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Egg size of the Common Tern *Sterna hirundo* in Slovenia

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Abstract

Clutch size and egg size of the Common Tern *Sterna hirundo* was studied in Slovenia. The total number of eggs measured was 242 from 90 nests. Among 90 complete clutches, 53.7 % had three eggs. Density of breeding pairs had no effect on the clutch size. The largest eggs were found in clutches with two eggs. Egg length averaged 41.23 mm, egg breadth 30.07 mm, egg volume 19.52 cm^3 and egg shape 0.73. No significant relationship was found between egg size (volume, breadth, length) and latitude and longitude (this study and literature data) within Europe.

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Introduction

The Common Tern *Sterna hirundo* has a wide range of distribution in the Holarctic region (Harrison 1982, Cramp 1985, Hume & Lemmetyinen 1997). Nevertheless, studies of Common Tern eggs are rather scarce (Glutz von Blotzheim & Bauer 1982, Cramp 1985, Burger & Gochfeld 1991, and references therein). In this paper I provide data on clutch size and egg size of the Common Tern in Slovenia. I also examine clutch and egg size between years and their geographic variation.

Study area

The data for this study were gathered in NE Slovenia, on Dravsko polje (46°25'N, 15°45'E) in Hoče gravel pit, where Common Terns breed in a colony with Black-headed Gulls *Larus ridibundus* (Vogrin 1991). Agricultural landscapes are dominant throughout, and there are numerous man-made water bodies (i.e. fish ponds, reservoirs, gravel pits) and small towns and villages. The area belongs to the sub-Pannonic phytogeographical area (Marinček 1987). The climate is modified continental (mean annual rainfall = 1000 mm, mean temperature = 8 °C; see Furlan 1990).

Methods

The present study was carried out in 1990 and 1991. I recorded clutch size and egg size of the nests initiated during the peak period of egg laying. All nests were marked individually, and the visits were distributed over a period of about ten days. The total number of eggs measured was 242 from 90 nests.

For describing the size and shape of eggs I used four parameters: EL = egg length (mm), EB = egg breadth (mm), EV = egg volume (cm^3) and ES = egg shape index. The maximum length and breadth were measured to the nearest 0.1 mm using dial calipers. Egg volume was calculated according to e.g. Horak et al. (1995) = $p/6 \times EL \times EB^2$. When comparing data from the literature, I recalculated egg volumes according to the same formula. Egg shape index (ES) was calculated according to Horak et al. (1995): EB/EL. The larger the ES is, the rounder are the eggs.

For statistical comparison Chi-square, ANOVA and Mann-Whitney U tests were used (Sokal & Rohlf 1995). Effects of latitude and longitude on the egg parameters were tested with multiple regression. Because data on single eggs are difficult to analyze statistically, e.g. because the eggs within a clutch are not independent, egg dimensions in this study were based on clutch means. The data were analysed using the SPSS 6.0 statistical programs.

Table 1. Number of nests and egg volume (cm^3) of the Common Tern *Sterna hirundo* in relation to clutch size in northeastern Slovenia.

Antal bon och äggvolym (cm^3) i förhållande till kullstorlek hos fisktärna i nordöstra Slovenien

Clutch size	No of nests	Egg volume		*Äggvolym*
		Mean	s.d.	Range
Kullstorlek	*Antal bon*	*Medel*		*Variationsbredd*
1	10 (11.1%)	19.14	1.34	17.79 – 20.95
2	31 (34.4%)	20.01	1.27	17.42 – 22.01
3	48 (53.3%)	19.19	1.11	16.98 – 21.04
4	1 (1.1%)	–	–	–

Results and discussion

The clutch size distribution is given in Table 1. The most common clutch size was 2–3 eggs, although clutches of 1 and 4 eggs sometimes occurred. Among 90 complete clutches, 53.3% had three eggs. Four eggs occurred only once (1.1%). The mean clutch size of the 90 nests was 2.69 (SD = 0.71). The average clutch size was similar to that found in other areas (e.g. Cramp 1985, Burger & Gochfeld 1991 and references therein). Four-egg clutches are very rare and are not found at all in some years (Burger & Gochfeld 1991), and the same was true in my study area as well.

In some species density of breeding pairs is negatively correlated with clutch size (Klomp 1970). For the Common Tern, however, Burger & Gochfeld (1991) found that larger colonies generally had higher mean clutch size. This rule was not true in my case. In Hoče gravel pit the difference in number of pairs was highly significant (27 pairs in 1990, 63 pairs in 1991; Chi-square = 14.4, df = 1, $P < 0.005$) (see also Vogrin 1991, where there are mistakes with numbers of pairs), but clutch size did not differ (Mann-Whitney U test, U = 141.3, $P > 0.05$).

In my study area it seems that the largest eggs (egg volume) of the Common Tern are in medium-sized clutches, i.e. clutches with two eggs (Table 1), but the differences between clutches were not significant ($F = 2.59$, $P > 0.05$). The same result was obtained also by Winkel (1970) for the Great Tit *Parus major* eggs.

According to e.g. Ojanen et al. (1981) and Järvinen (1996), in a variable environment, the correlation between egg size and clutch size varies from year to year depending on temperature. Buitron (1988), Järvinen & Pryl (1989), Goodburn (1991), and Horak et al. (1995) found that female body weight and warm weather during the egg laying period had positive effects on egg size. Opposite results were obtained by e.g. Kuitunen (1987) who points out that age, weight and size of the female did not correlate with clutch size. Anyway, Nisbet (1977) showed that female Common Terns with larger body reserves also lay larger clutches. The interpretation given to this has been that the laying of Common Terns is food-limited (the "pre-egg food limitation hypothesis" of Ankney & Macinnes 1978). The egg of the Common Tern weights about 20 g (Glutz von Blotzheim & Bauer 1982, Cramp 1985, Brenninkmeijer et al. 1997), which is 15% of the weight of an adult bird (Cramp 1985). Thus, a clutch of two eggs weighs 30% and a clutch of three 45% of the female weight. One egg is therefore a significant cost for Common Tern (see also Nisbet 1977). Modal clutch size could thus be affected by a significant increase in food prior to egg laying.

According to this I think that clutch and egg size in the Common Tern, at least in my study area, depend mostly on food availability (see also Lack 1947) and maybe also on calcium resources (see Brenninkmeijer et al. 1997, Nisbet 1997) prior to and during egg laying.

Egg length averaged 41.23 mm, egg breadth 30.07

Table 2. Dimensions of eggs of the Common Tern *Sterna hirundo* in Slovenia in 1990 and 1991. Clutch used as sampling unit.

Äggdimensioner hos fisktärna i Slovenien 1990 och 1991. Kullen använd som stickprovsenhet.

Variable *Variabel*	Mean *Medel*	SD	Range *Variationsbredd*	n
Length *Längd* (mm)	41.23	1.31	38.30 – 43.70	90
Breadth *Bredd* (mm)	30.07	0.75	28.40 – 31.45	90
Volume *Volym* (cm^3)	19.52	1.25	16.98 – 22.01	90
Shape *Form*	0.73	0.03	0.66 – 0.78	90

Table 3. Dimensions of the Common Tern *Sterna hirundo* eggs in different parts of Europe.
Dimensioner för fisktärneägg i olika delar av Europa

EL (mm)	EB (mm)	EV (cm^3)	No. of eggs *Antal ägg*	Country (latitude, longitude) *Land (latutud, longitud)*	Source *Källa*
41.8	30.4	20.22	90	Switzerland, Bodensee (47°N 9°E)	Noll (1943)
41.84 (1982)	30.56	20.46	416	Germany, Oberrhein	Glutz von Blotzheim & Bauer
41.9 (1982)	30.3	20.14	59	Slovakia, Danub (48°N 18°E)	Glutz von Blotzheim & Bauer
41.03 (1982)	30.2	19.59	114	Austria, Inn (48°N 13°E)	Glutz von Blotzheim & Bauer
41.4	30.4	20.03	14	Bulgaria, Lake Atanasov (42°N 27°E)	(Konigstedt et al. 1991)
41.5	30.6	20.34		Poland, Lake Jeziorsko (51°N 18°E)	Becker et al. 1997
41.8	30.3	20.09		Germany, Wadden Sea (53°N 08 °E)	Becker et al. 1997
–	–	19.72	199	Netherlands, Dutch Wadden Sea (53°N 5°E)	(Brenninkmeijer et al. 1997)
41.23	30.07	19.52	90*	Slovenia, Dravsko polje (46°N 16°E)	this work

* In this study: Number of clutches. *I denna studie: Antal kullar.*

mm, egg volume 19.52 cm^3 and egg shape 0.73 (Table 2). Application of ANOVA to the 1990–1991 data showed no significant variation in egg length ($F = 2.36$, n.s.), in egg breadth ($F = 1.71$, n.s.) or in egg shape ($F = 1.07$, n.s.) between the two years. However egg volume differed significantly between the years ($F = 4.13$, $P < 0.05$).

Correlation between egg length and egg breadth was 0.08 ($P > 0.5$). Egg volume depended more on egg breadth ($r = 0.88$, $P < 0.001$) than on egg length ($r = 0.50$, $P < 0.005$), whereas egg shape depended more on egg length ($r = -0.75$, $P < 0.001$) than on egg breadth ($r = 0.48$, $P < 0.005$).

The mean egg volume and egg size were similar to those found in e.g. the Dutch Wadden Sea (Brenninkmeijer et al. 1997), Lake Atanasov (Konigstedt et al. 1991), Germany and Poland (Becker et al. 1997) and also similar to data given by Cramp (1985) and Glutz von Blotzheim & Bauer (1982) – Table 3. Latitude and longitude had no significant effects on egg size (volume, breadth, length). It seems that egg size does not change with latitude and longitude in the Common Tern in Europe.

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Sammanfattning

Äggstorlek hos fisktärna Sterna hirundo *i Slovenien*

Trots att fisktärnan har ett vidsträckt utbredningsområde i Holarktis finns få studier av dess ägg. I denna artikel ger jag uppgifter om kull- och äggstorlek från en koloni i ett jordbruksområde i nordöstra Slovenien samt jämför dessa med uppgifter från andra regioner.

Bona i kolonin märktes individuellt och besöktes under en tiodagarsperiod under tiden för den mest intensiva läggningen. Sammanlagt samlades uppgifter från 242 ägg i 90 bon åren 1990 och 1991. Jag mätte äggens längd (EL) och bredd (EB) och beräknade sedan deras volym (EV) och form (ES). Volymen beräknades med formeln $EV = p/6 \times EL \times EB^2$. Formindex beräknades genom ES = EB/EL, vilket innebär rundare ägg ju högre värde för ES. När jag testade värdena statistiskt använde jag kullen som stickprovsenhet eftersom äggmåtten inom en kull inte är oberoende.

Tabell 1 visar kullstorlek och volym. Två eller tre ägg var vanligaste kullstorleken och fyra ägg förekom bara en gång. Detta stämmer med vad man funnit i andra studier. Hos vissa arter har man funnit att kullstorleken minskar när populationstätheten ökar, medan en studie av fisktärna (Burger & Gochfeld 1991) har visat att större kolonier också hade större kullstorlekar. I min koloni gällde dock inte detta. Ena året fanns 27 par och andra året 63 par, men den genomsnittliga kullstorleken var inte olika. Det fanns en tendens i mitt material, dock inte signifikant, att kullar med två ägg hade de största äggen (Tabell 1).

En teori säger att korrelationen mellan kull- och äggstorlek hänger samman med temperaturen i en variabel miljö. Många olika faktorer påverkar dock, och hos fisktärna har man funnit att honans kondition (vikt och storlek) påverkar kullstorleken. Detta har man tolkat som att fisktärnan är födobegränsad under perioden före äggläggningen. Fisktärnan lägger också relativt sett mycket stora ägg. Ett ägg utgör 15% och en treäggskull därför 45% av kroppsvikten, vilket gör det rimligt att anta att födotillfången före äggläggningen kan påverka kullstorleken.

Tabell 2 visar äggens längd och bredd. Det fanns ingen skillnad mellan åren i dessa mått och inte heller i äggens form. Däremot var det skillnad i äggens volym. Det fanns ingen korrelation mellan längd och bredd. Volymen berodde mer på äggens bredd än på deras längd medan det var tvärtom för formindex.

Jämförelsen med uppgifter från andra områden (Tabell 3) visade att det inte fanns några skillnader i äggstorlek, vilket innebär att jag inte kan påvisa några effekter på grund av latitud eller longitud inom Europa.