

# Global Ocean Observation System and Essential Salmon Ocean Ecology Variables

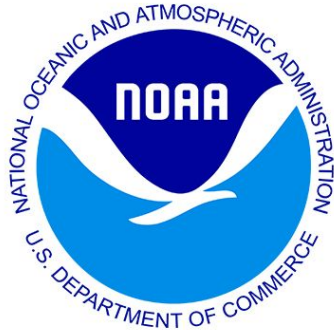


Brett Johnson, Ray Brunsting, Brian Hunt, Eric  
Peterson, Mark Saunders

“The biggest barrier to salmon science is the lack of access to standardized data”

- Rapid Ecosystem Changes and Technological Developments
- Multiple Scales of Siloed of Data
- UN’s Global Ocean Observation System
- A Modern Framework of FAIR Data
- Extending the GOOS Framework into Salmon Ocean Ecology
- Canadian Integrated Ocean Observation System
- International Year of the Salmon Ocean Observation System
- Barriers to Data Mobilization and Standardization
- Integration with Parallel Efforts

# ACKNOWLEDGEMENTS

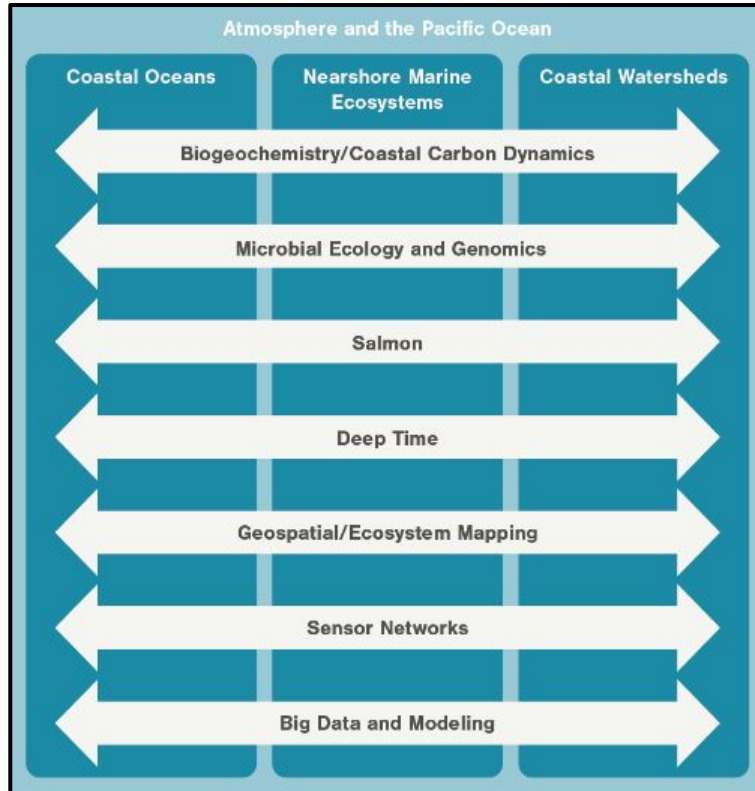


Fisheries  
Canada

Pêches et Océans  
Canada



# WHO OR WHAT IS THE HAKAI INSTITUTE?



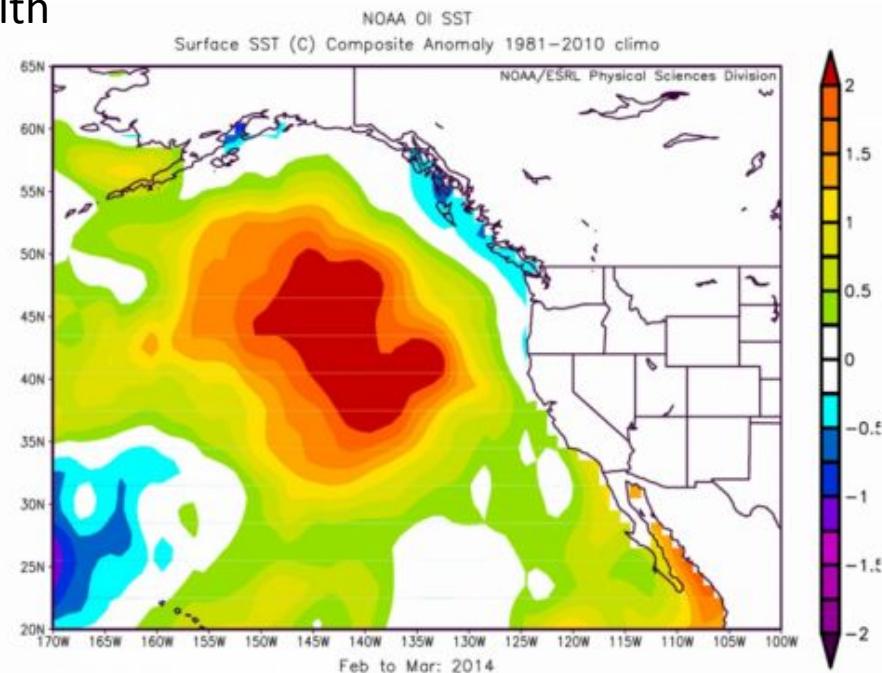
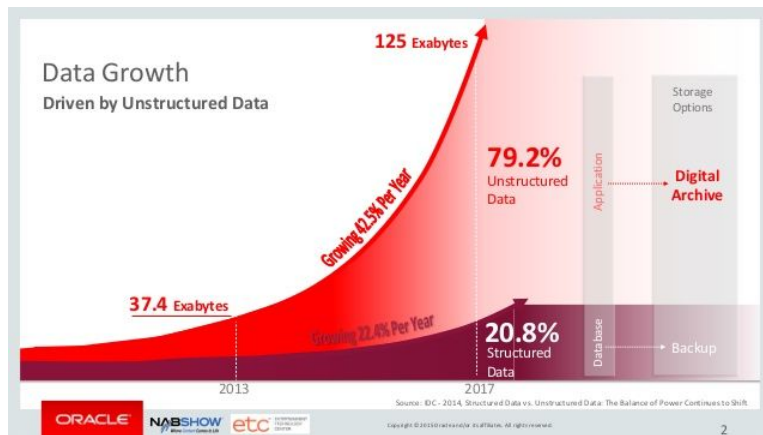
- Independent Research Institute
- Recently partnered with IYS and NPAFC on Data Mobilization

[www.hakai.org](http://www.hakai.org)



# ECOSYSTEM AND TECHNOLOGICAL CHANGES

- Unprecedented Ecosystem Changes
  - Our jobs: assess and predict the health of our ecosystems and stocks
- Synoptic Ecosystem Surveys
  - Expensive. Expect obs. to lead to actionable management scenarios
- Meanwhile we're drowning in data





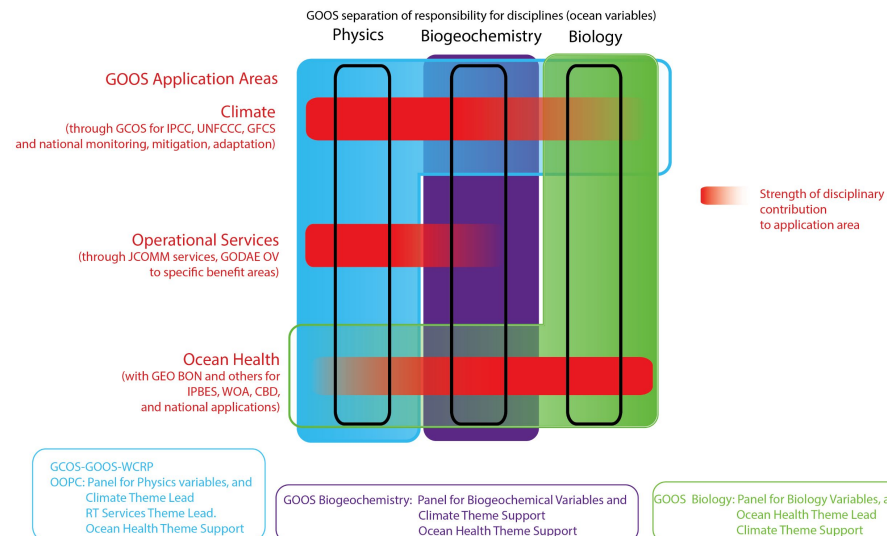
# SILOS OF KNOWLEDGE

- Little access to standardized data
- Implementation of information systems languishes
- National, international, and regional and even agency/institutional silos
- But also temporal silos
  - Data rescue!
- Data integration takes months, or years
  - Climate change is happening yesterday and right now



# GLOBAL OCEAN OBSERVATION SYSTEM - GOOS

- GOOS is executed by the Intergovernmental Oceanographic Commission (IOC) of the United Nations (UNESCO)
- Essential Ocean Variables
  - Physical
  - Biogeochemical
  - Biological and Ecosystems



# GOOS BioEco PANEL



Biology & Ecosystems Panel

The Global Ocean Observing System



OCEAN BIOGEOGRAPHIC  
INFORMATION SYSTEM



This collaboration between GOOS BioEco, OBIS and GEOBON MBON will build a unified and globally consistent observing system that will: strengthen the three initiatives; make use of the best available resources; share expertise; and ensure compatibility between outputs and advice from the three initiatives.



Darwin Core

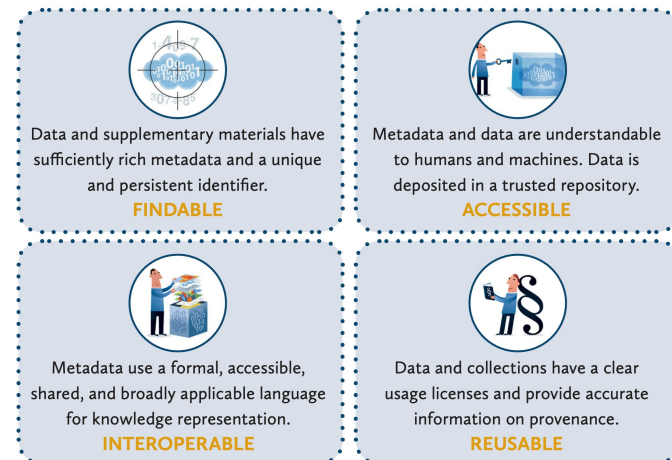
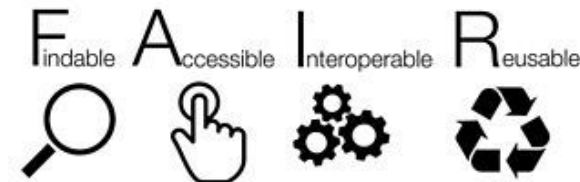
# MBON

Marine Biodiversity  
Observation Network



# FAIR DATA

- **Findable** - Use a metadata standard
- **Accessible** - Make your data open
- **Interoperable** - Use controlled vocabularies. Requires use a formal, accessible, shared, and broadly applicable language for knowledge representation. (Ontology).
- **Reusable** - This is the whole point
  - Meta(data) are richly described with a plurality of accurate and relevant attributes
  - (Meta)data are released with a clear and accessible data usage license
  - (Meta)data are associated with detailed provenance
  - (Meta)data meet ***domain-relevant community standards***



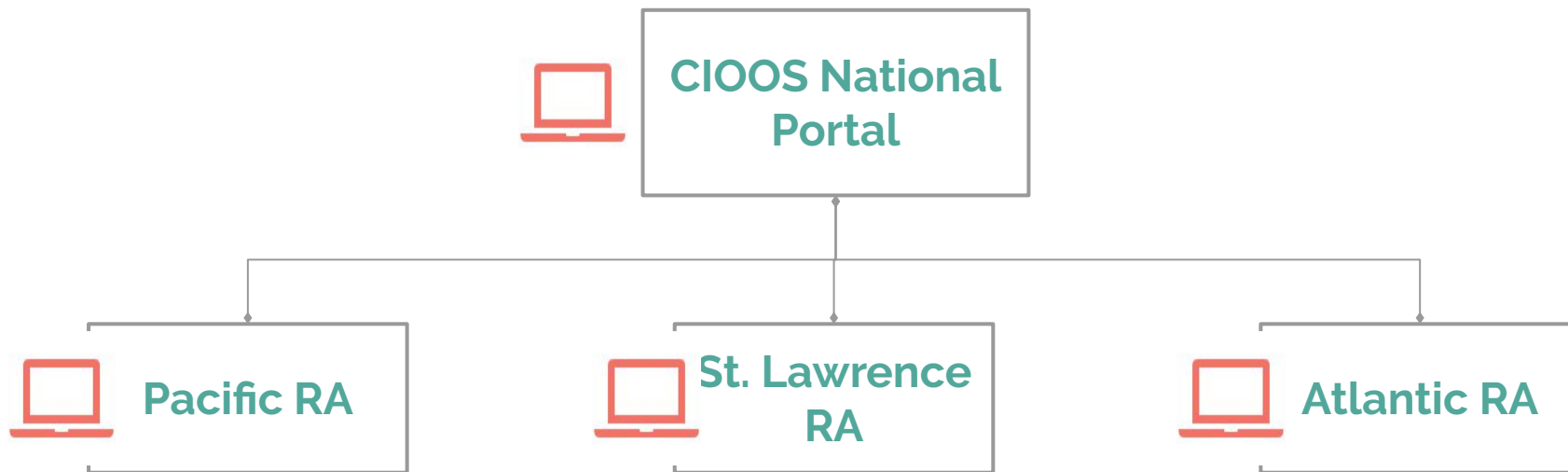
# OBJECTIVE: EXTEND GOOS TO SALMON BioEco

- What are the Essential Salmon Ocean Ecology Variables?
- Define those measurements by developing internationally recognized:
  - metadata standards, controlled vocabularies, and ontologies
  - Standard data structures and formats
- Challenges:
  - No one has time to re-transform their data
  - The need for your special data structure for your special tools
  - National Databases unlikely to change

BIOLOGY AND ECOSYSTEMS
Phytoplankton biomass and diversity
Zooplankton biomass and diversity
Fish abundance and distribution
Marine turtles, birds, mammals abundance and distribution
Hard coral cover and composition
Seagrass cover and composition
Macroalgal canopy cover and composition
Mangrove cover and composition
Microbe biomass and diversity (*emerging)
Invertebrate abundance and distribution (*emerging)

# CANADIAN INTEGRATED OCEAN OBSERVING SYSTEM

- Federated Approach
- Relies on Partnerships
- Common Technology Stack



# METADATA PROFILE AND CKAN CATALOGUE

- CIOOS Metadata Profile Based on:
  - ISO 19115-3, Harmonized North American Protocol
- Data Catalogue CKAN - Comprehensive Knowledge Archive Network

The screenshot displays the CIOOS Pacific Data Catalogue CKAN interface. The header includes the CIOOS Pacific logo and navigation links: HOME, ABOUT, APPLIED DATA, DATA TOOLS, and DATA CATALOGUE. The main content area shows search results for 'Ocean Variables' with a filter for 'Inorganic Carbon'. The results list several datasets, including 'Alutiiq Pride Shellfish Hatchery Burke-o-Lator data', 'Burke-o-Lator at Ketchikan Shellfish Hatchery', 'Hyacinthe Bay, BC Burke-o-Lator data', and 'Fanny Bay Oysters Burke-o-Lator data'. Each dataset entry includes a brief description and a link to the HTML view.

**CIOOS PACIFIC**  
REGIONAL ASSOCIATION OF THE  
CANADIAN INTEGRATED OCEAN OBSERVING SYSTEM

HOME ABOUT APPLIED DATA DATA TOOLS **DATA CATALOGUE**

/ Catalogue / Datasets

Filter by location Clear

Search datasets...

6 datasets found Order by: Relevance

Ocean Variables: Inorganic Carbon

**Alutiiq Pride Shellfish Hatchery Burke-o-Lator data**  
The Burke-o-Lator (BoL) pCO<sub>2</sub>/TCO<sub>2</sub> analyzer measures carbon dioxide partial pressure (pCO<sub>2</sub>) and total dissolved inorganic carbon (TCO<sub>2</sub>) both continuously from a flow-through...  
[HTML](#)

**Burke-o-Lator at Ketchikan Shellfish Hatchery**  
The Burke-o-Lator (BoL) pCO<sub>2</sub>/TCO<sub>2</sub> analyzer measures carbon dioxide partial pressure (pCO<sub>2</sub>) and total dissolved inorganic carbon (TCO<sub>2</sub>) both continuously from a flow-through...  
[HTML](#)

**Hyacinthe Bay, BC Burke-o-Lator data**  
The Burke-o-Lator (BoL) pCO<sub>2</sub>/TCO<sub>2</sub> analyzer measures carbon dioxide partial pressure (pCO<sub>2</sub>) and total dissolved inorganic carbon (TCO<sub>2</sub>) both continuously from a flow-through...  
[HTML](#)

**Fanny Bay Oysters Burke-o-Lator data**  
The Burke-o-Lator (BoL) pCO<sub>2</sub>/TCO<sub>2</sub> analyzer measures carbon dioxide partial pressure (pCO<sub>2</sub>) and total dissolved inorganic carbon (TCO<sub>2</sub>) both continuously from a flow-through...  
[HTML](#)

**Map data** © OpenStreetMap contributors  
Tiles by Stamen Design (CC BY 3.0)

**Ocean Variables**

Inorganic Carbon 6

Sub Surface Salinity 6

Sub Surface Tempera... 6

**Responsible Organization**

Hakai Institute 6

Alutiiq Pride Shell... 1

Dakunalytics 1

NOAA 1

OceansAlaska 1

Oregon State Univer... 1

Sitka Tribe of Alaska 1

- ERDDAP - Data Access Protocol
  - Developed by NOAA's Bob Simons
  - Looks like it's from the 80's but is amazing and open source

The screenshot shows the ERDDAP Data Access Form for the dataset titled "The List of All Active Datasets in this ERDDAP". The form includes a list of variables on the left, two columns of optional constraints (Constraint #1 and Constraint #2), and a section for minimum and maximum values or a list of values. The variables list includes datasetID, accessible, institution, dataStructure, cdm\_data\_type, class, title, minLongitude, maxLongitude, longitudeSpacing, minLatitude, maxLatitude, latitudeSpacing, minAltitude, maxAltitude, minTime, maxTime, timeSpacing, griddap, subset, tabledap, and MakeAGraph. The optional constraints section has two columns, each with a dropdown menu for selecting a constraint type. The minimum and maximum section has input fields for values and a dropdown menu for selecting a constraint type.

**ERDDAP**  
Easier access to scientific data

**ERDDAP > tabledap > Data Access Form**

Dataset Title: \* **The List of All Active Datasets in this ERDDAP** \* [RSS](#)

Institution: Hakai Institute (Dataset ID: allDatasets)

Information: [Summary](#) | [License](#) | [Metadata](#) | [Background](#) | [Subset](#) | [Make a graph](#)

☒ datasetID [?](#) ☒ accessible [?](#) ☒ institution [?](#) ☒ dataStructure [?](#) ☒ cdm\_data\_type (Common Data Model Type) [?](#) ☒ class (ERDDAP Class) [?](#) ☒ title [?](#) ☒ minLongitude (Minimum Longitude, degrees\_east) [?](#) ☒ maxLongitude (Maximum Longitude, degrees\_east) [?](#) ☒ longitudeSpacing (degrees\_east) [?](#) ☒ minLatitude (Minimum Latitude, degrees\_north) [?](#) ☒ maxLatitude (Maximum Latitude, degrees\_north) [?](#) ☒ latitudeSpacing (degrees\_north) [?](#) ☒ minAltitude (Minimum Altitude or -Depth, m) [?](#) ☒ maxAltitude (Maximum Altitude or -Depth, m) [?](#) ☒ minTime (Minimum Time, UTC) [?](#) ☒ maxTime (Maximum Time, UTC) [?](#) ☒ timeSpacing (seconds) [?](#) ☒ griddap [?](#) ☒ subset (URL of Subset Web Page) [?](#) ☒ tabledap [?](#) ☒ MakeAGraph (URL of Make-A-Graph Web Page) [?](#)

**Optional Constraint #1**

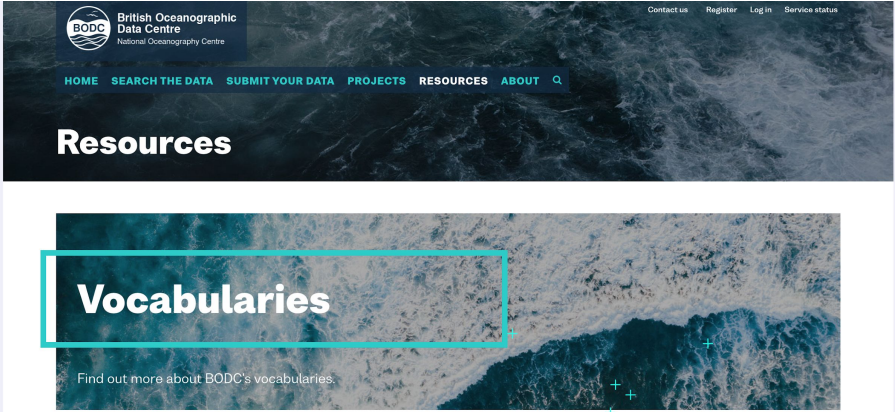
**Optional Constraint #2**

**Minimum** [?](#) **Maximum** [?](#)  
or a List of Values [?](#)



# CONTROLLED VOCABULARY SERVER

- British Oceanographic Data Centre
  - Various Controlled Vocabularies are hosted on the NERC Server
- There's no vocabularies that define fork length :(



British Oceanographic Data Centre  
National Oceanography Centre

HOME SEARCH THE DATA SUBMIT YOUR DATA PROJECTS RESOURCES ABOUT

## Resources

### Vocabularies

Find out more about BODC's vocabularies.

Resources > Vocabularies > Vocabulary search

## Vocabulary search help

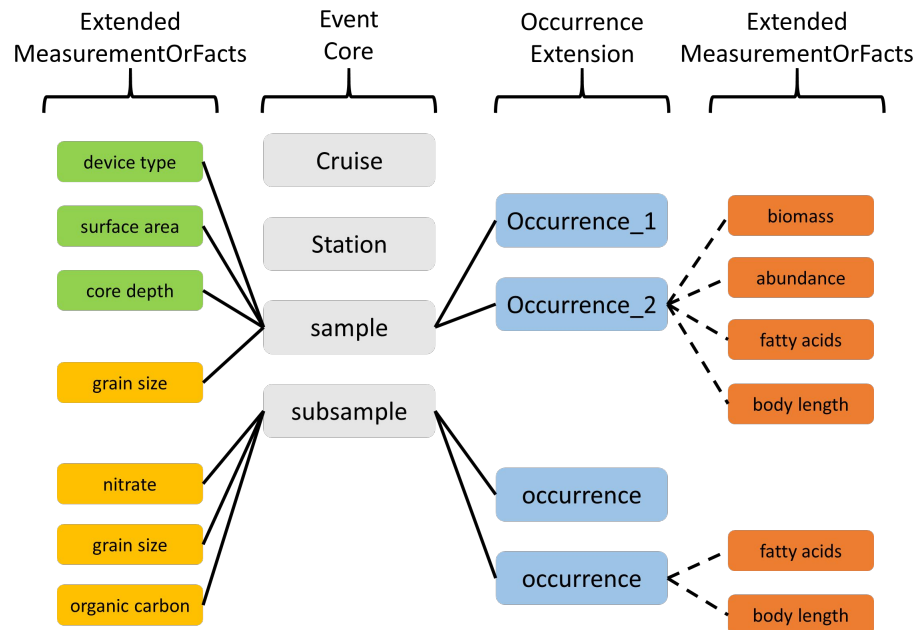
You searched for "fork length"

0 records found

# DARWIN CORE DATA SCHEMA

- Three tables only
  - Event Table
  - Occurrence Table
  - Measurements or Facts Table
- `Events` lead to `Occurrences` which have `Measurements or Facts`
- Accurately represents how ecologists work
- The ultimate `Long` or `Tidy` format

## OBIS-ENV Format



**Hakai**  
*Science on the Coastal Margin*

# GOOS Network Graph

- UN Decade of Ocean Science
- NOAA NWFS Stop-Light Chart
  - Lists many essential variables
- Modelling should inform essential variables
  - IBMs, Life History Stages, Ecosystem Based
- Other Efforts?



# INTERNATIONAL YEAR OF THE SALMON OOS

## Proximal Goal:

- My fun job is to integrate data from Pan Pacific High Seas Cruises 2019-2021
- North Pacific Anadromous Fish Commission Data Standards Group
- Define International Salmon Data Exchange Format



# THANK YOU

- Questions, Suggestions, Comments

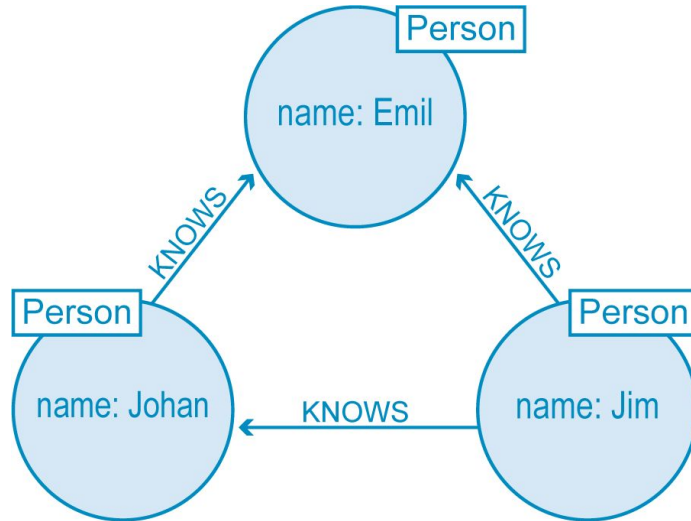




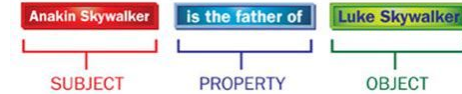
# SEMANTIC WEB (GRAPH THEORY)

Ultimate goal:

- To leverage machine intelligence: adopt recommendations from the World Wide Web Consortium (W3C) to bake our data model into the fabric of the world-wide-web



## How Semantic Web Works



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