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THE SPUR-WINGED PLOVER (*VANELLUS SPINOSUS*) IS A DETERMINATE EGG LAYER¹

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Birds can be categorized according to whether their clutch size can be altered by addition or removal of eggs during laying (indeterminate and determinate egg layers, respectively; Cole 1917, Kennedy 1991). We report a series of experiments that describes the Spur-winged Plover (*Vanellus spinosus*) as a determinate layer.

The Spur-winged Plover is the most abundant resident plover in Israel, where it resides throughout the Mediterranean region of the country. This species is

monogamic, and both members of the pair take equal share in nesting activities. Eggs are laid in a shallow depression in the ground, surrounded by small stones which the parents bring during the incubation period. Like most temperate zone Charadrii, most (60%) clutches of this species have four eggs (mean 3.4; SD = 0.84; $n = 632$), laid at about two day intervals (Yogev 1993). A population of this species was studied in kibbutz Giv' at Hayyim (32°23'N, 34°55'E) during the breeding seasons (March–September) of 1989–1992, and experiments to determine whether the Spur-winged Plover is a determinate or indeterminate egg layer were conducted during 1990. One egg per nest was added or removed after the second, third, or fourth egg was laid in a nest, either on the day of laying or on the next day. The added eggs were taken from other nests in the vicinity. Although Kennedy (1991) and Haywood

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TABLE 1. Mean clutch size of Spur-winged Plovers where an egg was either added or removed. Means are the actual number of eggs laid by the female (i.e., excluding added eggs and including the removed ones).

	Egg added after laying of				Eggs removed after laying of			
	2nd egg	3rd egg	4th egg	Mean	2nd egg	3rd egg	4th egg	Mean
Mean	3.66	3.70	4.00	3.74	3.00	3.60	4.00	3.68
SD	0.47	0.45	0.0	0.44	1.00	0.49	0.0	0.59
n	12	7	4	23	4	15	12	31

(1993) recommended that removal experiments start with the first egg laid, we did not follow this procedure because removal of the first egg in plovers causes desertion of the nest (Klomp 1951).

The average total number of eggs laid in nests where an additional egg was added or removed was 3.74 and 3.68 ($t = 0.428$, ns), respectively (Table 1). Both means were significantly larger than the population average ($t = 3.6$ and 2.8 , for the additions and removal experimental nests, respectively; $P < 0.01$ for both) which included nests where one egg was depredated. Only in one experiment (egg removal after the second egg was laid) was the average clutch size smaller than the population average, due to desertion of two (out of four) nests in that experiment. Hence, our results indicate that removing or adding eggs did not significantly change the mean clutch size of the Spur-winged Plover.

In their recent reviews Kennedy (1991) and Haywood (1993) stated that for five species of Charadriidae for which there are data (including the congeneric species *Vanellus vanellus*), females are indeterminate egg layers. These results are from nests where the first egg was removed, and the female laid in a new nest bowl (Laven 1940, Klomp 1951). Hence, Haywood (1993) classified the plovers as "tactile indeterminate layers type S" (i.e., loss of contact with a single egg is sufficient for the female to lay extra eggs). However, during our study we observed 20 nests where the first egg disappeared, mostly due to predation by hooded crows (*Corvus corone*), and in all cases the female deserted its nest. Six of the above females continued laying within the normal laying interval of 1–2 days in another nest: four laid 3 additional eggs, and two laid 2 eggs. Mean

clutch size, including the disappeared egg was 3.67 (SD = 0.47), i.e., not significantly different from the population mean ($t = 1.4$, ns). This natural experiment supports the conclusion that, unlike other Charadriidae, this species is a determinate egg layer. However, our experiments do not shed light on the possible reason that this species is different in this aspect from the other five species of Charadriiformes for which data are available.

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