

Exposure to diesel emissions on commercial fishing vessels before and after engine retrofitting

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Background:

In 2009 after the Maine Department of Environmental Protection (MDEP) and the Maine Marine Trades Association received federal stimulus funds from Region I EPA to support a repowering program (Clean Marine Engine Program or CMEP) within the lobster fleet in Maine, the MDEP asked Ann Backus of the Harvard ERC Outreach Program if there were a study that could be designed around this repowering program. Ann Backus collaborated with Lynn Cating to create a pre-post-empowerment study to measure changes in diesel emissions as a result of replacing dirty diesel engines with EPA Tier II compliant engines; the project was subsequently awarded ERC Pilot Project funds to implement the study.

Methods:

In July and August of 2009 an HSPH IH student took the pre-repowering measurements on-board 18 lobster boats, and in May and June 2010 an OEM resident made the post-repowering measurements on-board 14 lobster boats.

The measured variables included PM_{2.5} (2009 only), elemental carbon, organic carbon, total carbon, particle bound Polycyclic Aromatic Hydrocarbons (PAHs), and particle surface area.

Results:

Statistically significant drops were observed in the mean values of elemental and organic carbon in the diesel emissions. This corresponds to the decrease in visible soot or smoke reported by the lobstermen. There was also a mean decrease in particle surface area, although this decrease was not significant. There was, however, a statistically significant increase in the number of particle-bound PAHs.

Health Implications:

Diesel Exhaust has been described by IARC as a “probable human carcinogen” and PAHs have been recently been listed by IARC as a “known human



carcinogen.” EPA lists PAHs as a “probable human carcinogen.” In addition to the implications for cancer, there are health implications for cardiovascular illness as well. Therefore, reduction in exposure to diesel exhaust is very important. Although the literature still contains controversy about the relationship between different components of diesel exhaust and mortality and morbidity, there is strong evidence to suggest that reducing the elemental or soot component of diesel reduces overall mortality and cardiovascular-specific mortality. Thus the decreases in elemental carbon seen in this study, may, overtime, show reduction in mortality. The PAH component was measured on particles 0.1 μ m in aerodynamic diameter. The mean concentration of PAH was higher in the 2010, post-repowering measurements. One explanation may be that the PAHs emanating from “clean engines” may be forced to ride the smaller particles because the larger ones have been eliminated. From the standpoint of lung health, this is not protective of health because it is the small particles that can lodge deeply in the lungs. More research is needed to learn more about the formation, transport, and fate of bound PAHs.