PRELIMINARY REPORT ON CHANGES IN EGG-SHELL THICKNESS IN AUSTRALIAN *FALCO* SPECIES

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ABSTRACT

A significant decrease in mean egg-shell thickness since 1945 was found in two of the six Australian *Falco*: Peregrine (*F. peregrinus*) (10%) and Hobby (*F. longipennis*) (2%). The eggs of three other species, in certain localized areas only, showed significant thinning. The six Australian *Falco* conform to the general 'rules' influencing the degree of egg-shell thinning; that is, those pertaining to diet and distribution. At least one species, the Peregrine, could be expected to be suffering localized decreases in productivity due to breakage of thin-shelled eggs.

INTRODUCTION

DDT was first used in Australia in 1942, in small amounts, by the armed services; in 1946 non-services use commenced (Australian Academy of Science 1972). Usage reached a peak in 1973 (*Table 1*), since which time it has decreased but has not remained consistently low.

Table 1: DDT use in Australia since 1966 when total use was first recorded. All DDT has been imported since early 1971, when local production ceased. Import figures from Bureau of Statistics, production figures from Australian Academy of Science (1972). (In recent years China has replaced USA as the main supplier. Other recent suppliers include Italy, Taiwan, UK and France. An unknown quantity of DDT is re-exported.)

Year commencing July 1	Total DDT kg	Year commencing July 1	Total DDT kg
1966	1,269,804	1974	728,823
1967	1,100,741	1975	8,586
1968	1,075,154	1976	228,444
1969	1,141,249	1977	727,830
1970	—	1978	995,712
1971	1,364,540	1979	869,710
1972	1,401,931	1980	65,068
1973	3,625,005	1981	354,182

Table 2: Changes in egg-shell thickness since 1945 in the six Australian *Falco*. Thickness index calculated according to Ratcliffe (1967). Number in brackets is number of eggs. *P* is the significance of the difference between the thickness before 1946 and that after 1945, determined by analysis of variance. Percentage thinning is the decrease in thickness after 1945 as a percentage of pre-1946 thickness. M = mammals; B = birds; I = insects; R = reptiles; C = carrion. Populations trends are based on limited data.

Species	Thickness index Mean ± standard error		*P*	Percentage thinning		Main diet	Main distribution	Population trends
	Before 1946	After 1945		Mean	Max.			
Black Falcon (*F. subniger*)	1.92 ± 0.02 (62)	1.92 ± 0.01 (111)	ns	0	18	MBI	inland/sub-inland	stable
Peregrine Falcon (*F. peregrinus*)	1.93 ± 0.01 (183)	1.73 ± 0.01 (344)	<0.001	10	38	B	ubiquitous	local declines?
Australian Hobby (*F. longipennis*)	1.42 ± 0.01 (94)	1.39 ± 0.01 (141)	<0.05	2	20	BI	ubiquitous	stable?
Grey Falcon (*F. hypoleucos*)	1.76 ± 0.01 (71)	1.78 ± 0.02 (23)	ns	0	14	BR?	inland	stable
Brown Falcon (*F. berigora*)	1.78 ± 0.01 (482)	1.79 ± 0.01 (346)	ns	0	22	ICBMR	ubiquitous	stable
Australian Kestrel (*F. cenchroides*)	1.26 ± 0.01 (611)	1.27 ± 0.01 (585)	ns	0	33	IMBR	ubiquitous	stable

In July 1981 the two Australian cotton-growing states ceased official recognition of the use of DDT on cotton. This eliminated about 85 percent of the officially recognized use of DDT, which is now recommended for use only in 15–18 highly specific situations. However, misuse is not unusual, and control is difficult. There are provisions for regulating the use of DDT and other chemicals in only one state and these are not yet in effect. For these reasons DDT is still a threat to Australian raptors.

EFFECTS ON *FALCO* SPECIES

As part of a continuing survey of changes in egg-shell thickness of Australian raptors, data were collected on the six *Falco* occurring in Australia (*Table 2*).

Eggs were collected, mostly in the southern half of Australia, between 1876 and 1980. They represent 49 clutches of the Black Falcon (*F. subniger*), 200 of the Peregrine (*F. peregrinus*), 78 of the Australian Hobby (*F. longipennis*), 32 of the Grey Falcon (*F. hypoleucos*), 285 of the Brown Falcon (*F. berigora*) and 266 of the Australian Kestrel (*F. cenchroides*). In nearly all cases, the complete clutch was measured.

Overall there was a significant temporal change in mean egg-shell thickness in two of the six *Falco* (*Table 2*). However, in all species except the Grey Falcon there were significant decreases in the thickness of egg-shells collected in some localized areas since 1945.

Although the eggs were collected from a number of different areas, the proportion of egg-shells of the Peregrine and Hobby which showed significant thinning increased each decade since the 1940s (percentage of eggs >15% thinner than pre-1946 mean: Peregrine 1940s 0, 1950s 14, 1960s 18, 1970s 28; Hobby 1940s 0, 1950s 2, 1960s 3, 1970s 12). Thirty-four Peregrine eggs collected during 1975–77 in the state of Victoria, during a population study, showed a mean decrease in thickness of 20.4 percent (Pruett-Jones *et al.* 1981).

The two species which occur in the more arid inland, where there is little agriculture, show the least change in egg-shell thickness. The Black Falcon, which occurs over much of Australia as a nomad in the summer and autumn, could be expected to receive greater exposure to DDT than the Grey Falcon, and this is reflected in the greater maximum thinning found in Black Falcon eggs. In a previous study (Olsen & Olsen 1979), egg-shell thinning in the Peregrine was shown, in general, to be greatest in areas where DDT use was (or could be expected to be) greatest, according to land use.

The degree of shell thinning in the six species was associated with diet, as in other raptors (e.g. Newton 1979). The bird-eating Peregrine and Hobby have suffered greater thinning than those species more dependent on mammals and insects. Moreover, of the main bird-eaters, the Peregrine and Hobby have a greater proportion of insectivorous birds in their diet than the Grey Falcon and Black Falcon, which appear to eat mainly granivorous birds.

In conclusion, egg-shell thinning in Australian *Falco* species does not appear to be widespread, although there is cause for concern in the more intensively farmed and heavily populated areas. Two species, the Peregrine in particular, and the Hobby, have suffered significant decreases in egg-shell thickness, and the proportion of their eggs showing more than 15 percent thinning has increased each decade since the 1940s. Moreover, there is some limited evidence of low productivity and reduced nest site occupancy by Peregrines in at least one state, associated with a high level of egg-shell thinning (Olsen & Olsen 1981). The situation therefore warrants further monitoring.

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