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POLICY PERSPECTIVE

Impacts of the IUCN Red List of Ecosystems on conservation policy and practice

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Abstract

In 2014, the International Union for Conservation of Nature adopted the Red List of Ecosystems (RLE) criteria as the global standard for assessing risks to terrestrial, marine, and freshwater ecosystems. Five years on, it is timely to ask what impact this new initiative has had on ecosystem management and conservation. In this policy perspective, we use an impact evaluation framework to distinguish the outputs, outcomes, and impacts of the RLE since its inception. To date, 2,821 ecosystems in 100 countries have been assessed following the RLE protocol. Systematic assessments are complete or underway in 21 countries and two continental regions (the Americas and Europe). Countries with established ecosystem policy infrastructure have already

used the RLE to inform legislation, land-use planning, protected area management, monitoring and reporting, and ecosystem management. Impacts are still emerging due to varying pace and commitment to implementation across different countries. In the future, RLE indices based on systematic assessments have high potential to inform global biodiversity reporting. Expanding the coverage of RLE assessments, building capacity and political will to undertake them, and establishing stronger policy instruments to manage red-listed ecosystems will be key to maximizing conservation impacts over the coming decades.

KEYWORDS

conservation practice, ecosystem, impact, IUCN Red List of Ecosystems, monitoring, policy, risk assessment

1 | INTRODUCTION

Global biodiversity assessments influence conservation practice and policy at multiple levels. The International Union for Conservation of Nature (IUCN) Red List of Threatened Species™ (RLTS) was established in the 1960s and revised with a quantitative approach in the 1990s (Mace & Lande, 1991), while the IUCN Red List of Ecosystems (RLE) was adopted by the IUCN as the global standard for ecosystem risk assessment in 2014, following a period of development from 2007 to 2013 (Bland, Keith, Miller, Murray, & Rodríguez, 2017; Keith et al., 2015).

Biodiversity assessments such as the RLTS and RLE are assumed to have positive impacts on conservation, yet this remains to be quantified. In this policy perspective, we use an established impact evaluation framework (CSIRO, 2018) to identify the impacts of the RLE since its inception (Rodríguez et al., 2011). The Commonwealth Scientific and Industrial Research Organisation (CSIRO) impact framework assesses how research translates into real-world benefits by distinguishing research inputs, activities, outputs, and medium-term outcomes from long-term impacts (CSIRO, 2018; Morgan, 2014).

Compared to other biodiversity data sources (such as the RLTS, the World Database on Protected Areas, and the World Database of Key Biodiversity Areas), the RLE is at a relatively early stage of implementation. As IUCN celebrated its 70th anniversary in 2018, it is particularly timely to quantify the current impacts of the RLE and identify key challenges that must be addressed to maximize impact over the coming decades. We report inputs, activities, outputs, outcomes, and impacts to highlight the direct and indirect influences of the RLE (Figure 1). We also outline pathways to impact based on the experience of countries with established ecosystem risk assessment protocols (hereafter referred to as ecosystem red lists).

2 | THE RED LIST OF ECOSYSTEMS: FROM INPUTS TO OUTPUTS

Projects typically operate by deploying inputs (e.g., resources and staff) to complete activities (e.g., workshops, data compilation, and analyses) that lead to predefined outputs (e.g., publications and methodologies; Figure 1). We reviewed 3,687 ecosystem assessments including national-scale projects (Table S1). For the RLE, we considered systematic assessments (in which all ecosystem types within an area are assessed to inform relative risks and spatial planning) separately from strategic assessments (detailed diagnostic assessments targeting one or few ecosystem type(s) to develop management strategies). We reviewed 31 systematic RLE assessments and 36 strategic assessments (Table S1). While all strategic assessments conformed to the guidelines for version 2 of the RLE criteria (Bland et al., 2017), some systematic assessments predated the establishment of the RLE (3 assessments), some were based on version 1 of the criteria (2 assessments), and some did not conform to guidelines for criteria C and D (3 assessments; Table S1).

2.1 | Inputs

The RLE has attracted more than US$10 million in investment from 2011 to 2017 (E. Barrow, *pers. comm.*), including ~84% for personnel costs, most often in-kind (Juffe-Bignoli et al., 2016). National assessments have attracted from US$740,000 to US$3 million in funding (E. Barrow, *pers. comm.*). About 60% of this comes from governments and 40% from non-governmental organisations that work with government. In two cases, governments failed to engage in a substantial way. Approximately 70 full-time equivalent personnel time was spent on assessments, 90% of which has been deployed on systematic assessments (Table S1). About two-thirds of that

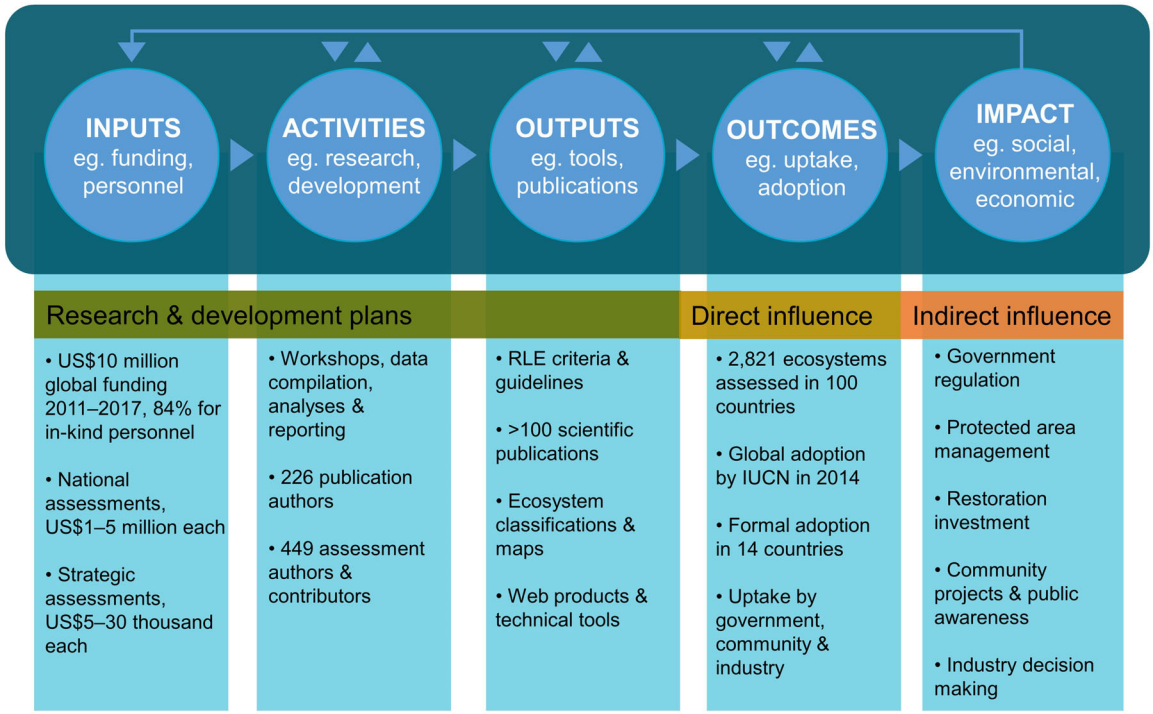

FIGURE 1 Impact evaluation of the International Union for Conservation of Nature Red List of Ecosystems (IUCN RLE), adapted from the Commonwealth Scientific and Industrial Research Organisation impact framework (CSIRO, 2018)

effort has gone into developing national red lists (supported by government agencies or nongovernmental organizations) and the remainder into two regional assessments for Europe and the Americas. It has been estimated that an additional US$43 million would be required to assess all the world's ecosystems by 2025 (Juffe-Bignoli et al., 2016).

2.2 | Activities

All RLE projects involved data compilation, analysis, and reporting through various media (Table S1). Most systematic assessments (70.9%) involved workshops, indicating the importance of stakeholder engagement. About 30% of strategic assessments involved workshops, indicating that these are typically smaller collaborations.

2.3 | Outputs

To date, 2,821 ecosystem units in 100 countries have been assessed with the RLE criteria versions 1 and 2 (Figure 2 and Table S1). Systematic assessments are complete or underway in 21 countries and two continental regions (the Americas and Europe), which together represent ~47% of the earth's land surface (Figure 2). While ~20% of these are ongoing projects, most have already produced new or revised ecosystem classifications and maps (Table S1). About two-thirds of systematic assessments were communicated in technical reports and one-third in the scientific literature. Two-thirds of systematic assessments engaged stakeholders in presentations and up to a third produced web products or analytical tools to support application. In contrast, strategic assessments rarely produced classifications, web products, or analytical tools, but a higher percentage (94.4%) were reported in the peer-reviewed literature.

More than 100 scientific publications related to the application of the RLE have been published (IUCN, 2018). About half of them are assessments and many describe the implementation of management and policy strategies that are underway or proposed to reduce risks. The remainder include policy perspectives, reviews and research contributions on the development and testing of new analytical tools. For a subset of publications with digital object identifiers (DOI; $n = 63$), we found 1,565 citations (Google Scholar), more than 3,000 readers in academic networks, and 1,646 posts in a range of web formats (e.g., social media, news feeds, and research highlights; Altmetric). RLE publications have been co-authored by 226 individuals and 449 authors and assessors contributed to RLE assessments. Training materials, tools (e.g., remote-sensing classification tools), and an online forum have supported the growing community of RLE practitioners (IUCN, 2018).

3 | OUTCOMES AND IMPACTS OF ECOSYSTEM RED LISTS

RLE assessments have led to a wide range of outcomes by influencing conservation actions; uptake by community,

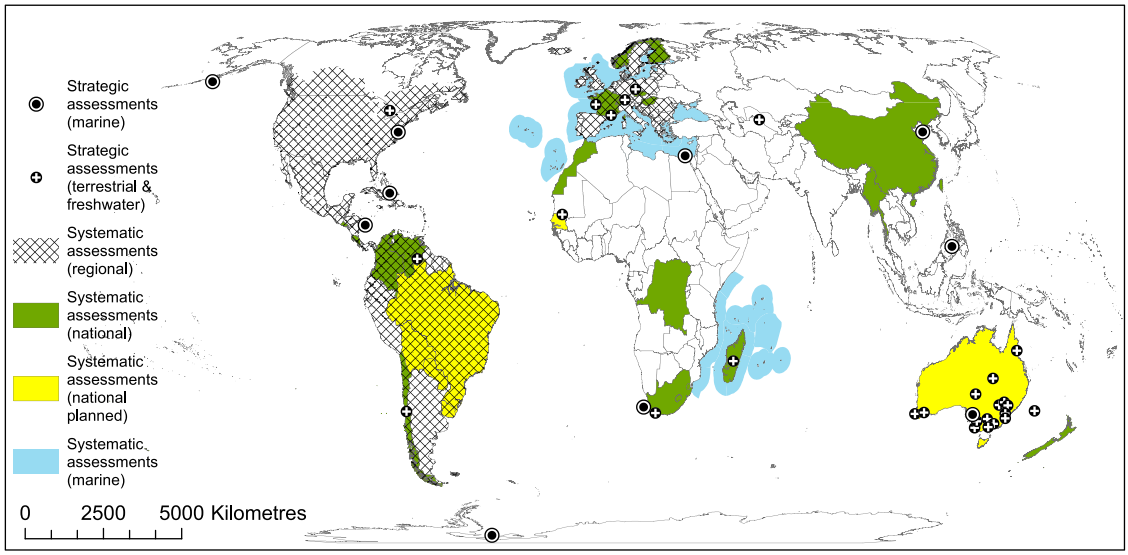

FIGURE 2 International Union for Conservation of Nature Red List of Ecosystems assessments conducted to date

industry, or government; and adoption by government or industry into policy frameworks (Table 1). Overall, outcomes were reported for 39.3% of systematic assessments and 50% of strategic assessments (Table 1). These outcomes provided pathways to substantial impact, including government regulation, protected area planning and management, restoration investment, community projects, public awareness and reporting, and industry decision making (Table 1). Both systematic and strategic assessments led to high levels of public awareness and reporting (36% and 47.2%, respectively) and influence on protected area planning and management (21.4% and 27.8%, respectively). Overall, impacts were observed for 36% of systematic assessments and 55.6% of strategic assessments (Table 1). A wide range of conservation impacts was evident in countries with established ecosystem red lists (e.g., Norway, Finland, and South Africa), although early impacts are occurring in countries that are undertaking their first ecosystem red lists (e.g., Colombia and Chile).

3.1 | Government regulation

Multiple jurisdictions have included the RLE within their legislation and government regulatory instruments. In Australia, the RLE criteria have been adopted as the Common Assessment Method to unite historically disparate listing methods across multiple jurisdictions. Several countries with established ecosystem red lists have adopted the RLE criteria (e.g., Norway) or are in the process of doing so (e.g., Finland and South Africa). Countries with no prior red lists of ecosystems are also adopting the RLE (e.g., Chile; Pliscoff, 2015).

Threatened ecosystem assessments can act as regulatory triggers, where listed threatened ecosystems are legally protected by becoming triggers for special land management or resource-use prescriptions. In Finland, the first systematic ecosystem assessment (Kontula & Raunio, 2009) lead to the incorporation of some threatened forests and mires into their *Environment Protection Act* and *Forest Act*. South Africa's third national assessment will continue the practice of regulatory protection and reporting for threatened ecosystems under the *National Environmental Management: Biodiversity Act (Act 10 of 2004)* (Republic of South Africa, 2011). In South Africa and Australia, regulations for environmental impact assessment identify Critically Endangered and Endangered ecosystems as direct triggers for full environmental impact assessments. National offset policy also uses threatened ecosystems to assess which impacts are not allowed to be offset and sets higher minimum offset ratios for threatened ecosystems.

Strategic RLE assessments have also influenced regulatory processes. For example, the assessment of the Coastal Upland Swamps as Endangered (Keith et al., 2013) influenced statutory listings in Australia, with legal protection and government recommendations for changes to the design of proposed mines to minimize hydrological impacts.

3.2 | Protected area planning and management

Systematic and national assessments across realms (terrestrial, marine, and freshwater) enable ecosystem types to be compared, ranked, and prioritized in conservation planning and management. In South Africa, threatened ecosystems are incorporated through systematic conservation planning into Bioregional Plans, which require that Critically Endangered and Endangered ecosystems are identified as "critical biodiversity areas" (Republic of South Africa, 2009). In areas where Bioregional Plans are gazetted, they constitute legal instruments that must be considered during land-use planning. Provisions are similar under the *Environmental Protection*

TABLE 1 Outcomes and impacts of International Union for Conservation of Nature Red List of Ecosystems assessments completed to date (versions 1 and 2 of the criteria and modifications thereof). For a full breakdown of assessments, please refer to Table S1

	Systematic assessments, % ($n = 28$)	Strategic assessments, % ($n = 37$)
Activities	96.4	100
Workshops	67.9	30
Data compilation	96.4	100
Analyses	96.4	100
Reporting	78.6	100
Outputs	96.4	100
Classification	67.9	0
Maps	67.9	59.5
Reports	96.4	21.6
Scientific publications	96.4	97.3
Presentations	78.6	56.8
Web products	71.4	0
Tools	67.9	0
Outcomes	39.3	48.6
Influence	25.0	27.0
Uptake	14.3	13.5
Adoption	17.9	8.1
Impacts	36.0	55.6
Government regulation	7.1	24.3
Protected area planning & management	21.4	27.0
Restoration investment	14.3	18.9
Community projects	3.6	4.9
Public awareness & reporting	36.0	45.9
Industry decision making	18.0	8.1

and Biodiversity Conservation Act 1999 in Australia. Critically Endangered and Endangered ecosystems are recognized as "matters of national environmental significance" and are considered in developing Regional Plans.

Ecosystem red lists also inform priorities for protected area expansion in South Africa to increase representation of threatened ecosystems. Similarly, Colombia has committed to increasing the extent of its protected area network from 12% to 17% of the country's land area by 2020 and the new RLE will inform the designation of new protected areas by identifying underprotected threatened ecosystems.

3.3 | Restoration investment

The Chilean RLE was used to assess the severity of impacts caused by extensive fires in 2017 and to inform priorities for forest restoration, particularly on private land (Martinez-Harms, Caceres, Biggs, & Possingham, 2017). Statutory listing based on the RLE assessment of Coastal Upland Swamps in Australia (Keith et al., 2013) was instrumental in securing undertakings from mining companies to restore swamps degraded by underground mining and fund research to support future conservation and restoration work (Dovers, Whinam, Krogh, Young, & Crawford, 2017). Similar restoration investments have been made on the basis of RLE data in France, Finland, and South Africa (Table S1).

3.4 | Community projects and sociocultural impacts

In Norway, the listing of Coastal Heaths as Endangered has resulted in high levels of community engagement to safeguard Coastal Heaths, which have depended on traditional land-use practices since the Bronze Age. Coastal Heaths have benefited from a National Action plan and have been given status as a priority ecosystem type according to the Norwegian *Nature Diversity Act*. A related benefit of systematic RLE assessments has been the establishment of long-lasting expert networks. In Finland, the first national RLE assessment brought together more than 100 specialists in eight thematic ecosystem groups. These teams have remained active in supporting the second ecosystem red list and in advising authorities on ecosystem management and policy. Similarly, long-lasting networks have been established and strengthened in South Africa over successive ecosystem red lists in 2004, 2011, and 2018.

3.5 | Public awareness and reporting

In South Africa, information on threatened ecosystems is used as a headline indicator in a number of national reporting frameworks, including the National Biodiversity Assessment and the South African Environmental Outlook. The requirements of the Convention on Biological Diversity are met through the compilation of national reports and a National Biodiversity Strategy and Action Plan (NBSAP), which report on the state of threatened ecosystems and policies to protect these ecosystems. RLE assessments in Norway have also been used as inputs for the country's NBSAP (Norwegian Ministry of Climate and Environment, 2015) and have been adopted as a basic input for a national mapping program on important ecosystem types. In Finland, the RLE serves as important background information for the European Union (EU) Habitats Directive Reporting and is currently being used to assess progress toward the EU Biodiversity Targets for 2020. In Colombia, the RLE has been included in National Biodiversity reports (Moreno, Rueda, & Andrade, 2018). Red lists have also been instrumental in raising public awareness in many countries through social media, traditional media, and public forums.

3.6 | Industry decision-making

Ecosystem red lists are used in a variety of innovative ways to inform voluntary ecosystem management by industries, particularly mining and forestry. In Colombia, the RLE has been included in Tremarctos (http://www.tremarctoscolombia.org/), a decision-support tool for industry that allows development projects (e.g., road infrastructure and energy and mining projects) to account for threatened ecosystems in the analysis of environmental, socioeconomic, and geophysical risks. The tool also allows for the calculation of offsets and compensations for immitigable impacts.

The IUCN assessment of the Mountain ash forest in Australia as Critically Endangered (Burns et al., 2015) triggered the establishment of an industry taskforce to provide recommendations for timber production, job security, and biodiversity objectives (www.forestindustrytaskforce.com.au). In South Africa, threatened ecosystems are mentioned in several ecocertification schemes, for example, for the forestry and wine industries. The RLE serves as important input information, together with the red list for species, within the Norwegian timber certification scheme (PEFC Norway, 2015). The International Finance Corporation recommends the use of RLE by its clients to address performance standards to conserve biodiversity, maintain ecosystem services and sustainably manage living natural resources (IFC, 2019, GN79).

4 | KEY AREAS FOR DEVELOPMENT

4.1 | Challenges in achieving and measuring impact

While the outputs and outcomes from RLE inputs and activities are clear (Figure 1 and Table S1), not all have led to apparent impacts. There are several reasons for this, the most obvious being insufficient time for impacts to be realized. Table S1 reveals that 57.1% of systematic assessments and 11.1% of strategic assessments are ongoing or were completed in the last two years (2017–2019). RLE assessments and associated impacts, particularly in terms of policy or legislative change, can take time to be realized. Substantial impact has occurred where recent RLEs have been integrated rapidly within existing policy infrastructure in countries such as Finland, Norway, South Africa, Australia, and the European Union.

A major reason for impact (and conversely lack thereof) is political will and support from local champions. Many of the systematic projects with the highest impact saw RLE assessments support existing environmental legislation (e.g., South Africa), were initiated by governments themselves (e.g., Finland), or had well-positioned local champions (e.g., Colombia). Conversely, a lack of political will or political instability (e.g., Venezuela) can result in underresourcing and resistance to policy implementation, with consequent lack of impact. Difficulties in communicating complex analyses to stakeholders and institutional perceptions about reporting on high ecosystem risks can inhibit implementation and impact (e.g., Morocco). In dealing with contentious assessments or unpalatable results, the RLE can learn from the RLTS. For example, conflicts between conservation and fisheries objectives for commercially important fish species (Davis & Baum, 2012) are comparable to potential conflicts between forestry activities and conservation for forest ecosystems (Burns et al., 2015).

Finally, many forms of impact are difficult to attribute to the RLE which, in several cases, was one of multiple initiatives that influenced policy action. Risk assessments for the Floodplain ecosystem of River Red Gum and Black Box were one of many scientific studies considered in a water management plan for the Murray-Darling Basin in south-eastern Australia (Table S1). In other cases, RLE assessment strengthened justification for prior statutory listings and clarified priorities for risk reduction. For example, the RLE assessment for the Eastern Stirling Range Montane Heath and Thicket community in Australia was used to update a prior listing and to strengthen evidence for conservation management (Table S1).

4.2 | Anticipated impacts on global biodiversity monitoring and international policy

The systematic application of the RLE criteria at continental and national scales provides broad-scale information on the status of ecosystems that can be used in global biodiversity monitoring. Red list indices for ecosystems have been compiled for the Americas and Colombia and these show clear signs of change in ecosystem status, extent, and condition (Ferrer et al., 2019). RLE indices have high potential to inform global biodiversity reporting, such as for the Aichi Targets of the Convention on Biological Diversity, the United Nations Sustainable Development Goals, the Global Environment Outlook, and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.

The IUCN Red List Index for species is used to monitor progress toward nine of the 20 Aichi Targets (Driscoll et al., 2018). Our analysis indicates that RLE indices could inform monitoring toward 12 Targets (Table S2), in particular those related to the rate of loss natural habitats (Target 5) and the management of fisheries (Target 6), forestry (Target 7), ecosystem services (Target 14), and ecosystem resilience (Target 15). RLE data could be used to inform progress toward a number of United Nations Sustainable Development Goals (SDGs), especially Goal 6 (sustainable water management), Goal 14 (life below water), and Goal 15 (life on land; Table S3). Calculating and aggregating RLE indices for subsets of ecosystems relevant to these targets

(e.g., marine fisheries, forests, and freshwater streams) will enable the monitoring of progress toward Aichi Targets and SDGs by quantifying changes in risks over time. Increased coverage of RLE assessments in the future will improve our ability to monitor the state of biodiversity globally. However, RLE assessments undertaken at a national scale can already be used to inform international targets, including through national reporting mechanisms.

4.3 | Further integration with social and economic initiatives

Mainstreaming the RLE into international and national policy will require increased coverage of assessments and pilot studies, as well as the development of interdisciplinary collaborative networks to embed the RLE into a number of initiatives. Alaniz, Perez-Quezada, Galleguillos, Vásquez, and Keith (2019) highlight how the RLE can improve the implementation of a number of policy instruments from local to regional scales. Future pathways to increased social and economic impacts include linking RLE assessments with natural capital accounting (UN SEEA, 2014), public health initiatives (e.g., to reduce the emergence of infectious diseases linked to ecosystem degradation; World Health Organization 2015), human well-being (Schleicher et al., 2018), disaster risk management (e.g., through Nature-Based Solutions; Nesshöver et al., 2017), and sustainable livelihoods. The RLE could also be used further to inform business decisions, for example, to help assess and manage environmental and social risks in development projects, such as with the Tremarctos tool in Colombia, the Species and Threats database in Australia, and industry standards for financing sustainable development (IFC, 2019).

5 | CONCLUSIONS

Identifying impacts is key to justifying continued investment in biodiversity assessments and enabling analysis and strategic planning to maximize future impact. In this policy perspective, we reported on the key outcomes and impacts of the RLE since its inception. We identified clear pathways to impact based on the experience of countries with preexisting policy infrastructure that are now adopting the RLE. We showed that RLE assessments can be embedded at national scales into conservation legislation, land-use planning, monitoring and reporting, and ecosystem management. In addition, RLE indices are expected to provide key information to monitor progress toward international biodiversity targets. Expanding the coverage of RLE assessments, building capacity and political will to undertake them, and establishing stronger policy instruments to manage red-listed ecosystems will be key to maximizing conservation impacts over the coming decades.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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