

Initial Results from the Environmental Effects Monitoring Program

Conducted for Hunt Oil Company of Canada Ltd.

The EEMP proceeded on schedule November 1, 2005. The seismic survey vessel, Gulf Pacific, passed within 138 m of the closest test vessel with the airguns firing at full pressure. Hatchery reared cod were placed in seven cages lined with ½-inch mesh. Two cages were placed at a control site well removed from any influence of the seismic airgun discharges. Five other cages were placed at a test site for exposure to airgun discharges. Approximately 15 fish were placed in each cage. The locations of the test and control sites are shown in Figure 1.

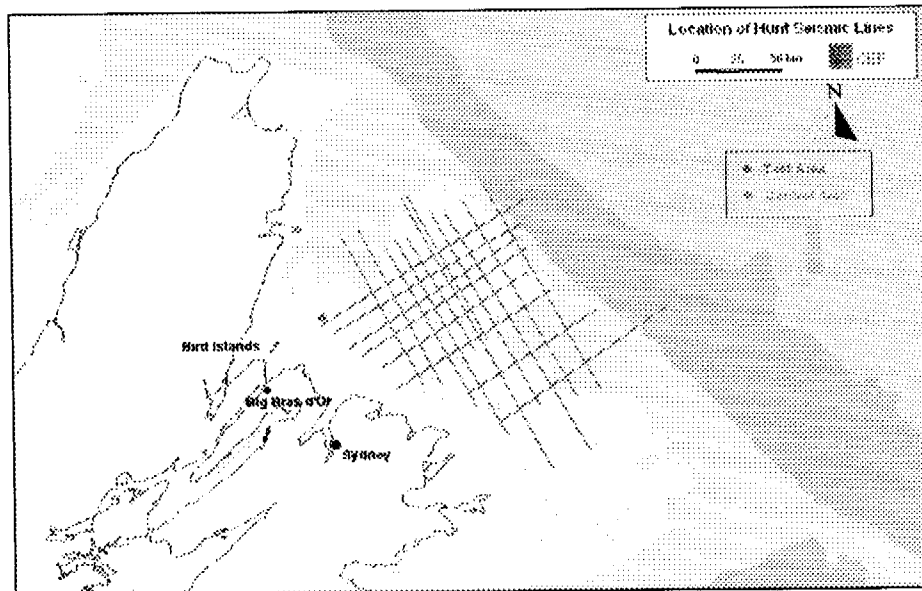


Figure 1: Location of Test and Control Sites for the Hunt EEMP

The primary objective of the experiment was to identify the threshold of exposure at which minor damage to ear structures occurred in juvenile cod between 10 and 15 cm in total length. Live fish were thus dissected and appropriate ear tissues removed and preserved for later analysis in a laboratory at the University of Maryland. Additional information on the effect of airgun discharges was obtained using video cameras observing fish behaviour in the cages during exposure. This study was a separate component funded by the NS Department of Energy. Preliminary analysis of the video indicated fish response to airgun discharges was minimal, with only a small startle response when the airguns were at their closest.

In preparation for the experiment, one cage was placed on the sea bottom at 100 m, 500 m, 1000 m and control sites in water depth of approximately 120 m. Depth was greater than anticipated and thus cages with camera or hydrophones attached needed to be suspended

from the fishing vessel to allow cables to reach the recording equipment onboard. This meant additional cages, intended to be placed on the bottom at 100 m, 500 m and control sites, were suspended from fishing vessels. In all cases, control fish were treated as similarly to test fish as possible.

Problems were encountered with positioning of the fishing vessel that placed the cages at 500 m and 1000 m. It is now clear that the 500 m site was approximately 200 m from the survey line, and further analysis is required to determine the location of the 1000 m cage. A laser range finder on the vessel stationed at the 100 m site confirmed a minimum distance of 138 m to the survey vessel. Results from the hydrophone recording of sound pressure levels are provided in the figure at the end of this report. The sound source level was 259 dB re 1 μ Pa at 1 m and maximum exposure levels were 204 dB re 1 μ Pa at 1 m.

All three suspended cages were recovered as soon as the seismic survey vessel had proceeded more than 500 m from the test sites. The cage on the sea bottom at the 1000 m site was also recovered as soon as possible after the survey vessel had passed.

Mortality from immediate recovery of the first four cages was 22%, most likely due to environmental conditions, notably low temperature (about 2.4°C), high tidal currents, and deep water (120 m). In cages recovered immediately, control mortality was 30.8%, and average mortality in the three cages near the path of the seismic survey vessel was 19.6%. Control and test mortality is considered to have occurred as a result of stress induced by the handling, exposure of the fish to large temperature fluctuations and erratic currents within the cages.

Three cages were left for retrieval for 5 days following the test exposure to check for injuries that took time to appear. Two of these cages were retrieved on Sunday, November 6. Weather had prevented recovery of the cages earlier. A third cage at the 500 m site could not be located and has been abandoned. Results from all cages are summarized in Table 1.

Table 1: Condition of Fish and % Mortality in Test and Control Cages

Fish Condition	100 m	100 m after 5 days	500 m	1000 m	Control	Control after 5 days
Dead before Test	0	0	0	0	4	0
Missing	0	9	0	0	0	9
Dead	0	0	2	2	4	1
Dieing	1	3	3	0	0	0
Unlively	8	1	0	1	0	2
Live	5	2	10	8	9	1
% Mortality	7.1%	80%	33.3%	18.2%	30.8%	76.9%

The delayed recovery of fish demonstrates the harsh conditions in the cages on the sea bottom. One fish in the initial test group was reduced to a bare skeleton within the 5 hours on the bottom. The rapid disintegration of this fish suggests seabed organisms, likely a form of mud flea, were present and a threat to fish on the bottom of the cages. The control cage started with 13 fish, but only 4 were recovered, whereas the test cages started with 15 fish and only 6 were recovered. These fish are assumed to have died and have been totally consumed by mud fleas within the cages when they were in contact with the bottom muds. There were no openings in the fine mesh on the cages that would have allowed a fish to escape. If all fish initially in the cages are considered dead and used in calculating mortality, control mortality becomes 76.9% and test mortality 80.0%.

Even though mortalities averaged 22% in cages recovered immediately after exposure and about 78% in delayed recovery cages, sufficient healthy fish should be available to allow statistically acceptable analysis of possible ear tissue injury. The mortalities observed do not suggest lethal impacts resulted from exposure to the airguns, at distances as close as 138 m.

This report provides only analysis of the field work portion of the study. The primary analysis of the EEMP will be based on the results of detailed laboratory analysis of ear tissue. Results of this analysis will not be available for many months.

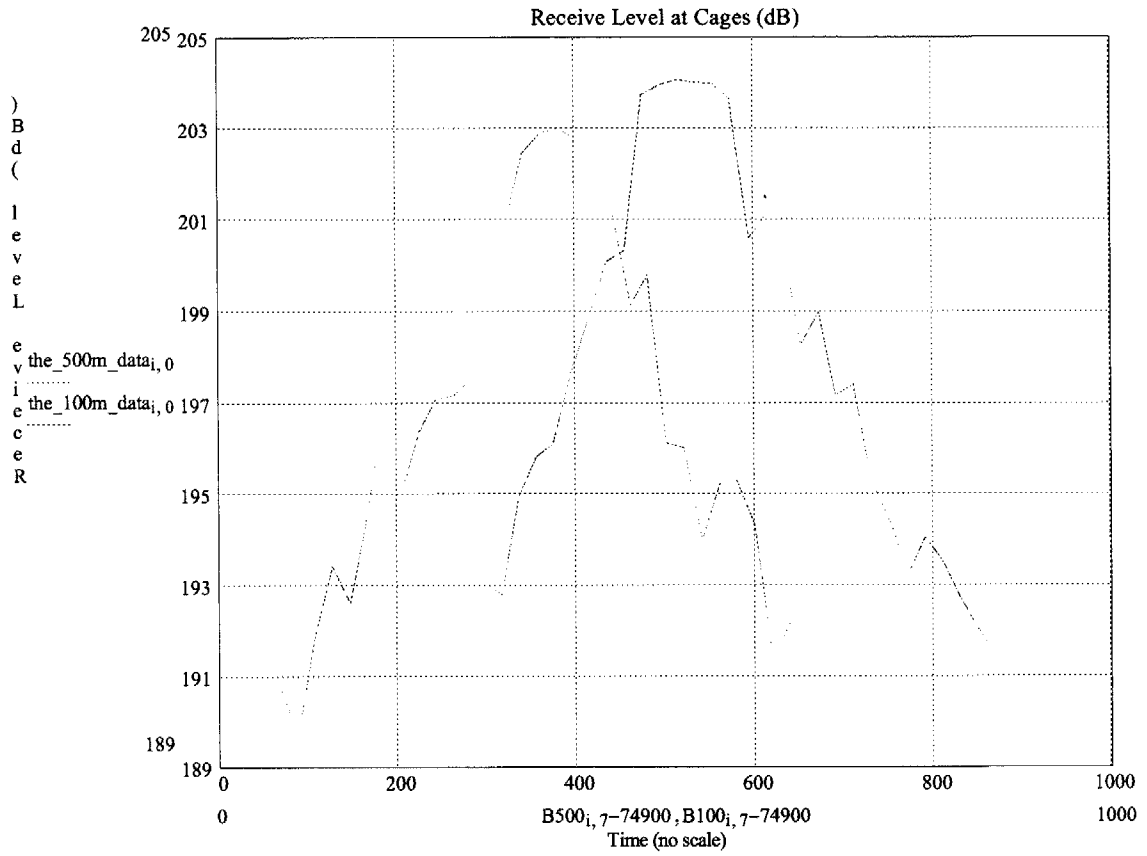


Figure 2: Recorded Sound Pressure Levels at Suspended Fish Cages