SCIENCE & DIPLOMACY

A quarterly publication from the AAAS Center for Science Diplomacy

Harold J. Annegarn and Robert J. Swap, "SAFARI 2000: A Southern African Example of Science Diplomacy," *Science & Diplomacy*, Vol. 1, No. 4 (December 2012*).
http://www.sciencediplomacy.org/article/2012/safari-2000.

*The complete issue will be posted in December 2012.

SAFARI 2000: A Southern African Example of Science Diplomacy

Harold J. Annegarn and Robert J. Swap

THE power of science diplomacy to improve international relations has drawn growing interest in diplomatic and scientific circles.[1] Naledi Pandor, South Africa's former minister of science and technology, extends the activist role of science to encompass a transformative developmental agenda, by arguing that science policy in South Africa's post-apartheid era should aim "to develop, for the first time, relations with African partners, but also to leverage international partnerships and investments in support of national programs and capacity building."[2]

International collaborations between scientists range from informal, bilateral interactions between groups of individuals to large, formal intergovernmental programs, such as the CERN supercollider or the recently announced Square Kilometer Array (SKA) astronomy project. At an intermediate scale are collaborations between multiple institutions in the form of regional science campaigns, such as the Southern African Regional Science Initiative (SAFARI 2000), which from 1998 to 2003 brought together two hundred scientists across sixteen countries. This article examines the role that such regional networks can

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play in creating necessary and enabling conditions for favorable science diplomacy outcomes.

The Nature of International Scientific Relationships

Typically, the relationships formed between the initiating scientists and the governments, institutions, and individual scientists in the host countries fall into one of three types:[3]

- Exploitative, where the powerful participant benefits at the expense of the less powerful (or less well resourced).
- Transactional or instrumental, usually on a fee-for-service basis.
- Transformational, with a more open, mutually beneficial process.

In *exploitative scientific engagements*, one country's institutions may send researchers into other countries with preset scientific agendas and finalized budgets, just to collect data. The researchers subsequently interpret and publish the data without further participation by host country scientists, beyond a perfunctory footnote acknowledgment. Participation of the host country members is limited to transactional arrangements of local logistics and incidental labor. The time cycles and logistical constraints often inhibit participation in formulating projects, and funding agencies make no provision for such preliminary engagements. The language of the granting contracts, particularly for government funding, precludes use of funds by persons who are not citizens of the funding country. Such projects engender mistrust and are damaging to science diplomacy.

While *transactional scientific engagements* have more local involvement, little effort is made to engage the local scientists as intellectual partners or to nurture local students and institutions. Again, planning and budgeting for such projects tend to take place in the developed country, ahead of any involvement of institutions in the host country. Such arrangements may generate some income for the local host organization and allow for incidental academic contact, but they make no provisions for developing longer-term relationships as the basis for a partnership. In unfavorable cases, a transactional type expedition could exploit scientific opportunities at the expense of local scientists and institutions, leaving a sense of deprivation, exploitation, and distrust. In better cases, there may be some spinoff capacity building that occurs as a result of the host country's participation.

In the context of scientific relationships between developed and developing regions, if scientists in the developed world follow the business-as-usual model, then the result is likely to be exploitive science at worst or transactional science at best. The inherently extractive conditions of grants often restrict the possibilities for partnerships.

Alternatively, *transformative scientific relationships* are founded on shared moral principles. In systematic and transformative relationships, Hugh Socket

argued, "the parties share responsibility for planning, decision making, funding, operations and evaluation of activities, and where each institution is transformed through the relationship."[4] When one member is at risk of exploitation because of significantly weaker power and resources, such shared responsibility is crucial. More importantly, shared responsibility contributes to science diplomacy.

The organizational structure that seems best able to foster partnerships (and by implication science diplomacy) is what Fredrik Söderbaum termed a *regional research programme and project* network.[5] This type of network is decentralized and horizontally structured. It has defined aims, primarily to build research capacities, produce new research results, and enhance "research cooperation, communication and contact."[6] It seldom comprises an autonomous institutional structure, apart from participants who take responsibility for coordination and fund management.

If the network is to be transformative, then additional players must be able to enter at any stage. The trust implied by allowing less able or less well-resourced participants into a network characterizes a transformative network. Unlike tightly controlled, centralized planning, a flexible network is exactly what makes possible richness, diversity, and the evolution of science diplomacy. This additional feature of open membership leads to a definition of a flat and open research network.

With the conceptual tools outlined here, an alternative approach to the design and implementation of collaborative international science projects is envisaged, in which conditions favorable for science diplomacy can be nurtured, without compromising the quality of the scientific endeavors.

SAFARI 2000—An Example of Science Diplomacy in Action

Conducted between 1998 and 2003, SAFARI 2000 was a multinational environmental and remote-sensing field campaign that observed a broad range of phenomena related to land-atmosphere interactions and biogeochemical functioning across southern Africa.

SAFARI 2000's central scientific objective was to better understand how aerosol and trace gas emissions affect local and regional climate and ecosystems. The initiative traced atmospheric emissions from sources to deposition and involved coordinated satellite, aircraft, and ground-based observations during intensive field campaigns and long-term monitoring at core ground sites across the Southern African Development Community (SADC) region. The main campaign took place from August to October 2000, with shorter summer field campaigns in March 2000 and February 2001. Approximately two hundred scientists participated, including twenty-five graduate students, from sixteen countries and with fifty institutional linkages. Findings were reported in three separate thematic journal issues and now total more than 180 refereed articles.

The principal international funders were the U.S. National Science Foundation (US$3 million) and the U.S. National Aeronautics and Space Administration (NASA)

(because SAFARI 2000 occurred before federal cost-accounting standards were applied, it is difficult to quantify NASA's contribution; however, direct grants to universities and indirect support through civil servant personnel dedicated to the larger initiative or in-kind over the five-year period is conservatively estimated by SAFARI 2000 project leadership to be approximately US$16 million). South African funding was provided by the Department of Science and Technology (US$0.7 million) and the national electrical utility company, Eskom (US$0.4 million). The conservative nature of this estimate reflects the difficulties in accounting for the human and social capital provided by all participants.

International and Institutional Participation

SAFARI 2000 originated at an informal meeting of U.S. and South African academic and state scientists held at the University of Virginia in February 1998 as an idea for a coordinated space, airborne, and ground observation campaign across southern Africa, with the primary aim of validating images from instruments on board the NASA Earth Observing System (EOS) Terra Platform. From the outset, lead scientists within the NASA EOS were open to notions of science diplomacy as they unfolded during SAFARI 2000. Likewise, South African participating scientists framed the emerging collaboration as a partnership, in which South Africa would invite and host international scientists to participate in the regional campaign.

Further planning meetings and campaign rehearsals took place in the United States, South Africa, Botswana, Zimbabwe, Namibia, and Mozambique. The base for ground operations was established at a central location—Polokwane International Airport in Limpopo, South Africa—facilitating airborne access to several parts of the region. Aircraft from the United States (including NASA's ER2 high-altitude surveillance aircraft), United Kingdom, South Africa, and Australia participated. Results meetings took place in Zambia (first), Mozambique, South Africa, and the United States.

Throughout the campaign participating scientists led public outreach activities focusing on youth. Principal investigators also presented the project to the cabinet of the South African government. (Then Deputy President Jacob Zuma chaired the cabinet meeting. The principal investigators, including the senior scientist from NASA, felt flattered by the high-level political interest, naively unaware that the interrogation had been motivated by serious geopolitical concerns of the South African and regional governments. Fierce debate had ensued within the cabinet on whether U.S. activities in the region, with satellites and high-altitude aircraft, were part of a surveillance program that could be used to the disadvantage of the less-developed countries in climate-related negotiations. Some cabinet members argued for immediately terminating further cooperation with the United States in this campaign. However, SAFARI 2000 was allowed to continue.)

Organizational Structure of SAFARI 2000

A small leadership group, comprised of experts from southern Africa, Europe, and the United States, initiated the planning by engaging the regional science community in dialogues and workshops at venues across the region. A consensus approach refined the science objectives around the theme of land-atmosphere interactions in southern Africa. A larger advisory group of funded principal investigators from the United States, Europe, and Africa supported the leadership team. Regional science-interest groups, identified by personal and professional networks of the core team, were invited to participate. As trust building continued, participants new to SAFARI 2000 were asked to identify and recruit other researchers, practitioners, and governmental representatives.

Participation in SAFARI 2000 required an explicit commitment to the collaboratively developed open data policy and the principles of an open research network. Neither budget size nor limited material or human resources restricted participation. Participants were encouraged to adhere to the principles of respecting existing scientific capacity; working toward establishing a lasting intellectual legacy; and conducting socially relevant science (determined in consultation with scientists and administrators from the region as part of the planning process).

At a general meeting of participants in Botswana during July 1999, the parties present formalized the SAFARI 2000 management structure and science plan. They approved a flat management structure of an executive committee of five members, and a science steering committee, representing major funded projects (with a threshold of US$100,000), country representatives (open to all eleven SADC countries, whether or not they were present), and nominated representatives. Participation in the steering committee was kept open, thereby creating enabling conditions for researchers to conduct scientific experiments with their own resources or by joining core experiments without incurring fees or overhead charges.

In keeping with the notion of a self-administered network, participating scientists, not funding agency administrators, convened the workshops and planning meetings. Although not all SADC countries or interest groups ultimately participated, the size of the already large science steering committee was not constrained by limiting its membership. Unwieldy though such large committees can be, in terms of enhancing research cooperation, the benefits to science diplomacy were invaluable. In the absence of resentments of exclusion, positive responses of open cooperation flourished.

Nature of Partnership

From the outset, initiating scientists framed the project as a partnership in which the participating international agencies and scientists would be the guests of the African host countries. This arrangement precluded transactional contracts, in which parties with large financial resources could become dominant partners.

Explicit in the notion of a guest-host relationship was an insistence that guests recognize existing human resource capacity in the host region, rather than starting with a presumption of developing capacity. As a reciprocal obligation, hosts would endeavor to facilitate all guest requirements, such as visas, research permits, customs requirements, and logistics. For example, the SAFARI 2000 hosts arranged with the South African government for a waiver of all landing fees and of all import duties on temporary equipment imports and on otherwise taxable commodities (such as 40,000 liters of high-octane fuel for NASA's ER2 aircraft).

Science Planning and Social Engagement

In keeping with the principle of equity, instead of all planning taking place in the United States as the initiating country of the project, collaborative planning meetings rotated between Washington, DC, Denver, Colorado, and locations in Botswana and South Africa. Local officials and academics in Africa, who would not have been able to attend planning meetings abroad, were able to participate at the African venues, which ensured a broader base of local participation at a much earlier stage of the project than would otherwise have been the case. While consensus building took time, these collaborative workshops resulted in an overarching science plan and, importantly, the open data plan that all scientists present had a voice in helping to shape. The SAFARI 2000 science plan served as an umbrella document for prospective participants and a scientific context for garnering financial support for their involvement.

Similarly, after the intensive field campaign, results meetings took place in the African host countries (the first one was held in Siavonga, Zambia, in September 2002) before researchers presented findings at international science meetings in the United States and Europe. Inevitably, this rotation of meetings to Zambia, Botswana, and Mozambique was less convenient and more expensive compared with possible venues at some central location in the United States. However, material costs were outweighed by the less tangible but more crucial benefits to science diplomacy: these planning and reporting processes gave recognition to the criteria of equity and integrity that helped establish SAFARI 2000 as a transformational partnership.

During the planning process scientists within the region demanded societal relevance to be an integral part of the science plan. This led to the incorporation of a science-to-policy component, coupled to the science activities.

Regional Participation of Students

Within the overall ambit of project funding, the science organizing team made a commitment to create opportunities for regional scientists and students to participate fully in the campaign. For students, this meant having them register for higher degrees based on data sets acquired from SAFARI 2000. This prescript framed the concept of leaving an intellectual legacy. The leadership team wrote letters of support and mentored scientists and students from smaller nations.

Despite practical and financial challenges, they brokered several pairings of students with supervisors, with registrations in Africa, the United States, and Europe. For example, officials from the Zambian Meteorological Services were registered for undergraduate and postgraduate degrees at three universities in South Africa. All five supported students (four BSc meteorology degrees, one MSc, and one PhD) who returned to government service after completing their degrees. Mozambican and Kenyan students were supported in part or whole for graduate research at NASA's Goddard Space Flight Center at the University of Maryland and the University of Virginia. A Zimbabwean student was supported for a three-year internship at a Max Planck Institute in Germany while completing doctoral studies. Implementation relied on developing trust and commitments within the framework of the partnership—some of these study arrangements were supported by funding arrangements beyond the core funding. Because of the different durations of the project life cycle and academic study programs, the support for and completion of individual study programs continued for several years after the formal end of SAFARI 2000, to meet the explicit commitments of science diplomacy.

Relationship of Funders to Scientists

The relationships between the science partners are key determinants of the kind of partnership that evolves. Equally important, though not realized explicitly at the time, is the nature of the relationships between funding agencies and scientists. Retrospective analysis reveals that each of the three funding agencies for SAFARI 2000 allowed for flexible and open management of funds by scientists and the science steering committee. This enabled the coordination of partnership activities aligned with the aims of science diplomacy, as articulated in the science plan.

The primary U.S. funding agency, NASA, channeled funds through U.S.-based universities rather than through a headquarters administrative team. This parsimonious alternative arrangement kept the cost of SAFARI 2000 to NASA to approximately one-third of what a similarly sized project with conventional deployment would have been.

In mid-1999 the South African Department of Science announced a call for proposals for large-scale innovative projects, with sub-clauses specifying international collaboration and regional development as crucial criteria. Within this scope, allocation of funding was flexible. A consortium led by the Council of Scientific and Industrial Research and incorporating several universities submitted a successful bid, thereby making the South African team financially viable, independent of international donor funding, and better able to play the role of host in a transformative partnership with more powerful partners.

The third funder, the South African state-owned power utility, Eskom, perceived that a better understanding of regional transboundary pollution transport was in its own long-term interest. It provided generous and relatively unconstrained funding to a consortium of academic scientists, further enhancing the autonomy

of regional scientists and minimizing their reliance on a shared portion of international grants.

Funding independence enabled a qualitative shift in the relationship between more and less powerful players, from that of supplicant and dependent (in the case of less-powerful players) to equal partners. This facilitated the role of the African contingent in defining the SAFARI 2000 agenda to include regional developmental aspects. In the absence of line-item management of the budgets by the agencies, the science organizers could also allocate funds for the administrative functions of hosting a large international scientific expedition.

The Science Diplomacy Legacy of SAFARI 2000

As a science campaign, SAFARI 2000 was successful. There were several journal special issues. Numerous southern African and developed country students graduated. NASA validated its sensors on the TERRA satellite platform. South Africa developed a near real time satellite-based fire early warning system. More to the point for present purposes is whether the initiative resulted in science diplomacy outcomes.

From Followers to Leaders

The success of any developmental program can be measured by tracking the subsequent performance of graduates. For SAFARI 2000, a deliberate preference for accepting students into graduate study was their status as midcareer professionals already in academic or government careers, seeking opportunities to complete their degrees. Many were subsequently promoted within their organizations and went on to represent their countries at international science and diplomatic meetings. Examples include the World Summit on Sustainable Development in Johannesburg in 2002; the Air Pollution Information Network Africa (APINA); the U.S. Global Dialogues on Emerging Science and Technology (2008); and the annual United Nations Framework Convention on Climate Change Conference of the Parties (COP) negotiations, including COP 15 in Copenhagen and COP 17 in Durban. SAFARI 2000 alumni took on leading roles in other international science campaigns, including the South African Fire Network (SAFNet), the Kalahari Transect experiment, and airborne trace gas and particle measurements over Africa and the Middle East. Two leading international conference series took place in Africa for the first time, chaired by SAFARI 2000 alumni (the International Geosphere-Biosphere Programme's International Global Atmospheric Conference in Cape Town in 2006 and the Institute of Electrical and Electronics Engineers' Geosciences and Remote Sensing Symposium in Cape Town in 2009).

The linking theme in this catalog of activities is the leadership roles played by SAFARI 2000 alumni, who—having researched and studied together—had established their own intraregional and international professional networks. They

had progressed from participants in SAFARI 2000 to confident, competent leaders, able to act on the international scientific stage. For example, when participating in COP preparatory and final negotiations, their shared experiences of the scientific issues, and networks with scientists from the developed world, allowed these delegates to play an informed, active role in negotiations.

Several of the following activities, spawned or enhanced by SAFARI 2000, were themselves arranged as flat and open regional research networks: SAFNet, Kalahari Transect, APINA, and ESAVANA (an educational partnership between the University of Virginia and African universities). Each related to and inherited aspects of SAFARI 2000, but none was intended as a continuation of SAFARI. As with SAFARI 2000, these networks flourished parsimoniously, with a minimal centralized administrative structure sustained by professional linkages and trust.

As part of the internal quality control, an international panel of four members evaluated SAFARI 2000 at the first results meeting held one year after the major field campaign. In addition to assessing the scientific program successes and gaps, the evaluators made several remarks to indicate their understanding of the deeper scientific diplomacy aspects of the project, as the following quotations illustrate:[7]

> "An important component is the intention to produce different levels of publications to spread the motivation and results of SAFARI, from 1st level students to policy decision makers."
>
> "Emission inventory on a country basis with effective participation of local institutions . . . is very important from a political point of view. . . . Local participation is crucial because of the implication of this kind of study to the emission balance required by the Climate Convention."
>
> "Official funding agencies should recognize the existence and chances for a 'bottom-up' framework used in this integrated field campaign. Funding agencies should capitalize on this type of approach."
>
> "Epilogue: The exercise SAFARI 2000 has given important impulses for the study of southern African ecosystem functioning. This international scientific community consisting of researchers of very disparate fields and of many different governmental and non-governmental institutions, brought together by SAFARI 2000, has set up links for cooperation to address relevant issues **for the future of society and environment.**" (emphasis added)

Science Diplomacy in a Regional Context

Less tangible are the science diplomacy benefits within the SADC region concerning perceptions of South Africa as a trustworthy partner. There are residues

of suspicion and resentment of South Africa as a hostile dominant regional power under the apartheid regime, and there is current suspicion of South Africa as a dominant economic power under the new government.

Economically and scientifically South Africa is the leading regional power. In terms of its own global position, South Africa strives to improve its standing and performance as a scientific nation. Thus strong policy and strategy imperatives exist for its scientists to form relationships with leading institutions and individual scientists in the developed world, and correspondingly few incentives to engage with counterparts in other African countries. Such pressures inevitably lead to increasing South Africa's isolation, rather than enhancing regional integration. SAFARI 2000, by creating a scientific caravan and then moving it around the region (and switching drivers), created a sense of regional participation. By bringing together scientists, students, and officials in a flat, open regional network, bonds of trust were established that later enhanced cooperation at multiple levels as the SAFARI 2000 alumni moved into senior positions within their own governments or universities. The best examples currently are in regional cooperation in meteorology and in the United Nations Framework Convention on Climate Change negotiations.

The role of South Africa as a regional power, intermediate in size between the United States and other SADC countries, allows both an upstream and downstream perspective of the proposed networking model. The given example illustrates the scalability of this network approach from global to regional powers. Although not proven, the need for this network approach likely remains the same, or is increased rather than decreased, by the magnitude of the power disparity, and having an intermediate-sized country in the middle is neither necessary nor sufficient for a successful partnership. Having scientists who are sensitive to the power dynamics of science diplomacy is probably a more critical factor than that of relative power.

Facilitating Science Diplomacy: Relationships between Scientists and Agencies

As the case of SAFARI 2000 illustrates, scientists can play an active role in science diplomacy. This role is not limited to science managers; participants at all levels ought to be introduced to the values of open sharing and trust that underpin sound partnerships. However, for scientists to play this role, certain necessary and enabling conditions need to be present. When controls are tightened in a strict managerial mode, it is detrimental both to the progress of science and to science diplomacy.

One benefit of running a regional research campaign as a transient, flat, and open network is good return on investment with constrained costs. Formal regional research associations or research centers of excellence all imply longer-term, costly commitments, with the risk of either dependent relationships or inevitable disappointments on termination of foundational funding. Transient

programs that achieve the desired outcomes of science diplomacy, as did SAFARI 2000, can be accomplished at lower net cost and without the risk of implied long-term dependency. The SAFARI 2000 program was conceived, planned, executed, published, and concluded within five years.

To sum up, open network campaigns of a defined duration provide innovative and complementary opportunities for officials to engage scientists in science diplomacy. Such networks are smaller than supercolliders or astronomical telescopes and bigger than individual or multiple Fulbright-type fellowships, lasting longer than the latter and having funding requirements smaller than the former. Science diplomats could help funding agencies by providing them with political cover to facilitate support for nontraditional programs in order to advance both national security and foreign policy goals. Such innovation needs to be backed up with accounts of successful examples.

Funding Models for International Participation

Diplomats and funding agencies determine the objectives when issuing funding solicitations and in formulating the associated administrative and reporting rules. If the rules are too prescriptive, then relationships between the diplomats/funders and the scientific community are likely to become transactional and hinder the creation of conditions that encourage trust and allow partnerships to flourish. If scientists are tightly constrained to perform according to the legal prescripts of the resulting awards, this will restrict them from exercising their discretion to recognize and act on opportunities to foster partnerships and science diplomacy.

Despite the success of transformative programs, such as SAFARI 2000, and diplomatic initiatives, such as the 2008 U.S. Department of State delegation visit to several African countries under the auspices of the Global Dialogue on Emerging Science and Technology,[8] there is still significant work to be done in communicating to agency funders that international partnerships cannot flourish under restrictive grant funding conditions. Such conditions limit the prime benefits of a program to U.S. students and young professionals who travel to and collect data in the host country, returning to their home institutions to complete data processing and reporting, leaving behind no tangible intellectual legacy in the host country. Such conditions reduce local scientists to the role of spectators while the visitors use superior equipment, resources, and funding to harvest scientific data. Science diplomacy cannot flourish under such conditions. Instead, these conditions risk creating resentment and mistrust in the partner country.

The South African National Research Foundation and state-owned enterprises have similar restrictions on payments of scholarships to and participation by foreigners. Such restrictions also inhibit South African policy on regional integration within the SADC and with the rest of Africa, denying the science diplomacy role that Pandor advocated.[9] This disjuncture, between the use of tax revenue for national science advancement and expenditure toward science

diplomacy, is thus a scaled problem, applying as much to regional powers as to the most developed countries.

Is there a way past these policy conflicts? A solution may require science diplomacy officials to engage with funding officials to explain how the structures of multinational partnerships can best support diplomatic objectives. For example, there could be a mandatory budget line item to cover costs of reporting meetings in the partner country. If the project requires data collection in a partner country, allowance should be made to also support, in an equitable way, the time and effort of the host country students and early career scientists. These suggestions go beyond the mere allocation of funding—they address underlying issues of research ownership and benefit and support equity in generating knowledge.

Recommendations

For the practice of international scientific collaboration to contribute to the advancement of science diplomacy, the scientists themselves must actively participate. They are more than foot soldiers doing science under the direction of funding agencies and higher levels of government. However, for scientists to play their part, certain conditions are necessary. Science program planners need to understand the nature of transformative partnerships and the value of involving scientists from inception. Trust between the funding agencies and scientists is essential—the agencies need to give scientists a large measure of autonomy, within the bounds of sound financial governance.

In turn, when scientists execute collaborative scientific projects, they need to make decisions that are mindful of diplomatic objectives, beyond the purposes of the scientific investigations themselves. Scientists at all levels, including students, need to be introduced to shared relevant values and modalities.

Budget line items are necessary to allow for activities that fall under the science diplomacy ambit; contracts must allow for flexibility of inputs and requirements of the host country partners. Funding restrictions for the exclusive use of funding nation citizens need to be relaxed to avoid an exploitative contractual arrangement. Explicit budget line items, missing in current funding solicitations, ought to be included, such as provisions for reporting to research partners in the host country, including, if applicable, reporting to groups who were the subject of research. Explicit budgetary provisions are required for coordinating and administrative functions for operating a research network. Some flexibility within budget categories and discretionary use of funds ought to be allowed.

Within many types of international scientific relationships, a highly effective arrangement for establishing and operating partnerships is through flat and open regional research networks, based on principles of closeness, equity, and integrity. Such regional research networks often can be flexible in allowing latecomers or parties with less resources to participate; parsimonious, by operating without large

administrative teams or a permanent center or institute; and nonbinding when it comes to long-term support from funders and donors.

The SAFARI 2000 regional science initiative demonstrated the advantages that occur when these various components come together. In addition to a wealth of scientific productivity, SAFARI 2000 produced powerful outcomes for science diplomacy. There is a legacy of skilled professional scientists who have remained in the region, in academia, government, and the private sector. These scientists are inculcated with the knowledge and spirit of transformative collaborative international science and the modalities for making this happen.

Tensions always exist between high-level national science managers and practitioners. However, if scientists are to fulfill their science diplomacy roles and responsibilities through deliberate planning rather than happenstance, then diplomatic and funding agencies should heed the lessons for success offered by SAFARI 2000. SD

Endnotes

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Financial support was provided by the University of Virginia, Charlottesville, the University of Johannesburg, Terence Y. Sieg, John and Dudley Macfarlane, the Barley Scholars Program, and the Office of the Vice Provost for Academic Programs at the University of Virginia. Shirley Pendlebury provided editorial assistance.