Mitigating and Preparing for Climate Change: Eleven Conservation Principles For Decision-makers

November 17, 2009

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Summary: Tropical forests are now at a tipping point. The Amazon rainforest and other tropical forests are in danger of being severely altered by increasing heat and drought – throwing off all calculations underpinning the December 2009 climate talks in Copenhagen and causing irreversible losses across the planet. To provide scientific guidance for a global climate agreement and climate policies and practices within governments, multilateral organizations and other bodies, we recommend the following principles for restoring the climate balance.

1. Create systems and policies that will reduce greenhouse gas (GHG) concentrations to levels approaching historic levels; and no higher than 350 parts per million carbon dioxide equivalent as soon as possible.
2. Cap and reduce GHGs from every major sector, including agriculture, animal husbandry, and forestry, with rewards and consequences in proportion to their performance.
3. Conserve and restore forests and other ecosystems, but forests will not be able to steadily offset increases in GHGs.
4. Phase out existing sources of GHG emissions as quickly as possible, starting with the dirtiest first.
5. Be cautious about ratifying or enacting new measures that curtail or remove existing domestic or international legal tools until the full implications are clarified.
6. Fund forest and wildlife restoration and adaptation fully and directly.
7. Use better science and enforcement to manage and limit the use of carbon offsets.
8. Practice stewardship in investment and procurement.
9. Require the transparent use of natural and social sciences and law in setting and enforcing limits.
10. Lead a race to the top, not the bottom.
11. Prepare for climate change.

Mitigating and Preparing For Climate Change
Eleven Conservation Principles
for Decision Makers

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The Society for Conservation Biology is a global community of over 10,000 conservation professionals whose careers are devoted to conserving life in all its diversity (www.conbio.org).[i]

New research across physical and social sciences over the past several years indicates that climate change is progressing much more rapidly than previously anticipated.[ii] Major ecosystems once thought capable of absorbing and offsetting more greenhouse gases are losing their ability to do so due to increasing heat and drought. In 2005, for example, the Amazon forest failed to sequester its usual 2 billion metric tons of CO2 and released 3 billion metric tons from dying trees for a net 5 billion ton addition to the atmosphere – an amount greater than the combined annual emissions of Europe and Japan.[iii]

While the evidence that climates are changing is overwhelming, the policy response has been slow. The longer real action is delayed, the greater the procrastination penalty that will need to be paid.[iv] To provide scientific guidance for a global climate agreement and climate policies and practices within governments, multilateral organizations and other bodies, we recommend the following principles.

1) CREATE SYSTEMS AND POLICIES THAT WILL REDUCE GREENHOUSE GAS (GHG) CONCENTRATIONS TO LEVELS[v] APPROACHING HISTORIC LEVELS; AND NO HIGHER THAN 350 PARTS PER MILLION CARBON DIOXIDE EQUIVALENT[vi] AS SOON AS POSSIBLE.[vii]

Rapidly accelerating changes attributable in large part to climate change and its drivers include: losses of biological diversity along with changes in species' ranges and numbers; melting of glacial and polar ice; permafrost melting with concomitant release of methane; ocean acidification; desertification and drought; extreme weather patterns; increasing rates of flooding; and forest fires. Therefore, the current level of greenhouse gases (about 389 ppm CO2 and rising globally at a rate of 2-3 ppm per year [viii]) or any level that is higher is increasingly risky for society and natural systems.[ix]

Policy responses include:

- Proceed as quickly as possible to limit emissions of all greenhouse gases and other driving agents such as black soot.
- Act to restore degraded ecosystems to a healthy status, which is the best defense against changing climates.[x]

2) CAP AND REDUCE GHGs FROM EVERY MAJOR SECTOR, INCLUDING AGRICULTURE, ANIMAL HUSBANDRY, AND FORESTRY, WITH REWARDS AND CONSEQUENCES IN PROPORTION TO THEIR PERFORMANCE.[xi]

Together these three account for roughly 40% of global greenhouse gas emissions.[xii] When properly managed, natural ecosystems provide the most effective means for sequestration and conversion of CO2 to released oxygen and carbon stored in growing plants. As an example, mature and old-growth forests in the Pacific Northwest are the nation's leading long-term carbon storage ecosystems[xiii] and should be conserved. To reach the 350 ppm-equivalent target, each nation and each sector (*e.g.*, power generation[xiv], commercial, industrial, agricultural, forestry, natural areas managers) should have annual greenhouse gas reduction and biological sequestration targets – with rewards and consequences in proportion

to their performance. One important step that can be taken in this regard is to adjust land-use practices to reduce greenhouse gas emissions.

Policy responses include:

- Manage ecosystems to optimize biological carbon sequestration potential.
- Adjust current agricultural subsidies to provide incentives for greenhouse gas reductions, soil conservation, and environmentally responsible and nutrition-enhancing stewardship.
- Require agencies to use greenhouse gases as a metric for land-use decisions through environmental assessment requirements and other laws and policies in order to reduce emissions.

3) CONSERVE AND RESTORE FORESTS AND OTHER ECOSYSTEMS, BUT FORESTS WILL NOT BE ABLE TO STEADILY OFFSET INCREASES IN GHGs.[xv] Although old growth forests often sequester carbon better than others—capturing nearly one-fifth of the carbon dioxide released each year from fossil fuel burning[xvi], as well as being deep repositories of biodiversity -- forests are declining, from the tropics to the temperate zones[xvii] to the taiga.[xviii] In fact, recent droughts and temperature increases have led to declines in carbon sequestration and have turned some tropical forests into net sources of greenhouse gases in some years. **In 2005, for example, the Amazon forest failed to sequester its usual 2 billion metric tons of CO2 and released 3 billion metric tons from dying trees for a net 5 billion ton addition to the atmosphere – an amount greater than the combined annual emissions of Europe and Japan.**[xix] Costa Rican forest growth is slowing in direct relationship to increases in ambient heat,[xx] Malaysian and Panamanian forests are growing more slowly as climate changes bring more clouds and heat, but less rain,[xxi] while so much Brazilian rain forest has been cleared that forest loss appears to have contributed to reductions in rainfall, water flows and fish populations, endangering the livelihoods of native peoples.[xxii]

Policy responses include:

- Reduce both climate and non-climate stresses on forests and other ecosystems, as healthy oceanic and aquatic ecosystems also play key roles in the overall carbon balance.[xxiii]
- Provide additional funding to restore degraded ecosystems in order to preserve their ability to sequester carbon, prevent methane releases associated with premature death or decay, convert carbon dioxide to oxygen and deliver the critical ecosystem services upon which all life depends.

4) PHASE OUT EXISTING SOURCES OF GHG EMISSIONS AS QUICKLY AS POSSIBLE, STARTING WITH THE DIRTIEST FIRST. This will avoid and minimize negative effects while maximizing the net positive impacts of improved environmental quality on ecosystems and human health. For example, in the energy sector, such combinations include efficiency, demand management (*e.g.*, reforming utility rates to help lower-income users while encouraging higher volume users to be more efficient), and the use of renewable energy sources and the cleanest available fuels. Natural gas could be used as a transition fuel along with full assessments of alternatives and costs.[xxiv] Studies in the U.S. and elsewhere have shown that major economies and some developing nations have several times the renewable energy capacity that they need at practical prices when external costs and subsidies are considered.[xxv] The Chairman of the U.S. Federal Energy Regulatory Commission declared in 2009 that the U.S. is likely to need no new traditional base-load (coal or nuclear) power plants[xxvi] if better efficiency standards and related initiatives are implemented.

Policy responses include:

- Replace highly polluting technologies with appropriate combinations of the best available technologies, determined transparently through environmental impact assessment and full life cycle cost accounting.

5) BE CAUTIOUS ABOUT RATIFYING OR ENACTING NEW MEASURES THAT CURTAIL OR REMOVE EXISTING DOMESTIC OR INTERNATIONAL LEGAL TOOLS UNTIL THE FULL IMPLICATIONS ARE CLARIFIED. Both before and within any new climate agreements or laws, governments should apply existing conservation treaties, laws and provisions.[xxvii] First among these are the international conservation treaties to which most nations are party or signatory. Also key are the development agreements and human rights principles that ensure that all the earth's peoples are partners in the project of creating and sustaining the earth and its communities. Domestic laws should not be set aside lightly. In the U.S., for example, the Clean Air Act and environmental assessment and wildlife laws can be applied to climate change. Several conservation treaties and agreements[xxviii] contain climate-relevant provisions that should be supported and empowered. For example, the community of nations has banned or strictly limited trade in products produced with unsustainable methods, as when enforcing the U.N. ban on high-seas driftnets. Other agreements contain provisions that can also be applied – The General Agreement on Tariffs and Trade has recognized for over 50 years the right of individual nations to enforce higher conservation standards in their markets if the standards are applied fairly. [xxix]

Policy responses include:

- Maximize the use of existing legal and financial tools to reduce GHG emissions while new and improved tools are developed.

6) FUND FOREST AND WILDLIFE RESTORATION AND ADAPTATION FULLY AND DIRECTLY. Results of legislation passed and negotiation commitments made so far indicate that some believe that domestic and international conservation objectives will be satisfied by devoting only a small percentage of the proceeds from the sale of pollution permits, a few new international funds, and offsets (*e.g.*, restoration after the fact). Reliance on such elements may be counterproductive, creating perverse incentives to continue emissions by selling permits to pollute in order to fund programs to help adapt to more pollution while hoping to avoid triggering massive climate change tipping points. Developed nations, having benefitted from resources extracted from developing countries in a manner that has degraded ecosystems, have a responsibility both to provide additional funds for restoration and to restrain themselves and others from practices that reduce biodiversity.[xxx]

Policy responses include:

- Develop a major international effort to restore degraded ecosystems funded in large part by developed nations.[xxxi]

7) USE BETTER SCIENCE AND ENFORCEMENT TO MANAGE AND LIMIT THE USE OF CARBON OFFSETS. Those responsible for harm to the environment are sometimes required, or choose, to make up for that harm. Many have done so by paying others to reduce their emissions, or for restoration projects to offset the harm. However, offsets are complex and may be problematic. Use of offsets can result in excessive heat, ozone stress on forests, and an undercutting of the conservation incentives of price signals in the developed world.[xxxii] The best approach is to avoid, minimize, and offset, in that order -- particularly if the offset is likely to be irregular, unreliable, or dependent on variables not controlled by the responsible party.

Policy responses include:

- Avoid relying on offsets as a pillar of government climate change policy, unless the science in a specific case justifies such action and variables in governance and natural systems[xxxiii] in that case can be adequately predicted and controlled.
- Encourage private, minor sources and voluntary actors to use offsets.

8) PRACTICE STEWARDSHIP IN INVESTMENT AND PROCUREMENT. Several trillions of dollars in pension funds and other investments are now managed according to the United Nations' Principles for Responsible Investment.[xxxiv] The UNEP Finance Initiative and many private services offer guidance in green investment, production, and procurement. Investing with stewardship in mind can deliver more than green technology. It can help all countries to meet international development goals in a sustaining and restorative manner -- not only to have forest cover, clean air and water, but to help ensure that children need not labor before learning and that women have the education, resources, and rights to determine the size of their families and the nature of their fates.[xxxv]

Policy responses include:

- Focus investments and spending so as to encourage measurable conservation progress and withhold investment from those who undercut this common cause.

9) REQUIRE THE TRANSPARENT USE OF NATURAL AND SOCIAL SCIENCES AND LAW IN SETTING AND ENFORCING LIMITS. Investments in restoring human and environmental health that pay for themselves over the long term should be distinguished from apparent savings that vanish when full life cycle costs are understood and accounted for.[xxxvi] A properly balanced climate program and budget will likely leave considerable sums for other social goods.[xxxvii] Technologies used in the name of climate change that provide greater risks or costs than other available production or efficiency technologies should be avoided. Treaties, statutes and regulations under development should include mechanisms to provide legal standing to scientists and other citizens to enable them to pursue remedies for failure to comply or inadequate compliance, such as those provided in existing U.S. law and the Aarhus and Nordic Conventions. Existing treaties, laws and regulations should also be analyzed and, where appropriate, modified to ensure that such remedies exist.[xxxviii] Independent scientists can also be encouraged to review and evaluate the efficacy of the measures taken.

Policy responses include:

- Establish fundamental rules and systems that will respond to and incorporate the best available science and full cost, life cycle accounting.[xxxix]
- Include interim goals based on the precautionary principle and update them as quickly as possible in response to new scientific and technological information.
- Apply the balanced use of legal limits and price signals, such as subsidies (or the elimination thereof), taxes[xl] and/or sales of pollution allowances[xli], well-informed resource management, regulations, and fair, comparable tariffs, with a portion of the proceeds -- including tax and tariff rebates -- that can be used for investments in renewable and restorative technologies.[xlii]

10) LEAD A RACE TO THE TOP, NOT THE BOTTOM. The transition to a carbon neutral world is likely to be the biggest economic opportunity of the 21st century. Numerous studies indicate that countries that act first to build a low carbon economy will reap economic benefits accordingly.[xliii] The urgency of climate change means each party cannot wait to take action until most other parties act. The transition to the new low-carbon global economy can be a healthy one for each part of the global community. Climate change requires greater leadership from the countries with the greatest resources. A starting place can be more aggressively applying existing treaties and elements thereof that have already been shown to work[xliv] or that have not yet been well enforced to restore degraded ecosystems, reduce greenhouse gases and create new jobs. Tariffs, incentives, taxes, aid, trade, and other tools should be designed to multiply their effectiveness domestically and internationally to support cleaner, safer methods for both environmental and economic benefits. Research shows that we can multiply the impact of these tools by devoting significant portions of the proceeds of fees and the savings from efficiency to clean up production and otherwise address climate change.[xlv]

Policy responses include:

- Create improved systems that more effectively enforce legal standards based on the best available science.
- Evaluate the effectiveness of measures taken and prescribe corrective or additional precautionary actions when warranted.

11) PREPARE FOR CLIMATE CHANGE. In addition to the mitigation measures discussed above, we, and the ecosystems on which we depend, need to be prepared for anticipated climate change effects. This can be done in part by using an adaptive management approach. This means reducing current environmental stressors that impair the capacity of ecosystems and species to adapt to climate change. This includes maintaining and restoring the resilient properties of ecosystems that allow them to adapt. Management should emphasize protecting critical ecosystem services like water and carbon storage, conserving biodiversity and restoring degraded ecosystems since lower diversity is associated with reduced resilience in the face of climate change.[xlvi] In addition, large intact watersheds and road-less areas should be protected for the critical ecosystem services they provide, such as the role that intact watersheds play in flood and drought abatement. Landscape and watershed connectivity for dispersing wildlife responding to changing climates must also be maintained.[xlvii]

Policy responses include:

- Support management of both public and private lands to prepare ecosystems for climate change.
- Integrate existing conservation treaties laws and plans, such as state wildlife action plans, directly into new climate agreements and laws so that the best science can guide and stimulate conservation action supported by new and additional resources.

ENDNOTES:

[i] The SCB mission is to advance the science and practice of conserving the Earth's biological diversity. In our peer-reviewed journals and magazine, we have published hundreds of articles on climate change. Our members' research helps the world understand the effects of climate change and take management steps that work to conserve biodiversity and to protect ecosystems under changing climatic conditions. Members have worked with executive branch agencies on climate change, testified before Congress, provided technical recommendations and served as a resource for other organizations, coalitions and policy makers. We formally briefed the Obama transition team recommending that they prepare a government-wide strategy for using existing law to address climate mitigation and adaptation in the U.S. and abroad, and identify the most important elements the Congress and the global negotiations should add. We are perhaps the first professional society to have offset the carbon dioxide emissions associated with our annual conferences; this is also an example of equity in relations between the developed and developing world. We are moving toward a zero carbon footprint in all our operations.

[ii] The IPCC reports themselves have been misunderstood by many, and in some ways misused by some policy makers. For example, the IPCC found by consensus that a 2 degree centigrade threshold for a temperature increase would likely occur at about 450 ppm carbon dioxide yet the IPCC consensus was that that level might avoid only the worst effects of climate change. The IPCC predicted considerable losses and changes at levels well below 450 ppm and we are seeing many of those changes now; thus the 450 mark was not intended to be perceived as "safe" or without serious losses and risks.

The United Nations Environment Program (UNEP) released in September 2009 a compendium of peer-reviewed climate science articles entitled Climate Change Science Compendium 2009. The UNEP news release speaks for itself in describing recent climate findings (http://www.unep.org/compendium2009/):

Impacts of Climate Change Coming Faster and Sooner: New Science Report Underlines Urgency for Governments to Seal the Deal in Copenhagen, Washington/Nairobi (September 24, 2009). Highlights from this report include the following:

> • The pace and scale of climate change may now be outstripping even the most sobering predictions of the last report of the Intergovernmental Panel of Climate Change (IPCC). An analysis of the very latest, peer-reviewed science indicates that many predictions at the upper end of the IPCC's forecasts are becoming ever more likely. Meanwhile, the newly emerging science points to some events thought likely to occur in longer-term time horizons, as already happening or set to happen far sooner than had previously been thought.
> · Water that can corrode a shell-making substance called aragonite is already welling up along the California coast decades earlier than existing models predict.
> • Losses from glaciers, ice-sheets and the Polar Regions appear to be happening faster than anticipated, with the Greenland ice sheet, for example, recently seeing melting some 60 percent higher than the previous record of 1998.
> · There is also growing concern among some scientists that **thresholds or tipping points may now be reached in a matter of years or a few decades** including dramatic changes to the Indian sub-continent's monsoon, the Sahara and West Africa monsoons, and climate systems affecting a critical ecosystem like the Amazon rainforest. Emphasis added.
> The report also underlines concern by scientists that the planet is now committed to some damaging and irreversible impacts as a result of the greenhouse gases already in the atmosphere:
>
> · Losses of tropical and temperate mountain glaciers affecting perhaps 20 percent to 25 percent of the human population in terms of drinking water, irrigation and hydro-power.
> · Shifts in the hydrological cycle resulting in the disappearance of regional climates with related losses of ecosystems, species and the spread of dry lands northwards and southwards away from the equator.
>
> [The report concludes that] [r]ecent science suggests that **it *may* still be possible to avoid the most catastrophic impacts of climate change.** However, this will only happen if there is **immediate, cohesive and decisive action** to both cut emissions and assist vulnerable countries adapt. Emphasis added.

For recent reviews of faster than anticipated climate changes, see also:

Rogelj, J., et al. 2009. Half way to Copenhagen, no way to 2 C. Nature Reports Climate Change. June 11, 2009. doi:10.1038/climate.2009.57. Work by the international community leading up to Copenhagen has so far not been enough to avoid "dangerous" climate change.

Meinshausen, M., et al. 2009. *Greenhouse-Gas Emission Targets for Limiting Global Warming to 2 C*, Nature 458:1158-1162.

Parry, M. et al. 2009. *Overshoot, Adapt, and Recover*, Nature 458:1102-1103.

Parry, M. L. (2007). *Climate change 2007: Impacts, adaptation and vulnerability: contribution of Working Group II to the fourth assessment report of the Intergovernmental Panel on Climate Change*-Chapter 4. Cambridge, U.K.: Cambridge University Press. See also IPCC Synthesis report, page 54.

[iii] Philips O.L. et al. *Drought Sensitivity of the Amazon Rainforest*. Science 323, 1344-1347. (2009). SCB's Conservation Magazine, Vol. 10, No. 3, p.7 (2009) summarized the findings of Philips et al. in "The Forest Giveth and the Forest Taketh Away." That summary in Journal Watch also included an article in Nature in 2009 (Lewis S.L., et al., 457, 1003-6) revealing that all of the world's tropical rainforests combined sequester 4.8 billion tons a year, which is less than net loss in the Amazon alone in the drought year of 2005 --

> A study in Science finds that increasing droughts could stunt tropical forests' growth. In that case, greenhouse-gas concentrations could shoot up even faster than they are now.

> The Science paper chronicles how, when one of the worst droughts of the last century hit the Amazon in 2005, scientists took advantage of the natural experiment. In a normal year, the Amazon forest absorbs about 2 billion metric tons of CO2. In the drought year, dying trees caused the forest to release 3 billion metric tons into the air. That 5-billion-ton net carbon belch is greater than the combined annual emissions of Europe and Japan.
>
> Granted, this is only a one-year example. But models foretell more future dry spells for tropical rain belts. University of Leeds ecologist Simon Lewis, an author on both papers, states that no one knows how well rainforests will bounce back from a bout of drier times. And right now, he says, scientists can't agree on how long the current tropical forest carbon sink will last–or when it will plateau or even reverse itself.

[iv] We are, however, encouraged by policy interest in climate change in Congress and the Obama administration. These include: statements made in the summer of 2009 by U.S. Secretary of Agriculture, Tom Vilsack, regarding the importance of the nation's forests in biological carbon sequestration and clean water; the proposals by the Department of the Interior and the Fish and Wildlife Service for climate change policies; and the Executive Order of October 5th 2009 by President Obama on climate change and federal agency management, which includes land acquisition and management, net greenhouse gas accounting , and a schedule of GHG reductions.

[v] Roughly 270-280 ppm CO2 in the pre-industrial era (historic human civilization prior to 1750).

[vi] Hansen, J., Mki. Sato, P. Kharecha, D. Beerling, R. Berner, V. Masson-Delmotte, M. Pagani, M. Raymo, D.L. Royer, and J.C. Zachos. *Target Atmospheric CO2: Where Should Humanity Aim?,* Open Atmos. Sci. 2J., 2, 217-231 (2008). doi:10.2174/1874282300802010217.

In this paper, Hansen and coauthors explain CO2 and CO2 equivalent levels thusly:

> …we take future CO2 change as approximating the net human-made forcing change, with two caveats. First, special effort to reduce non-CO2 GHGs could alleviate the CO2 requirement, allowing up to about +25 ppm CO2 for the same climate effect, while resurgent growth of nonCO2 GHGs could reduce allowed CO2 a similar amount (6). Second, reduction of human-made aerosols, which have a net cooling effect, could force stricter GHG requirements. However, an emphasis on reducing black soot could largely off-set reductions of high albedo aerosols (16).

For current reviews of emission trends, see Anderson, K, and A. Bows. 2008. Reframing the climate change challenge in light of post-2000 emission trends. Philosophical Transactions of the Royal Society A: Mathematical, Physical, and Engineering Science: 366(1882): 3863-3882; Meinshausen, M., et al. 2009. Greenhouse-gas emission targets for limiting global warming to 2 C. Nature 458:1158-1162; Rogelj, J., et al. 2009. Half way to Copenhagen, no way to 2 C. Nature Reports Climate Change. June 11, 2009. doi:10.1038/climate.2009.57.

[vii] Some greenhouse gases, such as carbon dioxide, remain in the atmosphere for a century or longer. Further emissions must be halted rapidly. Other, more powerful GHGs and climate-forcing factors can be reduced much more rapidly.

[viii] Economic recession reduced the rate of increase slightly for 2008-9.

[ix] International Energy Agency (IEA). 2009. How the energy sector can deliver on a climate agreement in Copenhagen. IEA, Paris. See also Parry, M. L. (2007). *Climate change 2007: Impacts, adaptation and vulnerability: contribution of Working Group II to the fourth assessment report of the Intergovernmental Panel on Climate Change*-Chapter 4. Cambridge, U.K.: Cambridge University Press.

[x] SCB called for the adopting the goal of 350 ppm as a guiding principle in the testimony of in-coming President of the North American Section, Dominick Dellasala, a forest ecologist, before the Subcommittee on Forests, Parks, and Public Lands of the Committee on Natural Resources in late February, 2009.
http://www.conbio.org/Activities/Policy/docs/Testimony%20of%20Dominick%20A.%20DellaSala.pdf

[xi] SCB called for such a cap in our comments to the US House Agriculture Committee in April 2009. http://www.conbio.org/Activities/Policy/docs/SCB_House_Ag_CC_Comments.pdf

[xii] The FAO estimates that livestock alone account for 18% of greenhouse gases, largely through methane released from their digestive tracts, but others, such as Robert Goodland, former environmental economist at the World Bank, and staff director of the Bank-sponsored Extractive Industries Review, have suggested that the number is significantly higher (from a briefing at the Institute for Policy Studies in 2008). FAO (www.fao.org): "Forests have four major roles in climate change: they currently contribute about one-sixth of global carbon emissions when cleared, overused or degraded; they react sensitively to a changing climate; when managed sustainably, they produce wood fuels as a benign alternative to fossil fuels; and finally, they have the potential to absorb about one-tenth of global carbon emissions projected for the first half of this century into their biomass, soils and products and store them - in principle in perpetuity." FAO on Livestock: "FAO's Intergovernmental Group on Meat and Dairy Products has recommended that countries should coordinate their livestock policies and practices to help the sector achieve its full potential in mitigating climate change.

[xiii] Smithwick, E.A.H., M.E. Harmon, and J.B. Domingo. 2002. Changing temporal patterns of forest carbon stores and net ecosystem carbon balance: the stand to landscape transformation. *Landscape Ecology* 22:77-94.

[xiv] Within the energy sector, it is essential to include the full and net life-cycle costs of all GHG emissions and all forcing agents such as black soot, a result of certain kinds of fossil fuel combustion. We must work to understand the full environmental and social costs of these activities. For example, methane is emitted from the pools behind many large dams, and such dams also have many other public health and environmental costs, a fact that is often not understood by policy makers nor counted in hydroelectric powers' net GHG contributions – See, Kemenes, A., B.R. Forsberg, and J.M. Melack. 2007. Methane release below a tropical hydroelectric dam. Geophysical Research Letters, 34.

[xv] Reducing stresses to ecosystems is an essential step. This is in addition to counting and controlling as much as possible the GHG emissions resulting from the management of lands and water. See, DellaSala testimony note xxv below. See also
Thompson, I., Mackey, B., McNulty, S., Mosseler, A. (2009). Forest Resilience, Biodiversity, and Climate Change. A Synthesis of the biodiversity/resilience/stability relationship in forest ecosystems. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 43, 67 pages. Thompson et al. note that primary forests tend to sequester carbon best and that biologically diverse forests tend to be more resilient in the face of climate and other stresses but that climate change threatens to convert forests to ecotypes that are less effective at sequestering carbon, for example converting tropical rainforests to savannahs in severe cases.

[xvi] Lewis S.L., et al. 2009. Increasing carbon storage in intact African tropical forests, Nature 457, 1003-1006.

[xvii] Dr. Dominick DellaSala President-Elect of the North American Section of SCB testified in February of 2009 before the U.S. House Natural Resources Committee's Public Lands Subcommittee making several recommendations for climate change policy and temperate forest management in particular. Dr. Mark Harmon also provided further detail on the carbon sequestration of forests and the relative releases of it in the harvest and production of wood products. See, www.conbio.org/resources/policy and the Natural Resources Committee websites respectively for the testimonies.

[xviii] Our nation's forests absorb the equivalent of about 10% of our carbon emissions from fossil fuels (Smith and Heath 2007, Depro 2007). Old-growth forests accumulate carbon for at least 300 to 800 years (Luyssaert et al. 2008). When old trees are cut down and replaced by younger ones there is a net reduction in carbon stores (Law et al. 2004, Depro et al. 2007). These losses are neither trivial nor compensated by fast growing, young trees; it could take hundreds of years until the new forests store as much carbon as did the original old forest (Harmon 2001). Losses of stored carbon are particularly severe on industrial forestlands where timber harvest rotations are much shorter (40-100 years) than it takes for carbon stored in the original old forest to be replenished (Harmon 2001, Luyssaert et al. 2008).

[xix] Philips O.L. et al. *Drought Sensitivity of the Amazon Rainforest.* Science 323, 1344-1347. (2009). SCB's Conservation Magazine, Vol. 10, No. 3, p.7 (2009) summarized the findings of Philips et al. in "The Forest Giveth and the Forest

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[xx] Clark, D.A., S.C. Piper, C.D. Keeling, and D.B. Clark. Tropical rain forest tree growth and atmospheric carbon dynamics linked to interannual temperature variation during 1984-2000. Proceedings of the National Academy of Sciences of the United States of America 100: 5852-5857 (2003).

[xxi] Feeley, K.J. et al. 2007. Decelerating growth in tropical forest trees. *Ecology Letters* 10(6): 461-469. Robin Meadows summarized these new findings for Conservation Magazine's Journal Watch as follows in the July-September issue, Vol. 8, No. 3 (2007). After noting that some had speculated that tropical rainforests generally would grow faster with global warming, Meadows discusses the results of two long term studies:

> …[N]ew research shows that trees in Panama and Malaysia are … growing more slowly. So if we were pinning our hopes on tropical forests working overtime to absorb excess CO2, we may need to think again. Moreover, the news isn't good for the many animals that depend on tropical forests or for the forests themselves. "Decreased growth will almost certainly slow the rate of forest recovery following logging," says Kenneth Feeley of Harvard University, who with four coauthors reports this work in Ecology Letters. The researchers determined growth rates of hundreds of tree species over the past 20 years at sites on Panama's Barro Colorado Island and in Pasoh, Malaysia. To their surprise, most trees at these sites are growing more slowly than they used to. For saplings, more than two-thirds of species censused in Panama and nearly all of those in Malaysia are growing more slowly. For the largest trees, one quarter of species censused in Panama and more than half of those in Malaysia are growing more slowly. Overall, forest growth rates have dropped about one- percent and about six percent per year, respectively, at the two sites. Slower growth in these forests is associated with higher temperatures, lower rainfall, and more cloudy days.

[xxii] Rosenthal, Elizabeth. "An Amazon Culture Withers as Food Dries Up", New York Times, A1, July 25, 2009. Driving peoples from their traditional homelands to dangerous or unhealthy locations, particularly through starvation caused by deforestation and global warming raises profound ethical and human rights issues.

[xxiii] Dr. Reed Noss, former President of the Society's North America Section, set out key rules for forest management in the face of climate change; Noss, R. F. *Conservation Biology*, in the article "Beyond Kyoto: Forest Management in a Time of Rapid Climate Change" Vol. 15 Issue 3, 578 (June 2001).

[xxiv] The biggest source of greenhouse-gas emissions in much of the developed world is electricity generation. Coal, the cheapest fuel, currently produces most of America's "baseload" power: coal-fired plants run nearly constantly to meet basic demand, while many natural gas plants are only switched on when demand is higher. But gas could play a bigger role: there is a third more gas-powered than coal-fired capacity available. *The Economist*, August 13, 2009, "The economics of natural gas -- Drowning in it." This raises the possibility that the dirtier coal-fired electric generation could be phased out more rapidly than expected in much of the country.

[xxv] *The Wall Street Journal*, for example, published a report on alternative energy on February 12, 2007 that described the potential of several approaches, such as the requirements in 20 states for more efficient appliances, buildings and renewable portfolio standards for utilities. The *Journal* noted that the DOE's Energy Information Agency has concluded

that the costs of new power from wind does not differ much from that of coal or gas and is cheaper than nuclear. They were 5.58 cents per kilowatt hour for wind, 5.25 cents for natural gas, 5.31 for coal and 5.93 for nuclear. The price of wind as a fuel of course, is zero, and the prices of the other fuels are, in general, rising.

Department of Energy (DOE) and other studies demonstrated as early as 1991 that wind farms in a few states could produce all of the electric energy the United States needs while eliminating more than a third of the climate-changing and health-damaging air pollution U.S. sources emit.[xxv] At the time of the 1991 DOE wind study, electricity was not widely considered a potential source of energy for transportation, as it is now with the advent of hydrogen, electric, and plug-in hybrid vehicles.[xxv]

In the spring of 2009 the Secretary of the Interior declared in hearings on the energy potential of coastal plain that the wind energy potential off the mid-Atlantic coast of the U.S. was three times the current U.S. demand for electricity. These estimates should be considered seriously in weighing climate options. The 1991 DOE study was entitled "An Assessment of the Available Windy Land Area and the Wind Energy Potential in the Contiguous United States", Pacific Northwest Laboratory, U.S. DOE, 1991. Further wind development beyond the windiest states was estimated in that 1991 study to have the potential to produce about 10.8 billion kilowatt hours, well more than twice the electric power the U.S. used in 2005.

Since that study was conducted, wind turbine design has improved. Each new utility-scale turbine now produces more than twice the power that the average turbine produced in the 1990s at any given time and several times as much over the course of a year due to increased efficiency at lower wind speeds and larger turbine sizes. Any energy technology should be applied after carefully ensuring minimal wildlife impacts and it is likely that a shift to properly applied wind, solar and small hydro, will also help to end practices like mountain top removal for coal, resulting in greatly reduced net mortality.

[xxvi] http://www.nytimes.com/gwire/2009/04/22/22greenwire-no-need-to-build-new-us-coal-or-nuclear-plants-10630.html. Numerous experts have suggested specific paths to a carbon free future. In addition to Barrett (2002) and Laitner (2004) such studies include the Harvard University Medical School's Center for Global Environmental Health *Healthy Solutions for the Low Carbon Economy -- Guidelines for Investors, Insurers and Policy Makers,* http://chge.med.harvard.edu/programs/ccf/healthysolutions.html. See also, Makhijani, A., Freeman, S. D., & Caldicott, H. (2007). *Carbon-free and nuclear-free: A roadmap for U.S. energy policy*, Takoma Park, MD: IEER Press; Brown, L. R., & Brown, L. R. (2009). *Plan B 4.0: Mobilizing to save civilization*, New York: W. W. Norton.

[xxvii] Society for Conservation Biology, "Recommendations for Actions by the Obama Administration and the Congress to Advance the Scientific Foundation for Conserving Biological Diversity" - *Recommendation #3,* p.7. For a review of some of the elements of existing law that may be applied to climate change see, Congressional Research Service Reports to Congress, Climate Change: Potential Regulation of Stationary Greenhouse Gas Sources Under the Clean Air Act by Larry Parker and James E. McCarthy, October 9, 2009 (7-5700 www.crs.gov R40585) and Climate Change Litigation: A Growing Phenomenon, Updated April 7, 2008 by Robert Meltz, Legislative Attorney, American Law Division. CRS papers such as Meltz' are often updated as the title indicates. One frequently revised public resource is Michael Gerrard's climate change chart, maintained for Columbia University. See www.law.columbia.edu/centers/climatechange <http://www.law.columbia.edu/centers/climatechange> .

[xxviii] Dr. Jeffrey McNeely, Chief Scientist of the IUCN until August 2009, and former President of the Society's Asia Section, provides a succinct introduction to several such conservation treaties that should be used, incorporated and empowered by any new climate agreement(s): "Applying the Diversity of International Conventions to Address the Challenges of Climate Change", 17 Michigan State Journal of International Law 1, at 123 (2009).

[xxix] These include the GATT sub-articles XX (b) and (g) allowing limits on imports to protect public health and natural resources, anti-corruption conventions, human rights declarations and decisions, and most development programs. If necessary, the GATT or any agreement can be changed to save the planet.

[xxx] Convention on Biological Diversity, Article 8(l). Nation states that are party to the convention have a duty to regulate activities having a significant adverse effect on biodiversity (such as GHG emissions and deforestation) (l) and these governmental actions would help mitigate climate change. Developed nations have a duty to help developing nations in

this process (8(m)). Any new agreement should build on existing international laws that tend to support the purpose of the new agreement but preempt any that inhibit rational controls on GHGs and deforestation.

[xxxi] Convention on Biological Diversity, Article 8 -- Nation states that are party to the convention have a duty to restore degraded ecosystems under the Convention on Biological Diversity (Article 8(f)).

[xxxii] The Government Accountability Office of the United States Congress has estimated that international offsets would be likely to undercut dramatically the price of carbon in the U.S., and reduce the effectiveness of the cap and trade system. Climate Change: Observations on the Potential Role of Carbon Offsets in Climate Change Legislation, GAO-09-456T March 5, 2009; See also, GAO Report; "The U.S. Voluntary Market Is Growing, but Quality Assurance Poses Challenges for Market Participants" August 29, 2008. http://www.gao.gov/new.items/d081048.pdf.

[xxxiii] Net reductions must be sufficient to offset additional pollution. To adjust for natural system variables, for example, each offset that results in an allowed level of emissions should result in two verifiable outcomes. First, there should be a parallel reduction in the credit that reflects any decline in the rate at which forests and other ecosystems are expected to sequester GHGs. Second, an alternative performance plan must be triggered if a given forest, for example, passes from a decline to a tipping point and becomes a source again.

[xxxiv] UN PRI are principles establishing a process that investors use to consider the impact of investment options. This process can be informed by evolving climate and biodiversity conservation science.

[xxxv] We recognize that a global answer to the twin challenges of climate change and biodiversity conservation will not be possible without achieving other elements of sustainable development from education to government accountability and the rule of law. While we do not consider ourselves to be experts in all these fields, we recognize the fact that social contract goals must be part of a set of mutually supportive global change solutions. See O'Brien, K. et al. 2009. Rethinking social contracts: Building resilience in a changing climate. Ecology and Society 14:12 [online] URL:http:///www.ecologyandsociety.org.

[xxxvi] For example, spending for fossil fuel converts assets into lost potential when oil that might be used for lubrication and medicines is traded for pollution that degrades human and natural capital at the same time. See, Nordhaus, W. D., & Kokkelenberg, E. C. (1999). *Nature's numbers: Expanding the national economic accounts to include the environment*. Washington, D.C.: National Academy Press.

[xxxvii] The U.S. National Academy of Sciences in October 2009 published a study on the life cycle costs of each major form of energy production. This provides new estimates of the indirect subsidies that result from the harms done by energy production and use that are not captured in the price for energy and energy services. It is also important to consider how the billions of dollars a year in direct subsidies now provided to the coal, nuclear, and oil industries in countries such as the U.S. might be better used for the transition to cleaner, safer energy forms.

[xxxviii] The right to petition for rulemakings and to sue to enforce the law and recover expert witness and attorneys' fees has been a fundamental strength of US environmental, wildlife, and administrative law. These include among others the U.S. Administrative Procedures Act, National Environmental Policy Act, the Endangered Species Act and the False Claims Act. In international law, somewhat similar procedures are included in the Aarhus and Nordic Conventions.

[xxxix] For example, in response to a call from the G8 leading economic powers, a project team run by UNEP and the EU called "The Economics of Ecosystems and Biodiversity (TEEB)" are preparing a series of papers analyzing the economic costs of biodiversity loss and policy and management options for preventing such losses.
http://www.teebweb.org/Home/tabid/924/language/en-US/Default.aspx;
http://www.teebweb.org/ForPolicymakers/tabid/1019/language/en-US/Default.aspx

[xl] The Congressional Budget Office found that tax adjustments can be efficient and effective. See, "Evaluating the Role of Prices and R&D in Reducing Carbon Dioxide Emissions", September 2006, a Congressional Budget Office Paper, by Terry Dinan. GHG taxes have been implemented by Sweden and proposed as tariffs by France and others, and more

recently as a source of funding to support forest conservation in the developing world, e.g., SUBMISSION BY COSTA RICA ON BEHALF OF DOMINICAN REPUBLIC, GUATEMALA, HONDURAS, MÉXICO, PANAMÁ, PARAGUAY AND PERÚ, San José, Costa Rica 23 February, 2007, Subject: Reducing Emissions from Deforestation in Developing Countries, available at http://unfccc.int/files/methods_and_science/lulucf/application/pdf/costa_rica.pdf.

[xli] Barrett, J., J. Hoerner, S Bernow, and B. Dougherty. 2002. "Clean Energy and Jobs: A comprehensive approach to climate change and energy policy", ECONOMIC POLICY INSTITUTE. This 2002 study modeled a set of policies in which 15% of the revenues from a carbon "charge" were devoted to income tax reduction, energy efficiency, renewables and related initiatives. This more than eliminated the adverse impacts on energy prices as consumers spent less -- 30% less on petroleum, almost 50% less on electricity and about 25% less on natural gas. Most importantly, the EPI group found that a $50 dollar per ton tax on carbon devoted to incentives for renewables would achieve reductions of carbon emissions of roughly 10% below 1990 levels by 2010, and by 2020 would reduce oil imports by the amount we import from all members of the Organization of Petroleum Exporting Countries at no net cost to the taxpayer, available at http://www.epi.org/publications/entry/studies_cleanenergyandjobs/; Hanson D., I. Mintzer, J. Laitner, and J. Leonard. 2004. "Engines of Growth: Energy Challenges, Opportunities, and Uncertainties in the 21st Century." Argonne National Laboratory. http://www.ari.vt.edu/hydrogen/Resources/BackDoc/Doc/engines_growth.pdf.

[xlii] If tariffs and assistance fails, even the current GATT would support embargoes against goods to protect human health and exhaustible natural resources (Article XX (b) and (g)).

[xliii] See, Barrett, et al., note xxvi.

[xliv] E.g., The Montreal Protocol, CITES, Sea Turtle conservation requirements for shrimp harvesting, Tuna-Dolphin fishing and labeling regulations have all helped to conserve the affected species or reduce the targeted substances by directly limiting or guiding trade in the affected products.

[xlv] See studies by Barrett, J. et al., (2002) and Hansen, D. et al. (2004) note xxvi.

[xlvi] Much research has shown that natural and managed systems with high diversity are more likely to have the capacity to adapt to climate change and maintain productivity-a recent report is CBD Secretariat. 2009. Forest resilience, biodiversity, and climate change. Available at http://www.cbd.int/doc/publications/cbd-ts-43-en.pdf. See also Suttle et al. 2007. Species interactions reverse grassland responses to climate change. Science 315, 640-642; Reusch et al. 2005. Ecosystem recovery after climatic extremes enhanced by genotypic diversity. Proc. Natl. Acad. Sci. USA 102, 2826-2831). See also, Thompson, et al., note xv above.

[xlvii] There is a growing body of literature on adaptation but agencies and experts are at the early stages of assessing what works best. Therefore, a precautionary and adaptive approach is advisable. See, Mawdsley, O'Malley and Ojima 2009. A review of Climate Change Adaptation Strategies for Wildlife Management and Biodiversity Conservation. Conservation Biology 23, 1080-1089. In a review of climate adaptation plans from five countries, these authors "found 16 general adaptation strategies that relate directly to the conservation of biological diversity." These were in four broad categories, with law and policy being the fourth: "Tools for implementing these strategies are similar or identical to those already in use by conservationists worldwide" …but …"mangers will likely need to apply these tools in novel and innovative ways to meet the unprecedented challenges posed by climate change."

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Climate Policy Principles
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Mitigating and Preparing for Climate Change
Eleven Conservation Principles for Decision-makers

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Contact

John M. Fitzgerald, J.D., Policy Director
Society for Conservation Biology
voice: 1-202-234-4133 x 107
jfitzgerald@conbio.org

Alan D. Thornhill, Ph.D., Executive Director
Society for Conservation Biology
1-703-973-1777
athornhill@conbio.org

Dominick DellaSala, Ph.D., President-Elect, North America Section
Society for Conservation Biology
1-541-482-4459 x 302

Society for Conservation Biology
A global community of conservation professionals
1017 O Street NW
Washington, DC 20001-4229 US
www.conbio.org

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