Nestling Food in the Desert Wheatear *Oenanthe deserti* in the Dzungarian Gobi, Mongolia

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Abstract

The quality and size of nestling food of the Desert Wheatear *Oenanthe deserti ssp. atrogularis* were investigated in the spring of 2001 in the Dzungarian Gobi in Mongolia. Data are based on observations of nine pairs. Nestling food consisted of several taxa caught on the ground and in the air. Diptera, Coleoptera larvae, and Hymenoptera were the most frequent prey, that is, they contributed 17 to 30 % of all food items each. The food composition changed with nestling age and season.

Food item size decreased with date. A higher proportion of multiple prey loadings were brought to nestlings in the second half of the season than in the first half. Prey items were significantly smaller in multiple prey loadings than in single prey loadings, but as a whole, multiple prey loadings were larger than single prey loadings. Despite the increase of the proportion of multiple prey loadings in the second half of the season compared with the first half, the loading size decreased with time. Presumably, large, profitable prey became rarer with the ongoing season. This may have caused the parents' feeding effort to increase and prevented them from starting regular second broods.

Key words: *Oenanthe deserti,* Mongolia, nestling food, prey size, loading size

Introduction

The Desert Wheatear breeds in a large area which extends from north-west Africa to China. Despite the species' wide distribution, only little information about the nestling food is available (ABDUSALYAMOV 1973, MAUERSBERGER et al. 1982).

In this paper I present data about the nestling food of the Desert Wheatear *Oenanthe deserti ssp. atrogularis* in the Dzungarian Gobi in Mongolia. This subspecies breeds from the southern Caucasus and Iran to Mongolia (CRAMP 1988, PANOV 2005). It inhabits mountains and hills with sparse vegetation in the semi-desert. Like most birds, *Oenanthe deserti* can be expected to time the rearing of a brood to the peak abundance of the main nestling food (LACK 1954, PERRINS 1970). But with weather conditions strongly varying both on a long and short time scale in the continental climate of the Dzungarian Gobi, the temporal and spatial development of prey may be difficult to anticipate (PANOW 1974). Thus, parents are expected to adjust their feeding effort carefully to the availability of food, the demands of the offspring as well as their own energetic requirements and capabilities. Wheatears are multiple prey loaders which often carry more than one food item per feeding trip. Parents may have several opportunities to optimize their feeding effort by adjusting prey size, prey quality as well as loading size to the demands of their brood and their own energy budget (MORENO 1987a). Therefore, attention was paid to the quality and quantity of the nestling food, and how its size and composition was related to the sex of the feeding parent, the nestling age, and the time of the season.

Study area and methods

The study area is situated in Takhin Tal in the Dzungarian Gobi in the Gobi-Altai Aimag (district), at the eastern border of the 'Great Gobi B Strictly Protected Area' (fig. 1). Observations were done on a slope of the Elmen mountain (93°36’ N /45°32’ E), a mountain range about 10 km south of the Altai mountain chain, as well as on two hills (Narijn Khur and Bor Tolgoi) rising 20 and 130 m above the surrounding flat steppes (1660 m a. sl.). The hills were 3 and 10 km away from the Elmen Mountain.

Fig. 1: Map of Mongolia with the position of the study area in the rectangle. Ulaanbaatar is the capital of Mongolia; source: http://upload.wikimedia.org/wikipedia.

Vegetation was sparse and fragmentary; the cover did not exceed 20 % in any place of the study area. Conspicuous and regularly found plants were *Caragana leucophloea*, *Convolvulus ammanii*, *Artemisia* sp., and *Stipa glareosa*. The vegetation is typical for the semi-desert and Gobi-steppe (ZHIRNOV & ILYINSKY 1986). The climate is extremely continental. During the project, air temperature ranged from -4°C to +38°C.

Fig. 2: Breeding site of the Desert Wheatear in Takhin Tal with *Caragana leucophloea* blooming.

Field observations and data analysis

Research lasted from mid-April to the beginning of August 2001. Food quality and food size were investigated by observing feeding adults with a telescope (20–45 x). Each prey was identified taxonomically, and its length, width and height were estimated in terms of quarters of Wheatear's mean bill size. The bill to skull part of a Desert Wheatear bill measures about 17.5 x 3.0 x 3.0 mm on average (CRAMP 1988 and own measurements). Transforming the prey size expressed in bill proportions into millimetres allowed an estimation of prey volume (mm^3) which was used for statistical analysis. For some analyses, data of the first and second half of the nestling stage were analysed separately. The first half refers to nestlings seven days old or younger, the second half to older ones. Additionally, patterns of the first and second half of the season were compared. The first half was before 20 June, the second half was afterwards.

In Coleopterans, imagines and larvae were distinguished because early in the season conspicuously many larvae were fed. Unlike the imagines, they were little chitinised. Therefore they were treated as a separate food class.

Fig. 3: A Desert Wheatear male with prey for the offspring.

Direct observations from a distance are advantageous in many respects: They leave adults and young ones undisturbed and do not attract predators to the nest. They permit data to be sampled from the very first day of hatching and do not influence nestling behaviour (ORIANS 1966, FAVINI et al. 1998), and they allow distinguishing between food brought in by males and females, respectively. As a drawback, however, they often do not allow to identify food items, particularly small ones. Still, the results presented here are considered to be sufficiently accurate as the items visible could be identified in 93.5 % of the feedings.

The data concerning the nestling food are based on the observation of nine nests. The sample sizes were not evenly distributed among the nests; they ranged from 3 to 38 items with an average of 14.2 ± 13.6 items per nest. In order to control the influence of this bias, "pairs" were included as a factor when statistically analyzing the influence of parent sex, nestling age and date on the food size.

27 % of all observations stem from one single replacement brood. Taking this nest into account was the only way to get indications of seasonal changes in the nestling food. Thus, the data of the second half of the season refer to this brood only, whereas those of the first half of the season refer to eight broods.

Data analysis

Analyses were performed by analysis of covariance (ANCOVA), Spearman rank correlation, and Chi square test. Food size was log-transformed prior to analysis. In ten items only the size, but not the taxon could be assessed. Thus, sample sizes of food composition and food size differ slightly.

Results

Food quality

Adult Desert Wheatears collected the nestling food in the sandy, flat part at the base of the hill as well as in the rocky slopes, and (to a lower proportion) in the air. Eight orders of arthropods and two additional groups (caterpillars, worms) were identified in the nestling diet. Diptera, Coleoptera larvae, and Hymenoptera each contributed more than 15 % of all food items (table 1). Together, they made up about two thirds of all items. Among Diptera, flies of the family Asilidae dominated (about 75 %). Probably all Coleoptera larvae were of the family Tenebrionidae. Ants (Formicidae) made up two thirds of the Hymenoptera.

No difference in the food composition between females and males was observed. The nestlings received significantly higher percentages of Coleoptera larvae in the first week after hatching than later, and they received significantly more Diptera in the second week (table 1). Additionally, a smaller proportion of Lepidoptera and a higher proportion of worms were provided in the first week than afterwards (table 1).

Significantly more Diptera and Coleoptera larvae were fed during the first half of the season, whereas the proportions of Saltatoria, Hymenoptera and worms were significantly higher in the second half (table 1).

Table 1: Numbers and proportions of all nestling food items identified, proportions of the nestling food items observed during the first and second half of the nestling stage (before and after age 7 days), respectively, as well as the first and second half of the season (before and after 20 June)

food type	total (n)	total (%)	1st half of nestling time (%)	2nd half of nestling time (%)	p	1st half of season (%)	2nd half of season (%)	p
O. Saltatoria	10	7.0	10.3	3.1	ns	3.8	15.8	<0.02
O. Hemiptera	2	1.4	0.0	3.1	ns	1.9	0.0	ns
O. Lepidoptera	6	4.2	0.0	9.4	<0.05	5.8	0.0	ns
O. Diptera	43	30.3	14.1	50.0	<0.01	38.5	7.9	<0.01
O. Hymenoptera	24	16.9	21.8	10.9	ns	9.6	36.8	<0.01
O. Coleoptera, Larvae	29	20.4	30.8	7.8	<0.01	26.0	5.3	<0.02
O. Coleoptera, Imago	5	3.5	2.6	4.7	ns	1.9	7.9	ns
O. Chilopoda	1	0.7	0.0	1.6	ns	1.0	0.0	ns
O. Araneae	4	2.8	2.6	3.1	ns	2.9	2.6	ns
caterpillar	13	9.2	11.5	6.3	ns	8.7	10.5	ns
worm	5	3.5	6.4	0.0	<0.05	0.0	13.2	<0.01
total	**142**	**100.0**	**100.0**	**100.0**		**100.0**	**100.0**	

ns = not significant; Chi square test

Size of food Items

An analysis of covariance revealed that the volume of the loadings did neither depend on the nestling age, individual pair number nor parent sex but was significantly related to date (table 2). With the ongoing season, the loading size decreased significantly (fig. 4). Nestling age and date were not interrelated.

Table 2: The result of an analysis of covariance with volume per loading (mm3) as the dependent variable, the pair number as well as sex of the feeding parent as factors, and nestling age as well as date as covariates

Indep. variable	df	MS	F-Ratio	p
pair	8	0.09	1.83	0.08
parent sex	1	0.05	1.03	0.31
nestling age	1	0.00	0.06	0.81
date	1	0.62	13.00	<0.001
Error	98	0.05		

n = 113, $r2 = 0.35$. The two-way interactions were tested but removed from the model because $p > 0.1$.

Similar results were found when the size of the single food items was related to pair number, parent sex, nestling age and date. Only date was significantly correlated to the prey size ($F = 25.2$, $p < 0.001$, $r2 = 0.51$, $n = 152$). Item size was negatively correlated with date (fig. 4). The slope of the regression was steeper than that of the loading size.

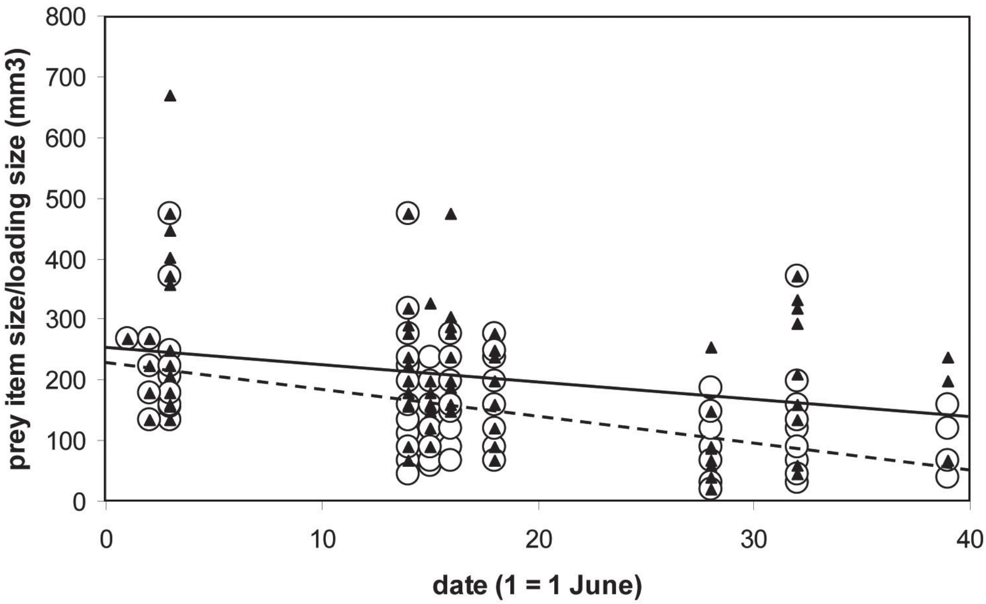

Fig. 4: Negative correlations between date and prey item size (▲; broken line; $y = -8.0x + 206$, $r = -0.49$, $p < 0.001$, $n = 152$) as well as loading size (○; $y = -5.6x + 225$, $r = -0.34$, $p < 0.001$, $n = 113$). When only one item per feeding trip was brought, the prey item size and the loading size were identical.

Fig. 5: Larvae of *Coleoptera* (beetles) as well as flies of the family Asilidae (right) both contributed substantially to the nestling food.

Single prey loadings vs. multiple prey loadings

In 29 % of all feeding trips the adults brought more than one prey to the nest (n = 113 feeding trips). Males delivered slightly more multiple prey loadings than females (32.4 % vs. 24.4 %), but the difference was not significant ($p > 0.05$, Chi square test).

The proportion of multiple prey loadings increased significantly from 21.1 % in the first half of the season to 60.9 % in the second half of the season ($p < 0.001$, Chi square test, fig. 6). Food items of single prey loadings were significantly larger than items of multiple prey loadings (ANCOVA with loading type and pair as factors and date as covariate, $p < 0.0001$, $r^2 = 0.46$, n = 152), but multiple prey loadings as a whole were larger than single prey loadings (ANCOVA with loading type and pair as factors and date as covariate, $p < 0.001$, $r^2 = 0.33$, n = 113).

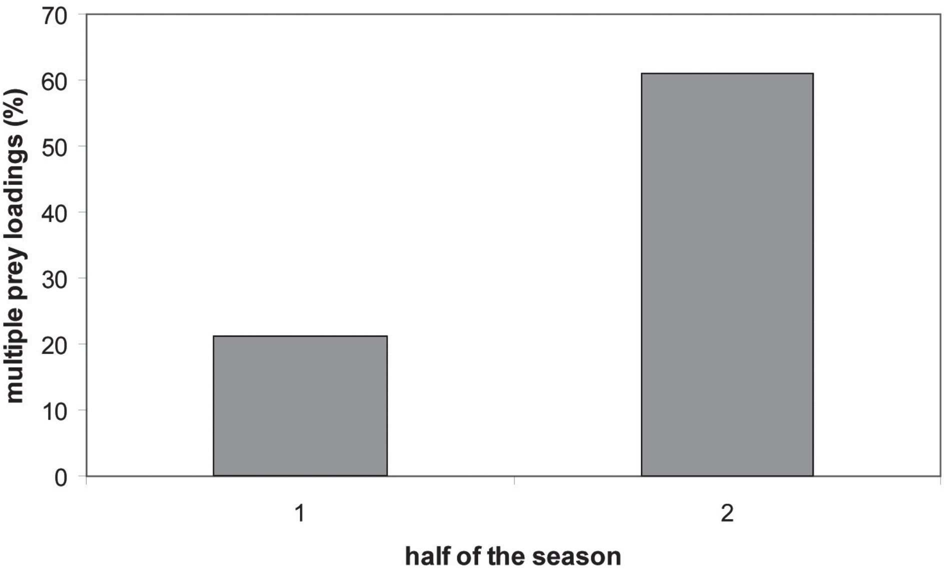

Fig. 6: Percentage of multiple prey loadings during the first (before 20 June) and second half of the breeding season.

Fig. 7: A Desert Wheatear male collects its prey on the ground.

Discussion

Food quality

The composition of the nestling food changed with nestling age and date. These changes most probably reflect environmental changes as well as adaptations of the parents to the growing size of their offspring, like it was found in many birds. For example, the Northern Wheatear *Oenanthe oenanthe* fed significantly higher proportions of spiders and caterpillars to small nestlings than to older ones, probably because their soft body is easily digestible (MORENO 1987b). Desert Wheatears showed a similar tendency: relatively soft-bodied coleopteran larvae, worms and caterpillars (although the difference was not significant in the latter) were fed more frequently during the first seven days after hatching than afterwards. This indicates that the adults adjusted the food quality to the age of their offspring on purpose.

Other observations suggest a strong effect of changes in the availability of prey on the nestling food. The first broods started almost simultaneously (REHSTEINER 2013). Nestling food was quite homogenous among these broods (own observations). It is probable that all parents fed similar food types because of their uniform abundance and availability in the whole area at this time. For example, larvae of coleopterans probably were abundant in the first half of the season but then became imagines. This may explain why these larvae disappeared almost completely from the nestling diet in the second half of the season. Instead, Hymenoptera and Saltatoria which probably had developed in the meantime became important constituents of the menu.

Food size

Prey item size and loading size significantly decreased in the course of the season. This confirms the assumption that changes in the availability of prey caused a large proportion of the changes in the nestling food. In many birds, parents try to adapt food size to the nestling size in order to optimize their feeding effort. In the Desert Wheatear, no significant relationship between nestling age and food size was found. Although nestling size logically increased with the ongoing season in the first broods, and observations of the single (and late) replacement brood were evenly distributed to the nestling growth period, the food size decreased significantly in the course of the season. Interestingly, the proportion of the feedings with multiple prey loadings heavily increased in the second half of the season compared to the first half of the season (fig. 6). Thus, profitable food may have become the longer the scarcer so that parents may have been forced to feed smaller prey. It looks like they have tried to compensate for the decreasing prey item size in the area by increasing the proportion of multiple prey loadings. Their effort was successful to a certain degree, as the slope of the negative regression between food size and date was less steep for loadings than for single prey items. In fact, multiple prey loadings were larger (on average) than single prey loadings. Nonetheless, the total volume of the loadings decreased steadily in the course of the season despite the proportion of multiple prey loadings increased.

Also, more energy may have been required to collect several small prey items rather than just one large one because of the higher searching and handling effort. The lack of regular second broods seems to confirm these assumptions (REHSTEINER 2013). Late in the season food abundance may have been too low and food size too small for rearing a second brood. Feeding efforts might have exceeded the expected yield at this time, be it in terms of reproductive output or in the chance of future adult survival (BRYANT 1991, PÄRT et al. 1992).

To conclude, the observations indicate that the time of favourable breeding conditions for Desert Wheatears in the Dzungarian Gobi is short and the scope for alternative breeding strategies is narrow. The species is part of a fragile ecosystem which deserves attention of both the international conservation community as well as scientists which perform investigations in this unique but little known and the longer the more threatened habitat.

Zusammenfassung

Nestlingsnahrung des Wüstensteinschmätzers *Oenanthe deserti* in der Dzungarischen Gobi, Mongolei

Aspekte der Nestlingsnahrung wurden im Frühjahr 2001 an neun Nestern des Wüstensteinschmätzers *Oenanthe deserti ssp. atrogularis* in der Dzungarischen Gobi in der Mongolei untersucht.

In der Nestlingsnahrung wurden Wirbellose aus acht Ordnungen sowie zwei weiteren Gruppen festgestellt. Die Beute wurde am Boden und (seltener) in der Luft erbeutet. Am häufigsten waren Zweiflügler *Diptera*, Käferlarven *Coleoptera* sowie Hautflügler *Hymenoptera*; jede dieser Gruppen war mit 17 % bis 30 % in der Nestlingsnahrung vertreten. Die Anteile einiger Beutetypen veränderten sich signifikant zwischen erster und zweiter Lebenswoche sowie zwischen erster und zweiter Saisonhälfte.

Wüstensteinschmätzer transportieren pro Fütterung nur ein Beutetier oder aber mehrere zusammen ans Nest, d.h. eine ‚Schnabelladung' kann aus einem oder mehreren Beutetieren bestehen. Die Grösse der einzelnen Beutestücke, aber auch das totale Nahrungsvolumen pro Fütterung nahm mit fortschreitender Saison ab. Kein Zusammenhang bestand zwischen Nahrungsvolumen und Nestlingsalter, individuellen Bruten oder dem Geschlecht der Eltern. In der zweiten Saisonhälfte transportierten die Altvögel viel häufiger mehrere Beutestücke pro Fütterung ans Nest als in der ersten. Damit vermochten sie zwar die im Saisonverlauf beobachtete Abnahme der pro Fütterung ans Nest gebrachten Nahrungsmenge leicht zu dämpfen, nicht jedoch zu verhindern. Dies lässt vermuten, dass die Eltern versuchten, durch das vermehrte Sammeln mehrerer Beutetiere pro Fütterung einem sinkenden Nahrungsangebot in der Umwelt zu begegnen. Das Fehlen von Zweitbruten war möglicherweise eine Konsequenz der sich mit fortschreitender Saison verschlechternden Ernährungsbedingungen.

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