J. Ethnobiol. 1 (1): 124-134 May 1981

ON THE RELATIVE CONTRIBUTION OF MEN AND WOMEN TO SUBSISTENCE AMONG HUNTER-GATHERERS OF THE COLUMBIA PLATEAU: A COMPARISON WITH *ETHNOGRAPHIC ATLAS* SUMMARIES

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ABSTRACT.—The subsistence dependence codes in Murdock's *Ethnographic Atlas* have been used to evaluate hypotheses as to the relative contribution of men versus women to hunter-gatherer subsistence. The *Atlas* codes are based in most cases on impressionistic ethnographic summaries of the role of gathering, hunting, and fishing in the societies of the sample. The validity of these coded data is evaluated for representative North American Indian cases by comparison with estimates of the caloric and protein contributions of the major subsistence resource types based on ethnohistorical and ethnobiological research. The *Atlas* data are shown to be systematically biased in favor of hunting and fishing resources at the expense of gathering resources.

INTRODUCTION

Lee's data on the relative caloric contribution of the products of hunting and gathering among !Kung Bushmen (Lee 1968:39) clearly demonstrate that the pervasive stereotype of men as providers, women as economically dependent childrearing specialists, does not apply to all foraging societies. In fact, comparable figures reported for other Bushman groups (Tanaka 1976) and for Australian Aborigines (Gould 1977) suggest that the female economic contribution as gatherer (measured as percent of caloric requirement provided) ranges between 60% and 80% generally among foragers in the arid tropics. Lee's cross-cultural sample drawn from the *Ethnographic Atlas* (Murdock 1967) indicates that only above ca. 40° latitude does the male economic contribution through fishing and hunting meet the bulk of subsistence requirements (Lee 1968:43).

However, the case is apparently not yet considered conclusive. Ember has recently argued to the contrary that among the 181 *Atlas* hunter-gatherer societies—those rated zero on Murdock's "subsistence dependence" code for animal husbandry and agriculture—"men, not women, . . .typically contribute substantially more to primary subsistence" (1978:441). If we accept the *Atlas* data at face value and sample as representative, Ember is correct, since 77% of the *Atlas* cases rate hunting and fishing (in which males are nearly always the primary producers) of greater value than gathering to subsistence. However, Ember chose to ignore the significance of the geographical bias in the *Atlas*. Fifty-seven percent of the hunter-gatherer cases in the *Atlas* are from at or above 42° latitude compared to only 17% of the total cases at or above that latitude. Eighty-four percent of the hunter-gatherer cases in the *Atlas* are from North America, while only 25% of the total cases are from that continent (see Table 1). The statistics from North America do not differ significantly from worldwide figures, however the correlation of latitude with the importance of gathering shows up clearly. Hunting and fishing are rated as exceeding the contribution of gathering among only 40% of societies below 42° but among 98% of those at or above that latitude.

There remains the questions of the face value of the *Atlas* subsistence ratings. Ember equates Murdock's scale with percentage of caloric requirements met (1978:441, 445). Murdock made no such claim. Rather, his 5 major subsistence factors —gathering, hunting, fishing, animal husbandry, and agriculture—are rated 0 to 9 with respect to "the relative dependence of the society" on the factor in question (Murdock 1967:46). There is no mention of calories, nor is any operational definition of "subsistence dependence" offered. To interpret Murdock's subsistence scale in terms of calories is to impute a spurious objectivity to the *Atlas* data. I hope to show here that in at least one major culture area, the Columbia-Fraser Plateau—which represents 13 of the 181 hunter-gatherer cases in the *Atlas*—Murdock's subsistence codes are seriously and systematically biased in favor of the hunting-fishing contribution if interpreted in caloric terms.

These 13 societies represent an area of 750,000 sq km drained by the Fraser and Columbia Rivers in what is now British Columbia, Washington, Idaho, and Oregon (see Fig. 1). The northern or British Columbia portion of the Plateau area is largely forested, while the southern portion is an arid sagebrush steppe and grassland surrounded by pine parkland and mountain forest. A diverse subsistence economy based on gathering, fishing, and hunting has supported continuous aboriginal populations for 10,000+ years (Cressman 1977). In no Plateau case does Murdock rate gathering as contributing more than 35% to "subsistence dependence."

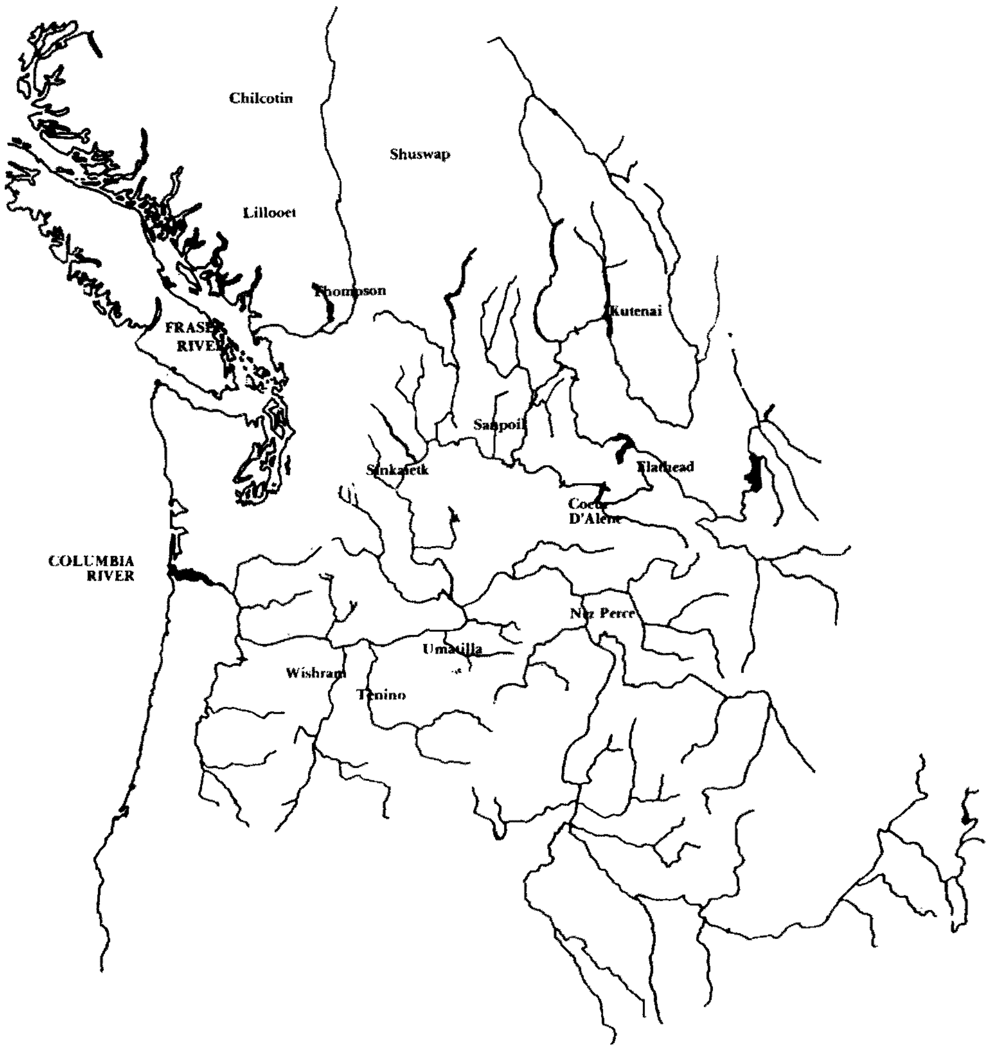

FIG. 1.—Map of the Columbia-Fraser Plateau Region of the Pacific Northwest indicating approximate locations of 13 *Ethnographic Atlas* societies.

TABLE 1.—*The correlation of latitude and the importance of gathering to subsistence among North American hunting-gathering societies (data from the* Ethnographic Atlas *[Murdock 1967]).*

SUBREGION	Number of Societies with Gathering Rated ≥ r on Murdock's Subsistence Scale ≥ 52° N	/ ≥ 42° N	Total number of Societies Total
Arctic/Subarctic	0/37	--	0/37
Northwest Coast	0/27	0/ 5	0/32
California	0/ 1	18/29	18/30
Plateau/Great Basin	2/20	9/13	11/33
Plains	0/11	0/ 5	0/16
Southwest	--	2/ 2	2/ 2
Northern Mexico	--	1/ 2	1/ 2
TOTAL: NORTH AMERICA	2/96	30/56	32/152
PERCENT WITH GATHERING ≥ 5	2.1	53.6	21.1
TOTAL: WORLDWIDE	2/103	40/78	42/181
PERCENT WITH GATHERING ≥ 5	1.9	51.3	23.2

*Murdock (1967) rates each society's subsistence economy on 5 major types of subsistence activity, gathering, hunting, fishing, animal husbandry, and agriculture, on the following scale: (0) zero to 5%, (1) 6% to 15%, (2) 16% to 25%, (3) 26% to 35%, (4) 36% to 45%, (5) 46% to 55%, (6) 56% to 65%, (7) 66% to 75%, (8) 76% to 85%, (9) 86% to 100% dependence on the subsistence type in question. The factors must add to equal 10.

DISCUSSION

The Data Base for Estimating Subsistence Contributions

Lee was able to measure actual consumption over a period of several months among a group of hunter-gatherers little affected by contact with modern civilization. The Columbia-Fraser Plateau situation, however, is quite different. European influences date to ca. 1730 when horses reached the area indirectly from Spanish sources in the Southwest (Haines 1938). Epidemics of smallpox dating to before 1780 (Boyd MS*a*) spread from early coastal or Great Plains contacts. Fur traders, missionaries, settlers, treaties and consequent Indian wars followed close on the overland explorations of Mackenzie and Lewis and Clark, leading to the restriction of most of the native population to reservations by the end of the nineteenth century. Hydroelectric dam construction on the Columbia begun in 1931 has now all but eliminated any semblance of traditional subsistence fishing patterns (Pacific Northwest Regional Commission 1976). Thus estimates of the relative contribution of gathering, hunting, and fishing to the caloric requirements rest on limited ethnohistorical documentation by early explorers and missionaries and the statements of elderly informants recorded by twentieth century ethnographers. These ethnobiological data—often quite detailed and extensive as to species recognized and used and the time and place of harvest—must now be interpreted in the light of scientific knowledge of the natural history and biochemistry of resource species.

Previous attempts to characterize the ecological parameters of Plateau subsistence have focused almost exclusively on salmon (Hewes 1947, 1973; Kew MS; Palmer 1975a; Sneed 1971). No attempt has yet been made to quantify the vegetable input. This one-sided emphasis on the economic value of the native fisheries seems to reflect a misunderstanding of the potential nutritional contribution of native plant foods. For example, Hewes (1973:134) assumed that "the satisfaction of this demand [for calories] must have been largely up to the fisheries. . . , since other natural foods available in the area in quantity are notoriously low in fuel value," among which he specifically includes bitterroot and camas (Ibid.:151), 2 Plateau staples. Hewes's estimation of the fuel values of native plants is simply wrong (e.g., for camas see Konlande and Robson 1972). Furthermore, recent ethnobiological and cultural ecological research in the area[1] clearly indicates a much more important role for vegetable products as sources of food energy than Hewes recognized.

For example, French and I have documented a folk classification system of extraordinary detail applied to a single taxonomically difficult genus, *Lomatium*, of the Umbelliferae. Fourteen basic folk taxa are named in Sahaptin, the language of the middle Columbia, at or below the scientific species level. Most of these species are important native foods including the staples, *Lomatium canbyi* Coult. & Rose and *L. cous* (S. Wats.) Coult. & Rose. These along with bitterroot (*Lewisia rediviva* Pursh), camas (*Camassia quamash* [Pursh] Greene), and huckleberries (especially *Vaccinium membranaceum* Dougl. ex Hook.) account for the bulk of vegetable foods gathered in the southern half of the Plateau region. Preliminary studies of densities and harvest rates of these species suggest the feasibility of reliance on vegetable resources in this area for the bulk of the calorie requirement (Hunn and French MS).

Estimates of Salmon Consumption

Hewes's estimates of salmon consumption are the most comprehensive attempted to date for the region. However, his interpretation of the nutritional factors is misleading. He does not allow for the fact that the edible fraction of whole salmon is generally considered to be approximately 80% of the total weight (Martinsen, pers. comm.). Furthermore his caloric calculations are based on commercial samples. These are biased in 2 respects. They selectively represent the fattest species, Chinook (*Oncorhynchus tschawytscha)* and Sockeye (*O. nerka)*, and they represent individuals taken at the beginning of the spawning migration. Yet Idler and Clemens (1959) have shown that migrating salmon (Fraser River Sockeye) lose on average 75% of their caloric potential during this migration, as do Amur River Chum Salmon (*O. keta*) (Pentegov et al. 1928).

Table 2 cites salmon samples on which the present argument rests. The 20 samples represent 6 species (including Steelhead Trout, *Salmo gairdneri)* and average 170 kcal/100 g. Table 3 lists Hewes's salmon consumption estimates for the 13 *Atlas* societies of the Plateau with kcal/person/day equivalents based on 80% edibility and the present 170 kcal/100 g standard energy value. These equivalents are then reduced by a variable migration calorie loss factor, which for Fraser River groups is as calculated by Kew (MS).[2] For Columbia River groups I determine the calorie loss factor by taking the ratio of the total length of the river (1936 km) to the distance up the main stem of the Columbia to the mid-range of the group cited. For groups resident on tributary streams only, I calculated the ratio as that of the distance from the Columbia River mouth to the mid-range of the group to the total distance to the limit of salmon migration on that tributary.[3] This ratio is then multiplied by 0.75, the average caloric value lost by salmon in migration, and the result subtracted from one. I use Hewes's value of 2000 kcal/person/day as the minimal daily requirement (MDR), in the absence of reliable estimates of body weight or population structure for pre-contact populations of the region.

The tabulated calculations clearly show that estimates of salmon consumption fall consistently well short of the percentages of subsistence dependence cited by Murdock, with the exception of Thompson. The caloric contribution of salmon throughout the Plateau based on Hewes's consumption figures averages 26% compared to the 44% average dependence on fishing cited by the *Ethnographic Atlas*. While other fish contributed to the total dependence on fishing (Hunn 1979), waste, loss to scavengers, and the use of salmon as fuel (Thwaites 1959:124) should tend to offset any increment from non-salmon fishing sources, except among groups such as the Flathead with restricted access to salmon.

TABLE 2.—*Salmon proximal analyses used, per 100 g.*

	G WATER	G PROTEIN	G FAT	KCAL*
Rivera 1949: canned				
11 samples, 6 species	66.95	22.17	8.61	172
Rivera 1949: fresh				
2 samples, sockeye & steelhead	67.7	22.0	9.13	176
Watt and Merrill 1963: fresh				
1 sample, Chinook	64.2	19.1	15.6	222
1 sample, pink	76.0	20.0	3.7	119
Watt and Merrill 1963: canned				
1 sample, Chinook	64.4	19.6	14.0	210
1 sample, chum	70.8	21.5	5.2	139
1 sample, Coho	69.3	20.8	7.1	153
1 sample, pink	70.8	20.5	5.9	141
1 sample, sockeye	67.2	20.3	9.3	171
AVERAGES	67.7	21.5	8.7	170

*kcal for fish is calculated on the basis of 4.27 kcal/g of protein and 9.02 kcal/g of fat (Watt and Merrill 1963).

TABLE 3.—*Estimates of salmon consumption (pounds/person/year), caloric yields (kcal/person/day), and percents of estimated MDR (2000 kcal/person/day).*

SOCIETY	Annual Consumption	Gross Caloric Yield	Calorie Loss Factor	Net Caloric Yield	% of MDR	*Atlas* Rating	Percent Difference
WISHRAM	400	676	.88	594	30	50	-20
TENINO	500	845	.87	735	37	50	-13
UMATILLA	500	845	.81	684	34	40	- 6
NEZ PERCE	300	507	.52	264	13	40	-27
	582	983	.52	511	26	40	-14
SINKAIETK	500	845	.67	566	28	40	-12
SANPOIL	500	845	.62	524	26	50	-24
COEUR D'ALENE	100	169	.25	42	2	30	-28
FLATHEAD	100	169	.25	42	2	40	-38
KUTENAI	300	507	.25	127	5	40	-35
CHILCOTIN	600	1014	.64	649	32	50	-18
SHUSWAP	500	845	.675	570	28	40	-12
LILLOOET	600	1014	.80	811	41	50	- 9
THOMPSON	900	1521	.81	1232	62	50	+12

Annual consumption figures are from Hewes (1973) except for the larger Nez Perce figure which is from Walker (1967). Calorie loss factors for the Fraser River groups, chilcotin, Shuswap, Lillooet, and Thompson, are from Kew (MS).[2] Gross caloric yields are derived from annual consumption figures by converting to kg/day and multiplying by 0.8, the edible portion. The calorie loss factor is calculated as the distance from the mouth of the Columbia River to the center of the particular group's range divided by the length of the main stem of the Columbia or, if the group occupied a tributary, by the distance to the limit of salmon migration on that tributary.[3] The resultant ratio is multiplied by 0.75, the fraction of caloric value lost by salmon in migration, and subtracted from 1.0. The net caloric yield is simply the gross caloric yield times the caloric loss factor.

The Contribution of Vegetable Staples

If no more than 30% of the calories come from fish, what might have supplied the rest? For the southern half of the Plateau there is solid evidence that the bulk of the remainder, and certainly in excess of 50% of the MDR, came from vegetable staples. The evidence is of 2 sorts. First, the following ethnohistorical and ethnographic observations may be used to estimate per capita consumption rates as they cite daily harvest rates, annual harvest totals, lengths of harvest season, and indicate elements of native procedure relevant to the estimation of harvest rates, such as the fact that roots are peeled before packaging.

> I saw a young woman at the Skitsoe village [Coeur D'Alene], who had collected and prepared sixty sacks of good Gamas [*Camassia quamash*], each sack containing 1-1/5 bushel; she was spoken of in the best terms throughout the village (Geyer 1845-1846, quoted in Hart [1976:16]).

> The digging of Gamass takes place as soon as the lower half of the flowers on the raceme begin to fade, or better, when the time of flowering has already passed (Ibid.).

> Gathering bitterroot was a tedious, although not difficult task. Women often worked three or four days to fill a fifty-pound sack. Each woman gathered at least two sacks, enough to sustain two people through the winter. A sack of bitterroot was worth . . . a horse, . . . (speaking of the Kutenai [Hart 1976:49]).

> The Sanpoil root digging grounds consisted of the entire portion of their territory lying south of the Columbia river, an area of over a million acres. . . . . the entire Sanpoil population moved from its winter home on the river and set up temporary quarters at various spots on this prairie early in April of each year. Here they remained for thirty to forty days, during which time the entire energies of the women were devoted to digging roots, for in this short period it was necessary to accumulate a sufficient supply to last the entire year. . . . Each woman dug over about one-half acre in one day. . . . The several varieties of camas [local vernacular for *Lomatium* spp., as well as the true camas, which does not occur in the region under discussion] were gathered in greatest quantity. Bitter root was second in importance. . .A good day of camas digging often netted as high as a bushel of roots. . . The skins of roots. . . were slipped off as they were dug, or more commonly at camp in the evening (Ray 1933:97-98).

> May and early June is the main collection season, . . . This root [*Lomatium cous*], along with camas, formed the bulk of the plant foods stored for winter use. A good digger gathered 50-75 pounds of /qamsit/ [*L. cous*] in a single day (speaking of the Nez Perce [Marshall 1977:52]). These different locations had camas marshes which matured at different times; the lowest, warmest ones were exploited in early to mid-June; the highest, collest [sic.] could be worked until September. . . Harbinger (1966) said that a good digger could gather 80-90 pounds per day of hard labor, while less intensive work would yield 40-50 pounds easily. . . My informants estimate that women gathered camas for two to three weeks (speaking of the Nez Perce, [Marshall 1977:55, 57]).

> People moving to the mountains for berries. They obtain at this season the large mountain huckleberry [*Vaccinium membranaceum*]. . .They are usually absent on these excursions [away form their village at the Dalles on the Columbia River], from four to six weeks; during which, each family lays in, for winter use, four or five pecks of nice dried berries (speaking of a Tenino-Wishram group, diary entry for August 19, 1843, of the missionary H. K. W. Perkins [Boyd MS*b*]).

The second source of consumption rates for vegetable staples is from my preliminary time-and-motion studies of contemporary Indian root-digging. One Umatilla woman, working at a normal pace and using the contemporary steel version of the traditional digging stick, dug 33 *L. cous* tubers/h, or 3.79 kg/h of peeled roots. I find that I can dig and "pocket" a *L. canbyi* tuber in 7 s. Allowing 3 s to find the next plant, we have 6/min or 360/h, which at 11.0 g/tuber (N=52) gives 3.96 kg/h. These estimates tend closely about a figure of 4 kg/h or a bushel (ca. 30 kg) in 7.5 h, not an unreasonable day's work. The close accord between the ethnohistorical/ethnographic estimates and my experimental figures is encouraging. These estimates are summarized in Table 4. The low value for the Kutenai bitterroot harvest cited is perhaps due to the fact that the Kutenai are on the northern fringe of that species' range (Daubenmire 1975), and the high value for the Flathead camas harvest is noted as a remarkable achievement (Geyer, in Hart 1976:16).

Per capita caloric consumption is based on a producer/consumer ratio of 1:4 with kcal/100 g standards as in Table 5. The harvest periods of tubers in spring, camas in summer, and huckleberries in fall were largely distinct. Thus we may add the estimates for spring tubers, camas, and the berry harvest to arrive at a rough but conservative annual per capita consumption figure:

SPRING (*Lomatium* spp. and bitterroot)	900 kcal
EARLY SUMMER (camas)	400 kcal
LATE SUMMER/FALL (huckleberries)	50 kcal
ESTIMATED ANNUAL PER CAPITA CONSUMPTION	1350 kcal

This figure is more than double the estimated contribution from salmon for this area and 67.5% of the estimated MDR. Compare this to the 30% "subsistence dependence" attributed by Murdock to the Wishram, Tenino, Umatilla, Nez Perce, Sinkaietk, Sanpoil, Coeur D'Alene, and Flathead, all known to have harvested several of these species in quantity.

It might be argued that harvests were not continuous during the periods of resource maturity. It is certainly true that women were called upon to preserve both fish and game harvested by the men. However, length of harvest figures cited in Table 4 are generally conservative.[4] Transport of the harvest to the winter villages might also pose problems, given the quantities involved, especially in prehorse times. However, spring roots and huckleberries were dried before transport reducing their weight by over 50%. In addition, there were many other fruits, berries, tubers, bulbs, and greens eaten on the spot which have not been included in this estimate. Thus 1350 kcal/person/day from gathering seems reasonably applicable throughout the southern Plateau. The more northerly groups generally lacked these staples, relying instead on a variety of liliaceous bulbs other than

TABLE 4.—*Estimates of plant food harvest rates (kg/woman/day), total harvests (kg/women/year), and caloric yields (kcal/person/day).*

SPECIES	Estimated Daily Harvest	Harvest Period/ Days	Total Annual Harvest	kcal Yield	Locale
SPRING:					
Lomatium canbyi	30	30-40 *	1050	800	Sanpoil[1]
Lomatium cous	22.7-34.1	ca. 40	1136	988	Nez Perce[2]
	33.3*	ca. 30	999	869	Umatilla[3]
Lewisia rediviva	30.3*	ca. 60	1818	1121	Umatilla[3]
	6.5	7	45	28	Kutenai[4]
EARLY SUMMER:					
Camassia quamash	36.4-40.9	14.21	677	524	Nez Perce[2]
	18.2-22.7	14-21	358	277	Nez Perce[2]
			2160	1672	Flathead[5]
LATE SUMMER/FALL:					
Vaccinium spp.		28-42	63.9-80.2	31	Tenino-Wishram[6]
			98	42	Umatilla[3]

Sources: (1) Ray 1933, (2) Marshall 1977, (3) Hunn and French MS, (4) Hart 1976, (5) Geyer 1845-46, Boyd MS*b*.
Note: Ranges of values are averaged for subsequent calculations.
*Based on 8-hour days.

camas, such as *Fritillaria* spp., *Erythronium grandiflorum* Pursh, and *Lilium columbianum* Hanson in Baker, and to a more considerable extent upon hunting (Palmer 1975a).

On Measuring Subsistence Dependence

The data compiled here do not demonstrate that the *Atlas* subsistence scale is incorrect, only that those scales cannot be reliably interpreted in caloric terms. Murdock's figures are based on ethnographic reports that are almost without exception mere impressions. For example, his rating of the Sanpoil as "32500" (i.e., 26-35% gathering, 16-25% hunting, 46-55% fishing, 0-5% animal husbandry and agriculture) is clearly in accord with Verne Ray's characterization of Sanpoil subsistence emphases. Gathering, says Ray, the Sanpoil ethnographer of record, is but "a valuable supplement to the meat and fish that hold first place in the diet of the Sanpoil (1933:97)." Ray devotes 20 pages each to fishing and hunting among the Sanpoil and but 9 to fruits and vegetable products. Yet Ray's own statements on the spring root harvest (quoted above) proves the contrary. Clearly the *Ethnographic Atlas* reflects both the bias of the ethnographer and of *his* informants for the less predictably available foods (cf. Lee 1968:40, for a similar informant bias among the Bushmen), which seem most always to be the special task of men to pursue.

In the final analysis, subsistence dependence cannot be reduced to calories. Though calories are the body's first and largest requirement, survival obviously requires an adequate balance of nutrients over the long run. Salmon provided protein in more than adequate amounts, a nutrient the region's starchy staples largely lack. And salmon is rich in Vitamins, especially A and D (Rivera 1949). Game might be relied upon when other foods were in short supply. Fruits and berries, even lichens (Turner 1977), contributed other vitamins and a variety of mineral nutrients, while "Indian celeries," eagerly sought in late winter and early spring after a winter on a diet of dried stores, are rich sources of Vitamin C.[5]

To single out one resource, one nutritional requirement, or one sex as the key to understanding the success of hunting-gathering adaptations is to miss the point entirely. Human foragers survived to colonize nearly the entire land surface of the earth by virtue of judicious selection of an ample and varied diet from an extensive, empirically sound folk biological inventory of the flora and fauna. To argue that either men or women were of paramount importance in the evolutionary history of the human species is to ignore the most human ecological characteristic, familial economic cooperation.

TABLE 5.—*Plant food proximal analysis used, per 100 g.*

SPECIES	G Water	G Protein	G Fat	G Carbo-hydrate	kcal
Lomatium canbyi					
av. 6 dried root samples[1]	11.68	2.58	1.48	82.41	352
same, adjusted for water content	71.9	0.9	0.47	26.22	112
1 sample, fresh[2]	71.9	0.8	0.12	25.9	108
Lomatium cous					
1 sample, fresh[2]	67.9	1.0	0.4	30.0	127
Lewisia rediviva					
1 sample, fresh[2]	76.6	0.7	0.1	21.6	90
Camassia quamash					
1 sample, fresh[2]	70.0	0.7	0.23	27.1	113
Vaccinium sp.					
blueberries, raw[3]	83.2	0.7	0.5	15.3	62

Sources: (1) Washington MS, (2) Benson et al. 1973, (3) Watt and Merrill 1963.

CONCLUSIONS

I have summarized evidence which demonstrates that the importance of vegetable resources gathered by women as sources of food energy is not confined to Bushmen or Australian Aborigines. Nor do plant foods play an insignificant role everywhere above 40° latitude. Murdock's *Ethnographic Atlas* "subsistence dependence" code summaries to the contrary, the food-collecting societies of the southern half of the Columbia-Fraser Plateau of northwestern North America (at ca. 45° - 48° N latitude) obtained in the neighborhood of 70% of their food energy needs from plant foods harvested by women. The wide divergence between the *Atlas* summaries and comparable figures based on the best available evidence for this region, raise serious doubts about the general validity of the *Atlas* subsistence codes.

ACKNOWLEDGMENTS

My research in Plateau ethnobiology has been supported by NSF grant BNS 76-16914 and by grants from the Melville and Elizabeth Jacobs Research Fund, Whatcom Museum Foundation, and the Graduate School, University of Washington. This work has also benefited from the collaboration and assistance of the Kamiakin Research Institute of the Yakima Indian Nation, and the Botany and Nutritional Sciences departments of the University of Washington.

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NOTES

1. These studies include research with Wishram and Tenino by D. and K. French, Umatilla and Yakima by E. Hunn, Nez Perce by A. Marshall, Wanapum and Sinkaietk by N. Washington, Thompson, Lillooet, and Okanagan Colville by N. Turner and the British Columbia Indian Language Project, Kutenai and Flathead by J. Hart, and Shuswap by G. Palmer (Hart 1974; Hunn and French MS, Marshall 1977; Palmer 1975a, 1975b; Turner 1973, MS; Turner, Bouchard, and Kennedy 1980; Washington MS).
2. Kew's calorie loss ratios are almost certainly overestimates since he states that, "Total caloric value of a sockeye measured at the river mouth will be reduced to nearly one half when it reaches the Upper Stuart spawning grounds ..." (MS:6). Idler and Clemens cite losses of 69.1% for males and 79.8% for females at the time of death on the Stuart Lake migration path (1959:18).

3. For the groups cited here, the Wishram mid-range is taken as the Dalles (Columbia River mile 190), the Tenino at the Deschutes River mouth (Columbia River mile 202), the Umatilla at the mouth of the river of that name (Columbia River mile 300), the Nez Perce at the confluence of the Clearwater and the Snake Rivers (Columbia River mile 324 + Snake River mile 140), the Sinkaietk at the mouth of the Okanogan River (Columbia River mile 534), the Sanpoil at the Sanpoil River mouth (approximately Columbia River mile 615), the Coeur D'Alene at Spokane Falls, limit of salmon migration on the Spokane River, the Flathead at Metaline Falls, limit of salmon migration on the Clark Fork-Pend O'Reille River, and the Kutenai at the head of migration on either the Columbia River (Columbia Lake) or the Kootenai River (below Kootenay Lake). Limit of migration on the Snake River is at Upper Salmon Falls (approximate Snake River mile 400). Mileage figures abstracted from Fagot (1970:111-124) and United States House of Representatives (1952).
4. In 1978 *L. canbyi* was exceptionally early and could have been harvested as early as February. In 1979 *L. canbyi* and *Lewisia rediviva* were commonly available up to ca. 600 m elevation by April 1. In 1977 *L. cous* and *Lewisia rediviva* were still being harvested by Umatilla Indians at 1400 m in the Blue Mountains of Oregon on June 22. Since camas may be harvested into September (Marshall 1977:57), a root harvest period of 100+ days is possible.
5. Benson et al. cite 66 mg/100 g ascorbic acid for the young growth of *Lomatium nudicaule* (Pursh) Coult. & Rose (1973:145), an important "Indian celery" of the region.