Vieraea **17**: 171-178
Junio 1987

ISSN 0210-945X

Additions to the ethogram of the lizard *Gallotia galloti* from Tenerife, Canary Islands.

M. MOLINA-BORJA

Lab. Fisiología Animal. Departamento Biología Animal. Facultad de Biología. Universidad de La Laguna. 38271 La Laguna. Islas Canarias. Spain.

(Aceptado el 17 de Enero de 1987)

MOLINA-BORJA, M., 1987. Additions to the ethogram of the lizard *Gallotia galloti* from Tenerife, Canary Islands. *Vieraea* 17: 171-178

ABSTRACT: From the study of behaviour of the lizard Gallotia galloti in a natural population of the Northwest of Tenerife (Canary Islands) some behaviour patterns, which had not been previously discovered could be described in detail. The lizards were observed through binoculars from a hide during several days per week of April, May and June. The actual sequence of behaviour patterns was verbally recorded on a microcasette and those that were discovered for the first time were carefully described using the "by consequence" criterion and considering behaviour as a series of discrete events. The presently described behaviour patterns contribute to enlarge the behavioural catalogue of the studied species and some of them are cited as lacertid lizards for the first time. The possible function of the patterns is also discussed.
Key words: Behaviour patterns, ethogram, lizards, Tenerife.

RESUMEN: Se describen en detalle algunas pautas de comportamiento que no habían sido descritas previamente para el lagarto Gallotia galloti y que se observaron cuando se realizaba un estudio de comportamiento en una población natural del Noroeste de Tenerife (Islas Canarias). Los lagartos se observaron a través de binoculares y desde una caseta durante varios días por semana de los meses de abril, mayo y junio. Se registraba verbalmente la secuencia de pautas de comportamiento en un microcasette y aquellas pautas que se descubrieron por primera vez se describieron usando el criterio de "por consecuencia" y considerando el comportamiento como una serie de hechos discretos. Las pautas de conducta que se describen contribuyen a ampliar el catálogo de comportamientos de la especie estudiada y algunas de ellas se citan por primera vez para lagartos lacértidos. Se discute también su posible función.
Palabras clave: Pautas de comportamiento, etograma, lagartos, Tenerife.

INTRODUCTION

The establishment of an ethogram (or catalogue of precisely described behaviour patterns) became a classic and useful way of initiating the behavioural study of any animal species (LORENZ, 1931; TINBERGEN, 1936; EIBL-EIBESFELDT,1953a; ALTMANN, 1962; ALVAREZ, BRAZA & NORZAGARAY, 1975).

Furthermore, the existence of a well established ethogram permits a more precise investigation of the physiology, function and evolution of the different behavioural categories or patterns (TINBERGEN, BROEKHUYSEN, FEEKES, HOUGHTON, KRUUK & SZUK, 1962; TINBERGEN, 1969).

In the case of reptiles, ethological studies have mainly concentrated on iguanid lizards (CARPENTER, 1961,1962,1963,1965,1967; CLARKE, 1965; JENSSEN, 1970, 1975; BERRY, 1974). However, the detailed description of a complete catalogue of behaviour patterns for species of that lizard Family was not made until some years ago for Sceloporus cyanogenys (GREENBERG, 1977a) and Iguana iguana (DISTEL & VEAZEY, 1982). For lacertid lizards, the information is more scarce (KRAMER, 1937; KITZLER, 1941; WEBER, 1957; VERBEEK, 1972) and an initial ethogram for one species (Gallotia galloti) of this Family has only recently been published (MOLINA-BORJA, 1981).

A considerable amount of time (more than 80 hours) was devoted to the observation of lizards in this last study. However, some new behaviour patterns were identified when studying another lizard population in the Northwest of the island of Tenerife (MOLINA-BORJA, 1985). The lizard population studied in the paper of 1981 corresponded to a southern locality.

These new behaviour patterns of the repertoire of Gallotia galloti are therefore described in detail in the present paper.

MATERIAL AND METHODS

A lizard population was studied during different days of the months of April, May and June in the locality of El Rayo, Buenavista (Northwest Tenerife). Specimens referable both to Gallotia galloti galloti (DUMERIL et BIBRON, 1839; BOULENGER, 1920; ARNOLD, 1973) and G. galloti eisentrauti (BISCHOFF, 1982) were present in the zone.

The animals were observed through binoculars (8 x 40) and from a hide situated 5 m away from and 1.5 above an area selected for the study.

The observation hours spanned from 9.00 (7.00 h, solar time) until 13.00 (11.00 h, s.t.) and during two or three days per week of the cited months. A total of 72 hours was dedicated to the lizard observations.

The different behaviour patterns observed to be performed by the individual animals were verbally recorded on a microcasette, using a numerical code previously assigned to them (MOLINA-BORJA & GOMEZ-SOUTULLO, 1984; MOLINA-BORJA, in press). Other details of the behaviour observation methods can be found elsewhere (MOLINA-BORJA, 1985).

To describe the new behaviour patterns discovered, the "by consequence" criterion (HINDE, 1970) was used and behaviour was considered as a series of discrete events (HUNTINGFORD, 1984). Some of the categories listed by CARPENTER (1962) for the description of aggressive displays in the iguanid Sceloporus undulatus were also used when possible.

Several behaviour patterns were filmed with a super-8 camera equipped with a 100-300 mm zoom lens and could therefore be analysed later.

RESULTS AND DISCUSSION

Each of the new behaviour patterns discovered has been tentatively included under a general behaviour category, that is not intended to signify an established function for the pattern.

Within an Exploratory category would be the behaviour pattern:

Head movements on substratum

It was commonly seen when an animal, usually and adult male, walked in its normal daily movements. It mainly consists of short head movements in the sagittal plane, directed to a specific point on the ground and with the nose pointing to it. The animal's body is maintained raised from the ground because the front legs are extended.

On several occasions this pattern was seen to be performed on an excrement of their own species and on a point on the ground where a female had previously been, respectively.

A sequence very similar to the latter was reported for a male of the Hierro giant lizard (G. aff simonyi) in the behaviour short notes given by MACHADO (1985) within a much broader work on the status of that endangered species.

While the function of the cited pattern is not yet clear, a suggestion is that it could contribute to the smelling of specific points from the animal's proximate environment in their daily activities. On other occasions, however, the lizards used the very common "tongue-flicking" that has been previously described as a means of detecting odour particles in the air by squamate reptiles (PORTER, 1972). This last pattern has been reported to be used for: detecting conspecific odours in several iguanid lizards (DE FAZIO, SIMON, MIDDENDORF & ROMANO, 1977; BISSINGER & SIMON, 1979, 1981; SIMON, GRAVELLE, BISSINGER, EISS & RUIBAL, 1981), locating hidden food by the teid Ameiva exsul (NOBLE & KUMPF, 1936) and in social interactions of different members of lizard families (BERRY, 1974; BURGHARDT, 1980).

In Gallotia galloti, "tongue-flicking" has been observed both in the field and in the laboratory (MOLINA-BORJA, 1981) but its precise function is not yet known.

Indeed, smelling through main olfactory pathways has not been studied very much. On the basis of several laboratory experiments, DUVALL (1981) suggested that, for the iguanid Sceloporus occidentalis, this system would be a "quantitative" sensing device for distant substances, while "tongue-flicking" and the Jacobson organ would be used in a more "qualitative" way, discriminating for example specific odours coming from conspecifics. The same author suggested that nasal olfaction could facilitate the triggering of lingual extrusions ("tongue-flicking").

During the behaviour recordings of Gallotia galloti, "Head movements on substratum" was seen to occur only five times in temporal association with "tongue flicking", some of these observations corresponding to a male or a female situated in the vicinity of an individual of the other sex. But more often, each kind of behaviour pattern was observed alone, the first one being sometimes associated with eating patterns and the second one with daily exploratory activities.

The previously cited hypothesis of DUVALL (1981) supporting the earlier suggestion of COWLES & PHELAN (1958) on rattlesnake olfaction, appears not to correspond very well with the observations for G. galloti; if nasal olfaction is a "quantitative distance sensing system" while "tongue-flicking" is a more qualitative and discriminating one: why do males of this species commonly used

only the first pattern when approaching a female? (see the description of "Male head approaching female body" in a posterior paragraph).

Within an Aggression category falls:

Male circling locomotion

Rapid circling locomotions were performed by both males engaging in an aggressive encounter. During the locomotion the lizards were separated by a distance between 30-40 cm. and faced each other keeping and engorged dewlap and a lateral compression of the anterior part of the body; the animals' legs (namely the front legs) are extended and in consequence the body is maintained separated from the ground (see Fig. 1).

After some seconds of performing this locomotion, one of the lizards retreats, usually being pursued by the other. However, on most occasions this pattern was not present since a single performance of dewlap display by one of the males was enough to produce the flight of the other.

The described pattern is very common within different lizard species, having been cited with same or similar characteristics for several iguanids (CARPENTER, 1963; CARPENTER, BADHAM & KIMBLE, 1970; CARPENTER & FERGUSON, 1977) and lacertids (KRAMER, 1937; KITZLER, 1941; VERBEEK, 1972); the last author also discuss the possible evolutionary origins of threat display in Lacerta.

Within a Courting category:

Male head approaching female body

A male approached a female, usually in rest, and directed its nose towards her neck, trunk or tail base. After this short interaction, each animal continued on its way separately.

With characteristics similar to those of the pattern "Head movements on substratum" (see above), its function has been supposed to do with a sort of smelling of the female body and, if so, it could contribute to a "sexual odour discrimination" (see previous discussion for that pattern).

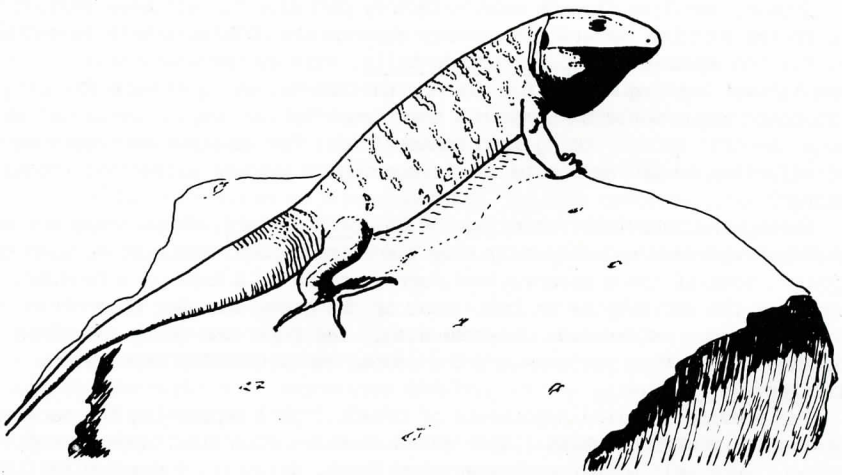

Fig. 1.- Posture displayed by male specimens when engaged in "Male circling locomotion.

Male circling locomotion around female and Up-and-down head movements.

The male performed circling locomotions around a female which kept resting with almost all her body in contact with the ground, her head lowered. While doing the circling locomotion, the male displayed up-and-down head movements (5 to 6), each sequence being repeated with short intervals.

This behaviour pattern has also been described for the subspecies Gallotia galloti palmae (MOLINA-BORJA, 1986a) from La Palma island, although the number of head bobs per sequence (between 3 and 5) could not be precisely determined. BÖHME & BISCHOFF (1976) briefly describe the general characteristics of behaviour patterns preceding mating in several canarian lizards but they did not include any indication of the number of male head bobs.

The same pattern with a varying number of head movements and temporal sequence had been previously reported for several iguanid lizards (JENSSEN, 1970, 1975; CREWS, 1975; STAMPS & BARLOW, 1973; JENSSEN & ROTHBLUM, 1977; JENSSEN & GLADSON, 1984), their careful analysis having led to a better understanding of philogenetic relationships between different species.

Male bite on female skin

The male approached a female, which kept in rest, and bit her neck skin. The times that this pattern was seen, the male soon released the female skin and each animal walked away separately.

This behaviour pattern constitutes one of the first stages of the copulating sequence in lizards and it is intriguing why in the observed interactions it was not followed by the other sequence patterns.

It has also been observed in the sub-species G. galloti eisentrauti (CARNERO personal communication), G. galloti caesaris (MOLINA-BORJA, 1986a) , G. g. gomerae and G. stehlini (BÖHME & BISCHOFF, 1976). However, in other species of lacertids such as Lacerta lepida and in other members of different lizard families the male bit the skin of the female trunk, this having been considered as a characteristic of taxonomic value (see BÖHME & BISCHOFF, 1976; MOLINA-BORJA, in press).

Male dewlap towards female

On several occasions different males were seen to perform a "low intensity" dewlap posture (inflated gorge) when they were near or approaching a female, but in those cases no up-and-down movement of their heads could be detected. This pattern was also seen in a previous field observation in Llano del Moro (El Rosario, Tenerife) (MOLINA-BORJA, 1981) with the same characteristics but accompanied by very short up-and-down head movements.

A tentative hypothesis is that there are different "intensities" for this pattern, ranging from the dewlap alone to same together with broad up-and-down head movements.

The description of the new behaviour patterns given above for the lizard G. galloti (subspecies galloti and eisentrauti) contributes to the establishment of a more complete behavioural repertoire. The whole catalogue established until present comprises approximately 50 different behaviour patterns, which makes this ethogram appear more complex than first suspected, considering the philogenetic antiquity of lacertids.

The function and/or specific place within a sequence of some of the patterns

remains, however, to be elucidated.

A more detailed study of certain components of the Courting sequence such as the up-and-down head movements in the male of G. galloti as well as in other Canarian lizards will surely contribute to a better understanding of their taxonomic interrelations or evolution (MOLINA-BORJA, 1986a), as has been the case for some iguanid species (JENSSEN, 1970, 1975, 1977; JENSSEN & GLADSON,1984).

It is hoped that this ethogram will contribute to enlarge the comparative view of the behaviour of lacertid lizards and the ways in which this behaviour helps to explain the adaptations of the animals to the different habitats and niches in which they live.

ACKNOWLEDGEMENTS

To Mr. Nicolás González and Mrs. Matilde García-Estrada, owners of the domain where the study was made. To my wife M. Prunell for her continuous cooperation and to Pauline Agnew for revising the English. A. Martin is also thanked for providing the original photograph.

REFERENCES

ALTMANN, S.A., 1962. A field study of the sociobiology of rhesus monkeys, Macaca mulata. Ann. N.Y. Acad. Sci. 102: 338-435.

ALVAREZ, F., F. BRAZA & A. NORZAGARAY, 1975. Etograma cuantificado del gamo (Dama dama) en libertad. Doñana Act. Vert. 2: 93-142.

ARNOLD, D.E.N., 1973. Relationships of the Paleartic lizards assigned to the genera Lacerta, Algyroides and Psammodromus (Reptilia: Lacertidae). Bull. Brit. Mus. (Nat. Hist.) Zool. 25(8): 289-366.

BERRY, K.H., 1974. The ecology and social behavior of the chuckwalla, Sauromalus obesus obesus, Baird. University of California Publications in Zoology, vol. 101, pp. 1-44. University of California Press. Berkeley.

BISCHOFF, W., 1982. Die innerartliche Gliederung von Gallotia galloti (Duméril et Bibron 1839)(Reptilia: Sauria: Lacertidae) auff Teneriffa, Kanarische Inseln. Bonn. zool. Beitr. 33(2-4): 363-382.

BISSINGER, B.E. & C.A. SIMON, 1979. Comparison of tongue extrusions in representatives of six families of lizards. J. Herpetol. 13: 133-139.

--- & -----, 1981. The chemical detection of conspecifics by juvenile Yarrow's spiny lizard, Sceloporus jarrovi. J. Herpetol. 15(1): 77-81.

BÖHME, W. & W. BISCHOFF, 1976. Das Paarungsverhalten der kanarischen Eidechsen (Sauria, Lacertidae) als systematisches Merkmal. Salamandra 12(3): 109-119.

BOULENGER, G.A., 1920. Monograph of the Lacertidae. Volume I. Trust British Museum, London.

BURGHARDT, G.M., 1980. Behavioral and stimulus correlates of vomeronasal functioning in reptiles: feeding, grouping, sex, and tongue use. In: Chemical signals (Ed. by D. Müller-Schwarze & R.M. Silverstein). pp. 275-301. Plenum Press, New York.

CARPENTER, C.C., 1961. Patterns of social behavior of Merriam's Canyon lizard (Sceloporus m. merriami - Iguanidae). Southw. Nat. 6: 138-148.

--- 1962. Patterns of behavior in two Oklahoma lizards. Am. Midl. Nat. 67: 132-151.

--- 1963. Patterns of behavior in three forms of the fringe-toed lizards (Uma-Iguanidae). Copeia 2: 406-412.

--- 1965. The display of the Cocos Island Anole. Herpetologica 21: 256-273.

--- 1967. Display patterns of the Mexican lizards of the genus Uma. Herpetologica 23: 285-293.

--- , J.A. BADHAM & B. KIMBLE, 1970. Behavior patterns of three species of Amphibolurus (Agamidae). Copeia 1970: 497-505.
--- & G.W. FERGUSON, 1977. Variation and evolution of stereotyped behavior in Reptiles. In: Biology of the Reptilia, vol. 7: Ecology and Behavior (Ed. by C. Gans & D. Tinkle). pp. 335-403. Academic Press. London.
CLARKE, R.F., 1965. An ethological study of the iguanid lizard genera Callisaurus, Cophosaurus and Holbrookia. The Emporia State Research Studies 13 (4):1-66.
COWLES, R.B. & R.L. PHELAN, 1958. Olfaction in rattlesnakes. Copeia 1958: 77-83.
CREWS, D., 1975. Inter- and intraindividual variation in display patterns in the lizard, Anolis carolinensis. Herpetologica 31(1): 37-47.
DE FAZIO, A., C.A. SIMON, G. MIDDENDORF & D. ROMANO, 1977. Substrate licking in an iguanid lizard: a response to novel situations in Sceloporus jarrovi. Copeia 1977: 706-709.
DISTEL, H. & J. VEAZEY, 1982. The behavioral inventory of the green iguana: a laboratory study. In: Iguanas of the world: behavior, ecology and conservation (Ed. by G.M. Burghardt & A.S. Rand). pp. 252-270. Noyles Publications. New Jersey.
DUMERIL, A.M.C. & G. BIBRON, 1839. Erpetologie Générale ou Histoire Naturelle Complète des Reptiles. 5. Paris.
DUVALL, D., 1981. Western fence lizard (Sceloporus occidentalis) chemical signals. II. A replication with naturally breeding adults and a test of the Cowles and Phelan hypothesis of rattlesnake olfaction. J. Exp. Zool. 218: 351-361.
EIBL-EIBESFELDT, I., 1953. Zur Ethologie des Hamsters (Cricetus cricetus L.). Z. Tierpsychol. 10: 204-254.
GREENBERG, N., 1977. An ethogram of the blue spiny lizard Sceloporus cyanogenys (Sauria, Iguanidae). J. Herpetol. 11: 177 -195.
HINDE, R.A., 1970. Animal behaviour: a synthesis of ethology and comparative psychology. McGraw-Hill. London. 876 pp.
HUNTINGFORD, F., 1984. The study of Animal Behaviour. Chapman & Hall. London. 411 pp.
JENSSEN, T., 1970. The ethoecology of Anolis nebulosus (Sauria: Iguanidae). J. Herpetol. 4: 1-38.
--- 1975. Display repertoire of a male Phenacosaurus heterodermus (Sauria: Iguanidae). Herpetologica 31: 48-55.
--- 1977. Evolution of the anoline lizard display behavior. Am. Zool. 17: 203-215.
--- & L.M. ROTHBLUM, 1977. Display repertoire analysis of Anolis townsendi (Sauria: Iguanidae) from Cocos island. Copeia 1977: 103-109.
--- & GLADSON, N.L., 1984. A comparative display analysis of the Anolis brevirostris complex in Haiti. J. Herpetol. 18(3): 217-230.
KITZLER, G., 1941. Die Paarungsbiologie einiger Eidechsen. Z. Tierpsychol. 4: 353-402.
KRAMER, G., 1937. Beobachtungen über Paarungsbiologie und soziales Verhalten von Mauereidechsen. Z. Morphol. Oekol. Tiere 32: 752-783.
LORENZ, K., 1931. Beiträge zur Ethologie sozialer Corviden. J. Ornithol. 79: 67-127.
MACHADO, A., 1985. New data concerning the Hierro Giant lizard and the Lizard of Salmor (Canary Islands). Bonn. zool. Beitr. 36(3-4): 429-470.
MOLINA-BORJA, M., 1981. Etograma del lagarto de Tenerife, Gallotia galloti galloti (Sauria-Lacertidae). Doñana Act. Vert. 8: 43-78.
--- 1985. Spatial and temporal behaviour of Gallotia galloti in a natural population of Tenerife. Bonn. zool. Beitr. 36(3-4): 541-552.
--- 1986a. Data on courting behaviour patterns in some canarian lizards.

Vieraea, 16: 17-22.
--- 1986b. Organization of behaviour in isolated lizards (Gallotia galloti galloti) as revealed by multivariate analyses. Doñana Act. Vert., in press.
--- & T. GOMEZ-SOUTULLO, 1984. Séquences de comportement de certains lézards (Gallotia galloti) isolés. In: Processus d'acquisition précoce. Les communications (Ed. by A. de Haro et X. Espadaler). pp. 453-456. Publ. Univ. Autónoma de Barcelona et Societé Française pour l'Etude du Comportement Animale. Barcelona.
NOBLE, G.K. & K.F. KUMPF, 1936. The function of the Jacobson's organ in lizards. J. Gen. Psychol. 48: 371-382.
PORTER, K.R., 1972. Herpetology. W.B. Saunders. Philadelphia.
SIMON, C.A., K. GRAVELLE, B. BISSINGER, I. EISS & R. RUIBAL, 1981. The role of chemoreception in the iguanid lizard Sceloporus jarrovi. Anim. Behav. 29: 46-54.
STAMPS, J.A. & G.W. BARLOW, 1973. Variation and stereotypy in the displays of Anolis aeneus (Sauria: Iguanidae). Behaviour 42: 67-94.
TINBERGEN, N., 1936. Zur Soziologie des Silbermöwe (Larus a. argentatus Pontopp.). Beitr. Fortpflanzungsbiol. Vögel 12: 89-96.
--- 1969. Ethology. In: Scientific Thought 1900-1960. (Ed. by R. Harré) pp. 238-268. Clarendon Press. Oxford.
---, G.J. BROEKHUYSEN, F. FEEKES, J.C. HOUGHTON, H. KRUUK & E. SZUK, 1962. Eggshell removal by the blackheaded gull (Larus ridibundus L.); a behavioural component of camouflage. Behaviour 19: 74-117.
VERBEEK, B., 1972. Ethologische Untersuchungen an einigen europäischen Eidechsen. Bonn. zool. Beitr. 23: 122-151.
WEBER, H., 1957. Vergleichende Untersuchung des Verhaltens von Smaragdeichsen (Lacerta viridis), Mauereidechsen (L. muralis) und Perleidechsen (L. lepida) Z. Tierpsychol. 14: 448-472.