Reptiles

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info fauna

&

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pdf can be found:
www.ursenbacher.com/teaching/Reptilien_UNIBE_2020.pdf


Reptilia: Crocodiles


Reptilia: Tuataras

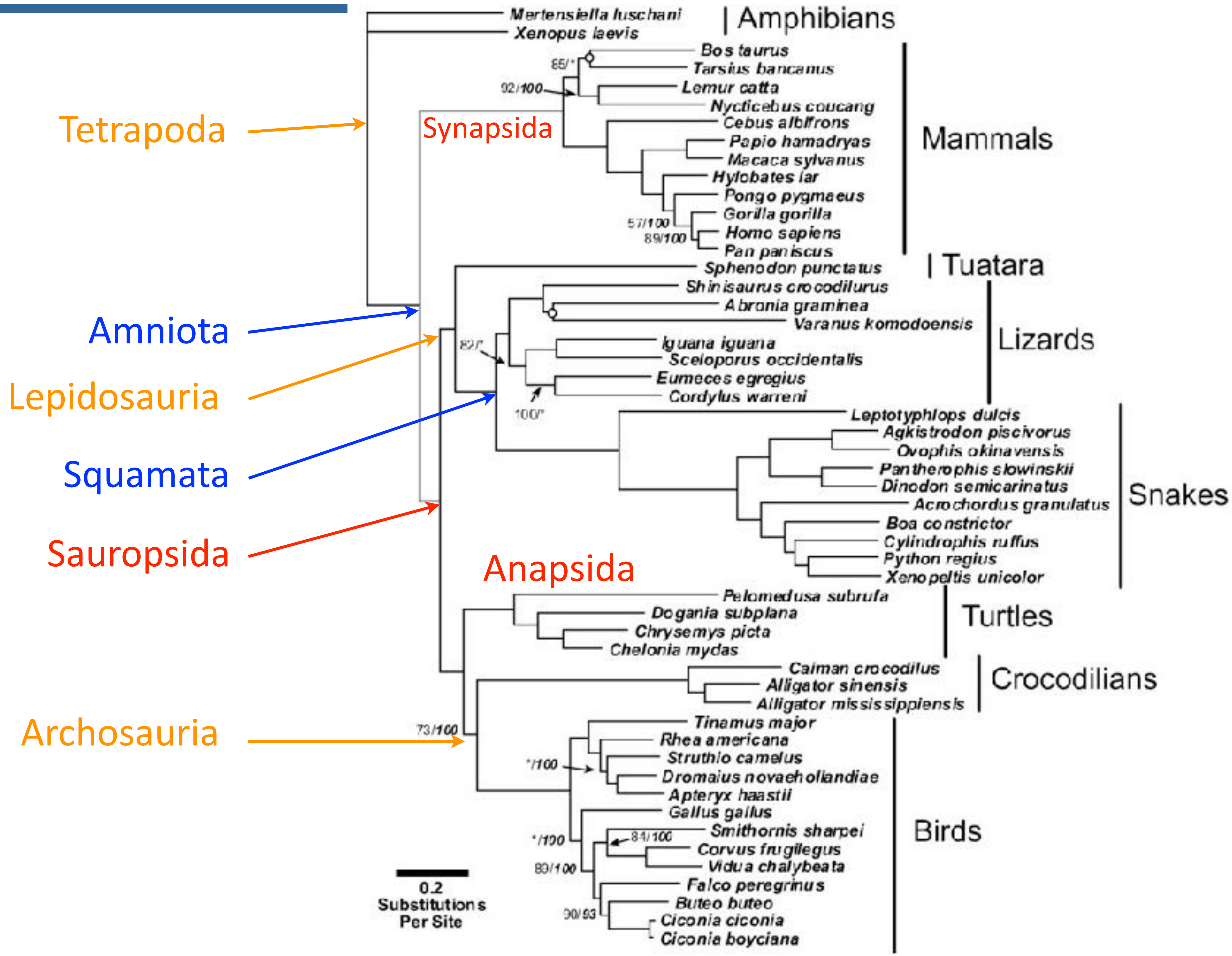

Reptilia: turtles


Reptilia: Squamata: snakes


Reptilia: Squamata: amphisbaenians

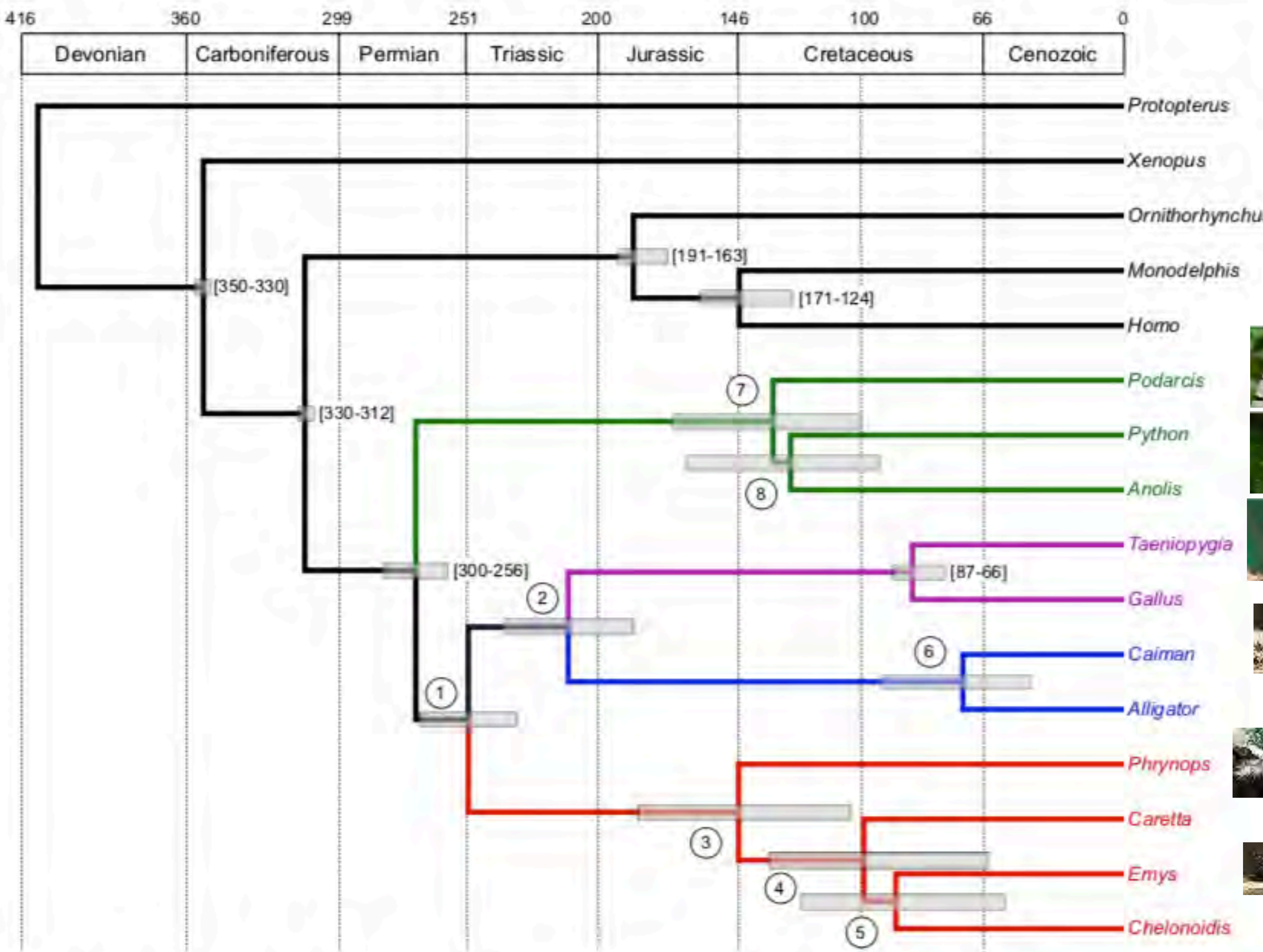

Reptilia: Squamata: lizards

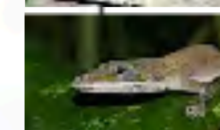
Phylogeny



Tetrapoda
Amniota
Lepidosauria
Squamata
Sauropsida
Archosauria
Synapsida
Anapsida
Amphibians
Mammals
Tuatara
Lizards
Snakes
Turtles
Crocodilians
Birds
Mertensiella luschani
Xenopus laevis
Bos taurus
Tarsius bancanus
Lemur catta
Nycticebus coucang
Cebus albifrons
Papio hamadryas
Macaca sylvanus
Hylobates lar
Pongo pygmaeus
Gorilla gorilla
Homo sapiens
Pan paniscus
Sphenodon punctatus
Shinisaurus crocodilurus
Abronia graminea
Varanus komodoensis
Iguana iguana
Sceloporus occidentalis
Eumeces egregius
Cordylus warreni
Leptotyphlops dulcis
Agkistrodon piscivorus
Ovophis okinavensis
Pantherophis slowinskii
Dinodon semicarinatus
Acrochordus granulatus
Boa constrictor
Cylindrophis ruffus
Python regius
Xenopeltis unicolor
Pelomedusa subrufa
Dogania subplana
Chrysemys picta
Chelonia mydas
Caiman crocodilus
Alligator sinensis
Alligator mississippiensis
Tinamus major
Rhea americana
Struthio camelus
Dromaius novaehollandiae
Apteryx haastii
Gallus gallus
Smithornis sharpei
Corvus frugilegus
Vidua chalybeata
Falco peregrinus
Buteo buteo
Ciconia ciconia
Ciconia boyciana
85/*
92/100
57/100
89/100
82/*
100/*
73/100
*/100
*/100
84/100
89/100
90/93
0.2
Substitutions
Per Site

Phylogeny





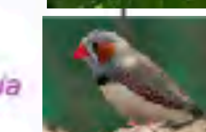


Figure 4 Bayesian relaxed molecular clock time scale. Chronogram obtained from the analysis of the nucleotide dataset using the CAT-GTR + G mixture model. Numbers in circles at nodes refer to lines of Table 3, and squared boxes represent 95% credibility intervals. Numbers between brackets represent the six calibration constraints implemented as soft bounds. Absolute ages of the geological periods follow Gradstein and Hogg [91].

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

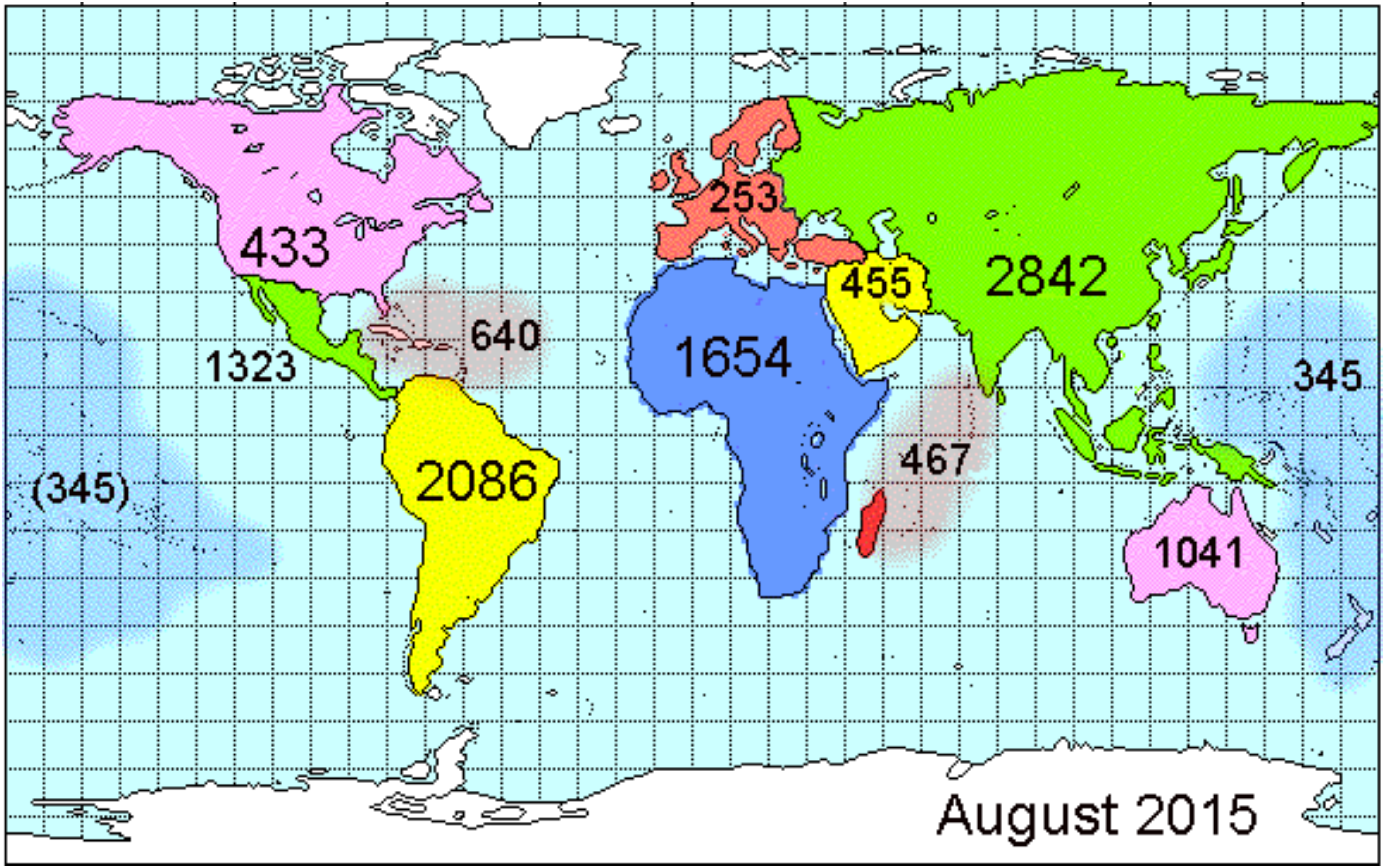
Mesozoic

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)	139	0
clade Lacertilia or Sauria (lizards)	6399	6
clade Ophidia or Serpentes (snakes)	3672	9
Total	**10639**	**16**

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

Worldwide diversity of reptiles (2015)



Turtles and lizard of Switzerland

Order <u>Testudines</u>

Family Emydidae (Pond Turtles)

European pond turtle *Emys orbicularis*

Order <u>Squamata</u>

clade <u>Lacertilia</u>

Family Anguidae (Slow worms)

slow worm *Anguis fragilis*

Italian slow worm *Anguis veronensis*

Family Lacertidae (Lizard)

viviparous or common lizard *Zootoca vivipara*

sand lizard *Lacerta agilis*

Western green lizard *Lacerta bilineata*

wall lizard *Podarcis muralis*

Snakes of Switzerland

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*

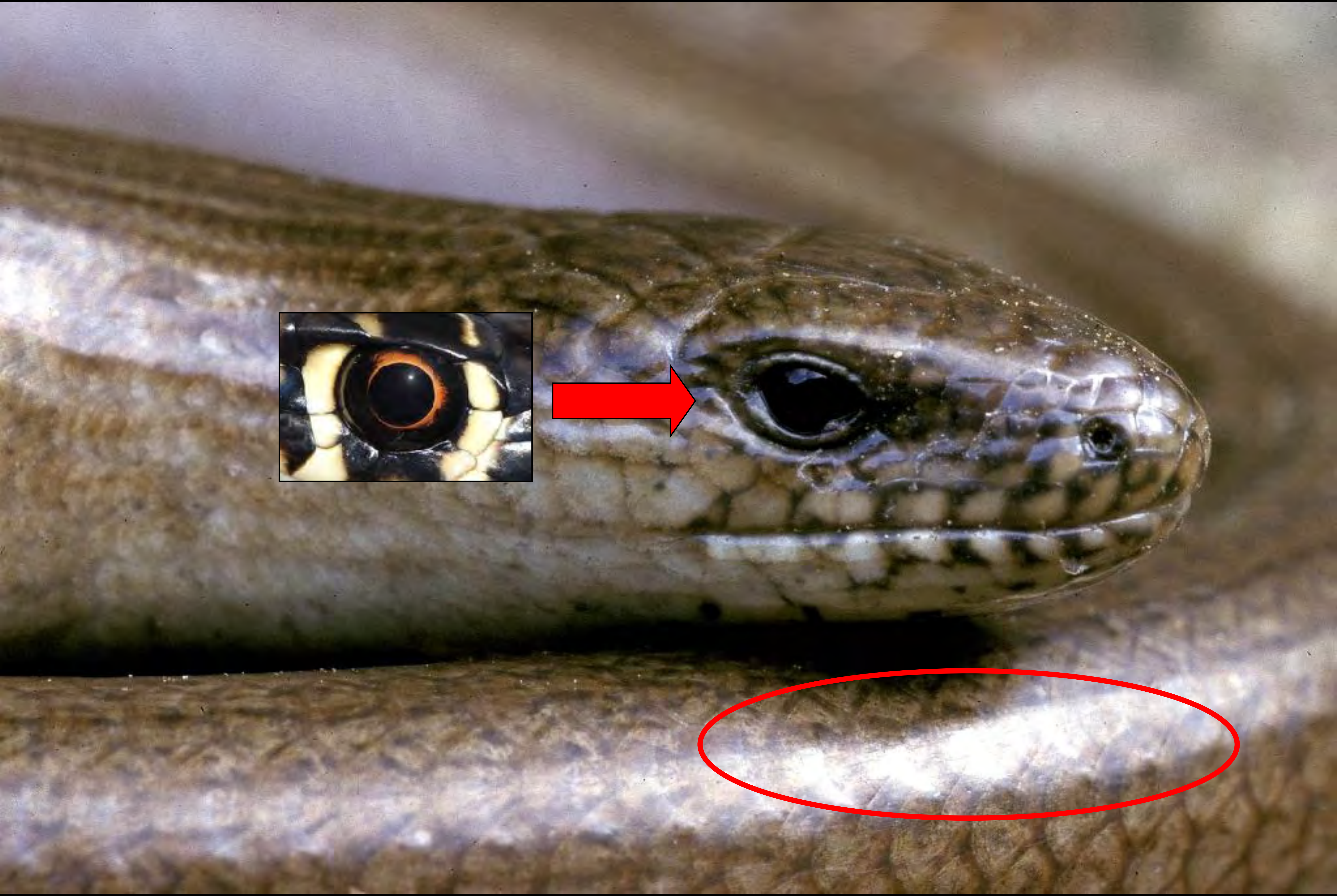
Slow worms (*Anguis fragilis*)

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…

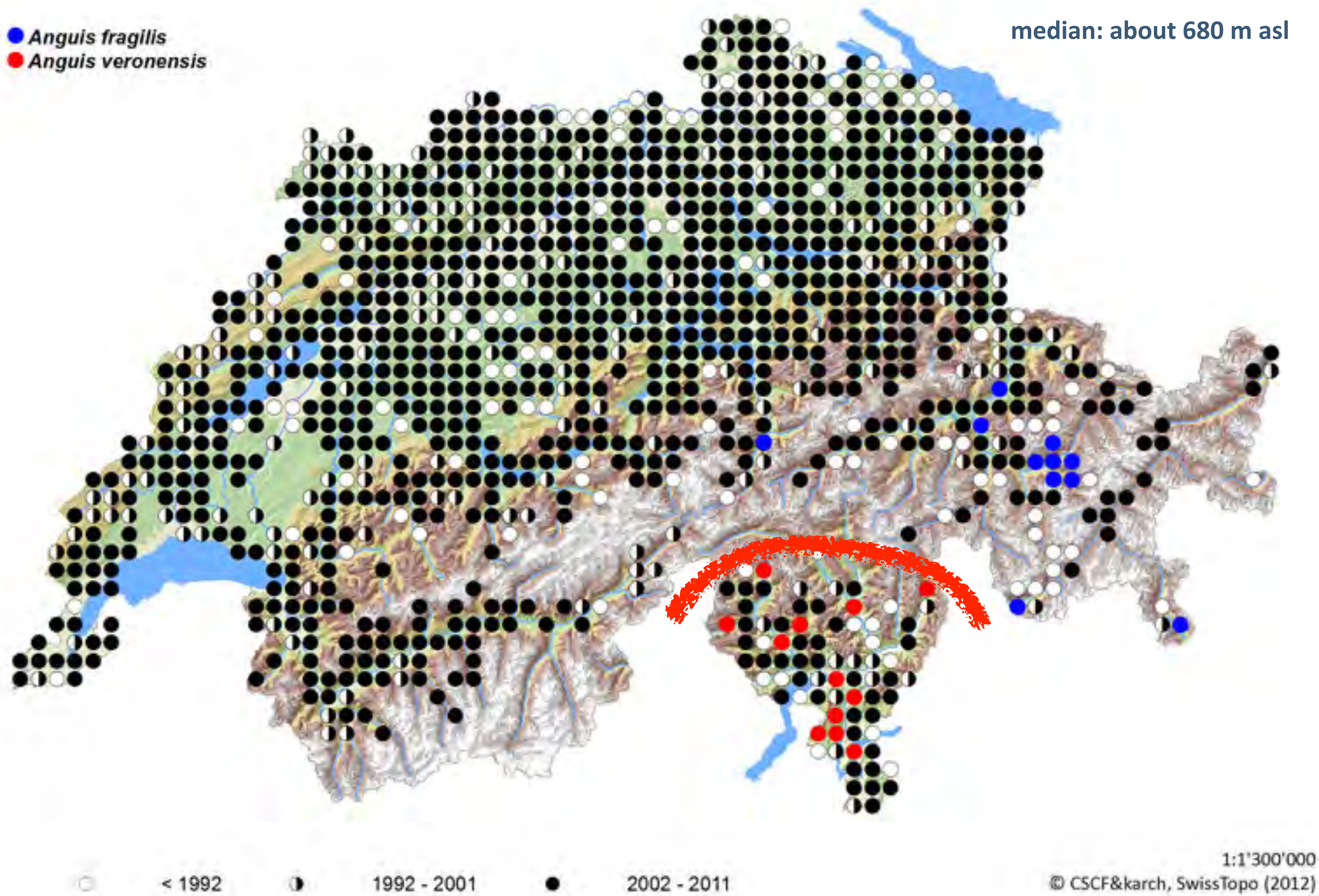
difference with snakes



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*

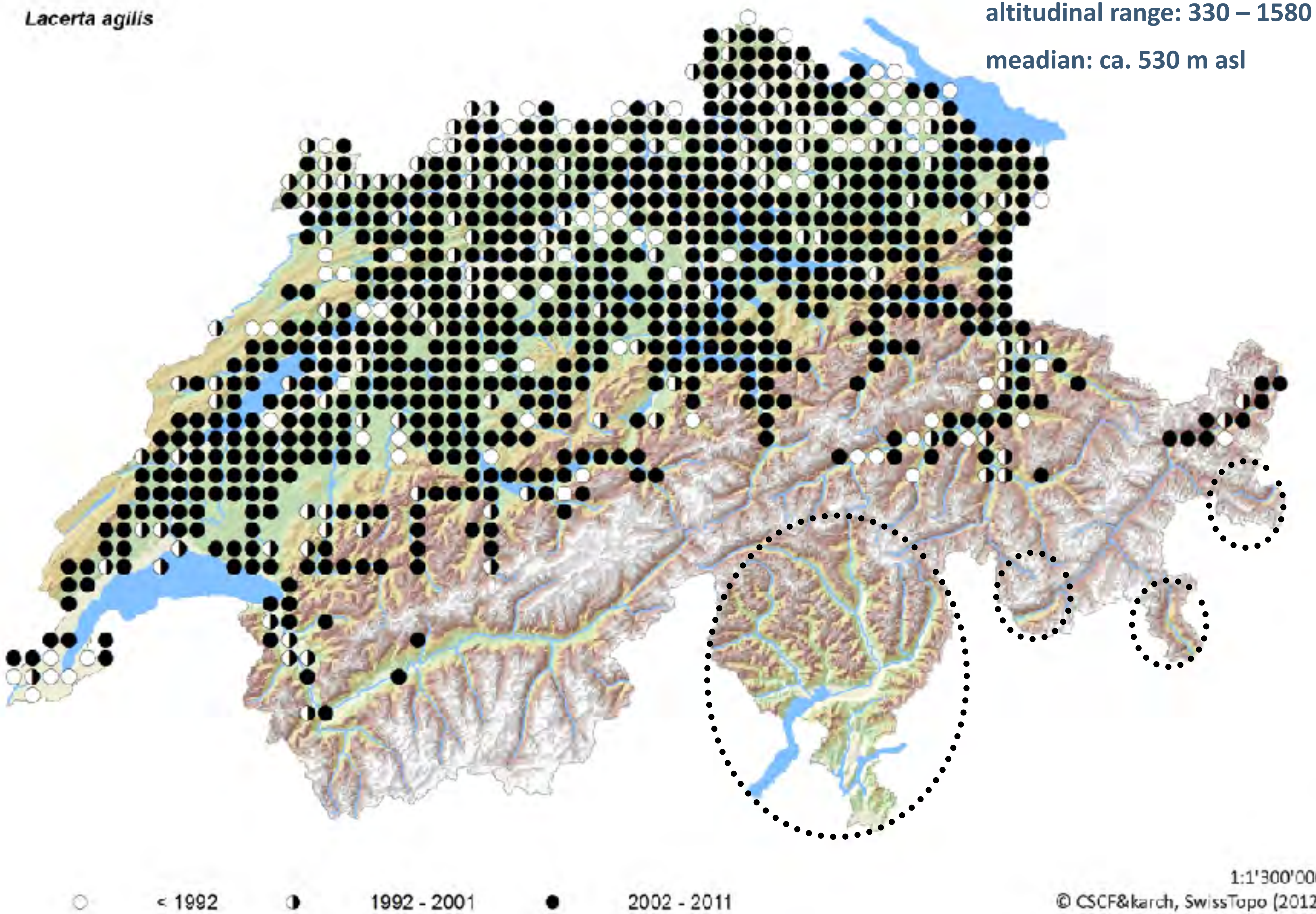
- solid body, large head
- round body section
- short tail, about 1/2 of the total length
- length: a bit more than 20 cm (♂ max. 22 cm, ♀ max. 21 cm)
- coloration: ♂ light green on the flancs, but braun on the back.
  ♀ and juveniles: braun with spots (light with edged with black) on the flancs
- oviparous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

♂

Sand lizard *- Swiss distribution*

altitudinal range: 330 – 1580 m asl.

meadian: ca. 530 m asl



Viviparous lizard (*Zootoca vivipara*)

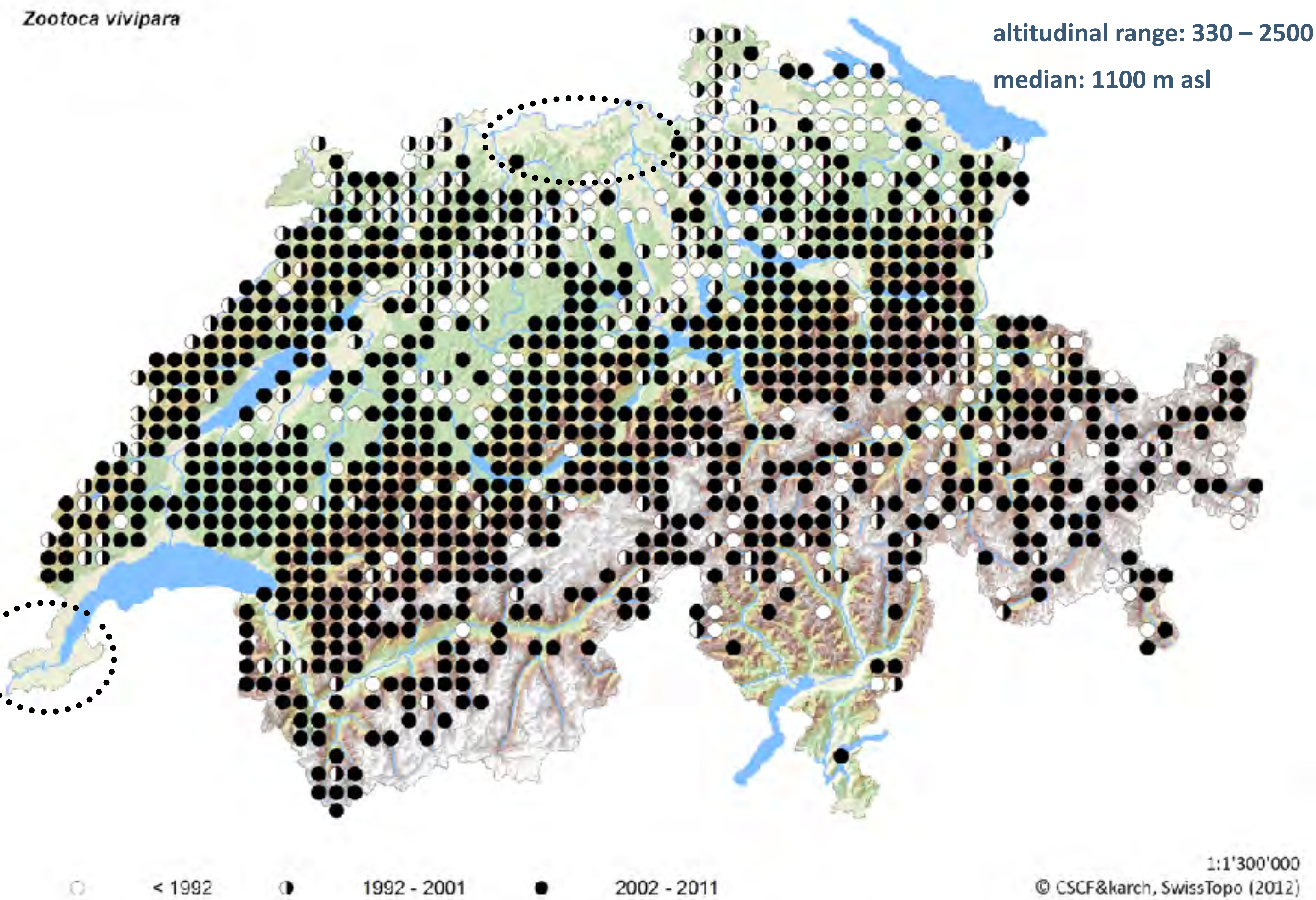
Viviparous lizard - *characteristics*

- 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*

altitudinal range: 330 – 2500 m asl

median: 1100 m asl



Wall lizard (*Podarcis muralis*)

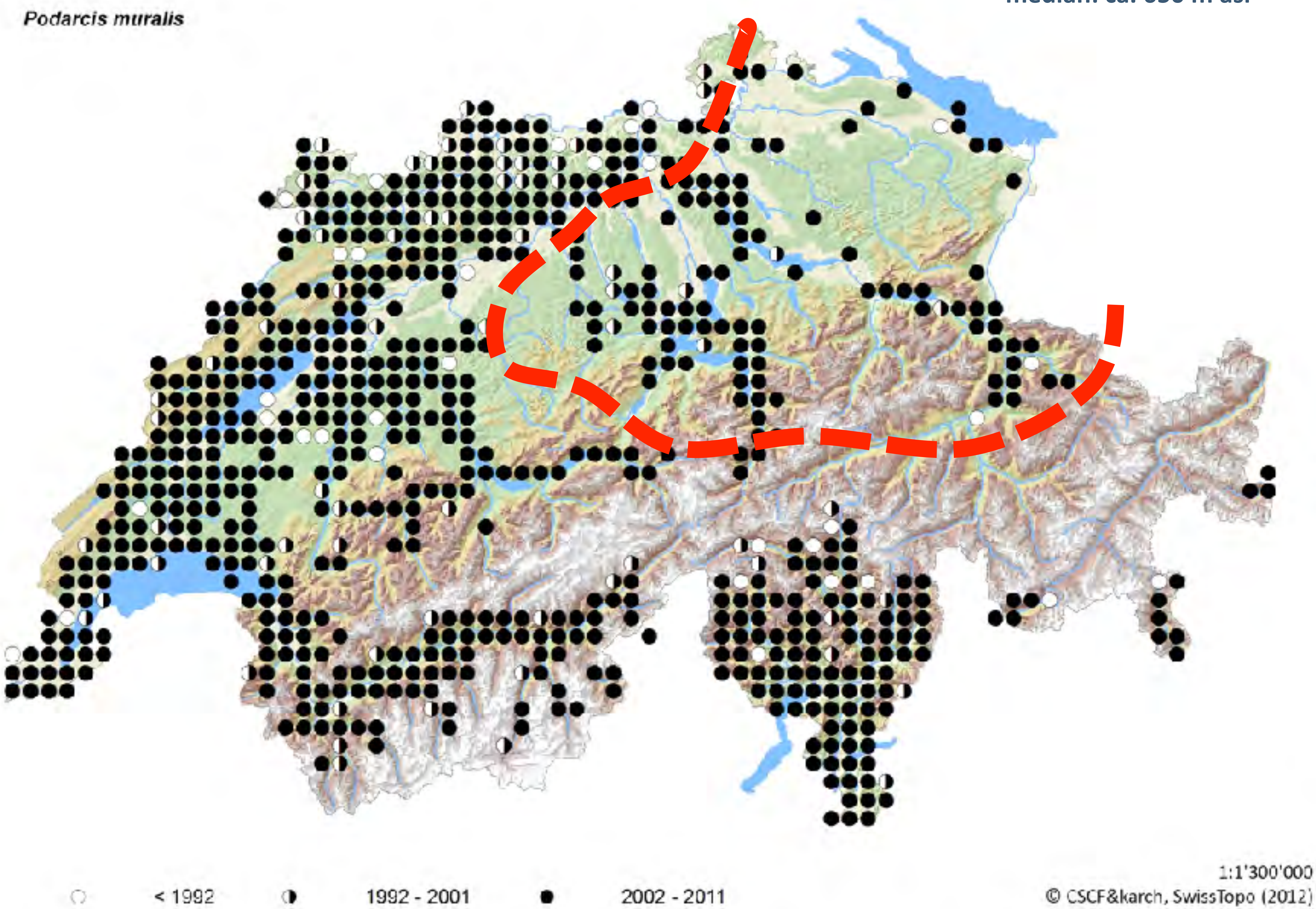
Wall lizard - *characteristics*

- 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*

altitudinal range : 190 – 2200 m asl

median: ca. 650 m asl




Western green lizard (*Lacerta bilineata*)

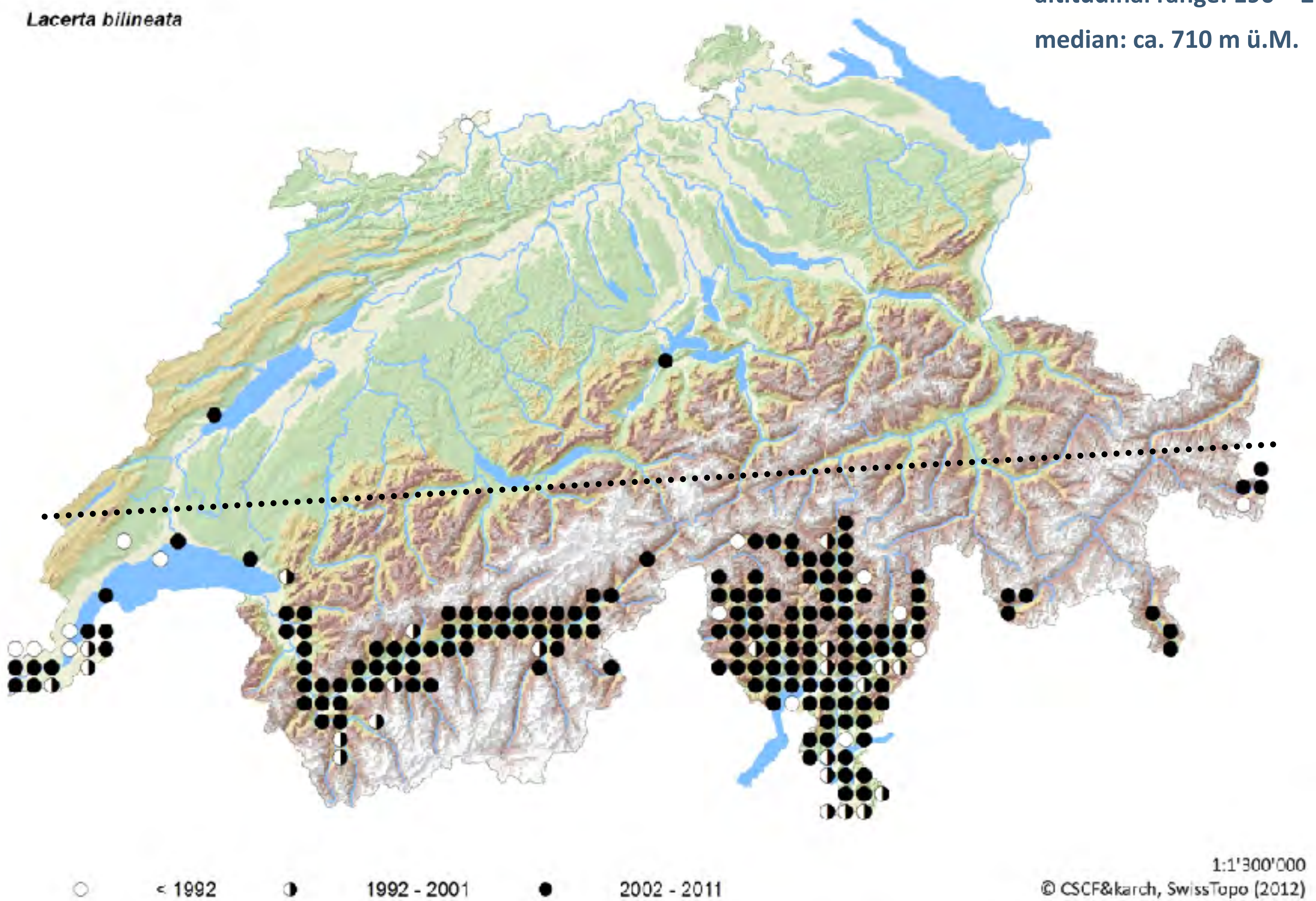
Western green lizard - *characteristics*

- 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 ü

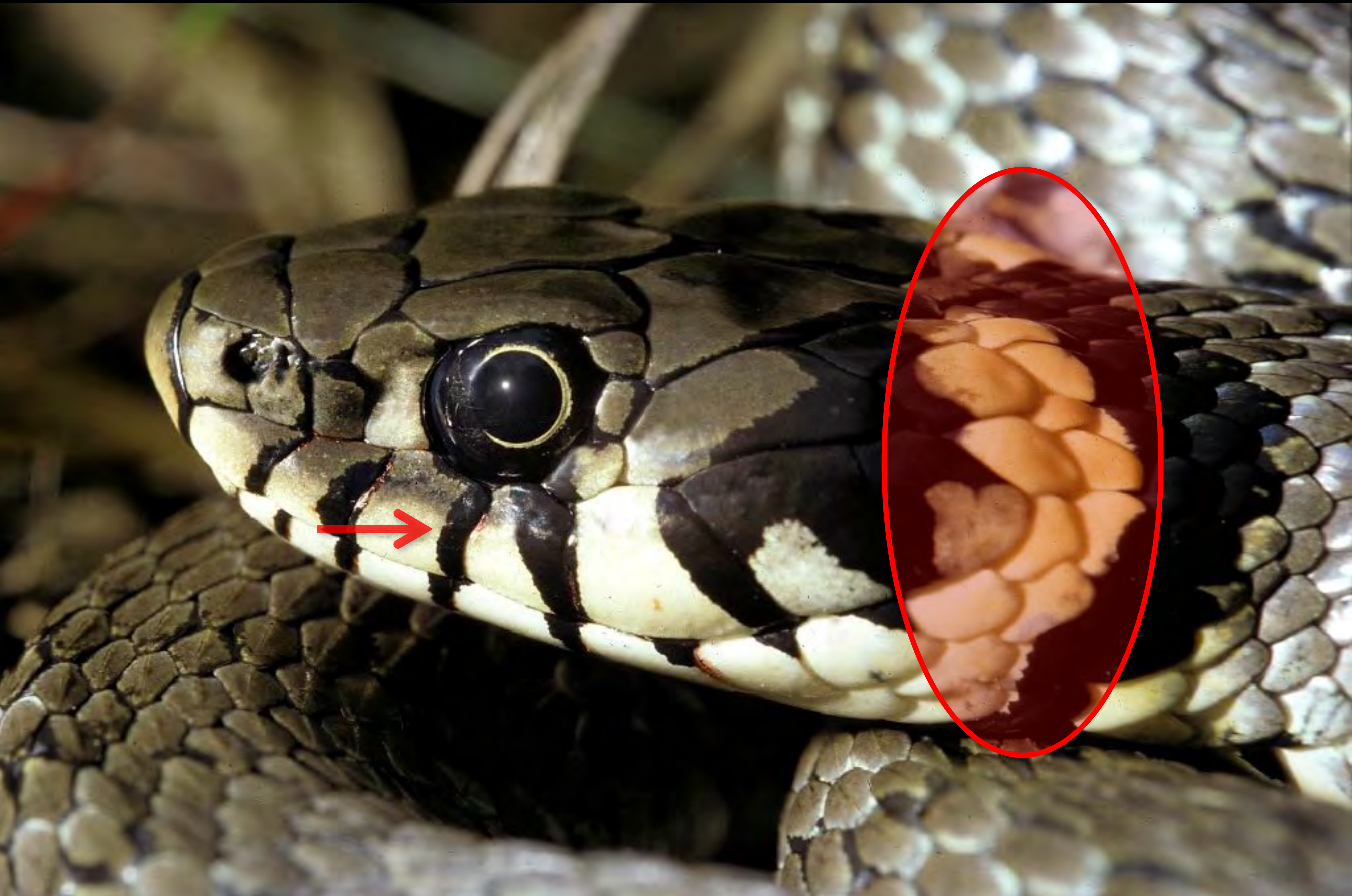
median: ca. 710 m ü.M.



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

Grass snakes - *characteristics*

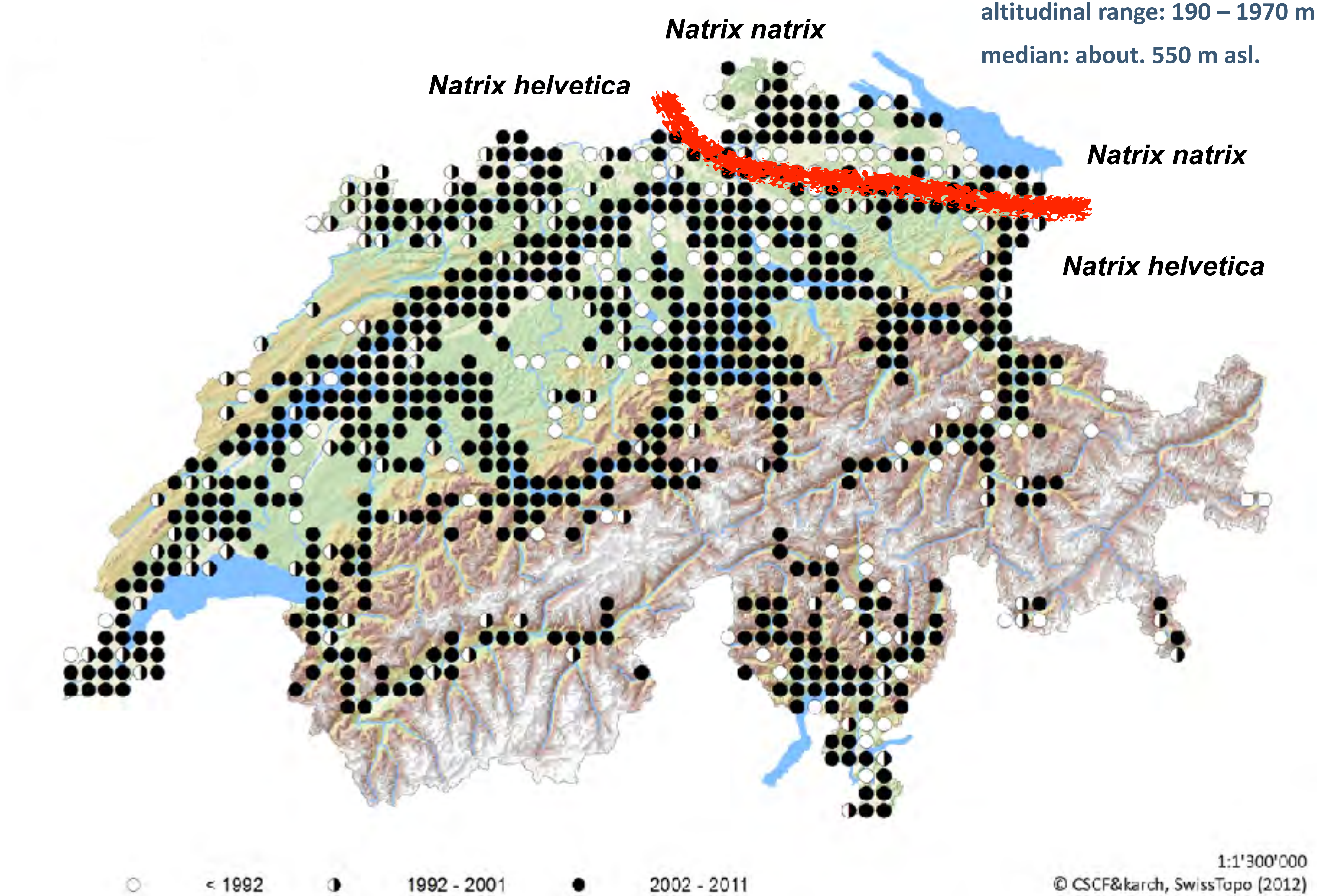
- quite massive snake (especially ♀♀)
- size: up to 130 cm (♂ max. 91 cm, ♀ max. 140 cm)
- round pupil
- keeled dorsal scales
- coloration: variable, generally grey or braun, more rarely olive or blue-grey, sometimes black. With lines on the flancs and on the back, larger for *N. helvetica* than for *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.

median: 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

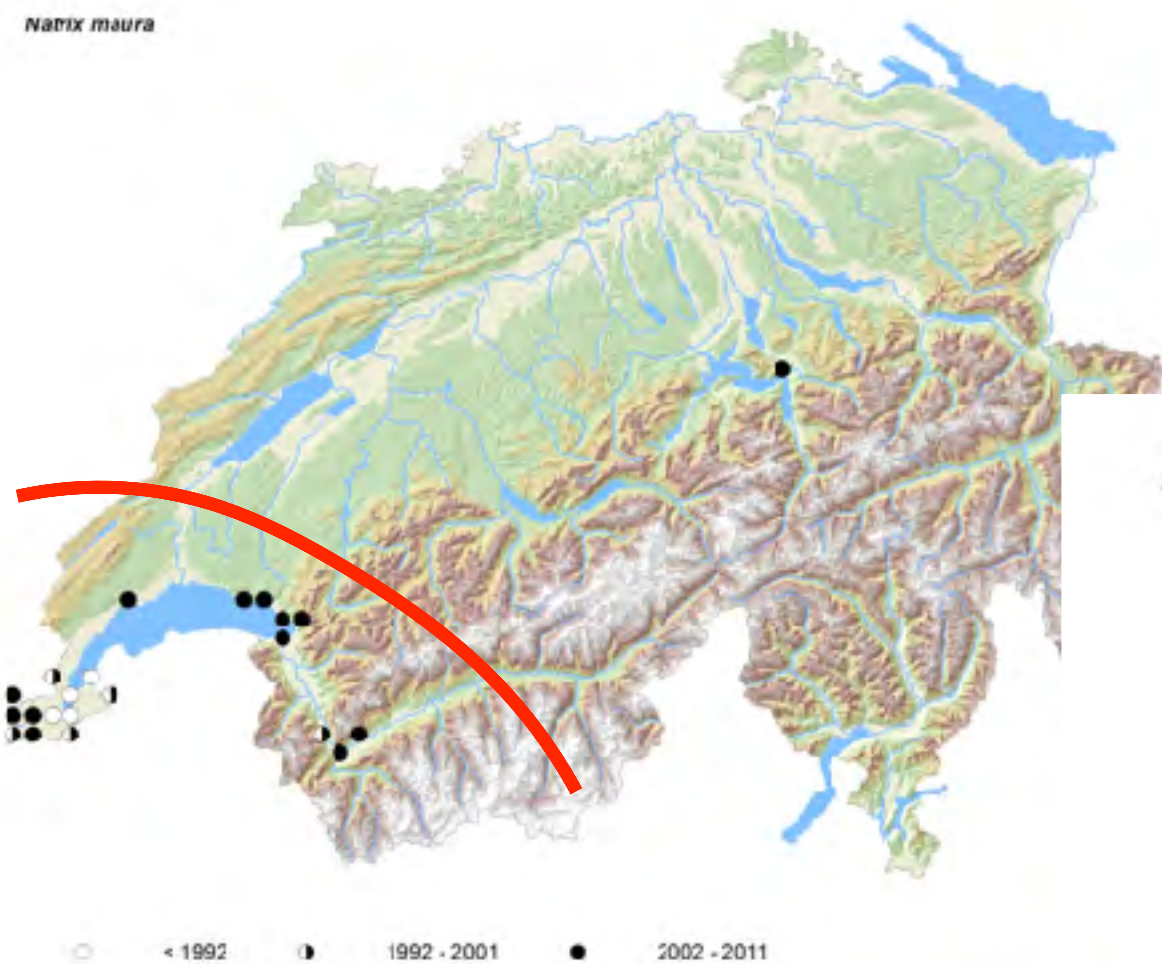
Dice snake
(Lumino, TI)


Viperine snake
(GE)

Dice snake and Viperine snake - *Swiss distribution*

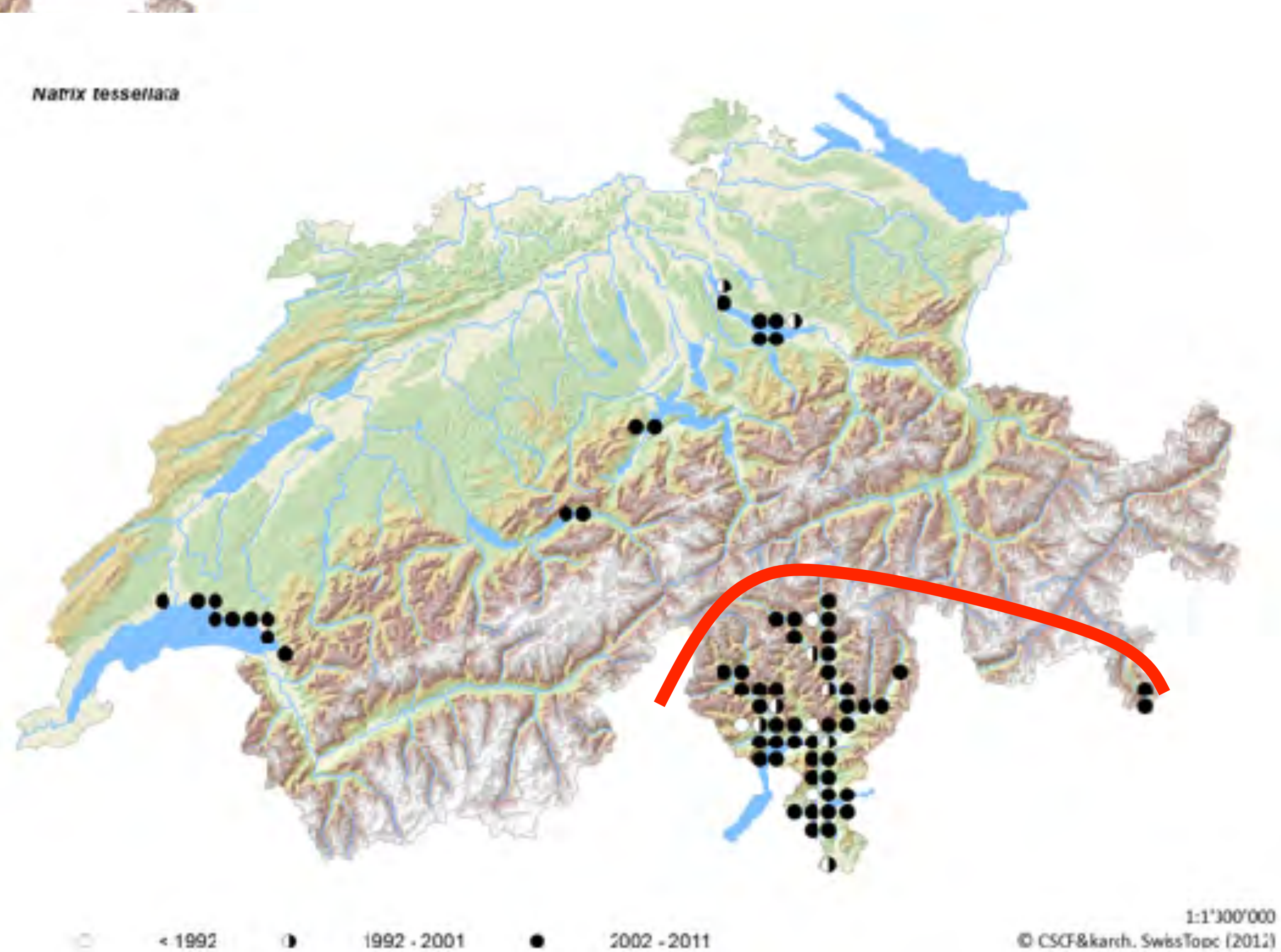
altitudinal range: 380 – 480 m asl

median: about 400 m asl



altitudinal range: 190 – 900 m asl

median: env. 400 m asl



Smooth snake (*Coronella austriaca*)

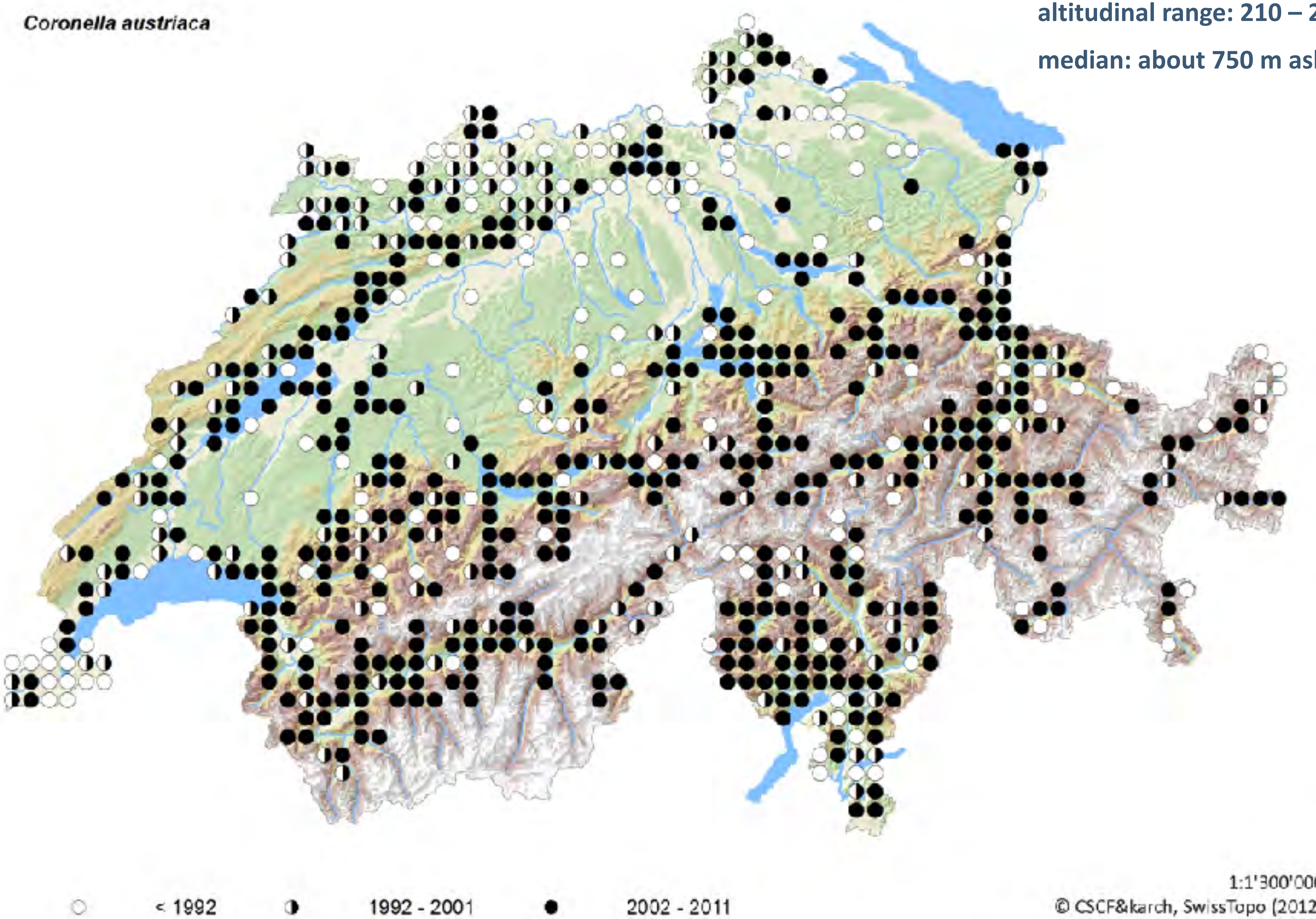
Smooth snake - *characteristics*

- 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*

altitudinal range: 210 – 2240 m as

median: about 750 m asl



Green whip snake (*Hierophis viridiflavus*)

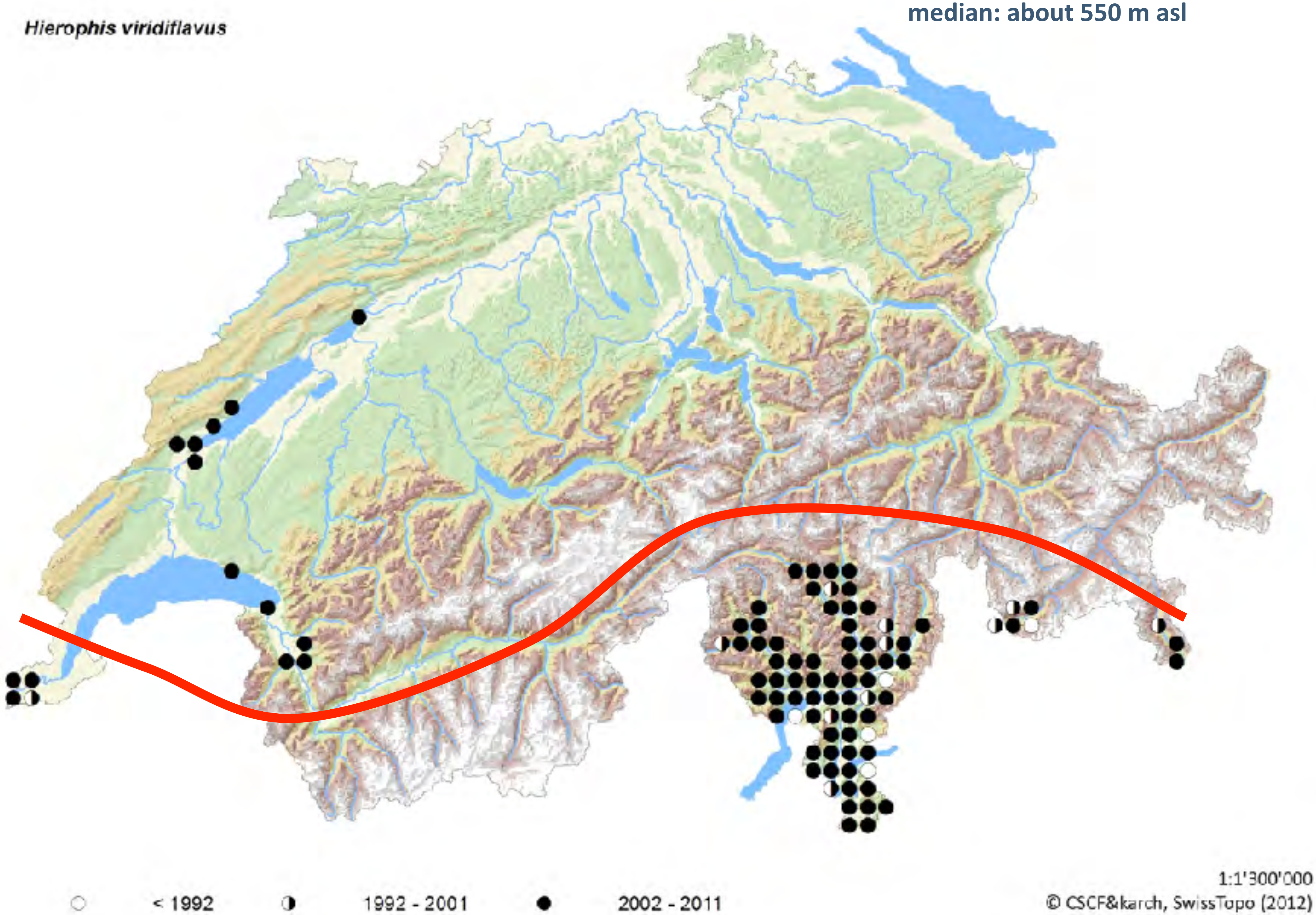
Green whip snake - *characteristics*

- 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



Aesculapian snake (*Zamenis longissimus*)

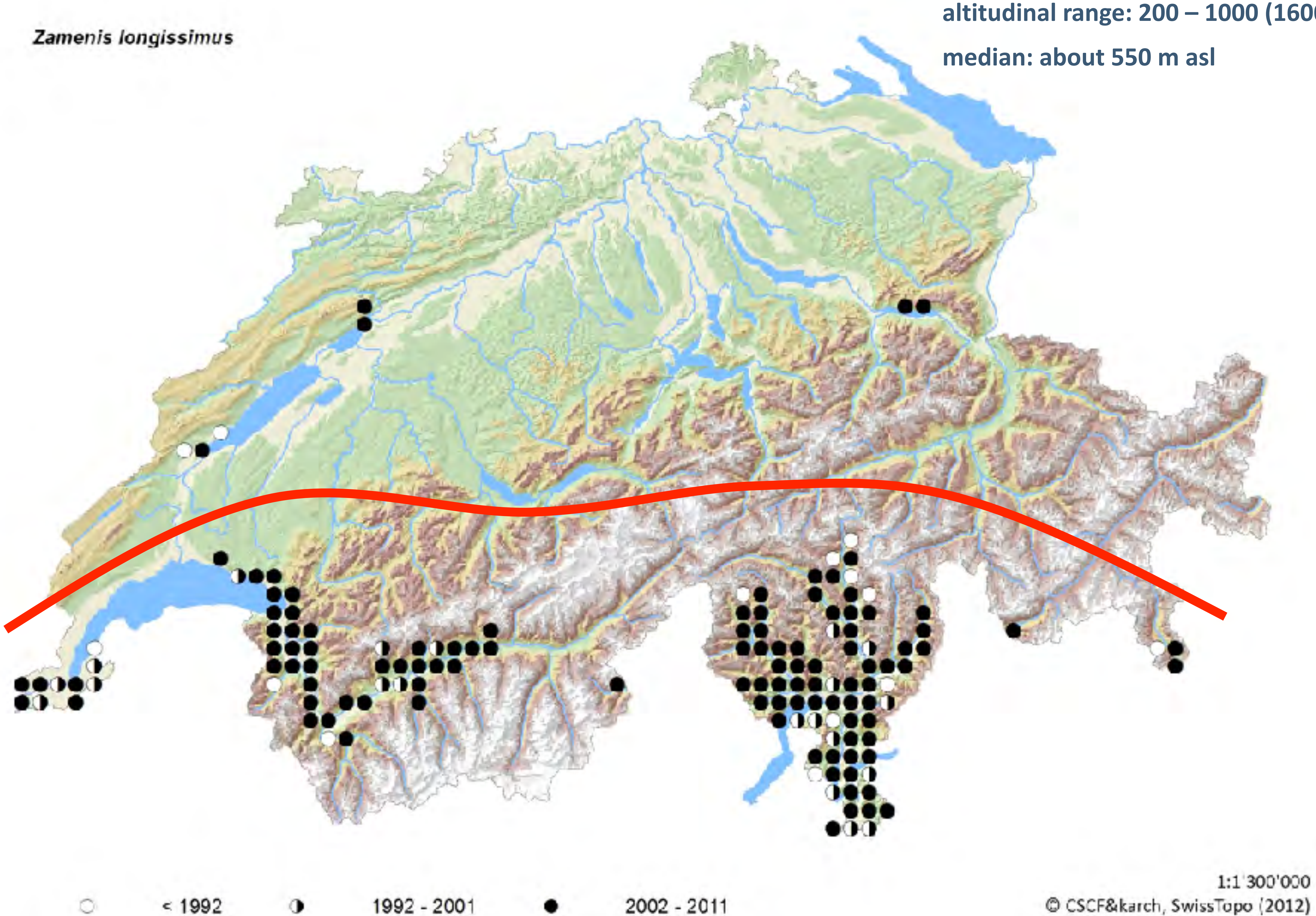
Aesculapian snake - *characteristics*

- 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



venomous snakes in Switzerland

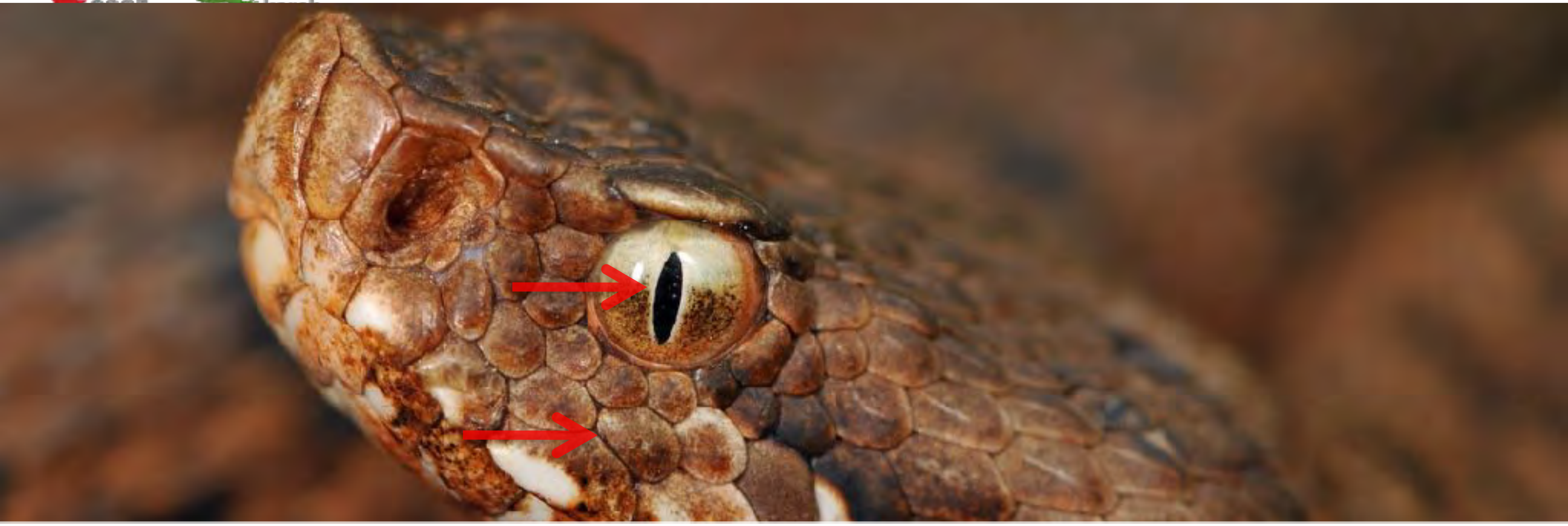
asp viper (*Vipera aspis*)

adder (*Vipera berus*)

What is a venomous snake?

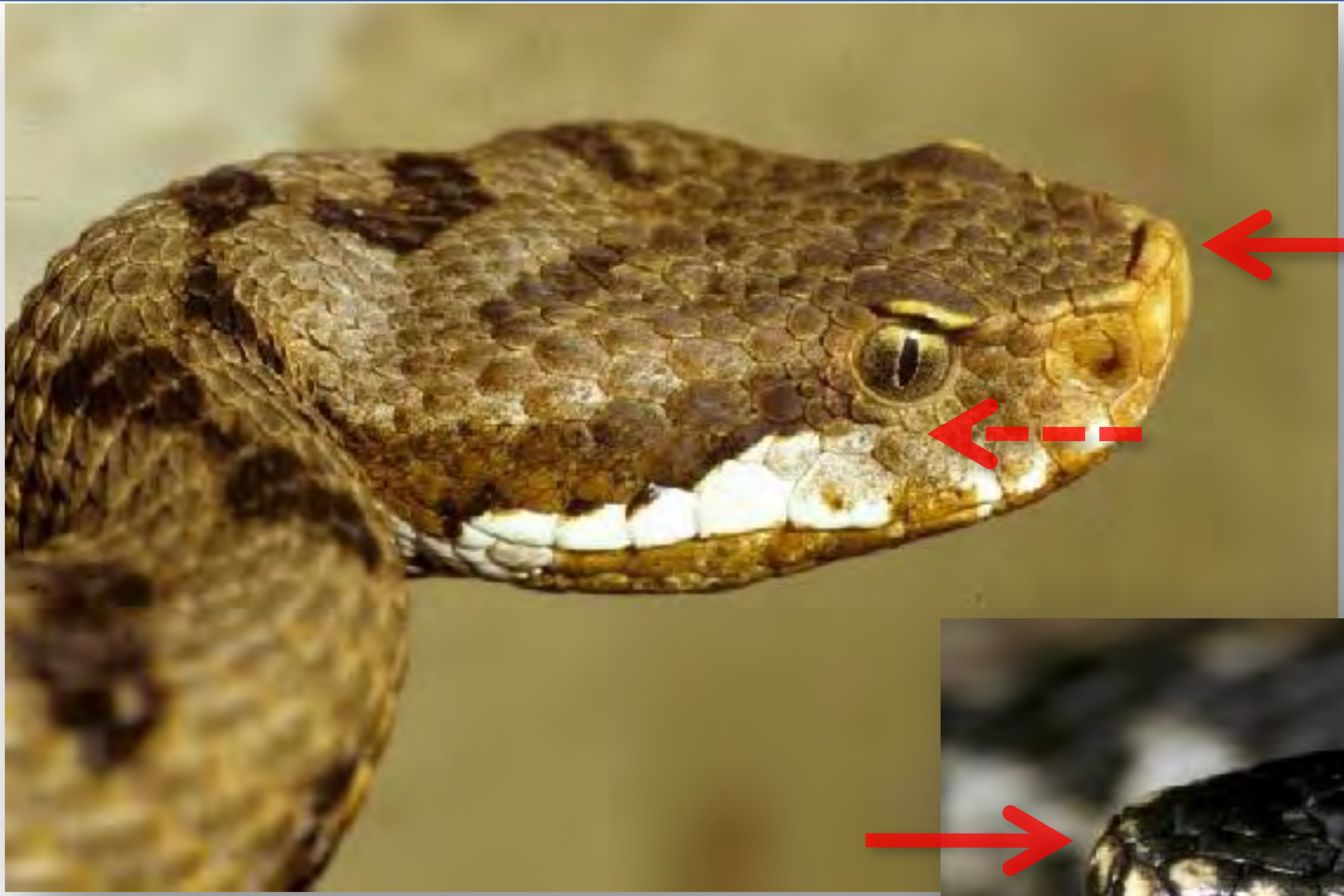
- there is no clear separation between venomous and non venomous snakes
- most of the species are not producing venom and are so considered as non venomous
- some species produce venom, but cannot actively inject it (no fang)
- some species produce venom, can inject it but the venom has practically no 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*)

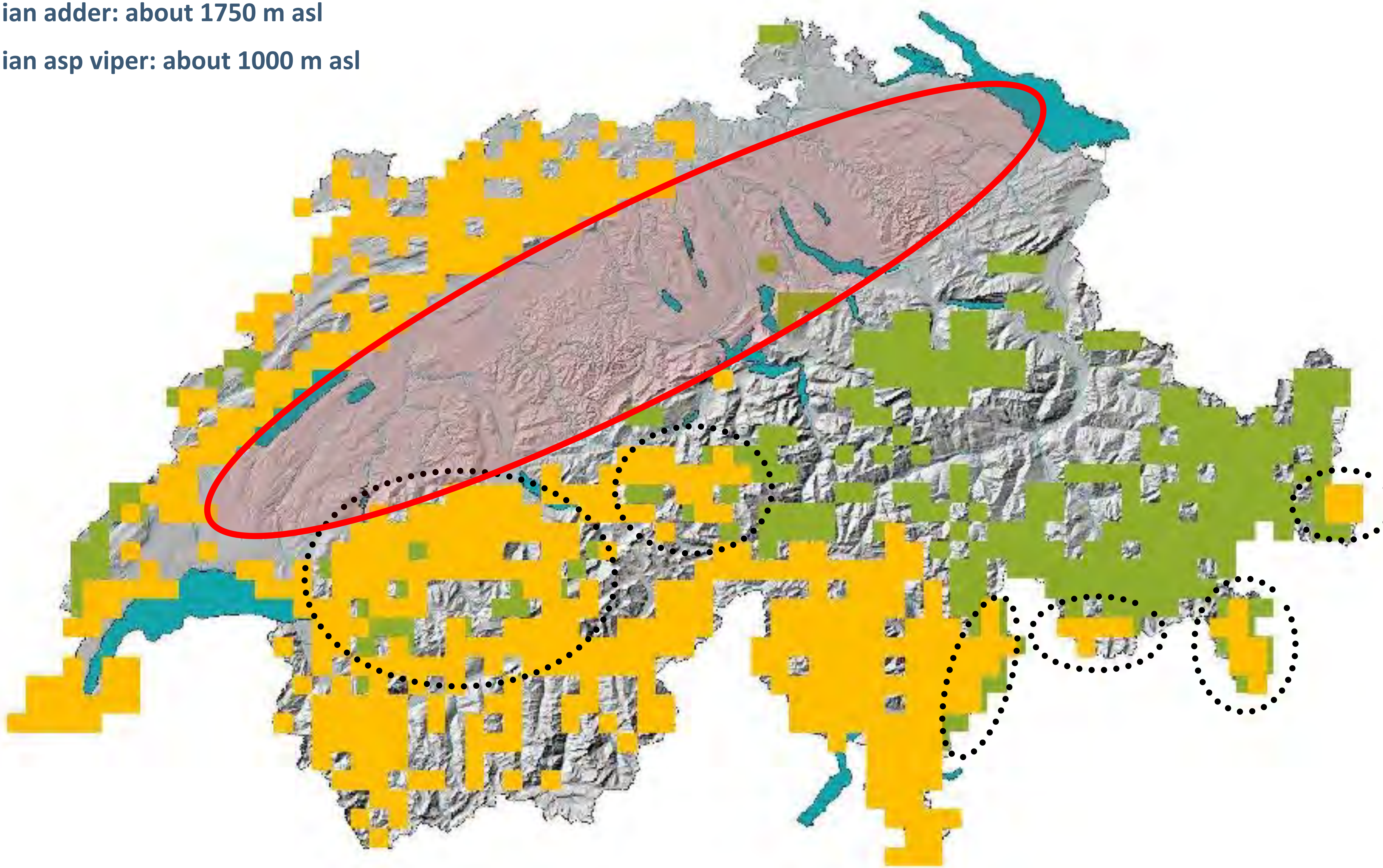
Asp viper and adder - *characteristics*

- 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



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asp viper
(*Vipera aspis*)


adder: female


adder: male

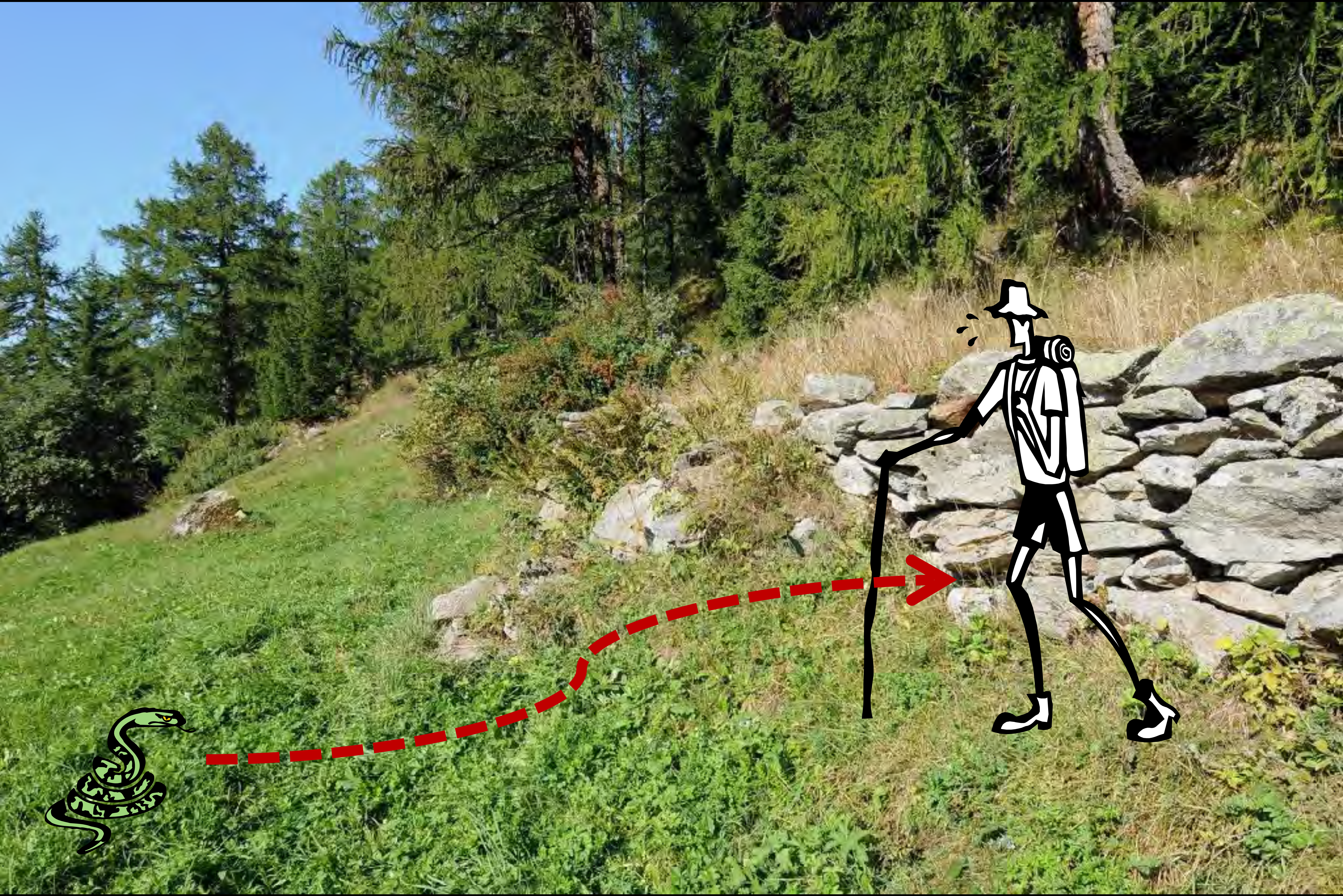

Asp viper (*Vipera aspis*)


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

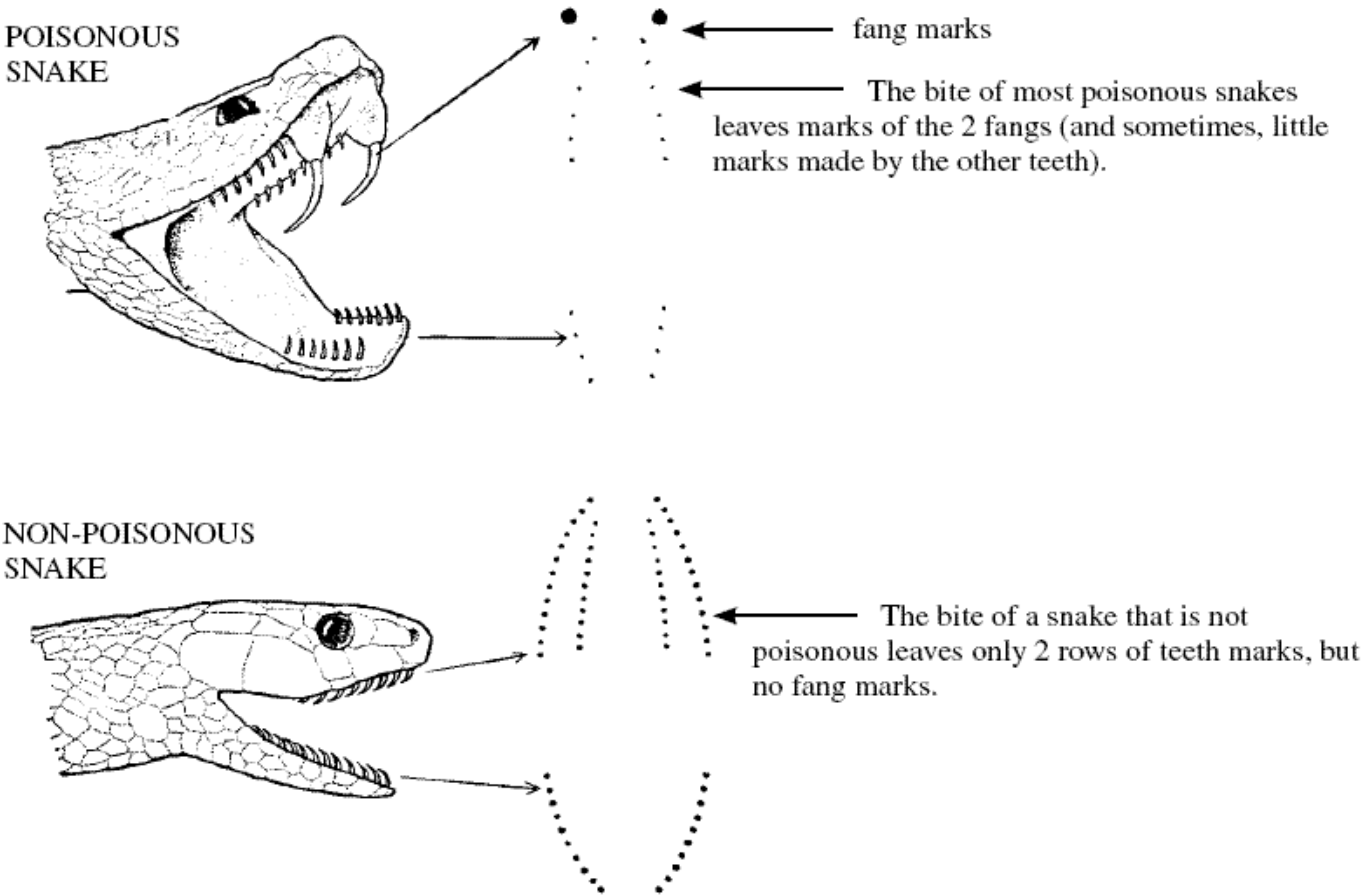
snakes love disorder! It provides lots of hiding places.

>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

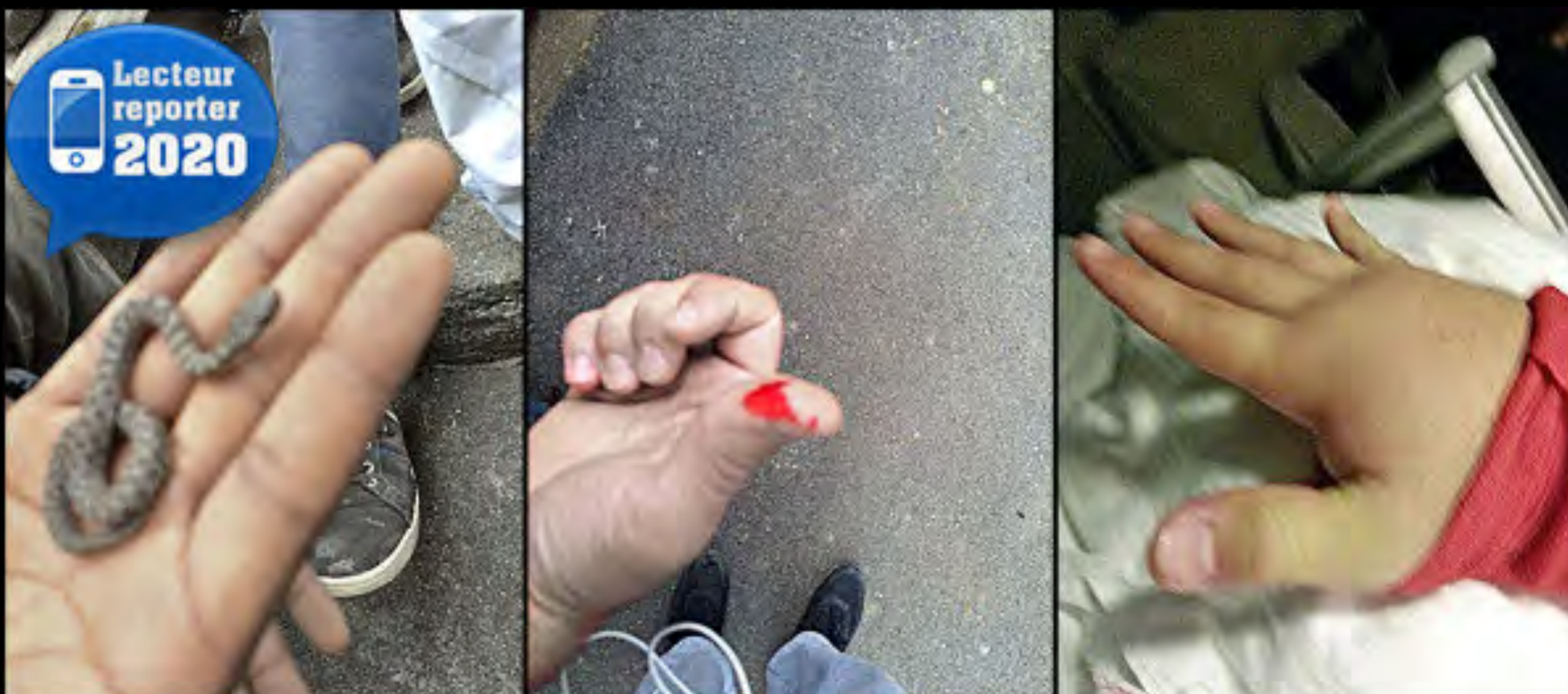
- 2 venomous species / 9 species
- about 20-40 cases every year
- last dead case: 1960’

- 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.



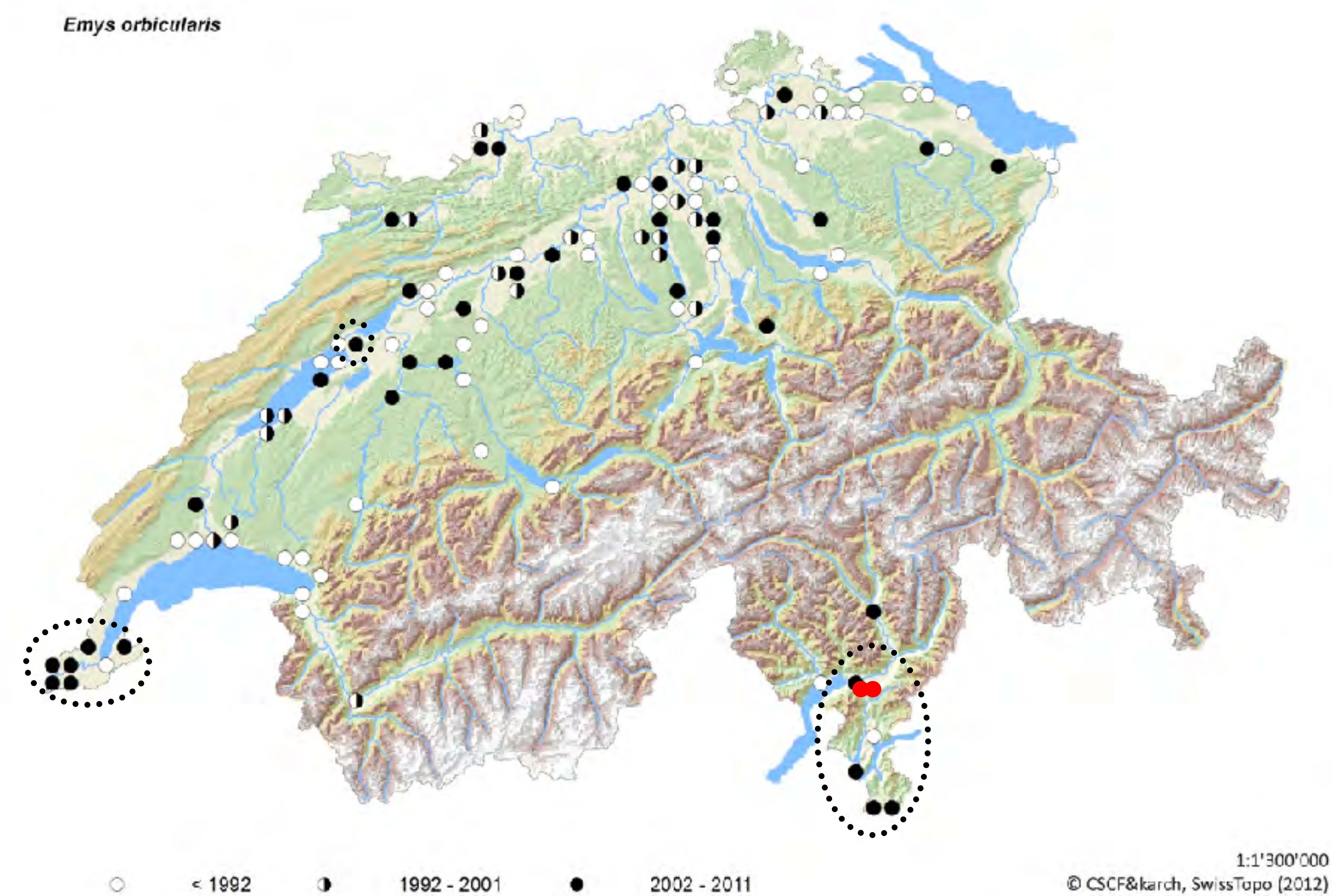
European pond turtle (*Emys orbicularis*)

European pond turtle - *characteristics*

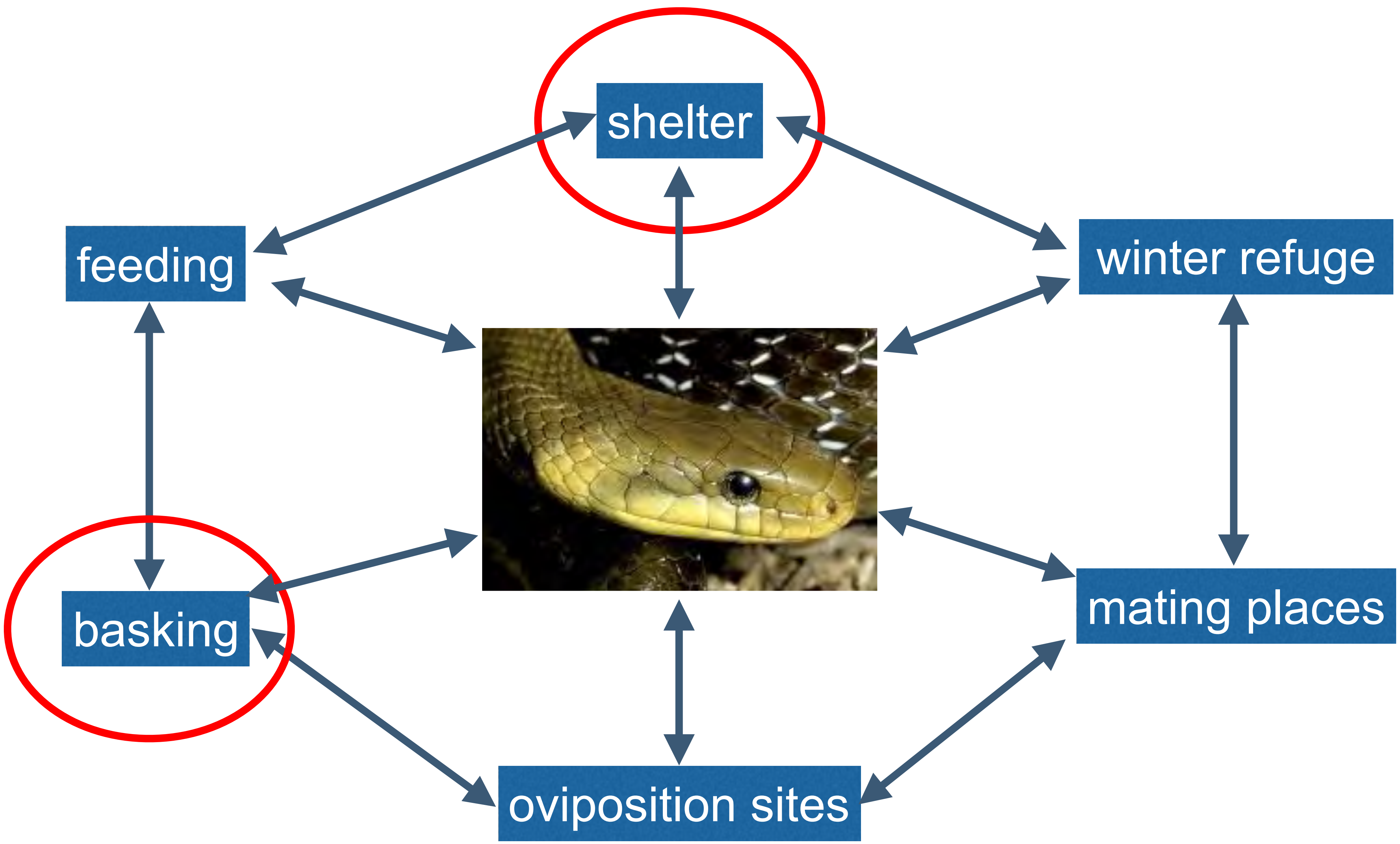
- no confusion with other endemic species; but frequently confused with introduced American aquatic turtles
- braun to black shell, sometimes with yellow points or lines. Head, neck and legs: black with yellow points (no large marking or bands)
- small and slender, up to 20 cm as total length
- live 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*

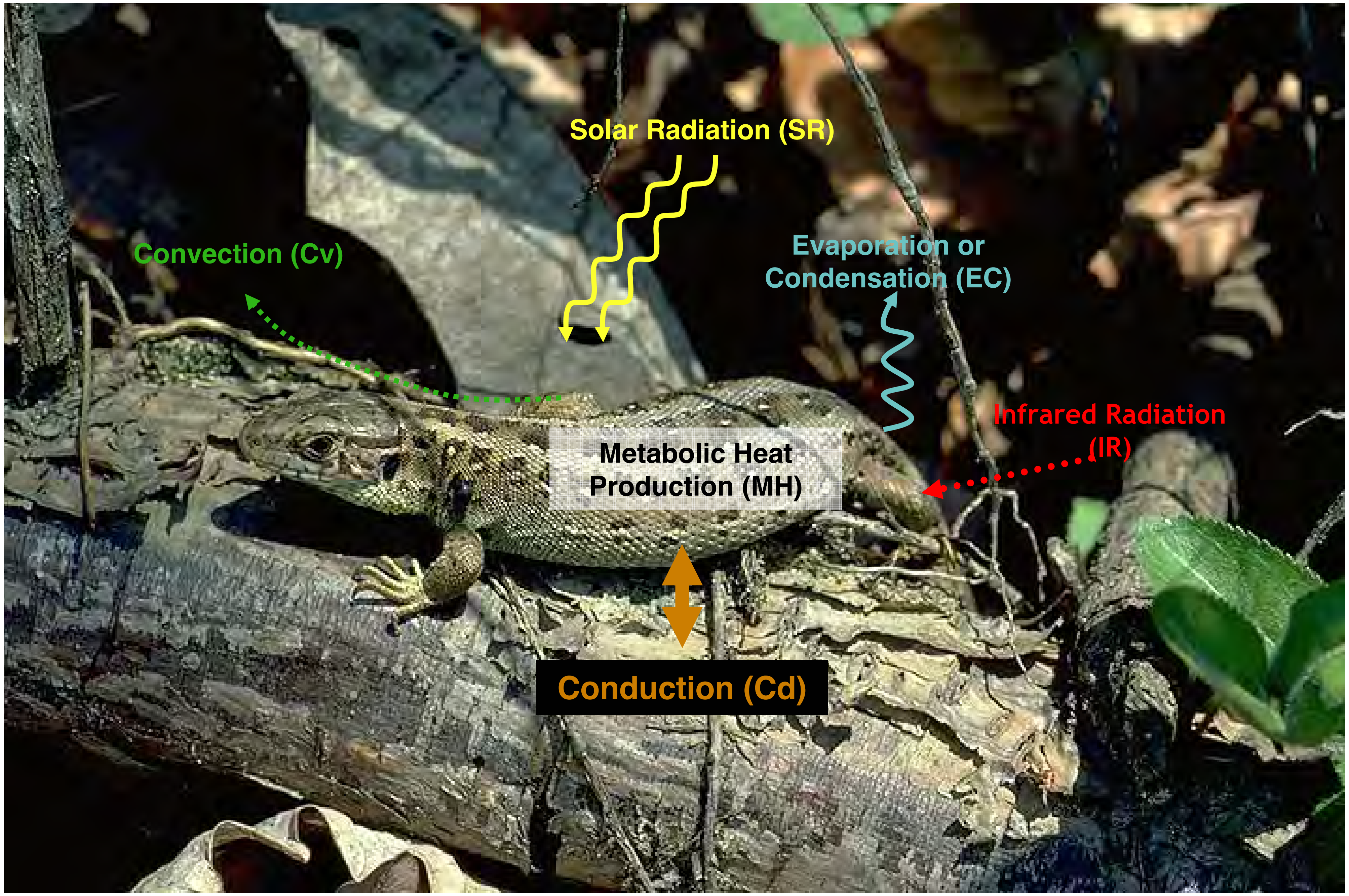
altitudinal range: below 500 m asl



Reptiles - *high requirements on their habitats*



Thermoregulation



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

Thermoregulation

thermoregulation: impact on the reptile activities

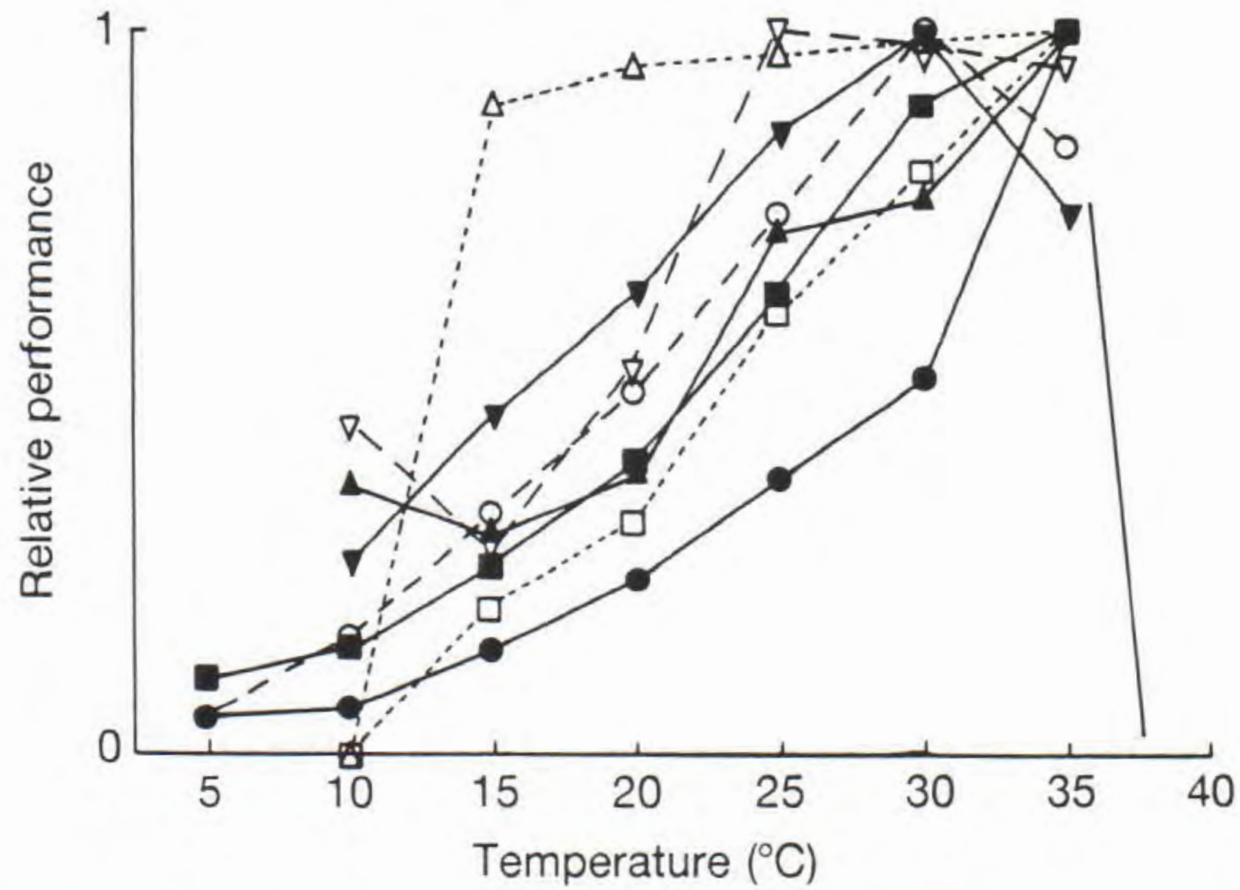


FIG. 3. The temperature-sensitivity of several physiological systems related to activity and digestion in *N. maura* (from Hailey, 1984). Rate (□) and efficiency (△) of digestion; increment of body lactate after 30s of activity (▽) and when exhausted (▲); burst speed (▼) and endurance (○); SMR (●) and aerobic scope (■). The fall to zero performance from 35–40 °C is drawn to indicate that the lethal maximum Tb is in this range.

Hailey A, Davies PMC (1988) Activity and thermoregulation of the snake *Natrix maura*. 2. A synoptic model of thermal biolgy and the physiological ecology of performance. Journal of Zoology, 214:325-342

Thermoregulation

thermoregulation: impact of the reptile coloration

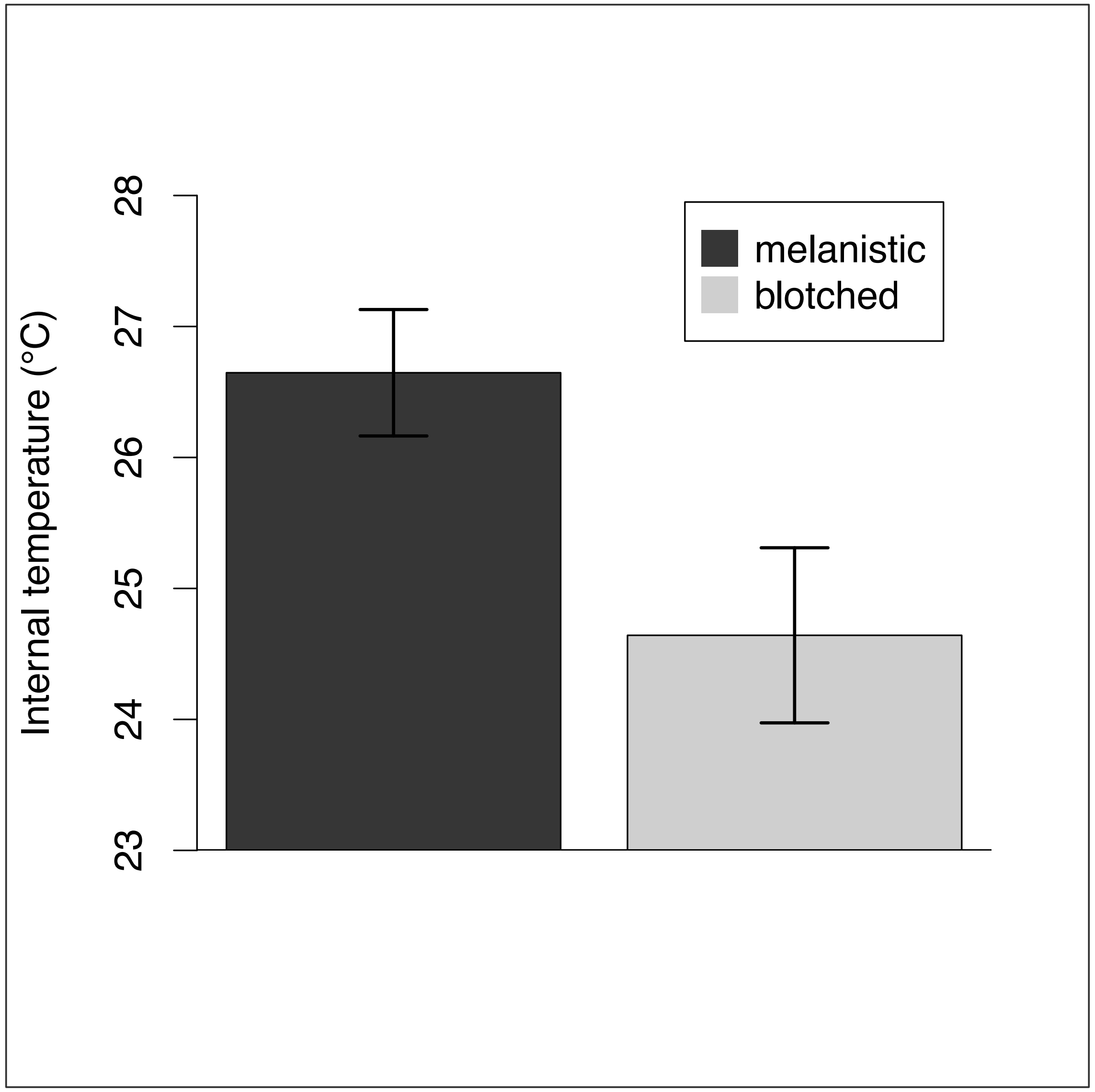


Figure 1 Average internal temperature for melanistic and blotched gravid females measured during 2014. Dark gray bar represents melanistic vipers while light gray one represents blotched vipers. Standard errors have been added on both bars. A significant difference in the average internal temperature can be observed between melanistic (26.65°C) and blotched (24.64°C) vipers.

Muri D, Schuerch J, Trim N, Golay J, Baillifard A, El Taher A, Dubey S (2015) Thermoregulation and microhabitat choice in the polymorphic asp viper (*Vipera aspis*). Journal of Thermal Biology, 53:107-112

Thermoregulation

Thamnophis sirtalis

- large communal overwintering dens (Manitoba)
- males mating with females
- "she-males" attract males to increase their own temperature

Shine R, O'Connor D, Mason RT (2011) Female mimicry in garter snakes: Behavioural tactics of 'she-males' and the males that court. Canadian Journal of Zoology 78:1391-1396

Mating

adder (*Vipera berus*)

Mating

Wall lizard (*Podarcis muralis*)

Reproduction

Oviparous

- lay eggs
- no or limited parental care

Ovoviviparous

- keep eggs inside

Viviparous

- keep eggs inside
- exchanges between mother and juveniles

Reproduction - *oviparous/viviparous*

Limits of oviparity

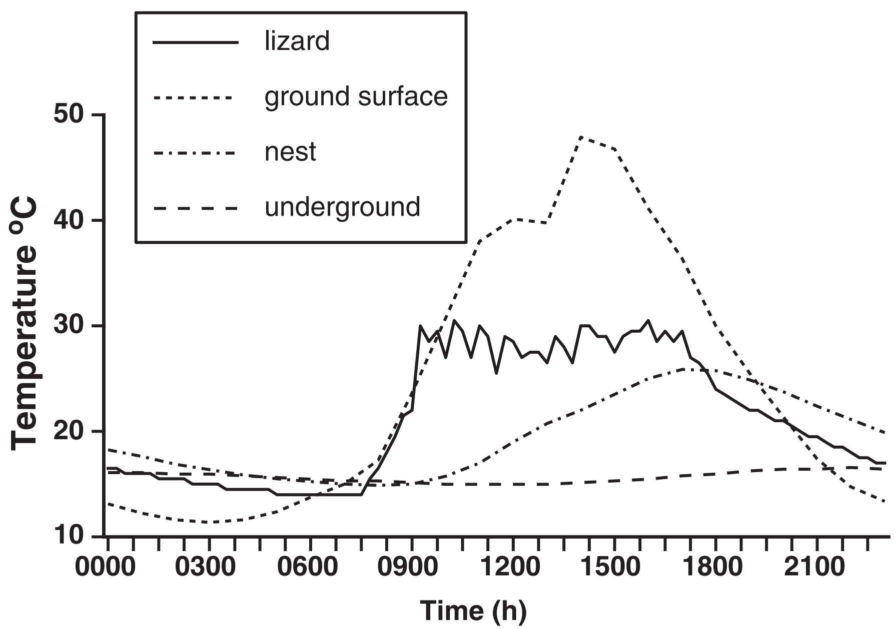


Figure 1. Diel variation in temperatures on a fine warm day (15 January 2001) at 1660 m asl (middle slopes of Mount Ginini) in the Brindabella Range. The graph shows output from miniature data-loggers that were (a) attached to the dorsal surface of a gravid female of a viviparous lizard species (*Eulamprus heatwolei*) in an outdoor arena, and thus free to thermoregulate ('lizard'); (b) glued to the upper surface of a grey concrete paver ('ground surface'); (c) placed under the paver, where eggs would typically be laid ('nest'); or (d) buried 30 cm deep under the paver ('underground').

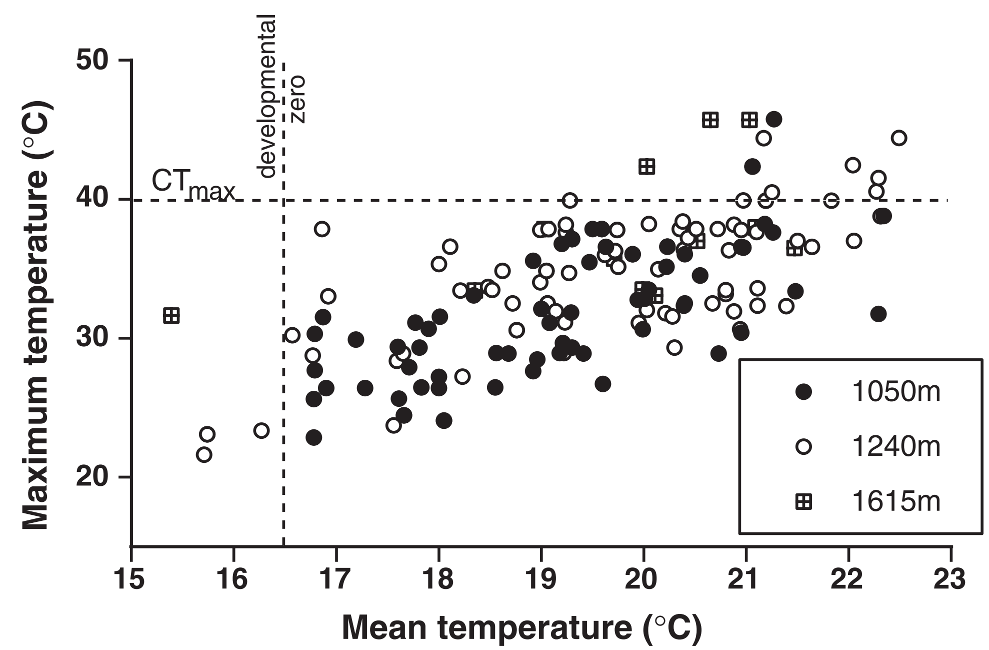


Figure 3. The relationship between mean temperature and maximum temperature for natural nests in the Brindabella Range (numbers show elevations in m asl). The horizontal line at a maximum temperature of 40°C represents the critical thermal maximum (CTmax), the level likely to be lethal to eggs. The vertical line at 16.5°C ('developmental zero') shows the minimum temperature below which embryogenesis ceases in this species. Thus, development can occur successfully only in the thermal region to the lower right of this Figure, bounded by these two lines (see text for further explanation). The graph shows data for natural nests (separately for three sites, at 1050, 1240 and 1615 m) monitored over a seven-year period. Higher mean values were associated with higher maximum values, and the relationship between mean and maximum nest temperatures varied with elevation (see text).

Shine R, Elphick MJ, Barrott EG (2003) Sunny side up: lethally high, not low, nest temperatures may prevent oviparous reptiles from reproducing at high elevations. Biological Journal of the Linnean Society, 78:325–334.

Reproduction - *oviparous/viviparous*

Limits of viviparity

Lourdais et al (2004): impact of °C

- June = number of ventral scales
- July = duration of gestation
- August = % stilborn

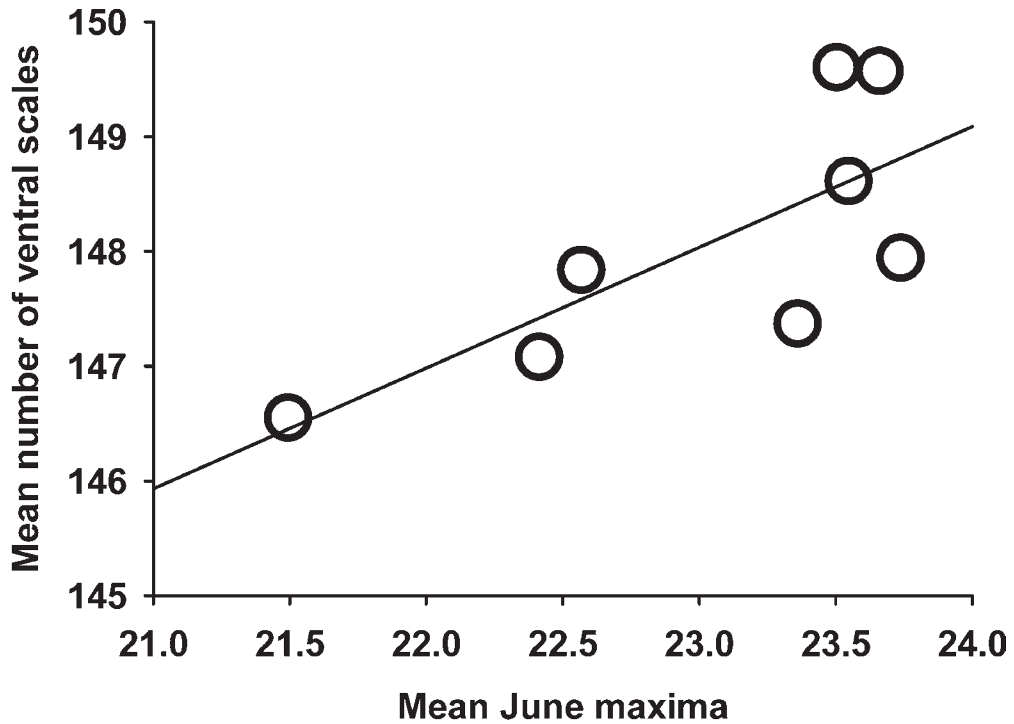


Fig. 3. Relationship between mean June ambient thermal maxima and mean number of ventral scales in neonatal vipers over the course of the study.

Table 2. Influence of mean temperatures during the three months of pregnancy on the duration of gestation in female aspic vipers.

Multiple Regression $r = 0.71$; $r^2 = 0.51$; $n = 80$; $F(3, 76) = 26.86$; $p < 0.0001$

	Beta	Partial correlation	p-value
June	0.23	0.18	0.11
July	−0.77	0.62	< 0.0001
August	−0.09	0.09	0.44

Lourdais O, Shine R, Bonnet X, Guillon M, Naulleau G (2004) Climate affects embryonic development in a viviparous snake, *Vipera aspis*. Oikos, 104, 551-560.

Feeding behaviour

Feeding behaviour

All Swiss snakes and lizards: predators

Lizards: arthropods

Slow worm: molluscs and eathworms

snakes: vertebrates

- *Natrix maura, N. tessellata*: manly fish (60-100%)
- *Natrix natrix, N. helvetica*: mainly amphibians (83-98%)
- *Coronella austriaca*: mainly reptiles (70-98%)
- *Zamenis longissimus*: also birds (good climber)
- *Herophis viridiflavus*: reptiles and mammals
- Vipers: mainly lizard when youngs, mainly mammals when adults

Emys orbicularis: omnivorous

Feeding behaviour

Feeding behaviour

asp viper (*Vipera aspis*)

asp viper (*Vipera aspis*)

asp viper (*Vipera aspis*)

asp viper (*Vipera aspis*)

asp viper (*Vipera aspis*)

asp viper (*Vipera aspis*)

Feeding behaviour

Feeding behaviour

Feeding behaviour

wall lizard (*Podarcis muralis*)

Digestion

Digestion

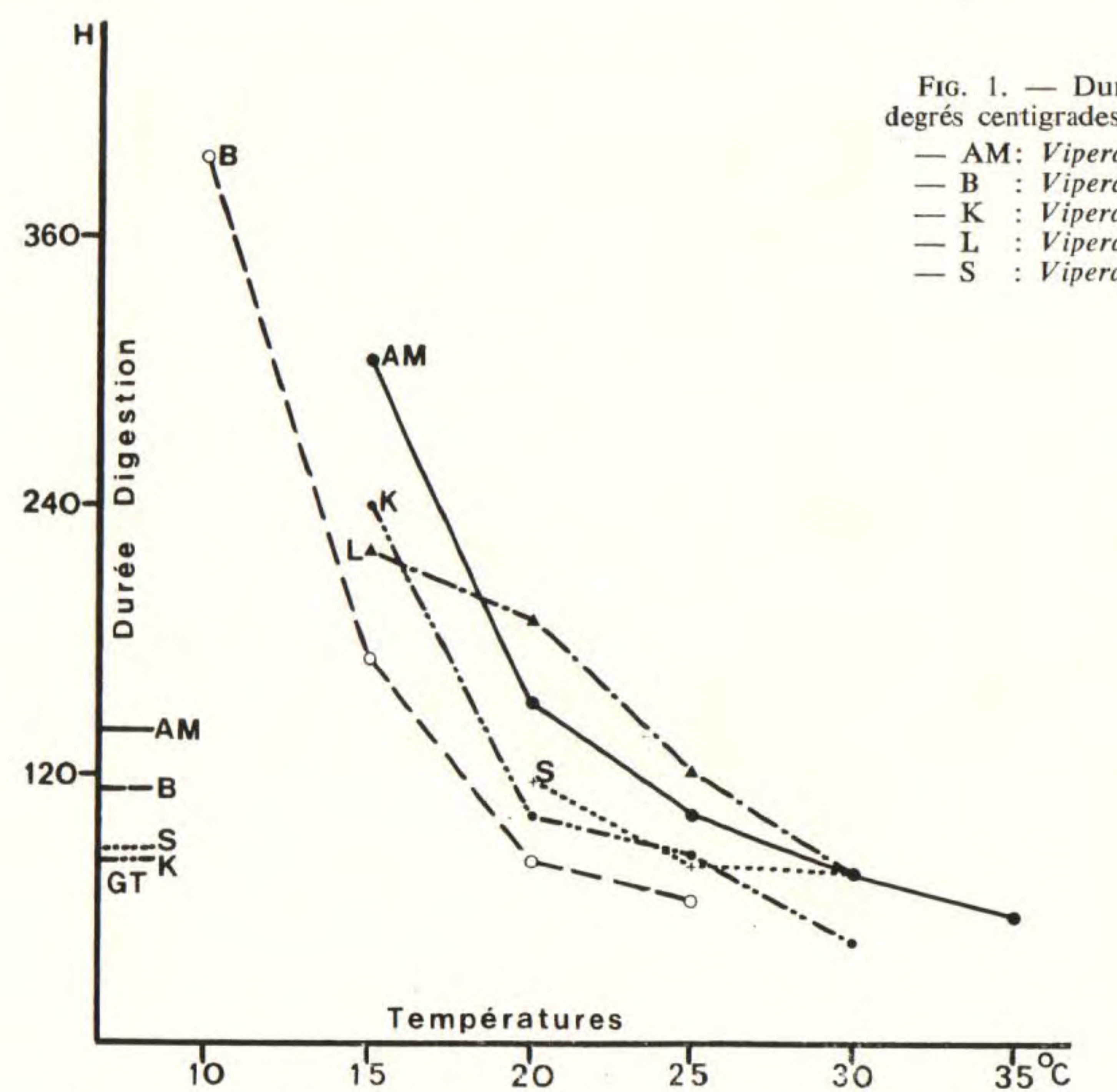


FIG. 1. — Durée de la digestion en heures en fonction de la température en degrés centigrades et en gradient thermique (G.T.).

— AM : *Vipera ammodytes*
— B : *Vipera berus*
— K : *Vipera kaznakovi*
— L : *Vipera latastei*
— S : *Vipera seoanei*

Naulleau G (1983) Action de la température sur la digestion chez cinq espèce de Vipères européennes du genre *Vipera*. Bulletin de la Société Zoologique de France, 108, 47-66.

Metabolism

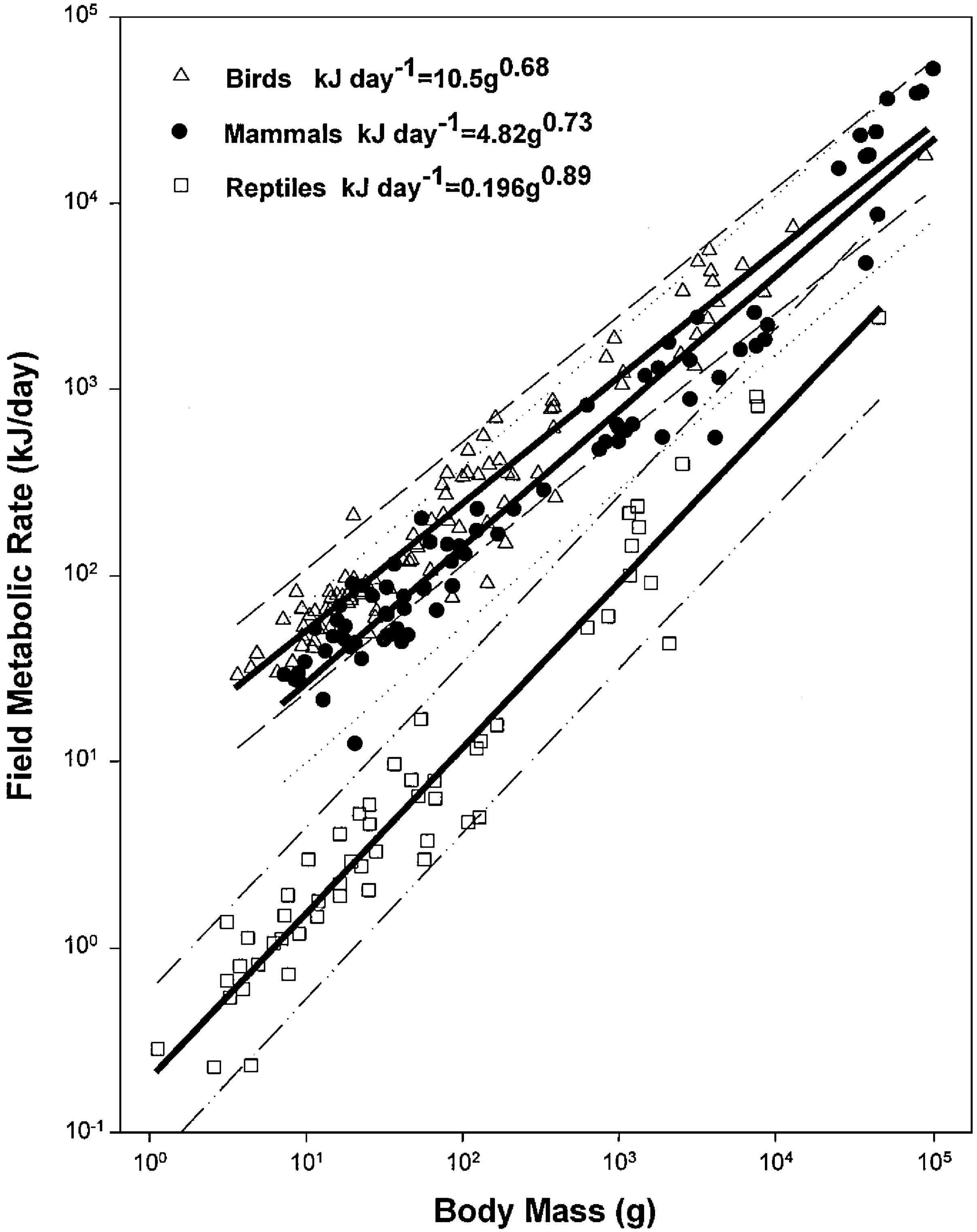


Figure 1 Allometry of field metabolic rate in terrestrial vertebrates. (*Solid lines*) least-squares linear regression lines for birds, mammals, and reptiles (see Equations 1, 17, and 32 in Table 2); (*dashed or dotted lines*) 95% confidence intervals of the prediction for each line.

Nagy KA, Girard IA, Brown TK (1999) Energetics of free-ranging mammals, reptiles, and birds. Annu. Rev. Nutr., 19:247-277

Predators

Predators

Predators

Annual activities *- summary*

- main activity period: March-April (May) - September-October
- reproductive cycles:
  - oviparous lizards: 1-2 clutch(es) / year
  - oviparous snake: 1 clutch/year
  - viviparous lizards : 1 clutch/year (probably biannual for the Slow worm)
  - viviparous snakes: biannual or triannual (or more)
- mating: spring, some species also in autumn
- gestation time (viviparous species): 3-4 months
- eggs incubation: 1-2 month(s)
- shedding: 2-3 / year for adults, a bit more for young.

Reptiles - *large decline*

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?

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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.

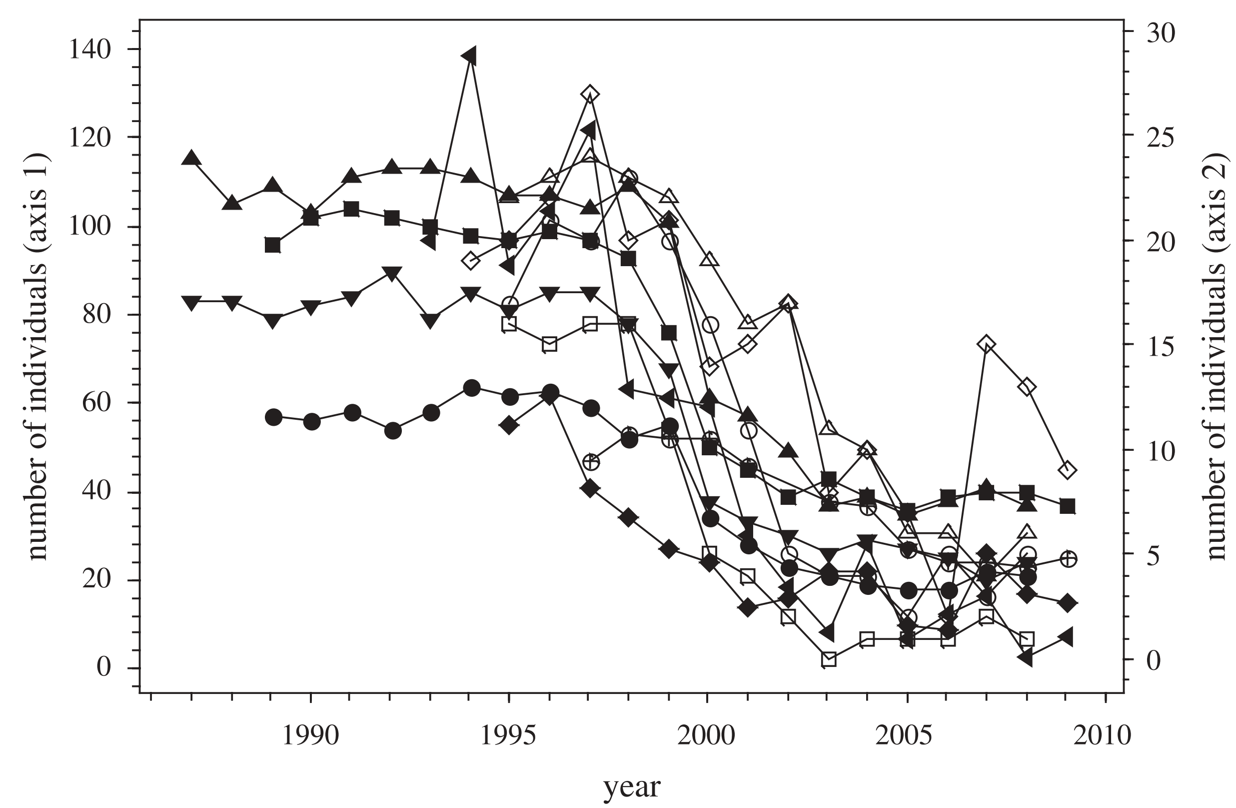


Figure 1. Annual total number of individuals found for each declining snake species population. Axis 1: filled left-pointed triangles, *Va*[1]; filled circles, *Va*[2]; filled squares, *Va*[3]; filled triangles, *Vu*[1]; filled inverted triangles, *Vu*[2]; cirlces with crosses, *Ca*; filled diamonds, *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.

Swiss Red List - *Monney & Meyer, 2005*

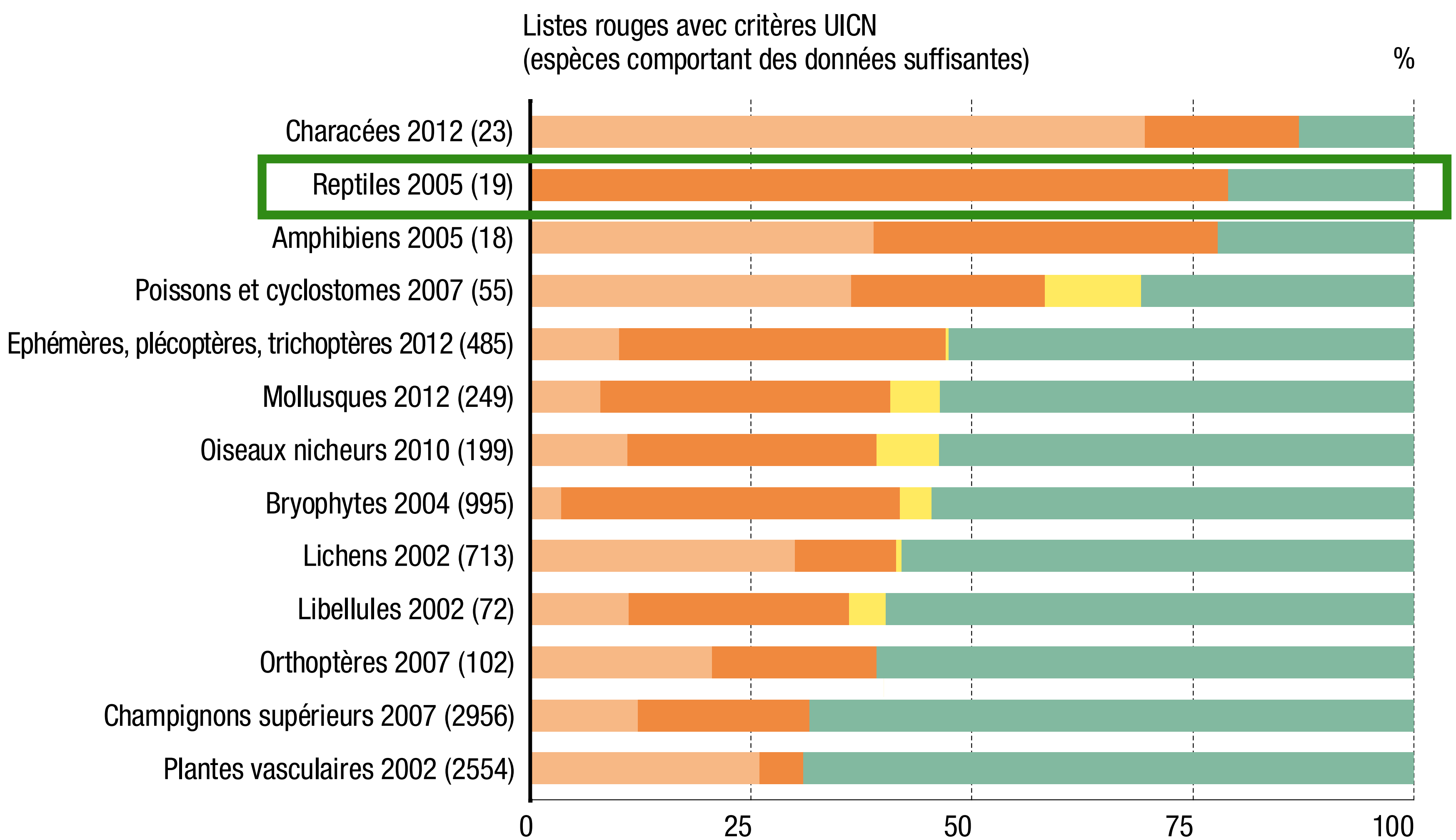
	19 taxa
CR (3)	European pond turtle Asp viper (*V. a. aspis*) Viperine snake
EN (7)	Adder (2 genetic clades) Asp Viper (*V. a. francisciredi*) Grass snake (*N. natrix*) Dice snake Whip snake Asculapian snake
VU (5)	Grass snake (*N. helvetica*) Smooth snake Asp viper (*V. a. atra*) Green lizard Sand lizard
LC (4)	Wall lizard (2 ssp) Common lizard Slow worm

79% (CR, EN, VU)

Swiss Red Lists - *comparison*

Fig. 36 > Proportions d'espèces rares par groupe d'organismes

Rare = petits effectifs et/ou aire de répartition restreinte et fragmentée (critères D, B2a; voir annexe C). Menacé = CR, EN, VU. Seulement groupes d'organismes avec critères UICN, donc listes rouges à partir de 2001. Les espèces «rares» représentent 19 % des espèces évaluées (1631 espèces sur 8418 évaluées selon critères UICN). Ce taux varie considérablement d'un groupe d'organismes à l'autre. Reptiles et amphibiens comptent les plus fortes proportions d'espèces à la fois rares et menacées.



Cordillot F, Klaus G (2011) Espèces menacées en Suisse. Synthèse des listes rouges, état 2010. Office fédéral de l'environnement, Berne. Etat de l'environnement n° 1120: 111 p.

Reptiles - *threats*

Landscape changes

- new construction, roads, etc..
- agriculture: intensification / extensification
- growth of forests (lack of sun on the ground)
- lack of dynamic in the landscape (rivers, avalanches, …)

direct human impact

- direct destruction
- predators (cat)
- competitor (introduced species)

Threats - *habitat destruction*

Threats - *habitat destruction*

Threats - *agricultural intensification*

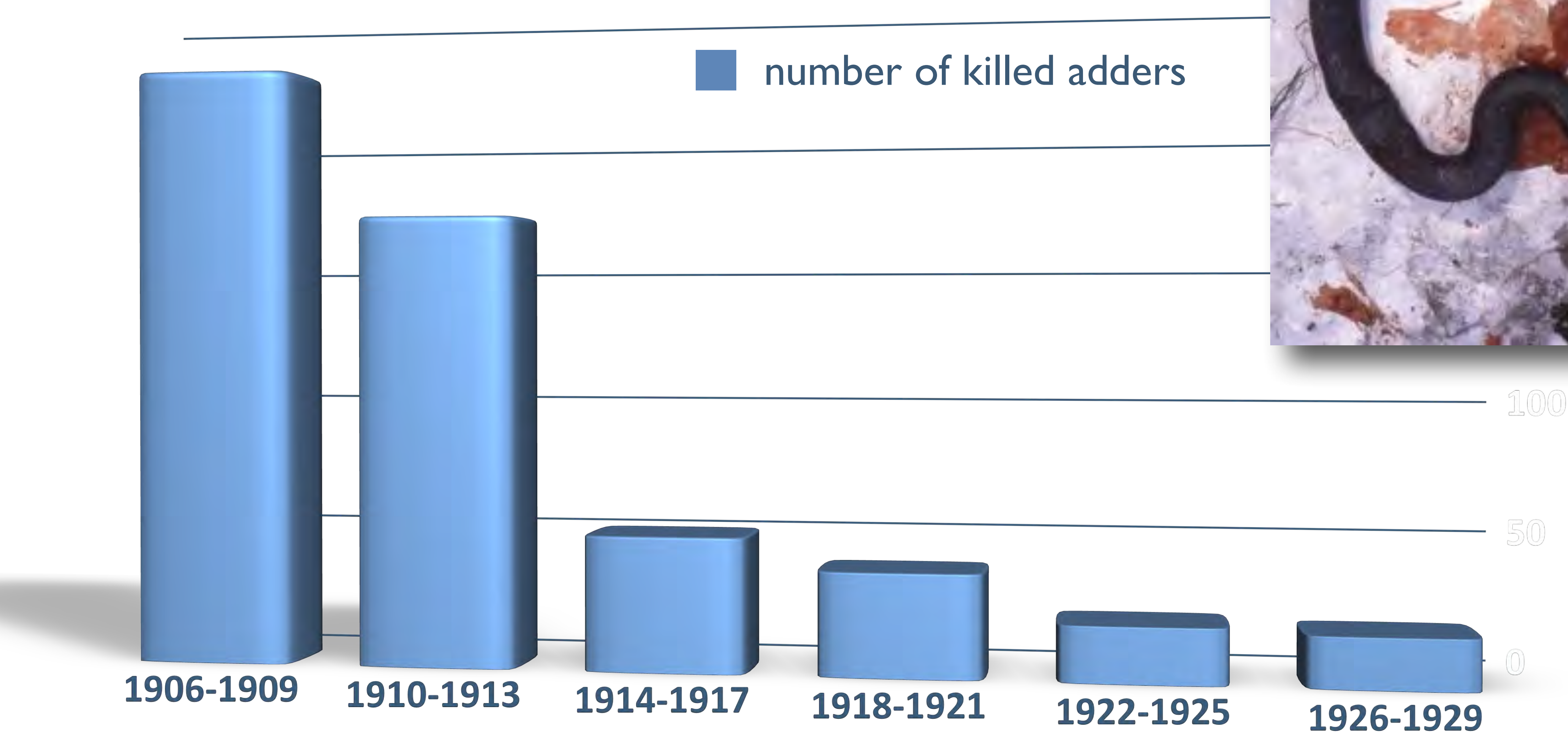
Threats - *forest growth*

Threats - *lack of dynamics*

Threats - *lack of dynamics*

Threats - *direct destruction*

Number of adders killed and paid at the municipality of Les Ponts (NE) between 1906 et 1928 (N=530) following Ischer (1930)



Ischer A (1930) La Vipère péliade des Ponts de Martel. Le Rameau de Sapin du club jurassien, 1:2-5.

Threats - *direct destruction*

Threats - *introduced species*

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ARTICLE

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The impact of free-ranging domestic cats on wildlife of the United States

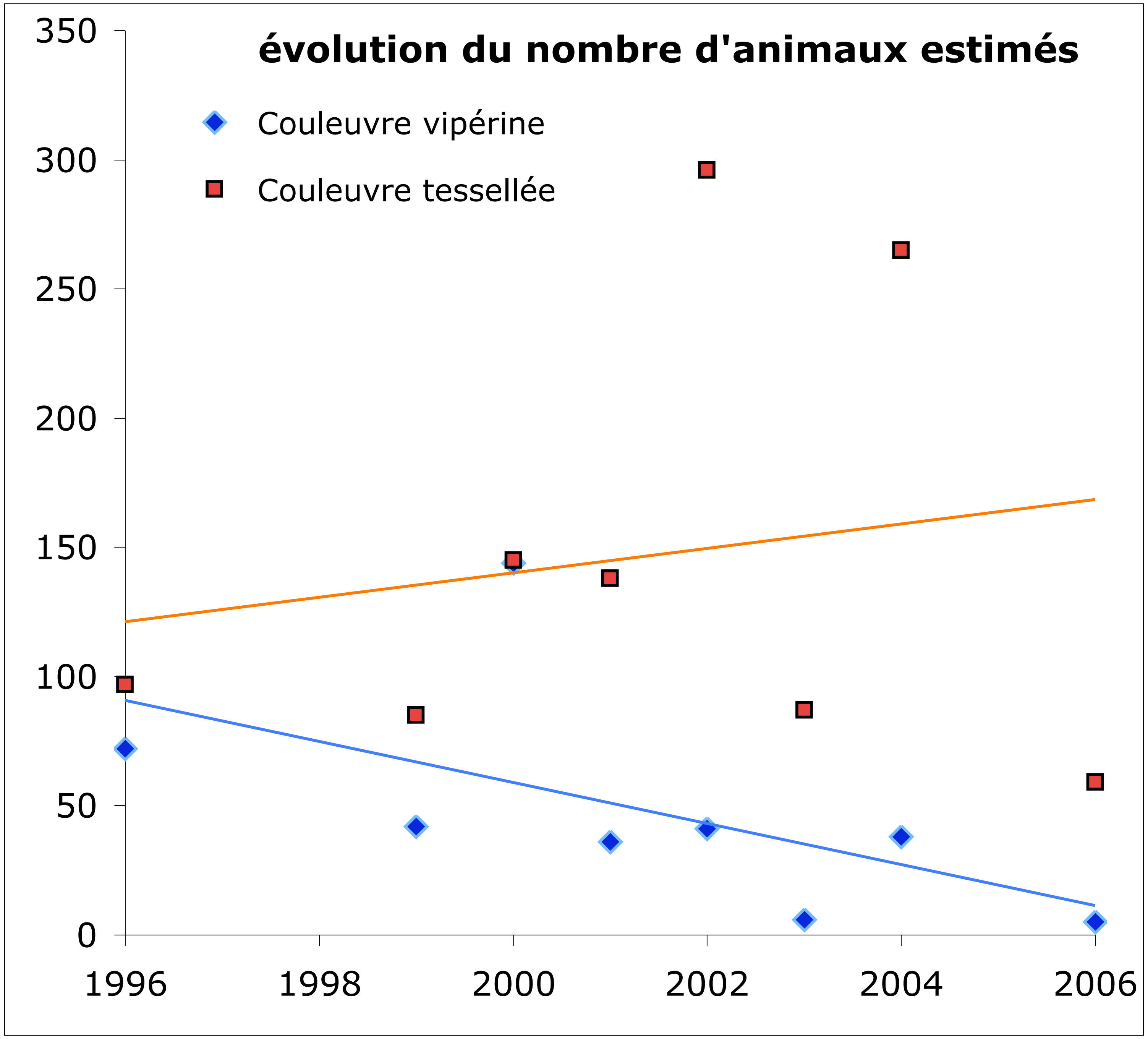
Scott R. Loss[1], Tom Will[2] & Peter P. Marra[1]

and will allow increased comparability of mortality sources[23]. Nonetheless, no estimates of any other anthropogenic mortality source approach the value we calculated for cat predation, and our estimate is the first for cats to be based on rigorous data-driven methods. Notably, we excluded high local predation rates and used assumptions that led to minimum predation rate estimates for un-owned cats; therefore, actual numbers of birds killed may be even greater than our estimates.

Free-roaming cats in the United States may also have a substantial impact on reptiles and amphibians. However, US studies of cat predation on these taxa are scarce. To generate a first approximation of US predation rates on reptiles and amphibians, we used the same model of cat predation along with estimates of cat predation rates on these taxa from studies in Europe, Australia and New Zealand. We estimate that between 258 and 822 million reptiles (median = 478 million) and between 95 and 299 million amphibians (median = 173 million) could be killed by cats in the contiguous United States each year. Reptile and amphibian populations, and, therefore, cat predation rates, may differ between the regions where we gathered predation data for these taxa and the United States. Furthermore, reptiles and amphibians are unavailable as prey during winter across much of the United States. Additional research is needed to clarify impacts of cats on US herpetofauna, especially given numerous anthropogenic stressors that threaten their populations (for example, climate change, habitat loss and infectious diseases) and documented extinctions of reptiles and amphibians due to cat predation in other regions[4,24].

The exceptionally high estimate of mammal mortality from cat predation is supported by individual US studies that illustrate high annual predation rates by individual un-owned cats in excess

Threats - *introduced species*



Threats - *what to do to improve it*

habitat improvement

- new habitats
- forestery
- improve connectivity
- …

Habitat improvement - *new habitats*

Habitat improvement *- new habitats*

Habitat improvement *- new habitats*

Habitat improvement *- new habitats*

Habitat improvement - *forestry*

info fauna CSCF info fauna karch

Habitat improvement *- connectivity*

Current research *- possible MSc projects…*

- Species distribution
  - what is a species / delimitation of genetic groups
- Invasive species
  - Snake fungal disease (SFD)
  - introduced Whip snake populations
  - …
- Translocated individual in destroyed habitats
- …

for more information…

Ecology of Swiss reptile species:

- Les amphibiens et reptiles de Suisse

  https://cscf.abacuscity.ch/fr/chf/A~22ARE05F/1~2~Typ/Amphibiens-Reptiles/Les-amphibiens-et-les-reptiles-de-Suisse

- Nos reptiles

  https://cscf.abacuscity.ch/fr/chf/A~99APU02F/2~20~Typ/Amphibiens-Reptiles/Reptiles/Nos-Reptiles

- www.karch.ch