

On the first recorded observations of egg-laying in *Dipsochelys arnoldi*

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The rediscovery of Seychelles giant tortoises in 1997 (Gerlach 1998; Gerlach & Canning 1998) led to the establishment of a captive breeding programme for both surviving Seychelles species *Dipsochelys hololissa* (Günther, 1877) and *D. arnoldi* Bour, 1982 (Gerlach 1998). This was established in July 1997 using animals purchased from a variety of captive locations in Seychelles. Of the two species *D. arnoldi* was initially represented by a single pair, two further males and a female being added subsequently. The first apparently successful matings were observed in 1999 and on 8th July 1999 eggs were laid by 'Clio', the original female *D. arnoldi*. Although it is presumed that all the living *D. arnoldi* were captive bred the notes made on the 8th July are the first recorded observations of egg-laying in captive *D. arnoldi* and may be the first reproduction in this species for some 75 years. As this is a significant event and there is no literature describing breeding in *D. arnoldi* careful notes were made and these are summarised below.

Mating

Although mating had been observed since 7th August 1997 no successful matings were observed until 1999. The female appeared to be un-cooperative, either sitting down when mounted or walking away. The male also seemed to be inexperienced and rarely positioned himself appropriately. On the few occasions where the male pursued the female and succeeded in mounting her she showed a greater degree of cooperation, stopping moving and raising the rear of her shell. This suggests that the female was using some degree of mate-choice by requiring a pursuit before being cooperative.

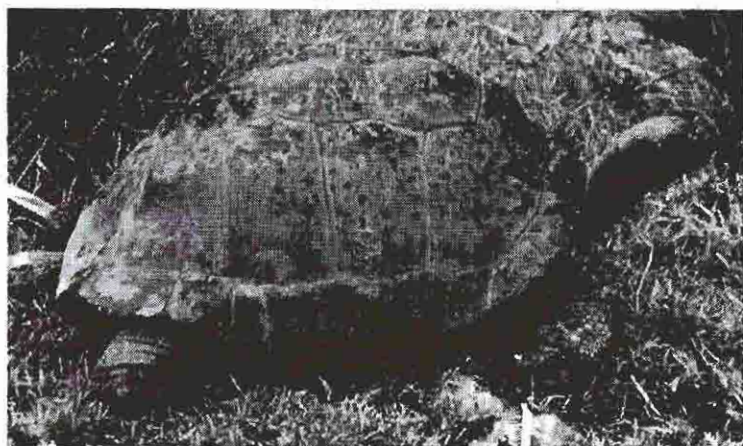


Fig. 1. 'Clio' - adult female *Dipsochelys arnoldi*

In July 1998 the female started showing signs of restlessness, pacing the enclosure, climbing and trying to climb out of the enclosure. The male (and two smaller males that were added in September 1997) was moved to a different enclosure in the hope that these behaviours were a prelude to nesting. By the end of the year no eggs had been laid and she returned to the males.

Mating was recorded from 11th January 1999. Behaviour patterns in the female did not differ appreciably from the previous year (cooperative matings represented 16% of attempts compared with 27% in the same time period of the previous year). Of the 7 cooperative mating attempts 2 (29%) appeared to be successful. Successful mating was observed on 16th January, at 15:00-15:15. The first abnormal behaviour was noted on 28th January when she was found attempting to mate with another female. The second possibly successful mating occurred on the 1st May, given the abnormal behaviour noted above prior to 1st May it is probable that fertilization occurred as a result of the 16th January mating.

Pre-nesting behaviour

The female's behaviour appeared to be normal (activity mainly restricted to feeding) until 28th January when she was recorded mounting the other female. This was also observed on 28th February, 15th June and 20th June, the dates suggesting an increasing frequency of this behaviour although other incidents may have been overlooked. On 28th April she was observed sitting on raised ground, this was followed by increasing restlessness from 18th June. Restlessness manifested itself as extended periods of perimeter walking, climbing onto raised ground and attempting to climb over the fence. This was constant from the 21st June.

An increase in appetite was apparent in early June, from 22nd June feeding was rarely observed. On 25th June she was removed to a separate and empty enclosure. Following this isolation 2 days were spent resting in the wallow and then pacing and climbing behaviour was resumed on 29th June and continued (with the exception of 30th June when behaviour was apparently normal).

The first nesting attempt occurred on 31st July when she was observed tearing up grass with her front legs. This was observed at 17:25 but ceased shortly afterwards. From the 4th-8th July she made regular visits to the abandoned hole and other sandy scrapes, including crab holes. In all cases she would stop and sit next to, or in the scrape, sniffing the ground carefully and watching movements in surrounding areas.

During the nights of 5th-6th July she slept in the water, on the 7th July she slept on land but was notably restless and turned around frequently.

Behaviour on the 8th July included perimeter walking in the morning, at 7:00 she was observed tearing the grass with her front legs. She investigated the scrape thus created but left it shortly afterwards. She slept from late morning through the afternoon, waking in the late afternoon to walk around. At 17:15 she returned to the scrape and nesting started from 17:23.

Nesting behaviour

Time	
17:15	investigating scrape created in morning
17:23	tearing grass with front legs, expanding open circle from 30cm to 60cm diameter
17:38	move forward over hole, sniff ground then lift shell and dig with right hind leg
17:39	continue digging with leg in hole, scraping forwards and back, then alternate leg
17:40	urinate in hole
18:02	urinate
18:19	back of shell sunk 4cm into hole
18:41	shell sunk into hole 10cm
20:00	25cm deep, left side sloping, right steep
20:50	30cm deep, straight sided
20:58	starting to dig bell pit, scraping forwards towards head, tail also pointing forwards
21:00	small quantity of urine
21:07	32cm deep, 21cm wide, bell 10cm deep, 6 wide
21:28	urinated
21:25	spoil falling into hole
21:37	35cm deep
21:52	urinate
22:14	small quantity of mucus leaking out of cloaca
22:19	40cm deep
22:27	mucus
23:09	pressing down spoil in hole but still scraping as well
23:12	having difficulty reaching spoil
23:14	stop, sank down, tail down
23:15	mucus string
23:16	1 st egg, cloaca at edge of hole, egg crushed between tail and ground
23:17	movement of right hind foot to cover hole, spoil knocked in
23:18	3 eggs together, preceded by mucus
23:18	movement of right hind foot to cover hole, more spoil knocked in
23:21	1 egg, preceded by mucus
23:23	2 eggs, preceded by mucus, not simultaneous but close
23:38	3 eggs, preceded by mucus, not simultaneous but close
23:40-53	breathing heavily, shell visibly moving 4mm due to breathing movement
23:54	1 egg preceded by few drops of blood, oval egg
23:55	1 egg with small quantity of blood in mucus, oval egg
23:56	fill hole, pushing spoil back in by use of lower leg (from knee), spread over egg chamber with claws, gentle side-to-side sweeping, alternating legs
24:35	hole 2/3 filled
24:36-07:00	[not observed]
07:00	still trampling area, tearing grass at edges
07:30	left nest site

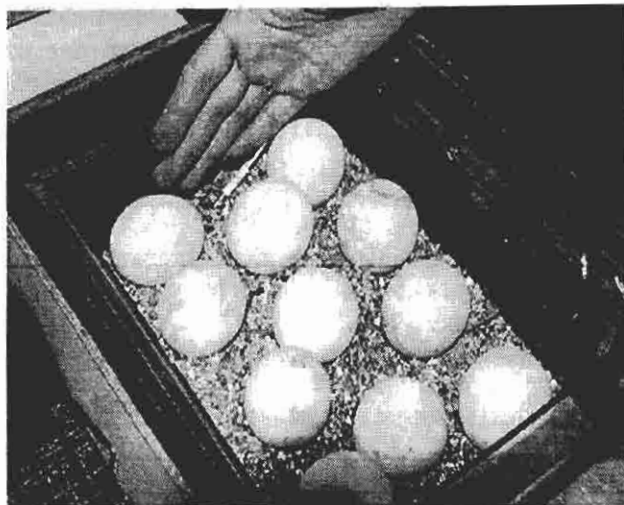


Fig. 2. The clutch of *Dipsochelys arnoldi* eggs (Photo: R. Gerlach).

Throughout the nesting digging continued at the same rate and without pause. Each leg was used for a mean of 37.8 ± 2.07 seconds ($N=42$). Timing of digging activity at 17:39, 18:02 and 22:06 suggested an increasing digging rate (42.1 ± 4.06 , 37.9 ± 3.25 and 32.8 ± 3.32 seconds respectively) but these differences are not significant (paired sample *t*-tests $t > 1.78$, $P > 0.05$ for all comparisons). The use of the alternate leg action resulted in the fresh spoil extracted from the hole being compacted next to the hole by the resting leg. This reduced the amount of spoil falling back into the hole. Each scoop of the right foot (lacking 3 claws) was estimated to be removing approximately 10cm^3 of soil, the left foot (lacking 4 claws) removed less than 5cm^3 .

Egg data are summarised in Table 1.

Table 1. Egg weights and measurements

(<i>n</i> =11)	Mean	SE
Weight (g)	80.91	2.11
Shortest dimension (mm)	48.66	0.27
Longest dimension (mm)	50.38	0.68

Table 2. Nest temperature variation

Location	Min. (°C)	Max. (°C)
surface	25	40
10cm	25	30
20cm	27	29
30cm	29	29
40cm	29	29

Nest site characteristics

The nest was positioned in the middle of an open area of *Stenotaphrum dimidiatum* grass growing on coral sand in full sun for 8:05 hours (08:10-16:15), temperature variation is given in Table 2. Nest site temperatures taken on 4th August were found to be a constant 28 °C at 30cm below the surface. The nest chamber was positioned at 30-40cm below the surface.

Behaviour following laying

In the days following nesting, activity was much reduced. On 9th-10th July she fed from 06:30-08:00 and then slept for the rest of the day. On 11th July perimeter walking was resumed after feeding, occupying the hour between 08:00-09:00. The duration of perimeter walking increased each day and included a resumption of climbing and ground sniffing from 12th July. Feeding throughout this time was limited to the early hours when small quantities were consumed, occasional bouts of grazing lasting 1-2 minutes were noted at other times. On 15th July activity lasted until 11:30am.

Egg incubation

The eggs were incubated in the range of 29-32°C. At the time of writing incubation continues and it is hoped that hatching may start in October 1999, this will be reported on in due course.

References

- Gerlach, J. 1998 - *Int. Zoo News* 45; 4-10
Gerlach, J. & Canning, L. - *Chelonian Conserv. & Biol.* 3; 3-19