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Weeds as a source for human consumption. A comparison between tropical and temperate Latin America

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Abstract: Weeds abound in urban and agricultural environments. Depending on region and site, up to 66% of weed species are edible, and may constitute an additional food source for humans. Based on 400 samples, $^1/_4$ m^2 each, collected in tropical areas (e.g., roadsides, urban vacant lots, streets, sugar cane and coffee plantations in Coatepec, Mexico), average figures of edible fresh biomass vary between 1277 and 3582 kg/ha. A similar survey performed in a temperate area (739 samples in Bariloche, Argentina) showed mean values between 287 and 2939 kg/ha. A total of 43 species were sampled in Coatepec and 32 species in Bariloche. The general means were 2.1 and 1.3 tons/ha, respectively. At a greater geographic scale, a comparison between Mexican and Argentine weeds shows that, proportionately, the food parts vary a little between regions. In general, from higher to lower, the order of uses goes from leaves, seeds, roots, fruits, herbals, flowers and condiments. Edible roots (including bulbs and rhizomes) appear to be more common among perennials than among annuals.

Key words: Argentina, Bariloche, Coatepec, edible weeds, food plants, gathering, Mexico, Patagonia, urban flora.

Although plants have sustained the hunting and gathering peoples since the Paleolithic, the prevailing knowledge about edible species began to be lost since the invention of agriculture in the Neolithic. Two well-preserved mummies found in Denmark, provided interesting information on food habits during the Iron Age. Their last meals contained 66 different plant taxa (Godwin 1960; King 1966), i.e., a diet much more diversified than that of modern man. According to FAO's Production Yearbooks, developed countries, and especially urban populations, began to depend almost entirely on the extensive and intensive agricultural production consisting in merely a little more than 100 food plants. Part of the old tradition is still maintained in some Latin American and eastern Asian countries. In Mexico, more than 20 "weeds" are also cultivated (Linares and Aguirre 1992). For instance, in Korean local markets 112 wild plants are sold at prices higher than those of cultivated species. Moreover, eleven species (some of them "weeds") are exported to the U.S.A. and used to prepare Korean and Chinese typical dishes (Pemberton and Lee 1996). Similarly, Moroccan weeds are exported with the same purpose to the U.S.A., Spain, Italy and Greece (Tanji and Nassif 1995).

The use of edible wild plants and weeds has been considered by several authors (Harris 1969, Kunkel 1984, Facciola 1990, Zurlo and

Brandão 1990, Duke 1992, Linares and Aguirre, eds. 1992, and references there). Some of these books only provide extensive lists of species, with indications of their edible parts, while others add descriptions and illustrations of the species. Clarke (1977), Michael (1980), and Linares and Aguirre (1992) include numerous recipes. Edible weeds, however, are scarcely used in many countries, and weed gathering is more of a weekend hobby than a regular source of food supply.

To our knowledge, no attempts have been made to assess quantitatively the potential amount of food provided by common weeds and escapes.

Our interest was to evaluate the available biomass of human food provided by weeds in urban, periurban and field habitats in the northern and southern Neotropical region. We tried to compare two samples obtained in different climatic regions, i.e., tropical (Coatepec, Mexico) and temperate to cold-temperate (Bariloche, Argentina) areas.

MATERIALS AND METHODS

The environments selected were abandoned fields, main (paved) roads, secondary roads (suburban dirt roads), pathways, vacant urban and suburban lots. Sugar cane fields, milpas, coffee plantations (only Coatepec), and orchards (only Bariloche) were also considered. In these cases, we gathered and weighed all the edible parts of species appearing in 0.25 m^2 quadrats (50 x 50 wooden frames). Along roadsides (haphazardly selected), we sampled at repeated 1 km distances, by laying ten quadrats regularly at 2 m distance each, parallel to the pavement. Urban vacant lots and fields were randomly sampled. The frames were laid along a random walk using a stopwatch to select compass direction and number of steps. The collected plants of each sample were kept in plastic bags and transported to the laboratory, separated by species and their edible portions were weighed with 0.01 g precision. Water content was calculated after 72 hr dehydration at 60-80 ° C (Rapoport *et al.* 1995). Additionally, in some cases, the yields were assessed in terms of biomass collected per minute of harvesting. This survey was performed in order to evaluate whether there is any profit in gathering a given species in sites where it is abundant. In this way, we were in the position of a person searching for food. The analysis of the proportions of edible parts (roots, leaves, fruits, seeds) of all Mexican and Argentine weed species was obtained from Kunkel's (1984) list, and from our own records. Comparisons of fresh edible weights among habitats were made by means of Kruskal-Wallis tests. The comparison of total fresh weights between Mexico and Argentina was made by means of a Mann-Whitney test. In the case of significant differences, the Student-Newman-Keuls' test of multiple comparisons was applied. The detailed statistical analysis of data is reported elsewhere (Ladio *et al.* 1998).

The main roads sampled in Bariloche were roads No. 258 (Bariloche-El Bolsón), No. 237 (Bariloche-Alicura and Bariloche-Airport) and No. 237 (Bariloche-Llao Llao). In Coatepec, the road sampled was Carretera Briones.

CLIMATE

Comparative data on climates appear in Table 1.

RESULTS

The majority of the sampled species appear in Kunkel's (1984) list of food plants, to which we added *Osmorhiza chilensis*, from Argentina, and *Drymaria gracilis*, *Galinsoga quadriradiata*, *Hydrocotyle bonariensis*, *Hydrocotyle mexicana*, *Margaranthus sulphureus*, *Oxalis latifolia*, *Sida glabra*, *S. spinosa*, and *Tripogandra*, *serrulata* from Mexico. These plants are commonly consumed by people and were repeatedly tasted by us.

In total, 43 species were recorded in Coatepec and 32 species in the Bariloche samples

TABLE 1

Comparative characteristics of both areas

	Coatepec	Bariloche
Altitude	1,252 m	750 m
Latitude	19°27° N	41° 08' S
Longitude	96° 57° W	71° 08-71° 36' W
Mean annual precipitation	2250 mm*	1000 mm**
Mean annual temperature	18.8° C	8.4 °C
Coldest month mean temp.	15.2°(Jan.)	2.3° (July)
Hottest month mean temp.	21.4 °C (May & June)	14.5 °C (Feb.)
Extreme temperature	3.9 to 33.5 °C	-18 to 35.5 °C
Prevailing winds	N & NW (winter), E, S & SE (spring, summer & fall)	W
Climate	A C (fm) w"a(i')g	GCs lk (Mediterranean regime)
Population	40,000	100,000
Source	Gómez and Soto 1990	Rudloff 1981; Grigera *et al.* 1989; UNC 1983

* Rains all year round, although more intense in summer.
** Rains and snow, with maximum precipitation in winter. Precipitation varies from 800 mm in the eastern to 1.600 mm/yr in the western parts of the city.

(Tables 2 and 3). They represent, however, a small fraction of the real richness in both areas. More than 24% of the 700 weeds listed in Mexico by anonymous (1991) are edible. Of the 320 exotic weeds recorded in northwestern Patagonia (Rapoport and Brión 1991), 90 species (28%) are edible.The Catalogue of Mexican Weeds (anonymous 1991) includes 168 edible species of which 36.3% are perennial and 63.7% annual and/or biennial. Similarly, in Argentina, the proportions are 35.0% and 65.0%, respectively, from a total of 160 edible weeds that are mentioned in Marzocca et al. (1976). Perennials show a significantly higher proportion of edible roots (including tubers or rhizomes) and herbals than among the annual-biennia species ($P = 0.027$ and 0.021, respectively; Table 4). In contrast, annual-biennials show a greater proportion of edible leaves and seeds than perennials ($P = 0.008$ and 0.012, respectively) as showed by means of a 2 x 2 contingency table.

Yields per hectare: Because the number of sites surveyed and the number of samples per site were numerous, we made a tentative assessment of the amount of food ava lable per hectare (Table 5). In the case of plantations and orchards, cultivated plants were not included. Coatepecan yields (2.1 tons, on average, per hectare) were apparently higher than the Barilochean yields (1. 3 tons per hectare). The extreme maximum yield was recorded on a main road between Coatepec and Xalapa (10,158.0 kg/ha) based on 10 samples taken in January 1996, and on a vacant lot in Bariloche (7,542.9 kg/ha) based on 7 samples taken in December 1996. When comparing equivalent Coatepecan and Barilochean environments by means of a Mann-Whitney test, the differences were not significant ($P>0.05$). However, the differences in the median values among total yields per hectare of Mexico and Argentina were significant ($U = 880$; $P = 0.03$)

Gathering harvest. Species' yields: The following data correspond to fresh weights of the edible parts obtained per species in a given period of time. Sites were selected for their special abundances, from the point of view of a person searching for food. The process of gathering in Mexico took 15 minutes for each sample (five samples per species) and the mean values are presented per minute (Table 6).

In Bariloche, only three species were evaluated. (i) *Taraxacum officinale* (8 sampling sites, 21 minutes total gathering time). Depending on its abundances, yields varied

TABLE 2

Coatepec, Mexico. Mean available food (fresh weight in grams) per 0.25 m² sample and frequencies (number of times each species was found in 100 samples); SD = standard deviation

Species	Vacant lots			Dirt roads & pathways			Plantations			Highways		
	mean weight	S.D.	freq.	mean weight	S.D.	freq.	mean weight	S.D.	Freq.	mean weight	S.D.	freq.
Acalypha wilkesiana	-	-	-	-	-	-	6.68	6.17	7	1.57	1.01	5
Amaranthus dubius	0.93	1.02	3	50.60	49.45	3	0.40	0.00	1	-	-	-
Amaranthus hybridus	30.71	34.22	6	6.53	5.29	3	-	-	-	17.63	27.05	14
Amaranthus spinosus	6.10	5.32	8	47.68	0.00	1	-	-	-	-	-	-
Anagallis arvensis	1.23	0.90	2	0.84	0.46	4	0.27	0.00	1	2.35	1.62	8
Bidens odorata	9.32	10.36	30	5.20	6.26	24	5.69	5.97	14	5.86	7.57	31
Brassica rapa	-	-	-	-	-	-	3.07	2.30	4	-	-	-
Canna indica	-	-	-	16.23	0.00	1	-	-	-	-	-	-
Chenopodium ambrosioides	-	-	-	59.32	0.00	1	4.03	0.00	1	13.29	0.00	1
Commelina diffusa	5.77	5.44	48	5.16	6.66	43	11.19	14.76	59	45.20	56.56	59
Commelina erecta	20.90	14.25	3	12.21	6.82	5	34.67	46.29	40	-	-	-
Drymaria cordata	5.32	6.65	27	1.31	1.46	15	5.92	7.73	24	0.92	0.45	2
Drymaria gracilis	7.04	6.71	9	6.54	9.46	12	3.45	8.18	10	34.66	74.19	27
Galinsoga quadriradiata	6.46	7.74	20	2.95	2.83	26	7.15	10.88	17	14.20	15.61	42
Heliconia caribaea	-	-	-	342.81	204.63	3	-	-	-	-	-	-
Hydrocotyle bonariensis	13.95	17.83	19	1.30	1.06	13	6.57	4.16	3	-	-	-
Hydrocotyle mexicana	1.99	1.56	3	7.38	11.24	9	-	-	-	-	-	-
Ipomoea purpurea	-	-	-	-	-	-	-	-	-	5.08	4.83	16
Ipomoea tilliacea	-	-	-	-	-	-	-	-	-	5.09	4.38	7
Ipomoea triloba	4.04	5.58	23	7.62	11.94	8	7.09	6.95	3	6.42	4.39	7
Margaranthus sulphureus	6.72	7.87	6	-	-	-	-	-	-	-	-	-
Oxalis corniculata	1.97	2.86	40	2.79	4.18	43	2.14	1.91	34	2.60	3.96	42
Oxalis latifolia	1.70	1.61	14	4.92	5.75	17	9.28	16.28	45	3.43	4.87	20
Phaseolus vulgaris	-	-	-	-	-	-	-	-	-	0.70	0.26	10
Piper auritum	-	-	-	23.92	0.00	1	-	-	-	35.99	24.18	2
Plantago hirtella	-	-	-	1.75	1.09	3	-	-	-	3.35	0.00	1
Plantago lanceolata	-	-	-	158.62	0.00	1	-	-	-	-	-	-
Portulaca oleracea	-	-	-	-	-	-	10.38	0.00	1	0.61	0.26	2
Rumex obtusifolius	25.57	27.19	10	15.66	9.64	10	26.26	29.43	18	25.70	19.68	11
Sida acuta	-	-	-	-	-	-	2.09	1.59	2	-	-	-
Sida glabra	1.33	0.00	1	-	-	-	-	-	-	-	-	-
Sida rhombifolia	5.78	7.02	49	4.37	2.19	17	-	-	-	3.74	4.51	14
Sida spinosa	2.87	2.26	10	14.05	12.59	8	5.41	6.87	4	-	-	-
Solanum nigrum	3.75	3.62	3	9.70	0.00	1	-	-	-	-	-	-
Sonchus oleraceus	8.99	2.05	2	22.13	14.96	3	-	-	-	-	-	-
Spilanthes americana	10.24	10.75	34	13.52	23.17	20	15.65	14.97	30	12.68	17.63	32
Tagetes micrantha	-	-	-	-	-	-	-	-	-	11.63	0.43	2
Taraxacum officinale	0.39	0.00	1	-	-	-	-	-	-	6.41	5.61	4
Tradescantia fluminensis	0.20	0.00	1	62.58	50.66	2	2.69	2.48	3	75.66	97.45	33
Trifolium repens	-	-	-	2.51	3.29	14	-	-	-	8.39	7.19	5
Tripogandra serrulata	13.27	28.39	22	10.71	13.54	11	20.88	20.08	55	-	-	-
Xanthosoma robustum	16.53	15.85	10	14.48	16.79	10	18.68	13.15	7	10.08	8.30	7
Youngia japonica	6.73	14.67	15	3.19	2.64	9	3.33	3.53	19	2.94	10.68	17

TABLE 3

Bariloche, Argentina. Mean available food (fresh weight in grams) and frequencies (f) per 0.25 m² sample. S.D.= standard desviation

Species	Dirt roads & Pathways			Highways			Vacant lots			Orchard			Aband. fields		
No. samples	191			210			178			65			80		
	mean weight	S.D.	f	mean weight	S.D.	f	mean weight	S.D.	f	mean weight	S.D.	f	mean weight	S.D.	f
Achillea millefolium	0.04	0.13	1	-	-	-	-	-	-	-	-	-	0.18	0.39	1
Alstroemeria aurea *	-	-	-	-	-	-	0.31	1.08	2	-	-	-	-	-	-
Berberis buxifolia *	-	-	-	-	-	-	0.02	0.06	1	-	-	-	-	-	-
Brassica rapa	2.88	3.90	18	2.83	4.73	26	3.39	4.58	23	14.36	10.99	24	0.35	0.77	1
Cichorius intybus	-	-	-	1.39	3.10	1	-	-	-	-	-	-	-	-	-
Cirsium vulgare	-	-	-	0.07	0.16	1	-	-	-	-	-	-	-	-	-
Claytonia perfoliata	-	-	-	-	-	-	0.13	0.44	6	-	-	-	-	-	-
Cytisus scoparius	-	-	-	-	-	-	0.01	0.02	1	-	-	-	-	-	-
Chenopodium album	3.16	6.36	5	14.09	21.00	6	4.94	10.50	10	21.71	14.87	36	1.49	3.34	2
Chrysanthemum leucanthemum	0.80	0.30	3	0.03	0.06	1	2.65	4.99	24	-	-	-	-	-	-
Hypochoeris radicata	0.44	0.96	4	1.12	0.66	11	0.10	0.29	4	-	-	-	-	-	-
Lactuca serriola	0.21	0.65	1	-	-	-	-	-	-	-	-	-	-	-	-
Malus sylvestris	1.34	4.22	1	-	-	-	-	-	-	-	-	-	-	-	-
Malva sylvestris	0.22	0.71	1	-	-	-	-	-	-	-	-	-	-	-	-
Medicago lupulina	-	-	-	0.03	0.06	1	-	-	-	-	-	-	-	-	-
Melilotus albus	-	-	-	10.65	9.81	21	0.29	0.71	2	-	-	-	-	-	-
Mentha spp.	-	-	-	-	-	-	10.14	34.48	2	-	-	-	-	-	-
Oenothera odorata *	0.92	1.76	6	2.65	2.89	28	0.04	0.14	2	-	-	-	-	-	-
Osmorhiza chilensis *	0.17	0.54	1	-	-	-	0.72	1.54	6	-	-	-	-	-	-
Papaver rhoeas	-	-	-	-	-	-	0.01	0.02	1	-	-	-	-	-	-
Plantago lanceolata	7.89	4.54	67	14.61	10.70	112	2.28	1.54	28	0.01	0.02	1	-	-	-
Rumex acetosella	1.60	1.24	25	3.08	2.46	34	3.38	4.83	22	34.46	74.70	9	3.35	2.75	19
Rumex longifolius	-	-	-	0.39	0.88	1	-	-	-	-	-	-	-	-	-
Sanguisorba minor	-	-	-	0.55	1.24	3	-	-	-	-	-	-	-	-	-
Silybum marianum	0.24	0.76	1	-	-	-	-	-	-	-	-	-	1.02	1.21	-
Sonchus asper	-	-	-	0.12	0.27	1	-	-	-	-	-	-	-	-	-
Sonchus oleraceus	-	-	-	2.21	4.72	7	-	-	-	-	-	-	-	-	-
Stellaria media	-	-	-	-	-	-	4.40	15.19	1	-	-	-	-	-	-
Taraxacum officinale	3.25	3.89	27	8.46	11.39	14	4.14	4.54	30	3.69	6.87	2	-	-	-
Tragopogon dubius	0.04	0.14	1	-	-	-	0.03	0.10	1	-	-	-	-	-	-
Trifolium repens	0.05	0.16	1	-	-	-	0.01	0.04	1	-	-	-	-	-	-

* native species

TABLE 4

A comparison of food parts in Mexican (168 species) and Argentine (160 species) weeds

	México		Argentina	
	Perennials (%)	Annuals/ Biennials (%)	Perennials (%)	Annuals/ Biennials (%)
Roots, rhizomes	15.4	7.7	19.1	8.0
Leaves, stems, buds	30.7	44.0	41.2	54.0
Flowers	4.4	3.5	8.8	4.3
Fruits	13.2	10.5	8.8	2.2
Seeds	19.8	26.6	11.8	24.8
Condiments	4.4	2.8	4.4	5.1
Herbals (tea, coffee)	12.1	4.9	5.9	2.2

TABLE 5

Assessment of available food per hectare

Coatepec	No. samples ($0.25\ m^2$)	Mean fresh weight yield (kg/ha)	sd
Plantation (coffee, sugar cane)	100	2031.3	1285.2
Urban & suburban vacant lots	100	1277.1	663.5
Streets and pathways	100	1453.4	1441.1
Main roads	100	3582.4	3051.0
Bariloche			
Abandoned fields	80	287.2	219.2
Urban & suburban vacant lots	193	1253.5	392.8
Orchards	65	2938.8	3064.0
Streets and pathways	191	1008.0	524.0
Main roads	210	1326.6	460.0

TABLE 6

Food yield (g) per minute in Coatepec, Mexico. Mean values based on 5 samples

Species	Coffee plantations	Sugar cane plantations	Dirt roads	Vacant lots
Bidens odorata	-	5.3	-	-
Commelina diffusa	11.8	12.8	13.8	-
Commelina erecta	18.2	-	-	-
Drymaria gracilis	14.6	10.8	-	-
Galinsoga quadriradiata	2.3	-	-	-
Heliconia caribaea	-	-	110.2	-
Hydrocotile bonariensis	4.8	-	-	1.7
Hydrocotyle mexicana	-	-	4.0	-
Oxalis latifolia	-	-	4.5	-
Rumex obtusifolius	23.8	-	37.8	-
Sida rhombifolia	-	-	-	5.0
Spilanthes americana	5.2	4.9	-	6.0
Xanthosoma robustum	33.2	29.4	15.0	21.6

between 9.1 and 36.4 g/min, with a mean of 17.0 ± 8.8 g/min. (SD) of leaf blades without their central nerves. (ii) *Chenopodium album* (3 samples, 9 minutes gathering time). Yields were from 38.3 to 56.3 g/min, with a mean of 48.0 ± 9.1 g/min. Only leaves and tender apical stems were considered. (iii) *Montia perfoliata* (11 sampling sites, 40 minutes total gathering time). Yields from 31.0 to 239.6 g/min, with a mean of 80.4 ± 65.0 g/min. Leaving aside the figures obtained in *Heliconia caribaea*, which represents a special case for its edible roots, yields seem more productive in Bariloche than in Coatepec. Outstanding biomasses are produced by *Montia perfoliata*, a North American invader of Patagonian urban forests.

The most profitable plants in Bariloche: *Montia perfoliata (=Claytonia perfoliata)*

This species shows clear capabilities to recover after harvesting. During the 1995 growth season, in Bariloche we measured the fresh biomasses of three $0.25\ m^2$ plots completely dominated by *M. perfoliata.* The procedure was repeated on the same plot ca. 30 and 60 days later, with the following results (in grams).

	October	November	December	Totals
Plot A	138.6	115.1	22.3	276.0 g.
Plot B	487.9	141.9	96.7	726.5 g.
Plot C	381.0	398.6	48.5	828.1 g.

On the basis of 34 samples where *M. perfoliata* was abundant, food biomasses varied from 108.5 to 973.6 g per $0.25\ m^2$ plot. Mean value 275.9 ± 210.6 g (SD). The aerial parts of this plant are 100 % edible. Average water content varied around 78.5 ± 7.3 %.

Plantago lanceolata

Leaf fresh weight per $0.25\ m^2$ plots (n = 25 plots) showed figures ranging from 39.2 to 309.2 g. Mean value 124.1 ± 60.2 g. Seeds should be added to this food source. At the end of the summer, we selected three $1\ m^2$ plots showing ripe fruits. On average, there were

TABLE 7

Proportions of food plants in different biomes and communities

Total No. spp.	No. edible spp.	%	Site	Source
Natural Ecosystems				
18,956	1,112	6	North America. Food plants used by the aboriginal populations	Duke 1992*
2,500	375	15	Sonoran Desert	Felger & Nabhan 1978*
430	26	6	Tierra del Fuego, Ona Indians (1)	Martínez-Crovetto 1968
360	75	21	Bolivian Amazon	Boom 1987
275	11	4	Peruvian Amazon (only fruit trees considered)	Peters *et al.* 1989
Anthropic Ecosystems				
653	124	19	SW Córdoba Province, Argentina	Bianco & Cantero 1992
446	77	17	W Uruguay, E Entre Ríos Prov., Argentina, S Brazil (Salto Grande Dam)	Lema 1988
165	55	33	Parque La Chata, La Habana, Cuba	E.H. Rapoport, C.R. Martínez, P. Herrera (unpublished)
Strictly Weeds				
51	31	61	Experimental Field, Saskatchewan	Derksen *et al.* 1993
14	6	43	Slash & burn, NE India	Misra *et al.* 1992
761	177	23	Weed Catalog, Argentina	Marzocca *et al.* 1976
300	90	30	Weeds and escapes, NW Patagonia	Rapoport & Brión 1991
200	59	30	Random sample, World Weeds	Rapoport unpublished
40	20	50	Most common weeds of Cuba	Sánchez & Huranga 1970
176	51	31	Urban weeds, Rosario City, Argent.	Franceschi 1996
168	111	66	Canadian weeds	Frankton & Mulligan 1977
422	177	42	U.S.A. weeds	Wilkinson & Jaques 1979
305	137	45	Xalapa City, Mexico	Domínguez-Barradas 1995
18	16	89	World's most aggressive weeds	Holm *et al.* 1977

* Data provided by the authors. The rest was assessed by us in Kunkel's (1984) list and our own records.

(1) Of the 9 Ona Indians extant only 6 were interviewed. They were very old people and only one woman used Shelknam language exclusively. Of the 430 native vascular species of the island 24 were used as food (5.6 %). Two additional native edible plants were ignored by the reporters. From 128 exotic species only Hypochaeris radicata and Taraxacum officinale were included in their diets, although there are 7 more species which appear as edible in Kunkel's list.

356.0 ± 38.4 spikes/m^2 in high density patches. Each spike may contain about 500 seeds measuring 2 mm each, showing about 36 % abortions. Viable seeds were assessed in 162.1 g/m^2. Although the process is laborious (about one hour-person to screen the seeds of one square meter), it is useful to know that a one hectare monospecific plot may yield more than 1.5 tons of seeds, in addition to almost 5 tons of leaves. Of course, it would imply the design of adequate mechanical technology to accelerate the process of screening seeds. Average water content of leaves varied around 78.6 ± 4.9 %.

Rumex acetosella

Yields vary between 8.9 and 186.7 g/0.25 m^2. Mean 53.3 ± 47.9 g (n = 15 samples). The species is widely distributed in disturbed and undisturbed habitats, especially in surrounding grasslands and pasturelands. Average water content varied around 77.1 ± 4.6 %.

Taraxacum officinale

Yields vary between 11.2 and 107.4 g/0.25 m^2 (central ribs excluded). Mean 47.2 ± 27.6 g (n = 17 samples). Average water content varied around 82.2 ± 4.7 %.

DISCUSSION

Common weeds prove to be an interesting resource in small to medium-sized human settlements where they may provide supplementary food. In large cities, suburban populations may also profit from edible weeds. The data from Table 7 show that edible, non-weedy plants comprise between 6 and 21 percent of the biomass of the natural communities surveyed. The proportion of edible plants increases considerably in anthropic environments, especially in weed communities. Roughly, ten percent of the 260,000 known vascular species of the world should be considered as a potential source for human consumption. It is probably not by mere chance that the majority of the centers of origin or domestication of cultivated plants proposed by Vavilov (1938) corresponded to ancient, sedentary cultures. The idea that civilizations arose in areas with abundant edible plants adequate for culturing is probably incorrect. Since edible plants abound everywhere, it seems that civilizations developed in any environment where for historical reasons, people had time enough to exploit their natural resources in a more permanent and intensive way. By selection, plants originally wild, began to be more productive and adequate for human consumption. Rye, oats, carrots and several other cultivated plants originated as weeds, a fact that gives a clear idea of the enormous potential of weeds and other wild non-weedy plants as a source for new cultures. The economic incentive provided by the revival of ancient gastronomic traditions persuaded some private entrepreneurs to change from the occasional gathering to a more permanent cultivation of "weeds". Popular markets in Mexico (Linares and Aguirre 1992) and Korea (Pemberton and Lee 1990) offer a variety of gourmet "weeds" at higher prices than the common vegetables.

A case of human-livestock-plant mutualism is mentioned by Kuznar (1993), especially referred to species of *Chenopodium* proliferating in unusual concentrations in corrals. Herd animals transport these forage species to pastoral campsites where the plants thrive in the organic corral soils. This creates a mutually beneficial relationship where certain plant species become camp followers of pastoral campsites. This is the process by which plant invaders reach the status of weeds first and, later on, the status of cultivars, according to Vavilov (1938). And this process may explain the fact that the majority of the most aggressive and cosmopolitan weeds are edible. Initially, plant domestication began early, and in an unconscious way, probably in the Paleolithic Age, in primitive hunter-gatherer cultures (Rapoport et al. 1995). It is interesting to note that leaf-cutting ants (*Acromyrmex*), as determined by Farji-Brener (1996), show clear foraging preferences for exotic ruderal weeds which, according to Coley *et al.* (1985), are plants that invest more energy in reproduction, growth and dispersal than in anti-herbivore chemical defenses. It is suggestive that 52% of the early introductions (archaeophytes) in Poland listed by Trzcinska (1982) are edible.

Our results show that in anthropic habitats there are immense amounts of edible plants which are not always totally profited from. This is clearly evident in Argentina where people have almost lost the ancient practice of gathering wild food plants. In a tropical area such as Coatepec, the overall 'standing crop' averages 2.1 tons/ha whilst in temperate Bariloche it reaches 1.3 tons/ha. Tropical weeds are richer in species number and more productive than temperate weeds. The latter are almost absent during the long winter season, although they can be dehydrated and cooked during the cold season.

Because a significant sector of the Argentine population suffers from serious problems of malnutrition, the Universidad del Comahue and Municipalidad de Bariloche published a booklet (Rapoport *et al.* 1997) illustrating the 20 most common edible weeds. Free copies were distributed in provincial public schools. This instruction manual represents the beginning of a program which hopes to restore, at least partially, our ancestors' knowledge. As a result of this printed information and a television program, a substantial increment of popular awareness and utilization of this resource, was registered.

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RESUMEN

Las malezas abundan en ambientes urbanos y rurales. Según la región y lugar, hasta el 66% de las especies de malezas pueden ser comestibles y constituir un recurso alimentario adicional para el ser humano. Sobre la base de 400 muestras de $^1/_4$ m^2 cada una, recolectadas en áreas tropicales (rutas, terrenos baldíos, calles y plantaciones en Coatepec, México) el promedio de la biomasa en peso fresco varió entre 1 277 y 3 582 kg/ha. Un muestreo similar en un área templada (739 muestras en Bariloche, Argentina) arrojó valores medios entre 287 y 2 939 kg/ha. En total se registraron 43 especies en Coatepec y 32 especies en Bariloche. La media general (total) fue de 2.1 y 1.3 ton/ha, respectivamente. A una escala geográfica mayor, una comparación entre las malezas mexicanas y argentinas no mostró mayores variaciones regionales en cuanto a qué partes u órganos son los comestibles. En ambos lugares, el orden de aprovechamiento, de mayor a menor, fue: hojas, semillas, raíces, frutos, infusiones, flores y condimentos. Las raíces comestibles (incluyendo bulbos y rizomas) parecen ser más comunes entre las especies perennes que entre las anuales.

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