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TIMING AND SUCCESS OF BREEDING IN SUBTROPICAL MASKED LAPWINGS

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The breeding activities of Masked Lapwings *Vanellus miles* were studied over two breeding seasons in a subtropical location near Brisbane, Queensland. Breeding parameters including timing, hatching and fledging success are presented. Although most pairs commenced breeding in May-June, renesting following high rates of nest failure (probably due to predation) continued over several months. Clutch size was very similar (3.5±0.7 and 3.6±0.6) while fledging success was 1.4±1.1 per pair and 0.3±0.4 per pair for the two years respectively. Rates of renesting were high with 80% of pairs in 1989 laying replacement clutches and three of eight pairs laying three clutches.

INTRODUCTION

Comparisons of species that are taxonomically close or ecologically similar yet occur in very different locations raise many questions about the evolution of differences in breeding parameters (e.g. Yom-Tov 1987; Woinarski 1989). A less ambitious yet potentially informative approach involves comparing populations of single species with very broad distributions.

In this context, the Masked Lapwing *Vanellus miles* is worthy of attention (Giese 1990). It is widespread throughout the continent and also occurs beyond Australia from equatorial regions to subantarctic islands (Blakers *et al.* 1984). The species has been fairly well studied on the Australian mainland (Allan 1967; Dann 1981), in Tasmania (Thomas 1969) as well as in both the South (Barlow *et al.* 1972) and North Islands (Moffat 1981 in Marchant and Higgins 1993) of New Zealand. All of these studies provide detailed information on the breeding biology for temperate areas of Australasia. This paper presents data on a two year study of the breeding biology of the Masked Lapwing in the subtropics.

METHODS

Study Species

The Masked Lapwing is a relatively large (30–37 cm in length, 230–400 g), sexually monomorphic plover, distributed throughout Australia, New Zealand, southern New Guinea and on many surrounding islands. Its distribution continues to expand (Blakers *et al.* 1984). The species inhabits a wide variety of open habitats and has been greatly favoured by the clearing of forests. It is apparently tolerant of much human development and is particularly common in pastures and grassed areas near watercourses and wetlands.

Masked Lapwings are solitary breeders with long but variable periods of breeding activity that are probably influenced by local climatic conditions (Favaloro 1944; Thomas 1969). In south-eastern Queensland, the main breeding season is July to December (Marchant and Higgins 1993). Eggs are incubated for 27–28 days, young fledge between 35 and 42 days (Thomas 1969) and pairs may breed successfully several times each year. Clutch replacement is common and can occur quickly after egg loss (Jones and Giese in press).

Study Site

The study was conducted at the University of Queensland Veterinary Research Farm at Pinjarra Hills, 12 km west of Brisbane (Fig. 1). Most of the site has been cleared of its original open forest for agricultural production. The dominant vegetation types are broad-scale improved pastures fringed with remnants of native eucalypt and casuarina forest. The site abuts the Brisbane River, and is also interspersed with numerous freshwater impoundments, intermittent watercourses and several broad marshes.

The climate is typically subtropical maritime with humid warm to hot summers and mild winters. During the breeding season, average daily temperatures range from 19°C to 25°C although maxima in the mid-30°Cs are common. Most of the annual rainfall (average total 1 200 mm) occurs between November and April.

Data collection and analysis

The study was carried out over two consecutive breeding seasons in 1989 and 1990. The breeding activities of Masked

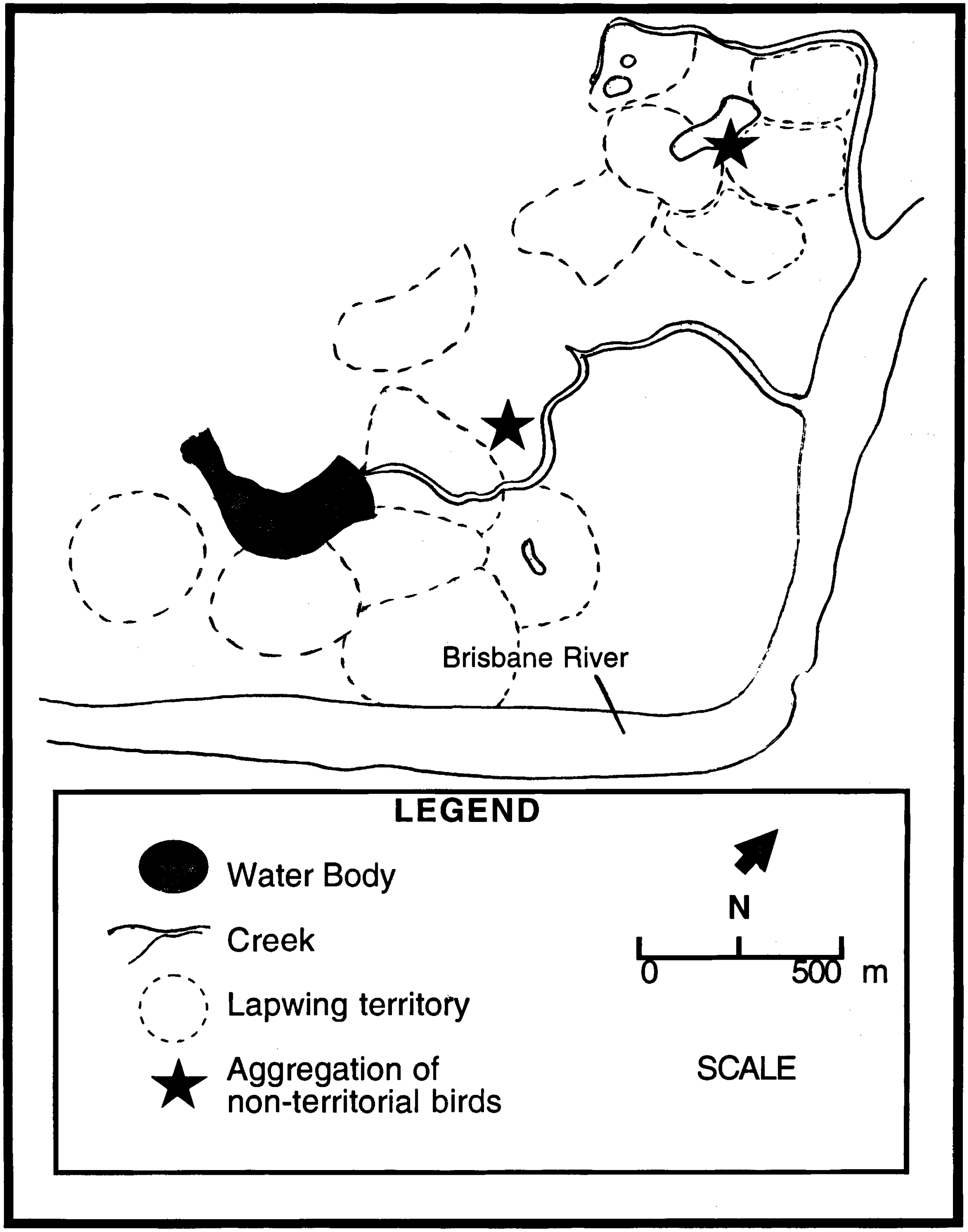


Figure 1. *Pinjarra Hills study site showing general boundaries of all Masked Lapwing territories during 1990.*

Lapwings were investigated by making very detailed observations of some pairs ('focal pairs': eight in 1989 and seven in 1990) and, in 1990, making less intensive observations of eight other pairs ('additional pairs'). This 1990 sample of 15 pairs represents roughly 80% of the Masked Lapwing population of the study site (which covered an area of 270 ha). Observations were carried out on 1–3 full days per week from May to December in both 1989 and December 1990. A vehicle was used as a mobile hide and usually allowed the observer to be not less than 70–100 m from the birds.

Pairs were identified primarily by their consistent presence on territories. No territorial pairs were ever seen to move into the territory of another pair during the day. No assumptions about the identity of a pair occupying a particular territory were made until both individuals had been detected and observed within their territory for a extended period on five separate occasions. The consistent use of territories by single pairs was confirmed by observations of four marked individuals (see below). This and other lapwing species typically show marked site fidelity throughout the breeding season (e.g. Allan 1953; Bourke 1953; Walters 1982). Territory size was determined by plotting all observed locations of pairs on a grided map of the site and estimating the area of the minimum convex polygon obtained.

In order to improve the reliability of individual identifications, an attempt was made to capture and mark all breeding birds. Two trap types were used: the funnel-trap described by D'Andria (1965) and a wire-mesh drop-trap of our own design. Both were dependant upon capturing birds at the nest as they returned to brood eggs. Although four birds were eventually caught and marked (using coloured leg-bands), further trapping was abandoned because of the probable relationship between trapping attempts and observed nest failure.

Means are presented with Standard Errors throughout.

RESULTS AND DISCUSSION

Breeding territories

Breeding pairs of Masked Lapwings occupied large, all-purpose (i.e. providing all feeding and breeding resources required, although some pairs did need to fly some distance to obtain water) territories fairly evenly distributed over much of the pasture land of the study site (Fig. 1). Pairs appeared to be resident on their territories, though not necessarily territorial, for most of the year. During the non-breeding period (January to May) there was some evidence that pairs and numerous unpaired birds aggregated at favoured foraging sites. However, paired birds did not mix freely with this larger group.

The mean size of territories was 20±8 ha (n = 15) and the range in size was highly variable (10 ha to 36 ha). Although most territories contained or adjoined waterbodies, this did not appear to be a critical feature of a territory as relatively little of the birds activities were conducted close to the waterbodies (unpubl. data). The geographical arrangement of territories at the site allowed most pairs to remain out of sight of neighbouring pairs. Boundaries appeared to coincide with naturally occurring features such as crests, changes in slope or wooded areas. Pairs moved and foraged around the central portions of their territories for most of the day and spent relatively little time near the waterbody. Pairs did not patrol their territory boundary on any discernibly regular basis but did fly directly to territorial boundaries when expelling or confronting trespassing conspecifics. Breeding pairs virtually never left their territories except on very rare occasions to drink from open water.

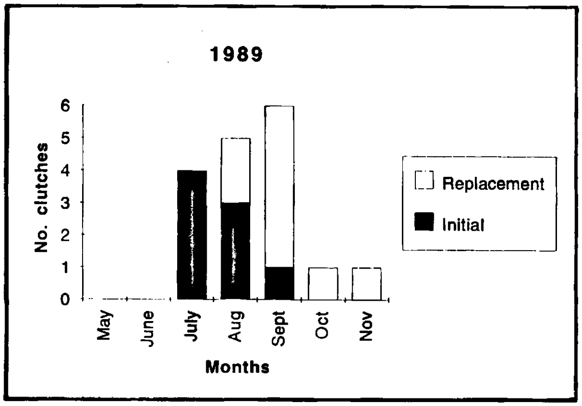
The study site contained two locations where nonbreeding birds (mainly the young of the year but also some presumably unsuccessful breeding pairs) aggregated, away from the mosaic of occupied territories (Fig. 1). Both of these locations were relatively close to permanent waterbodies. Aggregations often numbered 10–20 individuals but there was no evidence here of the large winter aggregations (often numbering 50 birds and more) common in more southerly latitudes (Favaloro 1944; Thomas 1969). As has been found elsewhere, paired birds tended to remain on their territories for most of the year (Barlow *et al.* 1972). This contrasts with findings from Tasmania (Thomas 1969) and northern New Zealand (Moffat 1981 in Marchant and Higgins 1993) where relatively few pairs remain, the majority joining large locally nomadic flocks.

The range of territory sizes found in this study conforms generally to the few data available from New Zealand (14.5 ha, Barlow *et al.* 1972; range 1.5–15.6 ha, Marchant and Higgins 1993). Unfortunately no comparable data are available for Australia.

Timing of breeding

The breeding season (defined as the range of months during which clutches were initiated) of the Masked Lapwing in the Brisbane area was from May to December in both years. The timing of breeding was similar across the study population, with the first evidence of nesting (usually nest building or eggs) being found in May but the majority of pairs incubating by July in 1989 and August 1990 (Fig. 2). The high incidence of nest failure and subsequent renesting resulted in highly asynchronous nesting throughout the rest of the breeding season.

The breeding seasons reported here correspond generally with those observed in southern Australia (Thomas 1969; Dann 1981) and New Zealand (Falla *et al.* 1978). Dann (1981) found that the availability of potential foods for fledglings (measured as invertebrate biomass) correlated well with the primary fledgling production in Victoria. However, given the high rates of nest failure and the subsequent extended period over which breeding may occur, this relationship must be regarded as being of limited predictive power. Moreover, in the tropics, eggs may be found at any time of the year, indicating a highly flexible reproductive capacity (see Marchant and Higgins 1993).



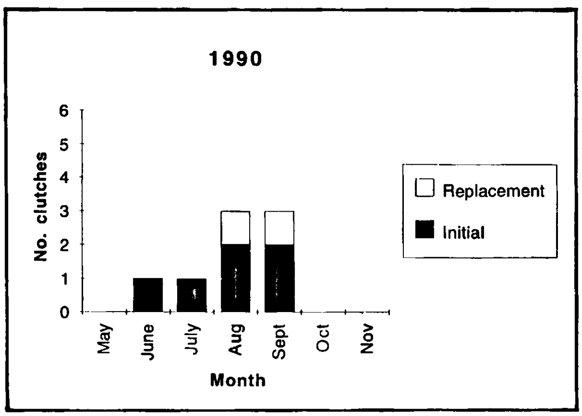


Figure 2. *Numbers of initial and replacement clutches of Masked Lapwings during the 1989 and 1990 breeding seasons.*

Nests

All nests (n = 29) detected were located in short to medium length (less than about 5 cm) pasture, the predominant habitat of the study site. Most of the site carried moderate densities of grazing animals (cattle and horses) and areas of longer grass were scarce. Although the site contained extensive waterside habitats, including small marshes and long mud flats along the edges of water bodies, no nests were placed in such locations and only one was found within 50 m of a waterbody. This contrasts with Barlow *et al.* (1972) who found more than two thirds of nests in southern New Zealand to be within 45 m of water.

Clutch size and breeding success

During the 1989 and 1990 breeding seasons, the focal pairs produced 19 (n = 8 pairs) and 10 (n = 7 pairs) clutches respectively. There were no significant differences between years for any of the breeding parameters compared. The mean clutch size was 3.1±0.9 (n = 27, two clutches disappearing before eggs were counted). Hatching and fledging success (calculated as the number of young per pair per season) was 1.6±1.7 and 1.4±1.2 respectively. This represented a mean percentage success rate of 27.5±28.1% hatching and 11.8±16.1% fledging per pair per season. In 1989 only one of the eight pairs successfully hatched all eggs laid and all other pairs lost some eggs. In 1990 only two pairs (out of seven) successfully hatched any eggs. For both years the highest fledging success for a pair was 50%, with eight pairs failing completely. No replacement nests were produced after November in either year.

Published hatching and fledging rates vary greatly in definitions used and sample sizes but three studies provide comparable data (using the percentage of eggs producing hatchlings or fledglings for pairs per season in each case). For Victoria, Dann (1981) reports a 45% hatching success and 9% fledging success; from New Zealand, comparable data from the South Island were 74% and 47% (Barlow *et al.* 1972), and 74% and 25% for the North Island (Moffat in Marchant and Higgins 1993), respectively.

The high rates of hatching and fledging failure reported here were due to losses of both eggs and chicks, almost certainly by predation (see below).

The contrasting data for the two years, however, are due to the different extent of renesting detected between the years (Table 1). In 1989, renesting was relatively high, with the mean number of clutches produced being 2.4 with an average of 6.5 eggs per pair per season. All focal pairs in 1989 produced at least two clutches and three produced three clutches. In 1990 three of the seven pairs produced replacement clutches (the mean number of clutches was 1.3). In both years renesting followed nest failure in almost all pairs; two pairs renested after successfully fledging young from an earlier clutch.

This high rate of renesting led to a peak of incubation in September for 1989 with 83% of nesting pairs incubating replacement clutches. No similar pattern was evident in 1990, apparently due to lower rate of renesting. It is possible that earlier nesting in 1990 may have been overlooked (despite intensive searches for nesting birds), and that the data presented for 1990 represents mainly replacement clutches. However, as the commencement of intensive observations relied upon detection the first nests during routine field checks of the entire site during May and early June, it is unlikely that more than a few nests were overlooked.

The exact causes of nest failure or clutch loss could not be verified during this study. The two most likely causes were predation or trampling by cattle. Predation was the most likely cause in most cases as trampling is evidenced by crushed eggs in the nest site (see below). In this study, shells and egg contents were found in only one of the nests from which eggs had disappeared; in all others, there was no evidence of eggs at all. The most likely egg predators present in the area were mainly either nocturnal mammals (Foxes *Vulpes vulpes* being the most common, pers. obs.) or diurnal reptiles (Lace Monitor *Varanus varius*) or birds (both Pied Butcherbirds *Cracticus nigrogularis* and Torresian Crows *Corvus orru* were

TABLE 1

Hatching and fledging success of focal pairs of Masked Lapwings at Pinjarra Hills for 1989 and 1990 breeding seasons. (Hatching and fledging success calculated as the number of chicks hatched or fledged per pair. The percentage of the total number of eggs laid is given in parenthases).

Pair No.	No. clutches per pair	Total eggs per pair (clutch sizes)	Hatching success (%)	Fledging success (%)
		1989		
1	3	12 (4,4,4)	4 (33)	3 (25)
2	3	8 (2,2,4)	4 (50)	3 (37)
3	2	2 (2,2)	0	0
4	3	9 (3,3,3)	3 (33)	0
5	2	2 (1,1)	0	0
6	2	4 (?,4)	4 (100)	2 (50)
7	2	7 (4,3)	2 (28)	1 (14)
8	2	6 (4,2)	2 (33)	2 (33)
Total	19	52	34	20
Mean	2.4±0.5	6.5±3.0 (3.5±0.7)	2.4±1.6	1.4±1.1
		1990		
1	2	7 (3,4)	2 (29)	1 (14)
2	1	4 (4)	0	0
3	2	7 (4,3)	4 (57)	1 (14)
4	1	3 (3)	0	0
5	1	3 (3)	0	0
6	1	1 (4)	0	0
7	2	4 (?,4)	0	0
Total	10	32	12	4
Mean	1.4±0.5	4.6±1.7 (3.6±0.4)	0.8±1.4	0.3±0.4

common on the site). Corvids, especially, are known to predate ground nests (Thomas 1969). Additional potential egg predators on the site, free ranging domestic dogs *Canis familiaris* and cats *Felis cattus*.

Human disturbance may also have been implicated in egg loss by predators. Increased predation following the presence of humans at nests has become a serious concern among researchers despite concerted attempts to minimize disturbance (Dawkins and Gosling 1991). Adult Masked Lapwings were easily disturbed and often remained away from the nest for extended periods (often more than one hour) following such disturbance. Only once were egg shells found in the nest, indicating trampling by cattle. In contrast to Thomas (1969), however, stock-related disturbance in the present study was not simply accidental but may have been related to the animal's investigation of the nest traps. Similarly, Pied Butcherbirds (tamed during an independent study) often investigated newly erected nest traps. Although nest loss due to cattle or butcherbirds was never directly observed, nest traps probably advertised the otherwise discrete location of Masked Lapwing nests. As a result, the use of nest traps was discontinued.

Two further nests were abandoned after earthworks were carried out within 40 m of the nest. Thomas (1969) also reported nest abandonment following nearby earthworks. In contrast, Masked Lapwings show surprising resilience to familiar activities, frequently nesting very close to pedestrian thoroughfares or even heavy traffic (Favaloro 1944; Thomas 1969).

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