

American White Pelican

Pelecanus erythrorhynchos

Order:

Pelecaniformes

Family:

Pelecanidae

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The American White Pelican occurs mainly in western and southern portions of North America, breeding inland in colonies on remote islands and wintering along warm southern coasts. The species is of particular interest because of its large body size, conspicuous white and black coloration, graceful flight, highly developed cooperative foraging, and the somewhat comic proportions of its large bill and pouch. White Pelicans are most commonly seen at foraging and adjacent loafing sites, where they are tolerant of human observers if not approached too closely. At breeding colonies, by contrast, they are shy and prone to desert or to leave eggs and young exposed to predators if approached.

Early spring migrants often arrive at colony sites before winter ice has left all surrounding waters. Courtship begins almost immediately, starting with aerial flights of often dozens of birds circling prospective breeding sites. Groups of newly paired birds at the same stage of the reproductive cycle then begin to form dense, synchronized nesting clusters or sub-colonies. As more birds arrive, additional sub-colonies form on other nearby portions of the colony, with the different sub-colonies commonly at different stages of the reproductive cycle.

Upon hatching, the altricial young are totally dependent on parents for food, warmth, and protection. By about 3 wks of age, they become more mobile, typically forming large overnight creches for protection and warmth, while the parents stay at the foraging grounds except for trips

to the colony to feed their young. Generally only one of the two young survives, the other being harassed or killed by its older nestmate, a form of siblicide.

Favored foraging sites are shallow marshes, rivers, and lake edges, where mainly fish of little commercial value are taken. White pelicans obtain their food by dipping their bills into the water and scooping up prey. They do not plunge-dive from the air like Brown Pelicans. Like some of the Old World species of pelicans, White Pelicans are widely noted for their habit of cooperative foraging. Coordinated flocks of swimming birds encircle fish or drive them into the shallows where they become concentrated and can be more easily caught with synchronized bill dipping.

The continental population of White Pelicans was considered threatened until the early 1960s by combinations of changing water levels, human disturbance, and possibly contaminants. The population has since recovered and continues to increase at >3%/year. These increases have created conflicts with the aquaculture industry in the Southeastern United States in the last decade, especially during spring migration.

The first significant inquiry into the biology of the American White Pelican was a study of food habits relative to game fish interests by Hall ([Hall 1925](#)) at Pyramid Lake, Nevada. Thompson ([Thompson 1933](#)) provided the initial estimate of the continental population, which has been repeated at various intervals since ([Findholt and Diem 1988](#), [Findholt and Diem 1988](#), [Sidle et al. 1985](#)). Behle ([Behle 1958](#)) summarized a decade of studies of the natural history of the species on Great Salt Lake, and that volume along with the ethological observations of Schaller ([Schaller 1964](#)) stimulated many additional studies of behavior and physiological ecology by Evans and his students at the University of Manitoba and breeding biology ecology by Knopf at Utah State University. Recent studies by King and his associates ([King and Michot 2002](#), [King and Werner 2001](#)) have again focused on behavior and food habits of the species, specifically relative to economic impacts on aquaculture in the Mississippi River Delta region.

Appearance



[Enlarge](#)

American White Pelican, in flight

American White Pelican, in flight; photographer William L. Newton



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American White Pelican, adult, nonbreeding plumage

American White Pelican, adult, nonbreeding plumage; photographer William L. Newton



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[Enlarge](#)

American White Pelican, juvenile

American White Pelican, juvenile; photographer William L. Newton



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American White Pelican, beginning pre-alternate molt.

American White Pelican, beginning pre-alternate molt.; photographer William L. Newton

Unmistakable. Large white bird with black primaries and outer secondaries, enormous bill with distensible gular pouch, and totipalmate webbed feet. Usually in flocks, flies with head withdrawn. Length: 127-165 cm. In early breeding season, bill and legs bright orange, head with white plumes and laterally flattened "horn" on upper mandible; post-breeding, leg color fades, head darkens, plumes and horn lost. Brown Pelican (*Pelecanus occidentalis*), normally found only in coastal regions, is smaller with generally darker body plumage; often forages by plunging, whereas White Pelican does not.

Linear Measurements

From ([Palmer 1962a](#)), 9 males and 10 females.

Wingspan

244-290 cm, males slightly larger than females.

Wing Length

Male, 608.2 mm ($r = 575-630$); female, 558.5 mm ($r = 525-603$).

Tail Length

Male, 153-167 mm; female, 135-166 mm.

Tarsus Length

Male, 122.5 mm ($r = 115-130$); female, 115.7 mm ($r = 108-123$).

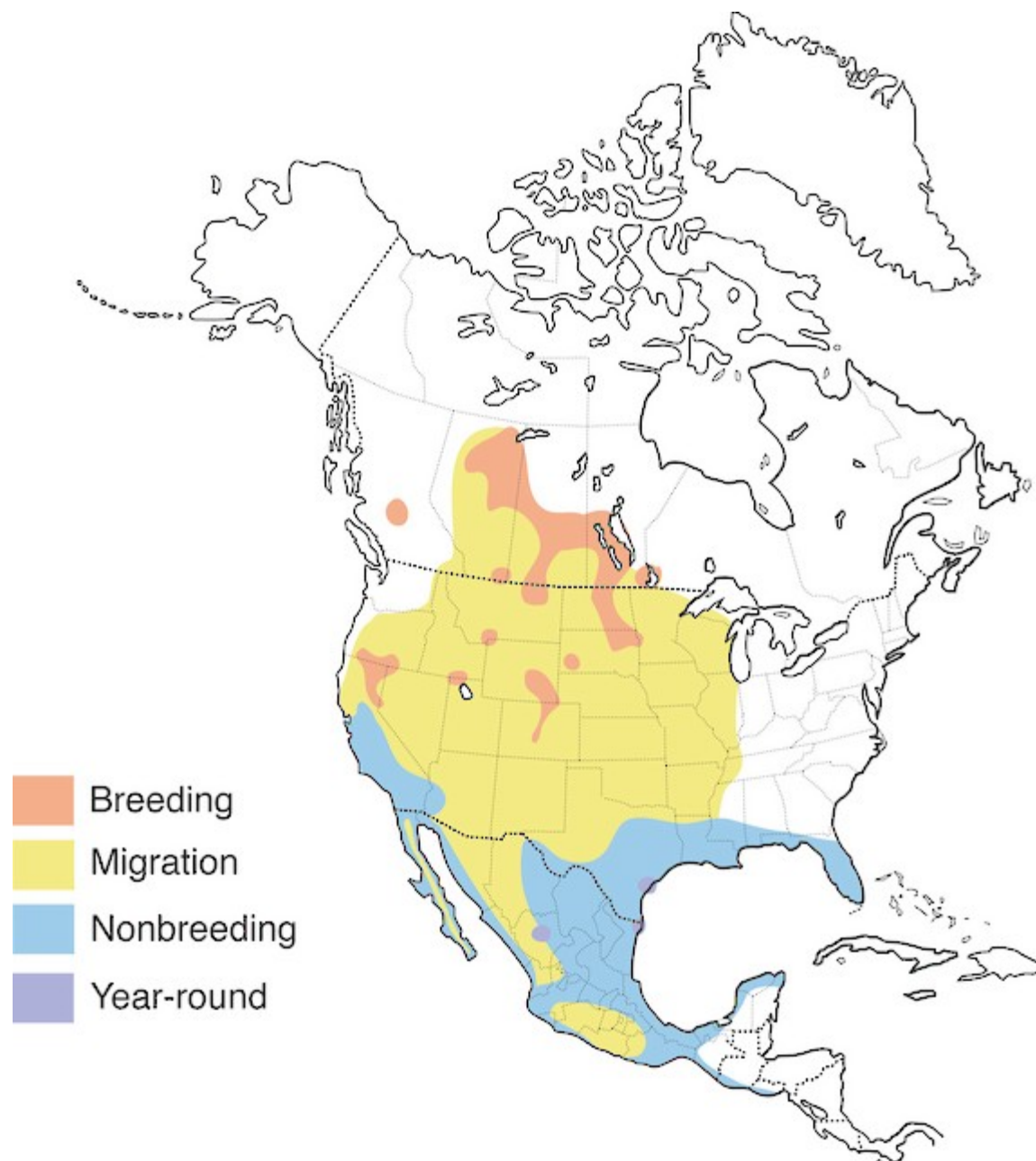
Bill

Male, 342.3 mm ($r = 320-365$); female, 287.6 mm ($r = 265-320$).

Mass

4.54-7.72 kg, reportedly up to 13.6 kg ([Behle 1958](#)). Most birds probably 5.4-9.0 kg; males heavier than females. Data needed on male/female differences.

Distribution in the Americas



Breeding Range

See [Figure 1](#) . From s.-central British Columbia, n. Alberta, ne. Saskatchewan, central Manitoba, sw. Ontario (Lake of the Woods), and n. Minnesota to sw. Minnesota, west through the Dakotas, n. Montana, Wyoming, n. Colorado, and n. Utah to w. Nevada, n. California, and s. Oregon ([Sidle et al. 1985](#), [Stepney 1987](#), [Findholt and Diem 1988](#)). Northeastern limit approximates 0°C Apr isotherm ([Vermeer 1970c](#)). Recent eastern extreme breeding attempt north of Lake Superior (Lake Nipigon, Ontario, 1991; J. P. Ryder pers. comm.). Populations broadly divisible into two groups on basis of breeding and migrating east or west of the continental divide, with limited mixing ([Behle 1958](#), [Vermeer 1970c](#), Houston [Houston 1970](#), [Houston 1972a](#), [Strait and Sloan 1975](#), [Ryder 1981](#), [Fish and Wildlife 1984](#), [Stepney 1987](#), [Hendricks and Johnson 2002](#)). Additional small non-migratory breeding populations on central coast of Texas and sporadically in e.-central Mexico ([Chapman 1988](#); [Figure 1](#)). Also reported breeding during winter in central Durango, Mexico ([Knoder et al. 1980](#)).

Away from the normal range, stray individuals have occurred as far north as Alaska ([Osborne 1982b](#)) and in many areas of e. Canada and the ne. United States, mainly in warmer months ([American Ornithologists' Union 1998a](#)). A few nonbreeders may summer nearly anywhere within the normal migrant and winter range.

Winter Range

Pacific coast from central California and s. Arizona south to Baja California, w. Mexico, Nicaragua, and from Florida, Gulf states, and s. Texas south through central plateau of Mexico to n. Yucatan Peninsula ([Figure 1](#); [Palmer 1962a](#), [Knoder et al. 1980](#), [Clapp et al. 1982a](#), [American Ornithologists' Union 1998a](#), [Howell and Webb 1995](#)). Usually winters where minimum Jan temperature stays above 4°C ([Root 1988b](#)).

Distribution Outside the Americas

None.

Nature of Migration

Annual, except for birds breeding in Texas ([Chapman 1988](#)) and Mexico, which are resident ([Figure 1](#)). Some migrate to breeding colonies at age 2 yr, before breeding age ([Miller 1977b](#)), and apparent nonbreeders may occur within breeding range ([Stepney 1987](#)). Some remain on winter range, with stragglers well beyond normal range ([Palmer 1962a](#)). Freezing of lakes and rivers over northern breeding range necessitates southward winter migration.

Timing and Routes of Migration

Populations breeding east of the Rocky Mountains migrate primarily southward and eastward towards the Gulf of Mexico coast, occasionally recorded from inland and west coast of Mexico (Houston [Houston 1970](#), [Houston 1972a](#), [Ryder 1981](#)). Populations breeding west of the Rocky

Mountains move primarily southward to California and the west coast of Mexico, rarely eastward to Gulf Coast ([Behle 1958](#), [Fish and Wildlife 1984](#)). These generalizations have the exceptions of birds from the Molly Islands of Yellowstone Lake ([Diem and Condon 1967](#)) and Canyon Ferry and Arod colonies of western Montana ([Hendricks and Johnson 2002](#)) actually crossing the continental divide to winter mostly along the Pacific rather than Atlantic coastline.

Arrival of spring migrants abrupt and regular, early Mar in Utah (see [Figure 3](#); [Behle 1958](#)). Last arrival dates uncertain. Arrivals late Feb and early Mar common in Nevada ([Alcorn 1943](#)), delayed until late Apr to May at Yellowstone Park, nw. Wyoming ([Schaller 1964](#)). Birds usually return to Canadian breeding grounds before lakes are free of ice but when rivers have some open water for foraging ([Vermeer 1970c](#)). First arrivals in Manitoba during the first 2 wk of Apr, most arriving 15 Apr to early May (RME).

Autumn migration spread out (see [Figure 3](#)), local dates uncertain owing to transients from other areas ([Behle 1958](#)). In Utah, stragglers of unknown origin noted on foraging grounds until 19 Dec ([Low et al. 1950](#)). Compressed departure reported for Yellowstone, from 5 to 15 Sep ([Behle 1958](#)), suggesting an effect of temperature.

Migratory Behavior

In flocks of varying size up to at least 180 ([Behle 1958](#)), diurnally in formations except when making use of energy saving thermals on sunny days (see Behavior: flight). Sexes migrate together, may stop overnight and continue on the next morning (spring migrants, East Shoal Lake, Manitoba; RME).

Control and Physiology of Migration

No information.

Habitat in Breeding Range

Breeds mainly on isolated islands in freshwater lakes, forages on inland marshes, lakes, or rivers, favoring shallows. Waters range from oligotrophic to eutrophic, muddy to clear; shorelines range from mud or sand to gravel and rock. Islands used for breeding commonly 50+ km from foraging areas. Species basically nests in two ecological settings. The first is on (sometimes large) islands in large lakes as at Gunnison Island in Great Salt Lake ([Behle 1958](#)), Molly Islands in Yellowstone Lake ([Schaller 1964](#), [Findholt and Diem 1988](#)) and Anaho Island in Pyramid Lake ([Hall 1925](#)). At these sites, birds often fly 100km or more to outlying rivers, marshlands and ephemeral wetlands to forage. In late summer, birds in these settings also may forage in deep lakes when sunning fish (especially carp, *Cyprinus carpio*,) are near the surface. The second ecological setting is one of nesting on ephemeral islands in shallower wetlands as in the northern Great Plains ([Evans 1972](#)) or on the Texas coast ([Carroll 1930](#), [Chapman 1988](#)). Periodic flooding of these islands helps restrict woody vegetation growth, making the island more attractive. Low site tenacity and high mobility appear to be important drought-related adaptations permitting pelicans to shift colony sites and take advantage of temporarily rich food

supplies or availability of an island as a result of changing water levels ([Evans 1972](#), [Knopf 1976](#), [Findholt and Trost 1981](#), [Paullin et al. 1988](#); see also Breeding: nest site, below). Emphasis on the importance of islands for protection from predators may be overstated (at least since the regional extirpation of larger predators as wolves and bears). Pelicans historically nested on marsh vegetation at Lower Klamath Lake and the tip of a land peninsula at Tule Lake, California ([Boellstorff et al. 1988](#)) and Bamforth Lake, Wyoming ([Findholt and Diem 1988](#)), on the shoreline of Honey Lake, California, as that water body was drying up ([Tait et al. 1979](#)), and on a saline-flat hummock in Salt Lake County, Utah, in 1974 (FLK).

Habitat in Migration

Inland, along river valleys, over deserts and mountains. Stops at aquatic foraging and loafing areas similar to those used during breeding season ([Alcorn 1943](#), [Behle 1958](#), [Sidle et al. 1990](#)). Increasingly heavier use of aquaculture ponds during spring migration through the Mississippi Delta region ([King and Werner 2001](#)).

Habitat in the Overwintering Range

Rarely winters at inland habitats ([Clapp et al. 1982a](#)), with the Salton Sea being a predictable exception ([Shuford et al. 2002b](#)). Favors shallow coastal bays, inlets, and estuaries with forage fish, exposed loafing sites ([Chapman 1988](#)), and minimum Jan temperatures above 4° C ([Root 1988b](#)). Appears more heavily dependent upon marine estuaries in winter, as evidenced by the carrying of many helminth parasites that also occur in Brown Pelicans ([Kinsella et al. 2004](#)). When inland, overwinters below dams or on large rivers where moving flows prevent the surface from freezing (S.J. Dinsmore pers. comm.). Sand bars for loafing and roosting appear equally as important as forage availability given that birds discontinue using the Mississippi River once rising water levels inundate bars during spring run-off ([King and Michot 2002](#))

Historical Changes to the Distribution

Bred from Great Slave Lake, central Minnesota, central Wisconsin, central Montana, s. Idaho, central Oregon, central Washington, and s. California ([Bent 1922](#), [Schorger 1954c](#), [American Ornithologists' Union 1998a](#), [Palmer 1962a](#), [Lies and Behle 1966](#), [Sloan 1982](#)) in the early 1900s. Present range similar to that of 1950s and 60s ([Palmer 1962a](#)), except for changes due to loss of specific colonies (e.g. in Washington and on Salton Sea in s. California; [Lies and Behle 1966](#)), gains owing to more complete coverage (e.g. British Columbia; [Lies and Behle 1966](#)), colonization of new breeding colonies at Antero Reservoir in Park County and McFarlane Reservoir in Routt County, Colorado ([Kingery 1998b](#)); at Pathfinder Reservoir in Carbon County ([Findholt 1986a](#)) and Bamforth Lake in Albany County, Wyoming, ([Findholt and Diem 1988](#)); and at Minnesota Lake in Faribault County ([Fall 1994](#)) and Johana Lake in Pope County ([Hiemenz 1994](#)), Minnesota. (For probable causes see Demography and Populations: population regulation).

Feeding

Main Foods Taken

In breeding season, fish. Aquatic amphibians and crayfish also taken seasonally on Northern Plains. Food habits during migration and over winter are not described.

Microhabitat For Foraging

Shallow water, 0.3-2.5 m ([Anderson 1991b](#)), open areas within marshes, along lake or river edges, on or below rapids, less commonly forages near surface in deep water of rivers and lakes where fish are either sunning themselves or feeding near the surface ([Findholt and Anderson 1995](#) [Findholt and Anderson 1995b](#), [Findholt and Anderson 1995a](#)) . In coastal marine areas in winter. Increasing use of aquaculture (catfish) ponds in Mississippi Delta region, especially during spring migration ([King and Michot 2002](#)).

Food Capture And Consumption

Nocturnal foraging common during breeding season ([Mcmahon and Evans 1992b](#)), but not in winter. Opportunistic-typically floats and swims on water surface, dips bill into water, scoops prey into pouch, then raises bill above horizontal to swallow prey. Prey probably located visually in the daytime, bill contact combined with increased rate of bill dipping becoming more important at night ([Mcmahon and Evans 1992b](#)). Rate of bill dipping highly variable, increasing with flock size to about 6/min for 4 or more foragers ([Anderson 1991b](#); [Figure 2](#)). Dip rate at front of foraging flocks 6.00 ± 4.00 (SD) dips/min ($n = 40$), a significantly greater rate than at middle, 3.49 ± 2.38 ($n = 26$) or back, 3.81 ± 3.37 ($n = 40$) of flock, presumably owing to greater density of prey at leading edge of flock ([Mcmahon and Evans 1992b](#), [Mcmahon and Evans 1992a](#)). Plunge-diving from flight to capture fish only seen twice ([Hall 1925](#), FLK), both times at Pyramid Lake, Nevada.

Prey capture rate significantly greater in flocks of 2-6 than for single birds, to maximum of 0.13 ± 0.21 (SD)/min ($n = 39$) for diurnal flocks of 3 ([Anderson 1991b](#)); variable for flocks to 100 birds. As for rate of bill dipping, capture rate greater in the front of flocks, 0.26 ± 0.43 /min ($n = 40$), than at back, 0.15 ± 0.34 ($n = 40$; [Mcmahon and Evans 1992b](#), [Mcmahon and Evans 1992a](#)). Capture rates greater during day than at night, probably owing to greater visibility of prey in daylight. Capture efficiency about 0.24 captures/bill dip for single foragers ([Anderson 1991b](#)), lower for large flocks, ranging up to 0.04 ± 0.05 /bill dip ($n = 40$; [Mcmahon and Evans 1992a](#)). Small fish (< one half bill length) predominant prey by day (90%) and night (77%); more large (> three quarter bill length) fish captured at night (18%) than during the day (2%; [Mcmahon and Evans 1992b](#)).

Coordinated And Cooperative Foraging

(For details see [Anderson 1991b](#), [Mcmahon and Evans 1992a](#); also [Figure 2](#)). Foraging behavior falls along a continuum from individual effort through increasing degrees of flock coordination and cooperation. Two or more foragers may form uncoordinated aggregations, grading to flocks

exhibiting coordinated movements and synchronized bill dipping. Foragers commonly spread out, then, with commotion produced by bill dipping and beating wings ([Goss 1888](#)), drive prey toward shore where they are more easily caught. Coordinated drives last up to 10 min. Flock may separate into two groups that drive toward each other. Experiments with models drawn through shallow water demonstrate driving of fish ([Anderson 1991b](#)). Semi-circular formations are highly coordinated, with almost perfectly synchronized bill dipping. Sometimes encircle prey ([Cottam et al. 1942a](#)).

Foragers tend to switch from less to more coordinated behavior when prey are located, revert to less coordination, greater spacing, and individual search when capture rates decline. The most highly coordinated flocks have the highest capture rates per individual forager ([Mcmahon and Evans 1992a](#)), supporting interpretation of cooperative foraging ([Cottam et al. 1942a](#), [Anderson 1991b](#)). Cooperative foraging also found to varying degrees in other pelican species.

Kleptoparasitism (stealing prey from neighbors) common in multi-species flocks, especially with Double-crested Cormorants (*Phalacrocorax auritus*). In deep lake water, White Pelicans steal prey brought to surface by other species. Success ranges from one quarter ([O'Malley and Evans 1983](#)) to one half ([Anderson 1991b](#)) of attacks. Also rob gulls and other pelicans trying to swallow large fish. Success rate 37.5% for attacks on other white pelicans ([O'Malley and Evans 1983](#)). May attempt to rob other pelicans regurgitating large fish to feed young (see Breeding: parental care).

Diet

Major Food Items

Throughout range eat mainly "rough" fish (plus crayfish and salamanders) of low economic value that occur in shallow wetlands. Also take deep-water fish as tui chub (*Gila bicolor*) at Pyramid Lake when chubs spawn in shallows ([Knopf and Kennedy 1980](#)). Small schooling fish (< one-half bill length) predominate, but also take larger sluggish bottom feeders, salamanders, tadpoles, and crayfish. Occurrence of regurgitated fish hooks and lures in colonies suggest they also take game fish injured or slowed by anglers. Take game fish during spawning runs locally ([Kaeding 2002](#); [Stapp and Hayward 2002](#)). Projected to take 3.5% of stream spawning cutthroat trout (*Oncorhynchus clarki bouvieri*; [Stapp and Hayward 2002](#)), the only quantitative evidence of potential competition with sport fisheries. Increased foraging during recent years on aquaculture (catfish) farms in Mississippi Delta.

Quantitative Analysis

In contrast to other Pelecaniforms that dive and actively pursue prey of specific species or size, white pelican is highly opportunistic in foraging ([Knopf and Kennedy 1981](#)). Comparisons of diet regionally show a predominance in numbers of smaller food items as crayfish, native minnows, and salamanders but the significant biomass usually being represented by carp and minnows. As an example, pelicans at Pathfinder reservoir were found to consume 1.4-12.4 % carp and 1.9-3.3% white suckers by numbers, but those two species represented 39.7-47.4 and 31.2-33.4% of the total dietary biomass ([Findholt and Anderson 1995a](#)). Where studies collected

diet samples multiple times within a season, diet was noted to shift drastically with availability of forage species due to changing water levels or reproductive activities of prey species, emphasizing the opportunistic nature of pelican foraging. See [Appendix 1](#). Additional studies in Palmer ([Palmer 1962a](#)).

Food Selection and Storage

Opportunistic, selecting on basis of availability. Food swallowed for transport to colony, never carried in pouch.

Nutrition and Energetics

Breeding adults estimated to eat 1.8 kg/d (20%-40% of body mass). Total food to rear one young to fledging estimated at 68.1 kg ([Hall 1925](#)).

Metabolism and Temperature Regulation

Nest, feed, and loaf at ambient and substrate temperatures ranging from below freezing in the northern spring to above 40°C in the south. At 10°C, resting oxygen consumption of isolated 18-22 d young 1.38 ± 0.15 (SD) cm³per g/h ($r = 1.24$ -1.54, $n = 20$), decreasing at 30°C to 1.00 ± 0.12 cm³per g/h ($r = 0.81$ -1.14, $n = 20$). Energy savings of 15.9% when huddled in group of four at 10°C ([Evans 1984g](#)).

When overheated, face away from sun, flutter vascularized gular pouch for evaporative cooling ([Behle 1944a](#), [Bartholomew et al. 1953](#)). Adult flutter rate: 195.4 ± 11.2 (SD)/min ($n = 12$; [Evans 1984f](#)). Subcutaneous air sacs may provide insulation from substrate ([Bartholomew et al. 1953](#)). A parent incubating in strong sunlight may extend wings laterally, probably to aid cooling (illustrated in [Evans 1992](#): Fig. 1a-c).

Drinking, Pellet-Casting, and Defecation

Scoop up water from surface. Not known to cast pellets. May defecate in flight, not in nest but otherwise indiscriminately within colony.

Locomotion

Walking, Hopping, Climbing, Etc

Leans body from side to side, awkward, but able to walk rapidly or run, often with wings spread. Can hop up on rocks at least 30 cm high.

Flight

From O'Malley and Evans [O'Malley and Evans 1982a](#), [O'Malley and Evans 1984](#), and others as noted. Pushes off with feet from both land and water, stretches feet out ahead when landing ([Behle 1958](#)), webs functioning like skis when landing on water. Flies gracefully, either singly, in flight formations, or soaring in thermal flocks. Singles common during departures from colony or foraging site, but they typically join others almost immediately or en route.

Formation flocks typically long lines, often with apex forming Vee or Jay (unequal length of arms), also in irregular patterns. Birds in line sometimes rise and fall in succession creating a wave-like effect. Alternate flapping (60%-75%) and gliding flight, usually at moderate height of 12-15 m ([Behle 1958](#)), at about 50 km/h (Ross 1933 in [Behle 1958](#)). Lead bird usually (42 of 58 instances) initiates phase shift between flapping and gliding, then phase shift passes back through flock in a wave. Response time usually < 0.5 s between successive birds. Wingbeat frequency stable at about 160-175 beats/min. Percent time flapping and wingbeats/hour tend to decrease behind leader, suggesting energy saving when in formation.

Flies close to water surface when going into wind on cloudy days. Much thermal soaring on sunny days. Soaring flocks form near colony, foraging site, or overland depending on location of thermal updrafts. Soaring birds attract others into flock. Soar upward, often beyond view of unaided eye or binoculars (10X). At destination, set wings, circle downward without flapping, often from great heights. Most travelling done from mid-morning to mid-afternoon, probably related to use of energy-saving thermal soaring (for flock sizes see also Behavior: social and interspecific). Soaring confined to thermals with wandering flights in lower portions of a thermal, commuting flights at mid thermal heights, and cross-country flights in the upper reach of a thermal columns ([Shannon et al. 2002](#)).

Swimming And Diving

Swims strongly. Sits high on water, buoyancy enhanced by large system of subcutaneous air sacs in breast area that increases volume up to 61.5% ([Richardson 1943](#)). Commonly swims in groups, with varying degrees of coordinated movements (see Food Habits: feeding). Does not dive like Brown Pelican, but two instances noted of dives from about 5 m ([Hall 1925](#), FLK), both times at Pyramid Lake, NV.

Self-Maintenance

Preening, Head-Scratching, Stretching, Bathing

(Details in [Schaller 1964](#)). Preening the most frequent maintenance behavior, 28.5 times/d, duration about 64 s (range = 1-709, $n = 98$; [Schaller 1964](#)). Breast feathers preened by tipping front of body upward, without disrupting incubation of eggs held under foot webs (see Breeding: incubation). Nibbles contour feathers with tip of hooked bill, draws flight feathers through bill, may bite breast feathers with side of bill. Stands with neck extended to scratch head, neck, or pouch. Stretches leg and wing on same side by extending caudally. Inverts and stretches pouch by opening bill and pulling lower mandible down over front of neck, function uncertain. Pouch also stretched by pointing open bill skyward with laterally flexed rami, called Yawn by Schaller ([Schaller 1964](#)), function unknown; similar to Bill Throw of Brown Pelican ([Schreiber 1977a](#)).

Shakes pouch vigorously by rapidly moving bill up and down, probably to rid pouch or bill of debris after preening, handling nest material, or feeding young. Bathes in water adjacent to colony, immerse bill, splash water with wing.

Sleeping, Roosting, Sunbathing

Incubating birds commonly tuck bill under back feathers and close eyes. Large dense loafing or roosting flocks form on sand bars or banks adjacent to foraging sites both by day and night ([O'Malley and Evans 1984](#), [Mcmahon and Evans 1992b](#)); similar aggregations form on shore at breeding colonies ([Hall 1925](#)). Will sit in full sun, but do not sunbathe.

Daily Time Budget

During incubation, adults exchange places every 72 h, then every 24 h during brooding ([Knopf 1976](#)). Often more birds loafing than actively foraging at foraging sites ([O'Malley and Evans 1984](#), [Mcmahon and Evans 1992b](#)).

Agonistic Behavior

Physical Interactions

Jabs with snapping bill at head, bill, and horn on upper maxilla, sometimes holding bill of other ([Schaller 1964](#), [Knopf 1979](#)). Common during territorial defense or by male directed toward rival male(s) during courtship, rarely also by female (RME). Courting male occasionally lunges at female, who bows or flees. Incubating or brooding parents jab at others, sometimes lunge at and bite or toss foreign young that approach nest. Sibling conflict intense soon after hatching (see Breeding: young birds). Jabbing with physical contact among adults much more common than observed in tree-nesting Brown Pelicans ([Schreiber 1977a](#)).

Communicative Interactions

Threat Displays Gaping. Same as unnamed threat illustrated in Van Tets ([Van Tets 1965](#), see also [Schaller 1964](#)). Here named after similar display in *Pelecanus conspicillatus* ([Vestjens 1977](#)). Head and opened bill extended toward other pelicans or aerial predators, pouch usually not or only slightly extended, sometimes head waved and bill snapped shut. Often associated with lunging and jabbing. Probably a high intensity threat.

Upright ([Schreiber 1977a](#)). Same as Head-up illustrated in Schaller ([Schaller 1964](#)) and Bill Raising illustrated in Van Tets ([Van Tets 1965](#): 35). Described for at least 5 pelican species. Stands erect, neck up, bill forward and upward near or above horizontal, with pouch conspicuously extended ventrally. May be accompanied by grunt. Directed at mate, foreign chicks, and neighbors. Usually considered a mild threat, but possibly for recognition ([Van Tets 1965](#)).

Aerial Upright ([Schreiber 1977a](#)). Same as unnamed aerial display illustrated in Van Tets ([Van Tets 1965](#)). From normal gliding or flapping flight, head and body axis quickly raised as if in a

stall, bill slightly below horizontal, with rapid and conspicuous ventral extension of pouch. Given mainly by male, rarely by female, usually when coming close to others during courtship flights over colony and before landing (RME). Probably a mild threat.

Appeasement Displays: Female Bow (see sexual behavior) when close to or attacked by others ([Knopf 1979](#)); may be appeasement ([Schaller 1964](#)). Smaller young at nest turns away and crouches with bill down when pecked and bitten by larger sibling (see Breeding: young birds).

Spacing

Individual Distance

Loafing flocks appear at a distance as dense bank of white, but individuals may threaten others ([Beaver 1980a](#)). Individuals in coordinated foraging flocks range to less than one bill length apart without aggression ([McMahon and Evans 1992a](#)). Distance between aerial flock members variable, ranging down to 1-2 m when in formations ([O'Malley and Evans 1982b](#)).

Territoriality

Defend immediate vicinity of nest. Territory established by the pair, adjacent to others, during final stages of courtship. Defended with jabs or threats by both members of pair (see agonistic behavior, above). Inter-nest distance, center to center $1.06 \text{ m} \pm 0.20 \text{ (SD)}$ ($r = 0.74-1.85$, $n = 172$; [Schaller 1964](#)); rim to rim $0.59 \text{ m} \pm 0.16 \text{ (SD)}$ ($n = 153$; [Knopf 1979](#)). Size of territory related to combined reach of neighbors on nests ([Behle 1958](#)), but can be smaller ([Schaller 1964](#)), sometimes larger. Maintained by male and female on alternate shifts until young about 3 wk of age, then abandoned by parents, although it may still form a focal point for feeding chicks during early stages of creching ([Evans 1984g](#); see Breeding: young birds).

Interspecifically territorial with Double-crested Cormorants, whose nests may be placed individually or in groups within or adjacent to a pelican sub-colony. Defend territory against gulls (*Larus argentatus*, *L. californicus*, *L. delawarensis*) and may usurp gull territories when these are established before pelicans select nest sites (RME). Winter territory and dominance hierarchies not reported.

Sexual Behavior

Mating System And Sex Ratio

Monogamous. Sex ratio unknown but not obviously skewed.

Pair Bond

Probably not paired on arrival at breeding colony.

Courtship Displays. Courtship Flight ([Schaller 1964](#)). Same as Circle-flying of Van Tets ([Van Tets 1965](#)). Flocks move rapidly, without soaring, around or across colony at low altitude. Origin and end point of individual flights variable, most associated with currently active groups of courting birds destined to become synchronized sub-colonies (see social and interspecific behavior, below). Flock size averages 2.56 birds ($r = 1-7$, $n = 207$) to 2.86 ($r = 1-10$, $n = 155$, mode = 2; [Evans and Cash 1985](#)). Several flocks may exist simultaneously, commonly fusing and splitting up in the air, with reductions to a single pair common. Courtship flights occur throughout the day, most commonly near midday; conspicuous, visible to humans with 10X binoculars over 3 km away. New arrivals attracted to area having the most courting birds visible ([Evans and Cash 1985](#)).

Strutting Walk ([Schaller 1964](#)). Two or more birds parade single file overland with heads erect, bills pointing down. Commonly precedes or follows Courtship Flight. When done by two birds, the larger typically behind, often jabbing at the smaller (presumptive male and female, respectively; [Schaller 1964](#)). May occur throughout the colony exclusive of areas occupied by incubating pelicans, but most common in vicinity of currently active courting groups, where it may terminate when female bows.

Bow (illustrated in [Schaller 1964](#), [Van Tets 1965](#)). Body tilted upward and neck arched, closed bill pointing down, pouch extended, folded wings elevated at the shoulders. Head commonly sways from side to side. Male may bow over neck or back of female. Head and neck held lower in the female, emphasising size differences between the sexes ([Van Tets 1965](#)). Usually associated with nest site selection, where female commonly Bows in response to aggressive jabs by others ([Knopf 1979](#)). Also occurs during nest relief. A "wave bow" and "reach bow" distinguished by Van Tets ([Van Tets 1965](#)), but may be intensity or context variants of single Bow display ([Schreiber 1977a](#)). Probably functions as threat and in recognition, possibly appeasement in female (see: Agonistic behavior). Bowing occurs in other pelican species, interpretations vary (discussion in [Schreiber 1977a](#)).

Head Swaying ([Beaver 1980a](#)). Similar in appearance to display of same name in *Pelecanus occidentalis* ([Schreiber 1977a](#)). Consists of a slow side-to-side head movement in a horizontal figure-eight pattern, bill down and pouch slightly distended. Grades into a single head turn with lateral exposure of the pouch. Given at the nest site during the latter part of courtship and, unlike *P. occidentalis*, is also common during nest relief ([Beaver 1980a](#), RME) and on occasion is directed toward a chick (FLK). Probably functions in individual recognition.

Mate Guarding: Not explicitly described, but aggression by newly paired males during the presumed fertile period of the female is common when new arrivals join actively courting and recently formed nesting groups ([Knopf 1979](#)).

Copulation, Pre- and Post-Copulatory Displays: Copulation may be preceded by Upright by both sexes, and female Bow at nest site. Male mounts and grasps back of female's head or neck, waves wings, grunts. Both members of pair may give Upright Display after copulation ([Schaller 1964](#), [Miller 1977b](#)).

Duration of Pair Bond. Interactions between mates become less common as breeding season advances and parents no longer remain with young or at nest site (see Breeding: parental care). Lasts functionally (parental care provided) at least until young leave colony. Subsequent duration not known.

Extra-Pair Copulations

Apparently rare. Two probable seen, non-complaisant (RME), but documentation remains inadequate.

Social and Interspecific Behavior

Degree Of Sociality

Highly gregarious, typically in groups when migrating, nesting, flying to and from foraging grounds, foraging, and loafing. Breeds in large dense colonies subdivided into smaller sub-colonies that are to varying degrees spatially and temporally separated ([Behle 1958](#), [Knopf 1979](#), [O'Malley and Evans 1980](#)). Sub-colonies originate when courting birds at same stage of reproductive cycle group together and select nest sites in same localized area. All reproductive activities typically more synchronous within, than between, sub-colonies.

Colony Size: Mean = 957.1 nests $\pm$ 1,258 (SD) n = 57 colonies across North America (calculated from data in [Sidle et al. 1985](#)). *Sub-colony Size:* 144.7 nests $\pm$ 146.4 (SD) (*range* = 2-633, n = 51; [Knopf 1979](#)). *Flying Flock Size:* 13 birds (r = 1-66, n = 122), 9.7 birds (r = 1-151, n = 260; [Low et al. 1950](#)). Mean flock size of 9.7 misprinted as "ninety seven" in Behle ([Behle 1958](#):121). Largest reported flock about 300 ([Behle 1958](#)). Thermal flocks (see flight, above) departing colony, 15.9 birds (r = 2-67, n = 52); non-thermal colony departures 2.4 birds (r = 1-13, n = 43; ([O'Malley and Evans 1982a](#)). *Foraging Flocks:* early Jun, daytime, 9.8 birds $\pm$ 25.5 SD (n = 95); night, 28.9 $\pm$ 40.2 (n = 50); late Aug and early Sep, daytime, 3.8 $\pm$ 35.9 (n = 1,220); night, 9.7 $\pm$ 40.8 (n = 578). Night flocks significantly larger than in daytime. Largest reported approximately 2,000 ([Mcmahon and Evans 1992b](#), b). *Loafing Flocks:* adjacent to foraging sites, early Jun, daytime, 22.9 birds $\pm$ 32.8 (n = 107); night 23.2 $\pm$ 28.2 (n = 16); late Aug and early Sep, daytime, 89.6 $\pm$ 119.5 (n = 195); night, 206 $\pm$ 215.8 (n = 43; [Mcmahon and Evans 1992b](#)). *Migratory Flocks:* 20, 40, and 180 birds ([Behle 1958](#)), range 1-250 ([Sidle et al. 1990](#)).

Play

Not known to occur.

Interactions With Members Of Other Species

Commonly share nesting islands with gulls and Double-crested Cormorants (see spacing, above). Less frequently nest near Canada Geese (*Branta canadensis*), Great Blue Herons (*Ardea herodias*), Common Terns (*Sterna hirundo*), and Caspian Terns (*Hydroprogne caspia*), but with few interactions. May forage in association with gulls and Double-crested Cormorants (see Food Habits: feeding), competition reduced when pelicans and cormorants take different sizes of fish

at different depths ([Knopf and Kennedy 1981](#)). Sometimes fly in mixed flocks with Double-crested Cormorants (RME).

Predation

Kinds Of Predators

Mammals include red fox (*Vulpes vulpes*) and coyote (*Canis latrans*). Avian predators mainly sympatric large white-headed gulls (*Larus argentatus*, *L. californicus*, *L. delawarensis*). Raven (*Corvus corax*) take eggs ([Thompson et al. 1979](#)), Great Horned Owls (*Bubo virginianus*) and Bald Eagles (*Haliaeetus leucocephalus*; [Koonz 1987b](#)) take young.

Manner Of Predation

Mammals other than man normally not a problem for colonies on islands, although low water levels can make colonies accessible ([Evans 1972](#), [Fish and Wildlife 1984](#), [Roney 1987](#), [Findholt and Diem 1988](#)). Access over ice possible when nesting begins before lake ice melts ([Blokpoel 1971](#)). Adults rarely subject to predation, but 10 deaths at a breeding colony attributed to foxes ([Blokpoel 1971](#)). Coyote predation of adults at a breeding colony ([Dunbar 1987](#)) and on mainland also reported (Skinner 1917 cited in [Behle 1958](#)), but rare. Coyotes ([Bunnell et al. 1981](#), [Thompson et al. 1979](#)), and probably foxes, take eggs and partially grown young.

Aerial predation restricted to eggs and small young. Gull predation can be severe when parents leave nests in response to human or other mammalian intrusion. Small nestlings from about 1 to 2 wk of age may leave disturbed nests prematurely, and can be vulnerable if unable to return quickly. Scavenging gulls also peck and eat wandering young (< 2 wk old) when evicted from nest by older sibling (See Demography and Populations: mortality and disease).

Response To Predators

Readily desert colony when disturbed by coyotes or man early in nesting period. Initial response of adults at colony to human approach is an Alert posture ([Schaller 1964](#)), similar to Alert posture of *Pelecanus conspicillatus* illustrated in [Vestjens 1977](#). Characterized by elevation of head, followed by standing with head up and wings partially raised, often with contagious wing flapping by many birds within a sub-colony. If encroachment continues, birds take flight and circle, then usually land on water nearby. May stay off nests for long periods early in nesting period. Later in nesting cycle will circle or loiter nearby, quickly walking back onto nests when disturbance ends. Late breeders and those on treed islands less likely to return quickly (RME).

No adult response to avian predators (gulls) until they approach nest site; then parents jab and gape at intruder (see agonistic behavior, above). Do not leave nest to chase predator or to rescue displaced young. Threat of gull predation wanes after 2-3 wk of rapid chick growth. Disturbed young commonly disgorge food, which may be eaten by gulls. Mobile young after about 3 wk typically group together into a creche (see Breeding: young birds) and may run into adjacent water. One instance reported of a chick running from a Raven ([Schaller 1964](#)).

Phenology

Pair Formation

Earliest migrants arrive on foraging grounds in vicinity of colony up to 3 wk before pairing. Courting and pairing occur rapidly once birds arrive at colony. Onset variable, later where spring temperatures lower. Last week of Mar, Utah ([Knopf 1979](#)); 15-26 Apr, s. Manitoba ([Evans and Cash 1985](#)); late Apr to early May, Wyoming ([Schaller 1964](#)); 27 Apr to 11 May, n. Alberta ([Beaver and Lewin 1981](#)).

Nest Building

Extends over 3-5 d at individual nests ([Knopf 1979](#)), beginning a day or two after onset of courting. Nest initiations proceed rapidly and synchronously among close neighbors within a sub-colony, usually for about 1 wk, range 2-9 d ($n = 12$ sub-colonies, [Knopf 1979](#)). Sub-colony growth ends when courting birds are no longer strongly attracted to birds already nesting and courtship shifts to another area. Later additions to sub-colonies occasionally occur, and later sub-colonies are sometimes positioned immediately adjacent to earlier ones. For colony as a whole, nest initiations extend over 3 mo, Utah ([Knopf 1979](#)).

Only Brood Per Season

Laying, Hatching . See [Figure 3](#) for Utah. Phenology within and between sub-colonies follows the same pattern as courtship and nest building. Total time from onset of courtship flights to onset of laying is about 5-8 d ([Evans and Cash 1985](#)). Laying starts about 4-5 d after nest site selection. Modal laying interval 2 d between 1st and 2nd egg. Hatching approximately 30 d after laying ([Knopf 1979](#)). *Departure of Young*. Young remain in nest attended by parent until 2-3 wk of age, then begin to form into creches (see young birds, below) as parents begin to leave nests unattended ([Evans 1984g](#)). First flights by 9-10 wk, young begin to leave colony, presumably for foraging grounds, by 10 wk ([O'Malley and Evans 1982a](#)).

Nest Site

Selection Process

Newly formed pair selects site adjacent to others at same stage of breeding cycle. May visit several potential sites before remaining at one. Selection accompanied by much jabbing and bowing (see Behavior), leading eventually to successful defense of site ([Knopf 1979](#)). Female typically in front of male when walking to potential site, but role of sexes in determining final choice uncertain. Selection of site after pairing differs from Brown Pelican ([Schreiber 1977a](#)) and many other Pelecaniformes ([Van Tets 1965](#)) in which male selects site prior to pairing. Nest site tenacity between years is low or absent. Sub-colonies commonly shift location from year to year when habitat is available.

Microhabitat And Site Characteristics

Habitat at colony site reflects local area. Nests placed on flat or moderately sloping surface for flight access and visibility. On low-lying islands, use higher central portions ([Hosford 1965](#)) less subject to natural flooding. Substrates variable, with gravel, sand, or soil preferred. Use of sparsely vegetated areas predominates in southern and dryer regions, grading to shrubs ([Hall 1925](#), [Schaller 1964](#)) and trees in forested regions ([Vermeer 1970c](#), [Trottier et al. 1980](#)). Nest site and territory support little or no vegetation, but nests commonly adjacent to or interspersed within available cover, for example, alkali weed (*Bassia*; [Alcorn 1943](#)), bluegrass (*Poa*), reeds (*Phragmites*; [Hosford 1965](#)), nettles (*Urtica*), and cinquefoil (*Potentilla*; [Trottier et al. 1980](#)). Herbaceous cover provides little shelter from rain, wind, or sun when nests first constructed. New growth may provide shade for young. In forested regions, sometimes nest under trees, including poplars (*Populus*), spruce (*Picea*), fir (*Abies*; [Trottier et al. 1980](#)) and willows (*Salix*). Must walk from nest to forest edge before flying ([Stepney 1987](#)). Trampling and nitrogenous wastes destroy cover near nests ([Miller 1982](#)). Unusual nesting substrates include floating bulrush mats and tops of partially submerged haystacks ([Thompson et al. 1979](#)).

Nest

Construction Process And Composition

Shallow depression with low rim formed from sitting position by raking up gravel, soil, or nearby vegetation with bill. Nest bottom of same material, vegetative insulation none to variable, no other lining. Occasionally dig with the bill into bottom of nest, may pull in additional material up to and after the onset of hatching ([Evans 1989](#)). Rim often trampled and poorly defined, providing only limited protection against eggs rolling out or movements of chicks. Unlike Brown Pelicans ([Schreiber 1977a](#)), both sexes build nest and neither leaves nest site to gather nest material ([Knopf 1979](#)).

Dimensions

Outside diameter up to 89 cm, usually about 61 cm, height up to 30 cm, usually about 20 cm ([Behle 1958](#)). Diameter at crown 38-51 cm ([Palmer 1962a](#)). Cup depth 5 cm or less at end of nesting season ([Schaller 1964](#)).

Microclimate

Nest cup normally covered by incubating parent. Nest provides minimal microclimatic buffer.

Nest Reuse

Nest material may be taken from abandoned nests, but nests not reused.

Nonbreeding Nests

Not known to occur.

coordination, it begs more actively, including running bill along edge of parent's mandibles.

Demography and Populations

Measures of Breeding Activity

Age At First Breeding; Intervals Between Breeding

Begins at 3 yr ([Sloan 1982](#)), probably annually thereafter.

Clutch

Normally 2 eggs. No authenticated reports of 1 or 3 eggs from the same female. Reduced clutches common due to egg loss. Larger clutches rare, probably result when abandoned eggs that roll from nearby nests are retrieved by adult ([Hall 1925](#), [Knopf 1979](#)). One clutch/yr. Not known if renesting occurs after early clutch loss.

Annual And Lifetime Reproductive Success

For Gunnison Island, Great Salt Lake population, 1973-1974, in herbaceous cover and bare areas, 0.85 young fledged/nest ($n = 1,057$ nests), 0.85/nest in shrubs ($n = 144$ nests), and 0.89/nest near driftwood ($n = 142$ nests). Success independent of sub-colony size, but decreases with season from a high of about one chick/nest for eggs laid in early Apr to about 0.4/nest or less for those laid in Jun, Utah probably reflecting later breeding by younger birds ([Knopf 1979](#)). For breeding colonies at Chase Lake NWR in North Dakota, from 0.34 ($n = 5,268$ nests) to 0.68 ($n = 6,142$ nests) young/nest (all early Aug counts), with subsequent losses of from 4% to 10% before departure from colony site ([Sidle et al. 1984](#)). Productivity highly variable among years, however ([Diem and Pugesek 1994](#)); see also Mortality and Disease, below). Lifetime reproductive success not known.

Life Span and Survivorship

In North Dakota, 41% mortality from fledging through first year, 16% in second year, mean of 21.3% for third through thirteenth year, ([Strait and Sloan 1974](#)). Similar rates for Colorado ([Ryder 1981](#)). Estimates of adult mortality demonstrably too high, due to band loss ([Strait and Sloan 1974](#), [Ryder 1981](#)). Maximum reported lifespan 26.4 yr, from 4,344 band returns ([Clapp et al. 1982b](#)).

Disease and Body Parasites

Infestations of biting lice (*Piagetiella peralis*, Mallophaga) common on breeding adults and dependent young ([Price 1970](#)); mainly on mouth and inside throat of adults; sometimes enter egg through pip hole ([Behle 1958](#)). Clusters of lice at back of neck and axilla of wing in naked young, extending into mouth and pouch by 1–2 wk ([Samuel 1982](#)). Up to 100% of 200 young and 98% of 300 young infected at 5–7 wk. Lice produce bleeding lesions subject to secondary infection, but no definite evidence of mortality ([Sidle et al. 1984](#)).

The nematode, *Contracaecum spiculigerum*, reported from stomach of adults and 3-wk old young. Adults also carry tape worms (*Hymenolepis* sp., *Dibothrium cordiceps*, *Oilgorchis longivaginatus*) in gut ([Behle 1958](#)). Subcutaneous mites (*Pelecanectes apunctatus*) noted from a single adult specimen ([Tuggle 1983](#)). No evidence of mortality from these parasites.

Causes of Mortality

In Utah, 20 (8.3%) of 242 eggs and 22 (9.9%) of 222 eggs rolled out of nest; nest desertion at 22.4% of 1,930 nests and at 28.7% of 2,348 nests significantly greater for peripheral than centrally located nests ([Knopf 1979](#); see also Conservation and Management: sensitivity to disturbance). Starvation of young reported in years when food is scarce. Minor causes of mortality include hail (601 of ~5,000 migrating pelicans killed on 15 Apr 1994, DeWitt and Lavaca counties, Texas (Texas Parks and Wildl. News 22 April 1994), lightning, hitting wires ([Behle 1958](#)), and botulism ([Hendricks and Johnson 2002](#); see below for additional causes of death).

Brood Reduction

Both young fledged at 9.7% and 9.4% of 195 and 374 nests, Utah ([Knopf 1979](#)), a maximum 3.15% of 127 nests, N. Dakota ([Johnson and Sloan 1978](#)), and none of 70 nests, Manitoba ([Cash and Evans 1986](#)). Smaller chick usually dies within first 1–2 wk, 3.15% alive at 2 wk ($n = 127$ nests), N. Dakota ([Johnson and Sloan 1978](#)). No second-hatched chicks alive at 12 d, ($n = 50$ nests); survival for an average of 3.7 ± 2.4 d ($n = 13$) and 4.9 ± 2.8 d ($n = 32$), Manitoba ([Cash and Evans 1986](#)). Second egg shown experimentally to function as “insurance,” replacing older sibling if it fails to hatch or dies early ([Cash and Evans 1986](#), [Evans 1996](#), [Evans 1997d](#)). Similar insurance function likely but unproven in other pelican species. Alternatively, asynchronous hatching in White Pelicans hypothesized to be a mechanism for reducing brood size for younger, inexperienced breeders given that eggs hatching synchronously often result in two chicks surviving ([Knopf 1980](#)).

Exposure

Newly-hatched naked young succumb within 5 min in full sun at nests with floor temperature up to 48°C ([Johnson and Sloan 1976](#)). If chilled to 10°C, young at 4–5 d huddle and vocalize, may become motionless, then active again upon rewarming ([Evans 1984f](#)). Vocalizing by exposed young elicits parental brooding ([Evans 1992](#)). Young at 1–2 wk of age may succumb to chilling if out of nest and unbrooded overnight (RME).

Predation

Adults rarely preyed upon. Eggs and young rarely taken at undisturbed colonies unless low water makes them accessible to coyotes. Scavenging gulls are the main predator at disturbed colonies, and at undisturbed colonies take deserted eggs and younger chicks that are expelled from the nest by an older sibling. See also Behavior: predation.

Range

Initial Dispersal From Natal Site

Instantaneous, without return at colonies where foraging areas are distant. In these cases, initial dispersal is the same as “Dispersal from breeding colony”. Not described when colonies are located in a wetland that also contains foraging opportunities.

Site Fidelity

Data needed. Some young return to natal colony as breeders: 2 noted by Behle ([Behle 1958](#)), 9 pre-breeding 2-yr olds noted by Miller ([Miller 1977b](#)) (= 2.3 % of dispersing cohort). Several color-coded birds banded as young in the late 1970s still breeding at natal colony in 1993 (East Shoal Lake, Manitoba; RME). Breeding away from natal colony also documented ([Ryder 1981](#)). Adults rarely, if ever, use the same nest site in successive years. Unknown if individuals faithful to local winter range in successive years.

Dispersal From Breeding Colony

From Great Salt Lake, UT, some move north into Idaho before migration, but major premigratory buildup is on summer foraging grounds ([Behle 1958](#)). For three colonies in n. California and Nevada, dispersal varied in direction and distance among both colonies and years ([Keith and O'Neill 2000](#)), suggesting an adaptive, nontraditional approach to exploiting ephemeral wetlands (FLK).

Home Range

Except for nest sites, living space is not defended. Home range includes land and water areas adjacent to breeding site, distant foraging areas, adjacent loafing bars, and aerial travel lanes in between. Loafing and feeding sites also used on migration ([Behle 1958](#), [Sidle et al. 1990](#)).

Population Status

Numbers And Trends

Numbers of breeders traditionally documented by one-time nest counts at colonies. Total known U.S. nests, 1964: 17,872 (calculated from [Lies and Behle 1966](#)), 1980–1981: 22,299 ([Sidle et al. 1985](#)). Total Canadian nests, 1967–1969: 14,103 ([Vermeer 1970c](#)), 1979–1980: 32,256 ([Sidle et al. 1985](#)), 1985–1986: 53,345 ([Koonz 1987b](#)). No suveys of colonies have been conducted since these dates, owing, in part, to availability of better data from the Breeding Bird Survey. Mexican nests sporadic, about 100 ([Chapman 1988](#)). Nonbreeders estimated at 13%–22% of breeders (calculated from [Lies and Behle 1966](#)). Long-term historical decline until 1960s ([Thompson 1933](#), [Lies and Behle 1966](#)), subsequently increased through 1980s ([Sidle et al. 1985](#), [Koonz 1987b](#)).

Breeding Bird Survey data indicate continental population increasing steadily and rapidly at rate of 3.9%/yr from 1980 through 2003 ($P = 0.01$, 172 BBS routes). These increases seem driven by expanding populations in the United States (5.6%/year, $P = 0.02$, 136 BBS routes) more so than in Canada (1.5%/year, $P = 0.20$, 30 BBS routes). Within the U.S., population changes are driven by recent increases in Minnesota (22.7%/yr, $P = 0.06$, 18 BBS routes), North Dakota (21.6%/year, $P = 0.06$, 16 BBS routes), and Wyoming (16.1%/yr, $P = 0.00$, 17 BBS routes) during that time period ([Sauer et al. 2003](#)).

Population Regulation

Influenced locally by water levels that flood nests or allow islands to become connected to the mainland and accessible to mammalian predators (see Behavior: predation), but continental impact reduced when populations are able to shift to more favorable areas (see Habitat). Largest colonies characterized by stable and adequate nesting habitat, food supplies, and minimal disturbance. Food shortage may limit reproductive success locally in some years ([Behle 1958](#), [Johnson and Sloan 1978](#)). Human disturbance and permanent destruction of foraging and breeding habitat considered critical historically ([Thompson 1933](#)) and remain the most important potential limiting factors despite recent population growth resulting from improved conservation efforts and legal protection ([Johnson and Sloan 1976](#), [Fish and Wildlife 1984](#), [Koonz 1987b](#)).