Esri Conservation Map Book

Table of Contents

Esri and SCGIS assist conservationist worldwide in using GIS through communication, networking, scholarships, and training. This support builds community and provides tools for the work of conservation science and action. Learn more about SCGIS at scgis.org.

The Esri/Society for Conservation GIS (SCGIS) International Conservation Mapping Competition was organized to find and recognize the best conservation mapping work in the world today. We specifically used the term "mapping" to take in the wide variety of digital and online work that have expanded our concept of mapping well beyond static paper maps. In all, we received more than 100 entries representing countries and projects from around the world. We are especially grateful to the international SCGIS for its critical role in reviewing and judging all the entries. Composed of conservation GIS practitioners and senior organization staff from every major nonprofit conservation group and many environmental agencies and businesses, SCGIS is the foremost society representing and supporting conservation GIS professionals worldwide.

Charles L. Convis

Charles Convis
Esri Conservation Program Coordinator

See Esri GIS for Conservation at **esri.com/conservation**.

Creativity Honorable Mention

Help Conserve Coral Reefs

By Melissa McVee, Jan-Willem Bochove, Lorrae Guilfoyle
Coral Cay Conservation
London, United Kingdom

Data Sources
Surveying point data: Coral Cay Conservation, Tobago boundary and contours: Buccoo Reef Trust

Coral Cay Conservation (www.coralcay.org) is a not-for-profit organization based in the UK that works with volunteers in developing countries to research and monitor their coral reefs for conservation purposes. They have survey sites in Tobago, the Philippines, and Cambodia. As well as providing scientific research and training, the organization works toward incorporating and involving local communities to ensure sustainable, workable outcomes with them and their local marine environments.

Coral bleaching is usually caused by prolonged periods of unnaturally high water temperature, increasing ocean acidity, sedimentation, or pollution. These factors are increasing because of climate change. These environmental stressors cause small algae called zooxanthellae, which live safely within the tissue of the coral, to be expelled. Zooxanthella is a cohost. In exchange for shelter, it can provide up to 90 percent of the food needed for the coral's survival. If the expelled zooxanthellae do not return to the coral, the coral will slowly die and turn white.

The coral reef map was designed to entice people to work with one of Coral Cays' survey areas of Tobago. In this case, the work would involve assisting in monitoring the effects of coral bleaching. The document uses emotional language, illustrations, and mapping within a scientific framework. Engaging the viewer was essential, as Coral Cay Conservation is reliant on a volunteer workforce to continue its scientific research.

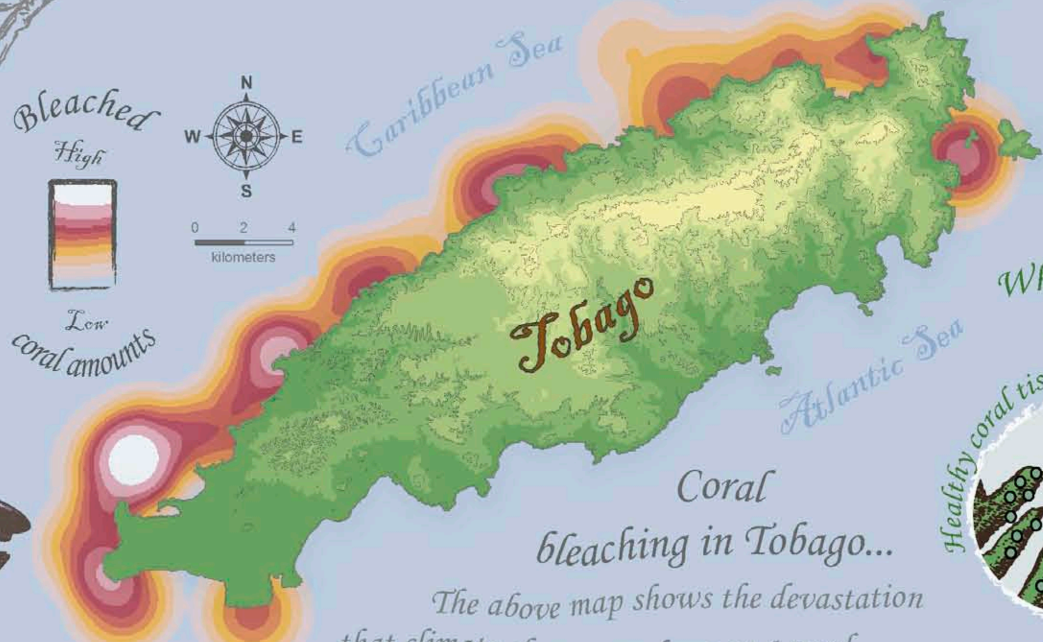
The map is simple and clear in its intention to show the devastating effects of bleaching over an area. The highly stylized approach is meant to engage but not overwhelm the reader with the scientific information available about the impact of coral bleaching found around the coastline of Tobago.

Colors, rather than topography details, were used. The whites and reds of high bleaching amounts were used to invoke a feeling of devastation, contrasting strongly with the lush greens of land.

Support for this project was provided by Coral Cay Conservation, London, UK.

Help conserve coral reefs

Don't let them become a thing of the past...



Why do corals bleach?

Coral bleaching in Tobago...

The above map shows the devastation that climate change can have on a coral ecosystem. In the summer of 2005, Tobagos' beautiful corals were close to being destroyed when, due to environmental pressures, the zooxanthellae (small organisms that are essential to the corals health) were expelled, putting the coral at risk, if they did not return. Through scientific research, education and conservation, the effects on these reefs can potentially be minimised or even reversed. Coral Cay Conservation is a non for profit organisation that has been helping developing countries conserve their coral reefs with the help from volunteers like you.

Make a difference to the world, contact Coral Cay Conservation today...

www.coralcay.org

Innovation First Place

The Land Protection History of The Nature Conservancy in New York

By Brad Stratton and Kate Hubbs
The Nature Conservancy
Albany, New York, USA

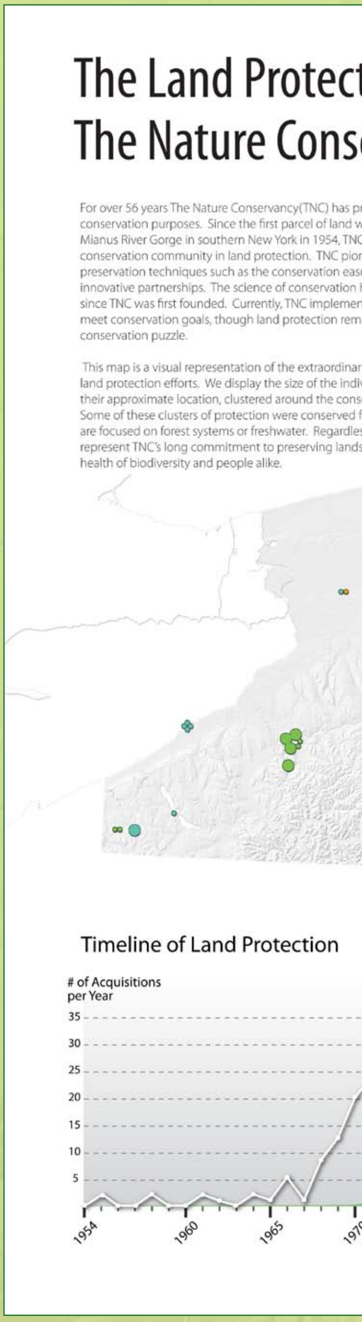
Data Sources
The Nature Conservancy, USGS 30 m NED

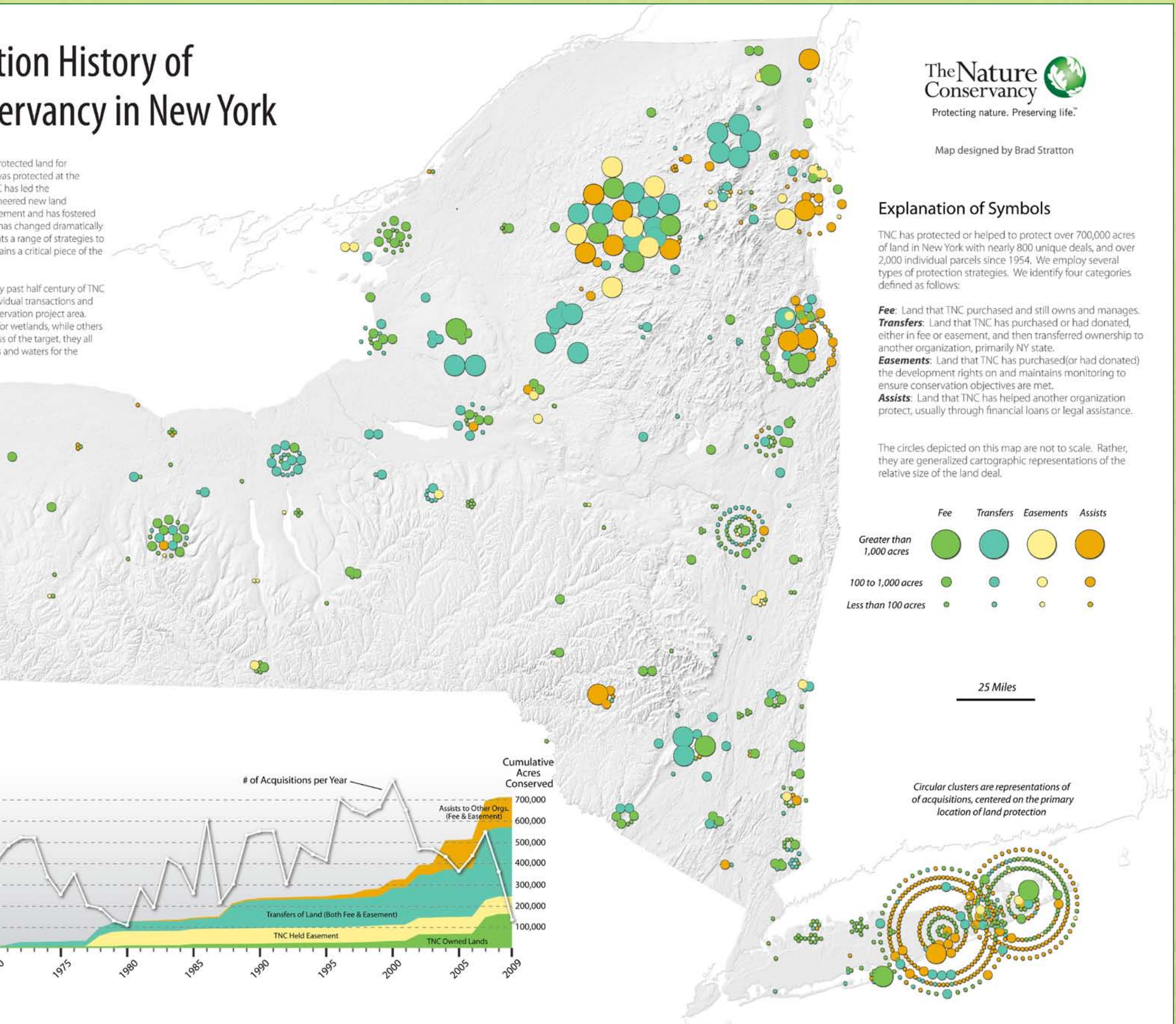
During the past 55 years, The Nature Conservancy (TNC) in New York has protected or helped protect 700,000 acres of land. The Land Protection History of The Nature Conservancy in New York map highlights the extent of the organization's land conservation efforts. It shows

- Land tracks by site
- Clusters of individual parcels around a primary conservation hot spot
- Fees, transfers, casements, and transaction assistance
- Transactions by type (fees, transfers, casements, and assists) and number of acres
- Time line graph of cumulative acres conserved

The map is a milestone in the five-year effort to create a comprehensive GIS database of all TNC land transactions. The project team tracked down paper deeds and surveys from the last half century to properly code the spatial data.

This map has been viewed by primarily TNC staff. It has helped them recognize that knowing the organization's conservation history is vital in understanding its present. This map helps people celebrate the organization in a way that a few numbers exported from a database could never do.




tion History of
ervancy in New York
rotected land for
vas protected at the
C has led the
neered new land
ement and has fostered
has changed dramatically
ts a range of strategies to
ains a critical piece of the
y past half century of TNC
vidual transactions and
ervation project area.
or wetlands, while others
ss of the target, they all
s and waters for the
The Nature Conservancy
Protecting nature. Preserving life.
Map designed by Brad Stratton
Explanation of Symbols
TNC has protected or helped to protect over 700,000 acres of land in New York with nearly 800 unique deals, and over 2,000 individual parcels since 1954. We employ several types of protection strategies. We identify four categories defined as follows:
Fee: Land that TNC purchased and still owns and manages.
Transfers: Land that TNC has purchased or had donated, either in fee or easement, and then transferred ownership to another organization, primarily NY state.
Easements: Land that TNC has purchased(or had donated) the development rights on and maintains monitoring to ensure conservation objectives are met.
Assists: Land that TNC has helped another organization protect, usually through financial loans or legal assistance.
The circles depicted on this map are not to scale. Rather, they are generalized cartographic representations of the relative size of the land deal.
Fee
Transfers
Easements
Assists
Greater than 1,000 acres
100 to 1,000 acres
Less than 100 acres
25 Miles
Circular clusters are representations of of acquisitions, centered on the primary location of land protection
Cumulative Acres Conserved
# of Acquisitions per Year
Assists to Other Orgs. (Fee & Easement)
Transfers of Land (Both Fee & Easement)
TNC Held Easement
TNC Owned Lands
700,000
600,000
500,000
400,000
300,000
200,000
100,000
1975
1980
1985
1990
1995
2000
2005
2009

Innovation Second Place

Climate of the United States for Continental and Multiscale Conservation Efforts

By Hans Edwin Winzeler, Phillip R. Owens, and Zamir Libohova
Purdue University
Gettysburg, Pennsylvania, USA

Data Sources

PRISM Climate Group (Oregon State University), SRTM digital elevation model

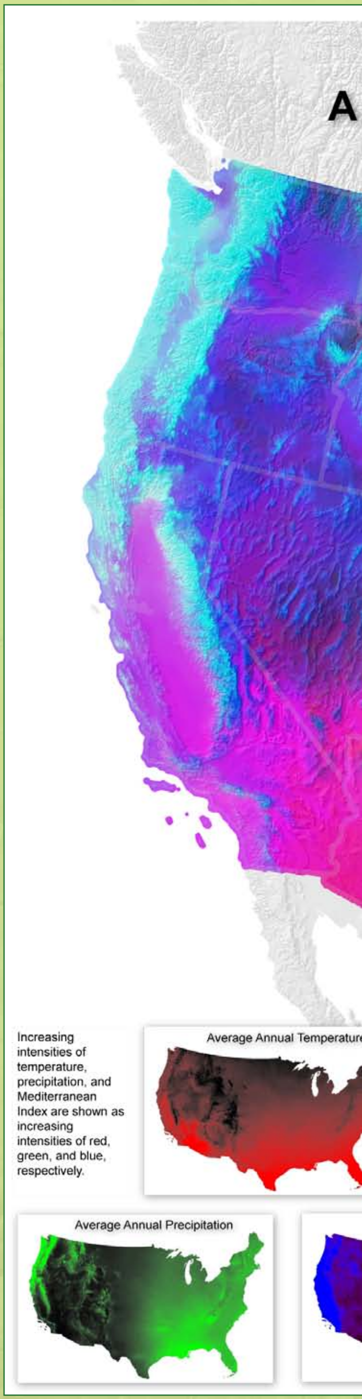
The purpose of this project is to provide a continuous classification of climate and a method for visualization of complex information using three color ramps combined in one red, green, blue visualization. It offers a method of visualizing climate that can be used in models of soil moisture, wetland preservation, species diversity efforts, and other natural resource management tasks. A continuous classification avoids discrete boundaries, which often do not exist in nature.

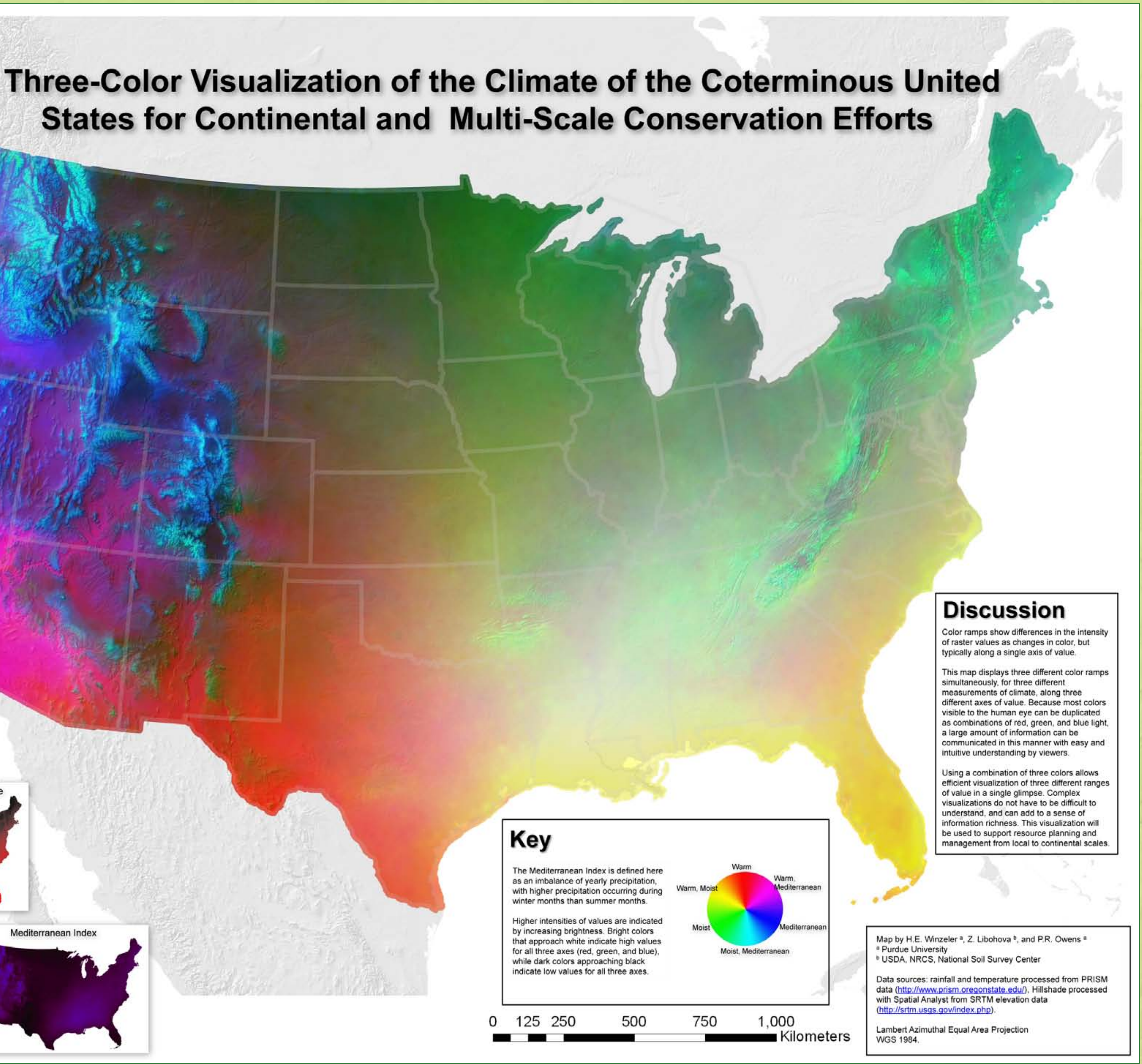
This map displays temperature, rainfall, and seasonality (a Mediterranean index that measures the strength of annual precipitation imbalance) using red, green, and blue. These measurements have traditionally played an important role in the understanding and classification of climate.

First, a standard deviation histogram stretch (n = 2) was applied to allow greater visualization of contrasts between high and low ranges of the histogram of values. Second, red, green, and blue rasters were combined into a single climate raster for visualization.

The climate inputs will be applied to the Newhall Simulation Model, which is a detailed simulation of soil moisture, to estimate soil moisture for the coterminous US at multiple scales. The understanding of soil moisture has important implications for wetland conservation, species diversity and management, and many other natural resource planning and management decisions. Hans Edwin Winzeler and his team are developing visualizations and estimates of soil moisture that can be used by natural resource planners at multiple scales.

Using choropleth classifications of climate, such as those of Koppen, with discrete categories, requires detailed documentation of those categories, as well as conceptual realization by map users. Continuous classifications can consist of measured values, such as 30-year climate inputs, on a pixel-by-pixel basis that can be more meaningful and, we believe, easier to interpret. Continuous classification also avoids implied abrupt boundaries between natural zones that may, in reality, have gradual boundaries.





Three-Color Visualization of the Climate of the Coterminous United States for Continental and Multi-Scale Conservation Efforts
Discussion
Color ramps show differences in the intensity of raster values as changes in color, but typically along a single axis of value.
This map displays three different color ramps simultaneously, for three different measurements of climate, along three different axes of value. Because most colors visible to the human eye can be duplicated as combinations of red, green, and blue light, a large amount of information can be communicated in this manner with easy and intuitive understanding by viewers.
Using a combination of three colors allows efficient visualization of three different ranges of value in a single glimpse. Complex visualizations do not have to be difficult to understand, and can add to a sense of information richness. This visualization will be used to support resource planning and management from local to continental scales.
Key
The Mediterranean Index is defined here as an imbalance of yearly precipitation, with higher precipitation occurring during winter months than summer months.
Higher intensities of values are indicated by increasing brightness. Bright colors that approach white indicate high values for all three axes (red, green, and blue), while dark colors approaching black indicate low values for all three axes.
Warm
Warm, Mediterranean
Warm, Moist
Moist
Mediterranean
Moist, Mediterranean
Mediterranean Index
0 125 250 500 750 1,000 Kilometers
Map by H.E. Winzeler [a], Z. Libohova [b], and P.R. Owens [a]
[a] Purdue University
[b] USDA, NRCS, National Soil Survey Center
Data sources: rainfall and temperature processed from PRISM data (http://www.prism.oregonstate.edu/), Hillshade processed with Spatial Analyst from SRTM elevation data (http://srtm.usgs.gov/index.php).
Lambert Azimuthal Equal Area Projection
WGS 1984.

Innovation Third Place

Priority Work Area Map in Western North Carolina

By Mark Endries
US Fish and Wildlife Service
Asheville, North Carolina, USA

Data Sources

The Audubon Society, US Environmental Protection Agency, North Carolina Division of Water Quality, Esri, US Gap Program, North Carolina Department of Environment and Natural Resources, North Carolina Department of Transportation, North Carolina Energy Office, North Carolina Natural Heritage Program, North Carolina Wildlife Resources Commission, One North Carolina Naturally, United States Department of Transportation, US Fish and Wildlife Service, US Forest Service, US Geological Survey, Wildlands

The US Fish and Wildlife Service's Asheville Field Office (AFO) is responsible for reviewing endangered species compliance for all federally authorized, funded, and permitted projects and implementing listing and recovery activities for federally listed endangered and threatened species and candidate species of concern in western North Carolina (WNC).

AFO used GIS to develop a work area habitat prioritization map that incorporates a wide variety of land-use, land-cover, and wildlife species data. It ranks the AFO work area landscape on a 1–10 scale based on federal trust resource priorities of the staff.

GIS is an ideal tool for regional assessments of landscapes, development and application of habitat models, and modeling of the potential distribution of species and habitats. It assists in the resolution of land-use conflict and the management of natural resources. Digital habitat and wildlife data is used to identify environmentally sensitive lands. GIS users can view their projects in a landscape perspective. Habitat quality and wildlife needs can be simulated, which is useful for proposing management plans.

To begin the mapping process, all the available spatial data relevant to wildlife in western North Carolina from 15 agencies was compiled and processed into 24 GIS data layers. These layers were organized into two categories: layers beneficial to federal trust resources (beneficial layers) and layers that are threats to federal trust resources (threat layers). All map input layers were classified on a 0–10 scale. The rank of 10 is assigned to the most beneficial layers, and 10 again to greatest threat layers. By doing this, all layers were scaled the same using an easy-to-understand range of values.

The ArcGIS® Desktop Grid stackstats command calculated a correlation analysis and identified significant correlation between the data layers. Significant correlations among data layers were resolved by removing eight layers from the modeling process.

Next, AFO staff ranked each map input layer on a 1–10 scale based on perceived benefit or threat to federal trust resources, and an average layer rank was calculated for each

Using GIS To Develop a Priority Work Area Map in Western North Carolina

Introduction

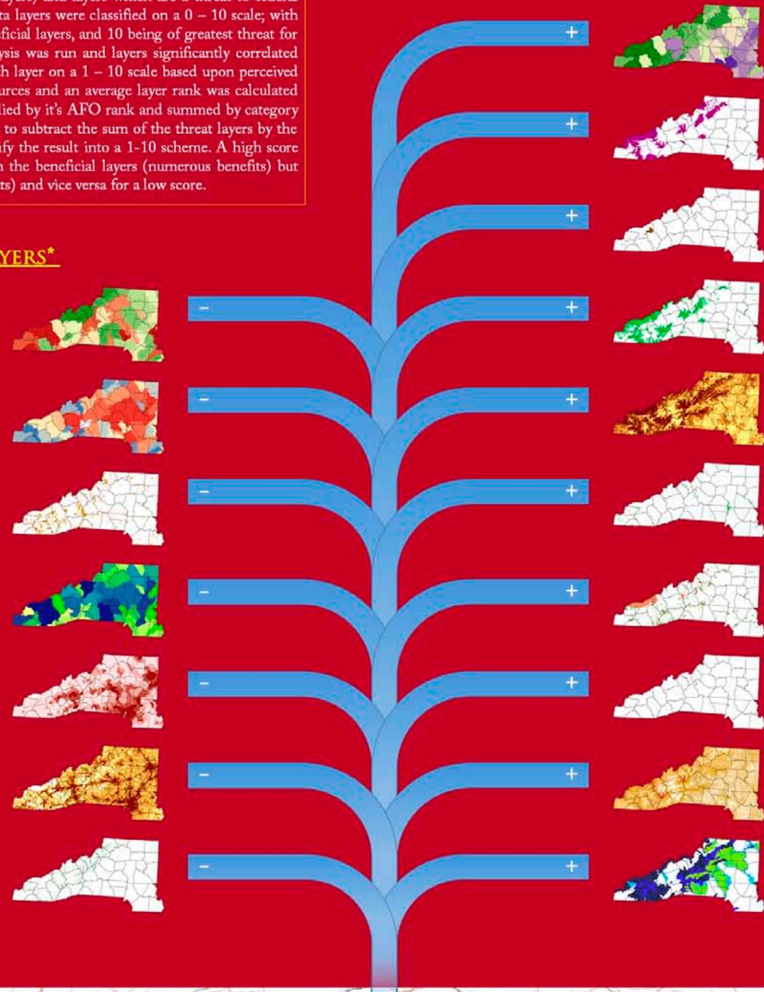
The U.S. Fish and Wildlife Service's Asheville Field Office (AFO) is responsible for reviewing for endangered species compliance for all federally authorized, funded, and permitted projects, and implementing listing and recovery activities for federally listed endangered and threatened species and candidate species of concern in Western North Carolina (WNC). These activities include conserving the habitats upon which the ecosystems these species depend, reducing impacts to these rare species and their habitats from development, and conducting education and outreach activities which support federal trust resource conservation. In an effort to prioritize the work area of the AFO and share this information with AFO constituents, we used geographic information systems to develop a work area habitat prioritization model. This model uses a wide variety of land use, land cover, and wildlife species data to rank the AFO work area landscape on a 1-10 scale based upon federal trust resource priorities of the AFO staff. The priority work area map was constructed in raster format using the Spatial Analyst extension of ArcGIS (ESRI, Redlands, CA). The pixel size used for the analysis was 30 x 30 m.

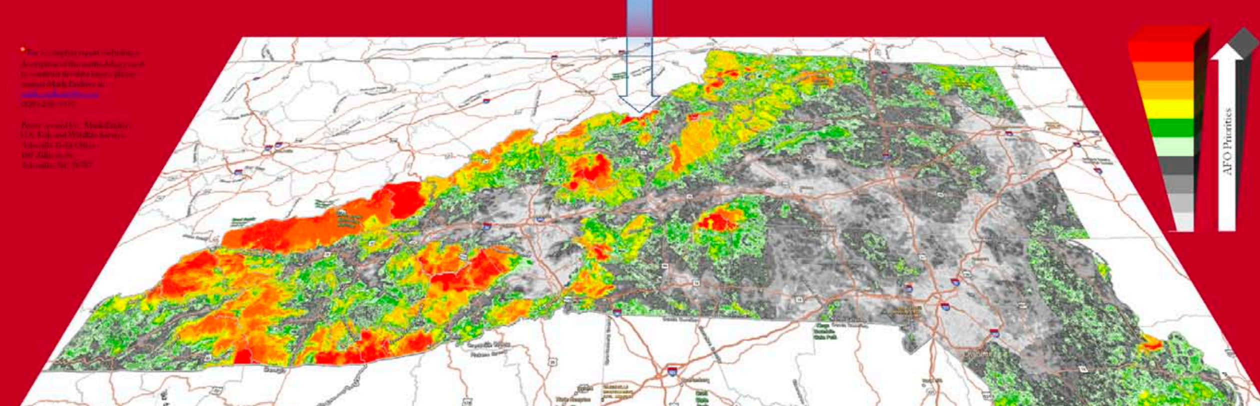
Model Construction

The data layers used as inputs in the model fell into two categories; layers beneficial to federal trust resources (beneficial layers) and layers which are a threat to federal trust resources (threat layers). All data layers were classified on a 0 – 10 scale; with 10 being of most benefit for the beneficial layers, and 10 being of greatest threat for the threat layers. A correlation analysis was run and layers significantly correlated were removed. AFO staff ranked each layer on a 1 – 10 scale based upon perceived benefit or threat to federal trust resources and an average layer rank was calculated for each layer. All layers were multiplied by it's AFO rank and summed by category (benefit or threat). The final step was to subtract the sum of the threat layers by the sum of the beneficial layers and classify the result into a 1-10 scheme. A high score indicates an area that ranked high in the beneficial layers (numerous benefits) but low in the threats layers (limited threats) and vice versa for a low score.

Beneficial layers*

Threat layers*





Priority Work Area Map in Western North Carolina (continued)

map input layer. To calculate the final map, all map input layers were multiplied by their AFO rank and summed by category (benefit or threat).

The final step was to subtract the sum of the threat layers by the sum of the beneficial layers and classify the result into a 1–10 scale. For the final map, a high score indicates an area that ranked high in the beneficial input layers (numerous benefits) but low in the threat input layers (limited threats). A low score indicates an area that ranked low in the beneficial input layers (limited benefits) but high in the threat input layers (numerous threats). AFO generated a custom 10-class color ramp for this map to highlight the high-ranking areas. Colors scale from light gray to dark gray, light green to dark green, yellow, orange, then red as the values in the final map increase from 1 to 10. As the values increase, the colors become hotter, which is similar to how a weather map shows intensity of storms.

The perspective image of the final map was created using Esri's 3D tools. Placing small images of each model input data layer above this perspective image makes data layers appear to hover over the map. A blue arrow tree (center in the poster) was used to point from each map input data layer downward, combining into a single arrow and pointing to the final map. This blue arrow tree graphically represents the actual combining of each individual model input layer and draws the viewer's eyes down to the final map. All this informs the viewer without any text that the data layers were combined to create the final map.

The AFO work area prioritization map data is provided in a file geodatabase along with all the input data layers and is offered to users free of charge. Data in this format gives users GIS capabilities to perform further analysis or inquiries with the data. For example, by using the Identify tool in ArcGIS, users can identify individual pixel values of the work area prioritization map results and any map input data layer at specific locations. They can then understand the importance of each map input data layer at specific locations.

People can use their own data in conjunction with the work area prioritization data. They can also customize and recalculate the work area prioritization by adding or removing data layers to better fit the specific task at hand. This capability improves the utility of the work area prioritization map by giving it the flexibility to suit the needs of specific projects or queries. As new or better data becomes available, AFO will update the map to keep it as current and accurate as the data available.

Baleen Whales Relative Distribution

By Brooke Wikgren and Kerry Lagueux
New England Aquarium
Boston, Massachusetts, USA

Data Sources
Right Whale Consortium Database, Esri; US Geological Survey

Marine spatial planning can mitigate conflicts between existing and future ocean uses. Determining the relative spatial distribution of marine animals has become increasingly important. Traditional distribution analyses based on survey sightings can create highly variable spatial data and is greatly dependent on survey effort. To help account for this, a methodology was created that incorporates survey efforts with sightings data, resulting in an index termed sightings per unit effort (SPUE). It involves assigning calculated SPUE values to spatially explicit gridded cells based on latitude and longitude.

SPUE is useful for correcting possible bias in survey efforts and quantifying sighting frequencies. SPUE values are computed for consistent spatial units (numbers of animals sighted per unit length of survey track) and can therefore be mapped or statistically compared across areas, seasons, years, etc.

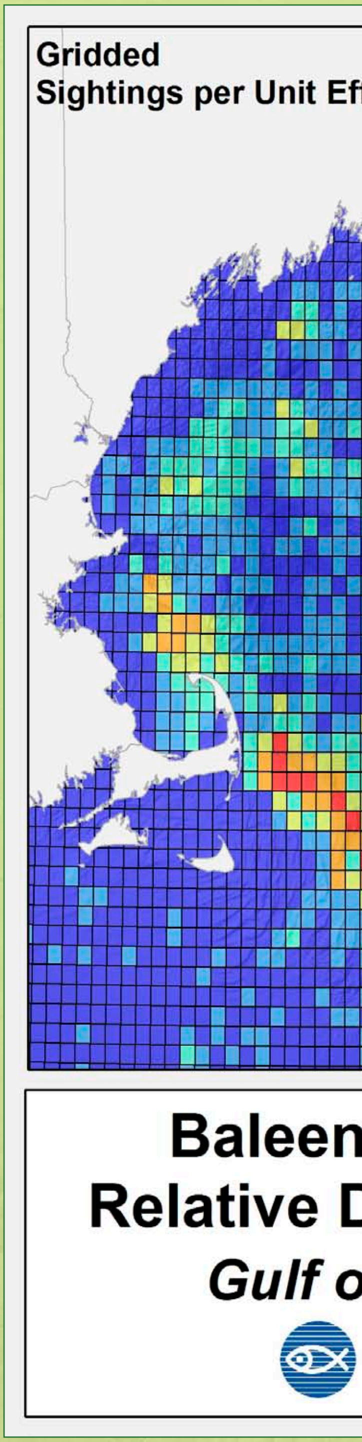
The study area was partitioned into a regular grid based on latitude and longitude using 5 x 5 minute cells.

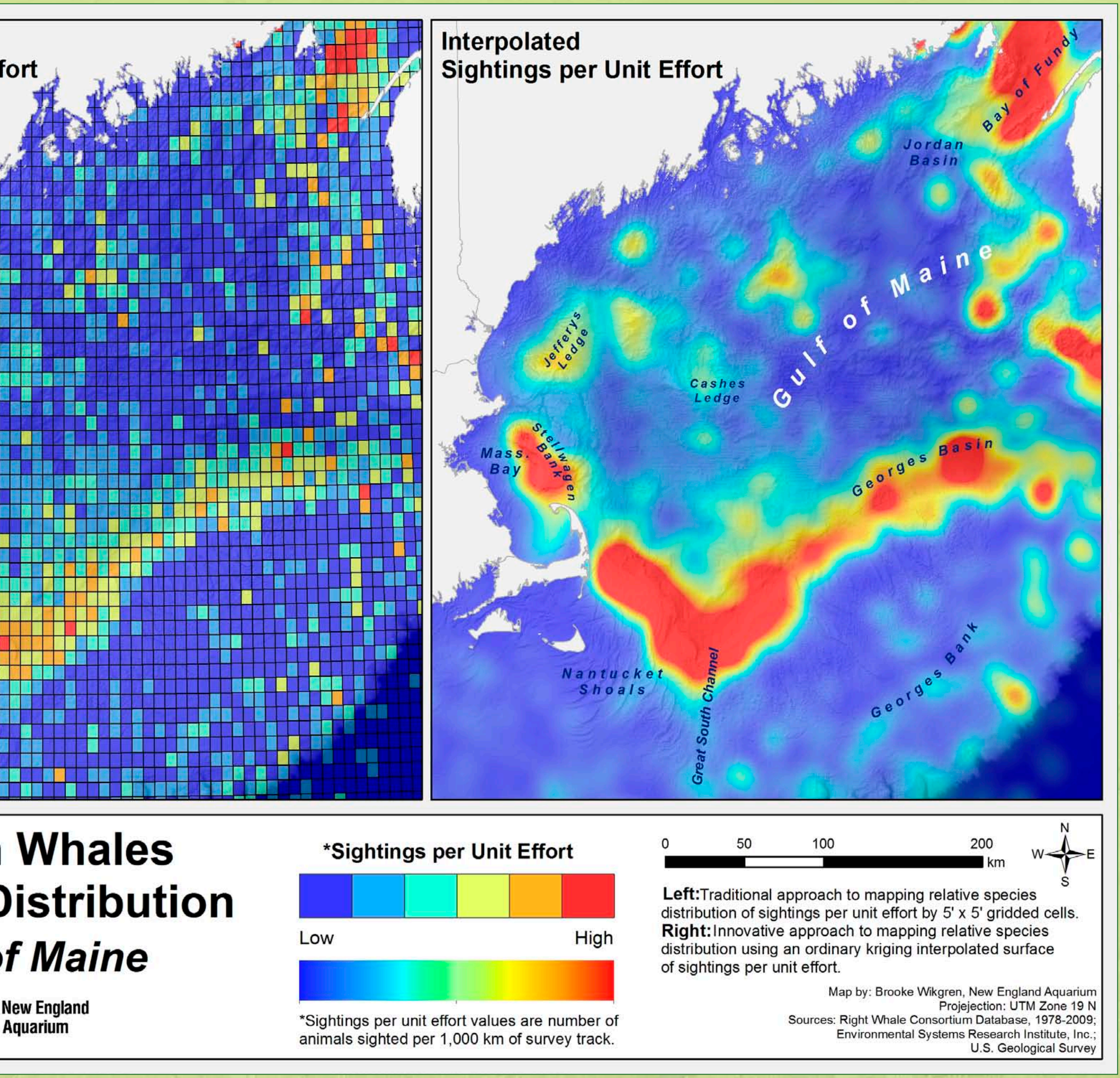
Aerial and shipboard survey tracks were broken down into grid cells and their lengths computed. Sightings were also assigned to cells, and the numbers of sightings per species were summed by cell. The number of animals in each cell was divided by the effort value and multiplied by 1,000 to create a SPUE index in units of animals per 1,000 km of survey track.

SPUE was provided from the Right Whale Consortium database and consists of sightings and survey efforts from 1978 to 2009. The SPUE results were summarized to grid cell center points and presented in dBASE files containing the species, SPUE calculation, latitude and longitude of 5 x 5 minute cell center points, season (annual, spring, summer, autumn, and winter), number of animals, and kilometers of track line effort. Annual data for a species grouping of all baleen whales was used. The dBASE file was imported into ArcGIS using the latitude and longitude of the 5 x 5 minute center point locations in the WGS 1984 geographic coordinate system and exported into an ArcGIS point feature class inside a file geodatabase.

The feature class was projected into UTM Zone 19 North, North American Datum 1983, for the kriging interpolation, which was performed by ArcGIS Geostatistical Analyst. The resultant point dataset was a regularly spaced grid of points with SPUE values for the annual distribution for all baleen whales.

Spatial autocorrelation is the tendency of locations closer together to be similar in values, and this relationship can be modeled using a semivariogram during the kriging




fort
Interpolated
Sightings per Unit Effort
Bay of Fundy
Jordan
Basin
Gulf of Maine
Jefferys
Ledge
Cashes
Ledge
Mass.
Bay
Stellwagen
Bank
Georges Basin
Nantucket
Shoals
Great South Channel
Georges Bank
n Whales
Distribution
of Maine
New England
Aquarium
*Sightings per Unit Effort
Low
High
*Sightings per unit effort values are number of animals sighted per 1,000 km of survey track.
0
50
100
200
km
N
W
E
S
Left: Traditional approach to mapping relative species distribution of sightings per unit effort by 5' x 5' gridded cells.
Right: Innovative approach to mapping relative species distribution using an ordinary kriging interpolated surface of sightings per unit effort.
Map by: Brooke Wikgren, New England Aquarium
Projejection: UTM Zone 19 N
Sources: Right Whale Consortium Database, 1978-2009;
Environmental Systems Research Institute, Inc.;
U.S. Geological Survey

Baleen Whales Relative Distribution (continued)

process. The Gaussian semivariogram model was used to weight the points in the search neighborhood to determine the spatial prediction. The average nearest neighbor of the SPUE points was used as the lag size along with a default of 12 for the number of lags.

A smoothing factor of 1 (the maximum) and a major and minor semiaxis of 20 km to include at least six points in the calculations were used for the predictions. The smoothing neighborhood decreased the interpolated surface values by approximately a factor of 10. Distributions matched the overall SPUE point distributions, and the interpolated surface provided the relative abundance for all baleen whales.

The final model of the annual distribution of all baleen whales was exported from an ArcGIS geostatistical layer to an ArcGIS raster grid with a 250-meter cell size. Any negative values as a result of the interpolation were reclassified as zero. The raster grid was mapped and symbolized on a stretched scale representing baleen whales relative to SPUE.

Global Nest Distribution of Green Turtles (*Chelonia mydas*)

By Andrew DiMatteo, Bryan Wallace, Brian Hutchinson, Rod Mast, Nicholas Pilcher, Jeffrey Seminoff, Andrea Whiting, Kellee Koenig, and Miya Su Rowe
Duke University
Norfolk, Virginia, USA

Data Sources

State of the World's Turtles database (includes data contributed by SWOT team members and reviewed literature), Natural Earth (Tom Patterson, NPS), GSHHS

Marine turtles are highly migratory, widely distributed marine megafauna. Several populations have experienced significant declines in recent decades. Most marine turtle species have circumglobal distributions that extend from tropical to temperate latitudes. Distinct populations of the same species can show variations in body sizes, reproduction habits, and population trends. Thus, regional and local conservation efforts can be better directed and placed in context when the broader, global, biogeography of a species is understood.

This map of green turtles (*Chelonia mydas*) is the culmination of six years of data collection efforts and displays more than six times the number of nesting sites than the original map produced in 2005, which featured leatherback turtles. Approximately 1,200 green turtle nesting sites are displayed in every tropical and subtropical ocean region around the globe.

Since 2005, the State of the World's Turtles (SWOT) project has compiled data on marine turtle nesting colonies worldwide through cultivation of a network of hundreds of data providers that share annual nesting abundance data. Each year, SWOT releases a print magazine that highlights inspiring and interesting stories of sea turtle conservation successes and challenges, and the centerpiece is a map of the global nesting biogeography of one species. These maps are the most comprehensive, up-to-date geographic representation of sea turtle nesting distributions and abundance in existence.

Among several challenges in creating this map (beyond the six years of data collection from over 500 sources), foremost was the sheer amount of data to be included. Not only were there almost 1,200 sites to display, but they also span the globe and need to be scaled by the size of the nesting colony.

The decision to keep the global extent of the main panel intact meant that the density of sites necessitated the creation of numerous insets around the periphery so that people viewing the map could discern individual sites. The creation of insets both alleviated and complicated the issue of annotating the map.

Because SWOT prioritizes proper attribution of every data point to its original provider, each site is linked to a data record found in the back of the magazine, and painstaking


rldwide Green Turtle Nesting Sites 2011
8 Bangladesh
9 Indonesia
13 Northern Mariana Islands (B)
Micronesia 14
16 Northern Territory
17 Northern Queensland
18 Southern Great Barrier Reef
19 Vanuatu
10 Palau
11 Guam
12 Northern Mariana Islands (A)
7 Lakshadweep Islands
Western 15 Australia
20 French Polynesia
21 Baja California Sur
22 Michoacan
23 Cozumel
24 Central Mexico
25 Cuba
26 Haiti and Dominican Republic
27 Central America
28 Florida
29 U.S. Virgin Islands
30 British Virgin Islands and Puerto Rico
31 Cayman Islands
32 Anguilla and St. Martin
33 Eastern Caribbean North
34 Eastern Caribbean Central
35 Eastern Caribbean South
36 Southern Caribbean
37 East Colombia
38 West Colombia
39 Trinidad and Tobago
projection: Eckert IV, central meridian 154° west
data: The SWOT Team and reviewed literature (go to www.seaturtlestatus.org for full report and seamap.env.duke.edu/swot for data and citations); Natural Earth, Tom Patterson, National Park Service
produced in partnership with: Conservation International, OBIS-SEAMAP, and the IUCN-MTSG
1000 km

Global Nest Distribution of Green Turtles (continued)

efforts are made to label each site. The insets help ensure that this connection was easy to make, but the inset titles also take up room on the main map. Many sections of the map went through several versions of annotation before the right balance between clarity of labeling and density of information was reached.

Inset design also represented a challenge, as in many cases, nesting sites were so closely spaced that bleed-over between insets was a concern. Some insets were at such a small scale that the Natural Earth background layer appeared fuzzy. In these cases, higher-resolution polygons were created using coastline data from the Global Self-consistent Hierarchical High-resolution Shoreline (GSHHS) dataset. Additionally, insets needed to be laid out in such a way as to be easily found from their reference points on the main map, limiting what order they could be placed in and how much space they could be allocated.

The map also needed to convey information about turtle distribution and abundance patterns, as well as the quality of the data used to make the map. Two important attributes are displayed for each nesting site: colony size (including a class for sites that are not quantified) and a binary classification as to whether the data shown had been collected in the last five years. Classification of abundance by symbol size allows viewers of the map to roughly quantify the abundance value of each point. By then referring to the data record in the back of the map, they can find the exact count provided by the citation or data provider. A transparency gradient was used to represent increasing abundance across nesting sites, thereby facilitating interpretation of numerous sites that were clustered spatially. A white halo was given to sites where data was collected in the last five years, and a gray halo to others, to subtly but clearly convey information about quality and accuracy of data.

The end result of collating many hundreds of data points from hundreds of distinct sources from around the world—while balancing data quality with being as inclusive as possible—is a visually compelling, multilayered, information-rich map that will draw in audiences from scientific researchers to casual observers to explore the dynamic and detailed world of green turtles.

This map was made under the auspices of the State of the World's Turtles project. Dr. Bryan Wallace, chair of the SWOT Scientific Advisory Board, can be reached at b.wallace@conservation.org.

Science Second Place

Sea Lice (*Lepeophtheirus salmonis*) on Juvenile Pink and Chum Salmon

By Karin Bodtker and Carrie Robb
Living Oceans Society
Sointula, British Columbia, Canada

Data Sources
British Columbia Ministry of Agriculture and Lands (BC MAL) updated by Living Oceans Society—March 2008

Sea lice (*Lepeophtheirus s almonis*) are small parasites that occur naturally on many different species of wild fish. They attach to the outside of marine fish, usually the skin, fins, or gills, and feed on the mucus, blood, and skin of their host fish. A few lice on a large salmon may not cause serious damage, but many lice on an adult fish or just one louse on a juvenile salmon can be harmful or fatal. Salmon farms are typically located in sheltered bays and inlets near rivers on or near the migratory routes that juvenile salmon use to reach the ocean. The adult fish living in high densities in salmon farms provide unnatural reservoirs of sea lice that juvenile wild salmon must swim past as they head for the ocean. Before commercial-scale salmon farming began, sea lice numbers were typically low in the spring, during the time of juvenile migration, because the number of available hosts in coastal areas was also low.

Juvenile salmon are especially at risk to sea lice because of their small size and the stresses associated with changes that occur when they enter saltwater. Just one or two sea lice are enough to kill a juvenile pink salmon newly arrived in saltwater. Much higher numbers have been observed recently on juvenile pink salmon near salmon farms in British Columbia (BC), Canada.

A substantial and growing body of research published in peer-reviewed journals began to demonstrate that sea lice were dangerous to wild salmon. Cutting-edge research published in the journal *Science* in December 2007 was the first study to calculate the impact individual wild salmon mortalities have on the population of a whole run.

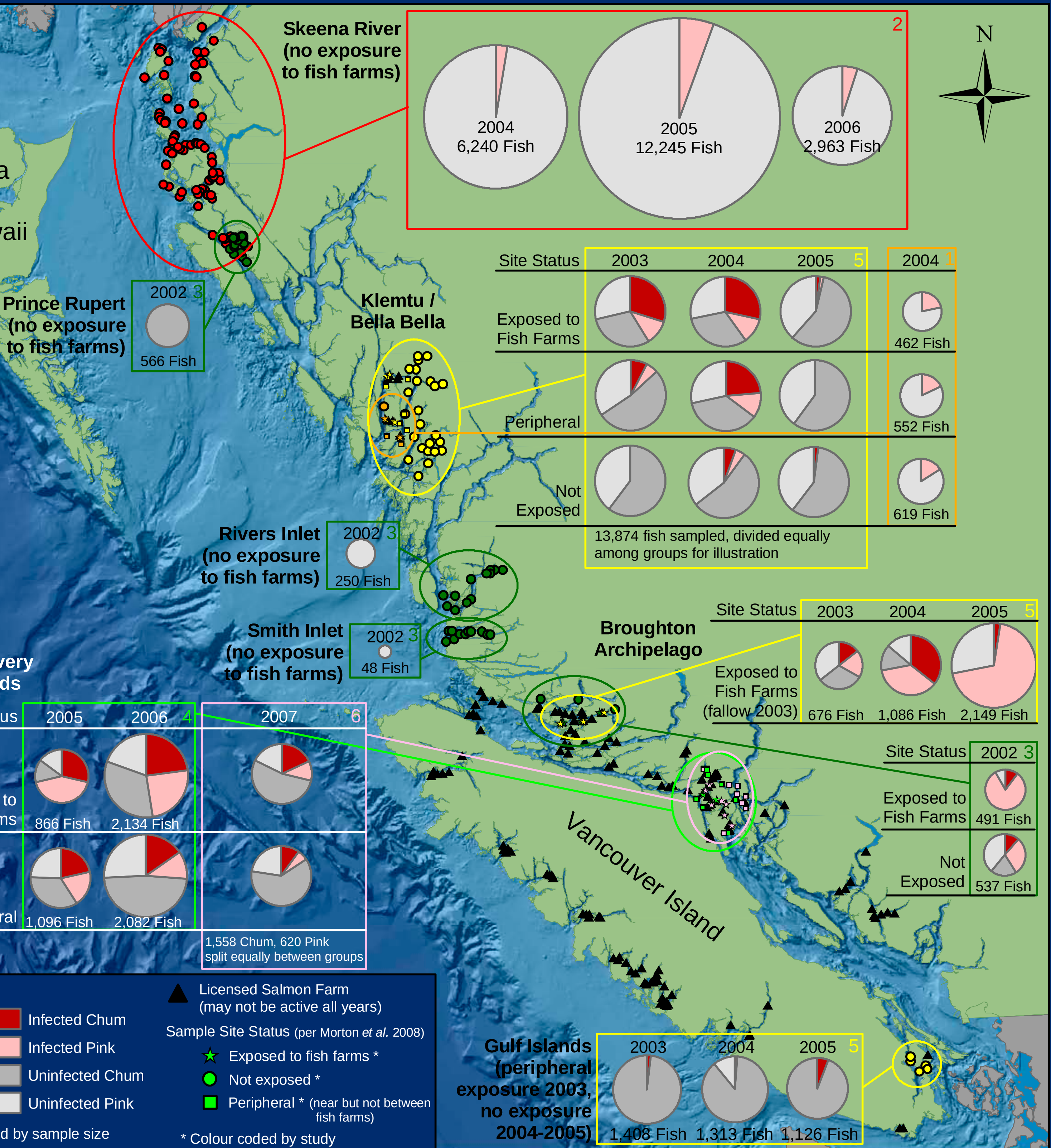
Living Oceans Society is Canada's largest organization that focuses exclusively on marine conservation issues. It is based in Sointula, a small fishing village on the central coast of British Columbia.

Living Oceans Society decided to create a map that would allow readers to easily weigh the evidence. The majority of data focused on pink and chum salmon, so the map represents the problems of sea lice on juvenile pink and chum salmon in BC. The map presents the best available science related to transmission of sea lice from open net-cage salmon farms to migrating wild juvenile salmon and puts the different studies into a single geographic context.

The basic question posed by various scientific papers was relatively straightforward: Do wild juvenile salmon that migrate past open net-cage salmon farms have a higher

Healthy Oceans. Healthy Communities.

Sea Lice (*Lepeophtheirus salmonis*) on juvenile pink and chum salmon in BC



Sea Lice (Lepeophtheirus salmonis) on Juvenile Pink and Chum Salmon (continued)

sea lice infection rate than those that do not migrate past salmon farms? However, the studies exhibited more differences than similarities. For example, juvenile wild salmon were sampled in different regions of BC and at different locations, using sample sizes that differed by orders of magnitude. Two different salmon species were sampled, but both species were not sampled in all studies. Some studies sampled control areas geographically removed from salmon farms. Lastly, the rates of sea lice infection were presented differently by different authors.

Map authors Karin Bodtker and Carrie Robb compiled the relevant published work, requested and obtained GIS data or geographic coordinates when available, and digitized juvenile salmon sampling locations from published illustrations when necessary. They needed to represent sample site status by indicating whether fish sampled at each site had migrated past salmon farms or not and showing which sites were related to which published study. They wanted to present infection rates by study, year, salmon species, and site status and report the number of fish sampled in each case. Finally, they needed to list the full citation for all the published (and one unpublished) sources of data. The map was created entirely within ArcGIS. Living Oceans Society made this map available for viewing and for download on its website and provided a printed copy to colleagues working on this issue who, in turn, used it as a communication tool to help summarize the state of scientific knowledge to others, including government, industry, and funders. The map served as a catalyst for discussion.

In June 2008, Marine Harvest Canada agreed to coordinate the stocking of its farms in the Broughton Archipelago region to establish safer migratory routes for the wild salmon as they make their way from the rivers to the open ocean. This migration corridor plan is expected to provide interim protection for some of the threatened wild salmon, but it is not a permanent or widespread solution to the conservation issue. Ultimately, open net-cage salmon farms must transition to closed containment to ensure the long-term health of our oceans.

More and more science is indicating that the impact of sea lice from salmon farms has a much greater reach than was previously studied. Results now suggest that BC's largest sockeye salmon run, the Fraser River sockeye, may be facing unnaturally high levels of sea lice because of open net-cage salmon farms. Sockeye salmon spawning returns to the Fraser River in 2009 were the lowest in over 50 years, and were only a small fraction of numbers expected. As a result, the Canadian federal government launched a commission of inquiry into the 2009 collapse of the Fraser River sockeye salmon. The Cohen Commission is currently under way and is examining a range of factors contributing to the collapse including the impact of salmon farming on wild stocks.

For more information on this important conservation issue, including a variety of informative maps, please visit the Living Oceans Society website (www.livingoceans.org).

Science Third Place

Planning for Conservation in the Ruvuma Landscape

By Adam P. Dixon, Jessica Forrest, and Stephan Ehl
World Wildlife Fund US
Washington, D.C., USA

Data Sources

WWF 2011; Birdlife International 2010; World Database on Protected Areas 2010; ArcGIS Online; Socioeconomic Data and Applications Center at Columbia University; Instituto Nacional de Estatistica of Mozambique; Dar es Salaam Corporation; Gazateer.de; DeLorme World Roads; IUCN Mission Report for Monitoring Selous Game Reserve; Baccini, A. et al., 2008, "A First Map of Tropical Africa's Above-ground Biomass Derived from Satellite Imagery," *Environmental Research Letters*

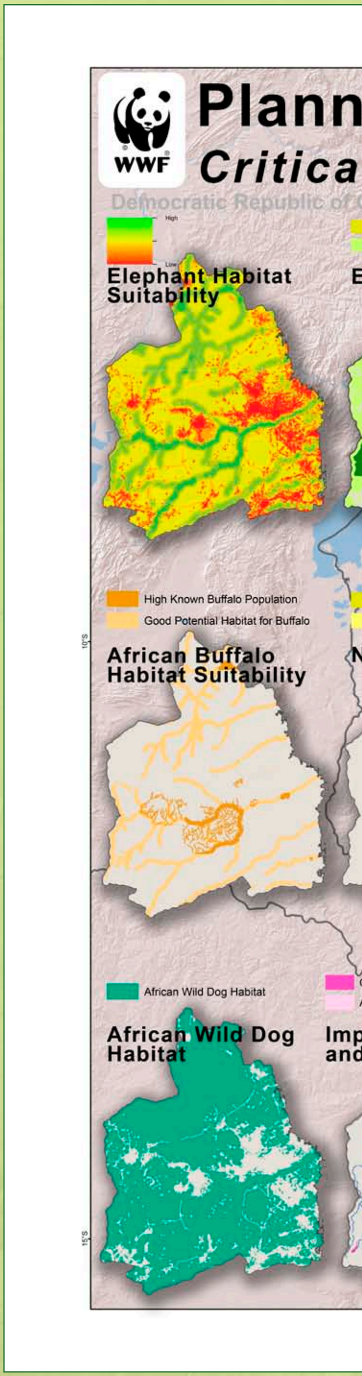
The Ruvuma Landscape has geographic features that make the challenge of conservation planning difficult. The landscape is bisected by the national boundary of Mozambique to the south and Tanzania to the north. Coordinating efforts to conserve natural resources is problematic because of differences in language, culture, and government commitment.

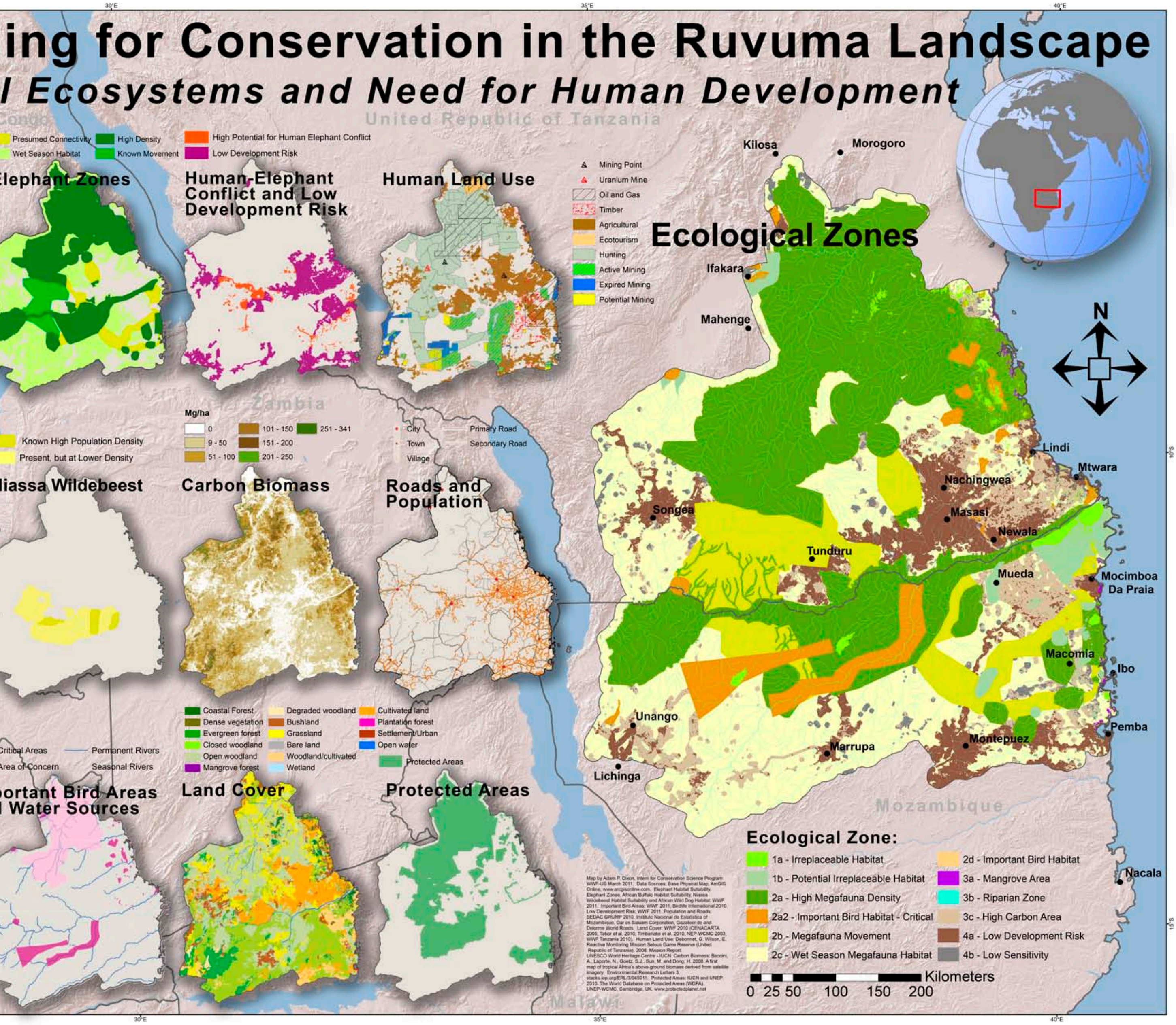
The decisions made on management protocols in these areas are critical to the ultimate success of conservation in the region. Furthermore, by comparing the protected areas to the Ecological Zones map, one can determine areas that may not have enough protection.

The map *Planning for Conservation in the Ruvuma Landscape* presents an initial graphic introduction to the concept of conservation planning though the display of the multiple criteria used to develop a final conservation plan. The final map, titled *Ecological Zones*, combines the complementary datasets into one comprehensive plan for conserving the unique biological heritage that the Ruvuma Landscape contains while addressing the needs of human development in this region of Mozambique. The *Ecological Zones* map was developed by displaying the most to least sensitive conservation targets in the region. Sensitive habitat starts as Zone 1a, then megafauna and bird habitats are considered, as well as mangroves, riparian zones, and areas of high carbon biomass. The final zones are areas that pose small risk to maintaining the ecological integrity of the region.

The map's national boundaries and country name labels are easily lost when attempting to show multiple concepts. Therefore, width and grayscale of country boundaries were used to suggest that the conservation landscape is transnational and that several countries form the geopolitical calculus of conservation planning in the region. The width and grayscale of the country boundaries were also intended to emphasize the fact that ecosystems do not have national boundaries. Nuance was critical in the development of this map.

Final touches to the map included processing outside ArcGIS. Dixon exported the map as several Adobe .ai files, thereby adding background shadows to each criteria map




ing for Conservation in the Ruvuma Landscape
l Ecosystems and Need for Human Development
United Republic of Tanzania
Congo
Zambia
Malawi
Mozambique
Presumed Connectivity
High Density
Wet Season Habitat
Known Movement
High Potential for Human Elephant Conflict
Low Development Risk
Elephant Zones
Human-Elephant Conflict and Low Development Risk
Human Land Use
Mining Point
Uranium Mine
Oil and Gas
Timber
Agricultural
Ecotourism
Hunting
Active Mining
Expired Mining
Potential Mining
Ecological Zones
Mg/ha
0
9 - 50
51 - 100
101 - 150
151 - 200
201 - 250
251 - 341
Known High Population Density
Present, but at Lower Density
City
Town
Village
Primary Road
Secondary Road
iassa Wildebeest
Carbon Biomass
Roads and Population
Coastal Forest
Dense vegetation
Evergreen forest
Closed woodland
Open woodland
Mangrove forest
Degraded woodland
Bushland
Grassland
Bare land
Woodland/cultivated
Wetland
Cultivated land
Plantation forest
Settlement/Urban
Open water
Protected Areas
Critical Areas
Area of Concern
Permanent Rivers
Seasonal Rivers
portant Bird Areas
l Water Sources
Land Cover
Protected Areas
Kilosa
Morogoro
Ifakara
Mahenge
Lindi
Mtwara
Nachingwea
Masasi
Newala
Songea
Tunduru
Mueda
Mocimboa Da Praia
Macomia
Ibo
Unango
Marrupa
Montepuez
Pemba
Lichinga
Nacala
N
Ecological Zone:
1a - Irreplaceable Habitat
1b - Potential Irreplaceable Habitat
2a - High Megafauna Density
2a2 - Important Bird Habitat - Critical
2b - Megafauna Movement
2c - Wet Season Megafauna Habitat
2d - Important Bird Habitat
3a - Mangrove Area
3b - Riparian Zone
3c - High Carbon Area
4a - Low Development Risk
4b - Low Sensitivity
Kilometers
0 25 50 100 150 200
30°E
35°E
40°E
10°S
15°S

Planning for Conservation in the Ruvuma Landscape (continued)

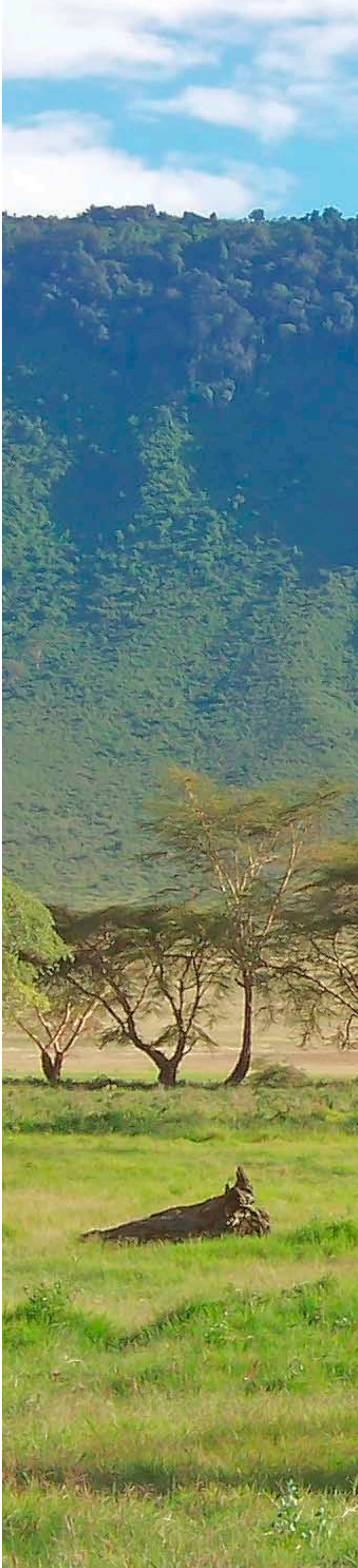
and showing the frame of the extent globe in the upper right-hand corner of the map. This makes it easier to see that each criterion is separate from the overall *Ecological Zones* map. It also makes the map more visually appealing and the viewer more likely to consider each criterion.

Each criterion in the map is drawn from geographic science to spatially represent the theme.

- Habitat suitability models are based on a literature-based methodology for developing a prediction of species occurrence.
- The water sources data included with the Important Bird Area themed map were developed from the World Wildlife Fund (WWF) and US Geological Survey Hydrosheds project.
- The Elephant Zones map was developed by using a habitat suitability model, a least-cost corridor analysis to model elephant movement in the region, radio collar data, and point observations from other elephant studies in the region.
- The land-cover dataset was based on a series of land-cover analyses in the region based on separate datasets for Tanzania and Mozambique. An amalgamation of data was ultimately used to process the final land-cover dataset.
- Social sciences data includes population and human land use such as oil and gas, timber, and mining concessions.
- Protected area boundaries are delineated.

To insinuate the decision-making process, Dixon positioned the datasets according to theme. The species datasets are more toward the left side of the map, the carbon biomass and land cover are placed near the middle, and the datasets that contain social and political data are more toward the right side of the map. The human-elephant conflict and low development areas, human land-use, roads, and population datasets were purposefully placed in the upper right-hand corner of the maps to emphasize their importance and inclusion in conservation planning.

The outcome of these efforts is a map that provides a comprehensive inclusion of criteria used to develop a conservation plan. Landscape-level planning comes from a combination of disciplines and, in this case, a blend of ecological and social research to suggest the best way to advance the protection of the unique biological heritage of an area with high rates of poverty and joblessness and inadequate development of public resources such as clean water and health care. Furthermore, the map presents a concept that forms a prediction of how best to conserve the natural environment and challenges the viewer to develop reasons why the map is logical or why the map might not present enough evidence to make a convincing case for the study.



Regional Conservation Design of the Southern Sierra Partnership

By Dick Cameron
The Nature Conservancy
San Francisco, California, USA

Data Sources

California Protected Areas Database 2010, Esri 2011, USGS 2000, Southern Sierra Partnership 2010, CA Department of Conservation 2004

The Southern Sierra Partnership, which is composed of Audubon California, the Conservation Biology Institute, The Nature Conservancy, the Sequoia Riverlands Trust, and the Sierra Business Council, conducted a collaborative conservation assessment that incorporated climate change across seven million acres of public and private lands. The outcome is the Regional Conservation Design (RCD), which is a spatial vision that links conservation goals, threat projections, and climate change responses to areas of the landscape that offer the best opportunities for sustaining biodiversity and ecosystem services in the southern Sierra regions of California.

This map is the primary spatial product of a yearlong planning process that defined what areas need to be managed for ecological values to sustain biodiversity. Many conservation issues are addressed in the planning process and discussed in the final report, including habitat connectivity, changes in species distribution due to climate change, the value of riparian areas for streamflows, and wildlife movement.

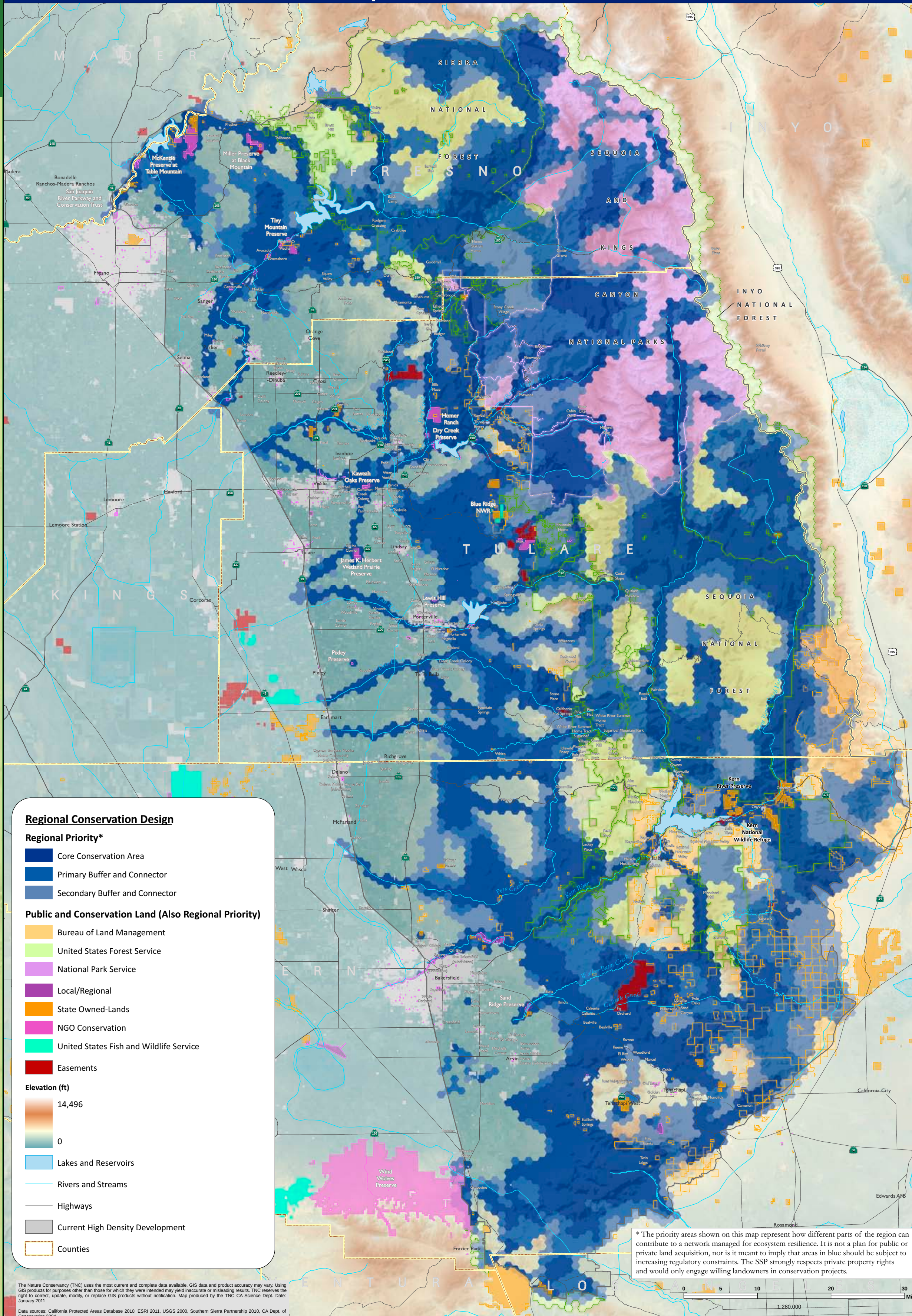
The map needed to be compelling visually so that it could command the attention of viewers. As such, it combines elements from traditional cartography with a design sense similar to an oil painting that uses lots of paint. The blue colors in the network are meant to be the primary storyline, conveying a sense that the landscape connections transcend ownership and elevation gradients.

The RCD needs to reinforce the value of ecological stewardship of different landholdings and provide the “connective tissue” between the existing protected and well-managed areas. As such, displaying public and private conservation land was critical but difficult given the high amount of overlap with the RCD and the need to make the RCD the primary visual element. Smaller preserves and parks are displayed on top of the RCD and used a complementary color palette and high saturation in the colors.

On the map, Bureau of Land Management, US Forest Service, and National Park Service holdings that cover the mountain regions have a background of a lighter set of colors and a higher transparency. Because it is important that the boundaries and patterns of ownership (e.g., consolidated vs. checkerboard) are displayed, two elements are used to represent the boundaries that make them clear yet secondary in the visual design. A wider transparent line weight highlights a thin strong line. The designation of each agency employs a similar yet more saturated color as the fill for the lands, thereby making the association between them easy for the map viewer.

Southern Sierra Partnership

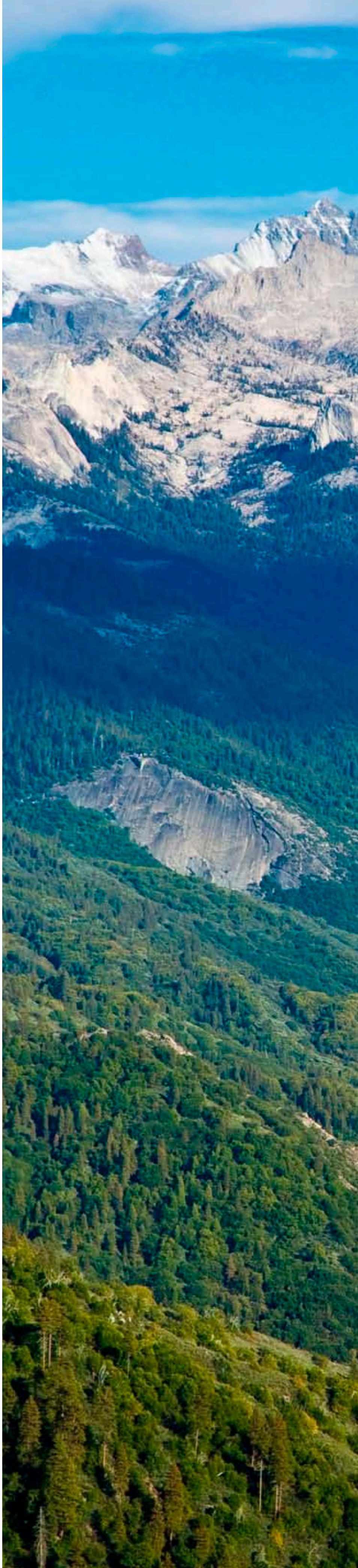
Regional Conservation Design



Regional Conservation Design of the Southern Sierra Partnership (continued)

The third theme represented is the diversity of land uses and steep elevation gradients. To do this, the basemap is a combination of a satellite image; a digital elevation model (DEM); and a smoothed, simplified hillshade. As this was a supporting message, it is very subtle and only draws the eye in a few places. The agricultural land uses in the San Joaquin Valley to the west are apparent but in a very subtle way.

Connectivity across habitats and ecosystems is a critical conservation goal in the face of both land use and climate change. Scientists project that many species' distributions will respond to climate change by shifting to areas with more suitable climate. Those movements, or range shifts, are constrained by past land-use conversion as well as future changes. The spatial dimensions of connectivity are just as diverse as its role in maintaining species viability and ecosystem functionality. At fine spatial scales, mobile species move at daily and seasonal frequency to forage, breed, and find cover. River systems access former channels, nearby wetlands, and floodplains during storms and seasonally. At broader time and space scales, the distribution of a species might move uphill to adjust to higher temperatures in its current range, and juvenile, wide-ranging species might disperse from their natal range to set up a new home range. Disturbance regimes, such as wildfire in the forests of the region, historically have operated over large areas, creating a mosaic of plant communities that changes connectivity for plants and animals over time.



Science

Conservation Lands Network

By Maegan Leslie Torres, Louis Jaffe, and Ryan Branciforte
GreenInfo Network, Bay Area Open Space Council
San Francisco, California, USA

Data Sources

Bay Area Open Space Council, CalVeg, GreenInfo/CPAD, many others

The nine-county San Francisco Bay Area in California hosts many species found nowhere else. It is also a biodiversity hot spot—an area with high biological diversity that suffers from extensive habitat loss. With 1.2 million acres already conserved for open space and natural resources, the Bay Area is an international leader in conservation. The region's high quality of life is frequently attributed to, in part, historic successes in conservation and accessibility to open space. The challenge is to continue these successes in the face of rapid development and environmental change.

The region has lacked a shared science-based vision for the future protection and stewardship of its hills, grasslands, and other upland resources. Without such a vision, it is challenging to be strategic or efficient in continuing conservation efforts. The Bay Area Open Space Council initiated the Upland Habitat Goals Project to develop this shared vision. With participation from 125 organizations and individuals, from the National Park Service to local ranchers, the project developed a collaborative scientific process to identify the types, amounts, and distribution of habitats needed to sustain diverse and healthy ecosystems in upland habitats—those beyond the bay's edge. This map, *Conservation Lands Network* (CLN), represents the culmination of that work, and the CLN map is a "greenprint" for action.

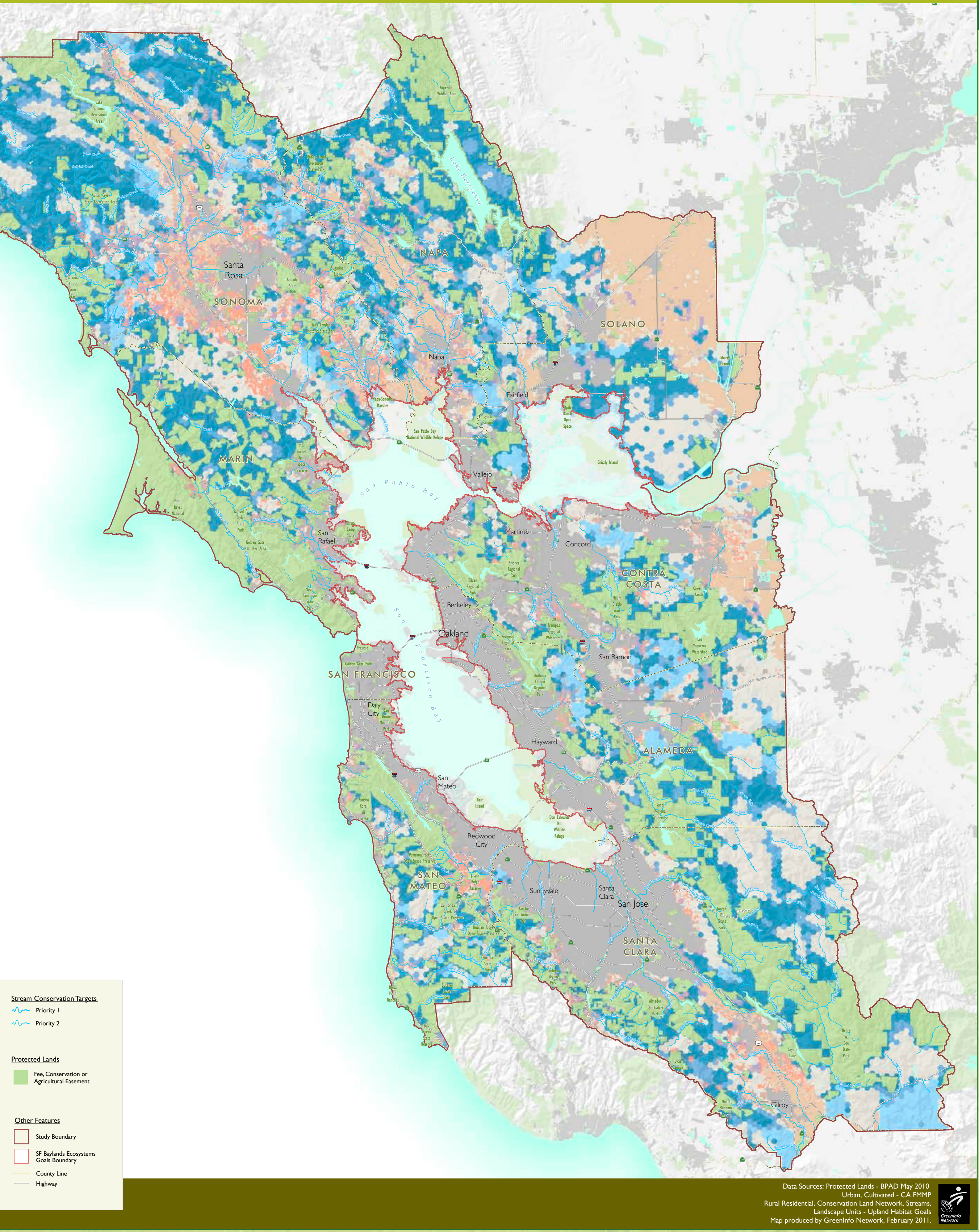
The CLN project instills a rigorous scientific method:

- Conducting a coarse filter gap analysis that inventoried distribution and current protection for all vegetation types in the Bay Area, identified gaps in protection, and set goals for future protection
- Refining those goals through a fine filter analysis of over a thousand specific conservation targets including species of plants, mammals, birds, fish, amphibians, reptiles, and invertebrates as well as key habitat elements such as serpentine soils and ponds
- Identifying the CLN using conservation planning software based on ~250-acre hexagonal planning units designed to identify the network of lands necessary to meet conservation goals (The analysis considered elements of ecological integrity and watershed functions to identify a network resilient to environmental disturbance.)

The resultant Conservation Lands Network represents a mosaic of interconnected habitats and linkages essential to meet the conservation goals and maintain biodiversity throughout the region.

GreenInfo Network, a key partner in data development, GIS analysis, web support,

Conservation Lands Network



Conservation Lands Network (continued)

and CLN map creation, led the map development effort, guiding the council through each step. Though many tools were developed to convey the message and facilitate the implementation of the CLN, the final map allows the entirety and complexity of the work to be displayed in one piece. Given the myriad of biological factors analyzed in development of the CLN, including habitat corridors, over a thousand conservation targets, landscape integrity, and rarity of vegetation communities, it was clear from the beginning that the comprehensive map would have to be a complex piece.

The online map can be seen at http://bayarealands.org/gis/maps.php. The viewer is first encouraged to recognize the vast swaths of blue areas representing the complex CLN, but when zoomed in to 100 percent or greater, the additional layers of information begin to unfold including more detail on the CLN, priority streams, converted lands, and the existing protected lands from which the network is built. The converted lands, made up of cultivated agriculture and urban and rural residential lands, are an important feature of the map, which shows fragmentation of the landscape and the resultant threat to the viability of the network to maintain a connected and functional ecosystem. While zooming in to the map, the viewer will also begin to see key labels of important priority streams and existing protected lands as well as city, county, and highway labels meant to help orient the reader.

GreenInfo used ArcGIS 10 to create the map and manage the underlying data. The main technical challenge in developing the map was the symbolization, taking a very detailed and extensive array of data and providing a sequence of understanding as the viewer moves from several feet away to close up.

Evolution of the System of Protected Areas of Madagascar

By Wildlife Conservation Society Madagascar and Madagascar Protected Areas System Committee
Antananarivo, Madagascar

Data Sources

Commission SAPM, geographic database from FTM (Malagasy National Hydrographic and Geographic Institute)

Madagascar is a global biodiversity hot spot, having an exceptionally high diversity of wildlife species and endemic flora and fauna. This biodiversity remains under severe threat from deforestation, fragmentation, and overexploitation. Past conservation planning efforts in Madagascar have suffered from the lack of an effective biodiversity database and the tools for its use.

The Madagascar project Réseau de la Biodiversité de Madagascar (REBIOMA) is a collaboration between the Wildlife Conservation Society (WCS) and University of California, Berkeley, that brings the latest analytic methods and technologies from the research community to bear on conservation problems.

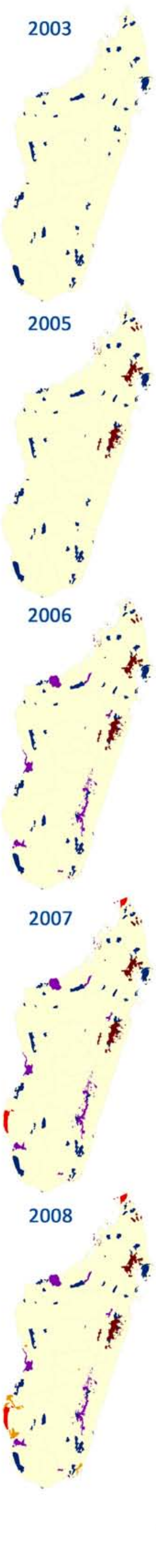
Since 2001, REBIOMA has improved biodiversity conservation planning in Madagascar by providing easy access to updated and validated biodiversity data and enabling institutions and scientists to share and publish their occurrence data for conservation uses such as quantitative conservation planning.

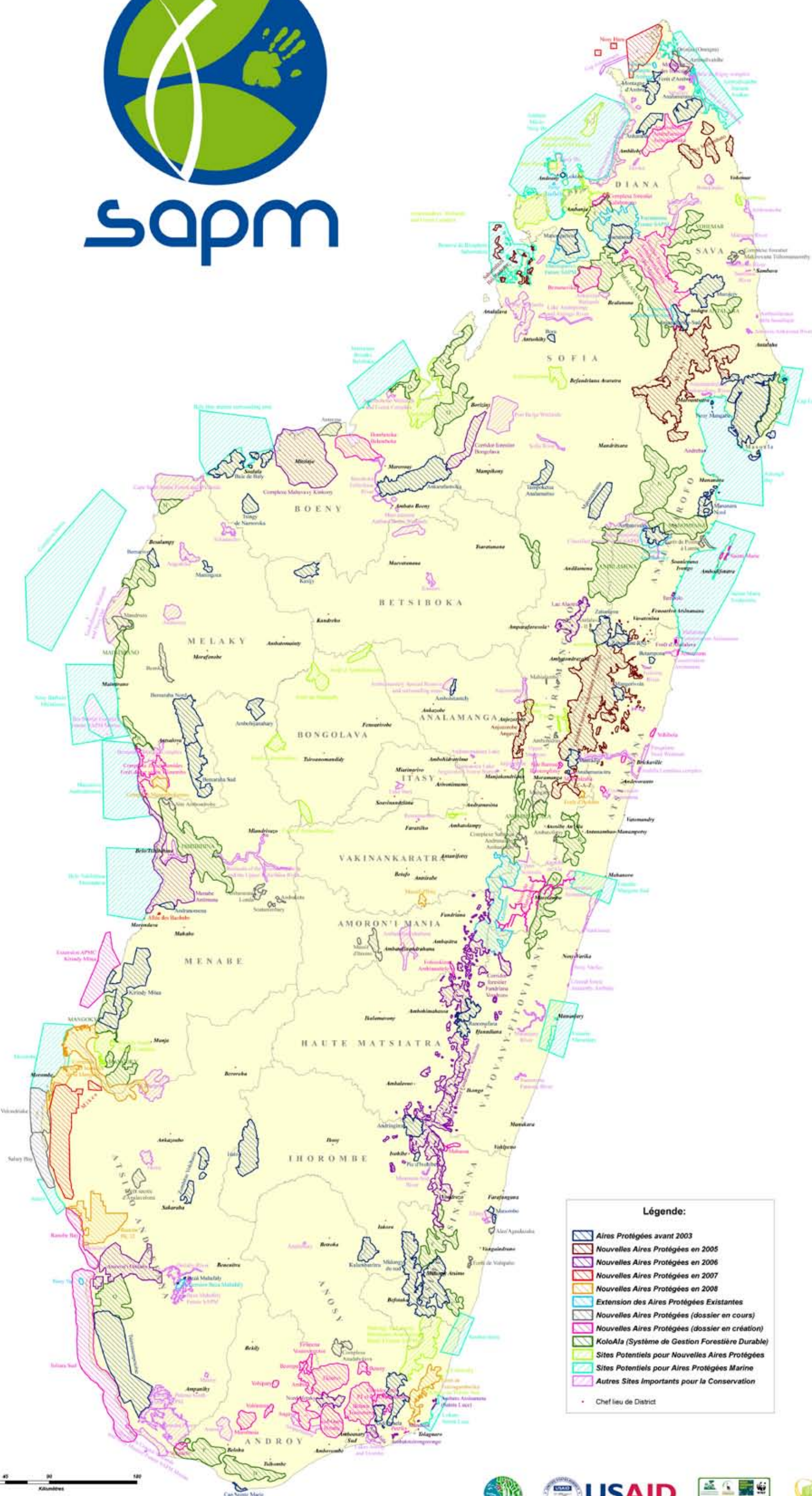
To depict biodiversity conservation hot spots, mapmakers chose the results of REBIOMA's 2008 Malagasy Protected Areas System (SAPM) analysis. Projects conducted by REBIOMA and its partners are indicated by hatch marks. SAPM generally consolidates information about the protected areas in Madagascar, which has been classified by category, periods of development, and management. Feature classes include existing protected areas, the extension of protected areas, protected areas with temporary status, new protected areas, important sites for conservation (priority sites for future protected areas), and potential sites for conservation (sites with high probability for future protected areas).

The selection of species shown along the right side of the map is a showcase of REBIOMA's contribution to Madagascar biodiversity conservation, but, sadly, it also highlights the illegal logging crisis.

EVOLUTION DU SYSTEME D'AIRES PROTEGEES DE MADAGASCAR Avant 2003 jusqu'en 2009

sapm





Sea Turtle Stranding Probability

By Agnese Mancini
Boomerang for Earth Conservation
Antony, France

Data Sources

Stranding data collected in Baja California Sur between 2006 and 2009, oceanographic data obtained from http://coastwatch.pfeg.noaa.gov, fishery data obtained from SAGARPA (2007), interviews with local fishers conducted by the author

Although sea turtle stranding networks have existed for many years, very little is known about why this occurs. From March 2006 to June 2008, a team from Boomerang for Earth Conservation surveyed sea turtle mortality along 220 km of coastline of Baja California Sur, Mexico. The team found a total of 757 stranded turtle carcasses but determined the mortality cause of 15 percent. Fishing was the largest cause.

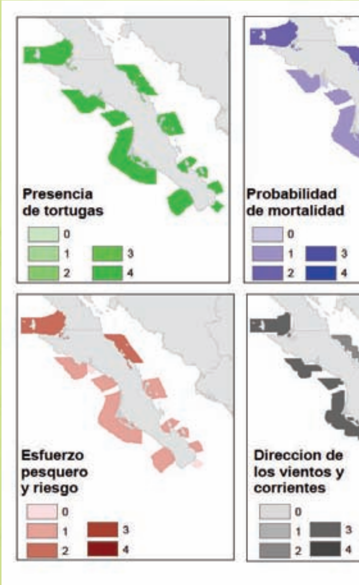
To determine the cause of death, the map author used GIS to create a model that identified high-risk areas for sea turtles. It included oceanographic (SST, chlorophyll concentration, wind and current direction and strength) and anthropogenic (fishing activity) variables to explain the absence or presence of sea turtle strandings on a beach. The model is composed of five steps:

1. Determine sea turtle presence/absence by analyzing chlorophyll concentration and sea surface temperature.
2. Quantify fishing activity and associated risk based on fishing gear used per month.
3. Estimate the probability of sea turtle mortality related to fishing activity.
4. Determine favorable/unfavorable wind and current conditions.
5. Estimate the probability of finding stranded sea turtles on a beach.

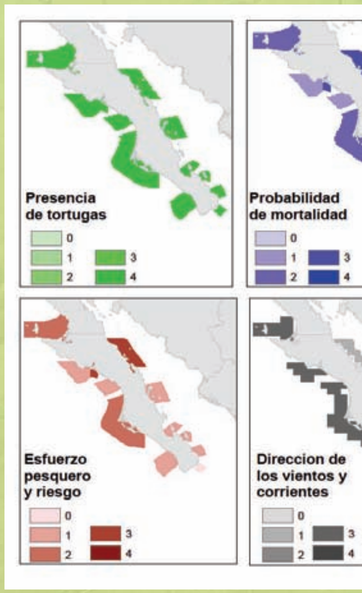
The 2007 map gives an account by month. Each page contains five maps, representing the five steps used to calculate the probability of finding stranded turtles on a specific beach. Color intensity rises as the impact numbers increase.

The maps were useful to identify high-risk areas and seasons for turtles in Baja California Sur. Furthermore, they highlight areas where incidental fishing activity could be a serious threat to turtles.

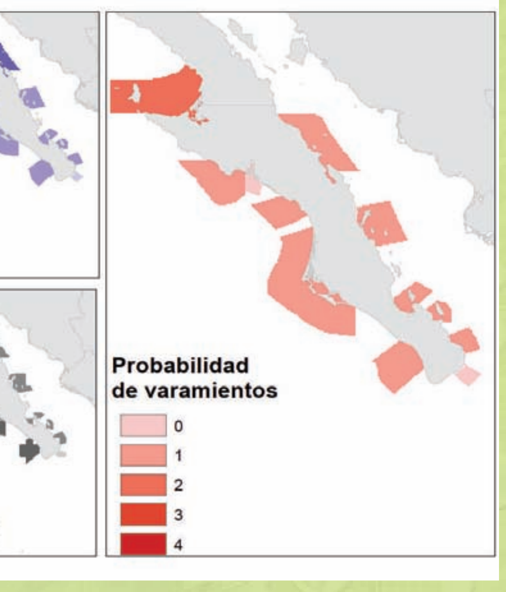
APRI



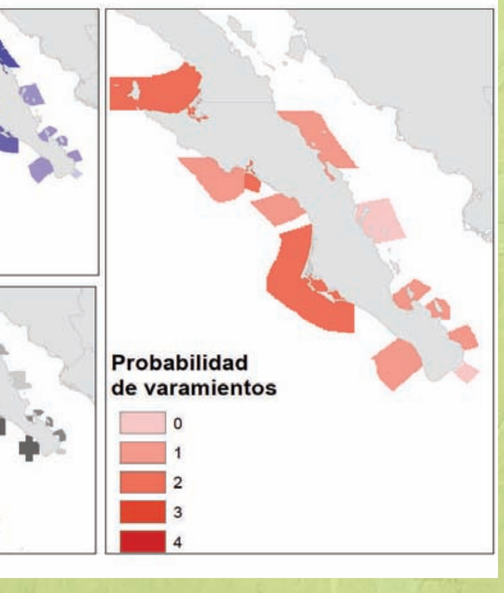
MA



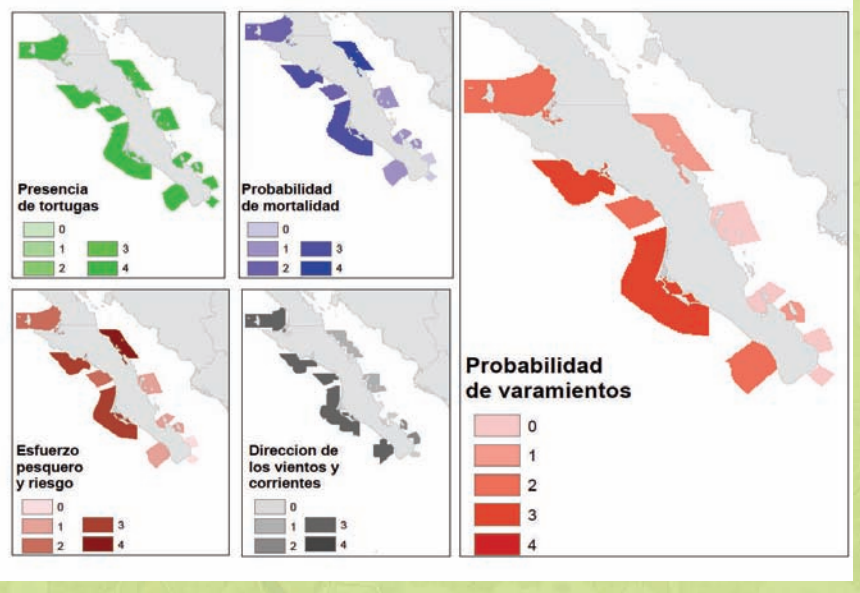
IL 2007



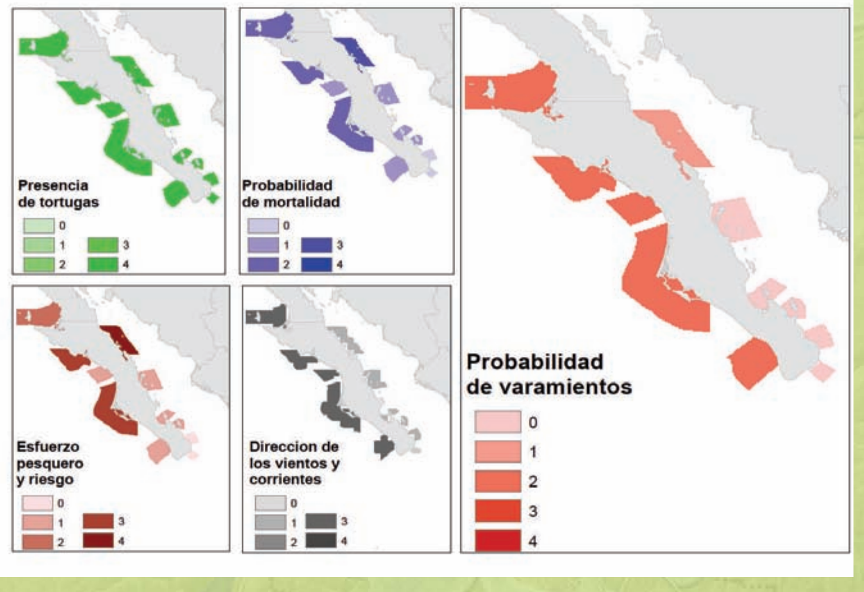
Y 2007



JUNE 2007



JULY 2007



Limpopo National Park (Mozambique)

By Craig Beech and Willem van Rieti
Peace Parks Foundation
Stellenbosch, West Cape, South Africa

Data Sources
Peace Parks Foundation, Tracks4Africa

Limpopo National Park (LNP) in Mozambique was proclaimed a national park in 2003. The core of the park has been cut off from the Limpopo River, which forms the eastern boundary of the park. Wildlife needs access to this river course because the interior of the park is predominantly veld land and has only seasonal water supply. The movement of larger mammals farther east to other parks, such as Banhine and Zinave, is a strong future consideration within the realms of the Great Limpopo Transfrontier Conservation Area.

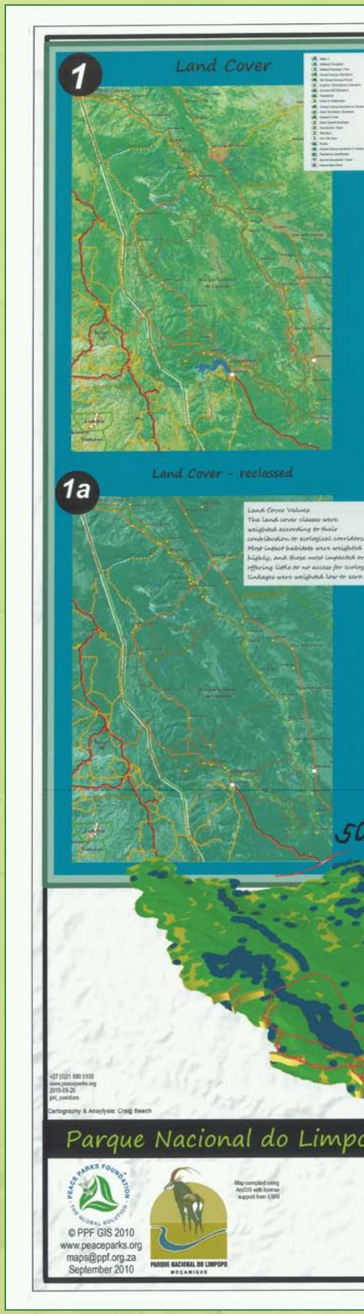
Peace Parks Foundation wanted to identify wildlife corridors from the core of LNP to the river. This corridor analysis used the factors of habitat use, ecological sensitivities, and land use. An overlay analysis was used to visualize the resource utilization buffer zone. The project included these components:

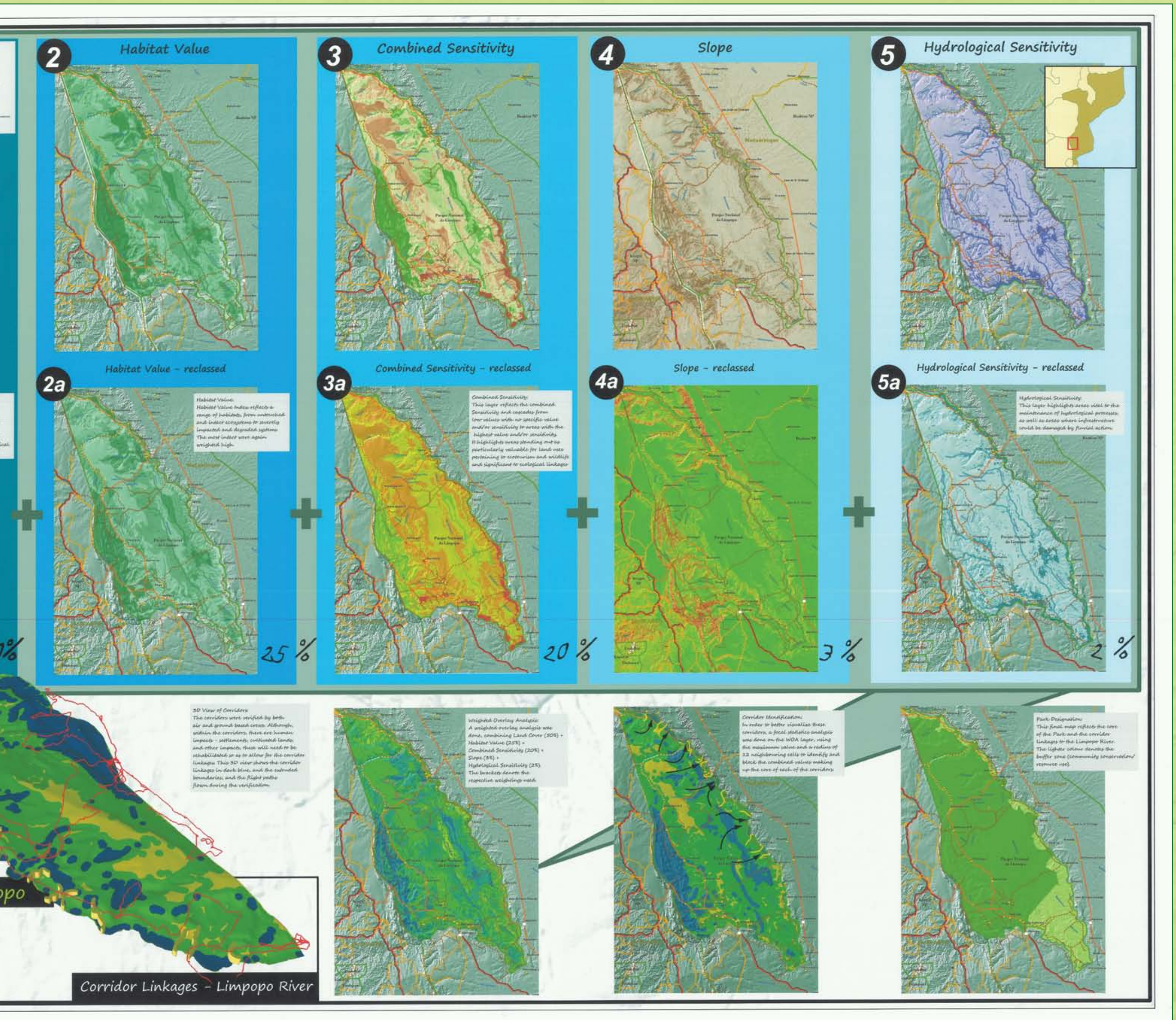
- Land-cover values in relation to ecological corridor contribution
- Habitat value from untouched to degraded status
- Sensitivity values for ecotourism, wildlife, land uses, and ecological linkages
- Hydrologic sensitivity in relation to hydrologic processes that could damage corridor infrastructure

Weighted overlay analysis was calculated by combining land cover (50%), habitat value (25%), combined sensitivity (20%), slope (3%), and hydrologic sensitivity (2%). The percentages denote the respective weightings used.

A 3D view of corridors was verified by air- and ground-based crews. This reveals that corridors are impacted by settlements, cultivated lands, and other activities that need to be rehabilitated to create corridor linkages. The 3D view shows the corridor linkages (dark blue), extruded boundaries, and flight paths of airplanes doing verification work.

This map poster reads from the top left in a sequence of input layers and analyses to the derived corridors. The 3D view, facing from northeast, allows the user to visualize the corridors as they link from the river back to the core of the park. The map has helped park authorities prioritize steps that create open connectivity from zones to the river as well as improve management and prevent human-wildlife conflict.




2
Habitat Value
3
Combined Sensitivity
4
Slope
5
Hydrological Sensitivity
2a
Habitat Value - reclassed
Habitat Value:
Habitat Value Index reflects a range of habitats, from untouched and intact ecosystems to severely impacted and degraded systems. The most intact were again weighed high.
3a
Combined Sensitivity - reclassed
Combined Sensitivity:
This layer reflects the combined Sensitivity and cascades from low values with no specific value and/or sensitivity to areas with the highest value and/or sensitivity. It highlights areas standing out as particularly valuable for land uses pertaining to ecotourism and wildlife and significant to ecological linkages
4a
Slope - reclassed
5a
Hydrological Sensitivity - reclassed
Hydrological Sensitivity:
This layer highlights areas vital to the maintenance of hydrological processes as well as areas where infrastructure could be damaged by fluvial action.
25 %
20 %
3 %
2 %
3D View of Corridors:
The corridors were verified by both air and ground based crews. Although, within the corridors, there are human impacts - settlements, cultivated lands, and other impacts, these will need to be rehabilitated so as to allow for the corridor linkages. This 3D view shows the corridor linkages in dark blue, and the extruded boundaries, and the flight paths flown during the verification.
Weighted Overlay Analysis:
A weighted overlay analysis was done, combining Land Cover (50%) + Habitat Value (25%) + Combined Sensitivity (20%) + Slope (3%) + Hydrological Sensitivity (2%). The brackets denote the respective weightings used.
Corridor Identification:
In order to better visualize these corridors, a focal statistics analysis was done on the WOA layer, using the maximum value and a radius of 12 neighbouring cells to identify and block the combined values making up the core of each of the corridors.
Park Designation:
This final map reflects the core of the Park and the corridor linkages to the Limpopo River. The lighter colour denotes the buffer zone (community conservation/ resource use).
Corridor Linkages - Limpopo River

Social Impact First Place

Urban Forest Restoration Sites

By Christopher Walter
Cascade Land Conservancy
Seattle, Washington, USA

Data Sources

Cascade Land Conservancy, Seattle Parks and Recreation, EarthCorps Science, King County GIS, Washington Department of Natural Resources

Within 20 years, experts estimate that 70 percent of the urban forest in Seattle, Washington, will become an ecological dead zone where invasive plants predominate, trees are dead or dying, and wildlife habitat is gone.

The Green Seattle Partnership is a unique, community-based collaboration administered by Cascade Land Conservancy and committed to restoring and establishing long-term maintenance for the city's 2,500 acres of forested parkland by the year 2025.

The *Urban Forest Restoration Sites* map was created in 2007 to help address the challenges of mobilizing a constituency and galvanizing support for a 20-year project and beyond. It supports publicity, outreach, and public education. Partnership staff and volunteers display the poster-sized map during frequent presentations to schools, businesses, and community groups and at a wide range of public venues such as community fairs, trade shows, and other events held throughout the city. In most cases, the map is part of a larger, visually oriented display that illustrates the threat of invasive plants, makes the case for restoring our urban forests, and demonstrates how the Green Seattle Partnership works to manifest a shared vision of healthy, sustainable urban forests throughout Seattle. Most importantly, the map and other display materials tell the story of how volunteers play a critical role in the success of the project and delivers the message that there is both need and opportunity for everyone to contribute.

The map illustrates the magnitude of the conservation challenge.

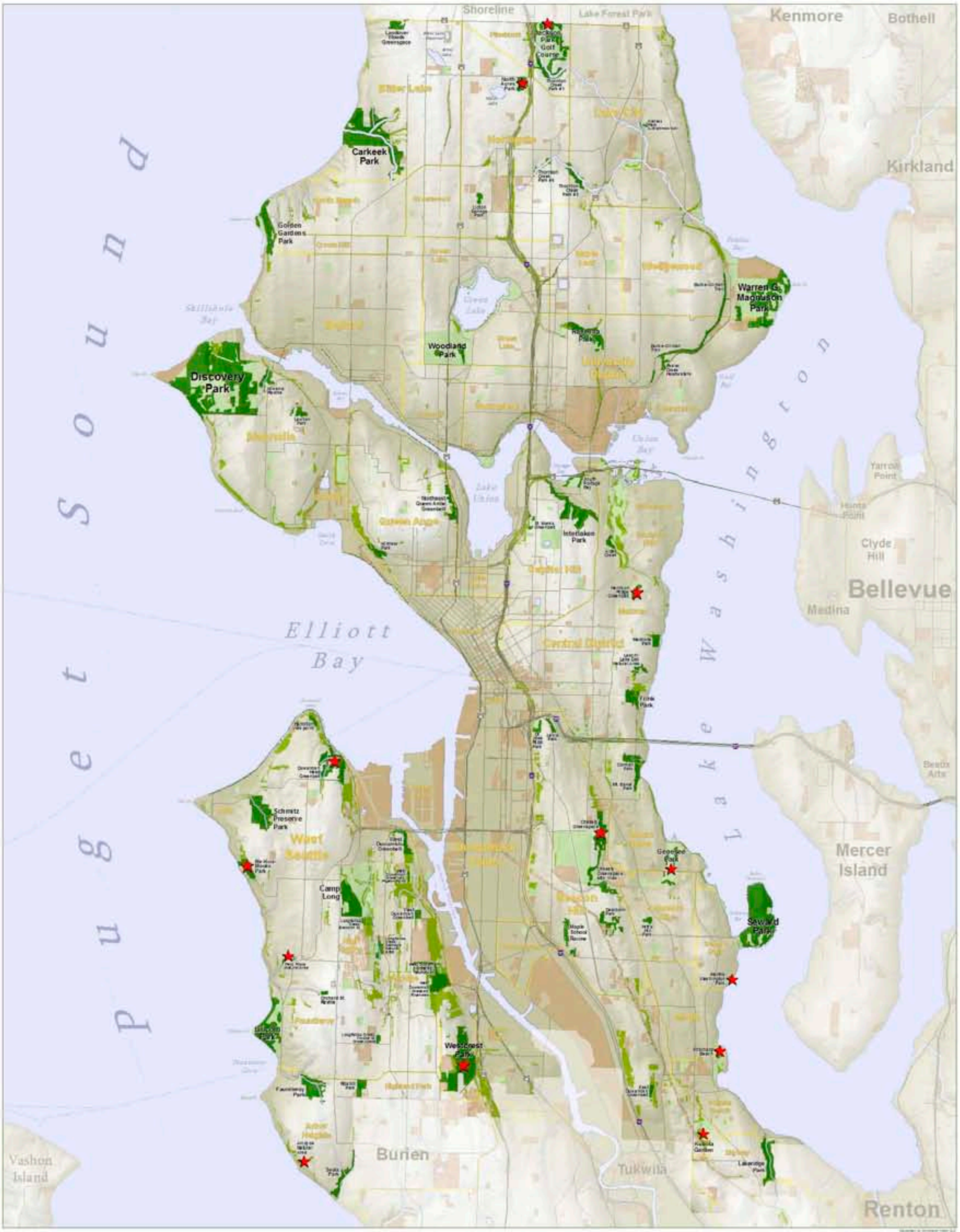
The "hook" relies on the conventional wisdom that the first thing someone looks for on a map is where they live. If they live in Seattle, chances are that there is a forested park within a mile of them in need of care and attention, and because it is prominently colored in a dark green and boldly labeled by name, viewers will note that proximity. Most residents are familiar with the larger destination parks, like Discovery, Interlaken, Lincoln, Magnusen, and Seward, but many are often surprised to learn that the small forested hollow or knoll nearby is also a city park. This brings both the challenge and the vision of a green Seattle to the neighborhood and squarely into the daily life of every potential volunteer.

Familiar navigational references, such as neighborhoods, highways, arterial and local streets, public trails, streams, water bodies, shoreline features, and parks, are all carefully portrayed and their names clearly labeled.

The basemap content takes advantage of Seattle's fascinating geography to draw viewers into exploring their landscape in greater detail. A subtle elevation color ramp

Urban Forest Restoration Sites

GREEN SEATTLE PARTNERSHIP



The Green Seattle Partnership brings together the City of Seattle, Cascade Land Conservancy and the residents of Seattle to restore 2,500 acres of forested parklands by the year 2025. In order to help the partnership meet its goal there needs to be a city-wide volunteer effort to remove invasive species and replace them with native plants. With Green Seattle work sites all over the city it is easy to find a park near you where you can help create a healthy and sustainable forest.

To learn more about the Green Seattle Partnership and how to get involved, visit www.greenseattle.org.

GREEN SEATTLE PARTNERSHIP

Map Legend

Green Seattle Partnership Parks

- Current Forest Restoration Activity
- Future Forest Restoration Planned
- Non-forested Parkland
- Forest Steward Needed

Other Public Lands

- Other Public Lands
- Neighborhood Boundary

Transportation

- State or US Highway
- Arterial Street
- Other Street
- Pedestrian Walkway
- Public Trail
- State Ferry Route

Hydrography

- Lake or Pond
- River or Stream

Urban Forest Restoration Sites (continued)

and shaded relief brings out the complex patterns of hills, valleys, bluffs, and sinks in noticeable detail. The variety of water features connecting the uplands to the sound and lake, which define Seattle's character, as do its forest and nearby mountains, are shown in a contrasting blue, in a detail appropriate to the scale of the map and with names clearly labeled.

Finally, to reach a wide and diverse audience, a successful map must have a simple message and must communicate it clearly. With the fundamental principles of cartography in mind, mapmakers layered and symbolized the dozen spatial datasets involved with careful attention to an appropriate hierarchy of information. For the main subjects of forested park sites and leadership vacancies, they chose bold green and red, respectively, and labeled park names in black with thin white halos to set them off against the park areas themselves. All elements of the basemap appear in various muted shades of either tan for land areas or blue for water. Labels for corresponding features have similar colors just different enough from the background to be read legibly yet avoid becoming a distraction.

Since its inception in 2004, thousands of volunteers have contributed more than 400,000 hours of labor to the partnership during 2,500 restoration events. The partnership has enrolled 625 acres of invasive species-infected parkland into the care of 108 volunteer stewards. To date, volunteers have planted some 65,000 native tree saplings to rejuvenate lost canopy on newly restored land.

Social Impact Second Place

Connecting Wildlife and Water Networks

By Will Allen and Jazmin Varela
The Conservation Fund
Chapel Hill, North Carolina, USA

Data Sources

Metropolitan Government of Nashville and Davidson County, Nashville Area Metropolitan Planning Organization, Cumberland Regional Tomorrow, Land Trust for Tennessee, the Conservation Fund, US Environmental Protection Agency Multi-Resolution Land Characteristics Consortium, Tennessee Wildlife Resources Agency, Tennessee Department of Environment and Conservation, US Fish and Wildlife Service, US Federal Emergency Management Agency, US Department of Agriculture Forest Service, US Army Corps of Engineers, US National Park Service, National Register of Historic Places, Esri ArcGIS Online, US Geological Survey, Tele Atlas North America

Purpose: To educate the community during a public forum of the Nashville: Naturally initiative. The forum and the associated maps were key elements in the development of an open space plan for Nashville-Davidson County, Tennessee.

This map was prepared by the Conservation Fund as part of the Nashville: Naturally initiative. The primary purpose of the map was to educate the community about its water and wildlife resources during a public forum of the Nashville: Naturally initiative in September 2010.

The forum and the associated maps were key elements in the development of an open space plan for Nashville-Davidson County, Tennessee. As a result, the public voted on resource priorities for implementation of the open space plan. Through an involvement process, the public identified four key themes to be included in the open space plan: water and wildlife networks, recreation, farming, and historic/iconic concerns. This plan, with a detailed set of conservation priorities, policy recommendations, and benchmarks for success, was released in April 2011.

To address the theme connecting water and wildlife networks, designers created a green infrastructure network GIS layer that represents an interconnected network of land and water area needed for clean air; clean water; and other economic, environmental, and social benefits for people and nature. These areas were determined as most suitable for protection.

Designers then used ArcGIS ModelBuilder™ to model how hubs and core forests, wetlands, and aquatic systems are linked by corridors. The map combines data from more than a dozen disparate sources and creates inventories of existing open space, flood-sensitive areas, and the green infrastructure network. A cartographic challenge was highlighting Davidson County within the context of the surrounding landscape. This

Nashville: *Naturally*

Creating, Enhancing and Preserving the Places That Matter

Connecting Wildlife and Water Networks

1 inch = 1 mile

SEPTEMBER 2010

1 0.5 0 1 2 3 Miles

LEGEND

References
- Davidson County - 336,386 acres
- Interstates
- US Highways
- State Highways
- Other Roads
- Natchez Trace Parkway
- Railroads

Public Conservation Lands
- 21,560 acres

Land Trust Conservation Easements
- 945 acres

Community Plan Dedicated Open Space
- 6,430 acres

Community Plan Potential Open Space
- 2,197 acres

Green Infrastructure Network
- 115,776 acres

Regulated Floodway + 75 Foot Buffer
- 16,086 acres

FEMA 100 and 500 Year Floodplain
- 38,824 acres

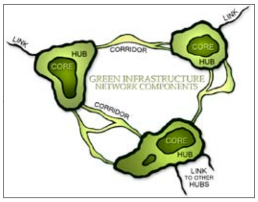
Open Water
- 13,267 acres

Mill Creek Watershed
- Nashville Crayfish Range

Project Data Sources: Metropolitan Government of Nashville & Davidson County, Nashville Area Metropolitan Planning Organization, Cumberland Regional Tomorrow, Land Trust for Tennessee, The Conservation Fund, US Environmental Protection Agency Multi-Resolution Land Characteristics Consortium, TN Wildlife Resources Agency, TN Department of Environment and Conservation, US Fish and Wildlife Service, US Federal Emergency Management Agency, USDA Forest Service, US Army Corps of Engineers, National Park Service, National Register of Historic Places, ESRI ArcGIS Online, US Geological Survey, Tele Atlas North America, Inc.

Map Spatial Reference: Tennessee State Plane, NAD83 datum, measured in feet

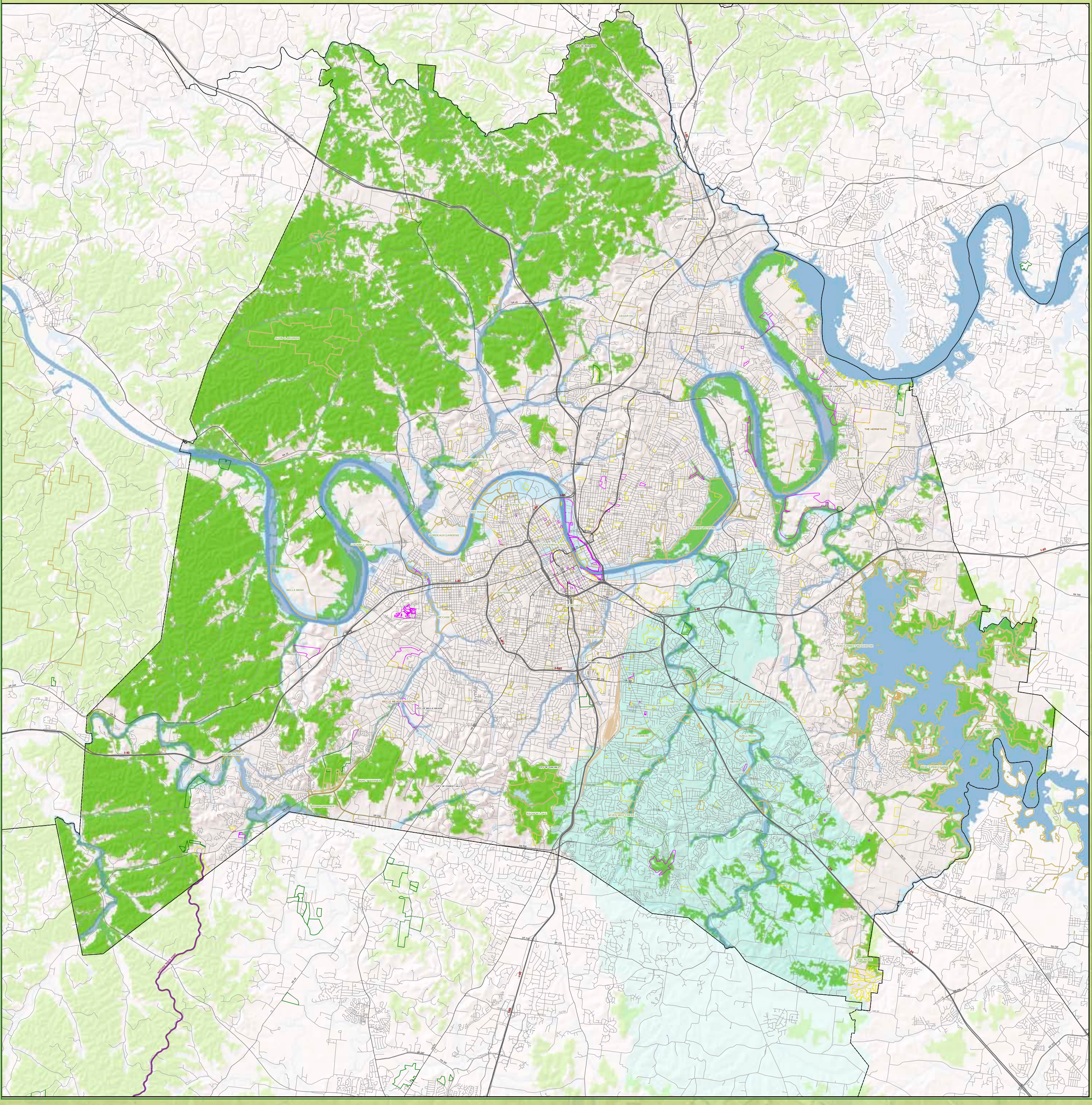
GOAL
The protection of an interconnected wildlife and water network that provides clean air, clean water, and other economic, environmental, and social benefits for people and nature.



More information of green infrastructure is available at:

http://www.greeninfrastructure.net
http://www.conservationfund.org/strategic_conservation

Will Allen
Director of Strategic Conservation
The Conservation Fund
wallen@conservationfund.org
919-967-2223 ext 124



Connecting Wildlife and Water Networks (continued)

was accomplished by using the ArcGIS℠ Online shaded relief map service and adding transparency to the green infrastructure network layer. Applying a transparency mask to areas outside the Davidson County boundary served to lighten but not remove them.

This project resulted in the first comprehensive inventory of open space and analysis of potential future open space in Nashville's history. This was particularly important, since Nashville experienced a major flood in May 2010. The public needed to understand the value of natural systems and regulated floodways, floodplains, open water, and the Mill Creek watershed as well as how conservation opportunities could mitigate future flood hazards.

Nashville's mayor Karl Dean is using a version of this map to highlight the importance of long-term recovery from the flood and explain to residents where to focus green infrastructure investments.

More information on the green infrastructure network design approach is available at www.greeninfrastructure.net.

Zonification of an Indonesian Archipelago

By Lucia Morales Barquero and Ruben Venegas Li
University of Bangor, Gwynedd, United Kingdom
Keto Foundation, Costa Rica

Data Sources

Landsat 5 TM, rest of data generated by fieldwork

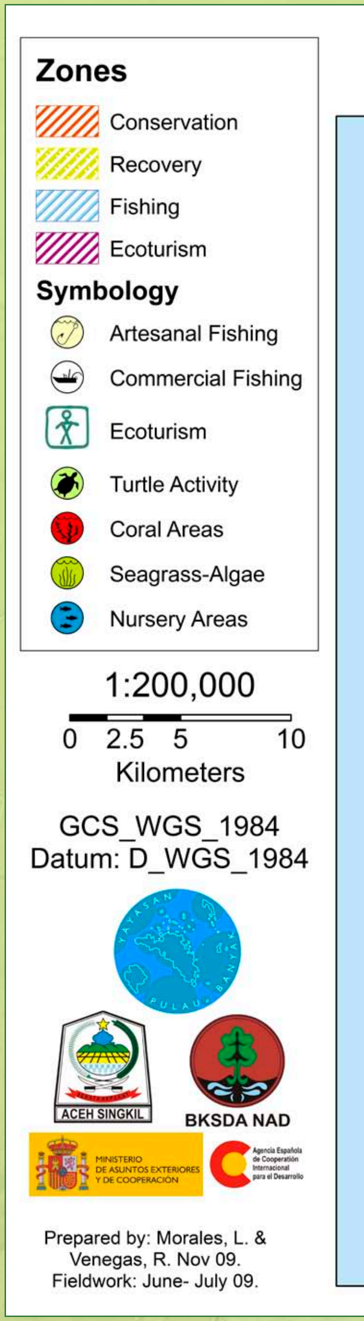
Kecamatan Pulau Banyak is an archipelago that is part of the Singkil Regency in the south of the Aceh province of Indonesia. It consists of approximately 70 islands and provides an important range of habitats such as coral reefs, sea grass and algae patches, freshwater swamps, and mangrove and lowland tropical rainforests. These habitats are home to a high diversity of plants and animals, some of which are yet to be discovered. Many species are designated as protected by the International Union for Conservation of Nature. Some of these are the mouse deer, coral species, reef fishes, dugongs, and three species of sea turtles.

The *Zonification of Palau Banyak, Aceh, Singkil* map was created for the local nongovernmental organization Yayasan Pulau Banyak and is the first map of its kind for this area. Designating conservation zones defines and minimizes the conflict between resource utilization and resource conservation. It is hoped that zonification will increase the probabilities of being effective, efficient, and equitable. A smart zonification and management plan of the area will ensure the long-term sustainability of the ecosystems and the well-being of the communities living off them.

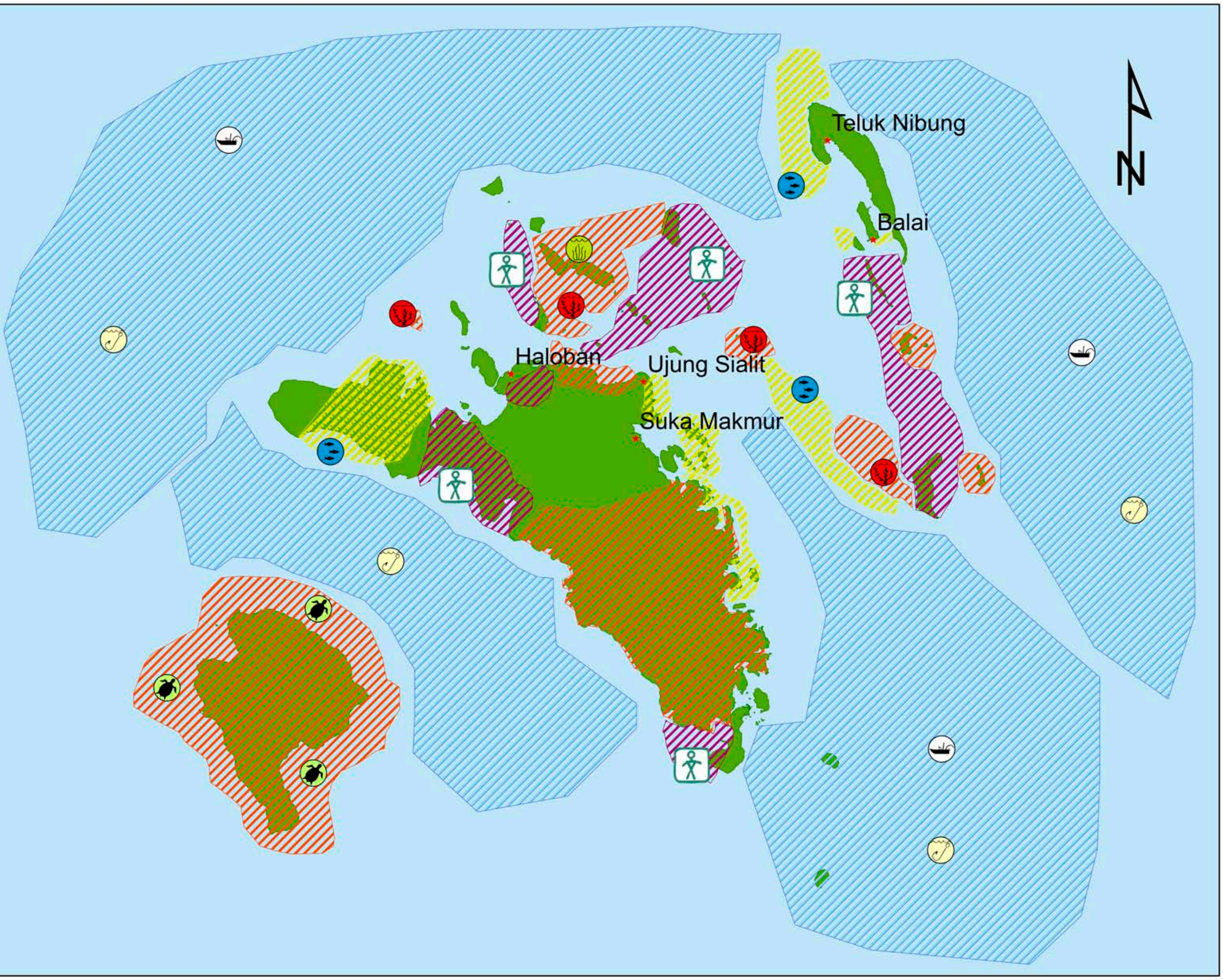
Researchers generated most of the data for the project, which included a habitat map, habitat assessment, and cultural data. The habitat map was the first of its kind for the Archipelago of Pulau Banyak. To create it, the authors classified Landsat 5 thematic mapper satellite images and performed extensive field surveys. Habitat assessment included surveys used for classifying the state of the different habitats. Point files were generated. The result of the effort was the creation of the first formal assessment of the state of the resources within the region. Finally, the researchers invited the participation of local people, especially fishermen. This information was essential for identifying the types of economic activities they did, how and where they did them, and the extent to which people considered these activities beneficial or detrimental for the environment and their economy.

The map and a report on zones were presented to Aceh Singkil government officials. As a result, these authorities requested that Yayasan Pulau Banyak prepare a management plan to be used by the Aceh Singkil government.

For more information about this project, contact the program director, Maggie Muurmans, at pulaubanyak@gmail.com.



Zonification of Palau Banyak, Aceh, Singkil



Social Impact Honorable Mention

Invasive Tree Map

By Logan Berner
Big Island Invasive Species Committee
Hilo, Hawaii, USA

Data Sources

GeoEye QuickBird satellite images; County of Hawaii Planning Department roads; US Geological Survey streams, coastline, and DEM; Hawaii GAP Analysis Program shrubs and trees

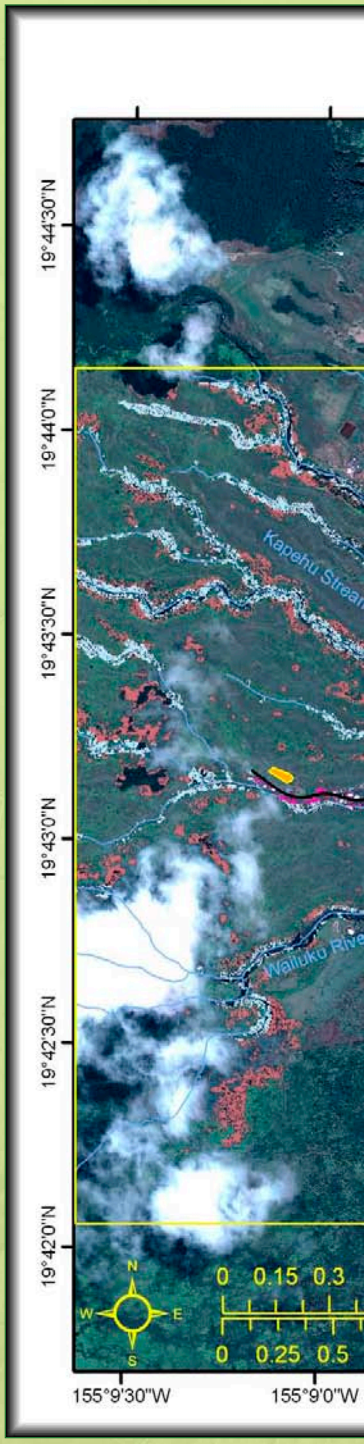
Invasive Tree Map conveys the distribution and hazards associated with an invasive tree in Hilo, Hawaii.

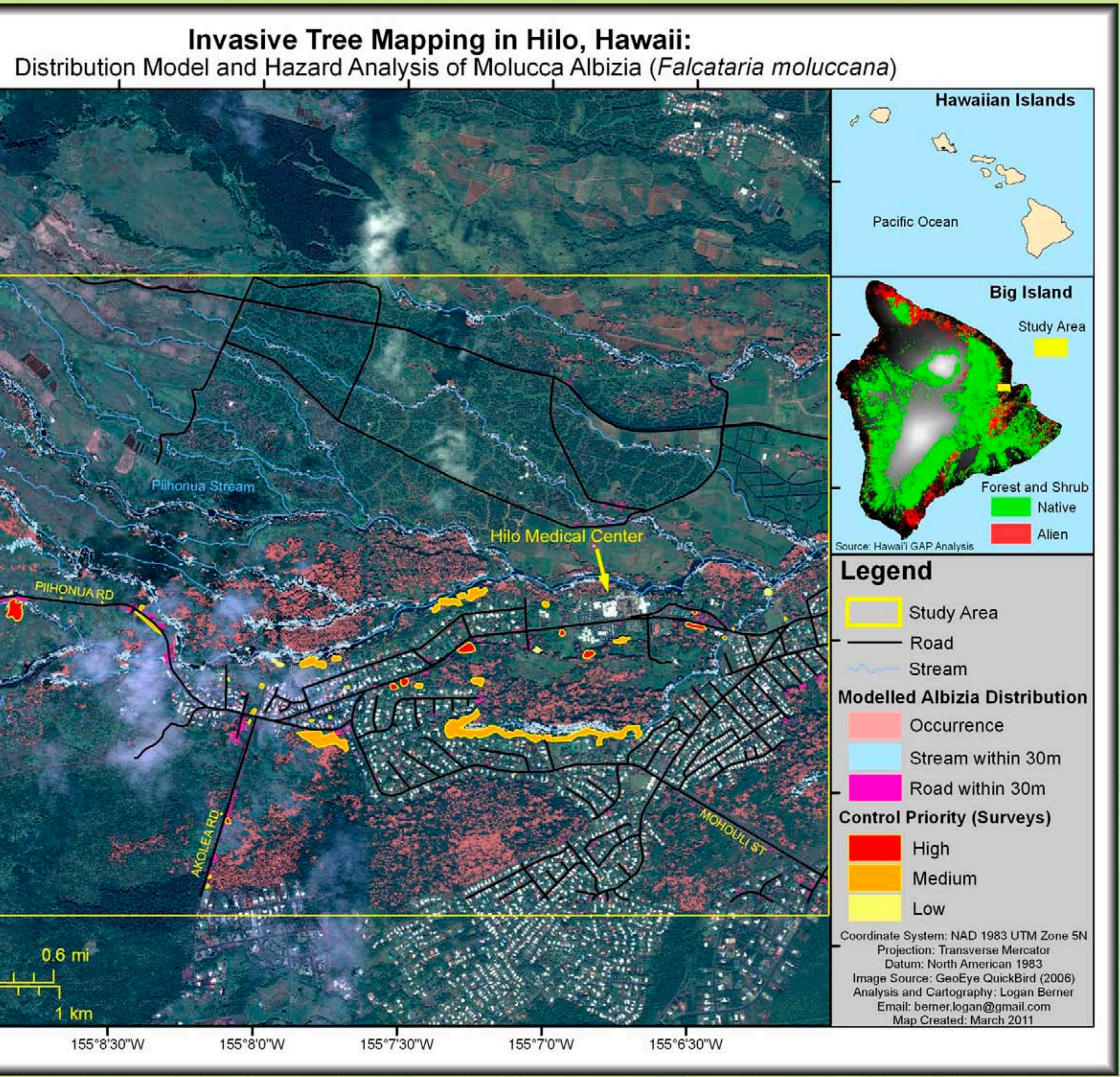
The Hawaiian archipelago, spanning nearly 2,400 km, is the most isolated island chain in the world and home to many endemic and endangered species. On Hawaii Island (the Big Island), a few intact lowland forests remain, but the invasive species *F. moluccana*, which is a tree from Southeast Asia, poses a significant threat to them. In addition, islanders are concerned about the spread of this tree in urban areas on the eastern side of Hawaii Island, where wind-thrown trees have caused fatalities and damaged homes and infrastructure.

Concern by the Piihonua Community Association (PCA) over the spread of *F. moluccana* within its Hilo neighborhood prompted the association to contact its legislative representative, Senator Takamine, who helped subsequently convene a community task force. As an interested neighborhood resident and volunteer, Logan Berner offered to conduct a mapping project to determine the extent of the problem in both the neighborhood and surrounding area. In doing so, he hoped it would be possible to convey to both the community and task force that the spread of *F. moluccana* was, in addition to a neighborhood-level problem, a regional problem, affecting urban areas and lowland forests.

Goals in creating the map were to show the distribution of *F. moluccana* in northwest Hilo; identify stands of *F. moluccana* that, if wind thrown, could hinder medical emergency access and damage infrastructure; suggest control priorities to county planners and natural resource agencies; and raise public and official awareness about the growing threat posed by the spread of *F. moluccana* in both natural and urban areas.

The Big Island Invasive Species Committee supported Berner with the distribution project. He began by gathering data via roadside surveys (n = 3) throughout the community to identify the location, size, age, and threat posed by stands of *F. moluccana* (n = 43). To better understand the landscape-level threat, he conducted a land-cover analysis using GeoEye QuickBird (2006) imagery. SPRING, which is a remote-sensing image processing system that integrates raster and vector data representations, was used to first run an image segmentation then an unsupervised iterative self-organizing cluster algorithm. Informed by the ground surveys, Berner used ArcGIS 10 to identify which cluster categories related to *F. moluccana* and identify areas where *F. moluccana* was growing within 30 meters (~100 feet) of roads and streams.





Invasive Tree Mapping in Hilo, Hawaii:
Distribution Model and Hazard Analysis of Molucca Albizia (*Falcataria moluccana*)
Hawaiian Islands
Pacific Ocean
Big Island
Study Area
Forest and Shrub
Native
Alien
Source: Hawai'i GAP Analysis
Piihonua Stream
Hilo Medical Center
PIIHONUA RD
AKOLEA RD
MOHOULI ST
Legend
Study Area
Road
Stream
Modelled Albizia Distribution
Occurrence
Stream within 30m
Road within 30m
Control Priority (Surveys)
High
Medium
Low
Coordinate System: NAD 1983 UTM Zone 5N
Projection: Transverse Mercator
Datum: North American 1983
Image Source: GeoEye QuickBird (2006)
Analysis and Cartography: Logan Berner
Email: berner.logan@gmail.com
Map Created: March 2011
0.6 mi
1 km
155°8'30"W
155°8'0"W
155°7'30"W
155°7'0"W
155°6'30"W

Invasive Tree Map (continued)

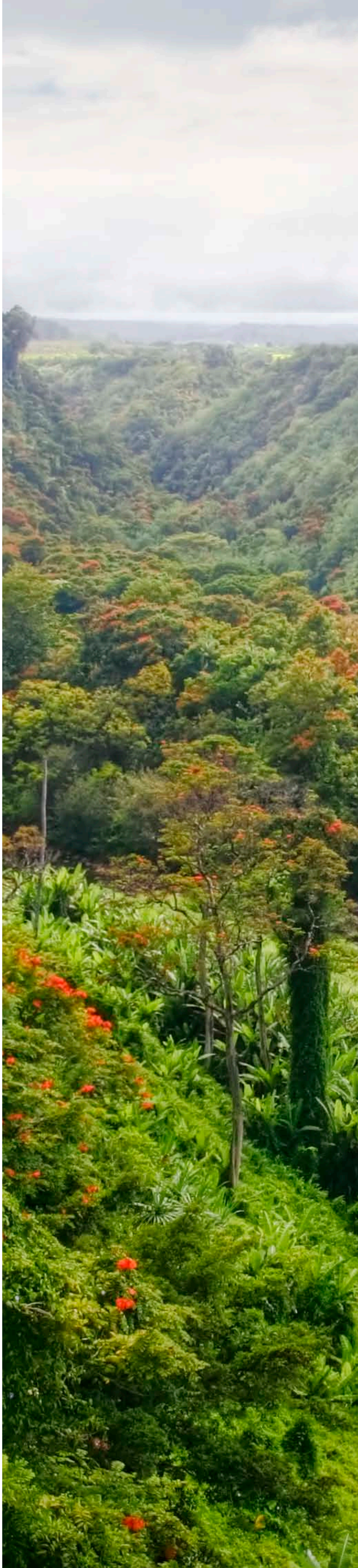
Many *F. moluccana* patches were immediately visible in the high-resolution images; however, the variability in canopy structure and sun-object-sensor angle hindered the use of a pixel-based land-cover classification scheme. The image segmentation proved to be a way of reducing intraclass spectral variability and improving the accuracy of the occurrence model. Spectral similarity with other tree species led to some errors of commission, a common problem in remote sensing of diverse tropical forests.

Using a hierarchical approach, all cartography was generated by ArcGIS 10. First, neighborhood control priorities were created based on the threat that *F. moluccana* stands posed to infrastructure and emergency access corridors. Second was the regional distribution of *F. moluccana*, particularly in relation to roads and streams. Third was the island-wide extent of invasive trees and shrubs. The hierarchical approach was intended to portray how neighborhood-level invasive species problems relate to regional and island-wide invasive species issues.

The 43 *F. moluccana* stands identified during the roadside survey were plotted on top of a multispectral QuickBird image of the greater Piihonua area and color coded (red, orange, or yellow) depending on the threat that they posed to the community. The model showing *F. moluccana* occurrence was then added, and trees within 30 m of either a road or stream were color coded to denote their proximity. GIS layers depicting roads and streams were used to place the distribution of *F. moluccana* in a context more recognizable to the community.

One inset map shows the Hawaiian island chain, and another shows the study area in relation to native and alien vegetation on the Big Island. Again, the hierarchical approach was used to place the neighborhood issue in a broader context. Berner tried to maximize the use of colors that contrasted with the satellite image and logically fit with the displayed features.

Mapping the distribution of invasive species plays a key role in building consensus among community stakeholders and planning control and restoration activities. Mapping *F. moluccana* in Piihonua helped empower the community association and foster a broadening dialog about the island-wide impacts of *F. moluccana* and other invasive species. The project demonstrates that high-resolution satellite imagery, together with novel image processing techniques, can be used to characterize the spread of invasive pests, something which has not been widely investigated in Hawaii.



What We've Accomplished in Martis Valley

By Larry Orman, Maegan Leslie, and Alexandra Barnish
GreenInfo Network
San Francisco, California, USA

Data Sources
Sierra Watch, California Protected Areas Database, US Geological Survey

The Sierra Watch *What We've Accomplished* map is the culmination of a five-year battle over habitat and development areas in the Martis Valley located in California's Sierra Nevada area, just north of Lake Tahoe. The map frames the achievement of a negotiated outcome that will generate over $75 million for land conservation and habitat restoration in the Tahoe region. The outcome modifies developments that otherwise would have been allowed free rein by the approving local government. It is a precedent-setting, innovative, major accomplishment in conservation.

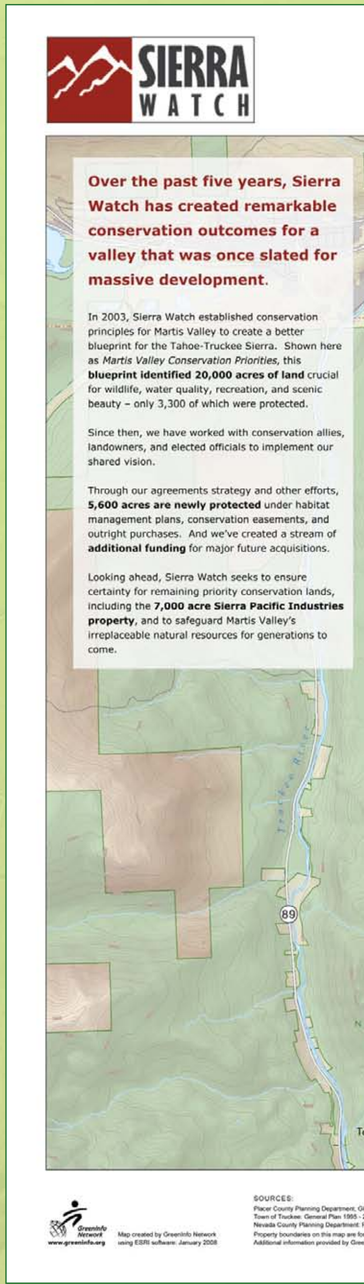
Sierra Watch, the nonprofit organization that played the leadership role in this effort, asked GreenInfo Network to develop the map to help define this complex victory so that individual and institutional funders and other key opinion leaders would realize what they had accomplished and be motivated to continue the effort to secure the last (huge) remaining parcel in the region (shown in orange). The map was created entirely in ArcGIS.

The campaign involved extensive use of GIS for conservation and other issue analyses, including defining the Priority Conservation Area (PCA) shown (an area with significant wildlife corridors and other natural resources). That PCA gave Sierra Watch a "bottom line" for the negotiations. However, because of the complexity of the final legal settlements and the process that got it there, Sierra Watch needed a single image that distilled its strategy, results, and future directions into one map product.

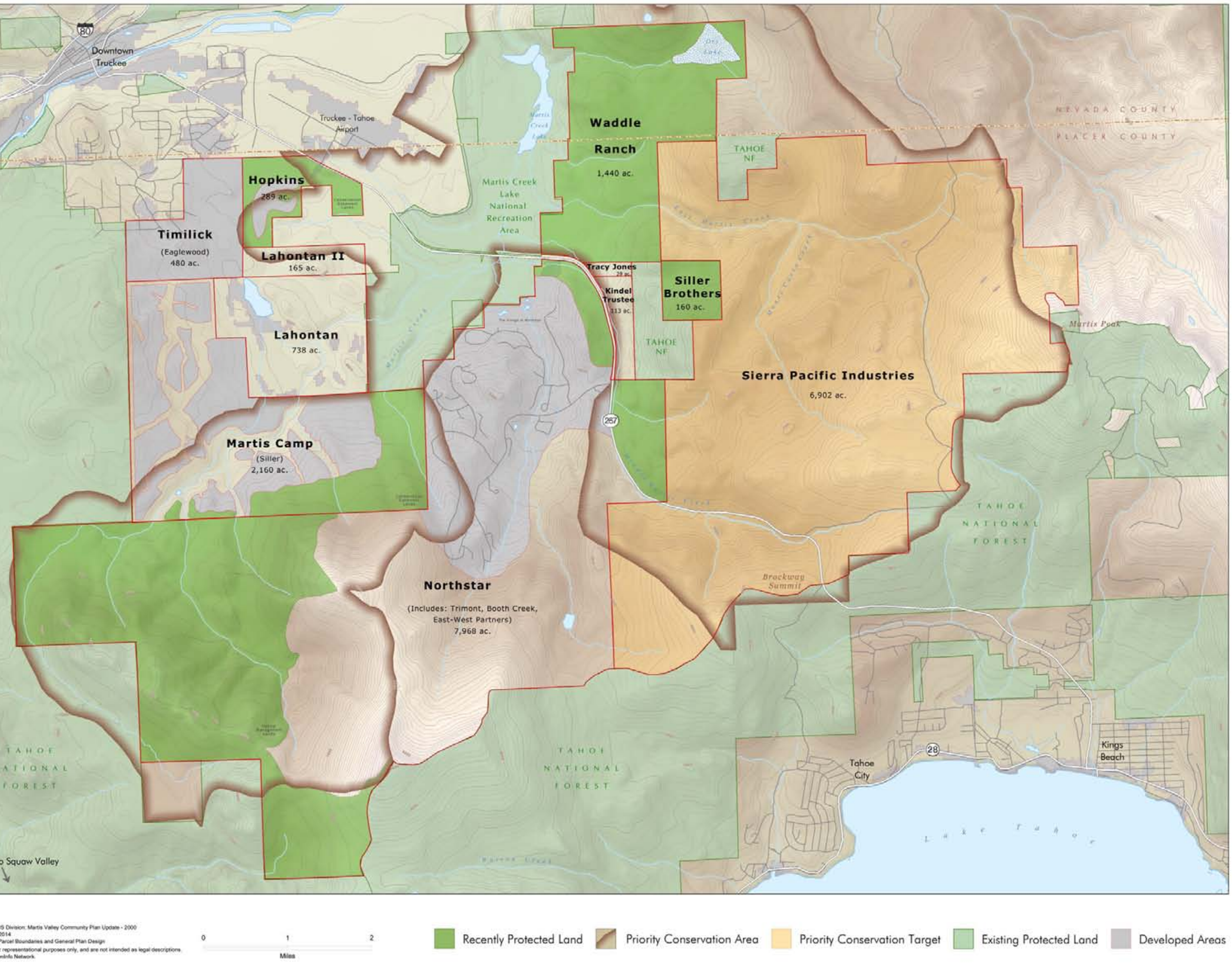
The process of creating the map and its actual use were of strategic value to Sierra Watch. It continues to be used now, two years after its creation. The process of creating the map started with distilling the short, high-level message that Sierra Watch needed to convey. This took the form of discussions and draft image concepts for the map itself and assessment of how best to frame the map with design elements. It was a crucial step mostly done in words, not with detailed map development.

From an initially more complex working map (more color themes, labels, and additional data), GreenInfo encouraged Sierra Watch to hone its visual, geographic message into two primary themes—land that had been saved and land that represented the next challenge. These themes had to be seen within the context of the area, including other protected lands, landscape, and the priority conservation zone.

The labeling hierarchy was carefully attended to as well. Labels were limited to key



What We've Accomplished
in Martis Valley



What We've Accomplished in Martis Valley (continued)

features, with some needing to be seen early from a distance while others intended to be seen only upon much closer examination.

The relief was kept subdued so it wouldn't distract from the primary themes but would be available to second looks. When the viewer moves in closer, contours emerge that help define the specific topography and also lend an elegant feel to the map cartography, making the viewer more emotionally confident in what it says.

Great care was taken to make the map colors unfold in a layer of meaning, where viewers see key information first, then gradually see other information as they view and move in closer to the map.

A key graphic technique in the map is the use of a feathered buffer around the conservation zone. After evaluating several options, GreenInfo chose an inside feather to invite the viewer's eye to focus on what is in the zone and use the sharper outside edge to "push away" the surrounding data when viewed closer up.

The printed versions are provided to donors and others who need or want to learn about the ongoing issues in the valley and future conservation opportunities. The map serves as a geographic reference for discussions.

It has also established a visual, geographic language for the organization. Since it was built out of GIS data and GIS software, layer control allowed GreenInfo to export the individual components of the map into images that can be shown individually or in animation format. A two-minute narrated movie was created by GreenInfo that includes map layers and other historical data to tell a time-series story of the campaign.

Traditional Second Place

Black Bear Bait-Station Surveys in Saskatchewan's East Boreal Plains

By Lori L. Arnold and Edward Kowal

Saskatchewan Ministry of Environment

Regina, Saskatchewan, Canada

Data Sources

Saskatchewan Ministry of Environment

The American black bear (*Ursus americanus*) is part of the heritage of Saskatchewan, Canada. This magnificent creature is timid and intelligent, and much of its behavior is governed by its search for food. This is a fortunate trait, because luring black bears to sardine-baited stations allows researchers to monitor population size.

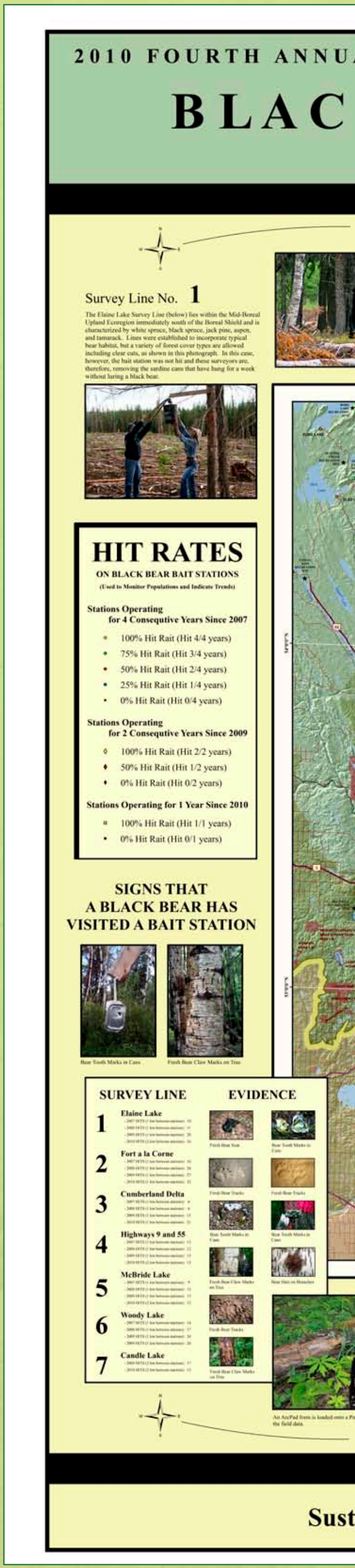
The thematic map *2010 Fourth Annual Black Bear Bait-Station Surveys, Saskatchewan's East Boreal Plains* was created for Saskatchewan Ministry of Environment's ongoing conservation project to sustainably manage American black bear populations.

To perform sustainable management of black bear populations, the Saskatchewan Ministry of Environment's Fish and Wildlife Branch conducts an annual survey. Specifically, the use of bait hit rates over consecutive years by black bears at a series of bait stations is used as an index for tracking changes in black bear population size over time.

A total of 16 lines are surveyed in the province, and 7 of these are located in Saskatchewan's east Boreal Plains. A line consists of 50 bait stations spaced 1 km apart. In 2009, survey techniques increased the spacing between stations up to 2 km, thereby reducing the probability of one bear visiting successive stations. Habitat along all survey lines is typical of bear habitat, which consists of various forest cover types including clear-cuts and burned areas.

GPS and GIS are used to navigate to stations, map routes, and collect data in the field. This mobile GIS includes a Panasonic Toughbook with integrated GPS and loaded with Esri® ArcPad® software. Data collection in the field that was originally achieved by entering data onto a hard-copy form has been replaced by digital collection using a stylus pen to enter data into an ArcPad form. This method eliminates the need to transfer data from paper to computer back in the office. Data is entered directly into a shapefile's attribute table, brought into an .mxd file, and used to update the annual *Black Bear Bait-Station Surveys* map.

The map includes access to complementary documentation, photos, and other relevant data. People can see information about the project's absolute and relative location, hit rates on bait stations, topography, habitat, and the protocol and methodologies of the study. This ability supports the goal of the map, which is to educate those unaware of the Saskatchewan Ministry of Environment's American black bear survey project and how it is progressing from year to year.




AL
K BEAR BAIT-STATION SURVEYS
SASKATCHEWAN'S EAST BOREAL PLAINS
Survey Line No. 1
Three sardine cans are hung (right) at the end of a board seven feet up a tree (to increase the chance that the bear will have to climb the tree and leave claw marks) at a bait station along the Elaine Lake Survey Line. The sardine cans are partially opened and some of the juice is spilled over foliage around the tree before they are hung to help lure a bear to the bait station, which is checked one week later. Three nails are used to hammer the board to the tree with the assumption that only a bear could pull it down.
Survey Line No. 2
This black bear was spotted along the Fort a la Corne Survey Line (left), which lies within the Boreal Transition Ecoregion and is dominated by jack pine in sandy soils. The route runs through the Fort a la Corne island forest, which is surrounded by agricultural land.
Survey Line No. 2
The Fort a la Corne Line (left) has received the highest number of black bear hits to date. This photograph shows a board that has been pulled down by a black bear in effort to get to the sardine cans that hung on the end, which were subsequently opened and the sardines, consumed. Here, the emptied cans are being picked up.
0 5 10 20 30 40
Miles
0 5 10 20 30 40 50 60
Kilometers
Canada
AREA OF DETAIL
1
THUNDER
ELAINE
LAKE
HILLS
ROAD
7
2
3
4
5
6
BOREAL SHIELD ECOZONE
BOREAL PLAINS ECOZONE
CUMBERLAND
DELTA
HIGHWAY NO. 123
THE
PASQUIA
HILLS
HIGHWAY NO. 55
HIGHWAY NO. 9
FORT a la CORNE
PROV. FOREST
DIVISION
ROAD
BOREAL PLAINS ECOZONE
PRAIRIE ECOZONE
MCBRIDE
LAKE
ROAD
WHITE BANCH ROAD
WOODY LAKE ROAD
THE
PORCUPINE
TENNANT LAKE ROAD
HILLS
Manitoba
Survey Line No. 3
The Cumberland Delta Line (above) runs through the flood plain of the Saskatchewan River along the old channel in the Mid-Boreal Lowlands Ecoregion, which consists largely of white spruce, balsam poplar, aspen, american elm, green ash, and manitoba maple. This photograph shows the ostrich ferns that are also abundant along the Cumberland Delta Line.
MAP KEY
Provincial Highway
Railway
Provincial Road
National Park
Paved
Provincial Park
Unpaved
Protected Area
Urban Municipality
Recreation Site
Indian Reserve
Hydrology
ECO-ZONE
ECOREGION
TAIGA SHIELD
Selwyn Lake Upland
Tazin Lake Upland
BOREAL SHIELD
Athabasca Plain
Churchill River Upland
BOREAL PLAINS
Boreal Transition
Mid-Boreal Lowlands
Mid-Boreal Uplands
Interlake Plain
PRAIRIE
Aspen Parkland
Moist Mixed Grassland
Mixed Grassland
Cypress Upland
Survey Line No. 4
The Highways 9 and 55 Line (right) runs along the northwest edge of the prominent upland area known as the Pasquia Hills, and spans two ecoregions within the Boreal Plains Ecozone: (1) The Boreal Transition Ecoregion, and (2) The Mid-Boreal Uplands Ecoregion. This photograph shows some of the more common vegetation along the route such as white spruce and trembling aspen (white poplar).
DATE: July 1, 2010
Survey Line No. 5
The McBride Lake Survey Line (left) also spans two ecoregions within the Boreal Plains Ecozone: (1) The Boreal Transition Ecoregion, and (2) The Mid-Boreal Uplands Ecoregion. This photograph of the Saginas Habitat Improvement Area shows some of the more common vegetation along the Line such as white spruce and trembling aspen.
AUTHOR: Lori L. Arnold
Survey Line No. 6
The Woody Lake Survey Line (above) runs through the Porcupine Forest within the Mid-Boreal Uplands Ecoregion. As seen here, trembling aspen (white poplar) occurs throughout the ecoregion. Other common species include white spruce, jack pine, black spruce, and tamarack.
Transverse Mercator Projection
Canadian Spatial Referencing System 1998 (CSRS98) Derivation of the North American Datum 1983 (NAD83)
ainable Management of the American Black Bear (Ursus americanus) Through Population Index Surveys

Zooming in on the Secret Life of Genetic Resources in Potatoes: High Technology Meets Old-Fashioned Footwork

By Henry Juárez, Franklin Plasencia, and Stef de Haan
International Potato Center
Lima, Peru

Data Sources
High-resolution IKONOS and QuickBird images combined with participatory mapping and in-depth consultation through interviews and focus group meetings

The International Potato Center in Peru—known by its Spanish acronym, CIP—is a research-for-development organization with a focus on potatoes, sweet potatoes, and Andean roots and tubers. Over the past 40 years, its mission has evolved from increasing crop productivity to the more complex challenge of hunger and poverty alleviation with sustainable development. CIP's research has expanded to include issues such as climate change, preserving biodiversity, food security, and improving livelihoods.

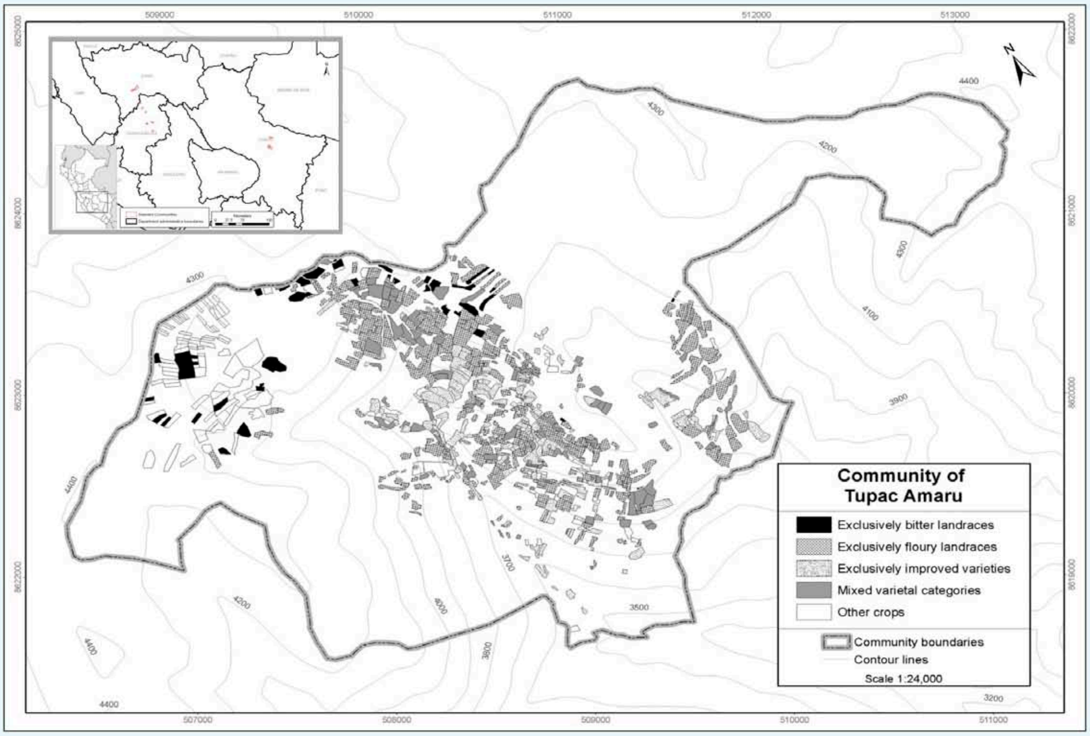
The Peruvian Andes region is one of the richest in potato biodiversity in the world. CIP has identified 3,800 native Andean varieties. The center is rising to the challenge of gathering information, which can be used to exploit and preserve this invaluable resource in the Peruvian Andes. It is employing high-resolution satellite images and participatory mapping to gather vital information about ancient agricultural methods in the Peruvian highlands.

The main research method involved participatory mapping combined with in-depth consultation through interviews and focus group meetings with members of 21 Andean highland communities in Cusco, Huancavelica, and Junin. Each family in the community was asked to identify its own plots of land on the map. Plots are assigned a numerical identifier. The family is then asked a series of in-depth questions including which varieties of potatoes it grows on each plot, when the planting was carried out, and which method of crop rotation was used.

Lino Mamani is a *papa arariwa* (Quechuan for "potato guardian") in the Sacaca farming community near Pisac in the Peruvian Andes. On their land, his and five neighboring communities have established a 12,000-hectare "potato park" where they cultivate and conserve Andean potato varieties. When researchers interviewed him, he described the situation:

> In the old days, the rain came at the right time, the land was very fertile, and the sun used to shine in the right amount. Now we see that the sun is hotter, the rains do not come at the right time, and we have hailstorms and freezing temperatures and droughts like we have never seen before. There is also an increase in insect pests and diseases. The potato varieties that our grandfathers grew down by the river are now moving higher up the mountain slopes. In this land, we have our *apu* [sacred mountains] around us, which help

n the secret life of genetic resources in
igh technology meets old-fashioned footwork

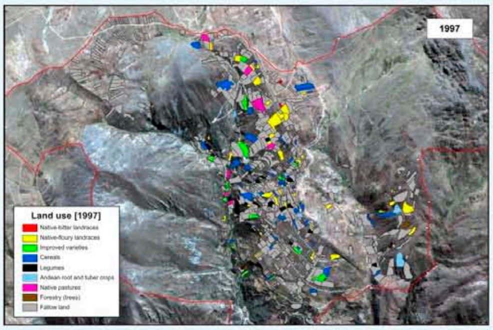


Most common native-floury landraces

Cultivar	(%)
Mactillo	23.7%
Muro huayro	14.9%
Peruanita	9.2%
Tumbay	7.9%
Papa carlos	6.4%
Puca bole	3.7%
Ttica bole	2.5%
Puca viruntus	2.2%
Puca qompis	1.8%
Sayllasiray	1.7%
Yana bole	1.6%
Pusi bole	1.2%
Alqa qompis	1.2%
Qompis	1.2%
Checche viruntus	1.0%
Thuqui huayna	1.0%
Yana socco	0.9%
Puca huayro	0.9%
Marquilla	0.8%
....	

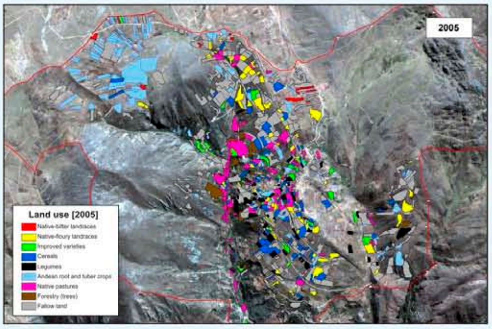
Most common native-bitter landraces

Cultivar	(%)
Yana kusi	41.1%
Yurac kusi	19.0%
Yurac waña	12.2%
Yurac ttalaco	8.1%
Azul waña	7.1%
Yurac qanchali	3.5%
Palta kusi	3.2%
Muru kusi	1.8%
Qanchali	1.2%
Yana palta kusi	1.1%
Yana ttalaco	0.5%
Yana qanchali	0.4%
Azul kusi	0.3%
Azul canchalli	0.2%
Yana waña	0.2%
kusi	0.1%
Waña	0.0%



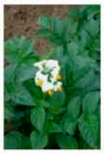
[up] exclusivity and non-exclusivity profile map for cultivar category content.

Land use tendencies between 1997 [left] and 2005 [right] showing the cropping area dedicated to improved varieties, native-floury landraces and native-bitter landraces.



Most common improved varieties

Cultivar	(%)
Yungay	25.6%
Colegiala	14.3%
Clon INIA	12.3%
Canchan	11.7%
Maria huanca	9.2%
Chasca	8.5%
Pallay poncho	7.1%
Cica	3.2%
Puca lliclla	2.5%
Cusqueña	2.2%
Revolucion	1.5%
Mi peru	0.7%
Unica	0.5%
Mariva	0.4%
Amarilis	0.2%
Perricholi	0.1%



Zooming in on the Secret Life of Genetic Resources in Potatoes: High Technology Meets Old-Fashioned Footwork (continued)

> our potatoes and the other crops and animals to grow. Once there was snow on those mountains; now they look sad, because the climate is getting warmer and there is no more snow. Other species and animals are suffering—the condor, foxes, deer, ducks, and fish that have always lived with us and are very dear to us. We know that *Pacha Mama* is not happy with all these changes, and we have to work together to make her happy again.

Land-use tendencies between 1997 and 2005 show that the total cropping area dedicated to improved cultivars has grown fast, while the area reserved for native floury and bitter landrace has remained more or less stable. Reduced fallow periods for existing fields and the gradual incorporation of high-altitude virgin pasturelands sustain growth. Although areas of improved cultivars are proportionally growing fastest at extremely high altitudes between 3,900 and 4,350 meters above sea level (masl), overall cropping intensity or fallowing rates are inversely related to altitude. No evidence of a straightforward replacement of one cultivar category by another was found.

This combination of high-technology tools and low-technology information gathering has also allowed the CIP team to chart the disintegration of communal cultivation methods over a 30-year period. Since Incan times, both family and communal plots have been widely dispersed to minimize risk. If one family's plots were scattered over a wide area, this lessened the possibility of entire harvests being devastated by natural disasters or disease. Similarly, whole communities would rotate their cultivation from year to year over a wide area, allowing land to lie fallow for up to five or nine years, thereby enhancing fertility and minimizing vulnerability to pests.

Data gathered during the initial five years of the project indicates that the practice of community rotation has been lost in many communities. Furthermore, both family and communal plots are generally widely dispersed to minimize risk. Field scattering over a wide area lessens the risk of an entire crop being devastated by biotic or abiotic stress in the high-risk mountain environment.

Accumulated information of this kind allows CIP scientists to develop an overview of patterns of cultivation and variation of varieties. It also allows the institute to draw conclusions about the effects of external phenomena, such as market forces, and climate change on traditional cultivation methods.

CIP, conscious of the importance of the interactive nature of its work, has ensured that the information it gathers goes back to the communities from where it originated. The information gathered by this ongoing project will be useful for both farmers on the ground planning their annual cultivation and scientists worldwide in studying the biodiversity and sustainability of this precious global resource.

Traditional Honorable Mention

Conservation Accomplishment & Opportunities

By Michael Scisco
New Mexico Land Conservancy
Santa Fe, New Mexico, USA

Data Sources

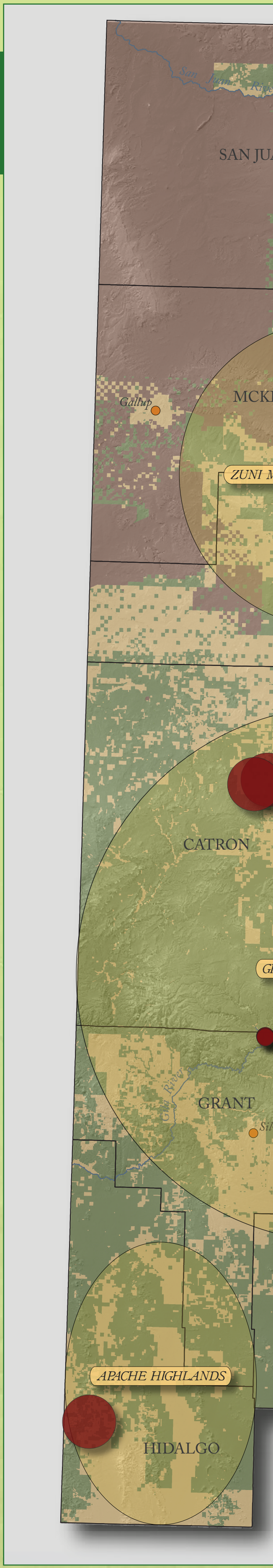
New Mexico Regional Geographic Information System, the New Mexico Land Conservancy

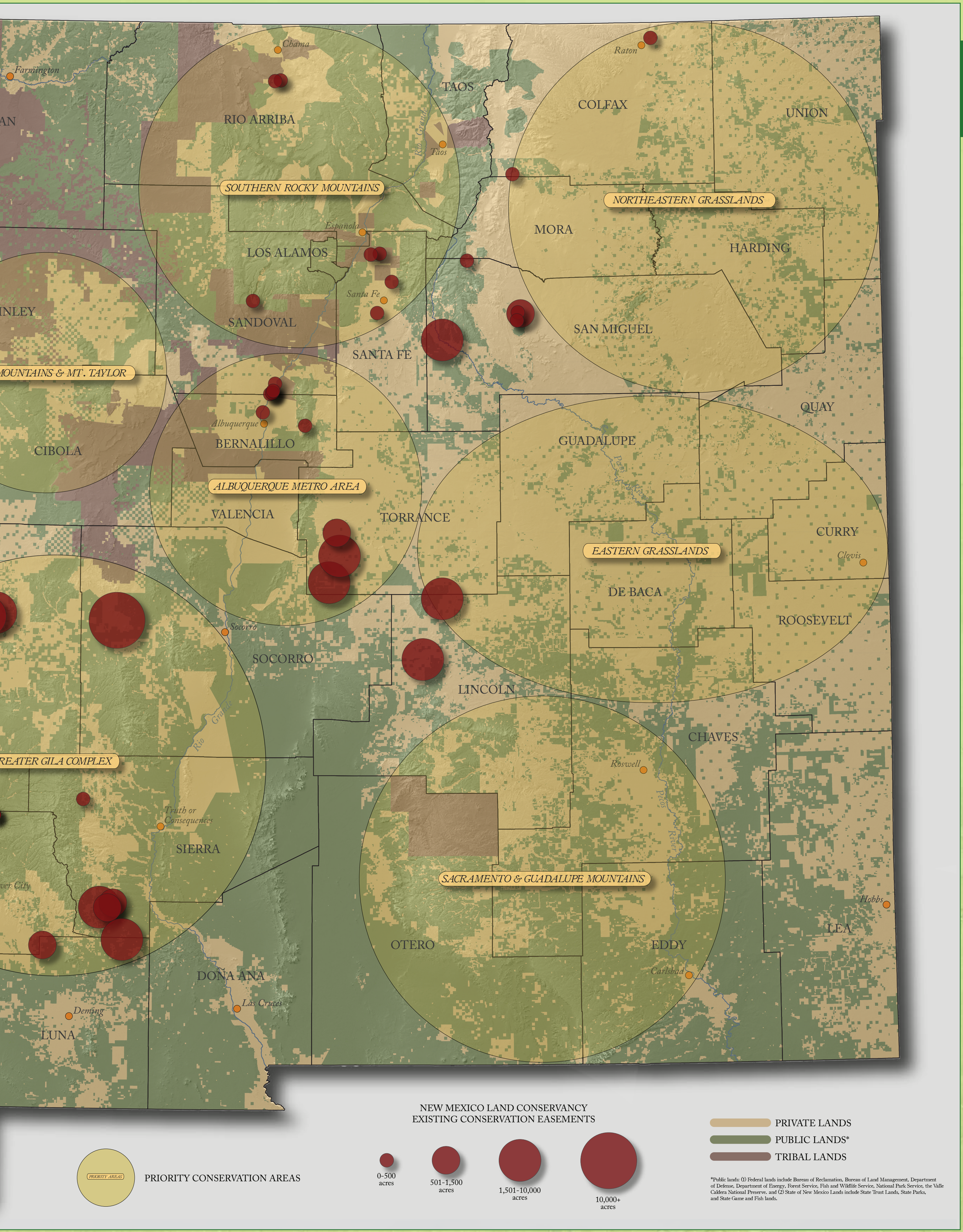
The *Conservation Accomplishment & Opportunities* map showcases accomplishments and continuing conservation opportunities of the New Mexico Land Conservancy (NMLC). It conveys that there are still many opportunities for large-scale land conservation within New Mexico. Specifically, it showcases the existing projects, involvement in legislation supporting land conservation, and specific financial outcomes of the transferable state tax credit for land or conservation easement donations.

Future opportunities for land conservation are shown by focusing on the large amount of private lands in the state and the delineation of focus areas where NMLC has chosen to work.

This map has been received well by the general public, landowners, and government agencies that are involved with land conservation across the state. The map has been showcased at conferences, workshops, fund-raising events, and other meetings with interested stakeholders.

Note that many cartographic techniques were used in the map production process including topographic relief generation; ordinal classification of landownership using GIS; graphic interval charts, timelines, and data tables; graduated symbols; image processing; abstract map symbols; and other miscellaneous symbology.




Chama
Farmington
AN
RIO ARRIBA
TAOS
Taos
Rio Grande
Raton
COLFAX
UNION
SOUTHERN ROCKY MOUNTAINS
NORTHEASTERN GRASSLANDS
Espanola
LOS ALAMOS
MORA
HARDING
INLEY
Santa Fe
SANDOVAL
SAN MIGUEL
SANTA FE
MOUNTAINS & MT. TAYLOR
QUAY
Albuquerque
BERNALILLO
CIBOLA
GUADALUPE
ALBUQUERQUE METRO AREA
VALENCIA
TORRANCE
CURRY
EASTERN GRASSLANDS
Clovis
DE BACA
ROOSEVELT
Socorro
SOCORRO
LINCOLN
CHAVES
Rio Grande
REATER GILA COMPLEX
Roswell
Truth or Consequences
SIERRA
SACRAMENTO & GUADALUPE MOUNTAINS
Hobbs
LEA
OTERO
EDDY
Carlsbad
DOÑA ANA
Las Cruces
Deming
LUNA
NEW MEXICO LAND CONSERVANCY
EXISTING CONSERVATION EASEMENTS
PRIVATE LANDS
PUBLIC LANDS*
TRIBAL LANDS
PRIORITY AREAS
PRIORITY CONSERVATION AREAS
0-500 acres
501-1,500 acres
1,501-10,000 acres
10,000+ acres
*Public lands: (1) Federal lands include Bureau of Reclamation, Bureau of Land Management, Department of Defense, Department of Energy, Forest Service, Fish and Wildlife Service, National Park Service, the Valle Caldera National Preserve. and (2) State of New Mexico Lands include State Trust Lands, State Parks, and State Game and Fish lands.

Migratory Birds within the Africa-Eurasia Region

By Andrew Cottam, Szabolcs Nagy, and Vicky Jones
United Nations Environment Programme, World Conservation Monitoring Centre (UNEP-WCMC) | Wetlands International | Birdlife International

Data Sources

Birdlife International World Birds database, Important Bird Areas database, Wetlands International, and International Water Bird Census database; UNEP-WCMC; World Database of Protected Areas; Ramsar Bureau; Wetlands of International Importance; Flickr image web services; Panoramio image web services; Esri ArcGIS Online

The Critical Site Network (CSN) tool is a web mapping application that supports the conservation of migratory birds in the Africa-Eurasia region. It brings together databases from many organizations to provide information on the most important sites for migratory bird species.

The main objectives of the site are to

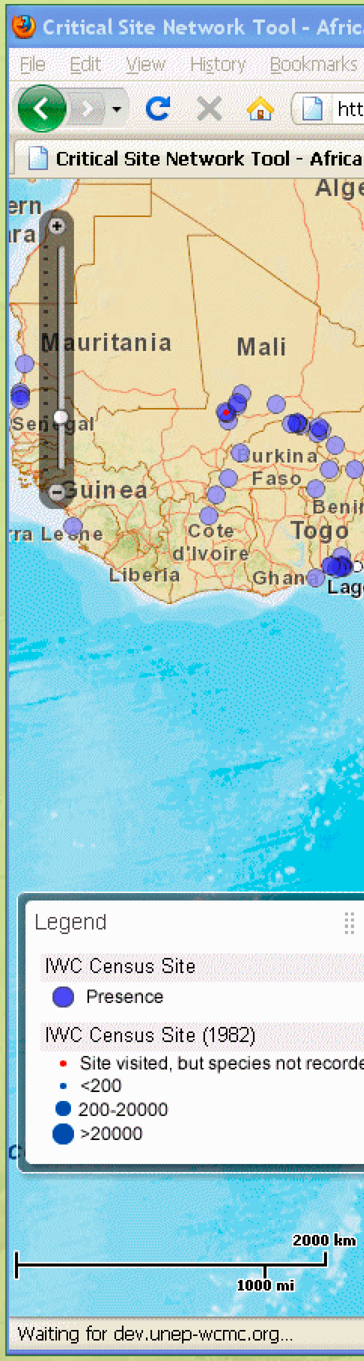
- Highlight the most important sites for a species flyway.
- Understand which sites are important at which times of the year.
- Identify which sites are protected and which ones need protection.
- Investigate how these factors are affected by external threats, land uses, etc.

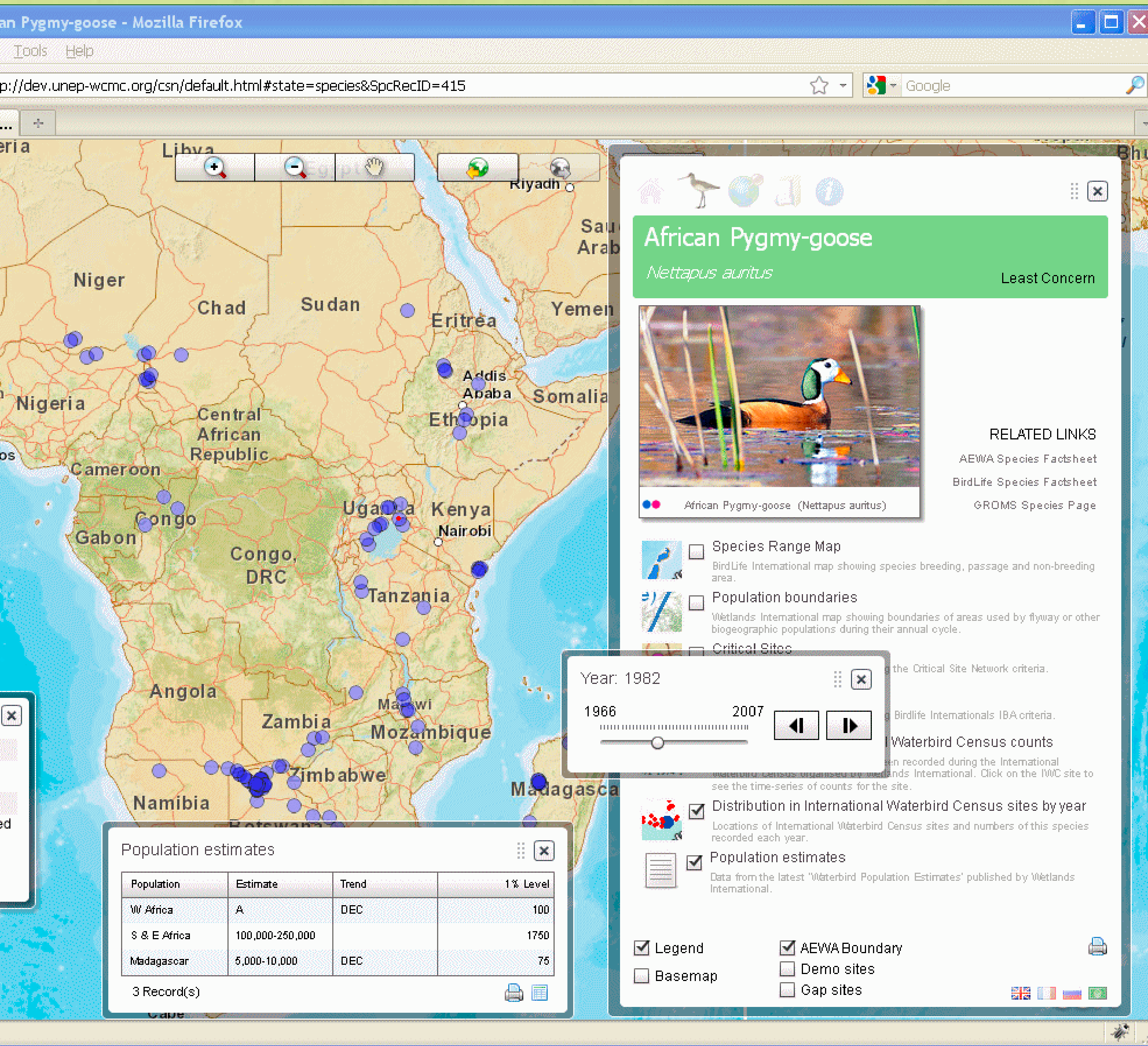
The CSN tool will be used in much of the Africa-Eurasia region, and this means that it must be accessible by users within those countries, so the site supports English, French, Russian, and Arabic. To make the site as engaging as possible, a number of external web services have been used in the CSN tool. For bird species, Flickr image web services have been used, and for sites, Panoramio image web services have been used.

The tool also includes many user interface (UI) features to make the site intuitive including Windows-style dialog boxes that can be dragged and dropped, a reporting tool that uses a set of filters that always produces matching results, synchronization between tabular data and the map display, and color coding used throughout to show species status.

The CSN tool uses information from large global databases, including the World Database on Protected Areas, and one of the key considerations has been performance. To enable a responsive UI, the tool was developed using a rich Internet application tool (Adobe Flash Builder), and all the web services have been optimized to be as efficient and fast as possible.

Wherever possible, symbology is changed on the client so that users can change how the map looks instantaneously without having to refetch all the data.



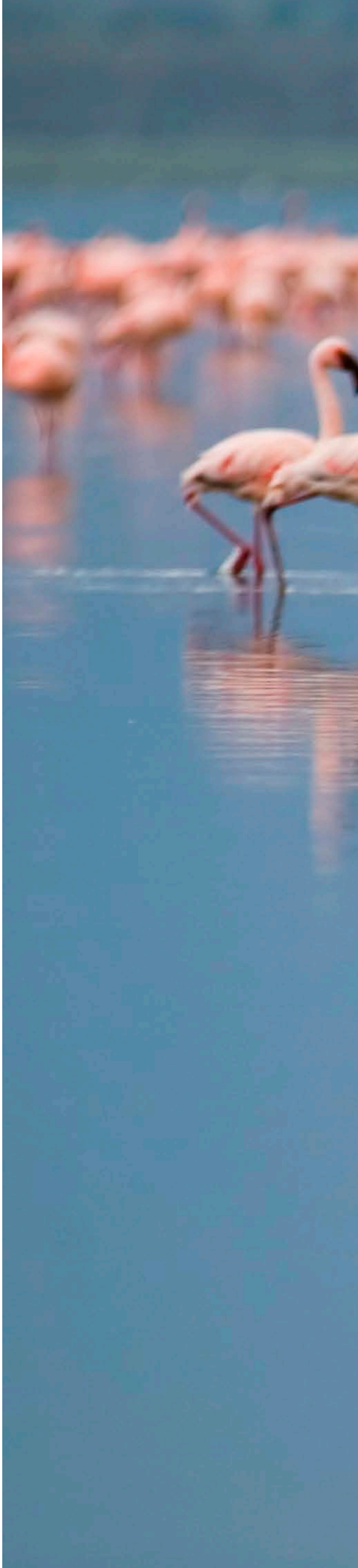


an Pygmy-goose - Mozilla Firefox
Tools Help
p://dev.unep-wcmc.org/csn/default.html#state=species&SpcRecID=415
Google
Libya
Riyadh
Niger
Chad
Sudan
Eritrea
Yemen
Nigeria
Addis Ababa
Somalia
Central African Republic
Ethiopia
Cameroon
Uganda
Kenya
Gabon
Congo
Nairobi
Congo, DRC
Tanzania
Angola
Malawi
Zambia
Mozambique
Zimbabwe
Namibia
Madagascar
African Pygmy-goose
Nettapus auritus
Least Concern
African Pygmy-goose (Nettapus auritus)
RELATED LINKS
AEWA Species Factsheet
BirdLife Species Factsheet
GROMS Species Page
Species Range Map
BirdLife International map showing species breeding, passage and non-breeding area.
Population boundaries
Wetlands International map showing boundaries of areas used by flyway or other biogeographic populations during their annual cycle.
Critical Sites
Year: 1982
1966
2007
Waterbird Census counts
Distribution in International Waterbird Census sites by year
Locations of International Waterbird Census sites and numbers of this species recorded each year.
Population estimates
Data from the latest 'Waterbird Population Estimates' published by Wetlands International.
Legend
AEWA Boundary
Basemap
Demo sites
Gap sites
Population estimates
Population
Estimate
Trend
1% Level
W Africa
A
DEC
100
S & E Africa
100,000-250,000
1750
Madagascar
5,000-10,000
DEC
75
3 Record(s)

Migratory Birds within the Africa-Eurasia Region (continued)

Another key consideration in the development of the CSN tool was its sustainability. The tool was designed so that future updates to the databases or the application could be made as easily as possible, keeping the information timely. All the data is held in a fully relational ArcSDE® database, which uses spatial views to make updating simple.

The reporting features of the site support not just interactive web mapping but also a number of other formats. All the tabular outputs are available as physical reports on demand (in Adobe Acrobat format) and there are also physical reports for maps and time-series charts. The site can also be used to report on data through time to support the temporal analysis of species counts. Where additional custom reporting is required, users can copy any tabular data to the clipboard to do their own analyses.



Web

The Canadian Wetland Inventory Progress Map

By Brian Kamerik, Andrew Pratt, Bill Tedford, and Gord Mathews
Ducks Unlimited Canada
Stonewall, Manitoba, Canada

Data Sources

Esri ArcGIS Online basemap street and imagery services, Canadian Wetland Inventory partner inventory polygons, detailed wetland polygons from Ducks Unlimited Canada

It is estimated that Canada has approximately 25 percent of the world's remaining wetlands. Despite their value, up to 70 percent of wetlands have been lost or degraded in Canada as a result of urbanization, agriculture, and industrial expansion. Currently, Canada lacks a comprehensive inventory of wetlands to be used in decision making and as a baseline for future monitoring of wetland status and trends, but advances are well under way.

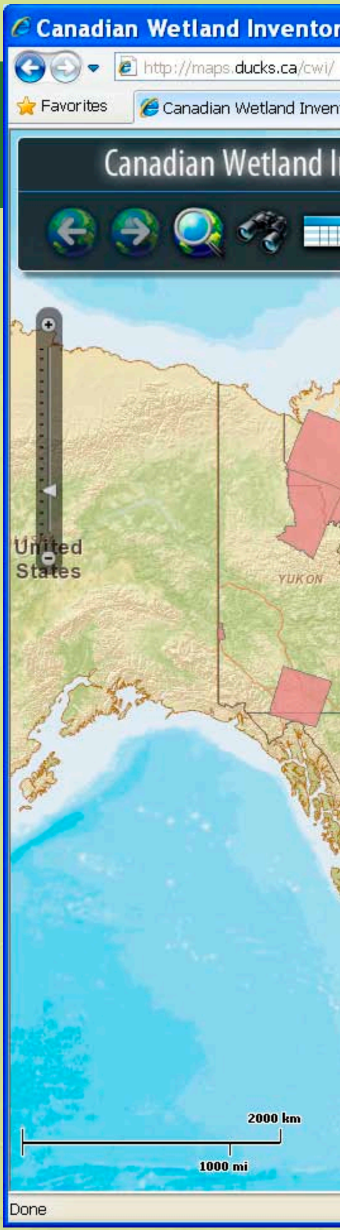
In 2002, the Canadian Wetland Inventory (CWI) partnership was established between Environment Canada, Canadian Space Agency, Ducks Unlimited Canada, and the North American Wetlands Conservation Council (Canada). Since that time, CWI partners, including several provinces and academic institutions, have developed standards for detecting, classifying, and mapping wetlands by the different wetland types across Canada.

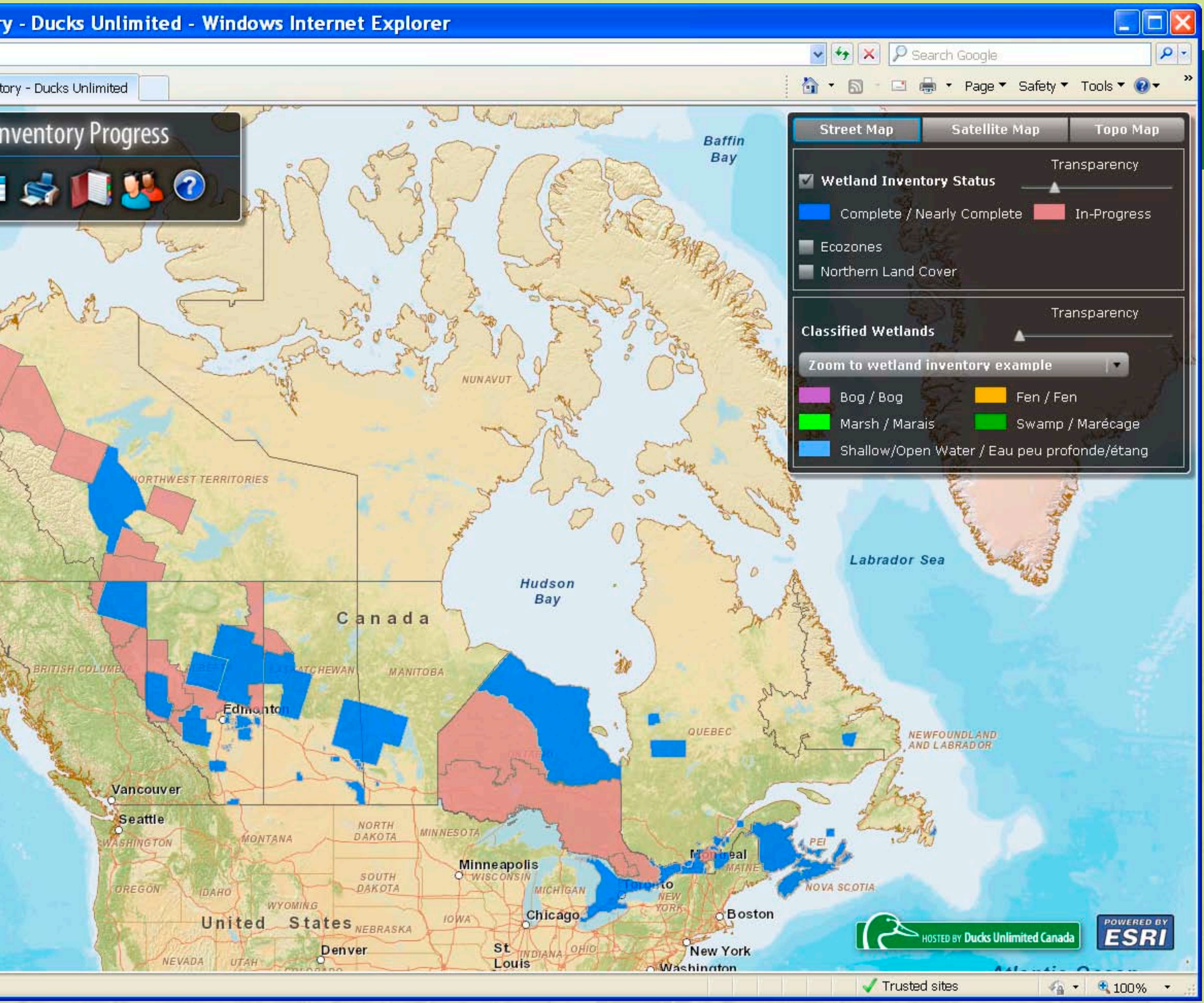
To better visualize and understand this data, Ducks Unlimited Canada, the North American Wetlands Council (Canada), and partners developed *The Canadian Wetland Inventory Progress Map*. It displays CWI-compatible wetland inventory areas that are completed or in progress across Canada. The GIS map permits the visualization of detailed wetland polygons and attribute information for certain areas where wetland inventory data has been made available.

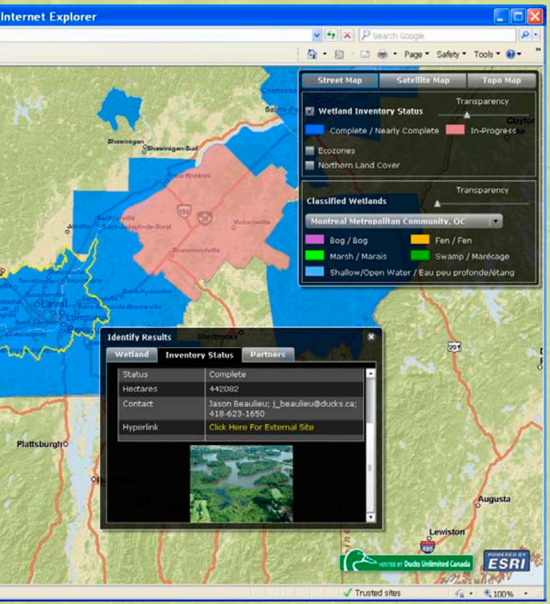
A significant portion of Canada has been or is in the process of being mapped. The GIS application provides partners, communities of interest, and the public with access to an interactive progress map that shows the location, status, and other important information about CWI-compatible inventories across Canada.

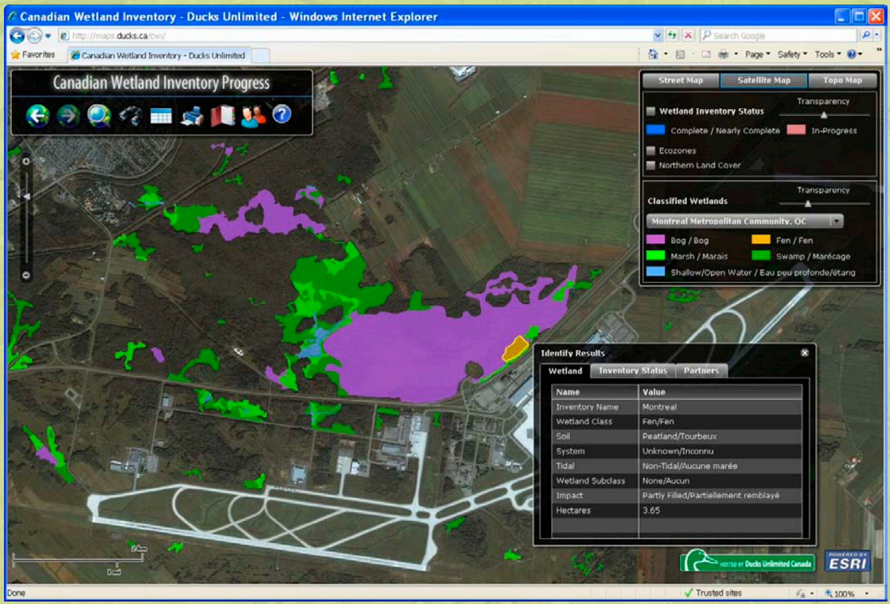
By clicking an inventory polygon, the user can find the agency responsible for the inventory along with the year, status, size, contact information, and partners involved. This map application also permits the visualization of detailed wetland polygons and attribute information for certain areas where wetland inventory data has been made available.

The objectives of CWI are to provide a national wetland map that can be used for the conservation and sustainable management of wetlands for environmental and societal benefits and to provide easy access to standardized digital wetland mapping products.




ry - Ducks Unlimited - Windows Internet Explorer
Search Google
tory - Ducks Unlimited
Page
Safety
Tools
nventory Progress
Street Map
Satellite Map
Topo Map
Transparency
Wetland Inventory Status
Complete / Nearly Complete
In-Progress
Ecozones
Northern Land Cover
Transparency
Classified Wetlands
Zoom to wetland inventory example
Bog / Bog
Fen / Fen
Marsh / Marais
Swamp / Marécage
Shallow/Open Water / Eau peu profonde/étang
Baffin Bay
NUNAVUT
NORTHWEST TERRITORIES
Labrador Sea
Hudson Bay
Canada
BRITISH COLUMBIA
MANITOBA
Edmonton
QUEBEC
NEWFOUNDLAND AND LABRADOR
Vancouver
Seattle
WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
PEI
Montreal
MAINE
Minneapolis
WISCONSIN
NOVA SCOTIA
OREGON
IDAHO
SOUTH DAKOTA
MICHIGAN
Toronto
NEW YORK
WYOMING
Chicago
Boston
United States
NEBRASKA
IOWA
Denver
St Louis
INDIANA
OHIO
New York
NEVADA
UTAH
Washington
HOSTED BY Ducks Unlimited Canada
POWERED BY ESRI
Trusted sites
100%


Internet Explorer
Street Map
Satellite Map
Topo Map
Wetland Inventory Status
Complete / Nearly Complete
In-Progress
Ecozones
Northern Land Cover
Classified Wetlands
Montreal Metropolitan Community, QC
Bog / Bog
Fen / Fen
Marsh / Marais
Swamp / Marécage
Shallow/Open Water / Eau peu profonde/étang
Identify Results
Wetland
Inventory Status
Partners
Status
Complete
Hectares
442082
Contact
Hyperlink
Click Here For External Site
Plattsburgh
Augusta
Lewiston
ESRI
Trusted sites
100%


Canadian Wetland Inventory - Ducks Unlimited - Windows Internet Explorer
Canadian Wetland Inventory Progress
Street Map
Satellite Map
Topo Map
Wetland Inventory Status
Complete / Nearly Complete
In-Progress
Ecozones
Northern Land Cover
Classified Wetlands
Montreal Metropolitan Community, QC
Bog / Bog
Fen / Fen
Marsh / Marais
Swamp / Marécage
Shallow/Open Water / Eau peu profonde/étang
Identify Results
Wetland
Inventory Status
Partners
Name
Value
Inventory Name
Montreal
Wetland Class
Fen/Fen
Soil
Peatland/Tourbeux
System
Unknown/Inconnu
Tidal
Non-Tidal/Aucune marée
Wetland Subclass
None/Aucun
Impact
Partly Filled/Partiellement remblayé
Hectares
3.65
ESRI
Trusted sites
100%

The Canadian Wetland Inventory Progress Map (continued)

The CWI progress map will make existing wetland information more accessible and useful for planning and decision making. It will give partners and the public a map-driven overview of wetland inventories in Canada by ecozone. This will help answer basic questions crucial to wetland management such as where the remaining wetlands are, how much area they cover, what type of wetlands they are, and whether they are threatened.

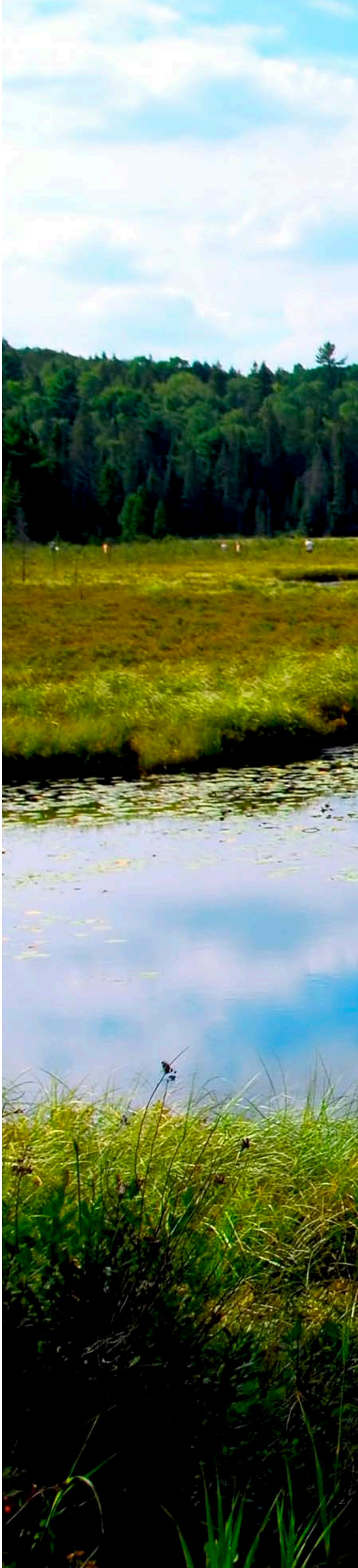
The CWI map will be an invaluable tool to help

- Support environmental assessment and sustainable development planning.
- Model wetland carbon storage and climate change and perform carbon budgeting.
- Develop policy based on science for all levels of government.
- Manage wetlands to sustain their functions and values.
- Measure performance toward sustainability objectives and assess the effectiveness of conservation programs.
- Focus conservation, restoration, and scientific research programs.
- Provide a foundation for national wetland monitoring.

The CWI progress map will identify gaps in wetland information and help focus resources and support to those areas of Canada where wetland mapping is inadequate. The application will also recognize the efforts of various partners that have contributed to mapping this critical resource.

The intended audience was diverse, including research scientists, conservation partners, land developers, resource managers, private landowners, government agencies at all levels, environmental groups, and the general public. The application was designed with ArcGIS API for Flex so that it would run on almost any computer, including those inside government networks. Simplicity and ease of use were kept foremost in mind. This is a focused application that performs efficiently and is intuitive to a wide range of computer users. The number of tools was kept to a minimum, and the identify functionality works without having to invoke an explicit tool. This was intentional so that non-GIS users would find the application intuitive and comparable to other popular web-based mapping applications. Using transparency on key layers is extremely helpful for viewing imagery underneath wetland polygons. The Inventory Search and Generate Report tools access summary information at the provincial level for viewing or printing. The Partner tool is a great way to recognize the support of various governments, private agencies, and companies with logos and links to their sites.

Experience the interactive CWI progress map at www.ducks.ca/cwi.



Conservation of America's Natural Places

By Lori Scott
NatureServe
Arlington, Virginia, USA

Data Sources

Data contributed from numerous partners—
www.landscope.org/about/guidelines/#Sources

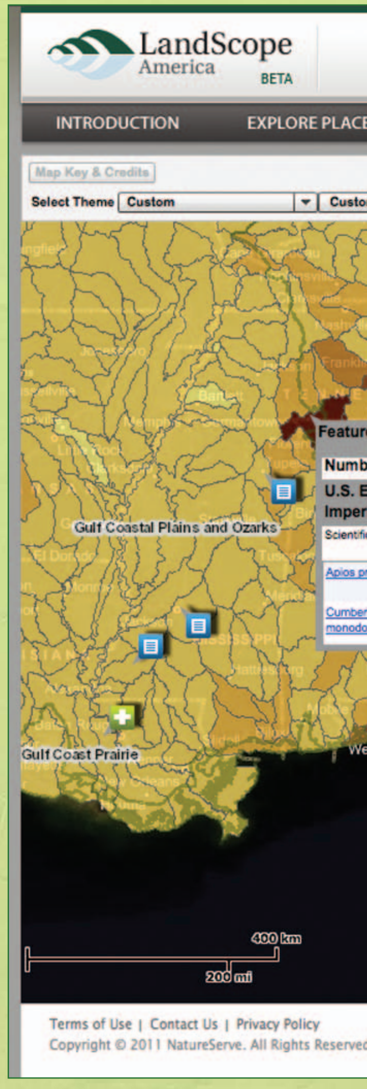
LandScope America, a partnership between NatureServe and the National Geographic Society, launched a dynamic map viewer that contains more than 150 layers from national to local scales organized into five themes (conservation priorities, protected areas, threats, ecosystems, and plants and animals).

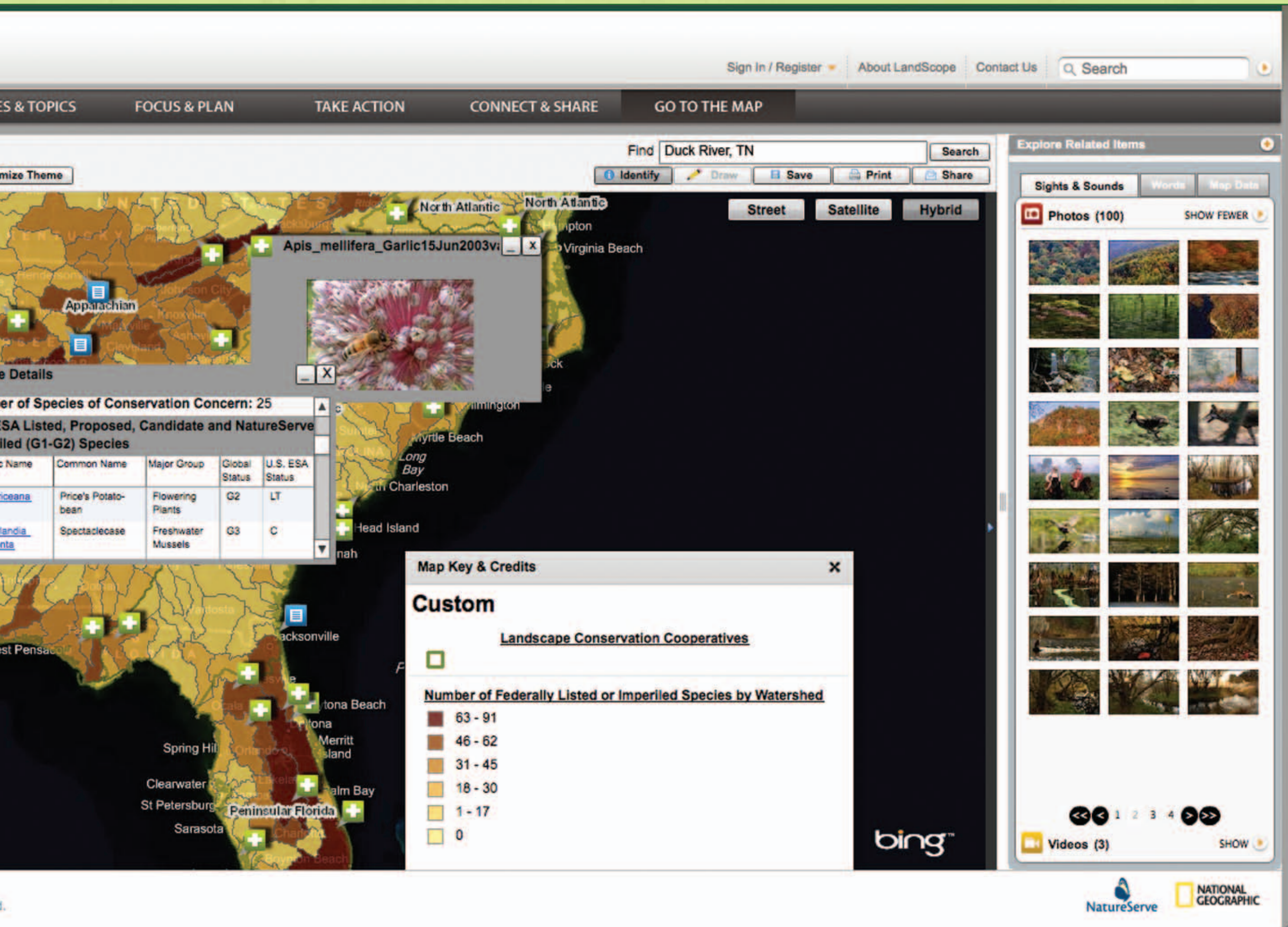
Users can explore their area of interest, and decision makers can quickly assess the conservation values, opportunities, and threats of a particular location. This information-rich resource decreases the cost of conservation research and planning and facilitates coordinated action by different groups of users organized around the places that matter to them.

A partnership network provided an incredible amount of authoritative content, including informational map data, inspirational multimedia, and educational articles. We engaged a leading web interaction design firm, NavigationArts, to build a LandScope America user experience that is, above all else, place based. We combined NatureServe's expertise in conservation with National Geographic's award-winning cartography and photography to deliver a first-of-its-kind platform for conservation action.

LandScope America established a partnership with the Land Trust Alliance (LTA), representing the vast majority of the nation's more than 1,700 US land trusts and helping them identify the most important conservation priorities in their service areas would directly contribute to our mission of advancing the pace and effectiveness of land protection. We worked with LTA to conduct an in-depth survey of their land trust members' needs and included features in our map viewer designed to help small to midsize land trusts that typically lack sophisticated GIS tools or dedicated staff. We also worked with LTA to conduct extensive outreach with its members and position LandScope as a tool to support LTA's existing strategic conservation curriculum.

We worked with Blue Raster LLC, 2010 Esri Worldwide Partner of the Year, to develop the Flex-based map viewer and multimedia content viewer components of LandScope America. Blue Raster brought a wealth of experience developing world-class map viewers using the ArcGIS API for Flex platform to the LandScope team. With guidance from Blue Raster, we organized the hundreds of conservation-focused map layers into five themes, each with a default national view consisting of one or more fused layers with a fast-performing map cache. We also provide users with the ability to customize their maps by selecting from among any of the available map layers to view at one time.




Sign In / Register
About LandScope
Contact Us
Search
ES & TOPICS
FOCUS & PLAN
TAKE ACTION
CONNECT & SHARE
GO TO THE MAP
Find
Duck River, TN
Search
Identify
Draw
Save
Print
Share
Street
Satellite
Hybrid
Apis_mellifera_Garlic15Jun2003v
North Atlantic
Virginia Beach
Appalachian
e Details
er of Species of Conservation Concern: 25
ESA Listed, Proposed, Candidate and NatureServe
lled (G1-G2) Species
Common Name
Major Group
Global Status
U.S. ESA Status
Price's Potato-bean
Flowering Plants
G2
LT
Spectaclecase
Freshwater Mussels
G3
C
Myrtle Beach
Long Bay
Charleston
Head Island
Map Key & Credits
Custom
Landscape Conservation Cooperatives
Number of Federally Listed or Imperiled Species by Watershed
63 - 91
46 - 62
31 - 45
18 - 30
1 - 17
0
Jacksonville
Daytona Beach
Merritt Island
Spring Hill
Clearwater
St Petersburg
Peninsular Florida
Palm Bay
Sarasota
bing
Explore Related Items
Sights & Sounds
Words
Map Data
Photos (100)
SHOW FEWER
1 2 3 4
Videos (3)
SHOW
NatureServe
NATIONAL GEOGRAPHIC

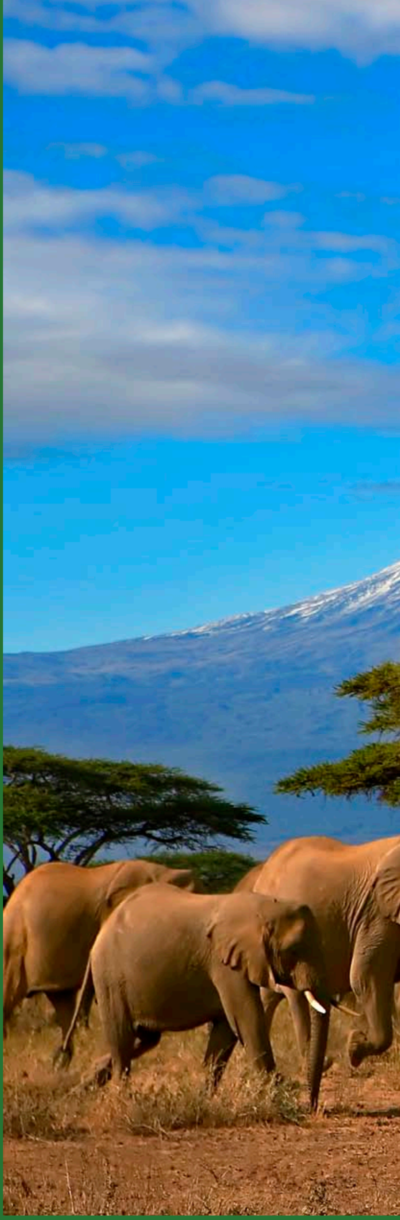
Conservation of America's Natural Places (continued)

To make the customized map functionality intuitive, we designed the map services with scale dependency, and we filter the list of available map layers depending on the scale and extent of the user's map window. For example, when a user is viewing the entire US, the list of available map layers includes just those that have a national and regional extent. When a user is zoomed in on the state of Virginia, the list expands to include the additional layers visible at that scale and within that state. The map key and credits (legend) are also dynamically generated.

A number of simple, user-friendly tools are included in the LandScope map viewer. An example use case that we wanted to support is a land trust user who would navigate to a potential project site, turn on layers representing conservation priorities and existing protected areas, use the simple drawing tools to annotate the map with their project boundary and associated label, then save the map to share the dynamic link via e-mail with colleagues or print/export the map to include in a report.

LandScope America compiles a large volume of high-quality content about conservation planning and natural ecosystems in one user-friendly website, including more than 3,200 distinct web pages; 3,000 images and videos; 300 georeferenced stories, case studies, and reports; and 150 map layers. More than 140 national, regional, and state partners recognize LandScope as the premier publishing platform for reaching the land protection audience, and we have established new relationships and data-sharing agreements each year since the website's launch. User testimonials praise LandScope as the best source for place-based conservation priorities, a go-to resource for visualizing the value of our nation's open space, and a powerful tool for inspiring the public to take action.

Behind the scenes, LandScope's user experience is driven by a sophisticated architecture that marries a customized content management system with the map viewer. All the website's content objects have rich metadata including location-specific tags, which support intuitive discovery of the stories, photos, and other place-based content in the proper context and drive location-aware tools like finding land trusts or navigating to the landing page for a LandScope state subsite. The rich content metadata ensures that the user's path through the website never reaches a dead end but instead presents numerous context-sensitive opportunities to learn, research, explore, and act. Custom widgets built on the Flex framework can be added to every web page, resulting in a nearly unlimited number of presentation combinations that draw the user's attention to explore related multimedia and map content items.

Esri
380 New York Street
Redlands, CA 92373-8100, USA
esri.com

G48008
126316 5C 6/11ed

Printed in the USA