State of California
The Resources Agency
Department of Fish and Game
Habitat Conservation Planning Branch

FORAGING BEHAVIOR AND DIET OF BREEDING WESTERN GULL-BILLED TERNS (*Sterna nilotica vanrossemi*) IN SAN DIEGO BAY, CALIFORNIA

by
Kathy C. Molina and Daniel A. Marschalek

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ABSTRACT

Breeding gull-billed terns (*Sterna nilotica vanrossemi*) are confined to only two locations in southern California, Salton Sea and San Diego Bay. In recent years San Diego gull-billed terns have been reported to prey on chicks of endangered California least terns (*Sterna antillarum browni*) and snowy plovers (*Charadrius alexandrinus nivosus*). To better understand the feeding ecology of breeding gull-billed terns, we conducted focal surveys of foraging birds in South San Diego Bay from 29 April through 26 July 2002.

Adult presence and foraging intensity tended to be greatest at stations in the southern portion of the bay where ocean intertidal substrates were consistently available, but was not significantly related to the relative proportions of available substrate. They foraged singly or in small loose groups; modal group size among stations was one adult, and median group size ranged from 1-3 birds. Observed food items in decreasing order of frequency included mole crabs, small fish, lizards and small chicks. Because of constraints posed by the size of the gull-billed tern, we suggest that predation by this taxon on least terns and snowy plovers is limited to the youngest, and therefore smallest, chicks, an age-class that typically experiences the lowest probability of survival.

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INTRODUCTION

The known breeding distribution of the western gull-billed tern (*Sterna nilotica vanrossemi*) is restricted to southern California, adjacent Baja California, and the coast of Sonora and Sinaloa, Mexico; this taxon may breed south along the Pacific Coast to Ecuador, but few or no colony sites have been documented (AOU 1957, Parnell *et al*. 1995). Breeding gull-billed terns are a California Bird Species of Special Concern (CDFG 1992) confined to only two locations in southern California: at the Salton Sea in the interior of the state, and in San Diego Bay on the coast (Parnell *et al*. 1995). Molina (2003) estimated the breeding population size at the Salton Sea, the larger of the two colonies, at 100-170 pairs in recent years. This total has diminished substantially from the population size of 500 pairs reported in the late 1920s (Pemberton 1927). Gull-billed terns colonized a single locality, the impoundments at Western Salt in San Diego Bay in 1986, which is now managed by the San Diego National Wildlife Refuge complex. This population has contained as many as 30 pairs (Statlander 1994) in recent years, and has not expanded to other locations.

Gull-billed terns are reported to have a more varied diet than most other terns, which often includes insects, marine invertebrates, reptiles, small mammals, and chicks of small birds (Parnell *et al*. 1995). However, information on diet for this cosmopolitan species as a whole is sparse with most existing studies focused on the nominate subspecies *nilotica* that breeds across Europe and northern Africa. In North America, a single study examined the diet of nestlings of the eastern subspecies *aranea* breeding in Virginia (Erwin *et al*. 1998). Although the breeding colonies of gull-billed terns in California have been monitored for a number of years, little information is readily available for the diet of the *vanrossemi* subspecies, apart from casual observations. Furthermore, to our knowledge, no studies have systematically examined the foraging behavior of either subspecies in North America.

In recent years San Diego gull-billed terns have been reported to prey on the chicks of state and federally endangered California least terns (*Sterna antillarum browni*) and federally threatened western snowy plovers (*Charadrius alexandrinus nivosus*). Substantial losses of eggs and young of least terns and snowy plovers have been attributed to gull-billed terns, despite insufficient direct evidence establishing the frequency of such behavior. In the absence of quantitative information on the impacts to least tern and snowy plover populations, gull-billed terns have been previously subjected to lethal control measures based on perceived impacts to these federal and state-listed populations.

To better understand the feeding ecology of the gull-billed tern, one of California's rarest and least studied breeding terns, we examined the spatial and temporal aspects of adult foraging behavior in the San Diego Bay area. Here we report on habitat use by foraging terns throughout the nesting season and describe the composition and relative abundance of prey items captured during foraging bouts and of prey returned to the single nesting colony established at the saltworks. To shed light on potential prey handling capabilities of gull-billed terns, we also examine the morphology of key elements of their skull anatomy and feeding apparatus, along with morphometric data for commonly selected and potential prey. We conclude with suggestions that might aid in a more accurate evaluation of the impacts of gull-billed tern predation on snowy plover and least tern populations.

METHODS

Study Area

We conducted focal surveys of foraging gull-billed terns in South San Diego Bay, California from 29 April through 26 July 2002, at seven viewing stations (Fig. 1) in three sectors of the bay. Along the northwest sector of the Bay we conducted observations from the visitors platform overlooking the bay along the bike path north of the Navy Yacht Club (Delta), and from the beach at the north end of Silver Strand State Beach campground (Strand). Along the east side of the bay we conducted observations from the bay shoreline of the Sweetwater Marsh NWR south of the estuary mouth (D Street), and from the shoreline of the Chula Vista Nature Center (Chula). At the south end of the bay, we conducted observations from the outer perimeter road of the saltworks (Salt), at the southern end of Imperial Beach from the dune along the north side of the Tijuana River mouth (NTJ), and on the beach at Border Field State Park parking lot (Border). All sites exhibited at least two (but usually three or more) of the following substrate categories from which to observe the foraging behavior of gull-billed terns: ocean, upper beach areas (colony sites of least terns and snowy plovers, including sparsely vegetated dunes), estuary (tidal mudflats and deeper portions of the bay), beach intertidal (surf zone), and upland scrub areas (Table 1.). Approximate straight line distances (in km) from the nesting colony at Salt to each of the six other observation stations are as follows: Delta – 7.75, Strand – 5.75, Chula – 3.75, D Street – 4.75, NTJ – 5.5, and Border – 8.

Observation Protocol

We searched for gull-billed terns at each of seven observation stations for a total of 30 minutes, varying the order in which stations were visited so that we had similar numbers of morning and afternoon visits for each. We made 38 visits (one per day) to each station except Border, when a wildfire closed entry to the park on 18 June, precluding our access.

To minimize bias toward detections of more conspicuous foraging events, we used focal scans of the substrates surrounding our observation stations. We performed 360-degree scans to a maximum radial distance of about 300 meters at each station. Scans for foraging gull-billed terns were performed within 2-minute intervals for a total of 15 successive scans. Scan duration was usually $\leq$ 1 minute. At the conclusion of each interval, we recorded the number of foraging birds detected in each complete 360-degree scan and assigned substrate categories to each detection. We also noted the presence of resting birds or those in direct flight, so that we could estimate the maximum number of birds in the study area on each visit. Because some substrates were linearly aligned and often abutted one another (e.g. intertidal beach and upper beach), foraging terns readily moved between substrate types and could be recorded foraging in multiple categories on a single scan. We recorded the number of prey captured and identified each prey item to one of the following classes: aquatic invertebrates, terrestrial invertebrates, fish, lizards, chicks, unidentified prey, and unidentified prey that due to its size and color could be confidently ruled out as a chick. Observations of prey delivered to the nesting colony, totaling 11.25 hours, were made independently on 11 occasions from 3 June through 10 July. Distinctive prey items such as fish, lizards, chicks, and eggs could be readily identified as their forms extended well beyond the margins of tern bills. Often only the extremities of aquatic and terrestrial invertebrates could be detected. Gull-billed terns feed on the wing with buoyant deep swoops and dips to the surfaces of aquatic and terrestrial substrates, rarely landing on or plunging to the surface to capture prey. They feed over a variety of shallow aquatic and sparsely vegetated terrestrial habitats, and may pursue aerial prey, such as larger flying insects or swarms of smaller ones (Parnell *et al*. 1995).

To qualify as a foraging flight (and to distinguish those from direct flights), we defined the former as flight behavior that exhibited the typical elements of foraging such as swooping to the surface, hovering, or stalling on wind currents.

To describe foraging intensity, we calculated foraging scores for each visit. These daily foraging scores were calculated as the product of the peak number of foraging adults multiplied by the proportion of scans with positive detections. We plotted these scores and the maximum estimate of the number of all birds, irrespective of behavior, for each visit to examine gull-billed tern presence and foraging behavior at each site over time.

The areal proportions of feeding substrates at each station (Table 1) were estimated from topographic maps and scaled images upon which the GPS coordinates of our observation stations were plotted. We centered a circular plot with a 500-meter radius over the location of our observation stations, placed an acetate grid over each plot and tallied the number of cells occupied by each substrate.

Statistical analysis is often difficult to apply to foraging data because studies designed to provide initial descriptive accounts of foraging behavior often inherently lack sampling independence and randomness (Noon and Block 1990). We examined differences in the mean number of detections across substrates with a Kruskal-Wallis test using only the initial foraging detection for each visit as suggested by Bell *et al*. (1990). A regression analysis using mean values was employed to explore the relationship between substrate extent and use.

To assess the average size of a commonly available prey item that was consumed readily by gull-billed terns in our study, we measured the linear dimensions of 75 mole crabs (*Emerita analoga*) that were randomly caught by hand from the surface of the sandy intertidal zone at Imperial Beach on 19 June 2002. To estimate the maximal extent of a gull-billed tern's gape, and thus provide a basis upon which to evaluate the potential size constraints posed by non-compressible prey items, such as mole crabs and bird eggs, we also measured the linear dimensions of eggs of varying sizes belonging to several ground nesting species that represented potential prey items in habitats frequented by gull-billed terns. All tern skeletons and egg sets are housed at the Natural History Museum of Los Angeles County.

RESULTS

From 29 April through 26 July we conducted a total of 265 surveys (38 visits to six stations, 37 visits to one) for foraging gull-billed terns at seven locations around south San Diego Bay for total observation time of 132.5 hours.

The proportion of visits that detected foraging events varied among stations and ranged from 0% at sites D Street and Chula, in the eastern sector of the bay, to 73% at the Border station in the southern sector of the study area (Fig. 2). As expected, the maximum number of adults detected on any single scan, irrespective of behavior, was greatest at Salt, the station adjacent to the nesting colony (Fig. 3c). Relatively large numbers of adults were also detected at Border and NTJ (Fig. 3b), while far fewer adults were detected at the northwestern stations of Delta and Strand (Fig. 3a). Although adult presence was most consistently observed throughout the study at the three southern stations of Salt, NTJ, and Border (Figs. 3b, 3c), foraging intensity was most consistent at only NTJ and Border (Fig. 3b). While foraging intensity was relatively high at Salt on occasion, the temporal pattern of foraging intensity was less consistent than that observed at either NTJ or Border, and more similar to the sporadic patterns of adult presence and foraging intensity observed at Delta and Strand (Fig. 3a). At NTJ and Border, maximum adult presence and foraging intensity exhibited two peaks: the first from early to mid- May, and the second from early to late July (Fig. 3b). The first peak generally coincides with the courtship and nest establishment phase of breeding gull-billed terns while the second coincides with the chick-rearing stage and the fledging of young.

Although foraging group size ranged from 1 to 12 adults, the modal size for all stations was 1 adult (Fig. 4). The median foraging group size varied among stations; the largest groups were observed in the southern sector (Border = 3 adults, NTJ = 2 adults, Salt = 1.5 adults). The median size for Delta and Strand was 1 adult at each location.

The number of foraging detections varied among substrate types and among stations (Fig. 5). Not all substrate types were represented at each station, though two substrate types, upper beach and ocean, were shared among all stations. We never detected gull-billed terns foraging offshore in either the ocean or the bay. The number of foraging detections associated with the intertidal beach substrate, when present, was consistently higher among stations than those of other available substrates (Fig. 5). When substrate associations of just the initial detections on each visit were considered, the use of intertidal beach tended to be greatest; however, only the mean for upland/scrub differed significantly from all other substrates (Fig. 6; $H = 9.5$, $df = 3$, $P = 0.03$). The variation in the use of different substrates among our observations was only weakly related to substrate extent (Fig 7). We found no significant linear relationship between the mean proportions of substrates present among stations and the mean number of initial detections of foraging (Linear regression, $r^2 = 50\%$, $P = 0.18$; Fig. 7).

We observed a total of 118 prey items delivered to the nesting colony and noted 123 prey items during observations conducted at our foraging stations (Fig 8). Small invertebrates (nearly all of marine origin, primarily mole crabs) constituted the most common prey category observed at both the nesting colony and from our foraging stations (Fig 8.). Other invertebrate prey observed infrequently were fiddler (*Uca* sp.) and pelagic (*Pleuroncodes* sp.) crabs, and an unidentified dragonfly (Odonata). Although observed only half as frequently as small invertebrates, fish were also relatively prominent as prey delivered to the nesting colony and during observations of birds in transit from our foraging stations. Although we never observed gull-billed terns foraging over deeper, open water, we occasionally detected them along the shallow margins of the Tijuana and Otay river channels, where small fish were potentially available. We more frequently observed gull-billed terns kleptoparasitizing Forster's terns (*S. forsteri*). Highly conspicuous prey items such as lizards and chicks were less frequently observed during our study and each of these categories constituted less than 10% of all items observed at the nesting colony or among observation stations (Fig. 8).

DISCUSSION

Our study provides the first descriptions of the foraging behavior and diet of gull-billed terns breeding on the southern California coast. Although gull-billed terns were reported to forage along the eastern sector of south San Diego Bay in previous years (at D Street, in particular), we did not observe them there or at Chula during our study, despite the presence of extensive mudflat habitat in the area and proximity to the nesting colony at the saltworks. Gull-billed terns consistently foraged along the southwestern sector (Salt, NTJ, and Border). Two temporal peaks of adult presence and foraging activity were apparent at NTJ and Border, with the first peak probably coinciding with pair-bonding and nest initiation and the latter with chick rearing and fledging. Little information is available on the average distance of the nesting colony to foraging grounds for gull-billed terns. Breeding individuals in our study commonly foraged at least 8-9 km from the nesting colony, and probably traveled farther as we lost sight of them as they flew south beyond the international border. San Diego breeding gull-billed terns tended to forage most frequently in the intertidal substrate (i. e. surf line) along the ocean shore, although the only significant difference among substrates was for the upland/scrub substrate, which was used least frequently. The lack of power in resolving the differential use of substrates was likely a result of low sample size. Substrate use was not dependent on the mean proportional extent of substrates among our observation stations. The mean proportion of intertidal substrate, a narrow band of wet sand and shallow water, was low among our sites, yet a majority of foraging observations was associated with it. Further, we never observed gull-billed terns using the ocean or open bay substrate where we frequently noted feeding Forster's and least terns, even though it comprised the major proportion of potential foraging substrates at all of our stations.

The diet of San Diego breeding gull-billed terns consisted of several classes of vertebrates (Osteichthyes, Reptilia, Aves) and two classes of invertebrates (Crustacea and Insecta). The diversity of prey items observed in our study was similar to that reported for gull-billed terns breeding in the eastern U. S. (Erwin *et al*. 1998) and in Europe (Bogliani *et al*. 1990). Small marine invertebrates less than or equal to one bill length (~ 35-38 mm) in size were the predominant prey taken by gull-billed terns during our observations. In Virginia tern prey were also predominantly marine invertebrates and were less than one bill length in size. The mole crab was the main species taken in San Diego, while the fiddler crab predominated in Virginia. The predominance of the mole crab in the delivery of food items to the colony further indicates the importance of the intertidal substrate for foraging gull-billed terns in San Diego.

Predation on Snowy Plovers and Least Terns

Of 241 observations of prey captured at our foraging stations or prey delivered to the nesting colony by San Diego breeding gull-billed terns, eight (3%) were of chicks. Five of these could be identified to species: three killdeer (*Charadrius vociferus*), one black-necked stilt (*Himantopus mexicanus*) and one snowy plover. All of the chicks we observed as prey items were small and downy, and were therefore likely to be just hours to less than a week post-hatching. The relative proportion of chicks among prey items noted during our observations was identical to the 3% reported by Bogliano *et al*. (1990) for a breeding population in Italy.

Gull-billed terns are relatively small-bodied seabirds weighing about 180 grams. When not transporting food to chicks, gull-billed terns, like other species of terns, generally immediately swallow prey whole. However, they may land and handle irregularly shaped prey by dislodging long and unwieldy appendages (such as those of a fiddler crab) to form a more compact and suitably sized bolus for swallowing. Most birds, including gull-billed terns, exhibit some degree of cranial kinesis in which certain skull bones move independently of others (i.e. are not fused to form an immobile structure) to allow for the swallowing of whole prey items (Proctor and Lynch 1993). Specifically, the quadrates of the cranium, to which the lower jaw or mandible (Fig 9a, b) articulates, possess the ability to move laterad (side to side) and anteriad (forward) to a slight degree as a bird manipulates food boluses prior to swallowing. Measures of the internal space between the two quadrates (Table 2) of a disarticulated skull provide an estimate of the static width of the gape or gullet of the tern, and thus approximates the lower limit of the maximum width of an item to be swallowed whole. Alternatively, the articulation of the quadrates of the skull with the articulars of the mandible, as in a living bird, causes the expanded jaw to bow outward to a slight degree. Interquadrate measurements taken in this position estimate the maximal width of the expanded gape (Table 2). These measures provide liberal estimates of the width of the jaw and its maximal expansion given that the presence of soft tissues in a living animal would result in a somewhat smaller gape. Despite the bias toward overestimation, we suggest that these measures remain informative for approximating a maximal size limit of prey suitable for the gull-billed tern. Based on these assumptions, we sought to evaluate the average size of a common prey item, the mole crab (Table 2) in relation to approximations of gape size. This crab's rigid carapace renders it relatively incompressible. From Table 2 it is apparent that the width of a typical mole crab collected from the surf zone at Imperial Beach falls well below the maximal expansion of the gape of approximately 30 mm. Further, one mole crab which was presumably rejected by a gull-billed tern and salvaged from near a nest measured over 40 mm in length and over 20 mm in width (Molina unpubl. data.).

To our knowledge, bird eggs as prey items of gull-billed terns have not been documented in the literature. Although gull-billed terns have been recently reported to take the eggs of snowy plovers and least terns in San Diego, we suspect these events to be relatively rare. The dimensions of bird eggs potentially available to gull-billed terns are listed in Table 2. Even the smallest, those of the snowy plover, which at their widest point measure on average over 22 mm (Table 2), approach the maximal jaw expansion of the tern. Recent reports by colony monitors of gull-billed terns taking, but subsequently rejecting, the eggs of least terns, which on average measure over 24 mm at their widest point (Table 2), along with our observations of increased handling times for terns attempting to consume some of the larger sized mole crabs, support our hypothesis of a critical limit of size for prey that are resistant to compression. Although gull-billed terns may take fairly large fish and lizards, the elongate shape, smaller cross-section, and compressibility of these prey types probably pose less of a challenge to the successful handling by gull-billed terns than do the more rigid prey. Because of their size and the difficulty with which gull-billed terns appear able to handle them, we suggest that the eggs of least terns and plovers, which are non-compressible and large, relative to the size of the bill and gape of the gull-billed, represent foraging miscalculations rather than regular prey items.

Because gull-billed terns are opportunistic foragers (Parnell *et al*. 1995, Erwin *et al*. 1998) and feed on a variety of food items, we recommend that managers and monitors of least tern and snowy plover breeding areas minimize disturbances to nesting colonies, particularly during the early hatching phases. We noted numerous instances during our observations in which least terns successfully repelled intruding gull-billed terns and chased them from their colonies. Efforts to minimize investigator disturbances at nesting colonies that stimulate upflights by incubating and brooding least terns and the dispersal of chicks may provide fewer opportunities for successful predation by gull-billed terns and other avian predators.

While gull-billed terns prey on chicks occasionally, and on eggs less frequently, our data suggest that the impact of their predation on populations of least terns and snowy plovers is likely minimal, as they are probably capable of preying on only the youngest age classes for which the probability of survival is least. Further, the gull-billed population in San Diego Bay is confined to nesting at a single site and its size has remained fairly stable at about 30 pairs. When assessing the impacts to populations by predators, it is useful to consider the reproductive and parental care strategies of prey species. Is a particular species predisposed to rapid renesting after loss of the first clutch? Is the San Diego breeding season sufficiently long to support the production of multiple broods? Powell (2001) indicates that the plover nesting season there is fairly protracted as it extends from March through August. As is also the case with snowy plovers, do species-specific or population-specific mating strategies allow one member of the pair to desert the current brood and initiate a new nesting attempt with another mate?

The commonly (and most easily) gathered data for breeding populations includes the number of breeding pairs, nest attempts, eggs laid, and hatchlings. While such data are extremely valuable in and of themselves, they unfortunately impart little or no information on the reproductive success of populations because we often lack longer-term information on the fledging success and rates of recruitment of young produced locally and of the dynamics of immigration and emigration between breeding colonies or populations. We recommend that more resources be used to document measures of productivity so that impacts of observed gull-billed tern predation on the plover and tern may be evaluated within an appropriate demographic context.

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Figures and Tables

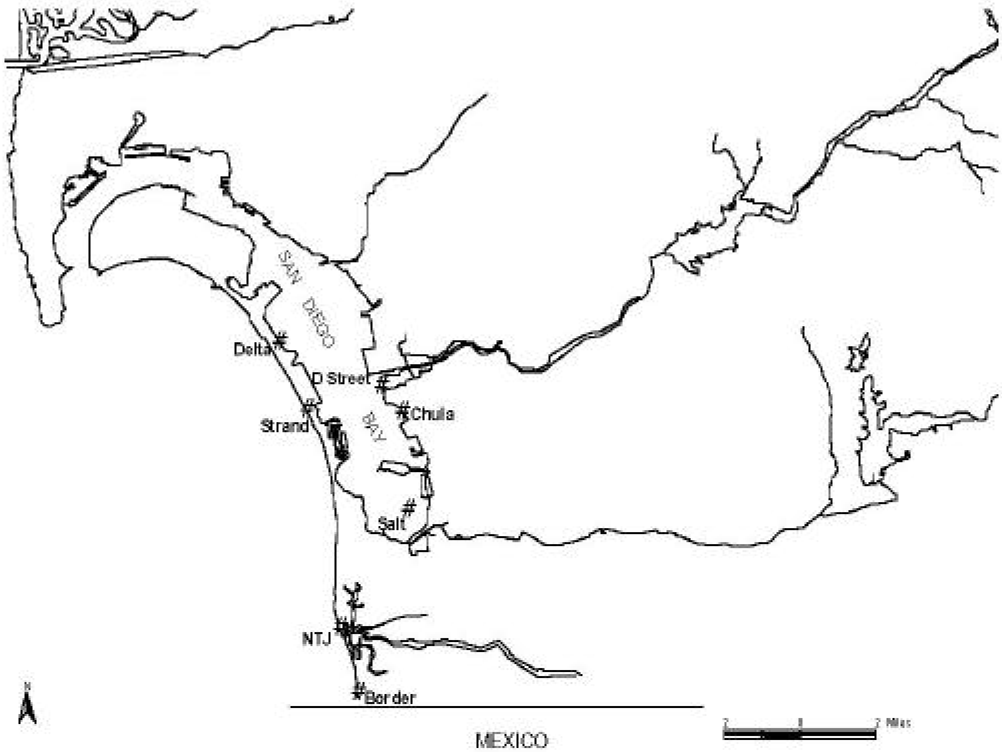

Fig. 1. Location of stations from which observations of foraging Gull-billed Terns were conducted in south San Diego Bay in 2002.

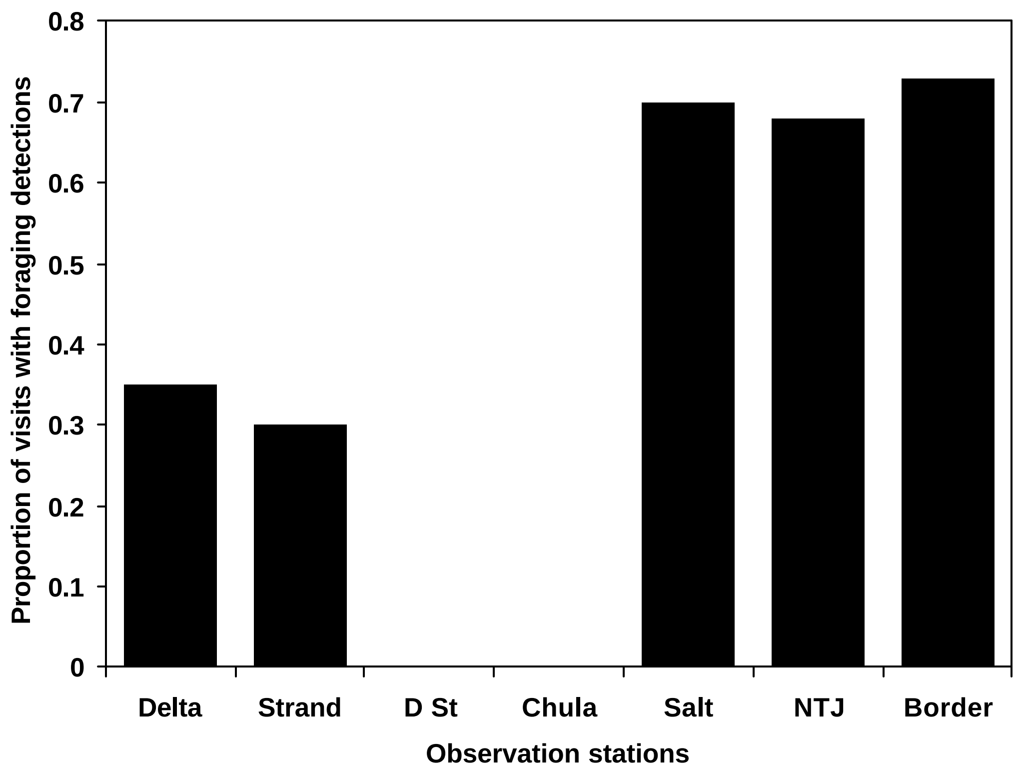

Fig. 2. Proportion of visits with detections of foraging birds among observation stations.

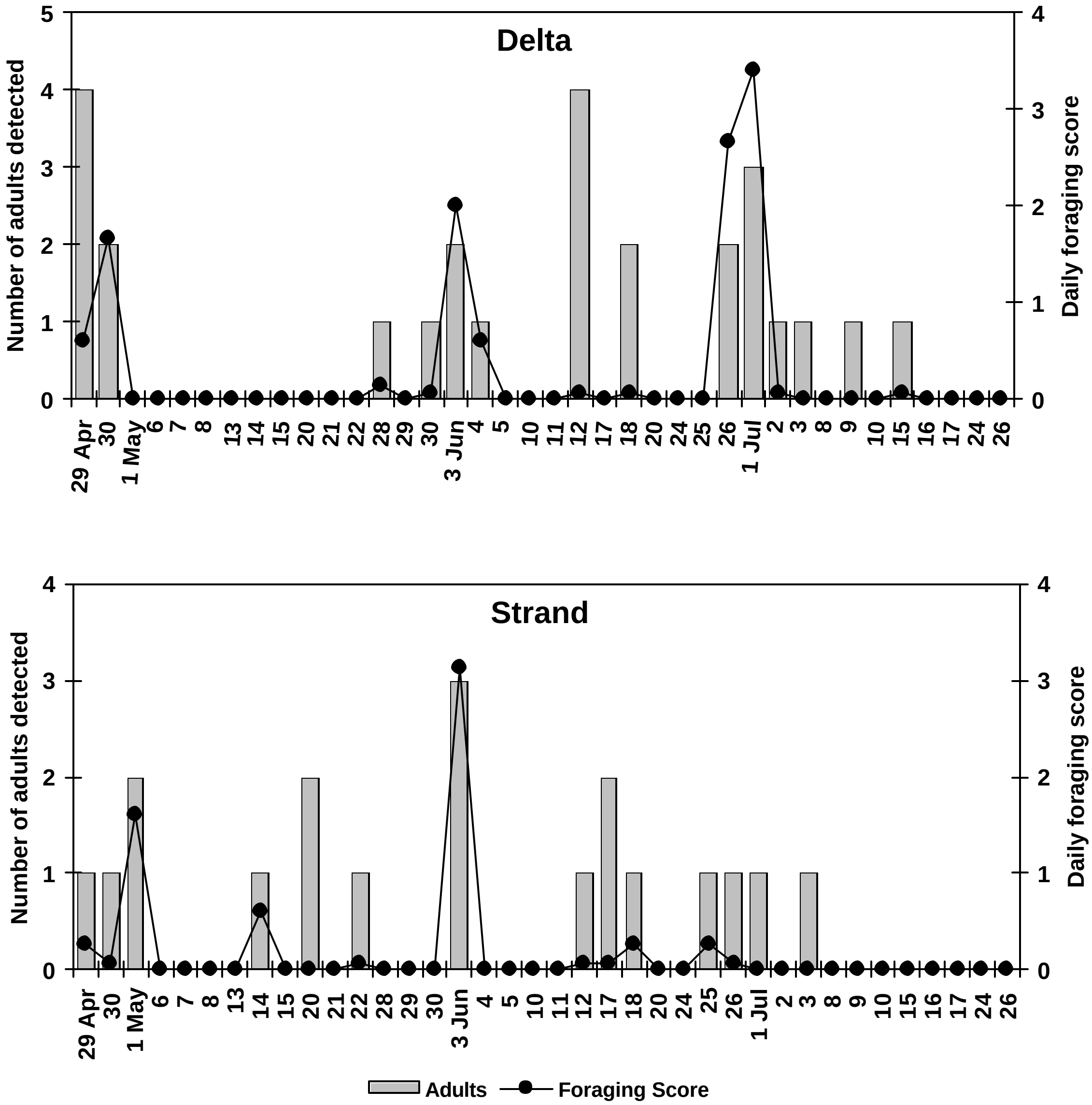

Fig. 3a. Temporal patterns of Gull-billed Tern adult presence and foraging intensity at observation stations in the northwestern sector of south San Diego Bay. Refer to methods for calculation of daily foraging scores.

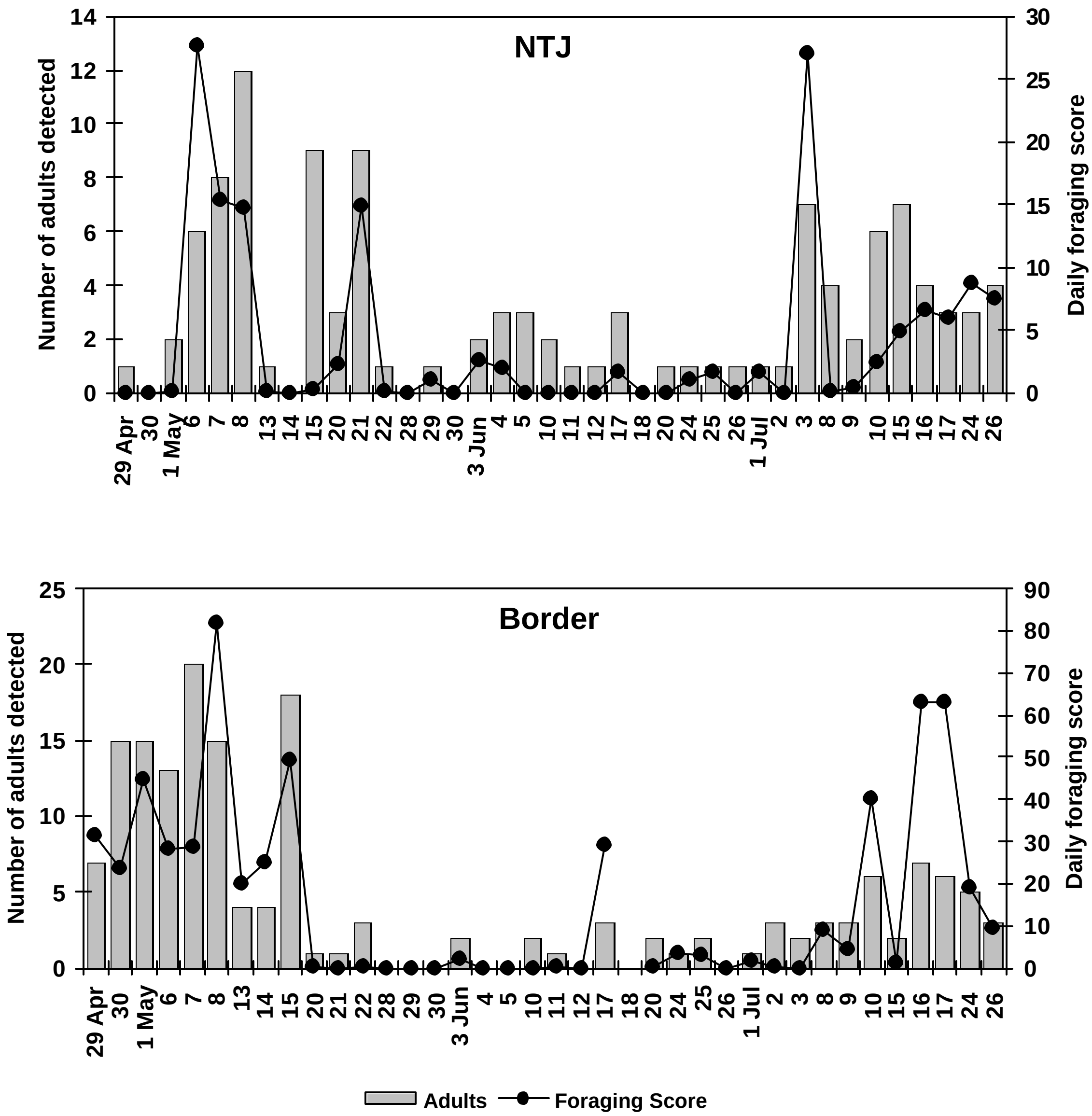

Fig. 3b. Temporal patterns of Gull-billed Tern adult presence and foraging intensity at observation stations in the southwestern sector of south San Diego Bay. Refer to methods for calculation of daily foraging scores.

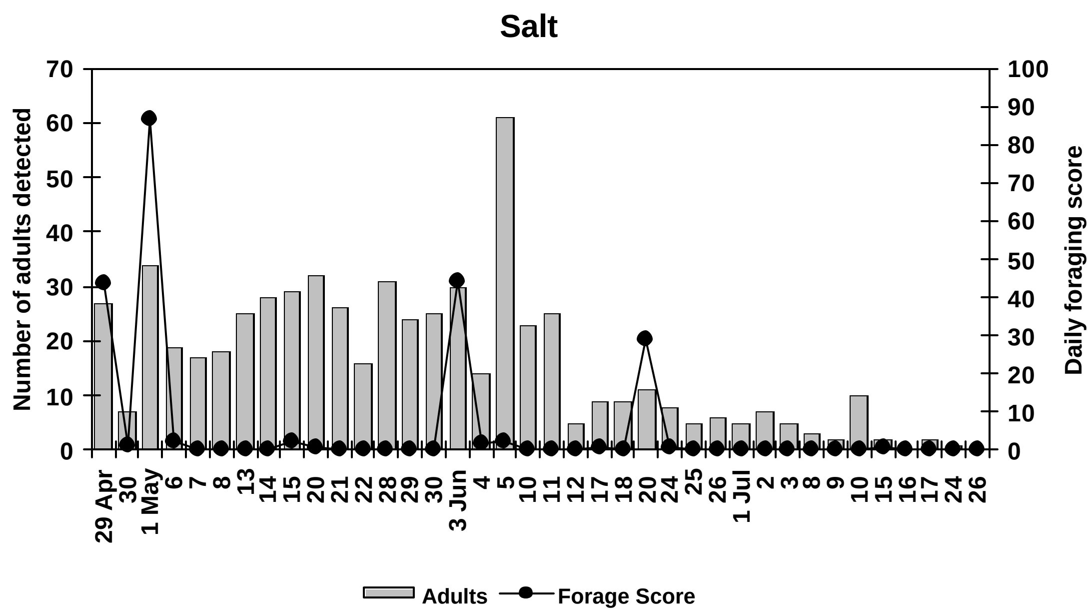

Fig. 3c. Temporal patterns of Gull-billed Tern adult presence and foraging intensity at observation stations in the southeastern sector of south San Diego Bay. Refer to methods for calculation of daily foraging scores.

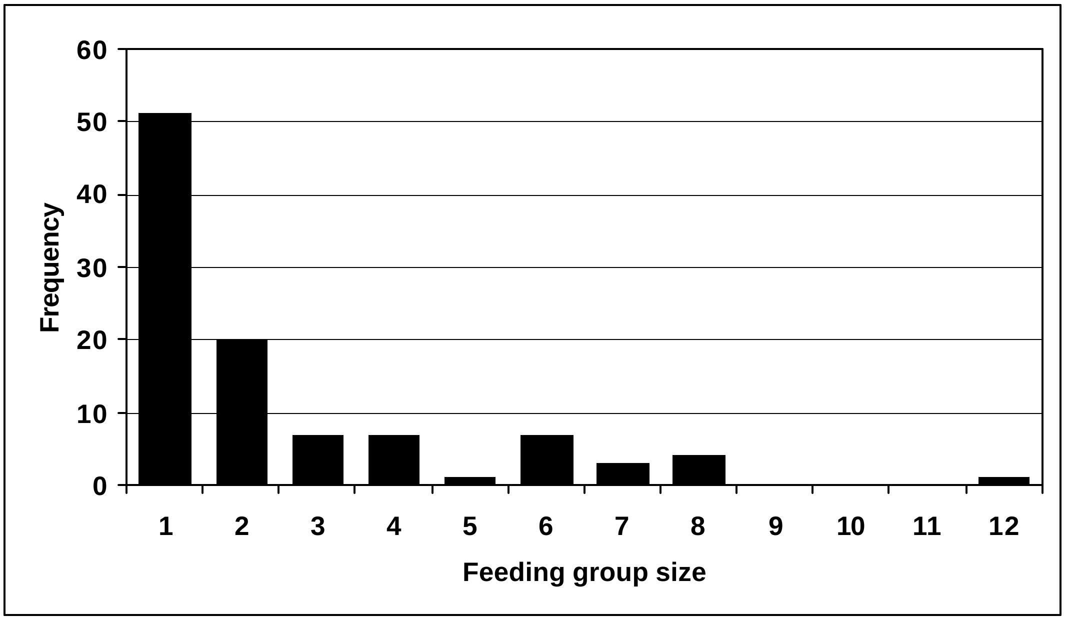

Fig. 4. Histogram of Gull-billed Tern feeding group sizes (N = 101 groups).

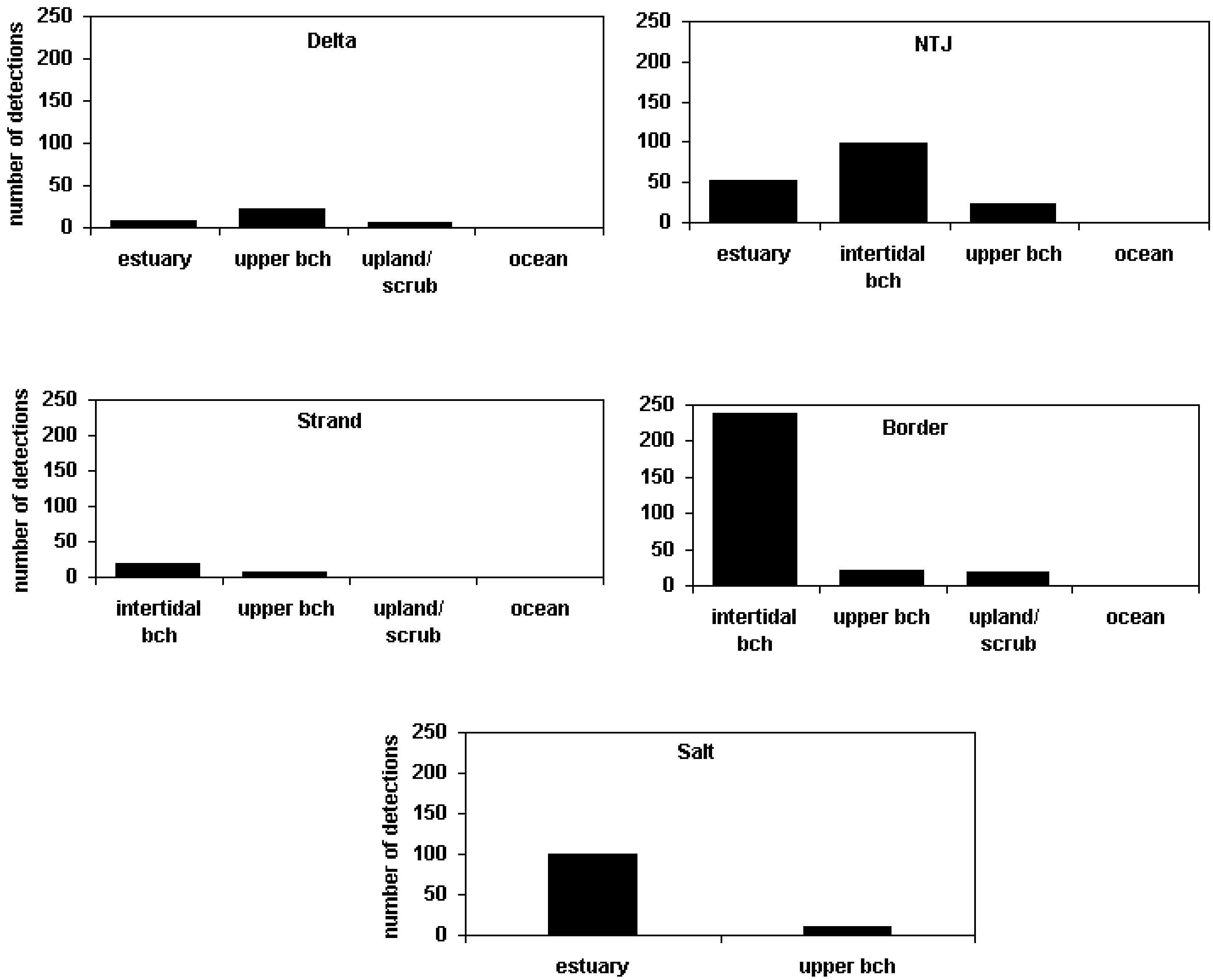

Fig. 5. Total number of foraging detections among substrates present at observation stations.

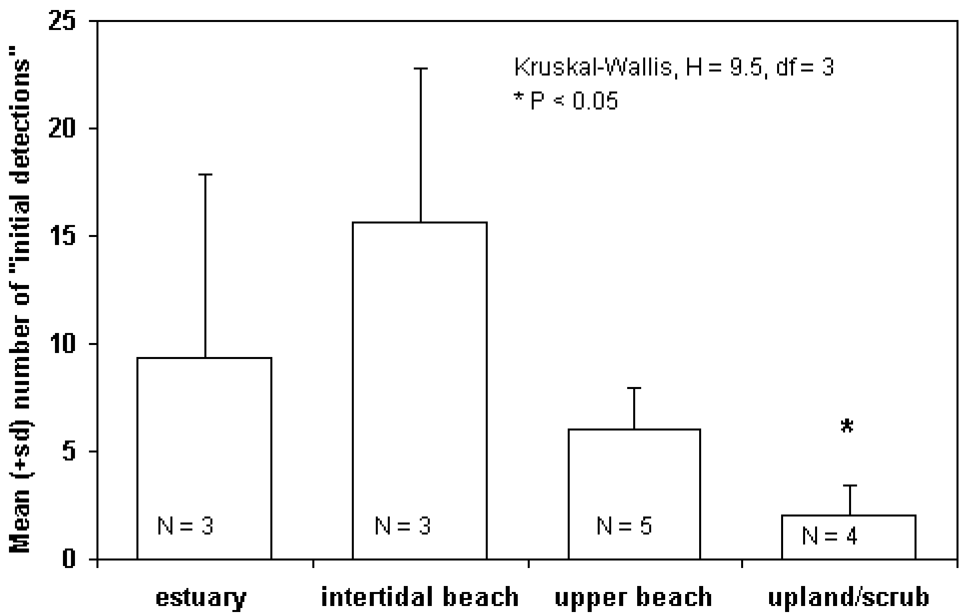

Fig. 6. Mean number of “initial foraging detections” among substrate types. Data from Salt station excluded because of potential bias due to its status as a breeding site. N = number of substrate replicates.

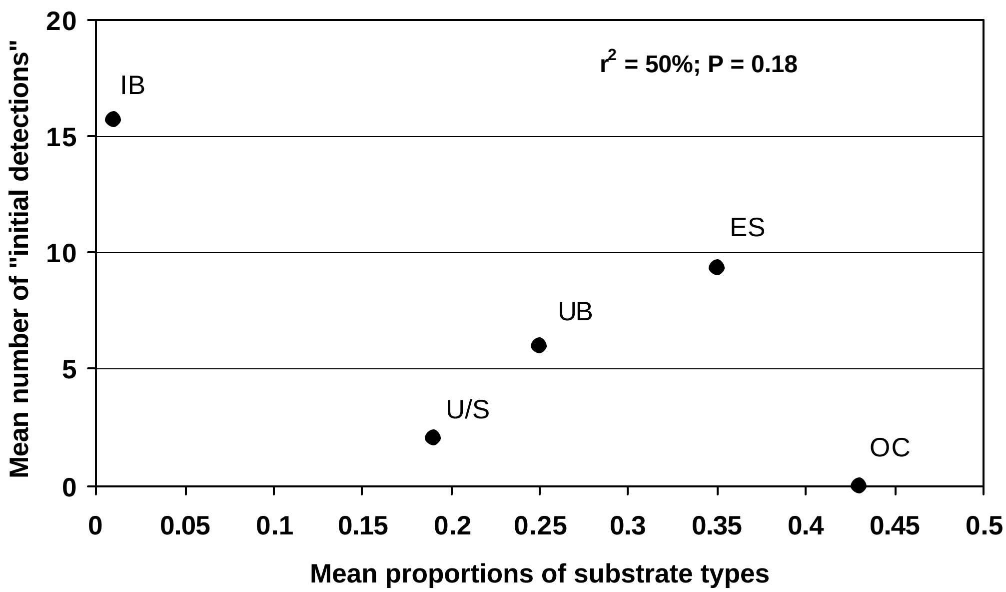

Fig. 7. Plot of the mean number of "initial foraging detections" (refer to methods) for substrate type against substrate proportion. Data from Salt was excluded because of potential bias due to its status as a breeding site for the focal species. ES = estuary, IB = intertidal beach, OC = ocean, UB = upper beach, and U/S = upland scrub.

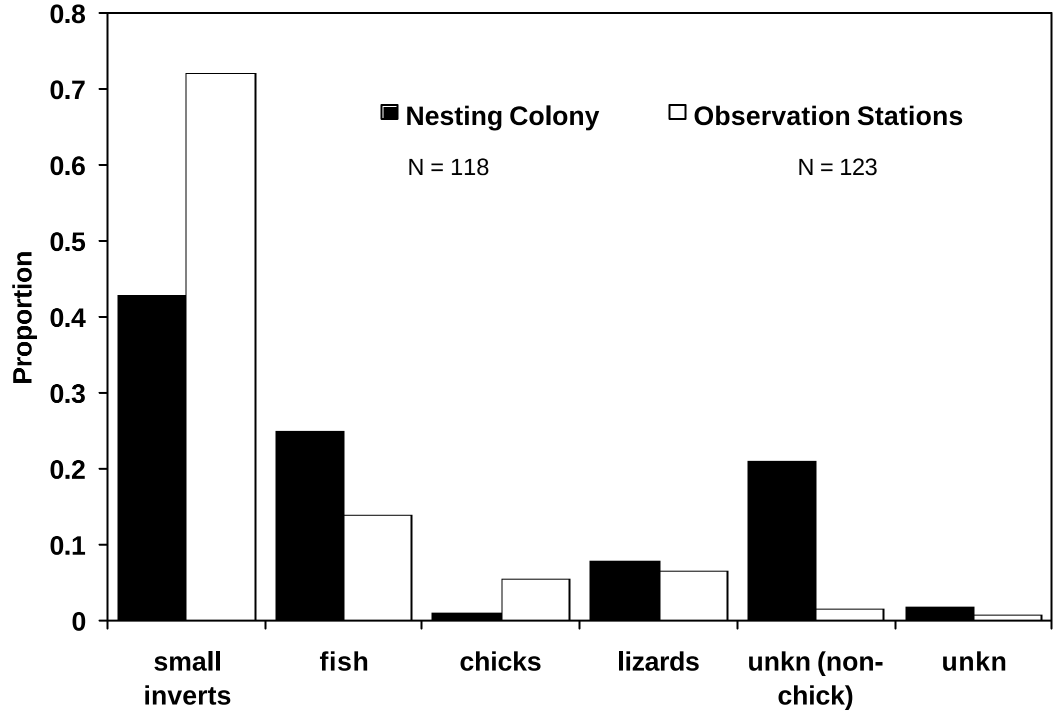

Fig. 8. Proportion of prey items delivered to nesting colony (solid bars) and of prey items taken at observation stations (open bars). N = the total number of prey items observed. Observations at foraging stations took place over the entire study period while those of deliveries to the nesting colony took place on eleven different days from 3 June through 10 July.

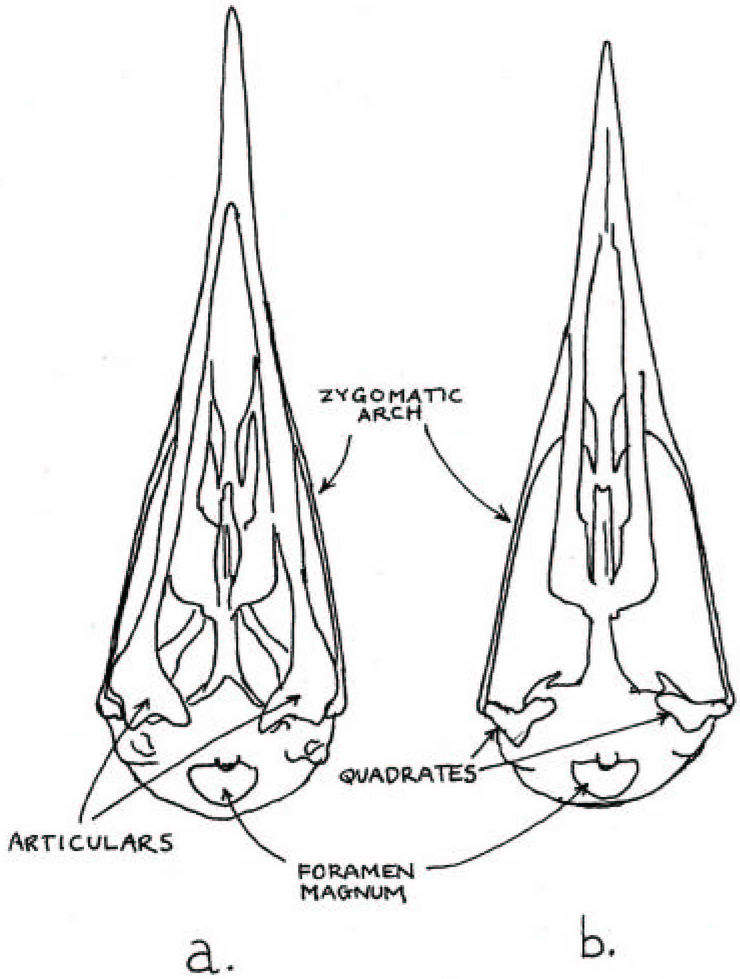

Fig. 9. Diagram of inferior aspect of a Gull-billed Tern skull demonstrating the articulation of the upper (maxilla) and lower mandible (a). The inferior aspect of the maxilla alone is shown in (b). It is this articulation of the quadrates of the maxilla with the articulars of the lower mandible that allows for a slight degree of lateral and anterior expansion of the jaw to allow for the swallowing of whole prey items (Proctor & Lynch 1993). Drawn by K. L. Garrett from xerox copies of actual skulls.

Table 1. Approximate proportions of substrate present at each observation station (refer to methods for estimation techniques).

Site	Estuary	Intertidal beach	Upper beach	Upland/scrub	Ocean
Border	na	0.01	0.12	0.32	0.48
NTJ	0.2	0.01	0.2	na	0.58
Salt	0.93	na	0.07	na	na
Strand	0.11	0.01	0.21	0.04	0.44
Delta	0.39	0.01	0.36	0.01	0.23
D St	0.53	na	0.34	0.14	na
Chula	0.54	na	na	0.46	na
Mean Proportion (± sd)	0.45 ± 0.29	0.01 ± 0.0	0.22 ± 0.12	0.19 ± 0.19	0.43 ± 0.15

Table 2. Metrics of selected elements of Gull-billed Tern skulls and jaws, and of known and suspected non-compressible prey items.

	Mean (± sd)	Range
Gull-billed Tern skull measurements (mm; N = 10)		
Internal width at quadrates	18.32 ± 1.1	15.98 - 19.91
Maximum width at quadrates during articulation with lower mandible (spread gape)	29.54 ± 1.7	26.91 - 32.62
Common prey item (mm; N = 75)		
Mole crab (length)	15.56 ± 0.64	5.6 - 35.7
Mole crab (width)	8.78 ± 0.39	3.3 - 20.1
Egg measurements (mm)		
Snowy Plover (N = 3)		
length	29.26 ± 0.7	28.43 - 29.81
width	22.38 ± 0.9	21.39 - 22.95
Least Tern (N = 2)		
length	31.59 ± 0.3	31.41 - 31.77
width	24.13 ± 0.2	24.0 - 24.25
Killdeer (N = 4)		
length	37.98 ± 0.89	36.84 - 39.01
width	26.5 ± 0.71	25.88 - 27.42
Black-necked Stilt (N = 4)		
length	44.49 ± 0.8	43.68 - 45.25
width	29.9 ± 0.4	29.37 - 30.17