Office of Science
Financial Assistance
Funding Opportunity Announcement
DE-PS02-07ER07-11

Program for Ecosystem Research

The U.S. Department of Energy's (DOE's) Office of Biological and Environmental Research (OBER), a part of DOE's Office of Science, hereby announces interest in receiving grant applications for new experimental research to develop a better scientific understanding of potential effects of climatic change on U.S. terrestrial ecosystems and their component organisms. Research should focus on the following question, directed at terrestrial vascular plants or animals in the United States: Do temperature increases projected by coupled atmosphere-ocean general circulation models for the coming 100 years have the potential to affect the abundance and/or geographic distribution of plant or animal species in the United States, and if so, to what extent? Research should be based on experimental manipulations of temperature in the field and/or the laboratory and directed at understanding cause-and-effect relationships between temperature change and the abundance and/or geographic distribution of terrestrial vascular plants or animals in the United States. Proposed research should not rely on correlations between presently observed temperature gradients or changes and the observed abundance or distribution of plant or animal species. High risk research having the potential to rapidly advance the field is encouraged.

PREAPPLICATIONS

Applicants are **required** to submit a two-page preapplication by email to jeff.amthor@science.doe.gov. Preapplications must be received by **DOE by 4:30 p.m., Eastern Time, January 5, 2007.** The subject line of the email should be: "PER Preapplication". The preapplication should be a Word file attached to the email, having 1 inch margins when printed.

The first page of the preapplication should identify the (1) Principal Investigator's name, telephone number, and e-mail address; (2) name of the Principal Investigator's employing institution; and (3) a clear and concise description of the proposed research. Item (3) should include a one-sentence description of the overall project goal. Background and significance of the proposed project should be limited to two sentences. Each task to be completed, including the experimental manipulation of temperature (including the method to be used to manipulate temperature), should be described in clear and concise statements. The location of all proposed research sites must be specified, and the plant and/or animal species to be studied must be identified. A one-sentence description of the main expected outcome of the research should be included. The approximate (i.e., +/- 10%) budget for each year of the proposed research should be included at the end of the first page of the preapplication.

The second page of the preapplication must be a curriculum vita that highlights the Principal Investigator's expertise and background in successful research related to effects of climatic change on terrestrial ecosystems and/or organisms.

Preapplications must be **received by January 5, 2007** (preapplications received after this date will not be considered). Preapplications will be screened and preapplicants will be notified if a formal application is encouraged. Preapplications will be reviewed for conformity with the guidelines given in this Announcement and suitability in the technical areas specified in this Announcement. It is expected that a response to the preapplications will be communicated, by **reply email**, by January 12, 2007 (hence, **the preapplication should be sent from the email address that will be monitored for the response**). Applicants who have not received a response regarding the status of their preapplication by this date are responsible for contacting the program to confirm this status. Note that notification of a successful preapplication is not a guarantee that an award will be made in response to a formal application. **Formal applications will be accepted only from preapplicants encouraged to submit a formal application.**

APPLICATION DUE DATE: April 10, 2007, 8:00 pm, Eastern Time

Applications must be submitted using Grants.gov, the Funding Opportunity Announcement can be found using the CFDA Number, 81.049 or the Funding Opportunity Announcement number, DE-PS02-07ER07-11. Applicants must follow the instructions and use the forms provided on Grants.gov.

FOR FURTHER INFORMATION CONTACT: Dr. Jeffrey S. Amthor, Program Manager, (301) 903-2507, jeff.amthor@science.doe.gov

SUPPLEMENTARY INFORMATION:

Background

Global warming has been underway for about 100 years (e.g., Smith & Reynolds 2005; Brohan et al. 2006). It is expected that additional warming will occur, at a more rapid rate, in the future due to continuing increases in greenhouse gas concentrations in the atmosphere (e.g., Tebaldi et al. 2005; Greene et al. 2006). The warming has been greatest, and is expected to remain greatest, at northern higher latitudes, e.g., in the Arctic (Tebaldi et al. 2005; Greene et al. 2006).

During the past several decades, some terrestrial plant and animal populations apparently extended their ranges toward the poles or to higher elevation (Parmesan & Yohe 2003). Increased extent and abundance of shrubs in Alaskan tundra (e.g., Tape et al. 2006) may be an important example because warming in Alaska has been greater than in other parts of the country.

Phenologies of plants and animals have also changed in some cases, with earlier-spring plant leaf expansion and flowering and earlier-spring animal breeding, nesting, and annual migration (Parmesan & Yohe 2003; Root et al. 2003). Earlier occurrence of spring biological events (and

later occurrence of some autumnal events) is consistent with expected effects of warming on biological processes.

While it is clear that warming has caused some changes in the seasonal timing of biological events and processes, observed increases or decreases in abundance of plant or animal species at any particular location might be confounded by factors other than temperature change, even if the observed increase or decrease appears correlated with temperature change. Factors such as human land-use change, introduction and spread of exotic species, changes in pathogen abundance or distribution, changes in atmospheric composition and deposition, and natural variability in the abundance and geographic distribution of plants and animals could all be causally related to observed changes in abundance or geographic distribution of plants and animals. It is important to be able to distinguish effects of climatic change per se from other factors.

It is possible that warming might be affecting (or driving) evolution in some species (e.g., Bradshaw & Holzapfel 2006) though observed genetic changes associated with past warming might be due to either local natural selection or invasion by genotypes from warmer locales, or both (Balanya et al. 2006).

The decline of some animal species has been attributed to warming. For example, based on circumstantial evidence (i.e., correlations with observed variation in recent temperature), Pounds et al. (2006) suggested that amphibian extinctions in the mountains of Costa Rica "associated with pathogen outbreaks is tied to global warming". In this case, warming was suggested to be shifting ambient temperature towards the growth optimum of a pathogenic fungus.

Modeling studies indicate that large-scale biome shifts (e.g., conversion of forest ecosystems to nonforest ecosystems, and vice versa) might occur in several parts of the United States as a result of projected climatic changes (e.g., Scholze et al. 2006). It is likely that before large-scale biome shifts are realized (if any), changes in the dominance of various primary producers, consumers, and decomposers would take place. Changes in biodiversity, suitability of habitat, and both quantity and quality of various ecosystem goods and services would all probably change before biome shifts would be observed. Difficulties in interpreting output from models of the geographic distributions of individual species, and relationships between climate, climatic change, and species distributions, arise because a wide range of (often contradictory) potential effects of climatic change on species distributions is predicted by different models (e.g., Elith et al. 2006; Araujo and Rahbek 2006) and because models of the geographic distribution of biomes are poorly tested with respect to climatic changes projected for the next 100 years. Better understanding of climate-species distribution relationships are needed to improve predictions of potential effects of climatic change on biodiversity, species distributions, and ecosystem/biome distributions.

In summary, global warming has a potential to cause changes in the abundance or geographic distribution of terrestrial plant and animal species, and may have already contributed to such changes. Warming-induced changes in plant or animal abundance or geographic distribution have the potential to affect both the quantity and the quality of goods and services provided by

terrestrial ecosystems, and might therefore be of importance to society, depending in part on which plant and animal species are affected and how extensive the changes become.

References

- Araujo MB, Rahbek C (2006) How does climate change affect biodiversity? *Science* 313:1396-7
- Balanya J, Oller JM, Huey RB, Gilchrist GW, Serra L (2006) Global genetic change tracks global climate warming in *Drosophila subobscura*. *Science* 313:1773-5
- Bradshaw WE, Holzapfel CM (2006) Evolutionary response to rapid climate change. *Science* 312:1477-8
- Brohan P, Kennedy JJ, Harris I, Tett SFB, Jones PD (2006) Uncertainty estimates in regional and global observed temperature changes: a new data set from 1850. *J Geophysical Res* 111:D12106
- Elith J, Graham CH, et al. (2006) Novel methods improve prediction of species' distribution from occurrence data. *Ecography* 29:129-51
- Greene AM, Goddard L, Lall U (2006) Probabilistic multimodel regional temperature change projections. *J Climate* 19:4326-43
- Parmesan C, Yohe G (2003) A globally coherent fingerprint of climate change impacts across natural systems. *Nature* 421:37-42
- Pounds JA, Bustamante MR, et al. (2006) Widespread amphibian extinctions from epidemic disease driven by global warming. *Nature* 439:161-7
- Root TL, Price JT, Hall KR, Schneider SH, Rosenzweig C, Pounds JA (2003) Fingerprints of global warming on wild animals and plants. *Nature* 421:57-60
- Scholze M, Knorr W, Arnell NW, Prentice IC (2006) A climate-change risk analysis for world ecosystems. *PNAS* 103:13116-20
- Smith TM, Reynolds RW (2005) A global merged land and sea surface temperature reconstruction based on historical observations (1880-1997). *J. Climate* 18:2021-36
- Tape K, Sturm M, Racine C (2006) The evidence for shrub expansion in Northern Alaska and the Pan-Arctic. *Global Change Biol* 12:686-702
- Tebaldi C, Smith RL, Nychka D, Mearns LO (2005) Quantifying uncertainty in projections of regional climate change: a Bayesian approach to the analysis of multimodel ensembles. *J Climate* 18:1524-40

Request for Applications

This Announcement solicits research to clarify potential effects of temperature change, as a direct casual factor, on changes in the abundance and/or geographic distribution of terrestrial animals (kingdom Animalia) or vascular plants in the United States. The temperature changes of interest are those that may occur during the next 100 years as projected by coupled atmosphere-ocean general circulation models (AOGCMs).

The two specific questions to be addressed are:

(1) Might terrestrial vascular plant or animal species near the "warm" end of their range in the United States decline in abundance during the coming 100 years **because of projected warming**? and/or

(2) Might terrestrial vascular plant or animal species near the "cool" end of their range in the Unites States increase in abundance, or extend their range, during the coming 100 years **because of projected warming**?

The proposed research must be based on experimental (controlled) manipulations of temperature (both air and soil) to demonstrate clearly whether warming per se affects species abundance or existence. The experimental research could be in the field and/or the laboratory, as appropriate to the approach to be used. The temperature treatments to be studied must be clearly justified based on published AOGCM output.

The application narrative must state concisely why the species to be studied is (or are) important. Reasons might include high existence value, large importance to the health or success of other species, endangered or threatened status, role in a critical ecosystem-scale process, or representativeness as a model organism (with a description of what it is a model of).

Applications must include an estimate of the time required to produce specific deliverables in the proposed study system and provide a concise timeline of the proposed activities. Applications requesting up to four years of support will be considered, and it is expected that the timeline will indicate the potential for significant results within that period.

Research on highly managed ecosystems (e.g., crops, forest plantations, and pastures), or on humans or human settlements, will not be considered for support. Research involving recombinant DNA molecules, or organisms known to contain recombinant DNA molecules, will not be considered for support.

The funded projects will be required to acknowledge support by the DOE Office of Science (OBER) in all public communications of the research results.

Posted on the Office of Science Grants and Contracts Web Site
November 22, 2006.