POST-BREEDING SEASON DIET OF THE MEDITERRANEAN GULL *LARUS MELANOCEPHALUS* AT THE BULGARIAN BLACK SEA COAST

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Milchev B., Kodjabashev N., Sivkov Y., Chobanov D. 200 . Post-breeding season diet of the Mediterranean Gull *Larus melanocephalus* at the Bulgarian Black Sea coast. Atlantic Seabirds 6(2): 65-78. *The seeds of three cultivated plants, Barley* Hordeum vulgare, *wheat* Triticum *sp., and Sunflower* Helianthus annuus, *and of ragwort* Senecio *sp., constituted the staple diet of Mediterranean Gulls* Larus melanocephalus *during their post-breeding residence at the Atanasovsko Lake Reserve (in 99% of pellets,* n = *2,397 pellets). Pellets with fully digested seeds of Barley, Wheat and Ragwort contained a significantly greater number of gastrolith fragments. The pellets containing only visibly undigested seeds constituted 19% of samples (*n = *2,397). Of these, the seeds of seven species germinated, and five of them had germination rates over 50%. Animal remains were found in 27% of the pellets (*n = *2,397) with terrestrial animals predominating. Of the invertebrate species, ground beetles in the genus* Harpalus *(32%,* n = *1,226 individuals) and grasshoppers (24%) occurred in greatest numbers. Vertebrates consisted mainly of marine and brackish benthic fishes (76%,* n = *238 individuals). The seeds and stones ingested as gastroliths came from stubble in crop fields. Gulls flew to beaches to obtain bivalve seashells as gastroliths and to forage extra food. Gulls feeding mainly in fields after the nesting season probably reflect the seasonal flush of available food in habitats suitable for feeding in the region.*

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INTRODUCTION

Gulls as adaptive, opportunistic omnivores have developed diverse methods of feeding and have mastered multiple feeding strategies (Burger & Gochfeld 1996, Oro *et al.*1997). During the nesting period Mediterranean Gull feeds mainly on land, chiefly consuming terrestrial and aquatic invertebrates. However, at other seasons, the species frequents shorelines and feeds mainly on marine fish and molluscs, as well as on garbage and on the refuse from trawlers

(Cramp & Simmons 1983, Fasola & Bogliani 1990, Burger & Gochfeld 1996, Snow & Perrins 1998, Meininger & Flamant 1999). Apparently, it adapts more easily than many other species to new habitats for nesting and wintering. Mediterranean gulls over the last century have successfully colonized regions vastly different from their original habitats in the Mediterranean and the Black Sea regions (Bekhuis *et al.* 1997, Pfeifer *et al.* 1997). Variability in their reported diet reflects differing uses in multiple habitats across seasons and years and depends on the available food sources (Glutz von Blotzheim & Bauer 1982, Zubakin 1988, Goutner 1986, 1994, Meininger *et al.* 1991, Meininger *et al.* 1993, Baccetti & Smart 1999).

This study describes the spectrum of feeding by Mediterranean gulls at the beginning of their post-breeding wanderings by analyzing the pellets of a flock residing at Atanasovsko Lake Reserve on the Bulgarian Black Sea coast. The observations were made during the birds' post-breeding moult, one of the most energy-demanding periods in the species' annual cycle. No in-depth study of diet of the species during this period has been available to date.

STUDY AREA AND METHODS

Lake Atanasovsko is situated in close proximity to the Western Black Sea Coast, near the town of Bourgas, Bulgaria. Historically used as salt-pans, the Lake has 12% of the total surface (1690 ha) are coastal and halophytic communities, 80% standing brackish and salt water and 8% fringe water vegetation. The lake is a nature reserve, RAMSAR site and IBA site. The Mediterranean Gull breeds irregularly there. The largest nesting colony to date was 62 pairs in 1994 (Michev *et al.* 1999). The species did not nest at the lake in 2001 (Michev, *pers. comm.*). Historically, in August and September, exclusively juvenile birds used to forage along the Bulgarian Black Sea Coast, while the mature birds appeared early in October (Nankinov *et al.* 1997). Our observations refer to a resting flock of predominantly mature birds in August 2001. The Lake is surrounded by plains and hills, mainly arable stretching to several scores of kilometres to the northeast, northwest and west. Crops from these lands are largely barley, wheat, and sunflower, with vineyards, orchards and other row crops on a smaller area. Barley harvesting starts about 20th June; wheat is harvested about 1st July; and sunflower about 15th August.

Observations on the diet spectrum is based on pellets from Mediterranean gulls resting on a salt pan (65 m x 10 m) and a dike (80 m x 3 m) among the network of evaporation ponds for seawater salt at the southern end of Atanasovsko Lake (42°31'N 27°29'E). The material was collected at noon on 4 August 2001 (a flock around 250 adults), 15 August 2001 (330 adults and 18 juveniles), 24 August 2001 (425 adults, 18 juveniles and 10 subadults) and 4

September 2001 (470 adults, 7 juveniles and 5 subadults). The sample comprised altogether 2397 intact pellets, 1.33 to 3.92cm long, averaging 2.63 cm ± 0.36, and 1.04 to 2.7 cm wide, averaging 1.64 cm ± 0.15 (n = 2,137 for measured pellets) plus disintegrated pellets. The flock of moulting gulls used the site for diurnal resting and did not spend the night there. Preparations for salt production in close proximity to the pan started in mid-August. Therefore, irrespective of the growing number of birds in the flock, the amount of collected diet refuse decreased, because gulls were increasingly driven away by workers.

Intact pellets remained in storage wrapped in paper until processing. Disintegrated pellets were combined into a sample from the respective collection date. The intact pellets were softened individually in water, rinsed with water through a thick-meshed sieve, and then dried. The combined sample of disintegrated pellets was processed in the same way. The seeds of wild-growing plants were identified by comparison with the Collection of the Faculty of Biology and the University of Forestry in Sofia. Animal remains were determined by comparison with our comparative collections and the Collection of the National Museum of Natural History. Quantification procedures always followed the rule of minimum numbers. We present the numbers of animal groups in the summarised material of intact and disintegrated pellets, as well as the average number of individuals per pellet from the corresponding taxonomic category. Biomass is not reported owing to the very small amounts of animal parts as compared to vegetation in the pellets and inherent inability to determine the amount of seeds ingested.

Stones and single pieces of glass consumed as gastroliths were counted and distributed into different categories: 1-5 pieces per pellet, 6-10 pieces, 11-20 pieces and > 20 pieces. The amount of fragments from bivalve shells is not reported. Pellets with very small fragments are probably the remains after digestion of larger fragments. Their counting out would not have given the actual number of swollen bivalve shells that took part in digestion. Various inorganic products, predominantly man-made, were also noted.

The pellets fall into three groups, according to the degree of seed digestion: type A – completely digested seeds, or with small quantities of undigested fragments; type B – about half of the seeds in the pellet were digested to some extent, while the rest remained unchanged or slightly damaged; type C – most seeds remained visibly unchanged, or slightly damaged.

The seeds visibly unchanged by digestion and having no traces of charring were tested for germination on moist cotton batting in Petri dishes at room temperature.

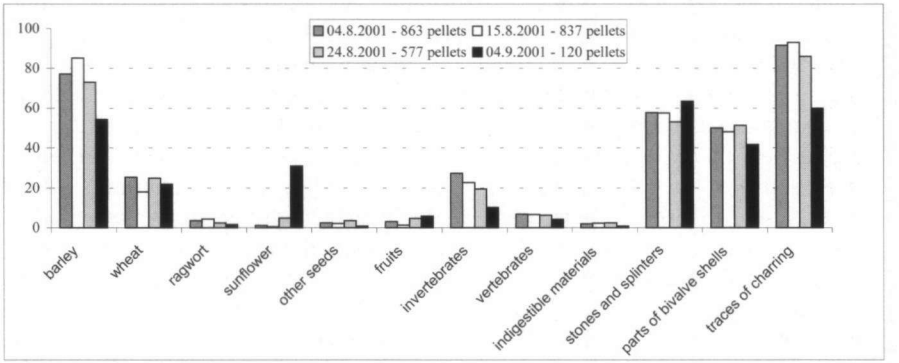

Figure 1. Contents of the pellets (%) of the Mediterranean Gull, Atanasovsko Lake, Bulgarian Black Sea coast.

Figuur 1. De inhoud van braakballen (%) van Zwartkopmeeuwen langs het Bulgaarse meer Atanasovsko, Zwarte Zeekust.

Statistical differences in occurrence of organic remains in the samples and the degree of digestion, depending on the existing gastroliths in the pellets, were calculated by means of a chi-square test, with $P < 0.05$.

RESULTS

Plant matter in the diet Most intact and disintegrated pellets contained remains of seeds and fruit (99.2%, n =2,397 pellets). The seeds of four plant species predominated in intact or in mixed pellets, with Barley *Hordeum vulgare* and wheat *Triticum* sp. seeds being the most numerous (Fig.1, Fig 2). Of these, only ragwort *Senecio* sp. is not a crop plant, but occurs as a weed in crop fields. Six pellets showed prevalence of fruit remains: Cultivated Grapes (3 pellets), Asian bittersweet *Celastrus orbiculata* (1 pellet) and European Plum *Prunus domestica* (2 pellets). Pellets with traces of charring on seeds and ears were common owing to the frequent post-harvest practice of burning the straw and stubble in the fields.

The occurrence of pellets with various vegetation remains was highly significant among the four collections (χ^2_{15}= 350.5, P <0.001). The pellets with Sunflower *Helianthus annuus* remains dominated in the collections after mid-August, when 82% (n =79) of the pellets collected sunflower seeds. In the same period, the occurrence of pellets with fruit remains (mainly of Cultivated Grapes) increased while the frequency pellets with Barley decreased. No significant differences were found in the occurrence of pellets with mixed seeds

Table 1. Pellets with various seeds of the principal plant species in the diet of the Mediterranean Gull Larus melanocephalus, *Atanasovsko Lake, Bulgarian Black Sea coast.*

Tabel 1. Braakballen met verschillende zaden van de voornaamste plantensoorten bij de Zwartkopmeeuwen langs het Bulgaarse meer Atanasovsko, Zwarte Zeekust.

Number of pellets with assorted seeds	Wheat	Senecio	Sunflower
Barley	92	66	4
Senecio	18	-	0
Sunflower	11	0	-

Table 2. Degree of digestion (%) of seeds and fruits in the pellets of the Mediterranean Gull Larus melanocephalus, *Atanasovsko Lake, Bulgarian Black Sea coast.*

Tabel 2. Mate van vertering (%) van zaden en vruchten in braakballen van Zwartkopmeeuwen langs het Bulgaarse meer Atanasovsko, Zwarte Zeekust.

Contents	type A	type B	type C
barley	53	25	22
wheat	81	11	8
ragwort	96	2	2
sunflower	93	1	6
other seeds	0	0	100
fruits	100	0	0
with stones and splinters			
barley	69	26	5
wheat	87	10	3
ragwort	100	0	0
sunflower	94	0	6
with parts of bivalve shells			
barley	63	2	10
wheat	89	8	3
ragwort	100	0	0
sunflower	90	0	10

of the four principal plant species in the different collections ($\chi^2_9 = 8.6$, $P>0.05$). Barley was found most often in intact pellets, and ragwort seeds occurred predominantly in the mixed samples (Table 1).

Gastroliths and the status of seed digestion Mediterranean Gulls ingest small stones, pieces of glass and fragments of bivalve shells as gastroliths (Table 2).

The stones and occasional fragments of glass averaged 6.3 ± 8.0 pieces in the pellets containing them, with a maximum 69 in one pellet. Most had rough edges and therefore were not ingested from seashores. The fragments of bivalve shells belonged to various marine species and did not form whole shells when reconstructed. Most shell pieces had well smoothed edges, even in the pellets with indigestible seeds. This observation supports ingestion at the seashore. Stones and bivalve shells were found in 852 pellets (43.5%, n =1,957 pellets with gastroliths). 341 pellets had charred fragments, mostly seeds of wheat and barley. Some seeds were quite hard and probably also served as gastroliths.

The pellets with better digested Barley and Wheat seeds showed a significantly greater number of stones and pieces of glass (χ^2_8 = 534.3, χ^2_8 = 39.5, P <0.001) and prevalence of bivalve shell fragments (χ^2_2 = 177.9, χ^2_2 = 31.7, P <0.001). Ragwort seeds in the pellets appeared to have undergone better digestion with in the presence of shell fragments (χ^2_2 = 6.4, P<0.01), and their digestion was higher in the pellets with stones and shells (χ^2_8 = 20.2, P <0.01). Sunflower digestion did not depend on the presence and amount of gastroliths in the pellets.

The pellets containing only apparently unchanged seeds constituted 19% (n = 2,397) (Table 2). Barley seeds were hardest to digest and were completely digested only in 53% of the pellets containing them. The maximum number of undigested seeds, occasionally in entire ears, was respectively 65 for Barley (21 ± 11.1 seeds, n = 412 pellets) and 43 for Wheat (15 ± 12.2 seeds, n = 45 pellets). Over 20 stones were in one pellet with Wheat and Barley seeds, but 20 and 16 seeds respectively remained undigested. Eighteen regurgitations with Barley (2%, n = 985 type A) and 25 with Wheat (6%, n = 432 type A) did not contain gastroliths, while the seeds in them were entirely digested.

The seeds of bedstraw *Galium* sp. predominated among the intact seeds of various weeds: 44 pellets (70.1%, n = 62), containing between one and 36 seeds (309 seeds altogether and averageing seven seeds per pellet). Other weeds were present as single seeds in the pellets, except for yellowcress *Rorippa* sp. Yellowcress was likely ingested as whole inflorescences, and between 42 and 66 seeds were present in each of three pellets.

Germination Seeds and fruit stones of seven plant species germinated in flats. Five of species had greater than 50% germination (Table 3). Despite being difficult to digest, the apparently intact Barley seeds had damaged embryos. A great number of the Bedstraw seeds tested probably also had damaged embryos. Individual intact Sunflower and Ragwort seeds had high germination rates.

Table 3. Seeds and fruit stones tested for germination from pellets of the Mediterranean Gulls Larus melanocephalus, *Atanasovsko Lake, Bulgarian Black Sea coast.*
Tabel 3. Zaden en pitten uit braakballen van Zwartkopmeeuwen die getest werden om het vermogen nog te ontkiemen na te gaan.

Plant species	Seeds Tested Number	Germination Number (%t)
Barley Hordeum vulgare	140	0
wheat *Triticum* sp.	21	2 (9.5)
ragwort *Senecio* sp.	8	5 (62.5)
Sunflower *Helianthus annuus*	10	8 (80)
bedstraw *Galium* sp.	128	0
Wild radish Raphanus raphanistrum	13	7 (53.8)
Asian bittersweet *Celastrus orbiculata*	13	13 (100)
yellowcrees *Rorippa* sp.	102	81 (79.4)
sage *Salvia* sp.	7	0
geranium *Geranium* sp.	1	0
Cantaloupe *Cucumis melo*	2	0
Mahaleb cherry *Prunus mahaleb*	2	1 (50)
Russian olive *Elaeagnus angustifolia*	4	0

Non- plant materials in the diet Only 18 pellets (0,8%, *n* =2,397) contained no seeds or fruit. Thirteen of these had mainly animal components: 5 pellets - fish, 4 – bird, 3 pellets – mammals and insects, and 1 pellet – Isopoda. Indigestible sausage packaging formed four pellets. One of the pellets contained the distal part of a corncob, without seeds. Pieces of plastic, tinfoil, rubber, styrofoam, and textile were found in small quantities in the pellets.

Animal remains occurred in 656 pellets (27%, *n* =2,397; Table 4). Of the invertebrates, grasshoppers *Calliptamus italicus* predominated – 187 individuals (accounting for 15% of the invertebrates), and ground beetles *Harpalus* sp. of the other insects – 184 individuals (15% of the invertebrates). One single pellet contains 33 *C. italicus* grasshoppers and one Vole *Microtus arvalis/rossiaemeridionalis*. The invertebrate prey species mainly inhabit the surface soil layer and grassy vegetation in both natural and agricultural habitats with xerothermic vegetation and prevalence of grass species.

Fishes constituted the greatest share of vertebrates in the diet of Mediterranean Gulls (76%, *n* = 238 individuals). They chiefly belonged to marine and brackish benthic species (89%, *n* = 180 individuals). All vertebrates occurred in low numbers in the pellets: 1.1 individuals on average. The soft tissues of animals consumed were digested, except in one pellet with undigested barley seeds and a well-preserved part of the distal tail column of a Gread

Table 4. Animals in the diet of the Mediterranean Gull Larus melanocephalus, *Atanasovsko Lake, Bulgarian Black Sea coast.*

Tabel 4. Dierlijke resten in braakballen van Zwartkopmeeuwen langs het Bulgaarse meer Atanasovsko, Zwarte Zeekust.

Animals	04.08	15.08.	24.08	04.09	Total
Carabidae	122	155	95	24	396
Tenebrionidae	41	23	12	4	80
Curculionidae	40	44	20	1	105
Coleoptera (other)	57	36	24	0	117
Orthoptera	132	105	49	4	290
Other Insecta	72	38	68	1	179
Malacostraca (Isopoda, Decapoda)	14	39	6	0	59
Subtotal Invertebrata	478	440	274	34	1226
(average per pellet)	(1.8)	(2.0)	(2.1)	(1.2)	(1.9)84%
Rutilus rutilus	0	1	0	2	3
Carassius auratus gibelio	3	0	1	0	4
Syngnathus acus	12	30	17	2	61
Syngnathus sp.	3	5	6	0	14
Perca fluviatilis	3	0	1	0	4
Symphodus roissali	2	4	1	0	7
Symphodus ocellatus	1	2	0	0	3
Symphodus sp.	0	2	1	0	3
Ophidion rochei	3	1	0	0	4
Scorpaena porcus	1	0	0	0	1
Neogobius ratan	14	5	2	0	21
Neogobius sp.	6	3	5	2	16
Mesogobius batrachocephalus	14	11	5	0	30
Osteichthyes	5	3	1	0	9
Subtotal Pisces	67	67	40	6	180
(average per pellet)	(1.1)	(1.1)	(1)	(1)	(1.1)12%
Sylvia sp.	1	0	0	0	1
Phylloscopus sp.	0	0	0	1	1
Carduelis sp.	1	0	0	0	1
Passeriformes ordo	1	0	0	0	1
Aves nonid.	1	0	1	0	2
Subtotal Aves	4	0	1	1	6
(average per pellet)	(1)		(1)	(1)	(1) 0.4%

Table 4. Continued. Tabel 4 vervolg.

Animals	04.08	15.08.	24.08	04.09	Total
Neomys annomalus	0	1	0	0	1
Crocidura suaveolens	1	1	0	0	2
C.leucodon	1	0	0	0	1
Mus musculus/spretus	8	4	4	1	17
Rattus sp. juv.	2	0	1	0	3
Microtus arvalis/rossiaemeridionalis	12	11	4	1	28
Subtotal Mammalia	24	17	9	2	52
(average per pellet)	(1.3)	(1.5)	(1.2)	(1)	(1.3) 4%
Subtotal Vertebrata	95	84	50	9	238
(average per pellet)	(1.1)	(1.2)	(1.1)	(1)	(1.1)16%
Total All Animals	573	524	324	43	1464

Note: The total number of individuals in the intact and disintegrated pellets excludes here one pellet with two tortoise *Testudo* sp. eggs from the first collection and the eggs of Thomas's Rapa Whelk *Rapana thomasiana* in the disintegrated pellets from the second collection.

Pipefish *Syngnathus acus*. No significant differences were found in the pellets containing invertebrates and the three groups of vertebrates, or in their amounts in the diet. Highly significant differences were apparent in the catch of the seven groups of invertebrates ($\chi^2_{18} = 108.1$, $P< 0.001$). Carabid beetles occurred in significantly greater numbers on the last collection date in contrast to the lower numbers in the first collection date. Crustaceans occurred in greater numbers on the second collection date, in in contrast to the first date. Among the "other" insects, significantly greater numbers were found in the third collection (47 individuals of ants) and lesser numbers in the second.

DISCUSSION

The seeds of three crop plants, Barley, Wheat and Sunflower, plus Ragwort constituted the main diet of the Mediterranean Gulls during this study. Ragwort was mostly mixed in with pellets containing barley and wheat seeds, as Ragwort grew in the fields under these crops. Seeds of crop plants have been found in gull diets during their breeding period as well, but were not a staple in the diet (Ardamatskaya *et al.* 1988, Goutner 1986, 1994, Meininger *et al.* 1991). Predominance of seeds in the gull diet reported here does not correspond to previous accounts of Mediterranean gull diets after nesting is completed, citing chiefly marine fishes and molluscs (Burger & Gochfeld 1996, Snow & Perrins 1998).

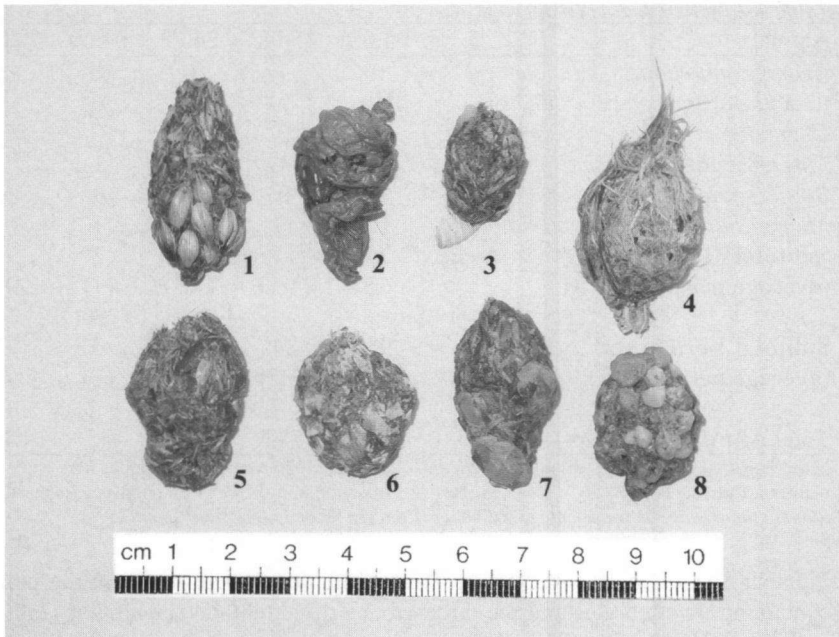

Figure 2. Pellets of the Mediterranean Gull, Atanasovsko Lake, Bulgarian Black Sea coast. 1) Barley Hordeum vulgare *seeds which were visibly unchanged and with traces of charring. 2) Indigestible sausage package. 3) Completely digested wheat* Triticum *sp. seeds with fragments from bivalve shells and stones as gastroliths. 4) Warbler* Phylloscopus *sp. 5) Good digested Barley and Sunflower* Helianthus annuus *seeds and stones as gastroliths. 6) Two tortoise* Testudo *sp. eggs with a vole* Microtus *sp. and some good digested seeds. 7) Fruit remains of European plump* Prunus domestica, *Cultivated Grapes and Wheat seeds. 8) Completely digested Barley and Wheat seeds with 26 stones as gastroliths.*

Figuur 2. Braakballen van Zwartkopmeeuw, Atanasovskomeer, Bulgaarse Zwarte zeekust. 1) Gerstezaden. 2) Onverteerbaar worstenvelletje. 3) Volledig verteerde tarwezaden met stukjes schelpen en steentjes als gastrolieten. 4) Boszanger sp. 5) Goed verteerde gerste- en zonnebloemzaden met steentjes als gastrolieten. 6) Twee schildpadeieren, een woelmuis en enkele verteerde zaden. 7) Restanten van pruim, druiven en tarwezaden. 8) Volledig verteerde gerste- en tarwezaden met 26 steentjes als gastrolieten.

Gulls collected seeds from field stubble, and many seeds were charred from field burning. The correlation of Barley and Wheat in the diet probably reflects the acreages under these crops. Mediterranean gulls fly up to 80 km

away off the nesting colonies (Burger & Gochfeld 1996) and flew up to 40 km away from Atanasovsko Lake. Therefore, this study cannot correlate diet with foraging from specific fields under these crops. An opportunistic diet consisting of seeds, seasonally accessible and widely available, is confirmed by the significant increase in the number of pellets with Sunflower seeds after the start of sunflower harvest in mid-August, and with seeds of cultivated grapes in the same period. Pellets with Sunflower seeds were rare before mid-August. According to Hoogendoorn (1995), Sunflower seeds were probably pecked directly from the combs, a much more difficult operation than picking them up among stubble.

Despite the prevalence of seeds in the diet, seeds are not the preferred food component of the gulls (Burger & Gochfeld 1996). Their digestive systems are not well suited for digesting seeds and the predominant Barley seeds were not visibly damaged in 22% of the pellets containing them. Probably the glumes, retained only in the Barley seeds, have higher silica content than glumes of the other three most frequently occurring seeds (Georgiev & Tschakalova 2000). Irrespective of the intake of gastroliths to make seeds more digestible, some pellets with a large number of gastroliths still had intact seeds. At the same time, a small number of pellets without gastroliths had well-digested barley and wheat seeds. Apparently, not only the quantitative proportion of the swallowed seeds and gastroliths, but the length of their processing in the stomach is important for their digestion. Pellets with undigested seeds is not unusual, and this evidence indirectly corroborates the assumption of Goutner (1994) that the death of young gulls is linked to their stomachs being full of Wheat seeds. Regurgitation of intact seeds was confirmed by the germination of seeds of seven plant species, testifying to the role of the Mediterranean Gull in ornithochory.

Animals supplemented the principally plant diet. Terrestrial animals predominated and appeared to be collected at random. No significant preferences appeared among major taxonomic groups. Dominance of grasshoppers and ground beetles among the insects and significant differences in the occurrence of invertebrates corroborate opportunism in food collection already verified by Isenmann (1975), Goutner (1986), Ardamatskaya *et al.* (1988), Zubakin (1988) and Meininger *et al.* (1991). Single pellets with predominantly animal remains reflect use of locally most numerous species. Fishes were mostly benthic species and, considering the ability of Mediterranean Gulls to fish (Cramp & Simmons 1983), they were probably gleaned as refuse from the fishing with dragnets in the Bourgas Bay. Ardamatskaya *et al.* (1988) have also established prevalence of pipefish and gobies in the fish diet of the gulls in the Ukraine, but during their breeding period.

The contents of the pellets point to the preferred feeding places of gulls. The unsmoothed edges of stones and pieces of glass showed that they were picked up in fields together with the seeds. The numerous fragments of bivalve shells had smooth edges and in our opinion were picked up along the seashore as gastroliths, after consuming vegetable food in the fields. The use of bivalve shells as gastroliths is supported by Ardamatskaya *et al.* (1988), but molluscs were the most important animal prey in Greek populations of Mediterranean gulls during the breeding period (Goutner 1994). Van Impe (1978) reported behavior of a Mediterranean gull dropping bivalves in September. Feeding in the fields with subsequent flights along the seashore to collect gastroliths and extra food before rest by day on Aatnasovsko Lake is also corroborated by the fact that 97% of the pellets with fish also contained seeds. The low content of garbage waste in ingested food corresponds to the paucity of gull visits to trash dumps in the Bourgas region. Feeding predominantly in the fields after the breeding season is not typical for Mediterranean Gulls. The diet as discerned from pellets probably reflects the seasonal supply of the most accessible food sources in suitable feeding habitats in the region and demonstrates typical feeding behavior of gull species in general (Burger & Gochfeld 1996).

ACKNOWLEDGEMENTS

We wish to thank Dr. D. Dimitrov, P. Glogov, Dr. Z. Boev and Dr. V. Beshkov for the identification of some of the food remains. Thanks also to V. Georgiev for his assistance in the field and to Dr. J. Weigand for improving the English-language text. Peter Meininger provided additional literature and he and an anomymous referee kindly commented on an earlier version of this paper.

HET VOEDSEL VAN ZWARTKOPMEEUWEN *LARUS MELANOCEPHALUS* NA DE BROEDTIJD AAN DE BULGAARSE KUST VAN DE ZWARTE ZEE

De zaden van drie gecultiveerde planten, Gerst *Hordeum vulgare*, tarwe *Triticum* spp. en Zonnebloem *Helianthis annuus* vormden het hoofdbestanddeel van het voedsel dat Zwartkopmeeuwen *Larus melanocephalus* bij elkaar scharrelen na de broedtijd in het Atanasovsko reservaat (aangetroffen in 99% van de braakballen, n = 2397). Braakballen met min of meer verteerde graankorrels en zaden bevatten een significant grotere hoeveelheid resten van gastrolieten (steentjes en harde brokjes die ter bevordering van de vertering in de maag worden opgeslagen). Sommige braakballen bestonden uit zo goed als onverteerd material (19%, n = 2397). Zeven verschillende soorten zaden in deze braakballen bleken nog uit te lopen en van vijf soorten liep niet minder dan 50% van de aangetroffen zaden nog uit.

Dierlijke resten werden in 27% van de braakballen aangetroffen en daarbij overheersten dieren van terrestrische oorsprong (landdieren). Bij de ongewervelden ging het vooral om loopkevers *Harpalus* spp. (32%, n = 1226 individuen) en sprinkhanen (24%). Onder de gewervelde prooidieren werden hoofdzakelijk zout- en brakwatervissen aangetroffen (76%, n = 238

exemplaren). De als gastrolieten ingeslikte zaden en steentjes kwamen van stoppelvelden. Langs de kust werden ook schelpen (Bivalvia) als gastrolieten opgezicht en daarnaast werd hier actief gevist.

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