New evidence for the emergence of a human–pet relation in early Roman Berenike (1st–2nd century AD)

Marta Osypińska[1] and Piotr Osypiński[2]
[1, 2] Institute of Archaeology and Ethnology, Polish Academy of Sciences (Poznań)

Abstract: Animals were as inextricable a part of the system of common ancient Egyptian beliefs as they were indicative of it. Their special role was manifested in a rich iconography and in multitudes of animal mummies deposited in the major religious complexes. Seen in this light, the cemetery of small animals of 1st–2nd century AD date, excavated since 2011 in the Red Sea port town of Berenike, comes across as entirely unique, notwithstanding the spiritual aspects of cats, dogs and monkeys. Contrary to Egyptian animal burials of all periods associated with human ones, the Berenike inhumations were not intended as afterlife companions of their last owners; neither were they ever mummified. Recent results of research present the variety of species kept in the households and provide insight into their behaviour. Pathological changes on one of the dog skeletons suggest a mortal condition, that is, osteosarcoma. The Berenike data also shed new light on the distribution of the cat beyond Egypt and a rising preference for keeping the animal as a pet in Europe and the Middle East.

Keywords: Roman Egypt, animal/pet cemetery, ancient cats/dogs/pets, animals in ancient Egypt

In Egypt, burials of animals described as pets are a well recognized phenomenon from predynastic times through the Roman period (Hornung 1967; Boessneck 1988; Feder 2003; Flores 2003; Kessler 1986; Ikram 2003; 2005; Linseele and Van Neer 2009; Yamaguchi et al. 2004). It is observed across animal species and funerary practices, with mummification being the most significant form (Visser 1938).

For the people of ancient Greece and later of ancient Rome, the significance of animals for Egyptian beliefs was one of the most characteristic features (see Herod. 2.65–67 as one example). Indeed, millions of animal mummies are known from special depositories beside temples and necropoles, with the greatest ones located in Tuna el-Gebel and Saqqara (Armitage and Clutton-Brock 1981; Ikram 2003; 2005). Animal mummies of specific species were deposited in Bubastis (cats), Elephantine (rams), Kom Ombo and Fayum (crocodiles), and Abydos (falcons). Typically, however, animals were viewed only as a manifestation of some of the

gods' domains or features (Feder 2003; Ikram 2007). Cats were, to some extent, an exception (particularly during the Ptolemaic and Roman periods) with so many meanings and taboos surrounding them that foreign authors described Egyptians as worshipping cats (Diod. 1.83 after Malek 1993).

Animal mummies recorded at Egyptian sites can be divided into four main categories: a) animals accompanying their last masters in the afterlife; b) animals deposited as food stock; c) mummies of sacred specimens; and d) votive mummies (Charron 2002; Ikram 2005; Kessler and Abd el Halim Nur el-Din 2005; Aglan 2013). The last category in the Ptolemaic period demonstrates true masterpieces of decorative wrapping. However, the term 'mummification' is also used to describe the natural drying of corpses without intentional processing (embalming, wrapping etc.). Thus, some of the published animal mummies could well have been burials without intentional body processing. In most cases of spontaneous mummification, an evident connection with human inhumations exists (Ikram 2005) and, significantly, only for dogs.

BERENIKE

Berenike or Berenike Trogodytica (Greek: Βερενίκη), was a port-town on the Red Sea. It was established as a military post protecting the landing of African elephants being carried by sea for Ptolemy II (285–246 BC), who named the place after his mother, Berenike (Sidebotham, Hense, and Nouwens 2008: 159–165; Sidebotham 2011). In the early Roman period (1st–3rd century AD), the area of the deserted Ptolemaic fort appealed again as one of the most important transshipping sites joining Upper Egypt, the Arabian Peninsula and the Indian Ocean. The latest phase of Berenike history as a local town of lesser importance dates to the 5th–6th centuries AD. Remains still visible beside the sea were recorded first by Giovanni Battista Belzoni in 1818. Systematic archaeological excavations were initiated in 1994 by Steven E. Sidebotham (University of Delaware) and have continued, except for a few years' break, until the present day. Currently, the Polish Centre of Mediterranean Archaeology, University of Warsaw, is a partner in these excavations (Sidebotham and Zych 2010; most recently, 2016).

EVIDENCE

Nearly 100 complete animal skeletons have been discovered so far in a relatively small area of about 100 m², located to the west of the so-called Great Temple [***Fig. 1***; ***Tables 1–3***]. This report describes the finds excavated during seasons 2011–2015 (see also Osypińska 2017).

Based on stratigraphic relations and the identification of numerous datable materials (pottery, coins, ostraca), we can assume with certainty that the area was used as a burial ground between the last quarter of the 1st and the first half of the 2nd century AD. This was a time of the greatest economic prosperity for Berenike, the harbor being a key link in the Roman Imperial trade via the Nile Valley to the Red Sea and beyond, to the Indian Ocean (Sidebotham 2011).

Most of the data on animal burials came from excavation trenches BE11-76, BE12-80 and BE15-107. A much

wider zone surrounding this area, known as the "Early Roman trash dump" has been explored since the beginning of archaeological fieldwork in Berenike, producing a plethora of priceless finds that have included new textual sources (ostraka, papyri). At the beginning of Berenike's history, however, this place was an empty sandy quarter, covering the ruins of poor Ptolemaic structures, between the town and the much earlier Ptolemaic fort set to the southwest. Within this roughly flat area covered with wind-blown sand, the first intentional burials of small animals were made during the last decades of the 1st century AD. Bodies were buried in well prepared pits and protected with textiles, mats and large sherds of chrono-distinctive amphorae [*Fig. 2*].

The turn of the 1st and 2nd centuries saw this area organised, with a stone structure (wall?) built around a sand dune summit from the north and east (as far as the current state of research indicates), with elevated ground all around the outside of this wall paved with yellow clay [*Fig. 3*]. Both features sealed animal burials of an earlier age. But some of the later burials cut into this clay pavement suggested a continuity of funerary activities.

The investigation has led us to assume that inhumations were made by preference in the nearest vicinity of this stone structure [*Fig. 4*]. The illusory gap between burials from these loci and the next cluster in the northern part of trench BE15-107 could be explained by large intrusive pits of younger origin (the deepest part of which is marked as locus *029* in *Fig. 3*).

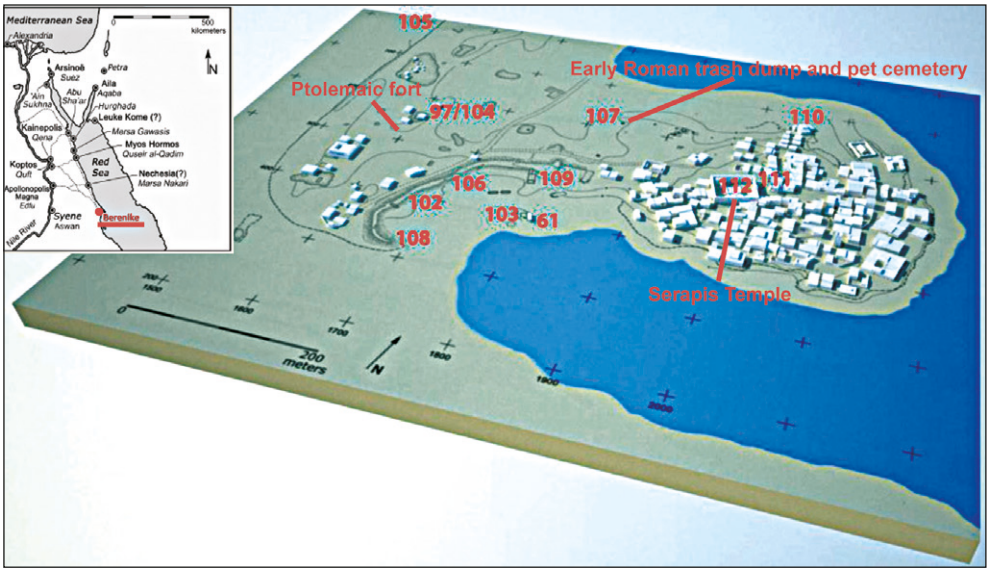

Fig. 1. Location of the animal cemetery within the early Roman port town of Berenike; inset, location of the harbor (Courtesy of PCMA–University of Delaware Berenike Project/M. Hense, 2016)

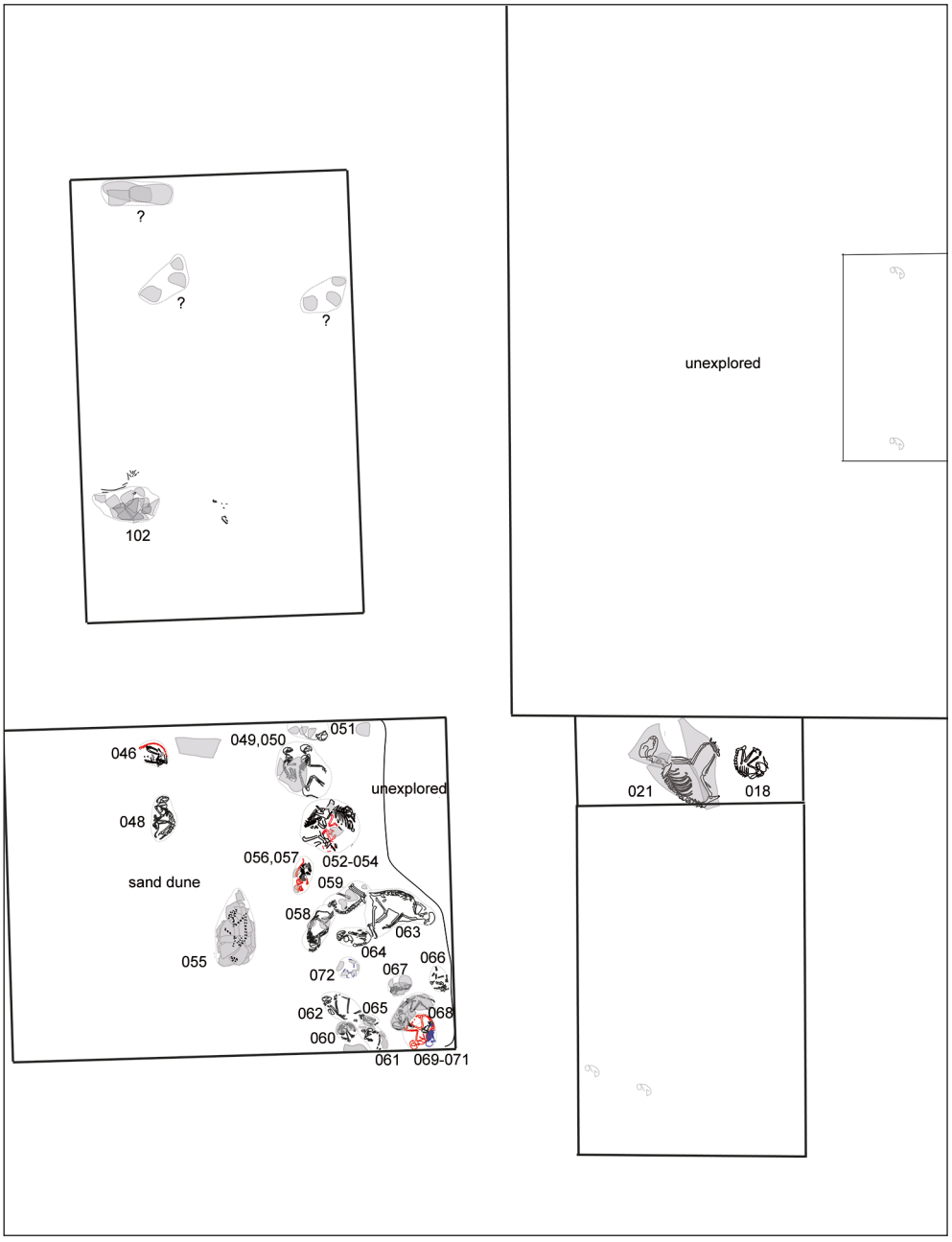

Fig. 2. Animal cemetery in Berenike: earliest phase from the second half of the 1st century AD (Courtesy of PCMA–University of Delaware Berenike Project/P. Osypiński)

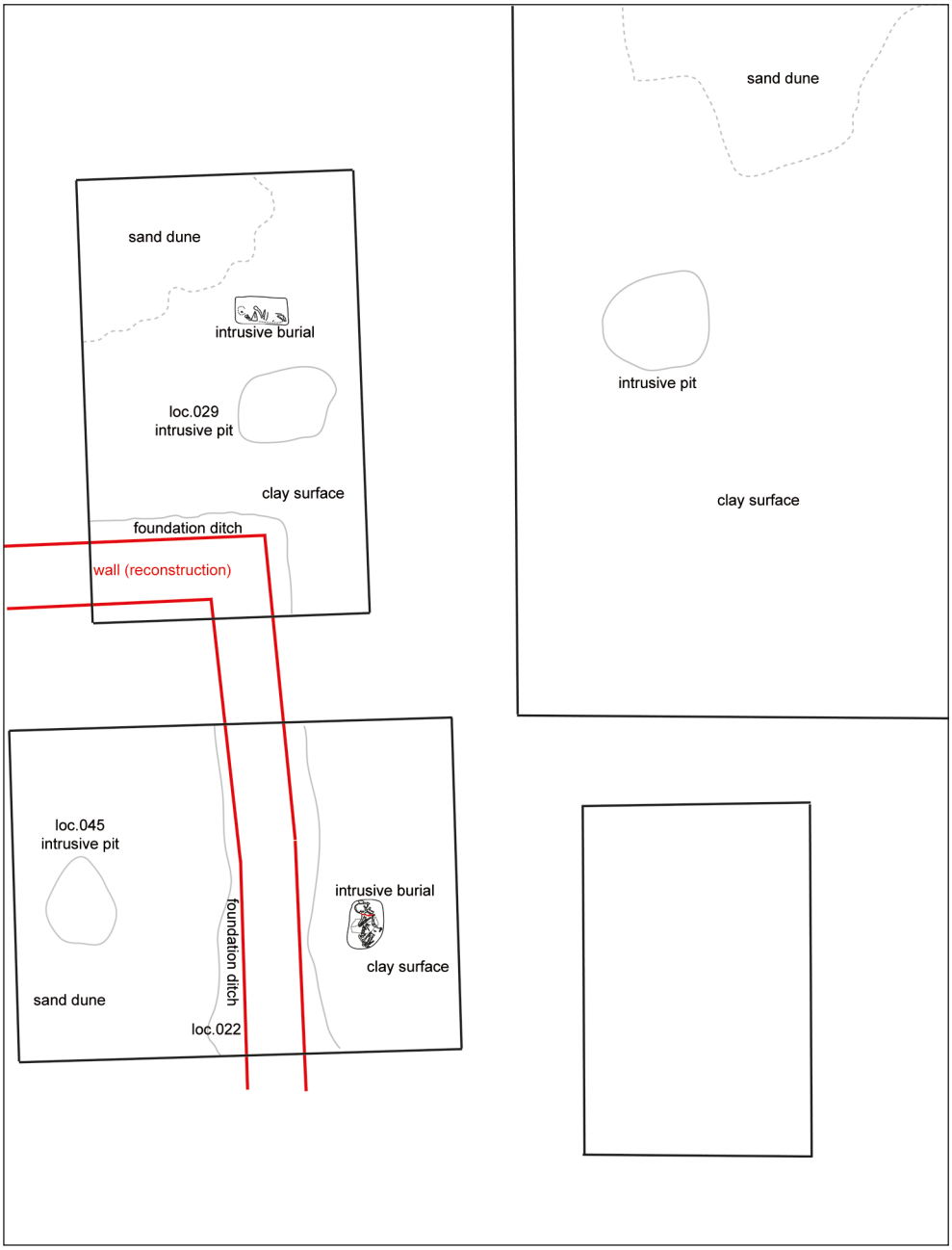

Fig. 3. Animal cemetery in Berenike: phase dated to the turn of the 1st century AD (Courtesy of PCMA–University of Delaware Berenike Project/P. Osypiński)

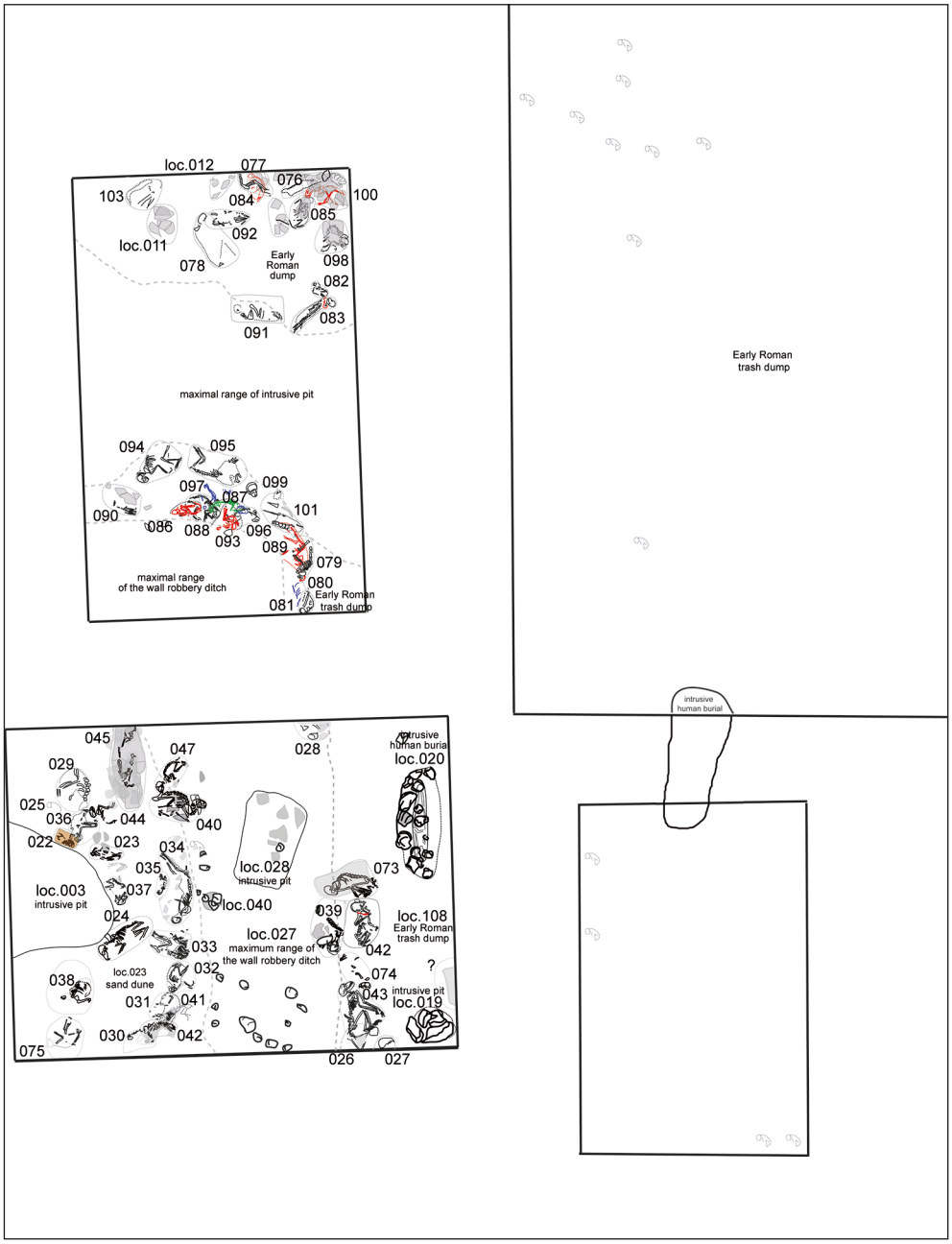

Fig. 4. Animal cemetery in Berenike: phase from the 2nd century AD (Courtesy of PCMA–University of Delaware Berenike Project/P. Osypiński)

The latest animal burials dug in the trash dumped in the area can still be dated to the 2nd century AD. Layers from the 3rd century AD (and younger) were free of complete animal inhumations apart from single bones of burials disturbed during digging (focusing mostly on extraction of stone blocks). Another episode of sepulchral utilisation of the area took place probably in the 5th century AD, but it appears to have concerned only human inhumations (a two-year old child in trench BE12-80 and an adult male between trenches BE11-76 and BE01-48). In the authorsй opinion, the two "cemeteries" reflected completely different funeral rites and were separated by at least two hundred years, a time of crucial cultural change in Berenike's history.

Preservation of animal burials was driven by the chemical processes taking place in the sediments in which they were deposited. Even in the small space excavated so far, the differences were clearly noticeable. In general, burials dug deeper in a sandy sediment of relatively constant humidity were better preserved. But burials deposited within later layers, that is, mainly trash dumps full of organic waste and pottery fragments, suffered much harsher conditions: daily temperature fluctuation, humidity and salt crystallisation. Large amounts of bones from these last contexts bore traces of maceration, fragmentation or even the beginnings of dissolution. Archaeozoological identification of such remains was possible exclusively *in situ*.

All explored burials reflected funeral practices: intentional and careful placing of animal bodies in sleeping position, protected with large fragments of pottery, textiles, mats or even wooden beams. There was no evidence of the animals being killed as was the case with the Nile Valley animal mummies (Armitage and Clutton-Brock 1981; Ikram 2003; 2005). Partly preserved skeletons in all the noted cases reflected post-depositional damages.

METHODS

Animal remains were analysed using conventional archaeozoological methods applied to funerary contexts. These involved species identification, anatomical analysis, ascertaining age (Smith 1969; Salles 1992; Amorosi 1989) and sex (Kratochvil 1976; Ruscillo 2015). All available osteometric data was collected (standards after von den Driesch 1976; Kratochvil 1977a; 1977b) and in addition pathological changes and other marks on the bones were noted. Species identification based on distinctive features of the examined bones was supported with comparative collections, available literature (Akajewski 1979; Popesko 2008; Plug 2014) and existing metrics (von den Driesch 1976).

Archaeozoological analysis was carried out during excavation (on the spot in the trenches) and afterward in the Berenike field laboratory. The preservation of remains was recorded and described in the field. All the bones were explored and collected by hand and the surrounding sediment was sieved (2 mm mesh) without exception.

ANIMAL CEMETERY

ARCHAEOLOGICAL PERSPECTIVE

No evidence has been forthcoming from Berenike on processes of animal mummification (whether intentional or natural). Dead animals were buried in pits reaching 0.40 m in depth [***Fig. 5***] and apparently without superstructures of any kind to mark individual graves.

Regardless of species, age or sex, animal cadavers were arranged in resting position. There was no preference for body side arrangement (either left or right). Limbs could be pulled up, as well as stretched out full length. A few cats were laid curled up. None of the identified body positions suggested chaotic dumping.

Bodies were frequently protected with large amphora sherds, which were occasionally arranged in a way that showed an effort toward reconstructing the original vessel shape, but using sherds from different vessels [***Fig. 6*** top]. Some bodies were also wrapped in textiles or covered with organic mats [***Fig. 6*** bottom]

Buried animals from Berenike typically had no grave goods. However, a few examples of accessories linked to animal-keeping were preserved. Two young cats were found with single ostrich eggshell beads by their necks, and another three cats and a grivet monkey had been buried with iron collars originally wrapped in

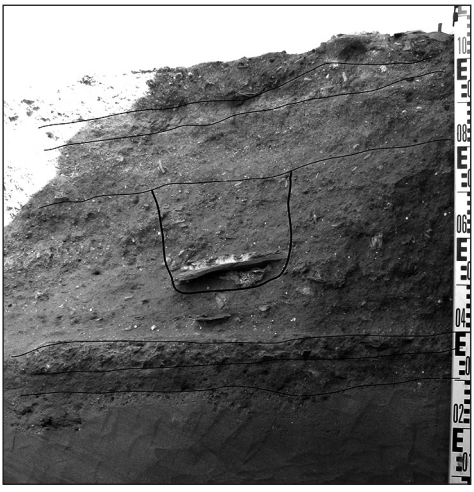

Fig. 5. Stratigraphic section through an animal burial (eastern baulk of trench BE12-80) (Courtesy PCMA–University of Delaware Berenike Project/photo P. Osypiński)

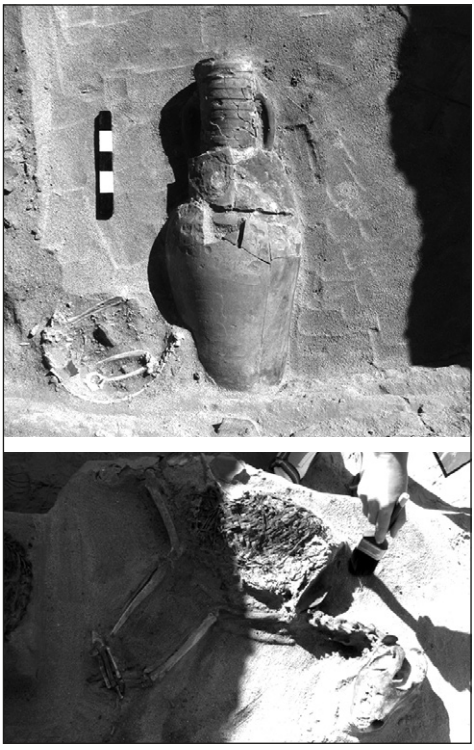

Fig. 6. Elements of burial protection: top, amphora sherds; bottom, organic mats (Courtesy PCMA–University of Delaware Berenike Project/photos P. Osypiński)

Fig. 7. Occasional accessories found with the animal burials: left, complete cattle tail; right, iron collar with glass beads (Courtesy PCMA–University of Delaware Berenike Project/photos P. Osypiński, Steven E. Sidebotham)

Fig. 8. Multiple burial of adult and juvenile cats (Courtesy PCMA–University of Delaware Berenike Project/photo P. Osypiński, Steven E. Sidebotham)

textile or hide and locked with a hook and loop system. An analogous collar with glass beads attached was found also within an intrusive pit, most likely cutting previous burials within trench BE15-107 [***Fig. 7*** right]. In addition, an almost complete cattle tail was found alongside a curled cat in BE12-80 [***Fig. 7*** left].

Beside single-animal inhumations, three burials contained two bodies [***Fig. 8***]. So far, the only species found in double burials were cats and, significantly, always contained an adult and a juvenile.

Burial morphology (orientation of inhumations, position, protection and accompanying elements) was not driven by chronological phases defined by the stratigraphy (before or after the space was organized with a stone structure and clay pavement). It is to be noted, however, that only cats (aside from a single dog burial) were inhumed in the older phase, whereas in the later period, cats, dogs, monkeys and one bird were buried. Of course, this summation may change as excavation in trench BE15-107 progresses to the deepest levels.

SPECIES

The animal most frequently buried in Berenike was the domesticated cat (*Felis silvestris catus* / *Felis silvestris* f. *domestica*). Egypt was undoubtedly one of the places where cats were first domesticated and were probably the most important animal at that (Van Neer et al. 2014). The presence of cat remains, including its wild relative *Felis silvestris libyca,* is observed in archaeological contexts from the predynastic period (Van Neer, Linseele, and Friedman 2004; Linseele, Van Neer, and Hendrickx 2007; Van Neer et al. 2014). The Berenike cemetery has produced so far 86 cat skeletons (and a number of single bones from disturbed burials) [***Table 1***]. Single bones of cats were identified in other parts of the early Roman port and in trash dumps as well (Van Neer and Ervynck 1999; Osypińska 2011). Currently, the assemblage consistsof 39.5% adult specimens, 23.2% sub-adult animals and 37.2% juvenile, infant or neo-natal [see ***Table 1***].

The next most numerous species recorded in the Berenike cemetery was dog (*Canis lupus* f. *domestica* / *Canis lupus familiaris*) [see ***Table 1:019, 020, 021, 024, 026, 027, 035, 098, 100***). Nine burials of dogs have been recorded to date. Only two were adult animals, with the rest being immature specimens. Apart from the currently described area, complete dog skeletons have been found on the western outskirts of Berenike's Southwestern Embayment (four specimens within a 5 m by 5 m trench BE10-63) and in the ruins of the Ptolemaic fort (one specimen in trench BE15-104). Single bones of dogs have also been identified in other parts of the town (Van Neer and Ervynck 1999).

Among the animals buried in Berenike cemetery, two species of monkeys were identified as well, both belonging to the Cercopitecidae family. Two of them were remains of the grivet monkey (*Chlorocebus aetiops*), another two of the olive baboon (*Papio anubis*) [see ***Table 1:042, 043, 086, 099***]. All monkeys died as immature animals. This is the first known evidence of these species in the Berenike bone assemblages. The two species did not occur in antiquity in the Berenike region (and are not found in the area in modern times), but the olive baboon is one of the most popular monkeys of sub-Saharan Africa, across Mali, central and southern Sudan

Table 1. List of animal burials from trenches BE11-76, BE12/14-80 and BE15-107

Burial No.	Context	Number of individuals	Species	Age	Sex
001	Organic trash dump BE11-76/locus *001*/PB001	1	Cat	Adult	♂
002	Organic trash dump BE11-76/locus *001*/PB999 (east baulk)	1	Cat	Subadult	?
003	Organic trash dump BE11-76/locus *003*/PB005+006	1	Cat	Juvenis	–
004	Organic trash dump BE11-76/locus *006*/PB014+015	1	Cat	Juvenis	–
005	Organic trash dump BE11-76/locus *006*/PB017+018	1	Cat	Juvenis	–
006	Organic trash dump BE11-76/locus *006*/PB019	1	Cat	Adult	♂
007	Sand dune BE11-76/locus *007*/PB027	1	Cat	Juvenis	–
008	Sand dune BE11-76/locus *007*/PB031+032+036	1	Cat	Subadult	?
009	Organic trash dump BE11-76/locus *999*/PB025+026	1	Cat	Adult	♂
010 011	Organic trash dump BE11-76/locus *999*/PB027	2	Cat	Adult Juvenis	♀ –
012	Organic trash dump BE11-76/locus *999*/PB029	1	Cat	Subadult	?
013	Organic trash dump BE11-76/locus *999*/PB030+034	1	Cat	Subadult	?
014 015 016 017	Organic trash dump BE11-76/locus *999*/PB038	4	Cat	Juvenis Adult Adult Subadult	– ♀ ♀ ?
018	Sand dune BE11-76/locus *999* (disturbed)	1	Cat	Juvenis	–
019	Sand dune BE11-76/locus *999* (disturbed)	1	Dog	Juvenis	♀
020	Sand dune BE11-76/locus *999* (disturbed)	1	Dog	Juvenis	?
021	Sand dune, wrapped in mats and covered with amphorae fragments BE11-76/locus *999* (disturbed)	1	Dog	Adult	♂
022	Sand dune, covered with a wooden beam BE12-80/locus *003*/PB013	1	Cat	Juvenis	–
023	Sand dune BE12-80/locus *011*/PB014	1	Wild bird	Adult	–
024	Sand dune BE14-80/locus *017*/PB028	1	Dog	Subadult	?
025	Sand dune BE12-80/locus *003*/PB031	1	Cat	Juvenis	–
026	Organic trash dump BE12-80/locus *999*/south baulk	1	Dog	Subadult	–
027	Organic trash dump BE12-80/locus *999*/south baulk	1	Dog	Subadult	–

Table 1. (continued)

Burial No.	Context	Number of individuals	Species	Age	Sex
028	Organic trash dump BE14-80/locus *024*/PB033 (north baulk)	1	Cat	Subadult	–
029	Sand dune BE12-80/locus *040*/BE14-80/locus *040*/PB025	1	Cat	Subadult	?
030	Sand dune BE14-80/locus *039*/PB024	1	Cat	Adult	♂
031	Sand dune BE14-80/locus *038*/PB023	1	Cat	Adult	♂
032	Sand dune BE14-80/locus *037*/PB022	1	Cat	Adult	♂
033	Sand dune BE14-80/locus *036*/PB021	1	Cat	Subadult	?
034	Sand dune BE14-80/locus *035*/PB020	1	Cat	Adult	♂
035	Sand dune BE14-80/locus *034*/PB019	1	Dog	Juvenis	–
036	Sand dune BE14-80/locus *033*/PB018	1	Cat	Subadult	?
037	Sand dune BE14-80/locus *032*/PB017	1	Cat	Adult	♀
038	Sand dune BE14-80/locus *031*/PB016	1	Cat	Subadult	?
039	Over clay floor, covered with sherds BE14-80/locus *027*/PB030	1	Cat	Adult	♂
040	Sand dune BE12-80/locus *027*/PB030	1	Cat	Adult	♂
041	Sand dune BE14-80/locus *043*/PB035	1	Cat	Juvenis	–
042	Cut in clay floor, iron collar BE14-80/locus *042*/PB036	1	Grivet	Juvenis	–
043	Above clay floor, covered with textiles BE14-80/locus *044*/PB045	1	Baboon	Juvenis	–
044	Sand dune BE14-80/locus *045*/PB034	1	Cat	Adult	♂
045	Sand dune, covered with sherds forming an amphora shape BE14-80/locus *053*/PB046	1	Cat	Subadult	?
046	Sand dune, cattle tail as grave good BE14-80/locus *054*/PB047	1	Cat	Subadult	?
047	Sand dune BE14-80/locus *055*/PB049	1	Cat	Subadult	?
048	Sand dune BE14-80/locus *046*/PB048/052	1	Cat	Subadult	?
049 050	Under clay floor, covered with sherds BE14-80/locus *047a,b*/PB054	2	Cat	Adult Juvenis	♀ –
051	Under clay floor, covered with sherds BE14-80/locus *047c*/PB054	1	Cat	Adult	♀
052 053	Under clay floor BE14-80/locus *058*/PB057	2	Cat	Adult Subadult	♀ ?

Table 1. (continued)

Burial No.	Context	Number of individuals	Species	Age	Sex
054	Under clay floor BE14-80/locus *058a*/PB057	1	?	?	–
055	Under a wall foundation ditch, covered with numerous sherds BE14-80/locus *057*/PB056	1	Cat	Subadult	?
056	Under clay floor, covered with sherds BE14-80/locus *059*/PB058	1	Cat	Neonatal	–
057	Under clay floor BE14-80/locus *059*/PB058	1	Cat	Neonatal	–
058	Under clay floor BE14-80/locus *038a*/PB023	1	Cat	Juvenis	–
059	Under clay floor, covered with sherds BE14-80/locus *060*/PB060	1	Cat	Adult	♂
060	Under clay floor, covered with sherds BE14-80/locus *051*/PB045	1	Cat	Adult	♀
061	Under clay floor, covered with sherds, faience bead as adornment BE14-80/locus *051*/PB060	1	Cat	Juvenis	–
062	Under clay floor BE14-80/locus *061*/PB061	1	Cat	Adult	♂
063	Under clay floor BE14-80/locus *062b*/PB062	1	Cat	Adult	♀
064	Under clay floor BE14-80/locus *062a*/PB066	1	Cat	Infans	–
065	Under clay floor, covered with sherds BE14-80/locus *063*/PB064	1	Cat	Adult	♀
066	Under clay floor BE14-80/locus *064*/PB068	1	Cat	Adult	♂
067	Under clay floor, covered with sherds BE14-80/locus *065*/PB069	1	Cat	Juvenis	–
068	Under clay floor, covered with sherds BE14-80/locus *066*/PB073	1	Cat	Juvenis	–
069	Under clay floor BE14-80/locus *068*/PB071	1	Cat	Juvenis	–
070	Under clay floor BE14-80/locus *067*/PB072	1	Cat	Juvenis	–
071	Under clay floor BE14-80/locus *052*/PB074	1	Cat	Subadult	?
072	Under clay floor, covered with sherds BE14-80/locus *069*/PB075	1	Cat	Infans	–
073	Cut in clay floor, covered with a big sherd BE14-80/locus *069*/PB075	1	Cat	Infans	–
074	Cut in a clay floor BE14-80/locus *069*/PB075	1	Cat	Adult	♀
075	Sand dune BE14-80/locus *070*/PB076	1	Cat	Juvenis	–
076	Above clay floor BE15-107/locus *007*/PB010	1	Cat	Juvenis	–
077	Above clay floor, covered with single sherds BE15-107/locus *008*/PB011	1	Cat	Juvenis	–

Table 1. (continued)

Burial No.	Context	Number of individuals	Species	Age	Sex
078	Above clay floor BE15-107/locus *009*/PB012	1	Cat	Juvenis	–
079	Above clay floor, iron collar BE15-107/locus *013*/PB020	1	Cat	Adult	?
080 081	Above clay floor BE15-107/locus *014*/PB021	2	Cat	Adult Juvenis	♀
082	Above clay floor BE15-107/locus *016*/PB023	1	Cat	Juvenis	–
083	Above clay floor, iron collar BE15-107/locus *015*/PB022	1	Cat	Adult	?
084	Above clay floor BE15-107/locus *017*/PB024	1	Cat	Subadult	?
085	Above clay floor, covered with a single sherd BE15-107/locus *019*/PB026	1	Cat	Adult	♂
086	Above clay floor BE15-107/locus *022*/PB032	1	Grivet	Juvenis	–
087	Above clay floor BE15-107/locus *023*/PB034	1	Cat	Adult	♂
088	Above clay floor BE15-107/locus *024*/PB033	1	Cat	Juvenis	–
089	Above clay floor, iron collar BE15-107/locus *025*/PB035	1	Cat	Adult	♀
090	Above clay floor, covered with a single sherd BE15-107/locus *026*/PB039	1	Cat	Juvenis	–
091	Above (cuts) clay floor BE15-107/locus *027*/PB036	1	Cat	Subadult	♀
092	Above clay floor BE15-107/locus *034*/PB043	1	Cat	Adult	♂
093	Above clay floor BE15-107/locus *035*/PB055	1	Cat	Adult	♀
094	Above clay floor BE15-107/locus *040*/PB052	1	Cat	Adult	♀
095	Above clay floor, wrapped in a textile BE15-107/locus *037*/PB053	1	Cat	Subadult	–
096	Above clay floor BE15-107/locus *038*/PB055	1	Cat	Juvenis	–
097	Above clay floor BE15-107/locus *039*/PB056	1	Cat	Juvenis	–
098	Above clay floor, covered with sherds BE15-107/locus *021*/PB028	1	Dog	Adult	♀
099	Above clay floor (skull only, fragment of burial 100(?) BE15-107/locus *042*/PB054	1	Mmonkey (grivet?)	Subadult	–
100	Above clay floor, covered with many sherds BE15-107/locus *020*/PB042	1	Dog	Subadult	–
101	Unexplored; above clay floor, wrapped in a textile and covered with a single sherd BE15-107/locus *036*/PB044	1	?	?	–
102	Unexplored; under clay floor, covered with many sherds BE15-107/locus *041*/PB052	?	?	?	–

and Ethiopia and the grivet inhabit both the upper part of the Nile Valley as well as the savannah and forest outskirts of Sudan, Eritrea, Ethiopia and Djibouti (Kingdon 1977; Stuart and Stuart 2006; Kingdon et al. 2013).

Fig. 9. Burial of a wild bird (Courtesy PCMA–University of Delaware Berenike Project/ photo P. Osypiński)

One of the latest contexts of the Berenike animal cemetery contained the remains of a bird [***Table 1:023***; ***Fig. 9***]. However, the identification of the species will require further study. Thus far, bird bones in the early Roman levels of Berenike were identified as representing both wild species (migrating ones, present in the region during winter season) and domesticated (mainly chicken, Van Neer and Ervynck 1999: 330).

ANIMAL MORPHOLOGY

CATS

The young age of a high number of the buried cats, as well as poor preservation of some of the remains prevented osteometrical estimation and evaluation of the morphology of all 86 animals. However, a corpus of collected data [***Table 2***] enabled some general identification and comparative studies of the cat population

Table 2. Osteometrical data for cat bones from the animal cemetery

Scapula	Humerus			Radius	Pelvis	Femur			Tibia			Talus	Calcaneus
GLP	GL	Bp	Bd	GL	LA	GL	Bp	Bd	GL	Bp	Bd	GL	GL
14.0	077.5			84.3	10.4			19.4		21.8		16.4	22.3
14.0	077.5			93.4	10.4			19.6		23.1		17.6	22.4
14.3	094.3			96.5	10.8			19.6		21.7		17.6	26.6
14.9	096.3			96.5	10.8			19.8		20.9			26.6
14.9	099.1		17.0	103.1	11.3			15.9			11.2		28.9
15.4	099.2		16.8	103.3	11.3			19.4		20.0			29.6
	101.4		18.7	103.3				19.4		20.3			29.6
	101.5		17.9	104.3				19.8		20.3			30.6
	101.5	19	17.0					21.3		19.1			30.6
	101.7		18.1					21.4		20.0			30.8
	101.7		18.1					22.3		19.1			30.8
	102.6		17.8			99.9				21.7			30.8
	104.0		18.5			99.9				21.8			30.8
	104.9		21.1			112.2		19.2	109.7	17.2	18.6		30.8

Table 2. (continued)

Scapula	Humerus			Radius	Pelvis	Femur			Tibia			Talus	Calcaneus
	104.9		21.1			112.5		18.8	114.2				32.1
	105.0		18.6			112.5		18.8	115.7				33.0
	106.0					112.6		18.9	115.7		14.8		33.0
	107.0		20.1			112.6	18.9		115.7		14.8		33.2
	107.0		20.1			114.0			115.7		14.9		
	107.0		20.2			114.0			115.9		15.0		
	107.0		20.2			114.7		18.5	116.6		14.7		
	107.0		22.0			114.7		18.5	118.4		19.3		
	107.0	21.3				117.6		19.0	119.0				
	107.6		19.3			118.4		19.3	121.0				
	108.8		21.9			118.4		19.4	121.0				
	109.1					118.4		19.3	121.5	19.4	14.8		
	109.2		18.5			119.1			121.9	19.0	14.5		
			16.5			119.1			122.6	18.7	12.6		
			17.6			128.1			122.6	18.7	12.6		
			17.6					22.3	128.5		14.7		
			18.0						128.5		14.7		
			18.1						130.6				
			18.1						131.4				
			18.3										
			18.3										
			18.3										
			18.4										
			18.5										
			19.0										
			19.0										
			19.4										
			19.8										
			20.0										
			20.0										
			20.5										
			20.5										
			21.0										
		21.2											
		21.3											
		21.4											
		21.4											

of Berenike and specimens known from the Nile Valley as well as other regions potentially linked with Berenike (Mediterranean Europe, Near East and India). Preliminary analysis of the metrics suggests a very homogenous population. The data corresponds well with the bone values of other Northeastern African cats [***Table 3***]. So far, no evidence of keeping other kinds of cats has been noted in the Berenike cemetery, for example, the jungle cat *Felis chaus* known from the Nile Valley (Baldwin 1975; Linseele, Van Neer, and Hendrickx 2007; Boessneck and von den Driesch 1992). Due to the still preliminary state of research on the ancient animal populations of the Red Sea coast, we cannot say whether the Berenike cats were locally bred, imported exclusively from the Nile Valley or from a number of different directions (as DNA analyses might suggest, Malek 1993; Mattern and McLennan 2000).

DOGS

Despite the much lower number of burials, more morphological features of dogs could be identified compared with cats. These skeletons were preserved in much better condition than the cat or monkey remains (all monkeys, due to their young age at death, were not suitable for osteometric analysis). All dogs recorded so far in Berenike early Roman contexts, beside the one specimen excavated in trench BE11-76, were of similar height, ranging between 44 and 52 cm [***Table 4***].

Table 3. Osteometrical data for cat bones from Berenike (compared to the standard in parentheses) and from other sites in Northeastern Africa (After Linseele, Van Neer, and Hendrickx 2007)

	Berenike (early Roman) (mm)	**Hierakonpolis (Predynastic) (mm)**	**Tel el-Dab'a (mm)**	**El Kab (mm)**
Scapula				
GLP	14.0–15.4 (14.58) / ∑6			
Humerus				
GL	77.5–109.2 (102.06) / ∑27	±120; 89.5♀; 95.1♂		112.0
Bd	16.5–22.0 (18.99) / ∑40	22.0; 16.0♀; 17.4♂	20.2; 20.0	20.5; 20.4
Radius				
GL	84.3–104.3 (98.08) / ∑8	94.2♂		
Pelvis				
LA	10.4–11.3 (10.83) / ∑6	11.5♀; 12.2♂	13.5	14.0
Femur				
GL	99.9–128.1 (114.37) / ∑18	± 111		
Bd	15.9–22.3 (19.54) / ∑22	23.0; 16.1♀; 18.8♂		
Tibia				
GL	109.7–131.4 (114.51) / ∑20	± 141; 113♂		
Bp	17.2–21.8 (20.13) / ∑19	26.5; 18.0♀; 21.4♂		
Bd	11.2–19.3 (14.80) / ∑14	17.8; 13.0♀; 13.2♂		
Talus				
GL	16.4–17.6 (17.20) / ∑3	19.5; 14.9♀; 16.5♂		
Calcaneus				
GL	22.3–33.2 (29.58) / ∑18	28.3♂		

Table 4. Height at the withers (WH) of dogs from Berenike, calculated based on the length of various bones (Koudelka 1885; cited after von den Driesch and Boessneck 1974)

	Scapula	Humerus	Ulna	Radius	Femur	Tibia	WH (average)
BE-76/21	55.0 cm	55.5 cm	50.7 cm	52.4 cm	54.7 cm	52.2 cm	**53.4 cm**
BE-104	–	49.0 cm	46.4 cm	46.3 cm	46.8 cm	46.2 cm	**47.4 cm**
BE-61/A	47.7 cm	–	–	–	–	–	**47.7 cm**
BE-61/B	–	47.3 cm	–	–	46.7 cm	46.8 cm	**46.9 cm**
BE-61/C	–	–	–	–	52.1 cm	–	**52.1 cm**
BE-61/D	–	44.4 cm	–	–	–	–	**44.4 cm**

Table 5. Osteometry of dogs from Berenike and Nubian contexts (NDRS after Grant 2001: 544–555, Table 12.2)

	BE-76/21 (Molossus)	BE-104	BE-61	NDRS – P37 (Kerma Moyen)	Kerma (2050–1750 BC)
Humerus GL	164.9 164.8	145.6 148.1	140.4 131.8	144 146	144.0–178.9 (164.7)
Radius GLI	163.0 158.6	157.9 161.3	–	150 GL	151.0–180.3 (167.9)
Ulna GL	190.6 190.4	174.1 175.2	–	–	175.4–212.4 (197.4)
Femur GLC	181.9 181.1	–	–	–	–
GL	178.4 178.2	155.5 156.4	173.2 155.4	162	165.0–200.0 (182.9)
SD	15.1 14.5	–	–	11.2	11.0–14.0 (12.5)
Bd	32.8 32.7	–	27.7	25.8	25.4–34.0 (29.9)
Tibia GL	180.3 180.3	158.3 158.0	160.5	164.5	164.9–199.0 (185.0)
Bp	35.6 35.8	–	24.9	–	27.5–35.5 (32.1)
SD	13.8 13.7	–	–	11.7	9.9–13.4 (12.0)
Bd	23.4 23.3	–	–	19.6	16.5–23.3 (20.6)
Calcaneus GL	42.8 42.7	–	–	39	–

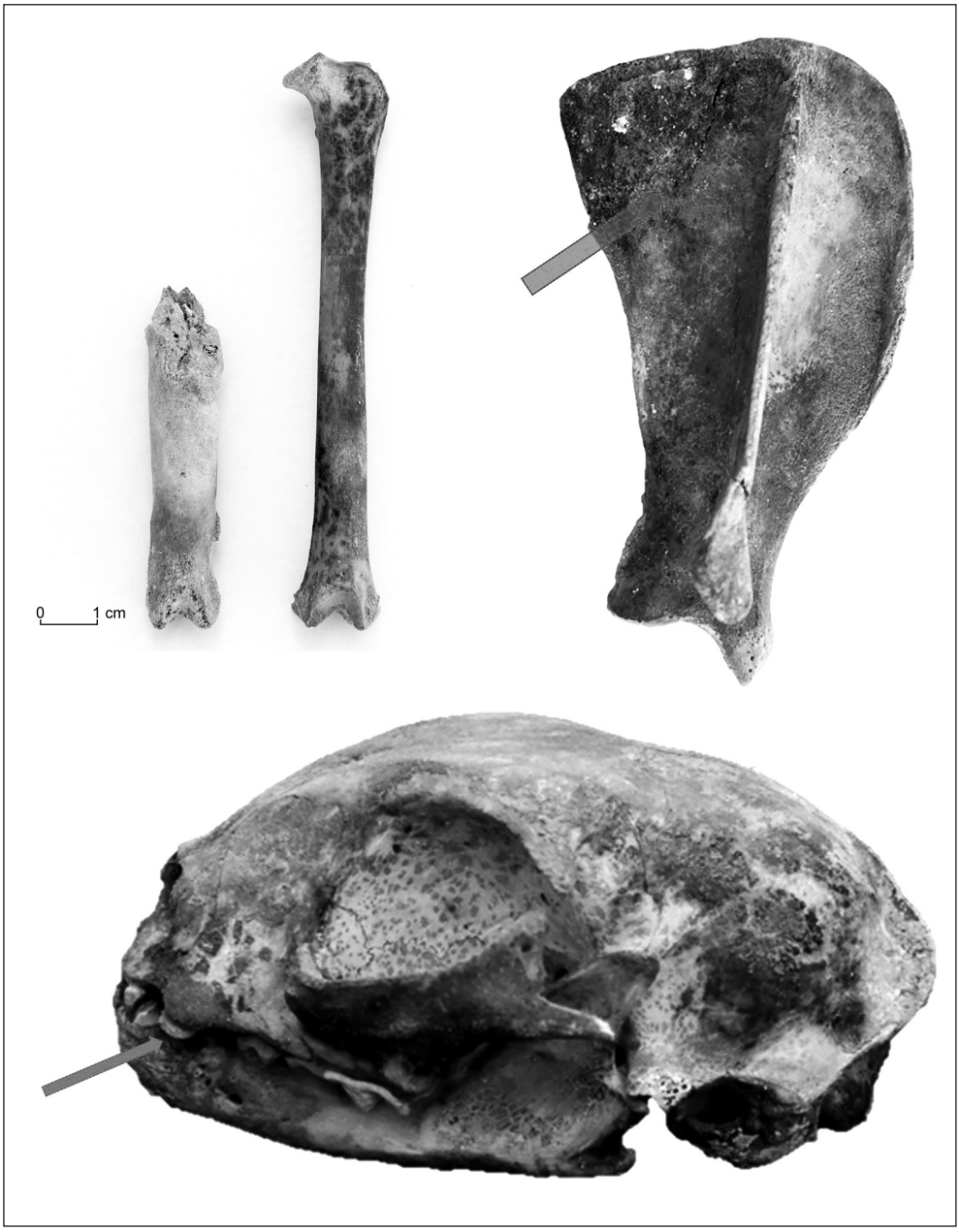

Fig. 10. Bone damages: top left, femur of a cat with healed trunk break; top right, healed scapula break of a puppy; bottom, shortened canines of a cat (see arrow) (Courtesy PCMA–University of Delaware Berenike Project/photos M. Osypińska)

Comparative studies of their metrics with the current local "baladi" dog population suggest numerous similarities. These were average-size dogs of the spitz type. Comparisons with other ancient dog populations from the Nile Valley (both cranial and postcranial metrics, ***Table 5***) shows further general similarities (Boessneck 1975; 1988; Bonnet et al. 1989; Churcher 1993; Chaix 1999). Remains of a dog (male) excavated in trench BE11-76 [see ***Table 1:020***] were preserved in particularly good condition, producing a complete set of data concerning its extraordinary morphology and behaviour.

PATHOLOGIES AND CHANGES ON THE BONES

Most of the well preserved, complete skeletons were free of life-time damages or changes. A search for potential evidence of intentional killing of animals, which is known from the Nile Valley mummies (Armitage and Clutton-Brock 1981; Ikram 2003; 2005; Flores 2004), did not bring forth any evidence.

One of the young cat skeletons [***Table 1:012***] revealed traces of a serious accident: its femur bone was broken in multiple places. Although partly healed, the bone did not knit properly, evidently handicapping the animal's movement [***Fig. 10*** top left].

Another cat skeleton, an adult specimen [***Table 1:006***], showed probable evidence of specific surgery resulting in the shortening of the canines. At first glance, such teeth could be interpreted as belonging to a senile specimen, but in this particular case all the other teeth were not worn. Such treatment is unknown from ancient evidence and current veterinary practice, but could be potentially explained as protection against biting [***Fig. 10*** bottom].

Finally, one of the buried dogs [***Table 1:018***] which died at the age of 10 months, had a healed scapula fracture [***Fig. 10*** top right].

Moreover, a dog skeleton [***Table 1:020***] revealed the oldest known evidence of cancer tumors found in ancient dogs.

DISCUSSION AND CONCLUSIONS

The species list of animals buried in Berenike is similar to numerous Greco-Roman animal cemeteries of Egypt. Thus, a great number of cats, commonly linked to the cat deity Bastet, was recorded. There were also some dogs, usually related to Anubis or Hekate. Baboons were usually considered as Thoth's embodiment (Weiss 2012). The cults of all these gods were popular in the Ptolemaic and Roman periods. Only the grivet monkey was not related directly to any beliefs; however, from predynastic (McArdle 1982; Linseele and Van Neer 2009) to medieval times (e.g., Osypińska 2014), it was a popular pet both in Nubia and Egypt. Burial morphology, no trace of embalment procedures, a diversified species list and the absence of "main" human inhumations — all these features lead to the conclusion that the Berenike cemetery reflected different aims and different cultural inspirations than the Nile Valley animal deposits. Naturally, that absence of mummies in Berenike could be assumed to reflect the deeply provincial character of the site and the absence of experts in em-

balming, so the animals were "processed" in a much less sophisticated manner. But one should not overlook the particular care given to body deposition, mostly reflecting sleeping animals. In our opinion, the described features suggest that the Berenike finds could be defined as a cemetery of house-kept pets instead of as a parallel to the known Egyptian deposits related to sacral or at least magical rites.

There is rich evidence confirming the ancient nature of the habit of keeping small pet-animals both in Egypt and Mediterranean Europe, with favored Roman dog burials commemorated with epitaphs (Lazenby 1949; Bodson 2000). Similarly informative are texts concerning diversified breeds, feeding advice and descriptions of veterinary cases (e.g., Varro 2,9:2–14). In Egypt, burials of dogs (sometimes in large numbers) have been interpreted as reflective of humanity's emotional bond to "the best man's companion" (Ikram 2013). Typically, however, these burials were deposited with a man, and it is difficult to suppose it suffered a natural death at the same time as its owner. In case of cats, we do not have any evidence of such kind, either from Egypt or from other regions (von den Driesch and Boessneck 1983). We see the almost mass production of cat mummies instead, with evidence of intentional animal killing (Morrison-Scott 1952; Ikram 2005), despite a commonly practiced taboo and various official bans in that matter.

One could wonder whether the burial of pets in Berenike was implemented by a foreign (Roman or Romanised) community or was merely an element of the "Imperial" cultural package adopted by a multi-ethnic and eclectic society of mer-chants and officials (Winnicki 2009). In our opinion, the first proposition is more believable, due to the limited time span of the cemetery (less than a century), correlated with the greatest prosperity of the port-town and its close relations with the core of the Empire. The exceptional character of the site is also significant; so far, there is no evidence of similarly dated cemeteries either in the Nile Valley or along the Near Eastern or Red Sea coasts. Naturally, we should keep in mind the current state of research, with excavations usually avoiding more rural areas. Notwithstanding, the Berenike animal cemetery is to be perceived as an important cultural marker or even a geo-demographic correlate similar to the exclusive Italian and Greek goods consumed in Berenike in these times (glass and pottery vessels, wine, olive, gastropods and *garum*, see Sidebotham 2011).

A Roman garrison presence in Berenike in the 1st–2nd century AD is suggested by numerous texts known from Berenike itself (ostraka, papyri) and its surroundings. These people used Latin and Greek, and bore Latin and Greek names and titles. However, the sources do not show whether this important (but most probably not numerous) community included whole families or just the necessary crew members. The presence of families has been suggested so far solely by evidence of a single child burial and some female adornments (Sidebotham 2011: 77).

The next specific feature of the Berenike cemetery is the very high percentage of cats being kept as domestic animals. Cats were a respected element of ancient Egyptian civilisation throughout history, well preceding the early Roman period, but such relations were never incorporated (at least on a similar scale) by the Mediterranean

European societies. In ancient Europe ruled by Rome, the cat started to be popular in the 1st century AD, together with Roman cat breeding habits transferred by the army (repeated after Toynbee 1973). Thus, could it be suspected that the eclectic (both Egyptian and Roman) Berenike evidence reflects the adoption of the cat into a community that subsequently buried its pets? Naturally, there are plenty of reasons for keeping cats in a port-town, which almost automatically brings to mind legions of rats. But the careful segregation of kitten inhumations from adult specimens suggests a more sophisticated kind of relationship than pure pragmatic coexistence.

The harsh ecological conditions in the region of Red Sea coast (limited access to drinking water, poor quality of soil almost disabling agriculture and general salinity) inclines one also to a reflection on the costs of keeping non-edible and non-traction animals. All species identified so far at the cemetery were undoubtedly imported (possibly excluding some dogs) and as can easily be imagined, kept in households at a moderately high cost.

The animal cemetery in Berenike is undoubtedly a unique case. Its potential is based on the possibility of evaluating the complex and important processes taking place within a multicultural town community. So far, issues concerning relations between people and pet-animals were recognised merely through a prism of archaeozoology, sociology and history. Too often, this sphere of social life is considered as modern behavior exclusively. The finds at Berenike seem to break with this stereotype.

Dr. Marta Osypińska
Institute of Archaeology and Ethnology, Polish Academy of Sciences, Poznań
61-612 Poznań, ul. Rubież 46
marta.osypinska@iaepan.edu.pl

Dr. Piotr Osypiński
piotr.osypinski@gmail.com

REFERENCES

Primary sources

Diod. Diodorus Siculus, *Library of history* I. *Books 1–2.34* [=*Loeb Classical Library* 279], transl. by C.H. Oldfather, Cambridge, MA: Harvard University Press, 1933

Herod. Herodotus, *The histories*; Polish translation: Herodot, *Dzieje*, transl. by. S. Hammer, Warsaw: Czytelnik, 2002

Varro Varro, *De re rustica*; Polish translation: Marek Terencjusz Warron, *O gospodarstwie rolnym*, transl. by I. Mikołajczyk, Wrocław: Zakład Narodowy im. Ossolińkich, 1991

Secondary sources

Aglan, H.E.A. (2013). *The aspects of animal sanctification in the Graeco-Roman monuments in Egypt. (Study in Classical influences)* (unpubl. Ph.D. diss.). Universität zu Köln

Akajewski, A. (1979). *Anatomia zwierząt domowych* [Anatomy of domestic animals]. Warsaw: Państwowe Wydawnictwo Rolnicze i Leśne [in Polish]

Amorosi, T. (1989). *A postcranial guide to domestic neo-natal and juvenile mammals: The identification and aging of old world species* [=*BAR IS* 533]. Oxford: BAR

Armitage, P.L. and Clutton-Brock, J. (1981). A radiological and histological investigation into the mummification of cats from Ancient Egypt. *Journal of Archaeological Science*, 8(2), 185–196

Baldwin, J.A. (1975). Notes and speculations on the domestication of the cat in Egypt. *Anthropos*, 70(3–4), 428–448

Bodson, L. (2000). Motivations for pet-keeping in Ancient Greece and Rome: a preliminary survey. In A.L. Podberscek, E.S. Paul, and J. Serpell (eds), *Companion animals and us: Exploring the relationships between people and pets* (pp. 27–41). Cambridge–New York: Cambridge University Press

Boessneck, J. (1975). Ein altägyptisches Hundeskelett aus der 11. Dynastie. *MDAIK*, 31, 7–13

Boessneck, J. (1988). *Die Tierwelt das alten Ägypten: untersucht anhand kulturgeschichtlicher und zoologischer Quellen*. Munich: C.H. Beck

Boessneck, J. and von den Driesch, A. (1992). *Tell el Dab'a VII: Tiere und historische Umwelt im Nordost-Delta im 2. Jahrtausend v. Chr. anhand der Knochenfunde der Ausgrabungen 1975–1986* [=*Denkschriften der Gesamtakademie* 11]. Vienna: Verlag der Österreichischen Akademie der Wissenschaften

Bonnet, C., Chaix, L., Lenoble, P., Reinold, J., and Valbelle, D. (1989). Sépultures à chiens sacrifiés dans la vallée du Nil. *CRIPEL*, 11, 25–39

Chaix, L. (1999). The dogs from Kerma (Sudan) 2700 to 1500 BC. In C. Becker, H. Manhart, J. Peters, and J. Schibler (eds), *Historia animalium ex ossibus: Beiträge zur Paläoanatomie, Archäologie, Ägyptologie, Ethnologie und Geschichte der Tiermedizin. Festschrift für Angela von den Driesch zum 65. Geburtstag* (pp. 109–132). Rahden/Westf.: Leidorf

Charron, A. (2002). *La mort n'est pas une fin: pratiques funéraires en Égypte d'Alexandre à Cléopatre* [exhibition catalogue]. Arles: Éditions du Musée de l'Arles Antique

Churcher, C.S. (1993). Dogs from Ein Tirghi cemetery, Balat, Dakhleh Oasis, Western Desert of Egypt. In A. Clason, S. Payne, and H.-P. Uerpmann (eds), *Skeletons in her cupboard: Festschrift for Juliet Clutton-Brock* [=*Oxbow Monograph* 34] (pp. 39–60). Oxford: Oxbow

Feder, F. (2003). Der ägyptische Tierkult nach den griechischen und römischen Autoren. In M. Fitzenreiter (ed.), *Tierkulte im pharaonischen Ägypten Beiträge eines Workshop am 7. und 8. Juni 2002* [=*Internet-Beiträge zur Ägyptologie und Sudanarchäologie* 3]. Berlin: Humboldt-Universität

Flores, D.V. (2003). *Funerary sacrifice of animals in the Egyptian Predynastic Period* [=*BAR IS* 1153]. Oxford: Archeopress

Flores, D.V. (2004). Funerary sacrifice of animals in the Egyptian Predynastic period. In S. Hendrickx, R.F. Friedman, K.M. Ciałowicz, and M. Chłodnicki (eds), *Egypt at its origins: Studies in memory of Barbara Adams. Proceedings of the international conference "Origin of the State. Predynastic and Early Dynastic Egypt," Krakow, 28 August–1st September 2002* [=*OLA* 138] (pp. 731–765). Leuven–Dudley, MA: Peeters

Hornung, E. (1967). Die Bedeutung des Tieres im alten Ägypten. *Studium Generale*, 20(2), 69–84

Ikram, S. (2003). The Animal Mummy Project at the Egyptian Musem, Cairo. In Z. Hawass and L. P. Brock (eds), *Egyptology at the dawn of the Twenty-first Century: Proceedings of the Eighth International Congress of Egyptologists, Cairo, 2000,* III. *Language, conservation, museology* (pp. 235–239). Cairo: American University in Cairo Press

Ikram, S. (2005). *Divine creatures: Animal mummies in Ancient Egypt*. Cairo: American University in Cairo Press

Ikram, S. (2007). Mummified menageries: Ancient Egyptian animal mummies. *British Institute of Radiology News*, 12–13

Ikram, S. (2013). Man's best friend for eternity: dog and human burials in ancient Egypt. *Anthropozoologica*, 48(2), 299–307

Kessler, D. (1986). Tierkult. In W. Helck and E. Otto (eds), *Lexikon der Ägyptologie* VI (cols 571–587). Wiesbaden: Harrassowitz

Kessler, D., and Abd el Halim Nur el-Din (2005). Tuna al-Gebel: millions of ibises and other animals. In S. Ikram (ed.), *Divine creatures: Animal mummies in ancient Egypt* (pp. 120–163). Cairo: American University in Cairo Press

Kingdon, J. (1977). *East African mammals. An atlas of evolution in Africa* IIIA. *Carnivores*. London: Academic Press

Kingdon, J., Happold, D., Butynski, T., Hoffmann, M., Happold, M., and Kalina, J. (eds). (2013). *Mammals of Africa* I–VI. London: Bloomsbury

Kratochvil, Z. (1976). Sex dimorphism of the domestic cat (*Felis lybica* f. *catus* L.) on the skull and on the mandible. *Acta Veterinaria Brno*, 45, 159–167

Kratochvil, Z. (1977a). Analysis of correlations between two characters of the postcranial skeleton of *Felis s. silvestris* and *F. lybica* f. *catus* (Mammalia). *Folia Zoologica*, 26(2), 115–128

Kratochvil, Z. (1977b). Contents of neurocranium, weight and length of body of wild cat (*Felis s. silvestris*) and domestic cat (*F. lybica* f. *catus*). *Folia Venatoria*, 7, 368–375.

Lazenby, F.D. (1949). Greek and Roman household pets. *The Classical Journal*, 44(4), 245–252

Linseele, V. and Van Neer, W. (2009). Monkey business: the earliest find of green monkey in the Egyptian Nile Valley. *Nekhen News*, 21, 24–25

Linseele, V., Van Neer, W., and Hendrickx, S. (2007). Evidence for early cat taming in Egypt. *Journal of Archaeological Science*, 34(12), 2081–2090

Malek, J. (1993). *The cat in ancient Egypt*. London: British Museum Press

Mattern, M.Y. and McLennan, D.A. (2000). Phylogeny and speciation of felids. *Cladistics*, 16(2), 232–253

McArdle, J. (1982). Preliminary report on the Predynastic fauna of the Hierakonpolis project. In M.A. Hoffman, *The predynastic of Hierakonpolis: An interim report* [=*Egyptian Studies Association Publications* 1] (pp. 116–121). Giza–Macombs: Cairo University Herbarium; Western Illinois University

Morrison-Scott, T.C.S. (1952). The mummified cats of ancient Egypt. *Proceedings of the Zoological Society of London*, 121(4), 861–867

Osypińska, M. (2011). Archaeozoological remains. In S.E. Sidebotham and I. Zych (eds), *Berenike 2008–2009: Report on the excavations at Berenike, including a survey in the Eastern Desert* [=*PCMA Excavation Series* 1] (pp. 67–76). Warsaw: PCMA UW

Osypińska, M. (2014). Animal husbandry and meat consumption in Makurite Dongola, Sudan. Faunal evidence from the royal residence area, 6th–17th century. *Archeologia*, 64, 67–81

Osypińska, M. (2017). Animal remains from Berenike, seasons 2010–2011. In S.E. Sidebotham and I. Zych (eds), *Berenike 2010–2011. Report on two seasons of excavations at Berenike, including survey in the Eastern Desert and reports on earlier work* [=*PCMA Excavation Series* 4] (pp. 251–272). Warsaw: PCMA UW

Plug, I. (2014). *What bone is that?: A guide to the identification of Southern African mammal bones*. Wierda Park: Rosslyn Press

Popesko, P. (2008). *Atlas anatomii topograficznej zwierząt domowych* [Atlas of topographical anatomy of domestic animals]. Warszawa: PWRiL [in Polish]

Ruscillo, D. (ed.). (2015). *Recent advances in ageing and sexing animal bones: Proceedings of the 9th Conference of the International Council of Archaeozoology, Durham, August 2002*. Oxford: Oxbow Books

Salles, L.O. (1992). Felid phylogenetics: extant taxa and skull morphology (Felidae, Aeluroidae). *American Museum Novitates*, 3047, 1–67

Sidebotham, S.E. (2011). *Berenike and the ancient maritime Spice Route*. Berkeley: University of California Press

Sidebotham, S.E., Hense, M., and Nouwens, H.M. (2008). *The Red Land: The illustrated archaeology of Egypt's Eastern Desert*. Cairo: American University in Cairo Press

Sidebotham, S.E. and Zych, I. (2010). Berenike: Archaeological fieldwork at a Ptolemaic–Roman port on the Red Sea coast of Egypt 2008–2010. *Sahara*, 21, 7–25

Sidebotham, S.E. and Zych, I. (2016). Results of the winter 2014–2015 excavations at Berenike Egypt and related fieldwork in the Eastern Desert. *Journal of Indian Ocean Archaeology*, 12, 1–34

Smith, R.N. (1969). Fusion of ossification centres in the cat. *Journal of Small Animal Practice*, 10(9), 523–530

Stuart, C. and Stuart, T. (2006). *Field guide to the larger mammals of Africa*. Cape Town: Struik

Toynbee, A. J. (1973). *Constantine Porphyrogenitus and his world*. London–New York: Oxford University Press

Van Neer, W. and Ervynck, A.M.H. (1999). The faunal remains. In S.E. Sidebotham and W.Z. Wendrich (eds), *Berenike 1997: Report of the 1997 excavations at Berenike and the survey of the Egyptian Eastern Desert, including excavations at Shenshef* (pp. 325–348). Leiden: Research School of Asian, African, and Amerindian Studies (CNWS), Universiteit Leiden

Van Neer, W., Linseele, V., and Friedman, R.F. (2004). Animal burials and food offerings at the elite cemetery HK6 of Hierakonpolis. In S. Hendrickx, R.F. Friedman, K.M. Ciałowicz, and M. Chłodnicki (eds), *Egypt at its origins: Studies in memory of Barbara Adams. Proceedings of the international conference "Origin of the State. Predynastic and Early Dynastic Egypt," Kraków, 28 August – 1st September 2002* [=*OLA* 138] (pp. 67–130). Leuven; Dudley, MA: Peeters

Van Neer, W., Linseele, V., Friedman, R., and De Cupere, B. (2014). More evidence for cat taming at the predynastic elite cemetery of Hierakonpolis (Upper Egypt). *Journal of Archaeological Science*, 45, 103–111

Visser, E. (1938). *Götter und Kulte im ptolemäischen Alexandrien*. Amsterdam: Noord-Hollandsche Uitg. Mij

von den Driesch, A. (1976). *A guide to the measurement of animal bones from archaeological sites* [=*Peabody Museum Bulletin* 1]. Cambridge, MA: Peabody Museum of Archaeology and Ethnology, Harvard University

von den Driesch, A. and Boessneck, J. (1983). A Roman cat skeleton from Quseir on the Red Sea coast. *Journal of Archaeological Science*, 10(3), 205–211

Weiss, K. (2012). *Ägyptische Tier- und Götterbronzen aus Unterägypten* II [=*Ägypten und Altes Testament* 81]. Wiesbaden: Harrassowitz

Winnicki, J.K. (2009). *Late Egypt and her neighbours: Foreign population in Egypt in the first millennium BC* [=*JJP Supplement* 12]. Warsaw: Raphael Taubenschlag Foundation

Yamaguchi, N., Driscoll, C.A., Kitchener, A.C., Ward, J.M., and Macdonald, D.W. (2004). Craniological differentiation between European wildcats (*Felis silvestris silvestris*), African wildcats (*F. s. lybica*) and Asian wildcats (*F. s. ornata*): implications for their evolution and conservation. *Biological Journal of the Linnean Society*, 83(1), 47–63