COOPER ORNITHOLOGICAL SOCIETY SYMPOSIUM
Avian Ecology and Conservation of the Salton Trough
Date: 27 April 2000 (Thursday)
Organizers: Kathy C. Molina, W. David Shuford, Michael A. Patten

Oral Presentations

[0915–0945]
1. INTRODUCTION—A BRIEF HISTORY OF THE SALTON SEA.
*MICHAEL A. PATTEN, Department of Biology, University of California, Riverside, CA; KATHY C. MOLINA, Section of Vertebrates, Natural History Museum of Los Angeles County, Los Angeles, CA; W. DAVID SHUFORD, Point Reyes Bird Observatory, Stinson Beach, CA.

[0945–1000]
2. HISTORY OF ORNITHOLOGICAL EXPLORATION OF THE SALTON SINK.
*KIMBALL L. GARRETT and KATHY C. MOLINA, Section of Vertebrates, Natural History Museum of Los Angeles County, Los Angeles, CA; MICHAEL A. PATTEN, Department of Biology, University of California, Riverside, CA.

Ornithological exploration of the Salton Sink began prior to the formation of the present-day Salton Sea with collecting efforts by Mearns and Holzner, Nelson and Goldman, Stephens and others from 1894 to 1905. The first exploration of the sea itself was reported by Joseph Grinnell in 1908. Additional studies by Dawson, van Rossem, L. Miller, 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 *Geochelidon* [=*Sterna*] *nilotica vanrossemi* on birds taken by Pemberton and described by 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 1950s and 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; agency census and management work has concentrated on harvestable waterfowl, but since the 1970s research has expanded to non-game species, including listed species such as the Yuma Clapper Rail. The role of the Salton Sink in the migration ecology of shorebirds, grebes, Ruddy Ducks and pelicans has received considerable recent study, as have breeding colonial waterbirds and Burrowing Owls. Present day research is largely focused on baseline data and predicted effects of various proposed remedial actions to stabilize the Sea.

Garrett, K. L.
Molina, K. C.
Patten, M. A.
LECTURE (15 minutes)
35mm slide projector

[1000–1015]
3. A BIRD'S-EYE VIEW OF AVIAN HABITATS AT THE SALTON SEA.
* TIMOTHY P. KRANTZ and STEVE HOOVER, Salton Sea Database Program, Center for Environmental Management, University of Redlands, Redlands, CA.

Using visual simulations and geographic information system (GIS) technology, the audience will view the Salton Sea as seen from space, zooming in to take closer looks at the rich avian resources and significant habitats of the area. We will visually display and discuss the potential impacts of restoration project alternatives on avian habitats, including potential impacts of the "No Action" alternative, with possible reductions of inflow to the Sea as a result of water transfers or other reductions of allocations from the Colorado River.

Krantz, Timothy P.
Hoover, Steve K.
LECTURE (15 minutes)
computer projector (will provide own)

[1015–1030]
4. MIGRATION OF LANDBIRDS THROUGH DESERT RIPARIAN HABITATS OF THE SALTON SEA AND ITS ENVIRONS.
*SUSAN L. GUERS, MAUREEN E. FLANNERY, GEOFFREY R. GEUPEL, and NADAV NUR, Point Reyes Bird Observatory, Stinson Beach, CA.

Waterbird and shorebird use of the Salton Sea has been studied in detail, however there is limited and mostly anecdotal information on landbird migration through the area. In 1999, the Point Reyes Bird Observatory systematically surveyed landbirds at the Salton Sea to determine the use of its desert riparian habitats as migratory stopover sites. Using constant-effort mist-netting, point count surveys, and area search surveys, we assessed the diversity and abundance of birds in these habitats. During spring we surveyed four riparian sites along the north, south and eastern shores of the Sea. In fall we surveyed five riparian sites and one residential site all on the eastern shore of the Sea. Using constant-effort mist-netting, we caught a total of 1,542 individuals of 47 species at overall rates of 137.1 and 345.3 birds per 100 net hours in April and May, respectively. Less than 1% of the birds we caught were hatch year birds. During fall, we caught a total of 892 individuals of 49 species at overall rates of 73.4 and 64.6 birds per 100 net hours in September and October, respectively. Hatch year birds accounted for 45% of all total captures. We evaluated the use of the area during migration by comparing it to other banding and survey locations throughout the West. During spring, we caught Wilson's Warblers at an overall rate of 82.8 birds per 100 net hours, which

accounted for 39% of all captures. More Wilson's Warblers were caught at the Salton Sea during spring migration than at any other mist-netting site in California. The abundance of neotropical migrants recorded during spring and fall, provides evidence that the area is used extensively by migrating passerines, including 11 species of statewide concern in riparian habitats. The high use of the Salton Sea and its environs by landbirds during migration suggests the need for effective management and restoration of desert riparian habitats.

Guers, S. L.
Flannery, M. E.
Geupel, G. R.
Nur, N.
LECTURE (15 minutes)
35 mm slide projector

[1030–1100] BREAK

[1100–1115]
5. WINTER RELATIVE ABUNDANCE AND SPATIAL USE OF THE SALTON SEA BY SELECTED WATERBIRDS. ROBERT L. MCKERNAN, Biology Section, San Bernardino County Museum, Redlands, CA; JOSEPH R. JEHL, JR., Hubbs-Sea World Research Institute, San Diego, CA.

The Salton Sea is the largest inland lake in California. It has long been postulated to be an important wintering and staging area for waterbird species. Between 1984 and 1999 we conducted a series of aerial surveys (>60 flights) of the entire Salton Sea monthly between October to March. Selected waterbird species were estimated monthly to determine winter relative abundance and spatial use of the Salton Sea. Primary species reported on are Eared Grebe, Western and Clark's Grebe, American White Pelican, Double-crested Cormorant, and Ruddy Duck. The monthly and yearly count results over the fifteen-year period confirms that this hypersaline lake is an major wintering and staging location for selected waterbirds. The yearly relative abundance and yearly trends for the Eared Grebe, Western and Clark's Grebes, Double-crested Cormorant, American White Pelican and Ruddy Duck indicate that greater than 1.5 million birds of these combine species can overwinter on the Salton Sea. For all counts the sea was divided into six areas; river inflows, four inshore areas and the offshore zone. Among specific sites, utilization by Eared Grebes and Ruddy Ducks were correlated with specific inshore areas and the offshore zone during certain months and among years ($P < 0.05$). And most American White Pelicans and Double Crested Cormorants used river inflow areas exclusively monthly as well as among years. The spatial and temporal use of the sea for selected waterbirds based on our results indicate that certain areas of the Salton Sea are utilized significantly more during certain months and among years. Over the fifteen-year period these count data indicate that the Salton Sea is an important wintering and staging area for selected waterbirds in the western United States.

McKernan, R.L.
Jehl, J. Jr.
LECTURE (15 minutes)
35mm slide projector

[1115–1130]
6. WATERBIRDS AND WETLAND CONSERVATION IN THE COLORADO RIVER DELTA, MEXICO
*OSVEL HINOJOSA-HUERTA, School of Renewable Natural Resources. University of Arizona. Tucson, AZ; CARLOS VALDES-CASILLAS, Center for Conservation of Natural Resources (CECARENA), ITESM Campus Guaymas, Sonora, Mexico; STEPHAN DESTEFANO, Massachusetts Cooperative Fish and Wildlife Research Unit, University of Massachusetts, Amherst, MA.

The Colorado River delta has long been recognized as an important area for wildlife. Even today, after the vast reduction and modification of this ecosystem, about 60,000 ha of remnant wetlands support a diversity of species. A key element in the delta restoration process and a goal of our research and monitoring efforts is to understand the effects that habitat alteration and resource management have on wildlife populations in this area. This is an on-going project, of which partial results from March 1999 to February 2000 are presented. The purpose of this research is to correlate distribution and abundance of waterbirds with available habitats and resource use practices in the delta. Presence of waterbirds in these wetlands has been documented for 101 species from 17 families. Delta wetlands are used by at least 30 waterbird species as breeding sites, and by 73 species as wintering grounds or migratory stopovers. Nine endangered or threatened bird species occur in this area. Shorebirds and waders are the most diverse and abundant group, followed by colonial nesters, waterfowl, and marshbirds. Important areas for waterbirds include the Cienega de Santa Clara, Hardy River, Colorado Riparian Corridor, Laguna Salada, and Intertidal Wetlands. The main impact on waterbirds has been drastic wetland loss caused by water management practices. In comparison, activities of local communities have much less of an effect, except for flood control practices, which include stream canalization, closing of secondary streams, and vegetation clearing. Environmentally sound strategies should be pursued for flood control and river management, with a strong emphasis on a bi-national and ecosystem approach for wetland conservation as a critical component within the Pacific Flyway.

Hinojosa-Huerta, O.
Valdes-Casillas, C.
DeStefano, S.
LECTURE (15 minutes)
35 mm slide projector

[1130–1145]
7. TRACE ELEMENT AND ORGANOCHLORINE CONTAMINATION IN PREY AND HABITAT OF THE YUMA CLAPPER RAIL IN IMPERIAL VALLEY.
CAROL A. ROBERTS, U.S. Fish and Wildlife Service, Carlsbad, California.

The endangered Yuma Clapper Rail (*Rallus longirostris yumanensis*) occurs in marshes along the Colorado River and around the Salton Sea in Imperial and Riverside Counties in California. This study was designed to determine the potential for contaminant exposure of the Yuma Clapper Rail inhabiting the Imperial Valley by investigating the amounts of trace elements and organochlorine pesticides in its environment (sediments) and diet (crayfish) when Colorado River water was used in habitat ponds. Available tissue samples were also analyzed in an effort to assess the potential for biomagnification. Sediments were analyzed for a suite of inorganics including arsenic, boron, cadmium, chromium, copper, lead, mercury, selenium and zinc. Maximum concentrations were 15.1, 30.3, 1.5, 25.5, 31.7, 20.1, 0.035, 9.6, and 74.6 parts per million (ppm) dry weight (DW), respectively. Crayfish had detectable concentrations of these same analytes with the exception of lead which was not detected in any of the 19 samples. Maximum concentrations in ppm DW were: arsenic, 12.2; boron, 30.9; cadmium, 0.5; chromium, 2.0; copper, 127.5; mercury, 0.16; selenium, 4.7; and zinc, 107.1. Maximum egg concentrations (collected when drainwater was used in the ponds) for boron, mercury, and selenium were 2.3, 1.1, and 7.8 ppm DW, respectively. This selenium concentration is within the range of embryo viability effects. Tissue concentrations for the same elements were 17.4, 3.7 and 11.8 ppm DW, respectively. Only four organochlorine compounds were detected in any of the sediment samples. Most concentrations measured were close to the detection limit with the highest detected concentration being for p,p'DDE at 0.13 ppm DW (0.099 ppm wet weight (WW)). The two rail eggs had concentrations of this compound of 0.27 and 0.34 ppm fresh wet weight, but only three of the 19 crayfish samples had detectable concentrations. The range for crayfish was <0.01-0.045 ppm WW. Of all the constituents examined, selenium is of greatest concern to the Yuma Clapper Rail. Use of irrigation drainwater in its habitat is not recommended.

Roberts, C. A.
LECTURE (15 minutes)
35 mm slide projector

[1145–1200]
8. THE ECOLOGY OF BURROWING OWLS IN THE IMPERIAL VALLEY, CALIFORNIA.
*DANIEL K. ROSENBERG and KATHERIN L. HALEY, Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR; DAVID F. DESANTE and ERIC D.RUHLEN, The Institute for Bird Populations, Point Reyes Station, CA; MELISSA M. YORK, NOELLE RONAN, and JENNIFER A. GERVAIS, Department of Fisheries and Wildlife, Oregon State University Corvallis, OR; KEN K. STURM, Sonny Bono Salton Sea National Wildlife, Calipatira, CA.

Exceptionally high densities of Burrowing Owls exist in the Imperial Valley, an area that we estimated to include over 70% of the California population. Reproductive success in the Valley was generally lower than other California populations. Chick survival was related to food availability, and may have been manifested through higher rates of

cannibalism and predation rather than starvation. Although pesticides were widely used, levels of DDE and other pesticide residues in eggs were low. Home-range size and spatial patterns of habitat use were similar to other California populations, but because of the high density of owls, overlap among pairs was higher. Edge habitat between roads, fields, and the irrigation system, were preferred foraging areas. The intensity of field use by the owls was dynamic, and apparently depended on the particular crop and irrigation practice. Although other California populations have a diet composed of both vertebrates and invertebrates, the diet in the Imperial Valley was mainly composed of invertebrates. The high year-round agricultural production in the Valley may support a high biomass of invertebrates, providing a relatively static food source for Burrowing Owls. This likely contributes to the large resident population. The presumably low biomass of rodents may be attributable to the same agricultural practices and may be a factor in the low reproductive success. We compare the ecology of Burrowing Owls in the Imperial Valley in comparison to other California populations and discuss local and regional management issues that may affect Burrowing Owls.

Rosenberg, D. K.
Haley, K. L.
DeSante, D. F.
Ruhlen, E. D.
York, M.
Ronan, N.
Gervais, J.
Sturm, K. K.
LECTURE (15 minutes)
35 mm slide projector

[1200–1400] LUNCH

[1400–1415]
9. THE SALTON SEA AS IMPORTANT WATERFOWL HABITAT IN THE PACIFIC FLYWAY.
*DOUGLAS A. BARNUM, U.S. Geological Survey, Delano, CA; STEVEN JOHNSON, U.S. Fish and Wildlife Service, Sonny Bono Salton Sea National Wildlife Refuge, Calipatria, CA.

The Salton Sea region is an important component of the Pacific Flyway for migrating and wintering waterfowl. The purpose of this paper is to illustrate the importance of the Salton Sea and its associated wetlands to Pacific Flyway waterfowl populations For the period January 1986 through January 2000, the average midwinter count of waterfowl in the Salton Sea Region, including Imperial and Coachella Valleys, was 100,714 birds (USFWS unpubl. data). Setmire et al. 1993 estimated waterfowl use of the Salton Sea region in "recent years" at 125,000 birds annually, but it is unclear how that number is to be put in context. If the total numbers of migrants and wintering birds are considered over the entire year, then the actual number of waterfowl utilizing the

Salton Sea is much greater. Meanwhile, the midwinter waterfowl counts for 11 Pacific States for roughly the same period of time, 1989-1999, indicates a Flyway average population of 5,421,707 birds (USFWS 1999). The Salton Sea midwinter waterfowl population thus represents less than 2% of the Pacific Flyway midwinter population. Similar data are being compiled for a comparison of Salton Sea populations to the rest of California. A comprehensive analysis of aerial survey data for waterfowl at the Salton Sea will delineate important species and habitat associations. Despite the apparent low percentage of wintering waterfowl, this paper will discuss and highlight the current importance of the Salton Sea in relation to Pacific Flyway populations and habitats.

Barnum, D. A.
Johnson, S.
LECTURE (15 minutes)
35 mm slide projector

[1415–1430]
10. PATTERNS OF SHOREBIRD USE OF THE SALTON SEA, CALIFORNIA.
*W. DAVID SHUFORD, Point Reyes Bird Observatory, Stinson Beach, CA; ROBERT L. MCKERNAN, San Bernardino County Museum, Redlands, CA; NILS WARNOCK, Point Reyes Bird Observatory, Stinson Beach, CA.

We conducted comprehensive surveys of shorebirds at the Salton Sea three to four times per year from 1989 to 1995 and in 1999. In 1999, we also conducted 18 surveys of portions of the Salton Sea and 3 comprehensive surveys of the Imperial Valley for Mountain Plovers. Shorebird populations at the Salton Sea from 1989 to 1995 averaged 24,000 in December, 90,000 in April, and about 85,000 individuals in August; numbers totaled about 70,000 in November 1999. These data document the Salton Sea as one of only eight sites in the interior of western North America that holds over 10,000 shorebirds in fall and five such sites in spring; it was one of only a few sites in the interior holding thousands of shorebirds in winter. The species composition and relative abundance of shorebirds at the Salton Sea in winter was more similar to that in the Colorado River delta than in California's Central Valley. Conservation and restoration initiatives need to address the differential distribution patterns of shorebirds around the Salton Sea and between the Sea and the Imperial Valley. The number of Mountain Plovers wintering in irrigated agricultural fields in the Imperial Valley represents about 30% to 38% of the species' entire population. Also, the Salton Sea continues to support the largest population of wintering Snowy Plovers in the interior of western North America and is one of a handful of key breeding areas for the species in the interior of California.

Shuford, W. D.
McKernan, R. L.
Warnock, N.
LECTURE (15 minutes)
35 mm slide projector

[1430–1445]
11. STATUS OF PELAGIC AND SUBTROPICAL WATERBIRDS AT THE SALTON SEA.
*GUY MCCASKIE, Imperial Beach, CA; MICHAEL A. PATTEN, Department of Biology, University of California, Riverside, CA.

In terms of biogeography, the Salton Sea has a close relationship with the Gulf of California. As a result, many species of seabirds and waterbirds that are rare in the interior of western North America occurring regularly (e.g., Brant, scoters, Least Tern), and sometimes commonly (e.g., Laughing and Yellow-footed Gulls), at the Salton Sea. Indeed, the strong relationship with the gulf has yielded nearly 40 records of eight species of Procellariiforms, the highly pelagic tubenoses. Likewise, species rare in the western United States, such as Blue-footed and Brown Boobies and Roseate Spoonbill, stage irregular incursions into the Salton Sink from their range in northwestern Mexico and the Gulf of California. Occurrences of all of them are non-random with respect to season. Virtually all records of these species and a host of others with similar ranges are from summer months, mainly May–October. During this period there is a dramatic change is wind patterns that favor dispersal and movement northward into the Salton Sink. Winds primarily blow southward from the San Gorgonio Pass through the Salton Sink to the Gulf of California during winter, but during summer a monsoonal flow develops annually such that winds from the gulf through the sink are exactly reversed. Movement of seabirds into the gulf is further aided by a change in sea surface temperatures off of west Mexico in summer. Sea surface temperatures off west Mexico are fairly cold in winter, with temperatures matching those off the Pacific coast of Baja California. These cold waters isolate the warm-water gulf during winter. Sea surface temperatures rise dramatically off west Mexico in summer, when much warmer than waters off the Pacific coast of Baja California and forming a uniform thermocline into the gulf, perhaps facilitating avian movement given the absence of a temperature "barrier." The geography of the Salton Sink effectively "traps" birds that reach it, given the mountainous barriers to the west, north, and east. Many seabirds and subtropical waterbirds that reach the sea presumably find their way back to the Gulf of California and west Mexico, although some are transients through the sink.

McCaskie, G.
Patten, M. A.
LECTURE (15 minutes)
35 mm slide projector

[1445–1500]
12. AVIAN RANGE EXPANSIONS AND POPULATION CHANGES IN THE SALTON SINK DURING THE PAST QUARTER-CENTURY.
MICHAEL A. PATTEN, Department of Biology, University of California, Riverside, CA; RICHARD A. ERICKSON, LSA Associates, Irvine, CA.

When Salton Sea formed in 1905 it was merely another lake in a long series of lakes that had filled at least a portion of the Salton Sink. Lake Cahuilla was the principal

historical forerunner, being last filled in the mid-1600s, but floods on the Colorado River carried water to the sink as late as 1891. The presence and persistence of the sea obviously greatly altered bird use of the region in the first third of the 20th Century. Increased agriculture, growing human settlements, and serious habitat alteration have affected bird use of the region in the past 25 years in almost as dramatic a fashion. As a general rule, landbirds colonizing the region have a distinctly Sonoran Desert affinity, with numerous species (e.g., White-winged Dove, Gila Woodpecker, Bronzed Cowbird) expanding westward into the novel suitable habitat of the Salton Sink. Most presumably reached the sink via the Río Hardy and Río Alamo drainages, thence to the Mexicali and Imperial Valleys. Fewer have colonized from cismontane southern California (e.g., Anna's Hummingbird, Northern Mockingbird), with these species moving into the Salton Sink from the north, via the San Gorgonio Pass. Other major expansions into the region have been part of broad scale range expansions by the species (e.g., Cattle Egret, White-faced Ibis, Inca Dove, Great-tailed Grackle), with agricultural and ranch land providing a wealth of habitat. By contrast, loss of mesquite bosques, formerly an abundant habitat in the Salton Sink, have led to the severe decline or extirpation of some species (e.g., Crissal Thrasher, Lucy's Warbler), whereas loss of open desert scrub has led to the virtual elimination of others (e.g., Le Conte's Thrasher). The Large-billed Savannah Sparrow (*Passerculus sandwichensis rostratus*), an endemic to the Gulf of California, has exhibited a mysterious pattern. It was common at the turn of the 20th Century, rare by the 1950s, and has become common again, with breeding recently established at Cerro Prieto, well north of the gulf. As a rule, seabirds and waterbirds have increased in the Salton Sink, with steep declines of the Wood Stork and Fulvous Whistling-Duck providing alarming exceptions.

Patten, M. A.
Erickson, R. A.
LECTURE (15 minutes)
35 mm slide projector

[1500–1530] BREAK

[1530–1545]
13. SALTON SEA BREEDING LARIDS: POPULATION TRENDS, COLONY SITES AND CONSERVATION.
KATHY C. MOLINA, Section of Vertebrates, Natural History Museum of Los Angeles County, Los Angeles, CA.

The Salton Sea currently supports one of the most species-rich communities of breeding larids in the interior of western North America. Composed of six species, this community regularly includes California Gulls (*Larus californicus*), Gull-billed (*Sterna nilotica*) and Caspian (*S. caspia*) Terns and Black Skimmers (*Rynchops niger*), with Laughing Gulls (*L. atricilla*) and Forster's Terns (*S. forsteri*) nesting sporadically. Many of these species maintain breeding populations that are of regional significance despite the paucity of suitable nesting habitat available. The larger of only two colonies of the Gull-billed Tern within the western United States occurs at the sea. During the 1990s,

population size and colony site occupation were variable among years. Of the species that nested annually, the number of breeding pairs of Gull-billed Terns ranged from 72 to 170, that of Caspian Terns ranged from 30 to >1500, and that of Black Skimmers ranged from 80 to nearly 500 pairs. The California Gull colonized the sea in 1997 with 22 pairs and the number of breeding pairs has increased to >40 pairs. One or two pairs of Laughing Gulls have attempted to nest and up to 20 pairs of Forster's Terns have nested occasionally during this period. Loss of suitable habitat at traditional colony sites due to fluctuations in the sea's elevation and the recent colonization by a large population of Double-crested Cormorants and, to a lesser extent, California Gulls is thought to influence the site occupation of Gull-billed Terns and Black Skimmers. By 1997 these two species have been restricted to only two of six colony sites used previously during the decade. Most colony sites occur on private lands; only one colony site is actively managed for ground nesting waterbirds. Increased human disturbance at some sites is believed to adversely affect breeding success.

Molina, K. C.
LECTURE (15 minutes)
35 mm slide projector

[1545–1600]
14. THE BREEDING BIRDS OF ISLA MONTAGUE, DELTA DEL RÍO COLORADO, MÉXICO: APPARENT VARIATIONS AT DIFFERENT TEMPORAL SCALES.
ERIC MELLINK, Centro de Investigación Científica y de Educación Superior de Ensenada, Apartado Postal 2732, Ensenada, B.C., México.

Ten species of waterbirds and one landbird nest on Isla Montague, at the mouth of the Rio Colorado. These species are: Great Blue Heron, Snowy Egret, Black-crowned Night-Heron, Laughing Gull, Royal, Elegant, Least, and Gull-billed Terns, Black Skimmers, American Oystercatcher, and Large-billed Sparrow. These nesting birds exhibit the effects of environmental variables at different scales: within-year, among years, several years, and several decades. 1) Within a given year the major environmental factor affecting the breeding birds have been the tides. In 1994 the island was covered almost completely at least 5 times during the breeding season, destroying most of the nests. 2) A comparison of the 1993 and 1994 breeding season exhibited interannual differences that were not clearly interpretable, but variations in river discharge was the closest apparent possible cause. 3) The 1997-1998 El Niño event promoted larger colonies of Black Skimmers and Least, Royal, and Elegant Terns. 4) Although data are very scant and circumstantial, it appears that the breeding ornithofauna might have been different at the turn of the 20th century. At a regional scale, it is not yet understood which other localities are involved in the dynamics of breeding bird communities on Montague. The closest breeding localities for some of the nesting species are, to the south, several hundreds of kilometers away, but to the north only a short distance: Cerro Prieto and the Salton Sea. Although no data on regional movement of individuals exists, these three sites could form a biological unit.

Mellink, E.

LECTURE (15 minutes)
35 mm slide projector

[1600–1630]
15. CLOSING REMARKS—FUTURE RESEARCH DIRECTIONS AND CONSERVATION PROSPECTS.
*W. DAVID SHUFORD, Point Reyes Bird Observatory, Stinson Beach, CA; KATHY C. MOLINA, Section of Vertebrates, Natural History Museum of Los Angeles County, Los Angeles, CA; MICHAEL A. PATTEN, Department of Biology, University of California, Riverside, CA.

Poster Presentations

1. CHRISTMAS BIRD COUNT STUDY OF THE SALTON SEA.
SHUZO YOSHIHARA, University of Redlands, Redlands, CA.

Christmas Bird Counts (CBCs) have been conducted at the Salton Sea since 1969. Observers gather at dawn and count until dusk on one day within a week or so of Christmas each year. Thus, the CBC data represents a long-term data set—essentially one-day snapshots—of wintering bird use at the Salton Sea from 1969 to 1998. Total numbers of birds are tallied for each species observed within a 7.5-mile radius circle at the north and south ends of the Sea, as shown on the map montage. More than 150 species of birds have been observed during the Salton Sea CBCs. From these data, we have presented the following trend analyses for the North, South and Total CBC counts: total number of birds counted, fish eating birds, shorebirds, geese, pelicans, and cormorants. The graphs depict the North, South and Total counts for each census year. Regression analyses were performed to determine positive or negative trends. R^2 values of greater than 50% indicate a positive fit of actual data to the linear regression line. *P* values denote the probability that the data is random, assuming its variance; *P* values of less than 5% are considered to represent definite trends.

2. AVIAN DISEASE AT THE SALTON SEA.
MILTON FRIEND, Salton Sea Science Subcommittee, Middleton, WI.

Recent disease outbreaks at the Salton Sea have killed large numbers of birds. These events have resulted in a national focus on the sea and issues associated with restoration actions. A review of existing information on disease occurrence was conducted from historical records, National Wildlife Refuge Narrative Reports, and the National Wildlife Health Center epizootic and diagnostic databases. There has been a substantial increase since the late 1980s in the importance of disease as a cause of bird mortality at the sea. Outbreaks have occurred since at least the 1920s. With the exception of 1932, annual outbreaks occurred during the period of 1925–1935, with each event killing a substantial number of birds. Type C botulism was the likely cause of those outbreaks. The frequency of outbreaks was much lower from 1936–1945 before increasing again since 1946. With few exceptions the magnitude of bird deaths associated with individual disease outbreaks during the period of 1936–1987 has been

low. Since 1987, the magnitude of losses from disease has increased substantially and there have been a number of catastrophic die-offs. During 1992, an estimated 155,000 birds died at the sea, including ±150,000 Eared Grebes, approximately 7% of the species' continental population. The cause of this event and recurring grebe mortality at the sea has not been determined despite extensive diagnostic evaluations. The 1996 outbreak of type C botulism was even more devastating regarding population impacts. That outbreak killed approximately 15–20% of the western population of American White Pelicans and killed more than 1,000 endangered California Brown Pelicans. During 1997 and again in 1098, all hatchlings from the Double-crested Cormorant colony on Mullet Island died from Newcastle disease. Avian cholera and salmonellosis are other important diseases that have appeared at the Salton Sea during recent years. Environmental quality is a factor in many disease events. The Salton Sea Restoration Project focus on improving the sea's environmental quality is a fundamental action required to reduce probability of major losses from disease. Current actions include enhanced surveillance to provide early detection of disease occurrences and aggressive response to outbreaks. Studies have been initiated to gain a greater understanding of the ecology of disease at the Sea. Findings from those studies will be of considerable value in guiding management actions to achieve the Restoration Project Goal to: "Provide a safe, productive environment at the Sea for resident and migratory birds and endangered species." Achievement of this goal is important because >90% of inland wetland acreage that was part of the California landscape no longer exists. As a result, millions of migratory birds within the Pacific Flyway have become highly dependent upon the habitat provided by the Salton Sea.

Papers not presented but expected for the *Proceedings*

1. THE IMPORTANCE OF THE SALTON SEA TO AMERICAN WHITE AND BROWN PELICANS - Daniel W. Anderson

2. NOTES ON BREEDING COLONIES OF HERON AND EGRETS AT THE SALTON SEA - Kathy C. Molina, Ken K. Sturm, and Norm Hogg

3. POLYTYPIC LANDBIRDS OF THE SALTON SINK - Philip Unitt