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Habitat use in Yellow-legged Gull *(Larus cachinnans michahellis)* coastal wetland colonies of North-East Greece

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Abstract — Yellow-legged Gull habitat use was studied at two colonies situated on lagoon islets (Lafri and Karatza) in North-East Greece. At the Lafri colony most nests (74.3%) were in high cover (>70%, overall average 78%). Sand dune and ruderal vegetation were avoided in preference for halophytic communities of *Halocnemum strobilaceum* (HS) and *Halimione portulacoides - Arthrocnemum fruticosum* (HP-AF); both were used in proportion to their availability. Both vegetation cover and type were important for nest placement and spacing. At the Karatza colony most nests (78.1 %) were in high cover (average 85 %). The most important plant communities were *Asparagus tenuifolius* (dominant) and HP-AF; both were used in proportion to their availability. In this colony vegetation cover seemed to be more important than vegetation type. This allowed a better breeding synchronization than at Lafri. Aspects of Yellow-legged Gull habitat use in the wider area are discussed.

Introduction

Vegetation is a primary factor in marsh nesting bird habitat selection (Burger 1985). Ground nesting species, such as gulls and terns, frequently breed in association with particular vegetation types, which provide shelter for adults and chicks against predation, sun, wind and rain and give nest site recognition cues (Blokpoel *et al.* 1978, Burger and Lesser 1978, Becker and Erderlen 1986). However, vegetation encroachment may have several adverse effects on nesting species, by preventing visual contact and social facilitation, and by limiting landing sites, leading finally to desertion (Massey 1974, Goutner 1986, Kotliar and Burger 1986). It may consequently be possible to attract or discourage several species from particular breeding sites through the management of vegetation (Morris *et al.* 1980, Saliva and Burger 1989). The Yellow-legged Gull *(Larus caehinnans)*, like its relative the Herring Gull *(Larus argentatus)* in the Atlantic, has increased considerably in some parts of the Mediterranean, displacing rare species such as Audouin's Gull through competition (Bradley 1986, Monbailliu and Torre 1986). Management of Mediterranean coastal wetlands and their colonial waterbird population needs information on the habitat requirements for each species. In the Mediterranean this has been obtained by Fasola (1986), Fasola *et al.* (1989), Fasola and Canova (1991, 1992), but quantitative information is still needed for Yellow-legged Gulls given the great plasticity of habitat selection in this species.In this paper I describe vegetation structure in two Yellow-legged colonies for the first time in Greece.

Study area

The two study colonies were situated on islets in the "Lafri" and "Karatza" lagoons, within a vast coastal wetland complex of eight lagoons and two freshwater lakes in North-Eastern Greece. All the lagoons in this area are managed as fisheries. The study sites are 12.6 km apart and, in 1987, they were the only breeding areas of Yellow-legged Gulls in this wetland system.

The Lafri islet (7.50 ha) was mainly covered by halophytic vegetation (Figure 1). Its banks were steep except at the far western edge. The Karatza islet (0.61 ha) had a relatively steep slope and was covered by dense vegetation (zone A in Figure 1). There was a vegetation-free area (B in Figure 1) and a dike-shaped edge (C in Figure 1) at the north-east.

Methods

The study sites were visited during the first ten days of May 1987, during the late incubation to early hatching stage of Yellow-legged Gulls. Vegetation

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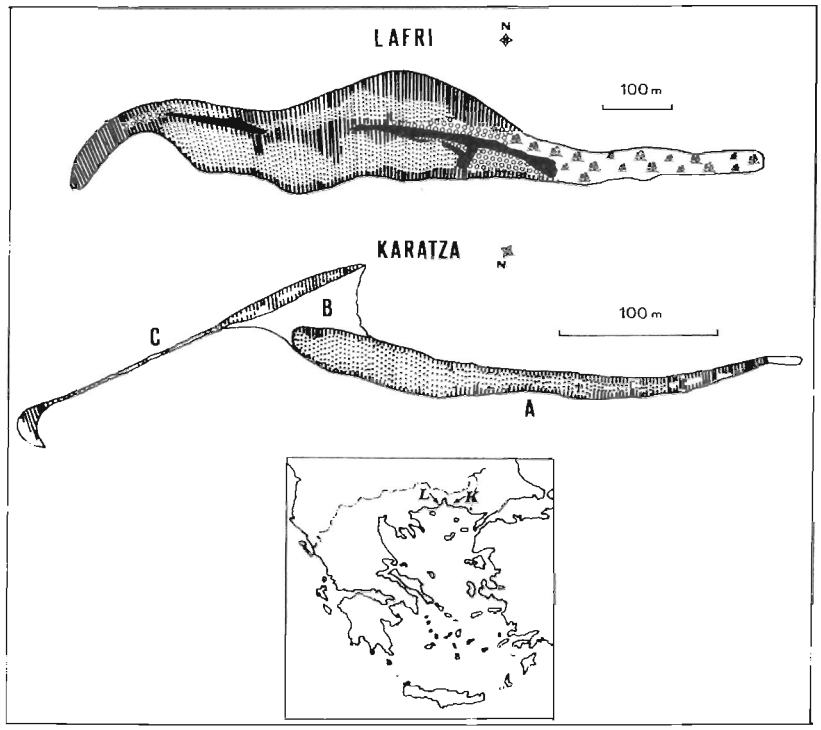

Figure 1. Map of the study islets at Lafri and Karatza Lagoons. Lafri: Hatching: *Halimione portulacoides - Arthrocnemum fruticosum* community. Dotted: *Halocnemum strobilaceum* community. Black: dense ruderal vegetation. Circles: *Artemisia monogyna - Limonium gmelinii* community. Plant symbols: dune associations.
Karatza: Hatching: *Halimione portulacoides - Arthrocnemum fruticosum* community. Dotted: *Asparagus tenuifolius* (mainly) area.
A, B and C are subdivisions described in the text.

cover was measured at nest sites using a 1 m^2 grid divided into 25 squares, each 20 X 20 cm. This method is frequently used in the study of vegetation and/or habitat preferences of gulls and terns although the size and shape of the grid used varies (Blokpoel *et al.* 1978, Kotliar and Burger 1986, Goutner 1987, Storey 1987, Goutner 1990, Fasola and Canova 1992). The central square was placed over each nest at a random orientation. Total cover and plant species were recorded. Distance from the nearest conspecific and distance to water were measured to the nearest cm. Two categories of distances from water were distinguished: one "close to water" and another "far from water". Adapting each category to the scale of each islet, for Lafri "close to water" was ≤ 10 m whereas for Karatza it was ≤ 5 m; "far from water" was >10 m and >5 m respectively. At Lafri all the nests found were measured. At Karatza data were collected for 163 (74 %) of the 221 nests in the colony portion A (Figure 1). The non-recorded part of the colony (B in Figure 1) was occupied by late or displaced breeders and their habitat choice might have been biased. In order to compare used and available vegetation I mapped the vegetation of each islet during visits in May and early June 1987.
Statistical tests were performed on arcsine and log transformed data for percentage vegetation cover and distance from nearest conspecific, respectively.

Results

Lafri

Most nests were found in high vegetation cover, 74.3% were in cover categories >70% (Table 1). Average nest cover was 78% (range 20-96%). Twenty three plant species were found around nests (Table 2). With the exception of plants of the Family Poaceae, dominant halophytes were *Halocnemum strobilaceum* (HS), *Halimione portulacoides* (HP) and *Arthrocnemum fruticosum* (AF). Other plants were mainly minor components of the vegetation in the samples. Vegetation mapping showed that the most widespread plant community was *Halimione portulacoides - Arthrocnemum fruticosum* covering most of the periphery (except the eastern side) and a strip along the middle of the islet (Figure 1) and a *Halocnemum strobilaceum* community covering

most of the inland portion of the islet. Both were similar in extent (Table 3). The eastern part was dominated by sand dune vegetation (*Eryngium* sp., *Anchuca* sp. etc). A strip from the mid-central to south east portion was covered by dense, high ruderal vegetation. Another minor portion was covered by an *Artemisia monogyna - Limonium gmelinii* community. Comparison with the nest vegetation data suggests that:

Sand dune and dense ruderal vegetation were avoided by nesting birds in preference for halophytic marshland.

Although HS alone was more frequent around nests, when samples with HP and/or AF are taken together (as they are the main constituents of their association, Babalonas 1979), their frequency is 49.5 % and this value is not far from that of HS (55.2%). This may mean that at least on a plant community level, the two major communities were used in proportion to their availability.

The mean % cover around nests made in HS alone was significantly higher than around nests in HP and/or AF ($F = 9.99$, $P = 0.003$, ANOVA, Table 4). Mean distance from nearest conspecific was significantly greater at nests made in HS ($F = 6.62$, $P = 0.014$, ANOVA, Table 4). When comparing all samples which simply contained HS to all containing HP and/or AF, mean % cover was still significantly different ($F = 3.38$, $P = 0.012$, ANOVA) whereas mean nearest conspecific distance did not differ significantly ($t = 1.60$, NS, t-test). There were significantly more nests close to water in the HP-AF community ($\chi^2 = 5.29$, $P = 0.02$, and $\chi^2 = 4.33$, $P = 0.04$, respectively, Table 4).

Karatza

In this colony too, most nests (78.1%) were surrounded by very high (>70%) vegetation cover (Table 1). Average nest cover was 85% (range 0-96%). Vegetation composition was somewhat complex here. A relatively high elevation (up to 1 m) allowed a variety of non-halophytic species to develop. On the other hand, the typical halophytic community of salt-water moistened ground, HP-AF, also appeared here. The dominant plant around nests was the bushy *Asparagus tenuifolius* (AT) and Poaceae were second in frequency, with HP following. All halophytes occurred at a frequency of >10% (Table 2). Samples containing HP and/or AF were 42.9% of the total, which is considerably lower than the AT frequency (60.1%). Mapping of the islet vegetation showed that AT was dominant both in the main colony area (A in Figure 1) and over the whole islet (Table 3); AT and HP/AF were used in proportion to their availability.

Mean % cover of nests made in HP-AF was similar to that of those made in AT ($t = 0.24$ NS, t-test, Table 4). Mean distance from nearest conspecific was shorter at the latter nests but not significantly different ($t = 1.40$ NS, t-test, Table 4). The number of nests made close to and far from water differed significantly between nests made in AT and in HP-AF ($\chi^2 = 7.73$ $P = 0.005$, Table 4).

Table 1. Vegetation cover near nests of Yellow-legged Gulls in Lafri (105 nests) and Karatza (205 nests).

	% frequencies	
% Cover categories	Lafri	Karatza
0-30	1.8	21.9
31-40	2.9	1.0
41-50	6.7	1.9
51-60	4.8	3.4
61-70	9.5	3.4
71-80	25.7	12.7
81-90	18.1	11.2
91-100	30.5	44.4

Table 2. Plant frequencies at nests of Yellow-legged Gulls at Lafri (N = 105) and Karatza (N = 163)

	% frequency	
Plant species	Lafri	Karatza
Asparagus tenuifolius	-	60.1
Halocnemum strobilaceum	55.2	-
Halimione portulacoides	33.5	38.0
Arthrocnemum fruticosum	29.5	15.9
Matricaria sp.	1.9	28.2
Juncus sp.	-	15.9
Bromus sp.	1.9	12.3
Limonium gmelinii	19.0	11.0
Artemisia monogyna	9.5	14.1
Festuca sp.	9.5	-
Fumaria officinalis	-	8.6
Geranium sp.	-	6.1
Bolboschoenus maritimus	-	6.1
Asphodelus microcarpus	0.9	3.7
Ephedra sp.	-	2.4
Aeluropus littoralis	3.8	-
Salicornia europaea	1.9	-
Sulsola kali	1.9	-
Lamium amplexicaule	1.9	-
Trifolium sp.	1.9	-
Senecio jacobaea	1.9	1.8
Ammophila arenaria	-	1.2
Moehringia trinervia	0.9	-
Galium aparine	0.9	-
Geranium sp.	0.9	-
Tamarix sp.	0.9	1.2
Onopordum sp.	0.9	11.7
Ornithogalum sp.	0.9	-
Plantago sp.	-	0.6
Atriplex sp.	-	0.6
Other (Poaceae)	21.8	50.9

Table 3. Surface percentages of different vegetation types on the two study islets at Lafri (7.50 ha) and Karatza (0.61 ha).

Habitat type	Lafri	Karatza	
		Part A (Figure 1)	Whole islet
Halimione portulacoides			
Arthrocnemum fruticosum	36.0	32.4	29.6
Halocnemum strobilaceum	33.4	-	-
Dune vegetation	16.5	-	-
Artemisia monogyna-Limonium gmelinii	7.2	-	-
Ruderal vegetation	6.9	-	-
Asparagus tenuifolius	-	65.1	40.8
Vegetation free areas	-	2.5	29.5

Table 4. Parameters at Yellow-legged Gull nests in the main plant communities at the two colonies. Sample is given in parenthesis.

Plants around nests	*Average* % Cover		Nearest neighbour distance		No of nests at distance from water <=10 m	>10 m
LAFRI						
H. strobilaceum only	82	(17)	653	(246)	10	18
H. portulacoides and/or A. fruticosum only	67	(17)	466	(17)	14	4
H. strobilaceum (in all samples except with HP and/or AF)	81	(41)	659	(39)	17	23
HP and/or AF (in all samples except with *H. strobilaceum*)	73	(35)	533	(35)	21	13
					No of nests at distance from water <=5 m	> 5 m
KARATZA						
HP and/or AF (all samples except with *A. tenuifolius*	86	(44)	287	(44)	22	22
A. tenuifolius (all samples except with HP and/or AF)	85	(70)	241	(70)	12	58

Discussion

At the Lafri colony Yellow-legged Gulls avoided dune and ruderal vegetation and preferred halophytic vegetation. Most nests near water were found in HP-AF communities and this simply reflected use of peripheral zones dominated by this community. The greater number of nests far from water which were in HS reflects the inland distribution of HS, a short bush of salty wetland plains (Babalonas 1979). HP-AF form dense low aggregations which leave almost no unvegetated spaces. The fact that we found that mean cover was significantly higher at nests in HS suggests that gulls bred near these plants, whereas in HP-AF they bred at the most uncovered sites. Mean closest conspecific distance was significantly greater at HS and this may be due to a better visibility between conspecifics, inducing a wider nest spacing. This may be important when HS alone is concerned: occurrence of other plant species near nests may well modify this effect. This may suggest that although these two plant communities were used in proportion to their availability, on a microhabitat level both cover and type of specific plant species played a role in nest placement and spacing.

At Karatza the mean distance to the nearest conspecific was considerably shorter than at Lafri. As at Lafri, distance to water distribution reflected the use of the dominant plant communities: most nests close to water were made in HP-AF and most in AT were far from water reflecting its inland distribution. Mean % cover and mean distance to the nearest conspecific were similar in both HP-AF and AT, and this may mean that in different plants birds probably selected sites where visibility was similar, a condition that may be important for social behaviour (Blokpoel *et al.* 1978). Birds in portion A (Figure 1) of the Karatza colony bred earlier and were more synchronised than at the Lafri colony as is shown by nest contents recorded on 9 and 10 May 1987: at Lafri 29.5% of nests contained only chicks, 50.5% only eggs and 20.0% both eggs and chicks. At Karatza these values were 64.0%, 19.5% and 16.5% respectively. A better synchronisation may also have resulted from the number of pairs in portion A of the Karatza colony: this was near the number that enhances optimum social facilitation in Herring Gulls (Burger 1979). As in other gulls (Burger and Gochfeld 1981), at Karatza vegetation types were not selected and were less important than cover.

In both colonies there were several common features in the vegetation selected. There seemed to be no special preference for dominant plant communities, but high nest cover was preferred. Some features in the habitat were avoided but these varied from one site to another.

Yellow-legged Gulls show a great plasticity in habitat selection. In the Mediterranean they breed in a variety of habitats from offshore islands to buildings, cultivated land and coastal wetlands (Isenmann 1975, Fasola 1986, Varela and de Juana 1986, Fasola *et al.* 1989, this study). Vegetative cover used in colony sites varies and frequently high cover is preferred (Fasola 1986, Monbailliu and Torre 1986, this study). In coastal North-Eastern Greece, Yellow-legged Gulls have bred for many years on Thassopoula, a coastal island situated opposite the Nestos Delta, 33 km from Lafri. On this island the birds have been breeding for a long time. The Lafri colony was first established in 1986 and the Karatza

colony in 1984. In 1983 Karatza islet was occupied by a Mediterranean Gull *(Larus melanocephalus)* colony which the following year was displaced by Yellow-legged Gulls. Within the vast coastal wetland complex from the Nestos Delta to Lafrouda Lagoon, apart from very limited areas in the lagoons of the Nestos Delta and Porto Lagos which are partly occupied by other breeding larids, there are no lagoon islets available other than those where the study colonies were situated. If their breeding population is increasing in the area, provided that Yellow legged Gulls have not developed the habit of using non-natural habitats in this part of their region, occupation of study islets was inevitable. If it was a movement of necessity for these gulls, it might not be expected that selected habitat is optimum. Nevertheless these birds once established, seem to have adjusted themselves to some features of the available vegetation.

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