Zapata Peninsula: important breeding sites for Cuban endemic birds are endangered!

Arturo Kirkconnell and James W. Wiley

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En el ecosistema de ciénaga una de las plantas más afectada es la palma sabal *Sabal maritima*, la cual es el substrato más importante para la nidificación de dos especies de carpinteros, búhos y otras especies de aves que nidifican en cavidades en la ciénaga de Zapata, Cuba. Dos de los sitios más importante en la península de Zapata son Bermeja y Mera-Molina, donde dichas especies han declinado dramáticamente durante el periodo de estudio. En Bermeja, la población de Carpintero Churroso *Colaptes fernandinae* actual es tan solo un 13% de los niveles de la población en 1995. Las poblaciones de Sijú Platanero *Glaucidium siju* y Sijú Cotunto *Margarobyas lawrencii* han declinado en un 41,7% y 54,5% respectivamente de los niveles del año 2006. El decline se debe a la carencia de palmas disponibles para la nidificación como parte de la actividad ilícita de los cazadores furtivos de pichones de cotorras. Se estima una población remanente de palmas muertas de un 10,2% con relación a la población original (1993). Se discute sobre las mayores amenazas que enfrenta la península de Zapata. Se mencionan los sitios más importantes para las aves de la península de Zapata donde deben llevarse a cabo prioridades realistas de conservación con el objetivo de establecer reservas más efectivas para mejorar el trabajo de conservación en dicha región.

The Ciénaga de Zapata (Zapata Swamp), which occupies most of the Zapata Peninsula, is one of the largest (512,037 ha) wetland ecosystems in the world (Fig. 1). The Ciénaga contains a mosaic of vegetation formations, including swamp, freshwater and saltwater marshes, as well as islands of tall vegetation (*petenes* or hammocks), underground pools (*cenotes*) and surface rivers with riverine habitat[13].

Zapata Peninsula is considered an Important Bird Area (IBA), and has the highest conservation priority in Cuba[22]. Of Cuba's 26 endemic bird species, 23 (88.5%) occur on Zapata Peninsula, with nine of those species considered globally threatened[2]. Zapata Peninsula is the only location in Cuba where all eight endemic genera occur[13]. Further, the peninsula harbours some of the most important breeding populations of Cuban native birds, notably several cavity-nesters.

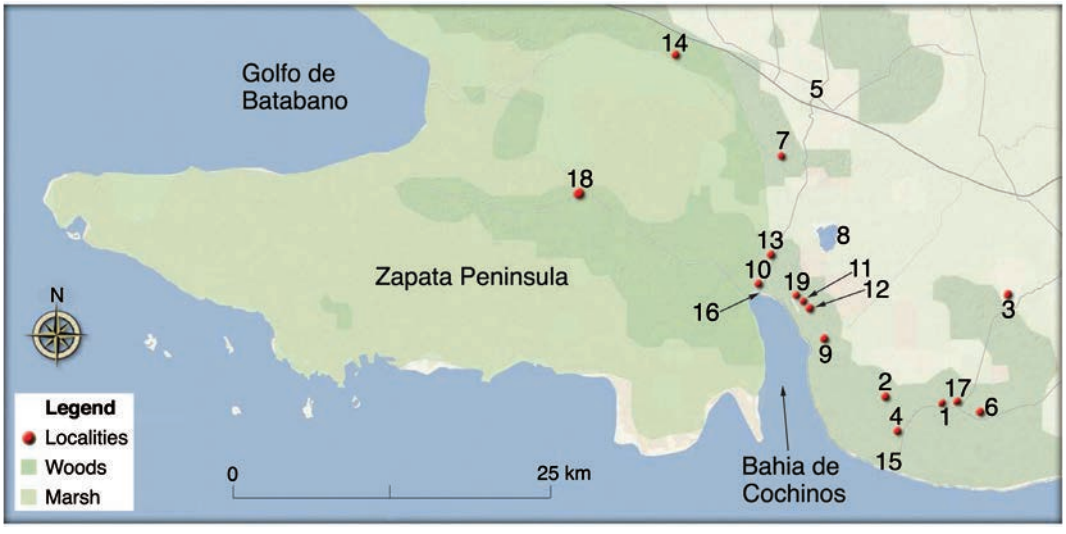

Figure 1. Zapata Peninsula, Cuba, showing the localities mentioned in the text. Numbers on map refer to the following sites (alphabetically ordered): 1. Bermeja, 2. Cayo Ramona, 3. Covadonga, 4. Helechal, 5. Jagüey Grande, 6. La Ceiba, 7. La Turba, 8. Laguna del Tesoro, 9. Los Sábalos, 10. Mario López, 11. Mera, 12. Molina, 13. Pálpite, 14. Peralta, 15. Playa Girón, 16. Playa Larga, 17. San Blas, 18. Santo Tomás, 19. Soplillar.

As a result of national and international concern for its conservation, Zapata Peninsula benefits from some degree of protection. Two areas are listed as being of National Importance: Ciénaga de Zapata National Park (Parque Nacional Ciénaga de Zapata, 418,921 ha, with a terrestrial area of 281,861 ha) and the 'Distinguished Natural Element,' Zapata Cave-Lake System (Sistema Espeleolacustre de Zapata Natural Landmark; 14,661 ha) (Fig. 2). Bermeja (811 ha) and Canales de Hanabana (6,710 ha) are classed as Faunal Refuges. Ciénaga de Zapata has also been designated a UNESCO Biosphere Reserve (628,171 ha; established 2000), as well as a Ramsar site (2001). Nevertheless, Zapata's 'upland' forests have received little protection, although they

Table 1. Bird species of conservation concern in Ciénaga de Zapata, Cuba, with status, threats, nest type and presence at two sites, Bermeja and Mera-Molina.

Species		Conservation status				Site: Bermeja		Site: Mera-Molina		
		Endemism[1]	National[2]	IUCN[3]	Nest type[4]	Presence	Status[5]	Presence	Status[5]	Threats[6]
West Indian Whistling Duck	*Dendrocygna arborea*	-	VU	VU	C	-	-	+	-	P, HD, Hunt, DP
Wood Duck	*Aix sponsa*	-	-	LC	C	-	-	+	-	P, HD, Hunt, CEHb
Masked Duck	*Nomonyx dominicus*	-	VU	LC	O	-	-	-	-	Hunt
Osprey	*Pandion haliaetus*	-	-	LC	O	-	-	+	-	PPD
Gundlach's Hawk	*Accipiter gundlachi*	E	EN	EN	O	+	-	+	Br	HD, PPD
Cuban Black Hawk	*Buteogallus gundlachii*	E	EN	NT	O	-	-	+	Br	PPD
American Kestrel	*Falco sparverius*	-	-	LC	C	+	-	+	Br	HD, IT, ExA, CEHb, DP
Zapata Rail	*Cyanolimnas cerverai*	E	CR	CR	O	-	-	-	-	HD, F, CSp, ExA
Sandhill Crane	*Antigone canadensis*	ESp	VU	LC	O	-	-	-	Extir	Hunt, F
White-crowned Pigeon	*Patagioenas leucocephala*	-	VU	NT	O	-	-	+	Br	Hunt
Plain Pigeon	*Patagioenas inornata*	-	VU	NT	O	-	-	-	Extir	Hunt
Blue-headed Quail-Dove	*Starnoenas cyanocephala*	E	EN	EN	O	+	-	+	Br	HD, Hunt, ExA, IT, IMP
Grey-fronted Quail-Dove	*Geotrygon caniceps*	E	VU	VU	O	-	-	+	Br	HD, Hunt, ExA, IT, IMP
Cuban Parrot	*Amazona leucocephala*	ESp	VU	NT	C	+	Br	+	Br	HD, Hunt, ExA, IT, ND, CEHb, DP
Cuban Parakeet	*Psittacara euops*	E	EN	VU	C	-	-	+	Form Br	HD, ExA, IT, ND, PCD, CEHb, DP
Stygian Owl	*Asio stygius*	-	-	LC	O	-	-	+	Br	HD, PPD, PSup
Cuban Pygmy Owl	*Glaucidium siju*	E	-	LC	C	+	Br	+	Br	HD, ExA, CEHb, DP
Bare-legged Owl	*Margarobyas lawrencii*	E	-	LC	C	+	Br	+	Br	HD, ExA, ND, DP
Greater Antillean Nightjar	*Antrostomus cubanensis*	E	-	LC	O	-	-	+	Br	HD, F, ExA
Bee Hummingbird	*Mellisuga helenae*	E	VU	NT	O	-	-	+	Br	HD
Cuban Trogon	*Priotelus temnurus*	E	-	LC	C	+	Br	+	Br	HD, ExA, CEHb
Cuban Tody	*Todus multicolor*	E	-	LC	C	+	Br	+	Br	HD
Fernandina's Flicker	*Colaptes fernandinae*	E	VU	VU	C	+	Br	+	Br	HD, ExA, DP, DEHb
Northern Flicker	*Colaptes auratus*	-	-	LC	C	-	-	+	Br	HD, ExA, DP, DEHb
West Indian Woodpecker	*Melanerpes superciliaris*	-	-	LC	C	+	Br	+	Br	HD, ExA, DP, DEHb
Cuban Green Woodpecker	*Xiphidiopicus percussus*	E	-	LC	C	+	Br	+	Br	HD, ExA, DP, DEHb
Giant Kingbird	*Tyrannus cubensis*	E	EN	EN	O	-	Extir	-	Extir	HD
Zapata Wren	*Ferminia cerverai*	E	EN	EN	O	-	-	-	-	F
Cuban Martin	*Progne cryptoleuca*	-	-	LC	C	+	-	+	Form Br	HD, ExA, DP, DEHb
Zapata Sparrow	*Torreornis inexpectata*	E	EN	EN	O	-	-	-	-	HD, F
Cuban Blackbird	*Dives atroviolaceus*	E	-	LC	C	+	-	+	Br	HD, ExA, DP, DEHb
Cuban Bullfinch	*Melopyrrha nigra*	ESp	NT	LC	O	+	-	+	Br	IT
Cuban Grassquit	*Tiaris canorus*	E	-	LC	O	-	-	-	Extir?	IT
Painted Bunting	*Passerina ciris*	-	VU	NT	-	-	-	+	Mig	IT
∑ no species						14		26		

[1] Endemism status (follows Garrido & Kirkconnell[9]): E = Endemic species, ESp = Endemic Subspecies.

[2] After González Alonso *et al.*[10]: Ex = Extinct, CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened.

[3] After IUCN[12]: Ex = 'Extinct,' CR = 'Critically Endangered,' EN = 'Endangered,' VU = 'Vulnerable,' NT = 'Near Threatened,' LC = 'Least Concern.'

[4] Nest type: C = cavity-nester; O = open-nester.

[5] Status: Br = breeds, Form Br = former breeder, Ex = extinct, Extir = extirpated, Mig = migrant.

[6] Threats: CEHb = competition with exotic honeybees; CSp = catfish *Clarias* sp. predation and habitat alteration; DP = destruction of suitable palms for nesting; ExA = exotic animals; F = fire; HD = habitat destruction; Hunt = hunting; IMP = inadequate management plan; IT = illegal trade; ND = nest destruction; P = poaching; PCD = persecution for crop predation; PPD = persecution for poultry predation; PSup = persecution because of superstition.

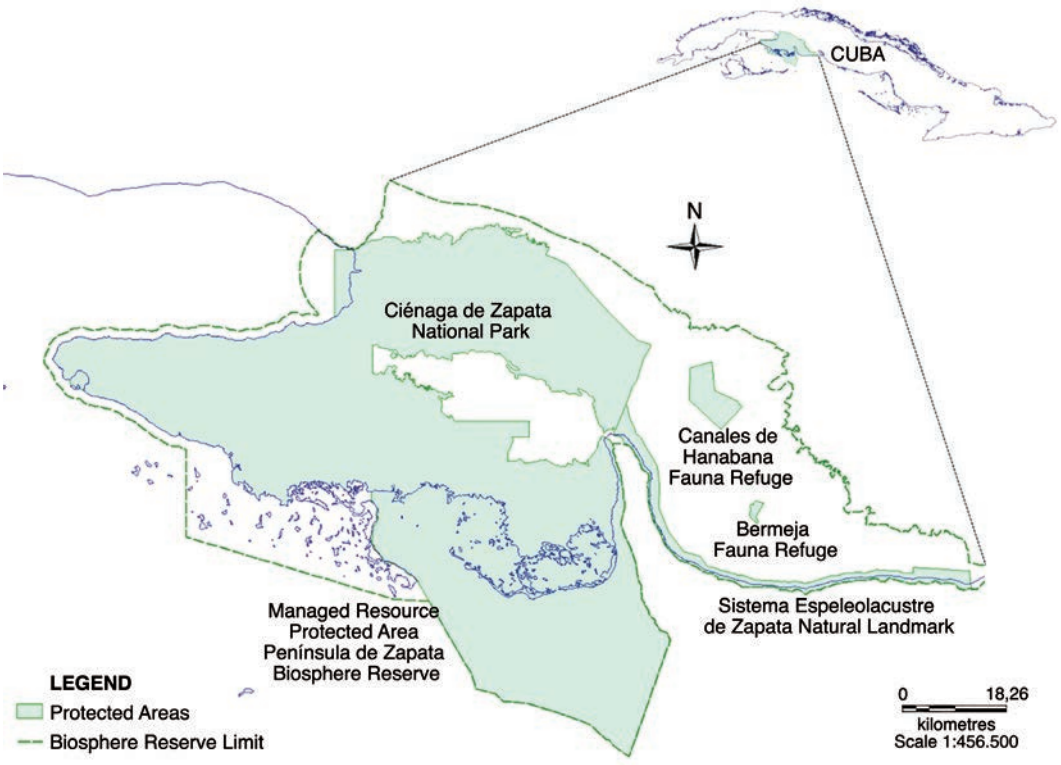

Figure 2. Zapata Peninsula showing areas presently protected by the Cuban government. Inset map at upper right shows location of the larger area within Cuba. Green-shaded areas are currently protected by the Cuban government; the dashed line shows the limits of the UNESCO Biosphere Reserve.

harbour most Cuban endemic birds[13]. Among the several threatened endemic species found in 'upland' forests are Gundlach's Hawk *Accipiter gundlachi*, Bee Hummingbird *Mellisuga helenae*, Cuban Parakeet *Psittacara euops*, Fernandina's Flicker *Colaptes fernandinae* and Blue-headed Quail-Dove *Starnoenas cyanocephala*. A list of bird species of conservation concern in the Ciénaga de Zapata, with their status, threats and nest type, is presented in Table 1. Indeed, Zapata is one of the most important regions for birds in Cuba.

Unfortunately, the impact of humans on Zapata's forests has been immense over the last 200 years, primarily through the extraction of timber and production of charcoal. Kirkconnell *et al.*[13] stressed the need to create and protect a national park that includes the entire peninsula; presently only 55% of the Ciénaga de Zapata is within the national park, which is confined to the western section of the peninsula. In contrast, the eastern section has almost no protection. Currently, the entire peninsula is considered only a Protected Area with Sustainable Use of Natural Resources (720,749 ha) within the IUCN category IV[12]. But, considering the huge economic interest that this region represents for the state and the fact that an earlier proposal to enlarge the national park to include the whole peninsula was subject to a comprehensive and, thereby, extended approval process, we decided to focus attention here on what we term the most critical Important Bird Sites (IBS) for Zapata Peninsula, where realistic conservation priorities should be set towards the goal of rapidly establishing effective reserves.

Here we present data that demonstrate the importance of the forests of Zapata Peninsula for conservation of Cuban bird populations. Kirkconnell *et al.*[13] presented some of the main threats to the biological diversity and natural resources of Zapata Peninsula. We discuss in greater detail these threats for the entire peninsula and report particular issues at two specific sites: Bermeja and Mera-Molina. We present field data collected from Bermeja and Mera-Molina, which we consider in urgent need of full protection to improve bird conservation in Zapata, and discuss several other important sites, emphasising their value to conservation of Cuban birds. As part of our determination of the importance of natural habitat,

Figure 3. Sabal palm *Sabal maritima* habitat in Zapata Swamp, showing live and dead standing palms used by several cavity-nesting species of birds (J. W. Wiley)

we examined densities of cavity-nesting birds as related to the presence and abundance of suitable palms in which to excavate a new cavity or to find a suitable already available hole. Palms are critical habitat for several species of cavity-nesting birds throughout the Zapata Peninsula.

As an example of the level of the problems in the peninsula, we focus on the effects of human activities and natural events on several cavity-nesting birds. Further, we present an overview of important threats to the peninsula's natural ecosystems.

Improving Cuba's conservation programmes while advancing economic development is a complex and challenging task. Our objective here is to provide useful field data that can assist decision-makers to reverse some of the negative effects of current management on Zapata's habitats. We believe a new policy can be established to provide complete protection to most IBS within the IBA. Also, we wish to draw the attention of national and international conservation organisations to Zapata Peninsula, where we believe their joint efforts could greatly improve the conservation future of this region.

Study areas and Methods

Bermeja Faunal Refuge (22°08'24"N 80°57'53'W) is characterised by second-growth swampy forest that is periodically inundated, interspersed with sabal palm *Sabal maritima* savanna (Fig. 3). Forests have an 8–15 m-tall canopy layer, with emergents reaching 20 m, and 90 species of semi-deciduous and epiphytic plants have been registered. Typical tree species include *Lysilomaloma latisiliquum*, *Bucida palustris*, *B. buceras* and *Talipariti elatum*. We examined active nest-cavities and determined status of all breeding pairs of Fernandina's Flicker, Cuban Pygmy Owl *Glaucidium siju* and Bare-legged Owl *Margarobyas lawrencii* during the breeding season (February–June) while conducting intensive field work on the flicker in 1995 and 2006–12 (Fig. 4). Extensive field work on owls was conducted from 2006 through 2012 (Table 2).

The Mera-Molina area (22°16'32"N 81°07'46"W; c.2,000 ha) has no legal protection. It is also characterised by seasonally inundated second-

Figure 4. Cavity-nesting bird species in the Zapata Peninsula: (A) Fernandina's Flicker *Colaptes fernandinae*, (B) Bare-legged Owl *Margarobyas lawrencii*, (C) Cuban Pygmy Owl *Glaucidium siju* and (D) Cuban Martin *Progne cryptoleuca* (A. Kirkconnell & J. W. Wiley)

growth swampy forest, interspersed by sabal palm savanna. Forest structure is similar to Bermeja, but typical tree species also include *Tabebuia angustata*, *T. leptoneura* and *Annona glabra*. The location and number of active breeding cavities of Fernandina's Flicker, Bare-legged Owl and Cuban Pygmy Owl were determined from 2007 through 2012, when we conducted a detailed natural history study of the owls (Table 2). Although Mera and Molina are two distinct, but nearby, localities, here we consider them as a single unit because of the practicality of creating a reserve including both sites.

We counted palms in two areas to determine availability of nesting habitat. In 1993 we estimated the density of larger (≥90 cm dbh) sabal palms in Bermeja in 18 sample plots. We counted all large palms (living and dead) on each 400 m^2 plot to estimate trees suitable for cavity-nesters. In 2010 we conducted another survey at Bermeja using 15 sample plots to compare with data collected in 1993. A control site was sampled

Table 2. Numbers of breeding pairs of three species of endemic birds at Bermeja and four species at Mera-Molina, Ciénaga de Zapata, Cuba, 1995–2012.

	Number of breeding pairs by locality						
	Bermeja			Mera-Molina			
	Species[1]						
Year	FEFL	BLO	CUPO	FEFL	BLO	CUPO	CUMA
1995	30	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]
2006	15	12	11	-[2]	-[2]	-[2]	-[2]
2007	7	8	10	5	6	9	27
2008	6	7	9	8	7	12	17
2009	5	6	9	6	5	7	7
2010	4	6	8	3	3	8	0
2011	4	5	7	3	4	6	0
2012	4	5	6	2	9	6	0

[1] FEFL = Fernandina's Flicker *Colaptes fernandinae*, BLO = Bare-legged Owl *Margarobyas lawrencii*, CUPO = Cuban Pygmy Owl *Glaucidium siju*, CUMA = Cuban Martin *Progne cryptoleuca*.

[2] Not surveyed.

for palm density in an undisturbed natural palm savanna along the central National Highway (22°37'52"N 81°23'02"W) in 2010 and 2012. The control site was selected to determine: (1) palm density in a natural, undisturbed palm habitat, and (2) if the palm habitat at Bermeja in 1993 approximated to a natural ecosystem. All palms in the sample plots (n = 15; each 400 m^2) were counted.

Results

The numbers of most cavity-nesting birds breeding in both study areas declined substantially over our study periods, from 1995 to 2012 (Table 2). This decline is mainly a result of the steady decrease in the number of palms suitable for nesting, primarily as a consequence of the activities of local poachers seeking Cuban Parrot *Amazona leucocephala* and Cuban Parakeet chicks.

In 1993, mean sabal palm density at Bermeja was 338 palms / ha, and 75% of those standing palms were dead (253.5 dead palms / ha). In 2010, we recorded only 64.5 palms / ha, with c.40% of these being dead standing palms, i.e. a mean 25.8 dead palms / ha. Approximately 10.2% of the original (1993) dead palm population was still suitable as nesting sites for cavity-nesters. Thus, by 2010, only 19% of the palm population remained in the area. Accordingly, in fewer than 20 years, almost 90% of suitable palms for cavity-nesters had been destroyed by poachers harvesting parrot chicks. That harvest process involves a person pushing over the fragile dead palm, which is loosely anchored in the thin soil layer overlaying limestone.

Although tropical storms are important natural factors shaping habitats in Cuba, the study areas have not been seriously affected by the strong hurricanes that have struck the Zapata Peninsula in the past 20 years. Our surveys revealed that fewer than 2% of dead palms were felled by storms in Bermeja.

We found a mean density of 400 palms / ha at the control site, which is comparable to 1993 palm density at Bermeja when palms had not been felled by poachers or hurricanes. Therefore, we concluded that the Bermeja site had a healthy natural sabal palm population in 1993.

In the 11-year period between 1995 and 2006, we observed a decline of c.50% in the Fernandina's Flicker breeding population at Bermeja. From 2007 through 2012, the population was c.13% of the 1995 level. At Mera-Molina, we observed a 60% decline in nesting flickers from 2007 to 2012 (Table 2).

Breeding pairs of the two endemic owls also declined substantially at Bermeja in 2006–12. Breeding pairs of Cuban Pygmy Owl declined to 41.7% and Bare-legged Owl to 54.5% of 2006 levels. At Mera-Molina, the pygmy owl population decreased by 33% in 2007–12, whereas the Bare-legged Owl breeding population increased to 33.3% above 2007 levels (Table 2). The population of another cavity-requiring nesting species, Cuban Martin *Progne cryptoleuca*, formerly a common breeder at Mera-Molina, declined sharply over the six years of our study; we found no nests in 2010–12, whereas it was a common breeder in earlier years (Table 2).

Discussion

Decline of cavity-nesting bird populations at two sites in Ciénaga de Zapata.—Undoubtedly, the decline of all the cavity-nesting birds in Bermeja is closely related to the decline (90% of original dead palms) of the sabal palm population there. This decline in palms is obvious in sabal palm habitat throughout the Zapata Peninsula.

Because of the risks to harvesters of climbing frail, poorly anchored dead palms, poachers simply push them over to gain access and collect chicks, and even eggs, of Cuban Parrot and Cuban Parakeet[19] (pers. obs.). This practice not only selectively destroys the best cavity-bearing trees (i.e., sites where pairs have successfully produced eggs and chicks) as future breeding habitat for parrots and parakeets, but destroys cavity-bearing trees suitable as breeding sites for other species. Poaching has resulted in the steady diminution of replacement in parrot and parakeet breeding populations. In 1994, AK & P. A. Bradley (unpubl.) noted the first substantial effect of parrot poachers at Bermeja, where c.200 sabal palms were felled in a two-month period. We observed high levels of palm destruction by parrot harvesters every year since 1993 (Fig. 5). Lucrative incentives drive poachers to push steadily further into the most remote parts of Zapata in search of parrots and other

Figure 5. Sabal palms *Sabal maritima* felled by poachers harvesting Cuban Parrot *Amazona leucocephala* chicks, Bermeja Faunal Refuge, Cuba (A. Kirkconnell)

species, whose value locally and internationally has increased substantially with their mounting rarity. Although populations of parrots in our study areas formerly rivalled all other known sites in Cuba, populations have declined dramatically over the past 20 years. In the late 1980s and early 1990s, the number of breeding pairs of Cuban Parrots at Bermeja was estimated to average c.50 pairs per year, with reasonably high nest success and productivity levels (AK unpubl.). In stark contrast, no parrot pair successfully fledged young in the area in 2005, as a result of local poachers harvesting all chicks. In 2010–12, no more than three nests were found per year and, as a result of local harvesting, no young fledged in any year.

In 2010, cavity habitat in the southern limit of the Bermeja refuge was partially destroyed by poachers during their harvesting activities, when c.52 palms were pushed over (AK & JWW unpubl.). Wechsler[24] and Mitchell[16] reported that poaching has had serious and long-term consequences for cavity-nesting species.

The solution to the poaching problem is not simple. Some local people depend on harvesting parrots and parakeets to earn a living. Among the main communities that have many people harvesting wildlife are Santo Tomás, Soplillar and Pálpite in the western Zapata Peninsula, and Cayo Ramona, La Ceiba and Bermeja in the east. A solution to the harvesting problem should involve a strategy to 'wean' harvesters away from such traditional practices, while providing an alternative means of supporting their families. Part of the solution might be to endow former harvesters with more environmental responsibility, such as involvement in ecotourism or environmental management. Certainly better vigilance and enforcement would help curb the problem, as would stronger deterrents against trade in wildlife products in Cuba.

The common local practice of cutting palm fronds for thatching houses has a direct effect on Zapata's wildlife populations[24]. This activity occurs year-round, but has the greatest effect on wildlife during the breeding season, when nests of species such as the endemic Cuban Oriole *Icterus melanopsis*, which nests among palm leaves, are destroyed.

The loss of palms from savannas and trees from forest and woodland has had a further effect on the region's environment. Once natural areas are cut, burned or otherwise altered, residents and managers too often view those sites as having no further natural value, but as potential for conversion to crop and pasture lands.

The sabal palm is the most important breeding substrate for two species of woodpeckers (Fernandina's Flicker and West Indian Woodpecker *Melanerpes superciliaris*), but is also extremely important as nest sites for other birds, including Bare-legged Owl, Cuban Pygmy Owl, Cuban Trogon *Priotelus temnurus*, Cuban Martin, American Kestrel *Falco sparverius* and many other cavity-nesting birds in Ciénaga de Zapata[16,17] (Table 1), as well as European honeybees *Apis mellifera* and several species of bats. Furthermore, sabal palm is an important nesting substrate for several open-nest endemic birds, e.g., Cuban Blackbird *Dives atroviolaceus*, Tawny-shouldered Blackbird *Agelaius humeralis* and Cuban Oriole. A. Kirkconnell & D. Wechsler (*in* Wechsler[24]) characterised sabal palm as a keystone species of the Zapata ecosystem, because it provides shelter and food for a wide array of birds and lizards. Royal palm *Roystonea regia*, a common species in the region, is also an important cavity-forming species for cavity-nesting birds.

A. Kirkconnell (*in* Wechsler[24]) estimated the Fernandina's Flicker population at Bermeja and adjacent areas at c.90 individuals in 1993. In 1995, Mitchell *et al.*[17] estimated the flicker breeding population at Bermeja at 30 pairs. Our data show an ongoing precipitous decline in Fernandina's Flicker breeding populations at our study areas, mainly due to the lack of suitable nest substrate, but clearing and general habitat disturbance have also permitted establishment of a large population of West Indian Woodpecker at Bermeja and Mera-Molina. This highly opportunistic species inhabits more open areas and opened woodland, and vigorously competes with Fernandina's Flicker for cavities, predating flicker chicks and eggs[16,17].

Pygmy owl breeding populations also declined as availability of palms for nest sites decreased at Bermeja and Mera-Molina study sites. Whereas Bare-legged Owl populations declined throughout our study at Bermeja and at Mera-Molina between

2007 and 2011, its population underwent a substantial increase (125%) in nesting pairs in 2012 at Mera-Molina. The reason for this difference between Bare-legged Owls and other cavity-nesting species is unclear. Possibly the fact that Bare-legged Owl accepts cavities in lower, broken-off palms than other species may be a partial explanation. Such low sites are not usually targeted by parrot poachers but instead left standing. The more stable numbers of suitable palms for nesting might explain a steady number of Bare-legged Owl nesting pairs, but it does not explain an increase. Possibly the increase is related to some form of ecological release or decrease in competition posed by other cavity-nesting species.

The Cuban Martin breeding population in Mera-Molina has also declined as a result of the lack of suitable nesting palm cavities for nesting.

Other threats to habitat and birds in Ciénaga de Zapata

Degradation and destruction of upland forest.—The original natural forests observed by Juan Gundlach in the 19th century and Fermín Zanón Cervera in the early 20th century are gone from the Zapata Peninsula, lost as a result of land modification for agriculture and timber harvest. Substantial degradation of Zapata's forests began in 1840 with the emergence of the sugar industry[1]. Some 43 sugar mills were established in or near the northern section of the Ciénaga, along with the development of a local railway through Zapata's interior.

Zapata's forests have a long history of selective logging and clear-cutting. The local economy has depended on harvesting timber, including wood-cutting for charcoal production, for more than 150 years. In 1900–25, many immigrants from rural Spain settled on the peninsula. The immigrants had a strong logging culture and trained Zapata residents in timber harvesting techniques[1]. Historically, substantial quantities of timber were removed from Zapata's forests to supply wood for local housing, construction and furniture, so that at present nearly the entire forest habitat is secondary. Although extraction, sale and purchase of local timber products are now strictly regulated by the Cuban government, no effective controls exist, so harvesting of remnant old-growth timber continues (Fig. 6).

Ceiba trees *Ceiba pentandra* have been harvested in Zapata since at least 1840, initially as the sugarcane industry developed. In the early 1980s, local residents were permitted to cut ceiba trees for use in constructing houses. Around 2004, a year-long ill-conceived policy of systematically removing ceibas was initiated by the forestry department. One of the ecological consequences of wide-scale eradication of ceiba has been the

Figure 6. Illegal timber harvesting, Los Sábalos, Cuba (A. Kirkconnell)

extirpation of Giant Kingbird *Tyrannus cubensis* in Zapata Peninsula[3]. Regalado[21] noted the importance of ceiba trees for breeding Giant Kingbirds in Najasa, Camagüey province, where nests of all 27 breeding pairs located were constructed in ceiba. However, there are recent observations of Giant Kingbird nesting in other tree species, including *Delonix regia* and *Pinus caribaea* (AK pers. obs.).In addition to loss of primary breeding substrate, Giant Kingbirds were affected by disappearance of most riparian forest from Zapata Peninsula, which represents critical habitat for the species[21]. The Endangered Giant Kingbird was last collected on the Zapata Peninsula in 1933.

With the weakening of the Cuban economy, in the 1990s local farmers commenced cultivating rice and other crops, and large areas of forest were cleared on the Zapata Peninsula[24], resulting in rapid, broad-scale deforestation and habitat fragmentation. As a consequence of local residents' survival efforts in response to the national economic crisis, along with a misguided habitat management strategy in some areas, the environment has suffered widespread destruction, which has resulted in all but a very few old trees disappearing from the region.

The changing threats of hurricanes and fires.—Mature trees afford natural forests protection against the destructive effects of hurricanes. Selective cutting and clearing has resulted in

fragmented, remnant forest with insufficient natural protection of mature forest to buffer the effects of strong winds on the fragile early successional forests of Ciénaga de Zapata. Thus, once the sturdy mature trees are gone, tropical storms wreak far greater habitat damage. Further, the frequency of strong hurricanes—categories 3–5 on the Saffir-Simpson scale—has increased in the Caribbean region over the last 30 years[6,7]. Consequently, tropical storms are causing an increasing amount of damage because of their more frequent occurrence, and their more devastating effects on habitat as a consequence of man-induced forest changes. Our observations in Zapata during hurricanes Lili (1996; Category 3) and Michelle (2001; Category 4) enabled us to assess storm-related damage in the peninsula's forests. We found that the most severely affected areas were those with younger second-growth forests (unpubl. data).

Another negative effect of hurricanes is the accumulation of many trees downed by the strong, un-dampened winds. Natural wildfires, ignited by lightning, receive additional fuel from dried fallen trees, and fires thereby increase in extent, duration and intensity. The most severely affected habitat is marshland, where small wooded islands within the heart of the swamp serve as natural shelters for marsh wildlife during fires and hurricanes. However, more intense fires and hurricanes have had considerable negative effects on these refuges. It is critical to effectively protect these hammocks.

Habitat burns can be natural, accidental or intentional. Vast expanses of marshes are intentionally burned annually, and these greatly exceed the natural rate in frequency and extent. Fires are started deliberately by poachers to provide short-term habitat improvement for their access to and detection of game. During the 1940s and 1950s, hunters from La Habana intentionally burned large areas of marsh to improve hunting habitat (A. Isunza, forest guard at río Hatiguanico station, pers. comm. to AK 1999). That practice has continued until the present, but to a lesser extent because of dangers of wildfire to crops and houses. Fires that start accidentally, or get out of control when farmers clear small plots of land for agriculture, occur frequently on the Zapata Peninsula. Such fires are often difficult to extinguish because poachers encourage the burning. Irrespective of origin, wildfires destroy natural habitat and kill substantial numbers of local fauna, including threatened species, especially those birds of weak flying capacity, e.g., Zapata Rail *Cyanolimnas cerverai* and Zapata Wren *Ferminia cerverai*. When these fires occur during the breeding season, many nests are destroyed causing high mortality, in addition to affecting production and habitat in future seasons.

Invasive plant species.—Gutiérrez[11] warned that invasive species can affect species composition, and the structure and function of an ecosystem. One of the most important effects of invasive species on ecosystem function relates to modification of trophic relationships. Habitat homogenisation by aggressive and adaptable invaders may exclude native species in transformed habitats. Zapata's natural ecosystems are facing serious and increasing threats from exotic plants. Among invasive plants, *Melaleuca quinquenervia* is a grave threat to Zapata's marshland, where it is already widespread and established in dense monoculture woodlots. The negative effects of this exotic species in ecosystems elsewhere have been well documented, e.g., southern Florida[15,20,23]. Still, Cuba has no plan to prevent the spread of the species through the Zapata Peninsula and beyond. A local effort is insufficient and massive resources are needed but, realistically, unavailable. Other invasive plant species threatening the Zapata ecosystem include *Dichrostachys cinerea*, *Casuarina equisetifolia*, *Myriophyllum pinnatum* and *Mimosa pigra*[18].

Some of these exotic species have not yet invaded Bermeja or Mera-Molina but, with the accelerating advance of these invasive species through Zapata, it is only a matter of time before they will threaten native habitats and their dependent faunas throughout the peninsula.

Exotic animals.—Several native aquatic species are at severe risk of extirpation or extinction in Ciénaga de Zapata because of an Old World catfish (African *Clarias gariepinus*) introduced to Cuba in the late 1990s. Catfish reached Ciénaga de Zapata by 2000 and have had the most severe adverse effect on the Zapata ecosystem of any introduced exotic animal because they voraciously devour aquatic vegetation and animals[9]. Populations of several animal species have been reduced by catfish, including American Bullfrog *Lithobates catesbeianus*, Cuban Tree-frog *Osteopilus septentrionalis*, several toads (Cuban Small-eared Toad *Peltophryne empusa*, Western Giant Toad *P. fustiger*, Gundlach's Caribbean Toad *P. gundlachi* and Tschudi's Caribbean Toad *P. peltocephala*), and many native fishes. Our surveys conducted along the río Hatiguanico revealed an estimated loss of c.95% of birds compared to pre-2000 surveys; most obvious among these are Least Grebe *Tachybaptus dominicus*, Northern Jacana *Jacana spinosa*, Green Heron *Butorides virescens*, Black-crowned Night Heron *Nycticorax nycticorax*, Snail Kite *Rostrhamus sociabilis*, and three rallids (Purple Gallinule *Porphyrio martinicus*, Common Gallinule *Gallinula galeata*, American Coot *Fulica americana*). Some birds have disappeared because their natural foods, such as young apple snails *Pomacea paludosa*, are no longer available. Other

cases involve direct predation, mainly of small birds and young nidifugous birds, including Spotted Rail *Pardirallus maculatus*, Yellow-breasted Crake *Hapalocrex flaviventer* and the Critically Endangered endemic Zapata Rail.

The predatory Javan Mongoose *Herpestes javanicus*, introduced in Cuba in 1830 and now common and widespread[4], has had a severe negative effect on animals in the Zapata Peninsula. Also, the now-ubiquitous introduced Old World Black Rat *Rattus rattus* (arrived 1493) and House Mouse *Mus musculus* (c.1510–30) have affected native species as competitors and predators[4].

Other introduced animals of concern include several ungulates. Water Buffalos *Bubalus bubalis*, introduced c.1985[4], have affected the habitat of several marshland endemic birds, via their habitat-modifying grazing and soil compaction. White-tailed Deer *Odocoileus virginianus*, introduced in Cuba during the 17th and mid-19th centuries[4], and free-ranging domestic cattle *Bos taurus* and goats *Capra hircus*, both introduced into Cuba in 1509, browse forest understorey plants, which has had a negative effect on many native species. Currently, free-ranging hoofed stock move freely within all of Zapata's reserves.

Several other introduced animals are present in a feral state in Zapata Peninsula, including pigs *Sus scrofa* (introduced in Cuba in 1493), and cats *Felis catus* and dogs *Canis lupus familiaris* (both introduced 1509)[4]. Cats and pigs are arguably the feral animals having the greatest effects on native birds, especially ground-dwelling species. Cats predate Grey-fronted Quail-Dove *Geotrygon caniceps*, Blue-headed Quail-Dove, Red-legged Thrush *Turdus plumbeus*, Fernandina's Flicker and Greater Antillean Nightjar *Antrostomus cubanensis*, among others; at night, cats hunt roosting birds as well. Pigs predate eggs and chicks of ground-nesting birds, e.g., Greater Antillean Nightjar, Antillean Nighthawk *Chordeiles gundlachii* and Killdeer *Charadrius vociferus* (pers. obs.)

Despite all of the known effects of introduced species on Zapata's ecosystems, no management programme exists to control or reduce, much less eradicate feral animals.

Hunting.—Poaching has a substantial negative effect on Zapata's wildlife. Several exotic and native species are the main targets of hunters; game species are chiefly mammals (feral pig, White-tailed Deer and Desmarest's Hutia *Capromys pilorides*), but also include Cuban Slider *Trachemys decussata* and the Critically Endangered Cuban Crocodile *Crocodylus rhombifer*. Waterfowl are among the most sought-after gamebirds, including West Indian Whistling Duck *Dendrocygna arborea*, Fulvous Whistling Duck *D. bicolor*, Blue-winged Teal *Anas discors*, Northern Shoveler *A. clypeata* and American Wigeon *A. americana*. Among terrestrial birds, pigeons and doves (White-crowned Pigeon *Patagioenas leucocephala*, Scaly-naped Pigeon *P. squamosa* and Mourning Dove *Zenaida macroura*) are favoured by hunters. Plain Pigeon *Patagioenas inornata*, a game species throughout Cuba and formerly vigorously hunted in Zapata Peninsula, is possibly extirpated locally, as it has not been reported there in the last 30 years[8].

In addition to game hunting, malicious killing of wildlife is common and is a substantial problem on the Zapata Peninsula (Fig. 7). After interacting with local people in Zapata Peninsula for many years, we have concluded that hunting is a vital part of local culture and important to local heritage. Older local residents claim that hunting has been a natural part of their livelihood; many people hunt to feed their families, whereas for others hunting has become a lucrative way of earning a living. Irrespective of its purpose, hunting needs to be regulated in Zapata.

Bird trade.—Many birds are trapped for personal and commercial purposes. Intensive and extensive animal trading in Zapata commenced in 1991 and is now rampant throughout the peninsula, as elsewhere in Cuba (Fig. 8). The globally threatened[2] parrot and parakeet are the most desired species sought by poachers, but Cuban Bullfinch *Melopyrrha nigra* and Cuban Grassquit *Tiaris canorus*, both threatened (unpubl. data) in Zapata and at other localities in Cuba, are also taken in large numbers. The bullfinch is declining rapidly in Zapata, whereas

Figure 7. Schoolboy shooting at nesting Fernandina's Flicker *Colaptes fernandinae* with slingshot, Soplillar, Ciénaga de Zapata, Cuba (J. W. Wiley)

Figure 8. Bird-trappers in Zapata (J. W. Wiley)

the grassquit has been extirpated from nearly the entire peninsula and is now found only in small numbers in very small areas. Nearctic-Neotropical migrants are trapped extensively as well, especially Indigo Bunting *Passerina cyanea*. In addition to being desirable cagebirds, several species are trapped as food, including Blue-headed and Grey-fronted Quail-Doves, both of which are of international conservation concern[2]. Again, none of these harvesting activities is adequately managed in Zapata Peninsula, and action is needed to bring wildlife harvesting under control.

The most important bird sites in Zapata need urgent protection

Zapata Peninsula is the most important stronghold of several Cuban endemic birds. The importance of Bermeja and Mera-Molina to birds within the peninsula is substantial and both areas represent the foremost sites for woodpeckers and owls in Cuba, as the high densities of breeding pairs that we found at these sites have yet to be recorded elsewhere.

We have explored many regions throughout the Zapata Peninsula and have found that no woodland supports as many endemic bird species as the Bermeja and Mera-Molina sites. Bermeja is a unique site, and arguably the most important woodland bird site in Cuba, especially because it is one of the best examples of original avian diversity on the peninsula and has the highest diversity of endemic bird species (69.2%) in Cuba. Following IUCN criteria[12], the Cuban Sistema Nacional de Areas Protegidas (SNAP) has defined eight categories for prioritising terrestrial and marine ecosystem protection[5]. Bermeja is presently designated as a Faunal Refuge (Fig. 2) of National Significance, a mid-level conservation category, and has been ranked fourth in order of importance in terms of protection in Cuba. We have concluded that Bermeja should enjoy greater conservation status and urge SNAP to assign a higher conservation category to improve the national conservation policy there. Similarly, Mera-Molina should be assigned a conservation category with high conservation priority, based on an array of features that demonstrate the site as unique with regional and national importance, including its bird diversity (117 species, equal to Bermeja) and high level of endemic bird species (61%). Although the forests of Bermeja and Mera-Molina have undergone extensive human-caused habitat modification, these areas still support high bird endemism and diversity, along with important populations of several threatened species. However, we doubt that these important sites can maintain sanctuary for their diverse flora and fauna if exploitation of their forests continues under the current unsustainable or non-existent management plans. Both sites require strict protection, with certain provisions for locals, to ensure the future of healthy natural ecosystems.

Other important sites needing protection

Additional IBS in the Zapata Peninsula require protection because of their critical conservation status. The presence of endemic and threatened birds at these IBS is a natural indicator of their value. Below we present three IBS we believe should receive immediate attention to ensure their survival (Fig. 1).

San Blas (22°09'56"N 80°55'14.6"W; Fig. 1) is c.3 km north of Bermeja and supports 87 bird species, including 14 endemics[14].

Peralta (22°57'73"N 81°31'89"W) is located along highway A1 at km 122, c.20 km west of the entrance road to Zapata (Fig. 1). Peralta trail is c.2.5 km long and transitions through second-growth swamp forest to marshland[14]. A total of 94 bird species of which 18 are endemics (including nine globally threatened species) have been recorded at Peralta (AK unpubl.), where Zapata Rail was last recorded (1999). Recently (2014), however, A. Mitchell *et al*. (pers. comm.) reported another record, albeit undocumented, from La Turba.

La Turba (22°28'31.7"N 81°13'31"W; Fig. 1): the road first passes through dry woodland but after a few kilometres enters marshland, with deep channels both sides of the broad track. A total of 93 bird species, including 17 endemics, has been recorded[14].

Recommendations

We consider the following management recommendations critical to ensuring conservation of birds and other fauna, along with their habitats, at Bermeja and Mera-Molina.

1. Designate Bermeja with the higher degree of protection afforded as an Ecological Reserve.
2. Establish a protected habitat corridor between Bermeja and San Blas, an area of great importance to cavity-nesting species.
3. Enlarge the Bermeja reserve to protect all palm habitat. Bermeja is currently too small to guarantee survival of the most critically threatened bird species because of the accelerated pace of habitat disturbance and fragmentation in the entire region. We believe faunal refuges must be enlarged to a minimum 30 km^2. New limits should be created by a team of biologists selecting the best representation of habitats and considering where the most threatened species are present.
4. Provide improved protection to Mera-Molina by designating the area a Faunal Refuge with National Significance. The limits of the Mera-Molina refuge must be formalised and legally established.
5. Maintain Bermeja and Mera-Molina as strict protection areas and manage them for recovery of their ecosystems.
6. The infrastructure at both Bermeja and Mera-Molina could be substantially supported by birding and other ecotourism activities, but will also require support of national and international organisations. Therefore, it is essential to secure international funding to ensure conservation needs of threatened bird species are met, especially improving their habitat and developing sound management programmes.
7. Prohibit wood-cutting and, during the bird breeding season, collecting of palm thatch.
8. Institute a programme of controlling catfish, mongoose and feral cats and dogs in areas critical for ground-nesting and ground-dwelling birds, and rigorously restrict livestock from protected areas.
9. Prohibit the felling of palms and erect fallen palm trunks to provide cavity-nesting birds with breeding substrates, similar to a programme that has been effective elsewhere in Cuba (e.g., for Cuban Parrot on the Isle of Pines[25]).
10. Establish vigorous and extensive environmental education activities among local communities, including Santo Tomás, Pálpite, Soplillar, Helechal, Cayo Ramona, Bermeja, San Blas and La Ceiba.
11. Increase the number of forest guards to four, to patrol Bermeja and Mera-Molina, and provide realistic logistical support, especially transportation. The additional personnel should come from local communities, drawing those individuals away from activities that adversely affect the environment and into activities that support conservation while developing a conservation awareness and ethic within local communities.
12. Control access and activities of people within the reserves to ensure compliance with conservation efforts.
13. Part of the revenues obtained from ecotourism and other activities should revert to local communities. Ecotourism should involve local individuals and communities so that they possess a real investment and return in these activities. We recommend that local woodsmen be trained as birding guides, with special emphasis on ethical aspects concerning local endemic and threatened wildlife.
14. In addition to Bermeja and Mera-Molina, San Blas requires further study to determine an

appropriate conservation category, Peralta should be designated an Ecological Reserve, and La Turba is best classed as a Faunal Refuge with Local Significance.

Conclusions

Numerous man-induced threats have had substantial effects on the environment of the Zapata Peninsula, resulting in population declines of some of the most important threatened breeding birds. Improved conservation efforts at all notable sites are critical to sustaining avian diversity in the Zapata Peninsula. Bermeja and Mera-Molina, with their high endemism and substantial sabal palm communities, are particularly important for the breeding and survival of all cavity-dependent species known in the Zapata region. As we have shown, breeding populations of the endemic Cuban Pygmy Owl and Fernandina's Flicker have declined precipitously in both areas, primarily due to loss of cavities and suitable cavity-forming trees. Also, the breeding population of Bare-legged Owl in Bermeja has declined. Parrot populations are in steep decline, and deserve special attention, as does the sabal palm habitat that provides the most suitable nest substrate for cavity-nesters. Other sites, including La Turba, Peralta and San Blas, are extremely important breeding sites for many Cuban endemic birds and urgently need protection.

Designation and implementation of improved regulations and much stronger penalties for infractions are needed at national and local levels to prevent the destruction of Zapata's unique natural environment. Unregulated and poorly managed logging activities at important conservation sites should cease immediately.

It is vitally important that local residents and decision-makers recognise that by protecting the region's flora and fauna, sustainable ecotourism activities will increase and, thereby, improve the local economy. Any further development of ecotourism, however, should be well managed to improve on the unregulated activities now pervasive. Unfortunately, unregulated ecotourism (particularly birding tours) has created considerable disturbance to avian communities in Zapata Peninsula and other regions of Cuba. Visits to nest sites in season have been particularly disruptive to bird populations and must be better regulated. Of special concern is the abuse of vocalisation playback to locate birds during the breeding season. A plan is urgently needed to establish the optimal number of birdwatching visitors an area can realistically support in daily and seasonal time scales without imposing negative effects on ecosystems. The plan should include alternative sites to distribute use over a broader range during periods with large numbers of visitors, especially the breeding season. Irrespective of location and season, ecotourism needs effective oversight to reduce disturbance.

As a key element in the development of conservation in the Zapata Peninsula, it is essential to involve community members in all management plans and ecotourism activities. We believe it is critical that national organisations involved in land conservation in Cuba play a greater role in providing the effective protection these sites need.

Although our goal here is to highlight several IBS in need of further protection and suggest ways of improving conservation efforts there, we acknowledge a greater need for expanding the area of protection of the Parque Nacional Ciénaga de Zapata.

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Arturo Kirkconnell
National Museum of Natural History of Cuba, Obispo 61, La Habana, Cuba.

James W. Wiley
Author for correspondence: PO Box 64, Marion Station, MD 21838-0064, USA. E-mail: jwwiley@mail.umes.edu.