



**NOAA
FISHERIES**

Alaska
Fisheries
Science
Center

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Developing and deploying
web-based tools to
visualize marine animal
movement data and explore
abundance and trend of
pinniped populations

19 November 2015

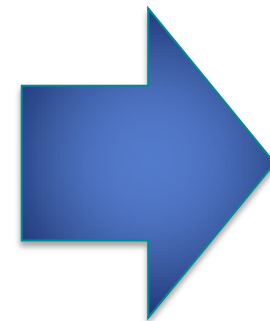
Alaska Fisheries Science Center developing Shiny web applications



Typical Information Flow

Data Collection & Research Initiatives

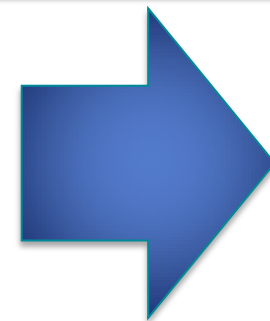
- Legislative and Regulatory Mandates
- Science and Conservation



Typical Information Flow

Data Analysis and Interpretation

- Big(ger) Data
- Highly Technical, Cutting Edge Statistics



Typical Information Flow

Publication

- Peer Reviewed Journals
- White Papers, Internal Memos, Contract Reports
- Status Reviews, Stock Assessment Reports

Analytical Deliverables

Deliverables are ...

- Static
- Often, Highly Technical

Should **also** be ...

- Interactive
- Flexible

The Modern Internet is Highly Interactive
(e.g. Google Maps, Online Banking)

The Public Expects Similar Interactivity from
Government Deliverables & Results

Shiny – It's R, It's Reactive, It's the Web

A blue rectangular graphic with a diagonal line pattern. The word "Shiny" is written in large white font, with "by RStudio" in smaller white font below it. Underneath, the text "A web application framework for R" is written in white, followed by "Turn your analyses into interactive web applications" and "No HTML, CSS, or JavaScript knowledge required" in a smaller white font.

Shiny
by RStudio

A web application framework for R

Turn your analyses into interactive web applications
No HTML, CSS, or JavaScript knowledge required

<http://shiny.rstudio.com>

Shiny – It's R, It's Reactive, It's the Web

Here is a Shiny app

Shiny apps are easy to write. No web development skills are required.

Number of bins in histogram (approximate):

20

Show individual observations

Show density estimate

Geyser eruption duration

Density

Duration (minutes)

ui.R server.R

```
shinyUI(bootstrapPage(  
  selectInput(inputId = "n_breaks",  
    label = "Number of bins in histogram (approximate):",  
    choices = c(10, 20, 35, 50),  
    selected = 20),  
  
  checkboxInput(inputId = "individual_obs",  
    label = strong("Show individual observations"),  
    value = FALSE),  
  
  checkboxInput(inputId = "density",  
    label = strong("Show density estimate"),  
    value = FALSE),  
  
  plotOutput(outputId = "main_plot", height = "300px"),  
  
  # Display this only if the density is shown  
  conditionalPanel(condition = "input.density == true",  
    sliderInput(inputId = "bw_adjust",  
      label = "Bandwidth adjustment:",  
      min = 0.2, max = 2, value = 1, step = 0.2)  
  )  
))
```

<http://shiny.rstudio.com>

Shiny – It's R, It's Reactive, It's the Web

Lake Erie Biological Station - Western Basin Trawl Survey

BETA VERSION STATEMENT: This data exploration tool is intended for use by Lake Erie fisheries managers, academia, the fishing industry and the public. The data presented here have been checked for accuracy, but are still considered provisional at this time. You may request a subset of the data by contacting us directly via email. Please send questions, comments, suggestions for improvements, and error reports via email to USGS - Lake Erie Biological Station c/o Richard Kraus (rkraus@usgs.gov) and/or Taylor Stewart (rstewart@usgs.gov). The current web location for this tool is temporary and it will be hosted on a USGS server as soon as a suitable one can be located.

Lake Erie Western Basin Map

Life Stage: All Life Stages

Available Life Stages for Yellow Perch:
(All Life Stages, Age 1, Age 2+, YOY)

[Download Plot Data](#)

Hover over point to display station number and detailed value for each plot.

2014 Autumn Yellow Perch
Number per Hectare Swept

2014 Autumn Yellow Perch
Kilogram per Hectare Swept

Spatial distribution of 2014 Autumn Yellow Perch density (N/ha) (top) and biomass (Kg/ha) (bottom) from bottom trawl samples collected in the western basin of Lake Erie. Symbol sizes are directly proportional to the values plotted, but are truncated at 2000 (N/ha) or 200 (Kg/ha) to be inclusive of all values greater. Hollow circles represent station localities.

Diagnostics for simple linear regression

Select a trend:

- Linear up
- Linear down
- Curved up
- Curved down
- Fan-shaped

Show residuals

This applet uses ordinary least squares (OLS) to fit a regression line to the data with the selected trend. The applet is designed to help you practice evaluating whether or not the linear model is an appropriate fit to the data. The three diagnostic plots on the lower half of the page are provided to help you identify undesirable patterns in the residuals that may arise from non-linear trends in the data.

Rate this applet
View code
Check out other apps
Want to learn more for free?

Regression Model
($R = 0.8597$, $R\text{-squared} = 0.7391$)

Residuals vs. Fitted Values

Histogram of Residuals

Normal Q-Q Plot of Residuals

Movie explorer

Filter

Minimum number of reviews on Rotten Tomatoes: 10

Year released: 1911 - 2014

Minimum number of Oscar wins (all categories): 0

Dollars at Box Office (millions): 0 - 800

Genre (a movie can have multiple genres): All

Director name contains (e.g., Miyazaki):

Cast names contains (e.g., Tom Hanks):

X-axis variable: Tomato Meter

Y-axis variable: Number of reviews

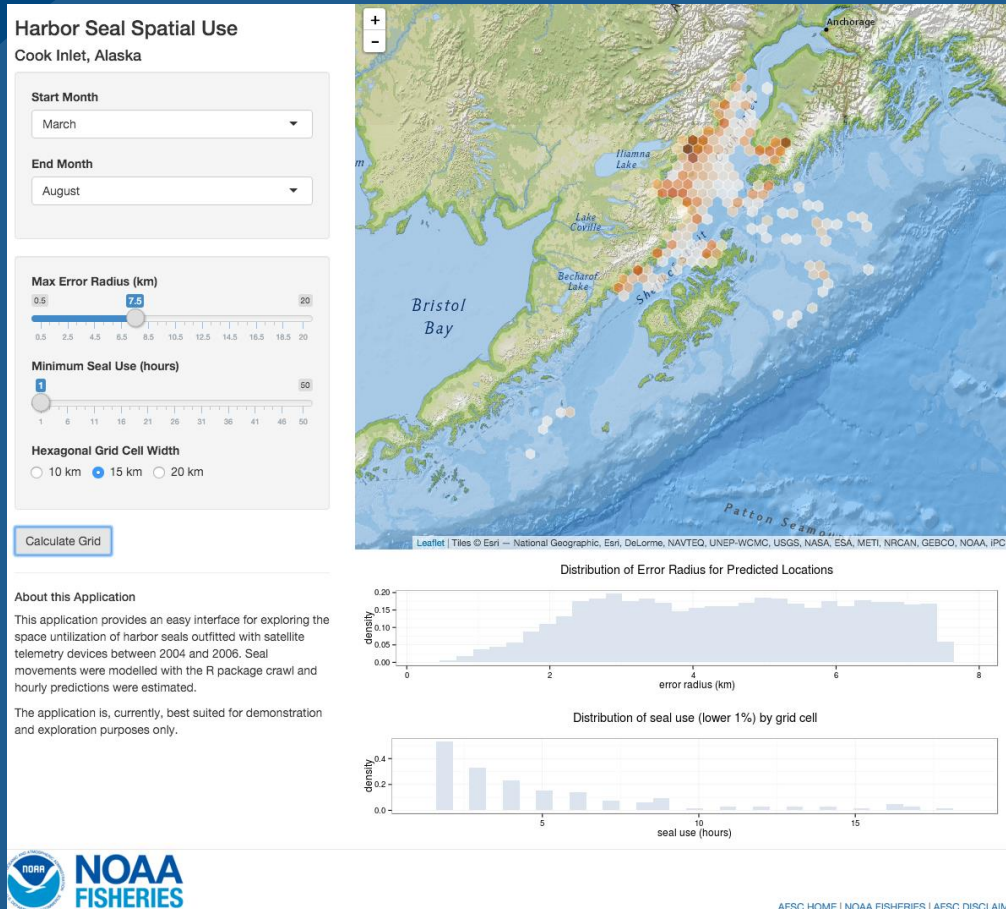
Number of movies selected: 2557

Note: The Tomato Meter is the proportion of positive reviews (as judged by the Rotten Tomatoes staff), and the Numeric rating is a normalized 1-10 score of those reviews which have star ratings (for example, 3 out of 4 stars).



Demo: Harbor Seal Spatial Use

<https://jmlondon.shinyapps.io/akpv-cookinlet-app>



Shiny Application – Spatial Use of Harbor Seals in Cook Inlet, Alaska

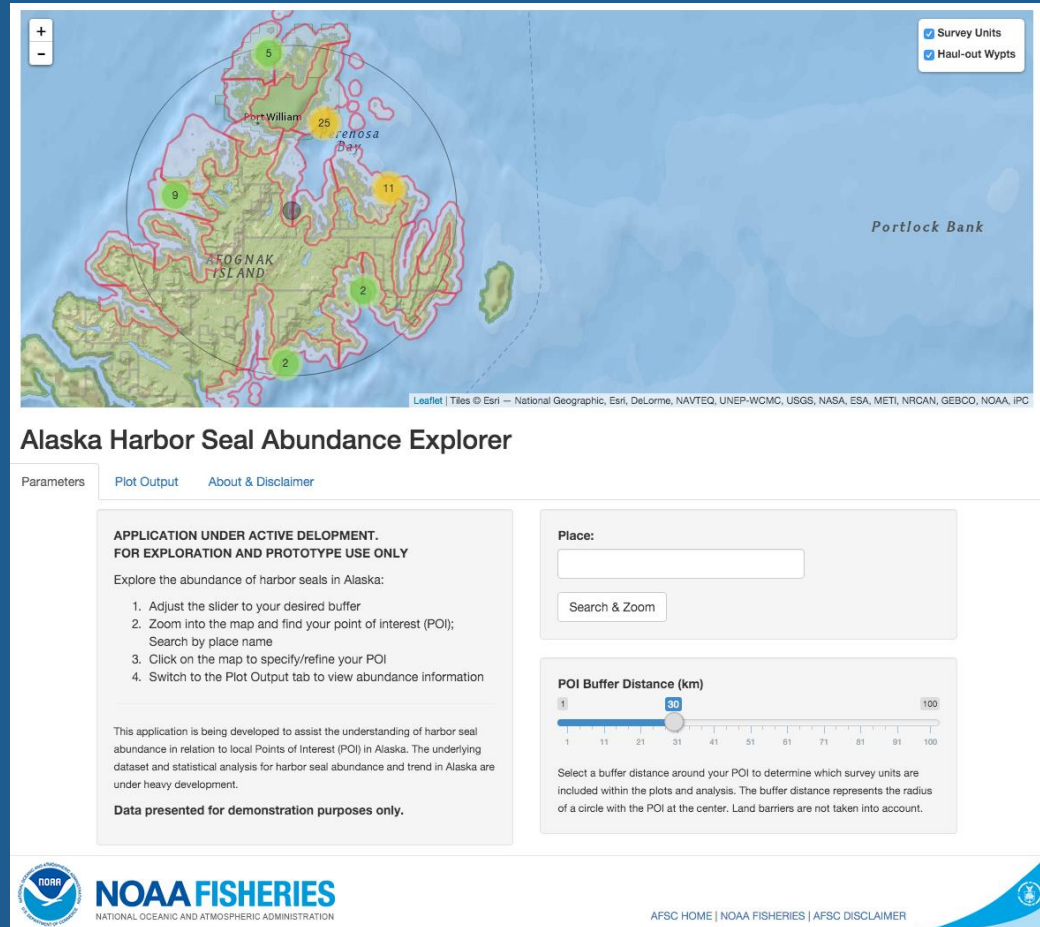
- BOEM/NOAA Collaboration
- Impacts of Oil & Gas Activities
- Incidental Take Authorizations (PR1)
- Built on R-package, *crawl*

Harbor Seal Surveys

<https://jmlondon.shinyapps.io/akpvsurveys-app>

Shiny Application – Abundance of Harbor Seals in Alaska

- One of the Largest Wildlife Regular Wildlife Surveys in the World
- Complex Statistical Analysis to Estimate Abundance
- Incidental Take Authorizations (PR1)
- ADF&G Consultations



Other AFSC Shiny Applications

Distance Sampling

- Line-transect
- Report Generation

Ice Seal Hotspots

- Data Exploration
- Interim Access

Sea Lion Trends

- Flexible Trends
- Population Trajectories

Benefits of Shiny to NOAA Fisheries

- NMFS Scientists can create interactive and engaging scientific products with existing skillsets and expertise (no HTML, Javascript)
- NMFS Managers and Constituents can explore and engage with scientific products without having to also be technical experts or install/acquire special software
- Interaction = Better Science, Better Management

Public Access to Research Results

- Shiny applications complement and enhance NMFS Open Data and Open Science
- Shiny applications provide context to NMFS data and NMFS scientific analysis
- Integration with NMFS Web sites to improve communication of complex issues

Shiny Server Pro --- NMFS Hosted Solution

- Requires Dedicated Server / NMFS Personnel
- Availability to the Internet = High Security Req.
- Requires Dedicated NMFS Support Personnel
- NMFS Controlled = More Customization, Internal Database Access, Confidential Data
 - \$15,000/year + Hardware + Maintenance
- Open Source Solution – Internal Testing/Dev
 - \$0/year + Hardware + Maintenance

Shinyapps.io --- A Cloud First Option

- Server, Software and Maintenance handled by Rstudio, Inc. --- leading experts in R and Shiny
- Built on Amazon Web Services; 24/7 Uptime
- Integrated and Efficient Deployment of Applications – deploy/update from within the Rstudio IDE
- Professional Subscription: \$3,200/year
 - 10,000 Hours of Active Use/month
 - High Performance Computing Backend
 - Domain Customization

Approval/Deployment Process a Burden

The Cloud First policy mandates that agencies take full advantage of cloud computing benefits to maximize capacity utilization, improve IT flexibility and responsiveness, and minimize cost.

- Clear, Best-value for Majority of NMFS
- Much uncertainty remains
- Existing procedures not developed with small business providers in mind

Approval/Deployment Process a Burden

AFSC IT staff were very patient and collaborated to find a viable route to approval

- uncertainty, lack of guidance, and an overabundance of caution made the process more time consuming than any of us

wanted

AFSC Approval for *Shinyapps.io* as a 'Prototype/Demonstration' project for 1 year

- Amazon US East – FedRAMP/FISMA low/moderate
- No Sensitive/Confidential Data

Short Term Needs

- NMFS-level approval for use of *Shinyapps.io* by NMFS Scientists – low/moderate risk data
- Center-level, scientist led teams responsible for managing, deploying and supporting development of Shiny applications
- Collaborate on a series of best practices and guidelines to insure applications are of high quality

Long Term Needs

- Scientists as Software Developers
- Software/Web Apps as Fundamental Research Communications
- Provide Scientists Flexible, Reliable Access to Cloud Infrastructure and Solutions
- Create a 'Culture of Yes'



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This PDF was later amended to
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compliant.

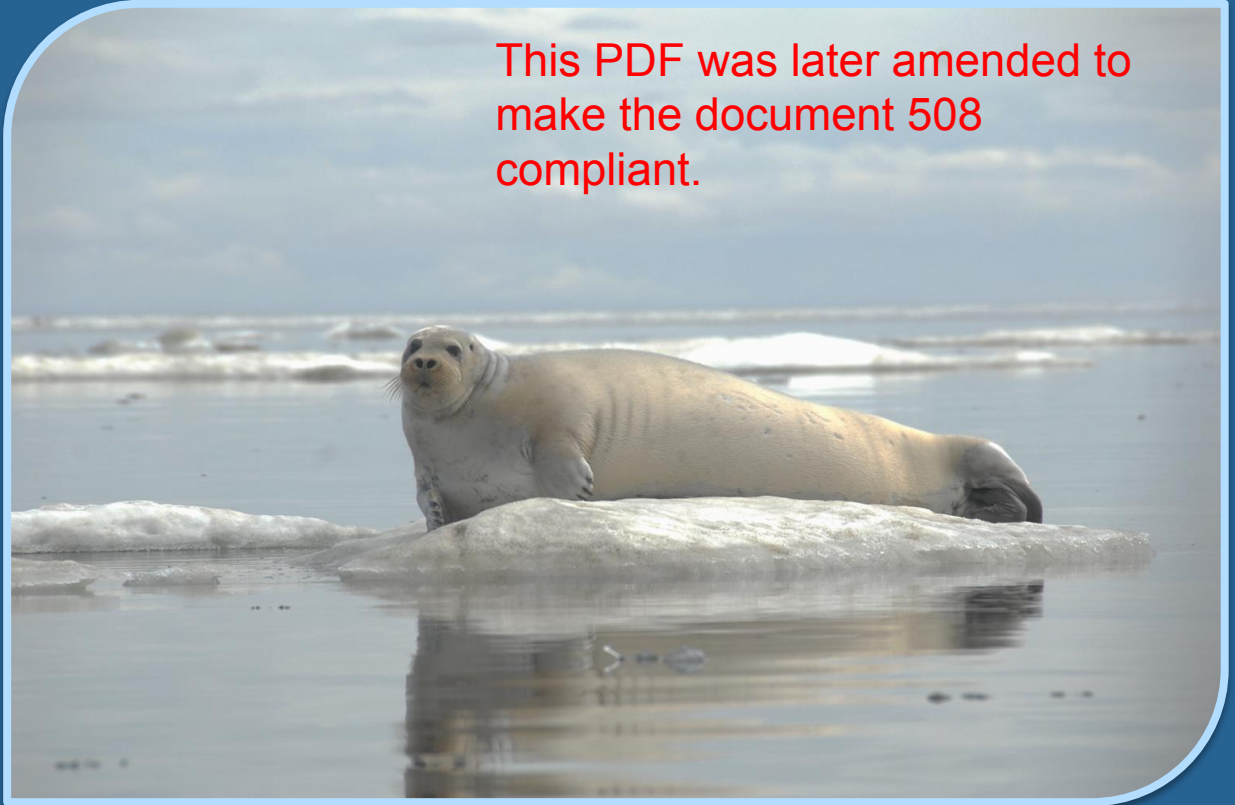


Photo credits: John K. Jansen, David E. Withrow
NMFS Research Permit #15126