

# NATURE RED IN CLAW : HOW AND WHY STARLINGS KILL EACH OTHER

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## ABSTRACT

In a 20-year nest box study of Starlings (*Sturnus vulgaris*) in New Zealand, intraspecific fighting was the main mortality factor recorded. All fights were between birds of the same sex, 24 male-male and 22 female-female, and most were in the breeding season. Fighting increased as the population rose from about 300 birds in 1969 to over 3000 after 1978. Because of the low annual mortality rate of Starlings in New Zealand (33%), the chances of ever breeding were small for many birds. Hence conditions were ideal for a high level of fatal fighting, which took the form of grasping the opponent round the head so that the claws penetrated the brain through the eye sockets.

## INTRODUCTION

Fighting, between animals of the same species, that is severe enough to cause serious wounds is normally so rare that individual reports merit publication (e.g. Taylor 1969, Lombardo 1986). Because of the high risk to the contestants, physical combat is usually replaced by conventional threat behaviour (Wynne-Edwards 1962). Smith & Price (1973) demonstrated that a "limited war" strategy could also arise through benefits to the individual and did not depend on group selection. Most discussion has centred on the obvious reluctance with which animals equipped with efficient weapons use them in intraspecific fights, but the list of apparently weakly armed species which occasionally fight to the death continues to grow (Hik & Cooke 1988, Huntingford & Turner 1988). Fatal fighting will evolve "when the value of a contested resource is similar to or greater than the value of the future", that is, "where a major part of a contestant's lifetime reproductive success is at stake" (Enquist & Leimar 1990). In most birds and mammals reproduction extends over several years and it pays to live to fight another day; hence we were surprised to find that intraspecific fighting was the major cause of death observed in a population of Starlings (*Sturnus vulgaris*) under study since 1970.

## METHODS

The 1500 ha study area at Belmont, 15 km northeast of Wellington, New Zealand (41°10' S, 174°54' E) was described by Flux & Flux (1981). It is open hilly pasture grazed by sheep and a few cattle, with no natural nest sites for Starlings within 3 km. Before the study began, about 26 pairs of Starlings nested successfully on ledges in disused army buildings in the centre of the area, and a flock of 300 birds fed in the area. A nest-box colony was set up in the buildings with 100 boxes in 1970, and 100 more were added each year until 500 were available from 1974 to the present. After 1975, 400 pairs nested and the population rose to at least 3000 birds by 1978.

The nest boxes were 40 cm wide, 20 cm high and 15 cm deep, with an entrance hole 6 cm square in the centre (280 boxes) or towards one side (220 boxes). Starlings preferred boxes with the hole off-centre and this preference was consistent between years (Flux & Flux 1981). We inspected the boxes every second day for the first two weeks of the breeding season,

and thereafter every 2-3 days until the chicks had flown. For the rest of the year, boxes were examined at 3-month intervals to check for dead birds and to repair broken boxes. From 1980, field work was curtailed to three or four visits during the laying period and two mortality checks, in spring and autumn each year, except for 1984 when the full programme was reinstated.

Evidence of mortality was recorded incidentally during brief visits to inspect the nest box contents, and so most corpses (301) were in boxes; another 20 were on the ground nearby. Corpses which had obvious peck marks, or blood in the eyes or bill, were classified as having died fighting. Those which were of normal body weight and in good physical condition with no wounds, but in a disturbed nest, were recorded as "possibly fighting". Birds showing signs of poor health, diarrhoea, or other ailments were recorded as "unknown", and the final category, "predation", included those with large wounds caused by rats, stoats or cats. Adult Starlings are not very palatable, and predators usually ate only the brain and some breast muscle.

## RESULTS

### Annual incidence of fighting

At the start of the study few Starlings were caught fighting, but this could have been related to the smaller number of nest boxes available (for example, 5 birds fighting in 1970 in 100 boxes would be equivalent to 25 in 1974 when 500 boxes were available). Even so, however, there was a significant increase in the number of fights per 500 boxes, comparing the first five years (55) with the second five years (110) ( $\chi^2 = 8.44$ ,  $P < 0.01$ ), as shown in Table 1.

TABLE 1 — Starlings found dead in nest boxes by 5-year periods and sex. For definitions of cause of death see text. After 1980, with reduced field work, few bodies could be classified as "fighting" and the number of "unknown" increased.

Cause of Death		Period				Total
		1970-74	1975-79	1980-84	1985-89	
Fighting	♂	2	6		6	14
	♀	2	6	1	2	11
Probably fighting	♂	6	25	20	5	56
	♀	13	37	21	16	87
Unknown	♂	5	7	24	15	51
	♀	3	13	37	18	71
Predation	♂	1	2	1	1	5
	♀		22	4		26
Total		32	118	108	63	321
Fights seen	♂	8	16	2	1	27
	♀	8	20	1	1	30

In the first four years when the number of boxes was increased by 100 each year, occupancy rates were 38%, 47%, 75%, and 78%. Thereafter, with 500 boxes available, occupancy remained steady at an average of 71% (range 67 to 80%). Empty nest boxes were evidently unsuitable or unavailable for other Starlings to nest in, probably because dominant males controlled several boxes. The presence of local birds ready to breed but unable to do so was verified by an experiment on 31 October 1980, when 18 incubating females were killed; by 22 November 1980 all except one of these boxes contained eggs or newly hatched young, and from the age of the chicks at least five of the new females had laid on the seventh day after the box became available.

### **Description and definition of fights**

Starlings are aggressive birds, both to other species at a bird-table or among themselves when feeding, but the recorded descriptions of fighting, bill stabbing and "Dance-fighting" (Feare 1984) do not include the sort of fighting seen in our nest boxes. In these fights the combatants were silent, motionless except for occasional muscular contractions of the wings or feet, and almost oblivious of their surroundings. Some pairs did not disengage even when picked up and carried to the ground for banding. Attempts by a bird to grasp its opponent's bill often resulted in the symmetrical head-to-tail position shown in Figure 1, and the sharp claws seemed to enter the brain through the eye socket. Normally one bird killed the other and then escaped, but in four boxes both birds died together, all in the head-to-tail position. In the following analyses "fighting" refers to serious encounters only, and not casual squabbling or "dance-fighting".

### **Sex and age of combatants**

All 46 fights where the sex of both birds was known were male v. male (24) or female v. female (22). No fights involved more than two birds.

First-year Starlings can be distinguished from older birds by the length of sheen on the throat feathers (Flux & Flux 1981). In the 22 female fights, 15 were between adults, 3 between an adult and a first-year bird, and 4 between first-year birds. Over the whole study, only 11.5% of the nesting females ( $n = 2981$ ) were first-year birds, and so the female fights involved more first-year birds than expected ( $\chi^2 = 5.85$ ,  $P < 0.05$ ). Because the percentage of first-year birds nesting varied widely between years (1.3-22.2%) the year with most fights was analysed separately: in 1977, 13 adult females and 9 first-year birds were found fighting, significantly more first-years than expected from the ratio of adult (336) to first-years (74) nesting that year ( $\chi^2 = 5.63$ ,  $P < 0.05$ ). In the 24 fights between males, 21 were between adults, 2 between an adult and a first-year bird, and 1 between first-year males. Males were not caught for banding, and so their age ratio in the study area was not known.

### **Quality of nest box and contents**

Although all the nest boxes were of the same size, material, and colour, in similar buildings, and at the same height (4 m), those with an entrance hole towards one side were obviously preferred by Starlings (92% occupancy)



FIGURE 1 — Two adult male Starlings found dead in a nest box, 20 October 1986, with claws penetrating each other's eyes

to boxes with a central hole (65% occupancy, Flux & Flux 1981). Of the 71 fights, 54 were in boxes with a side entrance, compared with 17 in boxes with a central entrance. This was significantly different ( $\chi^2 = 5.32$ ,  $P < 0.05$ ) from the expected ratio (40:31) based on the availability of the different boxes (280 side, 220 central), showing a tendency to fight for preferred boxes. However, the trend was not significant ( $\chi^2 = 1.66$ ) if the comparison was based on the proportion of occupied boxes (46:25).

Twenty-four male fights (73%) and 19 female fights (63%) were in boxes containing nests under construction. Two male fights and seven female fights were in nests containing eggs, one fight each for males and females was in a box with halfgrown young (10 and 12 days old), and two male fights were in boxes from which young had recently fledged. Six male fights and three female fights were in empty boxes.

### Seasonal distribution of fighting

Although fighting birds were obviously more likely to be encountered during the breeding season when boxes were examined at least every three days, the seasonal distribution of deaths caused by fighting (Table 2) should be less dependent on searching effort because Starling bodies lasted for several months. Most fights took place in the breeding season (September–November), with only 3 of 25 bodies showing signs of fighting in other months. All three were males, which visit their boxes daily throughout the year; but one pair of females was found, locked together, in a nest box on 11 April 1986, and so both sexes may fight occasionally outside the breeding season.

TABLE 2 — Seasonal distribution of deaths and fights seen in Starling nest boxes

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Males found dead					1	2		1		7	3		14
Females found dead										10	1		11
Two males fighting										13	6	1	20
One male and one unidentified fighting										7			7
Two females fighting				1						11	13		25
One female and one unidentified fighting										3	2		5

To examine the distribution of fighting within the breeding season in more detail, we grouped data from all years by 5-day periods, starting from the median first-egg laying date for each year. This is necessary to allow for differences in the start of laying between years, which may be as much as 22 days (Flux 1987). Within years, however, laying is remarkably synchronised, with almost all first clutches starting within 7 days of the median date. Figure 2 shows that males start fighting over boxes earlier than females do, and they continue longer (goodness of fit test, grouped data,  $\chi^2 = 8.07$ ,  $P < 0.05$ ). This agrees with the annual pattern of Table 2, but males were not more aggressive than females overall because the total

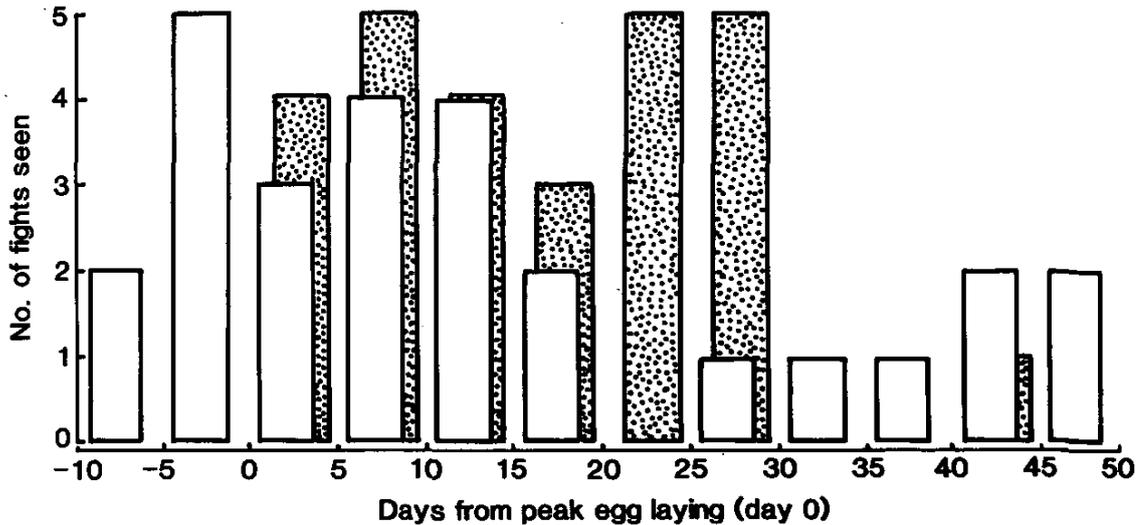


FIGURE 2 — Dates of 27 fights between males (blank columns) and 27 fights between females (shaded) in relation to the peak first egg laying date, combined data, 1970-1984

numbers of fights between males (35) and between females (38) were similar. The intensity of fights could be assessed by the chance of catching both birds locked together, or only one – again there was no significant difference between sexes (22 pairs, 13 single, males; 22 pairs, 16 single, females).

### Significance of mortality by fighting

Intraspecific fighting appears to be the commonest mortality factor of breeding birds in this Starling population, with 25 definite deaths and 143 probably deaths (Table 1). Although some of the “probably fighting” category may have died of other causes, some of the “unknown” category could have died in fights or from wounds or infection after a fight. The 31 birds that died of predation were mostly killed by stoats (*Mustela erminea*), which learned to climb to the boxes in 1976, killing 22 adult Starlings (mostly females on eggs) between 1976 and 1980. Three other Starlings were killed by feral cats (*Felis catus*).

Over the whole study an average of 16 bodies per year was found, while the average nesting population of 296 pairs, at 33% annual mortality, should have produced 195 bodies each year, or at least 49 during the 3-month nesting season. Hence most mortality went undetected, and the importance of fighting in population control could not be assessed. Factors killing birds which were not found are unlikely to be the same as for birds in boxes.

## DISCUSSION

The earliest record of serious fighting among Starlings in New Zealand seems to be by Hornby School (1946); in a nest box “two cock birds were seen to be fighting so fiercely that they were easily caught in one handful. Even then they fought each other if allowed”. Also in New Zealand, Coleman (1974) recorded one male-male and three female-female fights in nest boxes, and one participant died. Kessel (1957), at Ithaca, New York, found that “fights with intruding males become quite violent. Several times fighting pairs have been seen to fall to the ground, gripping each other strongly and

pecking savagely ... even when handled they will not always loosen their grip". Many of our fighters behaved similarly and tried to re-engage when separated instead of flying away. It is also significant that all recorded fights have been between birds of the same sex. Presumably a partner gains if its mate is replaced by a stronger bird, and so it does not pay in evolutionary terms to defend a weak mate.

Although casual fighting is normal in Starlings overseas (Feare 1984), serious fights seem commoner in our population than elsewhere. Some serious fighting may have been overlooked, even in a species as widely studied as the Starling, because recording aggression is not the main purpose of nest box studies. Thus, in New Jersey, Romagnano *et al.* (1986), describing suspected infanticide, incidentally recorded: "similar peck marks have been found around the head and neck of dead adults ( $n = 8$  pairs), suggesting that bill stabbing is not uncommon." On the same study area Stouffer *et al.* (1988) found that "female starlings fighting in nest boxes ( $n = 4$  fights in 1986) ... are not unusual events". In Britain, Evans (1988) recorded that "fights between two females at a nestbox (and between two males) were also observed at a few nests."

The number and intensity of fights are likely to vary with the shortage of nest boxes. In Belgium, where "nest boxes were not a limited resource" (Pinxten *et al.* 1989), "the competition between males for nest boxes was mainly one of primacy of occupation and not of physical struggle." At Belmont our population of over 3000 Starlings was clearly limited by the 500 boxes available, and the chances of getting a box were made worse by the low annual mortality in New Zealand of 33% compared with 50-70% overseas (Flux & Flux 1981). Hence conditions were ideal for the expression of fatal fighting: "When the value of the future is close to zero contestants will never give up after starting to fight; such fights will always be fatal for at least one of the opponents" (Enquist & Leimar 1990).

The Starling's ultimate weapon is the head grip (Figure 1), which has not been adequately described in any species to our knowledge, although it has been recorded for Bellbirds (*Anthornis melanura*) by Taylor (1969) and a photograph of a heron applying it illustrates an article by Huntingford & Turner (1988). If, as we believe, the 143 deaths of apparently healthy birds were caused by this grip, in addition to the 25 definite deaths, intraspecific fighting becomes the main mortality factor observed in our study area. It may be found to be more widespread in Starling populations elsewhere and in other birds facing severe competition once the symptoms are recognised.

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#### LITERATURE CITED

- COLEMAN, J.D. 1974. The use of artificial sites erected for Starlings in Canterbury, New Zealand. *NZ J. Zool.* 1: 349-354.
- ENQUIST, M.; LEIMAR, O. 1990. The evolution of fatal fighting. *Anim. Behav.* 39: 1-9.
- EVANS, P.G.H. 1988. Intraspecific nest parasitism in the European Starling *Sturnus vulgaris*. *Anim. Behav.* 36: 1282-1294.
- FEARE, C. 1984. *The Starling*. Oxford University Press. 315 pp.

- FLUX, J.E.C. 1987. Drift in laying dates of Starlings *Sturnus vulgaris*. *Ornis Scand.* 18: 146-148.
- FLUX, J.E.C.; FLUX, M.M. 1981. Population dynamics and age structure of Starlings (*Sturnus vulgaris*) in New Zealand. *NZ J. Ecol.* 4: 65-72.
- HIK, D.S.; COOKE, F. 1988. A possible case of intraspecific killing in the Lesser Snow Goose. *Wilson Bull.* 100: 665-666.
- HORNBY SCHOOL. 1946. Breeding habits of Starlings. *N.Z. Bird Notes* 2: 8-10.
- HUNTINGFORD, F.; TURNER, A. 1988. Aggression: a biological imperative? *New Scientist* 4 August 1988: 44-47.
- KESSEL, B. 1957. A study of the breeding biology of the European Starling (*Sturnus vulgaris* L.) in North America. *Am. Midl. Nat.* 58: 257-331.
- LOMBARDO, M.P. 1986. A possible case of adult intraspecific killing in the Tree Swallow. *Condor* 88: 112.
- PINXTEN, R.; EENS, M.; VERHEYEN, R.F. 1989. Polygyny in the European Starling. *Behaviour* 111: 1-4.
- ROMAGNANO, L.; LOMBARDO, M.P.; STOUFFER, P.C.; POWER, H.W. 1986. Suspected infanticide in the Starling. *Condor* 88: 530-531.
- SMITH, J.M.; PRICE, G.R. 1973. The logic of animal conflict. *Nature* 246: 15-18.
- STOUFFER, P.C.; ROMAGNANO, L.C.; LOMBARDO, M.P.; HOFFENBERG, A.S.; POWER, H.W. 1988. A case of communal nesting in the European Starling. *Condor* 90: 241-245.
- TAYLOR, R.H. 1969. Male Bellbirds locked in combat. *Notornis* 15: 63.
- WYNNE-EDWARDS, V.C. 1962. *Animal dispersion in relation to social behaviour*. Oliver and Boyd, Edinburgh and London. 653 pp.

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