A conservation strategy for Archbold

A blueprint for activities with impact

Version 1.1

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Contents

Introduction and vision

Archbold Biological Station is an ecological research center in southern Highlands County, Florida. Founded in 1941, Archbold includes the Station proper (5,193 acres [2102 ha] of relatively intact Florida scrub and flatwoods), the adjacent Archbold Reserve (a 3,648 acres [1476 ha] complex of seepage slope grasslands, wetlands, and flatwoods in various states of conversion to and restoration from pasture), and Buck Island Ranch, a 10,500 acre (4250 ha) working cattle ranch home to Archbold's agroecology research program. The Station and Reserve sit within a complex of private and public conservation lands that total over 50,000 contiguous acres, with many tens of thousands more nearby.

For decades, Archbold staff have been closely engaged in conservation activities on Archbold properties, in the surrounding community, and through engagement regionally, nationally, and internationally. However, much of this work has been reactionary (e.g., providing requested data or expertise to neighboring management agencies) or opportunistic (e.g., invited service on a state land acquisition review boards).

In August of 2021, Archbold initiated a formal conservation program with four goals:

1. **Target** proactive and strategic scientific, educational, and outreach activities to improve conservation outcomes at multiple scales;
2. **Scale** our impact to similar ecosystems and socio-ecological settings; and
3. **Evaluate** progress toward our stated conservation goals;
4. **Communicate** Archbold's conservation impacts.

With the support of Bellini Better World, Archbold made a new, bold commitment to proactive, deliberate conservation engagement with the creation of a Director of Conservation position to lead this new program.

The decision to create a conservation program emerged from organizational planning efforts in 2021 under the StratOp framework. Archbold staff and board members concluded that conservation practitioners (broadly defined to include land managers, government environmental agencies, private landowners, environmental organizations, conservation-oriented for-profit entities, and more) are Archbold's primary stakeholders. The mission of the Archbold conservation program is **to apply our scientific and place-based expertise to advance conservation-relevant decisions and outcomes.** Archbold aims to achieve this mission **by researching the biological and physical processes that affect conservation of species and ecosystems, by enhancing access to and communication of our science, and by supporting partners who share our commitment to data-driven planning and action.**

Archbold's conservation mission is targeted at **four conservation pillars:**

1. **Saving the rarest of the rare species and ecosystems;**
2. **Sustaining grasslands;**
3. **Connecting large landscapes and wildlife corridors; and**
4. **Addressing climate change.**

We build from experience in the Lake Wales Ridge scrub and Everglades headwaters regions to influence conservation Florida-wide and in large landscapes that are similar ecologically and/or socio-economically to Archbold's home region. This includes but is not limited to other subtropical grassland, shrubland, and savanna ecosystems, as well as ranching and fast-developing rural landscapes.

The scope of Archbold's conservation history

Since its founding, Archbold has been committed to conservation. Indeed, much of Archbold's staying power is due to its location in one of the world centers for imperiled and endemic species—the Lake Wales Ridge. The Ridge is a 110-mile-long, million-year-old sand dune that rises to 312 feet (113 m) elevation. Because of this elevation, it was once among the few parts of modern Florida above sea level, allowing the evolution of unique species and ecosystems now restricted or near-restricted to the Ridge. Thirteen plant species are endemic to the Ridge (Landscope 2022) and 21 plant and animal species found at Archbold are listed as federally threatened or endangered.

From its beginnings as a natural history institution focused on the ecology of these species and their Florida scrub habitats on the Lake Wales Ridge, Archbold has evolved to become the leading authority on conservation ecology of the region. Decades of science (e.g., Woolfenden & Fitzpatrick 1984; Menges & Hawkes 1998; Coulon et al. 2010; Bauder et al. 2016) have led us to advise local, state, and federal acquisition, easement, and management of surrounding lands for conservation of the Ridge and the surrounding Everglades Headwaters. In recent decades, Archbold has expanded the range and application of its science to meet pressing conservation challenges, while remaining committed to its core, lasting identity as a science organization (Figure 1). A relevant analogy is to a cell biologist who ensures the principles learned from his or her basic biological research is put into practice by clinical physicians. Similarly, we seek to ensure our knowledge of species and ecosystems is put into practice for conservation decision-making.

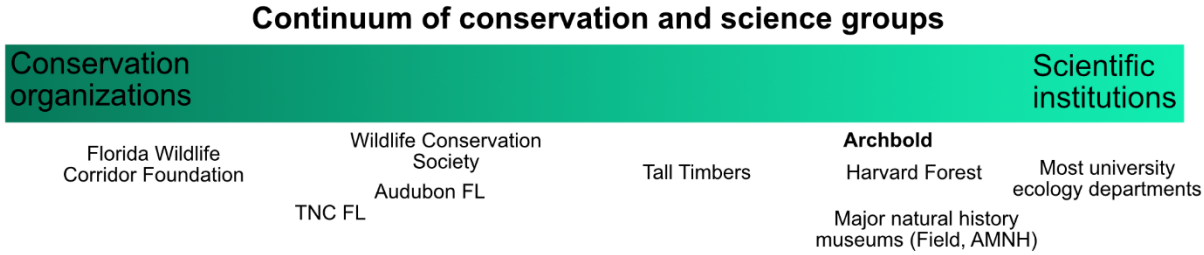

Figure 1–A continuum from science institutions producing primarily research to conservation organizations fully focused on applied outcomes. Example organizations are placed along the continuum according to their approximate mix of activities. Organizations working fully across this continuum are needed to develop and employ conservation science for positive outcomes.

Since 1998, Archbold's Agroecology research program based at Buck Island Ranch has focused on the science of sustainable ranching (e.g., Swain et al. 2013; Ho et al. 2018; Paudel et al. 2021). Central Florida's rangelands are of huge importance to the region's biodiversity and provide myriad ecosystem services from food production to water storage and filtration, to habitat for pollinators. Archbold not only publishes agroecological science but also uses the Ranch as a living laboratory for visiting groups to learn about sustainable ranching practices. School groups, state farm bureaus, legislators, agricultural industry groups, and others visit regularly.

The Agroecology program with its collaborators at the Long-term Agroecology Research network, by their nature applied in focus, have also shown the way to co-production of research with end-users. An aim of the new conservation strategy is to expand the use of these collaborative techniques to more-often include two-way exchange of information between researchers and decision-makers; doing so increases the likelihood that conservation science is used for impact (Cooke et al. 2021; Bisbal & Eaton 2022).

Archbold's newest research program, Conservation Science of Military Landscapes (CSML), also expands application of our research. Emerging from Archbold's nearly 30 years monitoring rare species at and around the Avon Park Air Force Range in northern Highlands and southern Polk Counties, the program includes research on Florida's scrub, flatwoods, and dry prairie ecosystems. We monitor and help recover populations of three rare bird species—the Florida Scrub Jay, Red-Cockaded Woodpecker, and the Florida Grasshopper Sparrow. The latter is among the rarest birds in the world with fewer than 300 individuals believed left in the wild.

The CSML program gives Archbold a voice at the table for the management of the 106,000-acre Avon Park Air Force Range—home to scrub, flatwoods, wetlands, and prairie habitats—and the surrounding 800,000+ acre Sentinel Landscape. The Sentinel Landscape is an area designated by the federal Department of Defense and its partners within which planning targets the overlaps in land use (e.g., undeveloped, fire-adapted and climate-resilient landscapes) that benefit conservation and the military mission.

The short history above is far from exhaustive but includes examples of the ways Archbold science has been translated into conservation action. It demonstrates the breadth of expertise we bring to partners and the range of ways we engage with on-the-ground conservation. Other long-term efforts that have had explicit conservation impacts include our Florida Scrub Jay and rare plant demographic studies, which have influenced state and federal land management practices and the rediscovery and population augmentation of plants including *Pseudoziziphus celata*, once-thought-extinct (Boughton & Bowman 2011; Menges et al. 2016).

Introduction to the Four Pillars

Archbold's four conservation pillars focus our work and help define our desired impact. The pillars encompass the conservation targets at risk at and around Archbold, the state of Florida, and beyond. Conversion of natural and working lands to development and the intensification of agriculture (e.g., loss of ranchland to sugarcane and to a lesser-extent citrus in central and south Florida) are among the chief threats to rare species, ecosystems, and ecological process like fire, dispersal, and nutrient cycling. Climate change, of course, is a globally distributed threat to people and ecosystems making it a priority for all conservation organizations.

Saving the rarest of the rare species and ecosystems

We help conserve the rarest plants, animals, and ecosystems at Archbold and worldwide. Through nearly a century of research on the demographics, habitat affinities, behaviors, and management of globally rare plants and animals on the Lake Wales Ridge and in the Everglades Headwaters, Archbold has become a world leader on the biology and conservation of the world's most at-risk species, and the ecosystems that support them. We implement this expertise in managing our 20,000 acres, by making recommendations to public and private land managers on the Lake Wales Ridge and throughout the Everglades Headwaters, and by sharing our science to help understand other centers of endemism and conservation threat.

Sustaining grasslands

We conserve natural and working grasslands through pioneering sustainability and conservation science. Our work at Buck Island Ranch and in the Avon Park Air Force Range Sentinel Landscape (e.g., De Luca

Preserve and Corrigan Ranch) leads to understanding the ecological function and biodiversity of working and natural grasslands in central Florida and beyond. The Ranch is a full-scale commercial operation home to experimental and observational studies to discover data-informed best management practices that we and other ranchers can follow. It also contributes to national development of agricultural sustainability as a member of the Long-Term Agroecosystem Research Network.

Conservation highlight—Farming water

Archbold supports conservation of ranchlands as a lead technical partner on the Northern Everglades Payment for Environmental Services project (Shabman et al. 2013; Shukla et al. 2017). This Southwest Florida Water Management District program is built on Archbold-supported science and pays 19 ranchers to hold additional water on their lands, slowing its flow south to the Everglades-proper and allowing natural filtration and hydrological processes to be restored, where historical drainage was constructed to create cattle pastures. Archbold is the primary monitoring and data management partner for the project and the payments help disincentivize the sale of ranches to developers.

Connecting large landscapes and wildlife corridors

We put data to work identifying and communicating the importance of natural ecosystems and ranches for wildlife, ecosystem processes, and rural economies. Archbold is the lead convener of science for the campaign to conserve the 18-million-acre Florida Wildlife Corridor (Archbold Biological Station Conservation Program 2022a, 2022b, 2022c). We bring data-driven concepts, cartography, analysis, and infographics to build the evidence base and support for the Corridor's conservation. Archbold also supports science complementary to our own (e.g., hydrology, economics, and sociology) by recruiting and communicating collaborators' science to Corridor conservation partners (e.g., a pending report from the University of Florida Water Institute on the water resources implications of Corridor conservation).

Conservation highlight—Saving a spiny scrub shrub

Archbold's plant ecology program shepherds the recovery and monitoring of several rare plants. Among them is Florida Ziziphus (Pseudoziziphus celata). Once thought extinct for over 30 years, the plant is now known from fewer than 20 sites, all on the Lake Wales Ridge. Archold's research has shown that at most locations, the species is uniclonal, meaning the population is simply clones of a single genotype. Our plant ecology team has led the search for new wild genotypes, which are propagated and conserved in partnership with Bok Tower Gardens, then planted in the wild to augment populations' genetic diversity, helping avoid detrimental effects of inbreeding (Weekley et al. 2002; Gitzendanner et al. 2012).

Addressing climate change

We apply scientific rigor and decades of data to understand and act on growing threats to ecosystems and the people that rely on them. Our legacy research and long-term data (e.g., Lake Annie monitoring) are

highly relevant for understanding biological, climatological, and hydrological trends and invaluable resources for tracking and modeling climate impacts. More recent work includes ecosystem carbon accounting (e.g., Wade et al. 2022) to inform climate-smart agricultural practices and potential future carbon markets, understanding species' responses to climate changes and variability (e.g., Morris et al. 2008), and partnering to assess the coupled human and natural risks of climate change and the ways that land conservation can help address these risks. The latter includes contributions to regional resilience planning efforts for the Central Florida Regional Planning Council (covering seven counties) and the Avon Park Sentinel Landscape.

Developing Archbold's conservation strategy

Goals

1. **Target proactive and strategic scientific, educational, and outreach activities to improve conservation outcomes at multiple scales.** This goal is about deliberately focusing our work and the communication of our research outcomes to end-users. It includes development of educational and outreach programming that helps move the needle on public understanding of and support for conservation.

   This goal does not diminish the importance of basic science (e.g., classical natural history studies) with no immediate conservation application. Indeed, these discovery-based efforts are often seeds for later, more applied studies and inspire professionals' and public love for nature, which can indirectly improve conservation outcomes.

2. **Scale our impact to similar ecosystems and socio-ecological settings.** A benefit of field stations is the intensive place-based understanding they foster. Indeed, the legacy of Lake Wales Ridge and Everglades Headwaters science and conservation runs deep for Archbold's community of staff and stakeholders; these are the geographies where we work most closely and where much of our conservation impact continues. However, we can grow the bang-for-our conservation buck by sharing our expertise for conservation of the world's shrublands (similar to the Florida scrub), sub-tropical rangelands (like Buck Island Ranch), grasslands (comparable to Florida dry prairies), rare species (subject to similar threats and demographic processes as the endemic plants and animals of Lake Wales Ridge), and ecosystem processes (e.g., wildfire and the cycling of water, carbon, and other nutrients).

3. **Evaluate progress toward our stated conservation goals.** Within the conservation sector, it is no longer sufficient to have good intent. Tracking outcomes is critical for monitoring the effectiveness of conservation interventions and for communicating to partners and funders. Better tracking the progress towards securing conservation targets can also help steer Archbold science. Where existing activities and strategies are not working, new science or new strategies may be needed.

   There are many ways to monitor programmatic impacts including experimental evaluations, expert elicitations, meta-analysis, and others (Reed et al. 2021). In this strategy, we establish an initial set of indicators to be tracked over time to understand Archbold's impacts on key conservation outcomes (See SMART metrics below, too).

Strategy development

To accomplish these goals, we built this conservation strategy using the Conservation Standards (https://conservationstandards.org/about) and the Theory of Change (https://www.theoryofchange.org/what-is-theory-of-change; Salafsky & Margoluis 2021), two organizational and project planning frameworks. The Conservation Standards are a widely used array of concepts and approaches that unify common terms, ideas, and activities for conservation project design, implementation, and monitoring. It was developed by the Conservation Measures Partnership (www.conservationmeasures.org; a large collaboration of non-profit, government, and academic conservation groups). The Theory of Change is a flexible approach to mapping the conceptual path from activities to impact; it helps define the "missing middle," i.e., all the intervening conditions and outcomes that are needed to go from program activities to desired outcomes, monitoring, and evaluation (Salafsky et al. 2021; Salafsky & Margoluis 2021).

Figure 2—The project cycle as depicted in the Conservation Standards framework. Archbold will use this as a broad guide for planning and evaluating our conservation activities.

The Conservation Standards include a cyclical process for project lifecycles (Fig. 2). It is not necessary to begin at step 1 (assess) for ongoing projects; rather one might start with building a robust analysis and adaptation plan. For new work, it makes sense to begin by assessing the situation.

An advantage of this project cycle is that it is scalable. We first consider the cycle in relation to creation of Archbold's new conservation program and this conservation strategy as a whole, but then later use it and the Theory of Change (equally scalable) to consider individual projects and their impacts.

Assessment and planning

StratOp planning in early 2021 included Standards Step 1—the assessment of needs for conservation planning at Archbold and the decision that conservation practitioners are the primary stakeholders for our work. Moreover, the decision to engage more proactively with conservation stakeholders was made. Archbold and conservation program leadership soon thereafter identified the four conservation pillars and shared these with program directors for refining.

Step 2, planning, was a highly collaborative process using two key tools from the Theory of Change — **situation models and strategy pathways**—to map our activities to conservation targets, to identify opportunities for engagement (i.e., where our efforts can have impact) and to develop a clear program of monitoring. **Situation models** map the conceptual landscape of conservation threats and strategies. They are diagrams illustrating the connections among contributing socio-economic and socio-political factors (e.g., growing human population) that create threats (e.g., excessive habitat conversion for development), strategies to address contributing factors and direct threats, and how threats impact key biophysical factors (e.g., habitat fragmentation or fire frequency) and conservation targets (e.g., persistence of a rare species'

population or maintenance of a key ecosystem service). Situation models are completed for a cohesive set of strategies meant to improve conservation outcomes for one or more related conservation targets. Through a series of all-staff workshops, we built four situation models, one for each conservation pillar (Figs. 3–6). The goal was not to draw all possible connections, but rather to draw the salient ones—those illustrating strong linkages and where invested time and resources can have a considerable conservation impact.

Following development of the pillar situation models, we used them to guide more detailed mapping of conservation activities for each of Archbold's programs. At the outset of this new conservation strategy, we did not aim to map and measure all relevant activity, but rather to define metrics to begin measuring each program's impact. We anticipate adapting these metrics and adding more after the first year or two of this new endeavor for Archbold.

With guidance from the Director of Conservation and hewing to the pathways mapped in the situation models, program directors and select staff from each research group and the education program developed one or more strategy pathways to guide conservation engagement and identify relevant metrics. Like situation models, **strategy pathways** are conceptual maps, but they are focused on a specific strategy (in the vocabulary of Theory of Change, one or more related activities meant to positively affect conservation outcomes for one or more conservation targets). These diagrams map the activities, intermediate results, and conditions needed to influence one or more of a program's identified conservation targets. In addition, **the points in the pathway at which key metrics should be recorded are marked as indicators**, the data used to track accomplishments and impact. Strategy pathways are included in Appendix A.

In the Theory of Change Framework, good indicators are "SMART;" Specific, Measurable, Achievable, Results-oriented, and Timebound. All these characteristics help ensure the chosen metrics are relatively easy to track, but also highly relevant to the activities and outcomes of interest. Table 1 lists the initial metrics identified for monitoring and reporting on in 2023.

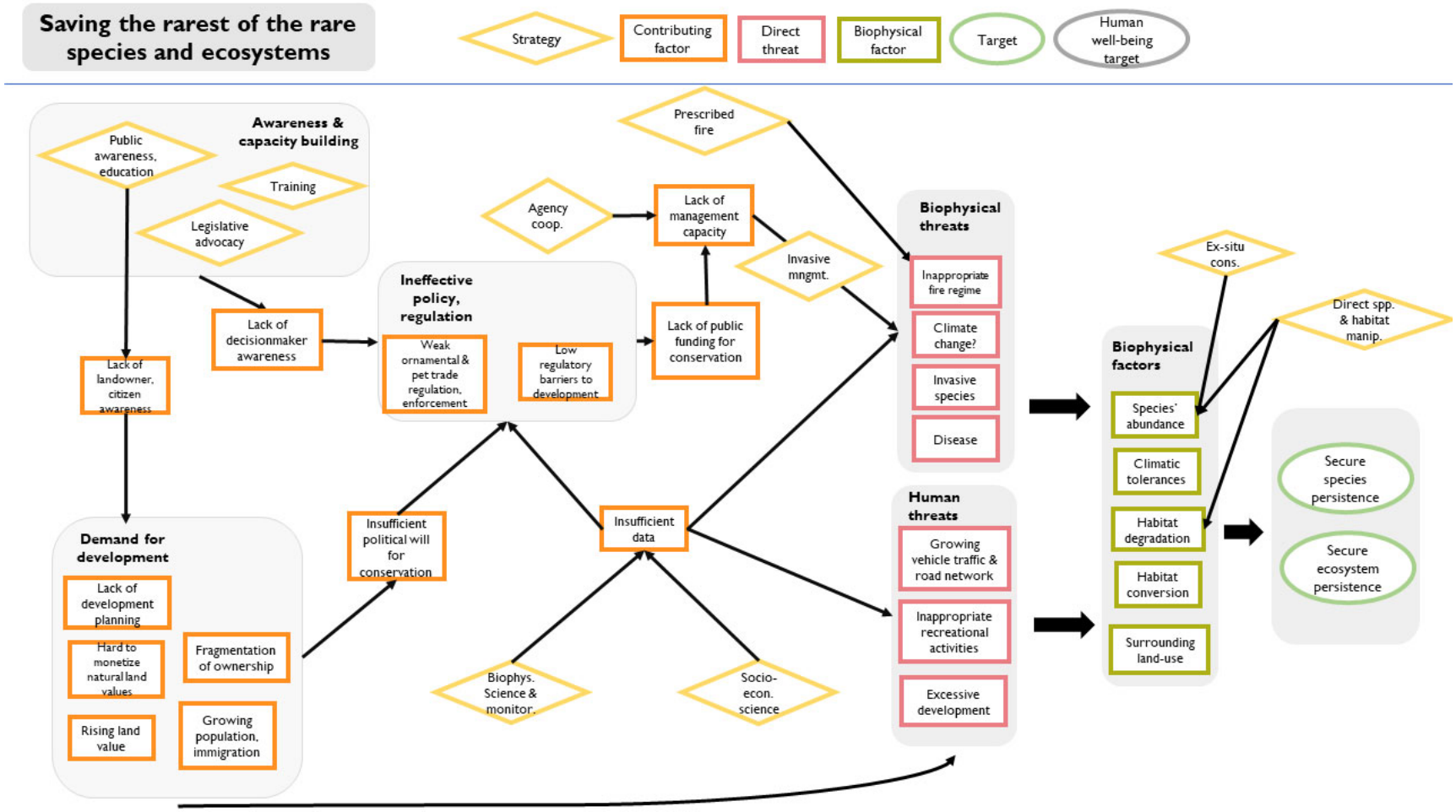

Figure 3–Situation model for Saving the Rarest of the Rare.

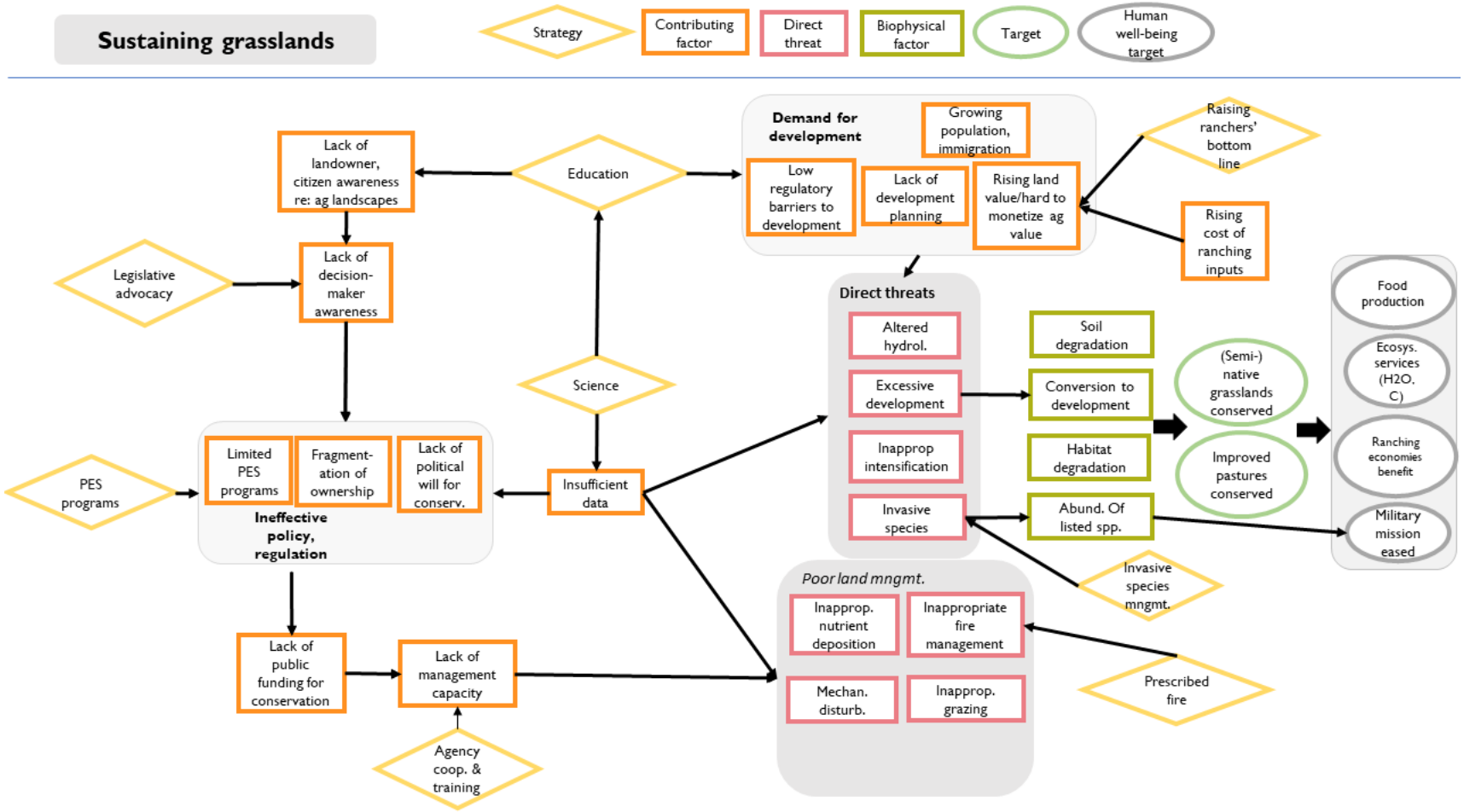

Figure 4–Situation model for Sustaining Grasslands.

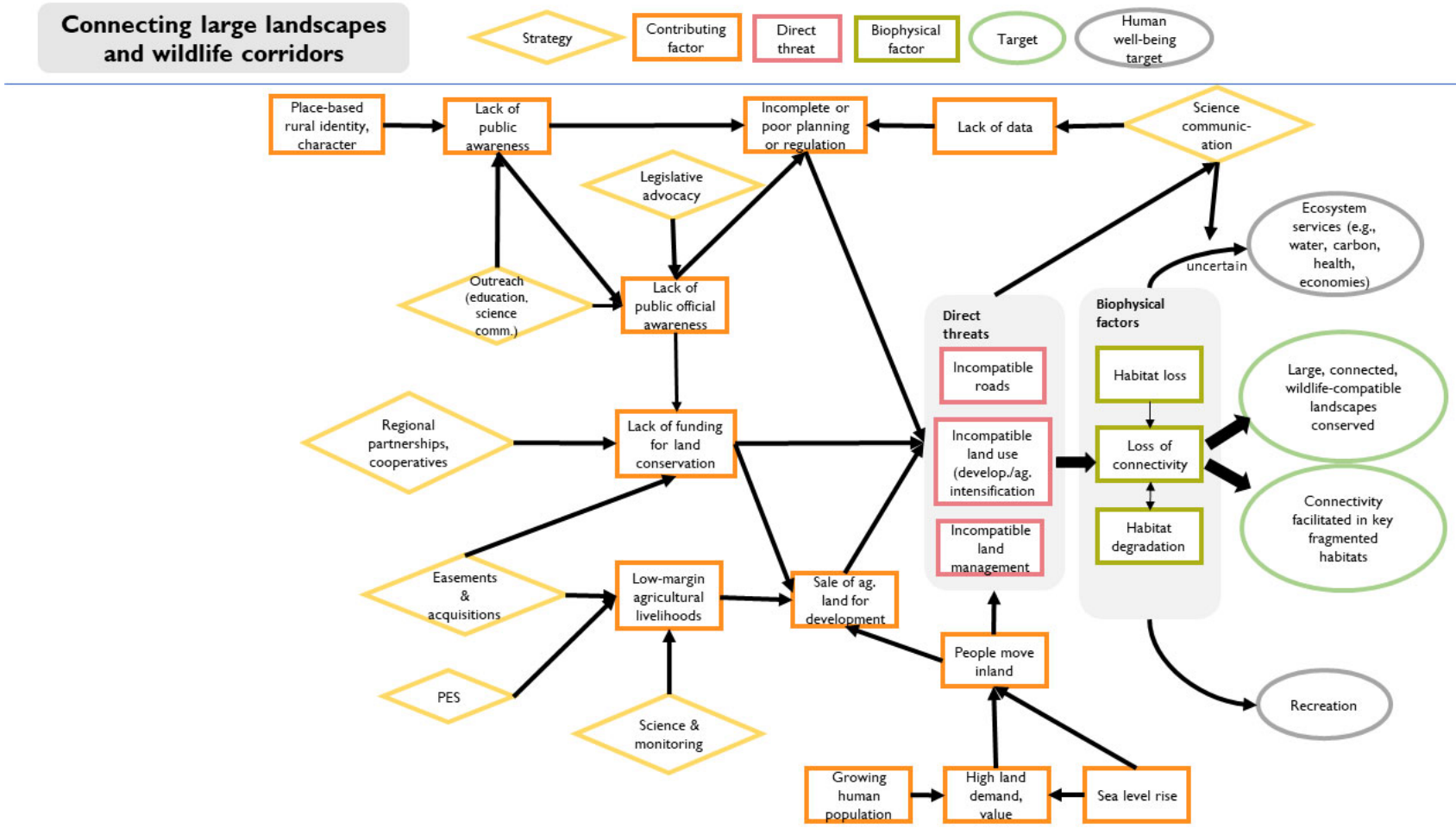

Figure 5–Situation model for Connecting Large Landscapes and Wildlife Corridors.

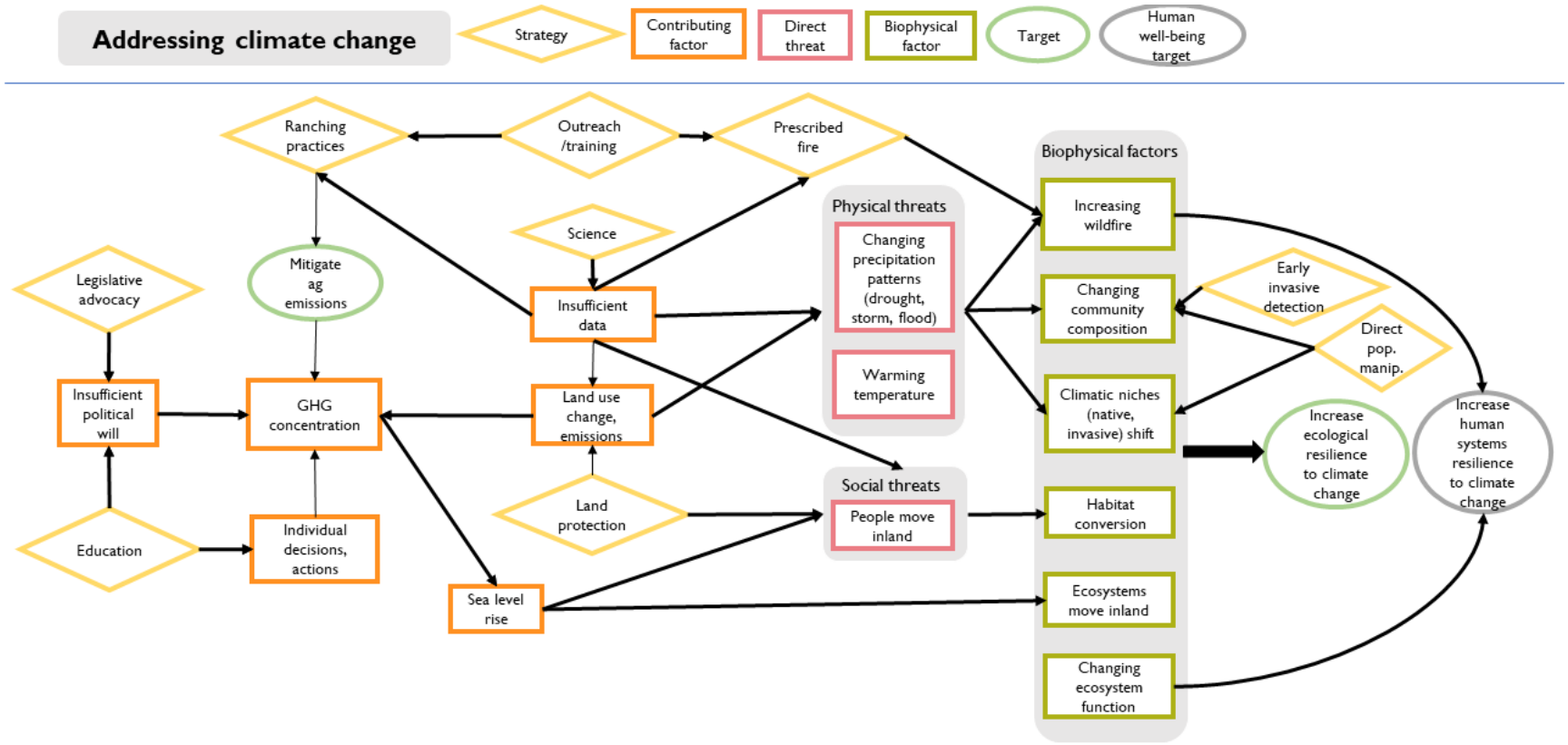

Figure 6–Situation model for Addressing Climate Change

Implement, adapt, and share

Archbold will implement this new conservation plan beginning in 2023. By early 2024, we will have collected the first set of metrics for future tracking and communication of our impacts. We also aim to share this initial conservation strategy with close partners in mid-2023 for their review and comment. Throughout the year and into the first half of 2024, we will be engaged in adapting the plan and metrics to arrive at a more refined, longer-term approach. We will test the pillar situation models with feedback from agencies, landowners, and organizations we believe are needed to effect positive conservation outcomes. Where edits are needed to more accurately reflect the reality of how outcomes are influenced, we will adapt situation models and the relevant strategy pathways and metrics.

Closing thoughts and outstanding challenges

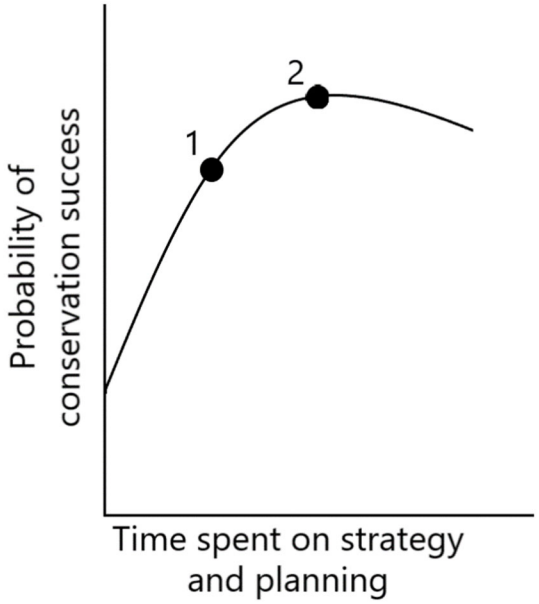

Figure 7—The expected gain in probability of conservation success increases at a decreasing rate as additional analysis is completed. Initial investment is very worthwhile, but spending too much time planning can lead to paralysis by analysis.

A key point about the Theory of Change tools and their application to conservation is that the process need not be perfected to achieve major benefits. Indeed, the greatest benefits likely come from early-stage, deliberate thinking about mapping actions to desired outcomes, identifying missing partners or activities, and defining key indicators for tracking. The process is of course iterative, as well. This is beneficial for Archbold, given competing demands on staff time and the limited staff devoted fulltime to conservation.

Following the first one or two years of program evaluation, we will amend strategy pathways and possibly add or subtract some based on staff experience with the process. In the meantime, multiple program directors and staff remarked during the production of strategy pathways that the purposeful mapping of desired conservation outcomes to their activities was helpful to see the path to greater impact, and in some cases, even to conceptualizing their greater research program.

A clear and unsurprising outcome of the strategy-mapping process is that more applied research is more easily connected to the conservation targets. It was harder to describe how research that is more targeted at conceptual scientific advances, or that is more discovery than not hypothesis driven (e.g., the Corridor Observatory, a large motion-triggered camera and acoustic sensor array led by the predator-prey program). These types of studies have immense value, but anticipating their impacts is difficult, especially early in a project. Collecting long-term datasets also helps set baselines for future conservation efforts, regardless of immediate application.

Most Archbold programs would benefit from more and earlier engagement with end-users as we seek to scale Archbold's conservation impact. An example comes from our work with the campaign to conserve the Florida Wildlife Corridor, inherently a multi-partner, multi-disciplinary set of activities. Archbold has acted as both a conceptual scientific leader and a lead data provider (cartography, statistical analysis, GIS) for the core campaign partners, but we have been guilty sometimes of acting ahead of these partners. Stakeholder engagement and public outreach organizations and land trusts have sometimes expressed excitement about maps or other products Archbold has proposed, but then not used the final product.

This is often due to a lack of sufficient up-front planning, e.g., a failure of scientists (Archbold here) to fully explain what is being produced and/or to hear what prospective end-users need. Helpful strategies are to avoid rushing to conclusions that a particular analysis or product will be "useful" without identifying the problem and the influential decision-makers (often individuals, not just organizations; Bisbal & Eaton 2022). **Archbold's conservation program will act as a resource to help other Archbold programs plan the conservation impacts of future work, ideally early in a project's lifecycle.**

Next steps

Going forward, each program will report their selected metrics by the end of the calendar year for inclusion in an annual February report led by the conservation program on Archbold's conservation impact. Archbold's Data and Technology staff will build the digital infrastructure needed to report and track the metrics year after year. In 2023, reporting will also require the submission of complete methods for how each metric is measured to ensure consistency year-to-year and in the interpretation reported to partners. Production of the annual report will include a short-form fact sheet in addition to the longer-form highlighting details of the year's activities and outcomes.

As this strategy is developed, and as the new conservation program matures, an explicit goal is to **scale Archbold's impact.** Already, we have decades of experience effecting change well beyond the boundaries of Archbold's properties. **Future strategy pathways and indicators should increasingly include larger-scale impacts that may accrue, for example, through engagement with research networks that span multiple geographies and communication of our Florida-based science to socio-ecologically analogous settings.** This could include, e.g., other ecosystems with high rates of endemism (Rarest of the Rare), where sustaining ranching economies is key to the maintenance of remaining habitat (Sustaining Grasslands), or where connectivity is fast being lost to development (Connecting Land Landscapes). Our education program is also growing to reach a wider audience through increased virtual programming as a result of lessons learned and technologies developed during the COVID pandemic. Ultimately, having an explicit plan for our impact and how we will track it should help grow our ability to influence conservation-relevant decisions and the ways we communicate the importance of our work to partners and supporters.

Table 1—Conservation metrics to be tracked in 2023

	Metric	Pillar(s)	Lead program	Corresponding strategy pathway (pp.)	Type of metric
1	Number of CO_2 and CH_4 records annually	Addressing climate change	Agroecology	Ranch greenhouse gas budgeting	Advancing the conservation evidence base
2	Number of (i) ranchers, (ii) policy-makers, and (iii) ag industry members visiting BIR for tours including discussion of GHG sources and sinks, or hearing same at conference, meeting, site visit, etc…	Addressing climate change	Agroecology	Ranch greenhouse gas budgeting	Outreach and capacity-building
3	Number of ranchers adopting identified best practices.	Addressing climate change	Agroecology	Ranch greenhouse gas budgeting	Conservation outcome
4	Estimated GHG reductions from ranchers implementing identified practices.	Addressing climate change	Agroecology	Ranch greenhouse gas budgeting	Conservation outcome
5	Area of enrolled watersheds monitored annually	Sustaining grasslands	Agroecology	Payment for ecosystem services programs (NE-PES)	Advancing the conservation evidence base
6	Number of enrolled sites monitored annually	Sustaining grasslands	Agroecology	Payment for ecosystem services programs (NE-PES)	Advancing the conservation evidence base
7	Number of water level and rainfall measurements from enrolled sites recorded annually	Sustaining grasslands	Agroecology	Payment for ecosystem services programs (NE-PES)	Advancing the conservation evidence base
8	Number of water samples analyzed from enrolled sites annually	Sustaining grasslands	Agroecology	Payment for ecosystem services programs (NE-PES)	Advancing the conservation evidence base

9	Number of agency and landowner Ranch visitors learning about wetland best management practices per year	Sustaining grasslands	Agroecology	Wetland science	Outreach and capacity-building
10	Total lifetime acres applying for grassland easements with Archbold assistance	Sustaining grasslands	Agroecology	Wetland science	Outreach and capacity-building
11	Total lifetime acres enrolled in grassland easements with Archbold assistance	Sustaining grasslands	Agroecology	Wetland science	Conservation outcome
12	Change in jay population size (13 populations)	Rarest of the rare	Avian ecology	Off-site Scrub-jay surveys	Conservation outcome
13	Long-term jay population size change (13 populations)	Rarest of the rare	Avian ecology	Off-site Scrub-jay surveys	Conservation outcome
14	Mean annual offspring per group	Rarest of the rare	Avian ecology	Off-site Scrub-jay surveys	Conservation outcome
15	Percent of scrub burned annually per population	Rarest of the rare	Avian ecology	Off-site Scrub-jay surveys	Conservation outcome
16	Corridor acres permanently conserved annually	Connecting large landscapes and wildlife corridors, Rarest of the rare	Conservation	Actional science communication	Conservation outcome
17	Corridor acres remaining to be permanently conserved	Connecting large landscapes and wildlife corridors, Rarest of the rare	Conservation	Actional science communication	Conservation outcome
18	Number of nests protected/year	Rarest of the rare	Conservation science of military landscapes	Direct population mgmt.; FL Grasshopper Sparrows	Conservation outcome
19	Number of pairs/year	Rarest of the rare	Conservation ecology of military landscapes	Direct population mgmt.; FL Grasshopper Sparrows	Conservation outcome

20	Number of recruitment clusters constructed.	Rarest of the rare	Conservation ecology of military landscapes	Direct population mgt.; Red-cockaded Woodpeckers	Conservation outcome
21	# of artificial nest cavities installed.	Rarest of the rare	Conservation ecology of military landscapes	Direct population mgt.; Red-cockaded Woodpeckers	Conservation outcome
22	Number of conservation science projects Archbold-wide	All	Data and technology	Science	Advancing the conservation evidence base
23	Total internet traffic to Archbold published datasets	All	Data and technology	Science	Advancing the conservation evidence base
24	Number of partners receiving RS data	All	Data and technology	Science	Advancing the conservation evidence base
25	Partners supported with GIS data	All	Data and technology	Science	Advancing the conservation evidence base
26	Partners supported with cartography	All	Data and technology	Science	Advancing the conservation evidence base
27	Number of conservation science publications.	All	Data and technology	Science	Advancing the conservation evidence base
28	Number of participants per year	All	Education	K–12 education	Outreach and capacity-building
29	Number of tortoise science publications	Rarest of the rare	Herpetology	Gopher tortoise science	Advancing the conservation evidence base

30	Number of practitioners hearing tortoise science and management implications per year	Rarest of the rare	Herpetology	Gopher tortoise science	Outreach and capacity-building
31	Total acres of tortoise habitat improved or restored	Rarest of the rare	Herpetology	Gopher tortoise science	Conservation outcome
32	Percent targeted high-priority areas surveyed annually	Rarest of the rare	Land management	Invasive animal management (aspirational)	Advancing the conservation evidence base
33	Percent targeted lower-priority areas surveyed every five years	Rarest of the rare	Land management	Invasive animal management (aspirational)	Advancing the conservation evidence base
34	Abundance of targeted species	Rarest of the rare	Land management	Invasive animal management (aspirational)	Conservation outcome
35	Percent of high-priority invasive plant areas surveyed annually	Rarest of the rare	Land management	Invasive plant management	Advancing the conservation evidence base
36	Percent of low-priority invasive plant areas surveyed every 5 years	Rarest of the rare	Land management	Invasive plant management	Advancing the conservation evidence base
37	Percent of surveyed 20m grid cells with high-priority invasive plants present	Rarest of the rare	Land management	Invasive plant management	Conservation outcome
38	Percent of surveyed 20m grid cells with low-priority invasive plants present	Rarest of the rare	Land management	Invasive plant management	Conservation outcome
39	Acres due for burning annually	Rarest of the rare; Sustaining grasslands; Addressing climate change	Land management	Fire management	Conservation outcome
40	Acres overdue for burning annually	Rarest of the rare; Sustaining grasslands; Addressing climate change	Land management	Fire management	Conservation outcome

41	Current staff with S130 / S190 training	Rarest of the rare; Sustaining grasslands; Addressing climate change	Land management	Fire management	Outreach and capacity-building
42	Current staff with Florida Certified Prescribed Burner training	Rarest of the rare; Sustaining grasslands; Addressing climate change	Land management	Fire management	Outreach and capacity-building
43	Native acres prescribe burned annually	Rarest of the rare; Sustaining grasslands; Addressing climate change	Land management	Fire management	Conservation outcome
44	Pasture acres prescribe burned annually	Rarest of the rare; Sustaining grasslands; Addressing climate change	Land management	Fire management	Conservation outcome
45	Lake color	Addressing climate change	Limnology	Lake Annie limnology	Conservation outcome
46	Lake level	Addressing climate change	Limnology	Lake Annie limnology	Conservation outcome
47	Archbold limnology knowledge survey	Addressing climate change	Limnology	Lake Annie limnology	Advancing the conservation evidence base
48	Lake Annie data downloads	Addressing climate change	Limnology	Lake Annie limnology	Advancing the conservation evidence base
49	Total potentially compatible Ziziphus genotype pairings IDed	Rarest of the rare	Plant ecology	Florida Ziziphus science	Advancing the conservation evidence base
50	Total Ziziphus populations established	Rarest of the rare	Plant ecology	Florida Ziziphus science	Conservation outcome
51	Average size of new populations	Rarest of the rare	Plant ecology	Florida Ziziphus science	Conservation outcome

52	Number of wildlife photos/year	Connecting large landscapes and wildlife corridors, Rarest of the rare	Predator-prey ecology	Corridor observatory science	Advancing the conservation evidence base
53	Hours of acoustic data/year	Connecting large landscapes and wildlife corridors, Rarest of the rare	Predator-prey ecology	Corridor observatory science	Advancing the conservation evidence base
54	Number of species detected/year	Connecting large landscapes and wildlife corridors, Rarest of the rare	Predator-prey ecology	Corridor observatory science	Advancing the conservation evidence base

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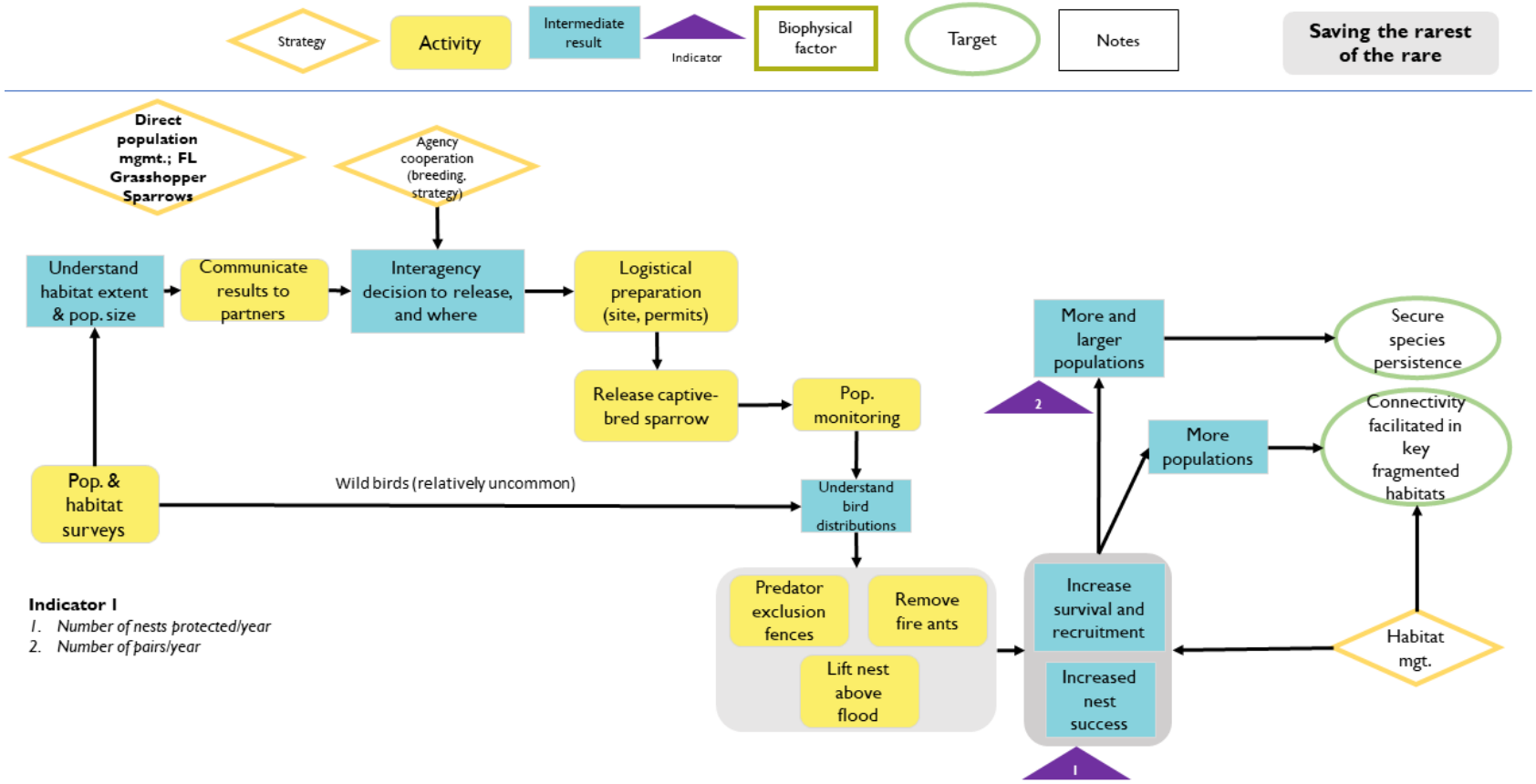
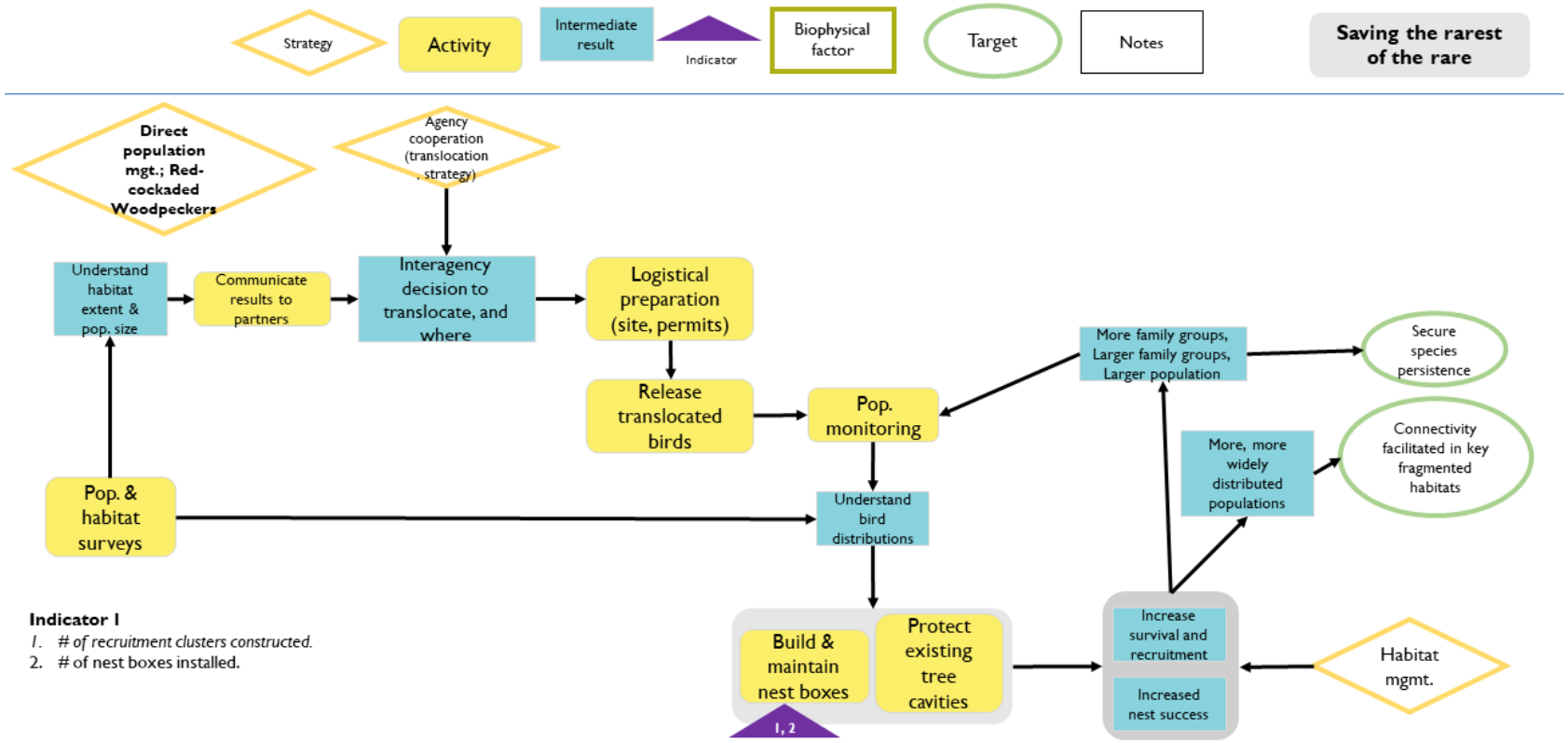
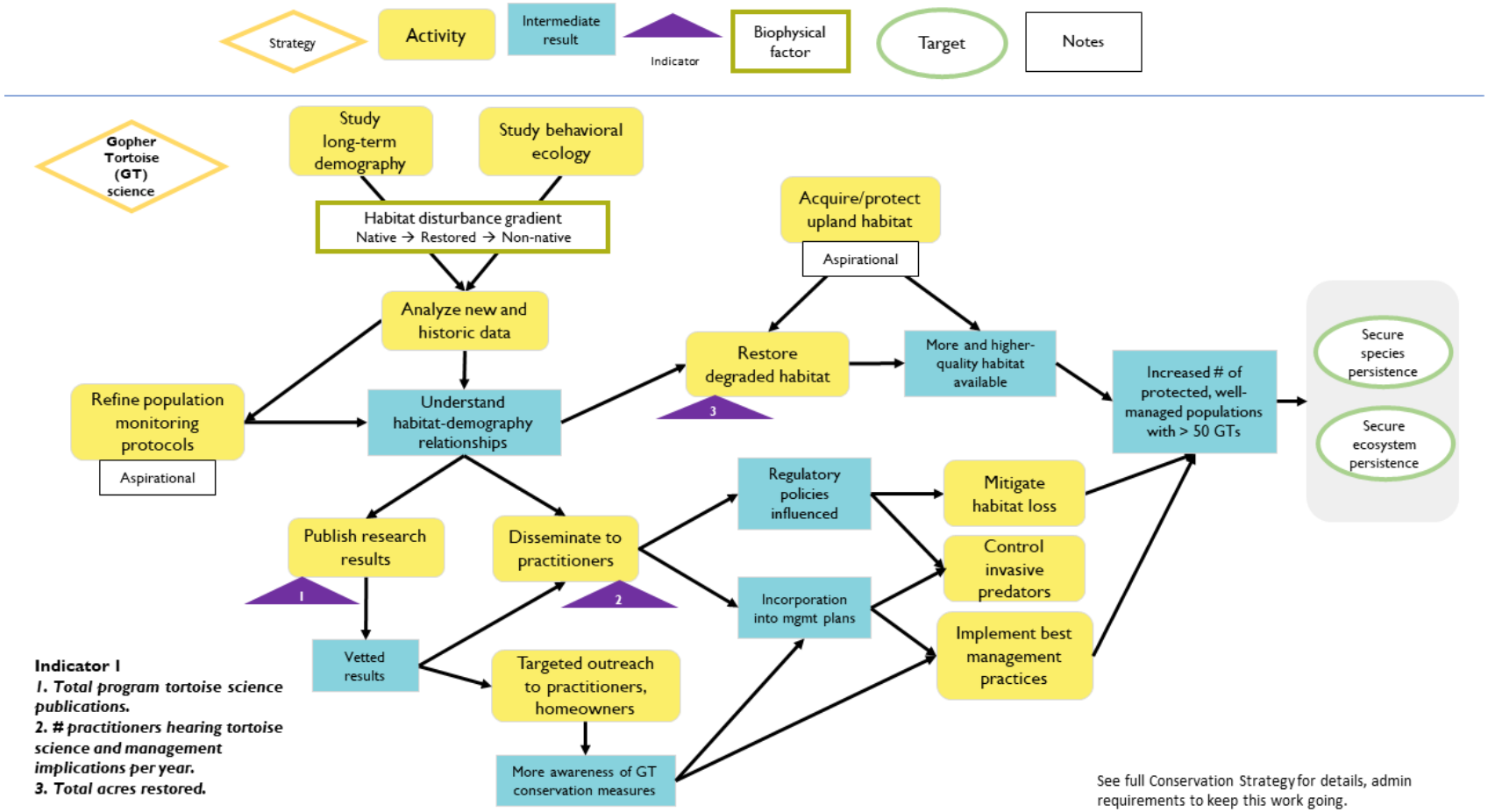
Appendix A: Strategy pathways



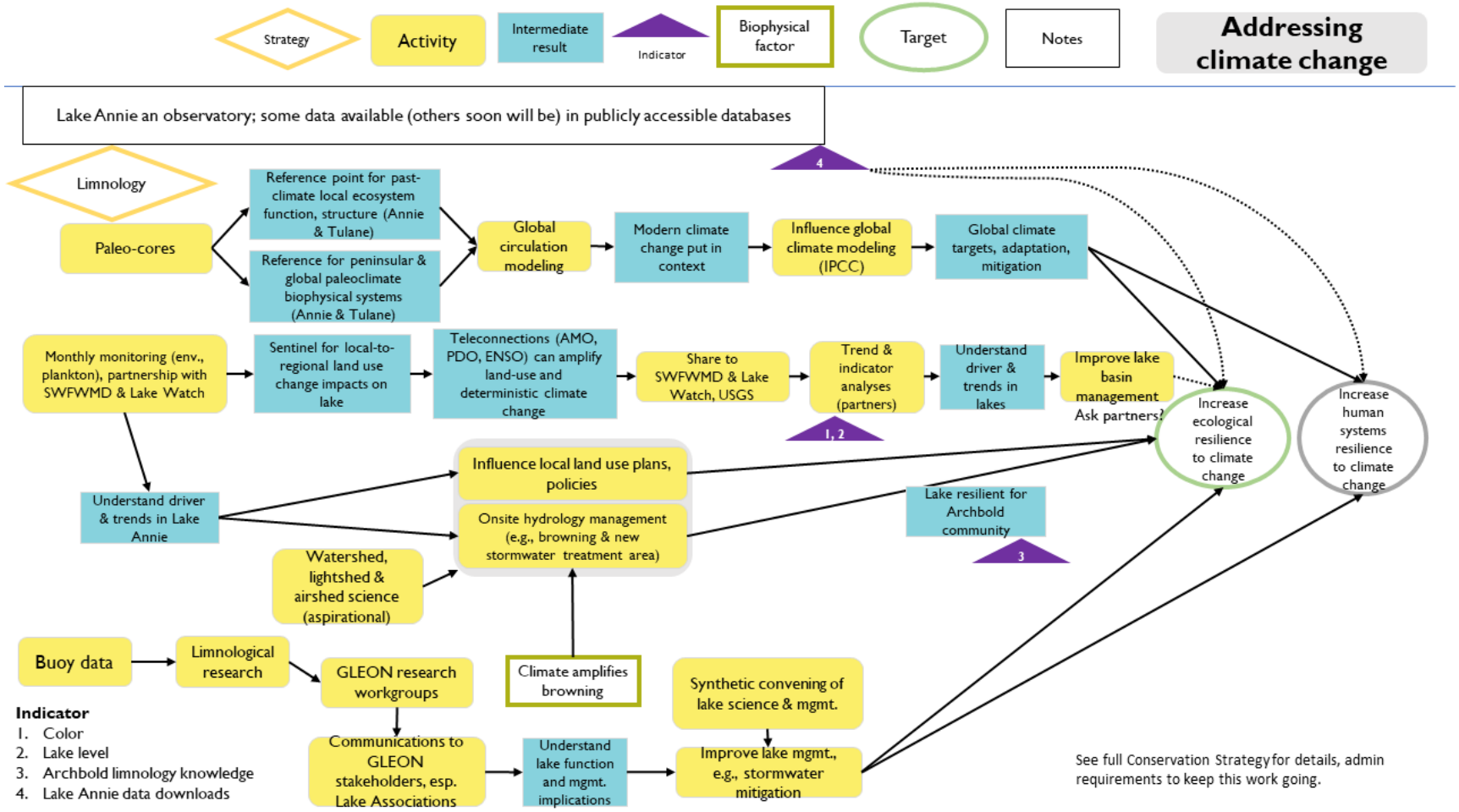
The Conservation Ecology of Military Landscapes Program monitors and helps supplement populations of the Florida Grasshopper Sparrow, one of the world's rarest birds.



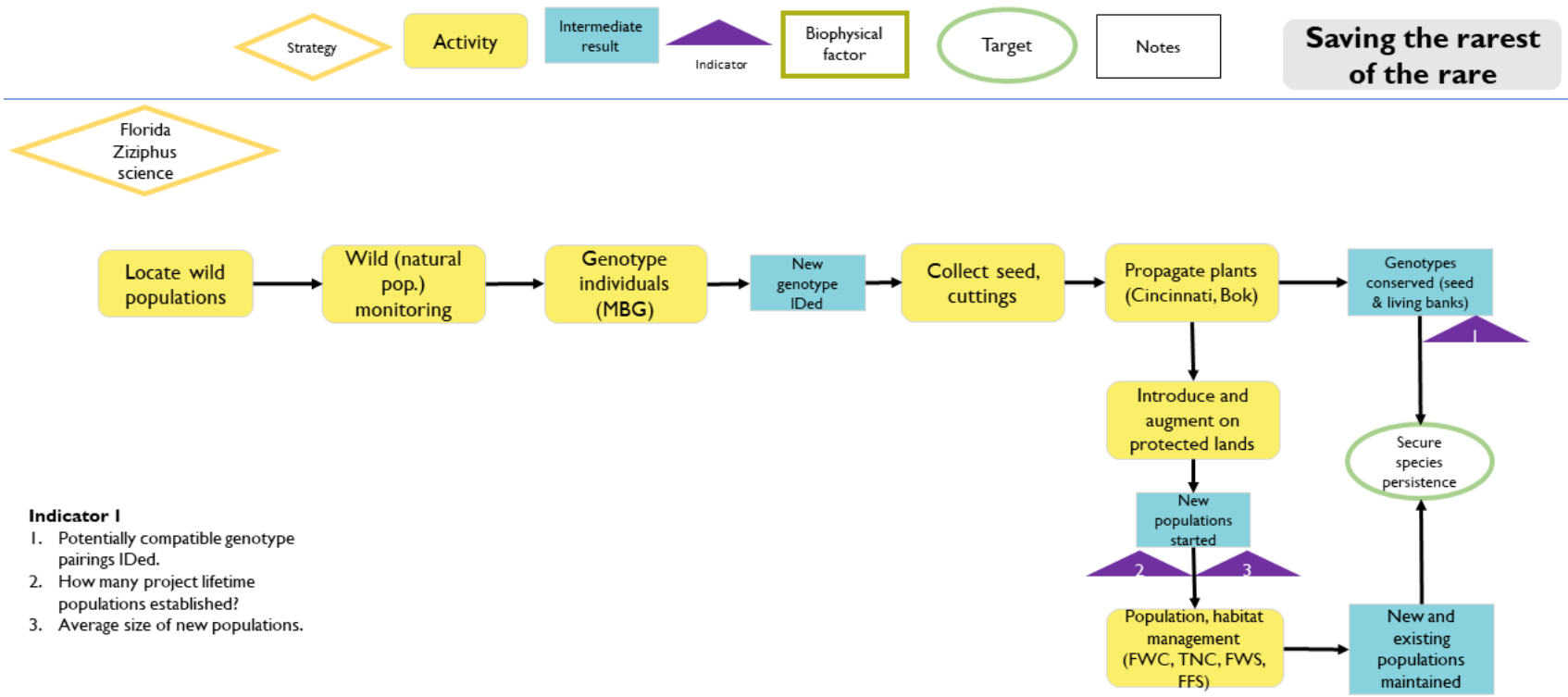
The Conservation Ecology of Military Landscapes Program studies the ecology of Red-cockaded woodpeckers at and around Avon Park Airforce Range where Archbold and partners manage habitat in part for the species' strict habitat requirements.



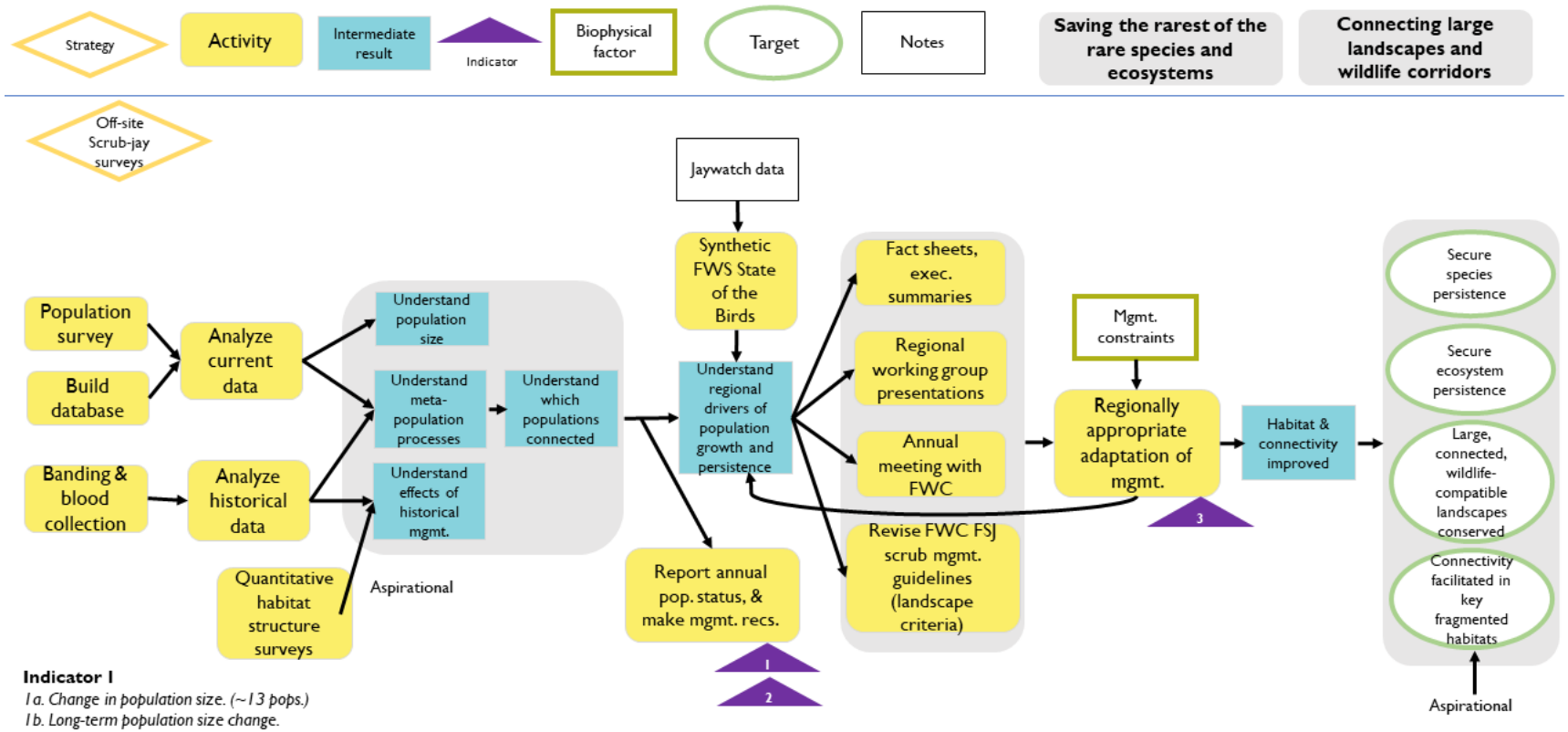
Archbold's herpetology program maintains a decades-long study of Gopher Tortoise demography, which contributes knowledge to development of best management practices for the species' habitat rangewide and for mitigating the impacts of development on the species.



Lake Annie, at the north end of Archbold Biological Station, is a globally significant limnological study site. Data collected there are used to develop models of the impact of worldwide climate change on lakes.



The Plant Ecology program monitors and helps restore populations of Florida Ziziphus, a species known from fewer than 10 sites globally, all on the Lake Wales Ridge. Special emphasis will be placed on translocating individuals of rare genotypes, which typically are not well-represented among propagated plants.



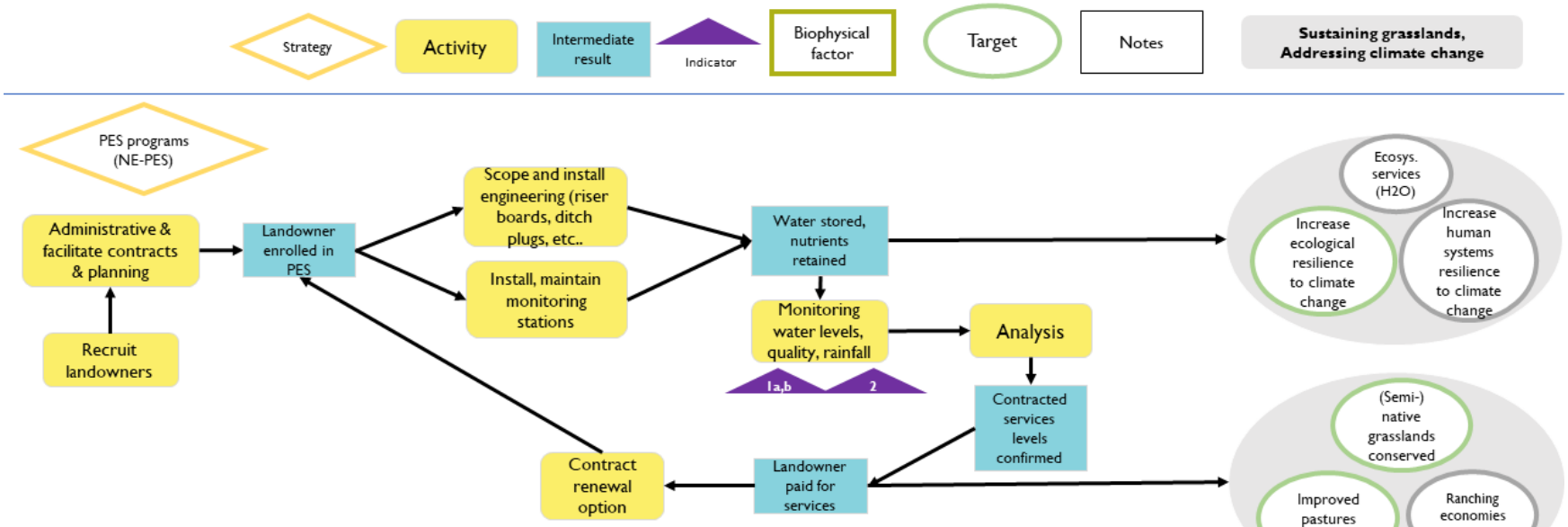
Indicator 1
1a. Change in population size. (~13 pops.)
1b. Long-term population size change.

Indicator 2
Mean annual offspring per group.

Indicator 3
Percent of scrub burned annually per population.

See full Conservation Strategy for details, admin requirements to keep this work going.

Thirteen Florida Scrub-Jay populations are monitored annually by Archbold's Avian Ecology program. The world contributes to science-backed management of the Florida-endemic species and its habitat statewide.



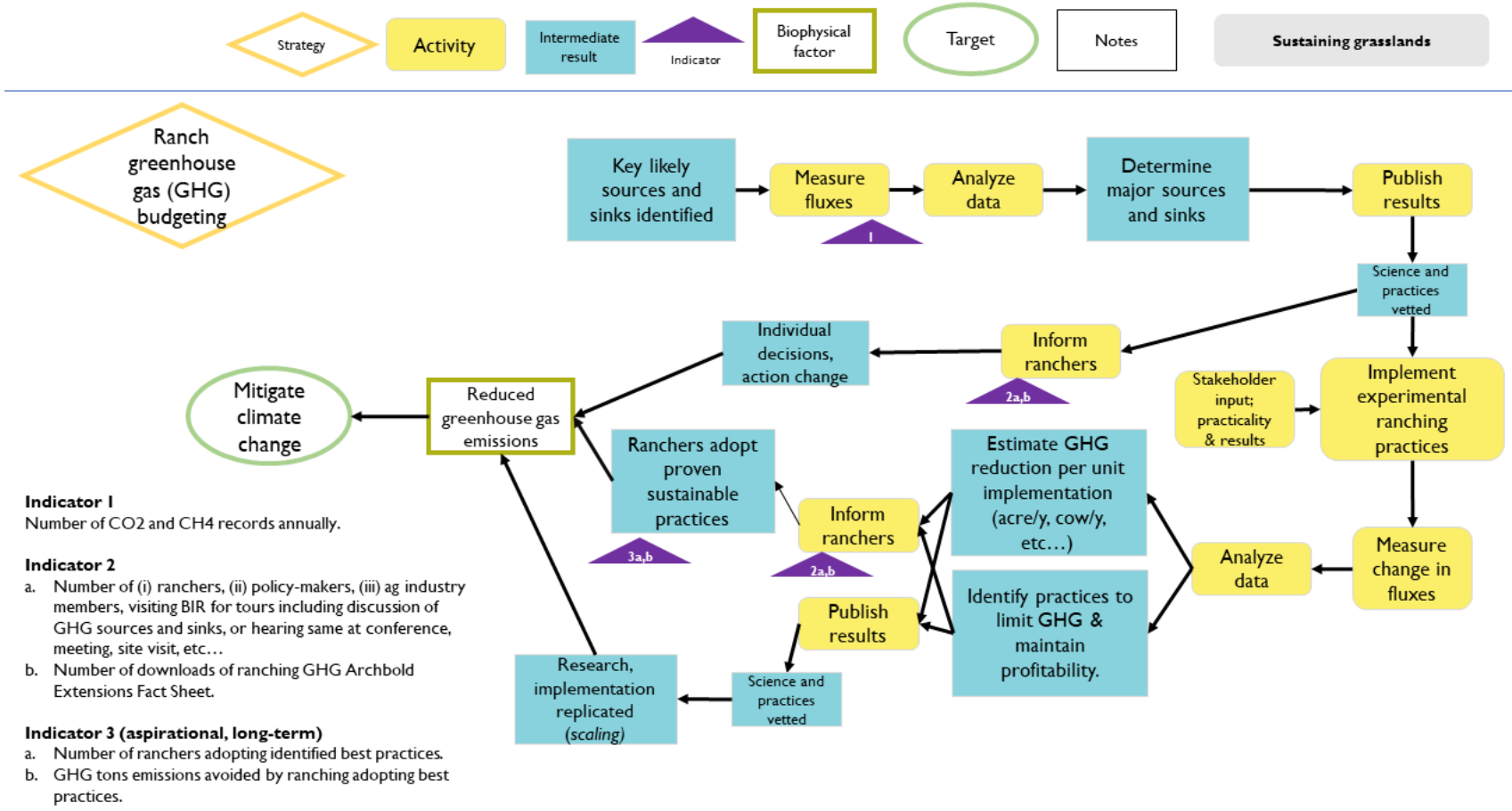
Indicator 1

a. Area of enrolled watersheds monitored annually.
b. Number of enrolled sites monitored annually.

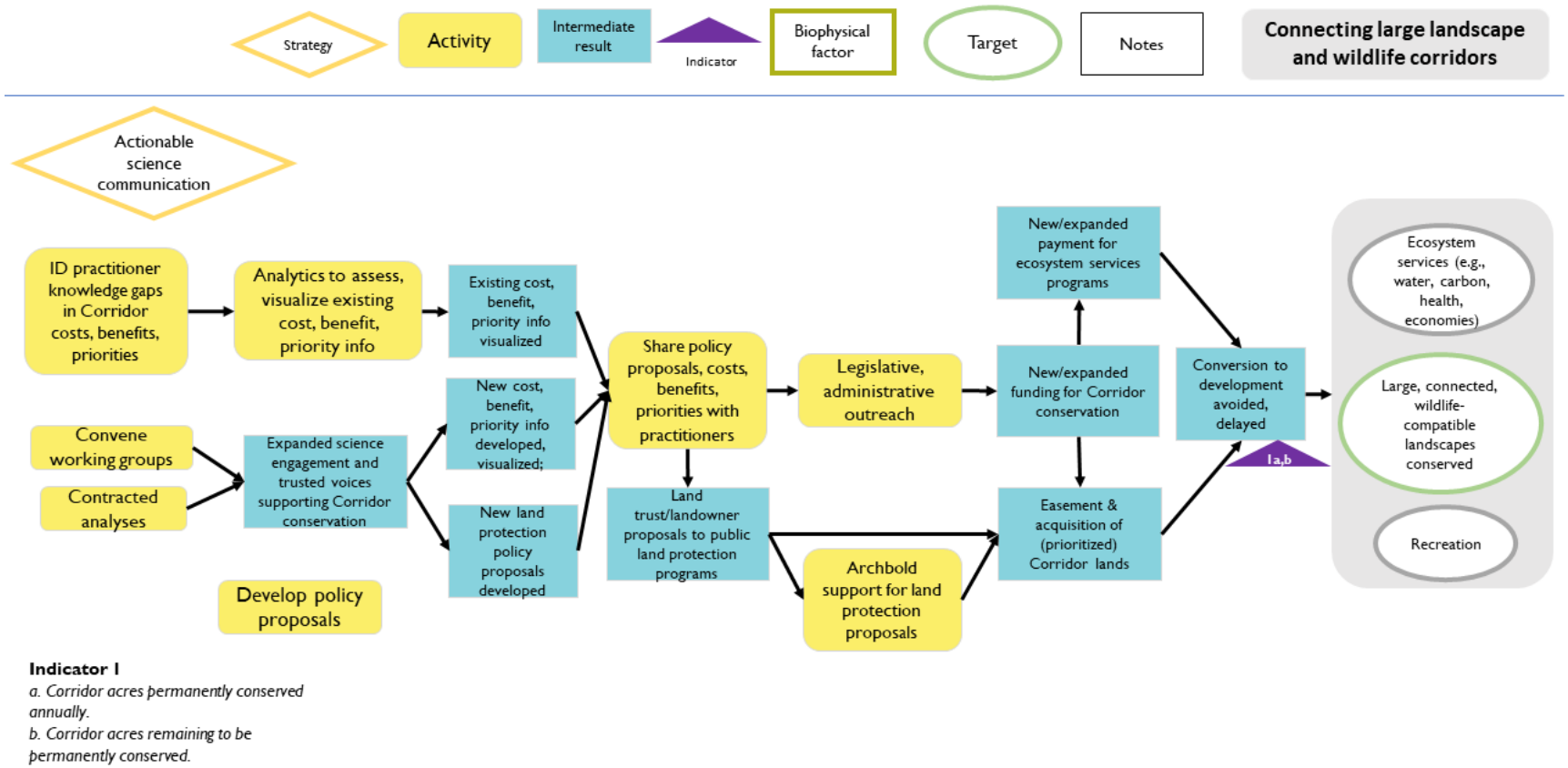
Indicator 2

a. Number of water level and rainfall measurements from enrolled sites recorded annually.
b. Number of water samples analyzed from enrolled sites annually.

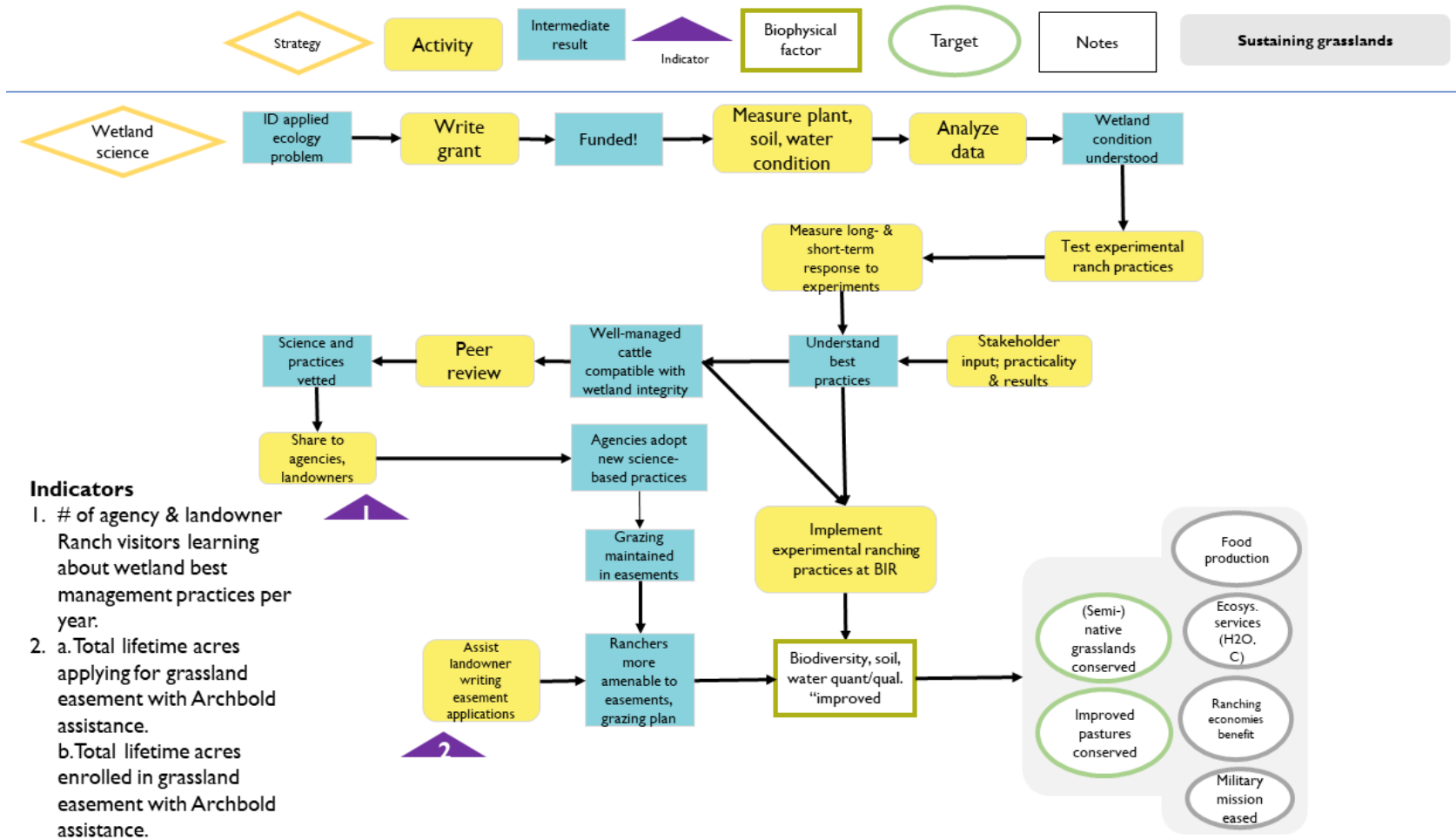
As the primary monitoring and evaluation partner in the Northern Everglades Payment for Environmental Services program, Archbold's Agroecology program helps ensure and quantify the benefits ranchers provide to Florida water resources. Under the program, the South Florida Water Management District pays landowners to store and filter water on ranches, helping restore historical water flow.



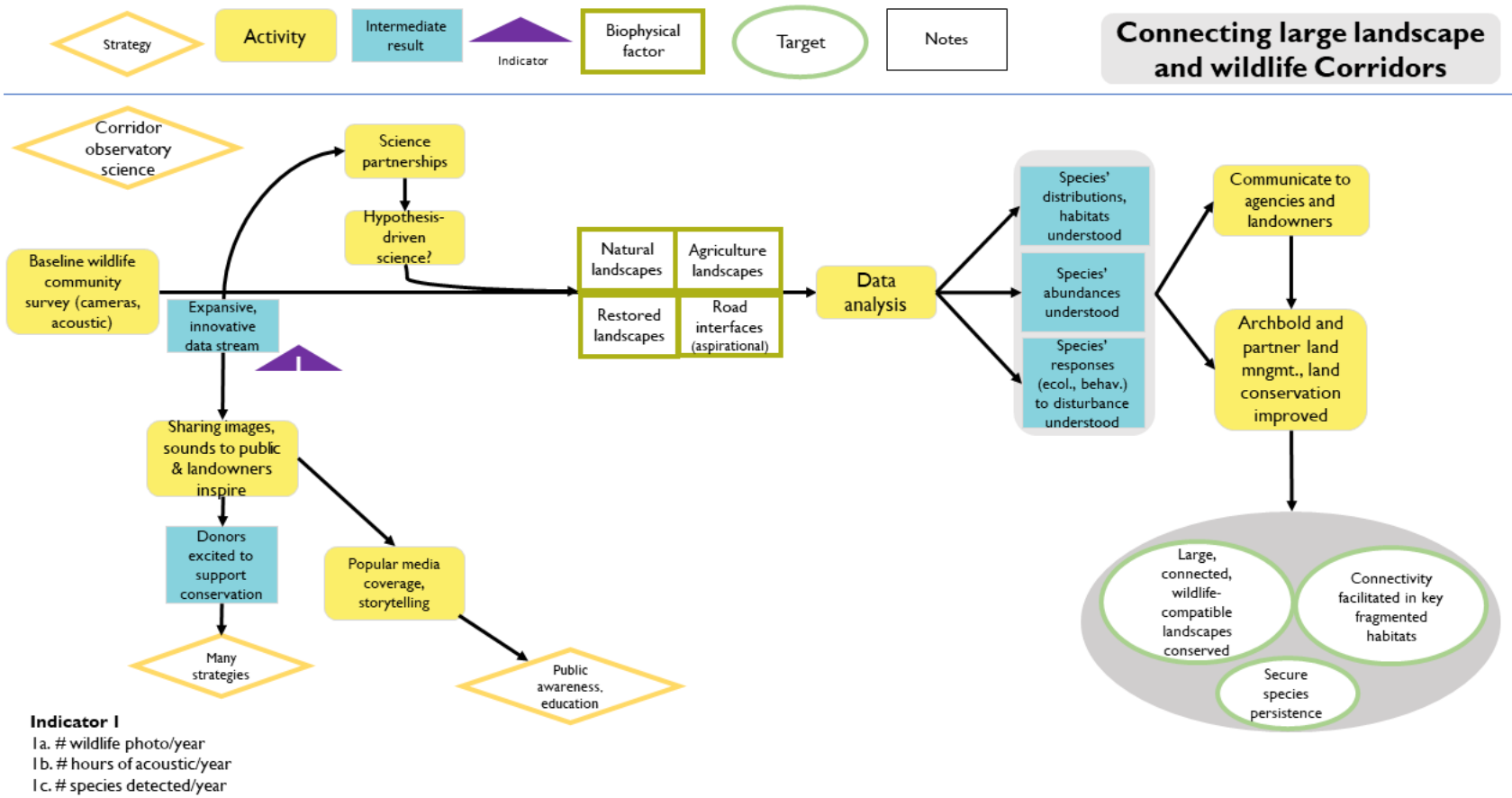
In first of its kind work, scientists at Archbold's Buck Island Ranch are completing a full-scale accounting of greenhouse gas sources and sinks associated with the property's ecosystems and ranch operations. Experiments will inform agricultural strategies that can lessen the global warming impact of cattle ranching in the southeast.



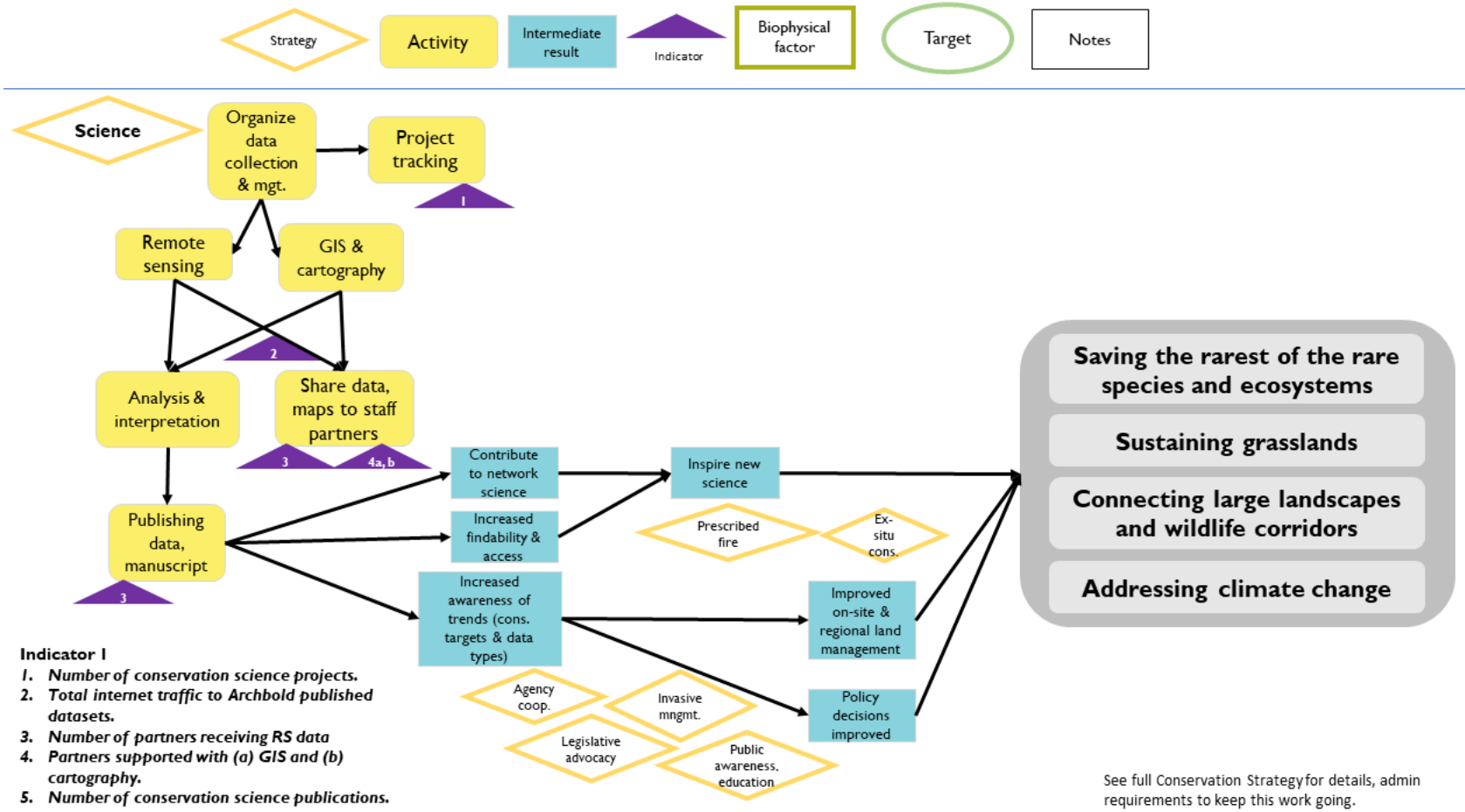
Staff in the Conservation and Data & Technology programs lead expansive, statewide engagement as the primary scientific parnter in the campaign to conserve the 18-million-acre Florida Wildlife Corridor. Their work includes provision of data and maps to stakeholder engagement and legislative outreach parnters, and both convening of workgroups and the recruitment of top experts to solve major challenges in large landscape conservation,.



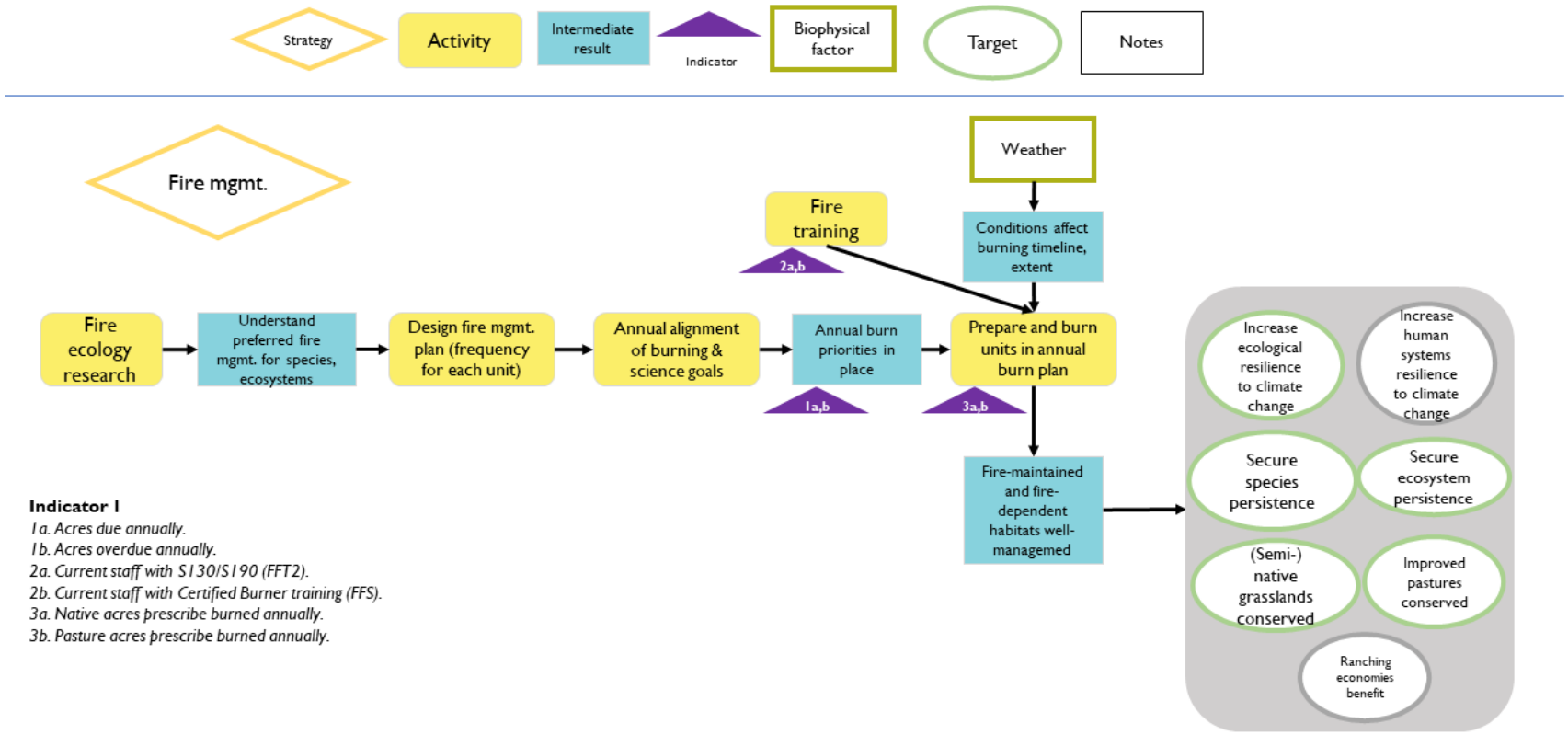
From an experimental study of 40 pasture wetlands, Archbold's agroecology program develops, implements, and disseminates to ranchers best management practices for grazing in around these aquatic habitats. Results of the work led directly to the allowance of grazing in federal conservation easements in Florida, greatly immensely boosting their relevance for habitat conservation in agricultural landscapes threatened by development.



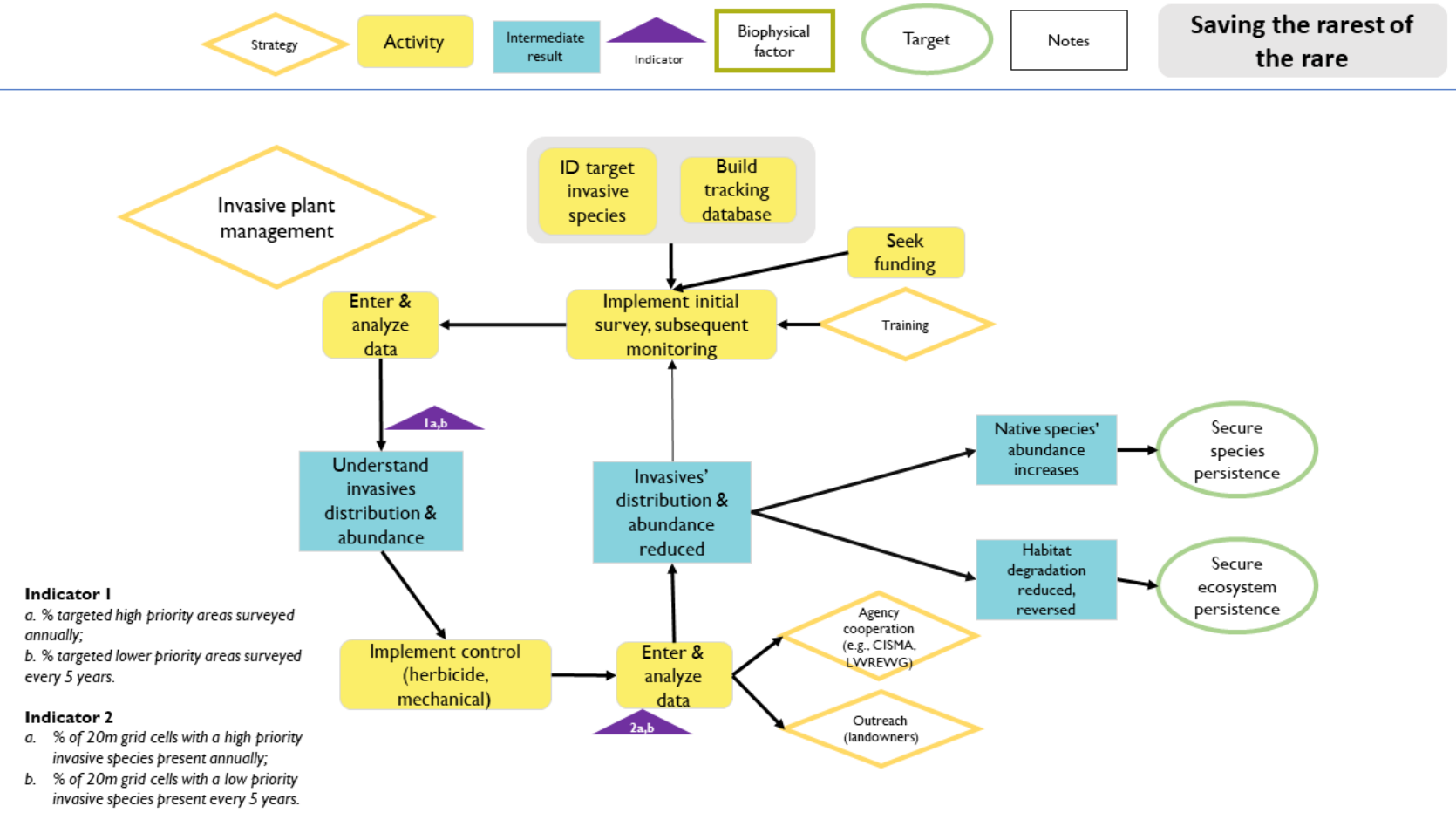
7Beginning in 2021, Archbold's predator prey ecology program has maintained an array of over 40 cameras and acoustic recorders in natural, agricultural, and restored habitats. The imagery is used for science in collaboration with academic partners and to raise public awareness of Florida wildlife.



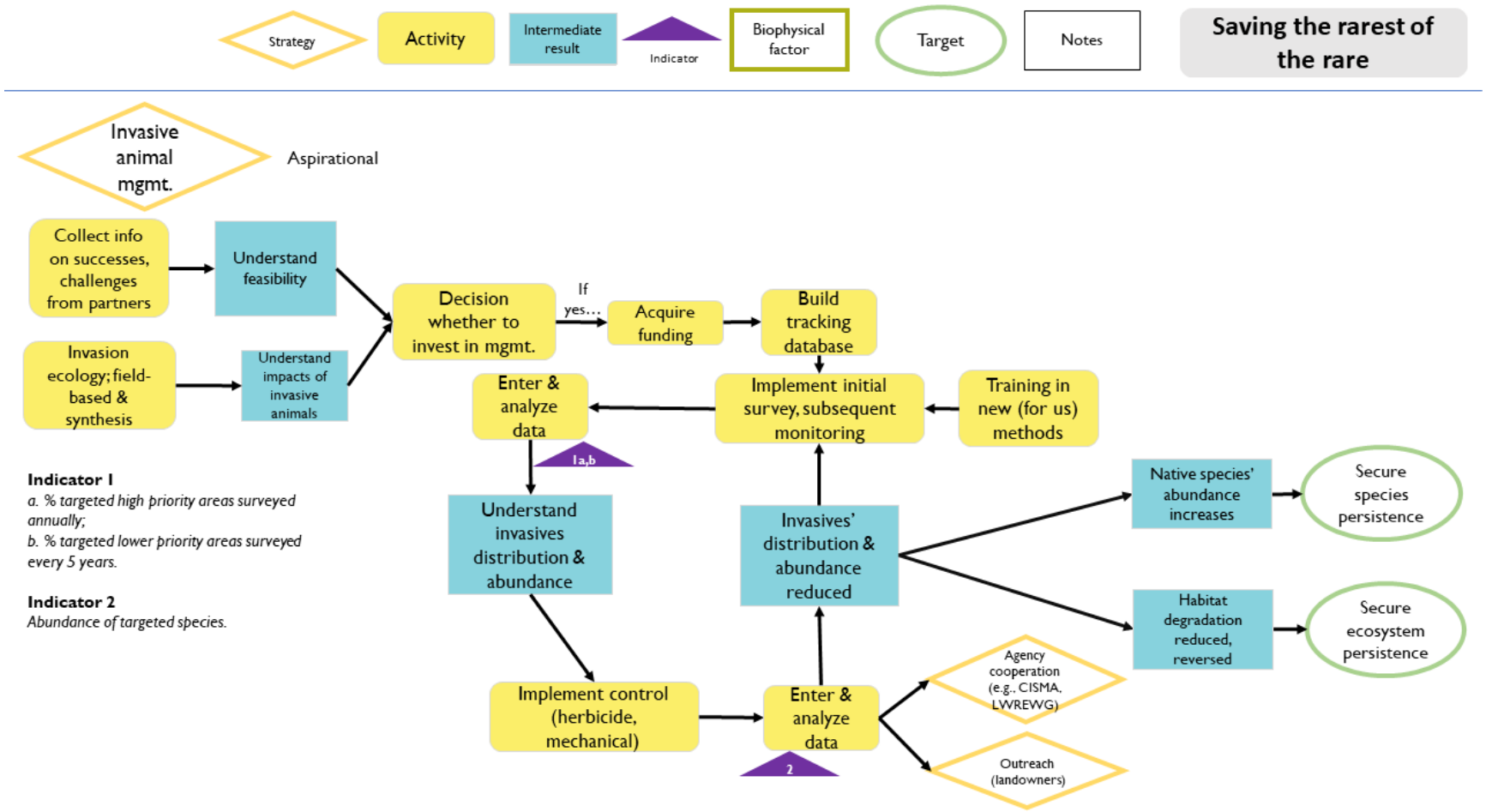
8Archbold's Data and Technology program facilitates and advances all of Archbold's work, tracking conservation outcomes and scientific productivity, producing maps and datasets for partner use in science, land protection, and habitat management.



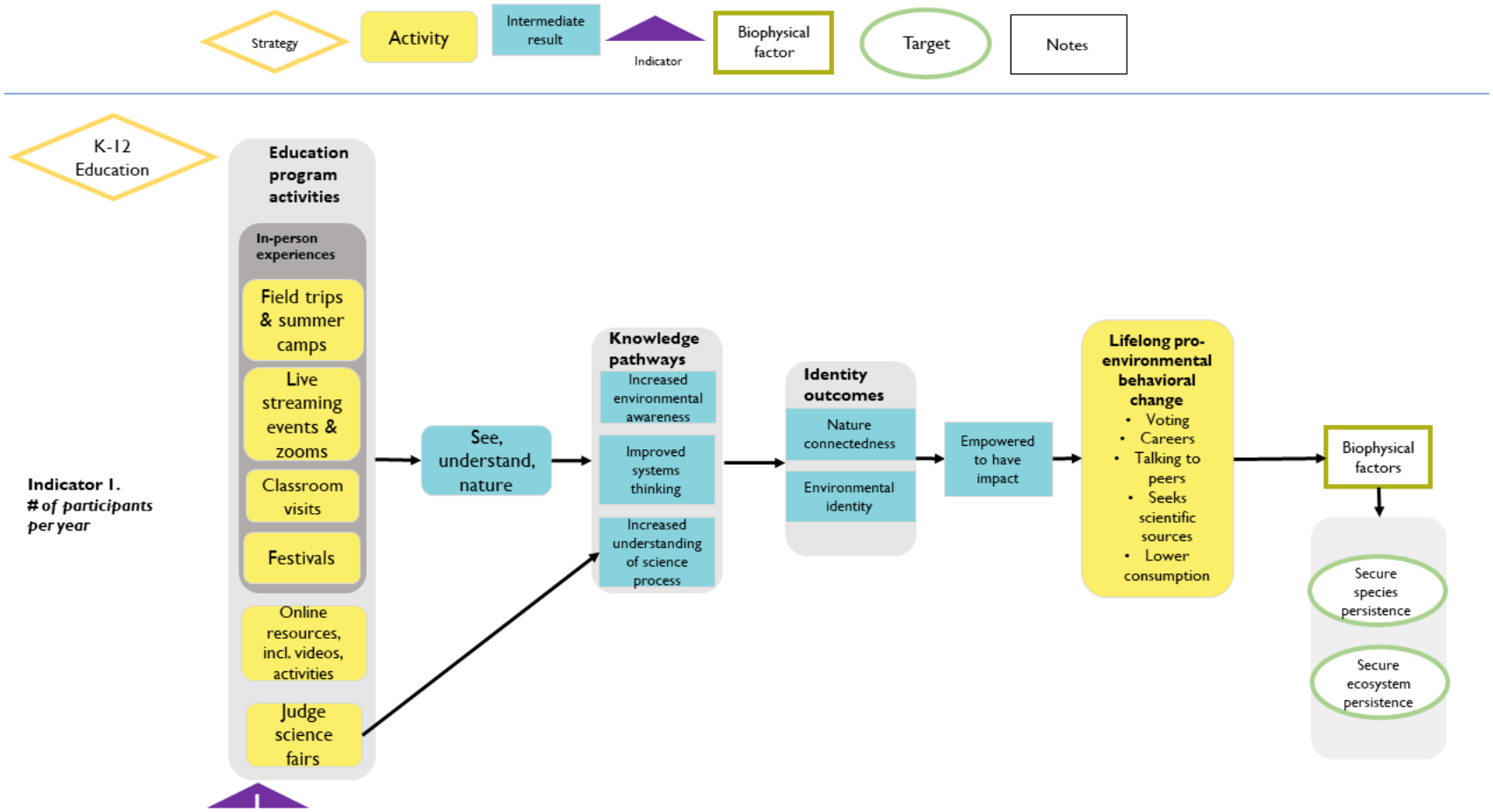
9Prescribed fire has been part of Archbold conservation for 50 years. Today, our fire planning is informed by science in all our labs and we know it to be the critical management activity that maintains scrub, flatwoods, and grassland ecosystems we and the species we study rely on.



Next to fire, invasive plant management is Archbold's biggest land management challenge. We are developing a geospatial database to track survey, treatments, and progress in controling these agressive non-native species.



10Although not implemented thoroughly as of 2022, we aspire to have a more complete approach to detecting, surveying, and controling invasive animals. Currently, this chiefly refers to feral hogs, but preparation and vigilance in advance of potential Argentine tegu and other invaders' arrival at Archbold is key.



1 1K-12 education is key way that Archbold engages with the Highlands County community and has long built an appreciation for Lake Wales Ridge and nature more broadly in the thousands of participants over decades of programming. Growing people's awareness of nature and wildlife makes them more likely to act on nature's behalf.