

# New evidence in support of a distinctive Red Crossbill (*Loxia curvirostra*) Type in Newfoundland

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This Red Crossbill was audio-recorded, captured, and measured at Whitbourne, Newfoundland on 15 July 2005. The recordings are similar to other recent recordings of Red Crossbills from Newfoundland, presumably all typical of Type 8, although previous brief recordings of calls by which Type 8 was described are distinctly different from more recent recordings. Photograph by Lester Rees.

## Abstract

On the basis of two four-second audio recordings made in 1981 by Jay Pitocchelli, Groth (1993) identified Type 8 Red Crossbill (*Loxia curvirostra*), which he considered possibly resident on the island of Newfoundland, where earlier ornithologists had described a large-billed resident form as subspecies *perna*. This Type, or subspecies, is thought to have experienced a precipitous population decline in the twentieth century (Pimm 1990, Benkman

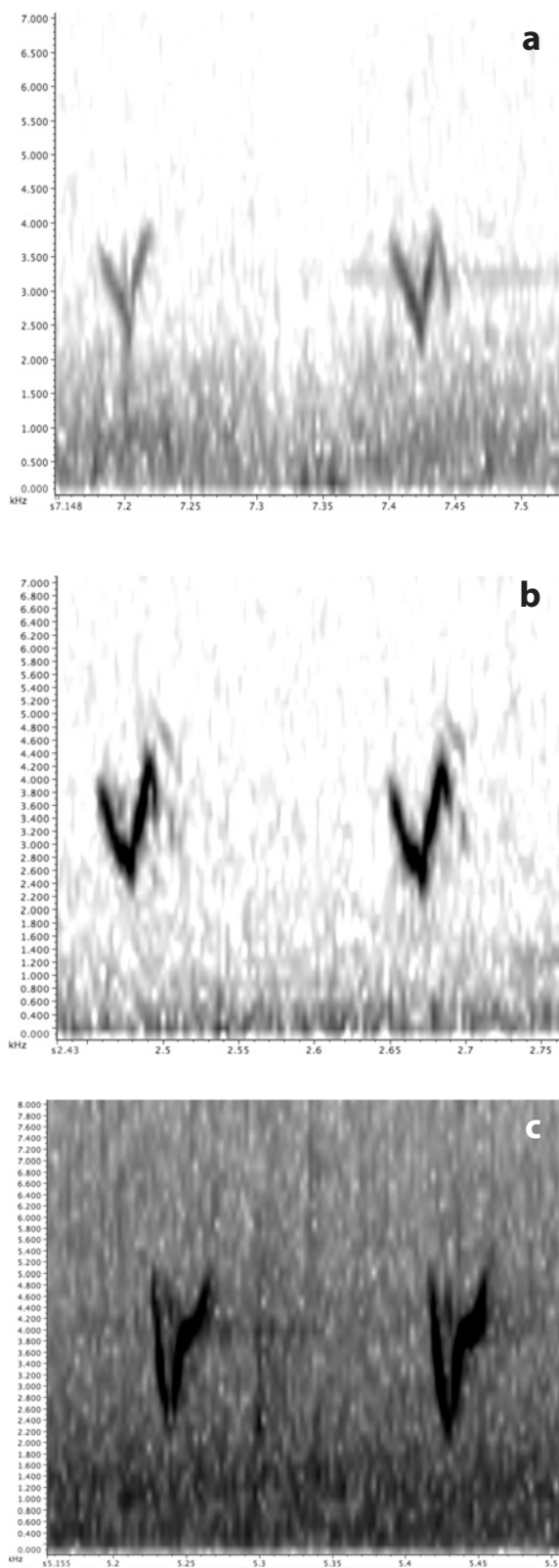
1993) and since 2004 has been listed as Endangered by the Species At Risk Act (COSEWIC 2004).

Audiospectrographic analysis of 30 recordings made during 2005-2011 (2 hours, 37 minutes) supports the claim of a distinctive Red Crossbill Type on the island of Newfoundland. We compared these recordings to other North American Types, including the recordings used by Groth to describe Type 8. The 2005-2011 recordings are different from the

Pitocchelli recordings and from other known Types but almost certainly represent Type 8, as no other North American Type has been recorded in recent times on Newfoundland, and morphological measurements of recent specimens and captures are very similar to those of other Newfoundland-breeding Red Crossbills.

## Background

Crossbills (*Loxia* spp.), distinctive cardueline finches, are unique among bird species



**Figure 1.** a) and b) Spectrographs of Red Crossbill calls recorded by Jay Pitocchelli at Cape Bonavista, Newfoundland 14 June 1981; used by Groth (1993) to describe Type 8. c) Spectrograph of Type 4 Red Crossbill flight call recorded by Young in Cayuga County, Summerhill, New York on 4 April 2009.

in having fully crossed bills. Red Crossbills (*L. curvirostra*) show variations in vocalizations, bill morphology, and ecology, and research conducted since the 1980s indicates that there are at least 10 North American “call-types” or Types (Groth 1993, Benkman 1999, Benkman et al. 2009b, Irwin 2010), each of which could represent an incipient species (Parchman et al. 2006). Many of these, including Types 1, 2, 3, 4, and 10, disperse large distances when cone crops of key conifers (see Benkman 1993b) fail in the core zones of occurrence where the respective Type most regularly breeds and is most common (Dickerman 1987, Knox 1992, Kelsey 2008, Young 2010). Their nomadic tendencies result from fluctuations in cone crops over large areas. Red Crossbill Types that inhabit islands (Newfoundland’s Type 8), island-like locales (Type 9, also known as South Hills Crossbill, *L. sinesciurus*), and/or areas with more stable cone crops (Type 5 and probably Type 6) apparently wander or “irrupt” less often or less extensively than Types from large areas of contiguous forest and/or areas with less stable cone crops (Benkman 1993a, Benkman and Siepielski 2004, Mezquida and Benkman 2005, Benkman and Parchman 2009a, Young 2010).

Red Crossbill Types have different bill depths, and many Types appear to forage most efficiently on a single “key” conifer that corresponds to their bill morphology, especially to bill depth (Benkman 1993b, Edelaar and Benkman 2006). All Types do, however, feed on seeds of other conifers that provide the highest energy yields (Benkman 1987). Type 8 may be associated with the local Black Spruce (*Picea mariana*) (Benkman 1993a) or White Pine (*Pinus strobus*). Benkman (1993a) has suggested that Type 8 Red Crossbills are ineffective competitors with introduced Red Squirrels (*Tamiasciurus hudsonicus*) for Black Spruce seed, but the decline in Type 8 could well have been caused by changes

in forest ecology, including Spruce Budworm (*Choristoneura fumiferana*) activity and the extensive logging in the nineteenth and twentieth centuries of White Pine, White Spruce (*P. glauca*), and Black Spruce.

Identification of Red Crossbill Types is currently only possible by recording their flight calls, rendering the recorded calls as audio-spectrographs, and analyzing the calls’ attributes. Ideally, morphological measurements of the calling birds would also be obtained and analyzed (Summers et al. 2002). In addition to Type 8, other Types likely inhabit Newfoundland on occasion: specimens collected in the late nineteenth century show a range of bill sizes, including some with smaller bills than what is described for Type 8 (Montevicchi, unpublished).

## Methods

In order to investigate more fully the claim of a resident Red Crossbill Type on Newfoundland, we analyzed 30 audio recordings of Red Crossbills made in Newfoundland since 2005 (a total of 2 hours, 37 minutes) and also compared morphological measurements of five individuals to measurements associated with presumed Type 8 specimens (Table 1); two of these individuals were also audio-recorded. We compared Pitocchelli’s two audio recordings (a total of 8 seconds) analyzed by Groth (1993) to the more recent recordings from 2005–2011. Of the 30 recent recordings, four were made at Whitbourne in the May–July period of 2005, 2006, 2007, and 2010 (2 hours, 4 minutes). In addition, similar recordings were made at Conception Bay South in February 2010 (26 seconds), at West Brook Ecological Reserve 29 and 31 March 2011 (23 minutes, 19 seconds), and at Howley 20 April 2011 (9 minutes, 36 seconds). When possible, recordings were made of single individuals perched in trees at a distance of 10–20 m and from flocks in flight at similar distances. Recordings were analyzed using Raven Pro 1.3 (Charif et al. 2004).

We have been able to take recent measurements of five Red Crossbills from Newfoundland; two of these individuals were also audio-recorded. At Whitbourne, hatch-year male and female (sexed by plumage and aged by extent of skull ossification) were captured by Fifield on 15 July 2005, measured (unflattened wing chord; bill length from nares to tip; bill depth at nares), photographed, banded, and released. These birds were audio-recorded, and all the birds recorded that day had similar flight calls (see Figure 2a). In addition, a dead second-year male Red Crossbill found in Terra Nova National Park 27 February 1998 was measured by Fifield and single juveniles at Blake-

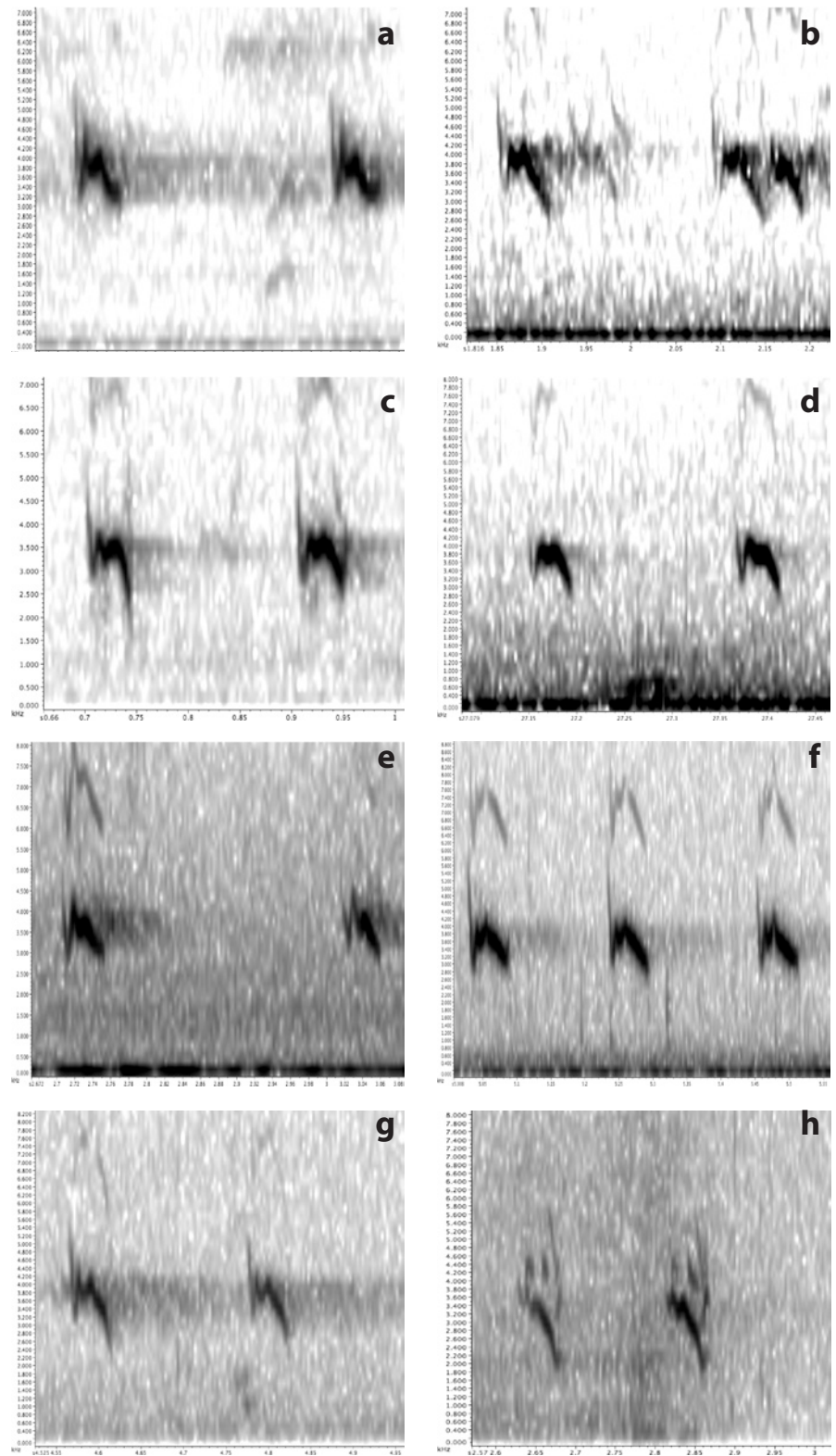
town (July/August 2010) and at Whitbourne (month unknown) were measured by Fifield.

## Results

The original Type 8 spectrograph from the recording by Pitocchelli can be described as V-shaped with a slight downward element at the end (Figure 1a-b). The main frequency is in the 2.3 to 4.0 kHz range. The flight call of Call Type 4 (Figure 1c) is presented for comparison, as it shares some similarities with the Pitocchelli recordings. These original recordings lack the ringing quality of more recent recordings and might be described as flat, quick, and a bit harsh by comparison. The more recent Newfoundland recordings of flight calls depict a complex modulated note that vaguely resembles the letter “M” (Figure 2a-g). The main frequency of sound is in the 3.25 to 4.0 kHz range. Additionally, there are often subtle modulated elements at beginning and end. The sound of the flight call of these more recent Newfoundland recordings can be described as bell-like or ringing and clear, resembling the *cheep* call of Evening Grosbeaks of the nominate subspecies.

The spectrographs of the Pitocchelli recordings appear most similar to those of Type 4 Red Crossbills. However, the closing downward element differs from Type 4 calls; moreover, the Pitocchelli recordings show a single modulated element, rather than two distinct modulated elements, as is typical of Type 4 (see Figures 1a-c). The initial downward modulated element in the Pitocchelli recordings is stronger than that seen in Type 4 calls. To the ear, the original Pitocchelli recordings sound similar to Type 4 flight calls but with a harsher, flatter quality. By comparison, the more recent crossbill recordings from Newfoundland (Figures 2a-g) do not resemble the Pitocchelli recordings, or recordings of Type 4, or any other North American Type. Differences in audiospectrographs between the 1981 recordings and 2005-2011 recordings are readily apparent. The recent recordings are perhaps closest to audiospectrographs of Type 3, most common in the Pacific Northwest (Groth 1993). Type 3 is easily ruled out in this case because Type 3 is the smallest-billed Type in North America; even the largest-billed Type 3 and smallest-billed Type 8 would not overlap in bill measurements (Groth 1993).

The spectrograph of one Red Crossbill flight call recorded at Howley 20 April 2011 (Figure 2h) is similar to the other recent Newfoundland calls, but it was produced in a lower frequency range and shows a downward element at the end. Also, the call appears to be produced polyphonically, that is, with different halves of the syrinx simultaneously.



**Figure 2.** Proposed Type 8 flight calls, all recorded on the island of Newfoundland. a) recorded by Fifield at Whitbourne 15 July 2005. b) recorded by Greg Stroud 10 June 2006 at Whitbourne. c) recorded by Martha J. Fischer 7 May 2007 at Whitbourne. d) recorded by Doug Hynes 2 February 2010 at Conception Bay South. e) recorded by Doug Hynes 16 July 2010 at Whitbourne. f) recorded by Bruce Rodrigues 31 March 2011 at West Brook Ecological Reserve. g) recorded by Bruce Rodrigues 20 April 2011 at Howley. h) unusual calls recorded by Bruce Rodrigues 20 April 2011 at Howley.

Nevertheless, the spectrograph of this call most closely matches the “M-shaped” spectrographs of the most recent Newfoundland recordings. The bird was recorded in Red Pine (*Pinus resinosa*) stands, and it is perhaps best left unassigned to Type.

In the Northeast, the nomadic Type 2 is the only large-billed Type similar to Type 8 that occurs with any regularity; there is also one recording of a large-billed Type 5 in New York in August 2006 (Young 2010). While there is some overlap in measurements of bill depth between Type 2 and Type 8, the bill depths of birds measured in this study are in the middle range of Type 8 (Table 1) and would be on the extreme high end of the range for Type 2 (Table 2).

## Discussion

Groth's (1993) description of Type 8 from two brief recordings was tentative, and it is possible that Pitocchelli's recordings are not of true flight calls but other sorts of calls (Irwin 2010). Although it is conceivable that the differences between the Pitocchelli recordings and the more recently recorded calls are due to a genetic bottleneck in Type 8, or even to recent colonization by an undescribed North American or European Type, it seems far more plausible that the more recent recordings more accurately represent Type 8 than the recordings analyzed by Groth. Red Crossbill flight calls appear to be relatively stable over time (Sewall and Hahn 2009), and so a radical change in flight call, even in a situation of sharp population decline, would seem unlikely.

Moreover, there is currently no evidence to support the notion that European Red Crossbills have colonized Newfoundland in recent times. Thomas et al. (in prep.), studying populations of Red Crossbill in the Atlantic provinces of Canada, sequenced a segment of the mitochondrial DNA control region from Red Crossbill tissue samples collected at locations from across Newfoundland, Québec, and Nova Scotia. Their analysis included comparison with tissue samples of crossbills from across Europe and from elsewhere in North America. Their results indicated clear distinctions between North American and European groups, but the North American samples did not reveal distinctive clusters for the gene regions investigated.

The most parsimonious explanation of the differences between the 1981 recordings and the 2006-2011 recordings, then, is that the more recent and complete set of recordings is typical of Type 8 Red Crossbill. The fact that recently measured individuals from Newfoundland were near the morphological mean of Type 8 (but near the extreme of Type 2) further supports the assignment of these birds to Type 8, despite the small sample size. Thus we infer that the more recent recordings refer more reliably to Type 8.

Clearly, more research on Red Crossbills in Newfoundland is needed. In Québec, there are reports of presumed Type 8 Red Crossbills from Anticosti Island (Benkman 1993a) and the Magdalen Islands (P. Thomas, pers. comm.), though there are no recordings to confirm identification. Other Red Crossbill

Types likely occur in Newfoundland on occasion, and several small-billed specimens have been noted in Newfoundland collections (Montevecchi, unpublished). Moreover, Types 1, 2, 3, 4, and 10 have been documented in nearby areas of northeastern North America (Groth 1999, Young 2008, 2010, 2011). More audio recordings are of Red Crossbill flight calls are sorely needed from Newfoundland and from nearby islands and the adjacent mainland. Identification of Red Crossbill Types in Newfoundland, as elsewhere, will require an abundance of audio recordings, ideally paired with morphological data from the calling individuals (Groth 1993, Robb 2000, Summers and Piernney 2003). Ongoing acoustical studies by Doug Hynes and Ted Miller (Memorial University of Newfoundland) have confirmed that the vast majority of Red Crossbill flight calls recorded recently in Newfoundland are of the kind we describe herein.

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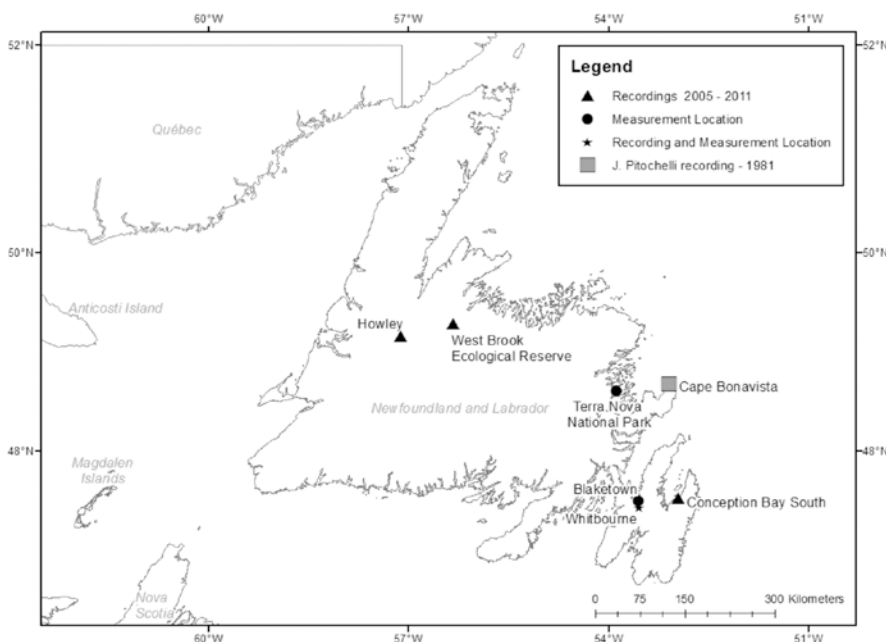


Figure 3. Site locations for recently measured and recorded Red Crossbills in Newfoundland.

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**Table 1.** Morphological measurements of Red Crossbills in Newfoundland, all apparently of Type 8. Measurements presented included single individuals, mean ± standard deviation, or a range, unless otherwise specified. Where relevant, the sample size is provided parenthetically. Measurements of males (m) and females (f) are presented separately in some cases.

source	bill length (mm) <sup>a</sup>	bill depth (mm) <sup>b</sup>	wing chord (mm)
Whitbourne (1711-08128) <sup>c</sup>	15.0	10.2	89
Whitbourne (1711-08131) <sup>c</sup>	15.7	10.2	90
Terra Nova National Park (see text)	14.5	10.3	91.5
Blaketown <sup>d</sup>	13.9	10.2	91
Whitbourne <sup>d</sup>	14.1	10.2	87
Payne (1987)	m 15.16 ± 0.52 (42) f 15.05 ± 0.74 (22)	m 10.54 ± 0.35 (41) f 10.49 ± 0.43 (21)	m 92.02 ± 1.70 (43) f 89.48 ± 2.11 (21)
Benkman (1993, 1989)	14.9 ± 0.18 (10)	10.6 ± 0.10 (10)	
Pyle (1997)	13.5–16.4	9.6–11.4	m 89–97 (43) f 85–93 (21)

<sup>a</sup> Mandible measured nares to tip.

<sup>b</sup> Measured at anterior tip of nares.

<sup>c</sup> Female and male with skull ossifications of approximately 66% and 50%, respectively, indicating hatching in early 2005.

<sup>d</sup> Juvenile specimens; see text.

**Table 2.** Morphological measurements of Type 2 Red Crossbills.

	bill length (mm)	bill depth (mm)	wing chord (mm)
Groth (1993)	m 16.14 ± 0.059 (188) f 15.68 ± 0.076 (118)	m 9.67 ± 0.026 (189) f 9.41 ± 0.029 (118)	m 93.78 ± 0.145 (189) f 90.56 ± 0.186 (117)
Benkman et al. (1989, 1993a)	m 15.8 ± 0.08 (105) f 15.41 ± 0.09 (74)	m 9.63 ± 0.03 (120) f 9.48 ± 0.04 (80)	m 92.8 ± 0.02 (110) f 90.5 ± 0.03 (72)
Pyle (1997)	13.8–19.2	8.9–10.5	m 89–99 (100) f 86–96 (100)

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