pdf can be found:
www.ursenbacher.com/teaching/Reptilien2019.pdf

info fauna CSCF

info fauna karch

University of Basel

Reptilia: Crocodiles

Reptilia: Tuataras

Reptilia: turtles

Reptilia: Squamata: snakes

Reptilia: Squamata: amphisbaenians

Reptilia: Squamata: lizards

Phylogeny

Tetrapoda

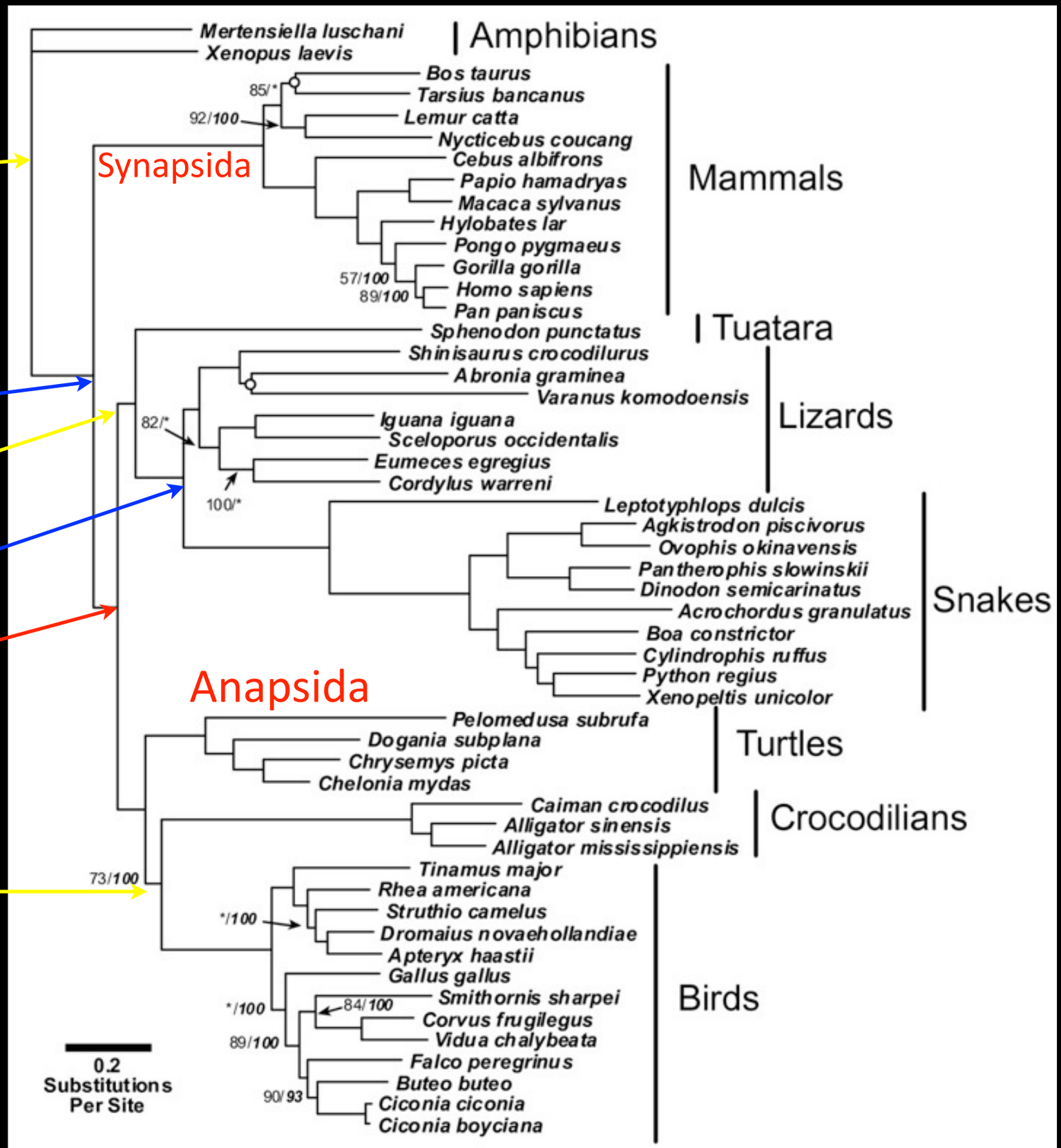
Amniota

Lepidosauria

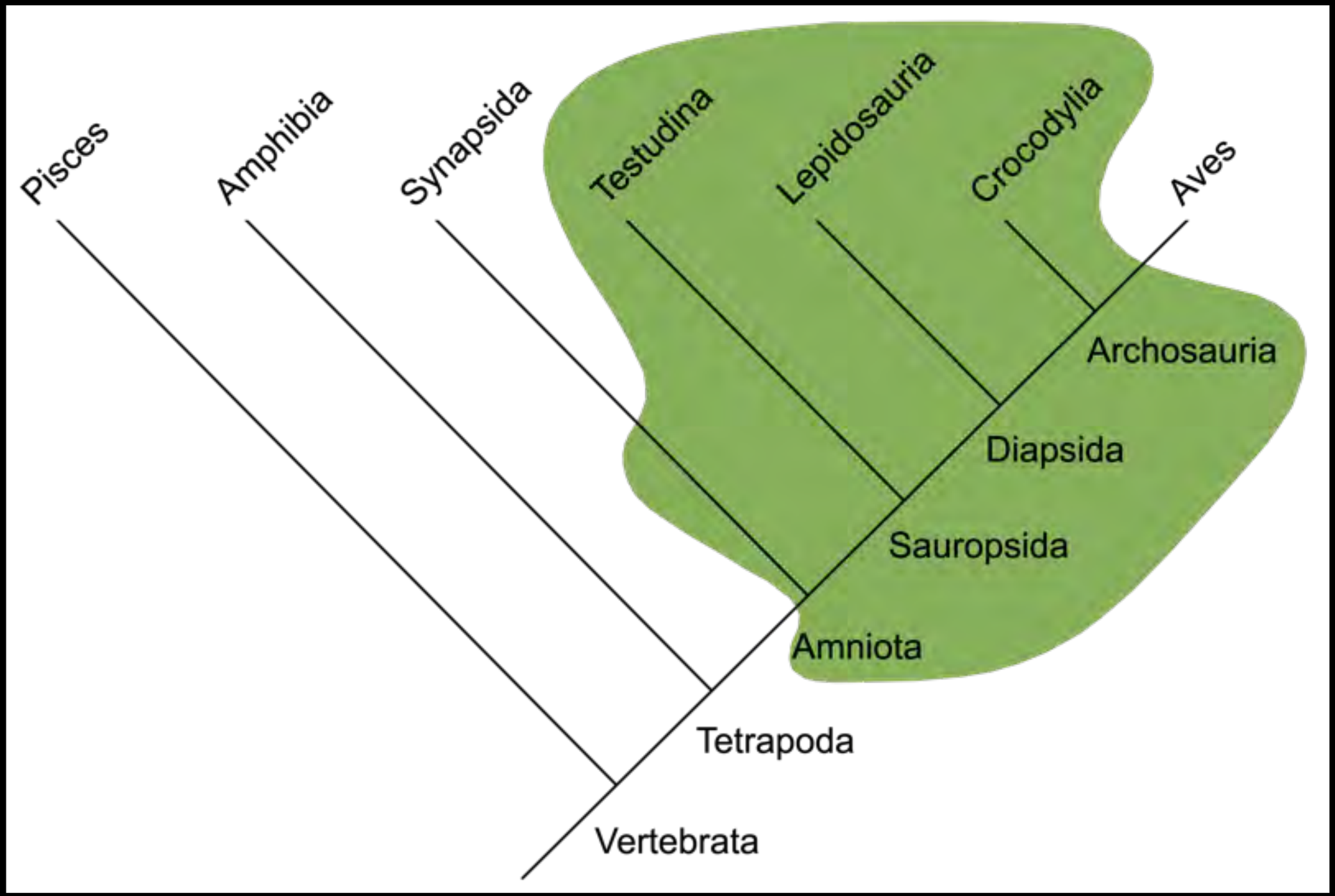
Squamata

Sauropsida

Archosauria



Phylogeny

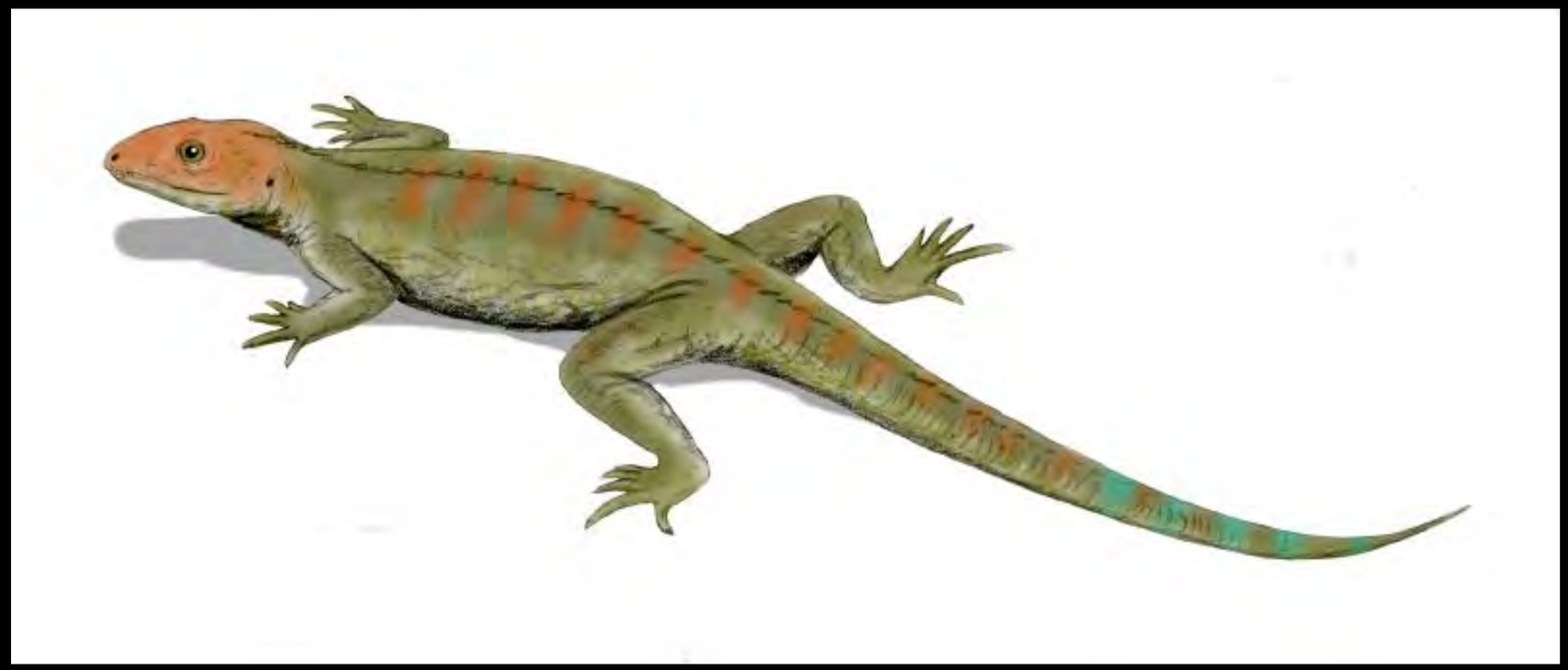

Pisces
Amphibia
Synapsida
Testudina
Lepidosauria
Crocodylia
Aves
Archosauria
Diapsida
Sauropsida
Amniota
Tetrapoda
Vertebrata

amphibians – reptiles: differences

	Amphibians	Reptiles
skin	*numerous glands, generally wet, without scales*	*without or with limited number of glands, dry, with scales*
reproduction	*most of them in water, larval stage*	*no links with water, without a larval stage*
eggs	*most of them in water, packed in tranparent jelly*	*not in water, hard shell (leathery or with calk)*
venom	*passive transmission of venom, toxic skin as passive protection*	*some species with active venom injection*
habitats	*Generally in humide and shady areas, nearby or directly in aquatic habitats*	*Generally dry and warm habitats, away from aquatic habitats*
migration	*large seasonal movements inducing big traffic problems*	*no or limited seasonal movements, limited traffic problems*

First reptiles

- first reptiles: about 320-310 millions years ago
- embryo is protected against dehydration
- ≈ 305 millions years ago: a dryer period ➜ new habitats for reptiles
- Mesozoic (252-66 mya): “Age of Reptiles”
- large disparition of species: ≈ 252 and 65 millions years ago



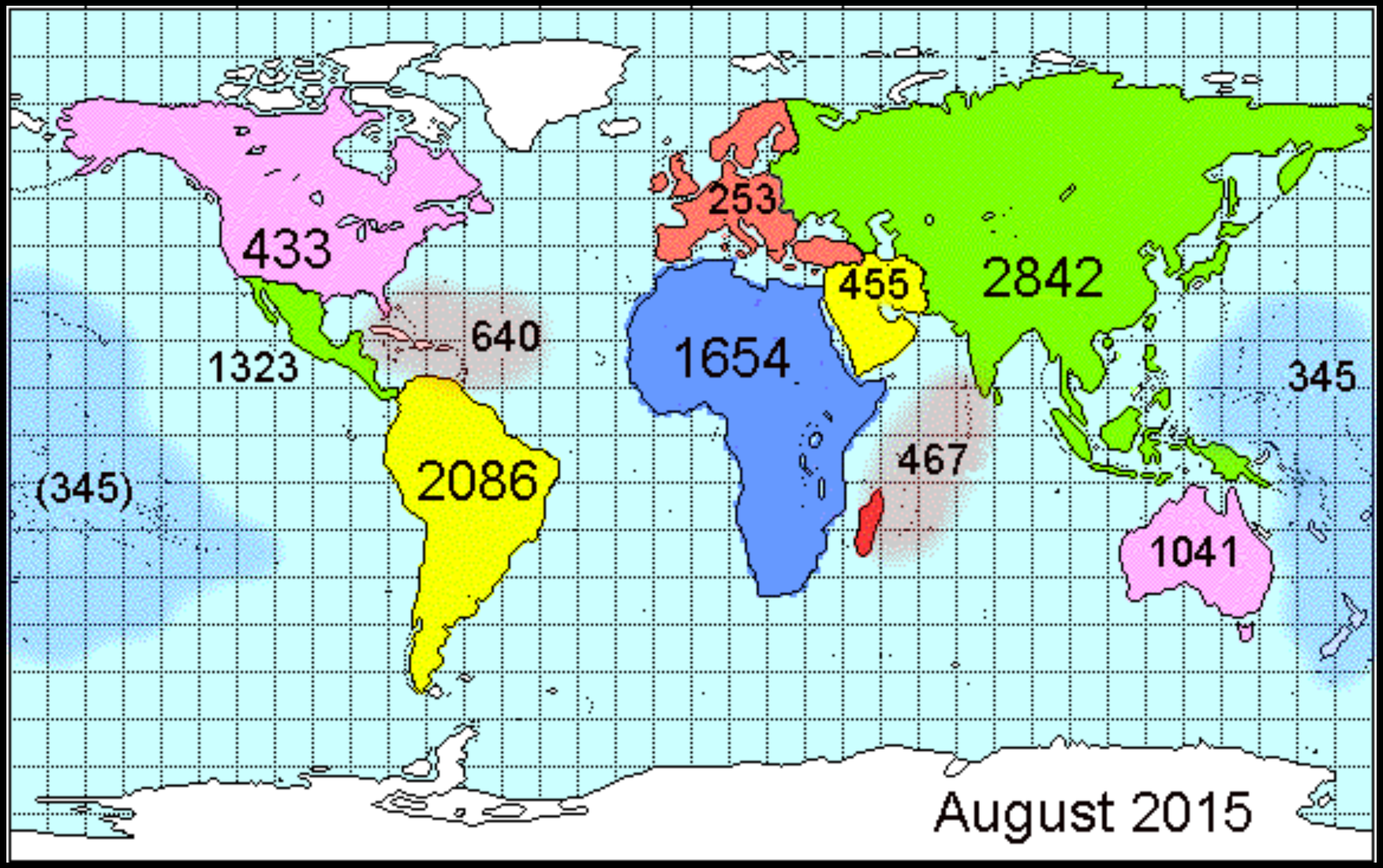
Mesozoic

quick systematic overview

	total species (Oct. 2017)	CH species
▪ **order Crocodylia (crocodiles)** ***Crocodiles, alligators, caimans and garvial***	**24**	**0**
▪ **Order Testudines (turtles)** ***terrestrial and aquatic turtles (tortoises and turtles)***	**350**	**1**
▪ **Order Rhynchocephalia** ***Tuataras***	**1**	**0**
▪ **Order Squamata (scales reptiles)**		
clade Amphisbaenia (*worm lizards*)	**193**	**0**
clade Lacertilia or Sauria (*lizards*)	**6’399**	**6**
clade Ophidia or Serpentes (*snakes*)	**3’672**	**9**
Total	**10’639**	**16**

source: http://www.reptile-database.org

worldwide diversity of reptiles (2015)



source: http://www.reptile-database.org

turtles and lizard of Switzerland

I. **Order Testudines**

Family *Emydidae* (Pond Turtles)

European pond turtle	***Emys orbicularis***

II. **Order Squamata**

clade Lacertilia

Family *Anguidae* (Schleichen)

slow worm	***Anguis fragilis***
Italian slow worm	***Anguis veronensis***

Family *Lacertidae* (Eidechsen)

viviparous or common lizard	***Zootoca vivipara***
sand lizard	***Lacerta agilis***
Western green lizard	***Lacerta bilineata***
wall lizard	***Podarcis muralis***

snakes of Switzerland

II. Order Squamata

clade Ophidia

Family *Colubridae* (Colubrids)

Western grass snake	***Natrix natrix***
Barred grass snake	***Natrix helvetica***
Dice snake	***Natrix tessellata***
Viperine snake	***Natrix maura***
Smooth snake	***Coronella austriaca***
Green whip snake	***Hierophis viridiflavus***
Aesculapian snake	***Zamenis longissimus***

Family *Viperidae* (Vipers)

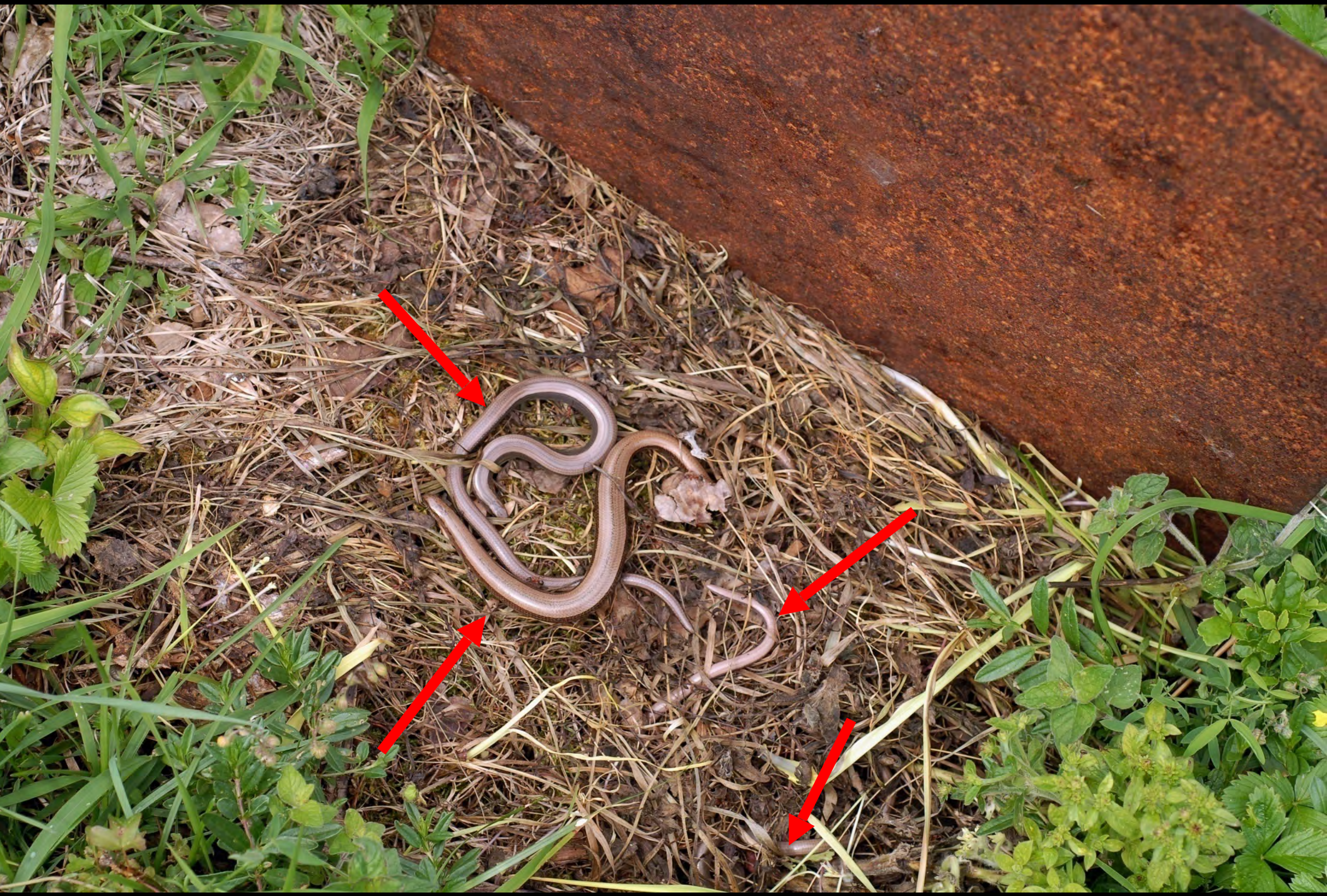
Adder	***Vipera berus***
Asp viper	***Vipera aspis***

slow worm (*Anguis fragilis*)

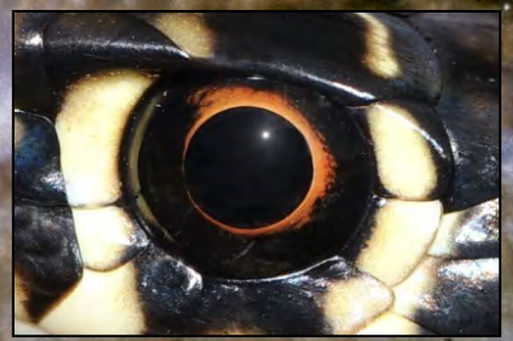
slow worm: characteristics

- length: about. 40 cm (♂ max. 48 cm, ♀ max. 38 cm)
- long tail, snout-vent length only about 1/3 of the total length
- bright and smooth scales
- similar scales on the back and on the belly (on the opposite to snakes)
- coloration: grey to copper brown;
  ♂: generally uniformly grey, sometimes with blue dots,
  ♀ and juveniles: dark on the flancs, generally with a small dark line on the back
- viviparous
- harmless

easy to find under plates, boards, etc…



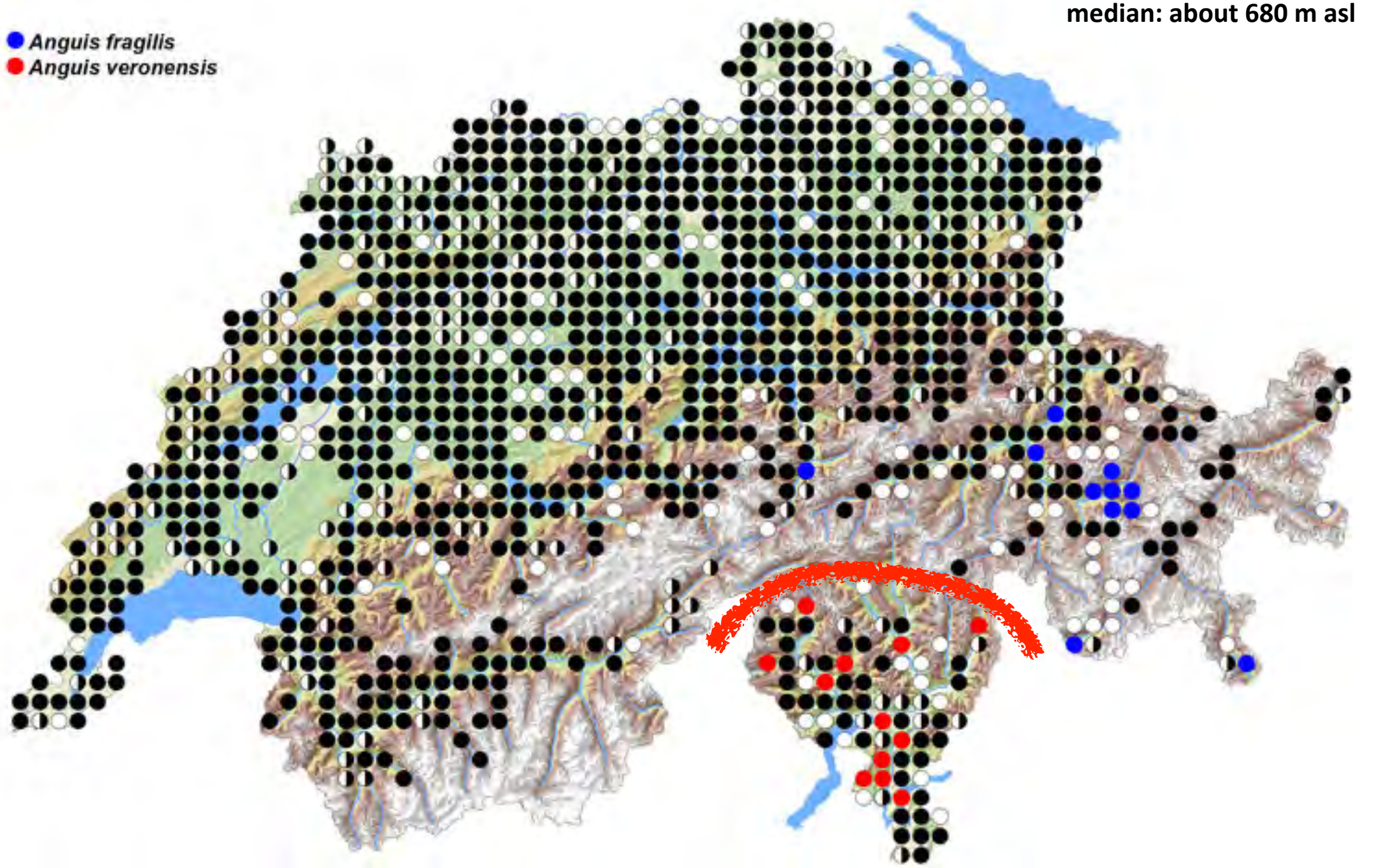
difference with snakes



Slow worms: Swiss distribution

altitudinal range: 230 – 2100 m asl

median: about 680 m asl



Italian slow worm, young male

Italian slow worm, female

Sand lizard (*Lacerta agilis*)

Sand lizard: characteristics

- solid body, large head
- round body section
- short tail, about 1/2 of the total length
- length: a bit more than 20 cm (♂ max. 22 cm, ♀ max. 21 cm)
- coloration: ♂ light green on the flancs, but braun on the back.
  ♀ and juveniles: braun with spots (light with edged with black) on the flancs
- oviparous
- relatively slow lizard, and really agile
- do not clim vertical structures

♂

Sand lizard: Swiss distribution

Lacerta agilis

altitudinal range: 330 – 1580 m asl.

meadian: ca. 530 m asl

< 1992 1992 - 2001 2002 - 2011

1:1'300'000

viviparous lizard (*Zootoca vivipara*)

viviparous lizard: characteristics

- small and slender body
- small and round head
- round body section
- tail relatively long, about 2/3 of the total length
- the smallest Swiss lizard about 15 cm (♂ max. 15 cm, ♀ max. 15 cm)
- coloration: always braun, with different shades of braun, some dorsal marks darker; belly is lighter, but can be orange; totally dark individuals frequent, especially juveniles
- viviparous
- move in the vegetation more or less like a snake
- does not climb vertical structures

Viviparous lizard: Swiss distribution

Zootoca vivipara

altitudinal range: 330 – 2500 m asl

median: 1100 m asl

< 1992 1992 - 2001 2002 - 2011

1:1'300'000

Wall lizard (*Podarcis muralis*)

Wall lizard: characteristics

- slender thin body
- flat body section, with a sharp snout
- long tail, about 2/3 of the total length
- long and fine fingers
- length: 16 - 20 cm (♂ max. 21 cm, ♀ max. 16 cm)
- coloration: colour and pattern variable, generally braun with dark markings
  ♀ and juveniles: with dark flancs, less flecked than males
- oviparous
- very quick, very good climber on wall or other vertical structures
- frequent in human modified habitats

Wall lizard: Swiss distribution

Podarcis muralis

altitudinal range : 190 – 2200 m asl

median: ca. 650 m asl

< 1992 1992 - 2001 2002 - 2011

1:1'300'000

Western green lizard (*Lacerta bilineata*)

Western green lizard: characteristics

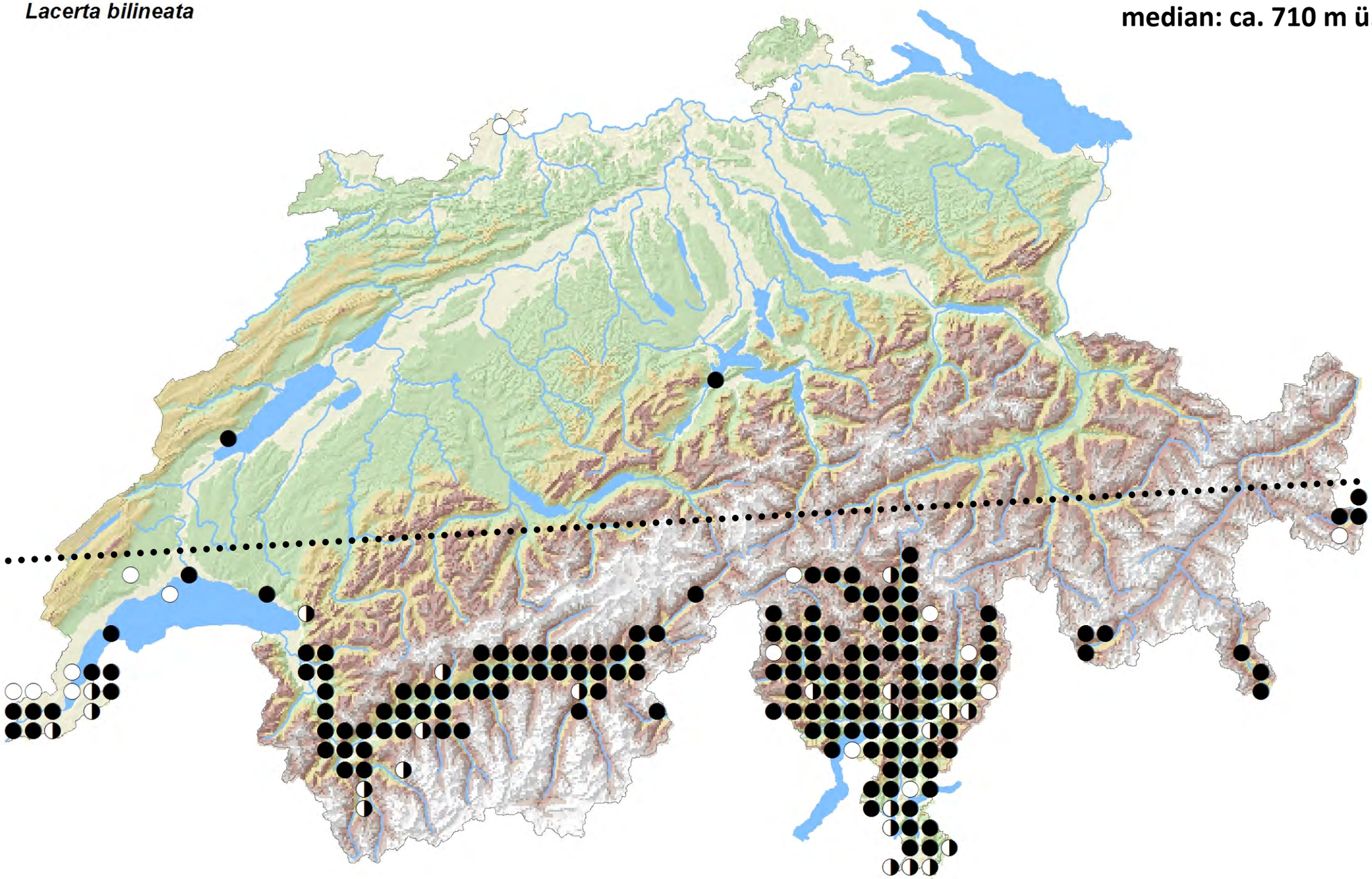
- large, massive body
- massive head, especially for ♂
- body section round
- long tail, about 2/3 of the total length
- the largest Swiss lizard: generally about 30 cm (♂ max. 36 cm, ♀ max. 33 cm)
- coloration: ♂ light green, both on the side and the flanks;
  ♀ and juveniles: more variable, but totally green, without dots. Frequently with 2 fines light lines on the back.
- oviparous
- quick, normal very shy
- generally do not clim on vertical structures

Western green lizard: Swiss distribution

altitudinal range: 190 – 2020 m

median: ca. 710 m ü.M.

Lacerta bilineata

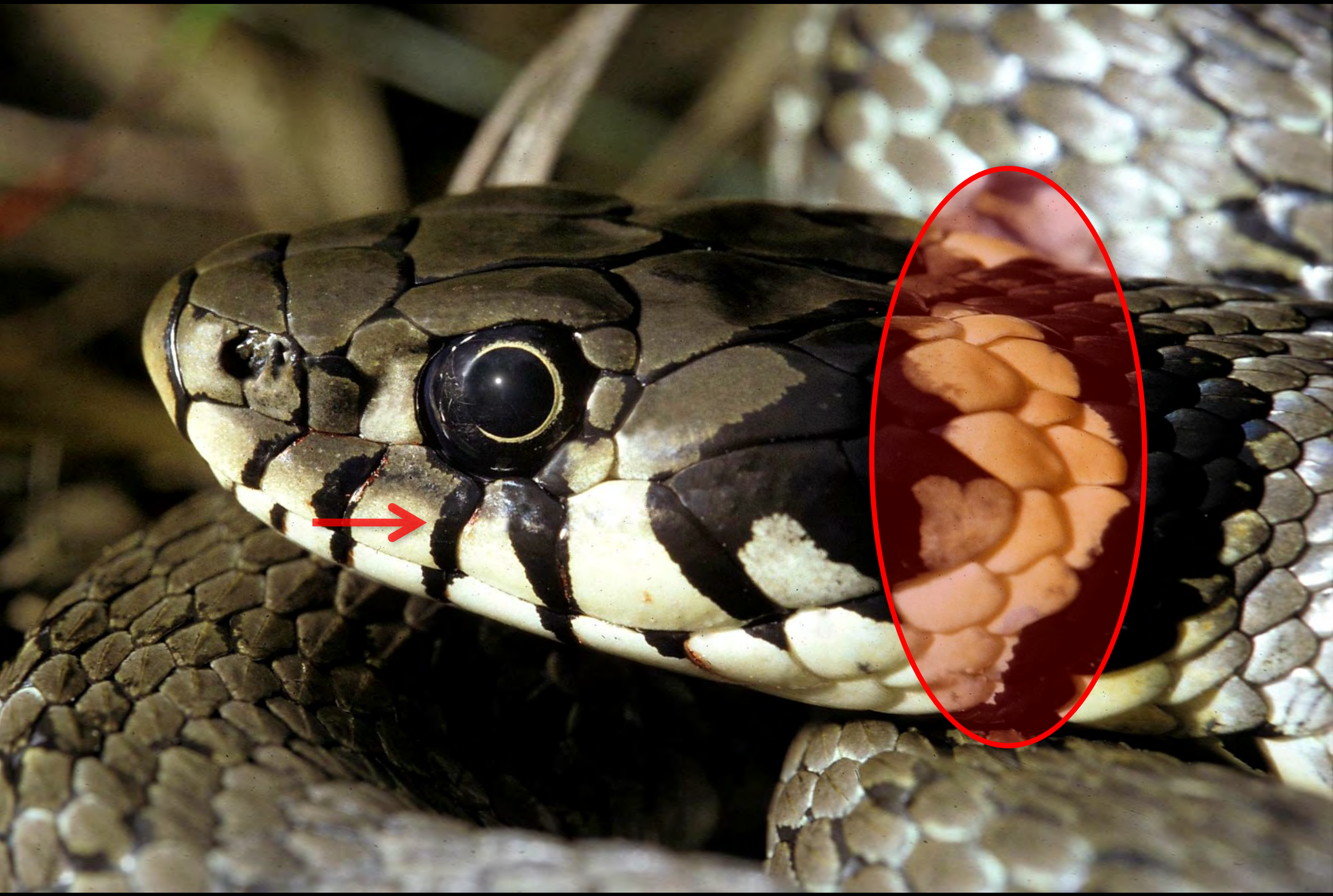


1:1'300'000

Grass snakes (*Natrix natrix* and *N. helvetica*)

grass snakes: characteristics

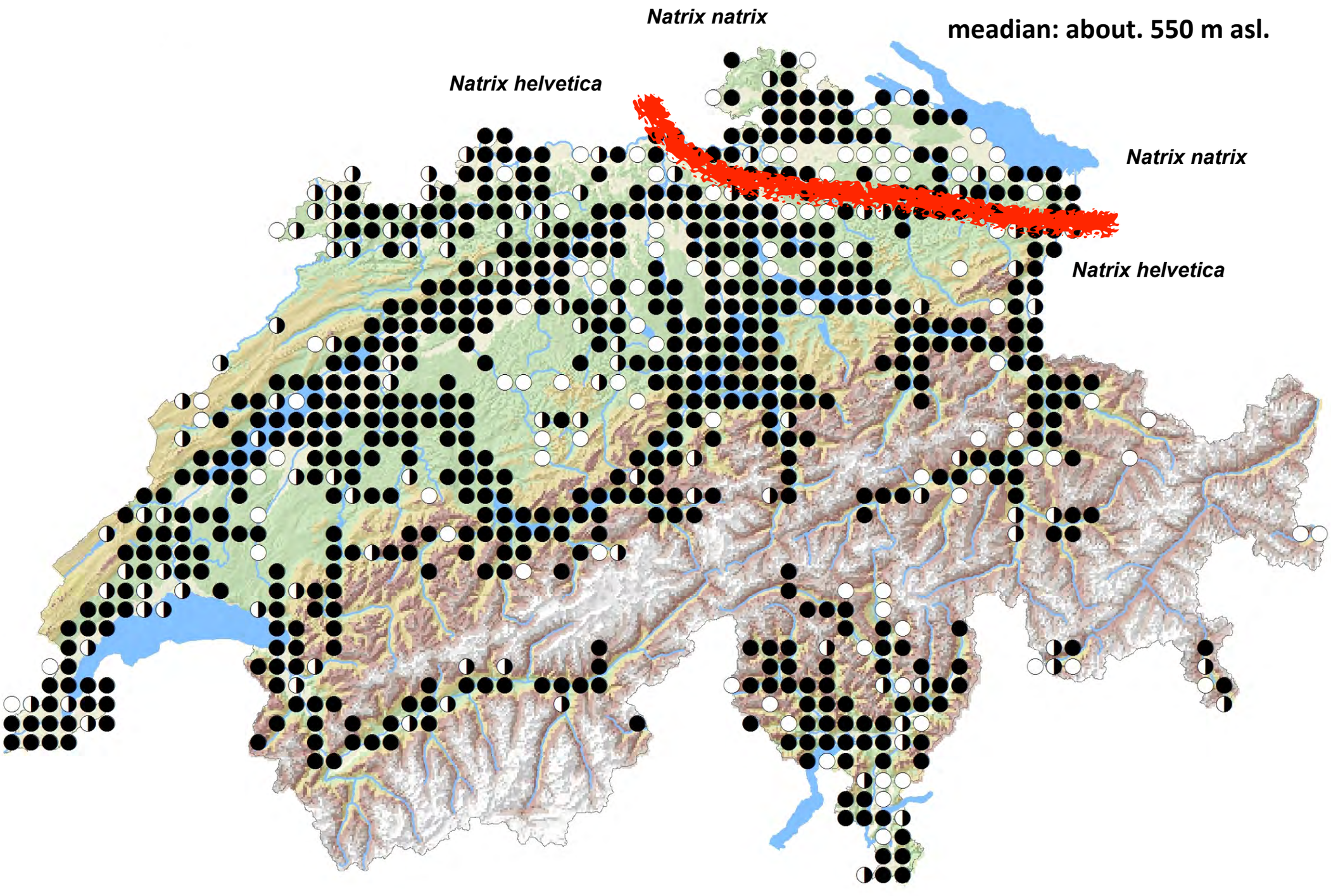
- quite massive snake (especially ♀ ♀)
- size: up to 130 cm (♂ max. 91 cm, ♀ max. 140 cm)
- round pupil
- keeled dorsal scales
- coloration: variable, generally grey or braun, more rarely olive or blue-grey, sometimes black. With lines on the flancs and on the back, larger for *N. helvetica* than for *N. natrix*.
- two crescent-shaped marks yellow followed by black on the neck; the crescent-shaped marks can be white or orange, or even lacking.
- oviparous
- relatively quick, shy
- very good swimmer and diver
- as defensive behavior: cloacal gland secretion, hissing, or can feign death
- not venomous, do not bite



Grass snakes: Swiss distribution

altitudinal range: 190 – 1970 m asl.

meadian: about. 550 m asl.



Dice snake (*Natrix tessellata*) and viperine snake (*N. maura*)

Natrix tessellata

Natrix maura

Dice snake and Viperine snake: characteristics

- morphologically and ecologically very similar
- size: *N. tessellata*: about 110 cm (♂ max. 76 cm, ♀ max. 117 cm)
  N. maura: about 70 cm (♂ max. 60 cm, ♀ max. 81 cm)
- small head, slender snout
- round pupil
- keeled dorsal scales
- coloration: braun/grey, sometime a bit more olive. *N. tessellata* with regular black marks on the back and on the flanks; *N. maura* more with a zigzag on the back
- viviparous
- aquatic species that eat mainly fish (some amphibians), so very good swimmer and diver
- run away in water when disturbed
- as defensive behavior: cloacal gland secretion, hissing, or can feign death
- non venomous, do not bite

Dice snake
(Lumino, TI)

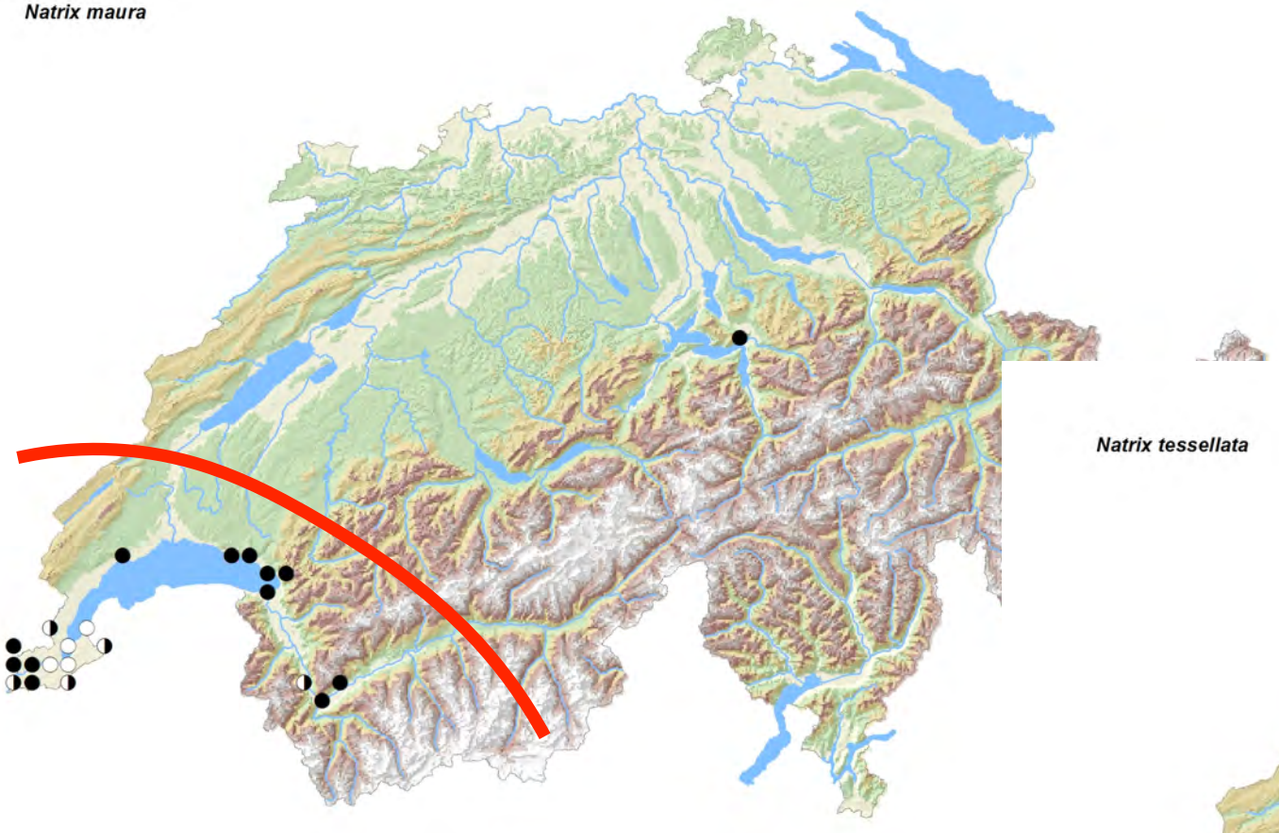
Viperine snake
(GE)

Dice snake and Viperine snake: Swiss distribution

altitudinal range: 380 – 480 m asl

median: about 400 m asl

Natrix maura

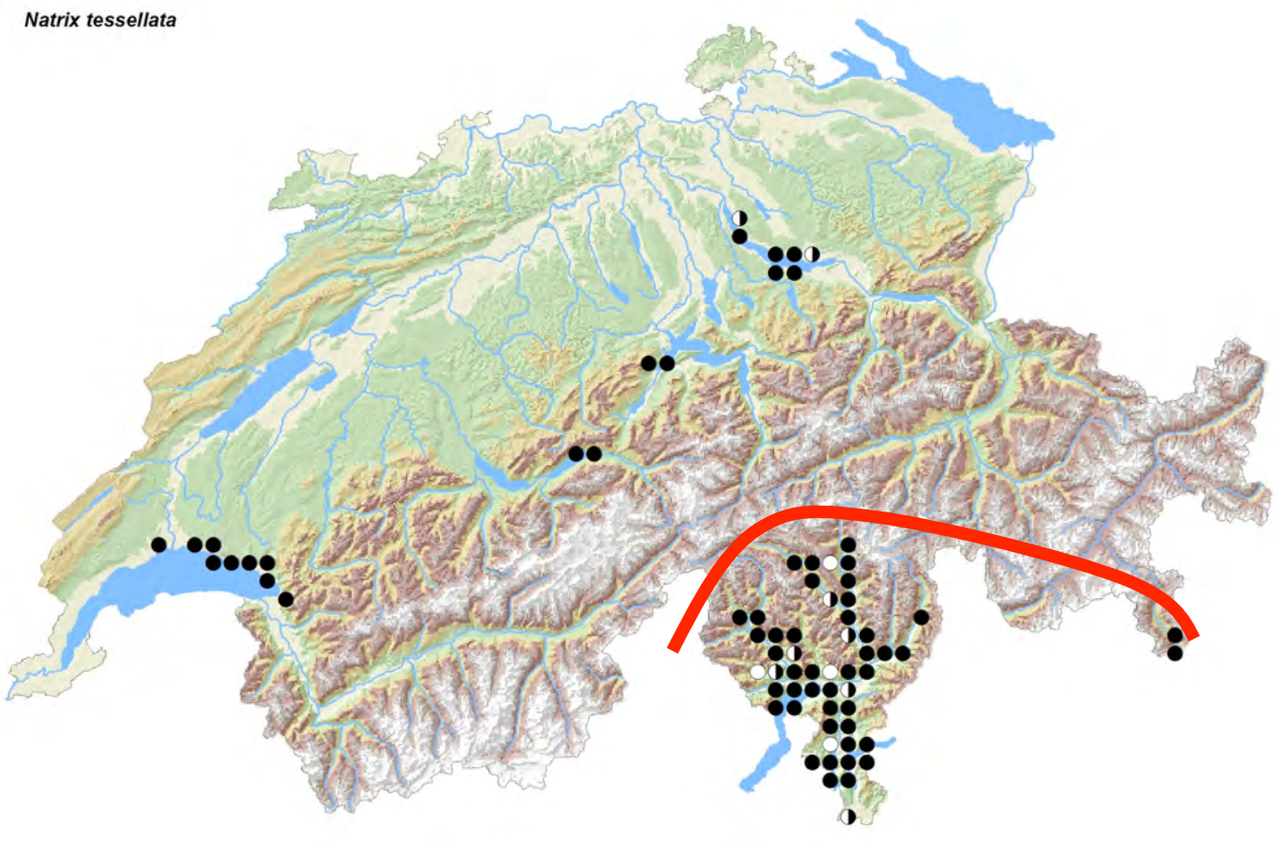


< 1992 1992 - 2001 2002 - 2011

altitudinal range: 190 – 900 m asl

median: env. 400 m asl

Natrix tessellata



< 1992 1992 - 2001 2002 - 2011

1:1'300'000

smooth snake (*Coronella austriaca*)

smooth snake: characteristics

- thin, slender snake, the smallest species in Switzerland
- size: generally about 60 – 70 cm (♂ max. 75 cm, ♀ max. 95 cm)
- head not differentiated from the body
- round pupil
- dorsal scales not keeled (seems to be very smooth)
- coloration: grey, braun or beige; some dark braun marks on the backs with pattern changing between individuals, sometimes forming lines
- one typical line on the head going through the eye; marks on the head and on the neck that are individually specific.
- viviparous
- prey: mainly reptiles, also small mammals
- can bite if captured
- move slowly; normally do not escape or only really late before being capture
- very shy species, difficult to see exposed
- non venomous, but can bite (harmless)

smooth snake: Swiss distribution

Coronella austriaca

altitudinal range: 210 – 2240 m as

median: about 750 m asl

< 1992 1992 - 2001 2002 - 2011

1:1'300'000

Green whip snake (*Hierophis viridiflavus*)

Green whip snake: characteristics

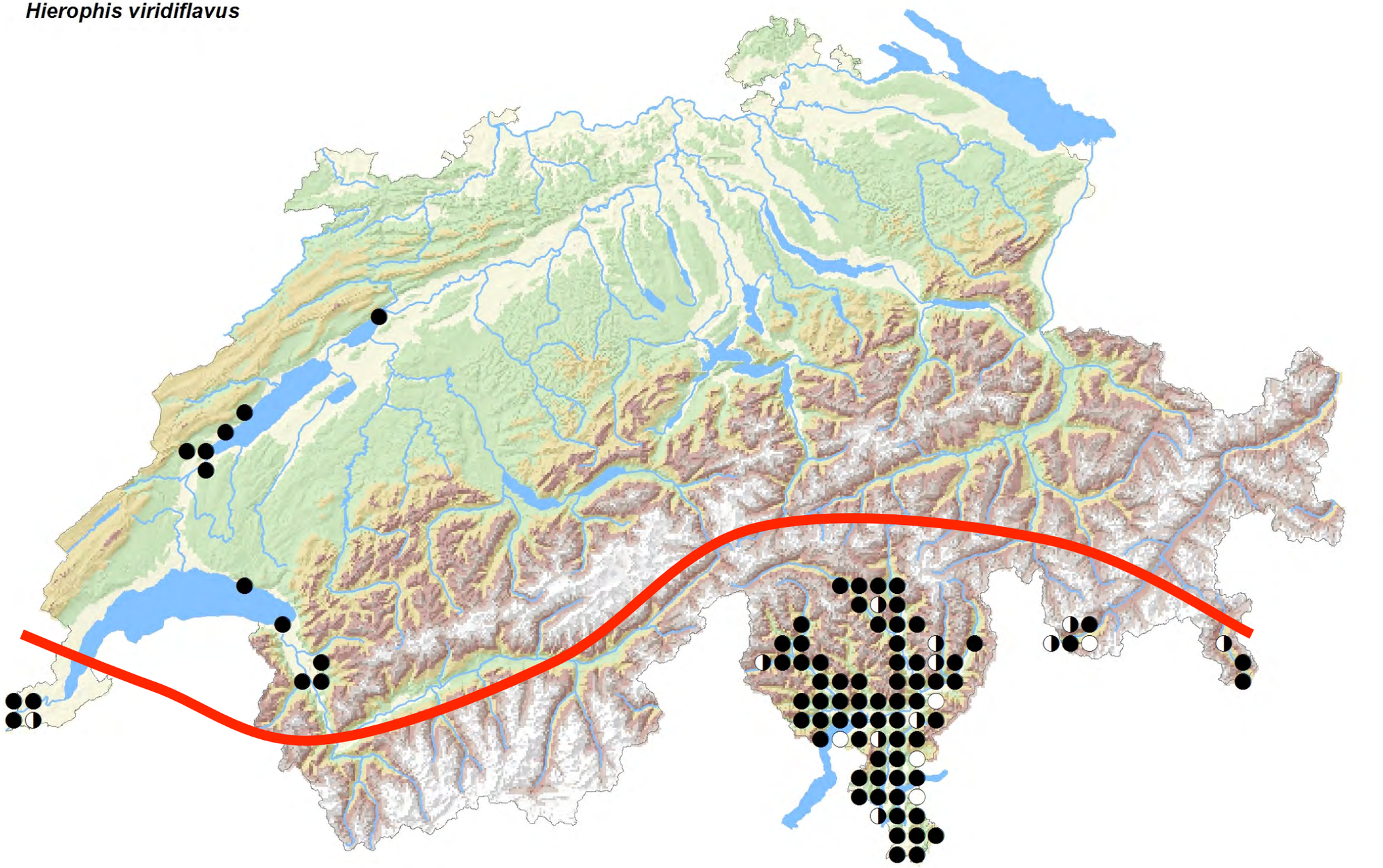
- slender but , strong body
- size: up to 150 cm (♂ max. 192 cm, ♀ max. 140 cm)
- head not separated from the body
- round pupil
- dorsal scales not keeled
- coloration: adult: quite dark with some yellow spots; juveniles more braun
- oviparous
- prey: not specific, eat more or less everything (reptiles, mammals, birds)
- move very quickly, noisily with a large escape distance
- when captured: bite immediately, very agressive.
- non venomous (harmless)
- frequent in Ticino

Green whip snake: Swiss distribution

altitudinal range: 195 – 1100 (1800) m asl

median: about 550 m asl

Hierophis viridiflavus



1:1'300'000

Aesculapian snake (*Zamenis longissimus*)

Aesculapian snake: characteristics

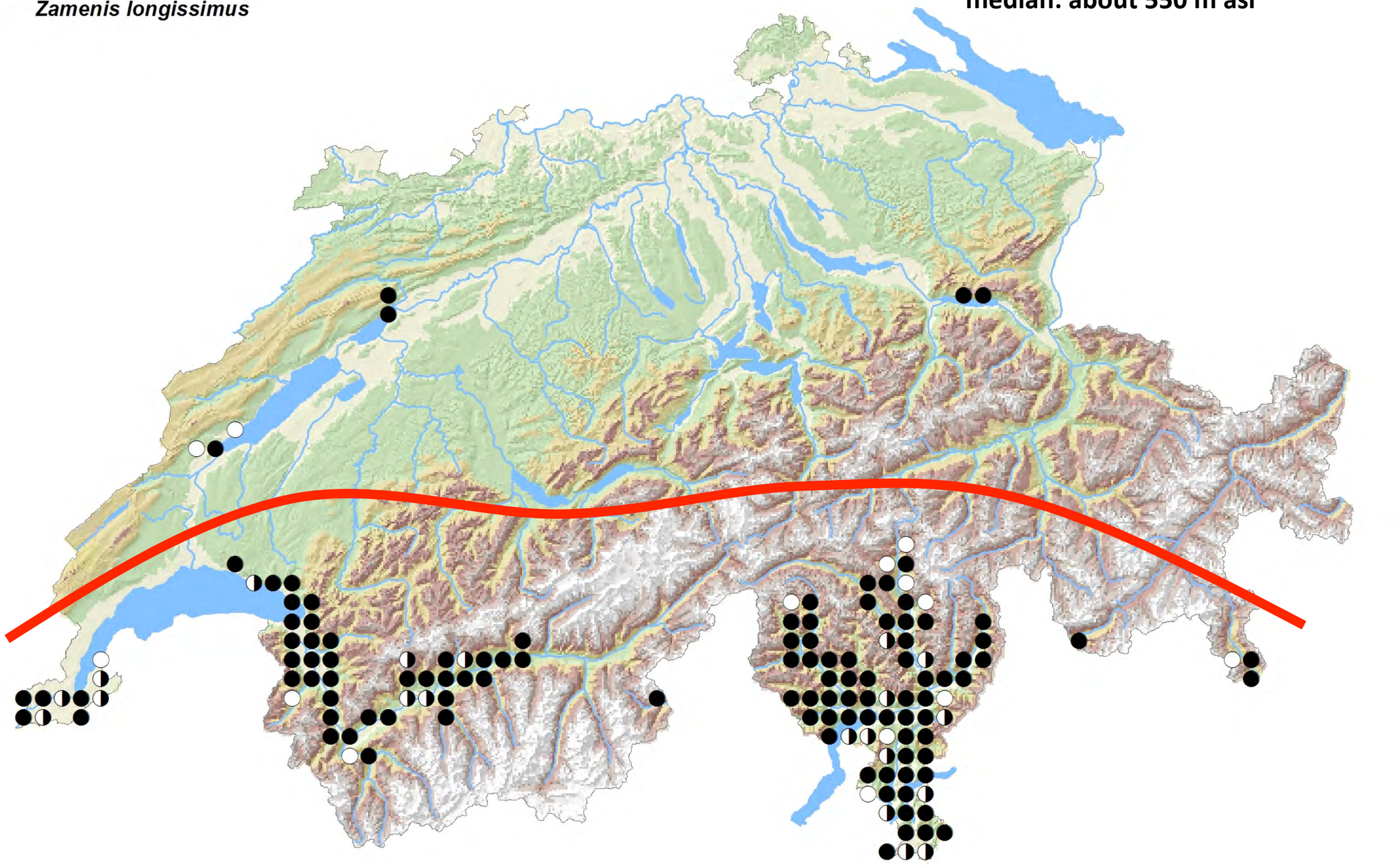
- slender, strong, elegant body
- size: generally up to 150 cm (♂ max. 148 cm, ♀ max. 122 cm)
- head not separated from the body
- round pupil
- dorsal scales not keeled
- Coloration: braun, sometime quite light, can also be a bit greenish or yellowish. Sometime lateral bande a bit darker. Juveniles with a small "collar" like the grass snakes, with more dark marks on the back.
- oviparous
- prey: small mammals, birds, eggs, rarely reptiles
- move slowly, short escape distance, stay generally without movement
- very discreet snake
- can bite when captured
- not venomous (harmless)

Aesculapian snake: Swiss distribution

altitudinal range: 200 – 1000 (1600) m asl

median: about 550 m asl

Zamenis longissimus



○ < 1992 ◑ 1992 - 2001 ● 2002 - 2011

1:1'300'000

venomous snakes in Switzerland

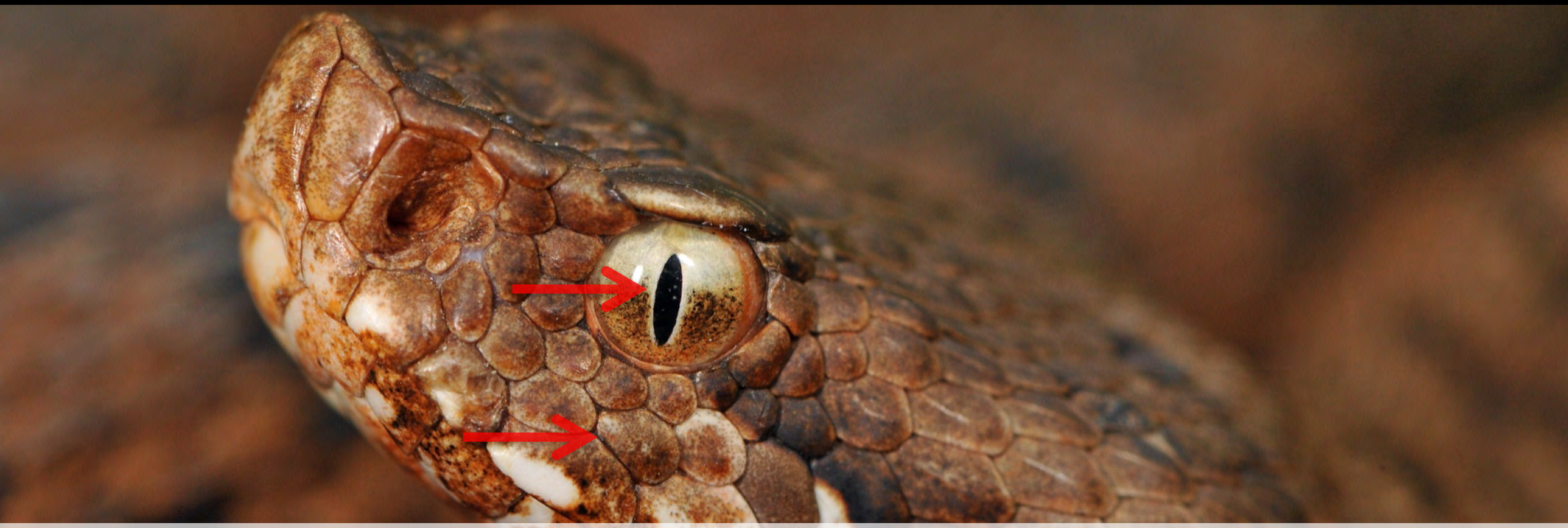
asp viper (*Vipera aspis*)

adder (*Vipera berus*)

What is a venomous snake?

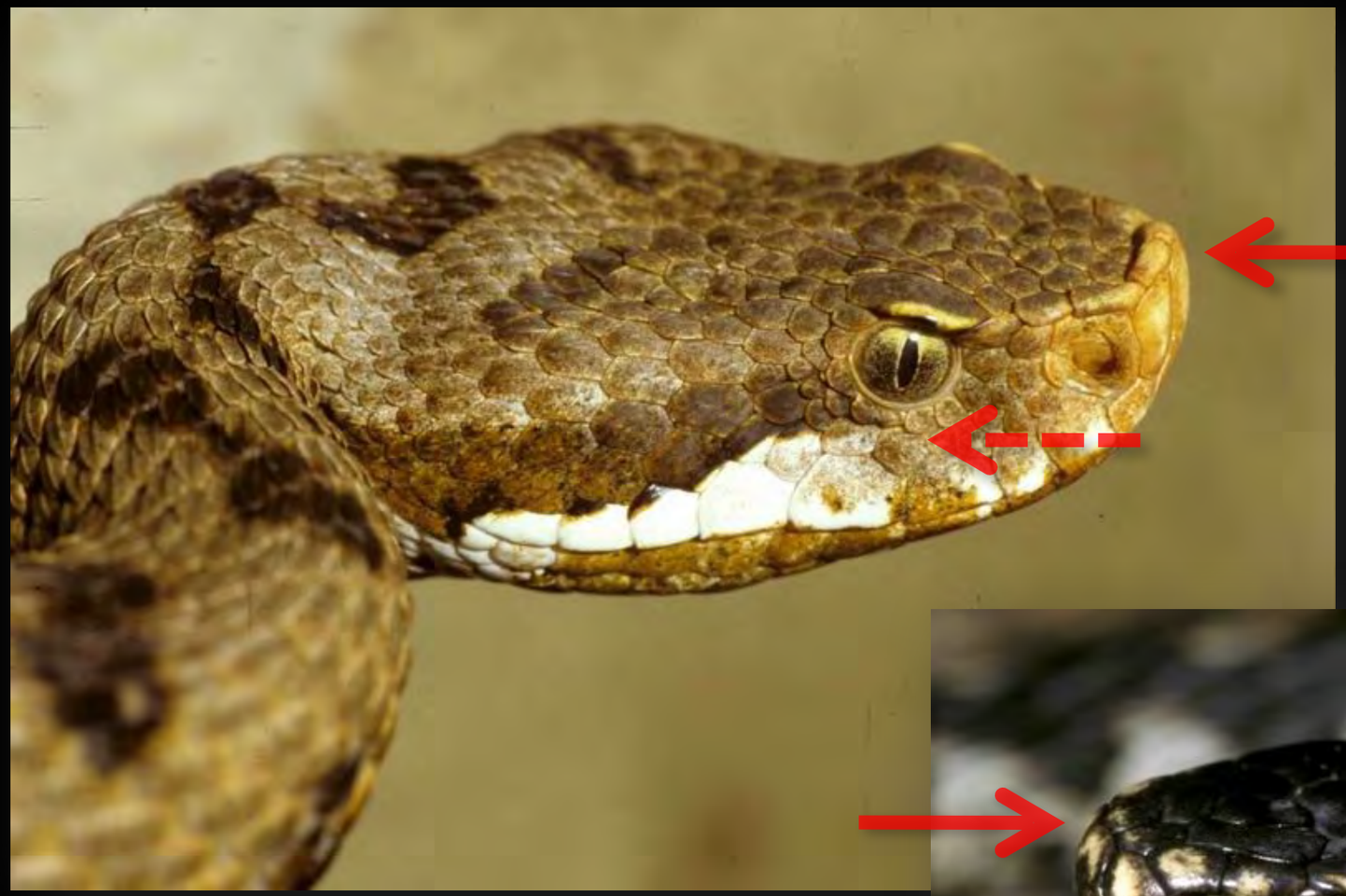
- there is no clear separation between venomous and non venomous snakes
- Most of the species are not producing venom and are so considered as non venomous
- Some species produce venom, but cannot actively inject it (no fang)
- some species produce venom, can inject it but the venom has practically no impact on human or, the amont is too low
- only a small proportion of snakes produce highly toxic venom for human and can inject it
- of the 3000 snake species, about 540 species have real impact on human
- So the medical impact of snakes in Europe is very limited: only 2 venomous species in Switzerland, about 9 species in Europe

venomous or not?



size: > 90 cm = not venomous (be careful: the size of a snake is always overestimated!)

Asp viper and adder: differences



Asp viper (*Vipera aspis*)

adder (*Vipera berus*)

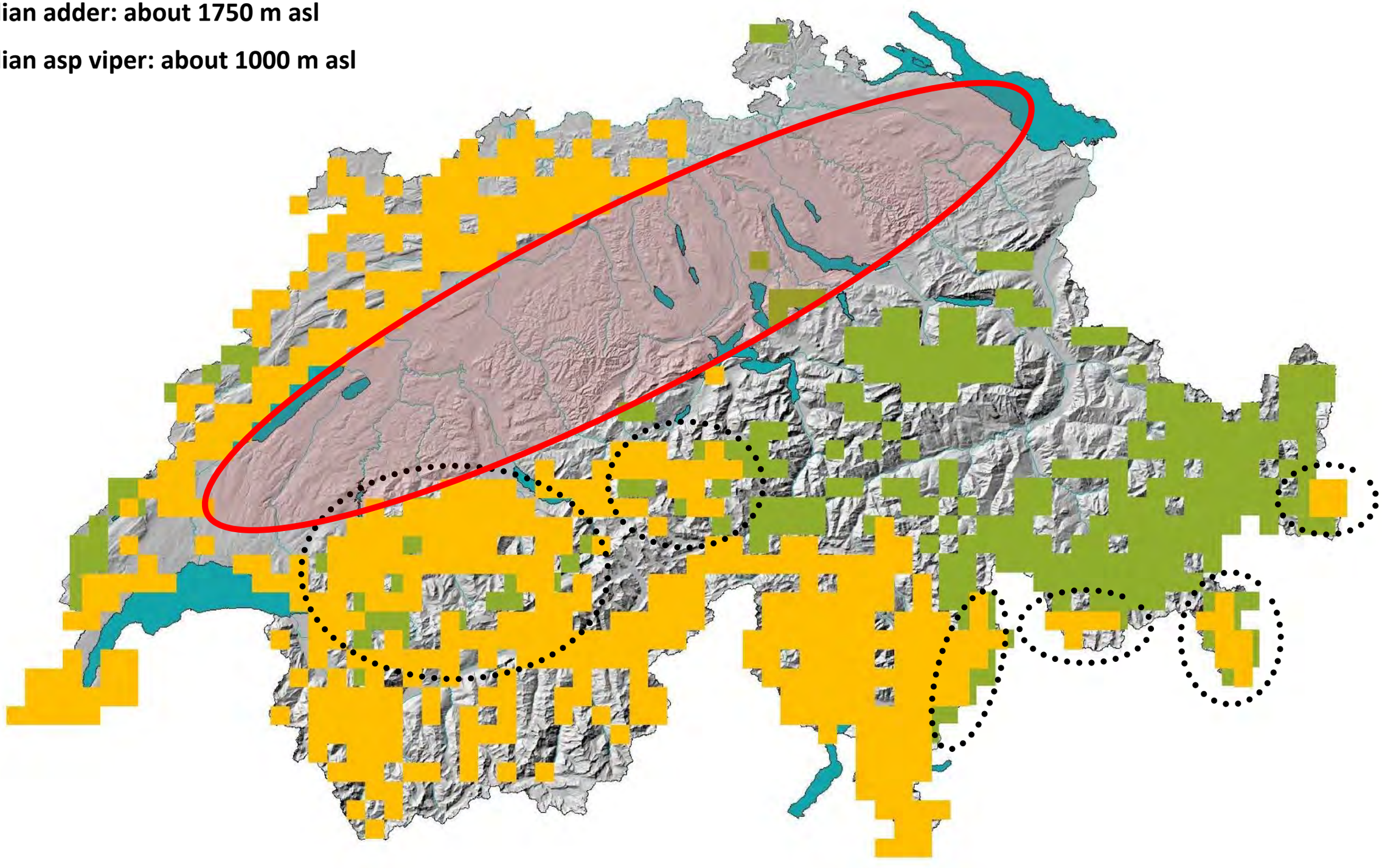
asp viper and adder: characteristics

- small, massive body, especially the pregnant females
- size: asp viper: 60 – 70 cm, rarely up to 85 cm (♂ max. 74 cm, ♀ max. 84 cm)
  adder: about 50 – 60 cm, rarely up to 80 cm (♂ max. 58 cm, ♀ max. 65 cm)
- head clearly set off from the neck
- snout clearly upper
- vertical pupil (like cats)
- keeled dorsal scales
- coloration: extremely variable color, but mainly with some dark bands on the back and on the flancs (asp vipers), that could in the Alps look like a dark zigzag on the back;
  adder: coloration: variable color, but with mainly a dark zigzag on the back;
- frequent totally black individuals
- viviparous
- prey: small mammals and lizards
- defensive behavior: hissing and later bite (venomous)
- move relatively slowly, but quite shy
- can be locally at high density

Asp viper and adder: Swiss distributions

median adder: about 1750 m asl

median asp viper: about 1000 m asl



asp viper
(*Vipera aspis*)
















adder: female

adder: male

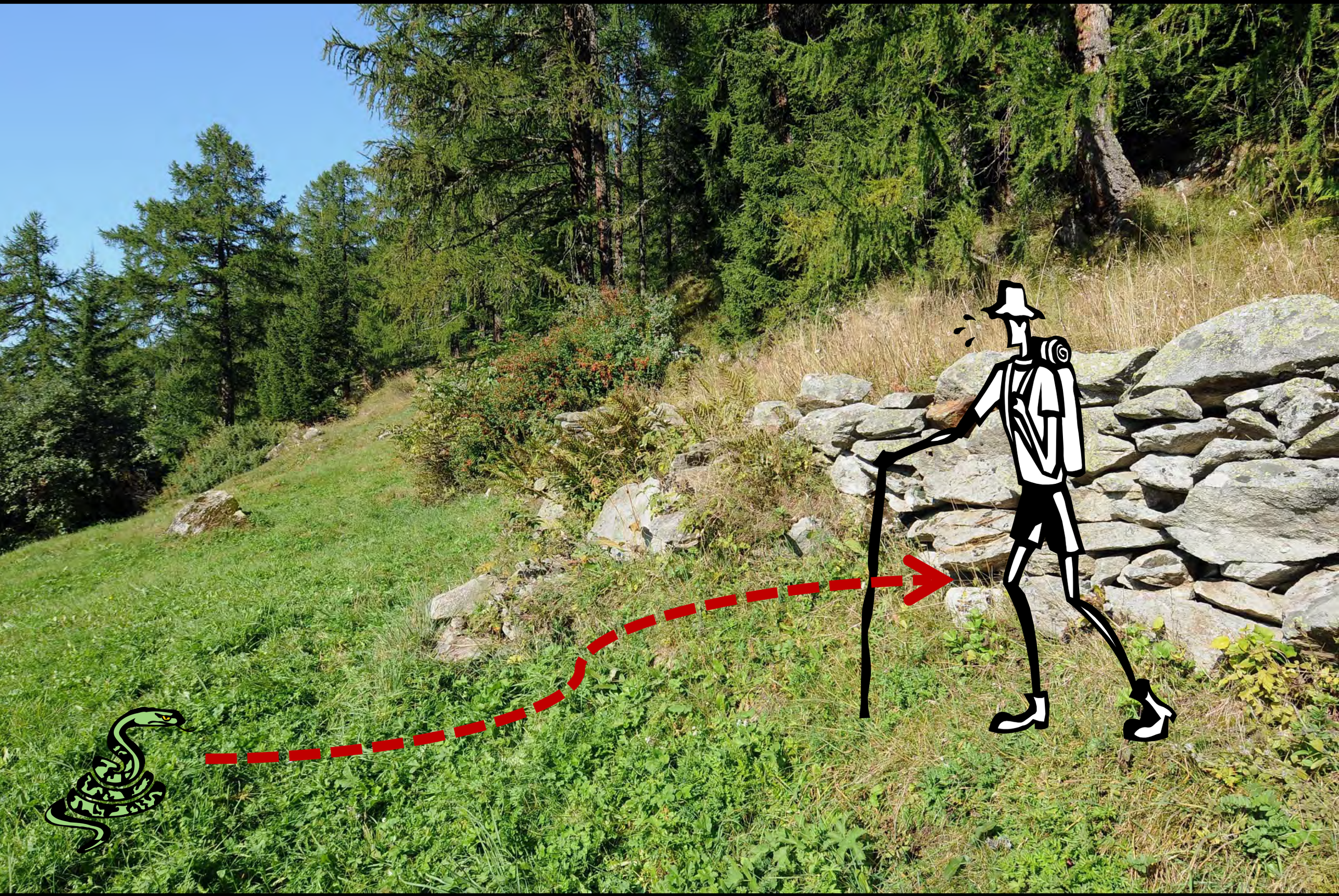
Asp viper (*Vipera aspis*)

Asp viper (*Vipera aspis*) or adder (*Vipera berus*)

adder (*Vipera berus*)

behaviour

- indigenous venomous snakes do not attack human!!
  > frequent misinterpretation of the movement of the snakes.

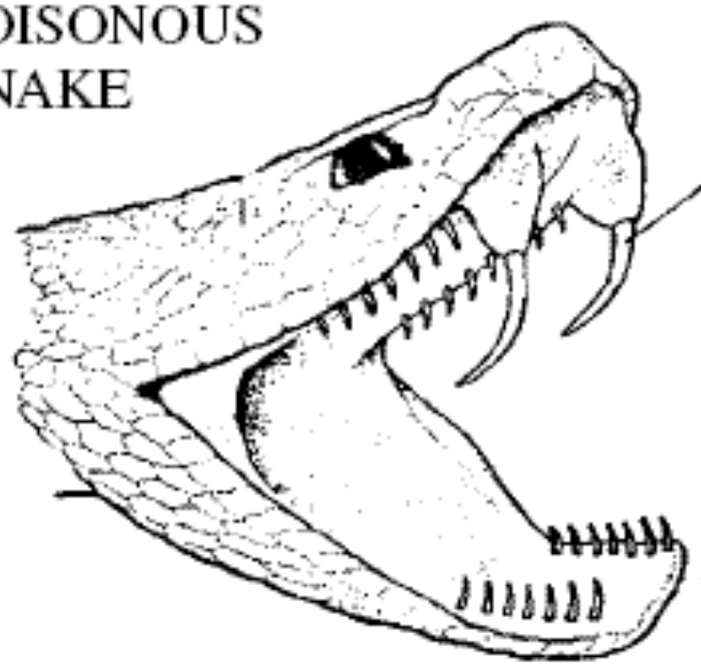


behaviour

- indigenous venomous snakes do not attack human!!
  > frequent misinterpretation of the movement of the snakes.
- Escape reaction of the snakes are almost always induced by visual observation, not really by terrestrial vibration!
  > hitting the ground is not really efficient!
- snakes bites only when they feel in danger, so most bites are human-induced!
  > large individual difference regarding the "aggressiveness" of the snakes
- snakes love disorder! It provides lots of hiding places.
  >no hiding places = no snake
- do not walk barefoot in places where venomous snakes occur!
- if necessary, just contact the local representative of the karch:

  www.karch.ch

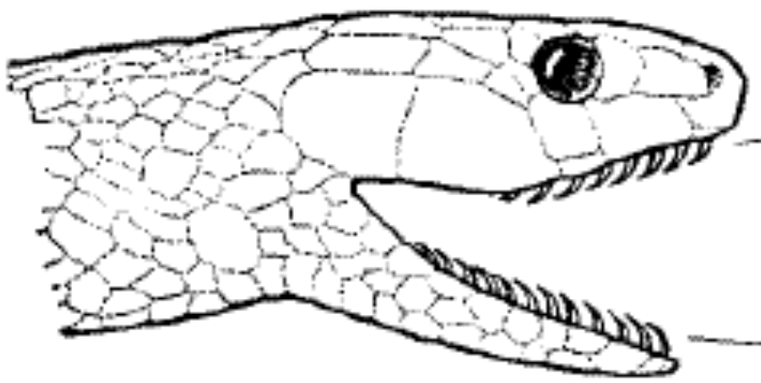
POISONOUS SNAKE



fang marks

The bite of most poisonous snakes leaves marks of the 2 fangs (and sometimes, little marks made by the other teeth).

NON-POISONOUS SNAKE



The bite of a snake that is not poisonous leaves only 2 rows of teeth marks, but no fang marks.

Venom

- 2 venomous species / 9 species
- about 20-40 cases every year
- last dead case: 1960’

- what to do if bitten?
- stay calm…
- avoid movement with the bitten arm or leg, in order to avoid spreading the toxins in the whole body.
- bring the bitten person to the nearest doctor; he/she must avoid any effort

- 50% of bites are without wenom
- serum injection: must be conducted in specific cases, only by medical doctor!

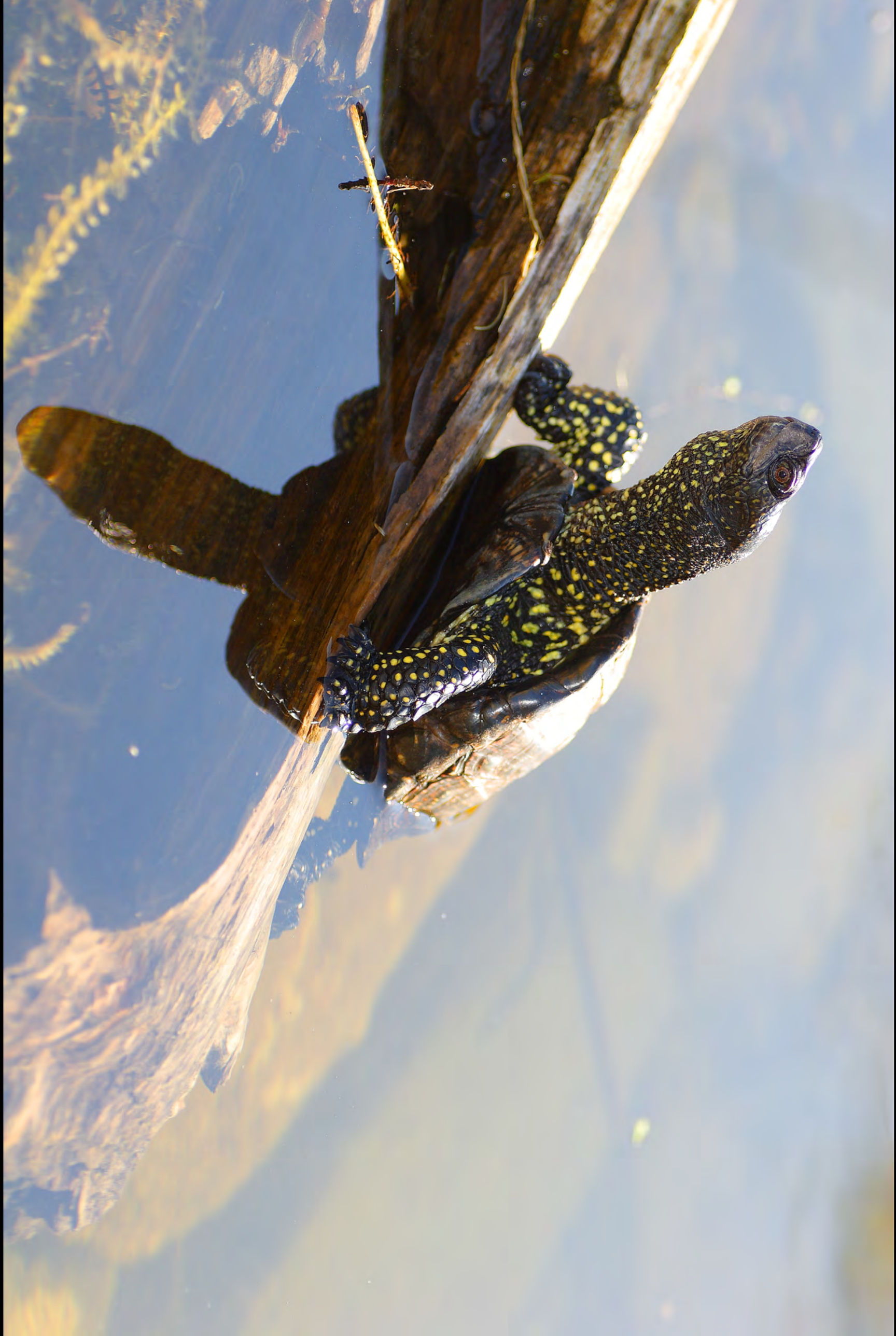
Il fait le mariole avec une vipère et termine à l'hosto

Un élève a été hospitalisé pendant une semaine après avoir joué avec un serpent venimeux.

European pond turtle (*Emys orbicularis*)

European pond turtle: characteristics

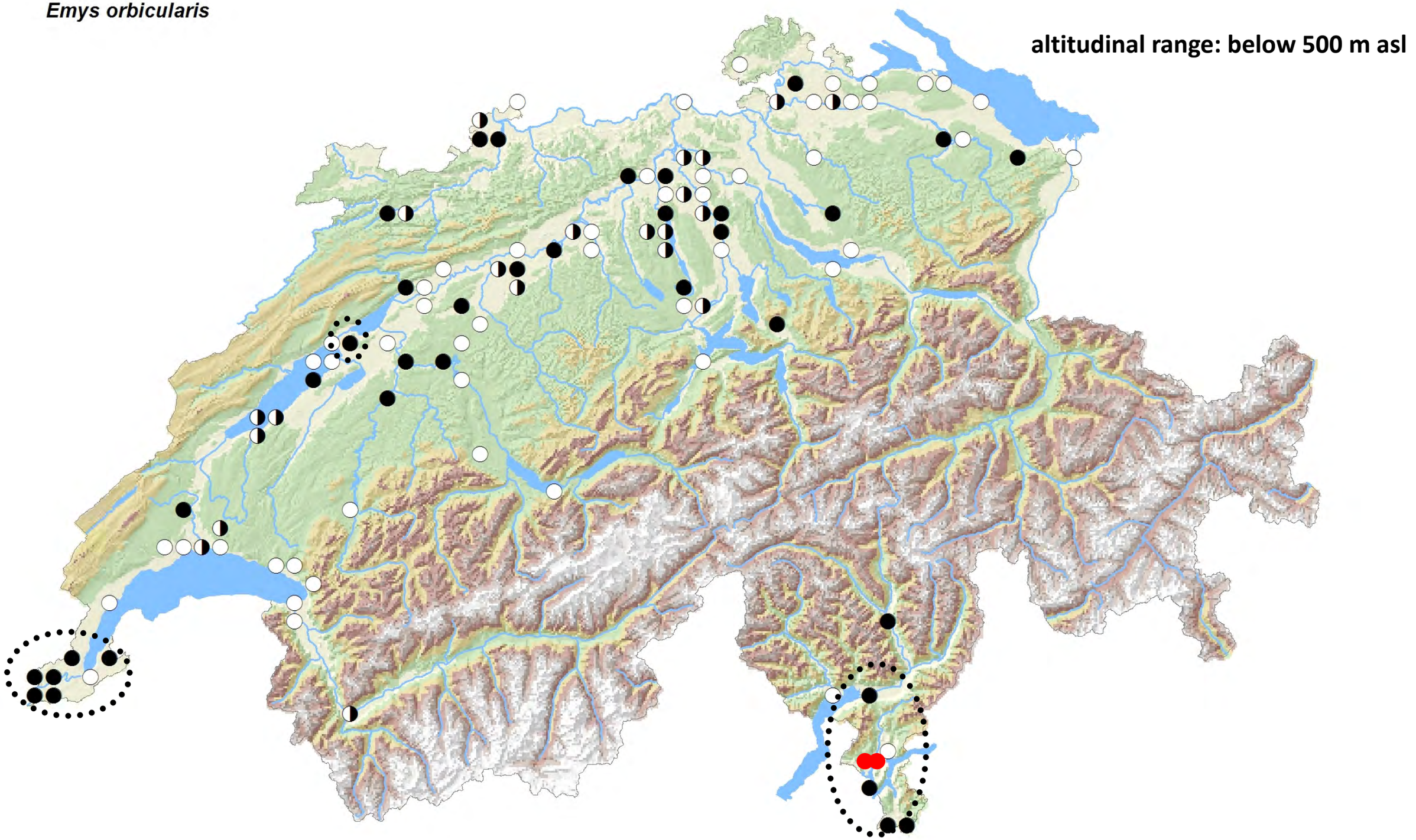
- no confusion with other endemic species; but frequently confused with introduced American aquatic turtles
- braun to black shell, sometimes with yellow points or lines. Head, neck and legs: black with yellow points (no large marking or bands)
- small and slender, up to 20 cm as total length
- live in the water most of the time; hibernation, mating, feeding, etc… all in water
- just go out for laying the eggs; can go up to 1km away from aquatic habitats
- really shy species



European pond turtle: Swiss distribution

Emys orbicularis

altitudinal range: below 500 m asl



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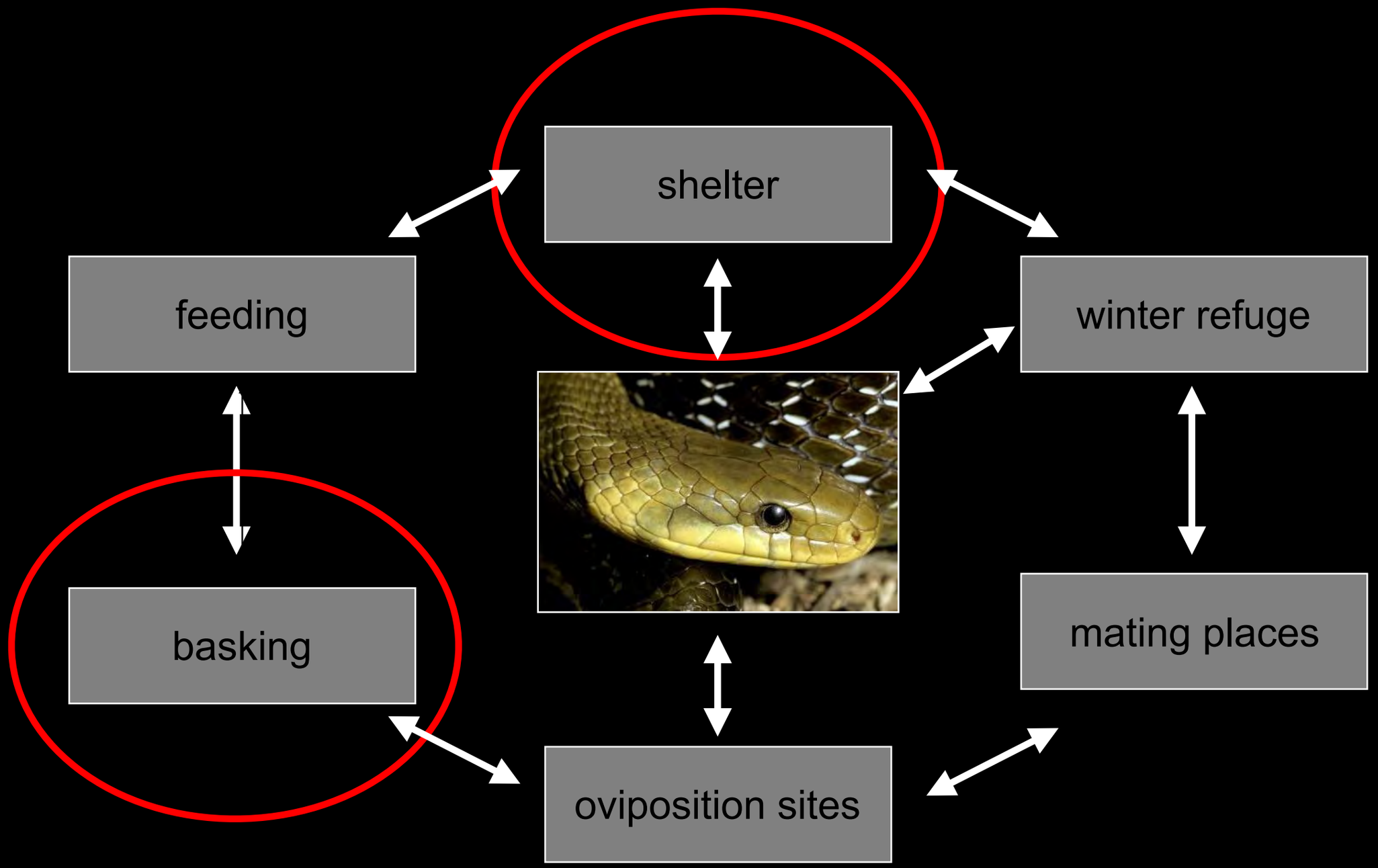
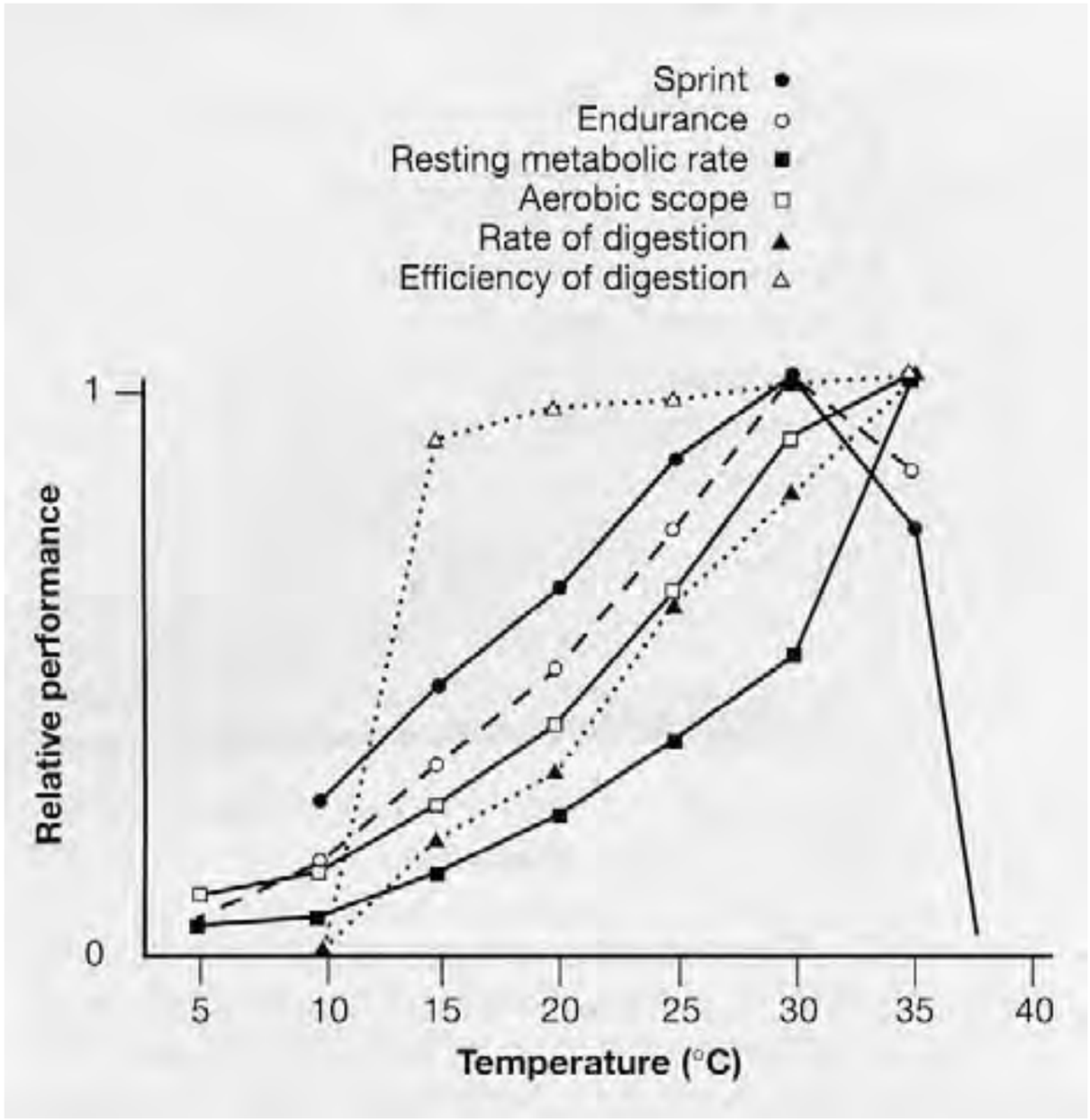
high requirements on their habitats

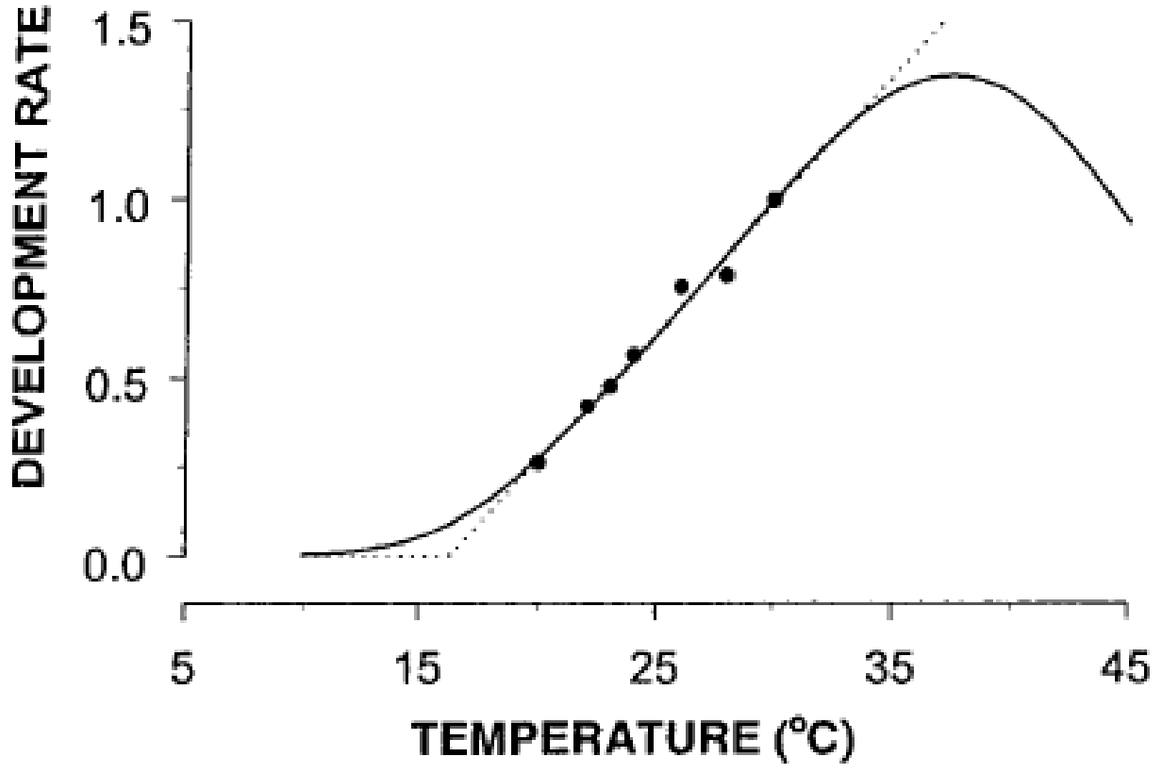


The importance of temperature in reptilian life



Relative performance of the Viperine Snake in relation to body temperature.

Hailey & Davies 1988, J Zool



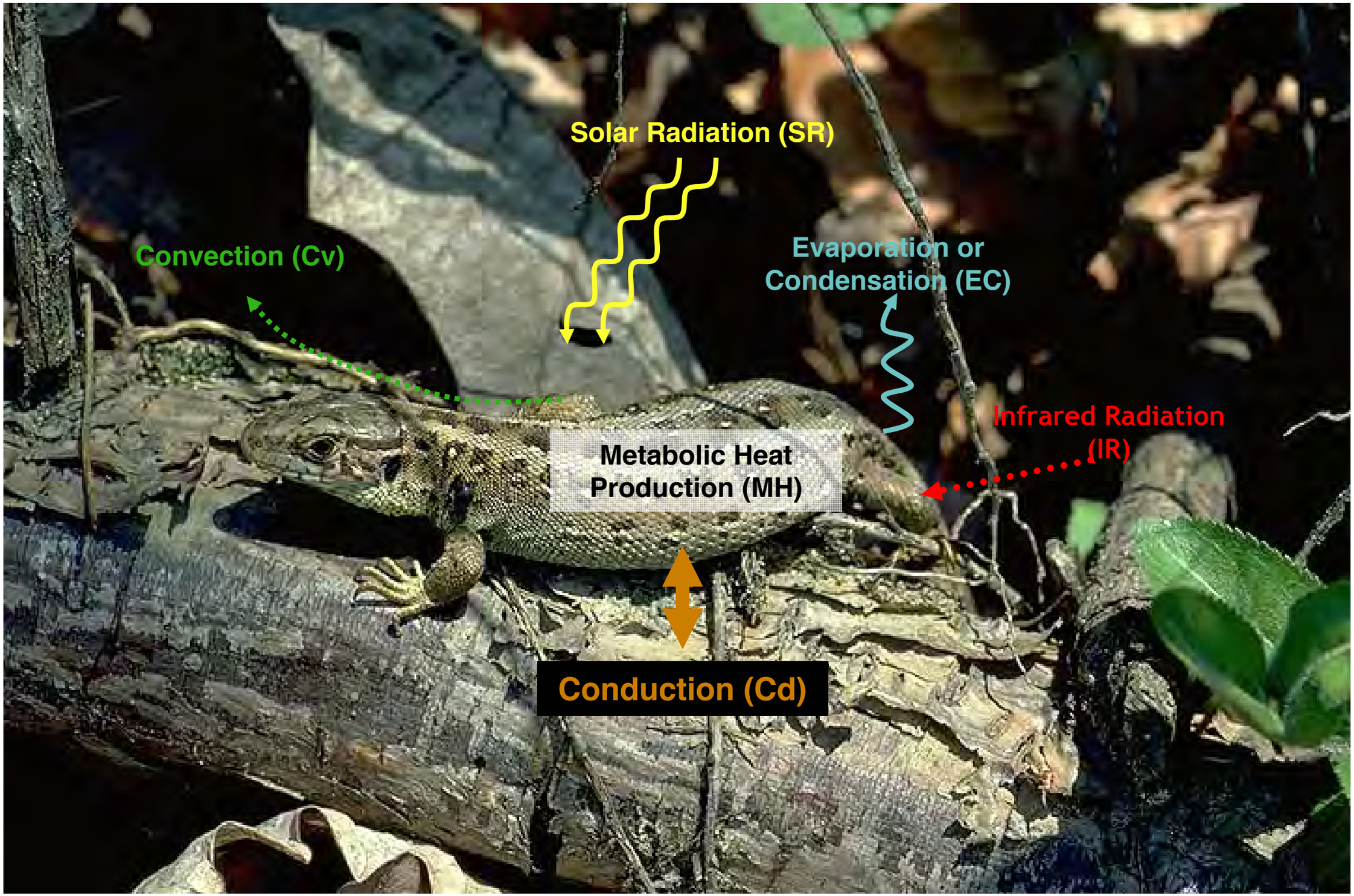
Development rate of an Australian lizard (*Bassiana duperreyi*) in relation to nest-site temperature.

Developmental arrest at ≤16.5°C

Egg mortality at ≥40°C

Georges et al 2005, Physiol Biochem Zool

Thermoregulation



Heat energy gained = **SR** + **MH** ± IR ± Cv ± EC ± Cd

Reproductive mode

Oviparity (Switzerland: 5 snakes, 3 lizards, 1 tortoise)

- Oviposition in nest-site, following short period of vitellogenesis
- Fully developed juveniles hatch after 4 to 12 weeks of incubation
- Thermal and hydric conditions of nest influence incubation length, hatching rate, and offspring survival

→ selection on maternal nest-site choice

Viviparity (3 snakes, 2 lizards)

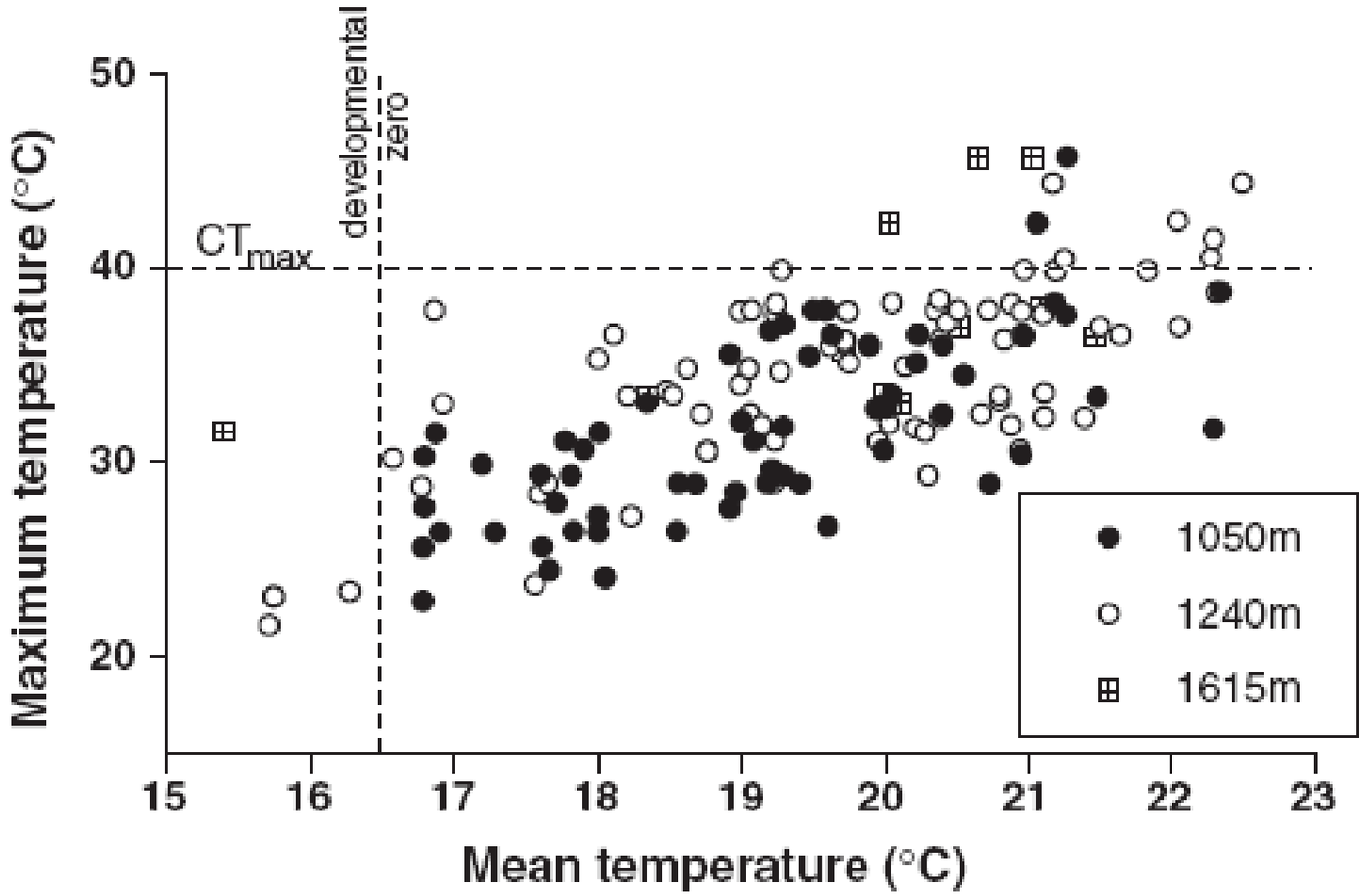
- Female controls embryonic development by thermoregulation
- Birth of fully developed juveniles following long period of vitellogenesis and 9 to 22 weeks of gestation
- Thermal conditions of basking sites influence gestation length, embryo survival and fitness-related traits of offspring

→ selection on maternal basking site choice

Thermal limits to oviparity

Relationship between mean and maximum temperature for natural nests of an Australian lizard (*Bassiana duperreyi*) at three elevations.

Maxima for given mean increase rapidly with elevation.



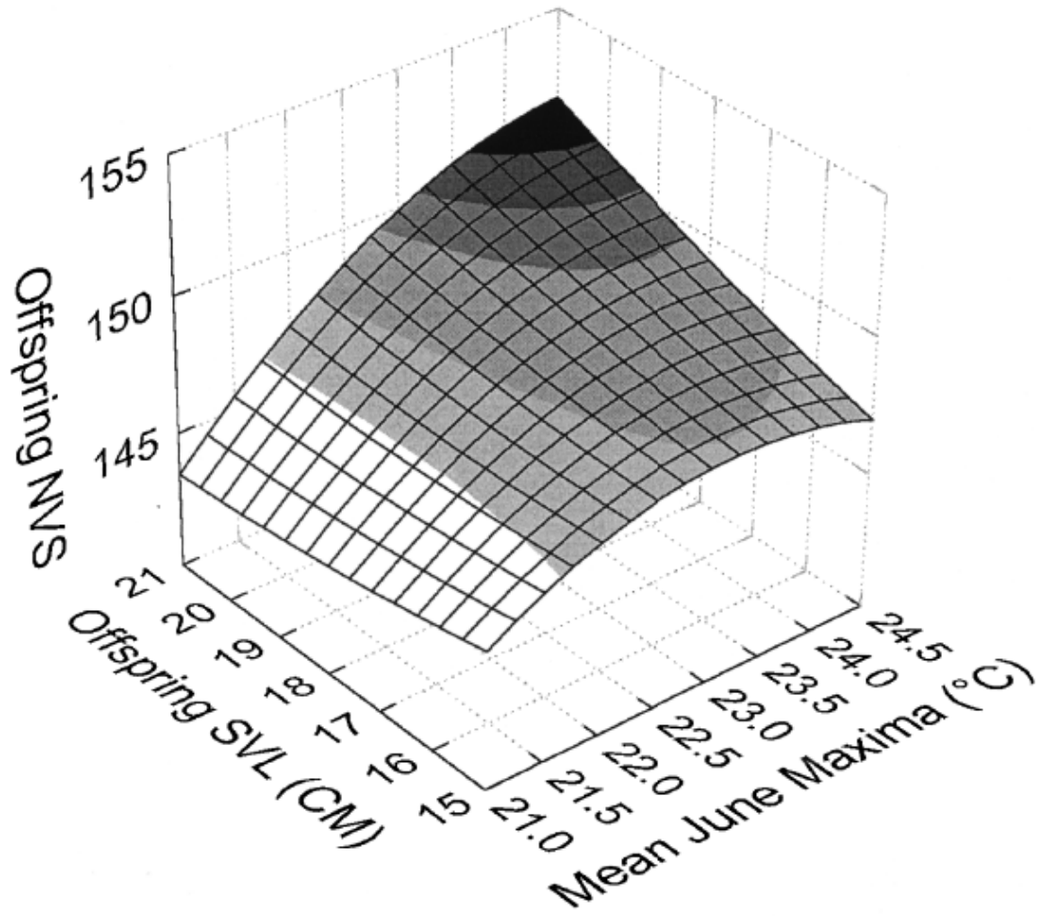
Shine et al 2003, Biol J Linn Soc

→ Potential nest-sites above an elevational (and possibly latitudinal) threshold only attain mean temperatures high enough to sustain embryogenesis by having lethally high thermal maxima.

Thermal limits to viviparity

Ambient thermal conditions influenced female body temperature, gestation length, embryo viability, and offspring phenotypes in *Vipera aspis*.

Thermal conditions during each of the three gestation months (June-August) affected different aspects of reproduction.



Lourdais et al 2004, Oikos

In severe weather conditions and harsh climate environments, actively thermoregulating females may be unable to provide optimal incubation regimes.

→ Embryonic thermal requirements may determine latitudinal and altitudinal range limits.

Diet

All indigenous reptiles are predators. Main prey items are:

- Arthropods
- Molluscs and earthworms
- Vertebrates

Lizards (*Lacerta, Podarcis*)
Slow Worm (*Anguis fragilis*)
Snakes

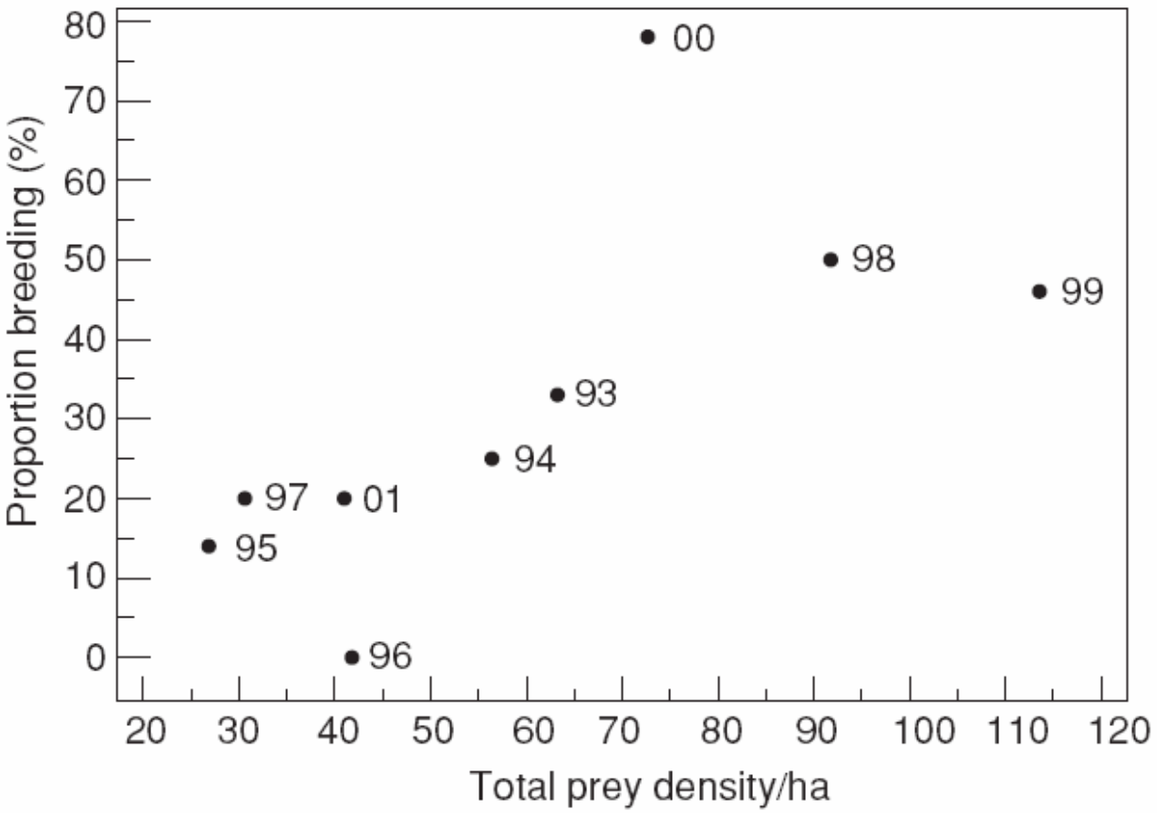
Four colubrids feed essentially on lower vertebrates:

- Fish (60-100%)
- Amphibians (83-98%)
- Reptiles (70-98%)

Natrix tessellata and *Natrix maura*
Natrix natrix
Coronella austriaca

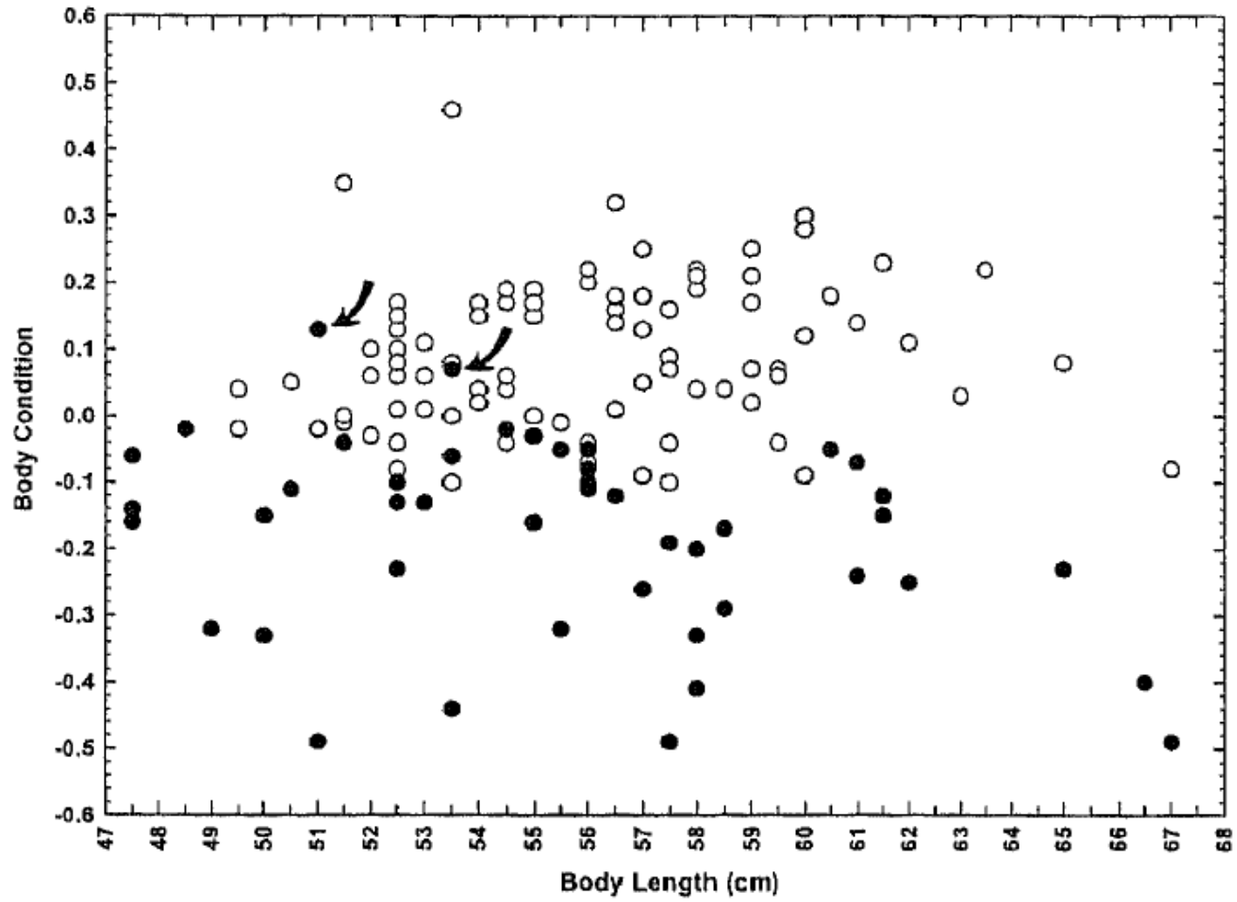
Prey density and female reproduction

Prey density affects the breeding frequency of female snakes.



Coronella austriaca females
Wareham forest (UK)
1993-2001, n=9
r^2 =47.0%, P=.042

Reading 2004, J Zool



Spring body length and body condition *of Vipera aspis* females (n=129)
Open circles: Females which became vitellogenic (ANOVA, F=133.4, p<.0001)

Naulleau & Bonnet 1996, Oecologia

The Red List of reptiles of Switzerland

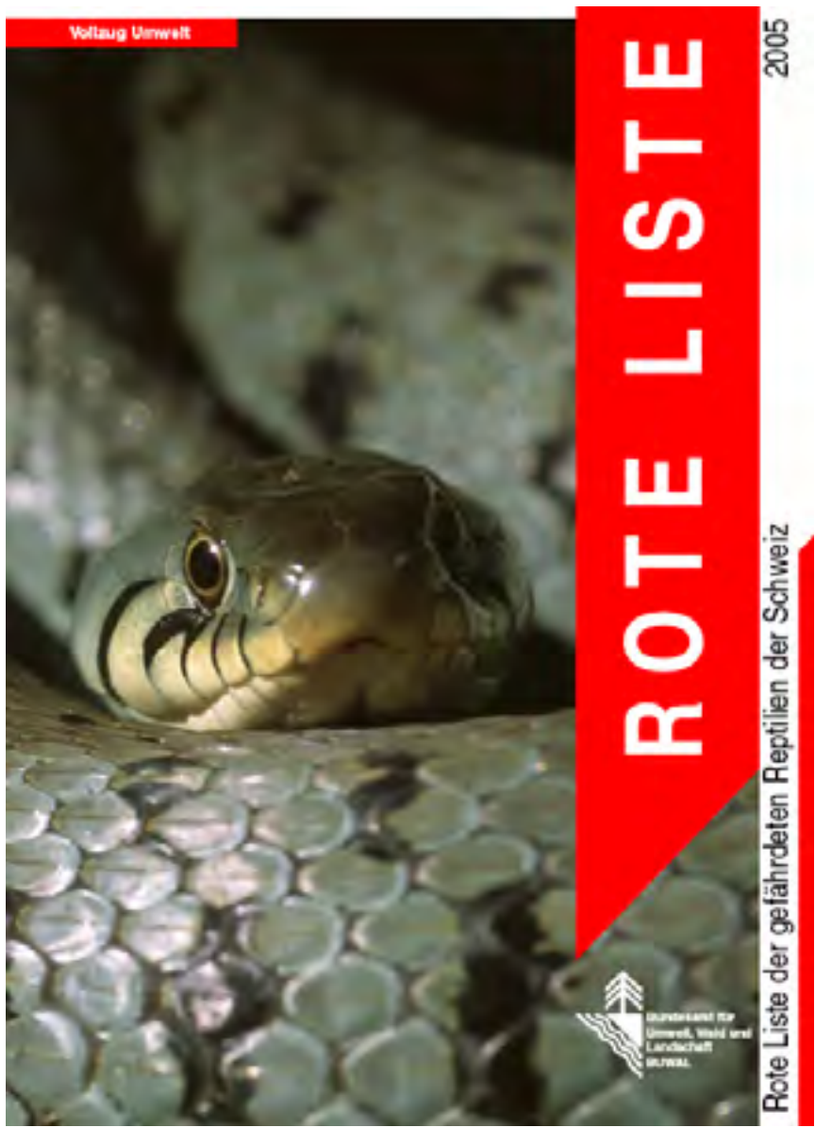
11 of Switzerland‘s 14 reptile species are on the Red List 2005, namely

- All 8 snake species
- The single species of tortoise (*Emys orbicularis)*
- 2 out of 5 lizard species

Major conservation issues

due to risk of regional extinction:

- Snakes in the Midlands
  (*Coronella austriaca*, *Natrix natrix*)
- Vipers in the Jura
- Semi-aquatic colubrids
  (*Natrix maura*, *N.tessellata*)
- Western Green Lizard in the Lavaux (VD)



Major threats to indigenous reptiles

Landscape change, acting by

- decreasing availability of basking sites, nest-sites and shelter sites
- decreasing lower vertebrate prey populations
- fostering fragmentation and isolation of populations
- increasing anthropogenic mortality

Invasive species, acting as

- predators (domestic cats)
- competitors (e.g., Dice Snake)

General decline of snake populations

biology letters
Conservation biology

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doi:10.1098/rsbl.2010.0373
Published online 9 June 2010

Are snake populations in widespread decline?

C. J. Reading[1,*], L. M. Luiselli[2], G. C. Akani[3], X. Bonnet[4], G. Amori[5], J. M. Ballouard[4], E. Filippi[6], G. Naulleau[4], D. Pearson[7] and L. Rugiero[2]

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Long-term studies have revealed population declines in fishes, amphibians, reptiles, birds and mammals. In birds, and particularly amphibians, these declines are a global phenomenon whose causes are often unclear. Among reptiles, snakes are top predators and therefore a decline in their numbers may have serious consequences for the functioning of many ecosystems. Our results show that, of 17 snake populations (eight species) from the UK, France, Italy, Nigeria and Australia, 11 have declined sharply over the same relatively short period of time with five remaining stable and one showing signs of a marginal increase. Although the causes of these declines are currently unknown, we suspect that they are multi-faceted (such as habitat quality deterioration, prey availability), and with a common cause, e.g. global climate change, at their root.

je peux ajouter quelques slides (3-4) sur l'écologie

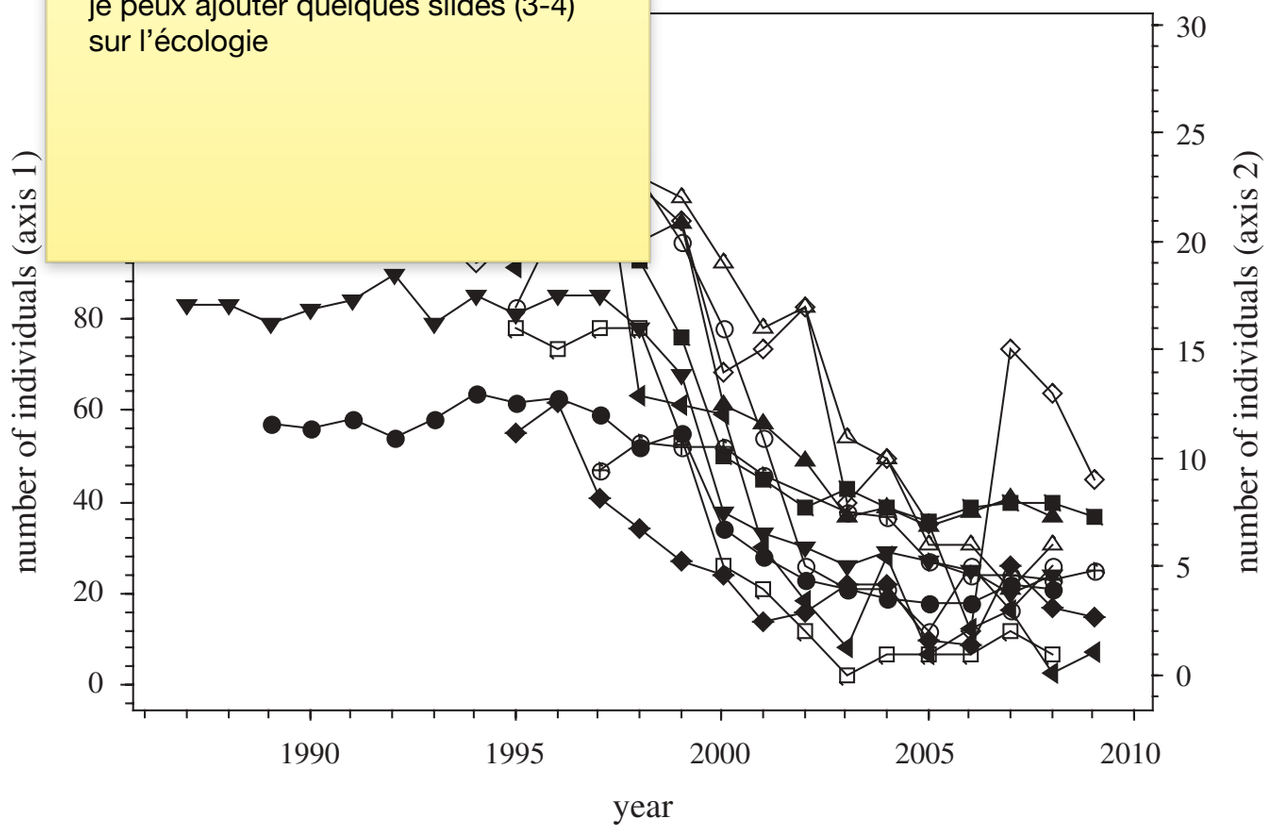


Figure 1. Annual total number of individuals found for each declining snake species population. Axis 1: filled left-pointed triangles, *Va*[1]; filled circles, *Va*[2]; filled squares, *Va*[3]; filled triangles, *Vu*[1]; filled inverted triangles, *Vu*[2]; cirlces with crosses, *Ca*; filled diamonds, *Hv*[1]. Axis 2: open circles, *Bg*; open squares, *Bn*; open triangles, *Pr*; open diamonds, *Zl*[1]. Values shown for *Va*[1] are one-third of true values. See table 1 for key to snake species abbreviations and country of origin.

Habitat improvements

Ongoing projects

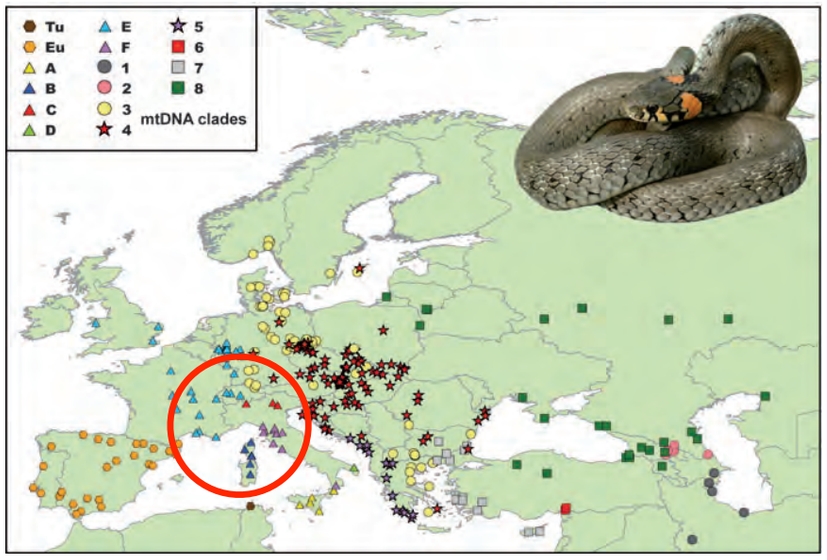
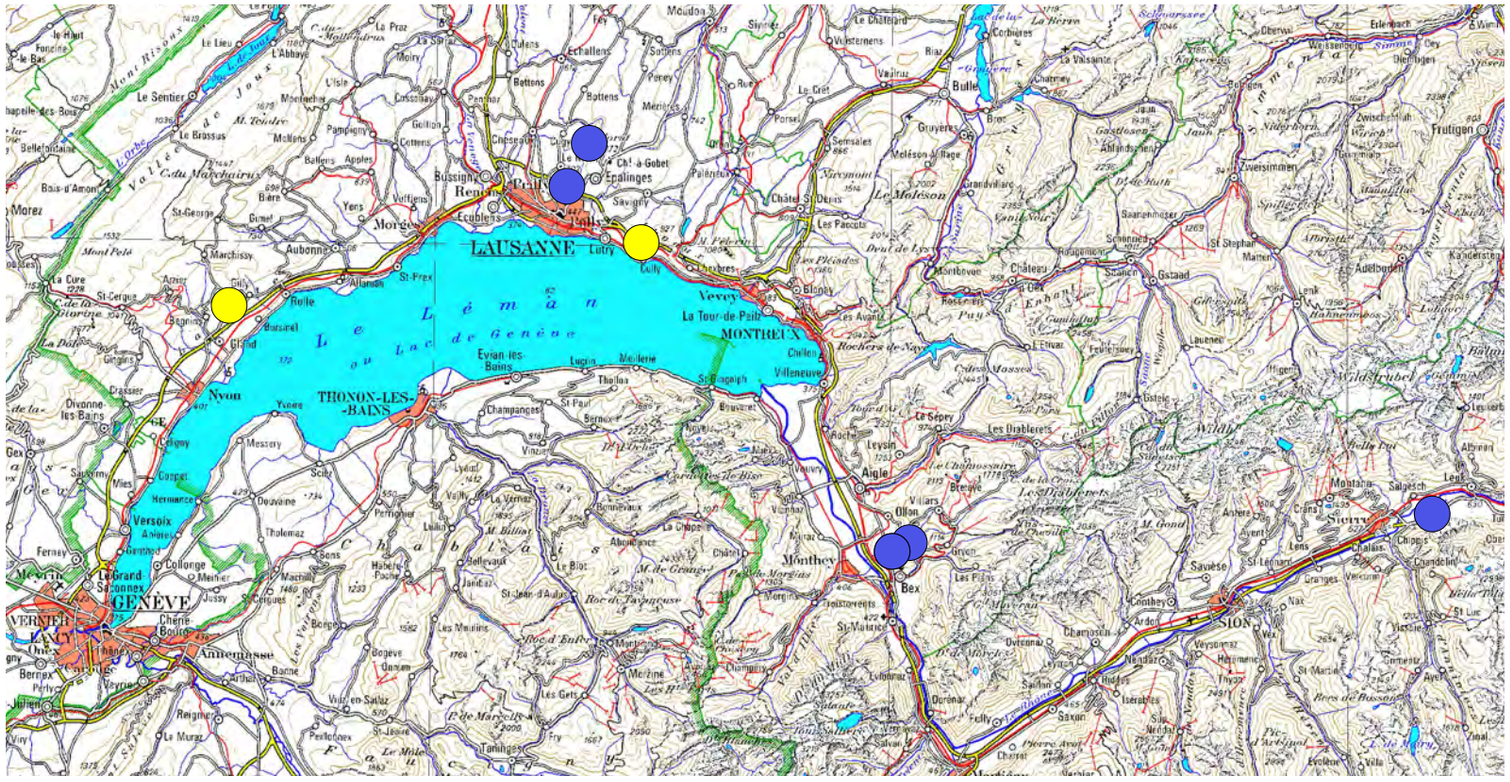
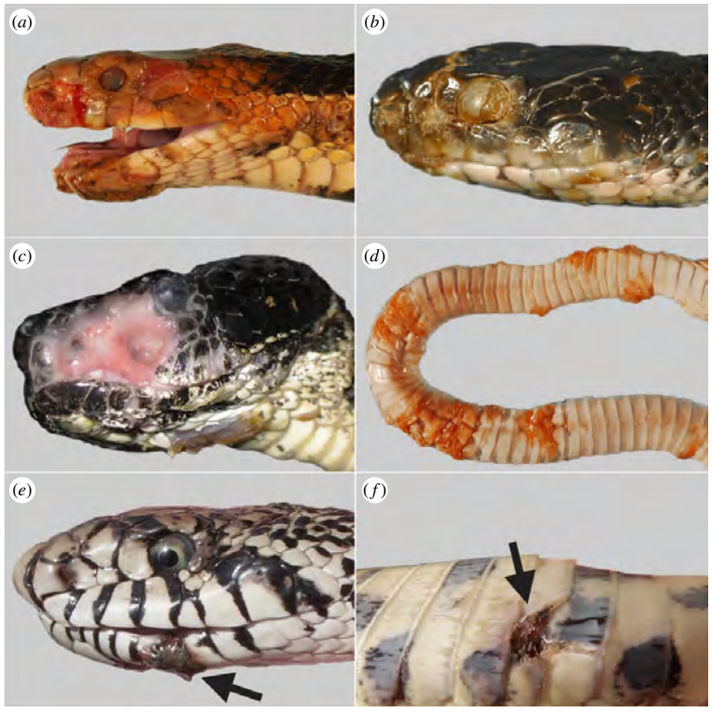


Fig. 1 Distribution of subspecies of *Natrix natrix* and *N. megalocephala* (top) and mitochondrial clades (bottom). Hatching along range borders of *N. natrix* subspecies indicates putative contact or hybrid zones. Distribution ranges combined from Kabisch (1999), Orlov & Tuniyev (1999), Kreiner (2007), Baier *et al.* (2009) and Göçmen *et al.* (2011). Inset (bottom): *N. natrix* from Mtskheta, Georgia (photograph: M. Auer).





Herpetology Notes, volume 11: 885-891 (2018) (published online on 17 October 2018)

First case of Snake Fungal Disease affecting a free-ranging *Natrix natrix* (Linnaeus, 1758) in Ticino Canton, Switzerland

Grégoire Meier[1], Tommaso Notomista[2], Daniele Marini[3,*], and Vincenzo Ferri[4]

Abstract. We here report a new European case of Snake Fungal Disease in a free-ranging *Natrix natrix* (Linnaeus, 1758) from Ticino Canton (Switzerland). This is the first Swiss case and only the second occurrence in a wild snake from continental Europe. We provide a description of clinical and methodological aspects beginning with the capture and the stabling period of the affected individual. Moreover, we report observations of *Natrix* spp. displaying clinical signs consistent with SFD in northern Italy.

Keywords. *Ophidiomyces ophiodiicola*, keratinophile, mycosis, dermatitis, emerging disease, *Natrix natrix*, case report, Switzerland