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Feeding Reduction and Recovery in Cunner *Tautogolabrus adspersus* Following Exposure to Crude Oil

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Cunners Tautogolabrus adsperus are found throughout the year in inshore Newfoundland waters in depths of less than 10 m (Green and Farewell 1971). This species is a bottom dweller and is commonly found around rocks, wharves, ledges and other areas where shelter is readily available (McClane 1974). This species' inshore habitat and non-migratory habit make it potentially susceptible to a pollutant such as oil.

Relatively large areas off the east coast of Canada are potentially at risk from shipping and oil industry influences and these areas make up some of the best fishing regions in the world. Payne et al. (1978) found little effect in cunners exposed to petroleum hydrocarbons for as long as 6 months. It has been reported, however, that prolonged exposure to oil at high concentrations reduces feeding in flounder (Fletcher et al. 1981) and codfish (Khan et al. 1981). In an actual oil spill situation exposure is usually short and at low hydrocarbon concentrations (Boehm et al. 1978; McAuliffe et al. 1981). Except for studying organisms from an oil spill area (Thurberg et al. 1978) very little work has been published on the effects of recovery time for feeding in oil-exposed fish.

This study was initiated to determine the time course of the onset of feeding reduction and recovery under environmentally realistic conditions experienced during an oil spill.

MATERIALS AND METHODS

Cunners were collected from Portugal Cove, Newfoundland (latitude 47°37.8'N, longitude 52°51.0'N) and held for 8 months under seasonally ambient conditions of temperature and photoperiod prior to the start of this study. At the onset of the study the fish were weighed, measured, tagged and placed in 2700 L tanks. These tanks were continuously supplied with seawater (32°/$_{oo}$ salinity) at approximately 15 L/min. The temperatures ranged from 3.4°C in May to 10.9°C in September 1980 when the experiment ended.

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One group of fish (20) was exposed to water soluble fractions of Hibernia P-15 crude oil while the other group (20) served as controls. Water accommodated oil fractions were prepared as in Kiceniuk et al. (1982) except that 500 mls was added to the head tank giving 200 μg/L initially and 50 μg/L at the end of the weekly periods. Oil concentrations were determined by fluorescence spectroscopy (Keizer and Gordon 1973) and class analysis of Hibernia crude by high performance liquid chromotography (Beckman model 110 using an energy analysis column from Waters Associates) indicated the following class composition: 10 mg/ml naphthalene equivalents of dicyclics, 2 mg/ml fluorene equivalents, 1.8 mg/ml phenanthrene equivalents of tricyclics, 0.8 mg/ml fluoranthene equivalents, 1.3 mg/ml pyrene equivalents of tetracyclics and 70.0 mg/ml asphaltenes (determined gravimetrically after pentane precipitation).

Exposure of the experimental group to oil commenced at week 3 and continued until week 11. At this point oiling was stopped and feeding continued until no significant difference was found between the exposed and control groups (week 15).

Both groups of fish were fed weighed amounts of freshly thawed capelin, Mallotus villosus, three times a week. Uneaten capelin were removed from the tanks prior to each feeding and a record of quantities consumed was kept. Food consumed at each feeding was calculated in terms of grams of capelin eaten divided by the biomass of cunner (kg) in the tanks. The mean food consumption per feeding was calculated for each week (g/kg x feeding) and a comparison between groups was done on a weekly basis by t-test. Fish were weighed and measured at weeks 3 and 11 and at the end of the experiment.

RESULTS AND DISCUSSION

Hydrocarbon concentrations associated with oil spills at sea have been reported to be in the range of 10-250 μg/L (Boehm et al. 1978; McAuliffe et al. 1981). Vandermeulen (1982) stated that concentrations of hydrocarbons in the water column for an offshore spill would be between 10-200 μg/L and these concentrations would be relatively short-lived, with levels returning to background after 1-2 weeks. The present study closely resembles what would occur in a real life situation as fish were exposed to water soluble fractions of Hibernia Crude Oil (50-200 μg/L) for a period of 8 weeks.

Reduction in feeding levels upon exposure to oil has been well documented in the literature (Korn et al. 1976; Woodward et al. 1981; Fletcher et al. 1981; Khan et al. 1981) and in the present study, a significant reduction in feeding was the signal for termination of oil exposure.

The amount of food consumed per group (g/kg x feeding) increased in both the exposed and control fish over the term of the

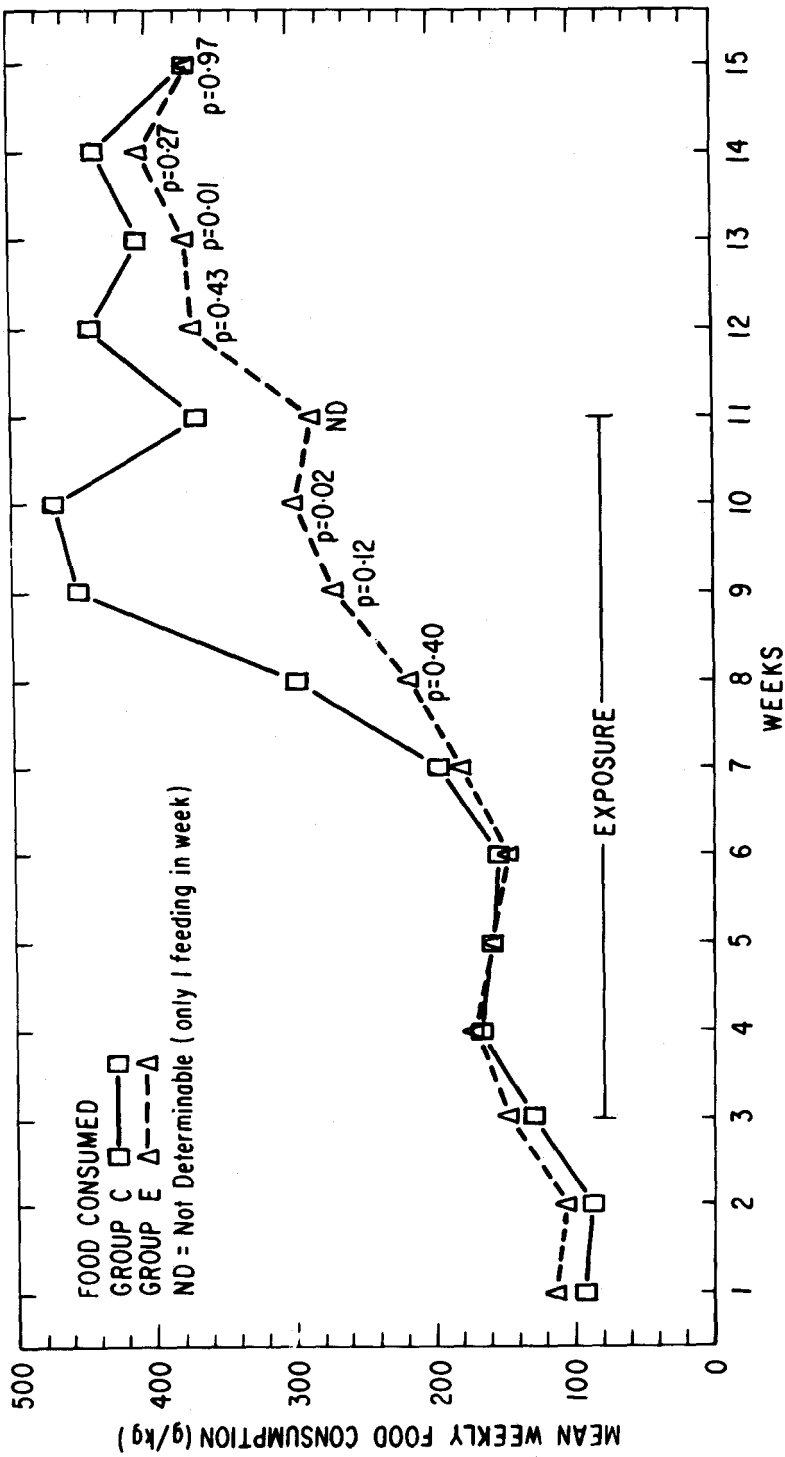

Figure 1. Mean weekly food consumption of cunner in control (C) and oiled (E) conditions.

experiment (see Fig. 1). In the pre-exposure period (weeks 1-3) there was no significant difference in feeding between groups. Seven weeks after exposure began, a difference in feeding between groups occurred and at week 10 a significant difference was found. At week 11, oiling of the exposed fish was halted and a noticeable difference in feeding continued for weeks 11 and 12 with a significant difference occurring for week 13. After week 13 feeding returned to normal.

Cunner feed only during the summer months (Green and Farewell 1971) with feeding commencing in May and reaching a peak during the summer. This trend continued in the present study as food consumption increased in both groups over the term of the experiment (May-September). The decreased food consumption in the oil exposed fish was also consistent with findings reported in the literature (Fletcher et al. 1981; Khan et al. 1981; McCain et al. 1978). This study shows that no significant disruption of food consumption occurred until 7 weeks of exposure to oil had elapsed and that recovery to normal feeding levels occurred 2-3 weeks after cessation of oiling. This indicates that the mode of action is not one of accumulation in an effector organ as this would be expected to decay more gradually. Compounds entering the body tend to be altered by liver, gill and kidneys whereas once in the bulk of the body lipids, lipophilic compounds are more refractory to degradation.

No difference in condition factor was found between groups in this study and this indicates that feeding was not altered enough to affect growth. Similar results were reported by Payne et al. (1978) who found no differences in condition factor in cunners exposed to Venezuelan crude oil for as long as 24 weeks.

Productivity of a fish stock is an important consideration and is the product of the number of individuals in that stock as well as their growth rates. Growth rate in fish is largely determined by food intake and any factor which affects this will be detrimental to the overall productivity of that stock.

Exposure of fish to relatively high concentrations of oil can result in a number of diverse and deleterious biological changes, one result of which is a depression of feeding. This study shows that a concentration in the 150-250 μg/L range for 4-5 weeks is required for the onset of feeding depression and recovery can occur in as few as 2-3 weeks. A particular population of cunners would have to be exposed to relatively high concentrations of oil for a prolonged period of time while they are actively feeding, before there would be an effect on the productivity of that population.

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