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GENETIC RESOURCES CONSERVATION PROGRAM
Division of Agriculture and Natural Resources
UNIVERSITY OF CALIFORNIA

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Dedication

**This report is dedicated to James B. Kendrick, Jr.,
recently retired Vice President for Agriculture and
Natural Resources, University of California.**

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This report is published and distributed by the University of California Genetic Resources Conservation Program as part of the public information function of the Program. The Program sponsors projects in the collection, inventory, maintenance, preservation, and utilization of genetic resources important for the State of California as well as research and education in conservation biology. These activities take place on the several campuses of the University of California with funds provided by the State of California to the University. Copies of this and other reports published by the Program may be obtained from:

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IMPORTANCE OF GENETIC RESOURCES

Genetic resources are sometimes called the "first resource" of the natural resources on this planet - the others being land, air, and water. Genes are the link from generation to generation of all living matter. Therefore, attention to genetic resources means attention to the vast diversity among and between species of animals, plants, and microorganisms. Within this diversity there is a hierarchy of organization and the term genetic resource has meaning at each level. At one level, genetic resources include all the individuals of a species, particularly if it is threatened with extinction. Genetic resources also include populations, gene pools, or races of a species which possess important attributes not found uniformly throughout the species. Breeding lines and research materials, such as mutant, genetic, or chromosomal stocks, are also genetic resources and are important in animal and plant breeding and in all phases of biologic research. Finally, genetic resources can refer to genes themselves, maintained in selected individuals or cloned and maintained in plasmids.

Genetic resources are the substance of agriculture and food production, major economic enterprises in California. For example, more than 250 crops are grown commercially in California, yet less than 1% of them are native to this state. California leads the nation in production of many of these crops. In 1985, 8.8 million of California's 100 million acres were devoted to crop production. Of these 250 crops, 61 are considered major, grown on a commercial scale. A summary of these with their individual acreages, production levels, and dollar values for 1985 are listed in Table 1. This high level of productivity has resulted from the development of new crops and new uses for old crops, the protection of annual productivity by means of pest-resistant varieties and pest-management schemes, and continuing research into the genetic systems that give rise to critical characteristics of crop species. These developments are totally dependent on the availability of genetic resources.

There is an analogous situation with regard to animals. Genetic improvement has profoundly increased productivity of livestock, dairy, and poultry operations. A summary of such productivity is also in Table 1. As with plants, agriculturally important animals are not native to California and continued productivity depends on genetic diversity acquired from outside the state. However, financial constraints for research have begun to limit researchers' abilities to maintain the large populations of animals that are necessary to maintain potentially useful genetic diversity. Research funding has typically not taken into account maintenance costs of genetic resource collections, yet research continuously needs and produces more genetic resources.

Beyond the easily recognized plants and animals used directly for human sustenance are lesser known useful genetic resources, such as yeast, microorganisms used in fermentation for bread, beer, and winemaking. Plants and animals in their natural habitats are valuable for their aesthetic values, their potential uses by humans, and for maintaining functioning ecosystems. California is one of the truly unique states of the United States for its range of habitats and wealth of endemic species. Special considerations for protecting the biologic and habitat diversity are needed.

Genetic resources must be maintained as an investment for the future. Past results from research with genetic resources in California have yielded very high returns on the public investments in research. Genetic resources have been capitalized by the public, including large and small farming operations, food and fiber processing organizations, banking and investment companies, many related industries, and ultimately, by consumers who have enjoyed the end products.

Table 1. Important agricultural commodities in California

Commodity category	Number in category	Quantity	Product value (million \$)
Plants		(acres)	
Field crops	13	5,834,000	3,000
Vegetable crops	23	985,000	3,100
Fruits and Nuts	23	1,960,000	2,900
Nursery & Flowers	2		1,294
Animals		(units)	
Cattle and Calves		5,000,000	1,090
Hogs		145,000	22
Sheep and Lambs		1,065,000	52
Dairy cattle		1,030,000	2,076
Chickens - meat		174,000,000	282
Eggs		8,052,000,000	336
Turkeys		20,500,000	205
Insects			
Bees - pollination fees*			30
Bees - honey & wax			11

* It should be noted that a majority of the fruit and nut, vegetable, seed, and forage crops rely on honey bees for pollination. (Data from California Dept. of Food and Agriculture. 1986. California Agriculture Statistical Review 1985.)

THREATENED GENETIC RESOURCES

There is no one means for attending to the various issues of genetic diversity and its conservation within the State of California. For native plants and animals, and some naturalized ones, there are numerous State and Federal agencies, private nonprofit organizations, and dedicated individuals who are involved with protection and preservation of individual species, their habitats, and whole ecosystems. Both public and private plant and animal breeding programs make use of national and international collections of genetic resources. Finally, researchers maintain collections of genetic stocks as they acquire or produce them.

As special collections of genetic resources increase in size and complexity while financial resources change or become scarce, a mechanism is needed to insure their accessibility and security. Rare and endangered plants and animals face extinction. Loss of habitat means loss of populations which reduces the genetic diversity of a species and can ultimately extinguish it. For the most part, the centers of wild genetic diversity of agricultural plants and animals important in California are outside our borders and usually outside the United States. Uncertain political

climates, poor ecological practices in these areas, and inaccessibility, all factors outside the State's control, can render these resources unavailable. These considerations make existing collections even more valuable. Vigorous programs for habitat protection and consolidation of certain genetic materials into preserved collections are essential. In the research arena, unstable funding and death or retirement of researchers can threaten existing genetic collections. There are several examples of loss of major collections of germplasm of crop plants, for example. Research funds cannot maintain collections produced by the funded research; with no alternative funding, such collections can be lost.

STRATEGIES FOR GENETIC RESOURCE CONSERVATION

There exist two main approaches to genetic resources conservation: offsite (*ex situ*) conservation, by which is meant the maintenance of the resources in a site or facility which is not their natural or native habitat, and onsite (*in situ*) conservation, by which is meant the preservation of the resources in their native habitats. Four strategy levels for conservation can be distinguished.

- Conservation of cloned genes, gametes, embryos, seeds, tissues, or whole organisms in a quiescent state.
- Conservation of plants, animals, or microorganisms in a confined or controlled environment, such as plantations, gardens, zoological parks, reserves, or on host organisms in the case of obligate parasites.
- Conservation of plants, animals, or microorganisms in their natural habitats where population size and structure are managed.
- Conservation of plants, animals, or microorganisms in their natural habitats without regard to population size or structure.

The successful conservation of any given genetic resource may involve combinations of two or more of these strategy levels, employing both onsite and offsite methods.

A variety of agencies are involved in onsite conservation (i.e., habitat protection) in California with the result that about half of California's 100 million acres can be considered to have some level of organized protection status. The federal government administers about 45.9 million acres; the state government administers about 2.5 million acres; and local governments administer about 1.7 million acres (California Statistical Abstract, 1986). Included in the state government holdings are about 85 thousand acres managed by the University of California Natural Reserve System. Private nonprofit organizations own or manage less than 100,000 acres for conservation purposes in a series of small holdings throughout the state. These levels of protection status include wilderness areas, multiple-use managed areas, parks and recreation areas, and research areas. Implicit in several of these designations is an intent to safeguard the natural resources that lie within the boundaries of the various areas. To the extent these areas protect the habitat of the native biota, they are protecting genetic resources primarily at the

species level. The identity, distribution, and density of California's flora and fauna are increasingly well documented, so that the attention of the management of these areas is especially focused on designated rare and endangered species. However, preservation of the genetic diversity within these species, i.e., genetic resources at the population or gene level, is not assured simply by protecting the individuals of a species that happen to fall within the boundaries of a designated area (unless the species is so rare that it consists only of those individuals). To assess the extent and distribution of genetic diversity within a species is a complicated task and obviously will never be achieved for most species. However, there are methods for sampling and measuring diversity that can indicate how well existing habitat protection will protect that diversity. Research using and improving such methods must be one facet of genetic resource conservation.

DEVELOPMENT OF AN ORGANIZED PROGRAM FOR CALIFORNIA

Given the importance of genetic resources to the State's natural environments and economy, it is in the State's interest to provide a means to assess the needs for genetic resource conservation, coordinate the various existing efforts, direct new efforts at preservation and collection, increase public awareness of conservation issues, and stimulate new research on topics of conservation biology. The UC Genetic Resources Conservation Program was developed to be such an entity. The origin of the program was motivated by a complex history of concerns, studies, and crises. Within the University, there has long been recognition of the need for a far-sighted approach to the conservation of genetic resources. Outside the University, State agencies and individuals have provided impetus to the development of an organized conservation effort. Below is a chronology of events leading to a program of genetic resource conservation in the University of California.

- 1977 A special issue (Volume 31, No. 9) of California Agriculture, the research progress report journal of the University of California Division of Agriculture and Natural Resources, was dedicated to discussions of the collection, screening, utilization, and conservation of specific plant genetic resources economically important to California.
- 1980-83 The State contracted with a private nonprofit organization, National Council on Genetic Resources (NCGR), to establish a California Gene Resources Program (CGRP). The NCGR was assisted by a large advisory committee with members from academia, the state legislature, state agencies, industry, a conservation organization, and the general public.
- 1981 The University of California made two proposals to the Agricultural Investment Program of the California Department of Food and Agriculture:
- (1) The California Crop and Range Plant Germplasm Conservation Project was proposed by the Department of Agronomy and Range Science at Davis to establish a germplasm conservation center to focus on field crops and rangeland species of actual and possible importance to California for food and livestock production, soil and water conservation, and aesthetic or

recreational uses with a five-year budget of \$1.9 million. This project included 23 faculty investigators.

(2) The Evaluation and Preservation of Animal Genetic Resources for Future Needs of California Agriculture Project was proposed by eleven animal scientists at Davis. Research was proposed to develop and preserve animal genetic resources, to identify criteria and methods of determining the value of different genetic materials with particular reference to adaptability, production efficiency, and resistance to pests and disease, and to assess the suitability of different genetic materials to alternative production systems for optimization of the use of resources available for animal agriculture. This project had a five-year budget of \$4.1 million.

Neither of these proposals was funded, but the proposals identified the research and facility needs for protection of a large portion of California agriculture commodities.

- 1982 Establishment of the National Clonal Germplasm Repository for fruit, vine, and nut crops at Davis, operated by the University of California for the National Plant Germplasm System of the US Department of Agriculture
- 1983 The California Gene Resources Report was commissioned by the California State Senate Office of Research. This report was prepared by Janet White for a 15-member University of California faculty task force. UC activities and plans for genetic resource conservation were recommended. The report concluded that the formation of an institute within the University of California, formally classified as an organized research unit and permanently funded, could promote continuity of protection of vital genetic resources for the State.
- 1983 The California Department of Food and Agriculture contracted with the University of California through its Division of Agriculture and Natural Resources (ANR) to evaluate the work of the California Gene Resources Program, to develop a list of biologic entities requiring conservation in California, to hold a symposium to allow expert and public discussion of the issues, and to make recommendations for action that the State should take in genetic resource conservation. A Steering Committee composed of faculty from several UC campuses evaluated the CGRP, compiled a list of California entities requiring conservation (see Appendix IV), held the Symposium and Workshop on Genetic Resources Conservation for California at Napa, California on April 5-7, 1984, and made recommendations for UC action.
- 1984 Symposium and Workshop on Genetic Resources Conservation for California. The purpose of the Symposium was to present state, national, and international perspectives on the issues, needs, and successes of genetic resource conservation and to describe current conservation methodology and

technology. The meeting concluded with commitments from the University Division of Agriculture and Natural Resources to initiate a program within the University (P.E. McGuire and C.O. Qualset (Eds.), 1984 Proceedings of a Symposium and Workshop on Genetic Resources Conservation for California, April 5, 6, & 7, 1984. Napa, California. 85 pages).

A major recommendation of the Symposium was that the University of California should develop a unit to deal with conservation of genetic resources important for California. This resolution was endorsed by the CDFA and accepted by Vice President Kendrick, L.N. Lewis, Assistant Vice President, ANR, and C.E. Hess, Dean of the College of Agricultural and Environmental Science, Davis. They recommended a Genetic Resources Conservation Program be established in the Office of the President through the Division of Agriculture and Natural Resources. A budget request was made and approved by the President and the Regents for one million dollars annually beginning with the 1985-86 fiscal year. The Governor supported the program, but reduced the annual funding to \$250,000.

- 1985 The UC Genetic Resources Conservation Program was initiated July 1, 1985. An *ad hoc* group of UC faculty and a representative from CDFA were convened to aid in the initial organization and direction of the program (see Appendix I for the composition of this group). The agenda for this group at a November 25, 1985 meeting included establishing the objectives of the program, priorities among the objectives, and the optimum organization within the budget constraints to address the objectives. The program was organized, for the most part, as recommended by the discussants at the Napa Symposium.

MISSION

The mission statement of the GRCP is derived from the recommendations of the Napa Symposium and the *ad hoc* advisory group of 1985-86. The mission has four components. The Program should:

- Develop a Genetic Resources Conservation Plan for California, working in concert with state, federal, and international organizations as appropriate, to develop policies and programs for conservation of genetic resources;
- Identify critical animal, plant, and microbial genetic resources and support their onsite and offsite conservation;

- Develop improved methods and strategies for procuring and maintaining genetic resources;
- Foster the adoption of genetic resources conservation theory and practice through training, workshops, conferences, seminars, publications, and other outreach activities.

ORGANIZATION OF THE CALIFORNIA PROGRAM

At the end of fiscal year 1985-86, GRCP consisted of a Management Office operating under the office of Assistant Vice President L. N. Lewis of the Division of Agriculture and Natural Resources. For this first year, the Program Director provided a 25% time commitment to GRCP to implement the recommendations of the *ad hoc* advisory committee. In February 1986, the shared use of two offices was generously donated by the Department of Agronomy and Range Science on the UC Davis campus for use by the GRCP. Remodeling was necessary to accommodate the GRCP needs in this limited space.

Roberta A. Hooker was appointed as full-time Administrative Assistant on April 28, 1986. Prior to this appointment, as a member of the office staff of the Dean of the College of Agricultural and Environmental Sciences, she had served the GRCP on a part-time basis. Dr. Patrick E. McGuire was appointed as a Genetic Resources Analyst on a half-time basis beginning December 1, 1985.

GRCP held discussions of how the program can be best advised to carry out its mission. A Policy Advisory Board will be appointed which will include academic and administrative representatives from throughout the University and representatives from appropriate state and federal agencies. Its purpose will be to advise the program administrators on policy matters, to review current and projected GRCP activities, to review and assist in budget development, and individually, to provide advice and guidance for genetic resource conservation activities to GRCP. Technical Advisory Committees for plant, animal, and microbial species will be appointed as appropriate. A broadly based Public Advisory Committee will function to review GRCP programs, identify important needs in genetic resource conservation, and assist in promoting and facilitating GRCP activities. This committee will include public and private sector representatives as well as representatives from the University of California and other universities.

PROGRAM ACTIVITIES

Because GRCP was not fully funded, not all components of its mission could be addressed. Priority was given to genetic resources collections that were in great danger of being abandoned, lost, or otherwise dissipated. In fact, it was the imminent loss of valuable materials that provided a major impetus to this program. A survey was conducted (see Appendix II for format) to develop information on the status of special collections of plant, animal, and microbial species.

Seventeen individuals responded to the survey producing a list of 115 collections that they considered imperiled. Of these collections, 108 involved plant taxa, five involved animal taxa, and two involved fungal taxa.

Rescue of Imperiled Collections Program. Of this large number of identified imperiled collections, some were in dire danger of being lost. A common situation was that a collection had been amassed during the career of a researcher and upon the researcher's retirement from University service, no means was available to maintain the collection. This situation was anticipated from many case studies presented at the Napa Symposium in 1984. Therefore, GRCP established, as its first priority activity, a program to rescue imperiled collections. In such cases, GRCP could provide short-term financial support for the assessment, inventory, consolidation, or proper storage of the collection, thereby reducing upkeep demands on space and personnel, until support for long-term conservation could be arranged. In other cases, a particular piece of equipment was required to institute more specialized storage or maintenance procedures that would in the long run be more cost- or space-efficient.

Fifteen of the 40 example species identified in 1984 (Appendix IV) are represented in the active projects in the Imperiled Collections Programs. These projects only attend to a single aspect of genetic resource conservation. Beyond the protection of special collections of genetic stocks, a comprehensive plan is needed for conservation of the biologic diversity of species important in California, including their use in agriculture and industry and as natural resources in California's wildlands and waterways. These broad considerations of genetic resources conservation will be the subject of GRCP's attention in the immediate future.

Conservation Research. Several of the first year's projects involved a research component along with the rescue of an imperiled collection. Maintenance of living collections of genetic resources is time- and space-consuming, requiring certain population sizes, optimal habitats, control of reproduction, and adequate sampling and storage, whether the resource be flocks, herds, colonies, populations, propagules, or cultures. Cryopreservation (storage by freezing at very low temperatures) is one promising alternative. It offers the opportunity to avoid maintenance of individuals or populations generation after generation just to have a particular genotype or character readily available. Entities that have been successfully preserved for various species are eggs, semen, and embryos of animals; pollen, seeds, or spores of plants; cultures of fungi and microbes; or DNA or tissue of any living thing. Cryopreservation is feasible for many genetic resources and will be used in several of the funded projects. However, its application is very species specific and therefore experimentation is involved in each extension to a new species. The potential for widespread use of cryopreservation justifies research to make it feasible.

Education. Less than 3% of this year's budget was available to be used toward the education function of GRCP. One activity which was supported is the Seed Saving Project at the Student Experimental Farm at UC Davis. A major component of this project is education about genetic resource preservation issues. To this end, the project maintains a demonstration garden displaying the genetic diversity available in a variety of vegetable crops; conducts workshops to demonstrate techniques for seed gathering and cleaning and for maintaining varietal purity; has an active public speaking schedule; and maintains a network of communication among local growers and seed savers and with a similar national program, the Seed Savers Exchange.

In September 1985, GRCP sponsored a seminar at UC Davis by internationally known Dr. Norman Myers, a scientist and writer. His talk was entitled "Conservation of genetic resources - a true priority?"

Collection. Emergency financial support was provided for the transportation of a collection of potato germplasm from Peru representing landraces still in cultivation there. The collection was made in the spring of 1986 by personnel from the Department of Vegetable Crops and the International Agriculture Development Program of UC Davis.

Management Office. About 25% of first year funds went to the establishing of the Management Office. In addition to the normal supplies necessary for administering an office, word processing equipment, filing systems, a computer for resource inventory and office administration, as well as various furniture items were purchased. The two rooms in Hunt Hall also needed remodeling to control noise and to facilitate shared usage.

RESCUE OF IMPERILED COLLECTIONS

The amount of funds presently available to GRCP cannot provide for the perpetual maintenance of collections, but can be used to enable the rejuvenation, consolidation, or transfer of collections. Most importantly, a plan for genetic conservation for special collections will be developed so that financial means for long-term conservation can be established. Permanent funding for the maintenance of collections will be sought by increasing the University budget for genetic resource conservation to GRCP or the designated curators of collections. External sources of permanent funding will also be sought.

A general call for proposals was distributed to all UC campuses (Appendix III). Twenty-two proposals were received, 18 of which were accepted for funding. The funded projects involved collections on five of the nine UC campuses and included eight on plants, six on animals, and four on microbial organisms. These projects dealt with 15 of the 40 high priority examples for California compiled in 1984 for the Napa Symposium (see Appendix IV). The GRCP had \$152,364 available for projects in 1985-86. There were 18 imperiled collection projects funded at an average of \$8,465 per project. A nineteenth project, at the Davis campus, to promote individual gardeners to conserve heirloom vegetable varieties, also received financial assistance.

Most projects were accepted for two-year funding because funds were not available until late in this first year. The Imperiled Collections Grant Program will be continued in the third year with additional projects expected to receive funding.

PROJECTS FUNDED

Brief abstracts are presented here for each project funded. In the next annual report, a status report will be given for each collection with a statement of how these collections can be best conserved for perpetuity.

PLANTS

Tomato Genetics Stock Center

8601 PRINCIPAL INVESTIGATOR: Charles M. Rick, Vegetable Crops - Davis

RESOURCE: The Tomato Genetics Stock Center comprises approximately 2,550 accessions which include about 850 monogenic mutant lines, about 800 accessions of linkage testers, genetic stocks, chromosomal variants, standard lines, primitive cultivars, and Latin American cultivars of *Lycopersicon esculentum* (cultivated tomato), and about 900 accessions of related wild species: nine of *Lycopersicon* and four of *Solanum*.

SUPPORT: General assistance and supplies were provided to the Tomato Genetics Stock Center to support the continuing activities of accessioning, maintenance, evaluation, inventory and documentation, and distribution. Lists of available stocks are issued annually in Reports of the Tomato Genetics Cooperative. Such lists are also made available on request to investigators who do not have access to the Reports.

Cucurbita Germplasm Collection

8602 PRINCIPAL INVESTIGATOR: Laura C. Merrick, Vegetable Crops - Davis

RESOURCE: The collection comprises approximately 600 accessions which are either landraces or wild or weedy species related to the cultivated species of *Cucurbita*. The material is primarily of Mexican origin, from approximately 30 states, as well as from five countries of Central America, four countries of South America, and several locations in the United States and Asia. Over 500 genetic lines from experimental, interspecific F₁ and F₂ crosses and backcrosses among wild and cultivated species of *Cucurbita* are also included. Most of the seed accessions are originally from collection expeditions conducted during the period 1979-1985, although some of the accessions are older. Approximately 130 of the accessions have been increased. In addition, the USDA Whitaker cucurbit

collection, housed in California but currently inactive, will be inventoried as part of this project. It comprises approximately 300 accessions but their status and amount of seed is not known.

SUPPORT: General assistance and supplies were provided for a detailed inventory of the collection which will compile passport data, number of seed available, species identification, history of the accessions in experimental programs, evaluation and characterization data, record of duplication in other gene banks, and date and availability of seed from the latest seed increase for each accession. The inventory will be available on request from the principal investigator and GRCP.

Medicago and *Trifolium* Genetic Stocks

8603 PRINCIPAL INVESTIGATOR: Larry R. Teuber, Agronomy and Range Science - Davis

RESOURCE: The collection of *Medicago* and *Trifolium* was amassed by Dr. E. H. Stanford over his career at Davis. Some entries have selection histories for resistance to nematodes and dwarf disease, for seed yield, and for persistence. Another portion of the collection represents original plant introductions, many of which are still in the pod, from California species of *Medicago* as well as foreign taxa. Many of these entries have been either lost or adulterated in the national collection. The remaining entries are genetic markers for which Dr. Stanford determined the inheritance. No other sources for these markers are available.

SUPPORT: General assistance and supplies were provided to inventory and, by means of Dr. Stanford's records and those of the

national collection, determine the status of individual entries. Letters have been sent to alfalfa scientists inquiring if additional sources of the marker lines exist, then methods of rescuing the genetic stocks will be determined. Priority will be placed on increase in reproductive isolation of the entries that are no longer available through the national collection. Genetic markers will be described and increased also to facilitate development of germplasm possessing these traits in high frequency for future use in breeding programs. A completed inventory of available germplasm will be distributed through the normal channels of the Department of Agronomy and Range Science at UC Davis and the North American Alfalfa Improvement Conference.

Wheat Genetic Stocks

8604 PRINCIPAL INVESTIGATOR: Jan Dvorak, Agronomy and Range Science - Davis

RESOURCE: The collection of several hundred cytogenetic stocks of wheat is comprised of additions and substitutions of whole chromosomes and telosomes from *Lophopyrum elongatum*, *Secale cereale*, *Aegilops longissima*, *Ae. umbellulata*, *Ae. speltoides*, *Ae. tauschii*, and *Triticum monococcum* in wheat. Except for *S. cereale* and *Ae. umbellulata*, all these stocks were developed by Dr. Dvorak and his collaborators at Davis. The collection also contains monosomic, ditelosomic, double ditelosomic, tetrasomic, and nulli-tetrasomic stocks of wheat developed by E. R. Sears.

SUPPORT: General assistance, supplies, and equipment were provided to improve storage conditions for the collection. In the spring of 1986, the entire set of disomic and

ditelosomic substitutions of *L. elongatum* in Chinese Spring wheat as well as two sets of Chinese Spring monosomics were increased, cytologically checked, and prepared for storage. Once stored they will be accessed only when working collections are depleted, when seed is requested by other workers, or when growout is necessary due to length of storage. Identity of stocks will be monitored at growout intervals. Ultimately the entire collection will be readied for storage. The collection will be catalogued on computer files along with relevant accession, generation, source, and chromosomal identity information. Material will be distributed as requested to investigators in California (and elsewhere) if no conflict of research interest exists.

Rescue of Endangered Fruit and Nut Collections

8605 PRINCIPAL INVESTIGATORS: Dan Parfitt, Chair, Kay Ryugo, Gale McGranahan, Jim Beutel, Dale Kester, Pomology - Davis

RESOURCE: The collections consist of filbert, pecan, pistachio, persimmon, *Prunus*, walnut, pear, and almond stocks. These have accumulated as research resources and teaching collections and many are unique.

SUPPORT: Supplies and equipment were provided for the preservation of these collections by consolidation and, where necessary, repropagation. The filbert, pecan, pistachio, and persimmon collections will be maintained in place but pruned to return them to health. A selection of *Prunus* cultivars representing a range of genotypes

and phenotypes will be made and repropagated on virus-free rootstocks. A new area for the walnut collection will be fumigated in preparation for planting rootstocks for the ultimate repropagation of the walnut cultivars. A portion of the pear collection will be moved also. The almond collections will be inventoried and divided into breeding materials, base germplasm to be propagated for entry into the National Clonal Plant Germplasm Repository, and cultivars to be maintained in the renewed Pomology Department collection. This latter group is estimated to be about 300 to 400 selections.

African Petaloid Monocots

8606 PRINCIPAL INVESTIGATOR: Harold Koopowitz, Arboretum - Irvine

RESOURCE: The collection consists of 82 species of African petaloid monocots considered to be "at risk" by the Threatened Plants Committee of the Botanic Gardens Conservation Coordinating Body, a branch of the International Union for the Conservation of Nature and Natural Resources. Many of these 82 species are of horticultural potential and can be used for breeding ornamentals; several are also related to important cut flower crop plants.

SUPPORT: General assistance and supplies were provided for aid in the continued maintenance and distribution of these species. This is labor intensive since several can be propagated only from seed which often requires hand pollination. An inventory of the species maintained and their status will be prepared.

Relocation of Endangered Grape Germplasm

8607 PRINCIPAL INVESTIGATORS: Carole Meredith and Cornelius Ough, Viticulture and Enology - Davis

RESOURCE: The collection consists of F₁ plants from crosses between accessions of *Vitis vinifera* with *V. rotundifolia*, first and second backcrosses between these F₁'s and *V. vinifera*, various breeding selections from intraspecific *V. vinifera* crosses, and a number of *V. vinifera* tetraploids. The parental plants were collected by Dr. H. Olmo from various parts of the world and most are already contained in the National Clonal Germplasm Repository at Davis. The derived breeding materials are not in the purview of the

Repository, but are very valuable resources for future breeding programs as sources of pest and disease resistance and fruit quality characteristics. Many of them have already been used in published work.

SUPPORT: General assistance and supplies were provided to the Department to reorganize, consolidate, and relocate the collection. An inventory will be prepared and made available to the Genetic Resources Conservation Program.

Daucus carota L. Tissue Culture Lines

8608 PRINCIPAL INVESTIGATOR: Z. Renee Sung, Plant Pathology - Berkeley

RESOURCE: The collection consists of 160 cell lines, including biochemical and developmental variants isolated from tissue cultures of cultivated carrot (*Daucus carota*) and wild carrot (Queen Anne's lace). The collection of biochemical variants has been an asset for basic studies in biochemistry, cellular and developmental processes, and genetic engineering of higher plants.

SUPPORT: A growth chamber was provided for stock maintenance and plant regeneration necessary for the continued maintenance and screening of the cultures. An inventory of the maintained cell lines and their characteristics will be made available to researchers.

Seed Saving Project

8619 PRINCIPAL INVESTIGATORS: Nancy Cherniss and Zea Sonnabend, Student Farm - Davis

RESOURCE: The Seed Saving Project is an organization engaged in locating and preserving vegetable varieties which are locally adapted, heirloom varieties, or endangered. The group has an education function with a demonstration garden,

speakers and workshops, and a newsletter directed to publicizing the need for germplasm conservation.

SUPPORT: General assistance and supplies were provided for gardening activities and seed storage.

ANIMALS

Cryopreservation of Embryos and Semen from Mammalian and Avian Genetic Stocks

8609 PRINCIPAL INVESTIGATORS: G. Eric Bradford, Tom R. Famula, Gary B. Anderson, Juan F. Medrano, Animal Science and Hans Abplanalp, Ursula K. Abbott, Frank X. Ogasawara, Avian Sciences - Davis

RESOURCES: (1) A collection of mice genotypes includes selected lines and a control having been maintained as closed lines for 70 to 90 generations and two mutant lines, high growth and dwarf. The selected lines have been used extensively for studies of the physiology and endocrinology of growth, the estrous cycle, ovulation rate, and all stages of prenatal development and are established as a model system for such work.

(2) A collection of sheep lines of the Targhee breed consisting of a control, a line selected for multiple births, and two lines selected for high 120-day weight.

(3) A collection of chicken genotypes including highly inbred lines developed over the last 30 years and used as experimental material nationwide, a series of congenic lines comprising 15 haplotypes of the major histocompatibility complex which are the major supply of types conferring disease resistance or susceptibility, and mutant lines such as dwarfing and limb, skin, and feather mutants.

SUPPORT: A controlled-rate portable freezer and liquid nitrogen storage tanks and general assistance were provided for low temperature storage (cryopreservation) of mice and sheep embryos and chicken semen. Cryopreservation of the sheep and mice embryos offers a means to preserve the stocks against possible loss, to free the stocks of disease, to permit reestablishment of the lines in the future even if they cannot be maintained continuously as breeding populations, and to permit transfer of these lines to other research centers. The chicken stocks must currently be maintained by annually breeding live birds. Freezing of semen will avoid this annual breeding as well as preserve these stocks free from diseases. Material from the collections will be available to researchers in the departments involved and to others elsewhere for collaborative research. The collections will be recorded and publicized through the Genetic Resources Conservation Program as well as the relevant newsletters or genetic stock registries.

Drosophila Genetic Stocks

8610 PRINCIPAL INVESTIGATOR: Melvin M. Green, Genetics - Davis

COLLABORATORS: George Lefevre, CSU-Northridge, Edward B. Lewis, California Institute of Technology

RESOURCE: The genetic stocks of various species of *Drosophila* are from three major collections not duplicated elsewhere. The collections have accumulated during the careers of three researchers, two of whom have retired and the third is near retirement. These stocks are used in teaching and research at several institutions in California as well as others in

the United States and other countries. No provisions have been made for the continued maintenance of these stocks following retirement of these workers.

SUPPORT: Supplies were provided for maintenance of the stocks for an interim period while the collections are consolidated and plans are made for their future support.

Domestic Rainbow Trout, *Salmo gairdneri*

8611 PRINCIPAL INVESTIGATOR: Graham A.E. Gall, Animal Science - Davis

RESOURCE: Two domestic stocks and an inbred line of rainbow trout have been used primarily for research. Considerable information has been published which can only be verified and expanded if the stocks remain intact. The domestic stocks are two of only six stocks in existence in California. The physical system used for trout also supports the only domestic stock of

Sacramento River white sturgeon maintained by a public institution.

SUPPORT: Equipment was provided including a new energy-efficient pump, capable of continuous operation necessary to provide continuous circulation of water without the interference of the unavoidable interruptions inherent in the existing supply.

Domestic White Sturgeon, *Acipenser transmontanus*

8612 PRINCIPAL INVESTIGATORS: Serge I. Doroshov and Graham A.E. Gall, Animal Science - Davis

RESOURCE: The collection consists of domestic white sturgeon stocks unique for the state and nation. The domestication of this fish and maintenance of a functional domestic broodstock will improve cultivation of sturgeon and reduce the negative impact of present aquaculture activities on the wild fish. The stocks are important for current investigations into the reproductive cycle of this fish and into the possibility of controlling reproductive processes in captivity by the administration of exogenous hormones and drugs. Such research on domestic stocks

adds important knowledge to the reproductive physiology and genetics of white sturgeon as a species. The progeny of domestic fish can be used for selective breeding and for stocking in some wild environments to meet the increasing demands on the sport fishery in California.

SUPPORT: The equipment provided is a large tank and hatching and juvenile-rearing facilities. These complement existing equipment in the Animal Science Department Fish Hatchery facility.

Genetic Stocks of *Apis mellifera* (Honey Bees)

8613 PRINCIPAL INVESTIGATOR: Christine Y.S. Peng, Entomology - Davis

RESOURCE: The collection consists of five mutant lines of honey bee: cordovan, black, white eye, diminutive wing, and chartreuse. The mutant lines were originally obtained by H. Laidlaw of the Entomology Department, UC Davis prior to his retirement. Even though part of the collection was transferred to the USDA Bee Stock Center, most of the mutant lines were lost during the past ten years. The extant lines in Dr. Peng's

laboratory are part of the original collection and some are the only known representatives.

SUPPORT: General assistance and supplies were provided for construction and maintenance of hives and feed needed for propagating the stocks. Research on bee semen cryopreservation will be facilitated by collaborative use of a controlled-rate freezer provided by the National Clonal Germplasm Repository at UC Davis.

Genetic Stocks of Freshwater Snail (*Biomphalaria glabrata*)

8614 PRINCIPAL INVESTIGATOR: David S. Woodruff, Biology - San Diego

RESOURCE: This species of snail is the intermediate host of human blood flukes (*Schistosoma*) which debilitate over 200 million people. The collection consists of about 30 genetically defined stocks of snails derived by field collecting and a long-term selective breeding program. Each stock is characterized on the basis of phenotypic and genetic markers and genetically based differences in parasite compatibility. The collection was begun by Dr. C. S. Richards with National Institute of Health support, but this support ceased upon his retirement. Some National Science Foundation support was obtained, but it expired in 1986. Some

selected stocks are being maintained privately. These native and inbred stocks are invaluable tools in basic research aimed at controlling schistosomiasis that is being carried out at several UC and other California campuses.

SUPPORT: General assistance and supplies were provided for interim aid in maintenance of selected stocks until a long term solution can be found. This support also makes possible continued characterization of the stocks for genetic variability. An inventory of the collection and an announcement of availability of founding samples will be published in appropriate journals.

MICROBIAL ORGANISMS

Ultra-Low Temperature Preservation of Aquatic Fungi

8615 PRINCIPAL INVESTIGATOR: John Taylor, Botany - Berkeley

RESOURCE: The collections of living fungi and algal cultures consist of more than 400 species representing all six classes of fungi as well as a diverse collection of more than 200 species of fresh and salt water algae currently housed in the UC Berkeley Microgarden. The Microgarden has an international reputation as a source of cultures, particularly aquatic fungi. Many of the fungal and algal cultures were isolated in California, including several of the rare, acid-forming aquatic fungi. Cultures are supplied

to other California institutions for instructional and research purposes. Malfunctions of the 25-year-old environmental rooms and cooling facilities endanger the collections.

SUPPORT: The equipment provided includes a programmable freezing unit, a liquid nitrogen storage system, and liquid nitrogen. This low temperature system will provide safe backup storage of cultures.

Cryopreservation of *Phytophthora* Species

8616 PRINCIPAL INVESTIGATOR: Mike Coffey, Plant Pathology - Riverside

RESOURCE: The collection of phytopathogenic fungi (*Phytophthora* species) originated with the work and research interests of Professor Zentmyer, now retired. It includes 41 species of *Phytophthora*, representing the majority of the species currently identified. It includes about 300 isolates from the four species which cause major problems in California agriculture. This collection is a major resource for research into the biology, pathology, ecology, and taxonomy of this important genus. The current maintenance

practice requires culturing the isolates which is a time and space intensive procedure.

SUPPORT: General assistance and supplies were provided to aid in the development of a cryogenic preservation system to streamline the maintenance procedure by avoiding the routine transfer at six to twelve-month intervals of thousands of cultures. The support is for the transfer of the collection from the culture system to the cryogenic system. The collection will be documented with an inventory and a record of all scientific information available on each culture.

Collections of Yeast and Yeast-like Organisms

8617 PRINCIPAL INVESTIGATOR: Michael J. Lewis, Food Science and Technology - Davis

RESOURCE: The collection of yeast and yeast-like organisms has been a source of materials and information for such California agricultural industries as food processing and preservation, dairying, wood and paper processing, medical/veterinary science, biotechnology, brewing, wine-making, and other industrial fermentations. It includes a group of wild yeasts isolated from many habitats in the world which are of benefit for studies on genetics, evolution, physiology, and biochemistry. The collection, which now numbers around 5000 strains, is endangered by the retirement of three researchers, the diversity of the collection, changes in research focus, and shortage of support funds.

SUPPORT: General assistance, equipment, and supplies were provided for the inventory, consolidation, and transfer to long-term storage of the collection. The support of a microcomputer permits editing and tabulating data associated with the holdings, producing a public database. Other equipment and personnel support allows the strains to be culled, subcultured, verified, consolidated, and then preserved by freeze-drying or other means of long-term storage. Long-term storage will reduce the need for support funds and culling and inventory will increase the collection's utility as well as remove redundancy in acquisition.

Phytopathogenic Bacteria

8618 PRINCIPAL INVESTIGATOR: Milton N. Schroth, Plant Pathology - Berkeley

RESOURCE: The International Collection of Phytopathogenic Bacteria originated with the work of Morton P. Starr, at UC Davis, now retired, and consists of thousands of bacterial strains. The collection is unique and is the principal source of strains for taxonomic work, teaching, and other research.

SUPPORT: The collection was transferred from Dr. Starr to the Department of Plant Pathology in Berkeley in May 1986. A technician has been trained to work with all of the procedures necessary to maintain a

culture collection. Half of the collection has now been examined, recultured, and stored at -70°C . Two -70°C freezers were purchased for storage purposes. This type of storage makes it easier to send cultures on request since it is not necessary to make and send lyophils of cultures. For future support of the collection plans are being made with the California Department of Food and Agriculture which may lead to partial support because of mutual needs and a grant proposal is being drafted to the National Science Foundation.

APPENDIX I - Composition of *ad hoc* Advisory Group, November 25, 1985

H. Abplanalp	Avian Sciences	UC Davis
D.W. Anderson	Wildlife & Fisheries Biology	UC Davis
G.B. Anderson	Animal Science	UC Davis
H. Ferris	Nematology	UC Davis
G.A.E. Gall	Animal Science	UC Davis
S.K. Jain	Agronomy and Range Science	UC Davis
H. Koopowitz	Arboretum	UC Irvine
D.E. Parfitt	Pomology	UC Davis
M. Race	Office of Vice President ANR	UC
D.J. Raski	Nematology	UC Davis
C.M. Rick	Vegetable Crops	UC Davis
D.Y. Rosenberg	Calif. Dept. of Food & Agric.	Sacramento
J.N. Rutger	USDA/ARS and Agronomy & Range Science	UC Davis
M.N. Schroth	Plant Pathology	UC Berkeley
R.W. Touchberry	Animal Science	UC Davis

Additional representatives from UC Berkeley and UC Riverside were invited, but could not attend.

APPENDIX II - Format for Imperiled Collections Survey

**UNIVERSITY OF CALIFORNIA
GENETIC RESOURCES CONSERVATION PROGRAM**

*Imperiled or Endangered Germplasm or
Genetic Stock Collections* Survey*

Please return one form for each collection identified as needing immediate attention for conservation.

Name of species or taxonomic group:

Approximate scope of the collection:

Current curator or contact person:

Name: _____ *Department:* _____

Campus: _____ *Telephone:* _____

Salient features of the collection:

Please return this form by December 20, 1985, or telephone information to:

*Calvin O. Qualset
UC Genetic Resources Conservation Program
Agricultural and Environmental Sciences
Dean's Office, 228 Mrak Hall
UC Davis, CA 95616 or Phone: (916) 752-0819*

**Imperiled or Endangered Collections can be animal, plant, or microbial species that are a significant biological resource that is in danger of being lost in the near future. It may be currently held in the University of California or elsewhere if it is believed to be an important entity for conservation in California.*

APPENDIX III - Format for 1985-86 Proposals

UNIVERSITY OF CALIFORNIA
GENETIC RESOURCES CONSERVATION PROGRAM

One function of the GRCP is to provide short-term assistance in the preservation of collections of germplasm and genetic stocks critical to California. Some of the existing collections urgently need attention; it is the intent of the GRCP to provide assistance to rescue imperiled or endangered collections. Such assistance will initially be in the form of grants to departments, laboratories, or individuals who will take responsibility for endangered collections. It is expected that collections to be assisted will be maintained and will be accessible to researchers. Reports documenting work enabled by the GRCP, including an inventory of the collections, will be required.

Proposals are being accepted now and must be submitted **no later than February 11, 1986** for funding for the period March 1 - June 30, 1986. Investigators may also include in their budget request the needs for July 1, 1986 - June 30, 1987.

The attached format should be followed when preparing proposals. **Submit five copies of the proposals** to:

Calvin O. Qualset, Director
Genetic Resources Conservation Program
Dean's Office
College of Agricultural and Environmental Sciences
University of California
Davis, California 95616
(916) 752-0819

UNIVERSITY OF CALIFORNIA
GENETIC RESOURCES CONSERVATION PROGRAM
IMPERILED COLLECTION PROPOSAL FORMAT

Include all of the following items in each proposal:

I. Identification

- A. Principal Investigator(s): Name, Address, Telephone Number.
- B. Name of species or other taxonomic group (or other appropriate identification).
- C. Scope of the collection.
- D. Brief history of the collection.
- E. Current status of the collection.

II. Rationale

- A. Significance to California of the collection.
- B. Factor(s) endangering the existence of the collection.

III. Objectives and Procedures

- A. Description of proposed activity.
- B. Description and justification of any requested supplies and equipment.
- C. Description of activities and objectives of any personnel to be funded.
- D. Description of how the collection will be documented and be accessible to users.
- E. Anticipated long-range problems.

IV. Supplemental Information

- A. Have other funding sources for the preservation of the collection been investigated?
- B. Is the collection duplicated elsewhere?
- C. How will access to the collection be assured?

V. Budget - Itemize support requested in the following categories:

- | | <u>March 1, 1986 -
June 30, 1986</u> | <u>July 1, 1986 -
June 30, 1987</u> |
|-------------------------|--|---|
| 1. General Assistance | | |
| 2. Supplies and Expense | | |
| 3. Equipment | | |
| 4. Other | | |
| 5. Total | | |

APPENDIX IV - 1984 High Priority Example List

HIGH PRIORITY EXAMPLES OF SPECIES FOR GENETIC RESOURCES
CONSERVATION FOR CALIFORNIA*

ANIMALS

- | | |
|---|---|
| <p>Avian species</p> <ul style="list-style-type: none"> California quail Coastal marsh non-game birds Chicken research stocks† <p>Mammalian species</p> <ul style="list-style-type: none"> Mice research stocks† Sheep research stocks† Cattle breeds with unique phenotypes Bighorn sheep Tule elk Salt marsh harvest mouse <p>Nematode species</p> | <p>Arthropod species</p> <ul style="list-style-type: none"> Honey bees† Predatory mite <p>Amphibian species</p> <p>Reptilian species</p> <ul style="list-style-type: none"> Island night lizard <p>Aquatic species</p> <ul style="list-style-type: none"> Pacific salmon Rainbow trout† Abalone |
|---|---|

PLANTS

- | | |
|---|---|
| <p>Forest tree species</p> <ul style="list-style-type: none"> Radiata pine Coast redwood Guadalupe Island cypress <p>Range and wildland species</p> <ul style="list-style-type: none"> Rose clover Slender wild oat Beach strawberry Meadowfoam <p>Agronomic crop species</p> <ul style="list-style-type: none"> Wheat† Rice Alfalfa† Blackeye pea | <p>Vegetable crop species</p> <ul style="list-style-type: none"> Brassicas Tomatoes† Cucurbits† <p>Horticultural species</p> <ul style="list-style-type: none"> Grape† Almond† Walnut† Citrus Pistachio† Chrysanthemum |
|---|---|

MICROORGANISMS

- Plant viruses
- Pathogenic and nonpathogenic fungi†
- Yeasts†

*This list was presented at the Symposium and Workshop on Genetic Resources Conservation for California, Napa, California, April 5, 6, and 7, 1984.

†Endangered collections involving these organisms were the subjects of grants by the GRCP in 1985-86.

APPENDIX V - Summary of 1985-86 Expenditure of Funds

Item	Amount	Percent of total
A. Agriculture & Natural Resources Overhead	\$12,500	5.00
B. Davis Management Office	85,135	34.06
1. Salaries	\$32,768	13.11
2. Furnishings	15,393	6.16
3. Equipment	23,210	9.28
4. Supplies and Expenses	4,639	1.86
5. Travel	1,259	0.50
6. Programmatic		
Potato Collection	1,000	0.40
Promotional/Education*	6,866	2.75
C. Grants†	152,364	60.95
TOTAL	\$250,000	

*Includes Seed Saving Project, Student Farm, Davis (GRCP #8619).

†18 grants at \$3,000 to \$21,300 for an average of \$8,465 per grant.