HABITAT SELECTION OF LACERTA VIVIPARA IN A LOWLAND ENVIRONMENT

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ABSTRACT

The habitat selection of *Lacerta vivipara* was studied in an area of inland dunes by comparing the relative occurrence of individuals with the relative presence of a number of potential habitats. Habitats with a strong spatial heterogeneity were clearly preferred, no matter whether they were humid or dry. The microhabitat of this lizard was always there where good possibilities for thermoregulatory behaviour were present within a very limited area. No differences in habitat selection were found for the age classes and sexes.

INTRODUCTION

Lacerta vivipara has an enormous distribution area which stretches from nothern Spain and the Balkan peninsula to Arctic Scandinavia and from Ireland to the Pacific coast of Siberia. Many authors have already said something of the habitat selection by this animal. In general only macrohabitat selection is mentioned, however. In the southern parts of the area this species seems mainly montane, having a strong preference for humid or even wet habitats (e.g. Palaus, 1974; Andrada, 1980; Salvador, 1985; Livet & Bons, 1981; Bruno & Maugeri, 1976; Radovanović, 1964). In more northern regions this species also occurs in lowlands and there is can be found in a very wide range of habitats, from very humid to rather dry and from very open places to densely grown woods (e.g. Smith, 1973; Arnold, Burton & Ovenden, 1978; Street, 1979; van de Bund, 1964; Bergmans & Zuiderwijk, 1986; Frommhold, 1959; Blab, 1980; Nikol'skii, 1963: Terent'ev, 1965). Only few authors describe the habitats to such extent that conclusions about microhabitat can be drawn (Castroviejo, Castroviejo & Salvador, 1970; Glandt, 1976; Parent, 1979, 1984; Haslewood, 1981; Pilorge & Xavier, 1981; Heulin, 1985). The overall conclusion that can be drawn from these descriptions is that *L. vivipara* prefers the drier spots in humid environments, the more open spots in densely vegetated regions and the more shady spots in open habitats.

In the years 1976-1981 we studied *L. vivipara* in a lowland environment near Nijmegen in the Netherlands. It is the only lizard species occurring there, precluding interference from other lizards.

STUDY AREA

This study was made in the reserve 'Overasseltse & Hatertse Vennen' at 5° 48' E.Long., 51° 48' N.Lat. in the Netherlands. The reserve is part of the ridge of inland dunes on the eastern and north-eastern Maas border (cf. Strijbosch, 1982). About $\frac{2}{3}$ of this reserve

consist of woodland. The original forest type was oakbirch wood, but since the beginning of this century nearly 90 per cent of this forest type has been replaced by pine plantations. The remainder of the area consists of more open habitats: dry heathlands with some patches of open drift sand, humid heathlands with a great number of moorland pools and finally also cultivated lands. These are mainly grasslands but locally there are also arable fields." The pools in the cultivated part are eutrophic. In order to carry out the study described here we selected an area of 12 ha in which all macrohabitats of this region were represented viz.: some undisturbed small moorland pools, one eutrophic pool, a patch of peat-bog, some small deciduous woods and coppice strips, pine woods, some dry dune tops, dry and humid grasslands, fields and even a farmstead and its yard.

METHODS

During the years of study the study area was visited by one or two persons on nearly every day on which lizard activity might be expected. When visiting we tried to search all parts of the area with equal intensity. The lizards found were divided into three age classes viz.: juveniles (born in the running calendar year), subadults (born in the previous calendar year) and adults (at least in their third season). The adults were subdivided into $\delta\delta$ and QQ. Every observation spot was accurately noted by means of coordinates (accuracy I metre). A vegetation map of the total study area was made (scale 1:500), on which 12 macrohabitats were distinguished. Maps 1:200 were drawn of five parts of this area in which lizards proved to occur in greater densities. These maps show trees, shrubs, bigger plants and other structures individually. By plotting the first 3500 sightings on the 1:500 map we established the macrohabitat selection. Now two types of macrohabitat proved to be highly preferred and we investigated the microhabitat selection in these two types with the help of the 1:200 maps, by plotting the first 1500 sightings of



TABLE 1: Macrohabitat selection of *Lacerta vivipara* in an area of inland dunes (area = 12 ha, sightings = 3500). a = high and dense pine plantations. b = border zones of oligotrophic moorland pools. c = peat bog and floating *Sphagnum* mats. d = open water. e = border zones of eutrophic pools. f = *Salix* and *Alnus* coppice. g = pastures. h = roads, paths and farm yards. i = arable fields. j = deciduous forest and coppice strips. k = open, dry grasslands and abandoned fields. l = dune tops with open, dry grassland, heather, broom and isolated small trees.

each. We now calculated the total area of all the various habitats. For isolated trees or shrubs we took as area the vertical projection of their foliage circumference. As a standard of preference for a certain habitat (habitat preference = HP) we used the quotient of the relative part of the sightings within that habitat and the relative area of that habitat, in the

formula:
$$HP_1 = \frac{\% \text{ sightings in } H^1}{\% \text{ area of } H_1}$$

RESULTS

Table 1 shows a survey of the macrohabitat selection. The high, dense pine woods, the corn fields and the open water are clearly totally avoided. The intensely trodden pastures are hardly selected. It is striking that those habitats that are neither very dense nor very open are preferred. They may be rather humid or even wet or rather dry. The common characteristic of these macrohabitats is that they have a great variation within a limited distance in open and closed spots (spatial heterogeneity). The habitats that are not or scarcely used are sometimes traversed during migrations, even the open water. This could be established by marking the animals after capture and we found once that one lizard, marked on a bog island in a pool, was recaptured some days later on the pool border. Thus it also appeared that some individuals traversed pastures. These migrations apparently happen in such a short time span that the chance of sighting the animal during such a migration is very slight.

Table 2 gives a survey of the microhabitat selection within the macrohabitat 'border zone of moorland pools'. It should be borne in mind, when considering the diagrams of the tables, that the order of microhabitats does not necessarily reflect their real distribution on the ground; in reality they are often intermingled. Open patches of *Molinia caerulea* which are not regularly inundated are distinctly preferred, especially if isolated trees are present. Then the birches are clearly preferred to the pine trees.



TABLE 2: Microhabitat selection of *Lacerta vivipara* in border zones of oligotrophic moorland pools (area = $6530m^2$, sightings = 1500). a = open water. b = border zone vegetation, always inundated (mainly *Phragmites*). c = border zone vegetation, frequently inundated (mainly *Juncus effusus*). d = open willow groves (*Salix cinerea*). e = open *Molinia-Sphagnum* vegetation, frequently inundated. f = dense *Molinia* vegetation, rarely inundated. g = open *Molinia* vegetation with *Erica tetralix, Andromeda polifolia* and *Oxycoccus palustris*. h = isolated, small *Pinus sylvestris* in *Molinia* vegetation. i = isolated, small *Betula* trees in open *Molinia-Erica* vegetation.

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5.7	9.4	0.5	1.4	2.4	1.4	3.1	7.2	4.8	56.1	6.2	1.
65	204	15	62	118	77	70	467	124	277	21	
4.3	13.6	1.0	4.1	7.9	5.1	4.7	31.1	8.3	18.5	1.4	÷
0.8	1.5	2.0	29	3.3	3.6	1.5	4.3	1.7	03	0.2	0

TABLE 3: Microhabitat selection of *Lacerta vivipara* on dry dune tops (area = $5450m^2$, sightings = 1500). a = groves of *Prunus spinosa* and/or *Robinia pseudo-acacia* (only present at the border zones of this macrohabitat). b = isolated, small *Quercus* trees. c = isolated, small *Pinus* trees. d = isolated, small *Betula* trees. e = isolated *Frangula alnus* shrubs. f = tree stumps and faggots. g = dense *Rubus* shrubs. h = open broom bushes (*Sarothamnus scoparius*). i = heather (*Calluna vulgaris*). j = closed, dry grassland of *Deschampsia flexuosa*. k = open, dry glassland of *Festuca ovina* and/or *Agrostis tenuis*. I = bare drift sand and open *Corynephorus* vegetation.

Table 3 gives a survey of the microhabitat selection within the open dune tops. In this macrohabitat the lizards show a more marked preference for shrubs (broom, alder buckthorn) than for isolated trees. The spots with old tree stumps and faggots score very highly as well. The difference between birch and pine trees is less marked than in the wetter border zones of moorland pools. The oaks score markedly lower than the other trees and the bramble bushes lower than the other shrubs. The dense combination of trees and shrubs in the *Robinia/Prunus* groves scores even lower.

m² % n % HP

Table 4 shows a survey of the correlation in habitat selection by the various age classes and the sexes. It is clear that the habitat selection by all groups is highly positively correlated.

DISCUSSION

All macrohabitats of Table 1, except the open water, are mentioned in literature as habitats of L. vivipara. The relative preference for the various habitats, however, shows marked and great differences. As far as humidity is concerned it appears that very humid as well as pronouncedly dry places are chosen, although the more humid places seem to house more animals. Those habitats that are structurally very uniform are more or less or even totally avoided, no matter whether they are either completely closed or completely open. A positive reaction to habitats with a greater structural diversity has been proved to exist for more lizard species (Pianka, 1967; Allen, 1977). Thus a tree in an open habitat provides a gradient in sun and shade, which is of great importance for an ectothermic animal as L. vivipara. For an organism of such small proportions a big Molinia tussock may also serve this

purpose. Besides this thermoregulatory advantage such structures mostly offer a good refuge for flight, too (antipredation function). Moreover the potential number and variety of prey species will be greater in a microhabitat with a greater diversity.

The differences in preference for certain tree and shrub species in Tables 2 and 3 can be explained by their very form. Thus the sun/shade gradient near a small pine tree with its low-hanging branches among high Molinia tussocks will be much shorter and more sudden than under a birch tree in the same environment. The small oaks growing on the dry dune tops (Table 3) are always more or less bulbous, i.e. the lower branches nearly always touch the surface. Therefore the area projected by their foliage circumference on the surface is mainly fully shaded, not allowing any of the other vegetation types which are present under most other trees and shrubs. Near and under the little pine trees there is a good sun/shade gradient on account of the absence of the tall Molinia tussocks as in the habitat of Table 2. The sun/shade gradient in the dry habitat of the dune tops is always better developed near the lower shrub groups, often comprising more individuals, than near the trees, where the sun often reaches the trunk foot.

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A	0.97	0.96	0.82	0.93	0.73	0.86
1	0.97	0.90	0.86	0.92	0.77*	0.80
11	0.79	0.97	0.67*	0.74	0.55*	0.62*

TABLE 4: Correlation between the habitat selection by juveniles, subadults and adult males and females (Spearman rank corr. test; x = P < .05, in all other cases P < .01). A = macrohabitat selection. I = microhabitat selection in border zones of oligotrophic moorland pools. II = microhabitat selection in dune tops.

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BROODING IN THE MALAYAN PIT VIPER, CALLOSELASMA RHODOSTOMA: TEMPERATURE, RELATIVE HUMIDITY, AND DEFENSIVE BEHAVIOUR

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ABSTRACT

A female Malayan pit viper (*Calloselasma rhodostoma*) laid a clutch of 27 eggs and remained coiled atop them until hatching. Possible functions of brooding were evaluated; these include regulation of temperature, regulation of moisture, and protection. The brooding female was not found to regulate the clutch's temperature but was found to vary the degree of egg exposure in accordance with fluctuations in the level of relative humidity. Body-jerking movements could be elicited in the female while she was brooding but not while she was off the nest. Body-jerking was elicited by prodding with an inanimate object as well as from a conspecific, and it is felt that this behaviour could function to ward off a potential predator.