

Supplemental materials

Past distribution of the Burrowing Owl (*Athene cunicularia*) in the Lesser Antilles: new evidence from Saint Martin and Guadeloupe (F.W.I.).

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Archaeological and Palaeontological evidence.

The Grotte des Bambous is a small cave that opens onto a gully some one hundred meters from the eastern coast of Grande Terre Island (16°21'0.8" N, 61° 23'29.8" O WGS 84). The cave produced a single deposit containing naturally accumulated terrestrial fauna in addition to a pre-Columbian burial. Excavations in 2014 and 2016 (Lenoble 2016, Cochard et al. 2019) recovered a vertebrate assemblage from which 15 radiocarbon dates were obtained on bone collagen; 14 on the endemic extinct rodent *Antillomys rayi* and one from an ulna of *Athene cunicularia*. The dates range from 500 BCE to 1500 CE, demonstrating the deposits to cover the entire Ceramic period.

Folle Anse is a multi-layer pre-Columbian midden buried in the coastal sand ridge off the western shore of Marie-Galante (15°56'15.5" N, 61°20'9.4" O WGS 84). First discovered by M. Barbotin in 1966, the site was excavated over the following years (Barbotin 1970). Only part of the faunal assemblage from Barbotin's initial excavations was studied by several authors (Wing and Reitz 1982, Williams and Steadman 2001, Olson and Lopez 2008). R. Chenorkian resumed excavations from 1997 to 2000 (Chenorkian 1999a, 1999b), with the faunal material from the two first years of excavations studied by S. Grouard (2001) and C. Bochaton (2016). The material collected during the third and final year of excavations, from which the fossil *Athene cunicularia* specimen derives, was left unstudied. A series of 10 recently obtained radiocarbon dates on bone collagen from the extinct rodent *Antillomys rayi* indicate all the material from the most recent excavations to belong to the middle phase of the Late Ceramic Age, or between 1050 and 1300 CE (Cochard et al. 2019).

Blanchard, Blanchard 2, Cadet 2, and Cadet 3 are all situated on a fossil cliff approximately 200 m from the current southern shoreline of Marie-Galante (Lenoble et al. 2009). Excavated between 2012 and 2014, Grotte Blanchard is a 30 meter-long cave containing a 4-meter-deep deposit (Goetz et al. 2014). A thin pre-Colombian layer from the Late Ceramic Age caps a rich fossil-bearing deposit subdivided into twelve layers (Gala and Lenoble 2015, Bailon et al. 2016, Stoetzel et al. 2016). An age-depth model based on 16 radiocarbon dates obtained on organic guano (Royer et al. 2017) indicates this deposit to

range from 3.5 (layer 1) to 40 ka cal. at the base (layer 12). The carbon and nitrogen isotope compositions of fossil guano from this site provides a record of environmental changes during the Late Pleistocene from 40 to 10 ka cal (Royer et al. *op cit.*)

Grotte Blanchard 2 is a small crevice cave opening several meters above Grotte Blanchard (15°52'55.9" N, 61°14'2.3" O WGS 84). It contains a half-meter thick colluvial deposit interpreted as a historical Aubudon's shearwater nesting site (Mallye et al. 2018). An initial date obtained on a *Puffinus lhermineri* humerus from the middle part of the deposit provides an age of 1443-1631 CE, while three recent dates on *Antillomys rayi* bones scattered throughout the upper part of the deposit range from 800 to 1400 CE. This large chronology reflects the reworked nature of the faunal assemblage other than *P. lhermineri*, which were introduced into the cave by colluvial processes (Mallye et al. *op. cit.*).

Some one hundred meters west on the same fossil cliff face can be found the Cadet cave complex (15°52'55" N; 61°14'6.1" O WGS 84). The Abri Cadet 3 contains Late Glacial to Holocene fossil deposits (Stouvenot et al. 2014), while Grotte Cadet 2 is an Amerindian funerary cave (Courtaud 2011) that also contains natural deposits documenting the island's final Pleistocene vertebrates (Lenoble et al. 2009). The material examined from Grotte Cadet 2 was collected during a sampling campaign in 2013 (Lenoble 2014), and documents Unit 5a (11.5 to 14.5 kyr BCE), and overlying unit 4, which is Holocene in age, while the material examined from the Cadet 3 rockshelter groups together bones collected during the first excavation season in 2004 with material collected from new excavations carried out in June 2018 and January 2019. Details concerning the stratigraphy and age of this two sites can be found in Bochaton et al. (2015) for Cadet 2 and Stouvenot et al. (2014) for the Cadet 3 rockshelter.

The cave of Pointe Gros Rempart 6 opens onto the coastal terrace of La Désirade (16°19'41.6" N, 61° 0'49.2" O WGS 84). The site preserves a stratified fossil-bearing deposit documenting three periods (Boudadi-Maligne et al. 2016): the pre-Columbian Ceramic period (layers 4 and 3), the Colonial period (layer 2), which on La Désirade starts with the permanent French settlement in 1728, and a modern layer (layer 1). The layer 3 and 4 are bracketed by radiocarbon dates on charcoal of 299-507 CE obtained from the base of the layer 4 (Lyon-14287/SacA-50616) and another of 1297-1373 CE (Lyon-14478, SacA-51014) on a *Nyctycorax violacea* pedal phalanx from the summit of layer 3. This age range reveals these layers to document the near entirety of the Ceramic Age period.

The Hope Estate site is located on a plateau in the northeastern part of Saint Martin (18°5'18.4" N, 63° 2' 40." W). Excavations of this pre-Columbian village were carried out by

various teams from the 1980s to the early 2000s (Haviser 1991, Hénocq and Petit 1998, Hofman and Hoogland 1999, Bonnissent 2008). This site produced burials, postholes, and a number of middens rich in native terrestrial vertebrates and fish (Grouard 2004). A series of thirty-five radiocarbon dates place the occupation of the village to the early Ceramic period, between 500 BCE and 700 CE (Bonnissent 2008). The examination of a sample of sieve residue from the various excavation seasons, carried out in May 2019, made it possible to isolate a large number of bird remains, including a fragment of *Athene* from the Hénocq excavations (1993), which is the subject of this study.

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Taxonomic identification and osteological description.

Comparative skeletal specimens used in this study for identification are from different collections, see Materials and Methods section for museum acronyms.

Athene cunicularia: PACEA O-758 adult unsexed; MEC 280313-A female adult; MNHN-ZO-AC-1897-571 age and sex indeterminate; USNM 330646 age and sex indeterminate.

Athene cunicularia troglodytes: USNM 292563 male; USNM 292564 and USNM 225966 female

Additional Specimens Consulted

Athene noctua PACEA-O-106 juvenile; PACEA-O-1123 Adult.

Tyto alba: PACEA O-639 male adult; PACEA O-640 Adult; PACEA O-008; O-028; O-157; O-191; O-209; O-531; O-557 age and sex indeterminate.

Otus scops: PACEA O-205 age and sex indeterminate.

Megascops choliba: PACEA O-928 adult unsexed.

Megascops nudipes: USNM 562457 male; 501799 female.

Margarobyas lawrencii: USNM 554287 and 54236 female

Strix aluco: PACEA O-029; O-030; O-110; O-110bis; O-556; O-663 age and sex indeterminate.

Asio otus: PACEA O-034; O-646; O-408 age and sex indeterminate.

Asio flammeus : PACEA O-035; O-184; O-236; O-339; O-349; O-530; O-640 age and sex indeterminate.

Bone	Specimen	Locality	Reference	n	Sex	Age	n	GL (min.)	GL (max.)	GL (mean)	n	Bp (min.)	Bp (max.)	Bp (mean)	n	Bd (min.)	Bd (max.)	Bd (mean)	
COR	<i>A. c. troglodytes</i>	Hispaniola	Olson and Hilgartner 1982	3	indet.	indet.	3	24,6	26,1*	25,4	-	-	-	-	-	-	-	-	
	<i>A. c. floridana</i>	Bahamas		3	indet.	indet.	3	26	27,2	26,6	-	-	-	-	-	-	-	-	-
	<i>A. c. spp.</i>	Bahamas fossils		2	indet.	indet.	2	21,5	21,7	21,6	-	-	-	-	-	-	-	-	-
	<i>A. c. spp.</i>	Guadeloupe fossils	This study	2	indet.	indet.	2	25,5*	27,2	26,4	-	-	-	-	1	8,3	-	-	
HUM	<i>A. c. troglodytes</i>	Hispaniola	Olson and Hilgartner 1982; this study	3	1M-2F	ad.	3	47,9	51,5	49,7	3	9	10,2	9,6	3	8,5	8,9	8,7	
	<i>A. c. floridana</i>	Bahamas	Olson and Hilgartner 1982	3	indet.	indet.	-	-	-	-	3	10,5	10,6	10,6	3	8,7	9	8,9	
	<i>A. c. spp.</i>	Bahamas fossils	Olson and Hilgartner 1982	2	indet.	indet.	-	-	-	-	1	9,2	-	-	1	7,8	-	-	
	<i>A. c. spp.</i>	Guadeloupe fossils	This study	2	indet.	indet.	1	51,1	-	-	1	10,8	-	-	2	9	9,2	9,1	
ULN	<i>A. c. troglodytes</i>	Hispaniola	Olson and Hilgartner 1982; this study	3	1M-2F	ad.	3	59,8	62,1	61	3	5,7	6,2	6	-	-	-	-	
	<i>A. c. floridana</i>	Bahamas	Olson and Hilgartner 1982	3	indet.	indet.	-	-	-	-	3	5,5	6,3	5,9	-	-	-	-	
	<i>A. c. spp.</i>	Bahamas fossils	Olson and Hilgartner 1982	3	indet.	indet.	-	-	-	-	3	5	5,2	5,1	-	-	-	-	
	<i>A. c. spp.</i>	Guadeloupe fossils	This study	3	indet.	indet.	-	-	-	-	2	5,8	-	-	1	5,1	-	-	
CMC	<i>A. c. troglodytes</i>	Hispaniola	Olson and Hilgartner 1982	3	indet.	indet.	3	26,9	28,9	27,9	3	3,6	4	3,8	-	-	-	-	
	<i>A. c. floridana</i>	Bahamas		3	indet.	indet.	3	31,5	32,1	31,8	3	3,7	4	3,9	-	-	-	-	
	<i>A. c. spp.</i>	Bahamas fossils		4	indet.	indet.	1	25,3	-	-	3	3	3,5	3,3	-	-	-	-	
	<i>A. c. spp.</i>	Guadeloupe fossils	This study	4	indet.	indet.	1	30,6	-	-	1	6,5*	-	-	3	4,5	5	4,8	
FEM	<i>A. c. troglodytes</i>	Hispaniola	Olson and Hilgartner 1982	3	indet.	indet.	3	35,6	36,4	36	3	6,5	7,5	7,0	3	7	7,5	7,3	
	<i>A. c. floridana</i>	Bahamas		3	indet.	indet.	3	36,8	39,3	38,1	3	6,8	7,5	7,2	3	7	7,5	7,3	
	<i>A. c. spp.</i>	Bahamas fossils		6	indet.	indet.	1	34,5	-	-	4	5,9	6,6	6,3	1	6,6	-	-	
	<i>A. c. spp.</i>	Guadeloupe fossils	This study	1	indet.	indet.	-	-	-	-	1	6,3	-	-	-	-	-	-	
TIB	<i>A. c. troglodytes</i>	Hispaniola	Olson and Hilgartner 1982; this study	3	1M-2F	ad.	3	61,3	63,5	62,4	-	-	-	-	3	6,5	6,7	6,6	
	<i>A. c. floridana</i>	Bahamas	Olson and Hilgartner 1982	3	indet.	indet.	-	-	-	-	-	-	-	-	3	6,4	6,9	6,7	
	<i>A. c. spp.</i>	Bahamas fossils	Olson and Hilgartner 1982	8	indet.	indet.	-	-	-	-	1	6	-	-	7	5,4	6,4	5,9	
	<i>A. c. spp.</i>	Guadeloupe fossils	This study	8	1 F	indet.	3	62,8	67,7	65,3	5	6,4	7,9	7,2	4	6,9	7,3	7,1	
TMT	<i>A. c. troglodytes</i>	Hispaniola	Ridgway 1914; Olson and Hilgartner 1982	23	10 M-10 F	indet.	20	38	45,5	41,8	3	6,4	6,7	6,6	3	7	7,1	7,1	
	<i>A. c. amauro</i>	Antigua et Nevis	Ridgway 1914	6	3 M-3 F	indet.	6	39,5	41,5	41,5	-	-	-	-	-	-	-	-	
	<i>A. c. spp.</i>	Antigua fossils	This study	2	indet.	sub.	2	39,1	41,9	40,5	2	6,7	7,1	6,9	1	6,8	-	-	
	<i>A. c. floridana</i>	Bahamas	Ridgway 1914	15	6 M-6 F	indet.	12	41	46,5	43,8	3	6,7	7,1	6,9	3	7,1	7,8	7,5	
	<i>A. c. spp.</i>	Bahamas fossils	Olson and Hilgartner 1982; this study	10	indet.	indet.	-	-	-	-	3	5,5	5,8	5,7	5	5,5	5,8	5,7	
	<i>A. c. guadeloupensis</i>	Guadeloupe	Cory 1886; Ridgway 1914	3	indet.	indet.	3	42,5	46,2	44,4	-	-	-	-	-	-	-	-	
	<i>A. c. spp.</i>	Guadeloupe fossils	This study	6	indet.	1 sub.	2	46	47,3*	46,7	3	7	7,3	7,2	5	7,4	7,8	7,6	

Table S1. Measurements (mm) of *Athene cucularia* from the literature and fossils used in this study (*A. c. spp./Fossil*). GL (Greatest length); Bp (Breadth of the proximal end); Bd (Breadth of the distal end); sub. (subadult). The measurements of incomplete elements are marked with an asterisk. COR (coracoid), HUM (humerus), ULN (ulna), CMC (carpometacarpus), FEM (femur), TIB (tibiotarsus), TMT (tarsometatarsus).

		Holocene																	
		Pre-human						Preceramic				Ceramic				Colonial		Preceramic-Colonial	
		Blanchard	Cadet 2	Cadet 3	Blanchard	Blanchard	Cadet 3	HE	Cadet 3	PGR 6	Bambous	Folle Anse	Cadet 3	Blanchard 2	Cadet 2	Cadet 2	Total		
Unit	6	5	5a	J-K	2	1	5	B-D	3		1	A	4'						
Skull				3				(1)		1				1		5 (+1)			
Vertebra						1										1			
Sternum				1												1			
Coracoid				1 (1)				(1)		1 (+1)					1	3 (+3)			
Scapula				1				(1)			(1)		1			4 (+2)			
Humerus					1					2						3			
Radius				1				1							1	3			
Ulna								1		2					1	4			
Carpometacarpus						1 (+1)		1								4 (+1)			
Wing phalanges				(1)				1 (+2)		(1)					1	3 (+5)			
Femur														(1)		2 (+1)			
Tibiotarsus		2		(1)				5		1					1	9 (+1)			
Tarsometatarsus				1			1	3 (+2)	(1)	1 (+2)					2 (1)	9 (+6)			
Pedal phalanges	1		(2)			3	4 (+2)	6		3 (+5)					2 (+1)	21 (+10)			
Total	1	2	(3)	8 (+3)	1	5 (+1)	10 (+2)	18 (+7)	(1)	12 (+9)	(1)	2 (+1)	1	11 (+2)	72 (+30)				

Table S2. Skeletal elements of *Athene cunicularia* and cf. *Athene cunicularia* (in brackets) from all levels of the 8 sites.

	Species	Island	Site	Type	Chronology	References
LESSER ANTILLES	<i>Athene cunicularia</i>	Sint Eustatius	Golden Rock	c	Early Ceramic	Van der Klif 1992
		Barbuda	Rat Pocket	nc	Pleistocene?	Pregill et al. 1994
			Two Foot Bay I-III, V			
		Antigua	Coconut Hall	c	Early Ceramic	Healy et al. 2001
			Royall's site		?	
			Indian Creek, Hawkes Bay		?	
Burma Quarry			c/nc	Late Holocene	Steadman et al. 1984 ; Pregill et al. 1988	
Mill Reef		c	Late Ceramic	Wing et al. 1968		
GREATER ANTILLES		Mona	?	?	?	Olson and Hilgartner 1982
		Hispaniola	?	?	?	Bernstein 1965
		Cuba	?	nc	?	Olson and Hilgartner 1982
		Grand Cayman	Dolphin Cave	?	?	Morgan 1994
	Patton's Fissure		?	Late Pleistocene		
	Cayman Brac	Pollard Bay Cave and Spot Bay Cave.	?	?		
		Little Exuma	Upper pasture cave	nc	?	Wetmore 1937; Olson and Hilgartner 1982
	New Providence	Banana Hole	nc	?	Olson and Hilgartner 1982	
		Sawmill Sink	nc	Pleistocene	Steadman et al. 2007	
	Abaco	Hole-in-the-Cave	nc	Holocene	Steadman and Franklin 2015	
<i>Athene cf. cunicularia</i>	Jamaica	Long Mile Cave	-	?	Olson and Steadman 1977	
<i>Athene sp.</i>	Porto Rico	caves	nc	Pleistocene	Pregill and Olson 1981	

Table S3. List of the sites that produced *Athene cunicularia* remains. Type of site: nc=non cultural c=cultural.



Figure S1. Characters of the *Athene cunicularia* coracoid: (1) *procoracoid process*; (2 – 3) shape of head and the glenoid facet (see Fig. 4 Olson & Hilgartner 1982). Left dorsal surface from Grotte des Bambous (BAM 2017-138).

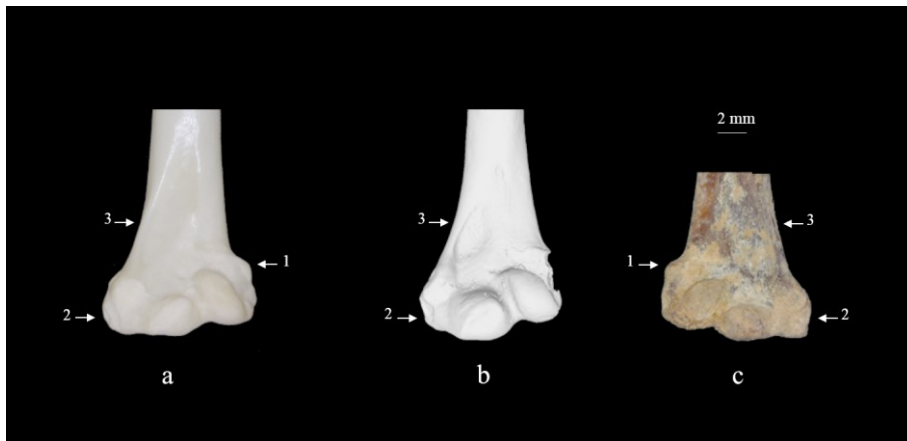


Figure S2. Characters of the *Athene cunicularia* distal humerus: (1) entepicondylar area; (2) ectepicondylar process; (3) brachial depression (see Fig. 5 Olson & Hilgartner 1982). Right cranial surface. (a) reference collection (MEC 280313-A); (b) Grotte des Bambous (BAM-03) and (c) Grotte Blanchard (O-215).



Figure S3. Left tarsometatarsi of *Athene cunicularia* in dorsal view. (a) reference collection (PACEA O-758); (b) Grotte des Bambous (BAM-04); (c-d) Burma Quarry in Antigua (USNM 330646).



Figure S4. Left tarsometatarsi in plantar surface. (a) *Athene cunicularia* from the reference collection (PACEA O-758) and (b) from Grotte des Bambous (BAM-04); (c) *Margarobyas lawrencii* from the reference collection (USNM 554287).

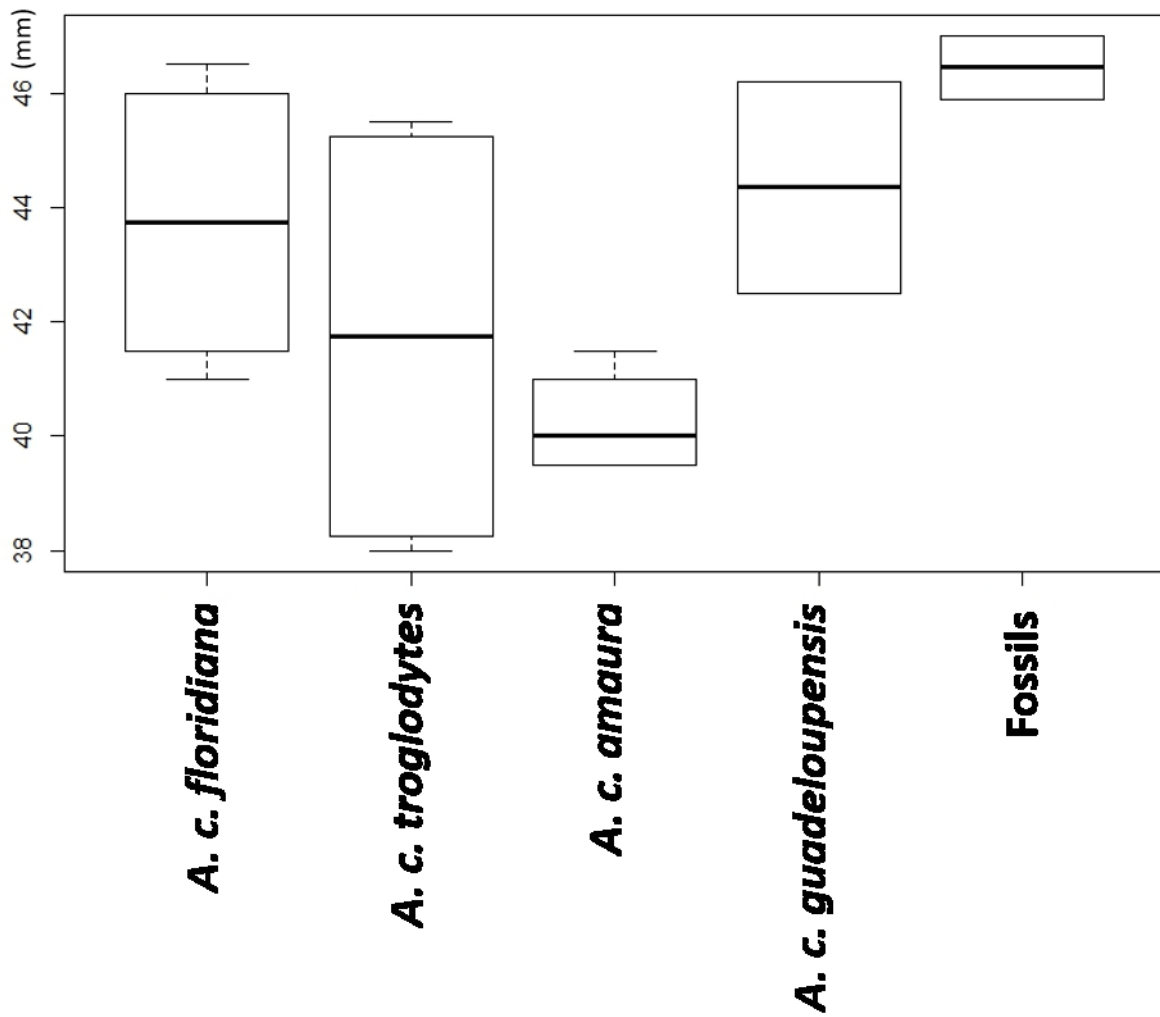


Figure S5. Greatest length (GL) in mm of the tarsometatarsus of subspecies of Burrowing Owl in West Indian and the fossils in this study (*A.c.* spp./Fossil).

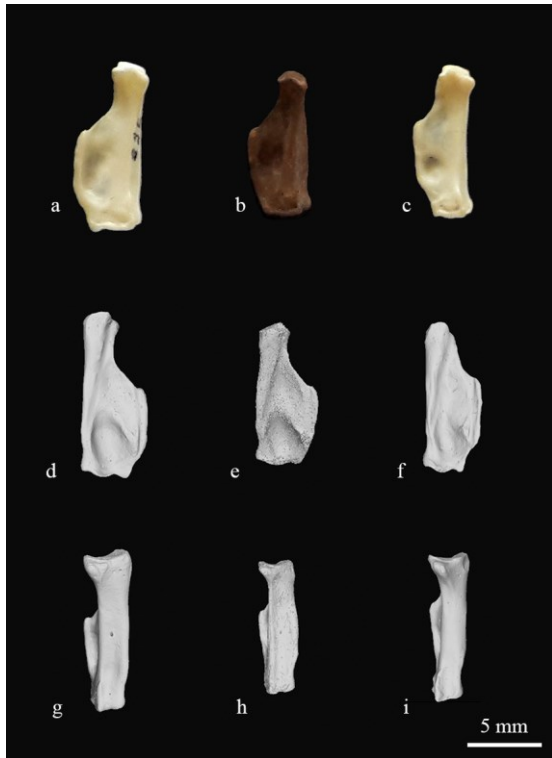


Figure S6. Left first wing phalanx of (a,d,g) *Athene cunicularia* from the reference collection (PACEA O-758) and (b,e,h) from Abri Cadet 2; (c,f,i) *Megascops choliba* (PACEA O-928). (a-c) ventral aspect; (d-f) ventral aspect; (g-i) cranial aspect.

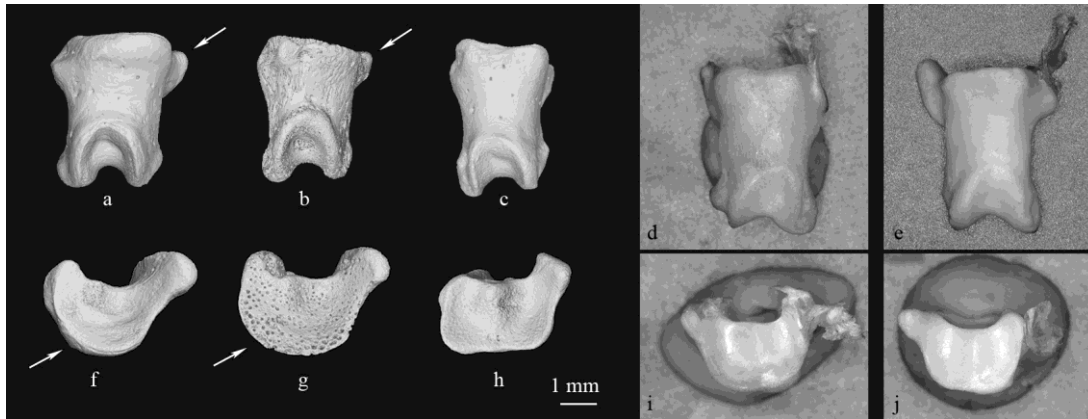


Figure S7. Right *pedal phalanx I* of the digit III of (a, f) *Athene cunicularia* from reference collection (PACEA O-758) and (b, g) Abri Cadet 2, (c, h) *Megascops choliba* (PACEA O-928), (d, i) *Megascops nudipes* (USNM 501799) and (e, j) *Margarobyas lawrencii* (USNM 554287). (a-e) dorsal surface; (f-j) proximal end.



Figure S8. Right pedal phalanx 1 of the digit II in plantar surface. (a) *Athene cunicularia* from the reference collection (PACEA O-758) and (b) Grotte de Cadet 2, (c) *Megascops choliba* (PACEA O-928), (d) *Margarobyas lawrencii* (USNM 554287).