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Long Term Effects of Crude Oil on Common Murres (*Uria aalge*) Following Rehabilitation

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Oil spilled or discharged at sea is known to contaminate and cause mortality in seabirds and in some instances, these losses can be substantial as reported recently following an oil spill from the Exxon Valdez in Alaskan waters (Piatt 1990). Crude petroleum alters the arrangement of the feather barbules causing a loss of buoyancy and hypothermia. These birds, unable to fly or forage become weak and dehydrated (Holmes 1984). Attempts to rehabilitate birds with light to moderate amounts of oil exposure have met with modest success. Following cleaning and release, many of these birds never recovered and little is known of their survival rate in nature subsequently. A number of oiled sea birds, primarily common murres (Uria aalge), were retrieved recently by the Canadian Coast Guard and attempts to rehabilitate them were conducted. Since the majority of birds were retained longer than the usual 4 to 5 days recommended by the Bird Rescue International Centre after retrieval, it soon became apparent that many were suffering from problems other than diet or thermoregulation. Following autopsy/necropsy, extensive organ damage was observed in all of the birds. The purpose of this communication is to report the long term effects of crude oil on common murres.

MATERIALS AND METHODS

Fifteen seabirds (13 common murres, Uria aalge, and two thick-billed murres, U. lomvia), lightly to moderately contaminated with crude oil primarily on the breast, wings, feet and head, were retrieved January 18 to 22, 1990, near Gooseberry Cove, Newfoundland, and transported to a rehabilitation center. The birds were alert but appeared to be dehydrated. They were fed saline before being washed in a detergent solution at 40°C for about 30 min. After rinsing, they were air-dried with forced air and held at 25°C for 6 to 13 d. All birds were also administered initially a nutrient

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broth, a vitamin supplement and Pepto-bismol. During the period of rehabilitation, they were fed freshly-thawed caplin, Mallotus villosus, ad libitum 3 times daily (morning, mid-day and evening) and provided with bowls of caplin and freshwater. After this time, they were moved to simulate natural conditions to a marine facility that was heated with two propane burners. The air temperature varied between 0 to -4°C. Three infrared heat lamps (250 W) provided heat on a floating platform (250 x 100 cm). A styrofoam ramp allowed the birds easy access to a swimming area (350 x 250 x 150 cm) where the seawater temperature was 0 to -1°C. Fluorescent lights supplemented normal daylight (0700 to 1800 hr) which entered through four windows. The feeding regime was similar to that mentioned previously and additional caplin was also available in a bowl placed on the platform. Two birds were forced-fed subsequently as they were unable to feed themselves.

Seven common murres were autopsied (within 6 hr after death) and four were necropsied following cervical dislocation. The body temperature of all birds, which succumbed, decreased to the ambient (0°C) until autopsy. Two additional murres (a thick-billed and a common murre), which were unable to fly because of oil-contamination and another (common murre) showing no evidence of contamination, were shot and autopsied. Thin blood smears and hematocrits were prepared and determined from cardiac blood. The weight of each bird was recorded. The color and texture of each organ were noted and samples of tissues which included liver, kidney, duodenum, heart, breast muscle, spleen, lung, salt gland and the entire brain, were fixed in 10% buffered formalin and/or Bouin's fluid. Tissue imprints of some organs, especially bone marrow, were also prepared. These and the blood smears were fixed in methanol and stained with Giemsa. Fixed tissues were dehydrated, embedded in paraffin, sectioned 5 to 10 µm in thickness and stained with either hematoxylin and eosin or Perl's Prussian blue. During histological examination, emphasis was placed on sections of liver, kidney and duodenum as these appeared from previous studies to be more susceptible to damage by crude oil (Hartung and Hunt 1966; Fry and Lowenstine 1985).

RESULTS AND DISCUSSION

Only two (one common and a thick-billed murre) of 15 murres were successfully rehabilitated and released. Nine common murres died and four were necropsied at intervals after retention. Two died (a thick-billed and a common murre) shortly after arrival at the marine facility but were not available for autopsy. In spite of the food consumed at regular intervals, all birds

lost weight continually following retrieval. The weight loss after capture in 11 common murres during this period, which varied from 17 to 42 days, was 304 ± 9 g (X ± S.E.) from an initial weight of 978 ± 11 g. Included in this group were two birds that initially lost weight but subsequently began to regain weight. With the exception of these two last-mentioned birds, all others were emaciated with marked atrophy of the pectoral muscles. At autopsy/necropsy, neither abdominal nor subcutaneous fat was present. The livers were discolored in parts by ovoid or linear areas of necrosis. Hematocrit values of 43 ± 4% were significantly lower than normal (55.8%) reported by Bradley and Threlfall (1974).

Examination of stained tissue sections revealed histopathological changes consistently in the liver, kidneys and intestine of all birds. The most common lesion observed in the liver was necrosis. In some instances, it was extensive whereas in others, multiple foci were present. In addition, congestion of the liver, fatty degeneration and dissociation of hepatocytes were apparent each in one bird. There was also evidence of pigment (hemosiderin) accumulation in both hepatocytes and Kuppfer cells of all birds.

Renal tubular degeneration and necrosis was present in all birds that were autopsied or necropsied. Focal necrosis was apparent in the distal collecting tubules where the cytoplasm was vacuolated and nuclei pycnotic. Additionally, cytoplasmic dissociation was observed in the tubules of 5 murres.

There was also extensive necrosis in the duodenum. Degeneration of villus tips, cellular vacuolation and inflammation in varying degrees were noted in all of murres. No parasites were observed in sections of the duodenum.

Autopsy of the three murres that were shot revealed changes only in two birds that exhibited evidence of external oil-contamination. Both birds were emaciated and lacked subcutaneous and abdominal fat, which were apparent in the 'unoiled' bird. There were pale, ovoid lesions in the liver of the oil-contaminated birds and both contained a black emulsion in the digestive tract which had a petroleum odor.

Histologic examination of the two oiled murres that were shot revealed extensive damage to the liver, kidney and intestine. Acute necrosis was observed in the tissues of all three organs. There was also evidence of dissociation of intestinal cells, rupture of capillaries and hemorrhage. None of these findings

was seen in the tissues of the murre that exhibited no external evidence of external oil-contamination. No parasites were observed in sections of the duodenum of these two birds.

Some of the observations made in the present study are consistent with reports that contamination of seabirds with crude oil or its byproducts cause weight loss and histopathological changes (Leighton 1983). Weight loss in the common murres was probably associated with malabsorption, impaired liver function and increased metabolic rate (Peakall et al. 1983; Holmes 1984). Fry and Lowenstein (1985) also observed hepatocellular dissociation, hemosiderosis, renal tubular necrosis and anemia in common murres that were necropsied about 14 d after a spill of bunker C sea fuel oil off the coast of California. While tissue changes in the salt and adrenal glands appeared to be minimal, pathological lesions in both control and oil-contaminated birds, attributed to parasitic and viral infections, complicated interpretation of the effects of the ingested oil. However, oil-induced damage was observed in Cassin's auklets (Ptychoramphus aleuticus) in the digestive tract after experimental exposure to weathered oil (Fry and Lowenstein 1985). Similarly, our study provides evidence of intestinal damage caused by the ingested oil in the common murres after rehabilitation. It is likely, as several authors have suggested for other species of seabirds, that ingestion of crude oil caused multiple sublethal effects which disrupted metabolism and ultimately culminated in debility and/or death of the common murres.

A broad range of secondary effects, in addition to those reported herein, have also been observed in birds which ingested petroleum or any of its derivatives. These include elevated mixed function oxidase levels (Gorsline et al. 1981), Heinz-body hemolytic anemia (Leighton et al. 1983), increase in corticosterone and thyroxin levels (Peakall et al. 1981), impairment of electrolyte regulation and salt gland function (Peakall et al. 1983) and interference with growth and reproduction (Peakall et al. 1983; Albers 1983; Butler et al. 1988). It is, therefore, not surprising that there is only one successful report of recovery of seabirds after oil-contamination, rehabilitation and release (Randall et al. 1980) in view of the long term tissue damage which might have permanently disabled the birds or protracted their recovery. A report of about 34,000 dead seabirds, killed by oil after the Exxon Valdez oil spill off Alaska (Piatt and Lensink 1990), might represent a considerable underestimate of mortality in view of the fact that many of the birds released after cleaning (several hundred) might not

have survived. Moreover, reproductive performance evaluated by egg production, fertility, hatchability, egg shell thickness and survival of unstressed young might be jeopardised (Albers 1983) and possible genetic abnormalities in offspring from successful parents cannot be overlooked (Vangilder and Peterle 1980). A theoretical model has predicted that it will take 10 to 60 years for some sea birds including common murres on the Pribilof Islands in the Bering Sea to recover in event of 50% mortality among all age classes (Ford et al. 1982; Holmes 1984). Large numbers of thick-billed and common murres overwinter and some inhabit small islands and coastal areas of Newfoundland (Nettleship and Evans 1985), which is located along one of the major shipping routes from Europe and oil appears to be continually and indiscriminately discharged from ships. Levy (1980) has demonstrated that a minimal amount of crude oil might result in the death of a seabird living in northern latitudes because of stress imposed by harsh environmental conditions especially evident during winter. In view of the high mortality in murres caused recently by spilled oil (estimated by the Canadian Coast Guard to be 18,000 birds during a 6-wk period in winter 1990) and unregulated hunting (estimated to be at least 500,000 birds annually out of a population of four to six million; unpublished data, Canadian Wildlife Service) as well as the low reproductive and recruitment rates (0.2 to 0.6 fledglings per breeding pair per year, vide Holmes 1984), it is likely that these seabird populations in eastern Canada will decline unless stringent regulations are introduced to protect them.

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