SHORT COMMUNICATIONS

DIFFERENCE IN SIZE OF EMUS ON TWO CONTRASTING DIETS ON THE RIVERINE PLAIN OF NEW SOUTH WALES

Saltbush steppe or low shrubland in the western part of the riverine plain of New South Wales is represented by the *Atriplex vesicaria* Hew. ex Benth. (Bladder Saltbush) alliance (Leigh and Noble 1972). After sustained overgrazing this may degenerate to a disclimax state dominated by unpalatable 'increaser' shrubs such as *Nitraria billardieri* DC (Dillon or Nitrebush) (Beadle 1948; Moore 1959). As part of a broader study into the biology and autecology of *Nitraria* in Australia, the relation between this species and the Emu *Dromaius novaehollandiae* was studied on two properties on the riverine plain.

The two properties where Emus were sampled were Barratta and Bali Hai. The former is in country dominated by typical low shrubland (*A. vesicaria* and *Kochia aphylla* R. Br. (Cottonbush) and *N. billardieri*) about fifty-six kilometres west of Deniliquin on the Moulamein–Deniliquin Road. Bali Hai, fifty kilometres north-east of Deniliquin on the Conargo–Jerilderie Road, is in the south-eastern part of the riverine plain where rainfall is higher, where *Nitraria* occurs rarely and where dryland cereals are grown on light-textured soils in most years. During the sampling period Emus on Bali Hai were usually found feeding on a low-yielding wheat crop, which remained unharvested owing to drought.

Emus on the riverine plain characteristically congregate into flocks while feeding on the ripening fruit of *Nitraria* and on wheat. This behaviour has been well documented with Emus in Western Australia (Davies 1963, 1967; Long 1959, 1965).

Emus like the fruit of *Nitraria*, which is a small drupe (up to 11 mm long x 5 mm wide), initially green but purplish red to black or yellow when fully ripe. The outer pericarp encloses the stone or putamen, which tapers to a point with small round depressions or pits at the opposite end. The fruit normally ripens on the riverine plain from December until late March and during this period Emus may congregate in large flocks (up to eighty) in communities dominated by fruiting *Nitraria*. During the fruiting period of December 1972 and January 1973, fruit and seed of *Nitraria* composed 91–96 per cent of the contents of the bird's crop and proventriculus

TABLE I

Diet of Emus (% dry weight contents of crop and proventriculus)

	Barratta Dec.	Jan.	Feb.
Nitraria fruit (Seed + pericarp ± S.E.)	96.4 ± 1.5	94.8 ± 1.3	58.6 ± 20.5
Nitraria leaf	—	0.1	—
Atriplex vesicaria	2.1	3.2	—
Angianthus strictus	—	0.1	—
Medicago spp.	—	—	0.1
Medic Burr	0.1	0.1	2.1
Rhagodia nutans	—	0.1	1.6
Bulbinopsis bulbosa	—	—	2.1
Atriplex lindleyi	—	—	0.7
Solanum esuriale	—	—	24.2
Insects	0.1	—	1.8
Stones	—	—	3.1
Other	0.6	1.7	5.6
	Bali Hai Dec.	Jan.	Mean (± S.E.)
Wheat grain	15.2	16.8	16.2 ± 7.0
Wheat rachis	2.0	5.8	4.4 ± 2.0
Stones	46.2	52.3	50.1 ± 8.0
Charcoal	7.4	15.5	12.6 ± 4.2
Other	29.2	9.6	16.5 ± 4.0

TABLE II

Internal separation of loads of *Nitraria* seed

	Crop and Proventriculus		Gizzard		Intestine		Total	
	No.	Wt(g)	No.	Wt	No.	Wt	No.	Wt
Emu								
December	854	87.9	3008	173.4	247	11.2	4109	272.5
January	2011	102.1	3277	169.0	1674	93.1	6962	364.2
February	294	11.0	975	39.1	58	1.9	1327	52.0
	Stomach		Intestine		Total			
	No.	Wt(g)	No.	Wt	No.	Wt		
Kangaroo	1134	142.3	333	15.8	1467	158.1		

as shown in Table I. The separation of *Nitraria* seed in different parts of the digestive tract of the Emu, together with similar separation in the gut of a kangaroo, are given in Table II. Single faecal deposits of Emus collected over this and previous fruiting periods carried up to 1,350 *Nitraria* seeds. Most of this seed was undamaged despite its passage through the bird and, in fact, it germinated better than a normal sample of seed. Experiments in 1972 with seed ingested by Emus demonstrated that an average of 62 per cent had germinated after twenty-four days compared with only 6 per cent for *Nitraria* seed collected by hand directly from the bush (Noble 1974).

Median measurements of Emus sampled on both properties during the period from December 1972 to March 1973 are shown in Table III. Whereas Davies (1967) used the Sign test on data from pairs of Emus, this analysis cannot be used on flocks. Instead another nonparametric test, the Wilcoxon Rank Test (Siegel 1956), was used. Measurements similar to those of Davies (1967) were made except that the number of ossicles in the tracheal aperture was also counted. This is the slit-like opening through which the Emu blows air into a neck-sac causing it to inflate and resonate, producing the characteristic drumming sound. This was measured because it could be a useful parameter in distinguishing populations of Emus (S. J. J. F. Davies, pers. comm.). Data on length of bill were omitted because of inconsistencies in measurement.

TABLE III

Median measurements of Emus sampled on two properties on the riverine plain (December 1972 to March 1973)

	Bali Hai (N = 11)	Barratta (N = 14)
Weight (kg)	41.3	35.8*
Tarsus (mm)	450	433
Wing (mm)	205	200
Toe (mm)	170	168
Wing Hook (mm)	20	20
Number of ossicles (tracheal aperture)	8	6.5

* Significant at the 5% level, i.e. the probability that the difference between samples from the two sites arising only by chance, is less than 0.05. The rest are not significant (Wilcoxon Rank Test).

The data in Table III for males and females together are pooled because statistical analysis showed that differences between sexes were not significant although median measurements of females were generally greater than those of males. Because samples were obtained from flocks, not pairs, it was difficult to confirm the sexual dimorphism reported by Davies (1967).

Differences between sites were significant ($P < 0.05$) for only one variable, viz weight. The heavier weights at Bali Hai were attributed to the high energy of the diet available to the birds feeding off the wheat crop. At this site, wheat composed approximately 20–25 per cent of the oven-dried content of the crop and proventriculus in December and January and considerable adipose tissue was found on dissection. Although there appeared to be a marked difference in number of ossicles between sites, this proved to be not significant.

On the basis of the grazing patterns observed on the riverine plain, the Emu may be classed as an apostatic generalist feeder (Harper 1969) or feeder that concentrates on the source of food in greatest supply, leaving this when supply becomes limiting. According to Harper this feeding pattern, because it penalizes species of plants occurring abundantly and favours those in minority, is frequency-dependent and may stabilize mixtures of species. The reverse appeared to apply in this study and evidently Emus disperse large quantities of *Nitraria* seed, which germinates readily. *Nitraria* in such a community may increase provided there are appropriate 'safe sites' in which the seedlings can establish themselves. Such niches occur with a reduction in competitive pressure from the original saltbush following over-grazing providing that competition from annual species (e.g. medics) is not excessive.

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MIGRATION OF PALAEARCTIC WADERS IN WALLACEA

Wallacea is used in this paper as a convenient term to designate a geographical area, the Indonesian islands lying between the Sunda and the Sahul continental shelves (Darlington 1957; White 1973). Because it is situated directly north of western and north-western Australia, Palaearctic migrant waders that winter in Australia must be expected to occur there as passage migrants. How far they also winter there is undocumented; for there have been no field studies of migrant waders in these islands.

Thomas (1970) considered that only a small part of the waders breeding in the eastern Palaearctic winters as far south as Australia. He also questioned the likelihood that they winter in large numbers in the Malayan Archipelago, stating 'Marchant (*in litt.*) has pointed out that in New Guinea and Indonesia extensive wader grounds for wintering birds are probably few or lacking' because estuaries and swamps are environmentally unsuitable, and beaches narrow and rocky or sandy.

Some light can be thrown on these questions by analysing the much scattered literature on birds in Wallacea, which largely consists of papers listing collections of birds from various localities, usually with details of the number of specimens of each species and the dates of collecting. An extensive but by no means exhaustive examination of this literature has yielded data for nearly 800 specimens. Because most collectors of birds in Wallacea were primarily concerned with obtaining specimens of the indigenous species, though no doubt many of them tried to make their collections as comprehensive as possible, there is little reason to suppose that any of them were biased towards collecting migrant waders. In the following list the numbers of specimens obtained and months of collecting are given. If the number of specimens was not stated it has been scored as one only, so that the totals are the minimum of actual specimens. Islands are not named unless they call for comment.

Because my data seem to substantiate the notion that Wallacea is not a major wintering ground for the waders of the eastern Palaearctic the problem of their destination remains. A long south-western migration as far as Africa appears unlikely because most of the species peculiar to the eastern Palaearctic are unknown in Africa; a few have been only rarely recorded. Thomas's suggestion of a major wintering area in north-western Australia has still to be investigated. Perhaps the bulk of the eastern Palaearctic waders are accommodated in southern Asia north of the equator. A fourth possibility has not been mentioned by Thomas. Are there in fact vast breeding populations of waders in Siberia east