Sequencing Conservation Actions Through Threat Assessments in the Southeastern United States

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Abstract—*The identification of conservation priorities is one of the leading issues in conservation biology. We present a project of The Nature Conservancy, called Sequencing Conservation Actions, which prioritizes conservation areas and identifies foci for cross-cutting strategies at various geographic scales. We use the term "Sequencing" to mean an ordering of actions over time and "Conservation Actions" to represent strategies implemented both at and across conservation areas, and from local to global scales. There are three outcomes of the Sequencing Project. The first is the ranking of conservation areas into four sequencing categories based on Relative Biodiversity Value and Relative Threat Status. These categories are: 1) Now, Right Now: conservation areas to be addressed immediately, 2) Now: conservation areas to be addressed in 3-5 years, 3) Soon: conservation areas that can be addressed in 5-10 years, and 4) Later: conservation areas that can be addressed in more than 10 years. The second outcome is the identification of foci for cross-cutting strategies based on common threats. It is around these foci that strategies can be developed. The third outcome compares Relative Conservation Opportunities across priority conservation areas. The results enable a conservation entity to effectively prioritize actions across conservation areas.*

Introduction

The identification of conservation priorities is one of the leading issues in conservation biology. In an effort to effectively preserve the world's biodiversity, conservation priorities have been assessed at the scale of biodiversity hotspots (Myers and others 2000, Reid 1998) with more recent consideration given to zones of ecological transition (Araújo 2002, Gaston and others 2001), reserve networks (Andelman and Willig 2003, Groves and others 2000, Margules and Pressey 2000, Rodrigues and others 2004), and for assessing strategies at conservation areas (Low 2003). However, given the estimated size of the reserve network to conserve the world's biodiversity (11.5% of land area [Chape and others 2003]) and the investments to make it a reality ($3-11 billion per year over the next 30 years [James and others 2001, Pimm and others 2001]), NGOs and agencies are constantly challenged to strategically consider where, when, and how to invest their limited funds to maximize conservation benefits (Meir and others 2004).

Assessing the priority of conservation areas has focused correctly on high biodiversity significance and protection status (Groves 2003, Pressey and others 2000, Ricketts 1999, Scott and others 1996, Smith and others 2002). Such an approach has provided significant influence on conservation efforts by public and private agencies. These studies, however, have not adequately incorporated threats impacting biodiversity, which is the primary temporal influence on conservation action. The more robust approaches have incorporated threats into their assessment process (Neke and du Plessis 2004, Noss 2002, Theobald 2003) and it is becoming increasing recognized that conservation will fail without detailed insights into the threats that are putting species and ecological systems at risk (Lawler and others 2002). Predicting future threats, such as those from population growth (Saterson and others 2001, McKee and others 2003, Rouget and others 2003), invasives (Dirnbock and others 2003), roads, agriculture, forestry and global climate change, can provide a proactive approach to conservation.

We present a project of The Nature Conservancy (TNC), called Sequencing Conservation Actions, which prioritizes conservation areas and identifies foci for cross-cutting strategies (strategies that impact conservation at multiple sites) at various geographic scales (state, ecoregion, region). The Nature Conservancy's mission is to protect biological diversity (Groves and others 2000), thus the conservation focus of this project is the protection of species, natural communities and ecological systems. We use the term "Sequencing" to mean an ordering of actions over time and "Conservation Actions" to represent strategies implemented both at and across conservation areas and from local to global scales.

In the Southeast U.S., the region in which the Sequencing project was developed, there are 1268 conservation areas identified in 11 Ecoregional Assessments. Ecoregional Assessments, done at the scale of ecoregions (Groves and others 2000, Velutis and Mullen 2000), identify targets of biodiversity interest, assess the viability of target occurrences, establish target occurrence and geographic goals, and circumscribe conservation areas of biodiversity significance (Groves and others 2000, Velutis and Mullen 2000). They present the complete set of conservation areas that protect multiple occurrences of the identified targets. Ecoregional Assessments have the added value of identifying multi-site strategies, engaging partners and collaborators, and identifying research and inventory needs. Sequencing Conservation Actions extends these Assessments by identifying the highest priority conservation areas and foci for cross-cutting strategies.

Three parameters were used to sequence conservation actions. First, an assessment of Relative Biodiversity Value, reflecting the significance of species and natural communities (total number of targets, rare targets), was assigned to each conservation area. Second, a Relative Threat Status was determined through the assessment of 30 standardized threats. Last, each conservation area was assessed for their Relative Conservation Opportunities. The first two are based on the characteristics of the conservation area; the conservation targets and the threats to those targets. The third parameter, takes into account the human dimensions of available funding, planning windows, the presence of partners, and project feasibility.

There are three outcomes to the Sequencing Project. The first is the ranking of conservation areas into four sequencing categories based on Relative Biodiversity Value and Relative Threat Status. These categories are: 1) *Now, Right Now:* conservation areas to be addressed immediately, 2) *Now:* conservation areas to be addressed in 3-5 years, 3) *Soon:* conservation areas that can be addressed in 5-10 years, and 4) *Later:* conservation areas that can be addressed in more than 10 years. The second outcome is the identification of foci for cross-cutting strategies based on common threats. It is around these foci that strategies can be developed, supported by the quantitative information gathered for each threat. The third outcome compares Relative Conservation Opportunities across priority conservation areas.

In this paper, we outline the methods used to obtain these outcomes and provide several examples. The results provide a basis for a conservation entity to prioritize conservation areas and a context for site specific actions, including land acquisition, threat abatement, land management and restoration, and influencing public policy or implementing sustainable land uses.

Methods: Description of the Sequencing Process

Parameters

Three parameters were used in the Sequencing Process to assess priorities of conservation areas and cross-cutting strategies.

1. Relative Biodiversity Value

In order to determine the Relative Biodiversity Value of a conservation area we calculated an index of "irreplaceability" (Pressey and others 1994). Used in other efforts to identify conservation priorities (Marshall and others 2004, Enquist and others 2004), this measure is dependent upon the targets represented at a conservation area and the number of conservation areas being considered (for example, scale dependent). Therefore, irreplaceability may be defined as the potential contribution of a target to meeting the conservation goals within the context of other conservation areas. The index changes as targets become more or less represented in conservation areas elsewhere in the Ecoregion (Pressey and others 1994). Targets that have fewer occurrences will have higher index values and contribute greater to a conservation area score (see scoring below). Target occurrence data from Ecoregional Assessments, provided by the Natural Heritage Program Network, was used to calculate the index.

2. Relative Threat Status

Relative Threat Status was obtained through the assessment of 30 standardized and defined threats (table 1) for each conservation area. Threats were defined as activities or conditions that limit the viability of populations or the functionality of ecological systems. They are the factors or sources (development, dams, grazing) contributing to the stresses (habitat destruction, altered hydrologic regime, sedimentation) impacting the targets.

Threats were ranked by two attributes: 1) the *Severity* of the threat – how severe the stresses of the threat are to the conservation targets and 2) *Percent of Ecoregional Target Occurrences Affected*– the proportion of the target occurrences on which the threat is acting at the ranked level of severity. Threats were assessed at the scale of the conservation area, across all the target occurrences. Threats were scored for two time frames, 1) *Active*

Table 1. Standardized Threats by Category.

Forest Threats	
	Forest Conversion
	Incompatible Forestry Practices and Management
	Forestry Roads
Agriculture Threats	
	Agriculture Conversion
	Incompatible Agricultural Practices
	Conversion to Pasture
	Incompatible Grazing Practices
	Livestock Feedlots/Production Practices
Resource Extraction Threats	
	Incompatible Resource Extraction
	Proposed/Potential Mineral Resource Extraction
Development Threats	
	Urban/Suburban Development
	Industrial Development
	Second Home/Vacation Development
	Development of Roads/Utilities
Hydrologic Threats	
	Operation of Dams/Impoundments
	Proposed Dams/Impoundments
	Water Withdrawal
	Proposed Water Withdrawal
	Excessive Groundwater Withdrawal
	Channel Modification
	Incompatible Water Quality
Other Threats	
	Invasive Species
	Parasites/Pathogens
	Altered Fire Regime
	Recreation
	Overexploitation of Species
	Airborne Pollutants/Nutrients
Coastal Threats	
	Shoreline Stabilization
	Sea-Level Rise/Global Climate Change
	Global Climate Change

– current or a very high probability of occurring within 10 years or 2) *Historic* – past threats that were no longer active but their impacts were still affecting biodiversity in the conservation area. Ranking was done on an ordinal scale (low, medium, high, very high) as defined in table 2. The ranking of threats was done in expert meetings for each ecoregion involving knowledgeable biologists and land managers. Based on the expertise present at the meeting, the collective "level of knowledge" about each conservation area and its target occurrences was also assigned a rank (table 3).

The collection of experts' intimate knowledge of the conservation areas was the most valuable asset during the threat assessment process. Although quantitative data pertaining to the spatial distribution of conservation areas within an ecoregion and the identification and location of targets was also made available at each expert meeting. These data were derived from Ecoregional Assessments and the Freshwater Biodiversity Conservation Assessment (Smith and others 2002). Spatial layers of roads, managed areas, rivers, and landuse (National Land Cover data 1992) were also provided. Threat maps were generated for selected threats such as population, predicted population growth, livestock facilities, and hydrologic dams and made available during discussions as needed.

3. Relative Conservation Opportunity

The addition of Relative Conservation Opportunities adds the circumstances under which conservation is conducted "on the ground." The scoring of this last component is done from the perspective of the whole conservation community and was also completed in expert meetings involving biologists and individuals knowledgeable about funding sources, public policy, partners, and stakeholders. The final product allows the comparison of the ecologically most important places to work with conservation areas that have the greatest conservation opportunities. Six attributes were used to score this parameter.

Funding Opportunities: presence of funding from any source (private or public) that is available and sufficient to begin implementation of key strategies for the specific conservation area. Sufficient funding is subjectively assessed across the range and cost of key strategies (protection, policy, land management).

Presence of Support in Key Agencies/Partners: the presence, or potential presence, of support within key partner agencies having sufficient competency and will have significant positive influence (directly or indirectly conserving target occurrences) on project success.

Policy and Constituency (Stakeholder) Support: the presence of policy, constituency, both state-wide and local, and the political context that will have significant influence (directly and indirectly conserving target occurrences) on the success of a project.

Feasibility: a measure of how likely conservation success (based on conservation of the majority of conservation targets by implementation of priority strategies) can be obtained at a conservation area. This measure is a combination of the ease of implementation of the project (for example, logistics, number of landowners) and the ecological integrity of the site (for example, how much restoration is needed or how difficult to abate threats such as hydrologic alteration or pathogens).

Unique Opportunity Windows: An unique opportunity window includes infrequent planning windows, a rare opportunity to purchase land, or currently established momentum for conservation. The unique opportunity window must be currently present or exist over the next 2-3 years and taking advantage of the window with focused conservation efforts will have significant conservation

Table 2. Rank definitions for the attributes of Severity and Percent of Ecoregional Target Occurrences Affected.

	Severity Ranks Defined
Very High	the **threat** is likely to destroy or eliminate (irreversible) one or multiple targets within thenext 5 years or currently a less severe threat that if not addressed immediately (invasive species; altered fire regimes) will become a very high rank within the next 5 years – or – **historically, the threat has destroyed or eliminated one or multiple targets**.
High	the **threat** is likely to seriously degrade (possible to restore but difficult and costly) one or multiple targets within the next 5 years or currently a less severe threat that if not addressed immediately will become a high rank within the next 5 years – or – **historically, the threat has seriously degraded one or multiple targets**.
Medium	the **threat** is likely to moderately degrade (possible to reverse) the target within the next 5 years – or – **historically, the threat has moderately degraded one or multiple targets**.
Low	the **threat** is likely to slightly impair (easily reversed) the target within the next 5 years – or – **historically, the threat has slightly impaired one or multiple targets**.
	Percent Ecoregional Target Occurrence Ranks Defined
Very high	the **threat** is likely to impact >50% of the target occurrences at the conservation area - or – **historically, the threat has impacted a majority of target occurrences**.
High	the **threat** is likely to impact one **irreplaceable** (see definition below) conservation target occurrence or 25 - 50% of the target occurrences at the conservation area – or **historically, the threat has impacted a high percentage of target occurrences**.
Medium	the **threat** is likely to impact 10 - 25% of the target occurrences at the conservation area – or – **historically, the threat has impacted a moderate percentage of target occurrences**.
Low	the **threat** is likely to impact <10% of the target occurrences at the conservation area - or – **historically, the threat has impacted a low percentage of target occurrences**.

Table 3. Rank definitions for varying degrees of the experts' level of knowledge about a conservation area and its target occurrences.

Level of Knowledge Defined	
Very High	A very high level of knowledge of the Conservation Area that includes a completed conservation area plan.
High	A high level of knowledge of the Conservation Area with one or more participants having first-hand knowledge of the whole site and over 50% of the targets.
Medium	A medium level of knowledge of the Conservation Area with one or more participants having first-hand knowledge of part of the site and less than 50% of the targets.
Low	A low level of knowledge of the Conservation Area with the participants having no first-hand knowledge of the site and will be making their best guesses for threats and leverage.

impact (directly and indirectly conserving target occurrences) at a single conservation area or across numerous conservation areas.

Opportunity for Significant and Real Leverage: Leverage is defined as investments of conservation resources in conservation action at one conservation area, through direct action or influencing management decisions, that results in or enables threat abatement and restoration across many other conservation areas. For example, this attribute would include exporting new conservation knowledge/approaches developed at one site to other sites.

Scoring

Relative biodiversity value

We calculated an index of "irreplaceability" to represent the Relative Biodiversity Value of a conservation area following the method outlined and incorporated in prioritization efforts by Marshall and others 2004. For each conservation target, the number of conservation areas (for a given ecoregion) at which it occurs was determined and the inverse of that number was calculated to represent the importance of a particular area. For example, a target occurring at 20 conservation areas would have an index of 1/20 and protecting any one of those 20 areas would protect an occurrence of the target (Marshall and others 2004). Targets captured at fewer areas would have higher index values giving them greater weight (for example, 1/2 is larger than 1/20) (Marshall and others 2004). The index values for all targets present for a given conservation area were then summed to give an index of irreplaceability (IRR): IRR = 1/(count of areas with target

Table 4. Threat Rank Matrix: results of Severity and Percent Ecoregional Target Occurrence ranks.

	Percent of Ecoregional Target Occurrence Ranks:				
	VERY HIGH	HIGH	MEDIUM	LOW	
Severity Ranks:	VERY HIGH	Very High	Very High	Very High	High
	HIGH	Very High	High	High	Medium
	MEDIUM	High	Medium	Medium	Low
	LOW	Medium	Low	Low	Low

Table 5. Example calculations for determining Relative Threat Status. Very High (VH), High (H), Medium (M), Low (L).

	Tallied Number of Threat Ranks:				**Threat Rank x Log 5 value:**				
Conservation Area	**VH**	**H**	**M**	**L**	**VH = 125**	**H = 25**	**M = 5**	**L = 1**	**Relative Threat Status**
A	7	9	7	0	875	+25	+35	+0	= 1135
B	4	3	0	0	500	+5	+0	+0	= 575
C	3	0	12	0	375	+0	+60	+0	= 435

a) + 1/(count of areas with target a) + 1/(count of areas with target a)…for all targets at a given area.

Relative threat status

The first step towards calculating the overall Relative Threat Status of a given conservation area is to assess the impact of a single threat at the given conservation area. The attributes of *Severity* and *Percent Ecoregional Target Occurrences* were ranked on an ordinal scale (low, medium, high, and very high) and combined according to the matrix in table 4, to obtain a *threat rank* for each threat.

The four *threat ranks* for a given conservation area were tallied and multiplied by its respective log 5 value (for example, number of *very high* ranks multiplied by 125, *high* ranks x 25, *medium* ranks x 5, and *low* ranks x 1, see table 5). Finally, Relative Threat Status is calculated as the sum of all *log values* within a given conservation area (table 5).

Conservation opportunities

Six attributes were also ranked on an ordinal scale (low, medium, high, or very high) for assessing Relative Conservation Opportunities. Ordinal scale values translated into numeric values from 1-4 (low = 1, very high =4) and the attributes of Funding and Opportunity Window were each weighted by 2 (4 x 2 = 8) while the Presence of Key Agencies/Partners was weighted by 1.5 (4 x 1.5 = 6). Subsequently, the highest possible value available for a given conservation area would be 34 (3 attributes x 4; 2 attributes x 8; 1 attribute x 6). Dividing scores into quartiles provided the Conservation Opportunity categories of very high, high, medium or low opportunity (fig. 2).

Example of Sequencing Results

Figure 1 illustrates the output that positions conservation areas along the two axes of Irreplaceability and Relative Threat Status for the South Atlantic Coastal Plain (SACP) ecoregion. The graph provides information on the Sequencing Category (determined by the region of the graph) and the level of knowledge about each conservation area brought to the assessment by experts (the color and size of the points). Action Sites, priority conservation areas subjectively identified in the South Atlantic Coastal Plain Ecoregional Assessment (TNC 2002), have been marked with an asterisk. Thresholds of Relative Threat Status were established on a log 5 scale at the 50 and 250 values. The conservation areas that fall within the region above the 250 threshold contain at least 2 threat ranks scored as very high while those within the region between 50 and 250 had at least 2 high threat ranks. The Irreplaceability index was placed on a log + 1 scale. The thresholds of Soon and Later represent the 50% and 75% quartiles of the largest log value within the data set (1.73 in the case of SACP). Therefore, a conservation area with a Relative Threat Status >250 and an Irreplaceability Index of <1.3 falls within the *NOW* sequencing category.

The Sequencing Categories, from bottom left to top right, are: *Later:* conservation areas that can be addressed in more than 10 years due to low threat and low irreplaceability value; *Soon:* conservation areas that can be addressed in 5-10 years due to low threat and medium to low irreplaceability; *Now:* conservation areas to be addressed in 3-5 years due to a medium to high threat and with a medium to low irreplaceability value; and *Now - Right Now:* conservation areas to be addressed

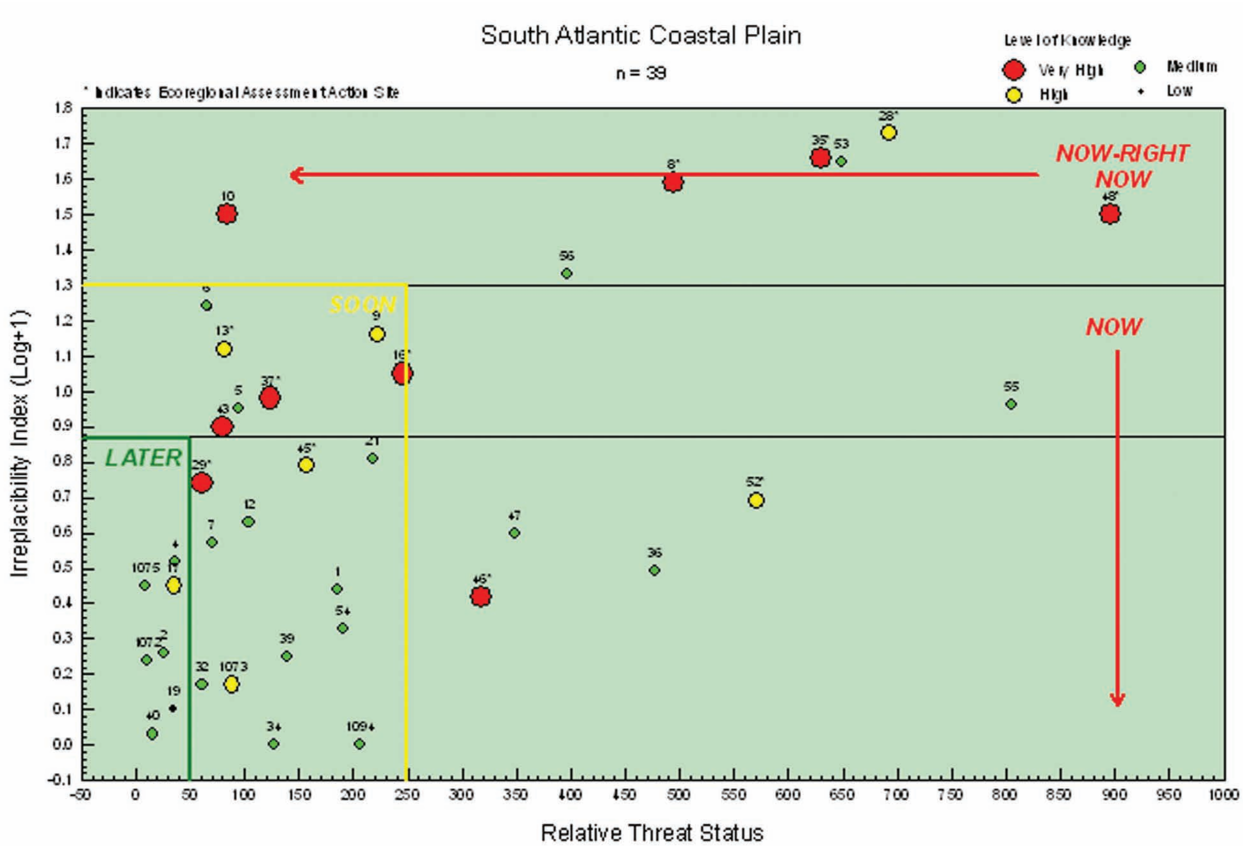

Figure 1. Four levels of Conservation Action for 39 conservation areas in the South Atlantic Coastal Plain Ecoregion. Each point represents a conservation area labeled by the conservation id. Sequencing Category thresholds are indicated by red (Now-Right Now and Now), yellow (Soon), and green (Later) lines. Participants Level of Knowledge about each conservation area is noted by different size and color points. Actions sites identified in Ecoregional Assessments are indicated by an asterisk.

immediately driven by their high irreplaceability value and a range of threat status from low to high. The dimensions of the *Now-Right Now* category reflects the duel desire of conservation entities to protect both high biodiversity areas that have low threat and those that have high threat. Table 6 lists the conservation areas in both the *Now-Right Now* and *Now* categories and provides the scores for Irreplaceability Index and Relative Threat Status.

Figure 2 illustrates the output that positions conservation areas along the two axes of Irreplaceability and Relative Threat Status for the state of Georgia (combination of five ecoregional assessments). The graph provides information on the Sequencing Category and the rank of Relative Conservation Opportunity (the color and size of the points). Note that all of the *Now-Right Now* conservation areas have either a very high or high conservation opportunity, an unusual result among the seven state assessments.

Figure 3 presents threat data for the state of Georgia. Percent occurrence of each of the 30 threats using just Very High and High threat ranks have been graphed. This information provides foci for identifying potential cross-cutting strategies.

All three figures may be graphed at various scales (state, ecoregion, region) and may represent different threats or ownership. For the latter, we have generated graphs for conservation areas in which the USFS and USFWS are primary land owners. Each parameter may also be assigned to a GIS layer and mapped to represent the spatial distribution of each threat or threat rank.

Discussion

The process of Sequencing Conservation Actions highlights several challenges in assessing the priorities across a set of conservation areas. An obvious concern is the completeness and quality of the data. The Southeast U.S. is one of the most thoroughly inventoried and data rich regions of the world. Over the 11 ecoregional plans and 1268 conservation areas, there were 38,000 target occurrences (representing some 3500 species groups and natural communities) and the process was enriched by the involvement of 160 field biologists and land

Table 6. South Atlantic Coastal Plain Conservation Areas with Sequencing Category of *Now-Right Now* and *Now*.

Conservation Area (CA)	State	Level of Knowledge	Targets	IRR[1]	RTS[2]	Sequencing Category
Coastal Islands and Estuaries	GA-SC-FL	High	92	52.94	693	NOW-RIGHT NOW
Altamaha River	GA	Very High	111	44.92	630	NOW-RIGHT NOW
New Trail Ridge	FL	Medium	87	43.81	649	NOW-RIGHT NOW
St. Marys River	FL-GA	Very High	64	30.43	896	NOW-RIGHT NOW
Ixia Flatwoods	FL	Medium	24	8.03	805	NOW-RIGHT NOW
Timucuan/Pumpkin Hill	FL	Very High	25	7.97	1098	NOW-RIGHT NOW
Durbin/Dee Dot	FL	High	15	3.95	570	NOW-RIGHT NOW
Savannah River Basin	SC-GA	Very High	108	37.60	495	NOW
Santa Fe/New River	FL	Medium	37	20.57	397	NOW
Crooked River/King's Bay	GA	Medium	8	2.94	348	NOW
Alapaha River	GA-FL	Medium	9	2.10	477	NOW
Grand Bay/Banks Lake	GA	Very High	6	1.63	318	NOW

[1] IRR = Irreplacibility Index
[2] RTS = Relative Threat Status

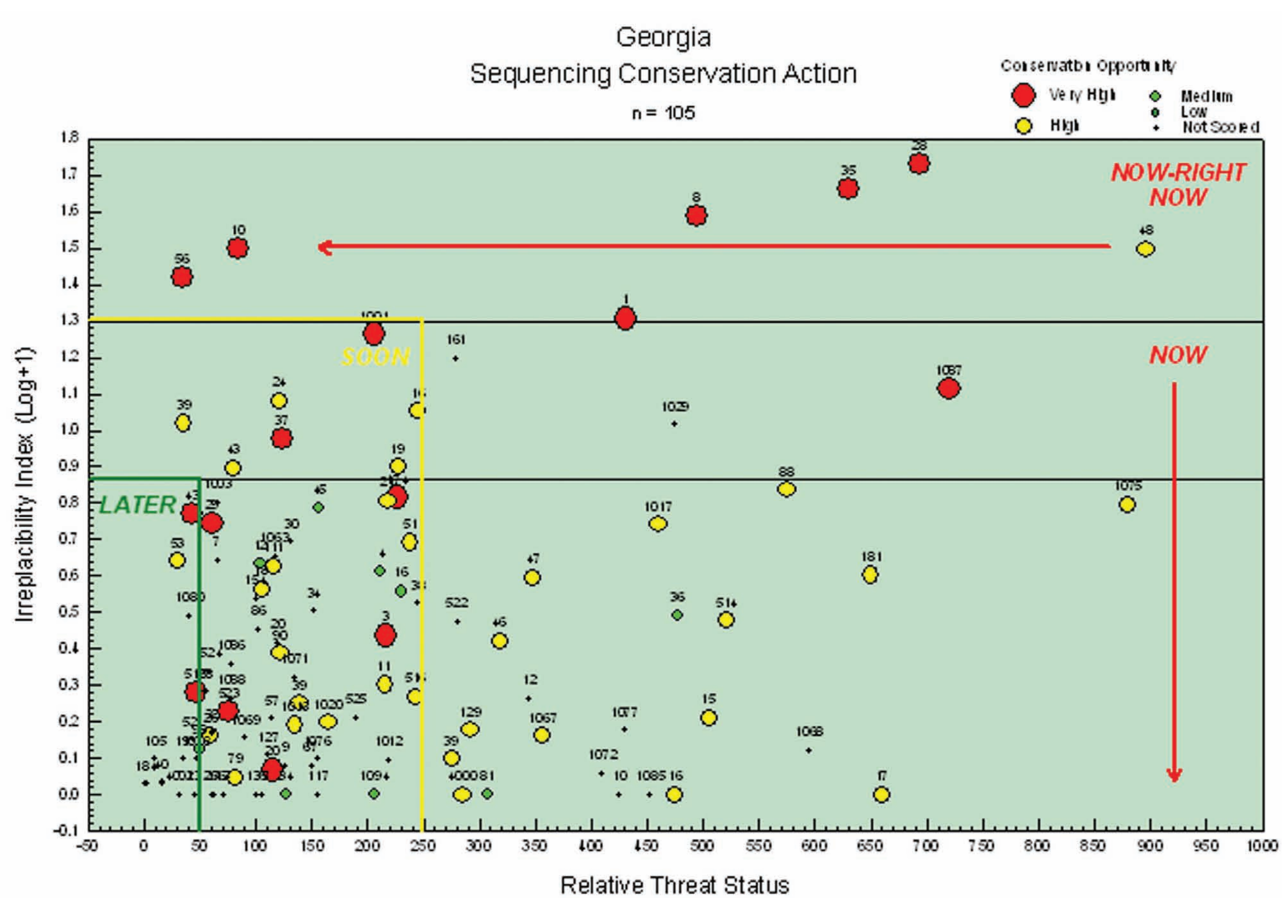

Figure 2. Four levels of Conservation Action for 105 conservation areas in Georgia from 5 ecoregional assessments. Each point represents a conservation area labeled by the conservation id. Sequencing Category thresholds are indicated by red (Now-Right Now and Now), yellow (Soon), and green (Later) lines. Conservation Opportunity is indicated by different size and colored points.

managers. While data was extensive, there are always problems with completeness. Even in well inventoried regions, not all target occurrences are known and within and across ecoregions there were obvious gaps in knowledge. There were also differences among ecoregions and states in compiling data and the involvement of experts. Consistency was greatest at the ecoregional scale. When rolling up data, the inconsistency across plans effects the accuracy of the results.

Developing an appropriate measure for Relative Biodiversity Value involved testing several indices before settling on the Irreplaceability Index. The goal was

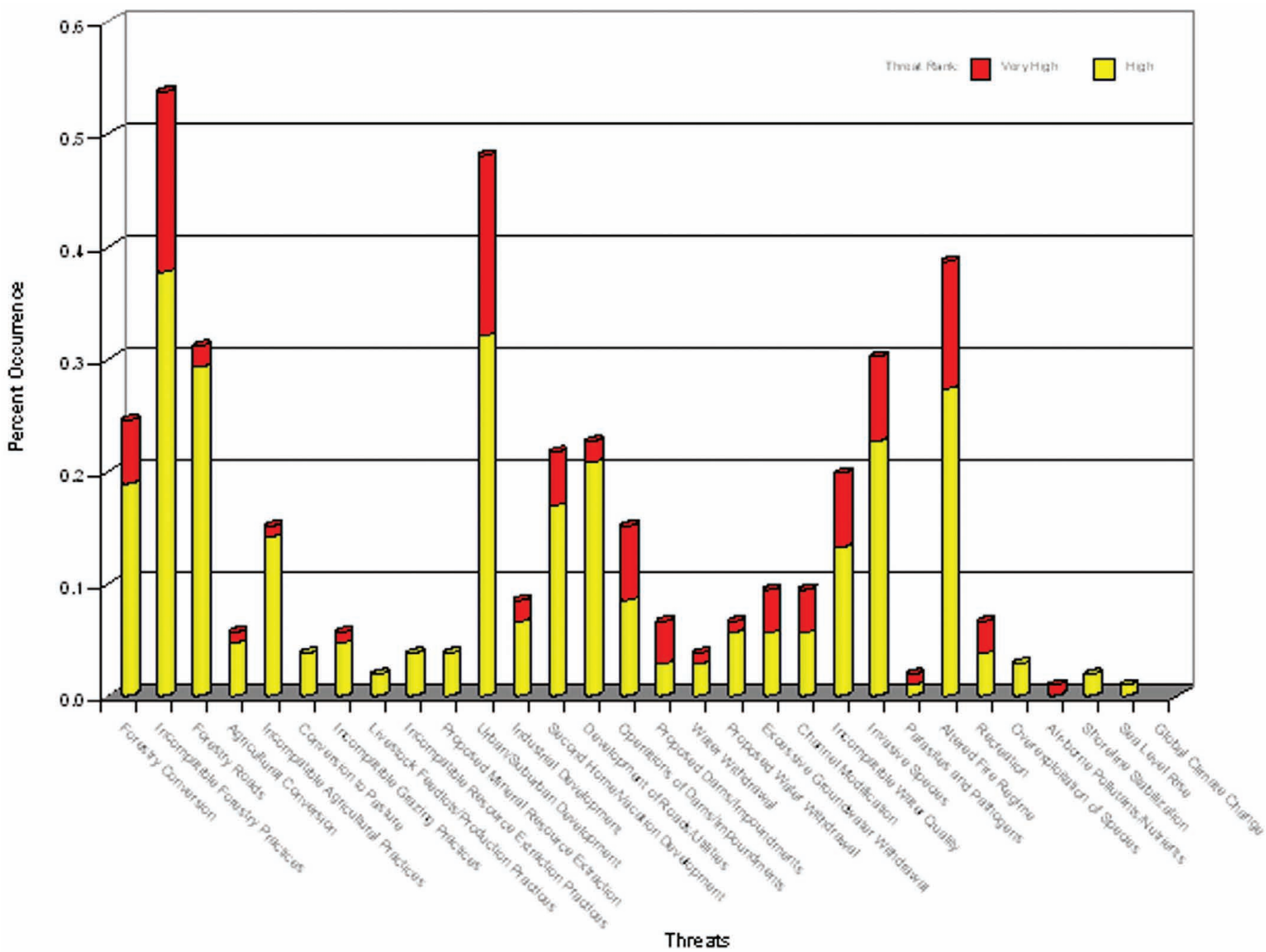

Figure 3. Very high and High Threats Ranks for each of the 30 threats scored for Georgia.

to rank conservation areas by a value representing the significant biodiversity of that area, moderating the bias of larger areas (usually having more targets), and giving additional weight to rare (having few occurrences across their range) and irreplaceable (occurring in only one location) targets. The first index used to represent Relative Biodiversity Value, incorporated the total number of ecoregional target occurrences and the number of globally rare targets (G1 and G2 ranked targets). However, this index did not represent conservation areas with "irreplaceable" targets (G1 targets found only at one conservation area in the ecoregion). Subsequently, conservation areas with an irreplaceable target were queried individually and assigned, by default, to the *Now-Right Now* sequencing category. In doing so, we lost the actual relationship between Relative Biodiversity Value and Relative Threat Status. Comparing the different indices found that each provided similar relational patterns between Relative Biodiversity Value and Relative Threat Status (Sutter and Szell unpublished data).

Enquist and others (2004) chose not to use the Irreplaceability Index, instead they used an index developed from 6 weighted attributes. While the correlation among their three indices were high (all greater than r=.85), they felt that the Irreplaceabiliy Index was more sensitive to sampling bias and the lack of knowledge of the distribution of targets among the conservation areas. We do not see this as an unique issue with the Irreplaceability Index, rather sampling bias will effect all indices in similar ways. With the Irreplaceability Index, only new targets at the scale of assessment (ecoregion, state) or the addition of an occurrences of a target in a new conservation area will have a substantial influence on the index. This, we believe, is outweighed by the simplicity and clarity of the Irreplaceability Index. In addition, the index's dynamic nature allows rapid re-evaluation of the "uniqueness" of a given conservation area as more target data becomes available. One does need to take care of interpreting a score of 1 for the Irreplaceability Index. This suggests that either the conservation area encompasses a target that only occurs at that location (1 of 1 occurrence) or many targets occur at multiple locations so when the many index values for a given conservation area are summed they give an index of irreplaceability (IRR) equal to 1. Thus the index does not guarantee that all very rare targets receive a high IRR score. The data itself (table 6) provides a means of assessing this.

Developing the Relative Threat Assessment measure also presented challenges. First, there was no standardized and comprehensive list of threats that could be adopted. We developed our own list of threats (table 1) from our experience, TNC conservation plans, and published articles (Salafsky and Margolius 1999). The content and structure of the list, as expected, evolved through the process, although we had to continue scoring threats in the categories first chosen. We would recommend others using our more comprehensive list, structured with primary threats and an associated list of threat descriptors (Appendix A, available on ConserveOnline). A standardized list of threats will be essential for studies that assess threats across different scales, assessments, and organizations.

Secondly, the associated time frame for ranking threats is a challenge. Threats can be ranked as historic (past threats that are no longer active but their impacts are still effecting biodiversity in the conservation area), active (current threat or one that has a very high probability of occurring over a selected time frame) and future (a potential threat that is not currently active). Historic threats become the focus of ecological restoration, while active threats need to be first addressed by some level of threat abatement. Some active threats that are scored at lower levels of severity (invasive species) and some future threats (climate change, sea level rise) need to be addressed proactively. For invasive species, control efforts are much more successful at low levels of invasion, before they reach levels that get scored as high severity. Efforts to mitigate the effects of climate change and sea level rise needs to be taken into account in conservation planning. While obvious from the nature of these threats, the scoring did not take these issues into account.

We had extensive input from practitioners into the Relative Conservation Opportunity parameter, for both the identification of attributes and the development of criteria. It was difficult developing a categorized and linear structure for a process that is complex and interrelated. A significant issue is the order in which these parameters are scored. We feel strongly that the biodiversity value and threat status of conservation areas should be assessed before opportunities are overlain. This order makes explicit the primary importance of what is ecologically significant before conservation opportunities are taken into account.

The results of Sequencing are not intended to be absolute, but guidance for conservation entities. The graphs allow the comparison of Relative Biodiversity Value and Relative Threat Status, providing the basis to assess the trade-off in acting at one site over others. As mentioned, where along the threat continuum a conservation entity works, from highly threatened to not threatened, is a matter of choice. The more threatened a conservation area is, the lower the probability of conservation success. Conservation areas scored with a very high Relative Conservation Opportunity in the *Now-Right Now* category, especially in the attributes of funding and opportunity windows, are clearly places for priority action. Conservation areas with low Relative Conservation Opportunity scores in the *Now-Right Now* category are places where opportunities can be developed. Conservation areas scored with a very high Relative Conservation Opportunity in the other sequencing categories challenge conservation entities to assess the trade-off among areas of different biodiversity values and threat status. Going through the process itself is an extremely valuable exercise as it poses important issues that any conservation entity needs to address. Sequencing facilitates a thoughtful approach to establishing conservation priorities.

The Sequencing process makes explicit several significant questions concerning how conservation is implemented. Some of these are: Should conservation entities focus conservation efforts on the most threatened or the best remaining conservation areas? How do conservation entities balance between working deep at a few conservation areas and working on broader, larger scale actions that influence conservation at multiple scales? Should conservation entities focus work on large landscape sites or a mix of spatial scales? Should conservation entities focus on conserving targets nearest to extinction or actions that influences all conservation targets equally? How do conservation entities make decisions between high priority conservation areas and opportunities for conservation at lower priority sites? These questions need wider discussion within the conservation community as NGOs and agencies consider where, when, and how to invest limited funds to maximize conservation benefits.

The results from Sequencing Conservation Actions provides significant insight into establishing priorities for conservation, explicitly showing the relationship of the conservation areas to biodiversity value, threat, and conservation opportunity. The process takes significant but not extensive time to complete and the scoring is straightforward and understandable. The overall benefit is that it provides consistency and transparency to the process of establishing conservation priorities and makes explicit important conservation decisions.

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