North American Red Crossbill Types: Status and Flight Call Identification

***by Matt Young**

As one of the most striking differences in bird occurrence from year-to-year, finch irruptions are often exciting events. As Ron Pittaway's finch forecast noted, it is likely to be an interesting winter for finches given the drought conditions and spotty food crops in the boreal forest. Red Crossbills are likely to feature prominently in this year's flight, and to a certain extent, already have. With crossbills on the move now, we are pleased to introduce Matt Young, who has become one of the North American experts on this incredibly complicated species complex. Red Crossbills have at least ten distinct call types in North America, each with its own ecological niche, appearance, areas of core occurrence, and patterns of movement. Matt has been gracious enough to compile this summary and share it with the eBird community. Please note also that a downloadable PDF is available along with sound files of all the types ready for your iPod, iPhone, iPad, or home computer.

INTRODUCTION

Red Crossbills (*Loxia curvirostra*) represent an ecological puzzle for biologists and birders alike, and an opportunity for pioneering fieldwork for those inclined to explore some of North America's little-birded higher elevation coniferous habitats. Since Jeff Groth's landmark work (1993), the value of recording crossbills for identification to type has become increasingly recognized. Groth's work laid out the idea that each taxon gives a unique, identifiable call type when in flight. As many as 10 "call types" of Red Crossbill can be found across North America (Groth 1993, Benkman 1999, Irwin 2010), each of which may represent a different incipient species (Parchman et al. 2006). The flight calls given by an individual bird have been confirmed to be relatively stable over time (Sewall 2009, Sewall 2010). These call types have also been shown to correspond with slight differences in morphology, genetics, and ecological associations (Groth 1993, Benkman 1993a, Parchman et al. 2006). This article discusses the 10 types of Red Crossbill in depth, empowering eBirders

to better understand, identify, and report their observations of crossbills in this potentially exciting crossbill winter.

It can be quite challenging to differentiate flight calls of the various Red Crossbill call types, but with some practice it's not an impossible task. The flight calls are the sound typically described as *jip-jip* and most frequently heard when the birds are flying overhead. In order to find and identify crossbills, it's essential to develop a familiarity with their flight call vocalizations, which can also be given by perched birds. In each section below I will try to describe the differences between the flight call vocalizations of the Red Crossbill calls--types 1-10.

In addition to flight calls, Red Crossbills also give other calls and various songs. Excitement calls, also known as "toop" calls, can aid in identification to call type, but at this time songs cannot be used for identification to call type (see this eBird paper for more on this and song and call of White-winged Crossbill as well). In order to keep things more focused on the best traits to identify birds to call type, I only discuss flight calls in this paper.

To be able to identify all individuals of each call type with 100% certainty, audiospectrographic analysis is needed. Computer programs such as Raven Lite can be used to do the audiospectrographic analysis. This analysis gives a computer printout of the bird's voice and therefore represents a signature of the call type. Additionally, and perhaps most importantly, the scale used when one analyzes crossbill spectrograms needs to be relatively consistent, and I would emphasize that the larger the scale the better, since using too small of a scale can lead to certain intricacies of a given call type to be missed.

DOCUMENTING AND RECORDING CROSSBILL CALLS

We encourage anyone encountering crossbills to attempt audio recordings. While we welcome recordings from those with professional grade recording equipment, even smartphones can adequately document the call types using their "voice memo" features. For example, on an iPhone just hit voice memo (included on any iPhone), hold your phone as steadily as possible with the speaker facing the crossbill, and then email the recording for analysis along with a link to your eBird checklist! External microphones can be purchased that improve the recording quality even more; read Bill Schmoker's

excellent review of the topic (for iPhones) and consider purchasing a $25 microphone to further improve the sound quality for your crossbill recordings!

Recordings can be sent directly to the author for assistance with identification. Of course, we also encourage you to enter your observations in eBird and, if identification to Type can be confirmed, we ask you to enter those in eBird as the species Type (if you click "add a species" and type "Red Crossbill" you will see a list of the possible Types.)

Below is a thorough summary of the ten North American Types of Red Crossbill. Please note that additional Types occur in Europe, Africa, and Asia, and that we welcome insight into that puzzle as well.

DISCLAIMER

It must be said that while much has been learned in recent years about Red Crossbills, there is still much to learn. Our understanding of how these populations interact and to what extent they are evolutionarily divergent and reproductively isolated is still not well understood. Birds that give certain call types appear to preferentially mate with others that give their own call type, but the big question is, is this what happens under all environmental conditions?

The status sections below highlight the emerging patterns based on analysis of hundreds of recordings, but our understanding of these movements is still relatively new and there is still much to learn. The status and known range are described in terms of "core areas of occurrence" to indicate the ecoregion where each Type is most regular (Young 2011), but note that due to year-to-year variation in food production, these birds may have "primary areas of irruption" and "secondary areas of irruption", which are effectively each Type's primary and secondary zones of dispersal during food shortages in their primary area of occurrence (Young et al 2011). Conifer composition in their primary zones of irruption are often similar to the conifer composition in their core zone of occurrence (i.e., Western Hemlock for Type 3 in the west often uses Eastern Hemlock in the east). Note also that although we present eBird maps for each Type, these give a very incomplete picture as most confirmed records of Types are not yet in eBird.

Some of the statements under "known range" below are provisional and reflect only what has been documented to date. Basic ecology of Types 6 and 7 are poorly-known as is the extent of movement that they may or may not undertake. With very few recordings from Mexico, there is much complexity yet to be understood with Type 6, including the very interesting possibility that an additional Type might exist in Middle America (additional recordings from Middle America would be particularly welcome).

2012 IRRUPTION

Red Crossbills are on the move this year, and in September some remarkable high counts were tallied at migration locations along the Great Lakes and elsewhere. We expect Red Crossbills to continue to turn up in new areas this fall. Back in June and July large numbers of Red Crossbills (Type 3, based on a few recordings received) were moving down the west coast. In July 2012 Red Crossbills appeared on the Farallon Islands off the coast for the first time since 1998, and these were very probably Type 3s. Type 2s have also moved in small numbers out into the Plains of Kansas.

Then in mid-August, a very significant west to east Red Crossbill movement occurred into the Great Lakes, Midwest, Ontario, and Northeastern states. This was a large movement and was much earlier than usual, which has made it particularly interesting to try to determine what Types have been involved. Recordings obtained so far (North Dakota, Wisconsin, Minnesota, New York City, Pennsylvania, Maryland and Quebec) have all involved the small-billed Type 3, which has its core range in the Pacific Northwest where it is most efficient at feeding on Western Hemlock. The Western Hemlock crop this year is reported to be poor, which is likely what has caused these birds to irrupt southward along the Pacific coast and eastward to the Atlantic coast. If anything, this flight has highlighted the remarkable dispersal abilities of Red Crossbills, since this movement has literally occurred from coast to coast.

It will be particularly interesting to see how it all plays out in the Northeast and southward along the east coast. Two particularly interesting questions with this year's finch movements include: 1) How will feeders play into it all given there's a lack of a food crop on most trees, and it's uncertain how good the quality of food is in areas where

the food crop looks to be good. The drought could very well have adversely affected the quality of the crop out there. It could be a big year at feeders. 2) Could the mid-Atlantic states and perhaps parts of the South experience a larger than normal irruption of finches? If seed and fruit quality are poor, more birds could show up at feeders, perhaps even Red Crossbills. They did this in the finch superflight of 1997-98.

RED CROSSBILL CALL TYPES

Type 1 – Appalachian Crossbill (Young et al. 2011) -- Medium-billed

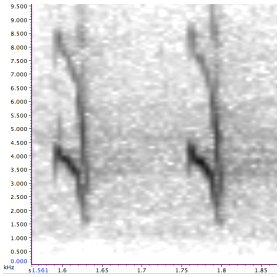
Taxonomy: Subspecies unknown; could match type specimen for *L. c. pusilla*, but has also been referred to as *L. c. neogaea*. This population most likely needs a new name but has yet to be formally described.

Known range: Primarily in the Appalachians from s. New York to Georgia; occasional in Adirondack Mts., NY, and central Mass northward into New England, and perhaps Great Lakes, Maritimes, and s. Ontario; rare to very rare in West. [**eBird map**]

Movements: Mostly resident in East; rarely irrupts into Pacific Northwest

Preferred trees: Red Spruce, Eastern White Pine, and hard-coned pines such as Pitch, Red, Virginia, and Loblolly; in the West has used Sitka Spruce and Western Hemlock.

Flight call: A quick attenuated *chewt-chewt*; compare Type 2.



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The Type 1 Red Crossbill flight call sounds much like a Type 2 Red Crossbill. In both call types the spectrograms are dominated by a downward component. To be able to identify these two types with

certainty, audiospectrographic analysis is essential. The Type 1 spectrogram above is typical, starting with an initial upward component the vast majority of time, and a downward part that descends more quickly than in Type 2. Overall, the Type 1 flight call is a more attenuated, dryer and sharper flight call than the Type 2 and it sounds like *chewt-chewt-chewt*. Like the Type 5, Type 1 can produce sound polyphonically (see Type 5 for more on polyphony), meaning they use separate parts of their syrinx like a *Catharus* thrush.

Status: ***West:*** Type 1 appears to be rare, maybe only occurring in irruption years, in the coastal Sitka Spruce and Western Hemlock forests of the Pacific Northwest (Young et al. 2011). ***East:*** The core zone of occurrence (area where a type occurs most commonly) for Type 1 is the Appalachians from southern New York to northern Georgia (Young et al., 2011). In the Appalachians they are most commonly encountered in areas of both red spruce (and other spruces) and Eastern White Pine, and to lesser amounts Eastern hemlock and various hard-coned pines (i.e., Pitch, Red, Virginia and Loblolly pines). The Type 1 Red Crossbill appears to be more of a generalist and is probably the least common of the more widespread call types found in North America. It is also perhaps the most genetically distinct of all the Types (Groth 1993, Parchman et al. 2006), and might warrant species status.

Type 2 – Ponderosa Pine Crossbill (Benkman 2007) -- Large-billed

Taxonomy: Might be most appropriately assigned to subspecies *L. c. benti*, but, in part, has also been assigned to *L. c. benderei*. This is another case where nomenclatural issues have created confusion that needs to be resolved.

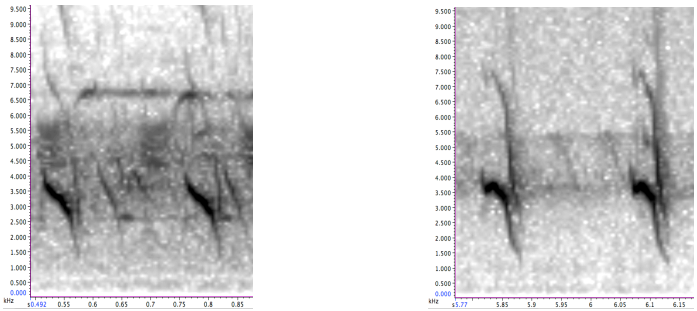
Known range: Continentwide in U.S. into very n. Mexico and parts of s. Canada. [**eBird map**]

Movements: Highly irruptive and can occur nearly anywhere.

Preferred trees: Hard-coned pines. Most efficient at feeding on Ponderosa Pine in the Intermontane West, but will use other hard pines as well, including Lodgepole and Jeffrey pines (West), Red, Jack,

Pitch, Virginia and Table Mountain Pines (East). Uses spruces and soft-coned pines as well.

Flight call: Like Type 1, but a husky, deeper *choowp-choowp*; can recall Pygmy Nuthatch or Olive-sided Flycatcher's *pip-pip-pip.*



Macaulay Library #161299 (left; unkinked variant) and #44960 (right; kinked variant)

Type 2 flight calls are a bit more powerful and husky sounding than those of Type 1. The downward component of the spectrograms is more gradual and modulated, and the initial upward component found in Type 1 is absent (unkinked spectrogram made from Macaulay Library #161299). Additionally, the call (as it appears on the spectrogram) will often level out a bit before continuing its downward trend. The call sounds like a *choowp-choowp-choowp*. Both types often have secondary ending components, but they're stronger and consistently present in Type 1. Additionally, the Type 2 flight call is given near or below 4.5kHz whereas the highest point of the initial upward component of the Type 1 flight call is usually between 4.5-5 kHz. This type tends to produce an "unkinked spectrogram in the east (unkinked Red Crossbill Type 2 Call). In the west, the Type 2 will often produce what is called a "kinked" spectrogram (see kinked variant above), and birds producing this type of spectrogram seem to be rare in the east. This kinked call type first goes down and then back up before going back down. This spectrogram can look a bit like a Type 3, but the difference in sound is quite evident with Type 2 sounding much stronger and huskier. To the ear, Pieplow (2007) likens some Type 2 calls to the piping calls of Pygmy Nuthatch or the *pip-pip-pip* call of Olive-sided Flycatcher.

Status: ***West:*** More than any type, Type 2 will readily feed on various hard pines (e.g., Ponderosa, Lodgepole, Red, and Jeffrey pines) throughout the United States, but its core zone of occurrence, where

it's most closely associated with Ponderosa Pine (Benkman 1993a), is the Intermountain West where this conifer is most common. ***East:*** This type has perhaps the most varied diet of the types and is the most widespread Red Crossbill call type in North America (Groth 1993), even occurring in areas of the Plains where ornamental conifers have been planted. Small numbers of Type 2 can be found every year somewhere in the East, where it often associates with Red, Jack, Pitch, Eastern White, Virginia and Table Mountain pines. Like all other crossbills, it also utilizes soft-coned conifers like spruces and white pines.

Type 3 – Western Hemlock Crossbill (Benkman 2007) -- Small-billed

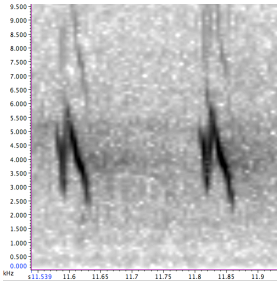
Taxonomy: This Type probably matches *L. c. minor*, but that name could also have been used for other small birds such as Type 10. The nomenclature needs to be clarified in this case as well.

Known range: Primarily in the northern coastal areas of western U.S.; occasional to Great Lakes into northeast and Ontario. [**eBird map**]

Movements: Highly irruptive into the Great Lakes, Northeast, Ontario and perhaps Maritimes every 5-10 years in numbers – last irruption occurred 2006-2007.

Preferred trees: Western Hemlock, Engelmann spruce, less often Douglas-fir or Sitka Spruce in the West; in the East, most often Eastern Hemlock or White and Red spruces.

Flight call: A squeaky or scratchy *tik-tik*; highly distinctive.



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The flight call of the Type 3 is weaker, squeakier, and scratchy sounding than the other types. The spectrogram looks a bit like a

lightning bolt with its zig-zag appearance – it starts out with a downward component followed by a short upward component connected to a second downward component. Occasionally, there can be tails at both the beginning (less common) and end of the typical zig-zag appearance. Additionally, during the second downward modulated component, the *tik-tik-tik* call can level out just a bit as it continues downward. Type 3 can sound a bit like a weaker version of a Type 1 or 2, but Type 1 are sharper and Type 2 huskier, lower and more powerful. However, the spectrograms of Type 3 cannot be confused with any other type unless too small of scale is used. If too small of a scale is used, Type 3 can look a bit like Type 5 or even a kinked Type 2 -- this is a prime example as to why a large enough scale is essential. Type 3 can sound a bit similar to Type 5, but Type 5's gives a twangy sound instead of a squeaky or scratchy sound.

Status: ***West:*** This call type prefers hemlock more than any of the other call types found in North America. Its core zone of occurrence, where it's most closely associated with Western Hemlock (Benkman 1993a), is in the Pacific Northwest. It will rarely occur in spruce/Douglas-fir forests of Intermountain West as well. ***East:*** Type 3, and less so, Type 10, are the most highly irruptive types in the East. Unlike Type 10, when Type 3 irrupt east in great numbers (as in 2012), nearly all retreat back to the Pacific Northwest in May-June when Western Hemlock cone crops start developing again. As with all other Types, Type 3 will readily use various spruces like White, Red and Engelmann spruce, but it most often associates with Eastern Hemlock in the Great Lakes and Northeast.

Type 4 -- Douglas-fir Crossbill (Benkman 2007) -- Medium-billed

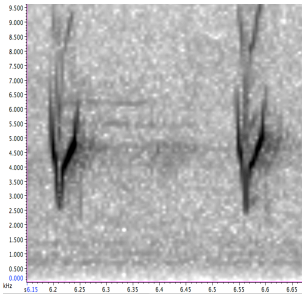
Taxonomy: Unknown; no historical subspecies can be assigned to it.

Known range: Core area in Pacific Northwest, with secondary area in Intermontane West; rare to very rare in the East. [**eBird map**]

Movements: Occasionally irrupts to Intermontane West and rarely into Northeast.

Preferred trees: Coastal variety of Douglas-fir, less often uses interior variety of Douglas-fir, spruces, or white pines.

Flight call: A bouncy *plick-plick*; distinctive, but compare Type 10.



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The flight call of the Type 4 is one the easiest to recognize even when compared to Type 10 (it was recently split from Type 10; see Type 10 below) and is a very bouncy, almost musical down up *plick-plick-plick*. The spectrogram (Red Crossbill Type 4 Call) is dominated by a down-up component with the ending section looking very similar to the Type 10 flight call.

Status: ***West:*** This type's core zone of occurrence, where it's most closely associated with the coastal variety of Douglas-fir (Benkman 1993a), is in the Pacific Northwest. It can also be found occasionally in the Intermountain variety of Douglas-fir in addition to spruces and white pines found in that area. ***East:*** Like Types 1, 2, 3 and 10, Type 4 has occurred across North America and is found at least rarely in the East. In the Northeast, it is known from just two recordings from New York and has been found in association with spruce and white pine (and other pines). It should be noted however that there is much dietary overlap in the East across call types and therefore it is not uncommon to find several types feeding on the same conifer species in the same area – this is particularly true in larger invasion years. Other eastern records of Type 4 include a couple recordings from Ohio in the 1969-70 (see Borror Laboratory of Bioacoustics' collection) invasion and a couple from Michigan (Groth 1993).

Type 5 – Lodgepole Pine Crossbill (Benkman 2007) -- Large-billed

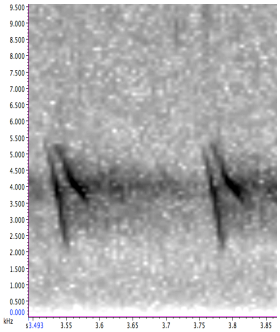
Taxonomy: Would be most appropriately assigned to subspecies *L. c. benderei*, but *L. c. benti* has also been assigned to birds that may represent Type 5.

Known range: Western in U.S. and Canada; vagrant to the East (New York). [**eBird map**]

Movements: Slightly to moderately irruptive in parts of the Intermontane West

Preferred trees: Lodgepole Pine and Engelmann Spruce, less often Douglas Fir, Blue Spruce or white pines.

Flight call: A springy or twangy *clip-clip*; quite distinctive.



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Type 5 Red Crossbills have two elements that drop in frequency, but the two elements are given in very slightly different frequency domains. The lower elements are generally simpler and show less variation individually, whereas the upper elements usually rise sharply before modulating downward (Groth 1993). The second element often starts a fraction of a second after the first element. On the spectrogram this second element often connects or hints at connecting to the first element thus forming the letter "n" or "h". Generally speaking, both elements are given nearly simultaneously. The idea that both elements modulate differently, basically over the same time span, is likely evidence that the Type 5 uses different halves of its syrinx, thus producing sound polyphonically not unlike a *Catharus* thrush (Groth 1993, Pieplow 2007). Unlike other types, the orientation of the call in general is slightly from the top-left to bottom-right as it would read directionally on a piece of paper. To the human ear, Type 5 can sound like very twangy *clip-clip-clip* and therefore unlike other types except Type 3 (which sounds softer and scratchy).

Status: ***West:*** Core zone of occurrence is the Intermountain West. Benkman (1993a) found that Type 5 Red Crossbills were morphologically adapted to most efficiently forage on Lodgepole Pine (*Pinus contorta* var. *latifolia*), which produces one of the most stable

cone crops in the world (Benkman 1993a). Because of this stable cone crop, Type 5's can be resident throughout much of the west where Lodgepole Pine is common. This type also readily feeds on Engelmann Spruce (Benkman and Miller 1996), and to a lesser degree Douglas-fir and Blue Spruce (Kelsey 2009). ***East:*** It has only been recorded in the East once, from Pharsalia, New York 6 August 2006 (Budney and Young Macaulay Library #138299), the only known recording east of the Rockies (Young 2010). With recent massive dieoffs of Lodgepole Pine from Mountain Pine Beetle (*Dendroctonus ponderosae*) outbreaks in the west, this type could become more nomadic and perhaps more regular in the East (Young 2010).

Type 6 – Sierra Madre Crossbill (Benkman 2007) -- Large-billed

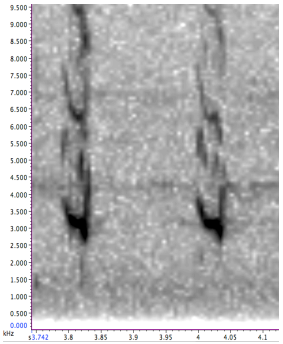
Taxonomy: Likely equates to *L. c. stricklandi*

Known range: Southwest U.S. to southern Mexico; possibly also Guatemala, Honduras, and El Salvador (recordings needed); in the U.S. it occurs in s. Arizona and s. New Mexico; museum specimens have been noted from Colorado and California. [**eBird map**]

Movements: Unknown

Preferred trees: Several hard-coned pine species of Mexico, including Apache Pine.

Flight call: A *cheep-cheep*, ringing, and tonal.



The Museum of Vertebrate Zoology at Berkeley # 5046_481_B_Groth # aF743

The *cheep-cheep-cheep* flight calls of Type 6 are tonal with a slightly downward-modulated frequency and an abrupt terminal rising

component (Groth 1993). Not much is known about Type 6, but by ear it does sound similar to the large-billed Type 8 of Newfoundland, although the spectrograms are obviously different. Type 6 is much less modulated than the m-shaped Newfoundland Type 8.

Status: ***West:*** Type 6 is most associated with Mexican pine species and its core zone of occurrence is the Sierra Madre Occidental (Benkman 2007) and north into the mountain ranges of southern Arizona and New Mexico. Recordings document this Type into southern Mexico, and it may be the form that occurs also in the highlands of Belize, Guatemala, Honduras, El Salavador, and Nicaragua. There is one record northward to California (San Diego Natural History Museum SDNHM 873) and Colorado has six specimens that match *L. c. stricklandi* (e.g., DMNS 4294, 4296, etc.; Spencer 2009). It has never been found in the East.

Type 7 – Enigmatic Crossbill -- Medium-billed

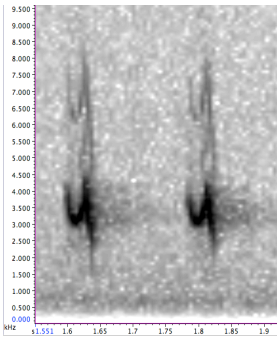
Taxonomy: Subspecies unknown or undescribed.

Known range: Presumably Rare; known only from interior areas of the Pacific Northwest U.S. and s. British Columbia.

Movements: Unknown, but likely relatively resident in areas of interior Pacific Northwest.

Preferred trees: Unknown, but possibly Western Larch or Western White Pine

Flight call: *Jit-jit*



Museum of Vertebrate Zoology at Berkeley # 4776_474_A_Groth # aF497

The spectrogram of Type 7 is often shaped like a small letter "u". Type 7 can sometimes sound a bit similar to Type 10 or even Type 9, but not many recordings of Type 7 exist, and thus describing it is challenging. The main frequency of sound (*jit-jit-jit*) can be described as short initial fall followed by a longer rise and then fall.

Status: West: Type 7's core zone of occurrence is apparently from nw. Oregon, sw. Washington to n. Idaho, w. Montana and s. British Columbia. It is unknown for sure what it's most closely associated with, but it could be Western Larch or Western White Pine. It appears to be the rarest of all the types in North America. Need more recordings. Searches should be conducted in Wallowa Mountains of Oregon and Washington into s. British Columbia. Unknown in the East.

Type 8 – Newfoundland Crossbill (Griscom 1937) -- Large-billed

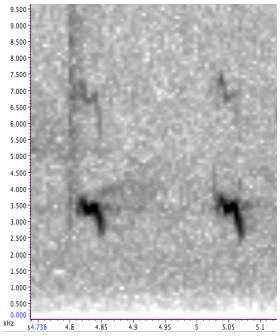
Taxonomy: The name *L. c. percna* is usually associated with this type and the subspecies *percna* is listed as Endangered by the Canadian Wildlife Service. Note however that some authorities (including eBird/Clements!) use the name *L. c. pusilla* as a synonym of *L. c. percna*. The nomenclatural confusion here still needs resolution.

Known range: Mainly restricted to the island of Newfoundland.

Movements: Thought to be resident to island of Newfoundland, but likely moves to Antocosti Island, Quebec and perhaps to other nearby Maritime coasts.

Preferred trees: Likely associates with Black Spruce.

Flight call: *Cheet-cheet*, ringing and complexly modulated



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Recent audiospectrographic analysis of recordings during 2005-2011 (n=30; 2 hr 37min of recordings) confirms the presence of a unique Red Crossbill type on the island of Newfoundland (presumably subspecies *percna*; see taxonomy below). These recent recordings were audiosprectrographically compared to the original two 4-second recordings used by Groth (1993), and much to our surprise, they did not match (Young et al. 2012). The most parsimonious explanation of the differences between the 1981 recordings and the 2005-2011 recordings, then, is that the more recent and complete set of recordings is typical of Type 8 Red Crossbill. Thus we adduce that the more recent recordings refer most reliably to Type 8 (Young et al. 2012).

The sound of the original recordings can be described as flat, quick, and a bit harsh compared to the ringing quality of the more recent Newfoundland recordings. The more recent Newfoundland recordings depict a complexly modulated note that vaguely resembles the letter "M" (Young et al 2012).

The main frequency of sound is in the 3.25 to 4.0 kHz range. The flight call can be described as up-down-up-down *cheet-cheet-cheet*. Additionally, there are often very subtle modulated components attached on either end. Like Type 6, 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 the Evening Grosbeak. Type 8 flight calls are much more modulated than Type 6 though.

Status: ***East:*** Type 8 is likely most closely associated with Black Spruce found on Newfoundland (Benkman 1993b), but it appears to also feed regularly on White Spruce, Eastern White Pine, and Red Pine and can commonly be found at feeders from February-May (Young et al. 2012). It has declined since the 1970's, resulting in *L. c. percna* (Type 8) being listed as Endangered on the Canadian Species at Risk Act and is of considerable conservation concern. More study is needed! Unknown in the West and as yet unknown away from the island of Newfoundland: it is unknown at this time whether it moves to nearby areas of mainland Canada or to offshore islands (e.g., Nova Scotia or Anticosti Island, Quebec).

Type 9 -- South Hills Crossbill (Benkman et al. 2009) -- Large-billed

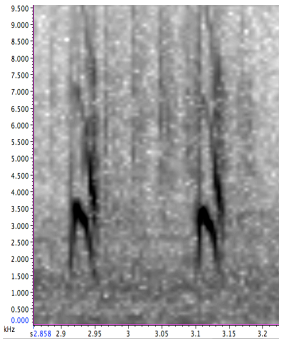
Taxonomy: *L. c. sinesciuris*. Originally described as a species and may well be the most distinctive form of Red Crossbill. It may be accepted as a species in the near future.

Known range: Restricted to South Hills and Albion Mountains of southern Idaho [**eBird map**]

Movements: Apparently resident, but may rarely wander to mountains to northeast of South Hills (Benkman et al. 2009).

Preferred trees: Uses local variety of Lodgepole Pine that has evolved in absence of cone-predating pine squirrels.

Flight call: Very dry *dip-dip*; very distinctive



Macaulay Library # 136591

Type 9 spectrogram starts with an initial upward component, therefore looking a bit like the Type 1 spectrogram. The downward modulation of the flight call is consistently given in a lower frequency domain (below 4.0 kHz) than Types 1 and 2. Like Type 1 it occasionally produces calls polyphonically (see Type 5 for discussion on polyphony) and also has secondary ending components. Overall, the Type 9 flight call sounds much lower and there's a flat harsh quality to them. To my ear the *dip-dip-dip* call actually has an agitated quality to it.

Status: ***West:*** This type was initially described as a full species--the South Hills Crossbill (*Loxia sinesciuris*)--by Benkman et al. (2009). Although the AOU did not accept a proposal to split this form, look for this type to possibly be accepted as a full species in the coming years. Starting in 1997, Benkman began studying this resident call type of Red Crossbills in the South Hills and Albion Mountains of southern Idaho in 1997. Type 9 is adapted to feed on Lodgepole Pine (var.

latifolia) in an area that lacks tree squirrels (e.g., Red Squirrel *Tamiasciurus hudsonicus*), a primary cone predator, and the crossbills thus are the primary predators on pine cones in those mountains. In the absence of mammalian cone predators, the South Hills Crossbill has been tightly coevolving with this specific variety of Lodgepole Pine, driving the South Hills Crossbills to have larger bills to access seeds in better and better protected cones. This type is thought not to wander much at all, perhaps wandering rarely to adjacent mountain ranges to the north (Benkman et al. 2009). Unknown in the East.

Type 10 – Sitka Spruce Crossbill (Irwin 2010) – Small-billed to medium-billed

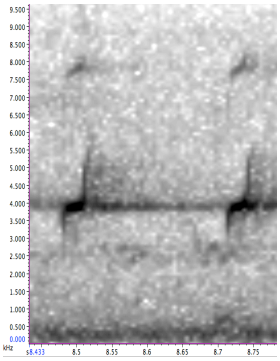
Taxonomy: Likely best matched by *L. c. sitkensis*, but many specimens identified as this form probably include other types of similar morphology such as Types 1, 3 or 4. Nomenclature in need of resolution.

Known range: Continentwide; primarily the coastal Pacific Northwest of northern California to central Oregon, but uncommon year-round in the Northeastern U.S. and southeastern Canada. [**eBird map**]

Movements: Moderately irruptive, with some sizeable incursions to the Northeast like in 1997-98 (Young 2011).

Preferred trees: Sitka Spruce in the Pacific Northwest; uses mainly other spruces and Eastern White Pine when it occurs in the East

Flight call: Very dry *whit-whit*; recalls *Empidonax* flycatcher *whit* note; very distinctive



Macaulay Library # 136593

The idea that there was a crossbill call type that gave a flight call similar to Type 4 but lacked a strong downward component had been known for several years, but Ken Irwin was the first to describe it formally and clarify its apparent ecological relationships (Irwin 2010). The flight call of Type 10 is perhaps one of the easiest call types to recognize. It's a very thin, slightly weak whit-whit-whit. The *whit-whit-whit* sounds much like the *whit* call of an Empidonax flycatcher (e.g., Least, Dusky, Gray, Willow, or Buff-breasted Flycatcher). The spectrogram is dominated by an upward component. There are distinct differences between Type 4 and 10 spectrograms, with Type 4 containing a downward and upward component and Type 10's usually just giving the upward component. Type 10 spectrograms do appear to be more variable than most of the other types (Irwin 2010). The spectrogram for Type 10's can look like a checkmark, uptick, or the letter "u". Type 10 flight call can sound similar to the White-winged Crossbill's *weet-weet-weet* call.

Status: ***West:*** This type's core zone of occurrence is in the Pacific Northwest, where it's most closely associated with Sitka Spruce (Irwin 2010). Irwin found large flocks of Type 10 regularly in the Sitka Spruce forests from coastal northern California to central Oregon (Irwin 2010), and there are records as far northwest as the Kenai Peninsula of Alaska. It should also be noted that Benkman (1993a) predicted a Sitka Spruce associating crossbill type many years ago. ***East:*** Despite being most common in Sitka Spruce forests of the West, Type 10 is also the most frequently occurring call type in the Northeast (Young 2011). In Groth's (1993) initial description of crossbill types, eastern records of Type 10 were lumped with Type 4, and only after Irwin's (2010) description of Type 10 did it become clear that the predominant Type in the Northeastern U.S. was Type 10. After Type 3, it's also the second most highly irruptive type in the Northeast. These two types likely often irrupt together, and in the great 1997-98 irruption the majority appeared to be Type 10 (identified at that time as Type 4), but some Type 3 were involved as well. Unlike Type 3, which nearly all seems to retreat back to Pacific Northwest, Type 10 remains quasi-resident in the Northeast in small numbers (Young 2011). In the Northeast, they seem to associate with various spruces first and foremost, but will also readily snack on Eastern White Pine as well.

CONCLUSION

Understanding how these differences relate to traditional taxonomy is fraught with complexity and is an area in need of additional research. Part of the complexity is in nomenclature, since it is unclear how present Types relate to named subspecies from the past. This is due in part to the fact that some of the named subspecies do not seem to be identifiable and multiple names may apply to a given population and/or Type (i.e., some named subspecies are not valid). Additional complexity arises from the fact that we don't understand the extent to which these different Types are reproductively isolated and whether or not they are behaving as species according to the Biological Species Concept. It could well be that some Types represent distinct species, or it could be that they are better treated as distinct forms that have not yet evolved to represent distinct species.

The 2012 eBird/Clements taxonomy (v6.7) includes not only the nomenclature and taxonomy of species, but also of subspecies. Subspecies cannot be reported in eBird unless it is included as an identifiable group, but Red Crossbills can be reported to Type in eBird. In all cases except one (Type 9), those types are not linked to a scientific name.

Every crossbill recording adds an important piece to the puzzle, especially when accompanied by notes on behavior and ecology, including tree species used for foraging and nesting. The conservation of crossbill call types will depend in large measure on our understanding of their complex distributions and ecological associations, and birders can make critical contributions to their conservation by recording crossbill calls and by reporting their findings.

APPENDIX A

Since an understanding of conifer species is essential to understanding crossbills, the above article discusses conifer species at some length. Below is a list of the scientific names (with Wikipedia links) for the tree species mentioned in the article.

PINACEAE

Pines -- Genus *Pinus*

Pines can be broken down further into soft-coned pines (the two White Pine species listed below) and hard-coned pines (all the others listed below). At some points in the above article we refer to hard-coned or soft-coned species.

- Eastern White Pine *Pinus strobus*
- Western White Pine *Pinus monticola*
- Apache Pine *Pinus engelmanni*
- Jack Pine *Pinus banksiana*
- Jeffrey Pine *Pinus jeffreyi*
- Loblolly Pine *Pinus taeda*
- Lodgepole Pine *Pinus contorta*
- Pitch Pine *Pinus rigida*
- Ponderosa Pine *Pinus ponderosa*
- Red Pine *Pinus resinosa*
- Table Mountain Pine *Pinus pungens*
- Virginia Pine *Pinus virginiana*

Douglas-firs -- Genus *Pseudotsuga*

- Douglas-fir *Pseudotsuga menziesii*

Spruces -- Genus *Picea*

- Black Spruce *Picea mariana*
- Blue Spruce *Picea pungens*
- Engelmann Spruce *Picea engelmannii*
- Norway spruce *Picea abies*
- Red Spruce *Picea rubens*
- Sitka Spruce *Picea sitchensis*
- White Spruce *Picea glauca*

Hemlocks -- Genus *Tsuga*

- Eastern Hemlock *Tsuga canadensis*
- Western Hemlock *Tsuga heterophylla*

Larches -- Genus *Larix*

Western Larch *Larix occidentalis*

Links:

To hear a great comparison between Type 1 and Type 3 calls, try this http://macaulaylibrary.org/audio/139452/autoplay . In the first 10 seconds, the recording has a Type 1, followed by Type 3, and then Type 1 again, making for a particularly good chance to compare the calls side-by-side.

To hear a long, and very interesting crossbill recording that includes songs and a variety of different crossbill flight calls, click http://macaulaylibrary.org/audio/161299/autoplay . In addition to the full gamut of crossbill sounds that one individual might produce (flight calls, toops, songs, chitters, etc.), this amazing cut includes four different call types: all four regular eastern ones (Type 1, Type 2, Type 3, and Type 10). See if you can sort them out!

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