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RESPONSES TO HUMAN DISTURBANCE FROM NESTING GULL-BILLED TERNS

Evgeniy V. Barbazyuk

Abstract. The phenomenon of nest relocation was found in colonies of Gull-billed Terns on Lakes Shalkar and Ayke, southern Russia, in 2000 and 2001. The phenomenon manifested itself largely on Lake Shalkar in 2001, while research work was conducted in a Gull-billed Tern colony. After visiting the island that colony occupied, during 14 days it was observed that some birds had abandoned their nests mainly in the densest plots of the colony, and at the same time new nests had appeared on the colony periphery. A typical detached nesting site of the colony (the sample plot) was charted on the map. In the sample plot, the number of nests decreased 1.7 times – from 113, before research work, to 68, after work in the colony. The sample plot area increased from 130.8 m^2 to 161.3 m^2, the length increased from 19.0 m to 21.1 m. Mean nearest-neighbor distance increased from 70.6 ± 2.2 cm (n = 113) to 96.4 ± 4.9 cm (n = 68; t_{180} = 5.5; p < 0.0001), density reduced 2.1 times – from 0.9 to 0.4 nests per m^2. It is supposed that such changes in the colony territorial structure resulted from repeated human disturbance caused by the long-term research activity in this colony of Gull-billed Terns.

Key words: Gull-billed Tern, *Gelochelidon nilotica*, human disturbance, density, colony, nest relocation.

Address: E.V. Barbazyuk, Laboratory of Biocenological Processes, Institute of Plant and Animal Ecology, 8-Marta St., 202, Ekaterinburg, 620144, Russia; e-mail: bev@mail.esoo.ru.

Реакция на фактор беспокойства гнездящихся чайконосых крачек. - Е.В. Барбазюк. - Беркут. 14 (2). 2005. - Описывается феномен перераспределения гнезд крачек, наиболее ярко проявившийся на оз. Шалкар в 2001 г., на юге России, восток Оренбургской области, во время проведения исследовательских работ в колонии. После посещения колонии в течение 13 дней было замечено, что некоторые птицы бросили свои гнезда в самых плотных участках, в то время как появились новые, преимущественно по краям колонии. Была сделана карта типичного обособленного участка колонии. Количество гнезд в нем сократилось в 1,7 раза - со 113, до проведения работ в колонии, до 68, после проведения работ, площадь этого участка колонии увеличилась с 130,8 $м^2$ до 161.3 $м^2$, длина увеличилась с 19,0 м до 21,1 м. Среднее минимальное расстояние выросло с 70,6 ± 2,2 см (n = 113) до 96,4 ± 4,9 см (n = 68; t_{180} = 5,5; p < 0,0001), а плотность сократилась с 0,9 до 0,4 гнезд/$м^2$. Предполагается, что такие изменения в территориальной структуре колонии произошли в результате регулярного беспокойства чайконосых крачек со стороны исследователя во время посещения колонии.

Introduction

The Gull-billed Tern (*Gelochelidon nilotica*) is one of the most poorly studied Larid species in terms of population ecology, at least for the Eurasian landmass, owing partly to the dramatic breeding range shrinkage in Western Europe that occurred in the second half of the 20th century, as well as to the constantly changing nesting sites and colonies redistribution within the breeding range (Møller, 1975, 1982), which makes investigation difficult.

The Gull-billed Tern belongs to a group of Laridae, forming nesting settlements, known as the "second type" (Kharitonov, Siegel-Causey, 1988). Type II species colonize areas for short periods initially with high nesting great densities. It is thought that normally later on territories diminish in size only imperceptively, and distances between nests are nearly constant throughout incubation in undisturbed colonies. The settlement process is synchronous and spatially organized into groups or subcolonies, at times as large as several thousand pairs. This type of colony formation has a high selective advantage for species nesting in unstable habitats (McNichol, 1975; Møller, 1982; Kharitonov, Siegel-Causey, 1988), such as those in the study area (see the Study Area section).

The following nest density data from the literature are important to understand possible causes for the nest relocation phenomenon described here. The mean nest distances in colonies of this species may vary from 21 to 1.5 m, with minimum 83-cm distance being considered as “very close” (Sears, 1978; Lind, 1963a; Borodulina, 1960 – review in: Cramp 1985). Minimum nest distances may range from 2–3 m to 0.6–0.8 m (Siokhin, Lysenko, 1988), and even reach up to 0.25–0.30 m (Vargas et al., 1978 – cited from: Møller 1982). Because the species is inadequately studied, any clearly articulated data on under what conditions do terns choose to nest in high densities, low densities or not nest at all are hardly available, though as the breeding population size increases the distance between nests is supposed to be reduced (Møller, 1982).

During 1999–2003 research was carried out on brackish lakes, in southern Russia, to study the nest-territory structure, territorial behavior, in Gull-billed Tern colonies as well as the other ecological and behavioral aspects within Gull-billed Tern nest colonies. Over that period 10 breeding settlements were recorded, with much higher nest densities in the most of them than those in the above cited literature sources (see Results section). On the lakes in the study area, Gull-billed Terns preferred to nest together with other colonial Laridae, usually on small temporary sandy alluvial islets surrounded by shallow water that receded by late June such that islets rejoined to the mainland by that date.

While carrying out research in colonies, it was detected that active nest density of the colony was significantly reduced by the beginning of hatching when compared with that of during early incubation. This resulted from some birds having deserted their nests in the densest plots while other new nests (believed to be those of pairs relocating from deserted nest sites) appeared predominantly in the peripheral areas of colonies. The nest relocation effect was stronger in an extremely dense Gull-billed Tern colony on Lake Shalkar, in 2001. This paper describes the given phenomenon, demonstrates certain characteristics of the colony sample plot before and after research activities in the colony and attempts to identify possible causes for the nest relocation.

Methods

The data presented in this paper comes from years 2000–2001 and are a part of wider research program carried out in 1999–2004. The major task of research was to determine the nest-territory structure and investigate antagonistic behavior in Gull-billed Terns. These results will be examined separately in another paper. The nest relocation phenomenon described in this paper was incidental to the primary research study.

For carrying out the primary specific research on determining the nest-territory structure, experiments were set up during which the neighboring nests of terns were steadily moved towards each other. Observations were made from a small portable camouflage fabric booth with several observation slits. For conducting one experiment, the investigator had to come out of the hide (each time for less than one minute), move an experimental nest some distance closer to a neighboring nest once every 10–20 minutes, and hide back in the booth so that to repeat moving the experimental nest again and so on.

Each experiment required several (usually 4–6) step-by-step movings of one nest towards the other. Consequently, the entire colony was to be disturbed several times (with all terns flying up and uttering alarm calls above the island before returning to their nests and resuming nesting activities each time the researcher/intruder was out of the hide) for each experimental nest movement test. On any one day no more than six nest movement experiments were performed, between 11^{00} and 18^{00}. In 2000, 2001, besides these experiments, no other research was conducted in the colonies and no reproductive and demographic parameters were measured so that additional activities would not affect somehow experimental work.

Having detected the intruder all terns in the colony flew up and wheeled above the island uttering alarm calls. After the observer hid in the booth, birds landed on their nests gradually and went on nesting. The nest moving experiments were conducted only in one or several small, mainly marginal segments of the colony rather than in a chaotic way all over the entire colony. Therefore, for most birds in the colony investigator disturbance resulted only in their repeated short bursts of flight and calling, while their nests and nest surroundings (vegetation, substrate etc. in the vicinity of nests) remained intact.

To examine nearest-neighbor distances, nests (with at least one egg) were marked with small wooden stakes during early incubation, after colony formation was completed and before research work was started. Nesting density was the highest possible at this point, and the entire settlement process (nest appearance) on a given island, or islet took on average no more than 7 days, with the egg-laying peak occurring at only 3–4 days (data in preparation), which is typical for birds with type II colony formation. Marking nests took about 15 minutes and the presence of slightly visible stakes afterwards seemed to have no any negative effects on the nesting birds. Research in colonies commenced a few days after marking. In 2000 all nests in a small colony were marked, but the colony map was not made and later on in the season, in July, only nearest neighbor distances of marked nests in the entire colony were measured. In 2001, the location of all nests marked in a sample plot was plotted later on the map and no experiments were carried out in the marked colony plot and in its vicinity. Distances were measured between the nest centers with a tape measure. Duration of eggs' incubation was determined by examination of their contents in some clutches and judging by the outer shell surface – the shell surface of new-laid eggs in Gull-billed Terns is lusterless, rough and not glossy unlike well incubated ones with the smooth and glossy surface as a result of their constant contact with the incubating bird.

In 2001, to generate x and y coordinates for the points and calculate nest density, mean nearest-neighbor distance and other nest characteristics, the computer programme "Map of animal settlements and activity" was used – ColonMap (in Russian) written by S.P. Kharitonov (Institute of Ecology and Evolution, Bird Ringing Center, Moscow) and given a good account of itself. Kharitonov (1998) considers a colony boundary as a "line" that can be drawn around a colony some distance from the edge nests. The distance from each nest to the line (colony boundary) should be the same as the distance from the particular edge nest to its nearest neighbor. If nest density near a colony edge is high, the boundary of that colony lies closer to the edge nests than in low-density areas. This definition of a colony boundary seems to be real, since it is well known that in dense areas territory sizes are usually smaller than in sparse ones (Patterson, 1965; Kharitonov, 1981). Computing a colony area and nest density, the program takes into account the feature mentioned above. MapInfo Pro 5.5 programme was also used to make maps and compute colony areas.

Study area

The study was conducted in Gull-billed Tern colonies on Lakes Shalkar (50º47´N 60º55´E) and Ayke (50º58´N 61º30´E) in southern Russia, near the Kazakhstan border, in 2000, 2001 and 2003 (Fig. 1). The lakes are located approximately 50 km apart, in the grassland (steppe) region with a dry, continental climate, in the northern middle-latitude zone. The average annual precipitation totals 250 mm. The average air temperature in January is –17ºC, in July – +21ºC.

The northern limit of the present-day breeding range of the Gull-billed Tern is to be found here (Ryabitsev, 2002), while most of the breeding range on the territory of the former USSR lies southward – in Kazakhstan and Turkmenistan (partially also in Ukraine, Black Sea) where the arid and semiarid climates are still hotter in summer (Zubakin, 1988).

The lakes studied are brackish water occurring in large shallow basins, with a surface area of more than 70 km^2, and prevailing depth 0.8–1.5 m and occupy bowl-like depressions in relief. Since the lakes lack streams offering

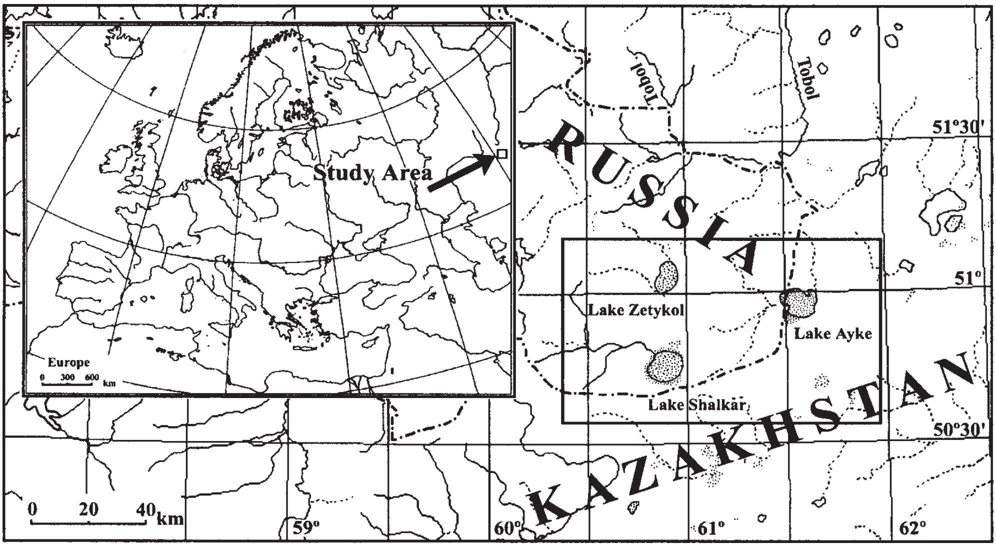

Fig. 1. Study area.

Рис. 1. Район исследований.

constant water flow, their level varies greatly seasonally and from year to year. About once in every ten years, the lakes dry up completely and every 3–5 years they freeze for their full depth. Their prevailing depth is 0.8–1.5 m. Roughly 70 % of the lake's surface may be covered with Common Reed (*Phragmites communis*), Bulrush (*Scirpus lacustris*), and Narrow-leaved Cattail (*Typha angustifolia*). Water in the reservoirs is brackish. The lakes are surrounded by semiarid steppe grasslands including combinations of Fescue (*Festuca sulcata*), Feather Grass (*Stipa* spp.) and Wormwoods (*Artemisia* spp.). In lowland areas, typical halophytes are very common – *Salicornia europaea*, *Halocnemum strobilaceum*, *Kochia prostrata* and other species growing in clay-based and alkaline soils, which makes plant cover a mosaic and heterogeneous mosaic (Ryabinina et al., 1996; Davygora, 2000; Sviridova, 2000).

Results

One of the dense colonies of Gull-billed Terns (Type II, see Introduction) was found and studied on the northern shore of Lake Shalkar in 2001. It was the densest colony that has ever been recorded by us in 1999–2004 and it occupied a small alluvial island, in shallow water near the mainland. Nests were arranged compactly on five dry sloping sand dunes mainly in shoots of *Tournefortia sibirica*. Nests were a well defined depressions in substrate, often lined abundantly with vegetation, chiefly with small dry pieces of *Salicornia europaea*. In the first monitoring (on May 24), the colony was in the final phase of its formation and numbered nearly 600–650 nests (Barbazyuk, 2001). Afterwards, when viewing hatching process (visual examination), it was determined that it took the terns no more than 7–8 days to form the whole colony, the bulk of birds nesting during only 4–5 days.

Tournefortia sibirica is a decumbent plant growing in sand and sandy soil. It has tender, thin stems spreading over the ground surface and small, white flowers with specific but in general pleasant scent. In time of flowering (mostly mid-June), the maximum height of continuous and thick plant cover is 20–30 cm. On May 29, though the shoots of *Tournefortia* came out of the sand and slightly decreased visibility between nests they did not yet form

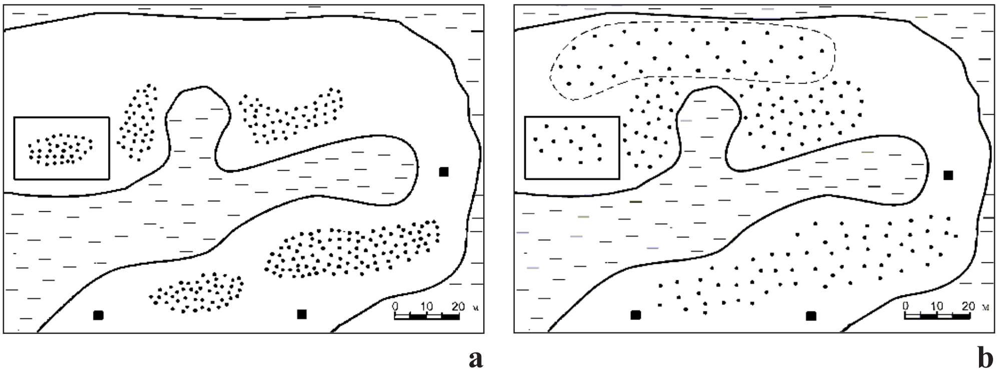

Fig. 2. The colony state: a – before research (on 29 May), b – after research (on 16 June).
Рис. 2. Состояние колонии: а – до проведения работ (на 29 мая), b – после проведения работ (на 16 июня).

In the diagram, the Gull-billed Tern colony on the Lake Shalkar island in 2001 is shown. The thick slightly wavy line indicates the island coast, dots – nests located initially only on five sloping sand dunes in *Tournefortia sibirica*. Dots in the rectangle are nests plotted on the map (the sample plot); dots outlined with the dashed line are a dispersed concentration of new nests that appeared after research work in the colony. Small black squares indicate main locations of the portable booth near the two dunes on which the experiments were conducted.

Черные точки – гнезда; точки в прямоугольнике – закартированный участок колонии; точки, обведенные пунктиром – разреженное скопление новых гнезд, появившееся после проведения работ; черные квадратики – основные местонахождения скрадка во время проведения работ.

an unbroken plant carpet. By mid-June, the plant greatly bushed out, hiding incubating terns and forming an visual between adjacent nests and almost the impenetrable for birds' visibility barrier between nests in some colony sites. However, vegetation apparently did not appear to preclude birds from incubating, and there was ample trampled open ground space around nests with no plants within, apparently resulting from permanent birds' activity near the nest.

On May 29 before conducting research in the colony, all nests were marked on one of the five sandy dunes for later mapping of the plot. After June 3, experimental work on examining the defended area around nests began. Nest movements were carried out only with nests located in the marginal segments on two sandy dunes, while the other three dune sites (including the sample plot) were left intact and experimentally undisturbed (Fig. 2a), and the only day of their visiting was the day of marking nests on May 29.

In 2001, on average 2–3 h daily were spent in the colony, during which nest movement was conducted in the indicated parts of the colony. A by-product of this work was disturbance of the entire colony when all the birds were forced to fly up and call whenever detecting the investigator as being out of the hide. On June 16 however, we made an interesting observation. On all the five dunes, in *Tournefortia*, some nests had been abandoned with the eggs pecked, crushed or missing. At the same time, at the edge of the dunes in areas, that were now overgrown with *Tournefortia*, new nests had appeared with the eggs just laid, along the border of the thick vegetation. This was primarily noted on the three dunes most distant from the observation booth. Thus, due to the desertion in the central parts of overgrown dunes a decrease in active nest density had occurred, whereas the total colony area increased on each of the five dunes due to new nests having been built in the outer parts of the dunes and in the nearby adjoining open

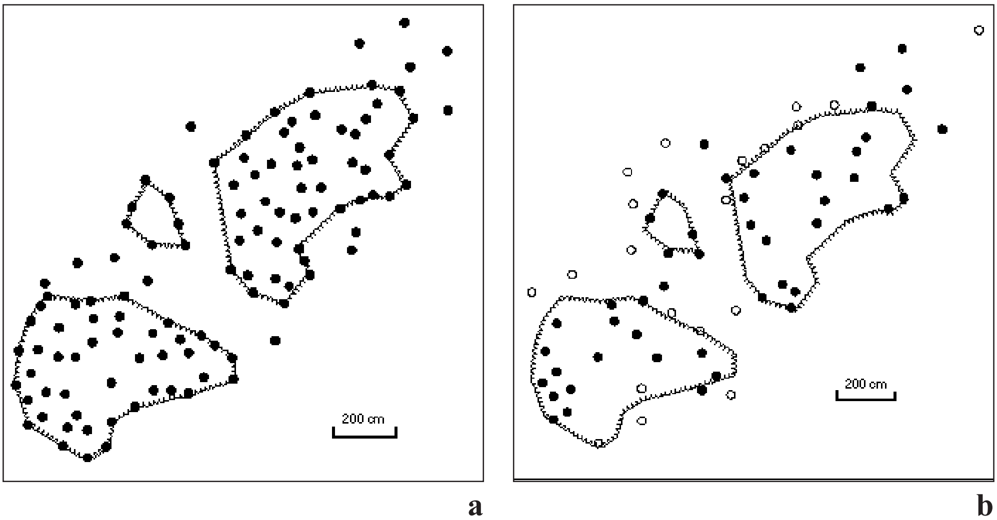

Fig. 3. Map of the colony sample plot: a – before research (on 29 May), b – after research (on 16 June).
Рис. 3. Состояние закартированного участка колонии: a – до работ (на 29 мая), b – после работ (на 16 июня).

Solid and open circles are nests; open circles are new nests that appeared after research work in the colony. The jagged line represents the boundary of continuous distribution of *Tournefortia sibirica*.

Черные и белые кружки – гнезда; белые кружки – новые гнезда, появившиеся после проведения работ в колонии; волнистая линия – граница распространения сплошной поросли турнефорции сибирской (*Tournefortia sibirica*), в которой располагались гнезда на песчаных холмиках.

parts in *Salicornia*. Furthermore, a dispersed concentration of new nests had appeared at the remotest end of the island, far away from the booth (Fig. 2b). These nests were located on a bare unvegetated sand area and by 16 June there were about 80–90 of them, with mean nearest-neighbor distance in the densest plot being 123.3 ± 6.1 cm (n = 6), minimum nearest-neighbor distance 104.1 cm, maximum 134.3 cm. In other parts of this dispersed concentration minimum nearest-neighbor distances were from 144 cm and much more.

Between 29 May and 16 June (from before beginning research to its conclusion) the staked sample plot area had changed from 130.8 m^2 (on May 29, before research) to 161.3 m^2 (on 16 June, after research), the sample plot length from 19.0 m to 21.1 m, and density had reduced from 0.9 nests per m^2 to 0.4 nests per m^2, while the number of nests decreased from 113 to 68. Mean nearest-neighbor distance increased from 70.6 ± 2.2 cm (n = 113) to 96.4 ± 4.9 cm (n = 68) (t_{180} = 5.49; $p < 0.0001$). Minimum and maximum nearest-neighbor nest distances changed from 38.0 to 48.9 cm and from 152.0 to 290.0 cm accordingly (Fig. 3a, b). The total birds' number of birds in the island was approximate estimated to have been reduced to 300–400 breeding pairs.

It took place on Lake Shalkar in 2000, on another similar sandy, temporary and sandy island, while conducting the same research experiments in a small tern colony (81 nests). The colony had settled also highly synchronously (during 8 days, beginning 26–28 May, with a laying peak of approximately 4–5 days after settling began, judging from daily visual examination of hatching). Nest movement experiments (disturbance period) were carried out from 10–18 June following initial nest staking as described for 2001. In this site, on 23 June and several days earlier, nests with new-laid and 1–1.5 week eggs were recorded on the colony periphery and within its some inner sparse areas, at a time when in most of the colony hatching had already been completed. The nests were initially arranged both in open spaces covered with *Salicornia europaea*, up to 10–15 cm in height, and on dry sandy dunes in *Tournefortia sibirica*. Mean nearest-neighbor nest distance before disturbance was 97.6 ± 3.9 cm (n = 81). The appearance of new unmarked nests with eggs was recorded in the field journal but the phenomenon was partly disregarded (as mentioned in Methods the colony map was not made and only nearest-neighbor distances of staked nests were measured), probably because it was not so widely spread as in 2001.

In 2000 and 2001, Gull-billed Terns generally formed one-species settlements with a small number of the Common Tern (*Sterna hirundo*) nests on dry reed banks, along the island's coast line. In 2000, besides Common Terns, a small colony of Black-headed Gulls (*Larus ridibundus*) occupied a moist muddy and shallow depression, separately from Gull-billed Terns, as well as a small isolated colony of Caspian Terns (*Hydroprogne caspia*). As the emphasis was given to the experiments with Gull-billed Terns, it should be noted only that no visual changes in the nest position in this species were documented.

Despite the absence of the advanced study on possible changes in nest density during early versus late incubation in intact colonies and research disturbed colonies, and despite that nest relocation phenomenon observed in both years was found somewhat incidentally, some visual examinations when monitoring hatching in several undisturbed specifically colonies provided no evidence of that mass, spontaneous desertion of nests, or as well as the appearance of numerous new ones by the beginning of hatching were recorded. Mean nearest-neighbor nest distance in one undisturbed colony was 91.3 ± 4.3 cm (n = 99) with nests arranged both in vegetation and in the open.

Discussion

Two contrary tendencies are traced in nesting larids. On the one hand, conditions permitting, birds seem to nest as close together as possible. In nesting densely, mutual social stimulation leads to more synchronous breeding and, therefore, higher reproductive success for individuals (Darling, 1938; Vermeer, 1973; Burger, 1979; Gauzer, 1983a). What is more, density is higher in vegetation because plant cover reduces visibility between incubating birds and protects them and their chicks from hot rays of sunlight (Burger 1974, 1976; Nisbet, 1975; Gauzer, Ter-Mikhaelyan, 1987). On the other hand, owing to particular spatial and ethological factors, co-existence in tightly-packed groups does not allow the population to reach its maximum reproductive potential. It is known that intraspecific aggressiveness is one of the main factors contributing to the lowered breeding success of larids. Chicks suffer most, during hatching and fledging periods. In dense colonies, chick mortality may be very high compared to low-density ones (Hunt, Hunt, 1975; Davis, Dunn, 1976; Ewald et al., 1980; Gauzer 1981; Sudmann, 1998). There are also studies showing negative consequences of high nest density at earlier reproductive stages. Thus, for example, due to high levels of aggression between birds defending nest territories many Avocets (*Recurvirostra avosetta*) nesting in high-density regions of colonies had already abandoned their nests in dense plots of colonies during egg-laying (Hotker, 2000). In Sandwich Terns (*Sterna sandvicensis*), nesting in close proximity in highly synchronized colonies resulted in prolonged bickering and possibly abandonment of one or more clutches (Smith, 1975).

Much attention has recently been given to negative effects of human disturbance on nesting colonial waterbirds. It is assumed that not only people involved in recreational activities but also those most interested in conserving wildlife can have detrimental effects, since investigators inevitably have to visit breeding sites, often repeatedly during a season. In gulls and terns, human disturbance causes mainly abandonment of nests and increases intra- or inter-specific predation following intrusion (Carney, Sydeman, 1999). In Common and Sandwich Terns, at the beginning of incubation, egg loss was mainly related to human disturbance – disturbed birds abandoned their nests, whereas the absence of disturbance minimized egg loss (Gauzer, 1983b).

The above-listed reports correspond to the phenomenon described in this study. Observed nest relocation in our study most likely resulted from regular research activity while visiting tern colonies. It is strongly suspected that our observations of nest abandonment do not reflect normal intra-specific nest aggression patterns, but are more likely a direct consequence of repeated human research disturbance of the colony. It is quite possible that we are seeing evidence of selection for increased inter-nest spacing out response to high density as aggressive interactions increase following repeated research related. Although this hypothesis has yet to be critically examined during further research several reasons still can be given for such a statement.

The Gull-billed Tern is a species with distinct territorial behavior and a high degree of aggressiveness (Cramp, 1985). Daily investigator disturbance is suspected to have multiplied the level (and/or frequency) of aggressiveness several foldtimes and birds apparently could not exist in such a dense settlement any more under these newly formed conditions. Fierce ground and aerial encounters were repeatedly recorded, when terns returned to their nests following disturbances. Often due to wind, birds were not able to land exactly on the nest and they had to make their way through vegetation and hostile territories, eliciting a neighbor's bill-snapping. All of this aggressive interaction seemed to further the terns' agitation levels. Despite the external obstacles, social stimulation for breeding was very high (probably due to a large number of birds present and high nest density), and a proportion of birds renested, with the densest plot in which mean nearest-neighbor nest distance was 123.3 ± 6.1 cm (n = 6). This, we believe, was the maximum density at which terns could exist (at least a number of birds) under conditions of regular disturbance.

Rapid growth of vegetation in June could theoretically prevent terns from resettling in the original nest sites, under the assumption of such possibility. But as the observations have indicated, Gull-billed Terns normally form nesting colonies by adding, or attaching new nests to the edges of an existing settlement, rather than by putting new nests into inner parts of the original settlement when, for example, some portion of late breeders arrive to the breeding grounds (data in preparation, see also Introduction, "the second type"). However, vegetation was probably not responsible (at least as the primary cause) for the abandonment of some nests in the densest colony sites as the remaining nests also were originally constructed in the similarly densest and overgrown sites.

The experiments have shown that Gull-billed Terns are very reluctant to abandon their nests and often do not leave them even during experimental moving of one nest towards the neighboring nest. Most frequent nest abandonment was recorded though in experiments with day 1 to day 6 early clutches, or when a nest was moved at a very close distance to another one (approximately 30–40 cm between the nests centers). In this latter case aggressiveness of the stationary nest's occupant grew dramatically upon sight of closely positioned movable nest, and was expressed in the significant increase in the number of attacks and aggressive rattles per time unit (Barbazyuk, 2005). In our case, a substantial part of the colony (especially in 2001) was not experimentally affected by actual movement of nests. The nest surroundings were not changed, the clutches were incubated at least one week and all the birds were simply forced to fly up periodically and then to take their nests again to keep incubating. It is difficult therefore to account for nest abandonment any other way but the neighbors' increased hostility and aggressiveness resulting from regular human disturbance or as a response to the disturbance alone. Tinbergen recorded the analogous phenomenon in disturbed or heavily predated colonies of Herring Gulls (*Larus argentatus*). The gulls abandoned their nests in the central parts of the colony and moved to the periphery thus spacing out and forming less dense settlements (Tinbergen, 1956).

We believe that the nests on sandy dunes periphery were constructed by the same birds originally having settled in May rather than those coming late from southern areas. Observations over a period of 1999–2004 have shown that normally the last portions of birds arrive at breeding grounds no later than on 20–30 May, and the first arrivers may be found in the study area as early as in late April. Nesting is possible since day 1–10 of May. Late birds, arriving the last 10 days of May get to breeding without delay. In 1999, though there was an exception to this observed pattern. The first birds arrived very late, in early June, due to cold prolonged spring. However, phenomenon described here was observed in "standard" years with high April – May temperatures when birds could be seen since mid April.

Additionally, birds just appearing at breeding grounds are most sensitive to human disturbance. Personal observations reported that even a single visit to tern roosts and gathering spots early in the nesting season might be enough for them to desert the prospective colony area. This agrees with other numerous studies on colonial waterbirds (the review in: Carney, Sydeman, 1999). It seems therefore unlikely that newly arrived terns would build their nests in affected areas. This increases the probability it was the same birds having originally settled for the first time before human visitation of the colonies, that were responsible for the late nesting effort. This could also indicate that a proportion of these birds, affected by strong social stimulation from the colony, was able to renest despite the external obstacles/disturbances still lowering the total number of breeding birds on the island.

It might be supposed that the effect became most discernible in 2001 because of large numbers of birds as well as the hydrological conditions that existed on the lakes during that period. In 2000 and 2001, the small island near the northern shore of Lake Shalkar was the only suitable place for Gull-billed Tern breeding within at least a 100 km radius, therefore birds did not have the chance to renest somewhere else – on nearby islands, as was the case in several other years.

Thus, to summarize, this response of nesting Gull-billed Terns to regular human disturbance can be expected to become stronger under high nest density that, in turn, may result from a shortage of nesting habitat and preference to nest in vegetation of different visibility, which is favorable during incubating and early hatching. Knowledge and considering this Gull-billed Terns' feature of responding in such a specific way to regular human disturbance are extremely important for planning and carrying out various population ecology researches in colonies of this species.

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