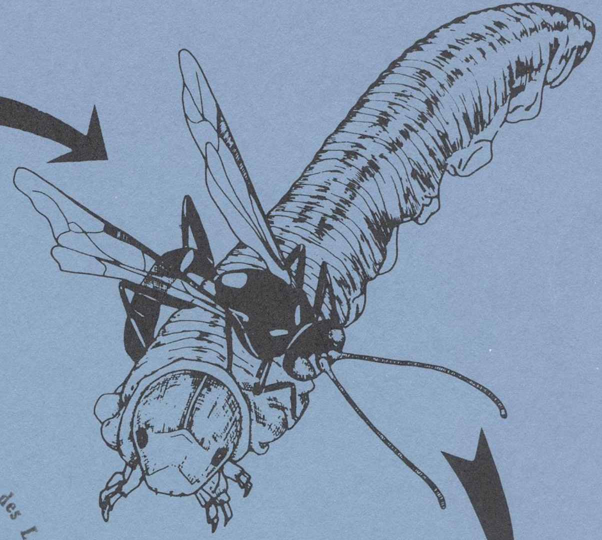
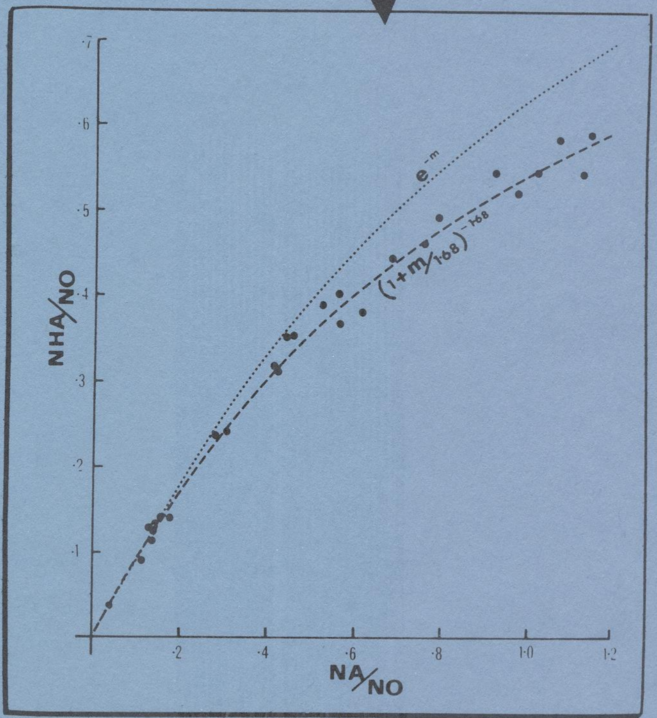
LAU-X-19



The Swaine jack pine sawfly life system: techniques for evaluating parasitoid populations



J. M. McLEOD, G. DÉSALLIERS
AND R. LAGUË

CENTRE DE RECHERCHES FORESTIERES
DES LAURENTIDES

Fisheries and Environment Canada
Pêches et Environnement Canada

Le Centre de recherches forestières des Laurentides (CRFL), un organisme relevant du Service de la Gestion de l'Environnement (Pêches et Environnement Canada), s'intéresse autant à l'environnement qu'aux industries forestières. Le but de ses travaux est de favoriser, par la recherche et par la mise en application des connaissances acquises, l'aménagement et l'utilisation la plus efficace et rationnelle possible des ressources forestières, de façon à ce qu'ils soient en harmonie avec les besoins de l'environnement.

Le CRFL se veut un élément actif de recherche scientifique au Québec. En collaboration avec divers groupes et organismes québécois, les chercheurs du CRFL visent à trouver des solutions pratiques aux nombreux problèmes forestiers du Québec. Le CRFL développe des projets susceptibles d'être appliqués par les usagers de la forêt québécoise: le gouvernement du Québec, les administrations régionales et municipales, l'industrie forestière et la population en général. Il joue aussi un rôle important dans le développement de méthodes acceptables pour l'amélioration et la sauvegarde de l'environnement forestier, de même qu'il veille à l'évaluation de l'impact du milieu forestier sur la qualité de l'environnement.

Les activités du CRFL peuvent être regroupées comme suit: la recherche dans le domaine des ressources forestières, la recherche dans le domaine de la protection, l'aménagement de terrains fédéraux et les services d'information au public. La recherche sur les ressources forestières comprend les projets tendant à l'amélioration des forêts et des arbres proprement dits alors que la recherche sur la protection vise à protéger les arbres contre deux de leurs grands ennemis naturels: les insectes nuisibles et les maladies. Soucieux de communiquer les résultats de recherche du CRFL, la Section de l'information diffuse de l'information sous forme de rapports scientifiques, de feuillets techniques ou de publications vulgarisées conçues spécialement pour le grand public.

The Laurentian Forest Research Centre (LFRC), Canadian Forestry Service, is a component of the Environmental Management Service in the Department of Fisheries and the Environment. The program of the LFRC is as much concerned with the forest environment as it is with the forest industry. Its objective is to promote, by research and technology transfer, the most efficient and rational management and use of forest resources so that they coincide with environmental concerns.

Scientists at the LFRC are actively engaged in research in Quebec. Many of the LFRC projects are conducted in cooperation with provincial agencies and other organizations, the primary concern being to look for practical solutions to diverse forestry problems in Quebec. Technology transfer to the users of Quebec forests -- the Quebec Government, regional and municipal administrations, forest industries, and the general public -- is attained through scientific and technical publications and by liaison and development activities. Last but not least, the LFRC plays an important role in the development of suitable methods to improve and conserve the forest environment and evaluates the impact of forestry practices and other activities by man on the quality of the forest and related environments.

LFRC research and related activities fall into the following broad categories: forest resources research, forest protection research, federal land management and public information. The forest resources research is concerned with improving the management of forests and trees, while forest protection of trees from two of their great natural enemies: insect pests and diseases. To communicate the results of LFRC research, the Information Section distributes information through scientific and technical reports, and through popular publications for the general public.

THE SWAINE JACK PINE SAWFLY LIFE SYSTEM:

Techniques for evaluating parasitoid populations

J.M. McLeod, G. Désalliers and R. Lagüe

RAPPORT D'INFORMATION LAU-X-19

March 1977

CENTRE DE RECHERCHES FORESTIERES DES LAURENTIDES
SERVICE CANADIEN DES FORETS
MINISTERE DES PECHES ET DE L'ENVIRONNEMENT
1080 ROUTE DU VALLON
C.P. 3800
SAINTE-FOY, QUEBEC
G1V 4C7

Copies available

Cover: Gilles Désalliers

ISSN 0703-2188

TABLE OF CONTENTS

ABSTRACT

This manual gives sampling techniques for evaluating parasitoid populations. A FORTRAN programme for summarizing the date is given.

RESUME

Ce manuel décrit les techniques pour évaluer les populations de parasites. Un programme FORTRAN pour l'analyse des données est aussi fourni.

INTRODUCTION

This manual presents techniques for evaluating parasitoid responses in a forest insect life system and for the storage and analysis of population dynamics data for both host and parasitoids. It continues a series on information storage and analysis of the Swaine jack pine sawfly, *Neodiprion swainei* Middleton life system. (McLeod, 1973; McLeod and Brochu, 1973; McLeod and Lagué, 1973; McLeod, 1974).

Some useful measurements in the evaluation of parasitoid responses in a field investigation are:

N_O, the actual number of hosts available for attack (i.e., the population of the attacked host stage in a given place and time).

N_{HA}, for a given No, the number of hosts attacked by the parasitoid.

N_A, for a given No, the total number of attacks generated by the parasitoid on a unit time, t, here taken as the lifetime of the parasitoid.

The values for N_{HA} and N_A are derived from dissection data from a randomly drawn sample of a selected host stage (N_O).

Let X_i (where i = 0, 1, 2, 3....*n*) an event parasitoids per host, where *n* = the last event in the series with a count, and let f_i represent the frequencies for each event, then

$$N_o = \sum_{i=0}^{i=n} (f_i)$$

$$N_{HA} = \sum_{i=1}^{i=n} (f_i)$$

$$N_A = \sum_{i=1}^{i=n} (f_i X_i)$$

and the arithmetic mean of the series, m, = N_A/N_0.

We seek a probability function which incorporates a parameter describing the distribution of parasitoid attacks, from perfect aggregation, i.e., where all the frequencies occur in one event, to pure chance.

This is amply given by a negative binomial probability function, having as parameters m, the arithmetic mean, N_A/N_0 and k, a constant measuring the degree of aggregation in the probability function. As $k \to 0$ aggregation becomes total, and as $k \to \infty$, aggregation approaches that due to chance and the probability function approaches the Poisson distribution. The approximation of k is provided by an algorithm of Fisher (1953) as follows:

$$\sum_{i=0}^{i=n} \frac{\sum_{i=i+1}^{i=n} (f_i+1)}{k+i} = \sum_{i=0}^{i=n} (f_i) \cdot \text{loge} \; \frac{1+\sum_{i=0}^{i=n} (f_i X_i)}{k} \qquad (4)$$

and the value of k is that for which the difference between the two sides of the equations is < a specified minimum, i.e., 1^{-4} for k estimated to 4 places.

To determine whether the observed attack distribution departs significantly from what expected had the attacks conformed to a negative binomial distribution with k as calculated in (4) we write

$$P = \sum_{x=0}^{x=\infty} \sum_{i=0}^{i=n} (f_i) \frac{k+x_i - 1(m/k+m)^{x_i}}{x_i\,!\,(k-1)\,!\,(1-m/_k)k} = 1 \qquad (5)$$

where x = the event, parasitoid attacks per host, i and n and m are as given and k is as calculated in (4).

In practice, (5) is iterated to the x_i where the probability of $f_i < 1$ and the remaining probabilities $x_i \ldots x_{1=2}$ obtained by substraction from 1 and assigning to that x_i. To determine whether the observed distribution departs significantly from a Poisson serie, we write

$$P = \sum_{x=0}^{x=\infty} \frac{m^x . e^{-m}}{x!} = 1 \qquad (6)$$

For both (5) and (6) the expected probabilities, as calculated, are compared to the observed probabilities using x_2.

It also may be of interest to calculate a common k for the series oscillation of the pest insect to determine whether the degree of aggregation in the distribution of parasitoid attacks changes as a function of time, or of density changes of the host, for if k is indeed a constant, it may have considerable predictive value in attack models such as

$$N_{HA} = No + 1 - \frac{N_A/No}{k} \quad {}^{-k}$$

(after the attack model of Griffiths and Holling, 1969). Such a model may provide some measure of the degree of stability in the host parasitoid system because, in general the lower the value of k, the wider will be the stability boundaries of the system. If attacks of the parasitoids are at random for instance, stability will be realized only at unique densities of predator and prey whereas at lower values of k, stable oscillations are possible.

Since k is calculated through a complete population oscillation of the pest insect, and since this represents the accumulation of many plot-years of information, the data must be stored in such a way that no loss of information will occur and we must store this information so that a common k as well as other information may be obtained from the pooled samples, and updated.

The techniques for recording parasitoid data, using the individual parasitoid as the response variable, have already been documented (McLeod, 1973). In this paper the methods for analysing the data are outlined.

Analysis

A generalized computer program PARASITE is presented. Its purpose is the summary and analysis of information on the frequency distribution of parasitoid progeny. The inputs are as described above.

The outputs include, for each locality, year and host age, the frequency distributions and pertinent statistics (Appendix II). These outputs may be selected for each parasitoid species, and for various arbitrary groupings. For a complete host of *N. swainei* parasitoid species and their respective codes, see McLeod (1973a, pp. 44-45). The parasitoid groups conform to the classes 1, 2 and 3 as outlined in McLeod 1973, i.e., larval, eonymphal, and cocoon parasitoids.

The other outputs include a fitting of the parameter "k" for the negative binomial series, to each frequency distribution, and χ^2 tests for the departure of observed frequency distributions from expected Poisson and negative binomial series (Appendix III).

A description of the functioning of this program follows (a copy of the program and flow chart are also included in Appendix IV and V). The program functions by study area and age, that is, when a switch is made from one study area to another, or one age to another, an output of all the completed years for these units occurs.

The numbers in brackets referred to below are references to the program (Appendix IV).

Instructions [800] to [801] comprise a "conversational" section. To reply to the questions posed just perforate the variables following the questions, with the appropriate response.

The first "READ" is for the lecture of 20 cards bearing the appropriate χ^2 probabilities. The values of χ^2 presented are for probabilities of .05, .01, and .005. These values are perforated, 3 per card, for d.f. 1-20 inclusive.

The second "READ" [30] is for the data. The following are the variable names:

IC - code (cf. Form 02:02, McLeod, 1973)

LOCA - locality

INT - age interval
IAN - year
IN - sawfly species
NINS - insect number (sawfly)
NDEST - sawfly fate
IS - parasitoid species
NPARA - parasitoid fate

Following read, we pass to instruction [67], only once, as it is an instruction for "END OF LECTURE". The instruction [50] is then passed, and if IND = 1 the program stops.

The filters are aimed to the limits prescribed. When the first card has passed the filters, the question is posed "INTER = 0"? If yes, we pass directly to instruction [50], where all matrices are indexed to 0, following which we return to instruction [57] and reset "INTER = I", the latter being the age interval ("INT") indexed to 1.

The instructions [54] to [57] are for eliminating accidentally duplicated cards, and are implemented only after the first card has passed. If a card bears the same insect number as the preceding, and one indicates the presence of a parasitoid whereas the former does not, the card bearing the 0 entry is eliminated; if there are two or more cards, all recording of parasitoids, all but one are eliminated.

Instructions [57] to [90] comprise compilations for N_A, N_{HA} and N_o (cf. p. 1) and relevant statistics, including frequency distributions. On the return to [51] if the age interval is not the same as for the preceding card, we branch to instruction [37] for the summation of the number of parasitoids, by species.

From instruction [37] to [70], the frequency distributions for each group are complied, as well as $\sum X^2$ and NHA. As for the groups, a sub-program "TAB3" is called, which performs the same operation.

From [90] to [92] the first output occurs (Appendix I), obtained by calling the sub-program "STATS" (McLeod and Brochu, 1973). From instruction [86], matrices for up to 50 plot-years are constructed for the frequency distributions, N_0, N_{HA}, N_A etc. and these are output in instructions [47] to [96] (Appendix II). Instruction [96] marks the beginning of compilations for "k" of the negative benomial distribution, and the χ^2 values for the appropriate Poisson and negative binomial distributions, as well as their respective degrees of freedom. For these, a sub-program "POIS" is called.

At instruction [50] if "IND" = 1 the program executes "STOP". The remainder of the program is for a conditional re-initialization of the matrices to 0. Up to this point, the program has furnished outputs only for individual parasitoid species. If groups are desired, the sub-program TAB3 is called. This choice is made in the "conversational" section, as is also the choice for output of "STATS" and "POIS".

The larval parasitoid group (1) comprises the species 01 to 05, 14-16, and 22-24. Note that "species" 18 is for "unknown" incapsulations and is not included. The eonymphal parasitoid group (2) comprises species 06 and 07. The cocoon parasitoid group (3) includes species 09 to 16 inclusive, and species 20 and 21. Note that species 08 (*Dahlbominus fuscipennis*) is not included. It is the only polyembrionic parasitoid of *N. swainei*, and may deposit up to 50 progeny in a single bost. Clearly, analyses of frequency distributions of attacks of this species are not applicable.

Other groups for which compilations are made include:

Group 01 in the presence of group 02 only
Group 01 in the presence of group 03 only
Group 02 in the presence of group 03 only
Group 01 in the presence of groups 02 and 03.

The sub-programs seem long, in relation to the main program. This is normal since they are essentially the same programs but adjusted for compilation of groups. All the sub-programs are optional, and may be engaged in the conversational section at the beginning of the program.

REFERENCES

McLeod, J.M. 1973. Information retrieval for the Swaine jack pine sawfly life system: a manual of coded sampling forms. Can. Centre Rech. For. Laurentides, Ste-Foy, Qué. Rapp. Inf. LAU-X-2. 95 p.

McLeod, J.M. 1974. Data collection and analysis in a continuing study of the Swaine jack pine sawfly life system. *In* Monitoring the Forest Ecosystem Through Successive Sampling. Joint Proc. I.U.F.R.O. subject Group S4.02 and S.A.F. Syracuse, N.Y. June 1974.

McLeod, J.M. 1974. Bird population studies in the Swaine jack pine sawfly life system. Can. Centre Rech. For. Laurentides, Ste-Foy, Qué. Rapp. Inf. LAU-X-10. 86 p.

McLeod, J.M. and D. Brochu. 1973. Fortran IV data summaries for the Swaine jack pine sawfly life system. Can. Centre Rech. For. Laurentides, Ste-Foy, Qué. Rapp. Inf. LAU-X-3. 59 p.

McLeod, J.M. and R. Lagüe. 1973. APL/360 programs for the development and analysis of life tables for the Swaine jack pine sawfly. Can. Centre Rech. For. Laurentides, Ste-Foy, Qué. Rapp. Inf. LAU-X-4. 73 p.

Appendix I

*************** NEODIPRION SWAINEI ECOLOGY ***************
************** PARASITOID DATA **************

********************** SAMPLE NO. 6 7 74 **********************

****************** SPECIES: 1 ******************

TOTAL NO. OF INSECTS : 505

TOTAL NO. OF PARASITES: 718.

MEAN PER INSECT: 1.42

SUM OF XX 0.203200E 04

VARIANCE OF X 0.200627E 01

STAND. DEV. 0.141643E 01

STAND. E. 0.630302E-01

NO. PARASITISED 353

PERCENT PARASITISM 69.90

Appendix II

TABLE 1. FREQUENCY DISTRIBUTIONS OF ATTACKS OF NEODIPRION SWAINEI LARVAL PARASITOIDS AS OBTAINED FROM DISSECTIONS OF AGE 7 HOSTS

SPECIES 1

AGE	CODE	PLOT	YEAR	FREQUENCIES 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
7	1	3	1963	621	81	12	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	3	1964	486	16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	3	1965	618	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	4	1962	344	105	44	14	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	4	1963	405	148	30	10	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	4	1964	429	58	12	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	4	1965	455	35	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	4	1966	436	61	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	4	1967	453	42	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	4	1968	456	50	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	4	1969	297	122	40	13	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	4	1970	338	133	51	11	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	4	1971	413	76	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	4	1972	375	99	19	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	4	1974	384	93	29	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	5	1962	311	148	31	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	5	1963	432	132	29	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	5	1964	452	46	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	5	1966	440	51	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	5	1967	382	86	22	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	5	1968	333	143	20	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	5	1969	243	143	54	37	17	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	5	1970	175	129	85	55	31	10	12	1	2	1	0	0	0	0	0	0	0	0	0	0
7	1	5	1971	130	71	29	16	8	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
7	1	5	1972	253	118	63	41	17	6	1	0	1	0	0	0	0	0	0	0	0	0	0	0
7	1	5	1973	346	106	39	5	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	5	1974	408	86	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	6	1967	415	78	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	6	1968	395	100	9	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	6	1969	262	143	66	17	10	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	6	1970	360	113	22	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	6	1971	413	79	18	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	6	1972	357	129	26	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	6	1973	385	91	7	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	1	6	1974	152	154	106	51	22	14	4	1	0	0	1	0	0	0	0	0	0	0	0	0

Appendix III

TABLE 2. CHI SQUARE VALUES OBTAINED WHEN OBSERVED DISTRIBUTIONS OF NEODIPRION SWAINEI LARVAL PARASITOIDS OBTAINED FROM DISSECTIONS OF AGE 7 HOSTS ARE COMPARED TO POISSON AND NEGATIVE BINOMIAL DISTRIBUTIONS. K VALUES FOR NEGATIVE BINOMIAL ARE CALCULATED ACCORDING TO METHOD 3 OF FISHER(BIOMETRICS 9:197-200.1953)

SPECIES 1

STUDY AREA	YEAR	NUMBER OF HOSTS DISSECTED	NUMBER OF HOSTS ATTACKED	NUMBER OF ATTACKS GENERATED	K	CHI SQUARE POISSON	CHI SQUARE NEGATIVE BINOMIAL	DEGREES OF FREEDOM POISSON	DEGREES OF FREEDOM N.BINOMIAL
3	1963	716	95	112	0.7528	7.1194*	0.0406	2	2
3	1964	503	17	18	0.4401	0.0272	0.0000	1	0
3	1965	621	3	3	50.0000	0.0000	0.0000	1	0
4	1962	509	165	243	1.1726	32.1754***	5.3401	3	4
4	1963	595	190	248	2.0462	10.9598*	1.8392	3	3
4	1964	501	72	90	0.5353	10.6758***	0.4275	2	2
4	1965	499	44	53	0.3542	18.9537***	3.1908	2	2
4	1966	499	63	65	50.0000	1.1948	1.2633	2	1
4	1967	499	46	50	1.4978	1.4069	0.0529	2	1
4	1968	508	52	54	50.0000	0.2145	0.2415	2	1
4	1969	475	178	254	1.9399	13.6486***	0.5929	3	3
4	1970	536	198	280	2.2194	12.5007**	2.0647	3	3
4	1971	496	83	90	50.0000	0.0209	0.0372	2	1
4	1972	497	122	149	2.4160	4.4103	0.0560	3	2
4	1974	513	129	173	1.0606	19.3601***	1.5998	3	3
5	1962	501	190	245	6.2711	3.5724	1.8657	3	3
5	1963	601	169	215	2.1193	8.4527*	0.3030	3	3
5	1964	501	49	52	8.2714	0.1085	0.0200	2	1
5	1966	493	53	55	50.0000	0.3214	0.3547	2	1
5	1967	495	113	147	0.9864	13.7128***	0.3970	3	3
5	1968	500	167	195	50.0000	2.3087	2.5150	3	2
5	1969	499	256	455	1.6551	66.6629***	9.9510	5	5
5	1970	501	326	742	1.7348	> 100 ***	8.2119	6	7
5	1971	266	127	228	1.2123	38.8881***	2.1068	4	5
5	1972	500	247	479	1.1380	99.1491***	8.0677	5	6
5	1973	500	154	217	1.1928	15.7190***	3.5309	3	3
5	1974	504	96	106	50.0000	0.0098	0.0055	2	1
6	1967	498	83	93	50.0000	0.7898	0.8721	2	1
6	1968	505	110	121	50.0000	0.7107	0.8179	2	1
6	1969	502	240	388	1.9477	35.8029***	2.4334	4	4
6	1970	513	144	187	1.5137	13.3663***	1.9839	3	3
6	1971	513	100	124	1.0933	9.0155*	0.5832	2	2
6	1972	519	162	203	3.9088	3.1580	0.3891	3	2
6	1973	485	100	112	5.7245	0.4478	2.3868	2	2
6	1974	505	353	718	3.5962	34.5295***	1.9036	6	6

*P<.05 **P<.01 ***P<.005

Appendix IV

```
C
C
C      PARASITE
C      FORMAT
C
C
       DIMENSION NODINS(15),NCMPAR(15,30),NAP(30),NFREQ(15,30,20),NXXN(15
      1,30),NTOT(15,30),NATL(2),NPLAN(50,2),NFRTO(50,30,20),NFPO(20),TABL
      2E(20,3),NODIN2(50),NOMPA1(50,30),NTOTT(50,30)
     1 FORMAT(I2,6X,4I2,10X,I3,2X,I1,1X,I2,1X,I2)
     2 FORMAT(1H1,20X,'TABLE 1. FREQUENCY DISTRIBUTIONS OF ATTACKS OF NEO
      1DIPRION SWAINEI LARVAL'/21X,'PARASITOIDS AS OBTAINED FROM DISSECTI
      2ONS OF AGE ',I2,' HOSTS')
     3 FORMAT(///,5X,'AGE CODE PLOT  YEAR',T62,'FREQUENCIES'/T29,'0     1
      1   2     3     4     5     6     7     8     9    10    11    12    13    14
      2 15    16    17    18    19'//)
     4 FORMAT(///61X,'SPECIES  ',I2)
     6 FORMAT( 5X,I2,2(3X,I2),2X,'19',I2,20(2X,I3))
     7 FORMAT(3(I2),'19',I2,20(I3))
     8 FORMAT(1H1,20X,'TABLE 2. CHI SQUARE VALUES OBTAINED WHEN OBSERVED
      1DISTRIBUTIONS OF'/21X,'NEODIPRION SWAINEI LARVAL PARASITOIDS OBTAI
      2NED FROM DISSECTIONS OF'/21X,'AGE',I3,' HOSTS ARE COMPARED TO POIS
      3SON AND NEGATIVE BINOMIAL DISTRI-'/21X,'BUTIONS. K VALUES FOR NEGA
      4TIVE BINOMIAL ARE CALCULATED ACCORDING'/21X,'TO METHOD 3 OF FISHER
      5(BIOMETRICS 9:197-200.1953)')
     9 FORMAT(//10X,'STUDY     YEAR',6X,'NUMBER OF',5X,'NUMBER OF',5X,'NUM
      1BER OF',6X,'K',13X,'CHI SQUARE',9X,'DEGREES OF FREEDOM'/11X,'AREA'
      2,T32,'HOSTS',T46,'HOSTS',8X,'ATTACKS',T83,'POISSON    NEGATIVE
      3POISSON     N.BINOMIAL'/29X,'DISSECTED',5X,'ATTACKED',6X,'GENERATED
      4',27X,'BINOMIAL'//)
    10 FORMAT(3(4X,F5.2))
    17 FORMAT(///21X,'*P<.05    **P<.01    ***P<.005')
    18 FORMAT(////55X,'NO DATA')
    42 FORMAT(1H1,30X,15('*'),' NEODIPRION SWAINEI ECOLOGY ',16('*'))
    43 FORMAT(31X,14('*'),5X,'PARASITOID DATA ',10X,14('*'))
    44 FORMAT(/25X,23('*'),' SAMPLE NO.',3I3,2X,23('*'))
    45 FORMAT(/32X,18('*'),' SPECIES:',I3,1X,18('*'))
       IND=0
       INTER=0
   800 CONTINUE
C
C
C      CHOOSE: NUMBER OF SPECIES,AND TYPE OF OUTPUT
C
C
C
C      MARGIN FOR INSTRUCTIONS AT SEVENTH COLUMN
C
C
C
C      IMP. FOR INSTRUCTIONS 19-21, 2 = NO
C      ANY OTHER NUMBER = YES
C
C      DO YOU WISH GROUPS ?
C
       NGROUP=1
C
C      DO YOU WISH OUTPUT POISSON AND NEGATIVE
```

```
      IAGE1=7
C
C     HIGHEST AGE INTERVAL
C
      IAGE2=7
  801 CONTINUE
      IAG=IAGE1-1
      JA=JEAR-1
      JAN=JYEAR-JA
      NSPEC=(NSPEC2-NSPEC1)+1
      KSP3=NSPEC1-1
      DO 159 JJ=1,20
      DO 159 KK=1,3
  159 TABLE(JJ,KK)=0.
      IF(NGROUP.EQ.2) GO TO 30
C
C
C     READ  PROBABILITY TABLE
C
C
      DO 20 J=1,20
   20 READ(1,10) (TABLE(J,K),K=1,3)
C
C
C     LECTURE
C
C
   30 READ(6,1,END=67) IC,LOCA,INT,IAN,IN,NINS,NDEST,IS,NPARA
C
C
C
C     FILTER
C
C
      IF(IAN.LT.JEAR.OR.IAN.GT.JYEAR) GO TO 30
      IF(INT.LT.IAGE1.OR.INT.GT.IAGE2) GO TO 30
      IF(LOCA.LT.LOC1.OR.LOCA.GT.LOC2) GO TO 30
      IF(IC.LT.NCODE1.OR.IC.GT.NCODE2) GO TO 30
      IF(IS.GT.NMAX) GO TO 30
      IF(NINS.EQ.0.OR.NINS.GT.NOMMAX) GO TO 30
      IF(IN.NE.INN) GO TO 30
      IF(INTER.EQ.0) GO TO 50
      I=INT-IAG
      IF(I.NE.INTER) GO TO 51
      IF(LOCAL.NE.LOCA) GO TO 51
      NO=0
      L=LOCA
      M=IAN-JA
      N=IS-(NSPEC1-1)
   53 IF(IANNE-M)51,54,51
C
C
C     IF MORE THAN ONE INSECT HAS SAME
C     NUMBER AND BOTH HAVE NO PARASITES
C
C
   54 IF(NINSEC.NE.NINS) GO TO 66
      IF(NPAR.EQ.0.AND.IS.EQ.0) GO TO 30
```

```
C     BINOMIAL DISTRIBUTIONS ?
C
      NPOIS=1
C
C     DO YOU WISH STATS ?
C
      NSTATS=1
C
C     LOWEST SPECIES CODE NUMBER TO BE SELECTED
C
      NSPEC1=1
C
C     HIGHEST SPECIES CODE NUMBER TO BE SELECTED
C
      NSPEC2=5
C
C     MAXIMUM SPECIES CODE NUMBER TO BE ENCOUNTERED
C     IN PASS ...(MAXIMUM = 30)...
C
      NMAX=30
C
C     HIGHEST YEAR NUMBER TO BE SELECTED
C
      JYEAR=74
C
C     LOWEST YEAR NUMBER TO BE SELECTED
C
      JEAR=62
C
C     MAXIMUM NUMBER OF PLOT YEARS (MAXIMUM =50)
C
      JE3=38
C
C     HOST SPECIES CODE (ONLY ONE ALLOWED)
C
      INN=1
C
C     MAXIMUM NUMBER OF INSECTS PER
C     SAMPLE DISSECTED.
C
      NOMMAX=800
C
C     REARED AND DISSECTED = 3
C     DISSECTED ONLY = 2
C
      NCODE1=2
      NCODE2=2
C
C     LOWEST LOCALITY NUMBER
C
      LOC1=3
C
C     HIGHEST LOCALITY NUMBER
C
      LOC2=6
C
C     LOWEST AGE INTERVAL
C
```

```
C
   58 NOMPAR(M,N)=NOMPAR(M,N)+1
      NPAR=N
      NAP(N)=NAP(N)+1
      IF(NGROUP.EQ.2) GO TO 55
      KI=KI+1
C
C
C     CLASS EACH PARASITE BY GROUP
C
C
      IF(IS-5)72,72,200
  200 IF(IS-7)73,73,206
  206 IF(IS-8)55,55,201
  201 IF(IS-13)74,74,202
  202 IF(IS-16)72,72,203
  203 IF(IS-19)55,55,204
  204 IF(IS-21)74,74,205
  205 IF(IS-24)72,72,55
   72 KLAR=KLAR+1
      GO TO 55
   73 KEON=KEON+1
      GO TO 55
   74 KCON=KCON+1
   55 NP=0
   51 IF(INTER.NE.I) LM=1
      IF(LOCA.NE.LOCAL) LM=1
      IF(LM.EQ.1) GO TO 37
   66 IF(IANNE.NE.M) GO TO 68
      IF(NINSEC.EQ.NINS) GO TO 30
   68 IF(NP.EQ.1) GO TO 57
      GO TO 37
   61 IF(JOT.EQ.0) GO TO 62
       IF(JOT.EQ.1) GO TO 30
C
C
C     IND=1  .....END OF LECTURE.....
C
C
   67 IND=1
C
C
C
C     CALCULATE EX2 ... NXXN
C     CALCULATE FREQUENCY DISTRIBUTION ... NFREQ
C     CALCULATE NHA ... NTOT
C
   37 MM=IANNE
      IF(NGROUP.EQ.2) GO TO 504
      CALL TAB3(MM,KI,IND,INTER,I,LOCAL,LOCA,MOI,MOIS,NSPEC,NODINS,NOMPA
     1R,KLAR,KEON,KCON,TABLE,NGROUP,NSTATS,NPOIS,JAN,JE3,KSP3,JA,IAG)
  504 IF(NP.EQ.1) GO TO 75
      DO 70 IU=1,NSPEC
      MK=NAP(IU)
      NAP(IU)=0
      IF(MK.GT.19) GO TO 70
      NXXN(MM,IU)=NXXN(MM,IU)+MK**2
      NFREQ(MM,IU,MK+1)=NFREQ(MM,IU,MK+1)+1
```

```
      IF(NPAR.EQ.0) GO TO 63
      JOT=1
      IF(NINSEC.EQ.NINS) GO TO 56
   63 DO 64 IB=1,NSPEC
   64 NFREQ(IANNE,IB,1)=NFREQ(IANNE,IB,1)-1
      NQ=1
      JOT=0
      IF(IS.LT.NSPEC1) GO TO 61
      IF(IS.GT.NSPEC2) GO TO 61
      GO TO 56
C
C
C     INITIALISATION FOR ONE INSECT
C
C
   57 NQ=1
      JOT=0
      LOCAL=L
      IANNE=M
      NINSEC=NINS
C
C
C     NUMBER OF HOSTS DISSECTED   ...NODINS...
C
C
      NODINS(M)=NODINS(M)+1
      INTER=1
      IF(NGROUP.EQ.2) GO TO 56
      KLAR=0
      KEON=0
      KCON=0
      KI=0
   56 IF(NQ.EQ.1) NPAR=37
      IF(IS.LT.NSPEC1) GO TO 61
      IF(IS.GT.NSPEC2) GO TO 61
      IF(NPAR.EQ.N) GO TO 53
      IF(N.NE.0) GO TO 59
C
C
C     SUMMATIONS FOR ONE INSECT
C
C
   62 MM=IANNE
      NPAR=0
      NP=1
C
C
C     CALCULATE FREQUENCY FOR ZERO CLASS
C
C
      DO 60 IU=1,NSPEC
   60 NFREQ(MM,IU,1)=NFREQ(MM,IU,1)+1
      GO TO 51
   59 IF(IS.EQ.18) GO TO 55
C
C
C     NUMBER OF PARASITES     ...NOMPAR...
C
```

```
      IF(MK.EQ.0) GO TO 70
      NTOT(MM,IU)=NTOT(MM,IU)+1
   70 CONTINUE
   75 IF(INTER.NE.I) GO TO 90
      IF(LOCAL.NE.LOCA) GO TO 90
      IF(IND.EQ.1) GO TO 90
      GO TO 57
   90 MES=0
      DO 92 M=1,JAN
      INTE=INTER+IAG
      IF(NODINS(M).EQ.0) GO TO 92
      MES=MES+1
      DO 93 N=1,NSPEC
      IF(NOMPAR(M,N).EQ.0) GO TO 93
      IF(NSTATS.EQ.2) GO TO 86
      SX=NOMPAR(M,N)
      SXX=NXXN(M,N)
      NA=NTOT(M,N)
      NTI=NODINS(M)
      WRITE(3,42)
      WRITE(3,43)
      MP=M+JA
      WRITE(3,44) LOCAL,INTE,MP
      K=KSP3+N
      WRITE(3,45) K
      CALL STATS(NTI,SX,SXX,NA)
C
C
C     DIMENSION MATRIX FOR 50 X N WHERE
C     N = NUMBER OF STUDY AREAS
C
C
   86 LI=MES+LL
      NODIN2(LI)=NODINS(M)
      NPLAN(LI,1)=LOCAL
      NPLAN(LI,2)=M+JA
      NTOTT(LI,N)=NTOT(M,N)
      NOMPA1(LI,N)=NOMPAR(M,N)
      DO 94 MK=1,20
   94 NFETO(LI,N,MK)=NFREQ(M,N,MK)
   93 CONTINUE
   92 CONTINUE
      LL=LI
       IF(IND.EQ.1) GO TO 47
      IF(INTER.NE.I) GO TO 47
C
C
C     OUTPUT FREQUENCIES
C
C
      IF(LOCAL.NE.LOCA) GO TO 50
   47 DO 96 N=1,NSPEC
      WRITE(3,2) INTE
      K=KSP3+N
      WRITE(3,4) K
      WRITE(3,3)
      NAAK=0
      DO 97 NI=1,JE3
```

```
      IF(NOMPA1(NI,N).EQ.0) GO TO 97
      NAAK=1
      WRITE(3,6) INTE,K,NPLAN(NI,1),NPLAN(NI,2),(NFRTO(NI,N,MK),MK=1,20)
      WRITE(2,7) INTE,K,NPLAN(NI,1),NPLAN(NI,2),(NFRTO(NI,N,MK),MK=1,20)
   97 CONTINUE
      IF(NAAK.EQ.0) WRITE(3,18)
   96 CONTINUE
C
C
C     PREPARATION SUBROUTINE POIS( CALCULATION OF POISSON
C     AND NEGATIVE BINOMIAL DISTRIBUTIONS )
C
C
      IF(NPOIS.EQ.2) GO TO 50
      DO 40 N=1,NSPEC
      NAAK=0
      WRITE(3,8) INTE
      K=KSP3+N
      WRITE(3,4) K
      WRITE(3,9)
      NAAL=N
      DO 41 II=1,JE3
      IF(NCODIN2(II).EQ.0) GO TO 41
      IF(NOMPA1(II,N).EQ.0) GO TO 41
      NOMPA2=NOMPA1(II,N)
      NCODIN3=NCODIN2(II)
      NTOTS=NTOTT(II,N)
      DO 199 MK=1,20
  199 NFRQ(MK)=NFRTO(II,N,MK)
      DO 99 MK=1,2
   99 NATL(MK)=NPLAN(II,MK)
      CALL POIS(NOMPA2,NCODIN3,NTOTS,NFRQ,TABLE,NATL,NSPEC,NAAK,NAAL,INTE
     1)
   41 CONTINUE
      IF(NAAK.EQ.0) WRITE(3,18)
      WRITE(3,17)
   40 CONTINUE
   50 IF(IND.EQ.1) STOP
      DO 130 M=1,JAN
      DO 131 J=1,NSPEC
      DO 132 K=1,20
  132 NFREQ(M,J,K)=0
      NTOT(M,J)=0
      NXXN(M,J)=0
      NOMPAR(M,J)=0
  131 NAP(J)=0
  130 NCDINS(M)=0
      L=LOCA
      M=IAN-JA
      N=IS-(NSPEC1-1)
      I=INT-IAG
      MCIS=0
      IM=0
      IF(INTER.NE.1) GO TO 114
      GO TO 57
  114 DO 113 J=1,JE3
      DO 112 K=1,NSPEC
      DO 111 L7=1,20
```

Appendix IV (Cont'd)

```
111 NFRTO(J,K,LD)=0
    NOMPA1(J,K)=0
112 NTOTT(J,K)=0
    DO 110 NW=1,2
    NATL(NW)=0
110 NPLAN(J,NW)=0
117 NODIN2(J)=0
    MOI=0
    LL=0
    LI=0
    GO TO 57
    END
```

```
      SUBROUTINE TAB3(MM,KI,IND,INTER,I,LOCAL,LOCA,MOI,MOIS,NSPEC,NODINS
     1,NOMPAR,KLAR,KEON,KCON,TABLE,NGROUP,NSTATS,NPOIS,JAN,JE3,KSP3,JA,I
     2AG)
      DIMENSION NFRX(15,20),NTXP2(15),NFRL(15,20),NGRIC(15),NGRINT(15),
     1NFRE(15,20),NGR2C(15),NGR2NT(15),NFRC(15,20),NGR3C(15),NGR3NT(15),
     2NGR4(15),NGR4A(15),NGR5(15),NGR5A(15),TABLE(20,3),NPLAN2(50,2),NFR
     3XX(50,20),NXIAX(50),NTXP2X(50),NOMPAR(15,30),NODINS(15),NFRLA(50,2
     40),NXLA(50),NGR6NT(50),MTOT12(50)   ,NFREO(50,20),NXEO(50),NGR7NT(5
     50),MTOT13(50)   ,NFRCO(50,20),NXCO(50),NGR8NT(50),MTOT23(50)   ,NTXP
     6(15),NGR4NT(15),NODIN2(50),NFPO(20),NATL(2),NFR12(15,20),NFR13(15,
     720),NFR23(15,20),NFR15(15,20),NGR5B(15),NGR56(15),NGR55(15),NFR12T
     8(50,20),NFR13T(50,20),NFR23T(50,20),NFR15T(50,20),MTOT15(50)   ,NG1
     95B(50),NG156(50),NG155(50),NG44T(50),NGR55T(50),NGR5NT(15),MTOT1(1
     15),MTOT2(15),MTOT3(15),MTOT4(15)
    2 FORMAT(1H1,20X,'TABLE 1. FREQUENCY DISTRIBUTIONS OF ATTACKS OF NEO
     1DIPRION SWAINEI LARVAL'/21X,'PARASITOIDS AS OBTAINED FROM DISSECTI
     2ONS OF AGE ',I2,' HOSTS')
    3 FORMAT(///,5X,'AGE CODE PLOT  YEAR',T62,'FREQUENCIES'/T29,'0     1
     1    2    3    4    5    6    7    8    9   10   11   12   13   14
     2 15   16   17   18   19'//)
    5 FORMAT(///61X'ALL SPECIES')
    6 FORMAT( 6X,I2,2(3X,I2),2X,'19',I2,20(2X,I3))
    7 FORMAT(3(I2),'19',I2,20(I3))
    8 FORMAT(1H1,20X,'TABLE 2. CHI SQUARE VALUES OBTAINED WHEN OBSERVED
     1DISTRIBUTIONS OF'/21X,'NEODIPRION SWAINEI LARVAL PARASITOIDS OBTAI
     2NED FROM DISSECTIONS OF'/21X,'AGE',I3,' HOSTS ARE COMPARED TO POIS
     3SON AND NEGATIVE BINOMIAL DISTRI-'/21X,'BUTIONS. K VALUES FOR NEGA
     4TIVE BINOMIAL ARE CALCULATED ACCORDING'/21X,'TO METHOD 3 OF FISHER
     5(BIOMETRICS 9:197-200.1953)')
    9 FORMAT(//10X,'STUDY     YEAR',6X,'NUMBER OF',5X,'NUMBER OF',5X,'NUM
     1BER OF',6X,'K',13X,'CHI SQUARE',9X,'DEGREES OF FREEDOM'/11X,'AREA'
     2,T32,'HOSTS',T46,'HOSTS',8X,'ATTACKS',T83,'POISSON    NEGATIVE
     3POISSON     N.BINOMIAL'/29X,'DISSECTED',5X,'ATTACKED',6X,'GENERATED
     4',27X,'BINOMIAL'//)
   15 FORMAT(/32X,18('*'),' GROUP 1 ON 2 ',18('*'))
   16 FORMAT(1H1,30X,15('*'),' NEODIPRION SWAINEI ECOLOGY ',16('*'))
   17 FORMAT(///21X,'*P<.05    **P<.01    ***P<.005')
   18 FORMAT(////55X,'NO DATA')
   19 FORMAT(///61X,'GROUP 1 ')
   21 FORMAT(///61X,'GROUP 2')
   23 FORMAT(///61X,'GROUP 3')
   34 FORMAT(/32X,18('*'),' GROUP 2 ON 3 ',18('*'))
   35 FORMAT(/32X,18('*'),' GROUP 1 ON 2+3 ',18('*'))
   36 FORMAT(///56X,'GROUP 1 ON 2')
   37 FORMAT(///56X,'GROUP 1 ON 3')
   38 FORMAT(///56X,'GROUP 2 ON 3')
   39 FORMAT(///56X,'GROUP 1 ON 2+3')
   43 FORMAT(31X,14('*'),5X,'PARASITOID DATA ',10X,14('*'))
   44 FORMAT(/25X,23('*'),' SAMPLE NO.',3I3,2X,23('*'))
   45 FORMAT(/32X,18('*'),' GROUP 1 ON 3 ',18('*'))
   46 FORMAT(/32X,18('*'),' GROUP NO. 2 ',18('*'))
   47 FORMAT(/32X,18('*'),' GROUP NO. 3 ',18('*'))
   48 FORMAT(/32X,18('*'),' ALL SPECIES ',18('*'))
   49 FORMAT(/32X,18('*'),' GROUP NO. 1 ',18('*'))
      IF(MOI.EQ.0) GO TO 151
      IF(MOIS.EQ.0) GO TO 151
  150 MOIS=1
      IF(KI.GT.19) GO TO 500
```

```
      IF(KI.EQ.0) GO TO 500
C
C
C     CALCULATE FREQUENCY FOR EACH GROUP
C     CALCULATE EX2 FOR EACH GROUP
C     CALCULATE NUMBER OF INSECTS ATTACKED FOR EACH GROUP
C
C
      NFRX(MM,KI+1)=NFRX(MM,KI+1)+1
      NTXP(MM)=NTXP(MM)+KI**2
      NTXP2(MM)=NTXP2(MM)+1
  500 IF(KLAR.EQ.0) GO TO 501
      NFRL(MM,KLAR+1)=NFRL(MM,KLAR+1)+1
      NGR1C(MM)=NGR1C(MM)+KLAR**2
      NGR1NT(MM)=NGR1NT(MM)+1
  501 IF(KEON.EQ.0) GO TO 502
      NFRE(MM,KEON+1)=NFRE(MM,KEON+1)+1
      NGR2C(MM)=NGR2C(MM)+KEON**2
      NGR2NT(MM)=NGR2NT(MM)+1
      NFR12(MM,KLAR+1)=NFR12(MM,KLAR+1)+1
      NGR4(MM)=NGR4(MM)+KLAR**2
      NGR4NT(MM)=NGR4NT(MM)+KLAR
      IF(KLAR.EQ.0) GO TO 502
      MTOT1(MM)=MTOT1(MM)+1
  502 IF(KCON.EQ.0) GO TO 504
      IF(KCON.GT.19) GO TO 503
      NFRC(MM,KCON+1)=NFRC(MM,KCON+1)+1
      NGR3C(MM)=NGR3C(MM)+KCON**2
      NGR3NT(MM)=NGR3NT(MM)+1
      NFR13(MM,KLAR+1)=NFR13(MM,KLAR+1)+1
      NGR5(MM)=NGR5(MM)+KLAR**2
      NGR55(MM)=NGR55(MM)+KLAR
      IF(KLAR.EQ.0) GO TO 506
      MTOT2(MM)=MTOT2(MM)+1
  506 NFR23(MM,KEON+1)=NFR23(MM,KEON+1)+1
      NGR5NT(MM)=NGR5NT(MM)+KEON**2
      NGR56(MM)=NGR56(MM)+KEON
      IF(KEON.EQ.0) GO TO 503
      MTOT3(MM)=MTOT3(MM)+1
  503 IF(KEON.EQ.0.OR.KCON.EQ.0) GO TO 504
      NFR15(MM,KLAR+1)=NFR15(MM,KLAR+1)+1
      NGR5A(MM)=NGR5A(MM)+KLAR**2
      NGR4A(MM)=NGR4A(MM)+1
      NGR5B(MM)=NGR5B(MM)+KLAR
      IF(KLAR.EQ.0) GO TO 504
      MTOT4(MM)=MTOT4(MM)+1
  504 IF(IND.EQ.1) GO TO 90
      IF(INTER.NE.I) GO TO 90
      IF(LOCAL.NE.LOCA) GO TO 90
      IF(MOIS.EQ.1) GO TO 25
   90 MIN=0
      DO 92 M=1,JAN
      INTE=INTER+IAG
      IF(NODINS(M).EQ.0) GO TO 92
      NXIA=0
      NXC=0
      NXE=0
      NXL=0
```

```
      NSP=NSPEC+8
      DO 93 N=1,NSP
      NOPB=0
      IF(N.GT.NSPEC) GO TO 40
      IF(NOMPAR(M,N).EQ.0) GO TO 93
      NX=NOMPAR(M,N)
      NXIA=NXIA+NX
      L=N+KSP3
      IF(L-5)95,98,300
  300 IF(L-7)97,97,306
  306 IF(L-8)93,93,301
  301 IF(L-13)96,96,302
  302 IF(L-16)98,98,303
  303 IF(L-19)93,93,304
  304 IF(L-21)96,96,305
  305 IF(L-24)98,98,93
   98 NXL=NXL+NOMPAR(M,N)
      GO TO 93
   97 NXE=NXE+NOMPAR(M,N)
      GO TO 93
   96 NXC=NXC+NOMPAR(M,N)
      GO TO 93
   40 LZ=N-NSPEC
      NTI=NODINS(M)
      GO TO(180,181,182,183,184,185,186,187),LZ
C
C
C     DIMENSION MATRIX FOR EACH SPECIES
C     FOR 50 YEARS ALL STUDY AREAS
C
C
  180 IF(NTXP(M).EQ.0) GO TO 93
      NOPB=NTI-NTXP2(M)
      MIN=MIN+1
      LX=MIN+LXX
      NPLAN2(LX,1)=LOCAL
      NPLAN2(LX,2)=M+JA
      NFRXX(LX,1)=NOPB
      NODIN2(LX)=NODINS(M)
      DO 30 MK=2,20
   30 NFRXX(LX,MK)=NFRX(M,MK)
      NXIAX(LX)=NXIA
      NTXP2X(LX)=NTXP2(M)
      GO TO 89
  181 IF(NGR1C(M).EQ.0) GO TO 93
      NOPB=NTI-NGR1NT(M)
      NFRLA(LX,1)=NOPB
      DO 31 MK=2,20
   31 NFRLA(LX,MK)=NFRL(M,MK)
      NXLA(LX)=NXL
      NGR6NT(LX)=NGR1NT(M)
      GO TO 89
  182 IF(NGR2C(M).EQ.0) GO TO 93
      NOPB=NTI-NGR2NT(M)
      NFREQ(LX,1)=NOPB
      DO 32 MK=2,20
   32 NFREQ(LX,MK)=NFRE(M,MK)
      NXEQ(LX)=NXE
```

```
      NGR7NT(LX)=NGR2NT(M)
      GO TO 88
  183 IF(NGR3C(M).EQ.0) GO TO 93
      NOPB=NTI-NGR3NT(M)
      NFRCO(LX,1)=NOPB
      DO 33 MK=2,20
   33 NFRCO(LX,MK)=NFRC(M,MK)
      NXCO(LX)=NXC
      NGR8NT(LX)=NGR3NT(M)
      GO TO 88
  184 IF(NGR4(M).EQ.0) GO TO 93
      DO 188 MK=1,20
  188 NFR12T(LX,MK)=NFR12(M,MK)
      NG44T(LX)=NGR4NT(M)
      MTOT12(LX)=MTOT1(M)
      GO TO 88
  185 IF(NGR5(M).EQ.0) GO TO 93
      DO 189 MK=1,20
  189 NFR13T(LX,MK)=NFR13(M,MK)
      NG155(LX)=NGR55(M)
      MTOT13(LX)=MTOT2(M)
      GO TO 88
  186 IF(NGR5NT(M).EQ.0) GO TO 93
      DO 190 MK=1,20
  190 NFR23T(LX,MK)=NFR23(M,MK)
      NG156(LX)=NGR56(M)
      MTOT23(LX)=MTOT3(M)
      GO TO 88
  187 IF(NGR4A(M).EQ.0) GO TO 93
      DO 191 MK=1,20
  191 NFR15T(LX,MK)=NFR15(M,MK)
      NGR55T(LX)=NGR4A(M)
      NG158(LX)=NGR5B(M)
      MTOT15(LX)=MTOT4(M)
   88 IF(NSTATS.EQ.2) GO TO 93
      WRITE(3,16)
      WRITE(3,43)
      MP=M+JA
      WRITE(3,44) LOCAL,INTE,MP
      GO TO(80,81,82,83,84,85,86,87),LZ
   80 WRITE(3,48)
C
C
C     PREPARATION SUBROUTINE STAT.
C
C
      SXX=NTXP(M)
      SX=NXIA
      NA=NTXP2(M)
      GO TO 95
   81 WRITE(3,49)
      NA=NGR1NT(M)
      SXX=NGR1C(M)
      SX=NXL
      GO TO 95
   82 WRITE(3,46)
      NA=NGR2NT(M)
      SX=NXE
```

```
      SXX=NGR2C(M)
      GO TO 95
   83 WRITE(3,47)
      NA=NGR3NT(M)
      SXX=NGR3C(M)
      SX=NXC
      GO TO 95
   84 WRITE(3,15)
      NA=MTOT1(M)
      SXX=NGR4(M)
      SX=NGR4NT(M)
      NTI=NGR2NT(M)
      GO TO 95
   85 WRITE(3,45)
      NA=MTOT2(M)
      SXX=NGR5(M)
      SX=NGR55(M)
      NTI=NGR3NT(M)
      GO TO 95
   86 WRITE(3,34)
      NA=MTOT3(M)
      SXX=NGR5NT(M)
      SX=NGR55(M)
      NTI=NGR3NT(M)
      GO TO 95
   87 WRITE(3,35)
      NA=MTOT4(M)
      SXX=NGR5A(M)
      SX=NGR5B(M)
      NTI=NGR4A(M)
   95 CALL STATS(NTI,SX,SXX,NA)
   93 CONTINUE
   92 CONTINUE
      LXX=LX
      IF(IND.EQ.1) GO TO 55
      IF(INTER.NE.I) GO TO 55
      IF(LOCAL.EQ.LOCA) GO TO 26
      IF(LOCAL.NE.LOCA) GO TO 151
   55 DO 91 N=1,8
      NAAK=0
      NAAL=49+N
      WRITE(3,2) INTE
      DO 99 ML=1,JE3
      GO TO(50,51,52,53,54,58,56,59),N
C
C
C       OUTPUT FREQUENCY FOR EACH GROUP
C
C
   50 IF(ML.EQ.1) WRITE(3,5)
      IF(ML.EQ.1) WRITE(3,3)
      IF(NXIAX(ML).EQ.0) GO TO 99
      NAAK=1
      WRITE(3,6) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFRXX(ML,MA),MA=1,
     120)
      WRITE(2,7) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFRXX(ML,MA),MA=1,
     120)
      GO TO 99
```

```
51 IF(ML.EQ.1) WRITE(3,19)
   IF(ML.EQ.1) WRITE(3,3)
   IF(NXLA(ML).EQ.0) GO TO 99
   NAAK=1
   WRITE(3,6) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFRLA(ML,MA),MA=1,
  120)
   WRITE(2,7) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFRLA(ML,MA),MA=1,
  120)
   GO TO 99
52 IF(ML.EQ.1) WRITE(3,21)
   IF(ML.EQ.1) WRITE(3,3)
   IF(NXED(ML).EQ.0) GO TO 99
   NAAK=1
   WRITE(3,6) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFRED(ML,MA),MA=1,
  120)
   WRITE(2,7) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFRED(ML,MA),MA=1,
  120)
   GO TO 99
53 IF(ML.EQ.1) WRITE(3,23)
   IF(ML.EQ.1) WRITE(3,3)
   IF(NXCO(ML).EQ.0) GO TO 99
   NAAK=1
   WRITE(3,6) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFRCO(ML,MA),MA=1,
  120)
   WRITE(2,7) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFRCO(ML,MA),MA=1,
  120)
   GO TO 99
54 IF(ML.EQ.1) WRITE(3,36)
   IF(ML.EQ.1) WRITE(3,3)
   NAAK=1
   IF(NG44T(ML).EQ.0) GO TO 99
   WRITE(3,6) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFR12T(ML,MA),MA=1
  1,20)
   WRITE(2,7) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFR12T(ML,MA),MA=1
  1,20)
   GO TO 99
58 IF(ML.EQ.1) WRITE(3,37)
   IF(ML.EQ.1) WRITE(3,3)
   IF(NG155(ML).EQ.0) GO TO 99
   NAAK=1
   WRITE(3,6) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFR13T(ML,MA),MA=1
  1,20)
   WRITE(2,7) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFR13T(ML,MA),MA=1
  1,20)
   GO TO 99
56 IF(ML.EQ.1) WRITE(3,38)
   IF(ML.EQ.1) WRITE(3,3)
   IF(NG156(ML).EQ.0) GO TO 99
   NAAK=1
   WRITE(3,6) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFR23T(ML,MA),MA=1
  1,20)
   WRITE(2,7) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFR23T(ML,MA),MA=1
  1,20)
   GO TO 99
59 IF(ML.EQ.1) WRITE(3,39)
   IF(ML.EQ.1) WRITE(3,3)
   IF(NG158(ML).EQ.0) GO TO 99
   NAAK=1
```

```
      WRITE(3,6) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFR1ST(ML,MA),MA=1
     1,20)
      WRITE(2,7) INTE,NAAL,NPLAN2(ML,1),NPLAN2(ML,2),(NFR1ST(ML,MA),MA=1
     1,20)
   99 CONTINUE
      IF(NAAK.EQ.0) WRITE(3,18)
   91 CONTINUE
      IF(NGROUP.EQ.2.OR.NPOIS.EQ.2) GO TO 100
      DO 42 N=1,6
      NAAK=0
      WRITE(3,8) INTE
      NAAL=N+42
      DO 41 II=1,J=3
      IF(NOPIN2(II).EQ.0) GO TO 41
      GO TO (200,201,202,203,220,221,222,223),N
C
C
C     PREPARATION SUBROUTINE POIS(CALCULATION OF POISSON
C     AND NEGATIVE BINOMIAL DISTRIBUTIONS )
C
C
  200 IF(II.EQ.1) WRITE(3,5)
      IF(II.EQ.1) WRITE(3,9)
      IF(NXIAX(II).EQ.0) GO TO 41
      NTOTS=NTXP2X(II)
      NOMPA2=NXIAX(II)
      DO 205 MK=1,20
  205 NFPO(MK)=NFRXX(II,MK)
      GO TO 204
  201 IF(II.EQ.1) WRITE(3,19)
      IF(II.EQ.1) WRITE(3,9)
      IF(NXLA(II).EQ.0) GO TO 41
      NTOTS=NGR5NT(II)
      NOMPA2=NXLA(II)
      DO 207 MK=1,20
  207 NFPO(MK)=NFRLA(II,MK)
      GO TO 204
  202 IF(II.EQ.1) WRITE(3,21)
      IF(II.EQ.1) WRITE(3,9)
      IF(NXFO(II).EQ.0) GO TO 41
      NTOTS=NGR7NT(II)
      NOMPA2=NXFO(II)
      DO 208 MK=1,20
  208 NFPO(MK)=NFRFO(II,MK)
      GO TO 204
  203 IF(II.EQ.1) WRITE(3,23)
      IF(II.EQ.1) WRITE(3,9)
      IF(NXCO(II).EQ.0) GO TO 41
      NOMPA2=NXCO(II)
      NTOTS=NGR8NT(II)
      DO 210 MK=1,20
  210 NFPO(MK)=NFRCO(II,MK)
      GO TO 204
  220 IF(II.EQ.1) WRITE(3,36)
      IF(II.EQ.1) WRITE(3,9)
      IF(NG44T(II).EQ.0) GO TO 41
      NOMPA2=NG44T(II)
      NTOTS=MTOT12(II)
```

```
      NODIN3=NGR7NT(II)
      DO 224 ML=1,20
224   NFPO(MK)=NFR12T(II,MK)
      GO TO 227
221   IF(II.EQ.1) WRITE(3,37)
      IF(II.EQ.1) WRITE(3,9)
      IF(NG155(II).EQ.0) GO TO 41
      NOMPA2=NG155(II)
      NTOT5=MTOT13(II)
      NODIN3=NGR8NT(II)
      DO 226 MK=1,20
226   NFPO(MK)=NFR13T(II,MK)
      GO TO 227
222   IF(II.EQ.1) WRITE(3,38)
      IF(II.EQ.1) WRITE(3,9)
      IF(NG156(II).EQ.0) GO TO 41
      NOMPA2=NG156(II)
      NTOT5=MTOT23(II)
      NODIN3=NGR8NT(II)
      DO 228 MK=1,20
228   NFPO(MK)=NFR23T(II,MK)
      GO TO 227
223   IF(II.EQ.1) WRITE(3,39)
      IF(II.EQ.1) WRITE(3,9)
      IF(NG158(II).EQ.0) GO TO 41
      NOMPA2=NG158(II)
      NTOT5=MTOT15(II)
      NODIN3=NGR55T(II)
      DO  230 MK=1,20
230   NFPO(MK)=NFR15T(II,MK)
      GO TO 227
204   NODIN3=NODIN2(II)
227   DO 206 MK=1,2
206   NATL(MK)=NPLAN2(II,MK)
      NAAK=1
      CALL POIS(NOMPA2,NODIN3,NTOT5,NFPO,TABLE,NATL,NSPEC,NAAK,NAAL,INTE
     1)
 41   CONTINUE
      IF(NAAK.EQ.0) WRITE(3,18)
      WRITE(3,17)
 42   CONTINUE
100   IF(IND.EQ.1) GO TO 25
151   DO 131 M=1,JAN
      DO 132 K=1,20
      NFR12(M,K)=0
      NFR13(M,K)=0
      NFR23(M,K)=0
      NFR15(M,K)=0
      NFRC(M,K)=0
      NFRF(M,K)=0
      NFRX(M,K)=0
132   NFRL(M,K)=0
      MTOT1(M)=0
      MTOT2(M)=0
      MTOT3(M)=0
      MTOT4(M)=0
      NGR58(M)=0
      NGR56(M)=0
```

```
      NGR55(M)=0
      NGR1NT(M)=0
      NGR2NT(M)=0
      NTXP(M)=0
      NTXP2(M)=0
      NGR1C(M)=0
      NGR2C(M)=0
      NGR3C(M)=0
      NGR4A(M)=0
      NGR4NT(M)=0
      NGR4(M)=0
      NGR5NT(M)=0
      NGR5(M)=0
      NGR5A(M)=0
  131 NGR3NT(M)=0
      IF(MCI.EQ.0) GO TO 114
      IF(MOIS.EQ.0) GO TO 150
   26 IF(INTER.NE.I) GO TO 114
      GO TO 25
  114 DO 63 JJ=1,JF3
      DO 64 JK=1,2
   64 NPLAN2(JJ,JK)=0
      DO 57 JM=1,20
      NFR12T(JJ,JM)=0
      NFR13T(JJ,JM)=0
      NFR23T(JJ,JM)=0
      NFR15T(JJ,JM)=0
      NFRXX(JJ,JM)=0
      NFRLA(JJ,JM)=0
      NFRED(JJ,JM)=0
   57 NFRCO(JJ,JM)=0
      MTOT15(JJ)=0
      MTOT23(JJ)=0
      MTOT13(JJ)=0
      MTOT12(JJ)=0
      NXIAX(JJ)=0
      NTXP2X(JJ)=0
      NXLA(JJ)=0
      NGR6NT(JJ)=0
      NXED(JJ)=0
      NXCO(JJ)=0
      NODIN2(JJ)=0
      NGR7NT(JJ)=0
      NG15B(JJ)=0
      NG156(JJ)=0
      NG155(JJ)=0
      NG44T(JJ)=0
      NGR55T(JJ)=0
   63 NGR8NT(JJ)=0
      IF(INTER.NE.I) GO TO 25
      MCI=1
      LX=0
      LXX=0
      GO TO 150
   25 RETURN
      END
```

```
      SUBROUTINE STATS(NTI,SX,SXX,NA)
C
C
C     CALCULATE STATS.
C
C
    6 FORMAT(//,45X,'TOTAL NO. OF INSECTS  :',I7)
    7 FORMAT( /,45X,'TOTAL NO. OF PARASITES:',F8.0)
    8 FORMAT(/,52X,'MEAN PER INSECT:',F8.2)
    9 FORMAT(/,52X,'SUM OF   XX   ',E14.6)
   10 FORMAT(/,52X,'VARIANCE OF X',E14.6)
   11 FORMAT(/,52X,'STAND. DEV.   ',E14.6)
   12 FORMAT(/,52X,'STAND.   E.   ',E14.6)
   13 FORMAT(/,52X,'NO. PARASITISED',I7)
   14 FORMAT(/,48X,'PERCENT PARASITISM',F8.2)
      VAR=0.
      ECA=0.
      ECM=0.
      XM=0.
      IF(SX     .EQ.0.) GO TO 34
      IF(NTI.LE.1) GO TO 32
      VAR=(NTI*SXX-SX**2)/(NTI*(NTI-1))
      ECA=SQRT(VAR)
      ECM=ECA/SQRT(FLOAT(NTI))
   32 IF(NTI.EQ.0) GO TO 34
      XM=SX/NTI
C
C
C     OUTPUT STATS.
C
C
   34 WRITE(3,6) NTI
      WRITE(3,7) SX
      WRITE(3,8) XM
      WRITE(3,9) SXX
      WRITE(3,10) VAR
      WRITE(3,11) ECA
      WRITE(3,12) ECM
      PERC=(NA/FLOAT(NTI))*100.
      WRITE(3,13) NA
      WRITE(3,14) PERC
      RETURN
      END
```

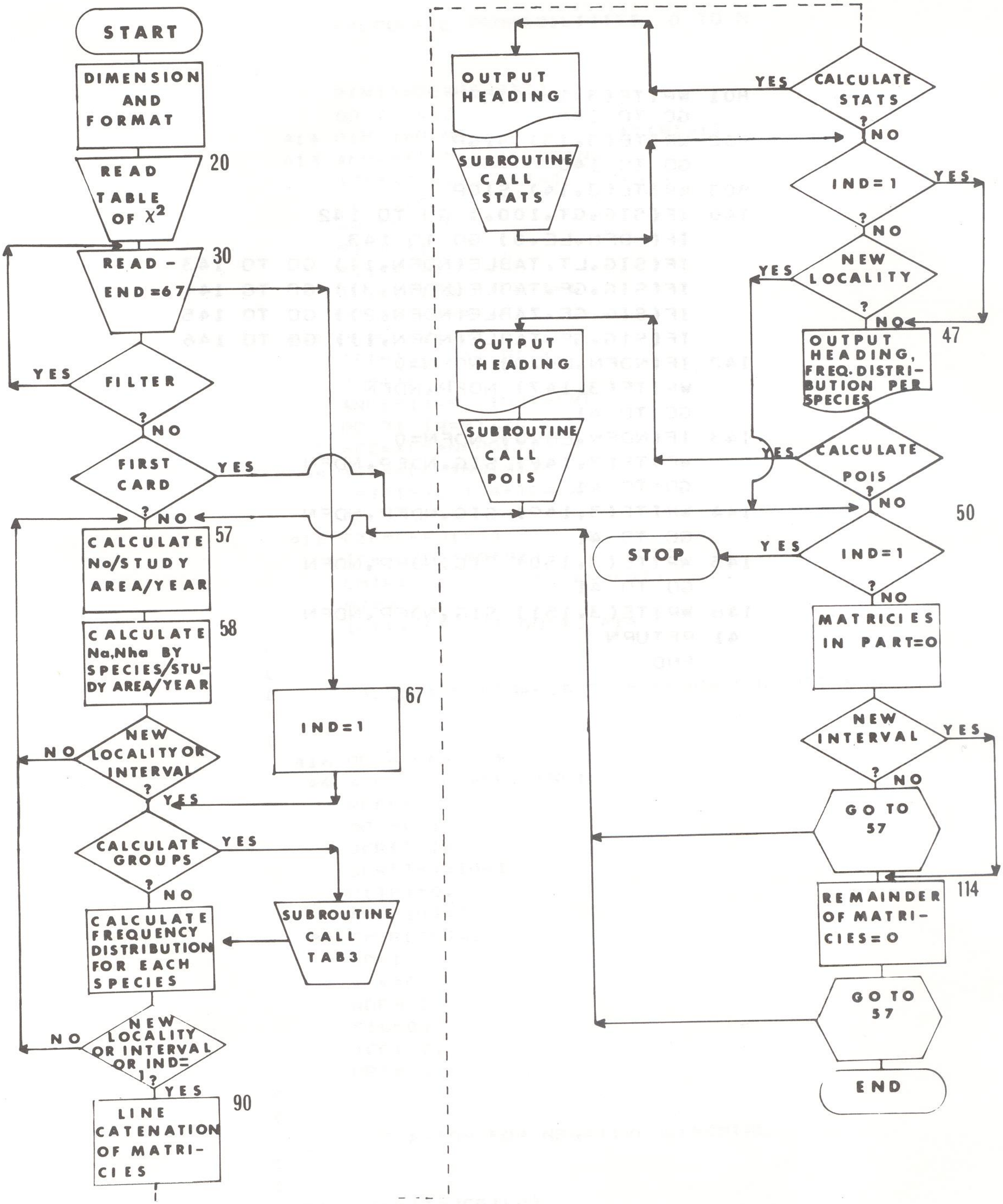
```
      SUBROUTINE POIS(NOMPA2,NODIN3,NTOT5,NFPO,TABLE,NATL,NSPEC,NAAK,NAA
     1L,INTF)
      REAL*8 Y,YY,BIK,AX,AXX,TCT1,TCT2,TCX ,ZTOT5,X,P(20),ANO(20),CHIP(2
     10),SIGP,PP,ACC,TCA,CZE,XC4,TCC1,PP1,ACR11,WZE,SIG,B,BN1,BN2,BNN
      DIMENSION NFPO(20),TABLE(20,3),NATL(2),JCR(20)
   11 FORMAT(T12,I2,6X,'19',I2,9X,I3,10X,I3,12X,I3,6X,F7.4)
   12 FORMAT(1H+,T45,'> 100 ***')
   13 FORMAT(1H+,T34,F7.4)
   14 FORMAT(1H+,T34,F7.4,'*')
   15 FORMAT(1H+,T34,F7.4,'**')
   16 FORMAT(1H+,T34,F7.4,'***')
   22 FORMAT(36X,I2,11X,'19',I2,6X,F9.6,2(12X,I3))
   26 FORMAT(3(I2,2X),'19',I2,3(2X,I3))
  147 FORMAT(1H+,T37,'> 100 ***',T109,I2,9X,I2)
  148 FORMAT(1H+,T36,F7.4,T109,I2,9X,I2)
  149 FORMAT(1H+,T36,F7.4,'***',T109,I2,9X,I2)
  150 FORMAT(1H+,T36,F7.4,'**',T109,I2,9X,I2)
  151 FORMAT(1H+,T36,F7.4,'*',T109,I2,9X,I2)
      ZTOT5=NTOT5
      BIK=NOMPA2/FLOAT(NODIN3)
C
C
C     ITERATION FOR POISSON DISTRIBUTION. CALCULATE EXPONENT ''K''
C     (K IDENTIFIED AS Y IN PROGRAM)
C
C
  119 Y=50.0000000000
      YY=10.0000000000
  117 AX=0.0000000000
       TCX=0.0000000000
      X=0.0000000000
  123 AX=AX+ZTOT5/(Y+X)
      DO 56 MK=2,20
      X=X+1.
      TCT1=NFPO(MK)
  125 TCX=TCX+TCT1
      TCT2=ZTOT5-TCX
   56 AX=AX+TCT2/(Y+X)
      AXX=NODIN3*(DLOG(1.+BIK/Y))
      IF((AX-AXX).LT.0.) GO TO 134
      IF(Y.LT.0.50) GO TO 132
      IF(YY.LT.(.00001)) GO TO 132
  137 Y=Y+YY
      YY=YY*.1
      Y=Y-YY
      GO TO 117
  134 Y=Y-YY
      IF(Y.GT.0.) GO TO 117
      GO TO 137
  132 MI=1
      DO 86 NN=1,20
      P(NN)=0.
      ANO(NN)=0.
   86 CHIP(NN)=0.
      NDFR=0
      TCA=0.
      PP=0.
      SIGP=0.
```

```
      BN1=DGAMMA(ACR11+1)*DGAMMA(Y)
      BN2=(1.+BIK/Y)**Y
      BNN=BN2*BN1
      P(LD)=B/BNN
      ANO(LD)=NODIN3*B/BNN
      IF(ANO(LD).GE.1.) GO TO 510
      P(LD)=0.
      ANO(LD)=0.
      LD=LD-1
      LDD=LD-1
      IF(LDD.EQ.0) LDD=1
      DO 599 JM=1,LDD
  599 PP1=PP1+P(JM)
C
C
C     CALCULATE PROBABILITIES, 0 TO N
C
C
      IF(LD.EQ.0) LD=1
      P(LD)=1.-PP1
      ANO(LD)=NODIN3*P(LD)
      DO 529 IQ=LD,20
  529 TCC1=TCC1+NFPO(IQ)
      XC4=TCC1-ANO(LD)
      CHIP(LD)=XC4*XC4/ANO(LD)
      GO TO 516
  510 WZE=NFPO(LD)
      XC4=WZE-ANO(LD)
      CHIP(LD)=XC4*XC4/ANO(LD)
      LD=LD+1
      IF(LD.LE.20) GO TO 509
C
C
C     CALCULATE DEGREES OF FREEDOM FOR NEG.BINOMIAL
C
C
  516 DO 512 NY=1,LD
  512 SIG=SIG+CHIP(NY)
      NDFN=LD-2
C
C
C     OUTPUT FOR POISSON AND NEG.BINOMIAL
C     DISTRIBUTION , K AND DEGREES OF FREEDOM FOR EACH.
C
C
      WRITE(3,11) NATL,NODIN3,NTOT5,NOMPA2,Y
      WRITE(2,26) INTE,NAAL,NATL,NODIN3,NTOT5,NOMPA2
      NAAK=1
      IF(NDFP.LE.0) GO TO 800
      IF(SIGP.GT.100.) GO TO 799
      IF(SIGP.LT.TABLE(NDFP,1)) GO TO 800
      IF(SIGP.GE.TABLE(NDFP,3)) GO TO 801
      IF(SIGP.GE.TABLE(NDFP,2)) GO TO 802
      IF(SIGP.GE.TABLE(NDFP,1)) GO TO 803
  799 WRITE(3,12)
      GO TO 140
  800 WRITE(3,13) SIGP
      GO TO 140
```

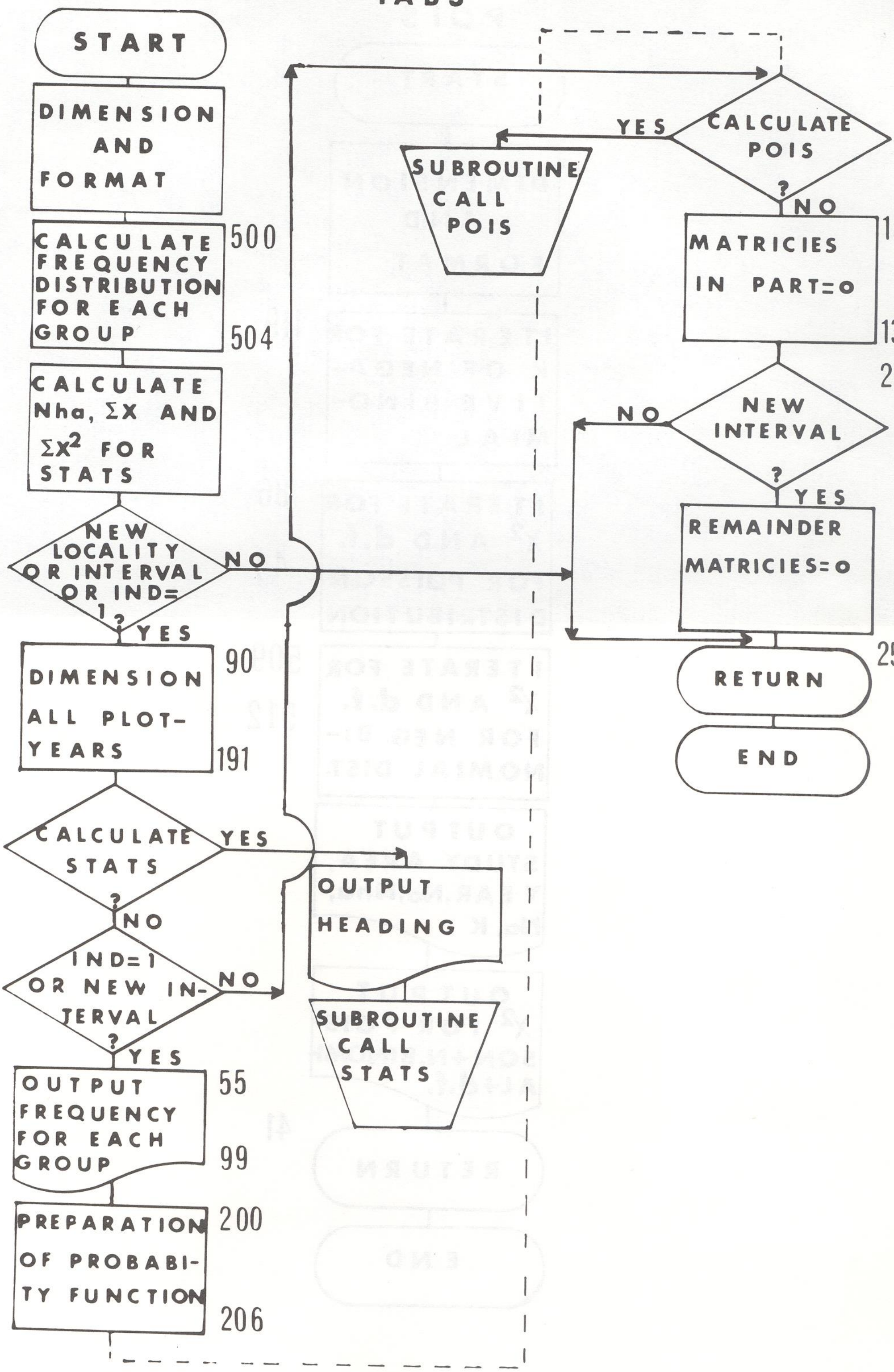
```
      ACC=0.
C
C
C     CALCULATE PROBABILITIES, 0 TO N
C
C
      P(MI)=DEXP(-BIK)
      GO TO 413
  414 P(MI)=P(MI-1)*BIK/FLOAT(MI-1)
  413 ANO(MI)=P(MI)*NODIN3
      IF(ANO(MI).GE.1.) GO TO 415
      P(MI)=0.
      ANO(MI)=0.
      MI=MI-1
      MII=MI-1
      IF(MII.EQ.0) MII=1
      DO 100 JP=1,MII
  100 PP=PP+P(JP)
      IF(MI.EQ.0) MI=1
      P(MI)=1.-PP
      ANO(MI)=NODIN3*P(MI)
      DO 31 IW=MI,20
   31 ACC=ACC+NFPO(IW)
   34 TC4=ACC-ANO(MI)
      CHIP(MI)=TC4*TC4/ANO(MI)
      GO TO 416
  415 CZE=NFPO(MI)
      TC4=CZE-ANO(MI)
      CHIP(MI)=TC4*TC4/ANO(MI)
      MI=MI+1
      IF(MI.LE.20) GO TO 414
C
C
C     CALCULATE DEGREES OF FREEDOM FOR POISSON
C
C
  416 DO 44 NR=1,MI
   44 SIGP=SIGP+CHIP(NR)
      NDFP=MI-1
      DO 84 IB=1,20
      JCP(IB)=0
      JCR(IB)=IB-1
      P(IB)=0.
      ANO(IB)=0.
   84 CHIP(IB)=0.
      LD=1
      XC4=0.
      NDFN=0
      SIG=0.
      TCC1=0.
      PP1=0.
C
C
C     ITERATION FOR NEGATIVE BINOMIAL
C
C
  509 ACR11=JCR(LD)
      B=DGAMMA(Y+ACR11)*((BIK/(Y+BIK))**ACR11)
```

```
801 WRITE(3,16)SIGP
    GO TO 140
802 WRITE(3,15) SIGP
    GO TO 140
803 WRITE(3,14) SIGP
140 IF(SIG.GT.100.) GO TO 142
    IF(NDFN.LE.0) GO TO 143
    IF(SIG.LT.TABLE(NDFN,1)) GO TO 143
    IF(SIG.GE.TABLE(NDFN,3)) GO TO 144
    IF(SIG.GE.TABLE(NDFN,2)) GO TO 145
    IF(SIG.GE.TABLE(NDFN,1)) GO TO 146
142 IF(NDFN.LE.0) NDFN=0
    WRITE(3,147) NDFP,NDFN
    GO TO 41
143 IF(NDFN.LE.0) NDFN=0
    WRITE(3,148) SIG,NDFP,NDFN
    GO TO 41
144 WRITE(3,149) SIG,NDFP,NDFN
    GO TO 41
145 WRITE(3,150) SIG,NDFP,NDFN
    GO TO 41
146 WRITE(3,151) SIG,NDFP,NDFN
 41 RETURN
    END
```

Appendix V


START
DIMENSION AND FORMAT
READ TABLE OF χ2
20
READ - END=67
30
FILTER ?
YES
NO
FIRST CARD ?
YES
NO
CALCULATE No/STUDY AREA/YEAR
57
CALCULATE Na,Nha BY SPECIES/STUDY AREA/YEAR
58
NEW LOCALITY OR INTERVAL ?
NO
YES
IND=1
67
CALCULATE GROUPS ?
YES
NO
SUBROUTINE CALL TAB3
CALCULATE FREQUENCY DISTRIBUTION FOR EACH SPECIES
NEW LOCALITY OR INTERVAL OR IND=1 ?
NO
YES
LINE CATENATION OF MATRICIES
90
OUTPUT HEADING
SUBROUTINE CALL STATS
CALCULATE STATS ?
YES
NO
IND=1
YES
NO
NEW LOCALITY ?
YES
NO
OUTPUT HEADING, FREQ. DISTRIBUTION PER SPECIES
47
OUTPUT HEADING
SUBROUTINE CALL POIS
CALCULATE POIS ?
YES
NO
50
IND=1
YES
NO
STOP
MATRICIES IN PART=0
NEW INTERVAL ?
YES
NO
GO TO 57
REMAINDER OF MATRICIES=0
114
GO TO 57
END

TAB3


START
DIMENSION AND FORMAT
500
CALCULATE FREQUENCY DISTRIBUTION FOR EACH GROUP
504
CALCULATE Nha, ΣX AND ΣX2 FOR STATS
NEW LOCALITY OR INTERVAL OR IND=1 ?
NO
YES
90
DIMENSION ALL PLOT-YEARS
191
CALCULATE STATS ?
YES
NO
IND=1 OR NEW INTERVAL ?
NO
YES
55
OUTPUT FREQUENCY FOR EACH GROUP
99
200
PREPARATION OF PROBABITY FUNCTION
206
OUTPUT HEADING
SUBROUTINE CALL STATS
SUBROUTINE CALL POIS
YES
CALCULATE POIS ?
NO
151
MATRICIES IN PART=o
131
26
NEW INTERVAL ?
NO
YES
REMAINDER MATRICIES=o
25
RETURN
END

Appendix V (Cont'd)