GENETICS OF MELANISM IN THE FANTAIL RHIPIDURA FULIGINOSA

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ABSTRACT

Melanism in the South Island Fantail is controlled by a single, dominant gene held at equilibrium by heterosis and panmictic mating at a frequency of 7%, and thereby holding the frequency of melanics at 13%.

The Fantail *Rhipidura fuliginosa* occurs in Australia, New Zealand and the Chatham Islands. Only the North Island and South Island races are reported to contain a melanistic colour phase. Table 1 shows the frequency of black and pied forms in sample counts. I am grateful to those people listed in the table who allowed me to use their data.

TABLE 1: Frequencies of melanistic and pied Fantails

Race	*Area*	*Pied*	*Black*	*Observer*
Australian				
	N.S.W. and Qld.	97	0	G. Caughley
N.I.				
	Central N.I.	80	0	C. N. Challies
	All N.I.	339	0	G. Caughley
		419	0	
S.I.				
	Canterbury high country	10	0	G. Caughley
	Coastal Canty.	35	8	L. W. Best and G. Caughley
	Fox Glacier to Haast	70	12	G. Caughley
	Haast to Arawhata	92	9	C. N. Challies
	Fiordland	91	15	R. E. Lambert and K. G. Tustin
		298	44	

black = 12.87%

Although I have seen 97 birds of the Australian race no black forms were recorded. The incidence of melanism must be low or zero.

Between us, C. N. Challies and I have counted 419 birds of the North Island race and have seen probably five times as many that were not counted. Neither of us has seen a black fantail in the North Island. However, the black form is present (Fleming 1953) and its distribution suggests that it does not comprise only immigrants from the South Island. Its frequency is almost certainly less than 0.05% and may not be much above the rate of mutation.

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The South Island samples could not be shown by Chi-square testing to be heterogeneous. The total of 342 birds have a melanistic frequency of 13%. Oliver (1955) reported a 20% frequency in Dunedin but did not record the raw frequencies required to test whether this differs significantly from the percentage reported here.

No intermediates between black and pied fantails have been reported although interbreeding and mixed broods are common. The genetic factor is therefore likely to be a single gene.

The information in Table 1 does not, of itself, reveal whether the gene for melanism is dominant or recessive, but Oliver (1955) has collected information on crossing that allows a test. His data are:

(a) of 17 broods resulting from pied x black matings, 15 were mixed, one consisted of four pied chicks and one consisted of three black chicks;

(b) the 17 crosses produced 31 black chicks and 30 pied chicks;

(c) six black x black matings each produced mixed broods; and

(d) one pied x pied mating produced one black and two pied chicks.

Oliver interpreted these data as indicating that pied is dominant over black. The fit of the data to this hypothesis will be re-examined.

From the calculated frequency of 13% melanics in the South Island we can calculate from the Hardy-Weinberg model the number of homozygotes and heterozygotes to be expected in a random sample if " pied " is dominant (Table 2).

TABLE 2: Expected frequencies of homozygotes and heterozygotes, and gene frequencies, if pied is dominant

Form	*Genes*	*% Frequency*	
homozygous pied	PP	40.9	87% pied
heterozygous pied	Pb	46.1	
homozygous black	bb	13.0	13% black
		100.0	
" pied " gene	P	63.9	
" black " gene	b	36.1	
		100.0	

We can now calculate the relative frequency of heterozygous and homozygous pied birds in the crosses reported under (a). Table 2 shows that the expected frequency of pied birds that are homozygous is 47%. The observed frequency as indicated by (a) is equal to or less than 6%.

The ratio of black to pied chicks expected from the black x pied matings is compared in Table 3 with the observed number reported under (b). The observed frequencies are at variance with expectation if pied is dominant over black.

TABLE 3: Frequencies of 61 offspring of pied x black matings to be expected if pied is dominant

Parents Pied	Black	*% Frequency of crosses*	*Offspring* Pied	Black
PP x	bb	47	28.7	0.0
Pb x	bb	53	16.15	16.15
		Expected =	44.8	16.2
		Observed =	30	31

Data under (c) is totally inconsistent with dominance of piedness. By this hypothesis no pied chick should result from a black x black mating. However, data under (d) is consistent with hypothesis.

The information presented by Oliver (1955) is, with the exception of one observation (d), completely at variance with his conclusion that pied is dominant over black. However, if the gene controlling melanism is postulated as dominant a different picture emerges. Table 4 shows the frequency of heterozygotes and homozygotes to be expected in a random sample of South Island fantails. Here the expected frequency of homozygotes amongst the black parents would be 3% as against an observed frequency (a) of equal to or less than 6%; a good agreement.

TABLE 4: Expected frequencies of homozygotes and heterozygotes, and gene frequencies, if black is dominant

Form	*Genes*	*% Frequency*	
homozygous pied	pp	87.0	87% pied
heterozygous black	pB	12.6	
homozygous black	BB	0.4	13% black
		100.0	
" pied " gene	p	93.3	
" black " gene	B	6.7	
		100.0	

Table 5 shows that the observed frequencies of black and pied offspring of black x pied crosses are also close to that expected were black dominant. The offspring of the six black x black matings reported under (c) is in agreement with expectation. The result of the pied x pied cross (d) is not.

TABLE 5: Frequency of 61 offspring of pied x black matings to be expected if black is dominant

Parents			*% Frequency of crosses*	*Offspring*	
Pied		*Black*		*Pied*	*Black*
pp	x	BB	3.0	0.0	1.8
pp	x	Bp	97.0	29.6	29.6
			Expected =	29.6	31.4
			Observed =	30	31

To sum up: the hypothesis of pied being dominant over black is grossly at variance with the data, whereas that of black being dominant provides a close fit between observed and expected. One observation — of two pied birds producing a mixed brood — is against the hypothesis that black is dominant, but also is against the weight of evidence indicating that the hypothesis is correct. I interpret this record as a misidentification of one parent.

Stead observed in 1932 that "there has not, I think, been any general alteration in the numerical proportions of Black to Pied Fantails in the South Island over the past thirty years," and there is no evidence of a change subsequent to 1932. The most likely explanation of such stability is that the frequency of the "black" gene is held steady by heterosis. The close fit of the Hardy-Weinberg equilibrium model to the observed frequency of heterozygotes deduced from (a) indicates that mating between and within colour phases is close to random.

These findings argue against Oliver's (1955) contention that melanistic and pied fantails are "semi-species," either in the sense of that term employed by Oliver or in the sense previously defined by Mayr (1940, 1942).

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