

Super-normal Clutches and Female-female Pairs in Gulls and Terns Breeding in Poland

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Abstract.—Super-normal clutches (five eggs or more) in the Caspian Gull (*Larus cachinnans*), Mediterranean Gull (*Larus melanocephalus*) and Whiskered Tern (*Chlidonias hybrida*) are described. These species have regularly bred in Poland since the beginning of the 1990s. The occurrence of super-normal clutches was 1.8%, 4.1% and 0.3% in the Caspian Gull, Mediterranean Gull and Whiskered Tern, respectively. The first descriptions of a female-female pair in the above species as well as in the Yellow-legged Gull (*Larus michahellis*) and an unusual mixed female-female pair of two gull species (Yellow-legged Gull and Caspian Gull), never mentioned in the literature before, are also presented. The first fully documented case of a multi-female association of the Mediterranean Gull was also identified. The frequency of the SNCs in this study was higher than in other colonies located in different parts of the geographical range of the species. Received 06 January 2007, Accepted 25 June 2007.

Key words.—clutch size, super-normal clutches, female-female pairs, multi-female association, mixed female-female pair.

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Super-normal clutches (hereafter SNCs) are defined as clutches exceeding the modal clutch size by more than 50% (Conover 1984a). In the case of birds laying usually three eggs, like most gulls and some tern species the SNCs contain five or more eggs (Cramp 1985). In most instances SNCs result from female-female pairing or multi-female associations. Nevertheless, sometimes clutches with four or even a smaller number of eggs can be attended by two females (Conover 1984a, b; Conover and Aylor 1985), for example in the Herring Gull (*Larus argentatus*) female-female pairs have been noted at nests containing one, two or three eggs (Shugart *et al.* 1988).

Usually, about 60-70% of all eggs in female-female clutches are fertilized (Lorek and Tryjanowski 1993). Consequently, breeding success of female-female pairs is lower than that of heterosexual pairs. A lower breeding success is also a result of the lack of courtship feeding and failures of parental care as compared with heterosexual pairs (Kovacs and Ryder 1983; Lagrenade and Mousseau 1983). Also, the quality of birds forming female-female pairs may be lower than that of heterosexual pairs (Mills 1989;

Nisbet and Hatch 1999). Despite this, female-female pairs may be formed as the last resort in a strategy that enhances the fitness or experience of females that cannot find a male mate (Nisbet and Hatch 1999).

There are several hypotheses explaining proximate factors of male shortage in some populations. First, parents may invest more in females during reproduction and males may have lower survival rates than females (Coulson and Wooler 1976; Griffiths 1992; Szczys *et al.* 2001). Second, they may also be more susceptible to DDT contamination (Gilman *et al.* 1977; Shugart 1980; Fry and Toone 1981), which has been recorded for at least some species (Conover 1983, 1984a; Fry *et al.* 1987). Finally, in gulls, sexes may differ in their tendency to migrate (Chabrzyk and Coulson 1976) and therefore, in new growing colonies, there may be an excess of females (Kadlec and Drury 1968).

In this paper we present evidence for the presence of SNCs (as well as nests containing four eggs) and multi-female associations in the colonies of Caspian Gull (*Larus cachinnans*), Yellow-legged Gull (*Larus michahellis*) and Whiskered Tern (*Chlidonias hybrida*) in southern Poland, as well as data on the Med-

iterranean Gull (*Larus melanocephalus*) from all of Poland. We also compare the frequency of SNCs in our study with published data from other colonies located in different geographical regions.

METHODS

Caspian and Yellow-legged Gull

Data relating to the Caspian Gull and Yellow-legged Gull were collected at the two largest inland breeding colonies of the first species in southern Poland located in Tarnów and Jankowice. The colony in Tarnów was located on "Czajki" sedimentation basins of Nitrogen Works (50°00'N, 20°57'E, 195 m asl, 20.7 ha). Four gull species were breeding there: Caspian Gull (the population has grown from one pair in 1992 to 177 in 2001), Black-headed Gull (*Larus ridibundus*), Common Gull (*Larus canus*) and Mediterranean Gull (Skórka *et al.* 2005, 2006). The second colony was located on Jankowice gravel-pit (50°02'N, 19°27'E, 215 masl, 41.5 ha) in the Upper Vistula River Valley. The colony of Caspian Gulls was located on one island and the number of breeding pairs has grown from ten pairs in 1998 (Skórka and Wójcik 2000) to about 100 in 2002-2004. Black-headed Gulls and Black-crowned Night Herons (*Nycticorax nycticorax*) were also breeding on this island. Usually, only few pairs of Yellow-legged Gulls were present in both colonies and they probably consisted of up to 5% of all breeding pairs of large gulls.

Gull colonies were visited several times during the breeding season for breeding biology studies and for chick ringing. Nests were visited at one-day intervals in 2000 and once or two times per week in other years. All nests were tagged. Caspian Gulls and Yellow-legged Gulls were trapped at nests during 1999-2004 using nooses prepared from a fishing line. Trapped gulls were weighed and standard measurements, enabling sex identification, were taken (Faber *et al.* 2001). Captured gulls were sexed using the functions described by Bosch (1996). Males of these species are larger than females (Faber *et al.* 2001)

Mediterranean Gull

Data on the clutch size of Mediterranean Gulls came from several gull colonies from Poland, and were gathered in the years 1996-2006. Usually, in Poland, Mediterranean Gull nests solitary or in small numbers in large colonies of Black-headed Gull (Zielinska *et al.* 2007). Nests of Mediterranean Gulls were visited several times during incubation. Eggs were placed in a container of water to determine incubation stage (Hays and LeCroy 1971).

Nests with SNCs were found in four places only: Jankowice (described above), Skoki gravel-pit near the city of Włocławek (52°37'N, 19°24'E, 65 masl, 170 ha), an island on the Vistula River near the town of Kazimierz Dolny (51°16'N, 21°52'E, 124 masl) and Przykona reservoir (former mining area (52°00'N, 18°39'E). The majority of Mediterranean Gulls were captured with walk-in traps put on nests with eggs or little chicks. Few birds were caught by application of nooses made of a fishing line. Gulls were sexed through a comparison of wing length and body mass. Males of this species are slightly

longer-winged and heavier than females (Snow and Perrens 1998). Birds captured on Przykona reservoir in 2006 were sexed on the basis of PCR method (Polymerase Chain Reaction; Griffiths *et al.* 1998).

Whiskered Tern

Monospecific colonies of the Whiskered Tern were located at the Goczalkowice Reservoir (49°55'N, 18°50'E, 255 masl, 3200 ha) and on the fishponds in the Upper Vistula River Valley near the town of Zator in the years 1993-2001. Nests of Whiskered Terns were platforms built from plants and floated on the water surface among water vegetation. Total size of the colonies ranged from eleven to 94 nests with the total population size reaching 207 pairs in 1995. Nests were visited five to eight times during the incubation period. Terns on nests containing SNCs were not trapped.

Evidence for Female-female Pairing and Other Multi-female Associations

Captures of birds were attempted on nests with SNCs. SNCs were classified as belonging to female-female pair when two females were captured at the nest, and no male was captured or observed in the nest vicinity. Observations were also conducted from the hide (13 h in total) and videotaping was used to identify birds attending SNCs. Additional, helpful clues to define SNCs were different background color of various eggs in the SNC and completion of eggs in very short time (e.g., two eggs in one day). Multi-female association refer to a situation when two females and a male were captured at one nest.

RESULTS

SNCs and Female-female Pairing in Caspian Gull

In the Caspian Gull colonies the percentage of SNCs reached 1.8% (N = 683 nests; Table 1). In the case of six SNCs with known history, in only one case did one egg hatch. Female-female pairs were noted at two nests (one with five and one with four eggs) in 2004. At both nests, only two females were captured during our efforts and no male was observed at the nests.

Proof that heterosexual pairs could attend SNCs, was gained. At two nests (one with seven and one with five eggs) the broods were probably parasitized by other females as heterosexual pairs were trapped at these nests. A five-hour videotaping and observation from the hide at one of these nests also failed to indicate that more than one known female attended the nests.

Table 1. Clutch size in the Caspian Gull colonies.

Year	Clutch size							Total
	1 egg	2 eggs	3 eggs	4 eggs	5 eggs	6 eggs	7 eggs	
1997	2	8	46	—	1	—	—	57
1998	1	12	57	2	1	—	—	73
1999	2	15	94	1	2	1	—	115
2000	1	9	113	3	2	—	—	128
2002	2	13	77	1	1	—	—	94
2003	—	8	88	—	1	—	1	98
2004	—	8	104	1	2	—	—	115
Total	8	73	579	8	10	1	1	683

Yellow-legged Gull Female-female Pair

In 2000 in the Tarnów colony of Caspian Gull a “double nest” (two nests touching at the edges; see Southern 1978) was found. The first nest contained five eggs and the second one egg. Two eggs in the first nest were unfertilized and the rest disappeared. In that nest, two female Yellow-legged Gulls were captured and no male was observed in the vicinity. It was the first known case of a female-female pair in this species.

Caspian Gull × Yellow-legged Gull Female-female Pair

In 2004, in the Caspian Gull colony in Jankowice, one nest with five eggs differing in background color was found. Two females were caught at this nest. One of them was a Yellow-legged Gull that was ringed as a chick in Italy in 1997. The second female caught was a typical Caspian Gull—not ringed previously. All eggs were unfertilized and the nest was abandoned about ten days after the laying of the first egg. After another ten days, a new nest with five eggs was discovered with the same Yellow-legged Gull female tending it, recognized by ten-hour videotaping, and no mate was observed. All eggs were of the same color and were unfertilized. To our knowledge it is the first case of mixed female-female pair of two species.

SNCs and Female-female Pair in Mediterranean Gull

In years 1996-2006 six SNCs were found, all with five eggs (4.1% of all known nests of

the species; Table 2). The nests were always located within the colonies of Black-headed Gull: single nests found in Jankowice in 2000 and 2004 contained unfertilized egg; one nest in the Skoki gravel-pit in 2001 were incubated by three adults, all captured and identified on the basis of comparison of their biometric data as two females and one male (two smaller individuals weighted 281 g and 283 g, whereas heavier (male) weighted 307 g). Two nests containing SNCs were found on an island on the Vistula River near Kazimierz Dolny in 2003 and 2005, but it is not known how many adults incubated these clutches. The clutch from Przykona reservoir was incubated by two females (sexed on the basis of PCR method).

SNCs in Whiskered Tern

The frequency of SNCs in the Whiskered Tern was 0.3%, and only three nests with such clutches were discovered (Table 3). These clutches were characterized by a clear difference in the background color but not in the laying dates of consecutive eggs. In one clutch of five eggs with known fate, two chicks hatched. In another nest, containing six eggs, four appeared to have not been fertilized (the fate of the two remaining is unknown). This suggests that the clutches could belong to female-female pairs.

Frequency of SNCs in Poland

The frequency of the SNCs was higher in colonies of the studied species in this study than in colonies from other geographical regions (Table 4). In fact, SNCs in Black and

Table 2. Clutch size of Mediterranean Gull in Poland.

Year	Clutch size					Total
	1 egg	2 eggs	3 eggs	4 eggs	5 eggs	
1996	—	2	1	—	—	3
1997	1	2	—	—	—	3
1998	1	1	—	—	—	2
1999	—	1	2	—	—	3
2000	—	2	8	—	1	11
2001	—	5	12	—	1	18
2002	1	3	12	—	—	16
2003	2	7	10	—	1	20
2004	2	5	12	—	1	20
2005	—	3	15	1	1	20
2006	1	7	21	—	1	30
Total	8	38	93	1	6	146

Mediterranean Sea basins were absent (Table 4). In case of Caspian Gull and Mediterranean Gull the differences were statistically significant. Significant differences in frequency of SNCs between the Caspian Gull, Mediterranean Gull and Whiskered Tern were also noted in Polish colonies ($G_2 = 6.2$, $P < 0.05$).

DISCUSSION

The percent of SNCs differed among Caspian Gull, Mediterranean Gull and Whiskered Tern (1.8%, 4.1% and 0.3% respectively). Most of SNCs in our studied species belonged probably to female-female pairs or other multi-female associations. The estimated frequency in SNCs was low as the nest checking frequency was not high enough to detect all cases of partial nest predation

(e.g., some SNCs could not be detected as eggs could be laid and then depredated between two controls). However, in earlier detailed studies we have shown that egg losses were minimal (Betleja 2003; Skórka *et al.* 2005) and in other colonies of these species SNCs were absent (Kostin 1983; Goutner 1986; Yudin and Firsova 1988, Bakaria *et al.* 2002). For that reasons, this probable bias did not influence interpretation of our results.

It was shown that occurrence of SNCs varied between colonies at different growth stages (Fox and Boersma 1983). In Ring-billed Gull (*Larus delawarensis*) the percent of SNCs was higher in new colonies breeding in areas of range expansion (2.8%) than within the center of species distribution (0.26%) (Fox and Boersma 1983). In gulls, sexes may differ in the tendency towards migration (Chabrzyk and Coulson 1976) so

Table 3. Clutch size in the colonies of Whiskered Tern.

Year	Clutch size						Total
	1 egg	2 eggs	3 eggs	4 eggs	5 eggs	6 eggs	
1993	2	5	44	—	—	—	51
1994	4	22	128	—	—	—	154
1995	2	34	170	1	—	—	207
1996	2	30	77	2	—	—	111
1997	3	13	50	—	—	—	66
1999	—	14	109	4	2	—	129
2000	1	20	85	5	—	1	112
2001	1	24	83	2	—	—	110
Total	15	162	746	14	2	1	940

Table 4. Comparison of the frequency of the SNCs in this study with colonies in other geographical regions. The results of the Fisher's exact test are shown.

Species	This study		Other colonies		P
	Normal and 4 egg clutches	SNCs	Normal and 4 egg clutches	SNCs	
Caspian Gull ^a	671	12	7,731	0	<0.0001
Mediterranean Gull ^b	140	6	835	0	<0.0001
Whiskered Tern ^c	937	3	369	0	>0.05

Data on clutch size distribution from other colonies were compiled from the literature: ^aKostin (1983) and Yudin and Firsova (1988), ^bGoutmer (1986), ^cBakaria *et al.* (2002).

in new colonies there may be an excess of females (Kadlec and Drury 1968). Such a biased sex ratio should be more apparent at the range boundary, where suitable habitat patches may be isolated, less stable and fewer (Nisbet and Hatch 1999; Holt and Keitt 2000; Doherty *et al.* 2003). As most of the colonies in this study were new and growing, a probable female-biased sex ratio, due to different migration propensity between sexes, may explain presence of SNCs.

The important unsolved problem is the status of four-egg clutches. These may belong both to female-female pairs, heterosexual pairs whose nests were parasitized by other females, or may be normal clutches. However, our data do not allow for convincing classification as only the background color of the eggs was known but no bird was captured at the nests. The frequency of four-egg clutches was especially high in Whiskered Terns. Conover (1983) found that in colonies of the other species, Caspian Tern (*Sterna caspia*), the proportion of four-egg clutches reached 4%. Two four-egg nests, where all birds were trapped, belonged to female-female pairs (Conover 1983). In the case of Roseate Terns (*Sterna dougallii*) studied by Nisbet and Hatch (1999) the frequency of SNCs in local populations varied yearly from 3.3% to 6.7% and even reached 13.7% in one subcolony. That local population was increasing and characterized by a female-biased sex ratio and birds forming female-female pairs appeared to be of a low phenotypic quality (Nisbet and Hatch 1999).

We think that data on clutch size distribution from different parts of the geographical range of studied species (and others) as well

as from old and new colonies within the same region are required. This could elicit interesting geographical patterns in ecology of species and could allow separate testing of two hypotheses: (1) that the frequency of SNCs should be higher in new growing colonies and (2) that the frequency of SNCs should be higher at the range boundary. If, as we hypothesize, most of SNCs belonged to female-female pairs, this could be also included in the modeling of population dynamics, especially in case of endangered species.

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LITERATURE CITED

- Bakaria, F., H. Rizi, N. Ziane, Y. Chabi and J. Bańbura. 2002. Breeding ecology of Whiskered Tern in Algeria, North Africa. *Waterbirds* 25: 56-62.
- Betleja, J. 2003. Ecological conditions of the expansion of Whiskered Tern. PhD Thesis. University of Wrocław. In Polish.
- Bosch, M. 1996. Sexual size dimorphism and determination of sex in Yellow-legged Gull. *Journal of Field Ornithology* 67: 534-541.
- Chabrzyk, G. and J. C. Coulson. 1976. Survival and recruitment in the Herring Gull, *Larus argentatus*. *Journal of Animal Ecology* 45: 187-203.

- Conover, M. R. 1983. Female-female pairings in Caspian Terns. *Condor* 85: 346-349.
- Conover, M. R. 1984a. Occurrence of super-normal clutches in the *Laridae*. *Wilson Bulletin* 96: 246-267.
- Conover, M. R. 1984b. Frequency, spatial distribution and nest attendants of super-normal clutches in Ring-billed and California gulls. *Condor* 86: 467-471.
- Conover, M. R. and D. E. Aylor. 1985. A mathematical model to estimate the frequency of female-female or other multi-female associations in a population. *Journal of Field Ornithology* 56: 125-130.
- Coulson, J. R. and R. O. Wooller. 1976. Differential survival rates among breeding Kittiwake Gull (*Rissa tridactyla* L.). *Journal Animal Ecology* 45: 205-213.
- Cramp, S. (Ed.) 1985. *The Birds of the Western Palearctic*. Vol. 4. Oxford University Press.
- Doherty, P. F. Jr., T. Boulonier and J. D. Nichols. 2003. Local extinction and turnover rates at the edge and interior of species' ranges. *Annales Zoologici Fennici* 40: 145-153.
- Faber, M., J. Betleja, R. Gwiazda and P. Malczyk. 2001. Mixed colonies of large white-headed gulls in southern Poland. *British Birds* 94: 529-534.
- Fox, G. A. and D. Boersma 1983. Characteristics of super-normal Ring-billed Gull clutches and their attendants. *Wilson Bulletin* 95: 552-559.
- Fry, D. M. and C.K. Toone. 1981. DDT-induced feminization of gull embryos. *Science* 213: 922-924.
- Fry, D. M., C. K. Toone, S. M. Speich and R. J. Peard. 1987. Sex ratio skew and breeding patterns of gulls: demographic and toxicological considerations. *Studies in Avian Biology* 10: 26-43.
- Gilman, A. P., G. A. Fox., D. B. Peakall, S. M. Teeple, T. R. Carrol and G. T. Haymes. 1977. Reproductive parameters and egg contaminant levels of Great Lakes Herring Gulls. *Journal of Wildlife Management* 41: 458-468.
- Goutner, V. 1986. The ecology of the first breeding of the Mediterranean gull (*Larus melanocephalus* Temminck 1820) in the Evros delta (Greece). *Ecology of Birds* 8: 189-197.
- Griffiths, R. 1992. Sex biased mortality in the Lesser Black-backed Gull *Larus fuscus* during the nestling stage. *Ibis* 134: 237-244.
- Griffiths, R., M. Double, K. Orr. and Dawson, R. 1998. A DNA test to sex most birds. *Molecular Ecology* 7: 1071-1076.
- Hays, H. and M. LeCroy. 1971. Field criteria for determining incubation stage in eggs of the Common Tern. *The Wilson Bulletin* 83: 425-429.
- Holt, R. D. and T. H. Keitt. 2000. Alternative causes for range limits: a metapopulation perspective. *Ecology Letters* 3: 41-47.
- Kadlec, J. A. and W. H. Drury. 1968. Structure of the New England Herring Gull population. *Ecology* 49: 644-676.
- Kostin, Y. V. 1983. *Pticy Kryma*. Nauka, Moskwa.
- Kovacs, K. M. and J. P. Ryder. 1983. Reproductive performance of female-female pairs and polygynous trios of Ring-billed Gulls. *Auk* 100: 658-669.
- Lagrenade, M. and P. Mousseau. 1983. Female-female pairs and polygynous associations in a Quebec Ring-billed Gull colony. *Auk* 100: 210-212.
- Lorek, G. and P. Tryjanowski. 1993. Female-female pairs in birds (a review). *Notatki Ornitolologiczne* 34: 141-156. In Polish with an English summary.
- Mills, J. A. 1989. Red-billed Gull. Pages 387-404 in *Lifetime Reproduction in Birds* (I. Newton, Ed.).
- Nisbet, I. C. T. and J. J. Hatch. 1999. Consequences of a female-biased sex-ratio in a socially monogamous bird: female-female pairs in the Roseate Tern *Sterna dougallii*. *Ibis* 141: 307-320.
- Shugart, G. W. 1980. Frequency and distribution of polygyny in Herring Gulls. *Bird Banding* 48: 276-277.
- Shugart, G. W., M. A. Fitch and G. A. Fox. 1988. Female pairing: a reproductive strategy for Herring Gull. *Condor* 90: 933-935.
- Skórka, P. and J. D. Wójcik. 2000. The ornithological value of the environs of the Rozkochow village—a proposal for protection. *Chronmy Przyrode Ojczysta* 56: 99-111. In Polish with an English summary.
- Skórka, P., J. D. Wójcik and R. Martyka. 2005. Colonization and population growth of Yellow-legged Gull *Larus cachinnans* in southeastern Poland: causes and influence on native species. *Ibis* 147: 471-482.
- Skórka, P., J. D. Wójcik, R. Martyka, T. Babiarez and J. Skórka. 2006. Habitat and nest-site selection in the Common Gull *Larus canus* in southern Poland: significance of man-made habitats for conservation of an endangered species. *Acta Ornithologica* 41: 137-144.
- Snow, D. W. and C. M. Perrins. 1998. *The Birds of the Western Palearctic*. Vol. 1. Oxford University Press, New York.
- Southern, W. E. 1978. Ring-billed Gull pair with 2 nests. *Wilson Bulletin* 90: 301-302.
- Szczys, P., I. C. T. Nisbet, J. J. Hatch and R. V. Kesseli. 2001. Sex ratio bias at hatching and fledging in the Roseate Tern. *Condor* 103: 385-389.
- Yudin, K. A. and L. V. Firsova. 1988. *Laridae*. In *Birds of the USSR*. Nauka Press, Moscow. 415 pp.
- Zielinska, M. P. Zielinski, P. Kolodziejczyk, P. Szewczyk and J. Betleja. 2007. Expansion of the Mediterranean Gull *Larus melanocephalus* in Poland. *Journal of Ornithology* 148: 543-548.