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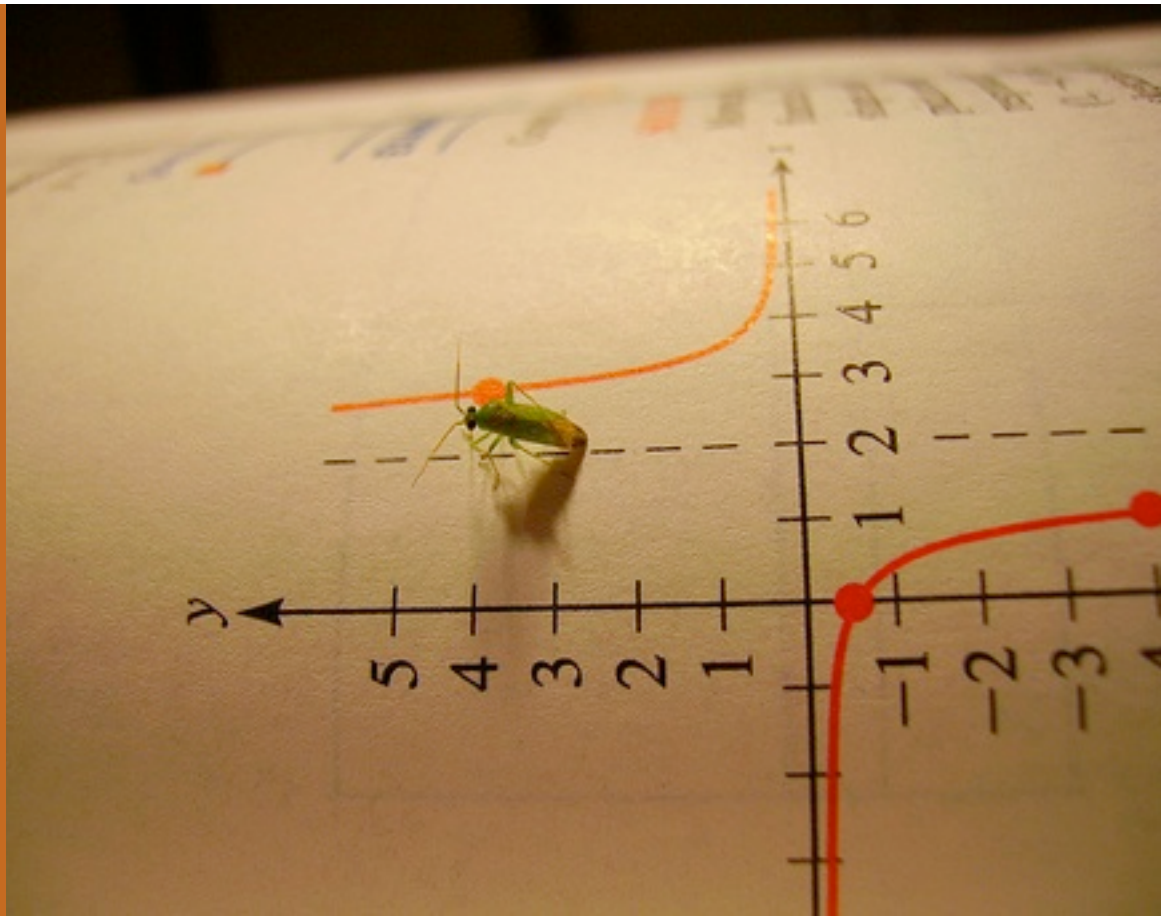

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Special Issue: Invasives + Planning Evolution Team Recommendations

Editor's Note

By Bob Lalasz

Invasives control is fast becoming the Rodney Dangerfield of conservation (and for those of you who, incredibly, might be too young to know what that metaphor means, go here). In the popular media, invasives control is being increasingly portrayed as Exhibit A of outmoded conservation orthodoxy, a quaint, quixotic quest to return to a reference point that never was all that referential by ripping out every last rootlet of purple loosestrife and garlic mustard, recruiting Saturday morning volunteer work crews of well-meaning adults and reluctant-looking teenagers to help us in our grim eradication campaigns...which must be fought over and over again, lest the enemy gain a foothold and overrun everything we hold dear.

Just the right time, I thought, to devote not one but two special issues of *Chronicles* to invasives. Because while it might be easy to caricature the ultimate futility of those valiant Saturday morning efforts, and assume that control methods in most cases are doomed in a world where destructive and potentially destructive non-native species are moving far too quickly through globalized trade and travel routes than we can rip or remotely sense or red-alert tag them, there are still an astonishing number of conservationists who think that fighting invasives is a fight worth having. It's a battle of ideas as much as it is one on the ground, one that's certainly not over yet, and it's healthy to broadcast such tussles. Thanks particularly to Marilyn Jordan for helping me connect with and recruit a bunch of Conservancy and external writers to contribute to the themes for this issue and next. We can't kill the topic, but I'd love to hear your thoughts on theirs — respectfully, of course.

"In the popular media, invasives control is being increasingly portrayed as Exhibit A of outmoded conservation orthodoxy."

Bob Lalasz

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1. To bring you the latest and best thinking and debates in conservation and conservation science;
2. To keep you up to date on Conservancy science — announcements, publications, issues, arguments;
3. To have a bit of fun doing #1 and #2.

Editor & Submissions Bob Lalasz

60 is Just a Number...If You're Babe Ruth Peter Kareiva

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Special Issue: Invasives
Is Fighting Non-Natives Worth the Costs?

Forum with Mark Davis, Daniel Simberloff and Peter Kareiva

Image: Crews search for invasive Asian carp near Chicago, Aug. 2, 2011, following several recent discoveries of their genetic material in Lake Calumet, IL. Credit: Jessica Vandrick-USACEpublicaffairs/

In an essay published in June in *Nature* entitled "Don't judge species on their origins," **Mark Davis** (professor of biology at Macalester College) and 18 colleagues argued that conservation too often unthinkingly vilifies non-native species and devotes precious resources to automatically targeting them for removal, resources that would be better spent on other issues. Reaction to the piece was quick and charged, both without and within the Conservancy; it included a letter to *Nature* by **Daniel Simberloff**, the Gore Hunger Professor of Environmental Studies as well as director of the Institute for Biological Invasions at the University of Tennessee-Knoxville, and 140 co-signers accusing the Davis piece of attacking straw men.

I asked a panel of Conservancy scientists and policy analysts who work or have worked on invasives issues to compose some questions to pose to Davis, Simberloff and TNC Chief Scientist **Peter Kareiva** (who has blogged about the Davis piece on Cool Green Science) about when, if and how conservation should deal with invasive species. Thanks to Davis, Simberloff and Kareiva for responding; their answers follow.

—Bob Lalasz

Question #1: The Davis et al 2011 essay is being read in many quarters as a broadside against control of any non-native species. In your view, what criteria should trigger intensive management of a non-native species? And what are some appropriate metrics to assess whether a species should be considered ecologically harmful?

Mark Davis: I agree that some people have interpreted the *Nature* essay as a broadside against the control of any non-native species, although it is difficult to understand how they could have come to this conclusion given that we clearly stated that this was not our message: "We are not suggesting that conservationists abandon their efforts to mitigate serious problems caused by some introduced species, or that governments should stop trying to prevent potentially harmful species from entering their countries." Species that threaten human health or significant economic harm should always trigger intensive management efforts.

However, the metrics used to define strictly ecological harm need to change. Currently, changes in relative species abundances and ecosystem processes are considered harm by many in the conservation field. For example, among its definitions of harm from non-native species, the U.S. National Invasive Species Council states that "harm includes significant changes in the composition and even the structure of native plant and animal communities." I believe the bar to initiate management of non-native species that are producing solely ecological effects should be set very high. Society seldom has the luxury (resources) to manage nature according to personal preferences for appearance, species composition or ecosystem processes.

Daniel Simberloff: That's not the right question. Many non-natives remain restricted and innocuous for years, even decades, then spread and become damaging. Brazilian pepper, a Florida scourge, is a good example. Another reason that isn't the right question is that some non-natives have highly consequential impacts, but these are sufficiently subtle that we don't recognize them for years — for example, some plants that affect nutrient cycles. So we shouldn't necessarily wait to see something happen (your "criteria") before deciding to try to eradicate an introduced species or, failing that, to attempt maintenance management. Davis et al. inveigh against wasted efforts managing non-native species that aren't very damaging. I could come up with many examples of "Damn, we should have kept it out or eradicated it ten years ago! Now we have a much more difficult problem."

Peter Kareiva: We should do everything possible to keep non-natives out, and then if they begin to establish a population, we should go full speed ahead on

eradication because early detection and early eradication is the most cost-effective approach to mitigating damage from invasive species. I think what your question is trying to get at is this: once a non-native has proven invasive, and is in fact really widely established and abundant over a broad area, do we engage in triage and learn to live with it? The reality is that TNC stewards routinely face this question and make choices about which invasive weeds in prairies, for instance, to focus on. Those decisions ultimately should be based on a return on investment (future damage averted/management cost), and it is my experience stewards make judgment calls about this every field season. We could get more scientific about it — especially if we had better measurements of treatment effects using before/after-treatment control designs.

Question #2: When a species has both positive and negative impacts (i.e., the lantana cited in the Davis et al. 2011 paper) how should natural resource managers weigh these impacts to make management decisions?

Mark Davis: Unfortunately, there is no simple answer to this question, and in fact the question is even more difficult than it appears. In cases like this, different stakeholders will likely differ in what they consider to be positive and negative effects. This means that there is not one set of positive and negative effects, but multiple sets. Thus, those responsible for setting management policy are not simply weighing positive and negative effects but also the desires and interests of different stakeholders. Those making the decisions should solicit input from diverse groups of stakeholders. Then, based on this input, those whose job it is to make management policy should do their best to decide what decision will be in the best interest of society as a whole. These comments are based on the assumption that the management efforts are funded by public dollars. Individual owners of property, or other private ownership groups, can make their management decisions based exclusively on their own system of values and priorities, as long as these decisions do not violate any existing laws or statutes.

Daniel Simberloff: Your question has no generic answer. Show me where Davis et al. 2011 mention lantana's impacts and I may be able to discuss that case (I don't see lantana in their Comment). Obviously, in any such case costs and benefits must be assessed very carefully, and ecological costs often don't translate readily into economic ones. For an introduced species, a site-manager ought also to consider the possibility of delayed impacts, the possibility that an unrecognized impact might already be occurring, and the possibility that a population doing no significant damage at his/her site might spread to another site where it could be more harmful. It's also important to consider who's doing the assessment of benefits, costs and practicality. By picking flycatchers over native riverine plant communities, aren't Davis et al. prejudging management outcome and doing some version of what they say not to: "It is impractical

to try to restore ecosystems to some 'rightful' historical state"? They're declaring what's practical and also judging that keeping the system at some '"future" state is more "rightful."

Peter Kareiva: "Positive and negative" are partly in the eyes of the beholder, and more importantly the measurement of positives versus negative impacts is rare, and nearly impossible in real time. Thus, I do not think managers spend much time dwelling on this question — their thinking is instead guided mainly by treatment effectiveness and treatment cost.

Question #3: Given the well-recognized expense and difficulties with eradication, what do you think are effective strategies in addressing a highly damaging invasive species? Are the impacts of any species so severe that it would be worth continued investment just to constrain its abundance rather than reduce it significantly?

Mark Davis: What constitutes an effective strategy will vary depending on the organism, its distribution, and the environments in which it inhabits. Once a highly damaging species is widespread, efforts to significantly reduce its abundance will normally be very expensive and likely have other undesirable effects. For such species, biological control will typically be the best option in terms of cost, effectiveness and minimizing collateral damage. If good biological control agents are not available, then society must resort to other measures, such as pesticides or physical removal, approaches that are usually very costly, not as effective and often produce other types of harm.

Without question, some non-native species cause such harmful impacts that society is justified in spending resources in perpetuity to at least constrain their abundance. A good example is the sea lampreys in the Great Lakes. Despite tens of millions of dollars spent annually by Canada and the US to reduce the abundance of these parasites, the Great Lakes population of lampreys still numbers in the hundreds of thousands. Nevertheless, experience has shown that the multi-billion dollar commercial and sport fishery industries can be maintained in the face of lamprey populations at this level.

Daniel Simberloff: Some eradications are not terribly expensive or difficult (especially when the species is detected early); others are. Your question has no generic answer; each case must be judged on its own merits. There are successes and failures with all relevant technologies — biological control, chemical control and mechanical and

physical control. In addition, often one wouldn't use a different strategy "just to constrain its abundance" than to "reduce it significantly." In other words, you're setting up what will frequently be a false dichotomy. Often reducing a population significantly entails doing more of whatever you're doing to constrain its abundance. Eradication, rather than just reducing a population significantly, is more likely to entail a different method, but even here that's not always so.

Peter Kareiva: Your question is a little like asking: "When did you stop beating your wife?" I am not so quick to accept the universal impracticality of eradication — having seen it work on TNC's own Santa Cruz Island program and knowing in general that, if eradication is successful, it can accrue huge benefits compounded year after year. But skipping over your unseemly prefatory remark, managers and reserve stewards for TNC routinely make decisions to contain and constrain as a viable management approach. The ultimate success of this approach likely depends on some basic unanswered ecological questions. Most importantly, if intact ecosystems with a full complement of native species and limited degradation can resist invasive species, then the "contain-and-constrain" approach is clearly wise (because intact, undegraded ecosystems will be able to resist seeds arriving from the contain infection). But if this hypothesis proves to be widely wrong, then the contain-and-constrain strategy loses much of its appeal. There is still a lot of basic ecology that needs addressing regarding invasive species, as well as better meta-analyses of the costs and effectiveness of the many different treatment cocktails one might apply to invading species.

Question #4: Look out 10 years from now. Are invasives going to be considered a bigger problem than they are today by conservation scientists and by the general public? Why or why not?

Mark Davis: No, at least with respect to species causing only ecological effects. In the United States and most countries, the term 'invasive' is reserved for non-native species that cause harm. While, people usually agree on what constitutes harm when the threat is economic or human-health related, they often disagree when it comes to strictly ecological effects. For simple pragmatic reasons, conservationists will need to learn to live with many of the ecological changes they previously designated as harm. Because the criteria for defining ecological harm will change in the future, fewer non-native species will be characterized by conservationists as "invasive." Also, as globalization continues and people becomes more accustomed to living among new species — in the same way that they are becoming more accustomed to living among people from other parts of the world — the public will become more accepting of new species, and claims of ecological harm from non-native species will become less frequent. However, it is possible that non-native species causing economic damage and harm to human health could become a larger problem in the future. Of greatest concern

are the possible introductions of new pathogens that could threaten widespread mortality of crops, livestock, timber and/or humans.

Daniel Simberloff: They'll be recognized as a bigger problem. The number of introduced species increases yearly (for many groups, TNC's Joe Fargione has shown a linear increase), and more recent ones are not less invasive or damaging. Also, more ecological and economic costs of established non-native species are recognized every year. Here in Tennessee our forests have long been devastated by chestnut blight and dogwood anthracnose; hemlock woolly adelgid and gypsy moth are more recent disasters; and now we're adding emerald ash borer and thousand cankers disease. A better question might be: What will our forests be like in 10 years? Just as the impact of anthropogenic global climate change isn't going to disappear because some scientists attract attention by saying it isn't happening or won't be so bad, the impact of invasions isn't going to wane because Mark Davis says we should "Learn to love 'em" (see his 2009 text book, p. 150, for the quote).

Peter Kareiva: Ah, this last question gets at the idea I liked in the Davis article, even though that idea may not have emerged as clearly as it should have. At one level, as we gain more and more estimates of the economic costs of invasive species and as "invaders from Hell" like the Asian carp in the Great Lakes come to our attention, we will be more confident that our anxiety about invasive species is justified. On the other hand, there will be increasingly large expanses of ecosystems that are infested with invasive species, some of which might seem like "pretty shrubs and flowers," and that support a lot of animal species — including threatened and endangered species. Because of the expanding human footprint, these infested and novel ecosystems will be valued, and not shunned as somehow unworthy. This is something Davis hints at, although it is perhaps better developed in Emma Marris's new book, *Rambunctious Garden*. So on one hand, the toll taken by invasive species will be more evident in 10 years, but the world will have faced so much change and human impact that some highly invaded ecosystems will be valued as "natural systems" in their own right. **SC**

Special Issue: Invasives
Global Homogenization, Invasives and the Conservancy's Mission

By Frank Lowenstein, climate adaptation strategy lead, The Nature Conservancy

Above: Flowers in South Africa's fynbos. Image credit: Paul Perton/Flickr.

"The fate of biological diversity for the next 10 million years will almost certainly be determined during the next 50-100 years by the activities of a single species." (Ehrlich and Pringle 2008)

The crisis of environmental degradation has progressed to the point of impacting evolutionary processes and outcomes on geologic time frames (Ehrlich and Pringle 2008; Mooney and Cleland 2001; Myers and Knoll 2001). The components of this degradation are sometimes collectively characterized as "global change" (Sala et al 2000), including:

- Global climate change and direct effects of rising carbon dioxide levels;
- Changes in other global biogeochemical cycles, particularly nitrogen enrichment;
- Movement of organisms worldwide; and
- Changes in global land-use patterns.

These changes are rapidly reshuffling the evolutionary deck and driving ever faster change in natural systems. For The Nature Conservancy, these dynamics present a significant mission challenge that is not yet fully recognized in our conservation thinking, actions, strategies and planning. And that challenge also requires a rethinking of how we address invasive species.

Rate of Species Creation and the Threat of Invasives and Homogenization to TNC's Mission

The nascent science addressing novel ecosystems (Hobbs et al. 2006, Lindenmayer et al. 2008, Seastedt et al. 2008) tries to grapple with appropriate conservation goals for our human-dominated world. This work correctly identifies that the past composition and structure of ecosystems is a poor guide for future management. For example, we are in a period of exceptionally rapid and accelerating climate change. Paleoecological studies show that during the last period of major climate change — following the end of the last glaciation — plant communities were radically unstable (Schoonmaker and Foster 1991). For example, different tree species responded individually and in dramatically different ways to changing climate. Community compositions that existed then may not exist anywhere today, and vice versa.

So, if the community compositions we see today are ephemeral responses to underlying conditions, and those conditions will change dramatically over the next decades, why should we worry about community composition, invasive species or any other aspect of which species is found where?

The answer is that invasive species are symptomatic of the one aspect of global change (Sala et al 2000) that most directly undermines TNC's conservation approach. Non-native and invasive species matter not only at the community level, but also at the level of biogeographic realms. Global biodiversity derives from evolution acting on separate assemblages of species. Darwin's finches on the Galapagos Islands, the diversity of marsupial life in Australia, and the unique fynbos flora of South Africa are all startling examples of how evolution can produce remarkable life histories and life forms given a long-enough geographic separation. Even if species shift around within a large region (think Australia), evolution still operates on the same pool of species.

"Invasive species are symptomatic of the one aspect of global change that most directly undermines TNC's conservation approach."

The Conservancy's conservation approach relies on ensuring the survival of the representative examples of the biotas of the many regions we work in. As a strategy to preserve global biodiversity, the success of such a representation approach relies on the existence of differences in biota derived from evolution operating over time — so that landscapes we work on in China result in the conservation of different species than we achieve via working in Argentina or Pennsylvania.

Today, homogenization via enhanced global movement of species is reducing the number of separate lineages of flora and fauna subject to evolution. Biogeographic barriers like the Bering Strait, the Pacific Ocean and the Isthmus of Panama are breached routinely and daily through unintentional hitchhikers on the planes and ships engaged in global trade, through intentional introductions for agriculture and horticulture, and via species carried with migrating humans for food or pleasure. And the pace of this exchange is accelerating (Levine and D'Antonio 2003, Westphal et al. 2008).

The ultimate effect is likely to be a reduction in the rate of creation of new species. This threat is entirely separate from the threat to biodiversity that TNC and many conservation biologists tend to focus on — accelerated rates of extinction — but it makes the impact of that second threat more dire (Myers and Knoll 2001).

In addition, global loss of specialist species due to habitat disruption, global environmental changes such as climate change, and breakdown in biogeographic barriers could result in loss of ecosystem resiliency and the ecosystem services that people rely upon (Clavel et al 2011).

When introduced to a new biogeographic realm, some but not all introduced organisms become widespread in natural areas and may reduce biodiversity as a result, either by competing with native species, by eating native species, or by changing underlying ecosystem processes. Destructive, aggressively spreading non-native species are labeled as invasives, and are often identified as key threats to biodiversity at the site or system level.

Is the Conservancy Focusing on the Symptom, But Missing the Disease?

In response to these kinds of threat assessments, our organization has invested deeply in invasives control and encouraged partners to do the same. Dozens if not hundreds of TNC staff in the organization's U.S. operating units have invasives control as part of their portfolios. These investments are often necessary, as at their worst invasive species can be game changers. For example, two species of invasive plants may bring East Africa's vast migratory herds to a halt (Witt 2011).

But by focusing on invasive species primarily once they manifest as a threat at a given place, the Conservancy is masking the more subtle and ultimately more troublesome source of this stress — the homogenization of the global biota. By focusing on the symptom, we have missed the disease, and produced a misallocation of resources, with operating units desperately trying to abate threats at the site or system level, while at the global level we now lack any capacity to address the policies that degrade the uniqueness and diversity of entire biogeographic realms. The North America CR Forest Health Protection Program does still work at the U.S. national level to prevent introduction and spread of one category of potential invaders, and some Conservancy operating units (e.g., Florida) have integrated invasives management efforts that extend from the site level to state policy. But since the demise of TNC's Global Invasive Species Team, we have had little organizational voice addressing the movement of biota across the globe or reinforcing these efforts at the national level in the United States or beyond.

"By focusing on invasive species primarily once they manifest as a threat at a given place, the Conservancy is masking...the homogenization of the global biota."

Today's most severe threats to biodiversity — derived from continued excessive use of fossil fuels, globalization of trade, and growth in human population and individual consumption — affect many places at once. These threats are not amenable to local

solutions acting in isolation, and they require a sustained commitment over long time scales to achieve strategy success.

What the Conservancy Needs to Do to Respond to These New Threats

We need a planning process that builds consensus for action to address these threats across multiple operating units, incorporates longer time scales, recognizes the dominant place of people in controlling and managing the forces that limit and shape biodiversity today, and ensures that evolutionary processes essential to TNC's mission success continue to operate.

TNC's new Global Challenges/Global Solutions (GCGS) framework begins to address the critical role of people in the future of biodiversity, but it is not yet integrated into the planning processes that guide most of our organization's day-to-day work. To build on the GCGS framework and make it real in the context of the threats mentioned above, we need a number of changes:

First, we need to ensure that our planning routinely evaluates not only threats to multiple conservation targets at a single site, but also 1) threats to a single target at multiple sites and 2) strategies to abate a single threat to multiple targets at multiple sites. Such broadening of our planning scope will allow us to focus on higher leverage strategies capable of benefiting multiple sites simultaneously.

Second, we need to address threats more proactively. The 10-year timeline commonly used in conservation-area planning steers our efforts strongly to imminent threats that are usually already severely damaging conservation targets. But longer-term threats often can be abated only through action well ahead of time. For example, invasive species strategies aiming to prevent future homogenization and associated invasion will rank low in our planning priorities because they do not likely address threats within the next 10 years. Climate change and atmospheric nitrogen enrichment are subject to similar time-frame ranking problems, and yet require actions across decades to abate the threat.

"Concerted action at the national and global levels can function to reduce the flow of species, and eventually I believe the Conservancy will again recognize the need for a global approach."

Third, the ranking of scope within our Conservation Action Planning results in the misrating of those threats that can be prevented only through early action. For example, the literature is clear that invasive species eradication efforts succeed best when attempted early in an invasion, when the geographic scale of the infestation is tiny (Simberloff 2003). But tiny infestations have minuscule scope, and may spread slowly enough that, even after 10 years, they will still rank low in scope. The focus on threats already affecting much of a conservation target impedes a proactive, preventative approach to invasives and many other issues.

Finally, TNC needs a framework for dealing with a host of novel conservation issues — such as our response to genetically modified organisms intended for introduction to natural areas (e.g. genetically modified American chestnuts); how to build on our

expertise in conserving biodiversity in working landscapes to cope with the spread of entirely novel habitats; and what to do about native species that begin to behave like invasive organisms due to climate change or altered ecosystem structure.

Beyond these changes to our planning efforts, we need difficult changes in our own organization. Operating units must overcome their mistrust of central programs and recognize that common action is essential to abate the underlying cause of common threats. Implementing this recognition will require more of some difficult tasks that many operating units already undertake: specifically it will require fundraising and leadership staff to successfully make the case for funding programs beyond their geography (including at the regional and global level), even at the expense of the growth of local efforts. And global programs must be held to standards of effectiveness so that operating units know their funds are well spent.

As to invasives, their threat did not decrease with the foundering of the Global Invasive Species Team, and the homogenization of the Earth's biota continues unabated, sowing the seeds literally and figuratively of tomorrow's invasives threats. Concerted action at the national and global levels can function to reduce the flow of species, and eventually I believe the Conservancy will again recognize the need for a global approach. But there are many ways to provide for unified action. Perhaps we will address the spread of organisms as one aspect of a team that tackles a range of trade-related conservation issues, such as illegal logging and its impacts on forest ecosystems, and the tradeoffs between biofuels, agriculture and poverty. Time will tell. All that is certain is that, in the case of invasives, the threat — symptom and disease — remains. Ignoring it, or claiming that its import is reduced in a time of novel ecosystems, ignores the role of evolution and history in our organization's future success. **SC**

***Author's Note**: During my nearly 19 years at the Conservancy, I have worked at the site, division, regional and global levels — but for the last several years I have worked almost exclusively at the national to global level, including on the issues of invasive species, trade and (most recently) global climate change. The latter experience may be influencing my thinking!*

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Special Issue: Invasives

You Can't Evolve If You're Extinct: Novel Ecosystems & the Forgotten Food Web

By Marilyn Jordan, senior conservation scientist, The Nature Conservancy

Image credit: Maigh/ Flickr

Novel ecosystems — new, historically unprecedented combinations of species caused by environmental change, human actions, introduction of new species and loss of native species — are now ubiquitous, and conservation ignores them at its peril. These ecosystems collectively cover close to 40% of the terrestrial ice-free globe as mapped by Ellis et al. (2010). Novel freshwater, estuarine and marine ecosystems also exist, but have not been similarly mapped.

Conservationists have often thought of novel ecosystems as degraded or worthless, although some now argue they may be potentially valuable habitats (Kareiva 2008; Ellis 2009). These ecosystems are certainly a varied lot, ranging from slightly altered to totally transformed. So how should we determine the value of a novel ecosystem? When can we simply rely on the resilience of nature to restore diversity, functionality and production of ecosystem goods and services, and when will active management be needed?

My answer: We should base our assessments on an understanding of both the benefits and deficiencies of novel ecosystems *and* their implications for genetic and species diversity, trophic linkages and ecosystem function. Let me illustrate this approach by focusing on what invasive plant species can mean for the diversity and nativity of producer species in terrestrial systems.

Extinctions and decreased diversity and abundance of resident species caused by intertrophic impacts of invasive predators and pathogens are well documented, whereas the effects of introduced plant species are less obvious and sometimes controversial (Davis 2003; Powell 2011; Gurevitch and Padilla 2004). Certainly, invasive plants can have many different types of impacts on plants, animals and ecosystem processes; some are positive and some negative, depending on context (Vila et al. 2011). However, invasives typically cause decreases in an ecosystem's producer species diversity and biomass, resulting in reduced nutrient uptake (Cardinale et al. 2007 and 2011). These patterns hold true in both aquatic and terrestrial ecosystems, and among herbivores, detritivores and predators (Cardinale et al. 2006).

Changes in food webs and energy flow among all trophic levels as diversity decreases have rarely been considered in biodiversity-ecosystem function studies (Schlaepfer et al. 2011). In particular, altered insect abundance and diversity can have profound effects (Wilson 1987). Herbivorous insects are the largest taxon of primary consumers: they convert plant material of low caloric density into nutritious packages — high in fats and proteins — that are essential for the growth and reproduction of many species of animals, including carnivorous insects, birds, and mammals.

Plants produce an array of toxic defense chemicals that discourage herbivory. Most insect species are specialists and can consume only those plant species containing the specific class of defensive compounds to which that species has adapted. Thus, introduced nonnative plants can rarely be eaten by native insects unless the nonnative plant species is closely related to a local plant lineage and shares similar defenses. A smaller number of insect species are more generalized in their use of host plants, but even they can use only a small number of plant species (Burghardt et al. 2010; Tallamy et al. 2009; Fox and Morrow 1981). Other studies on many insect orders and arthropod classes in different habitats and locations, and in experimental systems, have also found large reductions in aerial arthropod species diversity and biomass as nonnative plants increased (Heleno et al 2008; Litt & Steidl 2010; Herrara & Dudley 2003; Haddad et al. 2001). Thus, a shift from native to nonnative plants can clearly result in bottom-up reductions of energy available to higher trophic levels in food webs. Those of us old enough to remember the high "bug splat" density on vehicle windshields ~40 years ago can confirm that insect abundance appears much reduced today, though increases in nonnative plants may not be the only cause.

"Changes in food webs and energy flow among all trophic levels as diversity decreases have rarely been considered in biodiversity-ecosystem function studies."

Loss of specialist insects is but one example of a widespread "replacement" of specialist species by generalists in many taxa and in many contexts as a result of disturbance and global change (Clavel et al. 2011). This loss of functional diversity

results in functional homogenization (FH) of natural communities. Consequences of FH are likely a loss of ecosystem resilience, stability and ecosystem services at a landscape scale, since homogenous communities are less variable in their responses to disturbance (Clavel et al. 2011).

There are examples of some native species of plants and animals at least partially adapting to the impacts of invasive species, and of some invasive species becoming less damaging over time. However, we probably can't wait for evolutionary time and the resilience of nature to fully restore functional ecosystem diversity from the bottom up. For example, after >100 years in Florida, Melaleuca quinquenervia hosts only 8 species of herbivores, compared with 406 species in its homeland (Costello et al. 1995); *Phragmites australis* after 300 years in North America hosts 5 species versus 170 at home (Tewksbury et al. 2002). As species become increasingly rare, dispersed or extirpated, we are losing the diverse genetic material needed for evolution and adaptation to change. You can't evolve if you are extinct.

So what do we do about novel ecosystems altered by introduced species? Preventing the introduction of new potentially invasive species is the single most important strategy — for once established, invasive plants, animals and pathogens are nearly impossible to eradicate. We must prioritize scarce resources and be strategic in deciding which invasive species should — and can — be managed. Management and restoration of novel ecosystems will also require a triage approach. Sometimes it will be important and possible to restore native species and communities, and sometimes (most times?) we will accept novel ecosystems and work with them. Novel management strategies tailored to suit different ecoregions, microclimates, land uses and socioeconomic settings will be needed in order to maximize the conservation value and ecosystem services provided by these altered ecosystems (Hobbs et al. 2009).

"As species become increasingly rare, dispersed or extirpated, we are losing the diverse genetic material needed for evolution and adaptation to change."

A "whole ecosystem" approach (Ward 2011) is likely to work well for the increasingly (sub)urbanized and expanding developed matrix in which many conservation lands are embedded, as well as for relatively intact natural areas that contain human-impacted inholdings. Successful management of such areas must include the needs and concerns of human residents. About one-half of invasive plant species were introduced as ornamentals, and desirable ornamental plants have characteristics that contribute to invasiveness (Drew et al. 2010). Thus, strategies directed towards the nursery industry and consumers are essential. Increasing the use of native plants (and discouraging the use of invasive plants) in residential and commercial landscaping could be widely beneficial in supporting native insects and other native species across whole ecosystems.

Above all, we need a deeper understanding of novel ecosystems in order to manage them flexibly, innovatively, in ways that will promote ecosystem services and resilience to change while still protecting our native evolutionary biological capital. Declarations that novel ecosystems are the future might be true, but the work of approaching them

intelligently requires a full appreciation of their individual strengths and deficiencies. SC

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Special Issue: Invasives

Knowing (and Sharing) the Difference Between 'Non-Native' and 'Invasive'

By Ellen Jacquart, director of stewardship, The Nature Conservancy in Indiana

Image: Hedgehog in New Zealand (where it is non-native). Image credit: Mouse/Flickr

At the heart of the recent *Nature* article by Davis et al. (2011) is a common misconception; the authors have confused "non-native" species with "invasive" species. For those of us who work on invasive species issues, the difference between the two terms is one of the first things you explain to land managers, making the distinction by reciting the U.S. federal definition of invasive species (an invasive species is "…an alien (or non-native) species whose introduction does, or is likely to cause economic or environmental harm or harm to human health").

Most people are reassured to find out that the majority of non-native species cause no harm whatever, and that some are even beneficial. There is just this small subset of troublemakers we call *invasive species* — those non-native species that cause harm — to address. In case there is any lingering concern, we assure everyone that, no, we are not intent on eradicating soybeans or petunias from the United States. Those species are *non-native*, not invasive.

I am not sure how this basic misconception found its way into a peer-reviewed journal of such repute, but I'm afraid its appearance there tells us we're still not very good at talking about invasive species, even to our own colleagues. Perhaps there are practitioners out there focused on trying to control non-native species that aren't truly causing harm, but in my experience they're a rare exception. Most of us spend a great deal of time figuring out which non-native species are just innocent bystanders and which are real threats to conservation targets.

In fact, there are simple criteria for assessing and ranking invasive species at a site so we can focus efforts on the highest priority species. There are different systems of ranking out there, but my favorite is the one developed by the Conservancy's Global Invasive Species Team (GIST) back in the late 1990's in their Weed Management Plan Template. Since the loss of GIST due to budget cuts in March 2009, the University of Georgia has been gracious enough to host all the content from the former GIST website, including the Weed Management Template (http://www.invasive.org/gist/products.html).

The template poses four questions to land managers to help them prioritize among the invasive species at their sites and determine which species pose the greatest risk to conservation targets and which are a minor issue with no control needed.

The four questions are:

1) *What is the current extent of the invasive species* (with high priority going to the least prevalent species)?
2) *What are the current or expected impacts of the invasive species* (with high priority going to impacts that will threaten conservation targets)?
3) *What is the value of the habitat infested or that could potentially be infested* (with high priority going to habitats which hold conservation targets)?
4) *How difficult is the species to control* (with high priority going to species easy to control)?

"Most of us spend a great deal of time figuring out which non-native species are just innocent bystanders and which are real threats to conservation targets."

These questions are specifically designed help insure optimal resource use relative to the threat posed by invasive species.

This process is a common-sense approach to strategically taking on the invasive species problem. Importantly, the approach also involves identifying invasive species that are not yet on site but have potential to invade — and the prevention of those invasions becomes the highest priority for the land manager.

Admittedly, sometimes we don't have all the information we would like in order to answer those questions, particularly on what the current and expected impacts of a species might be. It can be difficult to know whether that little patch of teasel is going to stay put or move quickly through the prairie, displacing native plant species, decreasing habitat for grassland birds, etc. Like every other aspect of ecological management, we

have to make our best guess based on all known information. Monitoring to make sure that best guess was correct is part of the Weed Management Plan Template, as is changing the management strategy if it turns out the guess was wrong.

Ultimately, I guess, I'm wholeheartedly agreeing with the Davis et al. article's main premise. It *is* important to focus our attention on the non-native species that cause the most harm. Thanks to GIST, we've had the tools to help us do that for many years. Our challenge — one that we are failing to meet — is to share these tools internally and externally to help inform these kinds of debates. **SC**

Article

Planning for Tomorrow's Conservation Challenges: Recommendations of TNC's Planning Evolution Team*

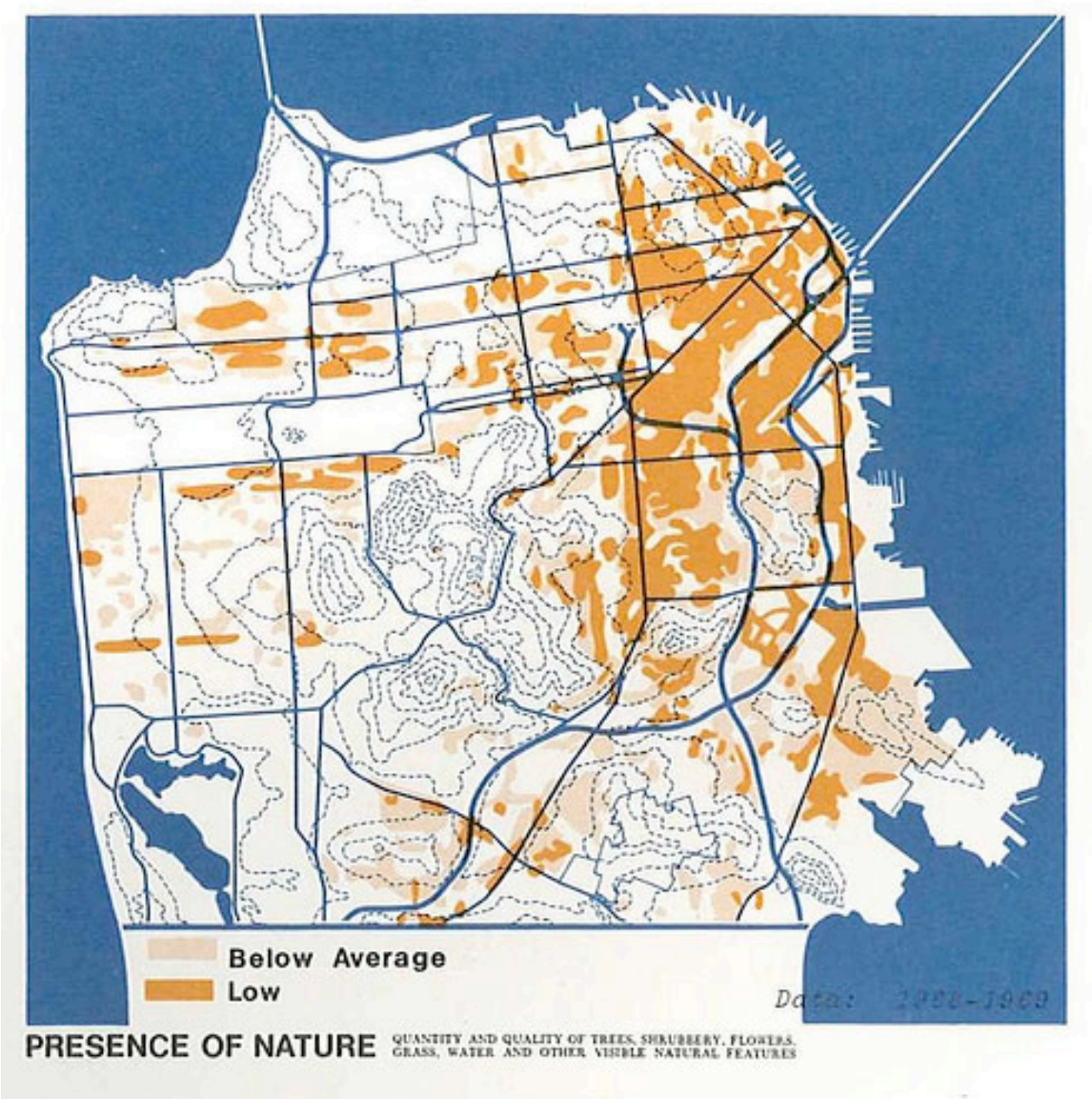

Image: The Urban Design Plan for the Comprehensive Plan of San Francisco. Image credit: Eric Fischer/Flickr.

The Nature Conservancy is widely recognized for its systematic approach to conservation. Conservation Action Planning (or CAP, the Conservancy's version of strategic planning); Ecoregional Assessments (ERAs); global habitat assessments; and the organization-wide effort to measure the effectiveness of our conservation work are hallmarks of this approach. While these planning and adaptive management methods have served the organization well, both conservation and the Conservancy have changed dramatically over the past 15 years. The rapid pace of environmental change, our focus on whole systems with emphasis on ecological process and ecosystem

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services, and the need to strengthen the linkage between human well-being and ecological systems are illustrative of many new challenges we face.

To meet these challenges and maintain our position as an industry leader in strategic conservation action and adaptive management, it is essential that we evolve and improve our conservation approach. The Conservancy's Executive Team commissioned the Planning Evolution Team (PET) to do just that — evaluate our existing approach and make recommendations for its improvement.

Over the last year, the PET — a geographically and programmatically diverse group of Conservancy and external staff — interviewed more than 100 Conservancy staff to evaluate our current approach; researched the latest methods and tools on strategic, business, and conservation planning; and identified many innovations inside and outside the Conservancy that could contribute to an improved conservation approach. We used three guiding principles in this effort:

1. Identify, disseminate and catalyze current best practices in conservation planning across the Conservancy and its partners.
2. Embrace a more flexible, toolbox approach to conservation planning while maintaining the ability to communicate effectively about the process and results from this planning.
3. Bring greater rigor to planning without making it more time-consuming and complicated.

The PET has just released a final report containing our recommendations, which can be downloaded here. In this report, we outline our principal recommendations, provide justification for the recommended changes, identify examples of projects that are implementing these recommendations, highlight methods or applications that are essential to evolving our conservation approach, and suggest improvements in project management that are fundamental to successful implementation of our collective recommendations.

Discuss these recommendations on connect.tnc.org

Innovative and cutting-edge conservation planning occurs across the Conservancy. The PET was always conscious of recognizing and building off this strength, and some teams reading these recommendations will see in them an evolution of their current practices. In nearly all cases, the PET drew from ongoing work in Conservancy field programs. However, a number of these recommendations do represent significant changes from business-as-usual planning in the Conservancy.

Recommendation #1: Enhance the Selection and Development of Strategies. Much of the energy of conservation planning has been focused on identifying conservation targets and threats. Planning fatigue often sets in before teams develop strategies and actions — and as a result, what is arguably the most important component of planning receives short shrift. We need to pay more attention to the process and tools for selecting and developing good strategies. We can accomplish this by placing a greater emphasis

on linking strategies to ultimate outcomes (ends, not means); thoughtfully comparing potential strategies; and thoroughly assessing the costs and risks of alternate interventions.

Justification: Strategy development and selection are probably the weakest components of our existing conservation approach, and yet these decisions are critically important to how we spend our dollars and whether we achieve our mission. Interviews with Conservancy staff consistently revealed that strategy selection is often opaque, biased towards traditional approaches, accomplished without sufficient engagement of policy, economic and other implementation experts, and opportunistic. Creative, cost-effective strategies are needed if we are to meet today's conservation challenges and rise to the priorities of the Global Challenges/Global Solutions framework. The confidence and freedom to develop and explore such strategies requires a strategic planning and decision-making system that is transparent, explicit about risk, and realistic about costs. Without major enhancements to the tools and process of strategy selection, it will remain difficult for the Conservancy to escape current limitations in determining how we work.

Recommendation #2: Develop a Single, Integrated Planning Approach: Conservation Business Planning. The Conservancy should develop and adopt a single, flexible strategic conservation planning framework that would build on but ultimately replace current versions of CAP, ERAs and business planning over the next 2 years. This framework — which we refer to as Conservation Business Planning — would be based around a common set of conservation, business planning and adaptive management questions, a version of which the PET has proposed, tested and peer reviewed (see Roadmap Figure on Page 12). Numerous planning tools, including those we currently use, can help provide answers to these questions, but the Conservancy should look to develop and support a set of made-for-purpose tools, especially for weak areas such as assessing costs and benefits of strategies and multi-objective planning. A revised approach to conservation planning should be applicable and applied to the full range of planning situations in the Conservancy, from traditional landscape, seascape, and watershed work to larger-scale policy strategies and global challenges.

"Strategy development and selection are probably the weakest components of our existing conservation approach, and yet these decisions are critically important to how we spend our dollars and whether we achieve our mission."

Justification:

Reduced confusion: The Conservancy engages in many different forms of planning—from CAPs to ERAs, business plans, and Operating Unit (OU) strategic plans. For many of our field programs, this diversity of plan types is confusing and their application has become inefficient. We can largely deliver the same basic information with different points of emphasis for different audiences through a single planning process.

Broader engagement in planning: We believe that Conservation Business Planning will better engage a variety of audiences that have not regularly participated in planning (e.g., the Conservancy's government relations and philanthropy staff as well as its senior managers) through application of planning to a greater variety of situations, avoiding

the tendency to get too bogged down in ecological considerations early in the planning process, and identifying a clear place for input from a diversity of disciplines.

Greater flexibility: Because project teams with different skills and capacities face different socioecological contexts and myriad challenges, we need to encourage the use of the most appropriate tools for the job. Although some tools within CAP and ERA methods will remain useful for answering some of the core questions outlined in the PET recommendations, a planning framework based on these core questions will enable flexibility in our toolkit while we retain the strength of speaking a common language and being recognized as a strategic organization.

Assessment of costs and benefits: Planning in the Conservancy has not been consistent in integrating information on the cost, benefits and risks associated with our strategic choices. This new planning framework creates the expectation that teams capture and use these important pieces of information.

Recommendation #3: Mainstream Multi-objective Planning. The Conservancy should adapt its core planning approach to more consistently accommodate multiple objectives (e.g., objectives relating to ecosystem services, human well-being, or other sectoral interests in addition to our traditional biodiversity objectives). This accommodation requires (a) a planning approach and tools that enable exploration of trade-offs between objectives, and (b) a greater use of scenario analysis to evaluate alternatives.

Justification: Because the Conservancy increasingly works with various sectors of society (e.g., the energy or fishing industry) at a landscape-seascape or greater scale, it will take on many more projects that do involve both biodiversity objectives and additional objectives related to human use of natural resources. Our present planning methods were designed with an intentional focus on biodiversity and are not sufficiently structured to transparently weigh or evaluate other objectives. Some great evolution has already happened in this regard — for instance, the adaptation of Ecoregional Assessment methods to Marine Spatial Planning or Development by Design — but there is still demand for more of our planning to explicitly acknowledge and incorporate the fundamental objectives of our partners and other stakeholders. New approaches such as Development by Design or new tools like multi-criteria decision analysis don't assume that we are adopting the objectives of others, but instead enable us and our partners to jointly explore scenarios that deliver on a range of conservation and human-use objectives.

"Our present planning methods were designed with an intentional focus on biodiversity and are not sufficiently structured to transparently weigh or evaluate other objectives."

Recommendation #4: Integrate Spatial and Strategic Planning. The Conservancy should adapt its core planning approach to integrate spatial (e.g., Ecoregional Assessment) and strategic planning (e.g., CAP), rather than conduct them as separate exercises.

Justification: From land protection to shellfish restoration to managing for sustainable ecological flows, the Conservancy employs a diversity of strategies to achieve its mission, and suitable places to deploy these strategies will not overlap perfectly with traditional portfolio sites from ERAs. Strategic action and place cannot be separated — so planning for them independently is inefficient. Most contemporary regional planning efforts or spatial prioritizations (ERAs are one type of such prioritization) incorporate strategy development in the planning process — while at the same time CAP is increasingly being used at a scale where a spatial understanding of targets, threats and enabling conditions is essential. Integrating spatial and strategic planning into a single planning framework will lead to more efficiency in aligning places with strategies.

Recommendation #5: Improve Plan Implementation. Even when the Conservancy excels at planning, implementation of those plans often falls short. Four courses of action will significantly improve implementation and lead to better conservation outcomes:

- First, greater attention should be paid to the planning context before a plan is initiated — why is the plan needed, how does it fit into broader strategic initiatives, who is the audience for the plan, what is its scope, what decisions will be made from the plan, and who will make those decisions.
- Second, project directors and other senior conservation leaders must be more engaged in leading and managing strategic planning processes to better connect these efforts to good management decisions.
- Third, the implementation of a project's strategic plan must be wholly integrated into the strategic and annual operating plan of Conservancy OUs.
- Finally, greater attention must be given to financial analyses related to both the costs and the feasibility of raising the necessary funds to move a project forward.

"Too many plans in the Conservancy have been developed as a rote exercise to fill a perceived Conservation by Design mandate, with not enough thought given to which questions the plan was intended to answer and who needed to know the answer to those questions."

Justification: No state-of-the-art planning methods and tools will improve conservation if the resulting plans are not implemented. Too many plans in the Conservancy have been developed as a rote exercise to fill a perceived Conservation by Design mandate, with not enough thought given to which questions the plan was intended to answer and who needed to know the answers to those questions. At the same time, planning — whether through CAPs or ERAs — has too often been viewed as a "science exercise," primarily the responsibility of conservation scientists and planners. Quite to the contrary, decisions about where the Conservancy is going to work and the strategies it will use are the foundation of sound project management and must have greater engagement and leadership by project and senior managers to engender the buy-in that is necessary for implementation and allocation of necessary resources. Strategic and annual operating plans of Conservancy OUs are more often the vehicle for directing what actually gets done in a program — and without better integration of conservation plans to OU, regional, and global team strategic plans, implementation is likely to continue to fall short.

Recommendation #6: Aim for Greater Rigor Without Greater Investment in Planning. Improving planning does not mean doing more planning — it means doing it more efficiently, doing more appropriate planning, and improving its quality. Efficiency can be gained by ensuring that the purpose and context for planning are clear (see Recommendation #5); limiting overlap in planning efforts; investing more intensive effort in plan development over shorter durations; and improving management of the planning process. Preliminary suggestions about the most important criteria to consider when making decisions on investments in planning include: likelihood for replication and leverage for selected strategies, financial and reputational risk, uncertainty of strategies, complexity of the planning context, and the anticipated longevity of the resulting decision.

Justification: Any conversation about planning in the Conservancy would be incomplete without some mention of "planning fatigue." The PET was routinely advised that any recommendations for improving planning had to be made within the context that many program staff are "planning weary." More investment in planning than is needed is a significant waste of resources, and it negatively impacts the perceived value of future planning efforts. To that end, we can be smarter about the investments we make in planning.

What Do these Recommendations Mean for You?

Senior Managers: This planning approach addresses a set of core questions for which the Conservancy's senior managers as well as project directors and other senior OU leaders need answers. Senior managers have a greater role to play to ensure that planning and peer review processes are better managed, that plans address a core set of questions that the PET is recommending, that investments in planning are scaled appropriately to the needs of individual projects and strategies, and that implementation of conservation plans is part and parcel of OU strategic and annual operating plans. One integrated planning process that merges CAP (strategic planning), ERAs and business planning should simplify matters and be appealing to a diversity of staff interests, from planning and science to management and philanthropy.

"Any conversation about planning in the Conservancy would be incomplete without some mention of 'planning fatigue'...More investment in planning than is needed is a significant waste of resources, and it negatively impacts the perceived value of future planning efforts."

Project and Program Directors: Our recommendations specifically ask many of you to take a greater responsibility in leading and managing strategic planning processes and in helping ensure that we improve implementation. This request does not imply that you should spend the bulk of your time leading planning efforts — only that you serve as the leader and manager of the process, helping ensure its relevance, transparency, accountability and, ultimately, its effectiveness.

Conservation Scientists, Planners and Coaches: This group will be critical to fully integrating these recommendations into the work of conservation teams. While recognizing that many Conservancy scientists, planners and coaches are pioneers of new methods and processes that the PET is recommending more broadly, these changes will mean that you will be learning, designing and mastering more tools in an expanding

toolbox (e.g., Return on Investment, Scenario Analyses). After these recommendations are carefully vetted, building on your experiences to harvest, develop and test new tools will be an ongoing process, and providing guidance and training will be a continuing effort that this group will need to support.

Philanthropy Staff: Information on conservation outcomes, strategies used to reach outcomes, and measures for evaluating whether the strategies are working are critical components of many proposals and reports to donors. Our recommendations as well as those in the most recent Measures Business Plan should make this information more transparent and available to you as outputs of any strategic planning process, and hopefully make your job easier as well. And a greater emphasis during planning on thoroughly understanding both the expected costs of a strategy and our ability to raise those resources makes your input during planning increasingly important.

Government Relations & External Affairs Staff: The emphasis on leverage, replication and opportunity implies that more of the Conservancy's future strategies and actions will be increasingly policy-oriented. Unlike traditional place-based projects, policy interventions have not generally been subject to the rigors of strategic planning. We envision an increased engagement by GR and XA staff in which the risks, assumptions, costs and benefits of alternate policy strategies are carefully evaluated.

Conservation Strategy and Learning Team (Conservation Programs) and **Conservation Methods Team** (Central Science): The bulk of responsibility for a) developing improved planning guidance, b) developing and supporting a limited set of new planning applications and tools, and c) supplying ample examples where these tools apply will fall to these two teams. You will have your work cut out for you in FY12 and 13!

Advancing the Recommendations of the Planning Evolution Team

Implementing these recommendations will be a journey, not something that should or will occur overnight. To successfully start this journey, several important steps should be taken in FY12:

- Although the PET received some review of its preliminary recommendations through a workshop that included a cross-section of Conservancy staff in April 2011, additional peer review is needed with field program staff to improve our products and build broader support.
- New planning approaches (e.g., evaluating alternate strategies) need to be field tested with real Conservancy field projects or strategies.
- A small number of new methods and tools will be added to the conservation planning toolbox in FY12 — for example, Return on Investment tools, expert elicitation tools, or social science methods. Over time, the toolbox will grow as innovative methods from inside and outside the Conservancy are added.

• The Interim Planning Guidance (completed by the Conservation Strategies and Learning Team in Spring 2011) will be updated and expanded to include the whole suite of PET core questions and recommendations as well as to integrate new field-tested approaches, methods, and tools as they become available. This expansion will be phased in over 2 years, with the majority completed in FY12.

• The Conservation Measures Partnership's (CMP) Open Standards for the Practice of Conservation is scheduled to be revised in FY12. As a charter member of the CMP, the Conservancy will be working alongside our partners to undertake this revision. The PET recommendations should make a useful contribution to the revision of the Open Standards.

Frequently Asked Questions

Q: *Do these recommendations imply that all conservation projects need to update their conservation plans based on the core planning questions and Interim Conservation Planning Guidance?*

A: No, plans should be updated when there is sufficient new information to suggest changes in strategy, such as substantive change in programmatic direction and desired outcome or if project directors or senior conservation leaders believe that a conservation plan is substantially deficient in an important area (e.g., measures, fundraising analysis, theory of change). Such deficiencies may come to light through management or peer review of conservation project plans. The primary focus of PET recommendations is for new projects or projects that do not have an adequate conservation business plan in place.

Q: *Have the PET recommendations incorporated the ideas of whole system conservation as outlined in the recent TNC North America Report: Stepping up to the Challenge: A Concept Paper on Whole System Conservation* (Science Chronicles, *July 2011)?*

"The need for an updated planning approach predates the discussions about a new mission, goal, vision and priorities and is not in any way dependent on the final outcome of those discussions."

A: Yes, the whole system concept emphasizes the larger spatial scales at which the Conservancy is working, including the matrix of lands and waters between conservation areas as well as an increased emphasis on the needs of people. Two of our recommendations specifically support these aspects of whole system conservation — mainstreaming multi-objective planning (including the needs of people from other sectors of society beyond conservation) and integrating spatial (ERAs) and strategic planning (CAP). The latter point on integration is recognition that, at larger spatial scales, we need to be setting spatial priorities for conservation and developing strategy simultaneously, as place-based priorities and strategy are inherently related.

Q: *Have the PET recommendations considered the new mission, vision, goal and conservation priorities (Global Challenges/Global Solutions) being proposed by the Conservancy's executive team and senior managers?*

A: Yes, the PET has stayed abreast of the ongoing organizational discussions on these topics, but the need for an updated planning approach predates the discussions about a new mission, goal, vision and priorities and is not in any way dependent on the final outcome of those discussions. That being said, the PET recommendation to emphasize multi-objective planning, including objectives of other sectors of society, directly supports the proposed new language in the mission and vision statements related to "making people count." In addition, all of the PET recommendations should better enable Conservancy practitioners to develop effective strategic plans that emphasize conserving biodiversity targets, solving major global conservation problems (i.e., the four Global Challenges), or both.

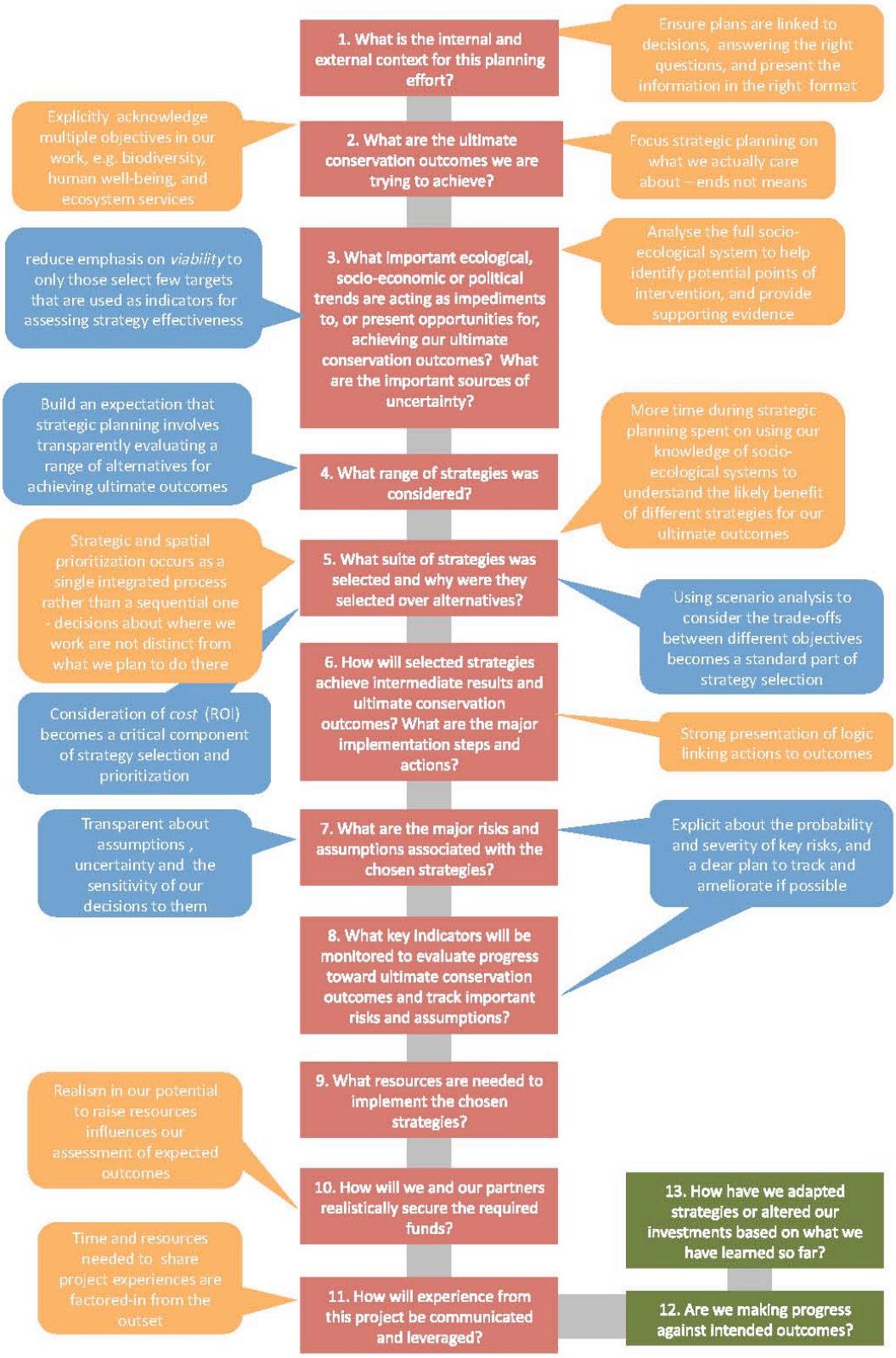
Q: *What is the relationship, if any, between the PET recommendations and the recommendations of the Measures Business Plan*?

A: The Conservation Approach of the Conservancy has four major components (see Conservation by Design) — setting priorities, developing strategies, taking action, measuring results. The vast majority of PET recommendations refer to the first two components of this approach (priorities and strategies). The core questions that we have developed that form the basis of Recommendation #2 are related to the entire conservation approach — that is to say, they include questions about planning but also about adaptive management (taking action and measuring results). The Measures Business Plan is an organization-wide initiative to improve the Conservancy's ability to evaluate the effectiveness of our conservation strategies and actions. As such, it is focused on the fourth component of the conservation approach — measuring results. Taken together, the actions outlined in the Measures Business Plan and the PET recommendations will improve our strategic planning efforts and better enable us to adaptively manage our conservation projects and global-regional strategies.

Q: *Will we still update or do new Ecoregional Assessments?*

A: Certainly, OUs that have a need or reason to update an existing ERA will do so. If ERA teams had not considered strategies to conserve portfolios of sites, it would be worthwhile to do so in any revision, as that consideration should influence not only the selection of conservation areas but also their relative priority for conservation action. Given the priorities outlined in the Global Challenges/Global Solutions framework, new ERAs might not be warranted unless the Conservancy is entering a new geography in which there is limited information on place-based priorities. Even in this situation, we would advise that any such planning effort should address the questions outlined in Recommendation #2 — a single conservation planning framework. **SC**

Roadmap for PET Recommendations*



*Questions 1-13 are a set of planning and adaptive management questions that apply to the entire life cycle of a conservation project. The emphasis of PET recommendations was on questions 1-7 and 9-10 because these questions are primarily about strategic and business planning. Questions 8, 12 and 13 are covered in the measures business plan.

Science Shorts

Do Funders Really Drive Monitoring & Evaluation?

Carman, J. 2009. Nonprofits, funders, and evaluation: accountability in action. *American Review of Public Administration* 39:374-390.

There is a persistent belief that funders are asking conservation organizations for measures — and ensuing bewilderment that only 5% of conservation projects end up conducting monitoring and evaluation (see: http://www.conservationmeasures.org/measures-summit "Survey of Current Practice"). This article lines up the data, surveying 300 non-profits to shed some light on the issue, and casts shadows on the claims made by funders. Only those organizations or programs that received substantial funding from the U.S. Federal government were motivated to conduct assessments by funder requirements. Foundations, whose public claims that they require measures are often among the most strident, actually had little or no influence on the behavior of grantees. Why not? The authors conclude that foundations are extremely heterogeneous — their demands are so disparate and tailored to their particular missions that grant recipients do the bare minimum to satisfy their reporting requirements, and results are rarely relevant to the actual work of non-profit programs.

— **Jensen Montambault**, applied conservation scientist, The Nature Conservancy

Cod: Fable of *Resilient* Nature?

Frank, K.E. et al. 2011. Transient dynamics of an altered large marine ecosystem. *Nature* 477:86-89.

The collapse of northwest Atlantic cod has become one of conservation's iconic doom-and-gloom fables. Books have been written about this ecological disaster, and the story that is most often told is that we ruined the ecosystem irreversibly, such that even after fishing was finally halted (too late of course), the stocks never recovered. Well, recent data tell a different story. Since 2006, cod and other large benthic predatory fish have been making a comeback — and their biomass is now approaching pre-collapse levels. This is an extraordinary reversal — instead of cod being a fable of fragile nature, cod is a fable of resilient nature. Yes the recovery was slow, but Frank and colleagues provide a good ecological explanation for why the recovery took so long. Essentially, forage fish that were once the prey of cod boomed after cod had been so severely depleted. These forage fish themselves feed on juvenile cod (in other words, the prey became predators), and at their elevated numbers prevented cod from recovering. But forage fish could not maintain huge numbers forever, and as they ran short of their own food supplies, they subsequently declined to the point that cod could start to recover. Management mistakes can be corrected. Of course, nothing about this recovery can make up for the thousands of fishermen who lost their livelihoods after the collapse of cod — but the biological story is at least much more hopeful than the standard scary conservation lore of collapse and irreversible declines.

— **Peter Kareiva**, chief scientist, The Nature Conservancy

The Importance of State Parks for Maintaining Conservation Citizens

Siikamaki, J. 2011. Contributions of the US state park system to nature recreation. PNAS 108: 14031-14036.

State parks in the US cost over $2 billion annually to operate and maintain. Consequently, as states are hit with financial woes, a common cost-saving action is to threaten to close or actually close state parks to the public. Unfortunately, this maneuver is likely to reduce the overall amount of nature recreation, which in turn reduces the connection between people and nature upon which conservation depends. Using an ingenious econometric method (difference-in-differences), Siikamaki shows that U.S. state parks actually *attract* recreation that would not exist if those parks had not been established (because access and convenience matters). In the United States, one-third of all nature recreation takes place in state parks. That is a remarkable number, and if one applies a "valuation of time" assessment, recreation at U.S. state parks is an environmental service worth $14 billion annually — far more than their annual cost.

— **Peter Kareiva**, chief scientist, The Nature Conservancy

Climate Stress and Increased Civil Conflict

Hsiang, S. et al. 2011. Civil conflicts are associated with the global climate. *Nature* 476: 438-441.

In their relentless compulsion to scare the public about climate change, environmentalists often use the story line that global climate change will increase wars and strife. The data to support this narrative are weak at best, and maybe nonexistent. But it is not a ridiculous hypothesis.

Hsiang and colleagues have analyzed the El Nino-La Nina cycle and whether the El Nino phase (usually drought) is statistically linked to increased civil strife. The analysis is possible statistically because the El Nino climate cycle impacts only a subset of the world's nations (~90 nations that are connected to the Pacific Ocean weather cycles), while leaving untouched another ~80 countries that are disconnected from this weather cycle. Using data from 1950-2004, Hsiang and colleagues conclude that El Ninos may have played a role in the onset of one-fifth of the civil conflicts that arose during that half century. The effect is most evident in low-income countries — although cause-and-effect are impossible to disentangle. Countries may be low-income because they experience the most severe El Nino climate effects, or low-income countries may be most vulnerable to climate-driven civil strife. In addition to the highly seductive conclusion, this paper is well worth the read to get ideas for how one can statistically ferret out climate impacts using national-level data for hundreds of countries and longish time series.

It is important to caution that this paper *does not* show that global warming is increasing civil conflict. Rather, it shows that the dry and hot conditions of El Nino years are associated with civil strife. Climate science has not yet delineated the impact of anthropogenic emissions on the El Nino-La Nina cycles of the Pacific Ocean. But it is worth reminding ourselves that like every other species on the planet, we humans are behaviorally and physiologically impacted by climate in ways that can be manifest as a higher-level phenomenon like strife. **SC**

— **Peter Kareiva**, chief scientist, The Nature Conservancy

Announcements

What Questions Do Conservancy Programs Need Answered to Achieve Our Goals on Grazed Lands? (Tell Us Now What You Think...in 15 Minutes or Less!)

By Sonia Hall, arid lands ecologist, The Nature Conservancy in Washington

Is your program implementing a grazing strategy, such as mitigating the impacts of grazing on native systems and species, making sustainable grazing economically feasible, influencing market forces to provide incentives for sustainable grazing, or facilitating the adoption of sustainable grazing practices across large landscapes? Are you facing challenges to achieving both conservation and socioeconomic objectives that science could help overcome?

Take our 15-minute survey **before Tuesday, September 20**, and **help us identify the most important questions that need to be answered to take advantage of the opportunity that grazed lands represent for conservation.**

Join us to hear about the results at the interactive "Transforming threat into opportunity – Grazing native grasslands and arid lands to conserve and restore their functions and services" session at the Conservation Science for People and Nature Conference, October 19 at 10:30 am. And if you provide your contact information, we'll also send you the survey results and session outcomes with our personal thank you!

Call for Proposals for SCB North America Congress for Conservation Biology

(And meet our mascot Stony: An American Pika): http://www.scbnacongress.org/home/theme-mascot-steering-committee.html#stony

The 2012 North American Congress for Conservation Biology: Bridging the Gap: Connecting people, nature, & climate will be held from 15-18 July 2012 in Oakland, California.

Proposals for symposia, workshops, discussion groups and short courses must be submitted by 7 November 2011.

Complete instructions for submitting proposals are available on the meeting Web site http://www.scbnacongress.org/registration-participation/call-for-proposals.html The time available for presentations at the meeting is limited, so we may not be able to accommodate all symposium submissions. Trainings and short courses are encouraged and will be accommodated if possible. Please review the selection criteria and other information below carefully prior to making your submission.

CRITERIA FOR SELECTION

To increase the probability that a symposium proposal will be selected for presentation, please consider the following criteria carefully:

- Scientific merit of the proposal: cutting-edge conservation science and quality of science.
- Application to conservation.
- Overall coherence of the session and logical linkage between the individual presentations.
- Clear focus on either science, management, policy, or a coherent linkage between these three areas.
- Relevance to the meeting theme ('Bridging the Gap: Connecting people, nature, & climate').
- Relevance to North American conservation issues
- Novelty of the topic
- Alignment with the goals of SCB, which are:
  - *Conservation Science*: The scientific research and knowledge needed to understand and conserve biological diversity is identified, funded, completed, disseminated and applied to research, management and policy.
  - *Conservation Management*: Conservation practitioners and managers are provided the scientific information and recommendations needed to conserve biological diversity at all scales.
  - *Policy*: Policy decisions of major international conventions, governments, organizations and foundations are effectively informed and improved by the highest quality scientific counsel, analysis and recommendations so as to advance the conservation of biological diversity.
  - *Education*: Education, training and capacity-building programs are identified, strengthened and developed to inform the public and education leaders, and support current and future

generations of conservation scientists and practitioners.

MEETING THEME: BRIDGING THE GAP: CONNECTING PEOPLE, NATURE, & CLIMATE

The greatest challenge to conservation science today is addressing gaps in information, understanding, and on-the-ground implementation. These gaps require bridging our efforts across multiple scales through inter-disciplinary study and effective practice. By sharing our conservation experience, we can benefit from information about how effective our practices are, advance our understanding, and foster useful lines of inquiry.

We are facing many environmental and social challenges that have common underpinnings and mutually desirable outcomes, justifying a clear need to integrate social, biological and physical sciences into the environmental problem solving process. Change is coming that will affect our climate, population and natural capital. Fostering a stronger connection between conservation science and practice that addresses people, nature and climate will improve the utility of our science in addressing the forecasted changes.

North America in particular will see changes that are likely to influence biodiversity at multiple scales, from large migratory routes to extirpation of locally adapted species. Our freshwater supplies will be stretched to accommodate population growth and development, and may likely become seasonally less predictable. Changes such as these have implications for human communities, protected areas, and working landscapes.

Developing conservation strategies to cope with our changing planet is arguably the greatest challenge facing the world and its biodiversity. Working to bridge the gaps we face in developing and implementing these strategies requires that all of us come together to benefit from our collective experience. Together we can build bridges connecting our collective disciplines across the continents and into the future.

Limits on number of presentations per presenter: Individuals may not submit more than one proposal and, as a general rule, no individual may give more than one presentation in each of the following categories: symposium, contributed paper (regular or speed) or contributed poster.

Financial support: It is the responsibility of organizers of symposia, workshops and discussion groups to obtain funding for their own expenses and those of their invited speakers or invited participants.

CHOOSING THE CATEGORY OF YOUR PROPOSAL

Please think carefully about the category that best meets your goals.

Symposia consist of a series of formal presentations on a common theme, sometimes followed by a panel discussion. It is the responsibility of the symposium organizer to make sure that all speakers submit their abstract and register according to the author registration rule.

Workshops, whether geared toward students or professionals, are more interactive than symposia and often have an educational component. To minimize conflict with symposia and contributed paper sessions, some workshops may need to be scheduled as pre-congress activities (longer than 1.5 hours) or during lunch or evening breaks.

Discussion groups are participatory and may be relatively informal. To minimize conflict with symposia and contributed paper sessions, discussion groups will be scheduled as pre-congress activities (longer than 1.5 hours) or during lunch or evening breaks.

Short courses and trainings are encouraged and will be expected to offer teachings on topics relevant to the practice of conservation for students and professionals. These will be scheduled as pre-congress activities (July 15, 2011).

SYMPOSIUM PROPOSALS

SCB will accept proposals for two-hour (up to eight presentations) or four-hour (up to 16 presentations) symposia.

Presentation length must be in multiples of 15 minutes (e.g. 15 minutes or 30 minutes) so that the timing of symposium presentations can be coordinated with contributed paper sessions. The last 15 minutes of the symposium may be left open for discussion, thereby reducing the number of presentations by one. Proposals must contain the following information:

1. Symposium title.
2. Length (two or four hours).

3. Proposed theme and justification (include why the topic is appropriate and significant for presentation at Conservation for a Changing Planet) (1,500 character limit).
4. Expected outcomes and, if appropriate, plans for communication of results (3,000-character limit).
5. Whether any necessary funding for organizer and speaker expenses has been secured (for example, are funds available for speaker travel?).
6. A tentative list of speakers, institution, presentation titles and whether each speaker has agreed to participate.
7. Organizer(s) name, affiliation and complete contact information, including email address

Author registration rule: If your proposal is accepted, all symposium speakers will be required to submit an abstract during the call for abstracts; please coordinate with your authors, according to the call for abstracts and early registration deadlines.

WORKSHOPS AND DISCUSSION GROUPS

Workshops and discussion groups will be scheduled as pre- congress activities (longer than 1.5 hours) or during lunch breaks.

Proposals must contain the following information:

1. Workshop or discussion-group title (specify whether workshop or discussion group).
2. Maximum number of participants that can be accommodated.
3. Length and preferred position in program (pre-meeting or lunch); Pre-meeting workshops and discussions may be proposed for a maximum of eight hours. Lunch sessions may be proposed for a maximum of 1.5 hours.
4. Format of workshop or discussion and any special logistic requirements (e.g. a room with internet access).
5. Proposed theme and justification (why the topic is appropriate and significant for Bridging the Gap: Connecting people, nature, & climate) (1,500 character limit).
6. Expected outcomes and, if appropriate, plans for communication of results (3,000 character limit).
7. Method of selecting participants (invited, open registration or a combination). If any participants will be invited, include a tentative list of individuals and indicate whether each has agreed to participate.
8. A tentative list of speakers, presentation titles and listing of whether each speaker has agreed to participate.
9. Organizer(s) name, affiliation and complete contact information, including email address.

SHORT COURSES AND TRAININGS

Short courses will be scheduled as pre-congress activities to minimize conflicts with symposia or contributed paper sessions (scheduling as per logistics and travel constraints, but dates finalized on course acceptance). Short courses should be aimed at development of professional skills in topics of key relevance to the practice of conservation.

Proposals must contain the following information:

1. Short course title.
2. Whether any special instructional or audio-visual equipment beyond that which the instructor(s) will provide is needed.
3. Description of the course content and explanation of how it relates to the meeting theme and the goals of SCB (1,500 character limit).
4. Expected outcomes (3,000 character limit).
5. Itemized budget for the short course (in $US) and a description of any funds available to cover costs. The budget should include a and a description of any funds available to cover costs or fee you would like to collect for those interested in attending the training.
6. Length of the course: 2-8 hours.
7. Minimum and maximum number of students that can be accommodated.
8. Instructor(s) name, affiliation, and complete contact information, including email address.

HOW TO SUBMIT

To submit a proposal according to the call instructions and requirements, please go tohttp://www.scbnacongress.org/registration-participation/call-for-proposals.html

For further questions email info@scbnacongress.org
Please click here now to stay up to date with notices about NACCB 2012http://www.scbnacongress.org/app/mailinglist.cfm **SC**

New Conservancy Publications

Conservancy-affiliated authors highlighted in bold.

Please send new citations and the PDF (when possible) to: pkareiva@tnc.org and rlalasz@tnc.org. Please include "Chronicles Citation" in your subject line so we don't miss it.

Some references also contain a link to the paper's abstract and a downloadable PDF of the paper. When open source or permitted by journal publisher, these PDFs are being stored on the Conservation Gateway, which also is keeping a running list of Conservancy authored science publications since 2009.

Beier, P., Spencer, W., Baldwin R.F. and **McRae, B.H**. 2011. Toward Best Practices for Developing Regional Connectivity Maps. Conservation Biology. http://onlinelibrary.wiley.com/doi/10.1111/j.1523-1739.2011.01716.x/full

Benson, S.R., T. Eguchi, D. G. Goley, K. A. Forney, H. Bailey, C. Hitipeuw, B.P. Samber, R.F. Tapilatu, V. Rei, **P. Ramhoia**, **J. Pita**, and P. H. Dutton. 2011. Large-scale movements and high-use areas of western Pacific leatherback turtles, *Dermochelys coriacea*. Ecosphere 2(7):art84. doi:10.1890/ES11-00053.1

Goldberg, Caren S., **A. Pocewicz**, M. Nielsen-Pincus, L.P. Waits, P. Morgan, J.E. Force, and L.A. Vierling. 2011. Predictions of ecological and social implications of alternative residential development policies to inform decision making in a rural landscape. Conservation Letters doi: 10.1111/j.1755-263X.2011.00194.x

Mangubhai, S., M. Saleh, Suprayitno, **A. Muljadi, Purwanto**, K. L. Rhodes, and K. Tjandra. 2011. Do not stop: The importance of seamless monitoring and enforcement in an Indonesian marine protected area. Journal of Marine Biology doi:10.1155/2011/501465

Safner,T., M.P. Miller, **B.H. McRae**, M.-J. Fortin, and S. Manel. 2011. Comparison of Bayesian clustering and edge detection methods for inferring boundaries in landscape genetics. International Journal of Molecular Sciences 12(2): 865-889. http://www.mdpi.com/1422-0067/12/2/865/