

MONITORING RADON LEVELS IN DENS OF HIBERNATING BEARS

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ABSTRACT

Hibernating animals may be exposed to high radon levels for extended periods of time. Due to the relatively long gestation period for development of lung cancer, only those animals with a long life span could be usefully studied for radon induced lung cancer. Many species of bear have a potential life expectancy of up to forty years. They often hibernate in excavated dens and caves with the entrance sealed by winter snows. Bears are not true hibernators in that their respiration is diminished by only 10 to 20 percent. This leaves them at risk from inhaling radon and radon progeny. Studies have shown that the bear is cancer prone, but no case of primary lung cancer has yet been observed among those confined to zoos. In confinement, bears are rarely in a sealed enclosure with high radon levels. Results of a two year study of radon levels in wild bear dens is presented.

INTRODUCTION

The purpose of this study is to aid in understanding the risk to animals and humans from exposure to elevated radon levels. The human population is exposed to many carcinogens other than, and often in addition to, excessive radon levels. The mobility of humans makes it difficult to correlate exposure with the development of cancer, since the cancer may develop as much as ten years after the exposure.

Studies performed on laboratory animals may not be valid as the animal is typically exposed to extremely high levels for a short time. This may not produce the same result as exposure to moderately high levels over long periods of time, which of course is a better analogy to the human experience. Those considerations have prompted a study of bears. A bear may live up to forty to forty-five years, long enough for radiation damage to be exhibited. Additionally it is known that bears confined in zoos are never subjected to radon levels much above the average outdoor level. They are not confined in sealed enclosures without direct access to the outdoors. Autopsies have been performed on bears confined in zoos to determine the cause of death. These necropsy studies have shown that cancer is a leading cause of death for these bears, but none have died from a primary lung cancer. The only cases of lung cancer observed were due to metastasis. The conclusion here is that bears of all species are cancer prone but are not afflicted with lung cancer when not exposed to high radon levels. Bears in the wild however, spend a significant fraction of their time in hibernation, frequently in excavated dens or caves. It is well known that subterranean excavations frequently exhibit extremely high radon levels. In the case of the bear den, the entrance may be nearly sealed with snow. The bear is not a true hibernator, the pulse and respiration is diminished by only ten to twenty percent, so if radon and its progeny are present there is high probability of it being inhaled. Authorities have stated that the interior of a large bear's den is extremely dusty and the movement of the animal keeps it stirred up, so inhalation of attached progeny from all isotopes of radon is likely.

Bears are counted among the more valuable wildlife, and as such, are studied extensively by wildlife specialists. This has eased the path for research of this kind. There has been extensive and much appreciated cooperation extended by the Michigan Department of Natural Resources and the Alaska Fish and Game Department for this project. Without their assistance it would not be possible, or legal, to locate bear dens. It is illegal, and probably unwise, to disturb a hibernating bear in Michigan. The wildlife specialists with those state agencies place radio telemetry collars on bears to study their habits. A radio transmitter in the collar emits a distinctive signal that can be used for tracking individual bears and locating their dens. Black bears are routinely located in their dens,

drugged, and removed for examination. They are then placed back in the den and left alone. It is while they are outside for examination that alpha-track monitors may be placed in the den for later retrieval. Larger bears, such as the grizzly and the Alaskan brown bear, are shot with tranquilizer darts from a helicopter to place the telemetry collars on them. Their dens are not visited.

METHOD

Initial work in Michigan started in early 1991. The method used was the attachment of alpha-track monitors to any protrusion, such as a tree root found in the den. Because the bear is not a true hibernator, they frequently awaken and are attracted by anything with an unusual odor. Boredom causes them to seek out the foreign object and play with it until it is destroyed. Ninety percent of the first monitors were lost for that reason.

The next attempt involved the use of plastics PVC pipe. A twelve inch section was cut with one end at a forty-five degree angle. Four inches from the other end two holes are drilled through, three quarters of an inch from each other. The pipe was driven into the ground with the angled end down. Polyethylene was pushed down the pipe to prevent soil gas from entering. The monitor was placed four inches from the top, inside the pipe, and secured by metal pegs inserted through the drilled holes. It was then driven flush with the ground. This made it difficult for the bear to reach the monitor. Eighty percent of these were lost, the bears simply dug them out. Some useful data has been gleaned from those not lost. That is presented later. The current method involves the use of miniature alpha-track monitors developed by R.E.M., Incorporated. These monitors were designed specifically for an attempt to establish a relationship between radon exposure and leukemia. The monitors are actually plastic wrist watches with the watch parts removed and an alpha-track film installed. These are installed between the butyl layers of the telemetry collars. Currently fifteen black bears and fifteen brown bears are wearing these collars in Alaska. It is expected that black bears in Michigan will be monitored in the same fashion during the winter of 1993-1994. Next year these collars and monitors will be retrieved and analyzed. It is expected that there will be full return of these monitors since that is the traditional expectation for the collars.

During the winter of 1992-1993 experiments were performed to validate the use of miniature monitors placed in telemetry collars. A miniature monitor was placed between the butyl layers of a collar. This was suspended in a radon chamber along with a Terradex monitor and a R.E.M. monitor. Another chamber identical to the above was also set up. One was kept at room temperature for thirty-four days while the other was left outside during December and January in Michigan for the same time interval. The miniature monitor encased in the butyl straps provided satisfactory agreement with the standard Terradex and R.E.M. monitors at both normal and low temperatures. This test was deemed necessary because alpha-track monitors are typically intended for home use and the thought was that lower temperatures might require recalibration.

RESULTS

The results in Table 1 are from monitoring dens in Michigan. The results are in general much lower than expected. This is probably due to the relatively mild winters with less than normal snow fall experienced in Michigan the past few years. Less snow and intermittent thaws cause the dens to be lesser sealed at the entrance. Many dens are under the root structure of fallen trees. Some are actually caves and excavations. The caves and excavations account for the higher recorded levels shown in the table.

Monitors one through five display the results from unoccupied bear dens on Drummond Island. Monitors six through ten are from occupied bear dens in the Marquette, Michigan area (they were under brush piles or root masses). Monitors eleven through fifteen are from unoccupied dens (not all bear) in the Grand Marais Michigan area (only number fourteen was an excavation, the others were under brush piles). Monitors sixteen through twenty-one are from unoccupied dens in the northern lower Michigan area (none were excavations). Monitors twenty-two through twenty-six are from Marquette, Michigan (these were occupied, excavated dens). Monitor twenty-seven is from the Munising, Michigan area. This was an excavated den that contained a sow and three yearling cubs.

Table 1

<u>Monitor</u>	<u>Installation Date</u>	<u>Retrieval Date</u>	<u>pCiL⁻¹</u>
1	4/29/91	6/6/91	0.6
2	4/29/91	6/6/91	0.8
3	4/29/91	6/6/91	4.6
4	4/29/91	6/6/91	1.6
5	4/29/91	6/6/91	0.6
6	3/11/92	4/10/92	7.2
7	3/11/92	4/10/92	6.5
8	3/13/92	4/4/92	4.1
9	3/11/92	4/23/92	2.2
10	3/11/92	4/23/92	1.7
11	11/10/91	5/2/92	1.1
12	11/10/91	5/2/92	1.4
13	11/10/91	5/2/92	0.5
14	11/10/91	5/2/92	42.1
15	11/10/91	5/2/92	0.3
16	11/10/91	5/2/92	0.2
17	11/10/91	5/2/92	0.3
18	11/10/91	5/2/92	0.2
19	11/16/91	5/2/92	0.6
20	12/2/91	5/14/92	0.2
21	12/2/91	5/14/92	0.2
22	10/5/92	5/5/93	1.4
23	10/5/92	5/5/93	3.4
24	10/23/92	5/5/93	13.2
25	10/23/92	5/5/93	1.7
26	10/5/92	5/5/93	1.5
27	3/5/93	6/5/93	58.0

SUMMARY

As previously indicated, the winters in Michigan have been less harsh in recent years. Monitors will again be placed in Michigan for the 1993-1994 winter, but an expansion of this project to Alaska looks even more promising.

Harry Reynolds, with Alaska Fish and Game Department began placing radio telemetry collars on grizzlies and Alaskan brown bears in May of this year. These collars contain the miniature wrist watch monitors designed by R.E.M. Incorporated. The collars will be retrieved the following year and the monitors will then be sent to R.E.M., Incorporated for analysis. Wildlife specialists with the Alaska Fish and Game Department will be monitoring the movement of the bears with the telemetry collars and will provide a record of the length of time spent in the dens. With that information the fraction of the number of tracks on the alpha-track monitor may be calculated, attributable to time spent in the den. With that information, both radon level and the time of exposure will be known.

Ultimately it is hoped that the telemetry collars will help answer the question of whether wild bears contract lung cancer. The telemetry collars not only inform when the bear has died, but also where the body may be found for autopsy. By this time fifteen black bears and fifteen brown (or grizzly bears), are wearing collars that contain monitors. It is expected that any success in Alaska will lead to expansion of the project there. It is only due to insufficient funding that only thirty bears are being monitored at this time.

Wildlife specialists are very interested in this project and have shared much information, in addition to much active cooperation, to make this project possible.

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