shown). Strong fluorescence in the gut lumen was detected also in larvae and in nymphs over two months old.

The soft tick *O. moubata* in the first nymphal instar has to survive long periods of starvation until it encounters a vertebrate host. My findings indicate that Vn can support tick survival without food intake for some months. This adds to the known role of yolk protein as the nutrient reserve for embryos a new role as a reserve for post-embryonic development and during starvation in the nymphal stage.

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The mating behavior of individuals of *Drosophila pseudoobscura* from New Zealand

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Summary. Recently discovered individuals in New Zealand of the North American species *Drosophila pseudoobscura* were analyzed for any divergence in mating behavior. Cultures collected from five localities in North American were mated with a stock from Rotorua, New Zealand. No significant divergence was obtained in any of the within North Americ, and more importantly, between North American and New Zealand mating experiments. Further analyses also showed no development of sterility between recently caught New Zealand and North American flies. We discuss our results in relation to others of this type.
Key words. Drosophila pseudoobscura; mating behavior; divergence; sterility.

D. pseudoobscura is distributed over large areas of the west of North America. Until recently the only other population of *D. pseudoobscura* known outside this area, was a population near Bogotá, Colombia[3]. However Parsons[4] recently reported collecting a single female of *D. pseudoobscura* from Te Kaha in the East Cape of New Zealand. Lambert and McLea[5] despite extensive trapping in this area were unable to collect any individuals of this species at the same locality. However in a systemic study of the central North Island of New Zealand these authors located eight sites, of which one near Rotorua consistently yielded *D. pseudoobscura*.

The Bogotá population of *D. pseudoobscura* has been studied extensively. Prakash[6] found no excess of homogamatic matings when conducting multiple choice experiments among the Bogotá and three mainland North American populations. First generation males obtained from crossing Bogotá females to males of mainland populations were found to be sterile. The genetic basis of the sterility has been investigated and found to be complex, involving gene interactions and maternal effects. Early electrophoretic studies[7,8] showed reduced genetic variability and a lack of unique alleles in the Bogotá population, usually with the highest frequency mainland allele being fixed. However Singh et al.[9] using four different electrophoretic conditions and heat stability tests have reported an immense increase in the genetic variability from that recorded previously. These authors also revealed undetected electrophoretic differences between the mainland and the isolated Bogotá population.

A large number of studies have examined the mating behavior of individuals of geographically distinct populations of *Drosophila*. Of these, a significant number have reported changes in the mate recognition system of individuals. However this apparent trend is not found in all species of *Drosophila*, as shown by Henderson and Lambert[10]. Using 29 worldwide populations of *D. melanogaster* in 38 multiple choice experiments these authors detected only two cases of a significant deviation from random mating despite both morphological and genetic differentiation among the populations tested. These findings are consistent with the less extensive studies of Petit et al.[11] and Cohet and David[12]. Similar results have been obtained for populations of *D. pseudoobscura*[7,13,14]. Indeed both *D. melanogaster* and *D. pseudoobscura* are interesting species because of the remarkable stability exhibited by their mate recognition system.

Materials and methods. Details of collection dates, locality and number of females trapped are provided in table 1 and the figure for all stocks of *D. pseudoobscura* used. The populations were maintained at an effective population size of about 500 until mating and sterility experiments were conducted.

Table 1. Collection details of North American and New Zealand populations of *D. pseudoobscura*

Number	Locality	Date	Number of female flies collected
1	Placer Country, California	20/12/82	18–23
2	Palomar Mountain, California	6/ 8/83	25–30
3	Cave Junction, Oregon	25/ 5/83	12
4	Vancouver Island, British Columbia	9/ 8/83	12
5	Port Coguiltlam, British Columbia	3/ 9/83	12
6	Rotorua, New Zealand	11/ 2/82	52

Table 2. Results of multiple choice experiments involving populations of *D. pseudoobscura* from North America and New Zealand

Cross	Number of experiments	♂$_1$ × ♀$_1$	♂$_1$ × ♀$_2$	♂$_2$ × ♀$_1$	♂$_2$ × ♀$_2$	Number mated	% mated	ZI ± ZE
	Controls							
1 × 1	13	37	28	36	48	149	52	1.33 ± 0.22
6 × 6	12	40	34	44	35	153	57	0.97 ± 0.16
	Within America crosses							
3 × 5	17	37	41	34	41	153	41	1.04 ± 0.17
4 × 5	18	51	40	46	40	117	45	1.05 ± 0.16
1 × 3	17	57	42	45	48	192	51	1.20 ± 0.17
	Between America and New Zealand crosses							
1 × 6	14	40	45	38	48	171	56	1.06 ± 0.16
2 × 6	17	48	37	34	41	160	43	1.25 ± 0.20
3 × 6	16	38	53	29	42	162	46	1.01 ± 0.16
4 × 6	16	40	43	50	35	168	48	0.80 ± 0.12
5 × 6	17	35	42	28	45	150	40	1.16 ± 0.19

Mating preference was tested using multiple choice experiments involving observation chambers[15]. For each experiment 11 virgin males and females of one population, plus 11 virgin males and females of a second population were introduced into the mating chamber and mating types recorded at 6-min intervals for 1 h. In order to distinguish the flies of the different populations, a small white dot was painted on the dorsal surface of the thorax with nontoxic ink. Painting was performed on lightly etherized flies at the same time as they were 'sexed'. All experiments involving any two populations were conducted between 09.00 and 12.00 h, at 25 ± 1 °C on the same day. Flies were kept separately for 4–5 days before experimentation, all flies in any one cross were of the same age. For each experiment the total number of homogamic and heterogamic matings were recorded and Levene's Joint Isolation Index (ZI)[16] was calculated according to the formula

$$ZI = \sqrt{\frac{X_{11} \cdot X_{22}}{X_{12} \cdot X_{21}}}$$

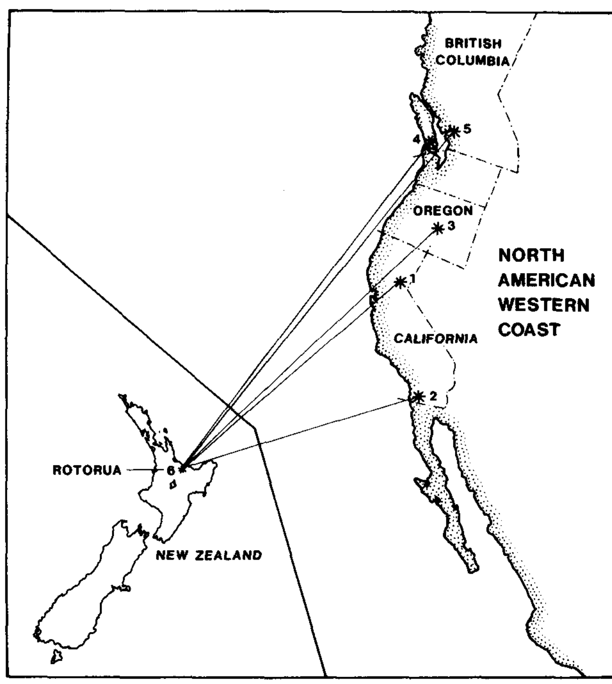
where x_{11}, x_{22}, x_{12}, and x_{21} represent, respectively, the mating between males of strain 1 and females of strain 1, males of 2 and females of 2, males of 1 and females of 2, and males of 2 and females of 1. A ZI value of 1 means random mating, a ZI value of greater than 1 means a tendency to homogamic mating and a ZI value of less than 1 represents a tendency to heterogamic mating. Goux and Anaxobeltere's[17] revised estimate of variance was also calculated.

Tests for interpopulational sterility were conducted by placing 20 4–5-day-old virgin females from the New Zealand population and 20 4–5-day-old virgin males from one of the five North American populations into a half-pint bottle with medium. After 6 h the flies were etherized, males discarded and females placed singly into vails of medium. The progeny of each female were mass mated and transferred to fresh vials to test F_1 fertility. In each case the reciprocal test was also conducted.

Results and discussion. Strains of New Zealand and North American *D. pseudoobscura* produce F_1 hybrids that are fertile (table 3). The same results were obtained for hybrids of geographic populations from within North America[13]. A notable exception is that between North American and Bogotá populations of *D. pseudoobscura*. The results of both within North America and between North America and New Zealand multiple choice experiments are reported in table 2. (Examination of the control section of table 2 illustrates that the marking of flies as previously described had no detectable effect on mating behavior of individuals.) Results from table 2 show no significant change in the mate recognition system of individuals. The behavioral results presented in this paper are consistent with the other studies involving *D. pseudoobscura*[7,13,14].

Table 3. Fertility of F_1's obtained from interpopulation crosses of North American and New Zealand *D. pseudoobscura*

Female parents	×	Male parents	$F_1 \times F_1$
2	×	6	Fertile
6	×	2	Fertile
4	×	6	Fertile
6	×	4	Fertile
3	×	6	Fertile
6	×	3	Fertile



Collection localities of population of *D. pseudoobscura* used in crossing experiments. The exact location, number of flies and date of collection are listed in table 1.

In combination with the results of this paper a total of 24 experiments attempting to measure divergence in mating behavior of individuals of *D. pseudoobscura* have now been reported. All of these except one, have resulted in nonsignificant deviation from random mating. As stated by Anderson and Erhman 'there is no apparent reason why *D. pseudoobscura* differs from most species ... in this regard'. There is however an apparent contradiction between these results and those from species such as *D. serrata*[18], *D. immigrans*[19] and *D. mojavensis*[20]. Our results may not seem surprising, however time may not be such an important factor in the divergence of mate recognition systems[21]. However it will be interesting to see if New Zealand *D. pseudoobscura* have diverged in, for example five years time. Arita and Kaneshiro[22] and Ahearn[23] have both demonstrated nonrandom mating in laboratory maintained stocks of Hawaiian *Drosophila*. These authors argue that this is the result of known population crashes in the culturing history of the flies. Powell's[21] experiment, which was designed to test Carson's[24] flush-crash model of speciation, is supporting evidence for this claim. Isofemale lines (a culture derived from a single wild caught female) have been used commonly in crossing experiments. Population crashes can also be the result of stochastic events in culturing such as parasitism by mites, poor media and microorganism growth[25]. Hence it appears possible that at least some previous experiments which reported nonrandom mating are in fact, the result of various culturing procedures. Our results reinforce previous studies indicating that the male-female communication system of some *Drosophila* species at least, shows a remarkable stability. Hypotheses for the stability of the mate recognition include, the action of strong stabilizing selection[26–29], a lack of time for divergence, a lack of directional selection and that the *structure* of the male-female communication system simply results in stability[28,29].

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Ascorbate content of foliage of eucalypts and conifers utilized by some Australian and North American mammals

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Summary. Ascorbate content of foliage of five species of Australian eucalypts and 10 species of North American conifers exhibited similar seasonal variation within the range of 100–350 mg per 100 g fresh weight.
Key words. Ascorbate; foliage; eucalypts; conifers; plant-herbivore interactions; mammalian herbivores; nutrient content.

Most mammals are able to synthesize ascorbic acid (vitamin C), but some groups such as anthropoid primates, bats and guinea pigs, have been found to lack the enzyme gulonolactone oxidase (GLO, EC 1.1.3.8) which catalyzes the final step in the biosynthetic pathway of ascorbic acid from glucuronic acid. These animals are therefore dependent on a dietary source of the vitamin, chiefly fruits and vegetables; the nutritionally available ascorbic acid of these foods is well documented. Much less is known about the wider distribution of ascorbic acid in the flowers and leaves of plants[2].

Several species of Australian arboreal marsupials subsist almost exclusively on eucalyptus foliage. Two of these, the greater glider, *Petauroides volans* (maintained on *Eucalyptus radiata*) and the ringtail possum, *Pseudocheirus peregrinus* (maintained on *E. andrewsii* and she-oak, *Casuarina torulosa*) have much higher blood levels of L-ascorbic acid than is found in most mammals[3]. On the other hand, another arboreal marsupial, the brushtail possum, *Trichosurus vulpecula*, consumes some *Eucalyptus* foliage (e.g. *E. meliodora*) as well as fruits, vegetables and flower buds but does not maintain high blood levels of ascorbate. All of these species appear to have the ability to synthesize L-ascorbic acid as evidenced by the presence of GLO in liver[4,5].

In North America one of the most obligate folivorous mammals is the red tree vole, *Aborimus longicaudus*, which subsists almost entirely on needles of Douglas fir, *Pseudotsuga menziesii*[6]. The showshoe hare, *Lepus americanus*, in some localities feeds heavily on foliage of white cedar, *Thuja occidentalis* or spruce, *Picea* spp. in winter[7]. This hare has very low levels of GLO and is unable to maintain normal levels of ascorbate in blood and tissues when fed on a diet devoid of ascorbate[8].

Our investigations of the ascorbate metabolism and economy of several of these mammals[5,8], indicated the need for data on