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Short Communication

Is conservation research money being spent wisely? Changing trends in conservation research priorities

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ABSTRACT

Conservation biology is often defined as a "mission driven crisis discipline", and as such research priorities should ideally parallel the relative importance of different conservation threats. Conservation research has increased exponentially over the last 22 years, rising from <150 articles in 1990 to >4000 articles in 2012. However, this growth has not and may not necessarily reflect changes in research needs. Consequently, it remains uncertain if growth and prioritization have been consistent between research themes, or subdisciplines. In other words, it is unknown if conservation priorities change in relation to research needs, or if instead to shifts in funding, which may or may not correspond to true research needs. Future conservation research priorities should ideally be based on conservation needs alone and must account for threats at both the immediate and long-term scales.

As conservation biologists we have the responsibility to study both conservation related topics and to ensure those topics can be used in either an applied, theoretical or foundational perspective.

Recent interest in temporal trends in ecological research has opened the door to addressing how well we are managing the allocation of public research funds. Temporal patterns in research priorities often change through a combination of political, social, economic and scientific drivers. Having multiple, and sometimes contrary, drivers may shift research focus away from "true" research needs in applied sciences towards those determined more by the availability of funding and/or popular trends. In certain research fields, such as conservation biology, the need for accurate coupling of research needs and priorities is paramount.

Conservation biology is often defined as a "mission driven crisis discipline", and as such research priorities should ideally parallel the relative importance of different conservation threats. Conservation research priorities (here measured by the number of conservation-related articles published annually in peer-reviewed scientific journals) have increased exponentially over the last 22 years, rising from <150 articles in 1990 to >4000 articles in 2012. However, as demonstrated by previous studies, this growth has not been consistent between taxonomic groups or geographic areas (Griffiths & Dos Santos 2012; Lawler et al. 2006; Wilson et al. 2005) and may not necessarily reflect changes in research needs. Consequently, it remains uncertain if growth and prioritization have been consistent between research themes, or subdisciplines. In other words, it is unknown if conservation priorities change in relation to research needs, or if instead to shifts in funding, which may or may not correspond to true research needs.

To address this question, we conducted a survey of the occurrences of phrases related to different research themes in the titles, abstracts, and keywords in >40,000 conservation-related articles published over the past 22 years (1990–2012), as well as the amount of money awarded by the US NSF for research on each of these themes (note: search terms were non-exclusive and thus articles and awards could be tallied under multiple research topics). It must be highlighted that these analyses are restricted to US funding patterns as comparable metadata from other countries could not be retrieved. As such, there is a possibility that the connections we draw between funding patterns and research priorities are not representative of the global conservation community. However North America, and particularly the US, has been responsible for a large proportion of global conservation research, while the US NSF is widely regarded as one of the largest funding agencies of conservation research in the world (Felton et al. 2009; Stocks et al. 2008). We therefore feel that funding trends presented here are representative of overall global patterns.

These analyses reveal several interesting and important trends. For example, the focus of conservation research on 'habitat fragmentation', as indicated by this phrases' appearance in publications, increased in relative frequency until 2000 at which point it

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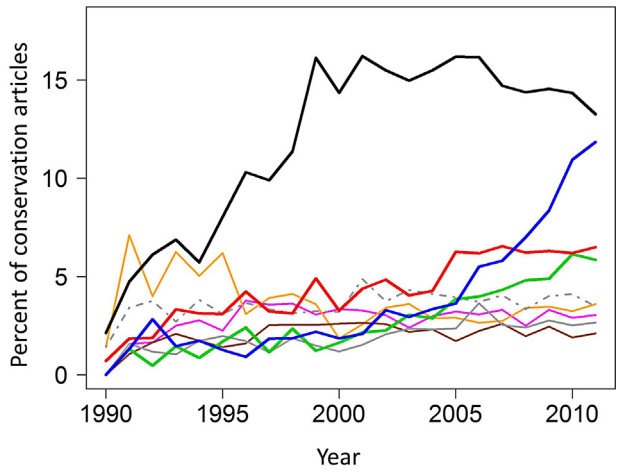

Fig. 1. The percent of conservation articles published per year for selected research topics. Black, habitat fragmentation; Blue, climate change; red, deforestation/habitat loss; green, invasive species; dashed grey, disease; pink, hunting; grey, fire; brown, logging. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.)

plateaued and then decreased after 2005 (Fig. 1). Likewise, research on 'habitat loss and deforestation' also increased in relative frequency up until 2005 at which point it levelled off. In contrast, the number of articles including 'invasive species' and 'climate change' have increased nearly exponentially in frequency through time.

These changes are not in accord with conservation threats or research needs (e.g., while the relative frequency of habitat loss and fragmentation related articles have decreased, the rates of habitat loss and fragmentation continue to increase worldwide and are still considered to be the primary threats to biodiversity (Hansen et al. 2010, 2013)).

Changes in funding (as measured by the number of new awards and total amount awarded by the US NSF's Directorate of Biological Sciences each year) show similar trends to the observed shifts in research prioritization (Figs. 2 and 3). While habitat fragmentation is the "most awarded" research topic, the number of new awards related to this topic has begun to decrease. Climate change, on the other hand, has experienced a meteoric rise in the number

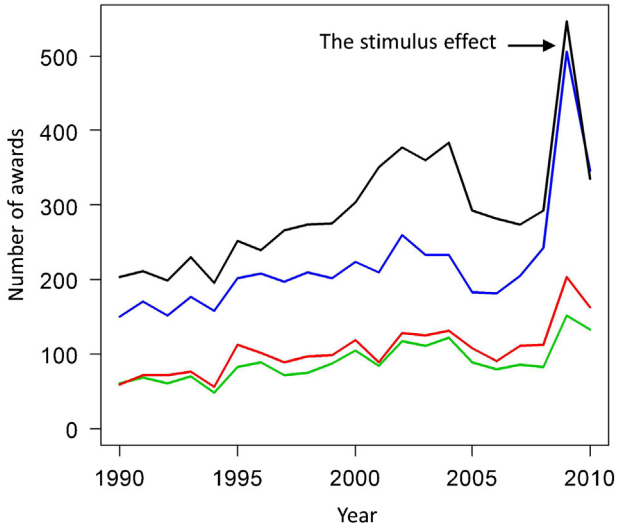

Fig. 2. The total number of new awards granted by the US NSF's DEB for different conservation related research topics from 1990 to 2011. Black, habitat fragmentation; Blue, climate change; red, deforestation/habitat loss; green, invasive species. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.)

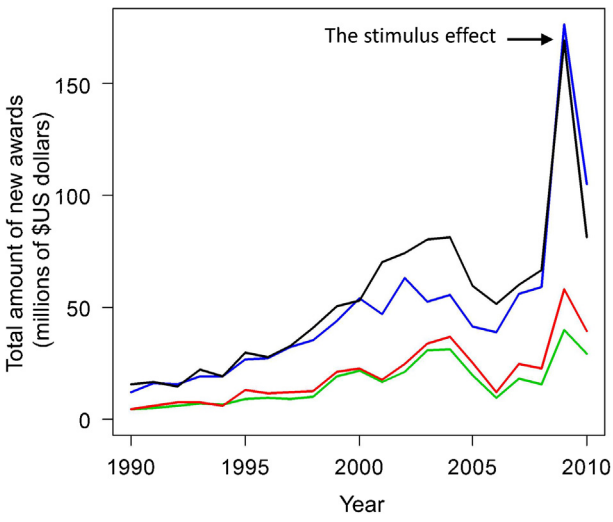

Fig. 3. The total amount of funds granted through new awards by the NSF's DEB (millions of $USD) for different conservation related research topics from 1990 to 2011. black, habitat fragmentation; blue, climate change; red, deforestation/habitat loss; green, invasive species. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of the article.)

of awards granted each year, and is likely to eclipse habitat fragmentation as the "most awarded" research topic in the near future. Furthermore the average size of awards for climate change research is greater, such that more total money is now awarded for studies of climate change than are awarded for any other subject in conservation biology. The large size of awards for climate change science is perhaps not surprising given the large temporal and spatial scale at which this research is generally conducted, as well as associated high technology demands. In 2009, all research topics experienced a sharp, but temporary, increase in number of total awards due to the American Recovery and Reinvestment Act (i.e., the stimulus). The effects of the stimulus on research prioritization and productivity are yet to be seen.

To avoid misinterpretation of search terms to non-conservation articles (e.g. energy conservation, conservation tillage) we repeated our search within articles published only in the journal *Conservation Biology* which is ostensibly the field's flagship outlet. Within *Conservation Biology*, search term popularity showed greater year to year fluctuations; although trends followed the same general patterns as previously described therefore we are confident in our analysis and subsequent interpretations using these search terms across all disciplines.

These results, along with the previous studies showing biases in taxonomic and geographic focus of conservation studies, suggest that shifts in research priorities are not driven solely by research needs but instead appear to be strongly associated with changes in funding priorities and monies awarded. Funding itself is likely to be determined by not only the underlying threats to biodiversity, but also by a combination of political agendas and popular trends. As a consequence, some biodiversity threats, such as habitat loss and fragmentation, may not be receiving the attention they deserve while other threats may be overprioritized. Future conservation research priorities should ideally be based on conservation needs alone and must account for threats at both the immediate and long-term scales.

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