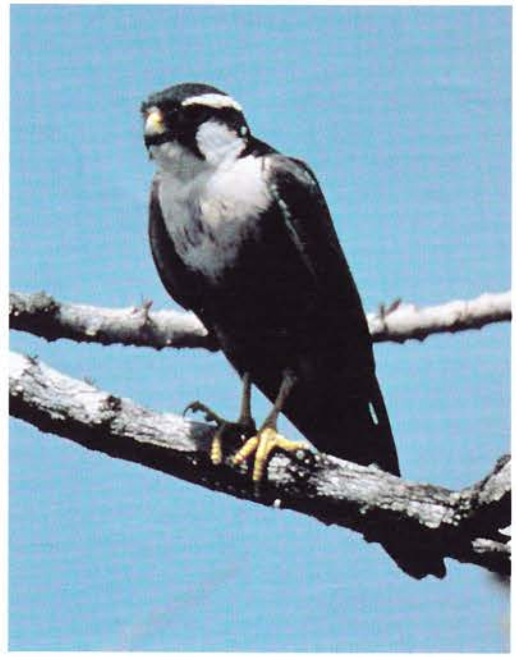
Jim - I greatly enjoyed your article about Aplos - Thought you might find these of interest. Maybe I'll get to fly one of these days! Dean K-H.

Falco femoralis

FRENCH: *Faucon aplomado*
SPANISH: *Halcón alzulado, Perdillero, Halcón fajado*

Aplomado Falcon



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The Aplomado Falcon is a colorful, long-tailed, long-legged falcon that inhabits lowland Neotropical savannas, coastal prairies, and higher-elevation grasslands from the southwestern United States south to Tierra del Fuego. It ranges from sea level to at least 4,000 m in the Altiplano of Peru and Ecuador. Severe eggshell thinning and pesticide contamination in eastern Mexico led to listing of the northern subspecies (*Falco femoralis septentrionalis* Todd 1916) as a federally Endangered species in 1986 (Kiff et al. 1980; Keddy-Hector 1986, 1990).

Proportioned and behaving somewhat like an accipiter hawk, with a tendency to perch on inner branches of trees and chase terrestrial prey on foot, this bird displays great speed in long aerial pursuits of doves and pigeons. Mated pairs remain together year-round and hunt cooperatively. Its diet is mostly birds and insects, but also small mammals and reptiles, and it kleptoparasitizes other birds. Aplomados nest in bromeliads (Bromeliaceae) or abandoned stick platforms of corvids and other raptors.

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

This species currently occurs in Campeche, Chihuahua, Oaxaca, San Luis Potosí, Tabasco, Tamaulipas, Veracruz, and probably other Mexican states. Determination of past and current status and trends in the United States is complicated by inconsistent sampling efforts and ongoing, rapid establishment of captive-reared individuals in Texas and northern Mexico. Reliable specimen records document past nesting activity at 6 general localities in southeastern Arizona, south-central New Mexico, western Texas, and the lower Texas coast.

Figure 1.
Distribution of the Aplomado Falcon in North and Central America. This species has been seen since 1980 north to the dashed line. Stars indicate release sites in the U.S. Its distribution throughout much of Mexico is not well known. This species also breeds in South America. See text for details.

Scattered sightings over the past 50 years suggest continued ephemeral occupancy of the United States and northward dispersal from Mexico.

Loss or degradation of coastal grasslands, desert grasslands, and marshlands and savannas to farmland, overgrazing, and improved pasture has eliminated much native grassland habitat for this species, while also increasing exposure to pesticides. Such habitat loss has been, at least partially, offset by conversion of tropical rain forest, deciduous forest, and thorn scrub to pasture. Evidence of continued contamination of potential falcon prey by organochlorine pesticides, mercury, selenium, and lead, plus heightened risks of organophosphate poisoning, favors intensified efforts to eliminate such environmental contamination from United States and Mexican ecosystems. This, coupled with restoration of desert and coastal grassland and tropical savanna, must become top priorities for long-term conservation of this species.

DISTINGUISHING CHARACTERISTICS

Medium-sized, colorful falcon; total length 38–43 cm (Blake 1977), mass 208–500 g, about the same as Cooper's Hawk (*Accipiter cooperii*) or American Crow (*Corvus brachyrhynchos*). Upperparts slate to bluish gray, head with bold black-and-white-striped facial pattern, underparts tricolored with whitish to buffy upper breast separated from cinnamon belly and under tail-coverts by blackish belly-band that narrows at midbelly. Tail banded black and white. Sexes similar in appearance, but females at least 45% heavier than males (Hector 1988; see Measurements: mass, below). Juveniles more brownish than adults, with whitish areas from head through breast replaced by cinnamon, and breast with bold, dark streaking. In flight, shows dark wing-linings like Peregrine Falcon (*Falco peregrinus*), extensive dark axillaries like Prairie Falcon (*F. mexicanus*), and white trailing edge on wing (Fig. 2). Wing-tips slightly rounded: primary formula 8 > 9 > 7 > 10 = 6 (Baird et al. 1905). Flies swiftly with deep, rapid wing-beats, but also more languid, slow flapping, gliding, or hovering flight.

Prairie Falcon and some immature Peregrines have similar facial patterns, but are not as starkly black and white, and postocular stripes usually do not extend to nape. Aplomado has longer, narrower tail, more rounded wing-tips, much darker ventral and dorsal surfaces, and much narrower wings proximally than Peregrine, Prairie Falcon, or Merlin (*F. columbarius*). Dark belly-band distinctive, but also well-defined in much smaller Bat Falcon (*F. rufigularis*) and more compact Orange-breasted Falcon (*F. deiroleucus*). These falcons lack striped facial patterns. Deep shadow on ventral parts of soaring peregrines and other species sometimes creates illusion of dark belly-band. Flight profile most similar to American Kestrel (*F. sparverius*), but distinguished by differences in tail-markings, facial pattern, and size. Kestrel also hovers more effortlessly and frequently. Merlin has similarly marked tail, but differs in facial pattern, ventral coloration, size, and proportions. Flight style most like Peregrine or Merlin. See Snyder and Snyder 1991, Clark and Wheeler 1995, and Keddy-Hector 1998 for photographs and additional field-identification hints.

Figure 2. Aplomado Falcon in flight, showing dark wing-linings, dark axillaries, and white trailing edge on wing. Photo by the author.

DISTRIBUTION

THE AMERICAS

United States. Figure 1. Scattered post-1950 sightings suggest at least ephemeral occupancy in U.S. (Harris 1964; Webster 1973, 1981; Oberholser 1974; Balch 1975; Hubbard 1978; Witzeman et al. 1979; Hector 1987; Williams and Hubbard 1991; Laguna Atascosa National Wildlife Refuge [NWR] records; W. G. Hunt and K. Riddle pers. comm., L. Meredith field notes).

Best documented post-1980 New Mexico localities include Gray Ranch, Hidalgo Co. (B. Brown pers. comm.); Separ, Grant Co. (N. Snyder pers. comm.); Carlsbad, Eddy Co. (G. Lasley pers. comm.); San Antonio, Socorro Co. (Williams 1993); Animas Valley, Hidalgo Co. (Williams 1994); Hachita, Grant Co. (Williams 1997); and 3 individuals observed in 1999 in Doña Ana and Otero Cos. One individual observed in 1999 had been banded at a nest in n. Mexico (J. Truett pers. comm.). Best documented post-1980 Texas localities include Marfa, Presidio Co. (Lasley and Sexton 1992); Laguna Atascosa NWR, Cameron Co. (J. J. Hickey, A. Henry, and DK-H pers. obs.); and Van Horn, Culberson Co. (Lasley et al. 1997). These sightings coincide with historical collecting localities in s. New Mexico, w. Texas, and coastal Texas. No recent documented occurrences in Arizona. Several successful nesting attempts by captive-reared individuals now documented on Matagorda I. and Cameron Co.

Mexico. Resident in n. Chihuahua (Bailey 1928, Montoya et al. 1997, J. Hubbard pers. comm.), Tamaulipas (N. Snyder pers. comm.), Veracruz, San Luis Potosí, Tabasco, Campeche, and Chiapas (Hector 1988); possibly also Coahuila, Guerrero, Jalisco, Oaxaca, Sinaloa, Sonora, and Yucatán, but little known about current or past status in these states (Friedmann 1950, Goldman 1951, Paynter 1955, Wauer 1977, Galucci 1981, Hector 1983, Howell and Webb 1995). Although reported from Sonora by experienced observers (Wauer 1977, Galucci 1981), occurrence in this state disputed by Russell and Monson (1998). Recent surveys of other parts of the Central Plateau have discovered additional occupied habitat (L. Kiff pers. comm.).

Central America. Resident in coastal savanna and cut-over rain forest of Pacific and Gulf Coasts of Belize (Russell 1964), Guatemala (Salvin and Godman 1897–1904, Baird et al. 1905, Griscom 1932), Honduras (Marcus 1983), Nicaragua (Hellmayr and Conover 1949; Howell 1971, 1972), Costa Rica (Friedmann 1950, Koford et al. 1980), and Panama (Griscom 1927, Wetmore 1965).

South America. Recorded from lowland tropical savanna, chaco, Atacama Desert, altiplano, and temperate grasslands of Colombia (Miller 1947), Venezuela (Cherrie 1916, Wetmore 1939, Mader 1981), French Guiana and Guyana (McElroy 1987), Suriname (Haverschmidt 1968), Trinidad and Tobago (Herklotts 1961, ffrench 1973), Brazil and Bolivia (Mitchell 1957), Paraguay (McElroy 1987), Argentina (Sclater and Hudson 1889, Donazar et al. 1993), Peru (McElroy 1987), Chile (Crawshay 1907, Johnson 1965, Humphrey et al. 1970), and the Falkland Is. (Blake 1977). Possibly resident throughout.

OUTSIDE THE AMERICAS

Not recorded.

HISTORICAL CHANGES

United States. Past status and trends impossible to determine because of inadequate or corrupted specimen records (see below). Described as "fairly common" (H. Benson in Bendire 1892), "frequently" encountered (Strecker 1930), and "not uncommon" (Fisher 1893), but only 26 specimens (eggs and skins) collected from Arizona, New Mexico, and w. Texas in 87 yr (1852–1939; Hector 1983). Twelve of these specimens collected in only 2 yr (1887 and 1924). New Mexico sightings and specimens from 1852 to 1924 limited to 6 skins, 7 observed falcons, and "several nests" discovered in 1908 and 1909 (J. S. Ligon in Bailey 1928). Other nesting records include 5 nests from se. Arizona in 1887 (H. Benson in Bendire 1892); 1 additional nest from s. New Mexico in 1952 (Ligon 1961); and 4 nests from Trans-Pecos, TX, in 1900 (Strecker 1930, Hector 1983). This equates to only slightly over 10 documented nesting attempts in 100 yr (1852–1952) from 5 localities: Ft. Huachuca, AZ; Deming and Jornada del Muerto, NM; and Davis Mtns. and Midland, TX.

Determining past status in coastal Texas complicated by allegations and statistical evidence of falsified data for 92 (80%) of 115 s. Texas egg sets or skins (Hector 1987). F. B. Armstrong and his assistants collected these specimens as part of a commercial collecting business based out of Brownsville, TX, in 1890–1910. Contemporaries of Armstrong alleged that many of his U.S. specimens actually came from Mexico (Hector 1987). Nine other collectors took only 23 egg sets and skins in 68 yr (1881–1949) from s. Texas, so exclusion of Armstrong specimens greatly impacts impressions of past abundance. Various authorities, however, did describe the species as at least locally "common" (Smith 1910) or "not very uncommon" (Merrill 1878), at least at 1 specific locality in s. Texas: Palo Alto Prairie, approximately half-way between Brownsville and Pt. Isabel. Friedmann (1925) and Griscom and Crosby (1925), however, felt the species was "uncommon" in Cameron Co. V. Lehman (pers. comm.) regularly encountered Aplomado Falcon on the King Ranch as late as 1950s. Released captive-reared Aplomados now nest at Palo Alto Prairie, Laguna Atascosa NWR, and on Matagorda I. (see Conservation and management: management, below).

Mexico. As in U.S., former status over most of Mexico difficult to determine because of inadequate specimen records. In n. and w. Mexico (Chihuahua, Coahuila, Guerrero, Jalisco, Oaxaca, and Sinaloa), only 10 individuals collected in 164 yr (1800–1964; Hector 1983). Only one historical nesting record from this region (n. Chihuahua, 1952; J. Hubbard pers. comm.). One individual observed in Durango (Webster and Orr 1952). This shortage of historical records weakens assertions that the species has either declined in this region or that it was a former resident species (e.g., see Howell and Webb 1995). The same restriction applies to Yucatán, where only 2 specimens collected in >100 yr (Paynter 1955).

The situation differs somewhat in e. and se. Mexico (Campeche, San Luis Potosí, Tamaulipas, Veracruz, and Tabasco), where individuals were still regularly encountered from 1977 to 1986 (Hector 1983, 1986b) and 50 egg sets or skins were collected between 1800 and 1964 (Hector 1983)—perhaps many more if e. Mexico is the actual source for Armstrong's turn-of-the-century specimens (see above).

FOSSIL HISTORY

Brodkorb (1964) described a *Rhynchofalco* specimen collected from the Pleistocene of Ecuador and Peru.

SYSTEMATICS

The name *Falco fusco-coerulescens* Vieillot (also spelled *fusco-caerulescens*) widely used for this species in the early 1900s apparently applies to *F. albigularis* Daudin (=*F. rufigularis*), the Bat Falcon (Eisenmann 1966).

GEOGRAPHIC VARIATION; SUBSPECIES

Three weakly differentiated subspecies recognized; based on differences in size and coloration (Hellmayr and Conover 1949, Friedmann 1950, Blake 1977, and Stresemann and Amadon 1979). Only 1 subspecies occurs in the U.S.

F. f. septentrionalis Todd, 1916 Resident sw. U.S. (s. Arizona east to s. Texas) south locally through Mexico; also recorded Guatemala and Nicaragua (Hellmayr and Conover 1949), where considered a straggler from the north (Stresemann and Amadon 1979). Large (based on wing length; see Appendix 1), with extensive and complete black belly-band and light-grayish upperparts (especially noticeable on crown).

F. f. femoralis Temminck, 1822: Resident from e. Panama south through lowland South America east of Andes. Absent from forested portions of Amazonia (R. S. Ridgely pers. comm.) to Tierra del Fuego; accidental to Falkland Is. One record for Belize ascribed to this race by Friedmann 1950 requires verification regarding racial identification and was not mentioned by Stresemann and Amadon (1979). Records from Costa Rica of unknown race but might be nominate *femoralis* based on range. Small (see Appendix 1), with less extensive (sometimes incomplete) black belly-band and less bluish gray upperparts than *septentrionalis*; smaller, paler dorsally, and with less deeply ochraceous-tawny abdominal area than *pichinchae*. Birds from Paraguay south ("*fusco-coerulescens*") similar to those to the north (Brazil, e. Bolivia, Venezuela "*femoralis*"), according to Hellmayr and Conover (1949), even though Swann (1936) divides these.

F. f. pichinchae Chapman, 1925: Resident in temperate zone of Andes from sw. Colombia, Ecuador, Peru, and Chile. Large (similar in size to *septentrionalis*; see Appendix 1), with dark upperparts (duskier, especially noticeable on crown), deep ochraceous-tawny abdominal area; black belly-band comparatively narrow and usually incomplete or nearly incomplete (divided medially).

RELATED SPECIES

Although formerly placed in monotypic subgenus *Rhynchofalco* (given generic rank by some authors, e.g., Oberholser 1974), probably most closely related to Bat Falcon and Orange-breasted Falcon, which share Neotropical distribution with Aplomado Falcon and various similar behaviors, including courtship, vocalization, sun-bathing posture, and certain aspects of morphology (Griffiths 1994, White et al. 1994). Bat and Orange-breasted falcons have been placed in separate subgenera apart from Aplomado Falcon, however, and Orange-breasted has been more closely allied to Peregrine Falcon by some. Griffiths (1994: 135) called Bat and Aplomado falcons "sister taxa."

Genus *Falco* placed in subfamily Falconinae (Tribe Falconini) according to phylogenetic analysis based on molecular (cytochrome *b* gene of mitochondrial DNA) and morphological (syringeal supporting elements) characters (Griffiths 1994).

MIGRATION

Winter (Nov–Feb) specimens and evidence of nesting activity suggest species is resident in sw. U.S. and e. Mexico (Hector 1988). Described as winter resident or vagrant in w. Mexico (A. Grayson in Lawrence 1874), but little known about actual status (see Distribution, above). Resident through most of Central and South America, although possibly withdraws from Patagonia and higher elevations of Andes (4,000 m) during austral winter (Salvin and Godman 1879–1904; Chapman 1925; Wetmore 1926a, 1926b; Swann 1936; Russell 1964; Howell 1971; Blake 1977).

HABITAT

UNITED STATES

Coastal prairies and desert grasslands (Fig. 3) with scattered yuccas (*Yucca torreyi*, *Y. elata*, *Y.*

Figure 3. Mesquite and yucca desert grassland near historical collecting sites of the Aplomado Falcon at Ft. Huachuca, Arizona. Photo by the author.

treculeana) and mesquites (*Prosopis glandulosa;* Bendire 1892, Smith 1910, Strecker 1930, Ligon 1961). Also, oak woodlands and riparian gallery forests in midst of desert grassland (Henshaw 1875, Willard 1910).

MEXICO

From Hector 1988, except as noted. In tropics, seasonally flooded coastal savanna and marshlands, cut-over rain forest, and cleared pastureland and farmland with scattered palms (*Sabal mexicana, Acrocomia mexicana, Scheelia liebmanii*), tropical live oaks (*Quercus oleiodes*), huisaches (*Acacia farnesiana*), crescentias (*Crescentia cujete*), silk cottons (*Ceiba petandra*), monkey-ear trees (*Enterolobium cyclocarpum*), and palo de rosas (*Tabebuia rosea*). Along the Rio Usumacinta in Chiapas, Campeche, and Tabasco, open floodplains with scattered groves of Mexican fan palms (*Sabal mexicana*), sparse woodlands of crescentias grading into extensive marshlands and cut-over rain forest. In mountainous regions of San Luis Potosí and the central coast of Veracruz, rolling terrain with dense, dry upland deciduous forest and riparian woodlands bordering smaller agricultural fields and seasonally burned pastureland. Near coast, frequents tidal flats and beaches.

On Central Plateau, lightly grazed desert grassland with scattered tree yuccas, mesquites, desert willows (*Baccharis thesoides*), condalia (*Condalia ericoides*), and little-leaved sumac (*Rhus microphylla;* Galucci 1981, Montoya et al. 1997). Open pine (*Pinus montezumae*) forest in highlands of Durango and Chiapas (Webster and Orr 1952, Del Toro 1964). Dry tropical deciduous woodlands and coastal shrublands in Sinaloa and Sonora (A. Grayson in Lawrence 1874, Wauer 1977).

SPACING OF VEGETATION

Nesting and hunting areas typically with scattered trees and shrubs or with trees concentrated along margins of streams and marshes. F. Nyc and J. Peterson (Western Foundation of Vertebrate Zoology [WFVZ] egg card) described one 1941 nesting area in Brooks Co. (s. Texas), as "... a clump of trees (2 or 3) [mesquites] every third or half mile apart." In Veracruz, 18 nest sites contained 1–31 trees/ha, with tree heights averaging 7.0–12.7 m (Keddy-Hector 1988). Chihuahuan nest sites contained 11–140 trees/ha, but these estimates include smaller shrubs not measured on the Veracruz study (Montoya et al. 1997). Foraging areas used by released falcons in s. Texas contained 2.6 trees/ha (Perez et al. 1996).

In e. Mexico, occupied nest sites with more vegetation within 0.25 m of the ground than unoccupied sites (n = 18 nest sites; Keddy-Hector 1988). Proliferation of woody vegetation associated with abandonment of specific nesting pastures (Keddy-Hector 1988). Extensive deforestation likely detrimental because many potential prey and species that construct potential falcon nest platforms depend on forest and thorn scrub (see Food habits: diet, below). This possibility supported by great differences in abundances of potential prey in tropical and desert grassland settings: 352 birds (of 81 species) and 235 potential avian prey/40 ha in tropical Mexico (Keddy-Hector 1988). Indeed, ideal habitat is probably open savanna or grassland surrounded by or bordering extensive woodland or wetlands.

FOOD HABITS

FEEDING

Main foods taken. Mostly birds and insects, but also bats, small rodents, and lizards (Hector 1985).

Microhabitat for foraging. See Habitat, above, and Food capture and consumption, below.

Food capture and consumption. Searches for prey from observation posts in trees, while soaring, or while flying at fast pace just above or through dense shrubs and trees (Wetmore 1926a, DK-H). Hunts near watering holes along desert streams (H. McElroy pers. comm.), riparian woodlands, tidal flats, marshlands, and probably also desert playas (Todd and Carriker 1922, Miller 1947, Friedmann and Smith 1955, Wetmore 1965, Humphrey et al. 1970). Sometimes hunts over fallow fields (Lasley et al. 1997). Often hunts well before sunrise and well after sunset (Friedmann and Smith 1955, DK-H). Sometimes enters villages at dusk (or later) to capture insects beneath street lights (G. Falxa, D. Whitacre, D. Ukrain, and H. Flanders pers. comm.). Also hunts near grassfires (Brooks 1933, Hector 1988, Ellis 1992, C. Perez pers. comm.), and feeds on lepidopteran larvae, snakes, lizards, and other animals displaced, killed, or injured by fire (DK-H). Observed flying alongside a train for several kilometers and intermittently and abruptly shifting from one side to the other, perhaps to surprise small birds (Loetscher 1941). Observed following a motorcycle and chasing small birds startled into flight by the machine (Mader 1981).

Highly insectivorous. One pair captured 17 insects in 21 attempts during 2 h of observations (Hector 1980). Sometimes captures insects in short flights after flushing them from the ground. Ascends rapidly from perches to capture more aerial insects or glides slowly from perches to intercept beetles and wasps flying to and from blossoming shrubs (DK-H). At other times, remains aloft and repeatedly captures, eviscerates, and eats small insects without landing.

Aggressively chases birds (Hector 1986a), especially flocks in transit or those surprised at feeding and watering areas. Sometimes approaches flocks of doves head-on without use of camouflage or cover. Hovers above birds trapped within crowns of trees or on the ground, then dives into cover or attacks as the birds take flight. Readily runs after grounded prey.

Mated pairs frequently hunt cooperatively when pursuing avian prey (Cherrie 1916, Wetmore 1926a, Friedmann and Smith 1955, Mader 1981, Hector 1986, McElroy 1987). Cooperative hunting occurred in 66% of 101 attacks of avian prey at 18 territories in e. Mexico, and was more than twice as successful (45%) as solitary hunting of birds (21%; Hector 1986a). Pairs hunting cooperatively also captured larger prey than solitary-hunting males (Hector 1986a). In such hunts, both falcons usually chased the same bird, even when attacking flocks, and adopted somewhat separate roles, with one (usually the male) hovering over hidden prey while the other flushed prey from cover (Hector 1986a). One call (Chip) seemed to instigate participation by the second falcon in cooperative hunts, even to the extent that incubating females left eggs to assist hunting males pursuing prey near nests (Hector 1986a). Trained Aplomado Falcons show similar tendencies by following falconers closely and even caching captured prey, foregoing feeding, then returning to the falconer to continue hunting (Baird et al. 1905, H. McElroy pers. comm.).

When feeding on insects, quickly removes wings, elytra, and other chitinous portions, then eats remainder, or simply removes and eats head and any attached viscera. Kills birds quickly with hard, twisting bites to head and neck. Often decapitates birds and discards heads and mandibles at kill sites. Sometimes removes flight feathers and larger contour feathers on ground, or moves to nearby fence post, lower tree branch, or other convenient low perch. Final depluming occurs on some larger horizontal branch or other stable, often secluded perch. One primary depluming perch was used consistently for many months, and perhaps even year-round (DK-H).

Consumes entire bodies of small birds in relatively few bites. Rapidly consumes pectoral muscles of larger carcasses. May or may not eat digestive tract and associated viscera, which are often simply pulled from the abdominal cavity and discarded.

Mated pairs feed simultaneously from single carcasses, often with female holding carcass in her feet and offering small bits of food to male. May dismember large carcasses into 2 pieces, then feed independently. Females conduct nearly all feedings of dependent young, even those 2–3 wk postfledging. At other times, adults simply drop off deplumed carcasses and small insects and allow nestlings to feed themselves.

Kleptoparasitism. Males and females collaborate in commandeering rodents, crayfish, fish, and other prey from other birds, including White-tailed Kites (*Elanus leucurus*), American Kestrels, Northern Harriers (*Circus cyaneus*), herons, and kingfishers (Hector 1988, Clark et al. 1989, Perez 1995, H. McElroy pers. comm.).

DIET

Major foods items. In U.S. and Mexico, recorded prey include Horned Larks (*Eremophila alpestris*; R. Kellogg in Bailey 1928); Brewer's Sparrow (*Aimophila breweri*; Strecker 1930); Lark Bunting (*Calamospiza melanocorys*), Lark Sparrow (*Chondestes grammacus*), and bats (Chiroptera; Ligon 1961); kangaroo rats (Dipodomys sp.), pocket mice (*Perognathus* sp.), and white-footed mice (*Peromyscus* sp.; Strecker 1930); lizards (Sauria; Bendire 1892); locusts and crickets (Orthoptera), beetles (Coleoptera), dragonflies (Odonata), butterflies (Lepidoptera), and wasps and bees (Hymenoptera; Bendire 1892, Bailey 1928, Brooks 1933). In e. and s. Mexico, captured at least 43 bird species and also bats. Beetles, cicadas (Homoptera), locusts, wasps, mayflies (Ephemeroptera), butterflies, and moths (Lepidoptera) predominated among insect prey (Hector 1985). Also fiddler crabs (*Uca subcylindrica*) in s. Texas (C. Perez pers. comm.).

In Chihuahua, meadowlarks (*Sturnella* sp.), Northern Mockingbird (*Mimus polyglottus*), Common Nighthawk (*Chordeiles minor*), Western Kingbird (*Tyrannus verticalis*), Brown-headed Cowbird (*Molothrus ater*), Mourning Dove (*Zenaida macroura*), Cactus Wren (*Campylorhyncus brunneicapillus*), Pyrrhuloxia (*Cardinalis sinuatus*), Ash-throated Flycatcher (*Myiarchus cinerascens*), Blue Grosbeak (*Guiraca caerulea*), and Canyon Towhee (*Pipilo fuscus*) made up the majority of 87 prey individuals detected in a composite sample of falcon prey remains, observed hunts, and feeding pellets (Montoya et al. 1997). In Chihuahua, also captured Greater Roadrunners (*Geococcyx californianus*), hummingbirds (Trochilidae), Loggerhead Shrike (*Lanius ludovicianus*), Scaled Quail (*Callipepla squamata*), and White-winged Dove (*Zenaida asiatica*).

Jimenez (1993) described the diet in n.-central Chile.

Quantitative analysis. In e. Mexico, Great-tailed Grackles (*Quiscalus mexicanus*; 17%), Mourning Doves (16%), White-winged Dove (10%), Groove-billed Anis (*Crotophaga sulcirostris*; 10%), Yellow-billed Cuckoos (*Coccyzus americanus*; 5%), meadowlarks (4.3%), and Northern Bobwhites (*Colinus virginianus*; 4.5%) contributed over half of dietary biomass (n = 240 prey items; Hector 1985). Insectivorous and omnivorous birds made up most prey individuals and most prey biomass. Birds composed 93.8% of individual prey in prey remains, but only 35% of individual prey in observed prey captures and feedings (Hector 1985). This smaller percentage of birds still accounted for 97.3% of prey biomass. Insects made up most (65%) of 234 observed captures, yet represented <3% of total dietary biomass (Hector 1985). In one sample of prey remains, observed hunts, and feeding pellets collected from 10 territories in Chihuahua, birds accounted for 94.3% and insects only 5.7% of prey individuals (Montoya et al. 1997).

Size of prey. In e. Mexico, birds in prey remains averaged 87.6 g ± 69.5 SD, with 77% of captured birds weighing <100 g. Birds detected in observed captures averaged 67.4 g ± 47.8 (Hector 1985). Avian prey ranged from <8 g (Tropical Parula, *Parula pitiayumi*) to 577 g (Plain Chachalaca, *Ortalis vetula*; Hector 1985) and possibly also Black-bellied Whistling-Ducks (*Dendrocygna autumnalis*), for which Leopold (1972) gives a body mass of 840 g. Montoya et al. (1997) reported prey as small as hummingbirds and as large as Greater Roadrunner. Avian prey in Chilean sample averaged 34.3 g (Jimenez 1993).

FOOD SELECTION AND STORAGE

Slightly less inclined than Bat Falcon to capture swift aerial species like swifts and swallows (Hector 1985), but does frequently capture nighthawks and Common Pauraques (*Nyctidromus albicollis*; Friedmann 1950, Friedmann and Smith 1955, Hector 1985), and at times even hummingbirds (Wetmore 1926b, Montoya et al. 1997). Many, perhaps most, prey attacked when foraging on ground, or in transit through falcon nesting territories while on migration, or in route between roosts, watering areas, nesting areas, and feeding areas.

Caches uneaten bird carcasses on larger horizontal tree branches, smaller clusters of branches, arboreal bromeliads, low shrubs, tufts of grass, palm fronds, old stick nests, and bare ground (DK-H). Transports carcass to cache sites with slow, flapping flight, then walks or hops along branches or ground before stuffing carcass into chosen spot. When feedings interrupted by potential predators, abruptly abandons carcass to attack intruders, then returns later to finish feedings. Aggressively defends cached carcasses and even empty cache sites, with females *kekking* and diving on intruders, and even approaching closely on foot when human observers climb too close to arboreal cache sites (DK-H). Sometimes feeds dependent young from a succession of 2 or 3 cached-prey carcasses during lulls in hunting activity (DK-H).

NUTRITION AND ENERGETICS

Essentially nothing known about nutritional requirements. Peregrine Fund, Inc. and University of California-Santa Cruz facility supplemented normal *Coturnix* quail diet of captive-reared Aplomado Falcons with crickets to mimic a natural diet containing insect prey.

Little known about field metabolic rates, but should be roughly 905 kJ / d / pair (male body mass = 250 g; female body mass = 350 g; Walsberg 1972) or equivalent to 713 1-g insects (at 4.93 kJ / g / d and 70% assimilation efficiency) or only 2 90-g birds (at 6.35 kJ / g / d and 80% assimilation efficiency). Daily energy requirements for a pair provisioning 3 fledglings would then be roughly 2,250 kJ / d, with no allowance for extra energetic costs of harvesting the required 3 or 4 additional birds / d. Field observations of capture rates in e. Mexico roughly match these predicted daily energy expenditures with incubating individuals capturing 2 birds and 13 insects, or 959.3 kJ / d; and individuals feeding nestlings and fledglings capturing 7.2 birds and 12 insects or 3,333.2 kJ / d (DK-H).

METABOLISM AND TEMPERATURE REGULATION

Little known.

DRINKING, PELLET-CASTING, AND DEFECATION

Pellet-casting and defecation often occur early to midmorning in midst of stretching-preening bouts (DK-H).

SOUNDS

VOCALIZATIONS

From DK-H.

Development. Nestlings produce high-pitched, plaintive Chittering (see Vocal array below), sometimes slightly preceding or concurrent with appearance of adult carrying food, or when some time has elapsed since the last meal. Older nestlings also *kek* and Wail. No information available on development of adult sounds.

Little known about timing of appearance of various vocalizations. Tremulous Wail, Chitter, and *kek* occur in nestlings. Wail and Chip probably develop next as young Aplomado Falcons mature and beginning courting prospective mates.

Vocal array. Four distinct 1- to 7-kHz calls, usually with multiple harmonics (Fig. 4). Male calls higher in frequency than female calls. Vocal array similar to those of typical large falcons in terms of sound quality and context (Cramp and Simmons 1980, Cade 1982).

Kek or *ki*. A staccato, *ki-ki-ki-ki-ki-ki-ki-ki* sound, with each note about 0.1 s in duration, and intercall interval of about 0.1 s. *Kek* used nearly exclusively in agonistic contexts such as appearance of potential predators, intrusion by conspecifics, and harassment of Aplomados by other species (see Behavior: social behavior, below). Fourteen-day-old nestlings *kek* when potential predators fly overhead or when handled by humans.

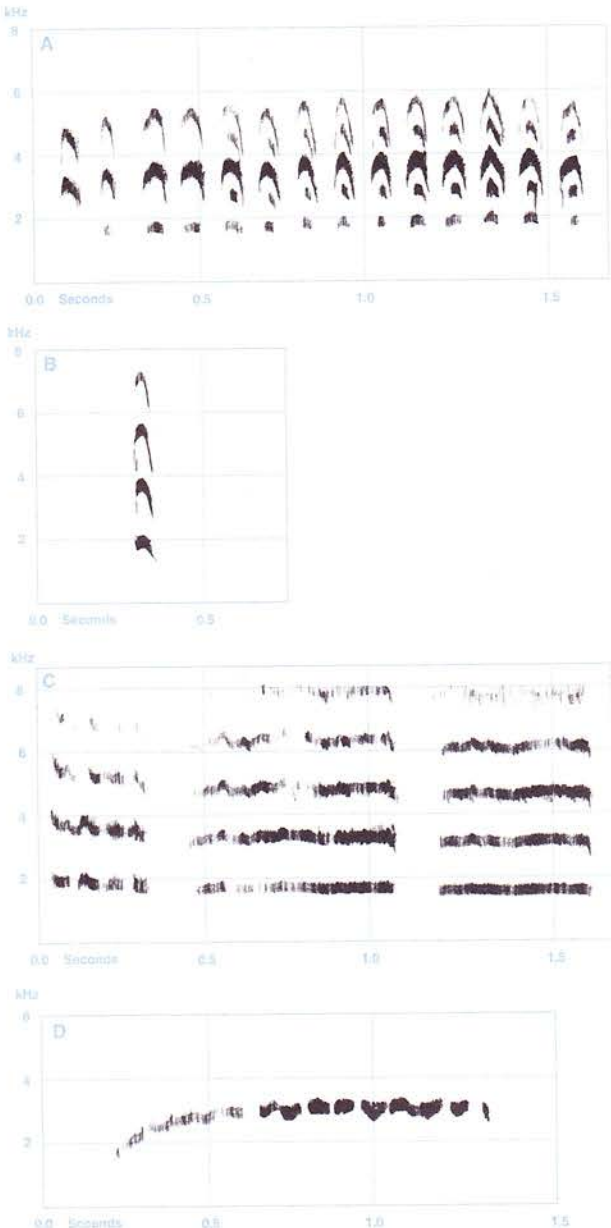

Figure 4. Aplomado Falcon vocalizations. A. *Kek* of adult male. B. *Chip* of adult female. C. *Wail* of adult female. D. *Chitter* of fledgling. Vocalizations recorded in Veracruz, Mexico, Apr–May 1984, by DK-H, using Sennheiser ME88 directional microphone and a Uher 4000 reel-to-reel or Sony TC DSM cassette recorder. Sound spectrograms prepared using Kay Elemetrics DSP 7029A Sona-Graph (wide band setting: 80-80,000 Hz).

Chip. A single sharp note or series of 2 or 3 notes, at irregular intervals, at 0.05 s/note. Chip used in greatest range of contexts: Nest Platform Displays, incubation switches, when depluming prey in presence of second adult, when male presents food to mate, when female feeds mate or dependent young, during cooperative hunts and cooperative nest defense, and when removing food from cache sites with second falcon nearby. Chip seems to coordinate collaborative activities (Hector 1986a).

Wail. Three or 4 notes, 0.2–0.6 s/note, sometimes modulated into tremulous or oscillating warble or tremulous Wail. At nest sites, this call given mostly by female prior to departure of male on solitary hunts or prior to removal of cached food by male. In e. Mexico, adult males began hunting birds on average 16 min (median delay 8 min; range 1–82) after 23 of 31 Wails given by adult females (DK-H). Female also Wails as male returns from successful or unsuccessful hunt. Male gives this call from prospective nesting platforms and prior to copulations.

Chittering. Seven or more notes, each only 0.02–0.03 s/note and internote interval of only about 0.1 s. Adults and older nestlings and fledglings Chitter in feeding interactions and in aerial agonistic encounters. Wails change quickly to Chitters as feeding interactions intensify. Nestlings Chitter during lulls between feedings or during periods of exposure to direct sunlight. Like Wail, nestling Chitters may instigate hunting by adults.

Phenology. *Kek* and Chip used by breeding and nonbreeding falcons. In nonbreeding pairs, use of Chip somewhat restricted to feeding contexts. Unmated adults probably use only *kek*. Wail mostly limited to breeding season.

Daily pattern. Most Wail, Chip, and Chitter in first 6 and last 3 daylight hours. *Kek* least restricted to this pattern since its use depends more on intrusion by other species.

Places of vocalizing. Wail, *kek*, Chip, and Chitter used in a variety of locations: from stationary surveillance posts—including both inner branches of trees and prominent perches near nest platform; while aloft; and from nest platforms, depluming perches, and nest platforms. Males and females Chitter loudly during transfer of prey carcasses. Male and female Chip from edge of nest platform when feeding nestlings or carrying out Nest Platform Displays. Male and female Chip at some distance from each other when initiating attacks on predators and avian prey, and also when carrying carcasses back to nesting territory. Females Chip from nest platform when incubating eggs or brooding nestlings just prior to incubation switches.

Repertoire and delivery of songs/social context and presumed functions. See Vocal array, above.

NONVOCAL SOUNDS

None known with a communicative function.

BEHAVIOR

LOCOMOTION

Walking, hopping, climbing, etc. Extremely agile afoot. Runs swiftly after grounded prey and deftly hops from branch to branch when pursuing prey through trees and shrubs.

Flight. Full-powered flight characterized by deep, rapid wing-beats. Slightly faster than Mourning and White-winged doves in horizontal flight. Executes sharp turns, hovering flight, and other aerobatics while pursuing birds through scattered trees and brush. Continues flapping rapidly even when diving vertically. McElroy (1987) and J. Langford (in McElroy 1987) noted tendency of trained falcons to accelerate rapidly upward from ground to pursue quail and other birds flushed from nearby hiding places. Hovers briefly over trapped prey. Soars readily.

SELF-MAINTENANCE

Preening, head-scratching, stretching, bathing, anting, etc. At nesting territories, spends much of each day preening flight feathers. Uses beak to extract uropygial gland secretions, then pulls each rectrix and remex systematically through bill. In double-wing stretch bows forward with rectrices fanned while abducting both wings dorsally; excrement sometimes then expelled. Double-wing stretch sometimes followed by head-bobbing, then departure and active flight. In single-wing stretch, one wing and leg on same side extended inferiorly, while rectrices fanned toward same side as stretched wing. Sometimes moves to exposed perch during rains, flutters wings, elevates contour feathers, bows forward, and rocks back and forth using the same movements used by other falcons while bathing (DK-H). Also bathes while standing on submerged rocks in shallow pools of larger streams (H. McElroy pers. comm.).

Sleeping, roosting, sunbathing. Early to mid-afternoon, frequently sleeps for brief periods. This especially true of females when males hunt away from the nest. During diurnal sleep, does not tuck head beneath wing. Roosts at night in inner branches of trees. Released individuals in s. Texas roosted in stands of mesquite on margins of more open hunting areas (C. Perez pers. comm.).

Daily time budget. During incubation at 2 nests in e. Mexico, adults spent 85–90% of total observation time ($n = 36.3$ h) perched within 100 m of the nest platform and only 2–7% in flight. During nestling and postfledging phases, males spent 79% of total observation time perched and 11% in flight; while females spent 79% perched and 5% in flight (DK-H). A total of 46% of flying time occurred during the first 3 h of daylight. All types of flying activity declined to a minimum during period 12:00–14:00, then increased again during final 4 h of daylight (DK-H).

AGONISTIC BEHAVIOR

Somewhat less frequently than other falcons, nestlings and fledglings bow or "mantle" over food, with wings draped and tail spread. Ellis 1992 reported talon-locking in an apparent aerial agonistic encounter between a juvenile female and adult male observed at a grassfire in central Venezuela. Also *keks* loudly at the approach of potential predators, especially caracaras (Caracarinae) and Brown Jays (*Cyanocorax morio*), then fly directly at these intruders at high speed, *kekking* in flight, and often striking them and driving them with repeated blows to the ground or nearest tree crown—generally away from Aplomado eggs and young.

SPACING

Territoriality. In e. Mexico, males fly long distances to challenge intruding males, but at other times allow soaring pairs to pass unchallenged over nesting territories (DK-H). Resident adults respond less predictably to intruding females. Male falcons soar above nesting territories and also perch prominently at surveillance posts within 1 km of nesting platforms.

Individual distance. Members of mated pairs spend much of each day perched no more than 100–200 m apart and often perch together in same tree within 1 m of each other.

SEXUAL BEHAVIOR

Mating system and sex ratio. Presumably monogamous, but no data available.

Pair bond. In e. Mexico, nonbreeders travel and feed together within home ranges (DK-H). During courtship, pairs move frequently from perch to perch over a rather large area, at times soaring for 15–20 min, then simultaneously diving to perch together prominently, or abruptly dashing off in cooperative pursuits of small birds. Pairs dive together to prominent perches. Males and females also interrupt soaring flight to chase each other in full-powered flight. At other times, males soar alone above perched females, then intermittently fly upward in flapping flight along a zig-zag path. Sometimes these ascents alternate abruptly with full-powered dives.

During Nest Platform Displays, males fly above or land on potential nest platforms and Chip. These flights often preceded by Wails from both sexes. At other times, female joins male at platform and both Chip and Wail while standing somewhat horizontally and approximately face to face. Males and females sometimes squat in nest cavities, Chip, and pick at sticks with their bills. At this stage, some pairs begin defending platform from potential predators.

Food Transfers. Male carrying bird carcass Chips as he flies toward nesting territory. Female Wails as she flies toward male, then takes the carcass in midair or at a perch. In midair transfers of prey, female sometimes drags male a short distance when male persistently clings to prey carcass. Both birds Chitter during tussles over prey carcasses. At other times, transfers take place with male relinquishing his grasp smoothly. Prior to onset of incubation or during courtship, males sometimes appear with prey, do not relinquish it, but instead hop from branch to branch and make short flights from tree to tree, keeping just out of reach of female (DK-H).

Copulation; Precopulatory Displays. Somewhat concurrently with Nest Platform Displays, male begins terminating solitary soaring flights by descending abruptly to land on female's back and copulating. At other times, male lands near female, then hops or flies a short distance to attempt copulation.

No data on duration of pair bond. Cooperative hunting, cooperative exploration of home ranges, cooperative attacks on other raptors and corvids, mutual feeding on captured prey, and copulations probably serve to maintain pair bonds (DK-H).

Extra-pair copulations. No data.

SOCIAL AND INTERSPECIFIC BEHAVIOR

Degree of sociality. Characteristically occurs in pairs, usually mated pairs. Siblings move together after fledging. Large foraging groups of released Aplomado Falcons in s. Texas likely an artifact of releasing these birds in groups larger than normal brood sizes.

Play. At 2 wk of age, nestlings grab sticks, bones, and other objects. Six- to 8-wk-old fledglings also grab branches and bromeliads. Adults chase each other during courtship period. Adults also perhaps playfully chase larger, possibly atypical, prey such as Black-bellied Whistling Ducks without attempting to capture these animals. Such flights resemble play, but intention of pursuers impossible to determine (DK-H).

Nonpredatory interspecific interactions. From DK-H. Some evidence that Aplomados forcibly take nesting platforms from Brown Jays, White-tailed Kites, and Roadside Hawks (*Buteo magnirostris*); active Aplomado nests found in what appeared to be freshly constructed nests of these other species. Pairs team up to drive Crested Caracaras (*Caracara plancus*), other raptors, and flocks of Brown Jays from vicinities of eggs, young, and perhaps also cache sites (see Predation, below). Also takes prey carcasses from other birds (see Food habits: diet, above). Sometimes interacts aggressively with Bat Falcons (D. Whitacre, G. Falxa, D. Ukrain, H. Flanders pers. comm.).

In e. Mexico, Gray-breasted Martins (*Progne chalybea*), Mangrove Swallows (*Tachycineta albilinea*), Fork-tailed Flycatchers (*Tyrannus savana*), Scissor-tailed Flycatchers (*T. forficatus*), Tropical Kingbirds (*T. melancholicus*), White-tailed Kites, and Roadside Hawks frequently harass adult Aplomados. At times, persistent harassment by flycatchers, swallows, and martins displaces resident falcons to inner branches of trees or more distant perch sites (DK-H).

In e. Mexico, adult Aplomados attacked all corvids and raptors that approached fledglings or nests with eggs or young. In 93 observed encounters, resident Aplomados attacked Crested Caracaras (18%), Turkey Vultures (*Cathartes aura*; 15%), Brown Jays (17%), Roadside Hawk (13%), but also White-tailed Kites, Laughing Falcons (*Herpetotheres cachinnans*), Amazon parrots (*Amazona* spp.), and Montezuma's Oropendolas (*Psarocolius montezuma*; DK-H).

In typical attacks of predators, both adults simultaneously attack intruders. Incubating females leave nest platforms to assist in these attacks. Such attacks very similar to cooperative hunts, with either male or female giving Chip Call at intervals in the midst of loud *kekking* and repeated diving strikes at intruders (see Food habits: feeding, above). Females usually more aggressive toward human intruders. Males more persistent in pursuit of avian intruders fleeing vicinity of nests, with females quickly breaking off pursuit to return to vicinity of nest.

PREDATION

Four of 30 nesting attempts (13%) monitored in e. Mexico showed evidence of predation; e.g., broken eggshells and nestlings disappearing (DK-H). In n. Chihuahua, predators killed two 3-wk-old nestlings at 2 of 7 nests (Montoya et al. 1997). In Cameron Co., TX, predators claimed 9 of 38 captive-reared fledglings (24%) within 2 wk of their release in 1993 and 1994; a Harris's Hawk (*Parabuteo unicinctus*) captured 1 of these fledglings, and a Great Horned Owl (*Bubo virginianus*) pellet contained remains of another (Perez 1995).

BREEDING

PHENOLOGY

In e. Mexico, eggs present mid-Feb–late May (21 May). Most pairs lay mid-Mar–mid-Apr, have nestlings mid-Apr–30 Jun, but some young fledge as late as early Aug (Fig. 5). First part of this period coincides with dry season, just prior to onset of nesting by resident passerine birds, spring migration of Mourning and White-winged doves, songbirds. In n. Chihuahua, Aplomados nest Feb–Jun (Montoya et al. 1997).

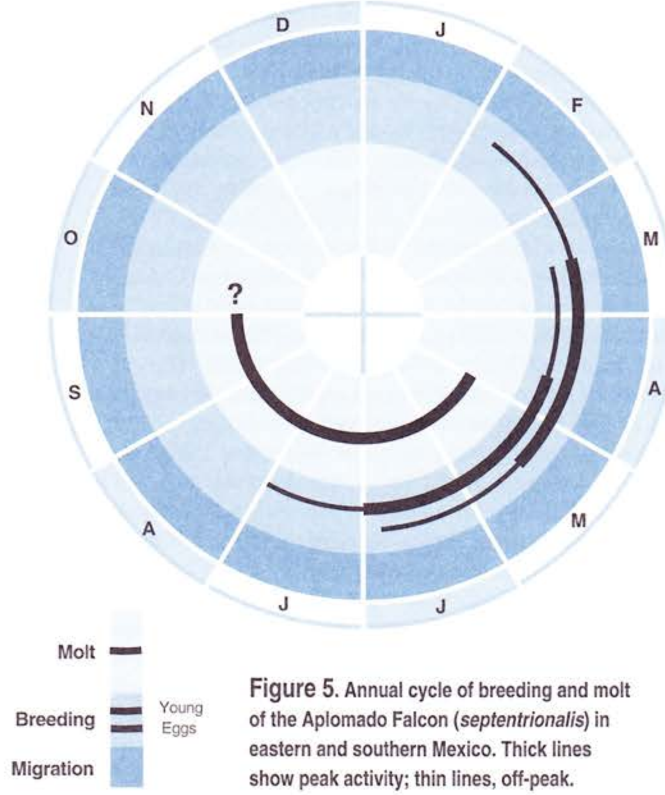

Figure 5. **Annual cycle of breeding and molt of the Aplomado Falcon (*septentrionalis*) in eastern and southern Mexico. Thick lines show peak activity; thin lines, off-peak.**

Some evidence of renewed interest by adults in new nesting platforms as early broods near independence. This suggests that some pairs may attempt to produce >1 brood/yr, but no data on this.

NEST SITE

Selection process. Vicinity of nest platform becomes focus of activity as male and female begin Platform ("ledge") Displays. Pairs likely discover nest platforms during courtship (or precourtship) exploration of the home range.

Nest-site characteristics. See Habitat, above. Nest-tree settings highly variable. In e. Mexico, includes open grassland with widely scattered trees, essentially closed-canopy oak woodlands adjacent to open pasture, and wooded margins of open marshes.

Nest platforms situated at bases of fronds of palm trees; in uppermost branches, where larger branches connect with main trunks, and some-what removed from main trunks but still on larger branches. Aplomado Falcons released in s. Texas have occupied stick platforms on crossarms of power-line poles and have also nested directly on ground.

Seven nest platforms in a n. Chihuahua yucca and mesquite grassland averaged 2.7 m (2.29–3.2 m) above ground (Montoya et al. 1997); 18 nesting platforms in e. Mexico averaged 11.3 m above ground (Hector 1980).

NEST

Construction. No evidence of nest construction; takes over old and perhaps freshly constructed nests of other raptors and corvids. Also nests in large arboreal bromeliads.

Structure and composition matter. Typical nest platforms in e. Mexico are flat or conical stick platforms or bromeliads of various shapes that saddle larger branches (DK-H). Occupied stick platforms originally constructed by White-tailed Kites, Gray Hawks (*Asturina nitida*), Roadside Hawks, Common Black-Hawks (*Buteogallus anthracinus*), Crested Caracaras, and Brown Jays, and presumably also White-tailed Hawks (*Buteo albicaudatus*). In sw. U.S., Aplomados used nests of Chihuahuan Ravens (*Corvus cryptoleucus*), Swainson's Hawks (*B. swainsoni*), White-tailed Kites, and Crested Caracaras (Hector 1988). In Venezuela, uses nests of Savanna Hawk (*Heterospizias meridionalis*; Mader 1981). One nest card from ne. Mexico describes a set of eggs collected from a stick platform on a cliff.

Some nests so flimsy that nestlings visible through bottom of nest. Other nests, such as those in bromeliads or presumed nests of Crested Caracaras and Common Black-Hawks, may be more substantial. One brood survived to fledging with no apparent nest visible in the vicinity, perhaps because the original nesting platform had fallen apart. These birds simply perched on larger branches of a tropical live oak (DK-H).

Dimensions. For 5 nesting platforms in e. Mexico, outer diameter of nest ranged from 28 to 100 cm (Hector 1980). Platform sometimes so small that tail of incubating adult protrudes over edge.

Microclimate. Often in locations exposed to direct sun, wind, and rain. Nest cups of old, dilapidated nests likely to be poorly insulated. Bromeliad platforms, platforms built by larger birds of prey, and platforms nestled in side fronds of palms likely to be at the other extreme in terms of conductive and convective heat loss or gain.

Maintenance or reuse of nests, alternate nests. Smaller stick platforms probably only available for a single season or single brood. More substantial stick platforms and bromeliads might be usable for more than 1 brood or season, although no records of this. Different bromeliads in same tree have been used in consecutive nesting seasons (DK-H).

Nonbreeding nests. At times, uses old nests as food-cache sites (DK-H).

EGGS

Shape. Short elliptical.

Size and mass. Twenty eggs from 20 clutches from Texas and Arizona, length 44.82 mm ± 0.87 SD, breadth 34.74 ± 0.87 SD. Twenty-eight eggs from e. Mexico, 43.75 × 35.06 mm (Kiff et al. 1980).

Color. Ground color whitish or buffy with scattered brownish or rust-colored spots and blotches.

Surface texture. Smooth, but not glossy (DK-H).

Eggshell thickness. Average thickness of 20 eggshells from pre-DDT (pre-1947) era, collected in coastal Texas and n. Mexico: 0.279 mm (range 0.262–0.317). Average thickness of 12 post-DDT eggshells collected in Veracruz: 0.220 mm (range 0.197–0.238; Kiff et al. 1980). Shells of 2 addled eggs collected from Texas nests in 1995 and 1996 measured 0.305 and 0.285 mm (Mora et al. 1997). Thickness indices 1.50 ± 0.04 SD for 56 eggs collected in s. Texas and ne. Mexico, 1892–1928; and 1.12 ± 0.04 SD for 32 eggs collected in Veracruz, 1957–1966 (Kiff et al. 1980).

Egg-laying. No field observations.

INCUBATION

Onset of broodiness and incubation in relation to laying. Little known regarding behavior of wild birds.

Incubation patch. Nothing known.

Incubation period. Thirty-one to 32 d (DK-H).

Parental behavior. From DK-H. At 2 e. Mexican sites, females incubated 74% and males 26% of total observation period (n = 36.3 h, 7 d). During 2 observation periods, males incubated more than females; 1 of these males covered eggs 74% of total observation time (n = 7 h). A second male incubated 55% of total observation time (n = 4 h). Prior to incubation switches, incubating individual gave Chip Call several times. At other times, nonincubating individual gave Chip Call, then flew to nest platform. Incubating bird usually departed quickly and flew low in opposite direction just as its mate arrived at nest. At other times, incubating birds delayed departure and both adults Chipped several times before incubating bird departed. At times, males brought carcasses to nest platform then Chipped until female took carcass and began feeding herself at a nearby perch. On several occasions, females left eggs to assist males in pursuit of birds and potential nest predators near nesting platforms (DK-H).

Hardiness of eggs against temperature stress; effect of egg neglect. Eggs sometimes untended 15–60 min at e. Mexican nest sites (DK-H). Nothing known about egg neglect.

HATCHING

No field observations.

YOUNG BIRDS

Condition at hatching. Helpless, covered with white down; mass 17.5 g (Peregrine Fund, Inc., data).

Growth and development. Few data. Two males at 14 d: 235 and 240 g. 2 females at 14 d: 300 g; 325 g at 21 d; and 445 g at 27 d (DK-H).

PARENTAL CARE

Brooding. Brooded closely by female for first week after hatching, then progressively less frequently. During rainstorms, females may attempt to brood young of near-fledging age. During this period, male hunts mostly solitarily and brings food to female (DK-H).

Feeding. Female usually feeds young. When male brings prey to nest, female quickly arrives, takes it from him, then feeds the young herself. Female offers small bits of food to nestlings and accompanies each offering with the Chip Call. This pattern continues until after young have fledged. Adult female even administers feedings of nearly independent fledglings. Male assists in feedings of older fledglings. Female sometimes holds carcasses down while older nestlings and fledglings tear food from it (DK-H). At 3 nests observed for 79 h, feedings averaged 8.6/d during incubation and 11.3/d during nestling and postfledgling periods (DK-H).

Nest sanitation. Nestlings 2–5 wk old sometimes forcibly expel excrement over edge of nest platform.

COOPERATIVE BREEDING

Not known to occur.

BROOD PARASITISM

No information.

FLEDGLING STAGE

Young depart nest 4–5 wk posthatching. All nestlings fledge within 2–3 d of each other. Fledglings make weak first flights to neighboring trees, then rarely return to the nest platform. Fledglings drift from tree to tree somewhat independent of each other, but usually within 500 m of nest platform. Adults bring food directly to one fledgling or perch in a nearby tree and Chip until fledglings converge. At this time, rectrices and remiges of fledglings still not completely developed (DK-H).

IMMATURE STAGE

Little known. In e. Mexico, presumptive sibling groups in Juvenal plumage observed moving about together in May and Jun hunting small birds and harassing other raptors (DK-H). Juvenile birds released in s. Texas hunt together (C. Perez pers. comm.).

DEMOGRAPHY AND POPULATIONS

MEASURES OF BREEDING ACTIVITY

Age at first breeding. No data. Several females at nests in e. Mexico in midst of Prebasic I molt, suggesting that females can form pair bonds and reproduce at the end of their first year (DK-H).

Clutch. Maximum size of 3 eggs is likely. This generalization complicated by the unnaturally large sets of F. B. Armstrong (see Distribution: historical changes, above). Average clutch size for 9 nests monitored in e. Mexico in 1977 and 1979 was 2.64 eggs. This is the same as the average clutch size of 28 clutches collected in the same area in the 1950s and 1960s (WFVZ egg cards).

Annual and lifetime reproductive success. From DK-H. Nothing known about lifetime reproductive success. Estimating annual reproductive success in tropical populations is complicated by asynchronous nesting activity: clutch starting dates range over 5-mo period (Feb–Jul; Fig. 5), so pairs could easily renest after unsuccessful or successful first attempts. Twenty-five nests in e. Mexico (1977–1986) produced 38 nestlings from an estimated 66 eggs (2.64 eggs/clutch), or 0.57 nestlings/egg, 1.52 nestlings/clutch, and 2.0 fledglings/successful nest. Seven nests in n. Chihuahua (1993) produced 11 nestlings from 18 eggs (2.6 eggs/clutch), or 0.61 nestlings/egg, 1.57 nestlings/clutch, and 1.33 fledglings/successful nest (Montoya et al. 1997).

Proportion of total females that rear at least one brood to nest-leaving. Of 19 pairs in s. Texas in 1999, 8 produced 12 fledglings (Sandfort et al. 2000).

LIFE SPAN AND SURVIVORSHIP

Nothing known about postfledging survivorship or life span in wild birds. One captive Aplomado Falcon has lived at least 12 yr in captivity.

DISEASE AND BODY PARASITES

Nestlings sometimes infested with ≥30 botfly (*Philornis*) larvae (Hector 1982). Smith (1968) documented severe *Philornis*-caused mortality in nestling oropendolas and Yellow-billed Caciques (*Amblycercus holosericeus*). This suggests that under some circumstances, *Philornis* larvae could kill nestling falcons.

CAUSES OF MORTALITY

No data on mortality, but see Conservation and management: effects of human activity, below. Only 1 instance of disappearance of an adult in 30 nesting attempts in e. Mexico study area. No postfledglings lost at study sites in e. Mexico. At least 3 clutches of eggs likely destroyed by avian predators, probably Brown Jays. Predation possibly by other birds of prey and mammalian carnivores such as Great Horned Owl, coyotes (*Canis latrans*), and bobcats (*Lynx rufus*) most important cause of mortality in falcons released in s. Texas (Montoya et al. 1997). Fire ants implicated in loss of at least 1 Texas nest (Sandfort et al. 2000). Some Aplomados also likely die from *Philornis* infestations as well as typical falcon diseases such as the *Trichomonas* infestations often carried by doves and pigeons. One instance of shooting mortality (DK-H), and possible researcher-caused losses of eggs or nestlings (Montoya et al. 1997).

RANGE

Initial dispersal from natal site. In Texas, some Aplomado Falcons releasd from locations on the King Ranch and Laguna Atascosa NWR dispersed widely in relatively few days. Some falcons monitored at Laguna Atascosa remained within 5 km of release site for several months (Perez et al. 1996). Wild fledglings spent most time their first month after departing nest within 1 km of nesting platform. No data on dispersal between natal site and site of first breeding.

Fidelity to breeding site and winter home range. No data for individuals. Some nesting pastures in e. Mexico have been occupied, though not necessarily by same individuals, continuously for at least 10 yr (DK-H).

Dispersal from breeding site. One Aplomado banded as a nestling in n. Chihuahua dispersed about 300 km to s.-central New Mexico. No evidence of territorial occupants in e. Mexico leaving home ranges seasonally. Field observations suggest most pairs use vicinity of previous season's nesting platform as a hunting, roosting, and display area throughout the year. In s. Texas, 28 radio-tagged fledglings ranged over 35.7–281.2 km^2 (Perez et al. 1996).

Home range. In e. Mexico, territories sometimes within 1 km of each other (DK-H). At least 5 pairs nested along one 96-km stretch of highway in 1977. Home-range areas for each pair 2.6–9.0 km^2, or 11–39 pairs/100 km^2 (Hector 1988). In n. Chihuahua, 10 home ranges occupied approximately 400 km^2, and individual home-range sizes based on radiotelemetry "fixes" were 3.3–21.4 km^2 (Montoya et al. 1997).

POPULATION STATUS

Numbers and trends. Despite federal Endangered status, no recent data available from any comprehensive population-monitoring program. No evidence of declines ever documented in any portion of Mexico (see Distribution: historical changes, above). In e. Mexico, Keddy-Hector (1986b) detected 7 individuals in 1,626 km (1 falcon/233 km) of highway surveys; see above. Donazar et al. (1993) detected 2 Aplomado Falcons in 1,234 km of driving in Patagonia highway surveys or 1/640 km. Sixty-six adult Aplomados detected in 1977 by Chihuahuan Desert Research Institute researchers at various locations in San Luis Potosí, Veracruz, and Tabasco. Most of these localities coincide with sites well known to oologists and bird-skin collectors for at least the past century. Savannas encountered along the Rio Usumacincta (Tabasco, Chiapas, and Campeche) by the Walker-Caddy Expedition of 1839–1840 (Pendergast 1967) coincide with locations of nesting Aplomado Falcons encountered by DK-H and J. Langford in 1977–1985. Remoteness and inaccessibility of historical nesting areas hamper efforts to assess current status in U.S. This, plus sparse spatio-temporal distribution of collected specimens, limits generalizations about past and present status and trends.

POPULATION REGULATION

No data; not well studied. Nest-platform availability likely a key limiting factor within otherwise suitable habitat.

CONSERVATION AND MANAGEMENT

EFFECTS OF HUMAN ACTIVITY

Shooting and trapping. Few data. One juvenile found shot in e. Mexico (DK-H). Vulnerable to shooting mortality because of general tameness and frequency of gamebird-prey species in its diet. For same reasons should also be vulnerable to pole traps set near poultry-, gamecock-, and gamebird-rearing facilities.

Pesticides and other contaminants/toxics. Severe eggshell thinning and pesticide contamination detected in eggs collected in e. Mexico in 1957–1977. Thirty-two eggs (13 clutches) collected 1957–1966 (Kiff et al. 1980) averaged 25.4% thinner than eggs collected before onset of DDT use. Average contamination of post-DDT shell membranes was 297 ppm DDE (range 110–530) and 93 ppm DDT. Shells and addled eggs collected in 1977 averaged 24% thinner than pre-DDT eggs.

Potential falcon prey (Great-tailed Grackles) from Tabasco, Chiapas, and U.S. contained elevated pesticide loads in 1990–1991 (Henry 1992). Potential prey from Veracruz contained reduced levels of DDT/DDE. Such spatial variability in contamination levels, coupled with individual variability in diet composition, may account for evidence of normal reproductive success by Aplomados in e. Mexico in 1977–1986. Eggs collected in 1990 from Chiapas were only 4% thinner than pre-DDT eggs (L. Kiff pers. comm.).

In n. Mexico and sw. U.S., heavy concentrations of DDE/DDT in potential falcon prey persist within historical distribution of this species (White et al. 1983, Fleming and Cain 1985, Hunt et al. 1986, Mora and Anderson 1991, Henry 1992). In particular, birds and other organisms collected over the past decade from lower Rio Grande, Laguna Madre, and other s. Texas water bodies contained heavy loads of PCBs, heavy metals, and organochlorine pesticides (Texas State Soil and Water Conserv. Board 1991, Environmental Protection Agency 1994, Texas Nat. Resour. Conserv. Comm. 1995). This conflicts with reports of low levels of organochlorines in potential falcon prey (doves and meadowlarks) in Arizona and s. Texas (King et al. 1995, Mora et al. 1997). These studies did not examine pesticide loads in grackles, shorebirds, and various insectivores that comprise over half the diet of e. Mexican Aplomados (see Food habits: diet, above) and that commonly contain 10–10,000 times the organochlorine loads detected in granivorous species like doves (Hubbard and Schmitt 1988, Mora and Anderson 1991, Henry 1992). Potential prey in Arizona also contained relatively heavy loads of selenium (King et al. 1995). Mora et al. (1997) also detected elevated levels of mercury in meadowlarks in s. Texas.

Organophosphate insecticides also threaten Aplomados because insects and small insectivorous birds are preferred prey, and because sites where this falcon has been released in Texas are near agricultural areas. Agricultural applications of organophosphates have killed thousands of Swainson's Hawks, waterfowl, and songbirds in Argentina and similar numbers of waterfowl and other birds in U.S. agricultural areas (White et al. 1982, White and Mitchell 1983, Flickinger et al. 1984).

Ingestion of plastics, lead, etc. Secondary lead poisoning is a serious threat in many portions of the historical U.S. range because Aplomados feed on gamebirds such as Mourning and White-winged doves and Northern Bobwhite. Use of lead shot and lead rifle bullets during hunting seasons implicated as likely cause of seasonal episodes of lead contamination in California Condors (*Gymnogyps californianus*; Janssen et al. 1986) and Golden Eagles (*Aquila chrysaetos*; Pattee et al. 1990) in California and Marsh Harriers (*Circus aeruginosus*; Pain et al. 1997) in France; Locke and Friend (1992) list several cases of lead poisoning in Peregrine and Prairie falcons. At public hunting areas in se. New Mexico, 8% of 250 Mourning Doves, and 9.7% of 245 Northern Bobwhite and Scaled Quail contained lead concentrations >3 ppm (Best et al. 1992a, 1992b). These and similar values reported from dove and quail by Locke and Bagley (1967), Lewis and Legler (1968), and Kendall (1980) likely underestimate actual incidence of this contaminant in wild prey populations (Locke and Friend 1992).

Grassfires. One nest containing a single nestling possibly killed by a grassfire in e. Mexico (J. Langford pers. comm.). At least 2 other nests with nestlings nearly destroyed by fire (DK-H).

Degradation of habitat. Extensive expanses of native grassland lost to farming and brush encroachment in U.S. (Keddy-Hector 1988). In Campeche and Tabasco, Mexico, rice-farming has eliminated much habitat occupied by Aplomados in the 1970s (DK-H). Extirpation of black-tailed prairie dogs (*Cynomys ludovicianus*) from Arizona, New Mexico, and Texas may have also been influential in eliminating an important prey species, associated open hunting areas, and a dependent community of other raptors and corvids, whose nests Aplomados use (J. Truett pers. comm.).

In U.S. and throughout the species' distribution, much suitable grassland and wetland habitat lost to farming, overgrazing, and water-table depression. Overgrazing by cattle promotes proliferation of woody vegetation and degrades wetlands and associated woodlands that support many potential prey. In e. Mexico and perhaps other parts of the tropics, conversion of marshlands and seasonally flooded savannas to rice and sugar cane has eliminated still more habitat. This impact may have been partially balanced, though, at the expense of forest-dwelling species, by Aplomado's ability to colonize clearings created in rain forest and other wooded areas.

Extensive brush-clearing and deforestation likely also detrimental, especially in desert grassland areas, where removal of wooded areas would diminish abundance of local resident prey. In some areas, this could reduce total prey availability or promote greater capture of agricultural or migratory species that tend to carry elevated levels of pesticide and heavy-metal residues.

Collisions with stationary and moving objects. No information. Aplomados potentially vulnerable to collisions with fences, power lines, and vehicles because of tendency to engage in high-speed, low-level, reckless pursuits of swift avian prey.

Electrocutions by power lines. Uninsulated power lines may electrocute Aplomados, especially in areas where this falcon has become conditioned to using stick platforms on artificial structures such as power-line poles (Williams 1999). This risk has recently lead to modification of uninsulated poles at Laguna Atascosa NWR, TX.

Accidental drownings. Four Aplomados in n. Chihuahua drowned in metal livestock watering tanks (R. Meyer and A. Montoya pers. comm.).

Disturbance around nests. Often tolerates close (<100 m) approach by researchers to falcon nests. Sometimes responds with aggression and *Kek* Call to researchers after nest site has been discovered or during inspection of nest contents. Has nested within 100 m of highways in e. Mexico (DK-H).

Direct human/research impacts. Montoya et al. (1997) ascribed abandonment of at least 1 nest in their study area to the trapping and radio-tagging of the resident female falcon.

MANAGEMENT

Despite Endangered status in U.S. and Mexico, viewed as Not Threatened globally (Bildstein et al. 1998). This appraisal may be appropriate because of broad geographic distribution and flexible habitat preferences, but should be accepted cautiously because of absence of comprehensive information on population status and reproductive health. Although determination of actual population size, distribution, and reproductive health was given top priority in the Aplomado Falcon Recovery Plan, we still know very little about the current status or severity of threats to this species (Keddy-Hector 1990). This continues to be the primary deficiency of ongoing conservation efforts. Endangered status in North America was accepted with little evidence regarding actual population status and no evidence documenting declines in Mexico (see Distribution: historical changes, above). Initial acceptance of Endangered status dependent on evidence of declines in U.S. and strong evidence of severe pesticide contamination in e. Mexico (Keddy-Hector 1990).

Despite peripheral status, release of captive-reared Aplomado Falcons in U.S. originally considered essential for re-establishment in a relatively pesticide-free environment (Keddy-Hector 1990). This justification for reintroduction may no longer be applicable because of equivocal impressions of historical abundance, recent evidence of natural dispersal from Mexico to

U.S., and indications that U.S. environment still heavily contaminated with organochlorines (see above).

Measures proposed and taken. First successful breeding project established in 1977 by W. G. Hunt, J. Langford, S. Belardo, and H. Flanders at the Chihuahuan Desert Research Institute (Alpine, TX). This project later taken over and enlarged by Peregrine Fund, Inc., through acquisition of additional Aplomado Falcon nestlings from e. Mexico study areas of DK-H. Potential release sites evaluated in 1985–1987, and initial releases took place in 1985 on the King Ranch (Keddy-Hector 1990) in Texas. Release work then shifted to Laguna Atascosa NWR and Matagorda I., TX. Initial nesting by captive-reared Aplomados took place in 1995. As of 2000, additional releases planned for sites in New Mexico and ne. Mexico.

Since 1980, the Peregrine Fund, Inc., has produced 545 Aplomado Falcons in captivity. Of these, 466 have been released into the wild at 8 sites along the Texas Gulf Coast. In 1999, 115 captive-produced Aplomados were released in Texas (Sandfort et al. 2000).

Of greatest importance to conservation efforts is protection and restoration of pesticide- and lead-free grassland and wetland communities and associated forest, woodland, and thorn scrub, via the following measures:

(1) Cattle removal or reductions of grazing intensity on all sw. U.S. public land sites within historic distribution of this falcon.

(2) Protection and restoration of sw. U.S. riparian woodlands, desert playas, and desert grasslands from past and ongoing impacts of overgrazing, deforestation, and water-table depression.

(3) Elimination of acute and chronic sources of environmental contamination including: (a) organochlorine insecticides; (b) acutely toxic organophosphates; and (c) lead shot for upland game bird–hunting.

(4) Increased protection for ravens, other corvids, and various raptors whose nests can be used by Aplomados.

Effectiveness of measures. In 1999, the Peregrine Fund, Inc., located 5 pairs of captive-reared Aplomados on Matagorda I., TX, and 14 pairs in vicinity of Laguna Atascosa NWR. Four of these pairs produced 12 young (Sandfort et al. 2000).

APPEARANCE

MOLTS AND PLUMAGES

From Eisenmann 1955, Blake 1977, and Hector 1988.

Hatchlings. Born with white first natal down, then molt into grayish-dusky second natal down at 1–2 wk of age.

Juvenal plumage. Second natal down gradually replaced by contour feathers from 2 to 6 wk of age. Nestlings depart nest in midst of Prejuvenal molt with wisps of natal down still evident and rectrices not fully developed.

Juvenal plumage with same pattern as Definitive Basic plumage (see below) except upperparts more brownish, and white or buffy areas from head through breast replaced with deep cinnamon. These areas quickly fade following Prejuvenal molt. Stripes on upper breast much broader than in Definitive Basic plumage, and obscure much of the lighter base color. Feathers of dark belly-band usually lack whitish margins. Wing-coverts narrowly margined with cinnamon. Secondaries narrowly margined on the outer web with paler coloration. Remiges with white spots on inner web visible both dorsally and ventrally.

Basic I plumage. Similar to Definitive Basic plumage (see below) except Prebasic I molt sometimes incomplete so that a few feathers from Juvenal plumage retained until next Prebasic molt. Basic I also with slightly heavier dark streaking on upper breast than in Definitive Basic.

Definitive Basic plumage. Little known about timing or sequence of Definitive Prebasic molt. Molted flight feathers found, and adults observed with missing flight feathers, in May–Jun in e. Mexico (DK-H).

Crown and nape blackish to dark gray; white or light buff postocular stripes extend dorsally, curving posteriorly from just above each eye and sometimes merging on back of nape. Eye-stripes demarcated and bordered below by broader black or dark-gray stripes. Thin blackish malar stripes extend downward from each eye.

Back, scapulars, rump, upper tail-coverts, and upper wing surface slate gray to bluish gray. Upper breast white to pale buff, or in some individuals light cinnamon or grayish, sometimes nearly immaculate or marked with scattered thin, vertical dark streaks. Blackish buff region on upper belly and lower breast extends medially from each axillary region, narrowing and usually (but not always) merging midventrally. Dark feathers of this belly-band sometimes (especially in males) marked with terminal white edgings that create impression of narrow crescent-shaped markings. Lower belly and under tail-coverts cinnamon to deep ochraceous-tawny. Tail blackish, marked with 8 well-defined white crossbars and white tip, although only 5 or 6 may be readily visible in the field.

Secondaries white-tipped to create a white trailing edge on wing. Wing-linings blackish with narrow white crossbars formed by white spots on inner webs of remiges and on under wing-coverts.

Friedmann (1950) described white- and cinnamon-breasted color morphs that may have represented Definitive Basic, Basic I, or Juvenal plumages. Much variation in coloration and degree of streaking in the upper breast evident in e. Mexico individuals. Adults have nearly white to cinnamon to gray upper breasts, sometimes nearly immaculate, sometimes more heavily streaked. Amount and breadth of streaking diminishes somewhat as individuals go through successive molts. Compared with females, males have more immaculate upper breasts and more pronounced white crescents or crossbars on belly-bands and wing-linings.

BARE PARTS

Bill. Dark gray to black at tip, grading into blue-gray or slate at base.

Iris. Dark brown or dusky, appearing almost black.

Eye-ring, cere, legs, and feet. Hatchlings and juveniles with bluish turquoise eye-rings and ceres, and pale-yellow legs and feet. These fleshy parts become brilliant orange-yellow as birds mature (Hector 1988).

MEASUREMENTS

LINEAR

See Appendix. Varies among subspecies, with *femoralis* averaging smallest in all dimensions and *pichinchae* and *septentrionalis* being of approximately same size.

MASS

Adults from e. Mexico (Hector 1988): 7 males averaged 260 g (range 208–305, $n = 7$); 6 females averaged 407 g (range 310–500). Adults from Chihuahua (Montoya et al. 1997): 8 males averaged 281 g (range 260–334); 9 females averaged 422 g (range 380–458). No data on seasonal change in mass.

PRIORITIES FOR FUTURE RESEARCH

The most critical research need for conservation purposes is information about distribution, abundance, and reproductive health in Latin America. This information should come from (1) intensive, long-term population-monitoring, (2) more cursory but still systematic and quantifiable roadside or breeding-bird surveys, and (3) remote sensing–based inventories of potential habitat. Intensive monitoring must, at a minimum, examine levels of pesticide contamination, eggshell thinning, rates of productivity, and rates of population turnover at selected sites in North and South America. An additional need is full determination of sources and levels of organochlorine and organophosphate pesticides in representative omnivorous, insectivorous, or piscivorous prey.

The following research topics would also fill important gaps in our knowledge of the natural history of this species:

(1) Because this species (especially the *pichinchae* form) ranges from sea level to above 4,000 m, it would provide an excellent subject for studies of adaptations for varying elevations in incubation physiology and behavior, as well as other aspects of behavior. In this regard, the well-documented ability of *pichinchae* to colonize the Altiplano of Chile, Peru, and Ecuador raises questions about why *septentrionalis* does not range farther north in the Northern Hemisphere.

(2) Nothing is known about the degree to which cooperative tendencies in this species are innate or opportunistic. We need additional observations of intersibling interactions of wild and released siblings, comparisons with intersibling interactions of other species, and comparisons of cooperative foraging rates under different conditions of prey availability. A full understanding of the adaptability of cooperation in foraging, nest defense, and kleptoparasitism of nest platforms and food would help our understanding of what factors limit the distribution and productivity of this species.

(3) Little is known about seasonal movements and locations of principal nesting areas throughout its range—especially the extent to which Andean and Patagonian birds withdraw to milder climates during cooler months.

(4) Little is known about what limits population growth in this species and what constitutes a viable population. Like Eurasian Hobby (*Falco subbuteo*), Aplomado Falcon lays clutches of only 3 eggs. Patterns of fecundity and mortality must differ from those of temperate-latitude falcons, which lay clutches of 4–5 eggs (Cramp and Simmons 1980, Cade 1982). These factors should be examined in field studies of population biology and also incorporated into computer simulations designed to examine risks of extinction under different scenarios of insularization and pesticide heavy-metal contamination.

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Appendix. Linear measurements (mm) of the 3 Aplomado Falcon subspecies. Data from Blake 1977. Data shown as mean (mm) and range.

Sample size (male/female)		*septentrionalis* 8/7	*femoralis* 23/25	*pichinchae* 5/10
Wing-chord:	Male	257 (248–267)	237 (226–254)	258 (235–272)[1]
	Female	290 (272–302)	263 (245–282)	298 (195–210)
Tail:	Male	182 (172–193)	153 (142–170)	168 (151–179)
	Female	199 (192–207)	172 (155–195)	202 (195–210)
Bill:	Male	17 (16–18)	15.5 (14–17)	16 (16–17)
	Female	19 (17–20)	18 (17–20)	19 (18–20)
Tarsus:	Male	51 (48–52)	44 (43–50)[2]	44.5 (42–46)
	Female	56 (50–60)	47 (45–51)[3]	50.0 (48–52)[4]

[1]Flattened wing instead of chord.
[2]For 11 males.
[3]For 7 females.
[4]For 6 females.

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