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Comments on the Ecology and Status of the Hispaniolan Crossbill *(Loxia Ieucoptera megaplaga)*, with Recommendations for its Conservation

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ABSTRACT. – The rare and unique Hispaniolan White-winged Crossbill *(Loxia Ieucoptera megaplaga)* is endemic to the mountains of Hispaniola. It is specialized for harvesting seeds from the cones of *Pin us occidentals*, and is dependent on the perpetual production of cone crops. Because large cone crops are produced only once **every** three or so years in any single area, crossbills require large areas to sustain their population. Pine forests throughout the mountains of Hispaniola need protection from cutting to ensure that sufficient pine seed is available every year. Such protection is necessary to reduce the risk of extinction to a crossbill that I argue should be recognized as a distinct species, and whose population size may number less than a thousand.

A pressing demand of biology is to provide the ecological information necessary for ensuring the survival of endangered populations and communities. Nowhere is this information more critical than in the tropics, especially in the West Indies. For example, 44 of the 139 resident bird species on Hispaniola have been classified as threatened or endangered (Hartshorn et al., 1981). One threatened species is the Hispaniolan White-winged Crossbill (*Loxia leucoptera megaplaga).*

The Hispaniolan Crossbill is confined to pine forests on three mountain ranges in Hispaniola (Cordillera Central, Sierra de Baoruco, and Massif de la Selle; Wetmore and Swales, 1931; Kepler et al., 1974; Dod, 1987). The crossbill is found in pine forests because (1) it is specialized for foraging on seeds in the cones of *Pinus occidentals* (Benkman, 1989) (which is found almost entirely on Hispaniola [Mirov, 1967]), and (2) presumably like other crossbills, this species is unable to compete with other species for other types of foods (Benkman, 1988). Consequently, the future of the Hispaniolan Crossbill is contingent on the perpetual availability of *P. occidentals* seeds. Below I discuss both the crossbill and its food resource, and use this information to guide recommendations for the crossbill's conservation.

Pinus occidentals Seed Availability and the Annual Cycle of the Hispaniolan Crossbill

Pine seed availability fluctuates within and among years. The cones and seeds of most conifers, including those of *P. occidentalis,* develop during the summer and mature by September. *Pinus occidentals* seeds remain in the cones until they begin opening between January and March (pers. ohs.). This pine undoubtedly holds at least some seeds in its cones into summer; other fire-adapted conifers with non-serotinous cones hold seeds in partly open cones during extended periods (Burns and Honkala, 1990).

Hispaniolan Crossbills probably forage on a given cone crop from July or August, when the seeds and cones are still developing, until the following July when most of the seeds have been shed; such behavior has been found for the Red Crossbill (*L. curvirostra)* foraging on ponderosa pine (*P. ponderosa)* in the Rocky Mountains (Benkman, 1987a, 1993a). Because few seeds likely remain in the cones more than a year, crossbills need to find a new cone crop each year.

Locally, *P. occidentals* produces a large cone crop about every three years (G. Basilisi and E. Marcano, pers. comm.). Large

cone crops are usually followed by two years of small or no cone crops (G. Basilisi, pers. comm.). This is consistent with my observations of old, new and developing cones during the winters of 1988 and 1991 in the Cordillera Central. This annual variation in cone production and at least occasional cone failures require crossbills to be nomadic and search for new cone crops (Wetmore and Swales, 1931; Benkman, 1987a).

Fortunately, cone production does not fluctuate in synchrony among all areas, otherwise many crossbills would starve in some years. Climate influences conifer cone production (Benkman, 1993b), and the greater the range of climatic variation among sites presumably the less synchronous are the cone crops. The tall mountain ranges in the Dominican Republic create gradients in temperature and rainfall (see e.g., Hartshorn et al., 1981) that promote asynchrony among areas. Indeed, the absence of such climatic variation might underlie the absence of crossbills from the more topographically uniform pine forests in Cuba.

Nevertheless, during some years cone failures may be extensive in Hispaniola. For instance, in January 1991 I found few cones between Pico Duarte, Jarabacoa and Constanza, and FORESTA collected very little pine seed from three widely separated areas at lower elevations in the Cordillera Central (T. Vargas M., pers. comm.). Not only were there few cones, but I was unable to find a single crossbill during four days of hiking in the pine forests in the Cordillera Central in January 1991.

Crossbill numbers fluctuate depending on the size of the cone crops. During years of very large cone crops crossbills increase in abundance, but during years of extensive cone failures crossbills decline. In fact, the more extensive the cone failure the greater the decline in crossbills (see Benkman, 1992). The severity of cone failures will increase as the geographic and altitudinal range of mature cone-producing pine forests decreases.

Crossbills nest when seeds are abundant and accessible, such as when cones are opening (Newton, 1972; Benkman, 1987b, 1990, 1992). In Hispaniola, crossbills start nesting when the cones begin opening in January (Wetmore and Swales, 1931; Kepler et al., 1974). Crossbills may continue to nest until May (Kepler et al., 1974). During other times food may not be sufficient to permit nesting. Between September and December seeds in closed cones are difficult to extract, and from June to August only a few seeds remain in the cones and seeds in developing cones are immature.

Island Crossbill Populations and Squirrels

Seven species and subspecies of crossbills are endemic to islands (Benkman, 1989). These populations usually occur on islands where conifers are fire-adapted and tree squirrels *(Sciurus* and *Tamiasciurus)* are absent. Fire-adapted conifers tend to produce cones more regularly and hold seeds longer in the cones than other conifers. This is critical for island crossbills because they are limited in the area over which they can search for seeds. The absence of squirrels is important because squirrels have acted as a selective agent for larger, more robust cones from which it is more difficult for crossbills to extract seeds. Squirrels are also important seed competitors. The incompatibility of squirrels and crossbills endemic to islands has been confirmed on Newfoundland, where within 10 to 20 years after squirrels were introduced the endemic crossbill declined precipitously and may now be on the verge of extinction (Benkman, 1989; Pimm, 1990). A successful introduction of tree squirrels onto Hispaniola might very well cause the demise of the already rare Hispaniolan Crossbill.

Status of the Hispaniolan Crossbill

The Hispaniolan Crossbill is uncommon even in the most productive pine forests (pers. ohs.). It never was very common (Wetmore and Swales, 1931), and now it is undoubtedly even less common due to loss of habitat. For example, 31 crossbills were collected in the Cordillera Central east of Pico Duarte in February and March 1917 (Wetmore and Swales, 1931). In this area I observed only four crossbills (in two

groups) during three days of hiking more than 50 km between La Cienega and the summit of Pico Duarte in late February 1988. I saw no crossbills in this area during four days in late January 1991. In the Sierra de Baoruco, I spent three days hiking in three areas and found only one group of four crossbills (3 adults, 1 fledgling). Similarly, Woods and Ottenwalder (in prep.) saw only five crossbills (in two groups) in 50 hours of walking transects in the Massif de la Selle, Haiti.

The Hispaniolan Crossbill is obviously very uncommon. In 1988 and 1991, I walked about 150 km along trails and dirt roads through pine forests and found eight crossbills. If I located all crossbills within 50 m on either side of me, I saw one crossbill per 1.9 km'. This, however, is-probably an overestimate of crossbill density because four of the eight crossbills were located only after searching an area where there was a localized large cone crop (in the Sierra de Baoruco), and one was found going to water while I was at camp. On the other hand, I may have missed concentrations of crossbills.

Large concentrations of Hispaniolan Crossbills, as found in continental forms of crossbills, are unlikely for at least two reasons. First, the smaller the geographic range of the conifers available to a crossbill population, the smaller the crossbill population from which to draw from. For example, the large concentrations of White-winged Crossbills sometimes found in North America *(L. l. leucoptera)* appear to represent individuals from across the continent (Benkman, 1987a, 1992). Second, extensive areas of pine seem to rarely produce many cones, especially in the Sierra de Baoruco (pers. ohs.). Thus, even occasional large increases in population sizes are unlikely. Given these considerations, I suggest one crossbill per 5 km^2 of pine forests in the Dominican Republic as a rough estimate of population density. Based on this estimate and the fact that pines occupied about 2846 km^2 of the Dominican Republic in 1983 (very few pines remain in Haiti and by 2008 very little is projected to remain [Fisher-Meero, 1983; Cohen, 1984]), the total number of Hispaniolan Crossbills is probably less than 1000 individuals. Because of the inevitability of at least occasional widespread cone failures, the vulnerability of crossbills to extinction is probably much greater than portrayed by my estimate of population size (see Benkman, 1993b).

Recommendations for the Conservation of the Hispaniolan Crossbill

The basic conservation strategy for protecting the Hispaniolan Crossbill should be to reduce the probability of an island-wide cone crop failure. Although National Parks cover a wide range of elevations, cone failures, such as in 1990-1991, may still occur throughout both Parks in the Cordillera Central. Additional protection of large tracts of mature forest over a wide range of elevations and geographic locations in both the Cordillera Central and Sierra de Baoruco is necessary to reduce the possibility of the crossbill's extinction. One strategy would be to protect ridges radiating from the Parks.

Crossbills would benefit from protection of areas that consistently produce the most cones. Pines grow best, and probably produce the most cones, at the mid to lower elevations in the Cordillera Central (Subtropical Lower Montane Wet Forest, between 850 and 2100 m elev.; see Hartshorn et al., 1981). In January 1991 I found many cone buds on most pines below 2300 m (from Jarabacoa westward to above La Cienega and south to Constanza), but very few cone buds were seen at higher elevations (to 3000+ m on Pico Duarte). Protection of the Subtropical Lower Montane Wet Forest would benefit crossbills and other native avifauna. Regrettably, this zone has been extensively altered by slash and burn agriculture (Hartshorn et al., 1981). Such habitat loss prompted Hartshorn et al. (1981) to recommend that protection of this forest type "should be a top priority of the Dominican government."

Areas with soil development and moisture provide important habitat for crossbills (and other endemics) in the more arid Sierra de Baoruco (pers. ohs.). Such an area includes the bench just south of Loma Los Aguacates at c. 2060 m elevation. This is

where on 4 March 1988 I observed four crossbills, including a female regurgitating pine seeds to a juvenile. This site is both near and similar to the site where the first nest of a Hispaniolan Crossbill was found (Kepler et al., 1974).

Mature forests are important because they are more likely to produce a cone crop during a given year and older trees produce more cones than younger trees (Benkman, 1993 b). Thus, mature forests should be protected, and regenerating pine forests should be allowed to mature. If logging is to occur, long rotations and asynchrony among cuts within a region would reduce the negative impact on crossbills. Selective cuts are preferable to either clear-cuts or shelterwood cuts. Dense tree plantations are not particularly good for crossbills because few cones are produced under such conditions.

Hartshorn et al. (1981) suggest that *P. oocarpa* might be planted as a "possible alternative" to *P. occidentals.* However, in terms of providing habitat for the Hispaniolan Crossbill, and possibly other endemics, *P. oocarpa* is not a substitute for P. *occidentals* and should not be planted as such.

Taxonomic Status and Considerations

The Hispaniolan Crossbill was recognized as a distinct species by Wetmore and Swales (1931), but now it is considered as a subspecies of the White-winged Crossbill. However, based on recent studies of other crossbills (Elmberg, 1993; Groth, 1993), the Hispaniolan Crossbill should be acknowledged as a separate species. In fact, the morphological differences between the Hispaniolan Crossbill and its closest relative, the North American White-winged Crossbill *(L. l. leucoptera),* are greater than differences between the Scottish Crossbill *(L. scotia)* and either the Parrot Crossbill *(L. pytyopsittacus)* or Red Crossbill *(L.* c. *curvirostra)* in Europe, or between most other putative species of crossbills. The Hispaniolan Crossbill has a bill structure very similar to that of the Red Crossbill common in the Rocky Mountain region of North America, whereas the North American White-winged Crossbill has a significantly smaller and narrower bill (Benkman, 1989, 1992). Based on extensive foraging data gathered on these two (and other) crossbill species (Benkman, 1987a, b, 1993a; unpubl. data), I doubt that either of the two New World subspecies of White-winged Crossbill could survive for long in each other's habitat. Moreover, they are so different that if they hybridized intermediate morphologies would be inefficient foragers on foods of either of their respective parents. Considering the importance of efficient foraging in the annual cycle of crossbills (see Benkman, 1987a, 1990) and the distinctiveness of the bill structure of the Hispaniolan Crossbill relative to its nearest relative, I argue that the Hispaniolan Crossbill should be recognized as a distinct species.

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E R R A T U M

Due to a printer's error, the page number for the "Note from the Editor" in Volume 30, Numbers 1-2, of the *Caribbean Journal of Science* was printed incorrectly in the Table of Contents on the back cover. The page number was printed as "152" but, in fact, should be "52." This is an unfortunate error, as the note explains about the 30th anniversary of the *Journal.* Please take a moment to read the note on p. 52 of that issue. Thank you.