

## AN APPARENT HYBRID PHILADELPHIA × RED-EYED VIREO ON SOUTHEAST FARALLON ISLAND, CALIFORNIA

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**ABSTRACT:** Interspecific hybrids in the Vireonidae have seldom been reported, and the hybrid combination of the Philadelphia (*Vireo philadelphicus*) and Red-eyed (*V. olivaceus*) Vireos has been reported only twice before. We here report an apparent hybrid that remained on Southeast Farallon Island 7–13 September 2008. Its breast color, head pattern, head shape, and measurements were intermediate between those of the Philadelphia and North American subspecies of the Red-eyed. Details of the wing structure eliminated the Warbling (*V. gilvus*) and South American subspecies of the Red-eyed as possible parental species.

Hybrids have been extensively documented in the wild and in captivity (Phillips 1991) in many families of birds (McCarthy 2006), yet hybridization is reported more frequently in some groups than in others. Within the Vireonidae, hybrids are rarely documented (Pyle 1997). On 7 September 2008, while operating the long-term research station on Southeast Farallon Island, we noticed an unusual vireo that seemed to defy identification; we suspected it to be either an eastern Warbling Vireo (*Vireo g. gilvus*), a Chivi Red-eyed Vireo (*V. olivaceus* of the South American *chivi* complex), or of hybrid origin. The bird was subsequently mist-netted, examined, measured, and photographed in the hand (Table 1, Figures 1–4). We suggest that this bird is a hybrid Philadelphia (*V. philadelphicus*) × Red-eyed Vireo. We thoroughly studied the bird in the field and photographed it extensively during its stay until it was last seen on 13 September.

The Philadelphia Vireo breeds across much of the boreal forest of Canada, east to Nova Scotia and west to eastern British Columbia and extreme southeast Yukon; its winter range is mostly in Central America (Moskoff and Robinson 1996). The vast breeding range of the North American subspecies of the Red-eyed Vireo, to which we refer subsequently simply as the Red-eyed Vireo, encompasses that of Philadelphia Vireo and extends south to the coast of the Gulf of Mexico and west to eastern Oregon, Washington, and parts of coastal British Columbia (Cimprich et al. 2000); local populations breed on the west side of the Cascades in Washington and northwestern Oregon (Marshall et al. 2003, Wahl et al. 2005). The winter range of the Red-eyed Vireo lies entirely within South America (Cimprich et al. 2000) or extends uncertainly to eastern Panama (Ridgely and Gwynne 1989). Elsewhere in the Pacific coast states, the Red-eyed Vireos and Philadelphia Vireos are vagrants (Hamilton et al. 2007). The Red-eyed outnumbers the Philadelphia in all parts of California and at all seasons except for winter, during which two records of

**Table 1** Measurements of the Apparent Hybrid Vireo on Southeast Farallon Island, Other Reported Hybrid Red-eyed x Philadelphia Vireos, and Similar Species<sup>a</sup>

Measurement	Southeast Farallon bird <sup>b</sup>	USNM 109920 (Quebec)	Ontario bird <sup>c</sup>	Western Warbling Vireo ( <i>V. g. swainsonii</i> and <i>V. g. brewsteri</i> )		Eastern Warbling Vireo ( <i>V. g. gilvus</i> )	Philadelphia Vireo ( <i>V. philadelphicus</i> )	Red-eyed Vireo ( <i>V. o. olivaceus</i> )	Chivi Vireo ( <i>V. o. chivi</i> and <i>V. o. diversus</i> )	Yellow-green Vireo ( <i>V. flavoviridis</i> )
Wing chord p9 - p5	63	70.5 <sup>d</sup> , 73 <sup>c</sup>	73, 74	62-75 <sup>e</sup> -0.4-1.5 <sup>f</sup>	66-74 <sup>e</sup> -(1.1-2.0) <sup>f</sup>	61-70 <sup>e</sup> 0-3.2 <sup>f</sup>	72-85 <sup>e</sup> 4-8 <sup>e</sup>	67.5-74.5 <sup>d</sup> -(1-1.5) <sup>g</sup>	71-83 <sup>e</sup> 1-5 <sup>e</sup>	
p10 - primary coverts (n = 5)	-5.45	<0 <sup>c</sup>	-4	2.0-5.3 <sup>f</sup>	2.1-4.6 <sup>f</sup>	-(2-5) <sup>e</sup>	-(3-9) <sup>e</sup>	-(3.6-4.4) <sup>f</sup>	-(6.8-7.5) <sup>h</sup>	
Tail	49	50 <sup>d</sup> , 51	50 <sup>d</sup> , 51	46-56 <sup>e</sup>	47-55 <sup>e</sup>	40-49 <sup>e</sup>	47-60 <sup>e</sup>	50-56 <sup>d</sup>	49-60 <sup>e</sup>	
Exposed culmen	11.35	14.9 <sup>d</sup> , 13 <sup>c</sup>	11.0 <sup>d</sup> , 11.3	8.0-9.2 <sup>f</sup>	9.0-10.9 <sup>f</sup>	9.5-10.5 <sup>e</sup>	11.6-13.6 <sup>e</sup>	11.5-14 <sup>d</sup>	12.9-15.3 <sup>e</sup>	
Nares to bill tip	8.35	6.5-7.9 <sup>e</sup>		6.5-7.9 <sup>e</sup>	7.5-8.8 <sup>e</sup>	7.7-8.1 <sup>h</sup> (n = 6)	8.7-10.2 <sup>g</sup>	0.4-9 <sup>h</sup> (n = 13)	9.0-11.4 <sup>h</sup> (n = 12)	
Tarsus	18.25	17.1 <sup>d</sup>		16.9-18.0 <sup>f</sup>	17.2-18.5	16.6-18.4 <sup>f</sup>	17.4-19.3 <sup>g</sup>	15.0-17.3 <sup>h</sup> (n = 13)	17.0-19.5 <sup>g</sup> (n = 9)	
Weight	13.4					10.3-16.1 <sup>f</sup>	15.1-29.5 <sup>g</sup>			

<sup>a</sup>All measurements are in millimeters except weight, which is in grams. Ranges of negative values are in parentheses.

<sup>b</sup>Measurements taken by Tietz on 7 September 2008. Other measurements taken: longest primary minus longest secondary, 17.1 mm; longest undertail covert to tail tip, 17.2 mm.

<sup>c</sup>Chartier (2008).

<sup>d</sup>Measurement recorded by Peter Pyle in February 2009.

<sup>e</sup>Pyle (1997).

<sup>f</sup>Measurements taken by Terrill at LSUMZ (n = 5 for all measurements).

<sup>g</sup>Cimprich et al. (2000).

<sup>h</sup>Measurements provided by Kimball L. Garrett from specimens in Natural History Museum of Los Angeles County.

<sup>i</sup>Moskoff and Robinson (1996).

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the Philadelphia (Hamilton et al. 2007) contrast with a lack of any records of the Red-eyed. This difference is likely due to the more southerly natural winter range of the Red-eyed Vireo, in South America, whereas the Philadelphia regularly winters as far north as southern Mexico (AOU 1998). In California, the bulk of Red-eyed Vireos have occurred along the coast during the fall, but they have occurred in all seasons except winter and in most regions. Philadelphia Vireo records, in contrast, are limited almost exclusively to fall, mostly on the coast, with only eight interior and eight coastal records and in late spring/early summer (California Bird Records Committee 2007; *N. Am. Birds* 54:327, 2000; 58:597, 2004; 59:652, 2005) Since daily monitoring began in 1967, Southeast Farallon Island has recorded 101 Red-eyed Vireos, 60 in the spring (5 May–2 Jul, mean date 9 Jun), 41 in the fall (18 Jul–6 Oct, mean date 12 Sep). In contrast, only 15 Philadelphia Vireos have been recorded, 2 in spring (6 Jun and 12 Jun), 13 in fall (11 Sep–9 Nov, mean date 29 Sep) (Richardson et al 2003, updated with current data).

### DESCRIPTION

The apparent hybrid we report here was a medium-sized vireo with a relatively short tail, long undertail coverts, and long primary projection. The bill appeared slightly longer and thicker than that of nearby Warbling Vireos, and the basal half of the culmen was straight before it increasingly curved downward to a distinctly hooked tip. The maxilla was mostly dark gray, whereas the lower mandible had a flesh-colored base. The crown was blue-gray with a brownish tinge, and there was a distinct slate-colored lateral crown stripe. The bird frequently had a somewhat crested appearance, which caused the forehead to appear long and relatively flat; the posterior edge of the blue-gray on the crown terminated near the top of the crest. The nape was olive-green and abruptly cut off from the blue-gray crown. The supercilium was mostly white with a little buff along the upper border; it arched slightly over the eye and ended abruptly about an eyeball's length behind the eye at the rear of the auricular. The eye appeared small and dark—the iris was dark brown. The eyeline was a dark slate color, which was strongest in the lores and ended posteriorly at the rear of the auricular. The face had a white lower eye-arc on a buffy-olive auricular. The throat was pure white, and the rest of the underparts were washed lightly with yellow, splotched variably with white across the chest and belly; the yellow was slightly more concentrated across the chest, down the sides, and on the undertail coverts. The legs were blue-gray.

The mantle, rump, uppertail coverts, and innermost scapulars were uniform olive-green. The outer scapulars, however, were retained juvenal feathers that had broad rusty fringes. The lesser and median secondary coverts were olive-green. The innermost two to four greater secondary coverts were olive-green with greenish edging and had been replaced during the bird's preformative molt, whereas the outer five coverts were retained juvenal feathers with pale white fringes. The primary coverts were also retained juvenal feathers that were pointed and dusky with pale greenish fringes.

The primaries, secondaries, tertials, and rectrices had worn, pointed tips, characteristic of juvenal flight feathers. The remiges had dusky inner webs, green edging on the outer webs, and white edging on the tips. The green

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Figure 1. A hybrid Philadelphia × Red-eyed Vireo in one of Southeast Farallon Island's Monterey cypress trees on 8 September 2008, after being banded. It remained on the island for 6 days and was captured many times, allowing for extensive measurement and study.

*Photo by Ryan S. Terrill*



Figure 2. Philadelphia × Red-eyed Vireo (on right) in comparison with a Warbling Vireo (*V. g. swainsoni* or *brewsteri*) on Southeast Farallon Island, 8 September 2008. Note especially the dark lores, thick bill, supercilium shape, bulky, crested head, and yellow wash across the breast of the hybrid.

*Photo by Ryan S. Terrill*

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Figure 3. Philadelphia × Red-eyed Vireo on Southeast Farallon Island, 8 September 2008. Note especially the strong face pattern, peaked head, and supercilium shape.

*Photo by Matthew L. Brady*



Figure 4. Philadelphia × Red-eyed Vireo on Southeast Farallon Island, 8 September 2008. Note especially the molt limit in the secondary coverts and the pointed tips to the rectrices, indicating a hatch-year bird.

*Photo by Matthew L. Brady*

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edging became increasingly broad toward the tertials such that the outer webs of the tertials were entirely washed olive. The rectrices were dusky, edged with olive-green, and pointed. In addition to the retained juvenal feathers discussed above, the bird's skull was less than 30% pneumatized, which corroborated its age.

### OTHER REPORTED HYBRIDS

Given the large area in which the Red-eyed and Philadelphia Vireos breed sympatrically, these two species have the opportunity to hybridize, and two previous instances have been reported from within the range of overlap in southeastern Canada. The first was a bird found dead in Quebec on 13 May 1883 and preserved in alcohol at the National Museum of Natural History, Smithsonian Institution (USNM 109920). It was originally labeled by C. H. Merriam as *Vireo flavoviridis*, the Yellow-green Vireo, which would represent a first record for eastern Canada, but in 1984 A. R. Phillips annotated the label "presumably *V. virescens* × *philadelphicus*" (Red-eyed/Yellow-green × Philadelphia). Although Phillips (1991) later listed this specimen as a hybrid, as it was subsequently referenced by Pyle (1997) and McCarthy (2006), Holder (2002) disagreed with the identification and suggested that it was more likely a Yellow-green Vireo. In February 2009, Peter Pyle (pers. comm.) measured the specimen's exposed culmen as 14.9 mm, which is beyond the range of Philadelphia and Red-eyed Vireos but well within the range of the Yellow-green. Considering the poor state of the alcohol-preserved specimen and the continued debate about its identification, we suggest that this bird is most appropriately left unidentified until perhaps genetic study can shed more light on the situation.

Chartier (2008) reported a vireo captured on 20 September 2003 at the Holiday Beach Migration Observatory in Essex County, Ontario, as a Red-eyed × Philadelphia. Good-quality photographs published of this bird allowed us to compare it with the one on Southeast Farallon. The birds were similar in many aspects, most notably the face pattern and the length of primary (p) 10 relative to the primary coverts. The dark lores and faint lateral crown stripes of both birds gave their faces a very similar look. A few differences are also worth mentioning. In Chartier's photographs, the crown seems perhaps to be more rounded, with less of an effect of a crest, as seen on the Red-eyed, which the Southeast Farallon bird showed both in the field and in the hand. Furthermore, the bill of the bird at Holiday Beach appears larger, heavier, and more strongly angled than that of the bird on Southeast Farallon. In addition, the eye of the Holiday Beach bird appears relatively larger, and the auricular and malar are whiter than on the Southeast Farallon bird. The bird at Holiday Beach provided the first well-documented instance of this hybrid combination, and the one on Southeast Farallon seems quite similar to it despite a few minor differences.

### COMPARISONS OF POTENTIAL PARENTAL SPECIES

Molt limits and schedules can occasionally provide clues to a bird's identification. According to Pyle (1997), the preformative molt of the Warbling and Philadelphia Vireos occurs in summer and includes all greater secondary

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coverts, except for western Warbling Vireos of the subspecies *swainsoni* and *brewsteri*, which may complete their preformative and prebasic molts on the wintering grounds. Although prebasic molt of the Red-eyed Vireo is suspended over migration, preformative molt occurs in the summer range and includes all greater secondary coverts (Pyle 1997). Mulvihill and Rimmer (1997) stated that >90% of the first-year Red-eyed Vireos captured at the Powdermill Nature Reserve in southwestern Pennsylvania had molted all body feathers and wing coverts prior to stopping over at Powdermill. Although the Yellow-green Vireo's molt has not been studied thoroughly, Pyle (1997) suspected it to be similar to that of the Red-eyed. Thus the retained juvenal scapulars and outer greater secondary coverts are not typical of any known similar species of vireo, and at least hint that the bird is unusual.

To eliminate other possibilities, we considered all similar species while studying this bird, and we believe that a combination of field marks and measurements is sufficient to eliminate any pure species of vireo.

Philadelphia Vireos have rounded heads and weak or no lateral crown streaks. In addition, Philadelphia Vireos typically have yellow equally concentrated in the center of the chest and throat (Terrill and Terrill 1981), whereas the Farallon bird's throat was much whiter than its chest. Furthermore, the wing and tail measurements were at the maximum for a Philadelphia Vireo (Table 1), contrary to expectations for a first-year bird (Pyle 1997). Finally, the outermost primary was very slightly shorter than measurements published for the Philadelphia Vireo (Table 1).

Although a pure Red-eyed Vireo can show yellow on the vent and flanks, it lacks yellow on the chest (Terrill and Terrill 1981), where our apparent hybrid showed splotchy yellow. In addition, the wing was 3 mm shorter than expected for the shortest-winged Red-eyed (Table 1). Moreover, the eye seemed to be too dark, even for a hatch-year Red-eyed Vireo, and the face pattern was not quite as strong as typical of that species.

The Yellow-green Vireo is superficially similar to the bird we captured, but it is even larger than the Red-eyed, has a larger bill with a pink or horn-colored base to the lower mandible, and has more weakly contrasting facial features (eyeline, supercilium, and lateral crown streak). Although the bird on Southeast Farallon did have substantial yellow on the underparts, its splotchy pattern did not match that of a Yellow-green Vireo, which has this color concentrated on the sides (including the neck) and vent, contrasting against a white chest and belly.

Nine subspecies of the Chivi Vireo complex occur in South America, although only the two most southerly subspecies are known (*V. o. chivi*) or suspected (*V. o. diversus*) to migrate north for the austral winter (Cimprich et al. 2000). Terrill inspected Chivi Vireos at the Louisiana State University Museum of Natural Sciences (LSUMZ) in March and August 2009 and August 2010 and at the Museum of Vertebrate Zoology (MVZ), University of California, Berkeley, in April 2009. These specimens were generally similar in size and shape to the Red-eyed, if not larger. Although some individuals of each subspecies showed a fairly bright yellow wash to the sides of the chest, none showed yellow in the center of the chest. In February 2009, Peter Pyle (pers. comm.) measured the wing chord, tail length, and exposed culmen of the migratory Chivi Vireos at USNM, *V. o. chivi* ( $n = 5$ ) and *V. o. diversus*

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( $n = 5$ ). Although in these subspecies p10 is shorter than the primary coverts (Terrill pers. obs.), the wings of Chivi Vireos are substantially shorter and rounder than those of Red-eyed Vireos (Cimprich et al. 2000). Moreover, in comparison to that of the migratory Chivi Vireos that have the longest and most pointed wings (Cimprich et al. 2000), the wing chord of the Southeast Farallon bird was  $>4$  mm shorter, and the difference between p9 and p5 was  $>3$  mm greater (Table 1); thus the wing of the Southeast Farallon bird was substantially shorter yet more pointed than that of migratory Chivi Vireos. Although Chivi Vireos are diverse and variable, none of the specimens at these museums appeared to be similar to the Southeast Farallon bird.

We eliminated the Warbling Vireo (both eastern *V. g. gilvus* and western *V. g. swainsoni* and *V. g. brewsteri*, hereafter referred to by group names *gilvus* and *swainsoni*) by plumage features and structure. The strong dark eyeline, lores, and lateral crown stripe were too bold for either *gilvus* or *swainsoni*. Terrill examined *V. g. gilvus* at LSUMNS, and even the brightest, most well-marked specimens did not show dark lateral crown stripes or yellow on the center of the chest. In addition, the flat, sloping crown rising to a peak at the back of the crown is quite different from a typical Warbling Vireo's rounded head. Although this shape may change with the bird's disposition, it was noticeable during the bird's entire stay on the island, and all observers noted the contrast with the Warbling Vireos on the island simultaneously. Another feature atypical of the Warbling Vireo is the long primary projection—a Warbling Vireo's primary projection is approximately half the length of the length of the visible tertials. The final and probably most critical mark against this individual being a Warbling is that p10 was 5.5 mm shorter than the primary coverts. The outermost primary of a Warbling Vireo of any subspecies should be at least 2 mm longer than the primary coverts (Table 1).

As the Warbling and Philadelphia Vireos are more closely related to each other than to the Red-eyed (Johnson et al. 1988, Murray et al. 1994), it might be expected that their hybridization is more likely, yet it has never been reported, and overlap of these two species' breeding ranges is minimal (Pyle 1997). The length of the longest primary relative to the primary coverts fits nicely within the range of the Red-eyed Vireo but well outside the range of the Warbling Vireo. If a Warbling Vireo were one of the parents, then the outermost primary should have been closer in length to the primary coverts. Furthermore, the shape of the supercilium was consistent with the Red-eyed, being straight, flared, and slanted upward posteriorly, as opposed to the curving, tapering supercilium of a Warbling Vireo. With the Warbling eliminated, the only hybrid pair that fits morphologically is Red-eyed × Philadelphia. By appearance, this bird does show features that look remarkably similar to a Red-eyed Vireo, such as the flat, sloping crown that peaks at the rear, dark lateral crown streaks, and a complete, dark eyeline, which, taken as a whole, gave this bird a "sterner" appearance than either a Warbling or a Philadelphia. The yellow wash across the middle of the chest is a trait of neither the Warbling nor the Red-eyed Vireo, and we infer that this mark came from Philadelphia Vireo parentage.

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