Monitoring Alaskan Fishes for Contaminants: Analyzing the Impact of Environmental Contaminants

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SOURCES OF ENVIRONMENTAL CONTAMINANTS

• LOCAL

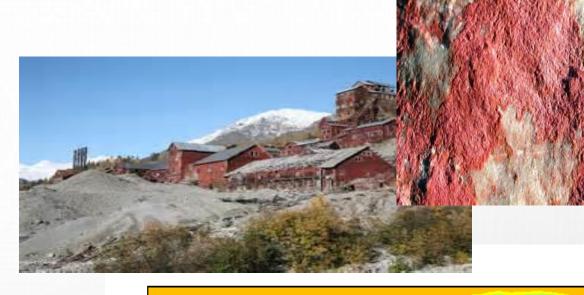
- NATURAL GEOLOGIC SOURCES, FOREST FIRES
- CITIES AND INDUSTRIAL PRODUCTION
- ACCIDENTAL RELEASES
- MILITARY SITES
- RESOURCE EXTRACTION- MINES, OIL EXPLORATION

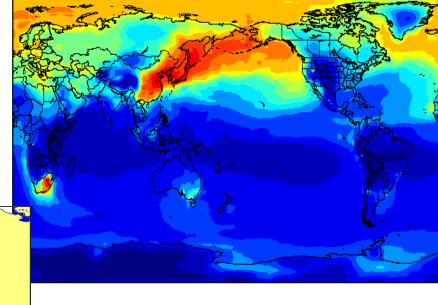
1000 MILES

PACIFIC O

LONG RANGE TRANSPORT

- ATMOSPHERIC
- OCEAN CURRENTS
- ANIMAL MIGRATION
- COMMERCIAL TRANSPORT





FISH TISSUE MONITORING PROGRAM

- STARTED IN 2001IN RESPONSE TO EPA CONCERNS RELATED TO FISH CONSUMPTION
- ADDRESS PUBLIC CONCERNS
- FISH SAMPLES FROM AROUND THE STATE -COLLABORATION
- AK FISH CONSUMPTION RECOMMENDATIONS -DHSS
- EVALUATE AQUATIC ECOSYSTEMS SUPPORTING ALASKAN

FISHERIES - CONSUMER CONFIDENCE



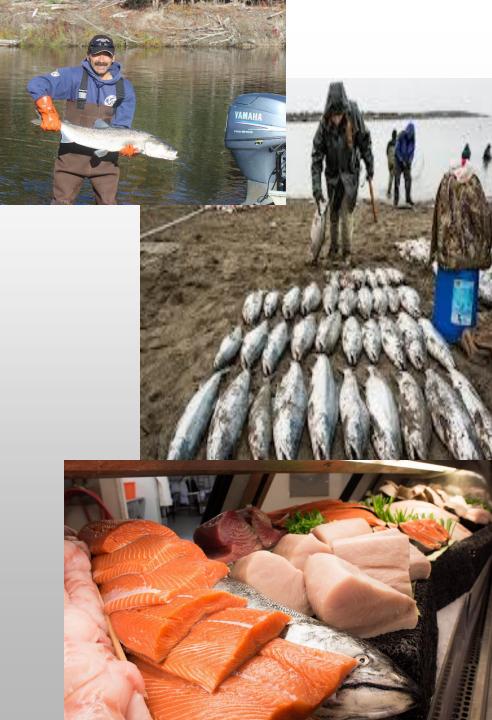
Fish Monitoring Program:

GENERAL SURVEY OF ALASKAN FISHES:

- COMMERCIAL, SUBSISTENCE, RECREATIONAL SPECIES
- COLLABORATIVE EFFORT FOR SAMPLE COLLECTION
 - FEDERAL AND STATE AGENCIES, COMMERCIAL,
 RECREATIONAL AND SUBSISTENCE FISH HARVEST
- MARKET FISH SURVEY

• **SELECTED COASTAL SITES:**

- REMOTE COMMUNITIES AND VILLAGES (SUBSISTENCE HARVEST)
- COMMERCIAL HARVEST AREAS
- ADJACENT TO ANTHROPOGENIC ACTIVITIES
 - CITIES, DISCHARGES/RUNOFF
- HISTORIC MINING SITES



EVALUATE ALASKAN FISH AND INVERTEBRATES:

- MEASURE CONTAMINANT LEVELS IN SKINLESS FILLET AND WHOLE FISH FROM FRESHWATER, ESTUARIES AND MARINE ENVIRONMENTS
 - DISTRIBUTION TO ORGANS, EGGS

• DATA IS USED TO:

- DETERMINE IF THERE ARE ANY AREAS, SPECIES, OR CONTAMINANTS THAT WARRANT MORE IN-DEPTH SAMPLING AND EVALUATION.
- PROVIDE ALASKAN RESIDENTS WITH INFORMATION TO MAKE AN INFORMED DIETARY DECISION BASED ON RISKS AND BENEFITS OF EATING ALASKAN FISH
- 2014 UPDATED FISH CONSUMPTION ADVICE FOR ALASKANS







• HEAVY METALS:

- MERCURY: TOTAL MERCURY, METHYL-MERCURY
- ARSENIC, CADMIUM, CHROMIUM, COPPER, NICKEL, LEAD, <u>SELENIUM</u>

• ORGANOCHLORINE COMPOUNDS:

- PCBS
- DIOXINS AND FURANS
- PESTICIDES (ORGANOCHLORINE PESTICIDES)

EMERGING CONTAMINANTS:

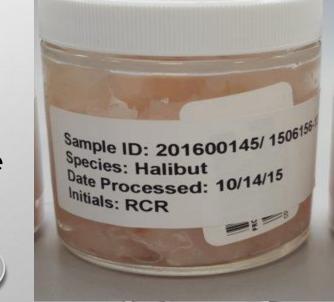
- BROMINATED FIRE RETARDANTS (PBDE)
- POLY-FLUORINATED COMPOUNDS (PFC, PFOS, PFOA)
- PHARMACEUTICALS, PERSONAL CARE PRODUCTS
- RADIONUCLIDES MONITOR FOR FUKUSHIMA RADIATION

NUTRITIONAL ANALYSIS

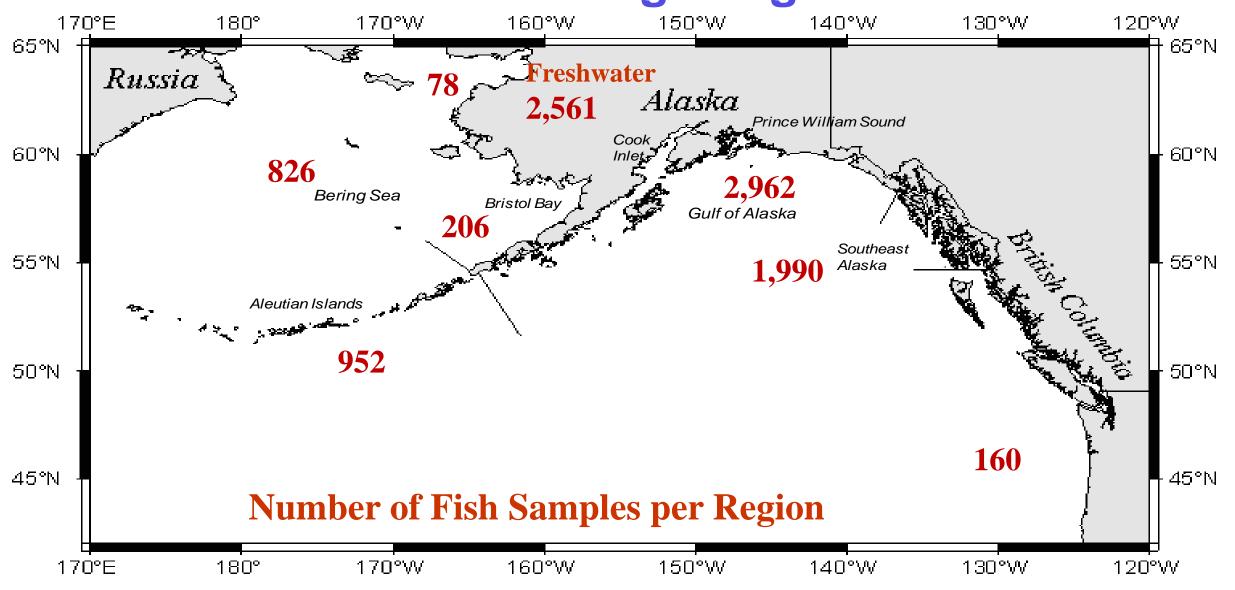
- FATTY ACIDS
- STABLE ISOTOPES



Tissue Archive

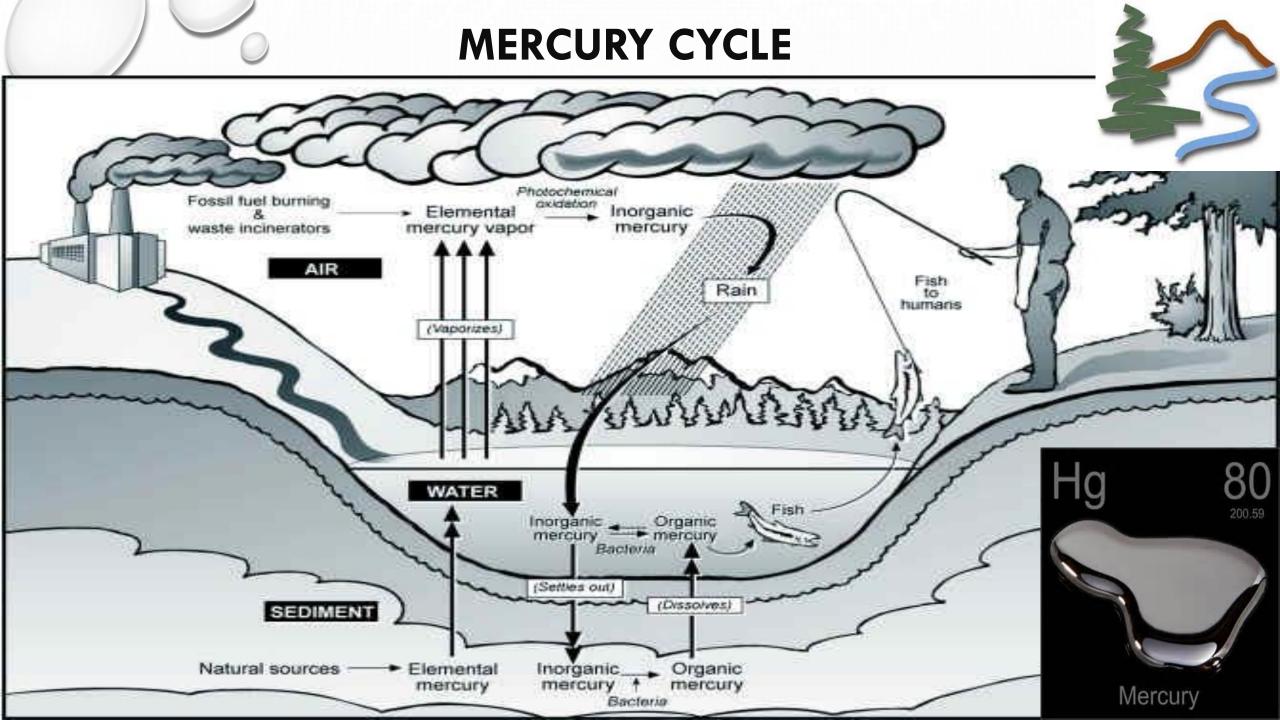


Areas Fish Were Collected for the ADEC Fish Monitoring Program

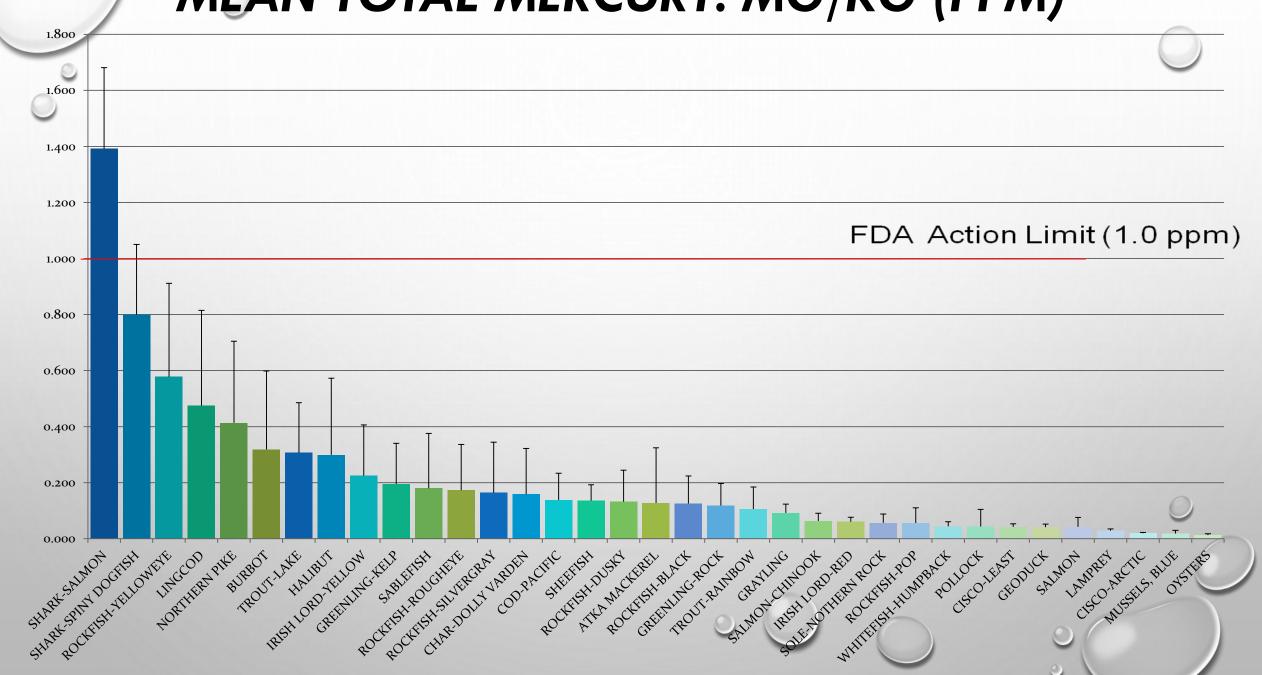


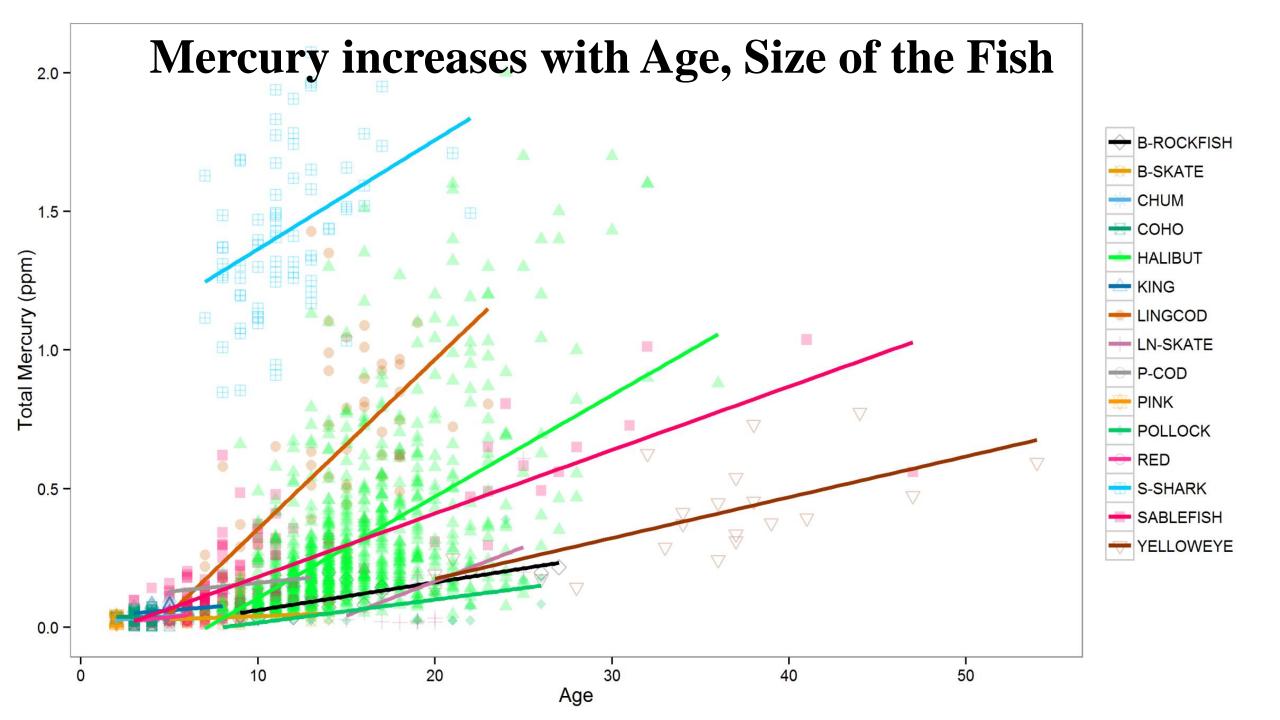
Total Samples collected so far > 10,000

91+ species (fish, shellfish, inver	stobratos)	OYSTERS-SCALLOPS	141
		POLLOCK	195
ATKA MACKEREL	10	ROCKFISH-BLACK	79
BURBOT	27	ROCKFISH-DUSKY	66
CAPELIN	45	PACIFIC OCEAN PERCH	83
CHAR-ARCTIC + DOLLY VARDEN	50	ROCKFISH-YELLOWEYE	116
CRABS	368		
CISCO	47	ROCKFISH SPECIES	66
CLAMS, COCKLES, CHITON,SEA CUMBER	379	SABLEFISH	249
COD	195	SALMON-CHINOOK	479
EULACHON (Candlefish)	35	SALMON-CHUM	302
GEODUCK	132	SALMON-PINK	188
GRAYLING	47	SALMON-RED	401
GREENLING	45	SALMON-SILVER	664
HALIBUT	1919	SAND LANCE	47
HERRING	32	SHARK	111
IRISH LORD-RED	19	SPINY DOGFISH	52
IRISH LORD-YELLOW	14	SHEEFISH	16
LAMPREY	10	SKATE	186
LINGCOD	230	SOLE, FLOUNDER	30
MUSSELS, BLUE	44	STICKLEBACK, SCULPIN	121
NORTHERN PIKE	572	TROUT-LAKE	124
OCTOPUS-SQUID	12	WHITEFISH	142



MEAN TOTAL MERCURY: MG/KG (PPM)





SURVEILLANCE MONITORING FOR CONTAMINANTS IN FISH



• **COMPLEX ISSUE:**

- VARIED SOURCES OF ENVIRONMENTAL CONTAMINANTS
- SITE SPECIFIC AND REGIONAL DIFFERENCES
- POSSIBLE IMPACTS ON ECOSYSTEM HEALTH —"ONE HEALTH ISSUE"
 - WATER QUALITY
 - ANIMAL HEALTH FOOD QUALITY
 - PUBLIC HEALTH
- NEED FOR MONITORING TO DETERMINE BACKGROUND PRESENCE
 AND EVALUATE TRENDS FOCUS OF RADIONUCLIDE MEASUREMENTS
- NEED FOR CLEAR INFORMATION TO THE PUBLIC



- IN 2014 UPDATED THE ACCEPTABLE DAILY INTAKE FOR MERCURY IN FISH:
 - 8,000+ FISH MONITORING DATA POINTS
 - REVIEW OF RECENT STUDIES ON NEURODEVELOPMENTAL, DIABETES, AND CARDIOVASCULAR ENDPOINTS
- RECOGNIZED THE IMPORTANCE OF FISH FOR NUTRITION, ECONOMICS, SPORTS, CULTURE, COMMUNITY, RELIGION, AND IDENTITY
- LARGE AMOUNTS OF FISH CONSUMED BY ALASKANS

NUTRIENT COMPOSITION

FISH ARE NOT JUST A TRANSPORT MECHANISM FOR CONTAMINANTS

- COMPLEX NUTRITIONAL FOOD: ENERGY 300 TO 900 CAL/LB
 - LEAN, HIGH QUALITY PROTEIN 15 TO 28%
 - PUFA (O-3, O-6 FA) TOTAL FATS 1 TO 20%
 - MINERALS –WELL BALANCED SUPPLY OF MINERALS
 - NA, K, CA, MG, PH, S, CL, SI, MN, ZN, CU, I
 - VITAMINS A, D, B1, B2, NIACIN, B6, B12, PANTOTHENIC ACID, BIOTIN

LIPID AND FATTY ACID COMPOSITION

- LIPIDS CONCENTRATION (ENERGY STORES) MAY BE AN INDICATOR OF FISH HEALTH
- RATIO OF O-3/O-6 FATTY ACIDS AS RELATED TO PUBLIC HEALTH



FISH CONSUMPTION

35

- IMPAIRED HEALTH
- CONTAMINANTS
 - MERCURY
 - PERSISTENT ORGANIC
 POLLUTANTS
 - OTHER METALS
 - RADIONUCLIDES



BENEFITS

- OMEGAS-3 FATTY ACIDS
- PROTEIN
- SELENIUM
- NUMEROUS OTHER NUTRIENTS
- SPORT
- CULTURE
- SUBSISTENCE
- ECONOMIC, COMMERCE

GUIDELINES INCORPORATE FISH SPECIES CONSUMED BY MOST ALASKANS



Guidelines for Alaska Women and Children

Mix and match your fish meals for up to:

12 POINTS PER WEEK

Note: A **meal size** is 6 ounces, uncooked weight (or roughly the size of a deck of cards).

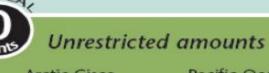
A laska fish is rich in nutrients and good for you. State health officials recommend that everyone eat fish at least twice per week. However, all fish contain some mercury, a toxic metal that can harm the developing nervous systems of unborn babies and children. Because of this, women who are or can become pregnant, nursing mothers and children should follow these guidelines to limit their mercury intake. Everyone else can eat as much seafood as they like.



Halibut 40–80 pounds Lake Trout Lingcod 35–40 inches



Halibut 80–140 pounds Lingcod 40–45 inches Longnose Skate



Arctic Cisco
Big Skate
Black Rockfish
Broad Whitefish
Dolly Varden
Dusky Rockfish
Grayling
Halibut <40 pounds
Humpback Whitefish
Least Cisco
Lingcod <35 inches

Pacific Cod

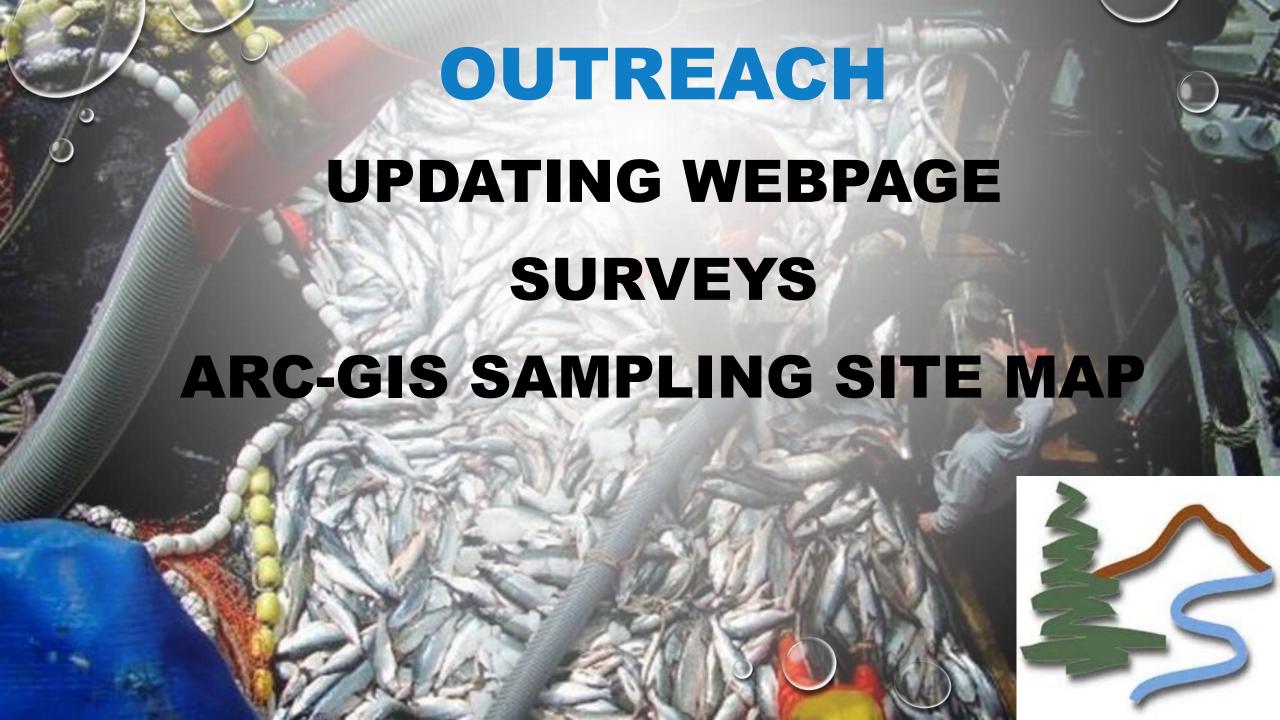
Pacific Ocean Perch
Rainbow Trout
Rougheye Rockfish
Sablefish
Salmon, Chinook (King)
Salmon, Chum
Salmon, Pink
Salmon, Red (Sockeye)
Salmon, Silver (Coho)
Sheefish
Walleye Pollock



Yelloweye Rockfish Halibut 140–220 pounds



Halibut >220 pounds Lingcod >45 inches Salmon Shark Spiny Dogfish

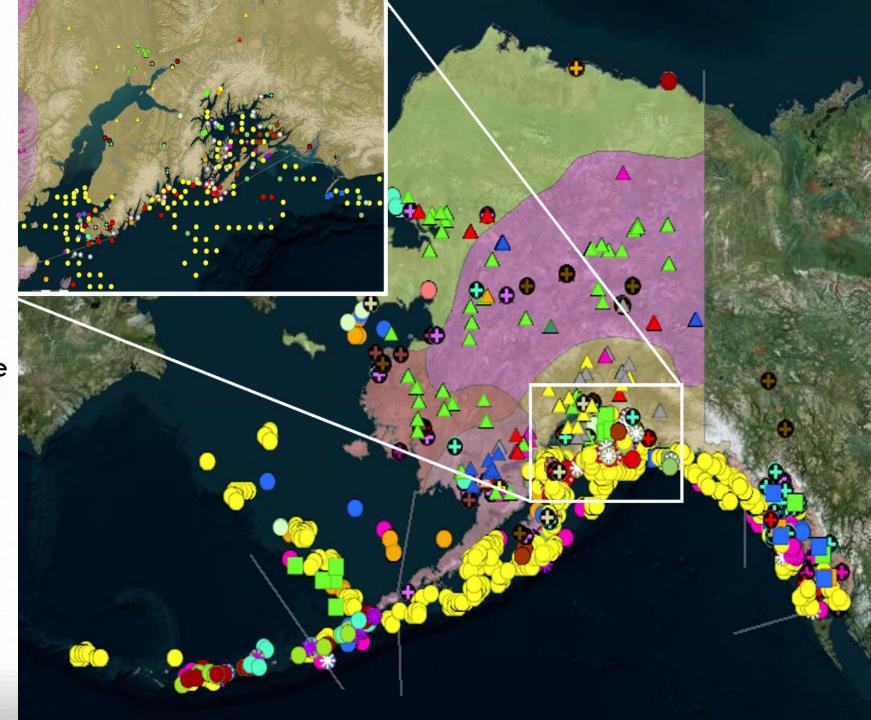




- SAMPLE LOCATIONS
- FISH SIZE, SEX AND AGE
- COLLECTION DATE
- MEAN, MIN, MAX: Hg and Se
- Total Arsenic
- WEEKLY UPDATES

FTMP webpage

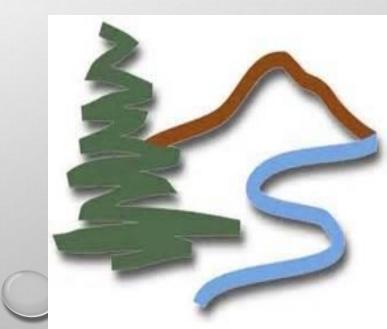
DEC Maps





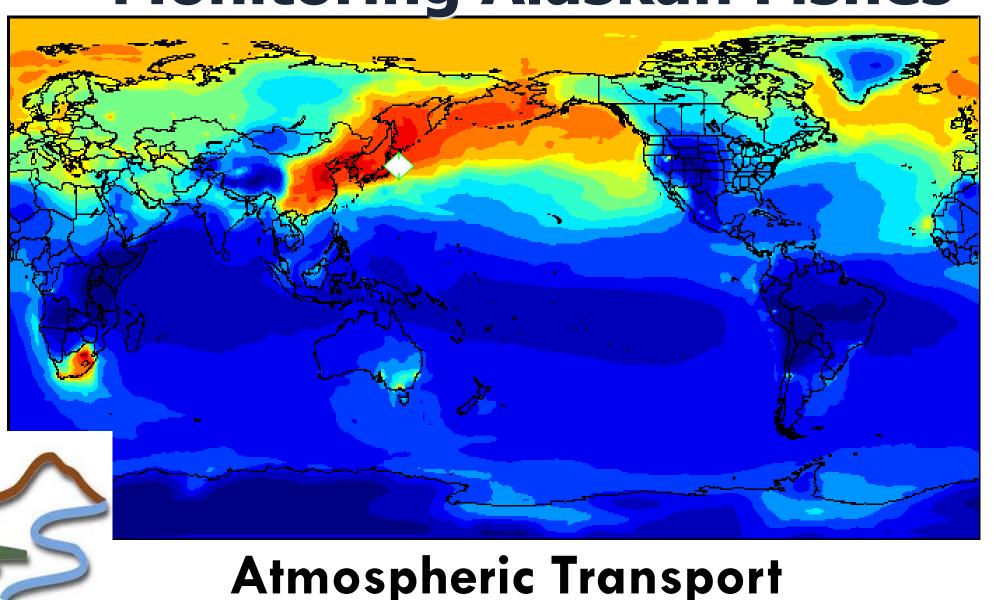
SURVEY

- AVAILABLE ON THE FISH MONITORING WEBPAGE
 - HTTP://DEC.ALASKA.GOV/EH/VET/FMP.HTML
- SURVEY PUBLIC:
 - SUBSISTENCE USERS,
 - RECREATIONAL,
 - AND SPORT FISHERS
- SURVEY COMMERCIAL FISHERIES





Fukushima: Concerns and Monitoring Alaskan Fishes



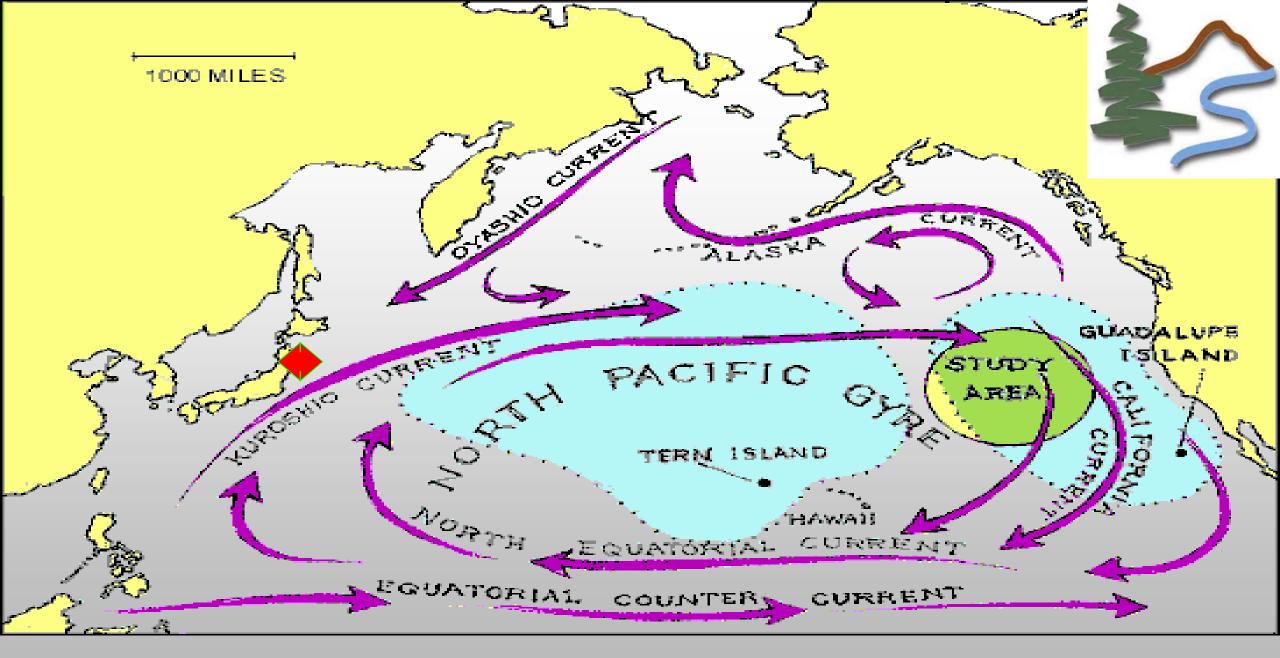
3.0

2.0

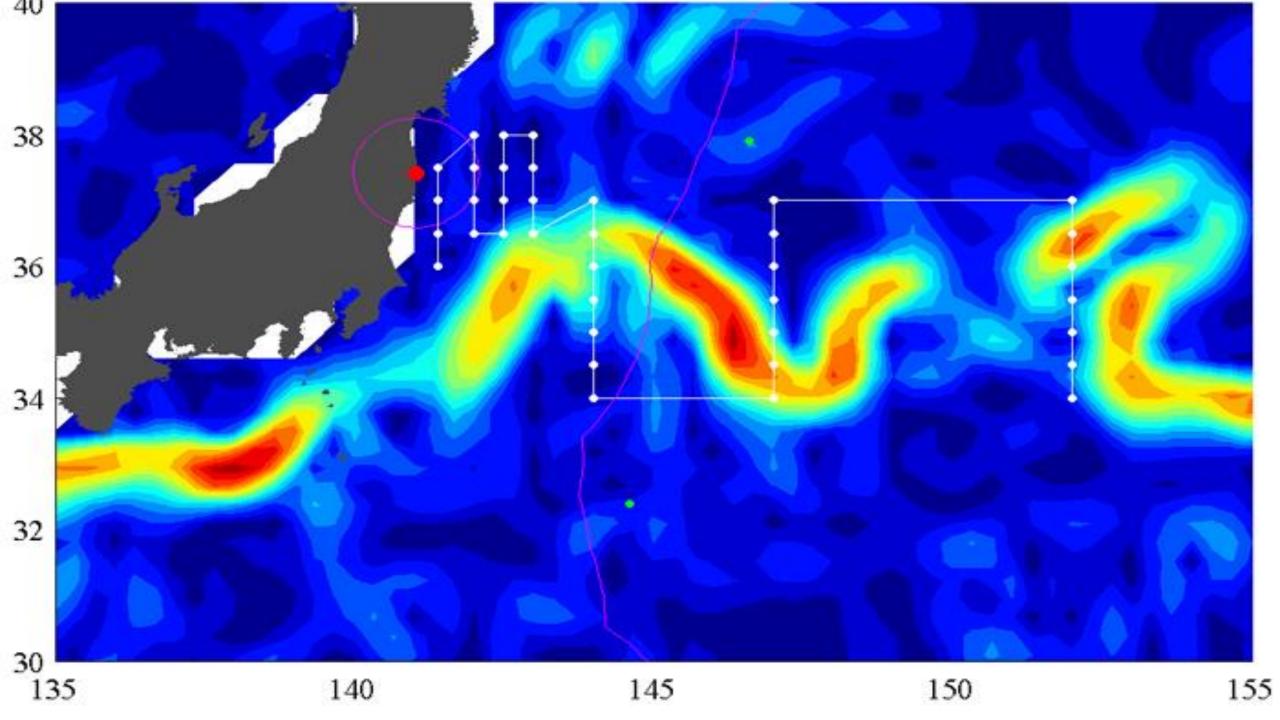
1.8

1.3

0.9



OCEAN CURRENTS: NORTH PACIFIC GYRE



WHAT IS RADIATION?

- ENERGY IN WAVES OR HIGH SPEED PARTICLES
- BACKGROUND RADIATION
 - NATURAL: RADIOISOTOPES IN THE SOIL, GRANITE IN YOUR BUILDING OR KITCHEN COUNTER TOP, COSMIC RAYS FROM THE SUN AND OUTER SPACE
 - MANMADE: MEDICAL OR DENTAL X-RAYS, MEDICAL LAB PROCEDURES, RADIOTHERAPIES, MICROWAVES FROM COMMUNICATIONS TECHNOLOGIES AND RADAR
 - BACKGROUND RADIATION IS THE STANDARD AGAINST WHICH DOSE RATES FROM UNUSUAL RADIATION SOURCES ARE MEASURED

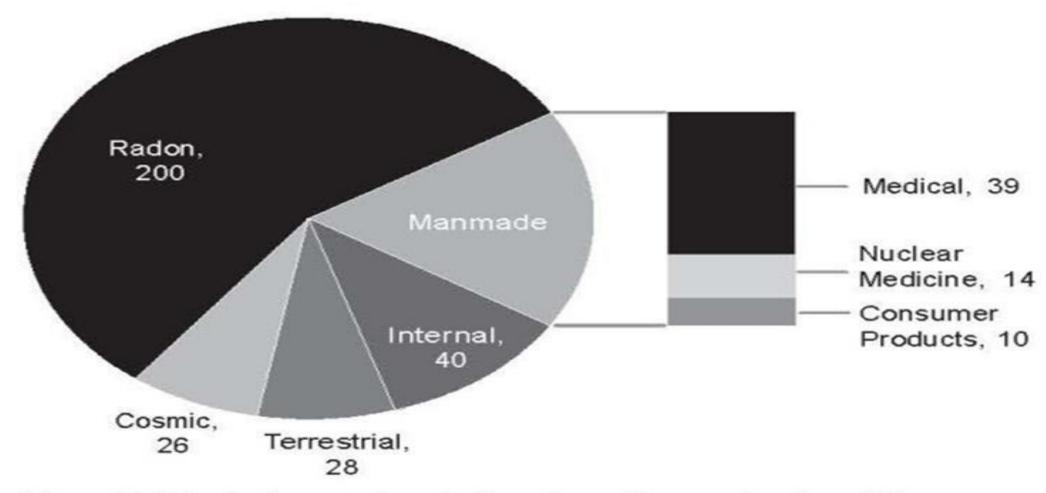


figure B-1. typical annual radiation doses from natural and Man-Made Sources (mrem). Source: NCRP Report No. 93 (NCRP 1987)

FUKUSHIMA BACKGROUND

- MARCH 2011 TSUNAMI AND EARTHQUAKE PRECIPITATE A NUCLEAR ACCIDENT IN FUKUSHIMA, JAPAN
- IN 2011, STATE AND FEDERAL AGENCIES IN ALASKA ISSUED JOINT PRESS RELEASE INDICATING SAFETY OF WILD FOODS (PLANTS AND ANIMALS)
- CONCERNS REMAIN OF FISH CONTAMINATED WITH FUKUSHIMA-RELATED RADIATION
 - AMCHITKA COLLECTIONS SHOWED LOW LEVEL ATMOSPHERIC DEPOSITION
 - TRIBAL AND NONTRIBAL CONCERNS OVER FOOD SAFETY
- DEC AND DHSS SET UP WEBSITES TO EXPLAIN RADIATION MONITORING, EXPOSURE, AND HEALTH RISK



MONITORING ALASKAN FISHES FOR RADIONUCLIDES

- COLLABORATIVE EFFORT WITH THE FDA
- FISH SPECIES WERE SELECTED BASED UPON IMPORTANCE TO:
 - SUBSISTENCE HARVEST
 - SPORT
 - AND COMMERCIAL FISHERIES
- DEC FOOD SAFETY INSPECTORS COLLECTED SAMPLES DURING ROUTINE INSPECTION
- FDA SAMPLE PROTOCOL FOOD EVALUATION PROCEDURES
- COLLECTIONS 2014 AND 2015

2016 CHANGE IN PROTOCOL

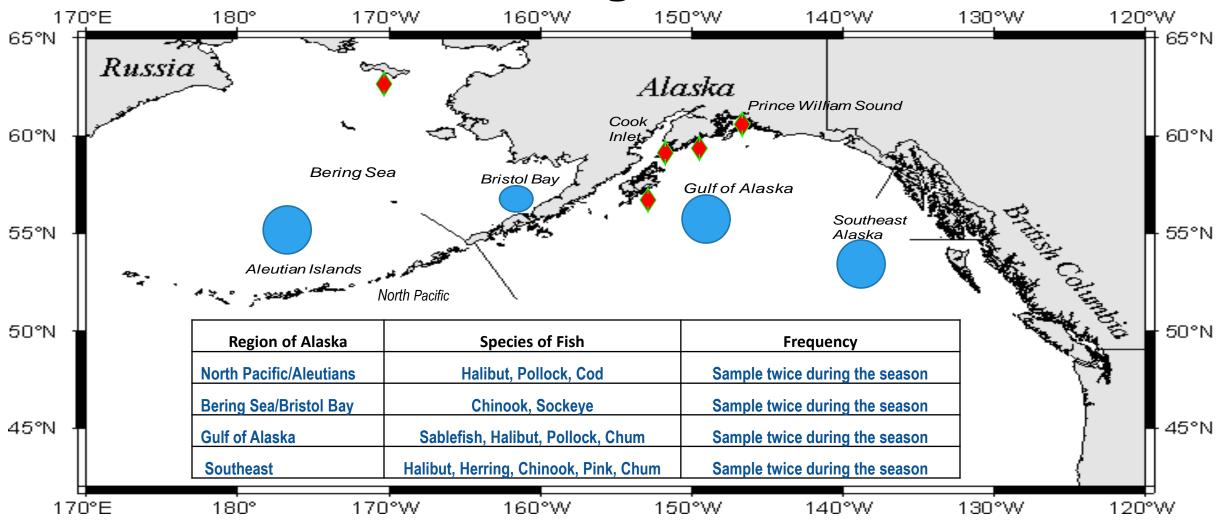
SAMPLE COLLECTION & ANALYSIS

- SAMPLES COLLECTED USING FDA STATISTICAL PROTOCOLS
- FISH SAMPLES COLLECTED FROM COMMERCIAL HARVEST SENT TO FDA LAB
 - HEAD REMOVED AND GUTTED OR FILLET TISSUE
 - HOMOGENIZED PLACED IN TO PLASTIC CONTAINER
- COMPOSITES SAMPLES (4 10 FISH PER SAMPLE) OF 4 POUNDS

- FDA STANDARD ANALYTICAL TECHNIQUES
 - HIGH RESOLUTION GAMMA SPECTROMETRY
 - RESULTS SENT TO ADEC AND POSTED



Areas Fish Were Collected for the DEC Fish Monitoring Program



Fish Samples per Region

♦ Water Sample sites —Woods Hole



FUKUSHIMA RADIATION CONCERNS IN ALASKA

HTTP://DEC.ALASKA.GOV/EH/RADIATION/INDEX.HTML



- ADEC FOOD SAFETY & SANITATION PROGRAM WEBPAGE
- BASIC BACKGROUND INFORMATION
- PUBLIC OUTREACH
- RECENT NEWS RELEASES
- FAQS
- STATE, FEDERAL, INTERNATIONAL RESOURCES INCLUDING MONITORING
- ARCHIVED NEWS



Radiation Screening: Radio-analytical Challenges

- LIMITED RADIO-ANALYTICAL CAPACITY NATIONWIDE DUE TO:
 - 1. RESOURCES REQUIRED FOR ESTABLISHING AND SUSTAINING LABORATORY INFRASTRUCTURE
 - 2. GLOBAL SHORTAGE IN RADIO-ANALYTICAL EXPERTISE

 TRADITIONAL ANALYTICAL METHODS REQUIRE SPECIAL EQUIPMENT AND LABORATORY SETTING

STANDARD LABORATORY

GAMMA-RAY DETECTION SYSTEM



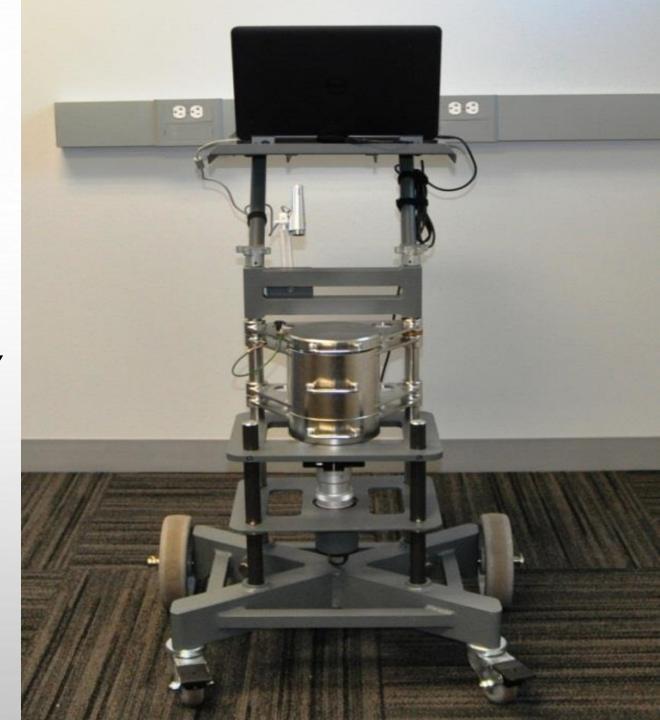
2016 PROJECT: PORTABLE GAMMA RAY DETECTOR

- LIGHT WEIGHT, MODULAR, SCALABLE, MOBILE
- FIELD USER DOES NOT NEED RADIONUCLIDE EXPERTISE
 - STURDY, ROBUST FIELD USE IN A VARIETY OF CIRCUMSTANCES
 - USER-FRIENDLY
 - LIMIT TIME AND RESOURCES REQUIRED IN THE FIELD
 - MEET DATA QUALITY OBJECTIVES FOR FOOD SAFETY
 - **DETECTION LIMITS A CONCERN** REQUIRE LONGER COUNTING TIME *** PROBLEM ***
 - HIGH QUALITY ANALYTICAL DATA (ISO 17025 COMPLIANT)
 - REAL TIME HIGH THROUGHPUT SAMPLE RESULTS
 - POTENTIALLY ALLOWING FOLLOW-UP ACTION (I.E. SAMPLE RELEASE OR INCREASED SAMPLING) IN ONE VISIT.



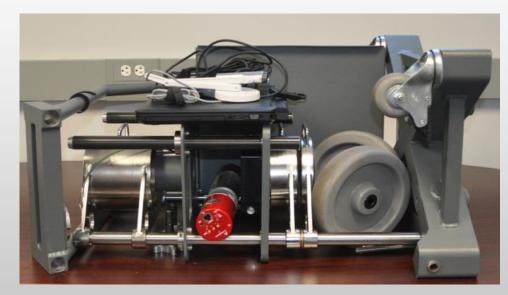


PORTABLE GAMMA-RAY ANALYSIS SYSTEM



SYSTEM PORTABILITY

- WEIGHS ~110 LBS
- ASSEMBLED IN LESS THAN TEN MINUTES
- STORED IN A 31"X21"X16" AREA (CAR TRUNK)



- LARGE BACK WHEELS PROVIDE EASY MOBILITY
- THE TEMPERATURE STABILIZED CERIUM BROMIDE DETECTOR PROVIDES ROBUST MEASUREMENT CAPABILITIES WITHOUT THE NEED FOR COOLING
- THE UNIT IS BATTERY POWERED BY THE LAPTOP PC'S USB PORT



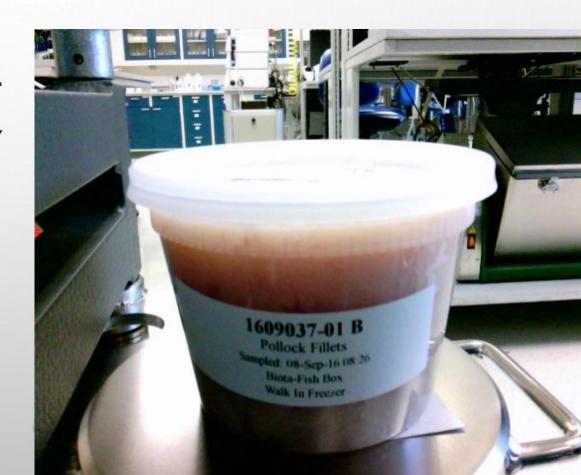
2016 FUKUSHIMA-RELATED RADIONUCLIDE TESTING

FISH SPECIES TESTED

- KING SALMON
- CHUM SALMON
- SOCKEYE SALMON
- PINK SALMON
- HALIBUT
- POLLOCK
- SABLEFISH
- HERRING
- PACIFIC COD

RADIONUCLIDES TESTED

- IODINE-131
- CESIUM-134
- **CESIUM-137**





Radionuclide Data Alaskan Fish (Bq/kg)

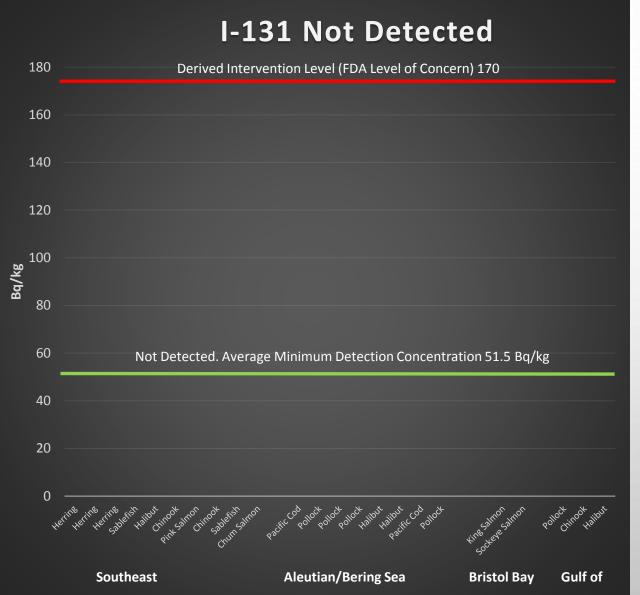
* MDC (Minimum Detection Concentration)

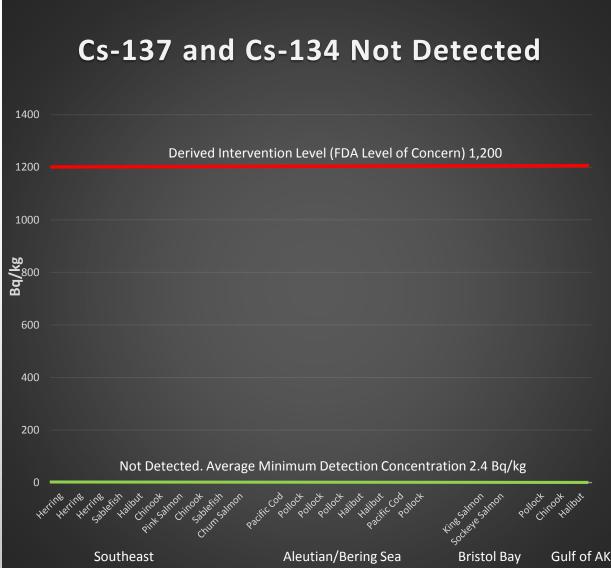
Area	Fish	I-131	*MDC	Cs-134	*MDC	Cs-137	*MDC	
	Pollock	ND	3.55	ND	2.12	ND	2.06	
	Pollock	ND	3.41	ND	1.88	ND	1.77	
Aleutian/ Bering Sea	Pollock	ND	5.92	ND	2.07	ND	1.74	
Dernig Sea	Pollock	ND	3.86	ND	2.56	ND	1.97	
	Halibut	ND	3.31	ND	1.81	ND	1.67	
	Sablefish	ND	2.11	ND	1.96	ND	1.68	
Gulf of	Sablefish	ND	2.72	ND	2.31	ND	1.86	
Alaska	Halibut	ND	2.67	ND	2.13	ND	1.94	
	Halibut	ND	2.34	ND	1.75	ND	1.51	

FDA's Derived Intervention Levels (DILs) for Each Radionuclide Group for Food in Domestic Commerce and Food

Radionuclide Group	DIL (Bq/kg)
lodine-131	170
Cesium-134 + Cesium-137	1200

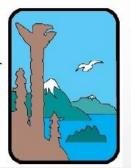
NO DETECTABLE LEVELS OF FUKUSHIMA-RELATED RADIONUCLIDES





ACKNOWLEDGMENTS







LASKA SEAFOOD













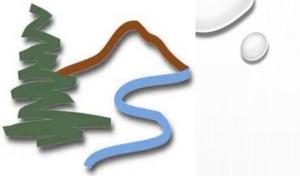












Questions?

• CONTACTS FOR THE FISH TISSUE MONITORING PROGRAM

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