11

Observations on the Present-Day (1983) Economic Plants in the Monte Verde Area and Their Archaeological Implications

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Introduction

Studies of hunter-gatherer plant utilization and diet in New World forests have previously focused on temperate deciduous (Hunn 1982; Keene 1981; Usner 1983), boreal (Bicchieri 1972), Amazon rain (Harner 1972; Hames and Vickers 1983; Holmberg 1950; Meggers 1971), and broadleaf evergreen forests (Hawkes et al. 1982). Another forested environment, the cool, temperate rain forest of south-central Chile, has been less-studied for its economic plant potential (Hoffmann 1982; Ortiz 1969; Veblen et al. 1983). As a result of the archaeological finds at the Monte Verde site, new attention was focused on the nature, distribution, and dynamics of economically useful plants in that region (Dillehay 1984; Ramírez 1989a, 1989b; Ugent et al. 1987).

In conjunction with the Monte Verde Archaeological Project, an ethnobotanical study of present-day economic plants was undertaken during the January–April 1983 field season. For the purposes of this study, an economic plant is defined as a plant with any potentially useful function to humans, either directly or indirectly, such as for food, medicine, construction, or fuel (Wickens 1990). The primary goals of this research were (1) to identify visible economic plants within a 5-km radius of the Monte Verde site, and (2) to estimate the present-day distribution and abundance of economic plants, and consequently its general ability to support an aboriginal group of plant gatherers. A key issue is whether or not the local environment could potentially support a small population on a year-round basis.

An additional goal of the ethnobotanical research was to develop an optimal foraging schedule of plant procurement patterns that might coincide with the observed cycles of economic plant availability (Jochim 1976:15–46). The presentation of this potential resource schedule is not meant to imply behavior at the Monte Verde site, but to provide a baseline from a localized resource perspective. Later in this volume (Chapter 12), this localized baseline will be considered in conjunction with the Monte Verde archaeological materials. In this manner, the strengths and weaknesses of optimal foraging models based on local environmental conditions may be discussed for this case study.

During this ethnobotanical study, a classification of economic plant microzones was developed. These microzones are defined as resource patches of useful plants, a central concept in the patch use model

Plantas económicas

Resource patch

branch of optimal foraging theory (Bettinger 1991: 87–93; Martin 1983; Winterhalder 1981). Ramírez (1989a) has presented a broad classification of forest formations covering all environments of south-central Chile from the coast to the *cordillera*. In contrast, the microzonal or resource patch classification presented here is a localized subset of Ramírez's classification and is based only on observations of plant communities within 5 km of the Monte Verde site. Also described are a variety of observations made on the economic plant communities of Monte Verde, including aspects of plant seasonality as it relates to economic plant microzones and prerequisite technologies that could promote plant exploitation.

A large collection of both uncarbonized and carbonized plant remains was recovered from the Monte Verde site, due to the excellent preservation of the site in peat (Ramírez 1989b). Ramírez (1989a, 1989b) identified 70 taxa, including 17 nonlocal species. Virtually all recovered specimens represent the economically useful parts of plants, either for food, medicine, construction, fuel, or a combination of those purposes (Ramírez 1989b). The ethnobotanical observations discussed here thus will be augmented by a substantial archaeobotanical record to infer broader ancient patterns of plant utilization and procurement strategies that may have occurred during late Pleistocene times (Chapter 12).

Conceptual Considerations

Archaeological and ethnobotanical studies of hunter-gatherer exploitation of their environment began with the development of "catchment area" analysis. An idealized catchment ring was envisioned around a given site, and available resources within that ring were analyzed (Vita-Finzi and Higgs 1970). Although catchment analysis began a new era of specialized studies accompanying archaeological projects, one major weakness of the approach was a lack of consideration of microzonal configurations and their dynamics (Roper 1979). This weakness was due, in part, to environmental changes that have occurred in an area since prehistoric habitation and thus do not allow reliable microenvironmental reconstruction.

One means of adding environmental dynamics to the study of hunter-gatherer resource procurement is known as "optimal foraging modeling" (Bettinger 1987, 1991; Mithen 1989; Pyle et al. 1977; Winterhalder and Smith 1981). Optimal foraging models may incorporate such factors as resource procurement, life history, mating pattern, settlement location, relocation interval, and predator avoidance (Bennett 1976; Keene 1981; Kelly 1983; Winterhalder 1981; Wobst 1974). The models generally assume that hunter-gatherers were sensitive to environmental fluctuations and changes in resource availabilities, and the models thus tend to imprint local environmental conditions onto human behavioral systems (Bettinger 1991; Thomas 1986:253–258; Winterhalder and Smith 1981). This attribute of optimal foraging models has been severely criticized by those who feel that human decision-making, ingenuity, or social relations are removed or suppressed in the models (Bender and Morris 1988; Mithen 1989). More simply, some critics feel that optimal foraging models ignore important differences between hunter-gatherer wants and the idealized dietary needs depicted by the models (Bettinger 1991:104–105; Graves 1992).

Despite the criticisms, the general format of optimal foraging models serves as a convenient framework for this study in that distributions and seasonal fluctuations in economic plant availabilities are observable, and it seems likely that aboriginal hunter-gatherers in a similar environment would follow local availabilities to an undetermined extent. This local plant study will thus appear to follow the mechanistic assumption that environmental distributions and seasonalities may be directly converted into human procurement schedules. However, the addition of the archaeobotanical data from the Monte Verde site (Chapter 12) will reveal that other dimensions of plant procurement, such as nonlocal and medicinal plants, cannot be totally understood through an optimal foraging model. This chapter presents a local procurement system, viewed through the local environment, which may represent a subset of plant procurement strategies of late Pleistocene hunter-gatherers at Monte Verde. A less mechanistic and more particularistic approach to hunter-gatherer resource use (Bender and Morris 1988; Graves 1992; Price and Brown 1985; Williams and Hunn 1982; Schrire 1984; Yesner 1980) will be described and utilized in the following chapter as the archaeobotanical data are added to the equation.

In order to discuss general possibilities for seasonality and scheduling of resource procurement, a differentiation must be made between foraging and collecting activities. Although some authors prefer a broad definition of "foraging" to cover the collection of all nonproduced food (Winterhalder 1981:16–17), a more specific definition of the term is useful in modeling potential hunter-gatherer procurement strategies (Binford 1980). For the purposes of this study, foraging refers to a generalized activity of gathering plants on an encounter basis. This is a more effective strategy where economic plant communities are mixed and interspersed, and where gathering activities are embedded (*sensu* Binford 1977) in hunting forays and vice-versa. Foraging emphasizes a knowledge of plant availability, that is, a knowledge of where and when mixed communities of useful plants may be located. Collecting, on the other hand, refers to a more specialized activity of seeking out a particular resource for harvest. Collecting emphasizes logistical expertise in organizing the harvest and transport of a plant that grows in pure stands and is more predictable in time and space. This conceptual dichotomy represents the idealized extremes of aboriginal behavior, and most often both are incorporated to some degree in the actual procurement of wild plants. Although the discussion focuses on plant procurement, compatible hunting activities would also have followed the same foraging-collecting continuum. In this case study, the conceptual dichotomy is particularly useful because it illustrates the importance of different procurement strategies to the plant exploitation of the Monte Verde area.

Research Setting

Monte Verde lies in the central depression of south-central Chile. The research area is a combination of low-lying bogs and cool, temperate rain forests (Dillehay 1989a). The hydrologic landscape consists of many small creeks and fewer secondary rivers flowing to the west or southwest and emptying into the area's major drainage, the Maullín River. This river in turn empties into the Pacific Ocean some 40 km to the west. The Monte Verde archaeological site is positioned along a small, slowly flowing drainage, Chinchihuapi Creek, about 4 km east of its confluence with the Maullín River.

Annual rainfall is between 1,900 and 2,000 mm, based on measurements taken at Puerto Montt and Maullín, each about 40 km from the study area (Veblen et al. 1983:9). Approximately 43 percent of the annual rainfall occurs during the winter months of June to August, when precipitation is virtually constant and the water table rises to inundate areas that are dry the remainder of the year. The region is generally described as containing a combination of evergreen and deciduous canopy forests (Veblen et al. 1983:10–11). Biological studies, however, indicate that the Monte Verde latitude (41° 30' S) represents an area of unusually diverse flora compared with other cool, temperate forests of southern Chile, such as in the Valdivia region located 200 km to the north (Hoffmann 1982:28–29). The Monte Verde vicinity is thus considered an environmental cul-de-sac that has not been previously surveyed for the density and distribution of its economic plants.

Another noteworthy attribute of the Monte Verde climate is its high photoperiodic or day-length variation, with a maximum of about 15 daylight hours on the December solstice and a minimum of about 9 hours, 20 minutes of daylight on the June solstice (Pearce and Smith 1984:19). In environments such as this, day-length variation becomes the most important triggering mechanism of plant flowering (Vince-Prue 1975). So-called short-day plants are induced to flower by chemical processes that may only occur during longer dark periods, while long-day plants require brief dark periods (Cockshull 1984; Deitzer 1984). In the Monte Verde vicinity, the great botanical diversity combined with high photoperiodic variation produces an environment of specific, strongly marked seasonalities in plant flowering, and consequently, the production of edible fruits and seeds. For example, most fruit-producing species of the Monte Verde area such as *calafate* (*Berberis* sp.), *chaura* (*Pernettya* sp.), *chilco* (*Fuchsia magellanica*) and *zarzaparrilla* (*Ribes magellanicum*) are long-day plants that produce fruits during the summer months (December to April). A minority of Monte Verde plants, particularly seed producing trees like *ulmo* (*Eucryphia cordifolia*) and *coigüe* (*Nothofagus dombeyi*) are short-day plants and produce during the winter months (June to August). Some ways that this marked seasonality affects the vicinity's economic plant microzones and potential procurement strategies will be discussed below. For example, long-day and short-day plants strongly tend to be associated with different economic plant microzones near Monte Verde and thus an annual procurement schedule may have been sensitive to cycles and spatial segregation of economic plant availabilities.

Archaeological and ecofactual evidence document similarities between the Monte Verde environment during the site's 13,000-year-old occupation and the present (Heusser 1984, 1989; Hoganson and Ashworth 1982; Ramírez 1989a). The pollen record indicates a slightly cooler but ameliorating climate than at present, including a similar plant inventory (Heusser 1989). Human intervention in the forms of land clearing, burning, and the introduction of Eurasian plants have produced ecological alterations, with a resulting presence of thickets and meadows that are not considered to be native plant communities (Ramírez 1989a:71–77; Veblen and Ashton 1978). In the study area, zones of native plant communities were interspersed with artificially produced communities. Despite this, it was possible to record the general configuration of native economic plant microzones. The study does not include distant highland and coastal zones, which are archaeologically represented (see Chapter 12; Ramírez 1989b). Since the study was undertaken in 1983, much destruction of native forests and bogs has occurred in and around the Monte Verde study area due to lumbering and continued human settlement.

Field Methods

The field research included three phases: (1) a six-week period of collection of an inventory of locally available economic plants, (2) the ordering of collected plant data and observations into a system of economic plant microzones, and (3) collection experiments to estimate the harvest potential of selected plants. Phase 3 is relevant to estimating the population size that could be supported by local plants and whether year-round habitation is possible based on these resources.

During Phase 1, the various areas within a 5-km radius of the Monte Verde site were each visited several times (Fig. 11.1). Economic plants were collected and brought to the archaeological field camp, where specimens were photographed, cataloged, inventoried, and stored. This allowed plant specimens to be examined by several local informants and to be transported to the Universidad Austral de Chile in Valdivia for further examination. Selected specimens were later dried and stored at the Instituto Botánico at that location.

Field collection and cataloging activities were carried out with the assistance of local informants with varying familiarity with the native plant communities, ranging from veteran woodsmen to casual plant collectors. It was thus possible to corroborate and replicate the collected information. Phase 1 collecting and inventory activities graded into Phase 2 of the research as topographic and hydrologic plant distribution data began to indicate repetitive, clearly demarcated economic plant microzones. An understanding of the dynamics of these zones, and the extrapolation of three months of observation into a complete annual cycle were accomplished through extensive interviews with several informants. During these interviews, it became clear that informants viewed the Monte Verde environment in terms of only two seasons: a relatively dry summer with long days, and a rainy, dark winter with short days. For this reason, the two-season dichotomy is retained, although other researchers sometimes refer to four seasons (Ramírez 1989b:168).

The final week of research involved specific collection experiments, which will be individually described in detail. It should be noted, however, that the research proceeded in more of a cumulative than a sequential manner through the three phases. That is, Phase 1 collecting and inventory, and once begun, Phase 2 zone documentation continued unabated during the research period. For instance, new economic plants were recorded even as harvest experiments were nearing completion.

Economic Plant Inventory

A total of 40 economically useful plants native to southern Chile were collected (Table 11.1; Fig. 11.2). These were classified into ten categories, based on plant form, size, and the economically useful portion of the plant. The classification is merely a general descriptive means of organizing economic plants based on their edible or functionally useful attributes:

1. fruit-bearing trees
2. fruit-bearing shrubs
3. other fruit-bearing plants
4. grains or grainlike plants
5. plants with edible leaves or stalks
6. plants with edible seeds (including trees and shrubs)
7. tubers
8. herbs
9. mushrooms
10. miscellaneous (including binding materials, medicinals, and hallucinogens)

Table 11.1 is a list of the collected plants, which does not purport to be a complete catalog of locally available economic plants. It is merely a list of the most visible and abundant plants available in the research area in 1983. Other economic plants may not have been found because they (1) were not recognized as economically useful by the authors or local informants, or (2) were more visible or available during the winter months, when plants were not collected.

Even as a partial economic plant inventory of the

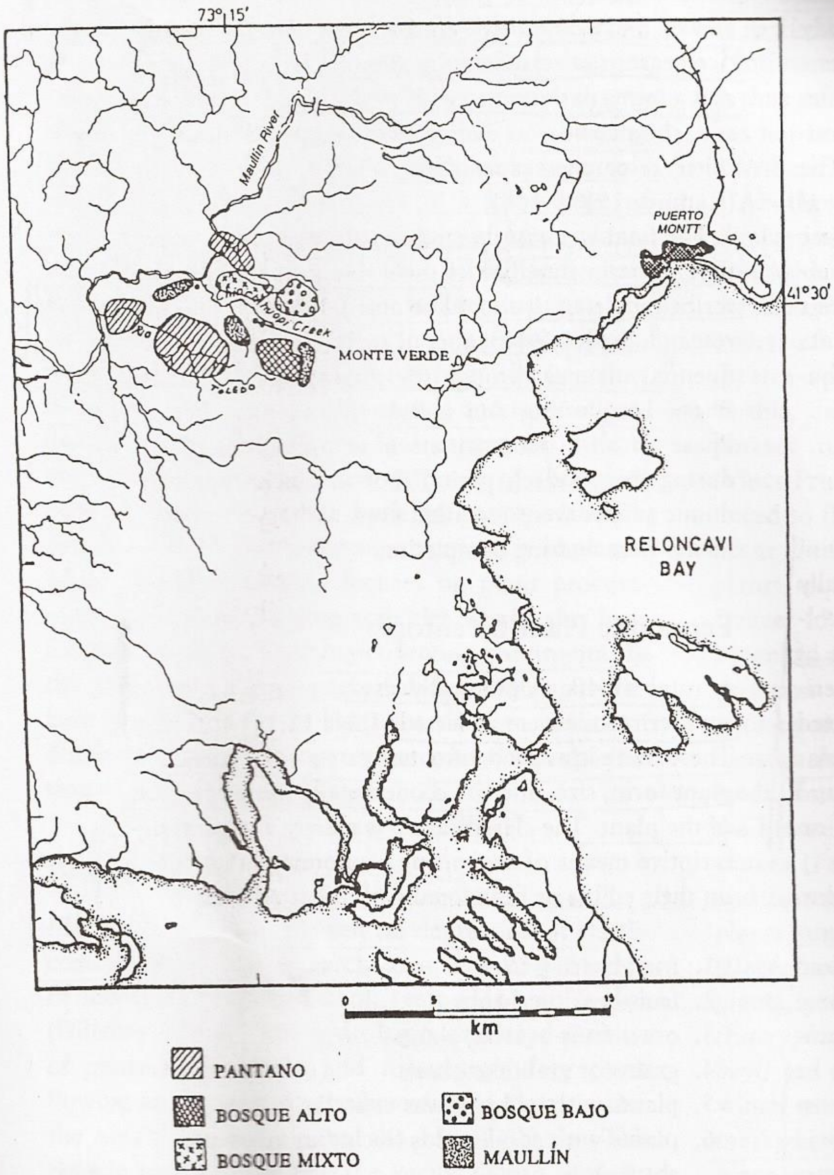


Fig. 11.1. Economic plant microzones within a 5-km radius of the Monte Verde archaeological site.

Monte Verde area, the list exhibits striking variety in seasonality and availability of useful plants for reasons to be discussed. In particular, the fruit-bearing trees and shrubs vary greatly in character, from species that produce large amounts of fruit for a brief period of time (approximately two weeks for *cauchau [Amomyrtus luma]*) to species that sequentially produce relatively small amounts of fruit for three months or more (*murra [Rubus constrictus]* and *calafate* [*Berberis* sp.]). The spatial distributions of plants also vary greatly, from plants available in large stands in several zones (*junco [Juncus procerus]* and *calafate* [*Berberis* sp.]) to plants with extremely specific, concentrated distributions (*papas [Solanum tuberosum]* and *ulmo [Eucryphia cordifolia]*).

Before proceeding, it should be noted that a few plants are difficult to place within this classificatory system, which is based on plant food value. Plants with possible medicinal and other uses are also important to hunter-gatherers, even if they do not make direct dietary contributions (Hoffmann 1982:62; Ramírez 1989b). Medicinal plants are further discussed in the companion paper that considers the Monte Verde archaeobotanical assemblage (Chapter 12).

Economic Plant Microzones

The area surrounding the Monte Verde site was classified into six primary economic plant microzones. As

Table 11.1. List of Some Native Economic Plants of the Monte Verde Area

Common Name	Scientific Name	Family
Fruit-bearing trees		
Arrayán	*Luma apiculata*	Myrtaceae
Avellano (chestnut)	*Gevuina avellana*	Proteaceae
Luma (cauchau)	*Amomyrtus luma*	Myrtaceae
Maqui	*Aristotelia chilensis*	Elaeocarpaceae
Melí	*Amomyrtus meli*	Myrtaceae
Fruit-bearing shrubs		
Arapita, Huarapo	*Myrteola barneoudii*	Myrtaceae
Boldo/Boldu	*Peumus boldus*	Monimiaceae
Calafate	*Berberis* sp.	Berberidaceae
Chaura	*Pernettya* sp.	Ericaceae
Chilco	*Fuchsia magellanica*	Onagraceae
Michay	*Berberis* sp.	Berberidaceae
Mora/Murra (blackberry)	*Rubus constrictus*	Rosaceae
Murta	*Ugni molinae*	Myrtaceae
Peta	*Myrceugenia exsucca*	Myrtaceae
Pillu-pillu	*Ovidia pillo-pillo*	Thymelaeaceae
Tepú/Tepa	*Tepualia stipularis*	Myrtaceae
Zarzaparrilla	*Ribes magellanicum*	Saxifragaceae
Other fruit-bearing plants		
Chupón	*Greigia sphacelata*	Bromeliaceae
Miñe-miñe	*Rubus radicans*	Rosaceae
Poes/Chupalla	*Fascicularia bicolor*	Bromeliaceae
Grainlike plants		
Junco	*Juncus procerus*	Juncaceae
Edible leaves or stalks		
Cortadera	*Cyperus eragrostis*	Cyperaceae
Nalkas/Pangue	*Gunnera tinctoria*	Gunneraceae
Caña	*Chusquea coleu*	Gramineae
Quila	*Chusquea quila*	Gramineae
Pacomel	*Chusquea tenuiflora*	Gramineae
Edible seeds		
Coicopigue	*Philesia magellanica*	Pilesiaceae
Ulmo	*Eucryphia cordifolia*	Eucryphiaceae
Coigüe	*Nothofagus dombeyi*	Fagaceae
Matico	*Buddleia globosa*	Buddleiaceae
Tenío, Tineo	*Weinmannia trichosperma*	Cunoniaceae
Edible tuber		
Papa	*Solanum* sp.	Solanaceae

Table 11.1. Continued.

Common Name	Scientific Name	Family
Herbs		
Canchelagua	*Centaurium* sp.	Gentianaceae
Limpiaplata	*Equisetum bogotense*	Equisetaceae
Natre	*Solanum gayanum*	Solanaceae
Mushroom		
Callampa	*Agaricus* sp.	Agaricaceae
Miscellaneous		
Boldo/Boldu	*Peumus boldus*	Monimiaceae
Boqui	*Campsidium valdivianum*	Bisnoniaceae
Canelo	*Drimys winteri*	Winteraceae

previously explained, the following microzones are highly localized within a 5-km radius of the Monte Verde site and are based on economic plant contents and availabilities. The zones may thus be considered to represent an economic subset or microdivisioning of broader, regional and biologically based classifications of plant communities.

1. *bosque alto* (high forest)
2. *bosque mixto* (mixed forest)
3. *bosque bajo* (low forest)
4. *mallín* (low, marshy areas)
5. *ñadi* (meadow or grassland)
6. *pantano* (bog)

All but one are considered to be representative of the ancient plant microzones of Monte Verde. The *ñadi* is a possible exception. Some authors consider *ñadis* to be artificially produced by excessive logging activities and underground fires that burn subterranean peat (Hoffmann 1982:37; Ramírez 1989b:73–74; Veblen and Ashton 1978). Both processes devastated large areas around the site during several archaeological field seasons. Others consider the *ñadi* to be a long-existing microzone that must be recognized as part of the ancient Pleistocene environment (Pino and Díaz-Vaz, pers. comm. 1983). This debate is further discussed below, but the basic premises of subsistence and scheduling presented here do not depend on the solution, because the microzone is notoriously poor in economic plant inventory and density (Ramírez 1989a:73–74).

Table 11.2 lists the inventoried economic plants by microzone. Each is briefly described below. The locations of the microzones relative to the Monte Verde site are depicted in Figure 11.1.

BOSQUE ALTO (HIGH FOREST)

The *bosque alto*, or high forest, is distinguished from other forest microzone types by its relative elevation difference. *Bosque altos* are located on terraces and on slight but well-defined rises set back from rivers and creeks. A change in elevation of only 5–10 m in this region can produce important differences in the botanical make-up of the resulting forest due to the region's high water table and microzonal differences in ground saturation and water runoff capabilities. The *bosque alto* is the highest elevation forest located in the Monte Verde vicinity. The *bosque alto* is an impressive, high (20 or more meters) canopy forest with relatively little brush or undergrowth, and generally dry, solid ground underfoot. It is economically dominated by *ulmo* (*Eucryphia cordifolia*), *coigüe* (*Nothofagus dombeyi*), and *arrayán* (*Luma apiculata*). The first two tree species produce edible seeds during the winter months of June through September, while the latter is a summer, fruit-bearing tree species. Also during the winter months, mushrooms such as *Agaricus* proliferate there. The archaeological remains of all these plants were found at Monte Verde (Ramírez 1989b). However, the *bosque alto* contains little in the way of edible fruits, grainlike plants, or tubers.

In 1983, a 4-sq-km area of *bosque alto* covered an area between 1 and 3 km southeast of the Monte Verde site (Fig. 11.1). The *bosque alto* in the study

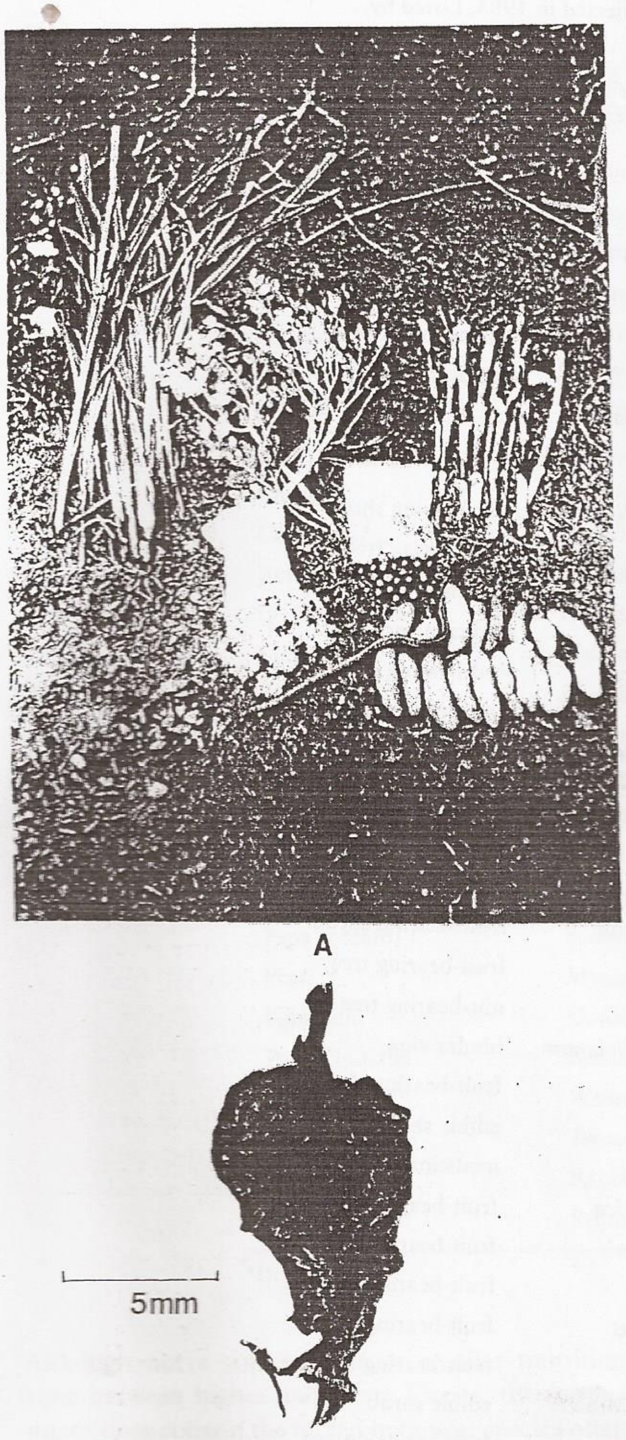


Fig. 11.2. (a) Examples of collected economic plants (clockwise from top left), *cortadera* stalks, *peta* branch with fruits, *cauchau* berries, *quila* shoots, white and red wild potatoes; (b) potato *(Solanum maglia)* recovered from Monte Verde archaeological site.

area has been devastated by clear-cut logging activities, because the size and quality of its trees and the ease of removing fallen logs is unmatched by other Monte Verde forest microzones. It is thus possible that ancient Monte Verde hunter-gatherers procured the large logs used in their architecture in the zone. The *bosque alto* is the most rapidly disappearing plant zone in the region, and it is likely that no true *bosque alto* will remain near Monte Verde in the near future.

BOSQUE BAJO (LOW FOREST)

The *bosque bajo*, or low forest, lies an average 10 m in elevation below the *bosque alto* in poorly drained lowland areas. In contrast to the high canopy and dry ground surface of the latter, the *bosque bajo* contains shorter, spreading trees such as *melí (Amomyrtus meli)*, *canelo (Drimys winteri)*, and *luma (Amomyrtus luma)*. Numerous shrubby plants, including *arapita (Myrteola barnaoudii)*, *chilco (Fuchsia magellanica)*, *murta (Ugni molinae)*, and *tepú (Tepualia stipularis)* produce edible fruits during the summer months. However, the *bosque bajo* has a wet ground surface and dense undergrowth, comprised of a combination of bamboos *(Chusquea quila* with *Chusquea tenniflora)*, thorny brush *(Rubus constrictus)* and vines *(Campsidium valdivianum)*. Although economically useful plants are found in the *bosque bajo*, the virtually impenetrable undergrowth makes collecting in the interior extremely difficult. The edges of the economic microzone, however, abutting either creeks or zones such as *mallíns* or *pantanos*, provide an accessible plant collecting fringe with fruit-bearing trees dominated by *luma-cauchau (Amomyrtus luma)* and blackberry shrubs *(Rubus constrictus)*. A 4-sq-km patch of *bosque bajo* located between 1 and 3 km east-northeast of the Monte Verde site was investigated in 1983 (Fig. 11.1).

BOSQUE MIXTO (MIXED FOREST)

The *bosque mixto*, or mixed forest, is an economic zone combining, as its title suggests, characteristics and virtually all the aforementioned species of the *bosque alto* and *bosque bajo*. Its average ground elevation falls between the two other forest types, and depending on the pattern of surrounding creek systems or a meter or two change in elevation, one will find high canopies, low, sprawling trees, dense undergrowth, clearings, and a range of ground surfaces.

Table 11.2. Monte Verde Area Economic Plants Collected in 1983, Listed by Economic Plant Microzone

Common Name	Scientific Name	General Plant Type
Bosque alto (high forest)		
Arrayán*	*Luma apiculata*	fruit-bearing tree
Callampa	*Agaricus* sp.	mushroom
Coicopigue	*Philesia magellanica*	seed-bearing shrub
Coigüe*	*Nothofagus dombeyi*	seed-bearing tree
Maqui	*Aristotelia chilensis*	fruit-bearing tree
Miñe-miñe	*Rubus radicans*	fruit-bearing plant
Ulmo*	*Eucryphia cordifolia*	seed-bearing tree
Bosque mixto (mixed forest)		
Arapita	*Myrteola barneoudii*	fruit-bearing shrub
Arrayán	*Luma apiculata*	fruit-bearing tree
Boldo	*Peumus boldus*	medicinal tree
Canelo	*Drimys winteri*	medicinal tree
Coicopigue	*Philesia magellanica*	seed-bearing shrub
Luma (cauchau)	*Amomyrtus luma*	fruit-bearing tree
Maqui	*Aristotelia chilensis*	fruit-bearing tree
Melí	*Amomyrtus meli*	fruit-bearing tree
Miñe-miñe	*Rubus radicans*	fruit-bearing plant
Bosque bajo (low forest)		
Arapita	*Myrteola barneoudii*	fruit-bearing shrub
Arrayán	*Luma apiculata*	fruit-bearing tree
Avellano (chestnut)	*Gevuina avellana*	nut-bearing tree
Boqui	*Campsidium valdivianum*	binder vine
Calefate	*Berberis* sp.	fruit-bearing shrub
Caña (bamboo)	*Chusquea coleu*	edible shrub
Canelo	*Drimys winteri*	medicinal tree
Chilco	*Fuchsia magellanica*	fruit-bearing shrub
Luma (cauchau)*	*Amomyrtus luma*	fruit-bearing tree
Melí	*Amomyrtus meli*	fruit-bearing tree
Murra (blackberry)*	*Rubus constrictus*	fruit-bearing shrub
Murta	*Ugni molinae*	fruit-bearing shrub
Pacomel (bamboo)	*Chusquea tenuiflora*	edible shrub
Poes/Chupalla	*Fascicularia bicolor*	fruit bearing plant
Quila (bamboo)*	*Chusquea quila*	edible shrub
Tenio, Tineo	*Weinmannia trichosperma*	seed-bearing tree
Tepú	*Tepualia stipularis*	fruit-bearing shrub
Mallín (low, swampy area)		
Calefate	*Berberis* sp.	fruit-bearing shrub
Junco*	*Juncus procerus*	seed-bearing reed
Zarzaparrilla	*Ribes magellanicum*	fruit-bearing shrub

Table 11.2. Continued.

Common Name	Scientific Name	General Plant Type
Pantano (peat bog)		
Avellano (chestnut)	*Gevuina avellana*	nut-bearing tree
Boqui	*Campsidium valdivianum*	binder vine
Calefate*	*Berberis* sp.	fruit-bearing shrub
Caña (bamboo)	*Chusquea coleu*	edible shrub
Canchelagua	*Centaurium* sp.	medicinal herb
Canelo	*Drimys winteri*	medicinal tree
Chaura*	*Pernettya* sp.	fruit-bearing shrub
Chilco*	*Fuchsia magellanica*	fruit-bearing shrub
Chupón	*Greigia sphacelata*	fruit-bearing plant
Cortadera*	*Cyperus eragrostis*	edible stalks
Junco*	*Juncus procerus*	seed-bearing reed
Quila (bamboo)*	*Chusquea quila*	edible shrub
Limpiaplata	*Equisetum bogotense*	medicina herb
Matico	*Buddleia globosa*	seed-bearing tree
Michay	*Berberis* sp.	fruit-bearing shrub
Murra (blackberry)	*Rubus constrictus*	fruit-bearing shrub
Nalkas/Pangue*	*Gunnera tinctoria*	leafy shrub
Natre	*Solanum gayanum*	medicinal herb
Pacomel (bamboo)	*Chusquea tenuiflora*	edible shrub
Papa (potato)	*Solanum* sp.	tuber
Peta	*Myrceugenia exsucca*	fruit-bearing shrub
Pillu-pillu	*Ovidia pillopillo*	fruit-bearing shrub
Poes/Chupalla	*Fascicularia bicolor*	fruit-bearing plant
Tenío, Tineo	*Weinmannia trichosperma*	seed-bearing tree
Tepú	*Tepualia stipularis*	fruit-bearing shrub
Tres cantos	*Baccharis sagittalis*	medicinal herb
Zarzaparrilla*	*Ribes magellanicum*	fruit-bearing shrub

*Dominant plant

Although not a true ecotone or smaller transition zone between higher and lower forests, the *bosque mixto* does contain the mixed botanical species often attributed to ecotones (Odum 1971).

The *bosque mixto* is a difficult zone to classify in terms of collecting potential. However, in general it has more in common with the *bosque bajo* than with the *bosque alto*. Its very unpredictability leads to a conclusion that, like the *bosque bajo*, it is primarily important economically for its borders or open areas, which contain a combination of *bosque alto* and *bosque bajo* plant resources. A long, relatively narrow (3-by-1-km) strip of this type of mixed forest microzone was situated 1 km north and northwest of the Monte Verde site (Fig. 11.1).

MALLÍN (WET, MARSHY AREAS)

The *mallín*, a wet, marshy area, is generally free of trees or heavy undergrowth. *Mallíns* are generally located on elevated, flat river terraces, although some appear on other well-drained high ground further from rivers and creeks near the *bosque alto*. These areas, which appear as clearings from a distance, are actually large stands of *junco* reeds (*Juncus procerus*) with a few interspersed shrubs such as *calafate*

(*Berberis* sp.) and *zarzaparrilla* (*Ribes magellanicum*). *Mallíns* vary greatly in size, from a hundred or so square meters in area to several hundred thousand square meters.

Three *mallíns* were located within a 5-km radius of the Monte Verde site: 1 km west-southwest, 4 km southeast, and 5 km west-northwest of the site (Fig. 11.1). *Junco* reed, which produces an edible stalk and grainlike seed, often grows in the *mallín* in vast amounts. Although the variety of plants in this zone is not great, the presence of *junco* in large amounts is economically significant because of its presence in hearths and a wooden mortar at the Monte Verde site (Ramírez 1989b).

ÑADI (MEADOW)

Ñadis, or meadows, are grassy fields interspersed with small groves of trees. Some of the present-day Monte Verde landscape was *ñadi* when the area was studied in 1983, including several hundred meters adjacent to the archaeological site that was forested at the time of initial fieldwork in 1976 (Fig. 11.1). *Ñadis* appear to be most prevalent on low hilltops and hillsides. It is not known how extensive the local *ñadis* were in the past, but pollen analysis of the Monte Verde site suggests that open meadows were part of a patchy forest environment 13,000 years ago (Heusser 1989). This microzone would have been utilized because potentially important summer fruits such as *calafate* (*Berberis* sp.), *murra* (*Rubus constrictus*), and *avellano* (*Gevuina avellana*), ripen later in the *ñadis* than in other microzones. This phenomenon is discussed later as "extended seasonality." Though not an extremely abundant zone in absolute terms, *ñadis* could have been important for extending the seasonal availability of certain fruits, particularly from April to June.

PANTANO (BOG)

The most varied and visually spectacular economic plant microzone is the *pantano,* or bog. *Pantanos* are located along primary and secondary rivers in low-lying floodplains. One major *pantano* lies only 4 km southwest of the Monte Verde site along the Toledo River (Fig. 11.1). The bog itself stretches for several kilometers and may be further subclassified into economic subzones based on plants found archaeologically at Monte Verde (Ramírez 1989b; Fig. 11.3).

1. *Quila zones,* or areas of extremely heavy *quila* (*Chusquea quila*) undergrowth and little else.
2. *Nalkas/chilco subzones,* dominated by *nalkas* (*Gunnera tinctoria*) and *chilco* (*Fuchsia magellanica*), but also containing a variety of fruit-producing shrubs such as *calafate* and *michay* (*Berberis* sp.), *chaura* (*Pernettya* sp.) and *peta* (*Myrceugenia exsucca*). These subzones are usually located at the most well-watered portions of

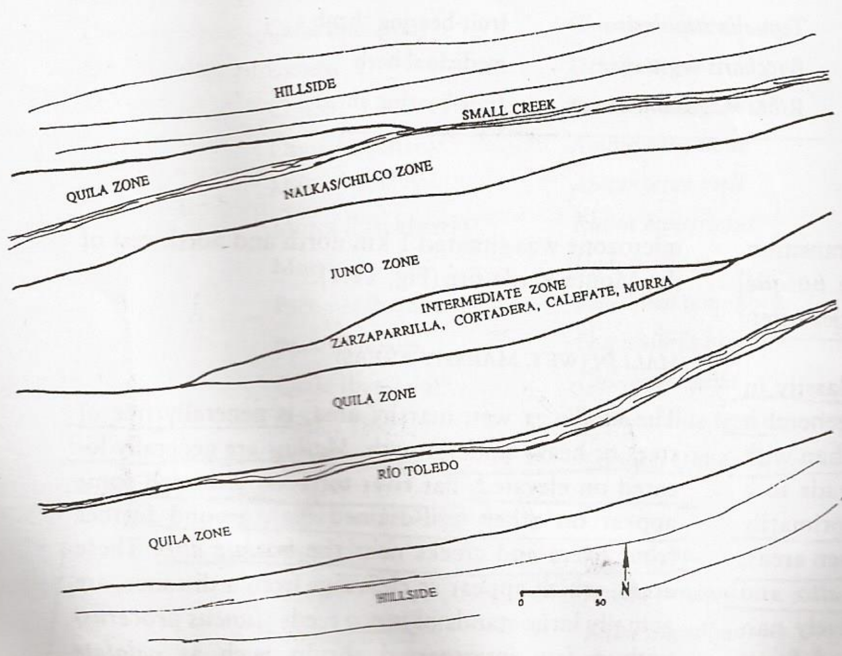


Fig. 11.3. Schematic representation of the economic plant divisions of the *pantano* economic plant microzone.

the *pantano*, or where water flow is most rapid. The subzone abuts the Toledo River and feeder streams in the large Toledo bog of the study area.

3. *Zarzaparrilla/murra/cortadera* subzones, or distinct intermediate areas between the *quila* and *nalkas/chilco* zones. These subzones are long, narrow, relatively clear and dry "islands," and are the exclusive *pantano* domain of the three important economic plants of its title *(Ribes magellanicum, Rubus constrictus, Cyperus eragrostis)* plus a variety of other useful plants, such as *calafate*. Patches of wild potatoes *(Solanum tuberosum)* also primarily occur in this subzone.
4. *Junco zones*, or pure stands of *junco* reed *(Juncus procerus)*. These subzones are distinguished from *mallíns* by their presence within a complex of *pantano* microzones.

The divisions are thought to represent an unmodified natural *pantano* configuration with one exception. It is possible that the *quila* zones are an invasion/replacement of what was originally a forested zone similar to the *bosque bajo* (Numata 1979:233–234). Despite this possible environmental change, the relative position and distribution of the various subzones are probably intact.

Distant Plant Zones

Archaeobotanical remains from the Monte Verde site suggest that environments beyond the immediate site vicinity, such as the sandy and rocky littoral zones (55 km west and 20 km south of the site) and the high Andean grassland (40 km east of the site) were also exploited for economic plants (Ramírez 1989a, 1989b). These zones were not included in this study because archaeological evidence had not yet suggested their utilization in 1983. It is, however, important to note that aboriginal plant exploitation was not confined to the immediate site vicinity study area, and that substantial additional plant resources were available in more distant zones. Nonlocal plants from the Monte Verde site are further discussed elsewhere (Chapter 12).

Configuration and Characteristics of Microzones

A few general patterns exist in the configuration of the various economic plant zones (Fig. 11.1). *Bosque altos* are usually located several kilometers west and southwest of the Maullín River on slightly higher ground, with the largest existing area located approximately 200 m southeast of the Monte Verde site. *Pantanos* tend to be located along secondary rivers and larger creeks. The vast Toledo River *pantanos* are located approximately 5 km southwest of the site, while a second *pantano* is located 3 km north of the site. *Mallíns* are widely distributed, both along the primary river (the Maullín River) and in depressed areas along secondary creeks. However, one large *mallín* abuts a *bosque alto* zone on relatively high ground approximately 2 km southeast of the Monte Verde site. Other zones, such as the *bosque mixto* and *bosque bajo*, are less predictably distributed in the vicinity. *Ñadis*, some of which appear to be modern landscape alterations, fill the many gaps between zones in Fig. 11.1.

Chinchihuapi Creek, where the Monte Verde site is located, drains a terrace including the higher microzones such as the *bosque alto, bosque mixto*, some *ñadis*, and downstream from the Monte Verde site, some *bosque bajo*. The wetter microzones such as the *mallíns* and *pantanos* are located lower in elevation and are not drained by Chinchihuapi Creek. The Monte Verde site is thus located centrally at an intermediate elevation (52 m above sea level) between distinctive forest and bog economic plant microzones. In comparison, the larger river areas such as the Maullín River are further removed from the variety of plant microzones described above. Thus, there appears to be distinct advantages, in terms of gaining easy access to a maximum number of microzones, to locating a settlement on a smaller creek on a higher terrace away from the main river. Easy availability of a large variety of plant resources would be significantly lower at a site positioned along the main river; and the large, wet, lower elevation *pantanos* along the secondary rivers would be undesirable settlement locations.

SEASONAL FLUCTUATION OF MICROZONES

As previously discussed, uneven seasonal rainfall and great photoperiodic variation are two factors that produce marked seasonality at Monte Verde. An average 860 mm of rain, or 43 percent of the annual average rainfall of 2,000 mm, falls during the winter months of June to August, during the same period when daylight hours are lowest. Thus, the economic plant microzones described above are dynamic, in that they seasonally change in size and form, with a concomitant change in economic plant accessibility and availability. Just as an elevational difference of only 5 m may produce dramatic environmental microzone changes due to the high water table, ground saturation and water runoff potential, the slight water table rise that occurs during the winter months transforms the Monte Verde landscape. In the relatively dry summer months of November to February *pantanos* are smaller and drier, making access to plant resources less difficult, while in the winter months of June to September, the *pantanos* expand in size and water content, making access difficult. Also during these winter months, the *bosque alto* produces its edible tree seeds and mushrooms.

EXTENDED OR STAGGERED SEASONALITY

The dynamism of plant zones at Monte Verde has another effect on economic plant availability. Several plants may be termed as having "extended" or "staggered seasonality," which is a lengthening of seasonality that occurs in plants growing in two or more Monte Verde microzones. That is, certain plants produce their edible fruits or seeds sequentially in time by zonal location. Many plants may thus be exploited for a longer period annually in areas like Monte Verde, with a variety of tightly clustered microzones, than elsewhere in southern Chile where forests or bogs may be more uniform across space (Ramírez 1989a).

Extended seasonality underscores the differences between economic plant microzones that are spatially compressed in the study area. The phenomenon is important to an understanding of potential aboriginal plant gathering patterns for two reasons. First, certain important economic plants are available for longer time periods because their fruits ripen sequentially according to zonal location. Second, this staggering effect would tend to diffuse the exploitation of individual plants in space and time, and thus lessen the chance of resource depletion.

Good examples of extended seasonality are *calafate* (*Berberis* sp.), *murra* (*Rubus constrictus*), and *avellano* (*Gevuina avellana*). The first two plants, both fruit-bearing shrubs, produce first in the wetter *pantanos* (February, March), later in the *bosque bajo* edge (March, April), and still later at the edges of the slightly higher elevation *bosque alto* (April, May). Thus, certain plants that normally have a two month seasonality are instead available for four months within a circumscribed area. Similarly, *avellano*, a nut-bearing tree, is available from late February through late June near Monte Verde, although the nuts don't normally appear at the Puerto Montt market, 40 km to the east, until late March or early April. This particular example of extended seasonality underscores the environmental richness that is unique to the immediate Monte Verde vicinity.

The greatest expression of extended seasonality at Monte Verde is the case of *junco* reed (*Juncus procerus*). This is related to the great seasonal differences in water content of the two primary *junco* habitats, *mallíns* and *pantanos*. During the rainy winter months, the *mallíns* simulate the summer *pantanos* in water content, while the *pantanos* expand and become inaccessible. Thus, a potential staple plant for its edible seeds, stalks and rhizomes, *junco* reed, is available in dense stands on a year-round basis.

In summary, extended or staggered seasonality is an important phenomenon that might serve to take environmental pressure off an aboriginal plant collector by temporally extending availability, spatially diffusing exploitation, and reducing chances of depletion of valuable plant resources. At Monte Verde, extended seasonality affects a large variety of both seasonal fruits and potential staple seed/stalk/rhizome plants such as *Juncus* and *Scirpus*.

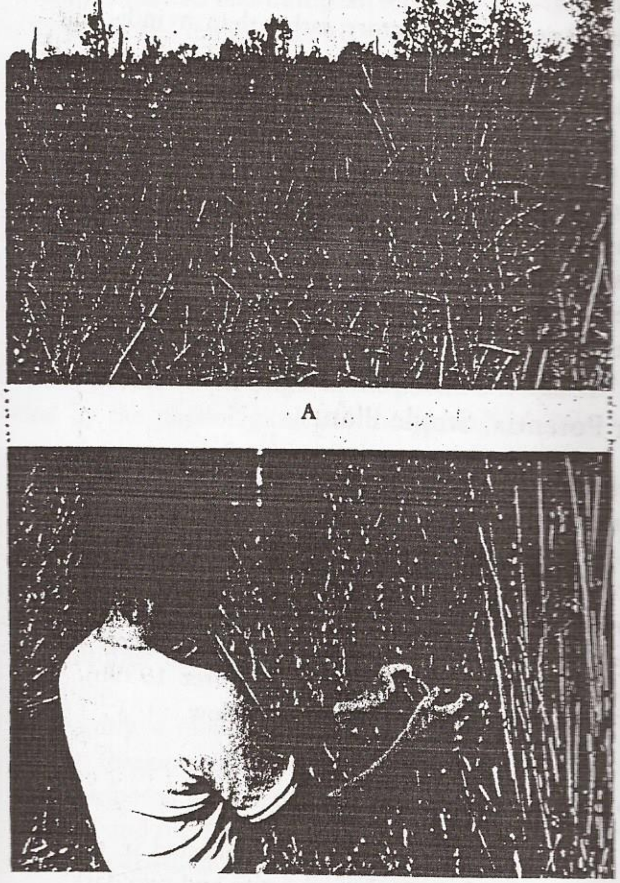
Harvest Experiments

Two harvest experiments were performed to estimate the collection potential of certain economic plant microzones. *Junco* reed was collected from a *mallín* zone, and *cauchau* and *murra* were collected from the edge of a *bosque bajo*. The purposes of these experiments were (1) to estimate summer fruit productivity of the forest edge and the harvest potential of a dense *junco* stand, and (2) to harvest resources that may have been collected in greater quantity, due to their potential to be dried and stored. Fruits with relatively brief seasonalities like *murra* and *cauchau* would be more likely to be collected in bulk quantities. In contrast, other resources like wild potatoes would not be collected in bulk, since tubers store naturally in the ground (Hatley and Kappelman 1980). They would be more likely collected in smaller amounts for daily use, and thus harvest experiments might be less likely to reflect actual procurement practices. The experiments thus allow a conceptualization, within narrow contexts, of the environmental abundance of two microzones and the energy expenditure necessary to their exploitation.

JUNCO REED HARVEST

Junco reed *(Juncus procerus)* is an abundant grainlike plant of the Monte Verde area. Both its seeds and stalks (1 to 5 m in length) are edible and easily harvested (Fig. 11.4). *Junco* seeds remain on the stalk for nearly the entire year, and the plant is available year-round in the *mallíns,* and for all but two or three winter months in the *pantanos.* Other reedy plants recovered archaeologically at Monte Verde, such as *Scirpus,* probably have harvest potential similar to *junco* reed.

Potential seed harvest was estimated by collecting a 10-sq-m area of *junco,* and pacing the entire *junco* field to estimate its total area. The area (3.16-by-3.16 m) to be harvested was first gridded within a typical 3-m-high *junco* stand. Approximately 15 stalks to a handful were grasped, bent, and cut with a simple split-pebble basalt tool resembling those recovered from the Monte Verde site (Fig. 11.4). Usually two to three strokes were sufficient to sever the stalks. The entire area was cut in this manner in 25 minutes (210 strokes). The stalks were then piled nearby for processing.



A

B

Fig. 11.4. (a) *Junco* field near Monte Verde; (b) cutting *junco* with replicated split pebble during harvest experiment.

Cleaning consisted of shaking and rolling the stalks with bare hands. This winnowing separated the seed clusters, which fell to the ground while the lighter chaff was carried off by the wind. Seeds were then placed into a bag for transportation to camp. Two people worked at a leisurely pace for 40 minutes to complete the cleaning task. The resulting seed harvest weighed 180 g. Slightly more than one hour of harvest and cleaning (65 minutes) thus produced a substantial amount of *junco,* probably sufficient to feed four people a serving. This harvest excludes the pile of edible stalks produced during the same work period.

A *mallín* area 300 m from the Monte Verde site contained a pure *junco* stand approximately 150-by-80 m in area. This was only one of several such zones observed within easy walking distance of the site which might have existed during the late Pleistocene period (Heusser 1989; Ramírez 1989a). This 12,000-sq-m *junco* stand alone contained a harvest potential of 108,000 g of *junco* seed, and many times that weight in edible stalks. In considering these figures, it is important to remember that the harvest was performed by people unfamiliar with wild plant collection, and a similar harvest performed by aboriginal people would presumably be more efficient. There is no doubt that *junco* was sufficiently abundant and available in the *mallíns* of Monte Verde to serve as a year-round staple food (Ramírez 1989a). The presumption of *junco* as a staple is somewhat supported by the archaeological presence of burned and unburned seeds, stalks and rhizomes in 23 site contexts, although it appears in lower frequency than many other species (Ramírez 1989b:150).

Unfortunately, the ethnographic literature gives little insight into the preparation and consumption of *junco.* Wild plant use in nearby Chiloé Island, for instance, is heavily dominated by introduced species, primarily for medicinal uses. Recorded use of *junco* is confined to the manufacture of baskets and matting (Meza and Villagrán 1991:53; Villagrán et al. 1983:30).

Junco reed was examined for nutritional content at the Instituto de Producción y Sanidad Vegetal at the Universidad Austral de Chile, in Valdivia, Chile (Table 11.3). *Junco* seeds and stalks were both found to contain high levels of sugar (seeds 15.9 percent,

Table 11.3. Nutritional Content of *Junco* (*Juncus procerus*)

Elements	Seeds	Stalks*
Protein	7.30	4.50
Lipids	3.20	1.10
Sugar	15.90	11.00
Reduced sugars	14.00	10.10
Starch	48.90	51.20
Residual cellulose	14.80	29.00
Minerals (mg/100 g)		
Sodium	34.00	66.00
Calcium	110.00	150.00
Magnesium	90.00	80.00
Manganese	2.30	0.03
Zinc	0.35	0.30
Iron	1.30	1.40
Copper	0.10	0.10

Note: Analyzed at the Universidad Austral de Chile, Instituto de Producción y Sanidad Vegetal, Laboratorio de Fitoquimica.

*Percentage when dry

stalks 11 percent) and starch (seeds 48.9 percent, stalks 51.2 percent), in addition to a substantial level of protein (seeds 7.3 percent, stalks 4.5 percent). Perhaps more revealing are the high levels of a range of important minerals found in *junco,* especially sodium, calcium, and magnesium (Table 11.3). Thus, on a nutritional level, *junco* is a sensible staple food.

BERRY HARVEST: *CAUCHAU* AND *MURRA*

In late March, the edge of a *bosque bajo* 200 m from the Monte Verde site was harvested in an attempt to estimate its economic potential. *Cauchau* and *murra* are the principle economic plants of the microzone edge.

Cauchau is a bright black or dark blue berry that grows on the *luma (Amomyrtus luma),* a small to medium-sized tree (Donoso 1975:100–101; Hoffmann 1982:80–81). For a two to three week period in late March and early April, the *cauchau* berries appear in abundance. *Murra (Rubus constrictus)* is a low spreading thorny bush that produces large black or indigo fruits known as blackberries in the United States. Although probably an introduced species, *Rubus constrictus* at the forest edge is suggestive of other native species of *Rubus* and other fruit-bearing plants that may have been displaced by its invasion. Unlike *cauchau,* the fruits ripen sequentially over a three-month period (March to May) and can be repeatedly harvested during that time.

Approximately 100 m of *bosque bajo* edge was foraged for approximately one hour at a leisurely pace. Because of the distribution of important economic plants along a linear area where the dense vegetation meets more open zones, the most effective collection strategy was to move along the zone edge, picking ripe fruit from the interspersed bushes and stopping at *luma* trees to pick *cauchau* from the lowest branches. One hour of foraging produced 1.3 quarts of *murra* (278 berries) and .7 quarts of the smaller *cauchau* (560 berries), enough fruit to provide servings to five to six people. This does not include a substantial number of berries eaten by the researcher during the foraging activity.

Once again, the collector's inexperience with wild harvests must be noted. An experienced collector may have been able to climb into the *luma* trees or devise another way of collecting *cauchau* from higher in the trees and *murra* from deeper in the thorny bushes. Also, a small group of collectors, rather than an individual, would have easily collected more berries. Even when harvested by an inexperienced person, the *bosque bajo* edge produces relatively large quantities of fruit for little effort from March to May. Although the fruits of the Monte Verde area contain low nutritional values in terms of vitamins, protein, calories, and trace elements (Hintze 1992), they would have provided an abundant, easily collected seasonal dietary supplement.

Other Potential Staple Plants

Besides *junco* reed, four other plants or plant groups are considered potential staples for aboriginal collecting populations in the Monte Verde area. The categorization is based on their availability in large quantities on a year-round basis. The plants, wild potatoes, bamboos, *nalkas,* and *cortadera,* were all recovered archaeologically at Monte Verde (Ramírez 1989b). Each plant is individually considered below.

WILD POTATOES

Four varieties of wild potato were collected in the field. These include two white varieties and two dark purple to black varieties. The white potatoes are certainly *Solanum tuberosum* and the black potatoes are probably a variety of the same species, as the species *S. maglia,* which was recovered archaeologically, is now quite rare in the region. Wild potatoes grow exclusively in the *pantanos.* Their low greens are difficult for an untrained eye to distinguish, but with time and practice, the patches become readily observable. These potatoes are today known by generic terms such as *papas rojas* (red potatoes), *papas socas* (topleaf potatoes), *papas negritas* (little black potatoes), and *papas forageras* (forage potatoes, collected to feed livestock). They are little-used today as a human food source, as larger domesticated varieties are easily grown.

Research on the history of the potato has been marked by controversy and disagreement (Hawkes 1990; Salaman 1970). It is generally agreed that there are two regions of wild potatoes in South America that are candidates for the plant's origin: (1) the Andean area of Peru, Ecuador, Colombia, Bolivia, and northwest Argentina, and (2) the southern Chile lowlands. Soviet scientists have long promoted Chile as the potato's place of origin (Juzepczuk and Bukasov 1929). American and European scientists have generally dismissed the argument and placed its origin in Andean Peru (Burton 1966:9–14; Correll 1962:4–6; Salaman 1970:55–57). The Soviets based their arguments on morphology and physiology, with Chilean potatoes being better adapted to the long-day growing season of northern temperate climates. In contrast, the Western scientists base their arguments on the archaeological record, which may be problematic because the vast majority of South American archaeology has been conducted in Peru.

The debate on the origin of the potato has been fueled by the physiological and morphological differences between the Peruvian *Solanum andigenum* and the Chilean *S. maglia* and *S. tuberosum* (Correll 1962; Grun 1990; Hawkes 1990; Salaman 1970). The Peruvian species developed in a dry, high altitude environment with little photoperiodic variation, while the Chilean species developed in a rainy, low altitude environment with great photoperiodic variation.

Recently, a model linking chemical ecology with human foraging and experimentation with plants has been proposed to understand plant domestication in general, and the development of the domesticated potato in particular (Johns 1990). According to this model, a series of human-manipulated chemical changes in potatoes, particularly selection for toxic glycoalkaloid reduction, was essential to potato domestication in Peru and Bolivia. In the Chilean case, however, it appears that the wild *Solanum tuberosum* is not bitter or toxic (Appendix 9; Ugent et al. 1987; see Johns 1990:123 for discussion). This raises the possibility that the development of potato utilization and, ultimately, domestication, were fundamentally different processes in Chile and Peru/Bolivia.

In any case, wild potatoes (or perhaps in some cases, introgressants that approximate wild populations [Grun 1990:47]) are readily available though little utilized today, and potatoes were recovered in relatively low frequency from the Monte Verde site (Appendix 9; Ugent et al. 1987). Even the low archaeological frequency is remarkable, considering their fragility and usual poor preservation in the archaeological record (see Martins 1976). Wild potatoes are significant for three reasons. First, they add a stable and dependable source of carbohydrates that is less sensitive to climatic fluctuations than above-ground plants to an aboriginal diet (Hatley and Kappelman 1980). Second, as tubers, they are "self-storing" in the ground (Hatley and Kappelman 1980). Third, because they grow in patches, they are particularly subject to protection from overexploitation by the winter expansion of the *pantanos.* Because of rising water, patches in the *pantano* interior become inaccessible for several months annually and have ample time to regenerate. Wild potatoes are thus another logical staple food for aboriginal collecting populations.

BAMBOOS

Three bamboos of the family Gramineae, *caña (Chusquea coleu), pacomel (Chusquea tenniflora),* and *quila (Chusquea quila)* were documented in the Monte Verde area. Of the three species, *quila* is by far the most plentiful, growing in the *bosque bajo* and the *pantano. Quila* stands produce dense vegetation with a 6 m or higher canopy.

Quila is generally believed to be more plentiful today than in the past, due to its propensity for invading disturbed soils and burned areas (Numata 1979:233–234). However, it (and to a lesser extent, the other two bamboos) must still be considered an important economic plant. The shoots, stalks, and rhizomes are edible and available much of the year, potentially adding substantial carbohydrates (14.9 percent) and fiber (11 percent) to an aboriginal diet (Sineath et al. 1953:54–55).

NALKAS

Nalkas (Gunnera tinctoria) is a leafy plant that grows in the *pantanos*. This continuously available plant often contains seven to nine leaves that measure 1.3-by-1 m in area, and the plants grow in patches that dominate one *pantano* microzone (Fig. 11.5).

Nalkas contains great potential as a staple salad green or vegetable, although its exact nutritional value is untested. Today, local residents of Monte Verde collect and eat the leaves, stalks, and rhizomes. The leaves are also used to smother fires during traditional pit smoking of meat and shellfish, called the *curanto*. It is claimed that the leaves add flavor to food cooked in this manner. The practice is suggestive of the many cooking uses the massive leaves may have had in the past. Lastly, *nalkas* has a variety of potential medicinal uses, including as a pain reliever, antibiotic, fever reducer, and wound healer (Bastien 1983:103; Hirschorn 1981:144; Houghton and Manby 1985:93; Murillo 1889:85–86; San Martin 1983:221; Villagrán et al. 1983:7, 28).

CORTADERA

Cortaderas are a series of herbaceous plant species in the Gramineae family. The common *cortadera* in the Monte Verde area is *Cyperus eragrostis*.

Cortadera appears in a distinctive *pantano* microzone that is intermediate between microzones dominated by *quila* and *nalkas* patches. Although not considered a useful food plant by modern humans, *cortaderas* are edible. Because of their constant availability and proximity to other year-round *pantano* staple plants, *cortadera* must also be considered a potential staple food source for aboriginal collectors.

Comestible

MEDICINAL PLANTS

Many trees and bushes in the Monte Verde vicinity have potential medicinal uses. The bark or leaves of several tree species may be used in some medicinal manner. The common uses are to make infusions or washes to combat mouth sores, sore throats, and intestinal problems like diarrhea and dysentery and to make dry powders and washes for external use on sores, skin irritations, and rheumatism (Farga and Lastra 1988; Hirschorn 1981; Houghton and Manby 1985; Montes and Wilkomirsky 1985; Murillo 1889; Muñoz et al. 1981; Zin 1929). Medicinal uses of Monte Verde plants are diverse and complex, depending on what part of the plant is used and how the plant is prepared and processed. Potential medicinal plants that were archaeologically recovered from the Monte Verde site are discussed in greater detail in Chapter 12. However, it is interesting to note ways in which Monte Verde residents utilized medicinal plants in 1983. To this end, a Monte Verde herb garden was collected and the gardeners interviewed to gain information about their knowledge of medicinal plants (Table 11.4). Despite changes in plant inventory and the addition of Eurasian medicinal plants,

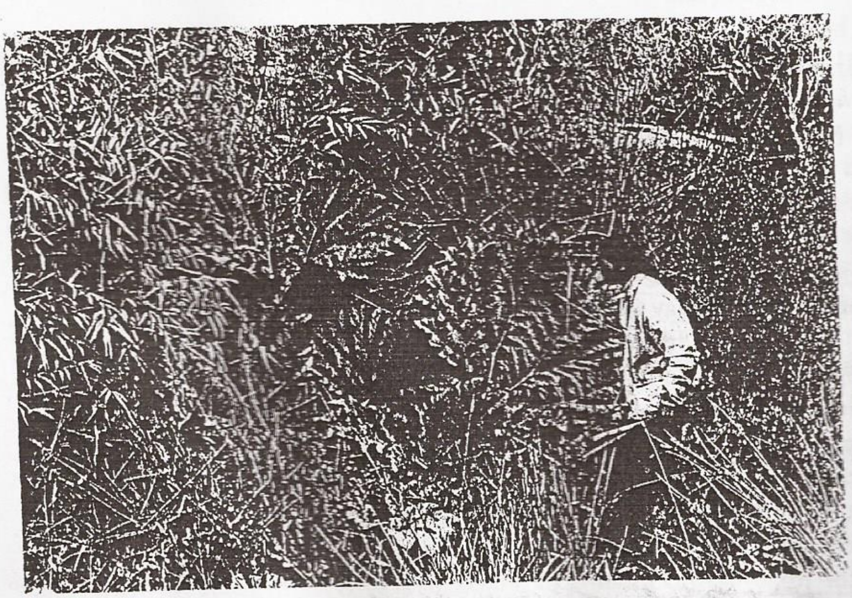


Fig. 11.5. *Nalkas* plant, with its large edible leaves, and *quila* (left) in the Toledo bog.

Table 11.4. Contents of a Monte Verde Area Herb Garden (1983) and Their Medicinal Applications

Local Name	Common Name	Latin Name	Medicinal Use and References
Native			
Cachanlagua		*Centauriam cachanlahuen*	Stimulates appetite, aids digestion, reduces fever, combats worms, jaundice, and rheumatism
Limpiaplata		*Equisetum bogotense*	Diuretic, used against dysentery (Muñoz et al. 1981); internal use for hemorrhage, ulcers, tumors, infection of liver, spleen, and bladder
Natre	Yerba de Chavalongo	*Solanum gayanum*	Tea used to reduce fever (Muñoz et al. 1981); headaches, wash intestines (Zin 1929)
Tres Cantos	Verbena de Tres Esquinas	*Baccharis sagittalis*	Relieves rheumatism and gout (Muñoz et al. 1981)
Eurasian			
Altamisa	Manzanilla	*Matricaria matricarioides*	Tea relieves stomach pain, inflammations (Thomson 1978)
Borraja	Borage	*Borago officinalis*	Reduces fever, poultice for inflammations calms nervous conditions, eyewash, aids lactation (Muñoz et al. 1981); restores vitality after illness, (Lust 1979; Zin 1929)
Hinojo	Fennel	*Foeniculum vulgare*	Stomach and intestinal remedy (Lust 1979); gargle for coughs, aids lactation, external use for arthritis, eyewash (Muñoz et al. 1981; Thomson 1978)
Laurel	Bay	*Laurus nobilis L.*	Salve for rheumatism, bruises, skin problems, leaves stimulate digestion: sudorific, expectorant (Thomson 1978; Zin 1929)
Pastoclavo	Hierbo del Chancho	*Hypochoeris radicata*	Stimulant and diuretic (Moore 1983)
Perejil	Parsley	*Petroselinum sativum*	Juice for asthma, coughs, dropsy jaundice, menstruation, pregnancy ills, stimulates appetite (aperative, stimulant) external use for cuts (Lust 1979; Thomson 1978; Zin 1929)
Poleo	Mint	*Mentha pulegium*	Tea relieves stomach and intestinal ailments: antispasmodic (Muñoz et al. 1981; Moore 1983; Zin 1929)
Siete Venas	English Plantain Ribgrass	*Plantago lanceolata*	Wash for cough irritations (Lust 1979); respiratory and intestinal ailments (Moore 1982); worms and ulcers (Muñoz et al. 1981); external use for cuts and insect bites (Thomson 1978)
Yantem	Common Plantain	*Plantago major*	Same as *P. lanceolata* (Lust 1979); also for skin infections, earaches (Muñoz et al. 1981)
Yerba Buena	Mint	*Mentha viridis L.*	Same as *M. pulegium* (Moore 1983); also calms nervous or angry conditions: antispasmodic (Zinn 1929)

basic patterns of medicinal plant use may have thousands of years of continuity at Monte Verde.

Teas, washes, gargles, and salves made from herbs are commonly used today at Monte Verde. Of 14 herbs collected from the local garden, however, only four herbs are native to the Monte Verde region. The remaining ten herbs are introduced species from Europe or Asia. The four native herbs are considered to be of primary importance. These plants, *cachanlagua (Centaurium* sp.), *limpiaplata (Equisetum bogotense), natre (Solanum gayanum),* and *tres cantos (Baccharis sagittalis)* are primarily used to combat intestinal problems and to reduce fevers. *Limpiaplata* in particular is a multipurpose medicinal plant that is also used against hemorrhages, ulcers, tumors, and infections of various internal organs such as the lungs (Table 11.4). These four herbs are still actively collected from creek side and *pantano* settings and are transplanted to herb gardens, with children often sent to perform the task.

The recurring medicinal use of plants for intestinal, skin, pulmonary and eye problems closely corresponds with the health problems suffered by field crews working at the Monte Verde site. Intestinal problems, skin cracking due to the extreme daily temperature variation, skin fungi, coughs due to the humid conditions, and eye infections were all common ailments. It is thus not surprising that medicinal plants and local knowledge concentrate on these pervasive health problems.

It is probable that today the added Eurasian herbs are replacing native plants in the medicinal plant use of Monte Verde people. Despite this, the sophisticated knowledge of herb and bark properties and preparation demonstrated by these people, who essentially have no access to modern medical care, offer suggestive evidence in interpreting the many potentially medicinal plants recovered from the Monte Verde site (Chapter 12).

Technological Prerequisites

A brief consideration of technological prerequisites to the exploitation of Monte Verde economic plants and their storage potential allows suggestive comparisons to be made with the Monte Verde archaeological site. In order to efficiently collect and utilize the array of wild plants discussed above, a few simple implements and technologies are necessary. Some form of container is useful in collecting fruits and berries. This role would probably be best filled by basketry made of *boqui (Campsidium valdivianum),* a resilient vine that grows in the *pantano* and *bosque bajo.* Simple split-pebble lithics, such as those recovered from the Monte Verde site, are useful in cutting *junco* reed and *quila* stalks. A simple wooden or bone implement, preferably with a flattened end, is useful in digging potatoes. Split rib fragments found archaeologically in great frequency may have been used for this purpose (Chapter 17). In winnowing *junco,* a tightly woven cloth or matting is needed to catch the small edible seeds. Matting made from *junco* reed, which could have served this purpose, was observed in households near Monte Verde in 1983.

Experimental grinding of *junco* reed was performed on both stone and wooden metates. Grinding *junco* on stone metates proved unsatisfactory. The light seeds were easily scattered and difficult to control. Grinding *junco* on a wooden metate, with its softer surface and structural flexibility, proved far more effective in controlling the *junco* and producing a fine flour. Two wooden mortars were recovered from the Monte Verde site. The technological superiority of wood over stone metates may be significant to raw material selection whenever small light seeds are utilized as a dietary staple.

In summary, only a few simple stone, wood, bone, *boqui,* and perhaps *junco* implements are necessary to perform plant-related tasks such as harvesting fruits, berries, bamboos, potatoes, and *junco,* and producing *junco* flour.

STORAGE

No direct evidence of food storage was recovered from the Monte Verde site. That is, no food remains were recovered in pits or small structures that would suggest accumulation or storage. This economic plant study, however, suggests that while storage could have been an effective adaptation in the Monte Verde environment, it was not necessary for the plants described above as staples. Storage could be an effective adaptation for the months of August to November, at the end of the dark rainy winter, when only some basic staple plants such as potatoes, *nalkas, cortadera, quila,* and mushrooms are available.

Plants that favor logistical collection would also be those most suited to storage. *Cauchau (Amomyrtus luma), sp. meli (Amomyrtus meli), chupón (Greigia sphacelata),* and *poes (Fascicularia bicolor)* are examples of highly seasonal fruit or berry-producing plants that are not subject to extended seasonality. As mentioned above, *cauchau* in particular produces massive harvests for a brief two-week period. If archaeological evidence of storage was found, fruits such as these would be expected. The fruits would be relatively simple to fire-dry, and, based on the above-described harvest experiment, a surplus could be easily produced. Fruits and berries could also be used to produce fermented beverages such as *chicha*, and informants remember this practice occurring in the past. *Chicha* is still produced locally, but is made exclusively from apples, although other fruits are used on Chiloé Island (Villagrán et al. 1983).

Conversely, plants like potatoes, *quila, nalkas,* and *junco* reed, which are available on a year-round basis, would not be expected to be found in storage features. Important below-ground resources such as wild potato tubers would store naturally in the earth and would probably not be stored on site (Hatley and Kappelman 1980). In the particular case of Monte Verde, Dillehay (1989a) has speculated that the tuber and rhizome "below-ground foods" with their long use-lives constitute a form of "natural" instead of "cultural" storage that may explain why sedentism at the site did not lead to further cultural developments. While potentially useful for fruits like *cauchau* with brief, plentiful seasonalities, food storage would not be necessary, and storage of tuber and rhizome staples would not be desirable for a small sedentary population at Monte Verde.

Seasonality and Scheduling of Economic Plants

In devising a schedule of localized plant exploitation based on present-day economic plant densities and distributions, there are four areas to be considered:

1. The great quantity and volume of economic plants in the *pantano,* including nearly year-round supplies of *junco, nalkas, quila, cortadera,* and *papas* (potatoes).
2. The winter food available in the *bosque alto,* especially *ulmo* and *coigüe* seeds and mushrooms.
3. The access to *junco* in the *mallíns.*
4. The availability of meat supplements through hunting and plants from more distant zones (Chapter 12).

In discussing seasonality and scheduling, it is assumed that hunting strategies and social boundaries did not somehow impede or alter plant collecting strategies, and that only environmental cycles and availabilities constrained collection. It is also assumed that plant procurement from distant zones such as the coast and Andean grassland did not seriously affect the localized exploitation pattern. If these assumptions are made, the overall quantity of natural plant food in the Monte Verde area fluctuates from a summer high, when the *pantano* flourishes with a variety of foods, to a winter low (Ramírez 1989b:168).

The relative seasonal importance of economic plant microzones are depicted in Figure 11.6, while the seasonalities of some major Monte Verde plants are depicted in Figure 11.7. The *pantano* and *mallín* microzones remain important throughout the year, although the two zones are qualitatively quite different. The *pantano,* with its great plant variety, potentially provides enough plant food during the summer months to virtually ignore the other zones. It is probable, however, that the *bosque bajo* and *bosque mixto* edges were exploited during these months for their abundant seasonal fruits. The *mallín,* with its low plant variety, may be considered the most stable of the zones, because *junco* reed, probably an important staple, is available there on a year-round basis. However, the *mallín* microzone flourishes during the wetter winter months, without becoming partially inaccessible like the *pantano.* Thus, the *mallín* would become slightly more important than the *pantano* during the winter, a combined result of its easier accessibility and a natural peaking of its plant resources at that time of year. This pattern is primarily attributable to a winter shift in *junco* availability from the *pantano* to the *mallín* because of a higher water table and greater ground saturation.

Verano

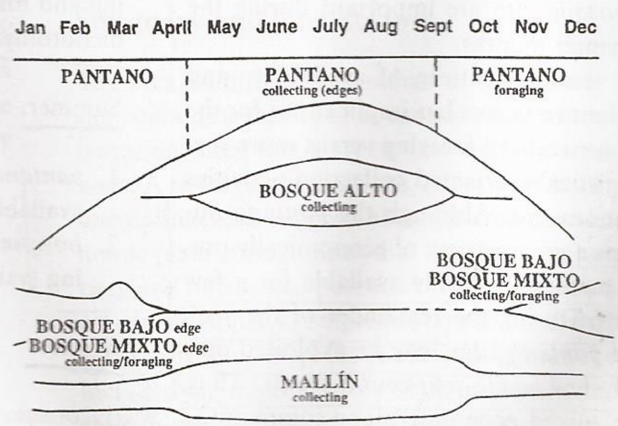


Fig. 11.6. Graphic representation of the relative seasonal importance of Monte Verde economic plant microzones. Band width represents relative importance for collecting/foraging.

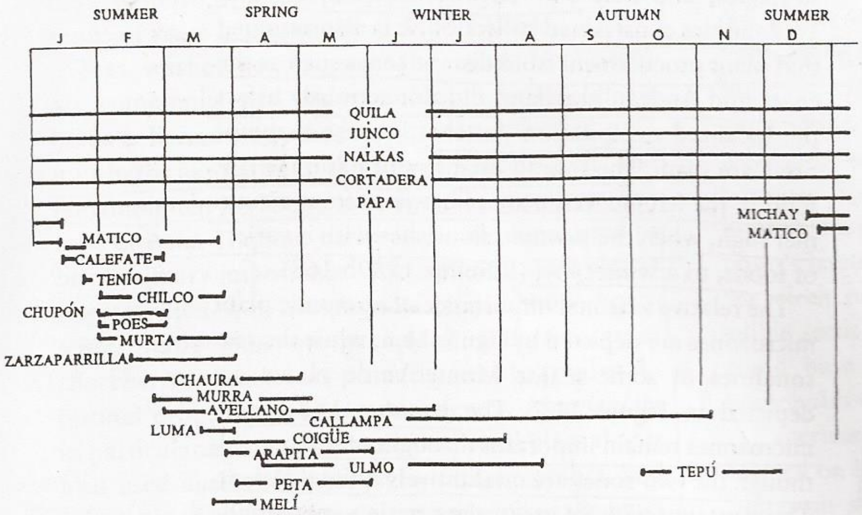


Fig. 11.7. Estimated seasonal availability of important Monte Verde economic plants.

Also during the winter, the *bosque alto* produces substantial plant food resources. Edible seeds of the *ulmo* and *coigüe*, both large trees of the climax forest, become available. Simultaneously, mushrooms litter the forest floor. Only during these few months does the *bosque alto* produce any notable plant food.

In summary, five economic plant microzones contain substantial amounts of potential resources. Two zones, the *pantano* and the *mallín*, have year-round procurement potential, but their natural peak cycles are in opposition, favoring emphasis on *pantanos* during the summer and *mallíns* during the winter. Other zones, the *bosque alto* and the edges of the *bosque bajo* and *bosque mixto*, provide important seasonal foods. In particular, the tree seeds and mushrooms of the *bosque alto* are important during the relatively lean winter months.

The strongly seasonal pattern of availability and abundance of plant resources has implications for the effectiveness of generalized foraging versus more specialized and logistically oriented collection activities during different seasons. Although the *pantano* microzone contains a great variety of economically useful plants, the majority are only available for a few summer months. During the remainder of the year, the *pantano* or *pantano* edge may be exploited only for its relatively few staple year-round plants. Thus, because of the mixed economic plant communities present in the summer *pantano*, generalized foraging is a more effective exploitation strategy.

During the winter, the exploitation of fewer staple plants at the *pantano* edge favors a more logistically oriented collecting strategy. Similarly, the relatively uniform and seasonal resources of the *bosque alto* and *mallín* zones also call for specific collecting strategies. In contrast, the linear *bosque bajo* edge, with its sequentially ripening *murra* and brief, abundant *cauchau* season, requires a combination of foraging and collecting such as employed in the above-described harvest experiment. Any group attempting to exploit the Monte Verde area on a year-round basis should optimally be able to shift between foraging and collecting strategies. In general, foraging is a much more effective strategy during the summer, while collecting is more effective during the winter.

A schematic outline of local scheduling of collecting and foraging strategies suggests a summer/winter dichotomy:

Summer:

1. *pantano* foraging (various fruits, peak *junco* availability)
2. *bosque bajo* and *mixto* edge foraging and collecting (various fruits)

Winter:

1. *bosque alto* collecting (tree seeds and mushrooms)
2. *mallín* collecting (peak *junco* availability)
3. *pantano* edge collecting (potatoes, *nalkas*)

ZONAL COMPLEMENTARITY

In assessing the Monte Verde series of closely compacted environmental zones with seasonally opposite, complementary production of wild plant foods, one is reminded of the Andean concept of zonal complementarity (Lynch 1971, 1973, 1981b; Murra 1972, 1975). However, the concept was originally formulated to postulate the seasonal transhumance of Peruvian hunter-gatherers, who may have followed the seasonally opposite, complementary resources available at different elevations of the central Andes.

In contrast, the Monte Verde region may represent a different type of zonal complementarity with three key attributes. First, at Monte Verde great differences in elevation are not necessary to produce distinctly different economic plant microzones. A difference of only 5 m of elevation is sufficient due to the high water table and ground saturation. Second, the different environmental zones are compacted to such an extreme that a small group may exploit several microzones in a single day from one strategically positioned location. Third, the (1) sheer mass, (2) opposition of plant seasonalities, (3) seasonal expansion and contraction of zones, and (4) extended plant seasonalities together make depletion of natural plant resources difficult to imagine. The combined use of foraging and collecting strategies permits optimal utilization of the above characteristics of the seasonal and scheduling regimen (Fig. 11.6).

Key staples, primarily self-storing stalks, rhizomes, and tubers, are available on a year-round basis. Seasonally available winter plants, though less abundant, are durable in that the collection of mushrooms and edible seeds from large trees do not destroy the reproductive and replenishing abilities of the plants. Simultaneously, the winter expansion of the *pantano* with the rising water table serves to protect large portions of that microzone from exploitation for much of the year, providing time for replenishment of primary summer foods. This compacted form of zonal complementarity at Monte Verde contains an unusual environmental potential for sedentary hunter-gatherer communities.

ETHNOGRAPHIC ANALOGY OF PLANT MANIPULATION

The present-day people of Monte Verde live in dispersed homesteads with garden plots, green apple orchards, and livestock. The green apple has replaced a variety of wild berries such as *cauchau, murra, maqui,* and *calafate,* according to informants, and thus represents a homogenizing force in the plant subsistence economy. In the course of collecting plants and meeting people at Monte Verde, it became apparent that wild plant exploitation continues to occur in the region. The present-day use of medicinal herbs and tree barks, and the past practice of using berries to produce *chicha* have already been discussed. In addition, it appears that a form of partial or semidomestication of plants is an ongoing process in the region.

People living above but near the *pantanos* work garden plots that grade into adjacent *pantanos*. Neat rows of native plants, as well as introduced Eurasian species, gradually descend and transform into the less-organized native plant distributions of the *pantano* microzones. Gardeners sometimes range far into the *pantano* to collect plants without recognizing boundaries between garden and *pantano*.

In this setting, wild and domesticated plants (such as potatoes) freely hybridize, and the boundaries between wild and domesticated plants are obscured. Fortunately for this study, the large Toledo *pantano* is not gardened in this manner. It would be difficult to assess the effect this practice has had on natural Monte Verde plant communities without further fieldwork. This blending of gardening with the rich natural plant communities may offer insights into the amounts and types of effort necessary to improve the already-large *pantano* yield. Perhaps even more important, future study may reveal, by ethnographic analogy, further details of a possible pathway of past plant manipulation in this cool, temperate environment.

Summary and Conclusions

The area within a 5-km radius of the Monte Verde site contains a variety of economic plant microzones, featuring three forest types, low marshy areas, and bogs. A series of observations, collections, and experimental harvests suggests that the area contains economic plant communities that are rich in volume, variety and nutritional potential. The plant microzones are also seasonally complementary in the distribution and availability of plant foods throughout the year. Included are staple sources of plant protein and minerals *(junco),* carbohydrates (potatoes and *quila*) and abundant seasonal supplies of fruits.

Exploitation of these plant communities would ideally include (1) seasonal exploitation of different economic plant zones, (2) logistically organized collection of resources that occur either in large stands (*junco*) or in large amounts for a brief time period (*cauchau*), and (3) seasonal foraging of areas with mixed plant communities. Plant availabilities generally favor a summer/winter dichotomy of exploitation strategy, with *pantanos* being the primary summer food source and the *bosque alto* and *mallíns* representing the primary winter food sources. When this combination of strategies is employed, along with minor supplements of animal protein, there appears to be sufficient, reliable natural food present to potentially support a small, stable population of sedentary hunter-gatherers. Natural environmental cycles such as the semi-annual expansion and contraction of microzones, extended seasonality and complementary opposition of plant availability peaks would serve to prevent overexploitation and depletion of plant resources. Overall, it appears that there would be little incentive to travel far from the site for food and thus the distant plants recovered archaeologically may represent social contacts or specific desires for medicinal plants (Chapter 12).

Finally, this study may help assess the utility and limits of optimal foraging theory for archaeology and ethnobotany. As mentioned early on, optimal foraging theory has been severely criticized in recent years because it tends to imprint local environmental conditions onto human behavioral systems, or because it removes decision-making, ingenuity, or social relations from human subsistence (Bender and Morris 1988; Mithen 1989; Thomas 1986). In the Monte Verde case, the patch use model branch of optimal foraging theory has been useful in providing an environmental baseline against which the archaeological evidence may be compared. Rather than using optimal foraging theory to describe a subsistence system, optimal foraging may be best used to understand potentialities. At Monte Verde, it appears that a local plant collecting system conformed closely to a patch use model, reaffirming the possibility of sedentary hunting-gathering at the site. The model also allowed the isolation of plants that do not conform to the local optimal model that may help us understand specific medicinal needs or distant social relations of the Monte Verde people (Chapter 12). In final assessment, the utility of optimal foraging models remains great when they are applied to isolate both the optimal and nonoptimal features of a particular hunting-gathering system.