# WORLD BOTANICAL ASSOCIATES ANNUAL REPORT

## NCI Contract N02-CM-17109

## YR II: September 1, 2002–August 31, 2003

## INTRODUCTION

Under a 3–5 yr reimbursable agreement, the World Botanical Associates (WBA) supplies the National Cancer Institute (NCI) with 1,000 samples of plants each year from the United States and Territories. Samples may be collected of any plant part, or any combination of plant parts, to yield 300–500 g dry in order to obtain 10 g of extract for testing against 60 different cell lines of cancer. Any plant is a candidate for collection, except those already collected—species, subspecies and varieties; this may include plant parts not previously collected and samples obtained during different seasons and from different habitats. Extracts of samples from one to two percent of the species screened may show significant antitumor activity to warrant further screening of active compounds for development as new anticancer drugs. Five (5)–ten (10) kg recollections may be required to isolate and identify antitumor active compounds. Examples of anticancer drugs developed from the NCI screening of natural products are taxol, first isolated from stem-bark of *Taxus brevifolia*–originally collected in Washington, and derivatives of camptothecin, isolated from wood of *Camptotheca acuminata*–collected in southern California.

The WBA field strategy is a systematic one based on phytogeographical relationships with limitations in regard to a RFP (Request for Proposal) submitted to the NCI, Nov. 2000 and April 2001. The limitations consider 5,000 samples already collected within the United States—by the Morton Arboretum (William Hess, PI, 1997–2001). Our analysis of their collections—in response to the NCI RFP—indicated they sampled mostly from deciduous forests of the eastern United States. We estimate that ~90% of the common indigenous US trees, perhaps 60% of the common US shrubs and 30% of the common herbs were collected. The fewest collections were from the Southwest and Northwest, lacking entirely from Alaska, Washington, and Hawaii. Additionally, the RFP listed 96 extracts for the Territory of Puerto Rico—from samples supplied by the New York Botanical Garden (Project Officer, Gordon Cragg, pers. comm.).

Vouchers are prepared for all samples. The PI (Richard Spjut) identifies plants in the field using manuals on local floras before sampling. Identifications of vouchers are reviewed by Roger Sanders except Asteraceae by Guy Nesom, Botanical Research Institute of Texas (BRIT). An additional set of vouchers is then sent to the US National Herbarium (US), and to other institutions as may be required by permits.

## SUMMARY OF ACCOMPLISHMENTS

During Year II, (Sep. 1, 2002–Aug. 31, 2003), the World Botanical Associates collected 941 samples from 521 species; see Appendix I for a species list arranged by family and genus. Last year we supplied 1,061 samples from 567 species; thus, our total for two years is 2,002 samples. This years samples were collected in Alaska, Arizona, California, Nevada, Oregon, Texas, and Washington.

## DETAIL

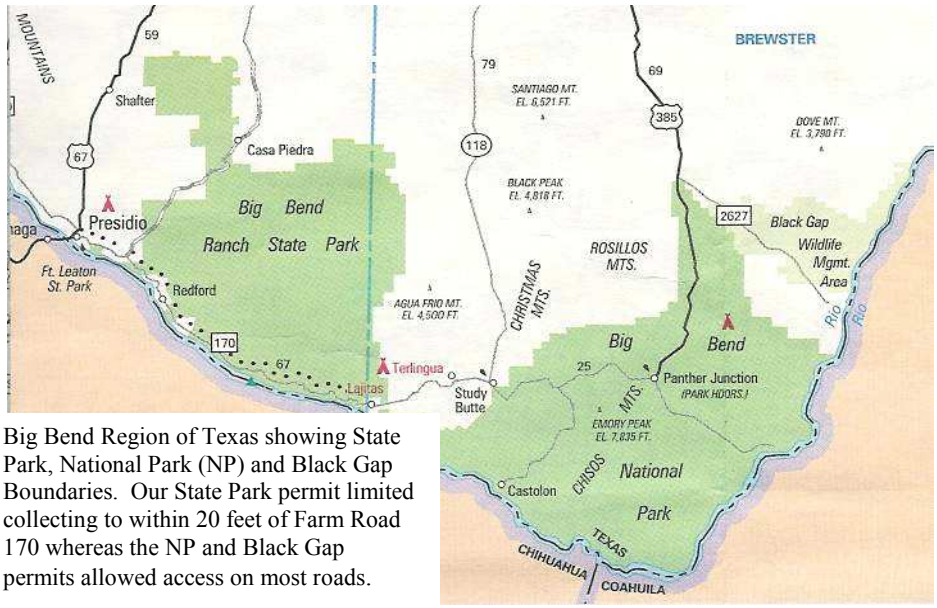
The following table (Table 1) shows that most samples were from public lands managed by the United States Forest Service (USFS, U.S. Department of Agriculture [USDA] followed by agencies of the US Department of Interior, the Bureau of Land Management (BLM), the Fish and Wildlife Service and the National Park Service.

***Table 1. Number of plant samples collected according to State and Land Ownerships***

*BLM (Bureau of Land Management), USFS (United States Forest Service), USFS (United States Fish and Wildlife, NPS (National Park Service), State (State Owned, General, not a State Park), Pvt Lnd (Private Land).*

| Region | BLM | USFS | USFW | NPS | State | Pvt Lnd | Total |
|---|---|---|---|---|---|---|---|
| Alaska | 3 | 172 | 15 | | 81 | 11 | 282 |
| Arizona | 10 | | | | | | 10 |
| California | 116 | 111 | | | 26 | 60 | 313 |
| Nevada | 48 | | | 1 | 13 | | 62 |
| Oregon | | 16 | | | | | 16 |
| Texas | | | 68 | 119 | 64 | | 251 |
| Washington | | 5 | | | | 3 | 8 |
| Total | 177 | 304 | 83 | 120 | 183 | 72 | 941 |

Accomplishments for Year II are discussed below by region of fieldwork, chronologically, beginning with Texas (Nov 2001), then California and Nevada (Apr-Jun, 2002), and finally Alaska (Jul-Aug). Collections from other states were incidental. For each region, samples are enumerated by species and plant parts—from base to apex of plant, abbreviated as follows: rt (root of herbaceous species or woody plants in which bark is not separated), or wr (wood of root in which bark was removed) and rb (root-bark), rh (rhizome), st (stem, plant usually entirely herbaceous) or ws-sb (woody-stem with bark) or ws (wood of stem in which bark was removed) and sb (stem-bark), or wst (woody-stem of a partially woody plant) and hst (herbaceous stem of a partially woody




Big Bend Region of Texas showing State Park, National Park (NP) and Black Gap Boundaries. Our State Park permit limited collecting to within 20 feet of Farm Road 170 whereas the NP and Black Gap permits allowed access on most roads.

plant), tw (twig), lf (leaf), if (inflorescence, with flowers and/or fruits), fl (flower), fr (fruit), and sd (seed). An herb sample, for instance, may include the entire plant for which the combined parts may be indicated rt-st-lf-fl-fr. Samples of whole plants lacking clear distinction of plant parts may be designated pl (for plant, e.g., *Cuscuta californica*). The expectations from further collecting in each region are also discussed.

**Texas: Nov. 1–24 (2002)**

We obtained 251 samples from southwestern Texas, largely from the Black Gap Wildlife Refuge (68 samples), the Big Bend National Park (76 samples), Amistad National Recreation Area (43 samples), and state land along roads bordering private lands in route to these areas (74 samples, 10 from AZ). Permits were obtained from the appropriate authorities in the National Park Service, the Texas State Department of Wildlife, and the Texas State Highway Department. Additionally, the INS Border Patrol offices were advised of our travel plans and vehicle data.

We traveled to Texas from southern California in two vehicles, collecting along the way in Arizona and Texas. In Arizona we collected 10 samples: *Blepharidachne kingii* rt-st-lf-fr; *Brickellia floribunda* rt, hst-lf-fl-fr; *Cercidium floridum* sb; *Chrysothamnus nauseosus* var. *oreophilus* rt, tw-lf-fl; *Clematis drummondii* st-lf-fr; *Verbesina enceloides* rt-st-lf-fl; and *Zinnia acerosa* rt-st, tw-lf.

**Black Gap Wildlife Management Area** (Nov. 10-12), Chihuahuan Desert, Brewster Co. Sixty-eight (68) samples were obtained from two general areas, (1) along the Rio Grande on limestone slopes and washes predominantly of a mixed spiny succulent and shrub cover of *Agave lechequilla, Leucophyllum spp., Opuntia phaecantha, Yucca spp., Larrea, Euphorbia antisyphillitica*, interspersed with grasses *Bouteloua* spp. and other ephemerals (elev. 1,740 ft, 29º33'20.2 N, 102º48'59.6"), and (2) along Brushy Creek Road near the Dead Horse Mountains, an area with more tree species such as *Ungnadia*

Camp shelter used for drying samples along Brushy Creek of the Black Gap Wildlife Management Area. Sample of *Opuntia leptocaulis* fruit collected in the Black Gap area.

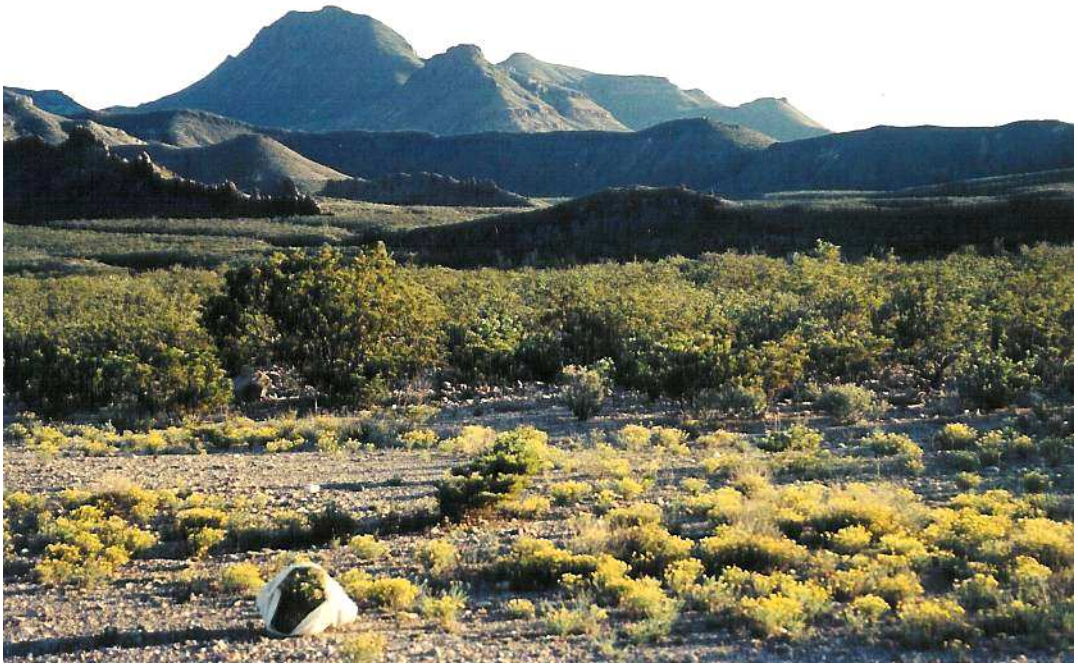
*speciosa, Juglans microcarpa, Rhus virens, Yucca thompsoniana, Yucca torreyi, Diospyros texana, Forestiera angustifolia, Cercis canadensis, Eysenhardtia texana, Fraxinus greggii, Quercus pungens* and *Leucaena retusa* (1,000 m, 29º33.62'N, 103º01.19' W).

Samples from near the Rio Grande included *Acacia constricta* rt (<2mm diam.), wr, rb, ws, sb, tw-lf; *Acacia greggii* var. *greggii* rt-rh, old ws-sb, new ws-sb, tw-lf; *Agave lechuguilla* fr-stalk, fr; *Arundo donax* rt-rh, st, if; *Ephedra antisyphylitica* rt, ws-sb, hst-lf-fr; *Lippia graveolens* rt, ws-sb, tw-lf-fl; *Mentzelia mexicana* rt, st-lf-fl-fr; *Opuntia leptocaulis* fr; *Perityle aglossa* rt, st-lf-fl-fr; and *Tecoma stans* rt, ws-sb , tw-lf-fl, fr.

Along Brushy Creek—where we had collected samples from 11 species last year (Oct. 2001)—this year we collected 29 samples from 12 species: *Acalypha monostachya* rt, st-lf-fl-fr; *Astrolepis integerrima* rt-rh-lf; *Cercis canadensis* var. *mexicana* rt, ws, sb, tw, lf; *Cissus trifoliata* tuber, rt, wst, tw, lf, fr; *Convolvulus equitans* rt, st-lf (fl-fr); *Cowania ericifolia* rt, ws-sb, tw-lf; *Cynanchum unifarium* rt-st-lf-fr; *Cyphomeris gypsophiloides* st-lf-fl; *Hedyotis angulata* rt, st-lf-fl; *Maurandya antirrhinifolia* rt-st-lf-fl; *Parthenium confertum* rt-st-lf-fl; and *Quercus pungens* var. *pungens* rt, ws, sb, tw, lf.

**Texas State Highways (Counties of El Paso, Culberson, Hudspeth, Presidio, Brewster, Terrell, Val Verde)**. Public lands with grassland vegetation in the western states are usually managed by BLM, but Texas is largely private land, including land leased by the Texas General Lands Office. However, Texas public roads have right-of-ways under jurisdiction of the Texas State Highway Department. Texas road margins are frequently mowed and may include wildflower introductions. Occasionally, indigenous plants—that have crept beyond fenced borders—may be found in sufficient growth for sampling. Such growth was recalled to be more extensive during the late 1970's. Over the years it appears that highway maintenance has not only increased, but succulents and other species have disappeared as a result of horticultural collecting for nurseries as reported by one state authority.

Nevertheless, we were able to collect 64 samples along Texas state roads outside NPS lands and state reserves. Included were *Atriplex acanthicarpa* rt, ws-sb, tw-lf (male), tw-lf-fr; *Atriplex obovata* rt, st-lf (male), st-lf-fr; *Bahia absinthifolia* rt-st-lf-fl; *Boerhavia intermedia* rt-st-lf-fr; *Boerhavia spicata* rt-st-lf-fr; *Bouteloua barbata* rt-st-lf-fl-fr;

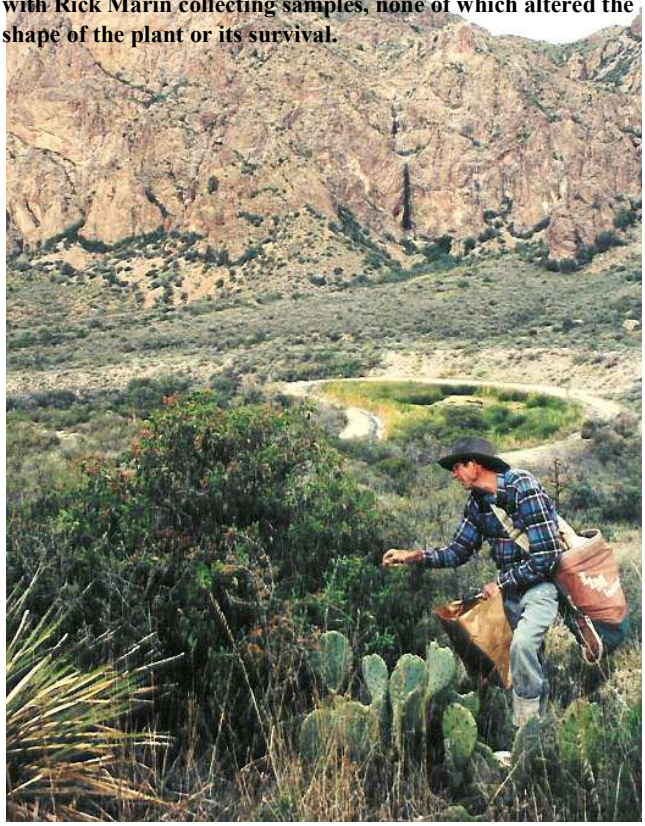


Looking south towards Chisos Mountains in the Big Bend National Park. Bag in foreground is filled with *Machaeranthera pinnatifida* var. *chihuahuana*, the dominant yellow-flowered plant. The common shrub in background is creosote (*Larrea tridentata*). The sample was collected from plants that were mostly behind the bag. This collection obviously had little impact on the population.

*Bouteloua ramosa* rt-st-lf-fl-fr; *Chamaesaracha sordida* st, lf-fl; *Chamaesyce parryi* rt-st-lf-fr; *Cleomella longipes* rt, st-lf-fl-fr; *Eriogonum abertianum* rt-st-lf-fl; *Eriogonum tenellum* var. *platypyllum* rt, st-lf-fl-fr; *Gaillardia pinnatifida* rt-st-lf-fl; *Gutierrezia sphaerocephalus* rt-st-lf-fl-fr; *Haploesthes greggii* rt, wst, tw-lf-fr; *Heteropogon contortus* rt-st-lf-fl; *Hilaria mutica* rt-st-lf-fl; *Indigofera linheimeriana* rt, st, lf, fr; *Kallstroemia grandiflora* rt-st-lf-fl; *Kallstroemia parviflora* rt-st-lf-fl; *Lycium puberulum* var. *berberioides* rt, ws-sb, tw-lf; *Machaeranthera pinnatifida* var. *chihuahuana* rt-st-lf-fl; *Muhlenbergia asperifolia* rt-st-lf-fl; *Munroa squarrosa* rt-st-lf-fr; *Nama harvardii* rt, st-lf-fl; *Oenothera triloba* rt-st-lf-fl; *Perityle vaseyi* rt-st-lf-fl; *Pectis angustifolia* rt-st-lf-fl; *Psathyrotes scoparia* rt-st-lf-fl-fr; *Salvia reflexa* rt-st-lf-fr; *Senna durangensis* rt, st, lf-fl-fr; *Senna lindhiemeriana* rt; *Sphaeralcea angustifolia* rt-st-lf-fl-fr; *Sphaeralcea subhastata* rt-st-lf-fl-fr; *Sporobolous wrightii* rt-st-lf; *Suaeda suffrutescens* rt, wst-lf-fr; *Thelesperma longipes* rt-st-lf-fl-fr; *Thymophila pentachaeta* var. *puberula* rt-st-lf-fl; *Tidestromia lanuginosa* var. *carnosa* rt-st-lf-fl-fr; *Wedelia hispida* var. *hispida* rt, wst-lf-fl; and *Xylothamia triantha* rt, wst, old growth tw, new growth tw, lf-fl-fr.

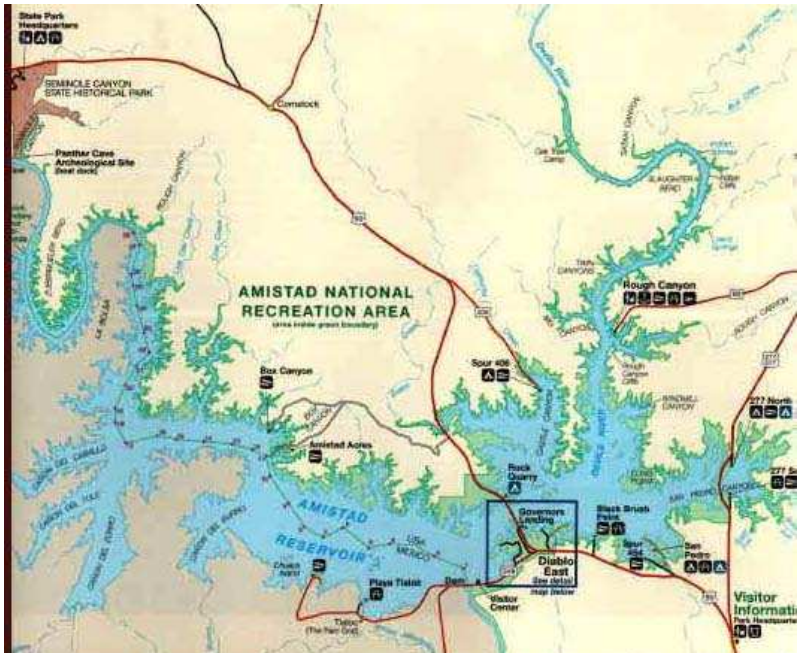
**Big Bend National Park**. The Big Bend region has a wide variety of vegetation types due to varied topography, its geographical location and its geological history. The national park status, its remote location in southwestern Texas, and the limited facilities for lodging undoubtedly help preserve the naturalness of the region. We observed

**Left and top right: *Rhus virens* var. *virens* in fruit, Chisos Mountains, Big Bend National Park. Although this species may be frequently seen in fruit in much of the Trans Pecos, the Chisos Mts. plants produced an abundance of fruit to the extent it was practical to obtain a sample for the NCI; left photo shows Rick Marin picking fruits from one shrub, followed by a close-up of the plant on right. Fruit is very viscous, not easily dried, as Thomas McCloud (Extraction Lab, NCI Frederick) may recall for a sample of *Rhus lentii* that we collected on the Vizcaíno Peninsula, Baja California, Mexico (May 1986). Lower right, *Vauquelinia corymbosa* var. *angustifolia*, Big Bend NP with Rick Marin collecting samples, none of which altered the shape of the plant or its survival.**



various research activities in the area, in addition to our own, that have little or no impact on the park, although smog is evident. During our visit, we stayed at primitive campsites that are nothing more than leveled parking spots; indeed, the sites are so primitive that the use of toilet paper is discouraged because it cannot be left buried.

We collected 76 samples in Big Bend NP, represented by *Abutilon incanum* rt, st-lf-fl; *Acacia texensis* rt, wst-tw-lf; *Acleisanthes longiflora* rt, st-lf-fl; *Ageratina wrightii* rt, st-lf-fl; *Allium kunthii* bulb, st-lf-fl; *Carlowrightia linearifolia* rt, wst-lf-fl; *Desmodium psilophyllum* rt, st-lf; *Dicraurus leptocladus* rt, wst, tw-lf-fl; *Eriogonum jamesii* rt, st-lf-fl-fr; *Garrya ovata* rt, ws-sb, tw, lf; *Gaura coccinea* rt, st-lf-fl; *Gilia stewartii* rt-st-lf-fl-fr; *Hibiscus denudatus* rt-wst, hst-lf-fl; *Ibervillea tenuisecta* rt, st-lf; *Isocoma plurifolia* rt, wst, hst-lf-fl; *Jefea brevifolia* rt, st-lf-fl-fr; *Lantana achryanthifolia* rt, wst-lf-fl-fr; *Macheranthera pinnatifida* var. *pinnatifida* rt-st-lf (fl-fr); *Matelea reticulata* rt-ws-tw-lf; *Melampodium leucanthum* var. *leucanthum* rt-st-lf-fl; *Opuntia phaecantha* rt, st; *Physalis lobata* rt-st-lf-fl-fr; *Pilostyles thurberi* fl-fr (with host parts of *Dalea formosa*); *Pinus*



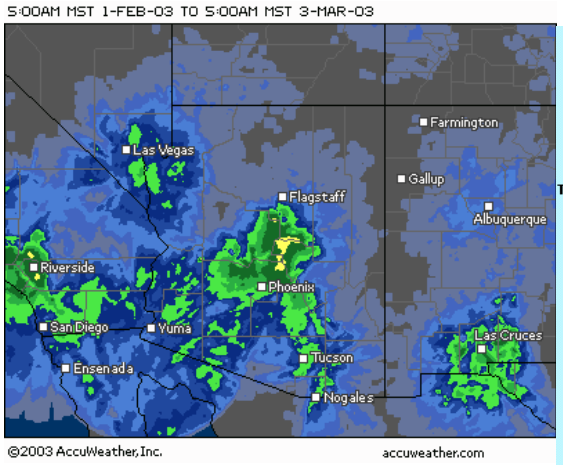

Amistad NP, the reservoir land in green along the shore in blue.

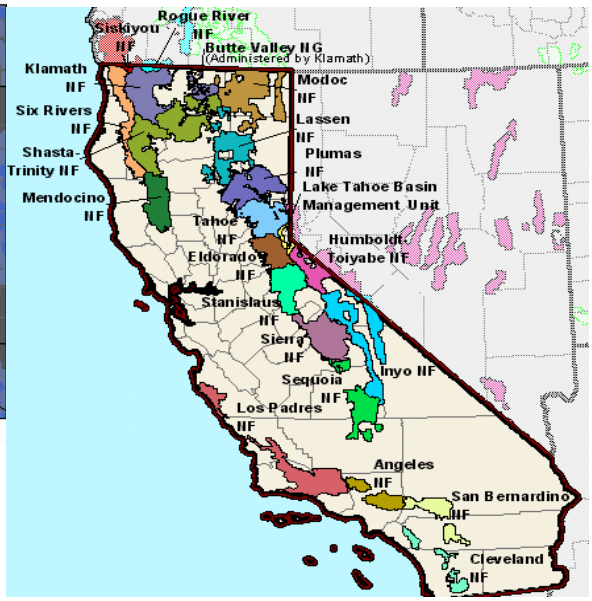
*cembroides* rt, ws, sb, tw-lf; *Prunus havardii* rt, ws-sb, tw-lf; *Psilotrophe tagetina* rt-st-lf-fl-fr; *Rhus virens* var. *virens* fr; *Rivina humilus* rt, st-lf-fl; *Salvia regla* rt, ws-sb, tw-lf; *Selinocarpus angustifolius* rt wst; *Selinocarpus parviflorus* rt, wst, hst; *Sisymbrium linearifolia* rt-st-lf-fl-fr; *Telesiphonia macrosiphon* rt-rh, st-lf (-fr); *Vauquelinia corymbosa* var. *angustifolia* wr, rb, ws, sb, tw, lf; *Verbena neomexicana* var. *hirtella* rt-st-lf-fl-fr; and *Verbesina encelioides* rt, st-lf-fl.

The Botanist at the Big Bend NP, Joe Sirotnak, offered to advise us on where we might find plants of interest; however, because of our unpredictable schedule, we were unable to meet with him. Upon our arrival, we learned that he had been out past midnight hours on an emergency mission looking for lost hikers.

**Amistad National Recreational Area**. This National Park is essentially a right-of-way along the reservoir analogous to the Department of Texas State Highway that maintains the roads and marginal areas. Lacking a boat, we collected only along access roads to the reservoir, 43 samples from 16 species: *Acacia berlandieri* wr, rb, ws, sb, tw-petiole-fr, lf; *Acacia rigidula* wr, rb, ws, sb, tw-lf-fr; *Bernardia myricifolia* rt, ws-sb, tw-lf-fr; *Calliandra conferta* rt, wst-lf; *Condalia viridis* wr, rb; *Croton incanus* rt, ws-sb, tw-lf (-fr); *Forestiera reticulata* rt, ws-sb, tw, lf (-fr); *Heliotropium torreyi* rt, wst-lf-fl; *Karwinskia humboldtiana* wr, rb; *Lantana urticoides x camara* rt, ws-sb, tw-lf-fl; *Merremia dissecta* rt, st, lf-fl-fr; *Penstemon bacharrifolius* st-lf-fl-fr; *Salvia ballotaeflora* rt; *Serjania incisa* st-lf (-fr); *Sida filipes* rt, wst-lf-fl; and *Sophora secundiflora* wr, rb, sb.

**Discussion of Texas Collections**. Our fieldwork in Texas has focused on collecting along the Rio Grande of Texas—from El Paso to near Eagle Pass. The previous supplier (Morton Arboretum) collected from Amistad NP to Laredo during April, while we collected mostly in the Trans Pecos—from October to November. Additionally, our samples of *Condalia viridis*, *Karwinskia humboldtiana*, *Salvia ballotaeflora* and *Sophora*




Left: Thirty-day accumulation for precipitation in the southwest, Feb-Mar, 2003. Most samples of herbs from southern California and Nevada came from the wettest areas shown. Right: Map differentiating 18 National Forests in California (Pacific SW Region).

*secundiflora* were limited to plant parts not previously collected. This region, and the adjacent Edwards Plateau and South Texas, receive precipitation primarily during the summer months. Thus, we have yet to collect during the primary flowering season, June-August, when other species that have not been collected for the NCI are expected to be available, especially in the families Acanthaceae, Asteraceae, Fabaceae, Hydrophyllaceae, Malpighiaceae, Malvaceae, Nyctaginaceae, Philadelphaceae, Polemoniaceae, Rhamnaceae, Rutaceae, and Sterculiaceae.

Although the NPS has allowed us to collect on their public lands in Texas, their land is rather limited compared to that under private ownership. We need to cover a lot of ground to obtain a good representation (sample) of the diverse flora of west and south Texas—that includes many endemics—because species often occur only locally due to spotty rains. This should be evident from the samples we have obtained thus far from the Black Gap Wildlife Management Area, Big Bend NP, Amistad NP, and roadsides outside the parks. The General Lands Office and the Big Bend Ranch State Park—where we have been limited to within 20 feet along Farm Road 170—perhaps could provide permits for further collecting in western Texas. Additionally, in South Texas, the Santa Ana National Wildlife Refuge in Hidalgo Co., a rather small area of ~2,000 acres with 450 plant species, has many collectable species new to the NCI screen.

**California and Southern Nevada (Sep 2001, Apr-May 2002)**

The Southwest US, which has been in severe drought for the past several years, received scattered rains during the past winter (2002-2003). The above figure shows the accumulated rainfall from Feb. 3 to Mar. 3, 2003. Most samples of herbaceous species were from areas of greater cumulative precipitation (green and yellow areas). Late spring herbs were especially abundant in the southern California chaparral eastward to the margin of the Sonoran Desert, otherwise, spotty along the California/Arizona state line, while much of the Sonoran Desert in California remained dry and barren.

Left: *Orothcarpus purpurascens* (= *Castilleja densiflora*, "owl's clover," Scrophulariaceae). Right: *Nemophila menziesii* (Hydrophyllaceae), San Diego Co., Lost Hills Rd at boundary of Cleveland NF. These tiny annual species are only practical to collect when found in mass profusion.

**California National Forests and Chaparral**. Most public land in California—vegetated by forest and chaparral—is managed by the USFS, the Pacific Southwest Region—divided into 18 different National Forests. Despite the effort made by the Chief of the Natural Products Branch to simply our need for Regional permits, we still had to obtain permits from each of the 18 National Forests in the Pacific SW Region. Notwithstanding, we report our collections for the Pacific SW Region (No. 5) on a forest-by-forest basis, starting from southern California chaparral. This is followed by reports on collections from BLM lands in California and Nevada.

One to ten day fieldtrips were made from our base in southern California. Samples were dried at our facilities.

**Cleveland NF**. Five samples, each consisting of the entire plant (rt-st-lf-fl-fr), were collected in chamise chaparral openings: Represented were *Cryptantha intermedia*, *C. muricata, Nemophila menziesii, Orthocarpus purpurascens* (= *Castilleja densiflora*) and *Salvia carduacea*.

**San Bernardino NF**. No samples. Collections were planned from this forest during May; however, the PI developed a severe rash from a plant while collecting in southern Nevada; consequently, collecting was suspended temporarily for one week, which was at the time we had planned to collect in this forest.

**Los Padres NF**. No response received in application for permit this year. Samples were not collected in this forest, which is readily accessible. Hopefully, a permit could be issued next year.

*Turricula parryi* (Hydrophyllaceae), a blue-flowered subshrub on a fire ridge in the Angeles NF, ~8,000 ft elevation. Three samples of this species—a genus new to the NCI screening program—were collected from this site, rt, ws-sb and tw-lf. Glandular hairs contain prenylated phenolics that may cause contact dermatitis. Nevertheless, scientists in Japan have reported carbon-prenylated derivatives of p-coumaric acids such as 3,5-diprenyl-p-coumaric acid show in vitro cytotoxic and in vivo activity against human tumor cell lines, and that other related substances such as caffeic-acid-phenelthyl-ester inhibit cell cultures of human breast carcinoma and melanoma. These substances have been isolated from bee hive materials (propolis), the nature of which varies according to where bees get their resin and other materials to create the hive.

**Angeles NF**. We obtained 41 samples from 26 species. Represented were: *Amsinckia tesselata* var. *gloriosa* rt, st-lf-fl; *Astralagus douglasii* st-lf, fr; *Castilleja foliosa* rt, st-lf-fl; *Clarkia unguiculata* rt-st-lf-fl-fr; *Claytonia parviflora* ssp. *parviflora* rt-st-lf-fl; *Claytonia perfoliata* rt-st-lf-fl-fr; *Cryptantha simulans* rt-st-lf-fl; *Cuscuta californica* pl; *Eriogonum fasciculatum* var. *polifolium* fl; *Eriogonum wrightii* var. *subscaposum* rt-rh-st-lf; *Galium angustifolium* ssp. *angustifolium* rt, st-lf-fl-fr; *Gilia brecciarum* ssp. *neglecta* rt-st-lf-fl; *Lomatium utriculatum* rt-st-lf-fl; *Malacothamnus marrubioides* rt, ws, sb, tw-lf; *Malacothrix saxatilis* rt, st-lf-fl; *Mentzelia veatchiana* rt-st-lf-fl; *Phacelia brachyloba* rt-st-lf-fl-fr; *Phacelia imbricata* ssp. *patula* rt, st-lf-fl; *Phacelia ramosissima* rt-st-lf-fl-fr; *Plagiobothrys arizonicus* rt-st-lf-fl; *Salvia leucophylla* rt, tw-lf-fl; *Spartium junceum* fl; *Taushia parishii* rt, st-lf-fl; *Thysanocarpus curvipes* rt-st-lf-fl-fr; *Trichostema lanatum* rt, ws-sb, tw-lf-fl; and *Turricula parryi* rt, ws-sb, tw-lf-fl.

**Sequoia NF**. Unlike other national forests in California, the vegetation within the Sequoia NF includes extensive grassland that is usually associated with BLM lands. Seventeen (17) samples were collected from this forest, mostly in grasslands and woodlands. Represented were *Anemopsis californica* rt, st-lf-fl; *Arctostaphylos viscida* ssp. *mariposa* fr; *Asclepias eriocarpa* rt, st-lf-fl-fr; *Calystegia longipes* st-lf-fl; *Chaenactis glabriuscula* var. *glabriuscula* rt-st-lf-fl-fr; *Gilia tricolor* ssp. *diffusa* rt-st-lf-fl-fr; *Layia pentachaeta* var. *pentachaeta* rt-st-lf-fl-fr; *Lotus scoparius* var. *brevialatus* rt, st-lf-fl-fr; *Nicotiana acuminata* rt-st-lf-fl-fr; *Phacelia cicutaria* rt-st-lf-fl; *Pholistoma*

*Layia pentachaeta* var. *pentachaeta* (Asteraceae), a yellow-flowered herb that covers hillsides along Hwy 178, Sequoia NF.

*auritum* rt-st-lf-fl-fr; *Senecio flaccidus* var. *monoensis* rt, st-lf-fl-fr; and *Salvia columbariae* rt-st-lf-fl-fr.

Mendocino NF. No reply to our application for permits, nothing to report.

**Inyo NF.** Fourteen (14) samples were collected from this forest, mostly in desert scrub. Represented were *Brickellia oblongifolia* rt-st-lf-fl-fr; *Camissonia heterochroma* rt-st-lf-fl-fr; *Chaetopappa ericoides* rt-st-lf-fl-fr; *Chorizanthe brevicornu* rt-st-lf-fr; *Cleome lutea* rt-stl-fl; *Eriastrum wilcoxii* rt-st-lf-fl; *Lycium cooperi* rt, ws-sb, tw, lf-fr; *Psorothamnus arborescens* var. *minutifolius* rt, tw-lf-fl-fr; *Stephanomeria parryi* rt-st-lf-fr; and *Stephanomeria exigua var. deanei* rt-st-lf-fl-fr.

**Sierra NF**. Three samples were obtained in late summer near 3000 m in elevation, represented by *Lonicera conjugialis* rt-rh, st-lf-fl-fr and *Lonicera involucrata* wst-tw-lf.

Stanislaus NF. No samples were collected in this forest.

Eldorado NF. No samples were collected in this forest.

Tahoe NF. No samples were collected in this forest.

Lake Tahoe NF. No samples were collected in this forest.

Plumas NF. No samples were collected in this forest.

**Lassen NF.** Nine samples were collected: seven (7) from rabbit-brush scrub along north shore of Eagle Lake—*Chrysothamnus viscidiflorus var. viscidiflorus* rt, st-lf-fl; *Chenopodium macrospermum* rt-st-lf-fl-fr; *Scirpus acutus* rt-rh, st, and *Tetradymia canescens* tw-lf-fl; and two of *Agastache urticifolia* (rt, st-lf-fl) from a ponderosa pine forest between Eagle Lake and Little Valley along FR 22.

*Tetradymia canescens* (Asteraceae) just north of Eagle Lake on Lassen NF near the boundary with BLM land. This species was sampled last year during the spring from western Nevada just SW of Reno before the plant flowered. Another tw-lf sample was obtained this year during mid August when the plant was mostly past flower. This species contains furanoeremophilanes that are toxic to sheep, especially when plants are in flower bud. The sesquiterpenes in a related genus, *Psacalium*, are known for their hypoglycemic activity, and are included in patents. Similar compounds also occur in other genera of the Tribe Senecionae such as *Senecio* and *Petasites*.

**Modoc NF**. Three samples were collected near northwest shore of Goose Lake: *Mentzelia laevicalulis* rt, st-lf-fl-fr and *Lotus purshianus* rt-st-lf-fl-fr. The latter species, which is common along roads in much of California, formed a nearly continuous ground cover along the west shore of the lake.

**Shasta Trinity NF**. No samples from within the boundary of the NF, but samples of *Iris purdyi, Lithospermum californicum, Potentilla glandulosa* and *Silene hookeri* were obtained in Douglas fir forest on BLM land off Oregon Road just above Weaverville, while samples of *Dichelostemma multiflorum* and *Micropus californicus* were obtained from private land in the vicinity of Weaverville.

**Klamath NF**. Twelve (12) samples—*Aralia californica* rt; *Arctostaphylos canescens* ssp. *canescens* ws-sb, tw, lf; *Brickellia californica* st-lf-fl-fr; *Eriogonum compositum* wst, tw-lf; *Heterotheca oregona* var. *compacta* rt-st-lf-fl-fr; *Saponaria officinalis* rt-rh; st-lf-fr, and *Woodwardia fimbriata* rt-rh; frond—were collected in the southwestern part of the forest near the Six Rivers NF.

Six Rivers NF. No samples collected in this forest.

## California and Nevada Deserts (BLM)

**California.** Most collections from BLM land were in desert areas where rainfall was greater as depicted on the preceding precipitation map; a total of 116 samples were collected. In contrast to the drought conditions of last year in which we were able to collect samples mostly from shrubs, this year we were able to collect samples from many herbs, evident in the following species listed with only one sample (of the entire plant).

Samples from California BLM lands included *Abronia villosa* var. *villosa* rt-st-lf-fr; *Adenophyllum cooperi* rt-st-lf-fl; *Ammobroma (Pholisma) sonorae* if-stalk, if-fr-head;

Amaragosa River south of Tecopa, California, showing salt flats with common *Oxystylis lutea* (Capparaceae), close-up of plant on right. This annual species is endemic to the Amaragosa Desert within the Mojave Desert Region. Our collection of 500 g had no impact on the environment or survival of the species.

*Amsinckia tesselata* var. *tesselata* rt-st-lf-fl; *Amsonia tomentosa* f. *brevifolia* rt-rh, st-lf-fl-fr; *f. tomentosa* rt-rh, st-lf-fl-fr; *Antirrhinum coulterianum* rt-st-lf-fl; *Atriplex joaquiniana* rt-st-lf; *Brandegea bigelovii* st-lf-fl; *Brickellia incana* rt, ws-sb, st-lf-fl (bud); *Caesalpinia virgata* rt, st-lf-fl-fr; *Calliandra eriophylla* rt, ws-sb, tw-lf-fl; *Calyptridium monandrum* rt-st-lf-fr; *Camissonia boothii* ssp. *desertorum* rt-st-lf-fl-fr; *Camissonia brevipes* rt-st-lf-fl; *Camissonia claviformis* ssp. *funera* rt-st-lf-fl; *Chaenactis fremontii* rt-st-lf-fl-fr; *Chamaesyce micromera* rt-st-lf-fl-fr; *Chorizanthe staticoides* rt-st-lf-fl-fr; *Cleome sparsifolia* rt, st-lf-fl-fr; *Cleomella obtusifolia* st-lf-fl; *Cryptantha angustifolia* rt-st-lf-fl-fr; *Cryptantha barbigera* rt-st-lf-fl-fr; *Cuscuta californica* pl (on *Ambrosia dumosa*); *Ephedra nevadensis* cones; *Eremalche rotundifolia* rt-st-lf-fl; *Eriastrum densifolium* ssp. *elongatum* rt, st-lf-fr; *Eriastrum eremicum* rt-st-lf-fl-fr; *Eriastrum sparsiflorum* rt-st-lf-fl-fr; *Ericameria cooperi* rt, tw-lf-fl; *Erigeron foliosus* var. *foliosus* rt-st-lf-fl; *Eriogonum deserticola* rt; *Eschscholzia californica* rt-st-lf-fl; *Eschscholzia minutiflora* rt-st-lf-fl-fr; *Gilia cana* rt-st-lf-fl-fr; *Gilia cana* ssp. *speciformis* rt-st-lf-fl; *Gilia inconspicua* rt-st-lf-fl, sd; *Gilia latiflora* ssp. *davyi* rt-st-lf-fl; *Gilia latifolia* rt-st-lf-fl; *Gilia minor* rt-st-lf-fl-fr; *Grayia spinosa* rt, tw-lf-fl; *Guillenia lasiophylla* rt-st-lf-fl-fr; *Hesperocallis undulata* st-lf-fr; *Isocoma acradenia* var. *bracteosa* rt, wst, leafy tw-lf-fl-fr; var. *acradenia* rt, ws-sb, hst-lf-fl-fr; *Kochia americana* rt-st-lf; *Langloisia schottii* rt-st-lf-fl-fr; *Lasthenia californica* rt-st-lf-fl-fr; *Linanthus aureus* rt-st-lf-fl-fr; *Lithospermum californicum* rt, st-lf-fl; *Lotus rigidus* rt-ws, st-lf-fl-fr; *Malacothrix glabrata* rt-st-lf-fl-fr; *Mentzelia obscura* rt-st-lf-fr; *Mentzelia veatchiana* rt-st-lf-fl; *Mimulus bigelovii* rt-st-lf-fl-fr; *Nama demissum* var. *demissum* rt-st-lf-fl; *Nitrophila occidentalis* rt-st-lf-fl; *Oenothera deltoides* rt-st-lf-fl-fr; *Oxystylis lutea* rt-st-lf-fl; *Palafoxia arida* var. *gigantea* rt, st-lf-fl-fr; *Pectocarya linearis* ssp. *ferocula* rt-st-lf-fl; *Penstemon fructiformis* rt, ws-sb, tw-lf-fl (bud); *Penstemon incertus* rt, st-lf-fl-fr; *Phacelia calthifolia* rt-st-lf-fl; *Phacelia fremontii* rt-st-lf-fl; *Plagiobothrys arizonicus* rt-st-lf-fl; *Porophyllum gracile* rt-st-lf-fl; *Potentilla glandulosa* ssp. *glandulosa* rt-rh, st-lf-fl; *Psorothamnus arborescens* var. *minutifolius* rt, ws-sb, tw-lf-fr; *Psorothamnus emoryi* wr, rb, ws-sb, tw-lf-fl-fr; *Psorothamnus polydenius* rt, tw-lf-fl; *Psorothamnus schottii* wr, rb, ws-sb, tw-lf; *Rafinesquia*

Left: *Buddleja utahensis*, a common shrub of limestone in southern Nevada, photo near Indian Springs, Nevada. Collection of twigs and leaves with flowers is believed to have cause the rash shown on the right, possibly the result of a combination (synergistic effect) of collecting several other species and sunlight.

*neomexicana* rt-st-lf-fl; *Stanleya elata* rt, st-lf-fl; *Stephanomeria exigua* ssp. *deanei* rt-st-lf-fl-fr; *Stephanomeria pauciflora* var. *pauciflora* rt, st-lf-fl; *Suaeda moquinii* rt-st-lf-fl; *Tetracoccus hallii* rt, ws-sb, tw-fl-fl; *Tiquilia plicata* rt-st-lf-fr; and *Xylorhiza tortifolia* var. *tortifolia* rt-wst, hst-lf-fl.

**Nevada.** Most samples from BLM land in Nevada were obtained in Clark, Esmeralda and Nye Counties. One sample, *Chorizanthe brevicornu* rt-st-lf-fl, came from the Lake Mead National Recreation Area (National Park) southeast of Christmas Pass in the Newberry Mountains. This widespread common desert annual is rarely practical to collect in quantity of 300–500 g; however, a sample was easily collected in the Newberry Mountains because late winter rains in that region produced unusually large plants in great abundance.

*Buddleja utahensis* is suspected to have caused severe dermatitis to the collector (PI). This plant was collected with gloves to avoid being scratched by dead branchlets that are generally present on desert shrubs. Several other species of herbs were collected that same day without gloves, *Lepidium lasiocarpum, Camissonia brevipes* and *Eriogonum trichopes*. A rash initially appeared on the right wrist, the only part of the skin that was exposed while collecting *Buddleja* samples. Within two days the rash spread to the left hand and both arms, as shown above. Cortisone injections quickly reduced the swelling.

In Nevada a total of 60 samples were collected as follows: *Acamptopappus sphaerocephalus* var. *sphaerocephalus* rt, wst-lf-fl; *Amphipappus fremontii* rt, wst-lf-fl; *Atriplex canescens* var. *canescens* fr; *Buddleja utahensis* rt, ws-sb, tw-lf-fl; *Camissonia brevipes* rt-st-lf-fl-fr; *Camissonia walkeri* ssp. *tortilis* rt, st-lf-fl-fr; *Chaenactis carphoclinia* rt-st-lf-fl-fr; *Chenopodium berlandieri* rt-st-lf-fl; *Chorizanthe brevicornu* var. *brevicornu* rt-st-lf-fr; *Chorizanthe rigida* rt-st-lf-fl-fr; *Cleome aff. platycarpa* rt-st-lf-fl; *Cryptantha angustifolia* rt-st-lf-fl-fr; *Eriastrum eremicum* rt-st-lf-fl; *Eriogonum deflexum* rt-st-lf-fl (-bud); *Eriogonum inflatum* rt, st-lf-fl; *Eriogonum ovalifolium* rt-st-lf-fl (bud); *Eriogonum reniforme* rt-st-lf-fl; *Eriogonum trichopes* rt-st-lf-fl (2); *Eriophyllum wallacei* rt-st-lf-fl-fr; *Eschscholzia glyptosperma* rt-st-lf-fl-fr; *Eucnide urens* rt, st, lf-(st)-

Left: Algodones (Imperial) Sand Dunes in southeastern California near Yuma, AZ, managed by BLM. Right: Flower heads of "Sand Food," *Ammobroma* (*Pholisma*) *sonorae* (Lennoaceae) on the dunes, once a favorite food of the Papagos and Cocopas Indians, appearing late April to early May if sufficient winter rain occurs. Otherwise, its vegetative parts lie deep under sand, parasitic on roots of dune perennials (*Ambrosia dumosa, Eriogonum deserticola, Tiquilia plicata, Psorothamnus emoryi*). This unusual plant occurs almost exclusively to these dunes, the number one recreational area for off-road vehicle (ORV) enthusiasts. Reportedly more than one million ORV's ride the dunes annually—stirring up the unique vegetation and also the environmentalists. The BLM has allowed up to 85% of the 265,000 acres for ORV use, but environmentalists, battling against the ORV lobbyists—in a recent lawsuit—temporarily scooped up more sand—49,310 acres, leaving the dune riders 70,000 acres to track. It has been suggested that BLM rangers, in enforcing the restrictions, carry batons, along with wearing helmets and gas masks, to defend against the dune riders who reportedly throw beer cans and other matter at the rangers. This past May (2003) sand food was observed only around shrubs of *Eriogonum deserticola* (nearly endemic to the dunes) not trampled by the ORV's. Two samples were collected, one of the flower stalk, which extends to two meters or more below ground, and another of the pincushion flower head as shown above with lavender flowers. We also collected a root sample of its host, *Eriogonum deserticola*.

fl; *Fraxinus anomala* ws, sb, tw, lf-fr; *Geraea canescens* rt-st-lf-fl; *Halogeton glomeratus* rt-st-lf-fr; *Hilaria rigida* rt-rh, st-lf-fl; *Lappula redowskii* rt-st-lf-fl-fr; *Lepidium flavum* rt-st-lf-fl-fr; *Lepidium lasiocarpum* rt-st-lf-fl-fr; *Lomatium parryi* rt-st-lf-fl; *Lycium pallidum* var. *oligospermum* rt, tw-lf-fl-fr; *Malcomia africana* rt-st-lf-fl; *Nicotiana obtusifoilia* rt, st-lf-fl; *Pectocarya recurvata* rt-st-lf-fr; *Phacelia crenulata* var. *minutiflora* rt-st-lf-fl-fr; *Pleurocoronis pluriseta* rt, tw-lf-fl; *Pluchea sericea* rt, ws, sb, tw-lf-fl; *Porophyllum gracile* rt-st-lf-fl; *Sarcobatus baileyi* rt, tw-lf; and *Stanleya pinnata* var. *pinnata* rt-wst, hst-lf-fl-fr.

**Proposed 2004 collections from California and southern Nevada**. Our recent experience in Hawaii, in consideration to what we reported last year for California on the apparent effects of grazing in NF, suggests we may need to collect in wilderness areas to meet the NCI objectives. In Hawaii, we frequently had to hike several miles to find native species because the native flora is being displaced by the introduced biota to the islands. In California, the PI has seen more lush growth of herbs in wilderness areas, which show little evidence of grazing, while an abundance of herbs has also been obvious in national parks and national monuments where cattle are not seen and where access is also easier by roads. Wilderness collections, however, will not be made until the year 2005.

In addition to dried samples that we normally collect, we will be collecting both fresh and dried samples during this fiscal year. As many as 100 fresh samples may be

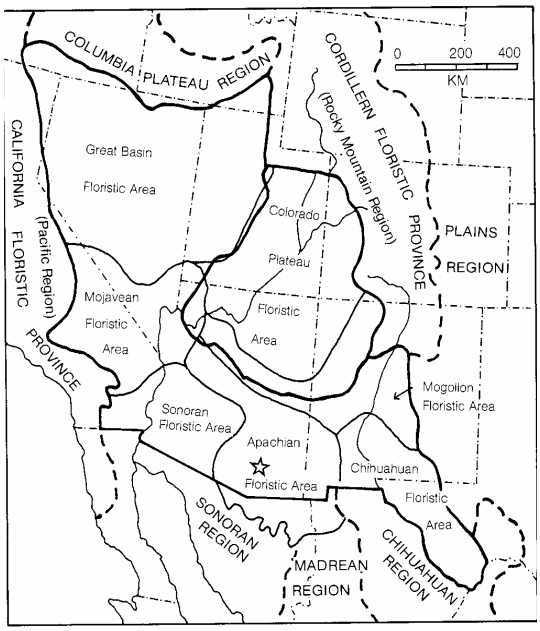
Annual species from late winter rains in the Mojave Desert from which samples were collected for the NCI. Left: *Phacelia fremontii* (Hydrophyllaceae) from near the Kingston Range in California. Right *Lepidium lasiocarpum* (Brassicaceae), Spring Mts. near Indian Springs, Nevada.

collected in California. The dry weight equivalent will be ~150 g instead of the 300 g we normally collect. Emphasis will be on latex or resin containing families (e.g., Anacardiaceae, Asclepiadaceae, the Cichorieae in the Asteraceae, Apocynaceae, Euphorbiaceae, Rutaceae) and species that are difficult to dry such as *Abronia latifolia* (Nyctaginaceae), *Aesculus californica* fl (Hippocastanaceae), *Ammobroma sonorae* (Lennoaceae), *Anenompsis californica* (Saururaceae), *Atriplex phyllostegia* (Chenopodiaceae), *Boschniackia strobilacea* (Orobanchaceae), *Cakile maritima* (Brassicaceae), *Calystegia soldanella* (Convolvulaceae), *Carpobrotus edulis* (Aizoaceae), *Claytonia* spp. (Portulacaceae), *Glehnia littoralis* (Apiaceae), *Heliotropium curassavicum* (Boraginaceae), *Lathyrus littoralis* (Fabaceae), *Opuntia* spp. (Cactaceae), *Oxalis oregona* (Oxalidaceae), *Portulaca olearacea* (Portulacaceae), *Rorippa nasturtium-aquaticum* (Brassicaceae), *Sarcodes sanguinea* (Pyrolaceae), *Sedum* spp, (Crassulaceae), *Tanacetum camphoratum* (Asteraceae), *Tidestromia* spp. (Amaranthaceae), *Trianthema portulacastrum* (Aizoaceae), and *Triglochin maritima* (Juncaginaceae), and fleshy fruits of various shrubs. Each fresh sample will be accompanied by a separate dried sample of equivalent weight and volume. These samples will count towards our regular annual quota of 1,000 samples. The NCI findings will be published.

These and other species may be collected in the following National Forests: Sequoia, Sierra Nevada, Eldorado, Stanislaus, Tahoe, Humboldt Toiyabe, Modoc, Mendocino, Klamath, Shasta Trinity, Six Rivers, Los Padres, Angeles, and San Bernardino.

**Arizona and Northwestern States**

Collections obtained from outside California and Texas thus far were incidental to our primary travel; those from Arizona were mentioned earlier. Also, we were able to meet the NCI objectives with travel short distances from our southern California base due to favorable winter rainfall.




Map showing floristic provinces, regions and areas of the southwestern United States according to J.E. Bowers and S. P. McLaughlin, *Flora and Vegetation of the Rincon Mountains*, *Pima County, Arizona,* Desert Plants (1987, Vol. 8, pt. 2). In Arizona the Morton Arboretum collected samples mostly from southeastern Arizona along the Mexican border. They also collected in SW Nevada (near Pahrump) and SW Utah during early April and in central and eastern Nevada along Hwy. 50 from early to mid October. The WBA plans to collect in the Colorado Plateau Floristic Area and the Cordillerin Floristic Province during May-June in Years IV and V.

In further review of collection data by the Morton Arboretum for the NCI, we plotted their locality data and collection dates on road maps of the western states. From this, we could see that—for Arizona—most collections were from the southeastern part of the state during August—in the Apachian Floristic Area along the Mexican border—south of I-10. A small number of samples were from the Sonoran Desert during the spring south of Interstate Hwy 8—in the Organ Pipe Cactus Monument. In Nevada they collected during April in the southwest part of the state—northwest of Pahrump, and in October from central to eastern Nevada along Hwy 50. In conclusion, we feel we can supply many samples of herbs from central and northern Arizona and much of Nevada. This will require collecting permits for the Apache NF, Coconino NF, and Tonto NF in Arizona, and the Humboldt Toiyabe NF in Nevada. We have permits for the Coronado NF where we have collected a small number of samples last year, and where the Morton Arboretum has also collected.

In the Pacific NW states, collections for the NCI thus far have been spotty. The Morton Arboretum collected many samples from Del Norte County in northwestern California and adjacent Josephine and Jackson Counties in southwestern Oregon during April. Other samples came from near central Oregon during November (1997)—near Eugene and Bend. No collections were noted for Washington, and essentially none are from Idaho as the only records there are from the Montana state line. Collections are apparently lacking from the Rocky Mountain areas (Colorado Floristic Plateau) in Utah, Colorado, and New Mexico. Thus, three major regions stand out for future collections.

1) Cascades in Oregon and Washington that would require permits for the Northern Cascades National Park and Mount Rainer National Park.
2) Coast Ranges in northern Oregon and Washington, especially in the Olympic NF and NP.
3) Southern Rocky Mountains National Forests and Intermountain Region. We need permits for the National Forests in this region.

Left: Drying samples in an attic of a State/Federal building at Broadview Farms near Cooper Landing, AK. Because many herbs collected in Alaska lack turgidity, they had to be removed from bags in order for them to dry properly. Right: The building also included a deck where on sunny days samples could also be laid out to dry. The use of the facility was arranged through the USFS Ecologist, Dr. Robert DeVelice.

**Alaska (July 5-August 7)**.

We obtained 282 samples from Alaska; 172 were from the Chugach NF on the Kenai Peninsula, 81 on state forests mostly near roads, 15 from the Kenai National Wildlife Refuge, and three (3) from the White Mountains National Recreational Area northeast of Fairbanks.

We are grateful for the assistance received from the USFS Ecologist, Rob DeVelice of the Chugach NF. He helped obtain the collecting permits, recommended plant collecting sites, arranged for us to stay at the Cooper Landing Field Station at no cost to the NCI, arranged for us to use attic space at Cooper Landing for drying samples, and temporarily loaned us a key to the US Forest Service gates for access to the Cooper Landing facility.

Our planning included a review of the detailed ecological studies by DeVelice et al. (1999) on *Plant Community Types of the Chugach National Forest: Southcentral Alaska* (USFS Tech Publ. R10-TP-76) in which the frequency of occurrence of species were indicated, including ferns, lichens and bryophytes. This type of publication is useful for predicting which species are most likely to be collected.

Plants were identified in the field using Hultén, *Flora of Alaska and Neighboring Territories* (1968, Stanford Univ. Press), D. C. Collet, *Willows of Southcentral Alaska* (Kenai Watershed Forum, 2002, with publication support from various Federal agencies), Viereck and Little, *Alaska Trees and Shrubs* (1972, USFS Agric. Handbk. 410), and DeVelice et al. (2001), *Vascular Plant Identification Guide, Chugach National Forest* (USFS Chugach NF, Anchorage, R10-MB-421). The guide books by DeVelice et al. (2001) and Collet (2002) were useful for many identifications.

**Palmer Creek Valley** on the Kenai Peninsula, Alaska, looking north from the upper part of the valley. The road up this valley ascends through a wide variety of vegetation types, ranging from coastal Sitka-lutz spruce forest to mountain hemlock forest, to subalpine willow thickets to dwarf alpine heath meadows. Most of our collections in the Chugach NF were from this valley.

Samples from the Chugach NF were represented by *Carex buxbaumii* rt-st-lf-fl-fr; *Carex echinata* rt-st-lf-fl-fr; *Carex macrochaeta* rt-st-lf-fl-fr; *Carex mertensii* rt, st-lf-fl; *Carex saxatilis* ssp. *laxa* rt-st-lf-fl-fr; *Castilleja unalaschensis* rt-rh, st-lf-fl; *Cladothamnus (Elliottia) pyrolaeflorus* rt, ws-sb, tw-lf-fr; *Cornus suecica* rt-st-lf-fl; *Delphinium glaucum* rt, st-lf-fl; *Diapensia lapponica* rt-st-lf; *Drosera anglica* rt-st-lf, *Dryas octopetala* rt-st-lf-fl; *Dryopteris dilatata* rt-rh, lf (frond); *Empetrum nigrum* rt-rh, tw-lf; *Epilobium angustifolium* ssp. *microphyllum* rt, st-lf, fl; *Epilobium latifolium* rt, st-lf-fl; *Equisetum arvense* rt-rh, st-lf; *Equisetum pratense* rt-st-lf; *Equisetum silvaticum* rt-st-lf; *Eriophorum angustifolium* rt-st-lf-fl; *Geocaulon lividum* rt-rh-st-lf; *Geranium erianthum* rt, st-lf-fl; *Geum rossii* rt, rh-st-lf-fl; *Gymnocarpium dryopteris* lf (frond); *Leptarrhena pyrolifolia* rt-st-lf-fl; *Loiseleuria procumbens* rt-rh, wst-lf-fr; *Luetkea pectinata* rt-st-lf-fl; *Lupinus nootkatensis* rt, st-lf-fl-fr; *Lysichiton americanum* rt, rt-base, lf-sheath, lf-blade, if-stalk, if-fl-fr; *Menziesia ferruginea* var. *ferruginea* rt, ws-sb, tw-lf, *Mertensia paniculata* rt, st-lf-fl-fr; *Nephrophyllidium* (*Fauria*) *crista-galli* rt-rh, lf, if (fr); *Oplopanax* (*Echinopanax) horridus* wr, rb, ws, sb, lf, fr;) *Oxytropis nigrescens* rt-st-lf-fr; *Petasites hyperboreus* rt-rh-st-lf-lf; *Phyllodoce aleutica* rt-rh, wst, tw-lf-fl; *Platanthera dilatata* rt-st-lf-fl; *Polemonium acutiflorum* rt-st-lf-fl; *Potentilla fruticosa* rt-rh, ws-sb, tw-lf; *Pyrola asarifolia* rt-st-lf; *Rhinanthus minor* ssp. *borealis* rt-st-lf-fl; *Ribes glandulosum* rt-rh, ws-sb-tw-lf; *Ribes laxiflorum* rt-rh, wst-tw-lf; *Rubus chamaemorus* rt-rh, lf; *Rubus spectabilis* rt; *Rumex longifolius* rt, st-lf, fr; *Salix alaxensis* wr, rb, ws, sb,

**One of the smallest willows on earth**! *Salix rotundifolia*, hardly larger than the typical moss, the photos—which were taken above timberline along gravel washes in the Palmer Creek area, Kenai Peninsula, AK—show numerous plants growing closely together as one might see in moss species of *Rhizomnium*. Indeed, mosses had to be separated from these willows. A freshly collected sample of the entire plant photo is lying among a mass of miniature willows along the cobblestone wash (left photo), followed by closer view of plants with maroon colored inflorescences (right photo).

tw, lf; *Salix arctica* wr, rb, ws-sb, tw-lf-fl; *Salix x barclayi* rt, ws-sb, tw-lf; *Salix x commutata* wr, rb, ws-sb, tw-lf (male); *Salix reticulata* ws-sb-tw-lf; *Salix rotundifolia* rt-st-lf-fl-fr; *Salix stolonifera* rt-rh, tw-lf; *Sambucus racemosa* rb, sb, fr; *Sanguisorba stipulata* rt, st-lf-fl (bud); *Saxifraga bronchialis* rt-st-lf-fl; *Saxifraga punctata* rt-st-lf-fl-fr; *Sibbaldia procumbens* rt-st-lf-fl; *Silene acaulis* rt-st-lf-fl; *Sorbus scopulina* wr, rb, ws, sb, tw-lf, fl, fr (immature); *Spiraea beauverdiana* rt, wst, tw-lf; *Swertia perennis* rt-st-lf-fl; *Tiarella trifoliata* rt-st-lf-fl-fr; *Trichophorum caespitosum* rt-rh-st-lf-fr; *Trientalis europaea* ssp. *arctica* rt-st-lf-fr; *Tsuga mertensiana* co (immature); *Vaccinium ovalifolium* rt-rh, ws-sb, tw-lf; *Vaccinium uliginosum* rt-rh, tw-lf-fr; *Vaccinium vitis-idaea* rt-rh-st-lf; *Valeriana capitata* rt, lf; *Valeriana sitchensis* rt, lf-fl; *Veratrum viride* ssp. *echscholtzii* rt, st, lf, if-fl; and *Viburnum edule* wr, rb, sb.

Those from the Kenai Wildlife Refuge were represented by *Betula nana* rt, ws-sb, tw-lf; *Chamaedaphne calyculata* rt, wst-tw-lf; *Iris setosa* var. ssp. *interior* rt-rh, st-lf-fl; *Ledum decumbens* rt-rh, wst-lf; *Menyanthes trifoliata* rt-rh, st-lf; *Myrica gale* rt, ws-sb, tw-lf; and the lichen *Nephroma arcticum*. The three samples from the White Mountains were of *Diapensia lapponica*, *Loiseleuria procumbens*, and *Cassiope tetragona*.

One often thinks of Alaska as a place of isolation; however, traffic, fishermen, fisherwomen and hikers were everywhere we went. Although we make an effort to stay out of sight so that we are able to work without interruption, most everyone we did meet was friendly and wished us luck in our collections. We encountered little skepticism as we often do in the lower 48 states. One passerby, who stopped to inquire while collecting between Anchorage and Fairbanks, happened to be a landowner of a mining area ~ 5 mi north of Cantwell. Wanting to contribute to the NCI program, he invited us to make general collections on his land where we collected eleven samples that included an unusual parasitic plant, *Boschniakia rossica* (Orobanchaceae).

**Plants of seldom screened families**! Left: Inflorescences of *Boschniackia rossica* (Orobanchaceae), a parasite on alder (*Alnus crispa*) roots, collected in the alpine heath of Alaska. Upper right: *Drosera anglica* (Droseraceae), an insectivorous plant of bogs in the mountain hemlock zone. Lower right: *Diapensia lapponica* (Diapensiaceae), a small prostrate plant often growing with *Arctostaphylos rubra* and *Loiseleuria procumbens* in the arctic tundra of Alaska.

In discussions we had with the Forest Ecologist, Dr. DeVelice, we feel that we have obtained most of the economical collectable samples in Alaska. Genera in the Alaskan flora not represented in our collections are mostly likely to be found near Prince William Sound and north of the Arctic slope; travel to these areas is not within our present budget, however.

In compliance with our collecting permits for the US National Forests, we found it necessary to suppress one campfire along the Palmer Creek drainage where one (unknown) camper had obviously left his or her campfire still smoking. We devoted approximately 30 minutes (of our field time) to extinguish this fire.

The only other concern we had was a hunter in green camouflage who kept his gun pointed at us while we drove by him along the Palmer Creek Road. He had a companion we met earlier on the road below; he indicated they were hunting for bear.

## Plants and Plant Parts Collected

### *Plants (Species)*

As we have indicated in previous reports, a high concentration of the collections made by previous supplier, Morton Arboretum, came from the northern and eastern US. This year we estimate that 90% of the samples (541 species, subspecies and varieties)—

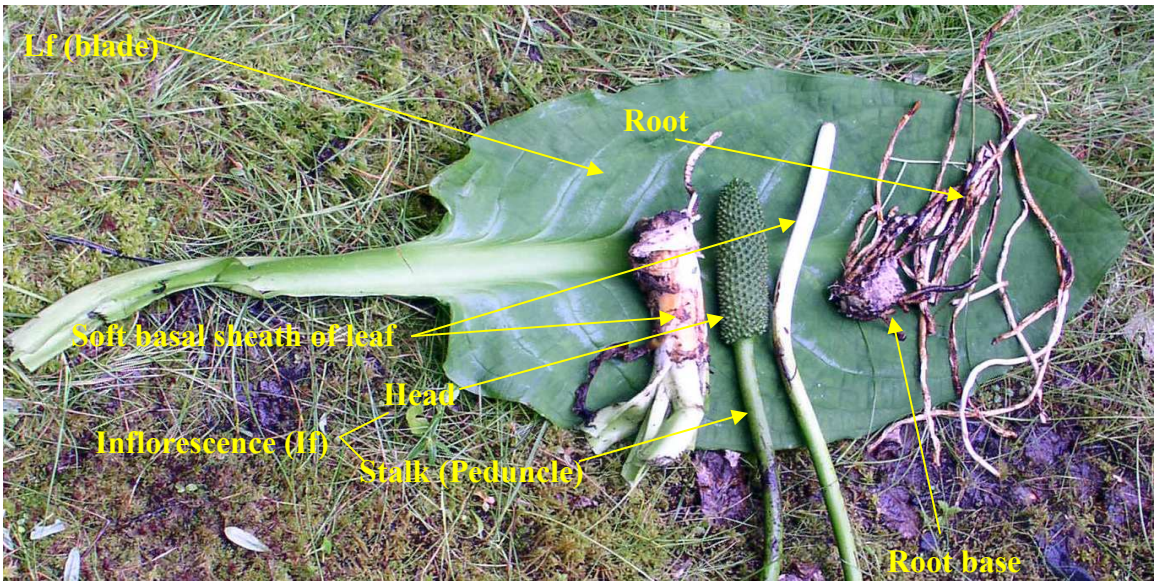
Representatives of the dwarf alpine heath (Ericaceae). Left: *Loiseleuria procumbens*, right *Cassiope tetragona.*

obtained from the western US, are new to the NCI project. As woody plants become less available for collection, we are left with the more difficult herbs to collect and dry. While this is to be expected, herbaceous samples have also been difficult to collect because of drought in the southwest and over-grazing in the northwest.

### *Plant Parts*

Generally, active species are more likely to be discovered if plants are divided into samples of their natural parts. This has been reviewed by Perdue and Hartwell in the Morton Arboretum Bulletin (Sep., 1969) and by Perdue in Cancer Treatment Reports (1976). One of the most intensive sampling of tropical plants for the NCI was by Perdue in East Africa during 1969–1971 (when the Agricultural Research Service was a primary supplier, 1960–1982). Spjut (unpublished) contrasted Perdue's collections with those from another collector (contract supplier) in South Africa who had collected in similar vegetation during the 1970's, but only tw-lf samples. The South Africa samples generated very few leads (active species) whereas Perdue's sampling generated numerous leads—because he separated plants into as many samples of plant parts as practical. Moreover, he obtained additional samples of root-bark after already obtaining more than 2,000 samples from Mufindi—during the dry season (1971). Because of the large number of collections, it was clearly apparent that activity in some East African species was closely associated with a seasonal change in flowering that took place just before the onset of the rainy season ("pre-rain flush"). This was further evident in recollections from Mufindi that were obtained later in the dry season by Spjut in 1973; for example, activity *Apodytes dimidiata* (Icacinaceae) was found only in a wood (ws) sample collected early in the dry season, but recollections from later in the season—when the plant was in full bloom—had activity only in stem-bark according to the chemist.

Spjut conducted further studies on active plant parts according to ecological regions (USDA memoranda 1978; summarized in poster presentations and abstracts, e.g. the 13th Annual Meeting, American Society of Pharmacognosy, "Sampling plants for general screening of biological active agents," San Juan, Puerto Rico, 1989), on the WBA website, www.worldbotanical.com (since May 1999), in a response to the NCI RFP




Six samples (plant parts) of "skunk cabbage," *Lysichiton americanus* (Araceae), collected in Alaska. All parts contained >90% water.

(November 2000), and in Annual Reports (2002), distributed to the NCI, USFS, NPS and to State authorities in Texas.

Much of the Southwest is desert scrub. The rocky terrain and sandy soils in a climate—where shrubs characteristically produce intricately divided spiny branches—make it difficult to obtain root and bark samples. Nevertheless, the present collections being made for the NCI, which perhaps are more thorough than those of past years (1960–1982), include a good representation of these samples.

*Root Samples*. Our emphasis on root samples includes separating burl and other underground parts (rt, bu, tu, rh, wr, rb, or burl) that accounted for 223 of the 941 samples. Because most of the samples were from herbs and subshrubs, root-bark was separated from only 19 species; last year we obtained samples of root-bark from 33 species.

*Stem-bark Samples.* Twenty-three stem-bark samples were collected this year in contrast to 57 obtained last year. This lower number relates to more samples obtained from herbs as just indicated.

*Leaf samples*. Last year we separated only 5 leaf samples. In our annual report we indicated we would obtain more leaf samples this year; 40 samples were collected this year.

*Inflorescence (flower and/or fruit) samples*. These are collected when available; 39 were obtained this year compared to 47 last year.

The majority of our samples, ~60%, are from herbs. Approximately 250 species of herbs were collected as whole samples, while most of the remaining herbs we separated

*Eriogonum trichopes* (Polygonaceae), a deflated form, occurring abundantly with creosote in southern Nevada

roots from the aerial parts. Occasionally, more than two samples from an herb were prepared as shown for skunk cabbage, *Lysichiton americanus* (Araceae).

**Plant Identifications, Vouchers and Databases**

Our agreement with the NCI includes a peer review of the PI's identifications by botanists at the Botanical Research Institute of Texas (BRIT). This type of review, as with any peer review, improves the quality of the data reported. Nevertheless, the PI does not rely entirely on the BRIT for identifications as he also identifies species in the field to minimize duplication in sampling and to help avoid species of concern such as those that are endangered, etc.

As a further measure to minimize duplication, the PI prepared taxonomic pictorial keys to all common species of *Arctostaphylos* and to all species of *Ceanothus* in the Western United States. The keys are weighted geographically to facilitate recognition of species in the field in contrast to keys in the Jepson Manual on California plants that are not suited for fieldwork.

Duplicate collection numbers of species as shown in the appendix generally represent different plant parts or samples obtained from different seasons; however, in other cases, samples were collected of the same species because it appeared morphologically different. Examples from different parts of the plant or from different seasons have already been mentioned. In other instances the same species may appear morphologically different in different areas. For instance, *Eriogonum trichopes* (Polygonaceae), an annual species, commonly has inflated stems, but extensive populations also occur with deflated stems that appear to flower later in the season; samples from both types were collected. Another example is two different forms of *Amsonia tomentosa* (Apocynaceae) that occur together in the same habitat, one densely pubescent, the other completely glabrous, without intermediates. Both occur in about the same frequency, and samples from both were obtained, noted as different forms on our shipping list.

Also, because we focus on common species, we rarely notice those species that are of concern as we are asked to report on in some permits. Moreover, if we do come across such species, we cannot scientifically document these because this would require additional voucher specimens that in turn would require additional permits.

In addition to maintaining vouchers as herbarium specimens, the WBA specimens are also scanned. Collection data are maintained in four inter-related files ("Locality", "Specimen," "Sample," and "Subtaxa"). These data are used to generate the reports for the NCI online database as well as voucher labels and shipping lists.

**Plans for Year III**

| | | |
|---|---|---|
| Sep-Oct 2003 | HI (Kauai, Oahu). Completed | 352 samples |
| Jan-Feb 2004 | Puerto Rico | 350 samples |
| Mar-Apr 2004 | S CA, AZ, Chaparral & Son. Desert | 100 samples |
| May 2004 | CA, NV, AZ, UT Mojave Desert | 100 samples |
| Jun 2004 | N CA, OR | 100 samples |
| Jul 2004 (alternate) | CA & OR Sierra Nevada, Cascades | 100 samples |
| Aug 2004 | HI (Kaui, possibly Hawaii) to be Applied to YR IV | |

Fieldwork in the desert and southern California chaparral depend on rain. If dry, we will spend more time in the Pacific NW.