

HISTORY OF ORNITHOLOGICAL EXPLORATION OF THE SALTON SINK

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Abstract. Ornithological exploration of the Salton Sink began prior to the formation of the present-day Salton Sea with collecting efforts by E. A. Mearns and F. X. Holzner, E. W. Nelson and E. A. Goldman, F. Stephens, and others from 1894 to 1905. The first exploration of the Sea itself was reported by Joseph Grinnell in 1908. Additional studies by W. L. Dawson, A. J. van Rossem, L. H. Miller, J. R. Pemberton, and others helped establish the uniqueness of the Sea's avifauna. Significant egg collections were also made in these early years. Among new taxa described from the Salton Sink, *Butorides virescens anthonyi* is based on a Mearns' specimen from 1894, *Melospiza melodia saltonis* on Grinnell's 1908 collection, and *Gelochelidon* [= *Sterna*] *nilotica vanrossemi* on birds taken by Pemberton and described by G. Bancroft in 1929. B. and M. Clary published several distributional records in the 1930s, and important collections were made by E. A. Cardiff in the 1940s through 1960s. A fuller understanding of the diversity of birds using the Salton Sink, including an array of post-breeding visitors from the subtropics, developed with work by serious amateur field ornithologists, notably G. McCaskie, beginning around 1960–1965 and continuing to the present. Also, from the 1950s to the present, birds breeding in the thermally challenging Salton Sea environment have served as subjects for research on avian physiological ecology and behavioral adaptations. The Salton Sea National Wildlife Refuge has maintained files on the avifauna of the region since the 1930s. Federal and state agency census and management work has concentrated on harvestable waterfowl, but especially since the 1970s research has expanded to non-game species, including listed species such as the Yuma Clapper Rail (*Rallus longirostris yumanensis*). The role of the Salton Sink in the migration ecology of shorebirds, grebes, and pelicans has received considerable recent study, as have breeding colonial waterbirds, Burrowing Owls (*Athene cunicularia*), and polytypic landbirds. Present day research is largely focused on baseline data and predicted effects of various proposed remedial actions to stabilize the Sea.

Key Words: history of ornithology; Salton Sea; Salton Trough.

HISTORIA DE LA EXPLORACIÓN ORNITOLÓGICA DE LA CUENCA DEL SALTON

Resumen. La exploración ornitológica de la Cuenca del Salton comenzó antes de la formación de lo que es hoy en día el Mar Salton, con los esfuerzos de colecta de E. A. Mearns y F. X. Holzner, E. W. Nelson y E. A. Goldman, F. Stephens, y otros entre los años 1894 y 1905. La primera exploración del Mar Salton en sí mismo fue reportada por Joseph Grinnell en 1908. Estudios adicionales conducidos por W. L. Dawson, A. J. van Rossem, L. H. Miller, J. R. Pemberton, y otros ayudaron a establecer la singularidad de la avifauna del Mar Salton. Significativas colecciones de huevos fueron hechas también durante estos primeros años. Entre las descripciones de nuevos taxones para la Cuenca del Salton, *Butorides virescens anthonyi* es basada en un espécimen de Mearns de 1894, *Melospiza melodia saltonis* basada en la colección de Grinnell de 1908, y *Gelochelidon* [= *Sterna*] *nilotica vanrossemi* en aves capturadas por Pemberton y descritas por G. Bancroft en 1929. B. y M. Clary publicaron varios records de distribución en los años 1930, e importantes colecciones fueron hechas por E. A. Cardiff entre las décadas del '40 al '60. Un entendimiento más completo de la diversidad de aves que usan la Cuenca del Salton, incluyendo un grupo de aves visitantes post-reproductivas del subtropical, se desarrolló con el trabajo de serios ornitólogos de campo aficionados, particularmente G. McCaskie, comenzó alrededor de 1960–1965 y continúa al presente. También, desde la década del '50 al presente, aves que se reproducen en desafiantes ambientes termales del Mar Salton han servido como sujetos de investigación en ecofisiología de aves y adaptaciones de comportamiento. El Refugio Nacional de Vida Silvestre del Mar Salton ha mantenido archivos de la avifauna de la región desde los años '30. Los censos y el trabajo de manejo de agencias federales y estatales se han concentrado en aves acuáticas de caza, pero especialmente desde la década del '70 la investigación se ha expandido a otras especies, incluyendo especies listadas como importantes para la conservación como el Rascón Picudo de Yuma *Rallus longirostris yumanensis*. El rol de la Cuenca del Salton en la ecología de migración de aves costeras, zambullidores, y pelícanos ha sido estudiado recientemente en forma considerable, de la misma manera que aves acuáticas coloniales, los Tecolotes Llaneros (*Athene cunicularia*), y diversas aves terrestres. La investigación actual está principalmente enfocada en datos base y la predicción de los efectos de varias acciones remediadoras conducidas para estabilizar el Mar Salton.

Palabras claves: Depresión de Salton; historia de la ornitología; Mar Salton.

The current prominence of the Salton Sea in bird research, management, and conservation efforts has been preceded by a long history of profound change in the landscapes of the Salton Trough (the modern-day Coachella and Imperial valleys south through the delta of the Colorado River) as well as an interesting, if not entirely thorough, eleven decades of ornithological exploration. Avifaunal change in response to changing habitats has been a hallmark of this region, from the periodic flooding of the Salton Sink (most recently embodied by the present-day Salton Sea), through the destruction of much of the native riparian and desert vegetation, the large scale importation of water for agriculture, the ongoing dynamics of the Salton Sea's aquatic ecosystems, and the recent extensive urbanization and industrialization of the Mexicali, Imperial, and Coachella valleys.

In the context of this symposium volume on the Salton Sink we provide a historical account of the development of knowledge about the region's avifauna. We take the approach of examining a series of broadly overlapping periods corresponding to (1) the initial exploration of the general biota of the Salton Sink region prior to the formation of the modern Salton Sea, (2) the early explorations and collecting efforts after the Salton Sea's formation in 1905–1907, (3) the establishment of game management areas and wildlife refuges and their associated research and management, (4) a long period of refinement of distributional and ecological information that continues to the present day, (5) behavioral and ecophysiological studies from the 1950s to the present using the Salton Sea as a laboratory of avian adaptation to a thermally challenging environment, and (6) recent (generally post-1970) focused research on sensitive and declining bird species and on ecosystem health, which has intensified greatly within the last decade.

EARLY EXPLORATION OF THE SALTON TROUGH PRIOR TO THE FORMATION OF THE SALTON SEA

Knowledge of the avifauna of the Salton Trough prior to the formation of the modern Salton Sea is quite limited and reflected primarily in collections of exploratory parties from the United States government, and in particular those collections housed in the National Museum of Natural History (formerly United States National Museum, hereafter USNM). Edgar A. Mearns, assisted by Frank X. Holzner, collected for the United States and Mexican Boundary Commission from 7 April to 6 May 1894 with an itinerary that included the following sites in the Salton Trough: Cooks Wells, Seven Wells, Gardner's Laguna, Salton River, Laguna del Al-

amo, Unlucky Lake, Indian Wells, New River, Laguna Station, and Mesquite Lake (Mearns 1907). Edward W. Nelson and Edward A. Goldman collected specimens, primarily for USNM, around 1905 to 1907. Frank Stephens collected in the general region in the 1890s, including some important collections from the Salton Sink itself; in later years he made additional important collections from the Salton Sink for the San Diego Natural History Museum, an institution whose interest in that area continues today with the collecting efforts of Philip Unitt, Roger Higson, and others.

The prehistoric avifauna of the Salton Sink has also been studied through the collection and identification of zooarchaeological remains along the shores of Lake Cahuilla, the forerunner of the modern Salton Sea that intermittently occupied the Salton Sink (see Patten and Smith-Patten *this volume* and references therein). The formation and early history of the Salton Sea, its antecedent lakes in the Salton Sink, and the relationship of the Salton Sink to the Colorado River are detailed by Sykes (1937).

EXPLORATION OF THE SALTON SEA AND THE COMPILATION OF AVIFAUNAL RECORDS THROUGH COLLECTIONS OF SKINS AND EGGS

The first ornithological exploration of the Salton Sea itself was made on 19 April 1908 when Joseph Grinnell rode the *Vinegaroon* from a starting point near Mecca at the Sea's north end some 65 km to Echo Island near the southeast end, about 20 km south of the railroad stop of Lano, "near Volcano"; it is unclear whether "Echo Island" refers to modern-day Obsidian Butte (Black Rock) or perhaps Mullet Island. The results of the voyage of the *Vinegaroon* were published in *The Condor* (Grinnell 1908).

Loye H. Miller collected a specimen of Louisiana Waterthrush, *Seiurus motacilla*, on 17 August 1908 "while passing the time between trains at the station at Mecca, Riverside County, in search of the English Sparrow [*Passer domesticus*] to determine its western progress along the Southern Pacific route" (Miller 1908). This constituted the first record of this waterthrush for California, and remained the only record until 1985 (Dunn 1988).

William L. Dawson visited the north end of the Salton Sea in 1913 and documented the Double-crested Cormorant (*Phalacrocorax auritus*) colony there in that species' account in his *Birds of California* (Dawson 1923). Dawson wrote of fish kills he encountered: "Fish of four or five kinds struggled feebly in the shallow waters or else lined the shores in windrows It was impossible to determine what was causing the

demise of these fish, whether the increasing saltiness of the water, or the exertions of the spawning season.”

Dawson was referring, of course, to various species of freshwater fish that had entered the Sea from the Colorado River (Walker 1961), but this early observation was a portent of the abundant fish “necromass” that was to characterize the Sea in later years.

John R. Pemberton (1927) discovered a unique land-locked breeding colony of the Gull-billed Tern (*Sterna nilotica*) at the south end of the Sea in 1927; follow-up visits to this colony were made in the following and subsequent years by Loye Miller, Adrian J. van Rossem, Raymond B. Cowles, Donald R. Dickey, and others. Pemberton’s Gull-billed Terns, several of which were collected by J. Stuart Rowley, who accompanied him, proved to be an undescribed subspecies, named two years later by Griffing Bancroft (Bancroft 1929). The Salton Sink, in fact, is the type locality for at least six avian subspecies: *Ardea virescens anthonyi* (Mearns 1895; now *Butorides virescens anthonyi*); *Dendrocygna bicolor helva* (Wetmore and Peters 1922) from “Unlucky Lake” (*helva* is now universally considered a junior synonym of nominate *bicolor*, rendering the species monotypic); *Melospiza melodia saltonis* (Grinnell 1909; best merged with *M. m. fallax*; Patten 2001, Arcese et al. 2002); *Gelochelidon nilotica vanrossemi* (Bancroft 1929) from the south end of Salton Sea [= *Sterna nilotica vanrossemi*]; *Pyrocephalus rubinus flammeus* (van Rossem 1934) from Brawley; and *Cistothorus palustris deserticola* (Rea 1986) from the New River, 3.2 km north-northwest of Seeley (best synonymized with *aestuarinus*; Unitt et al. 1996).

Oologists found profitable collecting in the Salton Sea region. Wilson Hanna made extensive egg collections, mainly between 1920 and 1950; over 500 egg sets from the Salton Sea area are housed at the San Bernardino County Museum (R. L. McKernan, pers. comm.), representing Hanna’s efforts as well as those of Joseph P. Norris earlier in the 20th century. Other egg collectors worked the Salton Sea and vicinity, with most of their collections now housed at the Western Foundation of Vertebrate Zoology in Camarillo, California.

ESTABLISHMENT OF WILDLIFE REFUGES, 1930— AN ERA OF WATERFOWL MANAGEMENT AND HABITAT ENHANCEMENT

The federal refuge at the south end of the Salton Sea was established in 1930 as the “Salton Sea Migratory Waterfowl Refuge.” It later became known as the Salton Sea National Wildlife Refuge (SSNWR), now amended to the Sonny

Bono Salton Sea National Wildlife Refuge. Maintenance of habitat for migratory waterfowl and game species was the overriding mission through much of the existence of this refuge, as well as for the State Waterfowl Management Area (now Imperial Wildlife Area) neighboring the federal refuge. Much of the early work by refuge personnel was in waterfowl management, with the goal of reducing crop depredations by grain-feeding waterfowl (O’Neill 1999).

Annual refuge narratives were begun by Luther C. Goldman, refuge manager, in 1939. They reveal the predictable emphasis on waterfowl and game birds, with Ring-necked Pheasant (*Phasianus colchicus*) releases, for example, documented in 1939. Even as early as that year, however, there was mention of Yuma Clapper Rails (*Rallus longirostris yumanensis*) on the refuge, a taxon which was to become of great management concern there. A card file of bird observations was also kept by Goldman.

Much of the originally designated federal refuge was soon submerged by rising water levels, and the refuge narratives plaintively read, “Until we do get lands above the water level, little can be done toward development on the Salton Sea Refuge.” When Edward J. O’Neill arrived as refuge manager in 1947 the entire original 32,400-acre refuge was underwater (O’Neill 1999). The refuge narratives contain interesting instances of human as well as avian behavior, such as the following entry: “One hunting tragedy occurred during the last day of the open season when a woman accidentally shot and killed her husband who was in a blind only a few feet from her own.”

O’Neill remained as refuge manager until 1958 and detailed his experiences there in a memoir (O’Neill 1999). During his tenure an emphasis on waterfowl management continued, but he also described some work with colonial waterbirds and landbirds. His book describes efforts directed toward habitat management, bird banding, the regulation of gamebird hunting and the enforcement of those regulations, noteworthy bird records, development of early bird lists, and nesting-biology studies. Signs of conservation problems abounded; for example, an Atomic Energy Commission installation usurped one former nesting islet in 1950. The 1955 refuge narrative contains a pointed comment regarding the abandonment of a Gull-billed Tern colony from disturbance by a photographer and egg-collector.

From 1959 to 1967 there were four different federal refuge managers, and biological information in the narratives became a bit more sketchy, with renewed emphasis on waterfowl and game bird management. Starting in the early

1960s many sightings from Guy McCaskie and other birders were entered into the refuge files. In 1985 and 1986, under Gary Kramer as refuge manager and William Henry as assistant refuge manager (and later wildlife biologist), the first real work on contaminants was reported and focused studies of the Burrowing Owl (*Athene cunicularia*) were initiated. After the 1980s additional long-term projects on non-game species were conducted, including those on colonial waterbirds, Yuma Clapper Rails, contaminant analysis of waterbirds using agricultural drains, and Burrowing Owls. The Salton Sea National Wildlife Refuge narratives are now available in CD-ROM format from the University of Redlands [<http://www.institute.redlands.edu/salton>].

The state of California's Imperial Wildlife Area, with its component Wister and Finney-Ramer units, also manages both game and non-game species. The Finney-Ramer Unit acreage was purchased from two professional baseball players in the early 1930s, and land for the Wister Unit was acquired in 1956 (Gillilan 1971, Nathenson 1972).

REFINING DISTRIBUTIONAL INFORMATION BY COLLECTORS AND FIELD ORNITHOLOGISTS

Various collectors worked the Salton Sea and surrounding areas from the period after the Sea's formation through the 1920s and beyond. Important collections of birds from the Salton Trough are housed at the Natural History Museum of Los Angeles County (mainly through the efforts of Frank Daggett and Luther Wyman), Museum of Vertebrate Zoology (University of California, Berkeley), San Bernardino County Museum, San Diego Natural History Museum, Dickey Bird and Mammal Collections (University of California, Los Angeles), University of Michigan Museum of Zoology, and Western Foundation of Vertebrate Zoology, with significant further collections in at least 16 additional major institutions.

Seven distributional notes regarding birds around the Coachella Valley and the north end of the Salton Sea were published in *The Condor* by Ben L. and Marjorie Clary of the Coral Reef Ranch, Coachella, between 1930 and 1936. These notes included documentation of California's first Blue-footed Booby (*Sula nebouxii*) on the Sea in November 1929, a species whose irregular irruptions into the Salton Sink from the Gulf of California are now well known. Regarding the booby record, Mrs. Clary (1930) wrote: "Frequently it lit on the levees within a few feet of him ['Mr. Hartley'], and on several occasions he was able to pick the bird up and carry it about. But if not in the mood for such demonstrations of affection, it did not hesitate to

prod him with its long, sharp bill." The Clarys also obtained the first Salton Sink specimen of Large-billed Savannah Sparrow (*Passerculus sandwichensis rostratus*) on 23 February 1930, an occurrence published by Willett (1930); this endemic subspecies of the Colorado River Delta and adjacent coasts has proven to be a regular non-breeding visitor to the Sea from late summer through early winter (Patten et al. 2003) and has recently expanded its breeding range to the southern tip of the Salton Sink (Molina and Garrett 2001).

Distributional information and specimen collections were obtained regularly from the 1940s through the 1980s by Eugene A. Cardiff (often with his brother Bruce E. Cardiff). Testifying to the continually changing nature of the Salton Sea, the tree in which California's first Cerulean Warbler (*Dendroica cerulea*) was collected by Eugene Cardiff on 1 October 1947 (Hanna and Cardiff 1947) is now well below the surface of the Sea. Scientific collecting in the Salton Sea area has continued through the efforts of Cardiff (and son Steven W. Cardiff, now with the Louisiana State University Museum of Natural Science), Robert L. McKernan, and Gerald Braden of the San Bernardino County Museum. Additional collecting, particularly with an eye toward the assessment of polytypic species, has also been conducted by Philip Unitt, Roger Higson, and others connected with the San Diego Natural History Museum.

Guy McCaskie made the first of his >850 visits to the Salton Sea in 1961. Born in Scotland, McCaskie brought his passion and efficient field-birding techniques to California in 1957 (Drennan 1992). McCaskie's efforts exemplify those of a host of talented amateur birders who have refined distributional information and increased our knowledge of breeding birds, post-breeding dispersal, vagrants, and rare migrants in the Salton Sea region. By 1962 McCaskie had discovered large numbers of Stilt Sandpipers (*Calidris himantopus*), a species represented previously in the region by only a handful of specimens and sight records. This prompted then *Audubon Field Notes* regional editor Arnold Small to write: "What must be regarded as a truly phenomenal number of Stilt Sandpipers for California was found by McCaskie and Stallcup on the Salton Sea National Wildlife Refuge August 31 (1961) . . . 99 birds." The results of decades of field records by McCaskie and others, along with an analysis of specimens, have recently been compiled into an avifaunal study of the Salton Sea (Patten et al. 2003).

The California Bird Records Committee of the Western Field Ornithologists has reviewed 425 records of vagrant and scarce migrant bird

species from the Salton Sink in Imperial and Riverside counties through 2001, accepting 338 of them (California Bird Records Committee files, maintained at the Western Foundation of Vertebrate Zoology in Camarillo, CA); the vast majority of these are photographic or sight records.

Annual scheduled field trips to the Salton Sea and Imperial Valley by numerous southern California chapters of the National Audubon Society and various bird clubs continue to generate distributional information. The first and, to date, only meeting of an ornithological society to be held in the Salton Sink was that of the Western Field Ornithologists in Imperial in August 1997. A Salton Sea International Bird Festival was initiated in 1998 and has been held nearly annually since at a resort in Holtville.

RESEARCH ON THE ECOPHYSIOLOGICAL CHALLENGES OF THERMOREGULATING IN THE SALTON SEA AREA

With mid-summer temperatures frequently exceeding 45°C, the Salton Sea area has proven to be a popular field laboratory for the study of avian behavioral and physiological responses to a thermally challenging environment. William L. Dawson speculated that the January nesting of Double-crested Cormorants he observed on his 1913 visit to the north end of the Salton Sea was an adaptation to the heat: "The remarkably early nesting may have been induced not only by the movements of the fish, but by the disciplinary experience of the effect upon young squabs of the Colorado Desert sun in, say, April (equivalent to July anywhere else)" (Dawson 1923).

George A. Bartholomew and William R. Dawson (along with refuge manager Edward J. O'Neill) investigated thermoregulation in American White Pelicans (*Pelecanus erythrorhynchos*) nesting on sandy islets near the southwestern shore of the Salton Sea (Bartholomew et al. 1953). Gilbert S. Grant of the University of California, Los Angeles, conducted his doctoral dissertation on behavioral adaptations to high temperatures in incubating recurvirostrids, *Charadrius*, *Sterna*, Black Skimmers (*Rynchops niger*), and Lesser Nighthawks (*Chordeiles acutipennis*) (Grant 1979, 1982), and Kathy C. Molina of California State University, Northridge, investigated parental care in Gull-billed Terns and Black Skimmers in the hot Salton Sea environment (Molina 1999).

FOCUSED MANAGEMENT FOR SENSITIVE, THREATENED, AND ENDANGERED SPECIES—RECONNAISSANCE STUDIES AND "SAVING THE SALTON SEA"

Particularly in the last decade of the 20th century, concerns about the Salton Sea's elevation,

salinity, contaminants, and disease outbreaks, coupled with regional and continental concerns about the conservation status of a suite of sensitive, threatened, or endangered bird species, led to a variety of focused species studies and larger-scale reconnaissance projects. Ecological problems and increasing demands from urban and agricultural regions outside the Salton Sink for Colorado River water (the source of nearly all of the Salton Sea's water) fostered the involvement of conservation organizations, universities, agrobusinesses, local commerce, various government agencies, and politicians. Having entered the political arena, the Salton Sea took a leap forward in the consciousness of politicians with the death on 5 January 1998 of Congressman Sonny Bono (R-Palm Springs). Bono had championed the cause of environmental cleanup and economic development of the Salton Sea, and "saving the Salton Sea" became something of a political mantra in his honor. A corollary of this political interest in the Salton Sea was governmental funding for various reconnaissance studies of the Sea's biota, ecology, and environmental health.

Studies on particular species or groups in recent years have included surveys of migratory shorebirds in 1989–1995 and again in 1999 (Shuford et al. *this volume*); the migration ecology of Eared Grebes (Jehl and McKernan 2002); the migration ecology of White and Brown (*Pelecanus occidentalis*) pelicans (ongoing work by Daniel W. Anderson, University of California, Davis); breeding herons (the late Norman D. Hogg; Molina and Sturm *this volume*); White-faced Ibis (Shuford et al. 1996); breeding larids (Molina *this volume*); Song Sparrows (Patten 2001); subtropical waterbirds and "pelagic" birds (Patten and McCaskie *this volume*); polytypic landbirds (Patten et al. 2003, *this volume*); rails (e.g., Laymon et al. 1990); Burrowing Owls (York et al. 2002, Rosenberg and Haley *this volume*); and Mountain Plovers (Knopf and Rupert 1995, Wunder and Knopf 2003, Shuford et al. *this volume*).

General avian reconnaissance studies were conducted in 1999 by workers from Point Reyes Bird Observatory (Shuford et al. 2000), forming a baseline against which anticipated avifaunal changes could be measured. A popular account of the Salton Sea's avifauna from the same time period, based on surveys at a number of sites around the Sea, was published by Massey and Zembal (2002).

Among numerous recent studies on avian diseases and ecosystem health in the Salton Sea region, that of Rocke and Friend (2003) is noteworthy for having relied heavily on the narra-

tives and other records maintained at the SSNWR.

CLOSING REMARKS

The current trend of management-oriented research is likely to continue as long as a biologically viable Salton Sea continues to exist. In fact, it is likely that long-term monitoring of avian populations and habitats will be mandated in conjunction with the testing and implementation of engineering solutions to the instability of the Sea. Increasingly, the Salton Sea and adjacent agricultural areas and riparian systems are being perceived as an inter-related unit, and these areas are in turn recognized as part of the larger unit of the entire Salton Trough, including the lower Colorado River and its delta. Therefore, future research is likely to involve collaborations with workers on the Mexican side of the Trough. On an even larger scale the Salton Sea is but one of

a series of shallow inland lakes throughout western North America (Jehl 1994), and part of a suite of migration systems that link far-flung regions throughout the Americas.

The Salton Sink of the future may ultimately appear as foreign to us as the present-day situation might have looked to Joseph Grinnell as he journeyed on the *Vinegaroon* in 1908, and most certainly to Mearns as his party collected specimens and explored the border region before the modern Salton Sea even existed.

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