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Cover: *In the Huayhuash Mountains, northeast of Lima, Peru, a Quechua boy pauses to rest with a load of scarce firewood. Photograph by John Maddock Roberts. Article on page 72.*

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A Least Tern Makes a Right Turn

With a little help from the Endangered Species Act, an imperiled California bird is on the road to recovery

by Barbara W. Massey

Photographs by George D. Lepp

One endangered animal that seems to have a good chance for survival is the California least tern (*Sterna albifrons browni*). This feisty bird, the smallest of its genus, is making a comeback, thanks to strong protective efforts on its behalf. The California least tern is one of three subspecies of *S. albifrons* that breed in the United States. On the eastern seaboard *S. a. antillarum* nests on beaches from Maine to Florida, its breeding biology very similar to the California least tern. An inland race, the interior least tern (*S. a. athalassos*) nests on sandbars in rivers of the Mississippi drainage system. The west coast birds breed from

San Francisco Bay to the tip of Baja California. All three subspecies are beset by problems, mostly due to loss of habitat, but thus far only the California least tern has been listed as endangered.

The California least tern has traditionally nested on beaches and salt flats adjacent to estuaries, feeding on small fish taken from a wide range of habitats—estuaries, open ocean, rivers, and lakes. The terns usually arrive in California in mid- or late April, and for several weeks engage in aerial courtship. One frequently observed aerial display is the fish flight, initiated by a male carrying a small fish and calling as he flies. He is joined by one and sometimes two other least terns (presumably females) for some fast and vocal high flying. Another spectacular display is the aerial glide—formation flying by a pair that rise high in a weaving pattern and then soar downward in unison in a beautiful glide. At night the terns congregate at roosting sites on beaches, using the same locations year after year. The ground phase follows aerial courtship and is characterized by acts that help cement the pair bond, with courtship feeding of females by their mates one of the most important rituals. Copulation is frequent at this stage. The male

Undaunted by the proximity of sunbathers, California least terns loaf on the beach in Venice, California. Developed extensively in recent decades, this coastal community was a tern nesting site until human disturbance finally drove the birds off the beach in the early 1960s. When 35 pairs reestablished a colony in 1977, however, protective fencing was quickly erected around the nesting area. About 150 pairs nested on the beach in 1980, making the colony the largest in the state.

often holds a fish in his bill throughout the precopulatory sequence, and the female reaches up and takes it from him at the moment of cloacal contact.

As the time for egg laying approaches, the pair begin to look for the particular spot where the nest will be scraped in the sand. They engage in elaborate scrape making, moving from place to place until the female finally selects a site to her liking and scrapes out a simple hollow for the eggs. From one to three eggs (usually two) are laid on consecutive days, after which both adults take turns at incubation duties.

The relative serenity of the incubation period is the lull before the storm. After about three weeks, the eggs hatch and the tempo quickens. The precocial chicks begin wandering away from the nest scrape a day or two after hatching. Their diet consists solely of small fish brought to them by both parents. Parents only feed their own chicks, and the chicks learn to respond only to the calls of their parents as they fly in with fish. Since the chicks are extremely mobile, and a colony of a hundred pairs of California least terns can have 200 chicks running around simultaneously, the communication system must be firmly established on the first posthatching day. The chicks are on the ground for about twenty days after hatching, eating voraciously and growing rapidly until they are mature enough to fly. During both the incubation and posthatching periods, the colony is extremely vulnerable, and eggs and chicks are regularly lost to ground and aerial predators. Disturbance by people can also have serious consequences during this time as the presence of intruders on the nesting grounds keeps adults off their eggs or away from their chicks. Once the chicks are airborne, the hazards diminish.

After fledging, the juveniles begin to fish for their own food, practicing in local ponds and still-water bays. It takes a lot of practice before they acquire the skills necessary to feed themselves, so parents continue to feed their young long after they have fledged. At dusk, adults and juveniles congregate at roosting sites on the beaches where they spend the night. These roosting areas and postbreeding fishing sites play an important role in the life history of the least tern, and must be protected along with the more obvious nest sites and adult fishing grounds. By August the nesting season is usually over and migration to wintering areas has begun. Family groups are maintained during migration, and adults can be seen feeding juveniles at fishing and loafing areas en route.

The least terns' predilection for nesting on beaches and foraging in estuaries was the major cause of their drastic decline in numbers. The tremendous growth of the human population in California after World War II, particularly along the southern coast, put pressures on the birds that they could not withstand. In terms of breeding habitat, undisturbed beaches became scarce and most of California's estuaries were dredged and converted into marinas. Colonies that once numbered hundreds of pairs were reduced to remnants or vanished altogether. But the terns showed remarkable adaptability and ingenuity in finding substitute nest sites;

As this least tern emerged from the egg, the first moments of its life were captured by the photographer. The chick's cryptic coloration provides a defense against predators.

In a sequence of courtship and mating, a male approaches a female with a fish. After much head moving and wing fluttering, the male mounts the female. During copulation the female reaches up and takes the fish.

they have nested successfully between runways on airports, on parking lots and freeway cloverleafs, and on an abandoned trash dump, to name just a few. Adaptability notwithstanding, the least tern was fighting a losing battle in southern California as coastal lands were relentlessly developed and would not have been around much longer if drastic steps had not been taken.

The passage of the federal Endangered Species Act in 1969 began a reversal of the downward spiral. The act covered not only species of endangered animals (for example, the California condor, *Gymnogyps californianus,* but also subspecies that were in jeopardy). California quickly passed its own act, and finally, there was legislation that could be used to assist beleaguered animals such as the California least tern. A list of endangered species and subspecies was drawn up by the U.S. Fish and Wildlife Service, the state of California followed with its own list, and the California least tern was on both lists.

My involvement with the birds began at this time. I was a middle-aged returnee to graduate school at California State University, Long Beach, retraining to become a field biologist. For a master's thesis project, I wished to do a field study, and my adviser, ornithologist Charles T. Collins, suggested the California least tern. It had just been listed as endangered, but there was almost no information on its breeding biology and, thus, no guidelines as to how to protect it. Several local breeding colonies made daily observations feasible. My commitment to the terns, in retrospect, was instant and total.

In 1971 the California Department of Fish and Game began to protect the birds during the breeding season and to fund some preliminary studies. A survey of nesting sites was made in 1971, and in 1973 the first statewide census was taken. The passage of the California Coastal Zone Act in 1972 resulted in the creation of regional commissions to monitor development along the coast and a statewide commission to hear appeals. The California Coastal Plan, written by the staffs of both the local and state commissions, was approved by the state legislature in 1976. A priority item in the plan is the preservation and restoration of coastal wetlands. Since its inception, the state commission has taken a strong stand on protection of coastal wetlands and endangered species and has supported all efforts made on behalf of the least tern.

The Endangered Species Act was much strengthened by Congress in 1973, and one of the results of the amended act was the formation of a recovery team to watch over the California least tern. Since 1974, the team has played a vital role in the turnaround in the fortunes of the tern (it is almost impossible to write about terns without at least one play on words). The team was charged with writing a recovery plan spelling out the procedures necessary to insure the survival of this endangered bird. One of the most important aspects of the plan was the delineation of habitats considered essential for successful breeding. Included were nest sites, fishing areas, loafing spots, night roosts—any place that was of importance in the breeding cycle and was in regular use by the birds during some part of their stay in California. The plan was completed in 1977 and approved by the U.S. Fish and Wildlife Service in 1980.

Protection of the terns' habitat is the core of the recovery plan. Currently, there are about a dozen nest sites under the protective aegis of a federal, state, or other public agency; the plan recommends secure nest sites in "at least twenty coastal wetlands ecosystems" throughout the birds' range. An annual census of the breeding population, surveillance of all colonies during the nesting season to spot and correct problems as they arise, creation of new nesting sites, research programs to learn more about the birds' breeding biology, exploration of Baja California during the spring to identify the rest of the breeding range, and exploration of the west coasts of Mexico and Central America to determine the wintering range are all aspects of the plan that have been implemented in varying degrees.

Since the first breeding census in 1973, the population has been monitored annually with funds made possible by the Endangered Species Act. About six hundred pairs were estimated in 1973 and for the next three years that figure remained stable. In 1977 there was a modest increase of about fifty

pairs and we were hopeful, but reserved judgment. Censusing techniques had improved, new colonies were being found, and the increase might simply reflect these factors and not be real. But the figures kept climbing in 1978 and 1979, and by 1980 more than nine hundred breeding pairs were counted. It is hearteningly apparent that protective measures are working.

With the increase in population came a need for new nesting areas. Creation of nest sites is an idea still in its youth, but decidedly past infancy. After several attempts that failed, but from which important information was obtained, two successful sites were created on islands in salt marshes in northern Orange County. They were used by the terns in 1979, 1980, and 1981. In all cases, the beaches associated with the salt marshes were heavily peopled during the summer months and no least terns had nested on them for more than thirty years. One of the sites was an existing landfill in the Seal Beach National Wildlife Refuge in Anaheim Bay, connected by a narrow causeway to the mainland. The rough surface of the island was leveled and topped with sand, and pairs of papier-mâché decoys were scattered about. One of life's more satisfying moments occurred when I saw a least tern land and offer a fish to a decoy. Soon there was a small group of nesting birds, and in early June 1979 the first chicks hatched. But as the season advanced, predators began to take a heavy toll of the chicks. By the end of the season the refuge managers knew that predator control was mandatory. In 1980, about a month before the terns were due to arrive, live traps were set around the island and twenty-nine skunks, five feral cats, three red fox, and two opossum were removed from the area, indicating the magnitude of the problem. An electric fence was then installed across the causeway. The measures proved reasonably effective against ground predators but no defense at all against birds of prey (American kestrels, burrowing owls, crows). Even though predation was a continuing problem, forty-three pairs of terns nested in Anaheim Bay in 1980 and produced a respectable number of fledglings.

At Venice Beach in Los Angeles another success story has unfolded during the past few years. In 1977, a resident of this beach-front community reported to the California Department of Fish and Game that several least terns nesting on the beach were being molested by dogs and people. Venice Beach is at the mouth of a former estuary, now almost totally channelized and converted into a marina. Once the site of a large nesting colony and now a heavily used bathing beach, Venice had not been used by the terns since the early 1960s. Concerted action by several agencies, prodded by concerned citizens of Venice, resulted in the erection of protective fencing around the few hardy pairs that were attempting to nest on the beach. The birds' response was immediate, and by the end of the 1977 season there were 35 pairs. The terns came back and nesting was successful the following year. (It has been our experience that if the terns succeed in hatching chicks they will usually return the next year, even if none of the chicks survive to fledge.) The colony has grown with giant steps

A male presents the small fish he has caught to his mate sitting in a nest scrape, below. The adult bird, right, is incubating a clutch of eggs at a nesting site on the coast of California.

each season, and in 1980 about 150 pairs nested in the fenced sanctuary, making it the largest in the state. An estimated 240 fledglings joined the migratory flock at the end of the season. The successful reestablishment of the Venice colony is an encouraging sign that there eventually may be California least terns nesting all along the coast on beaches from which they were extirpated.

Proper management of an endangered species must be based on a thorough knowledge of its life history. At the same time, the study of an endangered species must proceed with extreme caution in order not to jeopardize the subject one is trying to protect. Breeding California least terns do not tolerate more than a minimum amount of handling, and our research has been tailored to their needs. In 1976, we embarked on a long-term study based on color banding of chicks. The banding is done under the auspices of recovery team member Charles T. Collins, and my colleague on this project is Jon Atwood, a doctoral candidate in biology at UCLA. We have found that a group of three to five experienced people can move through a large colony in the early morning and collect growth data and color band about fifty chicks an hour, after which the colony is left to return to its daily routine. There have been no untoward effects from this procedure.

We have banded more than 2,000 chicks since 1976, and since 1978 have color coded youngsters so that many returning adults can be identified in the field as to age and natal colony. We now spend many hours during the nesting season in a blind looking for and trapping banded birds. The information being sought through banding includes age of first breeding, tenacity of the pair bond, duration of breeding life, intercolony movements, postseason wandering, and where the birds go for the winter. Data on returning birds are accumulating at an accelerated pace each year. We have learned that the terns begin breeding at the age of two; these young birds arrive on the nesting grounds about six weeks after the older, experienced breeders, and lay their eggs after the first wave of chicks has already hatched. None of the larger terns of the genus *Sterna* breeds regularly at such an early age, and this finding was quite unexpected. When the adults return for the first time to breed, they do not necessarily come back to their natal colony. Once they have bred successfully at a site, however, they show a marked tendency to return the following year.

Information on pair bonds is, at this stage, ambiguous. Pairs apparently remain together throughout a season, as evidenced by banded pairs renesting after the loss of eggs or chicks. But the tenacity of the pair bond from season to season varies. Some birds return annually to the same spot in a breeding colony with the same mate; others have returned to the same or a different colony with another mate. One pair of banded birds "divorced" after a year, and the following season each nested with a new mate within fifteen feet of its previous territory.

The question of where California least terns spend the winter is one of the most challenging aspects of our research.

When Jon Atwood and I organized a group to look for wintering areas in December 1978, our only sure knowledge was that the terns went south of the California border, as there were no wintering records in the United States. At that time there had been no banding recoveries outside the United States and we had no clues as to where to begin our search. (There has since been one recov-

Two- to three-day-old chicks are fed by their parents. Because the chicks have successfully hatched, the adult pair will return to the same nesting area next year, whether or not these young survive to fledge.

ery from Guatemala.) We decided to start at Guaymas on the northwest coast of mainland Mexico and work south, spot-checking estuaries all the way to Chiapas. On our first trip we saw no least terns at all. The following winter Alan Craig of California's Department of Fish and Game, and head of the recovery team, visited some of the areas we had not been able to cover and found a group of seventy-five least terns at an estuary in Colima, south of the city of Manzanillo. The terns, unfortunately, could not be approached closely enough for bands to be detected.

In January 1981 we headed south once again, this time to concentrate on the Colima coast. We found a small number of wintering least terns at three estuaries south of Manzanillo. Several of the birds were banded, and one memorable morning we saw a color-banded bird at Boca de Pescuales. It was identifiable, thanks to color coding, as a California least tern, banded as a chick at Huntington Beach State Park in Orange County in 1979.

Colima appears to be the northern limit of the birds' wintering range, but we have yet to identify the major wintering area, as we saw only twenty to thirty wintering least terns in Colima. Much of the coast of southern Mexico has not been searched, and the recovery of one bird from Guatemala suggests that the wintering range may extend south along the coast of Central America.

Our interest in finding the wintering grounds is more than academic. The birds are being protected in California during the nesting season, but two-thirds of their year is spent elsewhere, under conditions about which we know nothing. If we are to be effective in protecting this migratory bird, we must know its entire life history, not just the segment that takes place on our shores.

The goal of the recovery plan for the California least tern is to restore the breeding population to 1,200 pairs, or double the number in existence when the bird was first listed as endangered. With continued protection and the creation of additional nesting sites, that goal could be reached within five years. If at that time there are viable breeding colonies in at least twenty different coastal wetlands, all permanently protected, the birds' recovery will have been accomplished, and it can then be considered for removal from the endangered species list. That will be cause for celebration. □