August 15, 1983

Bristlecone Pine Project Status

Since the death of E. Schulman, the vast majority of time and funds (perhaps 90%+) expended on Bristlecone pine have been used to service the needs of isotope geochemistry. Geographically, most field work (again, perhaps 90%+) has been spent in the White Mountains of California. The lower forest border Bristlecone chronology there now reaches to 6700 B.C. Substantial sections of wood for isotopic work through all but the earliest 300 - 400 years of the chronology are now available in the lab or their locations are known in the field.

Given the strong emphasis on the California work, limited exploration of other lower forest border sites with potentially long (1000+ years) chronologies has occurred. In general, the selection of sites and the collections made at sites have not resulted in data that are suitable for climatic analysis.

Table 1 summarizes the available site data from the Bristlecone project that meet the following qualifications:

(1) There are more than one or two cores per site

(2) The material has been dated

(3) The site probably has potential for climatic analysis.

With the exception of about one third of the California White Mountain data, all of these series were dated, cross-checked and measured by Jim Burns or myself.

Table 1. Summary of Bristlecone pine project chronologies.

AREA	# DATED SERIES	DATE RANGE	PRIMARY COLLECTOR
California			
1. White Mts. Area	ca. 400	6700BC - AD1979	CWF
2. Inyo Mts.	18	131BC - AD1964	CWF
3. Panamint Range	8	AD 517 - AD1976	CWF
Nevada			
1. Silver Peak	12	AD 672 - AD1977	CWF
2. Mt. Jefferson	34	AD 905 - AD1980	DAG ✓
3. Pearl Peak	26	653BC - AD1969	CWF
4. Indian Garden	140	3258BC - AD1980	DAG ✓
5. Ely area	---	----------	CWF
6. Hill 10,842	?	AD 1 - AD1969	CWF,VCI
7. Highland Peak	18	AD1346 - AD1981	DAG
8. Sheep Range	26	AD 760 - AD1975	CWF
9. Spring Mts.	30	AD 1316 - AD1979	CWF,DAG
Utah			
1. Mammoth Creek	46	AD 439 - AD1980	DAG ✓
2. Badger Creek	17	AD1225 - AD1981	DAG
3. Bryce Point	11	AD1303 - AD1981	DAG

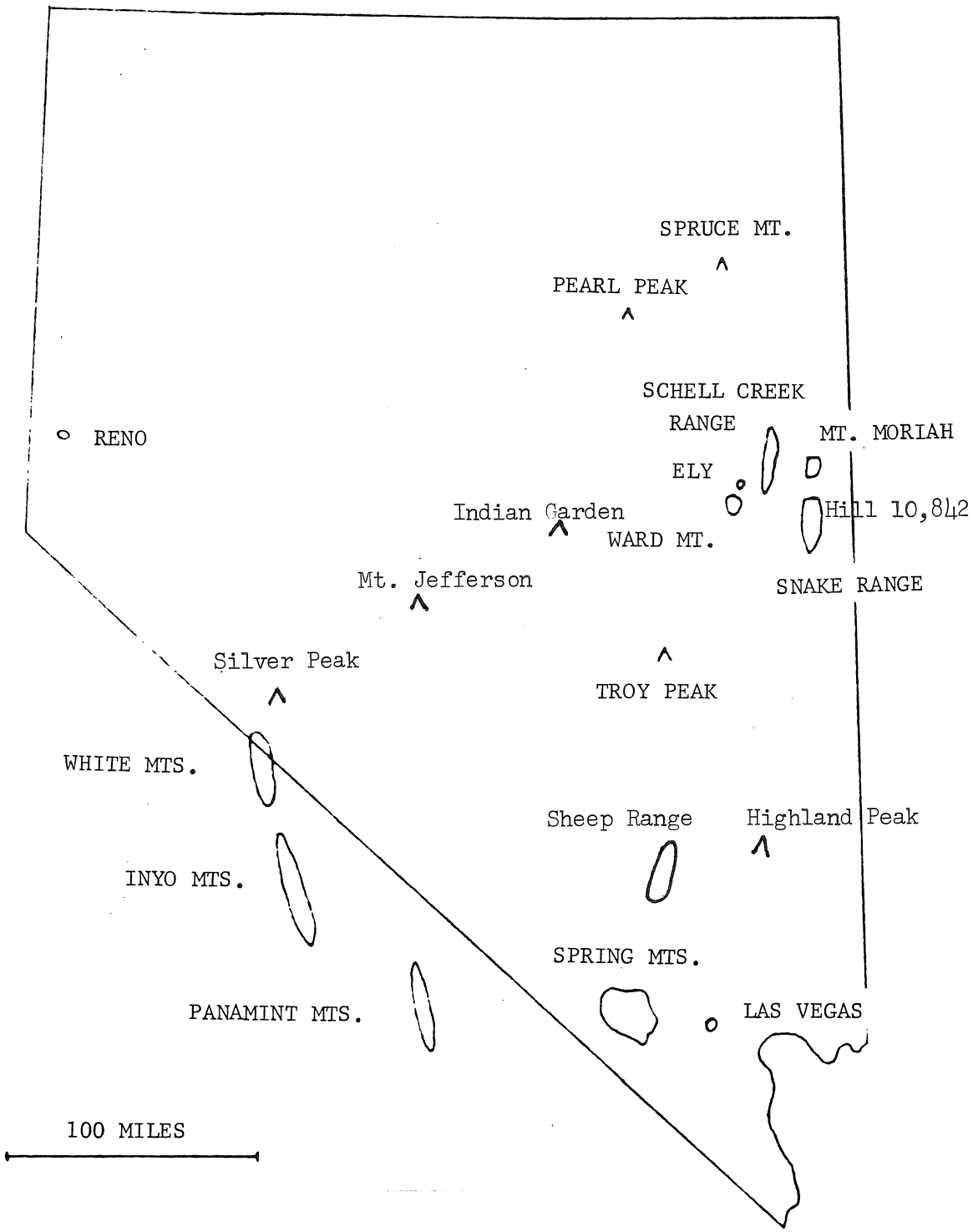


Fig. 1. LOCATION OF BRISTLECONE PINE SITES.

Notes regarding Table 1.

California

1. White Mountain Area

   The chronology needs 10-20 additional specimens in a few time periods in order to have a constant number of ca. 15-20 sensitive specimens per year for the full chronology. The time periods are 4400-4000 B.C. and 3300-900 B.C.

2. Inyo Mountains

   Slides I have seen suggest the area has at least a 2000 year BCP chronology potential. There are several areas of Bristlecone stands. The area needs exploration and collection.

3. Panamints

   This is in a good spot for a chronology in a climate grid. Access is 2 days walk both in and out. Wes has either lost or mislaid collections he made there in 1976 at Telescope Peak. The few cores we can find are from Sentinel Peak. There are no notes on exactly where the sites are or on the collections.

Nevada

1. Silver Peak

   Bob Thrompson has indicated there are quite a few more trees here than were sampled. The site needs recollected.

2. Mount Jefferson

   This is an upper tree line Limber pine site that is finalized.

3. Pearl Peak

   The collections here appear to range over several sites, exposures, slopes and, perhaps, 1000 or more feet in elevation.

This is based on looking at slides that CWF took. There are no map locations or notes that I can find. It is about the northernmost occurrence of BCP. The area needs to be re-collected.

4. Indian Garden

The series are all measured and plotted. I am in the process of evaluating them for final chronology construction this fall.

5. Ely Area

Wes has worked in most of the mountain ranges around Ely, but it was all oriented toward inventory for the Forest Service and the BLM. The work for the Forest Service is summarized in his 1970 report (Dendrochronology of Bristlecone pine in East Central Nevada). Some of the chronologies described there are relatively long but not suitable for climatic work. Again, reinvestigation of some areas would be required.

I obtained the BLM inventory data from their office in Ely. I don't think the lab had a copy of it. They apparently took 5-10 cores from various sites and sent them to Wes for analysis. The data sheets indicate ring counts only. The oldest trees per site are:

Heusser Mountain	714 years
Mt. Moriah	813 years
Ward Mountain	2831 years
Egan Range	1689 years
Majors Point	1449 years
Mt. Grafton	1740 years
Roc Peak	678 years
Meekers Peak	557 years

Sampled trees and innermost rings for various Nevada sites.[1]

Site	Species	No. Trees	Innermost Ring
Baker Lake	BCP	15	351 B.C.
Kraft Canyon	BCP	11	59 B.C.
Mt. Moriah	BCP	8	A.D. 126
Blue Lake	LbP	15	A.D. 527
Valley, Wheeler Peak	BCP	9	A.D. 1087
Valley, Wheeler Peak	LbP	16	A.D. 820
Strawberry Canyon	LbP	5	A.D. 715
Switchback	LbP	14	A.D. 1607
Switchback	DF	1	A.D. 1699
Viewpoint	DF	13	A.D. 1614
Viewpoint	LbP	1	A.D. 1640

[1] Progress report, 7 January 1969, Thomas P. Harlan.

from Ferguson, C.W.
Dendrochronology of bristlecone pine in east central Nevada. 1970

I can't find any of the cores, so we can't date and evaluate the statistical quality of any of the series. The BLM put the sites on maps so they could be relocated.

6. Hill 10,842

This is a long but complacent chronology. It can't be reanalyzed because I can't find the basic components. There is a site on the south facing basal slope of the mountain that should be investigated. It is referred to as Granite Basin on a USGS 15' (Garrison UT/NEV) quad. I have seen the site with binoculars. There appear to be 1000+ year old strip-bark BCPs. Wes collected several dead wood fragments some time ago from the site, but we can't find them. They were measured and plotted in the early 1970's. The length of these series plus the presence of the strip barks suggests the site may have a 2000-3000 year potential.

7. Highland Peak

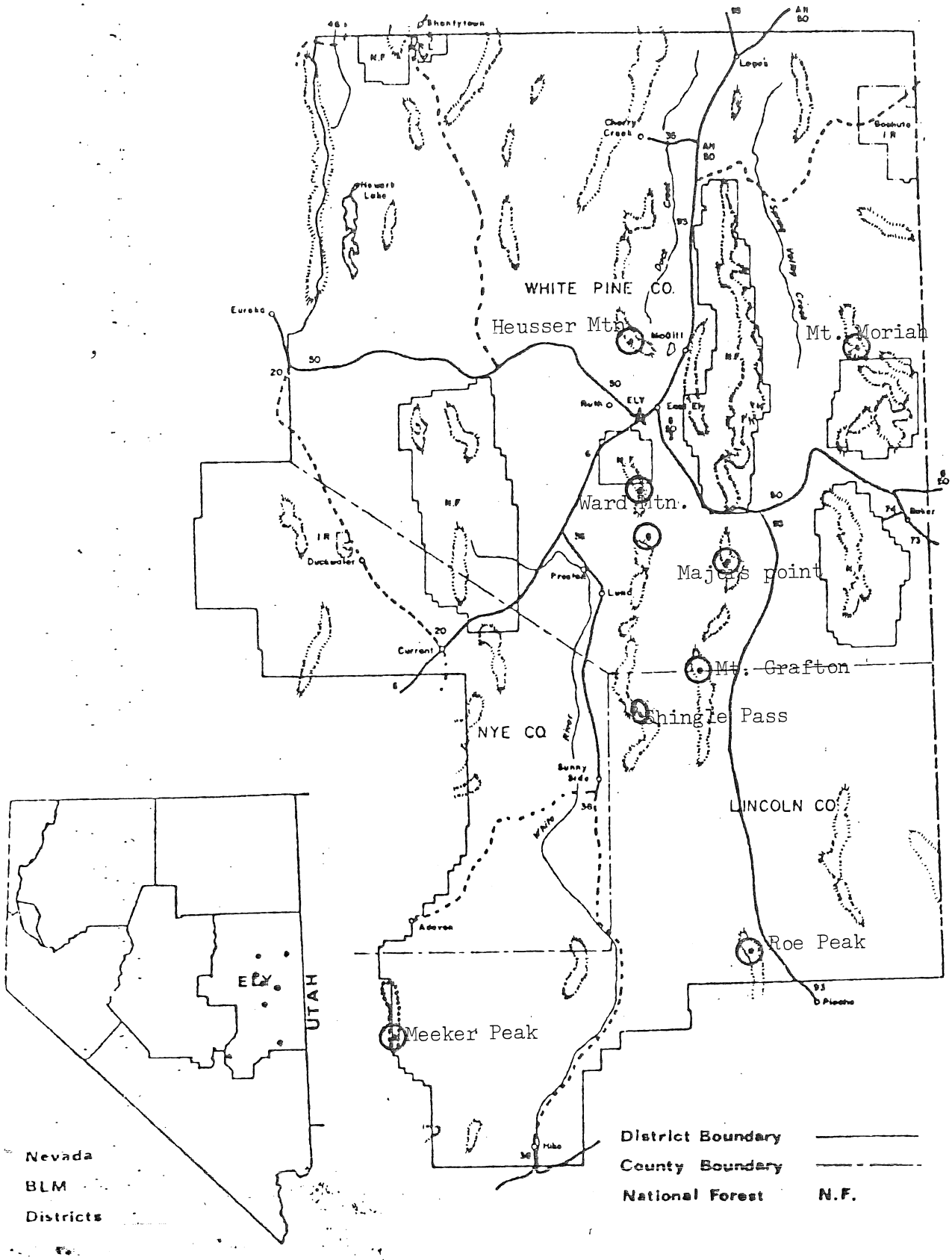
I collected the site in 1981 but got rained and hailed out before I could finish. It should be revisited. It probably has a 900-1000 year maximum age potential.

8. Sheep Range

The area should be revisited in a search for older trees and to obtain more cores for the last several hundred years.

9. Spring Mountains

The area needs further exploration. I have seen what were probably 1000 year trees, but Wes did not want to core them.



ELY DISTRICT

GENERAL LOCATIONS OF THE CORE COLLECTION SITES

One other area that may repay investigation is Troy Peak and Timber Mountain in east-central Nevada. Wes collected cores from one living tree on Troy Peak that has a ring count of 2310 years. There are no map locations or notes.

Utah

1. Mammoth Creek

   All trees at the site have been sampled and the chronology is completed.

2. Badger Creek

   The chronology needs to be finalized but will be weak in specimen depth because some cores were undatable. All trees present were cored.

3. Bryce Point Utah

   Only 11 of 27 cores were datable. The site is too harsh.

4. Utah - Miscellaneous Comments

   There are at least 15 more localities with Bristlecone that have not been investigated by lab personnel.

Summary Comments. There are three Bristlecone chronologies with adequate specimen depth that might be used for climatic purposes in the near future. They are:

Methuselah Walk, CA	800 BC - AD 1979
Indian Garden NV	2500 BC - AD 1980
Mammoth Creek UT	AD 800 - AD 1980

My experience with the Bristlecone project and at the lab in general have led me to think that there are two areas of project activity that could be managed and oriented differently from what they have been in the past. They are: (1) Service functions (2) Research and development of long chronologies.

Service Functions

It is unquestionable that the material provided by the laboratory for isotopic and other research purposes has been important for scientific progress in the various recipient disciplines involved. It is, however, questionable that the laboratory has made any substantial progress in tree-ring research from this activity. In any case, I think the external requests for this service will remain. If it continues to be laboratory policy to support this work, then I think it could be better organized and more efficient. Ideally, one 5-10 year goal would be to centralize the processing, distribution and record keeping. Currently we have no reasonable idea of what has been sent to whom, nor of the cost to the laboratory. A second goal, then, would be to make a cost-benefit analysis to determine what amount of time by what level of salaried personnel could reasonably be devoted to this work. A third goal would be to make the isotope geochemists and other concerned parties aware of the costs and let them develop funding at appropriate levels.

Research and Development of Long Chronologies

One of the most obvious resources that we have relatively immediate access to and could exploit for a variety of scientific purposes is tree-ring chronologies in the 1000 year and older range in the Western United States. The focus should not be on any single species but on the fullest possible range of data sets.

In order to approach this project, there needs to be a plan of research, personnel and managerial commitment. The following pages outline the research.

Potential Future Directions

It is suggested that one goal of tree-ring research espoused nearly thirly years ago could be reimplemented in the near future.

> The overriding objective of this research has been the discovery and development of the longest significant chronologies of year-by-year rainfall and river flow obtainable from the annual growth-rings of the oldest suitable trees. The derivation of such optimum dendrochronologies has thus far been most actively pursued in western North America, where much of the scientific basis for this work was established by A. E. Douglass some decades ago. Since gage records of rainfall, temperature, and river flow in this region are yet available in series only a few score years long, at best, the significant extension of these series, if possible, for many centuries into the past by means of growth indices is obviously a prime desideratum.
>
> But data which may serve to test, and perhaps amplify, climatic theories are not to be casually rerived from so characteristically complex a biologic variable as cambial growth, as the immense array of related research in experimental botany gives evidence. It is thus of profound importance that, in the areas surveyed in this report, the growth indices may be extended and replaced by successively more significant ones - by successive refinement of field criteria for the selection of specimens and by the refinement of laboratory methods. This rare property of successive "improvement" of tree-ring indices is exploited by (1) the finding and sampling of trees with ring growth more sensitive to fluctuations in the limiting climatic variable, (2) an increase in the number of such sampled trees, and (3) an increase in the length of the individual tree records, made possible by the finding of older trees of high sensitivity. (P.7 in Introduction, Dendroclimatic Changes in Semiarid America by E. Schulman, 1956.)

It would now be possible to continue this research direction. The explicit goal would be to develop networks of millenia to several millenia long chronologies in the western United States. This would provide the longest annual proxy records of precipitation, temperature and streamflow over a relatively large area that might conceivably be available in the next several decades. There have been four major developments that would

permit us to implement this type of research.

First, we have clear indications that tree-ring chronologies in the 800-1000 year span are available in most of the western United States in the range of 33° - 45° N. latitude and 104° - 120° W. longitude. Trees of this age are most readily available from lower forest border sites. It is also evident from Val La Marche's work that upper treeline sites with chronologies in this age range are also available.

Chronologies in the 2000+ year range are also available in a more restricted area than that described above. Several of these have been developed from archaeological and modern chronologies in the Southwest. Bristlecone and Limber pine in southern California, the Great Basin and the Colorada Rockies have this age potential. The conjunction of these data sets would provide a usable proxy climate grid between 33° - 40° N. latitude and 105° - 118° W. longitude.

Second, we have increased understanding of climate - growth relationships for conifers in general. In terms of working with longer lived species, we have the background provided by Fritts' ecological growth study on Bristlecone pine.

Third, the lab collectively has a substantial history now of working with large spatial grids of data. The software and statistical methods for analyzing this type of data are well developed.

Fourth, the climatic data base for the western United States is reasonably intensive in coverage and extensive in time depth.

Research Implementation

The first phase would be essentially political. At the most basic level it would be important to have some agreement on the value of this

work among lab personnel. At the University level we obviously need the support of the Dean and vice presidents. At the national level - NSF - we should begin to get reactions about this type of project first at an informal level. Depending on reactions at this level and on the funding fate of the Robinson, Dean and Graybill proposal, further decisions about directions to take can be made.

If the archaeology proposal is funded more fully than at present, it could be viewed in part as the first stage of getting a long chronology grid organized. Again, depending on funding, we should consider a few days exploration to see if the Bristlecone sites that overhap the archaeological areas have any age potential. Four specific sites are: (1) Near Creede, Colorado; (2) San Francisco Peaks; (3) South slope of Mt. Hillers, Henry Range, Utah; (4) Table Cliffs Plateau, Utah.

The second phase of the project concerns two related questions that will actually need to be reviewed throughout the project. They are: (a) How large an area can a network cover? (b) What age class(es) can be used over the area in question? The beginning of an answer to these would minimally involve five steps:

(1) A detailed assessment of all long or potentially extendable chronologies that we now have in the lab. Additionally, discussions with lab personnel would attempt to ascertain their knowledge or even suspicions of localities not yet sampled that might have long chronologies.

(2) Attempt to obtain detailed locational information about the Bristlecone pine sites illustrated in D. K. Bailey's taxonomic study. He could be contacted directly or we could contact all the herbariums that he listed as repositories for specimens.

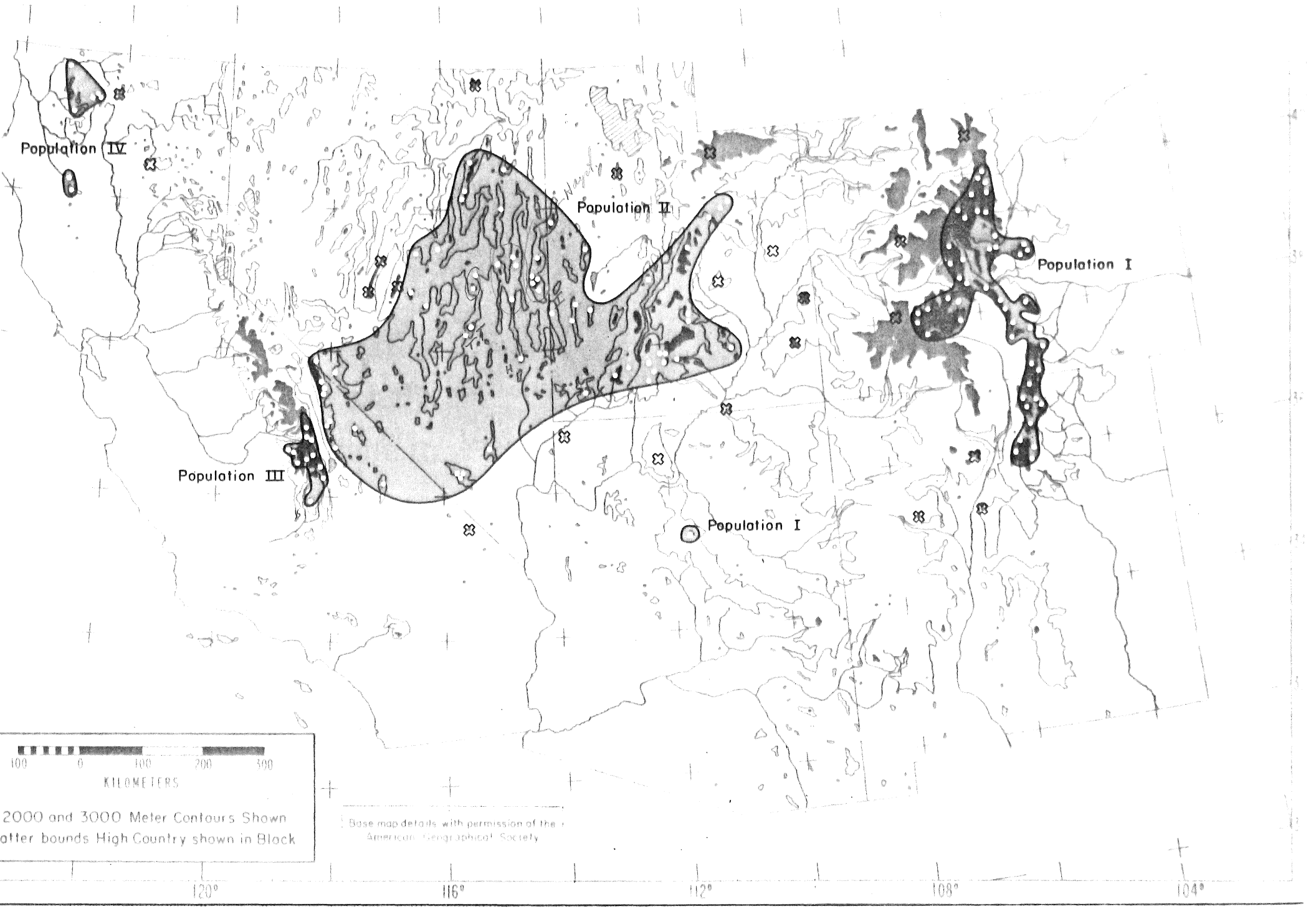
(3) Do an intensive literature search focusing on the distribution, age and location of Limber pine as well as Bristlecone.

(4) Investigate the age potential of Pinus strobiformis and of high elevation Juniperus deppeana in the Mogollon Rim and east of the Rio Grande.

(5) Target a number of Forest Service and BLM offices for mailings. Each mailing would include a brief statement of goals, a description of the type of trees and sites we are interested in and a request for locational information on the same. This would be particularly important in the northern areas of Limber pine distribution where few if any Lab projects have been accomplished. Communication with these groups is most effectively accomplished within about a year of an actual field work schedule.

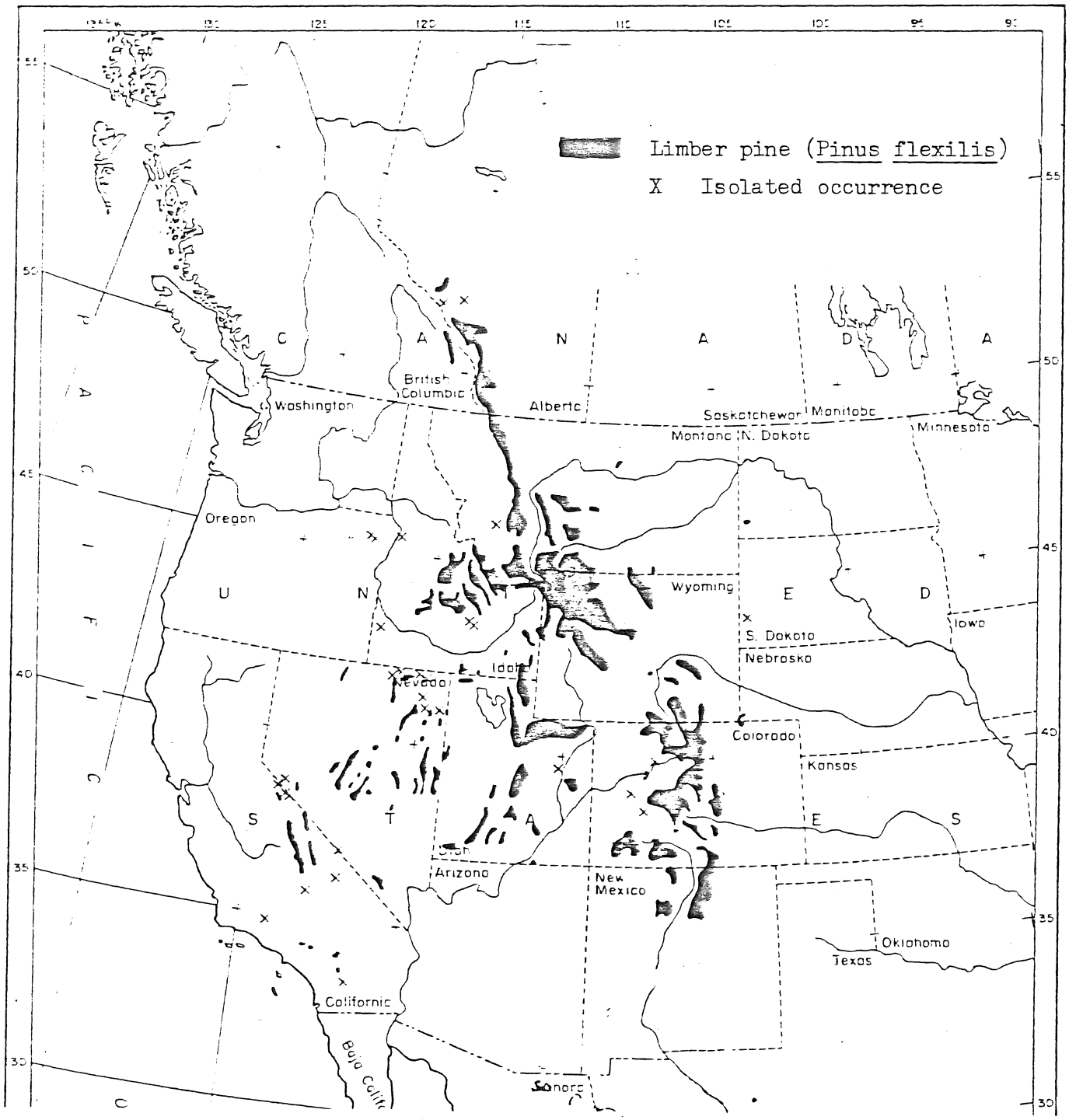
The third phase of the project would involve decisions about the kinds of climatic questions that could be considered with the projected network of chronologies. The nature of these will vary with the areal extent and time depth of a network as well as with the presence of absence of upper treeline data. I think the work planned on the southwestern reconstruction proposal would give us some useful insight into what we might realistically be able to attempt.

The fourth phase of the project would be to write a grant proposal, or a series of them over time, to do various stages of the research.



3.—Geographical distribution, illustrated by selected stations, of the four popula-
us subsect. *Balfourianae* Engelm. Open ×'s indicate locations with suitable
ere the pines, though recently looked for, have not been found.

from Bailey, D.K.
Phytogeography and taxonomy of Pinus subsection Balfourianae
Ann. Missouri Bot. Gard. 57:210-249. 1970


Limber pine (Pinus flexilis)
X Isolated occurrence
British Columbia
Alberta
Saskatchewan
Manitoba
Washington
Montana
N. Dakota
Minnesota
Oregon
Wyoming
S. Dakota
Iowa
Nebraska
Nevada
Idaho
Colorado
Kansas
Utah
Arizona
New Mexico
Oklahoma
Texas
California
Baja Calif.
Sonora
55
50
45
40
35
30