ORNITOLOGIA NEOTROPICAL 15: 121–131, 2004
© The Neotropical Ornithological Society

DIET OF THE COMMON TERN (*STERNA HIRUNDO*) DURING THE NONBREEDING SEASON IN MAR CHIQUITA LAGOON, BUENOS AIRES, ARGENTINA

Laura Mauco[1] & Marco Favero[1,2]

[1]Laboratorio Vertebrados, Departamento de Biología, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Mar del Plata, Funes 3250, (7600) Mar del Plata, Argentina. *E-mail:* lmauco@mdp.edu.ar

[2]Comisión Nacional de Investigaciones Científicas y Tecnológicas (CONICET), Av. Rivadavia 1917, (C1033AAJ) Buenos Aires, Argentina.

Resumen. – Dieta del Gaviotín golondrina (*Sterna hirundo*) en la estación no reproductiva en la Laguna de Mar Chiquita, Buenos Aires, Argentina. – El Gaviotín golondrina (*Sterna hirundo*) se reproduce ampliamente a lo largo del Hemisferio Norte en colonias distribuidas en América del Norte, Europa y Asia. Los gaviotines que se reproducen en la costa Atlántica de Estados Unidos de Norteamérica migran durante el invierno boreal hacia el Hemisferio Sur, mostrando una extensa distribución no reproductiva que incluye la costa Atlántica de Argentina y Brasil. Particularmente, la costa de la Provincia de Buenos Aires (Argentina) constituye la principal área de distribución no reproductiva de la especie en Sudamérica. En la Laguna de Mar Chiquita se estudió la dieta de los gaviotines mediante el análisis de egagrópilas (bolos con restos no digeridos de las presas). Fueron analizadas 538 muestras, que contuvieron 1092 presas. El 88% de las presas (en importancia numérica) estuvo constituida por peces, el 11,4% por insectos adultos y el 0,5% fueron crustáceos. Los insectos hallados en la dieta fueron adultos de Coleoptera, Odonata, Orthoptera, Hemiptera y Lepidoptera. Se identificaron un total de nueve especies de peces. La anchoíta (*Engraulis anchoíta*) representó el 70% del total de peces y el 51% de la biomasa total de peces consumida. El tamaño promedio de las presas fue 80.1 ± 17.0 mm. En relación a los hábitat frecuentados por los gaviotines, el 78% de las presas provinieron de ambientes marinos mientras que el 22% restante de ambientes estuariales. Futuros estudios incluirán el desarrollo de metodologías alternativas que permitan analizar posibles variaciones de la dieta en una escala temporal más fina y analizar también las variables ambientales que puedan estar involucradas en dichas variaciones.

Abstract. – The Common Tern breeds widely across the Northern Hemisphere in colonies all along North America, Europe and Asia. Common terns breeding in the Atlantic coast of North America migrate during the boreal winter to the Southern Hemisphere, showing a wide nonbreeding distribution that includes the Atlantic coasts of Argentina and Brazil. The coast of Buenos Aires Province (Argentina) constitutes the main wintering area of the species in South America. In Mar Chiquita Lagoon, their diet was assessed by the analysis of regurgitated casts collected on nonbreeding grounds. A total of 538 pellets were analyzed, containing 1092 prey. About 88% by number of prey were fish, 11.4% were adult insects and 0.5% were crustaceans. Adult Coleoptera, Odonata, Orthoptera, Hemipthera and Lepidoptera was the main insects found in the diet. A total of nine fish species were identified. Argentine anchovy (*Engraulis anchoita*) represented 70% by number and 51% of the consumed biomass of fish. The average length of fish prey was 80.1 ± 17.0 mm. With respect to habitat, 78% of the prey came from marine foraging habitats while the other 22% were from estuarine environments. Forthcoming studies will include the develop-

ment of additional methods in order to analyze to a finer scale the temporal variations in the diet and environmental variables involved in such changes. *Accepted 6 June 2003.*

Key words: Common Tern, *Sterna hirundo*, diet, fish prey, insects, Argentina.

INTRODUCTION

The Common Tern (*Sterna hirundo*) breeds widely across the Northern Hemisphere in colonies all along North America (Nisbet 2002), Europe and Asia (Gochfeld & Burger 1996). In North America, it breeds in colonies on barrier beaches and islands of the Atlantic coast (e.g., on Great Gull Island, Hays *et al.* 1997), and on inland waters (Kress *et al.* 1983, Gochfeld & Burger 1996, Nisbet 2002). During the boreal winter, terns migrate southward to the Southern Hemisphere, showing a wide nonbreeding distribution that includes Central (Erwin *et al.* 1986) and South America, including both the Pacific (e.g., Peru, Blokpoel *et al.* 1989) and Atlantic coasts (e.g., Lagoa do Peixe, Brasil, and Somborombon Bay, Argentina; Harrington *et al.* 1986, Hays *et al.* 1997, 1999; Mauco *et al.* 2001).

The diet of Common terns consists mainly in small fish such as Atlantic herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) in Germany and United Kingdom (Wendeln 1997, Robinson & Hamer 2000), menhaden (*Brevoortia* sp.), anchovies (*Anchoa* sp., *Stolephorus* sp.) and herring (*Clupea harengus, Etrumeus* sp.) in the United States (Erwin 1977, Safina & Burger 1988, Gochfeld & Burger 1996, Nisbet 2002). During the nonbreeding season, other items have been reported in their diet such as insects, small squids, polychaete worms and crustaceans (Cramp 1985, Blokpoel *et al.* 1989, Mauco *et al.* 2001). At Punta Rasa (Samborombón Bay, Argentina), clupeiform fish [Argentine anchovy, (*Engraulis anchoita*) and anchovy (*Anchoa marinii*)] constituted the bulk of their diet by mass, although adult insects (Coleoptera, Odonata, Orthoptera and Hemiptera) were also important prey by number (Mauco *et al.* 2001).

The coast of Buenos Aires Province constitutes the largest roosting area of Common Terns in South America (e.g., 30,000 birds at Punta Rasa) (Hays *et al.* 1997, Mauco *et al.* 2001). This high abundance could be related to high food availability in the area, together with foraging opportunities both in marine, estuarine and freshwater environments. During austral summer, a maximum of 3000 Common Terns were reported roosting at Mar Chiquita Lagoon (35 km from Mar del Plata city, Buenos Aires Province) (Favero *et al.* 2001a). A total of 28 fish species have been reported in the lagoon, and their occurrence and abundance showed different spatial and temporal patterns throughout the year (Cousseau *et. al.* 2001). Some of these fish species (e.g., anchovies, silversides, drums and hakes) have been reported in the diet of other seabirds which use Mar Chiquita Lagoon as a breeding, roosting and or refueling area (terns, skimmers, gulls and oystercatchers, among others) (Martinez & Bachmann 1997, Bachmann & MartÌnez 1999, Favero *et al.* 2000a, Favero *et al.* 2000b, Anónimo 2001).

In this paper, we report the first detailed information of the diet of Common Terns in Mar Chiquita Lagoon and its variation through the nonbreeding season. We made estimates of total fish consumption during the season and the foraging areas used by the species.

STUDY AREA AND METHODS

Mar Chiquita Lagoon (37°46'S, 57°27'W), situated 40 km North from Mar del Plata city in Buenos Aires Province, Argentina, is a MAB-

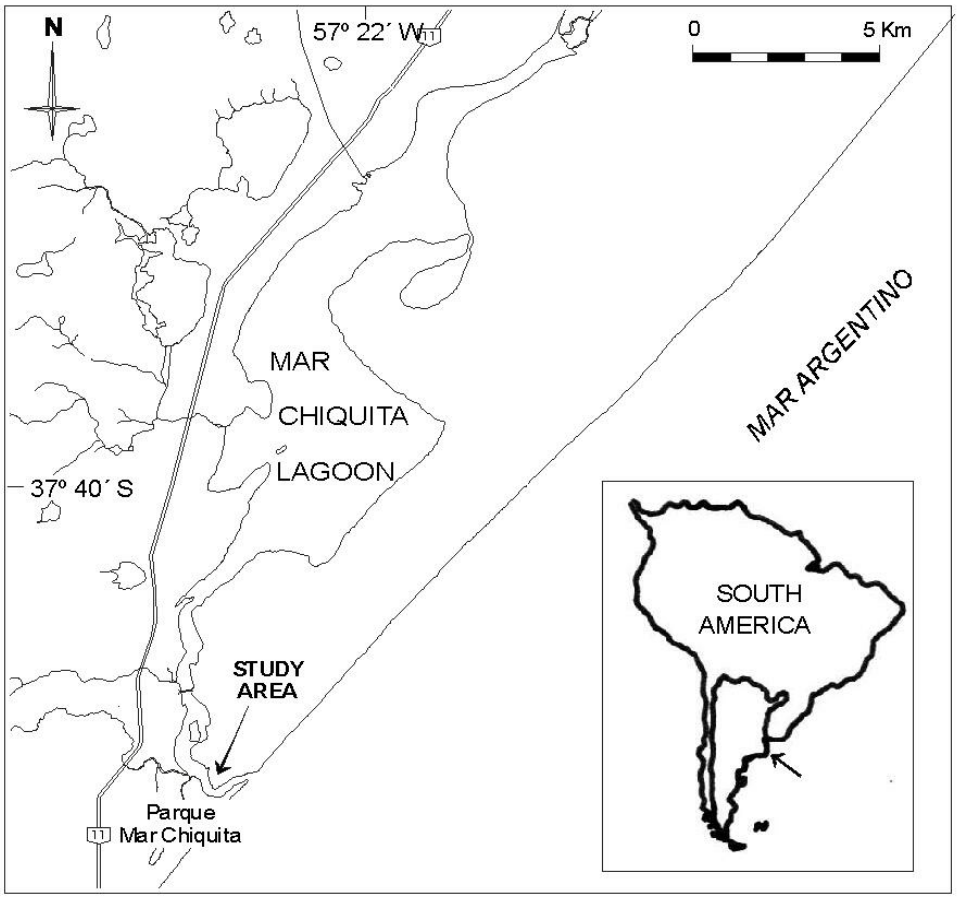

FIG. 1. Study area at Mar Chiquita Lagoon (37°46'S, 57°27'W), Buenos Aires Province, Argentina.

UNESCO Reserve. This lagoon has a mean surface of 46 km^2 and is divided into a wide northern and narrow southern part, the latter opening to the sea. A few small rivers feed it constantly with freshwater, while seawater enters and leaves it periodically with semidiurnal high tides, passing over a shallow sandbar at the mouth of the lagoon (Fasano *et al.* 1982, Spivak *et al.* 1994) (Fig. 1).

The diet of Common Terns was assessed by analysis of regurgitated casts collected monthly from December 2000 to March 2001. Pellets were kept at –20ºC, dissected and hard remains have been analyzed. Insects, crustaceans and other remains (head, elytra, legs, wings, etc.) were identified using a stereo microscope (x 20). To estimate the biomass of insects, 1 g was assigned to each specimen following Bó *et al.* (1996) and Bó (1999). Fish otoliths were identified using descriptions in the literature (Volpedo & Echeverría 1995) and reference material from our own collection. Otoliths of each species were separated into right and left and the most abundant was considered representative of the total number of prey in each pellet. Otolith length was mea-

TABLE 1. Frequency of occurrence percentages of insects in samples (F%) and importance by number (N%) of insects in diet samples of Common Terns in Mar Chiquita Lagoon (sample size in parentheses).

	December (57)		January (246)		February (104)		March (131)	
	F%	N%	F%	N%	F%	N%	F%	N%
Coleoptera								
Dynastidae								
Beetles (*Dyscinetus rugifrons*)	12.3	14.5	3.7	26.5	1.0	100.0		
D. gagates							6.1	78.6
Scarabaeidae								
Ground beetle (*Cyclocephala signaticollis*)	1.8	1.3	8.5	61.8				
Curculionidae: snout beetles	1.8	1.3	1.2	8.8				
Chrysomelidae: leaf beetles	1.8	1.3						
Odonata								
Aeshnidae: dragonflies (*Aeshna* sp.)	1.8	1.3						
Orthoptera								
Gryllidae: crickets	3.5	2.6						
Tettigoniidae: katyddids			0.4	2.9				
Gryllotalpidae: mole cricket (*Scapteriscus* sp.)	1.8	5.3						
Hemiptera								
Bellostomatidae								
Giant water bugs (*Bellostoma elegans*)	5.3	11.8					0.8	21.4
Lepidoptera								
Noctuidae: moths	21.1	60.5						
Total insects		76		34		1		14

sured with a digital caliper (to nearest 0.01 mm) and used to estimate fish size (total length) and mass using regressions in Favero *et al.* (2000a). Fish urostyles in samples with otoliths and without them were used to estimate the type of prey (i.e., identification to Family level) using reference material from our own collection.

The importance of each prey category was quantified 1) by the frequency of occurrence percentage (F%), referring to the percentage of samples in which a particular food type appeared, 2) by the importance by number (N%) as the percentage of prey items of one type among all prey items, and 3) by importance by mass (M%) as the percentage of mass of prey items of one type among total mass (Duffy & Jackson 1986, Rosenberg & Cooper 1990). Variations in the importance of preys through the study were analyzed by using chi square (χ^2) a priori hypothesis test. Means are given ± one standard deviation.

The number of Common Terns present at the roosting area (at the sandbar at the mouth of the lagoon, Fig. 1) was determined by the average of point counts performed at 05.00 h early in the morning, and during the afternoon after 20:00 h for each month. The total consumption of fish by terns was estimated through the calculation of daily energy expenditure (Duffy *et al.* 1987), using terns average mass of 120 g (Erwin 1977) and an energy content of 6.37 kj g^{-1} reported for the engraulid fish *Engraulis capensis* (Duffy *et al.* 1987), since engraulids constituted the bulk of the diet of Common Terns (see Mauco *et al.* 2001).

RESULTS

A total of 538 pellets were analyzed, containing 1092 prey items. About 88% of prey were fish, 11% were adult insects and less than 1% were crustaceans. Fish was the most frequent prey through the study (occurrence > 97%). excepting December, when fish occurred in 67% of the samples, while insects had 97% of occurrence. Crustaceans were occasionally found in the diet in December, January and February (F less than 1% in all months). Isopods were found in January, while unidentified crustaceans (Decapoda) were found in December and February.

Insects in the diet. A total of 64 pellets contained 125 insects (Table 1). Significant differences were observed in importance by number of insects vs. fish ($\chi^2_3 = 1357.23$, $P < 0.001$) in all months, being more frequent in December (60.8% out of all insects). In this month, moths (Lepidoptera, Noctuidae) had 60.5% of importance by number while the beetles *Discinetus rugifrons* (Coleoptera: Dynastidae) accounted for 14.5% of insect prey. Orthoptera (crickets, Gryllidae, and mole crickets, Gryllotalpidae) and Hemiptera (gigant water bugs *Bellostoma elegans*, Bellostomatidae) were also found in December, but in lower percentages. Ground beetles, *Cyclocephala signaticollis* (Sacarabaeidae, N% 61.8 and F% 8.5), and the beetles *Discinetus rugifrons* (N% 26.5 and F% 3.7) were also found in the diet in January, and *Discinetus gagates* (N% 78.6) were abundant in March (Table 1).

Fish in the diet. A total of 510 pellets (94.8% of the total) contained fish remains (961 fish prey). Some 286 of them contained 776 otoliths (corresponding to 588 fishes), and 255 had 521 urostyles (equivalent to 373 fishes through combined analysis with otoliths). Eighty three samples contained unidentified fish remains (e.g., scales)

Otoliths were from nine species belonging to six families, and urostyles were from three families (Table 2). Considering only the Engraulidae, Atherinidae and Sciaenidae, a significant difference was observed in importance by number ($\chi^2_6 = 441.98$, $P < 0.001$) of those fish prey species through the study.

TABLE 2. Frequency of occurrence percentage (F%) and importance by number (N%) of fish prey in diet samples of Common Terns in Mar Chiquita Lagoon (sample size in parenthesis).

	December (57)		January (246)		February (104)		March (131)	
	F%	N%	F%	N%	F%	N%	F%	N%
Engraulidae								
Argentine anchovy (*Engraulis anchoita*)	28.1	39.7	54.9	52.2	10.6	11.9	3.1	7.5
Anchovy (*Anchoa marinii*)	5.3	3.8	14.6	10.2	13.5	9.7	1.5	2.5
Unidentified Engraulidae*	14.0	41.0	20.3	30.4	26.9	28.1	1.5	2.5
Clupeidae								
Menhaden (*Brevoortia aurea*)			0.4	0.2				
Atherinidae								
Cornalito silverside (*Odonthestes incise*)	10.5	10.3	0.4	0.3	28.8	25.9	14.5	20.0
Pejerrey silverside (*O. argentiniensis*)			0.4	0.3	2.9	2.7	2.3	4.2
Unidentified Atherinidae*	3.5	3.8	3.3	1.7	18.3	20.0	28.2	47.5
Phycidae								
Squirrel hake (*Urophycis brasiliensis*)			1.2	0.5				
Pomatomidae								
Bluefish (*Pomatomus saltatrix*)			1.6	0.7	2.9	1.7	10.7	12.5
Sciaenidae								
White craoker (*Micropogonias furnieri*)			2.4	1.4				
Stripped weakfish (*Cynoscion guatucupa*)			4.9	2.1			0.8	0.8
Unidentified Sciaenidae*							2.3	2.5
Unidentified fish remains	7.0		5.3		15.4		38.2	
Total prey		78		578		185		120

*Identified to family level by using urostyles.

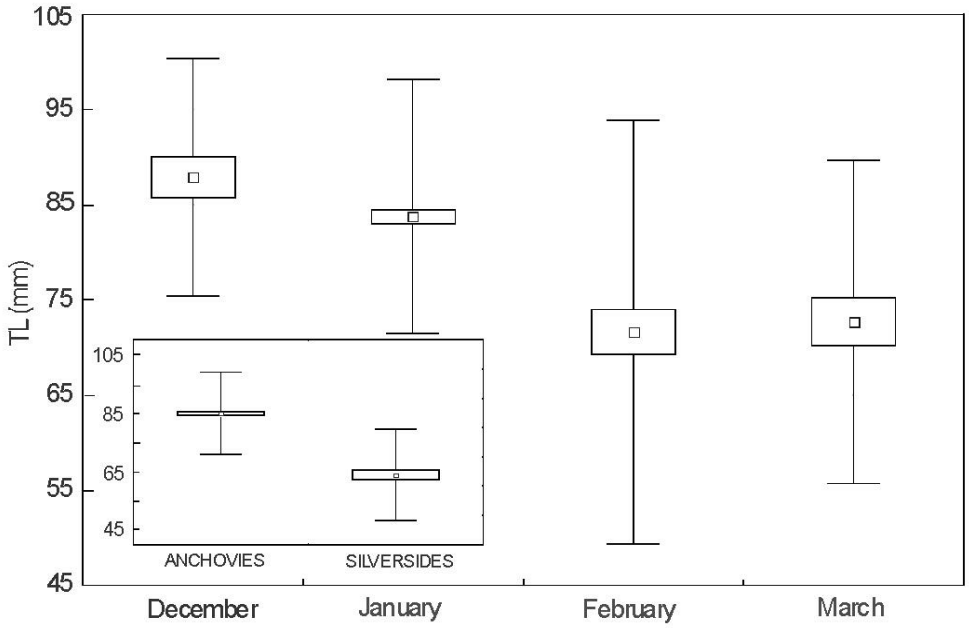

Figure 2. Average total length (TL ± one SD) of fish prey found in the diet of Common Terns in Mar Chiquita Lagoon. Inset: Average total length (TL ± one SD) of anchovies (*Engraulis anchoita* and *Anchoa marinii*) and cornalito silversides (*Odonthestes incisa* and *O. argentiniensis*) in the diet.

Anchovy (*Anchoa marinii*) and Argentine anchovy (*Engraulis anchoita*) were the most important prey, accounting together (engraulid fish) for the 74% of the fish and the 75% of the total mass consumed during the season. Cornalito silverside (*Odonthestes incisa*) were more important in February and March (N = 26% and 20.0%, respectively), while bluefish (*Pomatomus saltatrix*) showed the highest values in March (Table 2). The combined analysis of samples containing otoliths and urostyles shows Engraulids as constituting the bulk of the diet during December and January (84%) being less important in February and March (50%), when Atherinids increased in number (49% of total prey).

The average length of fish prey was 80.1 ± 17.0 mm (range 26–125 mm, mode 95 mm, n = 552). Significant differences in prey size were found between months (ANOVA, $F_{3–548}$ = 19.49, $P < 0.0001$). No differences were found in prey size between December and January (87.9 and 83.7 mm, respectively) or between February and March (71.6 and 72.7 mm, respectively) (Tukey post-hoc comparisons, $P > 0.7$ in both comparisons). However prey sizes observed during the period December–January differed significantly from those observed in February–March (Tukey post-hoc comparison, $P < 0.01$). Such differences could be attributable to the dominance of Engraulids in the first period (N > 80%) and Atherinids in the second one (N > 50%). The average length of Engraulids (85mm ± 14 SD, N = 428) was significantly larger (t_{505} = 11.95, $P < 0.0001$) than Aterinids (64 mm ± 16, N = 79) (Fig. 2).

A maximum of 3000 ± 200 Common Terns were found roosting in February in Mar Chiquita, while 2200 were present in January,

700 in March and 170 in December. Field observations carried out at the mouth of the estuary (LM unpubl.) showed that most terns foraged in marine habitats along marine coastline south of Mar Chiquita, while few of them used the lagoon to fish. Through a daily energy expenditure model (see Duffy *et al.* 1987), we estimated that a Common Tern needs 256 kj d^{-1}, which means roughly 40 g of fish per day. Linear extrapolations to all the population give a total consumption of 10 ± 2 tons of fish along the whole season.

DISCUSSION

As reported in previous studies in the United States and Europe (Cramp 1985, Gochfeld & Burger 1996), the diet of Common Tern in Mar Chiquita Lagoon was mainly composed of fish, insects and crustaceans. The strong temporal variation in the occurrence of insects in the diet could be due to strong differences in their local availability (Carmona *et.al.* 1994; A. Cicchino unpubl.). Among insects, moths predominated in December and January, and beetles in March. Ground beetles predominated among insects in January. During its annual cycle, burrowing *C. signaticollis* larvae (commonly known as white grubs) feed on commercial crops (potato, wheat and corn) in Pampa agrosystems (Mondino *et. al* 1997, Ghys 2002). Adults emerge in mid-December being more abundant in January (Remedi de Gabotto 1964). On the other hand, adult *Dyscinetus gagates* feed on commercial crops of wheat and trees from March onwards (Bosq 1945) when they are abundant in the diet of Common Terns.

All along their coastal distribution, the diet of Common Terns include a variable number of crustaceans such as isopods, euphausiids, shrimps and crabs (Nisbet 2002). In this study, crustaceans (Decapoda and Isopoda) were found occasionally, occurring only in one percent of the samples and constituting the first record of any crustacean in the diet of the species in Argentina. This low frequency disagrees with abundances reported by Muller (1976 *fide* Blokpoel *et al.* 1989) for North Carolina, and Blokpoel *et al.* (1989) for Peru, where the diet of the species involved exclusively crustaceans [mole crab (*Emerita talpoidea*) and sand crab (*E. analoga*), respectively].

Becker *et al.* (1997) reported strong differences between foraging in freshwater and seawater areas in the German Wadden Sea. In sea water, prey availability is constrained and influenced by tides and weather (Frank 1992). Therefore, flight times have to be longer and food intake per trip higher (Massias & Becker 1990, Wendeln 1997). On the other hand, in freshwater habitats, prey availability is not restricted and seems to be stable in time and space. Terns can forage at any time using less effort per trip and both mates can be present more frequently at the breeding territory (Becker *et al.* 1997). In this study, abundant estuary-dependent fishes in Mar Chiquita Lagoon [e.g., Cornalito silverside, white croaker (*Micropogonias furnieri*), menhaden (*Brevoortia aurea*) and mullet (*Mugil platanus*) (see Cousseau *et al.* 2001)] accounted for 4% by number in the diet of terns, while "marine" prey [e.g., Argentine anchovy, striped weakfish (*Cynoscion guatucupa*) and Cornalito silverside] accounted for 78% of total prey. Other estuarine "non dependent" fish prey accounting for 18% of total prey could not be used as indirect indicators of foraging areas. Marine preys tend to occur in waters averaging salinities higher than 25 UPS (Hansen 2000, Rico 2000); these results and our direct field observations constitute indirect evidence of the use of coastal marine habitats as main foraging areas of Common Terns overwintering in the Mar Chiquita Lagoon area.

Common Terns exploit seasonally abundant prey by concentrating feeding upon them [e.g., Atlantic silversides (*Menidia*

menidia) in Virginia, stickleback (*Gasterosteus* sp.) in Finland, or American sand eel (*Ammodytes americanus*) in New York (Erwin 1977). In Punta Rasa, (Mauco *et al.* 2001), as well as in Mar Chiquita Lagoon (this study), the Argentine anchovy was the most frequent fish prey. The northern population of the Argentine anchovy shows seasonal migration cycles, reaching the coast of Buenos Aires Province at the peak of its reproductive period (October–November), and leaving the coast for the continental shelf and the shelf break in autumn (Hansen & Madirolas 1996). This pattern of migration could explain, at least partially, the higher frequencies of this prey observed early in the season, and the lower frequencies observed during February–March, when anchovies were mainly replaced by other species such as Cornalito silversides and bluefish.

Common Terns share almost the same range of fish prey species with other seabirds in the area (Favero *et al.* 2000a). The closely related South American Tern (*Sterna hirundinacea*), with a similar body size, is a dominant species during the austral winter in Mar Chiquita. The average prey size of this species (76 mm ± 42.9) (Favero *et al.* 2000b) was similar to that reported for Common Terns in this study, but both species are temporally segregated. Despite their large size, Black Skimmer (*Rynchops niger*) generally feed on smaller fishes (72.5 mm ± 17.0) (Favero *et al.* 2001b) than those taken by Common Terns. Both species co-occur (Erwin 1977) during the austral summer in the study area, but diet segregation includes not only prey size but also prey types, since the former species feeds mainly upon estuarine fish (Mariano-Jelicich *et al.* 2003.) .

Sampling diet indirectly through by-products allows large sample sizes with minimal disturbance. The diet inferred from pellets analyses could be biased because of the over-representation of indigestible hard parts of some food types, and the lack of hard parts in others pellets. Moreover, hard remains such as otoliths could be partially eroded and otoliths from smaller fish may be under-represented because of their complete erosion or lost through the gastrointestinal tract (see Duffy & Jackson 1986). However, pellets are useful to identify main food items consumed by seabirds away form colony sites during the non-breeding season (Brown & Erwins 1996). Some of the potential biases can be overcome by the large sample sizes in studies using this methodology (Casaux *et al.* 1998). In this work, we provide the first information on the diet of Common Tern in Mar Chiquita Lagoon. Forthcoming studies will include the development of additional methods in order to analyze to a finer scale the temporal variations in the diet and environmental variables involved in such changes.

ACKNOWLEDGMENTS

We thank Dr. Armando Cicchino for his comments and María Juliana Bó for the map of the Mar Chiquita Lagoon, to Flavia Quintana and Inés Giordano for their assistance in the field. We also thank to R. Mc Neil and two anonymous referees contributed with helpful comments on an earlier version of the manuscript.

REFERENCES

Anónimo. 2001. Avifauna de Mar Chiquita. Pp. 227–250 *in* Iribarne, O. (ed). Reserva de Biósfera Mar Chiquita: características físicas, biológicas y ecológicas. Editorial Martin, Buenos Aires, Argentina.

Bachmann, S., & M. M. Martinez. 1999. Feeding tactics of the American Oystercatcher (*Haematopus palliatus*) on Mar Chiquita coastal lagoon, Argentina. Ornitol. Neotrop. 10: 81–84.

Becker, P. H., D. Frank, & M. Wagener. 1997. Luxury in freshwater and stress at sea? The foraging of the Common Tern *Sterna hirundo.* Ibis

139: 264–269.

Blokpoel, H., D. C. Boersma, R. A. Hughes, & G. D. Tessier 1989. Field observations of the biology of Common Terns and Elegant Terns wintering in Peru. Colon. Waterbirds 12: 90–97.

Bó, M. S. 1999. Dieta del Halcón plomizo (*Falco femoralis*) en el Sudeste de la Provincia de Buenos Aires, Argentina. Ornitol. Neotrop. 10: 95–99.

Bó, M. S., S. M. Cicchino, & M. M. Martínez 1996. Diet of Long-winged Harrier (*Circus buffoni*) in southeastern Buenos Aires Province, Argentina. J. Raptor Res. 30: 237–239.

Bosq, J. M. 1945. El "Escarabajo negro del trigo" (*Dyscinetus gagates*) puede ser da–ino a la silvicultura. Publicación miscelánea 197, Ministerio de Agricultura de la Nación, Buenos Aires, Argentina.

Brown, K. M., & P. J. Ewins, 1996. Technique-dependent biases in determination of diet composition: an example with Ring-billed Gulls. Condor 98: 34–41.

Carmona, D., A. M. Vincinni, A. López, H. Alvarez Castillo, & P. Manetti. 1994. Cambios estacionales en la comunidad de "insectos del suelo" (Coleoptera: Curculionidae, Scarabaeidae, Chrysomellisae y Elateridae), en el cultivo de papa en el Sudeste Bonaerense. Boletín técnico 126, Secretaría de Agricultura, Ganadería y Pesca, Instituto Nacional de Tecnología Agropecuaria, Centro Regional Buenos Aires Sur, Balcarce, Buenos Aires, Argentina.

Casaux, R. J., E. R. Barrera-Oro, M. Favero, & P. Silva. 1998. New correction factors for the quantification of fish represented in pellets of the Imperial Cormorant (*Phalacrocorax atriceps*). Mar. Ornithol. 26: 35–39.

Cousseau, M. B., J. M. Díaz de Astarloa, & D. E. Figueroa. 2001. La ictiofauna de la Laguna de Mar Chiquita. Pp. 187–203 *in* Iribarne O. (ed). Reserva de Biósfera Mar Chiquita: características físicas, biológicas y ecológicas. Editorial Martin, Buenos Aires, Argentina.

Cramp, S. 1985. The birds of the Western Palearctic. Volume 4. Oxford Univ.Press, Oxford.

Duffy, D. C., & S. Jackson. 1986. Diet studies of seabirds: a review of methods. Colon. Waterbirds 9: 1–17.

Duffy, D. C, W. R. Siegried, & S. Jackson. 1987. Seabirds as consumers in the southern Benguela Region. S. Afr. J. Mar. Sci. 5: 771–790.

Erwin, M. R. 1977. Foraging and breeding adaptations to different food regimes in three seabirds: the Common Tern *Sterna hirundo*, Royal Tern *Sterna maxima* and Black Skimmer *Rynchops niger*. Ecology 58: 389–397.

Erwin, M. R., J. Smith, & R. B. Clapp. 1986. Winter distribution and oiling of Common Terns in Trinidad: a further look. J. Field Ornithol. 57: 300–308.

Fasano, J. L., M. A. Hernández, F. I. Isla, & E. J. Schnack. 1982. Aspectos evolutivos y ambientales de la Laguna Mar Chiquita (Provincia de Buenos Aires, Argentina). Oceanol. Acta (Suppl): 285–291.

Favero, M., M. P. Silva, & L. Mauco. 2000a. Diet of Royal and Sandwich terns in Buenos Aires Province, Argentina. Ornitol. Neotrop. 11: 259–262.

Favero, M., M. S. Bó, P. Silva, & C. García-Mata. 2000b. Food and feeding of South American Tern during the nonbreeding season. Waterbirds 23: 125–129.

Favero, M., S. Bachmann, S. Copello, R. Mariano-Jelicich, M. P. Silva, M. I. Ghys, C. Khatchikian, & L. Mauco. 2001a. Aves marinas del Sudeste bonaerense. Pp. 251–267 *in* Iribarne, O. (ed). Reserva de Biósfera Mar Chiquita: características físicas, biológicas y ecológicas. Editorial Martin, Buenos Aires, Argentina.

Favero, M., R. Mariano Jelicich, M. P. Silva, M. S. Bó, & C. García Mata. 2001b. Food and feeding biology of the Black Skimmer in Argentina: evidence supporting offshore feeding in non-breeding areas. Waterbirds 24: 413–418.

Frank, D. 1992. The influence of feeding conditions on food provisioning of chicks in Common Terns *Sterna hirundo* nesting in the German Wadden Sea. Ardea 80: 45–55.

Ghys, M. I 2002. Aves asociadas a las actividades de labranza: su rol potencial como reguladoras de la macrofauna edáfica perjudicial o benéfica de cultivos en Mar Chiquita, Provincia de Buenos Aires. Tesis de Licenciatura. Univ. Nacional de Mar del Plata, Mar del Plata, Argentina.

Gochfeld, M., & J. Burger. 1996. Family Sternidae (Terns). Pp.624–667 *in* del Hoyo, J., A. Elliott, & J. Sargatal (eds.). Handbook of the birds of

the world. Volume 3: Hoatzin to auks. Lynx Edicions, Barcelona, Spain.

Hansen, J., & A. Madirolas. 1996. Distribución, evaluación acústica y estructura poblacional de la anchoíta (*Engraulis anchoita*). Resultados de las campañas del año 1993. Rev. Invest. Desarrollo Pesq. 10: 5–21.

Hansen, J. 2000. Anchoíta *Engraulis anchoita* . Pp. 205-216 *in* Síntesis del estado de las pesquerías marítimas en Argentina y la cuenca del Plata Años 1997–1998, con actualización 1999. P. Bezzi, R. Akselman & E. Boschi (eds), Instituto Nacional de Investigación y Desarrollo Pesquero (INIDEP), Mar del Plata, Argentina.

Harrington, B. A., P. T. Z. Antas, & F. Silva. 1986. Observations of Common Terns in Southern Brazil, 29 April–3 May 1994. J. Field Ornithol. 57: 222–224.

Hays, H., J. DiCostanzo, G. Cormons, P. T. Z. Antas, J. do Nascimento, I. Do Nacscimento, & R. E. Bremer. 1997. Recoveries of Roseate and Common terns in South America. J. Field Ornithol. 68: 79–90.

Hays, H., P. Lima, L Monteiro, J. DiCostanzo, G. Cormons, I. T. Nisbet, J. Saliva, J. Spendelow, J. Burger, J. Pierce, & M. Gochfeld. 1999. A nonbreeding concentration of Roseate and Common terns in Bahía, Brazil. J. Field Ornithol. 70: 455–464.

Kress, S. W., E. H. Weinstein, & I. C. T. Nisbet. 1983. The status of tern populations in northeastern United States and adjacent Canada. Colon. Waterbirds 6: 83–105.

Mariano-Jelicich R., M. Favero, & P. Silva. 2003. Fish Prey of the Black Skimmer *Rynchops niger* at Mar Chiquita, Buenos Aires Province, Argentina. Mar. Ornithol. 33:

Martinez, M. M., & S. Bachmann. 1997. Kleptoparasitism of the American Oystercatcher *Haematopus palliatus* by gulls *Larus* spp. in Mar Chiquita Lagoon, Buenos Aires, Argentina. Mar. Ornithol. 25: 68–69.

Massias, A., & P. H. Becker. 1990. Nutritive value of food and growth in Common Tern *Sterna hirundo* chicks. Ornis Scand. 21: 187–194.

Mauco, L., M. Favero, & M. S. Bó. 2001. Food and feeding biology of the Common Tern (*Sterna hirundo*) during the nonbreeding season in Samborombon Bay, Buenos Aires, Argentina. Waterbirds 24: 89–96.

Mondino, E. A., A. N. López, H. Alvarez Castillo, & D. Carmona. 1997. Ciclo de vida de *Cyclocephala signaticollis* Burmeister, 1847 (Coleoptera Scarabaeidae) y su relación con los factores ambientales. Elytron (Barc.)11: 145–156.

Nisbet, I.C.T. 2002. Common Tern (*Sterna hirundo*). *In* Poole, A., & F. Gill (eds.). The birds of North America, No. 618. The birds of North America, Inc., Philadelphia, Pennsylvania.

Rico, R. 2000. Salinidad y distribución espacial de la ictiofauna en el estuario del Río de la Plata. Tesis de Licenciatura, Univ. Nacional de Mar del Plata, Mar del Plata, Argentina.

Remedi de Gabotto, A. L. 1964. Ciclo biológico de *Cyclocephala signaticollis* Burm (Col. Scarabaeidae) y caracteres específicos de su larva. Patol. Veg. 5: 151–161.

Robinson, J. A., & K. C. Hamer. 2000. Brood size and food provisioning in Common Terns *Sterna hirundo* and Arctic Terns *S. paradisaea*: consequences for chick growth. Ardea 88: 51–60.

Rosenberg, K. V., & R. J. Cooper 1990. Approaches to avian diet analysis. Stud. Avian Biol. 13: 80–90.

Safina, C., & J. Burger. 1988. Prey dynamics and the breeding phenology of Common Terns (*Sterna hirundo*). Auk 105: 720–726

Spivak, E., K. Anger, T. Luppi, C. Bas, & D Ismael. 1994. Distribution and habitat preferences of two grapsid crab species in Mar Chiquita Lagoon (Province of Buenos Aires, Argentina). Helgol. Meeresunters. 48: 59–78.

Volpedo, A. V., & D. D. Echeverría 1995. Catálogo y claves de otolitos para la identificación de peces del Mar Argentino. Volumen 1: Peces de importancia económica. Editorial Dunken, Buenos Aires, Argentina.

Wendeln, H. 1997. Body mass of female Common Terns (*Sterna hirundo*) during courtship: relationship to male quality, egg mass, diet, laying date and age. Colon. Waterbirds 20: 235–243.