Getting to Green (G2G) Workshop Report
- *Science Addendum* -
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Executive Summary: G2G Final Report Science Addendum

The NCTC Net Assessment Branch (NAB) faces the difficult challenge of defining the adversarial forces facing each other in the arena of violent non-state actions targeted against the US and its allies. If this weren't challenging enough, NAB also faces an equally difficult challenge of defining the environment in which these forces face off. This challenge was sufficiently rich that it was necessary to first explore and establish key concepts and expressive metaphors to inform how to proceed in planning and executing the second major workshop, Green, in the 2014-2015 Blue-Green-Red (BGR) NCTC-NAB workshop series.

NAB coined the phrase "Getting-to-Green" (G2G) as the title for a preliminary workshop to prepare for the Green (Environment) Workshop. The G2G Workshop was held 4-5 December 2014 at the Krasnow Institute for Advanced Study at George Mason University. NAB chose this site because Krasnow represents a premier US institution of multidisciplinary inquiry and research which focuses on the application of what is known as "The Science of Emergence" to test ideas and concepts in ways that yield the maximum opportunity for discovery and application.

The primary purpose of the G2G Workshop at Krasnow was to explore the validity of a previously developed NAB hypothesis and adequately define several key terms and concepts that will guide the development of next generation net assessments and the US strategy that will operationalize these net assessments. Briefly, the hypothesis stated that there is a Green environment in which Red and Blue exist and interact. This interaction of RGB is conceptualized as a coevolutionary ecosystem of competing interests and ideas where threats and opportunities abound and where interactions may generate new and unknown outcomes.

Perhaps more simply stated, NAB wished to better understand how Red and Blue interact with and within this Green environment. Gaining a richer understanding of the Green Environment, its connectivity and its dependencies is a fundamental requirement to satisfy this goal. In order to enhance the study and articulation of the hypothesized ecosystem of Green, simple constructs were important to demonstrate the nuances of the interactions between Red and Blue. This Science Addendum reports on the constructs applied at G2G and the hypothesis validation conducted. It should be read in conjunction with the larger G2G report which covers broader issues beyond the hypothesis validation that also came out of the workshop.

During the Krasnow G2G Workshop, participants considered and debated the suitability of this hypothesis and the metaphor of an ecosystem that the hypothesis suggested. This was an important construct which enabled both scientific rigor and creativity simultaneously across all the discussions. Thanks to a remarkable group of scientists and leading thinkers in various disciplines and their collaborative "hypothesis testing" during the workshop, participants achieved a general if not total agreement that an ecosystem metaphor was likely applicable and that it might serve as a worthy construct around which to build the larger Green Workshop.

Background:

Subsequent to two important milestones in the development of the NAB Blue-Green-Red (BGR) Workshop series schedule, it became apparent that the addition of the G2G Workshop was an imperative. The first milestone occurred on 1 July 2014 during a meeting with Dr. Harold Morowitz, founding director of the Krasnow Institute and GMU Robinson Professor of Biology. During this meeting, Dr. Morowitz challenged the NCTC team's use of the word "ecosystem" when attempting to describe the environment in which terrorists developed, evolved and directed violent actions against the US homeland and its interests.

Dr. Morowitz, a theoretical biologist, pointed out that the term may be useful and might even be suitable, but NAB needed to look more critically at what this term meant and how it added value to defining the environment in which terrorism operates. Other Krasnow members present, Dr. Jim Olds (Krasnow Director) and Dr. Ken DeJong (Krasnow Associate Director) agreed. The three scientists suggested a science-focused workshop might help NAB better frame, explore and understand the issues in determining if an ecosystem framework was suitable for this task.

The second milestone occurred shortly after the July Krasnow meeting during follow-up discussions on how best to respond to Dr. Morowitz's challenge of the use of the term ecosystem. NAB's intuition was that the term "ecosystem" was still appropriate but a broader, more spirited debate would in fact be helpful in refining this hypothesis. NAB felt that in spite of the additional resources required, it would be valuable to bring together a small group of scientists from various disciplines to participate in the kind of workshop the Krasnow scientists proposed. It's important to also note that Krasnow offered to host and help orchestrate such a workshop.

It was at that point NAB decided to insert an additional science-focused workshop into the BGR series to solicit the insights of experts not only in the biological sciences but other disciplines such as computational social science and law that might help us better define terms and concepts.

NAB determined it would call this additional workshop "Getting to Green" ("G2G") to demonstrate the importance of better understanding the environment in which Red and Blue interact. The previously scheduled Green workshop was critical to understanding these interactions but it was also critical to fully understand what NAB meant in labeling this workshop Green. G2G thus became an important step on the path to better understanding how Red and Blue "mix" within the Green environment to produce the behaviors they do in the course of their interactions.

NAB then began the debate about several important components of the G2G workshop. First, as NAB intended this to be a science-based forum, the organization wanted to start with a testable hypothesis. Secondly, NAB wanted to contextualize the workshop around a manageable number of concepts that helped to focus the discussions about the hypothesis. Finally, NAB wanted to ensure the representation

of scientific disciplines present was sufficient to challenge NAB's premises and thinking. The next section, Preparation, discusses these components in detail.

Preparations for the G2G Workshop:

The use of the construct of a hypothesis helps to critically frame inquiry about interesting problems. For the purposes of clarifying the inquiry process as part of a tightly focused science-based workshop, NAB settled on a very simple hypothesis. Based on an informed conjecture that US-adversary interactions are traditionally reflected in the model of Red (adversary) versus Blue (the US homeland and US interests), NAB proposed that this model is overly constraining when it considers the myriad of factors that enable violent non-state actors and terrorism.

To help overcome those constraints NAB *hypothesized there is a "Green" environment in which Blue and Red exist and interact, and that this interaction of Blue, Green, and Red is conceptualized as a coevolutionary ecosystem of competing interests and ideas where threats and opportunities abound and where interactions as well as known and unknown factors contribute to generation of outcomes that threaten Blue.*

Thus, the notion that Green actually offers the essence of an ecosystem for Red and Blue interaction became the main theme of G2G. This was consistent with NAB's challenge from Krasnow to test whether or not the term ecosystem was useful, as well as leveraging the previous intuition and research about the utility of the concept of ecosystem in describing the interaction environment for Red and Blue. In addition, NAB felt this hypothesis could be tested in a modeling and simulation environment that was both informative through the use of visualizations and affordable while still offering scalability to the eventual needs of the NAB and NCTC.

NAB decided to take up Krasnow's offer to host the G2G workshop at their facility on the campus of George Mason University to leverage their multidisciplinary perspectives. It was also noteworthy that Krasnow had significant experience in computational social science (useful for the modeling and simulation component mentioned above). In light of the outcome of G2G, NAB believes this was an appropriate choice.

Dr. Carl Hunt teamed up with Krasnow's Dr. Claudio Cioffi, the head of the computational social science department, to develop a slate of appropriate participants for G2G. Dr. Cioffi, who also attended the Blue Workshop in November, 2014 nominated several of the total of eleven participants and Dr. Hunt the remainder. Dr. Kenneth DeJong, Interim Director of the Krasnow Institute attended, as did Dr. Wayne Porter, (WikiStrat, Inc), by special invitation of CAPT Todd Veazie, NAB. Dr. Porter also attended the Blue Workshop. Dr Cioffi attended and represented Krasnow Institute.

Dr. Cioffi's participants included Dr. Barry Hughes (University of Denver), Dr. Philip Schrodt (Parus Analytical Systems), and Dr. Michael Ward (Duke University).

Dr. Hunt's participants included Dr. Stuart Kauffman (Santa Fe Institute and Krasnow Institute), Professor Philipp Bobbitt (Columbia Law School and University of Texas Law School), Dr. David Davis (VGO Associates), Ms. Caryn Devins, Esq. (US District Court of the Western District of VA), and Mr. Jan Hauser (Integrated Innovations and Naval Postgraduate School). Dr. Kauffman participated via Skype from Santa Fe, NM.

All the participants were invited to attend a reception on the eve of the workshop also held at the Krasnow Institute. CAPT Veazie and Dr. DeJong hosted the reception and provided a high-level introduction of the workshop agenda and briefed the attendees on the main purpose of the event. All but two of the participants attended the reception which offered a fine opportunity for people to mix and set the stage for the intense science-focused discussions the next day.

NAB developed a comprehensive agenda to guide the execution of the actual workshop, held on 5 December. This agenda, attached at enclosure A., began with CAPT Veazie's mission-level discussion on the undertakings of NCTC's Net Assessment Branch, a "setting of the initial conditions" of the workshop to ensure participants kept this fundamental mission in mind. From that point, CAPT Veazie and Dr. Hunt co-moderated the discussion, building on the core of the agenda.[1]

The agenda presented the context of two major themes through which NAB encouraged the participants to consider their exposition of what likely composed the Green environment. The first theme was titled "The Ecological Imperative." NAB previously presented this section in the perspective of the following questions: "a. are we accurate in proposing that the environment in which Red and Blue interact may be modeled as an ecological system in the spirit of typical definitions such as that offered by Biology On-Line: 'the science concerned with the interactions of living organisms with each other and with their environment…'? ; and b), if this definition is adequate, can we characterize terrorism in the context of interactions, emergence, evolution (e.g., coevolution) and the environment in which it exists?"[2]

The second agenda theme was titled "Initial Conditions Matter." NAB previously characterized this theme as follows: "we propose to explore the baseline and framework from which terrorism behaviors emerge, coevolve and mutate among terrorist groups, their targets and the environment that sustains terrorism behaviors. If the emergence and coevolution of 'Actuals' occur as a result of the instantiating initial conditions, can we better understand these conditions and the interactions that lead to higher-order behaviors (the emergences) such that we can better 'predict' both 'Actuals' and 'Possibles'?"[3]

NAB presented both of these themes in a 2-page read-ahead document entitled "Getting to Green (G2G) Workshop Introduction." This introduction was emailed to the participants a week before the workshop along with final comments about the logistics of the workshop. The 2-page read-ahead document is included in this report as Enclosure B.

As discussed in the Conclusions Section below, NAB found more success in the first theme than the second, but the second theme was ultimately useful for introducing the construct of the "Adjacent Possible" and for lessening the need to focus on a requirement to understand the "initial conditions" of a situation in order to model it within Green and make progress in understanding it.

NAB also asked the participants to look at the two main themes through the lenses of emergence[4] and coevolution.[5] To ensure participants and future consumers of the results of this workshop understood the importance of emergence and coevolution, NAB and Kiernan Group Holdings (KGH) posted extensive references to these constructs on the KGH "BW Workshop" section of the main KGH website.[6]

The participants represented diverse backgrounds, ranging from Biology and Ecology, Political Science and International Relationships, Evolutionary Computation, Identity and Trust, Computational Social Science, Modeling and Simulation, Economics, Law (International and Domestic), Computer Science and Big-Data Analysis, and Cyberspace Science.

Execution of the Workshop:

The KGH Main G2G Report highlights the general conduct and execution of the workshop so this section emphasizes some key points about execution from the standpoint of the science dialogue flow.

From the start of the workshop in the preparation process, NAB asked participants to think in terms of the scientific method, e.g., think about inquiry, evidence presentation and assessment, and more inquiry. NAB stated at the outset that this workshop was much more about questions than answers. It was paramount that the hosts and moderators of this science-based workshop encourage the participants to think and articulate observations and positions like the scientists they were.

This encouragement exists at the other workshops, but in the other settings, NAB has also encouraged participants to share opinion and impressions as well as facts. In G2G, the moderators emphasized the presentation of evidence and fact upon which to draw conclusions. While relevant opinion was tendered liberally in G2G, it was important to identify it as such. G2G sought evidence-based insights above all. This was a valuable process as it helped to stay on the very tight agenda and elicit the workshop insights NAB sought.

The moderators also focused on discussion and dialogue rather than presentations. In fact, only one presentation was given and that by the Krasnow hosts as an example of modeling the Green environment. NAB used a slide presentation to ensure the workshop adhered to the agenda, but this presentation was neither descriptive nor prescriptive in terms of preconceived positions. The NAB agenda slides did display the main research hypothesis and background information about the dual organizing constructs of "ecosystem" and "initial conditions" but only to

ensure a consistent focus throughout. The slides used to display the agenda and to help organize the workshop are included at Enclosure C.

All of the participants took part in the workshop stream of information and dialogue. The individual contributions of each participant are covered in greater detail in the KGH main report, but significant positions from certain participants laid out novel highlights for the consideration of Green as an ecosystem. For example, Dr. Cioffi used his modeling and simulation presentation to demonstrate how components of agent-based models can reflect the constituent components of a polity-based ecosystem, with the information flows that tie the parts of the polity reflected in the rules that govern the agent-based model. "Ecologies and agent-based models are highly complementary," Dr. Cioffi explained to the group, and thus both will be useful to next generation net assessments.

Dr. Bobbitt, while by his own admission was not a fan of modeling and simulation (and apparently a bit skeptical about the ecosystem metaphor), discussed interactions of players within international polities in terms of relationships that shift nation-states towards what he calls market-states. Dr. Bobbitt said he thought metaphors we might use should be tied to state behaviors and terrorism will follow the behaviors of the state.

Dr. Kauffman, a medical doctor and biologist, reiterated several times that he felt the ecosystem metaphor was quite descriptive of the model of Green that seemed to be emerging in anticipation of the larger workshop. Dr. Ward, Dr. Davis, Dr. Hughes and Ms. Devins concurred with Dr. Kauffman on the use of the ecosystem metaphor, although Dr. Schrodt and Dr. DeJong wanted to make sure the metaphor added more value than not using it. Dr. Ward subsequently clarified his position that he felt Green could easily be characterized as a complex adaptive system, but wanted to make sure we in fact added value with the ecosystem metaphor. Importantly, Ms. Devins also pointed out how the use an ecosystem as a metaphor emphasizes the concepts of dependencies and interaction.

Apart from Dr. Bobbitt, no one at the G2G Workshop expressed major concerns over using the ecosystem metaphor to characterize Green as a substrate for Red and Blue interactions. Due to this finding alone, NAB is more comfortable beginning the Green Workshop from the premise that Green is an ecosystem although more remains to be done to flesh out these ideas prior to the actual workshop.

There was some level of pushback on the use of the term "Initial Conditions" as a construct for better understanding Green, however. Dr. Davis stated that he felt such a term referred more to physics and thus would only complicate the ultimate understanding of Green. Dr. Schrodt and Dr. Ward agreed. Dr. Kauffman pointed out that considering the concept of initial conditions would not add value to determining causality, but it might be useful in helping to understand what the conditions made possible as outcomes (this is consistent with Dr. Kauffman's premise about the "Adjacent Possible" discussed below). NAB does not view these

rebuttals negatively, however, and feels that it was a worthwhile conversation to introduce. NAB will likely drop this concept as an organizing construct for the larger Green workshop.

Conclusions from the Workshop: Why does the Ecosystem Metaphor Work?
(NOTE: This section is written in first person by the principal author of this addendum, Dr. Carl Hunt. This approach facilitates the expression of the joint viewpoint of both organization and moderation of the workshop events. The comments are the sole responsibility of the author of this section and should be considered in the light of the rest of this Science Addendum and the Main Report provided by KGH.)

CAPT Veazie tasked me with organizing and managing the conduct of this workshop to ensure we reached some level of maturity in posing the very hard questions we had in mind for the larger Green Workshop. He felt it was vital for NAB to pose a solid framework to the Green Workshop participants and to carefully test our hypothesis that we could use the concept of an ecosystem as a metaphorical framework for this critical workshop. After all, for us to better understand how Red and Blue interacted (no matter how they might be characterized by their respective workshop participants), we must understand the interaction environment.

As initially stated above in the Preparations Section, we felt we had tentative success in describing the Green environment as an ecosystem-like medium for Red and Blue to interact. This position found confirmation in the execution phase, again as noted above. Harold Morowitz challenged NAB in the initial July meeting to ensure that the ecosystem metaphor was both accurate and indeed added more value in its use than not using it. We're confident that we met Morowitz's advice, particularly in light of one of his closest colleagues, Stuart Kauffman, confirming we were on safe ground using the ecosystem as metaphorical model.

At this point, I'll peel that ecosystem model back one more layer to demonstrate our initial acceptance of this metaphor. Note also that the use of this metaphor will be under constant scrutiny just as any scientifically-based concept should be.

In our initial read-ahead to participants of G2G, we asked them to assess if were "accurate in proposing that the environment in which Red and Blue interact may be modeled as an ecological system in the spirit of typical definitions such as that offered by Biology On-Line: 'the science concerned with the interactions of living organisms with each other and with their environment'?"

Borrowing from the definition offered by Biology On-Line, we made worthwhile progress discussing the components of a Green environment as a medium that offers connectivity between the elements of its composition. These elements are not unlike amino acids, proteins and higher organic forms that find substance for growth and replication within the nurturing environment. They reflect very much what happens in the interactions between humans, both individually and

collectively, such as in the institutions they form for the development of economies, cultures, religions and other social interactions.

People form bonds between themselves as expressed by the social fabric they create, as they seek some form of equilibrium or balance. This is precisely what happens in an ecosystem: the components that make up the ecosystem seek an elusive form of equilibrium. It is this dynamic search process that can offer adaptations and protections against external perturbations.[7] This resilience comes about because of the strength of the interactive bonds of these organisms with each other and their environment, as the definition above points out; in the case of humans this includes institutions as bonds. The balance between the various components of the ecosystem is typically critical in order for the ecosystem to prosper or at least avoid dying out.[8]

If we look at the interactions of Red and Blue through the ecosystem metaphor, we begin to see how important it is to have an environment like we hypothesize Green to be. In fact, Red and Blue could not coevolve without Green. Without this environment for coevolution, either or both may stagnate or even die. In a strong sense, the components of the ecosystem need each other to avoid this stagnation.

We might look at this as an extension of the old saw "what doesn't kill us makes us stronger." We need this coevolutionary interaction to ensure growth and avoid death. The challenge Blue faces is in how to temper Red so that it disrupts Blue minimally while still offering Blue the maximum potential to grow and develop ever more resiliency: in a very deep sense, this is how Red has coevolved as a "weaker force" to achieve the kinds of success they have against Blue. Understanding and describing Green as an ecosystem can offer us clues to achieve that balance of states between Red and Blue.[9]

Wayne Porter began to describe a way of addressing this challenge. The remainder of this section will try to synthesize his insights with those of Kauffman (and his "Adjacent Possible" construct), Philip Schrodt and several important concepts introduced in Joshua Cooper Ramo's book *The Age of the Unthinkable*.[10]

In his comments on the use of the ecosystem metaphor, Porter introduced the idea of discovering and exploring a "shared opportunity space" that Green creates for the interactions of Red and Blue (and their respective interactions with Green). This is a potentially powerful concept in understanding the ecosystem characteristics we could uncover and examine in the Green Workshop.

We can consider this "shared opportunity space" as part of the overall ecosystem in the sense that ecosystems implicitly accommodate and exploit the opportunities that each component provides in the course of the component's rather selfish act of "making a living" in the ecosystem. An ecosystem like those described by Kauffman and hinted at by Porter do not require a "director" for the individual components to prosper…the components essentially "emerge" the ecosystem in the course of

exploring the space they share. This insight may offer a suggestion for a better understanding of Green: *it will be very difficult, perhaps a waste of resources even, to attempt to **control** the Green environment.*

We may be better off trying to more fully understand what creates survivability opportunities in the shared space and attempt to make sure that every component has the opportunity to make a living as long as that living doesn't damage the potential for the other components to do the same. Moreover, it may be worth protecting what Red is doing if in trying to inhibit Red's activities it decreases the overall fitness of the ecosystem. What I'm suggesting here is that Blue needs Red and Red needs Blue and both need Green in order to grow and evolve. Looking at the BGR ecosystem model through this perspective might help us significantly improve net assessments.[11]

Stated in a more biologically appropriate way, our current efforts to remove Red from the ecosystem may lead to the loss of resiliency of Blue in the shared opportunity space. The main caution here is that Blue just needs to make sure Red doesn't overly inhibit the exploration of the discovery space. Resiliency is another factor we have not sufficiently discussed in shaping the new ways to do net assessment.

It's likely that the construct of the Kauffman Adjacent Possible will help us ensure that everyone can keep making a living and improve the likelihood of growth and evolution for all. First, let's turn to Kauffman for his explanation of what the Adjacent Possible is and how it might work.

A simple way of thinking about the Adjacent Possible is through the lens of emergence, also one of the lenses we used in G2G to think about how components within an ecosystem adapt and coevolve with other components in the ecosystem. Kauffman tells us that "evolution flows into a typically unprestatable succession of Adjacent Possibles." Think in terms of information flows from the actual, through the process of emergence, into the Adjacent Possible as depicted at a high level in the figure below. In this sense emergence is the generator of the Actual within the Adjacent Possible, or as Morowitz writes "nature's search engine…pruning away the actual from the possible."[12]
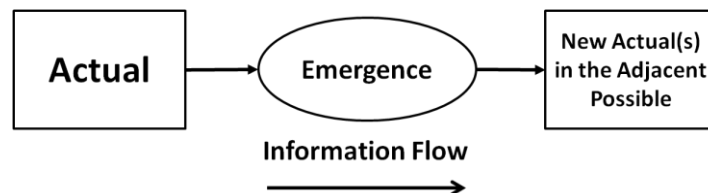
"Unprestatability" aligns well with the ideas behind the unpredictable nature of emergence. Biological emergence could also apply to the ideas and knowledge humans generate, as well. This could be why Big-Data analysis may be a genuine novelty: it apparently demonstrates ways to extract new knowledge…new

actuals…through the "engine" of emergence. Again, the Adjacent Possible may be a construct that helps to understand human idea and knowledge creation.[13]

Schrodt, in notes supplied as an after-action review of G2G, wrote that "we (may have) missed the fact that the 'adjacent possibles' is a fantastically effective tool," although he took issue with some of Kauffman's examples. Schrodt noted how the notion of the adjacent "[massively] limits the problem space to a [comparatively] tiny set of next steps: in evolution you get from a *T. rex* to a hummingbird via a long series of small steps, not one giant leap." He also agreed that the notion of "possible" also limits the search space nature uses for evolution. Schrodt's agreement here substantiates the role of emergence as an effective "search tool" as Morowitz claims.

So, we have unprestatability, emergence and coevolution working together to create new actuals within the Adjacent Possible. Does this work **for** Blue or **against** Blue as a component of the Green ecosystem? To address that question, we now focus on Ramo and his ideas on what he calls "Deep Security" as a way applying the ecosystem model and the Adjacent Possible to find answers.

Ramo suggests there are three key changes the US needs to make to execute Deep Security. Incorporating those three changes into US strategic analysis and planning, including net assessments, would transform the US away from the Industrial Age way of thinking and assessing while ensuring we are working towards the level of resilience we need to not only survive but to thrive in the Green Ecosystem Environment that exists today.

The three changes Ramo prescribes to achieve Deep Security include the following:

- *See the World Differently.* Borrowing a thought from Santa Fe Institute cofounder, Murray Gell-Mann, Ramo describes how analysts and decision-makers must think about the world through the "CLAW" – a Crude Look At the Whole. Problem decomposition is a favored, almost traditional reductionist approach to Western analysis – our problem comes when trying to fit the pieces of our analysis back into a contextual whole. Ramo points out how Eastern cultures seek context before detail, the opposite of what we do in the West. CLAW works nicely with the kinds of modeling and simulation approaches Claudio Cioffi and Ken DeJong presented at G2G. The CLAW approach may also help us better detect the Adjacent Possibles that bound the current environment, and will certainly assist us in looking at the larger ecosystem model we discussed in G2G.[14]
- *Abandon the Idea We Can Deter Threats.* Ramo points out the difficulty we have today in deterring information-based threats. He speaks of these information-based threats as the root of kinetic threats such as the evolution of IEDs and suicide bombing attacks that have become the weapons of choice in non-state violent behaviors against Blue. Ramo notes how these Red threats are likely emergent systems that were the consequences of Blue attempts to control the environment and deter Red. A much better approach,

Ramo writes, would be modeled on the human immune system, in which resilience against unforeseen attacks is the objective. In addition, Ramo discusses how the concept of resilience created via the immune system response helps to overcome what he calls "ecological lock-in," a problem that arises when the ecosystem loses its fluidity and ability to accommodate information flows. He also cites examples of adaptive leadership and policy on the part of both Red and Blue as candidate means to better thrive in the ecosystem. Western systems, he claims, seek tight networks based on command and control principles, whereas Eastern systems seek looser couplings between leadership and operating forces. This same concept applies in diplomacy and stock markets, Ramo asserts. Ecosystems seem to benefit from looser couplings, as well, allowing for the creation of new connections and adaptations among components within the ecosystem.[15]

- *Augment Instinct for Direct Action with Bias towards Indirect Action*. "Direct confrontation with problems is more than a habit of Western culture; in many ways it is a defining trait," Ramo claims. It's hard to dispute the way Blue likes to face problems head-on, particularly the US, a well-known practitioner in direct action. In 1954, famed British Military Historian B.H. Liddell Hart wrote *Strategy*, a classic book full of examples of military successes using the indirect approach, a reference more valuable today than ever before.[16] A key to becoming more proficient in the use of indirect approach is in analyzing and more importantly learning from past actions, asking "how would we change what we did and did not do?" in our reviews of reactions to events such as September 11, 2001, the Great Recession of 2008-2009 and other events that had major consequences for our nation. The US is typically excellent at recording the "lessons learned" but what we actually do learn and apply from those lessons is another matter; these lessons could reveal avenues for indirect actions and paths we might take in similar future events. Referring to relevant lessons learned can be an important component of next generation net assessments. Another contribution next generation net assessments can make is in ferreting out what within the relationships uncovered in ecosystem analysis can be shaped or manipulated through indirect levers to offer decision-makers alternatives to direct action. The users of this approach would certainly benefit from understanding emergence and the Adjacent Possible. Paraphrasing Ramo, a significant contribution net assessment could make to decision-makers is exploring the Green ecosystem to show what should be manipulated and what should be blown up. After all, by Ramo's advice, we are seeking to *augment* direct action with indirect action, a theme that should still resonate reasonably well in a kinetic action-focused entity like Blue.[17]

The Bottom Line: integrating the Green ecosystem metaphor through the supporting biological constructs of emergence, coevolution and the Adjacent Possible with Ramo's key changes can elevate the role of net assessment in ways we could not have foreseen...right into the net assessment Adjacent Possible!

While the Green Workshop in January, 2105 is a key next step in more deeply exploring the ecosystem metaphor, G2G succeeded in at least one important way: we validated that an ecosystem was indeed a meaningful way to look at Green as a substrate for Red and Blue interactions. Further, we identified this substrate as an interaction site that facilitated coevolution and emergence. With the exception of one participant, the rest of the group accepted this initial exploration and definition.

To answer the question posed in the Section Heading above, "Why does the Ecosystem Metaphor Work?" consider the following response. Net assessments, particularly as we envision them as a future analytical tool to integrate more holistic perspectives about not only Red and Blue, but the medium for their interaction (Green) must borrow from the insights living systems provide. Living systems, the "practitioners" of emergence, are also the source of human interaction, thinking and ultimately violent behavior.

It's unfortunate we must consider these otherwise benign constructs of coevolution and emergence as the tools of violence. The fact is, however, that life has always been both the object and the subject of ecosystems and arms races, the ultimate form of coevolution in terms of military and diplomatic pursuits. Ecosystems nurture all the components that make up them: that is just the nature of an ecosystem.

In the course of seeking equilibrium, ecosystems are subject to perturbations that can disrupt and even destroy them. Nature is a dynamic force and change is perhaps the most certain feature of life. What Blue must do in the next generation of net assessments is to find ways to harness change so that it works on behalf of Blue while at the same time finding ways for Red to "make a living". If we learn how to practice resilience within the Green ecosystem, we'll do just fine and even "empower" Red to help us grow stronger and ever more resilient.

The G2G workshop was indeed worth the time and the resources, and should be a worthy start of the all-important Green workshop.

NOTES

[1] G2G Workshop Agenda, enclosed with this report.

[2] The word "ecology" was coined in 1866 by the German scientist Ernst Haeckel. The term "ecosystem" was first used in a publication by British botanist Arthur Tansley. Tansley devised the concept to draw attention to the importance of transfers of materials between organisms and their environment. He later refined the term, describing it as "The whole system... including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment."

[3] Agenda, *ibid.*, enclosed with this report.

[4] The following is a composite definition of emergence drawn from multiple sources including Morowitz and Kauffman: The rise of some new entity or idea from interacting objects at a level below the emergence…sharing properties of the interacting entities or ideas but also possessing emergent properties distinct from the entities or ideas below. Typically, the creation of something more complex than the lower-level interacting entities: The emergent entity is "more than the sum of its parts"

[5] Coevolution is defined by New England Complex Systems Institute as "the change of biological object triggered by the change of a related object"…sometimes *adaptations* brought about by coevolution exhibit properties similar to an emergence (a sharing of some lower level properties of both coevolving entities) if the coevolving species become dependent on each other (e.g., some predator and prey relationships). (NECSI)

[6] Sample descriptions of Coevolution and Emergence from the CB Workshop G2G page may be found at the following respective websites: Coevolution: http://en.wikipedia.org/wiki/Coevolution and http://necsi.edu/projects/evolution/co-evolution/co-evolution_intro.html; Emergence: http://www.iep.utm.edu/emergenc/ and http://necsi.edu/guide/concepts/emergence.html. There are more similar resources on the CB Workshop website.

[7] Kauffman, S., At Home in the Universe, Oxford, New York, 1995. Kauffman notes "…cells, ecosystems and economic systems are…real nonequilibrium systems" and thus a great deal of emergence and coevolution take place within them, emphasizing the role of ecologies in facilitating adaptation and the rise of new, different species. These systems seek but never quite find equilibrium; the dynamism of this search results in the coevolution and emergence that occurs within the systems.

[8] Sometimes these critical interactions go super-critical as Ramo (see footnote below) describes based on the work of Danish scientist Per Bak in work on self-organizing criticality. See Bak, P., *How Nature Works: The Science of Self-Organized Criticality*, Copernicus, New York, 1996.

[9] As the author has consulted on the "final" development of the Blue description document, it is increasingly apparent that NAB's understanding of how Green works as a substrate for Blue to interact with Red will benefit significantly by the fusion of these efforts.

[10] Ramos, J. C., *The Age of the Unthinkable: Why the New World Disorder Constantly Surprises Us and What We Can Do About It*, Little Brown, NY, 2009. The author recommends NAB contact Mr. Ramos and encourage him to attend the final workshop in the RGB series, the Synthesis Workshop, once NAB has concluded the pending Green and Red workshops and better defined terms, concepts and frameworks in which Mr. Ramos might better apply his concepts.

[11] Enlightened historical military perspectives, as highlighted in Ramo for example, substantiate how both Red and Blue need each other. The coevolutionary "dance" or wrestling match in the words of Clausewitz, demonstrate that the US, as the prime representative of Blue, could never have achieved what it did industrially and socially without the advents of World Wars I and II and the threats posed by the Red of those eras. As damaging as these wars were (both to each other and to Green), Blue needed Red to advance on the global stage.

[12] Morowitz, H., *The Emergence of Everything: How the World Became Complex*, Oxford, New York, 2002, page 14.

[13] In G2G, Kauffman stated that the Adjacent Possible cannot be reduced to algorithms, so this example still offers debate when considering Big-Data insights as an emergence.

[14] See Ramo, pp. 155, 160-161, and 164 for specific context about these points.

[15] See Ramo, pp. 172, 178, 181, 190, 192, 197, and 198-199 for specific context about these points.

[16] Liddell Hart, B.H., *Strategy*, Faber & Faber, London, 1954.

[17] See Ramo, pp. 205, 211, 214 and 224 for specifics about these points.