

Brief report

The presence of conspicuous associates protects nesting Redshank *Tringa totanus* from aerial predators

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1. Introduction

Several non-colonial waders have been reported to associate actively with colonial species (Hohn 1967, Hildén & Vuolanto 1972, Göransson et al. 1975, Dyrz et al. 1981, Brearey & Hildén 1985). By associating with a colony, individuals might benefit from aggressive colony behaviour toward predators, from the warning system of the colony (Koskimies 1957, Neuchterlein 1981), or from an increase in alternative food items for the predator, represented by the associated species (Pienkowski 1984, Alberico et al. 1991, Rolland et al. 1998).

The Redshank *Tringa totanus* is known to join more demonstrative waders. This results in a higher breeding success because of the reduction of the predation rate. The antipredator activities of the joined "bold" species provide cover against aerial predators (Dyrz et al. 1981).

In the Venetian Lagoon this species nests in unusually dense aggregations within colonies of other breeding *Charadriiformes*, such as the Common Tern *Sterna hirundo*, the Little Tern *Sterna albifrons*, the Sandwich Tern *Sterna sandvicensis* and the Black-headed Gull *Larus ridibundus* (Valle & D'Este 1994, Valle & Scarton 1996). The reasons for this coloniality are still unclear, but improved defence against aerial predators seems the most likely reason.

The sudden disappearance of breeding gulls and terns from a large mixed colony, frequently used as a hunting ground by a Peregrine *Falco peregrinus*, gave us the opportunity to compare, at the same site, the incidence of predation on Redshanks with and without the occurrence of the other breeding species.

2. Material and methods

The observations were made during the 1997 breeding season (May–July), in the southern basin of the Venetian Lagoon (NE Italy; 45°15'N, 12°0'E). The area consists of a large open water body (about 8,000 ha), dotted with hundreds of muddy, intertidal islets covered with aphyllous vegetation (mainly *Puccinellia palustris*, *Limonium serotinum* and *Arthrocnemum fruticosum*). A few of these islets (10 to 20 each year) are occupied by colonies of one or, more frequently, several species of gulls (Black-headed Gulls; 92 pairs in 1997), terns (Common Terns, 1176 pairs; Little Terns, 30 pairs, and Sandwich Terns, 410 pairs) and other *Charadriiformes* (Redshanks, Avocets *Recurvirostra avosetta* and Black-winged Stilts *Himantopus himantopus*). Overall, the Lagoon hosts important populations of seabirds and waders at a national (for Common Terns and Black-headed Gulls) or international (for Red-

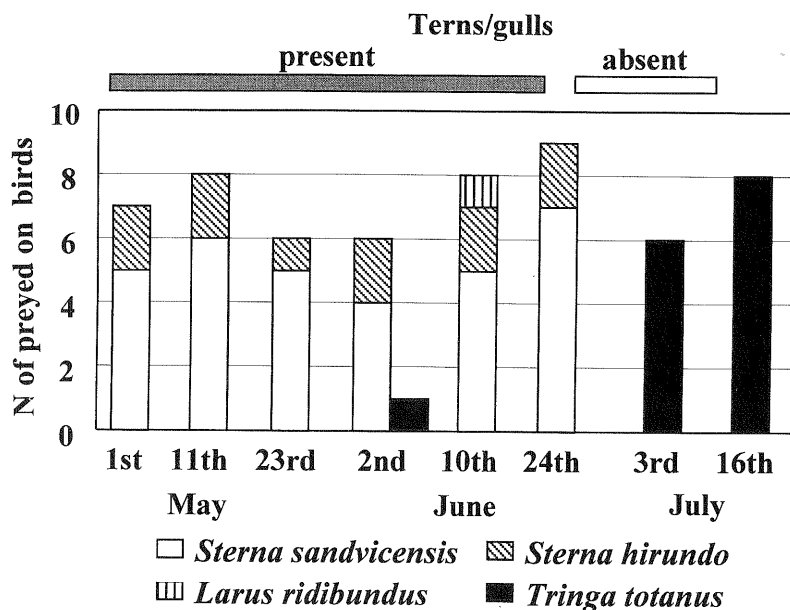


Fig. 1. Predation by the Peregrine (*Falco peregrinus*) on Redshanks (*Tringa totanus*) and *Larini* in relation to the presence of the latter, in the Venetian Lagoon (NE Italy) in 1997.

shanks and Sandwich Terns) level (Scarton & Valle 1997).

The largest colony occurring in the Lagoon, from which data presented here were collected, was located on a 3.6 ha islet. On this islet nested Redshanks (120 pairs; all the data refer to the maximum number of pairs or nests counted throughout the season), Sandwich Terns (410 pairs), Common Terns (164), Little Terns (7 pairs) and Black-headed Gulls (60 pairs). Other aerial predators, besides the Peregrine, were Harriers (*Circus aeruginosus* and *C. pygargus*) and Yellow-legged Gulls (*Larus cachinnans*).

Whilst our long-term project on several aspects of the breeding biology of nesting *Charadriiformes* in the Lagoon started in 1989 (Scarton et al. 1994), only since 1995 has the Peregrine been regularly observed at a few colonies. Most frequently, it has been observed at the site from which data presented in this paper were collected (Scarton et al. 1996).

During the 1997 breeding season we visited the marsh-island eight times, each visit lasting one to five hours. At each visit we firstly waited at a distance of 300 m to watch for possible Peregrine attacks and, later on, we landed on the islet to look for carcasses of preyed birds. Only the remains of birds evidently preyed upon by a Peregrine (i.e. with breast muscles eaten, or body dis-

membered) were considered for the following analysis.

3. Results and discussion

We saw a Peregrine only once and it was a female, which flew away when we were approaching the site; it had just killed a Common Tern. We did not witness any Peregrine attacks on terns, gulls or Redshanks. At another Mediterranean colony, attacks or even simple observations of Peregrines were also very rare (0.05 observations/day; Oro 1996). Nevertheless, 59 carcasses were found, allowing us to examine differences in the predation between species.

The Peregrine took a regular toll among terns and gulls; six to nine birds were found killed on each of the first six visits (1 May–24 June). Most of them were Sandwich Terns (overall 32 birds, plus 11 Common Terns and 1 Black-headed Gull, Fig. 1); apart from these birds, just one Redshank was found. For comparison, predation by the Peregrine of Common and Roseate Terns has been recently reported by Nisbet (1992), who found 31 birds over nine days. A lower incidence of predation was observed by Oro (1996) for Audouin's Gulls (*Larus audouinii*); five to ten birds, depending on the year, were found dead in about one

month at the same colony. Velarde (1993) also observed 50 larids killed by a pair of Falcons over a 66-day period.

The rate of predation at our study site, expressed as percentage of birds killed on the number of total adults, was 3.9% for Sandwich Terns, 3.4% for Common Terns, 0.8% for Black-headed Gulls and 0.4% for Redshanks. The rate of predation of the different species was not as expected, based on their abundance ($\chi^2_3 = 9.6$, $p < 0.05$); Sandwich Terns were preyed upon more and Redshanks less.

As far as we know, our findings are one of the first evidence that Peregrines regularly feed on seabirds at a Mediterranean site. Several previous studies (quoted by Oro 1996) did not list seabirds as prey in the diet of this falcon. The different rate of predation among the breeding species we observed is not in agreement with that reported by Velarde (1993), who found falcons taking prey from a seabird colony based on the availability of the species.

At our study site, in late June, a storm, accompanied by strong winds and an exceptionally high tide, washed away all the eggs, chicks and young of the gulls and terns, so that all the adults abandoned the marsh island. In contrast, some Redshanks chicks survived and 35 adults were still present during our first visit after the storm. In the absence of conspicuous, easily detectable *Larini*, the Peregrine rapidly turned to Redshanks, beginning to prey on adults and young birds, to a similar extent to which it had previously preyed on terns. Six to eight dead Redshanks were found during the two visits made after the storm (3 and 16 July). Taking into account the different number of visits, the difference in the number of Redshanks killed by the Peregrine before and after the storm is highly significant ($\chi^2_1 = 37.3$, Yate's correction, $p < 0.001$). Moreover, numbers of killed Redshanks and terns/gulls are inversely correlated with one another (Spearman rank-correlation, $r_s = -0.83$, $p = 0.010$, $n = 8$). This demonstrates that Redshanks, at our site, were equally suitable prey for the Peregrine, and no particular behaviour of the birds or morphological features of the site could be found to explain the very low predation rate observed in the first phase of the study.

In 1997, no other colony of Sandwich Terns occurred in the Lagoon, so it was impossible to

make any direct comparisons with another site. At the other gull and tern colonies, where Redshanks were breeding as well, predation by the Peregrine was very uncommon (pers. obs.). Observations of the same colony in 1998, when none of the breeding species apparently suffered from washed out eggs or nests, showed that predation of Sandwich Terns occurred regularly throughout the season (i.e. from May until late July), whereas Redshanks were very rare among the killed birds.

The main finding of our observations is that Redshanks may benefit by an increase in the survival rate of young and adults, by associating with more conspicuous, easily detectable, colonial *Charadriiformes*, because of a preference by aerial predators for the latter.

As previously mentioned, this reduction in the predation of Redshanks might result from three factors.

Firstly, early detection of predators by Redshanks, because of the warning system of the associated species. This may probably not play an important role in our case, since Redshanks themselves are generally very effective in predator detection (Cramp & Simmons 1983), and they may not obtain any additional advantage by the terns' warning system.

Secondly, aggressive behaviour by the "joined" associated species towards predators has been reported to increase breeding success through a reduction of the predation rate (Dyrce et al. 1981). We believe that in the Venetian Lagoon this factor reduces clutch predation by aerial predators, like Harriers (*Circus aeruginosus* and *C. pygargus*) and Yellow-legged Gulls (*Larus cachinnans*), which indeed are usually mobbed by terns and gulls (pers. obs.).

Finally, a third factor relates to the increase in alternative food represented by the associated species; this could be of major importance both for Harriers and large birds of prey like the Peregrine. Terns and gulls are more conspicuous and easy detectable as compared with cryptic, elusive Redshanks and Peregrines are known to prefer prey with conspicuous traits, e.g. light coloured plumage (Cramp & Simmons 1983).

In conclusion, at our study site nesting Redshanks gained an advantage, in terms of greater adult and young survival, by associating with terns

and gulls, which may represent an alternative, easier prey for avian predators.

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Selostus: Lokkien ja tiirojen läsnäolo alensi punajalkaviklojen riskiä joutua muuttohaukan saaliiksi.

Kirjoittajat tutkivat muuttohaukan saalislajistoa kesällä 1997 Venetsian lahden saarella, Italiassa. Saarella pesi lintukolonia, johon kuului pikku-, hieta- ja kalatiiroja, sekä naurulokkeja ja punajalkavikloja. Kun kaikki lajit olivat pesimäkoloniassa läsnä, muuttohaukka saalisti pääasiassa lokkeja ja tiiroja. Tulvan tuhottua kaikki lokkien ja tiirojen pesät saarelle jäi vain punajalkavikloja. Tulvan jälkeen muuttohaukan saaliiksi joutui vain punajalkavikloja. Havainto osoittaa, että muiden rantalintulajien läsnäolo suojaa punajalkavikloja muuttohaukan saalistukselta.

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