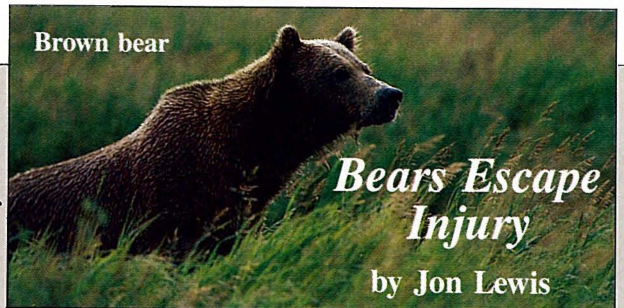

Brown bear

© John Hyde

Bears Escape Injury

by Jon Lewis

Shortly after the *Exxon Valdez* oil spill, biologists observed coastal brown bears in Katmai National Park feeding on oiled bird carcasses and intertidal invertebrates on oiled beaches. Bears also may have ingested oil by grooming their fur or by directly consuming tar balls. Oil ingestion and inhalation could cause immediate death or long-term physiological problems that could result in decreased reproduction or survival.

To document the effects of the oil spill on brown bears, the Alaska Department of Fish and Game (ADF&G), Division of Wildlife Conservation, in cooperation with the National Park Service, studied (1) the survival and reproduction of radio-collared female bears, (2) the size and density of the bear population along a portion of the Katmai coast, and (3) the concentration of petroleum hydrocarbons in fecal samples from captured brown bears. Biologists then compared results of these studies to data from a control bear population near Black Lake on the north side of the Alaska Peninsula, an area not exposed to crude oil.

Biologists fitted a total of 28 Katmai bears in 1989 and 42 Katmai bears in 1990 with radio-transmitters. We obtained blood, fecal, and hair samples, along with a tooth for aging from most bears. Estimates of population size and density were made in early June 1990 during four intensive aerial surveys of the study area. Each bear seen from the air was recorded, and it was noted whether a sighted bear was marked with a radio-transmitter or not. We calculated that the study area contained 1.4 bears per square mile, the highest brown bear density recorded to date in the state of Alaska.

After making the density estimate, Dick Sellers, the King Salmon area wildlife biologist, spent many hours in the air tracking the survival and reproductive histories of each radio-collared bear over the next two years. When a bear died, Dick landed and conducted a necropsy (animal autopsy) to find the cause of death. He also obtained tissue samples for laboratory testing. He collected information on survival in the Black Lake population in the same manner. Survival of radio-collared females in Katmai was 95% versus 93% (excluding hunting mortalities) at Black Lake. Intra-specific aggression, or bears killing bears, was the primary cause of death in both areas.

In scientific studies of some species, biologists obtain internal tissues for lab analysis by killing a sample of animals. This was not possible for brown bears, and therefore only fecal and blood samples were readily available for analysis. A fecal sample could contain petroleum metabolites expelled in the bile, or it could contain unmetabolized petroleum hydrocarbons from the digestive tract. At Black Lake, none of the 22 samples submitted showed indications of exposure. Of 27 samples analyzed from the Katmai bears, four (15%) contained concentrations of hydrocarbons that showed exposure to crude oil. Interestingly, one of those bears was a mother bear whose yearling cub was found dead. Dead less than 24 hours, the yearling displayed no obvious cause of death. In addition to the yearling found dead, this female had also lost her other yearling during the preceding week, but the carcass was never found. Hydrocarbon analysis of bile from the dead yearling bear documented naphthalene and phenanthrene concentrations of 160,000 and 18,000 parts per billion respectively. Chemists considered these concentrations highly elevated: pathologists have documented physical symptoms of exposure in other mammals when similar hydrocarbon concentrations were found in the bile.

While one yearling bear may have died from the oil spill and four bears of a sample of 24 were exposed to crude oil, the significance of exposure does not appear to be great in the bear population. Survival of the bears for the first two years after the oil spill was not greatly affected. Investigations of Katmai bears that are specific to the oil spill have been discontinued, but ADF&G and the National Park Service are continuing research on the survival and reproduction of radio-collared Katmai bears.

Jon Lewis is a Wildlife Biologist with the Division of Wildlife Conservation, ADF&G, Anchorage.

Impacts of Oil on River Otters

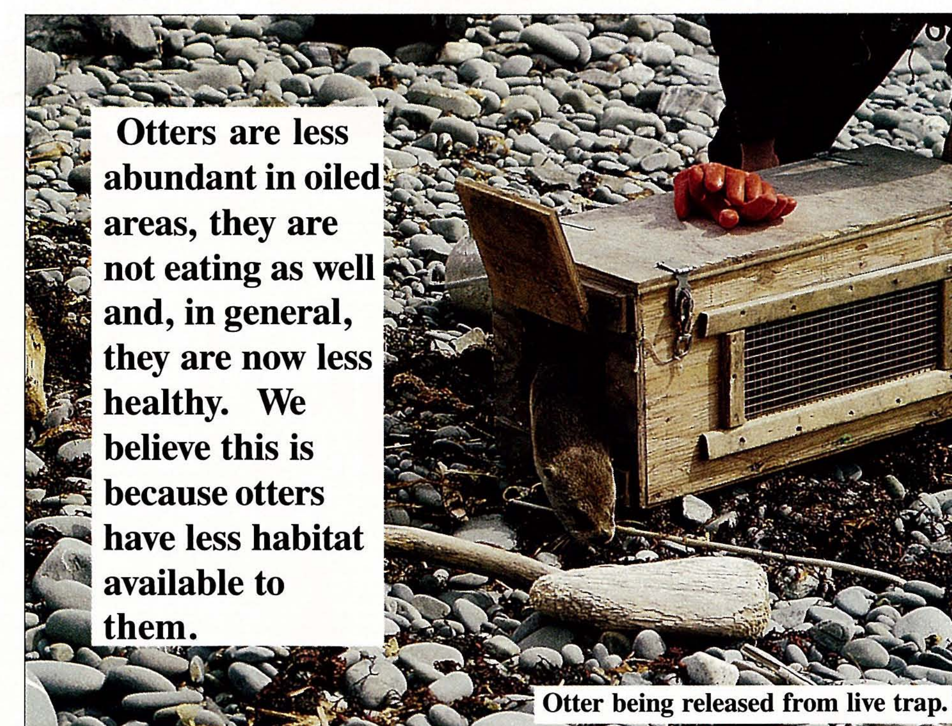
by Jim Faro

River otters are more than cute, playful water animals; they are also incredibly tough. That toughness was tested in Prince William Sound following the *Exxon Valdez* oil spill. In the Sound, the name "river otters" is misleading because they feed in the shallow near shore marine waters and don't have alternative freshwater feeding areas. In the early days of the spill, otters in the spill zone faced oil-covered waters when they entered the ocean to feed. Nobody will ever know how many otters died directly from oil coating or toxic crude oil fumes. Some speculate that most of these animals left the water and took refuge in underground dens where their bodies were never found. Only eleven river otters were picked up by beach clean-up crews.

Following the oil spill, otters were left with a drastically altered environment containing new and sometimes invisible hazards. Even with the crude oil seemingly gone from the water's surface, the otter's daily activities placed them at risk. Some of their foods were contaminated by hydrocarbons; the otters could be coated by a thin sheen of oil as they surfaced to eat. Unlike seals, river otters do not have insulating fat but rely on air trapped within their fur for insulation. Otters clean their fur by licking it. As late as the summer 1992, sheens of oil were present that could coat the fur of a swimming otter, and in grooming their fur, otters would consume oil.

Because dead oiled otters were seldom found, our project concentrated on live otters. Our assumption was that otters never exposed to oil were normal, and differences we might find would be the result of oil. We then asked whether otters in oiled areas were doing as well as those in nonoiled areas. Both otters and their habitats were examined. The area immediately north of Bligh Reef provided "clean data." But "oiled data" came from some of the most heavily polluted shorelines immediately to the south.

Because there is little scientific literature on river otters and crude oil, the study had to develop techniques and gather data simultaneously. A statistically valid pattern of injury emerged from nearly all lines of inquiry. Otters are less abundant in oiled areas, they are not eating as well, and in general, are now less healthy.


Otters are less abundant in oiled areas, they are not eating as well and, in general, they are now less healthy. We believe this is because otters have less habitat available to them.

Otter being released from live trap.

© Jim Faro

We believe this is because otters now have less usable habitat available to them. Otters have preferred latrine sites scattered along their home ranges, and these were examined to see if post-oil changes had occurred. In the summer of 1989, otters avoided sites with shallow slopes that tended to have the greatest impact from oil, even though they preferred such areas in clean habitat. In the summer of 1991, nearly four times as many latrine sites were abandoned by otters in oiled habitat as nonoiled. This indicates otters may have continued to lose habitat into the third summer following the spill. If habitat is not being lost, then there must now be fewer otters in the population to explain this lack of use. Neither conclusion bodes well for otters. The latrine sites also provided additional information. Scats (otter droppings) were collected and washed to leave only the hard materials behind. The remains were examined and the food identified by species. In the summer of 1990, otter scats from the oiled study area contained nearly 50 fewer species when compared to the previous year. In the nonoiled area, no significant decline in the number of summer species was documented. Oiled habitat no longer seems to have the diversity of diet that was present in the pre-oil days. This also supports the premise that otters in the oiled areas were not finding food as easily.

In 1989 and 1990, river otters were live-captured and surgically implanted with radio transmitters. Transmitters allowed the otters to be tracked even when they could not be seen. By plotting all the positions on a map, the summer home ranges of individual animals were established. Although intensive examination showed otter habitat in the oiled and nonoiled study areas to be basically identical, home ranges were nearly twice the size in the oiled area. If oil had made food scarce or some areas of habitat now unusable, otters would need a greater search area to meet their daily needs. Indeed, the tracking study demonstrated that the oiled otters' daily movements were extensive. Nonoiled otters tended to focus their activities in a specific area for several days, then moved on.

Live-captured otters were carefully measured and weighed. The data showed that adult otters in oiled areas weighed significantly less than their nonoiled counterparts.

Blood samples were drawn from captured otters and submitted to a series of lab tests much the same as those used to evaluate human health. Without supporting captive-animal studies, these tests cannot tell the exact nature or cause of a problem, but researchers view them as a general indicator of health. The blood samples provided definite health warnings for oiled otters. Indications are that significant sublethal problems are present; hydrocarbon toxins seem to be affecting body organs and the otters' ability to fight disease or infection.

Restoration

Unfortunately little hands-on restoration can be done. The factors that appear to be driving the population down are not ones easily addressed with modern technology. Toxins in the water or concentrated in the food eaten by otters must be flushed naturally from the ecosystem. With their position high on the food chain, the links below otters must recover before otters can be expected to respond.

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