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SHORT NOTES

FIJI'S SEDENTARY STARLINGS

Hill (1952) was the first to report the arrival of the Starling (*Sturnus vulgaris*) in Fiji. In 1951 he found it numerous on the island of Ono-i-lau (28° 48'S, 178° 45'W), the isolated southernmost island of the Fiji archipelago. Although not seen by Hill at the time, it was also resident on three offshore islands of Ono-i-lau (Parham 1955) and on Vatoa I., 130 km NNE of Ono-i-lau (Manson-Bahr 1953). Hill (1952) was told by the local inhabitants that the Starlings had arrived about 20 years previously following a hurricane, but some villagers told Carrick & Walker (1953) that the Starlings had arrived since 1948.

Mayr (1945) made no mention of the presence of Starlings in Fiji, apparently overlooking six skins in the collection of the Whitney South Sea Expedition. These had been collected by Jose Correia, the expedition's assistant collector at the time, when he visited Vatoa I., 17-19 June 1925, en route from Suva, Fiji, to Tongatapu, Tonga. The expedition's principal collector, Rollo H. Beck, missed this leg of the expedition.

In his journal, Correia (17-18 June 1925) identified the Starling (*Esturino* in his native Portuguese) and recognised it as a species not previously collected in Fiji. Apparently it was uncommon on Vatoa, only one flock being seen and it was very shy. Local villagers told him that the Starlings had arrived only about 6 months previously. On his subsequent visit to Ono-i-lau (20-24 June 1925), Correia did not mention seeing Starlings and did not collect any. Therefore, the

Starlings may have arrived first at Vatoa and colonised Ono-i-lau at a later date. It has probably also colonised Tongatapu, Tonga, 375 km east of Ono-i-lau, from one of these sources since it was not collected there by the Whitney South Sea Expedition (27 June-8 July 1925); it was first recorded from Tongatapu in the early 1970s (Carlson 1974, Dhondt 1976).

The origin of the Starlings that colonised Vatoa is not known. The nearest resident population was that on Raoul I., Kermadec Islands (1200 km south of Vatoa), descendants of a spontaneous colonisation from New Zealand before 1910 (Iredale 1910). The Starling has proved itself to be the most wide-ranging of New Zealand's exotic avifauna, having colonised more, distant offshore islands than any other species (Williams 1953).

No tropical cyclones were recorded in Fiji during 1924 or 1925, although five were recorded in 1923 (Gabites 1978), and so the Starling's arrival on Vatoa as a result of a hurricane seems unlikely. Since the distance between the New Zealand mainland and Raoul I. is similar to that between Raoul I. and Vatoa I., a natural colonisation is credible, especially in view of the likely assistance from the South-east Tradewinds which blow for much of the year. That the first Starlings apparently passed over the southernmost island group of Ono-i-lau is puzzling and supports an alternative theory that they may have been ship-assisted colonists (see Boyer 1955); they may also have arrived in Vatoa after one of the 1923 cyclones, rather earlier than the Vatoa villagers told Correia.

In view of the Starling's proven ability to colonise New Zealand's offshore islands and its probable arrival in Fiji, it is surprising that it has not spread northwards through the Fiji Lau group from Vatoa. The interisland distances are small, always shorter than 100 km, which is less than the distance between Vatoa and Ono-i-lau.

The Starling has been a very successful colonist in temperate regions but unsuccessful in the tropics (see Long 1981). This is clearly demonstrated in Australia, where it is well established in coastal areas of eastern Australia, including many offshore islands, up to about the Tropic of Capricorn (23°S). There are occasional records from many localities further north, including Port Moresby in Papua New Guinea (Pizzey 1980), which indicate a highly dispersive population. The inability of the Starling to establish itself in these tropical areas demonstrates the existence of an important physiological or ecological constraint. There appear to be no naturalised populations anywhere in the world within 18° of the Equator. The population on Jamaica, at 18°N, is almost at the same latitude north of the Equator as Viti Levu, Fiji's largest island, is south of it, and so the Starling's inability to spread through the Fiji Group is all the more surprising and should not, perhaps, be taken for granted. Similarly it will be interesting to see if the Starling is able to establish itself in Hawaii, 20°N, now that it has just arrived there for the first time (Elliot 1980). Starlings

were resident in the New Hebrides (Vila — 17° 45'S) at one time (Cain & Galbraith 1957) but have apparently died out, since they were not recorded by Medway & Marshall (1975) or Diamond & Marshall (1976).

The problem of thermal adaptation and the absence of significant seasonal change in photoperiod in the low tropics are the obvious factors which might affect Starling biology and prevent this temperate species from colonising the tropics. Johnson & Cowan (1975) have shown that the Starling is a relatively heat-tolerant species despite its temperate origins; however, tolerance to temperature extremes does not necessarily imply any ecological adaptation or breeding ability. The importance of photoperiod as a *Zeitgeber* of both gonad and moult cycles in the Starling has been demonstrated frequently (see Murton & Westwood 1977). For example, Gwinner (1977) showed that gonad and moult cycles could be synchronised by photoperiod cycles shorter than 1 year, even with a period of only 2.4 months (five cycles per year). However, Starlings will also undergo regular gonadal cycles in constant photoperiods of between 11 and 13 hours of light (Gwinner 1973), and the period of such gonadal activity is lengthened compared to typical temperate breeding cycles.

In view of their responses to artificially manipulated photoperiods, it seems likely that Starlings should be able to entrain a breeding season to the low-amplitude photoperiodic changes at tropical latitudes. Such gonadal responses have been demonstrated in the Rufous-collared Sparrow (*Zonotrichia capensis costaricensis*) at 10°N (Epple *et al.* 1972). In Fiji, at 20°S, there is a 2 h 27 min difference in daylength between the shortest and longest days. In the laboratory, food cues have been demonstrated to be important in determining whether Starlings respond to photoperiodic stimulation with gonadal growth (Westwood & Dobson 1981), and so it is possible that low latitudes do not adequately satisfy both light and food requirements at the same time to allow breeding.

Alternatively, it may be that the absence of suitable photoperiodic cues affects the initiation of the moult, which could in turn disrupt the annual cycle by affecting the breeding season, since these two events are apparently mutually incompatible in the Starling. Hill (1952) saw indications of the Starling's breeding in the second week of September on Ono-i-lau, and Parham (1955) recorded breeding in October. Of the Starlings collected by Correia on Vatoa in mid-June, two males and one female had enlarged gonads. These observations agree with the normal breeding season of most passerines in Fiji, which is from August/September to February/March (Watling 1982).

Whichever climatic or physiological factors might be affecting the Starling in the low tropics, it is very hard to imagine how they can operate and be limiting over very small distances. Fulaga is only 85 km north of Vatoa, and yet in 60 years the Starling has not managed to colonise it or any other of the 300 or so islands of Fiji. Within

30 years of its introduction to New Zealand the Starling had started to colonise New Zealand's offshore islands (Williams 1953) and after 60 years it had reached Norfolk Island (700 km), the Kermadecs (1100 km), and probably on to Vatoa (1200 km).

Whatever are the constraints on the spread of the Starling in Fiji and the tropics in general, and feeding ecology is obviously likely, they certainly merit a detailed study.

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NOTES ON SOME WADERS AT VATUWAQA, SUVA, FIJI

Between December 1979 and November 1981 I visited Vatuwaqa beach near Suva at least twice in each month except March 1980 to note the species of wader present, their plumage state, to count their numbers at or close to low tide and, where possible, to obtain information on their attachment to a particular area. The length of beach watched was about 2 km and included both banks of the Vatuwaqa River mouth,