Appendix from F. García-González, "Infertile Matings and Sperm Competition: The Effect of "Nonsperm Representation" on Intraspecific Variation in Sperm Precedence Patterns"

(Am. Nat., vol. 164, no. 4, p. 457)

Table A1
Infertile matings in insects

Order/species	Infertile matings (%)	*N*	Comments	Reference
Coleoptera:				
Aleochara curtula	35	48	Single copulations in which the tube of the spermatophore did not reach the spermatheca and sperm failed to fill the storage organ; in 11% of 62 single copulations, a spermatophore was not transferred into the genital chamber of the female	Benken et al. 1999
Araecerus fasciculatus	25	20	Once-mated females that laid only unfertilized eggs	Taher El Sayed 1935
Conotrachelus nenuphar	10	116	Once-mated females that were unfertile; at least half of the infertile matings were due to exclusive male infertility because half of the nonfertile females became fertile after mating with other males	Johnson and Hays 1969
Labidomera clivicollis clivicollis	11	9	Single copulations that resulted in a lack of sperm transfer	Dickinson 1986
Tenebrio molitor	25	21	Once-mated females that did not produce any offspring (experiment 1)	Worden and Parker 2001
T. molitor	25	44	Once-mated females that did not produce any offspring (experiment 2)	Worden and Parker 2001
T. molitor	5	43	Females mated four times to the same male that did not produce any offspring (experiment 2)	Worden and Parker 2001
Tetraopes tetraophthalmus	25	24	Once-mated females that produced only nonviable eggs	Lawrence 1990
Tribolium castaneum	48	37	Copulations that failed to result in progeny production	G. Bernasconi, unpublished data, cited in Bernasconi and Keller 2001
T. castaneum	15	130	Single copulations that resulted in a lack of sperm transfer	Bloch Qazi et al. 1996
T. castaneum	23	15	Males' first matings that failed to result in progeny production	Lewis 2004
T. castaneum	38	20	Single copulations that failed to result in progeny production; the males in this experiment were not necessarily virgins because they could have mated before with other females	Lewis 2004

Table A1 (*Continued*)

Order/species	Infertile matings (%)	*N*	Comments	Reference
T. castaneum	9	88	Females that did not produce offspring after their first mating	Lewis and Austad 1990
Dermaptera:				
Euborellia plebeja	19	32	Females mated three times with the same male that laid only infertile eggs; if data of females that did not lay eggs are included, the proportion is 26%	Kamimura 2003
Diptera:				
Ceratitis capitata	22	49	Failure to produce offspring after double mating	Saul and McCombs 1993
C. capitata	25		Naturally terminated copulations that resulted in inseminations failures; normal and irradiated (with nonfertilizing sperm) males were used	Seo et al. 1990, cited in Taylor and Yuval 1999
C. capitata	6	178	Naturally terminated copulations that resulted in inseminations failures	Taylor and Yuval 1999
C. capitata	1	186	Single copulations that resulted in a lack of sperm in the female tract	Taylor et al. 2000
C. capitata	11	208	Single copulations that resulted in a lack of sperm in the female tract; sterile (with nonfertilizing sperm) males were used	
C. capitata	7	240	Failure to produce offspring after copulation	Whittier and Kaneshiro 1995
C. capitata	2–5		Naturally terminated copulations that resulted in inseminations failures; normal and irradiated (with nonfertilizing sperm) males were used	Wong et al. 1984, cited in Taylor and Yuval 1999
Coenosia tigrina	23	26	Once-mated females that laid only nonviable eggs	Morris and Cloutier 1987
Drosophila melanogaster	0	107	All single-mated females were fertilized	Pyle and Gromko 1978
Stomoxys calcitrans	40	163	Once-mated females that were not inseminated	Harris et al. 1966
Hemiptera:				
Aquarius remigis	22	32	Naturally terminated copulations that resulted in inseminations failures; in some of the unsuccessful matings, the mating association did not last the minimum threshold of 15 min necessary for normal sperm transfer (Rubenstein 1989)	Campbell and Fairbairn 2001
A. remigis	7	27	Naturally terminated copulations that resulted in inseminations failures; only those matings that lasted 15 min or more are taken into account	Campbell and Fairbairn 2001
Lygaeus simulans	60	67	Single copulations that resulted in no insemination (28 pairs out of 67: 42%) plus single copulations that resulted in unfertile eggs following insemination (12 pairs out of 67: 18%)	Tadler et al. 1999
L. simulans	36	97	Single copulations that resulted in a lack of insemination	Tadler 1999
Phyllomorpha laciniata	31	26	Once-mated females that were not inseminated	García-González and Gomendio 2004
Lepidoptera:				
Atteva punctella	34	100	Once-mated females that were infertile (experiment 1); most of the females mated to a second male were fertile	Taylor 1967

Table A1 (*Continued*)

Order/species	Infertile matings (%)	*N*	Comments	Reference
A. punctella	24	153	Once-mated females that were infertile (experiment 2); as in experiment 1 the major portion of infertility was due to the male	Taylor 1967
A. punctella	63	87	Once-mated females that were infertile (experiment 3); individuals were from a highly inbred line	Taylor 1967
Danaus gilippus berenice	15	23	Copulations in which the male failed to pass a spermatophore	Pliske 1973
Epiphyas postvittana	27	97	Females that laid no fertile eggs after mating once with males that previously had mated from one to seven times (proportion of females that laid no fertile eggs ranged from 6.25 when they were mated with males that had mated only once previously to 54.5 when they were mated with males that had mated seven times previously)	Foster and Ayers 1996
Heliothis virescens	36	123	Once-mated females producing nonfertile eggs; the proportion of unfertile females after copulation with a second male was 19% ($n = 21$)	Pair et al. 1977
Heliothis zea	3	35	Rate of failure for the insertion of the spermatophore	Callahan and Chapin 1960
Laspeyresia pomonella	5	40	Once-mated females that received a spermatophore but had no sperm in the spermatheca	Robinson 1974
Peridroma margaritosa	0	25	Rate of failure for the insertion of the spermatophore	Callahan and Chapin 1960
Phthorimaea operculella	5	20	Females that laid infertile eggs after mating (average mating frequency is 1)	Nabi and Harrison 1983
Pseudaletia unipuncta	15	60	Rate of failure for the insertion of the spermatophore	Callahan and Chapin 1960
Spodoptera frugiperda	27	165	Once-mated females that failed to oviposit (39 of 165: 24%) or to produce viable eggs (six of 165: 4%)	Snow et al. 1970
Spodoptera litura	21	14	Once-mated females that received a spermatophore but had no sperm in the spermatheca (experiment 1)	Etman and Hooper 1979
S. litura	12	24	Once-mated females that received a spermatophore but had no sperm in the spermatheca (experiment 2)	Etman and Hooper 1979
S. litura	4	116	Mated females (one or multiple times) that received spermatophore but laid only infertile eggs	Seth et al. 2002
Orthoptera: *Teleogryllus commodus*	33	134	Once-mated females that received a spermatophore but laid only unfertilized eggs; if only females that are not young are taken into account, this figure is 29% (102 females)	Loher and Edson 1973
Teleogryllus oceanicus	5	105	Once-mated females that did not have sperm in the spermatheca; the same study showed that 10% of 61 spermatophores produced by different males were devoid of sperm	Simmons et al. 2003

Table A1 (*Continued*)

Order/species	Infertile matings (%)	*N*	Comments	Reference
T. oceanicus	31	396	Females mated twice to the same male that laid only nonviable eggs; females were mated in groups of three to the same male (n males = 132); failures in sperm transfer account for only 14% of the infertile cases or 4% out of the total of females mated	F. García-González and L. W. Simmons, unpublished data
Siphonaptera:				
Cthenocephalides felis	56	45	Once-mated females that produced only nonviable eggs	Hsu and Wu 2000
Zoraptera:				
Zorotypus barberi	15	20	Once-mated females that were not inseminated	Choe 1995

Note: Estimates of infertile matings for 30 species are given. In the majority of cases, the proportion of infertility is given as the proportion of once-mated females that were not successfully inseminated or that produced only infertile eggs. In some cases, infertility is given as the rate of failures in spermatophore transfer; thus this rate can be considered the lower threshold for the extent of nonsperm representation in the species (see text). N = number of females mated or the number of matings from which the percentage of infertility is calculated.

Table A2

Overall mean and range for the mean P_2 values and their associated standard deviations obtained in each set of simulations

Number of P_2 values	Rate NSR (%)		Overall mean	Minimum	Maximum	Overall number of P_2 values
10	0	Mean	.503	.235	.690	3,000
10	0	SD	.237	.120	.358	3,000
10	10	Mean	.500	.246	.742	2,978
10	10	SD	.299*	.120	.420	2,978
10	30	Mean	.513	.209	.877	2,768
10	30	SD	.381*	.165	.472	2,768
20	0	Mean	.498	.360	.635	6,000
20	0	SD	.239	.128	.326	6,000
20	10	Mean	.499	.316	.679	5,945
20	10	SD	.303*	.211	.373	5,945
20	30	Mean	.502	.265	.742	5,501
20	30	SD	.384*	.288	.458	5,501
30	0	Mean	.495	.377	.623	9,000
30	0	SD	.236	.165	.315	9,000
30	10	Mean	.505	.358	.647	8,927
30	10	SD	.304*	.238	.366	8,927
30	30	Mean	.502	.292	.737	8,228
30	30	SD	.382*	.269	.427	8,228
100	0	Mean	.501	.421	.559	30,000
100	0	SD	.237	.203	.283	30,000
100	10	Mean	.501	.419	.597	29,681
100	10	SD	.303*	.272	.338	29,681
100	30	Mean	.503	.393	.629	27,337
100	30	SD	.384*	.343	.411	27,337

Note: The number of simulations in each combination of nonsperm representation (NSR) and sample size for P_2 values is 300. The overall number of P_2 values represents the valid number of P_2 values in each set of simulations, after extracting the cases in which the relative fertilization success for both the first male and the second male is equal to 0 (no solution for P_2).

* $P \ll .001$ for the difference between SDs obtained under NSR > 0% and those obtained under NSR = 0% (*t*-test for independent samples, df = 598 in all cases).

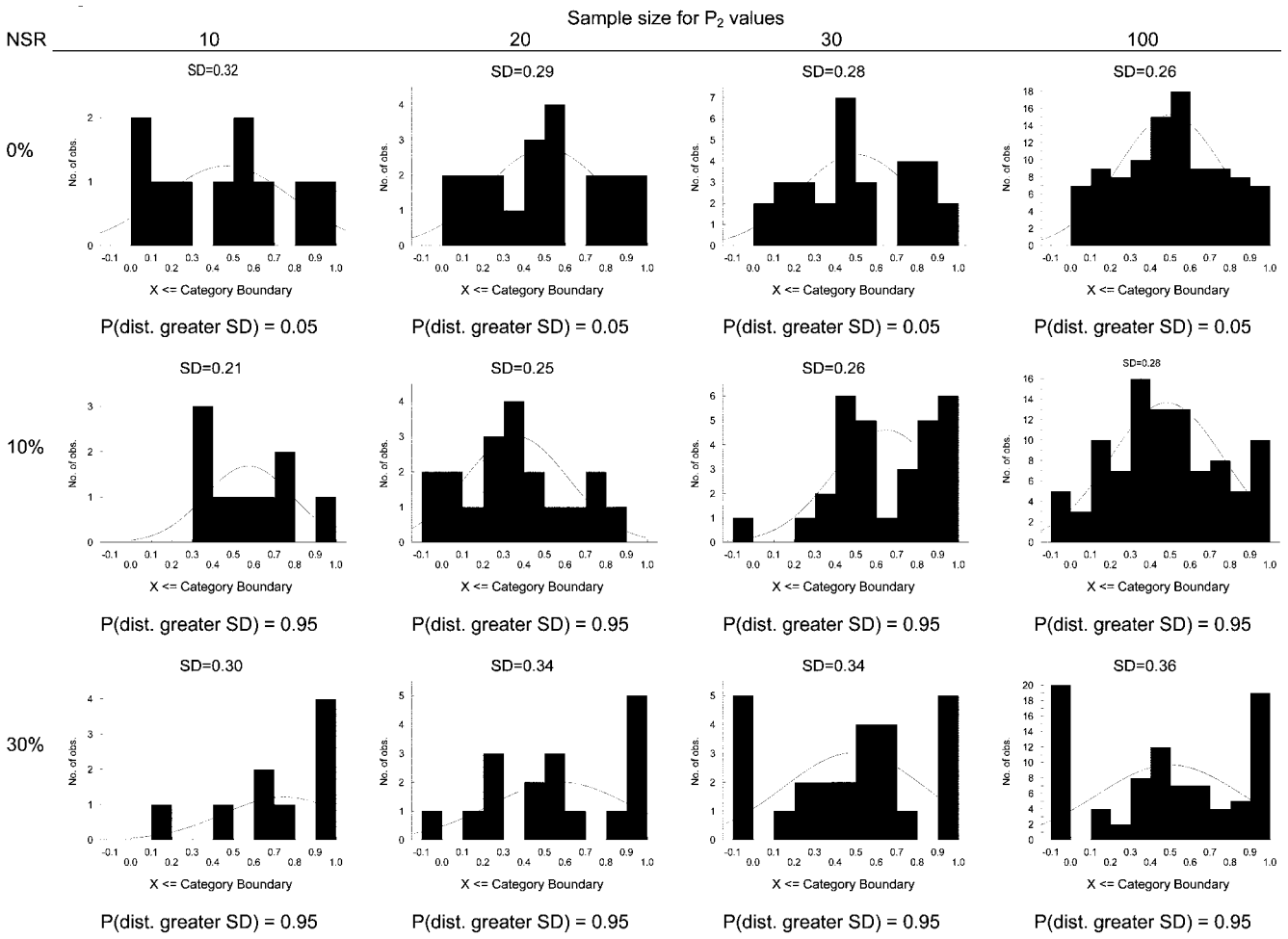

Figure A1: General assessment of the P_2 distributions under different condition of %NSR and the sample size of P_2 values (nP_2). For the cases in which NSR = 0%, it is shown that distribution with a SD beyond which the probability of obtaining a distribution with a greater SD = .05. For the cases in which NSR > 0%, it is shown that distribution with a SD beyond which the probability of obtaining a distribution with a greater SD = .95. SD is indicated for each distribution. The line indicates the normal curve.

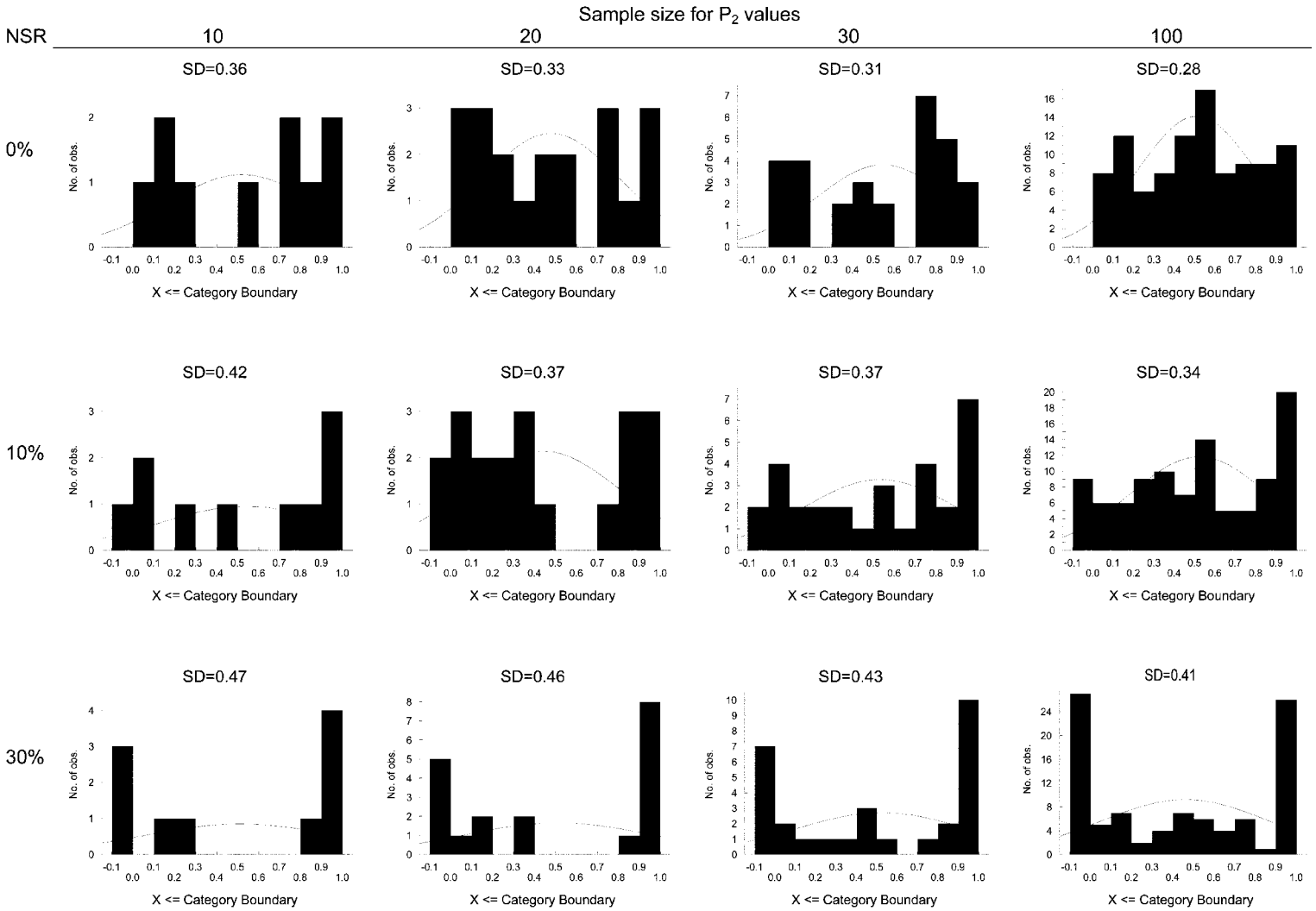

Figure A2: Distributions with the highest SD within each set of simulations. SD is indicated for each distribution. The line indicates the normal curve.