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Seasonal Phenology of Reptiles in a Mediterranean Environment ("Castel di Guido" Natural Park, Northern Latium, Italy)

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***Abstract*—** *The present work reports the seasonal phenology of the reptiles of the "Castel di Guido" Natural Park near Rome (Northern Latium, Italy). During field observations, between September 2014 and July 2016, transects were carried out along the ecotones of the park, in order to describe the period of seasonal activity of the reptiles present. The area is characterized by Mediterranean mesothermal climate. In the Mediterranean area, reptiles have a broader annual activity range than other European regions, greatly reducing winter latency. Reptile activities start very early, in some case it is possible to observe the snake Hierophis viridiflavus and lizards, such as Podarcis muralis and Podarcis siculus, in thermoregulation activity in the middle of winter. The mild climate that is recorded on average in autumn favors the activity in the period between September and December; Zamenis longissimus is observed regularly in October. Testudo hermanni mates regularly in autumn and it is active until the first decade of December. The research shows that during the winter period reptiles can be observed in activity; for some species, Chalcides chalcides, Podarcis sp., Hierophis viridiflavus, this seems to be a remarkable datum that broad considerably the annual phenology reported in the literature.*

***Keywords* — M*editerranean environment, phenology, reptiles, winter activity*.**

I. INTRODUCTION

The present study illustrates the phenology of the reptiles of the "Castel di Guido" Natural Park (Northern Latium, Italy) (Figure 1); the data relative to the reptiles species observed in the course of herpetological research are reported. In many species, biological activity and reproduction times are determined by a combination of endogenous cycles and exogenous signals; in particular for reptiles, ectoderm species that have body temperatures generally close to those of their environment, temperature and humidity influence many aspects of their biology (Whittier & Crewe, 1987).

In the literature, the phenology of reptiles varies a lot according to the latitude and the different habitats, as well as to the seasonal climatic trends that can vary from year to year (Sindaco *et al*., 2006; Corti *et al*., 2010). In Europe, certainly a distinction in phenological activities is observed in the continental climate range compared to the Mediterranean climate zone where the activities of reptiles begin very early compared to other environments in Europe (Bologna *et al*., 2000; Bologna *et al*., 2007).

In some cases it is possible to see in thermoregulation some lizards, such as *Podarcis muralis* (Laurenti, 1768) and *Podarcis siculus* (Rafinesque Schmaltz, 1810), in December and January; also *Hierophis viridiflavus* has been observed in mid-winter activity (Pizzuti Piccoli, 2016; Cattaneo, 2017).

The work doesn't concern *Emys orbicularis* (Linnaeus, 1758), *Anguis veronensis* Pollini, 1818, *Hemidactylus turcicus* (Linnaeus, 1758) and *Tarentola mauritanica* (Linnaeus, 1758), for which observations were based exclusively on the absence presence data. (Pizzuti Piccoli *et al*., 2017a; Pizzuti Piccoli *et al*., 2017b).

II. STUDY AREA

The present study was carried out in the Castel di Guido Natural Park, within the homonymous public farm, located in the Municipality of Rome, in the stretch between the 16th and the 20th km of the main road Aurelia. The public farm is under the direct management of the Municipality of Rome since 1978 and it produces cereals, fodder and cattle, bred in the stable (Italian Friesian cow) and in a wild state (Maremmana cow). The farm extends for 1966 ha and is characterized by hilly areas that degrade towards the coastal plain; the maximum altitude reached is 80 m above sea level, while the minimum altitude reaches about 10 m asl. The activity

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of man has further modified the territory, leading to the formation of mosaics of small natural areas, interesting because characterized by relict vegetation (Chirici *et al*., 2001).

Climatically the area is part of the Mediterranean Transitional Region, with mild climate, due to the proximity of the sea (Blasi, 1994). The minimum temperatures are recorded in January (average value 3.0 ° C), the highest in July and August (average value 30.0 ° C); rarely there are values below 0 ° C and above 40 ° C. In autumn there is maximum rainfall (over 275 mm), but also in spring there are frequent rains (175 mm) (Table 2) (Mangianti & Perini, 2001).

The study area is characterized by an evident vegetation complexity and by a great floristic richness, which can be seen in the various habitats present. Of the 1966 hectares of the Farm, 17% (366 hectares) is occupied by crops such as durum wheat, maize, barley, olive groves, and alfalfa meadows, 22% (430 hectares) by natural coppice woods with prevalence of *Quercus ilex* Linnaeus, 1758 and *Quercus pubescens* Willd., 1805, 22% (433 hectares) is used for permanent pasture, 28% (552 hectares) is covered by pine woods and areas of reforestation, while the remaining part of the territory is occupied by roads, farmhouses, stables and irrigation canals. (Filesi, 2001; Bartolucci & De Lorenzis, 2004).

The birds of the Park are represented by numerous resident and migratory species (Cecere, 2006); among the most representative mammals we find *Hystrix cristata* Linnaeus, 1758, *Vulpes vulpes* Linnaeus, 1758, *Meles meles* Linnaeus, 1758, *Martes foina* Erxleben, 1777, *Erinaceus europaeus* Linnaeus, 1758 and *Muscardinus avellanarius* Linnaeus, 1758 (Imperio *et al*., 2007). Remarkable the presence, recently proven, of the wolf, *Canis lupus* Linnaeus, 1758. The amphibians of the area are represented by five species: common toad *Bufo bufo* (Linnaeus, 1758), emerald toad *Bufotes balearicus* (Boettger, 1880), Italian tree frog *Hyla intermedia* Boulenger, 1882, green frog *Pelophylax bergeri* (Gunther, 1986) / *Pelophylax* kl. *hispanicus* (Bonaparte, 1839) and smooth newt *Lissotriton meridionalis* (Boulenger, 1882) (Pizzuti Piccoli & De Lorenzis, 2015). Reptiles are well represented with the confirmed presence of 14 species present (Table 1). (Pizzuti Piccoli *et al*., 2017).

III. MATERIAL AND METHODS

Data collection took place between September 2014 and July 2016; surveys were carried out weekly; the detection method adopted was that of the linear transect with "sight counts", V.E.S. = Visual Encounter Surveys (Heyer, 1988; Crosswhite *et al*., 1999; Greenwood & Robinson, 2006). As a transept was chosen a linear path of 2,200 meters, crossing all the representative environments and the ecotonal zones present; the presence of animals in the five meters on the right and on the left of the transept were considered (Hofer *et al*., 2002).

Field work was conducted following the regulations and with all the necessary authorizations for this kind of study.

IV. RESULTS

The data collected for the species are shown below.

Testudo hermanni Gmelin, 1789

During the field surveys, 38 specimens of *Testudo hermanni* were observed and captured. The species in the Mediterranean area is normally found from March to November, with bimodal activity in June and September (Calzolai & Chelazzi, 1991, Mazzotti *et* al., 2002). In the site the first observations date back to the first days of March and the species mates regularly in autumn; noteworthy the finding of a moving specimen on 10 December 2015(Figure 2).

Chalcides chalcides (Linnaeus, 1758)

Along the transept 14 specimens of *Chalcides chalcides* were observed; all the specimens presented the coloring with longitudinal dark stripes. In the literature, the species is active from spring to early summer, from the end of July a phase of sporadic activity begins until September and it has a winter latency from October to March (Sindaco *et al*., 2006).

Field observations confirm the start of activities in March, with observations also in August; in the study area individuals in activity were found until the end of October.

Podarcis muralis (Laurenti, 1768), *Podarcis siculus* (Rafinesque Schmaltz, 1810) and *Lacerta bilineata* Daudin, 1802

Podarcis siculus, appears to be more numerous than *Podarcis muralis*, the latter presents the typical color of the subspecies *nigriventris* (Sindaco *et al*., 2006). The two species appear to be well separated in habitat habitation. *P. siculus* appears to be confined to prairie areas, while *P. muralis* has been observed mainly in areas with tall trees, often above the trunks of trees.

Lacerta bilineata is present above all in the areas close to the watercourses and in the borders of *Rubus sp*. The phenology observed (Figure 3) indicates an intense activity for the three species between May and June; for *Lacerta bilineata* we also assist to significant activities in April; a further peak we find in the month of September (end of August - September for *Podarcis siculus*). In general, specimens were already active during the first sunny days of January, with a progressive increasing of

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biological activity with the peak in May and June. In the late autumn period we find specimens in activity until November. Between November and January the observations refer to specimens in basking activities, we have no data on trophic activity in this period; trophic activity and reproductive activity are observed from March. The observations are consistent with the data reported in the literature (Capula *et al*., 1993; Caldonazzi *et al*., 2002; Di Cerbo e Ditizio, 2008; Tenan, 2007).

Elaphe quatuorlineata (Bonnaterre, 1790)

For this species, the data in literature report individuals in activity between March and October (Pozio, 1976; Capizzi *et al*., 1996; Cattaneo, 2005; Cattaneo, 2017). The individuals observed during the research were found in the time range of April and July in both study years, confirming the phenological information in literature (Figure 4).

Hierophis viridiflavus (Lacépède, 1789)

Among the snakes, *Hierophis viridiflavus* is the most frequent; it has been observed 32 times along the transects in the ecotonal bands and, to a lesser extent, has been found in areas covered by tree vegetation and close to household goods. Found mainly on the ground, still or moving. For the species, the bibliographic data show activities from February to October (Capula *et al*., 1997; Capula & Luiselli, 1995; Filippi & Luiselli, 2000). In the study area, the species is observed regularly, albeit with few specimens, even in the months of November December and January.

Zamenis longissimus (Laurenti, 1768)

The species is present in the park, where it was found with five individuals in the ecotonal zones. The observations fall within the season range (between March - April and October - November) reported in the literature (Sindaco & Silvano, 1991; Gomille, 2002); interesting the observation of two individuals in October.

Natrix helvetica (Lacepède, 1789)

Natrix helvetica is the least common snake; it should be noted that the particular ecology of the animal, that needs presence of water bodies, makes it less observable in the habitat investigated with the transects. However its presence is confirmed with the capture of some individuals in the phenological range, described in literature for the species, between March and September (Gentili & Zuffi, 1995; Kindler *et al*., 2017).

Vipera aspis (Linnaeus, 1758)

In the area *Vipera aspis* was observed only in the period between April and July, despite being known, for the coastal Tyrrhenian locations, observations throughout all the year (Zuffi et al., 1999b; Grano et al., 2017).

V. CONCLUSION

The periods of activity of the observed species often appear in line with those in other Mediterranean coastal areas (Cattaneo, 2005, Mayor et al., 2006; Corti et al., 2010; Pizzuti Piccoli, 2016). The research shows that, during the winter period, reptiles can be observed in activity; for some species, Chalcides chalcides, Podarcis sp., Hierophis viridiflavus, this seems to be a remarkable fact that would greatly broaden the annual phenology (Figure 5). It is evident that these activities in the late autumn and winter can be correlated with seasonal climatic trends, which often offer mild, or even warm, winters (Table 2), favoring the activity of reptiles (Bologna et al., 2000; Bologna et al. ., 2007). In conclusion, the work carried out offers a contribution to the knowledge of the phenology of reptiles in the Mediterranean environment of the Tyrrhenian coast, with particular reference to the area of the Roman coast. It will certainly be important to investigate the phenology of the observed reptiles for the site, in order to obtain a more appropriated knowledge of the reptiles present.

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Table 1. The reptile species observed in the "Castel di Guido" Natural Park.

Species observed	
European pond terrapin	*Emys orbicularis*
Hermann's tortoise	*Testudo hermanni*
Mediterranean house gecko	*Hemydactilus turcicus*
European common gecko	*Tarentola mauritanica*
Italian slowworm	*Anguis veronensis*
Italian three-toed skink	*Chalcides chalcides*
Common wall lizard	*Podarcis muralis*
Italian wall lizard	*Podarcis siculus*
Western green lizard	*Lacerta bilineata*
Four-lined snake	*Elaphe quatuorlineata*
Western whip snake	*Hierophis viridiflavus*
Aesculapian snake	*Zamenis longissimus*
Grass snake	*Natrix helvetica*
Asp viper	*Vipera aspis*

Table 2. Monthly averages of meteorological data in the period 1987 – 2017 (Rome Ciampino Station) - Source www.ilmeteo.it.

Month	**T min**	**T max**	**Rain**	**Humidity**
January	3 °C	12 °C	103 mm	77 %
February	4 °C	13 °C	99 mm	75 %
March	5 °C	15 °C	68 mm	72 %
April	8 °C	18 °C	65 mm	73 %
May	11 °C	23 °C	48 mm	71 %
June	15 °C	27 °C	34 mm	68 %
July	17 °C	30 °C	23 mm	67 %
August	18 °C	30 °C	33 mm	66 %
September	15 °C	27 °C	68 mm	69 %
October	11 °C	22 °C	94 mm	74 %
November	7 °C	16 °C	130 mm	78 %
December	4 °C	13 °C	111 mm	78 %

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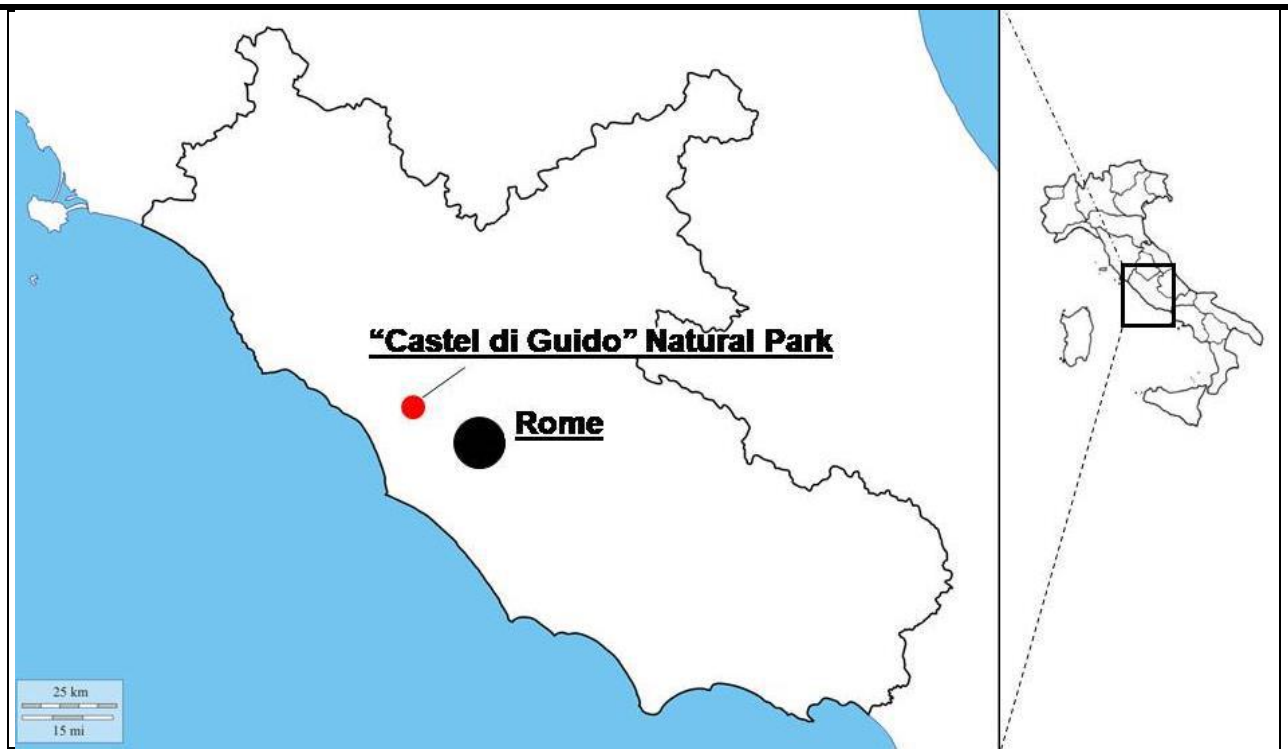

Fig.1: The "Castel di Guido" Natural Park.

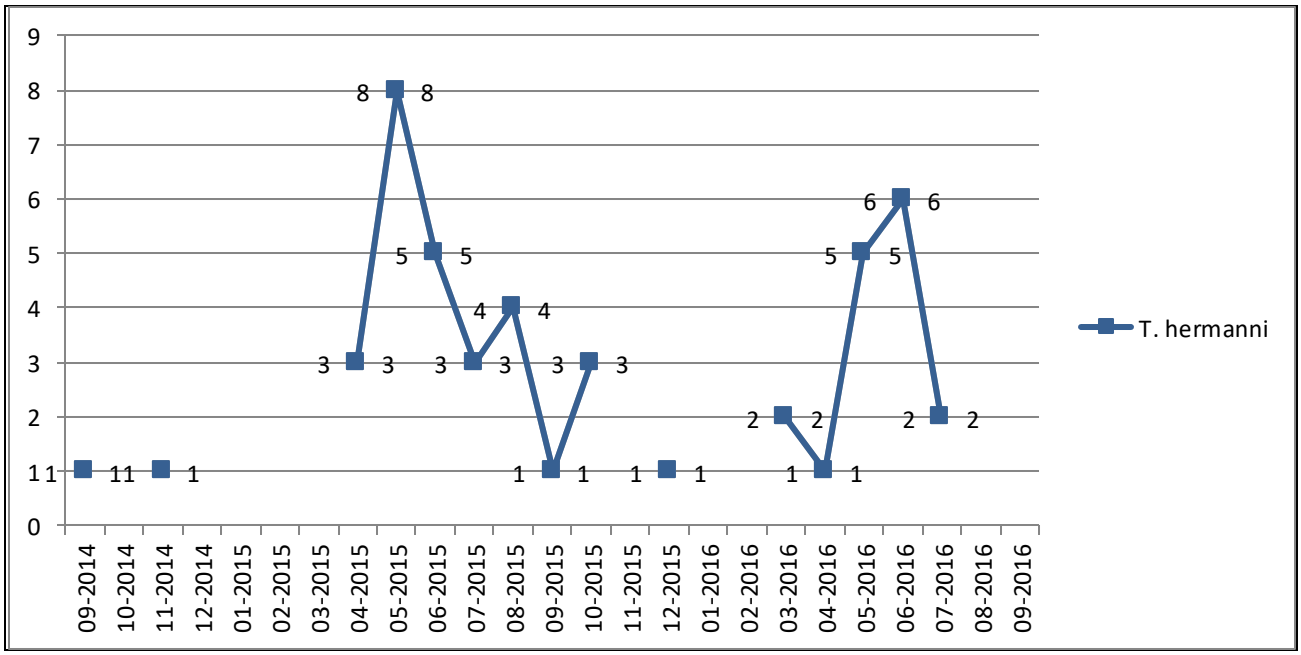

Fig.2: Testudo hermanni specimens observed during the study period.

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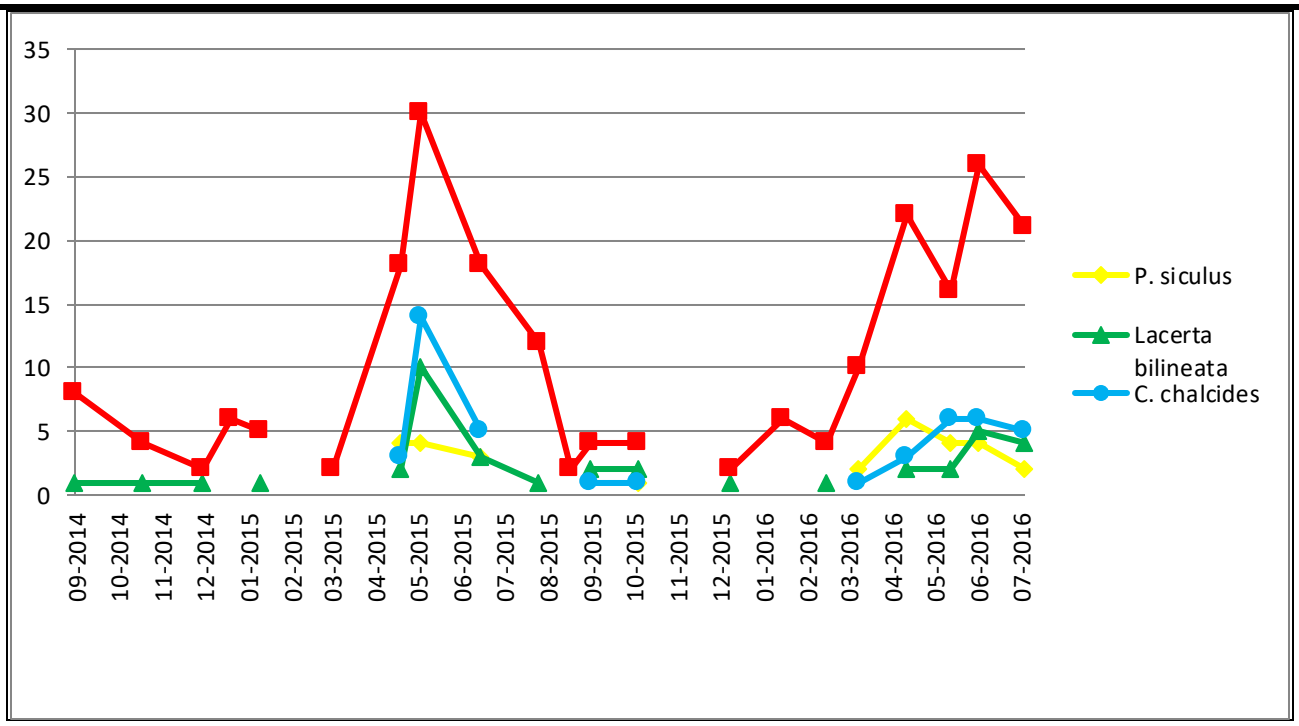

Fig.3: Observations during the study period of the lizards.

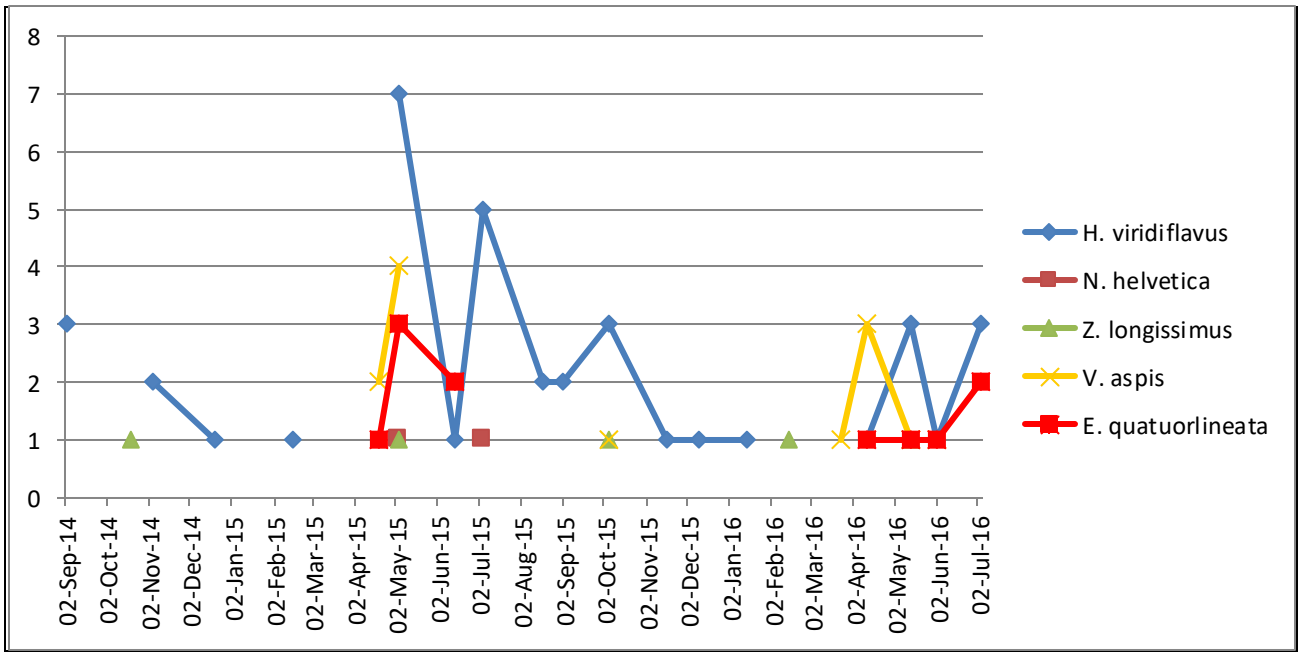

Fig.4: Observations of snake species during the study period.

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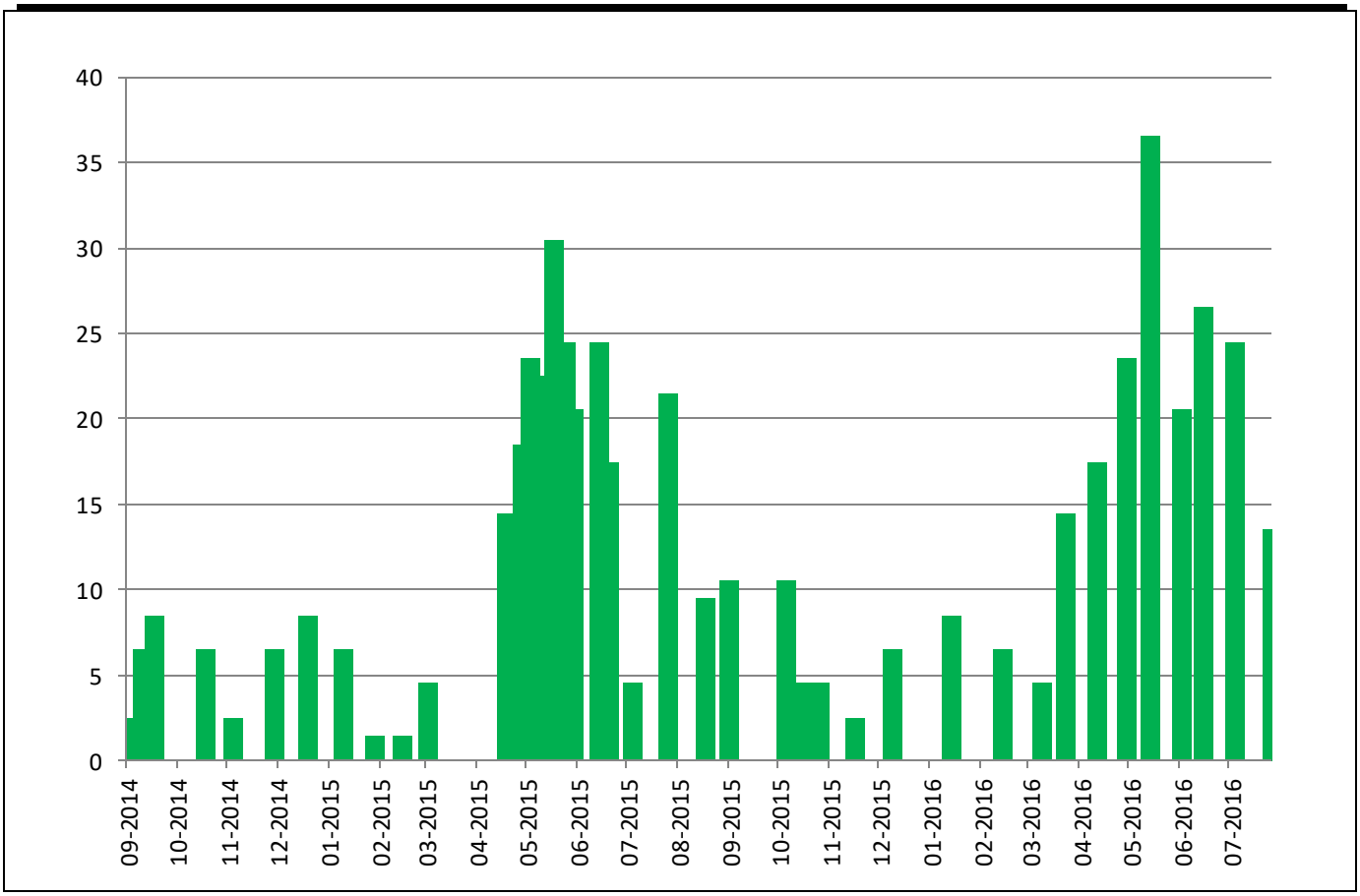

Fig.5: Seasonal observations of all reptile species during the study period.