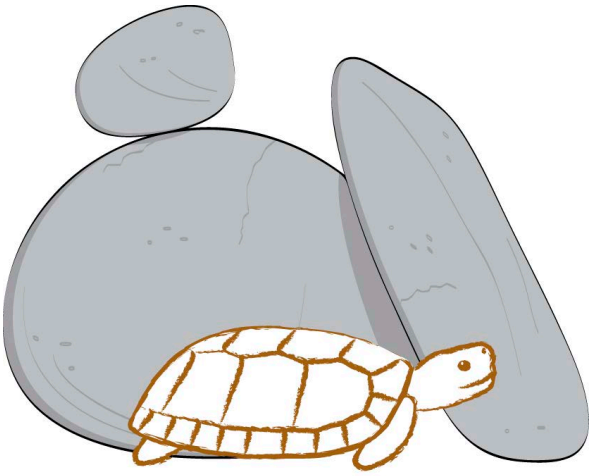
Dwarf Tortoise Conservation



Annual Report

2020

Victor Loehr
January 2021

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Dwarf Tortoise Conservation (previously Homopus Research Foundation) is a non-commercial organisation entirely run by volunteers. The aim of the foundation is to gather and distribute information on dwarf tortoises, to facilitate their survival in the wild. This aim is achieved through scientific field studies, and through the development and study of captive studbook populations. Our results are published in scientific and popular outlets.

1. INTRODUCTION AND ACHIEVEMENTS IN 2020

Dwarf Tortoise Conservation aims to facilitate the long-term survival of dwarf tortoises (*Chersobius* spp. and *Homopus* spp.) in the wild, by gathering and distributing information about their biologies and by the formation of genetically healthy *ex situ* populations. Dwarf Tortoise Conservation is the successor of the Homopus Research Foundation, which was renamed in 2018, following the resurrection of the genus *Chersobius* (previously *Homopus*). In 2020, several activities contributed to the aim of Dwarf Tortoise Conservation. The current report presents an overview of achievements in 2020, as well as activities planned for 2021 and thereafter. Moreover, the actual studbook populations for *Chersobius signatus*, *Homopus areolatus* and *Homopus femoralis* are described, focussing on changes that occurred in 2020. All previous annual reports since 1995 can be found on the website of Dwarf Tortoise Conservation.

1.1. Policies and permanent action points

From time to time, Dwarf Tortoise Conservation communicates policies and permanent action points to the participants in the *Chersobius* and *Homopus* studbooks and to other stakeholders. To avoid losing sight of actual issues, they are listed here.

- *Dwarf Tortoise Conservation and illegal activities (1 May 2011)*
  Dwarf Tortoise Conservation strongly condemns illegal activities. All *Chersobius* and *Homopus* registered in the studbooks and at studbook participants have legal and traceable origins. Each participant is responsible for the paperwork for his or her tortoises and will not fraud. Dwarf Tortoise Conservation will fully collaborate with authorities in case of legal investigations, providing backgrounds of studbook tortoises, DNA samples, etc. Moreover, illegal activities noted within the studbooks will be actively reported to the authorities, to facilitate prosecution. Obviously, participants involved in illegal activities will be unable to continue their participation.

- *Incubation of* C. signatus *eggs (January 2016 – see update in chapter 3)*
  The sex ratio of the *C. signatus* population is skewed towards males. Breeders need to use the following incubation protocol to reduce the production of males:
  - Day 1–29: diurnal temperature cycle of 33°C and 28°C
  - Day 30–50: constant temperature of 33°C
  - Day 51–hatching: diurnal temperature cycle of 33°C and 28°C

  All temperatures should be measured with a calibrated thermometer.

- *Information exchange with the studbook coordinator (20 December 2017)*
  Changes (births, deaths, transfers, physical and e-mail addresses, etc.) should be sent to the studbook coordinator by e-mail, and not via social media. The e-mail address that should be used is studbookhomopus@gmail.com.

- *Registration of* H. areolatus *(January 2018)*
  Because offspring *H. areolatus* produced in the studbook has been transferred outside the studbook (i.e., were lost to follow-up), there is a risk that genetically related tortoises will be registered in the studbook as unrelated founders. To avoid this, the studbook will not accept new founders with unknown or uncertain origin.

- *Outdoor husbandry of* C. signatus *(February 2019)*
  Outdoor husbandry of *C. signatus* in Europe has yielded unacceptable mortality rates, possibly due to climatic mismatches or due to stress involved with frequent transfers among indoor and outdoor enclosures. Since *C. signatus* does well in indoor enclosures, tortoises loaned from Dwarf Tortoise Conservation should be housed indoors year-round. Exceptions require written consent.

1.2. Outstanding action points in the 2019 annual report

The following table summarises plans in the 2019 annual report, with results obtained in 2020.

Outstanding action points in 2019 annual report, and results in 2020	**Due**
Manuscripts submitted on:	
• parasite infestations in wild *C. signatus*;	31-12-2020
• captive husbandry and breeding of *C. signatus* (Mertensiella);	31-12-2020
• tick infestation in a European indoor dwarf tortoise collection;	31-12-2020
• annual and seasonal behavioural variation in *C. boulengeri*;	31-12-2020
• fieldwork on *C. boulengeri* (TSF/CI final report);	31-12-2020
• fieldwork on *C. boulengeri* (TSA EU newsletter);	31-12-2020
• fieldwork on *C. boulengeri* (BCG journal);	31-12-2020
• fieldwork on *C. boulengeri* (NBSV magazine).	31-12-2020
2020: Most manuscripts were submitted. Only the manuscripts on captive husbandry and breeding of *C. signatus*, and on annual and seasonal behavioural variation in *C. boulengeri*, have not materialised. The former was cancelled and data for the latter were incorporated in a revised existing manuscript on behaviour in *C. boulengeri*. The manuscript on tick infestation in a European indoor dwarf tortoise collection has not yet been submitted (but see Appendix 3). An additional manuscript was published, dealing with reconstruction of an egg incubator. See also chapter 6.	
Fifth sampling period in field study on *C. boulengeri* conducted	Feb/Mar-2020
2020: In February–March, 6 weeks of sampling was conducted. See paragraph 1.5.	
Poster on Karoo tortoises co-produced with Endangered Wildlife Trust (South Africa) and funded by Dutch-Belgian Turtle and Tortoise Society	Feb/Mar-2020
2020: The poster was prepared and produced in July. See paragraph 1.5.	
Genetic relationships between *C. signatus* 7, 44, 72 and 118 verified	Feb/Mar-2020
2020: Tortoise numbers 7 and 44 have died before genetic analysis was conducted. Carcasses have been frozen for genetic analysis in 2021.	
Studbook management plan *H. areolatus* updated	31-12-2020
2020: The plan was updated, reviewed by participants, revised and finished.	
The importance of each live *C. signatus* categorised relatively to the goal of the studbook, to facilitate management	31-12-2021
2020: Studbook numbers 86, 170, 176, 177, 178, 182, 184, 190, 191, 193, and 208 were identified as highest concern and studbook participants were informed about their important responsibility. This was also done for the studbook on *H. areolatus* (highest concern studbook numbers 23, 40, 107, 111, 190, 191, 194, 196, 210, 214, 215, 216, 223, 282 and 283).	

Further achievements that are worth listing:

- Reprints of papers produced by Dwarf Tortoise Conservation were distributed through ResearchGate and directly to several researchers (e.g., Smithsonian Institution, USA) and private individuals. Studbook participants receive all papers produced.

- Review requests were received from:
  - African Journal of Herpetology;
  - Scientific Reports.

- Information requests were received regarding:
  - identification of a rescued "dwarf tortoise" (*Kinixys* sp.; private individual, South Africa);
  - identification of wild dwarf tortoises (*C. boulengeri* and *C. signatus*; Endangered Wildlife Trust, South Africa);
  - funding opportunities and literature for a field study on *Stigmochelys pardalis* (Kruger National Park, South Africa);
  - methodology used for size measurements in a magazine article on *C. solus* (Smithsonian Institution, USA);
  - diet of *C. boulengeri* (University of Toronto, Canada);
  - role of rooibos (*Aspalathus linearis*) as food item for wild tortoises (Kapidolo Farms, USA);
  - verification of several tortoise facts in a Dutch factsheet for school children (Wageningen University, Netherlands);
  - interview based on the paper "Unexpected decline in a population of speckled tortoises" (University of Vermont, USA; Appendix 3).

- Photographic material was provided to:
  - author of a book "Incubating Chelonian Eggs";
  - author of a book chapter about Galapagos tortoises;
  - publisher of a book "Turtles of the World";
  - author of a paper on evolutionary ecology of pancake tortoises;
  - author of a paper on the impact of corvids on chelonians;
  - editor of a website chelonia-science.de;
  - Crocodile Zoo Prague as decoration for an enclosure for *C. signatus*, and for an educational poster at a zoo exhibit (below).

MÁLO ZNÁMÉ TRPASLIČÍ ŽELVY JIŽNÍ AFRIKY

Pět trpaslíků

Každý zná velké ostrovní druhy jako želvy sloní z Galapág, želvy obrovské z ostrova Aldabra v Indickém oceánu, případně mezi tuzemskými chovateli oblíbené želvy zelenavé, žlutohnědé, vroubené či stepní.

Málokdo ale kdy slyšel o trpasličích želvách z jihu afrického kontinentu. V teráriích českých chovatelů se objevují jen naprosto výjimečně, v zoologických zahradách už vůbec ne. Přitom jde o pozoruhodné želvy, o jejichž životě zdaleka nevíme vše.

Je popsáno pět druhů, které jsou domovem v Namibii a Jihoafrické republice. Dva druhy patří do rodu *Homopus*, tři do rodu *Chersobius*. Zástupci prvně jmenovaného mají na předních nohách čtyři drápy, druhého pak pět. Jsou skutečně malé, v dospělosti dosahují obvykle délky 10 -12 cm, jeden druh až 17 cm.

Běžně používaný anglický název pro tyto želvičky zní padloper, což znamená visací zámek. Je skutečností, že svými rozměry i tvarem krunýřů mohou při troše fantazie připomínat některý z typů visacích zámků.

Snášejí téměř vždy jen jedno vejce, více by se jich do malého těla ani nevešlo. Snůšky mohou být během jedné sezóny dvě až tři. Samičky jsou větší než sameční.

Všechny druhy patří mezi ohrožené či zranitelné. Rizikem jsou pro ně nadměrné pastevectví, změny klimatu, těžba surovin a nerostů. Řada želviček končí na silnicích pod koly aut a volně žijícím populacím samozřejmě neprospívají ani aktivity pytláků, kteří želvičky chytají a následně ilegálně prodávají jako domácí mazlíky.

Želvička trpasličí

Chersobius signatus

Je nejmenší suchozemskou želvou na světě. Dosahuje velikosti nanejvýš 11 cm, samci jsou menší než samičky.

Ty mají vyšší karapax (horní část krunýře), aby se do ní vešlo vejce, v období gravidity se dokonce krunýř může trochu zvětšit. Obývá široký příbřežní pás v západní části Jihoafrické republiky, především polosuché oblasti.

Želvička trpasličí ve svém přirozeném prostředí

Želvička namibijská

Chersobius solus

Jak název napovídá, vyskytuje se pouze v Namibii, konkrétně v jihozápadní části. Je to suchá krajina, chudá na srážky, pokud prší, tak jen koncem léta a na podzim. Želvičky žijí často ve skalnatých oblastech, podle všeho se zdá, že není příliš hojná, o jejím životě víme pramálo. Délka do 15 cm.

V péči člověka se neobjevuje takřka vůbec, evropští chovatelé s nimi zkušenosti nemají, úspěšného odchovu docílil pan Alfred Schleicher v Namibii, kterému tímto děkujeme za poskytnutí velmi ojedinělých fotografií, jež jsou jinak prakticky nesehnatelné.

Želvička proměnlivá

Homopus areolatus

Středně velká trpasličí želva, dorůstá maximálně 12 cm a je domovem v jižních, přímořských oblastech Jihoafrické republiky. Ze všech pěti druhů je nejbarevnější, připomíná roztomilou hračku.

Má výrazný zobák, odtud také její anglický název parrot beaked tortoise, tedy želva s papouščím zobákem. Velmi agilní a pohyblivá želva, ve srovnání s jinými želvami je schopna se pohybovat značnou rychlostí.

Želvička proměnlivá ve svém přirozeném prostředí

Želvička větší

Homopus femoralis

Mezi trpasličími želvami je pravým obrem, může dorůst až 17 cm. Díky této velikosti dokáže v rámci jedné snůšky snést dvě až tři vejce. Její domovinou jsou centrální, hornaté oblasti Jihoafrické republiky. I proto ve volné přírodě během zimních měsíců hybernuje.

Ani tento druh není zatím ve svém přirozeném prostředí nijak důkladně prostudován. V lidské péči se již podařily úspěšné odchovy.

Habitat želvičky větší

Želvička Boulengerova

Chersobius boulengeri

Tvarem krunýře se velmi podobá želvičce trpasličí, je ovšem nepatrně větší, až 13 cm. Oblast výskytu je omezena na jižní vnitrozemskou část Jihoafrické republiky, obývá především skalnaté habitaty.

O jejím životě ve volné přírodě není známé takřka nic, v lidské péči se zřejmě vůbec nenacházejí a nejsou informace, že by je někdo úspěšně odchoval. Je ovšem vysoce pravděpodobné, že způsob chovu i rozmnožování bude shodný či obdobný jako u želviček trpasličích a proměnlivých, které se již úspěšně odchovat podařilo.

Dwarf Tortoise Conservation

je neziskovou nadací se sídlem v Nizozemí, postavenou na práci dobrovolníků, kteří se po mnoha letech výzkumu a studia trpasličích želv stali celosvětově respektovanými odborníky. Zabývají se výzkumy v terénu i rozvojí a studiu populací trpasličích želv v lidské péči.

Autorem většiny snímků je dr. Victor J.T. Loehr, jemuž patří dík za jejich poskytnutí.

Krokodýlí Zoo Praha nadaci finančně podporuje.

Odborníci Dwarf Tortoise Conservation při terénním výzkumu. Není to lehká práce. Vysoké teploty bez možnosti schovat se ve stínu, na zkoumaných lokalitách žijí kromě želviček i jedovatí hadi, včetně kober schopných plivat jed do očí.

- Input was provided to the European Studbook Foundation:
  - Fine-tuning the online database (HERP) for private studbook management, particularly regarding reporting capabilities;
  - development of a tool to choose long-term goals and methods for private studbooks.

- The CITES trade database was analysed for trade in *H. areolatus*, to reveal a large discrepancy between exporter- and importer-reported trade from South Africa. This indication of illegal trade was shared with all studbook participants, to make them aware that *H. areolatus* offered in the trade might have been poached, even when accompanied by an importing permit. The finding was also shared with the South African authorities.

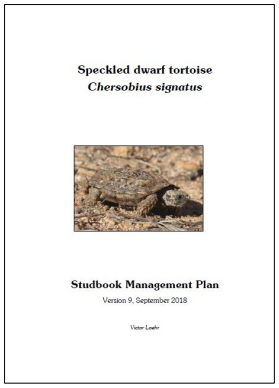
Global trade in live Homopus areolatus between 2015 and 2018

Year	Importer	Exporter	Origin	Importer reported quantity	Exporter reported quantity	Term	Purpose	Source	Remark
2015	CH	DE	NA	2	2	live	B	C	Non-commercial
2015	DE	CH	NA	2		live	P	C	Non-commercial
2015	DE	CH	NA		2	live	S	C	Non-commercial
2015	DE	CH		4	4	live	P	F	Non-commercial
2015	IT	ZA		2		live	T	F	
2016	DE	NA		20		live	P	C	Non-commercial
2016	DE	NA			20	live	S	C	Non-commercial
2016	JP	ZA		5		live	T	C	
2017	DE	CH		6	6	live	P	C	Non-commercial
2017	DE	ZA		29	14	live	T	C	
2017	HK	ZA		4		live	T	F	
2017	JP	ZA		1		live	T	C	
2017	TW	DE	ZA		2	live	T	C	
2018	CH	DE	ZA		2	live	B	C	Non-commercial
2018	DE	CH		3		live	P	C	Non-commercial
2018	DE	NA		17		live	P	C	Non-commercial
2018	DE	ZA		35		live	T	W	
Total exported from South Africa					14				
Total imported from South Africa				76					

- The Dwarf Tortoise Conservation website received updates regarding the *C. boulengeri* field project, *C. signatus* husbandry guidelines, *H. areolatus* husbandry guidelines, and adding items to the list of publications. A first version of husbandry guidelines for *C. boulengeri* was also produced and posted.

1.3. Studbook management plan Chersobius signatus

The first version of the studbook management plan for *C. signatus* was finished in 2013, and the plan was updated in 2016 and in 2018. It provides directions for the development of the studbook in the next years and decades, and will be updated every five years. The plan will also be updated after every supplementation of the studbook with new founders and after each change in the IUCN conservation status of the taxon. The annual reports of Dwarf Tortoise Conservation will report annual progress of the realisation of the plan.

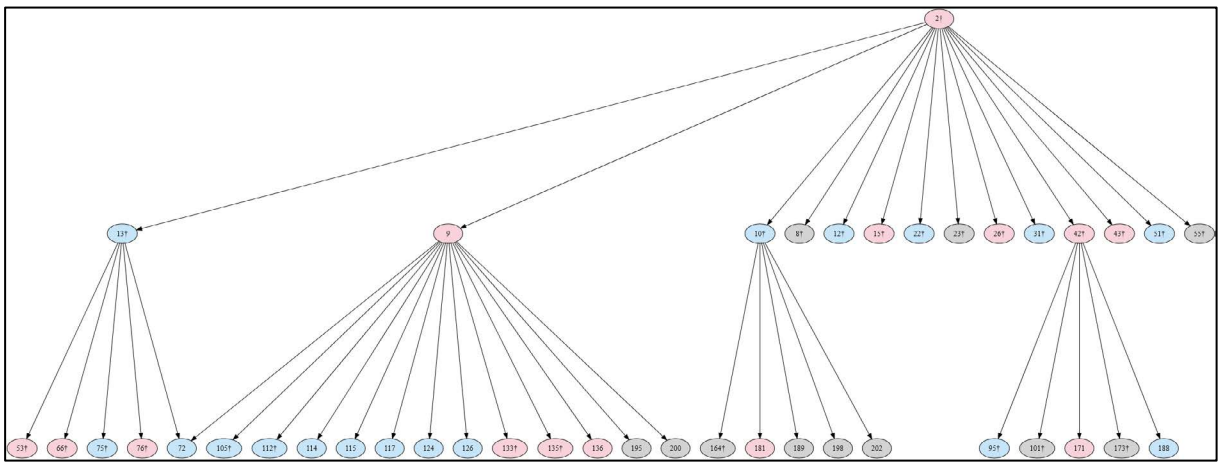


Two founder couples were alive in 2020, and one produced offspring. Unfortunately, the female from the other founder couple died. One new founder couple was formed by combining two solitary founders, so that two founder couples are remaining. In addition, two female offspring from deceased founder (WILD3 x) 159 were combined with male founders, resulting in two partial founder couples. No bloodlines went extinct in 2020.

The table at the right shows how well the genes of each founder are represented in the captive population. As would be expected, the number of available offspring from deceased founders decreased, and the number of available offspring in subsequent generations increased. However, gene distribution is not following the pattern envisaged in the studbook management plan. Ideally, each founder couple should produce 11 surviving offspring, after which each first-generation couple should produce two surviving offspring. The figure below gives an example of the actual pattern.

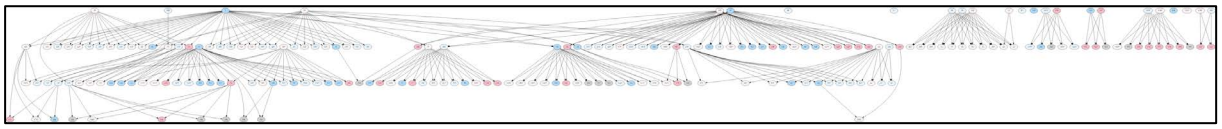
Founder	F1 offspring		F2 offspring		F3 offspring		Remark
	All	Available	All	Available	All	Available	
WILD1	1	0	1	0	0	0	Founder in the wild
WILD2	3	0	3	0	0	0	Founder in the wild
WILD3	2	2	0	0	0	0	Founder in the wild
1	34	5	70	33	1	0	
2	14	1	27	15	0	0	
3	21	4	47	18	1	0	
4	0	0	0	0	0	0	Bloodline extinct
35	30	17	32	16	0	0	
36	30	17	32	16	0	0	
37	23	13	10	8	0	0	
38	12	6	10	8	0	0	
60	13	2	1	0	0	0	
150	0	0	0	0	0	0	
151	5	2	0	0	0	0	
152	3	3	0	0	0	0	
153	8	7	0	0	0	0	
154	0	0	0	0	0	0	
155	0	0	0	0	0	0	Bloodline extinct
156	5	2	0	0	0	0	
157	3	3	0	0	0	0	
158	8	7	0	0	0	0	
159	2	2	0	0	0	0	

Grey numbers indicate unavailable founders. Red and green numbers indicate decreases and increases, respectively, compared to the previous annual report. Founders that were lost to follow-up and have no available offspring have been removed from the table. Note that each offspring has at least two founders, so numbers of offspring in a column should not be summed.



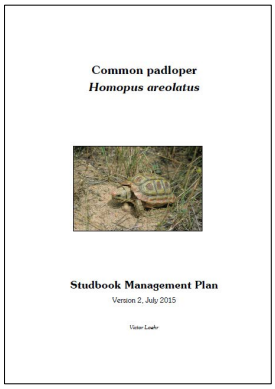
For most founders, the number of surviving (reproducing) first-generation offspring is less than 11 (e.g., only four offspring from founder 2 have reproduced in the figure above), hence second-generation offspring (e.g., 27 individuals in the figure above) originates from relatively few F1-individuals. The consequence of this aberration from the studbook management plan is that less founder genes are being preserved than planned. This will be taken into account in the next update of the studbook management plan in 2023.

Another important principle in the studbook management plan was to keep bloodlines separated as long as possible, to delay the need to inbreed. The schematic figure below shows all individuals in the studbook and their relationships. Considerable clustering into the first generation indicates separation of bloodlines. The clusters at the right originate from the founders that were added recently, in 2015. Because the number of founders and available offspring per founder are smaller than anticipated, increased blending of bloodlines (e.g., founders 1, 2, 3, 35, 36, 37 and 38) will be unavoidable into the third generation. There is no need yet to inbreed individuals, but over-representation of bloodlines should be limited by managing the number of offspring per bloodline (see chapter 3).



The fact that reproduction among bloodlines is very uneven emphasises a previous recommendation that the focus of the studbook should remain on optimising husbandry conditions and incubation techniques to reduce mortality and to annually breed all present founder couples and all F1 couples for which offspring is needed. Participants with adult couples and consent to breed (see chapter 3) should optimise husbandry, and if necessary exchange individuals, to promote breeding results. In case of unsuccessful incubation, possible causes that should be considered are too high incubation temperatures (e.g., not using a calibrated thermometer) and too high humidity (e.g., resulting in cracked eggshells). All participants should regularly review their husbandry conditions and incubation techniques, using the information in chapter 5 (see also previous annual reports) and current husbandry guidelines. Improved husbandry and breeding results, particularly for the four remaining (partial) founder couples, are key to justify imports of additional founders in the future.

1.4. Studbook management plan Homopus areolatus

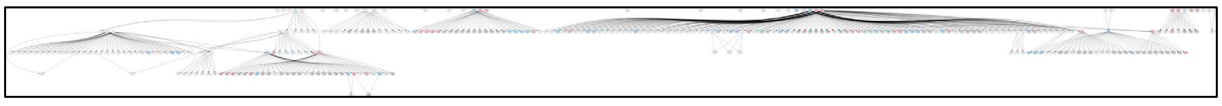


The first version of the studbook management plan for *H. areolatus* was finished in 2015, and the plan was updated in 2020. It follows the same format as the studbook management plan for *C. signatus*. A major difference between the two plans is that most tortoises in the studbook on *H. areolatus* are privately owned, meaning that the development of the captive population (i.e., the execution of the studbook management plan) is directly in hands of the participants, whereas the studbook coordinator has only a facilitating role.

One participant with one founder had been unresponsive for two years. Consequently, the founder and one offspring from genetically unrelated individuals outside the studbook (numbers 288 and 289) were considered lost for the studbook. Two other participants with a total of six founders have been unresponsive for one year, but will still be considered in this report.

The studbook management plan contains concrete recommendations for transfers of tortoises by studbook participants. None of the recommended transfers was executed in 2020. However, participants succeeded to combine genetically unrelated individuals to form two new breeding couples. Furthermore, participant 16414 was able to induce interaction between male founder 40 (no offspring yet) and female 81 (see Appendix 1), hopefully resulting in successful breeding in 2021.

The table on the following page shows how well the genes of each founder are represented in the captive population. Over-representation of founders 58, 59 and 60 is obvious (see also the schematic figure below, which includes unavailable individuals), but did not increase. Considerable clustering into the first generation indicates separation of bloodlines to delay inbreeding as long as possible.

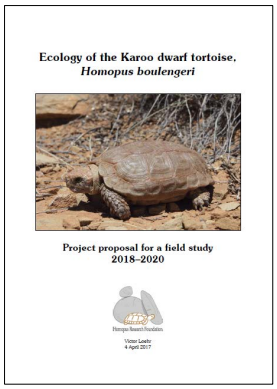


Founder	F1 offspring		F2 offspring		F3 offspring		Remark
	All	Available	All	Available	All	Available	
4	7	1	39	26	12	2	
5	7	1	39	26	12	2	
10	11	3	0	0	0	0	
11	14	3	0	0	0	0	
16	33	4	37	24	4	2	
17	34	4	37	24	4	2	
22	22	21	0	0	0	0	
23	0	0	0	0	0	0	
24	22	21	0	0	0	0	
40	0	0	0	0	0	0	
47	9	2	8	0	0	0	
58	89	45	39	21	0	0	
59 60	89	45	39	21	0	0	
63	1	1	27	21	0	0	
64	1	1	27	21	0	0	
190 191	7	5	0	0	0	0	
192	7	5	0	0	0	0	
210	0	0	0	0	0	0	
223	0	0	0	0	0	0	
288	1	0	0	0	0	0	Bloodline extinct
289	1	0	0	0	0	0	Bloodline extinct

Grey numbers indicate unavailable founders. Red and green numbers indicate decreases and increases, respectively, compared to the previous annual report. Founders that were lost to follow-up and have no available offspring have been removed from the table. Note that each offspring has at least two founders, so numbers of offspring in a column should not be summed.

The studbook population contains a reasonable number of genetically unrelated founders, but several have produced little or no offspring. Furthermore, participants are based in Europe, Africa and the USA, complicating combinations of genetically unrelated bloodlines. Unless new founders will become available, it is vital that participants on different continents start exchanging individuals (see studbook management plan). Currently, the captive population is free of inbreeding, and the general advise to all studbook participants remains to not combine offspring from the same bloodline and to avoid inbreeding. The studbook coordinator will continue to monitor and make recommendations regarding genetically preferred combinations of tortoises.

1.5. Progress field study Chersobius boulengeri



Upon the unexpected discovery of a wild *C. boulengeri* population in February 2017 (currently the only verified population of the species), great efforts were made to instantly prepare a broad ecological field study. Much of the available time at Dwarf Tortoise Conservation in 2020 was invested in the preparation (e.g., fund raising, recruiting volunteers, planning, purchasing research materials, supervising a student) and execution of a final sampling period in February–March 2020, a subsequent (genetic) dietary study in Europe, and in writing reports and papers for sponsors. The 2020 sampling was successfully completed despite the COVID-19 pandemic. For the study as a whole, 92 *C. boulengeri* have been found and marked, for 1,140 observations. Data gathered suffice for manuscripts on summer and spring inactivity, shell characteristics and population composition, body condition and reproduction, habitat use, and diet. A first manuscript is currently under review (see chapter 6) and data for a second are being processed. An illustrated field report was produced and posted on the project website. Furthermore, an internship report was produced by a student (Van Hall Larenstein University of Applied Sciences, Netherlands), and several popular and newsletter articles were written and submitted (see chapter 6).

The ear-marked funding obtained from the Dutch-Belgian Turtle and Tortoise Society in 2019 was used to co-produce a poster on Karoo tortoises (see paragraph 1.2) with the Endangered Wildlife Trust (South Africa). The poster is being distributed among Karoo residents to make them aware of tortoise diversity and to provide concrete suggestions that may help conserve tortoises. The trust's Drylands Programme aims to set up a Karoo Dwarf Tortoise Monitoring Project, for which Dwarf Tortoise Conservation reviewed a proposal and accepted an advisory role in the project.

The *C. boulengeri* field study is a co-production of Dwarf Tortoise Conservation and an independent South African researcher (Toby Keswick). Moreover, the study collaborates with the University of the Western Cape (South Africa; Retha Hofmeyr), Utrecht University (Netherlands; Ineke Westerhof), Van Hall Larenstein University of Applied Sciences (Netherlands; Ralf Mullers and Marcella Dobbelaar) and the Northern Cape Department of Environment and Nature Conservation (South Africa). Several organisations and individuals have generously provided funds, discounted prices, or in-kind contributions to the project:

- Knoxville Zoo (Quarters for Conservation Program)
- Turtle Conservation Fund and Conservation International
- Holohil Systems Ltd.
- Dutch-Belgian Turtle and Tortoise Society
- British Chelonia Group
- Turtle Survival Alliance Europe
- Pedak

- Jan Barth
- Kurt Engl
- Sheryl Gibbons
- Silja Heller
- Brian Henen
- Retha Hofmeyr
- Courtney Hundermark
- Lutz Jakob
- Libor Kopecny
- Johann Klutz
- Martijn Kooijman
- Matthias Kupferschmid
- Koos and Coby Loehr
- Frank van Loon
- Marcel and Lydia Reck
- Peter Sandmeier
- Uwe Seidel
- Paul van Sloun

1.6. Progress captive study Chersobius boulengeri

During the field study on *C. boulengeri* (see paragraph 1.5), it became clear that the composition of the population and secretive behaviour of the species hampered collection of data on reproduction and growth. Consequently, a small-scale captive study was initiated. Two males and two females were collected and transferred to captivity in February–March 2019.

In March 2020, the tortoises had sufficiently recovered from drought conditions in the wild to introduce the males to the females for 2 weeks. Mating and copulation were observed. One female produced two single-egg clutches in May–June, both of which hatched. In August, the males were introduced to the females again. The females produced six more single-egg clutches in September–November. All eggs were fertile, one hatched, one died and the remaining eggs are being incubated.

All eggs but one were oviposited in heated retreats that mimic natural sun-heated rock retreats. Eggs were measured and weighed, and incubated under strictly controlled and monitored conditions. Hatchlings were measured and weighed as well. They readily started feeding, providing excellent conditions for the anticipated growth study.

2. PLANS FOR 2021 AND THEREAFTER

The table below lists results anticipated for 2021 and thereafter, with progress indicated:

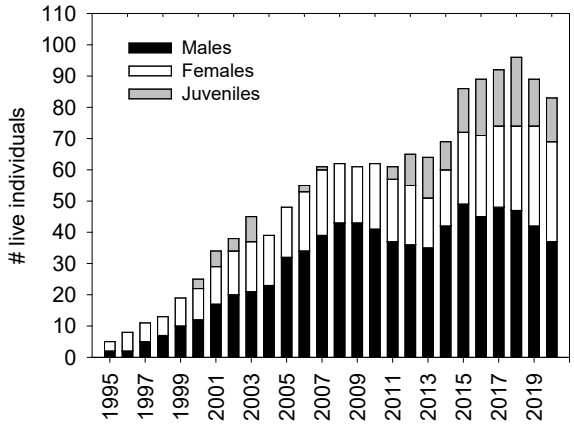
Result	Due	Current status
Manuscripts submitted on:		
• tick infestation in a European indoor dwarf tortoise collection;	31-12-2021	Manuscript in preparation (see also Appendix 2)
• captive husbandry and breeding of *C. signatus* (Mertensiella);	31-12-2021	Data available
• shell characteristics and population composition in *C. boulengeri*;	31-12-2021	Data available
• habitat use in *C. boulengeri;*	31-12-2022	Data available
• body conditions and reproduction in *C. boulengeri*;	31-12-2022	Data available
• diet in *C. boulengeri*.	31-12-2023	Data available
Updated IUCN assessments for *C. boulengeri*/*C. signatus* reviewed	01-02-2021	Not yet started
Genetic relationships between *C. signatus* 7, 44, 72 and 118 verified	31-12-2021	Samples of 72 and 118 collected
Studbook management plan *C. signatus* updated	31-12-2023	Not yet started
Studbook management plan *H. areolatus* updated	31-12-2025	Not yet started

3. STUDBOOK SUMMARIES

To keep the studbook registrations up to date, it is vital that all studbook participants keep the coordinator informed of any changes. In the studbooks on *C. signatus* and *H. femoralis*, each participant has accepted this obligation in a formal agreement between participant and Dwarf Tortoise Conservation. Regardless of the agreements, most participants are very motivated and inform the coordinator spontaneously when changes occur throughout the year. However, sometimes participants remain silent for an entire year or longer, despite repeated requests from the studbook coordinator. In order to keep track of where these communication flaws occur, the annual reports include a list of unresponsive participants. This will make it easier for the reader to assess the validity of studbook information per participant and will facilitate the coordinator when approaching a silent participant. In 2020, participants 16915, 14130, 14147, 14156, 14157, 14158, 14178 and 17654 (all *H. areolatus*) have been unresponsive. Tortoises from participants 14147 and 14158 were considered lost for the studbook, as no communication took place in 2019 either.

Chersobius signatus

Live specimens on 1 January 2020:
88 (excluding 17 specimens lost to follow-up)
Number of participants on 1 January 2020:
41 (13 countries, including 4 zoos)
New registrations:
3
Births:
5, at 5 participants
Deaths:
10 (1 wild-caught, 9 captive-bred), at 8 participants



Live specimens on 31 December 2020:
83 (excluding 20 specimens lost to follow-up)
Live inbred specimens on 31 December 2020:
0
Number of participants on 31 December 2020:
37 (12 countries, including 4 zoos)

The studbook population continued to shrink, but slightly less than in 2019. A wild-caught female founder died, after which a post mortem was conducted. It appeared that the (gravid) female had died due to an endogenously-caused metabolic disorder (i.e., depositions of calcium in the veins of the liver and kidneys, and in the heart muscles). A captive-bred male and female were found desiccated after the primary keeper had been away for several weeks, and the couple died soon thereafter (i.e., husbandry-related issues). In addition, a captive-bred male and two captive-bred females died unexpectedly, but were discovered too late for post mortem investigations. Another captive-bred couple died from unknown causes. A hatchling died 1 week after hatching.

Three tortoises were newly registered as lost for the studbook; these wild tortoises were already outside the studbook and were only registered to mark genetic relationships among their offspring inside the studbook. One of five offspring produced in 2020 originated from wild-caught founders. The remaining four represent second generation and a first third generation offspring. At as many as five participants, eggs were produced that were found broken (one participant), were infertile due to the lack of a mate (one participant), died from overheating during incubation (one participant) or failed to develop (two participants). Considering the egg production at 10 participants, the reproductive potential of the studbook population is considerable. Currently, 16 participants are keeping genetically unrelated adult couples (see table below).

Paragraph 1.3 interprets the 2020 results in light of the goal for the studbook described in the studbook management plan for *C. signatus*, and recommends that participants should adhere to the husbandry recommendations drawn up for *C. signatus* to improve breeding and (especially) reduce mortality, to ensure even population growth among bloodlines. The figure on the previous page shows that the incubation guidelines issued by Dwarf Tortoise Conservation in 2016 have led to an equal sex ratio in the population. Consequently, adjusted guidelines should match future needs for males and females among bloodlines. These guidelines are as following:

1. *Incubation for females*
    - Day 1–29: diurnal temperature cycle of 33°C and 28°C
    - Day 30–50: constant temperature of 33°C
    - Day 51–hatching: diurnal temperature cycle of 33°C and 28°C
2. *Incubation for males*
    - Day 1–29: diurnal temperature cycle of 33°C and 28°C
    - Day 30–50: constant temperature of 30°C
    - Day 51–hatching: diurnal temperature cycle of 33°C and 28°C

    All temperatures should be measured with a calibrated thermometer at the incubation spot(s).

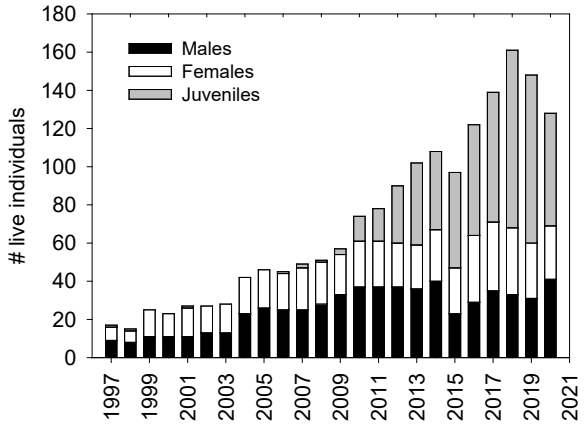
The table below assigns incubation guidelines to adult breeding couples. To avoid over-representation of bloodlines and future need for inbreeding, the table also provides maximum numbers of offspring that may be bred from each couple in 2021.

Bloodline	**Incubation guideline**	**Maximum number of offspring in 2021**
152 x 157	1 (incubation for females)	Unlimited
150 x 156	1 (incubation for females)	Unlimited
150 x (WILD x 159)	2 (incubation for males)	Unlimited
154 x (WILD x 159)	2 (incubation for males)	Unlimited
11 x 149	1 (incubation for females)	Unlimited
14 x 107	2 (incubation for males)	Unlimited
41 x 166	1 (incubation for females)	Unlimited
71 x 170	1 (incubation for females)	Unlimited
72 x 118	1 (incubation for females)	Unlimited
74 x 96	2 (incubation for males)	1
88 x 139	2 (incubation for males)	Unlimited
99 x 110	1 (incubation for females)	Unlimited
100 x 9	1 (incubation for females)	2
114 x 138	2 (incubation for males)	Unlimited
115 x 168	1 (incubation for females)	Unlimited
117 x 77 (related)	-	0
137 x 136	2 (incubation for males)	Unlimited

Homopus areolatus

Live specimens on 1 January 2020:
147 (excluding 66 specimens lost to follow-up)
Number of participants on 1 January 2020:
24 (10 countries, including 2 zoos)
New registrations:
0
Births:
4, at 2 participants
Deaths:
3, at 3 participants (3 captive-bred)

Live specimens on 31 December 2020:
138 (excluding 75 specimens lost to follow-up)
Live inbred specimens on 31 December 2020:
1 (studbook number 298; excluding 6 specimens lost to follow-up)
Number of participants on 31 December 2020:
24 (12 countries, including 1 zoo)



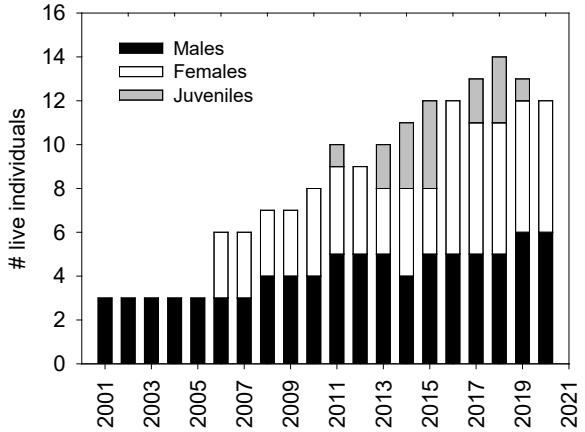
The studbook population shrank, due to 11 tortoises that were lost for the studbook combined with reduced reproduction compared to 2019. Mortality remained low, with only three individuals. A captive-bred female that had previously suffered from multiple cloacal prolapses died; a post mortem suggested that death was the result of chronic renal failure as a sequel to a renal infection. This was probably an ascending infection from the cloaca due to the previous cloacal prolapses. It however also could have been a hematogenic infection. A captive-bred male and a juvenile died from unknown causes.

Births occurred at two participants, one of whom had not bred *H. areolatus* previously. One of the offspring was inbred from sibling parents. Paragraph 1.3 interprets the 2020 results in light of the goal for the studbook described in the studbook management plan for *H. areolatus*, and recommends that participants avoid combining genetically related individuals.

Homopus femoralis

Live specimens on 1 January 2020:
13
Number of participants on 1 January 2020:
6 (5 countries)
New registrations:
2
Births:
0
Deaths:
1

Live specimens on 31 December 2020:
12 (excluding 2 specimens lost to follow-up)
Live inbred specimens on 31 December 2020:
0
Number of participants on 31 December 2020:
6 (5 countries)



The studbook population of *H. femoralis* shrank as a result of the death of a captive-bred male. A macroscopic post-mortem was performed, but a cause of death could not be identified. Two tortoises were newly registered as lost for the studbook; these wild tortoises were already outside the studbook and were only registered to mark genetic relationships among their offspring inside the studbook. Despite the low genetic variation in the *H. femoralis* studbook population, subadult couples kept at five participants provide good perspectives for the accumulation of reproductive and growth data for future publication.

4. ACTUAL STUDBOOK OVERVIEWS

The tables below give an overview of all live tortoises that are available in the studbooks on *C. signatus*, *H. areolatus* and *H. femoralis*. The tables do not include dead tortoises and tortoises lost for the studbook. Full overviews of all tortoises registered in the studbooks may be downloaded from the website.

Chersobius signatus: live and available studbook population.

Participant	Studbook number	Gender	Mother	Father	Date	Event	Keeper	Owner
17258	121	Male	36	35	16-12-2019	Transfer	17258	Dwarf Tortoise Conservation
					19-03-2019	Transfer	14229	Dwarf Tortoise Conservation
					19-01-2016	Transfer	14218	Dwarf Tortoise Conservation
					18-11-2011	Transfer	14205	Dwarf Tortoise Conservation
					23-09-2011	Hatch - birth	14120	Dwarf Tortoise Conservation
17626	195	Unknown	9	100	07-09-2020	Transfer	17626	Dwarf Tortoise Conservation
					13-10-2019	Hatch - birth	14206	Dwarf Tortoise Conservation
14135	131	Male	36	35	12-09-2015	Transfer	14135	Dwarf Tortoise Conservation
					04-10-2013	Hatch - birth	14121	Dwarf Tortoise Conservation
14148	144	Male	96	74	14-02-2018	Transfer	14148	Dwarf Tortoise Conservation
					20-06-2015	Hatch - birth	1276	Dwarf Tortoise Conservation
14116	115	Male	9	37	24-10-2019	Transfer	14116	Dwarf Tortoise Conservation
					06-11-2012	Transfer	14237	Dwarf Tortoise Conservation
					06-07-2011	Hatch - birth	1392	Dwarf Tortoise Conservation
	168	Female	36	35	20-04-2018	Transfer	14116	Dwarf Tortoise Conservation
					18-09-2016	Hatch - birth	14121	Dwarf Tortoise Conservation
14195	154	Male			30-03-2018	Transfer	14195	Dwarf Tortoise Conservation
					22-09-2015	Transfer	1392	Dwarf Tortoise Conservation
					~01-01-1900	Hatch - birth	Wild	Wild
	161	Female	159	205	05-07-2019	Transfer	14195	Dwarf Tortoise Conservation
					26-01-2016	Hatch - birth	1392	Dwarf Tortoise Conservation
14214	9	Female	2	1	06-09-2020	Transfer	14214	Dwarf Tortoise Conservation
					15-05-2014	Transfer	14206	Dwarf Tortoise Conservation
					30-11-1996	Hatch - birth	1392	Dwarf Tortoise Conservation
	100	Male	38	37	06-09-2020	Transfer	14214	Dwarf Tortoise Conservation
					05-06-2010	Transfer	14206	Dwarf Tortoise Conservation
					24-06-2008	Hatch - birth	1392	Dwarf Tortoise Conservation
	114	Male	9	37	~27-06-2011	Transfer	14214	Dwarf Tortoise Conservation
					04-07-2010	Hatch - birth	1392	Dwarf Tortoise Conservation
	138	Female	36	35	22-08-2020	Transfer	14214	Dwarf Tortoise Conservation
					15-04-2016	Transfer	14127	Dwarf Tortoise Conservation
					22-08-2014	Hatch - birth	14121	Dwarf Tortoise Conservation
14121	169	Female	36	35	~27-04-2018	Transfer	14121	Dwarf Tortoise Conservation
					20-04-2018	Transfer	14152	Dwarf Tortoise Conservation
					07-09-2016	Hatch - birth	14121	Dwarf Tortoise Conservation
	176	Female	158	153	30-04-2017	Hatch - birth	14121	Dwarf Tortoise Conservation
	178	Female	158	153	11-11-2017	Hatch - birth	14121	Dwarf Tortoise Conservation
	190	Female	158	153	06-06-2018	Hatch - birth	14121	Dwarf Tortoise Conservation
	191	Unknown	158	153	21-08-2018	Hatch - birth	14121	Dwarf Tortoise Conservation
	193	Unknown	158	153	06-09-2018	Hatch - birth	14121	Dwarf Tortoise Conservation
14134	99	Male	38	37	14-09-2019	Transfer	14134	Dwarf Tortoise Conservation
					05-06-2010	Transfer	14206	Dwarf Tortoise Conservation
					21-05-2008	Hatch - birth	1392	Dwarf Tortoise Conservation
	110	Female	7	44	03-05-2015	Transfer	14134	Dwarf Tortoise Conservation
					22-02-2012	Transfer	14219	Dwarf Tortoise Conservation
					22-01-2012	Transfer	14121	Dwarf Tortoise Conservation
					10-11-2011	Transfer	14196	Dwarf Tortoise Conservation
					23-03-2010	Hatch - birth	14121	Dwarf Tortoise Conservation
14178	86	Male	60	25	~20-04-2006	Hatch - birth	14178	14178
14217	79	Female	38	37	17-05-2016	Transfer	14217	Dwarf Tortoise Conservation
					05-11-2009	Transfer	14195	Dwarf Tortoise Conservation
					09-08-2006	Hatch - birth	1392	Dwarf Tortoise Conservation
	181	Female	79	10	01-05-2018	Hatch - birth	14217	Dwarf Tortoise Conservation
	189	Unknown	79	10	28-10-2018	Hatch - birth	14217	Dwarf Tortoise Conservation
	198	Unknown	79	10	21-04-2019	Hatch - birth	14217	Dwarf Tortoise Conservation
	202	Unknown	79	10	13-06-2020	Hatch - birth	14217	Dwarf Tortoise Conservation
113	132	Male	36	35	11-04-2015	Transfer	1103	Dwarf Tortoise Conservation
					~23-10-2013	Hatch - birth	14121	Dwarf Tortoise Conservation

Participant	Studbook number	Gender	Mother	Father	Date	Event	Keeper	Owner
14136	126	Male	9	37	13-06-2015	Transfer	14136	Dwarf Tortoise Conservation
					16-08-2012	Hatch - birth	1392	Dwarf Tortoise Conservation
14191	1	Male			08-03-2009	Transfer	14191	Dwarf Tortoise Conservation
					12-06-2004	Transfer	14170	Dwarf Tortoise Conservation
					30-09-1995	Transfer	1392	Dwarf Tortoise Conservation
					~01-01-1900	Hatch - birth	Wild	Wild
	35	Male			16-07-2016	Transfer	14191	Dwarf Tortoise Conservation
					26-10-2012	Transfer	14121	Dwarf Tortoise Conservation
					16-12-2001	Transfer	14120	Dwarf Tortoise Conservation
					06-10-2001	Transfer	1392	Dwarf Tortoise Conservation
					~01-01-1900	Hatch - birth	Wild	Wild
	174	Female	36	35	31-08-2017	Hatch - birth	14191	Dwarf Tortoise Conservation
14125	94	Male	7	44	08-03-2014	Transfer	14125	Dwarf Tortoise Conservation
					18-03-2013	Transfer	14229	Dwarf Tortoise Conservation
					10-03-2012	Transfer	14220	Dwarf Tortoise Conservation
					27-08-2007	Hatch - birth	14121	Dwarf Tortoise Conservation
	177	Female	158	153	14-12-2019	Transfer	14125	Dwarf Tortoise Conservation
					18-08-2017	Hatch - birth	14121	Dwarf Tortoise Conservation
	182	Male	156	151	14-12-2019	Transfer	14125	Dwarf Tortoise Conservation
					12-04-2018	Hatch - birth	1276	Dwarf Tortoise Conservation
1424	11	Male	3	1	23-10-2016	Transfer	14204	Dwarf Tortoise Conservation
					14-03-2015	Transfer	14221	Dwarf Tortoise Conservation
					16-09-2000	Transfer	14161	Dwarf Tortoise Conservation
					05-07-2000	Transfer	14120	Dwarf Tortoise Conservation
					22-11-1998	Transfer	14119	Dwarf Tortoise Conservation
					10-11-1997	Hatch - birth	1392	Dwarf Tortoise Conservation
	149	Female	36	35	01-11-2017	Transfer	14204	Dwarf Tortoise Conservation
					17-09-2015	Hatch - birth	14121	Dwarf Tortoise Conservation
	194	Unknown	149	11	25-07-2019	Hatch - birth	14204	Dwarf Tortoise Conservation
1421	37	Male			17-04-2016	Transfer	14201	Dwarf Tortoise Conservation
					12-06-2004	Transfer	1392	Dwarf Tortoise Conservation
					06-10-2001	Transfer	14170	Dwarf Tortoise Conservation
					~01-01-1900	Hatch - birth	Wild	Wild
14231	88	Male	60	25	11-03-2017	Transfer	14231	Dwarf Tortoise Conservation
					17-03-2014	Transfer	14201	Dwarf Tortoise Conservation
					24-11-2011	Transfer	14180	Dwarf Tortoise Conservation
					30-08-2010	Transfer	14207	Dwarf Tortoise Conservation
					~15-11-2005	Hatch - birth	14178	Dwarf Tortoise Conservation
	120	Female	7	44	04-10-2013	Transfer	14231	Dwarf Tortoise Conservation
					~19-09-2011	Hatch - birth	14121	Dwarf Tortoise Conservation
	139	Female	36	35	11-03-2017	Transfer	14231	Dwarf Tortoise Conservation
					13-03-2016	Transfer	14201	Dwarf Tortoise Conservation
					01-09-2014	Hatch - birth	14121	Dwarf Tortoise Conservation
14143	145	Male	36	35	10-09-2016	Transfer	14143	Dwarf Tortoise Conservation
					20-06-2015	Hatch - birth	14121	Dwarf Tortoise Conservation
14228	123	Male	38	37	13-12-2014	Transfer	14228	Dwarf Tortoise Conservation
					24-06-2012	Hatch - birth	1392	Dwarf Tortoise Conservation
14154	148	Male	36	35	03-04-2018	Transfer	14154	Dwarf Tortoise Conservation
					16-09-2015	Hatch - birth	14121	Dwarf Tortoise Conservation
	171	Female	42	73	14-09-2019	Transfer	14154	Dwarf Tortoise Conservation
					01-08-2017	Hatch - birth	14139	Dwarf Tortoise Conservation
14222	74	Male	3	1	12-03-2016	Transfer	14222	Dwarf Tortoise Conservation
					24-03-2007	Transfer	1276	Dwarf Tortoise Conservation
					31-07-2005	Hatch - birth	14170	Dwarf Tortoise Conservation
	96	Female	36	35	12-03-2016	Transfer	14222	Dwarf Tortoise Conservation
					12-09-2009	Transfer	1276	Dwarf Tortoise Conservation
					10-05-2009	Transfer	14202	Dwarf Tortoise Conservation
					13-04-2008	Transfer	14190	Dwarf Tortoise Conservation
					30-07-2007	Hatch - birth	14120	Dwarf Tortoise Conservation
	163	Female	96	74	10-08-2016	Hatch - birth	14222	Dwarf Tortoise Conservation
	196	Unknown	96	74	24-04-2019	Hatch - birth	14222	Dwarf Tortoise Conservation
	197	Unknown	96	74	01-09-2019	Hatch - birth	14222	Dwarf Tortoise Conservation
	203	Unknown	96	74	16-09-2020	Hatch - birth	14222	Dwarf Tortoise Conservation
14137	124	Male	9	37	12-09-2015	Transfer	14137	Dwarf Tortoise Conservation
					30-06-2012	Hatch - birth	1392	Dwarf Tortoise Conservation
14139	125	Male	96	74	31-01-2016	Transfer	14139	Dwarf Tortoise Conservation
					25-08-2015	Transfer	1276	Dwarf Tortoise Conservation
					01-03-2013	Transfer	1199	Dwarf Tortoise Conservation

Participant	Studbook number	Gender	Mother	Father	Date	Event	Keeper	Owner
					07-07-2012	Hatch - birth	1276	Dwarf Tortoise Conservation
	188	Male	42	73	16-10-2018	Hatch - birth	14139	Dwarf Tortoise Conservation
14183	41	Male	3	1	22-01-2010	Transfer	14183	Dwarf Tortoise Conservation
					12-10-2009	Transfer	14198	Dwarf Tortoise Conservation
					19-04-2003	Transfer	1277	Dwarf Tortoise Conservation
					25-07-2002	Hatch - birth	1392	Dwarf Tortoise Conservation
	166	Female	36	35	01-04-2018	Transfer	14183	Dwarf Tortoise Conservation
					07-06-2016	Hatch - birth	14121	Dwarf Tortoise Conservation
1276	184	Unknown	156	151	24-07-2018	Hatch - birth	1276	Dwarf Tortoise Conservation
14133	14	Male	3	1	14-03-2015	Transfer	14133	Dwarf Tortoise Conservation
					16-09-2000	Transfer	14161	Dwarf Tortoise Conservation
					22-11-1998	Transfer	14120	Dwarf Tortoise Conservation
					22-10-1998	Hatch - birth	1392	Dwarf Tortoise Conservation
	107	Female	36	35	11-03-2017	Transfer	14133	Dwarf Tortoise Conservation
					12-03-2016	Transfer	14231	Dwarf Tortoise Conservation
					08-03-2014	Transfer	14197	Dwarf Tortoise Conservation
					13-03-2010	Transfer	14205	Dwarf Tortoise Conservation
					21-07-2009	Hatch - birth	14120	Dwarf Tortoise Conservation
	179	Female	107	14	15-12-2017	Hatch - birth	14133	Dwarf Tortoise Conservation
	186	Unknown	107	14	12-08-2018	Hatch - birth	14133	Dwarf Tortoise Conservation
14216	71	Male	7	44	10-03-2012	Transfer	14216	Dwarf Tortoise Conservation
					22-01-2012	Transfer	14121	Dwarf Tortoise Conservation
					06-05-2008	Transfer	14196	Dwarf Tortoise Conservation
					25-06-2005	Hatch - birth	14121	Dwarf Tortoise Conservation
	170	Female	158	153	08-09-2019	Transfer	14216	Dwarf Tortoise Conservation
					21-09-2016	Hatch - birth	14121	Dwarf Tortoise Conservation
14153	106	Male	36	35	09-10-2018	Transfer	14153	Dwarf Tortoise Conservation
					19-01-2016	Transfer	14218	Dwarf Tortoise Conservation
					13-03-2010	Transfer	14205	Dwarf Tortoise Conservation
					20-05-2009	Hatch - birth	14120	Dwarf Tortoise Conservation
1423	142	Female	38	37	19-01-2018	Transfer	14203	Dwarf Tortoise Conservation
					15-05-2015	Hatch - birth	1392	Dwarf Tortoise Conservation
1776	147	Male	36	35	10-09-2016	Transfer	1776	Dwarf Tortoise Conservation
					28-08-2015	Hatch - birth	14121	Dwarf Tortoise Conservation
	200	Unknown	9	100	12-09-2020	Transfer	1776	Dwarf Tortoise Conservation
					01-08-2020	Hatch - birth	14206	Dwarf Tortoise Conservation
14197	113	Male	38	37	03-12-2011	Transfer	14197	Dwarf Tortoise Conservation
					16-06-2010	Hatch - birth	1392	Dwarf Tortoise Conservation
	152	Male			23-09-2015	Transfer	14197	Dwarf Tortoise Conservation
					22-09-2015	Transfer	1392	Dwarf Tortoise Conservation
					~01-01-1900	Hatch - birth	Wild	Wild
	157	Female			23-09-2015	Transfer	14197	Dwarf Tortoise Conservation
					22-09-2015	Transfer	1392	Dwarf Tortoise Conservation
					~01-01-1900	Hatch - birth	Wild	Wild
	172	Female	157	152	01-08-2017	Hatch - birth	14197	Dwarf Tortoise Conservation
	183	Female	157	152	30-06-2018	Hatch - birth	14197	Dwarf Tortoise Conservation
	201	Unknown	157	152	31-08-2020	Hatch - birth	14197	Dwarf Tortoise Conservation
1392	150	Male			30-03-2018	Transfer	1392	Dwarf Tortoise Conservation
					23-09-2015	Transfer	14195	Dwarf Tortoise Conservation
					22-09-2015	Transfer	1392	Dwarf Tortoise Conservation
					~01-01-1900	Hatch - birth	Wild	Wild
	156	Female			09-06-2020	Transfer	1392	Dwarf Tortoise Conservation
					23-09-2015	Transfer	1276	Dwarf Tortoise Conservation
					22-09-2015	Transfer	1392	Dwarf Tortoise Conservation
					~01-01-1900	Hatch - birth	Wild	Wild
	162	Female	159	205	25-02-2016	Hatch - birth	1392	Dwarf Tortoise Conservation
Amsterdam Zoo	77	Female	7	44	02-05-2014	Transfer	14237	Dwarf Tortoise Conservation
					14-08-2010	Transfer	14201	Dwarf Tortoise Conservation
					13-07-2006	Hatch - birth	14121	Dwarf Tortoise Conservation
	117	Male	9	37	06-11-2012	Transfer	14237	Dwarf Tortoise Conservation
					12-06-2011	Hatch - birth	1392	Dwarf Tortoise Conservation
Plzen Zoo	136	Female	9	37	27-09-2016	Transfer	14238	Dwarf Tortoise Conservation
					02-09-2014	Hatch - birth	1392	Dwarf Tortoise Conservation
	137	Male	36	35	25-12-2020	Transfer	14238	Dwarf Tortoise Conservation
					08-04-2016	Transfer	1268	Dwarf Tortoise Conservation
					21-06-2014	Hatch - birth	14121	Dwarf Tortoise Conservation
Wroclaw Zoo	119	Male	7	44	19-05-2018	Transfer	14241	Dwarf Tortoise Conservation
					08-09-2012	Transfer	14222	Dwarf Tortoise Conservation

Participant	Studbook number	Gender	Mother	Father	Date	Event	Keeper	Owner
					~20-04-2011	Hatch - birth	14121	Dwarf Tortoise Conservation
Wuppertal Zoo	72	Male	9|38	13|37	03-09-2018	Transfer	14242	Dwarf Tortoise Conservation
					17-10-2009	Transfer	14203	Dwarf Tortoise Conservation
					24-07-2005	Hatch - birth	1392	Dwarf Tortoise Conservation
	118	Female	7	44	06-05-2018	Transfer	14242	Dwarf Tortoise Conservation
					22-02-2012	Transfer	14217	Dwarf Tortoise Conservation
					22-01-2012	Transfer	14121	Dwarf Tortoise Conservation
					10-11-2011	Transfer	14196	Dwarf Tortoise Conservation
					01-05-2010	Hatch - birth	14121	Dwarf Tortoise Conservation

Homopus areolatus: live and available studbook population.

Participant	Studbook number	Gender	Mother	Father	Date	Event	Keeper	Owner
17255	242	Male	59|60	58	14-12-2019	Transfer	17255	17255
					12-12-2019	Transfer	14236	14236
					27-01-2018	Hatch - birth	14187	14187
	243	Female	59|60	58	14-12-2019	Transfer	17255	17255
					12-12-2019	Transfer	14236	14236
					28-01-2018	Hatch - birth	14187	14187
17654	200	Male	59|60	58	10-11-2020	Transfer	17654	17654
					15-12-2019	Transfer	17355	17355
					12-12-2019	Transfer	14236	14236
					06-02-2016	Hatch - birth	14187	14187
	250	Male	123	234	10-11-2020	Transfer	17654	17654
					15-12-2019	Transfer	17355	17355
					06-06-2018	Hatch - birth	14236	14236
17626	273	Unknown	128	234	11-08-2020	Transfer	17626	17626
					20-06-2020	Transfer	17691	17691
					31-08-2019	Transfer	14145	14145
					02-06-2019	Hatch - birth	14236	14236
	274	Unknown	129	234	20-08-2020	Transfer	17626	17626
					20-06-2020	Transfer	17691	17691
					31-08-2019	Transfer	14145	14145
					05-06-2019	Hatch - birth	14236	14236
17355	203	Female	59|60	58	15-12-2019	Transfer	17355	17355
					12-12-2019	Transfer	14236	14236
					21-02-2016	Hatch - birth	14187	14187
	275	Female	129	234	15-12-2019	Transfer	17355	17355
					05-06-2019	Hatch - birth	14236	14236
	278	Female	59|60	58	15-12-2019	Transfer	17355	17355
					12-12-2019	Transfer	14236	14236
					01-02-2019	Hatch - birth	14187	14187
14187	58	Male			09-09-1997	Transfer	14187	14187
					~01-01-1900	Hatch - birth	Wild	Wild
	59	Female			09-09-1997	Transfer	14187	14187
					~01-01-1900	Hatch - birth	Wild	Wild
	60	Female			25-03-1999	Transfer	14187	14187
					~01-01-1900	Hatch - birth	Wild	Wild
	277	Unknown	59|60	58	01-02-2019	Hatch - birth	14187	14187
	279	Unknown	59|60	58	01-02-2019	Hatch - birth	14187	14187
	280	Unknown	59|60	58	01-02-2019	Hatch - birth	14187	14187
14159	128	Female	59|60	58	09-03-2019	Transfer	14159	14159
					01-09-2016	Transfer	14236	14187
					03-02-2012	Hatch - birth	14187	14187
	175	Female	24	22	03-10-2020	Transfer	14159	14159
					24-09-2016	Transfer	14225	14225
					15-01-2015	Hatch - birth	14178	14178
	269	Male	17	16	23-01-2019	Transfer	14159	14159
					~01-01-1900	Hatch - birth	14161	14161
	292	Unknown	128	234	22-07-2019	Hatch - birth	14159	14159
	293	Unknown	128	234	22-07-2019	Hatch - birth	14159	14159
	297	Unknown	128	234	17-04-2020	Hatch - birth	14159	14159
14157	252	Unknown	129	234	08-12-2018	Transfer	14157	14157
					27-09-2018	Hatch - birth	14236	14236
14155	253	Unknown	129	234	21-10-2018	Transfer	14155	14155
					21-08-2018	Hatch - birth	14236	14236
	254	Unknown	129	234	21-10-2018	Transfer	14155	14155

Participant	Studbook number	Gender	Mother	Father	Date	Event	Keeper	Owner
					22-08-2018	Hatch - birth	14236	14236
14121	62	Female	4	5	25-07-2014	Transfer	14121	Dwarf Tortoise Conservation
					27-03-2011	Transfer	14185	Dwarf Tortoise Conservation
					~25-11-2007	Hatch - birth	14121	Dwarf Tortoise Conservation
	94	Male	17	16	~25-07-2014	Transfer	14121	14121
					05-06-2010	Transfer	14185	14185
					07-07-2009	Hatch - birth	14161	14161
	126	Male	59|60	58	12-09-2020	Transfer	14121	14121
					01-09-2016	Transfer	14236	14236
					01-02-2012	Hatch - birth	14187	14187
	186	Female	62	94	15-09-2015	Hatch - birth	14121	14121
	201	Female	62	94	16-08-2016	Hatch - birth	14121	14121
	223	Female			~11-10-2017	Transfer	14121	1177
					01-01-1900	Hatch - birth	Wild	Wild
	224	Unknown	62	94	29-04-2017	Hatch - birth	14121	Dwarf Tortoise Conservation
	225	Unknown	62	94	04-05-2017	Hatch - birth	14121	Dwarf Tortoise Conservation
	229	Unknown	62	94	15-07-2017	Hatch - birth	14121	14121
	230	Unknown	62	94	30-07-2017	Hatch - birth	14121	Dwarf Tortoise Conservation
	232	Unknown	62	94	19-09-2017	Hatch - birth	14121	Dwarf Tortoise Conservation
	233	Unknown	62	94	21-09-2017	Hatch - birth	14121	14121
	256	Unknown	62	94	11-06-2018	Hatch - birth	14121	14121
	257	Unknown	62	94	18-06-2018	Hatch - birth	14121	Dwarf Tortoise Conservation
	259	Unknown	62	94	17-08-2018	Hatch - birth	14121	Dwarf Tortoise Conservation
	260	Unknown	62	94	29-08-2018	Hatch - birth	14121	Dwarf Tortoise Conservation
	261	Unknown	62	94	01-10-2018	Hatch - birth	14121	14121
	262	Unknown	62	94	28-08-2018	Hatch - birth	14121	14121
	290	Unknown	62	94	06-06-2019	Hatch - birth	14121	Dwarf Tortoise Conservation
	291	Unknown	62	94	06-06-2019	Hatch - birth	14121	14121
14178	22	Male			15-09-2002	Transfer	14178	14178
					17-10-2000	Transfer	14166	14166
					~01-01-1998	Transfer	14165	14165
					~01-01-1900	Hatch - birth	Wild	Wild
	23	Female			15-09-2002	Transfer	14178	14178
					17-10-2000	Transfer	14166	14166
					~01-01-1999	Transfer	14165	14165
					~01-01-1900	Hatch - birth	Wild	Wild
	24	Female			15-09-2002	Transfer	14178	14178
					17-10-2000	Transfer	14166	14166
					~01-01-1993	Hatch - birth	14165	14165
	46	Male	24	22	30-09-2004	Hatch - birth	14178	14178
	107	Female	37	47	05-05-2010	Transfer	14178	14178
					08-03-2010	Hatch - birth	14185	14185
	111	Female	37	47	07-06-2010	Transfer	14178	14178
					29-03-2010	Hatch - birth	14185	14185
	172	Male	24	22	05-01-2014	Hatch - birth	14178	14178
	177	Male	24	22	15-02-2012	Hatch - birth	14178	14178
	178	Female	24	22	15-02-2009	Hatch - birth	14178	14178
	179	Female	24	22	15-02-2005	Hatch - birth	14178	14178
	180	Female	24	22	15-02-2004	Hatch - birth	14178	14178
	183	Female	24	22	11-08-2015	Hatch - birth	14178	14178
	211	Unknown	24	22	08-02-2016	Hatch - birth	14178	14178
	212	Unknown	24	22	17-03-2016	Hatch - birth	14178	14178
	213	Unknown	24	22	18-03-2016	Hatch - birth	14178	14178
	263	Unknown	24	22	~15-04-2018	Hatch - birth	14178	14178
	264	Unknown	24	22	~15-04-2018	Hatch - birth	14178	14178
1769	127	Male	59|60	58	20-08-2020	Transfer	17690	17690
					01-10-2017	Transfer	14145	14145
					01-09-2016	Transfer	14236	14187
					02-02-2012	Hatch - birth	14187	14187
14146	139	Unknown	59|60	58	~13-03-2017	Transfer	14146	14146
					~01-09-2016	Transfer	14236	14187
					~06-02-2013	Hatch - birth	14187	14187
	144	Unknown	59|60	58	~13-03-2017	Transfer	14146	14146
					~01-09-2016	Transfer	14236	14187
					~26-03-2013	Hatch - birth	14187	14187
	163	Unknown	59|60	58	13-03-2017	Transfer	14146	14146
					01-09-2016	Transfer	14236	14187
					29-01-2014	Hatch - birth	14187	14187

Participant	Studbook number	Gender	Mother	Father	Date	Event	Keeper	Owner
	168	Unknown	59|60	58	13-03-2017	Transfer	14146	14146
					01-09-2016	Transfer	14236	14187
					10-03-2014	Hatch - birth	14187	14187
14145	136	Female	59|60	58	01-10-2017	Transfer	14145	14145
					01-09-2016	Transfer	14236	14187
					~18-01-2013	Hatch - birth	14187	14187
	162	Male	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					29-01-2014	Hatch - birth	14187	14187
	164	Male	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					20-02-2014	Hatch - birth	14187	14187
	165	Female	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					20-02-2014	Hatch - birth	14187	14187
	167	Male	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					27-02-2014	Hatch - birth	14187	14187
	169	Female	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					13-02-2015	Hatch - birth	14187	14187
	170	Female	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					20-02-2015	Hatch - birth	14187	14187
	171	Unknown	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					20-03-2015	Hatch - birth	14187	14187
	197	Male	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					04-02-2016	Hatch - birth	14187	14187
	198	Male	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					04-02-2016	Hatch - birth	14187	14187
	199	Unknown	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					04-02-2016	Hatch - birth	14187	14187
	202	Female	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					20-02-2016	Hatch - birth	14187	14187
	204	Male	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					22-02-2016	Hatch - birth	14187	14187
	205	Male	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					03-03-2016	Hatch - birth	14187	14187
	206	Male	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					04-03-2016	Hatch - birth	14187	14187
	220	Unknown	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					18-10-2017	Hatch - birth	14187	14187
	221	Unknown	59|60	58	09-09-2018	Transfer	14145	14145
					11-06-2018	Transfer	14236	14187
					02-02-2017	Hatch - birth	14187	14187
	235	Unknown	129	234	09-09-2017	Transfer	14145	14145
					05-09-2017	Hatch - birth	14236	14236
	239	Unknown	128	234	24-06-2018	Transfer	14145	14145
					16-03-2018	Hatch - birth	14236	14236
	240	Male	123	234	08-12-2018	Transfer	14145	14145
					27-03-2018	Hatch - birth	14236	14236
	241	Unknown	128	234	09-09-2018	Transfer	14145	14145
					26-04-2018	Hatch - birth	14236	14236
	245	Male	128	234	24-06-2018	Transfer	14145	14145
					16-03-2018	Hatch - birth	14236	14236
	247	Unknown	129	234	09-09-2018	Transfer	14145	14145
					25-05-2018	Hatch - birth	14236	14236
	248	Unknown	129	234	09-09-2018	Transfer	14145	14145
					26-05-2018	Hatch - birth	14236	14236

Participant	Studbook number	Gender	Mother	Father	Date	Event	Keeper	Owner
	249	Male	123	234	09-09-2018	Transfer	14145	14145
					29-05-2018	Hatch - birth	14236	14236
	251	Unknown	129	234	09-09-2018	Transfer	14145	14145
					20-06-2018	Hatch - birth	14236	14236
	266	Male	17	16	~01-06-2019	Transfer	14145	14145
					23-01-2019	Transfer	14159	14159
					~01-01-1900	Hatch - birth	14161	14161
	267	Male	17	16	~01-06-2019	Transfer	14145	14145
					23-01-2019	Transfer	14159	14159
					~01-01-1900	Hatch - birth	14161	14161
	270	Unknown	128	234	31-05-2019	Transfer	14145	14145
					06-05-2019	Hatch - birth	14236	14236
	271	Unknown	128	234	31-05-2019	Transfer	14145	14145
					26-04-2019	Hatch - birth	14236	14236
14122	96	Male	59|60	58	~13-07-2013	Transfer	14122	14122
					~01-06-2012	Transfer	14194	14187
					~18-01-2010	Hatch - birth	14187	14187
	138	Male	59|60	58	19-03-2017	Transfer	14122	14122
					~01-09-2016	Transfer	14236	14187
					~27-01-2013	Hatch - birth	14187	14187
	141	Male	59|60	58	~19-03-2017	Transfer	14122	14122
					~01-09-2016	Transfer	14236	14187
					~17-02-2013	Hatch - birth	14187	14187
	145	Female	59|60	58	14-11-2017	Transfer	14122	14122
					~01-09-2016	Transfer	14236	14187
					~26-03-2013	Hatch - birth	14187	14187
	173	Male	24	22	24-09-2016	Transfer	14122	14122
					12-01-2014	Hatch - birth	14178	14178
	174	Male	24	22	24-09-2016	Transfer	14122	14122
					15-08-2014	Hatch - birth	14178	14178
	226	Female	62	94	08-09-2018	Transfer	14122	14122
					11-05-2017	Hatch - birth	14121	14121
	228	Male	62	94	08-09-2018	Transfer	14122	14122
					13-07-2017	Hatch - birth	14121	14121
1424	40	Male			06-02-2018	Transfer	14204	Dwarf Tortoise Conservation
					18-01-2018	Transfer	14242	Dwarf Tortoise Conservation
					28-03-1991	Transfer	14242	14242
					~01-01-1900	Hatch - birth	Wild	Wild
	79	Male	59|60	58	11-04-2015	Transfer	14204	Dwarf Tortoise Conservation
					~15-06-2008	Transfer	14193	Dwarf Tortoise Conservation
					~15-03-2007	Hatch - birth	14187	14187
	81	Female	59|60	58	~11-04-2015	Transfer	14204	Dwarf Tortoise Conservation
					~15-06-2008	Transfer	14193	Dwarf Tortoise Conservation
					~15-03-2007	Hatch - birth	14187	14187
14156	124	Male	59|60	58	08-12-2018	Transfer	14156	14156
					01-09-2016	Transfer	14236	14187
					24-01-2012	Hatch - birth	14187	14187
14231	185	Unknown	62	94	12-09-2016	Transfer	14231	Dwarf Tortoise Conservation
					12-09-2015	Hatch - birth	14121	Dwarf Tortoise Conservation
14236	129	Female	59|60	58	01-09-2016	Transfer	14236	14236
					04-02-2012	Hatch - birth	14187	14187
	234	Male	64	63	~25-04-2014	Transfer	14236	14236
					~01-11-2012	Hatch - birth	14224	14224
14211	69	Male	59|60	58	19-06-2010	Transfer	14211	14211
					~21-05-2006	Transfer	14194	14187
					~22-04-2004	Hatch - birth	14187	14187
	71	Female	59|60	58	19-06-2010	Transfer	14211	14211
					~21-05-2006	Transfer	14194	14187
					~06-03-2004	Hatch - birth	14187	14187
	130	Female	62	94	05-04-2019	Transfer	14211	14211
					16-03-2012	Hatch - birth	14185	14185
	132	Male	62	94	05-04-2019	Transfer	14211	14211
					18-07-2012	Hatch - birth	14185	14185
	133	Female	62	94	05-04-2019	Transfer	14211	Dwarf Tortoise Conservation
					13-08-2012	Hatch - birth	14185	Dwarf Tortoise Conservation
	149	Male	62	94	05-04-2019	Transfer	14211	Dwarf Tortoise Conservation
					27-04-2013	Hatch - birth	14185	Dwarf Tortoise Conservation
	298	Unknown	130	149	26-06-2020	Hatch - birth	14211	Dwarf Tortoise Conservation

Participant	Studbook number	Gender	Mother	Father	Date	Event	Keeper	Owner
1413	65	Unknown	24	22	28-09-2019	Transfer	14130	14130
					30-06-2018	Hatch - birth	14178	14178
	66	Unknown	24	22	28-09-2019	Transfer	14130	14130
					03-07-2018	Hatch - birth	14178	14178
	284	Unknown	24	22	28-09-2019	Transfer	14130	14130
					04-06-2019	Hatch - birth	14178	14178
	285	Unknown	24	22	28-09-2019	Transfer	14130	14130
					08-06-2019	Hatch - birth	14178	14178
	286	Unknown	24	22	28-09-2019	Transfer	14130	14130
					16-06-2019	Hatch - birth	14178	14178
	287	Unknown	24	22	28-09-2019	Transfer	14130	14130
					01-07-2019	Hatch - birth	14178	14178
16915	190	Female			08-04-2016	Transfer	16915	16915
					~01-01-1900	Hatch - birth	Wild	Wild
	191	Female			08-04-2016	Transfer	16915	16915
					~01-01-1900	Hatch - birth	Wild	Wild
	194	Female	190|191	192	08-04-2016	Hatch - birth	16915	16915
	196	Unknown	190|191	192	08-04-2016	Hatch - birth	16915	16915
	210	Female			01-12-2016	Transfer	16915	16915
					~01-01-1900	Hatch - birth	Wild	Wild
	214	Unknown	190|191	192	21-03-2017	Hatch - birth	16915	16915
	215	Unknown	190|191	192	21-03-2017	Hatch - birth	16915	16915
	216	Unknown	190|191	192	21-03-2017	Hatch - birth	16915	16915
14439	207	Unknown	11	10	11-04-2016	Hatch - birth	14439	14439
	209	Unknown	11	10	15-05-2016	Hatch - birth	14439	14439
	236	Unknown	11	10	04-04-2017	Hatch - birth	14439	14439
	237	Unknown	11	10	17-04-2017	Hatch - birth	14439	14439
14215	84	Male	59|60	58	02-06-2011	Transfer	14215	14215
					~07-02-2008	Hatch - birth	14187	14187
	85	Male	59|60	58	02-06-2011	Transfer	14215	14215
					~07-02-2008	Hatch - birth	14187	14187
14197	187	Female	62	94	12-09-2016	Transfer	14197	Dwarf Tortoise Conservation
					17-09-2015	Hatch - birth	14121	Dwarf Tortoise Conservation

Homopus femoralis: live and available studbook population.

Participant	Studbook number	Gender	Mother	Father	Date	Event	Keeper	Owner
14131	17	Female	4	3	25-07-2019	Transfer	14131	Dwarf Tortoise Conservation
					26-06-2017	Hatch - birth	1392	Dwarf Tortoise Conservation
	18	Male	4	3	25-07-2019	Transfer	14131	Dwarf Tortoise Conservation
					08-07-2017	Hatch - birth	1392	Dwarf Tortoise Conservation
	19	Male	4	3	25-07-2019	Transfer	14131	Dwarf Tortoise Conservation
					26-06-2018	Hatch - birth	1392	Dwarf Tortoise Conservation
14121	2	Male	21	20	06-07-2006	Transfer	14121	Dwarf Tortoise Conservation
					23-12-2001	Transfer	1277	Dwarf Tortoise Conservation
					~01-01-2001	Transfer	14172	Tortoise Trust
					~01-01-1900	Hatch - birth	1417	Wild
	15	Female	4	3	09-03-2019	Transfer	14121	Dwarf Tortoise Conservation
					10-09-2016	Transfer	14222	Dwarf Tortoise Conservation
					19-06-2014	Hatch - birth	1392	Dwarf Tortoise Conservation
14191	3	Male	21	20	30-05-2019	Transfer	14191	Dwarf Tortoise Conservation
					23-12-2001	Transfer	1392	Dwarf Tortoise Conservation
					01-01-2001	Transfer	14172	Tortoise Trust
					~01-01-1900	Hatch - birth	1417	Wild
	16	Female	4	3	09-09-2017	Transfer	14191	Dwarf Tortoise Conservation
					26-06-2015	Hatch - birth	1392	Dwarf Tortoise Conservation
14222	14	Female	4	3	10-09-2016	Transfer	14222	Dwarf Tortoise Conservation
					18-06-2014	Hatch - birth	1392	Dwarf Tortoise Conservation
1276	8	Male	4	3	26-06-2014	Transfer	1276	Dwarf Tortoise Conservation
					30-06-2010	Transfer	1392	Dwarf Tortoise Conservation
	10	Female	4	3	27-06-2015	Transfer	1276	Dwarf Tortoise Conservation
					28-05-2011	Transfer	1392	Dwarf Tortoise Conservation
14197	12	Male	4	3	02-08-2015	Transfer	14197	Dwarf Tortoise Conservation
					12-07-2013	Hatch - birth	1392	Dwarf Tortoise Conservation
	13	Female	4	3	10-09-2016	Transfer	14197	Dwarf Tortoise Conservation
					15-06-2014	Hatch - birth	1392	Dwarf Tortoise Conservation

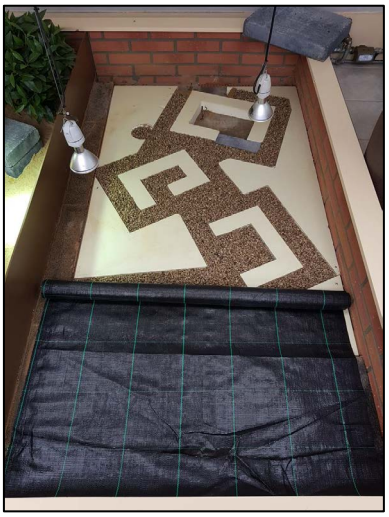
5. SPECIFIC INFORMATION FROM STUDBOOK PARTICIPANTS

Participant 1392

The (indoor) enclosures for adult *C. boulengeri* females were optimised. This setup would also be suitable for *C. signatus*.

XPS insulation (10 mm) was glued onto the concrete floor, after which a DCM Pro heating system (450W for 4 m^2) was installed. A further XPS layer (50 mm) was placed for weight reduction.

The heating system was covered with a thin layer of concrete, before the 50 mm XPS layer was replaced. Note the rubber tile with inserted feeding dish at the front, to avoid ingestion of soil during feeding.



Heated areas were covered with course pumice, after which a geotextile layer was placed. The heated retreat at the back, and a 10 cm-wide heated area at the back were not filled with pumice, but serve as egg-laying sites.

Geotextile was covered with 10–15 mm compressed loam, for a firm walking substrate. The egg-laying sites were filled with loose sandy loam (i.e., 1 part loam on 9 parts sand).

Finished enclosures. Sites with pumice can easily be opened and filled with sandy loam if additional egg-laying sites might be needed.

Nest site of *C. boulengeri* in a heated retreat. The concrete brick and heat mat that covered the retreat were removed for the photo, and the soil that covered the egg was moved away.

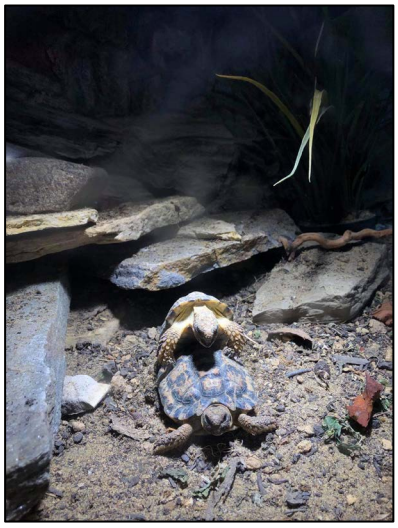
Incubation container for *Chersobius* spp. eggs. Each egg is incubated in a separate container. The Seramis is left to dry, and then humidified with 1 ml water through the ventilation holes.

Participant 14116

Since October 2019, I am keeping a couple *C. signatus* after a male was received from Amsterdam Zoo. The male immediately showed interest in the female. It followed the female and showed head-bobbing. It took about 2 months until successful mating could be observed. The tortoises live in their own room, so mating and egg-laying are not always noted. Early February, the female was observed laying its first egg. The egg was removed from the enclosure and candled, but no structures could be identified inside the egg. This was different compared to what I am used to in snakes, where veins can be seen immediately after laying. The egg was placed in an incubator and candled again after 3 weeks. Again, no structures were visible. When I was about to return the egg to the incubator, it exploded releasing a foul smell.

In the end of March, two eggs were found when the enclosure substrate was carefully inspected. Both were candled; one appeared empty whereas the other looked filled with an embryo. The eggs were placed in the incubator, where one egg remained bright white, whereas the other turned yellow and broke. Unfortunately, after 85–90 days of incubation, the incubator temperature reached 39°C due to extremely hot weather. The remaining egg was opened on day 100 and contained a fully developed dead young.

To avoid future overheating problems, I have constructed an incubator that can heat and cool. Furthermore, I have placed a camera in the enclosure to monitor mating and egg-laying activity.



Participant 14131

The *H. femoralis* become active as soon as humidity levels rise. This even happens during the night and tortoises will feed during darkness too.

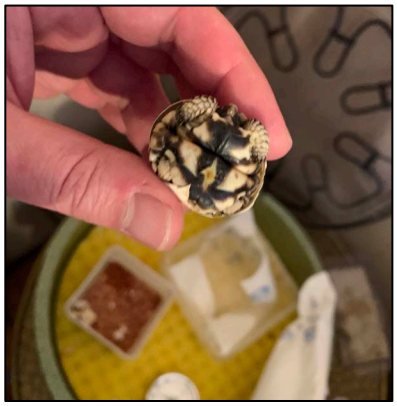
Participant 14197

The couple *H. femoralis* is growing well, and almost large enough to place the male with the female.

The couple *C. signatus* produced a healthy hatchling. Because of the incubation guidelines, I used two simple incubators and shifted the egg between both containers.

Participant 14217

The next *C. signatus* hatchling was born on 13 June.



The oldest hatchling (studbook number 181, body mass 60 g) could be identified as a female.


Participant 14222

One *C. signatus* hatched on 16 September. The previous offspring are doing fine.


Participant 14231

One *C. signatus* egg was produced and successfully hatched.


Participant Amsterdam Zoo

Mating activity was observed, and we found one broken egg on 22 April.

6. NEW PUBLICATIONS

The following overview summarises all manuscripts and articles that were submitted, accepted, published, or under review in 2020. A full list of publications authored or co-authored by Dwarf Tortoise Conservation is available at the website.

Subject	Submitted	Accepted	Published	Journal
Homopus signatus Gmelin, 1789, speckled padloper, two-egg clutching	2018	2018	2018[1]	African Herp News
Homopus femoralis (greater padloper). Reproduction and growth.	2018	2019	2019[1]	Herpetological Review (English)
Ombouw van een broedstoof (Reconstructing an incubator)	2019	2019	2020	Trionyx (Dutch)
De Karoo dwergschildpad: een uitstervende soort. Veldrapport over *Chersobius boulengeri*. (The Karoo dwarf tortoise: a vanishing species. Field report on *Chersobius boulengeri*).	2020	2020	2020	Trionyx (Dutch)
The Karoo dwarf tortoise (*Chersobius boulengeri*): field report on a vanishing species	2020			Testudo (English)
The Karoo dwarf tortoise (*Chersobius boulengeri*), a declining population	2020			TSA EU Newsletter (English)
High-level inactivity despite favorable environmental conditions in the rock-dwelling dwarf tortoise *Chersobius boulengeri*	2020			Herpetologica (English)
Health assessment of wild speckled dwarf tortoises, *Chersobius signatus*	2020			BMC Veterinary Research (English)

[1] Had not yet been reported in an annual report

7. FINANCIAL REPORT

All project expenses in 2020 were spent on the field study of *C. boulengeri*, including the spin-off on reproduction and growth in captivity, and were covered by funding that had been received from multiple NGO's and private individuals in 2017–2020. The largest expenses were for a dietary study, which involved genetic analysis of a large number of field-collected plant species and faecal samples at AllGenetics in Spain. The reproductive and growth studies required a lab incubator to more reliably (both spatially and temporally) control incubation temperature, to avoid noise in the dataset. Dwarf Tortoise Conservation contributed half the costs of the incubator. The Dutch-Belgian Turtle and Tortoise Society funded the production of a poster to raise awareness of tortoises among Karoo residents, and a smaller amount was used to supplement volunteer contributions to car rental and fuel costs (i.e., harsh field conditions required vehicles that are more expensive than originally planned).

All non-project expenses were covered by a private donation by the board of Dwarf Tortoise Conservation.

Revenues Net amount €	Item	***Expenses*** Amount €	Item
Projects		*Projects*	*Field ecology of* Chersobius boulengeri
9,034	Remaining funds from 2019	8,023	Dietary study (genetic analyses and plant identifications)
4,920	Donation Knoxville Zoological Gardens	2,000	Production poster Karoo tortoises (NBSV)
2,000	Donation Dutch-Belgian Turtle and Tortoise Society (posters)	1,500	Reproductive and growth study (contribution lab incubator)
635	Donations (2) private individuals	1,323	Contribution car rental and fuel
		3,742	Reservation publication costs 2021
16,589	Subtotal	16,589	Subtotal
Other		*Other*	
142	Donation private individual to cover overhead costs	142	Annual costs bank account
142	Subtotal	142	Subtotal
16,731	Total	16,731	Total

8. PERMIT OVERVIEW

The activities reported in this annual report would not have been possible without the following permits issued by the South African and Namibian authorities:

Collecting and exporting of C. boulengeri

- Collecting permit FAUNA 0952/2018 (Northern Cape Department of Environment and Nature Conservation)
- CITES exporting permit 217387 (Northern Cape Department of Environment and Nature Conservation)

Collecting and exporting of C. signatus

- Collecting permit 331/95 (Western Cape Nature Conservation Board, South Africa)
- Collecting permit 28/2001 (Northern Cape Nature Conservation, South Africa)
- Collecting permit 053/2015 (Northern Cape Department of Environment and Nature Conservation)
- CITES exporting permits 16579 and 281/95C (Department of Environmental Affairs and Tourism, South Africa)
- CITES exporting permit 148487 (Northern Cape Department of Environment and Nature Conservation)
- Permit to move animals/animal products 2001/10/3/A (Department of Agriculture, South Africa)

Collecting and exporting of H. femoralis

- Collecting permit AAA004-00010-0035 (CapeNature, South Africa)
- CITES exporting permit 58679 (Department of Environmental Affairs and Tourism, South Africa)
- Health declaration dated 17-03-06 (Department of Agriculture, South Africa)

Exporting of H. areolatus

- Exporting permit 49683 (Ministry of Environment and Tourism, Namibia)
- CITES exporting permit 8830 (Ministry of Environment and Tourism, Namibia)
- CITES exporting permit 3558 (Ministry of Environment and Tourism, South Africa)
- Health certificate 13\1\4\2\ 09/2- 1676/04 (Ministry of Agriculture, Water and Rural Development, Namibia)
- Various additional permits issued to individual studbook participants (Namibia)

Field study and surveys on C. boulengeri

- Research permits 755/05, 43/2005 and 35/2005 (Northern Cape Nature Conservation, South Africa)
- Research permit 245/2/2015 (Northern Cape Department of Environment and Nature Conservation, South Africa)
- Research permit FAUNA 0950/2017 (Northern Cape Department of Environment and Nature Conservation, South Africa)
- Research permits FLORA 0066/2017 and FLORA 0067/2017 (Northern Cape Department of Environment and Nature Conservation, South Africa)
- Plant export permission NNO 1/10/3/6/ 39738

Field studies on C. signatus

- Research permits 137/99, 84/99, 019/2001, 010/2001, 46/2003, 26/2003, 8/2003, 168/2003, 43/2003, 158/2003, 633/2003, 25/2003, 158/2004 and 633/2004 (Northern Cape Nature Conservation, South Africa)
- Research permits 428/2002 and 41/2002 (Western Cape Nature Conservation Board, South Africa)
- Research permits 152/2012 and 153/2012, 460/2013 and 052/2015 (Northern Cape Department of Environment and Nature Conservation, South Africa)

Field study on H. femoralis

- Research permit AAA-004-000185-0035
- Research permit AAA-004-00020-0028
- Research permit AAA-004-000392-0035
- Research permit AAA-004-00027-0028

Appendix 1

Reports from participant 14204.

Haltebericht Homopus areolatus

Januar 2020 von Partizipant 14204

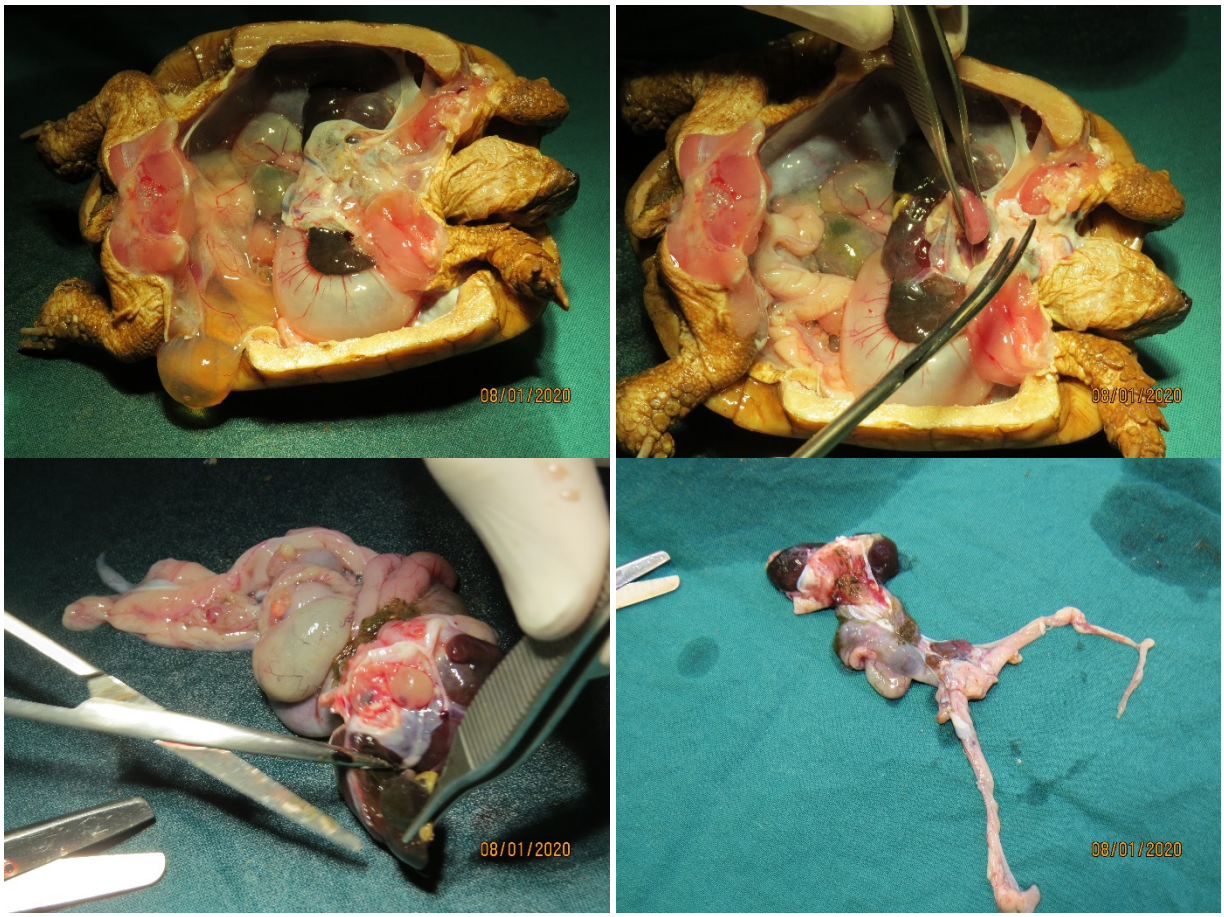
Am 5. Januar 2020 schrieb ich Tierarzt Peter Sandmeier folgendes:

Die Grossmutter Nr. 4, das Homopus Weibchen aus Wuppertal macht mir Sorgen, hat einiges an Gewicht abgenommen. Ich sah es vor 5 Tagen das letzte Mal fressen, sie macht nach dem Schlucken so komische seitliche Würgbewegungen hatte Heute etwa eine halbe Stunde den Kopf im Wasser.
Habe sie Heute gewogen, das Gewicht ist 275g gleich wie vor 5 Tagen, siehe Tabelle. Kot ist immer noch dünn wie bei dir. Was meinst du, wie soll ich vorgehen?

Auf dieses Mail antwortete Peter auch besorgt und ich vereinbarte einen Termin.

Leider war es schon zu spät. Im Eingangsbereich dieser Höhle, den ich einen Tag vorher einseitig leicht befeuchtete, fand ich sie Tod am 7. Januar um 9.00 Uhr.
Also ging unser Weg am 8. Januar zum Sezieren Richtung Baden in die Praxis.
Anbei noch einige Fotos vom Sezieren.

Es ist schon eindrücklich, was in dem kleinen Tier im Panzer alles Platz haben muss.



Beim letzten Foto sieht man den Eierstock mit den Eileitern.
Als Laien sind wir erstaunt, dass die Leber so schwarz war.

Peter Sandmeier schickte verschiedene Proben an ein Labor und wird anschliessend einen Bericht erstellen.

Da wir die Homopus nur noch halbjährlich wägen und baden, wie Victor vorgeschlagen hat, ist es viel schwieriger aussergewöhnliches an den Tieren festzustellen.
Stress hatte das Weibchen Nr. 4 jedenfalls nicht, denn das Männchen Nr. 40 aus Wuppertal ist eine Schlaftablette, er beachtet auch das Weibchen Nr. 81 kaum. Die Drei waren ja im selben Terrarium und eine ruhige Gruppe. Trotz strenger Beobachtung habe ich noch keine richtige Kopulation gesehen.

Haltebericht Homopus areolatus

Januar – Dezember 2020 von Partizipant 14204

Das jetzige Paar **Nr. 40 male (geboren 1.1.1991) aus Wuppertal seit 17. November 2017** bei uns und **81 female (geboren 15.3.2007) seit 13. April 2015** bei uns verhält sich noch immer sehr ruhig. Die Tiere waren in diesem Jahr von 21. Mai bis 26. September im Aussengehege.
Habe das ganze Jahr keine Kopulation gesehen, auch keine grabversuche. Das male beschnuppert das female nach wie vor, habe aber das Gefühl, dass das alte male Nr. 40 immer noch nicht weiss, wie und wo man bei einem female für eine richtige Kopulation aufsteigen muss.
Erstaunlich, da sie ja bereits seit dem 27. November 2018 zusammen sind. Für uns heisst das, dass diese Tiere nicht zusammenpassen, da das Paar keine Fortschritte macht mit Nachzuchten, oder was meint ihr dazu, was kann ich verbessern?

Das male von Partizipant 14187 **Nr. 79 (geboren 15.3.2007) seit 13. April 2015** bei uns befindet sich nach wie vor immer in einem separaten Gehege oder Terrarium.

male Nr. 40 Aussengehege Paar female Nr. 81

Neu im Aussengehege mit LED Lampen zum Aufwärmen (Tipp Peter Sandmeier)
Hat sich sehr gut bewährt.

male Nr. 79 separat Aussengehege

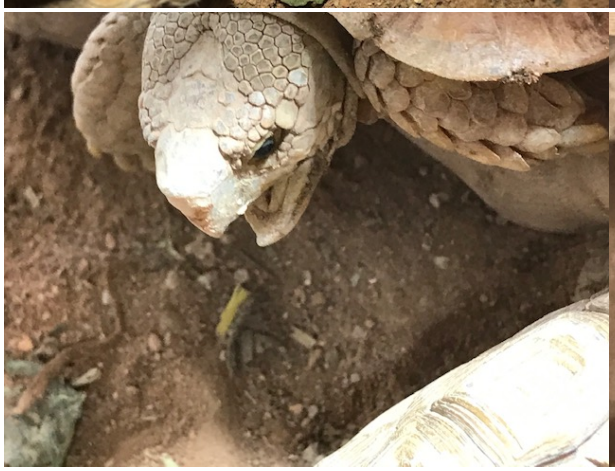
Innenterrarium

Paar

separates male

Nachtrag:

Auf Empfehlung von Victor Loehr vom 27. Oktober 2020 setzten wir die zwei male seit damals unter Aufsicht an verschiedenen Tagen Stunden weise zusammen um die Paarung von male Nr. 40 mit dem female Nr. 81 zu verbessern. Die male haben sich bei jeder Zusammenkunft beschnuppert, gekämpft und gebissen, bis Beide weisse Nasen hatten.



Das male Nr. 40 ist seither interessierter an dem female, verfolgt es mehr als vorher, haben aber eine Kopulation immer noch nicht gesehen. Ist auch aggressiver gegen mich geworden, har mich gebissen ist sogar an meinem Arm hängen geblieben.

Haltebericht Chersobius signatus

Januar – Dezember 2020 von Partizipant 14204

Die Beiden Nr. 11 und Nr. 149 verstehen sich nach wie vor sehr gut. Wie bereits beschrieben, pflegen wir die Tiere nur im Innenterrarium. Das male ist ruhiger geworden und kopuliert nicht mehr so oft wie früher.
Am 5. Februar und 18. März legte das female je ein Ei, erstaunlicher Weise direkt unter der Lampe im Lichtkegel und vergrub sie nicht. Wie sich herausstellte, waren sie wie erwartet nicht befruchtet.
Hat das female wohl gemerkt, dass diese Eier nicht befruchtet sind?

Die erwachsenen Tiere haben wir, damit sie nicht gestresst werden, seit 1.1.2020 am 1. Juli 2020 wieder mal gewogen, das heisst nur noch halbjährlich.

Im Terrarium wurde nichts verändert.

Jungtier Chersobius signatus Nr. 194

Schade, es tummelt sich noch immer allein in seinem Terrarium umher. Wir glauben, dass es in Zukunft noch etwas mehr Geduld braucht.
Seit der Geburt am 25. Juli 2019 mit 7,25 Gramm, wiegt es doch unterdessen am 1. Juli 2020 stolze 14,99 Gramm (das Doppelte).
Es bewegt sich vom Versteck unter den Strahler, an das Futter, sehr selten an das Trinkgefäss (schon gebadet) anschliessend in ein Versteck.

Wir bemühen uns den Tieren täglich frisches Naturfutter zu geben, vor allem Blüten.

Appendix 2

Report from participant Frank van Loon.

Outbreak of ticks (*Ornithodoros compactus*) in an indoor population of speckled dwarf tortoises (*Chersobius signatus*) in Europe

A tick infestation was detected in a captive, indoor population of speckled dwarf tortoises (*Chersobius signatus*) in Europe. Wild-caught and captive-bred adults and juveniles were affected. Ticks were identified as *Ornithodoros compactus* and were mostly found on captive-bred tortoises. In total, an estimated 4,000 ticks were manually removed from the tortoises during a period of almost a year. Ticks were not firmly attached and could easily be removed. A small number of adult ticks were found, but most were nymphs of different stages.

Infestation
On 26 June 2018, an adult captive-bred male *C. signatus* showed unusual behaviour. The tortoise repeatedly rubbed its head along his front limbs and vice versa. When examining the tortoise, a dark mass was discovered on the soft skin between the head and both front limbs. A closer look revealed that this mass was made up of hundreds of small ticks (figures below).

All tortoises in enclosures near the affected *C. signatus* (i.e., open-top enclosures separated by Plexiglass or hardboard) were checked for ticks. This concerned *C. signatus, Homopus areolatus, H. femoralis* and *Psammobates oculifer*. The affected enclosure was inhabited by one male and four female *C. signatus*, all nearly adult and captive-bred at this location. In one adjacent enclosure was an adult couple *C. signatus* that had been imported from the wild in September 2015. Upon collection, and again upon release in its enclosure, it had been checked for ectoparasites, but none were found. The wild-caught couple had reproduced successfully between 2015 and 2018.

A number of differently-sized ticks from different *C. signatus* individuals were collected, live or preserved in alcohol, and sent to the Utrecht Centre for Tick-borne Diseases in the Netherlands and to the Department of Veterinary Tropical Diseases of the University of Pretoria in South Africa. All ticks were identified as *Ornithodoros compactus*, an argaside (soft) tick inhabiting South Africa and Namibia.

Treatment

The first removal of ticks was conducted on 28 June 2018. After that, tortoises were checked every 2–3 weeks during 3 months. Subsequently, they were checked monthly, followed by random checks from 26 March 2019 onwards. On 26 March 2019, the last three nymphs were found and removed. From 12 July 2018 onwards, removed ticks were photographed (photos below) and from 23 July 2018 onwards, removed ticks were counted from photographs (table below).

Date	Number of ticks	Reduction
28-06-2018	-	-
12-07-2018	-	-
23-07-2018	868	-
05-08-2018	660	208
24-08-2018	361	299
17-09-2018	218	143
15-10-2018	76	142
16-11-2018	62	14
01-01-2019	18	44
26-03-2019	3	15

23-07-2018

05-08-2018

24-08-2018

17-09-2018

15-10-2018

Although ticks had initially not been counted, backward extrapolation of counts yields numbers in excess of 2,000 ticks for the first two treatment dates. Including these numbers, the estimated total amount of ticks removed from *C. signatus, H. areolatus, H. femoralis* and *P. oculifer* exceeded 4,000. Only a small number of ticks (total <50, and no adult ticks) were found in adjacent enclosures, and few ticks (<5) were

adults.

Ticks could easily be removed, sometimes with dozens at a time, with forceps. Nevertheless, it took about 30 minutes per tortoise to remove ticks, particularly for the initial sessions. Ticks on the neck were most difficult to remove. Eventually, tick removal was stressful for the tortoises.

Captive-bred tortoises had larger tick loads than wild-caught animals. Also, ticks were heterogeneously distributed over the tortoises' bodies. Most of the ticks were found on the soft tissue of the front limbs and neck, with fewer ticks on the hind limbs.

To avoid re-infestation after 26 March 2019, the substrate of all *C. signatus* enclosures was removed, and enclosures (including rocks) were cleaned and disinfected. Natural plants were discarded.

Discussion

It is not clear why, how and how fast this infestation of ticks could have taken place. All imported animals were checked and all animals are frequently observed during the year, mostly without handling. No imported plants were in the enclosures. It is also not clear why the captive-bred animals had far more ticks than the wild-caught animals. A possible answer could be that the thickness of the skin of the captive-bred animals is less than that of the wild-caught animals, but this is just an assumption.

A third point for discussion is why these ticks were mainly found on *C. signatus* and far less on the tortoises in the adjacent enclosures, which also inhabit South Africa and Namibia. In that respect, the article from Horak et al. (2006) is of interest. Their results showed that tortoises would appear to be the only host of *O. compactus*. All wild *C. signatus* (at that time *Homopus signatus signatus*) in the study (n=30) were infested.

Acknowledgements

I thank the South-African authorities for providing the necessary permits (collecting permit 053/2015 from Northern Cape Department of Environment and Nature Conservation, CITES exporting permit 148487 from Northern Cape Department of Environment and Nature conservation) to collect and export *C. signatus*. The Utrecht Centre for Tick-borne Diseases and the Department of Veterinary Tropical Diseases (F. Jongejan) and the University of Pretoria are thanked for identifying the ticks.

Reference

I.G. Horak, I.J. Mckay, B.T. Henen, Heloise Heyne, Margaretha D. Hofmeyr and A.L. De Villiers. 2006. Parasites of domestic and wild animals in South Africa. XLVII. Ticks of tortoises and other reptiles. Onderstepoort Journal of Veterinary Research, 73: 215-227.

Appendix 3

Interview

Tyler Schontag

3/9/20

Adult dwarf speckled tortoise (*Chersobius signatus*) basking. Photo credit: Arie van der Meijden

Big or small, we've gotta love 'em all!

I am sure you have heard of the giant tortoises, those seemingly mythical beasts that inhabit the islands of Aldabra and Fregate in the Seychelles, and most famously the Galápagos. However, I am willing to bet you haven't heard of their cousins on the other side of the spectrum: the dwarf tortoises of South Africa. So small they could fit in your hand! There are five species of dwarf tortoise, all of which live in South Africa. Unfortunately, we know very little about this species which makes it extremely hard to know if they are suffering or thriving. In the speckled dwarf tortoises (*Chersobius signatus*) case, the population was suffering. This is also true of many tortoise species worldwide, and a lack of data may mean it is already too late for some.

The Tortoise Guru

Before I dive deeper into the issue at hand, I want to first give you a little information about the man who has dedicated years of his life to studying these micro munchers. During (and even before) my short interview with Dr. Loehr, it became increasingly obvious that he has a strong connection and love for these tiny tortoises. In fact, his infatuation for them can be confirmed by the fact that he shares a Skype name

with the genus of tortoises he studies. Dr. Loehr has brought the idea of ‘taking your work home’ to a whole new level. In order to get a better understanding of the reproductive output of the speckled dwarf tortoise, Dr. Loehr has received permits that allow him to keep a few individuals at his home in The Netherlands. These tortoises are kept in a room with a computer-controlled environment that simulates their natural environment.

Dwarf tortoise enclosures inside Dr. Loehr’s home. Photo credit: Dr. Loehr

Unexpected decline?

As I mentioned earlier, there is so little information about this group of tortoises that it is nearly impossible to take measures to protect them. The life history of the tortoise may be one reason why there is a sufficient lack of data on the species. For 46 weeks out of the year, these tortoises hide themselves from the heat under rocks.

Creating a larger database for these species will allow future conservationists to make better decisions on how to manage them. So far, Dr. Loehr has concentrated his efforts on the two closely related species, the speckled and Karoo dwarf tortoises. The article by Dr. Loehr that I read was titled 'Unexpected decline in a population of speckled tortoises'. What began as a long-term population study to get a better idea of some of the population dynamics of this species (growth rate, diet, home range, etc) turned into a grim discovery. In order to collect data, Dr. Loehr and his team conducted two mark-recapture studies, one from 200-2004 and another from 2012-2015. A mark-recapture study is pretty straightforward and includes exactly what it sounds like. You capture a tortoise, mark it (with a radio collar in this instance) and then come back at a later date to see if you can locate the individual again. With a little bit of math, this data can give you an estimate to the population size. Over the course of the two mark-recapture studies, Dr. Loehr did not notice any immediate differences that would have threatened the tortoises or their habitat. Because of this, he expected that the population dynamics (sex ratio, age distribution, size distribution, etc) should have been in line with the dynamics he calculated in his first mark-recapture study. However, what Dr. Loehr and his team found, was that the population of speckled tortoises was in decline.

Why?

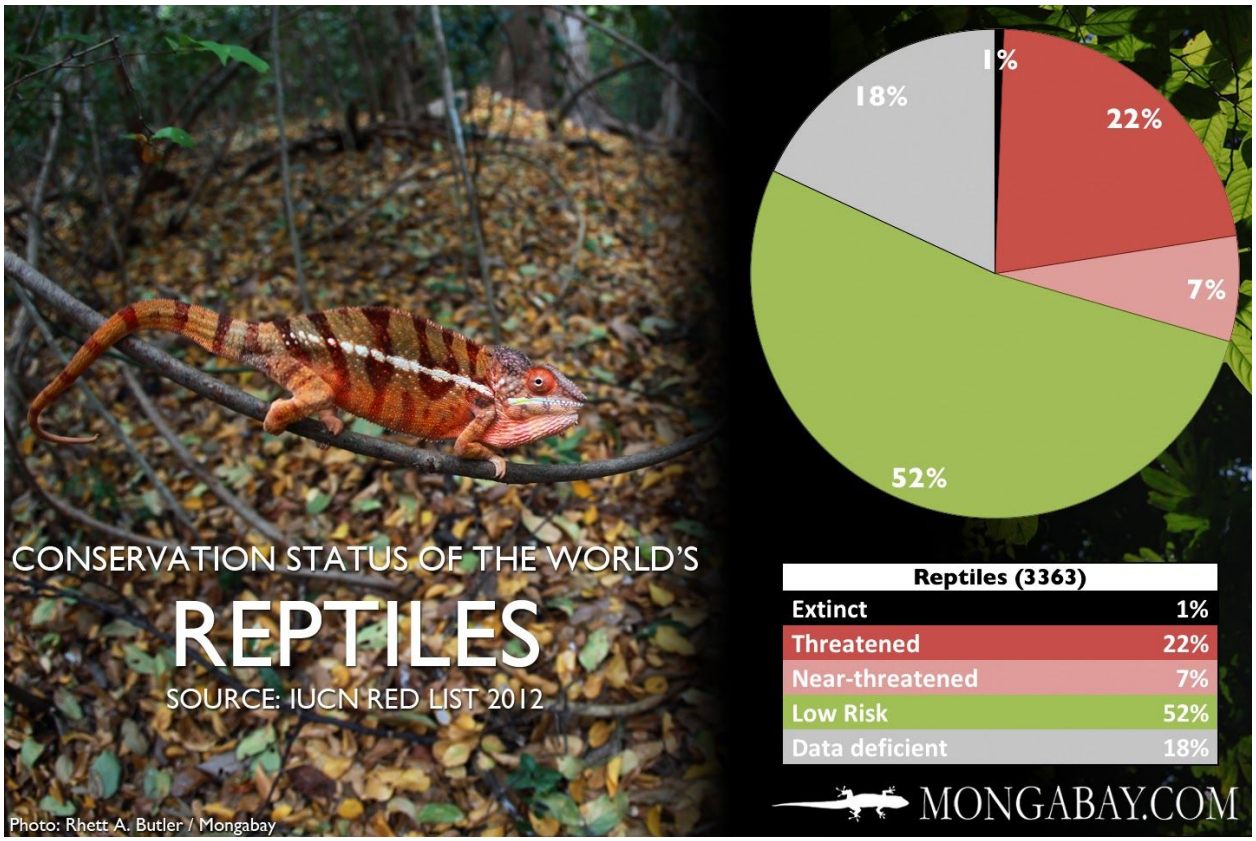
The reason this decline was so unexpected was because it was thought that the tortoise was fairly common and not listed as endangered or threatened by the IUCN. IUCN (the International Union for Conservation of Nature) is a global organization that assesses population trends and conservation concern for species worldwide. Dr. Loehr cites in the paper, that it is common for population declines to go unnoticed in long-lived species. Dr. Loehr believes that this is because prior to his research, there were no long term monitoring studies being conducted on the species and small annual declines were going unnoticed. The results of this study showed a distinct lack of entrants into the population (immigrants and hatchlings successfully being recruited into the

population), which Dr. Loehr concluded was the cause of the unexpected decline. The mechanism behind this is as of yet unknown, but Dr. Loehr predicts it may be due to increased predation on hatchlings from pied crows (*Corvus albus*). Another factor that contributes to population declines in many species (speckled dwarf tortoise included) is road mortality, which I will discuss later.

So what?

Dr. Loehr's work with dwarf tortoises is important in the larger context because it highlights the fact that many species of reptiles are data deficient. You can see in the graph below that 18% of reptile species are classified as data deficient. This means that conservationists lack enough information to make an effective decision regarding those species conservation. His paper also highlights the fact that tiny, obscure species are just as important to protect and acknowledge as larger, more well known ones. The function of an ecosystem depends on all parts being present, if you remove a species then that ecosystem will suffer. Additionally, the importance of long term monitoring studies on long-lived species (such as tortoises) is given light in Dr. Loehr's paper. Long-term monitoring studies give scientists a better understanding of the species life history and population dynamics. These components can allow conservationists to make a comprehensive decision on how to best protect that species. Let this paper serve as a testament as to why it is important to collect data on species who are data deficient. If Dr. Loehr hadn't decided to carry out this study, the speckled dwarf tortoise may have disappeared right from under our noses. Unfortunately, this could also be the case for many other species. During our interview, Dr. Loehr informed me that 70% of tortoise species are considered threatened or endangered, more than any other group of invertebrates on the planet. Although I knew that amphibians and reptiles were among the most threatened species globally, I had no idea that tortoises specifically

were so close to becoming the next dodo.



Pie chart created by IUCN showing percentage of reptile species in each of the seven categories. Credit: IUCN

Barriers to conservation

Imagine that you live in South Africa. Although most people see South Africa as a well-off African nation, it is devastated by poverty. More likely than not, you do not have enough money to afford a home, so you must build a shed out of materials that you find on the street or at the dump. More likely than not, you worry about how you will feed yourself that day. More likely than not, you are concerned with your own health and wellbeing and not anyone or anything else's. Now, imagine that you see a poster saying someone will be coming to talk about dwarf tortoises. You may have never heard of dwarf tortoises before even though they likely occupy the same space you do. Regardless, you go because the name intrigues you. During the talk you learn many interesting things about the tortoise. You begin to feel a sense of pride that your country

harbors the world's tiniest tortoises, rivaling the pride felt by Ecuadorians and Seychellois that they harbor the world's largest. At the end, the speaker tells you that these tortoises need your help in order to survive. You've fallen in love with these small testudines, how could you not fall in love with something whose shell is only 2-4 inches long? However, you have hardly enough money to feed your family. You live in a shed you built out of materials you found. How could you possibly spare any money to take care of a tortoise?

This predicament seems to be at the heart of conserving biodiversity in South Africa (and I imagine many impoverished nations). Even though the people and government may recognize and be in favor of conserving biodiversity, it goes against their instincts. Spending money on conserving a species when you can hardly sustain yourself would seem lucrative to anyone. South Africa is home to 25% of tortoise species found worldwide (many of which are found only in South Africa). The nation is also home to countless other species (over 900 species of birds [South Africa Venues] [1], 132 amphibian species [Mongabay] [2], 350 species of reptiles [southafrica.co.za] [3], 230 species of terrestrial mammals [South Africa Venues] [4], and 20,000 species of plants which represents 10% of all plants on earth [Fauna&Flora International] [5]). In order to curb the effects of a lack of funding for conserving biodiversity, Dr. Loehr believes there are some simple and cheap solutions for the dwarf tortoises.

Solutions

While scientists are working to curb data deficiency, it is important to combat human impacts on population declines for these species. Anything we can do to help decrease human impacts may help ensure the long term survival of this species, especially as natural threats are elucidated as more data is collected. One thing I didn't mention is that Dr. Loehr's work studying tortoises is not a full-time job. Dr. Loehr's more permanent job is serving as a consulting ecologist for the Dutch National Roads Agency. When the agency is considering building a new road or highway, they contact Dr. Loehr so that he can give his input on how to balance cost and travel efficiency with

conserving wildlife. With regards to the dwarf tortoises, Dr. Loehr believes the system for protecting them from road collisions is already in place. Since the soil of South Africa does not drain very well, there are many culverts that run under the road to prevent the roads from being washed away in heavy rains. With a little landscaping, Dr. Loehr believes the shoulder of the road could be cut sharply to prevent/deter the tortoises from ever having to cross over the road and risk being hit. Instead of crossing over the road, they would be forced to utilize the culverts to cross safely under the road.

Conclusion

Even though we typically give larger species more attention when it comes to conservation, it is also important we pay attention to the smaller, more obscure species. Knowing that there is little to no money that can be spent on conservation in developing countries (such as the case in South Africa) creative ideas must be thought of in order to prevent the loss of many species. We can help the scientists by coming up with creative ideas on or own and implementing them. Science provides the solution, all we need to do is enact it.

Speckled dwarf tortoise (*Chersobius signatus*) feeding. Photo credit: Dr. Loehr

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