

Another Group at High Risk for HIV

JON COHEN'S ARTICLE "ASIA AND AFRICA: on different trajectories?" (Special Section on HIV/AIDS in Asia, 25 June, p. 1932) gives prominence to those who argue that by aggressively targeting high-risk groups—intravenous drug users (IDUs), sex workers, and gay men—with prevention and anti-retroviral therapy, a "generalized epidemic" (defined as a national prevalence rate of 2% or more) will be averted in most Asian countries. An earlier article by Cohen ("Two hard-hit countries offer rare success stories," 19 Sept. 2003, p. 1658) presented convincing evidence that targeting has reversed the spread of the epidemic within these groups, most notably in Thailand and Cambodia. We are concerned, however, that Cohen places too much emphasis on these particular high-risk groups and not on a larger risk group that is mentioned only in passing—mobile and migrant workers and their sexual contacts.

the cross-border migrants (20.2% for Khmer and 16.1% for Myanmar fishermen) (2). In the port of Sihanoukville, Cambodia, in a survey of 446 fishermen, 17% of those who claimed to regularly use condoms were HIV positive, and 20% of irregular condom users were HIV positive (3). In Malaysia, fishermen are estimated to make up around 2% of the total adult population, but they account for between 6 and 7.8% of people known to be living with HIV (4, 5). Almost 29 million fisherfolk, 84% of the world total, work in Asia (6), with perhaps three or four times that number of dependents, so the high seroprevalence rates observed in fishing communities are likely to be regionally significant. If the epidemic has already taken a significant hold in these migrant and mobile subpopulations, then targeting IDUs and sex workers to contain the epidemic may prove to be too little, too late.

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6. Data from Food and Agriculture Organisation, Fisheries Information Division; see www.fao.org.

“ [F]ishermen and other seafarers (and their casual and long-term sexual partners)... are thought to be among the groups with highest prevalence rates of any occupational group other than commercial sex workers, in Asia as well as in some African countries...”

—ALLISON AND SEELEY

Cohen refers to the presence of “huge populations of migrant workers” in the region, and his earlier article on Myanmar identifies gem miners and loggers as migrant workers that are a “major conduit” of infection into the general population (“The next frontier for HIV/AIDS: Myanmar,” 19 Sept. 2003, p. 1650). He does not mention fishermen and other seafarers (and their casual and long-term sexual partners) who are thought to be among the groups with highest prevalence rates of any occupational group other than commercial sex workers, in Asia as well as in some African countries (1). Among many passing references to high incidences of HIV/AIDS in ports and fishing communities are three studies from southeast Asia that have surveyed seroprevalence. The results are worrying. A sample of 818 Thai, Khmer, and Myanmar fishermen working in the Thai trawler fleet in the late 1990s were 15.5% HIV positive, with the highest rates being for

Taxonomists and Conservation

Q. D. WHEELER *ET AL.* ARGUE FOR A redefinition of the role and job of taxonomists in order “to create a legacy of knowledge for a planet that is soon to be decimated” (“Taxonomy: impediment or expedient?”, Editorial, 16 Jan., p. 285). At some time in the past, scientists, and by extension their professional organizations, defined the role of scientists as dispassionate providers of information for policy-makers. Values need not intrude, as they might bias the information. For scientists and their societies to promote the description of what is being decimated, without attempting to stop it, can only be seen as blind adherence to an obsolete and dangerous perception of their role in society. Like all other groups in society, scientists have self-interest; they have

Letters to the Editor

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descendants and values. They are far better trained to predict the future than politicians, and the public understands this. If AAAS and other scientific organizations fail to advocate sensible population, conservation, and environmental policies, then their silence will certainly equal death. Wheeler *et al.* have not gone far enough in their call for redefining the role of taxonomists. It is time for scientific societies to step up to the plate and commit their considerable clout to the public debate about preservation of the planet. Otherwise, they invite the destruction that looms on the horizon.

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Response

MARTIN SUGGESTS THAT A FOCUS BY taxonomists on documentation of species and clade diversity possibly invites a greater level of species extinction by not couching its arguments explicitly in terms of conservation. Knowledge of Earth's species diversity and its patterns of distribution is precisely what conservation biologists and decision-makers need to make scientifically informed priorities in efforts to preserve life on Earth. Nothing could be more important, noble, or urgent than to conserve as much of life's diversity as possible for the future. However, there is a parallel and equally pressing need to explore life on Earth to assure as much baseline knowledge as possible, to document those components of diversity that will ultimately not survive. This burden of discovery and documentation rests heavily on taxonomists and the museum community. We seem to have condemned future generations to confront growing numbers of environmental problems in a world biologically impoverished to a greater or lesser extent; we need not ask them to do so in utter ignorance of the products of billions of years of evolution. This exploration of the life of an entire planet is a tall order for an ill-supported community. Taxonomists are unique and essential partners in successful plans to preserve life and its diversity, but to do so at the expense of what they alone

can contribute to the advance of knowledge would be a tragic mistake.

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Taxonomists and the CBD

IN THEIR EDITORIAL "TAXONOMY: IMPEDIMENT or expedient?", Q. D. Wheeler *et al.* make a strong case for the internationalization of taxonomy through a cyber-infrastructure that would give taxonomists and museums access to the right tools for documenting species diversity (16 Jan., p. 285). Most biologists are familiar with the biodiversity crisis, but not with the Convention on Biological Diversity (CBD), not mentioned by Wheeler *et al.*, which would govern such a globalized taxonomy (1). The CBD was instrumental in creating a global awareness of the "taxonomic impediment"—the incomplete knowledge of taxa and the dearth of taxonomists worldwide (2). This impediment is most acute in tropical, developing nations, which contain most of the world's biodiversity, yet produce far fewer taxonomists than developed countries. Two crucial ways to address the problem are (i) increased study of taxa in developing nations and (ii) increased taxonomic training in developing nations. The CBD provides a regulatory framework for these solutions (3), yet most taxonomists are little aware of this new "global regime" that affects their professional lives.

With the highest percentage of taxonomists of developed nations, the United States must shoulder much of the responsibility in overcoming the incomplete knowledge of taxa and the dearth of taxonomists in biodiversity-rich countries. This necessitates an understanding of the CBD by U.S. taxonomists. Because of greater institutional engagement, U.S. taxonomists at herbaria, museums, botanic gardens, and zoos tend to be more aware of the CBD than those at universities; however, U.S. universities need to become more engaged with the CBD because most U.S. taxonomists work at universities.

Universities, taxonomists, and funding agencies must work together to build the institutional support necessary to address CBD-related issues, such as the regulatory maze associated with collecting biological samples, and the international collaboration and training required to do so. If not

seen in a larger context, these regulations tend to be viewed as annoying bureaucratic hurdles whose ethical and sociopolitical dimensions are invisible (4).

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3. See related article of the CBD: Article 7, Identification and Monitoring; Article 12, Research and Training; Article 15, Access to Genetic Resources; Article 16, Access to and Transfer of Genetic Resources; Article 17, Exchange of Information; Article 18, Technical and Scientific Co-operation (available at www.biodiv.org/convention/articles.asp).
4. A. C. Revkin, "Biologists sought a treaty; now they fault it," *N.Y. Times*, 7 May 2002, p. F1.

Response

GEETA ET AL. EXPRESS CONCERN THAT OUR call for a taxonomic cyber-infrastructure was made without cognizance of the CBD or the urgent needs for taxonomic capacity in developing nations. Space constraints prohibited acknowledgment of the impressive and important gains made as a result of international activities growing from the CBD. The so-called taxonomic impediment can only be removed when taxonomy is transformed into a modern, efficient science. Our proposal is to address what taxonomists need to do so that they can work rapidly and efficiently through a virtual cyber-tool that opens access to sophisticated digital instruments, specimens, data, and literature—the sum of taxonomic and natural history knowledge. While this "tool" would permit taxonomists in the United States to do their work much better and faster, a major impact of the proposal would be to help level the playing field for scientists at smaller institutions and in developing nations, through remote access to virtual libraries, museums, and knowledge bases. Another positive impact would be the facilitation of multi-investigator, multi-institutional, and multi-national collaborations to accelerate the pace of species discovery, description, analysis, and classification, again to the immediate benefit of colleagues and students in developing nations. The kind of community cooperation described by Geeta *et al.* is, as they suggest, essential to success on all these fronts.

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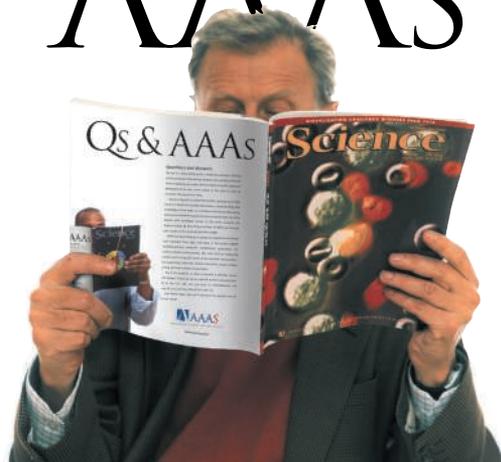
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Taxonomy: Exploring the Impediment

THE POSSIBILITIES FOR DRAMATICALLY improving taxonomic output painted by Q. D. Wheeler *et al.* in their Editorial (“Taxonomy: impediment or expedient?”, 16 Jan., p. 285) are exciting and necessary. However, unless these technical enhancements are matched by sociological changes by both providers and users of taxonomic information, their vision is unattainable.

The 1.78 million of Earth's species that have been described represent at best 42% of the total, and the expectation that taxonomists can rapidly name any sample is unrealistic. Wheeler *et al.* address this. However, an increase in taxonomic output must be matched by products that meet the needs and expectations of the wider user community. Despite this, the ratio between numbers of taxonomists and available funding to the number of species to be studied drives taxonomists to focus on core tasks rather than on developing “user-friendly” products.

Identifications, identification aids, and inventories require considerable time and museum resources, although funding bodies, holding the perception that these are available, rarely fund them. Funders recognizing the scale of work find it difficult to prioritize and may see the problem as intractable and unfundable.

Furthermore, career development and peer recognition accrue more from papers in *Science* and peer-reviewed journals than from field guides, Web pages, or identification handbooks. Career progression and institutional recognition exert selection pressure in favor of traditional research products. Many funding bodies also expect outputs of high-impact, cutting-edge science, published in key journals. This tendency leads to grants for developing novel methodologies rather than for implementing existing ones.

Solving these problems will require agreement about priorities. The CBD has highlighted many of these issues and the U.S. National Science Foundation, the UK Darwin Initiative, and Australian Biological Resources Study are leading the way in recognizing the trade-off between methodology development and implementation. Users must also ensure that their needs for taxonomic products are addressed in their project design and grant applications.

Taxonomic institutions should recon-

sider their functions, performance indicators, and appraisal criteria. The importance of outputs for nontaxonomists should be raised and impact assessment mechanisms devised. Because taxonomic and other institutions compete for funds, the process must involve discussions with supporting government departments and universities to ensure that novel performance indicators are agreed upon. If constructive action is not taken, we fear that, improved methodologies or not, taxonomy will fail to meet its users' needs and expectations, leading to further loss of a vital science, biodiversity, and human well-being.

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Museum Collections and Taxonomy

TAXONOMY IS A CRITICAL TOOL IN understanding biodiversity, and we applaud the view taken by Q. D. Wheeler *et al.* (“Taxonomy: impediment or expedient?”, Editorial, 16 Jan., p. 285) that natural history collections and an evolving cyber-infrastructure are central to the taxonomic mission. But their vision needs to be even bolder if we are to accomplish related grand challenges such as documenting the diversity of life, deciphering the Tree of Life, determining how biotas and their ecosystems shape global environmental systems, and creating a universal bioliteracy that enables practical outcomes and education for society.

Innovative tools such as genomic and biodiversity informatics and molecular-based identification can, for the first time, make these grand challenges attainable while there is still enough biodiversity left to matter. One critical piece of data is the 300 years of information associated with approximately 3 billion specimens of animals and plants in museums and herbaria worldwide (1–5). Wheeler *et al.* worry about some of these data being “outdated or unreliable.” Yes, specimen collections and their databases are imperfect, requiring taxonomic and geospatial updating and verification. But these improvements are now ongoing, while at the same time we deploy verified collections data for powerful analyses of environmental and societal phenomena, such as the spread of invasive and disease species, biosecurity, and the effect of climate change on species distributions and conservation. When museums use modern infor-

matics tools to digitize and fully share specimen data, they are fostering the collections and their information for research on the very biodiversity phenomena that those collections were intended to help elucidate (6–9).

Informatics complements expertise in taxonomic and morphological research, which is essential to understanding the complexity of life. But the biodiversity community needs to automate large segments of the process of species discovery and documentation using rapid identification with unique gene sequences and informatics-mediated taxonomic tools (5, 8–10). From the onset, large-scale floral and faunal studies should be Web-mediated digital library projects, with species treatments published online, and the biotic information disseminated by instant, open-access networks that empower the scientific community, the public, and policy-makers.

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Taxonomy and Natural History

ALTHOUGH I WHOLEHEARTEDLY CONCUR WITH the vital message in Q. D. Wheeler *et al.*'s Editorial "Taxonomy: impediment or expedient?" (16 Jan., p. 285), I would also argue the case for natural history. A taxonomic understanding of biodiversity is clearly an essential complement to the study of ecosystem structure and dynamics, but good, reliable natural history studies of organisms, often relegated to a backstage in setting research funding priorities, provide yet another essential underpinning of understanding biodiversity. To answer the challenging question about an organism, "what does it do for a living?", is a compelling and necessary partner to a plea for strengthening the research infrastructure for taxonomic studies. Museum natural history collections and studies on the lifestyles of the taxonomic units that comprise them must go hand in hand when defining funding priorities for biodiversity studies.

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CORRECTIONS AND CLARIFICATIONS

Special section on Immunotherapy: News: "Putting tolerance to the test" (9 July p. 194). The name of Lloyd Kasper of Dartmouth College was misspelled.

TECHNICAL COMMENT ABSTRACTS

COMMENT ON "Network Motifs: Simple Building Blocks of Complex Networks" and "Superfamilies of Evolved and Designed Networks"

Yael Artzy-Randrup, Sarel J. Fleishman, Nir Ben-Tal, Lewi Stone

Milo *et al.* (Reports, 25 October 2002, p. 824, and 5 March 2004, p. 1538) used network randomization schemes to test statistically for the presence of evolutionary design principles in complex biological and synthetic networks. The method identified significant "network motifs" (nonrandom recurring patterns of interconnections) to imply that evolutionary selection has been at play. We show that the approach may be inappropriate in a number of circumstances.

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RESPONSE TO COMMENT ON "Network Motifs: Simple Building Blocks of Complex Networks" and "Superfamilies of Evolved and Designed Networks"

Ron Milo, Shalev Itzkovitz, Nadav Kashtan, Reuven Levitt, Uri Alon

Our approach detects network motifs; it does not explain why they appear. That network motifs are selected for their function is one possible hypothesis, which is supported by recent experiments on gene networks. The toy hypotheses used in the comment, a random-lattice model for neurons and a preferential-attachment model for gene networks, do not capture the subgraph profiles of the corresponding real networks.

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