FINAL REPORT

THE INTERNATIONAL TREE-RING DATA BANK: GROWTH AND ADAPTATION TO THE WORLD COMMUNITY

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by

Henri D. Grissino-Mayer
Dept. of Physics, Astronomy & Geosciences
Valdosta State University
Valdosta, Georgia 31698-0055

and

Harold C. Fritts
DendroPower
5703 North Lady Lane
Tucson, Arizona 85704-3905

on behalf of the ITRDB Advisory Committee

1. Introduction

The International Tree-Ring Data Bank (ITRDB) was established in 1974 to serve as a repository for tree-ring data developed around the world. Today, with the support of the Office of Global Programs (OGP) at the National Oceanic and Atmospheric Administration (NOAA) and the Paleoclimatology Program at the National Geophysical Data Center (NGDC), the ITRDB has grown into one of the premier paleoclimatic databases, with support personnel and advisory committee members located throughout the world. The ITRDB has grown to include 3,516 individual tree-ring chronologies, over 1,500 raw measurement data sets, and numerous climate reconstructions developed from these data, representing over 1,300 locations in 35 countries from 120 different tree species. During the past eight years, the ITRDB has considerably increased its visibility in the worldwide scientific community, largely through support from the OGP, by (1) establishing an international Internet discussion forum for the exchange of ideas and to facilitate the contribution of tree-ring data, (2) continuing its Outreach Program to solicit data contributions from tree-ring researchers worldwide, (3) developing and distributing the most comprehensive set of computer programs yet developed for dendrochronology, and (4) assisting laboratories around the world in their efforts to develop and contribute tree-ring data.

The popularity of dendrochronology has resulted in the development of thousands of tree-ring chronologies from sites around the world. Many chronologies have already been used to assess past changes in climate to better understand the global dynamics of present and future climate change. The spatial coverage of tree-ring data is incomplete, however, but can be extended over space and time given support and encouragement. Additionally, considerable dendrochronological data have already been and will continue to be lost due to (1) the death of dendrochronologists, (2) the closure of tree-ring laboratories, (3) the switch to other disciplines by tree-ring scientists, and (4) the mishandling of tree-ring data. The continued development and operation of the Outreach Program of the ITRDB was therefore critical to help minimize further loss of these extremely valuable and irreplaceable tree-ring data, to help extend and update previously contributed tree-ring chronologies, and to facilitate contributions to the ITRDB.

During the most recently funded project (1995-1997), the primary goal of the ITRDB was to expand the number of holdings and increase the types of tree-ring data submitted to the ITRDB and the World Data Center-A (WDC-A) for Paleoclimatology. To maintain and ensure the high quality of tree-ring data being contributed, a second primary goal of the ITRDB during the last two years was the initiation and completion of an assessment on the quality of the entire holdings of tree-ring data in the ITRDB. Secondary goals included (1) the enhancement of the ITRDB Program Library and a release of a new version, (2) travel to other laboratories and workshops throughout the United States to increase the visibility of the ITRDB, and (3) submission of articles about the ITRDB and its data initiative for publication. We begin this report by first summarizing the data sets contributed to the ITRDB within the past two years.

2. Data Sets Contributed

The ITRDB is pleased to announce that 617 tree-ring data sets were contributed since the end of the last funded project (1994-1995), representing 431 chronology files and 186 measurement files. A partial listing of the more significant contributions is provided in Table 1. Tree-ring data sets were contributed from 19 countries: Austria, Belgium, Great Britain, Canada, China, The Czech Republic, The Dominican Republic, Finland, France, Germany, Italy, Mongolia, The Netherlands, New Zealand, Norway, Russia, Spain, Sweden, and the United States. In the United States, data sets were contributed from 18 states: Alabama, Arkansas, Arizona, California, Georgia, Idaho, Iowa, Maine, Michigan, Missouri, New Mexico, North Dakota, Ohio, Oregon, South Dakota, Virginia, Washington, and West Virginia. Contributors to the ITRDB during the last two years represented 15 countries (Table 2): the United States, Canada, Russia, Germany, The Czech Republic, The Netherlands, the United Kingdom, Belgium, France, Sweden, Finland, New Zealand, Austria, Mexico, and the People's Republic of China.

In addition to the actual data sets, the ITRDB was very successful and fortunate to receive numerous reconstructions of various climate variables, such as summer temperature, annual precipitation, and streamflow. We consider these reconstructions to be as important as the tree-ring data themselves, and strongly encourage their contribution. We were also pleased to see the broad worldwide geographic coverage represented by these reconstructions. Climate reconstructions based on tree-ring data were contributed for:

[1] **Huashan, China** (AD 1600-1988, Data Contribution Series # 96-020),
[2] **eastern Oregon** (AD 1705-1989, Data Contribution Series # 96-029),
[3] **New Mexico** (136 BC - AD 1992, Data Contribution Series # 96-002),
[4] **northwest Canada** (AD 1638-1988, Data Contribution Series # 95-024),
[5] **Lake Athabaska, Canada** (AD 1810-1967, Data Contribution Series # 94-015).

Finally, tree-ring data published in several chapters of the book *Climate Since A.D. 1500* were also contributed (Data Contribution Series # 92-015) and made available to the scientific community. These include climate reconstructions from:

[6] **Chile** (AD 1500-1986),
[7] the **eastern United States** (AD 1730-1982),
[8] **New Zealand** (AD 1700-1979),
[9] the **Ural Mountains, Russia** (AD 961-1969),
[10] **northern Sweden** (AD 1500-1981),
[11] **northern North America** (back to AD 1601), and
[12] the **Great Plains** (AD 1750-1963).

The actual number of data sets contributed fell short of our anticipated goal of one thousand data sets, due in part to a major change that occurred in the European dendrochronological community regarding data contributions. Rather than submitting raw tree-ring measurement and chronology data to a central repository, the Europeans have established a *European Catalogue* that contains information on tree-ring data available from individual researchers, but not the actual data. This change in policy occurred because of the unique situation facing European dendrochronologists. Tree-ring dating in Europe can be a lucrative and highly competitive business due to (1) the antiquity of wood found throughout Europe, (2) the desire to firmly and precisely date ancient structures, and (3) the need to publish in popular and scientific journals. The procurement and use of European tree-ring data can be abused by individuals and companies, however, who are more driven by profit than by scientific knowledge. This situation may lead to a degradation in the quality of tree-ring data and the research conducted, and potentially take projects away from the original developers of the tree-ring data. This situation has, in essence, created a "territorial" atmosphere – European dendrochronologists are therefore hesitant to contribute data that could easily be accessed by such individuals and companies who, in turn, could take projects and publications away from the original contributors. Nonetheless, several important contributions were made by Europeans during the last two fiscal years, suggesting to us that Europeans will continue to contribute data, though in reduced numbers.

Although the ITRDB received fewer contributions than the one thousand expected, we point out that we have received numerous verbal commitments for data contributions obtained via the Dendrochronology Internet Forum managed by the ITRDB. These commitments are filed with the ITRDB and will be followed up with communiques in the near future. We have received such commitments from:

[1] **Catherine Alington** of Colorado State University,
[2] **Elspeth Baalman** of the State Forest of New South Wales, Australia,
[3] **Valerie Barber** of the University of Alaska - Fairbanks,
[4] **David Barclay** of the State University of New York - Buffalo,
[5] **Renee Brooks** of the University of South Florida,
[6] **Craig Brunstein** of the U.S. Geological Survey,
[7] **Laary Cushman** of the University of South Carolina - Aiken,
[8] **Mark Gonzales** of the University of Denver,
[9] **Henri D. Grissino-Mayer** of Valdosta State University,
[10] **Malcolm K. Hughes** of the Laboratory of Tree-Ring Research,
[11] **Esther Jansma** of the Dutch Dendrochronological Centre,
[12] **Glenn Juday** of the University of Alaska - Fairbanks,
[13] **Joy Nystrom Mast** of Northern Arizona University,
[14] **David Orwig** of Harvard Forest, Massachusetts,
[15] **Patrick Pringle** of the Washington Department of Natural Resources,
[16] **Mark Rudnicki** of Michigan Technological Institute,
[17] **Kevin Smith** of the Northeastern Forest Experiment Station, USDA Forest Service,
[18] **Wolfgang Stümer** of the Technical University in Dresden, Germany,
[19] **Greg Wiles** of Macalester College, Minnesota,
[20] **Christian Wirth** of the University of Bayreuth, Germany, and
[21] **Joy Young** of Louisiana State University.

We will briefly discuss contributions made during the past two years (between May 1995 to November 1997) by geographic region (Table 1). Because we feel that publication in peer-reviewed journals and chapters in books represents an assurance of data quality, we report, when possible, any publication associated with the data contribution.

2.1 Tree-Ring Data Contributions

2.1.1 Austria

Georgio Strumia and his advisor Dr. Rupert Wimmer at the Universität für Bodenkultur in Vienna, Austria, contributed two tree-ring data sets (AUST109) consisting of Austrian pine (*Pinus nigra* Arnold) dating back to 1840. One data set consists of earlywood measurements only, to be used for measuring intra-annual cellular characteristics and assessing their implications for modeling wood density.

2.1.2 Belgium

Patrick Hoffsummer of the Université de Liege in Belgium contributed four master tree-ring chronologies developed from archaeological material collected at sites in Belgium. Two chronologies extend back to AD 672, making these some of the longest chronologies yet contributed by Europeans to the ITRDB. These also mark the first contributions ever from the country of Belgium, increasing the spatial coverage of tree-ring sites to coastal areas in Europe that are under represented.

2.1.3 Great Britain

Jennifer Hillam and her colleagues Cathy Groves and Ian Tyers (Department of Archaeology and Prehistory at The University of Sheffield) contributed seven master tree-ring chronologies, including one that has been absolutely dated to 72 BC. Another impressive chronology extends back to AD 1424. This group of researchers has been especially supportive of the ITRDB in the past, and we look forward to additional contributions from this group.

2.1.4 Canada

The number of contributions from Canada was surprising as no fewer than six separate research groups (from UCLA, SUNY-Buffalo, Simon Fraser University, University of Missouri, Université Québec, and the Canadian Forest Service in Edmonton, Alberta) contributed data to the ITRDB.

[1] Dr. Julian Szeicz of the Queen's University in Kingston, Ontario, and his former advisor, Dr. Glen MacDonald of the PISCES Paleoecology Laboratory at UCLA, contributed 10 master chronologies (CANA117-CANA126) for various provinces in Canada, including the Northwest

Territories and the Yukon Territory. These chronologies were developed exclusively from white spruce (*Picea glauca* (Moench.) Voss). Interestingly, the data sets were stratified into young (<200 years in age) trees and older trees to investigate the differential response by these two groups to climate, and published in the 1994 article "Age-dependent tree-ring growth responses of subarctic white spruce to climate," ***Canadian Journal of Forest Research***, Volume 23, pages 120-132.

[2] Dr. Richard P. Guyette of the Department of Forestry at the University of Missouri contributed six chronologies and two raw measurement data sets (CANA126-CANA127) for two sites in Ontario, Canada. Developed from eastern white pine (*Pinus strobus* L.), the oldest of these data sets extends back to AD 1547.

[3] Dr. Chris Larsen (now at the State University of New York - Buffalo) and his colleagues at McMaster University in Canada (which included Dr. Julian Szeicz) contributed raw measurement data and two master chronologies each for five sites (CANA129-CANA133) collected at Wood Buffalo National Park in Canada. Although not of great age, these trees were used to help clarify the relationship between climate and fire at this National Park in the following publication, "Fire and climate dynamics in the boreal forest of northern Alberta, Canada, from AD 1850 to 1989," ***The Holocene***, Volume 6, pages 449-456.

[4] Dr. Richard P. Guyette of the University of Missouri and his colleague Bill Cole of the Ontario Ministry of Forestry in Canada submitted the longest tree-ring chronology yet developed for Canada (CANA134), and to them the ITRDB is very grateful. Based on subfossil remnants of eastern white pine (*Pinus strobus* L.) trees submerged along lake margins, they were able to construct a continuous tree-ring chronology dating back to AD 892 that should eventually prove vital to understanding the past climate of eastern Canada on millennium time scales.

[5] Dr. Glen MacDonald of UCLA and his current graduate student Roslyn Case contributed six data sets consisting of three raw measurement files and their associated standard chronologies (CANA135-CANA137). These limber pine (*Pinus flexilis* James) data sets were described in a recent publication in ***Quaternary Research*** (Volume 44, pages 267-275) entitled "A dendroclimatic reconstruction of annual precipitation on the western Canadian prairies since AD 1505 from *Pinus flexilis* James."

[6] Dr. Julian Szeicz of the Queen's University in Kingston, Ontario, and his former advisor, Dr. Glen MacDonald of the PISCES Paleoecology Laboratory at UCLA, contributed the longest

chronology for the northern latitudes yet developed in North America. Based on tree-ring data from white spruce (*Picea glauca* (Moench.) Voss) sampled in the Northwest Territories, this chronology extends back to AD 1060 (CANA138), and was recently used to assess temperature and precipitation changes during the Little Ice Age in the journal ***The Holocene*** ("A 930-year ring-width chronology from moisture-sensitive white spruce (*Picea glauca* Moench) in northwestern Canada," Volume 6(2), pages 345-351).

[7] Eva Riccius, her advisor Dr. Ken Lertzman, and her colleague Joseph Fall, all of Simon Fraser University in Burnaby, British Columbia, contributed two data sets (CANA9 and CANA10) of raw measurements from two species, Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) and ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) collected in the Stein Valley. The Douglas-fir data set extends back to AD 1598 while the ponderosa pine data set impressively extends back to AD 1496. These data sets were used to assess the effects of climate on tree growth to help investigate factors contributing to the fire history of Stein Valley.

[8] Dr. Cornelia Krause and François Gionest of the Université Québec in Chicoutimi, Canada, under the direction of Dr. Hubert Morin, contributed six chronology files (CANA139-CANA144) and one measurement file from six sites in the province of Québec. The data represent several species: eastern white pine (*Pinus strobus* L.), black spruce (*Picea mariana* (Mill.) BSP), and balsam fir (*Abies balsamea* L.). These data sets were developed for whole stem analyses, and the contributors note: "The raw data from the whole stem analysis are extremely large and difficult to transfer to the ITRDB, and thus only the chronology files are available from the ITRDB." Because the ITRDB solicits and accepts tree-ring data used in stem analyses, we will work with these researchers in the future to see if these data can eventually be contributed.

[9] The team of researchers at the Canadian Forest Service in Edmonton, Alberta, is led by Dr. Ian Campbell. He and his colleagues, Thierry Varem-Sanders and David Lawrence, contributed numerous data sets from two sites in Saskatchewan, a white spruce collection from Boreas SSA Site 1 (CANA145), and a balsam fir collection from Boreas SSA Site 3 (CANA146). This contribution is remarkable because of the types of data contributed. Not only were standard tree-ring data contributed (*e.g.*, total ring-width measurements, standard, residual, and arstan chronologies), but data sets were also contributed for minimum earlywood density (*e.g.*, CANA145N) and maximum latewood density (*e.g.*, CANA145X), including the raw measurements and chronologies developed from each.

2.1.5 China

The ITRDB was pleased to receive 18 data sets (CHIN004) from the People's Republic of China from the late Dr. Wu Xiangding, Dr. Shao Xuemei, and their colleagues at the Laboratory of Tree-Ring Research in Tucson, Arizona, Dr. Malcolm K. Hughes, Jim Burns, and Gregg Garfin. Tree-ring data sets from China are rare and the ITRDB was pleased to received these data. They comprise numerous measurements of tree-ring variables and their respective chronologies from one site named Huashan. The variables include total ring width, earlywood width (CHIN004E), latewood width (CHIN004L), maximum latewood density (CHIN004N), minimum earlywood density (CHIN004N), and various average densities for the same variables. These data mark the first contribution from Armand's pine (*Pinus armandii* Franchet), and extend back to AD 1540. These data were discussed in detail in the article "A preliminary reconstruction of rainfall in north-central China since A.D. 1600 from tree-ring density and width," ***Quaternary Research***, Volume 41, pages 88-99.

2.1.6 The Czech Republic

The ITRDB was also fortunate to receive its first contributions of tree-ring data from The Czech Republic (CZEC001-CZEC002), increasing the spatial resolution of tree-ring data in eastern Europe. Dr. Constantin Sander and his advisor, Dr. Dieter Eckstein, both of the Institute of Wood Biology at the University of Hamburg, Germany, contributed eight data sets from two sites in the Krkonose Mountains developed from Norway spruce (*Picea abies* (L.) Karst.), and dating back to AD 1790. Developed along with Drs. Jaroslav Dobry and J. Kyncl, these data sets represent four raw measurement files (total ring width and maximum latewood density) and their associated standard chronologies. This contribution also marks one of the first data sets to be contributed to the ITRDB since the establishment of the European catalogue of tree-ring data.

2.1.7 The Dominican Republic

Xander van der Burgt of the Wageningen Agricultural University in The Netherlands contributed tree-ring data from West Indian pine (*Pinus occidentalis* Swartz) growing in the Dominican Republic. This contribution marks the first data contributed to the ITRDB from a subtropical tree species in North America. The raw measurement data, however, are *not* annual ring measurements as this species is known to produce multiple "rings" in one year, depending on the intra-annual distribution of rainfall. Therefore, these data sets are kept in a separate directory apart from the main holdings of the ITRDB. Nonetheless, this contribution represents tree-ring data that may one day shed new light on the growth dynamics of subtropical pine species, especially in relation to climate. These data and the results from his master's research were recently published in the ***IAWA Journal*** ("Determination of the age of *Pinus occidentalis* in La Celestina, Dominican Republic, by the use of growth rings," 1997, Volume 18, pages 139-146). The ITRDB is also acknowledged in his master's thesis.

2.1.8 Finland

Markus Lindholm and Jouko Merilainen of the University of Joensuu in Finland contributed two chronologies of Scots pine (*Pinus sylvestris* L.) for the northern latitudes of Scandinavia (FINL021 and FINL022). One of these chronologies extends back to AD 1398 and marks one of the longest tree-ring chronologies yet contributed to the ITRDB for this region of Europe, and for Scots pine. The data were used to reconstruct past climate for the northern Scandian area and were discussed in a recent 1994 issue of the ***Bulletin of the Geological Society of Finland*** ("Growing season thermal climate reconstructed at six pine stands in northern Lapland," Volume 66, pages 95-106).

2.1.9 France

Georges Lambert and his colleagues at the Laboratoire de Chrono-Ecologie, Université de Franche-Comte, in Besançon, France, contributed two very long chronologies (FRAN029-FRAN030) made up of both archaeological and living tree material. The Bourgogne master chronology extends to an impressive AD 561, and is a valuable addition to the ITRDB, as it will serve as master reference chronologies for this region in Europe. André Billamboz of the Archäodendrochronologisches Labor at the Landesdenkmalamt Baden-Württemberg in Hemmenhofen, Germany, also contributed an archaeological/living tree chronology for the Chartrans area that extends back to AD 1360.

2.1.10 Germany

One of the most impressive sets of contributions to the ITRDB was developed by André Billamboz for several archaeological sites in extreme southern Germany at the Bodensee (GERM021-GERM032). These are master chronologies containing absolutely dated tree rings from oak pile dwellings that date back to the early Bronze Age. The oldest chronology dates back to 4228 BC, and all of these data sets extend for several hundred years. A modern chronology containing both living tree and archaeological material was also contributed that extends from AD 1275 - 1986. The contributions of these data to the archeology of southern Germany can be seen in the 1996 publication "Tree rings and pile-dwellings in southwestern Germany: Following in the footsteps of Bruno Huber" (in J.S. Dean, D.M. Meko, and T.W. Swetnam, editors, ***Tree Rings, Environment, and Humanity***, Department of Geosciences, The University of Arizona, Tucson, pages 471-483).

2.1.11 Italy

The ITRDB has not received many tree-ring data sets from this country, so the contributions by Wulf Hüsken of the Abt. Geologie der Heinrich-Heine-Universität in Dusseldorf, Germany, were especially welcome. The three chronologies (ITAL023-ITAL025) represent Swiss stone pine (*Pinus cembra* L.), European larch (*Larix decidua* Mill.), and Norway spruce (*Picea abies* (L.) Karst.) from a site in extreme northern Italy called Fodora Vedla Alm. The oldest data set extends back to AD 1474. These data were discussed in the 1993 publication "Drei Jahrringchronologien aus den Pragser Dolomiten/Suedtirol" ("Three tree-ring chronologies from the Prags dolomites, south Tirol"), ***Dendrochronologia*** 11, pages 123-137.

2.1.12 Mongolia

Tree-ring data sets from central Asia are rare for various reasons, among them the relative inaccessibility of the sites and the difficulty in gaining permission from the respective governments and agencies. Dr. Kirill Christyakov of the St. Petersburg State University of Russia recently contributed five raw measurement data sets from Mongolia, some dating as far as back the late 1500s. Comprised mostly of Siberian larch (*Larix siberica* Ledeb.), these data sets were used in a recent publication by Dr. Gordon C. Jacoby of Columbia University to investigate trends in temperatures during the last five centuries. Published in the journal ***Science*** (Volume 273, pages 771-773), the article ("Mongolian tree rings and 20th century warming") appears to show that temperatures during the 20th century have been anomalously high compared with the pre-20th century period.

2.1.13 The Netherlands

One of the largest contributions of tree-ring data sets was made by Paul P.T.M. Maessen of Holtland Dendroconsult in Veenendaal, The Netherlands (NETH020-NETH034). Although none of the tree-ring chronologies is unusually long (only two of the 15 sites extend back to the 1700s), the chronologies expand the network of sites in The Netherlands, a country where long-lived trees are considered extremely rare. Both raw measurement and chronologies were contributed for each of the 15 sites, for a total of 30 data sets. Unfortunately, the quality control assessment revealed major internal dating inconsistencies with the measurement data sets, as 40-95% of the tested segments appeared to have dating problems. A decision will be made in the future concerning whether the ITRDB should continue to make these data available to the scientific community.

2.1.14 New Zealand

A significant contribution of 51 tree-ring chronologies (NEWZ059-NEWZ075) was made for New Zealand by Drs. Limin Xiong and Jonathan Palmer of the Plant Science Department at Lincoln University in Canterbury, New Zealand. These chronologies were developed from New Zealand cedar (*Libocedrus bidwillii* Hook. f.). Three of these chronologies are exceptionally old: NEWZ063, back to AD 1140; NEWZ073, back to AD 1330; and, NEWZ074, back to AD 1212. Some of these chronologies are updates from tree-ring data previously collected. For example, NEWZ059 is an update of a chronology first developed by Peter W. Dunwiddie and published in 1992. NEWZ060-

NEWZ063 are updates of data developed by Valmore C. LaMarche, Jr. and published in 1979. These data were featured in the article “Standardization approach selection for New Zealand cedar (*Libocedrus bidwillii*),” published in 1995 in S. Ohta, T. Fujii, N. Okada, M.K. Hughes, and D. Eckstein, editors, ***Tree Rings: From the Past to the Future. Proceedings of the International Workshop on Asian and Pacific Dendrochronology***, Forestry and Forest Products Research Institute *Scientific Meeting Report* 1, pages 88-93.

2.1.15 Norway

Markus Lindholm and Jouko Merilainen also contributed a chronology data set for northern Norway (NORW007) as part of their climate assessment for the northern Scandinavian area. The data set consists of Scots pine collected at 69 degrees north latitude and dates back to AD 1698. The data set was discussed in a recent 1994 article published in the ***Bulletin of the Geological Society of Finland*** (Volume 66, pages 95-106) entitled “Growing season thermal climate reconstructed at six pine stands in northern Lapland.”

2.1.16 Russia

Markus Lindholm and Jouko Merilainen also contributed three chronology data sets (RUSS016-RUSS018) for northern Russia near the boundary with Finland developed for their climate assessment of the northern Scandinavian region. The data sets also consist of Scots pine and date back to the late 1400s in one data set. Dr. Kirill Christyakov of the St. Petersburg State University of Russia also contributed a Russian tree-ring data set from a site near the border with Mongolia. This data set extends back to AD 1493 and increases the number of tree-ring data sets for the central Asia area.

2.1.17 Spain

The largest contribution of tree-ring data came from Klaus Richter, who was a graduate student at the Institute of Wood Biology in Hamburg, Germany, when these data were developed. These data sets had been sent previously to the ITRDB but had been misplaced during the transition period when the ITRDB was taken over by the National Geophysical Data Center around 1990. Richard L. Holmes of the Laboratory of Tree-Ring Research at the University of Arizona in Tucson helped develop the original data used by Dr. Richter and had the data sets on file. He subsequently contributed these data sets to the ITRDB, and to him and Dr. Richter we are very grateful. The data sets were developed from 32 sites and were discussed in a 1991 publication in the ***Tree-Ring Bulletin,*** Volume 51, pages 1-13, entitled “The dendrochronological signal of pine trees (*Pinus* spp.) in Spain.” The total number of data sets contributed was 128, consisting of the original raw total ring width measurements and their associated three chronology types (standard, residual, and arstan).

2.1.18 Sweden

Markus Lindholm and Jouko Merilainen also contributed a chronology data set (SWED018) for northern Sweden as part of their climate assessment of the northern latitudes for the Scandinavian region. The chronology consists of Scots pine and extends back to AD 1803. Lars-Ake Larsson of Saltsjobaden, Sweden, contributed a data set from Naemdoe, Sweden (SWED302), consisting of Scots pine, that extends back to AD 1588. Interestingly, some of the wood used in this data set came from “a ship, which is probably built in the area,” “a log in the remainder of a fishing bridge,” “two houses” and “free wood pieces,” and from “an old gatepost where the wood was extremely conserved by lots of resin.” An extensive text file was contributed that explains the details of the wood used in this data set.

2.1.19 United States

2.1.19.1 Alabama

Alabama is a state not represented very well in the holdings of the ITRDB. Hence, we were pleased to receive eight data sets from one site in Alabama (AL002) from John Kush of the School of Forestry at Auburn University and his colleagues Neil Pederson and Ralph Meldahl. The contribution is additionally important because earlywood widths and latewood widths were measured separately from which standard, residual, and arstan chronologies were developed. The data represent measurements from longleaf pine (*Pinus palustris* Mill.) and date back to AD 1880.

2.1.19.2 Arkansas

Dr. David W. Stahle and his colleague Dr. Malcolm K. Cleaveland of the Tree-Ring Laboratory at the University of Arkansas - Fayetteville have been staunch supporters of the ITRDB over the years, contributing numerous tree-ring data sets from all over North America. Their latest contribution, three tree-ring chronologies from a site in Arkansas (AR054), was developed from baldcypress (*Taxodium distichum* (L.) Rich.) growing in the St. Francis Sunklands. These data were used to analyze effects of the 1811-1812 New Madrid earthquake on ecosystems in the middle Mississippi River area, and were featured in an article entitled “Applications of dendrochronology to earthquake studies in the New Madrid Seismic Zone of the central United States,” in L.A. Owen, I. Stewart, and C. Vita Finza, editors, ***Neotectonics: Recent Advances***, ***Quaternary Proceedings***, Volume 3, pages 85-91.

2.1.19.3 Arizona

Arizona is another state well-represented in the ITRDB. Rex Adams of the Laboratory of Tree-Ring Research, and students from the introductory dendrochronology class, Kate Baird, Lauri

Baxter, Lisa Pedicino, Karriaunna Scotti, and Alexandru Tissescu, contributed three data sets from a Douglas-fir site (AZ556) in Scheelite Canyon, Huachuca Mountains. These data extend back to AD 1630, and extend the holdings for this state southerly down to the border with Mexico.

2.1.19.4 California

Richard L. Holmes and his colleagues Rex Adams and Marty Rose of the University of Arizona contributed a measurement data set (CA514.RWL) for Kennedy Meadows that extends back to AD 1607. The chronology file for this site had previously been contributed - during the Quality Control assessment, it was discovered that several chronology files had been contributed without their associated measurement data. Mr. Holmes kindly contributed this and other data sets from his records.

2.1.19.5 Georgia

Georgia is another state under represented in the holdings of the ITRDB. Neil Pederson of the J.W. Jones Ecological Center in central Georgia (now with the Lamont-Doherty Tree-Ring Laboratory at Columbia University) contributed ten tree-ring chronologies (GA005-GA008) based on measurement data from longleaf pine. The oldest of these data sets extends back to AD 1802. Previous tree-ring collections from baldcypress rim the periphery of the Southeast; hence, these data help fill in gaps for southern Georgia.

2.1.19.6 Idaho

This measurement data file, ID006.RWL, was another of those whose chronology file had previously been contributed. Richard Holmes kindly contributed this data set once it was discovered that the measurement file had not made its way to the ITRDB.

2.1.19.7 Iowa

Dr. David M. Meko of the Laboratory of Tree-Ring Research at the University of Arizona and his colleague from the USDA Forest Service Rocky Mountain Station in South Dakota, Carolyn H. Sieg, developed an extensive network of tree-ring chronologies for the northern Great Plains in a project sponsored in part by the National Science Foundation. One site was collected in extreme northwestern Iowa at Stone State Park (IA033) and extends back to AD 1796. This and the other data sets developed for the Great Plains were discussed in the 1996 publication "Dendroclimatic potential in the northern Great Plains" in J.S. Dean, D.M. Meko, and T.W. Swetnam, editors, ***Tree Rings, Environment, and Humanity***, published by the journal *Radiocarbon*.

2.1.19.8 Maine

G. Andrew Bartholomay of the Pennsylvania State University and his colleague Robert T. Eckert contributed three data sets from Acadia National Park in Maine (ME035) based on eastern white pine (*Pinus strobus* L.). These data extend back to AD 1886, and were discussed in a recent article "Reductions in tree-ring widths of white pine following ozone exposure at Acadia National Park, Maine, USA," published in the ***Canadian Journal of Forest Research***, Volume 27, pages 361-378.

2.1.19.9 Michigan

A measurement file for tree-ring data collected at Hartwick Pines State Park (MI001) was contributed by Dr. Henri D. Grissino-Mayer of the Laboratory of Tree-Ring Research at the University of Arizona. The chronology file had previously been contributed, but inadvertently without its measurement file.

2.1.19.10 Missouri

Richard P. Guyette of Department of Forestry at the University of Missouri contributed three data sets (MO038) from a site in Shannon County, Missouri. The data set was developed from shortleaf pine (*Pinus echinata* Mill.) and extends back to AD 1553, the longest chronology yet developed for this species.

2.1.19.11 New Mexico

One of the longest tree-ring chronologies contributed was developed from Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) and ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) trees growing at El Malpais National Monument in northwestern New Mexico. Contributed by Henri D. Grissino-Mayer of the Laboratory of Tree-Ring Research (NM572), this chronology extends back to 136 BC, and represents the longest single site tree-ring chronology ever developed in the greater Southwest. This chronology was used to investigate both long-term (>100 years) and short-term trends in past precipitation patterns, and helped clarify the relationship between past climate and wildfire occurrences. The data were discussed in the article "A 2129-year reconstruction of precipitation for northwestern New Mexico, USA," in J.S. Dean, D.M. Meko, and T.W. Swetnam, editors, ***Tree Rings, Environment, and Humanity***, pages 191-204.

Margot Wilkinson Kaye and her colleagues from the Laboratory of Tree-Ring Research, Christopher H. Baisan and Thomas W. Swetnam, contributed four data sets (NM573) from ponderosa pine trees growing in the Sacramento Mountains of southern New Mexico. These data will be used in the master's thesis currently being completed by Ms. Kaye.

2.1.19.12 North Dakota

Numerous tree-ring data sets were contributed by David Meko and Carolyn Sieg developed for their overall assessment of past climate for the northern Great Plains region of the United States. These 18 data sets (six measurement files, and 12 chronology files, one standard and one residual chronology) mark the first contributions to the ITRDB from North Dakota, and are extremely valuable because they extend the network of tree-ring sites into regions of North America where tree-ring data had not previously existed. These data sets consist of ponderosa pine, bur oak (*Quercus macrocarpa* Michx.), and Rocky Mountain juniper (*Juniperus scopulorum* Sarg.).

2.1.19.13 Ohio

Dr. James P. McClenahen has been active in tree-ring research for several decades, and recently contributed six tree-ring data sets from two sites in southern Ohio (OH004-OH005). The data sets were developed from white oak (*Quercus alba* L.) on two adjacent sites, one consisting of a relict prairie and the other consisting of an adjacent forest. The data are discussed in a 25 page report submitted to the USDA Forest Service, Ironton Ranger District, entitled "Comparative forest age structure and growth response within the Buffalo Beats Research Natural Area." An extensive text file was contributed that thoroughly documents these data sets.

2.1.19.14 Oregon

Sixteen measurement files were contributed to the ITRDB by Richard L. Holmes, Rex K. Adams, Martin R. Rose, Wu Xiangding, Thomas W. Swetnam, and Christopher H. Baisan, all (at the time of collection) with the Laboratory of Tree-Ring Research in Tucson, Arizona. These data sets represent the raw data for chronologies that had previously been contributed. The data contributed by Dr. Swetnam and his colleagues, OR029-OR041, represent tree-ring data that served as control data for assessing the impact of insect defoliators on tree growth in the Pacific Northwest. Mr. Holmes contributed very valuable data sets for Frederick Butte in Oregon (OR015), which represents the longest tree-ring chronology yet developed for that state and for the Pacific Northwest overall.

2.1.19.15 South Dakota

David M. Meko and Carolyn H. Sieg contributed the largest data set ever developed for the state of South Dakota, representing 54 data sets from 18 sites (one raw measurement file, one standard tree-ring chronology, and one residual chronology for each site). The primary species sampled were ponderosa pine and bur oak, while one data set from Rocky Mountain juniper was contributed. Prior to this contribution, only one other tree-ring chronology had ever been developed in South Dakota. These data will prove vital to understanding the climate dynamics for the central portions of North America, where tree-ring data have been particularly scarce.

2.1.19.16 Virginia

David Lawrence of the Tree-Ring Laboratory at the Lamont-Doherty Earth Observatory in Palisades, New York, contributed four data sets (VA019) from chestnut oak (*Quercus prinus* L.) trees growing near Charlottesville, Virginia. The chronology extends back to 1881, and will increase the spatial coverage of tree-ring sites in this state.

2.1.19.17 Washington

Dr. Christopher J. Earle and his colleagues at the College of Forest Resources, University of Washington, contributed 21 data sets from seven sites in Washington (WA085-WA091). One site, the Big Quilcene River Trail, was developed from long-lived Douglas-fir trees, and extends back to an impressive AD 1288. Another chronology from Olympic Road extends back to AD 1394. The University of Washington researchers are known for their high standards in tree-ring data collection and quality control, and we consider these data sets to be a major contribution to the ITRDB.

2.1.19.18 West Virginia

Steve Adams and his colleagues developed and contributed tree-ring data sets from the Fernow Experimental Forest in West Virginia (WV003). Consisting of chestnut oak (*Quercus prinus* L.), the chronology extends back to AD 1865, and increases the data sets in a state that is largely under represented in the ITRDB.

2.2 Climate Reconstructions

2.2.1 Canada

Julian Szeicz and Glen MacDonald contributed a reconstruction of summer (June-July) average temperature based on their collections from white spruce in the northwestern provinces of Canada (see section 2.1.4 for a full description of these data). This reconstruction extends back to AD 1638.

Charles W. Stockton and Harold C. Fritts of the Laboratory of Tree-Ring Research at the University of Arizona contributed a reconstruction of lake levels for Lake Athabasca, Canada, that extends between AD 1810-1967 (Data Contribution Series # 94-015). The reconstruction was discussed in detail in "Long-term reconstruction of water level changes for Lake Athabasca by analysis of tree rings," ***Water Resources Bulletin***, Volume 9, number 5, pages 1006-1027.

2.2.2 Chile

José Boninsegna and his colleagues from the tree-ring laboratory in Mendoza, Argentina, contributed reconstructions for various locations in Chile, as described in "South American dendroclimatological records," in R.S. Bradley and P.D. Jones, editors, ***Climate Since A.D. 1500***, Routledge Press, London, pages 446-462. These reconstructions include (1) winter precipitation at Santiago de Chile between AD 1500-1972, (2) summer and winter anticyclone positions between AD 1500-1972, (3) summer precipitation at Chiloe, Chile, (4) temperature deviations from normal for northern Patagonia, AD 1500-1974 (5) deviations from normal for summer temperature at Rio Alerce, AD 1500-1983, (6) annual riverflow for Atuel River, AD 1575-1970, (7) annual riverflow for Neuquen River, AD 1602-1966, and (8) annual riverflow for Limay River, AD 1602-1966. This study used principal components analysis to investigate past temperature, precipitation, streamflow, and pressure patterns based on a network of tree-ring sites throughout South America. Species used included Chilean cedar (*Austrocedrus chilensis* (D.Don) Florin & Boutelje), monkey puzzle tree (*Araucaria araucana* (Molina) K. Koch), and alerce (*Fitzroya cuppressoides* (Molina) Johnston).

2.2.3 China

Malcolm K. Hughes, Wu Xiangding, Shao Xuemei, and Greg M. Garfin contributed a reconstruction of precipitation for north-central China at Huashan, Shaanxi Province, between AD 1600-1988 (Contribution Series # 96-020, see section 2.1.5 for the original citation). Total ring width was used to reconstruct total April-July precipitation, while maximum latewood density was used to reconstruct May-June total precipitation.

2.2.4 New Zealand

David A. Norton and Jonathan Palmer of Lincoln University in Canterbury, New Zealand, contributed numerous reconstructions for New Zealand, discussed in detail in "Dendroclimatic evidence from Australasia," in R.S. Bradley and P.D. Jones, editors, ***Climate Since A.D. 1500***, Routledge Press, London, pages 463-482. The reconstructions include (1) summer (November-January) precipitation for Lake Coleridge between AD 1879-1977, (2) summer riverflow for Hurunui between AD 1879-1977, (3) summer (January-March) temperatures between AD 1750-1982 based on tanekaha (*Phyllocladus trichomanoides* D. Don in Lamb.) and toatoa (*Phyllocladus glaucus* Carr.), and (4) summer (December-March) temperatures between AD 1730-1978 based on southern beech species (*Nothofagus* spp.).

2.2.5 Northern North America

Rosanne D. D'Arrigo and Gordon C. Jacoby of the Tree-Ring Laboratory, Lamont-Doherty Earth Observatory, Columbia University, contributed a reconstruction of annual temperature for northern portions of North America, discussed in "Dendroclimatic evidence from northern North America," in R.S. Bradley and P.D. Jones, editors, ***Climate Since A.D. 1500***, Routledge Press, London, pages 296-311. The reconstruction was based on tree-ring data from white spruce (*Picea glauca* (Moench) Voss) and northern white cedar (*Thuja occidentalis* L.), and extends back to AD 1601.

2.2.6 Russia

Don Graybill of the Laboratory of Tree-Ring Research, The University of Arizona, and his colleague Stepan G. Shiyatov of Ural Division of Russian Academy of Sciences in Ekaterinburg, Russia, contributed a reconstruction of summer temperature for northwestern Russia based on Siberian larch (*Larix sibirica* Ledeb.) that extends back to AD 981. This reconstruction was discussed in "Dendroclimatic evidence from the northern Soviet Union," in R.S. Bradley and P.D. Jones, editors, ***Climate Since A.D. 1500***, Routledge Press, London, pages 393-414.

2.2.7 Sweden

Keith R. Briffa and Fritz H. Schweingruber contributed tree-ring based reconstructions of summer temperature based on Scots pine (*Pinus sylvestris* L.) data collected from northern Sweden at Tornetrask, as well as from northern Finland at Lake Inari. These reconstructions extend back to AD 1500, and were discussed in "Recent dendroclimatic evidence of northern and central European summer temperatures," in R.S. Bradley and P.D. Jones, editors, ***Climate Since A.D. 1500***, Routledge Press, London, pages 366-392.

2.2.8 United States

2.2.8.1 Eastern United States

Edward R. Cook, David W. Stahle, and Malcolm K. Cleaveland contributed a reconstruction of the Palmer Drought Severity Index (PDSI) for the eastern United States from AD 1700-1972, published in "Dendroclimatic evidence from eastern North America," in R.S. Bradley and P.D. Jones, editors, ***Climate Since A.D. 1500***, Routledge Press, London, pages 331-348. The reconstruction used factor scores derived from principal components analysis of tree-ring data from sites located throughout the United States east of the Great Plains. These data were also used to develop a reconstruction of precipitation derived from these factor scores.

2.2.8.2 Great Plains

David M. Meko of the Laboratory of Tree-Ring Research at the University of Arizona contributed reconstructions for the Great Plains area of central United States based largely on tree-ring data obtained from the holdings of the ITRDB. These reconstructions extend between AD 1750-1964, and were discussed in "Dendroclimatic evidence from the Great Plains of the United States," in R.S. Bradley and P.D. Jones, editors, ***Climate Since A.D. 1500***, Routledge Press, London pages 312-330. The reconstructions represent standardized regional tree- ring series for regions 0 to 9 (Figure 16.1 in the book) and scores of the first three eigenvectors from principal components analysis on regional tree-ring series.

2.2.8.3 New Mexico

Henri D. Grissino-Mayer of Valdosta State University in Valdosta, Georgia (then with the Laboratory of Tree-Ring Research at the University of Arizona), contributed a reconstruction of water-year annual precipitation total based on tree-ring data from El Malpais National Monument in northwestern New Mexico (Data Contribution Series # 96-002, see section 2.1.19.11 for citation). The reconstruction revealed seven major centuries-long periods during the last 2,000 years of above and below average rainfall.

2.2.8.4 Oregon

Gregg M. Garfin and Malcolm K. Hughes of the Laboratory of Tree-Ring Research at the University of Arizona contributed reconstructions for both precipitation and the Palmer Drought Severity Index (PDSI) for NOAA climate divisions 7 and 8 in eastern Oregon (Data Contribution Series # 96-029). The reconstruction extends back to AD 1705-1979, and a manuscript has been submitted for publication in the journal ***Northwest Science***.

3. The ITRDB Quality Assessment Initiative

A major goal of the ITRDB during the last five years concerned the initiation and completion of a massive quality control assessment of the entire holdings of the ITRDB. This assessment was begun in September, 1994 (see the Final Report for the previous ITRDB project funded by the OGP sent in 1995) and completed in December, 1996. The first phase assessed the crossdating accuracy of 887 raw measurement data sets then in the holdings of the ITRDB. The second phase assessed the quality of the remaining measurement data sets, specifically focusing on two data sets, the FORAST (Forest Response to Anthropogenic Stress) tree-ring data set recently contributed by the Oak Ridge National Laboratory in Oak Ridge, Tennessee, and the large contribution of over 250 raw tree-ring measurement data sets donated by Dr. Fritz H. Schweingruber and his colleagues at the Swiss Federal Institute of Forestry in Birmensdorf, Switzerland. However, *all* 1,985 raw tree-ring measurement data sets currently held in the ITRDB were eventually assessed in this massive project, based on critical guidelines established during the initial phases of the quality control assessment.

All remaining tree-ring measurement data sets in the ITRDB (Version 2.0) were downloaded from the National Geophysical Data Center in Boulder, Colorado, to the server at the Laboratory of Tree-Ring Research. We used the modified computer program COFECHA to facilitate the assessment by evaluating the crossdating and measurement accuracy of all raw measurement series. In December 1996, over two years since the inception of this project, our student assistant hired specifically for this assessment, Mariette Seklecki, completed the COFECHA runs on the 1,986 measurement data sets. All results from the assessment were permanently recorded on computer as ASCII text files so that future researchers wishing to use these tree-ring data can assess for themselves the quality of the data. All text files were subsequently sent to the NGDC for permanent archiving along with any raw measurement files that needed correcting. The statistics from the COFECHA output for each file were written to a spreadsheet file for more detailed analyses. In addition, all output was printed to be permanently stored at the University of Arizona's Laboratory of Tree-Ring Research. The two spreadsheets (one for the FORAST data set and one for all other data sets) containing the results from this quality control assessment can be obtained for review by contacting Dr. Henri D. Grissino-Mayer at his Valdosta State University address..

The FORAST data set was collected by a multidisciplinary group representing 15 eastern laboratories, and consisted of over 14,000 increment cores from over 7,000 trees from 17 states. The tree-ring data contributed represent measurement files only. A total of 507 data sets were contributed, representing a wide geographic area in the eastern U.S. Most series extended to the early 1900s, although several extend to the 1800s and even earlier.

This quality control assessment for the FORAST data set tested the crossdating accuracy of over 76,908 30-year segments in 14,159 series from 507 raw measurement files. We found that the FORAST data sets contained 15,181 problem segments, or 25.3% of all segments tested, compared to the 5.2% found for the original 887 data sets tested between 1994 and 1995. This is nearly five times greater than the average number of problem segments. Numerous obvious misdated segments were uncovered during this assessment that should have been found easily during the original quality control assessment made by the original developers of these data. Some data sets did not contain series with any common signal, as all series showed no correlations above the 0.40 level established for this assessment. In addition, the average interseries correlation for all 506 data sets was 0.54, compared to the 0.64 value found for the original 887 data sets. These findings indicate to us that the tree-ring data in the FORAST data set, as a whole, should be considered suspect, as it contains data sets we consider to be lower in quality compared to the standards imposed by the dendrochronological community. Furthermore, each individual measurement file should be carefully inspected prior to its use by future investigators, and the text file associated with each should be carefully reviewed. It is obvious to us that the FORAST data set did not undergo rigorous quality control assessment, as had been previously stated, although the data set contains a few high quality individual data sets. We therefore must conclude that the FORAST data set, in its present condition, is unsuitable for inclusion in the holdings of the ITRDB for general distribution, and will be kept in a separate directory at the NGDC server apart from the main holdings of the ITRDB.

The tree-ring measurement and chronology data sets contributed by Fritz H. Schweingruber and his colleagues at the Swiss Federal Institute of Forestry constitute a major contribution to the holdings of the ITRDB. We found that the 255 individual measurement data sets contained very few misdated segments in only a very few isolated series. We consider the quality of the crossdating in these data sets to be minimally affected, if at all, by these few misdated segments. Overall, the quality of the Schweingruber data set is very high compared to the standards established by the original 887 data sets tested between 1994 and 1995. For example, only 2,280 of the 39,944 50-year segments tested, or only 6.1%, were considered problem segments, which compares favorably with the 5.2% found for the original 887 data sets. In addition, the average interseries correlation for all 255 data sets in the Schweingruber collection was 0.61, which also compares favorably with the 0.64 value obtained for the original 887 data sets. We concluded that the data sets contributed by Dr. Schweingruber and his colleagues constitute high quality tree-ring data, and will be assimilated into the holdings of the ITRDB.

Based on this massive quality control assessment on nearly two thousand raw tree-ring measurement data sets, we feel we have now established guidelines and criteria for assessing the quality of tree-ring data contributed to the WDC-A for Paleoclimatology, to be used by NGDC personnel. Guidelines should be used to determine how the data contribution compares to the other data sets already in the holdings of the ITRDB. Criteria should be used to determine whether a data contribution should be accepted unconditionally, accepted provisionally, or accepted with reservations.

Guidelines:

[**G1**] The average length of a tree-ring data set contribution to the ITRDB was 255 years. The minimum requirement is 100 years, although this can be waived under certain circumstances.

[**G2**] The average number of series per measurement data set contributed to the ITRDB is 29 series. A useful guidelines would therefore be 30 series per data set. The minimum requirement established by the ITRDB is ten series.

[**G3**] The average interseries correlation for all 1478 measurement data sets tested was 0.64, which can be used to evaluate the quality of the internal crossdating. Because the distribution of interseries correlations is a positive exponential, no critical levels based on standard deviations could be established.

[**G4**] The average mean sensitivity, a descriptive statistic used to assess the amount of signal a series is likely to contain, was 0.29.

[**G5**] The average first-order (serial) correlation (which measures the amount of signal carried over from one year to the next) for all 1478 data sets was 0.73.

Guidelines Summary: The average contribution to the ITRDB consists of a chronology approximately 255 years in length based on 30 series. The average interseries correlation is 0.64, the average mean sensitivity is 0.29, while the average serial correlation is 0.73.

Criteria:

[**C1**] To maintain compatibility with this assessment and the following guidelines, an assessment of the quality of crossdating of a tree-ring measurement data sets should test 50-year segments in data sets with series long enough for such testing. The critical threshold correlation coefficient is therefore 0.32. Shorter series can be tested if 50-year segments are too long (*e.g.*, the FORAST data set).

[**C2**] The worst 5% of the 1478 data sets tested had interseries correlations less than or equal to 0.46 for the entire data set. Therefore, any data set with values less than this level will be considered suspect but will be accepted into the general holdings of the ITRDB, provided additional criteria described below are met.

[**C3**] The average percentage of problem segments in a tree-ring measurement data set was 5.2%. Because the distribution of problem segments was a negative exponential, no critical levels based on standard deviations could be established.

[**C4**] We considered a data set suspect if 10% of the segments tested proved problematic. Based on this critical level, 83% of the 1478 data sets fell below this level and were therefore considered acceptable. To determine the absolute rejection level, we calculated the percentage of problem segments associated with the worst 5% of the 1478 data sets, which came out to be exactly 22%. Based on these guidelines, a data set is considered (1) acceptable without condition if the percentage of problem segments is less than or equal to 10%, (2) acceptable with conditions if the percentage of problem segments is 10.1%-21.9%, and (3) acceptable with reservations if the percentage of problem segments is 22% or higher.

[**C5**] A 50-year segment was considered a probable misdate if the correlation coefficient for an alternative dated position was at least twice that determined for the original dated position.

[**C6**] An entire series was considered misdated if the majority of all 50-year segments tested dated better at positions other than the original dated positions based on the correlation coefficients. Furthermore, these alternative positions must be *systematic* across all segments and appear reasonable (for example, adjustments of -2, -2, -2, -1, -1, -1 years rather than adjustments of -10, -5, +3, +10, and -4 years).

Criteria Summary: Tree-ring data are expected to represent the highest quality in crossdating accuracy. A raw measurement data for a chronology submitted to the ITRDB must pass the following criteria: (1) The interseries correlation of all series should be higher than 0.46. (2) The measurement data set should have no higher than 22% of all segments tested as being problem segments based on 50-year segments. (3) The data set should have no segments or series misdated.

4. Travel to Other Tree-Ring Laboratories and Dendroecological Fieldweeks

As outlined in the original proposal, funding was requested to cover costs for domestic travel "...to allow ITRDB personnel to visit the laboratories of potential contributors to aid in their donation of tree-ring data." We consider this a vital function of the ITRDB to ensure: (1) tree-ring data are periodically contributed, (2) the tree-ring data will be of the highest quality, and (3) the ITRDB will be highly visible in the scientific community. Three trips were made by ITRDB personnel to the following tree-ring laboratories in the United States:

[1] the newly-initiated Tree-Ring Laboratory in the Department of Geography at the **University of Georgia**, Athens, Georgia, headed by Drs. Albert J. Parker and Kathleen C. Parker,

[2] the **USDA Forest Service** in Delaware, Ohio, where Dr. Elaine Kennedy Sutherland develops tree-ring data in her studies on climate/wildfire relationships, and

[3] the Department of Geography at The **Pennsylvania State University**, where Dr. Alan Taylor and his colleagues have initiated impressive tree-ring related projects for numerous locations in the United States.

These trips were mostly informative and educational, where ITRDB representative Dr. Henri D. Grissino-Mayer demonstrated and taught the basics of dendrochronology, and specifically focused on the quality of tree-ring data. Many researchers new to the field are not aware that dendrochronology is an exact science, and that no error should exist anywhere in the tree-ring data. Software was provided to these laboratories and set up on local personal computers as well, then demonstrated over the course of several days. These trips were made with the understanding that any future tree-ring data developed by these laboratories will make their way to the holdings of the ITRDB.

In addition, Dr. Henri D. Grissino-Mayer and Dr. Harold C. Fritts attended the Seventh North American Dendroecological Fieldweek at the USDA Forest Service Bartlett Experimental Forest in Bartlett, New Hampshire, in August, 1996, and the Eighth North American Dendroecological Fieldweek at the USDA Forest Service Bartlett Experimental Forest in Blue River, Oregon, in August, 1997. Up to 50 researchers participate annually in the North American Fieldweeks, which provides an opportunity for the ITRDB to increase its visibility in the scientific community while providing assistance to those developing tree-ring data. At these workshops, Drs. Grissino-Mayer and Fritts

[1] demonstrated the use of the ITRDB software for retrieving and displaying data sets,
[2] solicited tree-ring data from participants to the Fieldweeks,
[3] demonstrated and used the ITRDB Program Library in actual case studies for several of the projects conducted at the Fieldweeks,
[4] distributed diskettes containing the ITRDB Program Library, and sold numerous User's Manuals at cost, and
[5] gave four one-hour presentations about resources available to the dendrochronological community, including a brief history and background to the ITRDB.

5. Publications by the ITRDB

During the last two years, the ITRDB has published three articles in two major journals that helped increase the visibility of the ITRDB in the international scientific community. The publication of all three articles was a direct result of funding supplied by the NOAA OGP to the ITRDB over the years.

[1] "The International Tree-Ring Data Bank: An Enhanced Global Database Serving the Global Scientific Community," by Henri D. Grissino-Mayer and Harold C. Fritts, published in ***The***

Holocene, 1997, Volume 7, Number 2, pages 235-238. This journal specializes in publishing articles that investigate environments at time scales appropriate for the use of tree-ring data. This article outlines the 20-year history, information on the current holdings of the ITRDB, minimum data requirements and quality control standards, information on the current Advisory Committee of the ITRDB, and also provides detailed information for obtaining the holdings and software distributed by the ITRDB. The full text of this manuscript was placed online on the Worldwide Web at: http://www.valdosta.edu/~grissino/itrdb.htm.

[2] "An Updated List of Species Used in Tree-Ring Research, " by Henri D. Grissino-Mayer, published in the ***Tree-Ring Bulletin***, 1996, Volume 53, pages 17-45. The creation and maintenance of this important list was a direct result of funding supplied by the NOAA OGP to the ITRDB over the years. A full online version of this species list has recently been placed on the Worldwide Web at: http://www.valdosta.edu/~grissino/species.htm.

[3] "Computer-Assisted Independent-Observer Verification of Tree-Ring Measurements," by Henri D. Grissino-Mayer, published in the ***Tree-Ring Bulletin***, 1997, Volume 54, pages 29-41. This article provides information on quantitative and qualitative techniques for measuring ring sequences to ensure high-quality ring measurements are obtained. The creation of the computer program used for the verification process, VERIFY5, was a direct result of funding from the NOAA OGP (acknowledged in the manuscript) over the years. Reprints of all three manuscripts are being submitted to the NOAA OGP as part of this Final Report.

In addition, we hope to eventually publish an article about the findings from our Quality Control Assessment concerning the descriptive statistics for the 1498 data sets tested. During our assessment, we created spreadsheet files containing information about the species used, elevation, latitude, and longitude of the site sampled, and all important statistics used to describe tree-ring chronologies (*e.g.*, mean sensitivity, standard deviation, serial correlation). This information can therefore be used to summarize tree-ring data based on site characteristics, location, and species, along latitudinal, longitudinal, and elevational gradients. Such a publication would build upon a previous study by Harold C. Fritts and D.J. Shatz (1975) entitled, "Selecting and characterizing tree-ring chronologies for dendroclimatic analysis," ***Tree-Ring Bulletin***, Volume 35, pages 31-40.

6.0 Enhancements to the ITRDB Program Library

The ITRDB Program Library continues to be one of the major accomplishments of the ITRDB, and has made a major impact on the dendrochronological community since its first release in

August, 1992. In January 1997, we released Version 2.1 of the Program Library which contains improvements in many of the programs. These include increases in functionality of the DPL (Dendrochronology Program Library) and ARSTAN thanks to improvements made by Richard L. Holmes on behalf of the current ITRDB project. Thierry Varem-Sanders of the Canadian Forestry Service recently sent an improved version of his graphics program ITRVIEW, which now allows users to actually “slide” one tree-ring data series against another to help in the crossdating process. Henri D. Grissino-Mayer also improved the programs VERIFY5 and CONVERT5, incorporating suggestions made by users, and also updated the species and address databases distributed with the Program Library. Recently, both the ITRDB species (see section above) and ITRDB address databases were also made accessible via the Worldwide Web. Since January 1997, diskettes containing the ITRDB Program Library Version 2.1 have been distributed to 135 scientists worldwide in 23 countries (Table 3): United States, Canada, Spain, Russia, Sweden, Latvia, Japan, France, England, Germany, Northern Ireland, Ireland, Finland, Romania, Austria, Slovenia, Italy, Turkey, Australia, Nepal, Ukraine, Bermuda, and India. This does not include individuals who obtained the Program Library via anonymous ftp from the server at the Laboratory of Tree-Ring Research.

7.0 The Future

With the submission of this Final Report, the ITRDB data initiative, outreach program, and quality control assessment conducted over the last six years comes to an end. We believe the ITRDB has matured into the premier paleoclimatic database in the world and will continue to serve the scientific community for years to come. However, the ITRDB will continue its mission despite the decrease in external funding, and will continue to solicit for contributions through its advisory committee and through its participation and management of the Internet Forum. We believe we have educated the dendrochronological community about the importance of the ITRDB and its role for understanding global climate change and its trends in the past and well into the future. We have now archived over 3,500 tree-ring chronologies from around the world that can serve as baseline data for future climate modelers, and can serve to verify or fine-tune such modeling efforts. Eventually, the ITRDB would like to see an expansion of its holdings to include tree-ring data from the subtropical and tropical regions of the world to better understand such global events as the El Niño-Southern Oscillation, as well as the impacts of volcanism on global climate.

TABLE 1. New tree-ring measurement data and/or tree-ring chronologies contributed to the ITRDB between May 1995 and November 1997. M = measurement file containing raw data, C = chronology file.

Region/Country	File Name	Site Name	Range	Type	Contributor(s)
AUSTRIA	AUST109.RWL	Bierhaeusberg	1840-1995	M	Giorgio Strumia, Rupert Wimmer
	AUST109E.RWL	Bierhaeusberg	1840-1995	M	
BELGIUM	BELG001.CRN	Ardennes Archaeological	1118-1986	C	Patrick Hoffsummer
	BELG002.CRN	Liege Archaeological	672-1614	C	
	BELG003.CRN	Meuse Valley Arch.	672-1989	C	
	BELG004.CRN	Namur Archaeological	919-1638	C	
GREAT BRITAIN	BRIT029.CRN	Gloucester Blackfriars	BC72-72	C	Jennifer Hillam
	BRIT030.CRN	Aydon Castle	1424-1543	C	
	BRIT031.CRN	Bradfield	1879-1984	C	
	BRIT032.CRN	Porter Brook (ash)	1825-1987	C	
	BRIT033.CRN	Porter Brook (oak)	1818-1987	C	
	BRIT034.CRN	Bretton Lakes	1873-1984	C	
	BRIT035.CRN	Brookadale	1844-1984	C	
CANADA	CANA9.RWL	Stein Valley	1598-1995	M	Eva Riccius, Joseph Fall, Ken Lertzman
	CANA10.RWL	Stein Valley	1496-1995	M	
	CANA117.CRN	Discovery Ridge	1409-1991	C	Julian Szeicz, Glen MacDonald,
	CANA118.CRN	Discovery Ridge	1620-1991	C	J. Lundberg
	CANA119.CRN	Katherine Creek	1506-1989	C	
	CANA120.CRN	Katherine Creek	1700-1989	C	
	CANA121.CRN	Richardson Mountain	1547-1992	C	
	CANA122.CRN	Richardson Mountain	1580-1992	C	
	CANA123.CRN	Skipping Bullet	1588-1989	C	
	CANA124.CRN	Skipping Bullet	1780-1989	C	
	CANA125.CRN	Tombstone Mountain	1470-1992	C	

CANA126.CRN	Tombstone Mountain	1530-1992	C	
CANA127.RWL	Dividing Lake	1662-1994	M	Richard P. Guyette
CANA127.CRN	Dividing Lake	1662-1994	C	
CANA127A.CRN	Dividing Lake	1662-1994	C	
CANA127R.CRN	Dividing Lake	1663-1994	C	
CANA128.RWL	Hobbs Lake	1547-1994	M	
CANA128.CRN	Hobbs Lake	1547-1994	C	
CANA128A.CRN	Hobbs Lake	1547-1994	C	
CANA128R.CRN	Hobbs Lake	1552-1994	C	
CANA129.RWL	Wood Bufflao NP	1833-1989	M	Chris Larsen, Julian Szeicz,
CANA129.CRN	Wood Buffalo NP	1833-1989	C	M.Hutton, K.Moser
CANA129R.CRN	Wood Buffalo NP	1833-1989	C	
CANA130.RWL	Wood Buffalo NP	1846-1989	M	
CANA130.CRN	Wood Buffalo NP	1846-1989	C	
CANA130R.CRN	Wood Buffalo NP	1846-1989	C	
CANA131.RWL	Wood Buffalo NP	1866-1989	M	
CANA131.CRN	Wood Buffalo NP	1866-1989	C	
CANA131R.CRN	Wood Buffalo NP	1866-1989	C	
CANA132.RWL	Wood Buffalo NP	1852-1989	M	
CANA132.CRN	Wood Buffalo NP	1852-1989	C	
CANA132R.CRN	Wood Buffalo NP	1852-1989	C	
CANA133.RWL	Wood Buffalo NP	1857-1989	M	
CANA133.CRN	Wood Buffalo NP	1857-1989	C	
CANA133R.CRN	Wood Buffalo NP	1857-1989	C	
CANA134.CRN	Swan Lake, Ontario	892-1890	C	Richard Guyette, Bill Cole
CANA134.RWL	Swan Lake, Ontario	892-1890	C	
CANA134A.CRN	Swan Lake, Ontario	892-1890	C	
CANA134R.CRN	Swan Lake, Ontario	892-1890	C	
CANA135.CRN	Towers Ridge	1315-1992	C	Glen MacDonald, Roslyn Case
CANA136.CRN	Crowsnest Pass	1466-1989	C	

CANA137.CRN	Lundbreck Falls	1467-1992	C	
CANA135.RWL	Towers Ridge	1315-1992	M	
CANA136.RWL	Crowsnest Pass	1466-1989	M	
CANA137.RWL	Lundbreck Falls	1467-1992	M	
CANA138.CRN	Campbell Dolomite	1060-1992	C	Julian Szeicz, Glen MacDonald,
CANA138.RWL	Campbell Dolomite	1060-1992	M	J. Lundberg
CANA138A.CRN	Campbell Dolomite	1064-1992	C	
CANA138R.CRN	Campbell Dolomite	1068-1992	C	
CANA139.CRN	St-Marguerite	1768-1995	C	Cornelia Krause, François Gionest
CANA139.RWL	St-Marguerite	1768-1995	M	
CANA140.CRN	Cote Nord 30	1713-1996	C	
CANA141.CRN	Lac Liberal 23	1751-1995	C	
CANA142.CRN	Lac Liberal 12	1839-1994	C	
CANA143.CRN	Lac Onatchiway	1841-1993	C	
CANA144.CRN	Mont Valin	1789-1994	C	
CANA145.CRN	Boreas SSA, Site 1	1871-1994	C	David M. Lawrence, Ian D. Campbell,
CANA145A.CRN	Boreas SSA, Site 1	1871-1994	C	Thierry M.L. Varem-Sanders
CANA145.RWL	Boreas SSA, Site 1	1871-1994	M	
CANA145N.CRN	Boreas SSA, Site 1	1871-1994	C	
CANA145N.RWL	Boreas SSA, Site 1	1871-1994	M	
CANA145NA.CRN	Boreas SSA, Site 1	1872-1994	C	
CANA145NR.CRN	Boreas SSA, Site 1	1873-1994	C	
CANA145R.CRN	Boreas SSA, Site 1	1871-1994	C	
CANA145X.RWL	Boreas SSA, Site 1	1871-1994	M	
CANA145X.CRN	Boreas SSA, Site 1	1871-1994	C	
CANA145XA.CRN	Boreas SSA, Site 1	1872-1994	C	
CANA145XR.CRN	Boreas SSA, Site 1	1875-1994	C	
CANA146.CRN	Boreas SSA, Site 3	1903-1994	C	Pochalek, Lawrence, Campbell,
CANA146A.CRN	Boreas SSA, Site 3	1906-1994	C	Varem-Sanders
CANA146.RWL	Boreas SSA, Site 3	1903-1994	M	

	CANA146N.CRN	Boreas SSA, Site 3	1903-1994	C	
	CANA146N.RWL	Boreas SSA, Site 3	1903-1994	M	
	CANA146NA.CRN	Boreas SSA, Site 3	1903-1994	C	
	CANA146NR.CRN	Boreas SSA, Site 3	1906-1994	C	
	CANA146R.CRN	Boreas SSA, Site 3	1909-1994	C	
	CANA146X.RWL	Boreas SSA, Site 3	1903-1994	M	
	CANA146X.CRN	Boreas SSA, Site 3	1903-1994	C	
	CANA146XA.CRN	Boreas SSA, Site 3	1905-1994	C	
	CANA146XR.CRN	Boreas SSA, Site 3	1907-1994	C	
CHINA	CHIN004.CRN	Huashan	1540-1989	C	X.D. Wu, X.M. Shao, M.K. Hughes,
	CHIN004A.CRN	Huashan	1540-1989	C	J.M. Burns, G.M. Garfin
	CHIN004E.CRN	Huashan	1540-1989	C	
	CHIN004L.CRN	Huashan	1540-1989	C	
	CHIN004N.CRN	Huashan	1540-1989	C	
	CHIN004R.CRN	Huashan	1540-1989	C	
	CHIN004X.CRN	Huashan	1540-1989	C	
	CHIN004.RWL	Huashan	1540-1989	M	
	CHIN004E.RWL	Huashan	1540-1989	M	
	CHIN004L.RWL	Huashan	1540-1989	M	
	CHIN004N.RWL	Huashan	1540-1989	M	
	CHIN004X.RWL	Huashan	1540-1989	M	
	CHIN004EA.CRN	Huashan	1540-1989	C	
	CHIN004ER.CRN	Huashan	1540-1989	C	
	CHIN004LA.CRN	Huashan	1540-1989	C	
	CHIN004LR.CRN	Huashan	1540-1989	C	
	CHIN004XA.CRN	Huashan	1540-1989	C	
	CHIN004XR.CRN	Huashan	1540-1989	C	
THE CZECH	CZEC001.RWL	Krkonose Mountains	1790-1991	M	Constantin Sander, Dieter Eckstein,

REPUBLIC	CZEC001.CRN	Krkonose Mountains	1790-1991	C	Jaroslav Dobry, J. Kyncl
	CZEC001X.RWL	Krkonose Mountains	1790-1991	M	
	CZEC001X.CRN	Krkonose Mountains	1790-1991	C	
	CZEC002.RWL	Krkonose Mountains	1790-1991	M	
	CZEC002.CRN	Krkonose Mountains	1790-1991	C	
	CZEC002X.RWL	Krkonose Mountains	1790-1991	M	
	CZEC002X.CRN	Krkonose Mountains	1790-1991	C	
DOMINICAN	CRB14.RWL	La Celestina	RELATIVE	M	Xander van der Burgt
REPUBLIC	CRBCRN.RES	La Celestina	RELATIVE	C	
	CRBCRN.STD	La Celestina	RELATIVE	C	
FINLAND	FINL021.CRN	Karhunpe	1398-1993	C	Markus Lindholm, J. Merilainen
	FINL022.CRN	Uusijoki	1659-1992	C	
FRANCE	FRAN029.CRN	Bourgogne	681-1991	C	Georges Lambert, Christine Lavier,
	FRAN030.CRN	Franche-Comte	1294-1987	C	Yvonne Trenards
	FRAN031.CRN	Chartrans	1360-1984	C	Andre Billamboz
GERMANY	GERM021.CRN	Bodensee 1 Arch	BC4052-BC3812	C	Andre Billamboz
	GERM022.CRN	Bodensee 2 Arch	BC3737-BC3507	C	
	GERM023.CRN	Bodensee 3 Arch	BC3536-BC3275	C	
	GERM024.CRN	Bodensee 4 Arch	BC3232-BC2417	C	
	GERM025.CRN	Bodensee 5 Arch	BC1780-BC1503	C	
	GERM026.CRN	Bodensee 6 Arch	BC1187-BC850	C	Andre Billamboz
	GERM027.CRN	Upper Suevia 1 Arch	BC4228-BC3651	C	
	GERM028.CRN	Upper Suevia 2 Arch	BC3562-BC3263	C	
	GERM029.CRN	Upper Suevia 3 Arch	BC1955-BC1481	C	
	GERM030.CRN	Upper Suevia 4 Arch	BC2386-BC1963	C	

	GERM031.CRN	Upper Suevia 5 Arch	BC1258-BC871	C	
	GERM032.CRN	Bodensee	1275-1986	C	
ITALY	ITAL023.CRN	Fodora Vedla Alm	1474-1990	C	Wulf Huesken
	ITAL024.CRN	Fodora Vedla Alm	1520-1990	C	
	ITAL025.CRN	Fodora Vedla Alm	1598-1990	C	
MONGOLIA	CENTASIA.DAT	Harhira-Ula	1592-1992	M	Kirill V. Chistykov
	CENTASIA.DAT	Harhira-Ula	1637-1992	M	
	CENTASIA.DAT	Turgeny-Nuru	1581-1991	M	
	CENTASIA.DAT	Turgeny-Nuru	1745-1991	M	
	CENTASIA.DAT	Turgeny-Nuru	1757-1991	M	
NETHERLANDS	NETH020.RWL	Arcen	1883-1986	M	Paul Maessen
	NETH020.CRN	Arcen	1883-1986	C	
	NETH021.RWL	Bennekomsee Bos	1868-1990	M	
	NETH021.CRN	Bennekomsee Bos	1868-1990	C	
	NETH022.RWL	Bijvanck	1888-1991	M	
	NETH022.CRN	Bijvanck	1888-1991	C	
	NETH023.RWL	Bijvanck	1889-1991	M	
	NETH023.CRN	Bijvanck	1889-1991	C	
	NETH024.RWL	Bijvanck	1889-1991	M	
	NETH024.CRN	Bijvanck	1889-1991	C	
	NETH025.RWL	Landgoed Hillenraad	1783-1986	M	
	NETH025.CRN	Landgoed Hillenraad	1783-1986	C	
	NETH026.RWL	Leudal	1861-1986	M	
	NETH026.CRN	Leudal	1861-1986	C	
	NETH027.RWL	Paleispark ‘T Loo	1831-1989	M	
	NETH027.CRN	Paleispark ‘T Loo	1831-1989	C	
	NETH028.RWL	Mattemburgh	1836-1991	M	

	NETH028.CRN	Mattemburgh	1836-1991	C	
	NETH029.RWL	Mattemburgh	1836-1991	M	
	NETH029.CRN	Mattemburgh	1836-1991	C	
	NETH030.RWL	Mattemburgh	1841-1991	M	
	NETH030.CRN	Mattemburgh	1841-1991	C	
	NETH031.RWL	Neth Scots Pine	1783-1990	M	
	NETH031.CRN	Neth Scots Pine	1783-1990	C	
	NETH032.RWL	Oud Groevenbeek	1879-1986	M	
	NETH032.CRN	Oud Groevenbeek	1879-1986	C	
	NETH033.RWL	Oisterwijkse Vennen	1804-1989	M	
	NETH033.CRN	Oisterwijkse Vennen	1804-1989	C	
	NETH034.RWL	Paleispark ‘T Loo	1856-1989	M	
	NETH034.CRN	Paleispark ‘T Loo	1856-1989	C	
NEW ZEALAND	NEWZ059.CRN	Ahaura	1525-1992	C	Limin Xiong, Jonathan Palmer
	NEWZ059A.CRN	Ahaura	1610-1992	C	
	NEWZ059R.CRN	Ahaura	1530-1992	C	
	NEWZ060.CRN	Mt. Egmont	1616-1990	C	
	NEWZ060A.CRN	Mt. Egmont	1617-1990	C	
	NEWZ060R.CRN	Mt. Egmont	1623-1990	C	
	NEWZ061.CRN	North Egmont	1625-1990	C	
	NEWZ061A.CRN	North Egmont	1628-1990	C	
	NEWZ061R.CRN	North Egmont	1629-1990	C	
	NEWZ062.CRN	Takapari	1256-1992	C	
	NEWZ062A.CRN	Takapari	1256-1990	C	
	NEWZ062R.CRN	Takapari	1258-1990	C	
	NEWZ063.CRN	Urewera	1140-1992	C	
	NEWZ063A.CRN	Urewera	1141-1992	C	
	NEWZ063R.CRN	Urewera	1142-1992	C	
	NEWZ064.CRN	Clearwater	1450-1991	C	

NEWZ064A.CRN	Clearwater	1452-1991	C
NEWZ064R.CRN	Clearwater	1453-1991	C
NEWZ065.CRN	Flanagans Hut	1683-1991	C
NEWZ065A.CRN	Flanagans Hut	1684-1991	C
NEWZ065R.CRN	Flanagans Hut	1685-1991	C
NEWZ066.CRN	Hihitahi	1431-1991	C
NEWZ066A.CRN	Hihitahi	1431-1991	C
NEWZ066R.CRN	Hihitahi	1433-1991	C
NEWZ067.CRN	Moa Park	1490-1991	C
NEWZ067A.CRN	Moa Park	1490-1991	C
NEWZ067R.CRN	Moa Park	1491-1991	C
NEWZ068.CRN	Ohutu Ridge	1585-1991	C
NEWZ068A.CRN	Ohutu Ridge	1587-1991	C
NEWZ068R.CRN	Ohutu Ridge	1588-1991	C
NEWZ069.CRN	Ruahine Corner	1473-1991	C
NEWZ069A.CRN	Ruahine Corner	1473-1991	C
NEWZ069R.CRN	Ruahine Corner	1475-1991	C
NEWZ070.CRN	Rahu Saddle	1560-1992	C
NEWZ070A.CRN	Rahu Saddle	1562-1992	C
NEWZ070R.CRN	Rahu Saddle	1563-1992	C
NEWZ071.CRN	Stratford Side	1526-1990	C
NEWZ071A.CRN	Stratford Side	1627-1990	C
NEWZ071R.CRN	Stratford Side	1629-1990	C
NEWZ072.CRN	Hauhungatahi A	1511-1992	C
NEWZ072A.CRN	Hauhungatahi A	1512-1992	C
NEWZ072R.CRN	Hauhungatahi A	1513-1992	C
NEWZ073.CRN	Hauhungatahi B	1332-1992	C
NEWZ073A.CRN	Hauhungatahi B	1330-1992	C
NEWZ073R.CRN	Hauhungatahi B	1333-1992	C
NEWZ074.CRN	Hauhungatahi C	1213-1992	C

	NEWZ074A.CRN	Hauhungatahi C	1212-1992	C	
	NEWZ074R.CRN	Hauhungatahi C	1214-1992	C	
	NEWZ075.CRN	Werberforce	1672-1992	C	
	NEWZ075A.CRN	Werberforce	1678-1992	C	
	NEWZ075R.CRN	Werberforce	1679-1992	C	
NORWAY	NORW007.CRN	Karasjok	1698-1992	C	Markus Lindholm, J. Merilainen
RUSSIA	RUSS016.CRN	Paajarv1	1546-1993	C	Markus Lindholm, J. Merilainen
	RUSS017.CRN	Paajarv2	1471-1993	C	
	RUSS018.CRN	Paajarv3	1707-1993	C	
	CENTASIA.DAT	Mongun Tayga Mountain	1493-1991	M	Kirill V. Chistykov
SPAIN	SPAI022.RWL	Albarracin-Bezas	1821-1985	M	Klaus Richter
	SPAI022.CRN	Albarracin-Bezas	1821-1985	C	
	SPAI022A.RWL	Albarracin-Bezas	1822-1985	C	
	SPAI022R.RWL	Albarracin-Bezas	1824-1985	C	
	SPAI023.RWL	Albarracin-Valdecuenca	1887-1985	M	
	SPAI023.CRN	Albarracin-Valdecuenca	1887-1985	C	
	SPAI023A.CRN	Albarracin-Valdecuenca	1887-1985	C	
	SPAI023R.CRN	Albarracin-Valdecuenca	1888-1985	C	
	SPAI024.RWL	Anzo-Zuriza	1696-1985	M	
	SPAI024.CRN	Anzo-Zuriza	1696-1985	C	
	SPAI024A.CRN	Anzo-Zuriza	1696-1985	C	
	SPAI024R.CRN	Anzo-Zuriza	1697-1985	C	
	SPAI025.RWL	Las Banas 1	1745-1985	M	
	SPAI025.CRN	Las Banas 1	1745-1985	C	
	SPAI025A.CRN	Las Banas 1	1746-1985	C	
	SPAI025R.CRN	Las Banas 1	1749-1985	C	
	SPAI026.RWL	Puerto Llano	1585-1985	M	

SPAI026.CRN	Puerto Llano	1585-1985	C
SPAI026A.CRN	Puerto Llano	1587-1985	C
SPAI026R.CRN	Puerto Llano	1590-1985	C
SPAI027.RWL	Canada de la Fuente	1698-1985	M
SPAI027.CRN	Canada de la Fuente	1698-1985	C
SPAI027A.CRN	Canada de la Fuente	1699-1985	C
SPAI027R.CRN	Canada de la Fuente	1702-1985	C
SPAI028.RWL	Las Banas II	1836-1985	M
SPAI028.CRN	Las Banas II	1836-1985	C
SPAI028A.CRN	Las Banas II	1837-1985	C
SPAI028R.CRN	Las Banas II	1838-1985	C
SPAI029.RWL	Cuenca-Buenache	1711-1985	M
SPAI029.CRN	Cuenca-Buenache	1711-1985	C
SPAI029A.CRN	Cuenca-Buenache	1711-1985	C
SPAI029R.CRN	Cuenca-Buenache	1712-1985	C
SPAI030.RWL	Cuenca-Las Majadas	1809-1985	M
SPAI030.CRN	Cuenca-Las Majadas	1809-1985	C
SPAI030A.CRN	Cuenca-Las Majadas	1810-1985	C
SPAI030R.CRN	Cuenca-Las Majadas	1811-1985	C
SPAI031.RWL	Cuenca-Las Torcas	1728-1985	M
SPAI031.CRN	Cuenca-Las Torcas	1728-1985	C
SPAI031A.CRN	Cuenca-Las Torcas	1728-1985	C
SPAI031R.CRN	Cuenca-Las Torcas	1729-1985	C
SPAI032.RWL	Cuenca-Vega de Cordone	1794-1985	M
SPAI032.CRN	Cuenca-Vega de Cordone	1794-1985	C
SPAI032A.CRN	Cuenca-Vega de Cordone	1795-1985	C
SPAI032R.CRN	Cuenca-Vega de Cordone	1799-1985	C
SPAI033.RWL	Gredos-Hoyos de Espino	1813-1985	M
SPAI033.CRN	Gredos-Hoyos de Espino	1813-1985	C
SPAI033A.CRN	Gredos-Hoyos de Espino	1813-1985	C

SPAI033R.CRN	Gredos-Hoyos de Espino	1814-1985	C
SPAI034.RWL	Navarredonda	1769-1985	M
SPAI034.CRN	Navarredonda	1769-1985	C
SPAI034A.CRN	Navarredonda	1769-1985	C
SPAI034R.CRN	Navarredonda	1770-1985	C
SPAI035.RWL	Guadarrama-Camorca	1726-1985	M
SPAI035.CRN	Guadarrama-Camorca	1726-1985	C
SPAI035A.CRN	Guadarrama-Camorca	1726-1985	C
SPAI035R.CRN	Guadarrama-Camorca	1727-1985	C
SPAI036.RWL	Guadarrama-Iniesto	1749-1985	M
SPAI036.CRN	Guadarrama-Iniesto	1749-1985	C
SPAI036A.CRN	Guadarrama-Iniesto	1749-1985	C
SPAI036R.CRN	Guadarrama-Iniesto	1750-1985	C
SPAI037.RWL	Guadarrama-Noruego	1661-1985	M
SPAI037.CRN	Guadarrama-Noruego	1661-1985	C
SPAI037A.CRN	Guadarrama-Noruego	1663-1985	C
SPAI037R.CRN	Guadarrama-Noruego	1664-1985	C
SPAI038.RWL	Guadarrama-Rascafria	1599-1985	M
SPAI038.CRN	Guadarrama-Rascafria	1599-1985	C
SPAI038A.CRN	Guadarrama-Rascafria	1599-1985	C
SPAI038R.CRN	Guadarrama-Rascafria	1602-1985	C
SPAI039.RWL	Gudar-Fuentenarices	1681-1985	M
SPAI039.CRN	Gudar-Fuentenarices	1681-1985	C
SPAI039A.CRN	Gudar-Fuentenarices	1681-1985	C
SPAI039R.CRN	Gudar-Fuentenarices	1683-1985	C
SPAI040.RWL	Gudar-Pradillo	1859-1985	M
SPAI040.CRN	Gudar-Pradillo	1859-1985	C
SPAI040A.CRN	Gudar-Pradillo	1859-1985	C
SPAI040R.CRN	Gudar-Pradillo	1861-1985	C
SPAI041.RWL	Gudar-Los Roquetas	1681-1985	M

SPAI041.CRN	Guar-Los Roquetas	1681-1985	C
SPAI041A.CRN	Gudar-Los Roquetas	1681-1985	C
SPAI041R.CRN	Gudar-Los Roquetas	1682-1985	C
SPAI042.RWL	Gudar-Cantavieja	1844-1985	M
SPAI042.CRN	Gudar-Cantavieja	1844-1985	C
SPAI042A.CRN	Gudar-Cantavieja	1845-1985	C
SPAI042R.CRN	Gudar-Cantavieja	1846-1985	C
SPAI043.RWL	Gudar-Villarluengo	1829-1985	M
SPAI043.CRN	Gudar-Villarluengo	1829-1985	C
SPAI043A.CRN	Gudar-Villarluengo	1829-1985	C
SPAI043R.CRN	Gudar-Villarluengo	1830-1985	C
SPAI044.RWL	Hecho-Puerto de Acher	1605-1985	M
SPAI044.CRN	Hecho-Puerto de Acher	1605-1985	C
SPAI044A.CRN	Hecho-Puerto de Acher	1606-1985	C
SPAI044R.CRN	Hecho-Puerto de Acher	1607-1985	C
SPAI045.RWL	Cuenca - Una Site 1	1638-1985	M
SPAI045.CRN	Cuenca - Una Site 1	1638-1985	C
SPAI045A.CRN	Cuenca - Una Site 1	1638-1985	C
SPAI045R.CRN	Cuenca - Una Site 1	1639-1985	C
SPAI046.RWL	Cuenca - Una Site 2	1644-1985	M
SPAI046.CRN	Cuenca - Una Site 2	1644-1985	C
SPAI046A.CRN	Cuenca - Una Site 2	1645-1985	C
SPAI046R.CRN	Cuenca - Una Site 2	1646-1985	C
SPAI047.RWL	Urbion-Covaleda	1567-1985	M
SPAI047.CRN	Urbion-Covaleda	1567-1985	C
SPAI047A.CRN	Urbion-Covaleda	1569-1985	C
SPAI047R.CRN	Urbion-Covaleda	1570-1985	C
SPAI048.RWL	Urbion-Duruelo	1671-1985	M
SPAI048.CRN	Urbion-Duruelo	1671-1985	C
SPAI048A.CRN	Urbion-Duruelo	1671-1985	C

	SPAI048R.CRN	Urbion-Duruelo	1672-1985	C	
	SPAI049.RWL	Urbion-Quintenar	1593-1985	M	
	SPAI049.CRN	Urbion-Quintenar	1593-1985	C	
	SPAI049A.CRN	Urbion-Quintenar	1596-1985	C	
	SPAI049R.CRN	Urbion-Quintenar	1597-1985	C	
	SPAI050.RWL	Urbion-Vinuesa	1681-1985	M	
	SPAI050.CRN	Urbion-Vinuesa	1681-1985	C	
	SPAI050A.CRN	Urbion-Vinuesa	1681-1985	C	
	SPAI050R.CRN	Urbion-Vinuesa	1682-1985	C	
	SPAI051.RWL	Viella-Monte de Vilach	1752-1985	M	
	SPAI051.CRN	Viella-Monte de Vilach	1752-1985	C	
	SPAI051A.CRN	Viella-Monte de Vilach	1753-1985	C	
	SPAI051R.CRN	Viella-Monte de Vilach	1754-1985	C	
	SPAI052.RWL	Burgos-San Zanordil	1802-1985	M	
	SPAI052.CRN	Burgos-San Zanordil	1802-1985	C	
	SPAI052A.CRN	Burgos-San Zanordil	1803-1985	C	
	SPAI052R.CRN	Burgos-San Zanordil	1804-1985	C	
SWEDEN	SWED018.CRN	Kaaresu	1803-1992	C	Markus Lindholm, J. Merilainen
	SWED302.RWL	Naemdoe	1588-1995	M	Lars-Ake Larsson
UNITED STATES					
Alabama	AL002E.CRN	Flomaton Natural Area	1900-1994	C	John Kush, Neil Pederson, Ralph Meldahl
	AL002E.RWL	Flomaton Natural Area	1900-1994	M	
	AL002EA.CRN	Flomaton Natural Area	1900-1994	C	
	AL002ER.CRN	Flomaton Natural Area	1901-1994	C	
	AL002L.RWL	Flomaton Natural Area	1919-1994	M	
	AL002L.CRN	Flomaton Natural Area	1919-1994	C	
	AL002LA.CRN	Flomaton Natural Area	1920-1994	C	
	AL002LR.CRN	Flomaton Natural Area	1920-1994	C	

Arkansas	AR054.CRN	St. Francis Sunklands	1321-1990	C	David W. Stahle, Malcolm K. Cleaveland
	AR054A.CRN	St. Francis Sunklands	1322-1990	C	
	AR054R.CRN	St. Francis Sunklands	1325-1990	C	
Arizona	AZ556.CRN	Scheelite Canyon	1630-1995	C	Rex Adams, Kate Baird, Lauri Baxter,
	AZ556A.CRN	Scheelite Canyon	1630-1995	C	Lisa Pedicino, Karriaunna Scotti,
	AZ556R.CRN	Scheelite Canyon	1632-1995	C	Alexandru Tissescu
California	CA514.RWL	Kennedy Meadows	1607-1982	M	Richard L. Holmes, Rex K. Adams, Martin R. Rose
Georgia	GA005.CRN	J.W. Jones Center	1802-1994	C	Neil Pederson, Brian Palik, Bob Mitchell
	GA006.CRN	J.W. Jones Center	1802-1994	C	
	GA006A.CRN	J.W. Jones Center	1802-1994	C	
	GA006R.CRN	J.W. Jones Center	1804-1994	C	
	GA007.CRN	J.W. Jones Center	1911-1994	C	
	GA007A.CRN	J.W. Jones Center	1911-1994	C	
	GA007R.CRN	J.W. Jones Center	1913-1994	C	
	GA008.CRN	J.W. Jones Center	1871-1994	C	
	GA008A.CRN	J.W. Jones Center	1872-1994	C	
	GA008R.CRN	J.W. Jones Center	1872-1994	C	
Idaho	ID006.RWL	Grasshopper Trail	1492-1984	M	Richard L. Holmes, Rex K. Adams, V.C. Kirby, Chris J. Earle
Iowa	IA033.RWL	Stone State Park	1796-1991	M	David M. Meko, Carolyn Sieg
	IA033.CRN	Stone State Park	1796-1991	C	
	IA033R.CRN	Stone State Park	1799-1991	C	

Maine	ME035.CRN	Acadia National Park	1886-1992	C	G. Andrew Bartholomay, Robert T. Eckert
	ME035A.CRN	Acadia National Park	1886-1992	C	
	ME035R.CRN	Acadia National Park	1887-1992	C	
Michigan	MI001.RWL	Hartwick Pines S.P.	1770-1988	M	Douglas L. Koop, Henri D. Grissino-Mayer
Missouri	MO038.CRN	Shannon County	1553-1992	C	Richard P. Guyette
	MO038A.CRN	Shannon County	1554-1992	C	
	MO038R.CRN	Shannon County	1557-1992	C	
New Mexico	NM572.RWL	El Malpais NM	BC136-1992	M	Henri D. Grissino-Mayer
	NM572.CRN	El Malpais NM	BC136-1992	C	
	NM572R.CRN	El Malpais NM	BC132-1992	C	
	NM573.RWL	West Site Drive	1610-1994	M	M.W. Kaye, T.W. Swetnam, C.H. Baisan
	NM573.CRN	West Site Drive	1610-1994	C	
	NM573A.CRN	West Site Drive	1610-1994	C	
	NM573R.CRN	West Site Drive	1613-1994	C	
North Dakota	ND001.RWL	Burning Coal Vein	1592-1990	M	David M. Meko, Carolyn Sieg
	ND001.CRN	Burning Coal Vein	1592-1990	C	
	ND001R.CRN	Burning Coal Vein	1595-1990	C	
	ND002.RWL	Cross Ranch-Sanger Unit	1788-1990	M	
	ND002.CRN	Cross Ranch-Sanger Unit	1788-1990	C	
	ND002R.CRN	Cross Ranch-Sanger Unit	1790-1990	C	
	ND003.RWL	Icelandic State Park	1830-1990	M	
	ND003.CRN	Icelandic State Park	1830-1990	C	
	ND003R.CRN	Icelandic State Park	1833-1990	C	
	ND004.RWL	Killdeer-Dvirnak	1777-1990	M	

	ND004.CRN	Killdeer-Dvirnak	1777-1990	C	
	ND004R.CRN	Killdeer-Dvirnak	1778-1990	C	
	ND005.RWL	Masonic Island	1676-1990	M	
	ND005.CRN	Masonic Island	1676-1990	C	
	ND005R.CRN	Masonic Island	1678-1990	C	
	ND006.RWL	Theodore Roosevelt N.P.	1630-1990	M	
	ND006.CRN	Theodore Roosevelt N.P.	1630-1990	C	
	ND006R.CRN	Theodore Roosevelt N.P.	1632-1990	C	
Ohio	OH004.RWL	Buffalo Beats North	1856-1995	M	Jim McClenahen, Daniel Houston
	OH004A.CRN	Buffalo Beats North	1856-1995	C	
	OH004R.CRN	Buffalo Beats North	1857-1995	C	
	OH005.RWL	Buffalo Beats North	1681-1995	M	
	OH005A.CRN	Buffalo Beats North	1681-1995	C	
	OH005R.CRN	Buffalo Beats North	1857-1995	C	
Oregon	OR006.RWL	Spring Canyon	1405-1982	M	Richard L. Holmes, Rex K. Adams,
	OR012.RWL	Horse Ridge	1281-1982	M	Martin R. Rose, Wu Xiangding
	OR015.RWL	Frederick Butte	1097-1982	M	
	OR015B.RWL	Frederick Butte	1097-1982	M	
	OR018.RWL	Little Juniper Mountain	1377-1982	M	
	OR029.RWL	Cross Canyon	1485-1991	M	Thomas W. Swetnam, Chris H. Baisan,
	OR030.RWL	Grizzley Bear	1502-1991	M	Boyd E. Wickman
	OR031.RWL	Drumhill Ridge	1672-1990	M	
	OR032.RWL	Indian Crossing	1550-1991	M	
	OR033.RWL	Bally Mountain	1469-1991	M	
	OR034.RWL	Emigrant Springs	1761-1991	M	
	OR035.RWL	Lookout Mountain	1665-1991	M	
	OR037.RWL	Summit Springs	1760-1991	M	
	OR038.RWL	Big Sink	1665-1991	M	

	OR039.RWL	Fish Lake	1585-1991	M	
	OR040.RWL	Lugar Springs	1675-1991	M	
	OR041.RWL	Wenaha 1 and 2	1714-1991	M	
South Dakota	SD002.RWL	Buckhorn Mountain	1600-1991	M	David M. Meko, Carolyn Sieg
	SD002.CRN	Buckhorn Mountain	1600-1991	C	
	SD002R.CRN	Buckhorn Mountain	1603-1991	C	
	SD003.RWL	Blair	1753-1991	M	
	SD003.CRN	Blair	1753-1991	C	
	SD003R.CRN	Blair	1756-1991	C	
	SD004.RWL	Cedar Butte Pine	1646-1991	M	
	SD004.CRN	Cedar Butte Pine	1646-1991	C	
	SD004R.CRN	Cedar Butte Pine	1647-1991	C	
	SD005.RWL	Cedar Butte Juniper	1691-1991	M	
	SD005.CRN	Cedar Butte Juniper	1691-1991	C	
	SD005R.CRN	Cedar Butte Juniper	1692-1991	C	
	SD006.RWL	Crystal Cave	1833-1991	M	
	SD006.CRN	Crystal Cave	1833-1991	C	
	SD006R.CRN	Crystal Cave	1834-1991	C	
	SD007.RWL	Custer State Park	1775-1990	M	
	SD007.CRN	Custer State Park	1775-1990	C	
	SD007R.CRN	Custer State Park	1780-1990	C	
	SD008.RWL	Eagle Nest Canyon	1651-1990	M	
	SD008.CRN	Eagle Nest Canyon	1651-1990	C	
	SD008R.CRN	Eagle Nest Canyon	1655-1990	C	
	SD009.RWL	Frawley Dairy Farm	1807-1990	M	
	SD009.CRN	Frawley Dairy Farm	1807-1990	C	
	SD009R.CRN	Frawley Dairy Farm	1808-1990	C	
	SD010.RWL	Frawley Oak	1892-1990	M	
	SD010.CRN	Frawley Oak	1892-1990	C	

	SD010R.CRN	Frawley Oak	1893-1990	C	
	SD011.RWL	Grace Coolidge Oak	1767-1991	M	
	SD011.CRN	Grace Coolidge Oak	1767-1991	C	
	SD011R.CRN	Grace Coolidge Oak	1768-1991	C	
	SD012.RWL	Grace Coolidge Pine	1703-1990	M	
	SD012.CRN	Grace Coolidge Pine	1703-1990	C	
	SD012R.CRN	Grace Coolidge Pine	1704-1990	C	
	SD013.RWL	Hankins Group	1875-1990	M	
	SD013.CRN	Hankins Group	1875-1990	C	
	SD013R.CRN	Hankins Group	1876-1990	C	
	SD014.RWL	Lake Herman S.P.	1740-1991	M	
	SD014.CRN	Lake Herman S.P.	1740-1991	C	
	SD014R.CRN	Lake Herman S.P.	1743-1991	C	
	SD015.RWL	Orland Hutterite Colony	1859-1991	M	
	SD015.CRN	Orland Hutterite Colony	1859-1991	C	
	SD015R.CRN	Orland Hutterite Colony	1862-1991	C	
	SD016.RWL	Pilger Mountain	1646-1991	M	
	SD016.CRN	Pilger Mountain	1646-1991	C	
	SD016R.CRN	Pilger Mountain	1650-1991	C	
	SD017.RWL	Reno Gulch	1281-1991	M	
	SD017.CRN	Reno Gulch	1281-1991	C	
	SD017R.CRN	Reno Gulch	1286-1991	C	
	SD018.RWL	Rockerville	1717-1990	M	
	SD018.CRN	Rockerville	1717-1990	C	
	SD018R.CRN	Rockerville	1719-1990	C	
	SD019.RWL	Thompson	1747-1990	M	
	SD019.CRN	Thompson	1747-1990	C	
	SD019R.CRN	Thompson	1748-1990	C	
Virginia	VA019.RWL	Charlottesville	1881-1993	M	David M. Lawrence

	VA019.CRN	Charlottesville	1881-1993	C	
	VA019A.CRN	Charlottesville	1881-1993	C	
	VA019R.CRN	Charlottesville	1881-1993	C	
Washington	WA085.RWL	Annette Lake Trail	1515-1987	M	Chris Earle, Linda Brubaker, Gerardo Segura
	WA085.CRN	Annette Lake Trail	1515-1987	C	
	WA085R.CRN	Annette Lake Trail	1515-1987	C	
	WA086.RWL	Big Quilcene River Trail	1288-1987	M	
	WA086.CRN	Big Quilcene River Trail	1288-1987	C	
	WA086R.CRN	Big Quilcene River Trail	1288-1987	C	
	WA087.RWL	Deer Creek Pass	1502-1987	M	
	WA087.CRN	Deer Creek Pass	1502-1987	C	
	WA087R.CRN	Deer Creek Pass	1502-1987	C	
	WA088.RWL	Olympic Road	1394-1987	M	
	WA088.CRN	Olympic Road	1394-1987	C	
	WA088R.CRN	Olympic Road	1394-1987	C	
	WA089.RWL	Silver Creek	1539-1987	M	
	WA089.CRN	Silver Creek	1539-1987	C	
	WA089R.CRN	Silver Creek	1539-1987	C	
	WA090.RWL	San Juan Hill	1536-1987	M	
	WA090.CRN	San Juan Hill	1536-1987	C	
	WA090R.CRN	San Juan Hill	1536-1987	C	
	WA091.RWL	Tahoma Creek	1410-1987	M	
	WA091.CRN	Tahoma Creek	1410-1987	C	
	WA091R.CRN	Tahoma Creek	1410-1987	C	
West Virginia	WV003.RWL	Fernow Exp. Forest	1865-1993	M	Steve Adams, Rose-Marie Muzika, David M. Lawrence, Steve Stephenson
	WV003.CRN	Fernow Exp. Forest	1865-1993	C	
	WV003R.CRN	Fernow Exp. Forest	1865-1993	C	
	WV003A.CRN	Fernow Exp. Forest	1865-1993	C	

TABLE 2. List of contributors of tree-ring data to the ITRDB between May 1995 and November 1997.

Rex K. Adams
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

Dr. Steve Adams
Division of Arts and Sciences
Dabney S. Lancaster Community College
Clifton Forge, VA 24422 USA

Christopher H. Baisan
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

A.C. Barefoot
3401 Hampton Road
Raleigh, NC 27607-3131 USA

G. Andrew Bartholomay
Department of Natural Resources
University of New Hampshire
Durham, NH 03824 USA

Dr. Andre Billamboz
Landesdenkmalamt Baden-Wuerttemberg
Archaeodendrochronologisches Labor
D-78343 Hemmenhofen
GERMANY

Dr. Linda B. Brubaker
College of Forest Resources
University of Washington
Seattle, Washington 98195 USA

Xander M. van der Burgt
Department of Plant Taxonomy
Wageningen Agricultural University
6700 ED Wageningen
THE NETHERLANDS

Jim Burns
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

Dr. Ian D. Campbell
Forestry Canada, Northwest Region
Northern Forestry Centre
Edmonton, Alberta
CANADA T6H 3S5

Roslyn Case
Department of Geography
University of California-Los Angeles
Los Angeles, CA 90024-1524 USA

Kirill Christyakov
Department of Geography and Geoecology
St.-Petersburg State University
St. Petersburg
RUSSIA

Dr. Jaroslav Dobry
Institute of Botany
Czechoslovak Academy of Sciences
25243 Pruhonice near Praha
THE CZECH REPUBLIC

Dr. Christopher Earle
College of Forest Resources, AR-1
University of Washington
Seattle, WA 98195 USA

Dieter Eckstein
Institute for Wood Biology
University of Hamburg
D-21031 Hamburg
GERMANY

Gregg Garfin
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

Ian Gourlay
Plant Sciences Department
University of Oxford
South Parks Road
Oxford OX1 3RB
UNITED KINGDOM

Henri D. Grissino-Mayer
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

Richard P. Guyette
I-30 Agriculture Building
The School of Natural Resources
University of Missouri-Columbia
Columbia, MO 65211 USA

William Hafley
Department of Forestry
North Carolina State University
Raleigh, NC 27695-8002 USA

Jennifer Hillam
Archaeology Research School
The University of Sheffield
West Court
2 Mappin Street
Sheffield S1 4DT
ENGLAND

Patrick Hoffsummer
Universite de Liege
Laboratoire de Dendrochronologie
Place du XX Aout 7
B-4000 Liege
BELGIUM

Richard L. Holmes
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

Wulf Huesken
Abt. Geologie der
Heinrich-Heine-Universitat
Universitatsstr. 1
D-40225 Dusseldorf
GERMANY

Dr. Malcolm K. Hughes
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

Margot W. Kaye
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

Cornelia Krause
Science Fondamentales
Université Québec
Chicoutimi PQ G7H 2B1
CANADA

John Kush
School of Forestry
Auburn University
Auburn, AL 36849-5418 USA

J. Kyncl

Institute of Botany

Czechoslovak Academy of Sciences
25243 Pruhonice near Praha
THE CZECH REPUBLIC

Georges Lambert
Laboratoire de Chrono-Ecologie
Section de Dendrochronologie
Faculte des Sciences
Universite de Franche-Comte
16 Route de Gray
F-25030 Besancon Cedex
FRANCE

Chris Larsen
Department of Geography
McMaster University
1280 Main Street West
Hamilton, Ontario
CANADA

Lars-Ake Larsson
Palnasvagen 1
S-133 33 Saltsjobaden
SWEDEN

Catherine Lavier
Laboratoire de Chronoecologie du quaternaire, Dendrochronologie
Faculte des Sciences / La Bouloie
16 route de Gray
F-25030 Besancon cedex
FRANCE

David M. Lawrence
Tree-Ring Laboratory
Lamont-Doherty Earth Observatory
Columbia University
Palisades, NY 10964 USA

School of Resource and Environmental Management
Simon Fraser University
Burnaby, BC V5A 1S6
CANADA

Markus Lindholm
Saima Center for Environmental Sciences
Linnank. 11
SF-57130 Savonlinna
FINLAND

Paul Maessen
Holtland Dendroconsult
Rembrandtlaan 31
NL-3904 ZK Veenendaal
THE NETHERLANDS

Glen MacDonald
Department of Geography
University of California-Los Angeles
Los Angeles, CA 90024-1524 USA

James R. McClenahen
P.O. Box 272
Shreve, OH 44676 USA

Dr. David M. Meko
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

Jouko Merilainen
Saima Centre for Environmental Sciences
University of Joensuu
SF-57130 Savonlinna
FINLAND

Dr. Ken Lertzman
Hubert Morin
Science Fondamentales
Université Québec
Chicoutimi PQ G7H 2B1

CANADA

Rose-Marie Muzika
Northeastern Forest Experiment Station
180 Canfield Street
Morgantown, WV 26505 USA

Dr. Jonathan G. Palmer
Lincoln University
Plant Science Department
Canterbury
NEW ZEALAND

Neil Pedersen
J.W. Jones Ecological Research Center
Rt.2 Box 2324
Newton, GA 31770 USA

Eva Riccius
School of Resource and Environmental Management
Simon Fraser University
Burnaby, BC V5A 1S6
CANADA

Klaus Richter
Institute for Wood Biology
University of Hamburg
D-21031 Hamburg
GERMANY

Constantin Sander
Institute for Wood Biology
University of Hamburg
D-21031 Hamburg
GERMANY

Dr. Gerardo Segura
Centro de Ecologia
UNAM
Apdo. Postal 70-275
Cd. Universitaria
04510, Mexico D.F.
MEXICO

Dr. Shao Xuemei
Department of Climatology Research
Institute of Geography
Chinese Academy of Sciences
Beijing 100101
PEOPLE'S REPUBLIC OF CHINA

Carolyn H. Sieg
Rocky Mountain Forest and Range Experiment Station
South Dakota School of Mines and Technology
501 E. St. Joseph
Rapid City, SD 57701 USA

Steve Stephenson
Fairmont State College
Department of Biology
Fairmont, WV 26554 USA

Giorgio Strumia
Zentrum für Umwelt- und Naturchutz
Universität für Bodenkultur
A-1180 Wien
AUSTRIA

Dr. Thomas W. Swetnam
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

Julian Szeicz
Department of Geography
Queen's University
Kingston, Ontario

K7L 3N6 CANADA

Yvonnes Trenard
Entreprise Perrault
12 Rue Montbaron
F-78000 Versailles
FRANCE

Thierry L. Varem-Sanders
Forestry Canada, Northwest Region
Northern Forestry Centre
Edmonton, Alberta
CANADA T6H 3S5

Dr. Boyd E. Wickman
USDA Forest Service
1401 Gekeler Lane
La Grande, OR 97850 USA

Dr. Rupert Wimmer
Zentrum für Umwelt- und Naturchutz
Universität für Bodenkultur
A-1180 Wien
AUSTRIA

Dr. Wu Xiangding
Department of Climatology Research
Institute of Geography
Chinese Academy of Sciences
Beijing 100101
PEOPLE'S REPUBLIC OF CHINA

Dr. Xiong Limin
Lincoln University
Plant Science Department
Canterbury
NEW ZEALAND

TABLE 3. Individuals who have been sent the ITRDB Program Library between May 1995 and November 1997.

1. Trudy Kavanagh
Department of Geography
University of Western Ontario
London, Ontario N6A 5C2 CANADA

2. David Yamaguchi
Forestry and Forest Products Research Institute
7 Hitsujigaoka, Toyohira
Sapporo 062, JAPAN

3. Dr. Emilia Gutierrez
Dept. d'Ecologia
Fac. de Biologia
Univer. of Barcelona
Av. Diagonal, 645
E-08028 Barcelona
SPAIN

4. Ian Tyers
Archaeology Research School
The University of Sheffield
West Court
2 Mappin Street
Sheffield S1 4DT
ENGLAND

5. Dr. David R. Butler
Department of Geography
University of North Carolina
Chapel Hill, NC 27599-3220 USA

6. Jorge Marquinez
INDUROT
Universidad de Oviedo
Independencia 13
E-33004 Oviedo, SPAIN

7. David Orwig
Harvard University
Lamont-Doherty Earth Observatory
Columbia University
Palisades, NY 10964 USA
Harvard Forest
P.O. Box 68
Petersham, MA 01366-0068 USA

8. Dr. Thomas T. Veblen
Department of Geography
University of Colorado
Boulder, CO 80309 USA

9.Alan S. White
Harvard Forest
P.O. Box 68
Petersham, MA 01366 USA

10. John Kush
School of Forestry
108 M. White Smith Hall
Auburn University
Auburn, AL 36849-5418 USA

11. Dr. Franco Biondi
Scripps Institute of Oceanography
Geological Research Division
University of California
La Jolla, CA 92093-0215 USA

12. Barbara L. Gartner
Dept. of Forest Products
Forest Research Lab
Oregon State University
Corvallis, OR 97331-7402 USA

13. Dave Sauchyn
Dept. of Geography
University of Regina
Regina, Saskatchewan
CANADA S4S 0A2

14.David M. Lawrence
Tree-Ring Laboratory

15. Richard P. Guyette
I-30 Agriculture Building

University of Missouri-Columbia
Columbia, MO 65211 USA

16. Mr. B.P. Davis
94, Kenilworth Ave
Walthamstow
London E17 4PE
UNITED KINGDOM

17. Maarit Kalela-Brundin
Solbergsvegen 13
S-82072 Stromsbruk
SWEDEN

18. Milhail I. Petrov
Archaeological Research Centre
Iliina street, 26,
173000 Novgorod
RUSSIA

19. Laura Conkey
Department of Geography
Dartmouth College
6017 Fairchild Hall
Hanover, NH 03755-3571 USA

20. Dan McCarthy
Department of Geography
Brock University
St. Catherines, Ontario
CANADA L2S 3A1

21. Emily Heyerdahl
USDA Forest Service
PNW Research Station
4043 Roosevelt Way, NE
Seattle, WA 98105 USA

22. Mike Barwise
139 Templars House
Clays Lane
Archaeology
G-35 Goldwin Smith Hall
Cornell University
Ithaca, New York 14853-3201 USA

London E15 2HG
UNITED KINGDOM

23. Dr. Alexandru Tissescu
Ministry of Water, Forests, and
Environmental Protection
Str. Vasile Parvan nr. 2-4
Sc. C Ap. 33, Sector 1
70758 Bucharest
ROMANIA

24. Bob Keeland
National Wetlands Research Center
700 Cajun Dome Blvd.
Lafayette, LA 70506 USA

25. Maris Zunde
Institute of History of Latvia
19, Turgenew Str.
Riga, LV-1003
LATVIA

26. Thierry Varem-Sanders
Forestry Canada, Northwest Region
Northern Forestry Centre
5320-122 Street
Edmonton, Alberta
CANADA T6H 3S5

27. James R. McClenahen
P.O. Box 272
Shreve, OH 44676 USA

28. Dr. Malcolm K. Cleaveland
Tree-Ring Laboratory
Department of Geography
University of Arkansas
Fayetteville, Arkansas 72701 USA

29. Dr. Peter Ian Kuniholm
Dept. of the History of Art and

30. Dr. Albert J. Parker
Department of Geography
University of Georgia

Athens, GA 30602 USA

31. Markus Lindholm
Saima Centre for Environmental Sciences
Linnank. 11
FIN-57130 Savonlinna
FINLAND

32. Glen M. MacDonald
Department of Geography
UCLA
405 Hilgard Ave.
Los Angeles, CA 90095-1524 USA

33. Konrad Gajewski
Department of Geography
University of Ottawa
Ottawa, Ontario
K1N 6N5 CANADA

34. Rena Ann Abolt
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

35. Margot C. Wilkinson
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

36. Alex McCord
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

37. Dr. Rupert Wimmer
Universitaet fuer Bodenkultur Wien
Gregor Mendelstrasse 33
A-1180 Vienna
AUSTRIA
Universite du Quebec a Montreal
C.P. 8888, Succ. Centre-Ville
Montreal, Quebec
CANADA H3C 3P8

38. Enrique Monton Chiva
Department of Geography
Campus Crta. Borriol s/n
Jaime I University
Aptdo 224 12080
Castellon
SPAIN

39. Jean-Luc Dupouey
Forest Ecophysiology Unit
INRA
54280 Champenoux
FRANCE

40. John Spain
Palaeoecology Centre
Queens University of Belfast
Belfast BT7
NORTHERN IRELAND

41. Don Davis
211 Buckhout Lab
Dept of Plant Pathology
Penn State University
University Park, PA 16802 USA

42. Dave LeBlanc
Dept. of Biology
Ball State University
Muncie, IN 47306 USA

43. Ann Delwaide
Centre d'etudes nordiques
Universite Laval
Sainte-Foy, Quebec
G1K 7P4 CANADA

44. Danielle Charron
Groupe de Recherche en Ecologie Forestiere
45. Patrick Pringle
Washington Dept. of Natural Resources
Div. of Geology
PO Box 47007
Olympia WA 98504-7007 USA

46. Pete Kelly
Dept. of Botany
University of Guelph
Guelph, Ontario
N1G 2W1 CANADA

47. Laura Baxter
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

48. Jim Ehleringer
Department of Biology
University of Utah
Salt Lake City, Utah 84112 USA

49. Jean-Martin Lussier
Universite du Quebec a Chicoutimi
Departement des Sciences Fondamentales
Chicoutimi (Quebec) CANADA
G7H 2B1

50. Roy Switsur
Cambridge University
Godwin Laborarory
Free School Lane
Cambridge CB2 3RS
UNITED KINGDOM

51. Dr. David W. Peterson
Department of Forest Resources
University of Minnesota
1530 N. Cleveland Ave.
St. Paul, MN 55108 USA

52. prof. Leone Fasani
Dip.to Scienze della Terra
via Mangiagalli, 34
I-20133 Milan
ITALY

53. Dr. Peter Ian Kuniholm
Dept. of the History of Art and
Archaeology
G-35 Goldwin Smith Hall
Cornell University
Ithaca, New York 14853-3201 USA

54. Jo Ann Fites
68 Church Street
Blairsden, CA 96103 USA

55. Dr. Katarina Cufar
University of Ljubljana, Biotechnical
Faculty
Department of Wood Science and
Technology
p.p. 95
SI-1001 Ljubljana
SLOVENIA

56. Robert Olson
Lassen National Forest
55 S. Sacramento St.
Susanville, CA 96130 USA

57. David Snyderman
Jemez Mountains Field Station
Bandelier National Monument
Los Alamos, NM 87544-9701 USA

58. Greg LeBreton
Box 085
Department of Zoology
University of Guelph,
Guelph, Ontario,
CANADA N1G 2W1

59. Jaroslav Dobry
Forest Sciences Department
Faculty of Forestry
University of British Columbia
Vancouver, British Columbia
CANADA V6T 1Z4

60. Michael O’Connell
Palaeoenvironmental Research Unit
Department of Botany
University College
Galway

IRELAND

61. Robert P. Long
USDA Forest Service
359 Main Road
Delaware, OH 43015 USA

62. Sydney Smith
Modoc National Forest
1800 W. 12th Str.
Alturas, CA 96101 USA

63. Alan H. Taylor
Department of Geography
The Pennsylvania State
University Park, PA 16802 USA

64. Claude Morneau
Borealis RDE
2383, Chemin Sainte-Foy, bureau 205
Sainte-foy, Quebec
CANADA G1V 1T1

65. Fabian Menalled
104 Pesticide Research Center
Michigan State University
East Lansing, MI 48824 USA

66. Prof. Akira Osawa
Faculty of Intercultural Communication
Environmental Studies Laboratory
Ryokoku University
Ohtsu-shi, Shiga-ken 520-21
JAPAN

67. Dr. Unal Akkemik
University of Istanbul
Faculty of Forestry
74. Rosanna Fantucci
Str. Respoglio 12
01030 La Quercia, Viterbo
ITALY

75. Nate Hagan & Mark Heil
4901 Largo Str.

Department of Forest Botany
80895 Bahcekoy - Istanbul
TURKEY

68. Lissa M. Leege
166 Plant Biology Bldg.
Department of Botany and Plant Pathology
Michigan State University
East Lansing, MI 48824 USA

69. Joy Young
Tree-Ring Laboratory
Department of Geography
University of Arkansas
Fayetteville, Arkansas 72701 USA

70. Linda Alway
USDA Forest Service
Deschutes National Forest
1645 Highway 20 East
Bend, OR 97701

71. Jeff Dean
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

72. Jim Fairchild-Parks
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

73. Alan Lane
Velmex Inc.
P.O. Box 38
7550 Routes 5 & 20
East Bloomfield, NY 14469 USA

Farmington, NM 87402 USA

76. Jason McLachlan
Harvard University
Harvard Forest
Petersham, MA 01366 USA

77. John Topham
114 Mid Street
South Nutfield
Redhill RH1 4JH
ENGLAND

78. Andrew Dunn
Forestry Commission
Research Division
Northern Research Station
Roslin
Midlothian EH25 9SY
UNITED KINGDOM

79. Jason M. Fricke
1021 Ashland Rd Apt 704
Columbia, MO 65201 USA

80. Craig Brunstein
U.S. Geological Survey
Bos 25046, MS 902, Federal Center
Denver, CO 80225 USA

81. Paul Carrara
U.S. Geological Survey
Bos 25046, MS 902, Federal Center
Denver, CO 80225 USA

82. Pete Wyckoff
Botany Department
Box 90339
Duke University
Durham, NC 27708 USA

83. Tom Bragg
Department of Biology
University of Nebraska at Omaha
91. Istituto Italiano di Dendrocronologia
CSO Cavour 11
I-37121 Verona
ITALY

92. Paul Sneed
Department of Environmental Studies
Prescott College

Omaha, NE 68192-0040 USA

84. Ed Berg
PO Box 2608
Soldotna, AK 99669 USA

85. Dr. Wayne Williams
The Black Apple Institute
649 Wright St.
Santa Rosa, CA 95404 USA

86. Pat Dougherty
5079 Coleridge Dr.
Fairfax, VA 22032 USA

87. Stephen Karpuk
School of Resource and Environmental Management
Simon Fraser University
Burnaby, BC V5A 1S6
CANADA

88. Larry J. Cushman
PO Box 2347
Aiken, SC 29802 USA

89. Heidi Riesterer
USDA Forest Service
Forestry Sciences Laboratory
1133 Northwestern Ave.
Wenatchee, WA 98801 USA

90. Charles M. Ruffner
203 Forest Resources Lab
Pennsylvania State University
University Park, PA 16802 USA

220 Grove Ave.
Prescott, AZ 86301 USA

93. Emil Wegwitz
Natural Resources, Forestry Canada
Pacific Forestry Centre
506 W. Burnside Rd.
Victoria, British Columbia

CANADA V8Z 2H1

94. Cornelia Krause
Science Fondamentales
Universite Quebec
555 Boul de l'Universite
Chicoutimi PQ G7H 2B1
CANADA

95. Audrey Barker
Forest Ecosystem Science
University of Maine
Orono, ME 04469-5755 USA

96. Christian Wirth
Lehrstuhl Pflanzenökologie 1
Universitätsstr.1
95440 Bayreuth
GERMANY

97. Dale Blevins
U.S. Geological Survey, Rm. 221
301 W. Lexington
Independence, MO 64050 USA

98. Pam Allison
2918 S. Philadelphia
Amarillo, TX 79103 USA
99. Joseph Cepeda
Department of Life, Earth, and
Environmental Sciences
West Texas A&M University
Canyon, TX 79016 USA

100. Phillip Moore
AHTD Environmental Division
108. Matt Salzer
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

109. Ian Parker
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

P.O. Box 2281
Little Rock, AR 72203 USA

101. Ellen Hartig
Stone and Webster Environmental Services
250 W. 34th Str.
New York, NY 10027 USA

102. Daniel Van Petten
HNTB, Suite 700
1201 Walnut
Kansas City, MO 64106 USA

103. Kathryn Nelson
4524 Fulgreave Dr.
Toledo, OH 43623 USA

104. Judy Osment DeLoach
Corps of Engineers
167 N. Main Str. Rm B-202
Memphis, TN 38103-1899 USA

105. William Bull
Department of Geosciences
The University of Arizona
Tucson, AZ 85721 USA

106. Elsa Nunez
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

107. Matt Rollins
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

110. Eric Kahldahl
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

111. Robert W. Meyer
College of Environmental Science and
Forestry

State University of New York
Syracuse, NY 13210-2786 USA

112. Des Coleman
Department of Environmental Science
and Management
University of Adelaide
Roseworthy, South Australia 5371
AUSTRALIA

113. Michele Potkin
Chugach National Forest
3301 C Str., Suite 300
Anchorage, AK 99513 USA

114. Barry Sims
School of Natural Resources
George D. Aiken Center
The University of Vermont
Burlington, VT 05405-0088 USA

115. Jim Colbert
USDA Forest Service
180 Canfield St.
Morgantown WV 26505-3101 USA

116. Margaret E. Colenutt
Department of Geography
University of Western Ontario
London, Ontario
CANADA N6A 5C2

117. Annie DesRochers
dep. Renewable Resources
University of Alberta
4-42 Earth Sciences Bldg.
Edmonton, Alberta
CANADA T6G 2E3

118. Irina M. Koval
Laboratory of Forest Ecology
Ukrainian Forest Research Institute
Pushkinska, 86
310024, Kharkiv
UKRAINE

119. David L. Malmquist
Bermuda Biological Station for Research
Ferry Reach
St George's GE01
BERMUDA

120. Lauri Malmquist
3352 Hansel Ln.
Leavenworth, WA 98826 USA

121. H. Gene Paul
Forestry & Range Sciences Laboratory
1401 Gekeler Lane
LaGrande, OR 97850

122. V. Radhakrishnan
Department of Geology
V.O. Chidambaram College
Tuticorin - 628 008
INDIA

123. Lisa J. Graumlich
Laboratory of Tree-Ring Research
The University of Arizona
Tucson, AZ 85721 USA

124. Sharad Adhikary, Director
Himalayan Climate Center
P.O. Box 191
Kathmandu, NEPAL

125. Mariette Marsh
Agricultural Investigation and Research
2811 Lynnwood Dr.
Columbia, MO 65203 USA

126. Paul A. Knapp
Department of Geography
Georgia State University
Atlanta, GA 30303-3083 USA

127. Peter Soule
Department of Geography and Planning
Apalachian State University

Boone, NC 28608 USA

128. James R. Bouldin
Environment and Horticulture Department
University of California
Davis, CA 95616 USA

129. JoAnn Fites-Kaufman
68 Church Street
Blairsden, CA 96103

130. Dr. Thomas M. Yanosky
US Geological Survey
National Center, M.S. 461
Reston, VA 22092 USA

131. Elspeth Baalman
State Forests of NSW
P.O. Box J19
Coffs Harbour Jetty
NSW 2450 AUSTRALIA

132. Dr.Ernesto Martín Rodríguez
Departamento de Ciencias Históricas
Universidad de Las Palmas de Gran Canaria
Calle Pérez del Toro, 1
35003 Las Palmas de Gran Canaria
Islas Canarias
SPAIN

133. Alys Wall
Department of Geography
The Pennsylvania State
University Park, PA 16802 USA

134. Daniel Miles
c/o General Delivery
Pinecrest Post Office
Pinecrest, CA 95364 USA

135. Neil Sugihara
USDA Forest Service
3735 Neely Way
Mather, CA 95655 USA