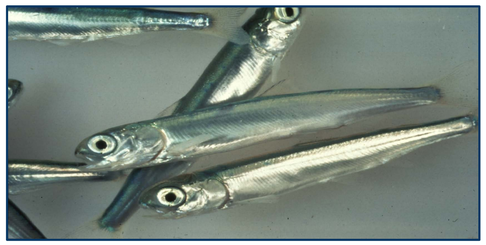
Effects of Polystyrene Ingestion on the Growth of Pink Salmon (*Oncorhynchus gorbuscha*)

Kevin Heffern [1], Jacek Maselko[1], Ashwin Sreenivasan[2], and Michael Garvin[3]

[1]Auke Bay Laboratories, Juneau, AK
Alaska Fisheries Science Center, NMFS, NOAA.
[2]Sitka Sound Science Center – Sitka, AK
[3]Frontier Genomics – Juneau, AK

Objective:

To determine if pink salmon fry will ingest polystyrene. If so, does ingestion effect growth.



Background:

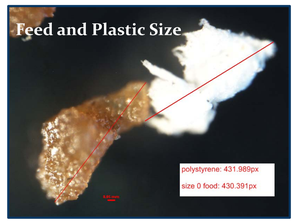
Surveys conducted in 2012 showed an overall 274% increase in the abundance of polystyrene on Gulf of Alaskan beaches from 2008 levels.

Plankton tows in the Gulf of Alaska (GOA) have produced measurable quantities of polystyrene and other plastics. Recent studies have reported plastic in the stomachs of salmonids (Myers et al 2013).

Polystyrene is a relatively inert polymer formed from aromatic hydrocarbons. However, it is non-polar and can sequester dissolved hydrophobic compounds such as organochlorines and polynuclear aromatic compounds.

Methods: Pilot Study

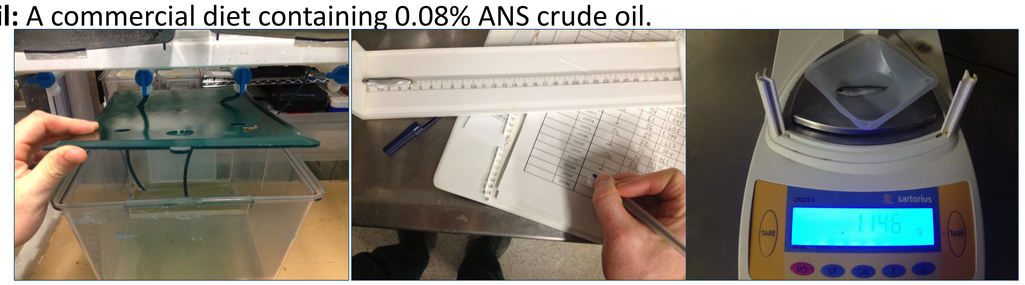
		Week 1	Week 2	Week 3	Week 5
Treatment	Tank 1	n=9	n=9	n=9	n=9
	Tank 2	n=9	n=9	n=9	n=9
	Tank 3	n=9	n=9	n=9	n=9



A pilot study was conducted to understand the effects of plastic on pink salmon fry.

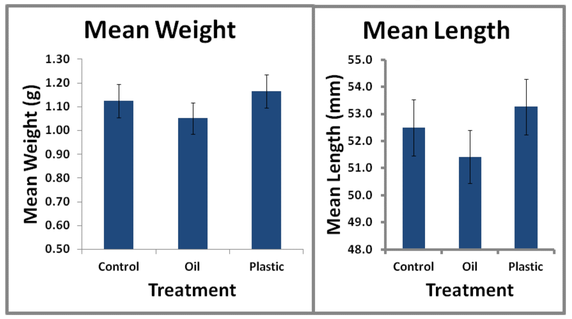
Treatments:

Control: Pink salmon fry (avg 46.5mm) were fed a commercially available diet.
Plastic: A commercial diet mixed with polystyrene collected from GOA beaches.
Oil: A commercial diet containing 0.08% ANS crude oil.

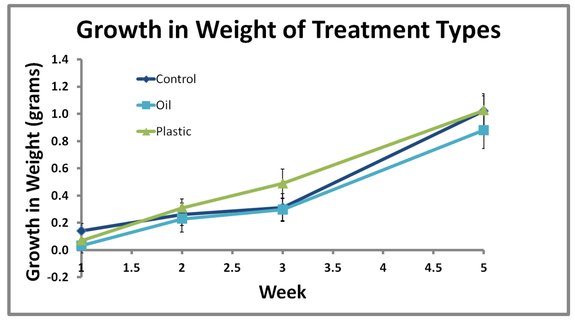


Length and weight were measured at each sampling event. A cellular instantaneous growth index (RNA/DNA ratios) was used to better elicit changes in growth rates over shorter time scales. A hydrocarbon stressor index Cytochrome P4501A (CYP1A) was used to determine hydrocarbon exposure (Carls et al, 2005). Total plastic ingested per fish was also determined using UV-VIS spectroscopy and microscope physical counts.

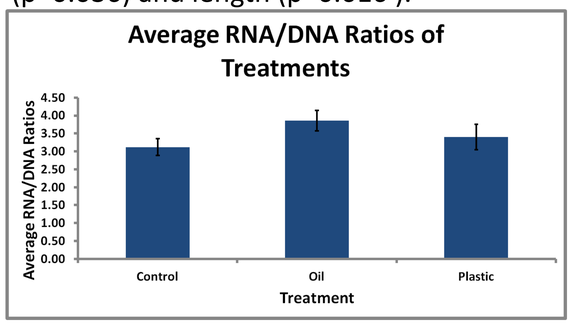
Results: Pink Salmon Fry Eat Plastic



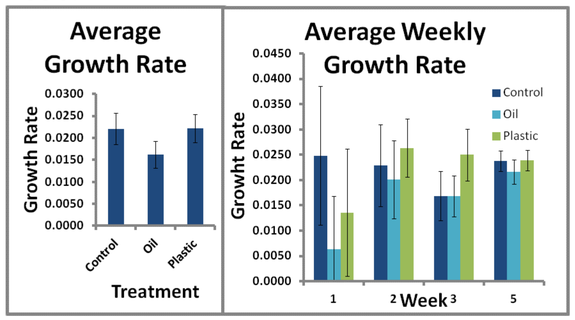
Significant negative treatment effect between control and oil for both weight ($p=0.036$) and length ($p=0.016$).



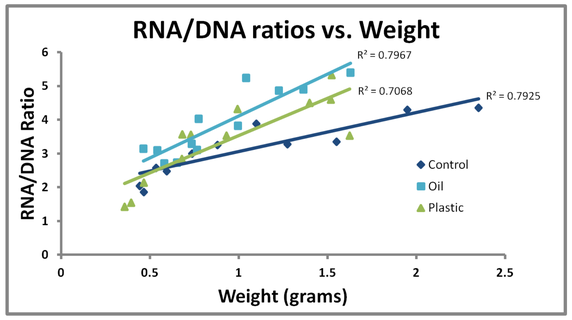
Differences in growth between oil and control mirror those seen in Carls et al. 1996.



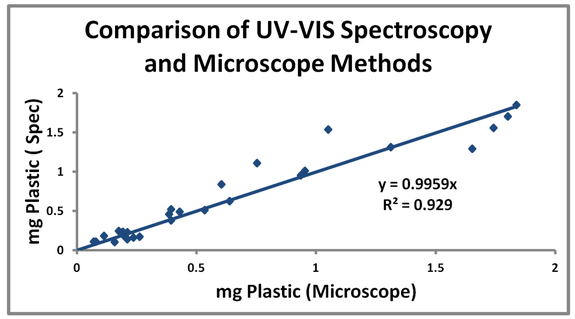
Oil and Plastic fed pink salmon have higher RNA/DNA ratios then control. Significant difference between oil and control ($p<0.005$).



Control growth rates are higher than oil However, no interaction exists between time and treatment.



RNA/DNA ratios suggest that both oil and plastic have a positive effect on growth.



Ingested plastic estimation by UV-VIS spectroscopy and microscope physical counts are comparable ($R^2=0.929$).

Conclusions:

- **All pink salmon fry in plastic treatment ingested plastic.**
- **UV-VIS spectroscopy method provides an easy away to quantify the amount of polystyrene ingested by fish.**
- **Discrepancy between higher RNA/DNA ratios and lower observed growth rates suggest that the oil fed pink salmon are ramping up enzymatic production, specifically CYP1A (Carls et al. 2005).**

The recommendations and general content presented in this poster do not necessarily represent the views or official position of the Department of Commerce, the National Oceanic and Atmospheric Administration, or the National Marine Fisheries Service.

Acknowledgements: Funding Provided by: NOAA Marine Debris Program. We thank: Ron Heintz, Jon Joyce, Andrew Eller, Bonita Nelson, Hannah Findlay, Connor Pihl, and Meghan Garrison

Biblography:
- Carls, MG. 1996a. Growth, feeding, and survival of pink salmon fry exposed to food contaminated with crude oil. Am Fish Soc Symp 18:608-618.
- Carls, MG. 2005. Cytochrom P450A induction in oil-exposed pink salmon Oncorhynchus gorbuscha embryos predicts reduced survival potential. Marine Ecology 301:253-265.
- Myers , Katherine, et al. 2013. Potential Mechanisms of Ocean Mortality of Juvenile Salmon and Steelhead Due to Ingestion of Plastic Marine Debris. NPAFC 9:169-170.