More than a Fish Tank
GIS at the Aquarium

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Education Coordinator at the **Aquarium of the Pacific**

Esri Ocean GIS Forum Lightning Talk Presentation
November 5th, 2015

Exhibit Maps

We use large maps to help orient guests to the geographic locations represented by our exhibits

Our Maps are popular with our guests & our residents

3 Main ways the Aquarium is using GIS

1. **Using map-based interactives to engage guests, encouraging exploration and hands-on learning about exhibit animals, habitats, and the surrounding world**

2. **Showing K-12 educators how they can use GIS in the classroom**

3. **To communicate important environmental issues to politicians, local stakeholders, and the public**

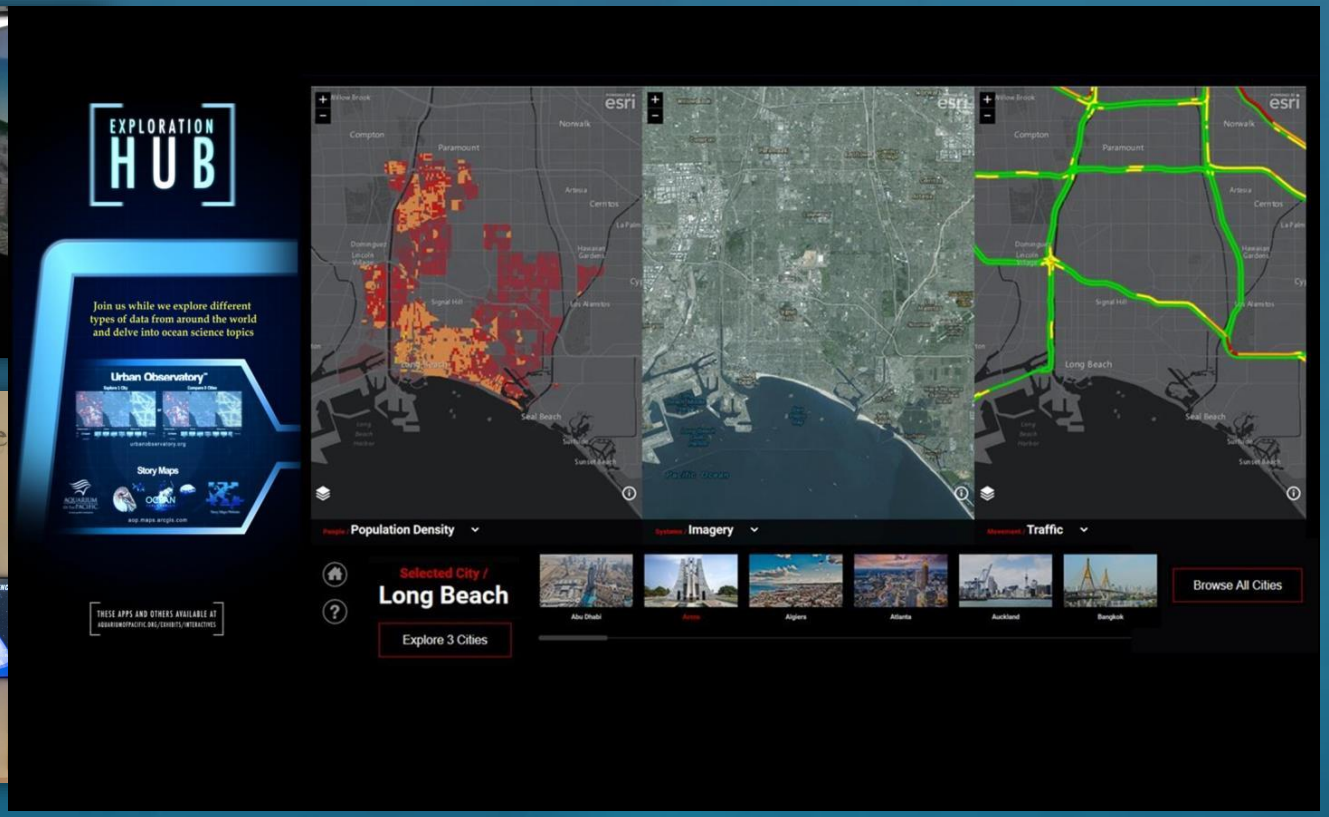
1. Using Map-based Interactives with Guests

Google Galaxy

1. Using Map-based Interactives with Guests

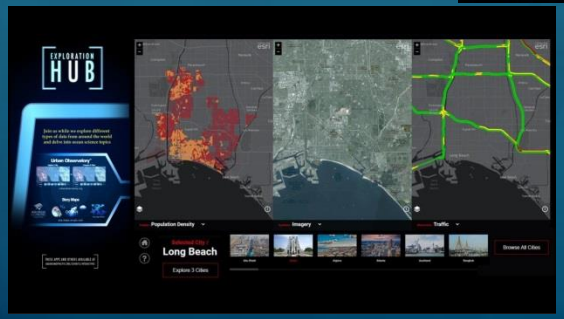
NOAA's Science on a Sphere

1. Using Map-based Interactives with Guests



Exploration Hub
featuring
Esri's Urban Observatory

1. Using Map-based Interactives with Guests



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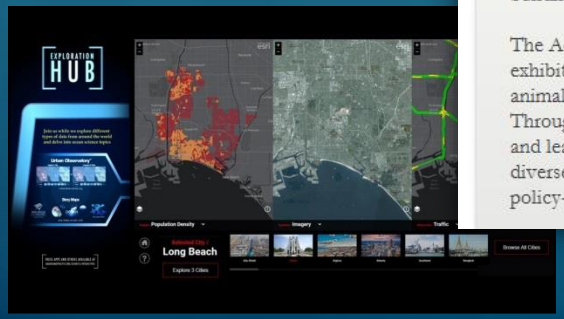
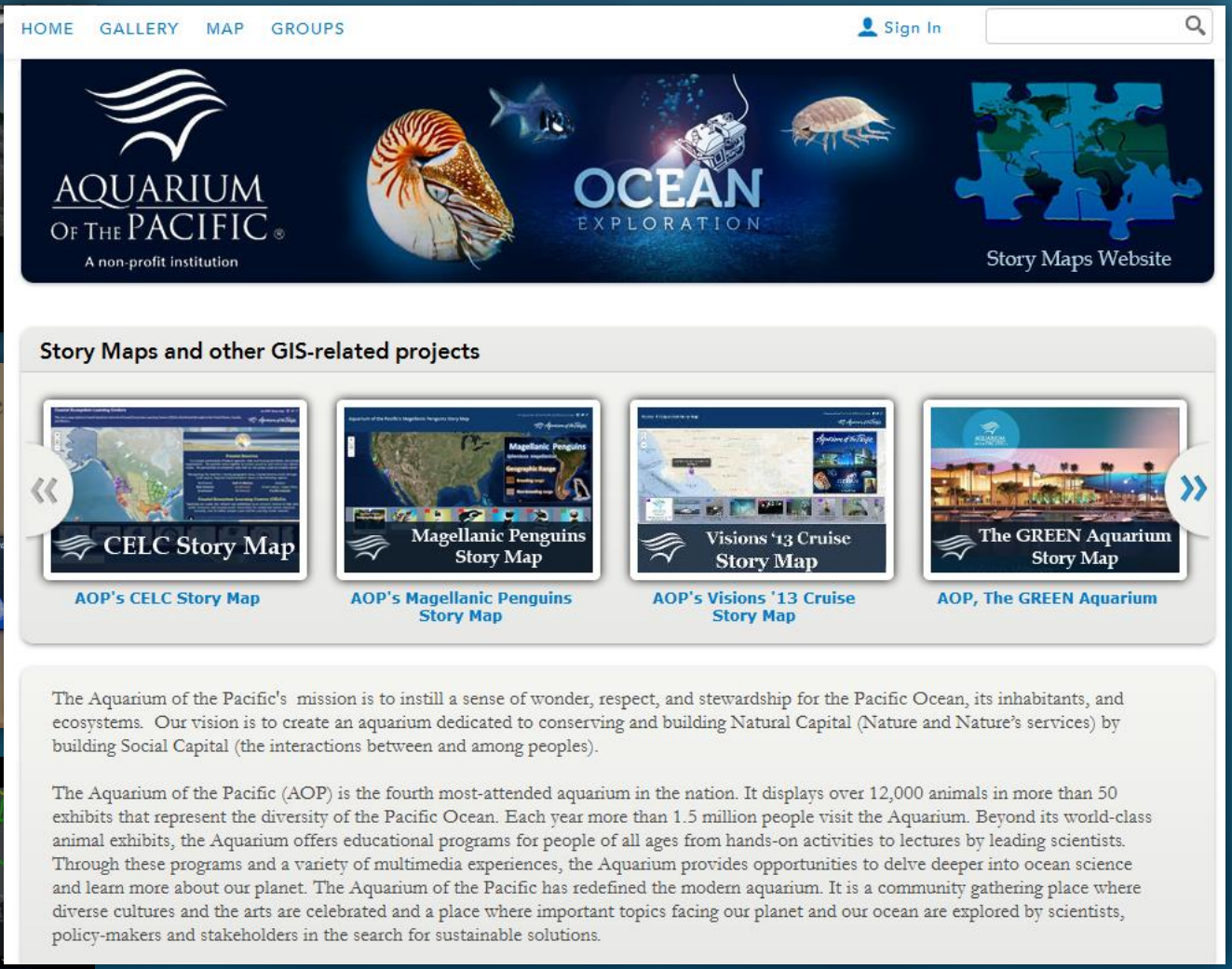




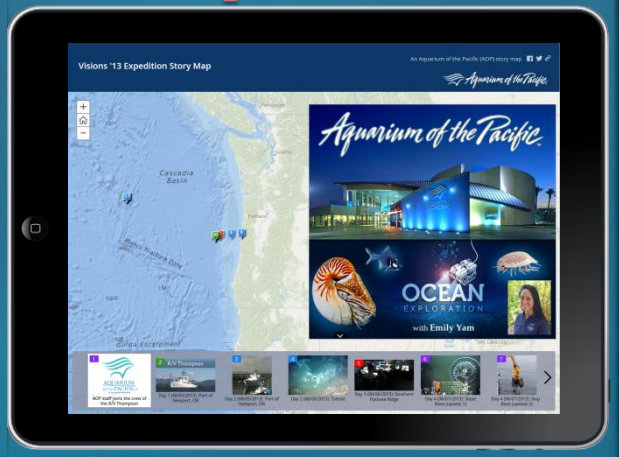
Story Maps

Using Story Maps to help guests learn more about our…

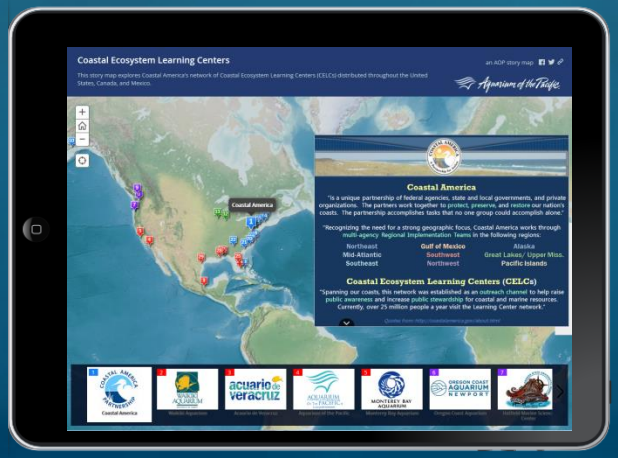
Animals

Exhibits

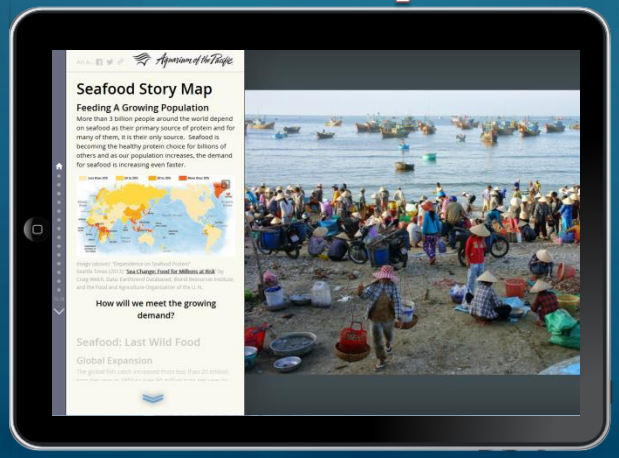
Experiences



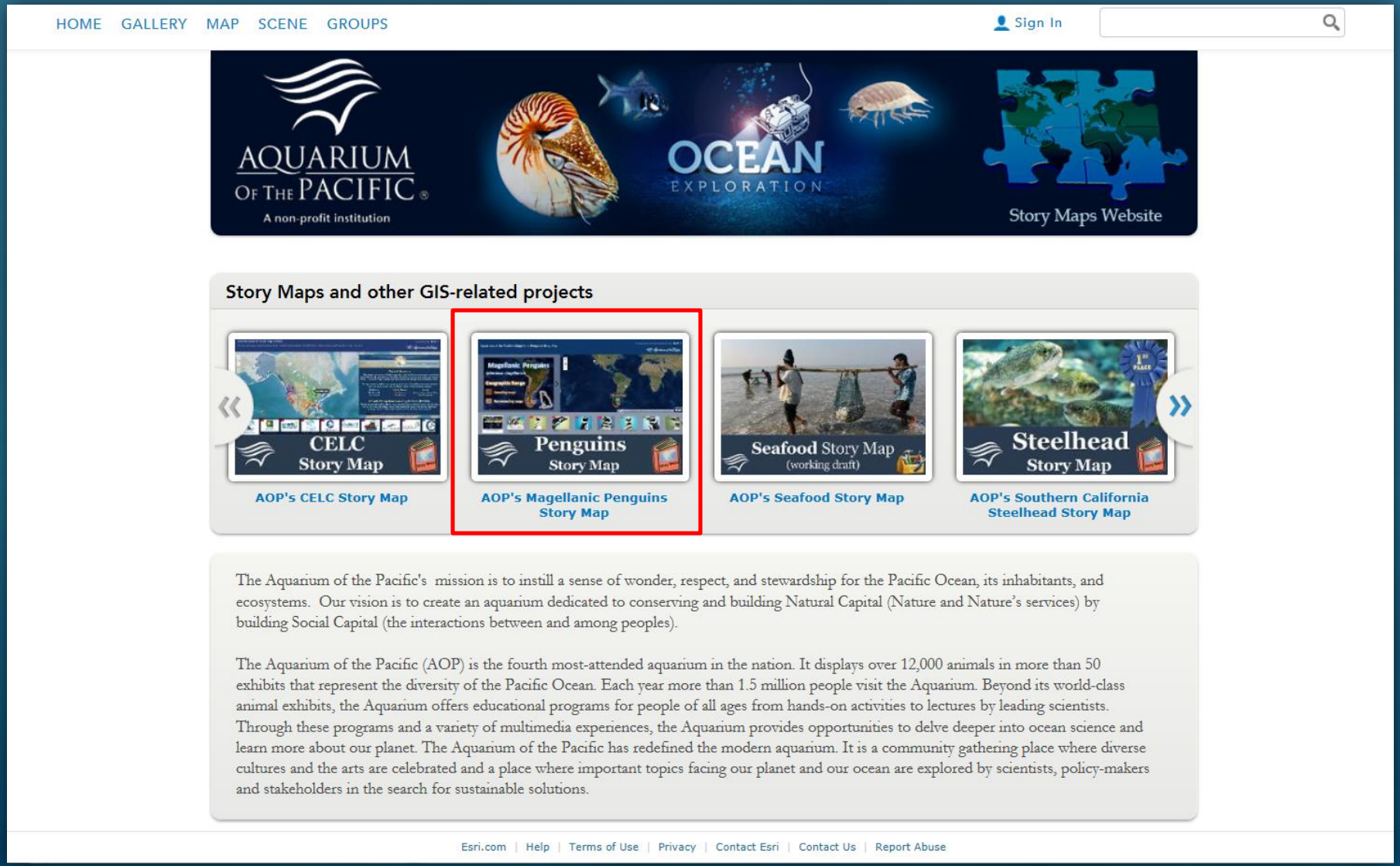
Locations



Issues & Topics



Example of a Story Map about our Animals



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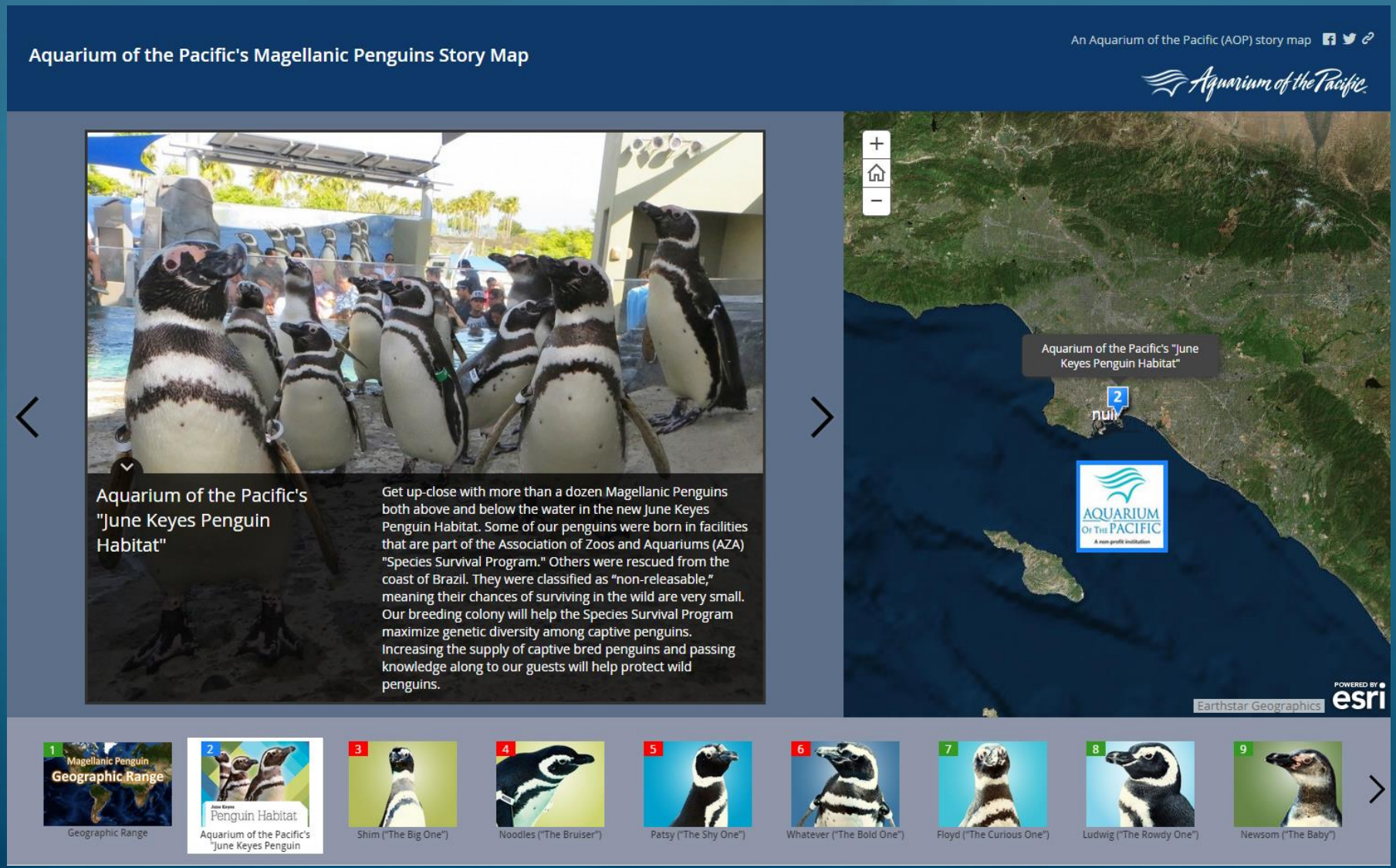
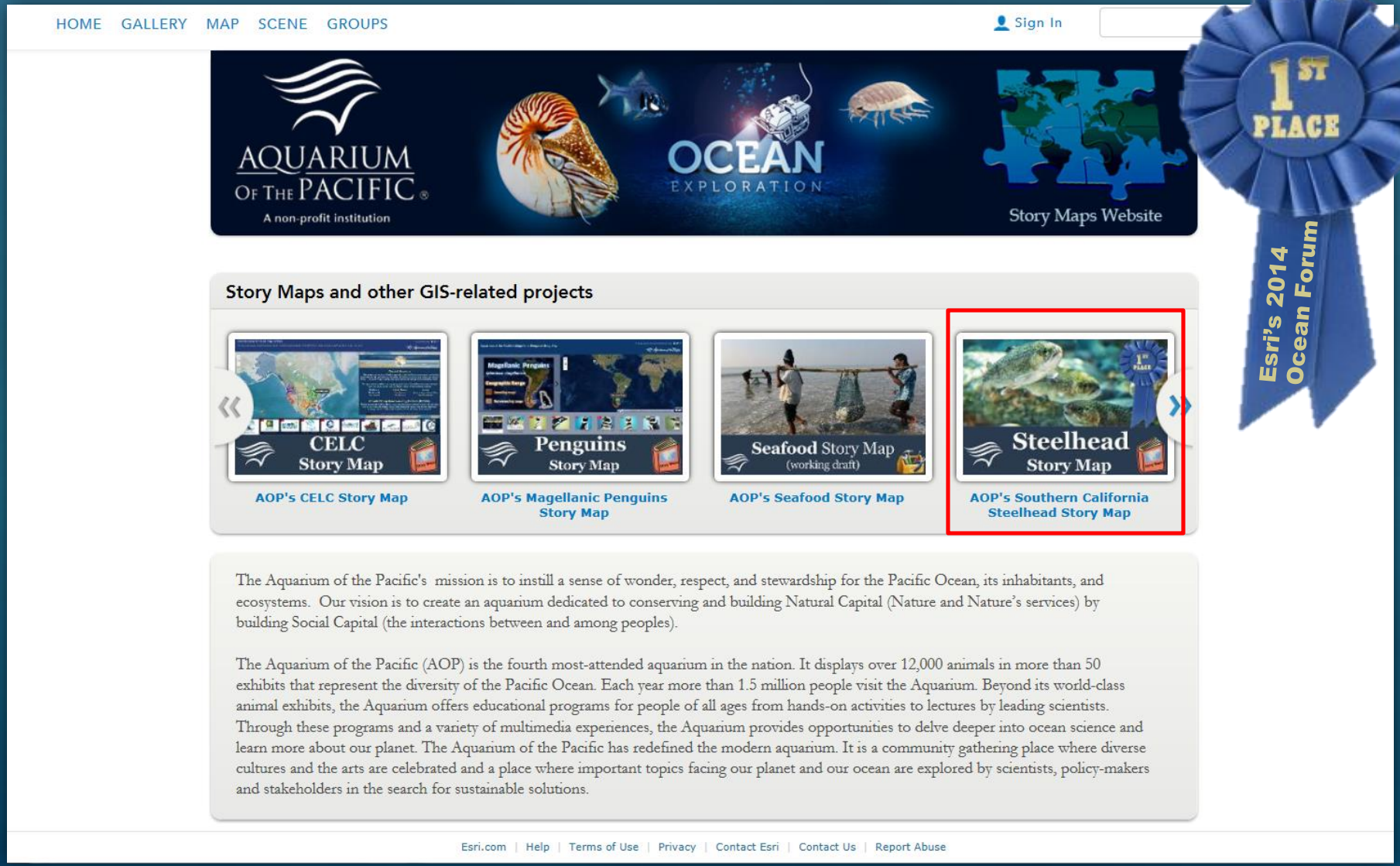


Example of a Story Map about our Animals

Example of a Story Map about our Exhibits

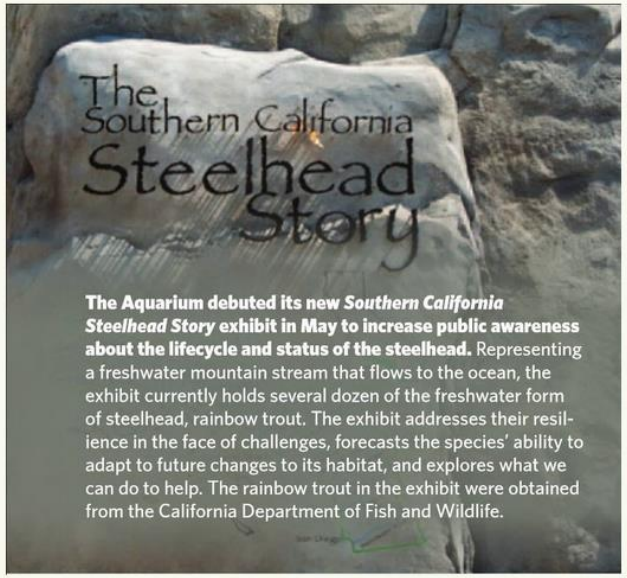


Example of a Story Map about our Exhibits

an AOP story map

Aquarium of the Pacific

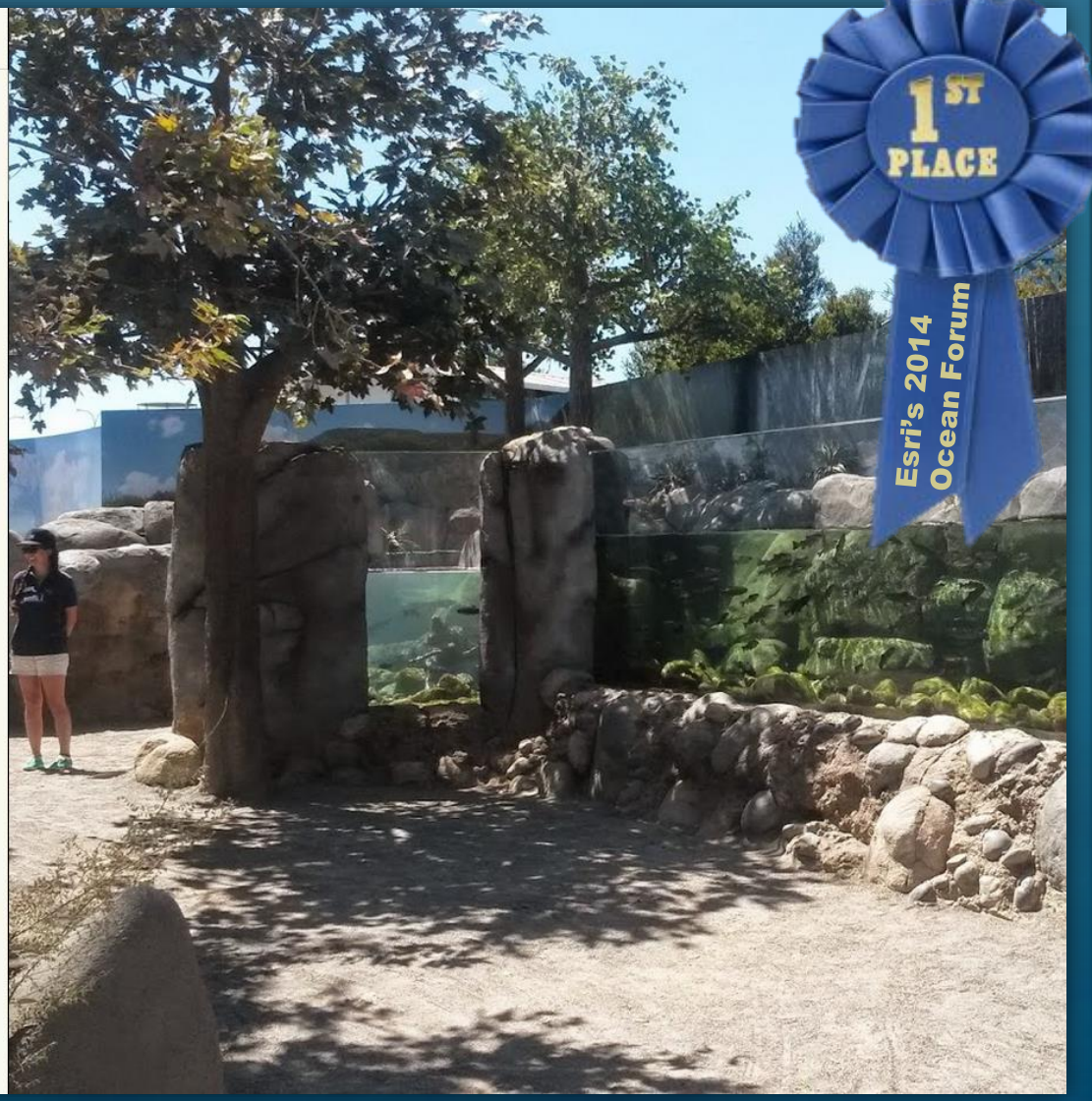
Southern California Steelhead



The Aquarium debuted its new *Southern California Steelhead Story* exhibit in May to increase public awareness about the lifecycle and status of the steelhead. Representing a freshwater mountain stream that flows to the ocean, the exhibit currently holds several dozen of the freshwater form of steelhead, rainbow trout. The exhibit addresses their resilience in the face of challenges, forecasts the species' ability to adapt to future changes to its habitat, and explores what we can do to help. The rainbow trout in the exhibit were obtained from the California Department of Fish and Wildlife.

Species Overview

Steelhead are members of the salmon family that includes all salmon species, trout, and char. Southern California steelhead are the only members of the salmon family native to Southern California. They are anadromous fish, that is, they hatch and live for a part of their life cycle in fresh water, migrate to the ocean where they spend to mature, and return to a freshwater stream, usually the one where they were hatched, to spawn. Unlike their salmon relatives, they usually do not die after spawning.



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Aquarium of the Pacific

Southern California Steelhead

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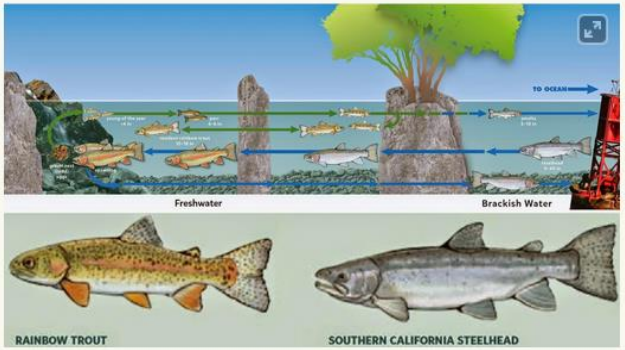
Steelhead is the name given to ocean-going rainbow trout. Steelhead are born and remain in freshwater for 1-3 years as juveniles, then migrate to the ocean and stay for 1-4 years while growing into adults. When rivers are typically swollen in winter, adults migrate to freshwater to spawn, usually in the stream where they were born. Steelhead belong to a family that includes all salmon, trout, and char. Unlike salmon, which spawn only once, adult Steelhead often return to the ocean after spawning and repeat the spawning migration the next year.



The image on the right is a painting by Ben Lovejoy titled "A Steelhead's Journey" (http://www.steelheadrecovery.org/images/lovejoy-painting-large.jpg)

Example of a Story Map about our Exhibits

an AOP story map

Aquarium of the Pacific

Southern California Steelhead

Historical Southern California Steelhead Populations

At one time steelhead spawned in the majority, if not all, of California's coastal rivers.

"Ventura River Steelhead Anglers, 1909" (NMFS's 2012 Southern California Steelhead Recovery Plan, page 5)

The map on the right shows the **historical distribution** of Southern California Steelhead populations.

Southern California steelhead can tolerate warm water and have a complex yet flexible life history that increases their resistance to environmental change. Steelhead are at risk of extinction, but restoring water quality and quantity, and removing or modifying man-made barriers to migration in certain Southern California streams would increase their chances of survival.

Present Day Southern California Steelhead Populations

Over the last 100 years the Southern California Steelhead population has declined 99% and some runs are extinct. Southern California Steelhead are

Example of a Story Map about our Exhibits

an AOP story map

Aquarium of the Pacific

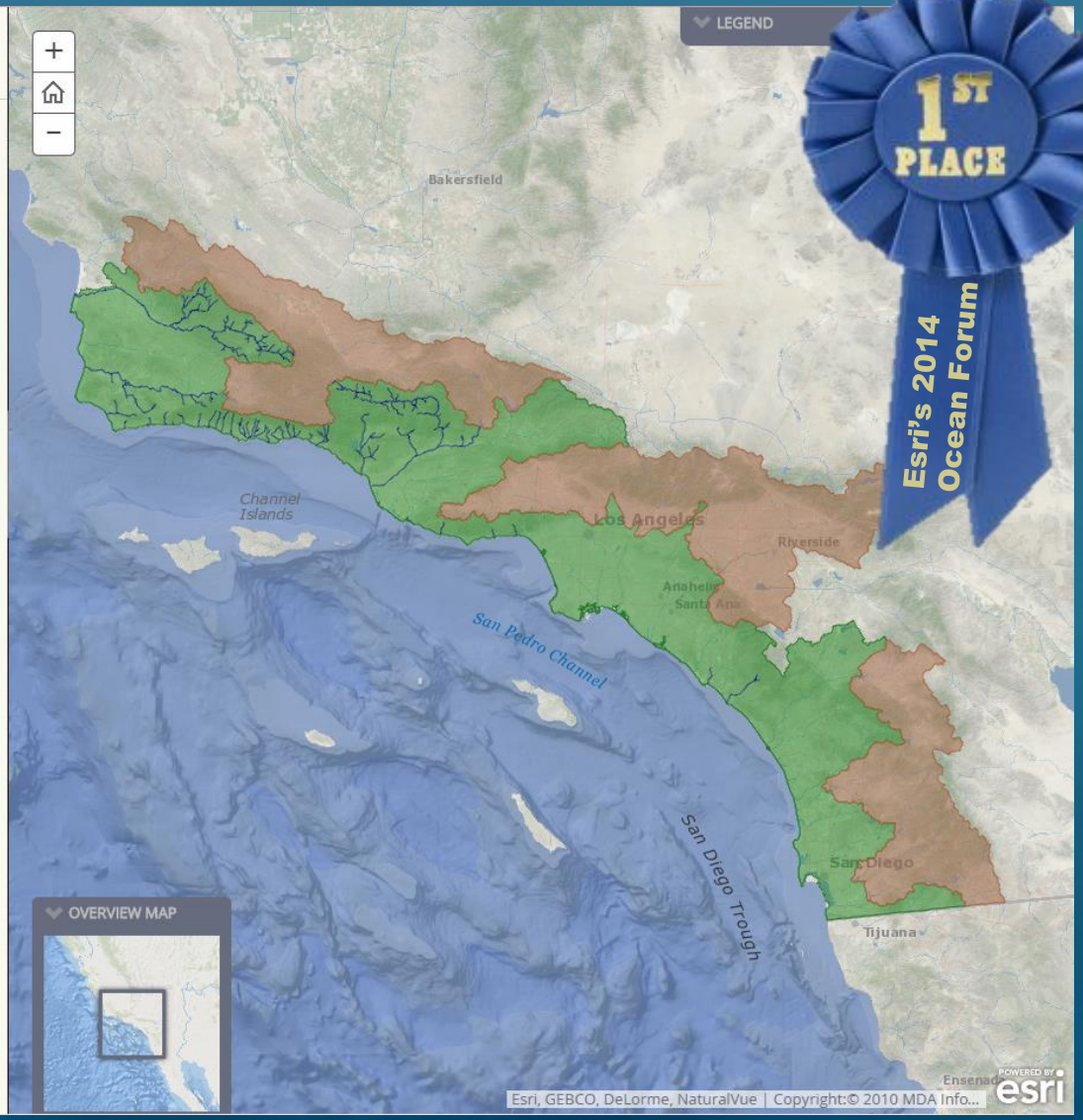
Southern California Steelhead

Present Day Southern California Steelhead Populations

Over the last 100 years the Southern California Steelhead population has **declined 99%** and some runs are extinct. Southern California Steelhead are now listed as endangered under the U.S. Endangered Species Act. The southern California population has declined from about 40,000 steelhead to less than 500. This decline was in large part the result of manmade infrastructure (like dams, concrete lined washes, etc).

The map on the right shows the current steelhead population range, the historical range which is now anthropogenically blocked , and the locations of major dams.

"Bradbury Dam, Santa Ynez River" (NMFS's 2012 Southern California Steelhead Recovery Plan, page 9)



Example of a Story Map about our Exhibits

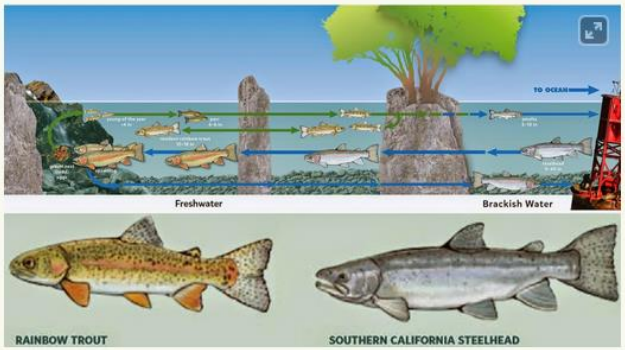
an AOP story map

Aquarium of the Pacific

Southern California Steelhead

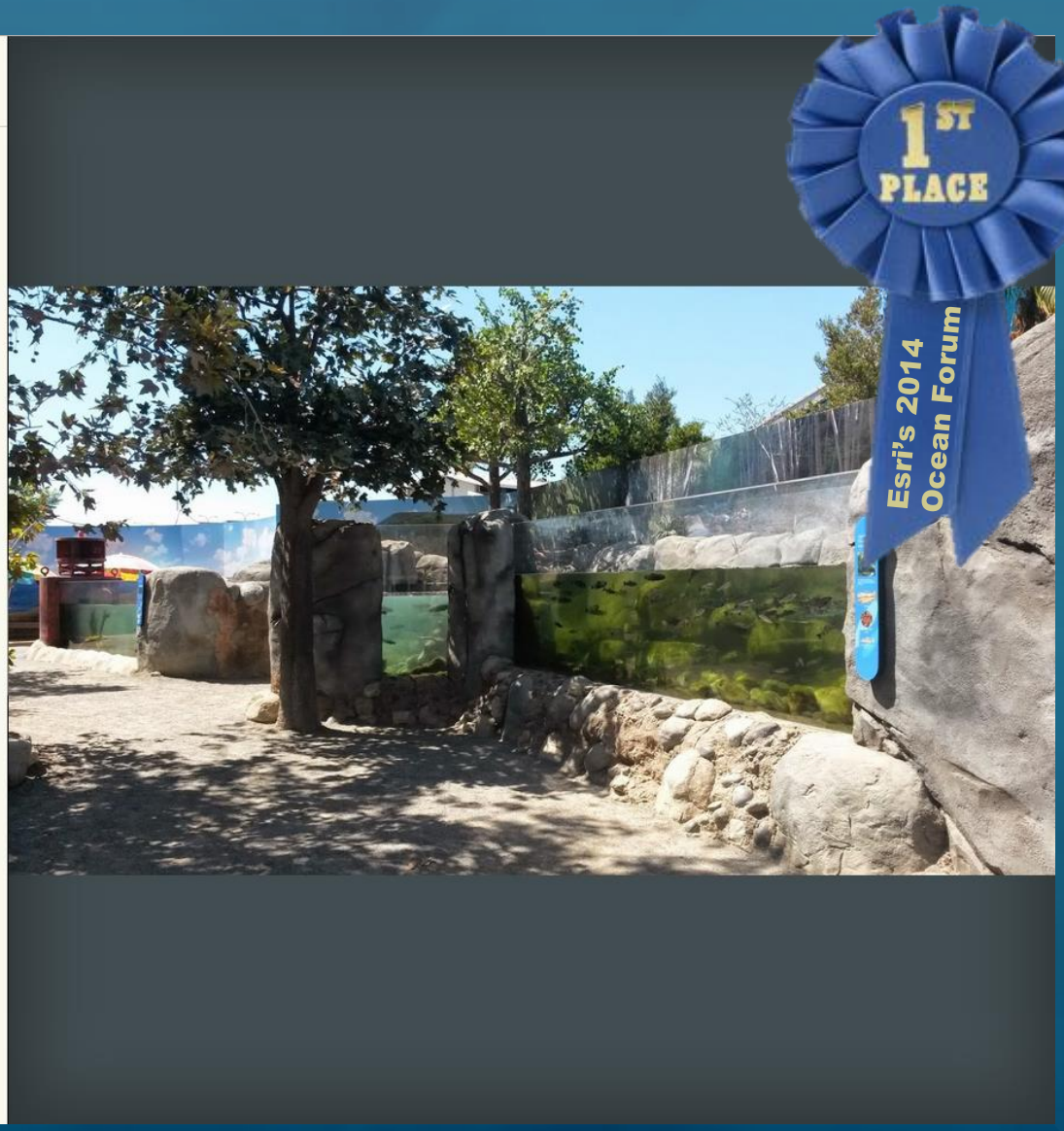
At the Aquarium

The Aquarium's steelhead exhibit transports visitors along a mountain path, allowing them to view these fish in three areas, representing the species' journey from freshwater to brackish water, and finally to the ocean. Through this exhibit, the Aquarium hopes to reveal the secrets of a little-known fish that lives amongst us in our urban environment and inspire conservation of this unique animal.



Upper Elevation Habitats

The places where adults spawn, eggs hatch, and young fish develop (0-1 year).



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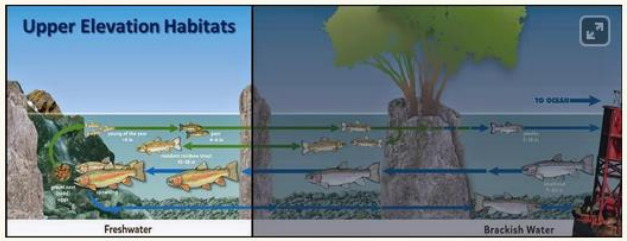

The first segment of the Aquarium's steelhead exhibit represents the **Upper Elevation Habitats** and is filled with **juvenile rainbow trout** (< 4 inch long).

Mid-Elevation Habitats

The places where young fish continue to grow. Some will stay in fresh water for life and remain as rainbow trout. Others will migrate to the ocean and become steelhead.

LEGEND

1ST PLACE

Esri's 2014 Ocean Forum

OVERVIEW MAP

CSUMB, Esri, DeLorme, NaturalVue | Copyright:© 2010 MDA Inf...

POWERED BY esri

Example of a Story Map about our Exhibits

an AOP story map

Aquarium of the Pacific

Southern California Steelhead

Mid-Elevation Habitats

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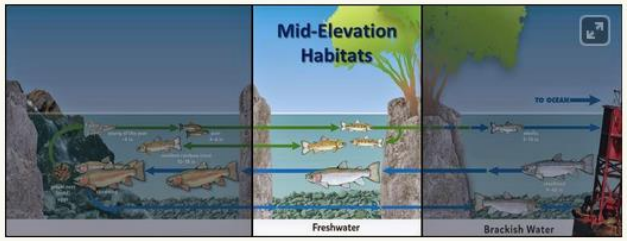
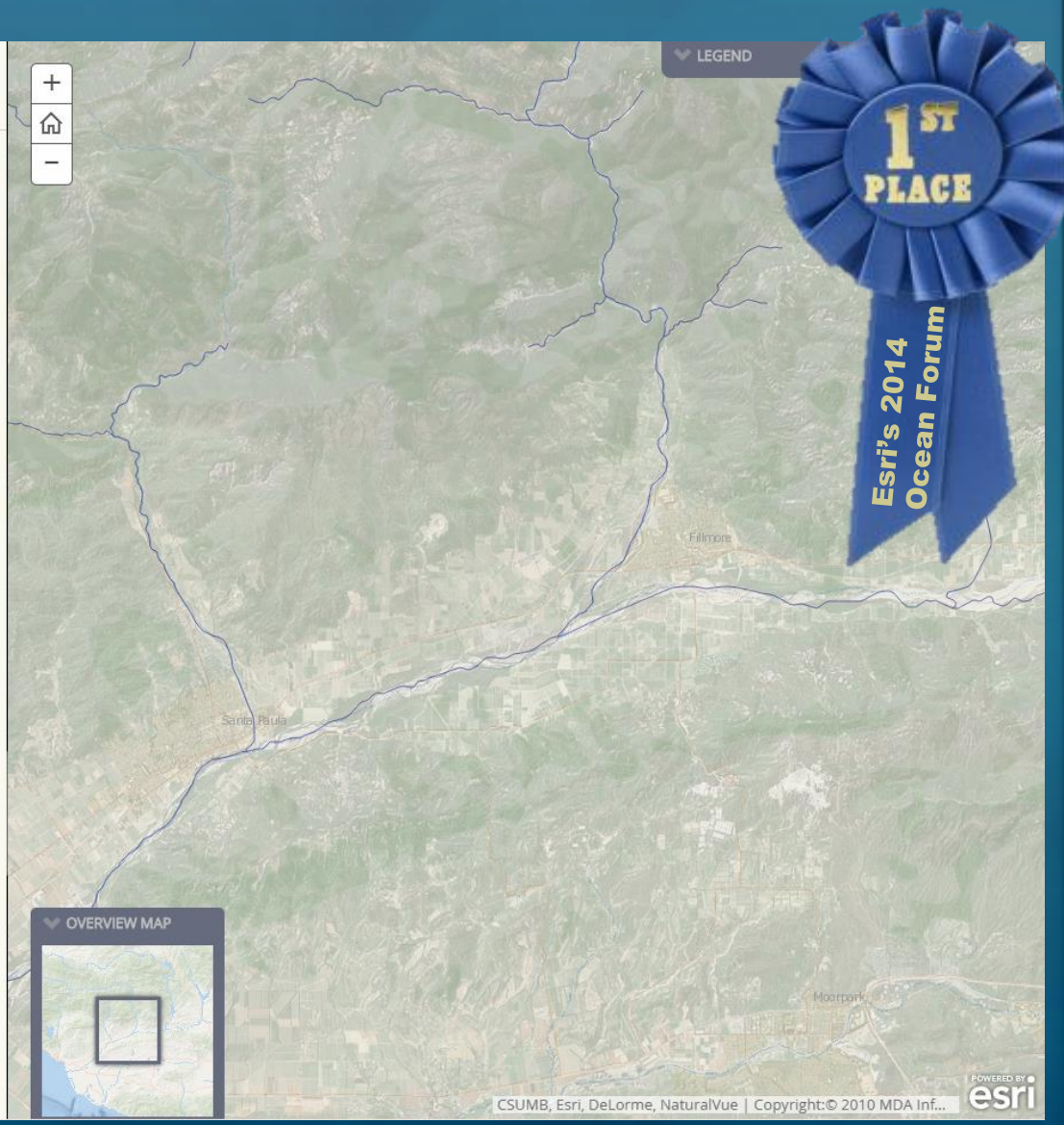


The middle segment of the Aquarium's steelhead exhibit represents the **mid-elevation habitats** and is filled with the **resident rainbow trout** (10-18 inch long)

Estuarine Habitats



Example of a Story Map about our Exhibits

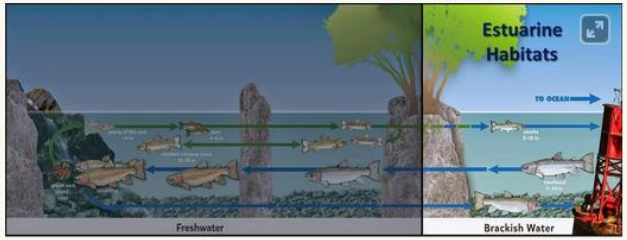
an AOP story map

Aquarium of the Pacific

Southern California Steelhead

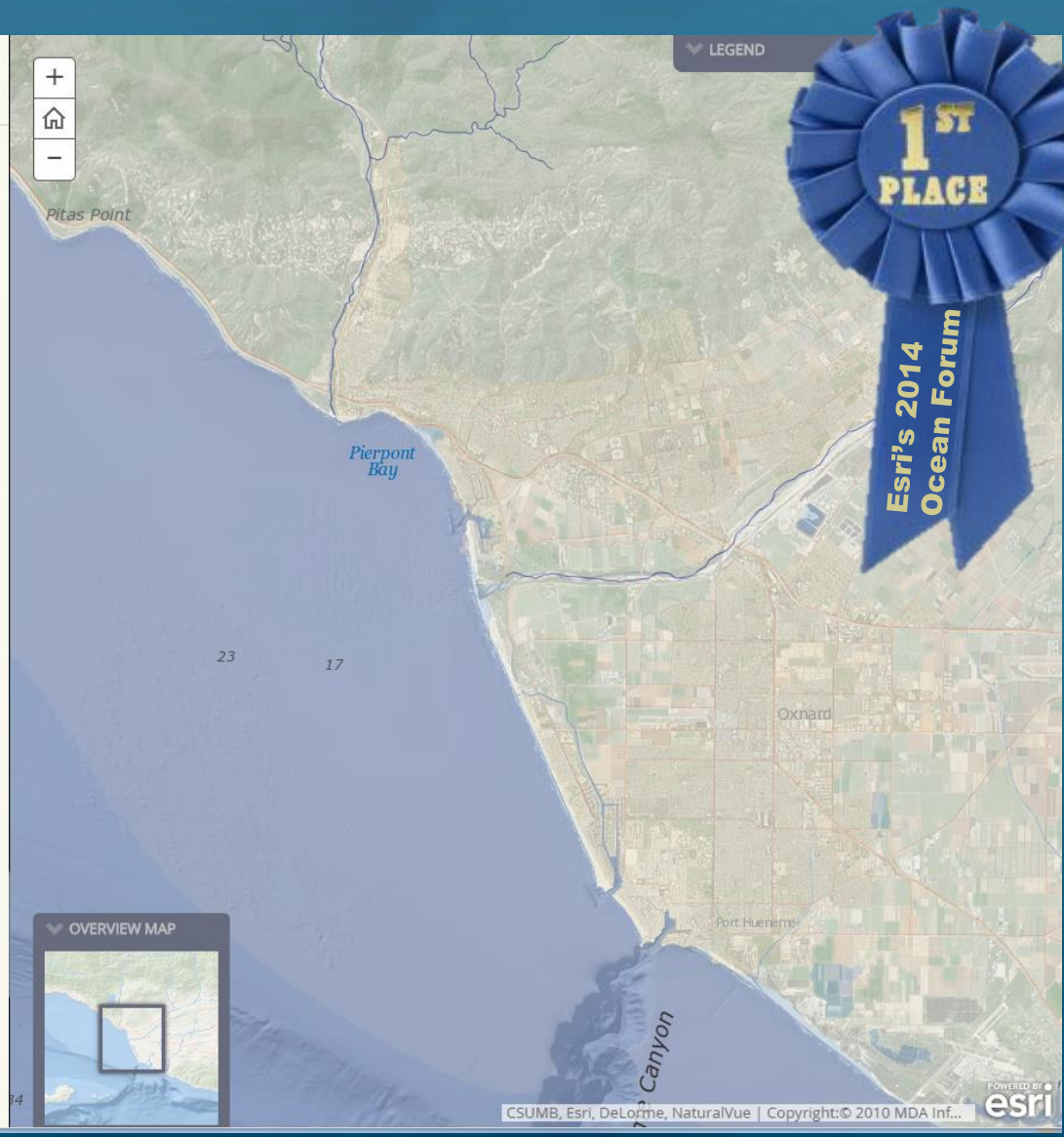
Estuarine Habitats

The places where most young fish grow and develop in preparation for their journey to the ocean where they become steelhead and the places to which they later return from the ocean on their way back upstream to spawn.



The last segment of the Aquarium's steelhead exhibit represents the estuarine habitats and is filled with the smolts (5-10 inch), which will hopefully turn into steelhead (9-40 inch) someday.

Read More



Example of a Story Map about our Exhibits

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Aquarium of the Pacific

Southern California Steelhead

Steelhead

Historian John G. "Tom" Tomlinson, Jr., in collaboration with the Aquarium of the Pacific, has written a book documenting the local history of the Southern California Steelhead, including historic photos, postcards, fishery data, newspaper clippings, and rainfall statistics.

This book gathers historical information about this fish species and describes its resilience in the face of the region's changing watersheds, rainfall levels, and manmade infrastructure.

Against the Currents is available for sale in the Pacific Collections gift store or online at shop.aquariumofpacific.org

Learn More

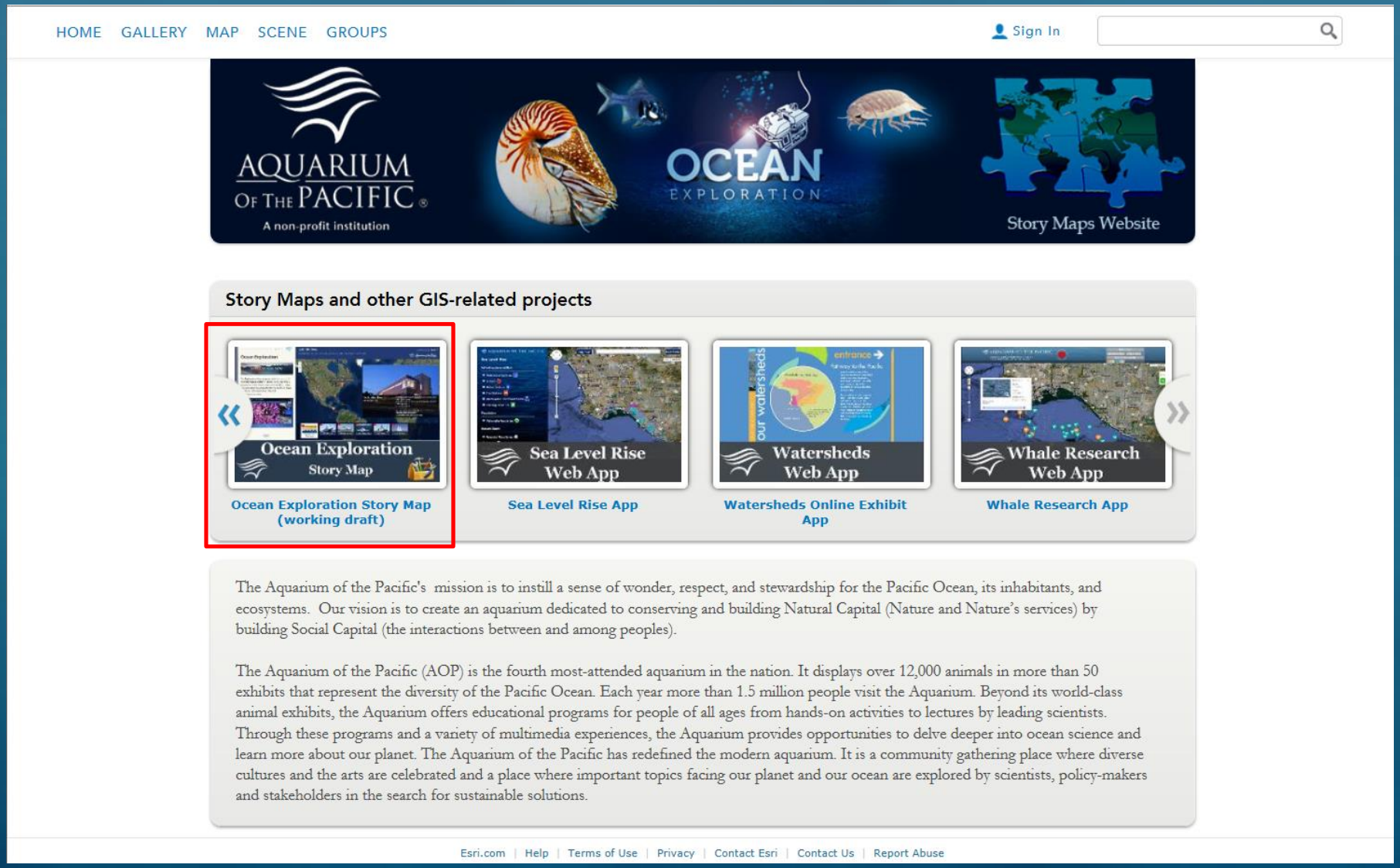
Watch "Southern California Steelhead: Against All Odds" by California Trout

available online at: http://vimeo.com/79393289

More information about southern California Steelhead can be found online at:

- The Aquarium's Online Learning Center "Southern California Steelhead" page
- National Marine Fisheries Service (NMFS) Steelhead profile
- The Recovery Plan for Southern California Steelhead (Jan. 2012)

Example of a Story Map about an Exhibit Topic



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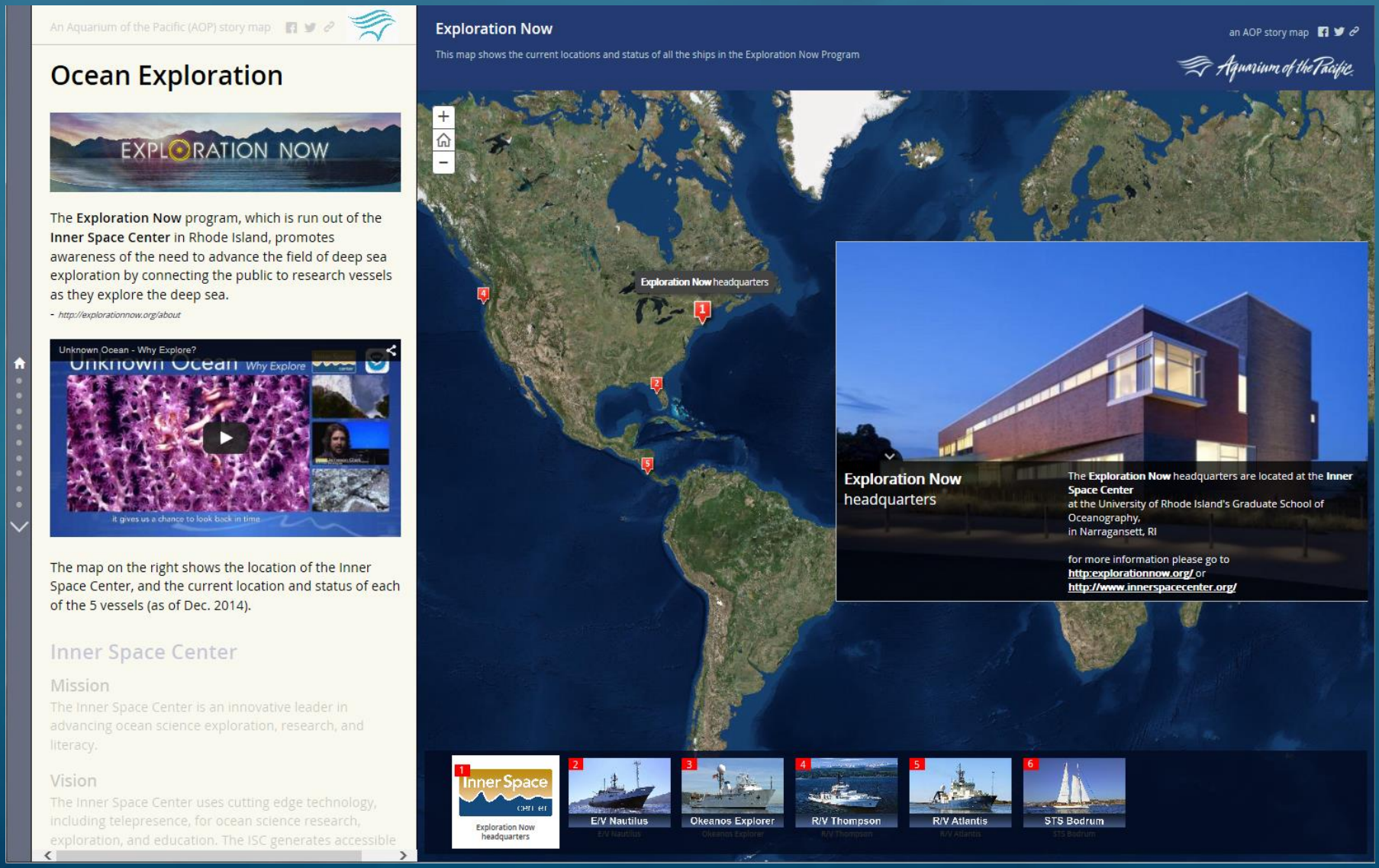
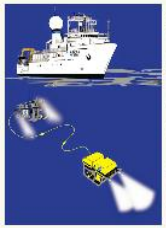


Example of a Story Map about an Exhibit Topic

An Aquarium of the Pacific (AOP) story map

Ocean Exploration

Research Submersibles

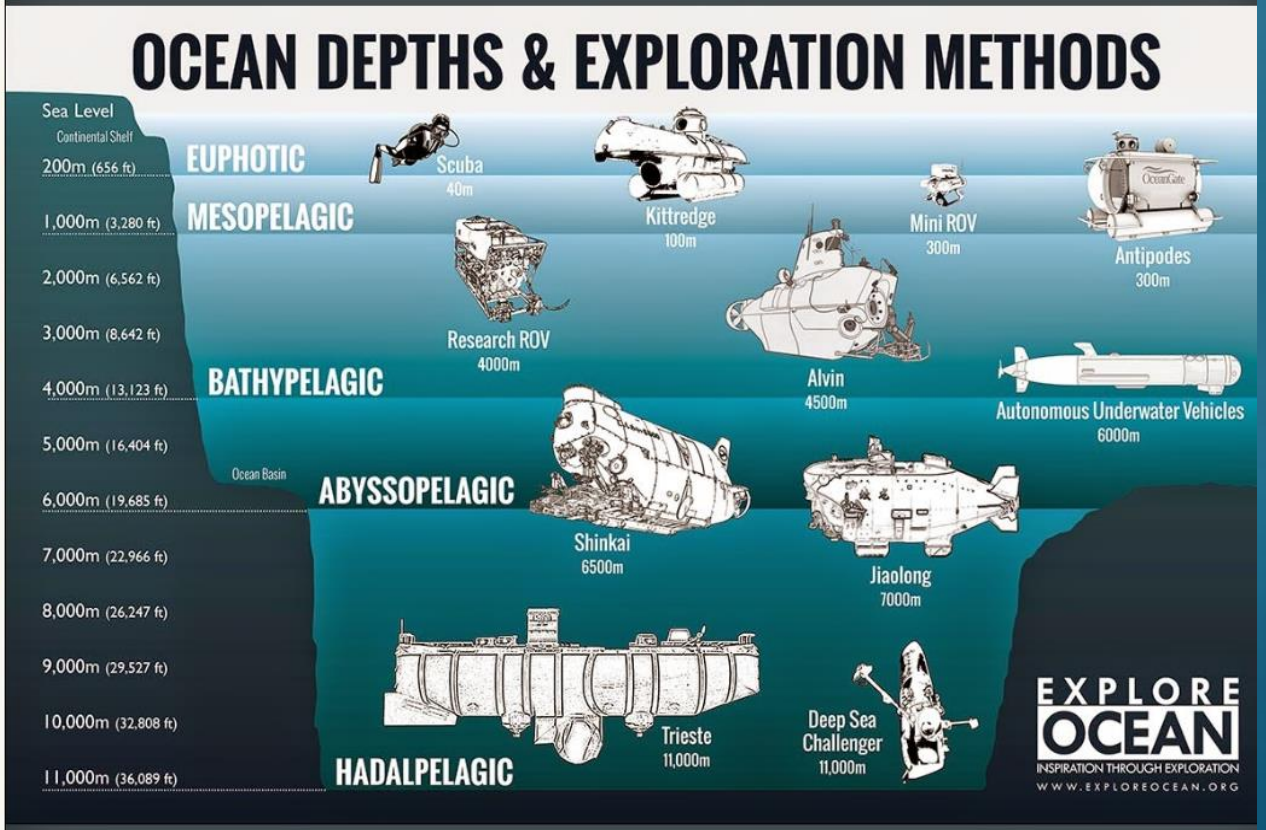


An ROV is a **remotely operated vehicle** used by research teams as a submersible.
ROVs are tethered to ships. They are controlled by a remote either on ship or land. They are powered by the ship. For the purpose of ocean exploration, the ROVs we follow have high definition video cameras that record the live streaming video.

E/V Nautilus

The Exploration Vessel (E/V) Nautilus,
is a a 64-meter research vessel operated by the Ocean Exploration Trust

The Ocean Exploration Trust was founded in 2008 by Titanic-discoverer and National Geographic Explorer-in-Residence Dr. Robert Ballard to engage in pure ocean exploration.



Example of a Story Map about an Exhibit Topic

An Aquarium of the Pacific (AOP) st...

Ocean Exploration

E/V Nautilus

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Map of the 2014 Nautilus Expeditions

Their international programs center on scientific exploration of the seafloor. In addition to conducting scientific research, their expeditions are made available to explorers on shore via live

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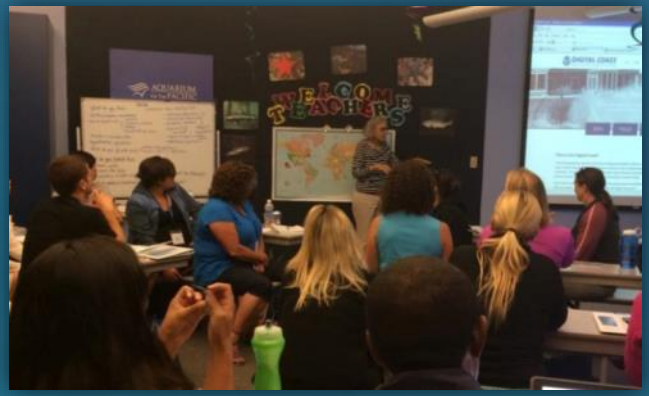
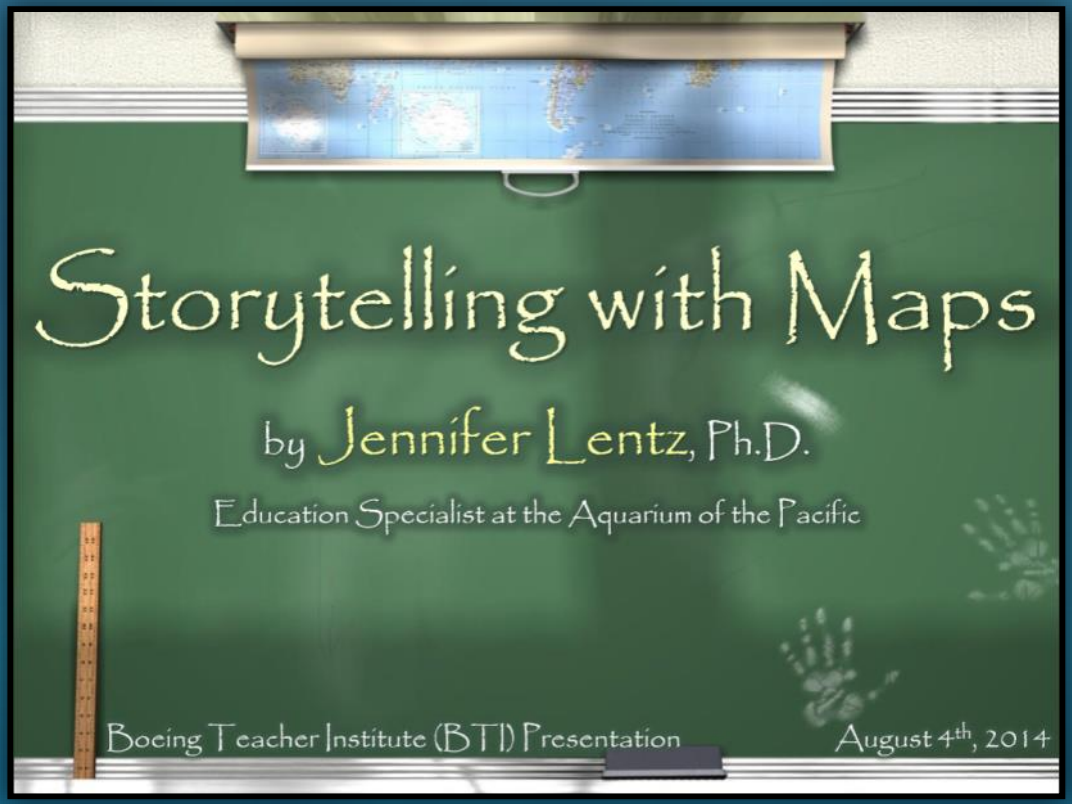
2. Introducing GIS to K-12 Educators





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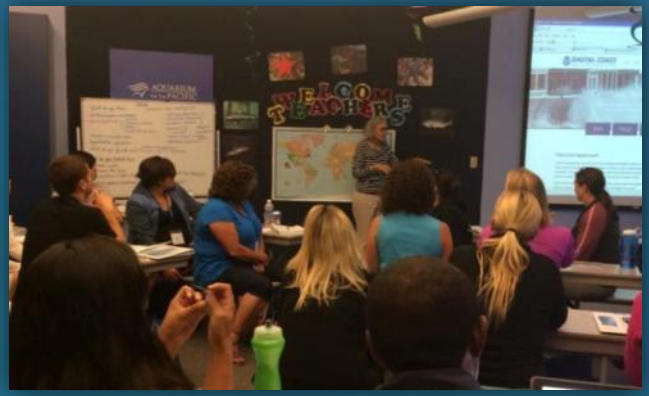

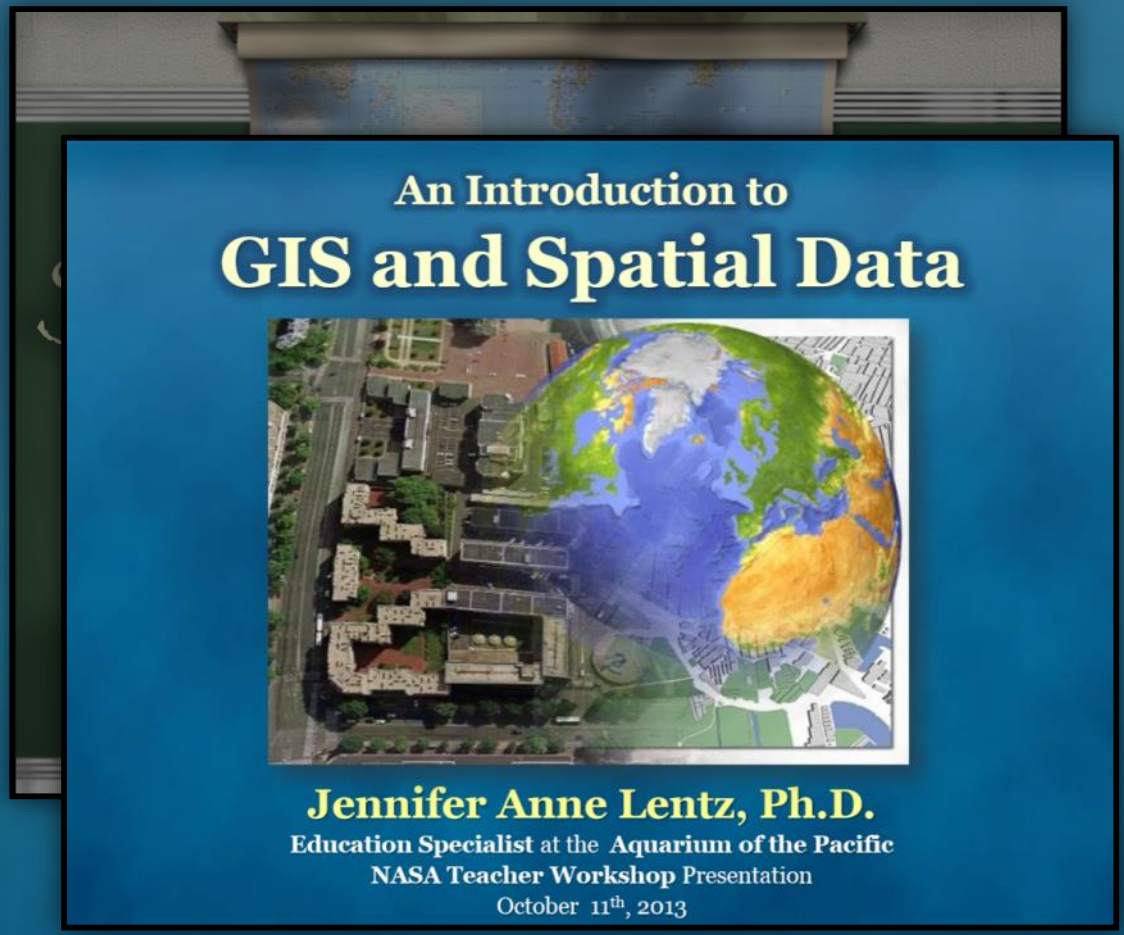

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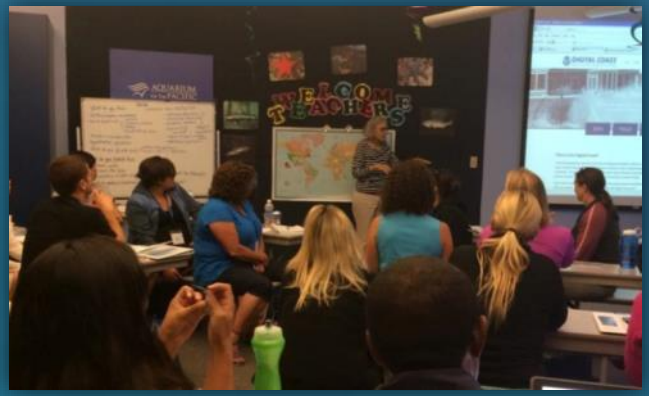
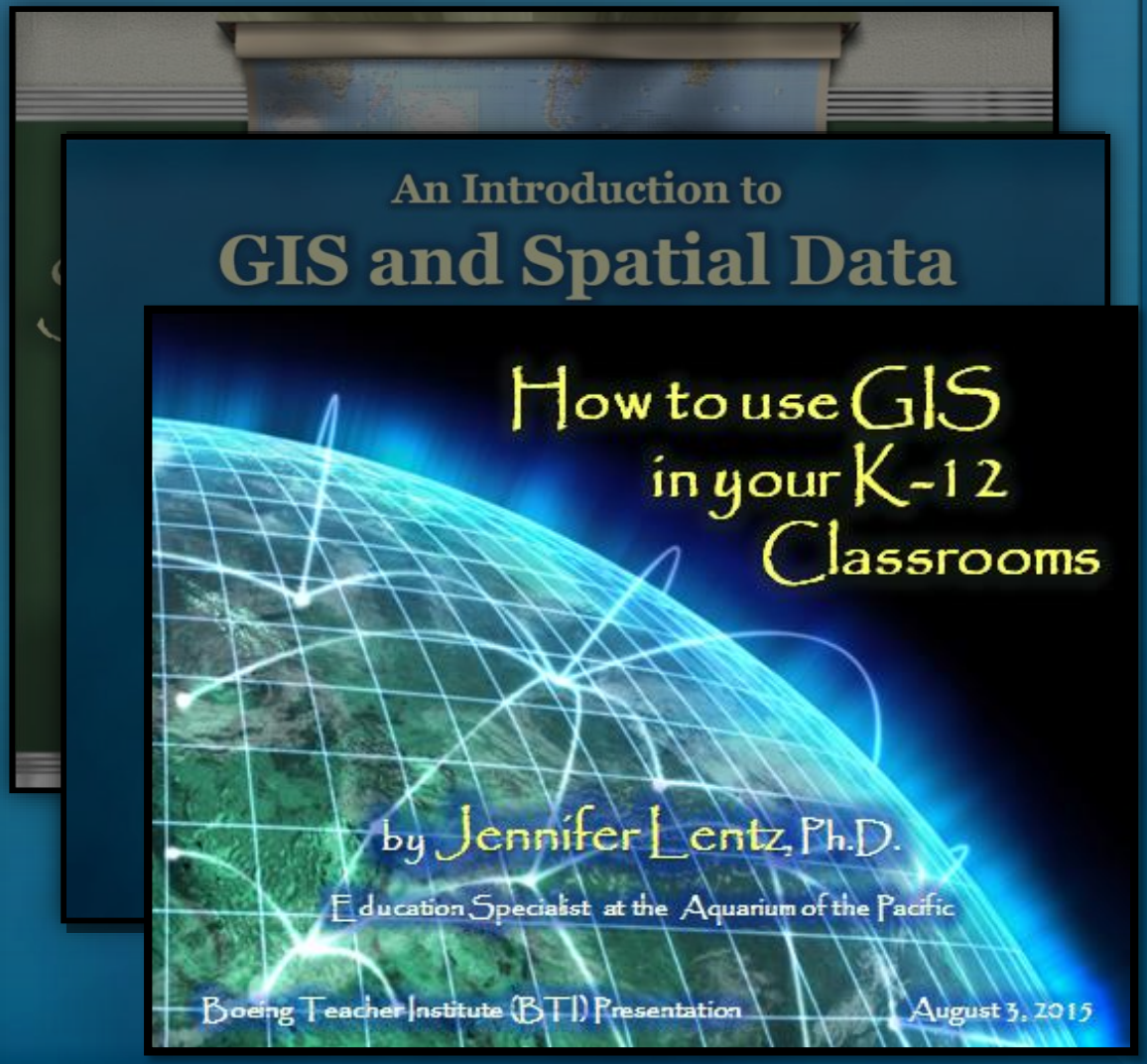
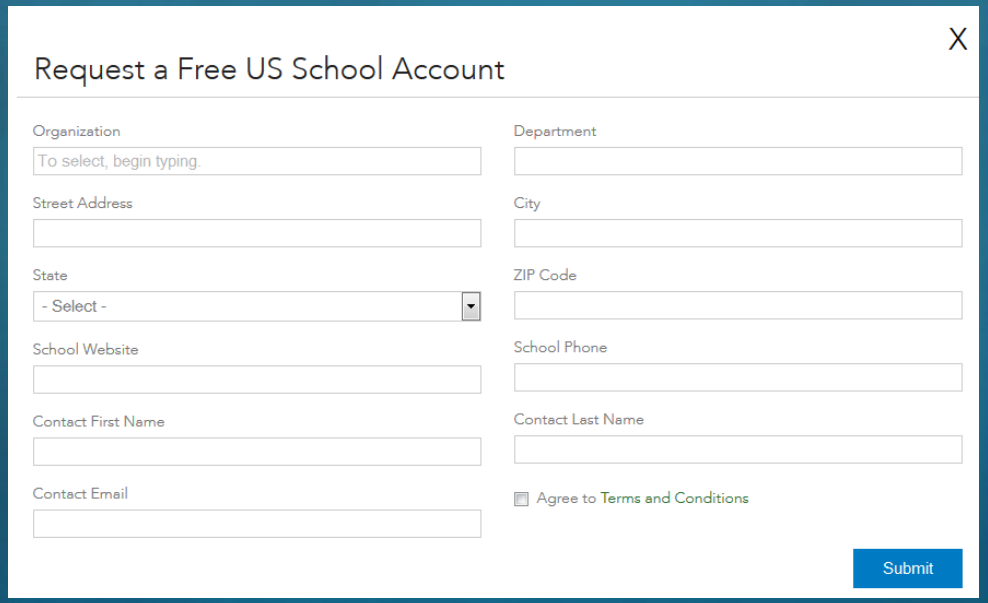




ConnectED Initiative

Free ArcGIS Online Accounts available for ALL K-12 Schools in the United States!



Sign up online at: http://www.esri.com/connected

(or use the form in your binders)

ConnectED Initiative

ArcGIS Online provides Project-based Learning in line with NGSS standards

These sites include…

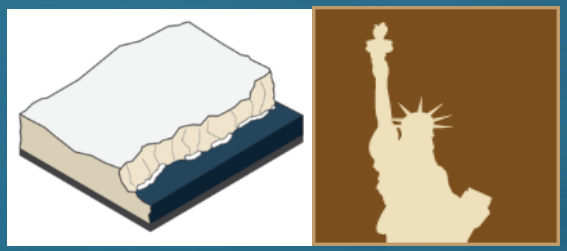
- Teacher Stories
- Student Videos
- Case Studies
- Resources
- Lessons Plans

http://www.esri.com/connected/

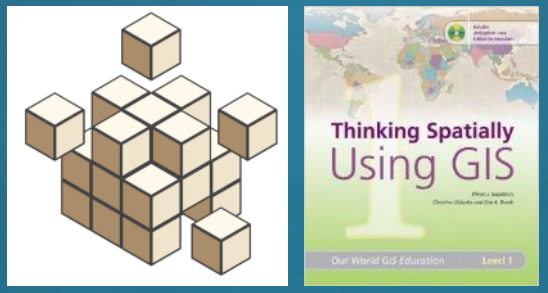
& http://edcommunity.esri.com/

Instructional GIS Materials for K-12

GeoInquiries



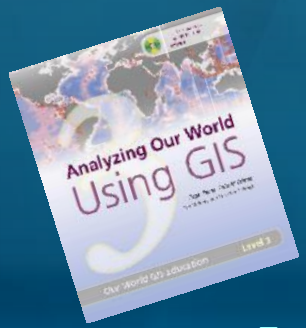
Thinking Spatially

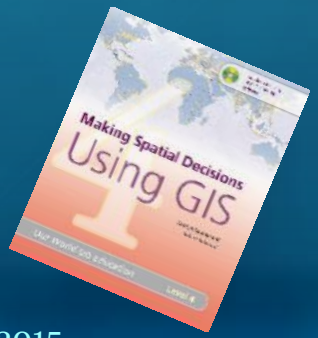


Mapping our World

Story Maps

and more!





Step-by-Step GIS & Story Map Tutorials

GIS Wildlife Data Tutorial

How to find, Map, & Spatially Analyze Wildlife Data in a GIS System

This Tutorial was Created by

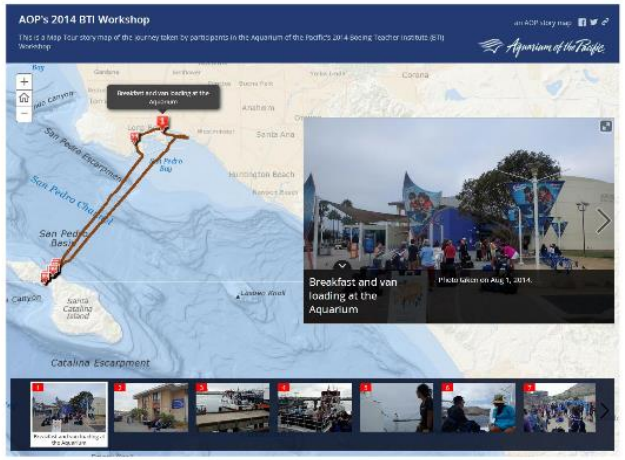
Jennifer Anne Lentz, Ph.D.

Education Specialist at the **Aquarium of the Pacific**

This tutorial, and other teaching-related materials by Dr. Lentz are available online at:
http://JenniferALentz.info/Teaching.html

Creating "Map Tour" Story Maps

How to create a Map Tour Story Map quickly and easily using your smartphone or tablet, and your ArcGIS Online Organization Account



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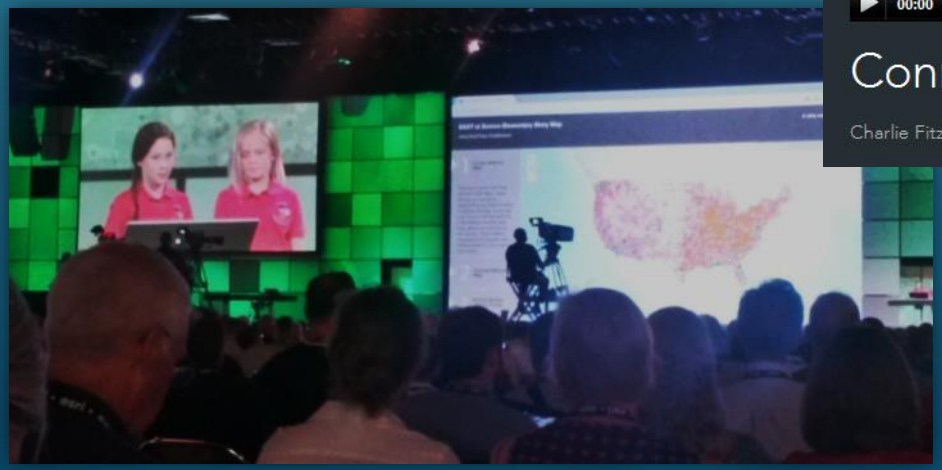
Available online at: *AOP.maps.arcgis.com* & *JenniferALentz.info*

So Easy 4th Graders Can Do It!



Watch Kylie & Rikki demo their GIS work online at:
http://video.esri.com/watch/3665/connecting-gis-with-education

"**GIS Kids Are Super!"** blog post (http://blogs.esri.com/esri/ucinsider/2014/07/15/gis-kids-are-super/)

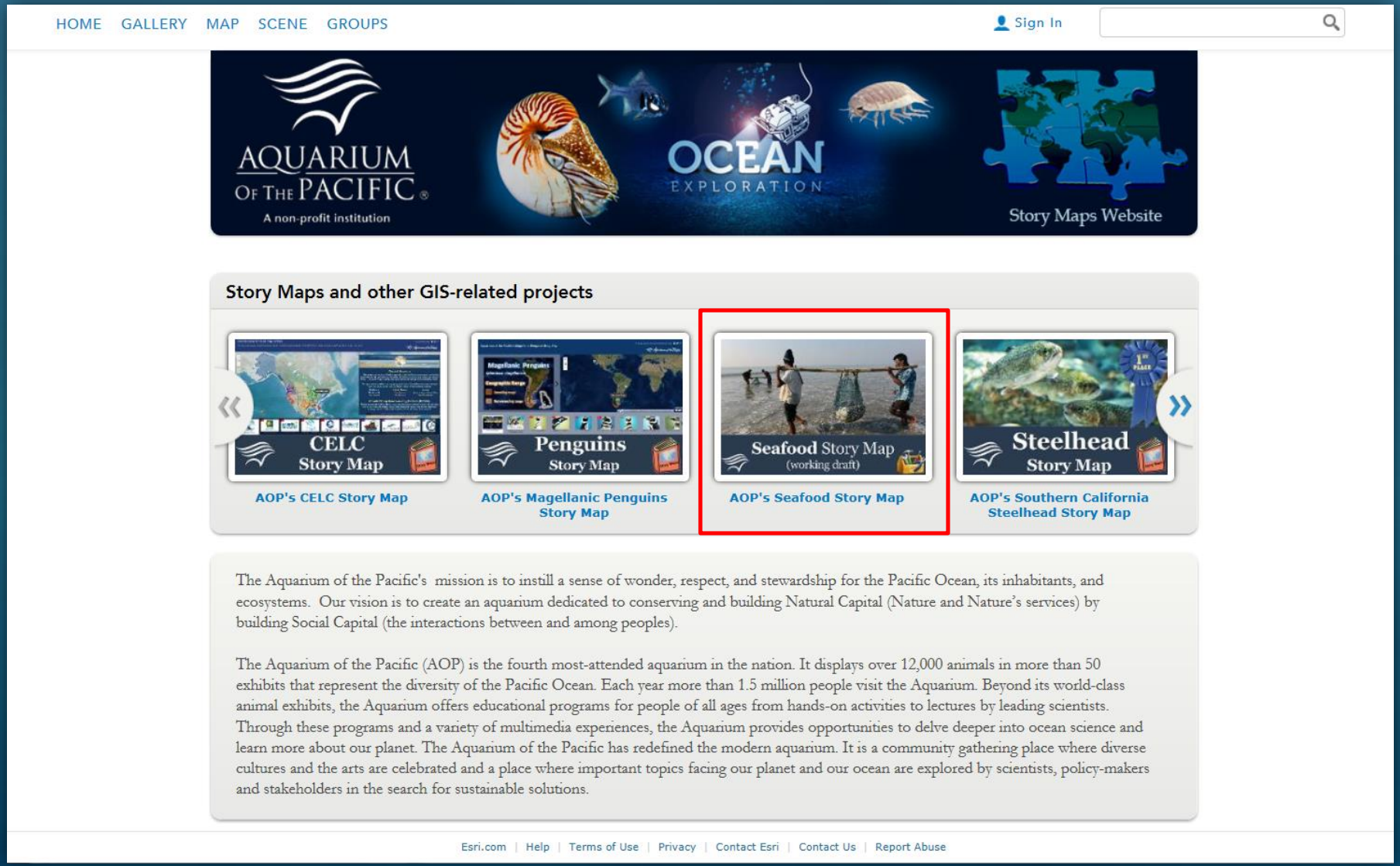
3 Main ways the Aquarium is using GIS

1. Using map-based interactives to engage guests, encouraging exploration and hands-on learning about exhibit animals, habitats, and the surrounding world

2. Showing K-12 educators how they can use GIS in the classroom

3. To communicate important environmental issues to politicians, local stakeholders, and the public

Sustainable Seafood Story Map



Sustainable Seafood Story Map

Aquarium of the Pacific

Seafood Story Map

Feeding A Growing Population

More than 3 billion people around the world depend on seafood as their primary source of protein and for many of them, it is their only source. Seafood is becoming the healthy protein choice for billions of others and as our population increases, the demand for seafood is increasing even faster.

Image (above): "Dependence on Seafood Protein" Seattle Times (2013) "Sea Change: Food for Millions at Risk" by Craig Welch. Data: Earthtrend Databased, World Resources Institute, and the Food and Agriculture Organization of the U. N.

16-17

Sustainable Seafood Story Map

Aquarium of the Pacific

Seafood Story Map

Overfishing

Today, nearly 30 percent of the world's fisheries are being harvested faster than they can replenish themselves and more than 60 percent are being fished at their maximum capacities, meaning that they cannot withstand additional fishing pressure.

Image (above): U.N. Food and Agriculture Organization (2014) ***State of the World Fisheries and Aquaculture***

Map (right): Worm et. al. (2009) ***Rebuilding Global Fisheries*** published by Science Magazine. Supplemental materials available at **The Future of Marine Animal Population** (FMAP).

The following is the figure legend provided by FMAP for this map:

"MMSY is "Multi-species maximum sustainable yield" - it is the level at which an ecosystem can maximally sustain fisheries yield across a number of species, not just one. Fishing below MMSY provides ecosystems with a chance to recover. PLEASE NOTE: Alaska (the East Bering Sea in particular) has never been fished above MMSY."

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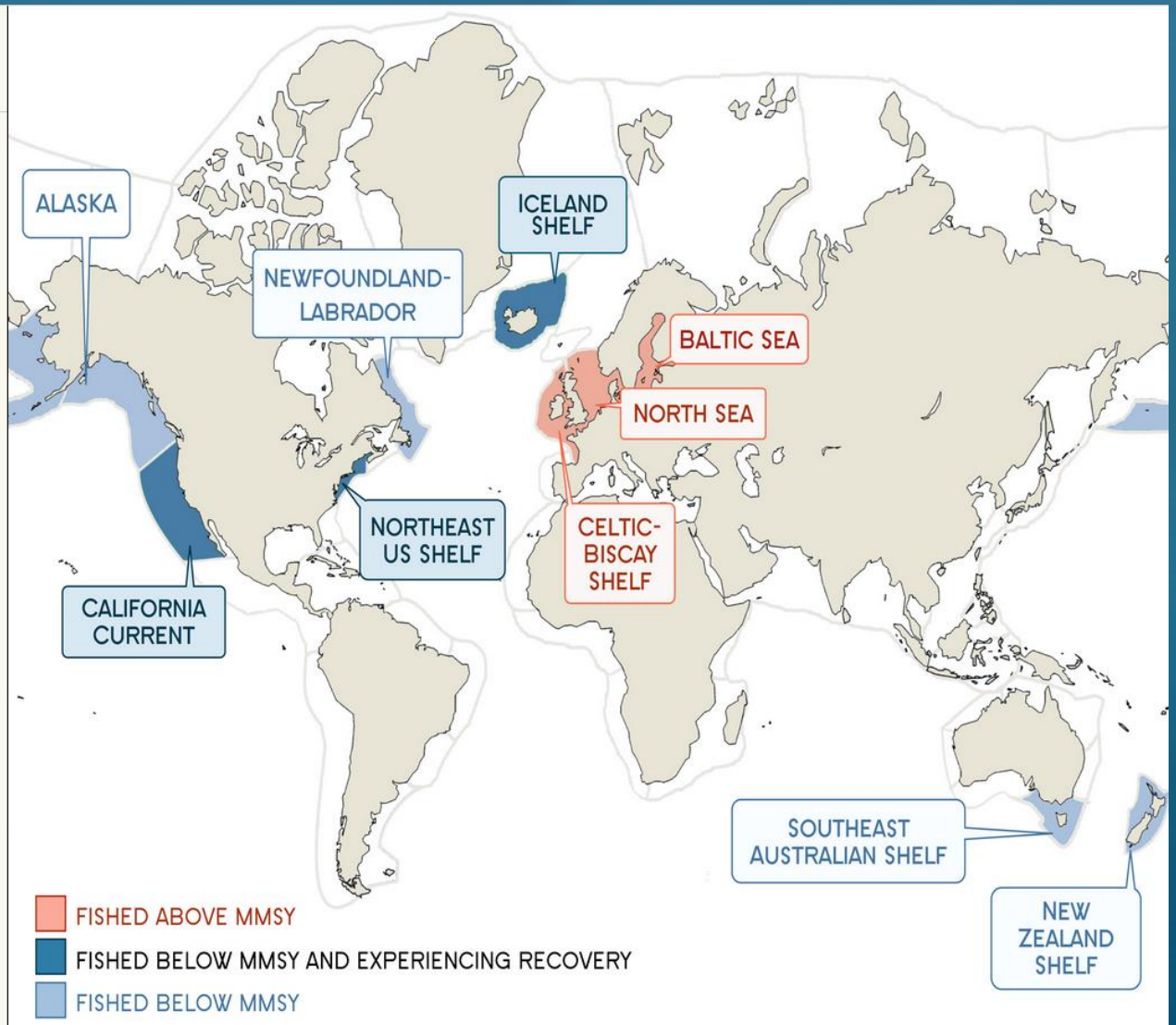
16-17



Sustainable Seafood Story Map

Aquarium of the Pacific

Seafood Story Map

Marine Aquaculture

There are many advantages of farming seafood in the marine environment, including fewer demands on space and fresh water.

But sustainable ocean aquaculture requires careful oversight. There have been numerous examples aquaculture operations around the world that are neither environmentally nor socially responsible. (see the "**Bad News**" image on the right)

But we know how to manage operations to produce quality seafood while maintaining healthy and productive ocean ecosystems. Recent advances in aquaculture science and technology have led to more sustainable systems. Many of those advances have been made in the U.S. (see the "**Good News**" image on the right)

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Seafood In The United States

Worldwide, seafood is one of the most traded commodities.

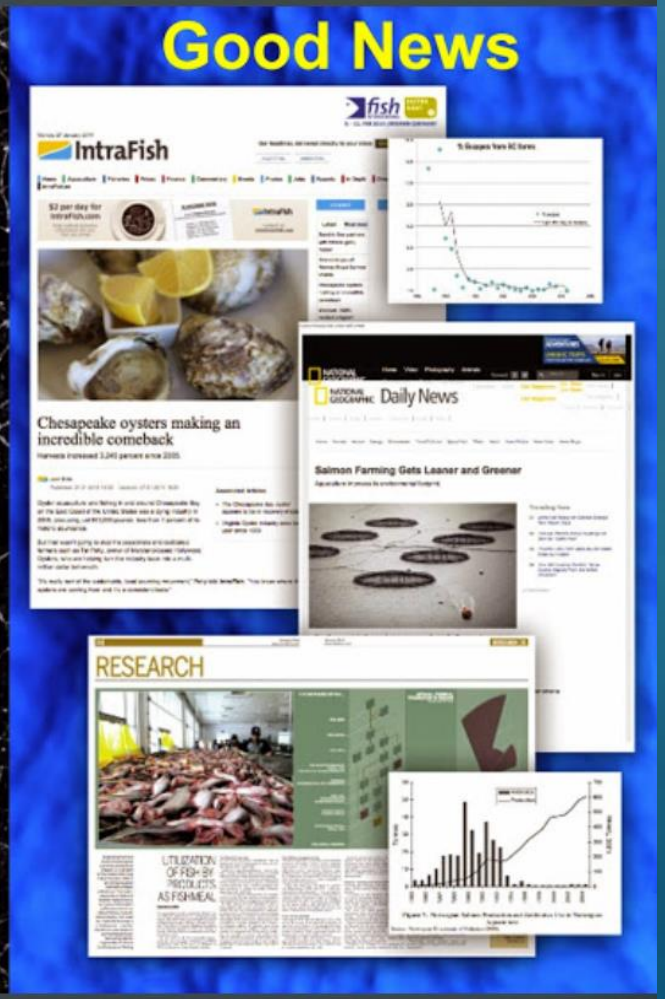
Fish is among the world's most traded food commodities

Worth almost US$130 billion (2012)

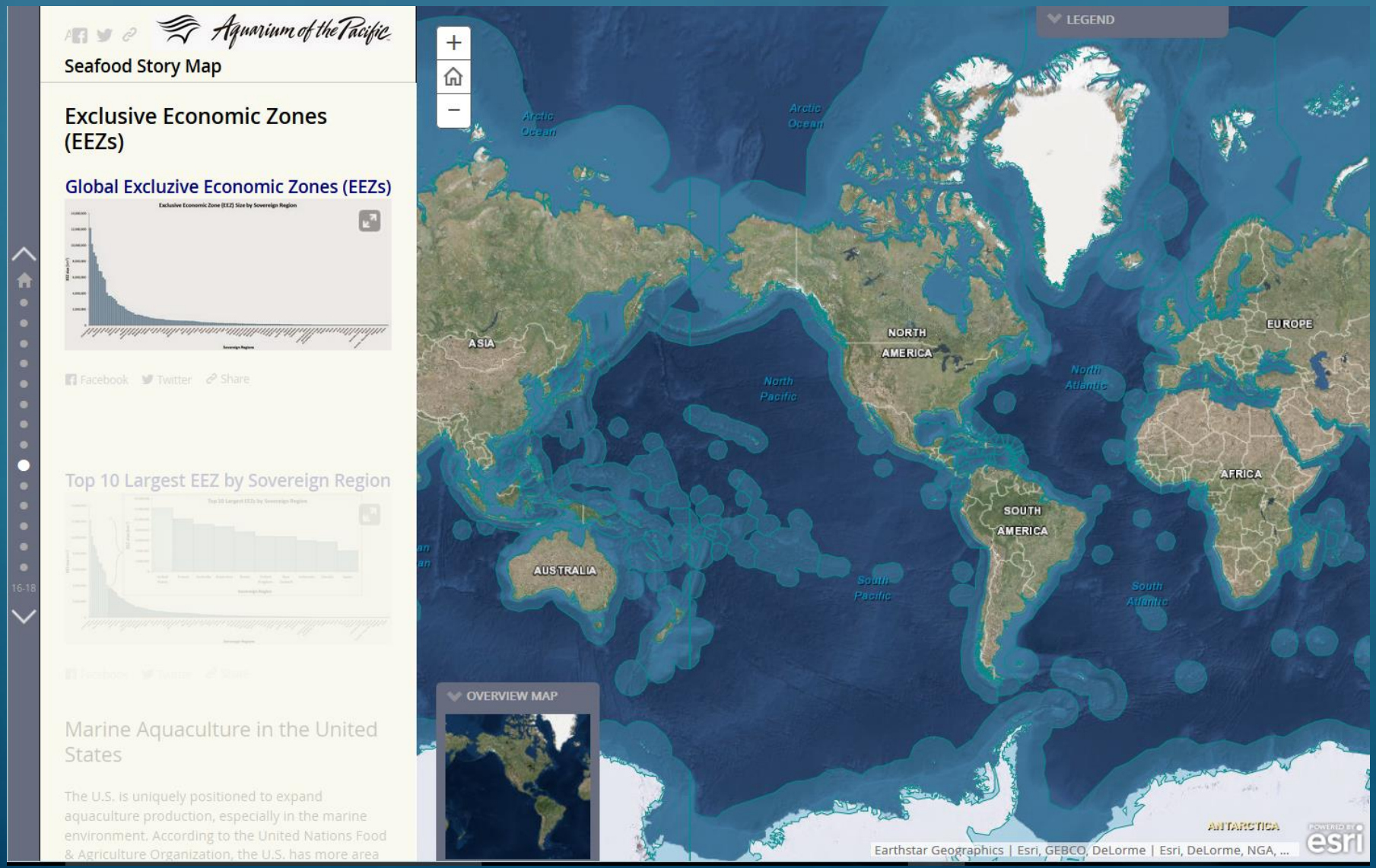
Developing economies account for 54% of total fishery exports by value

Developed economies account for 46% of total fishery exports by value

16-18



Sustainable Seafood Story Map



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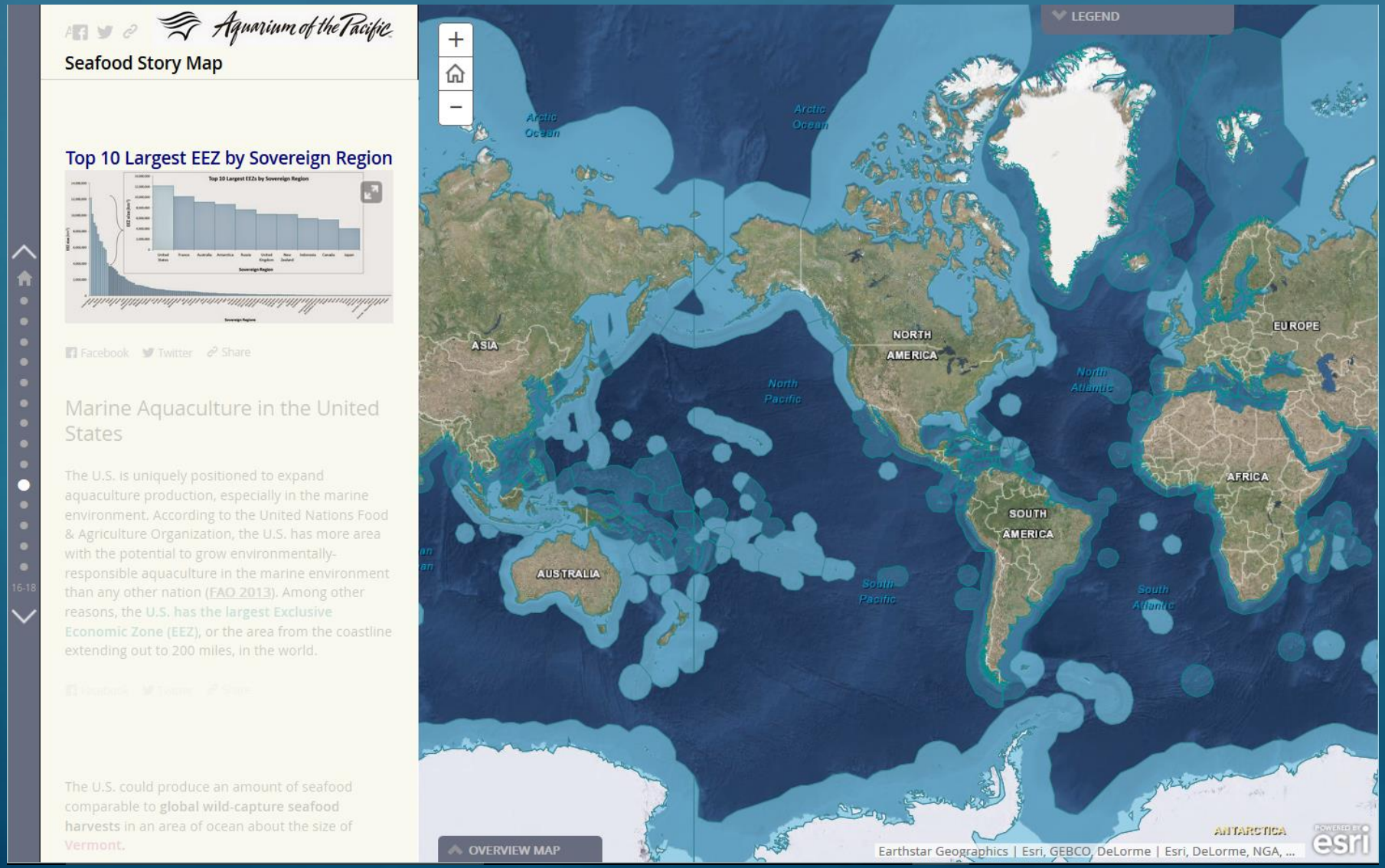

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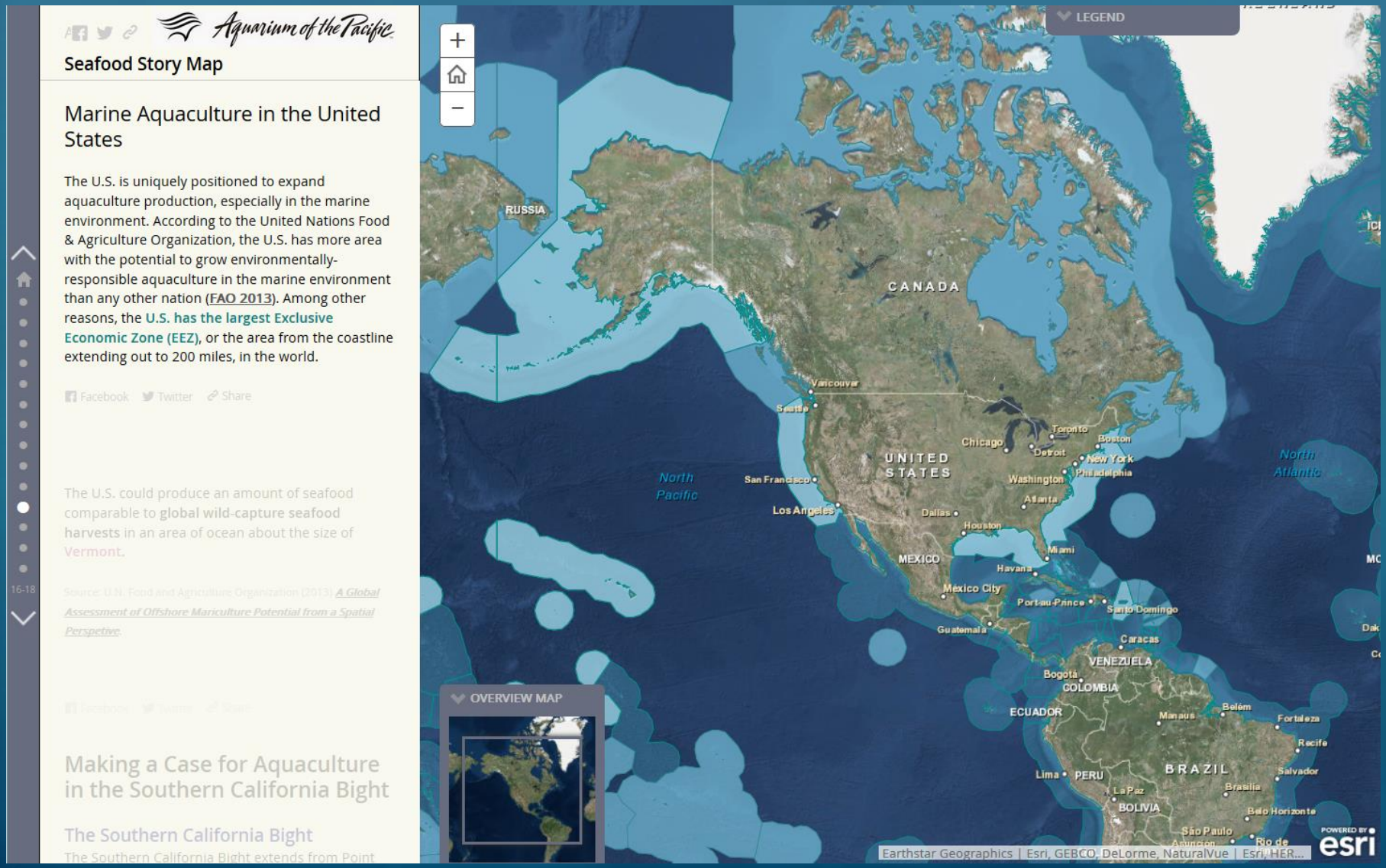

Sustainable Seafood Story Map

Aquarium of the Pacific

Seafood Story Map

The U.S. could produce an amount of seafood comparable to **global wild-capture seafood harvests** in an area of ocean about the size of Vermont.

Source: U.N. Food and Agriculture Organization (2013) ***A Global Assessment of Offshore Mariculture Potential from a Spatial Perspetive***.

To put the above statement into perspective, the entire State of Vermont fits into the Southern California Bight, with quite a bit of room to spare.

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Making a Case for Aquaculture in the Southern California Bight

The Southern California Bight

The Southern California Bight extends from Point

Sustainable Seafood Story Map

Aquarium of the Pacific

Seafood Story Map

The Future of Seafood

Globally, best management practices for fisheries and aquaculture is improving in many countries for various reasons, including international pressure and the collaborative efforts of multi-stakeholder groups working to improve fisheries and aquaculture in areas where management and enforcement are lacking.

In the United States, fishermen and aquaculture producers operate under one of the most comprehensive regulatory environments in the world. Seafood producers that are operating in U.S. waters must meet a suite of federal, state, and local regulations that ensure environmental protection, water quality, food safety, and protection of public health.

The U.S. has the science, technology, policy, and natural resource assets to produce environmentally-responsible seafood to meet our growing demand for seafood.

Image (above): NOAA Fisheries

Image (right): Aquarium of the Pacific (2014). ***Marine Aquaculture: Farming Seafood for People and the Planet.*** Created for NOAA Science on a Sphere.

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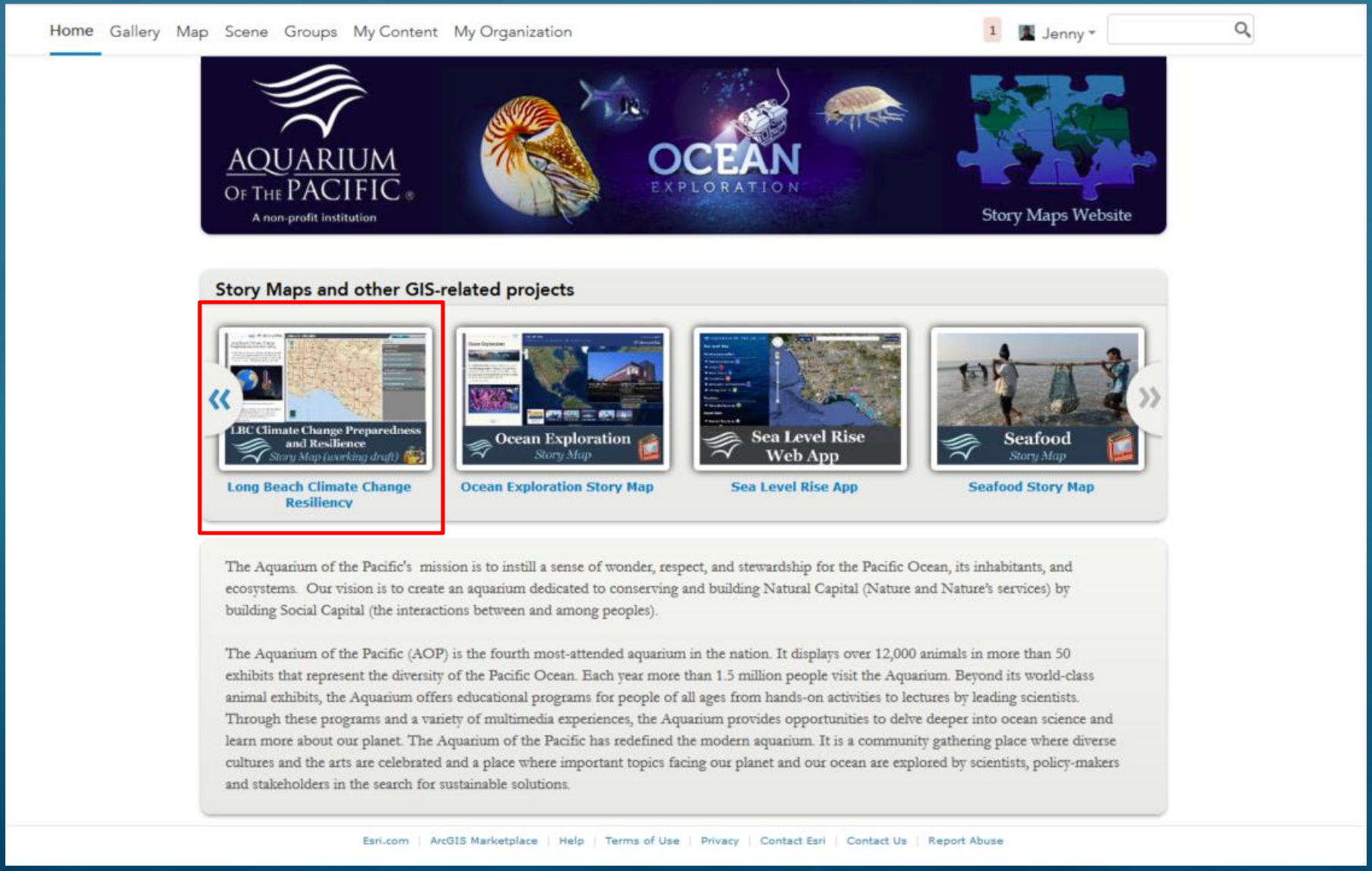
Long Beach Climate Resiliency Story Map



Long Beach Climate Resiliency Story Map

Aquarium of the Pacific

Long Beach Climate Change Preparedness and Resiliency

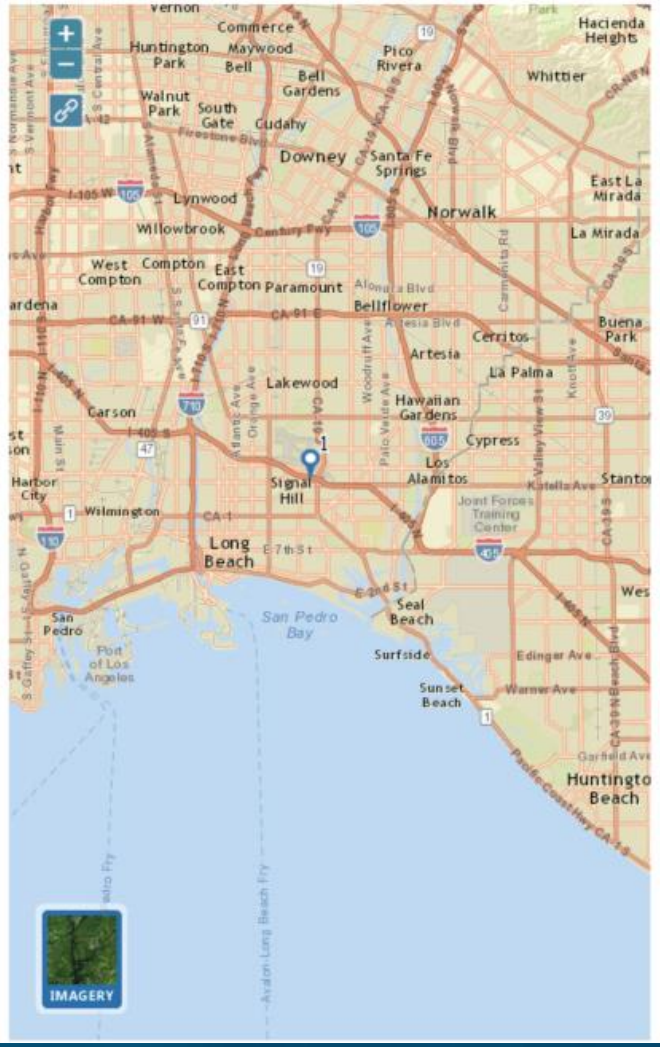
In his January 2015, State of the City Address, Long Beach City Mayor, **Dr. Robert Garcia**, announced the city was partnering with the Aquarium of the Pacific and scientific experts to create a "**Climate Resiliency Action Plan.**"

The above photo is from the Long Beach Post's January 14, 2015 article "Mayor Robert Garcia's state of the City Address: Long Beach Strong, Getting Stronger"

The "**Climate Explorer**" interactive map on the right was created by the **U.S. Climate**

CLIMATE EXPLORER

LAYERS | HISTORICAL DATA



TOPICS:

Coastal Flood Risk

Climate Stressors

- Inundation from Sea Level Rise (1ft)
- Inundation from Sea Level Rise (2ft)
- Inundation from Sea Level Rise (3ft)

People and Assets Impacted

- Population Density (2000)
- Coastal Vulnerability to Sea Level Rise
- Social Vulnerability Index

LAYER INFORMATION

Long Beach Climate Resiliency Story Map

Aquarium of the Pacific

Long Beach Climate Change Preparedness and Resiliency

Heat Waves

Cal Adapt information and images of heatwaves. - http://cal-adapt.org/temperature/heat/

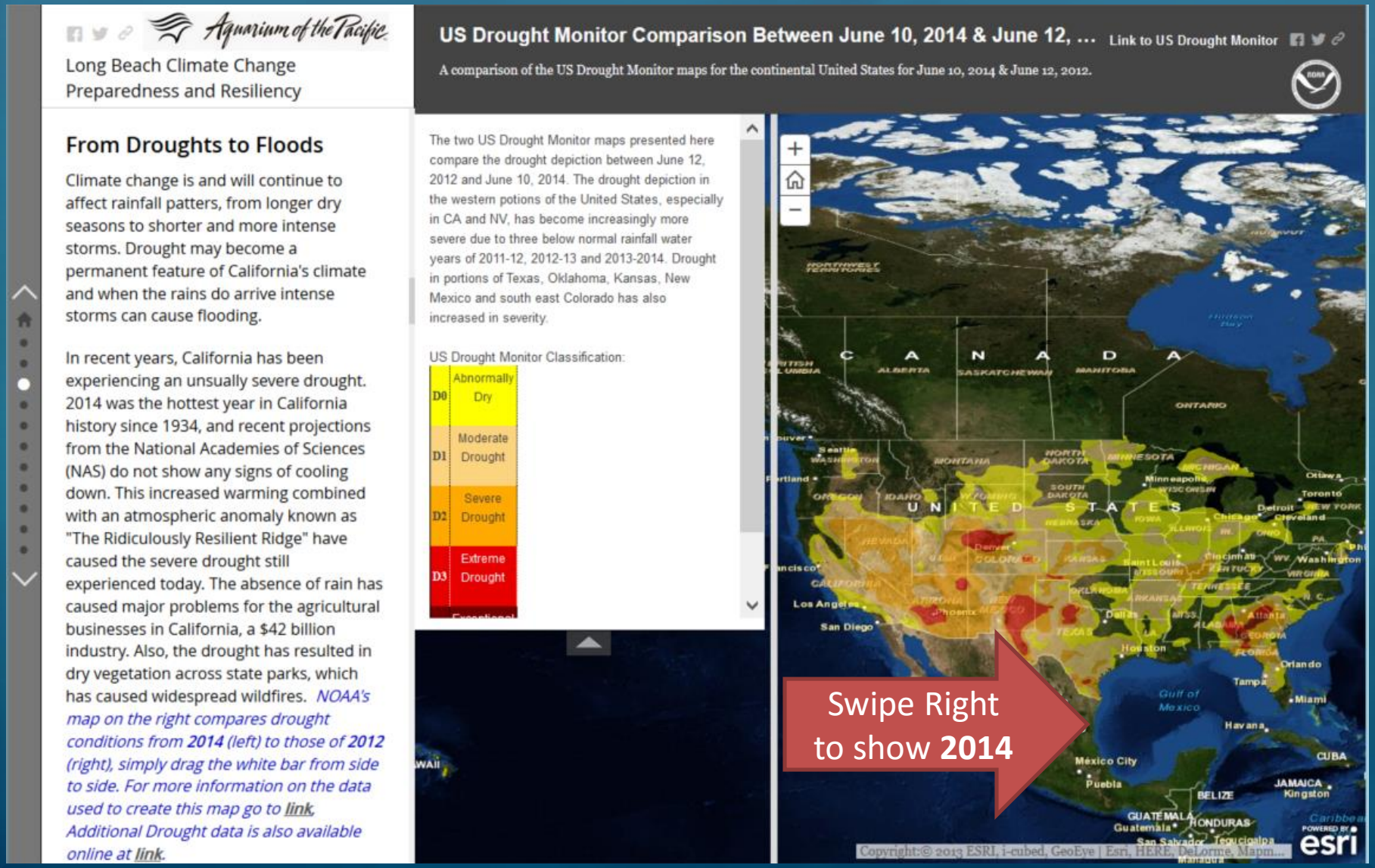
What is the Urban Heat Island Effect?

To learn more about urban heat islands see http://education.nationalgeographic.com/encyclopedia/urban-heat-island/

To find out how to protect yourself during a heat wave see http://www2.epa.gov/natural-disasters/extreme-heat

Image at right: Chicago Tribune http://www.chicagotribune.com/news/ct-chicago-heat-wave-20-years-later-met-20150715-story.html

Long Beach Climate Resiliency Story Map



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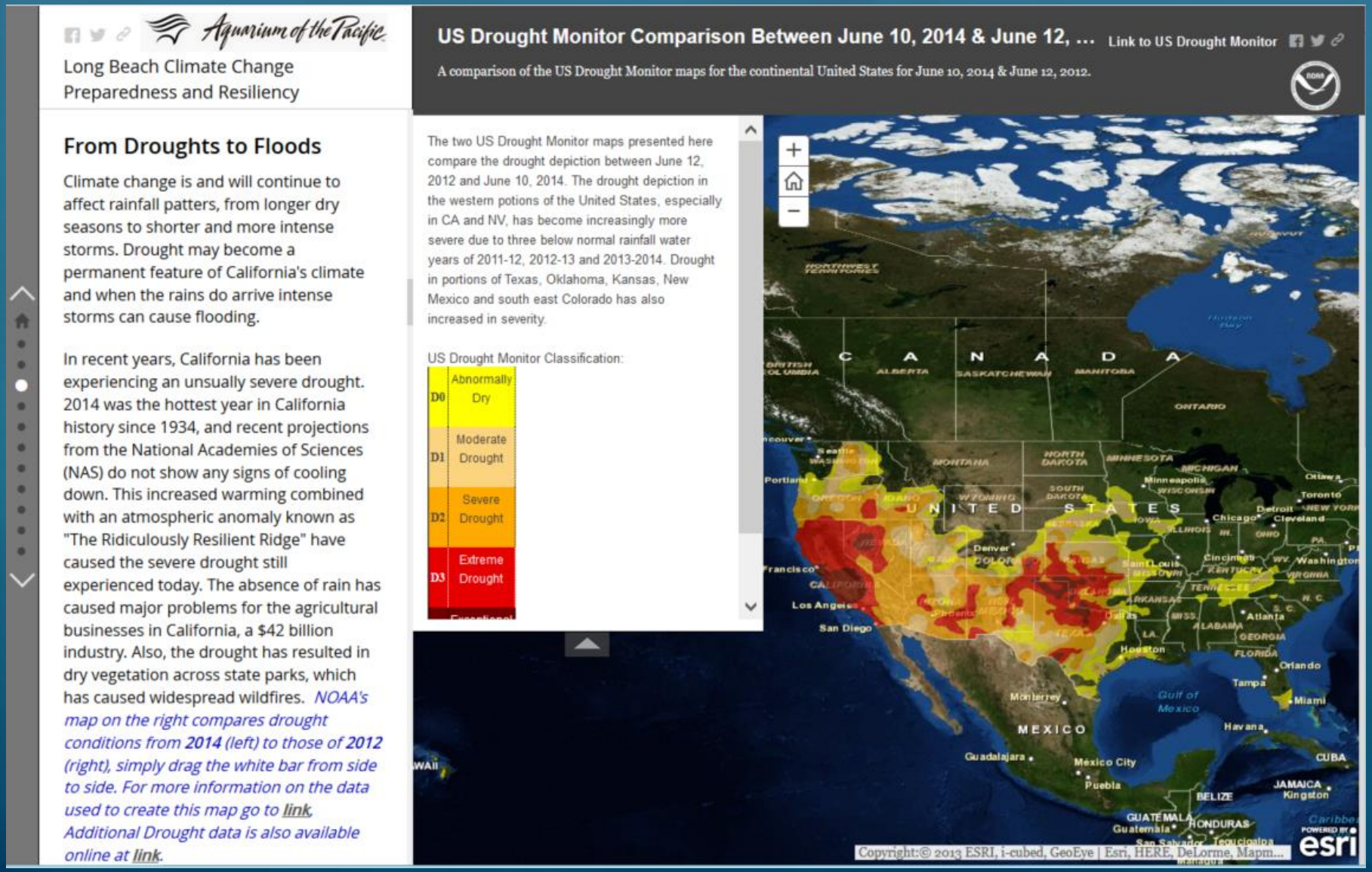
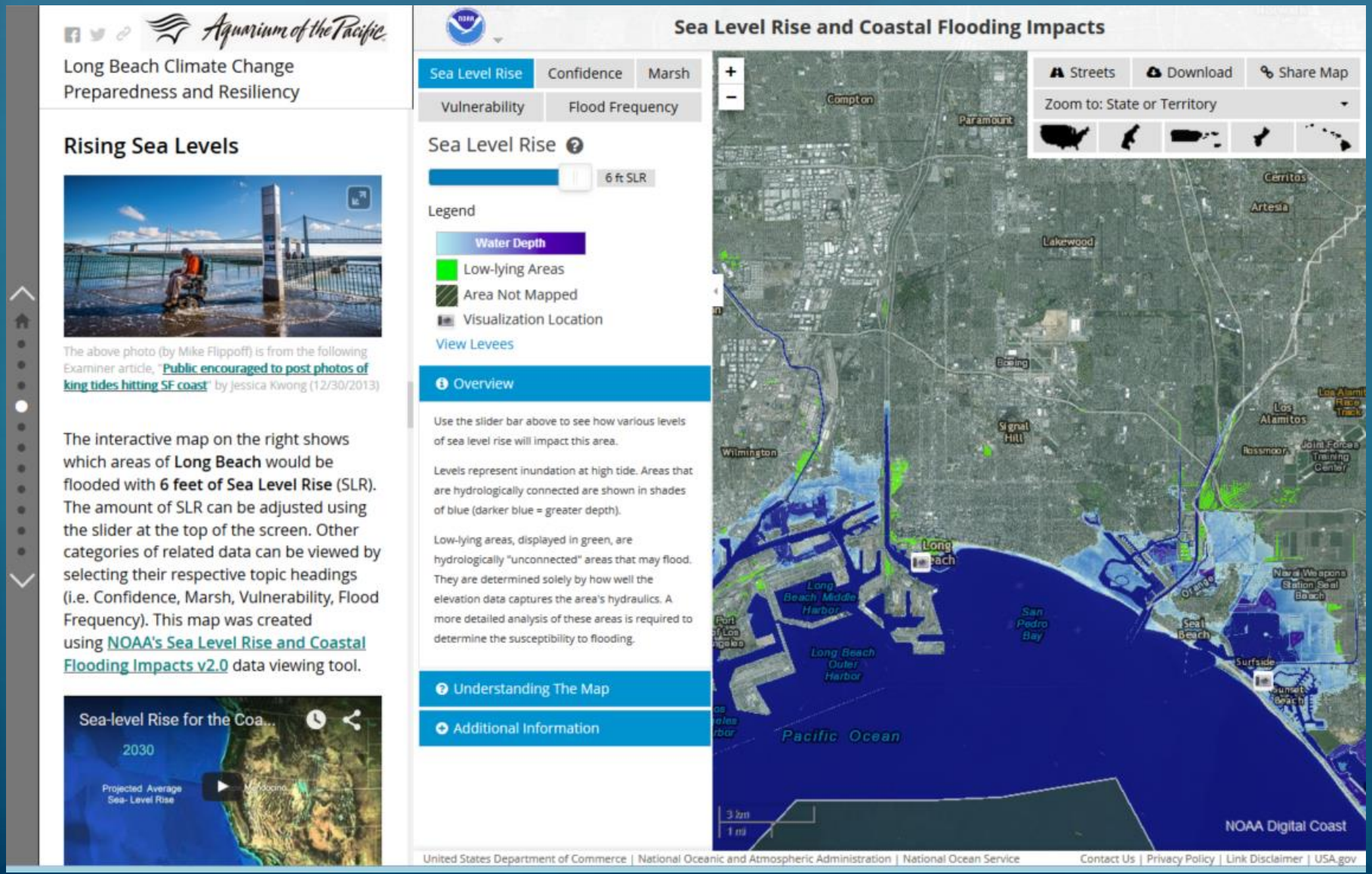


Long Beach Climate Resiliency Story Map



Long Beach Climate Resiliency Story Map

Aquarium of the Pacific

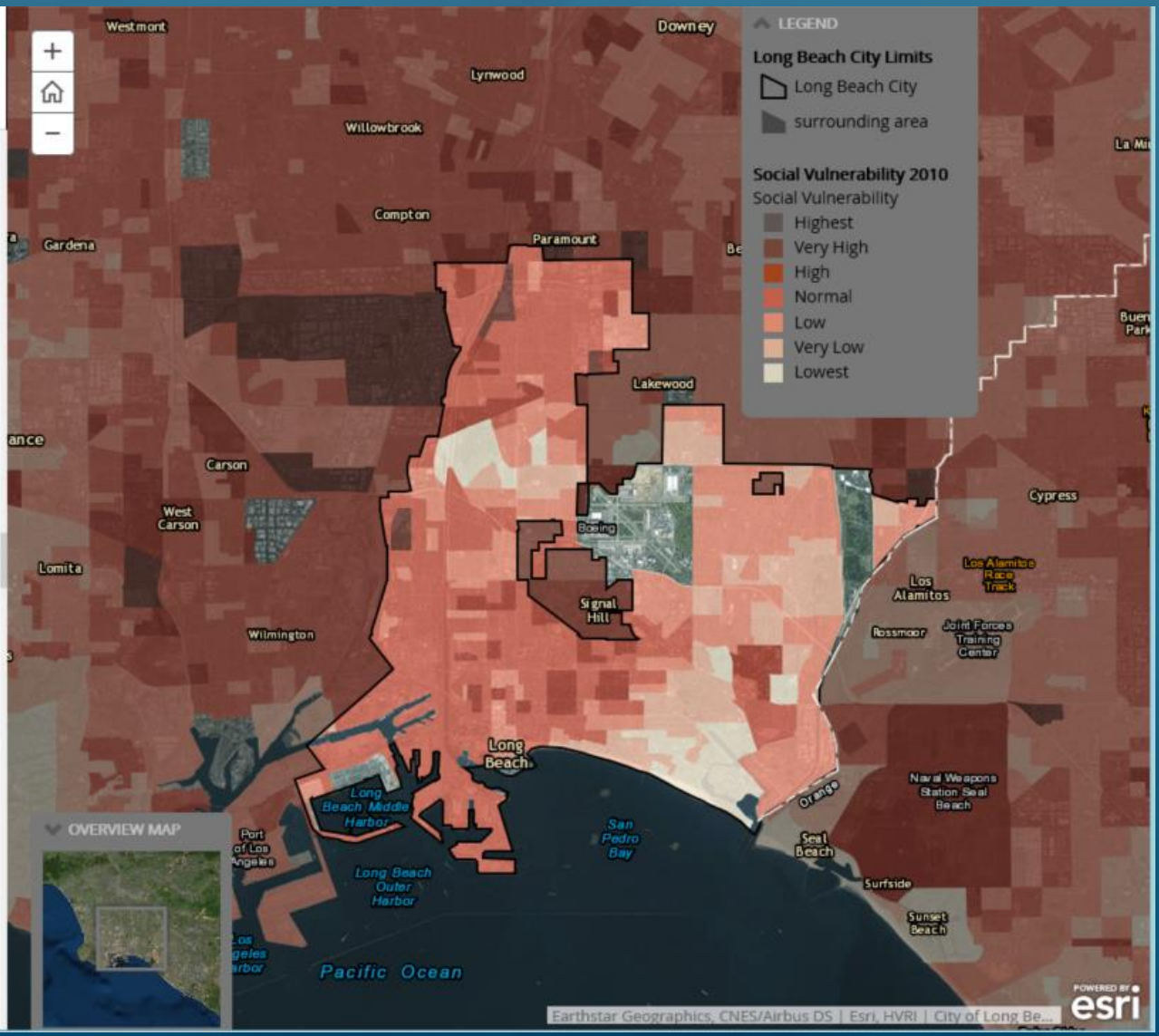
Long Beach Climate Change Preparedness and Resiliency

Impacting Our Most Vulnerable

the above image is from TreePeople Blog's website (http://blog.treepeople.org/)

The impacts of climate change do not affect all equally. The poor, elderly, kids, and sick are impacted worst and first when heat waves, droughts, flooding, and other disasters strike. In addition, those who are already socially marginalized and face pre-existing inequalities have fewer resources to respond to these calamities. In other words, climate change worsens socio-economic inequalities. This makes addressing climate change a particular challenge. However with this challenge also comes the opportunity to make our city more equitable while growing the local economy as we prepare for climate change. The following maps use data from the State of California to identify where and who in the city must be prioritized for building a safer and more resilient Long Beach.

Exposure to



Long Beach Climate Resiliency Story Map

Aquarium of the Pacific

Long Beach Climate Change Preparedness and Resiliency

Poverty

Poverty comes with significant societal disadvantages while conversely wealth brings great benefits. The same is true in regards to climate change risk and preparedness. The poorest populations have the least amount of resources to draw on for adapting and responding to extreme weather events like heat waves. For example, when a heat wave strikes not everyone has the financial resources to run fans and air conditioning units, let alone have these amenities in their homes or apartments. Those experiencing homelessness may not even have access to shelter and therefore face even greater threats from being outdoors during climate extremes like severe storms and high temperatures.

For the CalEnviroScreen tool the California Environmental Protection Agency defined those in poverty as individuals living below twice the federal poverty line. This threshold was used to account for California's high cost of living. Within Long Beach distinct pockets of poverty are apparent.

Orange County Register, 2013

Poverty Demographics

an AOP story map

Aquarium of the Pacific

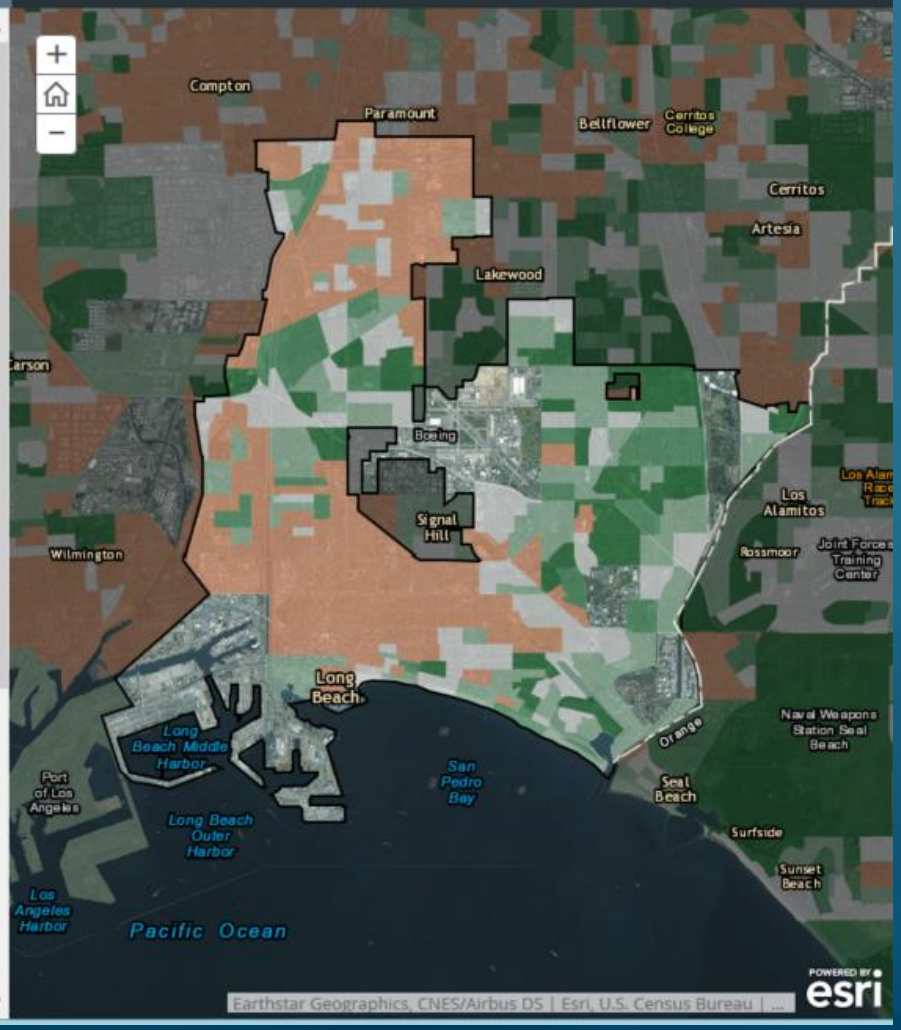
Poverty Ratio | Below Poverty Level

Ratio of Households Living Above and Below the Poverty Line

This map was created by AtlasPublisher and shows "the ratio of households living above the poverty line to households living below the poverty line. For the U.S. overall, there are **6.2** households living **above** the poverty line for every household living below. This map is shaded to clearly show which areas have about the same ratio as the U.S. overall, and which areas have far more families living above poverty or far more families living below poverty than 'normal.'"

The poverty threshold used in this map is based on the US Census Bureau's definition of poverty (for more information on how they measure poverty, please see link).

For more information on this web map please see link



Long Beach Climate Resiliency Story Map

Aquarium of the Pacific

Long Beach Climate Change Preparedness and Resiliency

Children and Elderly

Children and the elderly are particularly vulnerable to environmental and health impacts, from heat waves to droughts to changes in air quality. The elderly are more likely to have other health conditions which make their immune systems particularly susceptible when smog is worsened during extreme heat. Youth and the elderly are important populations for targeting outreach and preventative care around the effects of climate change. The map at right shows the percent of the population under the age of 10 and over the age of 65 for all census tracts within the city.

The above image is from the Healthy Schools Campaign's National Green Schoolyards Summit website

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Respiratory Ailments

Changes in temperature and rainfall patterns impact public health. Droughts and heat waves worsen both cardiovascular problems and respiratory ailments. As our cities become hotter smog may worsen with increasing levels of ozone. The health concerns of

Age Demographics

an AOP story map Aquarium of the Pacific

Median Age | Under 18 | 18 - 64 | 65 and over

Median Age of the US Population

This map was created by Esri and "shows the median age of people in the United States in 2012. The median age for the U.S. is 37 years of age. The data shown is from Esri's 2012 Updated Demographics. The map adds increasing level of detail as you zoom in, from state, to county, to ZIP Code, to tract, to block group data. This map shows Esri's 2012 estimates using Census 2010 geographies. Information about the USA Median Age map service used in this map is here. " for more information see link

Long Beach City Limits

Long Beach City

surrounding area

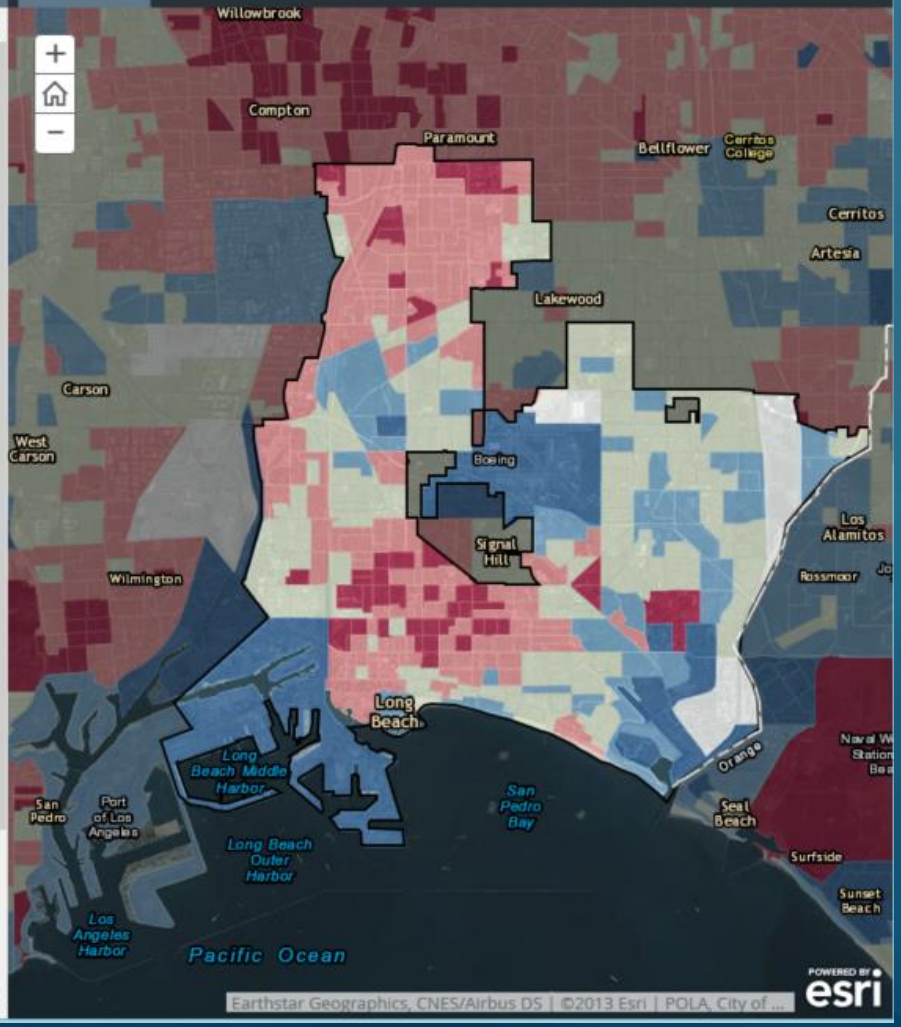
2012 USA Median Age (Mature Support)

Median Age

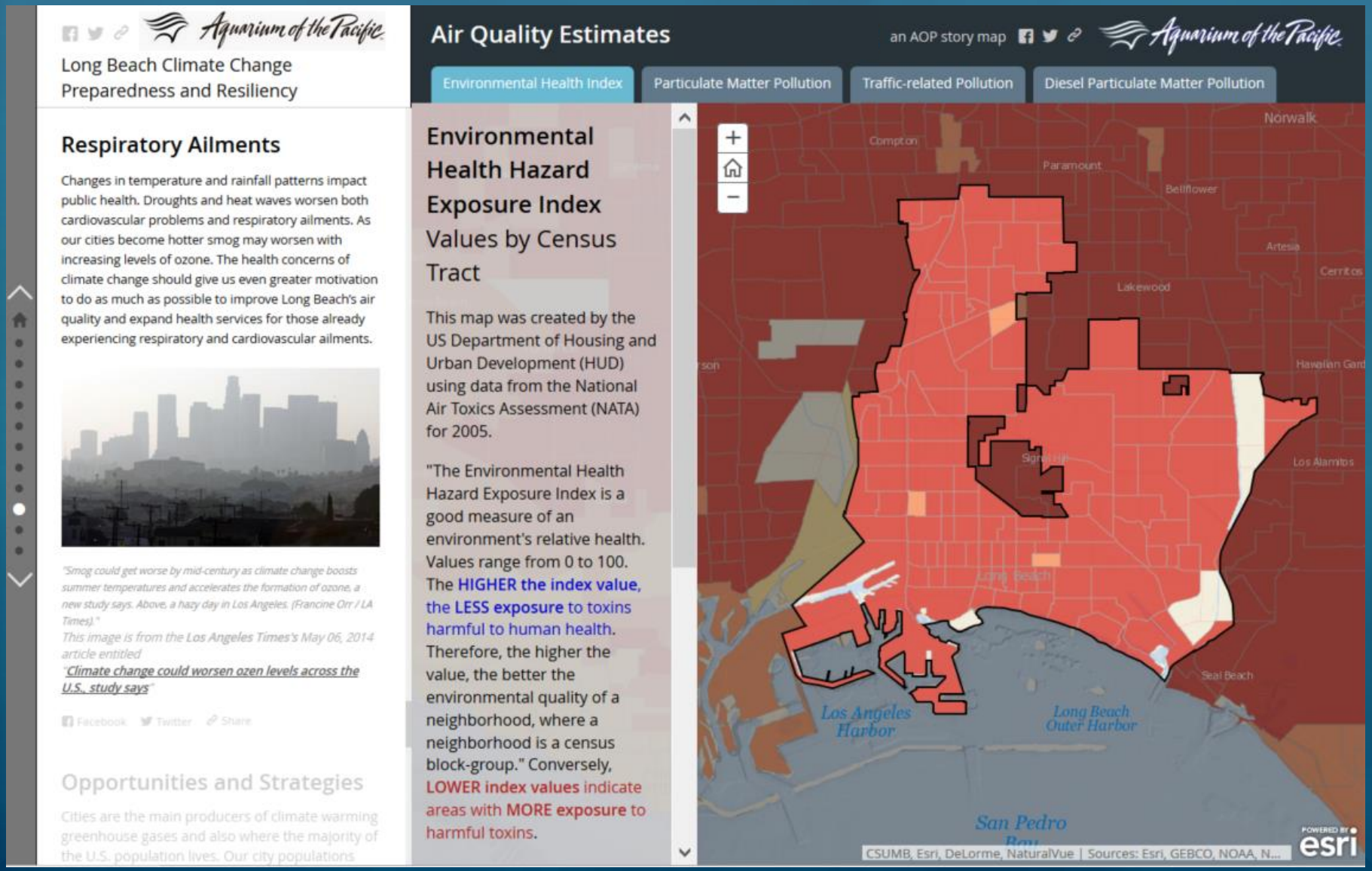
Block Groups

52.1 years or older

43.1 to 52 years old



Long Beach Climate Resiliency Story Map



Long Beach Climate Resiliency Story Map

Aquarium of the Pacific

Long Beach Climate Change Preparedness and Resiliency

How to be Part of the Solution

The above photo by JL/Flickr was part of the following article entitled "What's the Best Path to a Sustainable Future?" (published online March 17, 2015)

Everyone in Long Beach has a role to play in addressing the concerns of climate change on our city. Our first step can be to take the medical approach of do no harm. This would entail an accounting of our greenhouse gas emissions and doing all we can to reduce our contribution to climate change both individually and colelctively. However even if we were to completely decrease our greenhouse gas emissions to zero today, due to the emissions that have already been released we will continue to see the impacts of our previous actions. Therefore adaptation and mitigation must go hand in hand. Many cities across the globe are coming up with inventive and imaginative strategies to take action. Across our city many organizations are working to improve our air quality, green our neighborhoods and increase walkability, expand community health services, and connect with other cities and organizations to share best practices.

To learn more about how various places across the U.S. are addressing climate change see the **U.S. Climate Resilience Toolkit**.

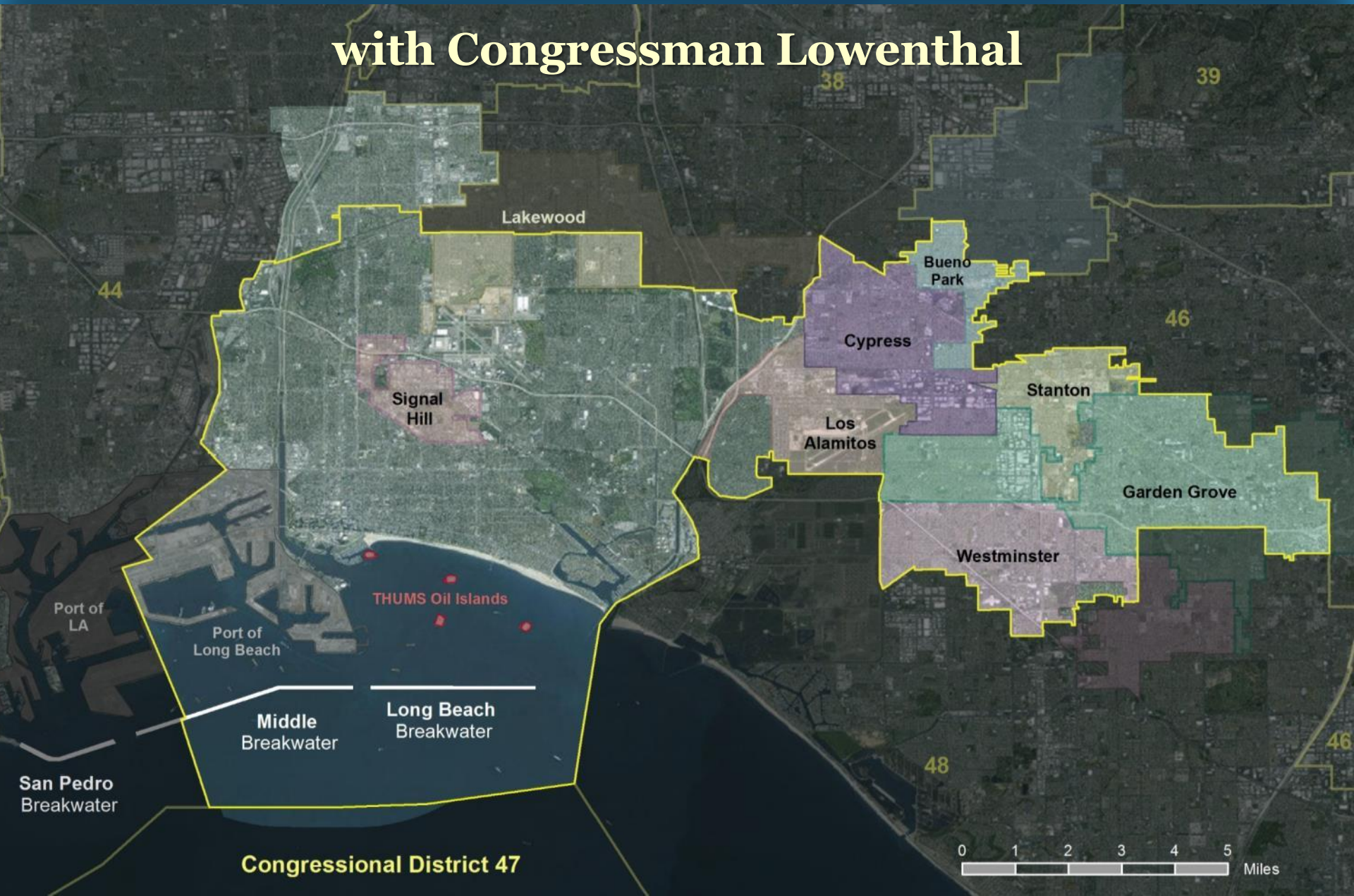
A story map esri

Water & Climate Resilience

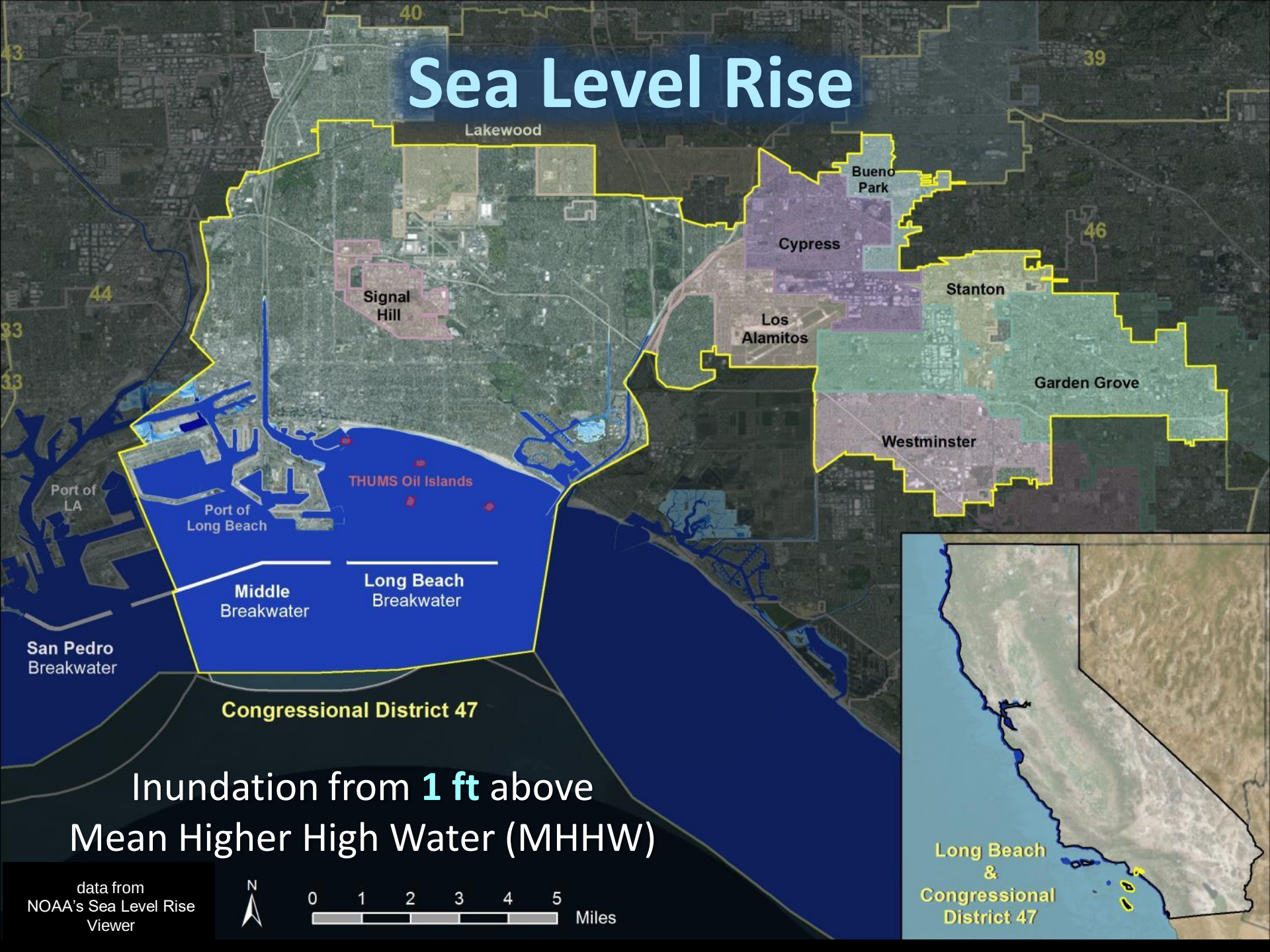
"Water is life," many would say, yet access to clean water is decreasing as temperatures and drought increase. Local, state, and federal governments have taken actions to protect water as a precious resources and mitigate coastal flooding. National flood insurance programs, sustainable agricultural policies, and clean water infrastructure are just some of the resilient actions being implemented.

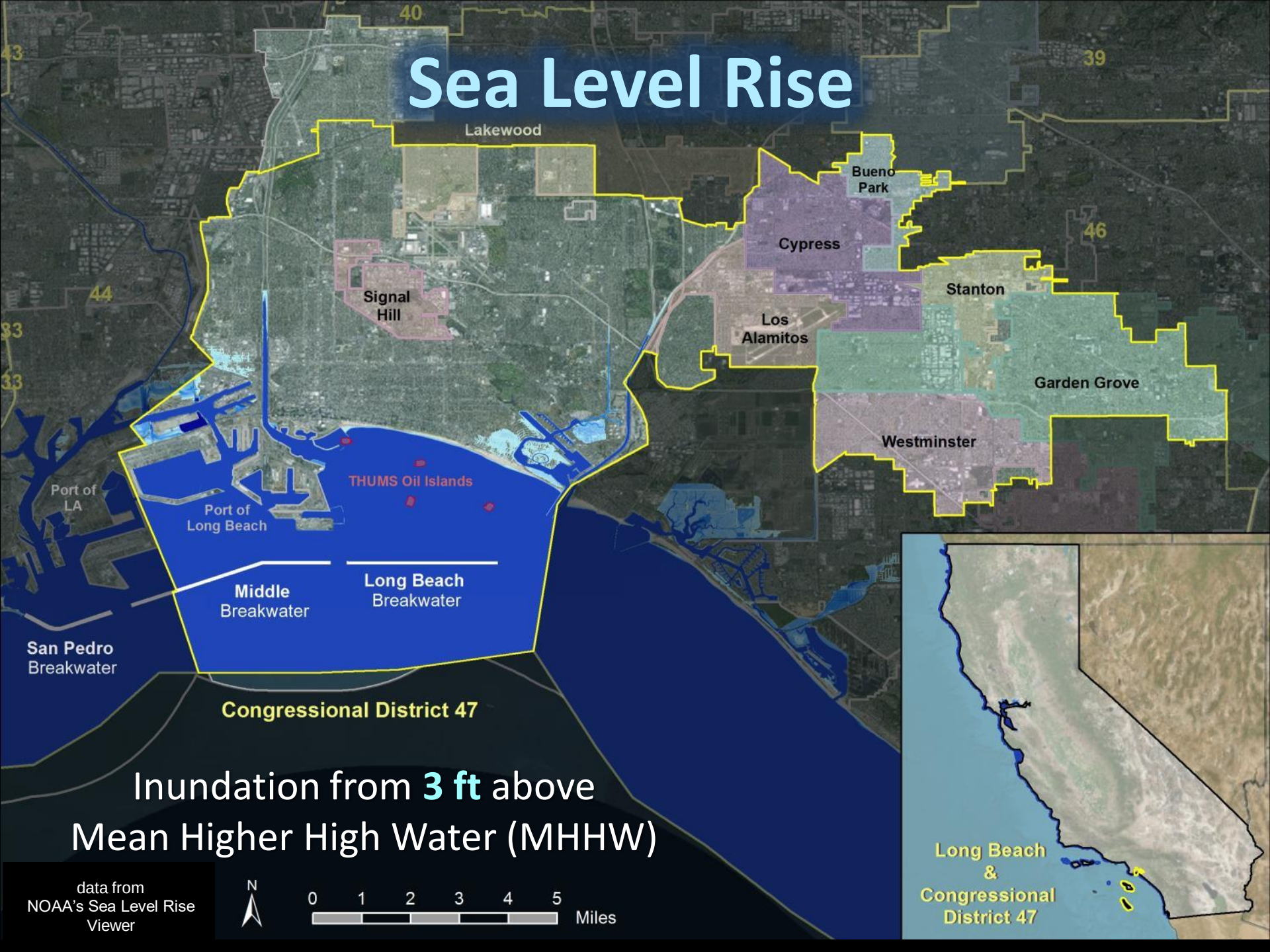
Climate Change Forum

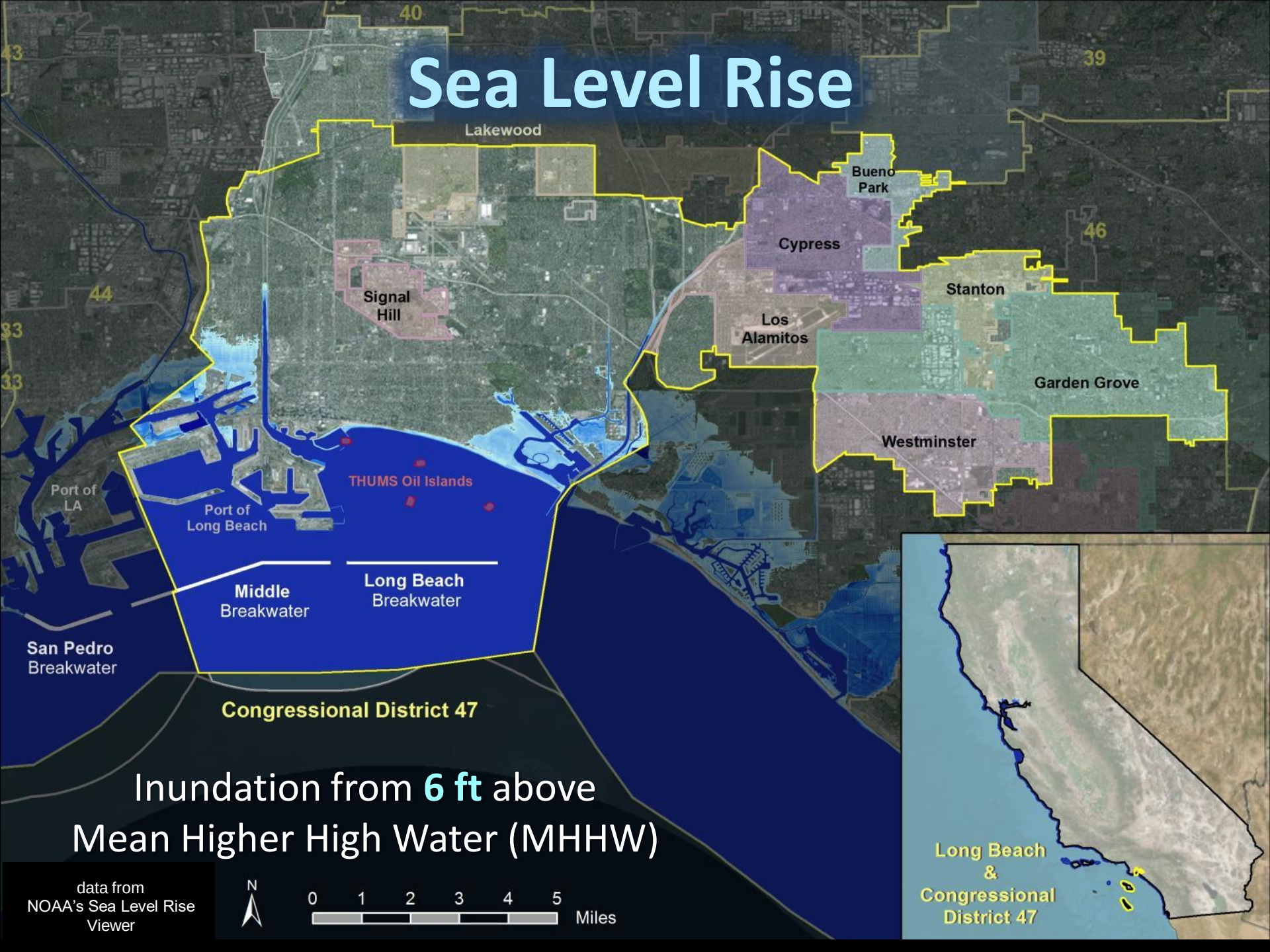
with Congressman Lowenthal



Sea Level Rise




Sea Level Rise
Lakewood
Bueno Park
Cypress
Signal Hill
Stanton
Los Alamitos
Garden Grove
Westminster
Port of LA
Port of Long Beach
THUMS Oil Islands
Middle Breakwater
Long Beach Breakwater
San Pedro Breakwater
Congressional District 47
Inundation from 3 ft above Mean Higher High Water (MHHW)
data from NOAA's Sea Level Rise Viewer
N
0 1 2 3 4 5
Miles
Long Beach & Congressional District 47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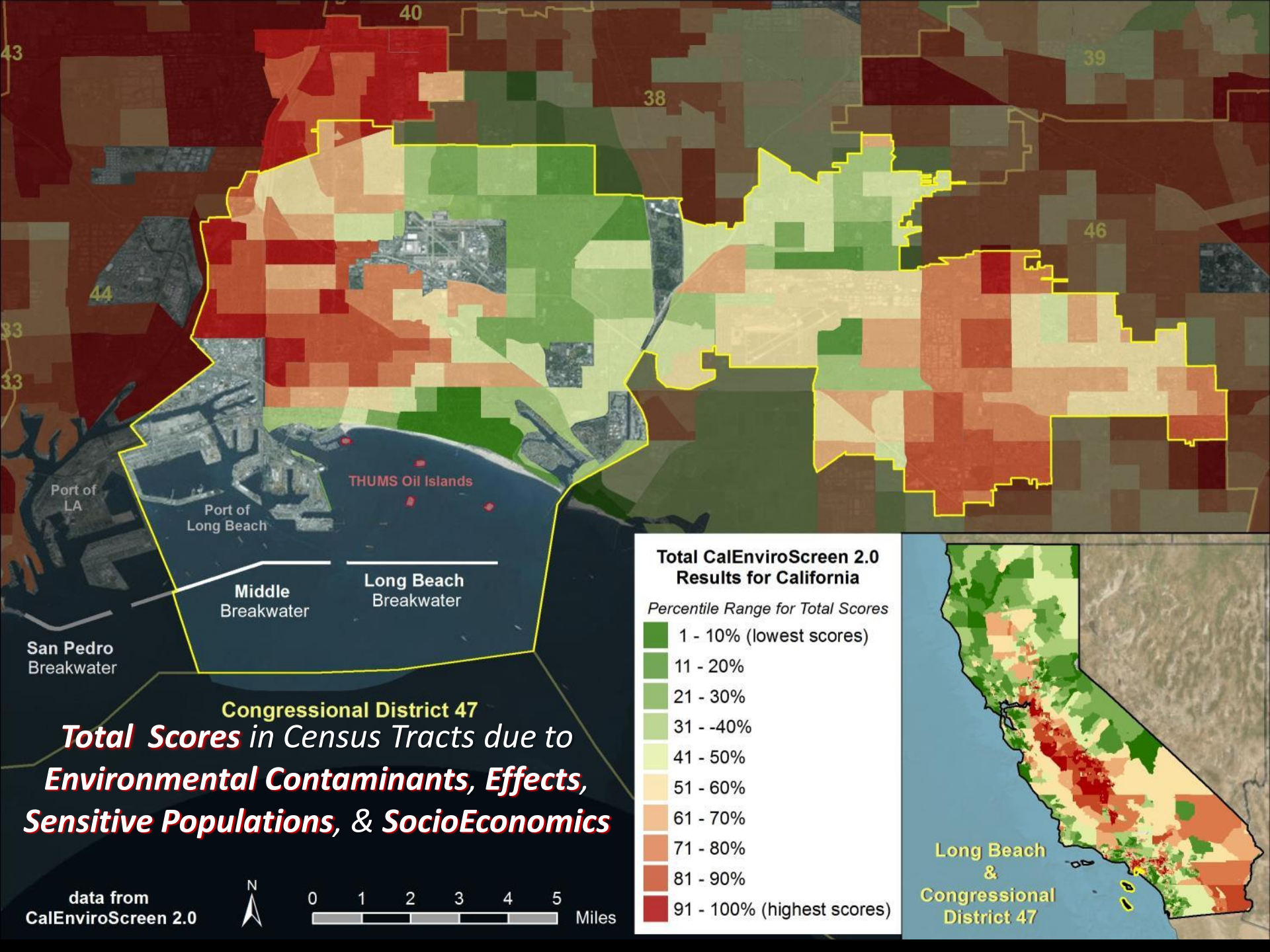

Total Scores *in Census Tracts due to* ***Environmental Contaminants, Effects, Sensitive Populations*** *&* ***SocioEconomics***

Our Challenge:
Finding the Right Balance between our Live Animal Exhibits and Digital Interactives

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Websites:

AquariumofPacific.org

AOP.maps.arcgis.org

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