Spatial organization of scincid lizards in Santubong Peninsula, Sarawak, Borneo

Wolfgang Denzer
Department of Chemistry, Univ. of Nottingham, Nottingham NG7 2RD, United Kingdom
and
Charlottenburger Ufer 16, 10587 Berlin, Germany

ABSTRACT

This paper deals with the spatial organization within an assemblage of seven sympatric skinks from Borneo. The spatial segregation in different habitats as well as possible responses to potential competition of syntopic species is reported. Results from earlier reports are briefly discussed.

Keywords: Reptilia, Scincidae, spatial organization, Sarawak, Borneo

INTRODUCTION

Generally, herpetofaunal assemblages are not uniformly distributed in space, i.e. one can find terrestrial, arboreal or semiaquatic species with more or less restricted habitat requirements. The preference of any species to stay in a particular type of habitat was defined by Heatwole *et al* (1977, 1987) as "habitat selection". The selection may depend on structural attributes and microclimate. Within a preferred habitat, the use of particular spaces may be limited by syntopic species which may prefer the same structural microhabitats. This competition for space is often compensated by different temperature responses, changes in the main activity period or the use of different food resources by one of the coexisting species.

STUDY AREA AND METHODS

The Santubong Peninsula is situated about 30 km north of Kuching in the southwestern part of Sarawak. It covers an area of about 20 sq. km with its highest elevation of about 810 m a.s.l. in Gunung Santubong. In any coastal part in Malaysia, this part of Sarawak has the highest annual total rainfall of 4500 mm. In Santubong Peninsula, five zonations can clearly be distinguished: tidal, coastal and open plains, heath forest, evergreen rainforest, and submontane vegetation on limestone. Small streams are embedded in all types of zones with the bigger ones running to the sea.

Earlier herpetological studies (Shelford, 1901; de Rooij, 1915; Smith, 1925) concentrated mainly on the species account and did not mention data

on the ecology of reptiles. During two field trips to G. Santubong in February 1991 and March 1992, the niche partitioning especially the spatial organization of common scincid lizards was qualitatively studied. Therefore, individuals of each species were caught and taxonomically classified according to literature (de Rooij, 1915; Inger and Hosmer, 1965; Greer, 1970). The relative abundance of a species was determined by crossing certain areas from the sea to the rainforest twice a day at different times and recording the sightings of a species in a particular habitat.

RESULTS

Sympatric populations of seven common scincid species belonging to six genera were observed in Santubong Peninsula. For each zone from the sea to the evergreen rainforest, all observed species were listed and relevant ecological data were noted. Since only limited field work was done in the submontane zone, this part is excluded from the discussion.

Tidal zone

This zone consists mainly of rocks in the sea and some stony beach. Only a few mangrove trees are present in a small bay. This kind of habitat is preferred by *Emoia atrocostata*, a species known from tidal zones around the Indoaustralian Archipelago. This diurnal species with its main activity period in the middle of the day hunts for small crabs and sometimes for young mudskippers (Periophthalmidae) (Hediger, 1934). During high tide, *E. atrocostata* can sometimes be observed swimming in the sea to reach the next rock. McCoy (1980) reported individuals entering tidepools in search of food (Crustacea and fishes) and remaining under water for several minutes (s. a. Brown, 1991). In areas closer to the shoreline and adjacent to brackish water, the species shares its habitat with the crab-eating frog *Limnonectes cancrivora*. This apparent competition for food is compensated by the use of different hunting grounds, i.e. the skink shows another temperature and light response (hunting on sun exposed rocks) and *L. cancrivora* seems to prefer more shaded places between the rocks where small pools are available.

Coastal zone and open plains

This area consists of the remote beach areas with palms and pines as well as inland open grassland with secondary growth. Near the beach some individuals of *E. atrocostata* could still be encountered but most often the terrestrial *Mabuya multifasciata* and the arboreal *Apterygodon vittata* were observed. *M. multifasciata* is a common skink of the Southeast Asian region and often associated with man. On sunny days, it can be observed on the ground hunting for insects. Sometimes, pairs are seen together but males show strong intraspecific territorial behavior. The sun exposed trees in the coastal region are inhabited by *A. vittata*, an endemic species of Borneo. One tree provides space to a pair and some juveniles. Males also show an aggressive intraspecific territorial behavior. Subadult males can often be found with regenerated parts of the tail which were lost due to bitings of adult males. The main activity period is in the middle of the day but individuals can also be found in the early morning and late afternoon lying on sun exposed branches for warming up. This arboreal habitat is shared only with the much larger agamid lizard *Bronchocela cristatella*. Potential competition between these two species is low because *B. cristatella* also lives in bushes and presumably prefers prey of a different size due to its bigger size.

Heath forest

This type of lowland forest consists mainly of tall trees with small leaves in a dense stand. The main canopy is below 10 m but large dipterocarps

can also be found. The streams running to heath forests show a dark brown color due to huge amount of organic material. The terrestrial niche is still occupied by *M. multifasciata* but this species is more and more replaced by its congener *M. rudis*, a common species of the Sondaic region. *M. rudis* is often found sunbathing on clearings but it is also found on rocks in and along streams where it hunts for insects. The trees are inhabited by *Dasia grisea*, a large species from the Malay Peninsula, Sumatra and Borneo. The main activity period of this species seems to be in the middle of the day. During inactive phases and after heavy disturbances, they hide in tree holes or under barks. They share this habitat with the larger agamid lizard *Gonocephalus liogaster* and flying lizards of the genus *Draco*. The niche partitioning of the two agamids and *D. grisea* results from the use of different food resources and contrasting behavior. The flying lizards of the genus *Draco* are predominantly anteaters and *G. liogaster* is mainly a sit-and-wait predator whereas *D. grisea* is actively seeking and foreaging for prey. A third scincid species sometimes found in and along streams is the semiaquatic *Tropidophorus beccarri* but its population density increases towards the primary forest.

Evergreen rainforest

This forest type consists predominantly of dipterocarp tree species in high diversity. The canopy is mostly dense and about 40 m high with clear streams running through the forest. The terrestrial niche is still occupied by *M. rudis* but the semiaquatic *Tropidophorus beccarii*, a species endemic to Borneos lowland forests is found near streams. The main activity peaks in the late morning hours when the habitat is still partly shaded. At this time, they hunt for insects on rocks in the streams; they have even been observed hunting for tadpoles and small fishes, respectively. When disturbed, they jump into the water and try to hide under stones or even dive for sometime. During inactive periods, they stay in hollows and abandoned burrows of mammals next to the running waters. The arboreal niche is occupied by *Sphenomorphus cyanolaemus*, a skink also endemic in Borneo. This species seems to prefer trees with rough barks where they can be observed at a height of 2-5 m. They share the inhabited trees with the gekkonid *Cnemaspis kendalli* which seems to prefer the lower parts of the trees especially the tree buttresses. As activity of both species peaks in the early morning and late afternoon hours, there may even be an additional niche separation concerning food resources. Presumably, the canopy is again inhabited by *A. vittata*. This assumption is supported by observations made by Bacon (Greer, 1970) that it is the most abundant species occurring in the canopy.

DISCUSSION

A summary of the presented results is depicted in Figure 1.

As can be derived from the scheme, only little spatial overlap occurs among scincid lizards. There is no overlap in the arboreal niche. Where an overlap in the terrestrial niche occurs, the population density of the syntopic species must be considered. In the heath forest, the two congeners *M. multifasciata* and *M. rudis* are co-occurring. The number of sightings made for each of these species implies that the population density of *M. multifasciata* decreases towards the evergreen rainforest whereas that of *M. rudis* increases. In places where the semiaquatic *T. beccarii* is abundant, *M. rudis* apparently prefers habitats away from streams. *S. cyanolaemus* and *A. vittata* may overlap in the arboreal niche but observations imply a spatial segregation if the same trees are inhabited, i.e. *S. cyanolaemus* is found in the lower parts whereas *A. vittata* may inhabit the canopy.

One interesting point is the high population density of *A. vittata* in the coastal region. In most

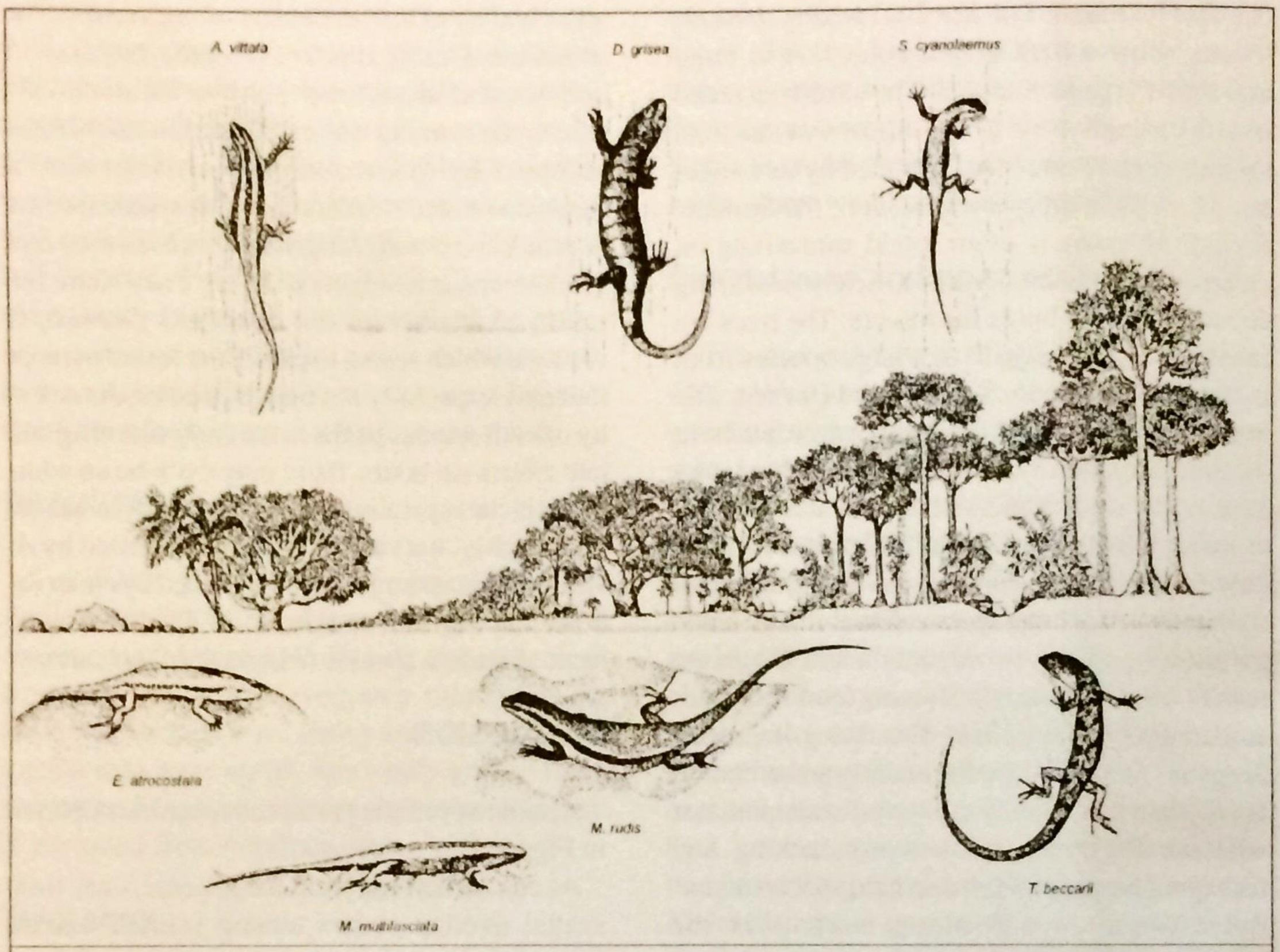

Figure 1. Schematic diagram of the spatial organization of seven scincid lizards in Santubong Peninsula, Borneo.

parts of Southeast Asia, trees near the coast are inhabited by *Dasia olivacea*. Interestingly, this species has not been found during the presented studies and an unoccupied niche is available. Due to its ecological adaptation to many sun exposed places, *A. vittata* uses this advantage to fill the gap.

Since the presented results were gathered only during the months of February and March, further field studies should determine whether the scincid lizards assemblage underlies seasonal changes.

As compared to other regions, similar results for seven sympatric Australian skinks (i.e. strict spatial segregation among those skinks) were reported by Pengilley (1972). He showed that the amount of time spent on the ground differs within this set of species. Four species showed more terrestrial preference and the remaining species were semiarboreal but all species preferred different microhabitats. For two Bornean skinks *(Sphenomorphus sabanus* and *Mabuya rudis),* different temperature responses, scarce activity period overlap and different food preferences were reported in places of co-occurrence (Inger, 1959).

ACKNOWLEDGMENT

The author would like to thank Mr. Rolito Dumalag of the ViSCA-GTZ Tropical Ecology Program for providing ink drawings of the mentioned species according to his photographs.

BIBLIOGRAPHY

BROWN, W.C. (1991)
Lizards of the genus *Emoia* (Scincidae) with observations on their evolution and biogeography. Mem. Calif. Acad. Sci., San Francisco, 15: 1-94.

BULLOCK, J.A. (1966)
The food of amphibians and reptiles. In: Observations on the fauna of Pulau Tioman and Pulau Tulai. Bull. Nat. Mus. Singapore 34: 85-96.

GREER, A.E. (1970)
The relationship of the skinks referred to the genus *Dasia*. Brevoria 348: 1-30.

HEATWOLE, H.F. (1977)
Habitat selection in reptiles. In: Biology of the Reptilia. Vol. 7, pp. 137-155, C. Gans & D. W. Tinkle (eds.)

HEATWOLE, H.F. and J. TAYLOR (1987)
Ecology of reptiles. Surrey Beatty & Sons Pty. Ltd., Chipping Norton, NSW 18: 325.

HEDIGER, H. (1934)
Beitrag zur Herpetologie und Zoogeographie Neu-Britanniens und einiger umliegender Gebiete. Zool. Jb., Jena, 65: 441-582.

INGER, R.F. (1959)
Temperature responses and ecological relations of two Bornean lizards. Ecology 40: 127-136.

INGER, R.F. and W. HOSMER (1965)
New species of scincid lizards of the genus *Sphenomorphus* from Sarawak. Israel J. Zool 14: 134-140.

MCCOY, M. (1980)
Reptiles of the Solomon islands. Wau Ecology Inst., Handbook No. 7, 6: 80.

PENGILLEY, R. (1972)
Systematic relationships and ecology of some lygosomine lizards from southeastern Australia. Ph.D. thesis, Australian National University, Canberra.

ROOIJ, N. DE. (1915)
The reptiles of the Indo-Australian archipelago. I. Lacertilia, Chelonia, Emydosauria. E.J. Brill Ltd., Leiden 14: 384.

SHELFORD, R. (1901)
A list of the reptiles of Borneo. J. Str. Br. Roy. As. Soc., Singapore 35: 43-68.

SMITH, M.A. (1925)
Contributions to the herpetology of Borneo. Sar. Mus. Journal 8: 15-34.