MERCURY CONTENT IN PACIFIC ALBACORE TUNA (*THUNNUS ALALUNGA)* DURING 2006 SEASON

Morrissey M.T; and L.A. Geise
Oregon State University Seafood Laboratory
2001 Marine Drive Suite 253
Astoria, OR 97103

INTRODUCTION:

Pacific albacore tuna during the 2006 season (July to October) were tested for total mercury concentration. The study mimicked a study completed during the 2003 season. Concerns of mercury concentrations in seafood has led to the U.S. Food and Drug Administration (FDA) recommending pregnant women, women of child-bearing age, and young children avoid certain seafood. The FDA set the fish consumption level for the general public at 12 oz/week of fish low in mercury and limiting albacore tuna consumption to 6 out of the 12 oz recommended (FDA, 2004).

The previous study in 2003 found total mercury levels of these smaller Pacific albacore tuna well below FDA and Canadian Food Inspection Agency mandated action levels, making it a safe and healthy food choice for most consumers (Morrissey et.al., 2004). This study also found total mercury levels, although slightly higher then previously reported, well below the government's action levels.

MATERIALS AND METHODS:

Sample Preparation: One hundred fourteen tuna from 23 vessels fishing off the Oregon, and Washington coasts were caught and tagged during the 2006 season from July to October. Thirty samples were caught on boats using troll gear, while the rest were caught using bait and line. The vessels were supplied with numbered tags which were placed on the fish at sea and corresponded with date, location, and vessel information. Whole fish were frozen at sea and upon landing were transferred to the Oregon State

University Seafood Laboratory in Astoria, OR (OSU-SFL). Rosalinda Rittenberg of American Albacore Fishing Association (AAFA) coordinated the tagging and transporting of the fish. The fish were thawed at 4°C for removal of the loins. The weight and length of each tuna was taken prior to removal of the loins. Fork lengths were taken from the tip of the mouth to the apex of the tail. Full lengths were taken from the tip of the mouth to the end of the tail fin.

Mercury Testing: A 100g sample of white muscle was taken from the upper right loin section and homogenized in a blender at high speed for 1 minute. Twenty-five grams of each sample was placed in separate plastic vacuum-sealed containers and frozen at -30°C for further analysis. The frozen samples were transported from the OSU-SFL to AM Testing Laboratories in Redmond, WA for mercury analysis. Two-gram aliquots of each sample were digested with 2 ml HNO_3, 4 ml H_2SO_4, 1.5 g $KMnO_4$, and 8 ml $K_2S_2O_8$. Samples sat overnight in reagents and were then cooked in a 98°C water bath for 2 hr. After digestion, hydroxylamine hydrochloride and stannous chloride were added and the mercury content was measured using a Perkin Elmer Atomic Absorption Spectrophotometer according to the cold-vapor atomic absorption EPA method 7471A.

Lipid Analysis: Lipid analysis was carried out using the modified AOAC Official Method 948.15 (Crude Fat in Seafood, Acid Hydrolysis Method, 1995).

RESULTS:

As shown in Figure 1, fish were caught between 44.10°N (Southern Oregon), and 46.22°N (Washington Coast); and -124 and -135°W (within 100 miles of the U.S Pacific coast). Table 1 shows the 71 fish with weight data ranged from 2.96-14.10 kg in weight with an average of 6.74± 1.8 kg; and the 87 fish with length data ranged from 53.3 to 91.44 cm in fork length with and average of 68.60± 6.7 cm. Six fish had broken tails so

the full length was unavailable. The 81 fish with available full length measurements ranged from 57.15 to 96.52 cm with an average of 74.01± 6.3 cm. The total mercury content ranged from 0.068 to 0.357 (ug/g), with an average of 0.179± 0.05 (ug/g) and a median of 0.177 (ug/g). Lipid analysis of all 113 tuna ranged from 1.54-21.12% with an average of 9.5± 4.9%.

Table 1: Mercury Content, Weight, and Length measurements for 113 samples of albacore tuna.

	Mercury Content (ug/g)	Weight (kg)	Fork Length (cm)	Full Length (cm)	%Lipid
Average ± Stdev	0.179 ± 0.05	6.74 ± 1.8	68.6 ± 6.7	74.0 ± 6.3	9.5 ±4.9
Range	0.068-0.357	2.96-14.10	53.3-91.4	57.2-96.5	1.54-21.12

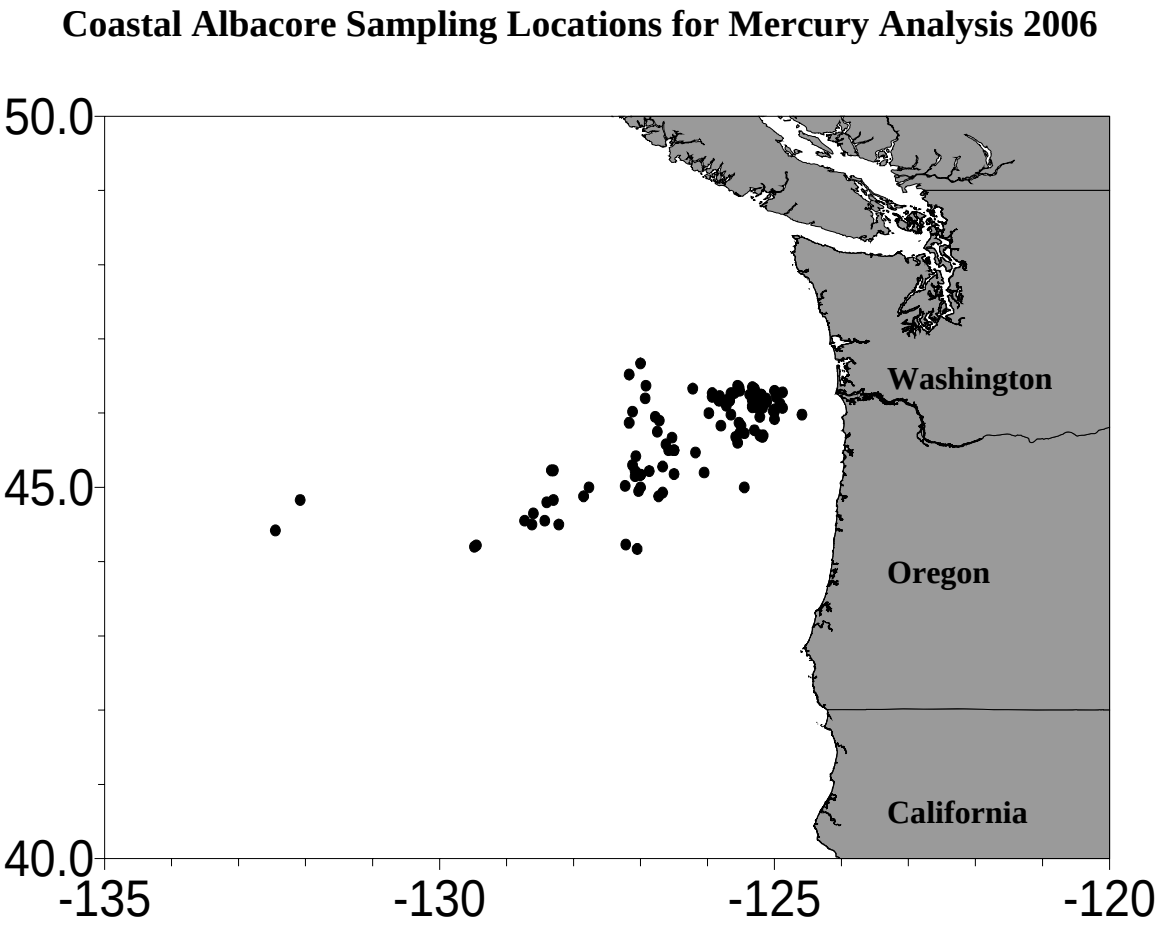

Figure 1: Geographic catch locations along the U.S. Pacific Coastline for the 113 albacore tuna analyzed in the present study.

Figure 2 shows the correlation between fish weight and mercury content. There is a slight positive correlation (R^2=0.24) for larger fish to have a higher mercury content. This slight correlation is also shown in Figure 3 with the correlation between fish fork length and mercury content (R^2=0.18). Figure 6 shows the positive correlation between percent lipid and seasonality (R^2=0.52). There was no correlation between seasonality and mercury content (Fig. 4), percent lipid and mercury content (Fig. 5), or percent lipid and weight (Fig. 7).

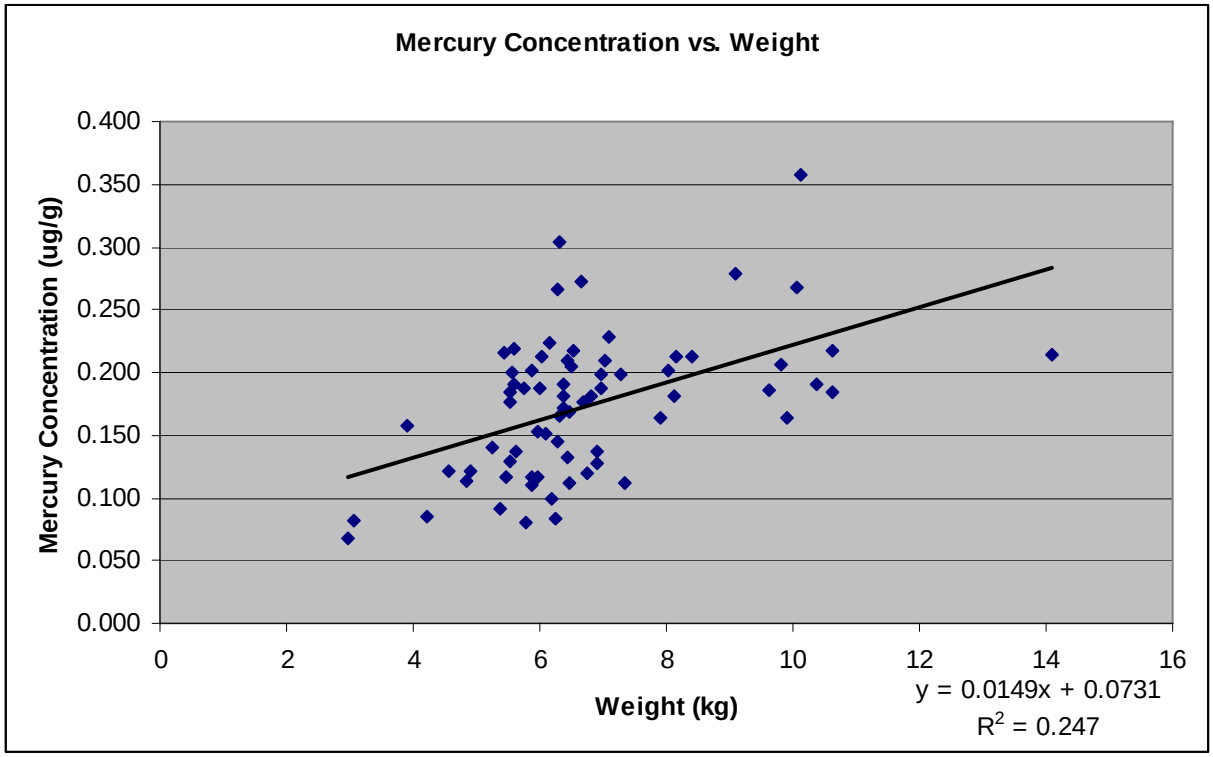

Figure 2: Correlation between weight and mercury concentration of 71 tuna in the present study.

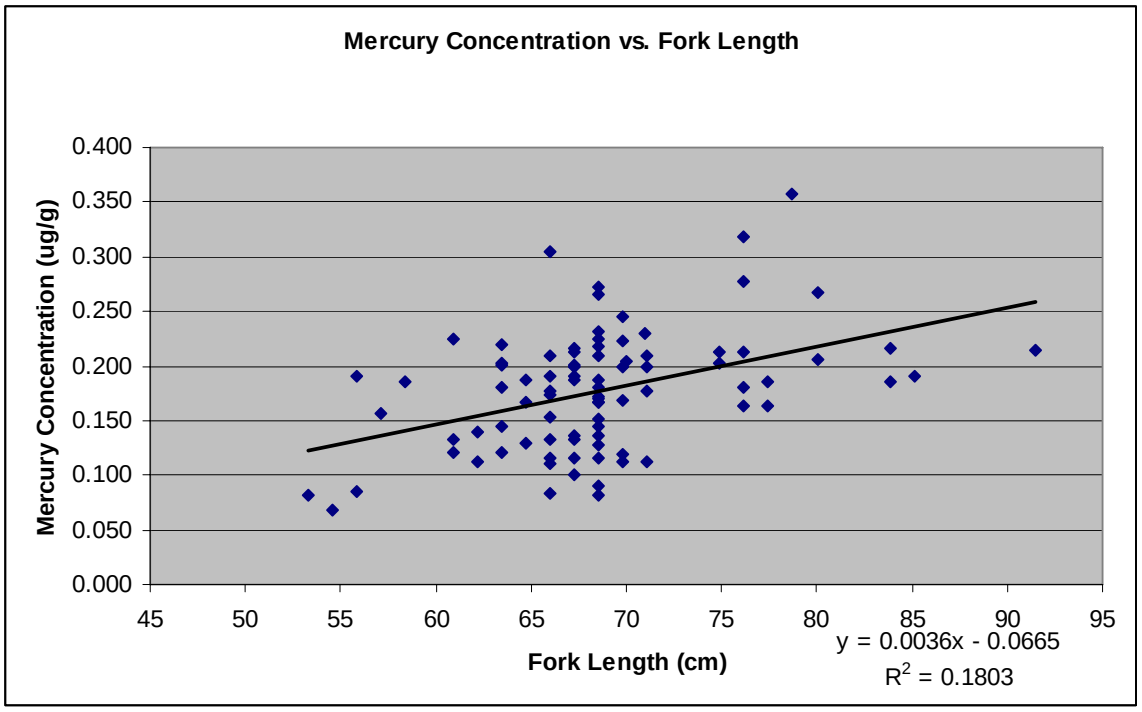

Figure 3: Correlation between fork length and mercury concentrations of 87 tuna in the present study.

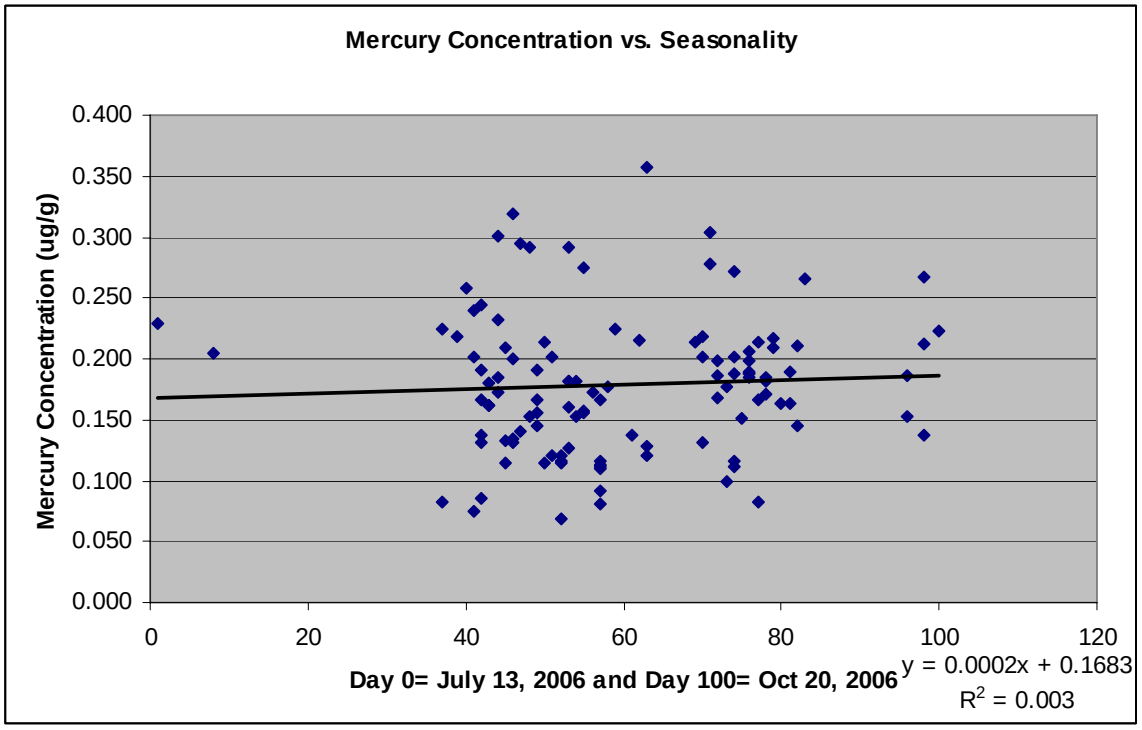

Figure 4: Correlation between mercury concentration and seasonality of 113 tuna in the present study.

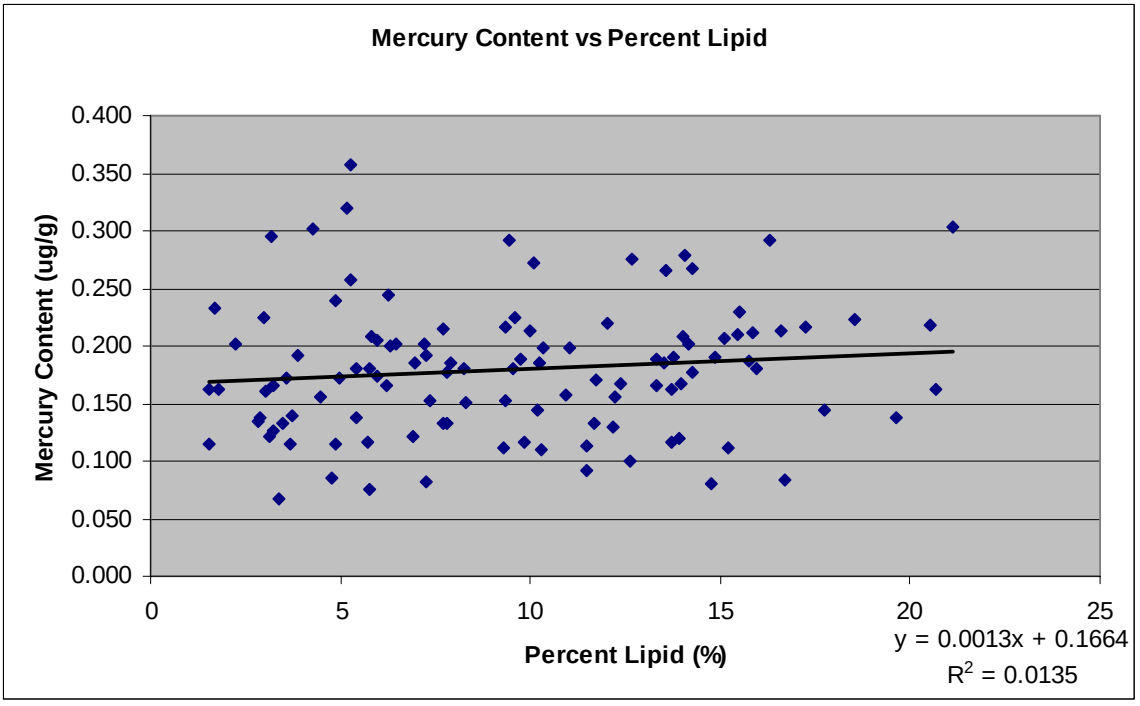

Figure 5: Correlation between mercury concentration and percent lipid of 113 tuna in the present study.

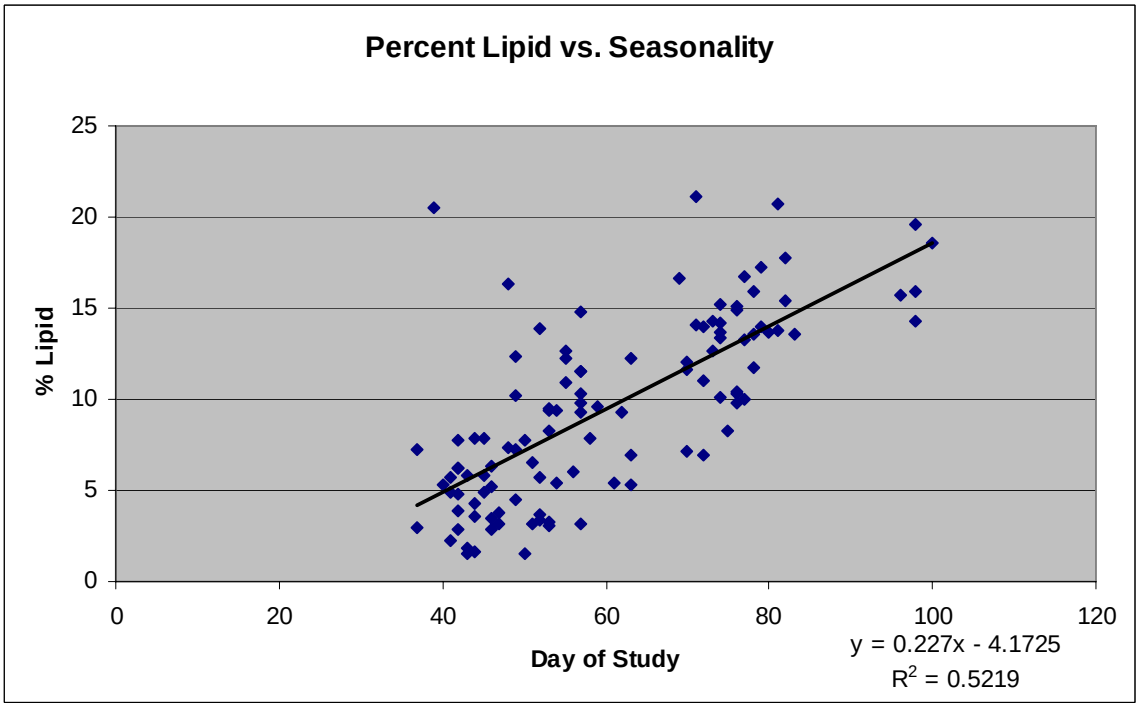

Figure 6: Correlation between percent lipid and seasonality of 113 tuna in the present study.

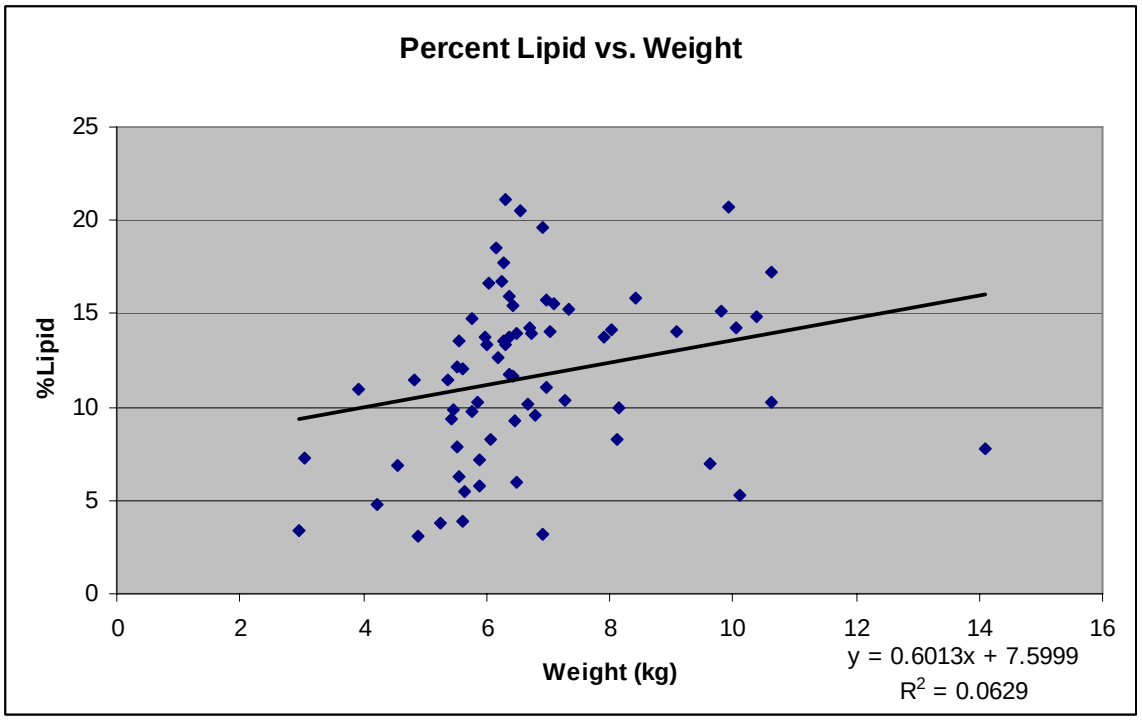

Figure 7: Correlation between percent lipid and weight of 71 tuna in the present study.

DISCUSSION:

The results from this study found higher mercury concentrations in Pacific troll-caught albacore tuna then in a previous study with a range of 0.068-0.357 ug/g with an average of 0.179± 0.05 ug/g and a median of 0.177 ug/g. Results from a previous study in 2003 on albacore tuna caught off the U.S. Pacific coast ranged from 0.027-0.26 ug/g with an average of 0.14±0.05 ug/g and a median of 0.14 ug/g (Morrissey et. al., 2004). The tuna's weights, lengths, and percent lipid were approximately equal in both studies. The correlation between weight and mercury content, and length and mercury content were lower than previously published. Although the mercury concentration is slightly higher in this study, it is still well below mandated action levels for the U.S. FDA (1.0 ug/g methylmercury) and the Canadian Food Inspection Agency's mandated action level of 0.5 ug/g total mercury.

The FDA reported average total mercury of 0.38 ppm (undetectable to 1.30 ppm) for 131 samples of fresh/frozen (unspecified) tuna. The FDA also reported an average total mercury value of 0.35 ppm (undetectable to 0.85) for 179 samples of canned albacore tuna, and 0.12 ppm (undetectable to 0.85 ppm) for 131 samples of light canned tuna analyzed over the years 1990-2003 (FDA, 2004). This study shows these Pacific troll-caught albacore tuna, although at slightly higher levels than the previous study, are still low in total mercury concentration with the average levels well below any North American government's limit. Further research should be performed in the future to determine if mercury levels continue to rise.

ACKNOWLEDGMENTS: This study is paid for by AAFA, American Tuna and WFOA. Special thanks to Rosalinda Rittenberg of American Albacore Fishing Association (AAFA) for coordinating the tagging and transporting of the tuna samples.

REFERENCES:

Morrissey, M.T; R.S. Rassmussen; and T. Okada. "Mercury Content in Pacific Troll-caught Albacore Tuna (*Thunnus alalunga)*. *Journal of Aquatic Food Product Technology*. Vol. 13, No. 4 p.41-52, 2004.

FDA, 2004. Mercury Levels in Commercial Fish and Shellfish. Accessible at: www.cfsan.fda.gov/~frf/sea-mehg.html.