

## PREDATORS OF THE COMMON LIZARD (*ZOOTOCA VIVIPARA*) IN A HABITAT OF FOREST GLADE IN SW POLAND

ROBERT MAŚLAK and LUKAŚZ PAŚKO

University of Wrocław, ul. Sienkiewicza 21, Wrocław 50-335, Poland

### ABSTRACT

Ecological studies were carried out in 1992-1995 in a population of *Zootoca (Lacerta) vivipara* inhabiting a humid meadow surrounded by a forest in SW Poland. The studies included, among others, identifying vertebrate predators of this species. Three amphibian species, 2 reptile species, 21 birds and 12 mammals are regarded as potential predators. Attempted attacks by the Kestrel and numerous attacks by the Jay on the lizards were observed. The opinion that a high proportion of lizards with regenerated tails unequivocally testifies to a high predation pressure is discussed.

### INTRODUCTION

*Zootoca (Lacerta) vivipara* is one of the best known reptile species. Numerous studies on various aspects of its biology have been conducted in Europe. The lizard's life span is usually 3-4 years, quite exceptionally longer than 7 years. The most critical period of life is the juvenile phase and the age of first reproduction (e.g. Pilorge and Castanet 1981; Heulin 1985; Strijbosch & Creemers 1988; Castanet 1994).

Predation is among the most important mortality factors. A high proportion of individuals with regenerated tails, finger damage etc. is associated with it. A review of anti-predatory strategies employed by Lacertidae can be found in Bauwens & Thoen (1981) and Gramentz (1995).

The lizards fall prey to invertebrates (McCormick & Polis 1982; Schwammer & Baurecht 1988; Bauer 1990; Blondheim & Werner 1990; Jehle et al. 1996) and vertebrates (e.g. Kabisch & Belter 1968; Osennegg 1995). This study was aimed at recognizing potential vertebrate predators of *Zootoca vivipara* in a forest glade near Wrocław (Lower Silesia, Poland). In addition, the proportion of specimens with body damage in the population was estimated.

### MATERIALS AND METHODS

The meadow which was the study area is located on the left bank of the Hyszczyca River valley, on a higher Holocene terrace, at the base of a Baltic terrace, at 118 m a.s.l. (Walczak 1970; Szczepankiewicz 1972; 1989). The location of the area results in a difficult water outflow. This is testified to by the fact that marshy ground forms a considerable part of the area, in spite of a network of drainage ditches which also cross and partly surround the meadow and the adjacent forests. The meadow is approximately rectangular, 250 x 140m, surface area 3.5 ha. Its eastern part is crossed by a drainage ditch. A similar ditch runs along the northern edge of the meadow. In the spring and after

heavy rains the ditches are filled with water which then floods a small belt along the eastern border of the meadow. The vegetation can be classified as belonging to the order Molinietales.

The study area is surrounded by a forest. On the southern and eastern side *Alnus glutinosa* dominates, on the northern side *Betula pubescens* and *Pinus silvestris*, on the western side *Picea abies*. Besides, there are single trees of *Quercus robur*, *Populus tremula* and *Fraxinus excelsior*. The margins of the ditch that crosses the meadow are overgrown by *Betula pubescens* and *Frangula alnus*.

The studies carried out in 1992-1995 included an array of aspects of the ecology of *Zootoca vivipara*. Within the studies, 467 individuals were marked individually by toe-clipping. Individuals with regenerated tails and damaged legs were registered. The observations each year started in the middle of March and ended at the beginning of October. The lizards were caught mainly in the morning and early afternoon.

Observations of potential predators of the lizard were carried out on the meadow and in the adjacent forest. The methods involved both direct observation and studying traces of predator's feeding, faeces etc. The results were compared with literature data.

## RESULTS AND DISCUSSION

A considerable proportion of individuals with regenerated tails were found in the population (Table 1). This may testify to a high predation pressure. The proportion of specimens with damaged toes is much lower. Besides these, a male with a completely missing fore leg was found.

In the study area the Field Frog (*Rana arvalis*) is very numerous; the Common Frog (*Rana temporaria*) and the Common European Toad (*Bufo bufo*) were found less often. Data from the analysis of stomach contents indicate that they devour vertebrates only exceptionally (e.g. Pisarenko & Usakov 1985; Juszczak 1987; Baruš et al. 1992a; own data). They can, however, constitute a threat, especially in the morning, when the first lizards leave their night shelters and still move slowly.

The Slow-Worm (*Anguis fragilis*) was observed on the meadow only a few times. Cases of consuming other lizards by this species were noted (Brown 1957; Radek 1964; Dely 1981; Petzold 1995).

The Grass Snake (*Natrix natrix*) was met often, especially in the summer, near the ditch crossing the meadow and in the forest. It sometimes devours lizards, mainly when amphibians are not available in sufficient numbers (e.g. Kabisch 1974; Kratzer 1974; Baruš et al. 1992b; Oseneck 1995).

Twenty one bird species – potential predators of the lizard – were recorded.

Storks were often observed in the study area. The White Stork regularly nests in a village ca. 1.5 km away from the meadow. However, it foraged on the meadow only rarely and always in the early morning hours. The White Stork, depending on local food conditions, may consume considerable numbers of lizards. For example in the area of Kherson (Ukraine) it feeds mainly on orthopterans and lizards, and only then frogs, snakes and small mammals (e.g. Szijj 1956/57; Kabisch & Belter 1968). Likewise, the Black Stork may feed on lizards (Cramp 1982a). The Black Stork in flight was seen often, especially in 1992. However, it was never observed to forage on the meadow.

Among Accipitriformes, the Buzzard and the Goshawk regularly visited the meadow, while the Sparrowhawk was seen only once. The Sparrowhawk in Silesia is not an abundant species (Dyrz et al. 1991). Though cases of killing lizards by that bird are known, it was never observed to eat them (Cramp 1982b). In the studies conducted in Poland by Kochan (1979) none of 69 examined alimentary tracts of the Goshawk contained a reptile. A considerable threat for the studied population could be constituted by the Buzzard which was often seen above the meadow. Though the food basis of this species is constituted by small mammals, reptiles, first of all Lacertidae, are under certain conditions an important supplement. Sometimes they can be consumed in considerable quantities. For example in Rügen (Germany) young Buzzard are to a large extent fed with birds and reptiles. Also in the case of easy availability of reptiles their proportion in the diet increases. For example in Italy and Spain these birds most often eat insects, then reptiles, and only then mammals. In France carrion, amphibians, reptiles and fish counted together constitute ca. 5-10% of consumed food (Glutz von Blotzheim et al. 1971; Garzon 1974; Cramp 1982b). In the studies carried out in Poland only one reptile was found in 104 examined alimentary tracts; it was *Zootoca vivipara* (Kochan 1979). With respect to mass, lizards constituted only 0.07 to 0.1% of consumed food (Czarnecki & Foksowicz 1954; Truszkowski 1976). Pomarnacki (1982), during a two-day observation of a low-situated nest, noted that the young were fed to a considerable degree with reptiles, as many as 3 lizards for each 4 mammals brought.

The only falconiform species in the study was the Kestrel. With respect to abundance this is the second bird of prey in Silesia (Dyrz et al. 1991). It visited the meadow regularly. Once an attack by the Kestrel on a lizard was observed. It was, however, unsuccessful, the lizard having managed to escape in tall grass. Lizards may constitute a few per cent of the food of the Kestrel. In studies in Hungary it was demonstrated that out of 94 stomachs analysed, besides remnants of 45 mammals and 9 birds, there were remnants of as many as 49 lizards (*Lacerta agilis*); in the Netherlands 900 stomachs examined contained 7.1% lizards (*Lacerta agilis*). In Germany the proportion was 5.2% (Glutz von Blotzheim et al. 1971). Among the amphibians and reptiles caught by the Kestrel, lizards of the genus *Lacerta* are a decidedly dominating group. In some conditions, e.g. in early spring, at the absence of small mammals, the number of consumed lizards may equal that of birds (Cramp 1982b). They can be also a supplementary food brought by parents for young in the nest (Piechocki 1952). Ortlieb (1963) observed that out of 41 vertebrates brought to the nest, 4 were lizards.

In the Owl, food lizards are found very rarely, because of the activity falling in different hours of the day (Cramp 1985). Ca. 700 m away from the study area, once the Long-Eared Owl was observed, but the Tawny Owl is an inhabitant of the surrounding forest. In the studies on the food of these owl species, carried out in Poland, no reptile remains were found (Kochan 1979). In Germany during 6 years of studies only 1 specimen of *Lacerta agilis* was found in the food of the Tawny Owl (Wendland 1963).

Among the observed galliform birds, only the Pheasant (*Phasianus colchicus*) sometimes eats small vertebrates, including lizards. It was noted that it consumed *Lacerta agilis* and *Eremias arguta* (Cramp 1982a). The pheasant is often met in the Odra River valley in the vicinity of Wrocław.

Placing the Black-Headed Gull on the list of potential lizard predators may seem surprising. There are, however, reports from the former USSR, on the sporadic consumption of reptiles (including lizards) by that species (cf. Cramp 1984). In the region of studies, passing gulls of this species were rarely seen, only in the early spring,

when they forage especially actively on refuse heaps and fields. The Black-Headed Gull never stopped on the meadow; the species never takes prey in places with tall grassy vegetation.

Among Passeriformes the only numerous species in the adjacent forest are the Blackbird and Mavis. Both species only exceptionally consume lizards. There exists an exact description of an attack of the Mavis on *Zootoca vivipara*, concluded with consumption of the lizard's rejected tail (Chater 1965; Cramp 1988).

The Robin was regularly seen in the study area. Sporadically, it can consume lizards. After killing the reptile, the bird picks small bits and eats them (Cramp 1988; Heath 1988). Representatives of the family Laniidae – the Red-Backed Shrike and the Great Grey Shrike – were only rarely seen in the study area. In south-western Finland 47.5% of the Great Grey Shrike's food during the reproductive period consists of vertebrates, 26.7% of these being *Zootoca vivipara* (Grönlund et al. 1970; Cramp 1993). Among the Corvidae, the Jay, Raven, Hooded Crow and Magpie visited the meadow the most often. The Jay, actively hunting lizards, was observed in the study area. The birds looked for lizards in the region of the ditch that crosses the meadow from low branches of the birches on its margins. During the summer heat the lizards were especially numerous there. However, the attempts at catching lizards were mostly unsuccessful. The birds that succeeded escaped with their prey to the upper parts of trees. On the day when these observations were made, the birds repeatedly returned to that place. In the corvid food lizards are usually found in small quantities (Cramp 1994). In studies on the Raven in Turkmenistan, among the remnants of 66 vertebrates, 7 lizards: 1 *Agama* and 6 unidentified, were found (Dementev et al. 1953). In the Magpie food lizards may constitute several per cent (Egelis 1964) of the diet.

Of mammals, the European hedgehog and shrews sometimes catch lizards (e.g. Serafiński 1956; Reeve 1994; Oseneegg 1995).

The study area is penetrated by the Red Fox. Lizards are rarely found in the food of this species, and mainly in the population inhabiting southern Europe. The proportion of this food is low, reaching 0.4%, though locally it may be higher which to a large degree depends on lizard availability (Rzebiak-Kowalska 1972; Goszczyński 1974; Ciampalini & Lovari 1985; Goszczyński 1986; Doncaster et al. 1990; Serafini & Lovari 1993).

The mustelids, though represented by several species, were observed only outside the meadow, from 300 m. (Weasel) to ca. 1 km (Stone Marten) away. No Badger tracks were found, but reliable information on its occurrence in the area was obtained. All the species mentioned consume lizards only occasionally, and in the studies on their stomach contents in Poland usually no lizards remains are found (Lockie 1961; Fruziński 1964; Goszczyński 1976; Ciampalini & Lovari 1985; Goszczyński 1986; Serafini & Lovari 1993, Sumiński & Goszczyński 1993). The proportion of reptiles in their food is low also in southern Europe. In Spain it was demonstrated that out of 66 vertebrates consumed by the Stone Marten 6 were lizards (Delibes 1978). In the diet of 4 Polecat in the former USSR the proportion of lizards was as high as 17% (Rzebiak--Kowalska 1972).

Placing the Wild Boar on the list of potential predators needs discussion. Traces of the presence of this species were found on the meadow each year. The animals left their rooting traces mainly in the early spring, when they were probably looking for plant shoots and wintering insect larvae. It cannot be excluded, however, that they could devour lizards that wintered not very deep, especially considering that the Wild Boar also eats lizards, when an opportunity arises (Haber 1964; Günther & Völkl 1996).

Dogs were seen several times in the study area, and – more often – cats were observed. The latter especially may be persistent lizard hunters. The animals came most probably from the farms ca. 1 km away.

A full list of potential predators recorded from the studied meadow and within 1 km from it is presented in Table 2.

A considerable proportion of lizards with regenerated tails may testify to a high predation pressure. Similar results were obtained by Kornacker (1993) – 38.5% adult males and 51.9% adult females with regenerated tails.

The autotomy ability is probably the same in both sexes, though in males the tails are longer than in females. The length of the autonomous part remains similar in both sexes (Barbarillo et al. 1995).

A higher number of females with regenerated tails may result from the fact that they are more vulnerable during pregnancy. This is especially important in viviparous species, in which all the embryonic development takes place in the female’s body. This affects the female’s behaviour, and thus the ability to successfully avoid danger created by predators (Bauwens & Thoen 1981; Damme et al. 1989).

Besides, some authors suggest that the higher proportion of individuals with regenerated tails in a population should not be associated with a higher predation pressure, but with a higher agility and efficiency of escape on the part of the lizards, or with a low efficiency on the part of predators. Where the predators are more efficient, all the attacked lizards should be killed and theoretically there should be no individuals with regenerated tails (Jaksić & Nunez 1979; Schoener 1979; Jaksić & Fuentes 1980; Jaksić & Greene 1984).

Damage to young is decidedly less frequent. This is probably because they are more often consumed whole than the adults. The mortality of the young in their first year may reach 90% (Avery 1975). Certainly, such a high mortality results not only from predation, but also from a lower survival of the young during their first winter, which is associated with the impossibility of accumulating adequate energy reserves (Avery 1970; Avery et al. 1974; Bauwens 1981). Adult lizards tolerate the winter decrease in temperature very well and their survival during hibernation is considerable (Bauwens 1981; Grenot 1994). The number of individuals with damaged toes should be regarded as low. Middelburg and Strijbosch (1988) report that out of 934 specimens of *Zootoca vivipara* collected during 4 years, as many as 8% had damaged toes.

**Table 1:** Proportion of individuals with regenerated tails and damaged toes

categories	% specimens with regenerated tails	% specimens with damaged toes
adult males	40.5	2.5
adult females	52	3.4
overwinters	15.3	0.8
young	5.1	0

**Table 2:** Vertebrates – potential predators of *Zootoca (Lacerta) vivipara*  
 – recorded from the study area and its immediate vicinity.  
 ++ – regularly observed, + – sporadically observed

SPECIES		OCCURRENCE
<b>AMPHIBIA</b>		
common European toad	<i>Bufo bufo</i>	++
common frog	<i>Rana temporaria</i>	++
field frog	<i>Rana arvalis</i>	++
<b>REPTILIA</b>		
slow-worm	<i>Anguis fragilis</i>	+
grass snake	<i>Natrix natrix</i>	++
<b>AVES</b>		
white stork	<i>Ciconia ciconia</i>	++
black stork	<i>Ciconia nigra</i>	++
goshawk	<i>Acipiter gentilis</i>	++
sparrowhawk	<i>Acipiter nisus</i>	+
buzzard	<i>Buteo buteo</i>	++
kestrel	<i>Falco tinnunculus</i>	++
tawny owl	<i>Sirix aluco</i>	++
long-eared owl	<i>Asio otus</i>	+
pheasant	<i>Phasianus colchicus</i>	++
black-headed gull	<i>Larus ridibundus</i>	+
blackbird	<i>Turdus merula</i>	++
mavis	<i>Turdus philomelos</i>	++
robin	<i>Erithacus rubecula</i>	++
red-backed shrike	<i>Lanius collurio</i>	+
great grey shrike	<i>Lanius excubitor</i>	+
raven	<i>Corvus corax</i>	++
hooded crow	<i>Corvus corone</i>	++
jackdaw	<i>Corvus monedula</i>	+
rook	<i>Corvus frugileus</i>	+
magpie	<i>Pica pica</i>	++
jay	<i>Garrulus glandarius</i>	++

MAMMALIA		
European hedgehog	<i>Erinaceus europaeus</i>	++
shrew	<i>Sorex sp.</i>	+
red fox	<i>Vulpes vulpes</i>	++
ermine	<i>Mustela erminea</i>	+
weasel	<i>Mustela nivalis</i>	+
polecat	<i>Mustela putorius</i>	+
pine marten	<i>Martes martes</i>	+
stone marten	<i>Martes foina</i>	+
badger	<i>Meles meles</i>	+
wild boar	<i>Sus serofa</i>	++
cat	<i>Felis sylvestris f. catus</i>	++
dog	<i>Canis lupus f. familiaris</i>	+

#### REFERENCES

- Avery, R.A. (1970). Utilization of caudal fat by hibernating Common Lizards *Lacerta vivipara*. *Comp. Biochem. Physiol.* **37**, 119-121.
- Avery, R.A. (1975). Age structure and longevity of common lizard (*Lacerta vivipara*) populations. *J. Zool.*, London **176**, 555-558.
- Avery, R.A., Shewry, D.R. & Stobart, A.K. (1974). A comparison of lipids from the fat body and tail of the Common Lizard, *Lacerta vivipara*. *Brit. J. Herpetol.* **5**, 410-412.
- Barbadillo, L.J., Bauwens, D., Barahona, F. & Sánchez-Herrera, M.J. (1995). Sexual differences in caudal morphology and its relation to tail autotomy in lacertid lizards. *J. Zool.* **236**, 83-93.
- Baruš, V. & Oliva, O. (1992a). *Obojživelníci-Amphibia*. Fauna CSFR, vol. 25. Praha: Academia.
- Baruš, V. & Oliva, O. (1992b). *Plazi-Reptilia*. Fauna CSFR, vol. 26. Praha: Academia.
- Bauer, A.M. (1990). Gekkonid lizards as prey of invertebrates and predators of vertebrates. *Herpetological Review* **21**, 83-87.
- Bauwens, D. (1981). Survivorship during hibernation in the european common lizard *Lacerta vivipara*. *COPEIA* **3**, 741-744.
- Bauwens, D. & Thoen, Ch. (1981). Escape tactics and vulnerability to predation associated with reproduction in the lizard *Lacerta vivipara*. *Journal of Animal Ecology* **50**, 733-743.
- Blondheim, S. & Werner, Y.L. (1989). Lizard predation by the widow spiders *Latrodectus pallidus* and *L. revivensis* (Theridiidae). *British Herpetological Society Bulletin* **30**, 26-27.
- Brown, F.C. (1957). Notes on Slow-worm. *Brit. J. Herpetol.* **2**, 95.
- Castanet, J. (1994). Age Estimation and Longevity in Reptiles. *Gerontology* **40**, 174-192.
- Chater, A.O. (1965). Song Thrush taking lizard. *British Birds* **58**, 501.
- Ciampalini, B. & Lovari, S. (1985). Food habits and trophic niche overlap of the Badger (*Meles meles* L.) and the Red Fox (*Vulpes vulpes* L.) in a Mediterranean coastal area. *Z. Säugetierk* **50**, 226-234.
- Cramp S. (1982a). *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic*, Volume I: *Ostrich to Ducks*. Oxford: Oxford Univ. Press.

- Cramp, S. (1982b). *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic*, Volume II; Hawks to Bustards. Oxford: Oxford Univ. Press.
- Cramp, S. (1984). *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic*, Volume III: Waders to Gulls. Oxford: Oxford Univ. Press.
- Cramp, S. (1985). *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic*, Volume IV: Terns to Woodpeckers. Oxford: Oxford Univ. Press.
- Cramp, S. (1988). *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic*, Volume V: Tyrant Flycatchers to Thrushes. Oxford: Oxford Univ. Press.
- Cramp, S. (1993). *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic*, Volume VII: Flycatchers to Shrikes. Oxford: Oxford Univ. Press.
- Cramp, S. (1994). *Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic*, volume VIII: Crows to Finches. Oxford: Oxford Univ. Press.
- Czarnecki, Z. & Foksowicz, T. (1954). Observations on the composition of the food of Buzzard. *Ekologia Polska* 2, 477-484.
- Damme, R., Bauwens, D. & Verheyen R.F. (1989). Effect of Relative Clutch Mass on Sprint Speed in the Lizard *Lacerta vivipara*. *Journal of Herpetology*, 23, 459-461.
- Delibes, M. (1978). Feeding habits of the stone marten, *Martes foina* Erxleben, 1777 in northern Burgos, Spain. *Z. Säugetierk.* 43, 282-288.
- Dely, O. (1981). *Anguis fragilis* Linnaeus 1758 – Blindschleiche. - In *Handbuch der Reptilien und Amphibien Europas*, Echsen I, 241-258. Böhme W. (Eds). Wiesbaden: Aula.
- Dementev, G.P., Kartašev, N.N. & Soldatova, A.N. (1953). Die Ernährung und praktische Bedeutung einiger Raubvögel in Süd-West-Turkmenien.
- Doncaster, C.P., Dickman, C.R. & Macdonald, D.W. (1990). Feeding ecology of red foxes (*Vulpes vulpes*) in the city of Oxford, England. *J. Mammal.* 71, 188-194.
- Dyreux, A., Grabiński, W., Stawarczyk, T. & Witkowski J. (1991). *Ptaki Śląska*. Wrocław: Uniwersytet Wrocławski.
- Eigelis, J.K. (1964). Feeding habits and economic importance of the magpie (*Pica pica* L.) in deciduous and pine stands of the steppe and forest-steppe of the european part of USSR. *Zool. Z. (Zoologiczeskij Zurnal)* 43, 1517-1529.
- Fruziński, B. (1964). Szkic monograficzny lownych gatunków z rodziny lasicowatych (Mustelidae). Czesc II, rodzaje: lasica (*Mustela*) i wydra (*Lutra*). Zachodni Poradnik Lowiecki 5, 17-26.
- Garzon Heydt, J. (1974). Contribution al Estudio del Status, Alimentacion y Proteccion de la Falconiformes en Espana Central. *Ardeola* 19, 279-330.
- Glandt, D. (1988). Populationsdynamik und Reproduktion experimentell angesiedelter Zauneidechsen (*Lacerta agilis*) und Waldeidechsen (*Lacerta vivipara*). In: Biologie und Schutz der Zauneidechse (*Lacerta agilis*), 167-177. Glandt, D. & Bischoff, W. (Eds.). Bonn: *Mertensiella* 1.
- Glutz von Blotzheim, U.N. (1971). *Handbuch der Vogel Mitteleuropas* 4. Frankfurt a. Main: Frankfurt Akad. Verlagsges.
- Goszczyński, J. (1974). Studies on the food of foxes. *Acta theriol.* 19, 1-18.
- Goszczyński, J. (1976). Composition of the food of martens. *Acta theriol.* 21, 527-534.
- Goszczyński, J. (1986). Diet of foxes and martens in Central Poland. *Acta theriol.* 31.
- Gramentz, D. (1995). Zur Mobilität und Antiprädationstrategie von *Lacerta agilis* LINNAEUS, 1758 (*Reptilia: Squamata: Lacertidae*). *Zool. Abh. Mus. Tierkd. Dresden* 48/16, 279-292.



- Grenot, C. (1994). The natural supercooling of the european lizard, *Lacerta vivipara*. V Symposium on Cold Hardiness in Animals and Plants – Arnhem, The Netherlands 1993. *Cryo-Letters* 15, 12-13.
- Grönlund, S.J., Itämies, J. & Mikkola, H. (1970). On the food and feeding habits of the great grey shrike *Lanius excubitor* in Finland. *Ornis fennica* 47, 167-171.
- Günther R., Völkl W. (1996). Waldeidechse – *Lacerta vivipara*. In *Die Amphibien und Reptilien Deutschlands*, 588-600. Günther, R. (Eds). Jena: Gustav Fischer Verlag.
- Haber, A. (1969). *Dzik*. Warszawa: PWRiL.
- Heath, P.J. (1988). Robin attacking common lizard. *British Birds* 81, 238.
- Heulin, B. (1985). Densité et organisation spatiale des populations du lézard vivipare *Lacerta vivipara* (Jacquin 1787) dans les landes de la région de Paimpont. *Bull. Ecol.* 16, 177-186.
- Jaksić, F., M. & Fuentes, E.R. (1980). Correlates of tail losses in twelve species of *Liolaemus* lizards. *J. Herp.* 14, 137-141.
- Jaksić, F., M. & Greene H.W. (1984). Empirical evidence of non-correlation between tail loss frequency and predation intensity in lizards. *Oikos* 42, 407-411.
- Jaksić, F., M. & Nunez H. (1979). Escaping behaviour and morphological correlates in two *Liolaemus* species of Central Chile (*Lacertilia: Iguanidae*). *Oecologia* (Berlin) 42, 119-122.
- Jehle, R., Franz, A., Kapfer, M., Schramm, H. & Tunner H.G. (1996). Lizards as prey of arthropods: Praying Mantis *Mantis religiosa* (LINNAEUS, 1758) feeds on juvenile Sand Lizard *Lacerta agilis* LINNAEUS, 1758. *Herpetozoa* 9, 157-159.
- Juszczak, W. (1987). *Plazy i gady krajowe. część II – Amphibia*. Warszawa: PWN.
- Kabisch, K. (1974). *Die Ringelnatter, Natrix natrix* (L.). Wittenberg-Lutherstadt: Ziemsen.
- Kabisch, K. & Belter, H. (1968). Verzehren von Amphibien un Reptilien durch Vögel. *Zool. Abh. Mus. Tier, Dresden* 29, 191-226.
- Kochan, W. (1979). Materialy do skladu pokarmu ptaków drapieżnych i sów. *Acta zool. Cracov.* 23, 213-146.
- Koenig, A. (1890). Ornithologische Forschungsergebnisse einer Reise nach Madeira und den cancarischen Inseln. *Journal für Ornithologie* 191-192(38), 257-488.
- Kornacker, P.M. (1993). Populationsökologische Untersuchungen an einer Bahndamm-Population von *Lacerta vivivpara* im Rheinland. *Salamandra* 29, 97-118.
- Kratzer, H. (1974). Beobachtungen über den Nahrungserwerb bei der Milos-Ringelnatter (*Natrix natrix schweizeri*). *Salamandra* 10, 49-54.
- Lockie, J.D. (1961). The food of the pine marten *Martes martes* in West Ross-shire, Scotland. *Proc.Zool.Soc.Lond.* 136, 187-195.
- McCormick, S. & Polis, G.A. (1982). Arthropods that prey on vertebrates, *Biol.Rev.* 57, 29-58.
- Middelburg, J.J.M. & Strijbosch, H. (1988). The reliability of the toe-clipping method with the common lizard (*Lacerta vivipara*). *Herpetological Journal* 1, 291-293.
- Ortlieb, R. (1963). Über die Brutbiologie des Turmfalken. *Die Falke* 10, 39-42.
- Osenegg, K. (1995). Untersuchungen zum Spektrum der Freßfeinde der Waldeidechse, *Lacerta vivipara* im Südwesten Frankreichs. *Die Eidechse* 6/14, 6-16.
- Petzold, H.-G. (1995). *Blindschleiche und Scheltopusik. Die Familie Anguidae*. Westarp Wissenschaften, Magdeburg.
- Piechocki, R. (1952). Beobachtungen zur Brutbiologie des Turmfalken (*Falco tinnunculus* L.). *Orn. Mitt.* 4, 25-33.
- Pilorge, T. & Castanet, J. (1981). Détermination de l'âge dans une population naturelle du lézard vivipare (*Lacerta vivipara*, Jacquin 1758). *Acta Oecol. Gen.* 2, 3-16.
- Pisarenko, S.S. & Ušakov, V.A. (1985). Rasprostranennost i formy kanibalizma u bezchvostnych. *Voprosy gerpelogii*, Leningrad 6, 165-166.

- Radek, G. (1964). Zur Ernährung der Blindschleiche. *Aquarien Terrarien Zeitschrift*. Stuttgart, 17, 317-318.
- Reeve, N. (1994). *Hedgehogs*. London: T. & A.D. Poyser.
- Rzebik-Kowalska, B. (1972). Badania nad pokarmem ssaków drapieżnych. *Acta zool. Cracov.* 17, 416-504.
- Schoener, T.W. (1979). Inferring the properties of predation and other injury-producing agents from injury frequencies. *Ecology* 60, 1110-1115.
- Schwammer, H. & Baurecht, D. (1988). Der Karstläufer, *Podarcis melisellensis fiumana* (Werner, 1891), als Beute der Europäischen Schwarzen Witwe, *Latrodectus mactans tredecimguttatus* (Rossi, 1970). *Herpetozoa* 1, 73-76.
- Serafini P. & Lovari S. (1993). Food habits and trophic niche overlap of the red fox and the stone marten in a Mediterranean rural area. *Acta theriol.* 18, 233-244.
- Serafiński, W. (1956). *Jeze*. Warszawa: PWN.
- Strijbosch, H. & Creemers, R.C.M. (1988). Comparative demography of sympatric populations of *Lacerta vivipara* and *Lacerta agilis*. *Oecologia* 76, 20-26.
- Sumiński, P., Goszczyński, J. & Romanowski, J. (1993). *Ssaki drapieżne Europy*. Warszawa: PWRiL.
- Szczepankiewicz, S. (1972). Nizina Śląska, In *Geomorfologia Polski*, 224-239, t. 2.
- Szczepankiewicz, S. (1989). Ziemie południowo-zachodniej Polski – morfogeneza i dzieje czwartorzędowe. *Studia Geograficzne* 48, *Acta Universitatis Wratislaviensis* No 1029, Wrocław.
- Szjij, J. (1956/7). Adatok A Fehérgolya (*Ciconia c. ciconia* L.) Táplálkozabiológiájához. *Aquila* 9/62, 83-94.
- Truskowski, J. (1976). Role of the Common Buzzard (*Buteo Buteo* L.) in Agrocenosis of the Middle Wielkopolska. *Polish Ecological Studies* 2, 101-108.
- Walczak, W. (1970). *Obszar przedsudecki*. Warszawa: PWN.
- Wendland, V. (1963). Fünfjährige Beobachtungen an einer Population des Waldkauzes (*Strix aluco*) im Berliner Grunewald. *Journal für Ornithologie* 104, 46-50.