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Achieving Balance between Humans and Nature

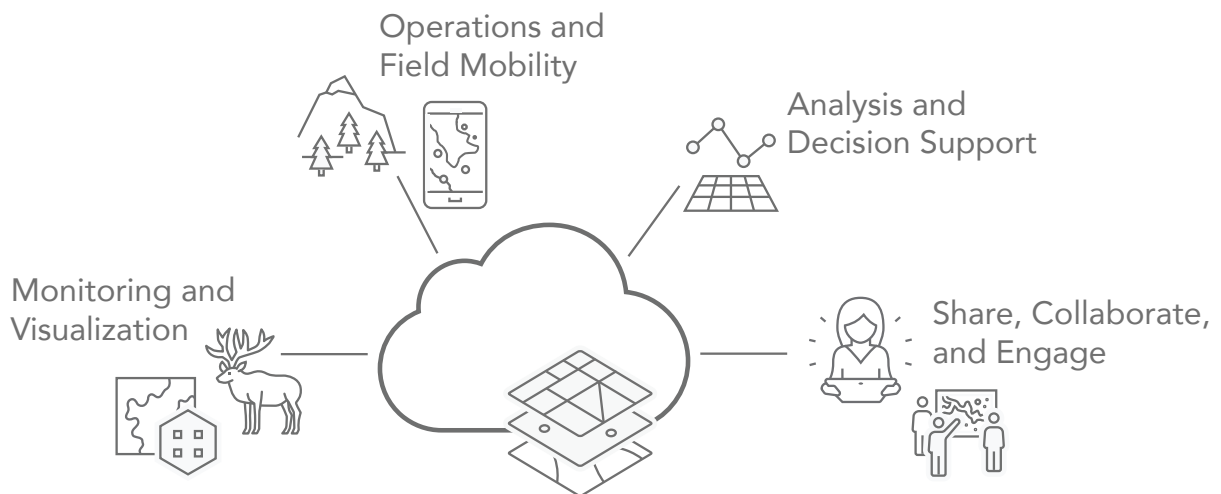
Environmental and natural resources agencies were some of the early adopters of Esri's world-leading geographic information system (GIS) technology, using it as a means to preserve and protect the earth through automated mapping and analysis. Because populations and habitats continue to grow and change, agencies are now increasingly turning to GIS to help ensure a healthy balance between humans and nature.

Esri's ArcGIS® solutions provide the software, training, and guidance you need when working to restore, protect, and preserve natural resources and the environment.

ArcGIS enables environmental and natural resources agencies to

- Monitor and visualize valuable resources in real time.
- Improve operational efficiency.
- Deliver analysis and science-based support for critical decision-making.
- Facilitate sharing, collaboration, and engagement with stakeholders and the public.

Geospatial Framework for Environment and Natural Resources



Monitoring and Visualization

- Real-time tracking
- Responding to changing needs
- Common operating picture

Operations and Field Mobility

- Gain efficiency
- Decrease response time
- Adapt easily

Analysis and Decision Support

- Advanced analytics
- Central business systems
- Agility
- Science-based support

Share, Collaborate, and Engage

- Increase engagement
- Nurture citizen scientists
- Easily illustrate return on investment (ROI)

Visualize Your Assets to Better Monitor Performance

You need to be able to take the pulse of your assets at any given moment, whether they are in the forests, farms, parks, or protected regions you manage. With Esri® GIS you get an up-to-the-minute comprehensive view of what is happening in any of your diverse environments.

- Keep an eye on performance in real time with operations dashboards.
- Manage program success and respond to changing needs.
- Gain a complete view of your operations for enhanced decision-making.

“With our real-time monitoring, we might be able to tell [air traffic controllers] on the hour when to watch out. ‘There’s a thousand pelicans coming past the airport. Be on the alert.’”

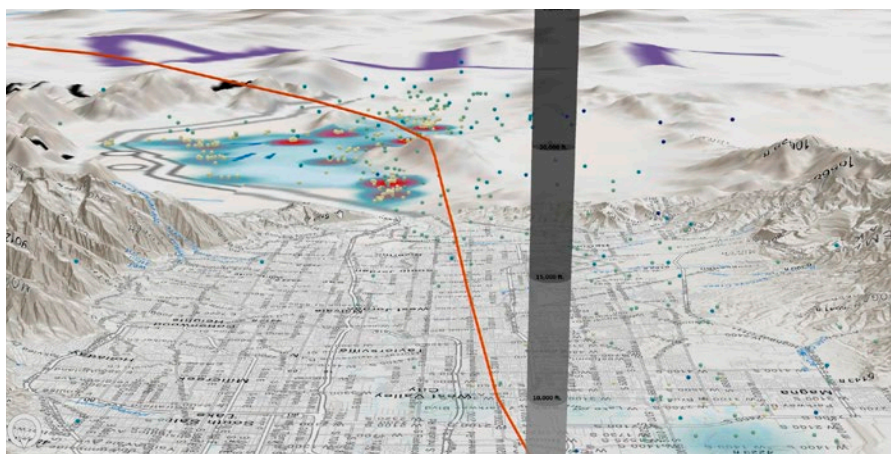
– Mike Styler, Executive Director at Utah DNR

Monitoring Pelican Migrations to Avoid Human Conflict

Utah’s Gunnison Island sits in the northwest corner of the Great Salt Lake and is home to nearly 20,000 American white pelicans. Right next to the lake is Salt Lake City International Airport. Planes have crossed paths with airborne pelicans in this conflict area with deadly results.

In an attempt to solve the bird strike problem, once a year, wildlife biologists with the Utah Division of Wildlife Resources (DWR) tag pelicans to study their migration patterns. Using ArcGIS, pelican movements are tracked and analyzed to better understand migratory patterns, survival rates, and human and wildlife interactions and to potentially reduce aircraft bird strikes. Together, Utah Department of Natural Resources (DNR) and DWR have built PeliTrack, a custom web-based map that dynamically updates pelican waypoint locations for analysis.

The Utah airport now has empirical data that can be used to adjust takeoff and landing routes at key times, reducing the risk of dangerous pelican strikes.



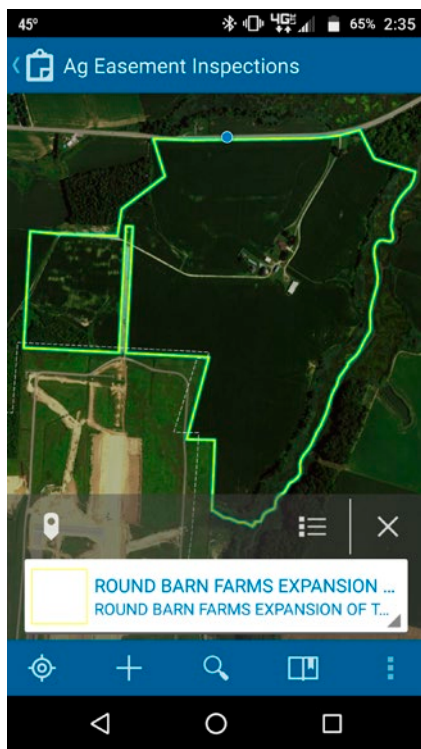
Utah DNR uses ArcGIS to display and analyze pelican migration patterns in 3D to help reduce the risk of pelican strikes with aircraft.



Take the Power of Location to the Field

Your work is focused on areas beyond the office walls; it is focused in the parks, in the lakes, in the forests, in the field. You need technology that works when and where you need it, seamlessly connecting the field with your workplace. With GIS, you can now perform your work, whether it be asset inventory, inspections, field notes, or work orders, from any location and on any device.

- Improve coordination and operation efficiency by enabling access to the same authoritative data from any location.
- Increase response time in critical situations by no longer having to wait for manual workflows.
- Easily adapt to changing needs; getting instant updates allows for course correction.



Using ArcGIS, the DDA is able to view easement boundaries and easily capture inspection data on a mobile device.

Automating Inspection Reports

The Delaware Department of Agriculture (DDA) went from a paper-based, manual process for assessing agricultural easements to a mobile GIS data collection workflow, reducing the work hours required by 75 percent and saving the department thousands of dollars.

Previously, the DDA inspectors' process took hundreds of hours each year. Managing the data and photos manually, as well as creating individual reports for each property, was tedious. Inspectors couldn't complete their reports until months after the inspections took place, generating a severe time lag.

With the mobile GIS solution, the inspectors can now easily capture all inspection data and photos using a single device. Having easement boundaries on a mobile map with real-time location details helps them get oriented quickly in the field. The ArcGIS offline capabilities make rural inspections much easier since the inspectors don't have to search for mobile service to upload their data.

The DDA now saves nearly 500 hours annually on completing inspections—75 percent of the time it used to take. With its more efficient GIS-enabled workflow in place, the department saved \$22,710 in the first year, and it is slated to save more than \$25,000 in each ensuing year.

Support Your Decisions with Science-Based Analysis

Analysts and scientists have long used computerized modeling to analyze and predict the impacts of both naturally occurring and man-made activities on our natural resources, such as human encroachment on species and vegetation, hurricanes and other detrimental weather phenomena, and real estate development. Today GIS tools allow you to take a simple approach to advanced analysis and visualization.

- Seamlessly integrate location data with your central business systems to reveal new insights.
- Support your decisions regarding critical habitats with science-based analysis.
- Transform complex datasets into manageable information through exploratory analysis to quickly uncover patterns, trends, correlations, and relationships.



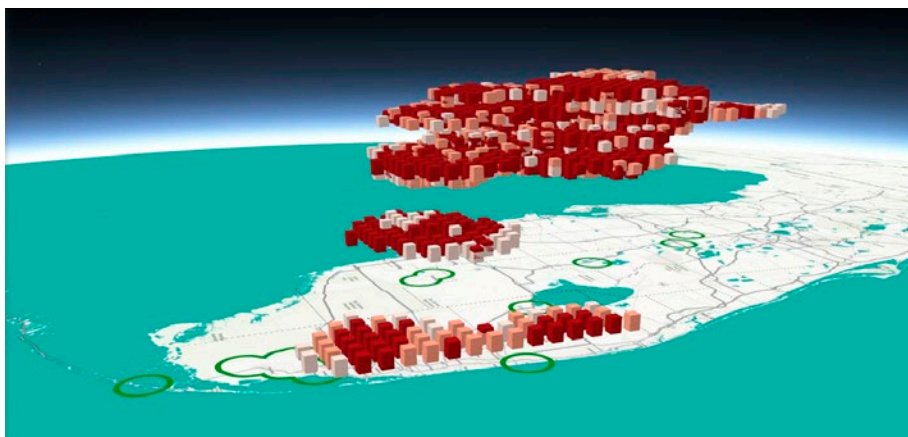
As part of the department's coordinated pest management efforts, FDACS employed ArcGIS technology to visualize Asian citrus psyllid trap counts collected at monitoring sites.

Visualizing Disease Outbreak

When one of the most threatening plant diseases began attacking one of Florida's leading crops, citrus, the Florida Department of Agriculture and Consumer Services (FDACS) used ArcGIS to better understand what was happening and to devise a plan to mitigate damage. Scientists and analysts at FDACS employed 3D GIS technology to analyze how the Huanglongbing disease spread over a five-year timespan to illustrate the spatial correlation and time delay between detections of disease-positive bugs, Asian citrus psyllid, and Huanglongbing disease-positive citrus.

The FDACS devised a GIS workflow using statistical regression to illustrate that rainfall is associated with treatment. However, the space-time cube analysis allowed staff to also validate that taking a more proactive and extensive approach to treatment can still be effective, despite an increase in rainfall.

The spatial modeling tools in ArcGIS have enabled FDACS to more effectively manage the outbreak by providing statistically significant data needed to justify and guide where and how to treat the invasive pest.



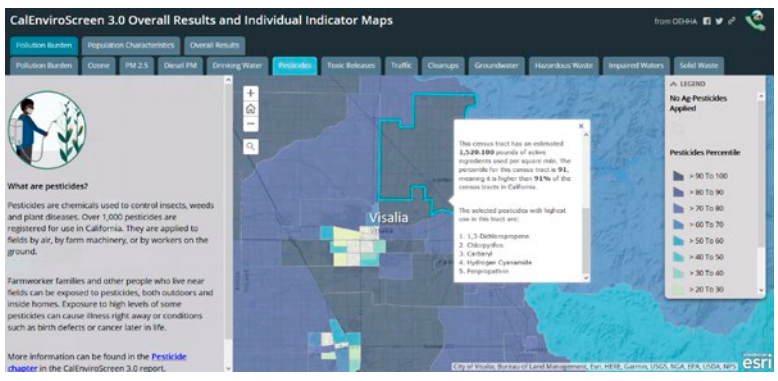
Using 3D GIS and spatial modeling, scientists and analysts at FDACS were able to visualize the spread of Huanglongbing disease over space and time, and produce statistically significant data to guide treatment efforts.

Increase Transparency to Improve Collaboration

In today's always connected world, people expect their government to have the same type of service, convenience, and open communication as they have with their personal networks. This evolution of citizen engagement is replacing old methods for communication and requiring organizations to become more transparent.

With GIS, you can publish apps that provide a two-way data exchange between your organization and citizens. These comprehensive apps enable agencies to more easily brief decision-makers on potential impacts of projects and elicit feedback from stakeholders and constituents. Mobile apps are replacing inefficient paper-based information sharing, allowing data to stay current and eliminating printing costs.

- Increase transparency with other departments and the public through real-time dashboards.
- Enable two-way information sharing with citizen scientists using mobile apps.
- Easily illustrate ROI to those impacted by a project and to the public using Esri Story Maps.



CalEnviroScreen uses ArcGIS to enable users to easily explore details of specific indicators, such as pesticide burdens, by census tract.

"GIS has been an indispensable resource that has enabled us to present CalEnviroScreen to the public, policy makers, and stakeholders in an easily understandable interactive format."

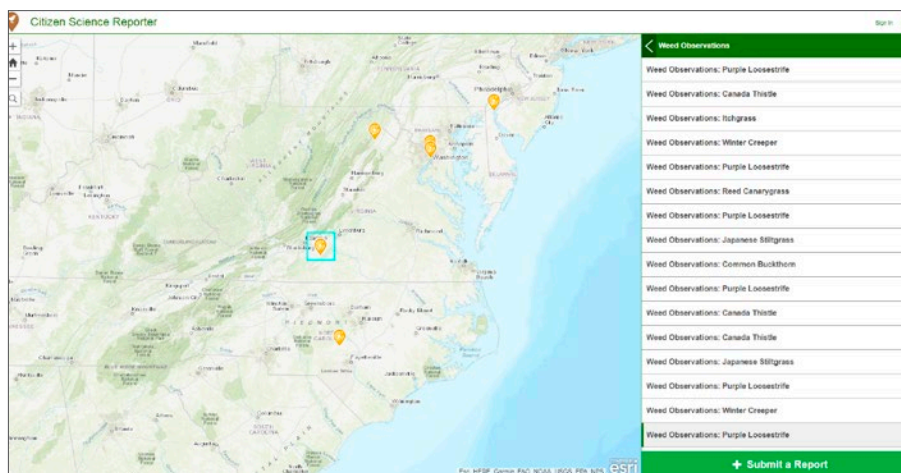
Collaborating through Maps for Environmental Justice

Maintaining Balance between Humans and Nature with Esri GIS

As we continue to uncover and learn about our ecological challenges, the job of environmental and natural resources agencies is becoming increasingly difficult. Incorporating GIS provides the infrastructure you need to ensure the quality of life of your residents while also maintaining a healthy ecosystem.

GIS enables natural resources and environmental agencies to do their best work.

- Keep an eye on your assets with real-time monitoring so you can react and course correct as needed.
- Connect the field with the office to streamline workflows, saving time and resources.
- Use science-based analysis to discover new truths and support critical decisions.
- Foster transparent and collaborative data sharing, encouraging a new generation of citizen scientists and outdoor enthusiasts.



Using Esri's Citizen Science Reporter app, anyone can report sightings of plants and animals from a mobile device.





Esri, the global market leader in geographic information system (GIS) software, offers the most powerful mapping and spatial analytics technology available.

Since 1969, Esri has helped customers unlock the full potential of data to improve operational and business results. Today, Esri software is deployed in more than 350,000 organizations including the world's largest cities, most national governments, 75 percent of Fortune 500 companies, and more than 7,000 colleges and universities. Esri engineers the most advanced solutions for digital transformation, the Internet of Things (IoT), and location analytics to inform the most authoritative maps in the world.

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