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## STATUS AND OCCURRENCE OF THE SANDWICH TERN *Sterna sandvicensis* IN CROATIA

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The authors present information on the status of the Sandwich Tern *Sterna sandvicensis* in Croatia using historical and recent data collected on the Adriatic coast in the period from 1984 to 1997. As well as providing a survey of occurrence, seasonal distribution and migration, they have estimated the number of wintering birds and listed the coastal areas that are most important for migration and wintering of Sandwich Terns on the coast of Croatia.

**Key words:** *Sterna sandvicensis*, Sandwich tern, occurrence, migrations, Croatia

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Autori su prikazali status dugokljune čigre *Sterna sandvicensis* u Hrvatskoj koristeći povijesne i sadašnje podatke prikupljene na obali Jadranskog mora u razdoblju od 1984. do 1997. godine. Osim pregleda pojavljivanja, sezonske rasprostranjenosti i selidbe, procijenjena je brojnost zimovalica i ukazano je na dio obale koji ima veću važnost za selidbu i zimovanje dugokljunih čigri na obali Hrvatske.

**Ključne riječi:** *Sterna sandvicensis*, dugokljuna čigra, pojavljivanje, migracije, Hrvatska

### INTRODUCTION

Sandwich Terns *Sterna sandvicensis* (ST) are rarely seen in Croatia (STIPČEVIĆ, 1996). Except for a few observations, collected birds and some recoveries of ringed birds, we have scant knowledge of the presence, numbers, migration and origin of Sandwich Terns on the Croatian coast. Authors who have investigated

the coast mainly locally and exclusively faunistically only seldom mention the Sandwich Tern (KOSIĆ, 1901; MAŠTROVIĆ, 1931; RUCNER, D., 1957, 1959, 1970; RUCNER, R., 1964; LISSAK, 1990), while many others have not recorded it at all. Investigating the ornithofauna of mid-Dalmatia for half a century KR PAN (1980) only mentioned one recovery of a ringed female, relating to a specimen in the Natural History Museum of Split, giving the Sandwich Tern the status of »stray«. Due to the scanty data, the status of the ST is unclear, but nevertheless MATVEJEV & VASIĆ (1973) accurately concluded that it could be found almost every year and in all seasons during migration or wintering in Istria, Kvarner and Dalmatia, and also in Slovenia, Herzegovina and Monte Negro. So the status is unclear on almost the entire east Adriatic coast, as might be seen from the distribution maps in the standard literature. It is well known that STs are regularly present in winter and that in other seasons visit the coast of Albania and Italy (GLUTZ *et al.*, 1982; HARRISON, 1982; CRAMP *et al.*, 1985; FASOLA, 1986). Concerning the Croatian coast it is clear that the scarcity of published data result from two reasons. First, except for RUCNER and MAŠTROVIĆ, most authors who investigated the coastal region for decades (KR PAN, 1980; IGALFFY, 1980) were unable to find the species. Second, the Croatian coastline is even today not covered by regular observation, only a few ornithologists occasionally investigating the coast.

The Western Palearctic populations of the Sandwich Tern *S. s. sandvicensis* breed in two widely dispersed groups, one on the Atlantic coast of western Europe and the other on the low-lying coast of the Mediterranean, Black and Caspian seas (CRAMP *et al.*, 1985). The most numerous colonies are found on the coasts of Britain and Ireland, France, the Netherlands, former West Germany, Denmark and on the Black Sea. Less numerous colonies in the Mediterranean are found on the mouths of great rivers such as the Ebro, Rhone, Po and Evros (CRAMP *et al.*, 1985; FASOLA, 1986; GOUTNER & KATTOULAS, 1984). Birds from the north-eastern Atlantic winter on the west coast of Africa, birds from the Black Sea stay in the Black Sea area and in the Mediterranean, while the Caspian Sea population has separate winter quarters in the Persian Gulf and the Arabian Sea (CRAMP *et al.*, 1985).

## STUDY AREA AND METHODS

Field work was conducted from 1984 to 1997, mainly in north Dalmatia and occasionally in Istria, Kvarner, Hrvatsko Primorje and in central and southern Dalmatia. Eight coastal wetlands in north Dalmatia and on the island of Pag have been surveyed regularly in all seasons from 1990 to 1991, including two salt-pans in the deep inlets on the island of Pag and one developed in a former lagoon in Nin, Plemići inlet and Ljubač inlet, the low-lying coast at Privlaka, the fresh-water lake Velo Blato on Pag and the brackish lake Vrana in Dalmatia. These coastal wetlands were surveyed at least once in each decade during spring (March, April, May) of 1990 and 1991 and during autumn (August, September, October) of 1990,

but at least once monthly during summer (June, July) 1990 and during winter (November, December, January, February) 1990/91.

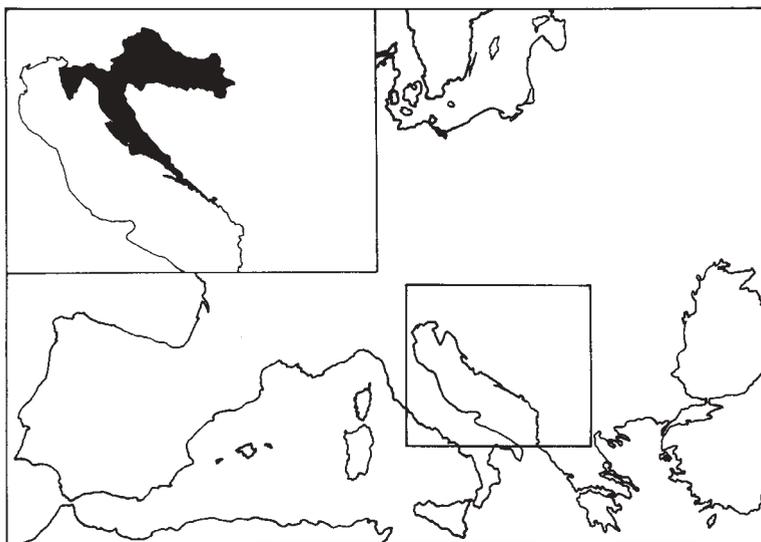


Figure 1. Croatia

Slika 1. Hrvatska

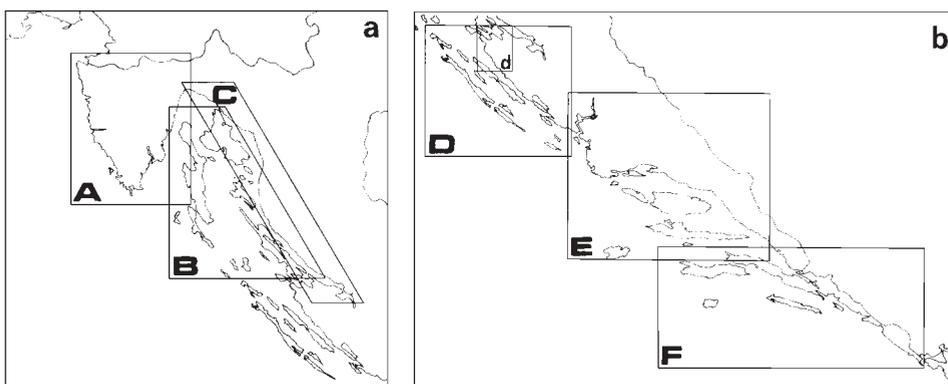


Figure 2. a – Northern Croatian coast: Istria (A), Kvarner (B), Hrvatsko Primorje (C);  
b – Southern Croatian coast (Dalmatia): northern Dalmatia (D), central Dalmatia (E),  
southern Dalmatia (F)

Slika 2. a – Sjeverna obala Hrvatske: Istra (A), Kvarner (B), Hrvatsko Primorje (C)  
b – Južna obala Hrvatske (Dalmacija): sjeverna Dalmacija (D), srednja Dalmacija (E),  
južna Dalmacija (F)

Several specimens of ST collected at the coast of the Adriatic Sea are found in the bird skin collection of the Institute of Ornithology in Zagreb (IO) (SUŠIĆ & RADOVIĆ, 1988) and in the stuffed bird collection of the Croatian Natural History Museum in Zagreb (CNHM) as well as in the stuffed bird collection of the Institute of Biology in Dubrovnik (IBD). Five specimens of ST with the rings of the Moscow ringing scheme were found on the Croatian coast (KRONEISL-RUCNER, 1959, 1960; STROMAR, 1980; SIROTIĆ, 1988).

## RESULTS

From literature we know that STs have been recorded (birds per day at any one different site) in Croatia between 1887 and 1997 on 35 occasions at 14 localities. We observed STs between 1984 and 1997 on 403 occasions at 30 localities. In order to simplify the review of the data the coastal belt was divided into four main regions: The northern region (fig. 2a) comprises Istria, Kvarner, Hrvatsko Primorje, and the southern region (fig. 2b) comprises Dalmatia, which in turn is divided into a northern (from the mouth of Zrmanja River to the mouth of the Krka River), a central (from the mouth of the Krka River to the mouth of the Neretva River) and a southern region (from the mouth of the Neretva River to the Montenegrin coast).

### Northern Croatian Coast (Istria, Kvarner, Hrvatsko Primorje)

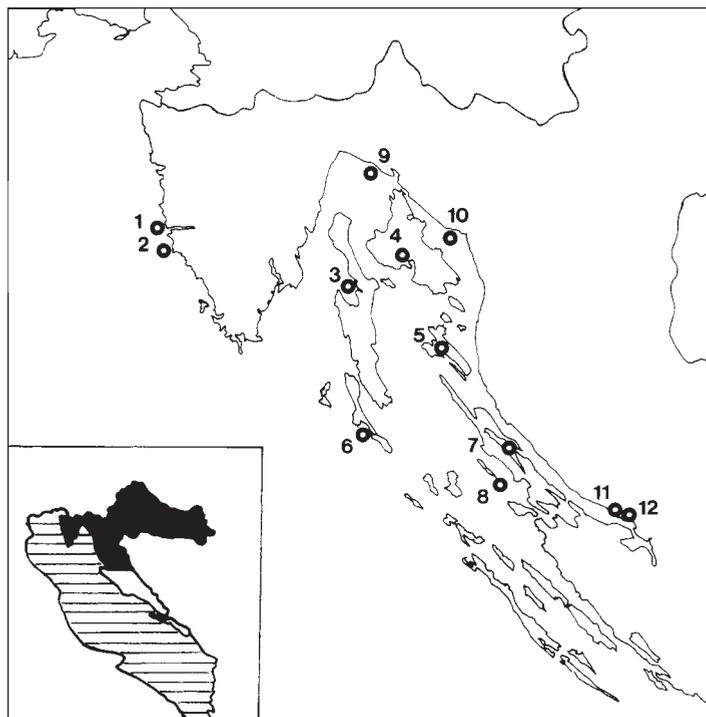
At the most northerly region of the Croatian coast we recorded STs on 19 occasions at 8 sites between 1985 and 1997 (table 2). STs were encountered on the west coast of Istria, along large channels at the mainland coast of Hrvatsko Primorje, on the largest Kvarner islands and around small islets. Apart from this 12 specimens were collected in Rijeka in 1887 and 1899 (RÖSSLER, 1902; CNHM). The presence of the ST could also be recorded on the islands of Lošinj, Rab and Krk (RUCNER, D., 1957; RUCNER, R., 1964) as well as on the west coast of Istria at Vrsar (RIŽNER & KMECL, 1991) (table 1).

Table 1. Published records of ST in Istria, Kvarner and Hrvatsko Primorje

13.11.1887	Rijeka – 1 collected specimen (RÖSSLER, 1902)
17.11.1887	Rijeka – 1 collected specimen (RÖSSLER, 1902; CNHM)
27.11.1887	Rijeka – 1 collected specimen (RÖSSLER, 1902; CNHM)
28.11.1887	Rijeka – 3 collected specimens (RÖSSLER, 1902; CNHM)
2.12.1887	Rijeka – 1 collected specimen (RÖSSLER, 1902; CNHM)
20.4.1899	Rijeka – 5 collected specimens (RÖSSLER, 1902; CNHM)
3.8.1949	Krk island (Soline bay) – »few« observed (RUCNER, D., 1957)
-----	Lošinj, Rab and Krk islands – recorded (RUCNER, D., 1964)
19.12.1990	Vrsar – 2 observed (RIŽNER & KMECL, 1991)

Table 2. Unpublished records of ST in Istria, Kvarner and Hrvatsko Primorje

23-26.10.1985 Rovinj – 5	15.4.1995 Novi Vinodolski – 3
19.3.1987 Starigrad-Paklenica – 3	16.4.1995 Starigrad-Paklenica – 1
16.1.1991 Cres island (Cres) – 2	16.12.1995 Starigrad-Paklenica – 1
20.1.1991 Cres island (Cres) – 3	18.9.1996 Starigrad-Paklenica – 1
23.1.1991 Cres island (Cres) – 1	11.10.1996 Seline – 2
28.1.1991 Cres island (Cres) – 3	15.1.1997 Starigrad-Paklenica – 1
22.2.1991 Krk island (Krk) – 13	1.2.1997 Starigrad-Paklenica – 1
23.2.1991 Krk island (Krk) – 6	25.2.1997 Starigrad-Paklenica – 3
17.3.1991 Cres island (Cres) – 1	3.3.1997 islet Mali Brušnjak, Sea Virsko more – 1
16.3.1993 Pag island (Metajna) – 1	



**Figure 3.** Northern Croatian coast – localities of STs records: 1. Vrsar, 2. Rovinj, 3. Cres, 4. Krk, 5. Rab, 6. Lošinj, 7. Metajna (Pag), 8. Mali Brušnjak islet, 9. Rijeka, 10. Novi Vinodolski, 11. Starigrad-Paklenica, 12. Seline

**Slika 3.** Sjeverna obala Hrvatske – lokaliteti nalaza dugokljunih čigri: 1. Vrsar, 2. Rovinj, 3. Cres, 4. Krk, 5. Rab, 6. Lošinj, 7. Metajna (Pag), 8. otočić Mali Brušnjak, 9. Rijeka, 10. Novi Vinodolski, 11. Starigrad-Paklenica, 12. Seline

## Southern Croatian Coast (Dalmatia)

**Northern Dalmatia** From northern Dalmatia we have 369 records from 14 localities for the period from 1984 to 1997. Before that period STs were recorded on 9 occasions only (table 3); 4 records at Nin from 1920 to 1926 (MAŠTROVIĆ, 1931), a single specimen was collected at Privlaka in 1921 (MAŠTROVIĆ, 1931; SUŠIĆ & RADOVIĆ, 1988; IO), and one ringed bird was found at Zadar in 1955 (KRONEISL-RUCNER, 1959). LISSAK (1990) observed STs in 1987 at Nin and Privlaka. Because of the greater number of records we divided this region into three separate areas according to the number of records and the relative importance of the area for the ST. Along the northern shore of northern Dalmatia (the low-lying, flat coastal area projecting at the northern part of northern Dalmatia, fig. 4d1) most STs concentrate at Privlaka during migration; here there is the greatest recorded concentration of the species on the coast of Croatia. At Zadar (fig. 4d2) STs were observed most often. The remaining part of northern Dalmatia is the most indented coastal area, and the greatest number of STs winter in it.

Table 3. Published records of STs in northern Dalmatia

28.4.1920	Nin – 1 (MAŠTROVIĆ, 1931)
20.12.1921	Nin/Privlaka – 1 collected specimen (MAŠTROVIĆ, 1931; SUŠIĆ & RADOVIĆ, 1988; IO)
2.5.1924	Nin – observed (MAŠTROVIĆ, 1931)
24.4.1925	Nin – observed (MAŠTROVIĆ, 1931)
29.4.1926	Nin – observed (MAŠTROVIĆ, 1931)
30.12.1955	Zadar – 1 ringed recovery (KRONEISL-RUCNER, 1959)
2.6.1987	islet Virić (Školjić), Privlaka – 12 (LISSAK, 1990)
3.6.1987	Nin/Sabunike – 1 (LISSAK, 1990)
14.6.1987	Nin/Sabunike – 1 (LISSAK, 1990)

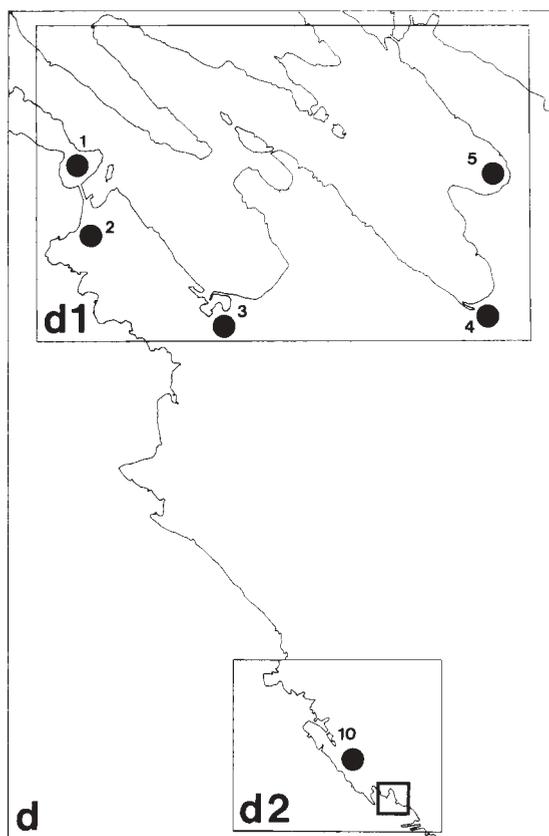
**The northern shore of northern Dalmatia** (fig. 4d1) is the most protruding area of Dalmatian coast between the Velebit Channel, and the islands of Pag and Vir. It embraces two shallow bays (Ninski Zaljev and Ljubački Zaljev) with extensive mudflats, sandy and shingle beaches. This area is sheltered from the strong seasonal north-easterly wind »Bora« and the southerly wind »Jugo« by the promontories of Privlaka and Bočetina, the southern part of the island of Pag and by the island of Vir. We recorded STs in this area on 57 occasions at 5 localities from 1986 to 1997 (table 4, figs. 5&6). The birds could be sighted mainly along coastal mudflats at the mouths of small streams near the villages of Privlaka, Nin, Ljubač and Miočići.

Table 4. Unpublished records of ST on the northern shore of northern Dalmatia, excluding Privlaka

2.5.1986	Nin – 1	19.10.1990	Ljubač – 12
30.11.1986	Vir island – 1	18.1.1991	Plemići – 2

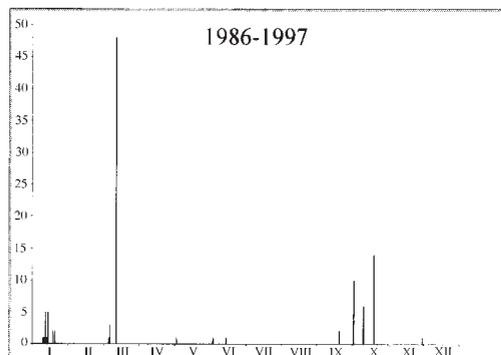
**Table 4. continued**

20.1.1988 Ljubač – 2	13.1.1993 Plemići – 1
5.3.1990 Nin – 1	14.1.1994 Plemići – 4
6.3.1990 Plemići – 3	14.1.1994 Ljubač – 1
11.3.1990 Nin – 48	12.1.1995 Plemići – 3
20.9.1990 Ljubač – 2	12.1.1995 Ljubač – 2
2.10.1990 Ljubač – 10	7.12.1996 Plemići – 6
10.10.1990 Ljubač – 6	11.1.1997 Vir island – 1 (IP)
19.10.1990 Plemići – 2	12.1.1997 Vir island – 1 (IP)



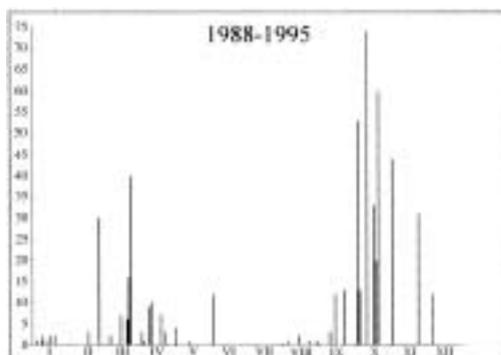
**Figure 4.** North shore of northern Dalmatia (d1) and Zadar (d2) – Localities of STs records: d1 – 1. Vir, 2. Privlaka, 3. Nin, 4. Ljubač, 5. Pleмиći; d2 – Zadar (square – inlet Brodanov Jaz)

**Slika 4.** Sjeverna obala sjeverne Dalmacije (d1) i Zadar (d2) – Lokaliteti nalaza dugokljunih čigri: d1 – 1. Vir, 2. Privlaka, 3. Nin, 4. Ljubač, 5. Pleмиći; d2 – Zadar (kvadrat – uvala Brodanov Jaz)



**Figure 5.** Numbers of STs counted on the north shore of northern Dalmatia (excluding Privlaka) from 1986 to 1997, including LISSAK 1990

**Slika 5.** Brojnost dugokljunih čigri na sjevernoj obali sjeverne Dalmacije (isključujući Privlaku) od 1986. do 1997, uključujući LISSAK 1990



**Figure 6.** Numbers of STs counted at the coast of Privlaka from 1988 to 1995, including LISSAK, 1990

**Slika 6.** Brojnost dugokljunih čigri na obali Privlake od 1988. do 1995, uključujući LISSAK, 1990

**Privlaka** The most important site for the ST in northern Dalmatia is the coast at Privlaka, where we recorded the species on 37 occasions from 1988 to 1997 (fig. 6). At Privlaka the majority of the birds gathered in spring and autumn between the small promontories of Soline and Kulin. During the day, terns assembled on stones and crags on the shoal on the eastern side of the promontory of Soline. The peak spring count was 40 STs in March 1989 and the peak autumn count was 74 STs in October 1990. Counts from the shore at Privlaka revealed a clear migration pattern for northern Dalmatia; an autumn passage from October to November and a spring passage from March to April.

Between the shore by Privlaka and the nearby island of Vir, on the islet Školjić 30 STs were counted at night roost on 27th February 1990. They were accompanied with mixed flocks of waders composed of the Curlew *Numenius arquata*, the Dunlin *Calidris alpina*, the Grey Plover *Pluvialis squatarola*, a single Greenshank *Tringa nebularia*, as well as Little Egrets *Egretta garzetta* and Yellow-legged Gulls *Larus cachinnans*.

**Zadar** (fig. 4d2) The shore near the city of Zadar was surveyed most often and so the greatest number of data were collected at the seaboard of this city. Regular counting started in 1995 at the inlet of Brodanov Jaz, the mouth of the stream Ričina with mudflats in the southern part of the city. This regular counting clearly

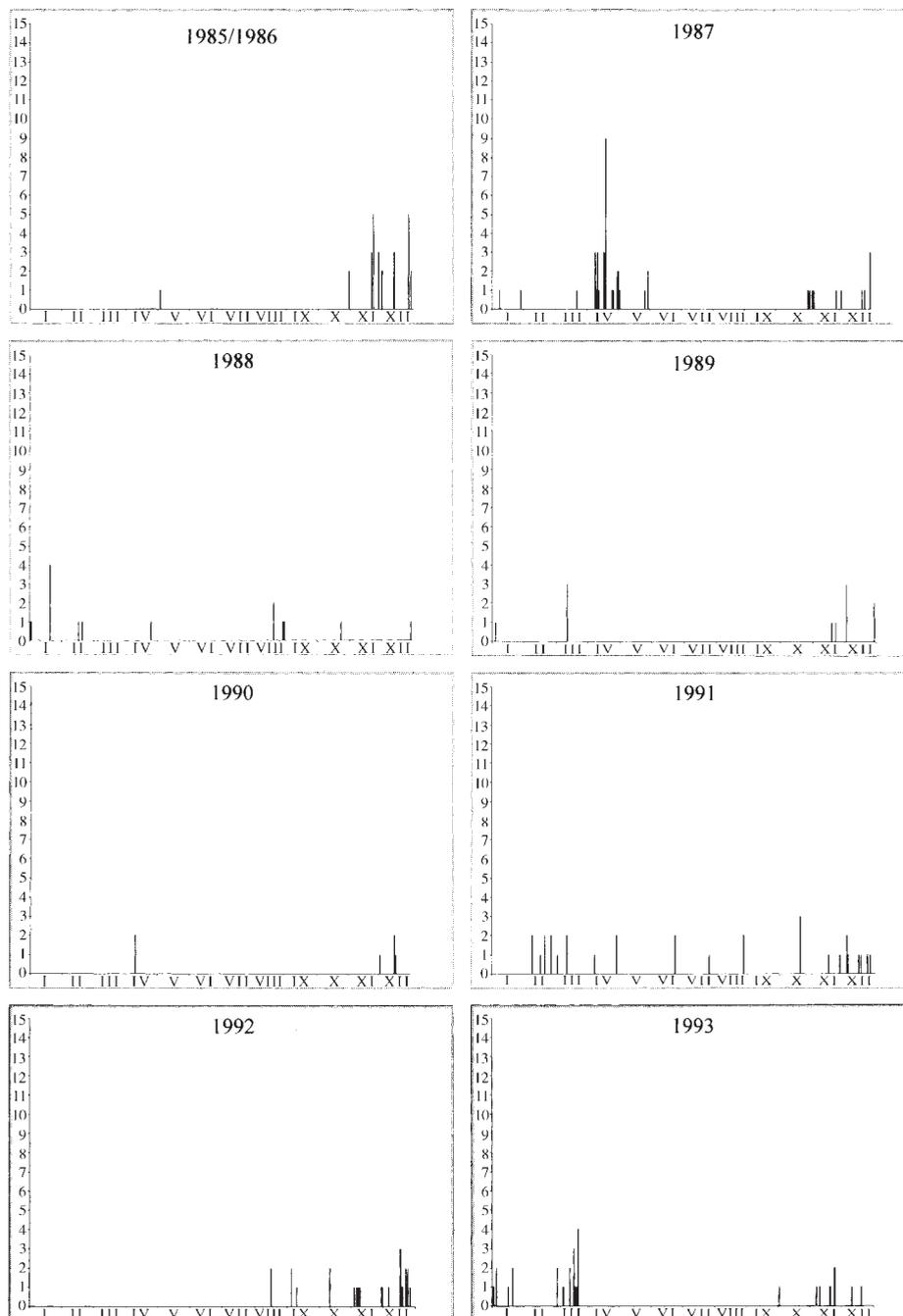


Figure 7. Numbers of STs counted by Zadar from 1985 to summer 1997  
Slika 7. Brojnost dugokljunih čigri u Zadru od 1985. do ljeta 1997.

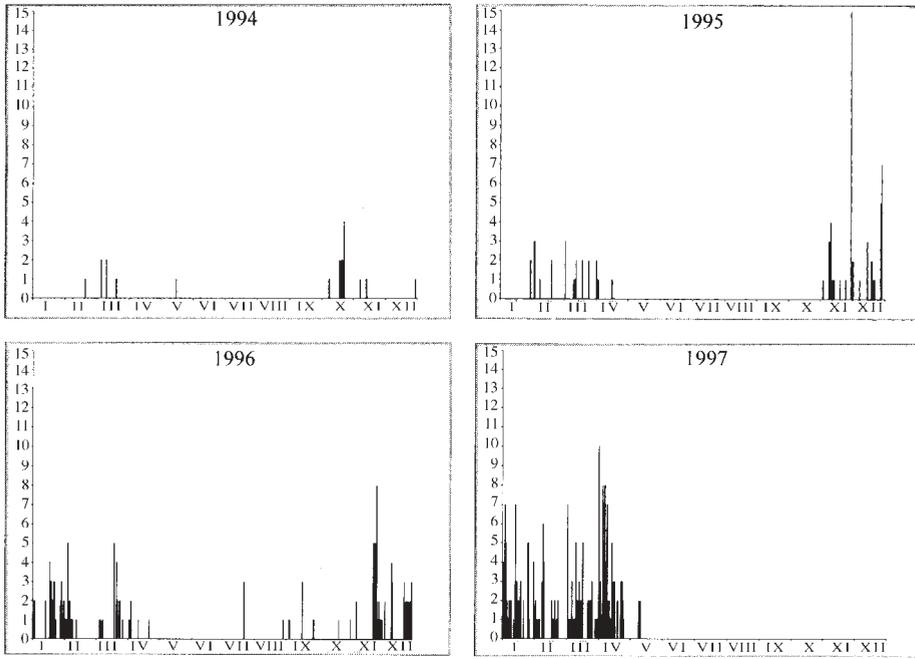


Figure 7. cont.  
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showed not only an increased number of records, as could be expected, but also revealed much higher numbers of STs admixed in flocks of several hundred Black-headed Gulls *Larus ridibundus*. Along the coast around the city, from 1985 to 1997 we saw STs on 282 occasions (fig. 7), but unlike near Privlaka we could not find any very large concentrations. Very seldom were we able to note more than five individuals together. Larger flocks or groups of 5-15 individuals occurred mainly in March, April and November.

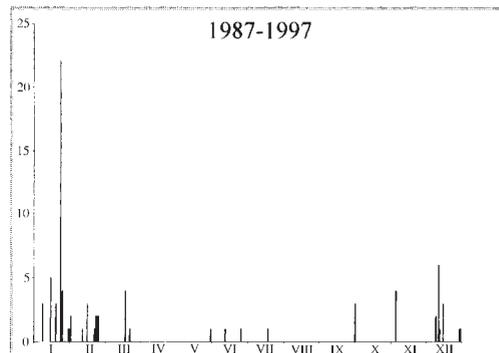


Figure 8. Numbers of STs counted in northern Dalmatia from 1987 to 1997 (excluding the area of the north shore and Zadar)

Slika 8. Brojnost dugokljunih čigri u sjevernoj Dalmaciji od 1987. do 1997. (isključujući područje sjeverne obale i Zadar)

*Northern Dalmatia (excluding the area of the north shore and Zadar)* is the most indented coastal area with numerous islands, islets, channels, bays and inlets. Between 1984 and 1997 STs were sighted on 30 occasions at 8 localities (table 5, fig. 8). STs appeared around larger islands, smaller islets, along the mainland seaboard and at the brackish coastal lake Vransko Jezero.

**Table 5.** Unpublished records of ST in northern Dalmatia, excluding the area of the north shore and Zadar

18.3.1987 Turanj – 2	16.2.1993 Sukošan – 3
18.3.1987 Biograd – 2	22.2.1993 Sukošan – 1
18.7.1987 Ugljan island (Sabaša inlet) – 1	19.1.1994 lake Vransko Jezero – 3
30.12.1988 Turanj – 1	25.1.1994 lake Vransko Jezero – 4
22.3.1989 Sukošan – 1	12.6.1994 channel Srednji Kanal/Dugi Otok island – 1
9.12.1989 Dugi Otok island (Sakarun inlet) – 2	25.6.1994 lake Vransko Jezero – 1
31.5.1990 lake Vransko Jezero – 1	5.11.1994 Kukljica – 2
22.2.1991 channel Zadarski Kanal/Kukljica – 2	5.11.1994 Ždrelac – 2
24.2.1991 Ždrelac – 2	8.1.1995 Prosika (Vransko Jezero, sea coast) – 3
12.12.1991 Ražanac – 1	1.10.1995 Ždrelac – 3
12.2.1992 Kukljica – 1	1.2.1996 Zadarski Kanal channel /Bibinje – 1
11.12.1992 Ždrelac – 6	25.2.1996 Preko (Ugljan island) – 2
15.12.1992 Ždrelac – 3	29.12.1996 Sukošan – 1
15.1.1993 lake Vransko Jezero – 5	23.1.1997 Tisno (Murter) – 22
30.1.1993 Sukošan – 1	1.2.1997 Tisno (Murter) – 2

*Central Dalmatia* Along the central Dalmatian coast the ST was recorded in the first half of the century on 3 occasions only (table 6). Further observations for this area are still lacking. One specimen was collected at Stobreč in 1900 (CNHM), a ringed bird was found in 1953 on the island of Hvar (KRPAN, 1980) and in 1958 on the Pakleni Otoci islands (KRONEISL-RUCNER, 1960). Several recent observations by the city of Trogir in 1986 and 1989 (Robert Crnković) and our additional observations in January 1994 (table 7) confirm at least a regular winter presence of STs in central Dalmatia.

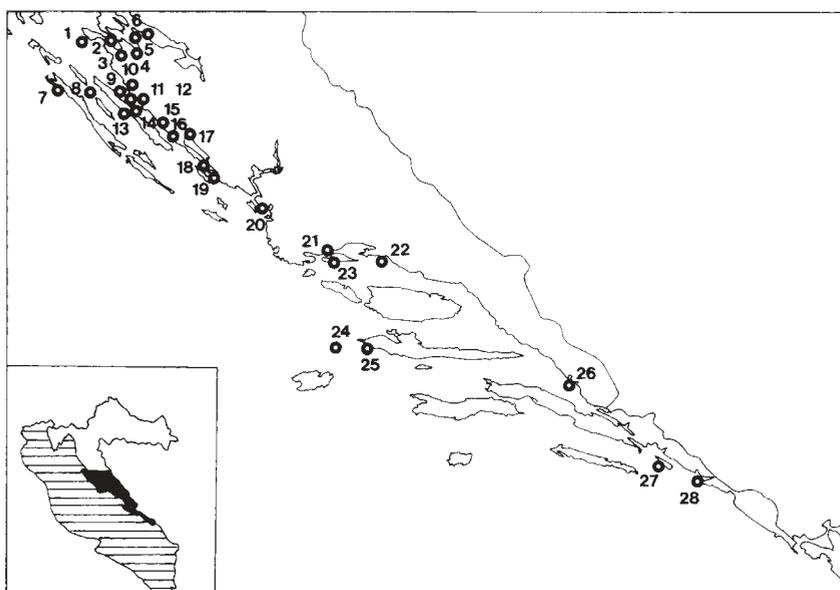
**Table 6.** Published records of STs in central Dalmatia

4.5.1900 Stobreč – 1 collected specimen (RÖSSLER, 1902; CNHM)
26.11.1953 Hvar island – 1 ringed recovery, specimen in Natural History Museum of Split (KRPAN, 1980)
23.11.1958 Lengva islet, Pakleni Otoci islands – 1 ringed recovery (KRONEISL-RUCNER, 1960)

**Table 7.** Unpublished records of STs in central Dalmatia

14.12.1986 Trogir – 2 (RC)	15–28.11.1989 Trogir – 3–8 (RC)
27.12.1986 Trogir – 16 (RC)	10.1.1994 Zaboričje (Jadrtovac/Krapanj, Šibenik) – 1
28.12.1986 Trogir – 14 (RC)	21.1.1994 Okrug Gornji (Čiovo island) – 2

**Southern Dalmatia** Along the extreme southern Croatian coast the ST was recorded on 13 occasions at 3 localities (table 8). Several records are from Dubrovnik, including the record of KOSIĆ (1901), two collected specimens (IBD) and a recovery of a ringed bird are from the island of Lokrum (ŠTROMAR, 1980). One specimen could also be collected on the island of Šipan (IBD). All other records are from the mouth of the Neretva River where several specimens were collected from 1950 to 1958 (RUCNER, D., 1970; SUŠIĆ & RADOVIĆ, 1988), and ringed birds were recovered in 1950 and 1981 (KRONEISL-RUCNER, 1960; SIROTIĆ, 1988). However, more frequent visits to the mouth of the river Neretva from 1994 to 1997 produced 9 additional observations from this coastal area (table 9).



**Figure 9.** Southern Croatian coast (Dalmatia) – localities of STs records: 1. Vir, 2. Privlaka, 3. Nin, 4. Ljubač, 5. Plemići, 6. Ražanac, 7. Sakarun inlet (Dugi Otok island), 8. Srednji Kanal channel/Dugi Otok island, 9. Preko (Ugljan) island, 10. Zadar, 11. Zadarski Kanal channel/Bibinje, 12. Sukošan, 13. Sabuša inlet (Ugljan island), 14. Ždrelac, 15. Turanj, 16. Biograd, 17. Vransko Jezero lake, 18. Prosika, 19. Tisno (Murter), 20. Zaboričje (Jadrtovac/Krapanj, Šibenik), 21. Trogir, 22. Stobreč, 23. Okrug Gornji (Čiovo island), 24. Lengva islet (Pakleni Otoci islands), 25. Hvar island, 26. mouth of the Neretva, 27. Šipan island, 28. Dubrovnik.

**Slika 9.** Južna obala Hrvatske (Dalmacija) – lokaliteti nalaza dugokljunih čigri: 1. Vir, 2. Privlaka, 3. Nin, 4. Ljubač, 5. Plemići, 6. Ražanac, 7. uvala Sakarun (Dugi Otok), 8. Srednji Kanal/Dugi Otok, 9. Preko (otok Ugljan), 10. Zadar, 11. Zadarski Kanal/Bibinje, 12. Sukošan, 13. uvala Sabuša (otok Ugljan), 14. Ždrelac, 15. Turanj, 16. Biograd, 17. Vransko Jezero, 18. Prosika, 19. Tisno (Murter), 20. Zaboričje (Jadrtovac/Krapanj, Šibenik), 21. Trogir, 22. Stobreč, 23. Okrug Gornji (otok Čiovo), 24. otočić Lengva (Pakleni Otoci), 25. otok Hvar, 26. ušće Neretve, 27. otok Šipan, 28. Dubrovnik

**Table 8.** Published records of STs in southern Dalmatia

16.11.1896	Gruž (Dubrovnik) – 1 collected specimen (IBD)
----- 1901	Dubrovnik – recorded (KOSIĆ, 1901)
28.3.1950	Neretva mouth – 2 collected specimens (SUŠIĆ & RADOVIĆ, 1988; IO)
1.5.1950	Neretva mouth – 1 collected specimen (SUŠIĆ & RADOVIĆ, 1988; IO)
7.5.1950	Neretva mouth – 1 collected specimen (SUŠIĆ & RADOVIĆ, 1988; IO)
12.7.1950	Neretva mouth – 2 collected specimens; 1 ringed recovery (KRONEISL-RUCNER, 1960; SUŠIĆ & RADOVIĆ, 1988; IO)
10.5.1953	Neretva mouth – recorded (RUCNER, D., 1970)
18.4.1958	Neretva mouth – recorded (RUCNER, D., 1970)
18.7.1960	Neretva mouth – 2 collected specimens (SUŠIĆ & RADOVIĆ, 1988; IO)
21.2.1963	Dubrovnik – 1 collected specimen (IBD)
25.2.1966	Šipan island (Dubrovnik) – 1 collected specimen (IBD)
12.11.1974	island Lokrum (Dubrovnik) – 1 ringed recovery (ŠTROMAR, 1980)
31.5.1981	Neretva mouth – 1 ringed recovery (SIROTIĆ, 1988)

**Table 9.** Unpublished records of STs in southern Dalmatia

18.1.1994	Neretva mouth – 3	24.1.1996	Neretva mouth – 3
24.5.1994	Neretva mouth – 1	15.3.1996	Neretva mouth – 1
24.6.1994	Neretva mouth – 3	15.8.1996	Neretva mouth – 4
28.4.1995	Neretva mouth – 2	30.3.1997	Neretva mouth – 3
27.6.1995	Neretva mouth – 2		

## DISCUSSION

**Coastal habitat** Outside the breeding season the ST prefers warm marine or estuarine waters where the birds winter, along coastlines that include sandy beaches, mudflats and rocky shores (DUNN, 1972). Most migration takes place within a few hundred meters of the coast line (MOLLER, 1981). In Croatia STs appear along the entire coastline in sheltered bays, inlets, channels between mainland and islands, and at river mouths. The species could be recorded throughout almost all the seasons at the Mediterranean brackish lake Vransko Jezero which is a few hundred meters distant from the sea coast. In Croatia so far no STs have been recorded in inland fresh water habitats. The Croatian coast is almost completely rocky, well indented and there are very few fragmentary and scattered low sandy beaches, mudflats, river mouths and wetlands. In contrast, there are great numbers of bays, inlets, straits and channels, islands and islets. Because of the configuration of the coast, STs appear at many places but in low numbers.

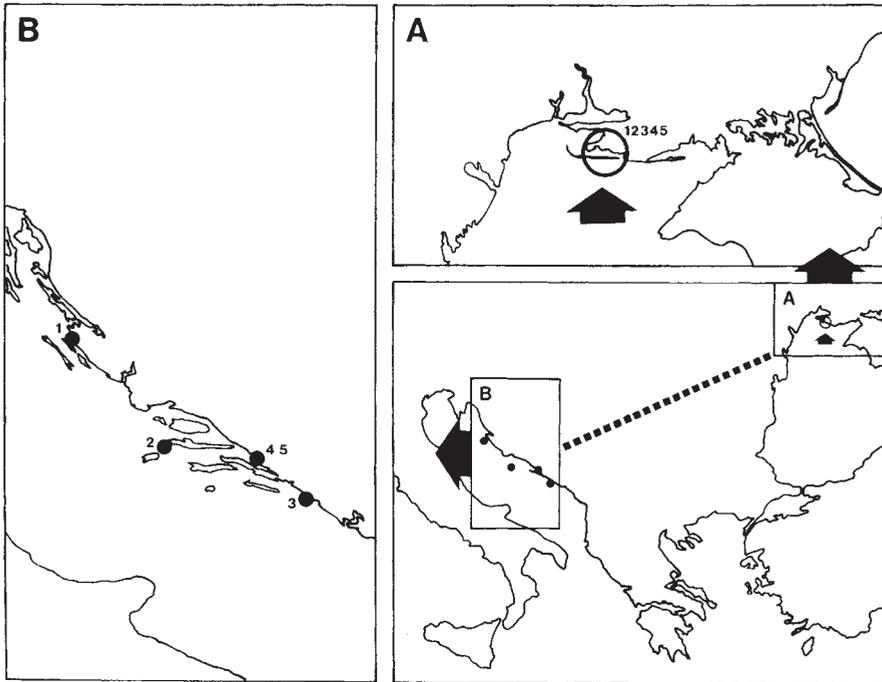
**Quantitative composition of flocks and concentrations** The ST is a gregarious species, and the birds assemble in larger flocks when fish prey is abundant and

concentrated, however throughout the entire year they feed mainly solitarily. Smaller groups are most often composed of formed pairs or family groups (CRAMP *et al.*, 1985). In all seasons we have seen mostly single birds or smaller groups of up to five birds. Excluding greater concentrations during spring and autumn migration on the northern shore of northern Dalmatia, we have seen larger groups sporadically, which indicates that STs disperse and concentrate in areas more abundant with surface fish. On a few occasions only, we recorded larger groups of ten birds. Occurrence of larger groups should be expected elsewhere along the coast, especially in winter at sites abundant with surface fish. Groups of 22 Terns fishing at Tisno in January, 12 in Zadar in December and up to 16 at Trogir in December revealed the regular winter occurrence of greater groups in Dalmatia in shallow, sheltered marine habitats. Larger groups of 10-20 individuals were encountered more frequently in spring and autumn, indicating the passage of migrating birds or premigratory gatherings. Such groups have been found in February (Krk Island, Privlaka), March (Zadar), September (Privlaka), October (Ljubač, Privlaka) and November (Zadar, Privlaka). Even during summer a group of 12 STs was observed near Privlaka (LISSAK, 1990).

The greatest numbers of STs gathered during the migration period on the shore near Privlaka in northern Dalmatia. From 1987 to 1991 the largest numbers were counted in October (74 STs) and in March (40 STs) including 48 STs in March in Nin. The coast around Privlaka is the only locality where such concentrations of STs could be recorded on the entire eastern Adriatic coast from Slovenia to Montenegro. According to the existing data the mouth of the Neretva River in southern Dalmatia could also have a significant importance for STs, but RUCNER, D. (1954, 1959, 1963, 1970) presented no quantitative figures or any counts. Except on the beaches around Privlaka, on the Croatian coast STs have not been regularly observed in groups larger than 20 birds. Similar group sizes were noted on the Bosphorous in Turkey where migration flocks consisted of 3–20 birds (KUMERLOVE, 1980).

**Winter occurrence** Principally Black Sea STs winter in the eastern Black Sea area, the central and south-east Mediterranean as well as along the coasts of Spain and Portugal, occasionally reaching west Africa (MULLER, 1959; ARDAMATSKAYA, 1977). Of all recoveries, 80% were found in the western Mediterranean (ARDAMATSKAYA, 1977; JACOB, 1979), reflecting the greater primary production and higher salinity of the western Mediterranean (ASHMOLE, 1971).

Three winter recoveries from November to December (KRONEISL-RUCNER, 1959, 1960; ŠTROMAR, 1980) (fig. 10) provide evidence that Black Sea birds winter on the eastern Adriatic coast. Also, STs were found wintering along the entire Croatian coast (fig. 11). Every winter, STs were observed on a daily basis in Zadar from 1985–1997. Regular wintering at the Croatian coast should not be in doubt, since it was confirmed by other observations in Istria, Kvarner and Dalmatia. Otherwise STs also winter elsewhere in the Adriatic sea (VASIĆ, 1977; CRAMP *et al.*, 1985; FASOLA, 1986; KAZMIERCZAK, 1986; ŠKORNIK *et al.*, 1990; RIŽNER & KMECL, 1991). Sporadic winter occurrence at some coastal areas can be explained by the

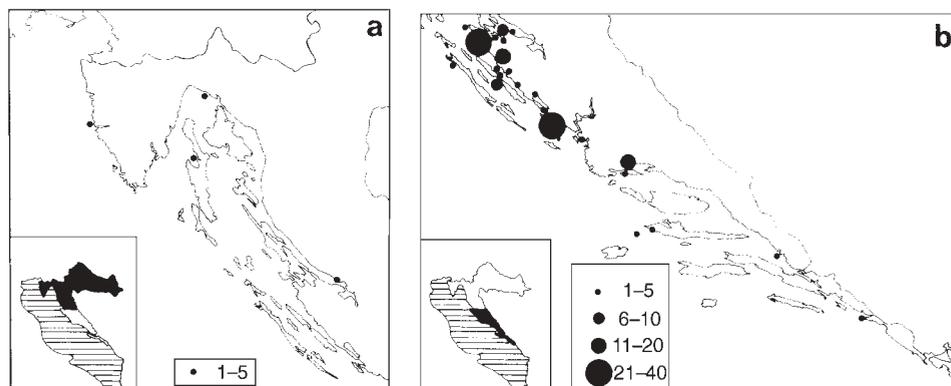


**Figure 10.** Breeding colonies of STs on the Black Sea (A) and recoveries of ringed Black Sea birds in Dalmatia (B): 1. Zadar, 2. Islet Lengva (Islands Pakleni otoci), 3. Islet of Lokrum (Dubrovnik), 4&5. Mouth of Neretva River

**Slika 10.** Kolonije dugokljunih čigri na Crnom moru (A) i nalazi prstenovanih crnomorskih ptica u Dalmaciji (B): 1. Zadar, 2. Otok Lengva (Pakleni otoci), 3. Otok Lokrum (Dubrovnik), 4.&5. Ušće Neretve

dispersal of STs in search of surface fish prey along the well indented Croatian coast.

During winter STs do not concentrate in very large numbers along the Croatian coastline. If this is not due exclusively to the lower fish prey abundance owing to the lower production of the Adriatic, the shortage of suitable coastal habitats in the form of sandy beaches, extensive mudflats, river mouths and wetlands along the uniformly rocky coast is also important. Presumably the appearance and abundance of surface fish shoals in the Adriatic, in addition to the absence of suitable low-lying habitats, cause the dispersal and movement of wintering birds in small scattered groups. In other areas of the Mediterranean STs never winter in large groups and greater concentrations are on the sandy beaches near wetlands, rarely or virtually never occurring along rocky coasts (ISENMANN, 1976; 1978, 1980; JACOB, 1979; VILAGRASA *et al.*, 1982; CARRERA & GARCIA-PETIT, 1986). Along the Croatian coast most STs winter in northern Dalmatia along low-lying and indented shores, whilst smaller scattered groups winter in other coastal regions.



**Figure 11.** Winter records of STs (from November 15th to February 15th) in the Croatia: a – northern Croatian coast (Istria, Kvarner, Hrvatsko Primorje); b – southern Croatian coast (Dalmatia)

**Slika 11.** Nalazi dugokljunih čigri u zimskom razdoblju (od 15. studenog do 15. veljače) u Hrvatskoj: a – sjeverna obala Hrvatske (Istra, Kvarner, Hrvatsko Primorje); b – južno obalno područje (Dalmacija)

Mainly smaller groups of up to five birds were recorded at 23 localities in the winter from 15th November to 15th February (fig. 11), from which arises a minimum figure of 100 STs wintering on the Croatian coast. Anyway, 22 STs were observed at Tisno (January), up to 16 at Trogir (December), 31 at Privlaka (November), and 15 at Zadar (November) indicating the wintering of larger flocks in other parts of the coast as well. However, the greater part of the coast has not been surveyed nor has ever been covered by any count. According to the data presented above we estimate a minimum figure of roughly 200–400 STs wintering along the entire coast of Croatia, of which about one third winter in northern Dalmatia.

**Autumn migration** After completing the breeding season on the Black Sea coast most STs depart from late July to late October via the Romanian coast through the Sea of Marmara to the Mediterranean, where the majority disperse west and south, less commonly east (CRAMP *et al.*, 1985). From their breeding colonies to the wintering area on the Croatian coast STs have to cover a distance of at least 2100 km following the coastline. Average values of speed during autumn migration for west European birds were 8.5–41.9 km/day (MOLLER, 1981). Assuming that Black Sea birds migrate with a similar average speed of about 25 km/day, they cross the distance between their colonies and winter quarters in the eastern Adriatic in about 84 days. This estimate corresponds quite well with the period of two and a half month between the dispersal from the Black Sea colonies in late July and the main concentration in October at Privlaka in northern Dalmatia. At Zadar, STs appear regularly around mid October and later. The frequency of observation implies that the main arrival of Black Sea birds takes place in October.

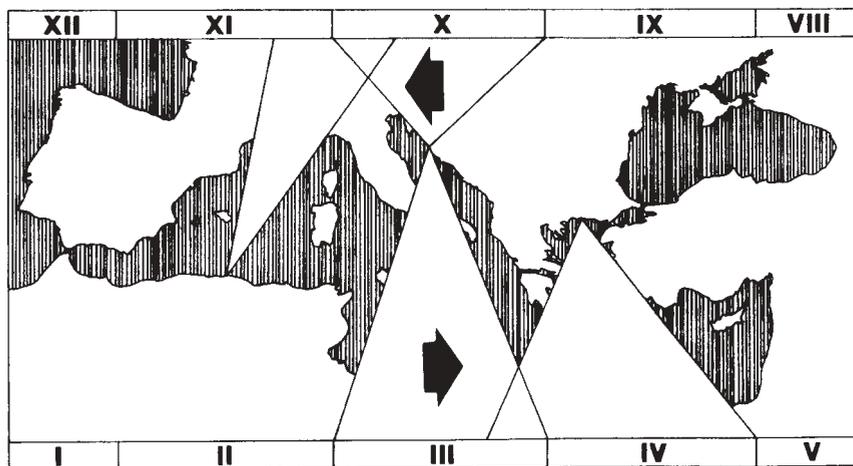


Figure 12. Autumn and spring passage of STs on the Croatian coast of north Dalmatia (Privlaka), Algeria (JACOB, 1983) and Greece (NOBEL *et al.*, 1990)

Slika 12. Jesenski i proljetni prolaz dugokljunih čigri na obali Hrvatske u sjevernoj Dalmaciji (Privlaka), Alžira (JACOB, 1983) i Grčke (NOBEL *et al.*, 1990)

The first birds arrive earlier in August and the main part comes in September and October. The peak of autumn migration at Privlaka is most pronounced between mid September and October. In November numbers suddenly decrease, presumably because the birds disperse along the coast or depart toward their north Adriatic winter quarters on the Italian coast.

The timing of the autumn passage at Privlaka coincides with the passage of Black Sea birds in the western Mediterranean (fig. 12). Black Sea birds are seen off the Algerian coast especially in late October and early November (JACOB, 1983) which is in agreement with observations in southern Spain (GARRIDO *et al.*, 1985).

**Spring migration** The major route of the Black Sea population during spring migration leads across Greece and the Balkans (ARDAMATSKAYA, 1977). The peak of spring migration at Privlaka in north Dalmatia lasts from the end of February to the end of April. The greatest concentrations were recorded in March. The peak of the spring migration at Privlaka is shorter and lesser pronounced than the peak of the autumn migration. This difference could be expected, because different factors influence the timing, speed, numbers and age composition of migrating birds during autumn and spring. The sharp decrease in numbers during April conform with the departure of STs from the Croatian coast toward the Black Sea colonies. Most observations in Zadar are concentrated in March and April, clearly indicating that most STs pass across the Croatian coast at that time. Birds wintering in the northern Adriatic undoubtedly follow the Croatian coast during spring migration. Therefore it could be presumed that all Black Sea birds wintering in the Adriatic have an accurately timed migration which implies the impor-

tance of the coastline of northern Dalmatia around Privlaka as a stop-over site for STs wintering in the Adriatic during spring migration. Between the departure from northern Dalmatia in April until the start of the main laying period in the Crimea in mid May (BORODULINA, 1960) they must cover the distance to their colonies in about 30–45 days to start breeding at the proper time.

Along the north-eastern coast of Greece in Porto Lagos, in spring 1987 STs were most numerous from the end of March until the end of April (NOBEL *et al.*, 1990), about one month later than the peak numbers at Privlaka in northern Dalmatia. So spring departure from northern Dalmatia corresponds quite well with the later passage of Black Sea birds across the Greek coast (fig. 12). Further, peak numbers at Privlaka correspond to the time of arrival and start of breeding of the smaller ST colonies on the north-eastern Italian coast in the Comacchio valley (BRICHETTI & ISENMANN, 1981). So far there have been no recoveries or any other evidence to confirm the presence of Italian or other Mediterranean breeders on the beaches around Privlaka or on the whole Croatian coast during migration or wintering.

**Summer presence** Along the Croatian coast STs could be seen only rarely during summer. So far they have been recorded between June to July mostly in northern but also in southern Dalmatia. A 2nd year Black Sea bird was recovered in mid July in Dalmatia (KRONEISL-RUCNER, 1960), confirming the presence of immature non-breeding birds on the Croatian coast. Another Black Sea bird, at least three years old, was found at the end of May in Dalmatia (SIROTIĆ, 1988), but the age of this bird is not known precisely. LISSAK (1990) observed 12 birds in the first decade of June in northern Dalmatia, but all other data from summer refer to individuals or couples. According to this observations, small numbers of immature birds and non-breeders remained during summer on the eastern Adriatic coast. Immature Black Sea birds up to their 2nd winter mainly frequent the coast of Iberia, France, Mediterranean Morocco, Algeria and Tunisia (TAIT, 1960, 1961; ARDAMATSKAYA, 1977). Up to 3 year old STs were recovered in winter quarters during July-August, since they normally started breeding at 2, most often at 3–4, and sometimes not until 5 years old (CRAMP *et al.*, 1985).

**Movements of Sandwich Terns in the Adriatic** The wintering quarters of STs migrating through northern Dalmatia by Privlaka are not known. Probably these birds winter in the Adriatic on the coast of Croatia and along the Italian coast. An incomplete census in Italy gave a total of 222 wintering individuals (FASOLA, 1986). There is also the possibility that STs wintering elsewhere in the Mediterranean appear during migration along the Croatian coast. However, the latter possibility is less likely, because for birds wintering outside the Adriatic it is not necessary to enter the enclosed and deeply recessed sea between the Apennines and the Balkans, it being easier and faster to cross the Strait of Otranto. This might be confirmed by comparing spring migration peaks on the northern shore of northern Dalmatia (Privlaka, Nin) and in Greece. Maximum spring counts at Privlaka were 40 birds in March 1989 and at Nin 48 in March 1990. At three localities on the north east coast of Greece during spring of 1987 the highest numbers counted were 575 and 269 STs in April and 175 in May (NOBEL *et al.*, 1990). This difference

in the proportions of numbers counted in Greece and Croatia indicates that those STs which gather in northern Dalmatia at Privlaka stay in low numbers during the winter somewhere in the Adriatic. The relatively symmetrical unimodality of autumn and spring numbers at Privlaka indicate the temporally accurate migration of a small population which winters in areas of the Adriatic Sea. It is possible that it represents the total wintering population of northern Dalmatia. Privlaka is an important coastal site for STs migrating across northern Dalmatia and it seems that birds occurring here winter mainly in the Adriatic. Occasionally some STs may pass on migration through the Adriatic before or after wintering in other regions of the Mediterranean, but there is no evidence to confirm this suggestion.

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## SAŽETAK

### Status i pojavljivanje dugokljune čigre *Sterna sandvicensis* u Hrvatskoj

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Na osnovu malog broja poznatih podataka iz zadnjeg stoljeća, dugokljune čigre rijetko posjećuju obalu Hrvatske. Svi podaci koje smo prikupili od 1984. godine pokazuju da ova vrsta redovno obitava na svim dijelovima obale u svim sezonama. Dugokljune čigre se pojavljuju uz niže i zaštićene obale, po zaljevima, uvalama, prolazima, kanalima i riječnim ušćima. Na nekim djelovima obale čigre dolaze samo povremeno u potrazi za ribljim plijenom. U Hrvatskoj je najvažnije područje za zimovanje i selidbu dugokljunih čigri sjeverna obala sjeverne Dalmacije kod Privlake.

Na obali Hrvatske je dokazana jedino prisutnost dugokljunih čigri crnomorske populacije. Uzduž cijele obale pojavljuju se u svim sezonama pojedinačni primerci ili manje grupe, najčešće do 5 ptica u skupini. Razlog takve disperzije bez većih koncentracija je jednoliko krševita obala bez većih pješčano-muljevutih obala,

riječnih ušća i močvara. Veća jata do 15 čigri su opažena samo u nekoliko slučajeva, a obično su to selidbene grupe ili skitalačka jata. Veći broj čigri se sakuplja za vrijeme selidbe samo oko Privlake. Tako su najviše 74 čigre izbrojene u listopadu 1990. za jesenske selidbe i 40/48 čigri u ožujku 1990. godine za proljetne selidbe, a to je najveća poznata koncentracija te vrste na obali Hrvatske.

Dugokljune čigre redovno zimuju na obali Hrvatske u malom broju i vrlo raštrkano. Po našoj gruboj procjeni, uz cijelu obalu zimuje 200–400 čigri, od čega oko jedna trećina zimuje u sjevernoj Dalmaciji.

U jesen crnomorske čigre dolaze na obalu Hrvatske u rujnu, a pik selidbe kod Privlake zabilježen je u listopadu. U studenom se čigre raspršuju duž obale.

U proljeće se čigre počinju okupljati kod Privlake od kraja veljače, a pik selidbe zabilježen je u ožujku. U travnju čigre odlaze iz sjeverne Dalmacije prema svojim kolonijama na Crnom moru.

Preko ljeta manji broj čigri, uglavnom spolno nezrelih i negnijezdećih ptica, ostaje na obali istočnog Jadrana, što pokazuje jedan nalaz i nekoliko opažanja na obali Hrvatske.

Karakteristike i vrijeme selidbe dugokljunih čigri u sjevernoj Dalmaciji pokazuju da se kod Privlake sakuplja isključivo manji broj ptica koje zimuju negdje unutar Jadrana ili samo u sjevernoj Dalmaciji. Obala kod Privlake je stoga važno stanište za selidbu dugokljunih čigri koje zimuju na Jadranu.