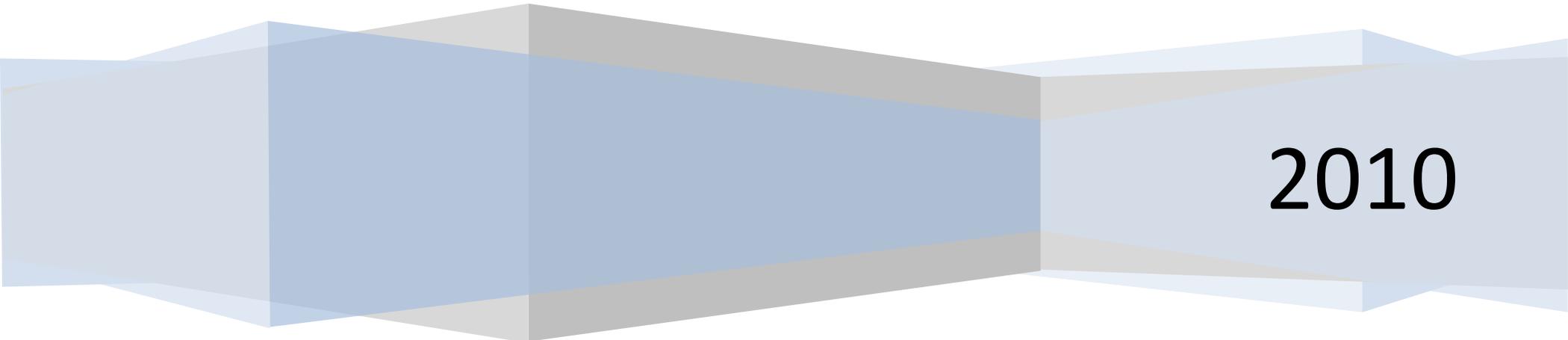


The Urban Harbors Institute, University of Massachusetts-Boston.

# Indicator Visualization Catalog

Prepared for the Massachusetts Ocean Partnership

Robert E. Bowen & Marin Kress



2010

## **Author Contact Information**

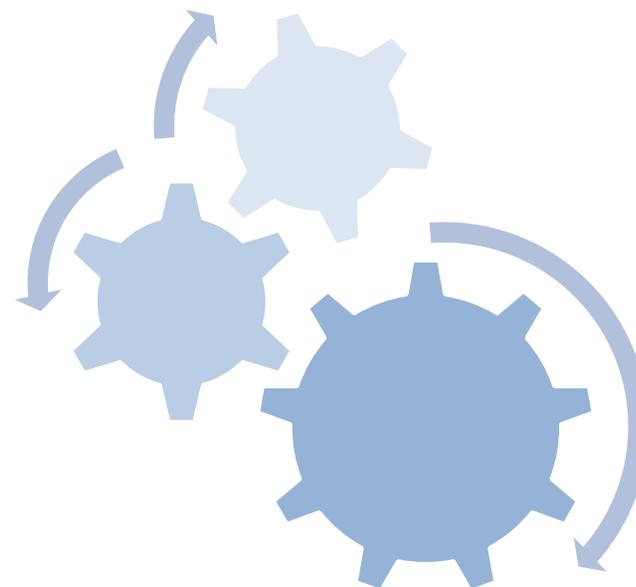
Robert E. Bowen  
Environmental, Earth, and Ocean Science Dept  
University of Massachusetts – Boston  
100 Morrissey Blvd  
Boston, MA 02125  
bob.bowen@umb.edu  
Tel: 617-287-7443

Marin Kress  
School of Marine Sciences  
University of Massachusetts – Boston  
100 Morrissey Blvd  
Boston, MA 02125  
marin.kress001@umb.edu  
Tel: 617-287-7440

The Urban Harbors Institute  
University of Massachusetts – Boston  
100 Morrissey Blvd  
Boston, MA 02125  
Urban.harbors@umb.edu  
Tel: 617-287-5570  
Fax: 617-287-5575

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## Introduction

This catalog emerges from a multi-disciplinary effort to understand and assess the relationship between social dynamics and environmental change. Socio-economic, demographic, geographic, biologic, chemical and physical data must all be used – in context – to move toward an integrated understanding in support of sustainable governance. The rich literature surrounding this topic is remarkable in its complexity and diversity of source. Ways to share insight across disciplines are needed if stakeholder groups are to communicate effectively.

This catalog is designed to emphasize and illustrate the need to bring visual tools to this broader indicator effort. Absent the development and use of visual tools to communicate relationships and trends in those data, stakeholders (including the scientific community) can become mired and confused by the volume of information needed by and available to them. One conclusion that can be drawn from this catalog is that visual tools hold enormous promise to help reveal a measure of insight that simple numeric representation cannot. And, because of breadth of disciplinary information relevant to these complex social/environmental questions, the authors believe that visual tools may be of equal value

to **all** stakeholders engaged in these questions. Visualization can be the common currency that bridges the intellectual cultures of individual stakeholder communities interested in a more effective way forward.

This project is the result of collaboration between the Massachusetts Ocean Partnership, the Environmental, Earth and Ocean Sciences (EEOS) Department and the Urban Harbors Institute of the University of Massachusetts-Boston. The catalog of visualizations compiled here is not an end point; rather, we hope it will be a starting point- for discussion, debate and collaboration. All of the examples included were collected between June and December, 2010. All were publicly available on the internet, often as part of larger reports originally designed to appear in print. Available access to information and research results is necessary, but is it sufficient? In an age increasingly defined by competition for attention, information, no matter how uniquely rigorous, may find too limited an audience. Results must increasingly be not only reliable, but intellectually accessible to those for whom the relevance is not always immediately evident.

These examples were selected for their variety of styles and are the result of a broad,

structured – but, obviously a non-exhaustive – search of relevant, publically available sources. This catalog is divided into three main categories, with a scope that progressively widens from local examples to visualization solutions from further afield. Each page is dedicated to one example used to convey information or results by an organization. There are multiple entries from the same source when it was deemed valuable to the overall effort. Readers can use this catalog to familiarize themselves with current indicator visualization styles, to find new models for their own data presentation needs, or as a resource for the development of new visualization tools.

The question left understandably unaddressed in this catalog is “which visual tool is best”? This is a challenging question. Visualization, by its nature, holds an esthetic that will be valued differently by almost every viewer. It is akin to asking whether one prefers Vermeer over Picasso. Esthetics are held as deeply personal. Therefore, absent an independent and systemic evaluation of these particular tools, little can be effectively inferred about the value of a given tool for a specific audience. The hope is that anyone with an interest in science, communication, design, or policy will find value among these pages. –*R.E.Bowen. & M.Kress*

Catalog section

Static or Dynamic graphic interface

Type of contributing organization

INDICATOR PROGRAM

STATIC GRAPHICS

ACADEMIC

Simple description of the graphic form displayed in the sample

**Visualization Type**  
Photograph

Description of the information represented in the sample

**Figure Description**  
This photograph shows the University of Massachusetts-Boston campus center at night.

Type(s) of data/information shown in the sample

**Data Types**  
Temporal, spatial

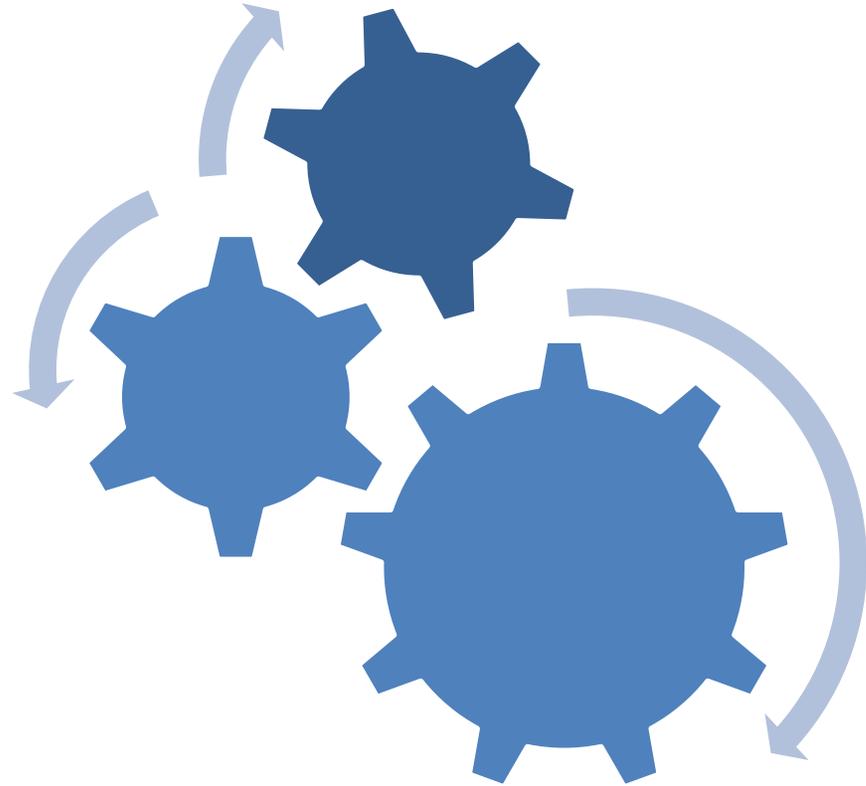


Sample of visualization

University of Massachusetts-Boston  
[www.disres.umb.edu/directions.php](http://www.disres.umb.edu/directions.php)

Citation information for sample, including author (if available), institution(s), and website address

# Northeast Regional Indicator Programs



## Visualization Type

Vertical histogram, 3 stacked categories

## Figure Description

This figure displays the number of acres closed to shellfishing activities in Buzzards Bay from the year 1960 to 2009. Yearly data does not begin until 1989; prior to 1989 data is labeled as being from the start year of the decade. Stacked blocks indicate the type of shellfish area closure, with the majority being year-round closures (red), fewer as temporary closures (yellow), and specific oil-spill related closures shown in brown.

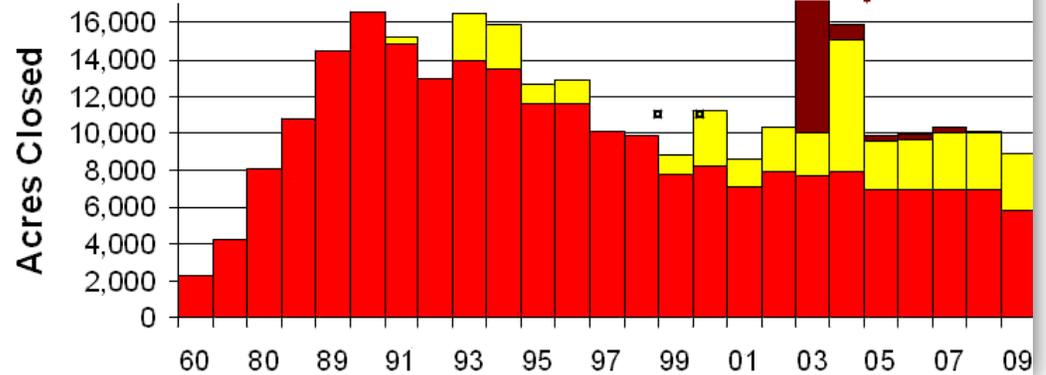
## Data Types

Temporal, categorical, numerical, color

## Buzzards Bay Shellfish Closures

■ oil closure  
■ temporarily closed  
■ closed year-round

\* = temporary closure data not available

oil closure=  
87,000 acres  
on 7/1/03

Buzzards Bay National Estuary Program

Technical Data: Status &amp; Trends

<http://www.buzzardsbay.org/trends.htm>

## Visualization Type

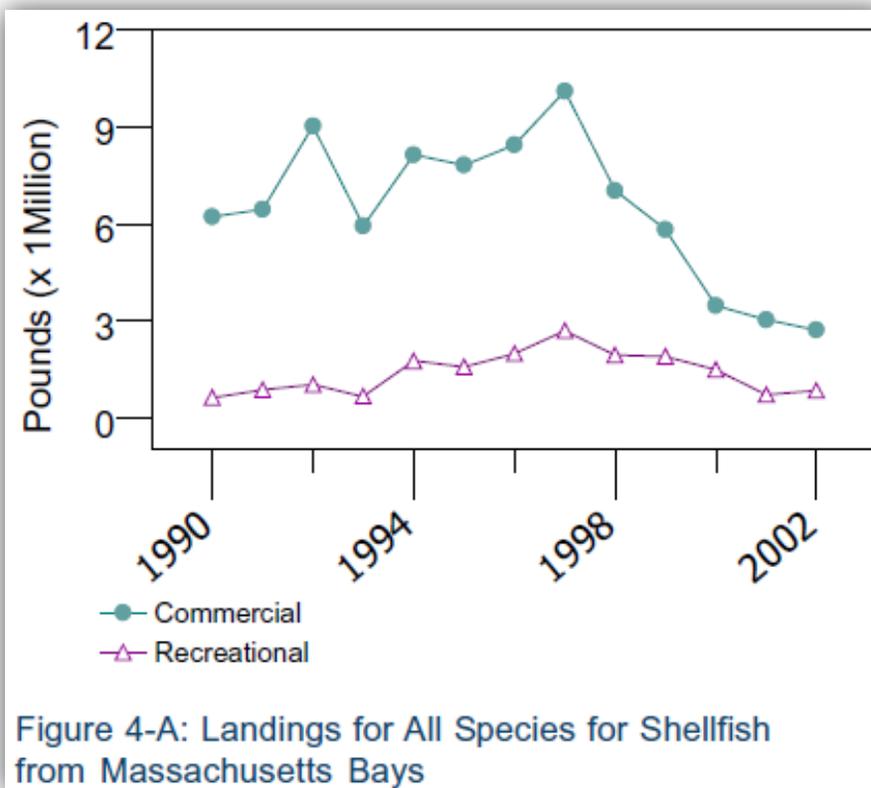
Line graph

## Figure Description

This line graph displays shellfish landings in Massachusetts Bays from 1990 and 2002, divided into commercial and recreational catch categories. Accompanying text states that the “Massachusetts Division of Marine Fisheries (DMF) collects shellfish landings and permit data supplied by municipal shellfish constables and DMF shellfish biologists. ... The most important problem is the discrepancy in reporting systems between various shellfish constables within and between towns over time. ...Methods can change over time in a single town and with changes in personnel, making comparisons difficult.”

## Data Types

Categorical, temporal, numerical



The Massachusetts Bays Program  
State of the Bays Report 2004 (PDF document)

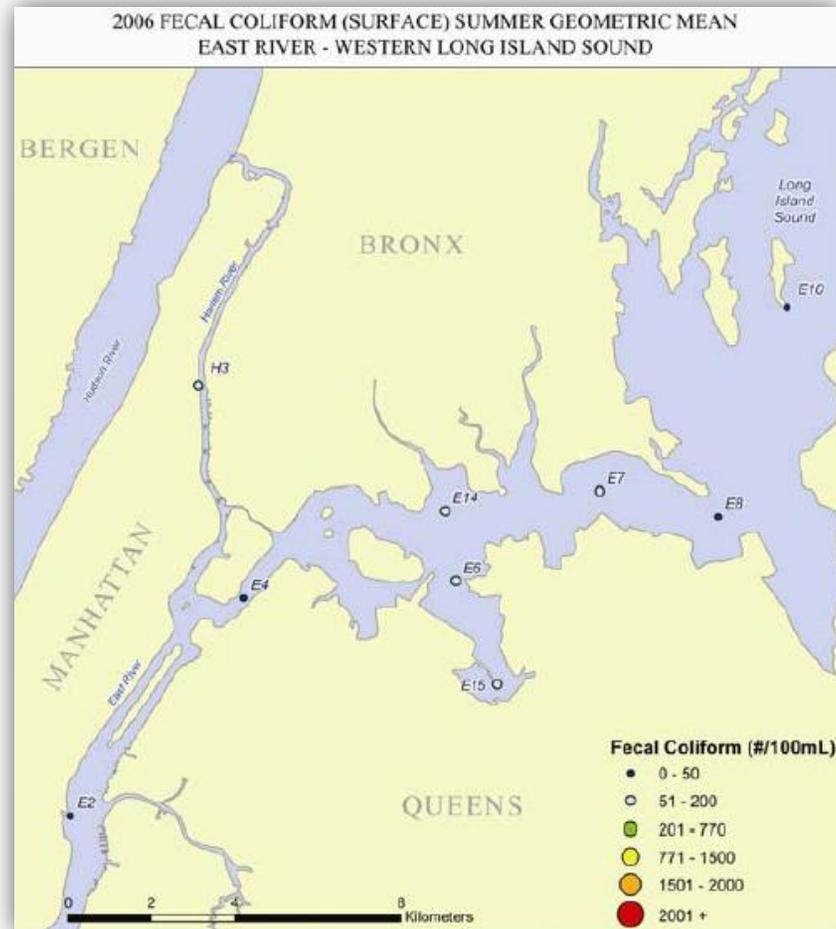
<http://www.mass.gov/envir/massbays/pdf/sob2004.pdf>

## Visualization Type

Map with color and size-coded dots

## Figure Description

This map shows the geometric mean of fecal coliform bacteria (number of bacteria/ 100 mL water) found in surface waters of the East River and Western Long Island Sound in New York at sampling stations during the summer of 2006. Dots are size and color coded, with higher count categories being both larger and more brightly colored. Although 6 count categories are shown in the legend, only the 2 lowest (0-50 and 51-200) are used on this map.



## Data Types

Spatial, numerical, categorical

New York/New Jersey Harbor Estuary Program

Harbor-wide Water Quality Monitoring Report for the NY/NJ Harbor Estuary, June 2008  
(PDF Document)

<http://www.harborestuary.org/reports.htm>

## Visualization Type

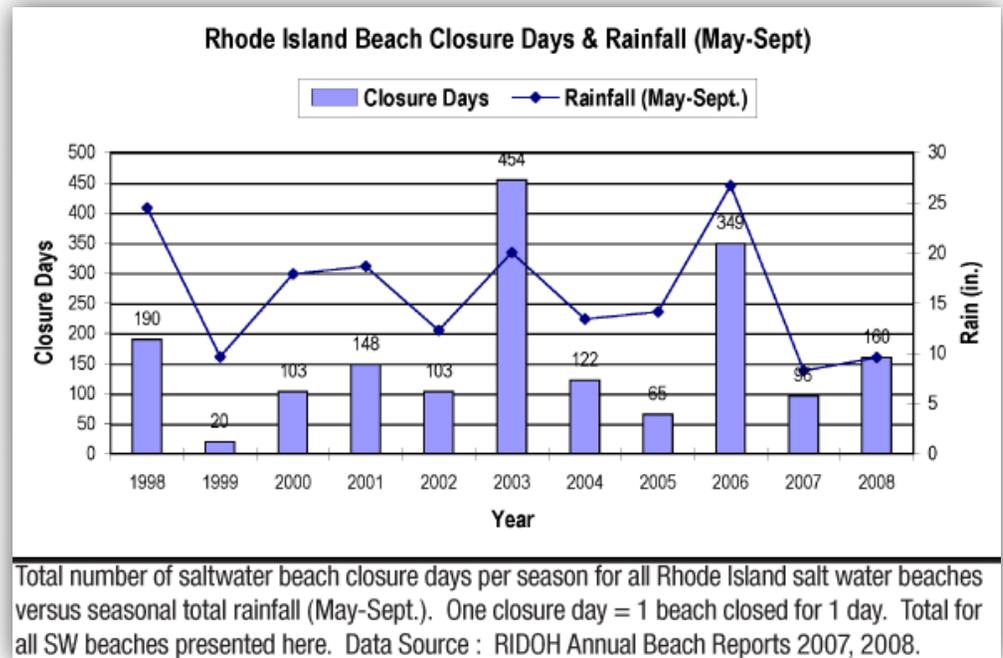
Histogram overlaid with line graph, 3 axes

## Figure Description

This figure shows Rhode Island saltwater beach closures (blue bars) and inches of rainfall for the summer beach-going season from May-September (line graph) for the years 1998-2008. Explanatory text states that “both beach and shellfishing area closures are strongly influenced by summer weather, particularly rainfall, which washes bacteria from the land into nearby storm drains. ...The upper reaches of the Bay... are closed to swimming and shellfishing due to high bacterial levels from urban runoff, CSOs and other sources.”

## Data Types

Temporal, numerical, relational



## Narragansett Bay Estuary Program

Currents of Change: Beach and Shellfish Closures.

[http://www.nbep.org/currents\\_change/beach\\_shellfish\\_closures.htm](http://www.nbep.org/currents_change/beach_shellfish_closures.htm)

## Visualization Type

Pie chart

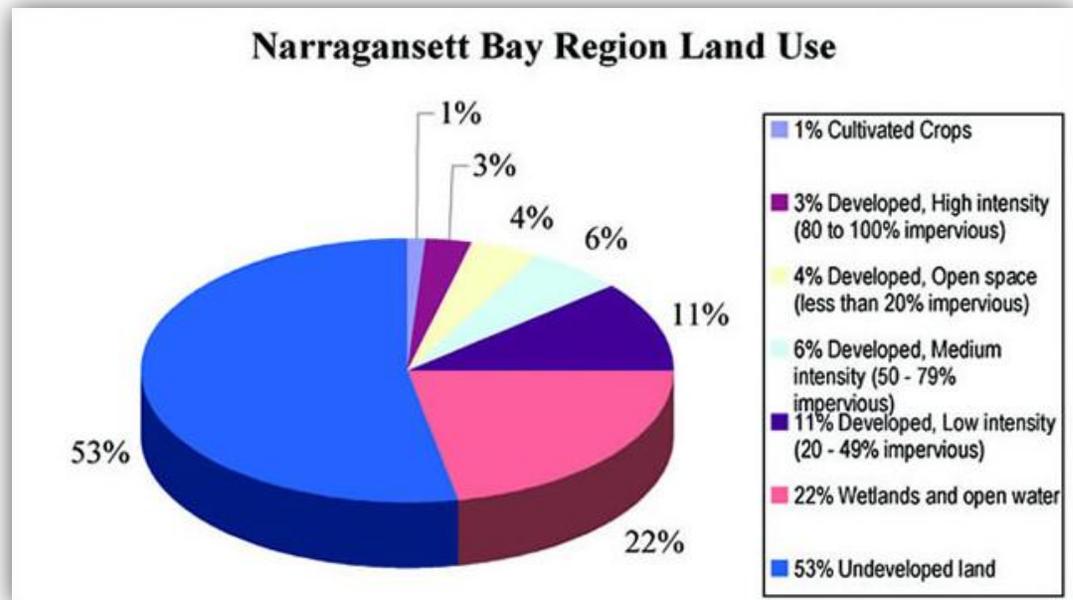
## Figure Description

This figure presents land use categories and predominance in the Narragansett Bay region watershed, including areas in Rhode Island and Massachusetts. Additional categorical information (percent impervious surface) is included in the figure legend next to the category title. Color-coding of the pie wedges does not represent an additional data dimension and is only for slice identification.

## Data Types

Numerical, categorical, proportional

## Narragansett Bay Region Land Use



## Narragansett Bay Estuary Program

Currents of Change, Land Use and Land Cover.

[http://www.nbep.org/currents\\_change/land\\_use-cover.html](http://www.nbep.org/currents_change/land_use-cover.html)

Visualization Type  
Table (top) and pie chart (bottom)

#### Figure Description

These two figures show nearly identical information in two different formats.

**A)** This table presents habitat types included in the habitat restoration program in 2009, number of sites within each type, and the percentage of sites represented by that habitat type.

**B)** This pie chart displays habitat types included in the habitat restoration program in 2009 and the percentage of sites represented by that habitat type.

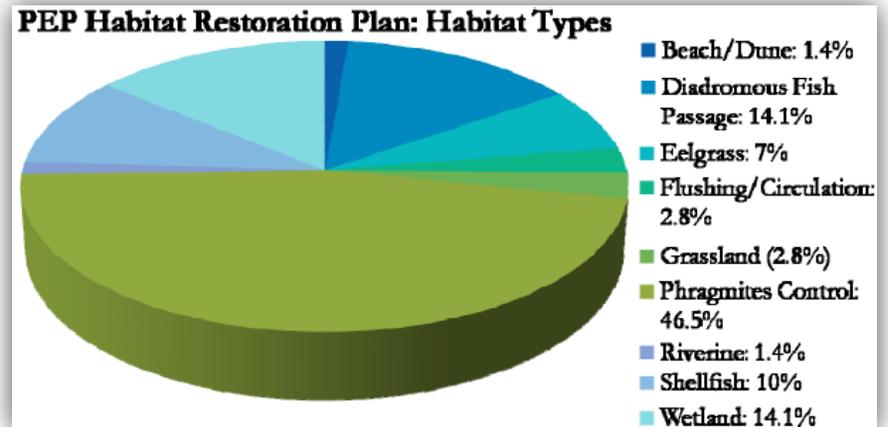
From the pie chart it is immediately apparent that one habitat type dominates the restoration plan; in the table this information is not as prominent.

Data Types  
Categorical, numerical, proportional, color

A)

Habitat Type	2009 Sites
Beach/Dune	1 (1.4%)
Diadromous Fish Passage	10 (14.1%)
Eelgrass	5 (7%)
Flushing/Circulation	2 (2.8%)
Grassland	2 (2.8%)
Phragmites Control	33 (46.5%)
Riverine	1 (1.4%)
Shellfish	7 (10%)
Wetland	10 (14.1%)
Total	71 (100%)

B)



Peconic Estuary Program  
Habitat Restoration Plan, November 2009 (PDF document-format adapted)  
<http://www.peconicestuary.org/pdf/2009PEPHabitatRestorationPlan.pdf>

## Visualization Type

Histogram overlaid with line graph, 3 axes

## Figure Description

This histogram uses vertical blue bars to represent the extent of the area (square miles) of hypoxia in the waters of Long Island Sound between the years 1987-2007. The scale for area of hypoxia is on the left vertical axis (blue text). The overlaying grey line indicates the duration of hypoxia in the same area measured in days. The scale for the days of hypoxia is on the right vertical axis (grey text). Years are abbreviated to two-digits, shown on the horizontal scale, starting with the earliest year (1987) on the far left.

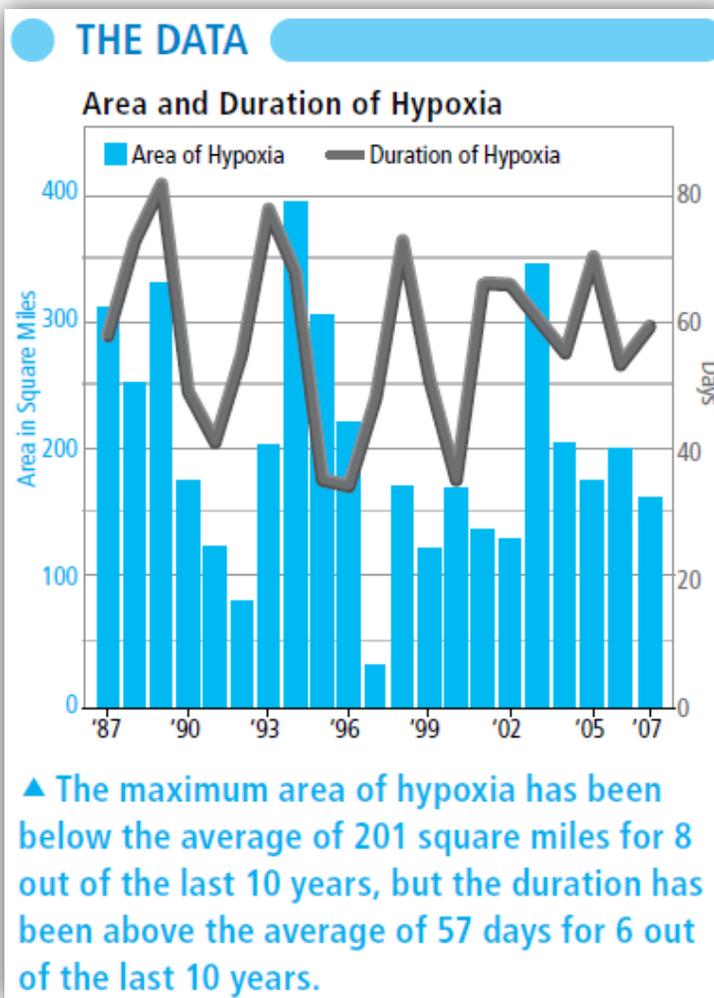
## Data Types

Temporal, numerical, categorical

Long Island Sound Study

[Sound Health 2008](#) (PDF document)

[http://longislandsoundstudy.net/wp-content/uploads/2010/03/sound\\_health\\_2008.pdf](http://longislandsoundstudy.net/wp-content/uploads/2010/03/sound_health_2008.pdf)



## Visualization Type

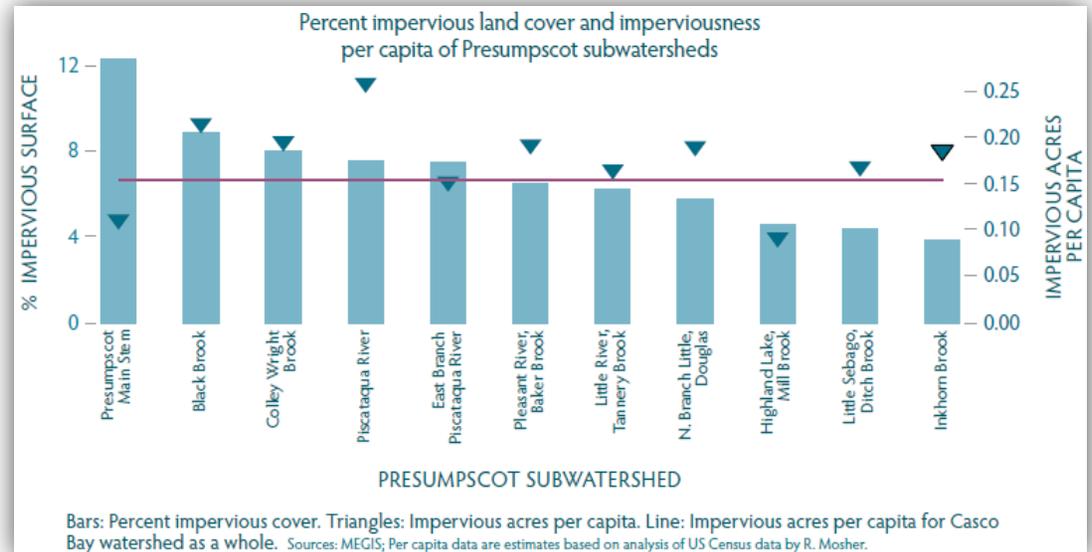
Vertical bar graph with scatterplot overlay, 3 axes

## Figure Description

This figure combines population, land use, and spatial categorical data. The Presumpscot watershed in the Casco Bay region of Maine is divided into eleven subwatersheds and the percent impervious land cover within each division is shown by blue bars (left axis). The scatterplot overlay uses blue triangles to mark the number of impervious acres per capita for each subwatershed (right axis). The horizontal red line represents the average impervious acres per capita across the entire Casco Bay watershed.

## Data Types

Categorical, numerical, proportional



Casco Bay Estuary Partnership  
[State of the Bay 2010](#) (PDF document)

[http://www.cascobay.usm.maine.edu/pdfs/State\\_Bay\\_2010.pdf](http://www.cascobay.usm.maine.edu/pdfs/State_Bay_2010.pdf)

## Visualization Type

Line graph with scatterplot points

## Figure Description

This figure displays multiple pieces of information related to the presence of *Clostridium perfringens* spores in the fine sediments of Boston Harbor. The baseline range is shown as shaded grey segments, while 2009 mean spore counts are shown as blue squares for individual stations. The scatterplot black dots show the mean spore count per station since the diversion went online. Explanatory body text points out that there has been “a decline in spore counts from stations located in the transition area, located between Boston Harbor and the outfall, where the single station sampled in 2009 had a spore count at the bottom of the baseline range.”

## Data Types

Numerical, spatial, comparative

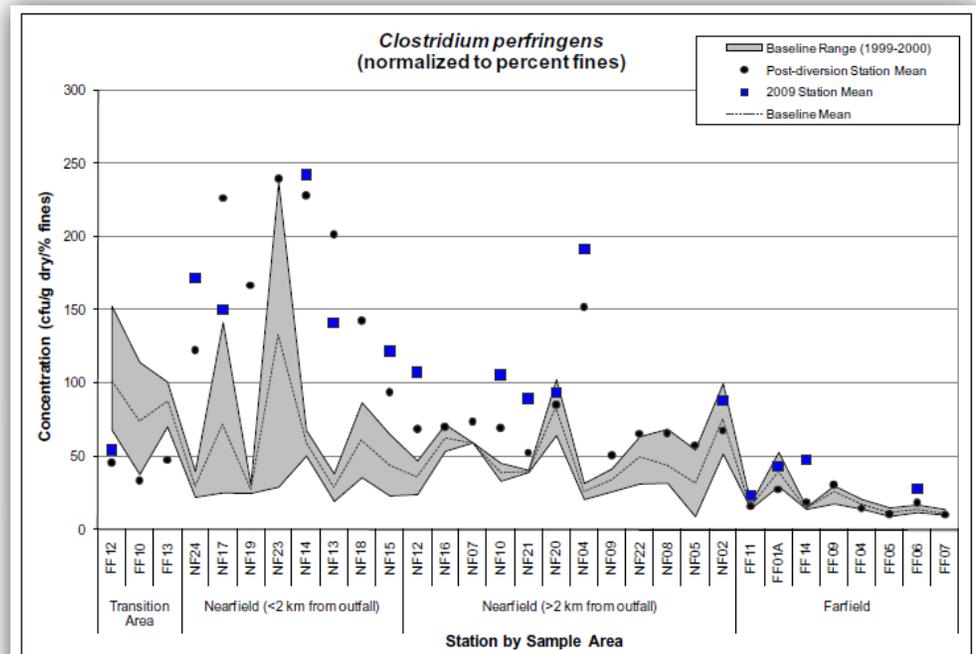


Figure 4-4. *Clostridium perfringens* spores normalized to percent fine fraction in the sediments compared to the late baseline range and post-diversion mean. Transition area” denotes stations located between Boston Harbor and the outfall; “Farfield” denotes stations offshore from the outfall.

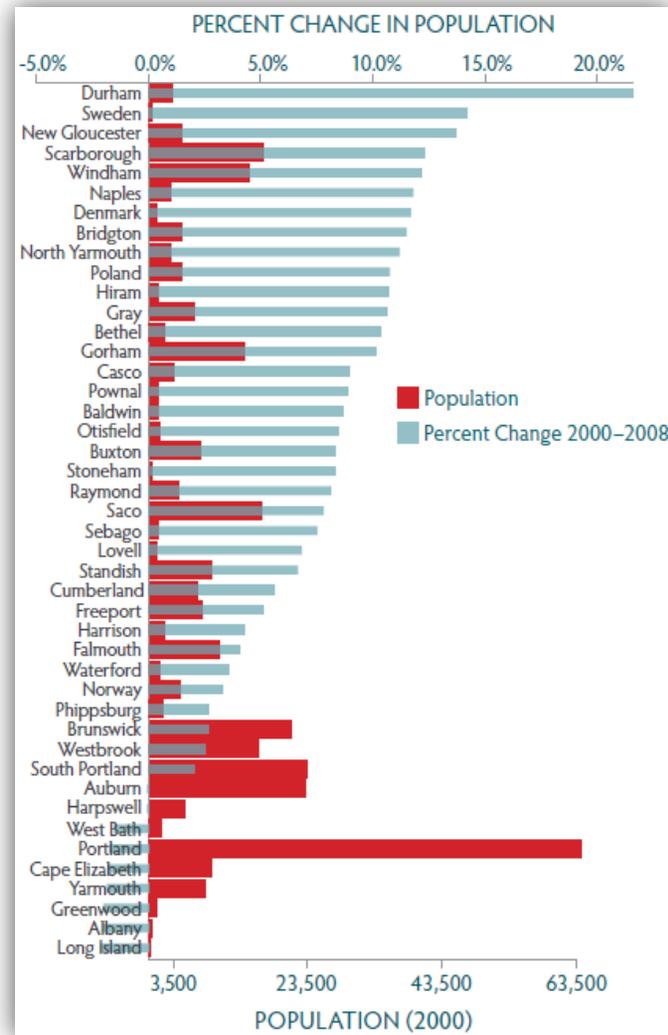
Massachusetts Water Resources Authority  
[2009 Outfall Monitoring Overview](#) (PDF document)

<http://www.mwra.state.ma.us/harbor/enquad/pdf/2010-19.pdf>

Visualization Type  
Horizontal bar graph, 3 axes

Figure Description  
This figure displays total human population in the year 2000 (red bars) shown against percent change in population from 2000-2008 (pale blue bars) in the area around Maine’s Casco Bay. This bar graph displays both positive and negative values for one of data types shown. For cities with a decrease in population between the years 2000 and 2008, the pale blue display bars overlap with city names listed at left in grey. This is the case for the cities of West Bath, Portland, Cape Elizabeth, Yarmouth, Greenwood, Albany, and Long Island.

Data Types  
Categorical, numerical, temporal, proportional



Casco Bay Estuary Partnership. State of the Bay 2010 (PDF document)  
[http://www.cascobay.usm.maine.edu/pdfs/State\\_Bay\\_2010.pdf](http://www.cascobay.usm.maine.edu/pdfs/State_Bay_2010.pdf)

## Visualization Type

Histogram overlaid with line graph, 3 axes

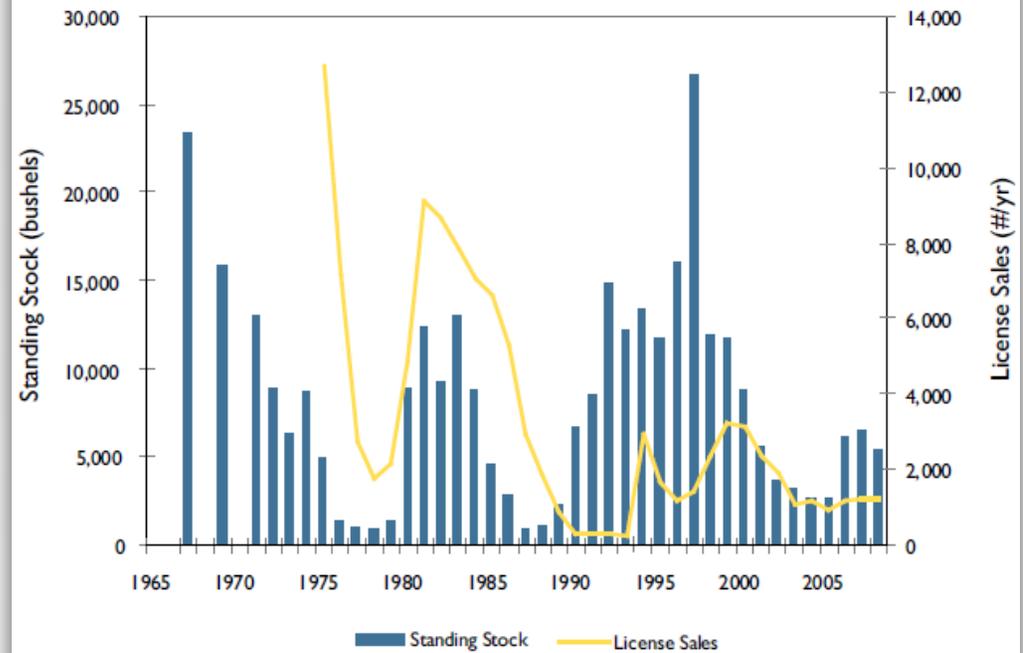
## Figure Description

This figure displays clam standing stock (blue vertical bars) in conjunction with yellow line-graph overlay showing number of harvest license sales in the state. Both indicators are plotted as yearly numbers (x-axis). This figure combines an environmental and a socio-economic indicator. Accompanying text explains that “recreational shellfishing in Hampton-Seabrook Harbor is estimated to contribute more than \$3 million a year to New Hampshire’s economy (PREP, 2000).” The management goal is to “maintain or exceed ... standing stock of 8,500 bushels of adult clams (>50 mm) in Hampton-Seabrook Harbor flats.”

## Data Types

Temporal, numerical, economic, environmental

**Clam standing stock in Hampton-Seabrook Harbor and harvest license sales in New Hampshire (Figure 19)**



Data Source: NextEra Energy Seabrook Station and NH Fish and Game Department

Piscataqua Region Estuaries Partnership  
State of the Estuaries 2009 (PDF document)

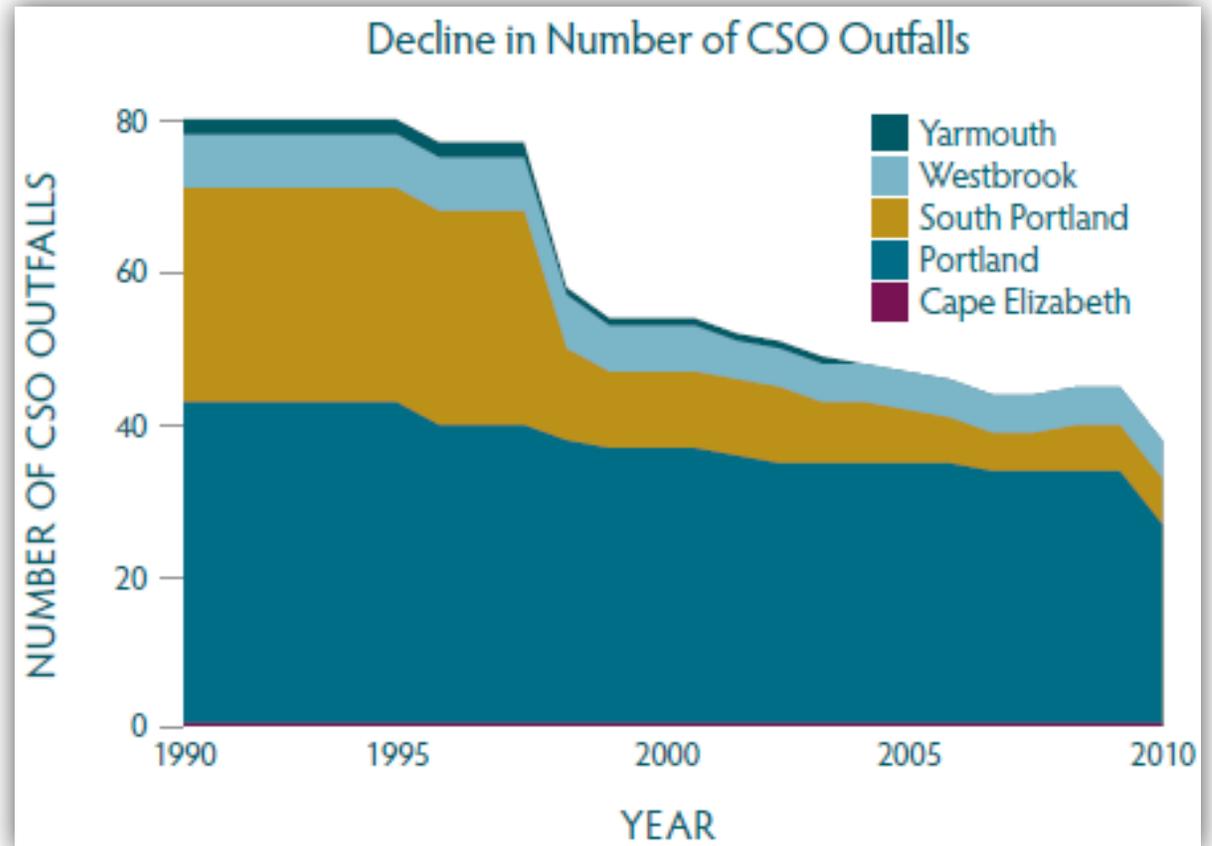
[http://www.prep.unh.edu/resources/pdf/2009\\_state\\_of\\_the-prep-09.pdf](http://www.prep.unh.edu/resources/pdf/2009_state_of_the-prep-09.pdf)

Visualization Type  
Stacked areas chart

#### Figure Description

This figure charts the number of combined sewer overflow (CSO) outfalls in 5 municipalities in the Casco Bay area of Maine from 1990 to 2010. Note that the number of CSO outfalls for the town of Cape Elizabeth (dark red) is shown as a nearly invisible line along the x-axis at the bottom of the chart area.

Data Types  
Temporal, categorical, numerical



Casco Bay Estuary Partnership  
State of the Bay 2010 (PDF document)  
[http://www.cascobay.usm.maine.edu/pdfs/State\\_Bay\\_2010.pdf](http://www.cascobay.usm.maine.edu/pdfs/State_Bay_2010.pdf)

**Visualization Type**

3-column table with color-coded cells

**Figure Description**

This figure shows a table based on 9 criteria used to evaluate waterfront quality in Massachusetts using a 10-point scale. The table also uses a 3-color highlighting system in support of the numerical rankings with the ranges as follows:  
 1-3 (red): poor information or status  
 4-6 (yellow): fair information or status  
 7-10 (green): good to excellent information or status.  
 'Explain this chart' links to another page on website.  
 Accompanying webpage gives background rationale for each indicator score with specific examples for each state rated.

**Massachusetts Ratings**

Indicator Type	Info	Status
Beach Access	8	3
Water Quality	7	6
Beach Erosion	9	-
Erosion Response	-	7
Beach Fill	6	-
Shoreline Structures	7	3
Beach Ecology	7	-
Surfing Areas	2	5
Website	7	-

[Explain this chart](#)

**Data Types**

Categorical, numerical, relational, color

Surfrider Foundation. State Report, Massachusetts

[http://www.surfrider.org/stateofthebeach/05-sr/state\\_summary.asp?zone=NE&state=ma](http://www.surfrider.org/stateofthebeach/05-sr/state_summary.asp?zone=NE&state=ma)

**NOTE:** This example is no longer available online. The new Surfrider Foundation website for State Report, Massachusetts is: [http://www.beachapedia.org/State\\_of\\_the\\_Beach/State\\_Reports/MA](http://www.beachapedia.org/State_of_the_Beach/State_Reports/MA)

Visualization Type

2-column table, color spectrum background

Figure Description

This figure presents a list of major coves and harbors in Buzzards Bay along with their water quality score based on the previous five years of data (2002-2007) on a 100-point scale. Places names are listed from healthiest (highest scores) to most degraded. The blue-to-red color background reinforces the message, with ‘poor/eutrophic’ areas shown in darker reds, ‘fair’ areas in yellow, and ‘good to excellent’ backed by blue. There are no specific cutoffs listed for each color category.

Data Types

Spatial, numerical, color

### What’s the State of Your Local Harbor or Cove?

5-yr (2001-2005) running average

**Healthy**

Penikese Island	94.0
West Falmouth, Outer Harbor	88.8
Quissett Harbor, Outer	88.2
Pocasset Harbor, Outer	86.6
Aucoot Cove, Outer	84.0
Mattapoisett Harbor, Outer	83.4
Hiller’s Cove	81.2
Onset Bay, Outer	77.3
Clarks Cove, Outer	76.0
Westport River, Inlet	75.6
Megansett Harbor	75.0
Mattapoisett Harbor, Inner	74.0
Cuttyhunk Harbor	74.0
Onset Bay, Inner	73.6
Onset Harbor, Shell Point Bay	72.8
Blankenship Cove	72.8
Aucoot Cove, Mid-Harbor	72.7
Phinney’s Harbor	71.9
Quissett Harbor, Inner	71.5
Sippican Harbor, Outer	67.2
Rands Harbor	66.2
West Falmouth, Mid-Harbor	66.1
Nasketucket Bay	65.1
Red Brook Harbor, Outer	64.6
New Bedford Harbor, Outer	64.4
Clarks Cove, Inner	64.4
Onset Bay, East River	63.4
Pocasset River	62.3
Apponagansett Bay, Outer	61.9
Fiddlers Cove	61.5
Buttermilk Bay	60.2
Westport River, Inner West Branch	56.9
Squeteague Harbor	56.7
Red Brook Harbor, Inner	56.7
Apponagansett Bay, Mid-Harbor	56.3

Good to Excellent

Fair

Hen Cove	55.4
Back River	54.6
Little River, Outer	54.1
Little Buttermilk Bay	53.7
Westport River, Outer East Branch	52.7
West Falmouth, Harbor Head	51.7
Marks Cove	51.2
Little Bay (Inner Nasketucket)	50.4
Sippican Harbor, Inner	49.1
Mattapoisett Harbor, River Mouth	48.7
Pocasset Harbor, Inner	48.6
Wareham River, Outer	48.4
Wild Harbor River	48.0
Weweantic River, Outer	47.7
New Bedford Harbor, Inner	47.6
Wild Harbor	46.7
Slocums River, Outer	45.0
Little Sippewissett Marsh	45.0
Eel Pond, Bourne	44.3
Broadmarsh River	43.8
Aucoot Cove, Inner	42.9
West Falmouth, Snug Harbor	42.0
Wareham River, Inner	42.0
Little River, Inner	40.8
West End Pond, Cuttyhunk Island	37.7
Weweantic River, Inner	35.6
Hammett Cove	35.4
Westport River, Inner East Branch	34.8
Slocums River, Inner	29.5
Apponagansett Bay, Inner	28.1
Westport River, Upper East Branch	25.2
Eel Pond, Mattapoisett	24.2
Acushnet River	23.9
Agawam River	17.6
Nasketucket River	13.0

Poor/Eutrophic

**Degraded**

The Buzzards Bay Health Index measures the nitrogen-related health of each of the Bay’s major harbors and coves. Central Buzzards Bay – which still exhibits good water quality – scores close to 100 on the Index. The list above shows average water quality in each area over the past five years ranked from healthy at top (100) to degraded (0).

The Coalition for Buzzards Bay

State of the Bay, 2007 (PDF document- *format adapted*)

<http://www.savebuzzardsbay.org/Document.Doc?id=9>

Visualization Type  
Color-coded shapes with numerical scores

#### Figure Description

These figures each use a 100-point scale to display:

**A)** overall score (45) and directional arrow (red, down = declining) of water quality change for Buzzards Bay;

**B)** directional arrow (blue, up = improving) reflecting improvement in the area of toxic chemical pollution releases into Buzzards Bay and indicator score as of 2007 report (47/100, improved from 45 in 2003);

**C)** wetlands acreage loss or gain (yellow box = almost unchanged) and indicator score (60/100).

Other indicators presented in the report include: bay scallops, eel grass, river herring, stream buffers, forests, bacteria, and nitrogen pollution.

Data Types  
Numerical, spatial, categorical, comparative, color

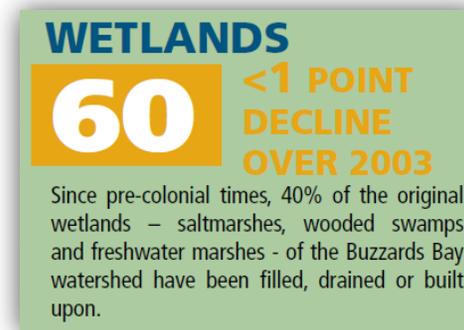
A)



B)



C)



The Coalition for Buzzards Bay  
State of the Bay, 2007 (PDF document)  
<http://www.savebuzzardsbay.org/Document.Doc?id=9>

## Visualization Type

Choropleth map of the same area, two timepoints

## Figure Description

These maps compare fecal coliform bacteria levels (season geometric means) in 1985 (left) and 2006 (right) through the New York/New Jersey estuary area. Sampling stations are shown as small black dots with a number/letter identification. There are 6 coliform categories with non-regular divisions. The maps differ slightly in their scale and display of municipal boundaries and place names. The 1985 map uses 3 shades of blue on the figure (only 2 are shown in the legend) but are otherwise comparable.

## Data Types

Spatial, categorical, temporal, point data, relational

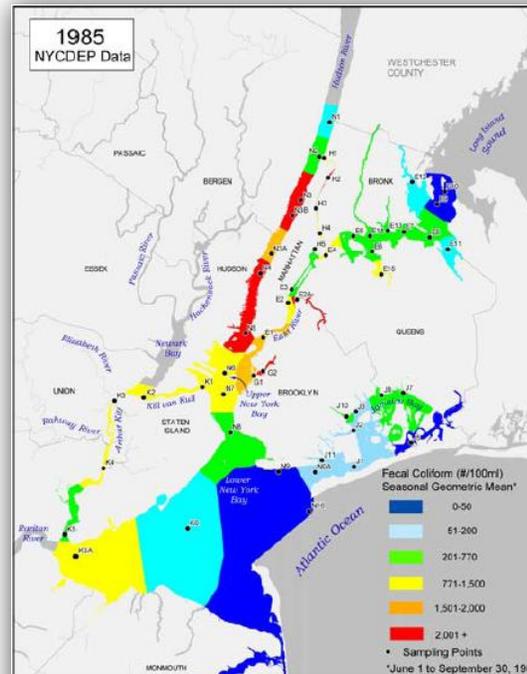


Figure 5. Map of Harbor-wide Fecal Coliform 1985<sup>1</sup>

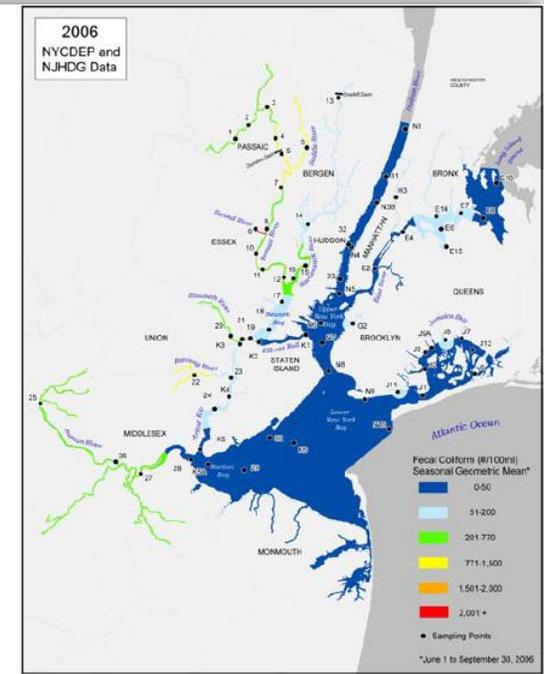


Figure 6. Map of Harbor-wide Fecal Coliform 2006<sup>1</sup>

New York/New Jersey Harbor Estuary Program  
Harbor-wide Water Quality Monitoring Report for the NY/NJ Harbor Estuary, June 2008 (PDF Document)

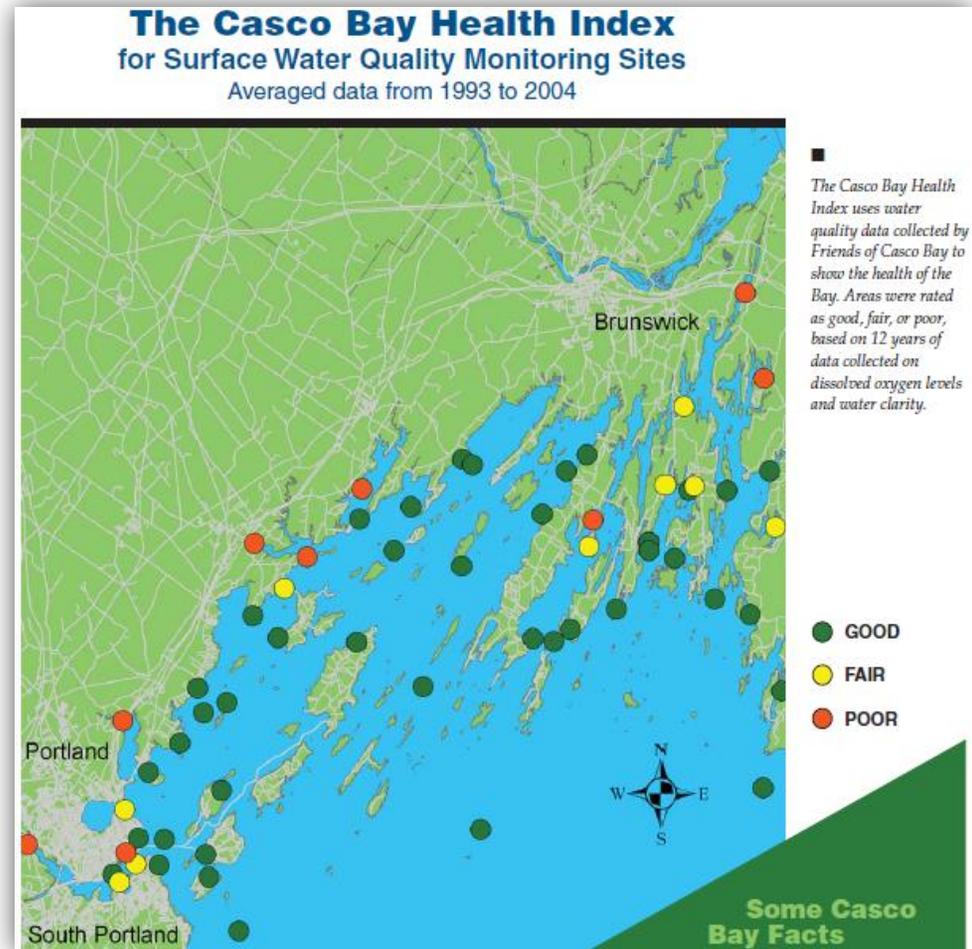
<http://www.harborestuary.org/reports.htm>

## Visualization Type

Map overlaid with color-coded dots

## Figure Description

This map of the Casco Bay area of Maine shows major roads and urban areas. Overlaid on the map is average water quality at observing stations rated as good (green dot), fair (yellow dot), or poor (orange dot). The data are averaged from 1993 to 2004. Accompanying text states that “the goal of this project is to turn all of the high quality data that FOCB has collected into meaningful public information that residents and decision makers can use to compare sites across Casco Bay and across the years.”



## Data Types

Spatial, categorical, point data

Friends of Casco Bay (FOCB)

[Making the Grade: The Casco Bay Health Index](http://friendsofcascobay.org/Documents/Making%20the%20Grade%20PDF.pdf) (PDF document)

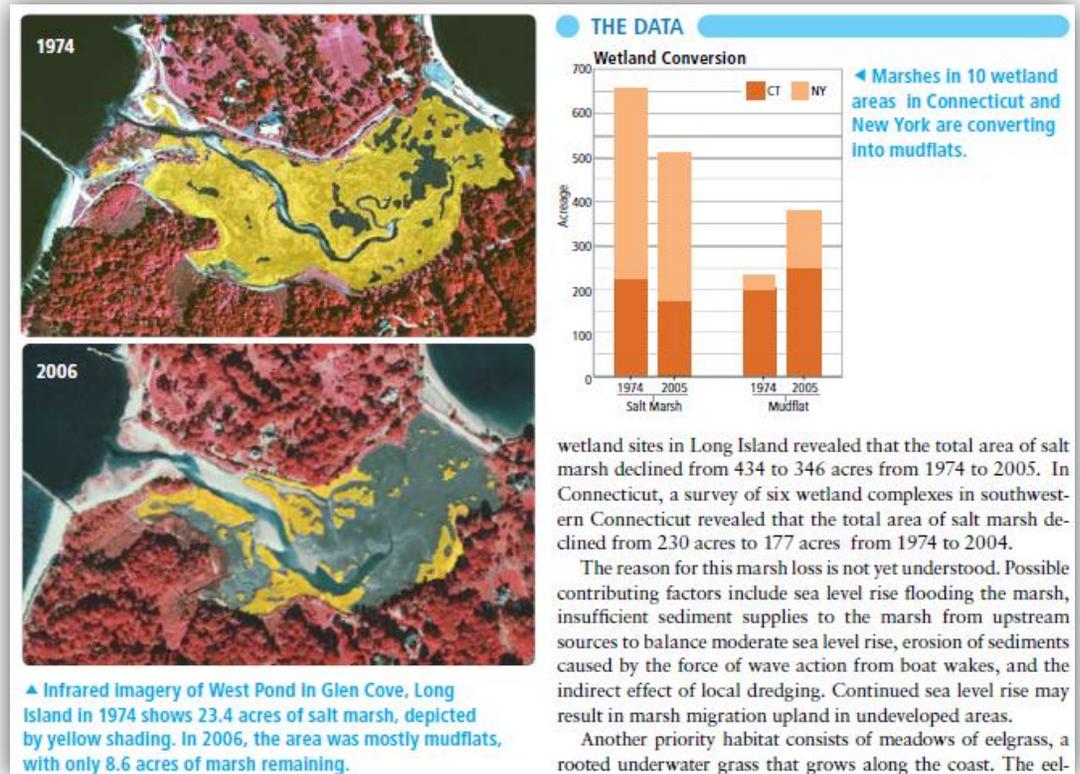
<http://friendsofcascobay.org/Documents/Making%20the%20Grade%20PDF.pdf>

## Visualization Type

Bar graph and comparative photographs

## Figure Description

On the left are infrared remotely-sensed images taken directly overhead at an example site at two time points, showing the conversion of salt marsh to mudflats over the course of 30 years. The photographs are juxtaposed with a bar graph presenting data about coastal wetlands. The bar graph shows state-specific data (acreage of salt marsh) for Connecticut and New York over same span of time. Supplementary body text goes into greater detail about possible causes of the loss of salt marsh habitat.



## Data Types

Spatial, numerical, categorical

Long Island Sound Study  
[Sound Health 2008](#) (PDF document)

[http://longislandsoundstudy.net/wp-content/uploads/2010/03/sound\\_health\\_2008.pdf](http://longislandsoundstudy.net/wp-content/uploads/2010/03/sound_health_2008.pdf)

**Visualization Type**

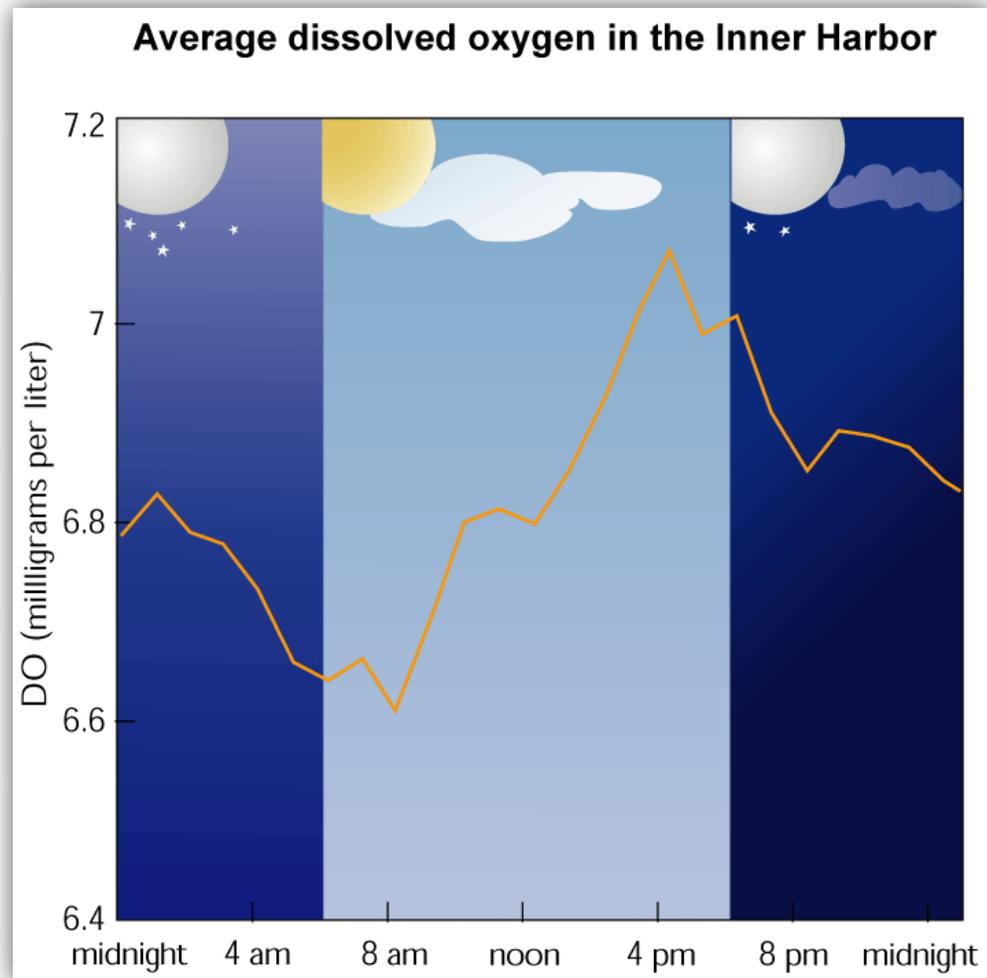
Line graph with background graphics

**Figure Description**

This figure displays average dissolved oxygen (DO) concentrations in Boston's Inner Harbor over a 24-hour period. Data are drawn as a line graph. Background graphics, corresponding to time of day, reinforce the temporal pattern of the data.

**Data Types**

Numerical, temporal, relational



Massachusetts Water Resources Authority  
<http://www.mwra.state.ma.us/harbor/graphic/2-11.gif>

## Visualization Type

Map with color coding and point data.

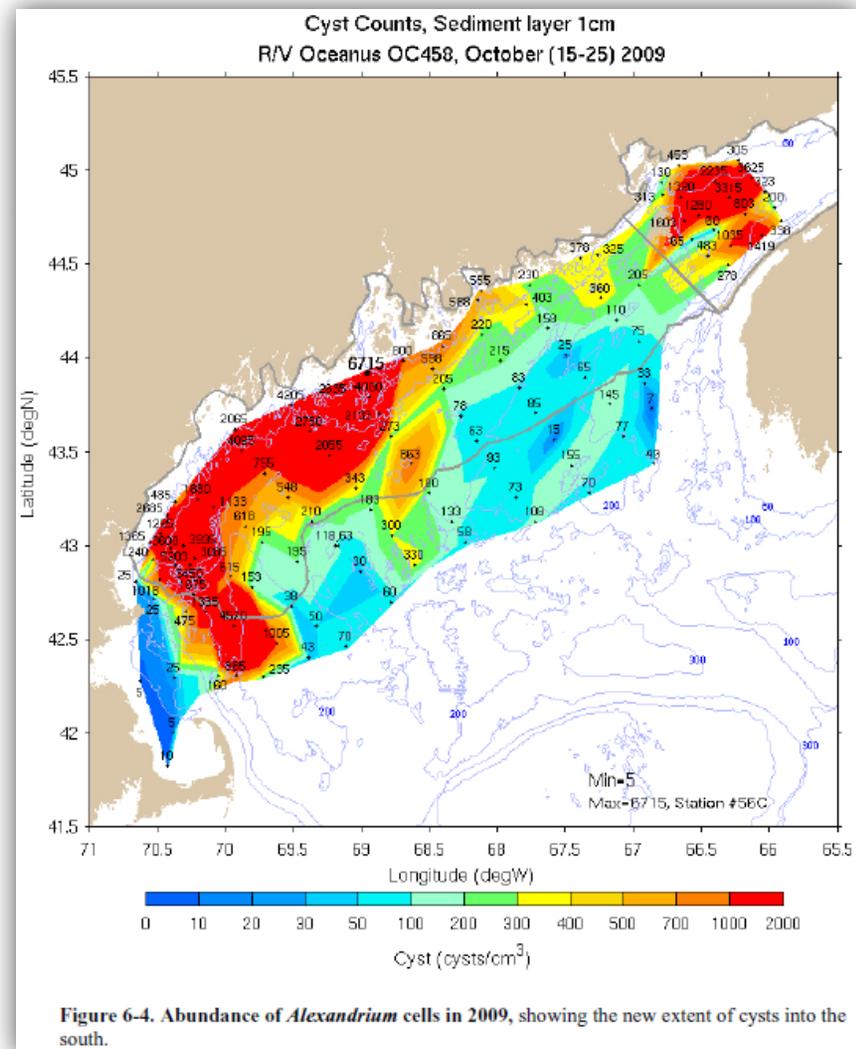
## Figure Description

This figure displays counts of *Alexandrium fundyense* cysts in the top 1cm of sediment, collected from sampling stations throughout the Gulf of Maine in October 2009. Sampling stations are identified by numbered dots on the map. Cyst count ranges are broken up into 12 non-linear categories on a blue-to-red spectrum. The category breakpoints are at 10, 20, 30, 50, 100, 200, 300, 400, 500, 700, 1000, or 2000 cysts per cubic centimeter. Accompanying text explains the importance of this measurement: “the abundance of cysts in seed beds off the coast of Maine, coupled with a population-dynamics model, as the best predictor of the magnitude of [harmful algal] blooms in the following year.”

## Data Types

Spatial, categorical, point data

Massachusetts Water Resources Authority. [2009 Outfall Monitoring Overview](http://www.mwra.state.ma.us/harbor/enquad/pdf/2010-19.pdf) (PDF document)  
<http://www.mwra.state.ma.us/harbor/enquad/pdf/2010-19.pdf>



## Visualization Type

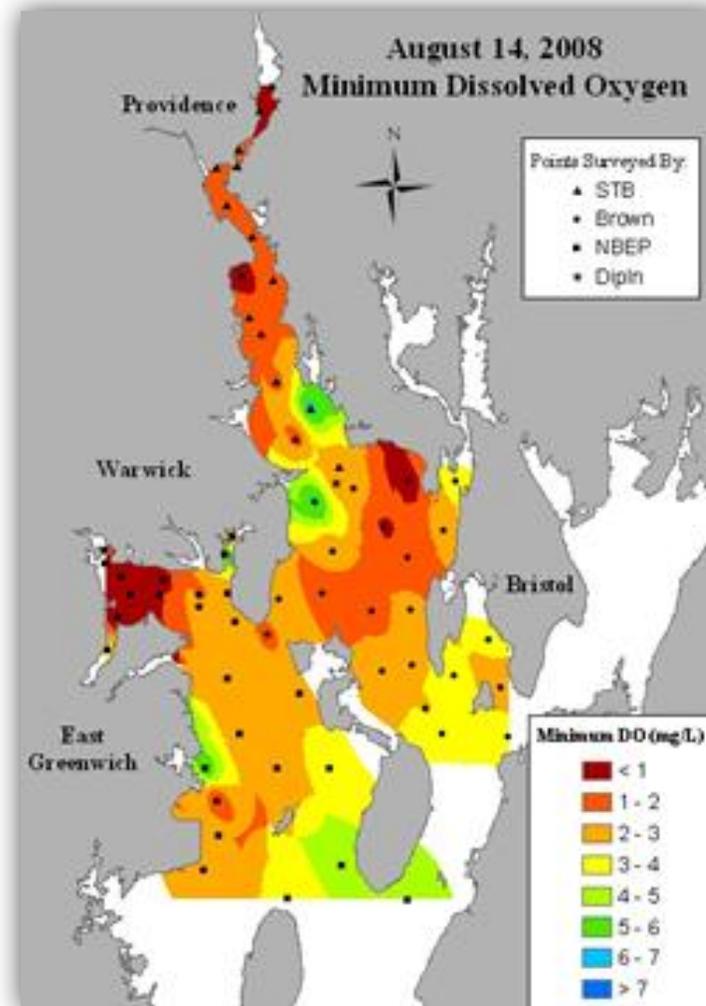
Color-coded map, overlaid with point data

## Figure Description

This map of Narragansett Bay presents dissolved oxygen (DO) levels color coded in categories from <1 mg/L (dark red) to >7 mg/L (dark blue). Small icons (triangles, circles, squares) indicate where sampling activities took place and who conducted them. Accompanying text offers likely causes for conditions throughout the Bay and the significance of dissolved oxygen for wildlife. “...In some areas of the Bay, events occur during which DO approaches zero (anoxia) in bottom waters, killing all but the hardiest organisms.”

## Data Types

Spatial, categorical, numerical, point data



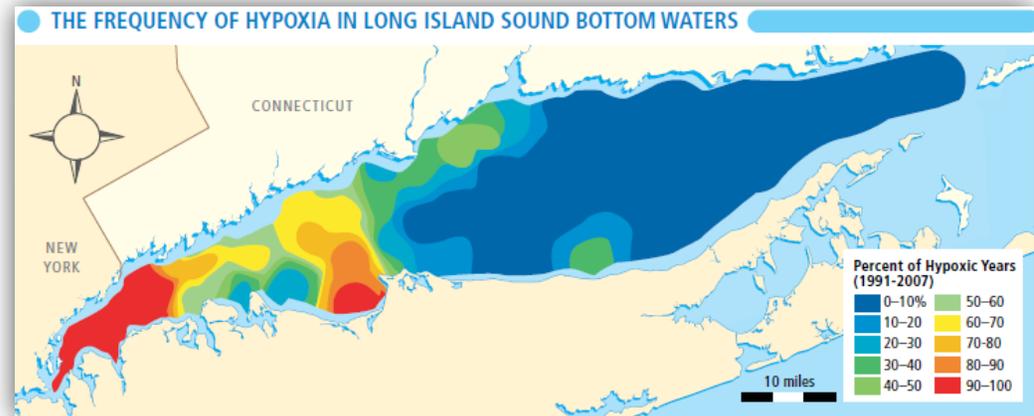
Narragansett Bay Estuary Program. Currents of Change, Hypoxia (Low Dissolved Oxygen).  
[http://www.nbep.org/currents\\_change/currents\\_hypoxia.html](http://www.nbep.org/currents_change/currents_hypoxia.html)

## Visualization Type

Color-coded map with explanatory caption

## Figure Description

This map of Long Island Sound between the states of New York and Connecticut displays the prevalence of hypoxic conditions across the Sound from 1991-2007. Percentage of hypoxic years is divided into 10 categories at 10% intervals. Each category is color-coded along a blue-green-yellow-red spectrum. Explanatory text defines hypoxia as occurring “when dissolved oxygen levels in bottom waters fall below 3 mg/L” and includes examples of natural and anthropogenic contributing factors.



◀ Hypoxic conditions occurred most frequently in the western Sound (areas in red and orange). In extreme hypoxic conditions, some organisms may suffocate and die, while others flee.

## Data Types

Spatial, categorical, color, administrative

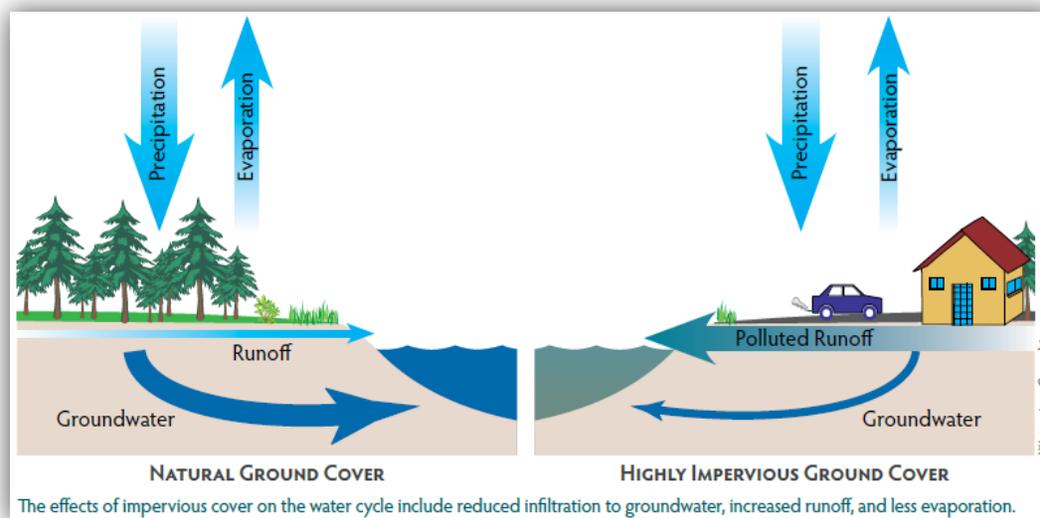
Long Island Sound Study  
Sound Health 2008 (PDF document)[http://longislandsoundstudy.net/wp-content/uploads/2010/03/sound\\_health\\_2008.pdf](http://longislandsoundstudy.net/wp-content/uploads/2010/03/sound_health_2008.pdf)

Visualization Type  
Comparative input-output diagram

#### Figure Description

This figure is a non-quantitative illustration comparing the fates of precipitation and groundwater as they move through the water cycle. The comparison is between a 'natural ground cover' versus a 'highly impervious ground cover' situation. Polluted runoff is indicated by darker blue arrows and polluted surface water is shown in grey. Thickness of the arrows is relative to the amount of water in any part of the cycle.

Data Types  
Comparative, color, relational



Casco Bay Estuary Partnership  
State of the Bay 2010 (PDF document)

[http://www.cascobay.usm.maine.edu/pdfs/State\\_Bay\\_2010.pdf](http://www.cascobay.usm.maine.edu/pdfs/State_Bay_2010.pdf)

## Visualization Type

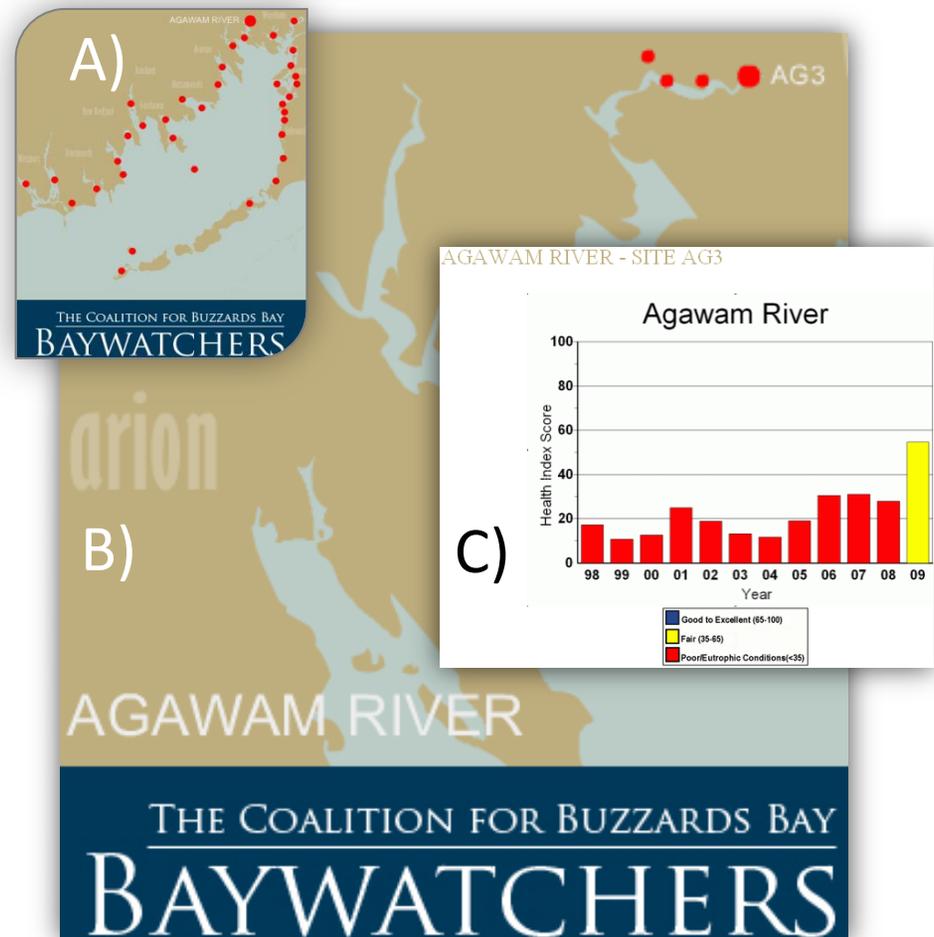
Interactive web-based data display tool

## Figure Description

- A)** In this figure, users can click on an animated map displaying sampling locations in Buzzards Bay;
- B)** This sample site map of the Agawam River displays the 4 local sampling stations, users can click on a station to see figures displaying various data collected by CBB volunteers on a split screen;
- C)** For each local station, users can view data including figures for chlorophyll, dissolved oxygen, and dissolved nitrogen levels, as well as an overall health index score for each station (shown at right for the years 1998-2009).

## Data Types

Spatial, numerical, categorical, color, temporal



The Coalition for Buzzards Bay  
Baywatchers Program

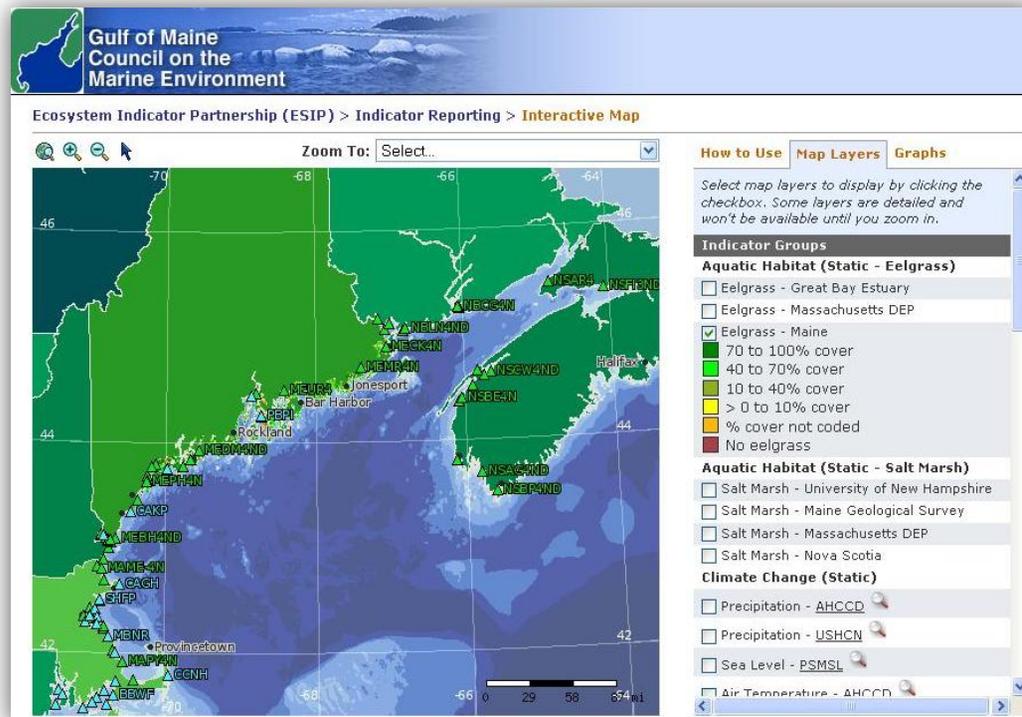
<http://www.buzzbaywatcher.org/baywatcher/>

### Visualization Type

Interactive web-based mapping and data display application

### Figure Description

This screenshot captures the opening page of the ESIP Indicator Reporting Tool. This application allows users to display information about a variety of environmental indicators collected for the Gulf of Maine region. Users can select layers to display from the scrolling menu on right side of screen. According to its website, the “ESIP Indicator Reporting Tool brings together data from Gulfwatch, GoMOOS, and Mussel Watch” along with point-source data and eelgrass areas (sample screenshot of eelgrass data shown at right).



### Data Types

Spatial, numerical, categorical, administrative, relational, point data

Gulf of Maine Council on the Marine Environment,  
Ecosystem Indicator Partnership (ESIP).

[ESIP Indicator Reporting Tool](http://www.gulfofmaine.org/esip/index.php#Primary%20Indicators)

<http://www.gulfofmaine.org/esip/index.php#Primary%20Indicators>

## Visualization Type

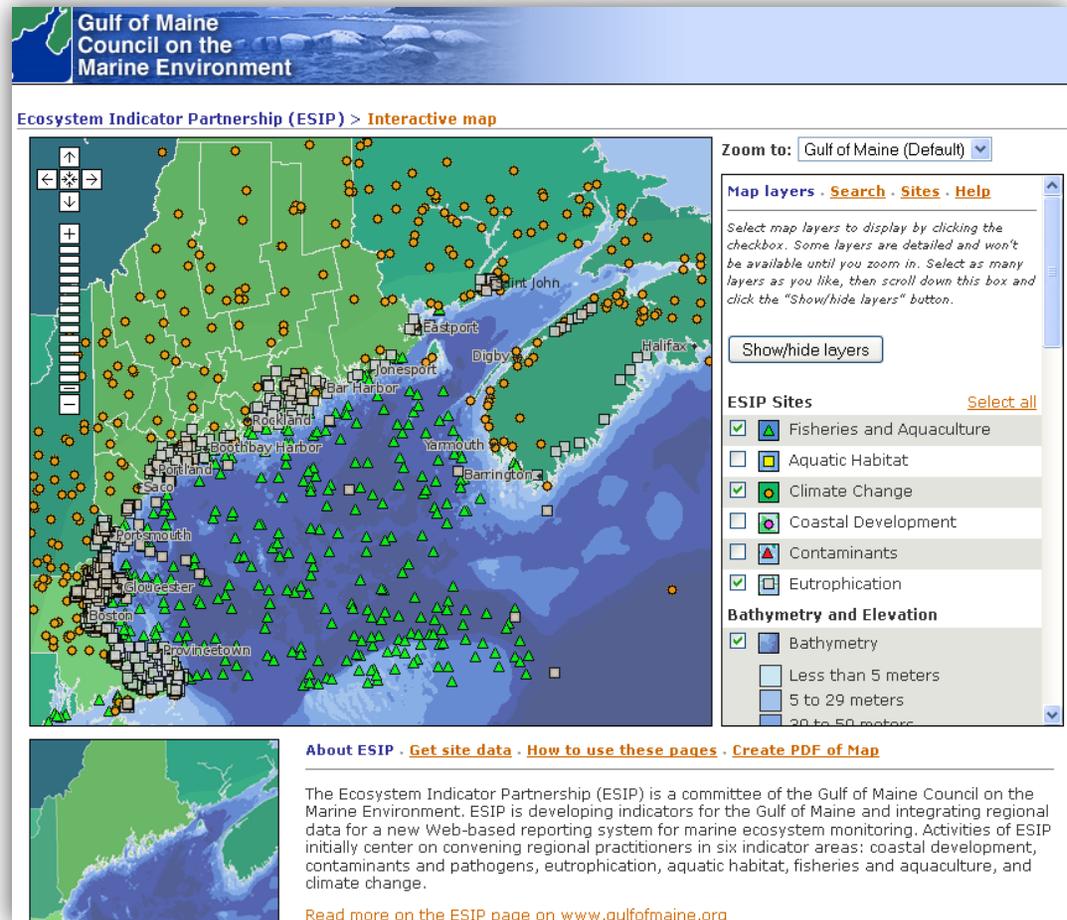
Interactive web-based mapping application

## Figure Description

This screenshot captures the ESIP Monitoring Map displaying the type and location of monitoring programs in the Gulf of Maine. This application is not designed to provide data from listed monitoring programs or sites. Instead, those data are destined for use in the ESIP Indicator Reporting Tool application.

## Data Types

Spatial, categorical, administrative, point data

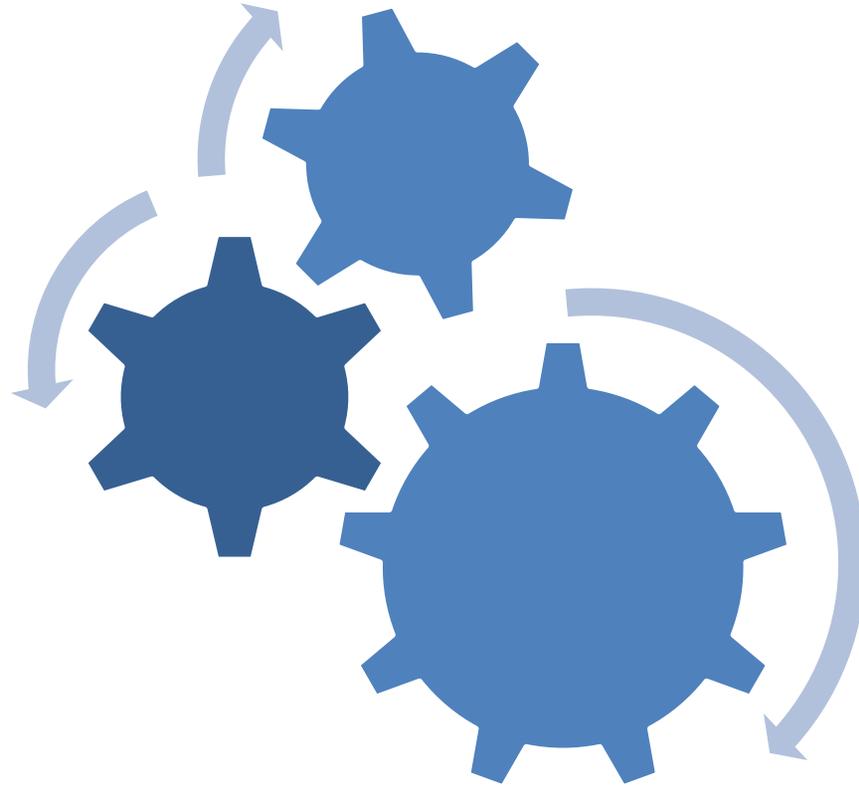


Gulf of Maine Council on the Marine Environment,  
Ecosystem Indicator Partnership (ESIP).

ESIP Monitoring Map

<http://www.gulfofmaine.org/esip/index.php#Primary%20Indicators>

# Environmental Indicator Programs



## Visualization Type

3-column table

## Figure Description

This table shows the yearly area (in hectares) of habitat closed to shellfish harvesting in the Canadian province of British Columbia (BC), and the subset of that area closed within the Georgia Basin (Puget Sound). The time span is from 1989 to 2004. Accompanying text explains that the “increase in closures is attributable more to expanded monitoring activities than degradation of water quality. The expanded monitoring also led to the approval of many previously untested areas for shellfish harvesting.”

## Data Types

Temporal, numerical, spatial

Trends in BC Shellfish Closures (Hectares)

Years	BC Total (hectares)	Georgia Basin Total (hectares)
1989	79176.2	63158.5
1990	81012.1	64816.4
1991	81631.3	65031.2
1992	82078.6	65360.0
1993	103576.0	65555.2
1994	105254.6	66746.9
1995	105939.0	67279.9
1996	110287.2	70466.3
1997	112519.0	70805.9
1998	111463.3	70238.6
1999	101854.9	69574.0
2000	103200.5	69767.7
2001	159029.8	70185.6
2002	123727.4	72165.9
2003	124276.9	71472.6
2004	123832.1	71817.9

Environment Canada, used in:

EPA Puget Sound Georgia Basin Ecosystem Indicators Program

Shellfish, What is Happening?

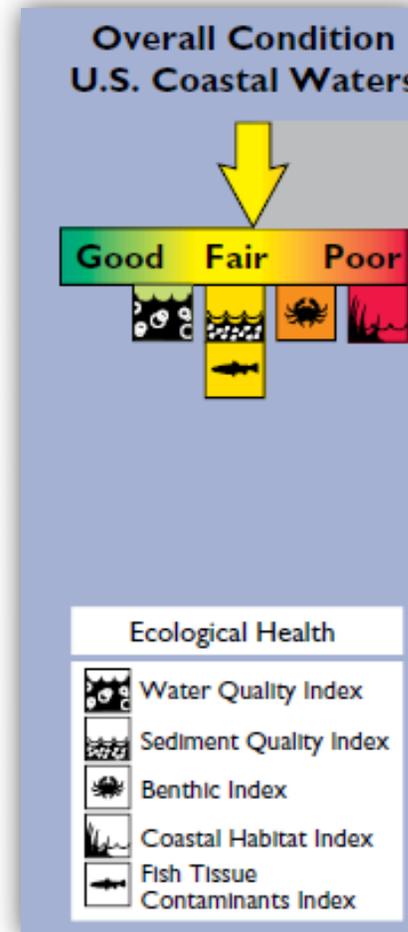
<http://www.epa.gov/region10/psgb/indicators/shellfish/what/index.htm>

## Visualization Type

3-level scale, with pointing arrow

## Figure Description

This figure shows the 2008 EPA rating of United States coastal waters as 'fair' on a scale of good-fair-poor. The rating is a result of combining 5 ecological indices. An icon for each contributory index is shown below the good-fair-poor scale according to its own rating. The indices are explained separately in the document, as are regional rankings. Discussed within the report, but not apparent from this graphic, are numerical, spatial, and temporal data about these ecological health indices and other individual indicators. The stoplight-theme colors (green, yellow, red) used on the 3-level scale do not convey other related data but serve to reinforce the ratings.



## Data Types

Categorical, descriptive, environmental

U.S. Environmental Protection Agency

[National Coastal Condition Report III \(2008\): Executive Summary](http://www.epa.gov/owow/oceans/nccr3/pdf/execsum-a.pdf) (PDF document)

<http://www.epa.gov/owow/oceans/nccr3/pdf/execsum-a.pdf>

## Visualization Type

Bar graphs, vertical and horizontal

## Figure Description

This figure combines bar graphs displaying achievement in multiple goal areas for the Chesapeake Bay: water quality; habitat & lower food web; and fish & shellfish. Each goal has 4 sub-indicators displayed as horizontal bar graphs with percentage achievement for each bar. These percentages are averaged and presented in a vertical bar graph for each goal area. For example, 'Water Quality' has an achievement level of 24%. This is an average of the 4 sub-category percentages:

- Dissolved Oxygen, 12%
- Mid-Channel Clarity, 26%
- Chlorophyll a, 29%
- Chemical Contaminants, 28%.

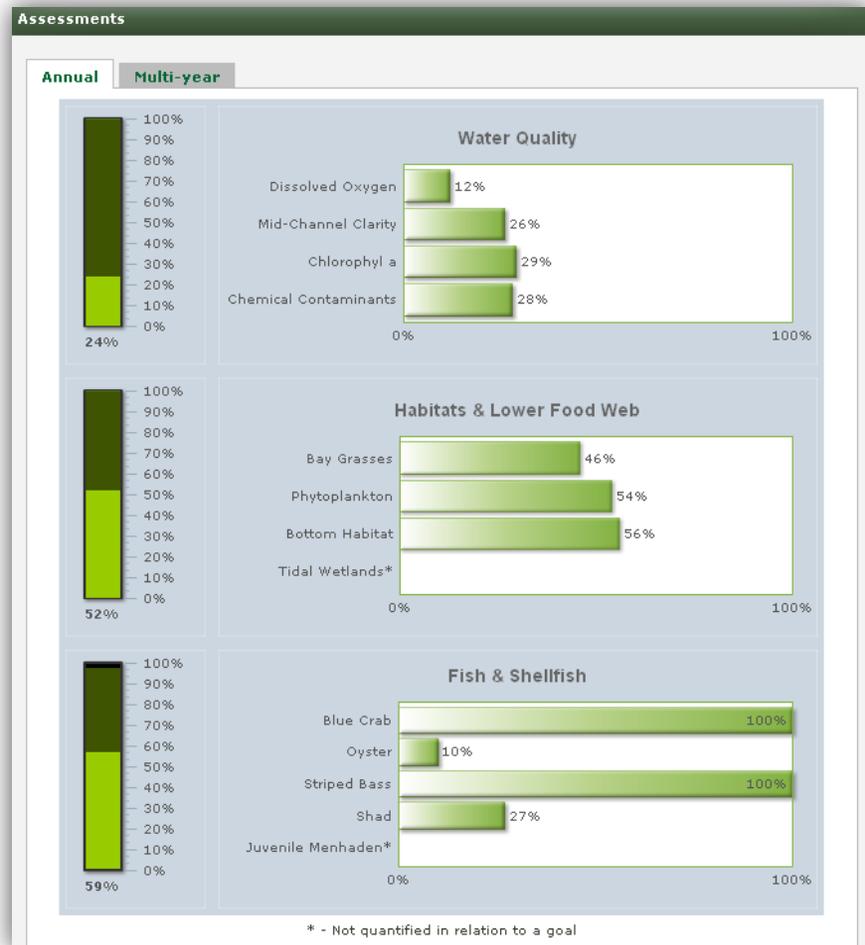
## Data Types

Categorical, numerical, proportional

## Chesapeake Bay Program

Bay Barometer, Bay Health Section (screenshot)

[http://www.chesapeakebay.net/status\\_bayhealth.aspx?menuitem=15048](http://www.chesapeakebay.net/status_bayhealth.aspx?menuitem=15048)



## Visualization Type

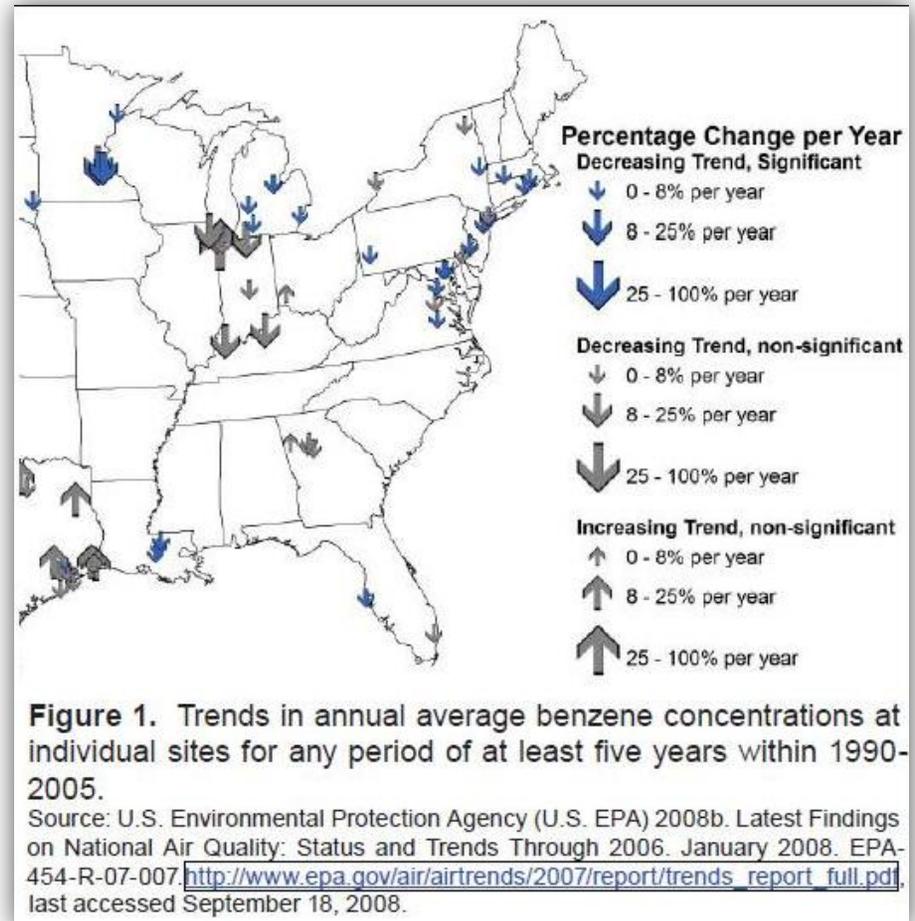
Map, overlaid with color and size-coded arrows

## Figure Description

This figure displays a map of the eastern United States showing trends in average annual benzene concentrations in the air at individual sites for any period of five years between 1990 and 2005. Arrow sizes indicate range of trend: 0-8% change (small), 8-25% change (medium), or 25-100% change per year (large arrow). Sites with a significant decreasing trend have blue down-arrows, decreasing non-significant sites have grey down-arrows, and sites with an increasing, but non-significant, trend have grey up-arrows.

## Data Types

Spatial, administrative, categorical, color



US EPA, State of the Lakes Ecosystem Conference (SOLEC)  
State of the Great Lakes 2009 (PDF Document)  
<http://www.epa.gov/solec/sogl2009/4202airquality.pdf>

**Visualization Type**

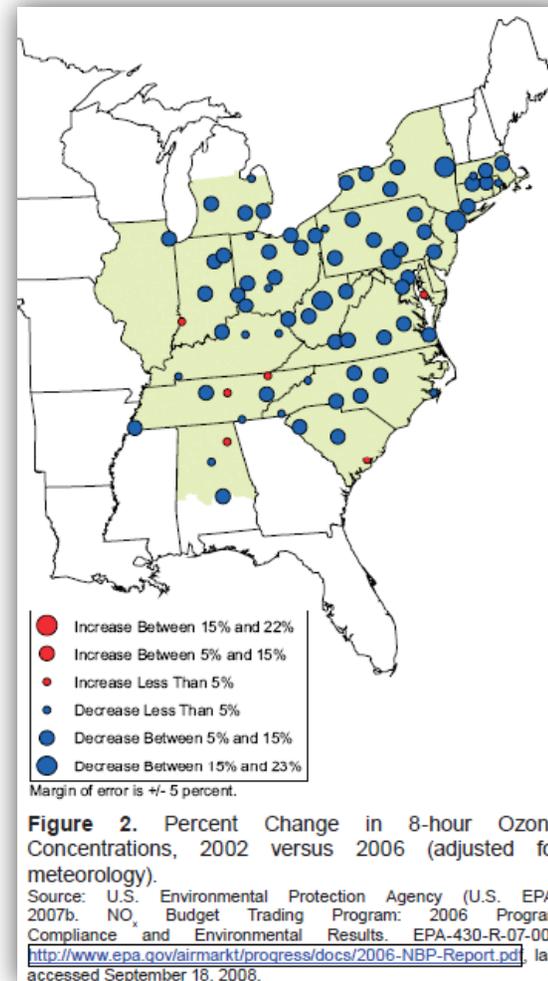
Map with partial shading, overlaid with color and size-coded dots

**Figure Description**

This figure displays a map of the eastern United States with measured partial shading. The data represented here concern the percent change in 8-hour ozone concentrations in 2006 compared to 2002, adjusted for weather conditions. Dots sizes indicate size of change: less than 5% change (small dot), 5-15% change (medium dot), or 15-22% change per year (large dot). Sites with a decreasing trend have blue dots, and sites with increasing ozone concentrations trend have red dots. The tan shading over many of the states does not provide any additional data.

**Data Types**

Spatial, administrative, categorical, color



US EPA, State of the Lakes Ecosystem Conference (SOLEC)  
 State of the Great Lakes 2009 (PDF Document)  
<http://www.epa.gov/solec/sogl2009/4202airquality.pdf>

Visualization Type  
Horizontal bar graph

#### Figure Description

This bar graph divides the USA into 'watershed' (dark blue bars) or 'shoreline' (light blue bars) areas. Within each of the 11 employment categories, the 'quotient of employment in 2007' is plotted to show whether coastal shoreline areas are more or less specialized within an employment category than the U.S. on average. Data have been normalized so that the center-line represents a national average for each sector.

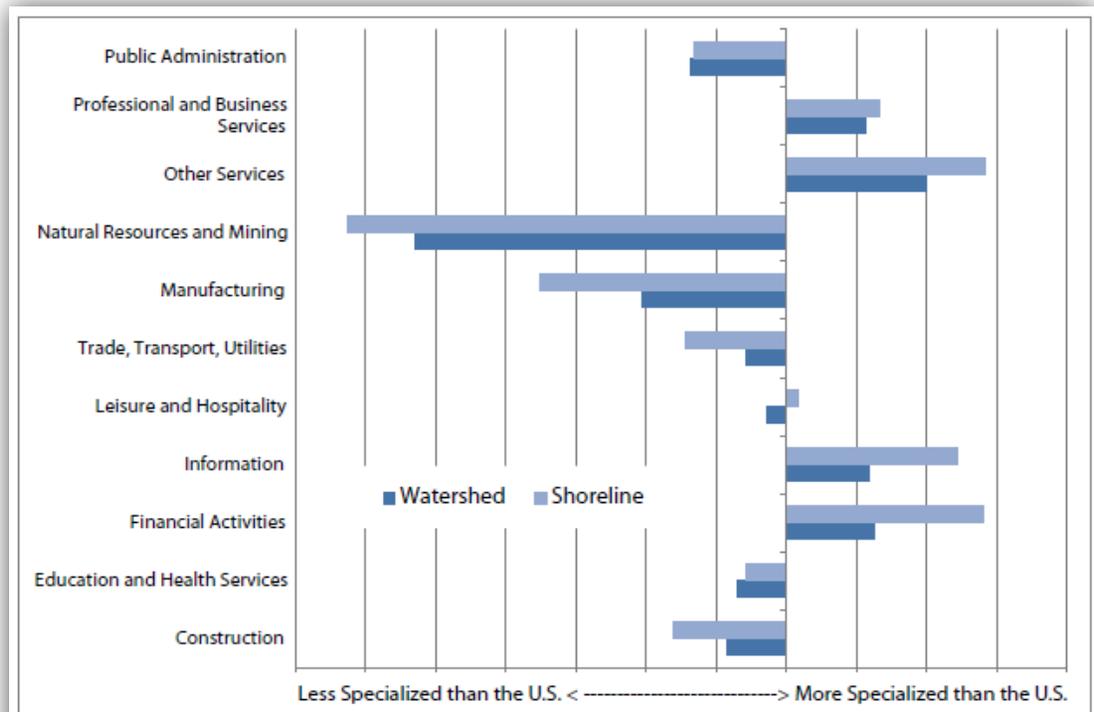


Figure 2.8 Specialization of coastal areas based on location quotient of employment, 2007

Data Types  
Categorical, relational, comparative

National Ocean Economics Program  
Recent publications: State of the U.S. Ocean and Coastal Economies

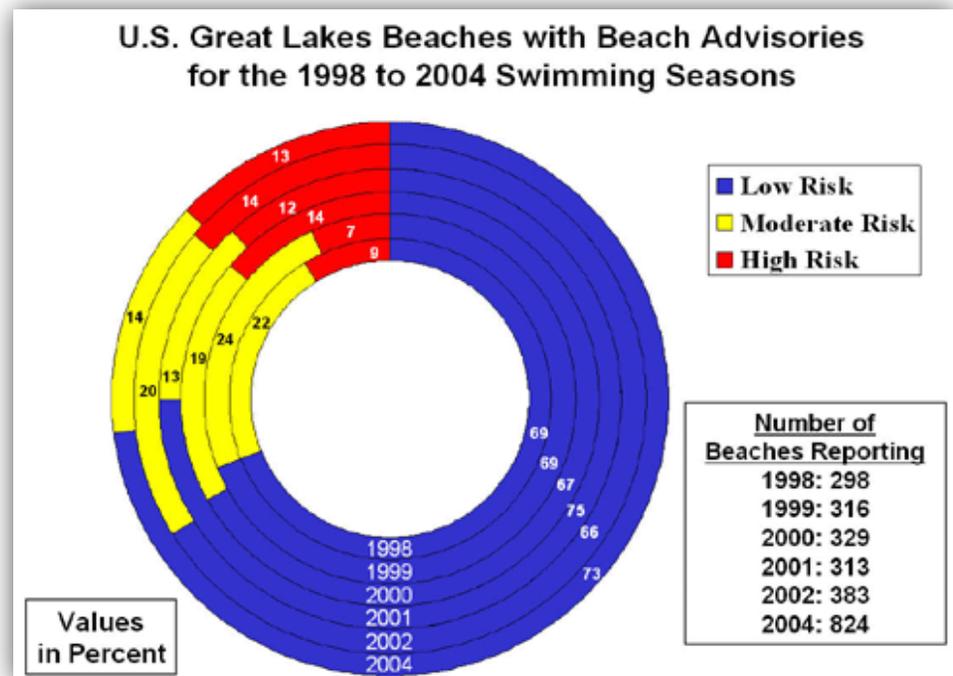
<http://www.oceaneconomics.org/Download/>

Visualization Type  
Concentric segmented rings

#### Figure Description

This figure shows data from 1998 -2004 from beaches along the Great Lakes shoreline that reported the frequency of swim advisories/closings by local authorities for fecal pollution or other reasons (lightning, high water, etc). Accompanying text provides further explanation: “a beach that is not posted during the swimming season has low risk. A beach that is posted 10% or more days during the swimming season has high risk. Beaches posted for one day or more but fewer than ten days (swimming season in the Great Lakes is defined as June to August) are characterized as medium risk. “

Data Types  
Numerical, temporal, color



US EPA, Great Lakes Monitoring  
Water Indicators, The Swimmability Index

<http://www.epa.gov/glnpo/glindicators/water/beachb.html>

## Visualization Type

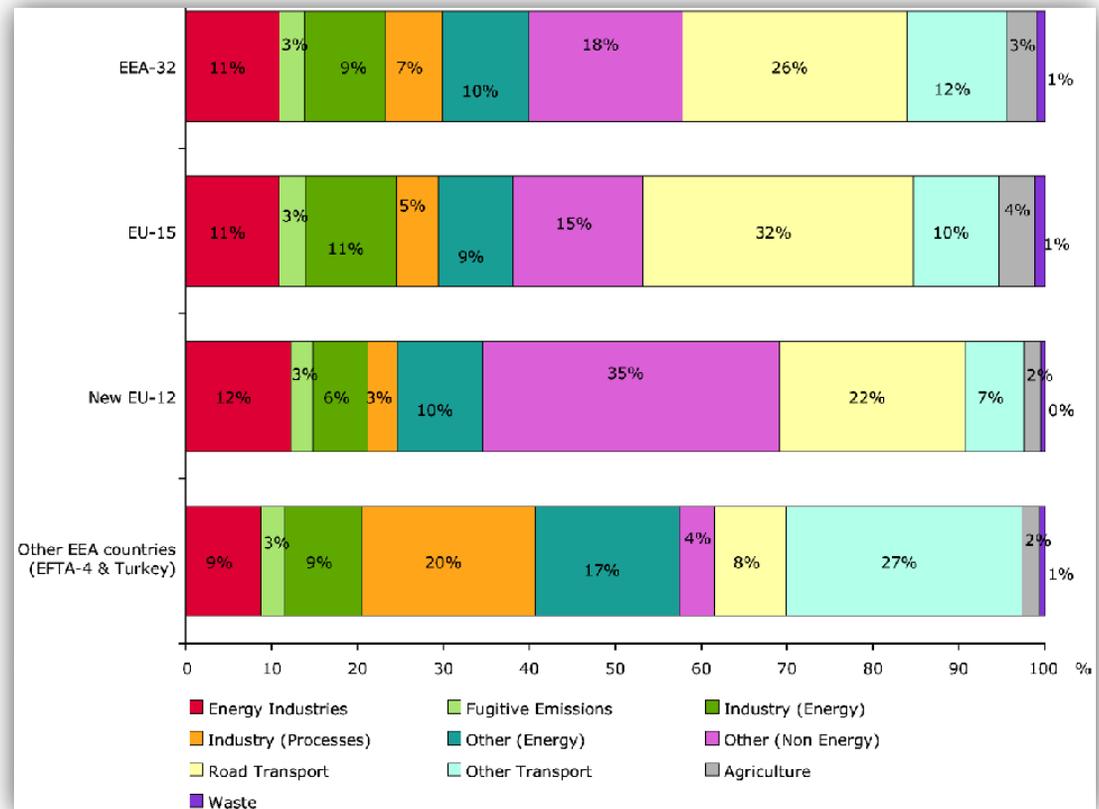
Horizontal stacked bar graph

## Figure Description

In this bar graph, each horizontal line represents a mix of countries in and around Europe, divided into recognizable groups such as EEA-32, EU-15, etc. Each horizontal line adds up to 100% of ozone precursor emissions for that group of countries. The divisions within each line are color-coded by emitter sector, with an overlaid number showing that sector's contribution to emissions within that country mix. This allows comparisons between different levels of groups. For example, how much of the ozone precursor emissions are from 'road transport' in the small group of EU-15 countries compares to the larger EEA-32 group.

## Data Types

Categorical, relational, proportional, color



## European Environment Agency

<http://www.eea.europa.eu/data-and-maps/figures/sector-split-of-emissions-of-ozone-precursors-eea-member-countries-eu-15-new-eu-12-other-eea-countries-efta-4-amp-turkey>

## Visualization Type

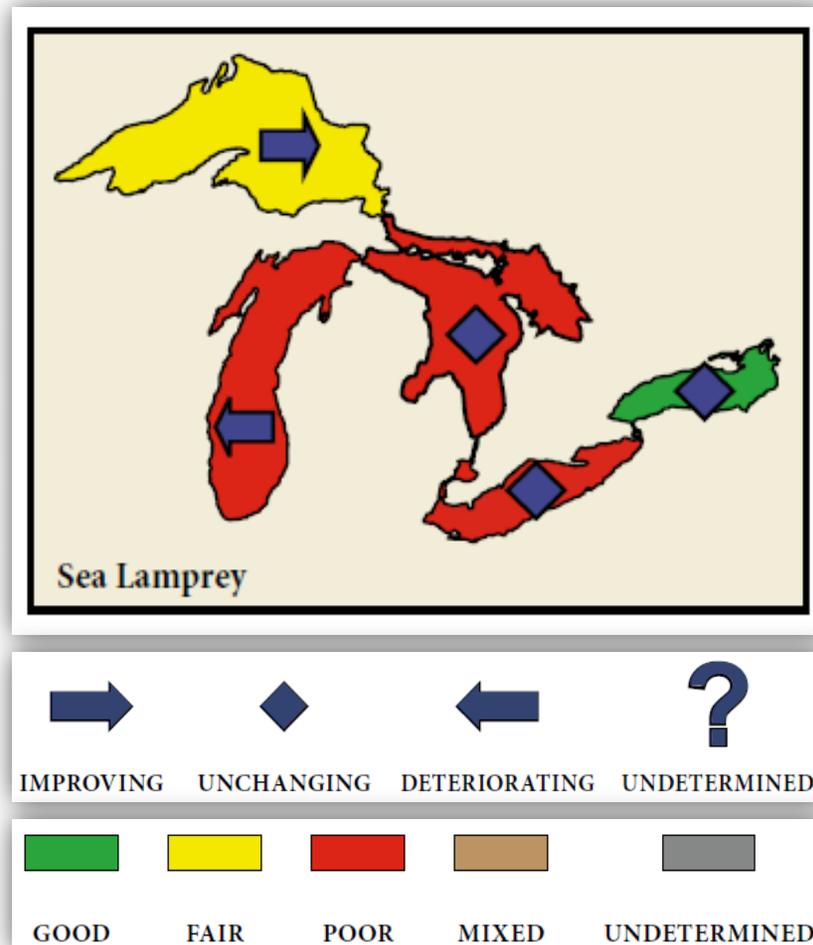
Map, color-coded and symbol-coded

## Figure Description

This figure depicts success of efforts at controlling the invasive sea lamprey in the Great Lakes as of 2009. Accompanying text explains: “decades of control measures have reduced the sea lamprey population by over 90 percent from its peak, but the need for sea lamprey control continues. The success of control efforts are measured against sea lamprey target population ranges agreed to by fishery management agencies, which should result in tolerable fish mortality rates.” No state or international boundaries are shown around the lakes.

## Data Types

Spatial, categorical, color



US EPA & Environment Canada

[State of the Great Lakes 2009, Highlights](#) (PDF document)

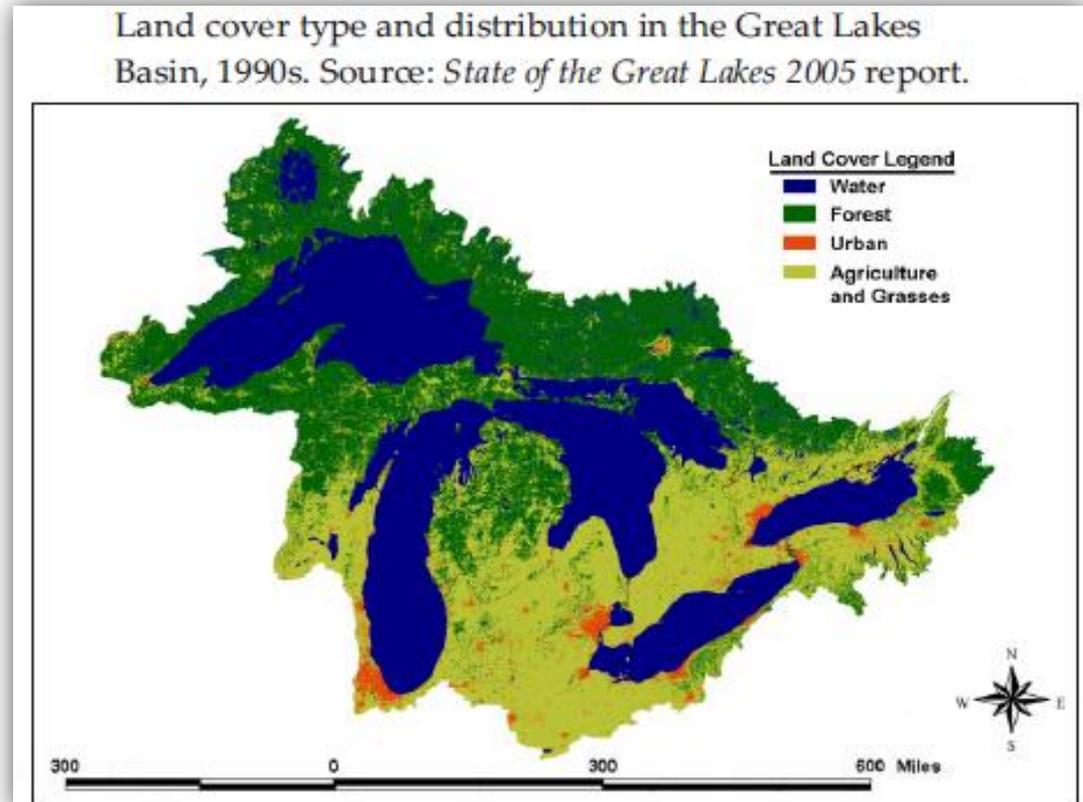
[http://binational.net/solec/sogl2009/sogl\\_2009\\_h\\_en.pdf](http://binational.net/solec/sogl2009/sogl_2009_h_en.pdf)

Visualization Type  
Choropleth map

#### Figure Description

This figure divides land cover type into 4 categories (water, forest, urban, agriculture and grasses) and shows distribution of each type in the areas of the United States and Canada for an area surrounding the Great Lakes during the 1990s. The four colors used for land cover are blue, green, orange, and yellow. State and national boundaries are not shown on this map, nor are major features labeled.

Data Types  
Spatial, categorical, color



US EPA, State of the Lakes Ecosystem Conference  
2005 Ecological Health Indicator Summary Sheets  
[What is the state of Great Lakes forests?](http://www.epa.gov/glnpo/solec/indicator_sheets/forests.pdf) (PDF Document)  
[http://www.epa.gov/glnpo/solec/indicator\\_sheets/forests.pdf](http://www.epa.gov/glnpo/solec/indicator_sheets/forests.pdf)

## Visualization Type

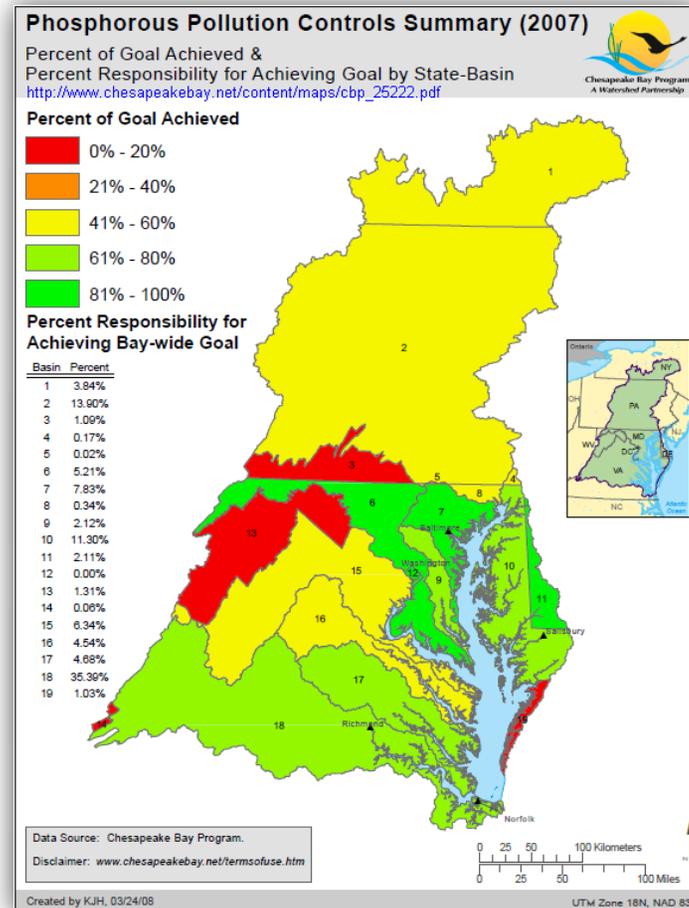
Choropleth map with sub-category labels, side table

## Figure Description

This figure is a map of the Chesapeake Bay watershed covering multiple states. Color-categories represent 'percent of goal achieved,' for phosphorus pollution reduction. Numbers within each bounded-color area lead to a 2-column side table with information about the importance of each sub-watershed's role in achieving the bay-wide goal. For example, as of 2007, the yellow '1' area (top of map, within NY state) had achieved 41-60% of the phosphorus pollution control goal for that sub-watershed. Overall the '1' section is responsible for 3.54% of the Chesapeake Bay-wide phosphorus pollution reduction goal. Inset: regional states map overlaid with watershed area in green.

## Data Types

Spatial, administrative, hydrological, numerical, categorical



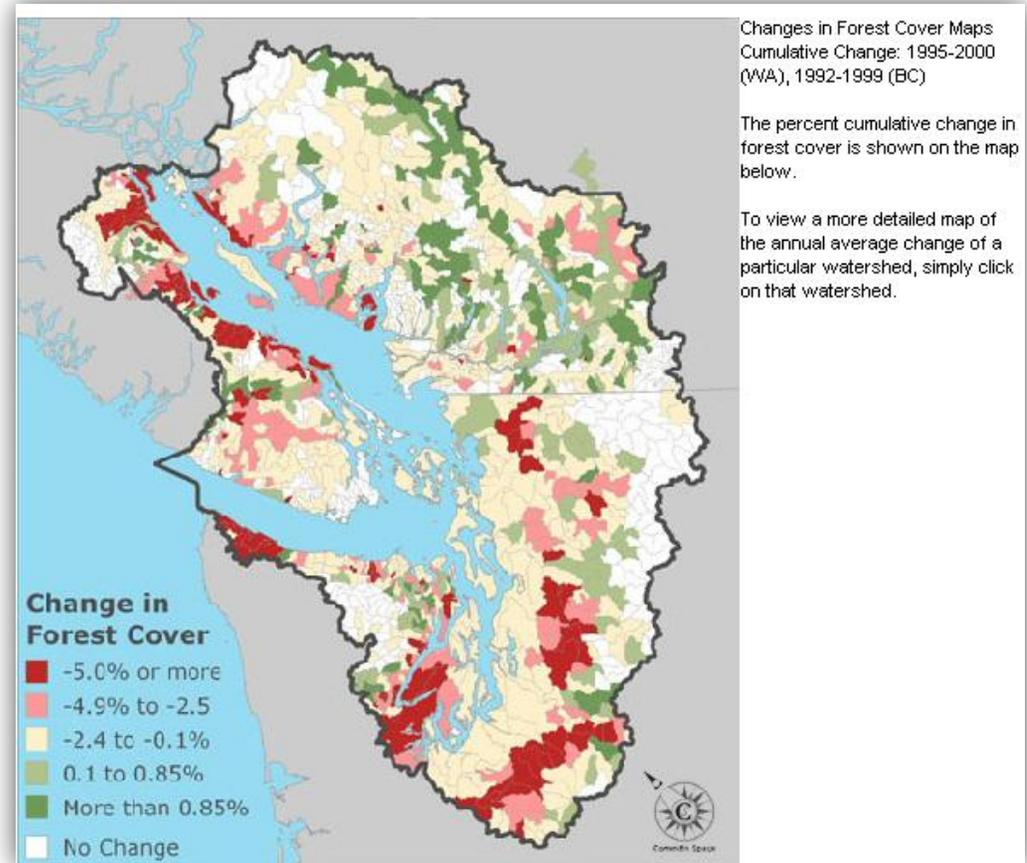
## Chesapeake Bay Program

Bay Resource Library, Maps, Habitat Restoration,  
[Phosphorus Pollution Controls Summary \(2007\)](http://www.chesapeakebay.net/content/maps/cbp_25222.pdf) (PDF document)  
<http://www.chesapeakebay.net/maps.aspx?menuitem=16830>

Visualization Type  
Choropleth map

#### Figure Description

This figure presents a map of the Puget Sound watershed straddling Washington State (USA) and British Columbia (Canada) while displaying the percent cumulative change in forest cover between 1995-2000 (Washington, USA) and 1992-1999 (British Columbia, Canada) for over 2000 local watersheds. Accompanying text explains the importance of this indicator, possible causes, and how it can affect individual residents.



Data Types  
Temporal, spatial,  
hydrological, administrative

EPA Puget Sound Georgia Basin Ecosystem Indicators Program  
[Executive Summary: Urbanization and Forest Change](#) (PDF Document)

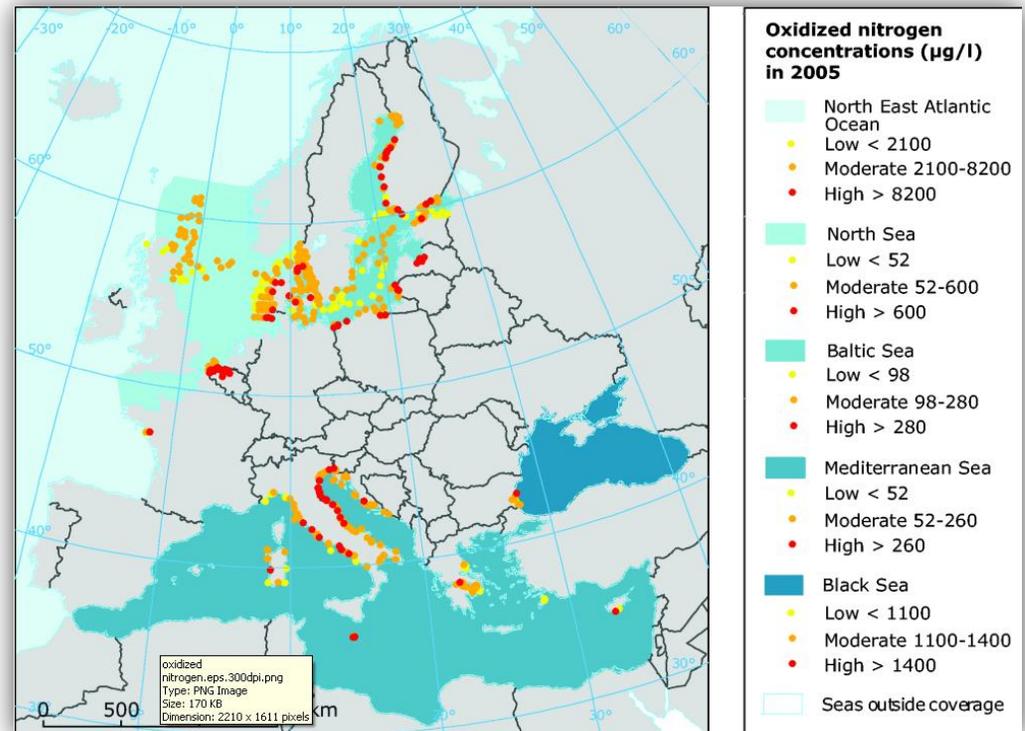
[http://www.epa.gov/pugetsound/pdf/Summary\\_Urbanization\\_and\\_Forest\\_Change\\_Indicator.pdf](http://www.epa.gov/pugetsound/pdf/Summary_Urbanization_and_Forest_Change_Indicator.pdf)

## Visualization Type

Map with color coding and point-data overlay

## Figure Description

This figure shows a map of Europe displaying oxidized nitrogen concentrations ( $\mu\text{g}/\text{liter}$ ) in Black, Mediterranean, Baltic, and North Seas, and North East Atlantic Ocean at observing stations in the year 2005. Pollutant concentration ranges are scaled to each water body to accommodate sea characteristics. Indicators are represented as yellow/orange/red dots (corresponding to low/medium/high) at specific observing sites, water bodies are distinguished by intensity of blue shading.



## Data Types

Spatial, point data, numerical, comparative, administrative

European Environment Agency

<http://www.eea.europa.eu/data-and-maps/figures/map-of-winter-oxidized-nitrogen-concentrations-observed-in-2005>

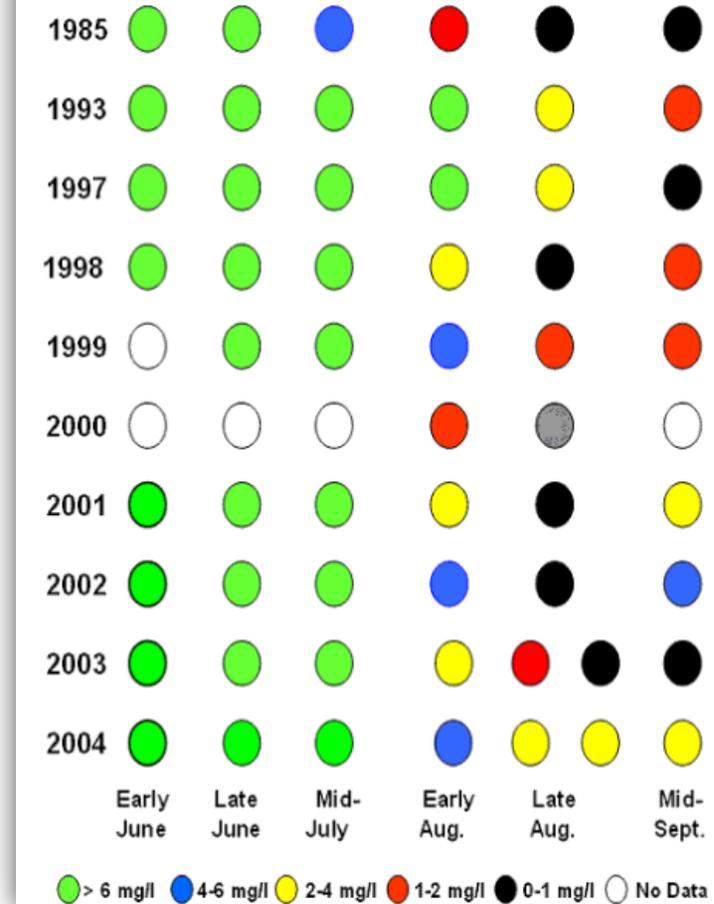
Visualization Type  
Matrix of color-coded circles

Figure Description

This figure displays a 6-by-10 matrix presenting seasonal levels for dissolved oxygen concentrations in Lake Erie. Each dot within the matrix is filled with a color corresponding to 1 of 6 possible conditions. The accompanying text includes information about the management goal supported by this indicator (“oxygen levels high enough to sustain healthy fishery”) and trends in the indicator (“duration of oxygen depletion is shorter than in the mid-1980’s”), as well as related water-quality issues.

Data Types  
Categorical, color, temporal

Lake Erie Central Basin D. O. Concentrations:1985 to 2004



US EPA, Great Lakes Monitoring. Water Indicators, Dissolved Oxygen in Lake Erie  
<http://www.epa.gov/glnpo/glindicators/water/oxygena.html>

Visualization Type  
Venn diagram with sub-categories

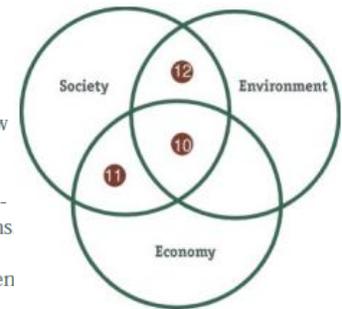
Figure Description

This screenshot captures a Venn-diagram made of 3 interlocking circles along with introductory text. Within each large open circle an indicator subset is shown as a smaller numbered circle (red, with white text). These indicators are arranged according to its applicability across categories within a goal-evaluation area (not shown). This diagram presents indicators that fit into multiple categories. Categories in this example are Society, Environment, and Economy. Indicators here are part of the goal-evaluation area: “Strong Community, Culture & Recreation” (not shown). Indicator numbers correspond to a larger list of 41 indicators used in the report.

Data Types  
Categorical, relational

**GOAL:** Create or enhance within New Jersey communities a positive sense of local identity and individual belonging, which promotes respect among neighbors, increases everyone’s feelings of safety and security, and provides abundant cultural and recreational opportunities.

Feeling good about where you live, feeling a connection to your neighbors and local institutions while surrounded by places to play and learn, is an ideal that many people seek. New Jersey offers a vast array of communities and neighborhoods - cities, small towns, old and new suburbs, rural lands - and an equally vast array of recreation and cultural options, from cranberry festivals to opera, from bicycle races to ethnic celebrations. Our community bond is weakened when we don’t participate in community events, when we fear to walk some streets, and when we can’t or don’t visit our cultural and recreational places.



What we know

10	Newspaper circulation decreasing .....	page 25
11	Crime rate recently decreasing .....	page 26
12	Open space available for public enjoyment increasing.....	page 27

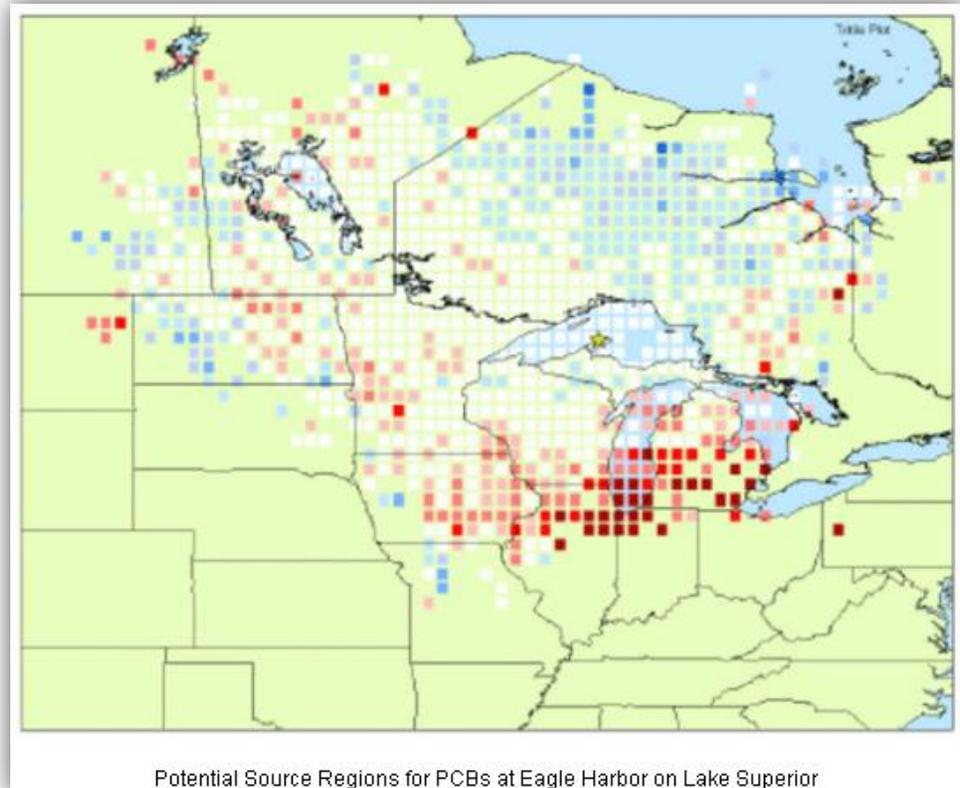
New Jersey Department of Environmental Protection,  
Office of Science and Interagency Sustainability Working Group  
Living with the Future in Mind (PDF Document)  
<http://www.state.nj.us/dep/dsr/sustainable-state/part-2.pdf>

Visualization Type  
Map with color-coded overlay

#### Figure Description

This regional map of the north central United States and south central Canada is overlaid with color-coded air quality grid. Air quality is shown using single color per square corresponding to scale value. A star indicates the sampling station for which the potential source regions are mapped. "A NOAA model was used to produce back-trajectories that show where the air that was sampled on a certain day at an Integrated Atmospheric Deposition Network (IADN) station came from." Red and pink squares show areas where more "dirty" trajectories passed through. These areas are considered potential source regions for the pollutant of interest.

Data Types  
Administrative, environmental, numerical, relational



US-EPA, Great Lakes Monitoring  
Atmospheric Deposition of Toxic Pollutants

<http://www.epa.gov/glnpo/glindicators/air/airb.html>

## Visualization Type

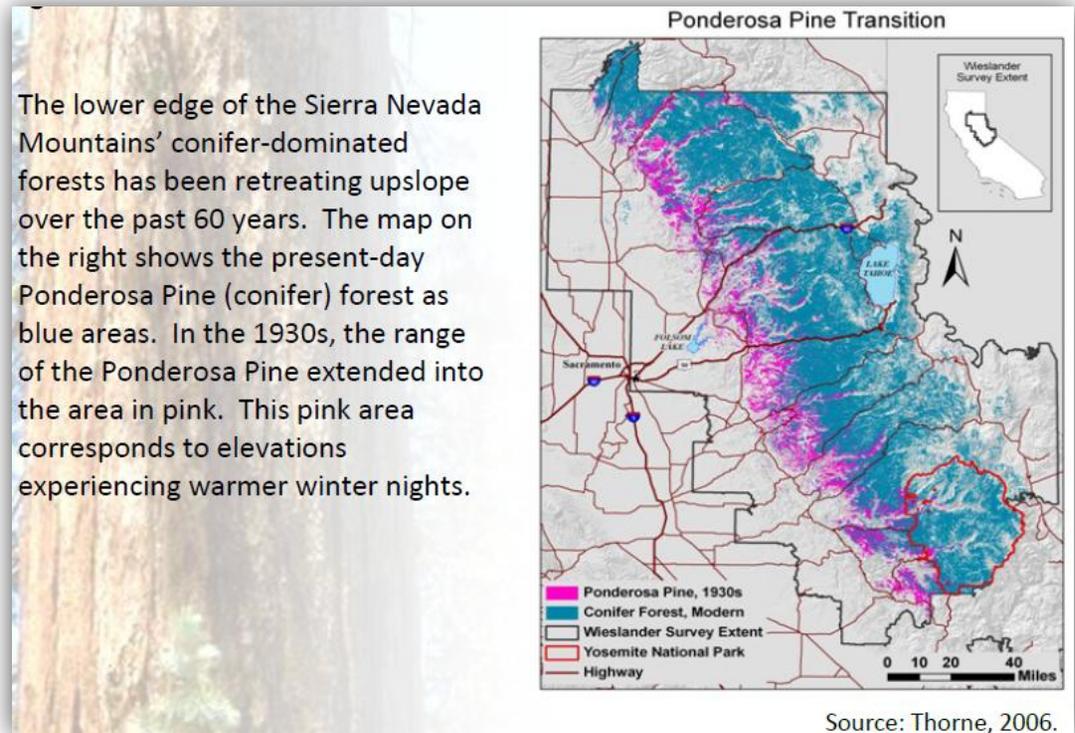
Map with color-coding and photo background

## Figure Description

This figure uses color-coding on an area map to convey information about an indicator, conifer forest range in California's Sierra Nevada Mountains, over the past 60 years. Major features such as national park boundaries, large lakes, and major highways are included on the map. Explanatory text links the data presented in the graphic with larger issues of concern in a non-technical way.

## Data Types

Descriptive, spatial, temporal, administrative



California Environmental Protection Agency,  
Office of Environmental Health Hazard Assessment  
[Indicators of Climate Change in California, Summary](#) (PDF)  
<http://www.oehha.org/multimedia/epic/pdf/ClimateSummary.pdf>

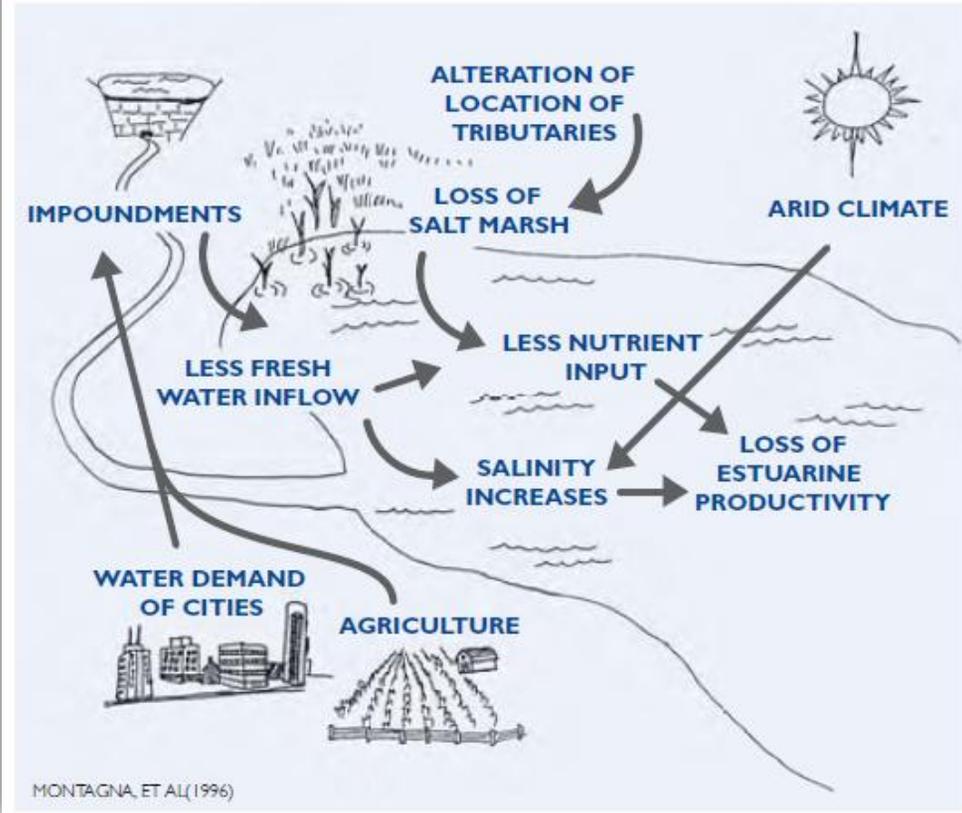
Visualization Type  
System diagram

#### Figure Description

This figure is an example of a non-quantitative illustration of the relationship between components that affect freshwater flows into estuaries. The placement of the icons is not as important as the arrows that link the different elements to tell a story relating human demands for water and downstream effects. Categories of use (agriculture, impoundments, etc) are also represented with small single-color drawings.

Data Types  
Relational, system (input-output)

### Effects of Changing Freshwater Flows to Estuaries



US Agency for International Development (USAID)  
[How Resilient Is Your Coastal Community](#) (PDF document)

[http://pdf.usaid.gov/pdf\\_docs/PNADH650.pdf](http://pdf.usaid.gov/pdf_docs/PNADH650.pdf)

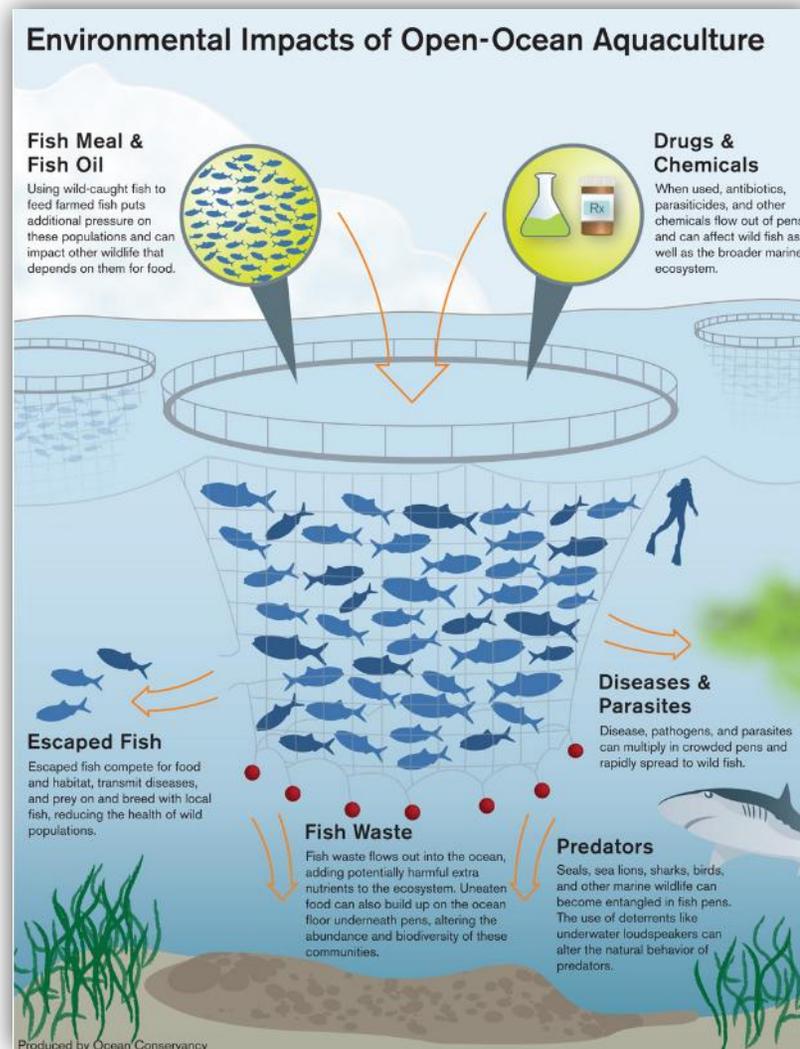
Visualization Type  
System diagram

### Figure Description

This figure is a system diagram displaying an interpretation of the environmental impacts of open-ocean aquaculture. Included in the diagram are physical inputs (food, chemicals) and outputs/effects (escaped fish, fish waste, diseases, predator behavior) linked by hollow orange arrows showing the direction of input or impact. Short textual explanations accompany the representative graphics.

Data Types

Relational, system (input-output)



Ocean Conservancy, Aquaculture

[http://www.oceanconservancy.org/site/PageServer?pagename=press\\_aquaculture](http://www.oceanconservancy.org/site/PageServer?pagename=press_aquaculture)

### Visualization Type

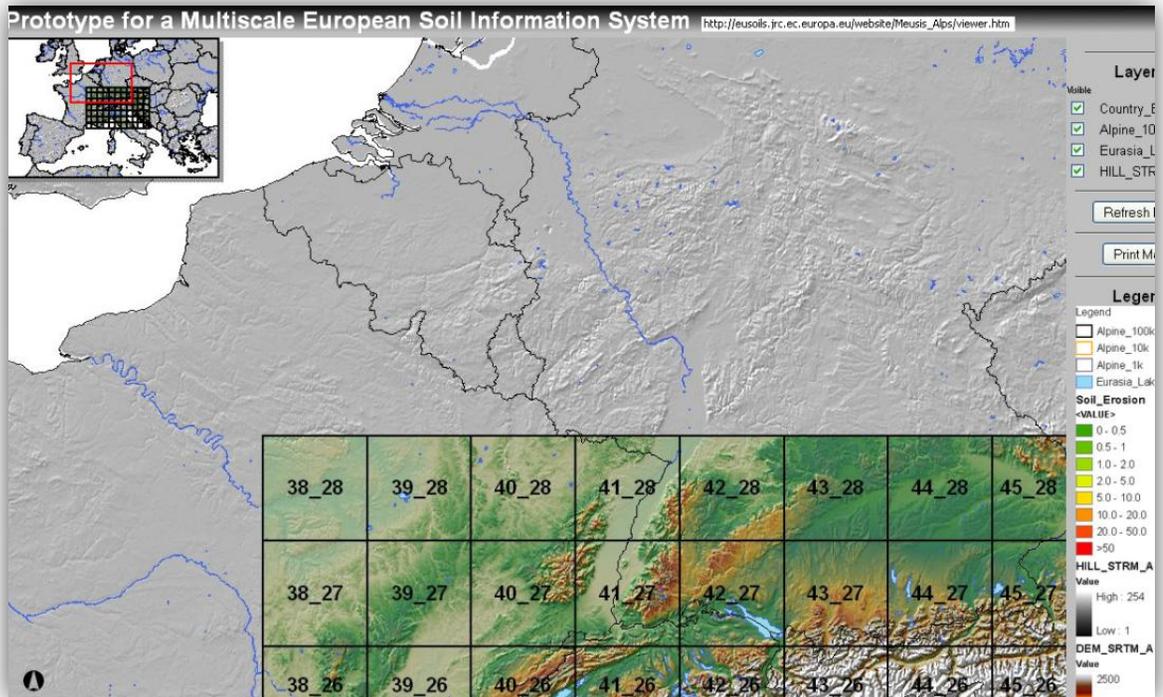
Interactive web-based mapping tool  
(prototype)

### Figure Description

This figure is a screenshot of a mapping tool that can display information related to European soil variables. It includes color-scale data projected on to maps. Currently available layers include information on soil erosion, land slope, lakes, and national boundaries. Users are able to select from multiple layers to display.

### Data Types

Spatial, numerical, categorical



European Commission, Joint Research Centre,  
Institute for Environment and Sustainability.  
Multiscale European Soil Information System (MEUSIS)  
(Screenshot of sample page)

[http://eusois.jrc.ec.europa.eu/website/Meusis\\_Alps/viewer.htm](http://eusois.jrc.ec.europa.eu/website/Meusis_Alps/viewer.htm)

## Visualization Type

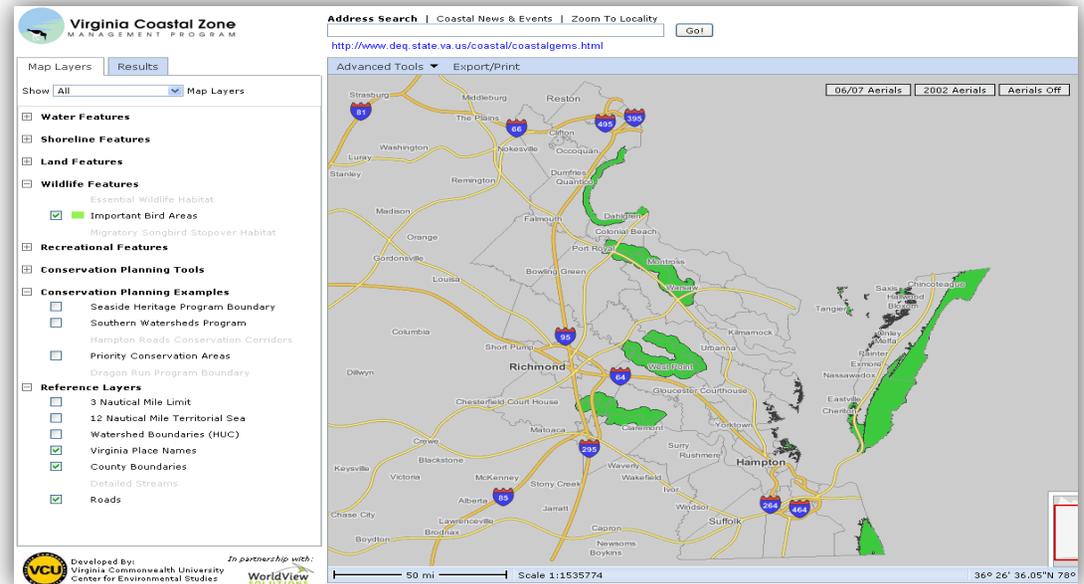
Interactive web-based mapping tool

## Figure Description

This screenshot captures the opening page of a web-based mapping tool. This application is designed to be a “gateway to Virginia’s coastal resource data and maps; coastal laws and policies; facts on coastal resource values; and direct links to collaborating agencies responsible for current data.” It is also designed to be a “growing inventory of water and land based natural resources, conservation planning tools, and planning examples....” accessible to the general public.

## Data Types

Spatial, categorical, administrative



Virginia Department of Environmental Quality  
Coastal Zone Management Program, Coastal GEMS.  
(Screenshot of sample page)

<http://www.deq.state.va.us/coastal/coastalgems.html>

## Visualization Type

Interactive web-based mapping tool

## Figure Description

This figure is a screenshot of a state-level natural resources mapping tool. This application is divided into 'Oceans', 'Shorelines,' and 'Estuaries' categories, with different data types available under each heading. Users can draw on maps, zoom, and view different layers. Available information includes shoreline erosion data, sea level rise, coastal storm at-risk areas, critical tidal and near-shore aquatic resources and habitats, shipping lanes, recreational fishing spots, and power transmission lines.



## Data Types

Spatial, categorical, use-category

Maryland Dept. of Natural Resources.

Coastal Atlas, Shorelines module

(Screenshot of sample page)

[http://www.dnr.state.md.us/map\\_template/coastalmaps/shorelines.html?agreecheck=o](http://www.dnr.state.md.us/map_template/coastalmaps/shorelines.html?agreecheck=o)

## Visualization Type

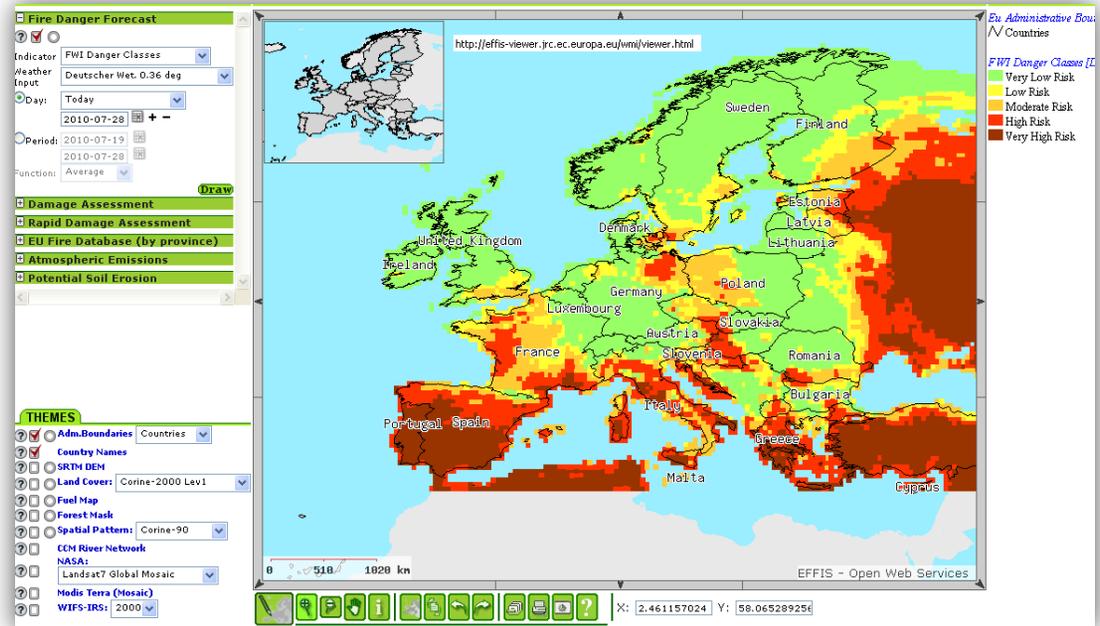
Interactive web-based mapping tool

## Figure Description

This figure displays a sample page (showing data related to fire risk) from a web-based data mapping tool. Within the application, users can select to display a variety of modules, including fire danger forecast, damage assessment, rapid damage assessment, European Union fire database (by province), atmospheric emissions, and potential soil erosion. This tool is limited to European environmental data only, but is available to the general public.

## Data Types

Spatial, administrative, categorical, numerical



European Commission, Joint Research Centre.

Institute for Environment and Sustainability.

European Forest Fire Information System. (Screenshot of sample page)

<http://effis-viewer.jrc.ec.europa.eu/wmi/viewer.html>

### Visualization Type

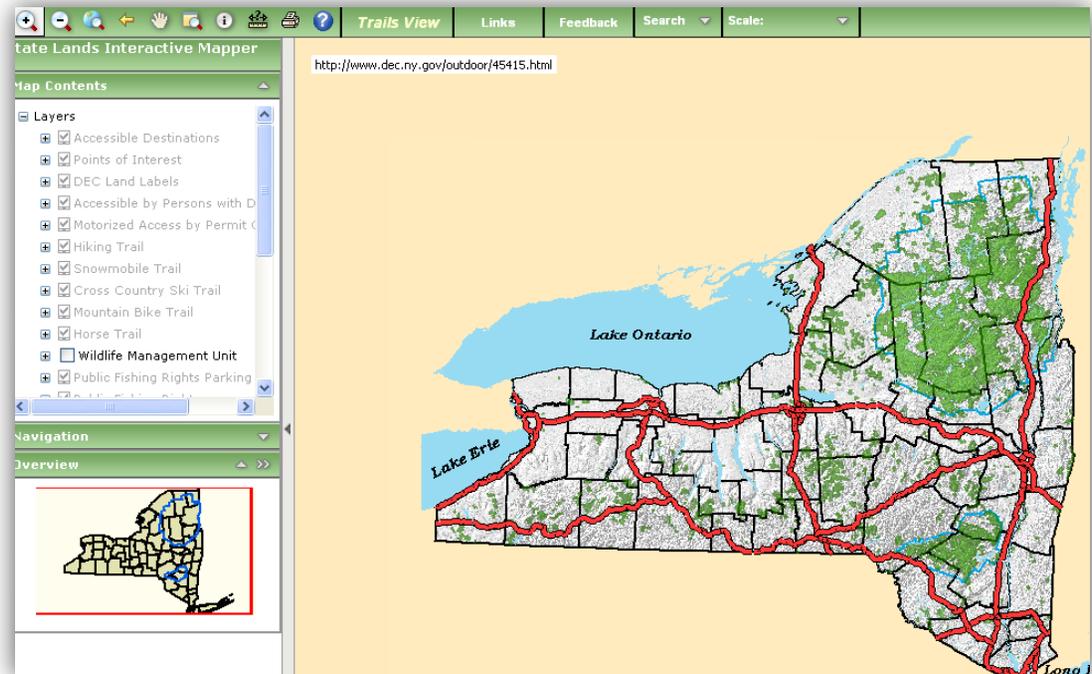
Interactive web-based mapping tools

### Figure Description

This screenshot presents the opening page of a web-based mapping tool. While available through one departmental web-portal, users must open each mapping application separately (E.g. New York Nature Explorer; Environmental Facilities Navigator). Multiple mapping/viewing applications allow users to view state data on recreational sites, biodiversity, geography, environmental facilities, conservation areas, industrial/mining areas, construction projects, and Hudson River benthos.

### Data Types

Spatial, administrative, categorical



New York State, Department of Environmental Conservation  
Interactive Online Maps  
(Screenshot of sample page)

<http://www.dec.ny.gov/pubs/42937.html>

Visualization Type  
Interactive web-based mapping tool

#### Figure Description

This screenshot displays a page within the data export portion of this web-based mapping tool. Within this publicly accessible system, users can choose stations by location and then select the type of data from a scrolling list. User can display information on a site map or download customized data sets. Additional functionality includes the ability to zoom in on maps and specify the type of map to display (based on Google Maps options).

#### Data Types

Numerical, spatial, temporal (availability of data varies by research reserve and station)

**NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM**  
Centralized Data Management Office  
<http://cdmo.baruch.sc.edu/get/export.cfm>

Home About CDMO About Data Get Data Web Services Contact CDMO

**Data Export System** Powered By The Centralized Data Management Office

Choose Reserve Choose Sampling Station View or Download Data Submit Info Complete!

**Please select a sampling station from Wells, ME:** \*\*Filter Sampling Stations By Data Type: All Stations

Station Name	Real Time	Status	Data Type	Station Code
Skinner Mill	Yes	Active	water quality	SM
Drake Island Downs	No	Inactive	water quality	DN
Inlet	No	Active	nutrient	IN
Inlet	No	Active	water quality	IN
Mud of Tide	No	Active	nutrient	UT

Map Satellite Hybrid Terrain

Imagery ©2010 DigitalGlobe, Maine GeoLibrary, USDA Farm Service Agency, Ches/Spot Image, GeoEye - Terms of Use

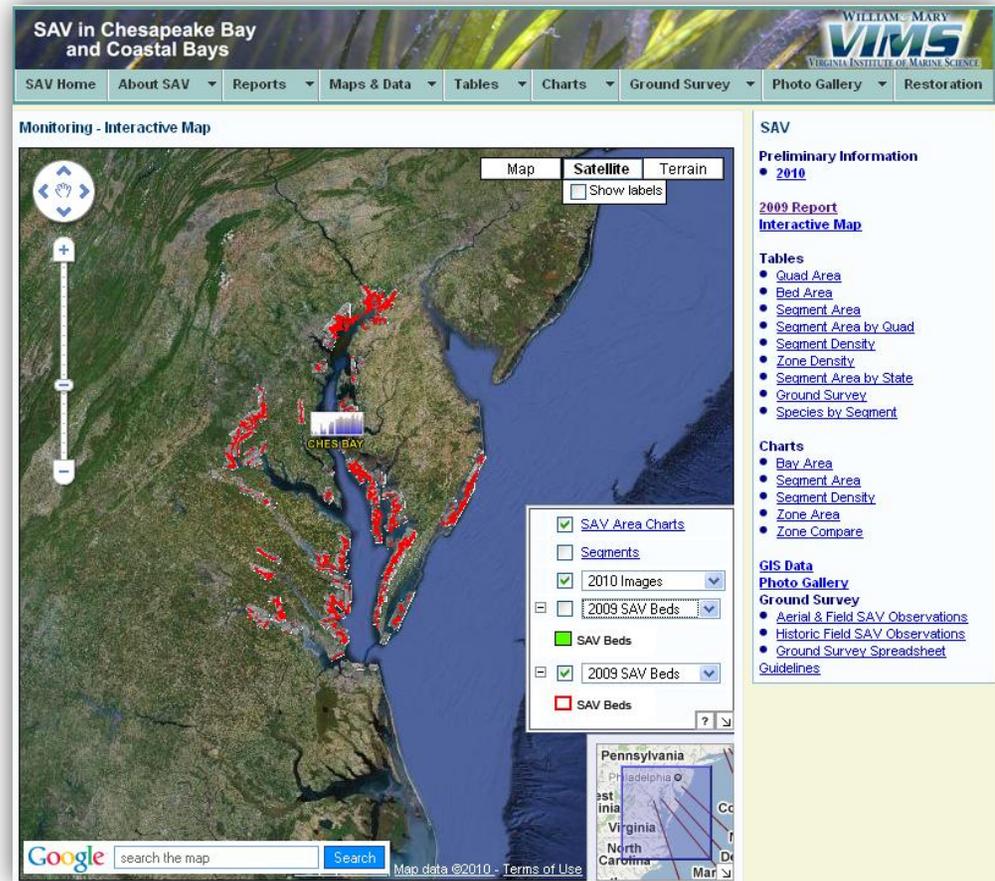
Your Station Selection: Inlet **Proceed With This Station >>**

National Oceanographic and Atmospheric Administration  
National Estuarine Research Reserve  
Centralized Data Management Office (Screenshot of sample page)  
<http://cdmo.baruch.sc.edu/get/export.cfm>

Visualization Type  
Interactive web-based map

#### Figure Description

This figure is a screenshot within a web-based mapping tool. From drop-down menus, users can view the extent of submerged aquatic vegetation (SAV) in the Chesapeake Bay area for most years between 1971 and 2009. Users can compare the area of SAV between two years by using the check boxes to turn on/off layers in this Google Maps-based application. Additional functions include the ability to zoom, label display (features such as cities, large bays, etc), and expand floating charts (histograms, line graphs) to display detailed SAV coverage data for specific regions.



Data Types  
Spatial, temporal, categorical

Virginia Institute of Marine Science, College of William & Mary  
2009 Distribution of Submerged Aquatic Vegetation in Chesapeake Bay and Coastal Bays.  
Special Scientific Report #152 (Screenshot of sample page)  
<http://web.vims.edu/bio/sav/maps.html?svr=www>

### Visualization Type

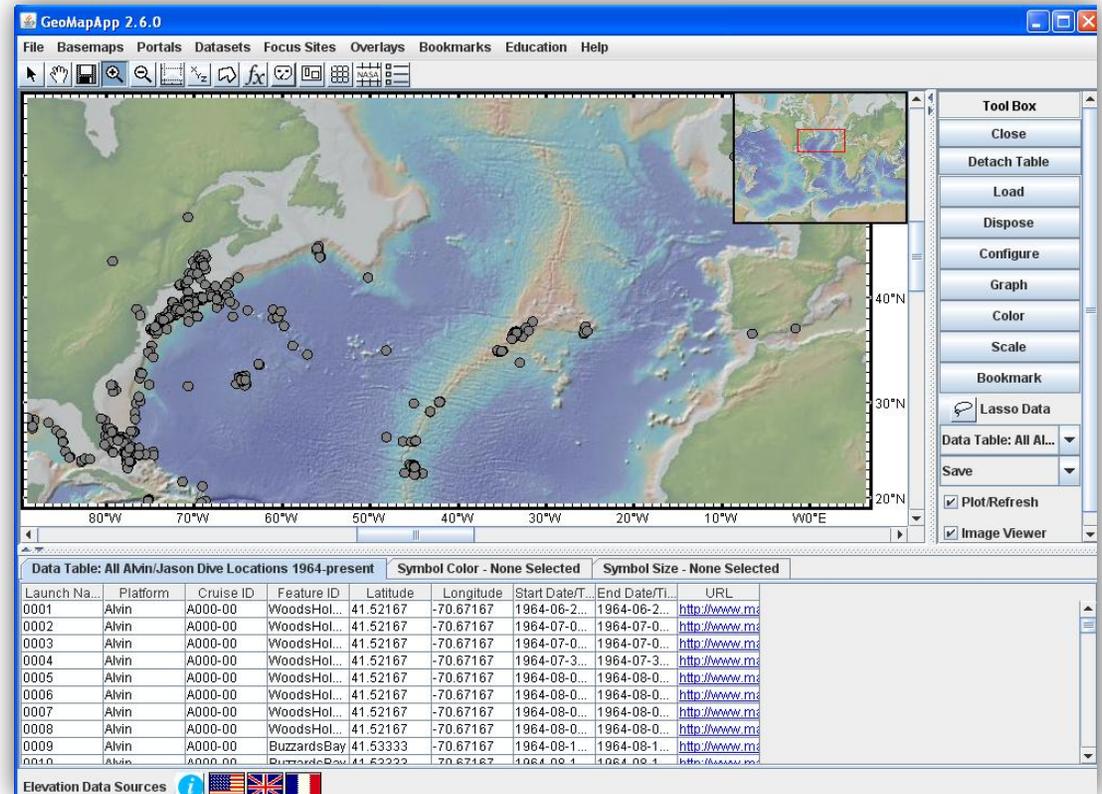
Interactive web-based mapping program

### Figure Description

This figure displays a web-based mapping and data-presentation tool called GeoMapApp. The “GeoMapApp relies on the internet to access a rich content of information for physical oceanography, paleoclimates, geochemistry, geology, seabed sediment and rock compositions, ocean crust age, spreading rates, bathymetry, and sediment thickness.” Users can display numerous layers and information types, zoom in/out, and pan across an area of interest.

### Data Types

Spatial, numerical, temporal, categorical



Lamont-Doherty Earth Observatory of Columbia University,  
Marine Geoscience Data System (MGDS) GeoMapApp.  
(Screenshot of sample page)

<http://www.geomapapp.org/>

## Visualization Type

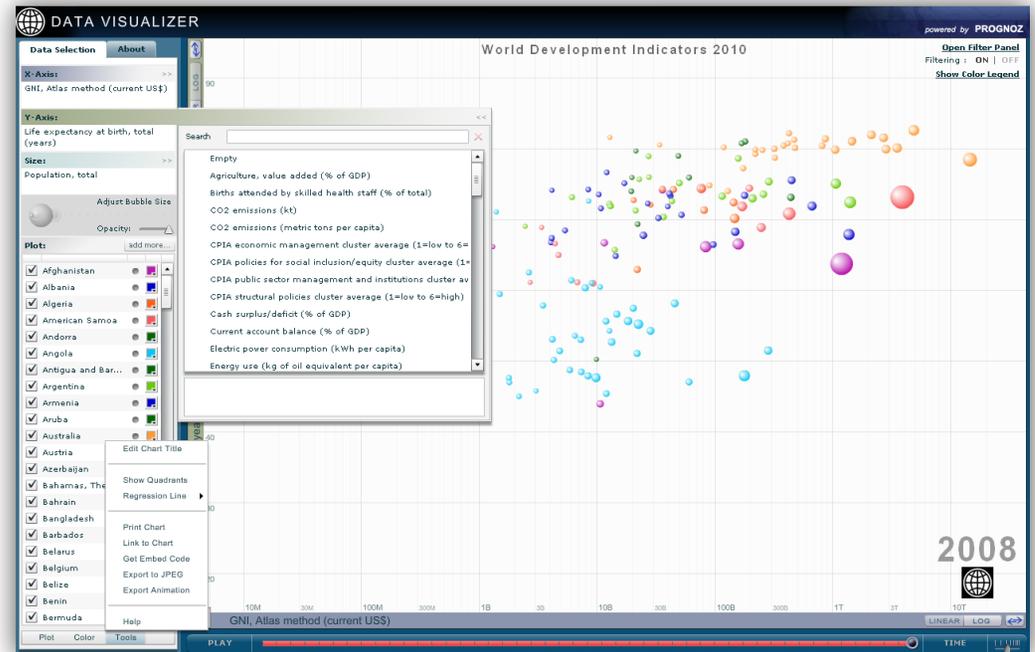
Interactive web-based animated bubble charts

## Figure Description

This screenshot captures a page with data displayed within web-based display tool. The Data Visualizer employs “bubble charts” to display data in four dimensions. In each chart, the size of the country circle represents a volume measure, such as population or GDP. The position of the bubbles is determined by the indicators selected for the horizontal and vertical axes. As of 2010, the Data Visualizer contained at least 49 indicators for 209 countries and 18 aggregates from the years 1960-2007. Available datasets include social, economic, financial, information & technology, and environmental indicators.

## Data Types

Temporal, categorical, numerical, color



## The World Bank, Data Visualizer

(Screenshot of sample page showing pop-out menus)

<http://data.worldbank.org/products/data-visualization-tools>  
<http://devdata.worldbank.org/DataVisualizer/>

### Visualization Type

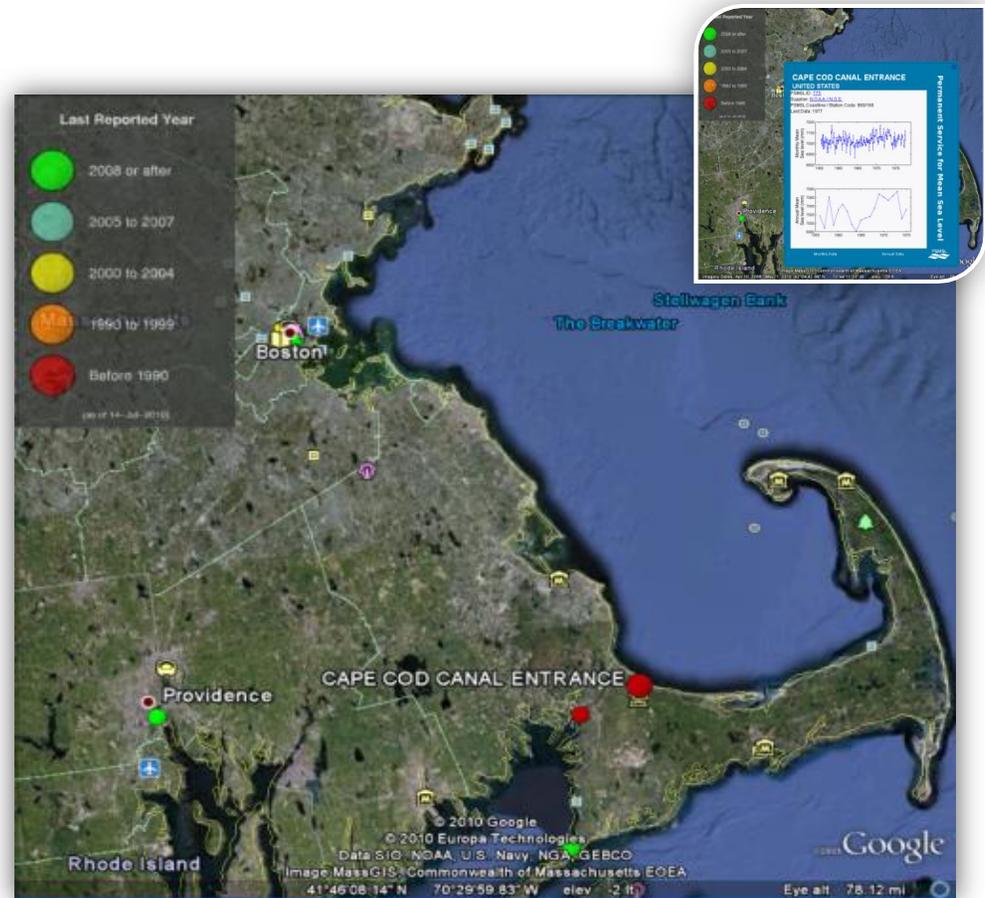
Interactive map with color-coded symbols

### Figure Description

This figure includes two screenshots from a 3<sup>rd</sup> party layer created for use in Google Earth. The Permanent Service for Mean Sea Level (PSMSL) created a publicly available map layer displaying sea level gauges that are part of a global reporting network. The Inset (top right) shows a screenshot for the same spatial area with pop-up box of information for a single station. Location of gauges, year established, last year with reported data, station code, owner institution, latitude, longitude are available for each location. Users can zoom in/out and inspect on any part of the globe to find sea level gauge information.

### Data Types

Spatial, point-data, pop-up charts for any type of data associated with a map feature.



### Permanent Service for Mean Sea Level (PSMSL)

Layer created for use in Google Earth ([www.google.com/earth](http://www.google.com/earth))  
 (Screenshot of sample page)  
[http://www.psmsl.org/about\\_us/](http://www.psmsl.org/about_us/)

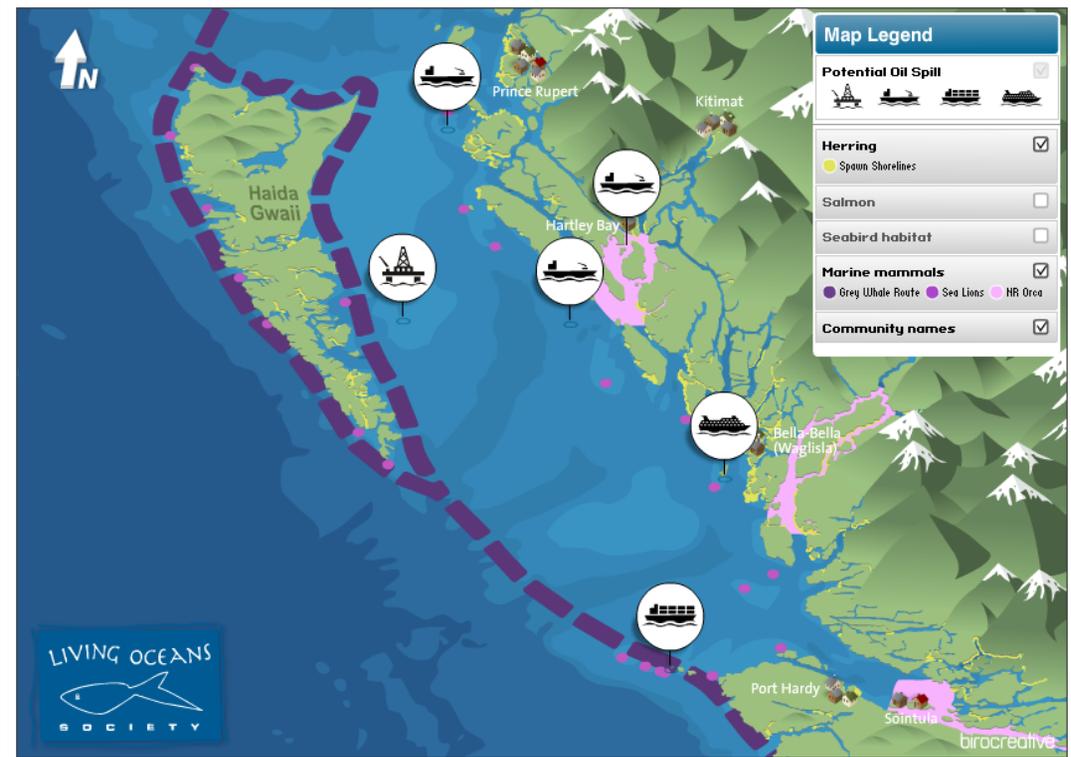
**Visualization Type**

Interactive web-based animated and static mapping tool

**Figure Description**

This figure is a screenshot from a web-based mapping tool. This restricted modeling application includes selectable layers which users can turn on/off to view different predictive scenarios displayed as animations. Predictions focus on the impacts from oil spill scenarios off of the British Columbia coast in Canada. Users can select type of spill, location, and see potential oil paths and impacted animals. This is not strictly indicator data, but it is a product built using such data.

Oil Spill Model

**Data Types**

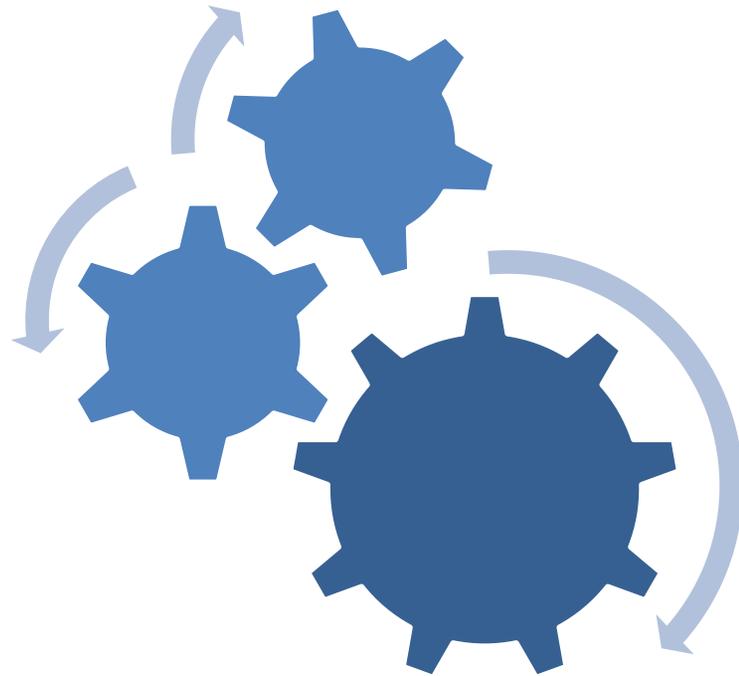
Spatial, temporal, predictive, categorical

**Living Oceans Society**

Oil Spill Model. (Screenshot of sample page)

[http://www.livingoceans.org/programs/energy/model/spill\\_model/oil\\_spill\\_model.aspx](http://www.livingoceans.org/programs/energy/model/spill_model/oil_spill_model.aspx)

# Complex Indicator Tools: Information Display from the Broader Indicator & Design Community



Visualization Type

Wheel of fortune, color-coded categories

#### Figure Description

This figure displays concentric levels of organization organized as a wheel. Each level is segmented into different attributes (e.g. ephemeral, persistent archival, persistent dynamic) to be used as part of a decision making process. The source description states that this assists in “illustrating possible choices for an institutional repository of published research.”

Data Types

Categorical, hierarchical, relational

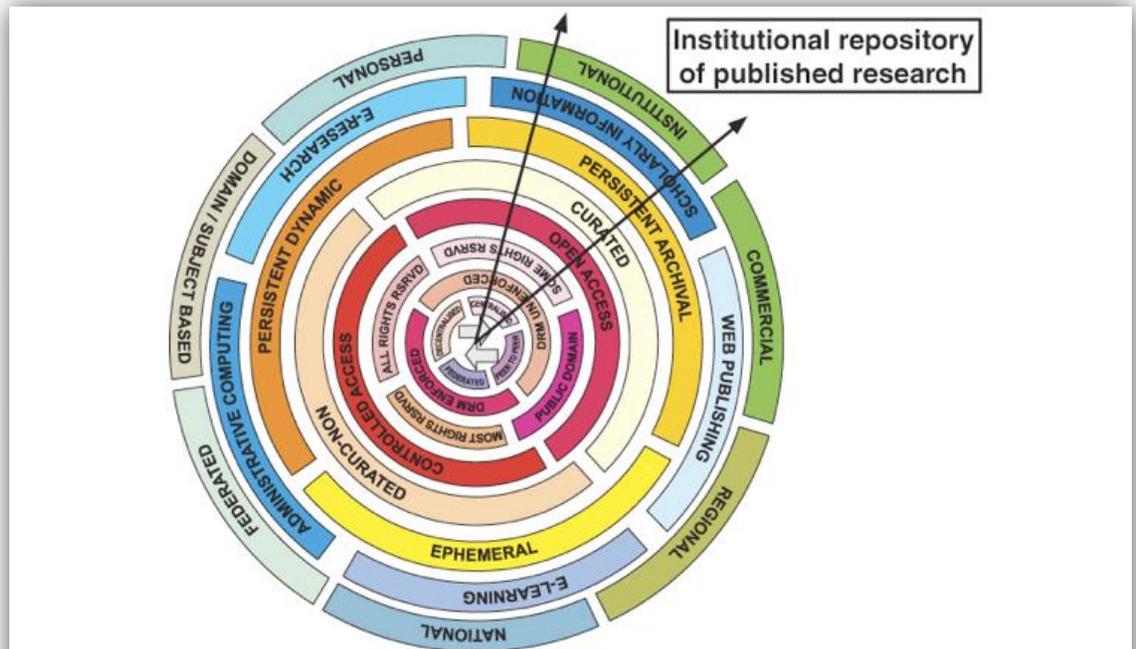


Figure 4: Repository 'Wheel of Fortune' (Source: Kerry Blinco, Personal Communication. Used with permission.)

Blinco, K. and McLean, N., 2004, *The Wheel of Fortune: A "Cosmic" View of the Repositories Space*.

Captured from: D-Lib Magazine, Sep/Oct 2007 Vol 13 #9/10

<http://www.dlib.org/dlib/september07/treloar/09treloar.html>

## Visualization Type

Color-coded map with symbols

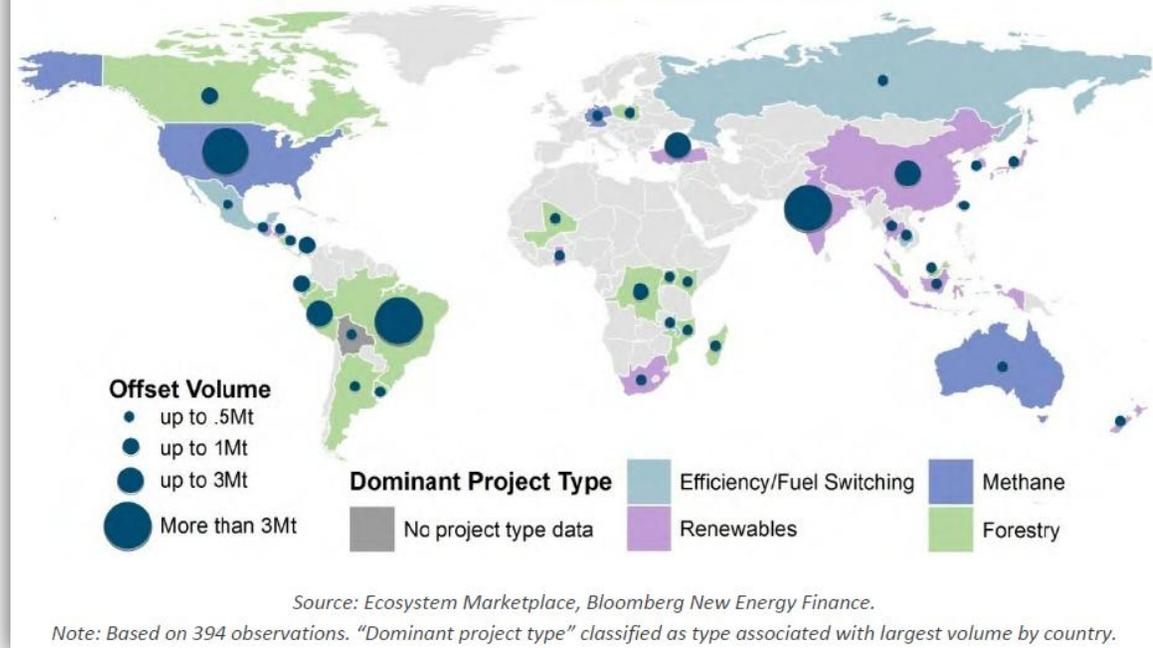
## Figure Description

This figure presents a world map of national boundaries. Each country for which information was available is color-coded according to one of 4 broad energy project categories. Within color-coded countries, the circles are sized to represent the amount of carbon-offset volume transactions documented for that country.

## Data Types

Spatial, administrative, categorical, economic (implied)

Figure 25: Transaction Volume and Project Type by Location



## Forest Trends Association

[Building Bridges: State of the Voluntary Carbon Markets 2010](#) (PDF document)

[http://www.forest-trends.org/documents/files/doc\\_2433.pdf](http://www.forest-trends.org/documents/files/doc_2433.pdf)

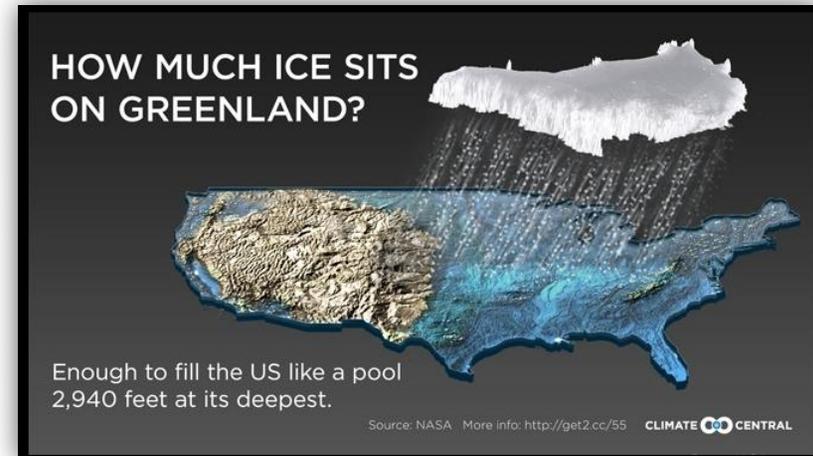
Visualization Type

Question-and-answer graphics

Figure Description

**Top:** "This image shows what would happen if [the Greenland ice sheet] all melted and rained down on the Lower 48 states, with high imaginary walls to keep the water from flowing into the ocean, Canada or Mexico."

**Bottom:** The effects of snowmelt timing in the western USA with forest fire severity in the same region. Explanatory text states that it shows "wildfire statistics... compared... with variations in snowmelt timing from 1970-2003. ...This graphic shows the region of analysis, and the ratio of the area burned in the 11 early-melt years, vs. the 11 late-melt years [with 12 'normal' years]. It is not meant to depict actual fire size or location."



Data Types

Spatial, comparative

Climate Central

[http://www.climatecentral.org/gallery/graphics/all\\_the\\_ice\\_on\\_greenland](http://www.climatecentral.org/gallery/graphics/all_the_ice_on_greenland)

[http://www.climatecentral.org/gallery/maps/mountain\\_snowmelt\\_and\\_fire](http://www.climatecentral.org/gallery/maps/mountain_snowmelt_and_fire)

## Visualization Type

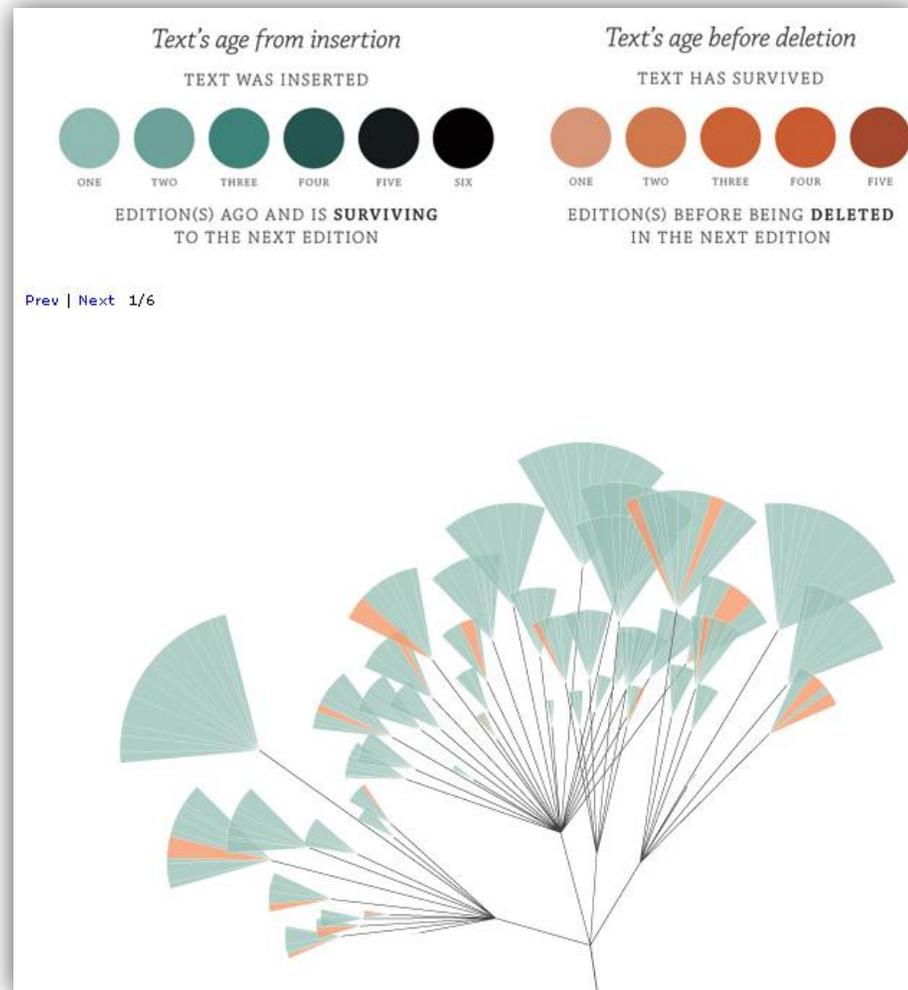
Branch/leaf/leaflet structure with color-coding

## Figure Description

This figure is part of a larger series using color-coded 'leaflets' (a single wedge within a leaf's fan-shape) to hold information about textual changes. The branch shown here represents a single chapter of the first edition of On the Origin of Species, by Charles Darwin. Accompanying text states; "within the diagram, chapters are divided into subchapters as in Darwin's original text, and these subchapters are divided into paragraph 'leaves'. Small wedge-shaped 'leaflets' represent sentences. Each sentence is colored according to whether the sentence will survive to the next edition (blue) or whether it will be deleted and not be within the next edition (orange)."

## Data Types

Categorical, hierarchical, temporal



Stefanie Posavec and Greg McInerney

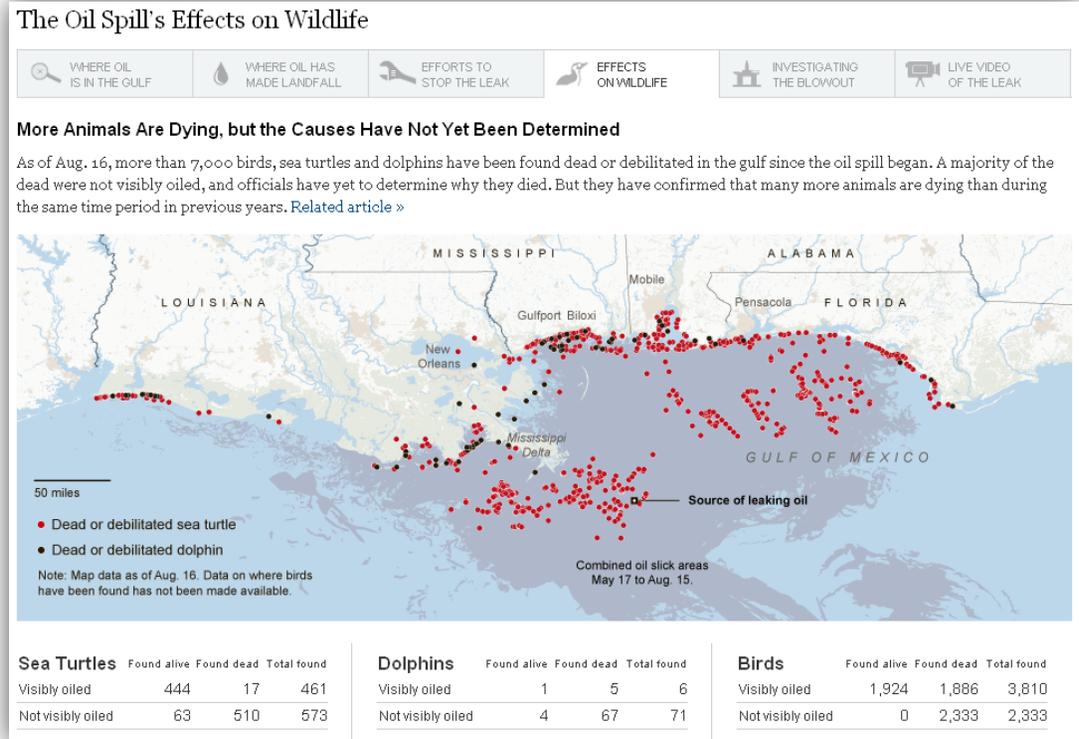
(Screenshot of sample page)

<http://www.itsbeenreal.co.uk/index.php?/on-going/chapter-close-ups/>

Visualization Type  
Interactive graphic; animated and static maps

Figure Description

This figure is a screenshot of an interactive map from a newspaper website. This graphic allows users to visualize a variety of indicators (dead animals, oil location, sources of pollution) related to the BP Deepwater Horizon oil spill in the Gulf of Mexico. This site displays photographs, informational diagrams, and animated graphics showing change in oil spread over time.



Data Types  
Spatial, numerical, categorical, administrative, temporal

The New York Times. US Section.  
The Oil Spill's Effects on Wildlife (Screenshot of sample page)

<http://www.nytimes.com/interactive/2010/04/28/us/20100428-spill-map.html?ref=us>

### Visualization Type

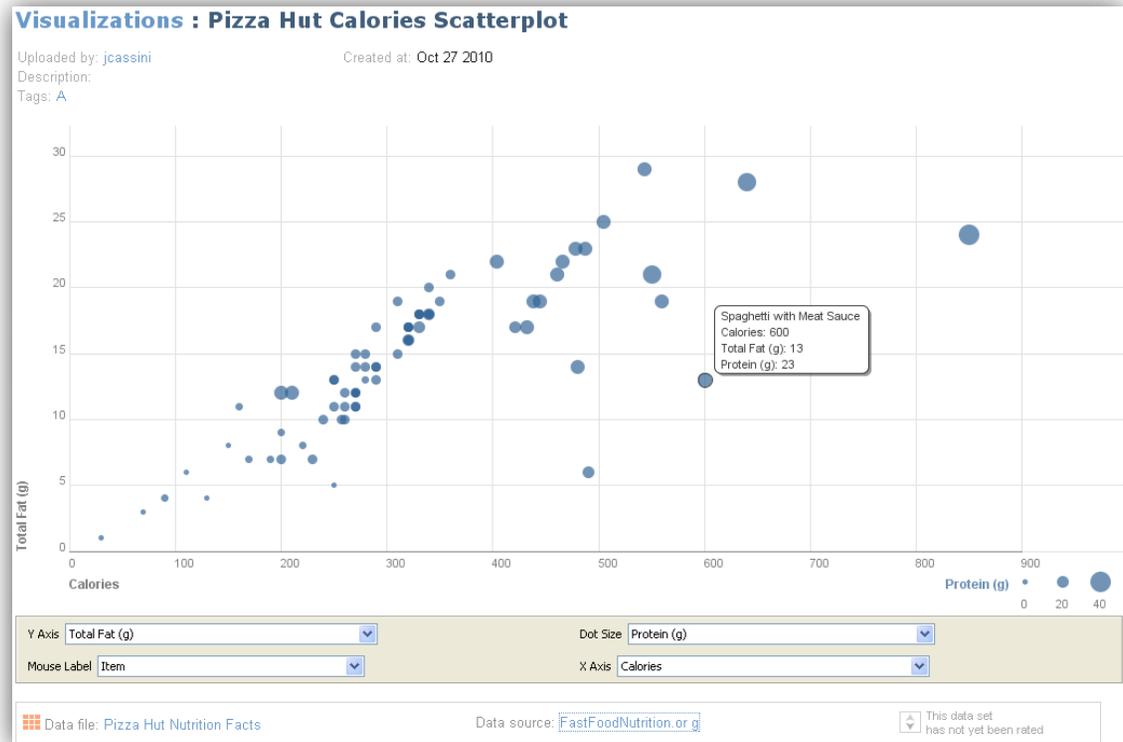
Scatterplot, with size-coded dots

### Information Type

“Each row in the data table is represented by a dot. The x-coordinate of a dot corresponds to one of the columns in the table. The y-coordinate corresponds to a different column. The size of a dot can also reflect another column.” In this example, the dot size corresponds to total grams of fat in each food item. Viewers can change the y-axis, x-axis, dot size categories using drop down menus. Pop-up bubbles show information for individual dots. This figure was created using IBM/Many Eyes website, ‘Scatterplot’ visualization option.

### Data Types

Numerical, categorical, relational



Created by user: jccassini

(Screenshot of sample page, with one pop-up label shown)

<http://www-958.ibm.com/software/data/cognos/manyeeyes/visualizations/pizza-hut-calories-scatterplot>





## Visualization Type

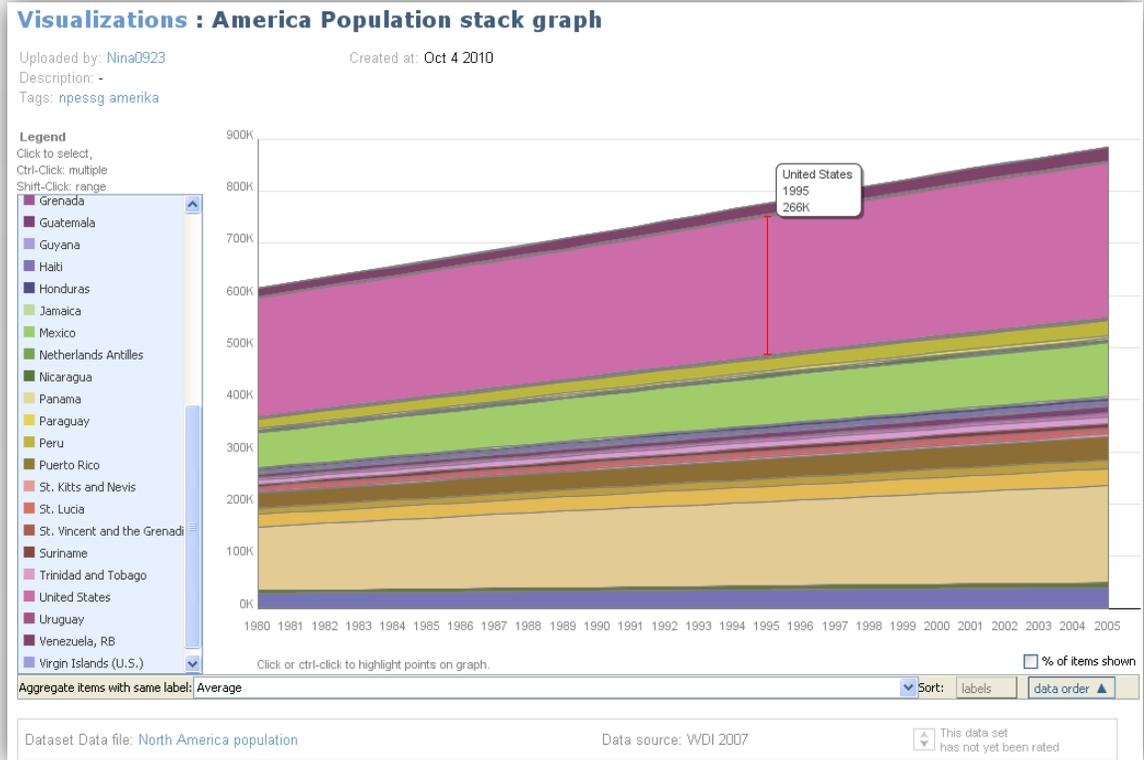
Stacked graph with color-coding

## Figure Description

This figure displays the population of countries in North and South America and the Caribbean between 1980 and 2005. The creators note that “this type of graph is especially useful when it makes sense to add up the underlying data points.” With this product, viewers can interact by holding the cursor over part of the graph to see category name, x-axis and y-axis information (in this example, pop-up bubble shows “United State, 1995, 266K”). Created using the IBM/Many Eyes website, ‘Stacked Graph for Categories’ visualization option.

## Data Types

Categorical, numerical, temporal, comparative



Uploaded by user: Nina0923

(Screenshot of sample page, with one pop-up label shown)

<http://www-958.ibm.com/software/data/cognos/manyeyes/visualizations/america-population-stack-graph>

Visualization Type

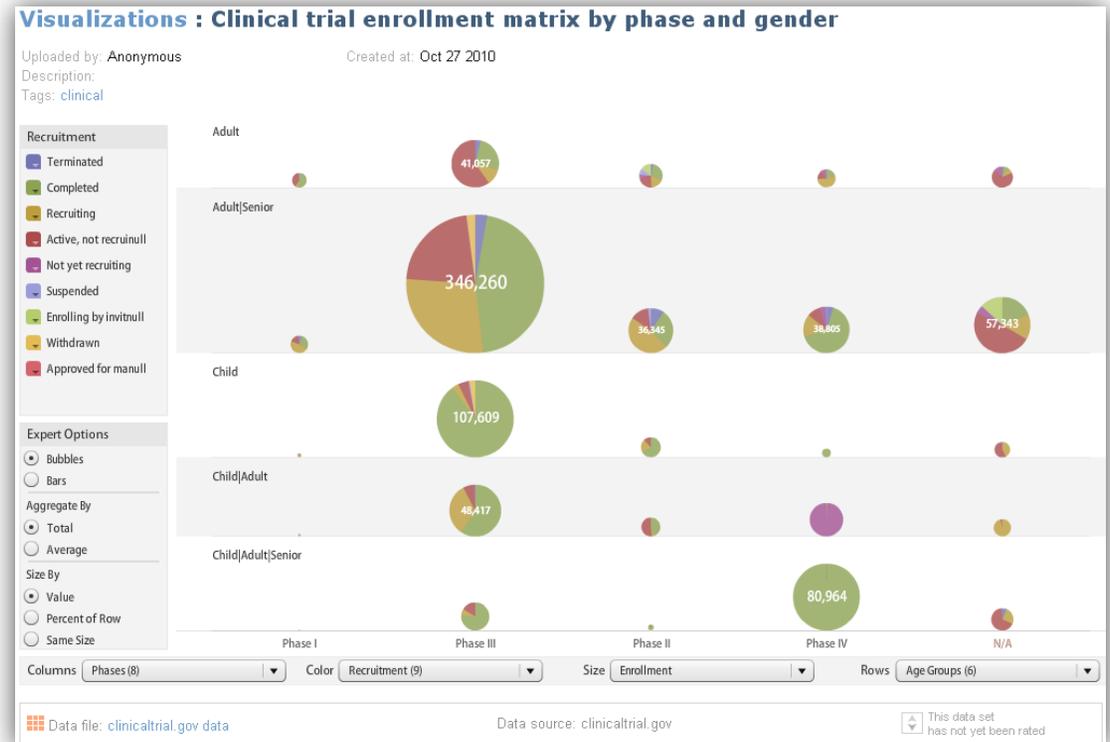
Table with embedded pie charts

Figure Description

This figure shows multiple aspects of clinical trial enrollment data. The row categories (age group) are displayed against column categories (development phase of medical trial). Each cell then shows a circle that represents the value for its row/column combination (people enrolled). Creators can display a third dimension of data using color-coded wedges within a circle. This tool allows viewers to change the displayed categories for column, color, size, and rows via drop-down menus. Created using the IBM/Many Eyes website, 'Matrix Chart' option.

Data Types

Numerical, categorical, comparative



Uploaded by an anonymous user.  
 (Screenshot of sample page)

<http://www-958.ibm.com/software/data/cognos/manyeyes/visualizations/clinical-trial-enrollment-matrix-b>

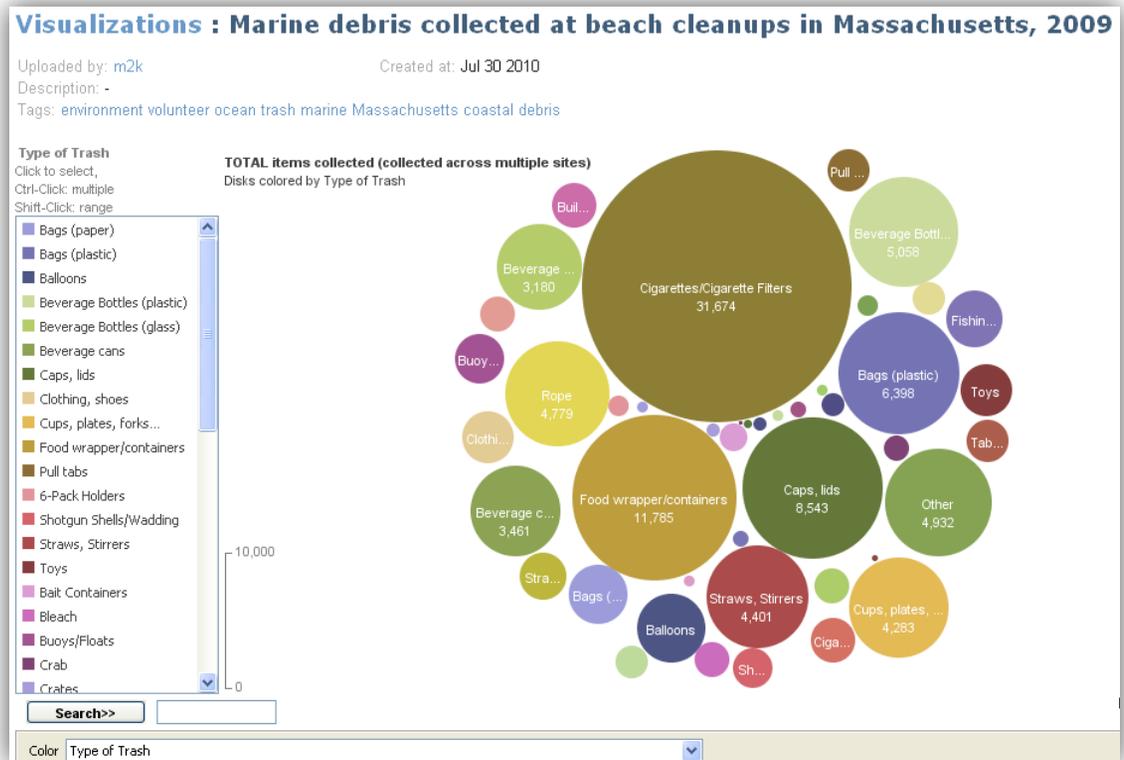
Visualization Type  
Bubble chart

Figure Description

The area of each bubble represents frequency of event within a category. The positions of the bubbles do not convey any aspect of the data, but are designed to pack the circles together with relatively little wasted space. This figure shows the number of marine debris items in different categories collected at beach cleanups in Massachusetts in 2009. Created using IBM/Many Eyes website, 'Bubble Chart' visualization option.

Data Types

Numerical, categorical, proportional



Uploaded by user: m2k  
(Screenshot of sample page)

<http://www-958.ibm.com/software/data/cognos/manyeyes/visualizations/marine-debris-collected-at-beach-c>



**Visualization Type**

Animated color and size-coded 'bubble chart'

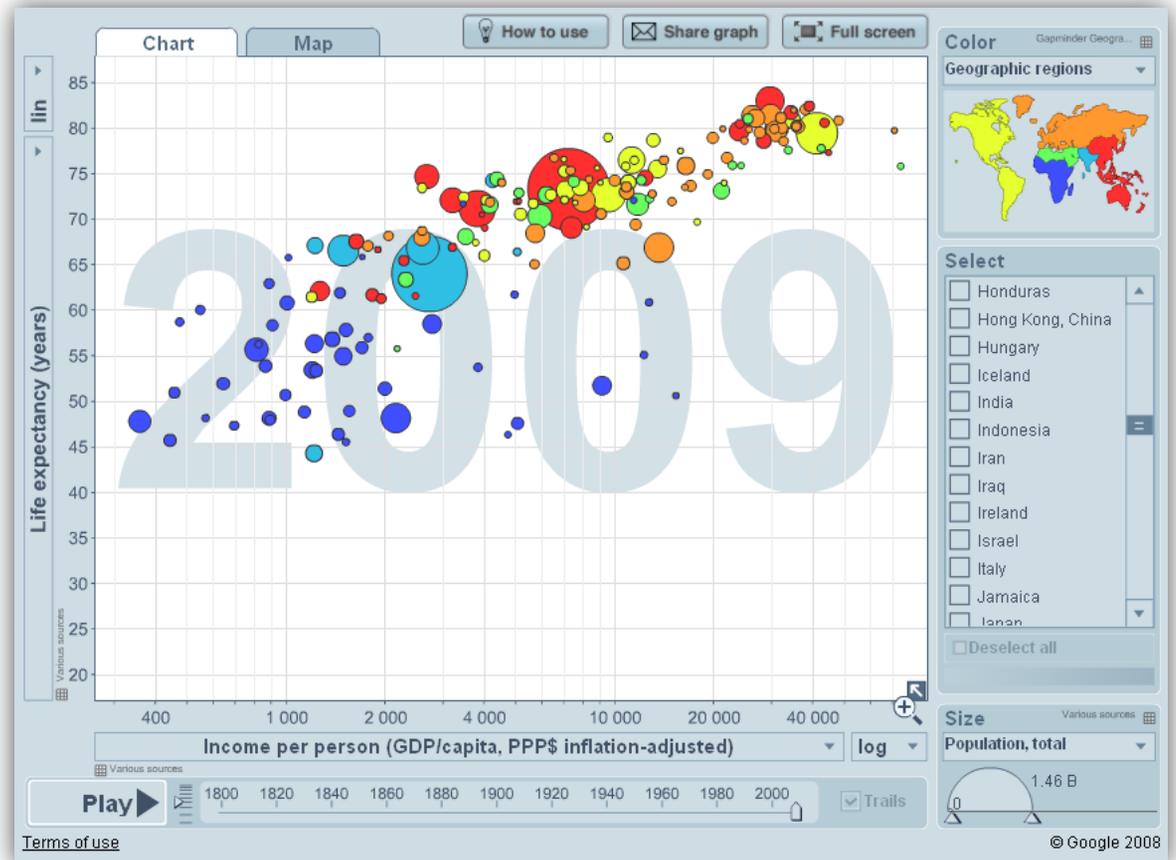
Log-linear display

**Figure Description**

This figure displays income per-person (log-scale, GDP/capita), plotted against life expectancy (linear, years). The size of each color-coded bubble represents the population of a given country. Bubble color corresponds to one of six world regions. Users can play with the animation to visualize relationships through time and choose from over 9 indicator categories to display along the axes.

**Data Types**

Temporal, numerical, categorical

**Gapminder**

Gapminder World, "Wealth & Health of Nations."  
(Screenshot of sample page)

<http://www.gapminder.org/world/>

**Visualization Type**

Animated color and size-coded 'bubble chart'

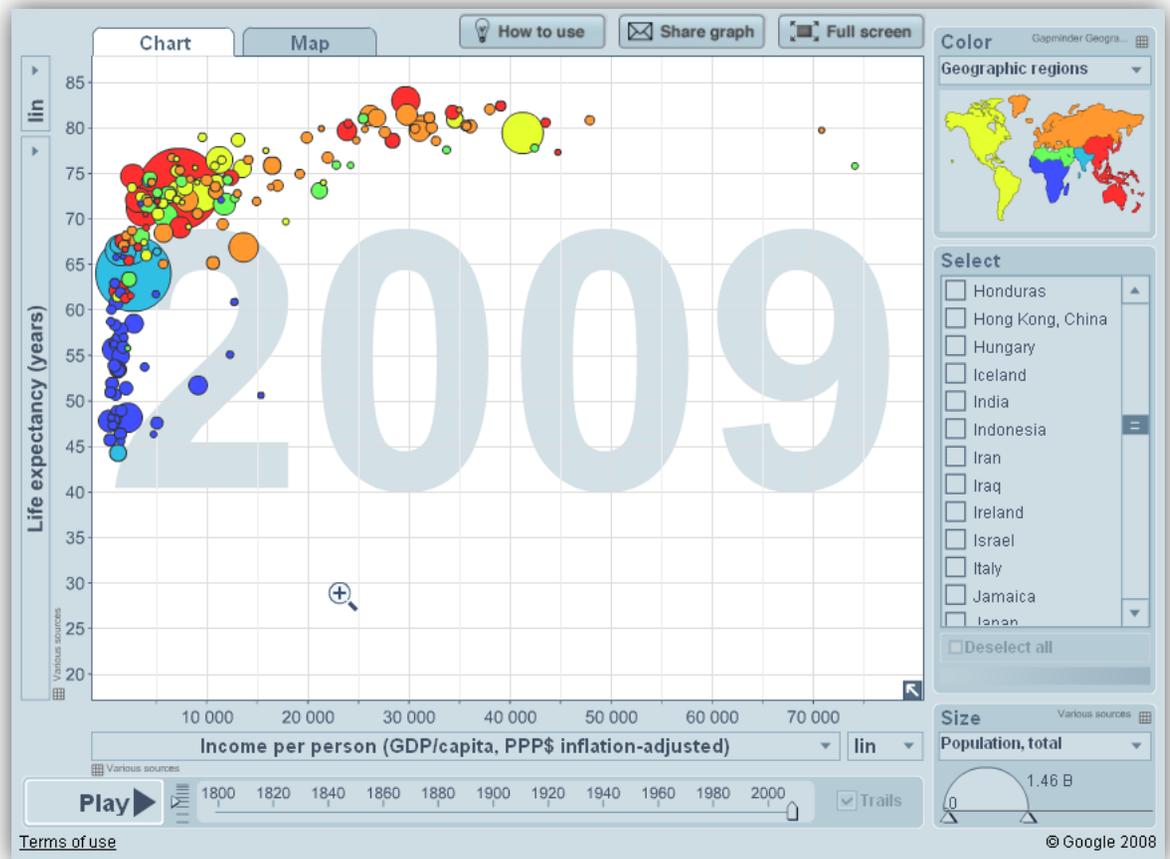
Linear-linear display

**Figure Description**

This figure displays income per-person (linear, GDP/capita), plotted against life expectancy (linear, years). The size of each color-coded bubble represents the population of a given country. Bubble color corresponds to one of six world regions. Users can play with the animation to visualize relationships through time and choose from over 9 indicator categories to display along the axes.

**Data Types**

Temporal, numerical, categorical

**Gapminder**

Gapminder World, "Wealth & Health of Nations."  
(Screenshot of sample page)

<http://www.gapminder.org/world/>

**Visualization Type**

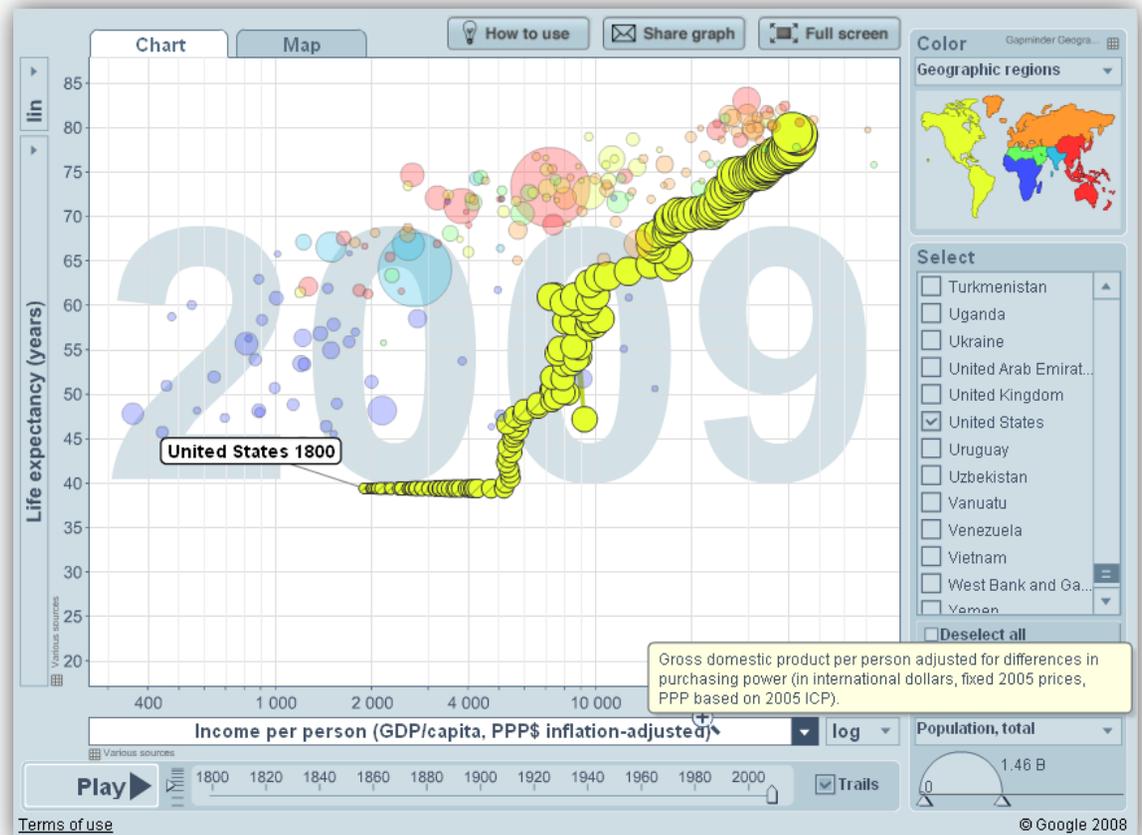
Animated color and size-coded bubble chart  
 Log-linear display  
 'Trail' for United States turned on

**Figure Description**

This figure displays income per-person (log-scale, GDP/capita), plotted against life expectancy (linear, years), with the size of the bubble representing population of the country. Bubble color corresponds to one of six world regions. Users can play with the animation to visualize relationships through time and choose from over 9 indicator categories to display along the axes. By selecting the 'trail' option users can see the path of an indicator relationship over time. In this sample the trail of the USA (1880-2009, yellow circles) is displayed.

**Data Types**

Temporal, numerical, categorical

**Gapminder**

Gapminder World, "Wealth & Health of Nations."  
 (Screenshot of sample page)  
<http://www.gapminder.org/world/>

## Visualization Type

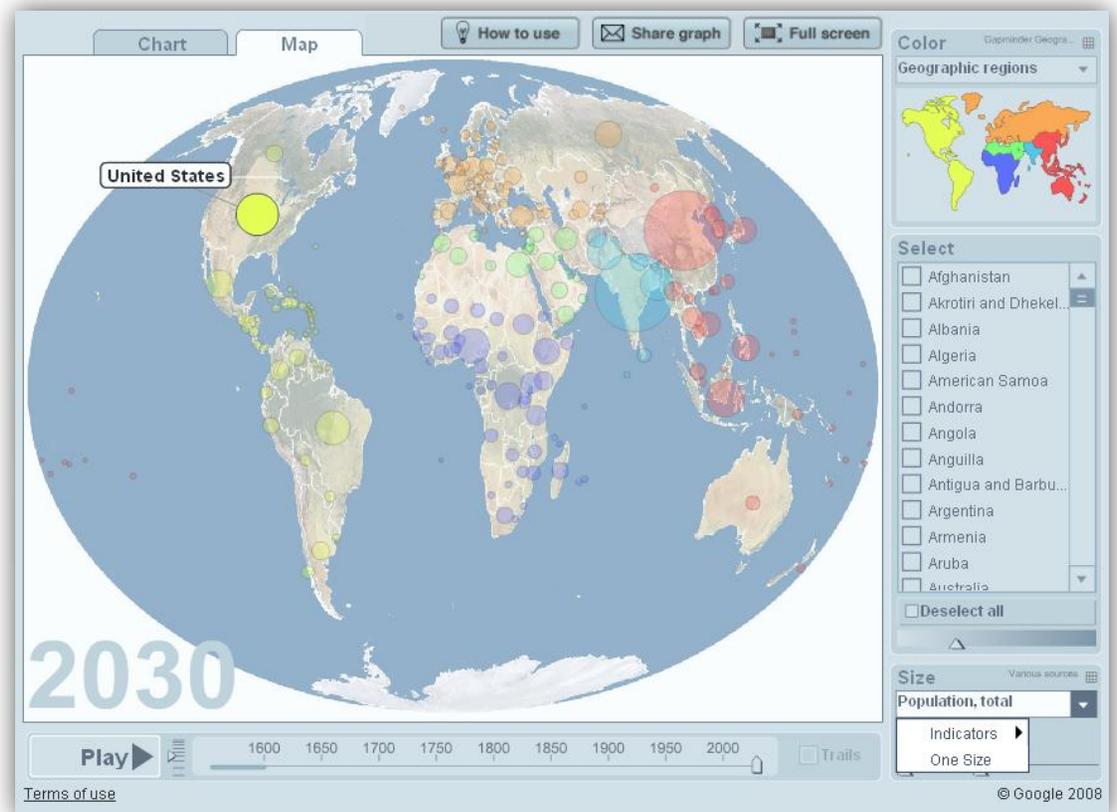
World map with animated indicator bubble

## Figure Description

This figure displays a map of population per country. The bubble-size corresponds to the value of the selected indicator, shown here is population in a given year. The year is displayed in grey in the lower left corner and is also animated. Bubble color corresponds to one of six world regions. Multiple indicators are available for display via a drop-down menu. Users can play with the animation to see how the indicator changes through time.

## Data Types

Numerical, spatial, categorical, temporal



## Gapminder

Gapminder World, "Wealth & Health of Nations."  
 (Screenshot of sample page)  
<http://www.gapminder.org/world/>