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MORPHOLOGICAL TRAITS OF HATCHLINGS OF THE WESTERN WHIP SNAKE *Hierophis viridiflavus* (LACÉPÈDE, 1789) FROM A CENTRAL ITALIAN POPULATION

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A western whip snakes' communal nesting site has been discovered in central Italy. The morphological characteristics, differences and anomalies of the hatchlings of this species are described. The results of body weight and size showed different values to historical data. Sexual dimorphism has been observed in the number of ventrals and subcaudals, as well as in the size and weight of the specimens. Differences, anomalies and malformations in the head scutellation have been observed in 16% of the examined specimens. The photographic material allowed a classification of five different main types of head pattern. The data are provided in tables and diagrams.

Keywords: Serpentes; Colubridae; *Hierophis viridiflavus*; western whip snake; hatchlings; morphology; anomalies; communal nesting site.

INTRODUCTION

The western whip snake, *Hierophis viridiflavus* (Lacépède, 1789) is a colubrid snake distributed all over Italy, including some territorial islands. Like other European colubrid species, *H. viridiflavus* is oviparous and may lay its eggs in communal nesting sites, which are frequently used by several females (Capula and Luiselli, 1995; Filippi et al., 2007). Clutches laid by this species can consist from 3 to 17 eggs (Zuffi et al., 2007).

A communal nesting site has been discovered in Abruzzo (Italy), where the hatching of western whip snakes had yearly been observed during the past ten years. In this area only melanistic specimens (*Coluber viridiflavus* var. *carbonarius* Bonaparte, 1833) are present (Fig. 1). The taxonomic status of "*carbonarius*" is controversial (see Schätti and Vanni, 1986; Nagy et al., 2002).

In the summer of 2014 from August 19 to September 6, more than 100 hatchlings of *H. viridiflavus* (Figs. 2 and 3) have been observed exiting from the communal nesting site in Abruzzo, where several eggs were previously laid by an unknown number of females. The specimens collected and observed were only a part of the total number of hatched whip snakes from this nesting site. Based on additional molted skins found there, an unidentified amount of hatchlings left the site, probably using other passages. The hatchlings spend their first days of life inside the nesting site, usually abandoning it after their first shed. Certainly, specimens have also been observed leaving the site during their first shedding.

The communal nesting site has also been analyzed during the previous years. However, 2014 has been the first year when such a high number of hatchlings has been observed, giving the opportunity to collect enough data about specimens of different clutches.

Fig. 1. Melanistic adult male from northern Abruzzi.

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Fig. 2. A colorful specimen (ID 062, see Table 1).

Fig. 3. Specimen with elaborate head pattern (ID 017, see Table 1).

MATERIAL AND METHODS

The data have been compiled based on 100 hatchlings of the melanistic form of *H. viridiflavus*, collected from a communal nesting site in Abruzzo (Italy). The study lasted more than 130 h of monitoring from August 19 to September 06, 2014. Sex, body weight and total length (TL to the nearest ±0.5 cm) of each specimen have been recorded. The determination of the sexes was possible by eversion of the hemipenes. The weight data have been measured with an electronic balance. Frontal and side view pictures of the heads and additional photographic material have been compiled to obtain precise data of the chromatic characteristics and variation of scutellation.

TABLE 1. List of Examined Specimens, Including Recorded Data on Sex, Body Weight, and Total Length

Id	Sex	Weight, g	Length, cm	Id	Sex	Weight, g	Length, cm
001	♀	7	34.5	051	♂	3	33.5
002	♀	6	35.0	052	♂	5	35.0
003	♀	5	36.0	053	♂	4	35.5
004	♂	5	34.5	054	♀	3	35.5
005	♂	3	33.5	055	♀	6	36.5
006	♀	3	34.0	056	♂	5	36.0
007	♀	3	36.5	057	♀	4	36.5
008	♂	3	31.0	058	♀	4	34.0
009	♀	3	30.5	059	♀	5	33.0
010	♀	5	32.5	060	♂	5	36.0
011	♂	3	34.0	061	♂	3	34.0
012	♂	4	31.0	062	♂	4	34.0
013	♂	3	33.5	063	♀	3	33.0
014	♂	5	33.0	064	♀	3	33.5
015	♀	4	31.0	065	♀	5	36.5
016	♂	4	35.0	066	♂	5	34.0
017	♂	3	33.0	067	♀	4	33.5
018	♀	5	36.5	068	♂	5	34.0
019	♀	4	34.0	069	♀	4	35.5
020	♂	5	36.0	070	♂	6	38.0
021	♀	7	37.0	071	♀	6	36.0
022	♂	4	35.0	072	♂	6	36.0
023	♀	5	35.0	073	♂	5	36.5
024	♂	3	32.0	074	♀	3	34.5
025	♂	3	33.5	075	♀	4	35.0
026	♀	5	32.5	076	♀	4	34.0
027	♀	5	34.5	077	♀	3	33.5
028	♂	6	35.0	078	♂	3	29.0
029	♀	6	36.0	079	♀	6	36.0
030	♂	5	36.0	080	♀	2	36.0
031	♂	5	34.0	081	♂	5	35.5
032	♀	4	33.5	082	♂	3	31.0
033	♀	4	33.5	083	♂	3	32.0
034	♀	3	35.0	084	♀	3	35.0
035	♀	4	34.0	085	♂	5	37.0
036	♂	1	30.0	086	♂	4	32.0
037	♀	2	30.0	087	♂	5	34.0
038	♂	6	35.0	088	♀	4	34.0
039	♀	5	36.0	089	♀	4	34.0
040	♂	3	34.0	090	♀	4	37.0
041	♂	5	33.5	091	♀	5	37.0
042	♂	4	32.5	092	♀	5	36.0
043	♀	5	36.0	093	♀	3	34.5
044	♀	5	36.0	094	♂	3	31.0
045	♂	5	36.5	095	♂	3	34.5
046	♀	3	32.0	096	♀	3	35.0
047	♂	5	35.0	097	♂	5	33.0
048	♂	3	34.0	098	♂	6	34.0
049	♀	3	31.0	099	♀	5	35.5
050	♀	4	33.0	100	♀	6	36.5

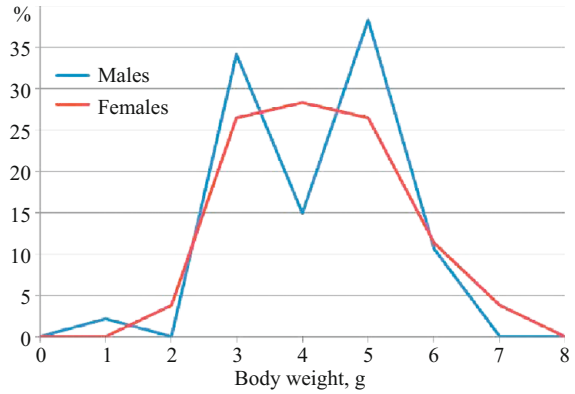

Fig. 4. Distribution graph of the body weight of male and female specimens.

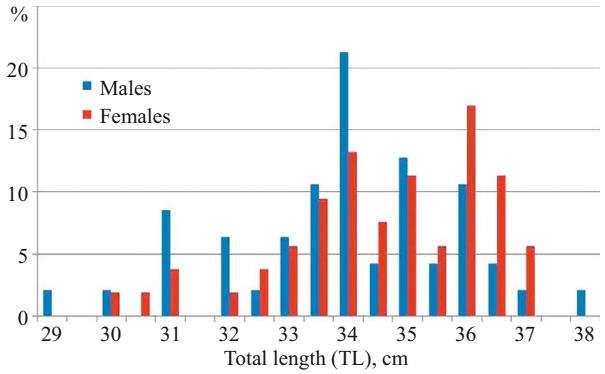

Fig. 5. Distribution of the total length of male and female specimens.

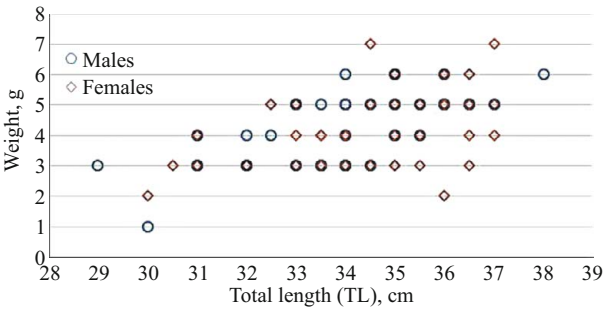

Fig. 6. Relation between weight and length in male and female specimens.

18 specimens of this group (9 males and 9 females) were examined to determine the scutellation, including dorsals (mid-body, in left to right order), ventrals (first reduced plates included) and subcaudals. Terminology and characters for the description of scutellation followed Shulz (1996).

After the study, all the collected specimens have been released in the surrounding area of their origin.

RESULTS

Sex Ratio, Body Weight, and Total Length

Based on my observations, the sex ratio within the hatchlings of *H. viridiflavus* examined was almost equal, consisting of 47 males and 53 females (see Table 1).

The sum of the body weight of all the collected specimens was 423 g. The minimal individual body weight recorded was of a male with 1 g, while the maximum was 7 g, observed in two females. The average of the body weight of the whole group was 4.23 g, while the mean value of the body weight in females was 4.26 g and in males 4.19 g. The weight of 95% of the hatchlings varied from 3 to 6 g, with 2% of them above and 3% below this range (Fig. 4).

The mean total length within the whole group was 34.28 cm, with an average of 34.57 cm in females and 33.96 cm in males. The total range of the size was observed to be between 29 cm (min.) and 38 cm (max.) (Fig. 5).

The major part of male specimens (55.32%) measured between 33 and 35 cm, with most specimens showing the same size at about 34 cm. The remaining males showed total lengths of 29 – 32.5 cm (21.28%) and 35.5 – 38 cm (23.40%). Contrary to males, most females were present in the ranges of higher values (47.17%: 33 to 35 cm; 39.62%: 35.5 – 38 cm) with the highest peak at about 36 cm, while only the 13.21% showed a total length comprised between 29 and 32.5 cm. As indicated by these values, the body weight did not always correlate with total length (see Fig. 6). Specimens with a body weight of 3 g displayed the largest range regarding the total body length data.

Body Scutellation

The scutellation has randomly been examined in 18 specimens. All 18 snakes had 19 dorsal scales (mid-body value) and a divided anal plate. In females a minimum of 206 and a maximum of 214 ventrals were observed, compared to a minimum of 195 and a maximum of 203 in males. There was a difference of 11 ventrals between the maximum and minimum value in both sexes. The difference of 3 ventrals between the highest value of males and the lowest value of females distinguishes the two sexes with a pronounced difference. The count of subcaudals showed inverse results. In males a major number of subcaudals was present, varying from 101 to 109, while in females the number was lower, from

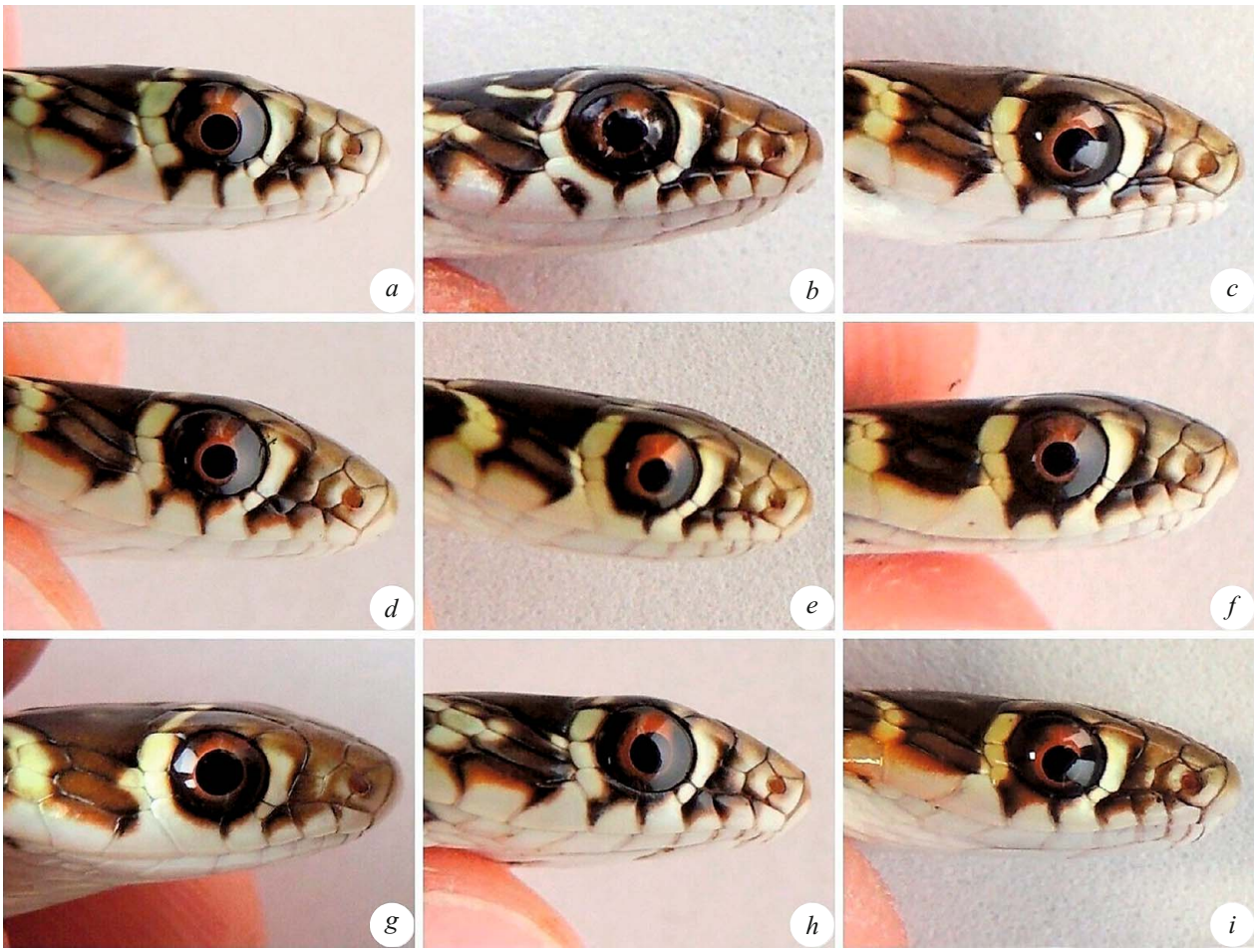

Fig. 7. *a*, Specimen with no anomalies in the head scutellation (Id 052); *b*, specimen with an additional supralabial (Id 098); *c*, specimen with malformation of supralabials and an additional small temporal close to the lower postocular (Id 009); *d*, specimen with a presubocular (Id 043); *e*, specimen with an additional loreal (Id 086); *f*, specimen with an additional subocular (Id 087); *g*, specimen with two posterior temporals (Id 002); *h*, specimen with three anterior temporals (Id 050); *i*, specimen with two posterior temporals (Id 005).

98 to 106. This resulted in a difference of 3 subcaudals between the maximum and minimum value of the sexes.

Head Scutellation and Anomalies

The major part of the specimens examined (84%) presented 8 supralabials, of which the 4th and 5th were in contact with the eye, 1 loreal, 1 preocular, 1 subocular, 2 postoculars, 2 anterior and 3 posterior temporals.

Anomalies in the head scutellation have been found in 16 specimens. In one female a malformation was present in the first 3 supralabials. Those were horizontally divided, with the upper ones measuring ¼ of the total size of the shields (Fig. 7*c*). This specimen also exhibited an additional small temporal in contact with the lower postocular and the 6th and 7th supralabial. Another female presented a presubocular (Fig. 7*d*), an unusual characteristic that has not been observed in any other specimen. In one male a second loreal was present (Fig. 7*e*). A second subocular has been found in another male (Fig. 7*f*). In 3 specimens (1 male and 2 females), an additional supralabial was present in front of the first one in contact with the eye (Fig. 7*b*). The most frequent head shield variation concerned the temporals. The major part of specimens examined had 2 anterior and 3 posterior temporals. In seven specimens (2 males and 5 females) 2 anterior and 2 posterior temporals were observed (Fig. 7*g*, *i*). One female had 3 anterior and 3 posterior temporals (Fig. 7*h*).

Anomalies like spinal, eyes or labial malformations have been found in small numbers during my previous researches occurred in the same nesting site.

Chromatic Characteristics

The juvenile color pattern of the melanistic form of *H. viridiflavus* is different from the adult's one. Coloration changes into a darker or even uniform black dorsal tint with the reaching of adult size and sexual maturity.

The juveniles observed displayed a large variation of pigmentation, especially in the anterior part of body. The color varies from cold tones as gray, light blue or olive, to warm shades as yellow, brown or orange (Fig. 9*l*), with a very bright experience in sunlight. The background tint is covered by a chess-like or blotched pattern (consisting of square/rectangular elements) of different size and color. This pattern begins deeply marked over the neck and gradually disappears within the anterior part of the body. In almost all specimens the dorsal color becomes greenish/olive at about the second third of their length, extending till the tip of the tail. The ventrals are very light, olive/cream, while the mental region is white. The head and the first dorsals of the neck are black or in a few cases of the same color of the dorsal blotches (Fig. 9*a*, *e*, *i*), usually patterned with yellow/cream markings. The snout is regularly lighter in color, grayish, yellowish or reddish, and the supralabials, preoculars and postoculars are partially white or cream. The iris is copper/orange and black and the tongue black with white tips.

Head Pattern Varieties

The pattern of the head shields consists in lines, dots, and other markings of a yellowish/cream color, which creates a strong contrast with the dark background pigment.

Three characteristic elements were present in all the specimens: 1) two symmetric lines starting from the posterior temporals and continuing to the first row of neck scales delineate the perimeter of the parietals. These marks may both, converge on the spine line in a squared or trapezoidal shape (Fig. 8*a*, *e*, *g*, *i* – *k*; Fig. 9*a*, *b*, *d* – *g*, *j*, *k*), or in some cases not connect to each other (Fig. 8*c*, *d*, *h*, *l*; Fig. 9*c*, *h*, *i*). Similar lines, usually parallel to the ones previously described, are present in the neck region and delimitate the beginning of the dorsal pattern. These lines start from the first dorsal scales in contact with the last supralabial and may converge (Fig. 8*b*, *e*, *f*, *k*; Fig. 9*a*, *b*, *e*, *g*, *h*, *j*) or create both symmetrical (Fig. 9*c*) and asymmetrical shapes (Fig. 8*a*, *c*, *h*); 2) two dots in contact with the lines previously described, each one positioned in the posterior limit of the parietal; 3) two symmetrical lines on the supraoculars, which can individually vary in dimension and shape, in some cases creating a single line crossing the frontal shield (Fig. 8*e*, *g*; Fig. 9*h*, *k*).

The largest variation of patterns has been found in the parietal shields. In 24% of the specimens examined there was a total absence of ulterior pattern (Fig. 8*a*, *e*, *i*), or presence by very indistinct markings (Fig. 9*a*) with the only exception of the characteristic elements previously described. In 32% solid dots or lines were present, arranged transversally or longitudinally in a symmetrical way. These markings may differ in number and position. They could consist of a single central dot (Fig. 8*d*), 2 or 3 longitudinal dots (Fig. 8*h*, *l*), 2 to 5 transversal dots (Fig. 8*c*, *g*), or combinations of these (Fig. 8*k*). In 39% the markings were less distinct, creating different symmetrical shapes (Fig. 9*b*, *c*, *e* – *g*, *i* – *k*). Only 3% had a complex but well defined pattern (Fig. 8*b*, *f*, *j*). The remaining 2% were patterned with an asymmetrical arrangement of lines and dots (Fig. 9*d*, *h*).

A second pattern was present in the prefrontal, frontal and supraocular shields. This one was a symmetrical composition usually consisting from 2 to 6 dots. The most common combination of these marks comprised from 3 to 4 elements disposed in a reversed Y-sign with its base in the prefrontals (Fig. 9*e*, *g*, *h*, *j*). In different specimens a single dot positioned at the junction of the

TABLE 2. Data on Specimens ($n = 18$) Selected for Scutellation Counts

Specimen	Id	Weight, g	Length, cm	Dorsals	Ventrals	Subcaudals
♀ 1	055	6	36.5	19	214	106
♀ 2	018	5	36.5	19	212	105
♀ 3	029	6	36.0	19	211	106
♀ 4	079	6	36.0	19	210	102
♀ 5	033	4	33.5	19	207	101
♀ 6	035	4	34.0	19	207	98
♀ 7	010	5	32.5	19	210	106
♀ 8	021	7	37.0	19	209	104
♀ 9	092	5	36.0	19	206	106
♂ 1	070	6	38.0	19	203	107
♂ 2	095	3	34.5	19	201	108
♂ 3	014	5	33.0	19	198	108
♂ 4	094	3	31.0	19	195	101
♂ 5	020	5	36.0	19	196	109
♂ 6	082	3	31.0	19	198	103
♂ 7	022	4	35.0	19	203	105
♂ 8	081	5	35.5	19	196	109
♂ 9	078	3	29.0	19	199	102

Note. The sexes are listed in the same casual order they were originally chosen and examined. Id numbers are the same as those in Table 1.

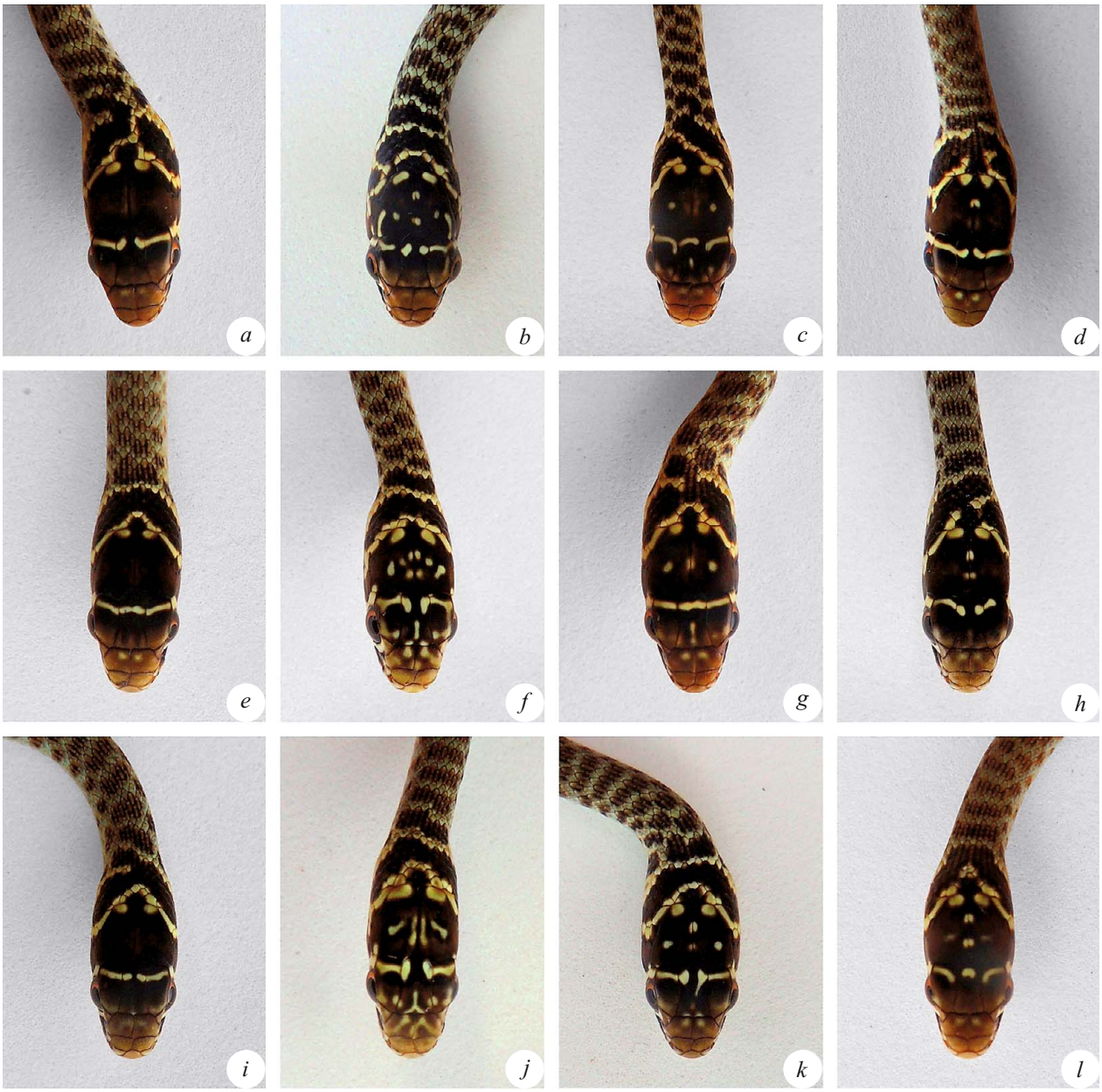

Fig. 8. *a*, specimen with no pattern on the parietals (Id 072); *b*, specimen with elaborated head pattern (Id 098); *c*, specimen with two dots transversally disposed on the parietals (Id 036); *d*, specimen with one dot longitudinally disposed on the parietals (Id 088); *e*, specimen with no pattern on the parietals (Id 039); *f*, specimen with elaborated pattern on upper side of head and snout (Id 017); *g*, specimen with three transverse dots on the parietals (Id 097); *h*, specimen with two longitudinal dots on the parietals (Id 016); *i*, specimen with no markings on the parietals (Id 083); *j*, specimen with elaborated pattern on upper side of head and snout (Id 010); *k*, specimen with four transverse and longitudinal dots on the parietals (Id 070); *l*, specimen with three longitudinal dots on the parietals (Id 053).

frontal with the prefrontals was the center of different compositions. These usually consisted in a pentagonal shape with 5 dots as external corners, or an asterisk sign (Fig. 8*c*) with 5 lines converging to the central dot. Six specimens had additional, more or less definite markings in the supraocular or prefrontal shields (Fig. 8*f*, *j*).

These patterns, independently of their arrangement, were well defined (Fig. 8*d* – *h*) in 29% and less clear (Fig. 9*g* – *i*) in 45% of the specimens examined. In the remaining 26% the markings were indistinct or almost absent (Fig. 9*a*, *c* – *e*, *j*).

Fig. 9. *a*, specimen without dark pigmentation on the head shields (Id 002); *b*, specimen with non-definite parietal pattern and bright orange rostral and internasals (Id 093); *c*, specimen with transversal pattern on the parietals (Id 064); *d*, specimen with asymmetrical pattern on the parietals (Id 079); *e*, specimen with no presence of dark/black pigmentation in the head shields (Id 009); *f*, specimen with non-definite parietal pattern, light forehead tone and yellowish rostral shield and internasals (Id 067); *g*, specimen with transversal parietal pattern and yellowish rostral shield and internasals (Id 089); *h*, specimen with asymmetrical pattern on the parietals (Id 082); *i*, specimen without dark pigmentation in the head shields (Id 005); *j*, specimen with non-definite parietal pattern and bright orange rostral shield and internasals (Id 062); *k*, specimen with transversal pattern on the parietals (Id 071); *l*, examples of the variation of dorsal color and pattern.

DISCUSSION

The data compiled allow to understand the different morphological aspects of hatchlings of melanistic *H. viridiflavus* belonging to the analyzed nesting site and partly of this species generally.

The sex ratio of the hatchlings examined was almost equal, consisting of 53% females and 47% males. Similar

values have been recorded in the summer months of 2012, where the specimens collected (originated from the same communal nesting site) consisted of 54.29% females and 45.71% males (Paterna, unpubl. data). Most of the specimens observed (98%) measured between 30 and 37 cm, and 95% had a weigh between 3 and 6 g. Only a few exceptions have been found (29 and 38 cm; 1, 2, and 7 g, respectively) which represented the minimum and maximum values of all the analyzed specimens.

The recorded values differ from those prevailing in literature, where hatchlings of *H. viridiflavus* are described measuring between 15 and 25 cm (Vanni and Nistri, 2006a, 2006b), about 20 cm (Rugiero et al., 2012), from 20 to 25 cm (Andreone, 2003; Bologna et al., 2000; Bruno, 1984, 1998; Bruno and Maugeri, 1990; Ferri, 1992, 1993; Ferri and Dell'Acqua, 1992; Ferri and Soccini, 2002; Gentilli and Scali, 2008; Heimens, 1993; Meyer et al., 2009; Vanni and Nistri, 2006a, 2006b; Vacher and Geniez, 2011; Vanni and Zuffi, 2011), 20 to 28 cm (Di Tizio et al., 2008), or about 23 cm (Frösch, 1985), and to have a weight of less than 1.2 g (Bruno, 1998).

Sexual dimorphism has been found in the different counts of ventrals and subcaudals. Females had a higher number of ventrals and a lower number of subcaudals than males. However, my analysis showed an additional distinctive character of sexual dimorphism. Even when the total length and weight averages were not significantly different between the sexes, results revealed that females reach higher weights. This could also be confirmed by the studies of the same communal nesting site in the years 2012 and 2013, where the weight of females ranged from 4 to 7 g and males from 3 to 6 g (Paterna unpublished data). Additionally, the percentage of longer individuals was higher in females than in males. These results are contrary to literature records where adult males are described to reach larger sizes than females (Kreiner, 2007; Meyer et al., 2009; Scali and Montonati, 2000; Schätti and Vanni, 1986, Springolo and Scali, 1998; Vanni and Nistri 2006a, 2006b).

My study regarding the head scutellation resulted that 84% of examined specimens shared the same number of shields, and the data in question match those of Schätti and Vanni (1986) and Vanni and Zuffi (2011). In 12% of the specimens divergences in their values of supralabials and temporals have been observed. The remaining 4% presented cases of anomalies or malformations concerning supralabials, suboculars, presuboculars and loreals.

The variations of color and dorsal pattern are summarized in Fig. 9*l*. The main categories of the head pattern concerning parietal and frontal shields are described and illustrated in Figs. 8 and 9.

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REFERENCES

Andreone F. (2003), *Rettili & Anfibi in Alta Valesia*, Parco Naturale Alta Valesia, 7 – 11.

Bonaparte C. L. (1883), *Iconografia della fauna italica* (*1832 – 1841*). *II. Anfibi. Fasc. 5*, Tipogr. Salviucci, Roma.

Bologna M. A., Capula M., and Carpaneto G. M. (eds.) (2000), *Anfibi e rettili del Lazio*, Fratelli Palombi Editori, Roma, pp. 90 – 91.

Bruno S. (1984), *Serpenti d'Italia*, Giunti, Firenze, p. 52.

Bruno S. (1998), *Serpenti*, Giunti Editore, Firenze-Milano, pp. 44 – 45.

Bruno S. and Maugeri S. (1990), *Serpenti d'Italia e d'Europa*, Editoriale Giorgio Mondadori, Milano, p. 113.

Capula M. and Luiselli L. (1995), "*Hierophis viridiflavus* (western whip snake), Communal nesting," *Herpetol. Rev. Lawrence*, **26**, 38 – 39.

Di Tizio L., Pellegrini Mr., Di Francesco N., and Carafa M. (eds.) (2008), *Atlante dei Rettili d'Abruzzo*, Ianieri-Talea Edizioni, Pescara, p. 78.

Ferri V. and Dell'Acqua A. (1992), *Guida al Terrario e al Terracquario*, De Vecchi Editore, Milano, pp. 126 – 128.

Ferri V. (1992), *Il libro dei serpenti di tutto il mondo*, De Vecchi Editore, Milano, pp. 78 – 79.

Ferri V. (1993), *I serpenti d'Italia e d'Europa*, De Vecchi Editore, Milano, p. 70.

Ferri V. and Soccini C. (2002), *Tutto Serpenti*, Mondadori Electa, Milano, pp. 58 – 59.

Filippi E., Anibaldi C., Capizzi D., Ceccarelli A., Capula M., and Luiselli L. (2007), "Long-term fidelity to comunal oviposition sites in *Hierophis viridiflavus*," *Herpetol. J.*, **17**, 7 – 13.

Frösch P. (1985), *Gli incompresi*, Jam SA Tipo-Offset, Lodrino, p. 107.

Gentilli A. and Scali S. (2008), *Ricerca e conservazion, Rettili della bassa Valtellina, ecologia, rapporti con l'uomo e problemi di conservazione*, Atti del Museo civico di Storia naturale di Morbegno, pp. 63 – 66.

Heimens P. (1993), "*Coluber viridiflavus* Lacépède 1789, Gelbgrüne Zornnatern," in: W. Böhme (Hrsg.), *Handbuch der Reptilien und Amphibien Europas. Band 3/I. Schlangen I*, Aula, Wiesbaden, pp. 177 – 198.

Kreiner G. (2007), *The snakes of Europe*, Chimaira, Frankfurt am Main, p. 76.

Lacépède B. G. E. (1789), *Histoire Naturelle des Quadrupèdes Ovipares et de Serpents. Vol. 2*, Imprimerie du Roi, Hôtel de Thou, Paris.

Meyer A., Zumbach S., Schmidt B., and Monney J.-C. (2009), *Les amphibiens et les reptiles de Suisse*, Haupt Verlag.

Nagy Z. T., Joger U., Guickung D., and Wink M. (2002), "Phylogeography of the European whip snake *Coluber* (*Hierophis*) *viridiflavus* as inferred from nucleotide sequences of the mitochondrial cytochrome b gene and ISSR genomic fingerprinting," *Biota Race*, **3**(1 – 2), 109 – 118.

Rugiero L., Capula M., Vignoli L., and Luiselli L. (2012), "Offspring condition determines dispersal patterns in western whip snakes, *Hierophis viridiflavus*," *Herpetol. J.*, **22**(4), 259 – 261.

Schätti B. and Vanni S. (1986), "Intraspecific Variation in *Coluber viridiflavus* Lacépède, 1789, and validity of its subspecies (Reptilia, Serpentes, Colubridae)," *Rev. Suisse Zool.*, **93**(1), 219 – 232.

Scali S. and Montonati S. (2000), "Analisi multivariata del dimorfismo sessuale in due specie di colubrini italiani (*Coluber viridiflavus* ed *Elaphe longissima*: Reptilia, Serpentes, Colubridae) su basi biometriche," in: "*Atti I Congresso nazionale SHI* (*Torino*, *1996*)," Museo regionale di Scienze naturali, Torino, pp. 429 – 434.

Schulz K.-D. (1996), *A monograph of the colubrid snakes of the genus* Elaphe *Fitzinger*, Koeltz Scientific Books, Havlikuv Brod.

Springolo S. and Scali S. (1998), "Sexual dimorphism and ontogenetic changes in *Coluber viridiflavus*: a head morphometric analysis," in: *Curr. Studies in Herpetol.*, Soc. Herpetol. Eur., Le Bourget du Lac (France), pp. 413 – 417.

Vacher J.-P. and Geniez M. (2011), *Les reptiles de France*, *Belgique*, *Luxembourg et Suisse*, Ed. Biotope/MNHN.

Vanni S. and Nistri A. M. (2006a), *Atlante degli Anfibi e dei Rettili della Toscana*, Edizioni Regione Toscana, Roma, pp. 288 – 291.

Vanni S. and Nistri A. M. (2006b), "*Hierophis viridiflavus*," in: Sindaco R., Doria G., Razzetti E., and Bernini F. (Eds.), *Atlante degli Anfibi e dei Rettili d'Italia* [*Atlas of Italian Amphibians and Reptiles*], Soc. Herpetol. Italica – Edizioni Polistampa, Firenze, pp. 544 – 547.

Vanni S. and Zuffi M. A. L. (2011), "*Hierophis viridiflavus* (Lacépède, 1789)," in: Corti C., Capula M., Luiselli L., Razzetti E., and Sindaco R. (eds.), *Fauna d'Italia. Vol. 45. Reptilia*, Calderini Ed., Bologna, pp. 509 – 516.

Zuffi M. A. L., Fornasiero F., and Bonnet X. (2007), "Geographic variation in reproductive output of female European whip snakes (*Hierophis viridiflavus*)," *Herpetol. J.*, **17**, 219 – 224.