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April 17, 2002

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and Members of the Science Advisory Board:

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All Species Foundation
P.O. Box 29462
San Francisco, CA 94129

Dear Ms. Phelan;

This letter comes to you from several evolutionary biologists who share a strong hope for the success of the All Species Inventory. As scientists who are greatly concerned about declining biological diversity we deeply appreciate and support the goals of discovery and conservation that motivate the All Species Foundation. From the perspective of the All Species website, the foundation seems to be the very model of a modern, forward-looking, ambitious, and highly valuable initiative, and the expertise that you have gathered in all of the many areas that are required for success is outstanding. Perhaps most impressive, given the diverse challenges you face, is the clear All Species commitment to putting science first.

We stress that our hopes for the success of the All Species Inventory are in earnest, for the purpose of this letter is to convey our concern that All Species's efforts overlook a fundamental issue in biodiversity research. Our concern is rooted in a frequently debated area of uncertainty in evolutionary biology: the lack of agreement among biologists over how species should be discovered and identified. All evolutionary biologists, and many lay persons, are familiar with the 'species problem', and the disquiet that arises at times when it is brought up can be discouraging. Be that as it may, uncertainty over species is a fact of life for those who study biological diversity.

We feel that species uncertainty need not be feared and should not be avoided in the course of planning and conducting research on biological diversity. The remainder of this letter briefly explains why an appreciation of the uncertainty around species should be a basic constituent of biodiversity research.

People generally understand species to be kinds of organisms, and professional biologists in particular are often in the business of discovering kinds of organisms. These named categories are called species taxa. Yet biologists also have another usage of 'species', for they tend to think of species as evolutionary role-players out in nature. This second kind of usage treats species as evolutionary and ecological entities of some sort. There are

important differences between species taxa and species as evolutionary entities, and biologists understand that species taxa may not match up well with species as evolutionary entities. There are two main reasons for the mismatch.

First, species taxa are devised by investigators and are partly a function of biologists' tools, circumstances, and inclinations. For many species, particularly those that can be easily observed and have distinguishing morphological characters, this subjective element can be overcome and biologists can agree on the organisms to be included in a species taxon. However for many organisms that live in soils, and waters, and within or upon other larger organisms, the gaps between species taxa and real evolving entities in nature are bound to be large. Many species will be difficult to identify and distinguish without complex and expensive methods. In these contexts a strict focus on species taxon discovery and on the counting of taxa will yield numbers that are in large part a function of investigator effort, regardless of the underlying magnitude and structure of biodiversity. Such numbers may be particularly misleading if they are generated under strong limitations of time and resources.

The second reason for disparity between species taxa, and species as evolutionary entities is that whereas the former are often defined by biologists using diagnostic criteria, the latter sometimes exchange genes with others or are nested within one another in various ways. In other words, the species taxa are defined on the basis of defining characteristics, whereas species in nature are often not distinct from other closely related species.

We reiterate these familiar issues in order to reinforce the fact that species taxa are tools that, though absolutely necessary in many contexts, have important limitations. This will be especially true for the very large majority of biological diversity that remains to be described. Most organisms that remain to be discovered, and for which new species taxa are to be devised, will be small and will live in habitats that are highly geographically, chemically and physically structured, and many of these will require new techniques for discovery and characterization. Also, like other such organisms, many will tend not to engage regularly in sex or recombination. These are contexts in which even the best of biologists have great difficulty devising and defending particular species taxa.

From documents on the All Species website and from the public face of the All Species Foundation as represented in newspaper articles, it is clear that the goal of discovering and cataloging all biological diversity was framed with the species taxon as the fundamental unit of diversity and discovery. Our concern is that if the All Species effort goes forward as currently envisioned, without addressing or acknowledging species uncertainty, then the costs of this oversight will grow with the effort and the 'success' of the initiative. In particular, the more the results are used to shape public knowledge and policy, the more it will be clear how the findings are sometimes ambiguous at the most basic level – the species themselves. This ambiguity, if not handled forthrightly, may draw negative attention to the initiative and may harm efforts to preserve biological diversity. If the All Species effort becomes as large and extensive as planners hope, it

could possibly draw well targeted, well justified, but harmful criticism. In this light it is perhaps not too difficult to imagine the potential donors who might wonder about the ambiguity of species (or be put up to it by an anti-environmentalist effort), or to anticipate how criticisms regarding species uncertainty are to be answered – constructively, honestly, and without revealing ignorance or duplicity.

We realize that the All Species founders and the many biologists involved with the All Species Inventory are fully aware of the species problem. Indeed it seems possible (and certainly understandable) that intimacy with some of the more obdurate and unsuccessful aspects of species debates has shaped a wish on the part of All Species framers to avoid mention of species uncertainty.

We have two suggestions, neither of which would diminish current All Species efforts that are based on existing taxonomies, and neither of which are novel or radical.

First, species uncertainty can be acknowledged as a fundamental component of biological research, and this can be done without undermining discovery or conservation efforts. The most adamant and unpleasant aspects of species-problem debates have concerned the narrow question of how to define the word ‘species’. Yet the dual usage of ‘species’ that is mentioned above is familiar to biologists, and biologists are familiar with the idea that species taxa can serve as hypotheses of species as evolutionary entities. In short, biologists appreciate the necessity of species taxa at the same time that they appreciate the limitations of species taxa as tools for describing and understanding biological diversity. Admitting the ambiguity of species as evolutionary entities and the necessity of species taxa is simply straightforward and honest, and a basic part of good biodiversity-related research.

Second, discovery efforts that seek out new undescribed species can be conducted in a way that brings in more information, with greater efficiency, than will arise under a straight species-counting approach. Species counts are basic essential measurements in contexts where taxa have been previously described. However for undescribed species, assessments of biodiversity can be greatly enriched by considering the roughly hierarchical pattern of relationships among living things. If the process of discovering and describing new species is undertaken in a phylogenetic context, such that new species are described concomitantly with their phylogenetic relationships to previously described taxa, then investigators can focus their efforts, as needed, towards those portions of the biodiversity spectrum where evolutionary history is less well understood.

The idea of taking a phylogenetic approach is not novel, and indeed is regularly practiced formally and informally by biologists in the field. It seems quite likely that a phylogenetic approach will be an implicit or explicit practice in many of the efforts to go forward as part of the All Species Inventory. However, the public face of the All Species Inventory - to all interested persons, including scientists, teachers and policy-makers - is of a strictly species-taxon-counting approach.

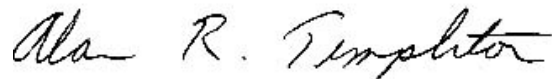
We realize that these suggestions are partly cosmetic, for we do not mean to criticize ongoing discovery or conservation efforts. We are aware that biologists working on discovering and preserving biological diversity, including the biologists assisting the All Species Inventory, recognize the problem of species uncertainty and often incorporate a phylogenetic approach in their work. However these insights arise from our knowledge of the field and of the issues, and they arise despite the public face of the All Species Foundation. That face is strictly centered on the goal of counting all undiscovered species taxa. It is a face that, in some basic ways outlined above, is at odds with biologists' understanding of species, and it is a face that may in the longer run hamper the goals of putting science first, and of biodiversity education, and for that matter of a growing public presence for the All Species Foundation.

In closing, we return to the emphasis at the beginning of the letter. We are strong supporters of the All Species effort, and view it as perhaps our best hope for large-scale science-based discovery and conservation efforts. We are making these suggestions in order to prevent or mitigate future problems that will arise under the narrow approach to species identification and counting that is described in the All Species literature.

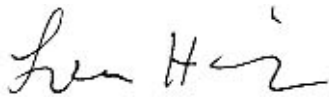
Sincerely



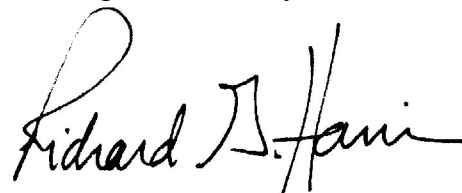
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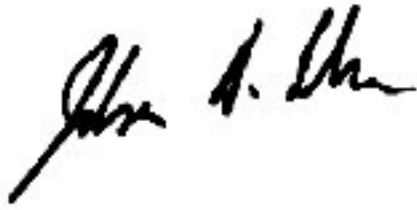
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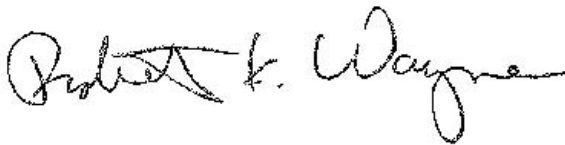
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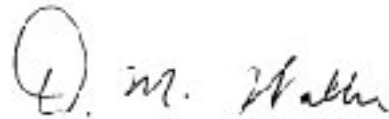
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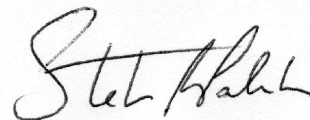
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