

# **NIST's role in marine mammal tissue banking, contaminant analysis, and development of measurement standards**

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## NIST:

- Founded in 1901 as the National Bureau of Standards (NBS), is the National Metrology Institute for the U.S. (NBS became NIST in 1988)
- Part of US Department of Commerce and headquartered in Gaithersburg, MD
- Mission ...to promote U.S innovation and industrial competitiveness by **advancing measurement science, standards, and technology** in ways that enhance economic security and improve the quality of life

## NIST at the HML: (established by 1995 agreement between NIST and NOAA):

- Improve the quality of marine chemical environmental measurements through **analytical methods development & application & quality assurance** activities
- Provide environmental **specimen banking** infrastructure
- Conduct **collaborative** interdisciplinary research



# ***NIST Facilities at the HML***

- Organic Analytical Laboratory (2,260 ft<sup>2</sup>)
- Inorganic Analytical Laboratory (1,760 ft<sup>2</sup>)
- Nuclear Magnetic Resonance Facility (5,600 ft<sup>2</sup>)
- Environmental Specimen Bank ( 2,600 ft<sup>2</sup>)  
co-located
- Reference Material Production Facility (900 ft<sup>2</sup>)



## ***NIST staff at the HML:***

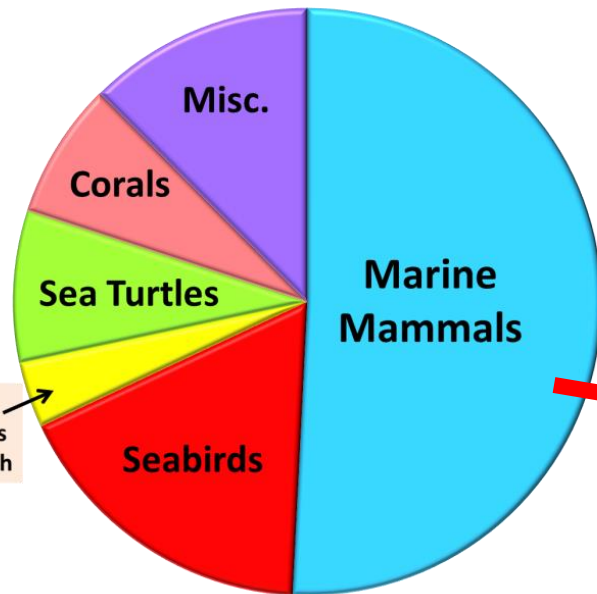
28 + 1 stationed in Hawaii + 1 Visiting Researcher



# Marine Environmental Specimen Bank



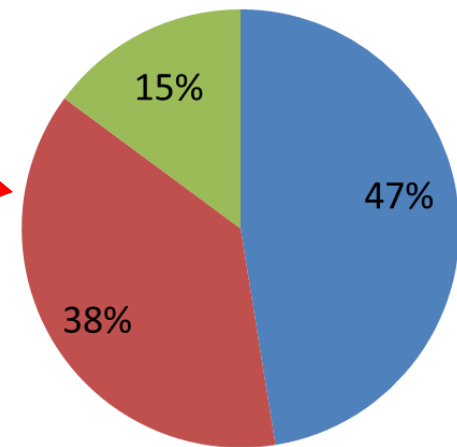
## National Marine Mammal Tissue Bank (Public Law 102-587; 1992)



Number of Specimens = 13,149  
Number of Aliquots = 90,508

### Marine Mammal Specimens

- Stranding/By-Catch/Subsistence
- Health Assessments
- DWH Chain-of-Custody



Specimens = 6,680; Aliquots = 53,993

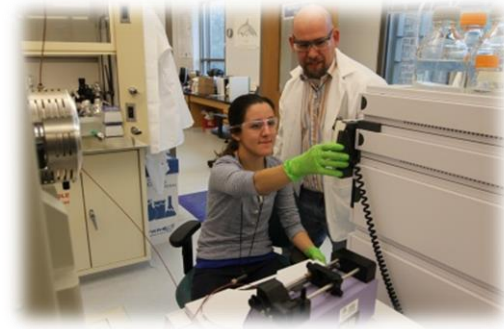
# ***Contaminant Analysis***

- **Legacy organic contaminants** (PCBs, toxaphene, DDTs, chlordanes, mirex, HCHs, & chlorobenzenes, etc.)
- **Chemicals of emerging concern** (perfluorinated acids, brominated flame retardants, phthalates, phosphate flame retardants, etc.)
- **Screening for other chemicals** - identify compounds missed by traditional analytical techniques
- **Heavy metals & trace elements**, including speciation
- **Element stable isotopes** – contaminant source tracking; ecological process studies

# ***Developing chemical methods for assessing environmental stress & disease state***

- **Hormone screening** (cortisol, testosterone, androstenedione, progesterone, 17-oh-progesterone, adrenosterone, and 11-deoxycortisol)
- **Metabolomics (NMR-based)** - develop metabolic biomarkers for assessing the effects of stressors on marine organisms.
- **Lipidomics** – examine lipidome using mass spectrometry for application to wildlife health and environmental research (*apply the lipidomics technique to dolphin populations with varying contaminant exposure histories*)
- **Identify & characterize new endocrine disrupting compounds displaying receptor agonistic or antagonistic activity**

# Quality Assurance for Chemical Measurements



- Develop Standard Reference Materials (SRMs) & Research Materials for chemical measurements



- Coordinate interlaboratory comparison exercises:  
**Persistent organic contaminants & trace elements (MMHSRP)**

1991-97 = 7 TE & 10 Organic (2-40 labs)

## Metabolomics

2010 = 7 labs

## Petroleum-related compounds

2010 - sediments = 33 labs

2010 – oil samples = 26 labs

2011 – mussels = 34 labs

2011 – spiked blood = 6 labs

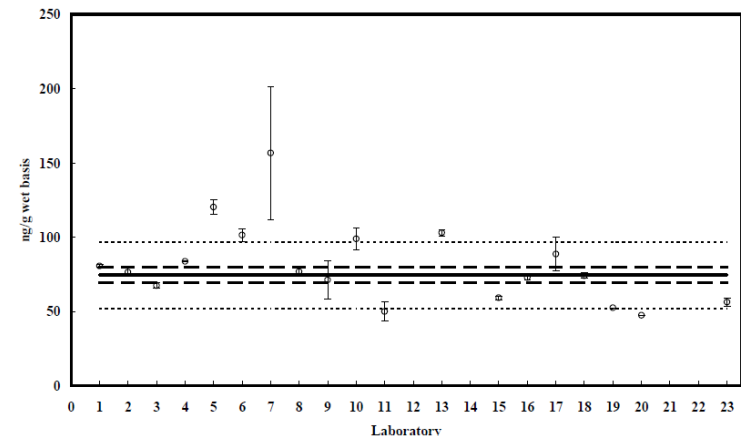
PCB 118

Value = 74.6 ng/g  $\pm$  5.1 ng/g (wet basis)

Reported Results: 19

SRM 1945

— Certified or Reference Value  
- - - Uncertainty  
- - - = 30 % of Certified or Reference Value



# *Development of Protocols & Standard Procedures*

- ❖ For sample collections & banking
- ❖ For chemical analysis

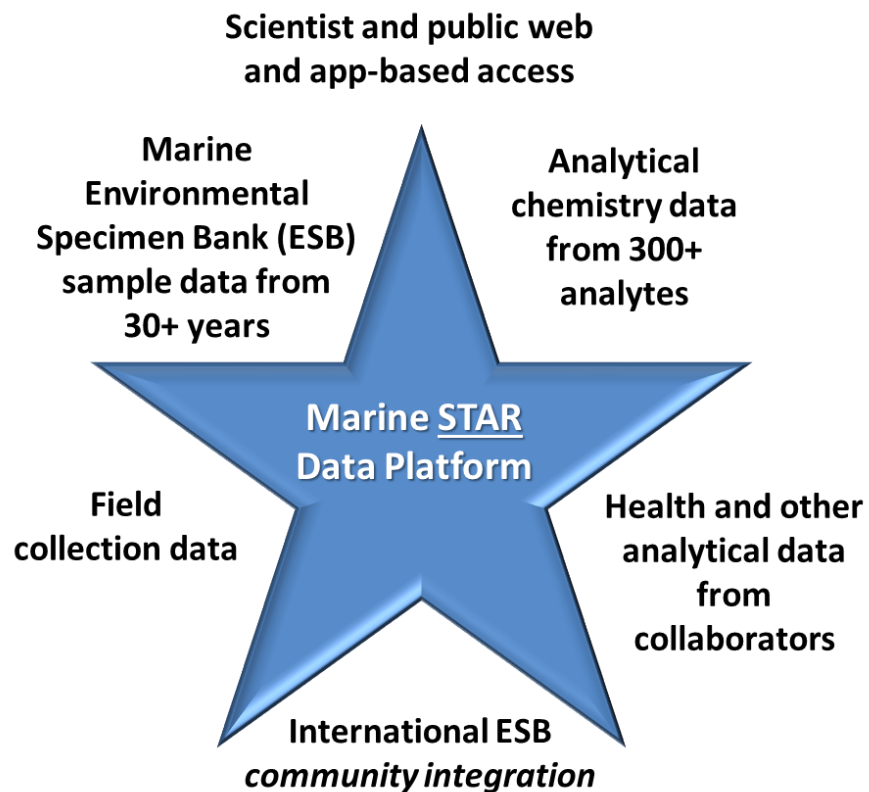
- **Live capture & dart biopsy operations** (collections for contaminant analysis)
- **New matrices & new applications of banked samples:**
  - **Genomics** (RNA stability in banked samples)
  - **Metabolomics** (collection protocols; stability of banked samples)
- **Future:**
  - Banking for **infectious disease**
  - Banking for **biotoxin exposure**





# ***Marine Sample Tracking & Analytical Reporting (STAR) database***

***In Development***



Combine the current 30+ years of Marine Environmental Specimen (ESB) sample data and analytical chemistry data from NIST with sample metadata and other analytical and health data generated by collaborators into a publicly accessible database via web and possibly app interfaces to allow greater accessibility and knowledge

# Marine Sample Tracking & Analytical Reporting

Scientist and public web and app-based access

Marine Environmental

Analytical chemistry data from 300+ analytes



## Marine Mammal Health M.A.P. A Conceptual Framework

The VISION for Marine Mammal Health MAP is a cost effective, collaborative, and user-friendly health mapping system that will facilitate and advance the detection of new diseases and tracking of trends in marine mammal health at varying scales and from various sources and provide a platform for rapid communication and integrated ecosystem-based analyses of marine mammal health data with physical, chemical, and biological environmental data.

Data Sources:

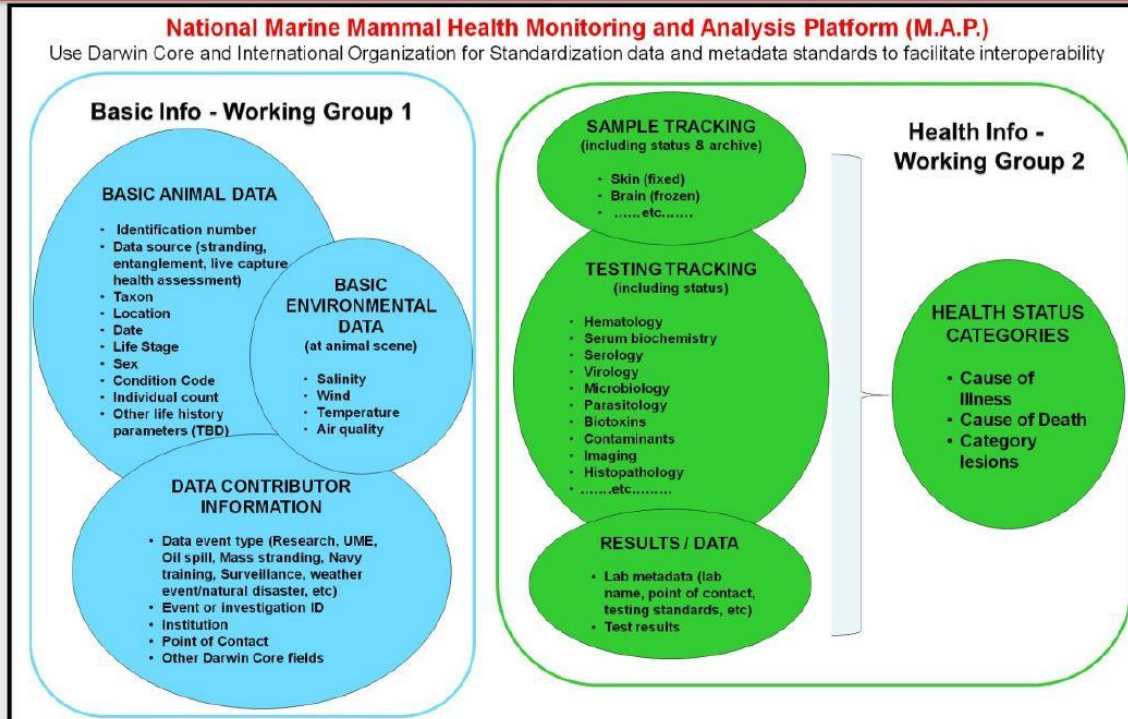


Data Collation:

**Data Diplomats at 5 regional nodes collate and QA/QC data entry**  
(West Coast, East Coast, Alaska, Gulf of Mexico, Pacific Islands)

Health and other analytical data from collaborators

Platform:



on

men  
sample

possibly

# ***Acknowledgments***

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## **Primary Collaborators & Partners:**

**NOAA (NOAA Fisheries OPR, NWFSC, PIFSC, SWFSC, Pacific Islands Region, & Alaska Region; NOS NCCOS CCEHBR), Sarasota Dolphin Research Project, Medical University of South Carolina, The Marine Mammal Center, Alaska SeaLife Center, North Slope Borough, Aleut Community of St. Paul Island Tribal Government, Georgia Aquarium, Shedd Aquarium, Mystic Aquarium, Alaska Veterinary Pathology Services, Hawaii Pacific University, Hawaii Marine Mammal Consortium, Dolphin Quest**