

# Trends in biodiversity research over two decades: paradigmatic finders keepers?

Robert L. France

Integrated Environmental Management Program, Department of Engineering, NSAC, PO Box 550, Truro, Nova Scotia, Canada B2N 5E3; Faculty of Graduate Studies, Dalhousie University, Halifax, Nova Scotia, Canada; Center for Technology and the Environment, Harvard University, Cambridge, Massachusetts, USA; e-mail: rfrance@nsac.ca

**Abstract:** Biodiversity research has been criticized for displaying the “founder effect” and not deviating in terms of study topic from the course set by its founding terrestrial ecologists more than three decades ago. I tested this hypothesis by examining over four thousand papers published between 1987 and 2008 in three international journals, *Conservation Biology*, *Biological Conservation*, and *Biodiversity and Conservation*. Analysis of temporal trends in types of organisms studied, types of ecosystems studied, types of methodologies used, and types of stresses investigated, revealed that there has been little movement away from the origins of the profession as being primarily concerned with the effects of forest habitat loss on charismatic terrestrial megafauna.

**Key words:** biodiversity/conservation biology research, literature review, temporal trends

## 1. Introduction

As fledgling scientific disciplines such as conservation biology experience their growing pains, self-examination (e.g. Soule 1985; Murphy 1989; Deshmukh 1989) and comparisons with related disciplines (e.g. Teer 1988; Thomas & Salwaser 1989; Bolen 1989; Edwards 1989; Yahner 1990) are not only natural, they become de rigueur during the process of maturation. Along these lines, conservation biology has been thought, for example, to be distinct from wildlife biology (Jensen & Krausman 1993; Bunnell & Dupris 1995) but not from applied ecology (Noss 1999). However, differences can often exist between perceptions and reality in issues of biodiversity research, as a careful examination of this latter question has shown (France 2001). To continue, appraisals of the rapidly developing field without corresponding quantification, as for example by Caughley (1994) in relation to a perceived growing prevalence of laboratory-based studies in conservation biology, can lead to anxiety and acrimony (Hedrick *et al.* 1996; Clinchy & Krebs 1997) until a thorough analysis calms the waters (France 1998). And despite the concerns raised by some about a tropical

bias existing in biodiversity research (Redford *et al.* 1990), the research effort has been found to be proportionally balanced in terms of its geographic distribution (France & Rigg 1998a). Likewise, fears that Canadian researchers might be under-performing and not addressing questions relevant to conservation biology (Bunnell & Dupuis 1994) were found to be unfounded following a careful quantitative analysis of the literature that revealed differences among all nations' productivity to be closely related to their GNPs (France *et al.* 1998). In short, if defensible conclusions are to be made about the typology of any particular scientific field, it is essential that they be supported by quantitative analyses of their literatures (e.g. Cooley & Golley 1984; Resh & Yamamoto 1994; Statzner *et al.* 1995; Peters *et al.* 1996; Peters 1997).

Case in point: more than two decades ago, a handful of researchers called attention to what they then perceived to be existing imbalances in biodiversity research, decrying the lack of attention paid at that time to marine organisms (Kaufman 1988), terrestrial invertebrates (Wilson 1987), terrestrial megafauna (Terbough 1988), and taxonomy (Disney 1989; Ehrenfeld 1989). Subsequently, Irish and Norse (1996) reviewed the accumula-

ted papers from a single international journal, *Conservation Biology*, and concluded that “our science exhibits the founder effect: conservation biology has not deviated from the course they [the terrestrial biologists Soule and Wilcox in their seminal 1980 book] set”. A short time after this, France and Rigg (1998b) expanded the literature survey to include additional four international journals putatively regarded as being “general” in scope, and confirmed from an analysis of more than two thousand articles published in the 9-year period from 1987 to 1995, that biodiversity research at that time was indeed quite narrowly focused, being predominantly concerned with the effects of forest habitat loss on charismatic terrestrial megafauna. The purpose of the present investigation is to examine whether there is any evidence that biodiversity research has become more diversified in the years since by searching for the presence of publication trends.

## 2. Methods

Assessment of biodiversity research was based on the detailed analysis of papers published in three international, peer-reviewed journals: *Conservation Biology*, *Biological Conservation*, and *Biodiversity and Conservation*, over the 22-yr time period from 1987 to 2008, the former date being selected as it was when *Conservation Biology* began publication. Previous investigations of field-laboratory (France 1998) and tropical study site (France & Rigg 1998a) perceived biases, discipline distinctiveness (France 2001), national research productivity (France *et al.* 1998), and the patterns and imbalances in the literature (France & Rigg 1998b) were made on the subset of data from 1987 to 1995 which also included the journals *Ecological Applications* and *Journal of Applied Ecology*.

More than four thousand published papers were carefully examined in their entirety, searching for temporal patterns in: (i) the types of organisms studied, (ii) the types of ecosystems studied, (iii) the types of methodologies used in the various studies, and (iv) the types of stresses investigated. Study organisms were categorized as “birds”, “herps” (reptiles and amphibians), “mammals”, “charismatic terrestrial megafauna” (birds, mammals, reptiles and amphibians grouped together), “fish” (both marine and freshwater), “plants” (including fungi and aquatic macrophytes), “aquatic invertebrates”, “insects”, “invertebrates” (aquatic and terrestrial organisms combined) and “all taxa” (discussion papers dealing with fauna or flora in general). Study systems were categorized as “forest”, “grassland and agriculture”, “marine”, “freshwater”, “wetland” (including estuaries and freshwater systems), “aquatic” (marine, freshwater and wetland studies combined), “reserve and island” (spatially bounded systems), “urban” (regions of popula-

tion density) and “other” (deserts, rocks, caves, mountains, tundra). The various methods of investigation employed were categorized as “field observational”, “field experimental”, “discussion paper” (no primary research but citation of previous studies), “theoretical modelling”, “lab experimental”, “data compilation” (manipulation and secondary-analysis of data from a variety of different studies) and “sociological survey” (questionnaires, interviews etc. usually regarding perception of species, reserves etc.). Stress types investigated were categorized as “habitat loss” (deforestation, agricultural expansion etc.), “chemistry” (geochemical cycling, toxicants and all types of pollution), “human exploitation” (hunting and harvesting of both terrestrial and aquatic systems), “global change” (climate warming, droughts, floods etc.), “interspecific relations” (species regulations/dynamics, competition etc.), and “population viability” (population dynamics due to stress, issues of genetic diversity etc.).

Time trends in the relative percentage of papers from 1987 to 2008 were calculated by dividing the number of papers in the category in question by the total number of papers published in all journals each year. In all cases, papers which involved more than one type of category received fractional values of 1/2 or 1/3 (never less), and would be rounded to whole integers when tallying totals. The number of journal papers per year per category ranged from 32 to 146 with a mean of 78. Temporal patterns were detected through trend analysis by using Kendall’s nonparametric slope estimator (Sen 1968).

As discussed in more detail in France *et al.* (1998), it is important to recognize the limitations of this survey. Implicit is the assumption that the measure of the profession can be assessed through an analysis of papers in these selective international journals. I believe these publication efforts (primarily arising from academics – Jensen & Krausman 1993) make a substantial contribution to the way the profession evolves, and influence how non-academic managers and technicians, busy working in the “front-line trenches”, conduct their important jobs. Secondly, the actual selection of particular journals can be fraught with biases. For example, I have concentrated on three international, putatively non-specialized, English-language journals, and have ignored more regional or different language publications. I also ignore the possibility that parochially-biased reviewers with an incomplete knowledge of the global literature (Wardle 1995) could generate regional differences in acceptance rates (Miller & Levin 1994), in turn dissuading biodiversity researchers in developing nations from submitting their work to the journals reviewed here (but see results in France & Rigg 1998a; France *et al.* 1998 as a defense for adopting the approach taken herein).

### 3. Results and discussion

No significant temporal trends were discernible in the proportional representation of different organisms studied. Zoologically, biodiversity research within the pages of the three reviewed journals continues to be dominated by studies on charismatic terrestrial megafauna (about 45%) at the expense of studies on insects and invertebrates (about 15%). No significant temporal trends were evident among the different systems of study. Biodiversity research in the three journals continues to be dominated by issues related to forests (about 27%) over those related to aquatic systems (about 9%). Alpine, desert, polar and “other” systems continue to be relatively ignored by conservation biologists publishing in these pages (all combined about 5%). No significant temporal trends existed in the proportional representation of the different study methodologies across all journals (field observational studies dominated at about 45%). The absence of a strong association between the proportional representation of discussion and of data compilation papers suggests that the former are mainly discursive in nature, rather than taking advantage of the accumulated empirical data base. The only significant trends observed were for the type of stresses being studied. Investigations of global change and population viability across the journals have significantly increased from 1987 to 2008 (going from about 5% to 15%), coincident with a consequent significant decrease in studies on habitat loss and interspecific relations (going from about 35% to 25%).

The temporal analyses undertaken here suggest that there has really been little systemic movement away from the origins of biodiversity research as being concerned with the effects of forest loss on charismatic terrestrial megafauna. Kaufman’s (1988) “sleeping dragon” is still in deep REM, aquatic research having showed little sign of arousal in the two decades since being flagged as an issue of importance. Likewise, Wilson’s (1987) invertebrates too remain somnolent in biodiversity research. Studies on the potential threats to biodiversity from chemical pollution in these journals are also in reverie. In short, to borrow from Arthur Koestler, our profession appears to be characterized by a high degree of “sleepwalking” when it comes to many of the issues that one might expect (hope) conservation biologists to be very concerned about.

Certainly, if one accepts the tenet that diversity, be it biological, cultural, linguistic etc., is somehow a “good” thing that should be encouraged, the lack of widespread movement away from the “founder effect” over the last two decades suggests that a laissez faire “business-as-usual” approach for biodiversity research is certainly not working and must be regarded as being worrisome. We therefore need to begin to explore ways in which to increase the diversity of the profession, at least as that represented in the pages in three of its most established journals. In consequence, Murphy’s (1989) charge that the “extreme self-congratulation” present in conservation biology should be toned down somewhat, is apt now more than ever.

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