Status, Distribution, and Identification of Merlin Subspecies in California

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ABSTRACT

While a large majority of Merlins (*Falco columbarius)* wintering in California are of the nominate subspecies (F. c. *columbarius*), small numbers of the darker "Black" Merlin (*F. c. suckleyi*) and the paler "Prairie" Merlin (*F. c. richardsonii*) are routinely reported. Estimating the proportion of Merlins comprised by these latter subspecies is problematic due to the difficulty of consistently identifying individuals, which may exhibit plumage variations within a subspecies or intermediate plumages resulting from intergradation between different subspecies. We used data and photos from eBird to make rough estimates of the proportion of Merlins of each subspecies present in California and examined their relative distribution within the state. Based on these data, *F. c. suckleyi* appears to be somewhat more common than *F. c. richardsonii* in most of the state, except for the southeastern deserts where *F. c. richardsonii* greatly outnumbers *F. c. suckleyi*. We also examined specimens collected during the breeding season and within the breeding range of each subspecies to look for features that may be useful for differentiating these subspecies in the field. The relative darkness of the auricular area (area just below the eye) and the ratio of the width of adjacent ventral tail bands appeared to be the most promising features for identifying individuals to subspecies.

The Merlin (*Falco columbarius*) breeds across North America from Alaska to Newfoundland and across Eurasia from Iceland to the Russian Far East. Nine subspecies are recognized, with three occurring in North America (Sale 2015), *F. c. columbarius*, *F. c. suckleyi*, and *F. c. richardsonii* (hereafter *columbarius*, *suckleyi*, and *richardsonii*). Breeding occurs by c*olumbarius* mainly throughout the taiga and boreal regions of Alaska and Canada; *suckleyi* along the humid west coast of southeastern Alaska, British Columbia, and northwest Washington; and *richardsonii* in the prairies of southern Alberta,

Saskatchewan, eastern Montana, northeastern Wyoming, and northwestern North Dakota (Wheeler 2003).

In winter, most *suckleyi* are believed to remain within their breeding range, with small numbers moving south mostly along the west coast (Wheeler 2003, Warkentin et al. 2005, Davis 2008), and some wintering in Utah (Haney and White 1999), Idaho (Haak 2012), and other western states (Wheeler 2003, Dickerman 2013). *Richardonsii* are partially resident within their breeding range, but most winter farther south in the Great Plains and elsewhere in the western U.S. and northern Mexico (Wheeler 2003, Warkentin et al. 2005, Davis 2008, Sale 2015). *Columbarius*, by far the most migratory of the three subspecies, winters along the west coast, throughout much of the lower 48 states, the Caribbean, Mexico, Central and northern South America (Wheeler 2003, Warkentin et al. 2005, Davis 2008, Sale 2015, eBird 2017). Consistent with this pattern, most Merlins wintering in California are *columbarius* (Dunn and Alderfer 2017, authors pers. obs.).

The variation in overall plumage coloration in these taxa conforms well to Gloger's Rule which postulates that populations occupying drier open habitats (e.g. *richardsonii*) tend to have pale plumage, while birds using more humid and densely vegetated areas are darker (e.g. *suckleyi*). *Columbarius* is generally intermediate in darkness between the other subspecies, however, plumage of the more eastern-breeding *columbarius* can be quite dark (Wheeler 2003, Sibley 2014, Dunn and Alderfer 2017) perhaps due to more humid eastern environments. In addition to the overall darkness of plumage, other features have been cited as useful to differentiate these subspecies in the field including:

- the number of pale tails bands (*richardsonii* having the most, *suckleyi* the fewest; Temple 1972, Pyle 2008, Davis 2008);
- the width of the pale tail bands (*richardsonii* widest, *suckleyi* narrow or absent, *columbarius* intermediate; Wheeler 2003, Pyle 2008, Crossley et al. 2013, Sibley 2014, Dunn and Alderfer 2017);
- relative amount of pale spotting or barring on the primaries (*richardsonii* the most, *suckleyi* little or no pale on primaries; Temple 1972, Wheeler 2003, Pyle 2008); and
- relative darkness of the auricular area (palest in *richardsonii*, darkest in *suckleyi;* Wheeler 2003, Crossley et al. 2013, Dunn and Alderfer 2017).

Consistent differentiation of these subspecies in the field is complicated by the fact that birds with intermediate characters are often observed (Haney and White 1999, Wheeler 2003, Crossley et al. 2013, Sibley 2014). These birds may be intergrades between two subspecies as the breeding ranges of *columbarius* and *richardsonii* overlap in parts of central Alberta, Saskatchewan, and Manitoba and the breeding ranges of *columbarius* and

suckleyi overlap in southwestern British Columbia and possibly in northwestern Alberta (Wheeler 2003). With dramatic increases in the Merlin population throughout its North American range in recent decades (Wheeler 2003, Warkentin et al. 2005, Sauer et al. 2011, Sale 2015), birders in California have increasing opportunities to observe the species and to attempt to identify individuals to subspecies.

Although all sources agree that *columbarius* is by far the most common Merlin subspecies wintering in California, published information is sparse on the relative abundance of the other two taxa in the state. Grinnell and Miller (1944) described *suckleyi* as a "vagrant, apparently rare" and *richardsonii* as "perhaps fairly common but verified records few". However, they cited more records for *suckleyi* than for *richardsonii*. In Northwestern California both *suckleyi* and *richardsonii* are noted as rare, with *suckleyi* found almost annually and *richardsonii* occasionally (Harris 2005). Both of those subspecies were considered rare in Sonoma County (Bolander and Parmeter 2000) and in the Sierra Nevada (Beedy and Pandolfino 2013). Roberson (2002) noted more records for *suckleyi* than *richardsonii* in Monterey County. Garrett and Dunn (1981) described *suckleyi* as casual in southern California, with most records along the coast. In contrast, they noted that *richardsonii*, though rare coastally, were "almost as frequent as *columbarius* in the eastern part of the region". In San Diego County, *richardsonii* is considered rare and *suckleyi* unrecorded prior to 1982 (Unitt 2004). Hamilton and Willick (1996) cited two Orange County records for *richardsonii* and three for *suckleyi*. Patten et al. (2013) cited three *richardsonii* records and eight of *suckleyi* at the Salton Sea (Imperial and Riverside Counties), in contrast to the observations of Garrett and Dunn (1981) that *richardsonii* was much more likely in the desert regions of southern California than *suckleyi*.

We used eBird data and photos to make estimates of the relative abundance and distribution of the two rarer subspecies. We also examined specimens of each subspecies collected in the breeding season within their core breeding ranges to determine features that might allow more consistent identification of these taxa in the field.

METHODS

Data Sources

We used data from eBird (Sullivan et al. 2009, Sullivan et al. 2014) for all years through February 2018 (complete checklists only). For photo analyses, we used photos from eBird checklists from October 2017 through April 2018.

Based on our experience, most eBird users do not routinely identify birds to subspecies. Even among those that do, often only identify to subspecies the rarer subspecies, recording the locally dominant subspecies only to species. Because of this, we expressed the relative abundance of the two

rarer Merlin subspecies (*suckleyi* and *richardsonii*) as a percent of all checklists that recorded Merlin, understanding that this produced a bare minimum for the actual relative abundance of these taxa. We also reviewed eBird checklists that included photos of Merlins and attempted to identify the birds to subspecies. When multiple checklists from the same location on the same day reported a Merlin subspecies, we assumed that involved one individual and counted that as one occurrence. Similarly, photos from the same locations were considered the same individuals unless it was obvious from the photos that the birds were different.

To assess relative distributions of *suckleyi* and *richardsonii* we compiled eBird data (including our review of photos) by county and grouped counties into five regions (Figure 1) as follows:

- Northeast California: Siskiyou, Modoc, Shasta, Lassen, Plumas, Sierra, and Nevada counties
- North Coastal: Del Norte, Mendocino, Sonoma, Marin, San Francisco, and San Mateo counties
- South Coastal: Santa Cruz, Monterey, San Luis Obispo, Santa Barbara, Ventura. Los Angeles, Orange, and San Diego counties
- Central Valley: Tehama, Glenn, Butte, Sutter, Yuba, Yolo, Sacramento, San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, and Tulare counties
- Southeast Desert: Inyo, San Bernardino, Riverside, and Imperial Counties.

Some counties were omitted because they overlapped different regions.

Specimen Analysis

We examined museum specimens from the California Academy of Sciences, the University of California Museum of Vertebrate Zoology, and the Royal British Columbia Museum (see Appendix 1 for details) and made qualitative and quantitative measurements of plumage features including: relative darkness of the auricular area (just below the eye, behind the malar stripe; Sibley 2014) and underparts on a qualitative scale of 1 to 5 based on increasing darkness (Figure 2). We also measured the width of dorsal and ventral tail bands. Dorsal tail band widths were measured using the central tail feathers, and ventral band widths were measured using the outer tail feathers. Measurements were taken from the middle of each band. We used the tail feathers that would be most visible on a perched bird (central dorsal and outer ventral) because we were looking mainly for features that could be used in the field or from a good photograph.

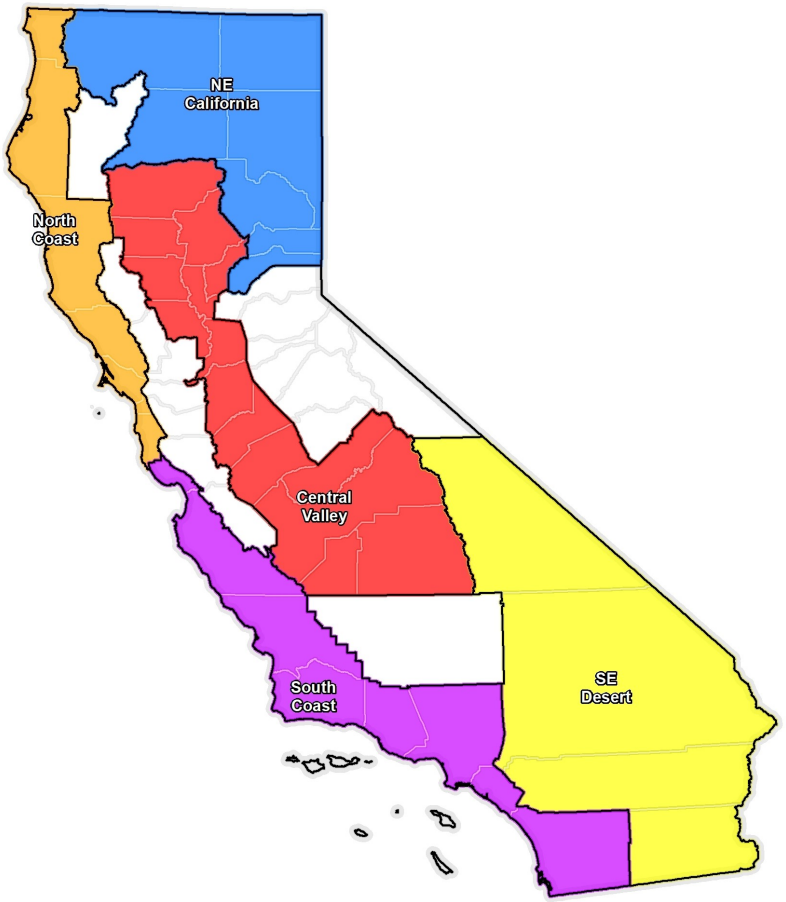


Figure 1. California regions used to compare relative distributions of *richardsonii* and *suckleyi*.

We restricted our analyses of specimens to those collected within the known breeding range of each subspecies and during the likely breeding season (March through August). It is possible that birds collected in March, April, or August may be migrants, however, it was necessary to use a broader range of dates to have sufficient numbers of specimens of each subspecies to analyze. We included one specimen collected in late February in an area of Alaska where only *columbarius* occurs. We did not use specimens from areas where two subspecies' ranges overlap (Figure 3). Due to the limited number of specimens that met our criteria and the difficulty of aging female Merlins (Pyle 2008), we were not able to analyze variations by sex or age.

Figure 2. Examples of specimens (from the University of California Museum of Vertebrate Zoology) rated for relative darkness of underparts and cheek. From left to right: MVZ89861 (rated 5 for underparts and 4.5 for auricular), MVZ49705 (rated 3 for underparts and auricular), MVZ81886 (rated 1 for underparts and auricular).

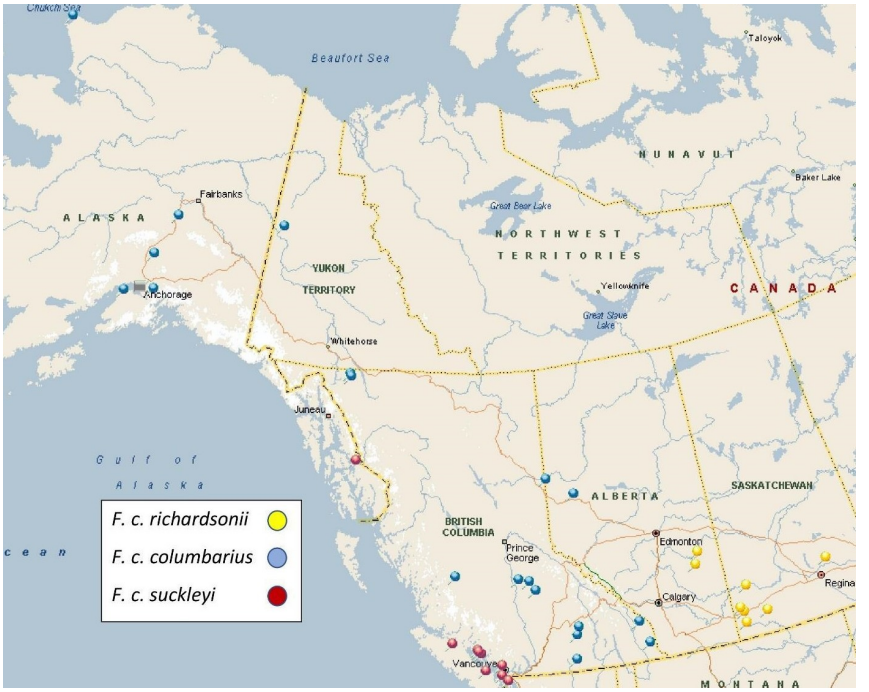


Figure 3. Approximate collection locations of specimens used in the analyses.

RESULTS AND DISCUSSON

Relative Abundance and Distribution of Subspecies

Of 42,254 California eBird checklists reporting Merlins, 155 reported the subspecies as *richardsonii* (0.4%) and 205 (0.5%) reported them as *suckleyi*. As noted above, we believe that most eBirders do not routinely identify Merlins to subspecies, making these numbers likely bare minimums. Of the two rarer subspecies, *suckleyi* was more commonly reported than *richardsonii* in every region of the state with the notable exception of the southeastern deserts (Figure 4) where 44 reports were of *richardsonii* and only one of *suckleyi*.

Our review of photos from eBird checklist (October 2017-April 2018) is probably more representative of the actual relative abundances of the subspecies. We reviewed photos of 387 individuals and were able to assign 309 (80%) to one subspecies. Of these, 268 (87%) were assigned to *columbarius*, 28 (9%) to *suckleyi*, and 13 (4%) to *richardsonii*. In 78 cases (20% of total) we were unable to assign the bird to a subspecies either due to poor photo quality or to the bird showing intermediate characters. Of the photographed individuals identified to subspecies by the observer, our subspecies assignments agreed with all but 12 (17%) of those identifications.

For 11 of those 12, were unable to assign the photographed bird to any subspecies. In only one case, an observer assigned a bird to a subspecies (*columbarius*) and we identified it as different subspecies (*suckleyi*). Thus, nearly all differences in identification between observers and us involved assignments of birds showing intermediate field marks, either due to normal variations among individuals or intergradation between subspecies. The distribution by subspecies based on our photo analysis (Figure 5) was similar to that based on all eBird checklists (Figure 4).

The preponderance of *richardsonii* found in the southeastern deserts suggests that this taxon, which breeds in drier, more open habitats, may show the same preference during winter in California. This habitat preference is consistent with the North American winter range for *richardsonii* which lies almost entirely within the Great Plains, Great Basin, and southwestern deserts (Wheeler 2003).

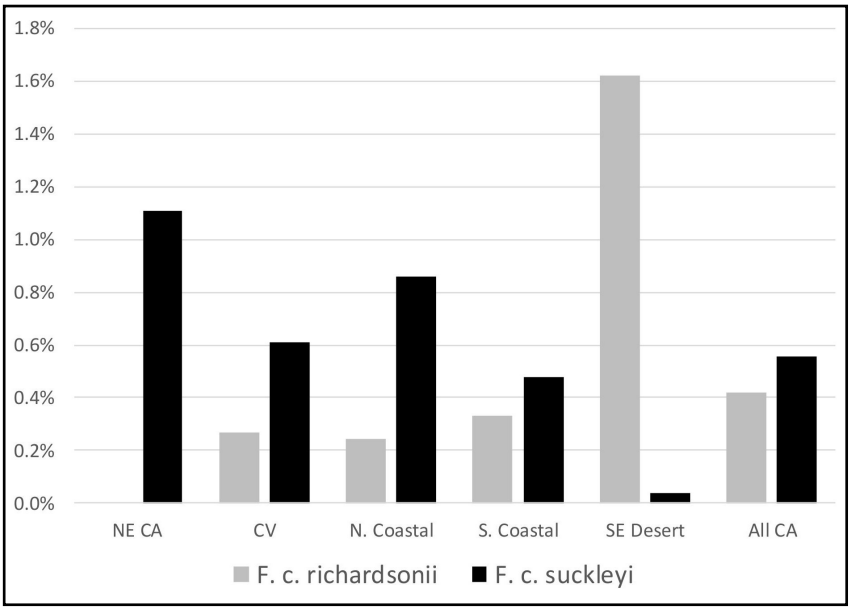


Figure 4. Percent of eBird checklist with reports of Merlin that reported subspecies as *richardsonii* or *suckleyi* by California region.

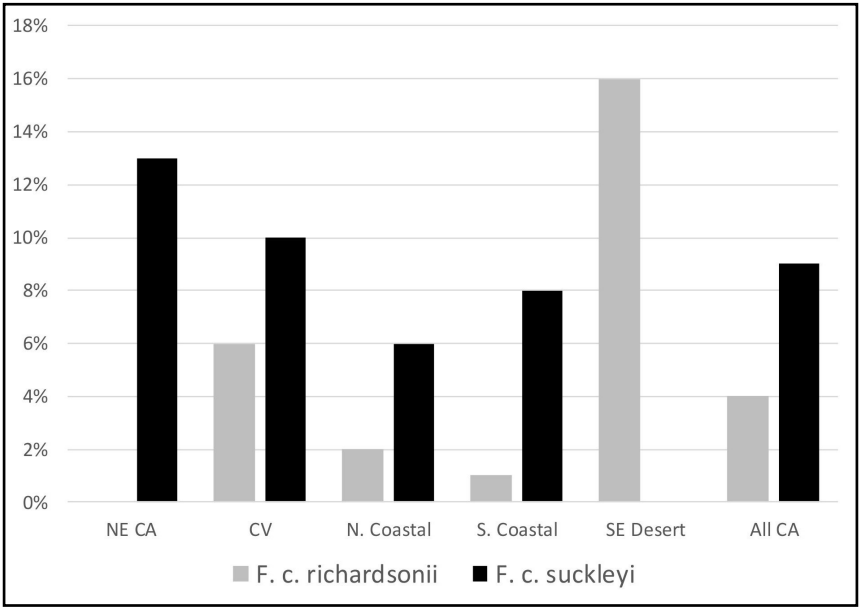
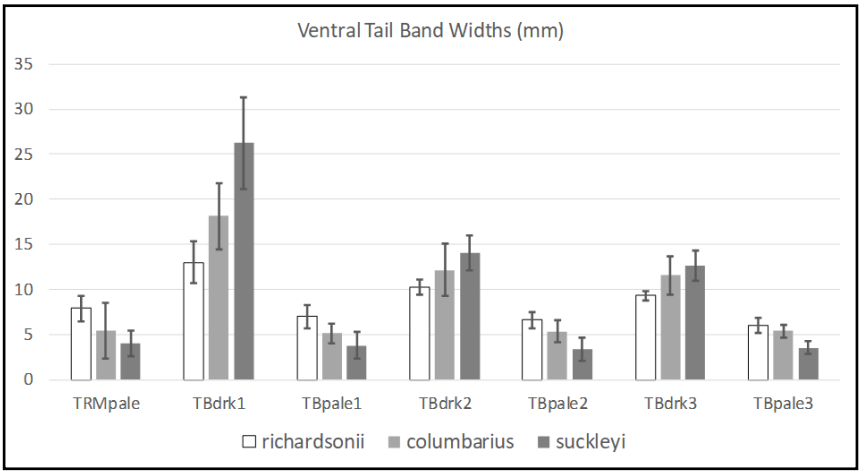


Figure 5. Relative distribution of *richardsonii* or *suckleyi* by region based on analysis of eBird photos, October 2017-April 2018.

Comparison of Plumage Characters

The pale ventral tail bands and terminal tip were, on average, all widest for *richardsonii*, intermediate for *columbarius,* and narrowest for *suckleyi*. The dark ventral tail bands showed the opposite pattern, typically widest for *suckleyi* and narrowest for *richardsonii* (Figure 6). The dorsal tail band widths showed the same pattern for all but the most proximal dark tail band (Figure 6). However, nearly all comparisons among subspecies showed overlap in characteristics, as indicated by overlapping standard deviations. The relative darkness of the underparts and auricular area were good discriminations between the subspecies (Figure 7) with *richardsonii* palest and *suckleyi* darkest. Comparison of the ratios of the widths of adjacent tail bands showed that the best discrimination between subspecies was produced by comparing the ratios of the first (most distal) dark ventral band to the first pale band (Figure 8).



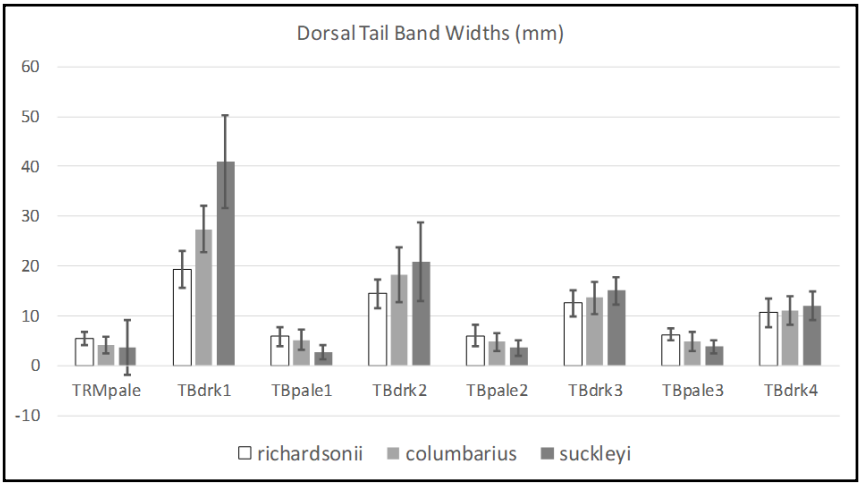


Figure 6. Comparison of the average widths of ventral and dorsal tail bands and the tail tips. TRMpale = the pale terminal tip; TBdrk1 = the first (most distal) dark tail band; TBpale1 = the first pale band; and so on moving upward from distal to proximal. Error bars represent the standard deviation.

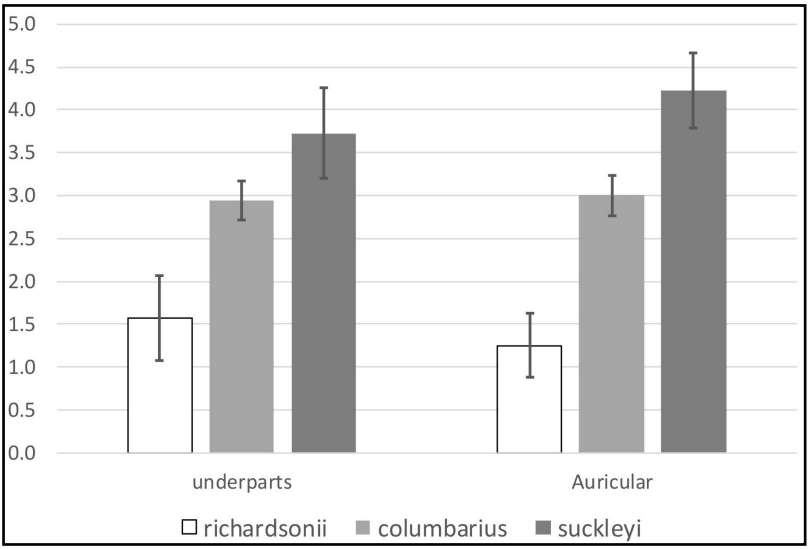


Figure 7. Comparison of the relative darkness of the underparts and auricular (1 = palest; 5 = darkest). Error bars represent the standard deviation.

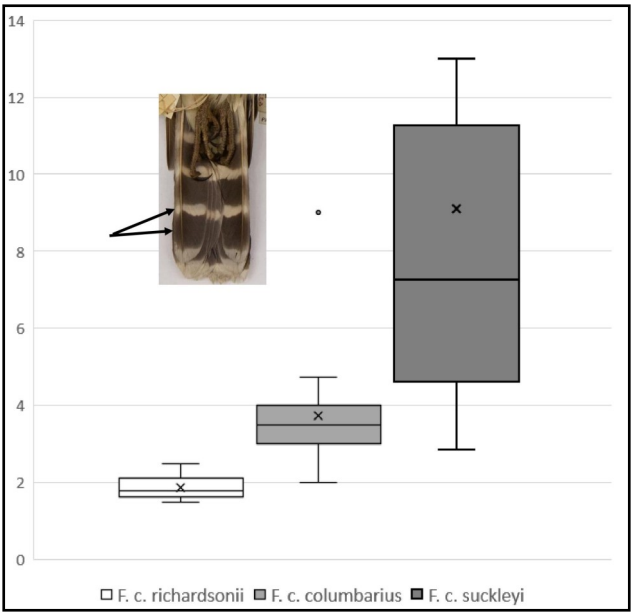


Figure 8. Comparison of the ratios of adjacent tail bands. The x within each box is the mean, the line within each box is the median, the box shows the second and third quartiles, and bars show the maximum and minimum values. The single dot beyond the range bars is an outlier value not included in calculations. Inset shows the bands used in calculating the ratio.

Field Identification of Merlin Subspecies

Many of the *suckleyi* and *richardsonsii* Merlins in California are easy to identify. Birds with all dark heads and little or no pale bands on the tail are clearly *suckleyi.* Birds with very pale underparts, very broad pale tail bands, and nearly unmarked auriculars are certainly *richardsonii*. Many birds, however, show intermediate characters and some (or all) of these may be intergrades between subspecies. Here, we summarize our conclusions about the usefulness of various features and suggest criteria for identifying most individuals.

Width of Pale Tail Bands. We confirmed that the relative width of pale tail bands shows a consistent trend (Wheeler 2003, Pyle 2008, Crossley et al. 2013) with *richardsonii* having the widest and *suckleyi* the narrowest. Many of the suckleyi specimens we examined had only small pale spots rather than complete pale bands. However, there is some overlap among individuals (as shown in Figure 6), and differentiating either of these taxa from *columbarius* with this mark alone can be difficult to impossible in the field or from a photograph.

Width of Terminal Tail Tip. Although we found a difference among the subspecies, many birds showed significant wear to the tip of the tail, making this a poor feature for consistently differentiating these taxa.

Darkness of Underparts and Auricular. We found both features helpful for differentiating subspecies. However, the relative darkness of the auricular area showed the best discrimination (Figure 7). Estimating the darkness of the underparts was more problematic due to differences in the contrast between the dark streaks and the paler ground color of the underparts among individuals within each subspecies. The relative darkness of the auriculars was easier to assess. Nearly all *suckleyi* showed auricular areas heavily marked and nearly as dark as the crown, often obscuring the malar stripe entirely. *Richardsonii* auriculars were lightly marked and much paler than the crown, often making the malar stripe easier to discern.

Ratios of Tail Bands. The ratio of the width of first (most distal) dark ventral tail band to the width of the adjacent pale band (proximal to that dark band) was the best single mark to differentiate these subspecies. This feature, while not necessarily easy to estimate in the field, can be determined from a good photograph showing the ventral tail.

Suggested Criteria for Identification of Subspecies

Based on our examination of specimens from the known breeding ranges of each subspecies, two key factors allow the identification of most birds to subspecies (Table 1):

1. The relative darkness of the auricular area (*suckleyi*> *columbarius*> *richardsonii*); and
2. The ratio of width of the most distal dark ventral tail band to the width of the adjacent pale band (*suckleyi* > *columbarius* > *richardsonii*)

Some of the birds falling into the indeterminate category may well represent intergrades between subspecies. Two of birds we examined from within *columbarius* range (RBC12524 and RBC12521) both showed the highest ratios of tail bands (4.8 and 9.0, respectively) and the darkest auriculars (3.5 for each) of any of the individuals within that subspecies breeding range. They were also the two specimens collected closest to the breeding range of *suckleyi* (Figure 9). Therefore, they may well represent *columbarius* x *suckleyi* intergrades.

Given the value of the tail band width ratio, we advise anyone photographing Merlins to try to capture the ventral tail. In any case, given the likelihood that intergrades occur in winter in California and given the substantial variations in field marks among individuals of each subspecies, one should be very cautious about assigning subspecies identification to any Merlin that does not show definitive field marks consistent with one of the subspecies.

Table 1. Criteria for identifying Merlin subspecies that occur in California and the results of applying criteria to specimens examined. Numbers in parentheses after subspecies names are sample sizes.

	richardsonii (8)	*columbarius (19)*	*suckleyi (13)*
Classification Criteria			
Tail Band Ratio	<2.5	3-4.5	5 or above
Auricular Darkness	2 or less	2.5-3	4 to 5
Classification Success			
Correct	7 (88%)	15 (79%)	10 (77%)
Mis-identified	0 (0%)	0 (0%)	0 (0%)
Indeterminate	1 (13%)	4 (21%)	3 (23%)

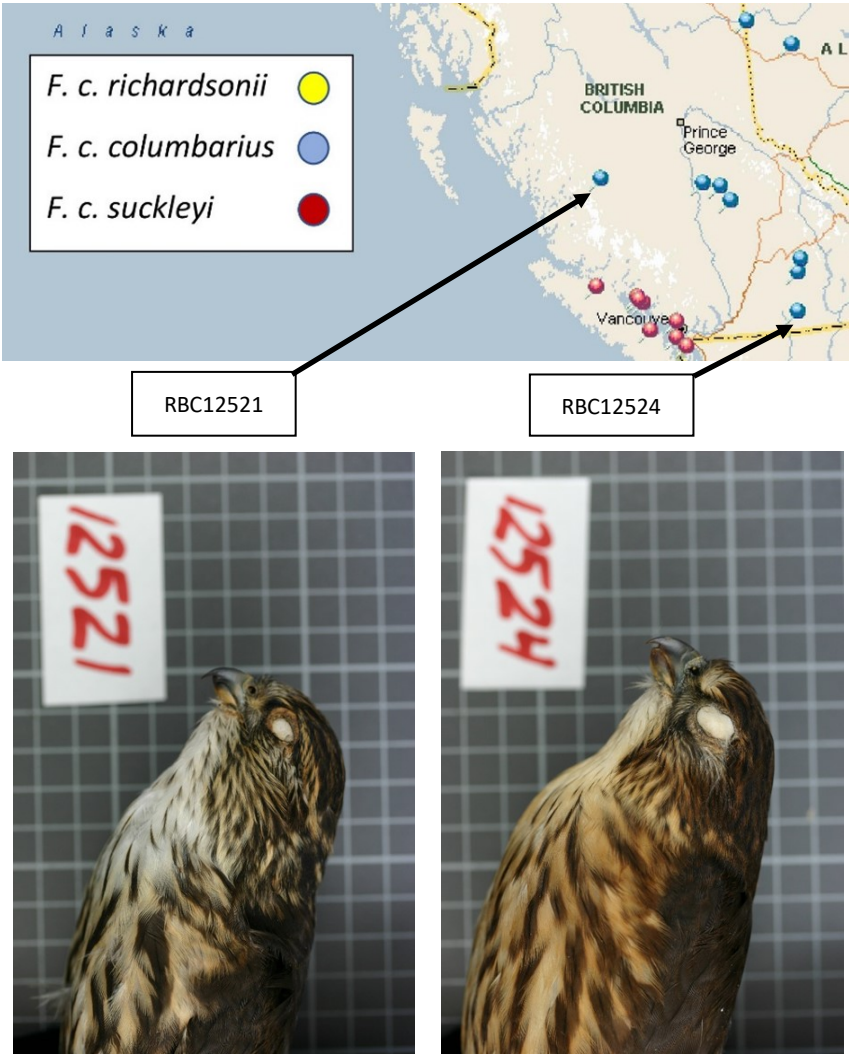


Figure 9. Collection locations for the two specimens from the *F. c. columbarius* range with the highest ventral tail band ratios and the darkest auricular areas. Inset shows the auricular views of those specimens.

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also supplied the specimen photos used in Figure 8. John Withrow of the University of Alaska Museum generously shared photographs of some of the Merlins in their collection and made helpful suggestions. Dan Airola, Kimball Garrett, and Brian Sullivan made many suggestions which substantially improved our analyses of relative abundance and enhanced the clarity and quality of the manuscript.

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APPENDIX 1

Spp #	Range	Sex	State/Prov	Location	Date
CAS60409	suckleyi	f	Alaska	Stikine River Mouth	19-Aug-1946
MVZ141175	columb	f	Alaska	Glenn Hwy, mi. #140	6-Aug-1956
MVZ141176	columb	f	Alaska	Girdwood	26-Feb-1959
MVZ158144	columb	m	Alaska	Pt Hope	23-Jul-1961
MVZ160044	richard	f	Saskatchewan	Cypress Hills	11-May-1934
MVZ44736	suckleyi	m	British Columbia	Atlin	15-Aug-1924
MVZ4960	columb	f	Yukon	Clinton Creek	10-Aug-1898
MVZ49705	columb	f	Alaska	Savage River	25-May-1926
MVZ81868	richard	m	Saskatchewan	Cypress Hills	17-Jun-1930
MVZ81870	columb	m	British Columbia	Okanaga Landing	14-Mar-1907
MVZ89861	suckleyi	m	British Columbia	Vancouver Island	9-Mar-1941
MVZ91290	columb	m	Alaska	Kenai	1-Mar-1901
MVZ99940	suckleyi	f	British Columbia	Vancouver Island	14-Mar-1943
MVZ99942	suckleyi	m	British Columbia	Seal Island	3-Aug-1927
MVZ99953	richard	f	Alberta	Castor	10-Mar-1924
MVZ99955	richard	m	Alberta	Sullivan Lake	27-Apr-1914
MVZ99964	columb	f	British Columbia	Carpenter's Mountain	20-Jul-1901
MVZ99971	columb	f	British Columbia	Okanaga Landing	25-Apr-1927
RBC10208	richard	m	Saskatchewan	Qu'Appelle Valley	15-Jun-1959

APPENDIX 1 (cont.)

Spp #	Range	Sex	State/Prov	Location	Date
RBC11177	columb	f	British Columbia	Columbia Lake	4-Aug-1940
RBC11180	columb	f	British Columbia	Wardner	25-Apr-1937
RBC12024	suckleyi	f	British Columbia	Vancouver Island	27-Mar-1973
RBC12481	richard	m	Saskatchewan	Cloverley	16-Aug-1935
RBC12498	suckleyi	f	British Columbia	Vancouver Island	29-Jul-1940
RBC12517	suckleyi	m	British Columbia	Vancouver Island	5-May-1938
RBC12520	suckleyi	m	British Columbia	Vancouver Island	16-Aug-1931
RBC12521	columb	f	British Columbia	Atnarko River	10-Aug-1940
RBC12524	columb	f	British Columbia	Oliver	9-Aug-1929
RBC12528	suckleyi	m	British Columbia	Vancouver Island	13-May-1939
RBC15563	columb	m	British Columbia	Lake La Hache	25-Apr-1946
RBC15567	columb	m	British Columbia	Williams Lake	27-Apr-1950
RBC17042	richard	f	Saskatchewan	Allenby Siding	20-Aug-1926
RBC18778	richard	f	Alberta	Walsh	24-Aug-1940
RBC19285	columb	f	British Columbia	Dawson Creek	17-Jul-1986
RBC2674	columb	f	British Columbia	Atlin	11-Aug-1914
RBC2675	columb	f	Alberta	Grand Prairie	11-Aug-1914
RBC4748	suckleyi	f	British Columbia	Vancouver Island	25-Mar-1923
RBC5074	suckleyi	m	British Columbia	Vancouver Island	9-Aug-1932
RBC5894	columb	f	British Columbia	Atlin	23-Apr-1931
RBC6353	suckleyi	m	British Columbia	Vancouver Island	19-Apr-1906