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A Novel Method for Identification and Domestication of Indigenous Useful Plants in Amazonian Ecuador

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The Amazonia: an incalculable value, an untapped emporium of germplasm for new economic plants.
Richard Evans Schultes, 1979

In the rain forests in eastern Ecuador (Oriente), a considerable number of indigenous societies still rely on plant gathering, hunting, and fishing. Our aims have been to foster cultivation of indigenous useful plants among these tribal societies to help improve their economy, to preserve knowledge about and germplasm of some of their important useful plants, and to help strengthen their cultural identity. We assumed that indigenous useful plants which are highly rated by their consumers will be sufficiently attractive to foster plant adoption and that social change, from plant gathering to plant cultivation, will follow with the least constraints if traditional societies first employ their own indigenous useful plants, prior to receiving domesticated foreign crops.

To fulfil these aims, useful indigenous plant species have been identified and botanically classified, selected and propagated in nurseries. To increase attractiveness of adoption, efforts were concentrated on identification and reproduction of the most tasteful plants as well of those considered to be the most efficacious medicinals. Nurseries have been established within the communities and, subsequently, plantlets distributed free to families willing to grow them, to be planted in their gardens.

METHODOLOGY

The most common language along the Upper Napo river is Quichua. However, in each community there is always a number of people, particularly teachers, who also know Spanish. These people provided translation services for our project. Most people were acquainted with the edible plants in their surrounding forests. As information on useful plants had already disappeared, we first sought to interview and survey the few remaining highly knowledgeable people. For the identification of edible plants, we attempted to interview selected informants, including those people recommended by at least five independent people, as the best knowledgeable

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plantsmen in the region. However, for rating of the most popular edible plants, any person willing to cooperate were included in order to obtain the widest possible concensus.

Preliminary Evaluation of Edible Plants

During several excursions with knowledgeable guides (informants) in the rain forests in several localities, along the Upper Napo river (Campano Cocha, Santa Rosa, and Caspi Sapa, Fig. 1), a list of 41 species of common edible plants was compiled (Table 1). Since plants from different culinary categories are difficult to directly compare, plants were classified into the following three types: food plants (plantas para tomar), juicy plants (plantas para chupar), and herbs and spices. Lists in alphabetical order, of Quichua plant names were presented to each person interviewed. Forty-five people were interviewed, usually on Sundays in church. Interviewees were requested to rate the plants of each category, according to declining preference, based on their own taste. When the order of culinary grades corresponded to the alphabetical order of the plant names, data was excluded from the study. Although, each interviewee was literate, we provided a tutor for each.

Preliminary Evaluation of Medicinal Plants

To identify the most attractive medicinal plants for the indigenous communities studied, we used a quantitative ethnopharmacological method developed among Bedouins in Israel (Friedman et al. 1986). During an ethnopharmacological field survey in the Negev desert, it was noticed that informants, when independently interviewed, sometimes have different ideas as to the major purpose for which a given medicinal plant is used. Such disagreements appeared also when highly reputed informants with at least six independent recommendations, were interviewed. To analyze the efficacy of the plants which were applied to different ailments, we requested information on the major and the secondary applications of medicinal plants from each informant. However, to avoid the risk of memory failure, each informant was also requested to elaborate on the uses of each plant within a given list (Table 2).

Based on field experience, a list of 100 commonly used species of medicinal plants (Table 2) was compiled. This enabled us to detect information missed due to memory failure, as well as species unknown to individual informants.

The percentage of informants claiming the use of a certain plant for the same major purpose, also known as its Fidelity Level (FL), was calculated for each species. Thus, plants could be rated on the basis of their relative efficiency, as they appear in the eyes of their consumers. Since some plants which received high FL values were

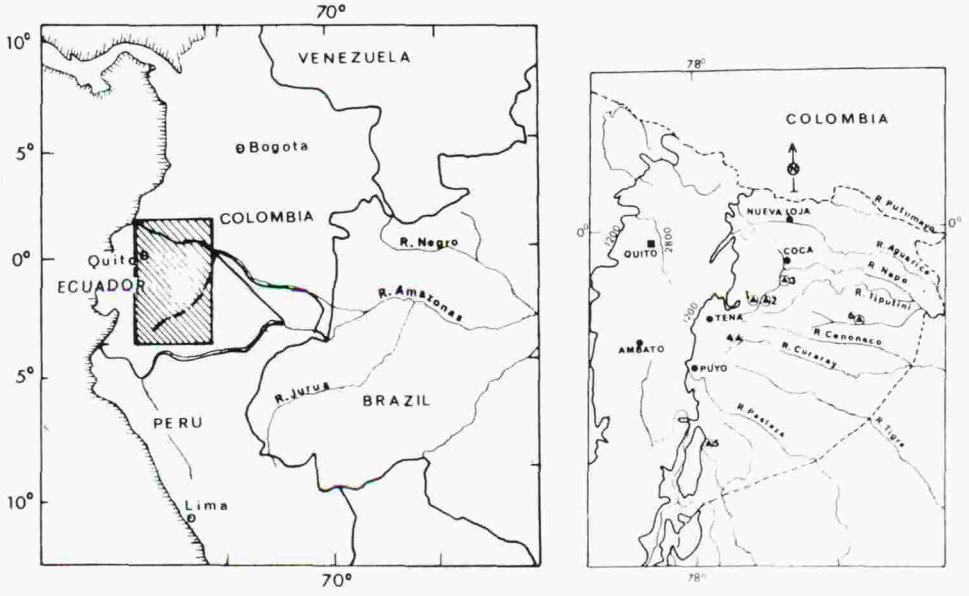

Fig. 1. Map of Ecuador and area under investigation.

Table 1. A list of edible plants from upper Napo river (Eastern Ecaudor).

Plant catagory Family	Species	Plant part consumed[z]	Way of consumption
Food plants			
Araceae	*Colocasia esculenta*	T	Fresh
Arecaceae	*Bactris gasipaes*	F,S	Fermented or cooked for chicha
Arecaceae	*Jessenia bataua*	F	Cooked
Arecaceae	*Mauritia flexusa*	F	Fresh
Convolvulaceae	*Ipomea batatas*	T	Cooked or fermented for chicha
Cucurbitaceae	Ucsha (species unknown)	F	Fresh/cooked
Dioscoraceae	*Dioscorea trifida*	T	Cooked
Euphorbiaceae	*Caryodendron orinocense*	S	Fresh/dried
Euphorbiaceae	*Plukenetia volubilis*	S	Cooked
Fabaceae	*Phaseolus vulgaris*	S	Cooked
Lecythidaceae	*Grias neuberthii*	F	Fresh/cooked
Mimosaceae	*Inga* sp. (Ilta)	F,S	Fresh/cooked
Phytolaccaceae	*Phytolacca rivinoides*	L	Fresh/cooked
Sapotaceae	*Chrysophyllum venezuelanense*	F	Cooked/fried
Sapotaceae	*Pouteria* sp.	F	Fresh
Sterculiaceae	*Herrania* sp.	S	Cooked
Sterculiaceae	*Theobroma bicolor*	S	Cooked fried
unknown	Butum; Butio	n.d.	n.d.
unknown	Garabatu yuyu	n.d.	n.d.
unknown	Sani papa	T	Cooked
unknown	Shimbi	n.d	n.d.
Juicy plants			
Annonaceae	*Annona cherimolia*	F	Fresh
Apocynaceae	*Tabernaemontana sananho*	F	Fresh
Bombacaceae	*Matisia cordata*	F	Fresh
Cecropiaceae	*Pourouma cecropiaefolia*	F	Fresh
Malpighiaceae	*Bunchosia* sp.	F	Fresh
Mimosaceae	*Inga edulis*	F	Fresh
Mimosaceae	*Inga* sp. (Machitona)	F	Fresh
Passifloraceae	*Passiflora* sp. (Maracuya)	F	Fresh
Passifloraceae	*Passiflora* sp. (Granadilla)	F	Fresh
Sapotaceae	*Pouteria caimito*	F	Fresh
Solanaceae	*Solanum quitoense*	F	For juice
Sterculiaceae	*Herrania nitida*	F	Fresh
Theophrastaceae	*Calvija harlingii*	F	Fresh
Herbs and spices			
Apiaceae	*Eryngium foetidum*	L	Fresh for salad or soup (similar to coriander)
Bignoniaceae	*Mansoa standleyi*	L	Fresh/dried, soup
Bixaceae	*Bixa orellana*	S	Fried/soup
Lamiaceae	*Ocimum basilicum*	L	Fresh/soup or salad
Lauraceae	*Ocotea quixos*	L, Calyx	Fresh/dried
Liliaceae	*Allium* sp.	L	Fresh/salad or soup (similar to chives)
Moraceae	*Brosimum uleti*	Latex	Fresh

[z]F = fruit; L = leaf; n.d. = no documentation; R = root; S = seed; St = stem; T = tuber.

Table 2. A list of medicinal plants from the upper Napo river (Eastern Ecuador).

Family	Species or Quichua name	Plant part[z]	Major use
Acanthaceae	Quihui yuyu (species unknown)	L,P	Sprain
Apocynaceae	*Himatanthus lancifolius*	La	Anemia, strengthening
Apocynaceae	*Tabernaemontana sananho*	B,L	Stomachache
Aquifoliaceae	*Ilex guayuosa*	L	Stimulant
Araceae	*Colocasia* sp.	Rh	Cuts
Arecacea	Supai chunda (species unknown)	Apex	Tonic, strengthening
Asteraceae	*Clibaduim asperum*	L,St	Fish poisoning
Asteraceae	*Spilanthes* cf.	L	Cuts
Bignoniaceae	*Mansoa standleyi*	L	Grippe
Boraginaceae	*Corida nodosa*	L	Gangrens from snakebite
Brassicaceae	Amarun uchu (species unknown)	P	Skin problems (granos)
Caesalpiniaceae	*Senna ruiziana*		
Capparidaceae	*Capparis sola*	B	Skin problems (granos)
Cecropiaceae	*Cecropia* sp.	B	Strengthening
Celastraceae	*Maytenus krukovii*	B	Rheumatism, body pains
Commelinaceae	*Commelina erecta*	B	Blood pressure
Crassulaceae	*Bryophyllum ginnatum*	L,St	Cuts, wounds
Cyclanthaceae	*Carludovica palmata*		Rheumatism, swelling
Erythroxylaceae	*Erythroxylum gracilipes*	L	Tranquilliar, rheumatism
Euphorbiaceae	*Croton lechleri*	La	Panacea, gingivitis
Fabaceae	*Lonchocarpus nicou*	St	Fish poison
Fabaceae	*Myroxylon balsamum*	B	Grippe, fever
Fabaceae	*Swarzia simplex*	B	Strengthening
Flacourtiaceae	*Neosprucea* sp.	B	Tuberculosis
Gesneriaceae	*Columnea archidonae*	L	Menstruation set up
Lamiaceae	*Hyptis pectinata*	L	Kidney disorder
Lauraceae	*Persea americana*	S	Contraceptive
Lecythidaceae	*Grias neuberthii*	B	Vomiting, diarrhea
Loganiaceae	*Potalia amara*	L	Snakebite
Malpighiaceae	*Banisteriopsis caapi*	B	Hallucinogen, "insight drug"
Melastomaceae	*Blackea* cf. *rosea*	L	Cuts, wounds
Melastomaceae	Cana agria (unknown species)	St	Cuts
Meliaceae	Flor del sielo (unknown species)	L, Fl	Rabies
Meliaceae	*Guarea cinnamomea*	B	Asthma
Mimosaceae	*Piptademia pteroclada*	B	Diarrhea, vomiting
Moraceae	*Brosimum utile*	La	Purgative for children
Ochnaceae	*Ourateae* sp.	B	Diarrhea, stomachache
Orchidaceae	Rayu palanda (unknown species)	L	Skin problems (granos)
Piperaceae	*Piper veneralense*	L	Diarrhea
Piperaceae	*Piper* sp.	L	Gingivitis
Polypodiaceae	*Asplenium* sp.	L	Nervous disorders
Polypodiaceae	*Lomariopsis* sp.	L	Diarrhea, vomiting
Rubiaceae	*Duroia hirsuta*	B	Diarreha, stomachache
Rubiaceae	*Simira* sp.	B	Contraceptive, menstruation set up
Sapindaceae	*Paullinia* sp.	St, (Sap)	Intestinal parasites
Smilaceae	*Smilax* sp.	R	Skin problems (acne)
Solanaceae	*Brugmansia arborea*	L	Hallucinogen
Solanaceae	*Brunfelsia chiricaspi*	R	Body pains, grippe
Solanaceae	*Brunfelsia grandiflora*	R	Body pains, grippe
Solanaceae	*Solanum mamosum*	F	Skin parasites in chicken
Theophrastaceae	*Clavija harlingii*	R	Grippe

Table 2. Continued.

Urticaceae	*Urera caracasana*	L,St	Pains, rheumatism
Verbenaceae	*Verbena brasiliansis*	L	Stomach disorders
Zingiberaceae	*Zingiber officinale*	R	Grippe
unknown	Accha huasca	B	Antibaldness
unknown	Amiruca panga	L	Hallucinogen, "insight drug"
unknown	Andia paju (caspi)	B	Diarrhea with blood
unknown	Armangui	L	Chicken parasites
unknown	Ayacara	B	Stomachache
unknown	Bujiu panga	L	Aphrodiatsiac
unknown	Chiri panga	L,St	Clean the body from evil spirits
unknown	Chunchu	B	Skin problems (granos)
unknown	Cucu tsicta	L	Hair parasits
unknown	Cuilichi lulu	L, La	Wounds
unknown	Dumduma	T	Snakebite
unknown	Flur huasca	St	Syphylis, diarrhea
unknown	Gallu caspi	B	Skin problems
unknown	Huagra huanduj	St	Rheumatism
unknown	Huarangayura	B	Stomachache, diarrhea
unknown	Huiqui huasca	La	Stomachache
unkown	Icsa nanai yura	B	Stomachache
unknown	Ilia huanga lumu		Rheumatism
unknown	Isla vapa yura	Resin	Skin problems
unknown	Lustunda	F,B	Tuberculosis
unknown	Luta luta	P	Sprains
unknown	Machacui caparina		Snakebite
unknown	Machacui mandi	T	Snakebite
unknown	Machacui mishu	T	Snakebite
unknown	Machi manga		Cancer
unknown	Mati muyu caspi	B	Grippe
unknown	Munu chupa	L,R	Diarrhea
unknown	Pala panga	L	Gential cancer
unknown	Pinsha caliu	P	Bleeding
unknown	Piri piri panga	L	Aphrodisiac
unknown	Puma yuyu	Mer, L	Hallucinogen, strengthening
unknown	Pupa huasca	St	Grippe
unknown	Puru panga	L	Menstruation set up
unknown	Quihuin ambi	L,St	Fish poison
unknown	Rayu paju		Skin-problems (granos)
unknown	Sacha huanduj	L	Rheumatism
unknown	Sacha limon	F,L	Grippe
unknown	Santa maria panga	L	Bleeding
unknown	Sarsiliu	B	Tuberculosis
unknown	Shia huasca	R,B	Diarrhea, stomachache
unknown	Shiu panga	L	Diarrhea, stomachache strengthening
unknown	Sirlu panga	L	Heart disorders
unknown	Sitimu panga	L	Diarrhea
unknown	Sucuva	La	Skin tumors
unknown	Supai caspi		Hernia
unknown	Suru panga	L	Clean the body from evil spirits
unknown	Yacami panga	L	Strengthening children

B = bark; F = fruit; Fl = flower; L = leaf; La = latex; Mer = meristem; P = plant; R = root; Rh = rhizom; S = seed; T = tuber. "Insight drug"—taken by witch doctor for a better diagnosis.

known to only a fraction of the informants, an appropriate correction factor was introduced. The Relative Popularity Level (RPL) can be calculated for each plant from the relationship between the number of informants who know of a certain plant and the average number of uses per plant (Friedman et al. 1986). The corrected fidelity level, or Rank Order Priority (ROP) of a given plant is: ROP = FL × RPL. Therefore, the ROP value can be used to classify medicinal plants according to their efficiency as evaluated by their consumers.

Establishment of Nurseries

Nurseries were established within the communities, usually in the vicinity of a school, or near the house of a family that showed interest in maintaining the nursery. With the help of the local people, 10 × 20 m plots were cleared and black polyethylene sheets were stretched across the plats to prevent weeds. A germinating box (5.0 × 1.5 × 0.4 m) filled with sand from the river bank floored on the polyethylene. Usually seeds were planted, but, if plants of interest were encountered at a season when no seeds were available, cuttings were inserted after disinfection. In some cases, standard plant hormones (NAA) at 2,000 and 4,000 ppm were applied to enhance rooting

Two to three weeks after emergence, young plantlets were transplanted into 25 × 30 cm plastic bags filled with sand. Some fast germinating seeds were planted directly in plastic bags. A black polyethylene shading net, which intercepts 30% of the sunlight was stretched above the plants.

RESULTS AND DISCUSSION

Six informants from disparate localities were selected for interviews, and provided information on 191 species. Despite occasional difficulties in ascertaining whether a particular plant grows mainly in nature and gathered form the wild, or is cultivated, our data suggest that of 59 edible plants, 41 species are gathered and the other 18 are sporadically cultivated. We found that 132 species were used for medicinal purposes.

Edible Plants

The eight most popular species obtained within a strip of 100 km, between Misahaulli and Coca, in the Upper Napo river region, are presented in Table 3. From the eight plants with the highest culinary grade, five were found to be already cultivated by tribal societies, although on a very small scale and only in a few home gardens. These include: *Bactris gasipaes*, *Theobroma bicolor*, *Pouruma cecropiaefolia*, *Passiflora* sp. (maracuya), and *Matisia cordata*. The major herbs and spices were amongst the uncultivated plants, perhaps because only small quantities of these plants are consumed and they could be easily gathered. Although the relative culinary level among the plants in each of the three locales was different, the same species listed in Table 1 were at the top of the list in each locality. A survey of the literature suggests that some of the highly regarded edible plants in various Latin American states are already at different stages of domestication, e.g. *Bactris gasipaes* (chontaduro, pejibaye),

Table 3. Preferred edible plants in the Upper Napo river, Ecuador. The primary eight of 41 species in each of three culinary categories arranged according to their culinary grades.

Plant category	Preliminary idenfication	Quichua name	Collected (CO) or Cultivated (Cu)	Culinary grade[z] ±SD
Food plants	*Caryodendron orinocense*, Euphorbiaceae	Achansu	Co	9.4±0.7
	Bactris gasipaes, Arecaceae	Chontaduro	CoCu	7.3±3.1
	Theobroma bicolor, Sterculiaceae	Patas	CoCu	6.9±3.4
Juicy fruit	*Purouma cecropiaefolia*, Cecropiaceae	Uvilla	CoCu	8.7±1.1
	Passiflora sp., Passifloraceae	Maracuya	CoCu	8.1±1.6
	Matisia cordata, Bombacaceae	Sapote	CoCu	8.1±1.7
Herbs & spices	*Ocotea quixos*, Lauraceae	Ishpingo	Co	8.3±1.8
	Eryngium foetidum, Apiaceae	Culantro	Co	7.8±2.8

[z]An average of 30 informants, 0 = least tasty, 10 = most tasty.

(Popenoe and Jimenez 1921; Johnanessen 1966; Balick 1985; Clement and Arkcoll 1989), or *Pourouma cecropiaefolia* (National Academy of Sciences 1975).

In the same area, we found one plant with only a single squash like fruit. Locally it is called *Ucsha* in Quichua and the plant has not yet been botanically identified. Two old people claimed that it is very tasty when cooked and so *Ucsha* was included in our list. Nevertheless, most of those interviewed were young and were not acquainted with this plant and thus, it obtained a very low culinary grade. Only older people, who liked it very much were familiar with this species. A search for more plants or fruits for propagation was unsuccessful, possibly because villagers who were unaware of its possibilities for propagation had overexploited the disappearing species. The seeds of this one and only fruit were planted and the resultant seedlings grew extremely fast. At present, a few hundred plants are being cultivated. Other highly regarded species, unknown to the majority of the interviewees may also have been overlooked and not included among our top quality edible plants. Interviewing a considerable number of young people who can read, may provide in a rather short time, a concensus on the culinary level of common edible plants. However, we feel that those who are educated may be the least knowledgeable about native plants. Thus, plants that were once commonly used and eventually disappeared in part due to over exploitation will be unknown and ignored. The transition from wandering communities of food gatherers in the rainforest into settled communities that preserve the habits of plant gathering, imposed increasing constrains on those highly regarded edible plants. Highly-exploited species which were not adopted for cultivation in their home gardens, were gradually eliminated from around the village. Special efforts must be directed to detect such species and propagate them in large numbers. In order to uncover these valuable species, which are at the point of extinction, special efforts to work with wandering communities of food gatherers, as well as with highly knowledgeable informants should be made. We recommend that the eight species identified in this study should be given top priority for further propagation and distribution.

Medicinal Plants

Although conventional medicines are gradually expanding into the rainforests either through missionary activities or through small scale trading, most people continue to use traditional systems of health care including medicinal plants alone or in combination with modern pharmaceuticals. Nevertheless, it was a difficult task to interview highly reputed informants, who were independently recommended by different people as very knowledgeable. Those few authorities who still practice traditional healing usually join small remote communities and arrive only intermittently in more crowded settlements. During the first year of our activities, we approached six informants (Table 4). Interviews were conducted only after a period of acquaintance after residing for a few nights in the community, sharing food and carefully explaining our aims. Because of the numerous medicinal plants in the region, and the practical limits of time for an interview, each interview was combined with a field excursion for identification and collection of specimens. Verification of plant names was maintained through field

Table 4. Most preferable medicinal plants and their major therapeutical uses in the Upper Napo River region together with their relative grades (0 = the least, 100 = the highest efficiency).

Preliminary identification	Quichua name	Therapeutical uses	Fidelity level (FL)[z]
Maytenus krukowii, Celestraceae	Chu chu huasu	Anemia, rehumatism, grippe, headache	100
Potalia amara, Loganiaceae	Curarina	Snakebite	100
Species not identified	Machaqui mandi	Snake or scorpion bites	100
Paullinia sp., Sapindaceae	Pacai huasca	Intestinal parasites diarrhea	76
Mansoa standlevi	Sacha aju (Bignoniaceae)	Grippe, fever, headache	76
Ourateae sp., Ochnaceae	Tacu caspi or Amaron caspi	Diarrhea	61

[z]Average of 6 selected informants.

excursions, but when rainstorms occurred, we used colored pictures. Since objects shown in pictures appear at a smaller scale and are two-dimensional, interviewees must be given time to interpret these illustrations. In general, pictures were found to be more efficient for verification of edible than of medicinal plants, perhaps because these were more widely and commonly known.

It became apparent that, maximum information was obtained from any informant, when interviews were repeated at three to four different times. Only on the third meeting, could we present our arbitrary list of 100 species of medicinal plants and enquire specifically about each plant.

The limited number of informants employed in this part of the study did not allow us to draw concrete conclusions as to the rank order priority (ROP) or the relative efficiency of the medicinal plants. However, these informants were very carefully selected and their authenticity was high. Some of these species have already been noted as important medicinal plants of the Northwestern Amazonian region, e.g. *Maytenus krukowii*, *Potalia amara*, *Paullinia* sp., and *Mansoa standleyi* (Schultes and Raffauf 1990). Therefore, the list in Table 2 must be considered a preliminary guide-line for selection of so-called "attractive" indigenous medicinal plants for cultivation.

Establishment of Plants in the Nurseries

Three nurseries were established in the Upper Napo river, in Campano Cocha, Santa Rosa, and in Caspi Sapa, among Quichuas, and a fourth one in Tonianpari on the Curary river amongst Waorhanis. During 1990-1991, the nurseries included about 4,000 plants comprising about 50 species of which half were edible and half were medicinals. After germination or rooting, growth rate was rapid and the response to slow release nitrogen articles was good. About 600 propagates were distributed to local people. Prior to distribution, detailed instructions for planting and plant care were provided. Each distribution was followed with a detailed registration in order to follow the level of plant adoption, and to study ways to encourage cultivation. Those receiving planting material appeared to be enthusiastic.

These findings, which were obtained during a period of two years work has led to increased documentation of traditional knowledge of plant utilization and enhancement of plant cultivation of little known useful plants. The third year of the project will be dedicated to enlarging the scale of production and following the rates of plant adoption. During this period we hope, to ensure that the original owners maintain intellectual property rights over these plants so that they will be the first to benefit from their heritage. We are concerned however that additional effort requiring at least three to five years, will minimally be needed to ensure the success of this program.

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