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ESTIMATES OF FIELD DENSITY
AND PRODUCTION OF
THE STREAM CADDISFLY
GLOSSOSOMA NIGRIOR BANKS¹
(TRICHOPTERA:GLOSSOSOMATIDAE)

MASTER

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NOTE FOR AEC REVIEW

This paper represents one of three (TD-COO-2002-17 through -19) on Glossosoma that are in preparation for submission to appropriate journals. Although some portions of the data and discussion were previously included in TD-COO-2002-3, it has been necessary to completely reorganize the information and rewrite the text material, not only to accommodate new data, but also to produce a manuscript of sufficiently condensed form for publication.

To avoid unnecessary and costly duplication of effort, the paper is presented here in extended outline form, rather than as a part of the Progress Report per se (TD-COO-2002-20).

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Table 3. Standing crop data for *G. nigror* in Linesville Creek, Pa. from 5 sample (900 cm² sample) transects (total transect area = 4500 cm² x 2.22 = m²)

Generation	Transect No.	Date	Day interval	Number per transect (4500 cm ²) by instar								Totals per m ²			$\bar{x}$ wt per individual (mg)
				I	II	III	IV	V	Pre-pupae	Pupae	Total	Number	Dry wt (mg)	Calories	
Summer 1964	2	Aug. 2	---	0	0	2	10	5	2	4	23	51.1	72.22		1.4144
	3	Sep. 1	30	0	0	0	0	1	0	25	26	57.7			
Winter 1964-1965	3	Sep. 1	30	0	3	0	0	0	0	0	3	6.7			0.3199
	4	Oct. 7	36	22	143	160	38	29	5	4	401	890.2	284.76		
	5	Nov. 13	37												
	6	Dec. 5	22												1.0133
	7	Jan. 19	45	0	2	3	5	2	1	2	15	33.3	33.73		
	8	Feb. 16	28	0	0	3	7	5	11	0	26	57.7	98.61		
	9	Mar. 13	26	0	0	2	6	3	18	1	30	66.6	134.05		2.0127
	10	Apr. 27	45	0	0	0	6	30	15	48	99	219.78			
	11	May 27	30	0	0	0	0	0	2	19	21	46.6			
Summer 1965	11	May 27	30	16	0	0	0	0	0	0	16	35.5			1.5918
	12	Jul. 1	35	42	180	216	228	86	24	16	792	1785.2			
	13	Aug. 4	34	15	10	12	42	28	9	60	176	390.7	621.95		
	14	Oct. 2	59	0	0	0	0	0	0	4	4	8.9			
	15	Dec. 4	63	0	0	0	0	0	0	2	2	4.4			
Winter 1965-1966	14	Oct. 2	59	17	49	36	20	7	0	0	129	286.4			0.9092
	15	Dec. 4	63	0	13	62	51	25	13	0	164	364.1			
	16	Jan. 7	28	1	2	23	40	15	13	0	95	210.9	191.75		
	17	Feb. 19	43	0	2	17	42	28	12	11	112	248.6	330.07		
	18	Mar. 19	29	0	2	3	32	31	38	2	108	239.8	435.48		
	19	Apr. 25	37	0	0	0	4	35	16	14	69	153.2	386.83		
	20	May 24	29	0	0	0	1	3	5	35	44	97.7			
Summer 1966	20	May 24	29	2	0	0	0	0	0	0	2	4.4			
	21	Jun. 24	31												
	22	Jul. 27	33	0	0	1	4	10	7	7	29	64.4			
	23	Aug. 30	34	1	1	0	0	0	0	5	7	15.5			
	24	Oct. 1	32	0	0	0	0	0	1	2	3	6.7			
	25	Nov. 8	38	0	0	0	0	0	1	3	4	8.9			
Winter 1966-1967	23	Aug. 30	34	1	1	0	0	0	0	0	2	4.4			
	24	Oct. 1	32	19	30	22	3	4	0	0	78	173.2			
	25	Nov. 8	38	1	22	16	14	11	0	0	62	137.6			

Tabl Glossosoma nigrior numerical and biomass standing crop estimate for transect 14 (10/2/65) from
Linesville Creek (Crawford Co., Pennsylvania).

Location Sample		Number and Biomass (mg dry wt) by age class										Total Number	Total Weight				
		I		II		III		IV		V				Pupae			
No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	N	Wt.				
Margin	1	3	0.0432	13	0.3003	18	1.6470	10	3.6750	1	2.5906	0	0	45	7.2561		
Center channel	2	3	0.0432	9	0.2079	3	0.2745	0	0	3	7.7718	0	0	18	8.2974		
	3	11	0.1584	26	0.6006	10	0.9150	6	1.6050	1	2.5906	0	0	54	5.8696		
	4	0	0	0	0	0	0	0	0	1	2.5906	1	2.8475	2	5.4381		
Margin	5	0	0	3	0.0693	6	0.5490	3	0.8025	1	2.5906	1	2.8475	14	6.8589		
Grand means $\pm$ S.E.														Number = 26.9 $\pm$ 9.8		Weight = 6.7440 $\pm$ 0.5079	
S.E. as % $\bar{X}$														Number = 36.9		Weight = 7.5	

Table 5. Standing crop data for G. nigrior in Augusta Creek (B. Ave.), Mich. from 0.25 m² (16 section) grid frames.

Generation	Grid Sample Number	Date	Day Interval	Number per grid frame (0.25 m ²) by instar								Totals per m ²			$\bar{x}$ wt. per individual (mg)
				I	II	III	IV	V	Prepupae	Pupae	Total	Number	Dry wt (mg)	Calories	
Summer 1970	0 ¹	Aug. 17	---	0	0	0	0	0	2	25	27	108			
	1	Sept. 4	18	0	0	0	0	0	0	25	25	100			
	2	Oct. 27	53	0	0	0	0	0	0	2	2	8			
Winter 1970-1971	0 ¹	Aug. 17	---	20	17	7	11	11	0	0	66	264			
	1	Sept. 4	18	9	17	9	15	39	5	0	94	376			
	2	Oct. 27	53	2	94	115	38	10	9	0	270	1080	210.24		0.7786
	3	Nov. 9	13	5	18	37	49	27	51	13	200	800	672.28		0.8404
	4	Jan. 27	79	0	13	92	35	18	18	1	177	708	274.16		0.3872
	5	May 17	110	0	0	0	0	29	11	32	72	288	985.46		3.4217
Summer 1971	6	Jun. 15	29	61	42	1	0	0	0	0	132	528			
	7 ²	Aug. 11	12	42	215	125	28	90	35	72	607	2428			

¹ Mean of two 16 square frames

² Mean of four 16 square frames

Fig. 8. An example of *G. nigrior* distribution within grid sample (no. 7) taken in Augusta Cr. (B Ave.) Aug. 11, 1971. Numbers at center of each square are prepupae + pupae (cases fastened down); total number of individual (all ages) per square are shown in parentheses. Areas: total = 4 0.25 m² frames (A + B + C + D) = 1 m²; frame (e.g. A) = 0.25 m²; square (e.g. 1, 2,...) = 0.016 m². (x = lost sample).

D 91(922)				C 140(432)			
64 2 (18)	63 0 (57)	62 13 (95)	61 3 (31)	60 1 (28)	59 2 (29)	58 21 (44)	57 7 (10)
49 1 (24)	50 3 (52)	51 2 (87)	52 6 (50)	53 5 (28)	54 1 (14)	55 5 (11)	56 9 (11)
48 1 (28)	47 52 (173)	46 0 (66)	45 0 (38)	44 2 (45)	43 5 (31)	42 13 (25)	41 16 (17)
33 4 (13)	34 0 (66)	35 2 (68)	36 2 (56)	37 9 (40)	38 7 (41)	39 14 (28)	40 23 (30)
32 9 (44)	31 0 (23)	30 1 (33)	29 1 (32)	28 8 (30)	27 7 (24)	26 12 (26)	25 1 (10)
17 5 (64)	18 10 (46)	19 0 (53)	20 4 (27)	21 8 (19)	22 14 (35)	23 10 (30)	24 20 (34)
16 X	15 1 (38)	14 0 (50)	13 2 (26)	12 1 (23)	11 14 (62)	10 18 (33)	9 11 (19)
1 2 (80)	2 1 (42)	3 7 (20)	4 X	5 3 (33)	6 4 (13)	7 3 (16)	8 3 (7)

A 43(578)
corrected = 49(661)

B 127(414)

Description of Fortran IV Program

BINOM for statistical analysis of sampling
data conformance to negative binomial distribution

DESCRIPTION: Program reads in data from paper tape and stores in temporary file referenced "-File" under the control of system control file "BINOMCON". BINOMCON then compiles the Fortran IV program "BINOM" and produces an object deck "-OBJ". The object deck is run with input device referenced 1 and output device referenced 2. Output occurs on file -OUT and is copied under control of BINOMCON.

DATA SPECIFICATIONS: More than one set of data may be processed with one compilation. Each data subset consists of a description line followed by N number of lines each 17 data values long. Subset ended with a negative value. Data values are in F17F3.0 format. Tabulation is set with interrupting commas controlled through file "BINOMCON". Description line of each subset in F15A4 which allows 60 characters per line. Read in routine searches for new description line if unsatisfied goes to end.

Example data tape:

Line #

1 DESCRIPTION LINE

2 0.,0.,0.,0.,0.,0.,0.,0.,-1.0.

3 DESCRIPTION LINE 2

4 0.,0.,...

...

...

N 0.,0., -1.0

PROGRAM DESCRIPTION

Program first produces a frequency table of the input data and determines the particular count (I), frequency of each particular count (F) and (A)

the total number of data values which exceed each particular count.

The mean and variance are then calculated for the untransformed data.

The maximum-likelihood equation is used in the calculation of K:

$$(1) \quad n \log_e \left(1 + \frac{\bar{x}}{\hat{K}} \right) = \sum \frac{A(x)}{\hat{K} + x}$$

where n is the total number of sampling units, $\log_e$ designates a natural logarithm and $A(x)$ is the total number of counts exceeding x from the frequency table. The equation is solved by iteration. The statistics T and U are calculated for the derived value of K:

$$(2) \quad U = s^2 - \bar{x} + \frac{\bar{x}^2}{K}$$

$$(3) \quad T = \frac{\sum x^3 - 3\bar{x}\sum x^2 + 2\bar{x}^2\sum x}{N} - s^2 \frac{2s^2}{\bar{x}} - 1$$

Depending on the size of the untransformed mean and the quantity $\frac{\bar{x}}{K}$

either T or U is chosen to represent K.

Based on the magnitude of K and the number of zero counts, a suitable transformation is done on the raw data:

K	Conditions	Transformation
$K > 2$	---	$X + K/2$
$K < 2$	no zero counts	$\log X$
$K < 2$	some zero counts	$\log(X+1)$

The mean of the transformed data is then calculated and a new variance estimated. Output is on device referenced 2. BINOMCON automatically copies the output file.

A. CONTROL FILE "BINOMCON" FOR MTS SYSTEM CONTROL OF FILE

"BINOM". CONTROL FILE READS IN AND STORES DATA IN TEMPORARY FILE

"-FILE", COMPILES AND RUNS THE FORTRAN IV PROGRAM AND COPIES
THE OUTPUT.

```

> 1 $SET ECHO=OFF
> 3 $C *SOURCE* TO *SINK*@SP
> 4 CL ME=TE ON=IK
> 5 TABS",*4,7,10,13,16,19,22,25,28,31,34,37,40,43,46,49
> 6 READER
> 7 CC=OFF
> 8 $ENDFILE
> 9 $C *MSOURCE*@SP TO -FILE(LAST+1)
> 10 $C -FILE
> 11 CC=ON
> 12 $RUN *FORTRAN SCARDS=BINOM SPUNCH=-OBJ
> 13 $RUN -OBJ 1=-FILE 2=-OUT
> 14 $C -OUT
> 15 $SOURCE PREVIOUS

```

B. PROGRAM BINOM IN FORTRAN IV FOR USE ON IBM SYSTEM 360.

```

> 1 C
> 2 C NEGATIVE BINOMIAL PROGRAM
> 3 C SEPTEMBER 27,1971
> 4 DIMENSION HEAD(60),X(100),F(100),A(100)
> 5 1,Y(100),AY(100)
> 6 1,XX(100)
> 7 C
> 8 C ZERO ALL ARRAYS AND VARIABLES
> 9 C
> 10 DATA F,A,Y,AY,XX/100*0.,100*0.,100*0.,
> 11 1100*0.,100*0./
> 12 22 CONTINUE
> 13 I=0

```

```

> 14      X2=0.
> 15      XPAR=0.
> 16      YEAP=0.
> 17      YEAP2=0.
> 18      VAR=0.
> 19      VAR2=0.
> 20      U=0.
> 21      T=0.
> 22      IC=0
> 23      X1=0.
> 24      X3=0.
> 25      X4=0.
> 26      M=0
> 27      XP=0.
> 28      YP=0.
> 29      Q=0.
> 30      REAL KF,KC
> 31      INTEGER FPC
> 32      KF=0.0
> 33      C
> 34      C BEGIN READ IN SERIES
> 35      C
> 36      READ(1,26,END=999)(HEAD(I),I=1,15)
> 37      K=1
> 38      KK=17
> 39      32 READ(1,2,END=999)(X(I),I=K,KK)
> 40      N=KK
> 41      IK=K
> 42      KK=KK+17
> 43      K=I+1
> 44      DO 30 I=IK,N
> 45      IF(X(I).EQ. -1.0) GO TO 31
> 46      30 CONTINUE
> 47      GO TO 32
> 48      31 N=I-1
> 49      C
> 50      C FORM FREQUENCY TABLE
> 51      C      I=PARTICULAR COUNT
> 52      C      F=FREQUENCY
> 53      C      A=TOTAL # COUNTS EXCEEDING X
> 54      C      SF= SUM FREQ = N
> 55      CC=-1.0
> 56      DO 3 I=1,100
> 57      F(I)=0.0
> 58      25 CONTINUE
> 59      CC=CC+1.0
> 60      DO 4 K=1,N
> 61      IF(X(K).NE.CC) GO TO 4
> 62      F(I)=F(I)+1.0
> 63      XX(I)=CC
> 64      IC=IC+1

```



```

> 65      IF(IC .EQ. N) GO TO 6
> 66      4      CONTINUE
> 67      IF(F(I).EQ. 0.0) GO TO 25
> 68      3      CONTINUE
> 69      6      CONTINUE
> 70      FPC=I
> 71      SF=N
> 72      DO 7 I=1,FPC
> 73      A(I)=SF-F(I)
> 74      SF=A(I)
> 75      7      CONTINUE
> 76      C
> 77      C      FORM MEAN AND VARIANCE
> 78      DO 23 I=1,FPC
> 79      XBAR=XBAR+(F(I)*XX(I))
> 80      X2=X2+(F(I)*XX(I)**2)
> 81      X1=X1+(F(I)*XX(I))
> 82      X3=X3+(F(I)*XX(I)**2)
> 83      X4=X4+(F(I)*XX(I)**3)
> 84      23      CONTINUE
> 85      XBAR=XBAR/N
> 86      VAR=(X2-(XBAR**2*N))/(N-1)
> 87      C
> 88      C      CALCULATE K VIA MAXIMUM LIKELIHOOD EQUATION
> 89      C
> 90      DO 12 K=1,500
> 91      SUMA=0.0
> 92      KF=KF+0.1
> 93      DO 13 I=1,FPC
> 94      SUMA=SUMA+(A(I)/(KF+XX(I)))
> 95      13      CONTINUE
> 96      SUMB=(N*ALOG(1+XBAR/KF))
> 97      DIFF=SUMA-SUMB
> 98      IF(K .NE. 1) GO TO 103
> 99      CK=DIFF/ABS(DIFF)
> 100      103      CONTINUE
> 101      CK2=DIFF/ABS(DIFF)
> 102      IF(CK2 .NE. CK) GO TO 102
> 103      DIFF1=DIFF
> 104      12      CONTINUE
> 105      KF=50.0
> 106      REAL KF1
> 107      GO TO 14
> 108      102      KF1=KF-0.1
> 109      KF=((0.0-DIFF1)*(KF-KF1))/(DIFF-DIFF1)+KF1
> 110      C
> 111      C      CALCULATE U AND T FOR SIGNIFICANCE OF K
> 112      C
> 113      14      U=VAR-(XBAR+XBAR**2/KF)
> 114      T=((X4-3.0*XBAR*X3+2*XBAR**2.0*X1)/N)-VAR*((2.0*VAR/X
* BAR)-1)

```

```

> 115      M=M+1
> 116      KC=(XBAR**2-VAR/N)/(VAR-XBAR)
> 117      C
> 118      C DECIDE ON TRANSFORMATION BASED ON VALUES OF K
> 119      C
> 120      IF(KF.GT.2.0) GO TO 15
> 121      IF (F(1).EQ.0.0) GO TO 17
> 122      DO 16 I=1,FPC
> 123      Y(I)=ALOG10(XX(I)+1)
> 124      YBAR=YBAR+(F(I)*Y(I))
> 125      Y2=Y2+(F(I)*(Y(I)**2.0))
> 126      16 CONTINUE
> 127      L=-1
> 128      GO TO 18
> 129      15 DO 19 I=1,FPC
> 130      Y(I)=ALOG10(XX(I)+(KF/2.0))
> 131      YBAR=YBAR+(F(I)*Y(I))
> 132      Y2=Y2+(F(I)*Y(I)**2.0)
> 133      19 CONTINUE
> 134      L=0
> 135      GO TO 18
> 136      17 DO 20 I=1,FPC
> 137      Y(I)=ALOG10(XX(I))
> 138      YBAR=YBAR+(F(I)*Y(I))
> 139      Y2=Y2+(F(I)*(Y(I)**2.0))
> 140      20 CONTINUE
> 141      L=1
> 142      18 CONTINUE
> 143      YBAR=YBAR/N
> 144      Y2=(Y2-(YBAR*YBAR*N))/(N-1)
> 145      C
> 146      C FORM DERIVED MEAN AND VARIANCE WITH ADJUSTMENTS
> 147      C
> 148      AY2=10**Y2
> 149      AYBAR=10**((1.15*Y2)+YBAR)
> 150      IF(L) 41,42,43
> 151      41 AYBAR=AYBAR-1
> 152      AY2=AY2-1
> 153      GO TO 43
> 154      42 AYBAR=AYBAR-KF/2.0
> 155      AY2=AY2-KF/2.0
> 156      43 CONTINUE
> 157      DO 21 I=1,FPC
> 158      AY(I)=10**(Y(I))
> 159      21 CONTINUE
> 160      C
> 161      C BEGIN WRITE SERIES
> 162      C
> 163      WRITE(2,45)
> 164      WRITE(2,1)(HEAD(I),I=1,15)
> 165      WRITE(2,2)(X(I),I=1,N)
> 166      WRITE(2,8)
> 167      DO 9 I=1,FPC
> 168      M=I-1
> 169      WRITE(2,10) XX(I),F(I),A(I),Y(I),AY(I)
> 170      9 CONTINUE

```

```

> 171      WRITE(2,44)N
> 172      WRITE(2,11)XBAR,VAR,KF,U,T,KC,YBAR,AYBAR,Y2,AY2
> 173      1   FORMAT(15X,15A4)
> 174      2   FORMAT(17F3.0)
> 175      26  FORMAT(15A4)
> 176      8   FORMAT('1'5X,'FREQUENCY TABLE'/5X,'X'10X,'F'9X,'A(X)'
> 177      16X,'Y'6X,'ANTILOG(Y)')
> 178      10  FORMAT(3X,5(F8.4,2X))
> 179      11  FORMAT(15X,'MEAN'10X,F10.4,/15X,'VARIANCE'6X,F10.4/15
* X,
> 180      1 'K'13X,F10.4,/15X,'U',13X,F10.4/15X,'T'13X,F10.4/15X,
> 181      1 'MOMENT K' 6X,F10.4/
> 182      115X,'TRANSFORMED MEAN'6X,F10.4/15X,'DERIVED MEAN'10X,
* F10.4
> 183      1/15X,'TRANSFORMED VARIANCE'3X,F10.4/15X,'DERIVED VARI
* ANCE'
> 184      16X,F10.4)
> 185      GO TO 22
> 186      44  FORMAT(/,15X,'N'16X,12)
> 187      45  FORMAT('1'5X,'RESULTS OF NEGATIVE BINOMIAL ANALYSIS'
> 188      1 ' FOR')
> 189      999 CONTINUE
> 190      END
# END OF FILE
#

```

C. Sample output from program "Binom" using published data from Elliott(1971).

RESULTS OF NEGATIVE BINOMIAL ANALYSIS FOR
ELLIOTT'S DATA P.58

FREQUENCY TABLE					
X	F	A(X)	Y	ANTILOG(Y)	
0.0	7.0000	13.0000	0.0	1.0000	
1.0000	3.0000	10.0000	0.3010	2.0000	
2.0000	4.0000	6.0000	0.4771	3.0000	
3.0000	2.0000	4.0000	0.6021	4.0000	
7.0000	1.0000	3.0000	0.9031	8.0000	
8.0000	2.0000	1.0000	0.9542	9.0000	
9.0000	1.0000	0.0	1.0000	10.0000	
N			20		
MEAN			2.4500		
VARIANCE			9.2079		
K			0.5583		
U			-3.9938		
T			-29.7548		
SXP			5.5421		
SYP			6.7579		
KC			0.8201		
TRANSFORMED MEAN				0.3914	
DERIVED MEAN				2.4795	
TRANSFORMED VARIANCE				0.1306	
DERIVED VARIANCE				1.3507.	

#

 >1 RESULTS OF NEGATIVE BINOMIAL ANALYSIS FOR
 > CLOSSOSOMA SAMPLE AUGUST 10-11 1971
 >80.42.20.37.13.16. 7.19.33.62.23.27.50.38.65.46.53.
 >27.19.35.29.34.10.26.24.30.32.33.23.44.13.66.56.40.
 >41.28.30.17.25.31.45.38.66.28.24.87.28.14.11.11.10.
 >44.

>1 FREQUENCY TABLE

X	F	A(X)	Y	ANTILOG(Y)
7.0000	1.0000	51.0000	1.5051	32.0000
10.0000	2.0000	49.0000	1.5441	34.9999
11.0000	2.0000	47.0000	1.5563	35.9999
13.0000	2.0000	45.0000	1.5798	37.9999
14.0000	1.0000	44.0000	1.5911	38.9999
16.0000	1.0000	43.0000	1.6128	40.9999
17.0000	1.0000	42.0000	1.6232	41.9999
19.0000	2.0000	40.0000	1.6435	43.9999
20.0000	1.0000	39.0000	1.6532	45.0000
23.0000	2.0000	37.0000	1.6812	47.9999
24.0000	2.0000	35.0000	1.6902	48.9999
25.0000	1.0000	34.0000	1.6990	49.9999
26.0000	1.0000	33.0000	1.7076	50.9999
27.0000	2.0000	31.0000	1.7160	51.9998
28.0000	3.0000	28.0000	1.7243	52.9999
29.0000	1.0000	27.0000	1.7324	53.9998
30.0000	2.0000	25.0000	1.7404	54.9999
31.0000	1.0000	24.0000	1.7482	55.9999
32.0000	1.0000	23.0000	1.7559	56.9999
33.0000	2.0000	21.0000	1.7634	57.9999
34.0000	1.0000	20.0000	1.7709	59.0000
35.0000	1.0000	19.0000	1.7782	59.9998
37.0000	1.0000	18.0000	1.7924	61.9999
38.0000	2.0000	16.0000	1.7993	62.9999
40.0000	1.0000	15.0000	1.8129	64.9999
41.0000	1.0000	14.0000	1.8195	65.9999
42.0000	1.0000	13.0000	1.8261	66.9999
44.0000	2.0000	11.0000	1.8388	68.9999
45.0000	1.0000	10.0000	1.8451	69.9999
46.0000	1.0000	9.0000	1.8513	70.9999
50.0000	1.0000	8.0000	1.8751	74.9998
53.0000	1.0000	7.0000	1.8921	77.9999
56.0000	1.0000	6.0000	1.9085	80.9998
62.0000	1.0000	5.0000	1.9395	86.9998
65.0000	1.0000	4.0000	1.9543	89.9997
66.0000	2.0000	2.0000	1.9590	90.9997
80.0000	1.0000	1.0000	2.0212	104.9997
87.0000	1.0000	0.0	2.0492	111.9996
N		52		
MEAN		33.6538		
VARIANCE		329.6821		
K		50.0000		
U		273.3765		
T		-689.4883		
MOMENT K		3.8045		
TRANSFORMED MEAN			1.7493	
DERIVED MEAN			33.6500	
TRANSFORMED VARIANCE			0.0165	
DERIVED VARIANCE			1.0388	