BREEDING ECOLOGY OF THE YELLOW-LEGGED GULL (*Larus michahellis*) IN OUED CHAREF DAM (SOUK AHRAS, NORTHEASTERN ALGERIA)

Nadhra BOUKROUMA[*], Moundji TOUARFIA[*,**], Loubna DERABLIA[*], Sara TOUAHRIA[*]

[*] *Department of Biology, Faculty of Nature and Life Sciences, University Mohamed Cherif Messaadia, 41000 Souk-Ahras, Algeria*
[**] *Laboratory: Terrestrial and Aquatic Ecosystem, Faculty of Sciences and Nature, University Mohamed Cherif Messaadia Souk-Ahras, 41000, Algeria*
Correspondence author: Nadhra Boukrouma, University Mohamed Cherif Messaadia, Faculty of Nature and Life Sciences, Department of Biology, Souk Ahras, Algeria,Zip code: 00213, phone:+2136452147896, e-mail: nboukrouma@yahoo.fr

Abstract. The influence of vegetation height and cover on breeding ecology of Yellow-legged gulls (*Larus michahellis*) nesting in the Islands of Oued Charef dam, northeastern Algeria, was investigated. The effects of habitat characteristics (vegetation height, cover) and nest features on breeding parameters (nests and eggs characteristics, clutch size and nesting success) of 40 nests recorded on the center of island were analyzed using Pearson correlation test. The present nesting distribution of the Yellow-legged gull in the small island of Oued Charef dam indicate an influence of vegetation height and cover on clutch size and chick productivity (chick survived and hatching). Egg-laying started in early January and continued to early June. Pearson correlation analysis revealed that increasing egg laying day was positively correlated with number of active nests. Hatching success was relatively lower compared with studies carried out in northeastern Algeria and an average of 1.5 chicks survived to 20 days. Clutch size averaged 3.9 ± 0.3 (195 eggs), (range: 1-4 eggs) with 79.2% hatching success. Our results provide new insights into some of the habitat parameters that affect the nest selection and breeding success of the target species.

Key words: Yellow-legged gull; vegetation height and cover; breeding ecology; Pearson correlation; Oued Charef dam.

INTRODUCTION

Water birds select sites for breeding according to various factors, among wihich safety from predators and presence of suitable nesting habitat are important [7, 22, 40]. Identifying this sites is a key factor which reliably explains occupation over time [6]. Nest site selection may be reflected in the shape of preferred habitats in the immediate surroundings of the nest and may affect reproductive output [26, 28, 44, 52]. Therefore, understanding how waterbirds identify and select nesting habitat is of particular importance [31]. The quality of the habitat inevitably changes over time, thus, adaptability to these changes is a key issue in conservation biology [30, 31, 45]. Anthropogenic changes in the environment generally influence nest site selection [56]; however, for some bird species the natural events such as flooding, windstorms and heavy rains effect not only breeding success but also reoccupation rate [26, 55, 56]. Loucif et al. (2021) [31] reported that nest site provide an ambient temperature for incubation which influences the physiological adaptations, survival rates and growth of waterbirds. The Yellow-legged gull (*Larus michahellis*) is a widely distributed gull in Africa, Asia and Europe [42, 43]. This species have a large breeding distribution throughout South–West Asia, Eastern Europe and North Africa [8, 34]. Extensive studies on the nest site selection of the species have been carried out through their range [3, 5, 21, 35, 37, 38]. Different aspects of the breeding biology of the species have been investigated in both natural and man-made habitats such as constructed islands [14, 18, 36] , natural islands [23] and barrier islands [48]. A study on yellow-legged gull nesting site selection have been performed also in Algeria, in the small rocky islands of Numidia coastline, North-East side of the Country, but this has focused only on halophiles vegetation cover [4, 53]. We believe that given the great plasticity of breeding nest site selection in this species quantitative information from other areas is still needed. Here we reoprt on study made on small rocky island of Oued Charef dam, wetland, Northeast of Algeria. The current study was carried out to deepen our understanding on the influence of wetland characteristics on nesting site selection and reproduction parameters of this species.

MATERIALS AND METHODS

Study area

This study was conducted at a small rocky island (area: 150 ha) in Oued Charef dam (36°5'22.91"N 7°23'20.78"E, alt. 920 m a.s.l., area: 1010 ha), off the coastal town of Souk Ahras, Northeast Algeria (Fig. 1). The annual precipitation varies in the range 158-480 mm with more than 70% concentrated in the winter. The mean annual temperature ranges from 11.9 to -22°C [32]. Even though the wetland is comprised of aquatic plants and it is surrounded by cereal crops consisted of Chenopodiaceae (*Atriplex halimus, Atriplex patula, Salicornia fruticosa, Salsola fruticosa, Suaeda fruticosa*), Brassicaceae (*Moricandia arvensis, Matthiola fruticulosa, Diplotaxis erucoides, Capsella bursa pastoris*) [33].

Data collection and nest monitoring

Surveys were carried between early January to early June 2019. Nests characteristics: internal diameters, external diameter, and depth were measured using the meter reel , vegetation cover and height was estimated in plot area of 2 × 2 m around the nest. Nest contents were monitored weekly and nesting success assessed. Chick productivity was assessed until 20 days after hatching because after 20 days almost all the eggs were hatched. Eggs were also marked using small individually numbered, weighed with a Pesola spring scale (Baar, Switzerland) and their length (mm) and width (mm) measured with vernier callipers to the

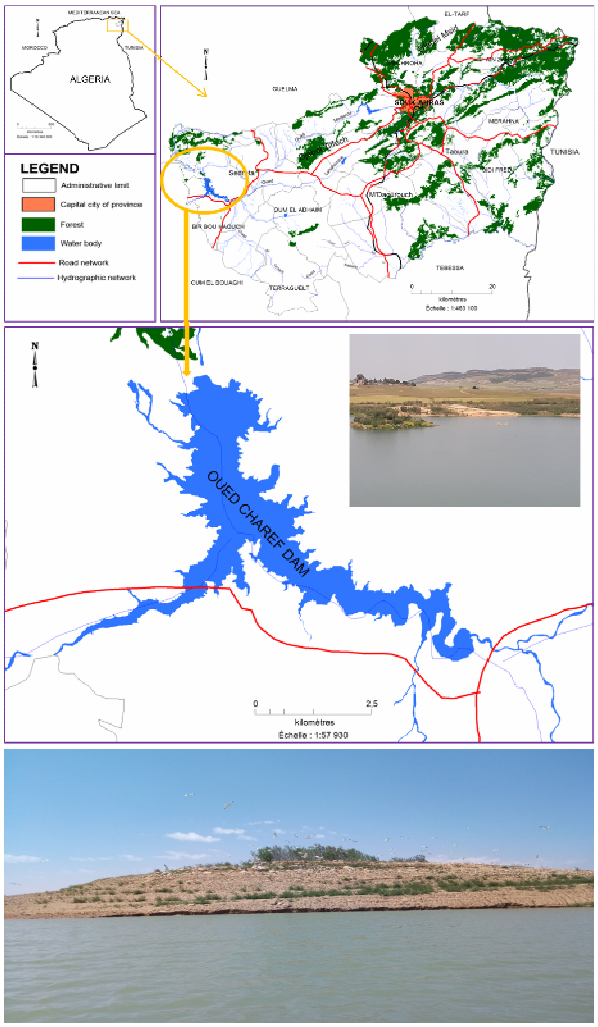

Figure 1. Location map of the study site, the small island in Oued Charef dam, off the Province of Souk Ahras, northeast Algeria (Estabished by Touarfia, 2021)

nearest 0.1mm. Egg volume was calculated as follows: Volume (cc) = (0.476 × length × width 2)/1000 [20]. The date when the first egg of a clutch was laid was considered as the laying date of a nest according to Lack (1950) [27]. When nests were first recorded during incubation, the first egg was inferred from hatching dates assuming an incubation period of 28 days. To study the influence of vegetation cover, plant density was rated as low (>30%), medium (>30% – <60%), and high (>60%). Egg-laying dates were pooled into early (1–12 days), middle (12–20 days), and late (60 days) clutch groups. Hatching success was estimated by the number of hatched eggs observed during the last survey before the nest was terminated. We recorded nest status as: (1) successful nests: if at least one hatched egg (Fig. 2), (2) abandoned nests,when no activity is observed (the eggs were cold), or the egg disappeared before the expected hatching date and (3) predated nests (eggs and chicks).

Statistical analysis

Descriptive statistics, given as arithmetic mean, standard error of the mean (SD), and range (minimum–maximum), summarized each measured parameter

Figure 2. Nest of a Yellow-legged gull (*Larus* michahellis) with two chicks in the small rocky island in Oued Charef dam, off the Province of Souk Ahras, northeast Algeria.

collected during the surveys. Variables that did not meet the assumption of normality were transformed (squarerooted) to meet parametric test requirements. The influence of vegetation height and cover on the hatching success of yellow-legged gulls has been analysed using Pearson correlation tests. All statistical tests were realized using the statistical software R (R core Team 2016) [41] out in "Rcmdr" package.

RESULTS

Characteristics of nests and eggs

We monitored a total of 40 yellow-legged gull nests located in height cover vegetation of the island during the study period from early January to early June 2019. The nests characteristics are listed in (Table 1).

Nesting chronology

In this study,the yellow legged gull began egg-laying on 12 January and ended on 13 June. The egg-laying period lasted 60 days, 60% of eggs were laid between 15-January and 22-May. There was a positive correlation between egg-laying period and Number of active nests (Pearson correlation: r^2= 0.672, $F_{1,52}$=1.482, P<0.001) (Fig. 3).

Distribution of the clutch size

Mean clutch size, hatching success and chick productivity of yellow-legged gull are shown in Table 2. It ranged from 1 to 4 eggs pernest during the breeding season. Also, there was no apparent trade-off between clutch size and mean egg volume (Pearson correlation: r^2= 0.325, $F_{1,52}$ =0.152, P>0.001).

Table 1. Nest characteristics and egg measurements of the yellow-legged gull in the small island of Oued Charef dam, Souk Ahras, northeast Algeria

Nest characteristics [unit]	Min	Max	Mean ± S.D.	Range
External diameter of nest (cm)	21.0 ± 2.02	31.2 ± 2.02	29.2 ± 2.02	21.0 – 31.0
Internal diameter of nest (cm)	12.2 ± 2.02	31.1 ± 2.02	20.5 ± 2.4	12.0 – 31.5
Nest depth [cm]	3.2 ± 0.2	5.2 ± 0.2	6.2 ± 0.2	3.0 – 5.5
Vegetation cover [m]	1.12 ± 0.1	3.52 ± 0.1	2.82 ± 0.1	1.8 – 3.5
Egg length (mm)	37.6 ± 1.1	51.9 ± 1.1	51.9 ± 1.1	37.4 – 65.1
Egg width (mm)	29.0 ± 1.6	28.0 – 1.6	29.0 ± 1.6	28.0 – 49.2
Egg volume (cm^3)	29.0 ± 5.7	113.0 – 5.7	71.3 ± 5.7	29.3 – 114.6
Egg weight (g)	55.9 ± 6.8	100.9 ± 6.8	78.9 ± 6.8	54.1 – 101.4

Table 2. Investigated breeding parameters (Clutch size, Hatching success, Breeding success from egg, Breeding success from hatching, Chick productivity) of the yellow-legged gull in the small island of Oued Charef dam, Souk Ahras, northeast Algeria

Parameters	Min	Max	Mean ± S.D.
Clutch size	1.2 ± 0.3	5.8 ± 0.3	3.9 ± 0.3 (195)
Hatching success (%)	32.8	92.7	79.2 (193)
Breeding success from egg (%)	25.1	62.3	47.6 (56)
Breeding success from hatching (%)	22.8	82.6	62.7 (56)
Chick productivity	0.2 ± 0.8	3.6 ± 0.8	1.5 ± 0.8 (56)

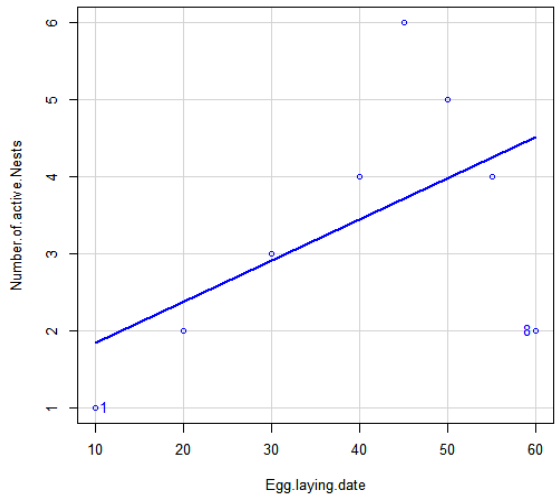

Figure 3. Correlation between egg laying date and number of active nests of the yellow legged gull at the small island of Oued Charef dam, northeast Algeria

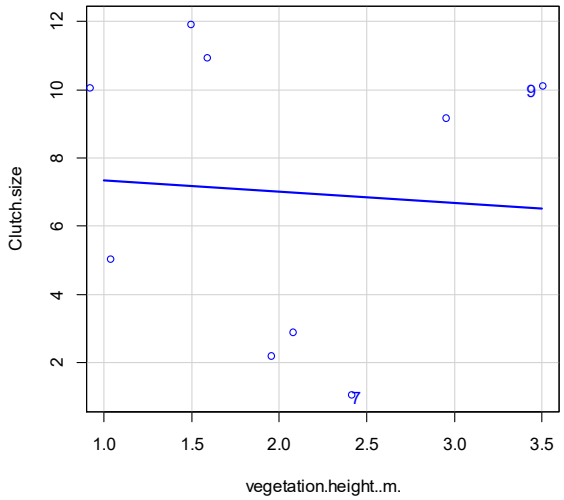

Figure 4. Clutch size per nest of yellow legged gull in relation to vegetation height, at the small island of Oued Charef dam, northeast Algeria.

Influence of nest site parameters on clutch size

The Pearson correlation test revealed that vegetation height presented a significant effect on the variation in clutch size recorded per nest (Pearson correlation: $r^2 = 0.562, F_{1,52} = 1.362, P < 0.001$) (Fig. 4).

Factors controlling the variation of nesting success

The average number of eggs hatched per nest varied according to nest location. Hatching success was 79.2%, breeding success from egg was 47.6 % and 62.7% of breeding success from hatching (Table2).

Chick productivity varied slightly with vegetation cover (1.5 chicks compared with 2 chicks, for medium and height nest cover, respectively) (Fig. 5).

Nesting success

Among the 40 nests monitored, the (79.2%) were successfull and the remaining (20.8%) failed, with (10%) that were abandoned, (5.8%) predated and (5%) found empty for unknown reasons.

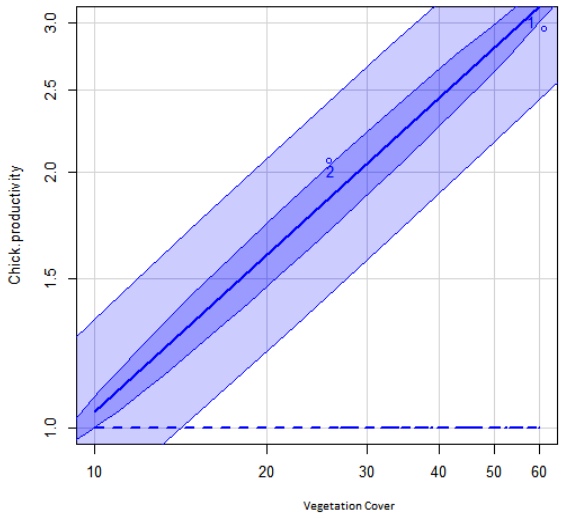

Figure 5. Distribution of chick productivity according to vegetation cover (<30% = 'low', >30% to <60% = 'medium', >60% = 'high')

DISCUSSION

This is the first report of the breeding ecology of yellow-legged Gull nesting in Oued Charef dam, northeastern Algeria.

Our data indicate that yellow- legged gulls prefer nesting on islets of cover vegetation located on the shores of the dam. The species nests in sites that confer it to avoid predation by selecting habitats well covered by vegetation and alternatively sites that have a good view of the surrounding area [25, 47]. The study findings were also close to those reported by Scarton & Valle (1996) [49], Bosch and Sol (1998) [9] and Fraissinet (2015, 2016) [16, 17]. The selection of nest sites is influenced by many factors such as access to the nest, predators, conspecifics and climate [10, 11, 39]. During the breeding season we found that the higher of the vegetation height and cover , the higher chick productivity and clutch size of yellow legged gull. Bosch & Sol (1998) [9] and Scarton & Valle (1996) [49] have demonstrated that yellow- legged gulls select a consistent pattern of vegetation densities across their range. Our results are similar to those of Salzman (1982) [48] and Amat et al. (2017) [2] in Mediterranean region but disagree with results obtained by Baaloudj et al. (2014), vegetation cover (20-80%) [4] in the islet of Srigina, Province of Skikda, northeast Algeria and to those obtained by Bosch and Sol (1998), vegetation cover (40-70%) [9] in the Medes islands colony, northeastern Spain. This difference may be partly explained by the form of the islands, which has more suitable nesting habitat, protected from westerly winds and at less than 160m from the coast. The species may hatch more eggs and may have higher offspring survival under cover than in nests with sparse cover [14]. Gounter (1992) [18] found that vegetation cover seemed to be more important than vegetation type in coastal wetland colonies of North-East Greece.

Results of nest diameter and egg dimensions were similar to those obtained by Isenmann (1976) [23] in Camargue. Our study detected a positive correlation between external and internal nest diameters in the yellow-legged gull colony. This results agree with results reported by Larsson & Forslund (1992) [29] in North of Africa.

We recorded that the first eggs were laid in early January. This is earlier than the 20th of March recorded at the island of El Euch, in northeastern Algeria [34] and later than the 18th of December found in Western Ghats of Tamil Nadu, India [1]. Food supply, competition, nesting conditions, predation pressure and climatic conditions are the factors known to influence the breeding time. As an example, it is known that the majority of the Pycnonotids, living in the equatorial rainforests and islands, breed throughout the year and raise several broods [15].

The nestling period (60 days) is longer than that reported by Faber et al. (2001) (10-20 days) [13]. Overall, the nesting period from the beginning of nest construction took about one month. This along with the long breeding season indicates that species raise multiple broods. The multiple brooding (i.e. producing two or more clutches per breeding season) as a reproductive tactic has been noted by Spencer et al. (1968) [51], this strategie was also confirmed by Westmoreland et al. (1986) [58].

One of our key findings is that number of active nests increase along the growing of laying day. This findings support results obtained by Hammouda et al. (2014) [19] of Yellow-legged gulls colony breeding in southern Tunisia. The mean clutch sizes recorded in our study are within the range of those documented in Algeria (2.7: [24]; 1.4–2.6: [33]) and elsewhere (2.5–2.7: [54]; 2.6–2.9: [9]). Our study revealed that there is no correlation between egg volume and clutch size in the yellow legged gull. Our findings disgaree with results obtained by Hammouda et al. (2014) [19] that volume of eggs is negatively correlated with clutch size due to an energy trade-off between dimensions of eggs and the number of eggs laid per nest.

Hatching success of yellow-legged gulls at the small island of Oued Chared dam were markedly lower (79.29%) than that reported in European colonies (94.7–97.4%: [34]; 91.5–94.5%: [10]; 82.8%: [12]). Chick productiivity in this study is lower than reported due to the High levels of anthropogenic disturbance caused by poachers when look for eggs and occasionally incubating females. Our findings showed that Chick productiivity of the yellow-legged gull was positively related to the vegetation cover. Amat et al. (2017) [2] reported that high vegetation cover around nests can limit heat stress by promoting lower temperatures and by minimizing exposure to the sun during the hotter periods. However, the nest predation rates are slightly less than that reported for other yellow-legged gull colonies. [46, 52, 55, 59]. Nest predation was significantly less during the incubation stage than in the nestling stage. Our results confirm the predictions of parental activity hypothesis [50, 57], which states that nests may suffer higher predation rates during the nestling stage because of increased parental activity that bring adults far from the nest in search for food.

The present study shows that nest site selection and breeding success of the Yellow-legged gulls are influenced by vegetation height and cover. This suggests that this species does not easily occupy any sites and thus confirms certain selective needs. Also, results show that vegetation height having a positive influence on clutch size and chick productivity in the Yellow-legged gulls. Although the small island of Oued Charef dam, northeastern Algeria is an important breeding area for the Yellow-legged gulls. It is essential to sustain the suitable conditions for maintaining and expanding the populations of the Yellow-legged gulls in this wetland, since this species along with other waterbirds ensures the heritage character of the site.

Conflict of interest. There is no actual or potential conflict of interest in relation to this article.

REFERENCES

[1] Ali, S., Ripley, S.D., (1987): Handbook of the Birds of India and Pakistan. Compact ed., Oxford University Press, New Delhi, pp. 737-740.

[2] Amat, J.A., Gómez, J., Liñán-Cembrano, G., Rendón, M.A., Ramo, C., (2017): Incubating terns modify risk-taking according to diurnal variations in egg camouflage and ambient temperature. Behaviour Ecology Socio biology, 71(4): 72-76.

[3] Arnal, A., Gomez-Diaz, E., Cerda-Cuellar, M., Lecollinet, S., Pearce-Duvet, J., Busquets, N., Garcia-Bocanegra, I., Pages, N., Vittecoq, M., Hammouda, A., Samraoui, B., Garnier, R., Ramos, R., Selmi, S., Gonalez-Solis, J., Jourdain, E., Boulinier, T., (2014): Circulation of a Meaban-like virus in yellow-legged Gull and seabird ticks in the western Mediterranean Basin. PLOS ONE, 13: e89601.

[4] Baaloudj, A., Samraoui, F., Alfarhan, A.H., Samraoui, B., (2014): Phenology, nest-site selection and breeding success of a North African colony of the yellow-legged gull, *Larus michahellis*. African Zoology, 49(2): 213-221.

[5] Belant, J.L., Seamans, T.W., Gabrey, S.W., Ickes, S.K., (1993): Importance of landfills to nesting herring Gulls. Condor, 95: 817-830.

[6] Bialas, J.T., Dylewski, L., Tobolka, M., (2019): Determination of nest occupation and breeding effect of the white stork by human-mediated landscape in Western Poland. Environmental Science and Pollution Research, 27: 4148-4158.

[7] Birkhead, T.R., (1977): The effect of habitat and density on breeding successin the common guillemot (*Uria aalge*). Journal of Animal Ecology, 46: 751–764.

[8] Bonaccorsi, G., (2002): Les Larides (*Larus, Rhodostethia, Pagophila, Xema, Rissa*) remarquables en Mediterranee: une synthèse. Alauda, 70: 327-339.

[9] Bosch, M., Sol, D., (1998): Habitat selection and breeding success in yellow-legged Gulls (*Larus cachinnans*). Ibis, 140: 415–421.

[10] Bosch, M., Oro, D., Cantos, F.J., Zabala, M., (2000): Short-term effects of culling on the ecology and population. Journal of Applied Ecology, 37(2): 369-385.

[11] Burger, J., Shisler, J., (1978): Selection of colony sites and nest sites by common terns *Sterna hirundo* in Ocean County, New Jersey. Ibis, 120: 433-449.

[12] Duhem, C., Bourgeois, K., Vidal, E., Legrand, J., (2002): Influence de l'accessibilité des ressources anthropiques sur les paramètres reproducteurs de deux colonies de goélands leucophées (*Larus michahellis*). Revue d'Ecologie (Terre & Vie), 57: 343-353.

[13] Faber, M.J., Betleja, A., Gwiazda, R., Malczyk, P., (2001): Mixed colonies of large white-headed gulls in southern Poland Brit Birds, 94: 169-178.

[14] Fasola, M., Canova, L., (1992): Nest habitat selection by eight syntonic species of Mediterranean Gulls and terns. Colonial Waterbirds, 15: 169-178.

[15] Figuerola, J., Jimenez-Clavero, M.A., Rojo, G., Gomez-Tejedor, C., Soriguer, R., (2007): Prevalence of West Nile virus neutralizing antibodies in colonial aquatic birds in southern Spain. Avian Pathology, 36: 209-212.

[16] Fraissinet, M., (2015) : The colonization of Italian urban centers by the Gull (*Larus michahellis*). To know the phenomenon, to prevent it, to manage it. ANCI and Councilor for the Environment of the Comuna di Napoli eds, Naples, pp. 32.

[17] Fraissinet, M., (2016): Monitoring of the population of Yellow-legged Gull *Larus michahellis* nesting in the city of Naples. Picus, 42: (81): 35-39.

[18] Gounter, V., (1992): Habitat use in yellow-legged gull (*Larus cachinnans michahellis*) coastal wetland colonies of north-east Greece. Avocetta, 16: 81-85.

[19] Hammouda, A., Selmi, S., Pearce-Duvet, J., (2014): Patterns of within -clutch variation in yolk lutein in the Yellow – legged Gull (*Larus michallis*): the effects of egg laying order and laying date. Journal of Ornithology, 155: 1009-1015.

[20] Harris, M.P., (1964): Aspects of the breeding biology of the gulls *Larus argentatus*, *L. fuscus* and *L. marinus*. Ibis, 106: 432-456.

[21] Hatch, J.J., (1996): Threats to public health from gulls (Laridae). International Journal of Environmental Health Research, 6: 5-16.

[22] Horn, H.S., (1968): The adaptive significance of colonial nesting in the Brewer'sblackbird (*Euphagus cyanocephalus*). Ecology, 49: 682-694.

[23] Isemmann, P., (1976): Contribution à l'étude de la biologie de la reproduction et de l'écologie du goéland argenté à pieds jaunes (*Larus argentatus michahellis*) en Camargue. Revue d'Ecologie (Terre & Vie), 30: 551-563.

[24] Jacob, J.P., Courbet, B., (1980): Oiseaux de mer nicheurs sur la côte en Algérie. Le Gerfaut, 70: 385-401.

[25] Janiszewski, T., Minias, P., Wojciechowski, Z., Podlaszczuk, P., (2014): Habitat selection by white storks breeding in a mosaic agricultural landscape of Central Poland. Wilson Journal of Ornithology, 126: 591-599.

[26] Janiszewski, T., Minias, P., Wojciechowski, Z., (2013): Occupancy reliablyreflects territory quality in a long-lived migratory bird, the white stork. Journal of zoology, 291: 178-184.

[27] Lack, D., (1950): The breeding seasons of European birds. Ibis, 92: 288-316.

[28] Lambrechts, M.M., Caro, S., Charmantier, A., Gross, N., Galan, M.J., Perret, P., Cartan-Son, M., Dias, P.C., Blondel, J., Thomas, D.W., (2004): Habitat quality as a predictor of spatial variation in blue tit reproductive performance: a multi-plot analysis in a heterogeneous landscape. Oecologia, 141(4): 555-561.

[29] Larsson, K., Forslund, P., (1992): Genetic and social inheritance of body and egg size in the barnacle goose (*Branta leucopsis*). Evolution, 46: 235-244.

[30] Lebbin, D.J., Parr, M.J., Fenwick, G.H., (2010): The American Bird Conservancy Guide to Bird Conservation. University of Chicago Press, pp. 25-26.

[31] Loucif, K., Cherif, M.M., Houhamdi, M., Chenchouni., (2021): Nest site selection and breeding ecology of the Ferruginous Duck (*Aythya nyroca*) in Algeria. Global Ecology and Conservation, 26: 1-21.

[32] Moualki, N., Boukrouma, N., (2021): The influence of environmental factors on the distribution and composition of plant species in Oued Charef dam, northeast of Algeria. Biodiversitas, 22(1): 346-353.

[33] Moulai, R., Sadoul, N., Doumandji, S., (2006): Effectifs et biologie de la reproduction du goéland leucophée (*Larus michahellis*) dans la région de Béjaia (Algérie). Alauda, 74: 225-234.

[34] Moulai, R., Sadoul, N., Doumandji, S., (2005): Nidification urbaine et à l'interieur des terres du

Goeland leucophee *Larus michahellis* en Algerie. Alauda, 73: 35-40.

[35] Nelson, M., Jones, S.H., Edwards, C., Ellis, J.C., (2008): Characterization of Escherichia coli populations from Gulls, landfill trash, and wastewater using ribotyping. Diseases of Aquatic Organisms, 81: 53-63.

[36] Oro, D., Bosch, D., Ruiz, X., (1995): Effects of a trawling moratorium on the breeding success of the yellow-legged Gull *(Larus cachinnans*). Ibis, 137: 547-549.

[37] Ouarab, S., Yanina, K., Taleb, A., Doumandji , S., (2004): Denombrements hivernaux des oiseaux d'eau du marais de Reghaia sur 25 ans (de 1977 à 2004). 8ème Jouree Ornithologique, 8 mars 2004, Dept. Zool. Agr. Fores., Inst. Nat. Agro, El Harrach, pp. 24.

[38] Ouarab, S., Yanina, K., Taleb, A., Doumandji, S., Derghal, N., Bachiri, D., Chaouati, M., Benyounes, B., Oumari, G., Boukharouba, A., (2003): Les oiseaux d'eau de la zone humide de Reghaia recenses en (2002). 7ème Journee. Ornithologique, 10 mars 2003, Dept. Zool. Agri. Fores., Inst. Nat. Agro, El Harrach, pp. 40.

[39] Parsons, K.C., Chao, J., (1983): Nest cover and chick survival in herring gulls (*Larus argentatus*). Colonial Water birds, 6: 154-159.

[40] Partridge, L., (1988): Lifetime reproductive success in Drosophila. In: Clutton-Brock TH Reproductive success: studies of individual variation in contrasting breeding systems. University of Chicago Press, Chicago, pp. 11–23.

[41] R Development Core Team., (2016): R. a language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. https://www.gbif.org/tool/81287/r-a-language-and-environment-for-statistical-computing.

[42] Ramos, R., Ramírez, F., Carrasco, J.L., Jover, L., (2011): Insights into the spatiotemporal component of feeding ecology: an isotopic approach for conservation management sciences. Diversity and Distributions, 17: 338-349.

[43] Ramos, R., Ramirez, F., Sanpera, C., Jover, L., Ruiz, X., (2009): Diet of yellow–legged gull (*Larus michahellis*) chicks along the Spanish Western Mediterranean coast: the relevance of refuse dumps. Journal of Ornithology, 150: 265-272.

[44] Reijnen, R., Foppen, R, (1994): The effects of car traffic on breeding bird populations in woodland. I. Evidence of reduced habitat quality for willow warblers (*Phylloscopus trochilus*) breeding close to a high-way. Journal of Applied Ecology, 31: 85-94.

[45] Ringelman, K.M., Walker, J., Ringelman, J.K., Stephens, S.E., (2018): Temporal and multi spatial environmental drivers of duck nest survival. The Auk, 135(3): 486-494.

[46] Roninson, W.D., Robinson, T.R., Robinson, S.K., Brawn, J.D., (2000): Nesting success of understorey forest birds in lowland Panama. Journal of Avian Biology, 31: 151-164.

[47] Ross, K.E., Balmer, D.E., Humphreys, E., Austin, G., Goddard, B., Rehfisch, M., (2016): Urban breeding gull surveys: a review of methods and options for survey design. The British Trust for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU 2APEM Ltd, 61 Regent St, Cambridge CB2 1AB, pp. 3-57.

[48] Salzman, A.G., (1982): The selective importance of heat stress in gull nest location. Ecology, 63: 742-751.

[49] Scarton, F., Valle, R., (1996): Colony and nest-sites election of yellow-legged gulls (*Larus cachinans michahellis*) on barrier islands of the Po Delta (NE Italy). Vogel welt, 117: 9-13.

[50] Skutch, A.F., (1949): Do tropical birds rear as many young as they cannourish? Ibis, 91: 430-455.

[51] Spencer, A.W., Steinhoff, H.W., (1968): An Explanation of Geographic Variation in Litter Size. Journal of Mammalogy, 49(2): 281-286.

[52] Stutchbury, B.J.M., Morton, E.S., (2001): Behavioral ecology of tropical birds. Academic Press, London, pp. 164.

[53] Telailia, S., Boutabia, L., Bensaci, E., Boucheker, A., Samar, M.F., Maazi, M.C., Saheb, M., Bensouilah, M.A., Houhamdi, M., (2015): Demographic development of breeding populations of yellow legged gull *larus michahellis naumann*, 1840 on the small islands and along the coastline of numidia (north-esstern algeria). The Journal of Animal & Plant Sciences, 25(4): 1160-1167.

[54] Tobolka, M., Kuźniak, S., Zolnierowicz, K.M., (2013): New is not always better: low breeding success and different occupancy patterns in newly built nests of a long-lived species, the white stork *Ciconia ciconia*. Bird Study, 60: 399-403.

[55] Tobolka, M., Dylewski, L., Wozna, J.T., Zolnierowicz, K.M., (2018): How weather conditions in non-breeding and breeding grounds affect the phenology and breeding abilities of white storks. Science Total Environnement, 636: 512-518.

[56] Tryjanowski, P., Kuźniak, S., Diehl, B., (2000): Does breeding performance of red-backed Shikellamy's collurio depend on nest site selection? Ornis Fennici, 77: 137-141.

[57] Varela, J.M., Juana, E., (1986): The *larus cachinnans michahellis* colony of chafarinas islands. In: Mediterranean marine avifauna. Population studies and conservation, (eds) medmaravis & X. monbailliu, Springer Verlag, Berlin, pp. 231–244.

[58] Westmoreland, D., Best, L.B., Blockstein, E.D., (1986): Multiple Brooding as a reproductive strategy: time-conserving adaptations in mourning doves. The Auk, 103(1): 196-203.

[59] Yasué, M., Dearden, P., (2006): The potential impact of tourism development on habitat availability and productivity of Malaysian plovers *Charadrius peronii*. Journal of Appllied Ecololgy, 43: 978-989.

Received: May 26, 2021
Accepted: September 21, 2021
Published Online: September 23, 2021
Analele Universităţii din Oradea, Fascicula Biologie
https://www.bioresearch.ro/revistaen.html
Print-ISSN: 1224-5119
e-ISSN: 1844-7589
CD-ISSN: 1842-6433
University of Oradea Publishing House