

## MASS MORTALITY EVENTS OF EARED GREBES IN NORTH AMERICA

JOSEPH R. JEHL, JR.

*Hubbs-Sea World Research Institute*  
2595 Ingraham St.  
San Diego, California 92109 USA

**Abstract.**—Large-scale mortality events involving Eared Grebes (*Podiceps nigricollis*) have been documented in the West for more than a century. The most persistent causes are adverse weather during migration and disease. The cause of the largest event, involving an estimated 150,000 individuals at the Salton Sea in 1992, has yet to be determined.

### MORTANDAD EN MASA DE INDIVIDUOS DE *PODZCEPS NIGRICOLLIS* EN NORTE AMÉRICA

**Sinopsis.**—Por más de un siglo ha sido documentado en la parte oeste de los Estados Unidos, mortandad a gran escala de individuos de *Podiceps nigricollis*. Las causas más persistente de este fenómeno lo son condiciones climatológicas adversas durante la migración y enfermedades. No se ha podido determinar la causa de la mayor mortandad registrada en la especie (150,000 individuos), que ocurrió en el 1992 en Salton Sea.

During the fall and spring migrations, the majority of the North American population of Eared Grebes (*Podiceps nigricollis*) passes through the Salton Sea, California, en route to or from wintering areas in the Gulf of California. Tens or hundreds of thousands also winter at the Salton Sea (Jehl 1988), where maximum daily counts have exceeded one million individuals. In early 1992, 150,000 grebes were found dead at the Salton Sea over a several-month period (W. Radke, USFWS, pers. comm.). The event received national attention because it was among the largest mortality events of any bird species—and certainly the largest for Eared Grebes—and because a cause for a large portion of the mortality was not apparent. I attempt to put this event in perspective by reviewing other dieoffs of Eared Grebes involving about 1000 or more individuals (Table 1). I disregard the annual low-level mortality that occurs at staging areas (see Jehl 1988 for estimates for Mono Lake, CA) and the chronic problem of collision with power lines (Malcolm 1982).

### RESULTS

**Historical dieoffs.**—The earliest dieoff known to me dates from 1880, when hundreds of long-dead carcasses were found in mid-May at Mono Lake, California (Denton 1949). This hypersaline lake, in addition to being the major fall staging area for hundreds of thousands of Eared Grebes, is also a summering area for several thousand nonbreeders (Jehl 1988). Evidently, conspicuous mortality was not unusual there, for local residents told Denton that birds “are killed during the heavy storms.” But storms occur mostly in fall and winter, which leaves disease or food shortage, as the likely alternatives.

Owens Lake, California, was another a concentration point in the 1880s

TABLE 1. Mortality events of Eared Grebes in North America.

Date	Location	Description	Cause	Reference
1880, mid-May	Mono Lake, CA	"hundreds . on the shore," found "almost every step."	Unknown, food shortage?	Denton 1949
? 1881, July-September	Owens Lake, CA	"two million 'dead ducks' ", based on extrapolation	Unknown, food shortage?	<i>Inyo Register</i> , 4 April 1882
1891, mid-June	Owens Lake, CA	"hundreds of dead ones . . along the shore." Extrapolated to 35,000	Unknown, food shortage?	Fisher 1893
1928, 12 December	Southern UT, Eastern NV	"many thousands"	Downed in snow-storm	Cottam 1929
1975, late November	Great Salt Lake, UT	5600	Erysipelas	Jensen and Cotter 1976
1977, November-December	Great Salt Lake, UT	7500	<i>Streptococcus</i>	Jensen 1979
1982, 9 and 25 December	Southern UT	>3000	Downed in snow-storm	Utah Div. Wildl. Res.
1982-1983, December-March	Southern CA and Baja California, Mexico	>25,000	Unknown, food shortage?	Jehl & Bond 1983, Nishikawa et al. 1984
1989, January-March	Salton Sea, CA	>40,000? (see text)	Unknown	Jehl, unpubl.
1991, 10 December	Southern UT	14,000	Downed in snow-storm	Jehl 1993
1992, January-March	Salton Sea, CA	150,000	Unknown, biotoxin?	Natl. Wildlife Health Ctr., fide L. Creekmore DVM; D. Paul, Jehl pers. obs.
1993, 17 January	Mohave Desert and San Bernardino Mts., CA	>800	Adverse weather; landed in irrigation canal and drowned	Jehl unpubl.
1993, ca. 19 December	Southern UT	1500	Downed in snow-storm	Utah Div. Wildl. Res.
1994, February-March	Salton Sea, CA	>2100	Unknown	Natl. Wildlife Health Ctr., fide L. Creekmore DVM
1994, mid-November	Great Salt Lake, UT	>6000	Avian cholera	Natl. Wildlife Health Ctr., fide L. Creekmore DVM; D. Paul, Jehl pers. obs.
1994, late November	Mono Lake, CA	>600 (1000?)	Downed in bad weather	Jehl, unpubl., L. Ford, R.E. Brannian DVM, pers. corn.

(Jehl 1994). In April 1882 the *Inyo Register*, noted a major dieoff at an unspecified time. The imaginative reporter wrote that arriving birds "only too soon become devoid of feathers and even the physical powers to prevent them from drowning when the surface of the water becomes ruffled by the continuous breeze. Certain it is that they will drown or otherwise perish and are cast up in wide windrows around the lake. On one of these occasions, a local gentleman of credibility counted the dead birds of a given space and on that basis figured out that there were fully two million dead 'ducks' piled around the lake." The oblique reference to wing molt suggests a date in early fall (1881?, Jehl 1988, Storer and Jehl 1985), but one can hardly be sure that the reference pertained to this event and was not simply background information based on local folklore.

A decade later, Fisher (1893:12-13) reported that large flocks of grebes were present into mid-June 1891. He also noted "hundreds of dead ones . . . along the shore . . . counted the bodies found within the limits of a given distance and estimated the total for the entire lake shore at 35,000." Fisher thought that "one of two causes, or both combined, must account for the death of so many. Either the water, which is saturated with salt and soda, is in some way injurious to them, or remaining to search for proper food, which does not exist in the lake, they become so weak from nutrition as to be unable to fly and die of starvation." Neither explanation is likely, however. Salt/soda toxicosis, a rare event under any conditions, is improbable because Owens Lake was relatively fresh then (total dissolved solids approximated only 74‰, Jehl 1994, Lee 1906), and grebes thrive for months at Mono Lake and even Great Salt Lake, where salt concentrations may be more than twice that concentration (Jehl 1988, 1993, and unpubl.). As for nutrition, Fisher failed to realize that tiny invertebrates, brine shrimp and brine flies, are not only proper food but are the exclusive food for Eared Grebes at hypersaline lakes (Jehl 1988). Indeed brine flies, at least, were abundant in Owens Lake (Jehl 1988, 1994), although perhaps not in early spring when the migrants begin to pass through.

While the Owens Lake dieoffs were obviously notable, their size is unknowable. Strong southwest winds beset this area almost daily, so that extrapolations from data collected along the north shore (the most likely site, owing to its proximity to settlements) would have grossly exaggerated the kill. Indeed, the "two million" suggested for the first-mentioned event approximates the size of the current North American population, which is perhaps 2-2.25 million in fall (Jehl 1988).

*Weather.*—In fall most Eared Grebes stage at Mono Lake or Great Salt Lake, remain until food disappears (typically in late November-January), and then leave over a several-week period (Jehl 1988). Owing to the compressed departure period, tens or hundreds of thousands of birds can be aloft on a single night. Downings (or wrecks) occur when snowstorms or fog cause the grebes to become disoriented (e.g., Jehl 1993). Typically, they take place several hours into the flight, and many have been reported

in the deserts and mountains of southern Utah, eastern Nevada, and southern California. A unusual wreck at Mono Lake in 1994 involved birds that had staged locally but evidently became disoriented in fog or snow and crashed back onto the lake within a few minutes of taking off. In another unusual case, 800 landed in a narrow canal in the Mojave Desert in January 1993 and were unable to get airborne before being drowned in irrigation pumps. That event coincided with a small downing in the nearby San Bernardino Mountains, both likely precipitated by the same weather system.

*Disease.*—Diseases including avian cholera and botulism annually kill thousands of waterfowl in the West. In Eared Grebes, Jensen and Cotter (1976) diagnosed that 5000 died of erysipelas at Great Salt Lake in late November 1975. A dieoff of similar magnitude (7500) at Great Salt Lake in November-December 1977 was attributed to an outbreak of *Streptococcus zooepidemicus* (Jensen 1979), whereas a third event there, involving >6000 grebes in mid-November 1994, was caused by avian cholera (L. Glaser DVM; L. Creekmore DVM, pers. comm.). Malcolm (1982) inferred that several hundred died of botulism in south-central Montana in 1980-1981. Interestingly, however, some major outbreaks of botulism at Great Salt Lake involving tens or hundreds of thousands of waterfowl, did not include grebes among the losses (Kalmbach 1935, 1968).

*El Niño?*—From late December 1982 through early March 1983, though mostly in late January 1983, perhaps 25,000 Eared Grebes died along the Pacific coast of southern California and northern Baja California (Jehl and Bond 1983), with additional mortality in the Gulf of California (Nishikawa et al. 1984.) Specimens examined by the National Wildlife Health Center showed no disease and the diagnoses were inconclusive (R. K. Stroud DVM, pers. comm.). The grebes were severely emaciated and those from California averaged about 200 g body mass vs the expected 300-350 g of migrants newly-arrived in wintering areas. The idea that they may have been forced down and delayed by bad weather along the route, so that they reached the coast in poor condition (Jehl and Bond 1983), now seems unlikely, because unless grebes are downed on water (and there is little along the route), they cannot take off again. An alternative idea—that grebes starved after reaching the ocean because of conditions related to the intense El Niño of 1982-83—had seemed implausible, because the dieoff was so widespread. But so was the El Niño, and observations that some grebes captured in San Diego recovered quickly when held in captivity support the idea that food shortage was involved.

*The Salton Sea.*—In the massive dieoff of 150,000 birds at the Salton Sea January-March 1992, sick grebes showed a suite of attributes atypical of healthy birds: coming ashore to rest and sunbathe on the beach; soaked plumage; continuous and vigorous preening; and intense drinking behavior, which led them to enter agricultural drains and natural seeps for fresh water. They were also in poor condition and their low body mass (mean 237 g) indicated that they had died slowly. In a smaller dieoff in 1994 (2100 birds), the grebes were heavier (mean 310 g) but showed the

same behaviors. Curiously, in both years Ruddy Ducks (*Oxyura jamaicensis*) were dying at the same time from avian cholera. Some grebes also died of avian cholera, but this was excluded as the reason for most of the deaths (L. Creekmore DVM, pers. comm.). Newspaper and television accounts quickly insinuated that anthropogenic factors were involved. Such speculation was not surprising, given the poor water quality of the Sea and then-recent alarm about selenium toxicity in waterbirds elsewhere in California. But no evidence of contamination ever materialized, despite much research. Current studies by the National Wildlife Health Center are investigating biotoxins from blue-green algae as a possible contributing factor (L. Creekmore DVM, pers. comm.)

Another large and previously unreported dieoff, which was virtually over before it was detected, occurred at the Sea in January-March 1989. The grebes were of normal mass for that season (mean 342 g) and had died quickly, as evidenced by the size of their subcutaneous fat deposits. The only behavioral observations were made by a local resident, who noted a large concentration "actively feeding" in runoff from freshwater pools. If they were drinking, as I suspect, it would represent a behavior common to all three events.

The size of this dieoff is hard to judge. Beached-bird counts in six locations along the west and north shorelines on 1 March, revealed 225 bodies/km (range 86-480/km); local residents found numerous carcasses on the south and east shores as well. Extrapolated to the entire Sea, these counts indicate that 39,600 birds perished ( $225 \times 176$  km of shoreline). Interestingly, these beached bird counts are essentially identical to those from made at the peak of the 1992 event (224/km, on 13 censuses around the lake on 19 and 26 February), which was ultimately judged to have involved nearly four times as many individuals (150,000). A strict comparison is unwarranted, because the factors affecting the distribution of either live migrants or of cadavers (e.g., prey abundance and location, proportion of dead reaching shore, wind speed and direction, duration of the dieoff) were not necessarily similar in the two years. Nevertheless, the 1989 event was of major magnitude and may have rivalled that of 1992.

#### CONCLUSIONS

Large-scale mortality among Eared Grebes is neither uncommon nor of recent origin; major dieoffs were reported almost as soon as settlers reached the West. For most instances the exact reason is unknown. The most common identifiable causes have been downings in bad weather and infectious diseases. The role of anthropogenic factors is speculative. Although some dieoffs have been extremely large (that in 1992 involved perhaps 7% of the New World population), they have had no detectable population consequences (Jehl, unpubl.).

#### ACKNOWLEDGMENTS

Many people assisted in gathering the information in this paper. They include: S. I. Bond, D. Paul, L. Creekmore DVM, L. Glaser DVM, P. Swift DVM, R. K. Stroud DVM, C. Jensen,

R. McKernan, D. Audet, M. Rivera, W. Radke, M. Hunnicutt, C. Bloom, L. Ford, D. Carle, J. Carle, F. Howe, P. White, D. Babb, and A. Henry. I am indebted to them and many others from Hubbs-Sea World Research Institute, the Utah Division of Wildlife Resources, the U.S. Fish and Wildlife Service (Carlsbad, CA and Salton Sea National Wildlife Refuge), and the National Wildlife Health Center (Madison WI) for information and assistance of various kinds. This paper is an outgrowth of studies sponsored by the Los Angeles Department of Water and Power and the Canadian Wildlife Service. P. K. Yochem DVM, C. Meteyer DVM, L. Creekmorr DVM, H. I. Ellis, and R. W. Storer provided helpful comments on the manuscript.

## LITERATURE CITED

- COTTAM, C. 1929. A shower of grebes. *Condor* 31:80-81.
- FISHER, A. K. 1893. Report on the ornithology of the Death Valley Expedition of 1891, comprising notes on the birds observed in southern California, southern Nevada, and parts of Arizona and Utah. Pp. 7-185, in *The Death Valley Expedition. Part II. North American Fauna No. 7*. U.S. Dept. Agr.
- DENTON, S. W. 1949. Pages from a naturalist's diary. V. Demon, ed. Alexander Printing Co., Boston, Massachusetts.
- JEHL, J. R., JR. 1988. Biology of the Eared Grebe and Wilson's Phalarope in the nonbreeding season: a study of adaptations to saline lakes. *Stud. Avian Biol.* No. 12.
- . 1993. Observations on the fall migration of Eared Grebes, based on evidence from a mass downing in Utah. *Condor* 95:470-473.
- . 1994. Changes in saline and alkaline lake avifaunas in western North America in the past 150 years. *Stud. Avian Biol.* 15:258-272.
- , AND S. I. BOND. 1983. Mortality of Eared Grebes in Winter of 1982-83. *Amer. Birds* 37:832-835.
- JENSEN, W. I. 1979. An outbreak of *Streptococcus* in Eared Grebes *Podiceps nigricollis*. *Avian Dis.* 23:543-546.
- , AND S. E. COTTER. 1976. An outbreak of erysipelas in Eared Grebes (*Podiceps nigricollis*). *J. Wildl. Diseases* 12:583-586.
- KALMBACH, E. R. 1935. Will botulism become a world-wide hazard to wild fowl. *J. Amer. Vet. Med. Assn.* 87:1833-187.
- . 1968. Type C botulism among wild birds—a historical sketch. *Bur. Sport Fish. Wildl. Spec. Sci. Rept.—Wildlife No. 10*, 8 pp.
- LEE, W. T. 1906. Geology and water resources of Owens Valley, California. C.S. Geol. Surv. Water Supply and Irrigation Pap. no. 181.
- MALCOLM, J. 1982. Bird collisions with a power transmission line and their relation to botulism at a Montana USA wetland. *Wildl. Soc. Bull.* 10:297-30.
- NISHIKAWA, K. E. MILLÁN, R. MENDOZA, A. JORAJURIA, AND E. AMADOR. 1984. Registro de la mortalidad del colimbo, Zambullidor moñudo (*Podiceps nigricollis*), en Baja California durante el primer trimestre de 1983. *Ciencias Marinas* 10(1):77-78.
- STORER, R. W., AND J. R. JEHL, JR. 1985. Moulting patterns and migration in the Black-necked Grebe *Podiceps nigricollis*. *Ornis Scand.* 16:253-260.

Received 3 Oct. 1995; accepted 27 Nov. 1995.