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Research Article/Araştırma Makalesi

Breeding Biology of the Yellow-legged Gull (*Larus michahellis*, Naumann, 1840): a Small Island Population in Southwestern Türkiye

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Abstract: Urbanization and fisheries affected a rapid increase in seagull populations in western Mediterranean populations of the yellow-legged gull. The main reason is the increased food resources such as fisheries, big ports, and dumps. In this study, we aimed to understand and to compare the breeding biology of the yellow-legged gull in eastern Mediterranean. We studied on the small island in southwestern Türkiye between 2013 and 2015. All nesting sites were determined, marked, and monitored once a week. The breeding season has started in late February, nesting and laying eggs have started at the beginning of March, and they left the island in the second half of June after fledging. The incubation period is 29.17±2.85 days, only one clutch in a season and 2 or 3 eggs were laid in the nests. There was a slight increase in the number of pairs and nests between years but there is no significant difference in all parameters such as laying date, clutch size, hatching and fledging success in Pırasalı Island population and the rate of both hatching and fledging success are lower than western Mediterranean populations. While predation is the weakest factor for lower breeding success, intraspecific predation may be the factor but the main effect is the lower food abundance for the hatchlings.

Keywords: Breeding, fledgling, food, nesting, yellow-legged gull.

Türkiye'nin Güneybatısında Küçük Bir Ada Populasyonu örneğinde Gümüş Martı *(Larus michahellis*, Naumann, 1840) Üreme Biyolojisi

Öz: Kentleşme ve balıkçılık Gümüş martı populasyonlarının Batı Akdeniz'de hızla artmasında etkili olmuştur. Balıkçılık, büyük limanlar ve çöplükler gibi artan gıda kaynakları bu artışın ana sebepleridir. Bu çalışmada, Doğu Akdeniz'de kuluçkaya yatan Gümüş martı üreme biyolojisini belirlemek ve karşılaştırma yapmak amaçlanmıştır. Türkiye'nin güneybatısında yer alan küçük bir ada popülasyonu 2013-2015 yıllarında çalışılmıştır. Tüm yuva alanları tespit edilmiş, işaretlenmiş ve haftada bir gün izlenmiştir. Üreme dönemi Şubat ayı sonlarında başlamış, yuva yapımı ve yumurta bırakma mart ayı başlarında gerçekleşmiş ve yavruların uçmasıyla birlikte tüm popülasyon Haziran ayının ikinci yarısında adadan ayrılmıştır. Kuluçka süresi 29.17±2.85 gün, üreme döneminde sadece bir kuluçka gerçekleştirilmiş ve yuvalara 2 veya 3 yumurta bırakılmıştır. Pırasalı Adası popülasyonunda yıllar arasında çift sayıları ve yuva sayıları açısından küçük bir artış olmasına rağmen, yumurta bırakma tarihi, kuluçka sayısı, yumurtadan çıkan yavru başarısı ve yuvadan uçan yavru başarısı parametrelerinde istatistiksel anlamda bir farklılık bulunmamıştır. Yumurtadan çıkan yavru başarısı ve yuvadan uçan yavru başarısı oranları Batı Akdeniz popülasyonlarından daha düşüktür. Predasyon düşük üreme başarısı için düşük bir faktörken, tür içi predasyon belki etkili olabilir, ancak yumurtadan çıkan yavrular için düşük besin bolluğu temel etkidir.

Anahtar kelimeler: Üreme başarısı, yavru, besin, kuluçka, Gümüşi martı.

1. Introduction

The Yellow-legged gull (*Larus michahellis*) is one of the common species and widely distributed throughout the Mediterranean (Vidal et al., 1998; Bosch et al., 2000). It is the most common gull species in the Mediterranean, Marmara Sea, and Black Sea in Türkiye (Kiziroğlu, 2009; Svensson et al., 2009). The Yellow-legged gull is a large sized gull (800-1500 g) among other species (Liebers et al., 2001) nesting in colonies on rocks or cliffs (Cramp, 1998).

In the last 30-40 years, there has been a great increase in seagull populations in Europe, North America and Australia due to the increasing food abundance as a result of human activities (Blokpoel and Spans, 1991; Pons, 1992; Smith and Carlile, 1993). Similar increases were observed in the populations of the Yellow-legged gull in the Mediterranean (Vidal et al., 1998). However, with this increase, negative effects have emerged in airports, cities, reservoirs, agricultural areas, and fisheries (Monaghan et al., 1995; Dolbeer et al., 1997).

The availability of food is a determining factor in the reproductive success and population dynamics of the species (Oro et al., 2006). In recent years, increasing the amount of waste with the human population has caused an increase in the population of the Yellow-legged gull (Pons, 1992; Kilpi and Öst, 1998). This situation has been influential to conduct numerous studies on the population dynamics, diet, and reproductive biology in the Mediterranean basin (Bosch et al., 2000; Perez et al., 2006; Arizaga et al., 2008; Ramos et al., 2009). Studies have been conducted on the breeding of the Herring gull (*Larus argentatus*) (Ayvaz, 1988) and heavy metal concentration in the eggshells of Audouin's gull (*Larus audouinii*) (Ayaş,

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Çelikkan and Aksu, 2008) but no comprehensive studies have been found in Türkiye, except for the distribution areas with the Yellow-legged gull: although, it is one of the most common seagulls (Tabur, 2002; Tabur and Ayvaz, 2005; Ekmekçi, 2011). We aimed with this research to understand the breeding biology such as incubation phenology, clutch size, hatching, and fledging success of the Yellow-legged gull population breeding on the small island in the Mediterranean coast of Southwestern Türkiye.

2. Material and Methods

This study was carried out during the breeding season (March-July) in 2013, 2014, and 2015. The field work was started at the beginning of March to determine the breeding biology of the Yellow-legged gull and research was carried out once a week until the end of July.

2.1. Study Area

The study area, Pırasalı Island, is a small rocky island about 1.5-2 ha, located 3.5 miles from the coast of Adrasan and 250 m from the mainland (Fig. 1). Pırasalı Island is located within the Beydağları Olympos National Park.

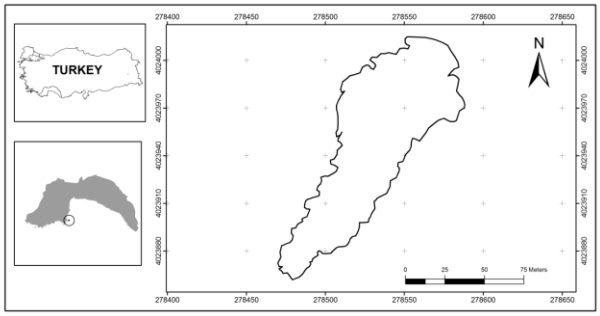

Figure 1. The location of the study area, Pırasalı Island.

2.2. Nest Monitoring

Nest monitoring studies started at the beginning of March each year and nest locations were determined. Nests are built on the ground between rocks and were easy to find by observing. Coordinates were recorded by using GPS (Garmin etrex 20) and by using small wood pieces marked and left close to the nests (Fig. 2). Nest building, laying dates, incubation period, and hatching dates were recorded by checking the nests once a week. Distribution maps of the nest locations on the island were prepared for each year.

Figure 2. One of the marked nests of the Yellow-legged gull on the island.

2.3. Statistical Analysis

The incubation period was calculated by using the data between the first hatching and the last laying egg dates. Hatching success was calculated by the proportion of the clutch that hatched and fledgling success was calculated by the proportion of the fledglings that left the island. The differences of egg number, hatchlings, fledglings, and dead hatchlings between years were tested by using one-way ANOVA (Dytham, 2011).

3. Results

In this study, 26 nests in 2013, 34 nests in 2014, and 38 nests in 2015 were found and monitored during the breeding seasons. The fact that the island is small and has very little vegetation provided the opportunity to determine the entire population nests on the island.

3.1. Nest Distribution and Breeding Phenology

The nests are almost located in the northern part where there is a small number of annual vegetation: although, the whole island is rocky. Only one nest was found in the southern part in 2014 and 2015 (Fig. 3). Nests were mostly built on this poor vegetation, with very few found to be built cliffs with few nesting materials, and in these nests eggs were laid directly on the rock. Although it is very difficult to tell whether the same pairs used the same nesting sites in subsequent years, it was evaluated that the pairs mostly used the old nesting sites (Fig. 3).

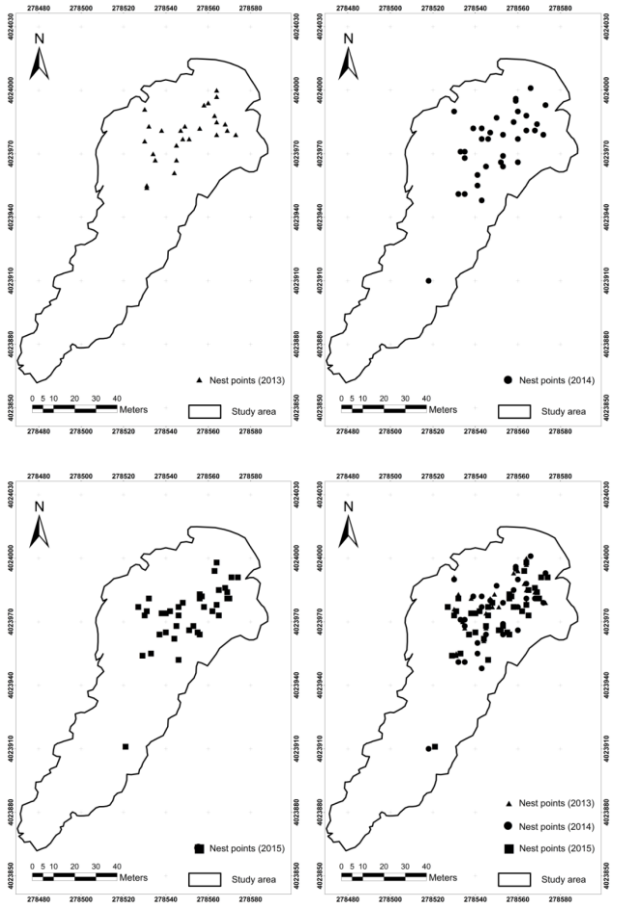

Figure 3. Distribution maps of all nests by year (Upper left 2013, upper right 2014, down left 2015 and downright all years).

The Yellow-legged gulls started to arrive the island in late February and started to lay eggs from the beginning of March. Laying the first egg in the nest was on 10th March (n=17, med. 15th March) in 2013, on 11th March (n=22, med. 21st March) in 2014, and on 11th March (n=25, med. 17th March) in 2015, respectively (Fig. 4). Hatching started on 13th April (n=17, med. 18th April) in 2013, on 12th April (n=22, med. 23rd April) in 2014, and on 13th April (n=25, med. 18th April) in 2015, respectively (Fig. 4). The breeding density in the colony was one pair within about 10-20 m^2 surface area with varying nesting locations ranging from 5 meters above sea level up to about 20 m.

3.2. Incubation Period and Breeding Success

The Yellow-legged gull has a single brood during the breeding season. There were unsuccessful broods in all the studied years: 9 nests in 2013, 12 nests in 2014, and 13 nests in 2015, respectively. These unsuccessful broods were excluded for the calculation of the incubation period and it is 29.17±2.85 days (n=64 nests) (Table 1). According to the age of hatchlings, the hatching dates were estimated. Although 2 or 3 eggs were laid in the nests, all of these eggs were not hatched. Three hatchlings were observed in only two 3-egg nests but one of the hatchlings died in a very short time in both nests. In addition, there was no statistically significant difference between years in terms of incubation period, brood length, number of eggs laid, hatchlings, dead hatchlings, hatchling success, fledglings, and fledgling success (Table 2).

4. Discussion

This study was carried out in 2013-2015 to investigate the breeding biology of the Yellow-legged gull (*Larus michahellis*) population on Pırasalı Island in southwestern Türkiye. About the breeding population on Kızkalesi, which is an ancient building, in Beyşehir Lake, Ekmekçi (2011) identified 270 individuals and 38 nests, 25 of which were active. Studies conducted on different populations in Spain (Ramos et al., 2009) and Italy (Rubolini et al., 2005) indicate that almost all of the pairs in the colony were nesting (between 300 and 1500 pairs). In this study, all observed adult birds in all seasons were incubating at the island. There were also non-breed individuals but these few individuals were immatures. Ekmekçi (2011) did not give information in detail about the number and proportions of immature and adult birds. However, in our study nesting of 30% individuals is a very low rate compared to other populations (Rubolini et al., 2005; Ramos et al., 2009).

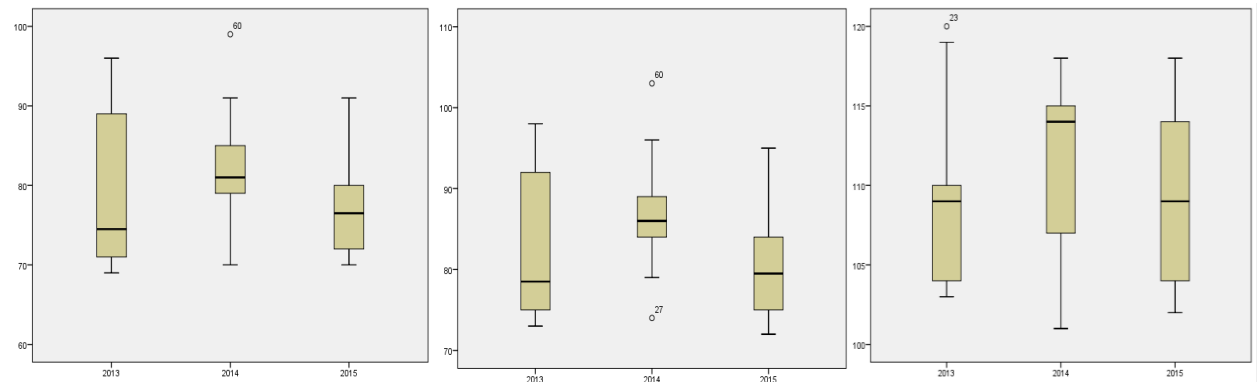

Figure 4. According to the years, the date distribution of laying first egg (left), laying last egg (middle), and hatching days (right). X axis shows the years and y axis shows the Julian date.

Table 1. Incubation time, number of eggs, number of hatchlings, number of fledglings, and death hatchlings of the yellow-legged gull according to the years.

		2013	2014	2015	3-years Mean
Incubation Period (day)	N	17	22	25	21.3
	Mean±SD	29.71±2.89	26.82±2.40	30.88±1.56	29.17±2.85
	Min-Max	25-35	23-33	29-34	23-35
Number of eggs	N	17	22	25	21.3
	Mean±SD	2.81±0.40	2.82±0.39	2.79±0.41	2.81±0.40
	Min-Max	2-3	2-3	2-3	2-3
Number of Hatchlings	N	35	41	47	41
	Mean±SD	1.35±1.06	1.21±1.12	1.24±1.02	1.26±1.06
	Min-Max	0-3	0-3	0-3	0-3
Number of Fledglings	N	26	29	34	29.6
	Mean±SD	1.00±0.94	0.85±1.05	0.90±0.80	0.91±0.92
	Min-Max	0-3	0-3	0-2	0-3
Number of Death Hatchlings	N	9	12	10	10.3
	Mean±SD	0.39±0.64	0.35±0.65	0.26±0.45	0.33±0.57
	Min-Max	0-2	0-2	0-1	0-2
Hatching Success		47.9%	42.7%	44.3%	44.7%
Fledging Success		35.9%	30.2%	32.7%	32.4%

Table 2. Differences between years about incubation time, number of laid eggs, hatchlings, fledglings, death hatchlings, hatchling success, and fledgling success.

	Years	Clutch size	N	Mean ± SD	ANOVA (between years)	P
Number of egg	2013	26	73	2.81±0.40		
	2014	34	96	2.82±0.39	0.937	>0.05
	2015	38	106	2.79±0.41		
Number of hatchling	2013	26	35	1.35±1.06		
	2014	34	41	1.21±1.12	0.873	>0.05
	2015	38	47	1.24±1.03		
Number of fledgling	2013	26	26	1.00±0.94		
	2014	34	29	0.85±1.05	0.826	>0.05
	2015	38	34	0.90±0.80		
Number of death hatchling	2013	26	9	0.39±0.64		
	2014	34	12	0.35±0.65	0.671	>0.05
	2015	38	10	0.26±0.45		

In Türkiye, there are not enough studies on the population biology of not only yellow-legged gull but also of many species. However, the populations of this species have increased in recent years (Bosch et al., 2000; Rubolini et al., 2005; Ramos et al., 2009; Arizaga et al., 2010). Although there are no statistically significant differences between years in Pırasalı Island population (see Table 2), there is a slight increase in the number of pairs and nests during the breeding season. Breeding data for Pırasalı Island population such as nest building, laying egg, and hatching dates are similar to other breeding populations in the Mediterranean (Bosch et al., 2000; Arizaga et al., 2010; Rubolini et al., 2011). Although the clutch size is 2 or 3, mostly 1 or 2 eggs were hatched in this study. Only in two nests all three eggs were hatched but one of these hatchlings died in a few days in both nests. According to Arizaga et al. (2010), the first hatchlings have an advantage over the others and the surviving offspring are generally these first hatchlings. Similarly, Perez et al. (2006) found out that hatchings from the first and second eggs have higher survival rate than third eggs. We did not mark and ring the hatchlings: thus, it is not possible to say the advantage of hatching priority.

Food competition and predation are important factors affecting hatching and fledging success. The survival rate of offspring is affected by food abundance, food competition, and predation (Arizaga et al., 2010). In our results, hatching and fledging success (see Table 1) are lower than western Mediterranean populations (between 60% and 65%) (Bosch et al., 2000; Rubolini et al., 2005; Ramos et al., 2009; Arizaga et al., 2010). Intraspecific predation might affect the hatching and fledging success (Martinez-Abrain et al., 2002). A small population of 40 pairs of our colony has also hatchlings mortality. We do not have any observation of intraspecific attacks but according to Arizaga et al. (2010), intraspecific predation may also cause these deaths in our population, too. However, there is not a big port and fisheries around the study area and this may be the most important factor as a low amount of nutrients resulting in having low hatching and fledging success. Gulls use pelagic prey, refuse dumps, brackish, and freshwater ecosystems to feed their offspring (Ramos et al., 2009) and big ports and fisheries provide abundant food (Bosch et al., 1994; Belant, 1997), the Yellow-legged gull interactions rate is very high (90.5%) in many aquaculture in Aegean Sea (Ceyhan and Akyol, 2020) and this adequate amount of food gives advantage to the survival rate of the hatchlings (Duhem et al., 2007). Moreover, the dumps also provide one of the best food abundance for many species including gulls. There is not any dump close to the breeding site. On the other hand, some predators such as Peregrine falcon (*Falco peregrinus*) and Eleonora's falcon (*Falco eleonorae*) breed on the cliffs of the mainland (Karaardıç, 2020) and many attacks (some of them successful) were observed against the Yellow-legged gulls and breeding population of Alpine swifts (*Apus melba*) (Karaardıç et al., 2013; Meier et al., 2018; Meier et al., 2020) on the island. Nevertheless, observed dead hatchlings mostly were not predated. This may help to explain the reason of the death as the low food abundance may decrease both hatching and fledging success.

5. Conclusion

The increase in urbanization and fisheries affected to a rapid increase in seagull populations in Europe, North America, and Australia due to the increasing food abundance as a result of human activities. Similar increases were observed in the populations of the Yellow-legged gull in the western Mediterranean, the reasons of food resources such as low fisheries, dumps, and others does not affect having the same increase in eastern Mediterranean populations. In Aegean Sea, Marmara Sea, and Black Sea regions, although the individual numbers of seagulls have increased, it cannot be expressed that there is a similar increase due to the lack of information on reproductive biology of the Yellow-legged gulls. However, according to this study, the population size is stable between years in the southwestern coastal breeding populations in Türkiye.

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