

MORPHOMETRY OF INLAND COMMON TERNS *Sterna hirundo* IN CROATIA AND SLOVENIA

Morfometrija navadnih čiger *Sterna hirundo* s celinskega dela Hrvaške in Slovenije

JELENA KRALJ¹, MILOŠ MARTINOVIĆ¹,
DAVORIN TOME², LUKA JURINOVIĆ³, ANA GALOV⁴,
IDA SVETLIČIĆ⁴

¹ Institute of Ornithology, Croatian Academy of Sciences and Arts, Gundulićeva 24, 10000 Zagreb, Croatia, e-mail: jkralj@hazu.hr; martinovic@hazu.hr

² National Institute of Biology, Večna pot 111, SI-1000 Ljubljana, Slovenia, e-mail: Davorin.Tome@nib.si

³ Croatian Veterinary Institute, Poultry Centre, Heinzelova 55, 10000 Zagreb, Croatia, e-mail: luka.jurinovic@gmail.com

⁴ Faculty of Science, University of Zagreb, Rooseveltov trg 6, 10000 Zagreb, Croatia, e-mail: ida.svetlicic@biol.pmf.hr, anagalov@biol.pmf.hr

Abstract

Morphometric data on Common Terns breeding in Croatia and Slovenia are presented herewith for the first time. 130 breeding adult Common Terns *Sterna hirundo* were measured between 2016 and 2019 along the Sava and Drava Rivers. Sex was determined for 53 birds: 22 males and 31 females. Significant sexual differences were found for head and bill length, length of bill to skull, and bill depth. Croatian and Slovenian terns had slightly shorter wings and tails compared to birds from the Netherlands, Germany and England and were lighter than birds from Germany and Italy. Head, bill and tarsus lengths were similar to those in north European populations. Contrary to results from Scotland, in our studied population, birds with head and bill lengths >79.0 mm could not be sexed as males reliably.

1. Introduction

Morphometric measures are routinely recorded during bird handling and ringing, resulting in

sets of biometric data of different populations. Although researcher's variation in the quality of measurements exists (MORGAN 2004), standardised methodology (such as SVENSSON 1992, BAKER 1993, ECK *et al.* 2011) allows the use of these data for morphometric analyses. Many bird species are monomorphic in their plumage, but show some size differences between sexes (HERNÁNDEZ *et al.* 2011). Furthermore, biometric differences recorded between bird populations of the same species found in different geographical areas enabled the identification of subspecies (SVENSSON 1992). Characterisation of the morphology of individual birds or populations helps to answer questions related to the aerodynamics of flight, responses to environmental changes etc. (ZINK & REMSEN 1986, RAYNER 1995).

Common Tern *Sterna hirundo* is a colonial species that breeds in Europe, Asia and North America, while it winters along sea coasts of the Southern Hemisphere. It inhabits coastal and inland habitats, nesting mostly on beaches and dunes or on rocky or gravel islands (BECKER & LUDWIGS 2004). In Croatia and Slovenia, the Common Tern breeds both along the coast and inland. The inland population breeds along the Sava and Drava Rivers, mostly on artificial islands of reservoirs and in gravel pits. Common Terns do not have sexual dimorphism in plumage, but females tend to be slightly smaller than males (BECKER & LUDWIGS 2004). A difference between sexes in head and bill lengths was reported; however, it does not allow determining sex of all birds (COULTER 1986, CRAIK 1999). The aim of this study was to investigate body measures and sexual differences in adult birds belonging to inland tern populations along the Sava and Drava Rivers in Croatia and Slovenia.

2. Methods

Between 2016 and 2018, we captured 130 breeding adult Common Terns, mostly using walk-in traps on the nest during the incubation stage (19th May to 18th July). Four birds were captured during the later phase of the breeding season with mist nets on a roosting site close to the colony. Along the Sava, 108 birds were captured in the surroundings of Zagreb, Croatia: 74 at Rakitje, 11 at Blato and 23 at a breeding platform on Siromaja gravel pit. Along

the Drava, 22 terns were captured on artificial islands at Lake Ptuj, Slovenia.

All birds were measured, fitted with plastic and steel rings and released at the same site. Morphometric measures taken include wing length (maximum length), tarsus length, length of head and bill, length of bill to skull and body mass (ECK *et al.* 2011). In 2017 tail and fork lengths (distance between the shortest and the longest tail feathers) were measured for 41 birds, but this was later omitted, as towards the end of the breeding period many birds have worn tail feathers. Bill depths and widths at distal edge of nostrils (DEMONGIN 2016) were measured for 44 birds captured in 2018 and 2019. Wing and tail lengths were measured using a stopped ruler with 1 mm precision, while head and bill lengths, lengths of bill to skull, bill depths and widths and tarsus lengths were measured by calipers with 0.1 mm precision. Body mass was obtained using a digital scale with 0.5 g precision. We took blood samples in order to perform molecular sexing (FRIDOLFSSON & ELLEGREN 1999). Sex was

determined for 53 birds: 22 males and 31 females, mostly those captured in 2018 and 2019. For a few individuals, sex was concluded by observing copulation of colour-ringed birds. Differences among sexes were tested by t-test. All measures of variation in text are presented as mean $\pm$ SD.

3. Results and discussion

Morphometric characteristics of adult Common Terns captured on colonies along the Sava and Drava Rivers are given in Table 1. Significant sexual differences were found for head and bill lengths, lengths of bill to skull, and bill depths. Tail length was the only variable that showed a bimodal distribution (Figure 1).

Measured variables were comparable with those reported for other Common Tern populations in Europe and North America (COULTER 1986, BECKER & LUDWIGS 2004, LICHIERI & SPINA 2005, DEMONGIN 2016). BECKER & LUDWIGS (2004) present sex-specific morphometry data of Common

Table 1. Morphometric characteristics of adult Common Terns along the Sava and Drava Rivers. Mean $\pm$ SD are given in the first, and range and sample size (N) in the second row. t-test: * $p < 0.05$, ** $p < 0.005$, *** $p < 0.0001$

Tabela 1. Morfometrične značilnosti odraslih navadnih čiger z območja Save in Drave. V prvi vrsti podajamo povprečje $\pm$ SD, v drugi vrsti pa rang in velikost vzorca (N). t-test: * $p < 0,05$, ** $p < 0,005$, *** $p < 0,0001$

	All birds	Males	Females	t-test
Wing length / mm	268.7 $\pm$ 6.33 252–283, N = 114	268.8 $\pm$ 6.49 253–279, N = 21	267.2 $\pm$ 6.17 256–280, N = 26	0.878 df = 45
Tarsus length / mm	21.2 $\pm$ 0.87 19.4–24.9, N = 127	21.4 $\pm$ 1.25 19.4–24.9, N = 22	21.1 $\pm$ 0.93 19.5–23.3, N = 29	0.961 df = 49
Head and bill / mm	77.5 $\pm$ 2.66 70.3–83.6, N = 128	79.6 $\pm$ 2.06 75.7–83.6, N = 21	76.5 $\pm$ 2.71 70.3–83.4, N = 30	4.413*** df = 49
Bill length / mm	45.2 $\pm$ 2.59 39.0–53.7, N = 128	45.9 $\pm$ 2.39 40.8–50.0, N = 21	44.1 $\pm$ 2.73 40.2–53.7, N = 30	2.539* df = 49
Bill width / mm	6.0 $\pm$ 0.41 5.2–6.9, N = 44	6.1 $\pm$ 0.45 5.2–6.9, N = 17	6.0 $\pm$ 0.40 5.2–6.8, N = 26	0.419 df = 41
Bill depth / mm	8.4 $\pm$ 0.62 7.0–9.7, N = 44	8.7 $\pm$ 0.50 8.0–9.7, N = 17	8.2 $\pm$ 0.58 7.0–9.7, N = 26	3.005** df = 41
Tail length / mm	149.8 $\pm$ 7.82 135.0–165.0, N = 41			
Fork length / mm	82.0 $\pm$ 6.17 63.0–98.0, N = 41			
Body mass / g	113.4 $\pm$ 7.54 96.0–141.0, N = 125	112.4 $\pm$ 7.70 96.0–127.0, N = 21	114.7 $\pm$ 7.33 105.0–141.0, N = 29	-1.054 df = 48

Tern populations from the Netherlands, Germany and England. Average wing lengths of adult birds from these populations were 271–273 mm for males and 270 mm for females. Our terns had on average 2–4 mm shorter wings. LICHIERI & SPINA (2005) gave mean wing length of Common Terns ringed in Italy per decade, with values mostly below 270 mm. The increase in wing length of northern populations and populations with longer migration is in line with both Bergmann's and Seebohm's rules (BERTHOLD 2001). Similar to wing length, tails of Croatian and Slovenian terns are up to 6 mm shorter than in the English population, while tarsus length was similar to north European populations (BECKER & LUDWIGS 2004).

Body mass shows seasonal variability and circadian fluctuations; therefore differences between populations should be analysed with caution (HERNÁNDEZ *et al.* 2011). Detailed study of body mass change in breeding Common Terns showed that both sexes were heavier during incubation than during the chick-rearing period (WENDELN & BECKER 1996). However, our terns were lighter than birds from German Wadden Sea, also weighted during

the incubation phase (133 ± 7.2 g for males and 136 ± 8.3 g for females, BECKER & LUDWIGS 2004). Italian birds were also heavier than Croatian and Slovenian, having mean body mass of 125.6–129.3 g in June (corresponding to the incubation phase) and 109.7–112.6 g in July (LICHIERI & SPINA 2005).

Head and bill lengths of our population correspond to those measured in populations of England and Scotland. CRAIK (1999) found that in Scottish population head and bill lengths are the best discriminators between sexes, with mean values for males being 79.79 ± 1.521 mm and for females 75.91 ± 1.792 mm. He suggested that individuals with head and bill lengths >79.0 mm can be identified as males and those with <76.9 as females with 95% confidence. In our studied populations, the difference between sexes in head and bill lengths was also the most significant, but still among 17 birds with known sex having head and bill >79.0 mm, five (29.4%) were females. Contrary, among 18 birds with known sex having head and bill <76.9 , only one (5.5%) was a male. Therefore, in our population, birds with head and bill lengths >79.0 mm could not be sexed as males reliably. COULTER (1986) found sig-

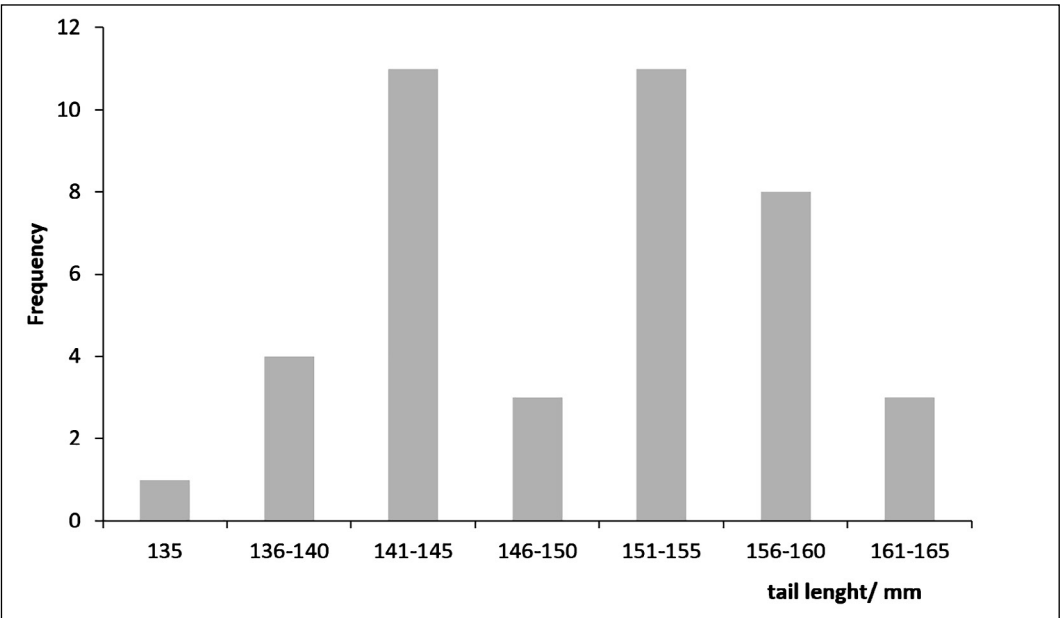


Figure 1. Histogram for the tail length of adult Common Terns sampled in Croatia and Slovenia (N = 41)

Slika 1. Histogram dolžine repa odraslih navadnih čiger iz Hrvaške in Slovenije (N = 41)

nificant differences among sexes in bill length, depth and width, based on 55 females and 50 males caught on Great Gull Island (NY, USA). The difference in bill width was shown to be the least significant variable ($P < 0.05$) in his, and non-significant in our sample. The bimodal distribution of tail length, characteristic for the presence of two groups, indicates that this variable showed differences between sexes, which was already confirmed in the English population (BECKER & LUDWIGS 2004). However, the outmost tail feathers are prone to wear, so this measurement can only be used for a limited period. Therefore, in our study tail length was not recorded in 2018 and 2019, when birds were sexed, so sexual differences in tail length could not be given.

Morphometric data of Common Terns breeding in Croatia and Slovenia are presented for the first time. We showed that it is not possible to use values of head and bill lengths proposed on the basis of the Scottish population to determine sexes in the studied population reliably.

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4. Povzetek

To je prvi prispevek, ki podaja morfometrične podatke gnezdečih navadnih čiger iz Hrvaške in Slovenije. Med letoma 2016 in 2019 smo z območja Save in Drave izmerili 130 odraslih navadnih čiger *Sterna hirundo*. Spol smo določili pri 53 osebkih: 22 je bilo samcev, 31 samic. Značilna spolna razlika je bila v meritvah dolžine glave, dolžine kljuna, dolžine glave in kljuna skupaj in višine kljuna. Čigre iz Hrvaške in Slovenije so imele v primerjavi z osebkami iz Nizozemske, Nemčije in Anglije nekoliko krajše peruti in rep in so bile nekoliko lažje od ptic iz Nemčije in Italije. Dolžine glave, kljuna in tarzusa so bile podobne kakor pri populacijah iz severne Evrope. V nasprotju z ugotovitvami iz Škotske, razlikovanje spola na podlagi dolžine glave in kljuna (mejna vrednost 79.0 mm) pri hrvaških in slovenskih pticah ni zanesljivo.

Key words: sexual dimorphism, head and bill lengths
Ključne besede: spolni dimorfizem, dolžina glave in kljuna

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