

**Common padloper**  
*Homopus areolatus*



**Studbook Management Plan**

Version 2, July 2015

*Victor Loehr*

## VERSION HISTORY

<b>Version</b>	<b>Date</b>	<b>Changes</b>
1 (draft)	April 2015	-
2	July 2015	Comments from studbook participants implemented

This plan will be reviewed and updated once every five years. Progress will be reported annually, in the annual reports of the Homopus Research Foundation.

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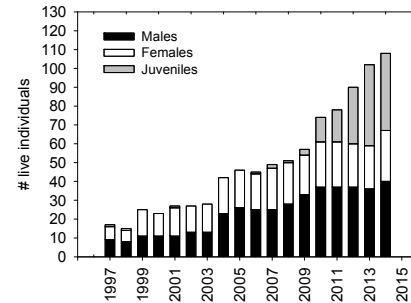
## 1. INTRODUCTION

In 1997, two wild-caught and four captive-bred *Homopus areolatus* were exported from South Africa to initiate a studbook. All six individuals were surplus at Tygerberg Zoopark in Kraaifontein. A second (eight wild-caught individuals) and third (four wild-caught individuals) export of surplus tortoises followed in 1999 and 2001, respectively. Since 2001, several *H. areolatus* that were already present in the Netherlands, Germany, Sweden en Namibia were added to the captive population.

Initially, husbandry success in the studbook was poor, in part due to the physical condition of the newly imported founder tortoises. However, since 2006 mortality rates decreased and breeding success increased, leading to a steadily increasing population size. The development of the captive population was reported annually in the [reports of the Homopus Research Foundation](#). The current population size makes it important to plan the long-term future of the studbook.

This studbook management plan is following up a discussion paper that was sent out to all studbook participants in 2013. Responses from participants on the discussion paper were summarised and distributed in 2014. The current plan is based on the discussion paper and summary, and a first draft (Version 1) that was reviewed by the studbook participants.

The following chapters clarify the long-term (i.e., 50 years) aims for the studbook, and the policies and methods that will be used to get there. The format is analogous to the [studbook management plan for \*Homopus signatus\*](#).



## 2. DISTRIBUTION

*Homopus areolatus* is endemic to South Africa, where it occurs in the Mediterranean southern coastal parts (Branch 2008). The taxon occurs in two provinces, the Eastern Cape and the Western Cape.

## 3. HABITAT

The habitat of *H. areolatus* is relatively moist and consists of heathland, thornveld, bushveld, fynbos and transitional habitats (Branch 2008; Boycott & Bourquin 2000). The tortoises prefer dense vegetation and use shrubs and grass tufts to retreat.

## 4. PROTECTED STATUS

In South Africa's range provinces, *H. areolatus* is protected fauna that may not be hunted, collected, or handled without permits from the provincial authorities. In both provinces, *H. areolatus* is a Protected Wild Animal as listed in Schedule 2 of the Nature and Environmental Conservation Ordinance No. 19 of 1974. In the Western Cape, this outdated Ordinance is currently being turned into the Western Cape Biodiversity Bill.

International trade of *H. areolatus* is regulated through the Convention on Trade in Endangered Species (CITES). The species is listed in Appendix II, because it is not necessarily threatened with extinction, but utilisation may be incompatible with its survival. An export permit or re-export certificate (only if the specimen was imported in accordance with the convention) issued by the Management Authority of the state of export or re-export is required. An export permit may be issued only if the specimen was legally obtained and if the export will not be detrimental to the survival of the species. Furthermore, live *H. areolatus* must be prepared and shipped in a way that minimises any risk of injury, damage to health or cruel treatment. Although CITES requires no import permit for species on Appendix II, it is a requirement in many national laws. Import permits in the European Union can only be issued after confirming the exporting country's non-detriment finding.

## 5. CONSERVATION STATUS

*Homopus areolatus* is not listed in the IUCN Red List of Threatened Species. However, its assessment is currently in preparation (Turtle Taxonomy Working Group [van Dijk, P.P., Iverson, J.B., Rhodin, A.G.J., Shaffer, H.B. and Bour, R.] 2014). The proposed status for *H. areolatus* is Least Concern, indicating that it is not currently threatened in the wild.

## 6. STATUS IN CAPTIVITY

The global [International Species Information System](#) (ISIS) lists 4.3.3 (= number of males.females.juveniles) *H. areolatus* at three public ISIS Species Holdings. Two institutions are located in the USA and one in Germany. One institution in the USA and the one in Germany participate in this studbook. Based on the studbook registration, the ISIS information appears outdated and should read 3.3.2.

The studbook totals 25.24.40 live individuals (1.1.1 at the Behler Chelonian Conservation Center in the USA, 2.1.0 housed at Wuppertal Zoo in Germany, the remaining 22.22.39 at private facilities). Most studbook locations are in Europe, except the Behler Chelonian Conservation Center in the USA and a private facility in Namibia.

Besides the animals listed here, several *H. areolatus* are present in private facilities in Europe and elsewhere. It is likely that these facilities produce (some) offspring. South Africa irregularly exports *H. areolatus* for commercial purposes. In the [CITES trade database](#), 35 individuals (all wild-caught) originating from South Africa were reported by importing countries between 2010-2014. It is questionable if these individuals should be regarded legal, because regulations in the range provinces (Western Cape and Eastern Cape) do not allow any tortoise to be captured in the wild for commercial purposes (E.H.W. Baard, CapeNature, pers. comm.).

*Homopus areolatus* can successfully reproduce in captivity. Reproduction has succeeded at many locations (see annual reports of the Homopus Research Foundation, and Barzyk 1994; Broschell 2000; Fleck & Fleck 2001; Gorseman 1980). Breeding has occurred into the second and third generation (Appendix 1). A husbandry protocol and publications are available at the [website of the Homopus Research Foundation](#). In the studbook, mortality does not appear to be excessive, with steady growth of the population as a result.

## 7. STUDBOOK COORDINATION AND CONTINUITY

To guarantee the continuity of the studbook, it is coordinated by two persons. Supervision of the [European Studbook Foundation](#) (ESF), a well-established private studbook organisation, gives access to a reservoir of experienced studbook coordinators. This studbook management plan will play an important role in the supervision by the ESF.

Currently, the studbook is coordinated by the following two persons:

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Mr. Martijn Kooijman (operational studbook management)  
The Hague, Netherlands  
E-mail [studbookhomopus@gmail.com](mailto:studbookhomopus@gmail.com)

## 8. PARTNERS AND STAKEHOLDERS

The studbook is a collaborative effort of the Homopus Research Foundation and the European Studbook Foundation. Public facilities may participate in the studbook. Eleven private facilities in Belgium, Germany, Namibia, Netherlands, Sweden, and Switzerland harbour the majority of the tortoises. Any

facility in Europe, Africa, USA, or elsewhere interested in participation in the studbook is considered a potential partner.

Although there is no relationship between the studbook and the wild *H. areolatus* population in terms of conservation, [CapeNature](#) (South Africa) is an important stakeholder for the studbook because it is responsible for conservation in most of the taxon's range. In addition, the Namibian [Ministry of Environment and Tourism](#) is considered a stakeholder because the ministry requires *H. areolatus* kept and bred in Namibia be registered in the studbook.

A final stakeholder is the [Chelonian Biodiversity and Conservation Programme](#) of the University of the Western Cape in South Africa. The studbook generates data on *H. areolatus* that might complement field studies conducted by the programme.

Due to the very small scale of the commercial trade in *H. areolatus* and the uncertainties regarding its legality (see Chapter 6), commercial reptile dealers are not considered stakeholders.

## 9. SUITABILITY OF FACILITIES PARTICIPATING

Most of the current participants in the studbook are tortoise husbandry experts, with long-term breeding experience. Many of them also have field experience. *Homopus areolatus* is a small tortoise species and does not require large enclosures. Their climate is easily imitated in indoor enclosures, and some keepers experiment with outdoor keeping during summer. *Homopus areolatus* requires a herbivorous diet that is easily catered for. A husbandry protocol is available at the website of the Homopus Research Foundation.

Of particular concern is the husbandry of founders that were recently caught in the wild. Poor husbandry results in the past indicate that such individuals should be housed at expert tortoise keepers, or at keepers with extensive experience keeping captive-bred *H. areolatus*.

## 10. ULTIMATE GOAL FOR THE CAPTIVE POPULATION

The goal for the captive population is the resultant of the following:

- *Homopus areolatus* is not threatened in the wild, so there is no need for an assurance colony.
- Available founders in the studbook originate from unknown and mixed locations, not suitable for the development of an assurance colony.
- *Homopus areolatus* is scarce in captivity and may disappear when the captive population is not properly managed.
- Imports of *H. areolatus* are virtually absent as a result of South African legislation.

Consequently, the studbook population should develop into a population that may persist without the need to (frequently) introduce additional wild-caught founders. Population management should minimise inbreeding to avoid genetic disorders such as morphological, growth and reproductive issues. Any *H. areolatus* available in captivity should be recruited, especially unrelated bloodlines. When captive *H. areolatus* will be irregularly added, the time-span to develop a captive population that does not need additional founders is estimated at approximately 25-50 years.

## 11. GENETIC AND DEMOGRAPHIC GOALS

### 11.1. Population size

A large population size can better conserve genetic variation over many generations than can small population sizes. However, with an increasing population size come, statistically, tortoises lost to follow-up and unresponsive participants. Missing tortoises and participants complicate the management of the studbook and increase administrative efforts. The studbook will seek balance and aims at an ultimate population size of approximately 400 live individuals (currently 89).

## 11.2. Number of founders and generation time

Given the goal for the captive population, the number of founders and generation time should be carefully chosen to facilitate the conservation of genetic variation within the maximum manageable population size. In general, founder couples should produce equal numbers of F1 offspring to fill the maximum population size, followed by a long generation time to avoid genetic loss from one generation to the next, and replacement breeding for subsequent generations.

In this studbook, starting with 50 founders would translate to the preservation of 99.99% of the genetic variation into the first generation (i.e., 25 couples times 14 offspring makes 350 individuals, plus 50 founders is 400 individuals). Fifty founders is at the lower end of the minimum number of founders recommended for tortoise studbooks (50-100 founders, E. Gubbels and G. Hofstra, pers. comm.), but appears realistic for a species that is scarce in captivity.

It is unlikely that all founders will be recruited for the studbook in a short period of time (i.e., Chapter 10 provides an estimate of 25-50 years). Therefore, the studbook will take care not to fill the maximum population size with offspring of founders that are already available. Based on the low mortality among captive-bred *H. areolatus*, the studbook will aim for approximately 20 offspring per founder couple, while deaths might be replaced by the production of additional offspring as long as founders are alive.

To avoid genetic loss into next generations, subsequent reproduction should be delayed. Considering growth rates and mortality in the studbook, reproduction should take place when captive-bred animals are at least 10 years old.

## 12. SEX RATIO

Male and female *H. areolatus* can be kept in couples year-round, so the studbook aims to form a population with equal numbers of males and females. The actual studbook population (including founders) is relatively balanced.

## 13. SOURCES FOR SPECIMENS INCLUDED IN THIS PLAN

The current studbook contains 12 founders (one deceased) and two potential founders. All but two founders are privately-owned. Additional founders will be sourced from keepers of *H. areolatus* outside the studbook. In addition, governments might like to place confiscated *H. areolatus* in the studbook, ensuring traceability of the tortoises and their offspring. Moreover, the studbook is able to guarantee that confiscated individuals will not be used for commercial purposes, a situation that already exists for 10 live *H. areolatus* formally owned by the Homopus Research Foundation. The studbook has no intentions to collect *H. areolatus* in the wild.

It must be noted that eight of the 14 (potential) founders in the studbook have produced little or no offspring into F1 (see Appendix 1). This indicates that a first priority for the studbook, along with recruiting new founders, is improving reproductive success of existing founders.

## 14. GENETIC ISSUES THAT NEED TO BE RESOLVED

Studbook numbers 5 and 4 are assumed to be genetically unrelated, but there is no certainty (see Appendix 1). Since the entire existing F1 and F2 stock would be inbred if tortoises 5 and 4 would be genetically related, the relationship between these two tortoises should be tested ( $H_0$ : 5 and 4 are not related;  $H_1$ : 5 and 4 are siblings).

The taxonomy of some wild *H. areolatus* populations is not clear (i.e., isolated populations may represent independent entities). Because the founders in the studbook originate from unknown localities, it is possible that the studbook hybridises different taxa. The issue of potential hybridisation is acknowledged and accepted, because:

- the risk of hybridisation is probably small, because it is more likely that founders originate from large populations than from isolated, small populations;
- the studbook does not have a conservation goal.

## **15. MANAGING THE STUDBOOK**

### **15.1. Dispersal of offspring**

Most *H. areolatus* in the studbook are privately owned. Therefore, the decision where offspring goes and the conditions for the transfer are often up to the studbook participants. For the successful realisation of the studbook management plan, it is important that offspring remains in the studbook (but see Section 15.2) and is transferred to participants that avoid inbreeding into the next generation. The studbook coordinator will advise participants where to transfer offspring to.

### **15.2. Surplus**

Studbook participants who privately own *H. areolatus* may breed offspring beyond the recommended number of 20 offspring per founder couple that is required for the studbook (see Section 11.2). This surplus will not be registered in the studbook.

### **15.3. Individual identification**

It is the responsibility of each studbook participant to individually recognise each tortoise. The shape and colour pattern of the carapace may help identify individual *H. areolatus*, but it is recommended to use nail polish, permanent marker, PIT tags, coloured marks for queen bees, or other tools to avoid confusion.

## **16. REQUIREMENTS TO SUCCEED IN ESTABLISHING A LONG-TERM CAPTIVE COLONY**

The most important and challenging requirement for the studbook management plan is the availability of privately-owned *H. areolatus* for the studbook. Participation in the studbook is voluntary but comes with responsibilities and restrictions. For example, the plan cannot succeed if participants would consistently place private interests over the interests of the studbook. What the studbook offers in return is a means to ensure that *H. areolatus* will remain available in captive collections in the long-term future. The current, unmanaged keeping of *H. areolatus* is not sustainable; eventually the captive population is likely to crash as a result of inbreeding and genetic drift. The studbook is a tool for keepers to join efforts and genetically manage the scarce captive *H. areolatus*.

Further requirements for success are:

- the presence of 36 additional unrelated founders in captivity over the next 25-50 years;
- successor studbook coordinators in the next decades.

## **17. ACKNOWLEDGEMENTS**

The Turtle Survival Alliance is thanked for making available the format for its Taxon Management Plans. All studbook participants are thanked for their valuable comments on the discussion paper preceding this studbook management plan.

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## APPENDIX 1: LIVE *HOMOPUS AREOLATUS* BLOODLINES AND INBREEDING IN THE STUDBOOK ON 1 JULY 2015, EXCLUDING INDIVIDUALS LOST TO FOLLOW-UP

All numbers are studbook numbers.

**Live *Homopus areolatus* bloodlines and inbreeding in the studbook on 1 July 2015 (excluding individuals lost to follow-up)**

- Tortoises 5 and 4 are offspring from the same group of founders, but treated as unrelated individuals because of the large group size and possibly WLD's sire parentage (i.e., the group consisted of wild tortoises in a zoo brought in by the public)  
 - Black cells indicate bloodlines that cannot produce additional offspring because they died (+) or are housed solitary

Reproduction into F1							Reproduction into F2			Reproduction into F3			
Bloodline:	A	B	C	D	E	F	G	Bloodlines:	WLD x D	A x D	A x D	Bloodlines:	A x (WLD x D)
Founders:	15 x 17	22 x 24	10 x 11	5 x 4	40	23	58 x (59+60)	F1:	47 x 37+	94 x 62	34 x 25	F2:	55 x 169
Offspring:	34	46 (+2)	160	25			79	Offspring:	30	130	53		157
	35		161	37+			81		107	131			
	39			62			82		108	132			
	48						84		109	133			
	49						85		110	149			
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**Conclusions:**

- The population is currently free of inbreeding
- The genetic variation in the founder population is not fully exploited, because two founders are housed solitary

**For maximum delay of inbreeding:**

- Continue to combine F1 produced by bloodlines A and D; do not combine F1 from these bloodlines with other bloodlines
- Combine F1 produced by bloodlines B and G
- Combine founders 40 and 23
- Improve breeding success of bloodline D