

*Carduelis
lawrencei*SPANISH:
*Dominiquito de
Lawrence,
Jilguero gris*

Lawrence's Goldfinch

Striking in appearance and enigmatic in behavior, Lawrence's Goldfinch is distinctive in many respects. As a breeding species, it is endemic to arid woodlands in the foothills of California and northern Baja California. In year-to-year movements, it is perhaps even more erratic than other goldfinches, and, unlike most birds, it shows little loyalty to former breeding sites. On this habit of Lawrence's, Ralph Hoffman (1927: 309), wrote: "A valley in southern California may be filled with the black-chinned gray-bodied birds one summer and the next year contain not one." Its behavior at other times of the year is just as mercurial. In some winters, for example, the species irrupts through Arizona, New Mexico, and even into western Texas and northern Mexico, but in other winters, it is virtually absent from those areas. Sometimes it seems to disappear from most of its breeding range without reappearing elsewhere.

**The
Birds of
North
America**
Life Histories for
the 21st Century

The distinctively plumaged male is an accomplished mimic, incorporating a variety of songs and calls from its foothill neighbors into its own rapid melody of wheezy whistles and tinkling, bell-like notes. At least in California, the species exhibits a special predilection for seeds of native plants and may feed largely on the those of fiddleneck (*Amsinckia* spp., Boraginaceae) in summer and chamise (*Adenostoma fasciculatum*, Rosaceae) in winter. The kind and amount of such seeds are important influences on this species' patterns of regional



© Brian E. Small

distribution and abundance. Lawrence's favors hotter and drier situations for nesting than other goldfinches, but its breeding sites are usually close to water, which it needs for drinking and bathing.



Figure 1. Distribution of Lawrence's Goldfinch. Occurrence within the mapped ranges is irregular, local, and discontinuous. Irregular throughout its breeding range during winter, and occasional in parts of its winter range during the breeding season. See text for extralimital records and other details.

It is gregarious throughout the year, forming large flocks during winter and smaller feeding groups during the nesting season. The strong flocking tendency in this species leads some birds to follow a pair to its nest, where they are sometimes tolerated and other times chased off by the nesting pair. Pairs usually nest solitarily, but their inconsistent intolerance of conspecifics occasionally leads to the formation of loose colonies of up to ten or more pairs. Whether nesting solitarily or colonially, its small territory is generally weakly defended.

Although the peculiarities of this species make it an interesting subject for study, few studies have been conducted, perhaps because of the difficulties associated with its limited range and irregular occurrence. A few early investigations, however, provided important information on nesting habits, diet, behavior, and vocalizations during the breeding season (Linsdale 1950, 1957, Coutlee 1968a, 1968b). This account relies heavily on these few, but detailed, studies.

The species was described and named in 1850 by John Cassin for George Lawrence, a New York businessman and ornithologist. Cassin's dedication included the following: "I have named this bird in honor of Mr. George N. Lawrence, of the city of New York, a gentlemen whose acquirements, especially in American Ornithology, entitle him to a high rank amongst naturalists, and for whom I have a particular respect, because, like myself, in the limited leisure allowed by the vexations and discouragements of commercial life, he is devoted to the more grateful pursuits of natural history" (Cassin 1850: 105).

DISTINGUISHING CHARACTERISTICS

Small (10–12 cm, 9–14 g), sexually dichromatic cardueline finch with a conical, flesh-colored bill. Male in breeding (Alternate) plumage is grayish overall with back often tinged olive green becoming brighter yellow-green on rump, yellow patch on central portion of breast, yellow wing-bars, and yellow patch on black wings (outer webs of flight feathers edged yellow); undertail-coverts white; tail black with subterminal white patches on inner webs of rectrices (except middle pair); head with distinctive black face (crown, forehead, lores, chin, and center of throat). Female similar to male except head entirely gray, yellow areas not as bright, and white on tail less extensive. Female also averages smaller than male (see Table 2). In nonbreeding (Basic) plumage, upperparts become browner and underparts duller in both sexes, but Basic and Alternate plumages otherwise similar. Juvenile similar to female but duller overall with yellow areas sometimes quite faint and reduced (can sometimes look essentially all brownish gray), wing-bars buffy, and, unlike American and Lesser

goldfinches (*Carduelis tristis* and *C. psaltria*), body is indistinctly streaked primarily below.

Bright yellow patches on wings distinguish Lawrence's Goldfinch from American and Lesser goldfinches in all plumages. Under certain field conditions, however, females could be confused with Basic-plumaged female American goldfinches, but tail patterns differ in these species (Kaufman 1993). Lawrence's Goldfinch has white patches on tail that do not extend to tip of tail (appearing as spots in middle of tail from below); American Goldfinch has white markings that extend to tip of tail. Some Lesser Goldfinches may have similar white tail-patches, but Lesser has white patch at base of primaries, yellow to greenish-yellow undertail-coverts, and juvenile lacks streaking.

Song similar to that of other goldfinches (see Middleton 1993, Watt and Willoughby 1999), but is higher pitched and more musical, has a narrower frequency range, and includes distinctive tinkling notes reminiscent of glass wind chimes; these latter notes make up the diagnostic Flight Call, a bell-like *tink-ul*, easily separable from the questioning, melancholy *tee-yee* of Lesser Goldfinch and the slightly whining *ti-dee-di-di* of American Goldfinch.

DISTRIBUTION

THE AMERICAS

Breeding range. Figure 1. Generally restricted to California west of Sierra Nevada-Cascade axis. Breeds from Tehama, Shasta, and Trinity Cos. south (irregularly) in foothills surrounding the Central Valley to Kern Co.; and from Contra Costa Co. south through the southern Coast Range (but generally excluding the immediate coast) to Santa Barbara Co.; and from there east through s. California to the western edge of the s. Mojave Desert and Colorado Desert, and south through the Peninsular Range (excluding the immediate coast) to 30°N in Baja California Norte (Small 1994, Howell and Webb 1995, Am. Ornithol. Union 1998). Rare in northern Coast Range (s. Mendocino Co. south to Marin Co.) and very rare on floor of Central Valley; occasionally common in the Sutter Buttes, Sutter Co. Rare and local in mountains (and rarely valleys) of Colorado Desert in s. California (e.g., Little San Bernardino and Eagle Mtns.; Miller and Stebbins 1964); and, at least formerly, in w. Arizona in Lower Colorado River valley (3 records; Rosenberg et al. 1991), and in w.-central Arizona near Phoenix and Wickenburg (4 records in Maricopa Co.; Rosenberg et al. 1980, Kaufman et al. 1980). Last documented nesting of species in Arizona was in 1980; a statewide breeding bird atlas project (1993–1999) has turned up no new records (T. Corman pers. comm.). Breeds predominantly in open woodlands of arid and semiarid foothills and valleys; usually near water;

from sea level near the coast and in some interior valleys to nearly 2,900 m on Mt. Pinos in s. California (Small 1994), 1,400 m in the Sierra Nevada at Ackerson Meadow in Yosemite (Gaines 1992), and to 2,500 m in nw. Baja California (Howell and Webb 1995). Erratic and irregular, however; may be present in some years but absent during others.

No evidence of breeding on Channel Is. in s. California (L. Jones pers. comm.); although Dawson (1923) described the species as "a regular breeder" on Santa Cruz I., no details were given.

Extralimital breeding noted in nw. California at Petrolia, Humboldt Co. (Harris 1996); se. California at Brock Ranch, Imperial Co.; and near Blythe, Riverside Co. (Garrett and Dunn 1981); and east of s. Sierra Nevada in Inyo Co. (3 records; McCaskie 1996, T. and J. Heindel pers. comm.). Nesting suspected in Siskiyou Co. in extreme n. California (Bailey et al. 1996) and in Mono Basin east of central Sierra Nevada (e.g., Yee et al. 1994), but unconfirmed.

Nonbreeding birds present occasionally during breeding season in Arizona (e.g., Monson and Phillips 1981) and New Mexico (e.g., Ligon 1961).

Winter range. Figure 1. Erratic and unpredictable in its movements, thus seasonal changes in distribution difficult to describe. Although species has been recorded in all portions of breeding range during winter, most usually withdraw from northern and central portions of California breeding range (Kern Co. north) during this period. Outside of breeding range, occurs irregularly during winter in coastal lowlands from Los Angeles Co. CA, south to Baja California Norte, and in foothills, lower mountain slopes, and warmer interior valleys of se. California deserts. Also wanders irregularly eastward and somewhat southward into the Colorado River valley, central and s. Arizona (rarely north to Yavapai Co.; e.g., Stejskal and Rosenberg 1993), sw. New Mexico (Hidalgo, Grant, Sierra, Luna, and Doña Ana Cos.; e.g., Williams 1997a), and, rarely, into central and nw. New Mexico (Socorro, Bernalillo, and San Juan Cos.; Hubbard 1978), s. Nevada (Clark Co.; e.g., Alcorn 1988), n. Mexico (to s. Sonora and nw. Chihuahua; e.g., Howell and Webb 1995, Williams 1997b, Russell and Monson 1998), and w. Texas (Trans-Pecos Range, mostly El Paso Co. but occasionally east to Hudspeth Co. and south to Presidio Co.; Texas Ornithol. Soc. 1995, Lasley et al. 1997a). Two Dec records from the Channel Is. (L. Jones pers. comm.). Extralimital record from s. Oregon (Lane Co., 24 Dec 1991–11 Jan 1992; Gilligan et al. 1994).

OUTSIDE THE AMERICAS

Not recorded.

HISTORICAL CHANGES

Unknown; lack of regional philopatry in this species makes any change in distribution hard to evaluate.

FOSSIL HISTORY

Unknown; maxillae of *Spinus* (*Carduelis*) finches from late Pleistocene deposits at Rancho La Brea (Los Angeles Co., CA) were determined from measurements not to be of this species (Sibley 1939).

SYSTEMATICS

GEOGRAPHIC VARIATION; SUBSPECIES

No geographic variation described and none expected given the species' nomadic nature and apparent genetic mixing. Genetic analysis of three specimens showed no genetic variability among 23 loci (Marten and Johnson 1986). No subspecies have been proposed.

RELATED SPECIES

Starch gel electrophoresis indicates closest North American relatives are Lesser and American goldfinches (Marten and Johnson 1986). Because this analysis was restricted to North American taxa, however, the evolutionary relationships of the 3 North American goldfinches with other members of *Carduelis* in Central and South America remain unknown. Formerly placed in subgenus *Astragalinus*, but this subsumed into subgenus *Spinus* (Am. Ornithol. Union 1998), which includes, among others, Pine Siskin (*C. pinus*), the next closest North American relative of the 3 goldfinches (Marten and Johnson 1986).

MIGRATION

NATURE OF MIGRATION IN THE SPECIES

Seasonal movements complex and confounded by nomadism; extent varies annually, probably in relation to availability of standing water and preferred seed crops (Linsdale 1957). Populations breeding north of Transverse Ranges of s. California (from about Kern Co. north) generally migratory; those to south are probably incompletely and irregularly migratory (e.g., Garrett and Dunn 1981). In some years, irrupts eastward in fall–early spring (sometimes in large numbers) through central and s. Arizona, sw. New Mexico, w. Texas, and n. Mexico (Sonora and nw. Chihuahua). Nature of these "flight years" is essentially unknown. Unlike most migrations in North America, much of movement in this species may be longitudinal rather than latitudinal. Upslope movement noted in fall, especially in drought years (e.g., Beedy and Granholm 1985).

TIMING AND ROUTES OF MIGRATION

See Figure 6.

Spring. Timing varies annually but, in general, most Lawrence's Goldfinches probably arrive in s. California by early Mar (e.g., Unitt 1984) and in n.

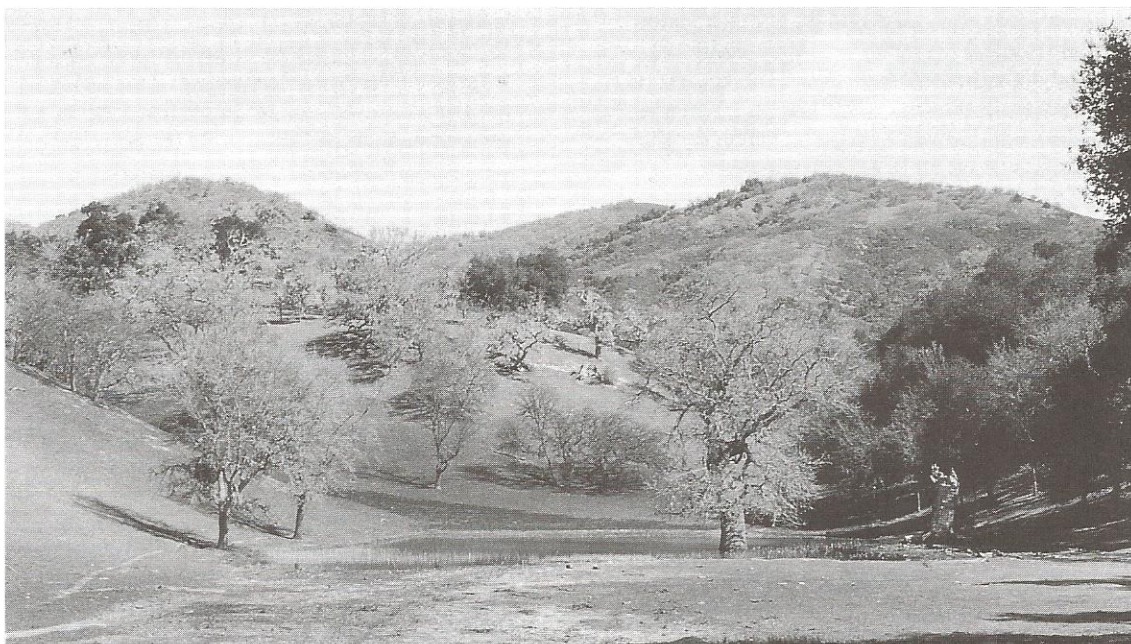


Figure 2. Blue-oak woodland habitat of Lawrence's Goldfinch in Carmel Valley, CA, where much of the work on this species was conducted in the 1930s–1950s. Photo by JND taken in early March, about the time when the birds begin to arrive for breeding.

California by early Apr (e.g., Roberson and Tenney 1993). Rare visitant to the Channel Is. in s. California 7 Mar–30 May (L. Jones pers. comm.) and on Southeast Farallon I. in n. California 8 Apr–26 May (Pyle and Henderson 1991). Very rare in sw. Nevada (Clark Co.; e.g., Kingery 1994). Extralimital record from s. Oregon (Jackson Co., 15 May 1997; Tweit and Lillie 1997). Individuals occasionally remain in Arizona, New Mexico, Texas, and nw. Mexico until early April (e.g., Howell and Webb 1995, Lasley et al. 1997b, Williams 1997b). Numbers of migrants are much larger in spring than in fall in San Diego Co., CA (Unitt 1984).

Fall. Generally departs breeding areas soon after fledging (Linsdale 1968), but may remain at favorable localities into the fall (Linsdale 1957). Most probably depart n. California by early Sep (e.g., Roberson and Tenney 1993) and much of s. California by late Sep (e.g., Garrett and Dunn 1981). Wanders widely outside of breeding areas, occasionally to extreme n. California (Modoc and Del Norte Cos.; Small 1994), also along the immediate coast, throughout the Central Valley, the Great Basin, and the Mojave and Colorado Deserts in California. Arrives in Arizona and nw. Mexico in Oct (e.g., Phillips et al. 1964, Rosenberg et al. 1991, Howell and Webb 1995) and in Texas in Nov (Oberholser 1974). Rare visitant on Southeast Farallon I. in n. California 29 Sep–31 Oct (Pyle and Henderson 1991) and on n. Channel Is. in s. California 10 Jul–14 Nov (L. Jones pers. comm.). Very rare in sw. Nevada (Clark Co.; e.g., Kingery 1994). A record for nw. Oklahoma (Beaver Co., 14 Nov 1984; Dunn 1985) was not accepted by the Oklahoma Bird Records Committee (J. Grzy-

bowski pers. comm.). A possible Louisiana record mentioned by Kaufman (1993) has not been substantiated (V. Remsen pers. comm.). Extralimital specimen record for s. Baja California (5 Nov 1968, California Academy of Sciences; D. Long pers. comm.).

MIGRATORY BEHAVIOR

Generally travels in pairs or flocks. Direction and extent of migration seem to vary annually. May migrate chiefly during the day to assess seed crops, but no data.

CONTROL AND PHYSIOLOGY

Not studied, but the distribution of favored seed crops is probably influential (e.g., Linsdale 1957). Drought may positively influence upslope movement in fall (Beedy and Granholm 1985).

HABITAT

BREEDING RANGE

Figure 2. Typically arid and open woodlands near 3 features: chaparral or other brushy areas; tall annual weed fields; and a water source such as a stream, small lake, or farm pond. Live oaks (*Quercus* spp.) and blue oak (*Q. douglasii*) are predominant trees where this species nests (Linsdale 1950, Coutlee 1968a). To a lesser extent, also uses riparian woodland; chaparral; coastal scrub; open coniferous and broadleaf evergreen forests; pinyon-juniper woodlands; plantings of cypress, cedars, or junipers; and ranches and other rural residential areas near weedy fields and



Figure 3. Lawrence's Goldfinch feeding on a native fiddleneck (*Amsinckia* sp.) in a mixed flock with Lesser Goldfinch (right). Drawing by N. John Schmitt.

water sources (Grinnell and Miller 1944, Rosenberg et al. 1991). A water source within 0.5 km is probably necessary (e.g., Coutlee 1968a).

SPRING AND FALL MIGRATION

In addition to those habitats used during the nesting season, uses many lowland and coastal habitats, including weedy pastures, meadows, cultivated fields, roadsides, coastal and riparian scrub, desert oases and washes, open mesquite woodland with scattered shrubs, orchards, gardens, suburbs, and city parks (Rosenberg et al. 1991, Small 1994). In fall, occasionally strays upslope to dry meadows and streamside thickets (Beedy and Granholm 1985).

WINTER RANGE

Similar to that in breeding range but, as in migration, tending toward more open areas along river floodplains, pastures, and lowlands where preferred seeds are abundant.

FOOD HABITS

FEEDING

Main foods taken. Seeds of annual plants, some perennials. Almost entirely granivorous, occasionally consuming fruit pulp and herbaceous material, and rarely animal matter (e.g., Ortega 1945, Culbertson 1946, Linsdale 1957, Coutlee 1968a).

Microhabitat for foraging. Figure 3. Forages in tall annual weed patches; meadows; open areas on

hillsides; and along creeks, river floodplains, fence-rows, rural roads, and weedy margins of agricultural fields; on stalks, foliage, or flowers of forbs and shrubs; also on ground or from fence post or wire; occasionally at artificial feeders. See also Habitat, above.

Food capture and consumption. Figure 3. Forages during the daytime, often in flocks, with peak periods in early morning and late afternoon (Coutlee 1968b). Gregarious even during the breeding season, though flock size is generally smaller than during winter. Flocks often contain other species, e.g., Lesser Goldfinch, House Finch (*Carpodacus mexicanus*), American Goldfinch, Dark-eyed Junco (*Junco hyemalis*), and Lark Sparrow (*Chondestes grammacus*; Linsdale 1957). Lesser Goldfinch, although it has a smaller body size, is dominant over Lawrence's and will sometimes displace it from food in the wild and in captivity (Coutlee 1968b).

Forages like other goldfinches, although seems to do so more deliberately (Linsdale 1957, Coutlee 1968b). Gleans seeds while perched on the seed-bearing plant, on a neighboring plant, or sometimes on a fence post or wire; also forages on the ground for fallen seeds. When perched, will contort its body in various ways or hang upside down if necessary to obtain seeds. Herbaceous plants often bend under bird's weight. Extracts and swallows seeds (e.g., achenes, nutlets, etc.) one at a time; may manipulate larger seeds in the bill to remove pappus or pericarp before swallowing. Pecks fleshy fruits (e.g., coffeeberry [*Rhamnus californica*]) to extract flesh or juice, but entire fruit is not removed from plant (Linsdale 1957).

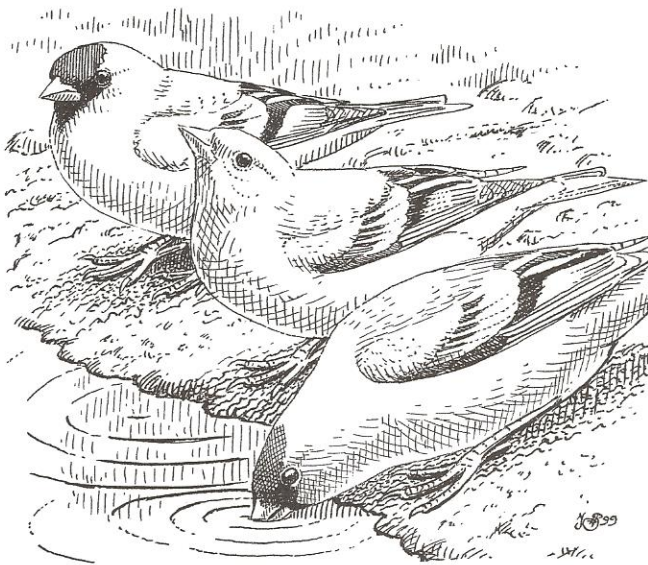


Figure 4. Lawrence's Goldfinch drinking from a quiet pool. The presence of water influences where this species nests. Drawing by N. John Schmitt.

In captivity, adult females consistently spent more time feeding than adult males, and juveniles spent more time feeding than adults (Coutlee 1968b). In this same study, compared with Lesser Goldfinch, Lawrence's fed in longer bouts, alternated with longer periods of inactive perching. This behavior suggests that Lawrence's may spend more time searching for rich food sources in the wild where it can remain and feed for several minutes; Lesser may feed for shorter periods on isolated stalks, enabling it to feed in areas not frequented by Lawrence's (Coutlee 1968b).

When feeding on salt at salt blocks, picks on bare ground within a foot of the block, often in flocks (Peterson 1942).

DIET

Major food items. Appendix. Diet varies by season and region. During the nesting season (early spring to early summer) feeds mainly on seeds (occasionally also buds) of annual plants in various phases of ripening. Shows a strong preference for seeds of the Boraginaceae, particularly fiddleneck, which is almost invariably used when available in spring (Linsdale 1950). Seeds (mature and in milky stage) of fiddleneck are a major food source. In fact, presence of fiddleneck may partly determine breeding range and nesting sites of the species (e.g., Linsdale 1957).

In winter, diet varies mostly by region. In much of California, achenes of chamise are eaten predominantly (Gander 1930, Martin et al. 1951, Linsdale 1957), with lesser amounts of annual seeds and berries such as mistletoe (*Phoradendron* spp.) and coffeeberry (Linsdale 1957). In Arizona, large flocks visit pigweed (*Amaranthus* spp.; Martin et al. 1951, S. Lima pers.

comm.); in the Lower Colorado River valley, uses inkweed (*Suaeda moquinii*) heavily (Rosenberg et al. 1991). Martin et al. (1951) reported significant use of star-thistle (*Centaurea* spp.), but B. Williams (pers. comm.) has not seen them use this plant Dec–Jun in n. California, although it is abundant and favored by other goldfinches.

Jumping galls (*Neuroterus saltatorius*) of valley oak (*Quercus lobata*) eaten in Aug from ground (mostly) and from leaves in Central Valley of California (Culbertson 1946). One recorded instance of a female on tree branch feeding from Mourning Dove (*Zenaidura macroura*) egg, of which it probably was the predator (Ortega 1945). Also regularly consumes salt (from salt-saturated ground around salt block), at least from mid-winter through the nesting season (Peterson 1942, Linsdale 1957). Occasionally also consumes sand and other gritty materials (Linsdale 1957).

In Carmel Valley, CA, diet more restricted than Lesser Goldfinch's; Lawrence's fed on 20 plant species, Lesser on 55 (Linsdale 1957). Disparity may reflect different foraging strategies (see Food capture and consumption, above) and/or bill morphologies. Lawrence's bill is shorter and less tapered than Lesser's (Coutlee 1968b). Thus, Lawrence's may not be able to handle larger seeds and extract others as efficiently and is therefore more restricted in its diet.

Quantitative analysis. Martin et al. (1951) reported 25–50% of diet in fall–spring (based on stomach contents from 29 specimens) was pigweed; in spring–summer, 10–25% was fiddleneck. Locations, habitats, dates of collection, and type of analysis not reported. Five stomach samples taken in Lower Colorado River valley in fall contained inkweed seeds and some unidentified plant material (Rosenberg et al. 1991).

FOOD SELECTION AND STORAGE

Sensitive to texture of foods in captivity (Stone and Granados 1985). Not known to store food.

NUTRITION AND ENERGETICS

No information, though its predilection for native plants and more restricted diet than its congeners may reflect different nutritional requirements.

METABOLISM AND TEMPERATURE REGULATION

No data on metabolic rates or requirements. Nestlings 2–6 g (age 0–5 d) have little ability to regulate body temperature, 7–9 g (age 6–8 d) have some control, and 10–11 g (age 9–11 d) have almost complete control (Stone and Granados 1985).

DRINKING, PELLET-CASTING, AND DEFECATION

Figure 4. Drinks readily throughout the day in the wild and in captivity (Linsdale 1957, Coutlee 1968b). Requires free water to process seeds and maintain water balance (Coutlee 1968b). Occurrence of fresh water strongly influences species' distribution, espe-

cially during nesting season (e.g., Linsdale 1957). Drinks from quiet streams, seeps, puddles, small ponds, artificial water troughs, etc. May prefer to drink from quiet pools rather than from dripping or running water in contrast to Lesser Goldfinch (Woods 1925), although this trend was not noted by Coutlee (1968b). Often arrives at water in pairs or flocks, sometimes with other species (Linsdale 1957). Drinks by putting head and body down and tail up in order to put bill in water; head and body up and tail down to swallow (Linsdale 1957). Rate of continuous drinking noted by Linsdale (1957) was 1 drink/1.5 s. Drinks much less frequently and for shorter periods in captivity than Lesser Goldfinch, suggesting greater water efficiency, which may account for habitat preferences (Coutlee 1968b).

Droppings only of gall hulls indicated no other food source (Culbertson 1946); not known to cast pellets.

SOUNDS

VOCALIZATIONS

Development. From Coutlee 1971. Nestlings begin uttering Begging Calls soon after hatching. When very young, call is soft and may be composed of a single, regularly repeated note; soon develops to a rhythmic two-note call, which is given through remainder of parental care period. Males begin singing warbling subsong at about 1 mo of age. Subsong resembles grouped begging calls, but notes are altered in pitch and general structure. Compared with adult song, subsong is lower-pitched, contains fewer notes/s, and is usually longer; sung at least through early fall.

Adult song incorporates calls of other bird and, rarely, nonbird species (Remsen et al. 1982). Judging from the quality of these imitations, males evidently learn song elements directly from other species rather than from conspecifics. Although no direct evidence for or against a critical learning period, other mimetic species are open-ended learners (e.g., Cabe 1993).

Vocal array. **SONG.** See Figure 5A. Long and complex, a high-pitched series of trickling ascending and descending trills, chirrs, and stuttering notes; similar to those of other North American goldfinches, but higher in pitch, weaker in volume, narrower in frequency range, and including thin tinkling notes (Coutlee 1971). The high-pitched, rapidly moving trill is broken by many longer notes with a characteristic finchlike slur. Unlike songs of Lesser and American goldfinches, most notes of Lawrence's song have only one fundamental frequency, giving the entire song a clearer and more musical quality (Coutlee 1971). Song may be composed almost entirely of sounds of other species (see Table 1; Dawson 1923, Remsen et al. 1982). Sounds that are loud, simple, and distinctive are the most commonly mimicked. Remsen

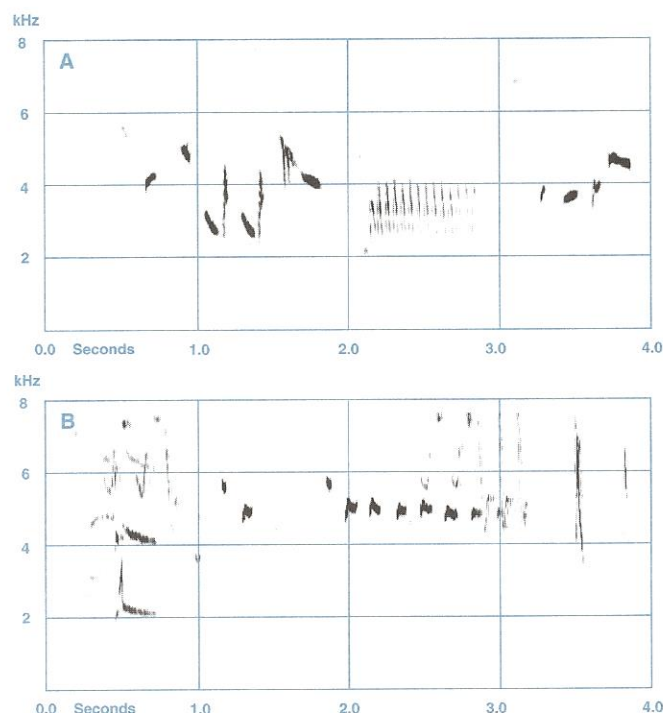


Figure 5. Vocalizations of Lawrence's Goldfinch. A. Representative song segment (from recordings on the Bird Songs of the Pacific States CD, Library of Natural Sounds [LNS], Cornell Laboratory of Ornithology; Alameda Co., CA, 18 May 1988 by Thomas G. Sander). B. The distinctive *tink-ul* Flight Call of Lawrence's Goldfinch. From recordings on the Peterson Western Birds CD (LNS no. 12756); Los Angeles Co., CA, 19 May 1961. Spectrograms prepared by the staff of the Borror Laboratory of Bioacoustics, Ohio State University, using a Kay Elemetrics DSP 5500 Sona-Graph (with an effective frequency resolution of 150 Hz and a 200 pt. FFT transform size).

et al. (1982) detected mimicked calls of American Kestrel (*Falco sparverius*), Western Wood-Pewee (*Contopus sordidulus*), Rock Wren (*Salpinctes obsoletus*), Western Bluebird (*Sialia mexicana*), American Robin (*Turdus migratorius*), and Lesser Goldfinch in repertoires of >50% of all singing Lawrence's, but there is probably regional variation. The quality of these imitations exceeds those given by Lesser Goldfinch. Reason for interspecific imitation not known; best explanation is that male's repertoire size offers female an index of male's level of fitness (Remsen et al. 1982), with older, experienced males having the largest repertoires; more study needed. Unlike Lesser and American goldfinches, male Lawrence's lacks a song flight display (Coutlee 1968a). Song primarily given by adult male chiefly in breeding season, but also in winter; female occasionally gives a short song.

FLIGHT CALL. Figure 5B. The distinctive, bell-like *tink-ul* is most frequently given in flight, but also as an advance call to flight, and is also interspersed with other notes in male's song.

CALLS. Phonetic representations vary widely; the following are from Linsdale (1957). Adults give a

Table 1. Species whose vocalizations are copied by Lawrence's Goldfinch. Adapted from Dawson 1923 and Remsen et al. 1982.

American Kestrel (<i>Falco sparverius</i>)	Bewick's Wren (<i>Thryomanes bewickii</i>)
California Quail (<i>Callipepla californica</i>)	House Wren (<i>Troglodytes aedon</i>)
Gambel's Quail (<i>Callipepla gambelii</i>)	Northern Mockingbird (<i>Mimus polyglottos</i>)
Killdeer (<i>Charadrius vociferus</i>)	Ruby-crowned Kinglet (<i>Regulus calendula</i>)
Greater Yellowlegs (<i>Tringa melanoleuca</i>)	Blue-gray Gnatcatcher (<i>Poliophtila caerulea</i>)
Spotted Sandpiper (<i>Actitis macularia</i>)	Western Bluebird (<i>Sialia mexicana</i>)
Acorn Woodpecker (<i>Melanerpes formicivorus</i>)	Hermit Thrush (<i>Catharus guttatus</i>)
Nuttall's Woodpecker (<i>Picoides nuttallii</i>)	American Robin (<i>Turdus migratorius</i>)
Hairy Woodpecker (<i>Picoides villosus</i>)	American Pipit (<i>Anthus rubescens</i>)
Northern Flicker (<i>Colaptes auratus</i>)	Cedar Waxwing (<i>Bombycilla cedrorum</i>)
Western Wood-Pewee (<i>Contopus sordidulus</i>)	Phainopepla (<i>Phainopepla nitens</i>)
Black Phoebe (<i>Sayornis nigricans</i>)	Yellow-rumped Warbler (<i>Dendroica coronata</i>)
Ash-throated Flycatcher (<i>Myiarchus cinerascens</i>)	California Towhee (<i>Pipilo crissalis</i>)
Cassin's Kingbird (<i>Tyrannus vociferans</i>)	Rufous-crowned Sparrow (<i>Aimophila ruficeps</i>)
Western Kingbird (<i>Tyrannus verticalis</i>)	Lark Sparrow (<i>Chondestes grammacus</i>)
Cassin's Vireo (<i>Vireo cassinii</i>)	Dark-eyed Junco (<i>Junco hyemalis</i>)
Western Scrub-Jay (<i>Aphelocoma californica</i>)	Western Meadowlark (<i>Sturnella neglecta</i>)
Violet-green Swallow (<i>Tachycineta thalassina</i>)	Brown-headed Cowbird (<i>Molothrus ater</i>)
Barn Swallow (<i>Hirundo rustica</i>)	Bullock's Oriole (<i>Icterus bullockii</i>)
Oak Titmouse (<i>Baeolophus inornatus</i>)	House Finch (<i>Carpodacus mexicanus</i>)
Verdin (<i>Auriparus flaviceps</i>)	Pine Siskin (<i>Carduelis pinus</i>)
White-breasted Nuthatch (<i>Sitta carolinensis</i>)	Lesser Goldfinch (<i>Carduelis psaltria</i>)
Rock Wren (<i>Salpinctes obsoletus</i>)	American Goldfinch (<i>Carduelis tristis</i>)
Canyon Wren (<i>Catherpes mexicanus</i>)	Pacific Treefrog (<i>Hyla regilla</i>)

harsh *kee-yerr*, a soft *chee*, a bell-like *kleee*, and a *pi-bi-di-dee-o* in flight or from a perch, faint tinkling notes reminiscent of glass wind chimes sometimes while perched, and slight *tsip-tsip* calls while foraging. Other calls include a *sweet* given by female and nestlings, a *chee-up* also given by nestlings, a *churr* given by fledglings, and plaintive and descending *chee* notes given by fledglings in the company of adults. Female utters a variety of calls while incubating including a ringing call (at intervals of 4 s), a querulous *mew*, and a *meow*. Male utters a short *whit* or *wheet* to incubating female.

Coutlee (1971), described 5 types of calls:

CONTACT CALL. Composed of 1–5 high-pitched and bell-like notes, given by either sex to maintain auditory contact with its mate; also given by individuals in a flock. Coutlee (1971) included the Flight Call, described above, in this category.

THREAT CRY. A harsh call with a broad frequency range, given in conjunction with agonistic displays toward subordinates; uttered by both sexes. Intensity of call increases with intensity of aggressiveness.

ALARM AND DISTRESS CALLS. A plaintive, wavering *de-ree* is given by a male or female when a ground predator is within about 15 m of an active nest. The call is shortened when a predator is within 5–7 m; upon even closer approach, a high-intensity *bee-ee* call is given. The latter call is nearly identical in frequency and amplitude in all North American goldfinches. Adults usually give these calls from within 7 m of the nest, but not at the nest itself. A louder

version of the *bee-ee* call, conveying distress, is given when a bird is handled.

COURTSHIP AND PRECOPULATORY CALLS. Given by male prior to courtship feeding (see Fig. 3G in Coutlee 1971); call may be given alone, as a prelude to song, or may be interspersed with other notes in song. Precopulatory Call, given by female just prior to being mounted by male, is similar to high-intensity Feeding Call (see below).

FEEDING CALLS. As the male approaches the nest with food and utters Contact Calls, the incubating or brooding female responds with a low-intensity *tee-tee*; she then gives a high-intensity version of this call just prior to being fed by the male.

Juveniles give a soft Begging Call soon after hatching (Fig. 5G in Coutlee 1971); variations in this call are produced as the young develop, but rhythm and amplitude remain unchanged. Nestlings and fledglings seem to give the call whenever they are hungry, whether the parents are present or not. When parents are present, the call serves to attract them to the young.

Phenology. Sings throughout the year, most regularly during early stages of nesting and least regularly from end of nesting season until late fall. Males sing most intensely for 4–5 d during breakup of spring flocks (Coutlee 1968a). During nest-building, song is more continuous and less strident than in many other small passerine birds (Linsdale 1957). Female song not well known; given infrequently during nesting; unknown from other times of year (Linsdale 1957).

Daily pattern of vocalizing. Pattern similar to that of other small song birds; sings throughout the day, but highly active in early morning hours, with a midday rest period and second late afternoon peak (e.g., Coutlee 1968b). Especially during early morning hours, sings while facing sun (Linsdale 1957).

Places of vocalizing. From Linsdale 1957. Often sings from the tops of trees, but also from a concealed perch within foliage, and in flight. Early in breeding season, male sings from trees in loose flocks containing other males and females. Later, male sings in nest tree or from neighboring tree while female builds nest, incubates, and broods; also after feeding young in late nestling stage; sometimes circles nest tree while singing from other trees. Also sings from tree while female gathers nesting material and in flight as he follows female back to nest. Female occasionally sings short and soft version of male song while on nest or in flight. Female also calls to male while she is on nest.

Repertoire and delivery of songs. Repertoire patterns unstudied. Males may sing for periods of ≥ 30 min (Linsdale 1957). In late summer and early fall, young males in a flock may sing subsong simultaneously (Coutlee 1971).

Social context and presumed functions of vocalizations. See above. During nesting season, male sings to attract a mate, later to maintain the pair bond, and to advertise and defend the small territory about the nest (Coutlee 1971). Male members of a flock sometimes sing simultaneously. Female utters a faint *meow* or *chee* note repeatedly while on nest presumably to call the male to feed her (Linsdale 1957). After feeding an incubating female, the male sometimes gives a short *whit*, which seems to signal completion of the feeding (Linsdale 1957). Female gives a soft *way* to caution young in nest in presence of nearby predator; young respond by crouching low in nest. During the nesting period, the *tink-ul* notes of the male are given as an advance to flight and seem to arouse flight in the female (Linsdale 1957). Grating *caw* Calls given by male when facing opponent indicate aggression; similar notes given by female when chasing cowbirds from nest area (Coutlee 1968a).

No reports of countersinging or dueting.

NONVOCAL SOUNDS

None described.

BEHAVIOR

LOCOMOTION

Walking, hopping, climbing, etc. Like other cardueline finches, hops (rather than walks) while foraging on ground; sidles along branches and hops between them.

Flight. Mobile and agile, typical of other finches. Long flights are undulating with an upward com-

ponent made by a series of quick wing-beats followed by an arcing descent on closed wings.

SELF-MAINTENANCE

Preening, head-scratching, stretching, bathing, anting, etc. From Linsdale 1957, except where noted. Preened more often and for longer intervals than other passerine species studied at the Hastings Reserve in central California. Warmth of sun may elicit preening activity. Bathes commonly at any hour of day, often with conspecifics. Bird enters shallow water of stream to a depth of about 1 cm, dips head into water, then lowers breast, fluffs contour feathers, flutters wings, and tosses water up over back while spreading and lowering tail; behavior lasts typically < 2 min, until plumage is thoroughly wetted; then flies to perch, where it shakes and preens (Coutlee 1968b).

Sleeping, roosting, sunbathing. Nightly winter roosts of ≥ 50 in a large patch of lemonade berry (*Rhus integrifolia*) noted in San Diego Co., CA (Gander 1930). Female occasionally sleeps on nest while incubating during day and presumably through the night (Linsdale 1957). Sunbathes regularly, perhaps most often during the first few hours of sunlight and in the afternoon (Linsdale 1957). Faces sun while perched but may orient head at right angle to incident rays, fluffing contour feathers (Coutlee 1968b). Male often sings while facing the sun (Linsdale 1950).

Daily time budget. General pattern of peak activity in early morning and late afternoon; in a laboratory study, females spent consistently more time feeding than males, and juveniles spent more time than females; in same study a female spent 31% of daylight hours feeding, 52% resting, and 17% engaged in other activities such as drinking and preening; in comparison, a male spent only 8% of daylight hours feeding, 79% resting, and 13% in other activities; a juvenile spent 39% of daylight hours feeding, 55% resting, and 6% in other activities (mean percentages over 5 d; Coutlee 1968b).

AGONISTIC BEHAVIOR

Physical interactions. From Linsdale 1957, except where noted. Members of nesting pair routinely chase conspecifics from nest tree or vicinity, together or singly, sometimes engaging in physical combat. Male-male intolerance and antagonism occur both at and away from nest area. Intolerance is most intense during spring flock breakup (Coutlee 1968a). One may challenge the other on the ground or on a perch; actual combat is usually in midair: males face each other in flight, hover a few centimeters apart, and battle with wings, bills, and/or claws; sometimes in foliage of shrub; defeated male retreats and victor remains.

Communicative interactions. Male Threat Display involves facing opponent, elongating body, compressing body-feathers, lowering wings, raising and fanning tail slightly, and sometimes pivoting side to

side, usually while also singing intensely (Linsdale 1957, Coutlee 1968a). This behavior highlights the entirely black facial region and sharply contrasting pale bill. Unlike other cardueline finches with black chins (e.g., Common Redpoll [*Carduelis flammea*]), male lacks a chin-lifting display (Coutlee 1968a). No documented variation in size of black face patch among males, such as known to indicate dominance status in other members of the genus (e.g., European Siskin [*Carduelis spinus*]; Senar et al. 1993). During courtship, female may terminate billing behavior with sharp pecks at male's head; male may then give Appeasement Display, retreating a few centimeters and assuming a submissive posture with body-feathers fluffed and legs and neck flexed, sometimes also while lowering and quivering wings; in other situations, females and juveniles display similarly (Coutlee 1968a). Displacement breast-preening is common during conflict situations (Coutlee 1968a).

SPACING

Territoriality. From Linsdale 1957, except where noted. Territorial only during nesting season. Territory is established after nest site has been selected. Female actively defends area immediately around nest; male defends larger, but still small, area encompassing neighboring trees (an area of 10–15 m in diameter; Coutlee 1968a). Territory is maintained primarily by male's song but also by occasional chases of intruders. Defense is rather weak and mainly intrasexual: males attack males and females attack females. Territory is inconsistently defended against conspecifics; tolerance of neighbors sometimes allows communal nesting to occur. Male-male intolerance is prominent during the early stages of nesting. Also exhibits inconsistent interspecific territoriality; sometimes chases intruding House Wren (*Troglodytes aedon*), Blue-gray Gnatcatcher (*Polioptila caerulea*), Wrentit (*Chamaea fasciata*), Lazuli Bunting (*Passerina amoena*), and Lesser Goldfinch. Generally avoids conflicts with larger species; e.g., although excited, a pair did not attempt to drive away a California Towhee (*Pipilo crissalis*) that approached their nest.

Dominance hierarchies not reported; but probably occur as in other members of the genus (see Senar 1993); a bird may occasionally peck another in a flock, causing it to move away.

Individual distance. Individuals in flocks may perch <5 cm apart on telephone or other wires; regularly feeds, drinks, and bathes side by side with other small seed-eaters (Linsdale 1957).

SEXUAL BEHAVIOR

Mating system and sex ratio. Seasonally monogamous; no reports of polygyny or polyandry. Sex ratio, based on banding records throughout the species' range during every month of the year from

1955–1997, is male-biased: 58% male/42% female ($n = 614$; Bird Banding Laboratory [BBL] data). Based on subset of above records for the breeding season only (Apr–Jul), sex ratio is 55% male/45% female ($n = 424$).

Pair bond; courtship displays. From Coutlee 1968a, except where noted. Male is subordinate to female and approaches her cautiously, alights 1–2 m away, then slowly sidles toward her until a few centimeters away. He may then sing or give Courtship Call, but female actually initiates courtship behavior by flying to and perching near the male. The two face each other and extend bodies fully, uttering soft Contact Calls continually, until tips of bills meet; process is repeated several times until male regurgitates food, which female accepts directly by gaping. Male may also utter a Courtship Call and female may respond with a short series of Precopulatory Calls. Members of the pair are strongly attached and associate in flocks and perch together when flocks are momentarily dispersed; male accompanies female on long trips for nesting material and sings nearby while female constructs nest; male appears to guard female from interlopers but attacks may be relatively mild; in flocks, males may repeatedly attempt to drive other males from near vicinity of a female; male feeds incubating female and accompanies her on occasional trips away from nest during this time and later during nestling stage; bond is strongest before start of incubation, wanes slightly thereafter, and apparently dissolves when they join postbreeding flocks. Apparent maintenance activities include flights where one member closely follows the other (male usually follows female), occasionally making physical contact and temporarily suspending powered flight; one report of attempted copulation during such flight. During late nestling period, female sometimes alights on male's back, balancing precariously for a moment, then perching next to him (Linsdale 1957); female quivers wings in male's presence and bows repeatedly toward male from a perch; members of a pair also engage in billing and courtship feeding.

Copulation. From Linsdale 1957, except where noted. In precopulatory display, male makes long circular flight away from perched female then returns and perches near her. They may both then fly around excitedly in nest tree and neighboring trees uttering various call notes constantly; male usually leads female. Female may then solicit copulation by flying to within 3 m of male, facing him, raising head and tail, and vibrating wings (Coutlee 1968a). Male then mounts female while briefly hovering above her. Pair occasionally copulates after start of incubation and even during nestling phase.

Extra-pair copulations. Gregarious nature during nesting season provides regular opportunities for extra-pair copulations, but none documented. Males posture and sing to foreign females.

SOCIAL AND INTERSPECIFIC BEHAVIOR

Degree of sociality. Gregarious at all seasons. Winter feeding flocks may contain up to 500–700 birds (Garrett and Dunn 1981, S. Lima pers. comm.), but <50 more common (e.g., Linsdale 1968). In winter, may roost at night in flock of ≥ 50 in isolated shrub (Gander 1930). Large spring flocks break up with pair formation. Feeding groups during nesting season typically contain <20 birds, and usually 4–6, most of which are male (e.g., Linsdale 1957, Coutlee 1968a). Occasionally nests in loose colonies; activities at such sites not necessarily synchronous, i.e., along with completed nests, some with young, and others still with eggs (Linsdale 1957). May share nest tree with other nesting species (e.g., Anna's Hummingbird [*Calypte anna*] or Lesser Goldfinch; Linsdale 1957).

Play. Unknown.

Nonpredatory interspecific interactions. Feeding flocks often contain other species, e.g., Lesser Goldfinch, House Finch, American Goldfinch, Dark-eyed Junco, and Lark Sparrow (Linsdale 1957). Members of these flocks often feed, drink, and bathe side by side even during the nesting season (e.g., Coutlee 1968a). Lesser Goldfinch is dominant over Lawrence's and will displace it from food and perches (Coutlee 1968b). A singing flock was silenced by alarm notes of California Quail (*Callipepla californica*); flock resumed singing when quail departed even though presumed threat (human observer) remained (Linsdale 1957). Linsdale (1957) also reported several species that attempted to drive Lawrence's from vicinity of their nests: Anna's Hummingbird, Western Wood-Pewee, Oak Titmouse (*Baeolophus inornatus*), Blue-gray Gnatcatcher, and Lesser Goldfinch. A nesting Black Phoebe (*Sayornis nigricans*) that drove away a House Wren (*Troglodytes aedon*) did not respond to a male Lawrence's 3 m away.

PREDATION

Kinds of predators. Flocking habit makes the species a regular target for predatory birds. Sharp-shinned Hawk (*Accipiter striatus*) and Cooper's Hawk (*A. cooperii*) often pursue Lawrence's in flocks but are rarely successful (Linsdale 1957). Western Scrub-Jays (*Aphelocoma californica*) and gray squirrels (*Sciurus griseus*) threaten nests (e.g., Coutlee 1968a). Bullfrogs (*Rana catesbeiana*) regularly attempted to prey on adults at a small pond in the central Sierra Nevada but were not known to be successful (JND).

Manner of predation. Only one instance of egg predation known—by a Western Scrub-Jay, a species that may be a significant threat throughout most of its breeding range (JND).

Response to predators. Western Scrub-Jays and gray squirrels are chased from nest sites, often by both members of the pair, but singly if only one member is present (Coutlee 1968a). After having a

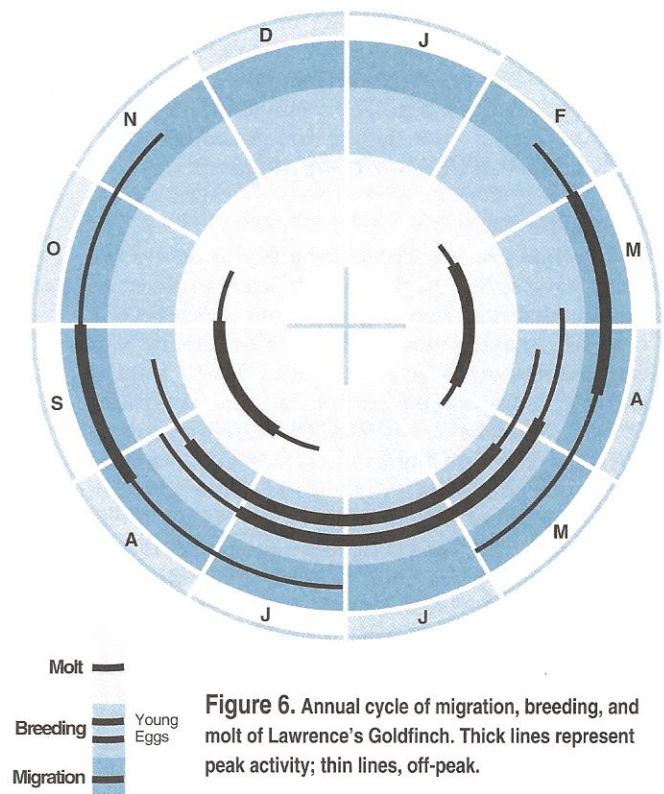


Figure 6. Annual cycle of migration, breeding, and molt of Lawrence's Goldfinch. Thick lines represent peak activity; thin lines, off-peak.

nest torn apart by a Western Scrub-Jay, a pair did not attempt to reneest nearby (JND). Nestlings freeze in rigid position upon detecting presence of nearby accipitrine hawks (Linsdale 1957).

BREEDING

PHENOLOGY

Pair formation. Pairs apparently form in pre-breeding flocks, typical of cardueline finches (see Middleton 1993, Watt and Willoughby 1999); formation may occur within 10–14 d after flock arrival in breeding area (Coutlee 1968a); most form mid-Apr to mid-May in central and s. California (Linsdale 1957, Coutlee 1968a); spring flocks may be composed entirely of distinct pairs (Linsdale 1957).

Nest-building. Female builds as early as mid-Mar to as late as late Jul, but most in mid-Apr to early Jul. First nest in Arizona, 15 Mar (Linsdale 1957); in Colorado River valley, 18 Apr (Rosenberg et al. 1991). Nest construction takes 4–8 d, but female continues to amend nest after start of incubation (Linsdale 1957, Coutlee 1968a).

First/only brood per season. Figure 6. First eggs laid as early as late Mar to as late as late Aug, but most late Apr to late Jul. Median date for completion of clutch is May 8 ($n = 25$ nests from across species' range; Western Foundation of Vertebrate Zoology [WVZ] nest record data, JND). No specific data on

timing of laying and hatching or on departure of young or length of parental care period.

Second/late brood(s) per season. Although the majority of birds are probably single-brooded, late nestings suggest some may be double-brooded (e.g., see Roberson and Tenney 1993); no specific data.

NEST SITE

Selection process. Prospecting begins as soon as pairs leave spring flocks. Female leads exploration for potential sites, hopping in and out of prospective crotches, making nest-building movements, and carrying nest material; male follows closely, singing and calling (Coutlee 1968a). In s. California, first nests of season may be in mistletoe or western sycamore (*Platanus racemosa*), but as the season advances and deciduous foliage is fully formed, blue oaks are favored (Coutlee 1968a).

Microhabitat. Nest is typically situated in fork of several, usually drooping, outer branchlets, 1–2 m from tip of a main branch (Coutlee 1986a); sometimes in clumps of lace lichen (*Ramalina reticulata*) or mistletoe. Colonial nesting is often in dense plantings of evergreen trees, affording greater cover than in native habitat. In central California, tend to nest in oaks of moderate to small diameter with some lichen (Linsdale 1957).

Site characteristics. In central California, favors small, lichen-festooned blue oaks, in dense stands on dry, often south-facing slopes within 0.5 km of a stream or other water source. At Hastings Reserve in Carmel Valley, CA, sites were 0.4–0.8 km from main feeding areas (Linsdale 1957). Common nest substrates in California include blue oak, interior live oak (*Quercus wislizeni*), canyon live oak (*Q. chrysolepis*), and coast live oak (*Q. agrifolia*); other substrates recorded include various conifers (e.g., *Pinus*, *Cupressus*, and *Pseudotsuga* spp.) and deciduous trees (e.g., *Alnus*, *Populus*, and *Salix* spp.; Linsdale 1957, Coutlee 1968b, WFFVZ nest records).

Mean nest height from throughout range in California = 3.08 m \pm 2.37 SD (range 0.61–12.12, n = 27; Linsdale 1957, WFFVZ nest records). Mean nest height in Los Angeles Co., CA = 7.60 m (range = 3–13, n = 24; Coutlee 1968a).

NEST

Construction process. Nest built entirely by female with male close by. Female makes repeated trips to favorable nest material collection areas, which may be up to 100 m from nest site (Linsdale 1957, Coutlee 1968a). She flies to ground, grasps stems of small forbs or grasses with her bill and tugs until they snap at base (Coutlee 1968a). At sites where foliose lichen is abundant, female collects bits of lichen from trees, including her own nest tree (sometimes from adjacent branches while sitting in nest to form cup) or even the nest tree of a conspecific (Linsdale 1957). Nest-building

activities may attract conspecifics and even congeners; some apparent interspecific competition for nest sites, with an occasional nest under construction being visited by both Lawrence's and Lesser goldfinches (Coutlee 1968a). Male accompanies female on long trips for building material, but not when she collects in vicinity of nest tree. He may sing from a perch while she collects, in flight on trip back to nest, and again from perch while she builds. Nest is constructed by weaving material and anchoring it from branches; at stage when there is a semblance of nest (after about first day), female moves body against sides to form cup (Linsdale 1957). Construction occurs episodically throughout the day and takes 4–8 d to complete (Linsdale 1957, Coutlee 1968a).

Structure and composition matter. Loosely woven cup typically composed of fine, fresh leaves and stems of grasses and forbs (especially of Geraneaceae), sometimes also with flower buds or blossoms; lined with very fine plant fibers, plant down, feathers, flowers, hair, and/or fur; often decorated with lichen (Linsdale 1957, Coutlee 1968a). Where lace lichen is abundant, may use as primary material (Linsdale 1957).

Dimensions. Mean dimensions, in cm, \pm SD (range); n = 13 nests: outside diameter 7.67 \pm 0.77 (7.0–8.90); outside height 5.28 \pm 1.13 (4.1–7.6 cm); inside diameter 4.19 \pm 0.30 (3.80–4.57); and inside depth 2.76 \pm 0.40 (2.03–3.30; Linsdale 1957).

Microclimate. Usually located in tuft of foliage; at least early in season, often situated on southeast- or south-facing branches (Linsdale 1957). Nests with soft, felted lining of feathers, plant down, fur, etc., presumably offer insulative value; no quantitative data.

Maintenance or reuse of nests, alternate nests. Not known to reuse nests; one recorded instance using material appropriated from Anna's Hummingbird nest and another from an abandoned House Finch nest (Cornell Nest Record Program [NRP]).

Nonbreeding nests. Not reported and not suspected.

EGGS

Shape. Oval to elliptical.

Size. Mean length \times mean breadth: 15.50 mm (range 14.47–16.60) \times 11.7 mm (range 11.14–12.32, n = 95 eggs from 20 clutches collected before 1947; WFFVZ).

Mass. Of fresh, whole egg; mean 1.04 g (range 0.82–1.18, n = 9 eggs; Hanna 1924), about 9.8% of adult female body mass (WFFVZ).

Color. Typically white and unmarked (Dawson 1923, Linsdale 1957); rarely very pale bluish white (e.g., Linsdale 1968); but generally distinct from eggs of other North American goldfinches, which have distinct bluish or greenish tones.

Surface texture. Smooth; slight gloss.

Eggshell thickness. No data; mean mass of empty shell 0.052 g (range 0.046–0.058, n = 95 eggs, 20 clutches; WFFVZ).

Clutch size. Three to 6 eggs; modal size 5 ($n = 21$ clutches; WFFVZ).

Egg-laying. No information on initiation relative to nest completion or time of day. One egg/d laid until clutch of 3–6 is complete. Male guards female closely during this time, singing continuously (Linsdale 1957). No evidence for intraspecific egg-dumping, although colonial nestings could facilitate this behavior.

INCUBATION

Onset of broodiness and incubation in relation to laying. Female begins intermittent incubation after 2–3 eggs are laid and continuous incubation before clutch is complete (Coutlee 1968a).

Incubation patch. A single medial abdominal patch forms in females only (Pyle 1997).

Incubation period. Normal period is 12–13 d, but may be protracted up to 20 d if eggs are infertile (Linsdale 1957).

Parental behavior. From Linsdale 1957. Female incubates almost continuously, taking only brief flights away, usually in early morning, and typically after being fed by male; male does not incubate. In cool weather, female postures over eggs such that she completely covers cup of nest with only tail and head protruding above rim. At one nest (observed for 56 h over 7 d), female was away only 3.3% of time; 85% of trips away ($n = 27$ trips) were for <6 min; maximum time away was 33 min; 60% of trips were in early morning, before 07:15. Male provided most food for female at this time, feeding regurgitative paste at a mean rate of 1 feeding/h. When male arrives at nest tree to feed female during early stages of incubation, he approaches from above the nest and follows a regular path to female. Later in incubation, paths to the female are variable, but the terminal approach is maintained. Male lands in nest tree, sometimes sings, especially in early stage of incubation, then approaches female, sidling up to her on approach twig. Female responds by uttering calls, then lifting head with bill wide open, and quivering wings. Male regurgitates food, heaving shoulders and putting bill inside female's mouth. Female usually quivers wings through entire process. After feeding female, male appears to coax her off the nest by uttering repeated *tink-ul* calls from a nearby perch. The two then typically fly off together. Upon returning to the nest, female pauses on rim and inspects contents before settling in. Female generally leaves nest only in presence of male except during last few days of incubation. On these occasions, upon arriving at mateless nest, male appears greatly disturbed and searches for female in, under, and around nest, calling repeatedly, and attempts to feed regurgitative material to empty nest.

During day, female often preens, rearranges nest material, occasionally sleeps, and sometimes sings. In warm weather, female sometimes stands in nest, with wings partly raised and bill open.

At one nest where eggs failed to hatch, regular incubation and male feeding routine continued 19 d after start of incubation. However, female regularly stood in nest and restlessly inspected its interior. Nest was abandoned at 21 d.

Hardiness of eggs against temperature stress; effect of egg neglect. No information; species nests in many areas where daytime temperature regularly exceeds 35°C.

HATCHING

No information.

YOUNG BIRDS

Condition at hatching. Altricial; skin on head dark pink; eyes closed; skin over eyes appears purplish blue; down well developed on spinal tract; inside of bill red; hatchlings capable of raising head slightly (Linsdale 1957).

Growth and development. From Linsdale 1957. For first few days, young stay low in nest unless adults are present; regularly perch on rim of nest ≥ 8 d posthatching. Completely feathered (natal down on top of head only), preen themselves, and are ambulatory (easily climbing to rim of nest) by 8 d posthatching. Young give *sweet*, *chee-up*, and *tsee tsee* calls, beat wings vigorously, preen often, and climb outside nest by 9 d posthatching. Young toward end of nestling phase respond to nearby predator by ceasing activity and vocalizations and freezing in rigid position in nest.

PARENTAL CARE

Brooding. Female broods almost continuously during first 4–5 d posthatching, then irregularly through day 7; when exposed to direct sunlight, female spreads wings to shield nest; male does not brood (Linsdale 1957).

Feeding. From Linsdale 1957. Male regularly feeds female on nest through about fourth day posthatching. After food is delivered to female, she feeds young, usually within 5 min of male's departure from nest tree. For first 3 d, female feeds by moving back on nest, then resettles forward after feeding. Male may attempt to feed young directly, but brooding female usually intercepts food. After day 4, female accompanies male on foraging trips; both typically arrive at nest together and take turns feeding young. Initially, male almost always feeds first, but toward end of nestling period, female feeds first as often as male does. Food is a sticky, cream-colored paste of regurgitated seeds; seed types and composition presumably similar to those in adult diet. One observation of female delivering green caterpillar (Lepidoptera) to young (JND). Young are fed at regular hourly intervals. At one nest, young were fed at mean rate of 1.3 feedings/h ($n = 109$ h of observation). A feeding may involve giving food to each young ≥ 20 times. Female

pauses motionless after feeding, then examines nest; male typically departs hurriedly. Young closest to adult and raising its head highest sometimes fed more than its nestmates. Adult arrival at nest is quiet and unobtrusive; departure conspicuous with open flight, often accompanied by song.

Nest sanitation. Incubating female may defecate on rim during incubation and brooding; female removes or consumes fecal sacs during first 5 d posthatching, sometimes directly consuming them upon emergence; after 4–5 d posthatching, young void over nest edge; nest usually messy, with rim covered with droppings at end of nesting (Linsdale 1957).

Female occasionally observed pecking on bottom of nest during incubation and nestling stage, possibly picking at macroscopic nest parasites (Linsdale 1957).

Not known to carry or otherwise transport young.

COOPERATIVE BREEDING

One report of an extra-pair female feeding young at a solitary nest in presence of nest owners; extra bird arrived with pair at nest after foraging trip, they took turns feeding young, then departed together (Linsdale 1957). Relationship of helper to nest pair not known.

BROOD PARASITISM

Rare host of Brown-headed Cowbird (*Molothrus ater*; Coutlee 1968a, WFVZ egg set), but no information on outcome or effects. Unlikely to be a significant host given general lack of insect food in diet. Adults chase cowbirds from nest sites together if both present, but female alone will chase, while uttering repeated *caw* notes, if male is absent (Coutlee 1968a).

FLEDGLING STAGE

Departure from the nest. About 13–14 d posthatching (Linsdale 1957). No information on condition of development at departure. Fledglings apparently capable of only brief flights and remain near nest for first few days after fledging; generally perch quietly until adults return with food or they become hungry (Coutlee 1968a). Beg by closely pursuing parents, uttering Begging Calls that intensify upon close approach, quivering or flapping wings, opening bill widely, and lunging body forward. Adults feed by regurgitation and occasionally by transferring seeds directly from plant to eager young (Linsdale 1957). By 5–7 d postfledging, young leave nest area to join adults on foraging trips; young remain in family group until they join premigratory flocks (Coutlee 1968a).

IMMATURE STAGE

Before independence, young join postnesting flocks containing adults and young, where they probably remain through the nonbreeding period (Linsdale 1957).

DEMOGRAPHY AND POPULATIONS

MEASURES OF BREEDING ACTIVITY

Age at first breeding; intervals between breeding. Assumed to breed during second calendar year of life and annually thereafter. No data.

Clutch. Clutch size 3–6 eggs, mean = 4.86 ($n = 21$ sets from California; WFVZ nest records).

Annual and lifetime reproductive success. No data.

Number of broods normally reared per season. Double-brooding undocumented; active nests in late Jun and Jul suggest a second attempt and not a replacement clutch (Roberson and Tenney 1993).

Proportion of total females that rear at least one brood to nest-leaving or independence. No data.

LIFE SPAN AND SURVIVORSHIP

No data; its status as uncommon and its lack of regional philopatry combine to make such information more elusive for this species than for most.

DISEASE AND BODY PARASITES

Diseases. No data. Goldfinches are known to get avian pox (Stone and Granados 1985), but disease not specifically documented in this species.

Body parasites. None documented.

CAUSES OF MORTALITY

Exposure. No data; small body size makes it vulnerable. However, the species generally winters where the temperature rarely drops below 0°C.

Predation. Possibly the most significant cause of mortality, but extent or frequency unknown. See Behavior: predation, above.

Competition with other species. Lesser Goldfinch sometimes displaces Lawrence's from food in the wild and in captivity (Coutlee 1968b). Lesser Goldfinch apparently also competes with Lawrence's for nest sites (Coutlee 1968a).

RANGE

Initial dispersal from natal site. No data. Young join flocks shortly after independence; flocks typically disperse soon after formation (Linsdale 1957).

Fidelity to breeding site and winter home range. Not studied; the species is an itinerant breeder and winterer with little apparent fidelity to formerly used sites. However, breeding sites that consistently provide favored seed plants and a permanent water source may attract the species annually; whether these are birds that fledged here or nested here previously is unknown. Of 40 birds banded during a 7-yr period (1990–1996) at 8 sites in central and s. California, none were recaptured (data from Monitoring Avian Productivity and Survivorship [MAPS] stations, Institute for Bird Populations). At the Sedgwick Reserve in Santa Barbara Co., CA, 47 birds were captured in 1997, 0 in 1998, and 5

in 1999; none were recaptured (M. Reynolds pers. comm.).

Dispersal from breeding site or colony. Disperses widely outside breeding and wintering ranges along the immediate coast; in the Central Valley; through the Mojave and Colorado Deserts and the Great Basin; and upslope in the Sierra Nevada Mtns. of California. Of 703 birds banded in North America (1955–1997), only 1 ever recovered away from original banding location—a hatch-year male banded and released in s. California (Orange Co.) Sep 1972, collected in Baja California, Mexico Jun 1973; specific locality not reported (Bird Banding Laboratory data).

Home range. No information. Probably depends on richness of food supply and proximity to water sources. In central California, Linsdale (1957) noted the species' preference for nest sites that are within 0.4–0.8 km of main feeding areas.

POPULATION STATUS

Numbers. Tremendous year-to-year variability in numbers at any particular site confounds significance of density estimates. In both grazed and ungrazed oak-pine woodland, 2 pairs/30 ha reported during breeding season in Madera Co., CA (Maynard 1989 and Milne 1989, respectively). For a cottonwood-willow riparian forest and a cottonwood-willow woodland (i.e., an open stand), 6.1 birds/ha and 1.8 birds/ha estimated respectively during the breeding season in Kern Co., CA (Fleshman and Kaufman 1983). Breeding population in Monterey Co., CA, estimated at 2,000–5,000 pairs (Roberson and Tenney 1993). Loosely extrapolating from this estimate, the species' entire population may be <200,000 individuals (JND).

Probably most abundant in central part of range, in sw. California (Santa Barbara to San Diego Cos.). Highest Breeding Bird Survey (BBS) numbers (mean = 10.6/yr) from a route in Santa Barbara Co., CA (Price et al. 1995). In the California Coast Ranges, always more numerous in inland valleys and foothills than on immediate coast (Unitt 1984, Roberson 1985, Burridge 1995).

Highest mean abundance on Christmas Bird Counts (of 10 sites reporting the species in 5 or more years) from se. Arizona near Tucson (Root 1988).

Trends. BBS data 1966–1993 show a downward, but statistically insignificant, population trend (Price et al. 1995). Johnson and Cicero (1985) reported a substantial increase in the population on San Benito Mtn. in central California over a period of 40–50 yr. This assessment was based on a comparison of their survey results with those of other researchers there in 1936 and 1944. However, the nomadic breeding habits of this species make the apparent trend equivocal.

Linsdale (1950) reported that populations on the nesting grounds in Monterey Co., CA, were highest when fiddleneck populations were highest and

declined when fiddleneck patches decreased. Roberson (1985) noted an apparent increase in numbers after extensive chaparral fires in Monterey Co., CA, presumably as a result of an increase in favored seed plants.

Probably more numerous and widespread in coastal Santa Cruz Co., CA prior to early twentieth century, when there was more grassland and scrubland (D. Suddjian pers. comm.). Early accounts support this hypothesis (e.g., Cooper 1870), although there is little evidence to work with.

POPULATION REGULATION

Few data; no studies. Availability of water, important seed plants, and winter temperatures and rainfall are likely to be the most significant factors affecting populations, especially given the species' presumably short life span and restricted diet.

CONSERVATION AND MANAGEMENT

EFFECTS OF HUMAN ACTIVITY

Has probably benefited from nonintensive agriculture, grazing, and general disturbance to native landscape. These activities have tended to result in an increase in Lawrence's food plants, which has positively influenced the species' numbers and range (Lindsdale 1950). Plantings of cypress and other dense-foliaged trees or shrubs are sometimes used for nesting.

Degradation of habitat. Habitat alteration (e.g., overgrazing, grading, and fire) that increases the number of annual seed plants can favor the species (Lindsdale 1950).

Disturbance at nest and roost sites. Disturbance believed to have caused nest abandonment (NRP data), but like most small passerines, they tolerate close approach and may not flush from nest until within a meter or so.

MANAGEMENT

Because of relatively small overall population size, could be vulnerable to loss of oak woodland and chaparral habitats; stabilization of roadside habitats and loss of disturbance regime (i.e., grazing, agriculture, and fire) could have a negative impact. Could also be vulnerable to herbicides; no data.

APPEARANCE

MOLTS AND PLUMAGES

Figure 6. Descriptions based on specimens at the Museum of Vertebrate Zoology, University of California, Berkeley, except where noted. *Italicized color names are from Smithe 1975–1981.*

Hatchlings. Down well developed only on spinal tract; head and remainder of body are bare (Linsdale 1957).

Juvenal plumage. Juvenal plumage recognizable by day 8 posthatching, but feathers still growing (Linsdale 1957).

Crown to back *olive brown*, sometimes very faintly streaked; rump and uppertail-coverts *tawny olive*; tail blackish brown (*Vandyke brown*), usually with small subterminal white patch on inner webs of outer 2 rectrices; wing-coverts and tertials dark brown (*sepia*), broadly edged (outer webs and tips) *buff to warm buff*; primaries and secondaries *dark grayish brown*, edged (outer webs) bright yellow (*spectrum yellow*); tertials broadly edged (outer webs) *whitish*; chin, throat, breast, belly, sides, flanks, and undertail-coverts mostly *drab gray* with blurred *olive-brown* streaks; center of breast sometimes shows light *spectrum yellow* wash. Sexes similar.

Basic I plumage. Prebasic I molt is partial to incomplete; occurs primarily on the summer grounds (Aug–Oct); usually includes all body-feathers, all median-coverts, the greater-coverts, 0 to all 12 rectrices, and sometimes 1–3 tertials; occasionally also includes distal 2–6 primaries and proximal 2–5 secondaries (see Pyle 1997).

MALE. Center of throat, chin, lores, forehead, and crown mostly *jet black*; otherwise similar to female but yellow more extensive on breast, wing-coverts, and rump. Rectrices, if new, are like those of Definitive Alternate Plumage; see below.

FEMALE. Similar to Juvenal plumage but without streaks; underparts mostly *drab gray* to *pale pinkish buff*; center of belly and undertail-coverts white; breast with more distinct yellow wash; greater and all median wing-coverts broadly edged on outer web with *spectrum yellow*, contrasting with duller primary-coverts; rump also *spectrum yellow*.

Alternate I plumage. Prealternate I molt partial (Mar–Apr); usually includes all body-feathers, a few to no greater wing-coverts, and sometimes 1–3 tertials (see Pyle 1997).

MALE. Similar to Basic I plumage but appearing crisper overall; uppertail-coverts, back, scapulars, nape, auriculars, sides of throat and breast, flanks, and edges of tertials (if new) *glaucous*; back infused with *spectrum yellow*; center of throat, chin, lores, forehead, and crown entirely *jet black*.

FEMALE. Similar to Basic I plumage but appearing crisper overall; breast and rump with more yellow; tertials, if new, broadly edged *glaucous*.

Definitive Basic plumage. Definitive Prebasic molt is a complete molt of all body and flight feathers; occurs Jul–Oct, mostly on summer grounds (Pyle 1997).

MALE. Resembles Definitive Alternate plumage (see below), but less bright overall; *spectrum yellow* infusion on back is duller, more brown, and extends to nape and lower back; greater wing-coverts with more yellow at bases, making separation of upper and lower wing bars less distinct.

FEMALE. Resembles Definitive Alternate plumage, but crown to back more uniformly brown; sides and flanks *pale pinkish buff*; and yellow breast patch smaller and duller.

Definitive Alternate plumage. Definitive Prealternate molt similar in extent to Prealternate I molt (see above; Pyle 1997).

MALE. Almost identical to Alternate I plumage, but tail and tertials always with adult features; primary-coverts not contrasting in shape and wear with other wing-coverts.

Center of throat, chin, lores, forehead, and crown entirely *jet black*; nape, auriculars, lower back, uppertail-coverts, sides of throat and breast, flanks, and belly *glaucous*; rump and center of breast and sometimes upper belly *spectrum yellow*; upper back infused with *spectrum yellow*; undertail-coverts white; tail blackish brown (*Vandyke brown*) with large white patches on inner webs of all but central pair of rectrices (patches not reaching tip of tail); patch on third rectrix usually smaller than others; tips of rectrices truncate, not tapered as with Juvenal tail; all rectrices finely edged *glaucous*; lesser and median wing-coverts *spectrum yellow* with indistinct *dark grayish brown* bases, forming a broad upper wing bar; greater-coverts *dark grayish brown*, broadly tipped *spectrum yellow*, forming an even broader lower wing-bar (innermost greater-coverts sometimes tipped *glaucous*); primary-coverts, alula, and remiges *dark grayish brown*; inner primaries and all secondaries broadly edged *spectrum yellow* at base, forming a distinct yellow panel on closed wing; tips of all remiges finely edged *glaucous*; tertials *dark grayish brown*, broadly edged *spectrum yellow* and broadly tipped *glaucous*.

FEMALE. Almost identical to Alternate I plumage; exceptions as with male (above).

Resembles male (see above) but lacks black on head; crown to back is *olive brown*; rump and uppertail-coverts are *tawny olive*; sides and flanks *drab gray*; yellow patch on breast is smaller and less bright; inner greater-coverts more broadly tipped *glaucous*; usually only outer 2 rectrices with medium-sized white patch on inner webs; sometimes fourth rectrix also with slight to moderate patch.

BARE PARTS

Color change with age or differences between sexes unknown, or at least undocumented.

Bill and gape. Bill *flesh color*.

Iris. *Dusky brown*.

Legs and feet. *Vinaceous pink*.

SKULL OSSIFICATION

Completed mid-Sep to Feb of first fall–winter of life (Pyle 1997). Similarity in appearance of ossified and unossified areas can make determination of age based on degree of ossification hard to evaluate.

Table 2. Linear measurements (mm)¹ and mass (g)² of Lawrence's Goldfinches. Data shown as mean \pm SD (range, *n*). For definitions of linear measurements, see Pyle 1997.

	Female	Male
Culmen	6.6 \pm 0.3 (5.9–7.2, 30)	6.7 \pm 0.3 (6.1–7.2, 30)
Exposed culmen ³	8.0 \pm 0.4 (7.2–9.1, 30)	8.3 \pm 0.4 (7.5–9.0, 30)
Bill width ³	4.2 \pm 0.3 (3.3–4.7, 30)	4.4 \pm 0.3 (4.0–5.2, 30)
Bill depth ³	5.5 \pm 0.3 (4.8–6.3, 30)	5.8 \pm 0.4 (5.2–6.5, 30)
Wing-chord ³	65.0 \pm 1.5 (62.0–68.6, 30)	67.2 \pm 1.7 (63.7–71.5, 30)
Tail ³	44.7 \pm 2.4 (37.3–50.0, 30)	46.3 \pm 2.2 (42.9–53.2, 30)
Tarsus ³	13.2 \pm 0.9 (11.4–15.2, 30)	13.6 \pm 0.7 (11.8–15.1, 30)
Mass	10.2 \pm 0.9 (8.5–12.0, 25)	10.1 \pm 0.7 (8.8–11.5, 29)

¹From study skins in the Museum of Vertebrate Zoology, University of California, Berkeley.
²From live birds captured May–Jun at the Sedgwick Reserve, Santa Barbara Co., CA, University of California, Santa Barbara.
³Females and males differ significantly ($p < 0.05$, two-tailed *t*-test)

MEASUREMENTS

LINEAR

Table 2. From Ridgway 1901, in mm, presented as mean (range, *n*). For females: wing, 65.5 (63.0–67.1, 4); tail, 44.7 (42.2–47.5, 4); exposed culmen, 8.1 (7.9–8.9, 4); bill depth, 6.6 (6.1–7.1, 4); tarsus, 13.0 (12.7–13.7, 4); middle toe, 10.2 (9.7–10.4, 4). For males: wing, 68.1 (66.3–70.1, 7); tail, 47.5 (46.0–50.8, 7); exposed culmen, 8.1 (7.9–8.4, 7); bill depth, 7.1 (6.9–7.1, 7); tarsus, 13.0 (12.7–13.2, 7); middle toe, 10.4 (10.2–10.9, 7).

MASS

Table 2. From Dunning 1993, in g, presented as mean \pm SD (range, *n*): females, 11.3 \pm 1.03 (9.8–14.3, 30); males, 10.6 \pm 0.85 (8.8–12.5, 33). Apparently larger mass of females may be due to measurement during egg-laying period; males of other cardueline finches are heavier than females (e.g., see Middleton 1993, Watt and Willoughby 1999). However, a few documented weights of birds during winter suggest the difference may not be season-specific (e.g., Coutlee 1968b).

OTHER

In central coastal California, nesting by all four temperate-breeding North American *Carduelis* species reported from a few sites ≤ 1 km² in area (Santa Cruz and Monterey Cos.; D. Suddjian pers. comm., D. Roberson pers. comm.). Considered 1 of 6 species endemic to the California bioregion (Stattersfield et al. 1998).

PRIORITIES FOR FUTURE RESEARCH

Although this species has been the subject of long-term observational studies in the field and of shorter-

duration studies in the laboratory, many aspects of its biology remain unknown. Nothing is known, for example, about its population dynamics and demographics, including reproductive success, number of broods per year, longevity, and survivorship. Experimental studies on vocal learning are needed to determine which song elements (e.g., rhythm and frequency?) are learned by imitation of conspecifics and which elements (e.g., syllabic structure and syntax?) are learned by imitation of other species. There is still much to be learned about its migration routes and wintering areas. While availability of seed crops and standing water is probably influential, little is known about the determinants of eastward irruptions. In winters when the species seems to vacate its breeding grounds without appearing in other parts of the United States, where does it go? Although a fair number of naturalists visit Baja California during winter, fewer make it to Sonora and Chihuahua, where the bulk of the population may winter.

ACKNOWLEDGMENTS

For providing information on the status and distribution of "Larry's" Goldfinch, I thank David Fix (nw. California), Bruce Deuel (n. California), Betty Burrige (Sonoma Co., CA), Brian Williams (n. Sierra Nevada), Robin Leong (Napa and Solano Cos., CA), Douglas Long (California Academy of Sciences), William Bousman (Santa Clara Co., CA), David Suddjian (Santa Cruz Co., CA), Doug Drynan (central Sierra Nevada), Lee Jones (Channel Is., CA), Tom and Jo Heindel (Inyo Co., CA), Matt Heindel (Kern Co., CA), Sylvia Gallagher (Orange Co., CA), Bob McKernan (Riverside Co., CA), Paul Lehman (California), Steven Lima (Arizona), Troy Corman (Arizona), Joe

Gryzbowski (Oklahoma), and Van Remsen (Louisiana). Sam Sumida and Lloyd Kiff provided nest records and egg measurements from the Western Foundation of Vertebrate Zoology, Jim Lowe of the Cornell Laboratory of Ornithology provided information from the Bird Population Studies Nest Record Program, Mark Reynolds and Mike Thibideau provided banding records from the Sedgwick Reserve (Santa Barbara Co., CA), Kathy Klimkiewicz provided banding records from the Bird Banding Laboratory, Phil Nott (Institute for Bird Populations, Pt. Reyes Station, CA) provided banding records from MAPS stations, Carla Cicero provided access to collections at the Museum of Vertebrate Zoology (University of California, Berkeley), and Sandra Gaunt and staff of the Borror Lab of Bioacoustics at Ohio State University prepared the sonograms. I am grateful to Brian Williams for doing much of the literature research and assisting with morphometric data collection. The account benefited from reviews by Alan Poole, Don Roberson, Keith Russell, David Suddjian, and Doris Watt. Cover photo of an after-hatch-year male © Brian E. Small; photographed at Mt. Pinos, CA, Jul 1994.

REFERENCES

- Alcorn, J. R. 1988. The birds of Nevada. Fairview Publ., Fallon, NV.
- American Ornithologists' Union. 1998. Check-list of North American birds. 7th ed. Am. Ornithol. Union, Washington, D.C.
- Bailey, S. F., D. S. Singer, and D. Yee. 1996. Middle Pacific coast region. Field Notes 50: 330.
- Beedy, E. C., and S. L. Granholm. 1985. Discovering Sierran birds. Yosemite Nat. Hist. Assoc. and Sequoia Nat. Hist. Assoc., CA.
- Burridge, B. 1995. Sonoma County breeding bird atlas. Madrone Audubon Society, Santa Rosa, CA.
- Cabe, P. R. 1993. European Starling (*Sturnus vulgaris*). In The birds of North America, no. 48 (A. Poole and F. Gill, eds.). Acad. Nat. Sci., Philadelphia, PA, and Am. Ornithol. Union, Washington, D.C.
- Cassin, J. 1850. *Carduelis lawrencei*. Proc. Acad. Nat. Sci. Phila. 5: 105.
- Cooper, J. G. 1870. Ornithology. In Geologic survey of California. Vol. 1: Land birds (S. F. Baird, ed.). Cambridge Univ. Press, Cambridge, U.K.
- Coutlee, E. L. 1968a. Comparative breeding behavior of Lesser and Lawrence's goldfinches. Condor 70: 228-242.
- Coutlee, E. L. 1968b. Maintenance behavior of Lesser and Lawrence's goldfinches. Condor 70: 378-384.
- Coutlee, E. L. 1971. Vocalizations in the genus *Spinus*. Anim. Behav. 19: 556-565.
- Culbertson, A. E. 1946. Lawrence Goldfinches feed on jumping galls. Condor 48: 40.
- Dawson, W. L. 1923. The birds of California. Vol. 1. South Moulton Co., Los Angeles, CA.
- Dunn, L. 1985. Lawrence's Goldfinches in Beaver County, Oklahoma. Bull. Okla. Ornithol. Soc. 18: 24.
- Dunning, J. B., Jr. 1993. CRC handbook of avian body masses. CRC Press, Inc. Boca Raton, FL.
- Fleishman, C., and D. S. Kaufman. 1983. South Fork Kern River Wildlife Area: effects of reservoir inundation. Spec. Pap. no. 3, Environ. Field Prog., Univ. of California, Santa Cruz.
- Gaines, D. 1992. Birds of Yosemite and the East Slope. Artemisia Press, Lee Vining, CA.
- Gander, F. F. 1930. Notes on winter bird roosts. Condor 32: 64.
- Garrett, K., and J. Dunn. 1981. Birds of southern California: status and distribution. Artisan Press, Los Angeles, CA.
- Gilligan, J., M. Smith, D. Rogers, and A. Contreras, eds. 1994. Birds of Oregon: status and distribution. Cincus Publ., McMinnville, OR.
- Grinnell, J., and A. H. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna no. 27, Cooper Ornithol. Club, Berkeley, CA.
- Hanna, W. C. 1924. Weights of about three thousand eggs. Condor 26: 146-153.
- Harris, S. W. 1996. Northwestern California birds. Humboldt State Univ. Press, Arcata, CA.
- Hoffman, R. 1927. Birds of the Pacific states. Houghton Mifflin Co., Boston, MA.
- Howell, S. N. G., and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford Univ. Press, New York.
- Hubbard, J. P. 1978. Revised checklist of the birds of New Mexico. New Mexico Ornithol. Soc. Publ. no. 6, Albuquerque.
- Johnson, N. K., and C. Cicero. 1985. The breeding avifauna of San Benito Mountain, California: evidence for change over one-half century. West. Birds 16: 1-23.
- Kaufman, K. 1993. Notes on goldfinch identification. Am. Birds 47: 159-162.
- Kaufman, K., J. P. Hubbard, and J. Witzeman. 1980. Southwest region. Am. Birds 34: 918-920.
- Kingery, H. E. 1994. Mountain west region. Field Notes 48: 324.
- Lasley, G. W., C. Sexton, W. Sekula, and M. Lockwood. 1997a. Texas region. Field Notes 51: 772.
- Lasley, G. W., C. Sexton, W. Sekula, M. Lockwood, and C. Shackelford. 1997b. Texas region. Field Notes 51: 896.
- Ligon, J. S. 1961. New Mexico birds and where to find them. Univ. of New Mexico Press, Albuquerque.
- Linsdale, J. M. 1950. Observations on the Lawrence's Goldfinch. Condor 52: 255-259.
- Linsdale, J. M. 1957. Goldfinches on the Hastings Natural History Reservation. Am. Midl. Nat. 57: 1-119.
- Linsdale, J. M. 1968. Lawrence's Goldfinch. Pp. 486-496 in Life history of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies (O. L. Austin, Jr., ed.) U.S. Nat. Mus. Bull. 237.
- Marten, J. A., and N. K. Johnson. 1986. Genetic relationships of North American cardueline finches. Condor 88: 409-420.
- Martin, A. C., H. S. Zim, and A. L. Nelson. 1951. American wildlife and plants: a guide to wildlife food habits. Dover Publ., Inc., New York.
- Maynard, W. R. 1989. Breeding bird census: ungrazed oak-pine woodland. J. Field Ornithol. (Suppl.) 60: 34-35.
- McCaskey, G. 1996. Southern Pacific coast region. Field Notes 50: 998.
- Middleton, A. L. A. 1993. American Goldfinch (*Carduelis tristis*). In The birds of North America, no. 80 (A. Poole and F. Gill, eds.). Acad. Nat. Sci., Philadelphia, PA, and Am. Ornithol. Union, Washington, D.C.
- Miller, A. H., and R. C. Stebbins. 1964. The lives of desert animals in Joshua Tree National Monument. Univ. of California Press, Berkeley.
- Milne, K. A. 1989. Breeding bird census: grazed oak-pine woodland. J. Field Ornithol. (Suppl.) 60: 35-36.
- Monson, G., and A. R. Phillips. 1981. Annotated checklist of the birds of Arizona. 2nd ed. Univ. of Arizona Press, Tucson.
- Oberholser, H. C. 1974. The bird life of Texas. Vol. 2. Univ. of Texas Press, Austin.
- Ortega, J. L. 1945. Lawrence Goldfinch eating egg of Mourning Dove. Condor 47: 41.
- Peterson, J. G. 1942. Salt feeding habits of the House Finch. Condor 44: 73.
- Phillips, A. R., J. T. Marshall, and G. Monson. 1964. The birds of Arizona. Univ. of Arizona Press, Tucson.
- Price, J., S. Droege, and A. Price. 1995. The summer atlas of North American birds. Academic Press, San Diego, CA.
- Pyle, P. 1997. Identification guide to North American birds. Part I. Columbidae to Ploceidae. Slate Creek Press, Bolinas, CA.
- Pyle, P., and R. P. Henderson. 1991. The birds of Southeast Farallon Island: occurrence and seasonal distribution of migratory species. West. Birds 22: 41-84.
- Remsen, J. V., Jr., K. Garrett, and R. A. Erickson. 1982. Vocal copying in Lawrence's and Lesser goldfinches. West. Birds 13: 29-33.
- Ridgway, R. 1901. The birds of Middle and North America. Part I. Bull. U.S. Nat. Mus. 50 (1): 1-715.
- Roberson, D. 1985. Monterey birds. Monterey Peninsula Audubon Soc., Carmel, CA.
- Roberson, D., and C. Tenney. 1993. Atlas of the breeding birds of Monterey County. Monterey Peninsula Audubon Soc., Pacific Grove, CA.
- Root, T. 1988. Atlas of wintering North American birds: an analysis of Christmas Bird Count data. Univ. of Chicago Press, Chicago, IL.
- Rosenberg, K. V., J. P. Hubbard, and G. H. Rosenberg. 1980. Southwest region. Am. Birds 34: 803-806.
- Rosenberg, K. V., R. D. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the Lower Colorado River Valley. Univ. of Arizona Press, Tucson.
- Russell, S. M., and G. Monson. 1998. The birds of Sonora. Univ. of Arizona Press, Tucson.
- Senar, J. C., M. Camerino, J. L. Copete, and N. B. Metcalfe. 1993. Variation in black bib of the Eurasian Siskin (*Carduelis spinus*) and its role as a reliable badge of dominance. Auk 110: 924-927.
- Sibley, C. 1939. Fossil fringillids from Rancho La Brea. Condor 41: 126-127.
- Small, A. 1994. California Birds: their status and distribution. Ibis Publ. Co., Vista, CA.

- Smithe, F. B. 1975-1981. Naturalist's color guide. 3 parts. Am. Mus. Nat. Hist., New York.
- Stattersfield, A. J., M. J. Crosby, A. J. Long, and D. C. Wege. 1998. Endemic bird areas of the world: priorities for biodiversity conservation. BirdLife International, Cambridge, U.K.
- Stejskal, D., and G. H. Rosenberg. 1993. Southwest region. Am. Birds 47: 286.
- Stone, B., and D. G. Granados. 1985. Rehabilitation notes: North American goldfinches. Int. Wildl. Rehab. Council J., Fall 1985.
- Texas Ornithological Society. 1995. Checklist of the birds of Texas. 3rd ed. Capital Printing, Inc., Austin, TX.
- Tweit, B., and G. Lillie. 1997. Oregon-Washington region. Field Notes 51: 921.
- Unitt, P. 1984. The birds of San Diego County. San Diego Nat. Hist. Soc., San Diego, CA.
- Watt, D. J., and E. J. Willoughby. 1999. Lesser Goldfinch (*Carduelis psaltria*). In The birds of North America, no. 392 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Williams, S. O. III, 1997a. New Mexico. Field Notes 51: 784.
- Williams, S. O. III, 1997b. New Mexico region. Field Notes 51: 910.
- Woods, R. S. 1925. Goldfinches' manner of drinking. Condor 27: 71.
- Yee, D. G., D. Fix, and S. F. Bailey. 1994. Middle Pacific coast region. Field Notes 48: 987.

Appendix. Known food plants of the Lawrence's Goldfinch, by season, listed in order of probable importance. Data from Marten et al. 1951 (California and Arizona), Linsdale 1957 (California), Miller and Stebbins 1964 (Joshua Tree National Monument, CA), Rosenberg et al. 1991 (Lower Colorado River valley), and JND (California). See Diet: major food items.

Common name	Scientific name	Family
Spring:		
Common fiddleneck	<i>Amsinckia menziesii</i> var. <i>intermedia</i>	Boraginaceae
Fiddlenecks	<i>Amsinckia</i> spp.	Boraginaceae
Popcorn flower	<i>Plagiobothrys nothofulvus</i>	Boraginaceae
Pigweeds	<i>Amaranthus</i> spp.	Amaranthaceae
Common peppergrass	<i>Lepidium nitidum</i>	Cruciferae
Shepherd's purse	<i>Capsella bursa-pastoris</i>	Cruciferae
Summer:		
Common fiddleneck	<i>Amsinckia menziesii</i> var. <i>intermedia</i>	Boraginaceae
Fiddlenecks	<i>Amsinckia</i> spp.	Boraginaceae
Cryptantha	<i>Cryptantha muricata</i>	Boraginaceae
Pigweeds	<i>Amaranthus</i> spp.	Amaranthaceae
Chamise	<i>Adenostoma fasciculatum</i>	Rosaceae
Coast tarweed	<i>Madia sativa</i>	Compositae
Slender tarweed	<i>Madia gracilis</i>	Compositae
Star-thistles	<i>Centaurea</i> spp.	Compositae
Venus thistle	<i>Cirsium occidentale</i> var. <i>venustum</i>	Compositae
Red maids	<i>Calandrinia ciliata</i>	Portulacaceae
Shepherd's purse	<i>Capsella bursa-pastoris</i>	Cruciferae
Rabbitleaf	<i>Lagophylla ramosissima</i>	Compositae
Red willow	<i>Salix laevigata</i>	Salicaceae
Chard	<i>Beta vulgaris</i>	Chenopodiaceae
Fall:		
Chamise	<i>Adenostoma fasciculatum</i>	Rosaceae
Prostrate amaranth	<i>Amaranthus blitoides</i>	Amaranthaceae
Tumbleweed	<i>Amaranthus albus</i>	Amaranthaceae
Pigweeds	<i>Amaranthus</i> spp.	Amaranthaceae
Star-thistles	<i>Centaurea</i> spp.	Compositae
Russian thistles	<i>Salsola</i> spp.	Chenopodiaceae
Inkweed	<i>Suaeda moquinii</i>	Chenopodiaceae
Red maids	<i>Calandrinia ciliata</i>	Portulacaceae
Vinegarweed	<i>Trichostema lanceolatum</i>	Lamiaceae
Horehound	<i>Marrubium vulgare</i>	Lamiaceae
Oak mistletoe	<i>Phoradendron villosum</i>	Viscaceae
California coffeeberry	<i>Rhamnus californica</i>	Rhamnaceae
Buckbrush	<i>Ceanothus cuneatus</i> var. <i>cuneatus</i>	Rhamnaceae
Jackass clover	<i>Wislizenia refracta</i>	Capparidaceae
Winter:		
Chamise	<i>Adenostoma fasciculatum</i>	Rosaceae
Pigweeds	<i>Amaranthus</i> spp.	Amaranthaceae
Napa thistle	<i>Centaurea melitensis</i>	Asteraceae
Star-thistles	<i>Centaurea</i> spp.	Asteraceae
Russian thistles	<i>Salsola</i> spp.	Chenopodiaceae
Chickweeds	<i>Stellaria</i> spp.	Caryophyllaceae
Knotweeds	<i>Polygonum</i> spp.	Polygonaceae
Canyon clarkia	<i>Clarkia unguiculata</i>	Onagraceae
Blue gum	<i>Eucalyptus globulus</i>	Myrtaceae

The Birds of North America

The Birds of North America series provides comprehensive, authoritative summaries of current knowledge of the breeding bird species of North America. Each of these accounts includes a major bibliography of references as well as unpublished information. Their purpose is to enable informed conservation management of our native birds and to define directions for future research. Accounts are published separately to ensure timely availability of their contents.

The Birds of North America accounts (ISSN 1061-5466) are published by The Birds of North America, Inc., with support from the American Ornithologists' Union, Cornell Laboratory of Ornithology, and the Academy of Natural Sciences. Copyright © 1999 by The Birds of North America, Inc. Printed by Smith-Edwards-Dunlap Company, Philadelphia, PA. All rights reserved.

The Birds of North America is supported by charitable and governmental organizations including: The Office of Migratory Bird Management (USFWS), National Fish and Wildlife Foundation, The McLean Contributionship, The Geraldine R. Dodge Foundation, The Richardson Foundation, and the American Birding Association. Benefactors of this program include Wallace C. Dayton and Joseph and Helen Taylor.

SUBSCRIPTIONS

To subscribe or request more information write:

The Birds of North America
1900 Benjamin Franklin Parkway
Philadelphia, PA 19103-1195
<http://www.birdsofna.org>

ABOUT THE AUTHOR

Jeff N. Davis received a B.S. in wildlife and fisheries biology from the University of California, Davis. He is cofounder and past research director of the Big Sur Ornithology Lab, an avian research station and subsidiary of the Ventana Wilderness Society on the central California coast. He is currently curator of the Museum of Natural History Collections for the Department of Environmental Studies and marine specialist (seabirds and marine mammals) for the Institute of Marine Sciences at the University of California, Santa Cruz. He has a special predilection for the biogeography, natural history, and population dynamics of California birds, and he prepared the BNA account on Hutton's Vireo (No. 189). Current address: Environmental Studies, University of California, Santa Cruz, CA 95064. E-mail: jndavis@cats.ucsc.edu. This is contribution No. 7 of the Big Sur Ornithology Lab.

TRANSACTIONAL REPORTING SERVICE

Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by The Birds of North America, provided that the appropriate fee is paid directly to Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

RECOMMENDED CITATION

Davis, J. N. 1999. Lawrence's Goldfinch (*Carduelis lawrencei*). In The Birds of North America, No. 480 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

OFFICERS

Frank Gill, President
Frederick Sheldon, Treasurer
Patricia Warner, Secretary

DIRECTORS

Kemp Battle
Erica Dunn
John Fitzpatrick
Edward W. Rose
Frederick Sheldon
Dennis Waters
Glen Woolfenden

STAFF

Alan Poole, Editor
Frank Gill, Editor
Patricia Warner, Managing Director
Christine Bush, Managing Editor
Keith Russell, Assistant Editor
Louis Bevier, Assistant Editor
Anne-Marie Hinds, Editorial Assistant
Natasha Atkins, Copy Editor

ASSOCIATE EDITORS

Sheila Conant
William Dawson
Sandra Gaunt
Kenn Kaufman
Don Kroodsmma
Marie Morin

PUBLISHING ASSOCIATES

Kermit Hummel
Henry Reath
Kathy Reid
Nancy Steele

