CDFW-OSPR Seabird Program Annual Report 2019

Photo credit: L. Henkel

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BACKGROUND AND OBJECTIVES

The essential functions of the California Department of Fish and Wildlife (CDFW) Office of Spill Prevention and Response (OSPR) Seabird Program are to investigate and monitor the health and pathology of marine birds to support to the best achievable care of oiled wildlife and detect emerging threats to seabird populations. This includes coordination with beached bird monitoring programs and wildlife rehabilitation organizations to monitor the trends and causes of mortality of seabirds. We investigate the occurrence and cause of unusual mortality events of seabirds and shorebirds through scientifically structured postmortem exams at the OSPR Marine Wildlife Investigations Lab and the USGS National Wildlife Health Center. The CDFW-OSPR Seabird Program includes: Seabird Program Leader: Cori Gibble, MS, PhD; MWVCRC Veterinary Pathologist: Melissa Miller DVM, PhD, MS, and MWVCRC Facility Director: Laird Henkel, MS.

In addition, we monitor the effects of chronic and unusual oiling events for marine wildlife. We coordinate these investigations with the OSPR wildlife response coordinator, the Oiled Wildlife Care Network (OWCN), and the OSPR Petroleum Chemistry Laboratory. The Seabird Program also maintains veterinary supplies and inventory related to oiled marine bird stabilization at the MWVCRC, coordinates with the OWCN, and assists in oil spill readiness and response for oil spills in California.

ANNUAL SUMMARY

Health and Pathology Studies

Seventy-seven seabirds and shorebirds received postmortem exams at the MWVCRC in 2019 (Table 1), additional information on most of these exams are listed below. Postmortem exams are completed via systematic necropsy, which includes external examination, morphometrics, photographs, internal examination, sampling of organs and tissues, and if warranted, radiographs, histopathology, and/or sample testing.

Western and Clark's Grebes (Spring 2019)

During February and March 2019, numerous stranded Western Grebes (*Aechmophorus occidentalis*) and Clark's Grebes (*Aechmophorus clarkii*) were found dead or were admitted live to rehabilitative care between San Luis Obispo and San Mateo Counties. A total of 10 birds were submitted to the MWVCRC for gross necropsy (19-0106-19-0107,19-0121-19-0122, 19-0158-19-0159, 19-0232-19-0236). The Society for the Prevention of Cruelty to Animals for Monterey County (MSPCA) submitted 4 birds that died

during rehabilitative care. Birds entering rehabilitative care at the MSPCA were reported to be emaciated, cold, weak and dehydrated. In addition, 2 beachcast (dead) grebes were submitted by the Greater Farallones National Marine Sanctuary Beach Watch program, and 4 beachcast (dead) grebes were submitted by biologists at Oceano Dunes State Vehicular Recreation Area (ODSVRA). This stranding event began approximately 2/10/2019 and the event ended approximately 3/10/2019. All grebes exhibited moderate to severe emaciation, characterized by depleted subcutaneous and internal adipose and atrophied skeletal muscle, a concave pectoral muscle complex, atrophied internal organs, and empty gastrointestinal tracts. All ten birds had large masses of dry, compacted feathers in the ventriculus. Mild to moderate feather consumption is considered to be part of the normal digestive process for grebes. This process may help slow gastrointestinal passage of ingested prey, and thus enhance the efficiency of digestion for small arthropods or other hard-bodied taxa. However, if too many feathers are ingested, the large mass of compacted feathers can cause digestive problems such as impaction (Jehl 2017). The cause of the observed emaciation is unknown, but starvation due to low prey availability is possible. No gross evidence of pre-existing disease was found. A final report for this event can be found in Appendix A.

Snowy Plover (Spring 2019)

This Western Snowy Plover (Charadrius nivosus; 19-0136) was found fresh dead by a member of the public on Del Monte Beach, north of the Tides Hotel in Monterey, CA, near a symbolic (cable) fence. The bird was found on 3/6/2019, was buried in the sand, and then uncovered again on 3/8/2019 by the same member of the public who was hoping to preserve the carcass. The bird was reported to Point Blue Conservation Science and brought to MWVCRC. It is suspected that this bird may have collided with the nearby fence. Postmortem radiographs were suggestive of an acute skull fracture near the occipital region on the right side of the skull and fracture of the clavicle on the left side of the body. The radiographic skull lesion corresponded grossly with a focally extensive region of vascular congestion and possibly, acute hemorrhage in the lower right portion of the cerebral hemisphere. Additional acute hemorrhages were apparent along the subcutis of the gape, chin neck, acute hemorrhage on the dorsal surface of the pectoral muscle, and hemorrhage under the keel in the proximal thoracic cavity. A large antemortem laceration was found externally on the left side of the neck near chin and gape. Marked bilateral renal venous engorgement was also noted. The proventriculus and ventriculus were full of partially digested insects, signifying the bird had been actively feeding prior to death. Adequate pericardial, subcutaneous and internal adipose stores and absence of pectoralis muscle atrophy indicate the bird was in excellent nutritional condition at the time of death. The bird was a juvenile male based on plumage and gonads. Acute blunt force/collision trauma was the presumptive cause of death. There was no gross evidence of other significant disease or postmortem scavenging. A final report for this necropsy can be found in Appendix A.

Common Murres (Summer 2019)

On 5/22/2019, Coastal Observation and Seabird Survey Team (COASST) reported that their group had documented over 120, mostly fresh, Common Murres (Uria aalge; COMU) near Mendocino on a ~7km stretch of beach. The event appeared localized, and on 5/23/19 COASST updated that areas south of Fort Bragg at Navarro Beach and Hare Creek beaches did not have dead birds. CDFW staff at the Fort Bragg office also reported COMU washing up on beaches in Mendocino County as of 5/24/2019. Wildlife rehabilitators in Sonoma and Marin Counties were also reported to be assisting with live debilitated birds. A few adjacent areas appear to have had variable increases in the deposition of COMU during May surveys. Beach Watch reported an elevated rate of dead COMU from Manchester Beach to Doran Beach in Sonoma County, and a slightly elevated rate of deposition of dead COMU from Salmon Creek Beach to Año Nuevo Beach during May. BeachCOMBERS reported a slight increase in COMU in Santa Cruz and Monterey Counties during May, with no signal found in survey areas south of Monterey. The event appears to have slowed as of 6/10/2019, with few COMU reported after 6/1/2019. Nine carcasses were sent to MWVCRC for examination, and 3 carcasses were shipped to the USGS National Wildlife Health Center (USGS NWHC) for examination. All nine COMU examined at MWVCRC shared the following characteristics at gross necropsy: All were adult COMUs in emaciated body condition. No fractures were found. There was severe, diffuse emaciation, characterized by depleted subcutaneous, internal and pericardial adipose, atrophied skeletal muscle, and a concave pectoral muscle complex. The internal organs were pale and atrophied. The gastrointestinal tract was empty, and mild melena (digested blood) was present in the esophagus, proventriculus, ventriculus, and intestines. The reproductive organs were hypertrophied (enlarged), indicative of active reproductive status. Findings from gross necropsy are suggestive of death due to severe emaciation. Emaciation was also determined to be the cause of death for the 3 birds examined at USGS NWHC. The cause of the observed emaciation is unknown, but starvation due to low prey availability is possible. A final report for this necropsy can be found in Appendix Α.

Snowy Plover (Summer 2019)

This fledgling plover (19-0415) was collected fresh dead on 7/1/2019 from the 6 exclosure shoreline at the W12W marker in dry wrack just above the high tide line at ODSVRA. This bird was banded from Snowy Plover nest 64 and was last seen alive at 28 days old on 6/24/2019 in the same area. Two siblings from the same nest were foraging nearby on the day it was collected. Some adult aggression was also observed in the area at that time. This bird was an emaciated juvenile male fledgling. The eyes were sunken, and the keel was prominent. No fractures were found grossly or by post-mortem radiographs. Severe, diffuse emaciation was characterized by depleted subcutaneous, internal and pericardial adipose, atrophied skeletal muscle and a concave pectoral muscle complex. The internal organs were pale. Scant insect fragments and sand were found in the ventriculus, and scant digesta was found in the

intestines. Scant urates were present in the cloaca and externally at the vent. No gross evidence of preexisting or concurrent disease was found. Findings from gross necropsy are suggestive of death due to severe emaciation. The cause of the observed emaciation is unknown, but starvation is possible. A final report for this necropsy can be found in Appendix A.

Least Tern (Summer 2019)

This California Least Tern (*Sternula antillarum browni*; 19-0475) was found on 7/23/2019 in the designated nesting exclosure approximately 220 feet east of the western fence at ODSVRA. There was no disturbance on the sand surface around the carcass. Because it was unbanded, information regarding this bird is sparse; however, ODSVRA staff believes the bird hatched locally and was approximately 21-30 days old on 7/23/2019, based on the ages of known unbanded chicks (11 of 52 chicks were unbanded) at this location. This bird was a juvenile male fledgling. No fractures were found grossly or on postmortem radiographs. The bird was thin, with mild pectoral muscle atrophy, scant subcutaneous and pericardial adipose, and no coelomic adipose. All internal organs were within normal limits grossly. The proventriculus and ventriculus contained a single large mass of compressed fibrous material that appeared to be a large piece of blue felt fabric. Scant digesta was found in the small intestines and colon. The kidneys were mildly congested, and scant urates were present in the cloaca and externally at the vent. Two small areas of symmetrical congestion were apparent near the base of the skull; no associated skin or brain lesions, or fractures were found. Cause of death was attributed to a suspected foreign body ingestion gastric impaction. No gross evidence of pre-existing or concurrent disease was found. A final report for this necropsy can be found in Appendix A.

Brandt's Cormorants and Pigeon Guillemots (Summer 2019)

The MSPCA reported an increase of Brandt's Cormorants (*Phalacrocorax penicillatus;* BRAC) and Pigeon Guillemots (*Cepphus columba;* PIGU) at intake between 8/28/2019 and 9/7/2019. Admitted birds were cold, emaciated and exhibited stuporous mentation. Four fresh-frozen carcasses (2 BRAC, 2 PIGU; 19-0618-19-0621) were sent to MWVCRC for examination. At gross necropsy all four birds were in fresh postmortem condition with no evidence of trauma. There was severe, diffuse emaciation, characterized by depleted subcutaneous, internal and pericardial adipose, atrophied skeletal muscle, and a concave pectoral muscle complex. The internal organs were pale and atrophied (starvation/inanition plus malnutrition associated anemia). The gastrointestinal tract was empty, and mild melena (digested blood) was present in the esophagus, proventriculus, ventriculus, and intestines. Scant urates were present in the cloaca. Findings from gross necropsy are suggestive of death due to emaciation. The cause of the observed emaciation is unknown, but starvation due to low prey availability is possible. A final report for this necropsy can be found in Appendix A.

Acanthocephalan Project (Surf Scoters, Shorebirds, Clark's Grebe- year round 2019)

Richard Grewelle, a PhD candidate at Stanford University, is working on a dissertation project that evaluates the transmission of *Profilicollis spp*.(Phylum: Acanthocephala) parasites between marine birds and southern sea otters. As part of that work, the definitive hosts are identified, as well as the species of *Profilicollis* in each host. We are working collaboratively with Richard Grewelle on this task and have necropsied and sampled many birds collected in California that may be serving as hosts, such as Surf Scoters (*Melanitta perspicillata*), shorebirds and Clark's Grebes (Table 1)

Individual Oiled Birds

In an effort to help monitor the effects of chronic oiling and unusual oiling events of marine birds, individually oiled birds collected by beach survey programs and other entities were examined in 2019 and petroleum was sampled (Table 2). Samples were sent to the CDFW-OSPR Petroleum Chemistry Lab (PCL) for archiving and potential fingerprinting.

We worked directly with two beach survey programs, BeachCOMBERS and Beach Watch, to better document oiled seabirds statewide. Each month each organization reports all oiled birds found on their monthly beach surveys to help us better track frequency of oiled birds in California in real time (Table 3). The greatest number of oiled birds was reported in March (n=24), and no oiled birds were reported from either program in September or December.

Technical Reports, Publications and Presentations

The Seabird Program produced several necropsy reports during 2019 (Appendix A). A manuscript entitled "Domoic Acid and Saxitoxin in Seabirds in the US between 2007-2018" was completed in 2019 and was submitted for US Geological Survey internal review. It is awaiting submittal to the journal Harmful Algae, with a planned publication in 2020. This publication focuses on the interactions between seabirds and harmful algal blooms that are largely under-reported. There is a dearth of information available in the literature in respect to concentrations of harmful algal bloom toxins in the tissues of seabirds. Through collaboration with UCSC, USGS NWHC, NOAA NMFS we will publish domoic acid and saxitoxin values already evaluated in the tissues of birds.

Cori and Melissa also participated in the 2019 Wildlife Disease Association Meeting (WDA; Tahoe City, CA) in August. Through an oral presentation entitled: An investigation of lethal and non-lethal domoic acid exposure in loons in California (Appendix B), we were able to share results and findings with our CDFW and OWCN colleagues and the greater science community.

ONGOING PROJECTS AND NEW PLANNED STUDIES

Lethal and Non-lethal Domoic Acid Exposure in Loons

Through collaboration with Dr. Rebecca Duerr of International Bird Rescue (IBR), we are investigating chronic and acute exposure of birds to DA. During a 2017 Santa Barbara Domoic Acid Event, we collected histopathology samples from beachcast loons with apparent acute exposure to domoic acid. These samples will be compared to samples from birds that died during rehabilitative care at IBR. We believe this study will allow us to examine the effects of two routes of domoic acid exposure in birds. *Update:* Histopathology has been completed; writing began in 2019, anticipated completion in 2020.

Diving Bird Lesion Study

This project is an IBR study funded by OWCN to identify development and progression of skin lesions in seabirds in the absence of donuts or booties, to begin to answer the question of whether protective wraps are worth the time/effort/resource investment and to develop a scoring system to grade severity as lesions change during care. International Bird Rescue has spearheaded this study and secured the funding. MWVCRC (Melissa) is collaborating on the histopathology portion of this study. This work will directly inform care for oiled wildlife. *Update:* This project has a target completion date of mid-summer 2020, with a possible follow-up study in 2021.

Update to Historic List of Oil Spills Affecting Wildlife in California

We are planning an update to Carter et al. (2003), a previous overview of oiling of seabirds in California. This update may occur in two separate papers: one would provide an updated summary of oiled birds in California, and a second related paper would involve an investigation of oil spills versus timing of live and dead birds. This would help to create an index of vulnerability for oiled seabirds during oil spill events.

Corvid Diet Investigation

Corvids like the Common Raven (*Corvus corax*) and American Crow (*Corvus brachyrhynchos*) have a varied diet that includes the eggs and chicks of other species of birds. In California, they prey on eggs and chicks of threatened and endangered species such as the SNPL and MAMU (Nelson 1995, Lafferty 2001, Peery et al. 2004, Colwell et al. 2005, Hébert and Golightly 2007). Working with Point Blue Conservation Science, a number of CORA and AMCR taken under depredation permits were previously examined at MWVCRC for stomach content analysis (2013-2015). A short communication piece is planned to demonstrate predation and demographics of these predators, which relates to ongoing oil spill trustee council restoration projects.

Snowy Plover Crush Trauma Paper

We received a number of SNPL with crush trauma contributing to death, and a descriptive paper

documenting these cases would be beneficial to the wildlife pathology community.

Retrospective Analysis of Tissues for Microcystin in Seabirds

Microcystis blooms are usually considered an issue in only freshwater systems, but freshwater-derived microcystins are polluting the coastal environment of central California (Gibble and Kudela 2014). Seabirds, including threatened and endangered species may be at risk for microcystin toxicity, but no one is currently testing to examine this toxin in birds. We plan to conduct retrospective toxicity testing of seabirds. Samples archived at the MWVCRC, taken from an assortment of birds that have died in the last 10 years, will be analyzed for microcystin toxin in collaboration with UC Santa Cruz. These data will give us a better understanding the spatial and temporal effects of this toxin in seabirds in California.

Retrospective Summaries for Rare Birds

We would like to examine available statewide pathology information on rare, threatened, and endangered coastal birds. In collaboration with CAHFS and NWHC, we will investigate available data to review the historic and current morbidity and mortality factors effecting these species.

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Necropsy		Necropsy				Final
Number	Species	Date	Collection Location	County	Presumed COD	Report
19-0080	Surf Scoter	2/20/2019	Pismo Beach	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	N
19-0081	Black Scoter	2/20/2019	Oceano Dunes	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	N
19-0082	Surf Scoter	2/20/2019	Cayucos	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0083	Surf Scoter	2/20/2019	Cayucos	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0084	Surf Scoter	2/20/2019	Salinas River State Beach	Monterey	acanthocephalan peritonitis (presumptive)	Ν
19-0106	Western Grebe	2/26/2019	Del Monte Beach	Monterey	severe emaciation	Y
19-0107	Western Grebe	2/26/2019	Monterey	Monterey	severe emaciation	Y
19-0121	Western Grebe	2/26/2019	Moss Landing State Beach	Monterey	severe emaciation	Y
19-0122	Western Grebe	2/26/2019	Carmel	Monterey	severe emaciation	Y
19-0136	Snowy Plover	3/8/2019	Del Monte Beach	Monterey	acute blunt force/collision trauma, (presumptive)	Y
19-0158	Western Grebe	3/13/2019	Pillar Point Harbor	San Mateo	severe emaciation	Y
19-0159	Western Grebe	3/13/2019	Pillar Point Harbor	San Mateo	severe emaciation	Y
19-0232	Clark's Grebe	4/25/2019	Oceano	San Luis Obispo	severe emaciation	Y
19-0233	Western Grebe	4/25/2019	Oceano	San Luis Obispo	severe emaciation	Y
19-0234	Clark's Grebe	4/25/2019	Oceano	San Luis Obispo	severe emaciation	Y
19-0235	Western Grebe	4/25/2019	Oceano	San Luis Obispo	severe emaciation	Y
19-0236	Western Grebe	4/25/2019	Ventura	Ventura	severe emaciation	Y
19-0321	Whimbrel	5/29/2019	Salinas River State Beach	Monterey	unknown, advanced decomposition	Ν
19-0322	Long-billed Curlew	5/29/2019	Atascedero	San Luis Obispo	emaciation	Ν
19-0323	Surf Scoter	5/29/2019	Salinas River State Beach	Monterey	acanthocephalan peritonitis (presumptive)	Ν
19-0324	Surf Scoter	5/29/2019	Oceano	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0325	Surf Scoter	5/29/2019	Oceano	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0326	Surf Scoter	5/29/2019	Morro Bay	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0327	Surf Scoter	5/29/2019	Morro Bay	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0328	Surf Scoter	5/29/2019	San Simeon	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0329	Common Murre	5/29/2019	Noyo Bay	Mendocino	severe emaciation	Y
19-0332	Common Murre	6/6/2019	MacKerricher State Park	Mendocino	severe emaciation	Y
19-0333	Common Murre	6/6/2019	Noyo Harbor Beach	Mendocino	severe emaciation	Y
19-0334	Common Murre	6/6/2019	MacKerricher State Park	Mendocino	severe emaciation	Y
19-0335	Common Murre	6/6/2019	MacKerricher State Park	Mendocino	severe emaciation	Y
19-0336	Common Murre	6/6/2019	MacKerricher State Park	Mendocino	severe emaciation	Y

19-0337	Common Murre	6/6/2019	MacKerricher State Park	Mendocino	severe emaciation	Y
19-0338	Common Murre	6/6/2019	MacKerricher State Park	Mendocino	severe emaciation	Y
19-0339	Common Murre	6/6/2019	MacKerricher State Park	Mendocino	severe emaciation	Y
19-0415	Snowy Plover	7/2/2019	Oceano Dunes	San Luis Obispo	emaciation	Y
19-0475	Least Tern	7/24/2019	Oceano Dunes	San Luis Obispo	suspected foreign body ingestion gastric impaction	Y
19-0618	Brandt's Cormorant	9/18/2019	Del Monte Beach	Monterey	emaciation	Y
19-0619	Brandt's Cormorant	9/18/2019	Marina State Beach	Monterey	emaciation	Y
19-0620	Pigeon Guillemot	9/18/2019	Del Monte Beach	Monterey	emaciation	Y
19-0621	Pigeon Guillemot	9/18/2019	Monterey	Monterey	emaciation	Y
19-0638	Surf Scoter	10/23/2019	Oceano	San Luis Obispo	acanthocephalan peritonitis (presumptive)	Ν
19-0639	Surf Scoter	10/23/2019	Pismo Beach	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0640	Surf Scoter	10/23/2019	Oceano	San Luis Obispo	aspergillosis, acanthocephalan peritonitis (presumptive)	Ν
19-0641	Surf Scoter	10/23/2019	Cayucos	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0642	Clark's Grebe	10/23/2019	Oceano	San Luis Obispo	emaciation	Ν
19-0643	Clark's Grebe	10/23/2019	Pismo Beach	San Luis Obispo	emaciation	Ν
19-0644	Red-necked Phalarope	10/23/2019	Oceano	San Luis Obispo	unknown, advanced decomposition	Ν
19-0645	Willet	10/23/2019	Los Osos	San Luis Obispo	acanthocephalan peritonitis (presumptive)	Ν
19-0646	Killdeer	10/23/2019	Oceano Dunes	San Luis Obispo	crush trauma (presumptive)	Ν
19-0647	Sanderling	10/23/2019	Oceano Dunes	San Luis Obispo	unknown	Ν
19-0648	Sanderling	10/23/2019	Oceano Dunes	San Luis Obispo	unknown	Ν
19-0649	Red-necked Phalarope	10/23/2019	Humboldt	Humboldt	unknown, advanced decomposition	Ν
19-0727	Rhinoceros Auklet	12/9/2019	Manresa State Beach	Santa Cruz	emaciation	Ν
19-0707	Surf Scoter	12/4/2019	Morro Bay	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0700	Surf Scoter	12/4/2019	Morro Bay	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0701	Surf Scoter	12/4/2019	Oceano	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0702	Surf Scoter	12/4/2019	Avila Beach	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0703	Surf Scoter	12/4/2019	Avila Beach	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0704	Surf Scoter	12/4/2019	Morro Bay	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0705	Surf Scoter	12/4/2019	Morro Bay	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0699	Surf Scoter	12/4/2019	Pismo Beach	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0706	Surf Scoter	12/4/2019	Oceano	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0708	Surf Scoter	12/4/2019	Pismo Beach	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0709	Surf Scoter	12/4/2019	Pismo Beach	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0710	Surf Scoter	12/4/2019	Morro Bay	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0711	Surf Scoter	12/4/2019	Cayucos	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0712	Surf Scoter	12/4/2019	Pismo Beach	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν

19-0713	Surf Scoter	12/4/2019	Morro Bay	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0714	Surf Scoter	12/4/2019	Morro Bay	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0715	Surf Scoter	12/4/2019	Oceano	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0716	Surf Scoter	12/4/2019	Cayucos	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0717	Surf Scoter	12/4/2019	Morro Bay	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0718	Surf Scoter	12/4/2019	Oceano	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0719	Surf Scoter	12/4/2019	Oceano	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0720	Surf Scoter	12/4/2019	Oceano	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0721	Surf Scoter	12/4/2019	Oceano	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν
19-0722	Surf Scoter	12/4/2019	Oceano	San Luis Obispo	acanthocephalan peritonitis (presumptive), emaciation	Ν

Oil Intake #	Species	Date Collected	Collecting Organization*	Collection Location	County
D1138 MWVCRC	Western Grebe	2/1/2019	USFWS	Ventura	Ventura
D1144 MWVCRC	Unidentified Alcid	4/4/2019	BeachCOMBERS	Rancho Guadalupe Dunes	Santa Barbara
D1147 MWVCRC	Western Grebe	2/17/2019	ODSVRA	Oceano	San Luis Obispo
D1148 MWVCRC	Pacific Loon	2/25/2019	ODSVRA	Oceano	San Luis Obispo
D1149 MWVCRC	Common Loon	2/16/2019	ODSVRA	Oceano	San Luis Obispo
D1150 MWVCRC	Western Grebe	2/28/2019	ODSVRA	Oceano	San Luis Obispo
D1151 MWVCRC	Western Grebe	3/3/2019	BeachCOMBERS	Morro Bay Sandspit	San Luis Obispo
D1156 MWVCRC	Western Grebe	2/1/2019	BeachCOMBERS	Morro Bay Sandspit	San Luis Obispo
D1157 MWVCRC	Common Loon	2/1/2019	BeachCOMBERS	Del Monte Beach	Monterey
D1162 MWVCRC	Western Grebe	2/9/2019	ODSVRA	Oceano	San Luis Obispo
D1163 MWVCRC	Western Grebe	2/10/2019	ODSVRA	Oceano	San Luis Obispo
D1164 MWVCRC	Common Murre	2/10/2019	ODSVRA	Oceano	San Luis Obispo
D1165 MWVCRC	Common Murre	6/13/2019	ODSVRA	Oceano	San Luis Obispo
D1166 MWVCRC	Common Murre	6/12/2019	ODSVRA	Oceano	San Luis Obispo
D1167 MWVCRC	Common Murre	6/15/2019	ODSVRA	Oceano	San Luis Obispo
D1168 MWVCRC	Rhinoceros Auklet	4/26/2019	BeachCOMBERS	Morro Strand, Morro Bay	San Luis Obispo
D1169 MWVCRC	Common Murre	6/3/2019	BeachCOMBERS	Morro Strand, Morro Bay	San Luis Obispo
D1170 MWVCRC	Horned Puffin	6/25/2019	ODSVRA	Oceano	San Luis Obispo
D1171 MWVCRC	Common Murre	7/2/2019	BeachCOMBERS	Morro Bay Sandspit	San Luis Obispo
D1172 MWVCRC	Eared Grebe	4/24/2019	ODSVRA	Oceano	San Luis Obispo
D1173 MWVCRC	Pacific Loon	4/2/2019	ODSVRA	Oceano	San Luis Obispo
D1174 MWVCRC	Common Murre	6/7/2019	BeachCOMBERS	Moonstone Beach	San Luis Obispo
D1175 MWVCRC	Common Murre	5/2/2019	BeachCOMBERS	Morro Bay Sandspit	San Luis Obispo
D1176 MWVCRC	Rhinoceros Auklet	5/2/2019	BeachCOMBERS	Morro Bay Sandspit	San Luis Obispo
D1177 MWVCRC	Surf Scoter	5/1/2019	Pacific Wildlife Care	Los Osos	San Luis Obispo
D1178 MWVCRC	Rhinoceros Auklet	12/9/2019	MWVCRC	Manresa Sate Beach	Santa Cruz
D1183 MWVCRC	Common Murre	9/3/2019	Sea Otter Savvy	Moss Landing State Beach	Monterey
D1184 MWVCRC	Common Murre	12/5/2019	MSPCA	Pacific Grove	Monterey
D1185 MWVCRC	Rhinoceros Auklet	5/3/2019	BeachCOMBERS	Zmudowski State Beach	Monterey
D1186 MWVCRC	Common Murre	4/10/2019	BeachCOMBERS	Manresa Sate Beach	Santa Cruz
D1187 MWVCRC	Unidentified Seabird	11/3/2019	BeachCOMBERS	Rancho Guadalupe Dunes	Santa Barbara

Table 3. Oiled birds recorded by beach survey programs in 2019. Beach Watch reported zero oiled birds August-December.

Organization	Month	Species	Beach Name	County	*Oil Intake #
BeachCOMBERS	1	Western Grebe	Summerland Beach	Ventura	
BeachCOMBERS	2	Common Loon	Del Monte	Monterey	D1157
BeachCOMBERS	2	Western Grebe	Summerland Beach	Ventura	
BeachCOMBERS	2	Western Grebe	Summerland Beach	Ventura	
BeachCOMBERS	2	Clark's/Western Grebe	Morro Bay Sandspit	San Luis Obispo	D1156
BeachCOMBERS	2	Western Grebe	Vandenberg	Santa Barbara	
Beach Watch	2	Clark's/Western Grebe	Seadrift Beach	Marin County	
BeachCOMBERS	3	Common Murre	Marina	Monterey	
BeachCOMBERS	3	Common Murre	Marina	Monterey	
BeachCOMBERS	3	Clark's/Western Grebe	Naval Base Ventura County	Ventura	
BeachCOMBERS	3	Common Loon	Naval Base Ventura County	Ventura	
BeachCOMBERS	3	Common Murre	Morro Bay Sandspit	Ventura	
BeachCOMBERS	3	Western Grebe	Hollywood Beach	Ventura	
BeachCOMBERS	3	Unidentified Grebe	Ormond North	Ventura	
BeachCOMBERS	3	Clark's/Western Grebe	Surfer's Knoll	Ventura	
BeachCOMBERS	3	Unidentified Grebe	Arroyo de la Cruz	San Luis Obispo	
BeachCOMBERS	3	Unidentified Grebe	Arroyo de la Cruz	San Luis Obispo	
BeachCOMBERS	3	Western Grebe	Padaro Beach	Santa Barbara	
BeachCOMBERS	3	Western Grebe	Padaro Beach	Santa Barbara	
BeachCOMBERS	3	Clark's Grebe	Morro Bay	San Luis Obispo	
BeachCOMBERS	3	Clark's Grebe	Morro Bay	San Luis Obispo	
BeachCOMBERS	3	Rhinoceros Auklet	Morro Bay	San Luis Obispo	
BeachCOMBERS	3	Western Grebe	Morro Bay	San Luis Obispo	D1151
BeachCOMBERS	3	Western Grebe	Vandenberg	Santa Barbara	
BeachCOMBERS	3	Western Grebe	Asilomar	Monterey	
BeachCOMBERS	3	Rhinoceros Auklet	Asilomar	Monterey	
BeachCOMBERS	3	Common Murre	Asilomar	Monterey	
BeachCOMBERS	3	Clark's/Western Grebe	Summerland	Ventura	
BeachCOMBERS	3	Clark's/Western Grebe	Surfer's Knoll	Ventura	
BeachCOMBERS	3	Clark's/Western Grebe	Surfer's Knoll	Ventura	
BeachCOMBERS	3	Clark's Grebe	Carpinteria	Santa Barbara	
BeachCOMBERS	4	Common Murre	San Carpoforo	San Luis Obispo	

BeachCOMBERS	4	Western Grebe	San Carpoforo	San Luis Obispo	
BeachCOMBERS	4	Common Loon	Naval Base Ventura County	Ventura	
BeachCOMBERS	4	Western Grebe	Arroyo de la Cruz	San Luis Obispo	
BeachCOMBERS	4	Unidentified Grebe	Arroyo de la Cruz	San Luis Obispo	
BeachCOMBERS	4	Pacific Loon	Summerland Beach	Ventura	
BeachCOMBERS	4	Unidentified Alcid	Rancho Guadalupe	Santa Barbara	D1144
BeachCOMBERS	4	Common Murre	Manresa	Santa Cruz	D1186
BeachCOMBERS	4	Rhinoceros Auklet	Morro Bay	San Luis Obispo	D1168
BeachCOMBERS	5	Unidentified Seabird	Rancho Guadalupe	Santa Barbara	
BeachCOMBERS	5	Clark's/Western Grebe	Leo Carrillo	Los Angeles	
BeachCOMBERS	5	Unidentified Grebe	Arroyo de la Cruz	San Luis Obispo	
BeachCOMBERS	5	Common Murre	Arroyo de la Cruz	San Luis Obispo	
BeachCOMBERS	5	Rhinoceros Auklet	Arroyo de la Cruz	San Luis Obispo	
BeachCOMBERS	5	Common Murre	Arroyo de la Cruz	San Luis Obispo	
BeachCOMBERS	5	Common Murre	Morro Bay Sandspit	San Luis Obispo	D1175
BeachCOMBERS	5	Rhinoceros Auklet	Morro Bay Sandspit	San Luis Obispo	D1176
BeachCOMBERS	5	Clark's/Western Grebe	Naval Base Ventura County	Ventura	
BeachCOMBERS	5	Common Murre	Naval Base Ventura County	Ventura	
BeachCOMBERS	5	Rhinoceros Auklet	Zmudowski	Monterey	D1185
BeachCOMBERS	6	Unidentified Loon	Hendry's Beach	Santa Barbara	
BeachCOMBERS	6	Common Murre	Morro Bay	San Luis Obispo	D1169
BeachCOMBERS	6	Common Murre	Moonstone Beach	San Luis Obispo	D1174
Beach Watch	6	Common Murre	Sharp Park	San Mateo	
Beach Watch	7	Common Murre	Bradley Beach	San Mateo	
BeachCOMBERS	7	Common Murre	Morro Bay Sandspit	San Luis Obispo	D1171
BeachCOMBERS	7	Unidentified Grebe	Hendry's Beach	Santa Barbara	
BeachCOMBERS	7	Unidentified Alcid	Rancho Guadalupe	Santa Barbara	
BeachCOMBERS	7	Common Murre	Zmudowski	Monterey	
BeachCOMBERS	7	Sooty Shearwater	Zmudowski	Monterey	
BeachCOMBERS	9	Common Murre	Marina	Monterey	
BeachCOMBERS	10	Common Murre	Del Monte	Monterey	
BeachCOMBERS	10	Common Murre	Asilomar	Monterey	
BeachCOMBERS	10	Western Grebe	Surfer's Knoll	Ventura	
BeachCOMBERS	11	Unidentified Seabird	Rancho Guadalupe	Santa Barbara	D1187

*Not all oiled birds recorded during beach surveys are sampled at MWVCRC. Only birds collected and sampled for oil at MWVCRC receive intake numbers.

Appendix A. Necropsy Reports Completed in 2019

CDFW SEABIRD MORTALITY EVENT NECROPSY REPORT



California Department of Fish and Wildlife Office of Spill Prevention and Response Marine Wildlife Veterinary Care and Research Center 151 McAllister Way Santa Cruz, CA 95060 (831) 469-1719 MWVCRC#:19-0106-19-0107; 19-0121-19-0120;19-0158-19-0159;19-0232-19-0235 Species: WEGR, CLGR UCD PATH#: N/A Report Status: Final

COMMON NAMES: Western Grebe, Clark's	Grebe SCIENTIFIC NAMES: Aechmophorus occidentalis, A. clarkii
DATE RANGE: 2/12/2019-3/3/2019	COLLECTION AREA: Monterey, San Mateo, San Luis Obispo
COUNTY: Monterey	STATE: California
CARCASS CONDITION: Frozen	OILED/FOULED: No
NECROPSY DATE: 2/26/2019	NECROPSY BY: C. Gibble, E.Dodd, K.Greenwald
REPORT DATE : 5/22/2019	REPORT BY: Corinne Gibble
HISTOPATHOLOGY TAKEN (Y/N?): N	REVIEWING PATHOLOGIST: Melissa Miller
	EVENT BACKGROUND

EVENT PROFILE

During February and March 2019, numerous stranded Western Grebes (WEGR) and Clark's Grebes (CLGR) were found dead or were admitted live to rehabilitative care between San Luis Obispo and San Mateo Counties. A total of 10 birds were submitted to the Marine Wildlife Veterinary Care and Research Center (MWVCRC) for gross necropsy. The Society for the Prevention of Cruelty to Animals for Monterey County (MSPCA) submitted 4 birds that died during rehabilitative care. Birds entering rehabilitative care at the MSPCA were reported to be emaciated, cold, weak and dehydrated. One bird was euthanized, while the others were dead on arrival, or died in care. In addition, 2 beachcast (dead) grebes were submitted by the Greater Farallones National Marine Sanctuary Beach Watch program, and 4 beachcast (dead) grebes were submitted by biologists at Oceano Dunes State Vehicular Recreation Area (ODSVRA). This stranding event began approximately 2/10/2019 and the event ended approximately 3/10/2019.

EVENT SUMMARY

Ten birds from three different counties were examined (Table 1). All ten had been frozen prior to necropsy, were minimally decomposed, and were adults, based on the gonad, thymic and bursal size at gross necropsy. All grebes exhibited moderate to severe emaciation, characterized by depleted subcutaneous and internal adipose (with the exception of 19-0121 which had moderate pericardial adipose) and atrophied skeletal muscle, a concave pectoral muscle complex, atrophied internal organs, and empty gastrointestinal tracts (with the exception of 19-0106 who was fed during rehabilitative care). All ten birds had large masses of dry, compacted feathers in the ventriculus. Mild to moderate feather consumption is considered to be part of the normal digestive process for grebes. This process may help slow gastrointestinal passage of ingested prey, and thus enhance the efficiency of digestion for small arthropods or other hard-bodied taxa. However, if too many feathers are ingested, the large mass of compacted feathers can cause digestive problems such as impaction (Jehl 2017). The cause of the observed emaciation is unknown, but starvation due to low prey availability is possible. No gross evidence of pre-existing disease was found.

COMPLETED TESTS/PROCEDURES

- 1.) Gross photographs
- 2.) Gross necropsy (including morphometric measurements)
- 3.) Cryoarchived samples

GROSS FINDINGS

Emaciation, severe, characterized by:

- Severe diffuse muscle atrophy with pectoral muscle markedly below keel (Figure 1A, 1B)
- Total depletion of subcutaneous and internal adipose (Figure 2A)
- Empty and variably atrophic gastrointestinal tracts (inanition)

	INCIDENTAL FINDINGS	
N/A		
	HISTOPATH SUMMARY	
N/A		
	HISTOPATH DIAGNOSES	
N/A		
	FINAL DIAGNOSES	

Findings from gross necropsy are suggestive of death due to severe emaciation. The cause of the observed emaciation is unknown, but starvation due to low prey availability is possible.

COMMENT

SAMPLES SAVED

Cryoarchived samples (-20): pectoral muscle, liver, kidney, spleen, bile, gastric, cecum and cloacal content.

N/A



Figure 1A (19-0106) View of ventral subcutis and coelom, showing keel muscle atrophy, depletion of subcutaneous adipose, and distension of the gastrointestinal tract associated with feeding as part of rehabilitative care; Figure 1B (19-0107) Ventral subcutis, showing keel muscle atrophy and depletion of subcutaneous adipose.



Figure 2A (19-0122) Ventral view with keel removed to show the coelomic cavity. There is marked depletion of subcutaneous and coelomic adipose; 2B (19-0106) Transected ventriculus and proventriculus, showing that the ventriculus is distended by greenish (bile-stained) feathers

PHOTOS

TABLES AND FIGURES

Necropsy #	Species	Date Collected	Location	Sex	Age
19-0106	WEGR	2/18/2019	Monterey County	Μ	Adult
19-0107	WEGR	2/21/2019	Monterey County	F	Adult
19-0121	WEGR	2/23/2019	Monterey County	Μ	Adult
19-0122	WEGR	2/24/2019	Monterey County	F	Adult
19-0158	WEGR	3/3/2019	San Mateo County	F	Adult
19-0159	WEGR	3/3/2019	San Mateo County	F	Adult
19-0232	CLGR	2/12/2019	San Luis Obispo County	F	Adult
19-0233	WEGR	2/14/2019	San Luis Obispo County	F	Adult
19-0234	CLGR	2/12/2019	San Luis Obispo County	Μ	Adult
19-0235	WEGR	2/14/2019	San Luis Obispo County	F	Adult

Table 1: Summary of Birds Examined

LITERATURE CITED

Jehl, JR. 2017. Feather-eating in grebes: A 500-year Conundrum. The Wilson Journal of Ornithology 129(3):446-458.

CDFW SEABIRD MORTALITY EVENT NECROPSY REPORT



California Department of Fish and Wildlife Office of Spill Prevention and Response Marine Wildlife Veterinary Care and Research Center 151 McAllister Way Santa Cruz, CA 95060 (831) 469-1719 MWVCRC#: 19-0136 Species: SNPL Band: None Report Status: Final

	EVENT PROFILE
COMMON NAME: Snowy Plover	SCIENTIFIC NAME: Charadrius nivosus
DATE FOUND: 3/6/2019	COLLECTION AREA: Monterey Bay
COUNTY: Monterey	STATE: California
CARCASS CONDITION: Mod Decomposition	OILED/FOULED: No
NECROPSY DATE: 3/8/2019	NECROPSY BY: Corinne Gibble
REPORT DATE : 3/14/2019	REPORT BY: Corinne Gibble
HISTOPATHOLOGY TAKEN (Y/N?): N	REVIEWING PATHOLOGIST: Melissa Miller

EVENT BACKGROUND

The plover was found fresh dead by a member of the public (Jacqueline Deely) on Del Monte Beach, north of the Tides Hotel, near a symbolic fence. The bird was found on 3/6/2019, was buried in the sand, and then uncovered again on 3/8/2019 by Jacqueline Deely who was hoping to preserve the carcass. The bird was reported to Carleton Eyster (Point Blue Conservation Science) and brought to Marine Wildlife Veterinary Care and Research Center (MWVCRC). It is suspected that this bird may have collided with the nearby fence.

NECROPSY SUMMARY

Postmortem radiographs were suggestive of an acute skull fracture near the occipital region on the right side of the skull and fracture of the clavicle on the left side of the body. The radiographic skull lesion corresponded grossly with a focally extensive region of vascular congestion and possibly, acute hemorrhage in the lower right portion of the cerebral hemisphere. Additional acute hemorrhages were apparent along the subcutis of the gape, chin neck, acute hemorrhage on the dorsal surface of the pectoral muscle, and hemorrhage under the keel in the proximal thoracic cavity. A large antemortem laceration was found externally on the left side of the neck near chin and gape. Marked bilateral renal venous engorgement was also noted. The proventriculus and ventriculus were full of partially digested insects, signifying the bird had been actively feeding prior to death. Adequate pericardial, subcutaneous and internal adipose stores and absence of pectoralis muscle atrophy indicate the bird was in excellent nutritional condition at the time of death. The bird was a juvenile male based on plumage and gonads. There was no gross evidence of other significant disease or postmortem scavenging.

COMPLETED TESTS/PROCEDURES

- 1.) Gross photographs
- 2.) Gross necropsy (including morphometric measurements)
- 3.) Cryoarchived samples

GROSS FINDINGS

Acute blunt force/collision trauma, presumptive, characterized by:

- Acute skull fracture, right occipital region (Figure 1)
- Possible left shoulder subluxation at junction of coracoid and humerus (Figure1)
- Possible partial fracture/ventral deflection of distal lower mandible (Figure 1)
- Acute fracture of the left clavicle (Figure 2)
- Large laceration on left side of neck, chin and gape (Figure 4A)
- Marked, acute vascular congestion and possible hemorrhage: base of mandible, proximal neck (Figure 4B)
- Left pectoral muscle: Focal acute hemorrhage (Figure 5A)

- Thoracic cavity: vascular congestion and hemorrhage (Figure 5B)
- Acute hemorrhage in the lower right portion of the cerebral hemisphere (Figure 6)
- Marked bilateral renal venous engorgement, dorsal thoracic subcutis

INCIDENTAL FINDINGS

N/A

HISTOPATH SUMMARY

Histopathology not performed due to severe autolysis.

HISTOPATH DIAGNOSES

Histopathology not performed due to severe autolysis.

FINAL DIAGNOSES

Presumptive cause of death: Blunt force trauma

COMMENT

Findings from gross necropsy appear to support the field diagnosis of collision with fencing or other fixed structures as the cause of death.

SAMPLES SAVED

Cryoarchived samples (-20): pectoral muscle, liver

IMAGES



Figure 1. Dorsoventral radiograph, showing suspected acute fracture near right occipital region of cranium



Figure 2. Ventrodorsal radiograph, showing suspected acute fracture at left clavicle; The fracture was difficult to discern from radiographs, but was confirmed at necropsy.



Figure 3A. External view of moderately decomposed carcass; Figure 3B. Subcutaneous view showing pectoral muscle even with keel and visible subcutaneous adipose



Figure 4A. Laceration spanning chin and neck; 4B. Subcutaneous vascular congestion and hemorrhage, chin and neck



Figure 5A. Focal acute bruising on dorsal aspect of left pectoral musculature, associated with an acute fracture of the left clavicle. Figure 5.B View of bird with the keel and heart removed; there is acute hemorrhage in the thoracic portion of the coelomic cavity



Figure 6. Acute congestion in region of suspected hairline occipital fracture of the calvarium.

CDFW SEABIRD MORTALITY EVENT NECROPSY REPORT



California Department of Fish and Wildlife Office of Spill Prevention and Response Marine Wildlife Veterinary Care and Research Center 151 McAllister Way Santa Cruz, CA 95060 (831) 469-1719 MWVCRC#:19-0329, 19-0332-19-0339 Species: COMU UCD PATH#: 19S0357 Report Status: Gross

EVENT PROFILE

COMMON NAMES: Common Murre	SCIENTIFIC NAMES: Uria aalge
DATE RANGE: 5/22/2019-5/27/2019	COLLECTION AREA: Mendocino
COUNTY: Mendocino	STATE: California
CARCASS CONDITION: Fresh (1) Frozen (8)	OILED/FOULED: No
NECROPSY DATE: 5/29/2019, 6/6/2019	NECROPSY BY: C.Gibble, E.Donnelly-Greenan, E.Dodd, F.Batac
REPORT DATE : 6/11/2019	REPORT BY: Corinne Gibble
HISTOPATHOLOGY TAKEN (Y/N?): Y (1)	REVIEWING PATHOLOGIST: Melissa Miller

EVENT HISTORY

On May 22nd, Coastal Observation and Seabird Survey Team (COASST) reported that their group had documented over 120, mostly fresh, Common Murres (COMU) near Mendocino on a ~7km stretch of beach. The event appeared localized, and on May 23rd COASST updated that areas south of Fort Bragg at Navarro Beach and Hare Creek beaches did not have dead birds. California Department of Fish and Wildlife (CDFW) staff at the Fort Bragg office also reported COMU washing up on beaches in Mendocino County as of Friday May 24th. Wildlife rehabilitators in Sonoma and Marin Counties were also reported to be assisting with live debilitated birds.

A few adjacent areas appear to have had variable increases in the deposition of COMU during May surveys. Beach Watch (Greater Farallones National Marine Sanctuary; Sonoma County to San Mateo County) reported an elevated rate of dead COMU from Manchester Beach to Doran Beach in Sonoma County, and only a slightly elevated rate of deposition of dead COMU from Salmon Creek Beach to Año Nuevo Beach during May. BeachCOMBERS (Beach Coastal Ocean Mammal and Bird Education and Research Surveys; Santa Cruz County – Los Angeles County) reported a slight increase in COMU in Santa Cruz and Monterey Counties during May, with no signal found in survey areas south of Monterey. The event appears to have slowed as of 6/10/2019, with few COMU reported after 6/1/2019. To investigate possible causes of this mortality event, 9 carcasses were sent to the CDFW Marine Wildlife Veterinary Care & Research Center (MWVCRC) for examination, and 4 carcasses were shipped to the USGS National Wildlife Health Center for examination.

SUMMARY OF EXAMINED BIRDS

MWVCRC #	Other ID	Date Collected	Location Collected	Species	Sex	Age	Body Condition
19-0329	19S0357	5/27/2019	Noyo Bay, Fort Bragg	COMU	Female	Adult	Emaciated
19-0332	NOYO-SWG-005	5/23/2019	MacKerricher Beach, Fort Bragg	COMU	Female	Adult	Emaciated
19-0333	CDFW-VO-01	5/22/2019	Noyo Harbor Beach, Fort Bragg	COMU	Male	Adult	Emaciated
19-0334	NOYO-SWG-006	5/22/2019	MacKerricher Beach, Fort Bragg	COMU	Female	Adult	Emaciated
19-0335	NOYO-SWG-008	5/22/2019	MacKerricher Beach, Fort Bragg	COMU	Male	Adult	Emaciated
19-0336	NOYO-SWG-009	5/22/2019	MacKerricher Beach, Fort Bragg	COMU	Female	Adult	Emaciated
19-0337	NOYO-SWG-008	5/22/2019	MacKerricher Beach, Fort Bragg	COMU	Female	Adult	Emaciated
19-0338	NOYO-SWG-010	5/22/2019	MacKerricher Beach, Fort Bragg	COMU	Female	Adult	Emaciated
19-0339	NOYO-SWG-007	5/22/2019	MacKerricher Beach, Fort Bragg	COMU	Male	Adult	Emaciated

GROSS FINDINGS

All nine COMU examined at MWVCRC shared the following characteristics at gross necropsy: All were adult Common Murres in emaciated body condition. No fractures were found. There was severe, diffuse emaciation, characterized by depleted subcutaneous, internal and pericardial adipose, atrophied skeletal muscle, and a concave pectoral muscle complex. The internal organs were pale and atrophied. The gastrointestinal tract was empty, and mild melena (digested blood) was present in the esophagus, proventriculus, ventriculus, and intestines. The reproductive organs were hypertrophied (enlarged), indicative of active reproductive status.

Additional necropsy findings pertinent to each bird are summarized below:

MWVCRC ID 19-0329 19S0357

Necropsy Findings:

This bird was an adult female Common Murre in fresh postmortem state. The bird was found floating in the water. The eyes were sunken, and keel was prominent. The spleen was markedly enlarged. Scant urates were present in the cloaca. The lungs were frothy, with possible scant fibrin in the lungs and air sacs (infection possible). Histopathology is pending.

MWVCRC ID 19-0332

Necropsy Findings:

This bird was an adult female Common Murre in fair postmortem state. The bird was found beachcast. On external examination, the eyes were sunken, and keel was prominent. A brood patch was present. Scant urates were present in the cloaca.

MWVCRC ID 19-0333

Necropsy Findings:

This bird was an adult male Common Murre in fair postmortem state. The bird was found beachcast. The eyes were sunken, and the keel was prominent. A brood patch was present. Nematodes were found in the cervical subcutis, possibly associated with the clavicular air sac.

MWVCRC ID 19-0334

Necropsy Findings:

This bird was an adult female Common Murre in fair postmortem state. The bird was found beachcast. The distal ends of primary flight feathers had been cut on the right wing (unknown if performed antemortem, or post-mortem as a method of marking a beachcast carcass). Scant urates were present in the cloaca.

MWVCRC 19-0335

Necropsy Findings:

This bird was an adult male Common Murre in fair postmortem state. The bird was found beachcast. The eyes were sunken, and the keel was prominent. A brood patch was present. Scant tarry digesta was found in the small intestines.

MWVCRC 19-0336

Necropsy Findings:

This bird was an adult female Common Murre in fair postmortem state. The bird was found beachcast. The eyes were sunken, and keel was prominent. A brood patch was present.

MWVCRC 19-0337

Necropsy Findings:

This bird was an adult female Common Murre in fair postmortem state. The bird was found beachcast. The eyes were sunken, and keel was prominent. A brood patch was present. Kidneys were mildly congested.

MWVCRC 19-0338

Necropsy Findings:

This bird was an adult female Common Murre in fair postmortem state. The bird was found beachcast. The eyes were sunken, and keel was prominent. A brood patch was present.

MWVCRC 19-0339

Necropsy Findings:

This bird was an adult male Common Murre in fair postmortem state. The bird was found beachcast. The eyes were sunken, and keel was prominent. A brood patch was present. Lung tissue was within normal limits, however, the bird exhibited possible fibrin deposition (mild fibrinous air sacculitis) on the right side.

TESTS/PROCEDURES

- 1.) Gross photographs
- 2.) Gross necropsy (including morphometric measurements)
- 3.) Cryoarchived samples
- 4.) Histology pending on 19-0239 (19S0357)

SUMMARY OF GROSS FINDINGS

- 1.) Emaciation, severe, characterized by:
 - Severe diffuse muscle atrophy with pectoral muscle markedly below keel
 - Total depletion of subcutaneous and internal adipose
 - Empty and atrophic gastrointestinal tracts (inanition), melena present
- 2.) All nine birds were adults with hypertrophied reproductive organs, indicative of active reproductive status
- 3.) Possible mild to moderate fibrinous pneumonia (1/9 birds), and air sacculitis (2/9 birds: Possible opportunistic bacterial infection)

HISTOPATH SUMMARY

Pending 19-0329 (19S0357)

HISTOPATH DIAGNOSES

Pending 19-0329 (19S0357)

FINAL DIAGNOSES

Findings from gross necropsy are suggestive of death due to severe emaciation. The cause of the observed emaciation is unknown, but starvation due to low prey availability is possible. Histology on 19-0329 is pending.

SAMPLES SAVED

Cryoarchived samples (-20): pectoral muscle, liver, kidney, spleen, bile

CDFW SEABIRD MORTALITY EVENT NECROPSY REPORT



California Department of Fish and Wildlife Office of Spill Prevention and Response Marine Wildlife Veterinary Care and Research Center 151 McAllister Way Santa Cruz, CA 95060 (831) 469-1719 MWVCRC#: 19-0415 Species: COMU UCD PATH#: 19S0533 Report Status: Gross Band: PG:GB

EVENT PROFILE

COMMON NAMES: Snowy Plover

DATE COLLECTED: 7/1/2019

COUNTY: San Luis Obispo

CARCASS CONDITION: Fresh

NECROPSY DATE: 7/2/2019

REPORT DATE: 7/9/2019

HISTOPATHOLOGY TAKEN (Y/N?): Y

SCIENTIFIC NAMES: Charadrius nivosus COLLECTION AREA: Oceano Dunes SVRA STATE: California OILED/FOULED: No NECROPSY BY: Corinne Gibble REPORT BY: Corinne Gibble REVIEWING PATHOLOGIST: Melissa Miller

EVENT HISTORY

This fledgling plover was collected fresh dead on 7/1/2019 from the 6 exclosure shoreline at the W12W marker in dry wrack just above the high tide line at Oceano Dunes State Vehicular Recreation Area (ODSVRA) by environmental scientist Amber Clark. This bird was banded from Snowy Plover nest 64, and was last seen alive at 28 days old on 6/24/2019 in the same area. Two siblings from the same nest were foraging nearby on the day it was collected. Some adult aggression was also observed in the area at that time. To investigate possible causes of death, the carcass was sent to the CDFW Marine Wildlife Veterinary Care and Research Center (MWVCRC) for examination.

GROSS FINDINGS

This bird was an emaciated juvenile male fledgling. The eyes were sunken, and the keel was prominent. No fractures were found grossly or by post-mortem radiographs. Severe, diffuse emaciation was characterized by depleted subcutaneous, internal and pericardial adipose, atrophied skeletal muscle and a concave pectoral muscle complex. The internal organs were pale. Scant insect fragments and sand were found in the ventriculus, and scant digesta was found in the intestines. Scant urates were present in the cloaca and externally at the vent. The cause of the observed emaciation is unknown, but starvation is possible. No gross evidence of pre-existing or concurrent disease was found.

TESTS/PROCEDURES

- 1.) Gross photographs
- 2.) Postmortem radiograph
- 3.) Gross necropsy (including morphometric measurements)
- 4.) Histology

SUMMARY OF GROSS FINDINGS

Findings from gross necropsy are suggestive of death due to severe emaciation. The cause of the observed emaciation is unknown, but starvation is possible. Histology is pending.

HISTOPATH SUMMARY

Pending

FINAL DIAGNOSES

1.) Emaciation, severe, characterized by:

- Severe diffuse muscle atrophy with pectoral muscle markedly below keel
- Total depletion of subcutaneous and internal adipose

PHOTOS



Figure 1A. View of ventral subcutis, showing keel muscle atrophy and depletion of subcutaneous adipose; Figure 1B. Ventral view with keel removed to show the coelomic cavity. There is marked depletion of subcutaneous and coelomic adipose

CDFW SEABIRD MORTALITY EVENT NECROPSY REPORT



California Department of Fish and Wildlife Office of Spill Prevention and Response Marine Wildlife Veterinary Care and Research Center 151 McAllister Way Santa Cruz, CA 95060 (831) 469-1719 MWVCRC#: 19-0475 Species: LETE UCD PATH#: 19S0566 Report Status: Gross Band: Unbanded

EVENT PROFILE

COMMON NAMES: California Least Tern

DATE COLLECTED: 7/23/2019

COUNTY: San Luis Obispo

CARCASS CONDITION: Fresh

NECROPSY DATE: 7/24/2019

REPORT DATE: 8/14/2019

HISTOPATHOLOGY TAKEN (Y/N?): Y

SCIENTIFIC NAMES: Sternula antillarum browni COLLECTION AREA: Oceano Dunes SVRA STATE: California OILED/FOULED: No NECROPSY BY: Corinne Gibble REPORT BY: Corinne Gibble REVIEWING PATHOLOGIST: Melissa Miller

EVENT HISTORY

This bird was found on 7/23/2019 in the designated nesting exclosure approximately 220 feet east of the western fence at Oceano Dunes State Vehicular Recreation Area (ODSVRA). There was no disturbance on the sand surface around the carcass. Because it was unbanded, information regarding this bird is sparse; however, ODSVRA staff believes the bird hatched locally and was approximately 21-30 days old on 7/23/2019, based on the ages of known unbanded chicks (11 of 52 chicks were unbanded) at this location.

GROSS FINDINGS

This bird was a juvenile male fledgling. No fractures were found grossly or on postmortem radiographs. The bird was thin, with mild pectoral muscle atrophy, scant subcutaneous and pericardial adipose, and no coelomic adipose. All internal organs were within normal limits grossly. The proventriculus and ventriculus contained a single large mass of compressed fibrous material that appeared to be a large piece of blue felt fabric. Scant digesta was found in the small intestines and colon. The kidneys were mildly congested, and scant urates were present in the cloaca and externally at the vent. Two small areas of symmetrical congestion were apparent near the base of the skull; no associated skin or brain lesions, or fractures were found. No gross evidence of pre-existing or concurrent disease was found.

TESTS/PROCEDURES

- 1.) Gross photographs
- 2.) Postmortem radiograph
- 3.) Gross necropsy (including morphometric measurements)
- 4.) Histology

SUMMARY OF GROSS FINDINGS

Findings from gross necropsy are suggestive of death due to gastrointestinal impaction.

HISTOPATH SUMMARY

Pending

FINAL DIAGNOSES

1.) Suspected foreign body ingestion gastric impaction, characterized by:

- Large mass of compacted, felt like fabric material in the proventriculus and ventriculus
- Probable anorexia and gastric dysfunction
- Mild emaciation



Figure 1. Ventro-dorsal radiograph images, showing no visible fractures



Figure 2A. Large mass of compacted, felt fabric like material in the proventriculus and ventriculus; Figure 2B. Enlarged view of large mass



Figure 3. Areas of symmetrical congestion near the base of the skull

CDFW SEABIRD MORTALITY EVENT NECROPSY REPORT



California Department of Fish and Wildlife Office of Spill Prevention and Response Marine Wildlife Veterinary Care and Research Center 151 McAllister Way Santa Cruz, CA 95060 (831) 469-1719 MWVCRC#:19-0618- 19-0621 Species: BRAC, PIGU UCD PATH#: N/A Report Status: Gross Band: N/A

EVENT PROFILE **COMMON NAMES:** Brandt's Cormorant SCIENTIFIC NAMES: Phalacrocorax penicillatus, Pigeon Guillemot Cepphus columba DATE RANGE: 8/28/2019-9/7/2019 **COLLECTION AREA:** Monterey, Marina **COUNTY:** Monterey STATE: California **CARCASS CONDITION:** Fresh Frozen **OILED/FOULED: No NECROPSY DATE: 9/18/2019** NECROPSY BY: C. Gibble, K. Greenwald, A. Reed **REPORT DATE: 9/23/2019 REPORT BY:** Corinne Gibble HISTOPATHOLOGY TAKEN (Y/N?): N **REVIEWING PATHOLOGIST:** Melissa Miller

EVENT HISTORY

The Society for the Prevention of Cruelty to Animals for Monterey County (MSPCA) reported an increase of Brandt's Cormorants (*Phalacrocorax penicillatus*; BRAC) and Pigeon Guillemots (*Cepphus Columba*; PIGU) at intake between 8/28/2019 and 9/7/2019. Admitted birds were cold, emaciated and exhibited stuporous mentation. To investigate possible causes death, 4 fresh-frozen carcasses (2 BRAC, 2 PIGU) were sent to the CDFW Marine Wildlife Veterinary Care & Research Center (MWVCRC) for examination.

SUMMARY OF EXAMINED BIRDS

MWVCRC #	Date Collected	Location Collected	Species	Euthanasia	Sex	Age	Body Condition
19-0618 19-0619 19-0620 19-0621	8/28/2019 9/7/2019 9/1/2019 8/29/2019	Del Monte Beach Marina State Beach Del Monte Beach Fisherman's Whaf	BRAC BRAC PIGU PIGU	No Yes No	Male Male Male Male	Juvenile Juvenile Juvenile Adult	Emaciated Emaciated Emaciated Emaciated

GROSS FINDINGS

At gross necropsy all four birds were in fresh postmortem condition with no evidence of trauma. There was severe, diffuse emaciation, characterized by depleted subcutaneous, internal and pericardial adipose, atrophied skeletal muscle, and a concave pectoral muscle complex. The internal organs were pale and atrophied (starvation/inanition plus malnutrition-associated anemia). The gastrointestinal tract was empty, and mild melena (digested blood) was present in the esophagus, proventriculus, ventriculus, and intestines. Scant urates were present in the cloaca.

Necropsy findings unique to individual birds are summarized below:

MWVCRC ID 19-0618 Brandt's Cormorant

The intestinal fat was atrophied, and nematodes were found throughout the gastrointestinal tract. Vascular congestion was found in the neck and aorta.

MWVCRC ID 19-0619 Brandt's Cormorant

Scant blood was found in the mouth and esophagus. Nematodes were found throughout the gastrointestinal tract. The pericardial sac was opaque, and the heart was pale and flaccid. Vascular congestion was found in the kidneys.

MWVCRC ID 19-0620 Pigeon Guillemot

The gastrointestinal tract was bile stained throughout.

MWVCRC ID 19-0621 Pigeon Guillemot

Squid beaks were found in the ventriculus. The lungs were mildly congested and slightly wet. Urate stasis found in renal tissue.

TESTS/PROCEDURES

1.) Gross photographs

2.) Gross necropsy (including morphometric measurements)

3.) Cryoarchived samples

SUMMARY OF GROSS FINDINGS

- 1.) Emaciation, mild to severe, characterized by:
 - Variable diffuse muscle atrophy
 - Depletion of subcutaneous and internal adipose
 - Empty and atrophic gastrointestinal tracts (inanition) with luminal melena

HISTOPATH SUMMARY

N/A

HISTOPATH DIAGNOSES

N/A

FINAL DIAGNOSES

Findings from gross necropsy are suggestive of death due to emaciation. The cause of the observed emaciation is unknown, but starvation due to low prey availability is possible.

SAMPLES SAVED

Cryoarchived samples (-20): pectoral muscle, liver, kidney, spleen, bile, cecal contents, cloacal contents

Appendix B. Wildlife Disease Association Presentation

AN INVESTIGATION OF LETHAL AND NON-LETHAL DOMOIC ACID EXPOSURE IN LOONS IN CALIFORNIA



CORINNE GIBBLE, MELISSA MILLER, REBECCA DUERR, KATHERINE GREENWALD, RAPHAEL KUDELA



BACKGROUND

Pseudo-nitzschia

- Widespread, chain forming diatom with elongate fusiform cells
- Pseudo-nitzschia blooms are increasing in intensity and duration worldwide
- Produces Domoic Acid
- Domoic Acid
 - Toxin production generally occurs in spring
 - Potent neurotoxin responsible for Amnesic Shellfish Poisoning (ASP)
 - Trophic transfer
 - Grazing inverts and fish can transfer DA to upper trophic levels



EVENT HISTORY

- Over 700 loons (Pacific Loons Gavia pacifica and Red-throated Loons G. stellata) were found beachcast, from April 18 May 1, 2017 in Santa Barbara, Ventura, and Los Angeles Counties.
- Concurrently, large numbers of loons entered rehabilitation at International Bird Rescue.
- Some of these birds showed symptoms suggestive of domoic acid (DA) poisoning, including tremors, seizures, and other neurological symptoms.
- Pseudo-nitzschia bloom conditions and high DA levels were recorded in the same coastal areas.
- Recreational Shellfish Closure in SB County early on April 13, 2017 and remained closed for their annual quarantine May1-October 31- CDPH.

- In the current literature:
 - Accounts of neurologic symptoms in birds during DA bloom
 - Fritz et al. 1992, Ochoa et al. 1996, Beltran et al. 1997
 - DA-positive GI content, but scant gross and histopathological findings
 - Work et al. 1993
 - First estimates of LD50 and ED50 for DA in laboratory-exposed birds, but scant lesions
 - Silvagni, unpublished PhD dissertation, UC Davis, 2003

- Key Points from Silvagni 2003:
 - Silvagni experimentally-exposed birds (intracoelomic dose): Pigeons, Mallards, and Common Murres
 - Behavioral changes included:
 - Agitation
 - Increased ambulation
 - Altered social interactions (ducks)
 - Loss of fear response (pigeons and ducks)
 - Depression (murres)
 - Lack of responsiveness (murres)
 - Thermoregulatory problems
 - Abducted wing posture
 - Fine muscular tremors



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Failure to respond to observation

- Key Points from Silvagni 2003:
 - Silvagni experimentally-exposed birds (intracoelomic dose): Pigeons, Mallards, and Common Murres
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 - Agitation
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 - Altered social interactions (ducks)
 - Loss of fear response (pigeons and ducks)
 - Depression (murres)
 - Lack of responsiveness (murres)
 - Thermoregulatory problems
 - Abducted wing posture
 - Fine muscular tremors



Postural change with abducted wings

- Key Points from Silvagni 2003:
 - Dose response varied by species:
 - Pigeons LD50 = 900 ppb
 - Mallards LD50 = 4,000 ppb
 - Common Murres LD50 = 4100 ppb, ED50 = 960 ppb based on observation of exposed birds
- Minimal lesions reported for necropsy and histology, but:
 - Short (8 hr) post-exposure interval
 - Not enough time to develop clear morphologic changes? (Gross and HP)

TAKING ADVANTAGE OF A NATURAL EXPERIMENT

Comparison groups:

- I. Birds that died acutely
- 2. Birds that died later in the event
- 3. Positive & negative controls from unrelated events

- Behavior* (IBR and USFWS reports)
- [DA] in various samples (LCMS: UCSC)
- Findings from gross necropsy and histopathology (MWVCRC & IBR)

* Behavioral data unavailable for many acute birds

COMPARISON GROUPS

- ACUTE: Fresh dead beachcast loons from early in the event (n = 16)
 - I3 gross necropsy, II/I3 with domoic acid testing
 - 3 gross necropsy, histopathology, domoic acid testing
- SUBACUTE: Loons that spent up to 86 days in rehabilitative care (n = 10)
 - 4 gross necropsy only
 - 6 gross necropsy, histopathology, domoic acid testing
- Positive controls for acute DA intoxication (n=2)
- Negative control (n=1)

BEHAVIOR - ACUTE

"Some of the live stranded wildlife were reported to show symptoms typical of domoic acid poisoning, including seizures, swaying heads, and foaming at the mouth." US Fish and Wildlife Service Press Release



Mandalay Beach April 23, 2017. Average of 242 birds/shoreline mile - USFWS

GROSS NECROPSY FINDINGS - ACUTE

- Fair/good nutritional condition
- Partially digested food in GI tract
- Diffuse vascular congestion (esp. brain, heart, liver, kidneys)
- Severe diffuse pulmonary edema







DOMOIC ACID TESTING - ACUTE

Identification	Sample	DA ppb
17-0084	stomach contents	6,270
17-0084	cloacal contents	6,300
17-0084	liver	3,690
17-0084	bile	580
17-0085	stomach contents	8,810
17-0085	cloacal contents	60,300
17-0085	liver	1,390
17-0085	bile	27,300
17-0086	stomach contents	71,150
17-0086	cloacal contents	681,190
17-0086	liver	6,850
17-0086	bile	49,690
17-0086	fish viscera from esophagus	88,630

DOMOIC ACID TESTING - ACUTE

Identification	Sample	DA ppb
17-0084	stomach contents	6,270
17-0084	cloacal contents	6,300
17-0084	liver	3,690
17-0084	bile	580
17-0085	stomach contents	8,810
17-0085	cloacal contents	60,300
17-0085	liver	1,390
17-0085	bile	27,300
17-0086	stomach contents	71,150
17-0086	cloacal contents	681,190
17-0086	liver	6,850
17-0086	bile	49,690
17-0086	fish viscera from esophagus	88,630



BRAIN HISTOPATHOLOGY - ACUTE

- Moderate/severe vascular congestion
- Microhemorrhages
- Spongiosis





Control loon brain

Brain from loon that died acutely with high DA

BEHAVIOR- SUBACUTE





- Surviving birds quickly re-attained waterproof plumage, normal body weight, and normal blood values.
- 48% of those bird that survived exhibited chronic abnormal behavior or medical problems that necessitated euthanasia
 - Clinically healthy, but floated aimlessly with minimal diving, and reduced fear/avoidance of humans
 - Behavior was similar to reports for experimentally-exposed birds: Silvagni 2003



GROSS FINDINGS - SUBACUTE

- Gross findings:
 - Plumage in good condition
 - Good/excellent nutritional condition
 - Brain, kidneys, liver, lungs and heart mildly congested or WNL for euthanized animals
 - Brain tissue:
 - variably swollen or shrunken
 - pale tan and wet-looking
 - sometimes with dilated ventricles and thin overlying cerebrum



DOMOIC ACID TESTING - SUBACUTE

[DA] below Silvagni 2003 LD_{50} and ED_{50} , but still detectable up to 57 days of captive care

"Control" loon that was euthanized due to foot lesions was DA-negative. It was housed at IBR during the same time period and was fed the same diet as loons from the DA event

Identification	Sample	РРВ	Total days in care
17-0597	Liver	21	4
17-0597	Kidney	8	4
17-0597	Cloacal	9	4
17-0597	Bile	86	4
17-0439	Liver	0	15
 17-0439	Kidney	0	15
17-0439	Spleen	0	15
17-0439	Bile	0	15
17-0406	Liver	72	17
17-0406	Kidney	47	17
17-0406	Spleen	0	17
17-0406	Cloacal	504	17
17-0406	Bile	31	17
17-0353	Liver	0	18
17-0353	Kidney	0	18
17-0353	Spleen	129	18
17-0353	Cloacal	0	18
17-0316	Liver	55	57
17-0316	Kidney	230	57
17-0316	Spleen	143	57
17-0615	Liver	0	86
17-0615	Kidney	0	86
17-0615	Spleen	0	86
17-0615	Bile	0	86

BRAIN HISTOPATHOLOGY - SUBACUTE

- Decreased neuronal density
- Moderate/marked spongiosis
- Discrete areas of tissue cavitation & mineralization
- Usually bilaterally symmetrical
- Widespread, but most severe near lateral ventricles & in diencephalon
- Minimal/mild perilesional inflammation



SUMMARY

- This natural experiment allowed us to assess acute and subacute impacts of DA on naturally-exposed birds.
- Acute cases had extremely high [DA] (up to 681,190 ppb), & exhibited diffuse, severe vascular congestion and pulmonary edema.
- [DA] in cloacal content from our naturally-exposed acute loons was up to **116X** higher than the LD50 reported for cloacal content of experimentally-exposed murres (Silvagni 2003).
- Birds that died after prolonged rehabilitative care (subacute cases) had positive tissue [DA], chronic behavioral abnormalities, and grossly-apparent brain pathology.
- Similar to DA-exposed marine mammals and humans, DA-exposed birds appear to develop chronic, severe brain pathology than can impact their ability to survive.
- This is the first documentation in naturally-exposed seabirds of:
 - High DA exposure
 - Chronic behavioral deficits
 - Development of severe, irreversible brain pathology

ACKNOWLEDGMENTS

Photo: Audubon.org

- We would like to thank:
 - BeachCOMBERS and Erica Donnelly-Greenan, Mike Harris
 - USFWS and Jenny Marek for carcass recover
 - Volunteers and staff at International Bird Rescue
 - Staff at MWVCRC for necropsy assistance
 - Angelina Reed for trimming and pathology prep
 - Kendra Negrey at the UCSC Kudela Laboratory for laboratory assistance

1 NWHC 27976- liver BRAC 12.42 2 17-0138 bile BRAC 1198.16 3 17-0138 liver BRAC 642.94 4 17-0138 kidney BRAC 642.94 4 17-0138 kidney BRAC 1803.44 6 17-0139 kidney BRAC 2124.80 7 17-0140 kidney PALO 33446.55 8 17-0140 liver PALO 1668.87 9 17-0140 liver PALO 0.65 10 17-0141 liver PALO 315.05 11 17-0141 kidney PALO 94.53 0 0 0.00 0.4 0.00 13 17-0142 kidney PALO 0.00 14 17-0142 kidney PALO 0.00 15 17-0142 kidney PALO 0.00 16 17-0145	Sample #	MWVCRC #	type of samp	Notes	DA ppb
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15 17-0142 bile PALO 0.00 16 17-0144 liver PALO 4.31 17 17-0144 kidney PALO 61.37 18 17-0144 bile PALO 63.09 19 17-0145 liver PALO 3.93 20 17-0145 kidney PALO 7.95 21 17-0145 bile PALO 2.82 22 17-0146 liver PALO 3.82 23 17-0146 kidney PALO 6.50 24 17-0146 bile PALO 76.28 - - - 0.00 25 17-0147 liver PALO 3.40 26 17-0147 kidney PALO 1.79 27 17-0147 bile PALO 2.51 29 17-0149 liver PALO 2.51 29 17-0149 liver PALO 36.43 31 17-0150 liver PALO 1.02 <	14	17-0142	kidney	PALO	0.00
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1717-0144kidneyPALO61.371817-0144bilePALO63.091917-0145liverPALO3.932017-0145kidneyPALO7.952117-0145bilePALO2.822217-0146liverPALO3.822317-0146kidneyPALO3.822417-0146bilePALO6.502417-0146bilePALO76.280000.002517-0147liverPALO3.402617-0147kidneyPALO1.792717-0147bilePALO6.542817-0149liverPALO2.512917-0149kidneyPALO7.843017-0149bilePALO36.433117-0150liverPALO1.023217-0150kidneyPALO4.10	16	17-0144	liver	PALO	4.31
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19 17-0145 liver PALO 3.93 20 17-0145 kidney PALO 7.95 21 17-0145 bile PALO 2.82 22 17-0146 liver PALO 3.82 23 17-0146 kidney PALO 3.82 23 17-0146 kidney PALO 6.50 24 17-0146 bile PALO 76.28 26 17-0147 liver PALO 3.40 26 17-0147 kidney PALO 1.79 27 17-0147 bile PALO 6.54 28 17-0147 bile PALO 2.51 29 17-0149 kidney PALO 7.84 30 17-0149 bile PALO 36.43 31 17-0150 kidney PALO 1.02 32 17-0150 kidney PALO 4.10	18	17-0144	bile	PALO	63.09
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21 17-0145 bile PALO 2.82 22 17-0146 liver PALO 3.82 23 17-0146 kidney PALO 6.50 24 17-0146 bile PALO 76.28 25 17-0147 liver PALO 0.00 25 17-0147 liver PALO 3.40 26 17-0147 kidney PALO 1.79 27 17-0147 bile PALO 6.54 28 17-0147 bile PALO 2.51 29 17-0149 liver PALO 7.84 30 17-0149 bile PALO 36.43 31 17-0150 liver PALO 1.02 32 17-0150 kidney PALO 4.10	20	17-0145	kidney	PALO	7.95
22 17-0146 liver PALO 3.82 23 17-0146 kidney PALO 6.50 24 17-0146 bile PALO 76.28 24 17-0147 liver PALO 0.00 25 17-0147 liver PALO 3.40 26 17-0147 kidney PALO 1.79 27 17-0147 bile PALO 6.54 28 17-0149 liver PALO 2.51 29 17-0149 kidney PALO 7.84 30 17-0149 bile PALO 36.43 31 17-0150 kidney PALO 1.02 32 17-0150 kidney PALO 4.10	21	17-0145	bile	PALO	2.82
23 17-0146 kidney PALO 6.50 24 17-0146 bile PALO 76.28 25 17-0147 liver PALO 3.40 26 17-0147 kidney PALO 1.79 27 17-0147 bile PALO 6.54 28 17-0147 bile PALO 2.51 29 17-0149 liver PALO 2.51 30 17-0149 bile PALO 36.43 31 17-0150 liver PALO 1.02 32 17-0150 kidney PALO 4.10	22	17-0146	liver	PALO	3.82
2417-0146bilePALO76.28	23	17-0146	kidney	PALO	6.50
Image: Constraint of the system Image: Consten Image: Constraint of the system	24	17-0146	bile	PALO	76.28
2517-0147liverPALO3.402617-0147kidneyPALO1.792717-0147bilePALO6.542817-0149liverPALO2.512917-0149kidneyPALO7.843017-0149bilePALO36.433117-0150liverPALO1.023217-0150kidneyPALO4.10					0.00
2617-0147kidneyPALO1.792717-0147bilePALO6.542817-0149liverPALO2.512917-0149kidneyPALO7.843017-0149bilePALO36.433117-0150liverPALO1.023217-0150kidneyPALO4.10	25	17-0147	liver	PALO	3.40
2717-0147bilePALO6.542817-0149liverPALO2.512917-0149kidneyPALO7.843017-0149bilePALO36.433117-0150liverPALO1.023217-0150kidneyPALO4.10	26	17-0147	kidney	PALO	1.79
2817-0149liverPALO2.512917-0149kidneyPALO7.843017-0149bilePALO36.433117-0150liverPALO1.023217-0150kidneyPALO4.10	27	17-0147	bile	PALO	6.54
2917-0149kidneyPALO7.843017-0149bilePALO36.433117-0150liverPALO1.023217-0150kidneyPALO4.10	28	17-0149	liver	PALO	2.51
3017-0149bilePALO36.433117-0150liverPALO1.023217-0150kidneyPALO4.10	29	17-0149	kidney	PALO	7.84
3117-0150liverPALO1.023217-0150kidneyPALO4.10	30	17-0149	bile	PALO	36.43
32 17-0150 kidney PALO 4.10	31	17-0150	liver	PALO	1.02
	32	17-0150	kidney	PALO	4.10

Extended results from acute necropsy - gross necropsy and DA testing only