# MEDICINAL PLANT USE PATTERNS AMONG THE AMUZGOS OF GUERRERO, MEXICO[1]

Gerald G. Robinson[2] and Barcimeo López C.[3]

## Abstract

Medicinal plant use among the Amuzgos of the State of Guerrero, México was investigated by questioning eleven individuals that claimed knowledge of curing. Each curer was asked whether he or she used each of approximately 450 plants for which Amuzgo names are recorded. One hundred twenty eight different species were identified as being used medicinally by one or more of the curers. For each of these plants information was elicited concerning the plant part used, how it was prepared and administered, for what infirmities it was utilized, and why it was effective.

The data from nine of the curers were analyzed using standard ecological similarity measures to detect possible distinct curing traditions among these practitioners. Simulated samples were constructed by Monte Carlo techniques to test for possible statistical significance and to provide probability estimates.

## Introduction

Modern medicine has been available in many rural areas of Mexico only recently. Consequently, people continue to rely on traditional medicine including the use of medicinal plant preparations. Knowledge of these aspects of indigenous cultures constitutes an important fund of information about the cultures and about potential new sources of active medicinal agents.

The village of Xochistlahuaca is an important center for the Amuzgo Indians of eastern Guerrero. Knowledge of traditional curing is still present in the population but is decreasing with the recent greater availability of chemical drugs. Because a large number of Amuzgo plant names had been assembled in the process of making a bilingual dictionary, it seemed advantageous to investigate medicinal plant use in traditional Amuzgo medicine.

## Materials and Methods

Using a list of approximately 450 known Amuzgo plant names, each of eleven individuals who claimed knowledge of medicinal plant use was asked which plants he or she used in treating

---

[1] Contribution of the Institute for Systematic Botany, University of South Florida, Tampa FL

[2] University of South Florida, Tampa FL 33620 USA

[3] Xochistlahuaca, Guerrero, México

Gerald G. Robinson and Barcimeo López C.
*Medicinal plant use patterns among the Amuzgos of Guerrero, México*
http://www.sil.org/mexico/amuzga/guerrero/A006i-MedicinalPlants-AMU.pdf [October, 1999]

diseases. For each plant labeled as medicinal by these individuals, the following information was elicited: the disease(s) for which the plant is used, the part of the plant used and how it is prepared, how the preparation is administered, and the reason that the preparation is effective. All interviews were conducted in Amuzgo by the junior author. The hand-recorded notes from the interviews were translated into English by Amy Bauernschmidt of the Summer Institute of Linguistics.

Data from two of the eleven interviewees were excluded from the analysis because it was felt that they were reticent to provide information and that such incomplete information might bias the data.

Possible distinct patterns of plant use among the curers were sought by calculating Jaccard's similarity index (Krebs 1989) for each possible pair of curers. In order to determine possible statistical significance for the patterns observed in Jaccard's indices, one hundred simulated samples for each possible pair of curers were generated by computer. The one hundred Monte Carlo draws were made from a list including all species used by either of the pair of curers. For example, curer 1 listed 34 plants as medicinal and curer 3 listed 27; the total number of species was 43. From the 43 species, one hundred samples were drawn of 34 for curer 1 and 27 for curer 3. The number of species used by both curers for each draw was determined and a table of the calculated concurrences was constructed. The values in this sample ranged from 5 to 16. The observed number of species actually used by both curers as determined from the interviews, 18 in this case, was then compared to the table of calculated values following the Probabilistic Similarity Index of Raup and Crick (1979). Based on these comparisons the pairs were divided into three groups. If the observed value was greater than 90% or more of the calculated values, the pair of curers was considered significantly similar. In our example, the observed was greater than any of the calculated values so 100 was placed on the table. If the observed value was larger than 10% or less of the calculated values, the curers were considered significantly dissimilar. The differences or similarity for the pairs for which the values fell between 10% and 90% were considered due to chance.

Identification of voucher specimens for almost all of the medicinal plants was made by the senior author, the director, and the curator of the University of South Florida Herbarium where the voucher specimens were deposited. Species for which no voucher specimens are available are indicated in quotation marks or by question marks in Table 4.

**Results and discussion**

One hundred and twenty eight of the approximately four hundred and fifty plants for which Amuzgo names have been recorded were indicated by at least one of the curers as a medicinal plant. None was mentioned by all nine individuals. The names of the plants mentioned by more than half of the curers are listed in Table 4 along with the part of the plant that is used, the disease for which it is used, the method by which the part is prepared and applied, and why the treatment is efficacious. In each case, the number of curers giving the particular information is

noted. Because a curer sometimes mentioned more than one of the possibilities, totals for each category may be higher than the number of curers.

Six of the 128 medicinal plants were named by eight of the nine curers. For five of these, there is essential agreement among the curers on the sickness to be treated with the plant, the part of the plant to use, the preparation of the plant, and the way to apply the medication. The reasons that the medication is considered effective show more diversity but agreement is still marked. The amount of agreement among the curers as to which disease should be treated with a particular plant seems to decrease as the number of curers using the plant decreases. Thus in eleven of the fifteen cases where seven curers mentioned using the plant were the diseases named substantially the same. The same figures for plants named by six curers and five curers respectively are five of eight and six of 11. However, better agreement remains as to which part of the plant to use, how to prepare it, and how to apply it.

If the data are examined from the standpoint of the consistency of the reason that the plant is effective in treating a certain disease, there is extensive agreement for some categories of disease. Table 1 shows the number of times the more commonly cited characteristics were mentioned as effective for some of the categories of diseases. If we group all categories of aches together, we find that "hot" remedies are mentioned 56 times. In contrast, bitter is mentioned 19 times, pungent 14 and astringent 10 times. In the category of diarrhea or dysentery, we find that "cold" cures are never mentioned. "Hot" treatments are mentioned 24 times and astringent 19 times. Messer (1991) mentions that in Mitla astringency seems to be an important identifying factor for remedies for diarrheas (designated "hot" diarrhea by her). One last notable case is that of the treatments for burns. All seven instances show "cold," astringent characteristics as the reasons the treatments are effective.

Pharmacological data are available for some of the plants named as medicinal by the Amuzgo curers. For many the information is equivocal but some interesting correlations appear. *Chenopodium ambrosioides* contains an ascaricidal constituent (Heinrich, M., et al. 1992a) and is widely used in a fashion similar to that reported by seven of the Amuzgo curers. A drink is prepared for use in cases of stomach or abdominal pain.

Another case in which the pharmacological basis for a plant's use seems well established is that of *Byrsonima crassifolia* which is used against cough and or cuts or splinters. A high tannin content as seen in this plant (Heinrich, M., et. al. 1992a) seems to be frequent in plants used against cough. Evidence of antibacterial (Caceres, A., et al. 1990) and antifungal actions (Caceres, A., et al. 1991b) provides support for the use on cuts and slivers.

In other cases, there is only suggestive data available. These include *Jatropha curcas* where the antidermatophytic activity (Macrae, W.D., et al. 1988) seems to support the use of the plant on burns by the Amuzgo.

A similar example is that of the genus *Acalypha* where several species have been tested in various regimes. Some results showed weak antibacterial effects (Caceres, A., et al. 1991a; Caceres, A., et al. 1987; Caceres, A., et al. 1990), others no antifungal activity (Caceres, A., et al.

1991b), still others some antiviral activity (Macrae, W.D., et al. 1988). The Amuzgo use of *Acalypha* aff. *villosa* against diarrhea is consistent in our sample not only in the infirmities treated but also in the methods of preparation and application. Such a pattern gives justification for more thorough investigation of the constituents.

Less convincing evidence is present in cases such as *Calea zacatechichi* in which the listing of a glycoside-like substance as a constituent (Messer, E., 1991) may provide a pharmacological basis for its use as a worm medication and a treatment of stomach and abdominal pain and indigestion by Amuzgos.

Methanol and chloroform extracts of the plant tentatively identified as *Myrtus communis* have demonstrated some antibacterial activity (Rios, J.L. et al. 1987). Whether the toasted and ground leaves have such action is not clear but it would be consistent with the Amuzgo use on sores and cuts.

The presence of soponins, glycosides, sterols, tannins and polyphenols in *Mangifera indica* (Wilbert, W. and G. Haiek 1991) provides possible reasons that the Amuzgo have chosen it to use against cough. Some tests indicate activity against one species of bacteria that causes respiratory disease (Caceres, A., et al. 1991a) but another study shows only some weak activity against bacteria (Caceres, A. et al. 1990).

Table 2 shows Jaccard's indices of similarity among the plants chosen as medicinal for each of the pairs of curers. Because large differences appeared among these indices, it was deemed important to examine the data for possible distinct traditions of curing that utilized different groups of plants.

The Probability Similarity Indices showed two distinct kinds of significant results (Table 3). The plants used by curers 1, 2, 3, and 6 are significantly similar to each other, as are those by curers 8 and 9. On the other hand, those chosen by the curer indicated by number 7 are significantly different from the plants of curers 4 and 5; those employed by curers 8 and 9 are significantly dissimilar from the plants utilized by curers 3, 4, and 5. No reason for this pattern is known at this time.

**Summary**

One hundred twenty eight of approximately 450 plants were considered medicinal by at least one of the curers interviewed. Six species were listed by eight of the nine curers in the sample. Considerable agreement was found among the curers as to the diseases to be treated by the commonly used plants as well as to the methods of treatment and reasons for their success.

The literature contains some evidence that indicates active agents may be present in some of these medicinal plants but such evidence is lacking for many more.

Similarity indices indicated that four of the nine curers are significantly similar to each other in their selection of medicinal plants. Two other curers were also found significantly similar to each other; these two plus one other curer were found to be significantly dissimilar from three of the others. These data may indicate the presence of disparate curing traditions in the community.

TABLE 1

**CHARACTERISTICS FOUND IN EFFICACIOUS PLANTS**

| Disease | Characteristics mentioned |
|---|---|
| Fever | "cold" 53, bitter 21, strong odor 14; total 61 |
| Aches of various sorts | "hot" 56, bitter 19, pungent 14, astringent 10; total 67 |
| anger, coraje | bitter 17, pungent 8, "hot" 8; total 22 |
| cuts, sores, ulcers | astringent 25, burny 12, "hot" 9, pungent 7; total 44 |
| sprains | "hot" 18, strong odor 11, astringent 6; total 23 |
| diarrhea, dysentery | "hot" 24, astringent 19, bitter 12; total 37 |
| cough | astringent 26, "hot" 21, pungent 12; total 43 |
| labor, abortion, post-partum | "hot" 32, astringent 7, pungent 7; total 36 slippery only in hard labor |

| CURERS | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| C | 1 | .477 | .419 | .307 | .355 | .441 | .372 | .178 | .157 |
| U | 2 | | .348 | .505 | .383 | .750 | .565 | .191 | .101 |
| R | 3 | | | .256 | .185 | .282 | .266 | .070 | .061 |
| E | 4 | | | | .409 | .526 | .495 | .136 | .128 |
| R | 5 | | | | | .390 | .352 | .131 | .379 |
| S | 6 | | | | | | .545 | .203 | .254 |
| | 7 | | | | | | | .167 | .210 |
| | 8 | | | | | | | | .333 |

**Table 2. The Jaccard's Index of Similarity for Each Pair of Curers**

| | CURERS | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| C | 1 | **99** | **100** | 44 | 84 | **98** | 86 | 59 | 24 |
| U | 2 | | **98** | 37 | 13 | **100** | 73 | 48 | 26 |
| R | 3 | | | 58 | **10** | 74 | 58 | **7** | **1** |
| E | 4 | | | | 27 | 48 | **9** | **3** | **1** |
| R | 5 | | | | | 17 | **2** | **9** | **3** |
| S | 6 | | | | | | 60 | 56 | 52 |
| | 7 | | | | | | | 22 | 20 |
| | 8 | | | | | | | | **99** |

**Table 3. The Probabilistic Similarity Index for Each Pair of Curers. Indices in bold indicate pairs deemed statistically significant.**

TABLE 4
**MEDICINAL PLANTS USED BY MOST CURERS**

| **Amuzgo name** | **Scientific name** | **Infirmity**[a] | **Plant part**[b] | **Prepared how**[c] | **Applied how**[d] | **Effective why**[e] |
|---|---|---|---|---|---|---|
| ts'oom lcwaa | *Lonchocarpus* cf. *eriophyllus* | Tf 4, Sv 3, Tc 2, Hp 2 | L 8 | Cw 7, Gp 2 | B 3, D 1 Bh 4, Ps 2 | C 6, Od 6 Bi 3, P 1 Sa 1 |
| ts'oom niom' | *Pterocarpus* cf. *acapulensis* | Np 7, W 1, Sv 1 | Sa 8 | Fr 8 | At 7, Av 1, Aw 1 | A 8, H 3 |
| ts'oom lcu | *Dendropanax arboreus* | Tf 5, Tc 1, Hp 2, Lp 1 P 1 | L 6, Ba 2 | Cw 6, S 1, B2 | Bb 5, Bh 3, Oh/b 3, Bl 1 | C 6, H 2, Bi 1, Od 3 |
| ts'oom nioom t'ui | *Acacia pennatula* | Co 8, Mi 1, Sv 2 | Ba 8 | B 6, Fr 3, Gw 1 | D 6, B 3, C 2 | A 8, H 2 |
| ts'oom ntom | *Adira inermis* | Gp/Dm 7, Db 1, Di 1 | Ba 8 | B 8 | D 8 | A 6, H 5, |
| ts'oom ta manco | *Mangifera indica* | Co 8 | L 8 | B 8 | D 8 | A 8, H 4, P 1 |
| tsco jñom canioom | *Chenopodium ambrosioides* | Gp or Ap 7 | S/L 4 St 2 Wh 1 | B 7 | D 7 | P 5, H 6, Nr 1 |
| tsco nchquian' | *Acalypha* aff. *villosa* | Db 4, D 4 | L 5, L/S 2 | B 7 | D 7 | H 5, Bi 3, A 2, P 1 |
| tsco nquiaa' catsjo | [?] | Sc 7 | S/L 7, Wh 1 | B 7 | B 7, D 1 | C 3, H 3, P 3, Bi 1 |
| tsco nlua'nta | *Chelonanthus alatus* | Lp/Bp 4 P 2, Bs 1 | L/Br 4 Wh 3 L 3 | B 7, Gw 1 | B 7 | H 6, Bi 3, A 1 |
| tsco tarontyjoom | "*Myrtus communis*" | W 6, Sl 3, Fn 1, Sv 1 | L 6, Wh 1 | T, G 6, B 2 | Aw 6, Bf 1 | A 7, H 1, Bu 1 |
| tsco tyantyquio | *Hyptis* aff. *lantanaefolia* | Bs 7 | L&S 6, L 1 | B 6, Gw 1 | B 6, D 3 | Bi 7, H 1 |

| **Amuzgo name** | **Scientific name** | **Infirmity**[a] | **Plant part**[b] | **Prepared how**[c] | **Applied how**[d] | **Effective why**[e] |
|---|---|---|---|---|---|---|
| tsco xua' catyee | *Mikania cordifolia* | Tf 6, Hp 1, Mi 1, Ae/Wr/Ve 1, Bs 1 | L 6, L&Br 1 | Cw 7 | B 5, D 5 | Bi 7, C 6 |
| ts'oo caxquiaa catsuee | [?] | Cj 6, Dm 1, Ap 1 | R 5, F 1, Wh 3 | G 5, B 2 | D 7 | Bi 7, P 1, H 1 |
| ts'oom tamaa[n] | *Ricinus communis* | Tf 7, Hp 3 | L 7 | Cut 4, Fr 4 | Af 7, Ar 1, Ab 1, Aa 1 | C 7, Od 3 |
| ts'oom tsco tjacanoom | *Calea zacatechichi* | Wr 7, Sp/Ap/Dm 4 | L 4, L&Tw 4 | B 7 | D 7 | Bi 7, H 4, P 1 |
| ts'oom tsjei[n] chom | *Helicteres guazumifolia* | W 7 | Sa 7, Fi 5 | Fr 7 | Aw 7 | P/Bu 7, A 2 |
| ts'oom tacachi | *Psidium guajava* | Co 2, Dm 3, Db 1, Di 1 | Ba 6, L 1 | B 7 | D 7 | A 7, H 5 |
| ts'oom tacanduu | *Godmania aesculifolia* | J 5, Lp 1, P 1, Co 1 | L 7, Ba 2 | Fr 5, B 3 | As 5, B 2, D 1 | Od 7, H 6, A 1 |
| ts'oom ta'jndyoo' | *Castilla elastica* | J 7, Lr 1 | Sa 7 | Fr 7 | As 7 | H 5, A 2, C 1, Od 1 P 1, Bu 1, St 1 |
| ts'oom taljaa' ncjo | *Erythrina lanata* | J 5, Tf 3, Hp 1 | L 4, Ba 4 | Fr 4, B 3, C 1 | B 3 As 3, Ar 2 | H 4, C 2, Od 2, Bi 1, A 2 |
| tsco cacho canda | [?] | warts 6 | L6, Wh 1, St 1 | Gp/Cp 6 | Av 6 | A 2, P 2, Od 2, Bi 1, Bu 1, Sm 1, Ir 1 |
| tsco chom' | *Bacopa procumbens* | Tf 6, Hp 2 | Wh 4, St 2 | Cw 6 | Bh 6, Bb 5, D 3 | Bi 6, C 5, Od 1 |

| Amuzgo name | Scientific name | Infirmity[a] | Plant part[b] | Prepared how[c] | Applied how[d] | Effective why[e] |
|---|---|---|---|---|---|---|
| tsco ndo’ | [?] | Sl 2, Eu 2, Sv 1, Ei 1, Cp 1 | L6 | G 3, B 2 Ju 1 | As 4, D 1, B 1 | A 5, P/Bu 4, Ir 1, Bi 1 |
| ts’oo caxquiaa taa’ | *Vernonia arctioides* | Bp 2, Lp 2, An/Cj 2, Ap 1 | R 6 | B 4, Gw 2 | D 3, B 3 | Bi 6, P 1, H 3 |
| ts’oom taxua cachi | *Jatropha curcas* | Br 5, Np 1, Sl 1 | Sa 6 | Fr 6 | As 6, At 1 | C 6, A 6 |
| ts’oom nioom jndaa chi’ | *Amaranthus dubius* | Sb 5, Fe 3, Si 1 | R 6, Ba 1 | Gp 6 | As 6 | C 5, Od 4, Bi 1, H 1 |
| ts’oom ntsuercaa | *Comocladia palmeri* | W 6 | Sa 6 | Fr 6 | Aw 6 | H 5, Ir 1, P/Bu 3 |
| ts’oom nioom wii | *Schrankia* cf. *brachycarpa* | sores at corner of mouth 5, Ll 1 | St 4, Sa 6 | Fr/Ju 6 | Aw 6 | A 6, Ir 1, P 1 |
| ljaa’ carquiee | *Caesalpinia pulcherrima* | An/Cj 3, Di 2 | F 4, Bd 2 | G 4, B 1 | D 5 | Bi 3, H 3, P/Bu 3, Sl 1 |
| ljaa’ tsua’ ljaa’ t’ma[n] | “*Talauma mexicana*” | Db 2, Dm 1, P 1, An/Cj 1 | F 5 | B 4, Gw 2 | D 5 | H 3, P 3, Bi 1 |
| tsco chjoom | *Crotalaria pumila*, *C. longirostrata* | Sb 5, Sv 1, ?e 1 | L 5 | Gp 5 | As 5 | Od 5, C 4, Bi 1 |
| tsco lcoo | *Piper sanctum* or *P. umbellatum* | P 3, Gp 1, Db 1 | L 5 | B 5 | D 5 | H 5, P 4 |
| tsco mantsaniya | *Chrysantemum parthenium* | Ps/Dm 5, flatus | L 2, F 1, S&L 2, Wh 1 | B 5 | D 5 | H 4, P 4, Nr 1 |
| tsco nch’a tyuaa | *Scoparia dulcis* | Tf 4, Hp 1, Db 1 | S&L 3, R 1, L 1 | Cw 4 B 1 | Bb 3, Bh 2, D 1 | C 4, Bi 3, Od 1, H 1 |

| Amuzgo name | Scientific name | Infirmity[a] | Plant part[b] | Prepared how[c] | Applied how[d] | Effective why[e] |
|---|---|---|---|---|---|---|
| tsco nda' canc'oo | [?] | Lp 3, Hp 2, Tf 1, P 1 | L 3, R 2, Br 1 | B 4, G 1, Cw 1 | Bh 2, B, Bb 2, Bl 1 | Bi 4, H 4, C 1 |
| ts'oo ndaa nchiu' | [?] | "yellow urine" 3, Up 2, Bp 2 | R 5 | Gw 4, Gp 1, B 1 | D 5, Pc 1 | H 3, Od 3, P/Bu 2, Bi 1, C 1 |
| ts'oo tjaa[n] chquii' | *Aristolochia* sp. | Bp 4, Lp 1, ?p 1 | R 5 | Gw 4, Gp 2 | D 4, Pc 2 | P/Bu 5, H 4, A 1 |
| ts'oom tata | *Citrus aurantifolia* | An/Cj 3, Co 1, Tf 1 | L 4, R 3 | B 3, G 3 | D 4, Pf/Bl 1 | Bi 4, P/Bu 4, C 1 |
| ts'oom seincjaa[n]' | *Cordia alliodora* | ?n 4, Lp 1 | L 4, Ba 1 | B 4, C 1 | Bf 3, Bl 1, As 1 | H 5, Bi 2, Bu 3 |

[a]Infirmities: First letter A = abdomen, B = back, C = thorax, D = digestive system, E = eye, F = foot, G = stomach, H = head, J = sprain, L = limb, M = throat, N = teeth, P = partiturition, S = skin, T = temperature, U = urinary, V = liver. Second letter b = bloody diarrhea, c = chill, e = swelling, f = fever, i = infection, l = sores, m = poor, n = fungus, p = pain, r = fracture, u = pustules, v = eruption. Special codes are An = angry, Ap = no appetite, Br = burn, Bs = sick baby, Co = cough, Cj = coraje, Di = diarrhea, Sb = boils, Sc = scorpion sting, W = cut or wound, Wr = worms.

[b]Plant part: Ba = bark, Bd = bud, Br = branch, F = flower, Fi = fibers, L = leaf, R = root, S = stem, Sa = sap or latex, St = stem tip, Tw = twig, Wh = whole.

[c]Preparation: First letter B = boil, C = crush (by hand), G = grind, S = soak, T = toast; Second letter p = to paste, w = into water; Other codes Fr = fresh, Ju = use juice.

[d]Application: First letter A = apply to, B = bathe, C = chew, D = drink, O = pour over, P = place paste on; Second letter a = abdomen, b = body, c = back, f = foot, h = head, l = legs, r = forehead, s = surface, t = tooth, v = eruption, w = cut or wound.

[e]Effective basis: A = astringent, Bi = bitter, Bu = burny, C = "cold", H = "hot", Ir = irritant, Nr = not recorded, Od = characteristic odor, P = pungent, Sa = saponaceous, Sl = slippery, Sm = slimy, St = sticky.

## Literature Cited

Caceres, A., L.M. Giron, S.R. Alvarado and M.F. Torres. (1987) Screening of antimicrobial activity of plants popularly used in Guatemala for the treatment of dermatumucosal diseases. *J. Ethnopharmacology* 20: 223-237.

Caceres, A., O. Cano, B. Samayoa and L. Aguilar. (1990) Plants used in Guatemala for the treatment of gastrointestinal disorders. 1: Screening of 84 plants against enterobacteria. *J. Ethnopharmacology* 30:55-73

Caceres, A., A.V. Alvarez, A.E. Ovando and B.E. Samayoa. (1991a) Plants used in Guatemala for the treatment of respiratory diseases. 1. Screening of 68 plants against Gram-positive bacteria. *J. Ethnopharmacology* 31:193-208.

Caceres, A., E. Juaregui, D. Herrera and H. Logemann. (1991b). Plants used in Guatemala for the treatment of dermatomucosal infections. 1: Screening of 38 plant extracts for anticandidal activity. *J.* Ethnopharmacology 33: 277-283.

Heinrich, M., H Rimpler and N. A. Barrera. (1992a) Indigenous phytotherapy of gastrointestinal disorders in a lowland Mixe community (Oaxaca, Mexico): Ethnopharmacologic evaluation. *J. Ethnopharmacology* 36:63-80.

Heinrich, M., M. Kuhnt, C.W. Wright, H. Rimpler, J.D. Phillipson, A. Schandelmaier and D.C Warhurst. (1992b) Parasitological and microbiological evaluation of Mixe Indian medicinal plants (Mexico). *J. Ethnopharmacology* 36:81-85.

Krebs, C.J. (1989) Ecological Methodology Harper-Collins Publishers.

Macrae, W.D., J.B. Hudson and G.H.N. Towers. (1988) Studies on the pharmacological activity of Amazonian Euphorbiaceae. *J. Ethnopharmacology* 22: 143-172.

Messer, E. (1991) Systematic and medicinal reasoning in Mitla folk botany. *J. Ethnopharmacology* 33:107-128.

Raup, D.M, and R.E. Crick. (1979) Measurement of faunal similarity in paleontology. *J. Paleontology* 53:1213-1227.

Ríos, J.L, M.C. Recio and A. Villar. (1987) Antimicrobial activity of selected plants employed in the Spanish Mediterranean area. *J. Ethnopharmacology* 21:139-152.

Wilbert, W., and G. Haiek. (1991) Phytochemical screening of a Warao pharmacopoeia employed to treat gastrointestinal disorders. *J. Ethnopharmacology* 34:7-11.