Acta Herpetologica 17(1): 71-76, 2022
DOI: 10.36253/a_h-11386

Preliminary data on the diet of *Chalcides chalcides* (Squamata: Scincidae) from Northern Italy

Andrea Ciracì[1], Edoardo Razzetti[2], Maurizio Pavesi[3], Daniele Pellitteri-Rosa[4,*]

[1] *Dipartimento di Scienze della Vita e Biologia dei Sistemi, Università di Torino, Via Accademia Albertina 13, I-10124 Torino, Italy*
[2] *Kosmos - Museo di Storia Naturale, Università di Pavia, Piazza Botta 9-10, I-27100 Pavia, Italy*
[3] *Museo di Storia Naturale, Corso Venezia 55, I-20121 Milano, Italy*
[4] *Dipartimento di Scienze della Terra e dell'Ambiente, Università di Pavia, Via Ferrata 9, I-27100 Pavia, Italy*
**Corresponding author*. E-mail: daniele.pellitterirosa@unipv.it

Submitted on: 2021, 22nd June; revised on: 2021, 17th November; accepted on: 2022, 11th February
Editor: Marco Mangiacotti

Abstract. The diet in skinks is known mainly for extra-European species, especially from Australian ones, where these lizards are represented by a great number of species, while, in comparison, data for species from other continents are scarce. The three-toed skink, *Chalcides chalcides*, is found in a restricted part of northern Africa and in Italy, where it is distributed almost uniformly throughout the peninsula and on the major islands. Although it is well studied for aspects such as morphology and ecology, data concerning trophic preferences are scarce, and available only for the populations of south-central Italy. In this note we report preliminary data about the diet of an Apennine population of the three-toed skink, *Chalcides chalcides*, at the northern boundary of its distribution area. Faecal contents from 20 individuals were collected in June 2015, obtaining an overall sample of 48 prey items. Araneae constituted the most preyed taxon (over 40%), followed by Hemiptera (35,4%) and other prey taxa (Hymenoptera, Coleoptera, and Dermaptera) in much lower percentages. We found no differences between smaller/younger and larger/older individuals in consumed preys. As well as confirming the general trophic predilection of this skink for spiders, we also found some interesting differences in preyed items with studied populations of south-central Italy.

Keywords. Apennines, *Chalcides chalcides*, diet, faecal pellets, Northern Italy, skink.

Diet in lizards is a very dynamic component, since it can be variable over time (Floyd and Jenssen, 1983; Dearing and Schall, 1992). Changes are often seasonal, related to different prey availability and abundance between seasons (Durtsche, 1995). Lizards diet can also vary among sites (Barden and Shine, 1994), since prey availability and abundance may vary geographically too. Lastly, it may be different between sexes, between adults and juveniles and also among morphs (Rocha, 1998; Fialho et al., 2000; Scali et al., 2016).

Skinks diet is known mainly for extra-European species, especially from Australia (Wapstra and Swain, 1996; Duffield and Bull, 1998; Clemann et al., 2004; Shea, 2006; Pavey et al., 2010), where these lizards are represented by a great number of species, while, in comparison, data for species from other continents are scarce. Skinks are known to be primarily insectivorous, even though some species may include plants in their diet, as shown in the ocellated skink *Chalcides ocellatus* (Kalboussi and Nouira, 2004; Lo Cascio et al., 2008; Carretero et al., 2010).

The three-toed skink, *Chalcides chalcides* (Linnaeus, 1758), is a scincid lizard found in a restricted part of northern Africa (NE Algeria, Mediterranean regions of Tunisia and Libya), and in Italy, where it is distributed almost uniformly throughout the peninsula and on the major islands (Caputo et al., 2010). The northern

ISSN 1827-9635 (print)
ISSN 1827-9643 (online)

boundary of its distribution coincides with the Northern Apennines since the species is almost absent from the Po plain, except for few populations near the Po delta (Caputo et al., 2010). The species shows a snakelike habitus, with reduced tridactyl limbs. The evolution towards limblessness has an adaptive meaning, as suggested by some authors, since it favours the locomotion in grassland habitat (Caputo et al., 1995).

Despite its quite wide range, there is paucity of information regarding some aspects of the biology of the species. This is probably due to its particular lifestyle, and to the consequent elusiveness that makes this reptile difficult to be captured in the field. So far, there is a good amount of information related to morphology and osteology (Caputo et al., 1995, 2000; Greer et al., 1998; Caputo, 2004; Guarino, 2010) and to the biology and ecology of the species (Orsini and Cheylan, 1980; Rugiero, 1997; Caputo and Silvano, 1999; Luiselli et al., 2005). On the contrary, data concerning structure and dynamic of the populations are absent, while those concerning trophic preferences are scarce, and available only for the populations of southern-central Italy. Rugiero (1997) analysed the stomach content of specimens from the surroundings of Rome, while Caputo (2000) studied the diet composition of a population from Molise. The present study aims to collect information about the diet of the three-toed skink in Northern Italy, analysing the faecal pellets of individuals from a population of Northern Apennines.

All data presented here were collected in June 2015, during the breeding period of the species. We sampled a population located in the so-called hilly area of the "Oltrepò Pavese", in the municipality of Codevilla (44°57'N, 9°4'E; Fig. 1). The site, situated at an altitude of 260 m a.s.l., was characterized by the presence of uncultivated grasslands, surrounded by woodland area represented for the most by *Quercus pubescens* and *Ostrya carpinifolia*. Bushy zones of *Rosa canina* and *Crataegus monogyna* were present at some spots inside the grasslands.

Fig. 1. Map showing the study site in Northern Italy (municipality of Codevilla, province of Pavia). Contour lines (elevation a.s.l. in meters) for Codevilla municipality are also displayed.

Table 1. Biometric variables of the juvenile and adult three-toed skinks (n = 20) measured in a population of the Northern Apennines in Italy (municipality of Codevilla, province of Pavia): SVL (Snout-Vent Length), Ta_L (Tail Length), TL (Total Length), HH (Head Height), HW (Head Width), HL (Head Length), W (Weight).

Code	Capture date	SVL (mm)	Ta_L (mm)	TL (mm)	HH (mm)	HW (mm)	HL (mm)	W (g)
COD01	12/6/2015	68.7	70.0	138.7	3.4	4.5	7.4	1.6
COD02	12/6/2015	75.8	76.0	151.8	3.6	4.6	7.9	2.1
COD03	13/6/2015	80.0	81.0	161.0	3.8	4.6	7.6	2.4
COD04	11/6/2015	81.5	85.0	166.5	3.3	4.7	7.9	2.2
COD05	7/6/2015	81.9	84.0	165.9	3.7	5.0	8.0	2.5
COD06	1/6/2015	83.3	91.0	174.3	3.6	4.9	8.4	3.2
COD07	1/6/2015	85.0	91.0	176.0	3.8	4.6	7.8	2.8
COD08	24/6/2015	88.0	60.0	148.0	4.1	4.9	8.5	3.0
COD09	10/6/2015	88.0	95.0	183.0	4.0	4.0	8.6	3.6
COD10	25/6/2015	89.9	96.0	185.9	4.1	4.9	8.6	3.5
COD11	24/6/2015	90.0	32.0	122.0	3.6	4.7	8.3	3.0
COD12	24/6/2015	93.0	98.0	191.0	4.1	4.9	8.9	3.6
COD13	25/6/2015	97.4	98.7	196.1	3.9	4.6	7.8	4.5
COD14	30/6/2015	106.6	119.7	226.3	4.2	5.1	8.9	4.5
COD15	24/6/2015	126.0	139.0	265.0	5.1	6.5	11.7	10.0
COD16	10/6/2015	126.0	138.0	264.0	4.6	5.7	10.2	9.8
COD17	25/6/2015	131.7	129.0	260.7	4.8	5.8	9.4	9.2
COD18	10/6/2015	138.0	138.0	276.0	4.9	5.7	10.3	12.0
COD19	24/6/2015	139.0	145.0	284.0	5.5	6.3	10.5	12.3
COD20	24/6/2015	172.0	93.0	265.0	6.1	6.6	12.2	19.5

We caught 20 individuals by hand, searching for them in the grass. Each individual was measured using a digital calliper (accuracy ± 0.1 mm) for snout-to-vent length (SVL), tail, head size (height, width, and length), weighed by a digital scale (accuracy ± 0.1 g) (Table 1), and photographed on the dorsal and ventral pattern. Faecal pellets were usually defecated by lizards immediately after capture, although sometimes they were obtained by applying a slight pressure on the belly of each individual, eliciting defecation. Pellets were preserved in sterile tubes containing 70% alcohol for subsequent analysis. All individuals in our sample were captured once, as assessed by the manual comparison of both biometric measures and photographic images (dorsal pattern, intersection of head and ventral scales, scars). After each sampling session, all individuals were released at the exact point of capture. It was not possible to attribute sex to captured skinks as this species lacks any external sexual dimorphism, except for very large pregnant females (Caputo et al., 2010). In order to tentatively evaluate possible differences in dietary habits between smaller, and consequently younger, individuals and larger/older animals, we separated the 20 skinks into two groups (10 juveniles and 10 adults), based

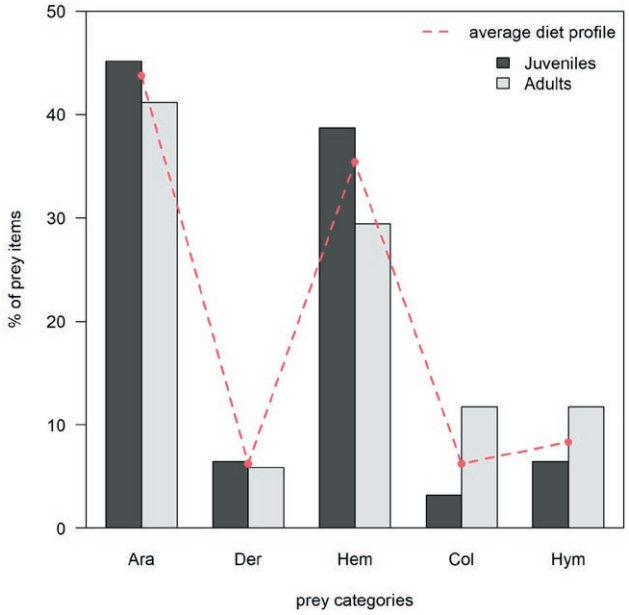

Fig. 2. Percentages of different taxa of preyed items in *Chalcides chalcides* for juveniles and adults, categorized by SVL (< 91 mm: juveniles, n = 10; ≥ 91 mm: adults, n = 10). Prey's legend: Ara – Araneae; Der – Dermaptera; Hem – Hemiptera; Col – Coleoptera; Hym – Hymenoptera.

on minimum size of adult individuals (SVL = 91 mm) as reported in literature (Caputo et al., 2010).

The analysis of faecal pellets is considered to be fully reliable to describe lizard feeding habits (Perez-Mellado et al., 2011; Civantos et al., 2013; Scali et al., 2016). Faeces were dissolved in a Petri dish to separate all prey items, which were identified by using a stereomicroscope by M.P., expert entomologist of the Natural History Museum of Milan (Italy). Where possible, prey items were recognized at the family taxonomic level, and were grouped at the order level. However, since some soft diet items (e.g., insect larvae, spiders) might not appear in faecal pellets, we carefully searched for body parts of small and soft-bodied prey taxa that are less likely to be digested (Civantos et al., 2013).

Overall, we obtained 48 prey items from a sample of 20 individual faecal pellets (mean ± SE: 2.4 ± 0.3, range: 1-6; 31 from juveniles and 17 from adults). The taxonomic composition of preyed items, with the percentage of contribution of each taxon, is reported in Table 2. Considering the overall small sample size, differences in prey items frequency between juveniles and adults for each prey taxa were tested using χ^2 with Monte-Carlo simulation (1000000 iterations) to obtain reliable P value (Patefield, 1981). The observed frequencies were not significantly different from the expected ones (P = 0.83; Fig. 2), indicating that juvenile and adult diets overlapped. In general, the most present taxon in the three toed-skink diet was represented by Araneae (juveniles: 14; adults: 7), followed by Hemiptera (juveniles: 12; adults: 5). Few items were identified as Coleoptera (juveniles: 1; adults: 2) and Dermaptera (juveniles: 2; adults: 1). It should be stressed that both Coleoptera belonging to Carabidae and Tenebrionidae families and Dermaptera are largely nocturnal, nevertheless they are not uncommon in the diet of diurnal lizards (Vitt and Blackmore, 1991). Formicidae (incidentally, consistently wingless insects), again with a quite small sample, represented the only taxon equally preyed (two prey items for both juveniles and adults). Ants are mostly diurnal, widespread, abundant, easy-to-catch insects, therefore their relative scarcity in the diet suggests they are not among the preferred prey.

The analysis of faecal pellets shows that the most predated invertebrates by the three toed-skink are repre-

Table 2. Prey items (n = 48) of *Chalcides chalcides* from a site of Northern Apennines. Analyses were based on the faecal pellets of 20 skinks (one pellet for each individual). Percentages refer to the number of items for each Suborder and Order of considered taxa with respect to the total of found items.

Order	Suborder	Family	n	Suborder (%)	Order (%)
Araneae	Labidognatha	Lycosidae	3	6.25	43.75
	Labidognatha	Not determined	18	37.50	
Dermaptera	Forficulina	Anisolabididae	1	2.08	6.25
	Forficulina	Not determined	2	4.17	
Hemiptera	Heteroptera	Not determined	6	12.50	12.50
	Fulgoromorpha	Issidae	5	10.42	22.92
	"Homoptera"	Not determined	6	12.50	
Coleoptera	Adephaga	Carabidae (larvae)	1	2.08	
	Polyphaga	Elateridae (adult)	1	2.08	6.25
	Polyphaga	Tenebrionidae (adult)	1	2.08	
Hymenoptera	Apocrita	Formicidae	4	8.33	8.33

sented by spiders, since they contributed 43.75% of preyed items. The previous studies, conducted on the trophic preferences of this skink in south-central Italy, led to the same result, with spiders being the most preyed taxon. In the study of Rugiero (1997), based on the analysis of the specimens' stomach content, spiders contributed 42.45% to the diet composition. Caputo (2000) found an even higher contribution, with Araneae contributing up to 51.11% to the diet composition. Further differences with respect to the previous studies are found in the contribution of the other prey taxa. In our study, Hemiptera constituted the second most preyed taxon (35.42%), while both Rugiero (1997) and Caputo (2000) found this group contributed lower percentages to the diet composition (2.83% and 13.33% respectively). Furthermore, we found a higher percentage of Formicidae (8.33%) compared to the studies of Rugiero (4.71%) and Caputo (2.22%, including all Hymenoptera). However, percentages of Formicidae remain quite low, when their abundance at the soil level is considered. This suggests that Formicidae are of quite low value as food for skinks, and only taken as second-choice preys, although not entirely refused. All the other prey taxa we found were present in much lower percentages, such as Coleoptera (6.25% considering both adults and larvae), which, on the contrary, contributed in a significant way both in the population of Rome (18.86%; Rugiero, 1997), and Molise (15.56%; Caputo, 2000). Interestingly, even if with low percentage (6.25%), we firstly detected the presence of Dermaptera in the diet of the three-toed skink**,** not found in the other Italian populations. Conversely, some taxa were found in south-central Italy, but not in Northern Apennines. For instance, Rugiero (1997) found a strong contribution of Isopoda (15.09%), which were not found nor in our work, nor in that of Caputo (2000). This may be related to a higher aridity of the studied habitats, resulting in a largely nocturnal activity of the quite hygrophilous Isopoda, since their abundance in Rugiero's samples indicates they are not counterselected as preys. The latter author found conversely a rather high contribution of Orthoptera (15.56%), absent both in the present work and in that of Rugiero (1997). Gasteropoda, Blattodea, Diptera were found by Rugiero (1997), even though in very small percentages, while Myriapoda were found by Caputo (2000). None of these taxa were found in our work. However, the differences we found with respect to these studies could be due both to the limited sample sizes in the various surveys and to the fact that none of them considers prey availability.

This study allowed not only to give some preliminary insight about the diet of the three-toed skink in Northern Italy, but also showed no differences in the consumed prey between juveniles and adults. An ontogenetic shift in diet composition, and thus in trophic preferences, has been reported for skinks, but only for extra-European species (Hall, 1972; Duffield and Bull, 1998; Shea et al., 2009). It represents a very fascinating topic never investigated before for European skink species, so further studies on this or even other species are needed, possibly taking into account larger sample sizes, in order to perform reliable statistical tests.

In conclusion, this study confirms the preference of the three toed-skink for spiders. As hypothesized by Caputo (2004), this might be due to the particular structure of the teeth of the species, similar to that of the other smaller species of the genus, characterized by a conical longitudinal section, rendering them particularly suitable for preys with a soft body, such as spiders.

Moreover, it is not surprising that adult Coleoptera are scarce in the faecal pellets of the three toed-skink. Coleoptera are usually preyed by larger species of skinks like *Chalcides ocellatus* and *Chalcides polylepis* (Bons, 1958; Schneider, 1981) which have a stronger bite that easily allows them to crush such hard-bodied preys. The differences we found in the other prey taxa might be due to different factors, such as habitat, climatic conditions or sampling season. This is not uncommon in reptiles that can be at least partially opportunistic in their food choices (Manicom and Schwarzkopf, 2011). However, our findings put light on a basic ecological aspect of the species in its northernmost distribution area and in a particular habitat, the Apennine mountains, never investigated before for skinks.

ACKNOWLEDGEMENTS

The study was realized in accordance with the National and local legislation and a research permit was granted by Regione Lombardia, DG Ambiente, Energia e Sviluppo Sostenibile RLAOOT1_2587 (prot. T1.2015.001437).

REFERENCES

Barden, G., Shine, R. (1994): Effects of sex and reproductive mode on dietary composition of the reproductively bimodal scincid lizard, *Lerista bougainvillii.* Austral. Zool. **29**: 225-228.

Bons, J. (1958): Contribution à l'étude de l'herpétofaune marocaine (Reptiles de la région d'Ifrane). Bull. Soc. Sci. Nat. Phys. Maroc. **38**: 73-75.

Caputo, V., Silvano, F. (1999): Luscengola. *Chalcides chalcides* (Linnaeus, 1758). Erpetologia del Piemonte e

della Valle d'Aosta. In: Atlante degli Anfibi e dei Rettili, pp. 200-201. Andreone, F., Sindaco, R., Eds., Museo Regionale di Scienze Naturali, Torino.

Caputo, V., Lanza, B., Palmieri R. (1995): Body elongation and limb reduction in the genus *Chalcides* Laurenti 1768 (Squamata Scincidae): a comparative study. Trop. Zool. **8**: 95-152.

Caputo, V. (2000): *Chalcides chalcides* (L., 1758), luscengola. In: Atlante degli Anfibi e dei Rettili del Lazio, pp. 88-89. Bologna, M., Capula, M., Carpeneto, G.M., Eds., Fratelli Palombi Editori, Roma.

Caputo, V., Guarino, F.M., Angelini, F. (2000): Body elongation and placentome evolution in the scincid lizard genus *Chalcides* (Squamata, Scincidae). Ital. J. Zool. **67**: 385-391.

Caputo, V. (2004): The cranial osteology and dentition in the scincid lizards of the genus *Chalcides* (Reptilia, Scincidae). Ital. J. Zool. **71**: 35-45.

Caputo, V., Guarino, F.M., Giovannotti, M. (2010): *Chalcides chalcides* (Linnaeus, 1758). In: Fauna d'Italia, vol XLV, Reptilia, pp. 295-309. Corti, C., Capula, M., Luiselli, L., Razzetti, E., Sindaco, R., Eds., Calderini Edizioni, Bologna.

Carretero, M.A., Lo Cascio, P., Corti, C., Pasta, S. (2010): Sharing resources in a tiny Mediterranean island? Comparative diets of *Chalcides ocellatus* and *Podarcis filfolensis* in Lampione. Bonn Zool. Bull. **57**: 111-118.

Civantos, E., Ortega, J., Lopez, P., Martin, J., Perez-Cembranos, A., Perez-Mellado, V. (2013): Diet selection by the threatened Chafarinas' skink *Chalcides parallelus* in North Africa. Afr. J. Herpetol. **62**: 78-89.

Clemann, N., Chapple, D., Wainer, J. (2004): Sexual dimorphism, diet, and reproduction in the swamp skink, *Egernia coventryi*. J. Herpetol. **38**: 461-467.

Dearing, M.D., Schall, J.J. (1992): Testing models of optimal diet assembly by the generalist herbivorous lizard *Cnemidophorus murinus*. Ecology **73**: 845-858.

Duffield, G.A, Bull, C.M. (1998): Season and ontogenetic changes in the diet of the Australian skink *Egernia stokesii*. Herpetologica **54**: 414-419.

Durtsche, R.D. (1995): Foraging ecology of the fringe-toed lizard, *Uma inornata*, during periods of high and low food abundance. Copeia **1995**: 915-926.

Fialho, R.B., Rocha, C.F.D., Vrcibradic, D. (2000): Feeding ecology of *Tropidurus torquatus*: ontogenetic shift in plant consumption and seasonal trends in diet. J. Herpetol. **34**: 325-330.

Floyd, H.B., Jenssen, T.A. (1983): Food habits of the Jamaican lizard *Anolis opalinus*: resource partitioning and seasonal effects examined. Copeia **1983**: 319-331.

Greer, A.E., Caputo, V., Lanza, B., Palmieri, R. (1998): Observations on limb reduction in the scincid lizard genus *Chalcides*. J. Herpetol. **32**: 244-252.

Guarino, F.M. (2010): Structure of the femora and autotomous (postpygal) caudal vertebrae in the three-toed skink *Chalcides chalcides* (Reptilia: Squamata: Scincidae) and its applicability for age and growth rate determination. Zool. Anz. **248**: 273-283.

Hall, R.J. (1972): Food habits of the great plains skink (*Eumeces obsoletus*). Am. Mid. Nat. **87**: 258-263.

Kalboussi, M., Nouira, S. (2004): Comparative diet of northern and southern Tunisian populations of *Chalcides ocellatus* (Forskal, 1775). Rev. Españ. Herpetol. **18**: 29-39.

Lo Cascio, P., Corti, C., Carretero, M.A., Pasta, S. (2008): Dati preliminari sulla dieta di due popolazioni insulari di *Chalcides ocellatus*. In: Herpetologia Sardiniae, pp. 314-317. Corti, C., Ed., Edizioni Belvedere, Latina.

Luiselli, L., Angelici, F.M., Di Vittorio, M., Spinnato, A., Politano A. (2005): Analysis of herpetofaunal community from an altered marshy area in Sicily; with special remarks on habitat use (niche breadth and overlap), relative abundance of lizards and snakes, and the correlation between predator abundance and tail loss in lizards. Contrib. Zool. **74**: 43-51.

Manicom, C., Schwarzkopf, L. (2011): Diet and prey selection of sympatric tropical skinks. Austral. Ecol. **36**: 485-496.

Orsini, J.P., Cheylan, M. (1980): *Chalcides chalcides*. In: Handbuch der Reptilien und Amphibien Europas. 1: Echsen (Sauria) 1: Gekkonidae, Agamidae, Chamaleonidae, Anguidae, Amphisbaenidae, Scincidae, Lacertidae, pp. 318-337. Bohme, W., Ed., Akademische Verlagsgesellshaft, Wiesbaden.

Patefield, W.M. (1981): Algorithm AS 159: An efficient method of generating random R × C tables with given row and column totals. J. Roy. Stat. Soc. C-App. **30**: 91.

Pavey, C.R., Burwell, C.J., Nano, C.E.M. (2010): Foraging ecology and habitat use of Slater's skink (*Egernia slateri*): an endagered Australian desert lizard. J. Herpetol. **44**: 563-571.

Perez-Mellado, V., Perez-Cembranos, A., Garrido, M., Luiselli, L., Corti, C. (2011): Using faecal samples in lizard dietary studies. Amphibia-Reptilia **32**: 1-7.

Rocha, C.F.D. (1998): Ontogenetic shift in the rate of plant consumption in a tropical lizard (*Liolaemus lutzae*). J. Herpetol. **32**: 274-279.

Rugiero, L. (1997): On the ecology and phenology of *Chalcides chalcides* (Linnaeus, 1758) in Central Italy. Herpetozoa **10**: 81-84.

Scali, S., Sacchi, R., Mangiacotti, M., Pupin, F., Gentilli, A., Zucchi, C., Sannolo, M., Pavesi M., Zuffi, M.A.L. (2016): Does a polymorphic species have a 'polymor-

phic' diet? A case study from a lacertid lizard. Biol. J. Linn. Soc. **117**: 492-502.

Shea, G.M. (2006): Diet of two species of bluetongue skink, *Tiliqua multifasciata* and *Tiliqua occipitalis* (Squamata: Scincidae). Austral. Zool. **33**: 359-368.

Shea, G.M., Jourdan, H., Sadlier, R., Bauer A. (2009): Natural history of the New Caledonian whiptailed skink *Tropidoscincus variabilis* (Bavay, 1869) (Squamata: Scincidae). Amphibia-Reptilia **30**: 207-220.

Schneider, B. (1981): *Chalcides ocellatus*. In: Handbuch der Reptilien und Amphibien Europas. 1: Echsen (Sauria) 1: Gekkonidae, Agamidae, Chamaleonidae, Anguidae, Amphisbaenidae, Scincidae, Lacertidae, pp. 338-354. Bohme, W., Ed., Akademische Verlagsgesellshaft, Wiesbaden.

Vitt, L.J., Blackburn, D.G. (1991): Ecology and life history of the viviparous lizard *Mabuya bistriata* (Scincidae) in the Brazilian Amazon. Copeia **1991**: 916-927.

Wapstra, E., Swain, R. (1996): Feeding ecology of the Tasmanian spotted skink, *Niveoscincus ocellatus* (Squamata: Scincidae). Austral. J. Zool. **44**: 205-213.