

Revision of the endemic West Indian genus *Melopyrrha* from Cuba and the Cayman Islands

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SUMMARY.—Hartert described the Grand Cayman population of *Melopyrrha* as separate from the Cuban population, but the two forms were considered conspecific by Bond and later authors. Based on differences in body size, plumage and vocalisations, we recommend the two populations be treated as separate endemic species: Cuban Bullfinch *Melopyrrha nigra* on Cuba, Isla de Pinos and cays of the Cuban archipelago, and Cayman Bullfinch *M. taylori* for Grand Cayman. We present natural history information for both populations.

Cuban Bullfinch *Melopyrrha nigra* occurs in the Cuban archipelago and on Grand Cayman in the Cayman Islands (Garrido & García Montaña 1975, AOU 1998, 2012, Raffaele *et al.* 1998, Bradley & Rey-Millet 2013). Bonaparte described the genus *Melopyrrha* in 1853 based on *Loxia nigra* named by Linnaeus. Cuban Bullfinch, called Negrito in Cuba and Black Sparrow in the Cayman Islands, was described by Linnaeus in 1758 under the name *Loxia nigra*, based on material from Cuba. In his earliest works, Gundlach (1856, 1876) was unaware that the bullfinch's range extended to the Cayman Islands, but mentioned Grand Cayman in a later (1893: 110) publication, as did Cory (1892: 112). The Cayman population was considered the same as the Cuban taxon until Hartert (1896) described the Grand Cayman population as *Melopyrrha taylori*. For several years, both taxa were treated

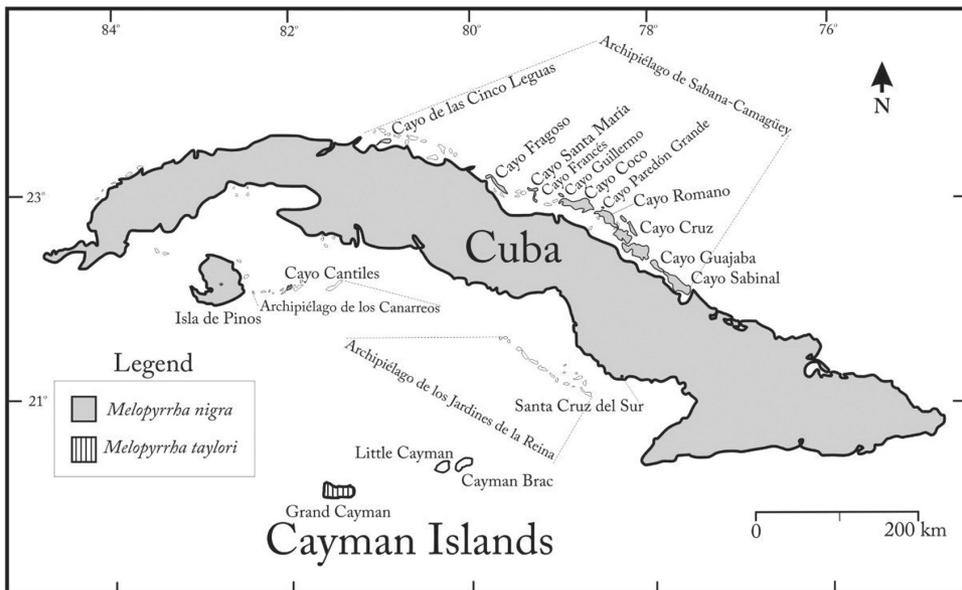


Figure 1. Distribution of Cuban Bullfinch *Melopyrrha nigra* in the Cuban archipelago and Cayman Islands, showing distributions of proposed species *M. nigra* and *M. taylori*.

specifically (Ridgway 1901: 562–563, Lowe 1910, Bond 1936: 388), but since Bond's first check-list (1940: 155) he and others (Hellmayr 1938: 168, Paynter & Storer 1970: 151, Garrido & García Montaña 1975, Sibley & Monroe 1990: 768, AOU 1998: 594, Dickinson 2003: 794) have treated them as conspecific, Cuban Bullfinch *Melopyrrha nigra*, with two subspecies, *M. n. nigra* of Cuba and its satellites and *M. n. taylori* of Grand Cayman (Fig. 1). Hellmayr (1938) recognised that whereas *M. n. taylori* was clearly a geographical race of Cuban Bullfinch, it was easily distinguished from birds in Cuba by being larger and having less glossy plumage.

Our investigation was stimulated by a birdwatcher who informed AK that he had the impression that Cuban and Grand Cayman bullfinches had different songs. His observations were correct, but we learned that not only are the vocalisations different, but the birds are morphologically distinct as well. Here, we describe the distinctions between the two populations and present the conclusions we draw based on those differences.

Methods

We measured Cuban Bullfinch specimens at nine USA and Cuban institutions (Table 1). All specimens were measured using a ruler and dial calipers to the nearest 0.1 mm, following Baldwin *et al.* (1931). Chord measurements were made with the wing flattened against the ruler. Culmen measurements are from the tip to the feathers. Only adults ($n = 211$) were used to compare morphometrics. Mass data were obtained from live ($n = 64$ individuals) and post-mortem ($n = 6$) birds. Descriptive statistics include standard deviation as a measure

TABLE 1

Mean, standard deviation, range and sample size (in brackets) for measurements of wing, tail, culmen, tarsus, and mass from 211 *Melopyrrha nigra* specimens from Cuba and Grand Cayman, examined in nine collections in the USA and Cuba¹ and live mist-netted birds (mass only).

Wing	Tail	Measurement (mm)			Tarsus	Mass (g)
		Culmen length	Culmen width	Culmen depth		
Males						
Cuba						
66.1 ± 2.2 (79)	57.6 ± 2.6 (75)	11.3 ± 0.9 (77)	9.8 ± 1.0 (16)	4.9 ± 0.5 (13)	17.6 ± 1.2 (78)	15.6 ± 1.1 (39)
60.5–73.0	52.0–67.0	9.1–14.9	8.5–11.4	4.6–5.6	15.0–21.4	13.4–17.9
Grand Cayman						
70.4 ± 2.9 (55)	58.0 ± 3.0 (57)	12.9 ± 0.7 (60)	10.8 ± 0.5 (31)	6.2 ± 0.5 (20)	20.4 ± 1 (47)	17.2 ± 0.8 (7)
65.0–79.0	53.–67.0	10.7–15.0	9.7–11.9	5.6–7.1	18.0–22.8	16.1–18.6
Females						
Cuba						
63.9 ± 2.2 (48)	54.5 ± 3 (49)	10.9 ± 0.6 (48)	8.9 ± 0.6 (10)	4.6 ± 0.5 (6)	17.2 ± 1.1 (49)	14.5 ± 0.6 (31)
59.0–70.0	45.0–63.0	9.6–12.3	8.0–9.9	4.4–4.9	15.0–19.9	13.5–16.0
Grand Cayman						
68.0 ± 2.1 (21)	56.4 ± 2 (23)	12.5 ± 0.8 (21)	10.5 ± 0.5 (8)	5.6 ± 0.5 (7)	20.5 ± 0.6 (20)	15.7 ± 0.3 (4)
64.0–72.0	53.0–61.0	11.0–14.0	10.0–11.2	5.3–6.0	19.1–22.0	15.4–16.0

¹Collections examined include Louisiana State University Museum of Natural Science, Baton Rouge; Museum of Comparative Zoology, Harvard University, Cambridge, MA; American Museum of Natural History, New York; National Museum of Natural History, Smithsonian Institution, Washington DC; Academy of Natural Sciences of Philadelphia, Philadelphia; Carnegie Museum, Pittsburgh; Field Museum of Natural History, Chicago; and Instituto de Ecología y Sistemática, and Museo Nacional de Historia Natural de Cuba, La Habana.

of variation about the mean. Comparisons of size between sexes were conducted using unpaired t-tests. A parametric test was used if populations showed normal distribution, whereas non-normally distributed data were analysed using Welch's approximate t, which assumes Gaussian populations with different standard deviations. Significance level for all tests was set at 0.05. Data on breeding biology were collected incidental to other studies on Cuba, Isla de Pinos (Isla de la Juventud) and the Caymans. G. B. Reynard provided recordings of bullfinch vocalisations that he made in Cuba using several models of Nagra and Uher reel-to-reel recorders, and a Sony TCM-5000 cassette recorder together with Sony, AKG and Sennheiser microphones, and parabolic reflectors with diameters of 43 cm, 61 cm or 91 cm. On Grand Cayman, AG-C used a portable Sony PCM-D50 96 KHz/24-bit Linear Recorder with two built-in microphones set at 90°. Frequency response was set at 20 HZ–20 KHZ, at high sensitivity (-35.0 dB / Pa 1 kHz). Raven (Ver. 1.0) sound analysis software was used to analyse vocalisations.

Results

Systematics.—We examined 356 bullfinch specimens from Cuba and 83 from Grand Cayman, although a sample of just 211 (all adults) of those was used in our analyses (Table 1). Before comparing populations from Cuba and Grand Cayman, we examined bullfinch populations within Cuban territory. Todd (1916) found no plumage differences between birds from Cuba and Isla de Pinos, a conclusion with which we agree. Further, we could find no differences in size or coloration within populations on the main island of Cuba.

We found some slight differences (non-significant) in size and coloration among birds from different Cuban cays. Garrido & Schwartz (1969: 38) noted: 'birds from [Cayo] Cantiles have the same coloration as Cuba and the Isle of Pines, but seem to be a bit larger. The colour is slightly darker in the females from Cantiles than those from Cuba and the Isle of Pines.' The series from Cayo Cantiles is not large enough for us to determine if these differences are

TABLE 2
Morphometric comparisons between populations of *Melopyrrha nigra* from Cuba and Grand Cayman, Cayman Islands. Comparisons made with unpaired t-test, with significance level set at 0.05. Level of significance: ** = < 0.01, and *** = < 0.001; ns = not significant.

Locality	Wing	Tail	Measurement (mm)			Tarsus length	Mass (g)
			Culmen length	Culmen width	Culmen depth		
Males							
Cuba	66.1 ± 2.2 (79)	57.6 ± 2.6 (75)	11.3 ± 0.90 (77)	9.8 ± 1.0 (16)	4.9 ± 0.5 (13)	17.6 ± 1.2 (78)	15.6 ± 1.1 (39)
vs. (t [df] P)	9.755 (132) ***	0.8190 (130) ns	11.350 (135) ***	4.594 (45) ***	7.298 (31) ***	13.427 (123) ***	4.81 (10) ***
Grand Cayman	70.4 ± 2.9 (55)	58.0 ± 3.0 (57)	12.9 ± 0.70 (60)	10.8 ± 0.5 (31)	6.2 ± 0.5 (20)	20.4 ± 1.0 (47)	17.2 ± 0.8 (7)
Females							
Cuba	63.9 ± 2.2 (48)	54.5 ± 3.0 (49)	10.9 ± 0.6 (48)	8.9 ± 0.6 (10)	4.6 ± 0.5 (6)	17.2 ± 1.1 (49)	14.4 ± 0.6 (31)
vs. (t [df] P)	7.219 (67) ***	2.758 (70) **	9.182 (67) ***	6.040 (16) ***	3.595 (11) **	12.634 (67) ***	7.25 (7) ***
Grand Cayman	68.0 ± 2.1 (21)	56.4 ± 2.0 (23)	12.5 ± 0.8 (21)	10.5 ± 0.5 (8)	5.6 ± 0.5 (7)	20.5 ± 0.6 (20)	15.7 ± 0.3 (4)

significant. We observed that wing lengths of specimens from Cayo Paredón Grande were substantially less than those of specimens from Cuba but, again, our sample sizes were too small to statistically confirm this. Adults from Cayo Coco are similar to Cuban adults, although females appear somewhat paler and duller. Therefore, we do not believe that Cuban Bullfinch has differentiated sufficiently within Cuban territory, including Isla de Pinos and the cays, to constitute geographical races.

We analysed size between populations on Cuba and Grand Cayman, examining within-sex measurements because of substantial sexual size dimorphism in both Cuban and Grand Cayman birds, particularly in wing, tail, some bill measurements, and mass (Tables 1, 3). In general, birds from Grand Cayman (*taylori*) were larger than Cuba (*nigra*) in both sexes; i.e., we found significant differences in all seven measurements for females, and all but one (tail length) of seven measurements of males (Table 2). Notably, the bill of *taylori* is substantially bulkier than that of *nigra*, being longer, wider and deeper (Fig. 2).

Although adult males of both forms are essentially uniform black with some white on the primaries, pattern and coloration are inconsistent, and are quite different in females and immatures. Adult male *M. n. nigra* is more lustrous or glossy black overall, with a violet sheen. In contrast, *M. n. taylori* is duller with no gloss. The two populations show differing amounts of white on the primaries. The great majority of *taylori* show more white on the fringes of the outer primaries, in both sexes. This white fringe is usually present in the two outer feathers in *taylori*, whereas in *nigra* it usually occurs in only one outer feather. Also, *taylori* shows considerably more white on the axillaries and underwing-coverts than *nigra* (although we did not quantify this difference morphometrically). Bond (1936: 389) noted that the 'outer rectrices [are] indistinctly tipped with whitish' in male *taylori*. The two populations also show different bill coloration: that of *nigra* is all black whereas that of *taylori* is silvery grey.

Female *nigra* is uniform dull slate-black and less glossy, sometimes almost dark slate, especially on the posterior underparts. The upperparts are almost uniform except the lower neck, back and rump are tinged brownish contrasting with the slate-black head. Female *taylori* is bicoloured, being mostly blackish slate on the head and upperparts, although not as dark as *nigra*, and has dull brownish olive-grey lower abdomen and flanks (Fig. 3). Throat, breast and upper abdomen are not dull black as in *nigra*, but are blackish grey contrasting with a paler lower abdomen and flanks. In Cuban females, the slate-black coloration is practically uniform from throat to undertail-coverts. Immature *nigra* resembles adult females, but have brownish wing feathers and tail, a smaller and less contrasting white wing patch, with no gloss or slate tones. Immature male *taylori* resemble adult females, with an olive-tinged dark head and much paler olive-grey posterior upperparts (Ridgway 1901), brownish fringes to the primaries, and abdomen tinged cinnamon. White in the wing is reduced or absent in both sexes (Bradley & Rey-Millet 2013).



Figure 2. Comparison of bill size between Cuban Bullfinch *Melopyrrha n. nigra* of Cuba (lower bird) and *M. n. taylori* of Grand Cayman (upper bird), United States National Museum, Smithsonian Institution, Washington DC (James W. Wiley)

TABLE 3

Sexual size dimorphism in populations of *Melopyrrha nigra* from Cuba and Grand Cayman, Cayman Islands. Comparisons made with unpaired t-test. Parametric test used if populations showed normal distribution; if not, Welch's approximate t is shown, which assumes Gaussian populations with different standard deviations. ns = not significant.

Population	Measurement	Mean \pm SD (<i>n</i>)		t	df	P
		Males	Females			
Cuba	Wing	66.1 \pm 2.2 (79)	63.9 \pm 2.2 (48)	5.464	125	<0.0001
	Tail	57.6 \pm 2.6 (75)	54.5 \pm 3.0 (49)	6.105	122	<0.0001
	Culmen length	11.3 \pm 0.9 (77)	10.9 \pm 0.6 (48)	2.723	123	0.0074
	Culmen width	9.8 \pm 1.0 (16)	8.9 \pm 0.6 (10)	2.561	24	0.0171
	Culmen depth	4.9 \pm 0.5 (13)	4.6 \pm 0.5 (6)	1.216	17	0.2407 ns
	Tarsus length	17.6 \pm 1.2 (78)	17.2 \pm 1.1 (49)	1.887	125	0.0614 ns
	Mass	15.6 \pm 1.1 (39)	14.4 \pm 0.6 (31)	5.60	59	<0.0001
Grand Cayman	Wing	70.4 \pm 2.9 (55)	68.0 \pm 2.1 (21)	3.456	74	0.0009
	Tail	58.0 \pm 3.0 (57)	56.4 \pm 2.0 (23)	2.351	78	0.0212
	Culmen length	12.9 \pm 0.7 (60)	12.5 \pm 0.8 (21)	2.171	79	0.0329
	Culmen width	10.8 \pm 0.5 (31)	10.5 \pm 0.5 (8)	1.513	37	0.1388 ns
	Culmen depth	6.2 \pm 0.5 (20)	5.6 \pm 0.5 (7)	2.733	25	0.0114
	Tarsus length	20.4 \pm 1.0 (47)	20.5 \pm 0.6 (20)	0.4154	65	0.6792 ns
	Mass	17.2 \pm 0.8 (7)	15.7 \pm 0.3 (4)	4.79	7	0.002

Vocalisations.—Males perch atop low trees to sing, repeatedly, a descending and ascending high-pitched melody. The call of Cayman birds is an insect-like *chi-p* and *zee zee*, the first note high-pitched, whereas the song begins as a trill *zee-zee-zee*, falls briefly then rises over 8–30 *tssi* notes, the longest reaching a very high and barely audible pitch, only heard at the onset of the breeding season (Bradley & Rey-Millet 2013). The call of Cuban birds is a staccato *chi-dip*, and thin *tsee*, often repeated (Garrido & Kirkconnell 2000). The song of Cuban birds is a thin, prolonged, melodious warble, *ti-ti-tisissiiiiitssiiiiitssiiii-toeee* (Garrido & Kirkconnell 2000).

Songs of the Cuban population are distinct from those of Grand Cayman, being typically more complex in structure, longer (mean_{Cuba} = 4.54 \pm 1.04 seconds [*r* = 2.32–6.25 seconds, *n* = 10] vs. mean_{Grand Cayman} = 2.03 \pm 0.71 seconds [*r* = 1.11–3.98 seconds, *n* = 46]; *t* = 7.28, *P* < 0.001, *df* = 10) and comprise more elements (mean_{Cuba} = 23.0 \pm 5.33 [13–33 elements, *n* = 10] elements / song vs. mean_{Grand Cayman} = 13.9 \pm 4.19 elements / song [*r* = 9–23 elements, *n* = 47]; *t* = 5.08, *P* < 0.001, *df* = 11) than songs of birds on Grand Cayman (Fig. 4). Songs of Cuban birds reach distinctly higher frequencies than on Grand Cayman during the first two seconds (Fig. 4). Songs of *M. taylori* possess a series of introductory elements with more uniform frequency than Cuban birds, with a duration of *c.*1.5 seconds, followed by a drop then an increase in frequency.

We noted slight variations in vocalisations within Cuba, as there are clearly different dialects in various regions. J. P. Sarracino (pers. comm.), a bird-fancier who has kept up to 500 bullfinches, informed OHG that birds from some parts of Pinar del Río province (western Cuba) possess dialects different from populations in other regions, although in AK's experience the song of Cuban Bullfinch at localities he has sampled in this province is typical of that elsewhere in Cuba (Fig. 6).

Natural history.—Few data have been reported on the ecology and behaviour of Cuban Bullfinch, although more are available for *nigra* than for *taylori*. Race *nigra* is common at

most mainland localities (where it has not been harvested excessively for the cagebird trade), including thickets, brushy pastures and forest from sea level to high (1,300 m) elevations (Barbour 1923: 129, Fong *et al.* 2005). It also forages in mangroves, including buttonwood mangrove (*Conocarpus erectus*) on the mainland and cayos. On the Cuban cayos and Isla de Pinos, however, it occurs only at sea level, and is found only in the low coastal southern part of Isla de Pinos, in dry brushland and woods. The bullfinch has long been a favoured target of Cuban 'pájareros' (bird trappers) and Barbour (1943: 128) already suggested it had been trapped excessively. Most harvested birds are males, because non-singing females are released. Captive males are often used in local singing competitions. It is also one of the birds most frequently smuggled out of Cuba to meet international demand for cagebirds, especially to Miami, Florida (Garrido & Kirkconnell 2000). Harvesting for the cagebird trade has resulted in a dramatic decline of populations in many areas where the species was formerly common.

Although formerly considered common on Grand Cayman, the bullfinch's range has been reduced and it is now rare to absent west of Savannah due to urban development and loss of habitat due to forest clearance and hurricanes. East of Savannah, it is a locally common resident breeding mainly in dry forest within the protected Botanic Park and Mastic reserve, and in shrubland and woodland in the north and east where continued development threatens habitats (Bradley 2000, Bradley & Rey-Millet 2013). It bred infrequently in mangroves but since Hurricane Ivan (2004) breeding has not been observed in mature black (*Avicennia germinans*), white

Figure 3. Comparison of plumage coloration between female Cuban Bullfinch *Melopyrrha nigra taylori* of Grand Cayman (left two individuals) and *Melopyrrha n. nigra* of Cuba (right two individuals): (A) upperparts, (B) lateral view, (C) underparts, United States National Museum, Smithsonian Institution, Washington DC (James W. Wiley)



(*Laguncularia racemosa*) and buttonwood mangroves; it was always absent from the interior red mangrove (*Rhizophora mangle*) of the Central Mangrove Wetlands. The only record of breeding in coastal habitat was in 1985. Johnston (1975) reported it was uncommon in sea grape (*Coccoloba woifera*)-tropical almond (*Terminalia catappa*) woodland, pure logwood (*Haematoxylon campechianum*) forest, pastures and cultivated areas; fairly common (December) to uncommon (April–May) in logwood-silver thatch palm (*Coccothrinax proctorii*)-red birch (*Bursera simaruba*) forest (now called shrubland); common (December) to fairly common (April, May, August) in limestone forest; and fairly common around houses, towns and roadsides. PEB (unpubl. data), however, found that its range is not seasonal.

Grand Cayman adults are shy, staying concealed except when foraging or when males perch on exposed branches to sing. In contrast, Cuban birds are considerably less shy. Immatures of all populations are very tame and curious.

Bullfinches on Grand Cayman forage for seeds and fruit (insects in breeding season) at all levels from the canopy, understorey, to near the ground in woodland and dry shrubland, rough pasture, inland gardens and mangrove edge, but seldom in littoral areas. Cuban birds are similar, foraging at all levels from canopy to near the ground in woodland. In Cuba, bullfinches also tend to forage in small groups (Gundlach 1876: 94, 1893: 110), although Barbour (1923: 129) did not observe the species associating in groups and thought it solitary. In winter, we found that one or two males often forage with several females and immatures of both sexes, and individuals often join mixed-species flocks of warblers (Hamel & Kirkconnell 2005). Grand Cayman males are occasionally solitary. Gálvez & Berovides (1991) noted Cuban birds occurred singly, as pairs or in small groups, with peak densities of individuals within groups in May–June and August–September.

On Isla de Pinos, Todd (1916) recorded it feeding in the blossoms of *Jatropha (glaucovirgens) integerrima*. Gundlach (1876: 94) gave its diet in Cuba as seeds, fruits and occasional insects. Danforth (1935) found small seeds and sand (grit) in the stomachs of eight birds from Cuba. During incidental observations ($n = 54$; all during breeding season) of foraging bullfinches at the Ciénaga de Zapata, Cuba, we recorded birds taking fruit ($n = 17$, 31.5% of observations), seeds (27, 50%) and insects (ten, 18.5%). Of two bullfinches we collected during the breeding season on Cayo Coco, Cuba, the stomach of one contained 32 seeds, whereas the other's contained insects and seeds. Johnston (1975) reported feeding ecology on Grand Cayman, where bullfinches forage on fruits, seeds and arthropods.

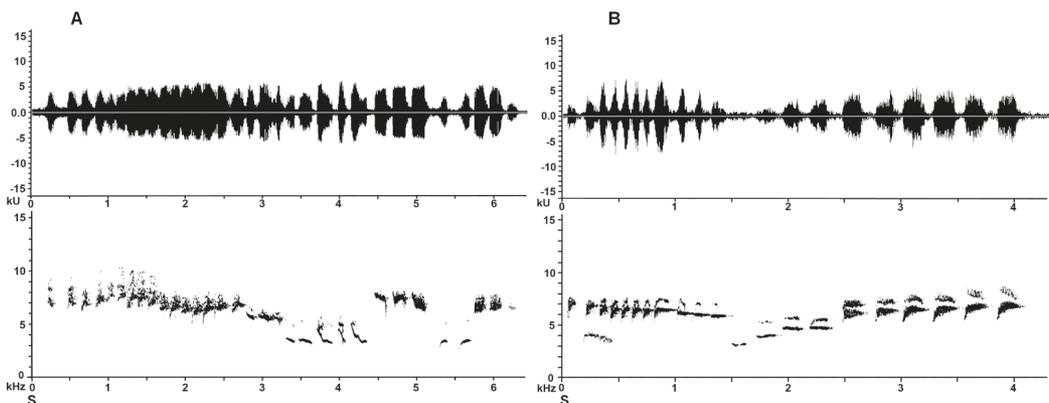


Figure 4. Song of Cuban Bullfinch *Melopyrrha nigra* from Santo Tomás, Ciénaga de Zapata, Cuba, recorded by G. B. Reynard (A) and an adult male at Queen Elizabeth Botanic Park, Grand Cayman, Cayman Islands, 16 May 2010, recorded by Alexandra Günther-Calhoun (B). Upper figure is waveform (kU), lower figure is spectrogram (kHz).

Animal matter (Lepidoptera larvae, Coleoptera and possibly Chrysomelidae) comprised 39% and vegetable matter (unidentified seeds) 61% of items in stomachs of four birds (Johnston 1975). At one nest we watched briefly ($\Sigma = 5.4$ hr) during the late nestling stage, 44 identifiable items were delivered to three chicks, including ten (22.7%) seeds and berries and 34 (77.3%) small insects, at a mean rate of 8.1 items per hour.

Breeding on Grand Cayman starts as early as January, with peak breeding in March–June, and occasional nests with young in July–early August. Onset of breeding is thought to be related to fruiting phenology (Bradley 2000, Bradley & Rey-Millet 2013). Johnston (1975) reported nests with young in May–June on Grand Cayman. In Cuba, Gundlach (1876: 94, 1893: 110) reported nesting in April–July. We have found nests in the Ciénaga de Zapata from late March (eggs) to early June (older chicks). Courtship can be prolonged, with male display involving wing-flashing, exposing the white axillaries, from January. Both sexes participate in nest-building through egg laying. Nest construction occurs mainly in March–August, although it has been observed as early as January on Grand Cayman (Bradley 2000, Bradley & Rey-Millet 2013). Nests are constructed mainly in dry low forest and shrubland, open woodland, rough pasture and gardens on Grand Cayman, where preferred trees include silver thatch palm *Sideroxylon horridum* and *Xylosma bahamense* (Bradley 2000). The majority of nests are of similar construction in Cuba and Grand Cayman: a large, woven, untidy enclosed globular nest, of palm fibres, grasses, twigs, hair and plant fibre, lined with red birch bark and hair, with a side entrance similar to grassquit (*Tiaris* spp.) or Bananaquit *Coereba flaveola* nests, built around vines or dense vegetation on a heavy branch. On Grand Cayman the nest is often in a tangle of *Selenicereus grandiflorus* vines or *Phoradendron rubrum*. A second nest type is occasionally constructed there: an apparently partially constructed nest comprised an open arch of twigs backed by a tree bole with a rough nesting cup (Bradley & Rey-Millet 2013). Nests are also used as roosts. Gundlach (1856) observed two pairs that had their nests destroyed rebuild the structures.

Gundlach (1876: 94; repeated by Bond 1936 and Valdés Miró 1984) noted bullfinches in Cuba lay 3–4 dull white eggs, often with a bluish or greenish tinge, spotted, chiefly at the larger end, with dark reddish brown and umber-brown and, to a much lesser degree, drab or lilac-grey. Eggs (3–4) on Grand Cayman are dull white with a greenish wash and reddish-brown spots. Gundlach (1876: 94) gave the dimensions of eggs from Cuba as 21 × 15 mm. Three clutches collected by C. Ramsden in eastern Cuba each comprised 2–3 eggs (mean = 2.33 ± 0.58). Four clutches we observed at Los Indios, Isla de Pinos were of 2–3 eggs (mean = 2.50 ± 0.58), whereas four clutches at the Ciénaga de Zapata, Cuba, were of 2–4 eggs (mean = 3.00 ± 0.82) ($t = -1.00$, $df = 5$, $P > 0.05$). We measured 29 eggs from Cuba and Isla de Pinos: eastern Cuba—mean = 21.26 ± 0.44 mm ($r = 20.8$ –22.1 mm; $n = 7$) × 15.44 ± 0.62 mm (14.9–16.7 mm, $n = 7$); central Cuba—mean = 21.17 ± 0.25 mm (20.8–21.5 mm, $n = 12$) × 15.27 ± 0.30 mm (14.7–15.7 mm, $n = 12$); Isla de Pinos—mean = 20.78 ± 0.77 mm (19.0–21.5 mm, $n = 10$) × 15.20 ± 0.30 mm (14.8–15.9 mm, $n = 10$). Sizes of eggs did not vary between eastern and central Cuba ($t = 0.50$, $P = 0.628$, $df = 8$) or Cuba (east and centre combined) and Isla de Pinos ($t = 0.95$, $P = 0.351$, $df = 24$). Both parents feed the young in both races, but PEB noted that only females incubated on Grand Cayman.

Discussion

The morphological differences, i.e. coloration of adult males, and especially females and immatures, plus the significant differences in size, particularly in the bill (length, width and depth of culmen), the differences in vocalisations, together with their isolated ranges, clearly suggests that *nigra* and *taylori* constitute separate species rather than subspecies. The AOU (1998) endorses the Biological Species Concept (BSC), in which species are

considered to be genetically cohesive groups of populations reproductively isolated from other such groups. According to the BSC, geographic isolation leads to genetic change and potentially to the reproductive isolation of sister taxa, which is the case in the bullfinch populations of the different archipelagos. No evidence of contact exists and therefore a lack of gene flow can be presumed. Reproductive isolation could be maintained via the different vocalisations, despite that these are learnt in oscine passerines. Our taxonomic treatment accords with the Comprehensive Biological Species Concept postulated by Johnson *et al.* (1999), in which an avian species is a series of populations representing an essentially monophyletic, genetically cohesive, and genealogically concordant lineage of individuals that share a common fertilisation system through time and space, present an independent evolutionary trajectory, and exhibit essential but not necessarily complete reproductive isolation from other species.

We found that populations from the Cuban archipelago, especially Isla de Pinos (50 km from the nearest point on the Cuban mainland), have not diverged from mainland populations, whereas the more distantly separated Grand Cayman population (240 km south of Cuba) has deviated substantially. Supporting this evaluation is the discovery of a fossil species of *Melopyrrha*: *M. latirostris* on Cayman Brac (Steadman & Morgan 1985). *M. latirostris* was a larger bird, with a more robust bill than *M. nigra*. Steadman & Morgan's (1985) discovery suggests that a *Melopyrrha* fossil could also be found in Cuba but, until now, palaeontologists there have devoted their attention mainly to large birds, and the passerine palaeofauna has not yet been examined. Undoubtedly the Cuban avifauna has a great affinity with that of the Caymans, because a total of 23 species of landbirds (79% of breeding species) are shared between them. Much landbird colonisation of the Caymans is the result of natural dispersal from Cuba, most probably from the south of the Cuban archipelago. The nearest point of Cuba to the Caymans is Santa Cruz del Sur, Camagüey province, 209 km from Cayman Brac, whereas Cayos de las 12 Leguas, Archipelago Jardines de la Reina, are the closest Cuban satellites to Cayman Brac (147 km).

Melopyrrha nigra formerly occurred on Cayman Brac, where Quaternary remains have been found (Morgan 1994). Steadman & Morgan (1985) reported that *taylori* and *latirostris* co-existed on Cayman Brac, and suggested 'latirostris may have swamped out *M. n. taylori* through interbreeding.' Plausible or not, they treated *taylori* as a subspecies of *nigra*. Steadman & Morgan (1985) also noted that six of the West Indian emberizid genera (*Melopyrrha*, *Tiaris*, *Loxipasser*, *Loxigilla*, *Euneornis*, *Melanospiza*) 'could be accommodated in an expanded genus *Tiaris* Swainson, 1827, on the basis of plumage and osteology.' As we have not compared skeletons of these taxa, we cannot comment on their suggestion, but we can mention an example that may support their opinion. In the early 1960s, Garrido & García Montaña (1975: 117), while collecting around Gibara, near Holguín, visited a 'pájarero' who had kept two sibling hybrid Yellow-faced Grassquit *Tiaris olivaceus* × *Melopyrrha nigra*. Both were slightly larger than *Tiaris*; one had more *Tiaris* features, whereas the other was more *Melopyrrha*-like. The pájarero had monitored the nestlings until they were large enough to be removed from the nest; thereafter he raised them in captivity until they were full grown. The male parent was *Tiaris*, whereas the female was *Melopyrrha*. Despite these observations and other reports, we remain sceptical of such hybridisation under natural conditions.

Based on the evidence we have presented, we propose that Cuba and Cayman forms of *Melopyrrha* should be treated as distinct species (Fig. 1), as follows:

Cuba

Melopyrrha nigra Linnaeus, 1758—Cuban Bullfinch, Negrito

Loxia nigra Linnaeus, *Syst. Nat.*, 10th edn., 1758: 175 (Cuba).

Distribution.—Cuba; Isla de Pinos; Cayo Cantiles and Cayo Arenoso (Archipelago de los Canarreos); Cayo de las Cinco Leguas, Cayo Francés, Cayo Las Brujas, Cayo Santa María, Cayo Ensenachos, Cayo La Aguada, Cayo Lucas, Cayo Aji, Cayo Ajcito, Cayo Caguanes, Cayo Cueva, Cayo Fábrica, Cayo Obispo, Cayo Palma, Cayo Salinas, Cayo Judas, Cayo Guillermo, Cayo Coco, Cayo Paredón Grande, Cayo Romano, Cayo Cruz, Cayo Guajaba, Cayo Sabinal, Cayo Ensenacho del Medio (Archipelago Sabana-Camagüey).

Cayman Islands

Melopyrrha taylori Hartert, 1896—Grand Cayman Bullfinch

Melopyrrha taylori Hartert, *Novit. Zool.* 3(3), 1896: 257 (Grand Cayman).

Distribution.—Grand Cayman. Scattered localities in the eastern half of the island.

Material examined

Localities of *Melopyrrha* from the Cuban archipelago and Cayman Islands.

Cuba.—Península de Guanahacabibes, Artemisa, Los Palacios, Sierra de Guacamaya, San Vicente, Nortey (Pinar del Río province); San Antonio de los Baños (La Habana province); Matanzas, Ciénaga de Zapata, Salinas de Bidos (Matanzas province); Casilda (Sancti-Spíritus province); Jobabo (Camagüey province); Cupeyal (Holguín province); La Municipión, Yateritas, Baitiquirí, Guantánamo, Baracoa, Tabajó, Maisí (Guantánamo province). Isla de Pinos. Cuban cayos.—Cayo Coco, Cayo Paredón Grande (Archipelago Sabana-Camagüey); Cayo Cantiles (Archipelago de los Canarreos).

Grand Cayman.—0.8 km north of Bodden Town; 5.6 km north of East End; 3.2 and 5.6 km south of North Side; 3.2 km north-east of West Bay; 3.5 km south of Old Man village.

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References:

- American Ornithologists' Union (AOU). 1998. *Check-list of North American birds*. Seventh edn. American Ornithologists' Union, Washington DC.
- American Ornithologists' Union (AOU). 2012. Check-list of North American birds. www.aou.org/committees/nacc/ (accessed 15 February 2013).
- Baldwin, S. P., Oberholser, H. C. & Worley, L. G. 1931. Measurements of birds. *Sci. Publ. Cleveland Mus. Nat. Hist.* 2: 1–165.
- Barbour, T. 1923. *The birds of Cuba*. Mem. Nuttall Orn. Cl. No. 6. Cambridge, MA.

- Barbour, T. 1943. *Cuban ornithology*. Mem. Nuttall Orn. Cl. No. 9. Cambridge, MA.
- Bonaparte, C.-L. 1853. Notes sur les collections rapportées en 1853, par M. A. Delattre, de son voyage en Californie et dans le Nicaragua. *Compt. Rend. Acad. Sci. Paris* 37: 913–925.
- Bond, J. 1936. *Birds of the West Indies*. Acad. Nat. Sci. Philadelphia.
- Bond, J. 1940. *Check-list of birds of the West Indies*. Acad. Nat. Sci. Philadelphia.
- Bradley, P. E. 2000. *The birds of the Cayman Islands: an annotated checklist*. BOU Checklist No. 19. British Ornithologists' Union, Tring.
- Bradley, P. E. & Rey-Millet, Y.-J. 2013 *A photographic guide to the birds of the Cayman Islands*. Christopher Helm, London.
- Cory, C. B. 1892. *Catalogue of West Indian birds, containing a list of all species known to occur in the Bahama Islands, the Great Antilles, the Caymans, and the Lesser Antilles, excepting the islands of Tobago and Trinidad*. Privately published, Boston, MA.
- Danforth, S. T. 1935. Investigations concerning Cuban birds, with special reference to their economic status, and consideration of those which might be desirable for introduction into Puerto Rico. *J. Agric. Univ. Puerto Rico* 19: 421–437.
- Dickinson, E. C. (ed.). 2003. *The Howard and Moore complete checklist of the birds of the world*. Third edn. Princeton Univ. Press.
- Fong G., A., Maceira F., D., Alverson, W. S. & Wachter, T. (eds.) 2005. *Cuba: Parque Nacional "Alejandro de Humboldt"*. Rapid Biological Inventories Rep. 14. Field Museum of Natural History, Chicago.
- Gálvez, X. & Berovides, V. 1991. Dinámica poblacional de Negrito (*Melopyrrha nigra*) y los tomeguines (*Tiaris canora* y *T. olivacea*) en el área protegida "Mil Cumbres" – resultados preliminares. *Pitirre* 4(2): 7.
- Garrido, O. H. & García Montaña, F. 1975. *Catálogo de las aves de Cuba*. Acad. Cienc. Cuba, La Habana.
- Garrido, O. H. & Kirkconnell, A. 2000. *Field guide to the birds of Cuba*. Cornell Univ. Press, Ithaca, NY.
- Garrido, O. H. & Schwartz, A. 1969. Anfíbios, reptiles y aves de Cayo Cantiles. *Poeyana* 67: 1–44.
- Gundlach, J. 1856. Beiträge zur Ornithologie Cuba's. *J. Orn.* 4(19): 1–16.
- Gundlach, J. 1876. *Contribución a la ornitología cubana*. Imprenta "La Antilla," La Habana.
- Gundlach, J. 1893. *Ornitología cubana*. Imprenta "La Moderna," La Habana.
- Hamel, P. & Kirkconnell, A. 2005. Composition of mixed-species flocks of migrant and resident birds in Cuba. *Cotinga* 24: 28–34.
- Hartert, E. 1896. Description of a new finch from the West Indies. *Novit. Zool.* 3: 257.
- Hellmayr, C. E. 1938. Catalogue of birds of the Americas and adjacent islands, pt. 11. *Publ. Field Mus. Nat. Hist. Zool. Ser.* 13(11).
- Johnson, N. K., Remsen, J. V. & Cicero, C. 1999. Resolution of the debate over species concepts in ornithology: a new comprehensive biological species concept. Pp. 1470–1482 in Adams, N. J. & Slotow, R. H. (eds.) *Proc. 22nd Intern. Orn. Congr., Durban*. BirdLife South Africa, Johannesburg.
- Johnston, D. W. 1975. Ecological analysis of the Cayman Island avifauna. *Bull. Fla. State Mus., Biol. Sci.* 19: 235–300.
- Linnaeus, C. 1758. *Systema naturae*, vol. 1. Tenth edn. Laurentii Salvii, Stockholm.
- Lowe, P. R. 1910. The ornithology of Grand Cayman. Pp. 332–356 in Hirst, G. S. S. (ed.) *Notes on the history of the Cayman Islands*. P. A. Benjamin Manf. Co., Kingston.
- Morgan, G. S. 1994. Late Quaternary fossil vertebrates from the Cayman Islands. Pp. 465–509 in Brunt, M. A. & Davis, J. (eds.) *The Cayman Islands: natural history and biogeography*. Kluwer Academic Publishers, Dordrecht.
- Paynter, R. A. & Storer, R. W. (eds.) 1970. *Check-list of birds of the world*, vol. 13. Mus. Comp. Zool., Cambridge, MA.
- Raffaele, H., Wiley, J., Garrido, O., Keith, A. & Raffaele, J. 1998. *Birds of the West Indies*. Princeton Univ. Press.
- Ridgway, R. 1901. The birds of North and Middle America, pt. I. *Bull. US Natl. Mus.* 50.
- Sibley, C. G. & Monroe, B. L. 1990. *Distribution and taxonomy of birds of the world*. Yale Univ. Press, New Haven, CT.
- Steadman, D. W. & Morgan, G. S. 1985. A new species of bullfinch (Aves: Emberizinae) from a late Quaternary cave deposit on Cayman Brac, West Indies. *Proc. Biol. Soc. Wash.* 98: 544–553.
- Swainson, W. 1827. A synopsis of the birds discovered in Mexico by W. Bullock, F. L. S. and H. S., and Mr. William Bullock, Jun. *Phil. Mag.* (N. Ser.) 1: 433–442.
- Todd, W. E. C. 1916. The birds of the Isle of Pines. *Ann. Carnegie Mus.* 10: 146–296.
- Valdés Miró, V. 1984. Datos de nidificación sobre las aves que crían en Cuba. *Poeyana* 282: 1–27.
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