

Forty years of Box Turtle husbandry

John Boonman
Tormentil 17
2631 DD Nootdorp
The Netherlands

john.boonman@xs4all.nl

All photographs by the author

INTRODUCTION

Retiring from work is the obvious moment to make all kinds of plans for the future. At the same time, it can also be the occasion to reconsider pieces of the past. Reaching that turning point in my life I came to the idea of describing my forty years of experience keeping Box Turtles, especially animals that have been in my possession for a considerable period of time, some for their entire life span to date. This paper is a description of my experiences with species of the genus *Terrapene* rather than a manual or prescription on how to keep these animals. As this is my personal experience, certain aspects are dealt with in a fashion that is no longer acceptable but was considered normal in the seventies. Call it a progressing insight.

THE NORTH AMERICAN BOX TURTLES OF THE GENUS *TERRAPENE*

Remarkably enough, in the literature an almost complete consensus prevails as to the systematics of the North American species, *Terrapene*. Our usual trusted bibles (like PRITCHARD, 1979 and ERNST & BARBOUR, 1989), as well as more recent sources, (like ZUPPA, 2003) mention two species for the US: *Terrapene carolina* and *T. ornata*, both with a number of subspecies, occasionally called races. The distribution area of two other species (*T. coahuila* and *T. nelsoni*) is restricted to some parts of Mexico. Restricting ourselves to the subjects of this paper, *T. carolina*, six subspecies are usually accepted: *T. carolina carolina*, *T. c. major*, *T. c. bauri*, *T. c. triunguis*, *T. c. mexicana* and *T. c. yucatanana*. In vivarium practice, as will be shown in this article, it is often difficult to attach a subspecies name to an individual

animal on the basis of external criteria. In recent years it became clear that modern genetics do not elevate the complexity to subspecies level in all cases (see e.g., MARTIN et al., 2013 as well as the response of FRITZ & HAVAŠ, 2014). In light of the large distribution area of the species and its subspecies (see below) regional variations are to be expected. On top of that numerous hybrid forms are reported (cf. LUTTERSCHMIDT et al., 2007). Taken all together it is remarkable that systematics is hardly disputed in the literature, or perhaps we simply don't know enough?

The genus is easily recognized by a) their relatively domed shells and well-developed plastral hinges, which enable the animals to close themselves off completely from the outside world, b) their terrestrial habitat, and c) that their feet are neither webbed nor elephantine. Males are easily distinguished by their plastral concavity. They often have bright red eyes and are usually slightly larger than females.

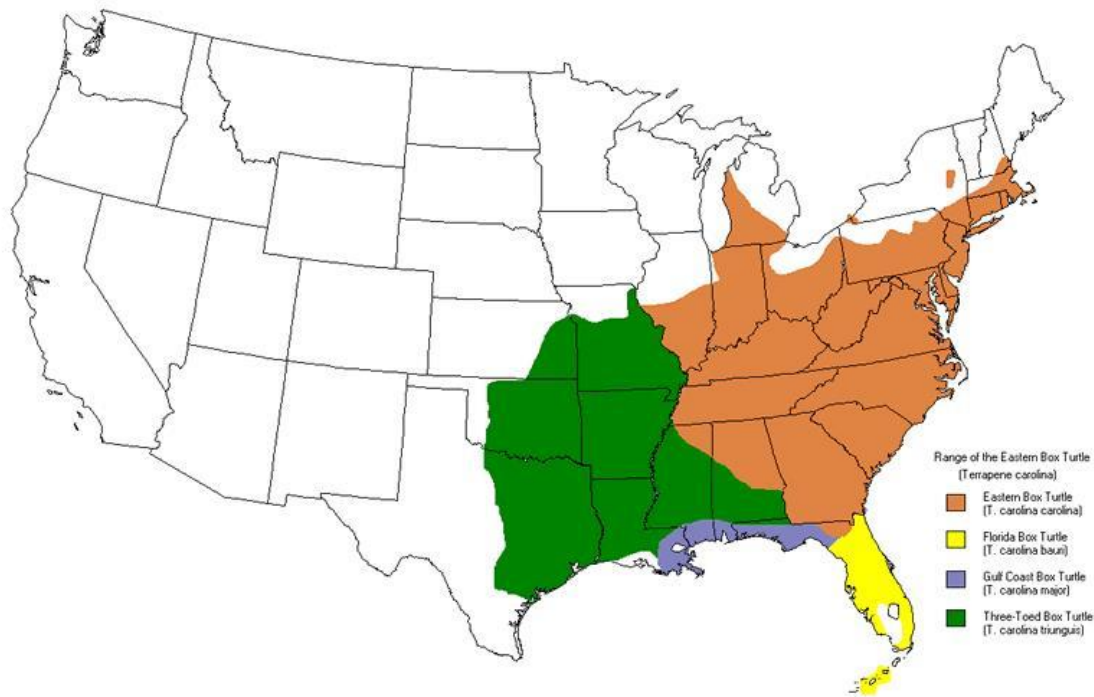
THE SUBSPECIES ACCORDING TO THE HANDBOOKS

Terrapene carolina carolina

The nominate form, the Eastern Box Turtle, is found in the US states from Massachusetts to Illinois and Georgia (see map in figure 1). The species inhabits pastures, marshy meadows as well as open woodlands and shores of rivers and lakes. Adult animals have high-domed brown or black carapaces with a variable pattern of yellowish stripes and blotches. Maximal carapace length is ca. 16 cm. The hind legs contain four toes.

Terrapene carolina major

The Gulf Coast Box Turtle inhabits the humid areas at the coasts of western Florida and South Carolina. The purest form lives in Florida. Animals in Louisiana are often



Distribution of *Terrapene carolina* in the USA. On-line: <https://wikispaces.psu.edu/display/Herps/Eastern++Box+turtle> (last seen: 26-02-2019)

hybrids with any of the other subspecies. These are the largest *T. carolina* subspecies reaching 20 cm in length. Apart from its length, the strongly flaring rear margins are characteristic for the subspecies. Colours are not really discriminative although white head markings occur frequently in adult males as do red colours on the front legs.

Terrapene carolina bauri

The Florida Box Turtle, as the name already indicates, is predominantly found in Florida. This subspecies lives in humid areas as well. The dark carapace has a bright pattern of light radiating lines resembling *Terrapene ornata*. However, the carapace of *T. c. bauri* is much higher domed and its head is more clearly marked. In addition, *T. ornata* has a dark marking on the plastron often covering it completely. The plastron of *T. c. bauri* is usually uniformly yellow. The Florida Box Turtle reaches 15 cm maximally and the hind legs have three toes.

Terrapene carolina triunguis

The Three-toed Box Turtle is found from the valley of the Mississippi river to Texas and up to Florida in the South. This subspecies prefers clearly drier areas compared to the others. It grows to a maximum length of 16 cm and shows light markings on a tan to brown background. Males often develop red, orange or yellow markings on the head and front legs. In order to enhance confusion Three-toed Box Turtles sometimes have four-toed hind legs. Together with *T. c. bauri* it is statistically the smallest Box Turtle.

The two other subspecies *T. c. mexicana* and *T. c. yucatanana* live in Mexico, in the north-eastern part of the country and Yucatan respectively. The former form has three-toed hind legs, the latter has four toes. Both are often light brown to yellow in colour with the size comparable to *T. c. carolina*, but much bigger animals, resembling *T. c. major*, can occur.

The complete species listing can be found on the IUCN Red List. All are classified as "vulnerable" (IUCN Red list, 2011) on the CITES appendix II.

THE ANIMALS

The four animals featuring in this story are still in my possession. Over the years several other specimens were kept, but for various reasons they disappeared. Some of them are also briefly mentioned here. *Terrapene carolina* experienced a pulse surge of exploitation for the international pet trade in the late 1980s and early 1990s, when the species was in demand after mass Mediterranean tortoise trade was curtailed by CITES; the genus *Terrapene* was itself included in CITES in 1994 after which exports ceased. The animals discussed here are from the “license free” period and are almost certain wild caught.

Animal 1

In May 1975 I bought a couple of Box Turtles from an, at that time, well-known pet shop. Without any doubt they were a male and a female. The female passed away after a couple of years from an infection of the respiratory tract, most probably caused by inadequate housing (draught). The male survived and is presently in perfect condition.

In 1975 his carapace was 14 cm long and he weighed 640 grams. As the animal was already at least a couple of years old at the time I bought him, after almost 44 years the creature may easily be 50 years old. This is not an exceptional age for Box Turtles. Reports mention ages of more than 100 years (BELZER, 2013), but accurate recordings are mostly missing. Ages of more than 60 years are certainly not exceptional (MILLER, 2001). This specimen is a uniformly tan-coloured animal with hardly any markings, neither on the carapace nor on head and legs. The hind legs have four toes. It looks like the nominate form, *T. c. carolina*, albeit a fairly big one, measuring almost 18 cm over many years and weighing between 750 and 800 grams.

Animal 2

In August 1988 I received three small Box Turtles in very poor condition measuring about 7 cm in length. Despite serious attempts to cure the animals, two of them died. The third one is still alive and is therefore more than 30 years old. It is a female, 12.5 cm in carapace length, weighs 450 grams, is brown in colour with some



Head of male *T. c. carolina* (animal 1).



Male *T. c. major*.

yellow and orange blotches on the head and neck. With three toes on the hind legs, it is likely to be a Three-toed Box Turtle (*T. c. triunguis*).

Animal 3 and 4

In June 1990 I bought two magnificent big Box Turtles, in another pet shop, a male and a female. At that time they were already huge, weighing close to 900 grams and measuring more than 17 cm in length. In the course of time they did not grow substantially (latest measurement: 17.1 cm for the female and 18.2 cm for the male). That means that the animals are at least 35 years old, probably more. The male is dark brown in colour with some vague stripings and intense red eyes. The female is beautifully coloured: brown with multiple yellow markings and blotches. Since they have strongly flaring rear margins it is likely to classify them as *T. c. major*. On top of that the male is developing white streaks on its head in recent years. The hind legs have four toes.

HOUSING

In the early years my Box Turtles were floor dwelling companions to large lizards like Iguanas. Although fairly spacious, these types of vivaria with animals having very distinct requirements (and intestinal microflora) are not recommended. The *T. c. carolina* male (animal 1) survived these sometimes harsh conditions, with draught and fluctuating temperatures. Since 1995 housing is as it is today: the animals spend the summer in the garden and live indoors during the winter. The four animals obviously feel good under these conditions, not having had any significant health problems so far. The approx. 3 m² outdoor enclosure is situated in a fairly sheltered back yard. An area of 3 m² is much less than what is available in nature. STICKEL (1989) reported a 3-acres (1.2 ha) home range for *T. c. carolina* in Maryland in the period from 1944 to 1981. The north-west side is protected by a

wooden fence, the other three sides are made of break-proof glass shields from scrapped railway coaches. This orientation ensures that the rising sun enters the enclosure rather early. Because of the surrounding houses, enough sunlight reaches the vivarium to warm the animals sufficiently only in the period from the beginning of May through to the end of September. The precise moment of moving the animals to or from the outdoor housing is determined by the weather and therefore changes from year to year. The chance of frost is the determining factor in spring. Lack of sunshine and increasing humidity are the key factors in autumn.

Apart from some macho behaviour between the two males (see below), this limited area never caused serious problems; no real confrontations nor any neurotic behaviour alongside the glass fences. The enclosure is maximally overgrown with wild plants, mostly carried by wind supplemented with seeded sown ones. Four active tortoises crush the vegetation but cooler days often limit activity



The small female *T. c. triunguis* in her outdoor enclosure.

and give plants time to recover. Additional seeding often is the final touch. Logs and stones create elevated areas for warming up. A large tunnel-like area made of stones covers the complete width of the enclosure. It shelters the animals for cold and wind but also for heat. The top of that construction appears a highly appreciated place to get warm. Finally, a shallow bowl is available containing clean water.

In winter the animals are housed in open plastic containers (50x70 cm, ground area) containing a thick layer of sawdust, hay and straw. Years of experimenting have indicated that these animals immediately switch to hibernation/aestivation mode as soon they are indoors. They don't show up for months and they don't drink or eat. Apparently, the containers are large enough. The animals are housed two by two, the two *T. c. major*-type animals together. Fresh water is constantly available. Temperature never drops below 10°C but usually is somewhat higher, which has never caused any substantial activity. The animals' behaviour will be discussed below.

FOOD

Box Turtles are said to be omnivorous. In a strict sense my animals are indeed. However, that does not mean that every individual takes any food item all the time. The animals change food preference continuously and do so independently of each other. Amateurs tend to search for regularity in the pattern. After all these years I have not succeeded, and, in fact, I gave up looking. As a consequence, I try to include as much variation to their menu as possible. All animals turn out to be easy consumers although they don't eat everything all the time.

The menu consists of:

Snails. Until recently only the Common garden snail (*Cornu aspersum*), the large brown ones, sometimes called the small vine snail, was on the menu. When eaten, it is with such an enthusiasm that it almost became extinct from my 80 m² back yard. In an earlier version of this paper, I stated that Grove snails (*Cepaea spec.*), the yellow or rose



T. c. carolina consuming an earthworm.



T. c. triunguis eating a strawberry.

variants alike, were not eaten. However, recently animal 1 (*T. c. carolina*) did consume a couple of those creatures. You never know with Box Turtles. The shells are cracked and the content is eaten. I have never seen a slug being eaten. However, it might be possible that this happens while they are out of my sight.

Earthworms. Although this food item is something you always can rely on, it looks like the animals easily lose their skills to catch them especially after hibernation. However, after stimulation by roommates (seeing is doing), ultimately the worms (especially the wriggly ones) will be eaten by every individual.

Mealworms. Not exactly their favourite food but sometimes useful.

Meat. I used to serve chopped beef heart once in a while. Interest was always rather limited. The real fall-back option nowadays is canned cat or dog food. Notably the “paté” types are available in multiple tastes and blends. In principal I prefer complete organisms to feed, nevertheless it is always comfortable to have some alternatives available.

Fruit. Another fall-back option is bananas. It is often eaten by all animals albeit in limited quantities. Occasionally some animals are attracted to other fruits too, preferably the ruddy coloured ones. Strawberries, tomatoes but also plums, apricots or peaches are the choices. Apples or pears are not eaten. I have never seen any animal eating any vegetable or wild plant from the enclosure.

In line with my observations in nature, Box Turtles are omnivorous and highly opportunistic in their feeding behaviour (FARRELL et al., 2006). There is no evidence of major shifts between the diets of juveniles and adults. The list of foods that Box Turtles have been observed taking is vast, but includes vertebrates and invertebrates (especially snails), fungi, and a variety of plant parts, including fruits, roots, stems, and seeds. Carrion is also be taken on occasion.

BEHAVIOUR

In the summer season, when the animals are outdoors, life seems quite simple. Being lovers of the morning coolness, they are active early, especially in the fresh dew. Remarkably some 12°C is enough to stimulate activity even for the two major animals who most likely are not used to such temperatures in the southern states of the US. Eating is not on the agenda yet, only simple strolling around. Bathing is often part of the routine. When temperature rises, activity increases. Some sunshine is appreciated at that time although it can easily become too hot for them, the animals quickly disappear in their shelters then or burrow underneath the humid grass. On warm summer nights, when the sun has left the enclosure, they reappear, certainly when a nice shower comes down. The animals prefer eating in the morning.



Weathered head of male *T. c. major*.

On a standard grey Dutch summer day activity will be much lower and is often limited to some looking around. When it is autumn-like weather the animals are often out of sight for a substantial period of time. Eating is not obvious under these conditions. Feeding frequency is limited to twice a week in order to prevent them from becoming overweight. Water is often supplied, especially during hot dry seasons. If it will become too dry animals will dig deep (occasionally up to 30 cm) holes, and disappear.

The four animals usually behave fairly decently. However, animal 1, the large *T. c. carolina* male, can be rather pushy or even aggressive. Notably directly after hibernation the old male can be a real testosterone bomb. His activity is usually directed towards the *T. c. major* female. One might worry about that but I refrain from interfering because the female does not care at all. She moves, eats, baths whenever she likes, no matter if

someone is sitting on her back or not. The male snorts and sighs without any violence whatsoever. The male *T. c. major* can be treated more aggressively. In some periods biting and bumping can be slightly too emphatic. Intervention might then be necessary. Peace will usually return soon. In all the years no serious accident has occurred. In practice the impressive attitude of the animal is the most annoying. When he approaches, like a bulldozer, to the food offered, the other animals have to withdraw. The message here – keeper, take care that every individual gets his part of the cake.

The mating activity of the *T. c. carolina* male with the *T. c. major* female never resulted in eggs. Only the small three-toed animal (*T. c. triunguis*) produced eggs twice. That will be discussed in the next chapter.

Then summer comes to an end and the amount of sunshine and heat that reaches the enclosure decreases. Their active season is over, especially when nights are getting cold, usually at the end of September/beginning of

October. The animals tend to dig in, often at a considerable depth (some 30 cm). I never dared to leave them outside. The literature indicates that Box Turtles are well able to cope with such conditions (see for instance CONGDON et al. 1989). However, in my opinion the winters in the Netherlands are much too precarious, with strongly fluctuating temperatures. On top of that the period of changeable weather in the Netherlands is much longer than that as described for South Carolina (October - April vs November - March).

Animals then go into hibernation, or at least winter rest, indoors. After a cool bath for cleaning and defecation, they are put in their plastic open container, two by two as described earlier. It is very remarkable that they will dig in immediately, even when the temperature is not very low (some 18°C). Within a few moments they are out of sight, not to reappear before March. The *T. c. major*

male never digs in. He simply sits on top of the substrate for months, hardly moving. Occasionally he will drink some water but never eats. The water bowls will stay clean over the whole period so there would be evidence if any animal was secretly moving.

In the literature (e.g., PLUMMER, 2004) hibernation, including their hibernacula, for Box Turtles is extensively reviewed. Immediate stimulus to enter hibernation is

cope with the difficult conditions in their habitat by combining a five-month hibernation with a three-month aestivation period. Only after the monsoon do they emerge from their shelters, although they have ended their hibernation some months earlier. An inactive subterranean period of eight months is the result. Box Turtles are said to be highly successful in dealing with long lasting harsh conditions of various kinds. The reported low metabolic rates of Box Turtles allow them to

rely on resource peaks for their energy, allowing them to “coast” through periods of less productive forage using stored energy. Box Turtles live at a slower pace than some other ectotherms and as such have evolved a strategy allowing them to survive in an uncertain resource environment by minimizing costs and risks (PENICK et al., 2002).

In early spring activity suddenly commences. Changing length of daylight seems not to be a significant factor as their artificial light (LED-light nowadays) is on for 12 hours per day every day. The temperature is, within certain limits, also constant so it is not clear what triggers the activation. Looking at the complexity of arousal from hibernation as described before, a combination of factors is

likely to be relevant. Usually it starts at some moment in March, first there is some movement, quickly followed by bathing and drinking. A (limited) interest in food comes later. Banana and cat food are the first preference, followed by earthworms. The female *T. c. major* is always the last. Usually it is too early to transfer the animals to their outdoor housing because of the weather outside and some period has to be tided over.



The beautifully coloured female *T. c. major*.

likely a combination of temperature and photoperiod. Burrows may be rather deep (30 cm or more) or very superficial, depending on the temperatures of the area. Separate factors may be responsible for arousal from hibernation, including warming of the soil temperature profile, precipitation, and ground moisture. The complexity of winter rest stimuli is demonstrated by *Terrapene ornata* inhabiting drier areas. Animals are able to



Three-toed Box Turtle (*T. c. triunguis*) laying eggs.

The plastic boxes are too small to give the animals sufficient room to move, but because of the limited period of time they spend in them, it is acceptable to complete the seasonal cycle.

BREEDING

In my opinion husbandry should be aimed at breeding the animals. However, the way I keep the Box Turtles does not allow successful breeding. The group is too diverse and is living in too limited an area. Probably I would have had to split the group and provide them with separate and larger accommodations. The two *Terrapene carolina major* might be a suitable couple but they are disturbed too much by the large *T. c. carolina* male. The latter frequently courted the female *T. c. major*, but this never resulted in eggs. Mating with the small three-toed female (*T. c. triunguis*) was never observed. Because of the substantial difference in size between the animals it would be rather complicated. Nevertheless, this small female produced eggs twice, in two early consecutive years. Each time four eggs were laid and burrowed according to the handbooks. Red discs indicated that the eggs were fertilized but standard incubation methods (in incubators in humid environments at various temperatures with vermiculite as a substrate or in a bain-marie container) did not result in hatchlings. It might be possible that an earlier mating had taken place, probably with one of the other animals with which she lived together for some period of time before she came into my possession. It is known that female Box Turtles have special organs that store sperm for up to four years (GIST & FISCHER, 1993).

FINALLY

With my knowledge of today, I would keep Box Turtles in a completely different way than I did before, and even than I do currently. I would give them more space and pay much more attention to the formation of suitable groups or couples. In any case I would never use them as scavengers for leftovers of other animals living in the same enclosure. Longer periods of outdoor housing looks possible in the Netherlands. Prolonged hibernation or winter rest turns out to not be detrimental for at least the four animals discussed here, even when different subspecies are concerned.

In any case Box Turtles turned out to be animals that can easily survive in Dutch outdoor conditions during the warmer seasons. However, it is essential to pay attention to the individual requirements of the animals. These needs can change without any obvious reason. Satisfactory husbandry for over 40 years is then possible.

SAMENVATTING

In dit artikel schets ik mijn ervaringen van meer dan 40 jaar met het houden van Amerikaanse Doosschildpadden van het geslacht *Terrapene*. De drie ondersoorten die ik beschrijf, blijken geschikt te zijn om gedurende de Nederlandse zomerperiode in een buitenverblijf gehouden te worden. Ook maandenlange periodes van winterrust zijn steeds zonder problemen verlopen. De zeer individuele en in verloop van tijd variërende wensen van de verschillende dieren, evenals hun gedrag, worden besproken. Een vergelijking met literatuurgegevens wordt ook gemaakt. Om tot succesvolle voortplanting te kunnen komen, moet extra aandacht besteed worden aan de vorming van geschikte paren en moet men afzien van storende invloeden van andere dieren.

LITERATURE

- BELZER, W., 2013. Field observations of North America's eastern Box Turtle (*Terrapene carolina carolina*) on-line: <http://herpetology.com/belzer/Boxturtle.htm> (Last checked: 26-02-2019).
- CONGDON, J.D., R.E. GATTEN JR. & S.J. MORREALE, 1989. Overwintering activity of Box Turtles (*Terrapene carolina*) in South Carolina. *J. Herpetol.* 23 (2): 179-181.
- ERNST, C.H. & R.W. BARBOUR, 1989. *Turtles of the world: 193-198.* Smithsonian Institution Press. Washington.
- FARRELL, T.M., C.K. DODD, JR. & P.G. MAY, 2006. *Terrapene carolina* – Eastern Box Turtle In: P.A. Meylan (ed.). *Turtle biology and conservation of Florida turtles.* Chelonian Res. Mon. 3: 225-248.
- FRITZ, U. & P. HAVAŠ, 2014. On the reclassification of Box Turtles (*Terrapene*): A response to Martin et al. *Zootaxa* 3835 (2): 295-298.
- GIST, D.H. & E.N. FISCHER, 1993. Fine structure of the sperm storage tubules in the Box Turtle oviduct. *J. Reprod. Fertil.* 97: 463-468.
- IUCN Red list of threatened species (2011). on-line: <http://dx.doi.org/10.2305/IUCN.UK.2011-1.RLTS.T21641A9303747.en> (last checked: 26-02-2019).
- LUTTERSCHMIDT, W.I., S.A. ESCOBAR & E.D. WILSON, 2007. Multivariate analyses of shell morphology of putative hybrid Box Turtles Southeast. *Nat.*, 6 (4): 571-576.
- MARTIN, B.T., N.P. BERNSTEIN, R.D. BIRKHEAD, J.F. KOUKL, S.M. MUSSMANN & J.S. PLACYK, 2013. Sequence-based molecular phylogenetics and phylogeography of the American Box Turtles (*Terrapene* spp.) with support from DNA barcoding. *Phyl. Evol.* 68: 119-134.
- MILLER, J.K., 2001. Escaping senescence: demographic data from three-toed Box turtle (*Terrapene carolina triunguis*). *Exp. Gerontol.*, 36 (4-6): 829-832.
- PENICK, D.N., J. CONGDON, J.R. SPOTILA, & J.B. WILLIAMS, 2002. Microclimates and energetics of free-living Box Turtles, *Terrapene carolina*, in South Carolina. *Phys. Biochem. Zool.* 75 (1): 57-65.
- PLUMMER, M.V., 2004. Seasonal inactivity of the Desert Box Turtle, *Terrapene ornata luteola*, at the species' southwestern range limit in Arizona. *J. Herpetol.* 38 (4): 589-593.
- PRITCHARD, P.C.H., 1979. *Encyclopedia of turtles: 163-172.* T.F.H. Publications, New York.
- STICKEL, L.F., 1989. Home range behavior among Box Turtles (*Terrapene c. carolina*) of a bottomland forest in Maryland. *J. Herpetol.* 23 (1): 40-44.
- ZUPPA, S., 2003. North American Box Turtles (*Terrapene*) on-line: <http://www.chelonian.org/articles/TerrapenecareSZ.htm> (last checked 26-02-2019).

Most recent observations

On February 5, 2019, during my daily observation, I noticed that all four animals came out of hibernation simultaneously. The couple of *T. c. major* in their separate enclosure immediately started mating activities (see photo). These observations are remarkable because arousal from hibernation was earlier than in any other previous year, although conditions have not changed over the years.

Most likely the complex set of conditions that promote arousal from hibernation happened to be good enough at this moment.

The female *T. c. major* usually emerged later than the other animals.

I never observed any mating activity between the two *T. c. major* animals before. Because the disturbing influence of the male *T. c. carolina* was absent (the animal is in a separate enclosure), the couple was apparently able to behave more naturally.

