THE BIOLOGY OF FREELIVING AND CAPTIVE *ELAPHE SITULA*.

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INTRODUCTION

Elaphe situla is considered to be one of the most beautiful of European snakes and is very popular among terrarium keepers. On researching the literature one has to conclude that scientific publications on this species are virtually absent. The only papers of real importance are Marchetti (1966) and Bruno (1969). The data on the biology of *Elaphe situla* presented here were obtained studying populations in Apulia from 1968 to 1981, and in Basilicata from 1979 to 1981.

Distribution

This species, which existed in the Palaeocene, is found in the Mediterranean with extensions into the Balkans, Caucasus and Anatolia. In Italy populations are found in Apulia (Pozio & Frisenda, 1977), Basilicata (Frisenda & Lionetti, in prep.) and Calabria and Sicily (Bruno, 1969). The Italian populations are found up to 600 m above sealevel. Two varieties exist, a spotted and a striped form (Frisenda et al, 1979). The striped variety exists exclusively among the populations on the Adriatic side of Italy and is much rarer than the spotted form. Bruno (1969) has wrongly described these two varieties as subspecies but the two can be found side by side.



Fig. 1. *Elaphe situla*. Foto: E. Pozio.



Fig. 2. *Elaphe situla*. Foto: E. Pozio.

BIOLOGY IN THE WILD

Elaphe situla, a typical snake of the mediterranean "macchia" is often found in human settlements such as gardens, vineyards, orchards, farms and in the suburbs. Contact with man often has a fatal outcome, people killing them thinking they are venomous. The colour and pattern often resembles *Vipera aspis hugyi*, a species that is found within the distribution of *Elaphe situla*.

Cycle of activity

The activity period of this species is from March to October, though in contrast to other authors we repeatedly found active individuals during November to February in places away from the coast and between 300 and 350 m above sea level.
During March, April and October *Elaphe situla* is active during the daytime when sufficient sunlight is available. In May and September the snake is active from 7.00 am to 7-10 pm. In June from 6.00 am to 10-11 pm. In July and August activity is low and restricted to the early morning and late evening (see fig. 4). These times are not fixed, but vary according to the weather. Also it is very rare to find an individual moving at the hottest hour of the day.
Although this species, in Apulia, shows a preference for the dry regions of the mediterranean "macchia" it also has a great liking for water. Due to this liking for water specimens are often found in wells, underground canals etc, where they have fallen into and occasionally are unable to climb out. In the months of May and June, at harvest time, individuals may be found under sheaves where they are searching for rodents. *Elaphe situla* rarely moves in open, uncovered terrain being normally found in shrubs such as mastik (*Pistacea lentiscus*) and sunrose (*Cistus sp.*). It is also found in areas of long grass or in crevices of

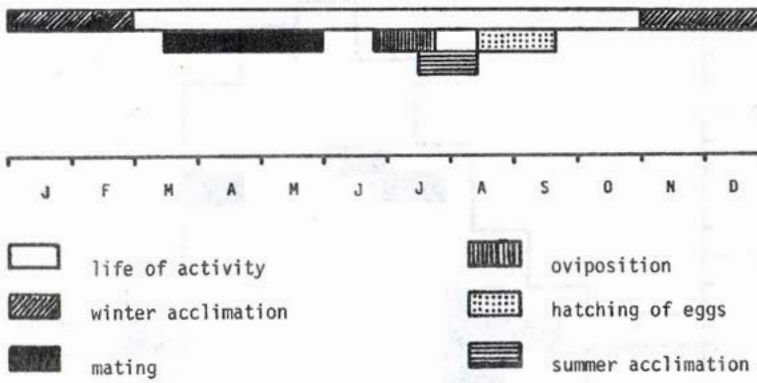


Fig. 3. Schematic presentation of the yearly cycle of *Elaphe situla*.

walls made from loose stones.
As with other snakes (Pozio, 1976) of the temperate regions the males are more active than the females and activity is greater in spring than in autumn.
It is very difficult to study places of hibernation and the only data we have obtained is the finding of an adult male in hibernation on January 12th. The animal was found inside a loose stone wall that was being pulled down.

Reproduction
Sexual activity is temperature dependent and related to arousal from hibernation. In the wild we have observed copulation between the middle of March and the end of May, with most observations being made between 1st and 20th May. In agreement with Bruno (1969) I have never observed fighting between the males. However, as this species never occurred in large numbers, at least in the area I studied, chance meetings of males must be rare.
Eggs are deposited in cavities in olive trees, between the roots of the mastik and in the neighbour-

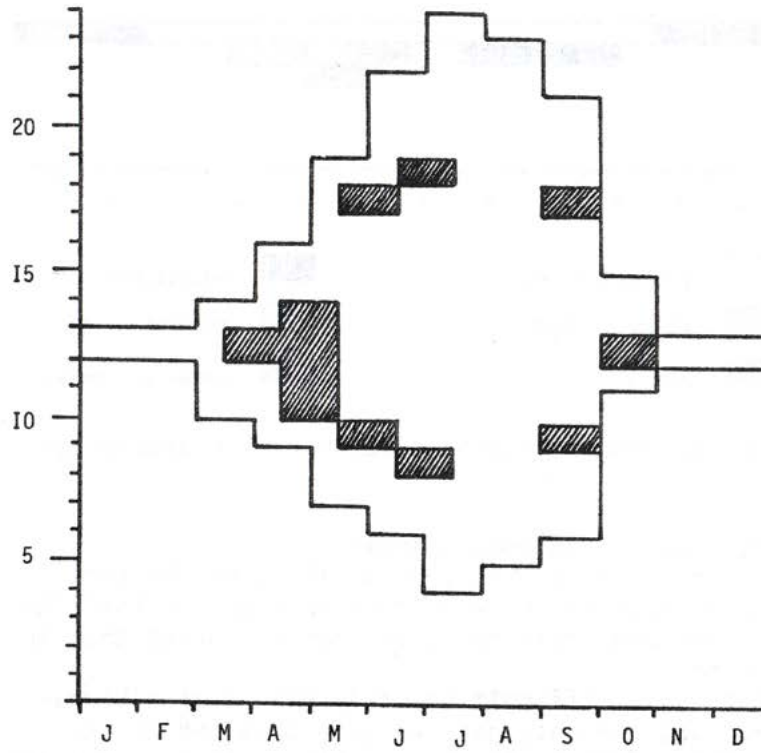


Fig. 4. Schematic presentation of the daily cycle of *Elaphe situla*. The hour of the day is indicated on the vertical axis, the month on the horizontal axis. The striped rectangles indicate the hours of most activity.

hood of dunghills (see "Reproduction in captivity").

Food

It is rare that recently fed individuals are caught and coproanalysis to determine prey is difficult and not always reliable. In captured individuals the following prey was identified:

- young individuals of *Elaphe situla*:
  insects (*Orthoptera*)
  young lizards (*Podarcis sicula*)
  hairless littermice (*Apodemus sp.*)
- adult individuals of *Elaphe situla*:
  lizards (*Podarcis sicula*)
  birds eggs (species unknown)
  winter shrew (*Suncus etruscus*)
  Crocidura sp.
  woodmouse (*Apodemus sp.*)
  housemouse (*Mus musculus*)
  young black rats (*Rattus rattus*)

Coproanalysis identified the following groups of prey:
- mammals 65%
- reptiles 15%
- birds or their eggs 7%
- insects 5%
- unidentified 8%

BIOLOGY IN CAPTIVITY

The observations presented here were made in an open terrarium. The terrarium had an area of 6 m^2 and a useful volume of 9 m^3. The lower section of the terrarium was made from eternite with dimensions 3x2x0.3 m, and was placed on an undercarriage that lifted it 0.5 m from the ground. The upper section was a profiled metal frame netted with wire mesh of 4x4 mm. Four doors, 1x1.5 m, served as entrances to the terrarium. The fittings inside consisted of two hibernating rooms of 30x20x20 cm dug in, each with an opening into the terrarium permitting the animals to enter and leave freely. Each also had a door to the outside of the terrarium to facilitate control. One of these rooms was directed to the north-west, the other south-east. A basin for water, with a sur-

face area of 1 m^2 and a depth of 2-20 cm was also placed in the terrarium. A tap was fitted to the floor of the basin to serve for quick removal of the soiled water. The substrate was a mixture of earth, sand, stones and gravel. The terrarium was planted with cork-oak (*Quercus ilex*), mastic shrub (*Pistacea lentisco*), ivy (*Hedera elix*) and grasses and plants that germinated freely. The inside of the hibernating rooms was covered with dry leaves, earth and gravel.

Cycle of activity

In captivity as in the wild this snake passes most of its time in the vegetation, preferring tops of shrubs, dry branches covered with ivy, being found much less on the ground. As most snakes of the genus *Elaphe* this species likes water and may spend days laying curled up in it, paricularly during digestion, sloughing and when the air temperature is in excess of 30°C. Rarely do they hide in underground holes preferring to hide among loose stone heaps or in the leaves of a shrub. They are good climbers and reach the highest part of the terrarium with ease. However, their climbing ability cannot be compared to that of *Elaphe longissima*.

Reproduction

The period of reproduction was as in the wild, springtime. We do not know, however, wether this snake, as with others, has a second reproductive period in September. The reproductive period is clearly subject to weather conditions, wether to occur earlier, later or longer, etc.

The various phases of the mating ritual are much like those of other snakes, with both sexes being less secretive. During the mating season the male is so excited he becomes less aware of observers and seeks a hiding place less urgently. The 'pre-

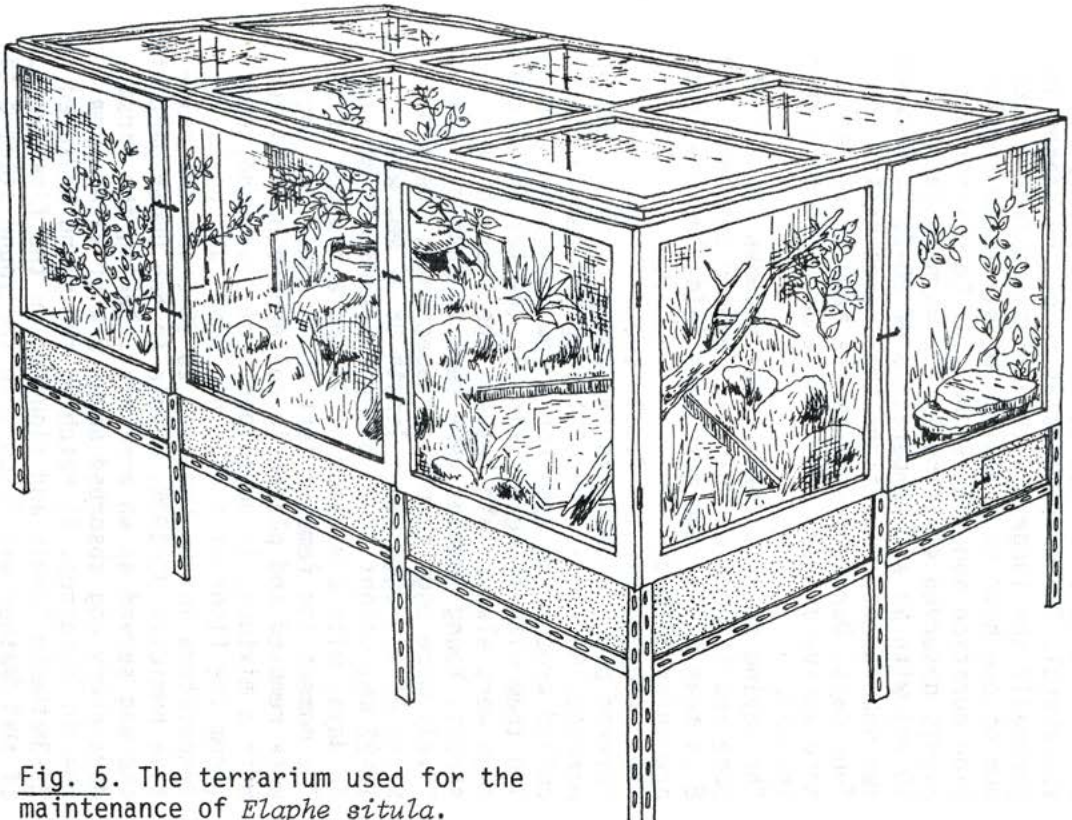


Fig. 5. The terrarium used for the maintenance of *Elaphe situla*.

lude' may vary in the length of time from a couple of minutes to a few hours, and is not always successful. The first copulation of the season is generally the longest with variations from a minimum of one hour to a maximum of six (mean copulation duration about three hours). Copulation was always observed starting in the morning (after 10 am) with an air temperature of 20-25°C, Between two subsequent copulations the snakes rested for four days. During gestation the females become more active and are seen active more frequent than the male.

The laying of eggs takes place between the end of June and the end of July, and number between 2 and 8 (a mean of 4), the more eggs laid the more that are unfertilised.

When ready to lay the female seeks a humid, well covered place usually in the early hours of the morning. On completion of laying the female stays curled around the eggs for a few days, often covering them with sloughed skin. In the terrarium the eggs were always laid between the roots of the shrubs. Young females were seen to produce relatively more eggs than older specimens. The dimensions of the eggs were: length 38-47 mm, width 16-22 mm; weight 17-24 g. Mean breeding time was 48 days, with a minimum of 42 and a maximum of 64. The moment the females left their eggs, the eggs were removed and placed in cellophane bags filled with a mixture, in equal parts, of riversand, earth (from the floor of a chestnut wood) and peat. The temperature in the bags was 23-28°C and the relative humidity 90-100%. A hole in the upper part of the bag served as an air inlet. During the first days every egg absorbed about 2 g of water from the surroundings. At hatching the young measured 29-36 cm in length and sloughed in the first week. If the weather was favourable the young started to feed almost immediately, but if hatching occurred

at the end of September the young would not feed until after hibernation.

Growth
The following data are for captive individuals, wild specimens probably grow slower.
1st year 41-47 cm
2nd year 50-55 cm
3rd year 59-63 cm
4th year 66-70 cm

Sexual maturity
Males and females have been observed as sexually active at 4½ years, though some are 6½ years old before seeming to reach maturity. Bruno (1969) indicates an age of 3½ years for both sexes.

Sloughing
Young individuals slough 5-6 times a year for the first two years, and from the third year the frequency drops to three. The duration of sloughing is about 10 days, and during this time the animal becomes irritable and lethargic spending most of the time under water. It is exceptional for animals to feed at this time.

Winter adaptation
In the open terrarium the animals normally remained in the hibernating rooms from November 15th until Febrary 15th, though on mild days in winter the snakes leave their hiding places as have repeatedly been observed. On such occasions the temperature in the rooms had risen from the usual 3-7°C to 10-14°C. Humidity in the rooms was recorded as 85-100%. Other climatic conditions such as rain, wind or sun seem to have no direct influence on hibernation, only an indirect one by way of influencing temperature.

Summer adaptation
In the summer from the end of July to the middle of August the snakes have a period of summer rest when all activity is suspended. This is more obvious in adults than in young animals.

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