At its 1998 and 1999 annual meetings the Organization of Biological Field Stations has collected data, conducted surveys, and synthesized information to demonstrate the ability of field stations to contribute towards detecting change in national environmental conditions and trends. This report highlights some of these discussions and analyses.

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The Organization of Biological Field Stations (OBFS), a member organization of AIBS, is an association of more than 160 field stations and 40 plus individual professionals concerned with field facilities for biological research and education, primarily in North America and Central America. Member field stations share the common interest of providing biological field facilities, although they may focus on terrestrial, freshwater or marine/coastal ecosystems. Field stations provide a direct linkage among research, education, outreach, land management, conservation, research collections, and data management activities. The members represent a wealth of relevant ecological knowledge accumulated this century. OBFS promotes the exchange of information and ideas among field stations on such topics as management of field stations and reserves, promotion of biological field education, research, and data management, environmental monitoring, and funding opportunities.

A full directory of member field stations is provided on the web **(** ://www.obfs.org). The majority of field stations are associated with public universities (e.g. Flathead Lake, University of Montana-Missoula and Hastings Natural History Reservation, U.C. Berkeley) or private universities (e.g. Jasper Ridge, Stanford University). Some are private independent institutions (such as Archbold Biological Station, FL, and Rocky Mountain Biological Laboratory, CO). A few field stations are affiliated with large non-governmental organizations (e.g. Southwestern Research Station, AZ, part of the American Museum of Natural History). Several field stations are linked with state agencies (e.g. Illinois Natural History Survey, a division of the Illinois Department of Natural Resources, Office of Scientific Research & Analysis) or federal agencies (H. J. Andrews Experimental Forest, jointly administered by Oregon State University and the USDA Forest Service). Finally a scattering of private and public field stations in other countries (including Canada, Central America, the Caribbean and Australia) make up the International OBFS (IOBFS http://www.capital.net/com/iobfs/).

Among the North American field stations, some primarily focus on educational activities - from small stations such as Wheaton College Science Station, SD to larger ones like Treehaven Field Station, WI. In contrast, other stations focus on research programs; for example most of the 21 NSF Long-Term Ecological Research (LTER) sites including Kellogg Biological Station, MI and Sevilleta Field Station, NM are also OBFS members. Some stations have relatively small acreage on site, but may conduct research on adjacent public lands and waters (e.g. Sierra Nevada Aquatic Laboratory CA, Flathead Lake Biological Station MT), or throughout a region (e.g. Institute for Ecosystem Studies,

NY), or investigate extensive coastal and offshore systems (Hatfield Marine Science Center OR, Barouch Marine Field Laboratory, SC),

Member field stations of OBFS are located throughout the lower 48 states of the US (Figure 1). This distribution was not planned – the establishment of many field stations has been serendipitous, driven by philanthropic actions including land donations, as well as more strategic efforts by agency and university faculty initiatives. The map is limited to the 118 stations in the lower 48 for which the OBFS network currently has accurate location information. Geographically these OBFS stations collectively form an established network of sites able to detect, understand, and interpret ecological change at a regional and national level. In the U.S., member stations are located in 41 states, with the greatest number in California (21), New York (13) and Illinois(11). Only AL, CT, DE, HI, MD, NH, ND, RI, and VT have no current member field stations. Two of the states with large numbers of field stations operate existing networks, which could be viewed as working examples of integration among field stations at a regional level. First the Illinois Natural History Survey (http://www.inhs.uiuc.edu/cbd/) manages eight statewide field stations. Second, many stations in California are part of an umbrella network, the U.C. Natural Reserve System NRS (://nrs.ucop.edu/), administered by the Division of Agriculture and Natural Resources within the University of California Office of the President.

A spatial overlay analysis of the location of OBFS field stations in relation to Bailey's (1997) ecoregional coverage (Figure 1) shows that OBFS stations represent data collection points in ecoregional provinces that encompass over 72% of the U.S. land area (Table 1). This breadth of geographical coverage is essential for any national program assessing the status of ecological patterns and processes in the context of entire ecosystems. There is field station representation in 15/20 ecoregional divisions and 25/35 ecoregional provinces in the lower 48 (Table 1). All 11 divisions within the humid subtemperate domain have field stations present and there is high field station representation in the mixed and broadleaf forests of the warm and hot continental divisions. In the dry domain field stations occur in 5/8 divisions (except tropical and subtropical regime mountains and temperate desert mountains), although there are divisions with large areas, such as the dry steppes of the Great Plains, that have only 1-2 stations present. The analysis suggests no representation (0/1) within the savanna division of the humid tropical domain (Figure 2). However, Archbold Biological Station, FL exists very close to this ecosystem, and is more accurately included in a recent study by Ricketts et al. (1999) within a biogeographical province – the Florida scrub – which is not defined by Bailey (1997). With more fine-tuning, our analysis could be more accurate, since we only used a point coverage to represent field stations and, in many cases, station research areas extend into neighboring ecoregions. OBFS intends to target new members, if present, in ecoregional provinces without current representation, such as temperate prairie parkland and the dry steppe and shrub of the southwestern plateau, to provide the organization with more complete ecoregional coverage.

The types of research questions addressed by OBFS field stations in all these ecoregions are varied, although usually site based and long-term in nature. The New Horizons

Report (Lohr et al. 1995), a collaborative effort of OBFS and the National Association of Marine Laboratories (http://www.mbl.edu/html/NAML), lists key research themes for the next decade at biological field stations and marine labs:

- relating fundamentals of basic biology and ecology
- measuring environmental change
- maintaining biodiversity
- sustaining ecological systems
- predicting consequences of management policies and actions
- restoring and rehabilitating damaged ecosystems
- demonstrating rates of change in biological diversity and the subsequent effects on community structure and ecosystem processes
- describing the biology of rare and declining species and the scientific information necessary to sustain such species
- defining the principles that govern outbreak and spread of pest and disease organisms

Field stations make a significant contribution to the basic research necessary to understand the environment. A survey of 42 member field stations at last year's OBFS meeting, found that 59.5% had active research programs on endangered species, 42.9% on habitat loss and fragmentation, 38.1% on fire processes and 59.5% on exotic species. These last three factors are high on the list of threats to the nation's imperiled species (Wilcove 1998). In terms of understanding the rate and scale of modifications to the environment, 61.9% of surveyed field stations conduct research on water quality issues, 23.8% on air quality, and 33.3% on global change. The marine field stations, which were underrepresented in this survey because they more typically attend the NAML meetings, have extensive research programs examining coastal and offshore systems.

Not only do field stations provide broad geographic and thematic coverage, but they have also established very strong networks with agencies and non-governmental organizations. In the same survey of 42 stations, at a federal level, 31.0% work with the US Forest Service, 14.3% with US Fish and Wildlife Service, 16.7% with the National Park Service. Given their potential to contribute to national monitoring efforts surprisingly few field stations work with the EPA (4.8%). At a state level, 38.1% work with state fish and game agencies, and 40.5% with state environmental protection agencies. At a local level 38.1% work with their local government. Nearly all field stations (71.4%) work with local environmental groups, or citizen organizations (59.5%). Many work with national conservation organizations, most particularly with the The Nature Conservancy (38.1%). Over 70% of surveyed field stations offer K-12 programs, thus providing tremendous direct linkage between research and K-12 education.

OBFS is, of course, only one of several other national and regional long-term ecological research and monitoring networks, many of which are agency based. NSF's LTER Network is a collaborative effort investigating long-term ecological processes over broad spatial scales at 21 sites, 18 of which are in the lower 48 states. The Association of Ecosystem Research Centers brings together 39 U.S. research programs in universities and private, state and federal laboratories located in 27 states. They conduct research, provide training and analyze policy at the ecosystem level of environmental science and

natural resources management. Several national ecological research and monitoring networks, including the Department of Interior (National Parks, National Forests), the Department of Energy (Environmental Research Parks), NASA, and the Department of Defense were reviewed at a recent workshop at the Ecological Society of America 1999 annual meeting in Spokane (http://esa.sdsc.edu/99sciprogram.htm). Although field stations have always been applauded for their individual roles in integrating long-term research, education and outreach (Eisner 1982, Wilson 1982, Gross and Pake 1997) their potential role, as part of such integrated national research and monitoring endeavors is only now being recognized, probably because of their relative independence.

These analyses confirm that OBFS field stations: (1) collectively hold a large set of ecological data describing pattern and trends in climatic, hydrologic, chemical and biological variables; (2) over most of the ecoregions of the US; and (3) have existing networks for dissemination of these data. But the massive data and other information resources collectively held by OBFS sites are not systematically archived in electronic media, and are not easily accessible for analysis and synthesis of strategic environmental issues (Stanford and McKee 1999). OBFS is now taking steps to build a unified strategy for development, analysis and synthesis of regional and national databases within this national network. These initiatives have been spearheaded at the last two OBFS annual meetings -- Archbold, FL 1998 and Mountain Lake, VA 1999. OBFS members have devised strategies for an inventory and systematic update of field station environmental informatics in modern electronic formats. Planning efforts have involved: a joint workshop with OBFS, LTER and the Ecological Society of America (Swain and Mitchener 1998) and a National Center for Ecosystem Analysis and Synthesis NCEAS workshop which produced the Field Station 2000 Initiative (Stanford & McKee, 1999). The aim is implementation of personnel and resources for collection, management, archiving and Internet posting of the biological data bases at as many OBFS sites as practical. OBFS participation in the recent NCEAS/LTER Knowledge Network for Biocomplexity funding award from NSF (://www.lternet.edu/documents/Newsletters/NetworkNews/ntwrknws24/) will provide early support. These efforts also tie in well with national initiatives of The National Science and Technology Council's Committee on Environment and Natural Resources to integrate and coordinate environmental monitoring and research networks and programs. OBFS is committed to enabling the broad geographic network of member field stations to play an important role in the comprehensive evaluation of the nation's environmental resources and its ecological systems.

Bailey, R.G. 1997. Ecosystem Geography. Springer Verlag. New York.

Eisner, T. E. 1982. For the love of nature: exploration and discovery at biological field stations. BioScience **32**:321-326.

Gross, K.L. and C.E. Pake. 1995. Final Report of the Ecological Society of America Committee on the Future of Long-term Ecological Data (FLED). Volume II: Directories to Sources of Long-term Ecological Data. Ecological Society of America, Washington D.C.

Lohr, S.A. et al. 1995. A New Horizon for Biological Field Stations and Marine Laboratories. Rocky Mountain Biological Laboratory, Miscellaneous Publication No. 3. 36 pp. (Download from http://www.obfs.org).

Swain, H.M. and W. Mitchener. 1998. Synopsis; from a field station perspective. Data and Information Management in the Ecological Sciences; a Resource Guide. NSF-LTER publication. P129-133.

Ricketts T. H. (Editor), E. Dinerstein, D.M. Olson, C.J. Loucks. 1999. Terrestrial Ecoregions of North America : A Conservation Assessment. Island Press, Covelo, CA

Stanford, J. 1999 and A. McKee. 1999. Field Station 2000 Initiative. Results of a NCEAS Workshop, May 17-22, 1998. Download from ://www.obfs.org/Networking/OBFS_NCEASreport/OBFS_NCEAS.html).

Wilson, E.O. 1982. The importance of biological field stations. BioScience 32:320.