INSECTS IN THE DIET OF THE GREATER CRESTED TERN *THALASSEUS BERGII BERGII* IN SOUTHERN AFRICA

DAVIDE GAGLIO[1], RICHARD B. SHERLEY[2] & TIMOTHÉE R. COOK[1,3]

[1]*Percy FitzPatrick Institute, DST/NRF Centre of Excellence, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa (swift.terns@gmail.com)*
[2]*Animal Demography Unit and Marine Research Institute, Department of Biological Sciences, University of Cape Town, Private Bag X3, Rondebosch 7701, South Africa*
[3]*Institute of Ecology and Environmental Sciences, Department of Evolutionary Ecology, Evolutionary Ecophysiology Team, Université Pierre et Marie Curie, Bâtiment A–7ème étage, 7 quai St Bernard, 75005 Paris, France*

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Many tern species are described as feeding primarily on aquatic organisms, which they snatch from the surface or capture by plunge-diving, dipping or contact dipping (Ainley 1977, Gochfeld & Burger 1996). However, some terns also forage on terrestrial prey. The Gull-billed Tern *Gelochelidon nilotica*, for example, eats more insects than fish, snatching insects from the air (Richards 1990, Gochfeld & Burger 1996), while marsh terns (*Chlidonias* spp.) depend heavily on insects, spiders, earthworms, amphibians and lizards (Richards 1990, Gochfeld & Burger 1996).

Coastal tern species, which generally forage at sea, may also feed on insects over the land. For example, male South American Terns *Sterna hirundinacea* were reported returning to their nesting colony with katydids (Tettigoniidae) throughout the courtship period (Woehler *et al*. 2013). Kerguelen Terns *Sterna virgata* prey mainly on fish during incubation but rely on insects when feeding chicks (Weimerskirch & Stahl 1988). Off the coast of Western Australia, Surman & Wooller (2003) compared the foraging ecology of five sympatric species of terns during breeding (Greater Crested Tern *Thalasseus bergii*, Roseate Tern *S. dougallii*, Sooty Tern *Onychoprion fuscatus*, Lesser Noddy *Anous tenuirostris* and Brown Noddy *A. stolidus*), and reported the presence of insects in the diet only for Sooty Terns. These observations suggest that the occurrence of insects in the diet might vary according to temporal and spatial differences in the local availability of these prey (Mauco & Favero 2004). Further studies are needed to assess species-specific patterns of insect consumption by terns and spatial and temporal patterns in their dietary contributions.

The Greater Crested Tern is a generalist predator that breeds in dense colonies on coastlines and islands from Namibia eastwards to the central Pacific (Crawford 2003). Its diet is mainly composed of sea-surface schooling clupeid fish (Crawford & Dyer 1995, McLeay *et al*. 2009), but also includes cephalopods and crustaceans, while insects and reptiles may be taken opportunistically (Gochfeld & Burger 1996). It is not clear whether insects are a regular component in the diet of Greater Crested Terns or whether they are exclusively fed to chicks or contribute to the energy intake of adults. In an Australian population studied over a five-year period, a total of 2 146 and 3 921 prey were identified from 1 400 and 1 561 regurgitates collected from chicks and adults, respectively. Insects contributed a low proportion of the total biomass (<0.5%) and species were not identified (McLeay *et al*. 2009).

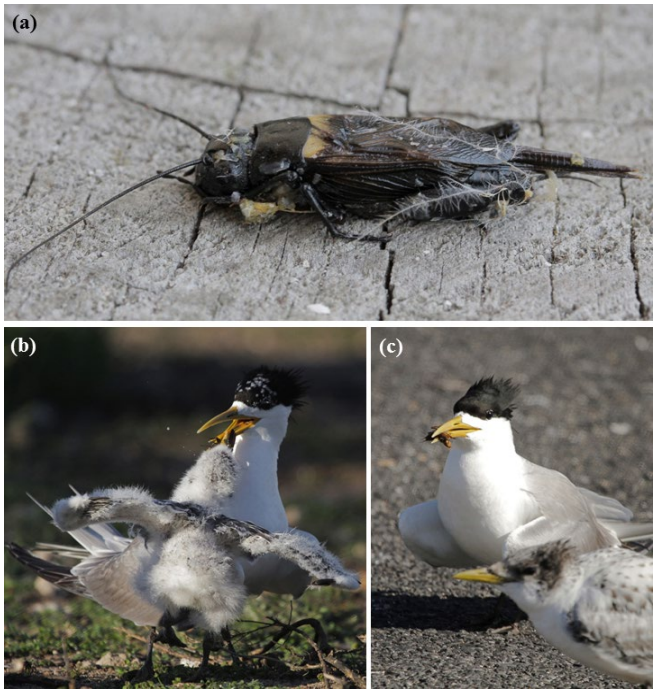

Fig. 1. (a) Two-spotted Cricket collected from a chick regurgitation. Greater Crested Tern chick being fed with (b) a Two-spotted cricket and (c) an African Mole Cricket.

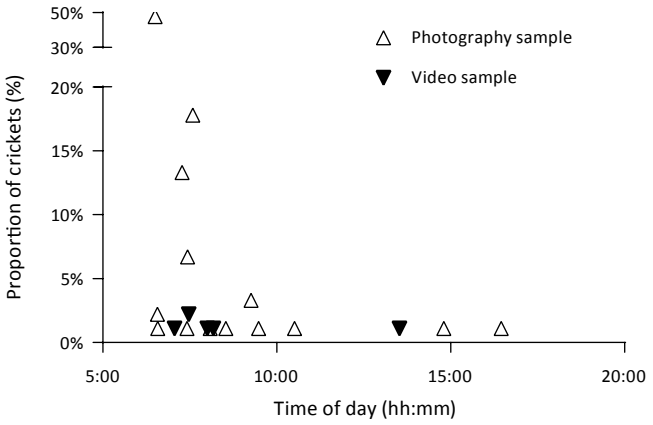

Fig. 2. Proportion of crickets in daily samples as a function of time of day (△ from photographic sample; ▼ from video-recording). Local time is UTC+2.

In southern Africa, the subspecies *T. bergii bergii* feeds predominantly on pelagic fish, mainly the Cape Anchovy *Engraulis encrasicolus* (Crawford & Dyer 1995). A study of chick diet from 1977 to 1984 off the west coast of South Africa showed that this species occasionally feeds insects to its chicks. However, the frequency of occurrence was very low, as only two of 1 311 chick regurgitation samples contained an insect, the Two-spotted Cricket *Gryllus bimaculatus* (Walter *et al*. 1987). This species occurs all over Africa, typically in association with human habitations, where it frequently occurs in high density (Scholtz & Holm 1985).

Here we report insect prey fed to Greater Crested Tern chicks at Robben Island, South Africa (33°48′S, 18°22′E), from February to May in 2013 and 2014. The diet was studied by photographing adults returning to their colony carrying prey in their bill. We also recorded videos of feeding events to chicks (1–3 d old) in the nest cup, and prey items were identified. In addition, regurgitations from chicks were collected during a ringing operation on 20 April 2014.

Over the two breeding seasons, we photographed 95 insects brought back to the colony while provisioning chicks, amounting to 0.76% of total prey items (n = 12 488). The Two-spotted Cricket (n = 3 in 2013; n = 87 in 2014) was photographed being carried back to the colony, and on a few occasions we observed this species being fed to chicks (Fig.1a, b). In 2014, we also recorded the African Mole Cricket *Gryllotalpa africana* (Fig. 1c) and a few other individuals of at least one other species of insect, possibly the cockroach *Periplaneta americana,* which is also found in association with the human settlement on Robben Island. In total, insects were observed on 15 (12%) of 122 d of photographic sampling. They were less commonly observed in 2013 (2 d, 5% of 44 d) than in 2014 (13 d, 17% of 78 d). On 18 March 2014, crickets contributed 43 (46%) of the total of 93 prey items photographed during a 30 min interval (06h50–07h20 UTC+2), whereas almost all the remaining prey items (49%) were fish. In both years, 81 (90%) of the crickets sampled were recorded before 08h00; only twice (2.2%) were they observed being carried back to the colony in the afternoon (Fig. 2). Additionally, of the 374 prey items observed by video-recording in 2014, six crickets were fed to chicks while in the nest cup, and five of these were delivered in the morning. When chick regurgitations were collected, we found one Two-spotted Cricket among 65 prey items (Fig. 2).

We have no direct information about how the terns captured the insect prey. The predominance of crickets in the early-morning prey samples may be explained by the fact that crickets fly mainly at night and are attracted by light (Ulagaraj 1975). Robben Island hosts a small resident human population, with artificial lights attracting insects and resulting in an aggregation of crickets at the base of lights, which could then be collected by the birds in the morning. Another area where terns may find crickets in abundance is the surf zone close to the colony. Crickets may drown in the sea and become concentrated near shore, where they should be easily visible to birds at first light (M. Picker, pers. comm.). Both photographic and video records showed an adult carrying two crickets in its bill. Greater Crested Terns are generally single-prey loaders, with multiple loads observed in only 0.6% of 2 639 cases by Duffy (1987). However, this observation and the ecology of the cricket species suggest that these insects might be picked up from areas of high density.

Our observations indicate a greater exploitation of insects than was previously reported for Greater Crested Terns and confirm the species' flexibility in diet and foraging habitat, highlighting its opportunistic foraging ecology. Insects have generally high energetic content, and therefore may be a valuable diet supplement for growing chicks. The occurrence early in the morning might be linked to the urgent energetic requirements of small chicks that have not been fed for several hours overnight.

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