A new Web site, Human Genome Central, is described that provides links to various public resources that have "ancillary information and tools that provide an ongoing picture of the [human] genome that is comprehensive and comprehensible." How greenhouse gas emission baselines could be calculated "so as not to penalize developing countries that enact and enforce strong environmental laws" is examined. And archaeological evidence used to determine when moas became extinct in New Zealand is discussed.

Help in Accessing Human Genome Information

The vast majority of the human genome sequence is now publicly available. About 25% of the genome sequence is in finished form, and most of what remains is in draft form. A publication on the working draft will be submitted later this year. As with other organisms, the full primary source data are available in each of three public databases: GenBank, European Molecular Biology Laboratory (EMBL), and DNA Data Bank of Japan (DDBJ). However, it is a daunting and time-consuming task for users to directly analyze the primary source data. Many users would like access to ancillary information and tools that provide an ongoing picture of the genome that is comprehensive and comprehensible. Such information includes the overlaps between clones, the correct genomic location of each clone, an integrated genomic sequence that merges the individual clones, and annotation of gene content. In fact, such resources have been developed and are freely available, but they are not widely known.

For ease of access, we have created a master Web site called Human Genome Central that contains a brief listing of links to some of the most useful public resources; further links to additional sites can be found within them. The Web sites will be regularly updated with new information. Human Genome Central can be found on the National Center for Biotechnology Information (NCBI) and European Bioinformatics Institute (EBI) sites at http://www.ncbi.nlm.nih.gov/genome/central and http://www.ensembl.org/genome/central/, respectively.

The International Human Genome Sequencing Consortium

Correspondence may be addressed to: **Eric Lander**, The Whitehead Institute/Massachusetts Institute of Technology, Center for Genome Research, 1 Kendall Square, Cambridge, MA 02139, USA. E-mail: lander@genome.wi.mit.edu. **John Sulston**, The Sanger Centre, Wellcome Trust Genome Campus, Hinxton, Cambs CB10 1SA, UK. E-mail: jes@sanger.ac.uk

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How could we calculate emission baselines to protect rain forests such as this one in Bolivia's Noel Kempff National Park?

Rain Forest Conservation Under Review

In the June 9th issue of *Science*, the authors of the report "Economic incentives for rain forest conservation across scales" (C. Kremen *et al.*, p. 1828) and the authors of the Perspective "Counting the cost of deforestation" (R. Bonnie *et al.*, *Science*'s Compass, p. 1763) raise a troubling aspect of the economics of carbon sequestration and its link to foreign investment incentives. Kremen *et al.* note that the Malagasy government has trouble capturing rents from logging concessions. Therefore, the authors discount the rate (or rent) required to compensate for carbon conservation. Yet, the Malagasy government's inability to enforce its laws makes it a candidate to receive more than its (discounted) "base" rent calculated under the Kyoto Protocol. A country that enforces tough environmental laws would receive just its (undiscounted) base rent. This rent enhancement is because, for countries such as Madagascar, without higher rent or an appropriately calculated base rent, it would be even more difficult for them to put in place the enforcement mechanisms to prevent the same deforestation the authors seek to avoid.

All agree that economic incentives should not discourage governments from environmental enforcement. But such a methodology has not yet been clearly enunciated under the Kyoto Protocol, nor by the authors. An analogy to the Madagascar case can be seen in Nigeria, whose law does not require the capture of flared natural gas. Is it realistic to expect Nigeria, like Madagascar, to accept less "Kyoto" rent from foreign investors to reduce gas emissions, simply because Nigeria's legislation does not meet international best practice? Although foreign investors should be encouraged to help Nigeria find ways to reduce emissions, what rules would ensure that the lure of such investment does not harm the incentive to enforce environmental law now? The same is true for countries that effectively ban unsound logging. Bonnie *et al.* note that "[emission baselines] must be established that account for the rate of deforestation that would have occurred in the absence of the conservation project." Is the "deforestation" they refer to that which would have occurred with or without enforcement of forest legislation? If greenhouse gas emission baselines are set appropriately, they can provide developing countries the helping hand to enforce environmental law. But how do we set the baseline to be sure not to discount rates for those countries now using scarce resources trying to enforce their environmental laws, and at what rates?

Charles Di Leva

Environmental Law Centre, IUCN–The World Conservation Union, Godesberger Allee 108-112, D-53175 Bonn, Germany. E-mail: CDiLeva@elc.iucn

Responses

Di Leva raises a challenging issue that negotiators of the Kyoto Protocol are discussing: How can greenhouse gas emission baselines be calculated to avoid creating anti-environmental incentives, such as countries not enforcing environmental laws or threatening to clear their forests? This maneuver can be avoided by requiring that baselines are calculated on emissions in years before the Protocol was finalized (before 1997). With this stipulation, a country cannot suddenly claim a higher baseline to leverage bogus emission reductions.

Negotiators could also implement rules to place countries with strong past environmental performances on equal footing with poorly regulated countries by requiring that baseline emission scenarios be set to standard or best management practices. With this formula, only additional emission reductions above these criteria would be eligible for carbon credit financing. However, requiring countries to meet such standards (which may not reflect on-the-ground reality) will lessen the prospect of engaging recalcitrant countries in emission reductions. In the case of Madagascar, we calculated

that the price per metric ton of CO_2 C would fall from $4.18 in an unregulated situation to $1.04 under best management practices using a 30-year time-frame with 3% discount rate (see Table 2 of our report).

Land use and forestry measures in climate change mitigation continue to be a contentious issue among delegates and observers to the Kyoto Protocol, and the challenge of determining baselines is part of this important debate. Including forest conservation in the Clean Development Mechanism (CDM) can be done credibly. It will give countries that want to keep their forests intact a source of conservation financing that is otherwise unavailable (*1*). Currently, many countries are receiving better offers from loggers (*2*). Until the world community compensates developing countries for the opportunity cost of not cutting their trees, we can expect this global baseline to continue unabated, causing an estimated 1.6 gigatons of carbon emissions each year (*3*).

Lastly, protecting existing tropical forests will, in addition to reducing greenhouse gas emissions, also maintain historical land surface conditions such as the hydrological cycle, the partitioning of latent and sensible heat, cloud cover, and other factors that modulate climate and weather. Most general circulation models and experimental data suggest that together these factors generally result in a net localized surface cooling of a few degrees celsius (*4*). In this regard, conserving existing tropical forests will produce secondary and tertiary benefits for climate stability that fossil-fuel reductions alone cannot provide.

John O. Niles
Claire Kremen
Center for Conservation Biology, Stanford University, Stanford, CA 94305–5020, USA. E-mail: jniles@bing.stanford.edu

Philip Guillery
Institute for Agriculture and Trade Policy, Minneapolis, MN 55404, USA

References and Notes

1. Fourteen countries submitted a position paper on this issue noting that, legally, forest conservation is eligible for activities under the CDM of the Kyoto Protocol. They argued that excluding this source of emissions would also deprive them of opportunities for sustainable development. Framework Convention on Climate Change document #FCC/SB/2000/MISC.1/Add.2.
2. "Buying destruction: A Greenpeace report for corporate consumers of forest products" (Greenpeace International, Amsterdam, 1999).
3. "Intergovernmental panel on climate change: Land use, land-use change and forestry" (Cambridge Univ. Press, Cambridge, 2000).
4. K. L. O'Brien, *Clim. Change* **44**, 311 (2000); J. Shukla, C. Nobre, P. Sellers, *Science* **247**, 1322 (1990); J. Lean and D. A. Warrilow, *Nature* **342**, 411 (1989).

Di Leva raises an important question as to how to establish appropriate emission baselines for greenhouse gas emission reduction projects under the Kyoto Protocol's CDM so as not to penalize developing countries that enact and enforce strong environmental laws. However, as Di Leva points out, this is not a concern that applies only to forest conservation projects in the CDM; it applies equally to projects in the energy sector. As such, the issue raised by Di Leva does nothing to undermine our call to include forest conservation as an eligible activity under the Kyoto Protocol.

Nonetheless, project baseline calculation requires considerable attention. The Kyoto Protocol requires that emission reductions under CDM projects be in addition to those that would have occurred in the absence of the project. Such a standard is counter-factual and, therefore, may prove challenging to implement for many projects. Perverse incentives with respect to enacting and enforcing environmental laws could be avoided if emission baselines are set by using deforestation rates that precede instigation of the CDM. The downside of such an approach is that baselines based on historic trends could result in outdated data for long-term projects. An alternative approach would be to require dynamic baselines that would be altered to reflect changes in environmental laws or other factors. For example, the deforestation baseline initially established for the Noel Kempff Mercado Climate Action Project was subsequently recalculated to reflect strengthened forest protection laws in Bolivia. The fact that the Bolivian government will receive a sizeable share of the greenhouse gas emission reduction credits generated by the 600,000-hectare project seems not to have dampened efforts to improve environmental laws there.

However baselines are calculated, countries with poor environmental records and thus greater potential for greenhouse gas emission reductions may theoretically attract more investment, as Di Leva points out. In practice, this may not be the case because the lack of stable democratic and legal institutions that often accompany environmental degradation increase the risk of project failure and thus may give project investors pause. However, because at least some investment is likely to flow to countries with spotty environmental credentials, it is vital that international negotiators develop rules that ensure the environmental integrity, protection of indigenous people's land tenure, and transparency of all CDM projects.

Robert Bonnie
Stephan Schwartzman
Environmental Defense, 1875 Connecticut Avenue, NW, Washington, DC 20009, USA

Less Is Moa

In their report "Rapid extinction of the moas (Aves: Dinornithiformes): Model, test, and implications" (24 Mar., p. 2250), Holdaway and Jacomb contribute a useful zoological