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LONGEVITY IN EXPERIMENTAL POPULATIONS OF *Drosophila*

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ABSTRACT

This paper presents a procedure for the study of longevity in *Drosophila* populations maintained in bottles by the serial transfer technique. Newly emerged flies were marked before being added to the adult survivors, a different colour mark being used in each census. The colour of the spot marks gave the age of each fly in the censes. Eight species of *Drosophila* were used. Mean longevity was based on age specific group sizes and mortality rates.

INTRODUCTION

Although many studies have been carried out with *Drosophila* experimental populations, longevity still remains relatively untouched. Data are restricted to six papers dealing with populations maintained in bottles by the serial transfer technique, devised by Buzzati-Traverso (1955) and modified by Dobzhansky and Pavlovsky (1961).

Levene (Appendix in Dobzhansky and Pavlovsky, 1961) has developed a mathematical model to estimate the mean longevity in the serial transfer

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populations, based on the mean number of living individuals divided by the mean number born per unitary interval of time. Death is considered an approximately continuous process while the birth process is essentially discrete. Death rate is considered independent of age and "birth" is not the time of biological birth, but the time at which an individual enters the population. On the average, when flies enter the population they are 1.75 days old using two transfers a week, and 1.17 days old with three transfers a week.

On a variety of experiments with five species of *Drosophila (D. pseudoobscura, D. serrata, D. birchii, D. melanogaster* and *D. willistoni)* Levene's model proved to be efficient for the study of longevity (Dobzhansky and Pavlovsky, 1961; Ayala, 1965, 1966, 1967; Mourão *et al.*, 1972; Benato *et al.*, 1976).

This paper presents an alternative procedure for the study of longevity in serial transfer populations with marked flies. It is based on age-specific group size and mortality rate.

MATERIALS AND METHODS

Eight species of *Drosophila (D. melanogaster* – Brazil; *D. arizonensis* – Mexico; *D. canalinea* – Mexico; *D. hydei* – Brazil; *D. eohydei* – Colombia; *D. neohydei* – Venezuela; *D. gibberosa* – El Salvador; *D. fulvimacula* – Panama) were used in experimental populations maintained in bottles. For each species three populations were founded (two for *D. arizonensis*) and kept at 25°C in banana-agar medium, for 22 up to 32 weeks, with censes on Tuesdays and Fridays.

These populations were studied for stable age distribution in a paper by Corradi and Mourão (1980) where the serial transfer technique (Dobzhansky and Pavlovsky, 1961) combined with the marking tecnique of the flies (Tadei and Mourão, 1976) is described in details. Briefly, newly emerged flies are marked with coloured spots before being added to the adult survivors. A different colour mark being used in each census, in subsequent censes the colour of the spot marks gives the age of each fly.

In each census the newly emerged flies (age a_{0d} = zero days) are introduced in the new bottle together with the adult survivors of the previous census. The age of the adults are a_{1d}(3.5 days), a_{2d}(7 days), a_{3d} (10.5 days) and so on ($d = 3.5$ days for two transfers a week). Therefore, for the flies of age a_{0d} that die before the next census, longevity is between a_{0d} and a_{1d}', on the average $a_{0d} + a_{1d}/2$ days. Being n_0, n_1, n_2, n_3, etc. the total number of flies of each age group in N censes, $n_0 + n_1 + n_2 + n_3$, etc. is the total number of flies produced. Thus there are $n_0 - n_1$ flies with longevity $a_{0d} + a_{1d}/2$, $n_1 - n_2$ flies with longevity $a_{1d} + a_{2d}/2$, $n_2 - n_3$ flies with longevity $a_{2d} + a_{3d}/2$, etc. Then the mean longevity of the flies in the N censes can be computed, based on age-specific group size and mortality rate.

RESULTS AND DISCUSSION

The populations reached equilibrium size by the fifth week. This was verified by simple inspection of the graphic record of the censes. Table I gives the means for population size and productivity used to estimate the longevity of the flies by Levene's model, given in Table III.

Table II gives the numbers of flies with different longevities in the populations, used to estimate mean longevities based on marked flies, also given in Table III.

Comparing the two longevity values for all 23 populations (Table III), the differences ranged between 0.09 (population B of *D. canalinea*) and 0.52 (population B of *D. gibberosa*).

For all 23 populations, means and standard errors were 8.12 ± 0.40 and 7.82 ± 0.39, respectively, for longevities based on Levene's model and on marked flies. The difference between these means is not significant ($t = 0.532$, $P > 0.05$, 44 df).

The correlation between the longevities obtained by the two procedures (Figure 1) is virtually perfect, $r = 0.999$ ($t = 102.504$, $P < 0.001$, 21 df). Such a correlation undoubteddly certifies the adequateness of both Levene's model and the marked flies procedure for estimating longevity in serial transfer populations of *Drosophila*.

Table I - Means for population size and productivity, with their standard errors, in 23 populations of *Drosophila*. N = number of censes.

Drosophila		N	population size	productivity
melanogaster	A	54	966 ± 26	479 ± 16
	B	54	933 ± 31	441 ± 19
	C	54	840 ± 28	452 ± 20
canalinea	A	38	270 ± 19	232 ± 22
	B	38	268 ± 24	224 ± 19
	C	38	281 ± 19	223 ± 22
eohydei	A	35	414 ± 37	350 ± 28
	B	35	352 ± 28	275 ± 25
	C	35	360 ± 28	338 ± 28
gibberosa	A	36	132 ± 12	88 ± 11
	B	36	135 ± 11	72 ± 6
	C	36	137 ± 11	88 ± 12
arizonensis	A	54	166 ± 18	136 ± 16
	B	54	121 ± 13	117 ± 13
hydei	A	46	383 ± 19	145 ± 10
	B	46	386 ± 17	128 ± 9
	C	46	284 ± 11	110 ± 7
neohydei	A	34	284 ± 33	143 ± 24
	B	34	364 ± 31	170 ± 20
	C	34	349 ± 26	179 ± 24
fulvimacula	A	37	299 ± 18	163 ± 17
	B	37	286 ± 17	168 ± 20
	C	37	296 ± 22	151 ± 24

Table II - Number of flies with different longevities in 23 population of *Drosophila*. Number of censes as in Table I.

Drosophila		longevity (in days)									
		1.75	5.25	8.75	12.25	15.75	19.25	22.75	26.25	29.75	33.25
melanogaster	A	7707	5586	4098	2858	1835	1659	1045	670	295	95
	B	7105	4979	3519	2733	1694	1401	1161	714	290	174
	C	7863	6021	3442	2286	1757	1134	917	597	318	78
arizonensis	A	2836	2202	1206	534	352	140	19	69	9	–
	B	2458	2104	1099	414	152	53	19	–	–	–
canalinea	A	3365	2578	1544	796	472	65	–	–	–	–
	B	2643	2878	1837	820	316	34	–	–	–	–
	C	3034	2271	1824	995	438	5	–	–	–	–
hydei	A	1302	1244	1025	909	783	612	377	311	121	–
	B	910	865	889	878	763	660	431	342	143	–
	C	960	968	770	708	642	449	298	169	83	–
eohydei	A	4678	3666	1977	1247	432	193	33	22	–	–
	B	3799	2546	1428	1051	514	196	52	40	2	–
	C	5342	3038	1727	1074	461	142	30	4	–	–
neohydei	A	1326	1221	637	520	604	378	104	54	24	4
	B	1272	1491	897	761	554	383	288	76	43	4
	C	1733	1295	893	777	583	421	127	125	44	–
gibberosa	A	1366	675	322	295	225	106	111	24	17	3
	B	838	490	429	315	279	152	58	15	5	–
	C	1195	702	346	339	276	155	54	26	7	–
fulvimacula	A	1880	1364	1034	712	456	251	194	110	35	3
	B	2089	1583	933	666	382	263	168	109	34	10
	C	1712	1256	1053	562	222	278	255	173	83	4

Table III - Mean longevity, in days, in 23 populations of *Drosophila*, based on Levene's model (a = crude longevity; m-a = correction factor; m = corrected mean longevity) and on marked flies (mean and standard error).

Drosophila		Levene's model			marked flies
		a	m-a	m	
melanogaster	A	7.05	2.04	9.09	8.81 ± 0.04
	B	7.40	2.05	9.45	9.11 ± 0.05
	C	6.50	2.03	8.53	8.26 ± 0.04
canalinea	A	4.07	1.96	6.03	5.82 ± 0.04
	B	4.19	1.96	6.15	6.04 ± 0.04
	C	4.41	1.97	6.38	6.11 ± 0.04
eohydei	A	4.14	1.96	6.10	5.88 ± 0.04
	B	4.48	1.97	6.45	6.22 ± 0.05
	C	3.72	1.94	5.66	5.45 ± 0.04
gibberosa	A	5.25	2.00	7.25	6.90 ± 0.11
	B	6.56	2.03	8.59	8.07 ± 0.12
	C	5.44	2.01	7.45	7.23 ± 0.11
arizonensis	A	4.27	1.97	6.24	6.02 ± 0.05
	B	3.61	1.93	5.54	5.38 ± 0.05
hydei	A	9.24	2.08	11.32	10.98 ± 0.09
	B	10.55	2.09	12.64	12.32 ± 0.10
	C	9.03	2.08	11.11	10.82 ± 0.10
neohydei	A	6.95	2.04	8.99	8.64 ± 0.09
	B	7.49	2.05	9.54	9.24 ± 0.08
	C	6.82	2.04	8.86	8.54 ± 0.08
fulvimacula	A	6.42	2.03	8.45	8.06 ± 0.08
	B	5.96	2.02	7.98	7.60 ± 0.08
	C	6.86	2.04	8.90	8.48 ± 0.09

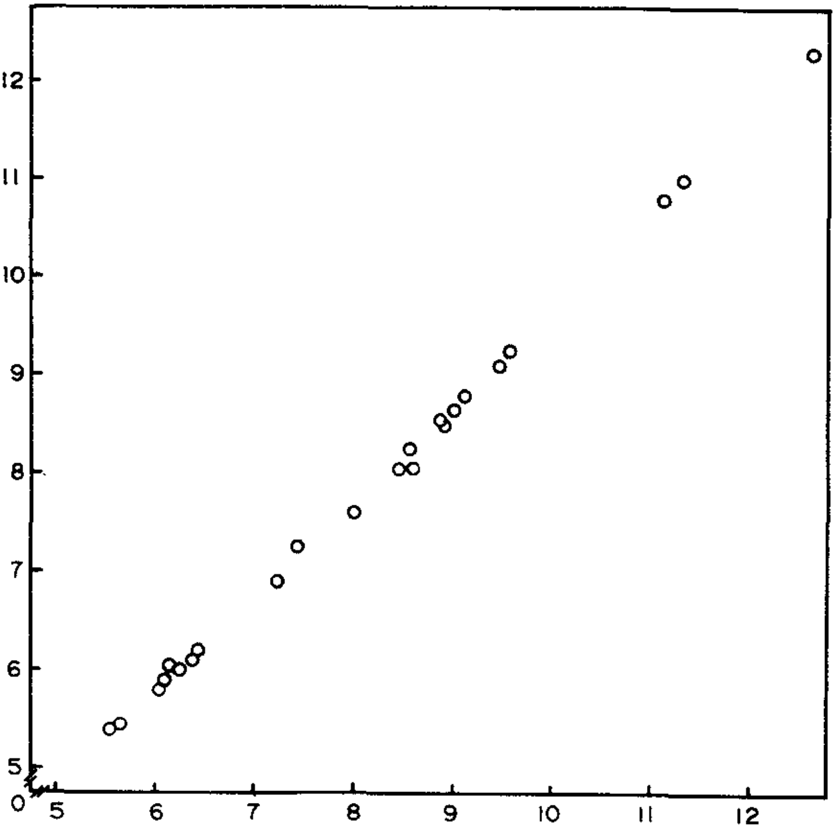

Figure 1 - Correlation of mean longevity, in days, in 23 populations of *Drosophila,* based on Levene's model (abscissa) and on marked flies (ordinate).

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RESUMO

Este trabalho apresenta um procedimento para o estudo da longevidade em populações de *Drosophila*, mantidas em garrafas pela técnica da transferência seriada. As moscas recém-nascidas foram marcadas antes de serem reunidas aos adultos sobreviventes, usando-se uma cor diferente em cada censo. As diferentes cores das marcas permitem determinar a idade de cada mosca nos censos subsequentes. Foram usadas oito espécies de *Drosophila* . A longevidade média é calculada com base nos tamanhos das classes etárias e respectivas taxas de mortalidade.

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