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The role of a discipline-specific journal in scientific discovery

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Abstract. The *Journal of the North American Benthological Society* (*J-NABS*) is celebrating its 25th anniversary with a special issue composed of review papers that address the progress of 18 subdisciplines within benthology and the role of the Journal in the development of each subdiscipline. The objectives of our paper were to define the underlying reasons for publishing the Journal by discussing the role of scientific journals, provide a brief history of the Journal, discuss the challenges and opportunities presented by the rapid evolution of scholarly publication, and provide a synopsis of the papers in this issue. *J-NABS* is a highly respected journal within the areas of ecology and marine and freshwater biology. The Journal is most similar to *Freshwater Biology* and *Fundamental and Applied Limnology* based on citation patterns. Changes in scientific publishing have created significant opportunities and challenges for the Journal. Digital information technologies and the World Wide Web have changed the way people seek, read, and use information; created opportunities to reach a global audience and to facilitate free and open exchange of information; and created a need among society-published journals for new business models as traditional revenue sources (individual and library subscriptions) continue to decline. The scope of *J-NABS* is habitat specific and most papers in the Journal address some aspect of stream ecology. Papers published in this anniversary issue of *J-NABS* fall into subdisciplines in 5 broad categories: 1) the physical environment (5 articles); 2) the interface of chemistry and biology (2 articles); 3) the biota (7 articles); 4) the human factor (4 articles); and 5) a synthesis. Many authors in this issue call for benthologists to find ways to apply their work to manage, conserve, and restore aquatic habitats and organisms.

Key words: benthology, role of scientific journals, scientific societies, scholarly scientific communication, electronic publishing.

The *Journal of the North American Benthological Society* (*J-NABS*, here and throughout this issue) is a publication of the North American Benthological Society (NABS). The Journal's mission is communication and discussion of scientific discoveries that substantially increase scientific knowledge related to understanding, conservation, and stewardship of freshwater ecosystems. Papers in *J-NABS* focus on basic (theoretical and empirical) understanding of freshwater ecosystems (streams, rivers, lakes, wetlands, coastal, and riparian areas); the interface between the ecological functioning of these systems and physical, chemical, and environmental sciences; and application of this knowledge to assessment, management, conservation, and restoration of their biological, hydrological, geological, physicochemical, or ecological structure and function. *J-NABS* is intended for an international audience consisting of scientists conducting basic and applied research, resource managers, policy-makers, regulators, and nongovernment organizations interested in conservation and stewardship.

Papers published in the Journal reflect the interests and idiosyncrasies of members of the Society as much as they do the broader discipline of benthology. For example, the scope of benthology includes physical, chemical, and biological process in marine, estuarine,

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lentic, lotic, and wetland habitats, but papers published in *J-NABS* tend to deal with freshwater systems that often are in or are associated with lotic habitats. This focus delimits a specific set of research questions, focal organisms, communities, and ecosystem processes that are characteristic of *J-NABS* papers. This focus has been described as habitat-specific (**Creutzburg and Hawkins 2008**[1]), but we argue that it is less narrow than it appears (see discussion below and papers in this issue). Moreover, the focus has widened and will continue to do so as more interdisciplinary teams work at the interfaces of benthic ecology and other aquatic sciences; aquatic and terrestrial ecosystems; social/economic sciences and aquatic sciences; and basic, applied, and management perspectives to solve local, regional, and global environmental problems.

This issue of *J-NABS* is a celebration of the first 25 y of its publication. It reviews the progress of science in 18 subdisciplines of benthology that broadly characterize articles published in *J-NABS*. Our introductory paper begins with a brief discussion of the role of scientific journals as a way to define the underlying reasons for publishing the Journal. Then we provide a brief history of the Journal and discuss the challenges and opportunities presented by the rapid evolution of scholarly communication and concurrent changes in the roles of scientific societies and their journals. Last, we provide a synopsis of the papers in this issue.

The role of scientific journals

Scientific journals are repositories of the collective research and knowledge of its authors and the scientific community; a proving ground for new ideas, novel approaches, and nascent disciplines; and a venue for syntheses and meta-analyses that mark progress and suggest new directions. They are an interface and communication tool that holds together a community of authors, readers, and users of a specific type of information (Schechter et al. 1989, Hurd 2000, Tobin 2003). They play a critical role in: 1) conveying scientific information to a globally diverse audience, 2) validating research results through the peer-review system, 3) nurturing and educating new scientists, and 4) establishing and maintaining standards of ethical research and publication practices.

Until the 1980s, printed scientific journals were the primary means of disseminating new scientific information (Friedlander and Bessette 2003). Readers either subscribed to a journal or used a library, which held aggregations of articles in a common repository. However, the advent of digital technology and widespread access to the internet has altered significantly the way in which scientific information is published, sought, and used (King and Tenopir 1998, Friedlander and Bessette 2003, Commission of the European Communities 2007). In the present era of apparently effortless access to information via electronic sources, one might reasonably ask why scientific information should be published in a journal at all. Why not simply post the information on a web site to be found by individuals using search engines? The answer lies in the factors that contribute to the ultimate influence of a scientific paper. Peer review, editing, and formatting associated with publishing in a scientific journal (whether printed or in electronic format) add value and credibility to the information contained in the article (Friedlander and Bessette 2003). Peer-reviewed articles are validated by the scientific community, and this process helps assure readers that the content of the article is likely to be reliable (CSE 2009, but see Neff and Olden 2006). Moreover, publishing a paper as part of an aggregation of other papers with similar themes increases the visibility of the paper, and thus, the likelihood that the paper will be found and read by the appropriate audience, whether the audience is using printed or electronic media. For example, one observation that arises from the papers in this issue is that articles published in special issues of *J-NABS* often have had greater visibility and attention than those published as regular contributions (**Boulton et al. 2010**, **Johnson and Host 2010**, **Lamberti et al. 2010**, **Stanley et al. 2010**, **Steinman et al. 2010**, **Winemiller et al. 2010**).

Journals published by scientific societies are the voice and the face of the society (Thornton 1983, Mackay 2005, but see Levitan 1979). Thus, they have the additional responsibility of representing the values and interests of the members of the society to the world (King et al. 1978, Tobin 2003, but see Levitan 1979). Changes in scope and focus of a society's journal are essential as a discipline develops because the journal provides the means to bring together papers on varied themes in a common source. This critical service is important to authors and readers, and it feeds back to the society and the science by facilitating communication of new ideas, increasing the visibility of the discipline and the society, and attracting and nurturing new professionals. For example, authors of many articles in this issue of *J-NABS* call for an increase in interdisciplinary work and inventions of new hybrid disciplines, and they call for the Journal to support these new directions by expanding its scope (**Hawkins et al. 2010**, **Lamberti et al. 2010**, **Poole 2010, Steinman et al.**

[1] Boldface indicates paper was published in *J-NABS*

2010). Moreover, the editorial boards and editors of journals define the role of the journal and the future of the fields they represent by the editorial decisions they make: i.e., scope of the journal, how best to represent the balance between the interests of readers and of authors, and criteria to apply when determining if articles are suitable for publication (King et al. 1978, Thornton 1983, Meffe 2006, Hildrew and Townsend 2007).

A very brief history of J-NABS

The history of *J-NABS* was described in detail in 2005 by the Journal's first Editor, Rosemary J. Mackay, in her book *Beneath the Surface: A history of the North American Benthological Society 1953 to 2003* (Mackay 2005). In 1981, Jerry L. Kaster founded a new journal, *Freshwater Invertebrate Biology* (*FIB*). Two years later, at a time when NABS was considering ways to initiate a journal devoted to the research interests of its members, Jerry Kaster offered his journal to the Society. NABS President, Vincent H. Resh, and the chairperson of the NABS Executive Committee, David M. Rosenberg, championed the acquisition of the journal and invited Rosemary Mackay to become its Editor. Irwin Polls was asked to develop a budget for the nascent Journal, and the proposal to acquire *FIB* was passed at the 1984 NABS business meeting in Raleigh, North Carolina. Incoming President Richard Merritt and his chairperson of the Executive Committee, Jack Webster, oversaw the vote by the Society that formally approved the acquisition. In 1985, at the NABS business meeting in Corvallis, Oregon, the Society agreed after a contentious debate to name its new journal the *Journal of the North American Benthological Society*.

The Journal has grown immensely from its small beginnings (Fig. 1A, B). Volume 5 (the first volume with the name *Journal of the North American Benthological Society*) consisted of 29 articles written by authors from 2 countries (USA and Canada) and was 325 pages. Volume 28 (2009) consisted of 84 articles written by authors from 13 countries and was 1102 pages. The total annual revenues and expenses for *J-NABS* also have increased noticeably since the first volume of the Journal was published in 1986. The total income and expenses for volume 5 (1986) were US$33,138 and $19,396, respectively. In 2008 (volume 27), total revenues and expenses had increased to $160,580 and $132,653, respectively. The annual fee for a print subscription to *J-NABS* in 1986 was $15 for NABS members and $25 for libraries and institutions. In 2009, the print subscription fee had increased to $65 for members, and an online subscription was $10 for individual members and $5 for students. Institutional subscription fees in 2009 were $125 for online and $150 for print.

J-NABS has had 3 editors in its 25-y history, and E. Fred Benfield served as editor for 1 y while Rosemary Mackay was on sabbatical leave. Each editor has dealt with a different set of challenges. Rosemary J. Mackay (1986–1997) was the founding Editor. In her account of the history of the Journal, she described the landmark events during her tenure (Mackay 2005). These included publication of the inaugural issue (March 1986) in May 1986, publication of the first on-time issue in December 1988, inclusion of *J-NABS* in the Institute for Scientific Information (ISI) Current Contents, and achieving an ISI impact factor (IF) of 2.5, largely because the December 1988 issue consisted of a widely cited special series of papers devoted to stream ecology ("Community Structure and Function in Temperate and Tropical Streams: Proceedings of a Symposium," volume 7, issue 4). As the Journal grew in size and in reputation, new sections were added to address the needs of its authors. In 1989, the Perspectives section was added to the Journal to encourage authors to think broadly and theoretically or to express opinions. Papers published in this section of the Journal often have had a disproportionately large effect on the development of the theoretical and conceptual framework within which stream ecologists have conducted their work (e.g., disturbance: **Cushing and Gaines 1989,** fluvial landscapes: **Stanford and Ward 1993**, disturbance and patch dynamics: **Lake 2000**). In 1994, the *BRIDGES* section was added to encourage publication of applied research in the Journal and to help bridge the gap between basic and applied sciences (**Aumen et al. 2010**). The decision to add this section greatly increased the proportion of articles with applied themes in the Journal.

Rosemary J. Mackay retired in 1997, and David M. Rosenberg (1997–2005) became the new Editor of the Journal. Early during his tenure, Andrew Mackay, Rosemary's husband and editorial assistant, donated money to establish the Rosemary Mackay Fund (RMF) that would pay an honorarium and page charges for authors of papers that were philosophical, speculative, and forward-looking. The first paper in this special series was Frost et al. (**2002**) and addressed ecological stoichiometry in the benthos. Themes of RMF papers since then have been an eclectic mixture (Table 1). A key challenge during the tenure of David M. Rosenberg was managing the growth and increasing breadth of the Journal (Fig. 1A). In 2001, he was joined by Jack W. Feminella as Co-editor, and in 2002, Pamela Silver became the second Co-editor. In 2000,

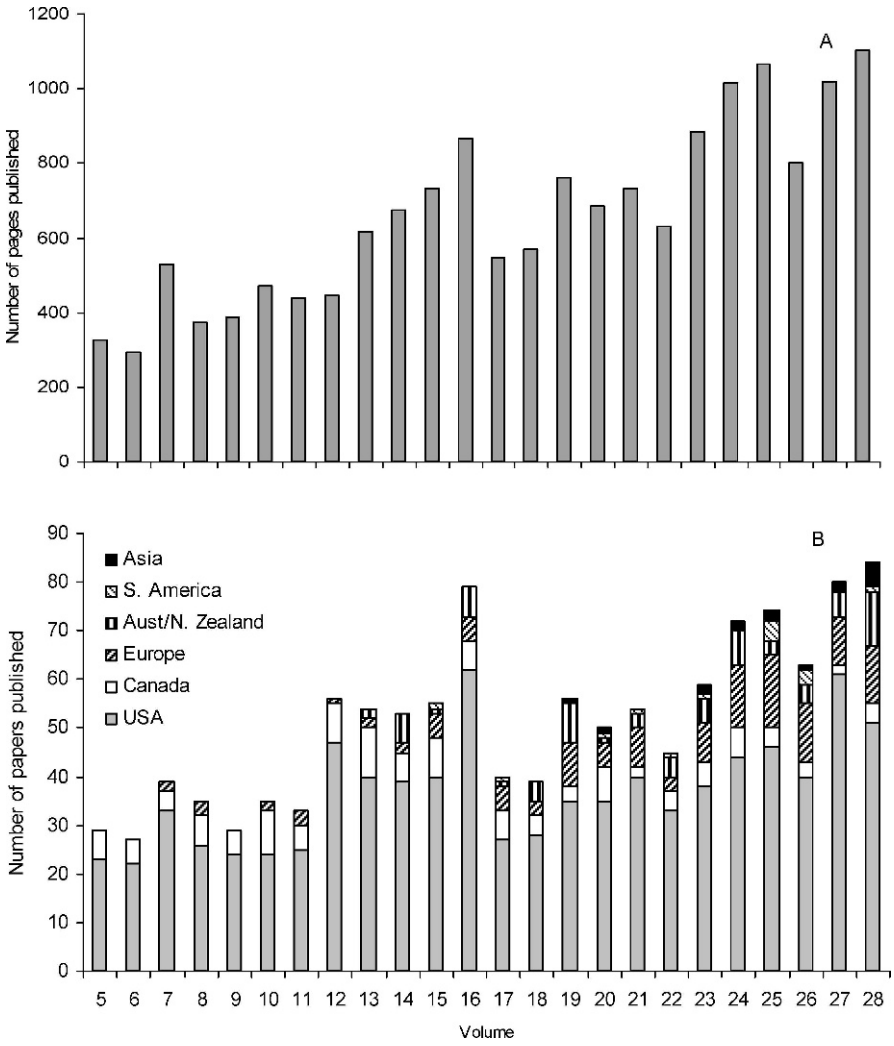

FIG. 1. Number of pages (A) and number of articles by geographic region (B) in volumes 5 to 28 of *J-NABS*.

the Journal became available online as well as in printed format. An important development occurred in 2003, when Irwin Polls negotiated revenue-sharing agreements between *J-NABS* and J-STOR (digital archiving) and between *J-NABS* and BioOne (bundled not-for-profit journal subscriptions and revenue-sharing).

Pamela Silver became Editor in 2005, and during the first 6 mo of her tenure, Jack W. Feminella and Alan D. Steinman were Co-editors. However, the Journal encountered financial challenges caused by declining individual and institutional print subscriptions and increasing operating expenses, and in 2006, Irwin Polls streamlined the business operations of the Journal by taking several key steps that balanced the Journal's budget. Pamela Silver became the sole Editor, and in 2006, all editorial office procedures, including manuscript submission and tracking, administration of the peer-review system, editing, and correcting proofs became strictly electronic. The use of electronic procedures improved manuscript turnaround time, but increasing submissions created a backlog of ready-to-be published articles awaiting room in the Journal. In 2007, the Journal began publishing print-ready articles online in the Issue in Progress to address this problem. The Journal has progressed from being available in print-only format (1986–1999) to print and online publication (in 2000) and is now poised to move to an online-only platform with printed copies available only on demand (in 2011).

For the entire period of the Journal's existence (1986–2009), Irwin Polls has served as the *J-NABS* Business Manager. His role was and is to sustain the Journal, to secure the financial resources necessary to support the operation, to provide watchful management of the Journal's operating expenses, and to position the Journal for success in an era of rapidly

TABLE 1. Rosemary Mackay Fund papers published in *J-NABS*.

Year	Authors	Title
2002	P. C. Frost, R. S. Stelzer, G. A. Lamberti, and J. J. Elser	Ecological stoichiometry of trophic interactions in the benthos: understanding the role of C:N:P ratios in lentic and lotic habitats
2005	D. G. Angeler and G. Garcia	Using emergence from soil propagule banks as indicators of ecological integrity in wetlands: advantages and limitations
2006	D. L. Strayer	Challenges for freshwater invertebrate conservation
2006	N. L. Poff, J. D. Olden, N. K. M. Vieira, D. S. Finn, M. P. Simmons, and B. C. Kondratieff	Functional trait niches of North American lotic insects: traits-based ecological applications in light of phylogenetic relationships
2007	R. S. Wotton	Do benthic biologists pay enough attention to aggregates formed in the water column of streams and rivers?
2009	R. T. Dillon and J. D. Robinson	The snails the dinosaurs saw: are the pleurocerid populations of the Older Appalachians a relict of the Paleozoic Era?
2009	G. E. Small, A. M. Helton, and C. Kazanci	Can consumer stoichiometric regulation control nutrient spiraling in streams?

evolving business models for not-for-profit scholarly publications.

Challenges and opportunities

The face of scholarly communication and scientific publishing is changing profoundly and rapidly (Friedlander and Bessette 2003) because of the growth of digital technologies. More than 95% of science publications are available online (Cox and Cox 2008), but most scientific journals are in a hybrid state and are published in print and online (Johnson and Luther 2008).

Electronic publication has significantly altered how scientists search, read, and use the literature. One might say that widespread use of electronic publishing methods has created shifts in spatial and temporal scales of information use: the spatial scale has expanded, whereas the temporal scale has contracted. Information is globally available, but the vast increase in available information has had the effect of reducing the percentage of that information that scientists have time to read (and thus, the percentage of time that is spent on each article read; Liu 2003). The steep increase in available scientific information and in the number of specialized journals might be forcing contemporary researchers to focus on recently published material (Graham and Dayton 2002), although electronic archives, such as J-STOR, provide the opportunity to search early issues of journals with far greater ease than in the past. Searching might be easier, but keeping up is more difficult, and reading habits have shifted from reading a complete article to scanning (Liu 2003). The widespread use of key words had led to searches for smaller and smaller units of information, but the counterintuitive result is that the scale at which the information is gathered and reassembled has become larger—metadata, networks, interdisciplinary projects. In some disciplines, such as taxonomy and systematics, the trend is to publish, maintain checklists and taxonomic records, and conduct the scientific dialog online rather than in print because of the responsiveness, flexibility in handling a wide variety of types of data, and ease of searching inherent to online media (**Holzenthal et al. 2010**). Thus, the digital age presents the challenge of learning new ways to handle a rapidly increasing pool of information and the opportunity to exploit that pool in innovative and useful ways.

Changes in scientific publication, the open access movement, and easy access to material on the World Wide Web have created challenges for publishers and for scientific societies. Many not-for-profit, society-published journals, such as *J-NABS*, are under increasing economic pressure because traditional sources of revenue (individual and institutional print subscriptions) have decreased substantially, whereas publication costs have not (Getz 1997). Approximately 75% (70% for *J-NABS* in 2008) of costs associated with publishing a journal are incurred before the first copy of an issue is printed or the first article is posted online (Getz 1997).

The decline in revenues from individual print subscriptions appears to be associated with the advent of electronic publishing. Widespread free access to electronic versions of journal articles renders individual print subscriptions an unnecessary expense for readers. For example, print subscriptions to *J-NABS* have decreased 65% since 2000 when the Journal became available online. *J-NABS* subscriptions and page charges accounted for 91% of the total income for volume 5 (1986) but decreased to 74% for volume 27 (2008).

Libraries are no longer able to subsidize journal costs by paying high institutional subscription fees (Bergstrom and Bergstrom 2006). This economic pressure is indicated by the development of new methods of assessing article influence and cost effectiveness, such as that used by C. T. Bergstrom

and colleagues (eigenfactor.org). These metrics are used as a tool by subscribers, especially libraries, to determine which scientific journals provide the best economic value in terms of cost/citation. Among the journals listed in the ISI Web of Knowledge as ''freshwater and marine sciences,'' *J-NABS* is ranked 12th in terms of article influence and 1st in terms of cost effectiveness (C. T. Bergstrom, University of Washington, personal communication). This ranking reflects the low institutional subscription fee for the Journal, but that low fee is possible because of a commitment to volunteerism on the part of the Editorial Board of the Journal, willingness of authors of papers published in *J-NABS* to bear part of the cost of producing the Journal (i.e., page charges), participation by the Journal in revenue-sharing agreements (e.g., BioOne and J-STOR), and careful management of the Journal's finances by the *J-NABS* Business Manager. Sustaining this delicate balance in the face of the economic upheaval engendered by the current revolution in scientific publishing will be a continuing challenge, but this challenge is accompanied by the opportunity to reach an increasingly global audience and to find ways to facilitate free and open exchange of information (Commission of the European Communities 2007).

The place of J-NABS *within the network of scientific journals*

Scientific journals can be regarded as nodes within a network of information flow (Rosvall and Bergstrom 2007; http://www.eigenfactor.org). The unit of information transfer is the article, but the nodes and the network are scales that cannot be neglected. Communication along paths within the network of disciplinary and interdisciplinary journals stimulates creativity and cross-thinking. It matters who reads your articles, uses them to generate more information, and adds their information to the network. The broad scientific influence of *J-NABS* depends on having authors who read and publish widely in other journals with different content, just as it depends on having readers who use articles published in other journals to stimulate work that they subsequently publish in *J-NABS*. Moreover, competition for authors and readers among journals with similar content forces each journal to use best practices and improves efficiencies of information sharing (idea drawn from Diamond 1999).

We conducted a journal-specific citation analysis (Thomson Reuters®, Journal Citations Reports [JCR], 2008 JCR Science Edition) to help us understand the place of *J-NABS* within the network of journals characterized in the ISI Web of Knowledge℠ as ''ecology'' and ''marine and freshwater biology'' journals. Within the areas of marine and freshwater biology, *J-NABS* is a highly respected and widely cited journal (2008 ISI 2-y citation IF = 2.360, 5-y IF = 3.023; 2008 marine and freshwater biology IF ranking = 14th of 87 journals). *J-NABS* articles are less widely cited within the broader area of ecology (2008 ecology IF ranking = 24th of 144 journals).

In 2008, *J-NABS* authors cited 4789 works: 10.1% were articles in *J-NABS*, 6.1% were articles in *Freshwater Biology*, 3.5% were articles in *Ecology*, 3.1% were articles in *Hydrobiologia*, 2.6% were US Environmental Protection Agency or US Geological Survey documents, and 2.4% were articles in *Ecological Applications* (Table 2). In the same year, *J-NABS* articles were cited 3135 times: 15.6% were from *J-NABS*, 9.3% were from *Freshwater Biology*, 6.9% were from *Hydrobiologia*, 4.5% were from *Fundamental and Applied Limnology* (formerly *Archiv für Hydrobiologie*), 3.1% were from *River Research and Applications* authors, and 2.1% were from *Canadian Journal of Fisheries and Aquatic Sciences* (Table 2). Thus, *J-NABS* authors, as a whole, communicate effectively and reciprocally with authors who publish in freshwater journals (a reflection of their discipline-specific focus) and use US government publications extensively (a reflection of the strong applied science basis of many articles published in *J-NABS*), but their work is less heavily cited in and draws less from the larger ecological literature. However, this analysis does not reflect the importance or usefulness of individual articles (described in most of the articles in this issue on a subdiscipline-specific basis; see **Aumen et al. 2010** for further discussion). The flow of information among *J-NABS* and other individual aquatic journals is low relative to the flow within *J-NABS* (Table 2). Among scientific aquatic journals, *J-NABS* is most strongly related to *Freshwater Biology* and *Fundamental and Applied Limnology* based on citation patterns (2008 JCR Science Edition) and to *Freshwater Biology* based on content (Neff and Jackson 2009). Neff and Jackson (2009) also concluded that information flow among aquatic journals tends to be lower than information flow within aquatic journals, and that each journal tends to have its own clearly separated niche defined by differences in subject matter, questions posed, analytical methods, and geographic origin of authors (see **Dolédec and Statzner 2010** for a discussion of this topic as it relates to bioassessment papers).

An important strength of *J-NABS* is that it publishes, within the same issue, papers with themes that range from taxonomy/systematics through population, community, and ecosystems to physicochemistry, hydrology, geomorphology, and bioassessment (**Creutzburg and Hawkins 2008**). In any given issue, one can read papers with basic and applied perspec-

TABLE 2. Number of citations from *J-NABS* authors to articles in other journals or publications and of citations from authors of articles in other journals to articles published in *J-NABS*. Only the 20 most frequently cited or citing journals are shown. Data are for 2008 (Thomson Reuters®, Journal Citations Reports [JCR], 2008 JCR Science Edition). EPA = US Environmental Protection Agency, USGS = US Geological Survey.

Journals cited by authors of papers in *J-NABS*			Journals of authors citing papers in *J-NABS*		
Journal	Number of citations	%	Journal	Number of citations	%
All journals	4789	100.0	All journals	3135	100.0
Journal of the North American Benthological Society	488	10.1	Journal of the North American Benthological Society	488	15.6
Freshwater Biology	293	6.1	Freshwater Biology	292	9.3
Ecology	170	3.5	Hydrobiologia	215	6.9
Hydrobiologia	150	3.1	Fundamental and Applied Limnology	141	4.5
EPA and USGS documents	126	2.6	River Research and Applications	97	3.1
Ecological Applications	114	2.4	Canadian Journal of Fisheries and Aquatic Sciences	66	2.1
Canadian Journal of Fisheries and Aquatic Sciences	114	2.4	Aquatic Conservation – Marine and Freshwater Ecosystems	50	1.6
Limnology and Oceanography	93	1.9	Environmental Management	50	1.6
American Midland Naturalist	73	1.5	Marine and Freshwater Research	47	1.5
BioScience	67	1.4	Water Resources Research	41	1.3
Fundamental and Applied Limnology	66	1.4	Ecology	40	1.3
Oikos	60	1.2	Oecologia	40	1.3
Journal of Molluscan Studies	45	0.9	Journal of Freshwater Ecology	38	1.2
Oecologia	44	0.9	Hydrological Processes	38	1.2
Canadian Journal of Zoology	39	0.8	Science of the Total Environment	37	1.2
Annual Review of Ecology and Systematics	37	0.8	Limnology and Oceanography	37	1.2
Environmental Management	36	0.7	Aquatic Ecology	31	1.0
Science	35	0.7	Aquatic Sciences	29	0.9
Conservation Biology	34	0.7	Wetlands	29	0.9
Environmental Toxicology and Chemistry	33	0.7	Journal of Geophysical Research	29	0.9

tives. This broad mixture of papers focused on different facets of a single over-arching theme facilitates communication across disciplines within benthology. More important, this characteristic provides an opportunity to position the Journal to publish articles at the interfaces of benthic ecology and other disciplines (**Aumen et al. 2010**, **Boulton et al. 2010**, **Hawkins et al. 2010**, **Mulholland and Webster 2010**, **Poole 2010**); to focus on linkages within and among disparate ecosystems (**Boulton et al. 2010**, **Johnson and Host 2010**, **Lamberti et al. 2010**, **Poole 2010**, **Tank et al. 2010**); and to welcome papers in areas within the scope of *J-NABS* but rarely submitted to it.

The 25th Anniversary Issue

The articles

The invited contributions that comprise this anniversary issue are divided into 5 broad categories: 1) the physical environment (5 articles), 2) the interface of chemistry and biology (2 articles), 3) the biota (7 articles), 4) the human factor (4 articles), and 5) a synthesis. Authors were asked to provide a broad review of the literature, to place the papers published in *J-NABS* within an historical context (each author provided a timeline of key papers in their field), to analyze the contribution of papers published in *J-NABS* to the subdiscipline, and to describe challenges and opportunities for future development of the field. Here we describe highlights from each paper in the issue, but we leave the details and the key citations to the timelines and references in individual papers.

The physical environment.—The physical environment sets the stage and, in many respects, *is* the stage upon which stream biology and chemistry play. Poole (**2010**) discusses stream hydrology and geomorphology and argues convincingly on behalf of the emerging field of hydrogeomorphology, which integrates fluvial geomorphology, channel hydrology, and hyporheic hydrogeology over different temporal and spatial dimensions. The theme of integration across boundaries is echoed by Boulton et al. (**2010**) as

they elaborate on the hyporheic zone. They reinforce the notion that a full understanding of streams requires us to look beyond the stream channel. Johnson and Host (**2010**) take an even broader perspective in their article on the application of landscape ecology to the study of aquatic ecosystems. Their message is that the landscape context is critical when investigators attempt to predict instream phenomena and is reinforced by Stanley et al. (**2010**), who examine the role of disturbance in streams. They emphasize that disturbance must be viewed in terms of the physical landscape and that full understanding of disturbance dynamics requires an appreciation of nonlinear processes. Disturbance creates habitat patches, and Winemiller et al. (**2010**) focus on landscape ecology and metacommunity approaches for understanding patch dynamics and environmental heterogeneity. They describe new conceptual frameworks that integrate geomorphic processes and patch–landscape dynamics.

The interface of chemistry and biology.—From its inception, *J-NABS* has been an important outlet for articles addressing the interface of chemistry and biology (nutrient cycling, organic matter dynamics, and stream metabolism). Nutrient dynamics are reviewed by Mulholland and Webster (**2010**), who identify the major conceptual advances in this field since the 1970s. Their analysis reinforces the message that streams are more complex than pipes, and that instream processes alter nutrient concentrations that enter streams from the terrestrial landscape. Another principal input from terrestrial habitats to streams is organic matter (OM), and Tank et al. (**2010**) describe a transition from descriptive decomposition studies before 1986 to recent studies that are comparative, involve substrates other than leaves, take place outside the stream channel, and include large-scale experimental manipulations. A key conclusion from their review is that metabolism is an important measure of stream health, but the factors controlling stream metabolism appear to be stream-specific.

The biota.—Biology lies at the core of *J-NABS*. One consistent theme in the papers in this category is a sense of urgency that arises from the global decline in biodiversity, especially in freshwater systems. A 2nd theme emerges from the first: a critical need exists to train scientists in traditional fields, such as taxonomy and life-history research, and in new interdisciplinary fields, such as ecosystem linkages and molecular ecology. For example, Holzenthal et al. (**2010**) argue the importance of taxonomy and systematics as a discipline in its own right and with respect to its application to studies of functional traits, community ecology, life histories, trophic interactions, behavior, and conservation.

The key role of microbes is elaborated by Findlay (**2010**), who describes our imperfect understanding of their diversity and their functional roles in streams, the urgent need to clarify the relationships between specific taxa and ecosystem function, and the necessity to consider microbial activity explicitly in the design and assessment of stream restorations. Periphyton also is critically important to stream functioning. Larned (**2010**) shows that *J-NABS* papers dealing with the effect of patch dynamics, resource limitation, and disturbance on periphyton communities have been particularly influential in the field of periphyton ecology, but that the topics of resource colimitation, allelopathy, competitive interactions, and hydraulic effects on periphyton have been relatively unexplored in *J-NABS*. He, like many other authors in this anniversary issue, calls for more focus on the development of conceptual models and interdisciplinary approaches. In contrast, Resh and Rosenberg (**2010**) call for more detailed studies of life histories of invertebrates. They report a decline in the number of publications on this topic over time, despite a critical need for information on species traits to inform bioassessment and conservation efforts. They suggest ways to increase attention given to life-history studies and call for significant involvement of nonprofessional scientists in this endeavor.

The challenging topic of biotic interactions is taken up by Holomuzki et al. (**2010**) who detail both negative (e.g., competition, predation, parasitism, herbivory) and positive (e.g., mutualism, commensalism, indirect facilitation) species interactions in freshwater benthic environments. They identify new areas for research and urge researchers working on biotic interactions to consider developing collaborations with geneticists and parasitologists. Interaction at a much larger scale is the theme of the article by Lamberti et al. (**2010**), who assess ecosystem linkages within the context of aquatic ecosystems. They argue that studies of ecosystem linkages should be prominent in aquatic research because ecological processes in aquatic systems are driven by exchanges among and within ecosystems. Like so many other authors in this issue, they call for more interdisciplinary research, more integrated training of our students, and publication outlets dedicated to linkage research. The theme of interactions also is foremost in the review of secondary production by Benke and Huryn (**2010**), who emphasize the use of secondary production to address an array of ecological questions, including foodweb analysis, chemical flows, resource use, effects of anthropogenic stressors, metabolic theory, and the relationship between biodiversity and ecosystem function.

The human factor.—Anthropogenic effects are pervasive in aquatic ecosystems. One key area in which papers published in *J-NABS* have made significant contributions is bioassessment. This vast field is addressed in 2 papers in this issue. Dolédec and Statzner (**2010**) begin the discussion with a review of methods, including biotic indices, multivariate approaches, and multimetric approaches, for assessing structural ecological integrity. Next, they assess direct (e.g., ecosystem metabolism) and indirect (e.g., multiple trait-based) approaches to assessing functional ecological integrity. They also present an analysis of North American vs non-North American approaches to bioassessment that provides an interesting perspective on the field. Hawkins et al. (**2010**) continue the discussion of bioassessment in their review of the application of benchmarks to ecological assessments, particularly as they apply to stream ecosystems. They address how the definition and estimation of benchmark conditions influence inferences regarding the biological condition of sites, examine the predictive methods of classification and modeling used to establish benchmarks, and point out important linkages between selection of ecological benchmarks and watershed science.

The theme of urgency is resumed by Strayer and Dudgeon (**2010**) as they review conservation of freshwater biodiversity. They point out that this theme is poorly represented in *J-NABS*, despite the magnitude of the biodiversity crisis in freshwater systems and intense interest in the topic among NABS members. The authors issue a call to action and outline 4 critical challenges for the future: 1) climate change, 2) need for immediate action, 3) bridging the gap between freshwater ecology and conservation biology, and 4) active engagement of freshwater-related societies and journals, including *J-NABS*, in conservation initiatives.

A special section of *J-NABS* called *BRIDGES* was created in 1994 to help bridge the gap between basic and applied sciences. Aumen et al. (**2010**) examine the emergence of topics in applied science in *J-NABS*, discuss the role of *BRIDGES* and its effect on applied science papers in *J-NABS*, and discuss new directions for *BRIDGES*, including a new format for the future.

J-NABS Looks to the Future

The final chapter by Steinman et al. (**2010**) synthesizes the themes that emerged from the papers in this anniversary issue, but here we emphasize a key message because it is relevant to the role of scientific journals. In the face of global change and current environmental crises, we perceive immediate needs for: 1) effective communication with the public, policymakers, and resource managers (**Pringle et al. 1993**, Parrish et al. 1995, Gosz 1999, **Barbour et al. 2008**), 2) interdisciplinary research across boundaries of scientific disciplines (**Hawkins et al. 2010**, **Lamberti et al. 2010**, **Poole 2010**) and across boundaries of science, politics, and economics (Rykiel 2001), and 3) research on and dissemination of badly needed information to nations facing pressures from health crises, population growth, economic development, and resource degradation (e.g., Saxena et al. 2004). We argue that scientific journals have a social responsibility to facilitate scientific progress and the application of that knowledge to problems faced by society at large (see also Shrader-Frechette and McCoy 1992, Harman et al. 1998, Franz 2001, Saxena et al. 2004, **Barbour et al. 2008**). However, the core mission of *J-NABS* (dissemination of scientific information to an international audience of scientists) cannot be forgotten as we try to deal with the interface between science and society. Thus, a major challenge is to develop the ethical and scientific positions from which to consider manuscripts that address policy, advocacy, and communication of scientific data to practitioners and policy makers (Gosz 1999, Rykiel 2001, **Pringle et al. 1993**, **Barbour et al. 2008**). These opportunities come at a time of global environmental crisis, and benthologists are positioned at a key intersection among scientific disciplines, science and policy, and policy and practice.

J-NABS will change as NABS and the scientists who publish in or read *J-NABS* rise to meet the many challenges ahead. Authors and readers will no doubt want rapid publication and new services/opportunities, and we expect readers and users to decrease their use of scientific information not available online. The Journal's content will reflect the coevolution among readers', editors', authors', and the Society's goals (King et al. 1978; see **Aumen et al. 2010**) as well as development of new technologies. The basic, applied, and policy-relevant content will grow, and we probably will see more seminal papers, ongoing dialogs, and special issues as scientists perceive the value of grouping articles thematically. Last, market forces will almost certainly result in *J-NABS* being produced in an electronic-only format with print-on-demand for an additional fee.

Authors of the papers in this issue have looked to the past for a context from which to speak of the future (Graham and Dayton 2002). Each of them has issued a call to action. We are honored and humbled by what they have achieved in the papers presented here. We look to the readers of these papers to do work that is useful *and* that is used by society (Gosz 1999, **Strayer and Dudgeon 2010**).

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