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*Ecology of Food and Nutrition*, 1983, Vol. 13, pp. 199–219
0367–0244/83/1304–0199 $18.50/0



# CAMAS (*Camassia* spp.) AND RICEROOT (*Fritillaria* spp.): TWO LILIACEOUS "ROOT" FOODS OF THE NORTHWEST COAST INDIANS

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*(Received September 14, 1982; in final form January 17, 1983)*

Two species of camas (*Camassia quamash* [Pursh] Greene and *C. leichtlinii* [Baker] S. Wats) and two species of riceroot (*Fritillaria camschatcensis* [L.] Ker-Gawl. and *F. lanceolata* Pursh) were important root foods for the Indians of the Northwest Coast of North America. Camas and the latter species of riceroot were used predominantly in the southern part of the region, whereas *F. camschatcensis* was used as far north as Alaska, as well as on the Aleutian Islands and the Kamchatka Peninsula. The bulbs of camas were an article of trade, and their harvesting and cooking were often large-scale communal enterprises. Nutritional analyses show that these species would have provided meaningful quantities of fiber, nitrogen, trace elements and energy, if thoroughly cooked.

KEY WORDS: camas, riceroot, *Camassia quamash*, *Camassia leichtlinii*, *Fritillaria camschatcensis*, *Fritillaria lanceolata*, indigenous foods, root foods, nutrient composition, minerals.

## INTRODUCTION

Over 25 species of underground "root" foods (including roots, rhizomes, bulbs, corms and tubers) were used traditionally as food by Indian people of the Northwest Coast of North America (cf. Turner, 1975; Gunther, 1973). Of these, only a very few, including bracken (*Pteridium aquilinum* [L.] Kuhn.) (Norton, 1979a), springbank clover (*Trifolium wormskioldii* Lehm.) and Pacific silverweed (*Potentilla anserina* L. ssp. *pacifica* [Howell] Rousi) (Kuhnlein, Turner and Kluckner, 1982; Turner and Kuhnlein, 1982) have been described in detail in terms of their ethnobotany and ethnonutrition on the Northwest Coast. It is the aim of this paper to provide pertinent information on the botanical characteristics, propagation, traditional harvesting and preparation techniques, native names and nutritional composition of two types of Northwest Coast root foods of the lily family (Liliaceae): edible camas (*Camassia quamash* [Pursh] Greene and *C. leichtlinii* [Baker] S. Wats); and riceroot fritillary (*Fritillaria camschatcensis* [L.] Ker-Gawl and *F. lanceolata* Pursh).

Like many liliaceous plants, these species, especially *C. leichtlinii* and *F. camschatcensis*, are relatively rare today and restricted in distribution (Marchant, 1981: 22; Taylor and MacBryde, 1977: 500). Indiscriminate harvesting of wild populations of these species as foods at the present time would be inadvisable. However in view of both their past significance in native diets and their potential as cultivated food and ornamental crops, it is important to record details of their traditional use and information that would be of value to future users of these plants.

These species are discussed together because, in some ways, they are counterparts in traditional native food use. Their habitats and distributions resulted in differing use patterns. *Camassia* spp. and *Fritillaria lanceolata*, on the one hand, were used predominantly along the southern part of the Northwest Coast region (southwestern British Columbia, southwards to northwestern California).† *Fritillaria camschatcensis*, conversely, is used much more widely on the central and northern Northwest Coast. In fact, with a few exceptions on Vancouver Island, use of *Camassia* spp. and use of *F. camschatcensis* were apparently mutually

†The Northwest Coast region, or North Pacific Coast as it is sometimes called, is defined by Drucker (1955: 1–23, 1965: 1–8). Our research centers mainly on coastal British Columbia, and most of the descriptions and examples contained here are from this area.

exclusive. Among the Nootka (or Westcoast) and Southern Kwakiutl peoples of Vancouver Island where both *Camassia* spp. and *F. camschatcensis* were used, camas was said to be available only through trade with Salishan neighbours.

Furthermore, the two types of bulbs (*Camassia* spp. and *Fritillaria* spp.) have been reported to differ significantly in their carbohydrate content. In *Camassia* spp., a substantial percentage of the total carbohydrate is inulin, a $\beta(2{:}1)$ polyfructosan containing 30 or more fructose units per molecule (Konlande and Robson, 1972: 194). In *Fritillaria*, however the major carbohydrate is reported to be starch (Yanovsky and Kingsbury, 1938: 652). As will be discussed, this difference in the nature of carbohydrates undoubtedly influenced traditional methods of preparation of camas and riceroot.

## BOTANICAL FEATURES

The two species of edible camas occurring on the Northwest Coast, *Camassia quamash* (Pursh) Greene var. *quamash* (common camas) (Figure 1), and *C. leichtlinii* (Baker) S. Wats. f. *suksdorfii* (Greenm.) Taylor and MacBryde (great, or Leichtlin's camas), are similar in many of their features. To our knowledge, they were not distinguished nomenclaturally in the languages of the native peoples of the British Columbia coast who used them. Since they often occur together, they were probably harvested and used together. Both species grow from brown-membraned, dark-scaled bulbs, and have scapose stems, with a basal whorl of linear, grasslike leaves. Their inflorescence is a simple terminal raceme. The flowers are large and conspicuous, from deep blue to light blue or occasionally white. The perianth segments are six, somewhat spreading and persisting at maturity. The stamens are six, the ovary three-celled, the style filiform, and the stigma three-lobed. The fruits are subglobose to oblong capsules (Taylor, 1966: 29–30). The seeds are black and shiny.

FIGURE 1 Common camas (*Camassia quamash*).

A major difference between the species is their relative size. The stems of *C. quamash* range from 0.2–0.7 m tall, those of *C. leichtlinii* from 0.2–1.2 m tall. The bulbs and leaves of *C. leichtlinii* are also proportionately larger (Figure 2). *Camassia quamash* is earlier blooming, from April to May, whereas *C. leichtlinii* flowers from May to June. After anthesis, the perianth segments, or tepals, of *C. quamash* remain spreading, but those of *C. leichtlinii* are connivent and twisted together over the ovary. Various other differences between the two species are noted in Taylor (1966: 30) and Hitchcock *et al.* (1969, Pt. 1: 779). A synonym of *C. quamash* is *C. esculenta* Lindl. (cf. Douglas, 1959: 105), and sometimes in earlier literature the genus name is spelled *Quamasia* (cf. Yanovsky, 1936:14).

Both *C. quamash* and *C. leichtlinii* are almost entirely restricted on the Northwest Coast to the relatively dry Coastal Douglas-fir Biogeoclimatic Zone (Taylor and MacBryde, 1977: 500). Within this zone, both grow on meadows, prairies and hillsides that are moist in the spring but might dry up by summer. Both are common in soil-filled pockets and crevices on the rocky outcrops around southern Vancouver Island and the Gulf Islands. Of the two species, *C. quamash* is more widespread in distribution. Isolated collections have been made from Chilliwack in the Fraser Valley (Scoggan, 1978, Pt. 2: 495) and from the Brooks Peninsula on the northwestern coast of Vancouver Island (R. T. Ogilvie, 1981, personal communication). Another variety, var. *maxima* (Gould) Boivin, occurs in southeastern British Columbia in the Columbia Valley (Taylor and MacBryde, 1977: 500; Taylor, 1966: 32). The distribution of the

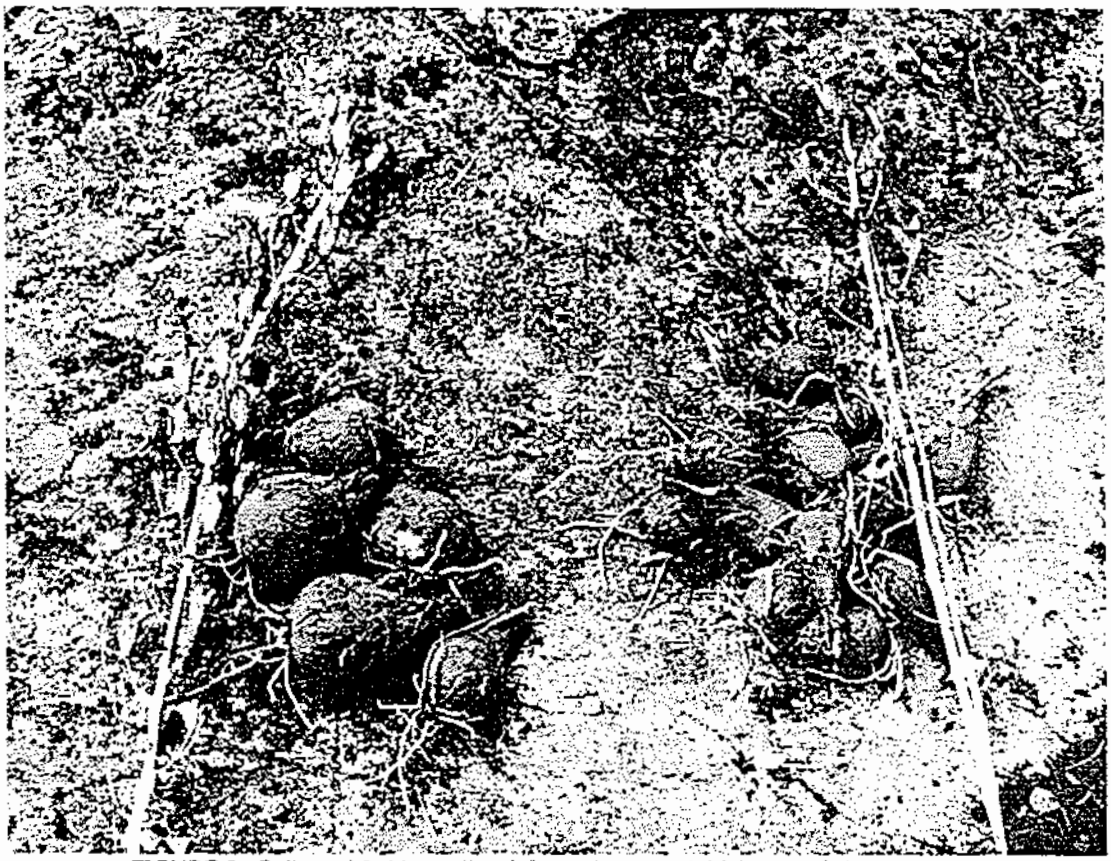

FIGURE 2 Bulbs and fruiting stalks of *Camassia quamash* (right) and *C. leichtlinii* (left).

species extends south to California and east to southwestern Alberta, Montana, Wyoming and Utah (Hitchcock *et al.*, 1969, Pt. 1: 780). The bulbs were utilized as food throughout its range (cf. Yanovsky, 1936: 14; Douglas, 1959: 105; Statham, 1975; Hart, 1979: 271). An isolated location near Haines, Alaska, is attributed to recent introduction (Scoggan, 1978, Pt. 2: 495). As discussed later, native people may have been responsible for extending the range. The distribution of *C. leichtlinii* extends southward to southwestern Oregon and Sierran California, but does not extend east of the Cascades (Hitchcock *et al.*, 1969, Pt. 1: 780). Its bulbs were also eaten throughout its range (Yanovsky, 1936: 14; Chesnut, 1902: 327). Three other species of *Camassia* are recognized, all of North America (Hitchcock *et al.*, 1969, Pt. 1: 779).

*Fritillaria camschatcensis* (L.) Ker-Gawl var. *camschatcensis* (riceroot, riceroot fritillary, mission bells, or Indian rice) (Figure 3) and *F. lanceolata* Pursh (also called riceroot, but more commonly known as chocolate lily) (Figure 4) are two of three species of *Fritillaria* occurring in the Pacific Northwest. The genus is a large one, consisting of about 100 species in the Northern Hemisphere. About 17 species are native to North America, but only these two occur on the Northwest Coast. A third species, *F. pudica* (Pursh) Spreng. (yellowbell or yellowbell fritillary), occurs in drier habitats east of the Cascade Mountains (Marchant, 1981: 20). The bulbs were used as food by interior Indian peoples (Turner, 1978: 84–87). Where the ranges of *F. lanceolata* and *F. camschatcensis* overlap, the two species were apparently distinguished nomenclaturally by the native peoples, including the Sechelt and Comox (both Coast Salish groups) who used them. Often, however, both species are known in English as Indian rice, and it is difficult to determine which one is meant in discussions with native people.

The bulb of *F. camschatcensis* consists of several large, fleshy scales surrounded by numerous rice-grain-like bulblets (Figure 5). The stems, usually 0.2–0.5 m tall, are sturdy and unbranched, with

FIGURE 3 Riceroot, or missionbells (*Fritillaria camschatcensis*).

entire, lanceolate leaves in 1–3 whorls of 5–10 each. Flowering occurs from April to July. The flowers, usually 2–7, are borne in a loose raceme on short pedicels. They are spreading or nodding and narrowly campanulate, the segments spreading when fully open. They are unmottled, usually dark greenish-bronze to brownish-purple and strong-smelling, as they are fly-pollinated. The tepals and stamens are six, the style deeply cleft, the tips of the stigma long and narrow. The fruits are unwinged, cylindric-ovoid capsules. The seeds are flattened and light-brown (Marchant, 1981: 20). *Fritillaria lanceolata* usually has fewer bulblets around its bulb (Figure 6) and has distinctly nodding, broadly campanulate flowers that are brownish-purple, but clearly mottled, usually with yellow markings. The capsules are broadly winged (Marchant, 1981: 21; Taylor, 1966: 49).

*Fritillaria camschatcensis* grows in moist, grassy areas on coastal bluffs, the upper edges of tidal flats and other coastal habitats from the Fraser River delta and Vancouver Island (and further south, on Whidbey Island and Snohomish Co., Washington) to the Queen Charlotte Islands and northwards to Alaska, extending across the Aleutian Islands to Kamchatka. In the southern part of its range, its distribution is entirely coastal; but in the north, it extends east as far as Babine and Alesa lakes, sometimes occurring in mountain meadows up to 1500 m (Marchant, 1981: 20; Hitchcock *et al.*, 1969, Pt. I: 791). A smaller subspecies, ssp. *alpina* Mats. & Toyok., occurs in the alpine zone of Japan (Hultén, 1968: 308). *Fritillaria lanceolata* is much more widespread in western North America, and occurs in British Columbia from central and southern Vancouver Island to the Okanagan Valley. It requires well-drained soils on open slopes (Marchant, 1981: 18) and, as mentioned, is often found on the same sites as camas on southern Vancouver Island and the Gulf Islands.

All four species discussed—the two *Camassia* species and two *Fritillaria* species—can be cultivated relatively easily in many parts of North America. Specific conditions for growing these species are given by Steffek (1954: 65), Marchant (1981: 21–22), Miles (1976: 98) and Kruckeberg

FIGURE 4 Chocolate lily (*Fritillaria lanceolata*).

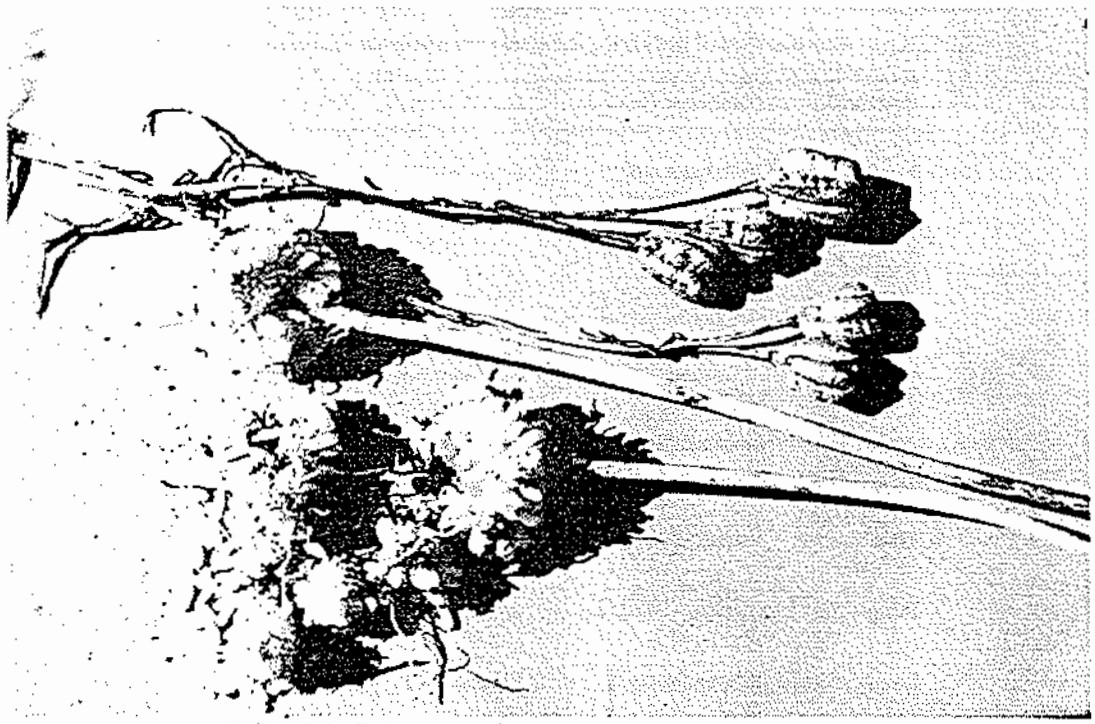

FIGURE 5 Bulbs and fruiting stalks of *Fritillaria camschatcensis*.

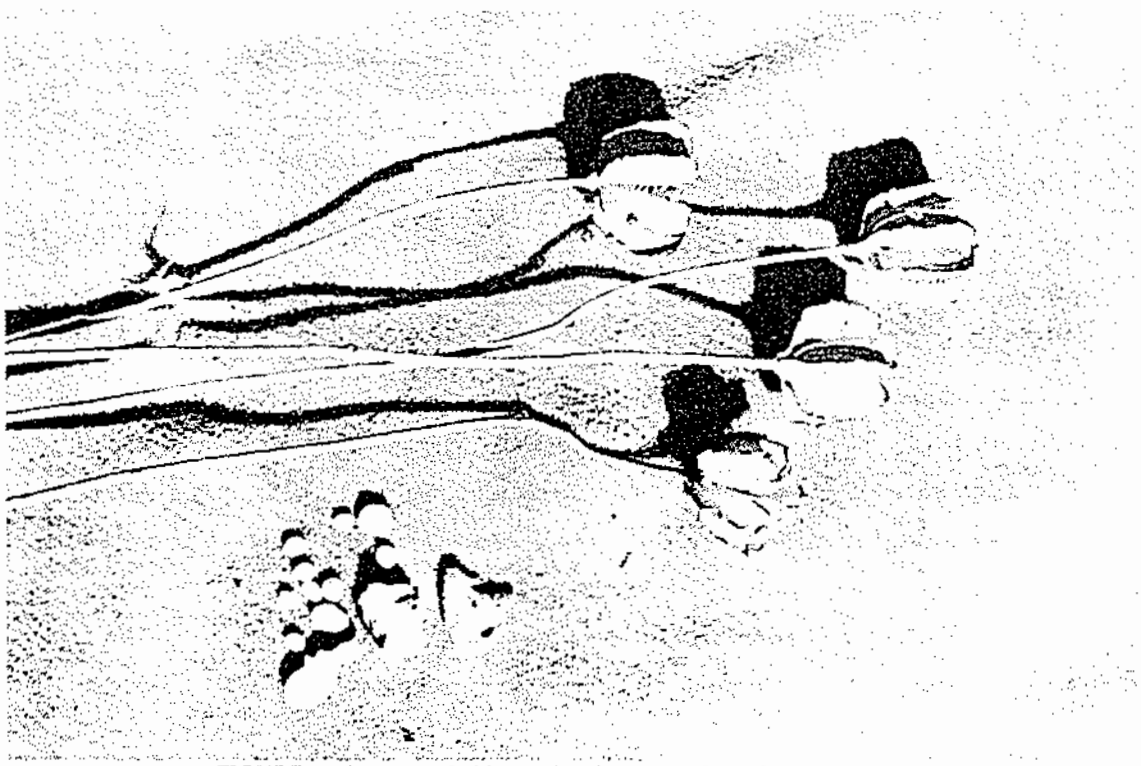

FIGURE 6 Bulbs and fruiting stalks of *Fritillaria lanceolata*.

TABLE I

Indian groups of British Columbia and neighbouring areas using camas bulbs (*Camassia* spp.) as a traditional food[a]

| Group (dialect) [Language Family] | Native Name[b] | Reference |
|---|---|---|
| Southern Kwakiutl[c] [Wakashan] | múť'exsdi | Turner and Bell, 1973: 272 |
| Nootka (Hesquiat)[c] [Wakashan] | kʷaʔus (bulb), kʷaʔus-mapt (plant) | Turner and Efrat, 1982: 54 |
| Nootka (Manhousat)[c] [Wakashan] | kwaʔus | Turner, Ellis and Bouchard, 1975, unpublished observations |
| Nitinaht[c] [Wakashan] | kʷa·dis | Turner *et al.*, 1982 |
| Makah [Wakashan] | kwádis | Gunther, 1973: 24 |
| Comox (Mainland) [Salish, Coast] | t'á7kw'umixw | Bouchard, 1976, unpublished observations |
| Sechelt [Salish, Coast] | spánaxw (also sometimes applied to *Lilium columbianum*) | Turner, Timmers and Bouchard, 1972, unpublished observations |
| Squamish [Salish, Coast] | spánanexw | Bouchard and Turner, 1976, unpublished observations |
| Halkomelem [Cowichan) [Salish, Coast] | spè·nxʷ (and other variants) | Suttles, W., 1982, personal communication; Turner and Bell, 1971: 74 |
| Halkomelem (Musqueam) [Salish, Coast] | spè·nxʷ | Suttles, W., 1982, personal communication |
| Halkomelem (Upriver) [Salish, Coast] | sk'áməthᵘ, *or* q'áq'ət'em sqá:wth (lit. "sweet potato")[c]; *or* spélɔxʷ, spé·lxʷ | Galloway, 1979, unpublished observations (first 2 terms; Suttles, W., 1982, personal communication (last 2 terms) |
| Straits (Saanich) [Salish, Coast] | qʷlá?al, kʷlá·l (bulb); spénɔxʷ (plant) | Suttles, W., 1982, personal communication; Turner and Bell, 1971: 74 |
| Straits (Sooke) [Salish, Coast] | kʷlə?ɔl (? qʷlá?al) | Suttles, W., 1982, personal communication |
| Straits (Songish) [Salish, Coast] | k̓ʷlá?al̓ (? qʷlá?al) | Suttles, W., 1982, personal communication |
| Straits (Lummi) [Salish, Coast] | qʷlá?al | Suttles, W., 1982, personal communication |
| Straits (Clallam) [Salish, Coast] | qʷlu?i?; qwlhoo'ee (sing.) *or* qwaylhoo'ee' (plural) | Fleischer, 1980: 207; Thompson, L., 1974, personal communication |
| Nooksack [Salish, Coast] | spé·nxʷ(*or* spé·lxʷ– prob. Upriver Halkomelem) | Suttles, W., 1982, personal communication |
| Lushootseed (Nisqually) [Salish, Coast] | sxádabs; *or* st'kwau | Gunther, 1973:24 (first term); Hess, T., 1982, personal communication (second term) |
| Lushootseed (Puyallup) [Salish, Coast] | sxádsəm | Gunther, 1973: 24 |
| Lushootseed (Squaxin) [Salish, Coast] | sxádzaĕb | Gunther, 1973: 24 |
| Lushootseed (Swinomish) [Salish, Coast] | dzábi | Suttles, W., 1982, personal communication |
| Lushootseed (Nuwhaha) [Salish, Coast] | dzábi (cooked bulbs), s?ɔ́sɬ (plant) | Suttles, W., 1982, personal communication |
| Lushootseed (Snohomish) [Salish, Coast] | čabid | Hess, T., 1982, personal communication |
| Twana (Skokomish) [Salish, Coast] | qáwˀəb | Kinkade, M. D., 1982, personal communication (see also Gunther, 1973: 24) |
| Upper Chehalis [Salish, Tsamosan] | qá·wmˀ; *or* qé?q (cooked bulbs) | Kinkade, M. D., 1982, personal communication (see also Gunther, 1973: 24) |
| Lower Chehalis (Salish, Tsamosan) | qílq | Kinkade, M. D., 1982, personal communication |
| Cowlitz [Salish, Tsamosan] | qáwmˀ; *or* qílq (prob. cooked bulbs) | Kinkade, M. D., 1982, personal communication |
| Quinault [Salish, Tsamosan] | kēlek; *or* muláqils | Gunther, 1973: 24; Olson, 1936 (first term); Kinkade, M. D., 1982, personal communication |
| Quileute [Chimakuan] | kʷá·la | Gunther, 1973: 51 |

TABLE I—*continued*

| Group (dialect) [Language Family] | Native Name[b] | Reference |
|---|---|---|
| Thompson[c] [Salish, Interior] | "ɛ̌tx$^{w}$xa," sx̌aqan; *or* q̓awax̌ (last 2 used by some for *Fritillaria lanceolata*) | Turner *et al.*, 1982, unpublished observations |
| Okanagan-Colville [Salish, Interior] | itxwa7 | Turner, Bouchard and Kennedy, 1980: 41 |
| Columbian [Salish, Interior] | ?itx$^{w}$a? | Kindade, M. D., 1982, personal communication |
| Flathead [Salish, Interior] | sxwe?li (raw bulbs); ?itxwe?e (cooked bulbs) | Hart, 1979: 271 |
| Coeur d'Alene [Salish, Interior] | sx̌á'ulutxwa (raw); étxwa (cooked bulbs) | Teit, 1973: 88 |
| Kootenay [Kootenay] | xapi | Hart, Turner and Morgan, 1981, unpublished observations |
| Sahaptin (Warm Springs) [Sahaptin] | wáq̓amu | Benson *et al.*, 1973: 144; French, D. H., 1982, personal communication; Gunther, 1973: 24, refers to Taitnapam Sahaptin as "Cowlitz" |
| Nez Perce [Sahaptin] | qém̓es | Marshal, 1977, unpublished observations |
| Blackfoot [Algonkian] | miss-issia | Johnston, 1970: 308 |
| Chinook Jargon [Trade language] | lakamás, *or* lækəmás | Suttles, E., 1982, personal communication |

[a] These are confirmed sources only, and pertain only to native groups of British Columbia or adjacent to British Columbia.
[b] Linguistic transcriptions used in orginal sources are maintained. (A question mark "?" denotes a glottal stop.)
[c] These groups had access to the bulbs only through trade, or travel over considerable distance.
[d] This term was also applied to corms of *Erythronium grandiflorum*, which were obtained through trade from the Thompson, and was apparently derived from the Thompson name for *Erythronium*, sx̌áṁats (Galloway, 1979, unpublished observations).
[e] Also applied to *Erythronium grandiflorum* (probably), cultivated potato, and Jerusalem artichoke (Galloway, 1979, unpublished observations).

(1982: 153) for the *Fritillaria* species. All of the species grow readily from seed. Additionally, the rice-like bulblets of the *Fritillaria* species can be used for propagation, and the bulbs of both *Camassia* and *Fritillaria* can be transplanted from natural populations. (In the interests of conservation, however, this should be done only if the plants are threatened by urban or industrial development.) In general, the species discussed here grow well in well-drained, loamy soils that are neutral to slightly acid (Steffek, 1954: 65; Marchant, 1981: 22).

There is some evidence that camas bulbs have been transplanted along the west coast of Vancouver Island. Hesquiat (Nootka) elders report that the bulbs were brought to Hesquiat about 100 years ago and planted in the "meadows" (peat bogs) behind the village (Turner and Efrat, 1982: 54). An elder from neighbouring Manhousat said that camas plants could be found at the mouth of the Megin River, north of Ahousat (near Pacific Rim National Park) (Turner, Ellis and Bouchard, 1976, unpublished observations), presumably having been planted there. However, neither of these reported locations has been verified by field collections. Elders of the Nitinaht and Saanich (Straits) groups have had recent success with transplanting and cultivating camas (Turner *et al.*, 1982; Turner and Bell, 1971: 75).

## TRADITIONAL USE OF *Camassia* spp. AND *Fritillaria* spp. ON THE NORTHWEST COAST

The extent of use of these species for the Northwest Coast and neighbouring areas is indicated by nomenclatural recognition of the plants and/or ethnographic information concerning their use among various Indian groups, as shown in Tables I and II. The geographic distribution of use is indicated by maps (Figures 7 and 8). The territories of most of the native groups mentioned are shown in Figure 9.

TABLE II

Indian groups of British Columbia and neighbouring areas using Indian-rice bulbs (*Fritillaria camschatcensis* or *F. lanceolata*) as a traditional food.[a]

| Group (dialect) [Language Family] | Native Name[b] | Species | Reference |
|---|---|---|---|
| Kamschatka [Chukchi-Kamchatkan] | — | *F. camschatcensis* | Hedrick, 1972: 282 |
| Aleut (SE Kodiak) [Eskimo-Aleut] | — | *F. camschatcensis* | Heller, 1976: 60 |
| Tanaina (Inland, Iliamna, Outer Inlet) [Na-dene] | qinazdli | *F. camschatcensis* | Kari, 1977: 109 |
| Tanaina (Upper Inlet) [Na-dene] | qinaydli | *F. camschatcensis* | Kari, 1977: 109 |
| Tanaina (Inland) [Na-dene] | qinazdluyi ("that which has many things") | *F. camschatcensis* | Kari, 1977: 109 |
| Tlingit [Na-dene] | "kooh" *or* "koch" | *F. camschatcensis* | Gorman, 1896: 78; Hedrick, 1972: 282 |
| Haida (Kaigani) [Haida] | stlaḵ'iist'aa ("thing you take take up with your fingers, like a marble") | *F. camschatcensis* | Norton, 1981: 440 |
| Haida (Masset) [Haida] | sƛeq̓ísta ("round-thing-you-dig-out-with-finger") | *F. camschatcensis* | Turner and Levine, 1972, unpublished observations |
| Haida (Skidegate) [Haida] | ?ɬnlə*y* (bulblets called "?ɬnlə*y*ts'i*y*," *or* "— teeth"; also for rice)[c] | *F. camschatcensis* | Turner and Levine, 1972, unpublished observations |
| Coast Tsimshian [Tsimshian] | — | *F. camschatcensis* | Laforet, A., 1980, personal communication |
| Nisgha [Tsimshian] | ḵ'a'asḵ | *F. camschatcensis* | McNeary, 1976: 116 |
| Gitksan [Tsimshian] | gasx̱ | *F. camschatcensis* | 'Ksan, People of, 1980: 124 Hindle and Rigsby, 1973: 11 |
| Bella Coola [Salish] | ilk | *F. camschatcensis* | Turner, 1973: 273 |
| Southern Kwakiutl [Wakashan] | xúkwem (bulbs); xúxwmes (plant) | *F. camschatcensis* | Turner and Bell, 1973: 273 |
| Nootka (Hesquiat) [Wakashan] | ku·xʷapi·ḥ | *F. camschatcensis* | Turner and Efrat, 1982 |
| Nitinaht [Wakashan] | kʷaxapx̱ (also appar. applied to *Lilium columbianum*) | *F. camschatcensis* | Turner *et al.*, 1982 |
| Comox (Mainland) [Salish, Coast] | ju7kw' (also applied to an edible fern "root") | *F. ? lanceolata* (one specimen collected) | Bouchard, 1973, unpublished observations Bouchard, 1975, unpublished observations |
| Sechelt [Salish, Coast] | (s)ḵ'áḵ'awx̱ | *F. ? camschatcensis* | Turner, Timmers and Bouchard, 1972, unpublished observations Newcombe, ca. 1903, unpublished observations |
| Sechelt [Salish, Coast] | (s)yú7ukw' | *F. ? lanceolata* | Bouchard, 1978, unpublished observations |
| Squamish [Salish, Coast] | lhásem | *F. ? lanceolata* | Bouchard and Turner, 1976, unpublished observations |
| Straits (Saanich) [Salish, Coast] | sƛ̓əlčə́ləq̓ʷɔs | *F. ? lanceolata* | Turner and Bell, 1971: 75 |
| Halkomelem (Cowichan) [Salish, Coast] | sƛ̓əlčə́ləq̓ʷɔs (also *Lilium columbianum*) | *F. ? lanceolata* | Turner and Bell, 1971: 75 |
| Halkomelem (Katzie) [Salish, Coast] | ƛ̓ə́ləq̓ʷ | *F. ? lanceolata* | Suttles, W., 1982 personal communication |
| Halkomelem (Upriver) [Salish, Coast] | stl'éleqw' | *F. lanceolata* | Galloway, 1979, unpublished observations |
| Lillooet (Pemberton) [Salish, Interior] | ḵ'éḵ'wex̱ | *F. ? camschatcensis* | Turner and Bouchard, 1974, unpublished observations |

TABLE II—*continued*

| Group (dialect) [Language Family] | Native Name[a,b] | Species | Reference |
|---|---|---|---|
| Lillooet (Fraser River, Pemberton) [Salish, Interior] | lhóssem (said to be borrowed) | *F. lanceolata* | Turner, van Eijk and Bouchard, 1972, unpublished observations; Bouchard, 1974, unpublished observations |
| Thompson [Salish Interior] | múle?, *or* q̓áw̓ax | *F. lanceolata* | Turner *et al.*, unpublished observations; Steedman, 1930: 481 |
| Shuswap [Salish, Interior] | sak̓'ámx̓wa | *F. lanceolata* | Palmer, 1975: 54; Bouchard, 1974, unpublished observations |

[a,b] See footnotes a and b, Table I.

[c] Curtis (1916: 207) applies these Masset and Skidegate Haida names to *Lilium columbianum*, but this species does not occur on the Queen Charlotte Islands.

*Historical Aspects*

The trading of camas bulbs on the British Columbia coast must have been widespread before the first Europeans arrived. The first explorers reported that the Pacheenaht (Nitinaht), and possibly some Nootka groups, were travelling to Straits (Salish) country for roots and fruits (Suttles, 1951, unpublished observations). The fact that there is a name for camas in Nitinaht and various Nootka dialects (Table I) supports this contention, at least for camas, since camas does not usually grow naturally in Nitinaht and Nootka territory, according to the distribution map in Taylor (1966: 97). The Nitinaht also obtained camas bulbs from the Cowichan (Halkomelem Salish) on the east coast of Vancouver Island using dried salmon in exchange, and also dug their own bulbs in Salish territory, with permission of Straits and Halkomelem people (Turner *et al.*, 1982). John Jewitt, an English captive of the natives of Nookta Sound in the early 1800's, stated that camas was traded to Nootka Sound by people some 300 miles (480 km) to the south (apparently Salish from Vancouver Island). The "roots," he noted, were "of a brownish colour . . . cooked by steam, [and] . . . always brought in baskets, ready prepared for eating . . ." (Jewitt, 1824: 107).

Dried camas bulbs were also traded to the Southern Kwakiutl of northern Vancouver Island (Turner and Bell, 1973: 272), the Upriver Halkomelem (Galloway, 1979, unpublished observations), the Mainland Comox (Bouchard, 1973, unpublished observations) (these last two are both Coast Salish) and the Thompson (Interior Salish) (Turner *et al.*, unpublished observations, 1982). In the last case, however, at least one of the names for camas is of the same etymon as those in other Interior Salish languages (Table I). This seems to indicate that at least some of the camas bulbs of the Thompson originated from the interior of Washington rather than from the British Columbia coast. Gunther (1973: 24) notes for western Washington that, "Except for choice varieties of dried salmon, there was no article of food that was more widely traded than camas."

With the development of the composite trade language, Chinook jargon, the French-derived name, *lecamas* (ləkamɑ́s) and its variants became widely used among native people, and in some cases, the original term for the bulbs was forgotten (cf. Gunther, 1973: 24; Reagan, 1934: 59; Turner and Bell, 1971: 74; W. Suttles, 1982, personal communication).

There is little mention in ethnographic literature of riceroot bulbs being an item of trade, although there is every reason to believe they were used as such on occasion. Suttles (1982, personal communication) was told that the Douglas (Lillooet) people used to walk through the mountains to get the bulbs of *F. lanceolata* ("ƛ̓ɔ́ləq̓ʷ"), which grew at the head of Pitt Lake in Katsie (Halkomelem) territory. When they met the Katsie people at the other end of the lake, they gave the Katsie some of this root saying, "We've been stealing your food." (from Suttles, unpublished field notes, 1952).

As would be expected from their prominence in the cultural ecology of native people, camas and riceroot are alluded to in native mythology (cf., Reagan, 1934: 60; Swanton, 1905: 229). Swanton provides the full text of a myth, "He-who-was-born-from-his-mother's-side," in which the hero vanquished the Cohoe Salmon people by spreading "ïnlhïng" [*F. camschatcensis* bulbs] before

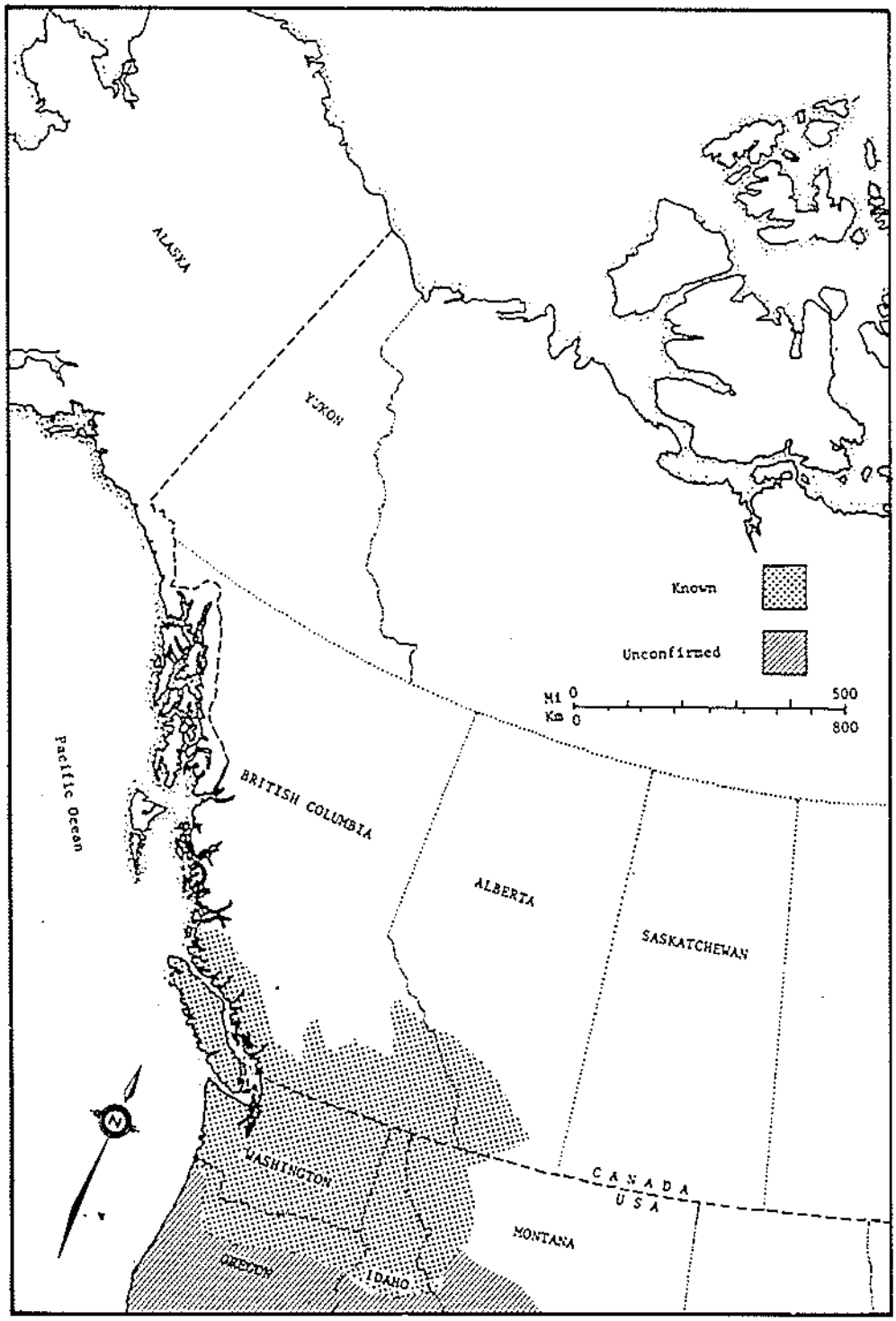


FIGURE 7 Approximate distribution of traditional use of *Camassia* spp. bulbs by native peoples of northwestern North America. The bulbs were available only through trade throughout much of the northern part of their use area.

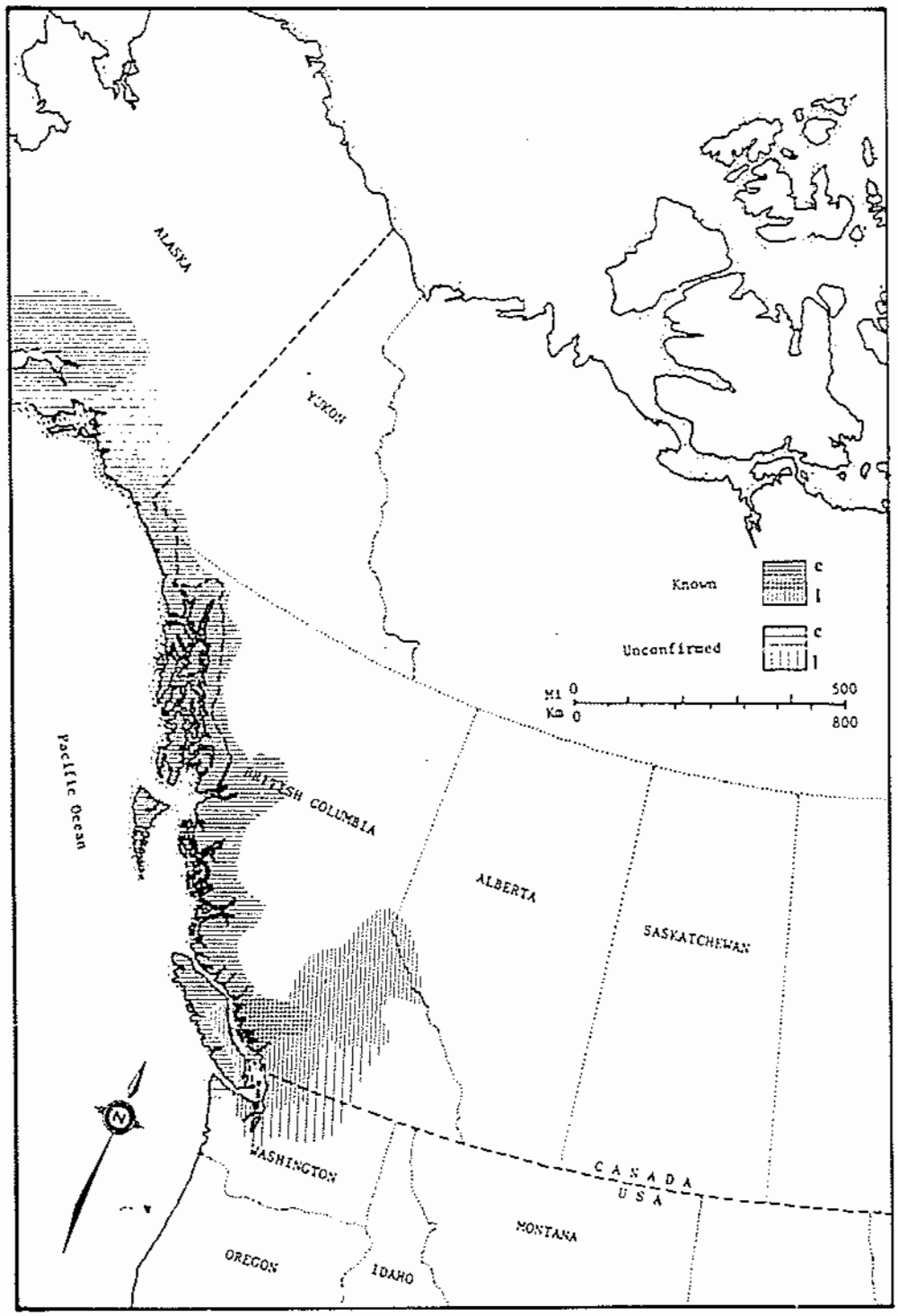


FIGURE 8 Approximate distribution of traditional use of *Fritillaria camschatcensis* ("c") and *F. lanceolata* ("l") bulbs by native peoples of northwestern North America.

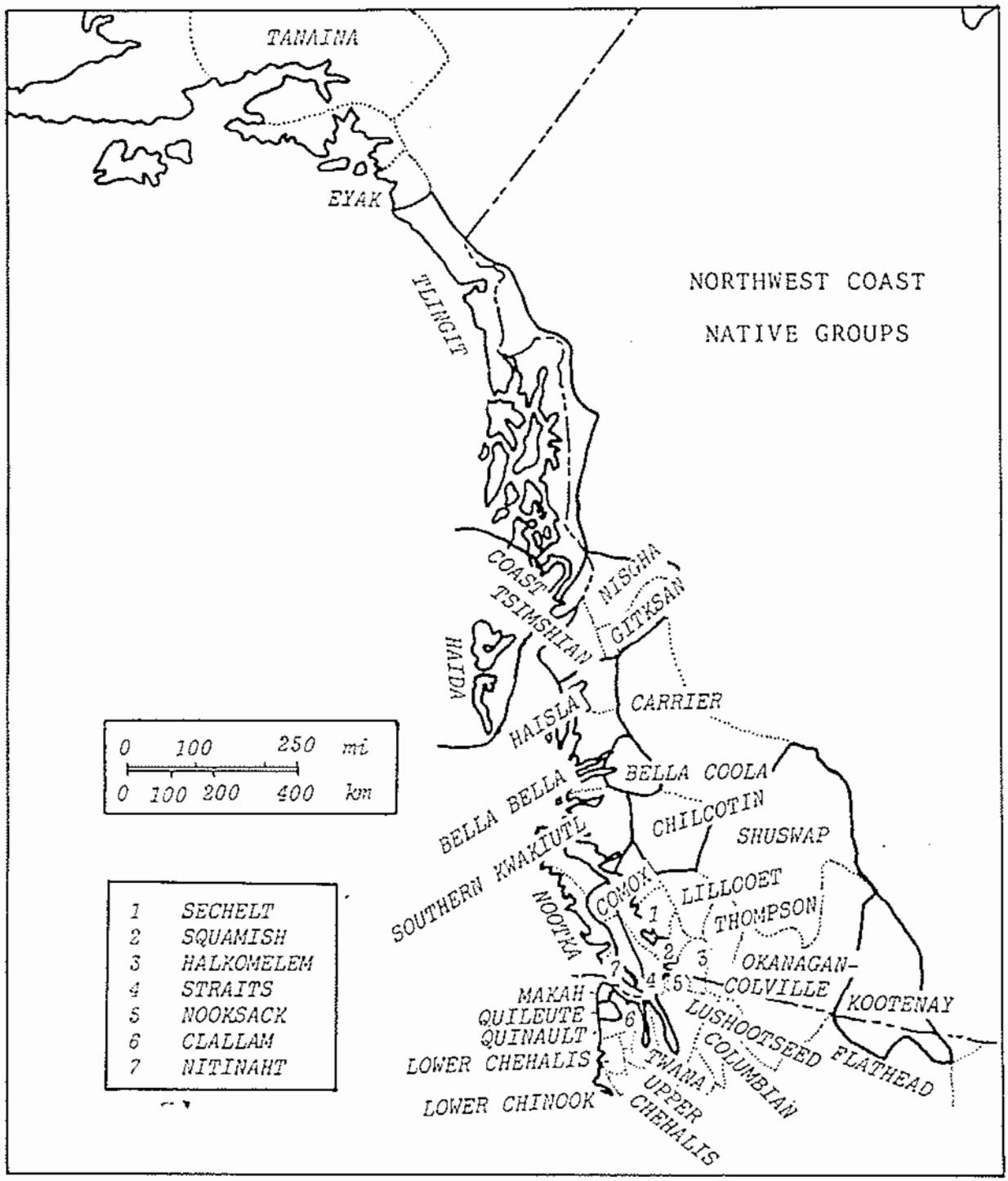


FIGURE 9 Approximate territories of native language groups of the central and northern Northwest Coast and neighbouring areas.

them. Then he "made cowards" of the Dog Salmon people by putting "inlhing teeth" (the bulblets) into their mouths.

*Harvesting*

As with the harvesting of most plant foods, the digging of camas and riceroot bulbs was usually done by women (cf. Suttles, 1951, unpublished observations; Stern, 1934: 42; Boas, 1921: 201); but, at least in the case of camas on southern Vancouver Island, sometimes entire families participated in the harvest, which lasted for many days (Turner and Bell, 1971: 75). Camas bulbs were usually dug in summer (late May through August, depending on the group) after the flowers had faded and the leaves had died down, but while the stalks and seed capsules were still visible. Care was taken not to confuse the bulbs with those of the death camas (*Zigadenus venenosus* S. Wats.), which grows in similar habitats and is highly toxic. Fortunately, even after the flowers have faded (*Zigadenus* flowers are creamy white), the fruiting stalks can be differentiated easily by the experienced eye. A Saanich (Straits) man noted that the membranous covering on *Camassia* bulbs is brown, whereas that of *Zigadenus* bulbs is white (Turner and Bell, 1971: 76).

A pointed digging stick of yew wood (*Taxus brevifolia* Nutt.) or some other hardwood such as oceanspray (*Holodiscus discolor* [Pursh] Maxim.), was used to pry up the turf covering the bulbs, which usually grow 5–15 cm below the surface. Digging sites over rock were often preferred because the bulbs were not very deep. At least among the Straits Salish groups, such as the Saanich, the best digging areas were owned by families and were frequented by them year after year, the property rights being passed down from one generation to the next (Suttles, 1951, unpublished observations; Turner and Bell, 1971: 74). However, most camas beds were available for public harvest (Suttles, 1951, unpublished observations; Stern, 1934: 43).

Although camas sites were not actually farmed in the conventional sense, they were cultivated in much the same way as were patches of springbank clover and Pacific silverweed by other coastal peoples (Turner and Kuhnlein, 1982: 423). The sites were cleared of stones, weeds and brush from year to year. Annual controlled burning was used to maintain an open prairie-type habitat for optimum camas production (Suttles, 1951, unpublished observations; Turner and Bell, 1971: 74; for further discussion of this practice in the Northwest, see Norton, 1979b). The turf was lifted out systematically in small sections and then replaced after only larger bulbs (3–6 cm across) had been removed. The smaller bulbs were left intact to grow for the next season. According to Stern (1934: 42), a common practice among the Lummi (Straits) people was to crush the soil where the bulbs were harvested and place the broken stalks bearing the ripe seed capsules into the holes before they were re-covered. Nooksack and Nuwhaha (Lushootseed), informants reported a similar practice (Suttles, 1951, unpublished observations). The very act of digging and breaking up the soil each year also enhanced the camas beds. As one of Suttles' informants said, "The more you dig, the better it [camas] grows." (Suttles, 1951, unpublished observations). Thus, although the annual harvests were large, a sustained yield situation was maintained. A Saanich man stated that each year his family used to collect four or five (50-pound/23 kg) potato-sacksful of bulbs at a single harvest (Babcock, 1967, unpublished observations). (Earlier, woven bags or baskets were used to hold the bulbs.) Jenness (ca., 1945, unpublished observations), notes that an energetic (Saanich) family could fill 10–12 bags over the three-week harvest period (Suttles, 1951, unpublished observations). As this level of harvesting apparently took place over many generations, this seems contrary to the commonly held belief as stated by Steffek (1954: 65) that "Today there are fewer (*C. quamash*) plants because the bulbs were used for food for so many years." More likely, the habitat destruction caused by urban, agricultural and industrial encroachment is the real cause of the depletion of populations. Suttles (1951, unpublished observations) and Norton (1979b: 187) both cite instances of decimation of camas populations by foraging livestock—sheep in the first case, hogs in the second.

Some native groups, such as the Songish and Semiahmoo (Straits), had prairies rich in camas behind their winter villages, but they also harvested bulbs from the small offshore islands around southern Vancouver Island, as other groups, such as the Saanich (Straits) did almost exclusively. After settlers began encroaching on the larger prairies around Victoria, the smaller islands became the only available harvesting sites (Suttles, 1951, unpublished observations).

To date, the productivity of camas in terms of

quantity of bulbs yielded per unit area of ground has not been tested. However, in one very dense bed of *C. quamash*, in Beacon Hill Park, Victoria, which was a traditional digging area for local Indian groups, we recently counted mature, flowering plants within two sample quadrats. There were approximately 200 plants per square meter. There were also many immature camas plants present.

Populations of the two riceroot species are seldom as dense, nor individual plants as numerous as with the camas species. However, riceroot bulbs are usually more shallow and, hence, relatively easy to dig. This is indicated by the Kaigani and Masset Haida names (Table II) for *F. camschatcensis*, which translate loosely as "round-thing-you-dig-it-out-with-[your]-finger" (Norton, 1981: 440; Turner and Levine, 1972, unpublished observations). Nevertheless, the bulbs were generally dug out with a digging stick, usually of yew or some other type of hard wood (cf. Turner and Kuhnlein, 1982: 419).

*Fritillaria* bulbs could be dug in spring as soon as the shoots appeared (Norton, 1981: 440; Turner and Bouchard, 1974, unpublished observations; Turner, 1973: 199), in the summer after flowering had occurred (Turner, 1971, unpublished observations; Bouchard, 1974, unpublished observations; Galloway, 1979, unpublished observations) or in the fall (Turner and Bouchard, 1974, unpublished observations; Bouchard, 1975, unpublished observations; Heller, 1976: 60).

### *Preparation Techniques*

Camas bulbs were almost always cooked before being eaten. The traditional method of cooking was in a steaming pit. The size of the pit varied according to the quantity of bulbs to be cooked. Suttles (1951, unpublished observations) provides a description of what would probably have been a typical cooking pit used in the Straits Salish area. It was circular, about 1.3. m ("four feet") across and 0.6 m ("two feet") deep. The following is a summary of the construction and use of the pit: A hot fire was lit in the bottom, and rounded beach cobbles about 8–10 cm across were placed in the fire and left until red-hot. Ashes and unburned material were then removed and the bottom of the hole leveled off. Then a layer of vegetation, consisting of such materials as kelp blades, blackberry vines (*Rubus ursinus* Cham. and Schlecht.), salal branches (*Gaultheria shallon* Pursh), fern fronds (*Pteridium aquilinum* [L.] K *munitum* [Kaulf.] Presl) and (*Abies grandis* [Dougl. ex D. D down over the rocks (Suttles, observations; Turner and Bell, and Kuhnlein, 1982: 424). The on top, followed by another laye vegetation. A hole was left thr was poured to generate steam. C to cover the pit, and a layer ab soil or sand was placed ove another fire was lit on top of t were usually allowed to cook f hours (Turner and Bell, 1971: 75 Saanich placed the bark of arbu *ziesii* Pursh) or red alder (*Al* together with the bulbs being co a reddish colour (Suttles, 19 observations). Sometimes othe springbank clover rhizomes and l roots, were cooked in the same camas (Turner and Kuhnlein, 19

At least within the last hund camas bulbs have also been coo methods. For example, the obtained the bulbs only throug them together with clover and silv steaming kettle (Turner and Kuh Turner *et al.*, 1982). Leechman that camas bulbs were boiled in w boxes or closely woven baskets l method but does not specify th information or the native group tainly, the pit method of cookin prevalently described in the li combe, 1903, unpublished observ 1934: 60; Suttles, 1951, unpublish Douglas, 1959: 105; Turner and Turner and Bell, 1973: 272; Gun Bouchard, 1973, unpublished Bouchard and Turner, 1976, unpu tions; Turner *et al.*, 1982), not onl west Coast, but throughout the ra (cf. Konlande and Robson, 1972: 17; Turner, Bouchard and Kenne

In contrast, riceroot was somet (Gorman, 1896: 78; Yanovsky, 1977: 109). When cooked, it was or boiled for a short period of tim using red-hot rocks or, more recen the stove. Often it was added to s (Turner, 1973: 199; Turner and B unpublished observations; Bo

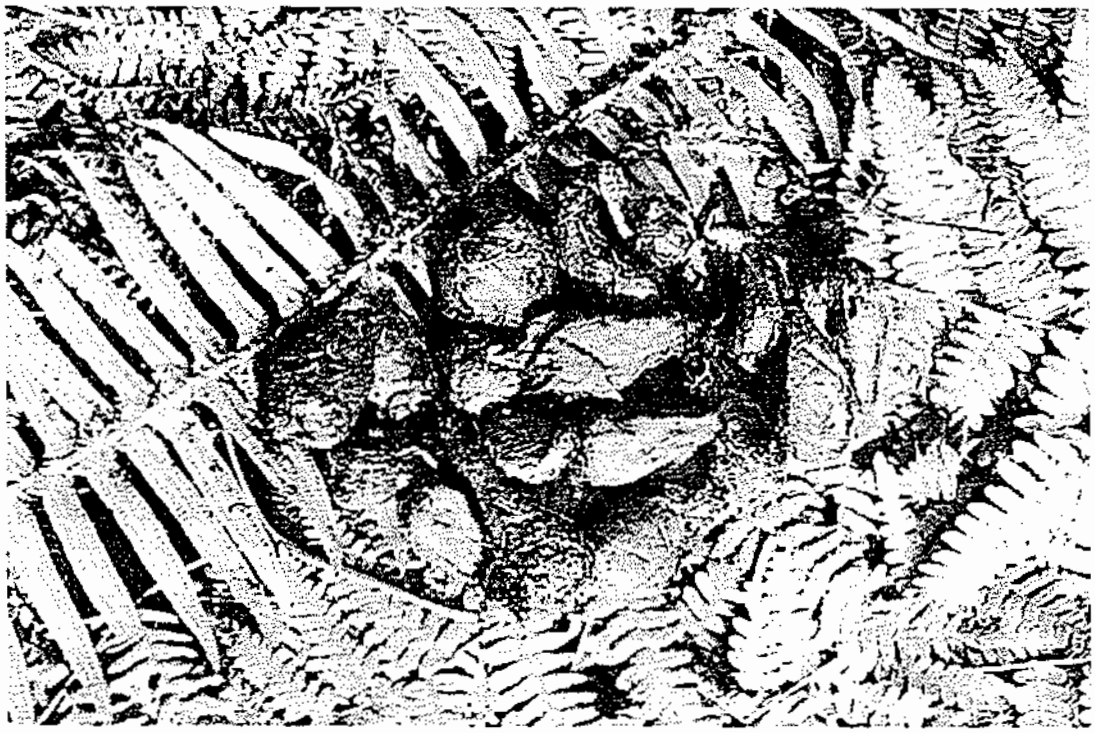

FIGURE 10 Bulbs of *Camassia quamash* after pit-cooking.

unpublished observations; Heller, 1976: 60; Kari, 1977: 109). Newcombe (1897, unpublished observations) reported that the Haida mashed the bulbs to a thin paste after boiling, or sometimes roasted them in the embers. Heller (1976: 60) states that the Alaskan natives pounded them into flour. Boas (1921) describes the preparation of *F. camschatcensis* bulbs by the Southern Kwakiutl:

> . . . then they take a small-meshed flat-bottomed basket and put it close to the top of the lily-box. With their hands they take the plants [bulbs] out of the box and put them into the . . . basket . . . [Then] they put the basket into a large dish and pour some water into it. Then they move the bulbs with their hands, so that the soil comes off. When they are all washed, two men take each one pair of long tongs, and with them they pick up the red-hot stones, they dip these into the water in the large buckets so that the ashes sticking to them come off, and they put them into the water in the square [cooking] box. They only stop putting in the red-hot stones when the water begins to boil; and . . . [then] they put the basket with the lily-bulbs into it; and when it is in, they put some more red-hot stones into it, not very many, so that the water boils hard. They [the bulbs] are not long in the water and they are done. Then they take out the basket with the bulbs, and they pour the boiled bulbs into the large dish . . . (Boas, 1921: 561–562).

Boas notes that this method of cooking the bulbs was used when they were to be eaten at a feast. The process was repeated several times until all the bulbs were cooked. Boas (1921: 563) also describes another method of cooking the bulbs by boiling them in a small kettle. The boiled bulbs were then mashed to the consistency of "wet flour."

There are also reports (Suttles, 1951, unpublished observations; Bouchard, 1975, unpublished observations; Bouchard, 1978, unpublished observations; Galloway, 1979, unpublished observations) of riceroot being pit-cooked; but in the majority of cases, preparation indicated was similar to Boas' description (Newcombe, 1897, unpublished observations; Turner and Levine, 1972, unpublished observations; Bouchard, 1973, unpublished observations; Bouchard, 1978, unpublished observations; McNeary, 1976: 41; Turner *et al.*, 1982). Boas (1921: 564) notes [contrary to Newcombe's (1897, unpublished observations) statement mentioned earlier] that "Lily-bulbs are never baked in ashes, for they are very soft when cooked."

The preferred native cooking methods for *Camassia* spp. and *Fritillaria* spp., namely prolonged pit-cooking for the former and rapid steaming or boiling for the latter, were undoubtedly due to the difference in the nature of their carbohy-

drates. It is probable that lengthy cooking is necessary for maximum conversion of the inulin in *Camassia* to fructose (Konlande and Robson, 1972). Since inulin is tasteless and mostly indigestible for humans (Oser, 1965) and fructose is sweet and highly digestible, it would be fair to state that without cooking—and probably without pit-cooking—camas could not have attained the importance it did in native diets. Konlande and Robson (1972: 195) note that on a dry weight basis, about one percent of raw camas was reducing sugars (interpreted as fructose), whereas pit-cooked camas was found to contain levels of reducing sugar equivalent in weight to the inulin (41 percent) content reported earlier by Yanovsky and Kingsbury (1938: 648). *Fritillaria*, whose major carbohydrate component is reported to be starch (Yanovsky and Kingsbury, 1938: 652), would be expected to be more digestible in the raw state or with short-term cooking.

Neither camas nor riceroot bulbs keep well in the fresh state; they soon become desiccated and soft. Hence, they were usually cooked, and those to be traded or stored for later use would subsequently be sun-dried (Gorman, 1896: 78; Yanovsky, 1936: 13; Suttles, 1951, unpublished observations; Bouchard, 1975, unpublished observations; Kari, 1977: 109; 'Ksan, People of, 1980: 124). Sometimes camas bulbs were pressed flat, "like biscuits" before being dried (Turner *et al.*, 1982). The Lummi (Straits) and Quinault of Washington, and probably other Northwest Coast groups as well, formed cooked camas bulbs into loaves for storing (Stern, 1934: 453; Olson, 1936: 53). The Nitinaht stored the dried bulbs interspersed with layers of dried grass in large open-work baskets of cedar bark, which were stowed up on scaffolding in the house (Turner *et al.*, 1982). Sometimes *Fritillaria* bulbs were dried without being cooked (Boas, 1921: 202). Dried bulbs of both camas and riceroot were re-constituted readily by soaking in water, usually overnight.

At least relatively recently, fresh camas bulbs were stored by some people in the same manner as potatoes and onions, by burying them fresh. For example, the grandfather of a contemporary Clallam woman used to store his camas bulbs and root vegetables in the dirt floor of his mother's Indian house (L. Thompson, 1974, personal communication). Within the last century, the Nuxalk people of Bella Coola stored riceroot bulbs fresh in boxes of moist soil in root cellars. They also practiced this technique in storing springbank clover, Pacific silverweed and bracken fern roots (Turner and Kuhnlein, 1982: 427).

*Notes on Taste and Serving*

The sweetness of cooked camas gave it utility as a sweetener and enhancer of other foods. Before sugar, molasses and honey were introduced by European traders, sweetening agents were in short supply among native peoples, and camas was highly valued in this capacity (Suttles, 1951, unpublished observations). One Nitinaht woman from Port Renfrew, Vancouver Island, commented, "Oh, it's nice, it was sweet . . . I still miss it." (Turner *et al.*, 1982). The Clallam, and probably other groups, used to mix it with their bitter-tasting confection of whipped soapberries (*Shepherdia canadensis* L.) (cf. Turner, 1981: 5; Newcombe, 1903, unpublished observations). Douglas (1959: 105) described cooked camas as tasting ". . . much like a baked pear." Olson (1936: 53) notes, "The Quinault were extremely fond of camas and regarded it almost as a confection." John Jewitt, the English captive at Nootka Sound, mentioned previously, described camas ("Quawnoose," [cf. Hesquiat k$^{w}$añus for camas bulbs]) as ". . . in truth, a very fine vegetable, being sweet, mealy, and of a most agreeable flavour. It is highly esteemed by the natives . . ." (Jewitt, 1824: 107).

*Fritillaria* bulbs were often said to be bitter tasting (Bouchard and Turner, 1976, unpublished observations; Turner, 1971, unpublished observations; 'Ksan, People of, 1980: 77). In fact, the Gitksan name "gasx" means "to be bitter" (Hindle and Rigsby, 1973: 11). Still, the taste was said to vary from one locality to the next (Turner, 1971, unpublished observations; Kari, 1977: 109). Plants of *F. camschatcensis* growing near the ocean and covered periodically with salt spray were said by one Haida man to have the best taste (Turner, 1971, unpublished observations). Bitterness was sometimes alleviated by overnight soaking in water (Kari, 1977: 109). The authors noted no bitter taste in sampling the raw or cooked bulbs of either *F. camschatcensis* or *F. lanceolata*, but one other person who ate the bulbs of *F. camschatcensis* at the sime time detected a bitter aftertaste akin to that found in zucchini when it is overmature (D. Lepofsky, 1982, personal communication). Captain James Cook ate the boiled bulbs of *F. camschatcensis* and found them "wholesome and pleasant" (Hedrick, 1972: 282). We noted that

raw camas bulbs were bland and extremely mucilaginous in texture, whereas the bulbs cooked by boiling or roasting were definitely sweet and very pleasant.

Both *Camassia* and *Fritillaria* bulbs were traditionally served with a dressing of some kind of grease or oil (Boas, 1921: 563, 564; Kari, 1977: 109; Turner *et al.*, 1982). Groups of the central and northern coast often used eulachon grease (rendered from a small, oily fish, *Thaleichthys pacificus*) (cf. Kuhnlein, Chan and Nakai, 1982, unpublished observations; Turner, 1973: 199), whereas Nootkan, Nitinaht and some Salish peoples used whale or seal oil (Jewitt, 1824: 107; Turner and Efrat, 1982: 55; Turner *et al.*, 1982). Recently, commercial vegetable oils often replace the indigenous oils in native diets (Kuhnlein, Chan and Nakai, 1982, unpublished observations). The bulbs were often served with fish or meat (Turner *et al.*, 1982; Turner and Bell, 1971: 75). The Kaigani Haida sometimes boiled *F. camschatcensis* bulbs together with the chopped leaves of "Indian rhubarb" (*Rumex occidentalis* S. Wats.). After European contact, they and other peoples added sugar or molasses to the usual dressing of grease for these bulbs (Norton, 1981: 440; Turner, 1971, unpublished observations; Turner, 1973: 199; 'Ksan, People of, 1980: 124). The Nuxalk (Bella Coola) and Gitksan mixed cooked riceroot bulbs with pre-cooked hemlock inner bark (*Tsuga heterophylla* [Raf.] Sarg.) and served this mixture with eulachon grease (Bouchard, 1975, unpublished observations; 'Ksan, People of, 1980: 124). The Tanaina sometimes served the bulbs raw with fish eggs (Kari, 1977: 109).

Both types of bulbs, but particularly camas, were often served at large feasts. It was noted that only a few decades ago the Cowichan Halkomelem used to serve a plate with two or three large cooked camas bulbs to each guest at a potlatch or winter dance (Turner *et al.*, 1982). Boas (1921: 560) writes that it was traditional among the Southern Kwakiutl for the owner of *F. camschatcensis* bulbs to give a feast to the Sparrow Society at the time when the people have a winter dance.

Today, camas and riceroot bulbs are hardly ever eaten. As expressed by contemporary Gitksan people for *F. camschatcensis:*

> Hardly anybody eats our wild rice today, but most of our elders tasted it in their younger days and the generation before theirs considered it to be a great treat. ('Ksan, People of, 1980: 124).

Dawson (1880: 114) confirmed that the bulbs of the "wild lily" [*F. camschatcensis*] on the Queen Charlotte Islands were not actively collected by the Haida at the time of his research. None of the Haida people interviewed by the first author in 1971–72 had eaten the bulbs since childhood (Turner, 1971, unpublished observations). However, the Coast Tsimshian people at Hartley Bay apparently are still eating the bulbs on occasion (A. Laforet, 1981, personal communication). On the southern British Columbia coast, camas bulbs, as mentioned earlier, were being served on special occasions until a few decades ago, but few members of the younger generations have tasted them. It appears that almost no contemporary people have eaten the bulbs of *Fritillaria lanceolata* on the coast, although in the adjacent interior some Thompson people still occasionally gather them from the vicinity of Botanie Valley near Lytton, British Columbia (Turner *et al.*, 1982, unpublished observations).

## COMPOSITION STUDIES OF *Camassia* spp. AND *Fritillaria* spp.

Several alkaloid components have been isolated from the bulbs of species of *Fritillaria* used for medicinal purposes in Asia (*F. roylei* Hook., *F. verticillata* Willd. var. *thunbergii* Bak., and *F. raddeana* Relel) (Hegnauer, 1963). Solanidine, solanthrene and a third unidentified alkaloid have been isolated from methanol extracts of *F. camschatcensis* from Hokkaido, but their presence was not quantified (Mitsuhashi, Nasai and Endo, 1969). Studies on North American populations have not been done. Saponins were found in the seeds of *Camassia cusickii* S. Wats. (Hegnauer, 1963), but to the authors' knowledge, no reports exist on toxicants in the bulbs of any species of *Camassia*.

Nutritional constituents of the Northwest Coast species of *Camassia* and *Fritillaria*, particularly the latter, are also not well known. To date, there are four research reports that include *C. quamash* (Yanovsky and Kingsbury, 1938; Benson *et al.*, 1973; Keely, 1980, unpublished observations; Konlande and Robson, 1972) and one including *C. leichtlinii* and *F. camschatcensis* (Yanovsky and Kingsbury, 1938). To our knowledge there have been no nutrient composition reports in the literature on *F. lanceolata*. The most complete nutrient data in these reports are given for *C. quamash* found in the dry, inland areas of central Washington, Oregon and Idaho. To date, no analyses have

been done on *Camassia* or *Fritillaria* species from British Columbia.

In this study nutrient investigations were done on *C. quamash*, *C. leichtlinii* and *F. camschatcensis* harvested from the southwest coast of Vancouver Island. *Camassia quamash* and *C. leichtlinii* were harvested separately and, from two sites where the species were mixed, they were harvested together as native people would likely have done. Approximately 1.5 kg of the bulbs of each camas species and 0.25 kg of *F. camschatcensis* bulbs were harvested. These were washed free of soil with distilled water and the camas bulbs were peeled. Native people of British Columbia customarily stripped off the black outer skin of these bulbs with their fingers after cooking and just before eating. We peeled the bulbs to the same extent with stainless steel knives. After peeling, the bulbs were frozen for later analyses. The bulbs of *F. camschatcensis* were washed but did not require peeling.

Proximate composition was assessed with standard methods and minerals analyzed with plasma atomic emission spectroscopy as previously described (Kuhnlein, Turner and Kluckner, 1982: 92). Neutral detergent fiber and acid detergent fiber analyses were conducted using the procedure of Goering and VanSoest (1970) with the addition of $\alpha$-amylase from porcine pancreas (Mongeau and Brissard, 1982).

The results of analyses of the raw samples and data from raw potato are given in Table III, together with published data on carbohydrate content. The values for *C. quamash* and *C. leichtlinii* are quite comparable for all measurements, except for iron, which is three-fold higher in *C. quamash*. Even at the higher level, however, camas would not be a good source of this nutrient (1.6 mg/100 g fresh weight), even if totally available. Iron in springbank clover and Pacific silverweed roots used by British Columbia native people was found to be much higher (4–9 mg/100 g), probably because the skin of the roots was used (Kuhnlein, Turner and Kluckner, 1982: 93).

*Fritillaria camschatcensis* has somewhat higher levels of nitrogen (protein) and magnesium, but lower amounts of calcium than the two species of camas. All three species have superior contents of sulfur, phosphorus, iron, zinc and strontium in comparison to common potato, the contemporary replacement for native root foods.

The carbohydrate composition of these foods deserves special attention since roots (as well as berries) probably contributed the major proportion of carbohydrate energy and fiber in precontact Northwest Coast native diets. Inulin, identified previously as the primary storage carbohydrate in camas, is digestible only when hydrolyzed to fructose. Today, native people occasionally use camas that has been cooked to softness by steaming for 30 minutes—the resulting product being slightly sweet and "potato-like" in texture, and highly appreciated. In light of previous work on camas cooking (Konlande and Robson, 1972), it is likely that the carbohydrates in steamed camas are not fully utilizable, and therefore should not be included in food energy computations. Nevertheless, steamed camas can still be promoted as a useful food for contemporary native people by virtue of its place in cultural traditions as well as the contents of other nutrients—such as minerals—reported here and small amounts of ascorbate.

TABLE III

Nutrients in raw bulbs of camas (*C. quamash* and *C. leichtlinii*) and riceroot (*F. camschatcensis*) in comparison to common potato (*Solanum tuberosum*)*

| Nutrient | *C. quamash* | *C. leichtlinii* | *F. camschatcensis* | *S. tuberosum* |
|---|---|---|---|---|
| | | percent | | |
| Moisture | 83.4 | 81.8 | 84.6 | 76.9 |
| Fat | 0.01 | 0.09 | 0.07 | 0.02 |
| Ash | 0.84 | 0.93 | 0.95 | 0.84 |
| | | per gram dry weight | | |
| Nitrogen, mg | 8.9 | 9.1 | 12.2 | 19.1 |
| Sulfur, mg | 1.15 | 1.31 | 1.28 | 0.95 |
| Calcium, mg | 1.04 | 1.05 | 0.39 | 0.44 |
| Phosphorus, mg | 2.70 | 2.71 | 2.70 | 1.86 |
| Magnesium mg | 0.52 | 0.47 | 1.31 | 1.04 |
| Iron, $\mu$g | 99 | 31 | 42 | 26 |
| Copper, $\mu$g | 3 | 4 | 4 | 4 |
| Zinc, $\mu$g | 27 | 22 | 30 | 9 |
| Strontium, $\mu$g | 6 | 6 | 8 | 1 |
| Barium, $\mu$g | 7 | 4 | —[b] | 1 |
| | | percent dry weight | | |
| Neutral detergent fiber | 7.06 | 6.03 | —[c] | |
| Acid detergent fiber | 6.16 | 6.02 | 4.3 | |
| Inulin[d] | 41.1 | 36.6 | 11.2 | |
| Reducing sugar[d] | 6.8 | 1.0 | 11.6 | |
| Starch[d] | 0.0 | 0.0 | 23.9 | |
| Crude fiber[d] | 3.0 | —[c] | 5.7 | |

* The 2 species of *Camassia* were peeled; the *Fritillaria* and potato were not.

[b] Undetectable. Other undetectable minerals, at < 5 ppm, were Cr, V, Co, As, Sb, Pb, Cd, Ni, and Mo.

[c] Analysis not completed.

[d] From Yanovsky and Kingsbury (1938). Mean of 6 samples of *C. quamash*, except for crude fiber (1 sample) and from 1 sample of *C. leichtlinii* and of *F. camschatcensis*.

thiamine and riboflavin (Benson *et al.*, 1973). Injested inulin would simply contribute to total dietary fiber.

In the report by Yanovsky and Kingsbury (1938: 652), *F. camschatcensis* contained similar proportions of reducing sugars (presumably mono- and di-saccharides) and inulin (11 percent of dry weight, each), with slightly more starch (24 percent). The nature and digestibility of the "starch" component is puzzling since we could not sufficiently hydrolyze our sample with $\alpha$-amylase to complete the neutral detergent fiber analysis.

Neutral detergent and acid detergent fiber content of the raw samples of camas were 6–7 percent of dry weight, comparable to that of oatmeal, and represented the combined contents of cellulose, hemicellulose and lignin (Mongeau and Brassard, 1982). Acid detergent fiber of *Fritillaria* was somewhat less at 4.3 percent. These values differ considerably from the crude fiber reports of Yanovsky and Kingsbury (1938: 652).

In addition to the composition studies of raw bulbs, identical portions of the four samples of camas were washed and cooked by either pit-roasting or kettle steaming for comparison of mineral contents to those of the raw samples. These were also peeled (and attached roots removed in the process) before the aliquots were prepared for analysis. The cooking of the camas samples was done with the traditional Nitinaht procedures of cooking roots as previously described (Turner and Kuhnlein, 1982: 424).

The results of the mineral analysis are given in Table IV. There were no significant increases in mineral content with the pit cooking method, corroborating our earlier report on pit-cooked vs. raw clover and silverweed roots (Kuhnlein, Turner and Kluckner, 1982: 94). However, with steaming in stainless steel kettles of the two mixed *C. quamash* and *C. leichtlinii* samples, there were small increases in calcium, magnesium and manganese. This may have been a result of migration of nutrients from the peel layer inward during the steaming process.

Benson *et al.*, (1973) reported higher levels of calcium (68.6 mg), iron (4.9 mg) and zinc (1.2 mg) in 100 g wet weight of barbequed (pit-cooked) and sugared camas prepared by native people of the Warm Springs Reservation than were found on Vancouver Island samples (calcium – 17.3 mg; iron – 1.6 mg; and zinc – 0.45 mg calculated per 100 g wet weight). However, it is not known if the Oregon camas has higher mineral content in the inner bulb, if the peels were included in analysis or perhaps both.

TABLE IV

Minerals in *Camassia quamash* and *Camassia leichtlinii* bulbs with two methods of cooking.[a]

| Sample | Ca | P | Mg | Zn | Cu | Mn |
|---|---|---|---|---|---|---|
| | mg/g dry weight | | | μg/g dry weight | | |
| *Camassia quamash* | | | | | | |
| raw | 1.04 | 3.01 | 0.52 | 27 | 3 | 17 |
| pit-cooked | 1.01 | 2.47 | 0.44 | 19 | 2 | 10 |
| *Camassia leichtlinii* | | | | | | |
| raw | 1.05 | 2.71 | 0.47 | 22 | 4 | 14 |
| pit-cooked | 1.13 | 2.33 | 0.42 | 22 | 2 | 13 |
| Mixed *C. quamash* and *C. leichtlinii* A | | | | | | |
| raw | 1.86 | 2.05 | 0.70 | 33 | 5 | 41 |
| pit-cooked | 1.71 | 2.00 | 0.64 | 32 | 4 | 37 |
| steamed | 1.95 | 1.92 | 0.80 | 37 | 6 | 54 |
| Mixed *C. quamish* and *C. Leichtlinii* B | | | | | | |
| raw | 2.25 | 2.84 | 0.66 | 27 | 5 | 24 |
| pit-cooked | 1.82 | 2.90 | 0.65 | 28 | 4 | 23 |
| steamed | 2.58 | 2.60 | 0.69 | 25 | 4 | 35 |

[a] Bulbs were peeled after cooking.

## CONCLUSIONS

Camas and riceroot were formerly important foods to native peoples of the Northwest Coast. Although wild populations of these species are presently not abundant in many parts of their former range, due mainly to overgrazing and urban development, they can be adapted for personal horticulture as a food crop. When prepared by native methods, these foods are nutritious and thoroughly enjoyable.

## ACKNOWLEDGEMENTS

The authors are grateful to the many knowledgeable native people of British Columbia who, both directly and indirectly, provided information for this study. We would particularly like to acknowledge the late Christopher Paul of Tsartlip, near Victoria; John Thomas of Victoria, and his mother, Ida Jones of Pacheenaht, near Port Renfrew; Margaret Siwallace and Felicity Walkus of the Nuxalk people of Bella Coola; and the late George Young of Skidegate.

We also thank Paul Kluckner and Jeff Van Haastreght for assistance with mineral analysis and Anthea Kennelly and Naomi Woo for assistance with proximate composition and fiber analyses. In addition we are indebted to the following people for their contributions to this study: Dr. Wayne Suttles,

Dr. David French, Randy Bouchard and Dorothy Kennedy, Dr. Thom Hess, Dr. M. Dale Kinkade, Dr. Brent Galloway, Dr. Andrea Laforet, Dr. Laurence C. and M. Terry Thompson, Dr. Robert T. Ogilvie and Dana Lepofsky. Robert D. Turner is gratefully acknowledged for his contributions to the maps and photographs.

This research was partially funded by support to Harriet Kuhnlein from the Natural Science and Engineering Research Council of Canada (A-7148) and from the National Museums of Canada (1630-1-052).

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