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A New Species of Late Pleistocene Rail (Aves: Rallidae) from Abaco, the Bahamas[1]

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Abstract—We describe a new species of rail from the Sawmill Sink blue hole on Abaco Island in the northern Bahamas. Known from abundant, beautifully preserved Late Pleistocene fossils, *Rallus cyanocavi* sp. nov. was a medium-sized, flightless species that probably was endemic to the Little Bahama Bank, which is a carbonate platform surrounded by deeper water. We are uncertain whether *R. cyanocavi* survived into the Holocene, when higher sea levels transformed the Little Bahama Bank from a single large, Late Pleistocene island (ca. 12000 km^2) to the scattering of smaller islands seen today, the largest of which is Abaco (1681 km^2). Fossils of additional extinct, flightless species of *Rallus* probably await discovery on some of the 21 other carbonate banks that span the Bahamian Archipelago.

Keywords: Rails, *Rallus*, Late Pleistocene, Bahamas, blue holes, extinction, flightlessness

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INTRODUCTION

Rails are especially prevalent among the extinct species of birds known from oceanic islands worldwide. Most insular species of rails were flightless and were endemic either to a single island or to a set of nearby islands that had been conjoined during glacial intervals when sea levels were lower than those of today (Steadman, 2006). On island after island, flightlessness became fatally disadvantageous after the arrival of humans and their accompanying non-native mammals such as various rodents (especially species of Muridae), pigs, and dogs.

In the West Indies, we are just beginning to understand the true distribution and diversity of flightless rails. The genus *Nesotrochis* is represented by three large, flightless, extinct species of the Greater Antilles, namely *N. debooyi* Wetmore, 1918 of Puerto Rico and the nearby Virgin Islands (Wetmore, 1918), *N. picapicensis* Fischer and Stephan, 1971 of Cuba (Fischer and Stephan, 1971), and *N. steganinos* Olson, 1974 of Hispaniola (Olson, 1974b). *Nesotrochis debooyi* certainly survived into prehistoric if not even historic times (Olson, 1977; Carlson and Steadman, 2009), whereas the other two species are known from Late Quaternary non-cultural deposits that have not yet been determined to be Late Pleistocene vs. Holocene in age. All three species of *Nesotrochis* were flightless (see Olson, 1977: Fig. 1). The only other West Indian rallid known to have reduced powers of flight is the Zapata Rail *Cyanolimnas cerverai* Barbour and Peters, 1927, a monotypic genus (as currently understood) consisting of an endangered, weakly volant species confined to several wetland areas in Cuba (Barbour and Peters, 1927; Raffaele et al., 1998; Taylor, 1998; Garrido and Kirkconnell, 2000). In its thick, deep bill (as opposed to the slender, shallow bill of *Rallus*), *C. cerverai* is similar to the two species of *Neocrex*, which may be related either to crakes (*Porzana* spp.) or gallinules (*Gallinula* spp.).

Until recently, in spite of a fairly substantial avian fossil record (Olson and Hilgartner, 1982), no flightless species of rails had been recorded from the Bahamian Archipelago, a set of limestone islands that stretches 900 km from ca. 27°N and 79°W in the northwest to ca. 21°N and 71°W in the southeast, and consists politically of the independent Commonwealth of the Bahamas (or "The Bahamas") and the Turks and Caicos Islands, a British Protectorate. Considering all of the 22 separate carbonate banks on which these islands are developed, the NW-to-SE extent of this archipelago was expanded to 1300 km during the last glacial maximum (25 to 18 ka) when sea level was as much as 130 m lower than today (Rabineau et al., 2006).

Because of scuba diving during the past decade in flooded caverns known as blue holes, a wealth of new information is being disclosed about the amphibians, reptiles, birds, and mammals that inhabited the Bahamian islands before human arrival about 1000 years ago (Keegan, 2007; Steadman et al., 2007; Franz and

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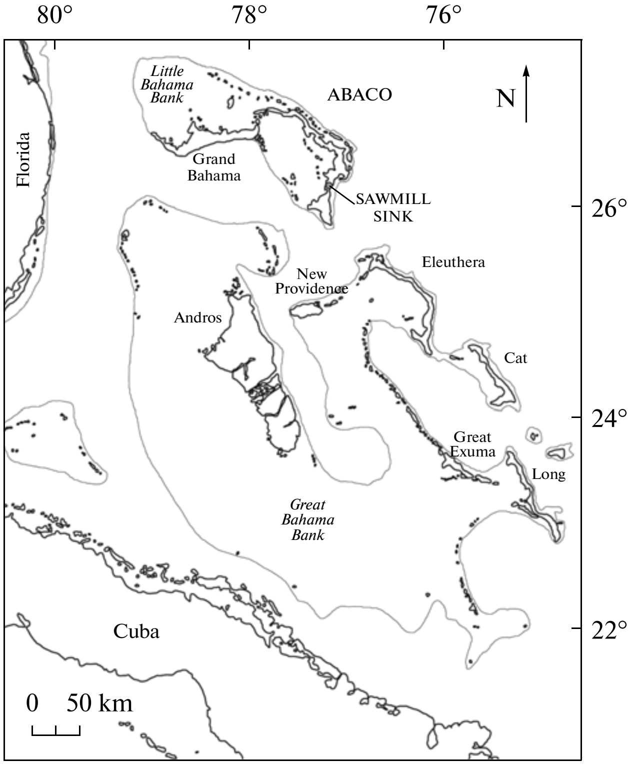

Fig. 1. The map of the Northwestern part of the Bahama Archipelago, showing the location of Abaco Island and the Sawmill Sink blue hole.

Franz, 2009). For example, the rich and growing fossil record on Abaco includes a number of extant species that still inhabit the island as well as many species that either are extinct or that do not exist today on Abaco. Within blue holes, the fossils occur mainly in Holocene peat deposits on submerged talus cones or from more deeply submerged Late Pleistocene owl roost deposits on ledges developed in the limestone walls.

The richest fossil assemblages discovered thus far on Abaco are from a blue hole called Sawmill Sink (Fig. 1), where both Holocene and Late Pleistocene sediments are highly fossiliferous (Steadman et al., 2007; Franz and Franz, 2009). The fossils of rails that we are about to describe are from Late Pleistocene microvertebrate contexts (owl roosts) discovered and collected by scuba divers. These deposits in Sawmill Sink are at depths ranging from 85 to 110 ft (25.9 to 33.5 m below present sea level). We interpret them to be owl roosts because they consist of concentrated microvertebrate remains (frogs, lizards, snakes, small birds, and bats) typical of West Indian roosts of the extant barn-owl (*Tyto alba*). In the case of Sawmill Sink, the lack of remains of the hutia (*Geocapromys ingrahami*) in the owl roost deposits is compatible with the fact that *T. alba*, rather than the larger, extinct *T. pollens*, is the only species of barn-owl that we have identified as a fossil. Extrapolating from high-resolution sea-level estimates (Clark and Mix, 2000; Bard et al. 2010), the minimum age for the owl roost deposits would be ca. 10,000 to 9,000 calendar years before present.

MATERIALS AND METHODS

Skeletons used for comparisons are from Florida Museum of Natural History (UF). We examined these modern specimens: *Aramides cajanea*, specimen UF, no. 24341; *Pardirallus maculatus* specimens UF, nos. 24340, 24348; *P.* (*Ortygonax*) *sanguintolentus*, specimens UF, nos. 45597, 45711; *Rallus elegans*, specimens UF, nos. 24312, 24313, 24314, 24315, 40098, 40954, 40955, 40967, 43215, 45759; *R. longirostris*, specimens UF, nos. 01981, 11691, 13600, 24200, 24296, 24297, 24299, 24303, 40956, 43100, 43325; *R. limicola*, specimens UF, nos. 19769, 21836, 24317, 24318, 24319, 24320, 24321, 24322, 24324, 24325, 43893, 46927; *R. aquaticus*, specimen UF, no. 34461; *Porzana carolina*, specimens UF, nos. 40961, 42848; *P. flaviventer*, specimen UF, no. 42672; *Laterallus jamaicensis*, specimen UF, no. 43067; *L. leucopyrrhus*, specimen UF, no. 24349; *Coturnicops novaeboracensis*, specimen UF, no. 24356; *Gallinula* (*Porphyriops*) *melanops*, specimen UF, no. 24357; *G. chloropus*, specimen UF, no. 39927; *Porphyrio martinicus*, specimens UF, nos. 39927, 42418, 42419; and *Fulica americana*, specimen UF, no. 40338. Following the classification of Olson (1973), the only Neotropical genera of rails for which we were unable to examine specimens are as follows: *Anurolimnas* (3 small species of mainland South America; probably close to *Laterallus*); *Amaurolimnas* (single species from Mexico to Brazil; in the West Indies, formerly only on Jamaica; thick, deep bill; likely related to *Aramides*); *Cyanolimnas* (monotypic; Cuban; thick, deep bill; see Introduction). The 142 fossil specimens of the newly described species from Abaco are cataloged in the UF Vertebrate Paleontology Collection as UF, nos. 241501-241642. They represent a minimum of 11 individuals, based on the left tibiotarsus.

We also examined other fossil specimens of rails in the UF Vertebrate Paleontology Collection, as follows: *Nesotrochis steganinos* UF uncataloged from Late Quaternary cave sites in Haiti (Trouing Jeremie no. 3) and Dominican Republic (Cabo Rojo); *Rallus recessus*, specimens UFPB (Florida Museum of Natural History, specimens from the Collection of Pierce Brodkorb), nos. 5116 (rostrum), 5858-5865 (coracoids), 5285 (scapula), 5195, 5196 (humeri), 5242–5247 (ulnae), 5340 (carpometacarpus), 5302, 5303 (femora), 5939, 5947–5949 (tibiotarsi), 5754, 5791, 5798 (tarsometatarsi), Bermuda; *Rallus ibycus*, specimens UFPB, nos. 5521 (rostrum), 5404, 5415, 5441, 5456 (coracoids), 5477 (scapulae), 5457, 6068 (humeri), 5406, 5423, 5440, 5458, uncatalogued (7 ulnae), 5407, uncatalogued (5 carpometacarpi),

Fig. 2. Crania and rostra of *Rallus cyanocavi* sp. nov. and extant species of *Rallus* in lateral aspect: (a) *R. elegans* Audubon, 1834, specimen UF, no. 45759, ♀, (b) *R. longirostris* Boddaert, 1783, specimen UF, no. 24297, ♀, (c) *R. limicola* Vieillot, 1819, specimen UF, no. 24320, ♀, (d, e, f) *R. cyanocavi* sp. nov.: (d) specimen UF, no. 241609; (e) specimen UF, no. 241621; (f) specimen UF, no. 241607; all sex unknown. Scale bar, 0.5 cm.

5436, 5438 (femora), 5541, 5542 (tibiotarsi), 5445, 5446 (tarsometatarsi), Bermuda.

Measurements were taken with electronic digital calipers (Fowler & NSK MAX-CAL) with 0.01 mm increments, rounded to the nearest 0.1 mm. Photographs were taken with a Canon EOS 5D Mark II digital camera. Osteological terminology follows that of Baumel and Witmer (1993).

SYSTEMATIC PALEONTOLOGY

Order Gruiformes

Family Rallidae Vigors, 1825

Genus *Rallus* Linnaeus, 1758

Rallus cyanocavi Steadman, Morris et Wright, sp. nov.

Etymology. From the Greek word *kyanos*, meaning dark blue and the Latin word *cavus* (hole, hollow; Brown, 1956). The name *cyanocavi* ("of a blue hole") refers to the submerged cavern or "blue hole" in which the specimens of this rail were recovered by highly skilled scuba divers, primarily Brian Kakuk.

Holotype. UF, no. 241537, complete tarsometatarsus; the Owl Roost deposit, Sawmill Sink, Great Abaco Island, Commonwealth of the Bahamas; Late Pleistocene.

Paratypes. Specimens UF, nos. 241501-251536, 251538-241642, 4 rostra, 2 mandibles, 8 sterna, 6 coracoids, 4 scapulae, 18 humeri, 11 ulnae, 5 radii, 4 carpometacarpi, 5 pelves, 9 femora, 23 tibiotarsi, 13 tarsometatarsi, 27 pedal phalanges; type locality.

Description (Figs. 2d, 2f, 3d, 3h, 31, 3p, 4d, 4h, 41). Rostrum: long, narrow, and shallow. Coracoid: acrocoracoid extends more medially, and processus procoracoideus extends farther cranially, such that the sulcus musculi supracoracoidei (foramen triosseum) is smaller; impressio musculi sternocoracoidei shallow. Scapula: facies articularis clavicularis relatively small and pointed. Humerus: in dorsal aspect, crista pectoralis extends farther distad relative to crista bicipitalis; proximal one-third of ventral corpus humeri more angled (less rounded); fossa musculi brachialis relatively deep; processus flexorius relatively small, leading to a shallow fossa olecrani. Ulna: corpus

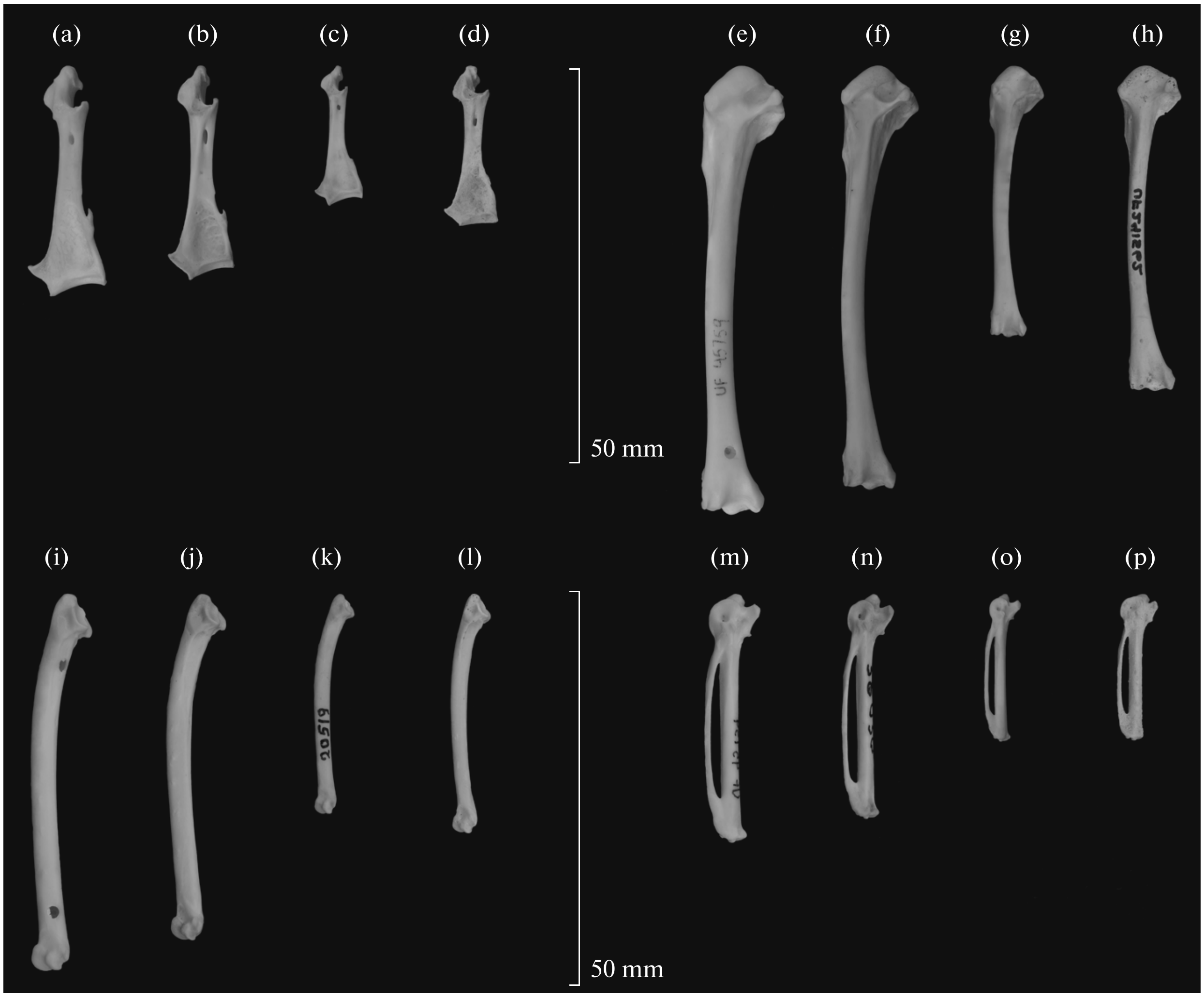

Fig. 3. Pectoral girdle and wing bones of *Rallus cyanocavi* sp. nov. and extant species of *Rallus:* (a, e, i, m) *Rallus elegans* Audubon, 1834, specimen UF, no. 45759, ♀, (b, f, j, n) *R. longirostris* Boddaert, 1783, specimen UF, no. 24297, ♀, (c, g, k, o) *R. limicola* Vieillot, 1819, specimen UF, no. 24320, ♀, (d, h, l, p) *R. cyanocavi* sp. nov.: (d) specimen UF, no. 241611; (h) specimen UF, no. 241562; (l) specimen UF, no. 241517; (p) specimen UF, no. 241587; all sex unknown, (a–d) coracoids in dorsal aspect, (e–h) humeri in anconal aspect, (i–l) ulnae in ventral aspect, (m–p) carpometacarpi in ventral aspect. Elements g, h, m, n, p shown as mirror images. Scale bars, 0.5 cm.

ulnae thin in dorsolateral aspect; cotyla dorsalis relatively small in medial aspect. Carpometacarpus: proximal juncture of os metacarpal minus and os metacarpale majus relatively close to processus pisiformis. Femur: crista trochanteris large in medial aspect; corpus femoris slender relative to its length; lineae intermusculares relatively distinct. Tibiotarsus: dorso-lateral and dorso-medial margins of corpus tibiotarsi relatively sharp rather than rounded; impressio ligamentum collateralis medialis relatively deep; crista cnemialis cranialis small in ventral aspect. Tarsometatarsus: corpus tarsometatarsi slightly wider than deep; medial sulcus hypotarsi not enclosed; fossa parahypotarsalis medialis shallow; acrotarsial surface of corpus metatarsi shallowly concave in proximal one-half (deeper in most others); fossa metatarsi I shallow; crista plantaris mediana slopes gradually (not steeply) to hypotarsus. The pedal phalanges also are referred to *Rallus* on the basis of size and proportions (generally stouter than in *Porzana*, *Laterallus*, or *Porphyrio*).

Measurments. See Table 1.

Comparisons. A medium-sized, flightless species of *Rallus* that differs from other species of *Rallus* as follows. Rostrum: tip more rounded (less pointed) in both dorsal and lateral aspects (Figs. 2d, 2e, 2f). Coracoid (Fig. 3d): sulcus musculi supracoracoidei relatively shallow; in lateral aspect, facies articularis humeralis more protrudent from corpus coracoidei, especially on sternal side; in dorsal or ventral aspect, margin of facies articularis sternalis straight (concave in others). Scapula: facies articularis humeralis relatively narrow and elongate. Humerus (Fig. 3h): tuber-

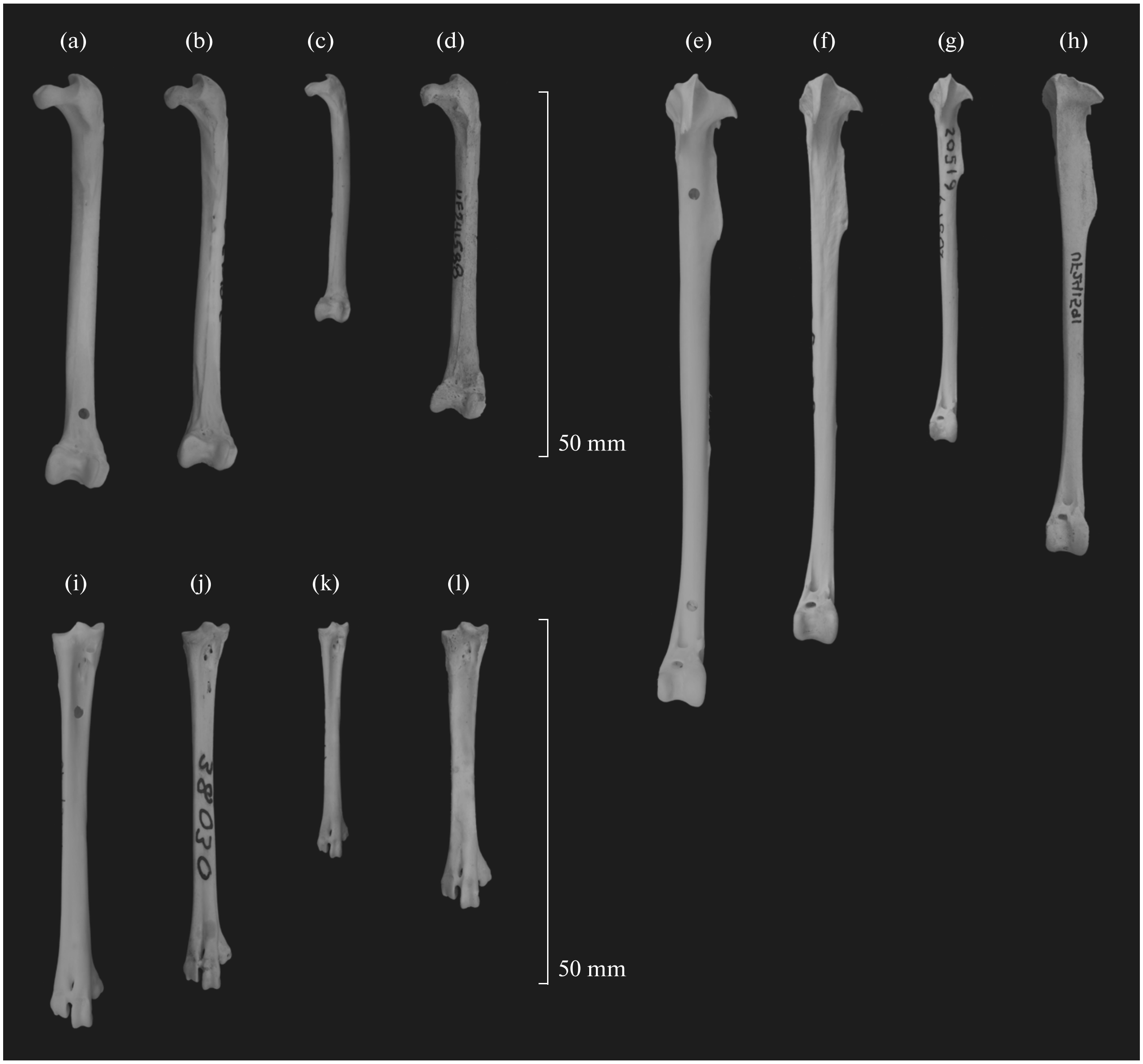

Fig. 4. Hindlimb bones of *Rallus cyanocavi* sp. nov. and extant species of *Rallus:* (a, e, i) *Rallus elegans* Audubon, 1834, specimen UF, no. 45759, (b, f, j) *R. longirostris* Boddaert, 1783, specimen UF, no. 24297, ♀, (c, g, k) *R. limicola* Vieillot, 1819, specimen UF, no. 24320, ♀, (d, h, l) *R. cyanocavi* sp. nov.: (d) specimen UF, no. 241588; (h) specimen UF, no. 241591; (l) specimen UF, no. 241537; all sex unknown, (a–d) femora in posterior aspect, (e–h) tibiotarsi in anterior aspect, (i–l) tarsometatarsi in acrotarsial aspect. Elements c, h, i, k shown as mirror images. Scale bars, 0.5 cm.

culum dorsale relatively large and highly protrudent from corpus humeri; corpus humeri relatively thin and curved (agrees in this character with *R. ibycus*); fossa olecrani shallow; processus supracondylaris dorsalis elongate. Ulna (Fig. 31): in anterior or posterior aspect, no notch visible between olecranon and cotyla dorsalis; depression musculo brachialis deep and well defined; corpus ulnae more ovoid (less circular) in cross-section. Carpometacarpus (Fig. 3p): os metacarpal relatively short; in dorsal or ventral aspect, trochlea carpalis more pointed (less rounded; agrees in this character with *R. ibycus*); processus extensorius less protrudent. Femur (Fig. 4d): obturator ridge elongate; lower one-fourth of corpus femoris expanded (more or less uniform width in other species); crista tibiofibularis more rounded (less pointed) in lateral aspect (agrees in this character with *R. ibycus*). Tibiotarsus (Fig. 4h): crista fibularis relatively long. Tarsometatarsus (Fig. 41): corpus metatarsi proportionately stout; in plantar aspect, trochleae metatarsi relatively short but splayed more medially and laterally. We note here that some of these characters in pectoral and

Table 1. Skeletal measurements (in mm) in *Rallus cyanocavi* sp. nov. and extant species of *Rallus*, with mean (in bold), range (below the bold line), and sample size (third line in each row). F, female; M, male; U, sex unknown. Specimens of all available subspecies of *R. longirostris* are combined, given that subspecific differences in size are much smaller than size differences between males and females. Wing length/leg length = (humerus length + ulna length + carpometacarpus length)/(femur length + tibiotarsus length + tarsometatarsus length). Measurements of the extinct *R. ibycus* and *R. recessus* of Bermuda are from Olson and Wingate (2000, 2001) except for those with an asterisk (*), which we took ourselves. Measurements of *R. aquaticus* (Europe) and the extinct *R. recessus* (Pityusic Islands) are from McMinn et al. (2005) except for those with an asterisk (*), which we took ourselves

Skeletal Element	*R. cyanocavi*	*R. longirostris*		*R. elegans*		*R. limicola*		*R. ibycus*	*R. recessus*	*R. aquaticus*	*R. eivissensis*
Sex	U	M	F	M	F	M	F	U	U	F	U
Coracoid length (head to internal distal angle)	**20.3**	**27.7**	**26.8**	**30.6**	**28.0**	**18.0**	**17.1**	**17.7***	**23.3**	**18.5**	–
		26.5–28.7	25.4–28.3	29.6–32.3	27.6–28.6	16.8–18.9	16.2–17.7	15.4–19.5	20.5–25.1		
	1	5	5	5	5	5	5	4	38	1	
Coracoid least width of shaft	**2.1**	**2.9**	**2.8**	**3.2**	**3.0**	**2.0**	**2.0**	–	–	**2.0***	–
	1.9–2.5	2.8–3.0	2.6–2.9	3.0–3.5	2.9–3.3	1.9–2.1	1.9–2.2			1	
	4	5	5	5	5	5	5				
Humerus length	**39.9**	**56.6**	**54.6**	**61.5**	**56.3**	**37.0**	**34.7**	**32.3**	**43.7**	**38.8**	**35.3**
	37.5–41.8	54.4–57.4	52.1–59.0	60.3–63.0	54.7–59.7	35.0–38.1	31.9–36.4	28.5–36.3	39.7–47.4	34.3–37.9	32.4–37.9
	7	5	5	5	5	5	5	18	60	34	18
Humerus midshaft width	**2.2**	**3.2**	**3.2**	**3.8**	**3.5**	**2.2**	**2.0**	**1.9**	**2.6**	**2.4**	**2.2**
	1.8–2.4	2.9–3.5	3.0–3.5	3.4–3.9	3.2–3.7	2.1–2.3	1.8–2.2	1.7–2.2	2.2–2.9	1.7–2.8	1.8–2.4
	15	5	5	5	5	5	5	18	60	35	26
Humerus proximal width	**8.0**	**10.9**	**10.7**	**12.6**	**11.1**	**7.1**	**7.0**	**6.6**	**9.4**	**8.0**	**7.3**
	7.3–8.7	10.6–11.3	10.1–11.3	12.1–13.0	10.8–11.5	6.9–7.4	6.8–7.3	6.0–7.2	8.4–10.5	7.3–8.7	5.2–8.2
	13	5	5	5	5	5	5	18	59	34	26
Humerus distal width	**5.6**	**7.5**	**7.3**	**8.7**	**7.8**	**4.9**	**4.6**	**4.4**	**6.1**	**5.3**	**4.8**
	5.3–5.9	7.3–7.8	6.9–7.9	8.4–9.0	7.5–8.1	4.6–5.0	4.3–4.8	4.0–4.8	5.6–6.7	4.8–5.7	4.4–5.4
	8	5	5	5	5	5	5	18	60	34	22
Ulna length	**29.3**	**45.9**	**44.6**	**51.1**	**47.2**	**30.4**	**28.1**	**24.8***	**34.1**	**31.2**	**27.0**
	28.1–31.0	44.0–46.9	41.9–48.8	49.9–52.0	44.6–49.9	28.9–31.7	26.0–29.9	22.8–26.8	29.3–37.3	25.0–33.9	24.8–28.6
	6	5	5	5	5	5	5	7	45	33	14
Ulna midshaft oblique width	**1.6**	**2.2**	**2.2**	**2.7**	**2.4**	**1.6**	**1.5**	–	–	**1.7**	–
	1.5–1.8	2.1–2.4	2.1–2.3	2.4–2.8	2.2–2.6	1.5–1.7	1.4–1.5			1.2–2.0	
	9	5	5	5	5	5	5			33	
Ulna proximal width	**3.7**	**5.0**	**5.0**	**5.9**	**5.2**	**3.4**	**3.0**	–	–	**3.5**	**3.2**

Table 1. (Contd.)

Skeletal Element	*R. cyanocavi*	*R. longirostris*		*R. elegans*		*R. limicola*		*R. ibycus*	*R. recessus*	*R. aquaticus*	*R. eivissensis*
Sex	U	M	F	M	F	M	F	U	U	F	U
	3.6–3.8	5.0–5.3	4.8–5.5	5.7–6.1	5.0–5.5	3.1–3.5	2.9–3.1			3.1–3.9	2.8–3.6
	4	5	5	5	5	5	5			32	14
Ulna distal depth	**3.1**	**4.4**	**4.4**	**5.1**	**4.5**	**2.9**	**2.7**	–	–	**2.9**	**3.2**
	3.0–3.3	4.1–4.7	4.1–4.9	5.0–5.2	4.2–4.7	2.8–3.0	2.6–2.9				2.9–3.4
	7	5	5	5	5	5	5			1	14
Radius length	**28.3**	**41.9**	**40.8**	**46.9**	**43.2**	**28.0**	**25.9**	–	**31.4**	**27.3***	–
	1	39.8–42.7	38.3–44.2	46.1–47.7	40.8–46.1	26.6–29.3	23.9–27.3		28.1–34.3		
		5	5	5	5	5	5		18	1	
Radius least width of shaft	**1.1**	**1.3**	**1.4**	**1.5**	**1.4**	**0.9**	**0.9**	–	–	**0.9***	–
	1.0–1.1	1.3–1.4	1.2–1.5	1.4–1.6	1.3–1.6	0.9–1.0	0.8–0.9				
	4	5	5	5	5	5	5			1	
Radius proximal width	**2.0**	**2.9**	**2.8**	**3.3**	**3.0**	**1.9**	**1.8**	–	–	**1.8***	–
	1.9–2.1	2.8–3.0	2.8–3.0	3.1–3.5	2.8–3.2	1.8–1.9	1.7–1.9				
	2	5	5	5	5	5	5			1	
Radius distal width	**2.9**	**3.7**	**3.6**	**4.2**	**3.7**	**2.5**	**2.3**	–	–	**2.5***	–
	2.8–2.9	3.5–3.8	3.3–3.9	4.1–4.3	3.5–3.8	2.3–2.7	2.1–2.4				
	3	5	5	5	5	5	5			1	
Carpometacarpus length	**18.6**	**29.5**	**29.3**	**33.9**	**30.9**	**20.2**	**18.7**	**14.8***	**22.9**	**21.5**	**18.5**
	18.0–19.0	28.3–30.2	27.8–32.0	32.9–35.4	29.3–32.4	19.2–21.6	17.6–19.5	13.9–16.9	20.5–24.5	19.4–23.3	15.9–20.8
	3	5	5	4	5	5	5	5	27	31	13
Carpometacarpus proximal depth	**4.8**	**6.4**	**6.4**	**7.2**	**6.6**	**4.2**	**4.0**	–	**5.5**	**4.7**	**4.5**
	4.8–4.8	6.2–6.5	5.9–7.0	6.9–7.4	6.1–7.0	4.0–4.4	3.9–4.2		5.0–5.9	4.2–5.1	4.2–4.9
	2	5	5	4	5	5	5		27	31	10
Femur length	**45.1**	**56.0**	**54.1**	**61.0**	**56.1**	**37.6**	**35.4**	**37.9**	**49.1**	**41.5**	**37.2**
	44.0–47.1	53.3–57.7	51.7–58.4	60.2–62.9	54.7–59.3	36.1–38.7	33.6–37.2	34.9–41.5	44.3–52.4	37.6–44.8	34.2–40.8
	3	4	5	5	5	5	5	16	26	34	13
Femur midshaft width	**3.1**	**3.6**	**3.5**	**4.2**	**3.8**	**2.5**	**2.4**	–	–	**2.7**	**2.7**
	2.9–3.3	3.5–3.8	3.3–3.6	4.1–4.4	3.4–4.1	2.4–2.6	2.2–2.5			2.4–3.1	2.5–3.0
	7	4	5	5	5	5	5			34	14

Table 1. (Contd.)

Skeletal Element	*R. cyano-cavi*	*R. longirostris*		*R. elegans*		*R. limicola*		*R. ibycus*	*R. recessus*	*R. aquaticus*	*R. eivissen-sis*
Sex	U	M	F	M	F	M	F	U	U	F	U
Femur depth of head	**3.5** 3.3–3.7 8	**3.8** 3.6–4.0 4	**3.6** 3.4–3.9 5	**4.4** 4.1–4.5 5	**3.8** 3.5–4.1 5	**2.5** 2.3–2.8 5	**2.3** 2.2–2.4 5	–	–	**2.6*** 1	–
Femur distal width	**7.2** 6.8–7.7 3	**8.4** 8.2–8.7 4	**8.3** 7.7–9.0 5	**9.5** 9.3–9.8 5	**8.6** 8.4–8.8 5	**5.5** 5.1–5.7 5	**5.1** 4.9–5.5 5	**6.3** 5.7–7.1 15	**8.3** 7.5–8.8 26	**6.1** 5.4–6.9 34	**5.8** 5.2–6.3 13
Tibiotarsus length without cnemial crest	**61.0** 58.4–62.4 3	**78.4** 74.8–80.9 5	**75.7** 71.7–82.1 5	**89.0** 87.8–90.9 4	**81.8** 78.1–87.8 5	**54.7** 53.5–56.1 5	**50.7** 48.4–52.5 5	**50.5** 45.7–55.5 28	**66.3** 58.0–71.9 30	**64.7** 57.6–68.5 32	**54.6** 49.7–60.3 11
Tibiotarsus midshaft width	**2.9** 2.6–3.2 11	**3.5** 3.3–3.7 5	**3.5** 3.1–3.8 5	**4.0** 3.6–4.3 4	**3.7** 3.5–4.0 5	**2.4** 2.2–2.6 5	**2.2** 2.1–2.4 5	–	–	**2.4** 2.1–2.8 32	–
Tibiotarsus distal width	**6.0** 5.4–6.4 10	**6.5** 6.3–6.7 5	**6.4** 6.1–6.8 5	**7.2** 6.9–7.6 4	**6.5** 6.2–6.8 5	**4.3** 3.9–4.6 5	**4.0** 3.8–4.2 5	**5.2** 4.7–5.8 27	**6.6** 6.0–7.2 30	**5.1** 4.5–5.6 32	**4.9** 4.6–5.3 12
Tarsometatarsus length	**36.6** 33.8–38.8 3	**51.8** 48.1–55.1 5	**49.9** 47.7–54.6 5	**61.6** 60.6–63.6 4	**54.8** 51.9–58.8 5	**36.7** 35.3–39.5 5	**33.3** 32.1–34.7 5	**30.2** 27.1–34.3 19	**40.9** 36.6–44.6 29	**41.4** 37.0–45.3 33	**34.3** 29.8–37.2 22
Tarsometatarsus least width of shaft	**3.2** 3.0–3.4 9	**3.0** 2.8–3.1 5	**3.0** 2.6–3.3 5	**3.4** 3.1–3.5 4	**3.2** 2.9–3.4 5	**2.1** 2.1–2.3 5	**2.0** 2.0–2.1 5	–	–	**2.5** 2.2–2.8 32	**2.6** 2.2–3.0 23
Tarsometatarsus proximal width	**6.3** 5.8–6.6 5	**6.7** 6.5–7.2 5	**6.8** 6.5–7.2 5	**7.6** 7.4–7.7 4	**6.8** 6.5–7.2 5	**4.6** 4.4–4.8 5	**4.3** 4.1–4.4 5	**5.4** 5.1–5.9 18	**7.0** 6.3–7.6 29	**5.3** 4.8–5.8 32	**5.2** 4.2–5.8 23
Wing length/leg length	**0.615**	**0.709**	**0.715**	**0.692**	**0.697**	**0.679**	**0.683**	**0.606**	**0.644**	**0.692**	**0.641**
Carpometacarpus length/humerus length	**0.466**	**0.521**	**0.537**	**0.551**	**0.549**	**0.546**	**0.539**	**0.458**	**0.524**	**0.554**	**0.521**
Tarsometatarsus length/femur length	**0.811**	**0.925**	**0.922**	**1.010**	**0.977**	**0.976**	**0.941**	**0.801**	**0.833**	**0.986**	**0.922**

wing elements are developed to some extent in flightless species even in families other than rails, such as the ibises (Threskiornithidae; see Olson and Wetmore, 1976; Olson and Steadman, 1977, 1979; Olson and James, 1991).

Remarks. The combination of characters, mentioned above under the "description" section, allows for referring the fossil from Abaco to the genus *Rallus* rather than to other genera of Neotropical rails (*Nesotrochis, Aramides, Pardiralius, Porzana, Laterallus, Coturnicops, Porphyriops, Gallinula, Porphyrio, Fulica*).

In overall size, *Rallus cyanocavi* does not closely resemble any living congeneric species, being larger than *R. limicola* or *R. aquaticus* (especially in its leg elements) but consistently smaller than *R. elegans* and *R. longirostris* (especially in its wing and pectoral elements; Table 1, Fig. 3). The relative lengths of certain wing and leg elements are informative in distinguishing *R. cyanocavi* from its congeners except for the Middle Pleistocene *R. ibycus* of Bermuda (see Olson and Wingate, 2000). First, in overall wing length vs. leg length, *R. cyanocavi* and *R. ibycus* have the relatively shortest wing, being approached in that feature only by the flightless, Late Pleistocene *R. recessus* of Bermuda (believed to be descended from *R. elegans*; Olson and Wingate, 2001; table herein), and the flightless, Late Pleistocene and Holocene *R. eivissensis* of the Pityusic Islands, Mediterranean Sea (McMinn et al., 2005). Second, the carpometacarpus is much shorter relative to the humerus in *R. cyanocavi* or *R. ibycus* than in any congeners, an indication of extremely weak development of primary flight feathers. Third, the short, stout tarsometatarsus (relative to the femur) would suggest that *R. cyanocavi* and both of the flightless Bermudan species were slow runners, which would make sense on islands free of mammalian predators. These three characters are paralleled in the Old World when comparing flightless vs. volant species of *Gallirallus* (Kirchman and Steadman, 2006).

Material. Holotype; paratypes.

DISCUSSION

Rallus cyanocavi sp. nov. is the first species of flightless rail to be described from the Bahamian Archipelago. We suspect that additional species of extinct, flightless rails await discovery in blue holes (or other karst features) elsewhere in the island group. Nevertheless, it is puzzling that no evidence of flightless rails exists in any of the fossil sites on the Great Bahama Bank, such as on Great Exuma, Eleuthera, New Providence, and Andros (Wetmore, 1918; Olson and Higartner, 1982; D.W. Steadman, personal observations). Thus we must entertain the possibility that the largest carbonate bank in the Bahamian Archipelago (Fig. 1) never sustained flightless rails.

All fossils of *R. cyanocavi* found thus far are from Late Pleistocene microvertebrate (owl roost) contexts. While recognizing that negative fossil evidence is never absolute, we must consider that *R. cyanocavi* may not have survived into the Holocene. It could be that the enormous reductions in Bahamian land area that accompanied the Pleistocene-to-Holocene rise in sea level (overall ca. 90% loss of land area; Buden, 1987) led to this rail's demise. On the other hand, when compared to islands in the Atlantic and Pacific oceans, the current land area and elevation of Abaco (1681 km^2, 44 m) are more than adequate to sustain a long-term population of flightless rail. A priority of future research on Abaco is to develop a more comprehensive microvertebrate fossil record from Holocene deposits. Right now, fewer than 100 Holocene avian fossils have been recovered on Abaco, compared to >1000 avian fossils from the Late Pleistocene owl roost.

On a global scale, insular flightless rails include both very large and very small species (Olson, 1977; Olson and James, 1991; Steadman, 2006). Lacking clearly shared characters that would ally *R. cyanocavi* uniquely with a living species, it is difficult to speculate which mainland form of *Rallus* (the larger *R. longirostris* or *R. elegans* vs. the smaller *R. limicola*) might be most closely related to *R. cyanocavi*. One possibility would be the Pleistocene form of *R. limicola*, which averaged larger and stouter than modern specimens of the species (Brodkorb, 1954; Olson 1974a, 1977). Looking at the status of the three living North American species of *Rallus* in the Bahamas today, *R. limicola* is a rare migrant, whereas *R. longirostris* is a widespread permanent resident of mangrove habitats, and *R. elegans* is unrecorded (White, 1998: 236; Hallett, 2006: 65, 66).

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