagonal of A matrix	
A2	main diagonal of A matrix.	


WEIGHT
ENTER
Obtain Total Mid Point Conc. by Segment
TNUM
Compute Total No. by Segment and Estuary
Compute Fractional Number in Each Segment
Obtain Net Migration Rates
EXIT

MIGN1-REL/LIB$ CREATE:02/01/73,11:28:01 FREQ:63 SIZE:1 BACKUP:02/02/73,
05:21:27 KIND:DISK LIFE:PERM ACCESS:REPL

```
IL
 1000          SUBROUTINE MIGN(EINV,CP,G,NDIM,Y,DERY,DECY,VI)
 1010      C THIS ROUTINE COMPUTES THE RATE OF MIGRATION BETWEEN SEGMENTS
 1020      C BASED UPON THE USE OF EMPIRICAL DATA WHICH PRESUMES WHERE THE ST
 1030      C WILL BE LOCATED AT A GIVEN TIME
 1040          DIMENSION DECY(25,25),EINV(25,25),CP(25,1),G(25,1),Y(1),DERY
 1045          DIMENSION CX(25,1),VI(1),CN(25,1)
 1050          COMMON/MWGHT/GG(25),AL(25),KAGE,MJUV
 1052          IF(MJUV.EQ.0)GO TO 200
 1060          MSEG=NDIM-1
 1100          DO 120 J=1,MSEG
 1105          IF(GG(J))100,105,110
 1110      100 CP(J,1)=GG(J)*AL(J+1)
 1115          GO TO 120
 1120      105 CP(J,1)=0.
 1125          GO TO 120
 1130      110 CP(J,1)=GG(J)*AL(J)
 1140      120 CONTINUE
 1142          CP(NDIM,1)=0.
 1145          CX(NDIM,1)=CP(NDIM,1)/VI(NDIM)
 1170          CX(1,1)=-CP(1,1)/VI(1)
 1180          DO 30 J=2,NDIM
 1190          CX(J,1)=(CP(J-1,1)-CP(J,1))/VI(J)
 1200       30 CONTINUE
 1210          CALL MXMUL(EINV,CX,NDIM,1,G)
 1220      C COMPUTE THE DERIVATIVE OR CHANGE IN CONC. AS A RESULT OF MIGRATI
 1230      C AND DECAY.                                  DO 35 J=1,NDIM
 1235          CALL MXMUL(DECY,CX,NDIM,1,CN)             35 CX(J,1) = Y(J)
 1240          DO 40 J=1,NDIM
 1250       40 DERY(J)=G(J,1)-CN(J,1)                                  RAN
 1260          RETURN                                                  TE
 1261      200 DO 210 J=1,NDIM
 1262      210 CX(J,1)=Y(J)
 1263          CALL MXMUL(DECY,CX,NDIM,1,CN)
 1264          DO 220 J=1,NDIM
 1265      220 DERY(J)=-CN(J,1)
 1266          RETURN
 1270          END
 10
```

WGHT1-PNC/LIB$ CREATE:02/01/73,11:27:27 FREQ:11 SIZE:1 BACKUP:02/02/73,
05:22:03 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE

```
L
1000          SUBROUTINE WEIGHT(GG,CE,YJ,MJ,SUM,G,A1,A2,A3,VI,DI,EP,
1010         *TOTNUM,MEGG,NSEG,DTS,T)
1020      C ROUTINE COMPUTES TOTAL MIGRATION RATE (ORGANISMS/DAY)INTO
1030      C SEGMENTS GG(1:NSEG).
1040      C ALSO COMPUTES TOTAL CONC. AT EACH BOUNDARY FOR ALL SEGMENTS
1050      C DI(1:NSEG).
1060          DIMENSION GG(1),CE(25,1),YJ(25,1),G(25,1),A1(1),A2(1),A3(1)
1070          DIMENSION  VI(1),DI(1),EP(1),SUM(25,1)
1080      C OBTAIN TOTAL MIDPOINT CONC. BY SEGMENT CP(1:NSEG,1)
1090          DO 10 J=1,NSEG
1100          SUM(J,1)=0.
1110          DO 10 K=1,MEGG
1120       10 SUM(J,1)=SUM(J,1)+CE(J,K)
1130      C OBTAIN TOTAL NO. OF ORGANISMS IN EACH SEGMENT G(1:NSEG)
1140      C AND THE TOTAL NUMBER FOR THE ESTUARY TOTNUM.
1150          CALL TNUM(G,SUM,1,A1,A2,A3,VI,TOTNUM,NSEG)
1160      C OBTAIN CURRENT FRACT. PER CENT OF NO. OF ORGANISMS TO TOTAL
1170      C NOS. IN THE ESTUARY.
1180          DO 20 J=1,NSEG
1190       20 GG(J)=G(J,1)/TOTNUM
1200      C OBTAIN NET MIGRATION INTO SEGMENTS IN GG(1:NSEG).
1210          TEMP=TOTNUM/(DTS-T)
1220          DO 30 J=1,NSEG
1230       30 GG(J)=(YJ(J,MJ)-GG(J))*TEMP
1240      C COMPUTE TOTAL AGE GROUP CONC. AT EACH BOUNDARY WITH APPROPRIATE
1250      C WEIGHTS FOR EACH AGE GROUP CONC.
1260      C DI(I) IS FROM SEGMENT I TO I+1.
1261          MSEG=NSEG-1
1262          GG(1)=-GG(1)
1263          DO 100 J=2,MSEG
1264      100 GG(J)=GG(J-1)-GG(J)
1265          GG(NSEG)=0.
1280          DO 40 J=1,NSEG
1320       40 DI(J)=G(J,1)
1321      C
1322      C     DI(J) IS TOTAL NO. ALL AGE GROUPS IN SEG. J
1323      C
1330          RETURN
1340          END
IQ
```

PATCH1:

Functional description:

PATCH1 computes the total number of organisms in each segment prior to the initiation of a new time step. It then treats each segment as closed tank and subjects the total numbers contained to their respective decay rates and entrainment rates if pertinent for one time step. The total numbers in each segment are then summed to yield the expected total numbers in the estuary. This estuary total is used to correct per step errors introduced via the numerical technique.

Inputs:

.Calling sequence

G	Total number of organisms in each segment
CE	Concentration in each segment by age group
K	Current age group
A1	Lower diagonal of A matrix
A2	Main diagonal of A matrix
A3	Upper diagonal of A matrix
VI	Volume for each segment of the estuary.

TOTAL - Total number of organisms for age group for estuary.

NSEG - Number of segments the estuary is subdivided into.

STEP - Time step (days) (Δt)

DECY - Decay matrix (k_E)

GQP - $f_E Q_p/V$

Equations:

$$Ni_n = Ni_o \, e^{-(k_e + \frac{f_e Q_p/V}{V} \Delta t}$$

yields the new total number in each segment at the end of one time step, Δt. The new total numbers

$$T = \sum_{i=1}^{NSEG} Ni_n$$

Output:

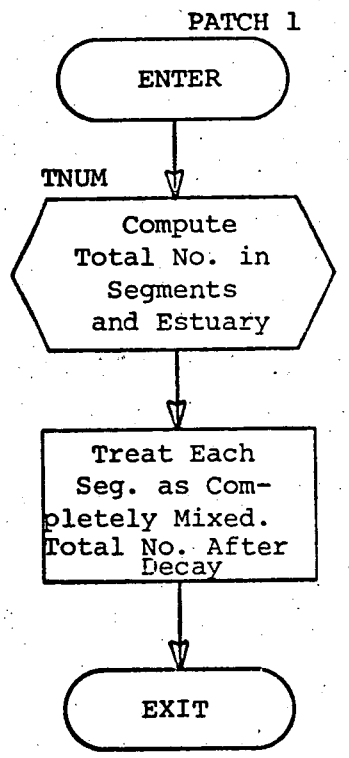
Total Numbers - TOTNUM

Subroutines called:

TNUM - computes total numbers

Referenced by:

TMODEL - transport model.


PATCH 1
ENTER
TNUM
Compute Total No. in Segments and Estuary
Treat Each Seg. as Completely Mixed. Total No. After Decay
EXIT

```
PATCH1-PNC/LIB$  CREATE:02/01/73,11:27:51 FREQ:11 SIZE:1 BACKUP:02/02/73,
05:21:31 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
   10          SUBROUTINE PATCH1(G,CE,K,A1,A2,A3,VI,TOTAL,NSEG,ISW,
   15         *STEP,DECY,GQP)
   20          DIMENSION G(25,1),CE(25,1),A1(1),A2(1),A3(1),VI(1),YZ(25)
   25          DIMENSION DECY(25,25),GQP(25)
   30          CALL TNUM(G,CE,K,A1,A2,A3,VI,TOTAL,NSEG)
   40          TOTAL=0.
   50          DO 10 JJ=1,NSEG
   60          XX=(DECY(JJ,JJ)-GQP(JJ))/A2(JJ)+GQP(JJ)
   80          YZ(JJ)=G(JJ,1)*EXP(-XX*STEP)
   90       10 TOTAL=TOTAL+YZ(JJ)
  100          RETURN
  110          END
IQ
```

PATCH 2:

Functional description:

PATCH 2 corrects the error introduced by the numerical technique resulting at the end of one time step. To do this, PATCH 2 uses the distribution acquired from the numerical technique and the total number in the estuary computed for 1 time step in the routine PATCH 1. It redistributes this total number from PATCH 1 according to the distribution obtained from the Runge-Kutter numerical technique.

Input:

.Calling sequence:

G	computed total number/segment from RKUTTA
CE	current conc./seg/age group
LL	current age group
A1	lower diagonal of A matrix
A2	main diagonal of A matrix
A3	upper diagonal of A matrix
VT	volume for each segment
TOTAL1	total number obtained from RKUTTA
TOTAL	total number obtained from PATCH 1
NSEG	number of segments

EINV - E^{-1}, refer to analysis section

CP - temporary array

TNUMBR - total number computed as a result of redistribution

Equations: Procedure

1. Let

$$f - \frac{G\ (J,1)}{TOTAL1}$$

2. TN(J) = f x TOTAL

3. G(J,1) = TN(J)/VI(S)

4. J = NSEG; DO STEPS

   ELSE SET J = J + 1 AND GO TO 1

5. REcompute new midpoint conc/segment.

6. exit.

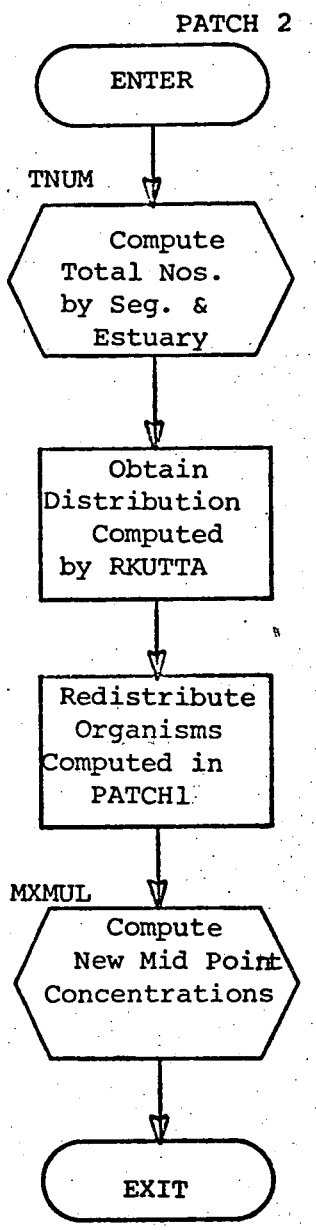
Subroutines called:

TNUM - computes total numbers

MXMUL - performs matrix multiply

Referenced by:

TMODEL - transport model.


PATCH 2
ENTER
TNUM
Compute Total Nos. by Seg. & Estuary
Obtain Distribution Computed by RKUTTA
Redistribute Organisms Computed in PATCH1
MXMUL
Compute New Mid Point Concentrations
EXIT

```
TCH2-PNC/LIB$  CREATE:02/01/73,11:27:54 FREQ:11  SIZE:1 BACKUP:02/02/73,
  :29 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE ON:SPN
      SUBROUTINE PATCH2(G,CE,LL,A1,A2,A3,VI,TOTAL1,TOTAL,NSEG,
     *EINV,CP,TNUMBR)
      DIMENSION G(25,1),CE(25,1),A1(1),A2(1),A3(1),VI(1)
      DIMENSION CP(25,1),EINV(25,25),TNUMBR(25)
      CALL TNUM(G,CE,LL,A1,A2,A3,VI,TOTAL1,NSEG)
      IF(TOTAL1.NE.0.)GO TO 9
      DO 3 J=1,NSEG
    3 CP(J,1)=0.
      GO TO 19
    9 DO 10 JJ=1,NSEG
      FRAC=G(JJ,1)/TOTAL1
      TNUMBR(JJ)=FRAC*TOTAL
   10 G(JJ,1)=TNUMBR(JJ)/VI(JJ)
C......FIND NEW MID POINT CONC.
      CALL MXMUL(EINV,G,NSEG,1,CP)
   19 DO 20 JJ=1,NSEG
   20 CE(JJ,LL)=CP(JJ,1)
      RETURN
      END
IQ
```

TNUM:

Functional description:

TNUM performs the computation of the total number of organisms (of the same ilk) within a segment. This computation is based upon knowing the concentration of organisms at the boundaries and the exchange coefficient between adjacent segments with the volume of the segment under consideration.

Inputs:

.Calling sequence

G	output array, total number for segment
ZZ	concentration/segment/age group
IK	age group
A1	lower diagonal of A matrix
A2	main diagonal of A matrix
A3	upper diagonal of A matrix
VI	volume for segment
TOT1	total number organisms in estuary
NSEG	number of segments the estuary is divided into.

Equations:

Total numbers in segment 1 and N are:

$$T_{1,IK} = V_1 \ (A2_1 \cdot C_{1,IK} + A3_1 \cdot C_{2,IK})$$

$$T_{N,IK} = V_N \ (A1_N \cdot C_{N-1,IK} + A2_N \cdot C_{N,IK})$$

V = volume; C = concentration, A1, A2, A3 defined, where first subscript is segment and second is age group. Total number in segment j where j = 1, N is given by:

$$T_{j,IK} = V_j \ (A1_j \cdot C_{j-1,IK} + A2_j C_{j,IK} + A3_j C_{j+1,IK})$$

The total number in estuary is

$$T_{IK} = \sum_{j=1}^{N} T_{j,IK}$$

for IK^{th} age group.

Outputs: G(1:NSEG), TOT1.

Subroutines called: None

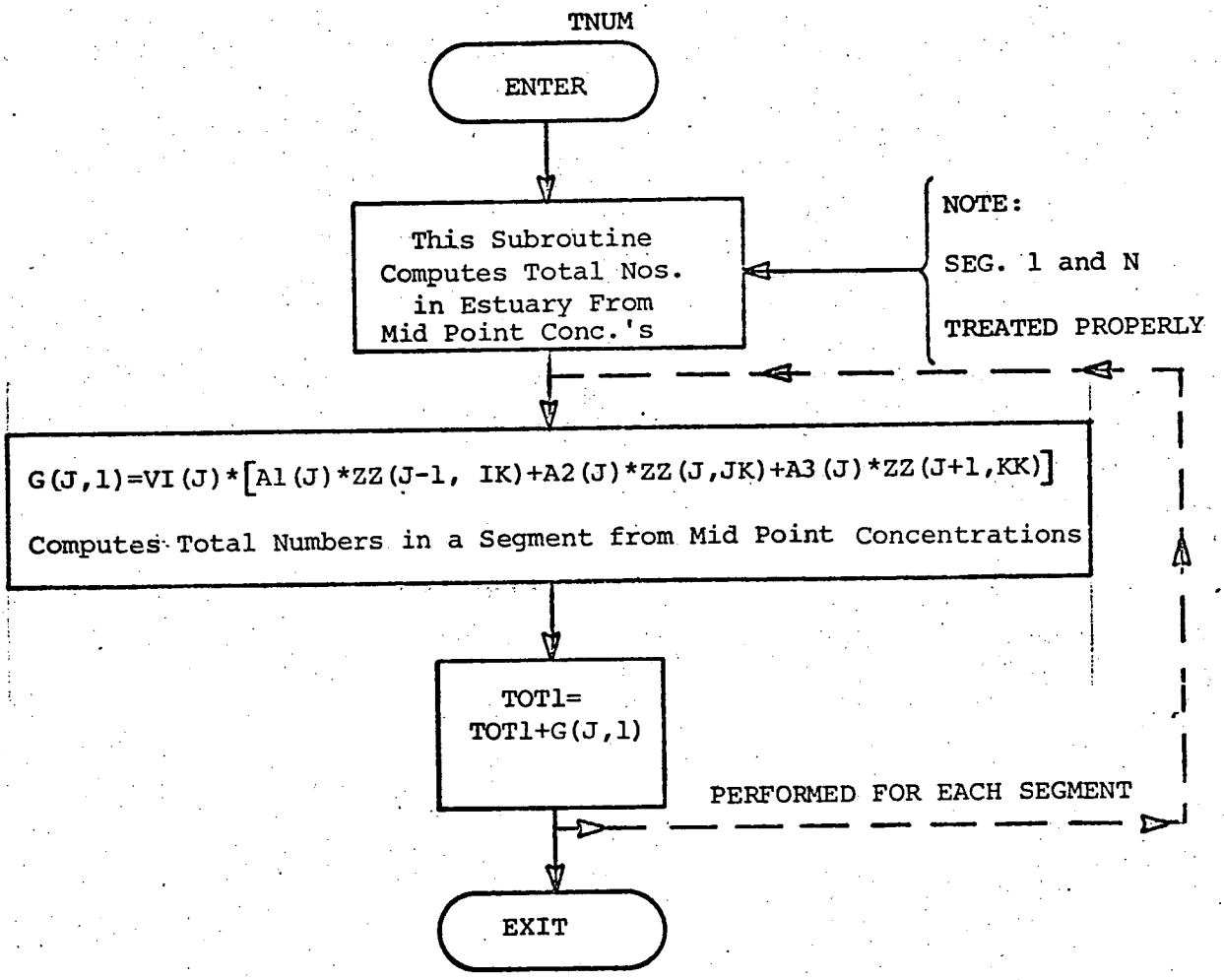
Referenced by:

TMODEL

WEIGHT

PATCH1

PATCH2


TNUM
ENTER
This Subroutine Computes Total Nos. in Estuary From Mid Point Conc.'s
NOTE:
SEG. 1 and N
TREATED PROPERLY
G(J,1)=VI(J)*[A1(J)*ZZ(J-1, IK)+A2(J)*ZZ(J,JK)+A3(J)*ZZ(J+1,KK)]
Computes Total Numbers in a Segment from Mid Point Concentrations
TOT1=
TOT1+G(J,1)
PERFORMED FOR EACH SEGMENT
EXIT

```
TNUM-PNC/LIB$  CREATE:02/01/73,12:10:38 FREQ:11 SIZE:1 BACKUP:02/02/73,05:21:3
 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
1000            SUBROUTINE TNUM(G,ZZ,IK,A1,A2,A3,VI,TOT1,NSEG)
1010      C
1020      C WHEN G IS RETURNED TO THE CALLING ROUTINE IT WILL CONTAIN
1030      C TOTAL NOS. IN EACH SEGMENT BASED ON THE AVERAGE CONCENTRATION
1040      C IN EACH SEGMENT (COMPUTED FROM THE MIDPOINT CONCENTRATIONS
1050      C IN ADJACENT SEGMENTS). VI(1:NSEG) IS THE VOLUME (CU. MI.)
1060      C PER SEGMENT, ZZ(1:NSEG) IS THE MIDPOINT CONC. FOR THE
1070      C IK TH AGE GROUP IN EACH SEGMENT.
1080      C A1,A2,A3 ARE THE ELEMENTS OF THE E MATRIX WHICH WERE
1090      C COMPUTED IN THE MAIN PROGRAM, TOT1 IS THE TOTAL NUMBER OF ORGANIS
1100      C IN EACH SEGMENT.
1110      C
1120            DIMENSION G(25,1),ZZ(25,1),A1(1),A2(1),A3(1),VI(1)
1130            G(1,1)=VI(1)*(A2(1)*ZZ(1,IK)+A3(1)*ZZ(2,IK))
1140            TOT1=G(1,1)
1150            MSEG=NSEG-1
1160            DO 479 J=2,MSEG
1170            G(J,1)=VI(J)*(A1(J)*ZZ(J-1,IK)+A2(J)*ZZ(J,IK)+A3(J)*ZZ(J+1,IK
1180        479 TOT1=TOT1+G(J,1)
1190            G(NSEG,1)=VI(NSEG)*(A1(NSEG)*ZZ(NSEG-1,IK)+A2(NSEG)*ZZ(NSEG,I
1200            TOT1=TOT1+G(NSEG,1)
1210            RETURN
1220            END
IQ
```

DECAY:

Functional description:

DECAY computes the general compensatory decay rate for each segment and outputs a Matrix of coefficients called DECY which relates decay of organisms in adjacent segments based upon midpoint concentrations. This is performed on a per time step basis. The routine permits per step random compensatory decay rates.

Inputs:

EI	first order decay rate
SO	minimum decay rate
FE	current conc.
TC	carrying capacity conc. of a segment
DECY	decay matrix to be computed
VI	volume of a segment
NSEG	number of segments
A1	lower diagonal of A matrix
A2	main diagonal of A matrix
A3	upper diagonal of A matrix
GQP	fQ_p/V

.Named Common RANDV is required

Equations:

$$K'_E = K_E + (K_E - K_O) \cdot \left(\frac{N - N_s}{N_s}\right)^3$$

$$D_{j,j} = K'_{E,j}\, A2_j + \left(\frac{f\, Q_p}{V}\right)_j \qquad j = 1,\ldots,NSEG$$

$$D_{j,j+1} = K'_{E,j}\, A_{3j} \qquad j = 1,\ldots,NSEG-1$$

$$D_{j,j-1} = K'_{E,j}\, A1_j \qquad j = 2,\ldots,NSEG$$

$$D = (D_{ij})$$

Outputs: DECY matrix

Subroutines called: RANDN

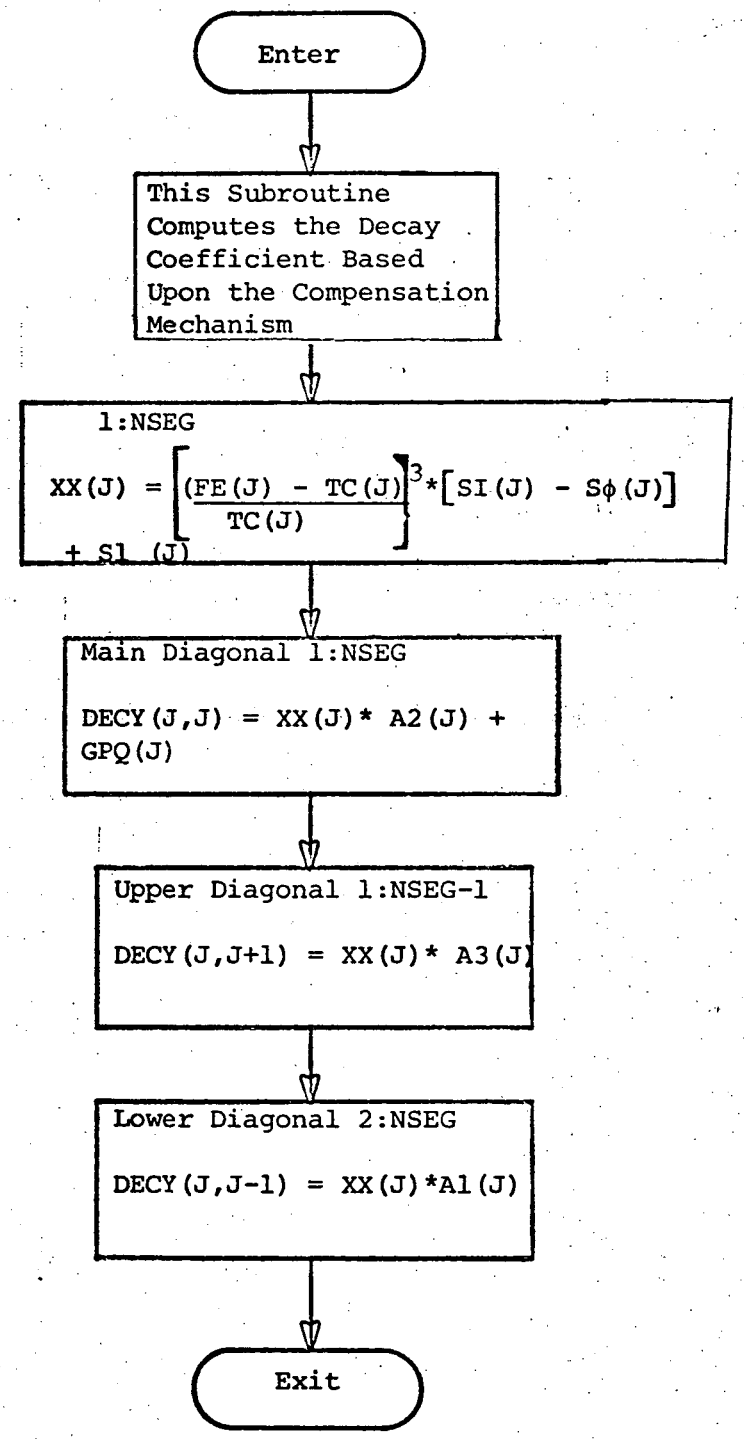
Referenced by:

TMODEL

MIGN

FCT

DECAY


Enter
This Subroutine Computes the Decay Coefficient Based Upon the Compensation Mechanism
1:NSEG
XX(J) = [(FE(J) - TC(J)) / TC(J)]^3 * [SI(J) - Sϕ(J)] + S1 (J)
Main Diagonal 1:NSEG
DECY(J,J) = XX(J)* A2(J) + GPQ(J)
Upper Diagonal 1:NSEG-1
DECY(J,J+1) = XX(J)* A3(J)
Lower Diagonal 2:NSEG
DECY(J,J-1) = XX(J)*A1(J)
Exit

```
DCY-PNC/LIB$  CREATE:02/02/73,08:36:55 FREQ:11 SIZE:1 BACKUP:02/03/73,05:27:56
 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE ON:SPN
IL
 100          SUBROUTINE DECAY(E1,SO,FE,TC,DECY,VI,NSEG,A1,A2,A3,GQP)
 105          COMMON/RANDV/IRAN,DYY(25),SDYY(25)
 110          DIMENSION E1(1),SO(1),S1(25),XX(25)
 140          DIMENSION FE(1),DECY(25,1),VI(1),TC(1),GQP(1)
 160          DIMENSION A1(1),A2(1),A3(1)
 300          MSEG=NSEG-1
 301    C IF IRAN=0, NO RANDOMIZATION
 302          IF(IRAN.EQ.0)GO TO 100
 303          DO 50 J=1,NSEG
 304          XMEAN=DYY(J)
 305          STDEV=SDYY(J)
 306          CALL RANDN(X,XMEAN,STDEV)
 307          S1(J)=X
 308       50 CONTINUE
 309          GO TO 200
 310      100 DO 75 J=1,NSEG
 320       75 S1(J)=E1(J)
 321      200 CONTINUE
 322          DO 3 J=1,NSEG
 323          XX(J)=0.0
 324          AA1=TC(J)
 325          AA2=FE(J)
 326          IF(AA1.EQ.0.)GO TO 3
 327          AA3=(AA2-AA1)/AA1
 328          AA3=AA3*AA3*AA3
 329          XX(J)=AA3
 330        3 CONTINUE
 331    C.....MAIN DIAGNOL
 340    C
 400          DO 5 J=1,NSEG
 410        5 DECY(J,J)=(S1(J)+(S1(J)-SO(J))*XX(J))*A2(J)
 420         *+GQP(J)
 450    C
 460    C     UPPER DIAGONAL
 470    C
 500          DO 10 J=1,MSEG
 510       10 DECY(J,J+1)=(S1(J)+(S1(J)-SO(J))*XX(J))*A3(J)
 580    C
 590    C     LOWER DIAGONAL
 600    C
 620          DO 15 J=2,NSEG
 650       15 DECY(J,J-1)=(S1(J)+(S1(J)-SO(J))*XX(J))*A1(J)
 800          RETURN
 900          END
IQ
```

COMPUT:

Functional description:

COMPUT determines the number of larval organisms that are in a specific age category i.e. 10-21 days old, 4-10 days old, etc.

Inputs:

T	current time (days)
LL	number of age groups for larval stage
CE	concentration of larvae/segment/age group
NSEG	number of segments
VI	volume of a segment
A1	lower diagonal of A matrix
A2	main diagonal of A matrix
A3	upper diagonal of A matrix
G	total number of larval organisms/seg.
I1	starting age group of first batch
I2	starting age group of second batch
I3	ending age group
STAGE	time step used
CONSTI	conversion from TCF to cu. miles
CONST2	total estuary volume in cu. miles

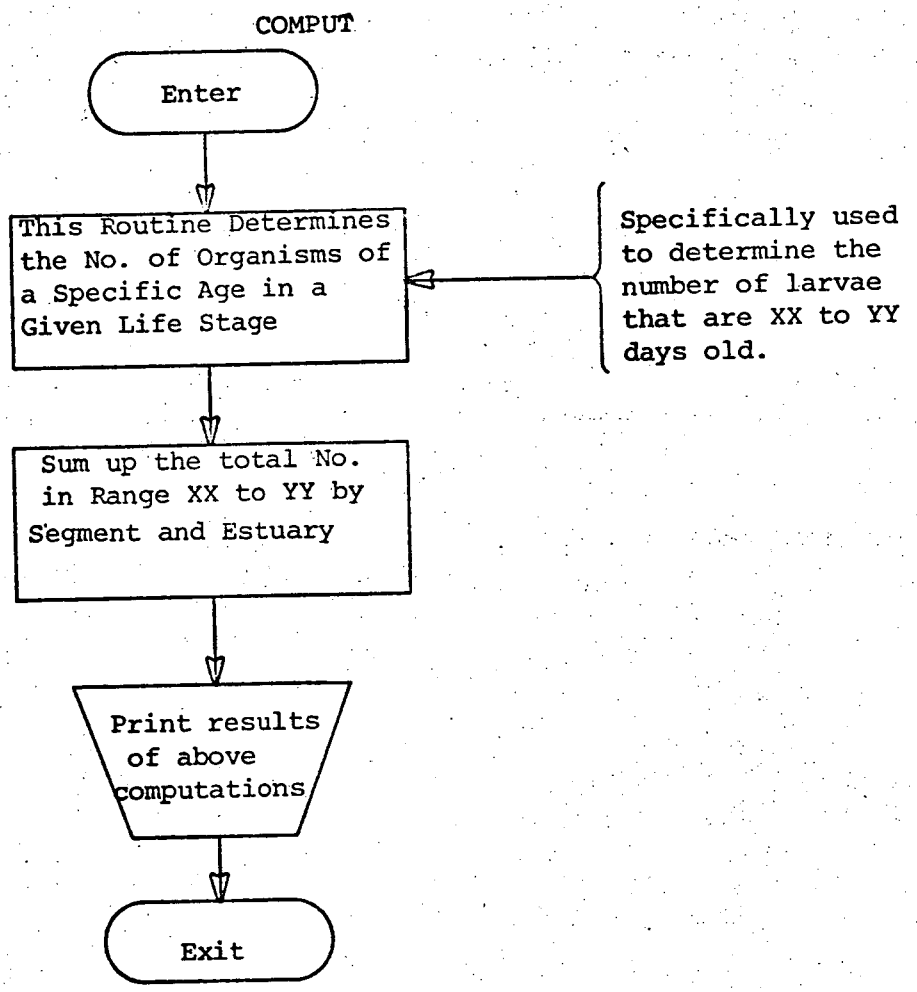
Equations: None

Subroutines called:

TNUM

Referenced by:

TMODEL


COMPUT
Enter
This Routine Determines the No. of Organisms of a Specific Age in a Given Life Stage
Specifically used to determine the number of larvae that are XX to YY days old.
Sum up the total No. in Range XX to YY by Segment and Estuary
Print results of above computations
Exit

```
COMPUT-PNC/LIB$  CREATE:02/01/73,11:27:40 FREQ:11 SIZE:1 BACKUP:02/02/73,
05:21:37 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
100          SUBROUTINE COMPUT(T,LL,CE,NSEG,VI,A1,A2,A3,G,I1,I2,I3,STAGE,
110         *CONST1,CONST2)
120          DIMENSION CE(25,1),VI(1),G(25,1),A1(1),A2(1),A3(1)
130          DIMENSION A(25),B(25,1),EE(25)
140          IF(LL.LT.I1)GO TO 70
150          IS=I1
160        5 IAGE=FLOAT(IS)*STAGE + .0001
165          IEN=FLOAT(I3)*STAGE+.0001
170          WRITE(6,10)T,IAGE,IEN
180       10 FORMAT(//' ###TIME---',F8.2,5H AGE ,I3,' - ',I3,' DAYS OLD')
190          S1N=0.
200          S1C=0.
210          DO 20 J=1,NSEG
220       20 B(J,1)=0.
230          DO 30 J=1,NSEG
240          DO 30 K=IS,I3
250       30 B(J,1)=B(J,1)+CE(J,K)
260          CALL TNUM(G,B,1,A1,A2,A3,VI,S1N,NSEG)
270          DO 40 J=1,NSEG
280          A(J)=G(J,1)*CONST1/VI(J)
285          EE(J)=G(J,1)
290       40 CONTINUE
295          S1C=S1N*CONST1/CONST2
300          WRITE(6,50)S1N,(EE(J),J=1,NSEG)
310       50 FORMAT(' #TOTAL NO.(LARV)=',F15.0,8(1X,F10.0))
320          WRITE(6,60)S1C,(A(J),J=1,NSEG)
330       60 FORMAT(' #TOTAL CONC.(LARV)=',9(1X,F8.5))
340          IF(IS.EQ.I2)GO TO 70
345          IF(LL.LT.I2)GO TO 70
350          IS=I2
360          GO TO 5
370       70 RETURN
380          END
IQ
```

Output:

Functional description:

Display key input parameters on computer printout as specified on the flow chart.

Inputs: See named common in INPUT.

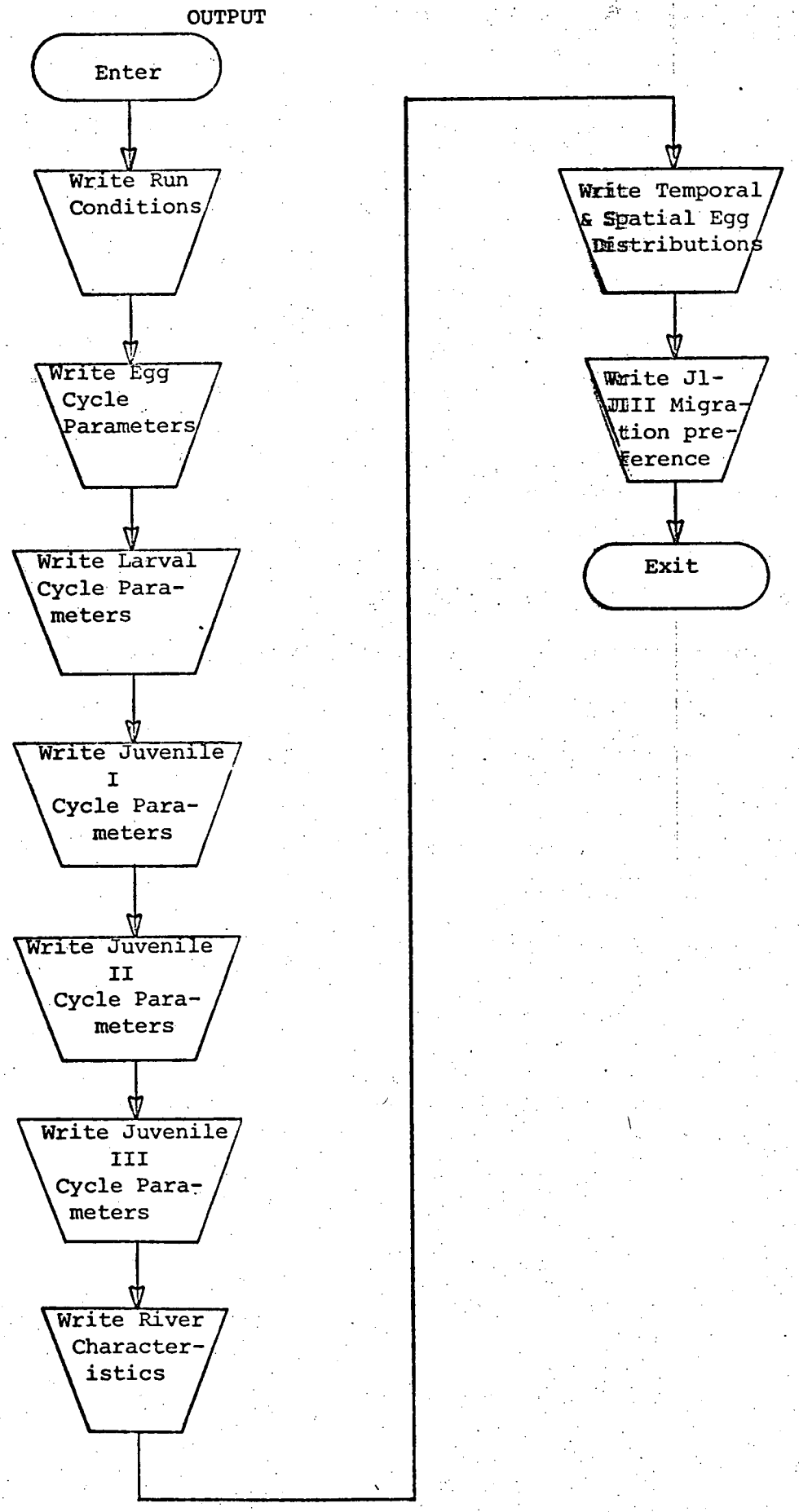
Equations: none

Output: See flow chart.

Subroutines called: none

Referenced by:

TMODEL only if IOPT = 1.


OUTPUT
Enter
Write Run Conditions
Write Egg Cycle Parameters
Write Larval Cycle Parameters
Write Juvenile I Cycle Parameters
Write Juvenile II Cycle Parameters
Write Juvenile III Cycle Parameters
Write River Characteristics
Write Temporal & Spatial Egg Distributions
Write J1-JIII Migration preference
Exit

```
OUTPUT-PNC/LIB$  CREATE:02/01/73,11:27:34 FREQ:11 SIZE:4 BACKUP:02/02/73,
05:21:40 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
 1000          SUBROUTINE OUTPUT
 1010          INTEGER PIMPE,PNEGG1,PCEGG1,PNEGG2,PCEGG2,PLPROD,PLPTB1,PLPT
 1020          INTEGER PIMPL,PNLAR1,PCLAR1,PNLAR2,PCLAR2,PJ1PRO,PJ1PT1,PJ1P
 1030          INTEGER PIMPJ1,PNJ11,PCJ11,PNJ12,PCJ12,PJ2PRO,PJ2PT1,PJ2PT2
 1040          INTEGER PIMPJ2,PNJ21,PCJ21,PNJ22,PCJ22,PJ3PTN,PJ3PTC
 1050          INTEGER PEENT,PNEEN,PLENT,PNLEN,PJIENT,PNJ1EN
 1060          INTEGER PJ2IMP,PNJ2IM,PJ3IMP,PNJ3IM
 1065          INTEGER PNJ32,PCJ32,PA1PTN,PA1PTC,CONENT,CONIMP
 1070          COMMON/MLIFE/SVE(25),SVO(25),FVE(25),TCE(25),SVL(25),SVLO(25
 1075         1FVL(25),TCL(25),SVJ1(25),SVJ1O(25),FVJ1(25),TCJ1(25),SVJ2(25
 1080         2SVJ2O(25),FVJ2(25),TCJ2(25),SVJ3(25),SVJ3O(25),FVJ3(25),TCJ3
 1085         3NEGG,AEP,DTE,DTL,DTJ1,DTJ2,DTJ3,DTA,TE,WI(25,10),TP(10),PP(1
 1090         4DT,ICP,IEND,SVA(20),FEC(20),FRAT(20),FMAT(20),SVAO(20),IFACT
 1091         5,TJ33,TSPW
 1095          COMMON/PLANT/LYR,LPYR(25),GP(25),*PLANT(25),KKSW,IOPT
 1120          COMMON/MCHAR/NSEG,NCHANG,VI(25),AX(25),SLEN(25),
 1130         *QI(25,10),EP(26),EI(25,10),TQE(10),OI(25)
 1140          COMMON/MIGRT/TMIG(10,3),NCJ1,NCJ2,NCJ3,YJ1(25,10),YJ2(25,10)
 1142         1YJ3(25,10)
 1144          COMMON/COMPRT/NCOMR,IAGE(10),IEAGE(10)
 1150          COMMON/INITAL/LEGG,LCHA,T,KNOW,JEGG,JLARV,JJ1,JJ2,JJ3,
 1160         *LPIX,NLPIX,IDAY,IFINAL,PRMT(5),AUX(16,25),TEMPER(26,55),NTEM
 1170         *T1967P,TCUT(25)
 1180          COMMON/IDSTEP/IDTE,IDTL,IDTJ1,IDTJ2,IDTJ3,IYR
 1190          COMMON/EGIND/NESP,PIMPE,PNEGG1,PNEGG2,PLPROD,PLPTB1,
 1200         *PLPTB2,PCEGG1,PCEGG2,PEAVG
 1210          COMMON/LVIND/NLSP,PIMPL,PNLAR1,PNLAR2,PJ1PRO,PJ1PT1,PJ1PT2,
 1220         *PCLAR1,PCLAR2,PLAVG
 1230          COMMON/J1IND/NJ1SP,PIMPJ1,PNJ11,PNJ12,PCJ11,PCJ12,
 1240         *PJ2PRO,PJ2PT1,PJ2PT2,MJUV1,PJ1AVG
 1250          COMMON/J2IND/NJ2SP,PIMPJ2,PNJ21,PNJ22,PCJ21,PCJ22,
 1260         *PJ3PTN,PJ3PTC,MJUV2,PJ2AVG
 1270          COMMON/J3IND/NJ3SP,PNJ32,PCJ32,PA1PTN,PA1PTC,MJUV3
 1280          COMMON/EIMP/CONENT,CONIMP,PEENT,PNEEN,PLENT,PNLEN,
 1290         *PJ1ENT,PNJ1EN,PJ2IMP,PNJ2IM,PJ3IMP,PNJ3IM
 1300          COMMON/TIMSTP/SL,SJ1,SJ2,SJ3
 2000          WRITE(6,5)
 2010          WRITE(6,10)LYR,NSEG,IEND,NCHANG,NEGG,ICP,NCOMR,KKSW,NCJ1,NCJ
 2020          WRITE(6,15)
 2030          WRITE(6,20)DTE,DT
 2040          WRITE(6,70)
 2050          DO 500 J=1,NSEG
 2060      500 WRITE(6,80)J,SVE(J),SVO(J),FVE(J),TCE(J)
 2070          WRITE(6,15)
 2080          WRITE(6,30)DTL,SL
 2090          WRITE(6,70)
 2100          DO 510 J=1,NSEG
 2110      510 WRITE(6,80)J,SVL(J),SVLO(J),FVL(J),TCL(J)
 2120          WRITE(6,15)
 2130          WRITE(6,40)DTJ1,SJ1
 2140          WRITE(6,70)
```

```
      DO 520 J=1,NSEG
  520 WRITE(6,80)J,SVJ1(J),SVJ1D(J),FVJ1(J),TCJ1(J)
      WRITE(6,15)
      WRITE(6,50)DTJ2,SJ2
      WRITE(6,70)
      DO 530 J=1,NSEG
  530 WRITE(6,80)J,SVJ2(J),SVJ2D(J),FVJ2(J),TCJ2(J)
      WRITE(6,15)
      WRITE(6,60)DTJ3,SJ3
      WRITE(6,70)
      DO 540 J=1,NSEG
  540 WRITE(6,80)J,SVJ3(J),SVJ3D(J),FVJ3(J),TCJ3(J)
      DO 550 J=1,NCHANG
      WRITE(6,15)
      WRITE(6,90)
      WRITE(6,110)TQE(J)
      WRITE(6,100)
      DO 545 K=1,NSEG
      WRITE(6,120)K,QI(K,J),EI(K,J),AX(K),QP(K),VI(K),SLEN(K),LPYR
  545 CONTINUE
  550 CONTINUE
      WRITE(6,15)
      WRITE(6,130)
      DO 560 J=1,NEGG
      WRITE(6,140)TP(J),PP(J)
      WRITE(6,150)
      WRITE(6,160)(L,WI(L,J),L=1,NSEG)
  560 CONTINUE
      WRITE(6,15)
      WRITE(6,170)
      DO 570 KK=1,3
      IF(KK.EQ.1)MM=NCJ1
      IF(KK.EQ.2)MM=NCJ2
      IF(KK.EQ.3)MM=NCJ3
      DO 580 J=1,MM
      WRITE(6,180)KK,TMIG(J,KK)
      WRITE(6,150)
      IF(KK-2)572,574,576
  572 WRITE(6,160)(L,YJ1(L,J),L=1,NSEG)
      GO TO 580
  574 WRITE(6,160)(L,YJ2(L,J),L=1,NSEG)
      GO TO 580
  576 WRITE(6,160)(L,YJ3(L,J),L=1,NSEG)
  580 CONTINUE
  570 CONTINUE
      WRITE(6,15)
      RETURN
    5 FORMAT(1H1,41X,'TABLE OF INPUT PARAMETERS'///)
   10 FORMAT(1X,'SIMULATION ',I3,' YEARS'/
     11X,'NUMBER OF SEGMENTS ',I3/
     21X,'NUMBER OF ADULTS   ',I3/
     31X,'NUMBER OF FLOW AND DISPERSION CHANGES ',I3/
     41X,'NUMBER OF TEMPORAL EGG RATE WEIGHTS ',I3/
     51X,'COMPENSATION IN ADULTS ',I3/
```

```
2640          61X,'INTERMEDIARY LARVAL PRINTOUTS ',I3/
2650          71X,'TEMPERATURE PROFILE (2=NO,ELSE YES) ',I3/
2660          81X,'NUMBER OF J1,J2, AND J3 MIGRATION DISTRIBUTIONS ',3I4/
2670          91X,'.....................................................'//)
2680       15  FORMAT(1HI)
2690       20 FORMAT(1X,'EGG STAGE PARAMETERS'/
2700          11X,'STAGE DURATION',1X,F5.2/
2720          21X,'TIME STEP USED IN NUMERICAL TECHNIQUE ',F5.2//)
2730       30 FORMAT(1X,'LARVAL STAGE PARAMETERS'/
2740          11X,'STAGE DURATION ',F5.2/
2750          21X,'TIME STEP USED IN THE NUMERICAL TECHNIQUE ',F5.2//)
2760       40 FORMAT(1X,'JUVENILE 1 STAGE PARAMETERS'/
2770          11X,'STAGE DURATION ',F5.2/
2780          21X,'TIME STEP USED IN NUMERICAL TECHNIQUE ',F5.2//)
2790       50 FORMAT(1X,'JUVENILE 2 STAGE PARAMETERS'/
2800          11X,'STAGE DURATION ',F7.2/
2810          21X,'TIME STEP NUMERICAL TECHNIQUE ',F5.2//)
2820       60 FORMAT(1X,'JUVENILE 3 STAGE PARAMETERS'/
2821          11X,'STAGE DURATION ',F7.2/
2822          21X,'TIME STEP USED IN NUMERICAL TECHNIQUE ',F5.2//)
2830       70 FORMAT(1X,4HSEG  ,
2840          116H    K RATE EQUI   ,
2850          216H    K RATE MIN.   ,
2860          316H   PLANT FACTOR      ,
2870          416H    SATUR. #/TCF   /)
2880       80 FORMAT(I4,4(1X,E15.7))
2890       90 FORMAT(1X,'RIVER CHARACTERISTICS'/)
2900      100 FORMAT(1X,4HSEG ,
2910          116HADVECTION          ,
2920          216HDISPERSION         ,
2930          316HCROSS SECTIONAL        ,
2940          416HPLANT INTAKE       ,
2950          516HVOLUME             ,
2960          616HLENGTH             ,
2970          716HPLANT OP(YEARS)    /)
2980      110 FORMAT(1H0,1X,'TIME ',F10.2/)
2990      120 FORMAT(I4,6(1X,E15.7),1X,I10)
3000      130 FORMAT(1X,'TEMPORAL AND SPATIAL DISTRIBUTIONS APPLIED ',
3005         1'TO COMPUTE THE AVERAGE RATE OF EGG PRODUCTION.'/)
3020      140 FORMAT(1X,'TIME=',F10.2,5X,'TEMPORAL WEIGHT =',F8.5)
3030      150 FORMAT(5(1X,3HSEG,2X,6HWEIGHT))
3040      160 FORMAT(5(1X,I3,1X,F8.5))
3050      170 FORMAT(1X,'MIGRATION PREFERENCES' )
3060      180 FORMAT(1X,'JUVENILE ',I3,' STAGE'
3070         11X,'TIME=',F10.2)
3080          END
IQ
```

RANDN:

Functional description:

RANDN (random number generator) generating a pair of random number deviates and then uses these deviates if they are both in the interval (p, 1) to generate a pair of normal deviates. It returns one of these deviates to be used as a random decay rate to predict random survival.

Equations:

Generate a pair of random deviates.

Let $Io = 2^{18} + 3$

Let $N_I = 2(2^{34} - 2) + 1 \quad \text{mod } 35$

Now

1. $N_1 = N_I * I_o$
2. $N_2 = N1 * 2^{-35}$
3. $A1 = (N1-1)^2 + (N2-1)^2$
4. IF $A1 > 1.\phi$

   No, Go to 5

   Yes, $N_I = N_2$ go to 1
5. Compute normal random deviates.

$Z = (-2 \ln (N_1)^{1/2} * \&$

o = standard deviation

$u = \quad * N_2$

$S_{m'} = \cos (u) * Z + m$

$S_{n2} = \text{sim} (u) * Z + m$

m = mean

Output:

X - normal deviate

Subroutines called: none

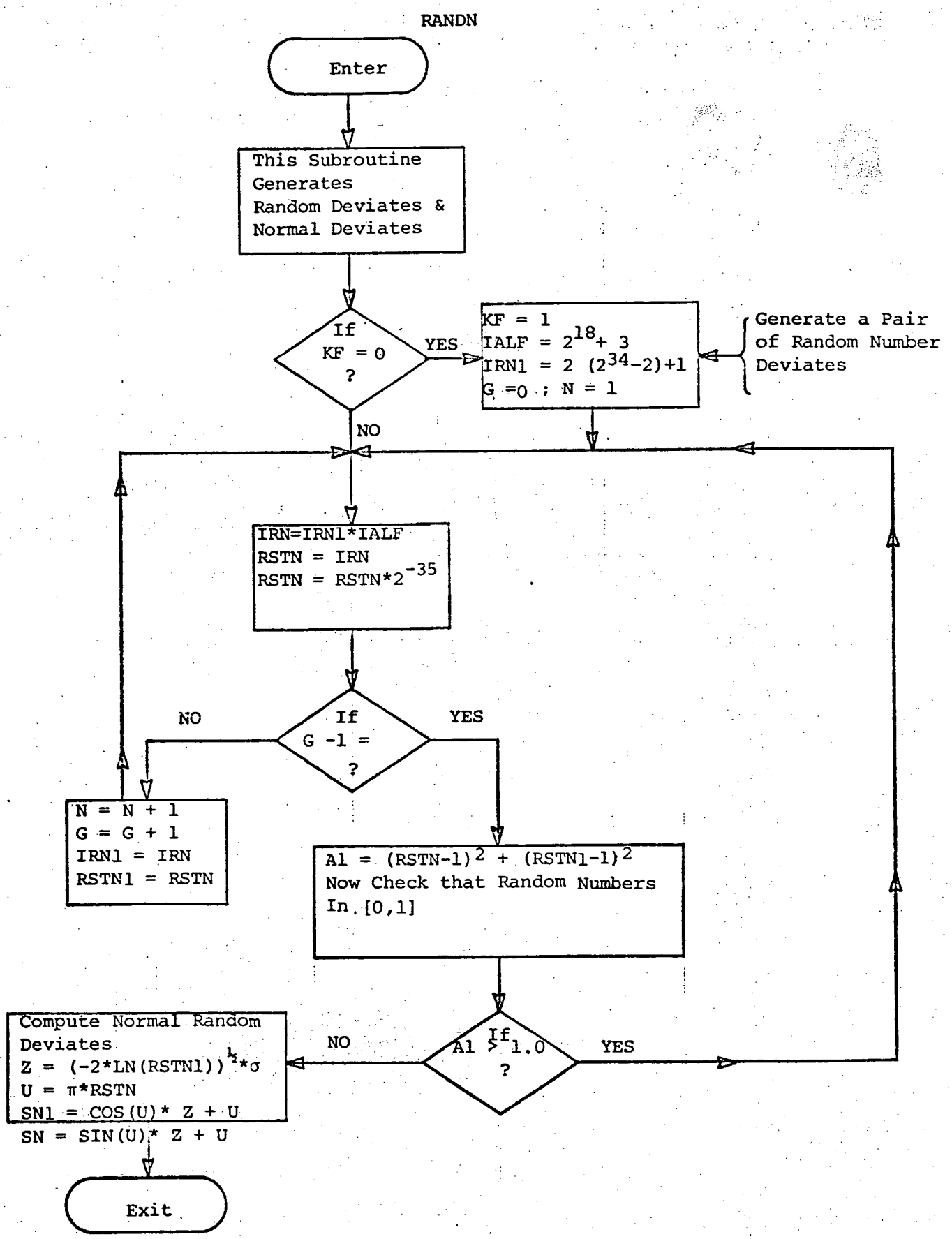
Referenced by:

TMODEL

HISTG

GROSSK

GROWTH


RANDN
Enter
This Subroutine Generates Random Deviates & Normal Deviates
If KF = 0 ?
YES
KF = 1
IALF = 2^18 + 3
IRN1 = 2 (2^34-2)+1
G =0 ; N = 1
Generate a Pair of Random Number Deviates
NO
IRN=IRN1*IALF
RSTN = IRN
RSTN = RSTN*2^-35
If G -1 = ?
NO
YES
N = N + 1
G = G + 1
IRN1 = IRN
RSTN1 = RSTN
A1 = (RSTN-1)^2 + (RSTN1-1)^2
Now Check that Random Numbers In [0,1]
If A1 > 1.0 ?
NO
YES
Compute Normal Random Deviates
Z = (-2*LN(RSTN1))^½*σ
U = π*RSTN
SN1 = COS(U)* Z + U
SN = SIN(U)* Z + U
Exit

```
RANDN-PNC/LIB$  CREATE:02/08/73,09:47:21 FREQ:7 SIZE:1 KIND:DISK KEY:1 LIFE:
TERM ACCESS:UPDATE ON:SPN
IL
 10          SUBROUTINE RANDN(X,XMEAN,STDEV)
 20          INTEGER G
 30          DATA PI2/6.28318/
 40          DATA KF/0/
 50           IF(KF)1,3,1
 60        3 KF=1
 70          IALF=2**18+3
 80          IRN1=2*(2**34-2)+1
 90          G=0
100          N=1
110        1 IRN=IRN1*IALF
120          RSTN=IRN
130          RSTN=RSTN*2.0**(-35)
140          IF(G-1)7,6,7
150        7 N=N+1
160          G=G+1
170          IRN1=IRN
180          RSTN1=RSTN
190          GO TO 1
200        6 A1=(RSTN-1.0)**2+(RSTN1-1.0)**2
210          G=0
220           IF(A1.GT.1.0)GO TO 7
230          Z=SQRT(-2.0*ALOG(RSTN1))*STDEV
240          U=PI2*RSTN
250          SN1=COS(U)*Z+XMEAN
260          SN=Z*SIN(U)+XMEAN
270          G=0
280           N=N+1
290          IF(SN1.GT.0.)X=SN1
300          IF(SN.GT.0.)X=SN
310          RETURN
320          END
IQ
```

The following is a list of sample input data and run streams to DMODEL.

D8

```
DB-PNC/LIB$  CREATE:02/13/73,16:57:13 FREQ:7 SIZE:2 KIND:DISK KEY:1 LIFE:PERM
ACCESS:UPDATE ON:SPN
IL
 1060      1,0,0,0,0,0
 1070      8,7,3,13,1,0,1,1,0,0,2,0,1
 1080      1.53506,1.53506,.0,.0
 1090      1.53506,1.53506,.0,.0
 1100      1.53506,1.53506,.0,.0
 1110      1.53506,1.53506,.0,.0
 1120      1.53506,1.53506,.0,.0
 1130      1.53506,1.53506,.0,.0
 1140      1.53506,1.53506,.4,.0
 1150      1.53506,1.53506,.0,.0
 1160      6.77543E-2,6.09789E-2,.0,2.0
 1170      6.77543E-2,6.09789E-2,.0,2.0
 1180      6.77543E-2,6.09789E-2,.0,2.0
 1190      6.77543E-2,6.09789E-2,.0,2.0
 1200      6.77543E-2,6.09789E-2,.0,2.0
 1210      6.77543E-2,6.09789E-2,.0,2.0
 1220      6.77543E-2,6.09789E-2,.4,2.0
 1230      6.77543E-2,6.09789E-2,.0,2.0
 1240      5.3647899E-2,4.82831E-2,.0,.50
 1250      5.3647899E-2,4.82831E-2,.0,.50
 1260      5.3647899E-2,4.82831E-2,.0,.50
 1270      5.3647899E-2,4.82831E-2,.0,.50
 1280      5.3647899E-2,4.82831E-2,.0,.50
 1290      5.3647899E-2,4.82831E-2,.0,.50
 1300      5.3647899E-2,4.82831E-2,.2,.50
 1310      5.3647899E-2,4.82831E-2,.0,.50
 1320      .51344219E-2,4.62098E-3,.0,.10
 1330      .51344219E-2,4.62098E-3,.0,.10
 1340      .51344219E-2,4.62098E-3,.0,.10
 1350      .51344219E-2,4.62098E-3,.0,.10
 1360      .51344219E-2,4.62098E-3,.0,.10
 1370      .51344219E-2,4.62098E-3,.0,.10
 1380      .51344219E-2,4.62098E-3,14680.0,.10
 1390      .51344219E-2,4.62098E-3,.0,.10
 1400      1.06509E-2,9.58581E-3,.0,.075
 1410      1.06509E-2,9.58581E-3,.0,.075
 1420      1.06509E-2,9.58581E-3,.0,.075
 1430      1.06509E-2,9.58581E-3,.0,.075
 1440      1.06509E-2,9.58581E-3,.0,.075
 1450      1.06509E-2,9.58581E-3,.0,.075
 1460      1.06509E-2,9.58581E-3,30260.0,.075
 1470      1.06509E-2,9.58581E-3,.0,.075
 1480      3.29856E-3,3.29856E-3,3.29856E-3
 1490      1.5,28.,30.,149.5,335.,365.,.1,49.,128.,2157.75E6
 1500      .0,.0,.0,.0,.0,.0,1.53069E-3,.0
 1510      0,0,0,0,0,0,1,0
 1520      0,0,0,0,0,0,1,0
 1530      1.37348E-2,1.37348E-2,1.37348E-2,1.37348E-2
 1540      1.37348E-2,1.37348E-2,1.37348E-2
 1550       .67,.67,.67,1.33,1.33,1.33,9.33
 1560      .45782E-2,.45732E-2,.45782E-2,.45782E-2
```

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D8

```
1570    .45782E-2,.45782E-2,.45782E-2
1580     1.0,1.33,1.33,1.33,4.0,8.0,8.0
1590    .35218E-2,.35218E-2,.35218E-2,.35218E-2,.35218E-2
1600    .35218E-2,.35218E-2,.35218E-2
1610     1.0,1.33,1.33,1.33,4.0,8.0,8.0
1620    22.5,19.3,10.2,11.3,12.2,11.8,11.0,20.0
1630    1.3272E-3,2.6544E-3,4.0174E-3,4.3044E-3,5.0218E-3
1640    5.4522E-3,5.3805E-3,7.5327E-3
1650    2.9862E-2,5.1230E-2,4.0977E-2,4.8640E-2,6.1266E-2
1660    6.4336E-2,5.9186E-2,15.0654E-2
1670    16.,46.,100.
1680    7.,14.,21.,28.,35.,42.,49.
1690    29.5
1700    59.5
1710    207.
1720    .0,.000833,.001665,.006661,.018318,.248543,.226894,.497086
1730    .0,.0,.0,.0,.0,.0,.0,.0
1740    0.,0.,0.,0.,0.,0.,0.,0.
1750    .0000,.7681,.0086,.1885,.0307,.0040,.0000,.0000
1760    .0000,.0000,.0000,.3190,.0000,.1237,.0573,.0000
1770    .0000,.6407,.0360,.0392,.0000,.1178,.1663,.0000
1780    .0000,.4300,.0455,.2587,.0517,.1521,.0620,.0000
1790    .0000,.0000,.0302,.4902,.1763,.2882,.0151,.0000
1800    .0000,.0000,.0000,.0000,.0000,.0000,.0000,.0000
1810    .0000,.0000,.0000,.0000,.0000,1.000,.0000,.0000
1820    .0536,.0243,.2361,.4432,.2365,.0000,.0013
1830    0.,0.,.5
1840    0.,0.,.52
1850    0.,0.,.54
1860    .345E6,.25,.56
1870    .438E6,.75,.58
1880    .615E6,.95,.6
1890    .752E6,1.,.62
1900    .82E6,1.,.64
1910    .909E6,1.,.66
1920    .91E6,1.,.68
1930    .964E6,1.,.7
1940    1.136E6,1.,.7
1950    .908E6,1.,.7
1960    1,1,1,1,1,0
1970    10,0,0,1,0,0,1,0,1,1.0
1980    10,0,0,1,0,0,1,0,1,1.0
1990    10,0,0,1,0,1,0,0,1,1,1.0
2000    10,0,0,1,0,1,1,1,1,1.0
2010    10,1,1,1,1,0
2020    1,1,1,10,1,10,1,10,1,10,1,10
2030    .5,1.0,1.0,1.0
2040    0.,0
IQ
```

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D10

```
D10-PNC/LIB$  CREATE:02/13/73,17:03:59 FREQ:7 SIZE:2 KIND:DISK KEY:1 LIFE:PER
ACCESS:UPDATE ON:SPN
IL
 1060      1,0,0,0,0,0
 1070      8,7,3,13,1,0,1,1,0,0,2,0,1
 1080      1.53506,1.53506,.0,.0
 1090      1.53506,1.53506,.0,.0
 1100      1.53506,1.53506,.0,.0
 1110      1.53506,1.53506,.0,.0
 1120      1.53506,1.53506,.0,.0
 1130      1.53506,1.53506,.0,.0
 1140      1.53506,1.53506,.4,.0
 1150      1.53506,1.53506,.0,.0
 1160      6.77543E-2,6.09789E-2,.0,2.0
 1170      6.77543E-2,6.09789E-2,.0,2.0
 1180      6.77543E-2,6.09789E-2,.0,2.0
 1190      6.77543E-2,6.09789E-2,.0,2.0
 1200      6.77543E-2,6.09789E-2,.0,2.0
 1210      6.77543E-2,6.09789E-2,.0,2.0
 1220      6.77543E-2,6.09789E-2,.4,2.0
 1230      6.77543E-2,6.09789E-2,.0,2.0
 1240      5.3647899E-2,4.82831E-2,.0,.50
 1250      5.3647899E-2,4.82831E-2,.0,.50
 1260      5.3647899E-2,4.82831E-2,.0,.50
 1270      5.3647899E-2,4.82831E-2,.0,.50
 1280      5.3647899E-2,4.82831E-2,.0,.50
 1290      5.3647899E-2,4.82831E-2,.0,.50
 1300      5.3647899E-2,4.82831E-2,.2,.50
 1310      5.3647899E-2,4.82831E-2,.0,.50
 1320      .51344219E-2,4.62098E-3,.0,.10
 1330      .51344219E-2,4.62098E-3,.0,.10
 1340      .51344219E-2,4.62098E-3,.0,.10
 1350      .51344219E-2,4.62098E-3,.0,.10
 1360      .51344219E-2,4.62098E-3,.0,.10
 1370      .51344219E-2,4.62098E-3,.0,.10
 1380      .51344219E-2,4.62098E-3,14680.0,.10
 1390      .51344219E-2,4.62098E-3,.0,.10
 1400      1.06509E-2,9.58581E-3,.0,.075
 1410      1.06509E-2,9.58581E-3,.0,.075
 1420      1.06509E-2,9.58581E-3,.0,.075
 1430      1.06509E-2,9.58581E-3,.0,.075
 1440      1.06509E-2,9.58581E-3,.0,.075
 1450      1.06509E-2,9.58581E-3,.0,.075
 1460      1.06509E-2,9.58581E-3,30260.0,.075
 1470      1.06509E-2,9.58581E-3,.0,.075
 1480      3.29856E-3,3.29856E-3,3.29856E-3
 1490      1.5,28.,30.,149.5,335.,365.,.1,49.,128.,2157.75E6
 1500      .0,.0,.0,.0,.0,.0,1.53069E-3,.0
 1510      0,0,0,0,0,0,1,0
 1520      0,0,0,0,0,0,1,0
 1530      1.37348E-2,1.37348E-2,1.37348E-2,1.37348E-2
 1540      1.37348E-2,1.37348E-2,1.37348E-2
 1550       .83,.83,.83,1.67,1.67,1.67,11.67
 1560      .45782E-2,.45782E-2,.45782E-2,.45782E-2
```

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D10

```
1570    .45782E-2,.45782E-2,.45782E-2
1580     1.25,1.67,1.67,1.67,5.0,10.0,10.0
1590    .35218E-2,.35218E-2,.35218E-2,.35218E-2,.35218E-2
1600    .35218E-2,.35218E-2,.35218E-2
1610     1.25,1.67,1.67,1.67,5.0,10.0,10.0
1620    22.5,19.3,10.2,11.3,12.2,11.8,11.0,20.0
1630    1.3272E-3,2.6544E-3,4.0174E-3,4.3044E-3,5.0218E-3
1640    5.4522E-3,5.3805E-3,7.5327E-3
1650    2.9862E-2,5.1230E-2,4.0977E-2,4.8640E-2,6.1266E-2
1660    6.4336E-2,5.9186E-2,15.0654E-2
1670    16.,46.,100.
1680    7.,14.,21.,28.,35.,42.,49.
1690    29.5
1700    59.5
1710    207.
1720    .0,.000833,.001665,.006661,.018318,.248543,.226894,.497086
1730    .0,.0,.0,.0,.0,.0,.0,.0
1740    0.,0.,0.,0.,0.,0.,0.,0.
1750    .0000,.7681,.0086,.1885,.0307,.0040,.0000,.0000
1760    .0000,.0000,.0000,.8190,.0000,.1237,.0573,.0000
1770    .0000,.6407,.0360,.0392,.0000,.1178,.1663,.0000
1780    .0000,.4300,.0455,.2587,.0517,.1521,.0620,.0000
1790    .0000,.0000,.0302,.4902,.1763,.2882,.0151,.0000
1800    .0000,.0000,.0000,.0000,.0000,.0000,.0000,.0000
1810    .0000,.0000,.0000,.0000,.0000,1.000,.0000,.0000
1820    .0536,.0243,.2361,.4482,.2365,.0000,.0013
1830    0.,0.,.5
1840    0.,0.,.52
1850    0.,0.,.54
1860    .345E6,.25,.56
1870    .438E6,.75,.58
1880    .615E6,.95,.6
1890    .752E6,1.,.62
1900    .82E6,1.,.64
1910    .909E6,1.,.66
1920    .91E6,1.,.68
1930    .964E6,1.,.7
1940    1.136E6,1.,.7
1950    .908E6,1.,.7
1960    1,1,1,1,1,0
1970    10,0,0,1,0,0,1,0,1,1.0
1980    10,0,0,1,0,0,1,0,1,1.0
1990    10,0,0,1,0,1,0,0,1,1,1.0
2000    10,0,0,1,0,1,1,1,1,1.0
2010    10,1,1,1,1,0
2020    1,1,1,10,1,10,1,10,1,10,1,10
2030    .5,1.0,1.0,1.0
2040    0.,0
IQ
```

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D14

```
D14-PNC/LIB$  CREATE:02/13/73,17:00:03 FREQ:7 SIZE:2 KIND:DISK KEY:1 LIFE:PERS
ACCESS:UPDATE ON:SPN
IL
 1060      1,0,0,0,0,0
 1070      8,7,3,13,1,0,1,1,0,0,2,0,1
 1080      1.53506,1.53506,.0,.0
 1090      1.53506,1.53506,.0,.0
 1100      1.53506,1.53506,.0,.0
 1110      1.53506,1.53506,.0,.0
 1120      1.53506,1.53506,.0,.0
 1130      1.53506,1.53506,.0,.0
 1140      1.53506,1.53506,.4,.0
 1150      1.53506,1.53506,.0,.0
 1160      6.77543E-2,6.09789E-2,.0,2.0
 1170      6.77543E-2,6.09789E-2,.0,2.0
 1180      6.77543E-2,6.09789E-2,.0,2.0
 1190      6.77543E-2,6.09789E-2,.0,2.0
 1200      6.77543E-2,6.09789E-2,.0,2.0
 1210      6.77543E-2,6.09789E-2,.0,2.0
 1220      6.77543E-2,6.09789E-2,.4,2.0
 1230      6.77543E-2,6.09789E-2,.0,2.0
 1240      5.3647899E-2,4.82831E-2,.0,.50
 1250      5.3647899E-2,4.82831E-2,.0,.50
 1260      5.3647899E-2,4.82831E-2,.0,.50
 1270      5.3647899E-2,4.82831E-2,.0,.50
 1280      5.3647899E-2,4.82831E-2,.0,.50
 1290      5.3647899E-2,4.82831E-2,.0,.50
 1300      5.3647899E-2,4.82831E-2,.2,.50
 1310      5.3647899E-2,4.82831E-2,.0,.50
 1320      .51344219E-2,4.62098E-3,.0,.10
 1330      .51344219E-2,4.62098E-3,.0,.10
 1340      .51344219E-2,4.62098E-3,.0,.10
 1350      .51344219E-2,4.62098E-3,.0,.10
 1360      .51344219E-2,4.62098E-3,.0,.10
 1370      .51344219E-2,4.62098E-3,.0,.10
 1380      .51344219E-2,4.62098E-3,14680.0,.10
 1390      .51344219E-2,4.62098E-3,.0,.10
 1400      1.06509E-2,9.58581E-3,.0,.075
 1410      1.06509E-2,9.58581E-3,.0,.075
 1420      1.06509E-2,9.58581E-3,.0,.075
 1430      1.06509E-2,9.58581E-3,.0,.075
 1440      1.06509E-2,9.58581E-3,.0,.075
 1450      1.06509E-2,9.58581E-3,.0,.075
 1460      1.06509E-2,9.58581E-3,30260.0,.075
 1470      1.06509E-2,9.58581E-3,.0,.075
 1480      3.29856E-3,3.29856E-3,3.29856E-3
 1490      1.5,28.,30.,149.5,335.,365.,.1,49.,128.,2157.75E6
 1500      .0,.0,.0,.0,.0,.0,1.53069E-3,.0
 1510      0,0,0,0,0,0,1,0
 1520      0,0,0,0,0,0,1,0
 1530      1.37348E-2,1.37348E-2,1.37348E-2,1.37348E-2
 1540      1.37348E-2,1.37348E-2,1.37348E-2
 1550       1.17,1.17,1.17,2.33,2.33,2.33,16.33
 1560      .45782E-2,.45782E-2,.45782E-2,.45782E-2
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1570    .45782E-2,.45782E-2,.45782E-2
1580     1.75,2.33,2.33,2.33,7.0,14.0,14.0
1590    .35218E-2,.35218E-2,.35218E-2,.35218E-2,.35218E-2
1600    .35218E-2,.35218E-2,.35218E-2
1610     1.75,2.33,2.33,2.33,7.0,14.0,14.0
1620    22.5,19.3,10.2,11.3,12.2,11.8,11.0,20.0
1630    1.3272E-3,2.6544E-3,4.0174E-3,4.3044E-3,5.0218E-3
1640    5.4522E-3,5.3805E-3,7.5327E-3
1650    2.9862E-2,5.1230E-2,4.0977E-2,4.8640E-2,6.1266E-2
1660    6.4336E-2,5.9186E-2,15.0654E-2
1670    16.,46.,100.
1680    7.,14.,21.,28.,35.,42.,49.
1690    29.5
1700    59.5
1710    207.
1720    .0,.000833,.001665,.006661,.018318,.248543,.226894,.497086
1730    .0,.0,.0,.0,.0,.0,.0,.0
1740    0.,0.,0.,0.,0.,0.,0.,0.
1750    .0000,.7681,.0086,.1885,.0307,.0040,.0000,.0000
1760    .0000,.0000,.0000,.8190,.0000,.1237,.0573,.0000
1770    .0000,.6407,.0360,.0392,.0000,.1178,.1663,.0000
1780    .0000,.4300,.0455,.2587,.0517,.1521,.0620,.0000
1790    .0000,.0000,.0302,.4902,.1763,.2882,.0151,.0000
1800    .0000,.0000,.0000,.0000,.0000,.0000,.0000,.0000
1810    .0000,.0000,.0000,.0000,.0000,1.000,.0000,.0000
1820    .0536,.0243,.2361,.4482,.2365,.0000,.0013
1830    0.,0.,.5
1840    0.,0.,.52
1850    0.,0.,.54
1860    .345E6,.25,.56
1870    .438E6,.75,.58
1880    .615E6,.95,.6
1890    .752E6,1.,.62
1900    .82E6,1.,.64
1910    .909E6,1.,.66
1920    .91E6,1.,.68
1930    .964E6,1.,.7
1940    1.136E6,1.,.7
1950    .908E6,1.,.7
1960    1,1,1,1,1,0
1970    10,0,0,1,0,0,1,0,1,1.0
1980    10,0,0,1,0,0,1,0,1,1.0
1990    10,0,0,1,0,1,0,0,1,1,1.0
2000    10,0,0,1,0,1,1,1,1,1.0
2010    10,1,1,1,1,0
2020    1,1,1,10,1,10,1,10,1,10,1,10
2030    .5,1.0,1.0,1.0
2040    0.,0
IQ
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@IL  CPY  DBI001/NORRIS,RAM1

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = RAM1     PROCESSED ON 14 DEC 72 AT 12:05:07


NO PCF ELEMENT REQUESTED

1000 @O RUN,O RAM1,DBI001,NORRIS,X11523,120E,10000 DEC. 7, 1972
1010 @ ASG A=$DMOD
1020 @ APR DBI001
1030 @ XQT CUR
1040   IN A
1044   DEL FACTOR/CODE
1045 @EFT ER5,& FACTOR
1050 @N XQT DMODEL
1060 1,0,0,0,0,0
1070 8,7,3,13,1,0,1,1,0,0,2,0,1
1080 1.53506,1.53506,.0,.0
1090 1.53506,1.53506,.0,.0
1100 1.53506,1.53506,.0,.0
1110 1.53506,1.53506,.0,.0
1120 1.53506,1.53506,.0,.0
1130 1.53506,1.53506,.0,.0
1140 1.53506,1.53506,.41,.0
1150 1.53506,1.53506,.0,.0
1160 .99,.99,.0,2.0
1170 1.492045E-01,3.7301126E-02,.0,2.0
1180 9.743760E-02,2.4359401E-02,.0,2.0
1190 7.004865E-02,1.7512163E-02,.0,2.0
1200 5.517498E-02,1.3793745E-02,.0,2.0
1210 5.820145E-02,1.4550363E-02,.0,2.0
1220 7.304865E-02,1.8262163E-02,.39,2.0
1230 5.096844E-02,1.2742110E-02,.0,2.0
1240 5.3647899E-2,.026824,.0,.50
1250 5.3647899E-2,.026824,.0,.50
1260 5.3647899E-2,.026824,.0,.50
1270 5.3647899E-2,.026824,.0,.50
1280 5.3647899E-2,.026824,.0,.50
1290 5.3647899E-2,.026824,.0,.50
1300 5.3647899E-2,.026824,.09,.50
1310 5.3647899E-2,.026824,.0,.50
1320 .51344219E-2,2.56721E-3,.0,.10
1330 .51344219E-2,2.56721E-3,.0,.10
1340 .51344219E-2,2.56721E-3,.0,.10
1350 .51344219E-2,2.56721E-3,.0,.10
1360 .51344219E-2,2.56721E-3,.0,.10
1370 .51344219E-2,2.56721E-3,.0,.10
1380 .51344219E-2,2.56721E-3,14680.0,.10
1390 .51344219E-2,2.56721E-3,.0,.10
1400 1.06509E-2,5.32545E-3,.0,.075
1410 1.06509E-2,5.32545E-3,.0,.075
1420 1.06509E-2,5.32545E-3,.0,.075
1430 1.06509E-2,5.32545E-3,.0,.075
1440 1.06509E-2,5.32545E-3,.0,.075
1450 1.06509E-2,5.32545E-3,.0,.075
1460 1.06509E-2,5.32545E-3,30260.0,.075
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1470 1.06509E-2,5.32545E-3,.0,.075
1480 3.29856E-3,3.29856E-3,3.29856E-3
1490 1.5,28.,30.,149.5,335.,365.,.1,49.,128.,2157.75E6
1500 .0,.0,.0,.0,.0,.0,1.53069E-3,.0
1510 0,0,0,0,0,0,1,0
1520 0,0,0,0,0,0,1,0
1530 1.37348E-2,1.37348E-2,1.37348E-2,1.37348E-2
1540 1.37348E-2,1.37348E-2,1.37348E-2
1550 1.,1.,1.,2.,2.,2.,14.
1560 .45782E-2,.45782E-2,.45782E-2,.45782E-2
1570 .45782E-2,.45782E-2,.45782E-2
1580 1.5,2.,2.,2.,6.,12.,12.
1590 .35218E-2,.35218E-2,.35218E-2,.35218E-2,.35218E-2
1600 .35218E-2,.35218E-2,.35218E-2
1610 1.5,2.,2.,2.,6.,12.,12.
1620 22.5,19.3,10.2,11.3,12.2,11.8,11.0,20.0
1630 1.3272E-3,2.6544E-3,4.0174E-3,4.3044E-3,5.0218E-3
1640 5.4522E-3,5.3805E-3,7.5327E-3
1650 2.9862E-2,5.1230E-2,4.0977E-2,4.8640E-2,6.1266E-2
1660 6.4336E-2,5.9186E-2,15.0654E-2
1670 16.,46.,100.
1680 7.,14.,21.,28.,35.,42.,49.
1690 29.5
1700 59.5
1710 207.
1720 .125,.125,.125,.125,.125,.125,.125,.125
1730 .0,.0,.0,.0,.0,.0,.0,.0
1740 0.,0.,0.,0.,0.,0.,0.,0.
1750 .0000,.7601,.0086,.1885,.0307,.0040,.0000,.0000
1760 .0000,.0000,.0000,.0190,.0000,.1237,.0573,.0000
1770 .0000,.6407,.0360,.0392,.0000,.1178,.1663,.0000
1780 .0000,.4300,.0455,.2587,.0517,.1521,.0620,.0000
1790 .0000,.0000,.0302,.4902,.1763,.2882,.0151,.0000
1800 .0000,.0000,.0000,.0000,.0000,.0000,.0000,.0000
1810 .0000,.0000,.0000,.0000,.0000,1.000,.0000,.0000
1820 .0536,.0243,.2361,.4482,.2365,.0000,.0013
1830 0.,0.,.5
1840 0.,0.,.52
1850 0.,0.,.54
1860 .345E6,.25,.56
1870 .438E6,.75,.58
1880 .615E6,.95,.6
1890 .752E6,1.,.62
1900 .82E6,1.,.64
1910 .909E6,1.,.66
1920 .91E6,1.,.68
1930 .964E6,1.,.7
1940 1.136E6,1.,.7
1950 .908E6,1.,.7
1960 1,1,1,1,1,0
1970 10,0,0,1,0,0,1,0,1,1.0
1980 10,0,0,1,0,0,1,0,1,1.0
1990 10,0,0,1,0,1,0,0,1,1,1.0
2000 10,0,0,1,0,1,1,1,1,1.0
2010 10,1,1,1,1,0
2020 1,1,1,10,1,10,1,10,1,10,1,10
2030 .5,1.0,1.0,1.0
2040 0.,0
2050 @ FIN
```

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@IL  CPY  DBI001/NORRIS,RAM2

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = RAM2      PROCESSED ON 14 DEC 72 AT 12:05:09


NO PCF ELEMENT REQUESTED


1000 @O RUN,O RAM2,DBI001,NORRIS,X11523,1200,10000 DEC. 7, 1972
1010 @ ASG A=$DMOD
1020 @ APR DBI001
1030 @ XQT CUR
1040   IN A
1044   DEL FACTOR/CODE
1045 DEFT ERS,& FACTOR
1050 @N XQT DMODEL
1060 1,0,0,0,0,0
1070 8,7,3,13,1,0,1,1,0,0,2,0,1
1080 1.53506,1.53506,.0,.0
1090 1.53506,1.53506,.0,.0
1100 1.53506,1.53506,.0,.0
1110 1.53506,1.53506,.0,.0
1120 1.53506,1.53506,.0,.0
1130 1.53506,1.53506,.0,.0
1140 1.53506,1.53506,.41,.0
1150 1.53506,1.53506,.0,.0
1160 .99,.99,.0,2.0
1170 1.492045E-01,3.7301126E-02,.0,2.0
1180 9.743760E-02,2.4359401E-02,.0,2.0
1190 7.004865E-02,1.7512163E-02,.0,2.0
1200 5.517498E-02,1.3793745E-02,.0,2.0
1210 5.820145E-02,1.4550363E-02,.0,2.0
1220 7.304865E-02,1.8262163E-02,.39,2.0
1230 5.096844E-02,1.2742110E-02,.0,2.0
1240 5.3647899E-2,.026824,.0,.50
1250 5.3647899E-2,.026824,.0,.50
1260 5.3647899E-2,.026824,.0,.50
1270 5.3647899E-2,.026824,.0,.50
1280 5.3647899E-2,.026824,.0,.50
1290 5.3647899E-2,.026824,.0,.50
1300 5.3647899E-2,.026824,.09,.50
1310 5.3647899E-2,.026824,.0,.50
1320 .51344219E-2,2.56721E-3,.0,.10
1330 .51344219E-2,2.56721E-3,.0,.10
1340 .51344219E-2,2.56721E-3,.0,.10
1350 .51344219E-2,2.56721E-3,.0,.10
1360 .51344219E-2,2.56721E-3,.0,.10
1370 .51344219E-2,2.56721E-3,.0,.10
1380 .51344219E-2,2.56721E-3,14680.0,.10
1390 .51344219E-2,2.56721E-3,.0,.10
1400 1.06509E-2,5.32545E-3,.0,.075
1410 1.06509E-2,5.32545E-3,.0,.075
1420 1.06509E-2,5.32545E-3,.0,.075
1430 1.06509E-2,5.32545E-3,.0,.075
1440 1.06509E-2,5.32545E-3,.0,.075
1450 1.06509E-2,5.32545E-3,.0,.075
1460 1.06509E-2,5.32545E-3,30260.0,.075
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1470 1.06509E-2,5.32545E-3,.0,.075
1480 3.29856E-3,3.29856E-3,3.29856E-3
1490 1.5,28.,30.,149.5,335.,365.,.1,49.,128.,2157.75E6
1500 .0,.0,.0,.0,.0,.0,1.53069E-3,.0
1510 0,0,0,0,0,0,1,0
1520 0,0,0,0,0,0,1,0
1530 1.37348E-2,1.37348E-2,1.37348E-2,1.37348E-2
1540 1.37348E-2,1.37348E-2,1.37348E-2
1550 1.,1.,1.,2.,2.,2.,14.
1560 .45782E-2,.45782E-2,.45782E-2,.45782E-2
1570 .45782E-2,.45782E-2,.45782E-2
1580 1.5,2.,2.,2.,6.,12.,12.
1590 .35218E-2,.35218E-2,.35218E-2,.35218E-2,.35218E-2
1600 .35218E-2,.35218E-2,.35218E-2
1610 1.5,2.,2.,2.,6.,12.,12.
1620 22.5,19.3,10.2,11.3,12.2,11.8,11.0,20.0
1630 1.3272E-3,2.6544E-3,4.0174E-3,4.3044E-3,5.0218E-3
1640 5.4522E-3,5.3805E-3,7.5327E-3
1650 2.9862E-2,5.1230E-2,4.0977E-2,4.8640E-2,6.1266E-2
1660 6.4336E-2,5.9186E-2,15.0654E-2
1670 16.,46.,100.
1680 7.,14.,21.,28.,35.,42.,49.
1690 29.5
1700 59.5
1710 207.
1720 .026490,.055629,.083444,.111258,.139073,.166887,.194702,.222517
1730 .0,.0,.0,.0,.0,.0,.0,.0
1740 0.,0.,0.,0.,0.,0.,0.,0.
1750 .0000,.7681,.0086,.1855,.0307,.0040,.0000,.0000
1760 .0000,.0000,.0000,.8190,.0000,.1237,.0573,.0000
1770 .0000,.6407,.0360,.0392,.0000,.1178,.1663,.0000
1780 .0000,.4300,.0455,.2587,.0517,.1521,.0620,.0000
1790 .0000,.0000,.0302,.4902,.1763,.2882,.0151,.0000
1800 .0000,.0000,.0000,.0000,.0000,.0000,.0000,.0000
1810 .0000,.0000,.0000,.0000,.0000,1.000,.0000,.0000
1820 .0536,.0243,.2361,.4482,.2365,.0000,.0013
1830 0.,0.,.5
1840 0.,0.,.52
1850 0.,0.,.54
1860 .345E6,.25,.56
1870 .438E6,.75,.58
1880 .615E6,.95,.6
1890 .752E6,1.,.62
1900 .82E6,1.,.64
1910 .909E6,1.,.66
1920 .91E6,1.,.68
1930 .964E6,1.,.7
1940 1.136E6,1.,.7
1950 .908E6,1.,.7
1960 1,1,1,1,1,0
1970 10,0,0,1,0,0,1,0,1,1.0
1980 10,0,0,1,0,0,1,0,1,1.0
1990 10,0,0,1,0,1,0,0,1,1,1.0
2000 10,0,0,1,0,1,1,1,1,1.0
2010 10,1,1,1,1,0
2020 1,1,1,10,1,10,1,10,1,10,1,10
2030 .5,1.0,1.0,1.0
2040 0.,0
2050 @ FIN
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@IL  CPY  DBI001/NORRIS,RAM3

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = RAM3     PROCESSED ON 14 DEC 72 AT 12:05:11


NO PCF ELEMENT REQUESTED


1000 @D RUN,0 RAM3,DBI001,NORRIS,X11523,1200,10000 DEC. 7, 1972
1010 @ ASG A=SOMOD
1020 @ APR DBI001
1030 @ XQT CUR
1040  IN A
1044  DEL FACTOR/CODE
1045 @EFT ERS,& FACTOR
1050 @N XQT DMODEL
1060 1,0,0,0,0,0
1070 8,7,3,13,1,0,1,1,0,0,2,0,1
1080 1.53506,1.53506,.0,.0
1090 1.53506,1.53506,.0,.0
1100 1.53506,1.53506,.0,.0
1110 1.53506,1.53506,.0,.0
1120 1.53506,1.53506,.0,.0
1130 1.53506,1.53506,.0,.0
1140 1.53506,1.53506,.41,.0
1150 1.53506,1.53506,.0,.0
1160 .99,.99,.0,2.0
1170 1.492045E-01,3.7301126E-02,.0,2.0
1180 9.743760E-02,2.4359401E-02,.0,2.0
1190 7.004865E-02,1.7512163E-02,.0,2.0
1200 5.517498E-02,1.3793745E-02,.0,2.0
1210 5.820145E-02,1.4550363E-02,.0,2.0
1220 7.304865E-02,1.8262163E-02,.39,2.0
1230 5.096844E-02,1.2742110E-02,.0,2.0
1240 5.3647899E-2,.026824,.0,.50
1250 5.3647899E-2,.026824,.0,.50
1260 5.3647899E-2,.026824,.0,.50
1270 5.3647899E-2,.026824,.0,.50
1280 5.3647899E-2,.026824,.0,.50
1290 5.3647899E-2,.026824,.0,.50
1300 5.3647899E-2,.026824,.09,.50
1310 5.3647899E-2,.026824,.0,.50
1320 .51344219E-2,2.56721E-3,.0,.10
1330 .51344219E-2,2.56721E-3,.0,.10
1340 .51344219E-2,2.56721E-3,.0,.10
1350 .51344219E-2,2.56721E-3,.0,.10
1360 .51344219E-2,2.56721E-3,.0,.10
1370 .51344219E-2,2.56721E-3,.0,.10
1380 .51344219E-2,2.56721E-3,14680.0,.10
1390 .51344219E-2,2.56721E-3,.0,.10
1400 1.06509E-2,5.32545E-3,.0,.075
1410 1.06509E-2,5.32545E-3,.0,.075
1420 1.06509E-2,5.32545E-3,.0,.075
1430 1.06509E-2,5.32545E-3,.0,.075
1440 1.06509E-2,5.32545E-3,.0,.075
1450 1.06509E-2,5.32545E-3,.0,.075
1460 1.06509E-2,5.32545E-3,30260.0,.075
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1470 1.06509E-2,5.32545E-3,.0,.075
1480 3.29856E-3,3.29856E-3,3.29856E-3
1490 1.5,28.,30.,149.5,335.,365.,.1,49.,128.,2157.75E6
1500 .0,.0,.0,.0,.0,.0,1.53069E-3,.0
1510 0,0,0,0,0,0,1,0
1520 0,0,0,0,0,0,1,0
1530 1.37348E-2,1.37348E-2,1.37348E-2,1.37348E-2
1540 1.37348E-2,1.37348E-2,1.37348E-2
1550 1.,1.,1.,2.,2.,2.,14.
1560 .45782E-2,.45782E-2,.45782E-2,.45782E-2
1570 .45782E-2,.45782E-2,.45782E-2
1580 1.5,2.,2.,2.,6.,12.,12.
1590 .35218E-2,.35218E-2,.35218E-2,.35218E-2,.35218E-2
1600 .35218E-2,.35218E-2,.35218E-2
1610 1.5,2.,2.,2.,6.,12.,12.
1620 22.5,19.3,10.2,11.3,12.2,11.8,11.0,20.0
1630 1.3272E-3,2.6544E-3,4.0174E-3,4.3044E-3,5.0218E-3
1640 5.4522E-3,5.3305E-3,7.5327E-3
1650 2.9862E-2,5.1230E-2,4.0977E-2,4.8640E-2,6.1266E-2
1660 6.4336E-2,5.9136E-2,15.0654E-2
1670 16.,46.,100.
1680 7.,14.,21.,28.,35.,42.,49.
1690 29.5
1700 59.5
1710 207.
1720 .004120,.017840,.040342,.073502,.118121,.174863,.244295,.326917
1730 .0,.0,.0,.0,.0,.0,.0,.0
1740 0.,0.,0.,0.,0.,0.,0.,0.
1750 .0000,.7681,.0086,.1885,.0307,.0040,.0000,.0000
1760 .0000,.0000,.0000,.8190,.0000,.1237,.0573,.0000
1770 .0000,.6407,.0360,.0392,.0000,.1178,.1663,.0000
1780 .0000,.4300,.0455,.2587,.0517,.1521,.0620,.0000
1790 .0000,.0000,.0302,.4902,.1763,.2882,.0151,.0000
1800 .0000,.0000,.0000,.0000,.0000,.0000,.0000,.0000
1810 .0000,.0000,.0000,.0000,.0000,1.000,.0000,.0000
1820 .0536,.0243,.2361,.4482,.2365,.0000,.0013
1830 0.,0.,.5
1840 0.,0.,.52
1850 0.,0.,.54
1860 .345E6,.25,.56
1870 .438E6,.75,.58
1880 .615E6,.95,.6
1890 .752E6,1.,.62
1900 .82E6,1.,.64
1910 .909E6,1.,.66
1920 .91E6,1.,.68
1930 .964E6,1.,.7
1940 1.136E6,1.,.7
1950 .908E6,1.,.7
1960 1,1,1,1,1,0
1970 10,0,0,1,0,0,1,0,1,1,0
1980 10,0,0,1,0,0,1,0,1,1,0
1990 10,0,0,1,0,1,0,0,1,1,1,0
2000 10,0,0,1,0,1,1,1,1,1,0
2010 10,1,1,1,1,0
2020 1,1,1,10,1,10,1,10,1,10,1,10
2030 .5,1.0,1.0,1.0
2040 0.,0
2050 0 FIN
```

```
QIL  CPY  DBI001/NORRIS,RAM4

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = RAM4     PROCESSED ON 14 DEC 72 AT 12:05:13


NO PCF ELEMENT REQUESTED

1000 @@ RUN,0,RAM4,DBI001,NORRIS,X11523,1200,10000 DEC. 7, 1972
1010 @ ASG A=$DMOD
1020 @ APR DBI001
1030 @ XQT CUR
1040  IN A
1044  DEL FACTOR/CODE
1045 DEFT ERS,& FACTOR
1050 @N XQT DMODEL
1060 1,0,0,0,0,0
1070 8,7,3,13,1,0,1,1,0,0,2,0,1
1080 1.53506,1.53506,.0,.0
1090 1.53506,1.53506,.0,.0
1100 1.53506,1.53506,.0,.0
1110 1.53506,1.53506,.0,.0
1120 1.53506,1.53506,.0,.0
1130 1.53506,1.53506,.0,.0
1140 1.53506,1.53506,.41,.0
1150 1.53506,1.53506,.0,.0
1160 .99,.99,.0,2.0
1170 1.492045E-01,3.7301126E-02,.0,2.0
1180 9.743760E-02,2.4359401E-02,.0,2.0
1190 7.004865E-02,1.7512163E-02,.0,2.0
1200 5.517498E-02,1.3793745E-02,.0,2.0
1210 5.820145E-02,1.4550363E-02,.0,2.0
1220 7.304865E-02,1.8262163E-02,.39,2.0
1230 5.096844E-02,1.2742110E-02,.0,2.0
1240 5.3647899E-2,.026824,.0,.50
1250 5.3647899E-2,.026824,.0,.50
1260 5.3647899E-2,.026824,.0,.50
1270 5.3647899E-2,.026824,.0,.50
1280 5.3647899E-2,.026824,.0,.50
1290 5.3647899E-2,.026824,.0,.50
1300 5.3647899E-2,.026824,.09,.50
1310 5.3647899E-2,.026824,.0,.50
1320 .51344219E-2,2.56721E-3,.0,.10
1330 .51344219E-2,2.56721E-3,.0,.10
1340 .51344219E-2,2.56721E-3,.0,.10
1350 .51344219E-2,2.56721E-3,.0,.10
1360 .51344219E-2,2.56721E-3,.0,.10
1370 .51344219E-2,2.56721E-3,.0,.10
1380 .51344219E-2,2.56721E-3,14680.0,.10
1390 .51344219E-2,2.56721E-3,.0,.10
1400 1.06509E-2,5.32545E-3,.0,.075
1410 1.06509E-2,5.32545E-3,.0,.075
1420 1.06509E-2,5.32545E-3,.0,.075
1430 1.06509E-2,5.32545E-3,.0,.075
1440 1.06509E-2,5.32545E-3,.0,.075
1450 1.06509E-2,5.32545E-3,.0,.075
1460 1.06509E-2,5.32545E-3,30260.0,.075
```

```
1470 1.06509E-2,5.32545E-3,.0,.075
1480 3.29856E-3,3.29856E-3,3.29856E-3
1490 1.5,28.,30.,149.5,335.,365.,.1,49.,123.,2157.75E6
1500 .0,.0,.0,.0,.0,.0,1.53069E-3,.0
1510 0,0,0,0,0,0,1,0
1520 0,0,0,0,0,0,1,0
1530 1.37348E-2,1.37348E-2,1.37348E-2,1.37348E-2
1540 1.37348E-2,1.37348E-2,1.37348E-2
1550 1.,1.,1.,2.,2.,2.,14.
1560 .45782E-2,.45782E-2,.45782E-2,.45782E-2
1570 .45782E-2,.45782E-2,.45782E-2
1580 1.5,2.,2.,2.,6.,12.,12.
1590 .35218E-2,.35218E-2,.35218E-2,.35218E-2,.35218E-2
1600 .35218E-2,.35218E-2,.35218E-2
1610 1.5,2.,2.,2.,6.,12.,12.
1620 22.5,19.3,10.2,11.3,12.2,11.8,11.0,20.0
1630 1.5272E-3,2.6544E-3,4.0174E-3,4.3044E-3,5.0218E-3
1640 5.4522E-3,5.3805E-3,7.5327E-3
1650 2.9862E-2,5.1230E-2,4.0977E-2,4.8640E-2,6.1266E-2
1660 6.4336E-2,5.9186E-2,15.0654E-2
1670 16.,46.,100.
1680 7.,14.,21.,28.,35.,42.,49.
1690 29.5
1700 59.5
1710 207.
1720 .000428,.003635,.013398,.036166,.079948,.154382,.270647,.441396
1730 .0,.0,.0,.0,.0,.0,.0,.0
1740 0.,0.,0.,0.,0.,0.,0.,0.
1750 .0000,.7681,.0086,.1885,.0307,.0040,.0000,.0000
1760 .0000,.0000,.0000,.8190,.0000,.1237,.0573,.0000
1770 .0000,.6407,.0360,.0392,.0000,.1178,.1663,.0000
1780 .0000,.4300,.0455,.2587,.0517,.1521,.0620,.0000
1790 .0000,.0000,.0302,.4902,.1763,.2882,.0151,.0000
1800 .0000,.0000,.0000,.0000,.0000,.0000,.0000,.0000
1810 .0000,.0000,.0000,.0000,.0000,1.000,.0000,.0000
1820 .0536,.0243,.2361,.4482,.2365,.0000,.0013
1830 0.,0.,.5
1840 0.,0.,.52
1850 0.,0.,.54
1860 .345E6,.25,.56
1870 .438E6,.75,.58
1880 .615E6,.95,.6
1890 .752E6,1.,.62
1900 .82E6,1.,.64
1910 .909E6,1.,.66
1920 .91E6,1.,.68
1930 .964E6,1.,.7
1940 1.136E6,1.,.7
1950 .908E6,1.,.7
1960 1,1,1,1,1,0
1970 10,0,0,1,0,0,1,0,1,1.0
1980 10,0,0,1,0,0,1,0,1,1.0
1990 10,0,0,1,0,1,0,0,1,1,1.0
2000 10,0,0,1,0,1,1,1,1,1.0
2010 10,1,1,1,1,0
2020 1,1,1,10,1,10,1,10,1,10,1,10
2030 .5,1.0,1.0,1.0
2040 0.,0
2050 @ FIN
```

```
@IL CPY DBI001/NORRIS,RAM5

BASIC-TO-BATCH FILE MANIPULATOR, VERSION 3.1

FILE NAME = RAM5  PROCESSED ON 14 DEC 72 AT 12:05:16


NO PCF ELEMENT REQUESTED

1000 @O RUN,O RAM5,DBI001,NORRIS,X11523,1200,10000 DEC. 7, 1972
1010 @ ASG A=$DMOD
1020 @ APR DBI001
1030 @ XQT CUR
1040  IN A
1044  DEL FACTOR/CODE
1045 DEFT FR5,& FACTOR
1050 @N XQT DMODEL
1060 1,0,0,0,0,0
1070 8,7,3,13,1,0,1,1,0,0,2,0,1
1080 1.53506,1.53506,.0,.0
1090 1.53506,1.53506,.0,.0
1100 1.53506,1.53506,.0,.0
1110 1.53506,1.53506,.0,.0
1120 1.53506,1.53506,.0,.0
1130 1.53506,1.53506,.0,.0
1140 1.53506,1.53506,.41,.0
1150 1.53506,1.53506,.0,.0
1160 .99,.99,.0,2.0
1170 1.492045E-01,3.7301126E-02,.0,2.0
1180 9.743760E-02,2.4359401E-02,.0,2.0
1190 7.004865E-02,1.7512163E-02,.0,2.0
1200 5.517498E-02,1.3793745E-02,.0,2.0
1210 5.820145E-02,1.4550363E-02,.0,2.0
1220 7.304865E-02,1.8262163E-02,.39,2.0
1230 5.096844E-02,1.2742110E-02,.0,2.0
1240 5.3647899E-2,.026824,.0,.50
1250 5.3647899E-2,.026824,.0,.50
1260 5.3647899E-2,.026824,.0,.50
1270 5.3647899E-2,.026824,.0,.50
1280 5.3647899E-2,.026824,.0,.50
1290 5.3647899E-2,.026824,.0,.50
1300 5.3647899E-2,.026824,.09,.50
1310 5.3647899E-2,.026824,.0,.50
1320 .51344219E-2,2.56721E-3,.0,.10
1330 .51344219E-2,2.56721E-3,.0,.10
1340 .51344219E-2,2.56721E-3,.0,.10
1350 .51344219E-2,2.56721E-3,.0,.10
1360 .51344219E-2,2.56721E-3,.0,.10
1370 .51344219E-2,2.56721E-3,.0,.10
1380 .51344219E-2,2.56721E-3,14680.0,.10
1390 .51344219E-2,2.56721E-3,.0,.10
1400 1.06509E-2,5.32545E-3,.0,.075
1410 1.06509E-2,5.32545E-3,.0,.075
1420 1.06509E-2,5.32545E-3,.0,.075
1430 1.06509E-2,5.32545E-3,.0,.075
1440 1.06509E-2,5.32545E-3,.0,.075
1450 1.06509E-2,5.32545E-3,.0,.075
1460 1.06509E-2,5.32545E-3,30260.0,.075
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1470 1.06509E-2,5.32545E-3,.0,.075
1480 3.29856E-3,3.29856E-3,3.29856E-3
1490 1.5,28.,30.,149.5,335.,365.,.1,49.,128.,2157.75E6
1500 .0,.0,.0,.0,.0,.0,1.53069E-3,.0
1510 0,0,0,0,0,0,1,0
1520 0,0,0,0,0,0,1,0
1530 1.37348E-2,1.37348E-2,1.37348E-2,1.37348E-2
1540 1.37348E-2,1.37348E-2,1.37348E-2
1550 1.,1.,1.,2.,2.,2.,14.
1560 .45782E-2,.45782E-2,.45782E-2,.45782E-2
1570 .45782E-2,.45782E-2,.45782E-2
1580 1.5,2.,2.,2.,6.,12.,12.
1590 .35218E-2,.35218E-2,.35218E-2,.35218E-2,.35218E-2
1600 .35218E-2,.35218E-2,.35218E-2
1610 1.5,2.,2.,2.,6.,12.,12.
1620 22.5,19.3,10.2,11.3,12.2,11.8,11.0,20.0
1630 1.3272E-3,2.6544E-3,4.0174E-3,4.3044E-3,5.0218E-3
1640 5.4522E-3,5.3805E-3,7.5327E-3
1650 2.9862E-2,5.1230E-2,4.0977E-2,4.8640E-2,6.1266E-2
1660 6.4336E-2,5.9186E-2,15.0654E-2
1670 16.,46.,100.
1680 7.,14.,21.,28.,35.,42.,49.
1690 29.5
1700 59.5
1710 207.
1720 .000028,.000459,.003100,.013580,.044135,.117051,.268553,.553094
1730 .0,.0,.0,.0,.0,.0,.0,.0
1740 0.,0.,0.,0.,0.,0.,0.,0.
1750 .0000,.7681,.0086,.1885,.0307,.0040,.0000,.0000
1760 .0000,.0000,.0000,.8190,.0000,.1237,.0573,.0000
1770 .0000,.6407,.0360,.0392,.0000,.1178,.1663,.0000
1780 .0000,.4300,.0455,.2587,.0517,.1521,.0620,.0000
1790 .0000,.0000,.0302,.4902,.1763,.2882,.0151,.0000
1800 .0000,.0000,.0000,.0000,.0000,.0000,.0000,.0000
1810 .0000,.0000,.0000,.0000,.0000,1.000,.0000,.0000
1820 .0536,.0243,.2361,.4482,.2365,.0000,.0013
1830 0.,0.,.5
1840 0.,0.,.52
1850 0.,0.,.54
1860 .345E6,.25,.56
1870 .438E6,.75,.58
1880 .615E6,.95,.6
1890 .752E6,1.,.62
1900 .82E6,1.,.64
1910 .909E6,1.,.66
1920 .91E6,1.,.68
1930 .964E6,1.,.7
1940 1.136E6,1.,.7
1950 .908E6,1.,.7
1960 1,1,1,1,1,0
1970 10,0,0,1,0,0,1,0,1,1,0
1980 10,0,0,1,0,0,1,0,1,1,0
1990 10,0,0,1,0,1,0,0,1,1,1,0
2000 10,0,0,1,0,1,1,1,1,1,0
2010 10,1,1,1,1,0
2020 1,1,1,10,1,10,1,10,1,10,1,10
2030 .5,1.0,1.0,1.0
2040 0.,0
2050 @ FIN
```

```
@IL  CPY  DBI001/NORRIS,AEC1

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = AEC1     PROCESSED ON 14 DEC 72 AT 12:05:18


NO PCF ELEMENT REQUESTED

1000 @@ RUN,0 AEC1,DBI001,NORRIS,X11523,1200,10000 DEC. 8, 1972
1010 @ ASG A=$DMOD
1020 @ APR DBI001
1030 @ XQT CUR
1040  IN A
1044  DEL FACTOR/CODE
1045 NEET FR5,3 FACTOR
1050 @N XQT DMODEL
1060 1,0,0,0,0,0
1070 8,7,3,13,1,0,1,2,0,0,2,0,1
1080 1.53506,1.53506,.0,.0
1090 1.53506,1.53506,.0,.0
1100 1.53506,1.53506,.0,.0
1110 1.53506,1.53506,.0,.0
1120 1.53506,1.53506,.0,.0
1130 1.53506,1.53506,.0,.0
1140 1.53506,1.53506,.41,.0
1150 1.53506,1.53506,.0,.0
1160 .99,.99,.0,2.0
1170 1.492045E-01,3.7301126E-02,.0,2.0
1180 9.743760E-02,2.4359401E-02,.0,2.0
1190 7.004865E-02,1.7512163E-02,.0,2.0
1200 5.517498E-02,1.3793745E-02,.0,2.0
1210 5.820145E-02,1.4550363E-02,.0,2.0
1220 7.304865E-02,1.8262163E-02,.39,2.0
1230 5.096844E-02,1.2742110E-02,.0,2.0
1240 5.3647899E-2,.026824,.0,.50
1250 5.3647899E-2,.026824,.0,.50
1260 5.3647899E-2,.026824,.0,.50
1270 5.3647899E-2,.026824,.0,.50
1280 5.3647899E-2,.026824,.0,.50
1290 5.3647899E-2,.026824,.0,.50
1300 5.3647899E-2,.026824,.09,.50
1310 5.3647899E-2,.026824,.0,.50
1320 .51344219E-2,2.56721E-3,.0,.10
1330 .51344219E-2,2.56721E-3,.0,.10
1340 .51344219E-2,2.56721E-3,.0,.10
1350 .51344219E-2,2.56721E-3,.0,.10
1360 .51344219E-2,2.56721E-3,.0,.10
1370 .51344219E-2,2.56721E-3,.0,.10
1380 .51344219E-2,2.56721E-3,14680.0,.10
1390 .51344219E-2,2.56721E-3,.0,.10
1400 1.06509E-2,5.32545E-3,.0,.075
1410 1.06509E-2,5.32545E-3,.0,.075
1420 1.06509E-2,5.32545E-3,.0,.075
1430 1.06509E-2,5.32545E-3,.0,.075
1440 1.06509E-2,5.32545E-3,.0,.075
1450 1.06509E-2,5.32545E-3,.0,.075
1460 1.06509E-2,5.32545E-3,30260.0,.075
```

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1470 1.06509E-2,5.32545E-3,.0,.075
1480 3.29856E-3,3.29856E-3,3.29856E-3
1490 1.5,28.,30.,149.5,335.,365.,.1,49.,128.,2157.75E6
1500 .0,.0,.0,.0,.0,.0,1.53069E-3,.0
1510 0,0,0,0,0,0,1,0
1520 0,0,0,0,0,0,1,0
1530 1.37348E-2,1.37348E-2,1.37348E-2,1.37348E-2
1540 1.37348E-2,1.37348E-2,1.37348E-2
1550 1.,1.,1.,2.,2.,2.,14.
1560 .45782E-2,.45782E-2,.45782E-2,.45782E-2
1570 .45782E-2,.45782E-2,.45782E-2
1580 1.5,2.,2.,2.,6.,12.,12.
1590 .35218E-2,.35218E-2,.35218E-2,.35218E-2,.35218E-2
1600 .35218E-2,.35218E-2,.35218E-2
1610 1.5,2.,2.,2.,6.,12.,12.
1620 22.5,19.3,10.2,11.3,12.2,11.8,11.0,20.0
1630 1.3272E-3,2.6544E-3,4.0174E-3,4.3044E-3,5.0218E-3
1640 5.4522E-3,5.3805E-3,7.5327E-3
1650 2.9862E-2,5.1230E-2,4.0977E-2,4.8540E-2,6.1266E-2
1660 6.4336E-2,5.9186E-2,15.0654E-2
1670 16.,46.,100.
1680 7.,14.,21.,28.,35.,42.,49.
1690 79.0,94.0
1700 59.5
1710 207.
1720 .0,.001076,.005443,.0,.000456,.056515,.014862,.921648
1721 .0,.0,.000954,.0,.001526,.250366,.177988,.569166
1730 .0,.0,.0,.0,.0,.0,.0,.0
1740 0.,0.,0.,0.,0.,0.,0.,0.
1750 .0000,.7681,.0086,.1885,.0307,.0040,.0000,.0000
1760 .0000,.0000,.0000,.8190,.0000,.1237,.0573,.0000
1770 .0000,.6407,.0360,.0392,.0000,.1173,.1663,.0000
1780 .0000,.4300,.0455,.2587,.0517,.1521,.0620,.0000
1790 .0000,.0000,.0302,.4902,.1763,.2882,.0151,.0000
1800 .0000,.0000,.0000,.0000,.0000,.0000,.0000,.0000
1810 .0000,.0000,.0000,.0000,.0000,1.000,.0000,.0000
1820 .0536,.0243,.2361,.4482,.2365,.0000,.0013
1830 0.,0.,.5
1840 0.,0.,.52
1850 0.,0.,.54
1860 .345E6,.25,.56
1870 .438E6,.75,.58
1880 .615E6,.95,.6
1890 .752E6,1.,.62
1900 .82E6,1.,.64
1910 .909E6,1.,.66
1920 .91E6,1.,.68
1930 .964E6,1.,.7
1940 1.136E6,1.,.7
1950 .908E6,1.,.7
1960 1,1,1,1,1,0
1970 10,0,0,1,0,0,1,0,1,1.0
1980 10,0,0,1,0,0,1,0,1,1.0
1990 10,0,0,1,0,1,0,0,1,1,1.0
2000 10,0,0,1,0,1,1,1,1,1.0
2010 10,1,1,1,1,0
2020 1,1,1,10,1,10,1,10,1,10,1,10
2030 .5,1.0,1.0,1.0
2040 0.,0
2050 END
```

```
@IL  CPY  DBI001/NORRIS,LS05

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = LS05     PROCESSED ON 14 DEC 72 AT 12:05:20


NO PCF ELEMENT REQUESTED


1000 @D RUN,0,LS05,DBI001,NORRIS,X11523,1200,10000 DEC. 7, 1972
1010 @ ASG A=$DMOD
1020 @ APR DBI001
1030 @ XQT CUR
1040  IN A
1044  DEL FACTOR/CODE
1045 DEFT ER5,& FACTOR
1050 @N XQT DMODEL
1060 1,0,0,0,0,0
1070 8,7,3,13,1,0,1,1,1,0,2,0,1
1080 1.53506,1.53506,.0,.0
1090 1.53506,1.53506,.0,.0
1100 1.53506,1.53506,.0,.0
1110 1.53506,1.53506,.0,.0
1120 1.53506,1.53506,.0,.0
1130 1.53506,1.53506,.0,.0
1140 1.53506,1.53506,.41,.0
1150 1.53506,1.53506,.0,.0
1160 .10699,2.67476E-2,.39,2.0
1170 .10699,2.67476E-2,.39,2.0
1180 .10699,2.67476E-2,.39,2.0
1190 .10699,2.67476E-2,.39,2.0
1200 .10699,2.67476E-2,.39,2.0
1210 .10699,2.67476E-2,.39,2.0
1220 .10699,2.67476E-2,.39,2.0
1230 .10699,2.67476E-2,.39,2.0
1240 5.3647899E-2,.026824,.0,.50
1250 5.3647899E-2,.026824,.0,.50
1260 5.3647899E-2,.026824,.0,.50
1270 5.3647899E-2,.026824,.0,.50
1280 5.3647899E-2,.026824,.0,.50
1290 5.3647899E-2,.026824,.0,.50
1300 5.3647899E-2,.026824,.09,.50
1310 5.3647899E-2,.026824,.0,.50
1320 .51344219E-2,2.56721E-3,.0,.10
1330 .51344219E-2,2.56721E-3,.0,.10
1340 .51344219E-2,2.56721E-3,.0,.10
1350 .51344219E-2,2.56721E-3,.0,.10
1360 .51344219E-2,2.56721E-3,.0,.10
1370 .51344219E-2,2.56721E-3,.0,.10
1380 .51344219E-2,2.56721E-3,14680.0,.10
1390 .51344219E-2,2.56721E-3,.0,.10
1400 1.06509E-2,5.32545E-3,.0,.075
1410 1.06509E-2,5.32545E-3,.0,.075
1420 1.06509E-2,5.32545E-3,.0,.075
1430 1.06509E-2,5.32545E-3,.0,.075
1440 1.06509E-2,5.32545E-3,.0,.075
1450 1.06509E-2,5.32545E-3,.0,.075
1460 1.06509E-2,5.32545E-3,30260.0,.075
```

```
1470 1.06509E-2,5.32545E-3,.0,.075
1480 3.29856E-3,3.29856E-3,3.29856E-3
1490 1.5,28.,30.,149.5,335.,365.,.1,49.,128.,2157.75E6
1500 .0,.0,.0,.0,.0,.0,1.53069E-3,.0
1510 0,0,0,0,0,0,1,0
1520 0,0,0,0,0,0,1,0
1530 1.37348E-2,1.37348E-2,1.37348E-2,1.37348E-2
1540 1.37348E-2,1.37348E-2,1.37348E-2
1550 1.,1.,1.,2.,2.,2.,14.
1560 .45782E-2,.45782E-2,.45782E-2,.45782E-2
1570 .45782E-2,.45782E-2,.45782E-2
1580 1.5,2.,2.,2.,6.,12.,12.
1590 .35218E-2,.35218E-2,.35218E-2,.35218E-2,.35218E-2
1600 .35218E-2,.35218E-2,.35218E-2
1610 1.5,2.,2.,2.,6.,12.,12.
1620 22.5,19.3,10.2,11.3,12.2,11.8,11.0,20.0
1630 1.3272E-3,2.6544E-3,4.0174E-3,4.3044E-3,5.0218E-3
1640 5.4522E-3,5.3805E-3,7.5327E-3
1650 2.9862E-2,5.1230E-2,4.0977E-2,4.8640E-2,6.1266E-2
1660 6.4336E-2,5.9186E-2,15.0654E-2
1670 16.,46.,100.
1680 7.,14.,21.,28.,35.,42.,49.
1690 29.5
1700 59.5
1710 207.
1720 .044065,.075729,.078190,.092812,.171459,.180051,.100889,.256805
1730 .006300,.010827,.034581,.041048,.064628,.067867,.218520,.556228
1740 0.,0.,0.,0.,0.,0.,0.,0.
1750 .0000,.7681,.0086,.1885,.0307,.0040,.0600,.0000
1760 .0000,.0000,.0000,.8190,.0000,.1237,.0573,.0000
1770 .0000,.6407,.0360,.0392,.0000,.1173,.1663,.0000
1780 .0000,.4300,.0455,.2587,.0517,.1521,.0620,.0000
1790 .0000,.0000,.0302,.4902,.1763,.2882,.0151,.0000
1800 .0000,.0000,.0000,.0000,.0000,.0000,.0000,.0000
1810 .0000,.0000,.0000,.0000,.0000,1.000,.0000,.0000
1820 .0536,.0243,.2361,.4482,.2365,.0000,.0013
1830 0.,0.,.5
1840 0.,0.,.52
1850 0.,0.,.54
1860 .345E6,.25,.56
1870 .438E6,.75,.58
1880 .615E6,.95,.6
1890 .752E6,1.,.62
1900 .82E6,1.,.64
1910 .909E6,1.,.66
1920 .91E6,1.,.68
1930 .964E6,1.,.7
1940 1.136E6,1.,.7
1950 .908E6,1.,.7
1960 1,1,1,1,1,0
1970 10,0,0,1,0,0,1,0,1,1.0
1980 10,0,0,1,0,0,1,0,1,1.0
1990 10,0,0,1,0,1,0,0,1,1,1.0
2000 10,0,0,1,0,1,1,1,1,1.0
2010 10,1,1,1,1,0
2020 1,1,1,10,1,10,1,10,1,10,1,10
2030 .5,1.0,1.0,1.0
2040 0.,0
2050 D FIN
```

```
@IL  CPY  DBI001/NORRIS,LS10

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = LS10    PROCESSED ON 14 DEC 72 AT 12:05:23


NO PCF ELEMENT REQUESTED


1000 @O RUN,O LS10,DBI001,NORRIS,X11523,1200,10000 DEC. 7, 1972
1010 @ ASG A=$DMOD
1020 @ APR DBI001
1030 @ XQT CUR
1040  IN A
1044  DEL FACTOR/CODE
1045 @EFT ERS,& FACTOR
1050 @N XQT DMODEL
1060 1,0,0,0,0,0
1070 8,7,3,13,1,0,1,1,1,0,2,0,1
1080 1.53506,1.53506,.0,.0
1090 1.53506,1.53506,.0,.0
1100 1.53506,1.53506,.0,.0
1110 1.53506,1.53506,.0,.0
1120 1.53506,1.53506,.0,.0
1130 1.53506,1.53506,.0,.0
1140 1.53506,1.53506,.41,.0
1150 1.53506,1.53506,.0,.0
1160 8.22352E-2,2.05588E-2,.39,2.0
1170 8.22352E-2,2.05588E-2,.39,2.0
1180 8.22352E-2,2.05588E-2,.39,2.0
1190 8.22352E-2,2.05588E-2,.39,2.0
1200 8.22352E-2,2.05588E-2,.39,2.0
1210 8.22352E-2,2.05588E-2,.39,2.0
1220 8.22352E-2,2.05588E-2,.39,2.0
1230 8.22352E-2,2.05588E-2,.39,2.0
1240 5.3647899E-2,.026824,.0,.50
1250 5.3647899E-2,.026824,.0,.50
1260 5.3647899E-2,.026824,.0,.50
1270 5.3647899E-2,.026824,.0,.50
1280 5.3647899E-2,.026824,.0,.50
1290 5.3647899E-2,.026824,.0,.50
1300 5.3647899E-2,.026824,.09,.50
1310 5.3647899E-2,.026824,.0,.50
1320 .51344219E-2,2.56721E-3,.0,.10
1330 .51344219E-2,2.56721E-3,.0,.10
1340 .51344219E-2,2.56721E-3,.0,.10
1350 .51344219E-2,2.56721E-3,.0,.10
1360 .51344219E-2,2.56721E-3,.0,.10
1370 .51344219E-2,2.56721E-3,.0,.10
1380 .51344219E-2,2.56721E-3,14680.0,.10
1390 .51344219E-2,2.56721E-3,.0,.10
1400 1.06509E-2,5.32545E-3,.0,.075
1410 1.06509E-2,5.32545E-3,.0,.075
1420 1.06509E-2,5.32545E-3,.0,.075
1430 1.06509E-2,5.32545E-3,.0,.075
1440 1.06509E-2,5.32545E-3,.0,.075
1450 1.06509E-2,5.32545E-3,.0,.075
1460 1.06509E-2,5.32545E-3,30260.0,.075
```

```
1470 1.06509E-2,5.32545E-3,.0,.075
1480 3.29856E-3,3.29856E-3,3.29856E-3
1490 1.5,23.,30.,149.5,335.,365.,.1,49.,128.,2157.75E6
1500 .0,.0,.0,.0,.0,.0,1.53069E-3,.0
1510 0,0,0,0,0,0,1,0
1520 0.0,0,0,0,0,1,0
1530 1.37348E-2,1.37348E-2,1.37348E-2,1.37348E-2
1540 1.37348E-2,1.37348E-2,1.37348E-2
1550 1.,1.,1.,2.,2.,2.,14.
1560 .45782E-2,.45782E-2,.45782E-2,.45782E-2
1570 .45782E-2,.45782E-2,.45782E-2
1580 1.5,2.,2.,2.,6.,12.,12.
1590 .35218E-2,.35218E-2,.35218E-2,.35218E-2,.35218E-2
1600 .35218E-2,.35218E-2,.35218E-2
1610 1.5,2.,2.,2.,6.,12.,12.
1620 22.5,19.3,10.2,11.3,12.2,11.8,11.0,20.0
1630 1.3272E-3,2.6544E-3,4.0174E-3,4.3044E-3,5.0218E-3
1640 5.4522E-3,5.3805E-3,7.5327E-3
1650 2.9862E-2,5.1230E-2,4.0977E-2,4.8640E-2,6.1266E-2
1660 6.4336E-2,5.9186E-2,15.0654E-2
1670 16.,46.,100.
1680 7.,14.,21.,28.,35.,42.,49.
1690 29.5
1700 59.5
1710 207.
1720 .044065,.075729,.078190,.092812,.171459,.180051,.100889,.256805
1730 .006300,.010827,.034581,.041048,.064628,.067867,.218520,.556228
1740 0.,0.,0.,0.,0.,0.,0.,0.
1750 .0000,.7681,.0086,.1885,.0307,.0040,.0000,.0000
1760 .0000,.0000,.0000,.8190,.0000,.1237,.0573,.0000
1770 .0000,.6407,.0360,.0392,.0000,.1178,.1663,.0000
1780 .0000,.4300,.0455,.2587,.0517,.1521,.0620,.0000
1790 .0000,.0000,.0302,.4902,.1763,.2882,.0151,.0000
1800 .0000,.0000,.0000,.0000,.0000,.0000,.0000,.0000
1810 .0000,.0000,.0000,.0000,.0000,1.000,.0000,.0000
1820 .0536,.0243,.2361,.4482,.2365,.0000,.0013
1830 0.,0.,.5
1840 0.,0.,.52
1850 0.,0.,.54
1860 .345E6,.25,.56
1870 .438E6,.75,.58
1880 .615E6,.95,.6
1890 .752E6,1.,.62
1900 .82E6,1.,.64
1910 .909E6,1.,.66
1920 .91E6,1.,.68
1930 .964E6,1.,.7
1940 1.136E6,1.,.7
1950 .908E6,1.,.7
1960 1,1,1,1,1,0
1970 10,0,0,1,0,0,1,0,1,1.0
1980 10,0,0,1,0,0,1,0,1,1.0
1990 10,0,0,1,0,1,0,0,1,1,1.0
2000 10,0,0,1,0,1,1,1,1,1.0
2010 10,1,1,1,1,0
2020 1,1,1,10,1,10,1,10,1,10,1,10
2030 .5,1.0,1.0,1.0
2040 0.,0
2050 @ FIN
```

The following is sample output of a transport model run. The data input is contained in the sample data section and is file D8.

TABLE OF INPUT PARAMETERS

```
SIMULATION   1 YEARS
NUMBER OF SEGMENTS   8
NUMBER OF ADULTS   12
NUMBER OF FLOW AND DISPERSION CHANGES   3
NUMBER OF TEMPORAL EGG RATE WEIGHTS   7
COMPENSATION IN ADULTS   0
INTERMEDIARY LARVAL PRINTOUTS   0
TEMPERATURE PROFILE (2=NO,ELSE YES)   2
NUMBER OF J1,J2, AND J3 MIGRATION DISTRIBUTIONS   1   0   0
.................................................
```

ECG STAGE PARAMETERS
STAGE DURATION 1.50
TIME STEP USED IN NUMERICAL TECHNIQUE .10

SEG	K RATE EQUI	K RATE MIN.	PLANT FACTOR	SATUR. #/TCF
1	.1535060+01	.1535060+01	.0000000	.0000000
2	.1535060+01	.1535060+01	.0000000	.0000000
3	.1535060+01	.1535060+01	.0000000	.0000000
4	.1535060+01	.1535060+01	.0000000	.0000000
5	.1535060+01	.1535060+01	.0000000	.0000000
6	.1535060+01	.1535060+01	.0000000	.0000000
7	.1535060+01	.1535060+01	.4100000-00	.0000000
8	.1535060+01	.1535060+01	.0000000	.0000000

LARVAL STAGE PARAMETERS
STAGE DURATION 28.00
TIME STEP USED IN THE NUMERICAL TECHNIQUE .50

SEG	K RATE EQUI	K RATE MIN.	PLANT FACTOR	SATUR. #/TCF
1	.9900000-00	.9900000-00	.0000000	.2000000+01
2	.1492045-00	.3730113-01	.0000000	.2000000+01
3	.9743760-01	.2435940-01	.0000000	.2000000+01
4	.7004865-01	.1751216-01	.0000000	.2000000+01
5	.5517498-01	.1379374-01	.0000000	.2000000+01
6	.5820145-01	.1455036-01	.0000000	.2000000+01
7	.7304865-01	.1826216-01	.3900000-00	.2000000+01
8	.5096244-01	.1274211-01	.0000000	.2000000+01

JUVENILE 1 STAGE PARAMETERS
STAGE DURATION 20.00
TIME STEP USED IN NUMERICAL TECHNIQUE 1.00

SEG	K RATE EQUI	K RATE MIN.	PLANT FACTOR	SATUR. #/TCF
1	.5364790-01	.2682400-01	.0000000	.5000000-00
2	.5364790-01	.2682400-01	.0000000	.5000000-00
3	.5364790-01	.2682400-01	.0000000	.5000000-00
4	.5364790-01	.2682400-01	.0000000	.5000000-00
5	.5364790-01	.2682400-01	.0000000	.5000000-00
6	.5364790-01	.2682400-01	.0000000	.5000000-00
7	.5364790-01	.2682400-01	.9000000-01	.5000000-00
8	.5364790-01	.2682400-01	.0000000	.5000000-00

JUVENILE 2 STAGE PARAMETERS
STAGE DURATION 149.50
TIME STEP NUMERICAL TECHNIQUE 1.00

SEC	K RATE EQUI	K RATE MIN.	PLANT FACTOR	SATUR. #/TCF
1	.5134422-02	.2567210-02	.0000000	.1000000+00
2	.5134422-02	.2567210-02	.0000000	.1000000+00
3	.5134422-02	.2567210-02	.0000000	.1000000+00
4	.5134422-02	.2567210-02	.0000000	.1000000+00
5	.5134422-02	.2567210-02	.0000000	.1000000+00
6	.5134422-02	.2567210-02	.0000000	.1000000+00
7	.5134422-02	.2567210-02	.1465000+05	.1000000+00
8	.5134422-02	.2567210-02	.0000000	.1000000+00

JUVENILE 3 STAGE PARAMETERS
STAGE DURATION 156.00
TIME STEP USED IN NUMERICAL TECHNIQUE 1.00

SEG	K RATE EQUI	K RATE MIN.	PLANT FACTOR	SATUR. #/TCF
1	.1065090-01	.5325450-02	.0000000	.7500000-01
2	.1065090-01	.5325450-02	.0000000	.7500000-01
3	.1065090-01	.5325450-02	.0000000	.7500000-01
4	.1065090-01	.5325450-02	.0000000	.7500000-01
5	.1065090-01	.5325450-02	.0000000	.7500000-01
6	.1065090-01	.5325450-02	.0000000	.7500000-01
7	.1065090-01	.5325450-02	.3026000+05	.7500000-01
8	.1065090-01	.5325450-02	.0000000	.7500000-01

RIVER CHARACTERISTICS

TIME 16.00

SEG	ADVECTION	DISPERSION	CROSS SECTIONAL	PLANT INTAKE	VOLUME	LENGTH	PLANT OP(YEARS)
1	.0000000	.0000000	.1327200-02	.0000000	.2986200-01	.2250000+02	0
2	.1373480-01	.1000000+01	.2654400-02	.0000000	.5123000-01	.1930000+02	0
3	.1373480-01	.1000000+01	.4017400-02	.0000000	.4097700-01	.1020000+02	0
4	.1373480-01	.1000000+01	.4304400-02	.0000000	.4664000-01	.1130000+02	0
5	.1373480-01	.2000000+01	.5021800-02	.0000000	.6126600-01	.1220000+02	0
6	.1373480-01	.2000000+01	.5452200-02	.0000000	.6433600-01	.1100000+02	0
7	.1373480-01	.2000000+01	.5380500-02	.1530690-02	.5918600-01	.1100000+02	1
8	.1373480-01	.1400000+02	.7532700-02	.0000000	.1506540-00	.2000000+02	0

RIVER CHARACTERISTICS

TIME 46.00

SEG	ADVECTION	DISPERSION	CROSS SECTIONAL	PLANT INTAKE	VOLUME	LENGTH	PLANT OP(YEARS)
1	.0000000	.0000000	.1327200-02	.0000000	.2986200-01	.2250000+02	0
2	.4578200-02	.1500000+01	.2654400-02	.0000000	.5123000-01	.1930000+02	0
3	.4578200-02	.2000000+01	.4017400-02	.0000000	.4097700-01	.1020000+02	0
4	.4578200-02	.2000000+01	.4304400-02	.0000000	.4864000-01	.1130000+02	0
5	.4578200-02	.2000000+01	.5021800-02	.0000000	.6126600-01	.1220000+02	0
6	.4578200-02	.6000000+01	.5452200-02	.0000000	.6433600-01	.1180000+02	0
7	.4578200-02	.1200000+02	.5380500-02	.1530690-02	.5918600-01	.1100000+02	1
8	.4578200-02	.1200000+02	.7532700-02	.0000000	.1506540-00	.2000000+02	0

RIVER CHARACTERISTICS

TIME 100.00

SEG	ADVECTION	DISPERSION	CROSS SECTIONAL	PLANT INTAKE	VOLUME	LENGTH	PLANT OP(YEARS)
1	.0000000	.0000000	.1327200-02	.0000000	.2986200-01	.2250000+02	0
2	.3521800-02	.1500000+01	.2654400-02	.0000000	.5123000-01	.1930000+02	0
3	.3521800-02	.2000000+01	.4017400-02	.0000000	.4097700-01	.1020000+02	0
4	.3521800-02	.2000000+01	.4304400-02	.0000000	.4864000-01	.1130000+02	0
5	.3521800-02	.2000000+01	.5021800-02	.0000000	.6126600-01	.1220000+02	0
6	.3521800-02	.6000000+01	.5452200-02	.0000000	.6433600-01	.1180000+02	0
7	.3521800-02	.1200000+02	.5380500-02	.1530690-02	.5918600-01	.1100000+02	1
8	.3521800-02	.1200000+02	.7532700-02	.0000000	.1506540-00	.2000000+02	0

```
MIGRATION PREFERENCES
JUVENILE   1 STAGE TIME=      29.50
SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT
  1   .12500   2   .12500   3   .12500   4   .12500   5   .12500
  6   .12500   7   .12500   8   .12500
JUVENILE   2 STAGE TIME=      59.50
SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT
  1   .00000   2   .00000   3   .00000   4   .00000   5   .00000
  6   .00000   7   .00000   8   .00000
JUVENILE   3 STAGE TIME=     207.00
SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT
  1   .00000   2   .00000   3   .00000   4   .00000   5   .00000
  6   .00000   7   .00000   8   .00000
```

EMPORAL AND SPATIAL DISTRIBUTIONS APPLIED TO COMPUTE THE AVERAGE RATE OF EGG PRODUCTION.

```
TIME=      7.00      TEMPORAL WEIGHT =  .05360
SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT
  1   .00000   2   .76610   3   .00860   4   .18650   5   .03070
  6   .00400   7   .00000   8   .00000
TIME=     14.00      TEMPORAL WEIGHT =  .02430
SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT
  1   .00000   2   .00000   3   .00000   4   .81900   5   .00000
  6   .12370   7   .05730   8   .00000
TIME=     21.00      TEMPORAL WEIGHT =  .23610
SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT
  1   .00000   2   .64070   3   .03600   4   .03920   5   .00000
  6   .11790   7   .16630   8   .00000
TIME=     28.00      TEMPORAL WEIGHT =  .44620
SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT
  1   .00000   2   .43000   3   .04550   4   .25870   5   .05170
  6   .15210   7   .06200   8   .00000
TIME=     35.00      TEMPORAL WEIGHT =  .23650
SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT
  1   .00000   2   .00000   3   .03020   4   .49020   5   .17630
  6   .28820   7   .01510   8   .00000
TIME=     42.00      TEMPORAL WEIGHT =  .00000
SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT
  1   .00000   2   .00000   3   .00000   4   .00000   5   .00000
  6   .00000   7   .00000   8   .00000
TIME=     49.00      TEMPORAL WEIGHT =  .00130
SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT SEG  WEIGHT
  1   .00000   2   .00000   3   .00000   4   .00000   5   .00000
  6  1.00000   7   .00000   8   .00000
```

BEGIN EGG PRODUCTION

***** = 1.00 DAYS									
TOTAL NO.(EGGS) =	7512028.	533220.	4939070.	769283.	1181053.	343922.	37196.	5936.	2348.
EGG CONC.= TC=	.1049	.1213	.6550	.1275	.1650	.0381	.0039	.0007	.0001
***** = 2.00 DAYS									
TOTAL NO.(EGGS) =	8961524.	605994.	5627117.	925563.	1334040.	413602.	45574.	6809.	2825.
EGG CONC.= TC=	.1203	.1379	.7462	.1534	.1863	.0459	.0048	.0008	.0001
***** = 3.00 DAYS									
TOTAL NO.(EGGS) =	8961524.	605994.	5627117.	925563.	1334040.	413602.	45574.	6809.	2825.
EGG CONC.= TC=	.1203	.1379	.7462	.1534	.1863	.0459	.0048	.0008	.0001
***** = 4.00 DAYS									
TOTAL NO.(EGGS) =	8961524.	605994.	5627117.	925563.	1334040.	413602.	45574.	6809.	2825.
EGG CONC.= TC=	.1203	.1379	.7462	.1534	.1863	.0459	.0048	.0008	.0001
***** = 5.00 DAYS									
TOTAL NO.(EGGS) =	8961524.	605994.	5627117.	925563.	1334040.	413602.	45574.	6809.	2825.
EGG CONC.= TC=	.1203	.1379	.7462	.1534	.1863	.0459	.0048	.0008	.0001
***** = 6.00 DAYS									
TOTAL NO.(EGGS) =	8961524.	605994.	5627117.	925563.	1334040.	413602.	45574.	6809.	2825.
EGG CONC.= TC=	.1203	.1379	.7462	.1534	.1863	.0459	.0048	.0008	.0001
***** = 7.00 DAYS									
TOTAL NO.(EGGS) =	8961524.	605994.	5627117.	925563.	1334040.	413602.	45574.	6809.	2825.
EGG CONC.= TC=	.1203	.1379	.7462	.1534	.1863	.0459	.0048	.0008	.0001
***** = 8.00 DAYS									
TOTAL NO.(EGGS) =	4691497.	85913.	808818.	428672.	2123775.	681392.	359344.	147292.	56291.
EGG CONC.= TC=	.0630	.0195	.1073	.0711	.2966	.0756	.0379	.0169	.0025
***** = 9.00 DAYS									
TOTAL NO.(EGGS) =	4063187.	16062.	147634.	307432.	2222092.	733989.	400302.	168253.	67424.
EGG CONC.= TC=	.0545	.0037	.0196	.0510	.3104	.0814	.0423	.0193	.0030
***** = 10.00 DAYS									
TOTAL NO.(EGGS) =	4063187.	16062.	147634.	307432.	2222092.	733989.	400302.	168253.	67424.
EGG CONC.= TC=	.0545	.0037	.0196	.0510	.3104	.0814	.0423	.0193	.0030
***** = 11.00 DAYS									
TOTAL NO.(EGGS) =	4063187.	16062.	147634.	307432.	2222092.	733989.	400302.	168253.	67424.
EGG CONC.= TC=	.0545	.0037	.0196	.0510	.3104	.0814	.0423	.0193	.0030
***** = 12.00 DAYS									
TOTAL NO.(EGGS) =	4063187.	16062.	147634.	307432.	2222092.	733989.	400302.	168253.	67424.
EGG CONC.= TC=	.0545	.0037	.0196	.0510	.3104	.0814	.0423	.0193	.0030
***** = 13.00 DAYS									
TOTAL NO.(EGGS) =	4063187.	16062.	147634.	307432.	2222092.	733989.	400302.	168253.	67424.
EGG CONC.= TC=	.0545	.0037	.0196	.0510	.3104	.0814	.0423	.0193	.0030
***** = 14.00 DAYS									
TOTAL NO.(EGGS) =	4063187.	16062.	147634.	307432.	2222092.	733989.	400302.	168253.	67424.
EGG CONC.= TC=	.0545	.0037	.0196	.0510	.3104	.0814	.0423	.0193	.0030
***** = 15.00 DAYS									
TOTAL NO.(EGGS) =	34935445.	1962629.	18221577.	2617339.	1513740.	771930.	3010392.	4300663.	2537176.
EGG CONC.= TC=	.4689	.4465	2.4163	.4339	.2114	.0856	.3179	.4936	.1144
***** = 16.00 DAYS									
TOTAL NO.(EGGS) =	39478124.	2230051.	20770700.	3191973.	1464734.	731431.	3291733.	4797896.	2999608.
EGG CONC.= TC=	.5299	.5073	2.7544	.5292	.2046	.0811	.3476	.5507	.1353
***** = 17.00 DAYS									
TOTAL NO.(EGGS) =	39478124.	2250747.	20824312.	2693555.	1473250.	849539.	3670952.	4886774.	2828996.
EGG CONC.= TC=	.5299	.5120	2.7615	.4466	.2058	.0942	.3876	.5609	.1276
***** = 18.00 DAYS									
TOTAL NO.(EGGS) =	39476124.	2251097.	20820541.	2667628.	1475337.	858201.	3693473.	4893104.	2818744.
EGG CONC.= TC=	.5299	.5121	2.7610	.4423	.2061	.0952	.3900	.5616	.1271
***** = 19.00 DAYS									
TOTAL NO.(EGGS) =	39476124.	2251097.	20820541.	2667628.	1475337.	858201.	3693473.	4893104.	2818744.
EGG CONC.= TC=	.5299	.5121	2.7610	.4423	.2061	.0952	.3900	.5616	.1271

***** T = .00 DAYS									
TOTAL NO.(EGGS) =	39478124.	2251097.	20820541.	2667628.	1475337.	858201.	3693473.	4993104.	2818744.
EGG CONC.= TC=	.5299	.5121	2.7610	.4423	.2061	.0952	.3900	.5616	.1271
***** T = 21.00 DAYS									
TOTAL NO.(EGGS) =	39478124.	2251097.	20820541.	2667628.	1475337.	858201.	3693473.	4993104.	2818744.
EGG CONC.= TC=	.5299	.5121	2.7610	.4423	.2061	.0952	.3900	.5616	.1271
***** T = 22.00 DAYS									
TOTAL NO.(EGGS) =	70394111.	3000020.	27705152.	5092799.	14744581.	5094487.	8646365.	4306343.	1804366.
EGG CONC.= TC=	.9448	.6925	3.6740	.8443	2.0594	.5649	.9130	.4943	.0814
***** T = 23.00 DAYS									
TOTAL NO.(EGGS) =	74943226.	3111588.	28731776.	5434486.	16568392.	5835855.	9273547.	4341659.	1645925.
EGG CONC.= TC=	1.0059	.7079	3.8101	.9010	2.3141	.6471	.9792	.4984	.0742
***** T = 24.00 DAYS									
TOTAL NO.(EGGS) =	74943226.	3111588.	28731776.	5434486.	16568392.	5835855.	9273547.	4341659.	1645925.
EGG CONC.= TC=	1.0059	.7079	3.8101	.9010	2.3141	.6471	.9792	.4984	.0742
***** T = 25.00 DAYS									
TOTAL NO.(EGGS) =	74943226.	3111588.	28731776.	5434486.	16568392.	5835855.	9273547.	4341659.	1645925.
EGG CONC.= TC=	1.0059	.7079	3.8101	.9010	2.3141	.6471	.9792	.4984	.0742
***** T = 26.00 DAYS									
TOTAL NO.(EGGS) =	74943226.	3111588.	28731776.	5434486.	16568392.	5835855.	9273547.	4341659.	1645925.
EGG CONC.= TC=	1.0059	.7079	3.8101	.9010	2.3141	.6471	.9792	.4984	.0742
***** T = 27.00 DAYS									
TOTAL NO.(EGGS) =	74943226.	3111588.	28731776.	5434486.	16568392.	5835855.	9273547.	4341659.	1645925.
EGG CONC.= TC=	1.0059	.7079	3.8101	.9010	2.3141	.6471	.9792	.4984	.0742
***** T = 28.00 DAYS									
TOTAL NO.(EGGS) =	74943226.	3111588.	28731776.	5434486.	16568392.	5835855.	9273547.	4341659.	1645925.
EGG CONC.= TC=	1.0059	.7079	3.8101	.9010	2.3141	.6471	.9792	.4984	.0742
***** T = 29.00 DAYS									
TOTAL NO.(EGGS) =	44085545.	431704.	4012678.	2821690.	17244762.	6936675.	9649356.	2324840.	663840.
EGG CONC.= TC=	.5917	.0982	.5321	.4678	2.4086	.7692	1.0189	.2669	.0299
***** T = 30.00 DAYS									
TOTAL NO.(EGGS) =	39545010.	46746.	429684.	2324116.	17338601.	7095958.	9690285.	2104736.	514884.
EGG CONC.= TC=	.5308	.0106	.0570	.3853	2.4217	.7868	1.0232	.2416	.0232
***** T = 31.00 DAYS									
TOTAL NO.(EGGS) =	39545010.	46746.	429684.	2324116.	17338601.	7095958.	9690285.	2104736.	514884.
EGG CONC.= TC=	.5308	.0106	.0570	.3853	2.4217	.7868	1.0232	.2416	.0232
***** T = 32.00 DAYS									
TOTAL NO.(EGGS) =	39545010.	46746.	429684.	2324116.	17338601.	7095958.	9690285.	2104736.	514884.
EGG CONC.= TC=	.5308	.0106	.0570	.3853	2.4217	.7868	1.0232	.2416	.0232
***** T = 33.00 DAYS									
TOTAL NO.(EGGS) =	39545010.	46746.	429684.	2324116.	17338601.	7095958.	9690285.	2104736.	514884.
EGG CONC.= TC=	.5308	.0106	.0570	.3853	2.4217	.7868	1.0232	.2416	.0232
***** T = 34.00 DAYS									
TOTAL NO.(EGGS) =	39545010.	46746.	429684.	2324116.	17338601.	7095958.	9690285.	2104736.	514884.
EGG CONC.= TC=	.5308	.0106	.0570	.3853	2.4217	.7868	1.0232	.2416	.0232
***** T = 35.00 DAYS									
TOTAL NO.(EGGS) =	39545010.	46746.	429684.	2324116.	17338601.	7095958.	9690285.	2104736.	514884.
EGG CONC.= TC=	.5308	.0106	.0570	.3853	2.4217	.7868	1.0232	.2416	.0232
***** T = 36.00 DAYS									
TOTAL NO.(EGGS) =	5072445.	7241.	66558.	260086.	2102593.	1019207.	1112231.	369740.	114789.
EGG CONC.= TC=	.0681	.0016	.0088	.0464	.2937	.1130	.1174	.0424	.0052
***** T = 37.00 DAYS									
TOTAL NO.(EGGS) =	0.	0.	0.	0.	0.	0.	0.	0.	0.
EGG CONC.= TC=	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
***** T = 38.00 DAYS									
TOTAL NO.(EGGS) =	0.	0.	0.	0.	0.	0.	0.	0.	0.
EGG CONC.= TC=	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
***** T = 39.00 DAYS									
TOTAL NO.(EGGS) =	0.	0.	0.	0.	0.	0.	0.	0.	0.
EGG CONC.= TC=	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

LARVAL SECTION

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******T =      6.50 DAYS
TOTAL NO.(LARV) =        6328514.   263236.  2706801.  1448047.  1024584.   648097.   206046.    20429.     7474.
LAR.CONC.= TC=      .0649      .0599      .3589      .2401      .1431      .0719      .0212      .0034      .0003
******T =     11.50 DAYS
TOTAL NO.(LARV) =        9649504.   122690.  1430400.  1617943.  2259171.  1909671.   889118.   261345.   159178.
LAR.CONC.= TC=      .1151      .0279      .1897      .2682      .3155      .2118      .0939      .0300      .0072
******T =     16.50 DAYS
TOTAL NO.(LARV) =       16251071.   382156.  3786785.  1818040.  2350828.  2899818.  2283925.  1343503.  1386016.
LAR.CONC.= TC=      .2191      .0869      .5022      .3014      .3283      .3216      .2412      .1542      .0625
******T =     21.50 DAYS
TOTAL NO.(LARV) =       37366413.  1259369. 12477970.  4974665.  3086739.  3087663.  3919631.  3460688.  5099690.
LAR.CONC.= TC=      .5015      .2865      1.6547      .8247      .4311      .3424      .4139      .3972      .2300
******T =     26.50 DAYS
TOTAL NO.(LARV) =       68015759.  1841025. 18349253.  8443600. 11044137.  7934087.  7271378.  5288854.  7843423.
LAR.CONC.= TC=      .9129      .4188      2.4333      1.3999      1.5425      .8798      .7678      .6071      .3537
******T =     31.50 DAYS
TOTAL NO.(LARV) =       79653929.  1255962. 13003987.  8693311. 16461733. 13239504. 10284503.  6584435. 10130497.
LAR.CONC.= TC=      1.0691      .2857      1.7244      1.4413      2.2992      1.4681      1.0860      .7558      .4568
******T =     36.50 DAYS
TOTAL NO.(LARV) =       81960904.   521405.  5714273.  6329092. 18704456. 17784539. 13201804.  7861309. 11844033.
LAR.CONC.= TC=      1.1001      .1186      .7578      1.0493      2.6125      1.9721      1.3940      .9023      .5341
******T =     41.50 DAYS
TOTAL NO.(LARV) =       58668981.   249355.  2831273.  3522230.  9794221. 13331166. 10175403.  6514893. 12250440.
LAR.CONC.= TC=      .7875      .0567      .3755      .5840      1.3680      1.4782      1.0745      .7478      .5524
******T =     46.50 DAYS
TOTAL NO.(LARV) =       42196613.   134836.  1567917.  1965476.  5095970.  8926894.  7842355.  5409238. 11253926.
LAR.CONC.= TC=      .5664      .0307      .2079      .3259      .7118      .9899      .8281      .6209      .5075
******T =     51.50 DAYS
TOTAL NO.(LARV) =       29329661.    79847.   927965.  1093537.  2742175.  5648365.  5569996.  4146754.  9121022.
LAR.CONC.= TC=      .3937      .0182      .1231      .1813      .3830      .6263      .5882      .4760      .4113
******T =     56.50 DAYS
TOTAL NO.(LARV) =       16636458.    41909.   435090.   326346.  1057887.  2935265.  3241725.  2587544.  6010691.
LAR.CONC.= TC=      .2233      .0095      .0577      .0541      .1478      .3255      .3423      .2970      .2710
******T =     61.50 DAYS
TOTAL NO.(LARV) =        6237270.    15346.   150416.    74434.   296336.  1020964.  1210754.  1014859.  2454162.
LAR.CONC.= TC=      .0837      .0035      .0199      .0123      .0414      .1132      .1276      .1165      .1107
******T =     66.50 DAYS
TOTAL NO.(LARV) =        151057.        6.       127.       490.      1480.     14201.     27089.     28832.    79733.
LAR.CONC.= TC=      .0020      .0000      .0000      .0001      .0002      .0016      .0029      .0033      .0036
******T =     71.50 DAYS
TOTAL NO.(LARV) =        141338.        4.       117.       450.      1191.     11363.     22272.     25751.    80191.
LAR.CONC.= TC=      .0019      .0000      .0000      .0001      .0002      .0013      .0024      .0030      .0036
******T =     76.50 DAYS
TOTAL NO.(LARV) =         41840.        1.        35.       135.       334.      3173.      6304.      7520.    24338.
LAR.CONC.= TC=      .0006      .0000      .0000      .0000      .0000      .0004      .0007      .0009      .0011
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******T =     40.00 DAYS
TOTAL NO.(EGGS) =          0.          0.          0.          0.          0.          0.          0.          0.          0.
EGG CONC.= TC=        .0000       .0000       .0000       .0000       .0000       .0000       .0000       .0000       .0000
******T =     41.00 DAYS
TOTAL NO.(EGGS) =          0.          0.          0.          0.          0.          0.          0.          0.          0.
EGG CONC.= TC=        .0000       .0000       .0000       .0000       .0000       .0000       .0000       .0000       .0000
******T =     42.00 DAYS
TOTAL NO.(EGGS) =          0.          0.          0.          0.          0.          0.          0.          0.          0.
EGG CONC.= TC=        .0000       .0000       .0000       .0000       .0000       .0000       .0000       .0000       .0000
******T =     43.00 DAYS
TOTAL NO.(EGGS) =     189490.         12.        114.        376.       2907.      22803.     127558.      26639.       9082.
EGG CONC.= TC=        .0025       .0000       .0000       .0001       .0004       .0025       .0135       .0031       .0004
******T =     44.00 DAYS
TOTAL NO.(EGGS) =     217372.         14.        130.        421.       3304.      26253.     143970.      32409.      10871.
EGG CONC.= TC=        .0029       .0000       .0000       .0001       .0005       .0029       .0152       .0037       .0005
******T =     45.00 DAYS
TOTAL NO.(EGGS) =     217372.         14.        130.        421.       3304.      26253.     143970.      32409.      10871.
EGG CONC.= TC=        .0029       .0000       .0000       .0001       .0005       .0029       .0152       .0037       .0005
******T =     46.00 DAYS
TOTAL NO.(EGGS) =     217372.         14.        130.        421.       3304.      26253.     143970.      32409.      10871.
EGG CONC.= TC=        .0029       .0000       .0000       .0001       .0005       .0029       .0152       .0037       .0005
******T =     47.00 DAYS
TOTAL NO.(EGGS) =     217372.         12.        125.        431.       3270.      26861.     143975.      31861.      10837.
EGG CONC.= TC=        .0029       .0000       .0000       .0001       .0005       .0030       .0152       .0037       .0005
******T =     48.00 DAYS
TOTAL NO.(EGGS) =     217372.         12.        125.        431.       3264.      26892.     143981.      31839.      10828.
EGG CONC.= TC=        .0029       .0000       .0000       .0001       .0005       .0030       .0152       .0037       .0005
******T =     49.00 DAYS
TOTAL NO.(EGGS) =     217372.         12.        125.        431.       3264.      26892.     143981.      31839.      10828.
EGG CONC.= TC=        .0029       .0000       .0000       .0001       .0005       .0030       .0152       .0037       .0005
******T =     50.00 DAYS
TOTAL NO.(EGGS) =      27882.          1.         16.         50.        397.       3663.      16448.       5599.       1707.
EGG CONC.= TC=        .0004       .0000       .0000       .0000       .0001       .0004       .0017       .0006       .0001
**********LARVAE PRODUCTION TABLE**********

TOTAL NO.(LARV) =   215772530.    7523270.   70531249.   17900307.   46515699.   22722219.   26267269.   15509809.    8802688.
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**********JUV. I PRODUCTION TABLE**********

TOTAL NO.(JUV. 1) =	34114324.	50496.	694605.	1244078.	2517626.	5259761.	5752493.	5001550.	13593717.

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******T =     39.50 DAYS
TOTAL NO.(J 1 ) =    2519651.     24346.     28615.     49780.    133384.    441682.    507683.    407415.    926746.
J1  CONC.= TC=        .0338      .0055      .0038      .0083      .0186      .0490      .0536      .0468      .0418
******T =     49.50 DAYS
TOTAL NO.(J 1 ) =    6316656.     81612.    122471.    289296.    576399.    947789.    940963.    854310.   2503817.
J1  CONC.= TC=        .0846      .0186      .0162      .0480      .0805      .1051      .0994      .0961      .1129
******T =     59.50 DAYS
TOTAL NO.(J 1 ) =   16544319.    278733.    599147.    966858.   1527326.   2464258.   2561694.   2272341.   5883962.
J1  CONC.= TC=        .2221      .0634      .0781      .1603      .2133      .2733      .2705      .2608      .2653
******T =     69.50 DAYS
TOTAL NO.(J 1 ) =   15685216.    479799.    752097.    864758.   1272810.   2288321.   2517856.   2261499.   5249075.
J1  CONC.= TC=        .2105      .1089      .0997      .1434      .1778      .2537      .2659      .2596      .2367
******T =     79.50 DAYS
TOTAL NO.(J 1 ) =    8936883.    447712.    573926.    629059.    815328.   1270439.   1378931.   1260283.   2561207.
J1  CONC.= TC=        .1200      .1019      .0761      .1043      .1139      .1409      .1456      .1447      .1155
******T =     89.50 DAYS
TOTAL NO.(J 1 ) =    2529396.    144871.    185264.    224905.    289037.    408088.    442745.    415561.    718924.
J1  CONC.= TC=        .0380      .0330      .0246      .0373      .0404      .0453      .0468      .0477      .0324
******T =     99.50 DAYS
TOTAL NO.(J 1 ) =      56374.      2948.      3327.      3960.      4943.      6711.      8508.      9638.     16139.
J1  CONC.= TC=        .0008      .0007      .0004      .0007      .0007      .0007      .0009      .0011      .0007
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**********..V. 2 PRODUCTION TABLE**********

TOTAL NO.(JUV. 2) =	8,835,839.	670,399.	714,074.	739,895.	867,473.	1,208,631.	1,271,131.	1,170,796.	2,193,441.

JUPITER 2 SECTION

******T = 60.50 DAYS									
TOTAL NO.(J 2) =	391160.	49444.	31550.	47725.	81128.	144263.	148067.	114734.	274238.
J2 CONC.= TC=	.0120	.0112	.0042	.0079	.0113	.0160	.0156	.0132	.0124
******T = 70.50 DAYS									
TOTAL NO.(J 2) =	2160089.	138717.	126793.	141092.	182301.	283804.	296300.	268123.	720961.
J2 CONC.= TC=	.0290	.0316	.0168	.0234	.0255	.0315	.0315	.0308	.0325
******T = 80.50 DAYS									
TOTAL NO.(J 2) =	5931219.	454697.	468503.	459504.	522340.	733008.	765400.	702306.	1825461.
J2 CONC.= TC=	.0796	.1034	.0621	.0762	.0730	.0813	.0808	.0806	.0823
******T = 90.50 DAYS									
TOTAL NO.(J 2) =	8111968.	536781.	577830.	598225.	698586.	966976.	1017678.	939994.	2775899.
J2 CONC.= TC=	.1099	.1221	.0766	.0992	.0976	.1072	.1075	.1079	.1252
******T = 109.50 DAYS									
TOTAL NO.(J 2) =	7749791.	466870.	502319.	520057.	606049.	838654.	882935.	816318.	3115789.
J2 CONC.= TC=	.1040	.1062	.0666	.0862	.0848	.0930	.0932	.0937	.1405
******T = 119.50 DAYS									
TOTAL NO.(J 2) =	7346269.	397413.	427614.	442689.	516564.	713847.	751526.	694706.	3401909.
J2 CONC.= TC=	.0986	.0904	.0567	.0734	.0721	.0792	.0794	.0797	.1534
******T = 129.50 DAYS									
TOTAL NO.(J 2) =	6942169.	332913.	358229.	370636.	432703.	597911.	629445.	581732.	3638421.
J2 CONC.= TC=	.0932	.0757	.0475	.0615	.0604	.0663	.0665	.0668	.1641
******T = 139.50 DAYS									
TOTAL NO.(J 2) =	6530757.	273093.	293856.	304179.	354902.	490347.	516169.	476910.	3821310.
J2 CONC.= TC=	.0877	.0621	.0390	.0504	.0496	.0544	.0545	.0547	.1723
******T = 149.50 DAYS									
TOTAL NO.(J 2) =	6110186.	217966.	234547.	242772.	283229.	391263.	411823.	380360.	3948226.
J2 CONC.= TC=	.0820	.0496	.0311	.0402	.0396	.0434	.0435	.0437	.1780
******T = 159.50 DAYS									
TOTAL NO.(J 2) =	5694530.	167778.	180540.	186861.	217976.	301055.	317158.	294376.	4018786.
J2 CONC.= TC=	.0763	.0382	.0239	.0310	.0304	.0334	.0335	.0338	.1812
******T = 169.50 DAYS									
TOTAL NO.(J 2) =	5263235.	122685.	132034.	136659.	159395.	220068.	233417.	224272.	4034705.
J2 CONC.= TC=	.0706	.0279	.0175	.0227	.0223	.0244	.0246	.0257	.1819
******T = 179.50 DAYS									
TOTAL NO.(J 2) =	4860236.	82262.	88538.	91634.	106858.	147456.	163649.	191218.	3988622.
J2 CONC.= TC=	.0652	.0187	.0117	.0152	.0149	.0164	.0173	.0219	.1799
******T = 189.50 DAYS									
TOTAL NO.(J 2) =	4490112.	47251.	50854.	52622.	61349.	84611.	106074.	178067.	3909264.
J2 CONC.= TC=	.0603	.0107	.0067	.0087	.0086	.0094	.0112	.0204	.1763
******T = 199.50 DAYS									
TOTAL NO.(J 2) =	4153991.	17872.	19236.	19898.	23195.	31981.	57860.	166704.	3817245.
J2 CONC.= TC=	.0558	.0041	.0026	.0033	.0032	.0035	.0061	.0191	.1721

**********_ ENTLE 3 PRODUCTION TABLE**********

TOT JUV? PROD=	3857044.	-0.	0.	-0.	-0.	4464.	27582.	156528.	3668470.			
FACTOR	0.	0.	0.	0.	0.	0.	14680.	0.				
FACTOR	.00000	.00000	.00000	.00000	.00000	.00000	.00580	.00000				
TOT JUV? CONC=	.0518	-.0000	.0000	-.0000	-.0000	.0005	.0029	.0180	.1654			

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******T =   217.00 DAYS
TOTAL NO.(J 3 ) =   3069674.        0.        4.       14.      105.     4255.    25969.   147786.  2891541.
J3 CONC.=  TC=      .0412     .0000     .0000     .0000     .0000     .0005     .0027     .0170     .1304
******T =   227.00 DAYS
TOTAL NO.(J 3 ) =   2657872.        1.        5.       19.      142.     4042.    24480.   138522.  2490262.
J3 CONC.=  TC=      .0357     .0000     .0000     .0000     .0000     .0004     .0026     .0159     .1123
******T =   237.00 DAYS
TOTAL NO.(J 3 ) =   2358948.        1.        6.       22.      159.     3837.    23093.   130376.  2201454.
J3 CONC.=  TC=      .0317     .0000     .0000     .0000     .0000     .0004     .0024     .0150     .0993
******T =   247.00 DAYS
TOTAL NO.(J 3 ) =   2114497.        1.        6.       23.      169.     3640.    21797.   122264.  1966599.
J3 CONC.=  TC=      .0284     .0000     .0000     .0000     .0000     .0004     .0023     .0140     .0887
******T =   257.00 DAYS
TOTAL NO.(J 3 ) =   1903250.        1.        6.       24.      174.     3453.    20582.   114612.  1764399.
J3 CONC.=  TC=      .0255     .0000     .0000     .0000     .0000     .0004     .0022     .0132     .0796
******T =   267.00 DAYS
TOTAL NO.(J 3 ) =   1715810.        1.        6.       24.      176.     3275.    19442.   107419.  1585467.
J3 CONC.=  TC=      .0230     .0000     .0000     .0000     .0000     .0004     .0021     .0123     .0715
******T =   277.00 DAYS
TOTAL NO.(J 3 ) =   1547583.        1.        6.       24.      177.     3106.    18371.   100671.  1425227.
J3 CONC.=  TC=      .0208     .0000     .0000     .0000     .0000     .0003     .0019     .0116     .0643
******T =   287.00 DAYS
TOTAL NO.(J 3 ) =   1396098.        1.        6.       24.      177.     2945.    17365.    94348.  1281232.
J3 CONC.=  TC=      .0187     .0000     .0000     .0000     .0000     .0003     .0016     .0108     .0578
******T =   297.00 DAYS
TOTAL NO.(J 3 ) =   1259904.        1.        6.       24.      175.     2793.    16418.    88429.  1151959.
J3 CONC.=  TC=      .0169     .0000     .0000     .0000     .0000     .0003     .0017     .0102     .0519
******T =   307.00 DAYS
TOTAL NO.(J 3 ) =   1137502.        1.        6.       24.      173.     2649.    15526.    82893.  1036232.
J3 CONC.=  TC=      .0153     .0000     .0000     .0000     .0000     .0003     .0016     .0095     .0467
******T =   317.00 DAYS
TOTAL NO.(J 3 ) =   1026084.        1.        6.       23.      169.     2511.    14686.    77718.   932970.
J3 CONC.=  TC=      .0136     .0000     .0000     .0000     .0000     .0003     .0016     .0089     .0421
******T =   327.00 DAYS
TOTAL NO.(J 3 ) =    930445.        1.        6.       23.      165.     2381.    13894.    72882.   841092.
J3 CONC.=  TC=      .0125     .0000     .0000     .0000     .0000     .0003     .0015     .0084     .0379
******T =   337.00 DAYS
TOTAL NO.(J 3 ) =    843471.        1.        6.       22.      161.     2258.    13147.    68366.   759510.
J3 CONC.=  TC=      .0113     .0000     .0000     .0000     .0000     .0003     .0014     .0078     .0342
******T =   347.00 DAYS
TOTAL NO.(J 3 ) =    766064.        1.        6.       21.      156.     2141.    12442.    64149.   687148.
J3 CONC.=  TC=      .0103     .0000     .0000     .0000     .0000     .0002     .0013     .0074     .0310
******T =   357.00 DAYS
TOTAL NO.(J 3 ) =    697171.        1.        5.       21.      151.     2029.    11777.    60211.   622976.
J3 CONC.=  TC=      .0094     .0000     .0000     .0000     .0000     .0002     .0012     .0069     .0281
**********ADULT 1 PRODUCTION TABLE**********

TOTAL NO.(J 3 ) =    647525.        1.        5.       20.      146.     1945.    11271.    57250.   576887.
J3 CONC.=  TC=      .0087     .0000     .0000     .0000     .0000     .0002     .0012     .0066     .0260
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ADULT SECTION

FACTOR	0.	0.	0.	0.	0.	0.	30260.	0.	
FACTOR	.00000	.00000	.00000	.00000	.00000	.00000	.07439	.00000	

CURRENT YEAR 0
TOTAL ADULTS = 923086.
TOTAL EGGS IN ESTUARY = 2157749800.

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	647525.	2	194257.	3	58277.	4	17483.	5	4210.
6	1014.	7	244.	8	59.	9	14.	10	3.
11	1.	12	0.	13	0.				

EQUILIBRIUM (I.O) = .9947458-00

BEGIN EGG PRODUCTION

******T = 1.00 DAYS									
TOTAL NO.(EGGS) =	7812007.	533220.	4939068.	769282.	1181053.	343921.	37195.	5925.	2343.
EGG CONC.= TC=	.1049	.1213	.6550	.1275	.1650	.0381	.0039	.0007	.0001
******T = 2.00 DAYS									
TOTAL NO.(EGGS) =	8961492.	605994.	5627113.	925563.	1334039.	413601.	45573.	6791.	2818.
EGG CONC.= TC=	.1203	.1379	.7462	.1534	.1863	.0459	.0048	.0008	.0001
******T = 3.00 DAYS									
TOTAL NO.(EGGS) =	8961492.	605994.	5627113.	925563.	1334039.	413601.	45573.	6791.	2818.
EGG CONC.= TC=	.1203	.1379	.7462	.1534	.1863	.0459	.0048	.0008	.0001
******T = 4.00 DAYS									
TOTAL NO.(EGGS) =	8961492.	605994.	5627113.	925563.	1334039.	413601.	45573.	6791.	2818.
EGG CONC.= TC=	.1203	.1379	.7462	.1534	.1863	.0459	.0048	.0008	.0001
******T = 5.00 DAYS									
TOTAL NO.(EGGS) =	8961492.	605994.	5627113.	925563.	1334039.	413601.	45573.	6791.	2818.
EGG CONC.= TC=	.1203	.1379	.7462	.1534	.1863	.0459	.0048	.0008	.0001
******T = 6.00 DAYS									
TOTAL NO.(EGGS) =	8961492.	605994.	5627113.	925563.	1334039.	413601.	45573.	6791.	2818.
EGG CONC.= TC=	.1203	.1379	.7462	.1534	.1863	.0459	.0048	.0008	.0001
******T = 7.00 DAYS									
TOTAL NO.(EGGS) =	8961492.	605994.	5627113.	925563.	1334039.	413601.	45573.	6791.	2818.
EGG CONC.= TC=	.1203	.1379	.7462	.1534	.1863	.0459	.0048	.0008	.0001
******T = 8.00 DAYS									
TOTAL NO.(EGGS) =	4690765.	85912.	808812.	428662.	2123703.	681368.	359350.	146781.	56177.
EGG CONC.= TC=	.0630	.0195	.1073	.0711	.2966	.0756	.0379	.0168	.0025
******T = 9.00 DAYS									
TOTAL NO.(EGGS) =	4062167.	16061.	147627.	307420.	2221996.	733949.	400319.	167540.	67256.
EGG CONC.= TC=	.0545	.0037	.0196	.0510	.3103	.0814	.0423	.0192	.0030
******T = 10.00 DAYS									
TOTAL NO.(EGGS) =	4062167.	16061.	147627.	307420.	2221996.	733949.	400319.	167540.	67256.
EGG CONC.= TC=	.0545	.0037	.0196	.0510	.3103	.0814	.0423	.0192	.0030
******T = 11.00 DAYS									
TOTAL NO.(EGGS) =	4062167.	16061.	147627.	307420.	2221996.	733949.	400319.	167540.	67256.
EGG CONC.= TC=	.0545	.0037	.0196	.0510	.3103	.0814	.0423	.0192	.0030
******T = 12.00 DAYS									
TOTAL NO.(EGGS) =	4062167.	16061.	147627.	307420.	2221996.	733949.	400319.	167540.	67256.
EGG CONC.= TC=	.0545	.0037	.0196	.0510	.3103	.0814	.0423	.0192	.0030
******T = 13.00 DAYS									
TOTAL NO.(EGGS) =	4062167.	16061.	147627.	307420.	2221996.	733949.	400319.	167540.	67256.
EGG CONC.= TC=	.0545	.0037	.0196	.0510	.3103	.0814	.0423	.0192	.0030
******T = 14.00 DAYS									
TOTAL NO.(EGGS) =	4062167.	16061.	147627.	307420.	2221996.	733949.	400319.	167540.	67256.
EGG CONC.= TC=	.0545	.0037	.0196	.0510	.3103	.0814	.0423	.0192	.0030
******T = 15.00 DAYS									
TOTAL NO.(EGGS) =	34913914.	1962841.	18223543.	2617624.	1513900.	772010.	3011536.	4280140.	2532321.
EGG CONC.= TC=	.4696	.4465	2.4166	.4340	.2114	.0856	.3180	.4913	.1142
******T = 16.00 DAYS									
TOTAL NO.(EGGS) =	39448613.	2230299.	20772994.	3192330.	1464974.	731422.	3293529.	4770379.	2992688.
EGG CONC.= TC=	.5295	.5074	2.7547	.5293	.2046	.0811	.3478	.5476	.1350
******T = 17.00 DAYS									
TOTAL NO.(EGGS) =	39448345.	2251058.	20827195.	2693951.	1473483.	849884.	3670354.	4858873.	2823547.
EGG CONC.= TC=	.5295	.5121	2.7619	.4466	.2058	.0942	.3876	.5577	.1273
******T = 18.00 DAYS									
TOTAL NO.(EGGS) =	39448291.	2251409.	20823430.	2668021.	1475571.	858553.	3692813.	4865166.	2813331.
EGG CONC.= TC=	.5295	.5122	2.7614	.4423	.2061	.0952	.3899	.5584	.1269
******T = 19.00 DAYS									
TOTAL NO.(EGGS) =	39448291.	2251409.	20823430.	2668021.	1475571.	858553.	3692813.	4865166.	2813331.
EGG CONC.= TC=	.5295	.5122	2.7614	.4423	.2061	.0952	.3899	.5584	.1269

******T = 20.00 DAYS									
TOTAL NO.(EGGS) =	39448291.	2251409.	20823430.	2668021.	1475571.	858553.	3692813.	4865166.	2813331.
EGG CONC.= TC=	.5295	.5122	2.7614	.4423	.2061	.0952	.3899	.5564	.1269
******T = 21.00 DAYS									
TOTAL NO.(EGGS) =	39446291.	2251409.	20823430.	2668021.	1475571.	858553.	3692813.	4865166.	2813331.
EGG CONC.= TC=	.5295	.5122	2.7614	.4423	.2061	.0952	.3899	.5564	.1269
******T = 22.00 DAYS									
TOTAL NO.(EGGS) =	70348475.	3000086.	27705765.	5092900.	14744662.	5094661.	8645556.	4285631.	1799217.
EGG CONC.= TC=	.9445	.6925	3.6740	.8444	2.0594	.5649	.9129	.4919	.0811
******T = 23.00 DAYS									
TOTAL NO.(EGGS) =	74918478.	3111574.	28731643.	5434454.	16568340.	5835948.	9272763.	4322760.	1640998.
EGG CONC.= TC=	1.0056	.7079	3.8101	.9010	2.3141	.6471	.9792	.4962	.0740
******T = 24.00 DAYS									
TOTAL NO.(EGGS) =	74918478.	3111574.	28731643.	5434454.	16568340.	5835948.	9272763.	4322760.	1640998.
EGG CONC.= TC=	1.0056	.7079	3.8101	.9010	2.3141	.6471	.9792	.4962	.0740
******T = 25.00 DAYS									
TOTAL NO.(EGGS) =	74918478.	3111574.	28731643.	5434454.	16568340.	5835948.	9272763.	4322760.	1640998.
EGG CONC.= TC=	1.0056	.7079	3.8101	.9010	2.3141	.6471	.9792	.4962	.0740
******T = 26.00 DAYS									
TOTAL NO.(EGGS) =	74918478.	3111574.	28731643.	5434454.	16568340.	5835948.	9272763.	4322760.	1640998.
EGG CONC.= TC=	1.0056	.7079	3.8101	.9010	2.3141	.6471	.9792	.4962	.0740
******T = 27.00 DAYS									
TOTAL NO.(EGGS) =	74918478.	3111574.	28731643.	5434454.	16568340.	5835948.	9272763.	4322760.	1640998.
EGG CONC.= TC=	1.0056	.7079	3.8101	.9010	2.3141	.6471	.9792	.4962	.0740
******T = 28.00 DAYS									
TOTAL NO.(EGGS) =	74918478.	3111574.	28731643.	5434454.	16568340.	5835948.	9272763.	4322760.	1640998.
EGG CONC.= TC=	1.0056	.7079	3.8101	.9010	2.3141	.6471	.9792	.4962	.0740
******T = 29.00 DAYS									
TOTAL NO.(EGGS) =	44071767.	431683.	4012483.	2821485.	17243405.	6936129.	9648027.	2317139.	661417.
EGG CONC.= TC=	.5915	.0982	.5321	.4678	2.4084	.7691	1.0188	.2660	.0298
******T = 30.00 DAYS									
TOTAL NO.(EGGS) =	39535176.	46742.	429640.	2323900.	17336975.	7095256.	9689075.	2100863.	512726.
EGG CONC.= TC=	.5306	.0106	.0570	.3853	2.4215	.7868	1.0231	.2411	.0231
******T = 31.00 DAYS									
TOTAL NO.(EGGS) =	39535176.	46742.	429640.	2323900.	17336975.	7095256.	9689075.	2100863.	512726.
EGG CONC.= TC=	.5306	.0106	.0570	.3853	2.4215	.7868	1.0231	.2411	.0231
******T = 32.00 DAYS									
TOTAL NO.(EGGS) =	39535176.	46742.	429640.	2323900.	17336975.	7095256.	9689075.	2100863.	512726.
EGG CONC.= TC=	.5306	.0106	.0570	.3853	2.4215	.7868	1.0231	.2411	.0231
******T = 33.00 DAYS									
TOTAL NO.(EGGS) =	39535176.	46742.	429640.	2323900.	17336975.	7095256.	9689075.	2100863.	512726.
EGG CONC.= TC=	.5306	.0106	.0570	.3853	2.4215	.7868	1.0231	.2411	.0231
******T = 34.00 DAYS									
TOTAL NO.(EGGS) =	39535176.	46742.	429640.	2323900.	17336975.	7095256.	9689075.	2100863.	512726.
EGG CONC.= TC=	.5306	.0106	.0570	.3853	2.4215	.7868	1.0231	.2411	.0231
******T = 35.00 DAYS									
TOTAL NO.(EGGS) =	39535176.	46742.	429640.	2323900.	17336975.	7095256.	9689075.	2100863.	512726.
EGG CONC.= TC=	.5306	.0106	.0570	.3853	2.4215	.7868	1.0231	.2411	.0231
******T = 36.00 DAYS									
TOTAL NO.(EGGS) =	5068904.	7240.	66547.	280039.	2102237.	1019036.	1111944.	367921.	113840.
EGG CONC.= TC=	.0680	.0016	.0088	.0464	.2936	.1130	.1174	.0422	.0051
******T = 37.00 DAYS									
TOTAL NO.(EGGS) =	0.	0.	0.	0.	0.	0.	0.	0.	0.
EGG CONC.= TC=	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
******T = 38.00 DAYS									
TOTAL NO.(EGGS) =	0.	0.	0.	0.	0.	0.	0.	0.	0.
EGG CONC.= TC=	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
******T = 39.00 DAYS									
TOTAL NO.(EGGS) =	0.	0.	0.	0.	0.	0.	0.	0.	0.
EGG CONC.= TC=	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

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******T =      .00 DAYS
TOTAL NO.(E    ) =          0.        0.        0.        0.        0.        0.        0.        0.        0.
EGG CONC.= TC=      .0000     .0000     .0000     .0000     .0000     .0000     .0000     .0000     .0000
******T =    41.00 DAYS
TOTAL NO.(EGGS) =          0.        0.        0.        0.        0.        0.        0.        0.        0.
EGG CONC.= TC=      .0000     .0000     .0000     .0000     .0000     .0000     .0000     .0000     .0000
******T =    42.00 DAYS
TOTAL NO.(EGGS) =          0.        0.        0.        0.        0.        0.        0.        0.        0.
EGG CONC.= TC=      .0000     .0000     .0000     .0000     .0000     .0000     .0000     .0000     .0000
******T =    43.00 DAYS
TOTAL NO.(EGGS) =     189403.       12.      114.      375.     2906.    22798.   127529.    26604.     9065.
EGG CONC.= TC=      .0025     .0000     .0000     .0001     .0004     .0025     .0135     .0031     .0004
******T =    44.00 DAYS
TOTAL NO.(EGGS) =     217231.       14.      130.      420.     3304.    26246.   143934.    32344.    10840.
EGG CONC.= TC=      .0029     .0000     .0000     .0001     .0005     .0029     .0152     .0037     .0005
******T =    45.00 DAYS
TOTAL NO.(EGGS) =     217231.       14.      130.      420.     3304.    26246.   143934.    32344.    10840.
EGG CONC.= TC=      .0029     .0000     .0000     .0001     .0005     .0029     .0152     .0037     .0005
******T =    46.00 DAYS
TOTAL NO.(EGGS) =     217231.       14.      130.      420.     3304.    26246.   143934.    32344.    10840.
EGG CONC.= TC=      .0029     .0000     .0000     .0001     .0005     .0029     .0152     .0037     .0005
******T =    47.00 DAYS
TOTAL NO.(EGGS) =     217233.       12.      125.      431.     3269.    26853.   143936.    31798.    10807.
EGG CONC.= TC=      .0029     .0000     .0000     .0001     .0005     .0030     .0152     .0036     .0005
******T =    48.00 DAYS
TOTAL NO.(EGGS) =     217233.       12.      125.      431.     3263.    26884.   143942.    31776.    10799.
EGG CONC.= TC=      .0029     .0000     .0000     .0001     .0005     .0030     .0152     .0036     .0005
******T =    49.00 DAYS
TOTAL NO.(EGGS) =     217233.       12.      125.      431.     3263.    26884.   143942.    31776.    10799.
EGG CONC.= TC=      .0029     .0000     .0000     .0001     .0005     .0030     .0152     .0036     .0005
******T =    50.00 DAYS
TOTAL NO.(EGGS) =      27829.        1.       16.       50.      397.     3661.    16438.     5570.     1695.
EGG CONC.= TC=      .0004     .0000     .0000     .0000     .0001     .0004     .0017     .0006     .0001
**********LARVAE PRODUCTION TABLE**********


TOTAL NO.(LARV) =   215533760.  7523643. 70534743. 17900415. 46511431. 22720449. 26254900. 15333333.  8754835.
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LARVAL SECTION

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******T =      6.50 DAYS
TOTAL NO.(LARV) =      6378042.    263229.   2706718.   1447985.   1024541.    648059.    200861.     29266.      7382.
LAR.CONC.= TC=      .0849      .0599      .3589      .2401      .1431      .0719      .0212      .0034      .0003
******T =     11.50 DAYS
TOTAL NO.(LARV) =      8642362.    122663.   1430201.   1617642.   2258716.   1908952.    889568.    257870.    156750.
LAR.CONC.= TC=      .1160      .0279      .1897      .2682      .3155      .2117      .0939      .0296      .0071
******T =     16.50 DAYS
TOTAL NO.(LARV) =     16202129.    382120.   3786402.   1817448.   2350275.   2896756.   2284974.   1317749.   1366404.
LAR.CONC.= TC=      .2175      .0869      .5021      .3013      .3283      .3212      .2413      .1513      .0616
******T =     21.50 DAYS
TOTAL NO.(LARV) =     37143119.   1258932.  12473409.   4971910.   3084925.   3085021.   3893820.   3358403.   5016698.
LAR.CONC.= TC=      .4985      .2864     1.6541      .8243      .4309      .3421      .4112      .3855      .2262
******T =     26.50 DAYS
TOTAL NO.(LARV) =     67607239.   1840407.  18341995.   8436119.  11037195.   7927686.   7221645.   5129753.   7672434.
LAR.CONC.= TC=      .9074      .4187     2.4323     1.3986     1.5416      .8791      .7626      .5888      .3460
******T =     31.50 DAYS
TOTAL NO.(LARV) =     79078993.   1255468.  12997761.   8684779.  16448552.  13225829.  10213939.   6380997.   9871652.
LAR.CONC.= TC=     1.0614      .2856     1.7236     1.4398     2.2974     1.4666     1.0785      .7324      .4452
******T =     36.50 DAYS
TOTAL NO.(LARV) =     81252318.    520895.   5708233.   6321536.  18691338.  17763700.  13114213.   7621332.  11511071.
LAR.CONC.= TC=     1.0906      .1185      .7570     1.0480     2.6106     1.9698     1.3848      .8748      .5191
******T =     41.50 DAYS
TOTAL NO.(LARV) =     57897104.    248999.   2827021.   3516251.   9781721.  13307716.  10078261.   6273530.  11863606.
LAR.CONC.= TC=      .7771      .0566      .3749      .5830     1.3662     1.4756     1.0642      .7201      .5350
******T =     46.50 DAYS
TOTAL NO.(LARV) =     41467173.    134605.   1565069.   1961385.   5087185.   8905633.   7749914.   5191165.  10872217.
LAR.CONC.= TC=      .5566      .0306      .2075      .3252      .7105      .9875      .8184      .5959      .4903
******T =     51.50 DAYS
TOTAL NO.(LARV) =     28712654.     79697.    926098.   1090989.   2736956.   5630615.   5487224.   3964084.   8796990.
LAR.CONC.= TC=      .3854      .0181      .1228      .1809      .3823      .6244      .5794      .4550      .3967
******T =     56.50 DAYS
TOTAL NO.(LARV) =     16216119.     41841.    434315.    325545.   1055861.   2923910.   3184225.   2464096.   5786325.
LAR.CONC.= TC=      .2177      .0095      .0576      .0540      .1475      .3242      .3362      .2828      .2609
******T =     61.50 DAYS
TOTAL NO.(LARV) =      6054567.     15320.    150157.     74299.    295785.   1016024.   1185479.    962095.   2355417.
LAR.CONC.= TC=      .0813      .0035      .0199      .0123      .0413      .1127      .1252      .1104      .1062
******T =     66.50 DAYS
TOTAL NO.(LARV) =       146022.         4.       127.       490.      1477.     14087.     26240.     27091.     76506.
LAR.CONC.= TC=      .0020      .0000      .0000      .0001      .0002      .0016      .0028      .0031      .0034
******T =     71.50 DAYS
TOTAL NO.(LARV) =       134599.         4.       116.       449.      1184.     11211.     21347.     23952.     76336.
LAR.CONC.= TC=      .0018      .0000      .0000      .0001      .0002      .0012      .0023      .0027      .0034
******T =     76.50 DAYS
TOTAL NO.(LARV) =        29616.         1.        35.       135.       331.      3119.      6006.      6952.     23037.
LAR.CONC.= TC=      .0005      .0000      .0000      .0000      .0000      .0003      .0006      .0008      .0010
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********** I PRODUCTION TABLE**********

TOTAL NO.(JUV. I) =	33112364.	50369.	692783.	1240524.	2510361.	5231323.	5625051.	4734655.	13027298.

******T = 39.50 DAYS									
TOTAL NO.(J 1) =	2452198.	23724.	27985.	49079.	132454.	439348.	499247.	389175.	891184.
J1 CONC.= TC=	.0329	.0054	.0037	.0081	.0185	.0487	.0527	.0447	.0402
******T = 49.50 DAYS									
TOTAL NO.(J 1) =	6122007.	79236.	119964.	286160.	572021.	939988.	918663.	809580.	2396396.
J1 CONC.= TC=	.0822	.0180	.0159	.0474	.0799	.1042	.0970	.0929	.1081
******T = 59.50 DAYS									
TOTAL NO.(J 1) =	16069372.	271236.	580779.	957458.	1516143.	2444219.	2501913.	2156669.	5640955.
J1 CONC.= TC=	.2157	.0617	.0770	.1587	.2118	.2710	.2642	.2475	.2544
******T = 69.50 DAYS									
TOTAL NO.(J 1) =	15206393.	465423.	737463.	849843.	1256523.	2262647.	2454849.	2148545.	5030701.
J1 CONC.= TC=	.2041	.1059	.0978	.1409	.1755	.2509	.2592	.2467	.2269
******T = 79.50 DAYS									
TOTAL NO.(J 1) =	8664946.	435276.	560276.	614624.	800059.	1251348.	1343225.	1202648.	2457491.
J1 CONC.= TC=	.1163	.0990	.0743	.1019	.1117	.1388	.1418	.1380	.1108
******T = 89.50 DAYS									
TOTAL NO.(J 1) =	2734269.	140442.	179190.	217525.	281068.	399153.	429794.	397442.	689655.
J1 CONC.= TC=	.0367	.0320	.0238	.0361	.0393	.0443	.0454	.0456	.0311
******T = 99.50 DAYS									
TOTAL NO.(J 1) =	53067.	2776.	3132.	3724.	4647.	6322.	8000.	9231.	15234.
J1 CONC.= TC=	.0007	.0006	.0004	.0006	.0006	.0007	.0008	.0011	.0007

**********J PRODUCTION TABLE**********

TOTAL NO.(JUV. 2) =	8565324.	648770.	694495.	721414.	848908.	1187173.	1237767.	1120717.	2106081.

JUVENILE 2 SECTION

******T = 69.50 DAYS									
TOTAL NO.(J 2) =	865634.	47439.	30295.	46207.	79416.	142683.	145599.	109962.	264032.
J2 CONC.= TC=	.0116	.0108	.0040	.0077	.0111	.0158	.0154	.0126	.0119
******T = 79.50 DAYS									
TOTAL NO.(J 2) =	2094036.	133476.	123020.	137887.	179160.	279862.	291285.	256164.	693182.
J2 CONC.= TC=	.0281	.0304	.0163	.0229	.0250	.0310	.0308	.0294	.0313
******T = 89.50 DAYS									
TOTAL NO.(J 2) =	5758404.	440272.	456974.	449907.	513060.	721742.	746361.	672278.	1757809.
J2 CONC.= TC=	.0773	.1002	.0606	.0746	.0717	.0800	.0788	.0772	.0793
******T = 99.50 DAYS									
TOTAL NO.(J 2) =	7864067.	519676.	562048.	583219.	683498.	949545.	990723.	899685.	2675472.
J2 CONC.= TC=	.1056	.1182	.0745	.0967	.0955	.1053	.1046	.1033	.1206
******T = 109.50 DAYS									
TOTAL NO.(J 2) =	7511974.	451886.	488473.	506870.	593576.	823344.	859381.	781414.	3007030.
J2 CONC.= TC=	.1006	.1028	.0648	.0840	.0829	.0913	.0907	.0897	.1356
******T = 119.50 DAYS									
TOTAL NO.(J 2) =	7124247.	384835.	416016.	431660.	505496.	701139.	731818.	665322.	3287962.
J2 CONC.= TC=	.0956	.0875	.0552	.0716	.0706	.0777	.0773	.0764	.1483
******T = 129.50 DAYS									
TOTAL NO.(J 2) =	6740026.	322729.	348890.	361991.	423896.	587915.	613619.	557750.	3523229.
J2 CONC.= TC=	.0905	.0734	.0463	.0600	.0592	.0652	.0648	.0640	.1589
******T = 139.50 DAYS									
TOTAL NO.(J 2) =	6352683.	265217.	286722.	297472.	348322.	483048.	504134.	458123.	3709646.
J2 CONC.= TC=	.0853	.0603	.0380	.0493	.0487	.0536	.0532	.0526	.1673
******T = 149.50 DAYS									
TOTAL NO.(J 2) =	5959160.	212226.	229432.	238021.	278686.	386426.	403255.	366327.	3844786.
J2 CONC.= TC=	.0800	.0483	.0304	.0395	.0389	.0428	.0426	.0420	.1734
******T = 159.50 DAYS									
TOTAL NO.(J 2) =	5561211.	163844.	177129.	183752.	215121.	298223.	311534.	284649.	3926958.
J2 CONC.= TC=	.0746	.0373	.0235	.0305	.0300	.0331	.0329	.0327	.1771
******T = 169.50 DAYS									
TOTAL NO.(J 2) =	5165759.	120175.	129938.	134799.	157793.	218668.	230062.	218134.	3956191.
J2 CONC.= TC=	.0693	.0273	.0172	.0223	.0220	.0242	.0243	.0250	.1784
******T = 179.50 DAYS									
TOTAL NO.(J 2) =	4784841.	80788.	87359.	90622.	106056.	146892.	161908.	188146.	3923069.
J2 CONC.= TC=	.0642	.0184	.0116	.0150	.0148	.0163	.0171	.0216	.1769
******T = 189.50 DAYS									
TOTAL NO.(J 2) =	4431722.	46524.	50307.	52175.	61047.	84505.	105169.	175776.	3856220.
J2 CONC.= TC=	.0595	.0106	.0067	.0087	.0085	.0094	.0111	.0202	.1739
******T = 199.50 DAYS									
TOTAL NO.(J 2) =	4108159.	17635.	19070.	19772.	23131.	32010.	57400.	164848.	3774293.
J2 CONC.= TC=	.0551	.0040	.0025	.0033	.0032	.0035	.0061	.0189	.1702

**********. T[illegible]F 3 PRODUCTION TABLE**********

TOT JUV3 PROD=	3819026.	-0.	0.	-0.	-0.	4418.	27298.	154984.	3632326.
TOT JUV3 CONC=	.0513	-.0000	.0000	-.0000	-.0000	.0005	.0029	.0178	.1638

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******T =   217.00 DAYS
TOTAL NO.(J 3 ) =   3051370.      0.      4.     14.    100.   4207.  25683.  145900.  2875462.
J3 CONC.=  TC=      .0410   .0000   .0000   .0000   .0000   .0005   .0027   .0167   .1297
******T =   227.00 DAYS
TOTAL NO.(J 3 ) =   2642665.      1.      5.     18.    133.   3993.  24194.  136445.  2477876.
J3 CONC.=  TC=      .0355   .0000   .0000   .0000   .0000   .0004   .0026   .0157   .1117
******T =   237.00 DAYS
TOTAL NO.(J 3 ) =   2344224.      1.      5.     20.    148.   3787.  22806.  127261.  2190195.
J3 CONC.=  TC=      .0315   .0000   .0000   .0000   .0000   .0004   .0024   .0146   .0988
******T =   247.00 DAYS
TOTAL NO.(J 3 ) =   2099526.      1.      6.     21.    155.   3590.  21509.  118527.  1955718.
J3 CONC.=  TC=      .0282   .0000   .0000   .0000   .0000   .0004   .0023   .0136   .0882
******T =   257.00 DAYS
TOTAL NO.(J 3 ) =   1887044.      1.      6.     22.    157.   3403.  20295.  110295.  1753667.
J3 CONC.=  TC=      .0253   .0000   .0000   .0000   .0000   .0004   .0021   .0127   .0791
******T =   267.00 DAYS
TOTAL NO.(J 3 ) =   1699993.      1.      6.     22.    158.   3225.  19156.  102571.  1574856.
J3 CONC.=  TC=      .0228   .0000   .0000   .0000   .0000   .0004   .0020   .0118   .0710
******T =   277.00 DAYS
TOTAL NO.(J 3 ) =   1531465.      1.      6.     21.    157.   3056.  18086.   95344.  1414795.
J3 CONC.=  TC=      .0206   .0000   .0000   .0000   .0000   .0003   .0019   .0109   .0638
******T =   287.00 DAYS
TOTAL NO.(J 3 ) =   1379817.      1.      6.     21.    154.   2896.  17081.   88594.  1271064.
J3 CONC.=  TC=      .0185   .0000   .0000   .0000   .0000   .0003   .0018   .0102   .0573
******T =   297.00 DAYS
TOTAL NO.(J 3 ) =   1243495.      1.      5.     21.    151.   2744.  16136.   82298.  1142138.
J3 CONC.=  TC=      .0167   .0000   .0000   .0000   .0000   .0003   .0017   .0094   .0515
******T =   307.00 DAYS
TOTAL NO.(J 3 ) =   1121279.      1.      5.     20.    147.   2600.  15247.   76434.  1026825.
J3 CONC.=  TC=      .0150   .0000   .0000   .0000   .0000   .0003   .0016   .0088   .0463
******T =   317.00 DAYS
TOTAL NO.(J 3 ) =   1012038.      1.      5.     20.    143.   2464.  14410.   70977.   924019.
J3 CONC.=  TC=      .0136   .0000   .0000   .0000   .0000   .0003   .0015   .0081   .0417
******T =   327.00 DAYS
TOTAL NO.(J 3 ) =    914641.      1.      5.     19.    138.   2334.  13621.   65904.   832619.
J3 CONC.=  TC=      .0123   .0000   .0000   .0000   .0000   .0003   .0014   .0076   .0375
******T =   337.00 DAYS
TOTAL NO.(J 3 ) =    827954.      1.      5.     16.    133.   2212.  12878.   61192.   751516.
J3 CONC.=  TC=      .0111   .0000   .0000   .0000   .0000   .0002   .0014   .0070   .0339
******T =   347.00 DAYS
TOTAL NO.(J 3 ) =    750862.      0.      5.     17.    127.   2095.  12177.   56819.   679621.
J3 CONC.=  TC=      .0101   .0000   .0000   .0000   .0000   .0002   .0013   .0065   .0306
******T =   357.00 DAYS
TOTAL NO.(J 3 ) =    682301.      0.      4.     17.    121.   1985.  11516.   52763.   615894.
J3 CONC.=  TC=      .0092   .0000   .0000   .0000   .0000   .0002   .0012   .0061   .0278
**********ADULT 1 PRODUCTION TABLE**********

TOTAL NO.(J 3 ) =    622927.      0.      4.     16.    116.   1901.  11014.   49732.   570143.
J3 CONC.=  TC=      .0085   .0000   .0000   .0000   .0000   .0002   .0012   .0057   .0257
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ADULT SECTION

CURRENT YEAR 1
TOTAL ADULTS = 908488.
TOTAL EGGS IN ESTUARY = 2157749800.

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	622027.	2	194257.	3	56277.	4	17483.	5	4210.
6	1014.	7	244.	8	59.	9	14.	10	3.
11	1.	12	0.	13	0.				

EQUILIBRIUM (1.0) = .9723200-00

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******T =     69.50 DAYS
TOTAL NO.(J 2 ) =     291169.     49444.     31550.     47725.     81128.    144263.    146067.    114734.    274239.
J2  CONC.= TC=        .0120      .0112      .0042      .0079      .0113      .0160      .0156      .0132      .0124
******T =     79.50 DAYS
TOTAL NO.(J 2 ) =    2160069.    139717.    126793.    141092.    182301.    283804.    298300.    268123.    720961.
J2  CONC.= TC=        .0290      .0316      .0168      .0234      .0255      .0315      .0315      .0308      .0325
******T =     89.50 DAYS
TOTAL NO.(J 2 ) =    5931219.    454697.    468503.    459504.    522340.    733008.    765400.    702306.   1825461.
J2  CONC.= TC=        .0796      .1034      .0621      .0762      .0730      .0813      .0808      .0806      .0823
******T =     99.50 DAYS
TOTAL NO.(J 2 ) =    8111968.    536781.    577830.    598225.    696586.    966976.   1017678.    939994.   2775899.
J2  CONC.= TC=        .1099      .1221      .0766      .0992      .0976      .1072      .1075      .1079      .1252
******T =    109.50 DAYS
TOTAL NO.(J 2 ) =    7749791.    466870.    502319.    520057.    606849.    838654.    882935.    816318.   3115789.
J2  CONC.= TC=        .1040      .1062      .0666      .0862      .0848      .0930      .0932      .0937      .1405
******T =    119.50 DAYS
TOTAL NO.(J 2 ) =    7346269.    397413.    427614.    442689.    516564.    713847.    751526.    694706.   3401909.
J2  CONC.= TC=        .0986      .0904      .0567      .0734      .0721      .0792      .0794      .0797      .1534
******T =    129.50 DAYS
TOTAL NO.(J 2 ) =    6942189.    332913.    358229.    370636.    432703.    597911.    629445.    581732.   3638421.
J2  CONC.= TC=        .0932      .0757      .0475      .0615      .0604      .0663      .0665      .0668      .1641
******T =    139.50 DAYS
TOTAL NO.(J 2 ) =    6530757.    273083.    293856.    304179.    354902.    490347.    516169.    476910.   3821310.
J2  CONC.= TC=        .0877      .0621      .0390      .0504      .0496      .0544      .0545      .0547      .1723
******T =    149.50 DAYS
TOTAL NO.(J 2 ) =    6110186.    217966.    234547.    242772.    283229.    391263.    411823.    380360.   3948226.
J2  CONC.= TC=        .0820      .0496      .0311      .0402      .0396      .0434      .0435      .0437      .1780
******T =    159.50 DAYS
TOTAL NO.(J 2 ) =    5694530.    167778.    180540.    186861.    217976.    301055.    317158.    294376.   4018786.
J2  CONC.= TC=        .0763      .0382      .0239      .0310      .0304      .0334      .0335      .0338      .1812
******T =    169.50 DAYS
TOTAL NO.(J 2 ) =    5263235.    122685.    132034.    136659.    159395.    220068.    233417.    224272.   4034705.
J2  CONC.= TC=        .0706      .0279      .0175      .0227      .0223      .0244      .0246      .0257      .1819
******T =    179.50 DAYS
TOTAL NO.(J 2 ) =    4860236.     82262.     88538.     91634.    106658.    147456.    163649.    191218.   3988622.
J2  CONC.= TC=        .0652      .0187      .0117      .0152      .0149      .0164      .0173      .0219      .1799
******T =    189.50 DAYS
TOTAL NO.(J 2 ) =    4490112.     47251.     50854.     52622.     61349.     84611.    106074.    178067.   3909284.
J2  CONC.= TC=        .0603      .0107      .0067      .0087      .0086      .0094      .0112      .0204      .1763
******T =    199.50 DAYS
TOTAL NO.(J 2 ) =    4153991.     17672.     19236.     19898.     23195.     31981.     57860.    166704.   3817245.
J2  CONC.= TC=        .0558      .0041      .0026      .0033      .0032      .0035      .0061      .0191      .1721
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BEGIN EGG PRODUCTION

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******T =      1.00 DAYS
TOTAL NO.(EGGS) =     7512028.    533220.   4939070.    769283.   1181053.    343922.     37196.      5936.      2340.
EGG CONC.= TC=          .1049       .1213       .6550       .1275       .1650       .0381       .0039       .0007       .0001
******T =      2.00 DAYS
TOTAL NO.(EGGS) =     8961524.    605994.   5627117.    925563.   1334040.    413602.     45574.      6809.      2825.
EGG CONC.= TC=          .1203       .1379       .7462       .1534       .1863       .0459       .0048       .0008       .0001
******T =      3.00 DAYS
TOTAL NO.(EGGS) =     8961524.    605994.   5627117.    925563.   1334040.    413602.     45574.      6809.      2825.
EGG CONC.= TC=          .1203       .1379       .7462       .1534       .1863       .0459       .0048       .0008       .0001
******T =      4.00 DAYS
TOTAL NO.(EGGS) =     8961524.    605994.   5627117.    925563.   1334040.    413602.     45574.      6809.      2825.
EGG CONC.= TC=          .1203       .1379       .7462       .1534       .1863       .0459       .0048       .0008       .0001
******T =      5.00 DAYS
TOTAL NO.(EGGS) =     8961524.    605994.   5627117.    925563.   1334040.    413602.     45574.      6809.      2825.
EGG CONC.= TC=          .1203       .1379       .7462       .1534       .1863       .0459       .0048       .0008       .0001
******T =      6.00 DAYS
TOTAL NO.(EGGS) =     8961524.    605994.   5627117.    925563.   1334040.    413602.     45574.      6809.      2825.
EGG CONC.= TC=          .1203       .1379       .7462       .1534       .1863       .0459       .0048       .0008       .0001
******T =      7.00 DAYS
TOTAL NO.(EGGS) =     8961524.    605994.   5627117.    925563.   1334040.    413602.     45574.      6809.      2825.
EGG CONC.= TC=          .1203       .1379       .7462       .1534       .1863       .0459       .0048       .0008       .0001
******T =      8.00 DAYS
TOTAL NO.(EGGS) =     4691497.     85913.    808818.    428672.   2123775.    681392.    359344.    147292.     56291.
EGG CONC.= TC=          .0630       .0195       .1073       .0711       .2966       .0756       .0379       .0160       .0025
******T =      9.00 DAYS
TOTAL NO.(EGGS) =     4063187.     16062.    147634.    307432.   2222092.    733989.    400302.    168253.     67424.
EGG CONC.= TC=          .0545       .0037       .0196       .0510       .3104       .0814       .0423       .0193       .0030
******T =     10.00 DAYS
TOTAL NO.(EGGS) =     4063187.     16062.    147634.    307432.   2222092.    733989.    400302.    168253.     67424.
EGG CONC.= TC=          .0545       .0037       .0196       .0510       .3104       .0814       .0423       .0193       .0030
******T =     11.00 DAYS
TOTAL NO.(EGGS) =     4063187.     16062.    147634.    307432.   2222092.    733989.    400302.    168253.     67424.
EGG CONC.= TC=          .0545       .0037       .0196       .0510       .3104       .0814       .0423       .0193       .0030
******T =     12.00 DAYS
TOTAL NO.(EGGS) =     4063187.     16062.    147634.    307432.   2222092.    733989.    400302.    168253.     67424.
EGG CONC.= TC=          .0545       .0037       .0196       .0510       .3104       .0814       .0423       .0193       .0030
******T =     13.00 DAYS
TOTAL NO.(EGGS) =     4063187.     16062.    147634.    307432.   2222092.    733989.    400302.    168253.     67424.
EGG CONC.= TC=          .0545       .0037       .0196       .0510       .3104       .0814       .0423       .0193       .0030
******T =     14.00 DAYS
TOTAL NO.(EGGS) =     4063187.     16062.    147634.    307432.   2222092.    733989.    400302.    168253.     67424.
EGG CONC.= TC=          .0545       .0037       .0196       .0510       .3104       .0814       .0423       .0193       .0030
******T =     15.00 DAYS
TOTAL NO.(EGGS) =    34935445.   1962629.  18221577.   2617339.   1513740.    771930.   3010392.   4300663.   2537176.
EGG CONC.= TC=          .4689       .4465      2.4163       .4339       .2114       .0856       .3179       .4936       .1144
******T =     16.00 DAYS
TOTAL NO.(EGGS) =    39478124.   2230051.  20770700.   3191973.   1464734.    731431.   3291733.   4797896.   2999608.
EGG CONC.= TC=          .5299       .5073      2.7544       .5292       .2046       .0811       .3476       .5507       .1353
******T =     17.00 DAYS
TOTAL NO.(EGGS) =    39478124.   2250747.  20824312.   2693555.   1473250.    849539.   3670952.   4886774.   2828996.
EGG CONC.= TC=          .5299       .5120      2.7615       .4466       .2058       .0942       .3676       .5609       .1276
******T =     18.00 DAYS
TOTAL NO.(EGGS) =    39478124.   2251097.  20820541.   2667628.   1475337.    858201.   3693473.   4893104.   2818744.
EGG CONC.= TC=          .5299       .5121      2.7610       .4423       .2061       .0952       .3900       .5616       .1271
******T =     19.00 DAYS
TOTAL NO.(EGGS) =    39478124.   2251097.  20820541.   2667628.   1475337.    858201.   3693473.   4893104.   2818744.
EGG CONC.= TC=          .5299       .5121      2.7610       .4423       .2061       .0952       .3900       .5616       .1271
```

ALTERNATE NT FILE
"E SUM,E RAM1,CB1001, ,X11523,1200,10000 DEC. 7, 1972
ICC NUMBER= RAM1

Migration Run <J1 stage varies>
differential mortality
(J2, J3 stationary)

BALANCE TO EQUILIBRIUM.....
KO= .39010230-02 KN= .39010230-02 D= .22118911-08 I= 9
END OF FORMAT.....

Larval $K_0 = .25 K_E$

TIME T= .00 EGG ENTRAINED= -24. -- RATE
0. 0. 0. 0. 0. 0. -24. 0.
TIME T= 1.00 EGG ENTRAINED= 14. -- RATE
0. 0. 0. 0. 0. 0. 14. 0.
TIME T= 2.00 EGG ENTRAINED= 22. -- RATE
0. 0. 0. 0. 0. 0. 22. 0.
TIME T= 3.00 EGG ENTRAINED= 22. -- RATE
0. 0. 0. 0. 0. 0. 22. 0.
TIME T= 4.00 EGG ENTRAINED= 22. -- RATE
0. 0. 0. 0. 0. 0. 22. 0.
TIME T= 5.00 EGG ENTRAINED= 22. -- RATE
0. 0. 0. 0. 0. 0. 22. 0.
TIME T= 6.00 EGG ENTRAINED= 22. -- RATE
0. 0. 0. 0. 0. 0. 22. 0.
TIME T= 7.00 EGG ENTRAINED= 398. -- RATE
0. 0. 0. 0. 0. 0. 398. 0.
TIME T= 8.00 EGG ENTRAINED= 1698. -- RATE
0. 0. 0. 0. 0. 0. 1698. 0.
TIME T= 9.00 EGG ENTRAINED= 1877. -- RATE
0. 0. 0. 0. 0. 0. 1877. 0.
TIME T= 10.00 EGG ENTRAINED= 1877. -- RATE
0. 0. 0. 0. 0. 0. 1877. 0.
TIME T= 11.00 EGG ENTRAINED= 1877. -- RATE
0. 0. 0. 0. 0. 0. 1877. 0.
TIME T= 12.00 EGG ENTRAINED= 1877. -- RATE
0. 0. 0. 0. 0. 0. 1877. 0.
TIME T= 13.00 EGG ENTRAINED= 1877. -- RATE
0. 0. 0. 0. 0. 0. 1877. 0.
TIME T= 14.00 EGG ENTRAINED= 16712. -- RATE
0. 0. 0. 0. 0. 0. 16712. 0.
TIME T= 15.00 EGG ENTRAINED= 67708. -- RATE

0.	0.	0.	0.	0.	0.	67708.	0.	
TIME T=	16.00	EGG ENTRAINED=	72920.	-- RATE				
0.	0.	0.	0.	0.	0.	72920.	0.	
TIME T=	17.00	EGG ENTRAINED=	73457.	-- RATE				
0.	0.	0.	0.	0.	0.	73457.	0.	
TIME T=	18.00	EGG ENTRAINED=	73487.	-- RATE				
0.	0.	0.	0.	0.	0.	73487.	0.	
TIME T=	19.00	EGG ENTRAINED=	73487.	-- RATE				
0.	0.	0.	0.	0.	0.	73487.	0.	
TIME T=	20.00	EGG ENTRAINED=	73487.	-- RATE				
0.	0.	0.	0.	0.	0.	73487.	0.	
TIME T=	21.00	EGG ENTRAINED=	65815.	-- RATE				
0.	0.	0.	0.	0.	0.	65815.	0.	
TIME T=	22.00	EGG ENTRAINED=	48083.	-- RATE				
0.	0.	0.	0.	0.	0.	48083.	0.	
TIME T=	23.00	EGG ENTRAINED=	47510.	-- RATE				
0.	0.	0.	0.	0.	0.	47510.	0.	
TIME T=	24.00	EGG ENTRAINED=	47510.	-- RATE				
0.	0.	0.	0.	0.	0.	47510.	0.	
TIME T=	25.00	EGG ENTRAINED=	47510.	-- RATE				
0.	0.	0.	0.	0.	0.	47510.	0.	
TIME T=	26.00	EGG ENTRAINED=	47510.	-- RATE				
0.	0.	0.	0.	0.	0.	47510.	0.	
TIME T=	27.00	EGG ENTRAINED=	47510.	-- RATE				
0.	0.	0.	0.	0.	0.	47510.	0.	
TIME T=	28.00	EGG ENTRAINED=	37210.	-- RATE				
0.	0.	0.	0.	0.	0.	37210.	0.	
TIME T=	29.00	EGG ENTRAINED=	9061.	-- RATE				
0.	0.	0.	0.	0.	0.	9061.	0.	
TIME T=	30.00	EGG ENTRAINED=	6456.	-- RATE				
0.	0.	0.	0.	0.	0.	6456.	0.	
TIME T=	31.00	EGG ENTRAINED=	6456.	-- RATE				
0.	0.	0.	0.	0.	0.	6456.	0.	
TIME T=	32.00	EGG ENTRAINED=	6456.	-- RATE				
0.	0.	0.	0.	0.	0.	6456.	0.	
TIME T=	33.00	EGG ENTRAINED=	6456.	-- RATE				
0.	0.	0.	0.	0.	0.	6456.	0.	
TIME T=	34.00	EGG ENTRAINED=	6456.	-- RATE				
0.	0.	0.	0.	0.	0.	6456.	0.	
TIME T=	35.00	EGG ENTRAINED=	9241.	-- RATE				

0. 0. 0. 0. 0. 0. 9241. 0.

TIME T= 36.00 EGG ENTRAINED= 2464. -- RATE

0. 0. 0. 0. 0. 0. 2464. 0.

TIME T= 37.00 EGG ENTRAINED= 0. -- RATE

0. 0. 0. 0. 0. 0. 0. 0.

TIME T= 38.00 EGG ENTRAINED= 0. -- RATE

0. 0. 0. 0. 0. 0. 0. 0.

TIME T= 39.00 EGG ENTRAINED= 0. -- RATE

0. 0. 0. 0. 0. 0. 0. 0.

TIME T= 40.00 EGG ENTRAINED= 0. -- RATE

0. 0. 0. 0. 0. 0. 0. 0.

TIME T= 41.00 EGG ENTRAINED= 0. -- RATE

0. 0. 0. 0. 0. 0. 0. 0.

TIME T= 42.00 EGG ENTRAINED= -86. -- RATE

0. 0. 0. 0. 0. 0. -86. 0.

TIME T= 43.00 EGG ENTRAINED= 17. -- RATE

0. 0. 0. 0. 0. 0. 17. 0.

TIME T= 44.00 EGG ENTRAINED= 56. -- RATE

0. 0. 0. 0. 0. 0. 56. 0.

TIME T= 45.00 EGG ENTRAINED= 56. -- RATE

0. 0. 0. 0. 0. 0. 56. 0.

TIME T= 46.00 EGG ENTRAINED= 56. -- RATE

0. 0. 0. 0. 0. 0. 56. 0.

TIME T= 47.00 EGG ENTRAINED= 48. -- RATE

0. 0. 0. 0. 0. 0. 48. 0.

TIME T= 48.00 EGG ENTRAINED= 48. -- RATE

0. 0. 0. 0. 0. 0. 48. 0.

TIME T= 49.00 EGG ENTRAINED= 135. -- RATE

0. 0. 0. 0. 0. 0. 135. 0.

TIME T= 50.00 EGG ENTRAINED= 36. -- RATE

0. 0. 0. 0. 0. 0. 36. 0.

TIME T= 1.50 LARVAL ENTRAINED= 5. -- RATE

0. 0. 0. 0. 0. 0. 5. 0.

TIME T= 6.50 LARVAL ENTRAINED= 155. -- RATE

0. 0. 0. 0. 0. 0. 155. 0.

TIME T= 11.50 LARVAL ENTRAINED= 2235. -- RATE

0. 0. 0. 0. 0. 0. 2235. 0.

TIME T= 16.50 LARVAL ENTRAINED= 17306. -- RATE

0. 0. 0. 0. 0. 0. 17306. 0.

TIME T= 21.50 LARVAL ENTRAINED= 39486. -- RATE

```
0.        0.        0.        0.        0.        0.        39486.        0.
TIME T=    26.50 LARVAL ENTRAINED=    55966. -- RATE
0.        0.        0.        0.        0.        0.        55966.        0.
TIME T=    31.50 LARVAL ENTRAINED=    64716. -- RATE
0.        0.        0.        0.        0.        0.        64716.        0.
TIME T=    36.50 LARVAL ENTRAINED=    73823. -- RATE
0.        0.        0.        0.        0.        0.        73823.        0.
TIME T=    41.50 LARVAL ENTRAINED=    60646. -- RATE
0.        0.        0.        0.        0.        0.        60646.        0.
TIME T=    46.50 LARVAL ENTRAINED=    50171. -- RATE
0.        0.        0.        0.        0.        0.        50171.        0.
TIME T=    51.50 LARVAL ENTRAINED=    37781. -- RATE
0.        0.        0.        0.        0.        0.        37781.        0.
TIME T=    56.50 LARVAL ENTRAINED=    23329. -- RATE
0.        0.        0.        0.        0.        0.        23329.        0.
TIME T=    61.50 LARVAL ENTRAINED=    8066. -- RATE
0.        0.        0.        0.        0.        0.        8066.        0.
TIME T=    66.50 LARVAL ENTRAINED=    272. -- RATE
0.        0.        0.        0.        0.        0.        272.        0.
TIME T=    71.50 LARVAL ENTRAINED=    225. -- RATE
0.        0.        0.        0.        0.        0.        225.        0.
TIME T=    76.50 LARVAL ENTRAINED=    53. -- RATE
0.        0.        0.        0.        0.        0.        53.        0.
TIME T=    29.50 J1 ENT =    165. -- RATE
0.        0.        0.        0.        0.        0.        165.        0.
TIME T=    39.50 J1 ENT =    953. -- RATE
0.        0.        0.        0.        0.        0.        958.        0.
TIME T=    49.50 J1 ENT =    2020. -- RATE
0.        0.        0.        0.        0.        0.        2020.        0.
TIME T=    59.50 J1 ENT =    5541. -- RATE
0.        0.        0.        0.        0.        0.        5541.        0.
TIME T=    69.50 J1 ENT =    4996. -- RATE
0.        0.        0.        0.        0.        0.        4996.        0.
TIME T=    79.50 J1 ENT =    2810. -- RATE
0.        0.        0.        0.        0.        0.        2810.        0.
TIME T=    89.50 J1 ENT =    809. -- RATE
0.        0.        0.        0.        0.        0.        809.        0.
TIME T=    89.50 J1 ENT =    23. -- RATE
0.        0.        0.        0.        0.        0.        23.        0.
TIME T=    59.50 J2 IMPING.=    3. -- RATE
```

ALTERNATE NT FILE
ME RUN,0 RANI,CB1001, ,X11523,1200,10000 DEC. 7, 1972
LOG NUMBER= RANI

Migration Run <J1 stage varies>
differential mortality
(J2, J3 stationary)

BALANCE TO EQUILIBRIUM.....
KO= .39010261B-02 KN= .39010263D-02 D= .22118911-08 I= 9
END OF EQUAL.....

Sawal $K_0 = .25 K_E$

TIME T= .00 EGG ENTRAINED= -24. -- RATE
0. 0. 0. 0. 0. 0. -24. 0.
TIME T= 1.00 EGG ENTRAINED= 14. -- RATE
0. 0. 0. 0. 0. 0. 14. 0.
TIME T= 2.00 EGG ENTRAINED= 22. -- RATE
0. 0. 0. 0. 0. 0. 22. 0.
TIME T= 3.00 EGG ENTRAINED= 22. -- RATE
0. 0. 0. 0. 0. 0. 22. 0.
TIME T= 4.00 EGG ENTRAINED= 22. -- RATE
0. 0. 0. 0. 0. 0. 22. 0.
TIME T= 5.00 EGG ENTRAINED= 22. -- RATE
0. 0. 0. 0. 0. 0. 22. 0.
TIME T= 6.00 EGG ENTRAINED= 22. -- RATE
0. 0. 0. 0. 0. 0. 22. 0.
TIME T= 7.00 EGG ENTRAINED= 398. -- RATE
0. 0. 0. 0. 0. 0. 398. 0.
TIME T= 8.00 EGG ENTRAINED= 1698. -- RATE
0. 0. 0. 0. 0. 0. 1698. 0.
TIME T= 9.00 EGG ENTRAINED= 1877. -- RATE
0. 0. 0. 0. 0. 0. 1877. 0.
TIME T= 10.00 EGG ENTRAINED= 1877. -- RATE
0. 0. 0. 0. 0. 0. 1877. 0.
TIME T= 11.00 EGG ENTRAINED= 1877. -- RATE
0. 0. 0. 0. 0. 0. 1877. 0.
TIME T= 12.00 EGG ENTRAINED= 1877. -- RATE
0. 0. 0. 0. 0. 0. 1877. 0.
TIME T= 13.00 EGG ENTRAINED= 1877. -- RATE
0. 0. 0. 0. 0. 0. 1877. 0.
TIME T= 14.00 EGG ENTRAINED= 16712. -- RATE
0. 0. 0. 0. 0. 0. 16712. 0.
TIME T= 15.00 EGG ENTRAINED= 67708. -- RATE

0. 0. 0. 0. 0. 0. 67708. 0.

TIME T= 16.00 EGG ENTRAINED= 72920. -- RATE

0. 0. 0. 0. 0. 0. 72920. 0.

TIME T= 17.00 EGG ENTRAINED= 73457. -- RATE

0. 0. 0. 0. 0. 0. 73457. 0.

TIME T= 18.00 EGG ENTRAINED= 73487. -- RATE

0. 0. 0. 0. 0. 0. 73487. 0.

TIME T= 19.00 EGG ENTRAINED= 73487. -- RATE

0. 0. 0. 0. 0. 0. 73487. 0.

TIME T= 20.00 EGG ENTRAINED= 73487. -- RATE

0. 0. 0. 0. 0. 0. 73487. 0.

TIME T= 21.00 EGG ENTRAINED= 65815. -- RATE

0. 0. 0. 0. 0. 0. 65815. 0.

TIME T= 22.00 EGG ENTRAINED= 48083. -- RATE

0. 0. 0. 0. 0. 0. 48083. 0.

TIME T= 23.00 EGG ENTRAINED= 47510. -- RATE

0. 0. 0. 0. 0. 0. 47510. 0.

TIME T= 24.00 EGG ENTRAINED= 47510. -- RATE

0. 0. 0. 0. 0. 0. 47510. 0.

TIME T= 25.00 EGG ENTRAINED= 47510. -- RATE

0. 0. 0. 0. 0. 0. 47510. 0.

TIME T= 26.00 EGG ENTRAINED= 47510. -- RATE

0. 0. 0. 0. 0. 0. 47510. 0.

TIME T= 27.00 EGG ENTRAINED= 47510. -- RATE

0. 0. 0. 0. 0. 0. 47510. 0.

TIME T= 28.00 EGG ENTRAINED= 37210. -- RATE

0. 0. 0. 0. 0. 0. 37210. 0.

TIME T= 29.00 EGG ENTRAINED= 9061. -- RATE

0. 0. 0. 0. 0. 0. 9061. 0.

TIME T= 30.00 EGG ENTRAINED= 6456. -- RATE

0. 0. 0. 0. 0. 0. 6456. 0.

TIME T= 31.00 EGG ENTRAINED= 6456. -- RATE

0. 0. 0. 0. 0. 0. 6456. 0.

TIME T= 32.00 EGG ENTRAINED= 6456. -- RATE

0. 0. 0. 0. 0. 0. 6456. 0.

TIME T= 33.00 EGG ENTRAINED= 6456. -- RATE

0. 0. 0. 0. 0. 0. 6456. 0.

TIME T= 34.00 EGG ENTRAINED= 6456. -- RATE

0. 0. 0. 0. 0. 0. 6456. 0.

TIME T= 35.00 EGG ENTRAINED= 9241. -- RATE

0. 0. 0. 0. 0. 0. 9241. 0.
TIME T= 36.00 EGG ENTRAINED= 2464. -- RATE

0. 0. 0. 0. 0. 0. 2464. 0.
TIME T= 37.00 EGG ENTRAINED= 0. -- RATE

0. 0. 0. 0. 0. 0. 0. 0.
TIME T= 38.00 EGG ENTRAINED= 0. -- RATE

0. 0. 0. 0. 0. 0. 0. 0.
TIME T= 39.00 EGG ENTRAINED= 0. -- RATE

0. 0. 0. 0. 0. 0. 0. 0.
TIME T= 40.00 EGG ENTRAINED= 0. -- RATE

0. 0. 0. 0. 0. 0. 0. 0.
TIME T= 41.00 EGG ENTRAINED= 0. -- RATE

0. 0. 0. 0. 0. 0. 0. 0.
TIME T= 42.00 EGG ENTRAINED= -86. -- RATE

0. 0. 0. 0. 0. 0. -86. 0.
TIME T= 43.00 EGG ENTRAINED= 17. -- RATE

0. 0. 0. 0. 0. 0. 17. 0.
TIME T= 44.00 EGG ENTRAINED= 56. -- RATE

0. 0. 0. 0. 0. 0. 56. 0.
TIME T= 45.00 EGG ENTRAINED= 56. -- RATE

0. 0. 0. 0. 0. 0. 56. 0.
TIME T= 46.00 EGG ENTRAINED= 56. -- RATE

0. 0. 0. 0. 0. 0. 56. 0.
TIME T= 47.00 EGG ENTRAINED= 48. -- RATE

0. 0. 0. 0. 0. 0. 48. 0.
TIME T= 48.00 EGG ENTRAINED= 48. -- RATE

0. 0. 0. 0. 0. 0. 48. 0.
TIME T= 49.00 EGG ENTRAINED= 135. -- RATE

0. 0. 0. 0. 0. 0. 135. 0.
TIME T= 50.00 EGG ENTRAINED= 36. -- RATE

0. 0. 0. 0. 0. 0. 36. 0.
TIME T= 1.50 LARVAL ENTRAINED= 5. -- RATE

0. 0. 0. 0. 0. 0. 5. 0.
TIME T= 6.50 LARVAL ENTRAINED= 155. -- RATE

0. 0. 0. 0. 0. 0. 155. 0.
TIME T= 11.50 LARVAL ENTRAINED= 2235. -- RATE

0. 0. 0. 0. 0. 0. 2235. 0.
TIME T= 16.50 LARVAL ENTRAINED= 17308. -- RATE

0. 0. 0. 0. 0. 0. 17308. 0.
TIME T= 21.50 LARVAL ENTRAINED= 39486. -- RATE

```
0.        0.        0.        0.        0.        0.        39486.    0.
TIME T=   26.50 LARVAL ENTRAINED=        55966. -- RATE
0.        0.        0.        0.        0.        0.        55966.    0.
TIME T=   31.50 LARVAL ENTRAINED=        64716. -- RATE
0.        0.        0.        0.        0.        0.        64716.    0.
TIME T=   36.50 LARVAL ENTRAINED=        73823. -- RATE
0.        0.        0.        0.        0.        0.        73823.    0.
TIME T=   41.50 LARVAL ENTRAINED=        60846. -- RATE
0.        0.        0.        0.        0.        0.        60846.    0.
TIME T=   46.50 LARVAL ENTRAINED=        50171. -- RATE
0.        0.        0.        0.        0.        0.        50171.    0.
TIME T=   51.50 LARVAL ENTRAINED=        37781. -- RATE
0.        0.        0.        0.        0.        0.        37781.    0.
TIME T=   56.50 LARVAL ENTRAINED=        23329. -- RATE
0.        0.        0.        0.        0.        0.        23329.    0.
TIME T=   61.50 LARVAL ENTRAINED=        8066. -- RATE
0.        0.        0.        0.        0.        0.        8066.     0.
TIME T=   66.50 LARVAL ENTRAINED=        272. -- RATE
0.        0.        0.        0.        0.        0.        272.      0.
TIME T=   71.50 LARVAL ENTRAINED=        225. -- RATE
0.        0.        0.        0.        0.        0.        225.      0.
TIME T=   76.50 LARVAL ENTRAINED=        53. -- RATE
0.        0.        0.        0.        0.        0.        53.       0.
TIME T=   29.50 J1 ENT =                 165. -- RATE
0.        0.        0.        0.        0.        0.        165.      0.
TIME T=   39.50 J1 ENT =                 958. -- RATE
0.        0.        0.        0.        0.        0.        958.      0.
TIME T=   49.50 J1 ENT =                 2020. -- RATE
0.        0.        0.        0.        0.        0.        2020.     0.
TIME T=   59.50 J1 ENT =                 5541. -- RATE
0.        0.        0.        0.        0.        0.        5541.     0.
TIME T=   69.50 J1 ENT =                 4996. -- RATE
0.        0.        0.        0.        0.        0.        4996.     0.
TIME T=   79.50 J1 ENT =                 2810. -- RATE
0.        0.        0.        0.        0.        0.        2810.     0.
TIME T=   89.50 J1 ENT =                 809. -- RATE
0.        0.        0.        0.        0.        0.        809.      0.
TIME T=   99.50 J1 ENT =                 23. -- RATE
0.        0.        0.        0.        0.        0.        23.       0.
TIME T=   59.50 J2 IMPING.=              3. -- RATE
```

DOCUMENTATION FOR MATHEMATICAL MODELS OF THE HUDSON RIVER STRIPED BASS POPULATION

VOLUME II: COMPLETELY MIXED MODEL

July 1974

ANALYSIS:

The completely mixed model of the Hudson River striped bass population treats the river as a totally mixed volume of water in which the concentration or density of any fish life stage is the same at all points. Consequently, the completely mixed approach does not deal with the hydrodynamic characteristics of the Hudson. In preparing impact estimates, the assumption of complete mixing is considered to be conservative because it forces every organism in the River to be equally subject to entrainment, whereas in reality, only those organisms which pass Indian Point while they are in the entrainable stage and which do not avoid the plant are subject to entrainment by the Indian Point station.

Derivation of the equations and analysis for the completely mixed model documented below is presented in John P. Lawler's testimony of April 5, 1972 on "The Effect of Entrainment at Indian Point on the Population of the Hudson River Striped Bass".

HISTG:

Functional description:

HISTG is the main subroutine of the completely mixed model. It reads in all required input parameters. It writes or displays to the line printer all key inputs upon request. HISTG computes the fraction of total production on a per time step basis for each stage. It permits the superimposition of a temperature profile on the juvenile II stage. Averaging of values in the production table occurs when different time steps are used in various stages. That is, the production table must correspond to the way organisms are to be produced into the next stage. Combining of these impulse productions for purposes of consolidation is permitted. Superimposition of impulses is permitted. Random variation of early stage decay rate parameters grossly for the year and on a per step basis is permitted. Cycling of adults and reconciliation of completely mixed to transport model is effected. Compensation in adult year classes 1 thru 3 may occur if ICP = 1ϕ.

Inputs: see page #15 - #19 of the subroutine INPUT.

Equations: see HISTG, EQUAL, KXNEW, NRHAP, and analysis.

Outputs: report of adult population status on a year by year basis.

Referenced by: DMODEL

Subroutines called:

GROWTH

SWITCH

KXNEW

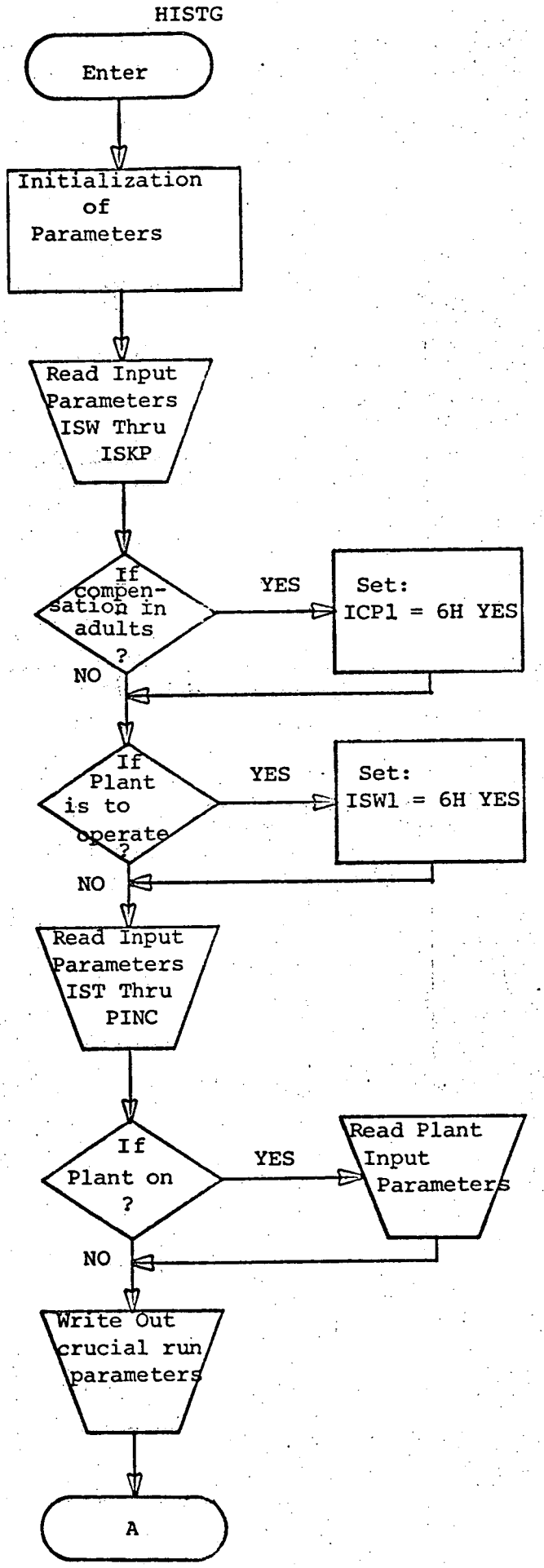
EQUAL

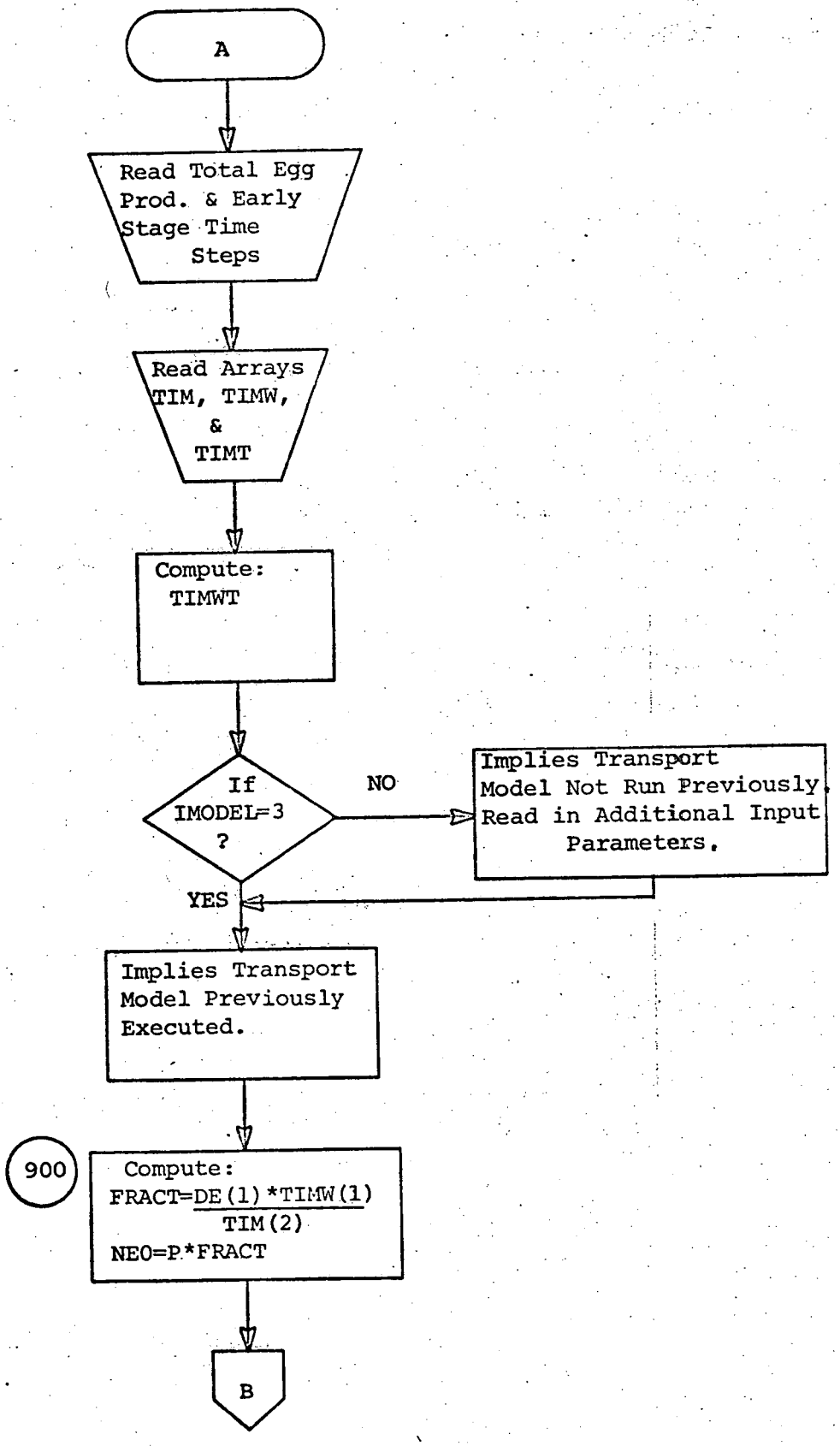
Special considerations:

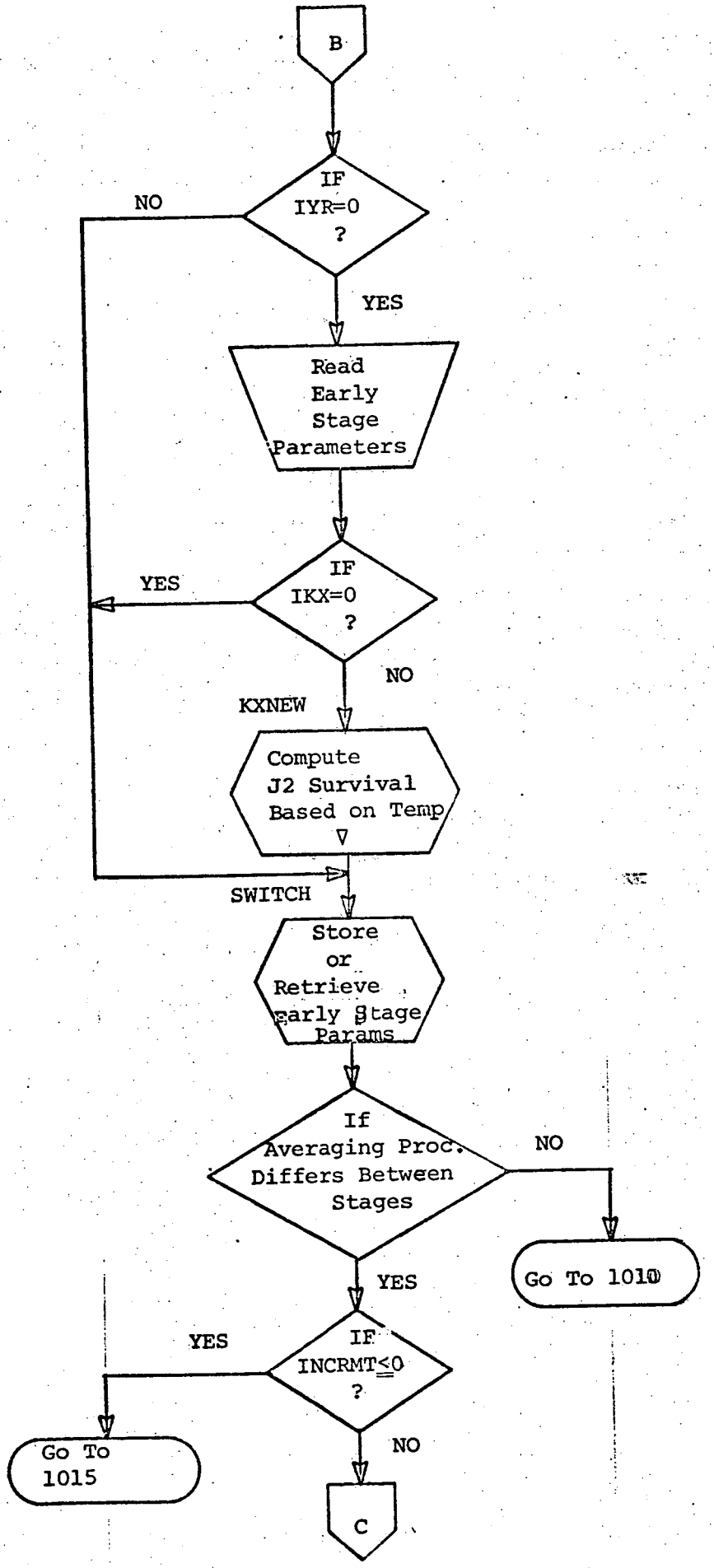
This routine is made to effect the same results as the transport model if

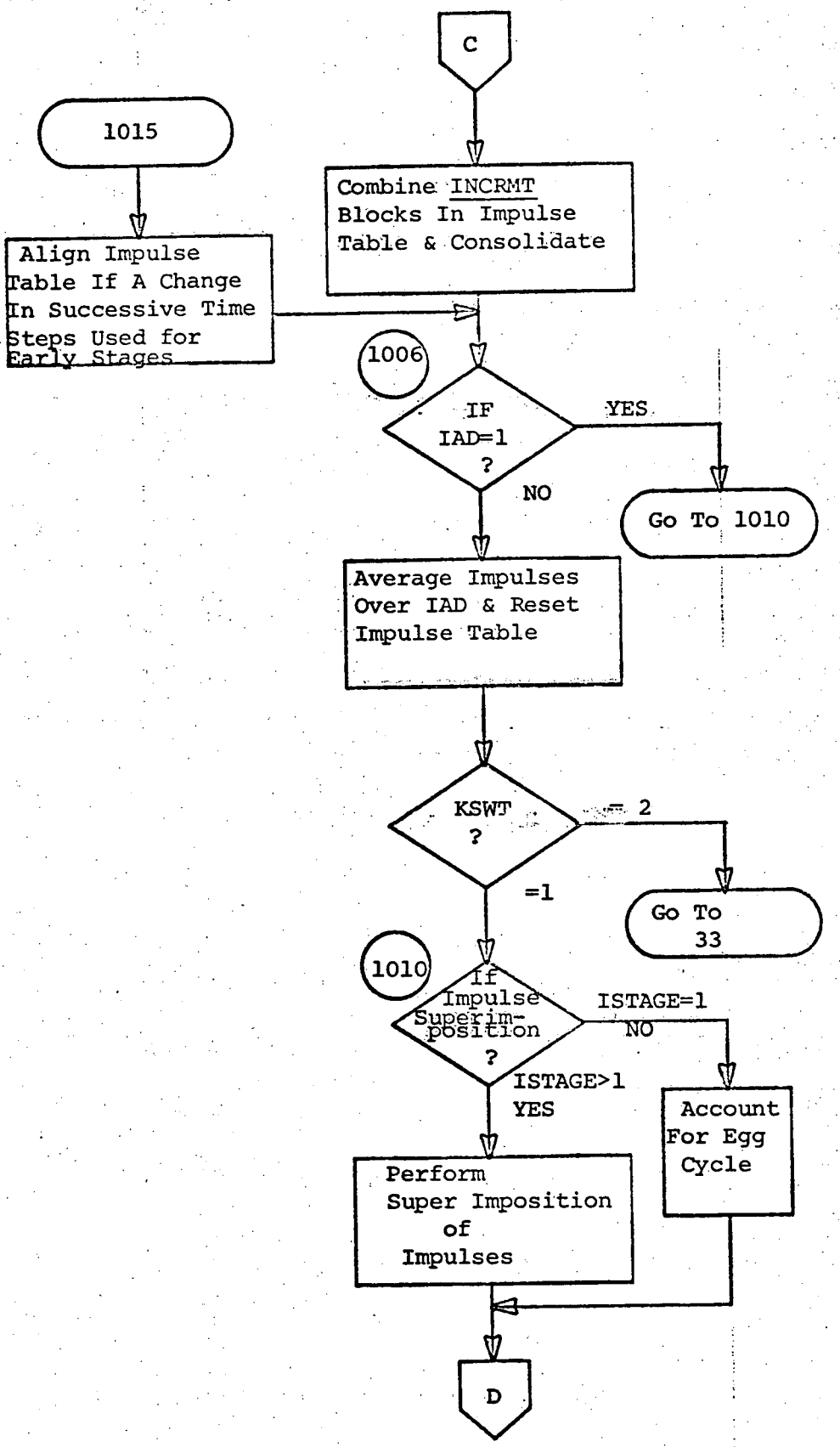
$$TRT = \frac{ADULT_1 \text{(transport)}}{ADULT_1 \text{(completely mixed)}}$$

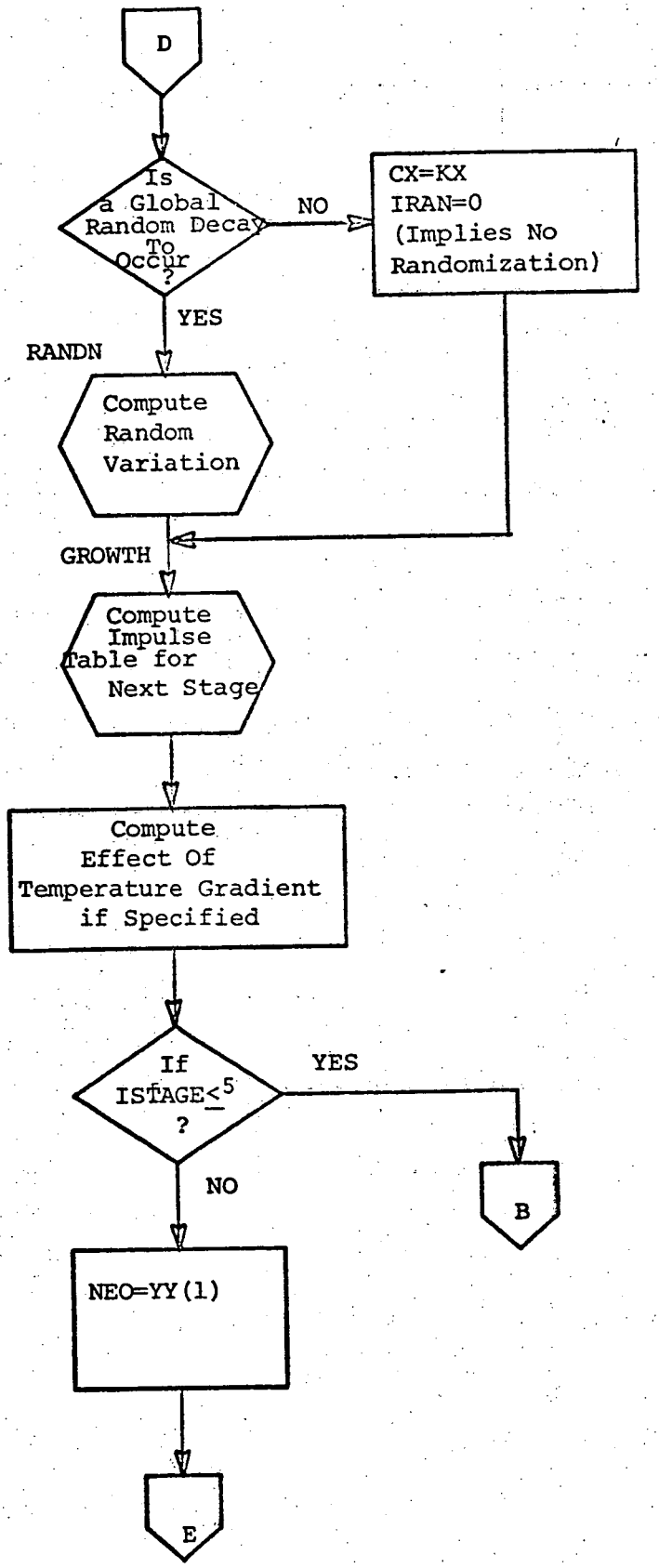
is known. This will effect the recruiting of the same number of ADULT 1's to year class 1 as in the transport model for concurrent and succeeding years. The reason for this computational procedure is to take advantage of the run time of the completely mixed model which takes about 30 CPU's through 20 years analysis as opposed to the transport models requirement of 10000 CPU's to perform the same analysis.

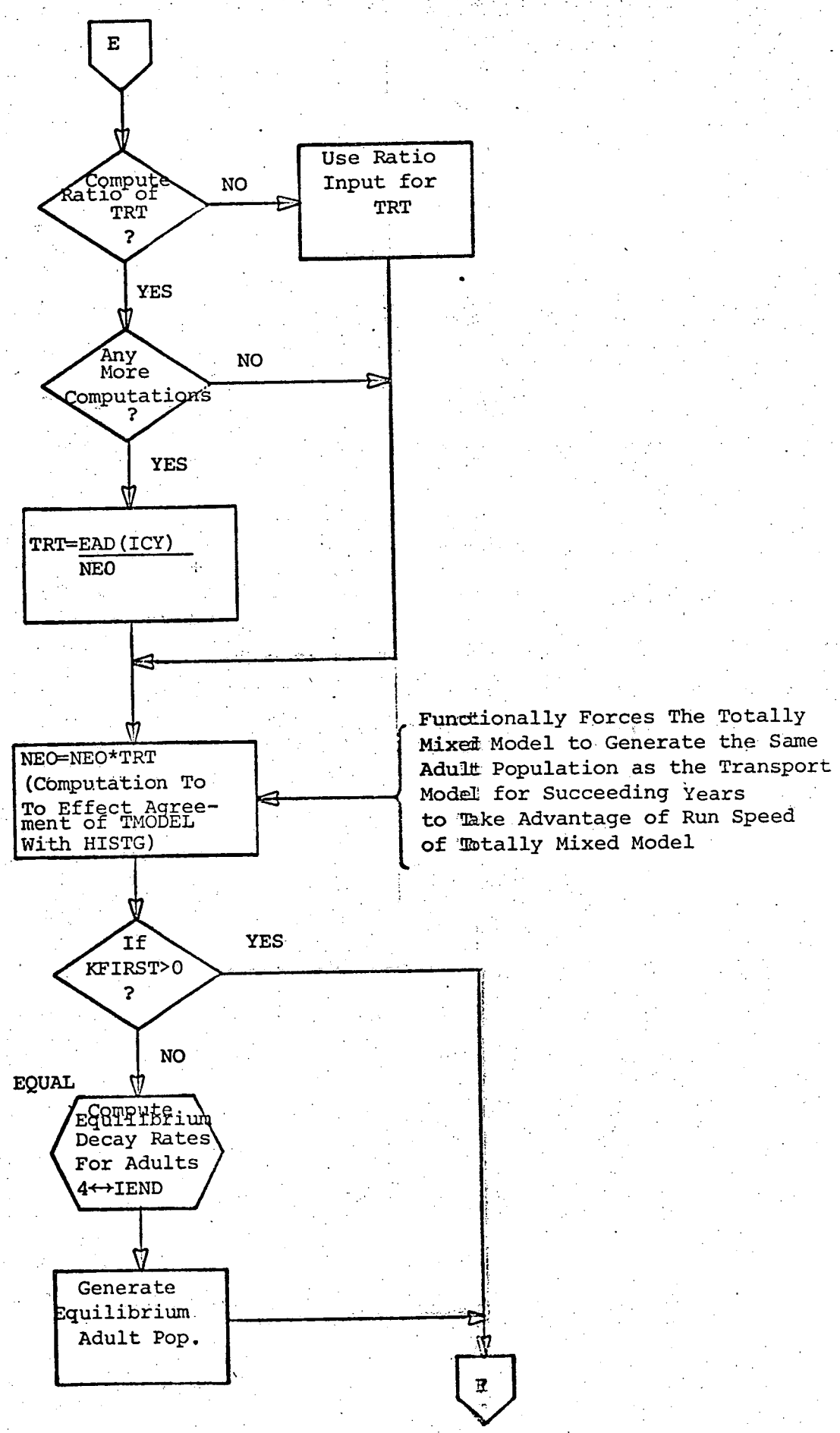

HISTG
Enter
Initialization of Parameters
Read Input Parameters ISW Thru ISKP
If compen-sation in adults ?
YES
Set: ICP1 = 6H YES
NO
If Plant is to operate ?
YES
Set: ISW1 = 6H YES
NO
Read Input Parameters IST Thru PINC
If Plant on ?
YES
Read Plant Input Parameters
NO
Write Out crucial run parameters
A

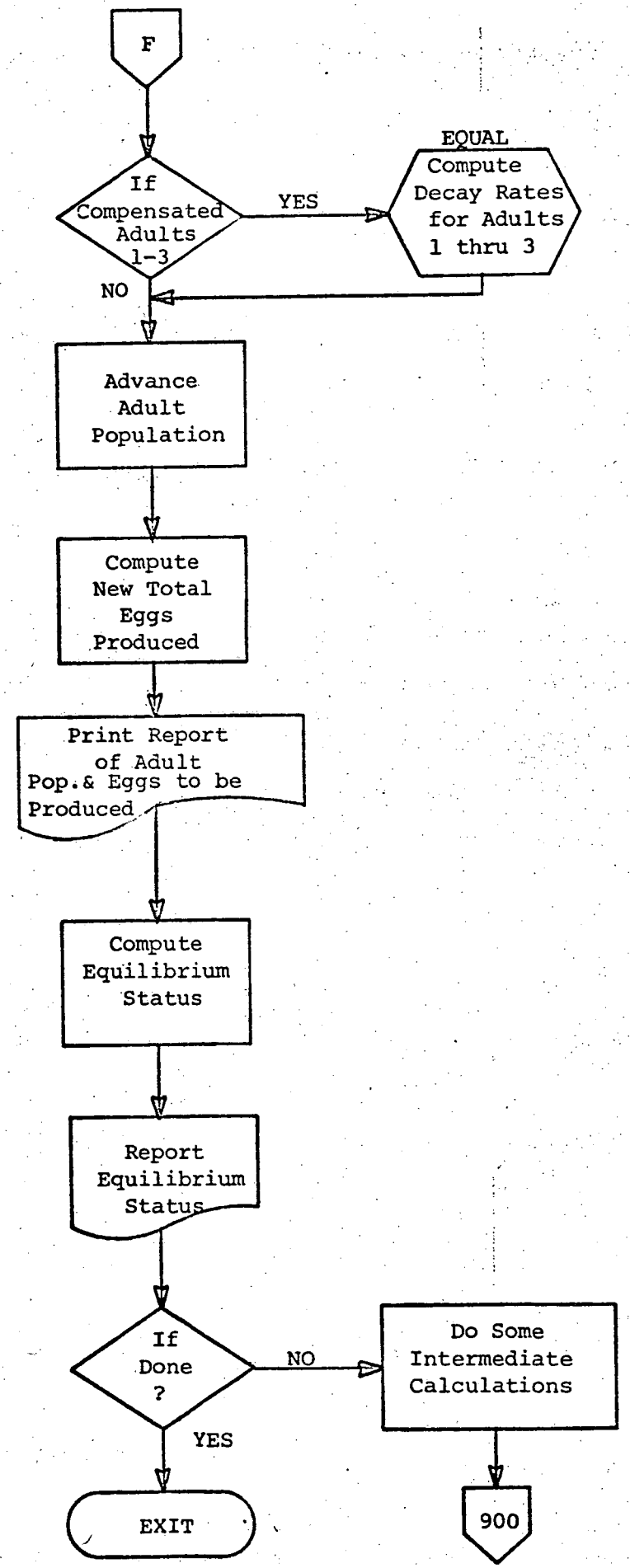

A
Read Total Egg Prod. & Early Stage Time Steps
Read Arrays TIM, TIMW, & TIMT
Compute: TIMWT
If IMODEL=3 ?
NO
Implies Transport Model Not Run Previously. Read in Additional Input Parameters.
YES
Implies Transport Model Previously Executed.
900
Compute:
FRACT=DE(1)*TIMW(1) / TIM(2)
NEO=P*FRACT
B


B
IF IYR=0 ?
NO
YES
Read Early Stage Parameters
IF IKX=0 ?
YES
NO
KXNEW
Compute J2 Survival Based on Temp
SWITCH
Store or Retrieve Early Stage Params
If Averaging Proc. Differs Between Stages
NO
Go To 1010
YES
IF INCRMT≤0 ?
YES
Go To 1015
NO
C


C
1015
Combine INCRMT Blocks In Impulse Table & Consolidate
Align Impulse Table If A Change In Successive Time Steps Used for Early Stages
1006
IF IAD=1 ?
YES
NO
Go To 1010
Average Impulses Over IAD & Reset Impulse Table
KSWT ?
= 2
=1
Go To 33
1010
If Impulse Superim-position ?
ISTAGE=1 NO
ISTAGE>1 YES
Account For Egg Cycle
Perform Super Imposition of Impulses
D


D
Is a Global Random Decay To Occur ?
NO
CX=KX
IRAN=0
(Implies No Randomization)
YES
RANDN
Compute Random Variation
GROWTH
Compute Impulse Table for Next Stage
Compute Effect Of Temperature Gradient if Specified
If ISTAGE≤5 ?
YES
B
NO
NEO=YY(1)
E


E
Compute Ratio of TRT ?
NO
Use Ratio Input for TRT
YES
Any More Computations ?
NO
YES
TRT=EAD(ICY) / NEO
NEO=NEO*TRT (Computation To To Effect Agreement of TMODEL With HISTG)
Functionally Forces The Totally Mixed Model to Generate the Same Adult Population as the Transport Model for Succeeding Years to Take Advantage of Run Speed of Totally Mixed Model
If KFIRST>0 ?
YES
NO
EQUAL
Compute Equilibrium Decay Rates For Adults 4↔IEND
Generate Equilibrium Adult Pop.
F


F
If Compensated Adults 1-3
YES
EQUAL
Compute Decay Rates for Adults 1 thru 3
NO
Advance Adult Population
Compute New Total Eggs Produced
Print Report of Adult Pop. & Eggs to be Produced
Compute Equilibrium Status
Report Equilibrium Status
If Done ?
NO
Do Some Intermediate Calculations
YES
EXIT
900

```
CMM-PNC/LIB$  CREATE:02/08/73,08:41:15 FREQ:8 SIZE:7 KIND:DISK KEY:1 LIFE:PER
ACCESS:UPDATE ON:SPN
IL
995          SUBROUTINE HISTG(ADULT,SRAT,SMAT,FEC,DCY,DCYO,KFIRST,ADULTS,
996         *DCYU,RMF,IMODEL,IRA,EAD,ITY)
1000         INTEGER OF1,OF2
1010         REAL NEO,KX,KXO,NX
1020         COMMON W(5000),YY(5000)
1030         COMMON /PAR/ ISW,CX,KXO,YS,QP,V,FKILL(5),KTYO,KSTP,ISKP,STDE
1040         COMMON /RKTTA/ NX,DNXDT,AUX(16,1)
1050         DIMENSION CHAR(6),DCY(20),SRAT(20),SMAT(20),FEC(20),ADULT(20
1055         DIMENSION DCYO(20),DCYU(20),ADULTS(20),RMF(20),PAD(20),IRA(5
1060         DIMENSION PNDAY(4),ASUM(4),TIMT(20),TIMWT(20),EAD(20),QQ(100
1070         COMMON/WGHT/TIM(20),TIMW(20),P,DE(5)
1080         COMMON/CYC/SNAME(6,5),IMP(5),MUL(5),DX(5),DXO(5),
1090        *DYS(5),SDT(5),ST(5)
1100         TIM(1)=0.
1101         ICY=0
1104         OF2=12
1105         SQP=0.
1110         TJ2=0.
1130         IF1=5
1140         OF1=6
1141         ICP1=6H    NO
1142         ISW1=ICP1
1143         QQ(1)=0.
1145         IPL=0
1150         DO 202 I=1,500
1160    202  YY(I)=0.
1170         READ(IF1,5)ISW,IEND,LYR,KSTP,TCUT,TSTART,TEND,PJ2,IKX,ICP,IS
1171         LYR=LYR-1
1172         IF(ICP.NE.0)ICP1=6H   YES
1173         IF(ISW.EQ.1)ISW1=6H   YES
1180         TF=TEND-TSTART
1185         READ(IF1,5)IST,IK,IEN,TRT,NN,LCP,INCPOP,PINC
1186         IN=0
1190         WRITE(OF1,7)
1220         IF(ISW.EQ.1)READ(IF1,5)(QQ(N),N=1,LCP),V,(FKILL(L),L=1,5),IP
1221         IF(ISW.EQ.1)LYR=LYR+ISW
1222         SQP=QQ(1)
1223         WRITE(OF1,4000)IEND,LYR,TCUT,ICP1,ISW1,IPL,TRT
1224         WRITE(OF1,7)
1230         IF(NN.EQ.1)WRITE(OF2,3010)
1240         IF(ISW.EQ.1.AND.NN.EQ.1)WRITE(OF2,3020)QP,V,(FKILL(JJ),
1241        *JJ=1,5)
1242         QP=0.
1250    C      TRACE GROWTH HISTORY OF EGGS ...STAGE 1
1260         ISTAGE=1
1265         KSWT=1
1270         IYR=0
1280         READ(IF1,5)P,(DE(JJ),JJ=1,5)
1285         PEQUAL=P
1290         READ(IF1,5)NSPAN,(TIM(J),J=2,NSPAN)
1300         KSPAN=NSPAN-1
```

```
      READ(IF1,5)(TIMW(J),J=1,KSPAN)
      READ(IF1,5)(TIMT(J),J=1,KSPAN)
       IF(NN.EQ.1)WRITE(OF2,4010)
      DO 4007 K=1,KSPAN
      TIMWT(K)=TIMT(K)*TIMW(K)
      IF(NN.EQ.1)WRITE(OF2,4020)TIM(K),TIM(K+1),TIMW(K),TIMT(K),
     *TIMWT(K)
 4007 CONTINUE
      IF(IMODEL.EQ.3)GO TO800
      READ(IF1,5)(DCY(J),J=1,3)
      IF(ICP.GT.0)READ(IF1,5)(DCYO(K),K=1,ICP)
      READ(IF1,5)(SRAT(J),J=1,IEND)
      READ(IF1,5)(SMAT(J),J=1,IEND)
      READ(IF1,5)(FEC(J),J=1,IEND)
  800 READ(IF1,5)(PNDAY(J),J=1,4)
      IF(NN.EQ.1)WRITE(OF2,3065)
      IF(NN.EQ.1)WRITE(OF2,3070)(J,DCY(J),SRAT(J),SMAT(J),FEC(J),
     *J=1,IEND)
      PTIME=0.
  900 FRACT=DE(1)*TIMW(1)/TIM(2)
       NEO=P*FRACT
      IF(IYR.LE.IST)IN=1
      IF(IYR.GE.IEN)IN=1
      IF(IN.EQ.1)WRITE(OF1,950)IYR
  950 FORMAT(///,1X,'.................................'/
     *1X,'..CURRENT YEAR.......',' - ',I3,'- ','..'/
     *1X,'.................................'//)
 1000 IF(IYR.GT.0)GO TO 1001
      IF(ISTAGE.EQ.1.AND.IN.EQ.1)WRITE(OF1,3040)P,(DE(JJ),JJ=1,5)
C ...................
      READ(IF1,6)(CHAR(I),I=1,6)
      READ(IF1,5)IMPUS,MULT,KX,KXO,YS,DTE,TE
      IF(IKX.EQ.0)GO TO 1001
      IF(ISTAGE.LE.3)TJ2=TJ2+DTE
      IF(ISTAGE.NE.4)GO TO 1001
      CALL KXNEW(TF,TEND,TJ2,PJ2,TIM,TIMWT,KSPAN)
      IF(YS.EQ..0)KXO=KX
 1001 CALL SWITCH(IYR,ISTAGE,IMPUS,MULT,KX,KXO,YS,DTE,TE,CHAR)
      IF(ISTAGE.NE.1)ASUM(ISTAGE)=DE(ISTAGE)/DE(ISTAGE-1)
      IF(ISTAGE.EQ.1)MM=(DTE/DE(1)+.0001)
      IF(ISTAGE.EQ.1)IPT=((TCUT-DTE)/DE(1))+SIGN(.0001,(TCUT-DTE))
      IF(ISTAGE.EQ.1)III=IPT+MM
      IF(III.EQ.0)IPT=0
      IF(IPT.NE.0)IPT=IABS(IPT)
      IF(ISTAGE.EQ.1.AND.IPT.LE.0)IPT=0
      IF(KFIRST.EQ.0)LPT=IPT
      IF(NN.EQ.1)WRITE(OF1,7)ISTAGE,(CHAR(I),I=1,6)
      IF(ISKP.NE.0.AND.NN.EQ.1)WRITE(OF1,3050)KX,KXO,
     *YS,DTE,TE
      IF(ISTAGE.EQ.1.OR.ISTAGE.EQ.5)GO TO 1010
      AA=ABS(PNDAY(ISTAGE)-PNDAY(ISTAGE-1))
      BB=ABS(DE(ISTAGE)-DE(ISTAGE-1))
      IF((AA.LT..0001).AND.(BB.LT..0001))GO TO 1010
      L=1
```

Note

Total Time for current stage

IF (IST EQ.4 OR.IST.EQ.5) FKILL(IST) = FKILL(IST) / DTE

```
      INCRMT=ASUM(ISTAGE)+.001
      IF(INCRMT.LE.0)GO TO 1015
      IX=0
      IPT=FLOAT(IPT)/FLOAT(INCRMT)
      DO 1005 I=1,KTYO,INCRMT
      AVG=0.
      IX=IX+INCRMT
      DO 1003 J=I,IX
      AVG=AVG+YY(J)
 1003 YY(J)=0.
      YY(L)=AVG
      L=L+1
 1005 CONTINUE
      KTYO=L
 1006 IAD=PNDAY(ISTAGE)/DE(ISTAGE)+.001
      IF(IAD.EQ.1)GO TO 1010
      DO 1009 K=1,KTYO,IAD
      L=K
      LL=K+IAD-1
      AVG=0.
      DO 1007 N=L,LL
 1007 AVG=AVG+YY(N)
      DO 1008 N=L,LL
 1008 YY(N)=AVG/IAD
 1009 CONTINUE
      GO TO (1010,33),KSWT
 1015 IQ=1.0/ASUM(ISTAGE)+.001
      IVY=-IQ
      MM=KTYO
      IKTYO=KTYO*IQ
      DO 1016 K=IKTYO,1,IVY
      YY(K+IVY+1)=YY(MM)
      YY(MM)=0.
 1016 MM=MM-1
      DO 1018 K=1,IKTYO,IQ
      J=K
      JJ=K+IQ-1
      AM=YY(K)/IQ
      DO 1017 N=J,JJ
 1017 YY(N)=AM
 1018 CONTINUE
      KTYO=IKTYO
      GO TO 1006
 1010 IF((ISTAGE.EQ.1).OR.(IMPUS.EQ.0))GO TO 30
C        IMPULSES SUPERIMPOSITON..
      DO 20 I=1,KTYO,MULT
      SUM=0.
      II=I+MULT-1
      DO 15 J=I,II
      BUFFER=YY(J)
      YY(J)=0.
   15 SUM=SUM+BUFFER
   20 YY(I)=SUM
   30 JA=ISTAGE
```

I=6-10

Fraction

DO 1016 M=1,IKTYO,IQ
K = IKTYO - M + 1

Allows impulse at t=0

```
2272          IF(IRA(JA).EQ.0.OR.(IYR.EQ.0))GO TO 98
2273          IRAN=IRA(JA)
2274     5351 STDEV=.5*KX
2275          IF(STDEV.GT.1.0)GO TO 5351
2276          CALL RANDN(CX,KX,STDEV)
2277          GO TO 99
2278       98 CX=KX
2279          IRAN=0
2280       99 CALL GROWTH(ISTAGE,NEO,DTE,PTIME,TE,STDEV,IRAN)
2290          IF(ISTAGE.GT.1)GO TO 70
2295          KSWT=2
2296          GO TO 1006
2300       33 TOT1=0.
2310          TOT2=0.
2315          KSWT=1
2320          DO 50 J=1,KTYO
2330          TOT1=TOT1+YY(J)
2340          IF(J.LE.IPT)YY(J)=0.   — TEMPERATURE KILL
2350       50 TOT2=TOT2+YY(J)
2351          RATE1=100.*TOT1/P
2355          RATE=100.*TOT2/TOT1
2360          IF(NN.EQ.1)WRITE(OF1,60)TOT1,RATE1,TOT2,RATE
2370       60 FORMAT(' TOTAL PRIOR TO TEMPERATURE GRADIENT ='E20.10/
2375         *' % SURVIVAL=',E10.4/
2380         *' TOTAL AFTER TEMPERATURE GRADIENT =',E20.10/
2385         *' % SURVIVAL=',E10.4)
2386          NTOT=TOT2
2390          AA=ABS(TOT1-TOT2)
2400          IF(AA.GT.1000.)GO TO 80
2410          DO 65 J=1,KTYO
2420       65 W(J)=YY(J)/TOT2
2430          GO TO 80
2440       70 TOT1=0.
2450          DO 75 J=1,KTYO
2460       75 TOT1=TOT1+YY(J)
2465          RATE=100.*TOT1/NTOT
2466          NTOT=TOT1
2470          IF(NN.EQ.1)WRITE(OF1,78)TOT1,RATE
2480       78 FORMAT(//' TOTAL=',E20.10/
2485         *' % SURVIVAL=',E10.4)
2490       80 CONTINUE
2500    C        TRACE GROWTH HISTORY IN LATER STAGES...
2510    C .... STAGE 2=LARVAE
2520    C .... STAGE 3-5=JUVENILE I-III
2530    C ...................
2540          ISTAGE=ISTAGE+1
2550          PTIME=PTIME+DTE
2560          IF(ISTAGE.EQ.5)PTIME=PTIME+TIM(NSPAN)
2570          NEO=YY(1)
2580    C     IF(NEO.LT.1.)GO TO 5000
2590          IF(ISTAGE.LE.5)GO TO 1000
2591          IF(ITY.EQ.0)GO TO 1607
2592          IF(ICY.GT.ITY)GO TO 1607
2593          ICY=ICY+1
```

.GE. 3/15/73

```
2594          TRT=EAD(ICY)/NEO
2595          WRITE(6,4060)TRT
2596     1607 NEO=NEO*TRT
2600          IF(KFIRST.GT.0)GO TO 1700
2605          CALL EQUAL(ADULT,ADULTS,DCYU,DCYO,DCY,FEC,SMAT,SRAT,
2606         *NEO,ICP,IEND,PEQUAL,KFIRST,RMF,RO)
2610          KFIRST=1
2620    C        GENERATE ADULT CLASS
2630          ADULT(1)=NEO
2640          DO 1600 J=2,IEND
2645          SURV=EXP(-DCYU(J-1)*365.)
2650          ADULT(J)=ADULT(J-1)*SURV
2651          IF(INCPOP.GT.0)DCYU(J-1)=-ALOG(SURV+PINC*SURV)/365.0
2655     1600 CONTINUE
2656          IF(INCPOP.EQ.0)GO TO 2000
2657          SURV=EXP(-DX(5)*SDT(5))
2658          DX(5)=-ALOG(SURV+PINC*SURV)/SDT(5)
2659          DXO(5)=DX(5)
2660           GO TO 2000
2665     1700 IF(ICP.EQ.0)GO TO 1776
2666          CALL EQUAL(ADULT,ADULTS,DCYU,DCYO,DCY,FEC,SMAT,SRAT,
2667         *NEO,ICP,IEND,PEQUAL,KFIRST,RMF,RO)
2668     1776 CONTINUE
2670          DO 1800 J=IEND,2,-1
2680     1800 ADULT(J)=ADULT(J-1)*EXP(-DCYU(J-1)*365.)
2690          ADULT(1)=NEO
2700    C        COMPUTE NEW TOTAL PRODUCTION.
2705     2000 CONTINUE
2710          P=0.
2720          DO 2100 J=1,IEND
2725          SSF=ADULT(J)*SRAT(J)*SMAT(J)*FEC(J)
2730     2100 P=P+SSF
2740    C        PRINT ADULT DISTRIBUTION AND NEW TOT. PROD.
2750          SP=0.
2760          DO 2200 J=1,IEND
2770     2200 SP=SP+ADULT(J)
2771          IF(IYR.GT.0)GO TO 2250
2772          DO 2225 K=1,IEND
2773     2225 PAD(K)=100.*ADULT(K)/SP
2774          SPE=SP
2775          GO TO 2775
2776     2250 IF(IYR.EQ.0)GO TO 2775
2777          DO 2270 K=1,IEND
2778     2270 PAD(K)=100.*ADULT(K)/SPE
2779     2775 PSP=SP/SPE
2780          IF(IN.EQ.1)WRITE(OF1,3060)P
2790          IF(IN.EQ.1)WRITE(OF1,3080)(J,ADULT(J),J=1,IEND)
2800          IF(IN.EQ.1)WRITE(OF1,3090)SP
2805          IF(IN.EQ.1)WRITE(OF1,4030)
2806          IF(IN.EQ.1)WRITE(OF1,4040)(K,PAD(K),K=1,IEND)
2807          IF(IN.EQ.1)WRITE(OF1,4050) PSP
2810    C........COMPUTE EQUILIBRIUM
2820    C........ASSUMING FIRST ORDER DECAY MECHANISM
2830    C........COMPUTE   EXP   TERM
```

IEND1 = IEND-1
DO 1800 M=1, IEND1
J= IEND -M+1

IF (IYR.NE.0) GO TO 22
A10 = ADULT(1)
AT0 = SP
2222 CONTINUE
IF (IYR.NE. 1) GOT 225

7

R1 = ((A11-A10)/A10)*

IF(IYR.EQ.LYR) WRITE
4.07

R1, R2, R3

IF(IYR.EQ.LYR) WRITE

```
2835          IF((ISW.EQ.1).AND.(IPL.EQ.IYR))QP=0.
2900    C.......COMPUTE A(J,K)*M(K)*S(K)*F(K)
2910          E2=1.
2920          SUMA=0.
2930          DO 2300 K=1,IEND
2940          IF(K.NE.1)E2=E2*EXP(-DCYU(K-1)*365.)
2950     2300 SUMA=SUMA+E2*RMF(K)
2960    C.......COMPUTE SUM OF WEIGHTS   PSI
3070          SM=SUMA*(NEO/PEQUAL)
3080          IF(IN.EQ.1)WRITE(OF1,3030)SM
3090          IF(IYR.EQ.LYR)GO TO 5000
3100          IYR=IYR+1
3105          IF(IYR.EQ.1)QP=SQP
3106          ITEST=MOD(IYR,IK)
3107          IN=0
3108          IF(ITEST.EQ.0)IN=1
3110          ISTAGE=1
3120          PTIME=0.
3125          IPT=LPT
3126          IF(LQP.GE.IYR)QP=QQ(IYR)
3130          GO TO 900
3140     5000 IF(IN.EQ.1)WRITE(OF1,5050)   - WRITE
3145     5050 FORMAT(//' END HISTG........')
3146          STOP
3150     5    FORMAT()   (20G99)          (20I99)
3160      6   FORMAT(10A6)
3170     3040 FORMAT(///,' GIVEN:',/,2X,' TOTAL EGGS PRODUCED IN ESTUARY
3180         1E20.10,/,2X,' TIME STEP SIZE (DAY) '/
3190         22X,' EGG   LARV   JUV 1   JUV 2   JUV 3'/
3200         35(1X,F4.2,2X)/)
3210      7  FORMAT(///, '*****************************************',//,
3220         1 ' STAGE',I3,' ......',10A6)
3230     3050 FORMAT(//,' KX(1/DAY)= ',E20.10,/,' KXO(1/DAY)= ',
3240         1 E20.10,/,' YS(#/DAY)= ',E20.10,/,' LIFE PERIOD(DAY)= ',
3250         2 F10.4,/,' PRODUCTION PERIOD(DAY)= ',F10.4,/)
3260     3010 FORMAT(1H1,' TRACING LIFE HISTORY OF STRIPED BASS FISH ',
3270         1 /,' IN HUDSON RIVER, WITH GROWTH-RATE MODEL IN EACH ',
3280         2 /,' STAGE GIVEN BY:',//
3290         3 5X,' D(NX)/DT=-(KX+(KX-KXO)*((NX-YS)/YS)**3)*NX')
3300     3020 FORMAT(16X,'-FKILL*QP*NX/V',//,' WHERE, QP(MI**3/DAY)= ',
3310         1 E10.4,/,7X,'V(MI**3)= ',E10.4/
3320         22X,' FRACTIONAL KILL OF',/
3330         32X,' EGGS                ',E10.4/
3340         42X,' LARVAE              ',E10.4/
3350         52X,' JUVENILE 1          ',E10.4/
3360         62X,' JUVENILE 2          ',E10.4/
3370         72X,' JUVENILE 3          ',E10.4)
3380     3060 FORMAT(///1X,'TOTAL EGGS PRODUCED ',F15.0///
3390         *1X,'ADULT DISTRIBUTION BY AGE CLASS'///
3400         *5(13H AGE NUMBERS        ))
3410     3080 FORMAT(5(1X,I3,1X,F8.0))
3420     3090 FORMAT(1X,'TOTAL ADULTS ',F15.0/)
3430     3065 FORMAT(///,4H AGE,1X,10H      DECAY,1X,10H      RATIO,1X,
3440         110HMATURATION,1X,12H   FECUNDITY/
```

```
3450          216X,10H(FEM/TOT.)/)
3460     3070 FORMAT(I4,1X,E10.4,1X,E10.4,1X,E10.4,1X,E12.4)
3470     3030 FORMAT(1X,'EQUILIBRIUM (1.0) =',E10.4//)
3480     4000 FORMAT(' NO. ADULT AGE CLASSES - ',I2/
3490          *' MODEL SIMULATES - ',I3,1X,'YEARS'/
3500          *' TIME IN DAYS FOR CHANGE IN TEMPERATURE - ',F5.2/
3501          *' COMPENSATION......',A6/
3502          *' PLANT OPERATING...',A6/
3503          *' FOR ..............',I3,' YEARS.'/
3504          *' ADULT 1 MODIFIER..',F5.2/)
3510     4010 FORMAT(//' PRODUCTION DATA WEIGHTS'/
3520          *10H   TIME   ,1X,5H PROD,1X,5H TEMP,1X,5H W*T /)
3530     4020 FORMAT(2(1X,F4.1),3(1X,F5.2))
3531     4030 FORMAT(//' PERCENT......'/
3532          *1X,5(12HAGE PERCENT  )/)
3533     4040 FORMAT(5(1X,I3,1X,F7.3))
3534     4050 FORMAT(' % RELATION TO POP. AT  EQUIL. ...',F6.2)
3535     4060 FORMAT(1X,'----------'/
3536          11X,'COMPUTED TRT (RATIO OF ADULT 1) =',F10.6/
3537          21X,'-----------'/)
3540          END
IQ
```

GROWTH:

Functional Description:

GROWTH computes the growth of each early stage (eggs, larvae, juvenile I through III).

Inputs:

ISTAGE	current early stage indicator
NXØ	impulse concentration
DELT	stage duration
PTIME	sum of all stage durations to current time
TIME	production period
STDEV	standard deviation
IRAN	{0-off random survival. 1-on

Equations:

Solves:

$$\frac{dN_x}{dt} = -[K_x + (K_x - K_{xo}) \cdot \left(\frac{N_x - Y_s}{Y_s}\right)^3] \cdot N_x - f \frac{Q_p \cdot N_x}{V}$$

The program computes

(i) N_x at T^-

(ii) transfer, which takes place at T^-

(iii) production of N_x at T

(iv) resulting N_x at T^+

where

$$N_x^+ = N_x^- \text{ transfer + production.}$$

In each early stage there are three phases

A production only

B production & transfer

C transfer only

The egg stage experiences A, B, & C.

The larval stage experiences A, B, & C.

The juvenile I stage experiences A, B, & C.

The juvenile II stage experiences production and decay only.

The juvenile III stage experiences decay only.

Outputs:

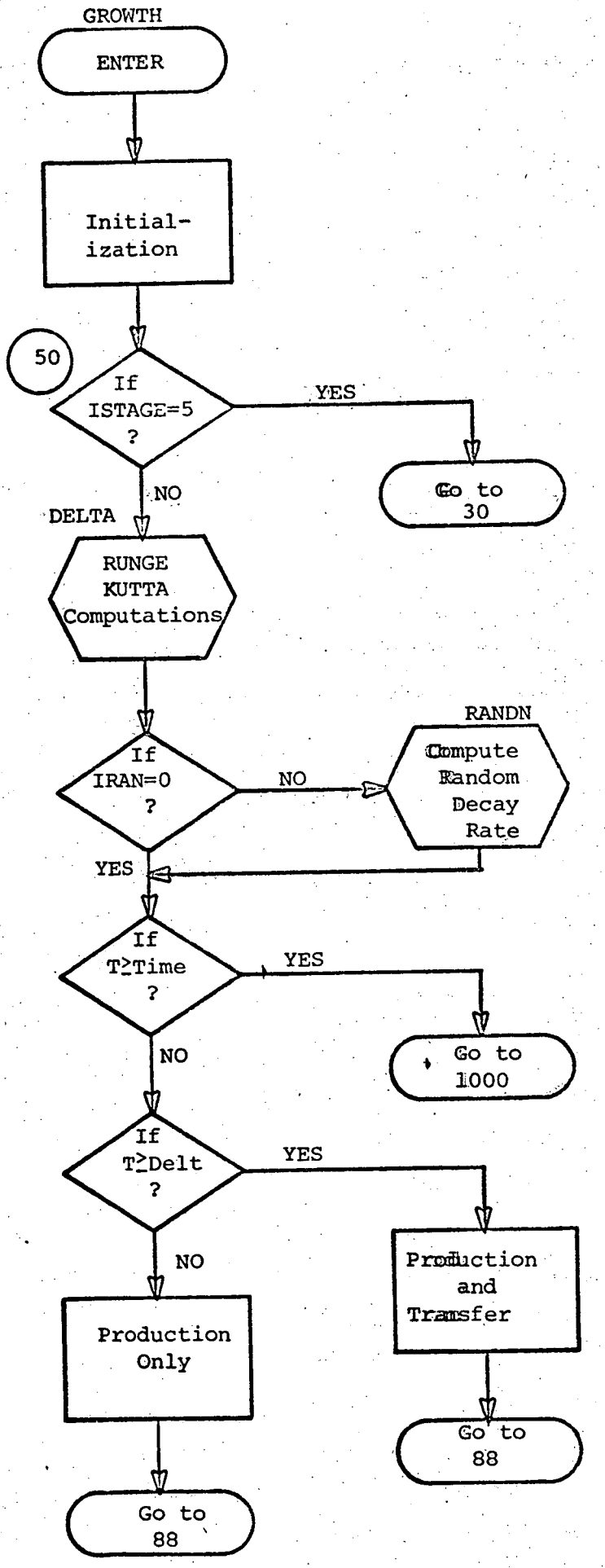
A Report on (i), (ii), (iii), & (iv) and a production table to the next stage.

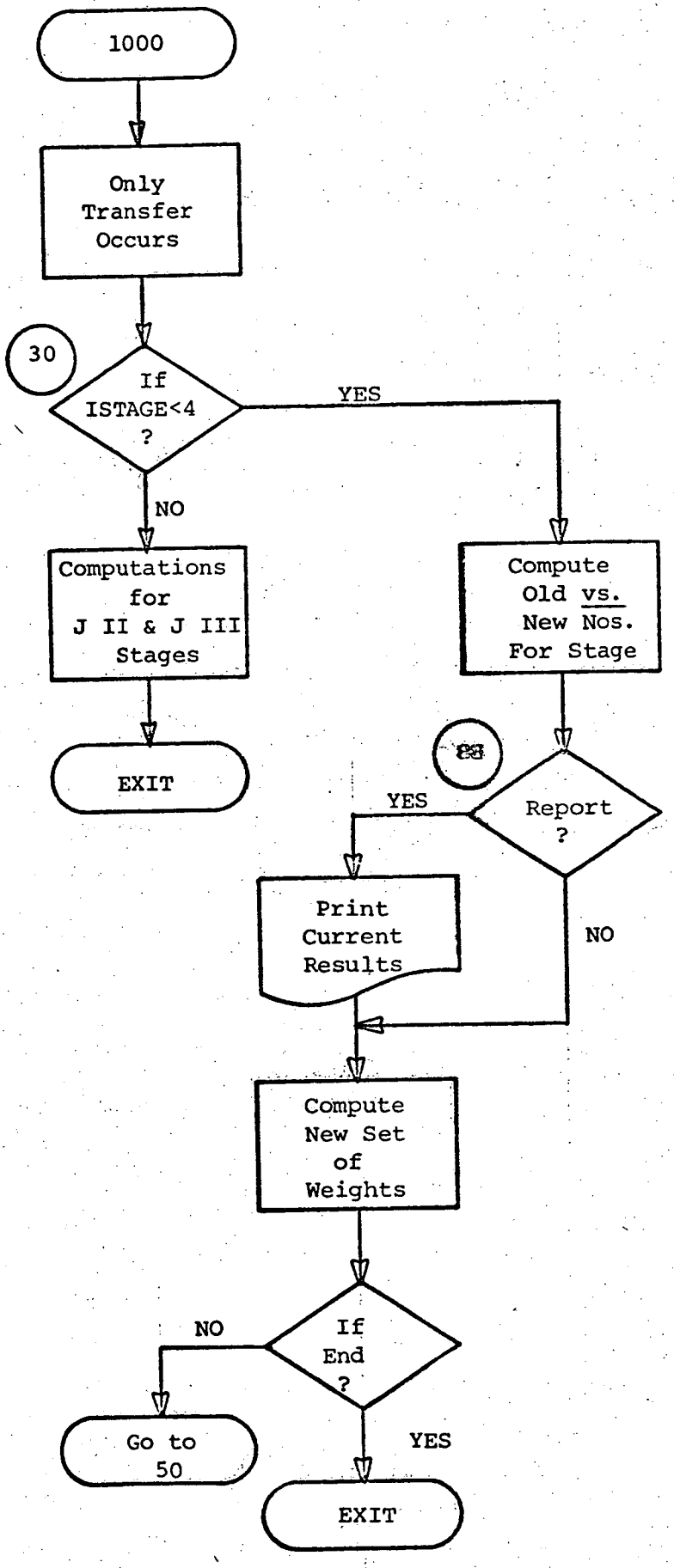
Referenced by: HISTG

Subroutines called:

DELTA

RANDN


GROWTH
ENTER
Initial-
ization
50
If
ISTAGE=5
?
YES
Go to
30
NO
DELTA
RUNGE
KUTTA
Computations
RANDN
If
IRAN=0
?
NO
Compute
Random
Decay
Rate
YES
If
T≥Time
?
YES
Go to
1000
NO
If
T≥Delt
?
YES
Production
and
Transfer
Go to
88
NO
Production
Only
Go to
88


1000
Only Transfer Occurs
30
If ISTAGE<4 ?
YES
NO
Computations for J II & J III Stages
EXIT
Compute Old vs. New Nos. For Stage
Report ?
YES
NO
Print Current Results
Compute New Set of Weights
If End ?
NO
YES
Go to 50
EXIT

```
GROW1-PNC/LIB$  CREATE:02/01/73,11:27:42 FREQ:12 SIZE:3 BACKUP:02/02/73,
05:21:36 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE ON:SPN
IL
      SUBROUTINE GROWTH(ISTAGE,NXO,DELT,PTIME,TIME,STDEV,IRAN)
      INTEGER DF1
      REAL NXO,NX,KX,KXO
      COMMON W(5000),YY(5000)
      COMMON/WGHT/TIM(20),TIMW(20),P,DE(5)
      COMMON /PAR/ ISW,KX,KXO,YS,QP,V,FKILL(5),KTYD,KSTP,ISKP
      COMMON /RKTTA/ NX,DNXDT,AUX(10,1)
C                                                  1/8/74 TE
C        INITIALIZATION
C
      STDEV=STDEV*2.
      XMEAN=KX
      DF1=6
      ISTP=KSTP*ISTAGE
      J4=2
      T=0.
      DTX=DE(ISTAGE)
      NDT=0
      IND=0
      ISTART=2
      YYY=0.
      W(1)=1.
      FTIME=PTIME+DELT+TIME
      TT=PTIME+T
      KOUNTY=0
      OLDNX=0.
      NX=NXO
      KOUNTX=1
      IF(ISKP.NE.0)WRITE(DF1,2)
      IF(ISKP.NE.0)WRITE(DF1,5)TT,OLDNX,YYY,NXO,NX
   50 IF(ISTAGE.EQ.5)GO TO 30
      CALL DELTA(DTX,1,ISTAGE)
      IF(IRAN.NE.0)CALL RANDN(KX,XMEAN,STDEV)
      NDT=NDT+1
      TT=PTIME+NDT*DTX
      OLDNX=NX
C
C        COMPUTE GROWTH HISTORY OF PRESENT STAGE AND
C        RECORD HISTORY OF NEXT-STAGE INPUT IMPULSES..
C
      IF(T+0.001+DTX.GE.TIME)GO TO 1000
      IF(T+0.001+DTX.GE.DELT)GO TO 100
      KOUNTX=KOUNTX+1
      IF(ISTAGE.NE.1)NXO=YY(KOUNTX)
C ***** A---ONLY PRODUCTION OCCURS
      NX=NX+NXO
      YYY=0.
      GO TO 88
C ***** B---PRODUCTION AND TRANSFER OCCUR
  100 KOUNTY=KOUNTY+1
      IF(ISTAGE.NE.1)NXO=YY(KOUNTX+KOUNTY)
```

```
1470          YY(KOUNTY)=NX*W(KOUNTX)
1480          NX=NX-YY(KOUNTY)+NXO
1490          YYY=YY(KOUNTY)
1500          GO TO 88
1510    C *****  C---ONLY TRANSFER OCCURS
1520    1000  KOUNTY=KOUNTY+1
1530          NXO=0.
1540          IF(ISTAGE.NE.1)NXO=YY(KOUNTX+KOUNTY)
1550    C       FROM JUVENILE II STAGE ON, NO TRANSFER EXCEPT SURVIVAL...
1560       30 IF(ISTAGE.LT.4)GO TO 53
1570          NXO=0.
1580          NDT=0
1600          YYY=0.
1605       40 IF(IRAN.NE.0)CALL RANDN(KX,XMEAN,STDEV)
1606          BUF=0.
1607          IF(YS.EQ.0.)GO TO 41
1610          BUF=(KX-KXO)*((NX-YS)/YS)**3.
1612          DBF=KX+BUF
1615          IF(V.EQ.0.)GO TO 42
1620       41 DBF=DBF+ISW*FKILL(ISTAGE)*QP/V
1630       42 OLDNX=NX
1640          NX=NX*EXP(-DBF*DTX)
1650          NDT=NDT+1
1660          T=TT+NDT*DTX
1670          IF(T.GE.FTIME)GO TO 45
1680          IF(MOD(NDT,ISTP).GT.0)GO TO 40
1690          IF(ISKP.NE.0)WRITE(OF1,5)T,OLDNX,YYY,NXO,NX
1700          GO TO 40
1710       45 NXO=NX
1720          YY(1)=NX
1730          DO 47 J=2,5000
1740       47 YY(J)=0.
1750          RETURN
1760       53 IF(IND.EQ.0)ISTART=1
1770          IND=1
1780          YY(KOUNTY)=NX*W(KOUNTX)
1790          NX=NX-YY(KOUNTY)
1800          YYY=YY(KOUNTY)
1810          ISTART=ISTART+1
1820       88 IF(MOD(NDT,ISTP).GT.0)GO TO 89
1830          IF(ISKP.NE.0)WRITE(OF1,5)TT,OLDNX,YYY,NXO,NX
1840       89 IF(ISTAGE.GE.4)GO TO 43
1850        8 SUM=0.
1860          DO 10 I=ISTART,KOUNTX
1870          II=KOUNTX+ISTART-I
1871          W(II)=0.
1872          IF(NX.EQ.0.)GO TO 10
1880          W(II)=OLDNX*W(II-1)/NX
1890          SUM=SUM+W(II)
1900       10 CONTINUE
1910          W(ISTART-1)=1.-SUM
1920       43 IF(TT.GE.FTIME)GO TO 200
1930          T=NDT*DTX
1940          IF(ISTAGE.NE.1)GO TO 50
```

```
      AA=ABS(T-TIM(J4))
      IF(AA.GT..00001)GO TO 50
      NXO=P*DTX*TIMW(J4)/(TIM(J4+1)-TIM(J4))
      J4=J4+1
      GO TO 50
C
C       QUIT FOR EXIT
C
  200 IF(ISTAGE.EQ.1)GO TO 909
C       ZERO UNUSED PART OF YY(I) TO SHOW NO PRODUCTION THEREON
      KTY1=KOUNTY+1
      DO 99 I=KTY1,KTYO
   99 YY(I)=0.
C       STORE # OF ELEMENTS USED IN YY(I)
  909 KTYO=KOUNTY+1
      RETURN
    5 FORMAT(F10.3,5X,4(E10.5,5X))
    2 FORMAT(//,3X,'TIME(I)',2X,'POPULATION(-)',4X,'TRANSFER(-)',
     1  2X,'PRODUCTION(I)',2X,'POPULATION(+)'/)
      END
IQ
```

DELTA:

Functional description:

Delta is the Runge-Kutta equations used to advance one time step forward for the given early stage:

Inputs:

H	time step
NDIM	number of segments - fixed at 1.
ISTAGE	current early stage.
	1 = egg stage
	2 = larval stage
	3 = juvenile I stage
	4 = juvenile II stage
	5 = juvenile III stage

Named common: RKTTA

Y (1) = N_x = current concentration

DERY (1) = $\frac{dN_x}{dt}$ = change in concentration

AUX (16, 1) = auxillary array

Equations: see flow chart

Output:

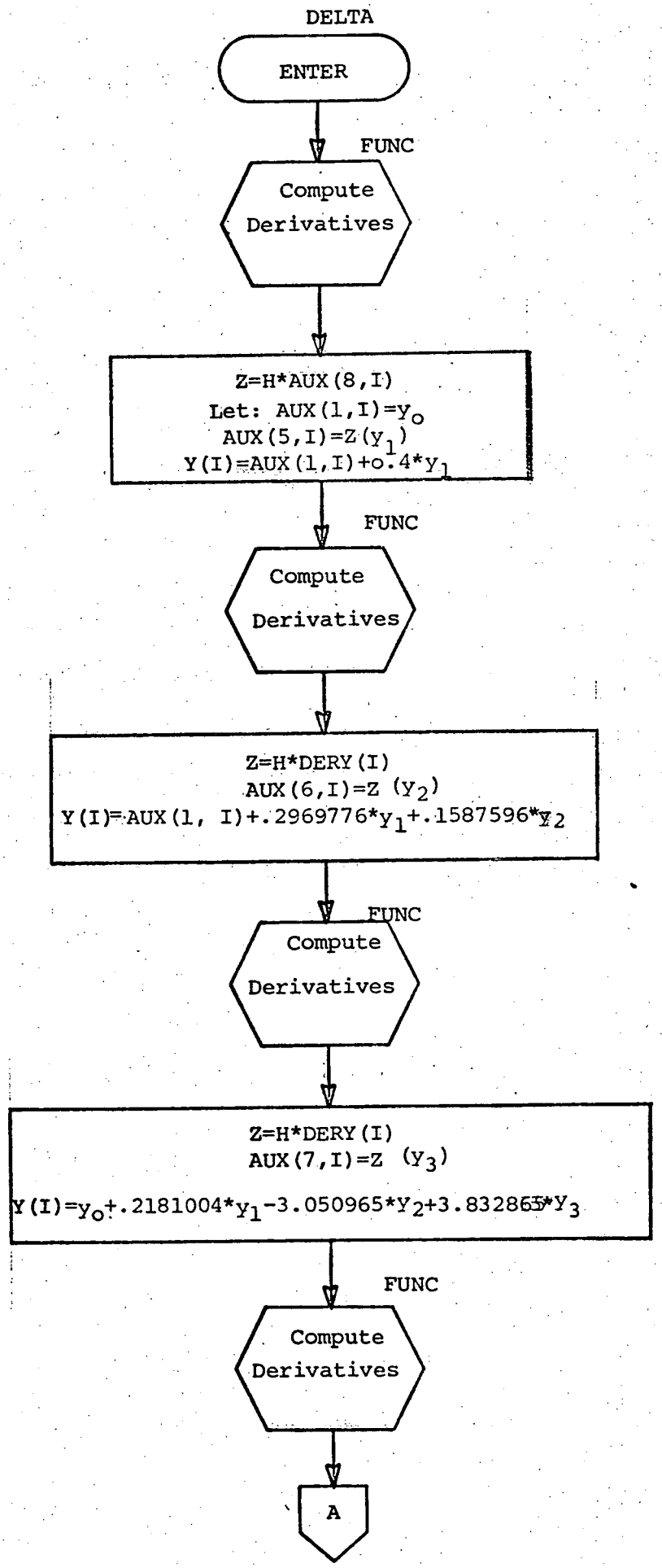
Y (1) - new concentration at end of one time step.

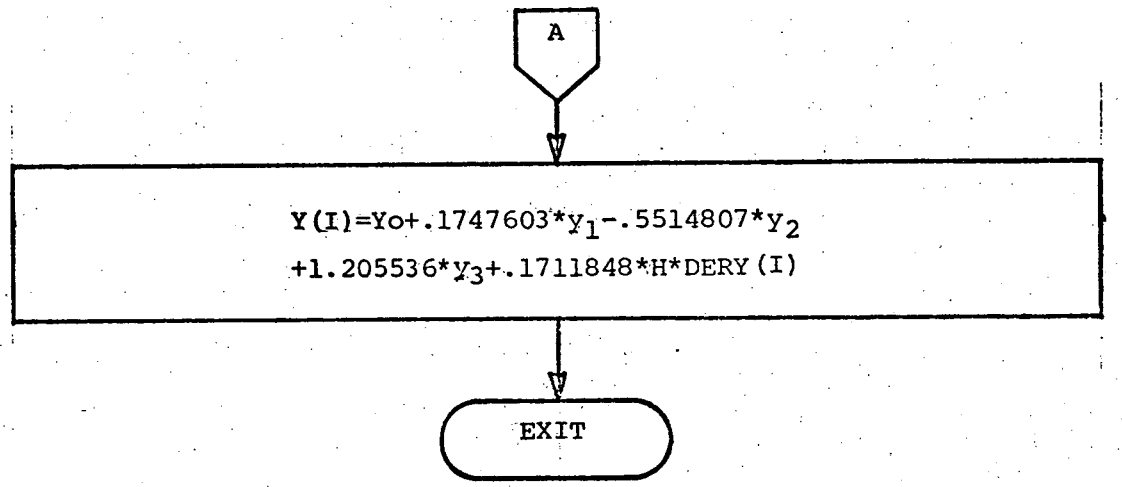
Referenced by:

GROWTH

Subroutines called:

FUNC


DELTA
ENTER
FUNC
Compute Derivatives
Z=H*AUX(8,I)
Let: AUX(1,I)=y_o
AUX(5,I)=Z(y_1)
Y(I)=AUX(1,I)+o.4*y_1
FUNC
Compute Derivatives
Z=H*DERY(I)
AUX(6,I)=Z (y_2)
Y(I)=AUX(1, I)+.2969776*y_1+.1587596*y_2
FUNC
Compute Derivatives
Z=H*DERY(I)
AUX(7,I)=Z (y_3)
Y(I)=y_o+.2181004*y_1-3.050965*y_2+3.832865*y_3
FUNC
Compute Derivatives
A


A
Y(I)=Yo+.1747603*y1-.5514807*y2
+1.205536*y3+.1711848*H*DERY(I)
EXIT

```
DELTA-PNC/LIB$  CREATE:02/01/73,11:27:30 FREQ:13 SIZE:1 BACKUP:02/02/73,
05:22:04 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
 10            SUBROUTINE DELTA(H,NDIM,ISTAGE)
 20            COMMON /RKTTA/Y(1),DERY(1),AUX(16,1)
 40      C THIS ROUTINE PERFORMS THE RUNGE KUTTA CALCULATIONS.
 60            CALL FUNC(ISTAGE)
 70            DO 7 I=1,NDIM
 80            AUX(1,I)=Y(I)
 90          7 AUX(8,I)=DERY(I)
100          8 CONTINUE
110      C RUNGE-KUTTA EQUATIONS FOLLOW
120        100 DO 101 I=1,NDIM
130            Z=H*AUX(8,I)
140            AUX(5,I)=Z
150            Y(I)=AUX(1,I)+.4*Z
160            IF(Y(I).LT.0.)Y(I)=0.
165        101 CONTINUE
170      C     Z=X+.4*H
190            CALL FUNC(ISTAGE)
200            DO 102 I=1,NDIM
210            Z=H*DERY(I)
220            AUX(6,I)=Z
230            Y(I)=AUX(1,I)+.2969776*AUX(5,I)+.1587596*Z
240            IF(Y(I).LT.0.)Y(I)=0.
245        102 CONTINUE
250      C
260      C     Z=X+.4557372*H
280            CALL FUNC(ISTAGE)
290            DO 103 I=1,NDIM
300            Z=H*DERY(I)
310            AUX(7,I)=Z
320            Y(I)=AUX(1,I)+.2181004*AUX(5,I)-3.050965*AUX(6,I)
330           *     +3.832865*Z
340            IF(Y(I).LT.0.)Y(I)=0.
345        103 CONTINUE
350      C     Z=X+H
360            CALL FUNC(ISTAGE)
380            DO 104 I=1,NDIM
390            Y(I)=AUX(1,I)+.1747603*AUX(5,I)-.5514807*AUX(6,I)
400           *     +1.205536*AUX(7,I)+.1711848*H*DERY(I)
410            IF(Y(I).LT.0.)Y(I)=0.
415        104 CONTINUE
420        150 RETURN
430            END
IQ
```

KXNEW:

Functional description:

Computes the time in days to use for the calculation of the juvenile II decay rate to be used resulting from the superimposition of a temperature profile. It also estimates the juvenile II decay rate based on this time and refines this estimate in the subroutine NRHAP.

Inputs:

TF	time from initiation of spawn (days)
TEND	time at which all JII's reclassified JIII
TJ2	$\Delta t_E + \Delta t_L + \Delta t_{J1}$
PJ2	fractional juvenile II survival
TIM	last day of each week for egg production time distribution (days)
TIMWT	TIMT * TIMW
KSPAN	number of weeks of egg production - 1.

Procedure:

$$S_2 = (PJ_2)\ \Sigma\ \frac{W_i t_i}{\Delta T_{i,i-1}}$$

$$T_f = T_{END} - T_{START}$$

$$T_{J_2} = \Delta t_E + \Delta t_L + \Delta t_{J_1}$$

$$T = S_1 = S_3 = 0$$

$$S_1 = S_1 + \frac{W_i t_i}{\Delta T_{i,i-1}}$$

$$S_1 < S_2$$

NO

$$D = \frac{S_2 - S_3}{W_i t_i} \cdot \Delta T_{i,i-1}$$

$$T_u = T_f - (T + D + T_{J_2})$$

$$K_o(\text{estimate}) = -\text{ALOG}(PJ2)/T_u$$

EXIT

Yes

$$S_3 = S_1$$

$$T = T + \Delta T_{i,i-1}$$

Outputs:

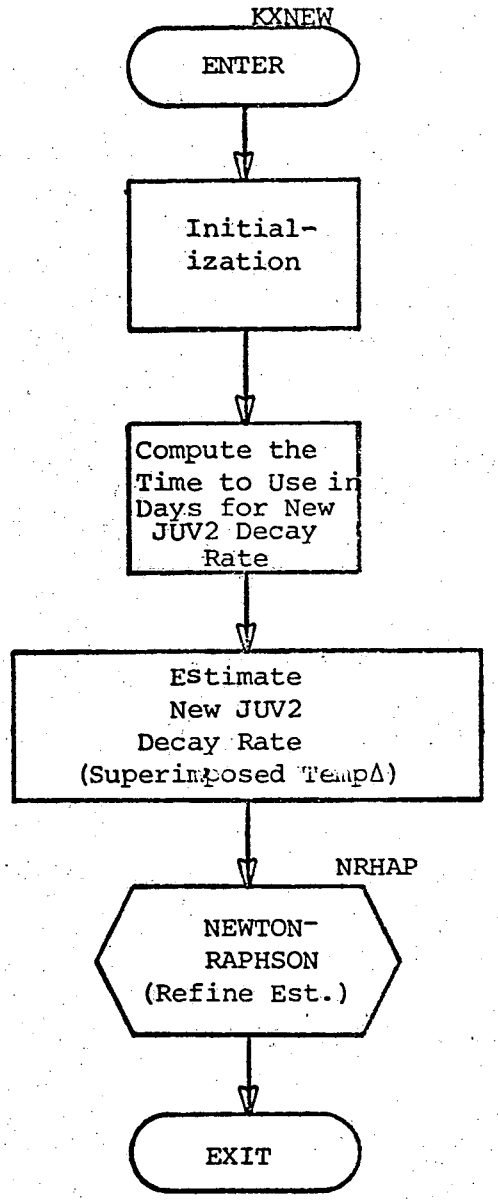
Estimated juvenile II decay rate which includes the effect of a temperature profile.

Referenced by:

HISTG

Subroutines called:

NRHAP


KXNEW
ENTER
Initial-
ization
Compute the
Time to Use in
Days for New
JUV2 Decay
Rate
Estimate
New JUV2
Decay Rate
(Superimposed TempΔ)
NRHAP
NEWTON-
RAPHSON
(Refine Est.)
EXIT

```
KXNEW-REL/LIB$  CREATE:02/01/73,11:28:01 FREQ:63 SIZE:1 BACKUP:02/02/73,
05:21:27 KIND:DISK LIFE:PERM ACCESS:REPL
IL
1000          SUBROUTINE KXNEW(TF,TEND,TJ2,PJ2,TIM,TIMWT,KSPAN)
1010          DIMENSION TIMWT(20),TIM(20)
1020          REAL KX1,KX
1025          INTEGER OF1
1030          COMMON/PAR/ ISW,KX
1040          OF1=12
1050          S1=0.
1060          S2=0.
1070          S3=0.
1075          S4=0.
1080          T=0.
1090          DO 5 J=1,KSPAN
1100        5 S3=S3+TIMWT(J)
1110          S4=PJ2*S3
1120          DO 10 K=1,KSPAN
1121          LL=K
1130          A=TIM(K+1)-TIM(K)
1140          S1=S1+TIMWT(K)
1150          IF(S1.GT.S4)GO TO 20
1160          S2=S1
1170          T=T+A
1180       10 CONTINUE
1190          WRITE(OF1,15)
1200       15 FORMAT(///' ****ERROR....NO PRODUCTION POSSIBLE')
1210          RETURN
1220       20 D=((S4-S2)/TIMWT(LL))*A
1230          TUSE=TF-(T+D+TJ2)
1240          KX1=-ALOG(PJ2)/TUSE
1250          WRITE(OF1,30)KX,KX1,TUSE
1260       30 FORMAT(///' OLD KX=',E15.9,' NEW KX=',E15.9/
1261         *' TIME USED TO COMPUTE NEW KX - ',F7.2/)
1262          CALL NRHAP(KX1,TF,TIM,TIMWT,KSPAN,PJ2)
1263          WRITE(OF1,33)
1264       33 FORMAT(' END OF KXNEW......'////)
1270          KX=KX1
1280          RETURN
1290          END
IQ
```

FUNC.

Functional description:

FUNC computes the change in concentration of organisms due to decay and the plant (provided the plant is operating).

Input:

ISTAGE - current early life stage

Named Common: PAR

ISW	ϕ - off plant operation 1 - on
KX	First order decay rate
KXϕ	Minimum decay rate
YS	Carrying capacity for estuary
QP	Plant intake flow
V	Estuary volume
FKILL	f - factor for current stage

Equations: see flow chart

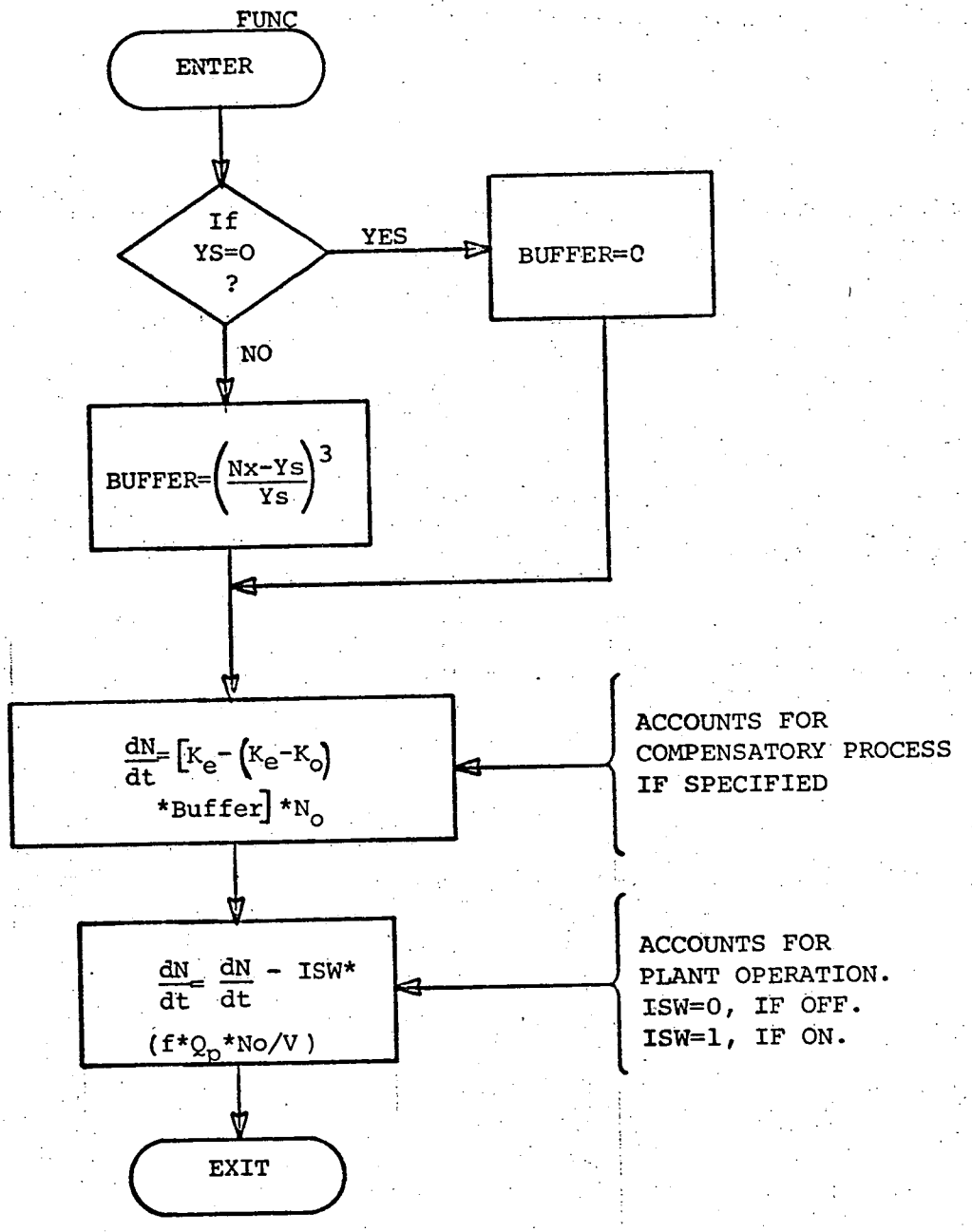
Output: $\frac{dN_x}{dt}$ - change in concentration of organisms.

Referenced by:

DELTA

Subroutines called:

None


FUNC
ENTER
If
YS=O
?
YES
BUFFER=O
NO
BUFFER=$\left(\frac{Nx-Ys}{Ys}\right)^3$
$\frac{dN}{dt}=\left[K_e-\left(K_e-K_o\right)\right.$
$\left.*Buffer\right]*N_o$
ACCOUNTS FOR
COMPENSATORY PROCESS
IF SPECIFIED
$\frac{dN}{dt}=\frac{dN}{dt}$ - ISW*
$(f*Q_p*No/V)$
ACCOUNTS FOR
PLANT OPERATION.
ISW=0, IF OFF.
ISW=1, IF ON.
EXIT

FUNCT-PNC/LIB$ CREATE:02/01/73,11:27:29 FREQ:12 SIZE:1 BACKUP:02/02/73, 05:21:42 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE ON:SPN

IL

```
      SUBROUTINE FUNC(ISTAGE)
      REAL KX,KXO,NX
      COMMON /PAR/ ISW,KX,KXO,YS,QP,V,FKILL(5)
      COMMON /RKTTA/ NX,DNXDT, AUX(16,1)
      BUFFER=0.
      IF(YS.EQ.0.)GO TO   5
      BUFFER=((NX-YS)/YS)**3.
    5 DNXDT=-(KX+(KX-KXO)*BUFFER)*NX
      IF(V.EQ.0.)RETURN
      DNXDT=DNXDT-ISW*FKILL(ISTAGE)*GP*NX/V
      RETURN
      END
```

KX = (NX - YS) / YS

IF (ISTAGE.EQ.4.OR.ISTAGE.EQ.5) GOTO 6

6 IF (QP.EQ.0) RETURN
DNXDT = DNXDT - ISW * FKILL (ISTAGE)
RETURN

IQ

NRHAP:

Functional Description:

NRHAP computes the juvenile II decay rate if a temperature profile has been introduced.

Inputs:

KXI - Estimated decay rate for juvenile II from Newton - Raphson equations.

TF - Time from initiation of spawn.

TIM - Times for change in temperature profile.

TIMWT - (Temperature weights) x (production distribution weights).

KSPAN - Number of temperature weights

PJ2 - Fractional juvenile survival estimated in routine KXNEW.

Named Common: CYC

SNAME(6,5) - description of early stage

IMP(5) - impulse { 0 - off, 1 - on }

MUL(5) - multiplicity { 0 - off, 1 - on }

DX(5) - first order decay rate of each stage

DXO(5) - minimum decay rate of each stage

DYS(5) - stage saturation, carrying capacity

SDT(5) - stage duration

ST(5) - production period.

Equations:

Let

$$f_1 = (.5) = PJ_2 - \left(\sum_{i=1}^{M} W_i t_i\right) \text{ (a fixed number) for survival}$$

$$f_2 = -\sum_{i=1}^{M} \frac{W_i t_i}{\Delta T_{i,i-1}} \left(\frac{1}{k_o}\right)\left(e^{-K_o \overline{W}_1} - e^{-K_o \overline{W}_2}\right)$$

where:

W_i = the fraction of total eggs produced during time of spawning in a time span of $\Delta T_{i,i-1}$.

t_i = the fraction of eggs surviving due to a given temperature profile.

$\Delta T_{i,i-1} = T_i - T_{i-1}$

$$T_{START} = T_o < T_1 < \ldots < T_M = T_{STOP} + T_{START}$$

T_{START} = start of spawning (Julian date)

T_{STOP} = number of days of spawning

$\overline{W}_1 = \overline{W}_2 - \Delta T_{i,i-1} V_i$

$\overline{W}_2 = T_{END} - T_{START} - \Delta t_E - \Delta t_L - \Delta t_{j_1} - \Delta t_{i-1,i-2} V_i$

k_o = estimated value of k required to start Newton-Raphson procedure.

$f = f_1 + f_2$ seeking that k such that $f = 0$

T_{END} = the julian date at which all juvenile II's are designated as juvenile III's.

$f_1' = 0$

$$f_2' = \sum_{i=1}^{M} \frac{W_i t_i}{T_{i,i-1}} \left\{\frac{S_o}{k_o^2} + \frac{\overline{WS}_1}{k_o}\right\}$$

$$S_o = e^{-k_o \overline{W}_1} - e^{-k_o \overline{W}_2}$$

$$\overline{WS}_1 = \overline{W}_1 e^{-k_o \overline{W}_1} - \overline{W}_2 e^{-k_o \overline{W}_2}$$

$$\overline{W}^2 S_2 = \overline{W}_1^{\,2}\, e^{-k_o \overline{W}_1} - \overline{W}_2^{\,2} e^{-k_o \overline{W}_2}$$

$$f' = f_2'$$

The Newton Raphson requires for convergence that

(i) $f \cdot f'' > 0$ (monotonic convergence)

or holds.

(ii) $f \cdot f'' < 0$ (oscillatory convergence)

$$f = f_2'' = -\sum_{i=1}^{M} \frac{W_i t_i}{\Delta T_{i,i-1}} \left\{ \frac{2S_o}{k_o^{\,3}} + \frac{2\overline{W}S_1}{k_o^{\,2}} + \frac{\overline{W}^2 S_2}{k_o} \right\}$$

I. $f < 0 \rightarrow f_2 > 0$

$\rightarrow f_2'' > 0$

$\rightarrow f \cdot f'' < 0$

II. $f > 0 \rightarrow$ ① $-.5 < f_2 < 0$ or ② $.5 > f_2 > 0$

① $\rightarrow f \cdot f'' < 0$

② $\rightarrow f \cdot f'' > 0$

III. $f = 0 \rightarrow k_o$ is the k we are looking for.

<u>Newton - Raphson</u>

1. $k_n = k_o$

2. $k_{n+1} = k_n - f/f'$

3. $|k_{n+1} - k_n| < .1E-7$

4. 3 not satisfied check if maximum iterations reached. Go to step 5.

5. Maximum iterations reached, go to step 8.

6. If maximum iterations not reached, go to step 1 prior to setting

   $k_n = k_{n+1}$.

7. If step 3 or step 5 satisfied, the desired $k = k_{n+1}$.

8. Exit.

To obtain an initial k_o: Procedure used in KSNEW.

$$S_2 = (PJ2) \sum_{i=1}^{M} \frac{W_i t_i}{\Delta T_{i,i-1}}$$

$$T_f = T_{END} - T_{START}$$

$$T_{j_2} = \Delta t_E + \Delta t_L + \Delta t_{J_1}$$

$$T = S_1 = S_3 = 0$$

$$S_1 = S_1 + \frac{W_i t_i}{\Delta T_{i,i-1}}$$

$$S_1 < S_2$$

No

$$D = \frac{S_2 - S_3}{W_i t_i} \cdot \Delta T_{i,i-1}$$

$$T_u = T_f - (T + D + T_{J_2})$$

$$k_o = -\log (PJ2)/T_u$$

Yes

$$S_3 = S_1$$

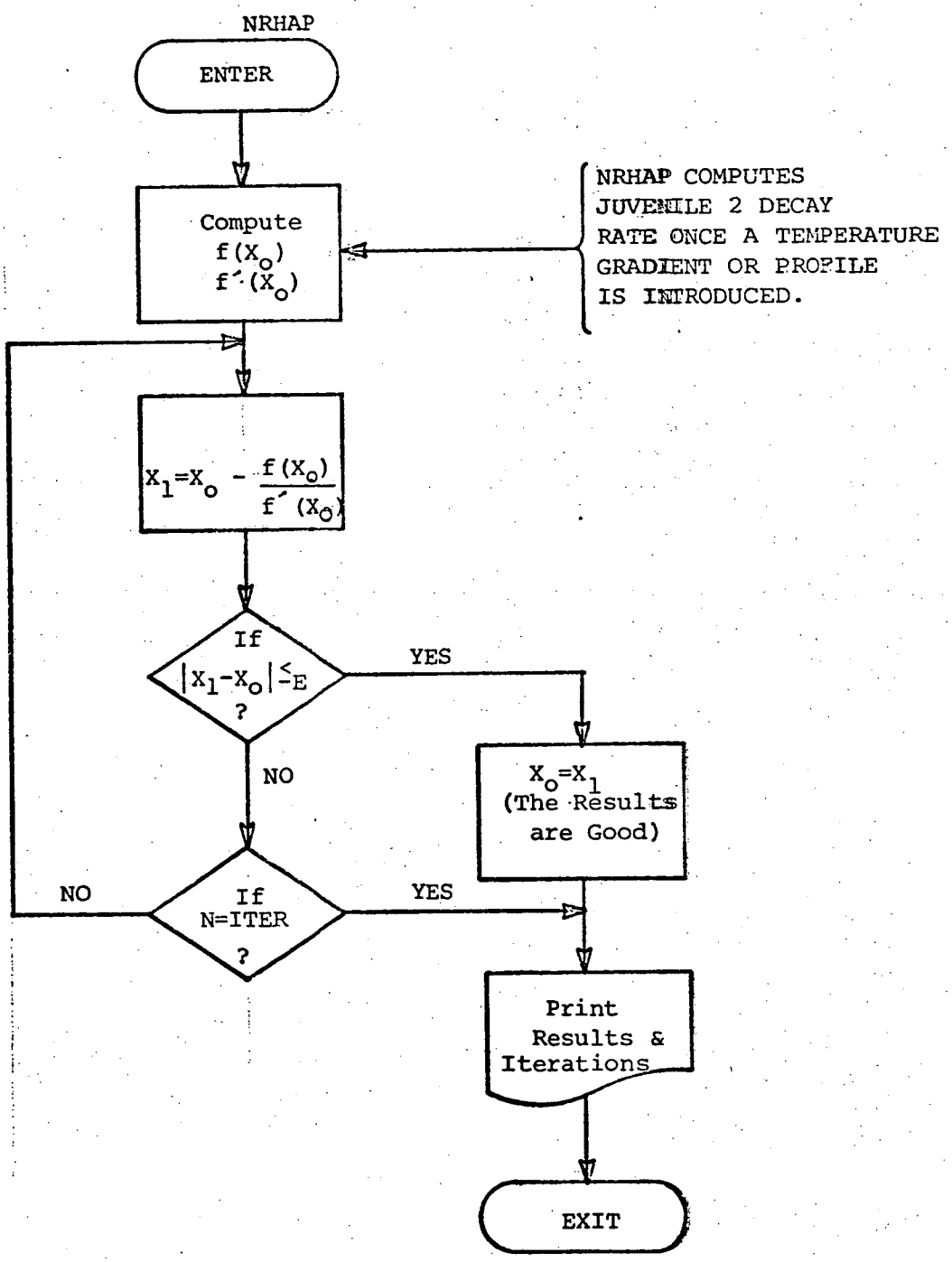
$$T = T + \Delta T_{i,i-1}$$

Outputs:

Updated juvenile II decay rate which reflects the temperature profile induced.

Referenced by: KXNEW

Subroutines called: None


NRHAP
ENTER
Compute
f(X_o)
f'(X_o)
NRHAP COMPUTES JUVENILE 2 DECAY RATE ONCE A TEMPERATURE GRADIENT OR PROFILE IS INTRODUCED.
X_1=X_o - f(X_o)/f'(X_o)
If |X_1-X_o| ≤ E ?
YES
NO
X_o=X_1 (The Results are Good)
If N=ITER ?
NO
YES
Print Results & Iterations
EXIT

```
NRHAP-REL/LIB$  CREATE:02/01/73,11:28:13 FREQ:63 SIZE:1 BACKUP:02/02/73,
05 21:22 KIND:DISK LIFE:PERM ACCESS:REPL
IL
 1000          SUBROUTINE NRHAP(KX1,TF,TIM,TIMWT,KSPAN,PJ2)
 1010          DIMENSION TIM(20),TIMWT(20),TIMD(20),TMUL(20)
 1020          COMMON/CYC/SNAME(6,5),IMP(5),MUL(5),DX(5),DXO(5),
 1030         *DYS(5),SDT(5),ST(5)
 1040          REAL KX1,KN,KO
 1042    C     WRITE(12,3)KX1,TF,KSPAN,PJ2
 1043        3 FORMAT(' KX1=',E15.8,' TF=',F5.0,' KSPAN=',I2,' PJ2=',F6.3)
 1050          ITERX=20
 1060          ITER=0
 1070          DTEST=.1E-7
 1071          XE=0.
 1072          DO 100 K=1,KSPAN
 1073      100 XE=XE+TIMWT(K)
 1080          KO=KX1
 1090          TE=0.
 1100          DO 10 K=1,KSPAN
 1110          TIMD(K)=TIM(K+1)-TIM(K)
 1120          TMUL(K)=TIMWT(K)/TIMD(K)/XE
 1130       10 TE=TE+TIMD(K)
 1140          W2=TF-SDT(1)-SDT(2)-SDT(3)
 1150          DO 5 J=1,KSPAN
 1160    C     WRITE(12,4)TIM(J),TIM(J+1),TIMD(J),TMUL(J),TIMWT(J)
 1170        4 FORMAT(3(1X,F5.2),2(1X,F10.8))
 1180        5 CONTINUE
 1181          WRITE(12,7)W2,TE,SDT(1),SDT(2),SDT(3)
 1182        7 FORMAT(5(1X,F8.3))
 1190       20 F1=PJ2
 1220          FP1=0.
 1230          FP2=0.
 1240          F2=0.
 1250          DO 30 K=1,KSPAN
 1251          IF(K.EQ.1)XW2=W2
 1252          IF(K.NE.1)XW2=XW2-TIMD(K-1)
 1260          W1=XW2-TIMD(K)
 1270          AXP1=EXP(-KO*W1)-EXP(-KO*XW2)
 1280          ADV1=TMUL(K)/KO
 1290          F2=F2-AXP1*ADV1
 1300          AXP2=W1*EXP(-KO*W1)-XW2*EXP(-KO*XW2)
 1310          ADV2=TMUL(K)/(KO**2.)
 1320          FP2=FP2+AXP1*ADV2+AXP2*ADV1
 1330       30 CONTINUE
 1340          FF=F1+F2
 1350          FP=FP1+FP2
 1360          QUOT=FF/FP
 1370          KN=KO-QUOT
 1380          ITER=ITER+1
 1390          DF=ABS(KN-KO)
 1400    C     WRITE(12,40)KO,KN,DF,ITER
 1410       40 FORMAT(' KO=',E15.9,' KN=',E15.9,' D=",E15.8,' I=',I3)
 1420          IF(ITER.EQ.ITERX)GO TO 50
 1430          IF(DF.LE.DTEST)GO TO 50
```

```
1450      KO=KN
1455      GO TO 20
1460   50 KX1=KN
1461      WRITE(12,40)KO,KN,DF,ITER
1465      WRITE(12,55)
1466   55 FORMAT(' END OF NRHAP......'///)
1480      RETURN
1490      END
IQ
```

SWITCH:

Functional description:

SWITCH at year zero stores all early stage parameters. For successive years SWITCH recalls the required early stage parameters.

Inputs:

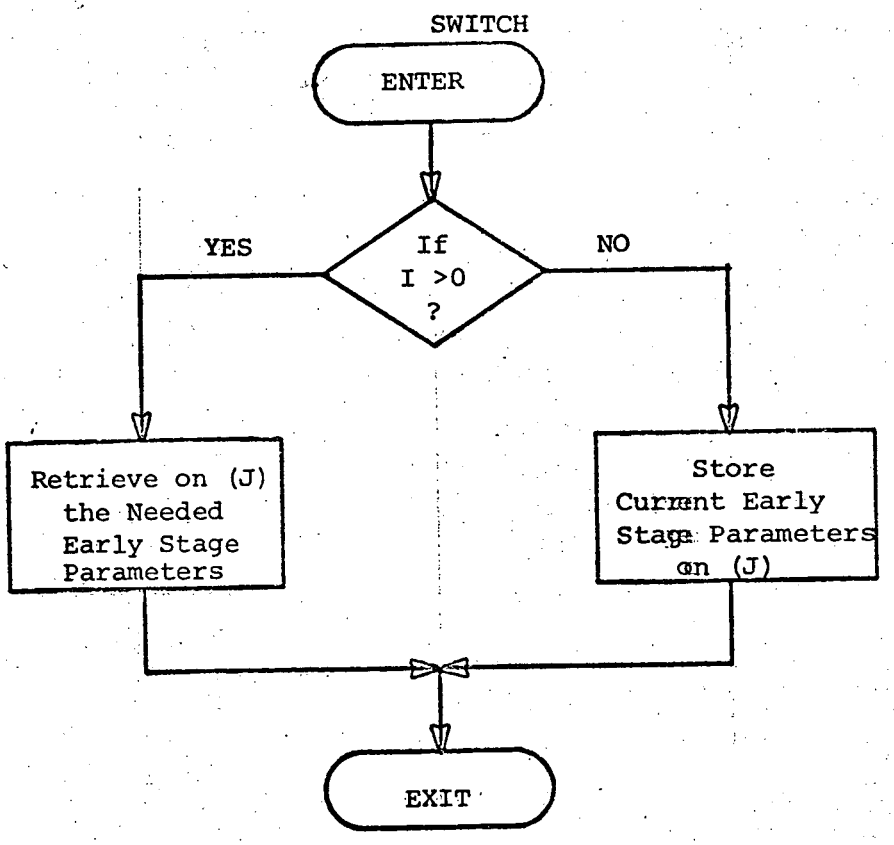
I	current year
J	stage (1, 2, 3, 4 or 5)
L	impulse
M	multiplicity
R1	first order decay rate
R2	minimum decay rate
R3	carrying capacity
R4	stage duration
R5	production period of stage
R6	stage description

Equations: None

Outputs: Named common: CYC - defined by inputs.

Referenced by: HISTG

Subroutines called: none


SWITCH
ENTER
If
I >0
?
YES
NO
Retrieve on (J)
the Needed
Early Stage
Parameters
Store
Current Early
Stage Parameters
on (J)
EXIT

```
SSWT-PNC/LIB$  CREATE:02/01/73,11:27:28 FREQ:11 SIZE:1 BACKUP:02/02/73,05:21:
 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
 1000          SUBROUTINE SWITCH(I,J,L,M,R1,R2,R3,R4,R5,R6)
 1010          COMMON/CYC/SNAME(6,5),IMP(5),MUL(5),DX(5),DXO(5),
 1020         *DYS(5),SDT(5),ST(5)
 1030          DIMENSION R6(6)
 1040          IF(I.GT.0)GO TO 100
 1050          DO 10 K=1,6
 1060       10 SNAME(K,J)=R6(K)
 1070          IMP(J)=L
 1080          MUL(J)=M
 1090          DX(J)=R1
 1100          DXO(J)=R2
 1110          DYS(J)=R3
 1120          SDT(J)=R4
 1130          ST(J)=R5
 1140          RETURN
 1150      100 DO 120 K=1,6
 1160      120 R6(K)=SNAME(K,J)
 1170          L=IMP(J)
 1180          M=MUL(J)
 1190          R1=DX(J)
 1200          R2=DXO(J)
 1210          R3=DYS(J)
 1220          R4=SDT(J)
 1230          R5=ST(J)
 1240          RETURN
 1250          END
IQ
```

EQUAL:

Functional description:

EQUAL balances the ADULT decay rates via a NEWTON RHAPHSON technique to satisfy the equilibrium condition.

Inputs:

ADULT	input Adult 1-3 array
ADULTS	carrying capacity of adults 1-3
DCYU	generalized decay rate (adults)
DCYϕ	minimum decay rate (adults)
DCY	first order decay rate (adults)
FEC	fecundity
SMAT	maturation
SRAT	sex ratio
NEO	recruits to adult 1 year class
ICP	ϕ - no compensation in adults 3 - yes
IEND	number of adult year classes
PEQUAL	total eggs in estuary (overspawning)
KFIRST	ϕ - yes if first time in EQUAL 1 - no
RMF	FEC*SMAT*SRAT
RO	see equations

Equations:

Let E_{eq} = total number of eggs at which equilibrium is satisfied.

E = total number of eggs computed through a single cycle of the completely mixed model (CMM).

Note: at equilibrium (when no plant, no compensation initially:

$$E_{eq} = E$$

Let $A(j,k-1) = \exp^{-\sum_{j=1}^{k-1} K_j \Delta t_j}$

where $A(1,0) \equiv 1$ or $\sum_{j=1}^{k-1} K_j \Delta t_j \equiv 0$ for $k = 1$.

Let A_1 = recruits via a single cycle of CMM to adult year class 1.

Where at equilibrium

$$A_1 = E_{eq} \sum_{i=1}^{M} \frac{W_i T_i \psi_i}{\Delta t_{i,i-1}} \text{ (i Exp.)}$$

Let $R_o = \frac{E_{eq}}{A_1}$

$$S = M_1 S_1 F_1 + M_2 S_2 F_2 \; e^{-K_1' \Delta t_1}$$

$$+ M_3 S_3 F_3 \; e^{(-K_1' \Delta t_1 - K_2' \Delta t_2)}$$

$$+ M_4 S_4 F_4 \; e^{(-K_1' \Delta t_1 - K_2' \Delta t_2 - K'_3 \Delta t_3)}$$

Where a prime (K') indicates a modified decay rate due to compensation in the given adult stage (1,2, or 3).

Let

$$S' = e^{-K_1' \Delta t_1 - K_2' \Delta t_2 - K_3' \Delta t_3}$$

Hence,

$$\left[\frac{R_o - S}{S'}\right] = \sum_{k=5}^{13} e^{-\sum_{j=4}^{k-1} k, \Delta t_j} M_k S_k F_k \qquad \text{[Equation 1]}$$

For j = 4,...,12

assume $K_j = K$ & $\Delta t_j = \Delta t$

Let $D = \left[\frac{R_o - S}{S'}\right]$

$$D = \sum_{k=5}^{13} e^{-K\left\{(k-4)\cdot\Delta t\right\}} M_k S_k F_k$$

Let $f(K) = D - \sum_{k=5}^{13} e^{-K\left\{(k-4)\Delta t\right\}} M_k S_k F_k$

$$f'(K) = \sum_{k=5}^{13} (k-4)\cdot\Delta t\cdot e^{-K\left\{(k-4)\Delta t\right\}} M_k S_k F_k$$

Using Newton Raphson with an initial $K_o = .1E-3$

$$K_{n+1} = K_n - \frac{f(K_n)}{f'(K_n)} \qquad n = o,1,2,...,20.$$

$$D = |K_{n+1} - K_n| < .1E-10$$

Modify K_1, K_2, K_3, if compensation, as follows:

$$K_1' = K_1 + (K_1 - K_{0_1})\cdot\left[\frac{A_1 - Y_{A_1}}{Y_{A_1}}\right]^3$$

A_2 and A_3 are the existing adults from previous year.

$$K_2' = K_2 + (K_2 - K_{0_2}) \cdot \left[\frac{A_2 - Y_{A2}}{Y_{A_2}} \right]^3$$

$$K_3' = K_3 + [K_3 - K_{0_3}] \cdot \left[\frac{A_3 - Y_{A3}}{Y_{A_3}} \right]^3$$

Output:

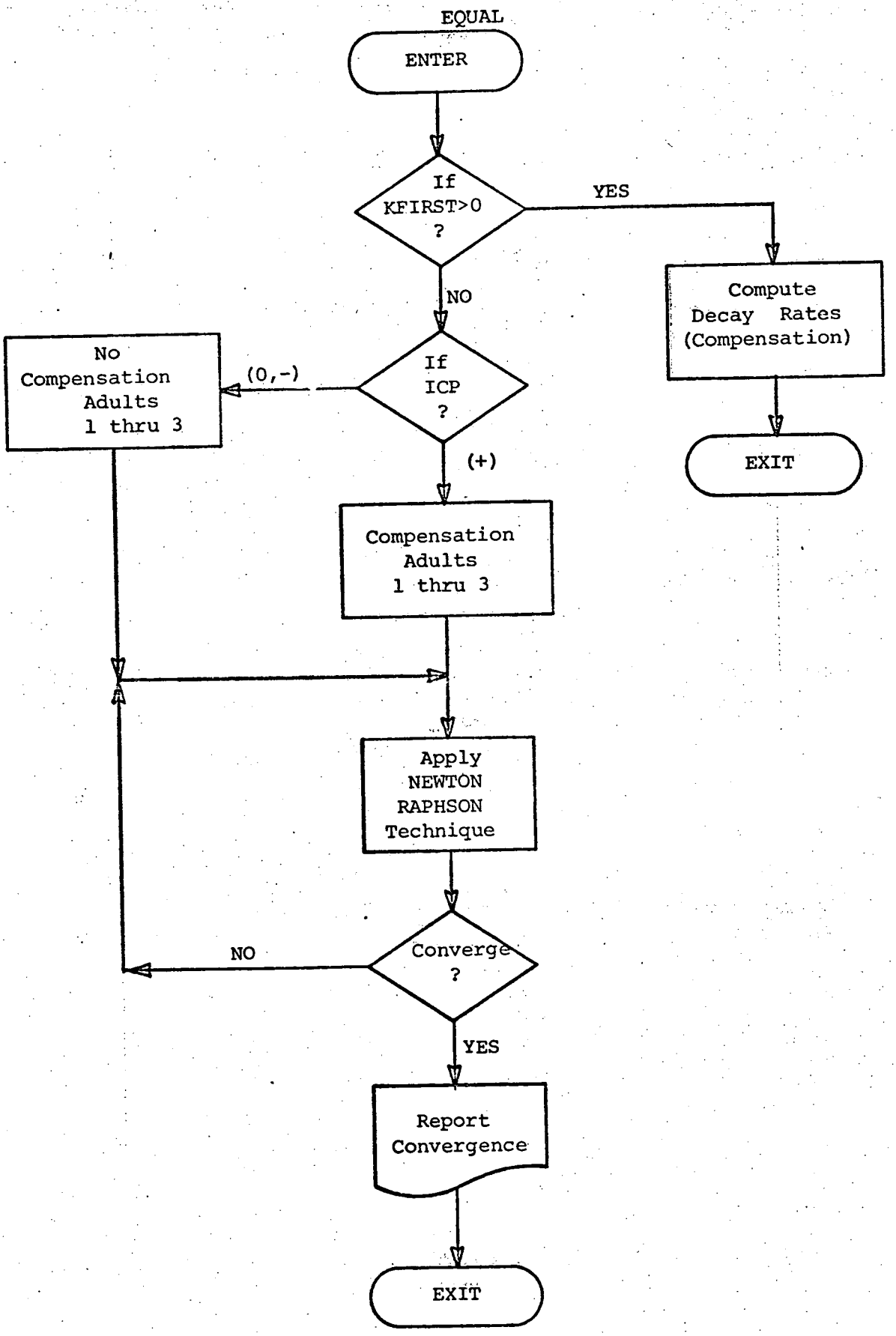
DCYU (1:IEND) generalized decay rates balanced to satisfy equilibrium equations.

Referenced by:

TMODEL

HISTG

Subroutines Called: None


EQUAL
ENTER
If KFIRST>0 ?
YES
Compute Decay Rates (Compensation)
EXIT
NO
If ICP ?
(0,-)
No Compensation Adults 1 thru 3
(+)
Compensation Adults 1 thru 3
Apply NEWTON RAPHSON Technique
Converge ?
NO
YES
Report Convergence
EXIT

```
EQUAL-PNC/LIB$  CREATE:02/01/73,11:27:30 FREQ:11 SIZE:2 BACKUP:02/02/73,
05:21:43 KIND:DISK KEY:1 LIFE:PERM ACCESS:UPDATE
IL
      SUBROUTINE EQUAL(ADULT,ADULTS,DCYU,DCYO,DCY,FEC,SMAT,SRAT,
     *NEO,ICP,IEND,PEQUAL,KFIRST,RMF,RO)
      REAL NEO,NS,KO,KN
      DIMENSION ADULT(20),ADULTS(20)
      DIMENSION SRAT(20),SMAT(20),FEC(20),RMF(20)
      DIMENSION DCYU(20),DCY(20),DCYO(20)
      IF(KFIRST)10,10,120
   10 IF(ICP)20,20,40
   20 DO 30 K=1,3
   30 DCYU(K)=DCY(K)
      GO TO 60
   40 NS=NEO
   45 FORMAT(///' BALANCE TO EQUILIBRIUM..........')
      DO 50 K=1,3
      ADULTS(K)=NS
      COEF=((NS-ADULTS(K))/ADULTS(K))**3.
      DCYU(K)=DCY(K)+(DCY(K)-DCYO(K))*COEF
   50 NS=NS*EXP(-DCYU(K)*365.)
   60 RO=PEQUAL/NEO
      WRITE(12,45)
      DO 70 K=1,IEND
   70 RMF(K)=SRAT(K)*SMAT(K)*FEC(K)
      S1=RMF(1)
      AXP=1.
      DO 80 K=2,4
      AXP=AXP*EXP(-DCYU(K-1)*365.)
   80 S1=S1+RMF(K)*AXP
      D=(RO-S1)/AXP
      DTEST=.1E-7
      ITERX=20
      ITER=1
      KO=6.30845E-3
      WRITE(12,1000)RO,S1,AXP,D
 1000 FORMAT(' RO=',E15.8,' S1=',E15.8,' AXP=',E15.8,' D='E15.8)
   85 FPK=0.
      FK=D
   87 FORMAT(' KO=',E15.9,' KN=',E15.9,' D=',E15.8,' I=',I3)
      PX=1.
      DO 90 K=5,IEND
      AK=K
      PX=EXP(-KO*(AK-4.)*365.)
      FK=FK-RMF(K)*PX
   90 FPK=FPK+365.*(AK-4.)*RMF(K)*PX
      QUOT=FK/FPK
      KN=KO-QUOT
      DF=ABS(KN-KO)
      WRITE(12,87)KO,KN,DF,ITER
      ITER=ITER+1
      IF(ITER.EQ.ITERX)GO TO 100
      IF(DF.LE.DTEST)GO TO 100
      IF(KN.LT.0.)KN=.5*KO
```

```
1480          KO=KN
1490          GO TO 85
1495      100 KK=4
1496          IF(ICP.NE.0)KK=ICP+1
1500          DO 110 K=KK,IEND
1510      110 DCYU(K)=KN
1512          WRITE(12,87)KO,KN,DF,ITER
1515          WRITE(12,105)
1516      105 FORMAT(' END OF EQUAL......'////)
1520          RETURN
1530      120 NS=ADULT(1)
1540          DO 130 K=1,ICP
1550          COEF=((NS-ADULTS(K))/ADULTS(K))**3.
1560          DCYU(K)=DCY(K)+(DCY(K)-DCYO(K))*COEF
1570      130 NS=ADULT(K)*EXP(-DCYU(K)*365.)
1580          RETURN
1590          END
IQ
```

The following is a list of sample input data for the completely mixed model.

```
@IL  CPY  DBI001/NORRIS,BLKEI1

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = BLKEI1  PROCESSED ON 13 DEC 72 AT 15:55:49


NO PCF ELEMENT REQUESTED


1000 @O RUN,S BLKEI1,DBI001,NORRIS,X11523,60,2000 DEC.12, 1972
1001 @PRL TEL INF000,DBI001
1005 @ ASG A=$DMOD
1010 @ APR INF000,DBI001
1011 @ MSG ......PLEASE GIVE OUTPUT TO EITHER JOHN LAWLER OR
1012 @ MSG ......BOB NORRIS OF QUIRK LAWLER AND MATUSKY
1015 @ XGT CUR
1020  IN A
1340 @N XQT DMODEL
1350 2,0,0,0,0,0
1360 1,13,20,600,.0,128.,335.,.5,0,0,0
1361 1,1,1,1.0179,0
1365 1.53069E-3,.506151,.4,.4,.2,.00647,.10017,20
1370 2157.75E6,.1,.5,1.,2.,1.
1380 8,7.,14.,21.,28.,35.,42.,49.
1390 .0536,.0243,.2361,.4482,.2365,.0,.0013
1400 1.,1.,1.,1.,1.,1.,1.
1410 3.29856E-3,3.29856E-3,3.29856E-3,3.29856E-3
1440 .50,.52,.54,.56,.58,.60,.62,.64,.66,.68,.70,.70,.70
1450 .0,.0,.0,.25,.75,.95,1.,1.,1.,1.,1.,1.,1.
1460 .0,.0,.0,.345E6,.438E6,.615E6,.752E6,.82E6,.909E6
1470 .91E6,.964E6,.1136E7,.908E6
1480 1.,1.,1.,2.
1490 EGG STAGE
1500 0,0,1.53506,1.53506,.0,1.5,49.
1510 LARVAL STAGE
1520 0,0,6.77543E-2,6.77543E-2,1.48248E8,28.,49.
1530 JUVENILE 1 STAGE
1540 0,0,5.3647899E-2,5.3647899E-2,3.70621E7,30.,49.
1550 JUVENILE 2 STAGE
1560 0,0,.51344219E-2,.51344219E-2,7.41242E6,100.5,49.
1570 JUVENILE 3 STAGE
1580 0,0,1.06509E-2,1.06509E-2,5.55931E6,158.,0.
1590 @ FIN

************END OF FILE
```

```
@IL  CPY  DBI001/NORRIS,BLKEI8

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = BLKEI8  PROCESSED ON 13 DEC 72 AT 15:55:53


NO PCF ELEMENT REQUESTED


1000 @O RUN,S BLKEI8,DBI001,NORRIS,X11523,60,2000 DEC.12, 1972
1001 @PRL TEL INF000,DBI001
1005 @ ASG A=$DMOD
1010 @ APR INF000,DBI001
1011 @ MSG ......PLEASE GIVE OUTPUT TO EITHER JOHN LAWLER OR
1012 @ MSG ......BOB NORRIS OF QUIRK LAWLER AND MATUSKY
1015 @ XQT CUR
1020  IN A
1340 @N XQT DMODEL
1350 2,0,0,0,0,0
1360 1,13,20,600,.0,128.,335.,.5,0,0,0
1361 1,1,1,.7712,0
1365 1.53069E-3,.506151,.4,.4,.2,.00548,.08668,20
1370 2157.75E6,.1,.5,1.,2.,1.
1380 8,7.,14.,21.,28.,35.,42.,49.
1390 .0536,.0243,.2361,.4482,.2365,.0,.0013
1400 1.,1.,1.,1.,1.,1.,1.
1410 3.29856E-3,3.29856E-3,3.29856E-3,3.29856E-3
1440 .50,.52,.54,.56,.58,.60,.62,.64,.66,.68,.70,.70,.70
1450 .0,.0,.0,.25,.75,.95,1.,1.,1.,1.,1.,1.,1.
1460 .0,.0,.0,.345E6,.438E6,.615E6,.752E6,.82E6,.909E6
1470 .91E6,.964E6,.1136E7,.908E6
1480 1.,1.,1.,2.
1490 EGG STAGE
1500 0,0,1.53506,1.53506,.0,1.5,49.
1510 LARVAL STAGE
1520 0,0,6.77543E-2,5.4203439E-2,1.48248E8,28.,49.
1530 JUVENILE 1 STAGE
1540 0,0,5.3647899E-2,4.2918319E-2,3.70621E7,30.,49.
1550 JUVENILE 2 STAGE
1560 0,0,.51344219E-2,4.1075374E-3,7.41242E6,100.5,49.
1570 JUVENILE 3 STAGE
1580 0,0,1.06509E-2,8.5207198E-3,5.55931E6,158.,0.
1590 @ FIN

************END OF FILE
```

```
@IL  CPY  DBI001/NORRIS,BLKFI1

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = BLKFI1  PROCESSED ON 13 DEC 72 AT 15:55:56


NO PCF ELEMENT REQUESTED

1000 @O RUN,S BLKFI1,DBI001,NORRIS,X11523,60,2000 DEC.12, 1972
1001 @PRL TEL INF000,DBI001
1005 @ ASG A=$DMOD
1010 @ APR INF000,DBI001
1011 @ MSG ......PLEASE GIVE OUTPUT TO EITHER JOHN LAWLER OR
1012 @ MSG ......BOB NORRIS OF QUIRK LAWLER AND MATUSKY
1015 @ XQT CUR
1020  IN A
1340 @N XQT DMODEL
1350 2,0,0,0,0,0
1360 1,13,20,600,.0,128.,335.,.5,0,0,0
1361 1,1,1,1.0179,0
1365 1.53069E-3,.506151,.03,.15,.05,.00647,.10017,20
1370 2157.75E6,.1,.5,1.,2.,1.
1380 8,7.,14.,21.,28.,35.,42.,49.
1390 .0536,.0243,.2361,.4482,.2365,.0,.0013
1400 1.,1.,1.,1.,1.,1.,1.
1410 3.29856E-3,3.29856E-3,3.29856E-3,3.29856E-3
1440 .50,.52,.54,.56,.58,.60,.62,.64,.66,.68,.70,.70,.70
1450 .0,.0,.0,.25,.75,.95,1.,1.,1.,1.,1.,1.,1.
1460 .0,.0,.0,.345E6,.438E6,.615E6,.752E6,.82E6,.909E6
1470 .91E6,.964E6,.1136E7,.908E6
1480 1.,1.,1.,2.
1490 EGG STAGE
1500 0,0,1.53506,1.53506,.0,1.5,49.
1510 LARVAL STAGE
1520 0,0,6.77543E-2,6.77543E-2,1.48248E8,28.,49.
1530 JUVENILE 1 STAGE
1540 0,0,5.3647899E-2,5.3647899E-2,3.70621E7,30.,49.
1550 JUVENILE 2 STAGE
1560 0,0,.51344219E-2,.51344219E-2,7.41242E6,100.5,49.
1570 JUVENILE 3 STAGE
1580 0,0,1.06509E-2,1.06509E-2,5.55931E6,158.,0.
1590 @ FIN

************END OF FILE
```

```
@IL  CPY  DBI001/NORRIS,BL8E1

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = BL8E1   PROCESSED ON 13 DEC 72 AT 15:55:58


NO PCF ELEMENT REQUESTED


1000 @O RUN,S BL8E1,DBI001,NORRIS,X11523,60,2000 DEC.12, 1972
1001 @PRL TEL INF000,DBI001
1005 @ ASG A=$DMOD
1010 @ APR INF000,DBI001
1011 @ MSG ......PLEASE GIVE OUTPUT TO EITHER JOHN LAWLER OR
1012 @ MSG ......BOB NORRIS OF QUIRK LAWLER AND MATUSKY
1015 @ XQT CUR
1020  IN A
1340 @N XQT DMODEL
1350 2,0,0,0,0,0
1360 1,13,20,600,.0,128.,335.,.5,0,0,0
1361 1,1,1,1.0179,0
1365 1.53069E-3,.506151,.4,.4,.2,.00691,.10008,20
1370 2157.75E6,.1,.5,1.,2.,1.
1380 8,7.,14.,21.,28.,35.,42.,49.
1390 .0536,.0243,.2361,.4482,.2365,.0,.0013
1400 1.,1.,1.,1.,1.,1.,1.
1410 3.29856E-3,3.29856E-3,3.29856E-3,3.29856E-3
1440 .50,.52,.54,.56,.58,.60,.62,.64,.66,.68,.70,.70,.70
1450 .0,.0,.0,.25,.75,.95,1.,1.,1.,1.,1.,1.,1.
1460 .0,.0,.0,.345E6,.438E6,.615E6,.752E6,.82E6,.909E6
1470 .91E6,.964E6,.1136E7,.908E6
1480 1.,1.,1.,2.
1490 EGG STAGE
1500 0,0,1.53506,1.53506,.0,1.5,49.
1510 LARVAL STAGE
1520 0,0,6.77543E-2,6.77543E-2,1.48248E8,28.,49.
1530 JUVENILE 1 STAGE
1540 0,0,5.3647899E-2,5.3647899E-2,3.70621E7,30.,49.
1550 JUVENILE 2 STAGE
1560 0,0,.51344219E-2,.51344219E-2,7.41242E6,100.5,49.
1570 JUVENILE 3 STAGE
1580 0,0,1.06509E-2,1.06509E-2,5.55931E6,158.,0.
1590 @ FIN

************END OF FILE
```

```
@IL  CPY  DBI001/NORRIS,BL8E9

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = BL8E9   PROCESSED ON 13 DEC 72 AT 15:56:01


NO PCF ELEMENT REQUESTED


1000 @O RUN,S BL8E9,DBI001,NORRIS,X11523,60,2000 DEC.13, 1972
1001 @PRL TEL INF000,DBI001
1005 @ ASG A=$DMOD
1010 @ APR INF000,DBI001
1011 @ MSG ......PLEASE GIVE OUTPUT TO EITHER JOHN LAWLER OR
1012 @ MSG ......BOB NORRIS OF QUIRK LAWLER AND MATUSKY
1015 @ XQT CUR
1020  IN A
1340 @N XQT DMODEL
1350 2,0,0,0,0,0
1360 1,13,20,600,.0,128.,335.,.5,0,0,0
1361 1,1,1,.8750,0
1365 1.53069E-3,.506151,.4,.4,.2,.00638,.09350,20
1370 2157.75E6,.1,.5,1.,2.,1.
1380 8,7.,14.,21.,28.,35.,42.,49.
1390 .0536,.0243,.2361,.4482,.2365,.0,.0013
1400 1.,1.,1.,1.,1.,1.,1.
1410 3.29856E-3,3.29856E-3,3.29856E-3,3.29856E-3
1440 .50,.52,.54,.56,.58,.60,.62,.64,.66,.68,.70,.70,.70
1450 .0,.0,.0,.25,.75,.95,1.,1.,1.,1.,1.,1.,1.
1460 .0,.0,.0,.345E6,.438E6,.615E6,.752E6,.82E6,.909E6
1470 .91E6,.964E6,.1136E7,.908E6
1480 1.,1.,1.,2.
1490 EGG STAGE
1500 0,0,1.53506,1.53506,.0,1.5,49.
1510 LARVAL STAGE
1520 0,0,6.77543E-2,6.0978869E-2,1.48248E8,28.,49.
1530 JUVENILE 1 STAGE
1540 0,0,5.3647899E-2,4.8283109E-2,3.70621E7,30.,49.
1550 JUVENILE 2 STAGE
1560 0,0,.51344219E-2,4.6209797E-3,7.41242E6,100.5,49.
1570 JUVENILE 3 STAGE
1580 0,0,1.06509E-2,9.5858099E-3,5.55931E6,158.,0.
1590 @ FIN

************END OF FILE
```

```
@IL  CPY  DBI001/NORRIS,BL8E8

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = BL8E8   PROCESSED ON 13 DEC 72 AT 15:56:03


NO PCF ELEMENT REQUESTED


1000 @O RUN,S BL8E8,DBI001,NORRIS,X11523,60,2000 DEC.13, 1972
1001 @PRL TEL INF000,DBI001
1005 @ ASG A=$DMOD
1010 @ APR INF000,DBI001
1011 @ MSG ......PLEASE GIVE OUTPUT TO EITHER JOHN LAWLER OR
1012 @ MSG ......BOB NORRIS OF QUIRK LAWLER AND MATUSKY
1015 @ XQT CUR
1020  IN A
1340 @N XQT DMODEL
1350 2,0,0,0,0,0
1360 1,13,20,600,.0,128.,335.,.5,0,0,0
1361 1,1,1,.7665,0
1365 1.53069E-3,.506151,.4,.4,.2,.00585,.08758,20
1370 2157.75E6,.1,.5,1.,2.,1.
1380 8,7.,14.,21.,28.,35.,42.,49.
1390 .0536,.0243,.2361,.4482,.2365,.0,.0013
1400 1.,1.,1.,1.,1.,1.,1.
1410 3.29856E-3,3.29856E-3,3.29856E-3,3.29856E-3
1440 .50,.52,.54,.56,.58,.60,.62,.64,.66,.68,.70,.70,.70
1450 .0,.0,.0,.25,.75,.95,1.,1.,1.,1.,1.,1.,1.
1460 .0,.0,.0,.345E6,.436E6,.615E6,.752E6,.82E6,.909E6
1470 .91E6,.964E6,.1136E7,.908E6
1480 1.,1.,1.,2.
1490 EGG STAGE
1500 0,0,1.53506,1.53506,.0,1.5,49.
1510 LARVAL STAGE
1520 0,0,6.77543E-2,5.4203439E-2,1.48248E8,28.,49.
1530 JUVENILE 1 STAGE
1540 0,0,5.3647899E-2,4.2918319E-2,3.70621E7,30.,49.
1550 JUVENILE 2 STAGE
1560 0,0,.51344219E-2,4.1075374E-3,7.41242E6,100.5,49.
1570 JUVENILE 3 STAGE
1580 0,0,1.06509E-2,8.5207198E-3,5.55931E6,158.,0.
1590 @ FIN

************END OF FILE
```

```
@IL CPY DBI001/NORRIS,BEST55

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = BEST55  PROCESSED ON 13 DEC 72 AT 15:56:06


NO PCF ELEMENT REQUESTED


1000 @O RUN,S BEST55,DBI001,NORRIS,X11523,60,2000 DEC. 13, 1972
1001 @PRL TEL INF000,DBI001
1005 @ ASG A=$DMOD
1010 @ APR INF000,DBI001
1011 @ MSG ......PLEASE GIVE OUTPUT TO EITHER JOHN LAWLER OR
1012 @ MSG ......BOB NORRIS OF QUIRK LAWLER AND MATUSKY
1015 @ XGT CUR
1020  IN A
1340 @N XQT DMODEL
1350 2,0,0,0,0,0
1360 1,13,1,600,.0,128.,335.,.5,0,0,0
1361 1,1,1,1.0,0
1365 1.53069E-3,.506151,.41,.39,.09,.00374,.01249,1
1370 2157.75E6,.1,.5,1.,2.,1.
1380 8,7.,14.,21.,28.,35.,42.,49.
1390 .0536,.0243,.2361,.4482,.2365,.0,.0013
1400 1.,1.,1.,1.,1.,1.,1.
1410 3.29856E-3,3.29856E-3,3.29856E-3,3.29856E-3
1440 .50,.52,.54,.56,.58,.60,.62,.64,.66,.68,.70,.70,.70
1450 .0,.0,.0,.25,.75,.95,1.,1.,1.,1.,1.,1.,1.
1460 .0,.0,.0,.345E6,.438E6,.615E6,.752E6,.82E6,.909E6
1470 .91E6,.964E6,.1136E7,.908E6
1480 1.,1.,1.,2.
1490 EGG STAGE
1500 0,0,1.53506,1.53506,.0,1.5,49.
1510 LARVAL STAGE
1520 0,0,6.77543E-2,1.69386E-2,1.48248E8,28.,49.
1530 JUVENILE 1 STAGE
1540 0,0,5.3647899E-2,.026824,3.70621E7,30.,49.
1550 JUVENILE 2 STAGE
1560 0,0,.51344219E-2,2.56721E-3,7.41242E6,100.5,49.
1570 JUVENILE 3 STAGE
1580 0,0,1.06509E-2,5.32545E-3,5.55931E6,158.,0.
1590 @ FIN

************END OF FILE
```

```
@IL CPY DBI001/NORRIS,BEST66

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = BEST66  PROCESSED ON 13 DEC 72 AT 15:56:08


NO PCF ELEMENT REQUESTED


1000 @O RUN,S BEST66,DBI001,NORRIS,X11523,60,2000 DEC.12, 1972
1001 @PRL TEL INF000,DBI001
1005 @ ASG A=$DMOD
1010 @ APR INF000,DBI001
1011 @ MSG ......PLEASE GIVE OUTPUT TO EITHER JOHN LAWLER OR
1012 @ MSG ......BOB NORRIS OF QUIRK LAWLER AND MATUSKY
1015 @ XQT CUR
1020  IN A
1340 @N XQT DMODEL
1350 2,0,0,0,0,0
1360 1,13,1,600,.0,128.,335.,.5,0,0,0
1361 1,1,1,1.0,0
1365 1.53069E-3,.506151,.41,.39,.09,.00727,.02469,1
1370 2157.75E6,.1,.5,1.,2.,1.
1380 8,7.,14.,21.,28.,35.,42.,49.
1390 .0536,.0243,.2361,.4482,.2365,.0,.0013
1400 1.,1.,1.,1.,1.,1.,1.
1410 3.29856E-3,3.29856E-3,3.29856E-3,3.29856E-3
1440 .50,.52,.54,.56,.58,.60,.62,.64,.66,.68,.70,.70,.70
1450 .0,.0,.0,.25,.75,.95,1.,1.,1.,1.,1.,1.,1.
1460 .0,.0,.0,.345E6,.438E6,.615E6,.752E6,.82E6,.909E6
1470 .91E6,.964E6,.1136E7,.908E6
1480 1.,1.,1.,2.
1490 EGG STAGE
1500 0,0,1.53506,1.53506,.0,1.5,49.
1510 LARVAL STAGE
1520 0,0,6.77543E-2,6.77543E-2,1.48248E8,28.,49.
1530 JUVENILE 1 STAGE
1540 0,0,5.3647899E-2,5.3647899E-2,3.70621E7,30.,49.
1550 JUVENILE 2 STAGE
1560 0,0,.51344219E-2,.51344219E-2,7.41242E6,100.5,49.
1570 JUVENILE 3 STAGE
1580 0,0,1.06509E-2,1.06509E-2,5.55931E6,158.,0.
1590 @ FIN

************END OF FILE
```

```
@IL CPY DBI001/NORRIS,KE55

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = KE55    PROCESSED ON 13 DEC 72 AT 15:56:11


NO PCF ELEMENT REQUESTED


1000 @O RUN,S KE55,DBI001,NORRIS,X11523,60,2000 DEC. 13, 1972
1005 @ ASG A=SDMOD
1010 @ APR DBI001
1015 @ XQT CUR
1020  IN A
1340 @N XQT DMODEL
1350 2,0,0,0,0,0
1360 1,13,1,600,.0,128.,335.,.5,0,0,0
1361 1,1,1,1.0,0
1365 1.53069E-3,.506151,.41,.39,.09,.00412,.01367,1
1370 2157.75E6,.1,.5,1.,2.,1.
1380 8,7.,14.,21.,28.,35.,42.,49.
1390 .0536,.0243,.2361,.4482,.2365,.0,.0013
1400 1.,1.,1.,1.,1.,1.,1.
1410 3.29856E-3,3.29856E-3,3.29856E-3,3.29856E-3
1440 .50,.52,.54,.56,.58,.60,.62,.64,.66,.68,.70,.70,.70
1450 .0,.0,.0,.25,.75,.95,1.,1.,1.,1.,1.,1.,1.
1460 .0,.0,.0,.345E6,.438E6,.615E6,.752E6,.82E6,.909E6
1470 .91E6,.964E6,.1136E7,.908E6
1480 1.,1.,1.,2.
1490 EGG STAGE
1500 0,0,1.53506,1.53506,.0,1.5,49.
1510 LARVAL STAGE
1520 0,0,6.77543E-2,3.38771E-2,1.48248E8,28.,49.
1530 JUVENILE 1 STAGE
1540 0,0,5.3647899E-2,.026824,3.70621E7,30.,49.
1550 JUVENILE 2 STAGE
1560 0,0,.51344219E-2,2.56721E-3,7.41242E6,100.5,49.
1570 JUVENILE 3 STAGE
1580 0,0,1.06509E-2,5.32545E-3,5.55931E6,158.,0.
1590 @ FIN

************END OF FILE
```

```
@IL CPY DBI001/NORRIS,KE7575

BASIC-TO-BATCH FILE MANIPULATOR, VERSION  3.1

FILE NAME = KE7575  PROCESSED ON 13 DEC 72 AT 15:56:13


NO PCF ELEMENT REQUESTED


1000 @O RUN,S KE7575,DBI001,NORRIS,X11523,60,2000 DEC. 13, 1972
1001 @PRL TEL INF000,DBI001
1005 @ ASG A=$DMOD
1010 @ APR INF000,DBI001
1011 @ MSG ......PLEASE GIVE OUTPUT TO EITHER JOHN LAWLER OR
1012 @ MSG ......BOB NORRIS OF QUIRK LAWLER AND MATUSKY
1015 @ XQT CUR
1020  IN A
1340 @N XQT DMODEL
1350 2,0,0,0,0,0
1360 1,13,1,600,.0,128.,335.,.5,0,0,0
1361 1,1,1,1.0,0
1365 1.53069E-3,.506151,.41,.39,.09,.00458,.01510,1
1370 2157.75E6,.1,.5,1.,2.,1.
1380 8,7.,14.,21.,28.,35.,42.,49.
1390 .0536,.0243,.2361,.4482,.2365,.0,.0013
1400 1.,1.,1.,1.,1.,1.,1.
1410 3.29856E-3,3.29856E-3,3.29856E-3,3.29856E-3
1440 .50,.52,.54,.56,.58,.60,.62,.64,.66,.68,.70,.70,.70
1450 .0,.0,.0,.25,.75,.95,1.,1.,1.,1.,1.,1.,1.
1460 .0,.0,.0,.345E6,.438E6,.615E6,.752E6,.82E6,.909E6
1470 .91E6,.964E6,.1136E7,.908E6
1480 1.,1.,1.,2.
1490 EGG STAGE
1500 0,0,1.53506,1.53506,.0,1.5,49.
1510 LARVAL STAGE
1520 0,0,6.77543E-2,5.0815724E-2,1.48248E8,28.,49.
1530 JUVENILE 1 STAGE
1540 0,0,5.3647899E-2,4.0235924E-2,3.70621E7,30.,49.
1550 JUVENILE 2 STAGE
1560 0,0,.51344219E-2,3.8508164E-3,7.41242E6,100.5,49.
1570 JUVENILE 3 STAGE
1580 0,0,1.06509E-2,7.9881749E-3,5.55931E6,158.,0.
1590 @ FIN

************END OF FILE
```

The following is an example of output of a computer run of the totally mixed model. The corresponding data input is contained in the sample data section and is file BL8E9.

```
@O RUN,X BL8E9,DBI001,        ,X11523,60,2000 DEC.13, 1972
LOG NUMBER=  BL8E9

@PRL TEL INF000,DBI001

@ ASG A=$DMOD
FSTRND ASSIGNMENTS*    A= 2/00 $DMOD

@ APR INF000,DBI001

@ MSG ......PLEASE GIVE OUTPUT TO EITHER JOHN LAWLER OR

@ MSG ......BOB NORRIS OF QUIRK LAWLER AND MATUSKY
```

```
@ XQT CUR
    1.  IN A
        END FILE --- UNIT A
        END CUR
```

ON XQT DMODEL

DRUM LENGTH 042314
THIS ALLOCATION WAS DONE ON 13 DEC 72 AT 15:49:45

```
*************************************

STAGE
NO. ADULT AGE CLASSES - 13
MODEL SIMULATES -  20 YEARS
TIME IN DAYS FOR CHANGE IN TEMPERATURE -    .00
COMPENSATION......     NO
PLANT OPERATING...    YES
FOR ............... 20 YEARS.
ADULT 1 MODIFIER..   .88

*************************************

STAGE

.................................
..CURRENT YEAR.......  -   0-  ..
.................................

GIVEN:
  TOTAL EGGS PRODUCED IN ESTUARY        .2157750000+10
  TIME STEP SIZE (DAY)
   EGG    LARV    JUV 1    JUV 2    JUV 3
  .10     .50    1.00     2.00     1.00

TOTAL EGGS PRODUCED      2157749800.

ADULT DISTRIBUTION BY AGE CLASS

AGE NUMBERS   AGE NUMBERS   AGE NUMBERS   AGE NUMBERS   AGE NUMBERS
  1  634587.    2  190376.    3   57113.    4   17134.    5    4214.
  6    1036.    7     255.    8      63.    9      15.   10       4.
 11       1.   12       0.   13       0.
TOTAL ADULTS          904796.

PERCENT......
AGE PERCENT AGE PERCENT AGE PERCENT AGE PERCENT AGE PERCENT

  1  70.136   2  21.041   3   6.312   4   1.894   5    .466
```

6	.115	7	.028	8	.007	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... 1.00
EQUILIBRIUM (1.0) = .1000+01

```
..............................
..CURRENT YEAR....... -  1- ..
..............................
```

TOTAL EGGS PRODUCED 2157749800.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	578776.	2	190376.	3	57113.	4	17134.	5	4214.
6	1036.	7	255.	8	63.	9	15.	10	4.
11	1.	12	0.	13	0.				

TOTAL ADULTS 848986.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	63.968	2	21.041	3	6.312	4	1.894	5	.466
6	.115	7	.028	8	.007	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .94
EQUILIBRIUM (1.0) = .9121-00

```
..............................
..CURRENT YEAR....... -  2- ..
..............................
```

TOTAL EGGS PRODUCED 2157749800.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	578776.	2	173633.	3	57113.	4	17134.	5	4214.

6	1036.	7	255.	8	63.	9	15.	10	4.
11	1.	12	0.	13	0.				

TOTAL ADULTS 832243.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	63.968	2	19.190	3	6.312	4	1.894	5	.466
6	.115	7	.028	8	.007	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .92

EQUILIBRIUM (1.0) = .9121-00

.....

..CURRENT YEAR..... - 3- ..

.....

TOTAL EGGS PRODUCED 2157749800.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	578776.	2	173633.	3	52090.	4	17134.	5	4214.
6	1036.	7	255.	8	63.	9	15.	10	4.
11	1.	12	0.	13	0.				

TOTAL ADULTS 827220.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	63.968	2	19.190	3	5.757	4	1.894	5	.466
6	.115	7	.028	8	.007	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .91

EQUILIBRIUM (1.0) = .9121-00

.....

..CURRENT YEAR..... - 4- ..

.....

TOTAL EGGS PRODUCED 2064968100.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	578776.	2	173633.	3	52090.	4	15627.	5	4214.
6	1036.	7	255.	8	63.	9	15.	10	4.
11	1.	12	0.	13	0.				

TOTAL ADULTS 825713.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	63.968	2	19.190	3	5.757	4	1.727	5	.466
6	.115	7	.028	8	.007	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .91

EQUILIBRIUM (1.0) = .9121-00

.....
..CURRENT YEAR..... - 5- ..
.....

TOTAL EGGS PRODUCED 2014362900.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	562752.	2	173633.	3	52090.	4	15627.	5	3843.
6	1036.	7	255.	8	63.	9	15.	10	4.
11	1.	12	0.	13	0.				

TOTAL ADULTS 809318.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	62.197	2	19.190	3	5.757	4	1.727	5	.425
6	.115	7	.028	8	.007	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .89

EQUILIBRIUM (1.0) = .9178-00

```
.............................
..CURRENT YEAR.......  -   6- ..
.............................
```

TOTAL EGGS PRODUCED 1982416600.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	547155.	2	168825.	3	52090.	4	15627.	5	3843.
6	945.	7	255.	8	63.	9	15.	10	4.
11	1.	12	0.	13	0.				

TOTAL ADULTS 788823.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	60.473	2	18.659	3	5.757	4	1.727	5	.425
6	.104	7	.028	8	.007	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .87

EQUILIBRIUM (1.0) = .9236-00

```
.............................
..CURRENT YEAR.......  -   7- ..
.............................
```

TOTAL EGGS PRODUCED 1971967500.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	540079.	2	164146.	3	50648.	4	15627.	5	3843.
6	945.	7	232.	8	63.	9	15.	10	4.
11	1.	12	0.	13	0.				

TOTAL ADULTS 775604.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	59.691	2	18.142	3	5.598	4	1.727	5	.425
6	.104	7	.026	8	.007	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .86

EQUILIBRIUM (1.0) = .9263-00

.....

..CURRENT YEAR..... - 8- ..

.....

TOTAL EGGS PRODUCED 1948177800.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	537762.	2	162024.	3	49244.	4	15194.	5	3843.
6	945.	7	232.	8	57.	9	15.	10	4.
11	1.	12	0.	13	0.				

TOTAL ADULTS 769322.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	59.435	2	17.907	3	5.443	4	1.679	5	.425
6	.104	7	.026	8	.006	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .85

EQUILIBRIUM (1.0) = .9273-00

.....

..CURRENT YEAR..... - 9- ..

.....

TOTAL EGGS PRODUCED 1906753000.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	532481.	2	161328.	3	48607.	4	14773.	5	3737.
6	945.	7	232.	8	57.	9	14.	10	4.
11	1.	12	0.	13	0.				

TOTAL ADULTS 762180.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	58.851	2	17.830	3	5.372	4	1.633	5	.413
6	.104	7	.026	8	.006	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .84

EQUILIBRIUM (1.0) = .9294-00

.....

..CURRENT YEAR..... - 10- ..

.....

TOTAL EGGS PRODUCED 1868415300.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	523267.	2	159744.	3	48398.	4	14582.	5	3633.
6	919.	7	232.	8	57.	9	14.	10	3.
11	1.	12	0.	13	0.				

TOTAL ADULTS 750852.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	57.833	2	17.655	3	5.349	4	1.612	5	.402
6	.102	7	.026	8	.006	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .83

EQUILIBRIUM (1.0) = .9331-00

.....

..CURRENT YEAR..... - 11- ..
.....

TOTAL EGGS PRODUCED 1844458600.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	514716.	2	156980.	3	47923.	4	14520.	5	3586.
6	893.	7	226.	8	57.	9	14.	10	3.
11	1.	12	0.	13	0.				

TOTAL ADULTS 738920.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	56.888	2	17.350	3	5.297	4	1.605	5	.396
6	.099	7	.025	8	.006	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .82

EQUILIBRIUM (1.0) = .9367-00

.....
..CURRENT YEAR..... - 12- ..
.....

TOTAL EGGS PRODUCED 1826823400.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	509362.	2	154415.	3	47094.	4	14377.	5	3571.
6	882.	7	220.	8	56.	9	14.	10	3.
11	1.	12	0.	13	0.				

TOTAL ADULTS 729994.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	56.296	2	17.066	3	5.205	4	1.589	5	.395

6	.097	7	.024	8	.006	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .81
EQUILIBRIUM (1.0) = .9390-00

.....
..CURRENT YEAR..... - 13- ..
.....

TOTAL EGGS PRODUCED 1804429900.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	505414.	2	152808.	3	46324.	4	14128.	5	3536.
6	878.	7	217.	8	54.	9	14.	10	3.
11	1.	12	0.	13	0.				

TOTAL ADULTS 723377.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	55.859	2	16.889	3	5.120	4	1.561	5	.391
6	.097	7	.024	8	.006	9	.002	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .80
EQUILIBRIUM (1.0) = .9407-00

.....
..CURRENT YEAR..... - 14- ..
.....

TOTAL EGGS PRODUCED 1777512600.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	500393.	2	151624.	3	45842.	4	13897.	5	3474.

6	869.	7	216.	8	53.	9	13.	10	3.
11	1.	12	0.	13	0.				

TOTAL ADULTS 716387.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	55.304	2	16.758	3	5.067	4	1.536	5	.384
6	.096	7	.024	8	.006	9	.001	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .79

EQUILIBRIUM (1.0) = .9429-00

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..CURRENT YEAR..... - 15- ..

.....

TOTAL EGGS PRODUCED 1753152800.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	494346.	2	150118.	3	45487.	4	13753.	5	3418.
6	854.	7	214.	8	53.	9	13.	10	3.
11	1.	12	0.	13	0.				

TOTAL ADULTS 708259.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	54.636	2	16.591	3	5.027	4	1.520	5	.378
6	.094	7	.024	8	.006	9	.001	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .78

EQUILIBRIUM (1.0) = .9456-00

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..CURRENT YEAR..... - 16- ..

.....

TOTAL EGGS PRODUCED 1734256900.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	488861.	2	148303.	3	45035.	4	13646.	5	3382.
6	840.	7	210.	8	53.	9	13.	10	3.
11	1.	12	0.	13	0.				

TOTAL ADULTS 700348.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	54.030	2	16.391	3	4.977	4	1.508	5	.374
6	.093	7	.023	8	.006	9	.001	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .77

EQUILIBRIUM (1.0) = .9481-00

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..CURRENT YEAR..... - 17- ..
.....

TOTAL EGGS PRODUCED 1717473100.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	484599.	2	146658.	3	44491.	4	13511.	5	3356.
6	832.	7	207.	8	52.	9	13.	10	3.
11	1.	12	0.	13	0.				

TOTAL ADULTS 693721.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	53.559	2	16.209	3	4.917	4	1.493	5	.371
6	.092	7	.023	8	.006	9	.001	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .77

EQUILIBRIUM (1.0) = .9501-00

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..CURRENT YEAR.......  -  18- ..
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TOTAL EGGS PRODUCED 1699370400.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	480806.	2	145379.	3	43997.	4	13347.	5	3323.
6	825.	7	205.	8	51.	9	13.	10	3.
11	1.	12	0.	13	0.				

TOTAL ADULTS 687951.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	53.140	2	16.068	3	4.863	4	1.475	5	.367
6	.091	7	.023	8	.006	9	.001	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .76

EQUILIBRIUM (1.0) = .9519-00

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..CURRENT YEAR.......  -  19- ..
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TOTAL EGGS PRODUCED 1680512100.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	476710.	2	144242.	3	43614.	4	13199.	5	3282.
6	817.	7	203.	8	50.	9	13.	10	3.
11	1.	12	0.	13	0.				

TOTAL ADULTS 682134.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	52.687	2	15.942	3	4.820	4	1.459	5	.363
6	.090	7	.022	8	.006	9	.001	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .75

EQUILIBRIUM (1.0) = .9538-00

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..CURRENT YEAR..... - 20- ..

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TOTAL EGGS PRODUCED 1663288600.

ADULT DISTRIBUTION BY AGE CLASS

AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS	AGE	NUMBERS
1	472435.	2	143013.	3	43272.	4	13084.	5	3246.
6	807.	7	201.	8	50.	9	12.	10	3.
11	1.	12	0.	13	0.				

TOTAL ADULTS 676124.

PERCENT.....

AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT	AGE	PERCENT
1	52.214	2	15.806	3	4.783	4	1.446	5	.359
6	.089	7	.022	8	.006	9	.001	10	.000
11	.000	12	.000	13	.000				

% RELATION TO POP. AT EQUIL. ... .75

EQUILIBRIUM (1.0) = .9559-00

END HISTG.....

CSCX CSC85F 13 DEC 72 15:49:34 USER DBI001 BL8E9

CARDS IN 33 OUT 0 LINES 801 PROCESSING TIME 29. 0 SECONDS