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ETNOBOTÁNICA COMPARATIVA DE PLANTAS COMESTIBLES RECOLECTADAS EN SISTEMAS DE AGRICULTURA TRADICIONAL DE MÉXICO Y ZIMBABWE

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Colegio de Postgraduados, 2008

La recolección de plantas comestibles es un componente importante en sistemas de agricultura tradicional. Estas plantas forman parte de las dietas locales. El objetivo de esta investigación fue comparar el conocimiento y uso de plantas comestibles recolectadas que complementan la dieta basada en maíz en comunidades rurales, con el fin de identificar patrones generales en dos poblaciones con condiciones similares, pero sin contactos directos en el pasado. Se recopiló información en Santa Catarina Roatina y Villa Talea de Castro de Oaxaca, México y Chipupuri y Maradzika de Honde Valley, Zimbabwe mediante entrevistas grupales e individuales, diarios de alimentos y observación participante. También se muestrearon los arvenses de cultivos de maíz para medir la disponibilidad de plantas recolectadas comestibles, registrar y analizar la composición biogeográfica. Se documentan entre 67 y 72 plantas comestibles recolectadas que se consumen como verdura, fruta, condimento, bebida, botana, fuentes de aceite comestible y carbohidratos en México y Zimbabwe. Las cuatro comunidades comparten cuatro especies, siete genera y nueve familias botánicas. Hay similitudes en el número promedio (11-13) de plantas conocidas por persona, la riqueza de especies conocidas y el numero de arvenses comestibles en el cultivo de maíz en ambos países, lo cual sugiere patrones globales en la selección de plantas comestibles. Las opiniones de la gente y la perdida de información entre los niños y jóvenes confirman la tendencia internacional hacia la perdida de conocimientos etnobotánicos. El conocimiento es específico para el género y depende de los ámbitos distintos de los hombres y las mujeres. Las diferencias en la composición florística y las formas de uso reflejan la influencia del ambiente local y la cultura respectivamente en la selección y uso de recursos vegetales. Las semejanzas encontradas en el estudio sugieren generalidades universales en conocimientos etnobotánicos. Las comunidades de México tuvieron mayor diversidad de arvenses en el cultivo de maíz que las de Zimbabwe. Hubo una presencia sustancial de especies de origen americana (80 % en México y 32 % en Zimbabwe) lo cual confirma la hipótesis que los arvenses migran con el cultivo con el cual coevolucionaron.

Palabras clave: conocimiento etnobotánico, arvenses, origen biogeográfica

COMPARATIVE ETHNOBOTANY OF GATHERED EDIBLE PLANTS IN TRADITIONAL AGRICULTURAL SYSTEMS OF MEXICO AND ZIMBABWE

Idah Tichaidza Manduna

Colegio de Postgraduados, 2008

Gathered edible plants are an important component in traditional agricultural systems. These plants are part of the local diets. The purpose of this research was to compare the knowledge and use of gathered food plants that complement maize-based diets in rural communities in order to identify general patterns in two groups that have similar conditions but without direct contact. Information was compiled from group and individual interviews, food diaries and participant observation in Santa Catarina Roatina and Villa Talea de Castro of Oaxaca, Mexico and Chipupuri and Maradzika of Honde Valley, Zimbabwe. Maize crop weeds were also sampled to determine the availability of gathered edible plants as well as to record and analyze their biogeography. Between 67 and 72 gathered edible plants that are consumed as vegetables, fruit, condiments, beverages, snacks and sources of oil and carbohydrates in Mexico and Zimbabwe are documented. The four communities share four species, seven genera and nine botanical families. There are similarities in the average number (11-13) of plants known per person, the species richness of known edible plants and the number of edible weeds in the maize fields in both countries, which suggests global patterns in the selection of plants foods. The opinions of the people and loss of information amongst the children and the young adults confirm the international trend towards the loss of ethnobotanical knowledge. Knowledge is gender-specific and depends on the division of labour between men and women. The differences in the floristic composition and use respectively reflect the influence of the local environment and culture in the selection and use of plant resources. The similarities found in the study indicate universal patterns in ethnobotanical knowledge. The Mexican communities had a higher diversity of maize weeds than those of Zimbabwe. There was a substantial presence of species of American origin (80% in Mexico and 32% in Zimbabwe) which confirms the hypothesis that weeds migrate with the crop with which they coevolved.

Key words: ethnobotanical knowledge, weeds, biogeographical origins

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INTRODUCCIÓN GENERAL

"The frequent occurrence of similar phenomena in cultural areas that have no historical contact suggests that important results may be derived from their study, for it shows that the human mind develops everywhere according to the same laws. The discovery of these [laws] is the greatest aim of our science."

_Franz Boas, 1888

Este trabajo presenta los resultados de un estudio comparativo sobre el conocimiento y el uso de plantas recolectadas comestibles entre dos comunidades rurales del estado mexicano de Oaxaca, en México y dos de Honde Valley, Zimbabwe, con un enfoque etnobotánico. El trabajo contribuye a la identificación de patrones en el uso del medio vegetal. Pretende cuantificar el empleo tradicional de estas plantas en diferentes poblaciones e identificar las similitudes y diferencias entre las tradiciones mexicanas y zimbabuenses en el uso de plantas recolectadas comestibles. Propone explicaciones e hipótesis sobre la influencia del ambiente, cultivo principal y cultura sobre el aprovechamiento de recursos vegetales.

La identificación de patrones, correlaciones y generalizaciones, así como las diferencias y causas dentro y entre diferentes culturas en el uso de recursos biológicos resulta de estudios comparativos (Coley 2000). Dichas comparaciones son importantes para documentar las características de las similitudes entre distintos grupos humanos. Permiten la elaboración de explicaciones teóricas sobre fenómenos universales y contribuyen al entendimiento de los principios que regulan la relación de los seres humanos con su entorno ecológico (Berlin 1992; Caballero y Cortés 2001).

A pesar de la existencia de aproximadamente de 20 000 especies de plantas comestibles, sólo alrededor de 30 especies aportan el 90% del consumo de calorías al mundo (Ratheesh Narayanan et al. 2003). Sin embargo las plantas recolectadas siguen siendo elementos importantes en la dieta de muchas sociedades rurales del mundo. Son relativamente accesibles y baratas (Santos-Oliveira y Fidalgo de Carvalho 1975; Casas et al. 2001; Machakaire et al. 1998; Grivetti y Ogle 2000; Murray et al. 2001). Mejoran la calidad de las dietas básicas ya que proporcionan fibra, minerales y vitaminas (Packham, 1993, Flyman y Afolayan, 2006).

Algunas plantas recolectadas son *sensu stricto* plantas silvestres, y se desarrollan en hábitats naturales y poco alterados, y no invaden ambientes modificados por seres humanos. Las especialistas de la vegetación perturbada o secundaria, llamadas malezas, son las que crecen espontáneamente en lugares con disturbio como campos de cultivos (arvenses), zonas de habitación y orillas de caminos (ruderales) y otros ambientes similares. Comparados con las plantas domesticadas, las malezas ocupan sitio intermedio en el nivel de transformación por el ser humano, a través de la creación de nuevos ambientes, la selección inconsciente y el transporte a nuevas regiones que se transforman en consecuencias genéticas. Las plantas domesticadas también evolucionaron bajo estas influencias, y además fueron producto de un largo proceso de selección dirigida y consciente.

Las poblaciones humanas interactúan con los recursos vegetales en diferentes formas e intensidades y se clasifican las plantas de acuerdo a estas relaciones. Las plantas útiles pueden ser recolectadas, toleradas, fomentadas, protegidas, sembradas o trasplantadas (Casas et al. 1987; Casas et al. 1994); cualquiera de estas formas de aprovechamiento es manejo incipiente, si altera la composición genética de las poblaciones (Alcorn 1981; Bye 1979 y 1993; Hernández–Xolocotzi 1993; Caballero y Cortés 2001; Blanckaert 2007).

No existen límites claros entre las diferentes formas de manejo o entre las plantas silvestres, cultivadas y domesticadas. Además, algunas especies reciben una o varias formas de manejo (Bye 1993; Ogle 2001). Por esta razón, en este trabajo se utiliza el término 'silvestre' para referirse a todas las plantas que crecen espontáneamente (sin ser sembradas) en las comunidades de estudio. El término se utiliza para distinguir éstas de las domesticadas, cuyos sistemas de reproducción han sido alterados a través de la selección genotípica o fenotípica, y dependen de los seres humanos para sobrevivir y dispersarse (Cunningham 2001).

Se define el conocimiento como el consenso cultural entre informantes (Reyes-Garcia 2001). La cultura es una entidad que se aprende; por lo tanto, la suma de los conocimientos de los individuos de una comunidad comprende la cultura de la misma (Goodenough 2003). La percepción sobre la cultura de una persona cambia con el tiempo a través de generaciones y conlleva la evolución o el cambio cultural. En ambas regiones de estudio existe cambio cultural como resultado de la modernización que ha provocado cambios en estilos de vida, en la dieta y la pérdida de mecanismos de transferencia de conocimientos (Shava 2005). Esto ha dado como resultado la pérdida de conocimientos etnobotánicos (Kunkel 1981; Machakaire et al. 1998; Rapoport et al. 1998; Díaz-Betancourt et al. 1999; Benz et al. 2000; Marshal 2001; Grubben y Oyen 2004) y resalta la importancia de estudios etnobotánicos para documentar esta información, obtener indicaciones para el desarrollo futuro,la conservación *in* y *ex situ* y el uso sostenible de estos recursos.

El conocimiento dentro y entre culturas varía de acuerdo a diferentes factores socioculturales tales como la edad, el género, la clase social, la religión, la capacidad para leer (escolaridad) y los idiomas que se hablan, la etnia, la dieta, la religión, el medio ambiente biológico y el nivel de cambio cultural (Alexiades 1996; Cotton 1996; Martin 1995). La edad y el género de las personas frecuentemente son los más importantes en la distribución de conocimientos.

Se adquieren conocimientos etnobotánicos en la niñez a través de una combinación de procesos como la imitación, la enseñanza y el aprendizaje activa que ocurre durante actividades cotidianas (Lozada et al. 2006). Algunos estudios etnobotánicos demuestran que los miembros de mayor edad en las comunidades tienen más conocimientos sobre recursos vegetales que los miembros más jóvenes (Reyes-García 2001; Lozada et al. 2006). La perspectiva del género en estudios etnobotánicos toma en cuenta los conocimientos y percepciones según los diferentes papeles socioculturales de hombres y mujeres. Es importante entender cómo se distribuyen los conocimientos entre jóvenes y personas mayores, entre mujeres y hombres para poder aplicar sus experiencias al diseño, la implementación, el monitoreo, y la evaluación de las políticas y los programas de desarrollo o de conservación (Howard-Borjas 1999; Arango-Caro 2004).

Desde que John Harshberger acuñó el término 'etnobotánica' en 1896 (Hamilton et al. 2003, Balick y Cox 1997), los trabajos etnobotánicos se hacen generalmente con los propósitos de documentar la relación ser humano-planta en sus diferentes manifestaciones. Sobresalen las plantas comestibles para cubrir las necesidades de alimento. Algunos propósitos fundamentales de los estudios etnobotánicos son rescatar la información tradicional, apoyar el manejo tradicional de las plantas, aportar mejor información para la toma de decisiones sobre la distribución y la conservación de recursos y facilitar el desarrollo de plantas para su uso fuera del ámbito original y comercial (Barrera 1983; Caballero 1983; Hernández-Xolocotzi 1983; Given y Warwick 1994, Hamilton et al. 2003).

El presente trabajo aportta al conocimiento científico al responder a la pregunta: ¿Qué conocimientos tienen agricultores de subsistencia de diferentes culturas sobre plantas comestibles recolectadas y cómo los utilizan para complementar dietas basadas en maíz?

1. OBJETIVOS

Se plantearon los siguientes:

Objetivo general

Comparar el uso de plantas recolectadas comestibles entre México y Zimbabwe, contrastando dos regiones con condiciones físicas similares y el mismo cultivo principal, el maíz. México es el área de origen de este cultivo.

Objetivos particulares

1. Describir sistemáticamente el conocimiento existente sobre el uso de las plantas comestibles y su manejo.
2. Documentar las percepciones de la gente local sobre el uso de plantas recolectadas comestibles.
3. Cuantificar el uso actual de plantas alimenticias silvestres.
4. Elaborar y analizar listas florísticas de plantas recolectadas comestibles conocidas de cada comunidad bajo estudio.
5. Determinar la riqueza, abundancia y composición biogeográfica de arvenses comestibles y no comestibles en el cultivo de maíz en las áreas de estudio.

Hipótesis

1. Se encuentran similitudes en tipos de plantas, uso, conocimientos y percepciones sobre plantas recolectadas entre grupos humanos que no han estado en contacto directo, pero que dependen de ambientes y cultivos similares. El análisis de estas similitudes permite proponer patrones universales.

2. Existen diferencias en cuanto al conocimiento, el consumo y opiniones sobre las plantas comestibles silvestres entre géneros y clases de edad.
3. La frecuencia de consumo de plantas recolectadas dependerá de la disponibilidad de alternativas cultivadas.
4. La composición florística de las plantas comestibles silvestres refleja la composición florística del entorno y preferencias culturales de los habitantes.
5. Se encuentra una mayor diversidad de arvenses comestibles y no comestibles en el cultivo de maíz en México que en Zimbabwe debido a la convivencia más larga entre los agricultores, su cultivo y sus arvenses, por la misma razón en México se encuentra una proporción mas alta de plantas nativas.

Las dos regiones en que se trabajaron tienen las siguientes características sociales comparables:

- En las comunidades de ambas países, la fuente de ingresos es la agricultura tradicional de subsistencia.
- La gente generalmente llevan a cabo actividades como la recolecta, la pesca y ocasionalmente la caza.
- Se complementan sus ingresos económicos con empleos pagados fuera del esquema de subsistencia tradicional (migración a centros urbanos, empleos en el comercio).

Métodos empleados

Se siguió el mismo protocolo en cada una de las cuatro comunidades para tener congruencia en los datos recaudados, ajustando el idioma a las características del área. Se emplearon métodos cualitativos y cuantitativos (Cuadro 1) seleccionados por ser complementarios, mejorar la confiabilidad del muestreo y de los resultados (Marsland et al. 2001), considerando la disponibilidad de tiempo para el trabajo de campo en ambos países.

Cuadro 1. Métodos utilizados en la investigación

	Objetivos				
	Conocimiento	**Percepciones**	**Consumo**	**Lista florística**	**Diversidad**
Métodos Cualitativos					
Entrevistas semiestructuradas	✓	✓		✓	
Observación participante	✓	✓	✓		
Métodos Cuantitativos					
Listados libres	✓			✓	
Diarios de alimentos			✓	✓	
Muestreo de vegetación arvense				✓	✓
Recorridos y colecta botánica				✓	
Análisis estadístico	✓	✓	✓	✓	✓

Los métodos cualitativos consisten en muestreos dirigidos, entrevistas semiestructuradas, observación participante, y otras técnicas antropológicas para la obtención de información sobre las percepciones, preferencias, y prioridades de la gente entorno a algún tema. En cambio, las técnicas cuantitativas utilizan muestreos al azar, entrevistas estructuradas, y técnicas de análisis estadístico (Carvalho y White 1997).

Los métodos cuantitativos han aumentado considerablemente el rigor científico (prueba de hipótesis y cuantificación) de investigaciones etnobotánicos (Begossi 1996; Hamilton 2003; Hoffman y Gallaher 2007). En este trabajo se ocuparon métodos ecológicos como los índices de diversidad y heterogeneidad (capitulo 4), listados libres, diarios de alimentos e índices de importancia cultural (capitulo 1 y 2) para la recopilación y el análisis de información. Índices de diversidad y equidad en el conocimiento indican las plantas usadas por la mayoría de la población en forma homogenea, o e predominio de algunas especies.

Esta investigación se apoyó en listados libres para estudiar los conocimientos sobre plantas comestibles recolectadas. En la etnobotánica, los listados libres permiten identificar plantas y usos culturalmente importantes e indagar variables socio-demográficos que influyen en la distribución de conocimientos. Son rápidos y sencillos para aplicar, se pueden cuantificar los resultados y revelan los componentes salientes de cualquier dominio (Quinlan 2005). Índices de importancia cultural de plantas como él de los elementos salientes aportan resultados comparables entre investigaciones (Sutrop 2001).

Los diarios de alimentos son un método prospectivo de documentar los tipos, la frecuencia de consumo y las cantidades de plantas consumidos. Complementan a los listados libres y entrevistas para compilar listados florísticos. Tienen la ventaja de ser precisos si los participantes son cuidadosos. Sin embargo, requieren de la capacidad de leer y escribir de los participantes, suficiente motivación para dar continuidad a la documentación, y una buena memoria (en caso de consumo intermitente). Demandan mucha atención tanto del participante como del investigador/a (Ogle 2001).

2. ANTECEDENTES

Los estudios etnobotánicos interculturales ayudan a explicar la creación, el mantenimiento y la transmisión de conocimientos dentro y entre comunidades humanas. Hay evidencia de la existencia de principios comunes para conocer y clasificar organismos entre comunidades tradicionales (Berlin 1992; Caballero y Cortés 2001). La etnobotánica comparativa de grupos indígenas de Mesoamérica sugiere patrones generales en las formas de percepción, clasificación uso y manejo de recursos vegetales. (Caballero y Cortés 2001). Los resultados de este análisis aportan información valiosa en cuanto a las familias más importantes las categorías importantes (medicinal, alimento) lo cual es indispensable para la planeación del manejo sustentable de los recursos. Leonti et al. (2006) identificaron un grupo de especies de verduras importantes para Grecia, Italia y España que se pueden aprovechar para la venta en mercados urbanos y así conservar su uso. De acuerdo a Hadjichambis et al. (2008), el proceso de globalización da como resultado la disponibilidad de algunos especies en múltiples culturas.

Estudios comparativos entre regiones han tenido éxito en el ámbito de plantas medicinales. Investigaciones en plantas medicinales muestran muchos usos etnobotánicos parecidos de especies emparentadas por diferentes culturas y regiones. La etnobotánica comparativa de plantas medicinales permite la identificación de nuevos compuestos terapéuticos. Especies de plantas con usos similares en diferentes regiones tienen más probabilidad de contener sustancias activas por ser descubrimientos independientes (Moerman 1996;Bletter 2007). De acuerdo a Moerman et al. (1999). La similitud de floras medicinales entre floras de países del hemisferio norte muestran raíces antiguas de conocimientos humanos relacionados con las migraciones desde Asia a Norteamérica, con tendencias globales de conocimientos y la presencia de compuestos químicos similares. Existen otros puntos de contacto para la transmisión de información entre culturas como una historia cultural común propuesto por Ali-Shtayeh et al. (2008) para comunidades del Norte del Banco Occidental (Northern West Bank), Palestina.

La selección de alimentos es dirigida por el sabor, el olor, la textura, las características visuales, las técnicas de procesamiento y los beneficios fisiológicos percibidos (Hadjichambis et al. 2008). Otros trabajos comparativos también han mostrado el papel que juegan aspectos socio-culturales en la selección y el uso de recursos vegetales comestibles, por ejemplo en La Patagonia (Ladio y Lozada, 2003) y en Italia (Ghirardini et al., 2007). Messer (1989) y Rivera et al. (2007) mencionan que los aspectos culturales (factores sociales, simbólicos y económicos) interactúan con aspectos sensoriales y preferencias para formar los patrones de la selección de alimentos. Adicionalmente, las características ambientales determinan la abundancia y la disponibilidad de plantas comestibles e influyen en las diferencias entre grupos.

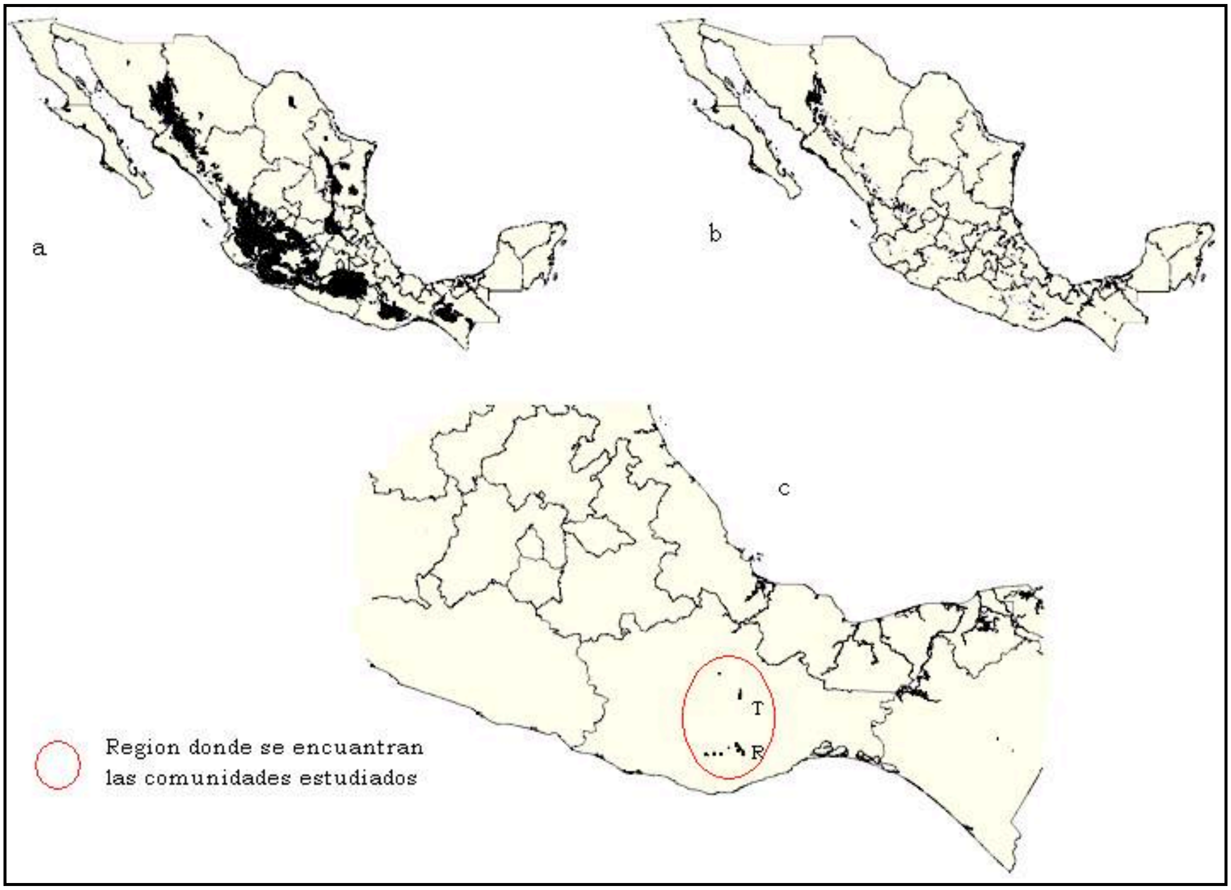
3. ÁREAS DE ESTUDIO

Las áreas de estudio fueron seleccionados para México y Zimbabwe, buscando lo más posible condiciones similares. Todos los sitios son de altitudes medianas del trópico montañoso, con un sitio más húmedo y uno más árido. La variación fue considerable en cuanto a la temperatura media anual (12 a 19°C), la altitud (500 a 1900 m) y la precipitación media anual (600 a 1200 mm). Hay que anotar que hubo diferencias grandes dentro de cada localidad, dado que se trata de regiones montañosas. En la selección de sitios se puso énfasis en características del suelo (acrisol húmico) por la predominancia de suelos ácidos en África, pero que son relativamente escasos en México. Las características corresponden al ambiente de la Unidad de Tierras G7 (Anderson et al. 1993) de las tierras comunales de Zimbabwe donde se inició el trabajo de campo.

La figura 1 ilustra el proceso de selección del área de estudio en México con un sistema de información geográfica proporcionado por la CONABIO. El primer corte (criterio de selección) fue un mapa que se hizo con las especificaciones de altitud y precipitación. En el segundo corte se añadió la temperatura y para el tercer corte se incorporaron los suelos acrisol húmico.

Además de la consideración de características físicas, también fue necesario encontrar comunidades donde el maíz era la base de la dieta, cultivado bajo un sistema de subsistencia y en condiciones de temporal. Adicionalmente, se consideró la disponibilidad de las autoridades y la población local para participar en el estudio. Cabe mencionar que no se encontraron condiciones similares en todos los aspectos.

Figura 1. Esta figura ilustra el proceso de la selección de área de estudio enMéxico, con base en mapas elaboradas con un sistema de información geográfica

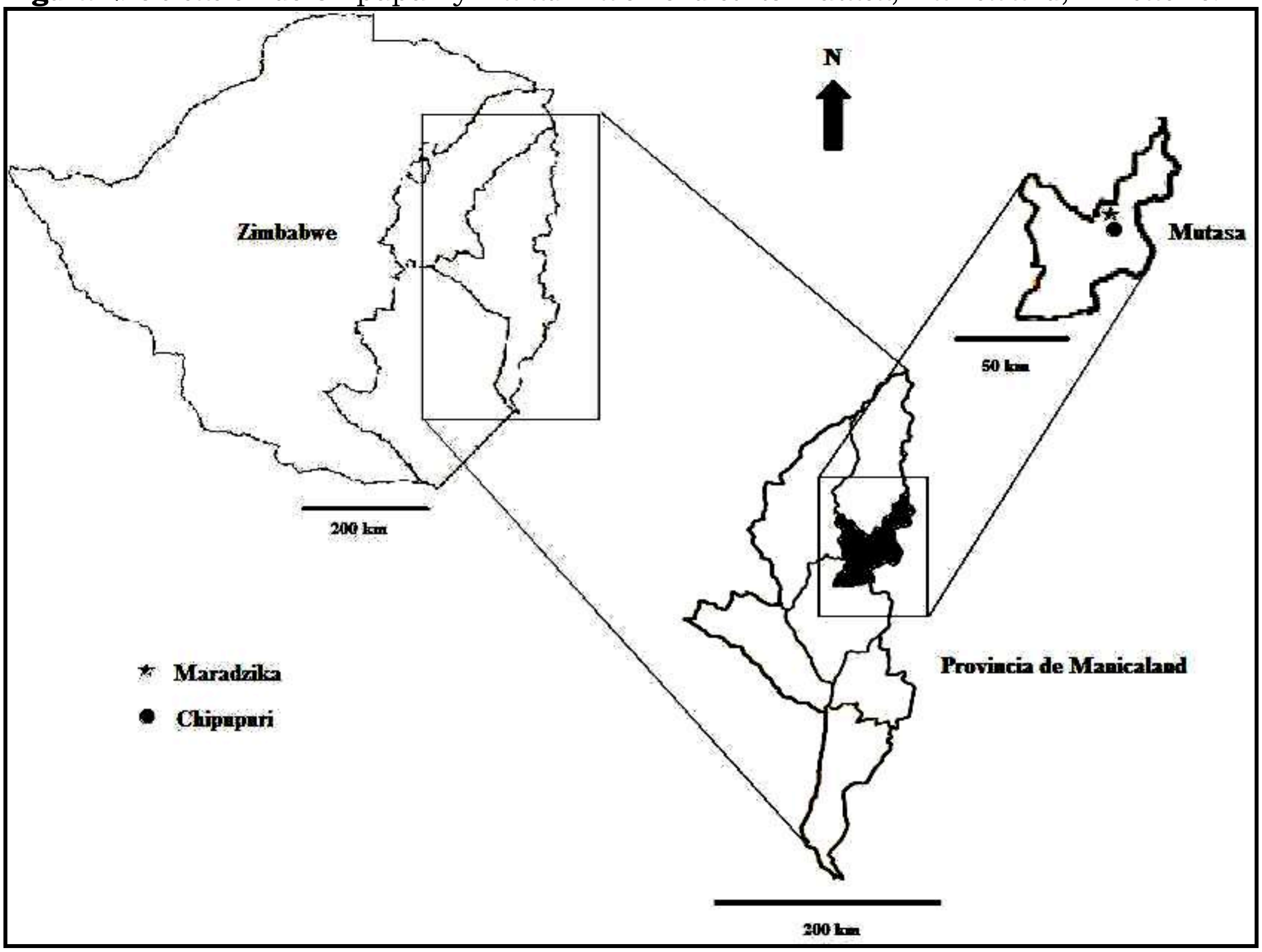


a. Corte 1: altitud + precipitación; b. Corte 2: temperatura + Corte 1; c. Corte 3: suelo (acrisol húmico) + Corte 2; R = Roatina; T = Talea.
Fuentes: INEGI, 1998; Vidal-Zepeda, 1990; INIFAP, 1995.

Zimbabwe

Se seleccionaron dos comunidades rurales, Chipupuri y Maradzika, dos aldeas en el distrito de Mutasa North, de la provincia de Manicaland (Figura 2). Las dos son parte de lasTierras Comunales que se encuentran en el valle del Rio Honde (Honde Valley). Chipupuri está ubicada en una elevación de 952 m y en las coordenadas 18º 33' sur, 32º 45' este y Maradzika se encuentra a 1200 m y 18° 30' latitud sur, 32° 45' longitud este (datos tomados desde la casa del jefe de la aldea).

Figura 2. Ubicación de Chipupuri y Maradzika en el distrito Mutasa, Manicaland, Zimbabwe.



La fisiografía en el Valle de Honde es un complejo de mesetas y valles muy inclinadas con elevaciones entre 500 y 1900 m. Presenta un subsueb de rocas de granito compuestas de adamelita y granodiorita con inclusiones gnéisicas menores. Los suelos son francoarenosos de color café-rojizo oscuro, profundos y con buen drenaje. De acuerdo a FAO/UNESCO /ISRC (International Soil Reference Centre), los suelos son acrisol haplico y húmico, y ferrasol. Son químicamente infértiles, muy ácidos y la topografía restrictiva para el transporte y la agricultura (Anderson et al. 1993). Las mediciones de pH de suelo para la presente investigación indicaron suelos muy ácidos (pH entre 4.0 y 5.5).

Chipupuri y Maradzika se encuentran en la región natural y agroecológica I de Zimbabwe. Las regiones se clasificaron de acuerdo con la precipitación anual (Cuadro 2). La Región Agroecológica I recibe precipitación promedia anual de más de 1000 mm que cae principalmente durante la estación de verano (Noviembre– Marzo/Abril).

Cuadro 2. Regiones Agroecológicas en Zimbabwe

Región Agroecológica	Precipitación (mm)	Actividades Agrícolas
I	Más de 1000	Silvicultura, agricultura y producción animal intensiva. Se cultivan café y té negro en áreas sin heladas
II	800-1000	Cultivos intensivos, producción de forrajes. Aporta el 90 % de la producción nacional.
III	650 - 800	Producción de ganado y producción suplementaria de cultivos de temporada corta.
IV	450 - 650	Ranchos de ganado y de animales silvestres.
V	Menos de 450	Ranchería extensiva de ganado bovino y animales silvestres.

Fuente: Anderson et al. (1993); Katerere et al. (1993); Ministry of Mines, Environment and Tourism (1998).

De acuerdo a mediciones en Mukande, la estación meteorológica más cerca al área de estudio, la precipitación total fue de 1462 mm durante Noviembre 2005-Abril 2006. La topografía influye en la precipitación. La cantidad de precipitación orográfica es más alta en las inclinaciones de barloventos, normalmente hacia el este (Joint ECA/FAO Agriculture Division, 1983). Observaciones personales indicaron que Maradzika recibe más lluvia que Chipupuri.

Aunque Zimbabwe se encuentra en los trópicos, hay diferencias marcadas de temperatura entre la estación fria y la estación seca y calurosa. La temperatura media anual es de 15-19ºC. Los meses más fríos son junio y julio y las heladas son frecuentes.

La región tiene áreas limitadas del extremo seco de bosque tropical lluvioso, aunque la mayor parte ha sido tumbada para la agricultura. Las partes más secas están representadas por montes del tipo 'Miombo' (Fig. 3.), un ecosistema tropical dominado por árboles de los géneros *Brachystegia, Jubernardia* y *Isoberlinia* – subfamilia Caesalpinioideae de la Familia Fabaceae (Anderson et al. 1993; Campbell et al. 1996). Tienen parches significativos de especies frutales importantes como *Uapaca kirkiana* Müll. Arg., que se mantienen relativamente bien conservados.

Figura 3. Vegetación del área de estudio en Zimbabwe

Izquierda: Vegetación Miombo; *Derecha*: Manchón uni-específico de *Uapaca kirkiana*

La zona es importante para el turismo. La topografía de cambios bruscos de altitudcrea vistas conocidas como las cataratas Mutarazi y Muchururu (Fig. 4). Las piedras encimadas (en Mahwemasimike), resultado de la erosión de las rocas de granito, también contribuyen con paisajes atractivas en Honde Valley. La vegetación local lo hace uno de los mejores lugaresdel país para la observación de varias especies de aves (BirdLife International, 2007).

Figura 4. Las cataratas Mutarazi y Muchruru, Honde Valley, Zimbabwe

Chipupuri y Maradzika tienen aproximadamente 1200 y 800 habitantes. Pertenecen a la etnia de los Shona y hablan el dialecto Chimanyika del idioma Shona. Ambas aldeasestán bajo el mando tradicional del sub-rey Samanga, residente en Maradzika en el reinado tradicional de Mutasa. Los habitantes son agricultores de subsistencia que cultivan principalmente maíz, frijoles, calabazas, sorgo, mijo, malanga, cacahuates, bambara, plátanos, café, mangos, aguacate, cebollas, jitomate y variedades de coles de hoja. Existe migración hacia las ciudades grandes, especialmente entre la población masculina, y sus ingresos suplementan al de la agricultura de subsistencia.

Las dos aldeas son de las tierras comunales creadas por el gobierno colonial ingles como reservaciones y fueron creados en zonas no viables agronómica o económicamente (Anónimo, 1994). Hoy en día, son áreas rurales densamente pobladas y con mucha erosión del suelo y sobrepastoreo.

El sistema de agricultura es comunal. La tierra es propiedad estatal y los habitantes locales tienen derechos usufructuarios. De acuerdo a las leyes vigentes, los consejos de los distritos asignan los terrenos. Sin embargo los campesinos no los toman en cuenta y siguen los costumbres tradicionales, y los líderes son responsables para todos los asuntos de la tierra.

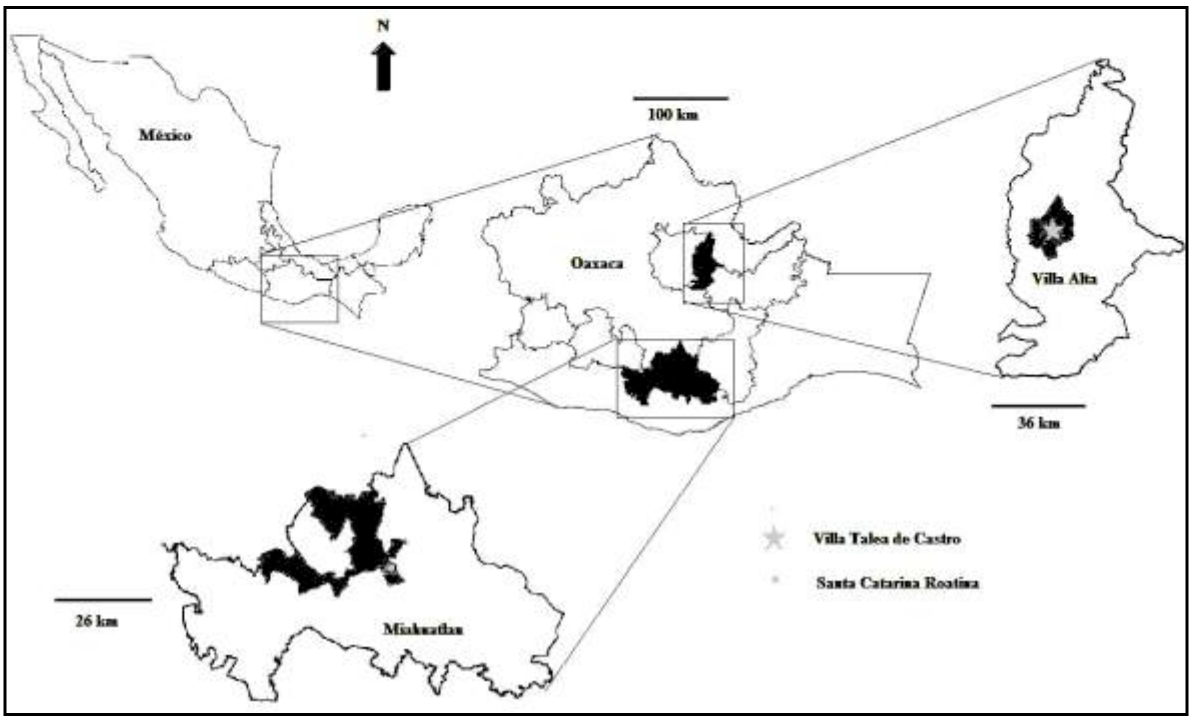
Chipupuri está cerca de la carretera principal de Honde Valley y otros caminos secundarios. Los servicios básicos (escuela, comercios, clínica y el molino) están relativamente accesibles para los habitantes. Los comercios, las escuelas y la clínica tienen electricidad aunque solamente la gente más rica tiene electricidad en sus viviendas.

Maradzika es más alejada de la carretera principal y es casi inaccesible durante la temporada de lluvias. Los comercios, la clínica y la escuela están ubicados cerca de la carretera principal La gente camina distancias de aproximadamente 4-6 km para obtener algunos servicios. Tiene que caminar distancias más largas para acceder al molino que se encuentra en los comercios de Chipupuri.

México

En México, el estudio se llevó a cabo en dos comunidades rurales en el estado de Oaxaca (figura 5). Santa Catarina Roatina es una agencia municipal del municipio de Miahuatlan de Porfirio Díaz, distrito de Miahuatlán, en la región de la Sierra Sur de Oaxaca. El centro se encuentra a 1789 m y en las coordenadas 16º16' latitud norte y 96º 31' longitud oeste, pero las tierras rurales pueblo se encuentran entre 1650 y 1860 m. La otra comunidad es Villa Talea de Castro que es cabecera del municipio con el mismo nombre. Está ubicada a las coordenadas 17º 22' norte, 96º15 oeste. El centro se encuentra a una elevación de 1600 m y las milpas varían de 1000 a 1750 m. Villa Talea de Castro se encuentraen el distrito de Villa Alta, en la región de la Sierra norte de Oaxaca.

Figura 5. Ubicación de Santa Catarina Roatina y Villa Talea de Castro, Oaxaca, Mexico.



El municipio de Miahuatlán se localiza en el valle de Miahuatlán, planicie de llanos y lomas bajas con elevaciones de hasta los 1600 m en promedio. El valle es geográficamente un apéndice del Valle Grande de Oaxaca. Presenta una geología de rocas ígneas extrusivas del Terciario, y los suelos dominantes son regosol eútrico y acrisol húmico a pequeña escala. Las mediciones del pH para los propósitos de este trabajo mostraron suelos alcalinos (7.13-8.57). Se encuentra en la cuenca del Río Atoyac.

El municipio de Miahuatlán tiene un clima templado sub húmedo con lluvias en verano (Mayo/Junio – Octubre). La precipitación media anual es 535.9 mm y la temperatura media anual es de 19.9 °C. La vegetación es principalmente de pastizal, y bosque de pino-encino hacia la sierra al sur. La vegetación secundaria forma 90 % de la superficie según el uso del suelo en el municipio (INEGI, 2004 y 2006; INAFED, 2005).

Santa Catarina Roatina tiene una población de casi 2000 habitantes de origen zapoteco pero no hablan la lengua indígena. Han adoptado las costumbres de los mestizos. Los agricultores son pequeños propietarios. Cultivan maíz, frijoles y calabazas en terrenos de 0.5 a 1 hectárea. Muchos de los campesinos consideran que el cultivo de maíz ya no esredituable y encuentran trabajo en la cabecera municipal donde laboran como jornaleros, principalmente en la construcción. Sólamente el 30% se dedican a la agricultura. Aproximadamente el 20% han migrado a Estados Unidos de América y a otras regiones de Mexico.

Santa Catarina Roatina cuenta con servicios sociales como una escuela primaria, una telesecundaria y una clínica de salud con atención del personal del Seguro Social cada 15 días. La mayoría (70 %) de los habitantes cuentan con electricidad y tienen bienes como televisores y refrigeradores. No tienen servicio de drenaje. Los demás servicios se encuentran en la cabecera municipal a una distancia de 30 minutos en vehiculo automotor sobre una carretera de terracería.

Villa Talea de Castro se encuentra en una región denominada el Rincón de la Sierra Juárez de Oaxaca. La sierra tiene cumbres que exceden los 2000 metros. El Rincón está rodeado de cadenas montañosas en tres lados y dos ríos (Río Cajonos y Río del Rincón) que forman la única apertura hacia la cuenca del Rio Papaloapan. Estas aperturas traen humedad del Golfo de México y proporcionan a Rincón más precipitación que otras partes de la sierra (González 2001). Villa Talea de Castro recibe un promedio anual de 1583 mm de precipitación. La temperatura media anual es de 20.9°C, con bajas temperaturas y heladas durante el invierno.

Figura 6. Villa Talea de Castro en el Rincón de la Sierra de Juárez.

Los suelos dominantes para la región son acrisol húmico y áreas muestreadas para el presente trabajo indican suelos ácidos con pH de 4.99-6.50. La vegetación es bosque de pino-encino húmedo. Según el uso de suelo, la vegetación secundaria cubre un tercio de la superficie del municipio (INEGI, 2006).

Villa Talea de Castro tiene 2237 habitantes (INEGI, 2006) en la cabecera municipal. La mayoría de la población se dedica a la agricultura. Los cultivos principales son maíz, café, caña de azúcar, frijoles y calabazas. Otros pobladores laboran en otros sectores como el comercio y la construcción y algunos dependen de remesas de emigrantes en otras regiones de México y Norte América. Los habitantes de Villa Talea de Castro son principalmente de origen zapoteco y 2028 personas hablan el subgrupo 'Rincón' del idioma zapoteco (de la Fuente, 1994); quince de ellos no hablan el español (INEGI, 2006).

Los terrenos dedicados al cultivo son propiedad privada de los agricultores mientras que las zonas de bosque están bajo régimen comunal (de la Fuente, 1994; Gonzalez, 2001). Los lugareños pueden cortar leña y usar los recursos no maderables. El uso comercial de madera está prohibido. De acuerdo a Gonzalez (2001), la región del Rincón no ha sido sujeta a las reformas ejidatarias.

Aunque se encuentra relativamente aislada, la cabecera municipal es moderna y cuenta con servicios de comercio, está conectado a Internet y debido a la alta tasa de migración a los Estados Unidos de América, también tiene servicio de paquetería hasta Los Ángeles. Tiene escuelas primaria y secundaria y una preparatoria. Hay servicio de caja de ahorro, restaurantes y hoteles. Los habitantes que viven cerca del centro tienen servicio de drenaje. Casi todos los pobladores tienen energía eléctrica y agua potable.

4. PRESENTACIÓN

Este trabajo se presenta en cinco secciones. Los primeros dos capítulos documentan conocimiento y uso de la flora silvestre comestible en las comunidades de Zimbabwe y México respectivamente. Se describe el conocimiento etnobotánico de plantas recolectadas comestibles de cada comunidad como punto de partida para la comparación. Ambos capítulos ofrecen listados de la flora comestible un Anexo, cuantifican frecuencia del consumo de recursos y describen las percepciones de las poblaciones de estudio sobre el uso de plantas comestibles. Se parte de la hipótesis que existen diferencias entre géneros y clases de edad. La tercera sección es una comparación de la flora arvense en el cultivo de maíz en cada nación. Tomando en cuenta tanto los componentes comestibles como no comestibles, esta sección presenta resultados de muestreos de plantas arvenses en el cultivo de maíz y documenta la diversidad. El capitulo 3 también registra y analiza la composición biogeográfica de las especies arvenses. Se prueba la hipótesis que México tendrá mayor diversidad de especies por la larga coevolución que existe entre el maíz y sus arvenses. La cuarta parte compara la etnobotánica de plantas comestibles silvestres de las cuatro áreas de estudio entre México y Zimbabwe y busca patrones universales en el aprovechamiento de tales recursos. Además, se analiza la importancia cultural de las familias botánicas de las plantas en estudio para cada comunidad. La última sección es de análisis general de los resultados obtenidos y se presenta la conclusiòn del trabajo.

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CAPÍTULO 1

KNOWLEDGE AND USE OF EDIBLE WILD PLANTS IN TWO RURAL VILLAGES OF HONDE VALLEY, EASTERN ZIMBABWE[1]

1.1. ABSTRACT

This study documents the ethnobotanical knowledge and use of 92 edible wild plants in Honde Valley, Zimbabwe. Fruits and leafy vegetables formed the bulk of the wild plants consumed 2-5 times a week during the study period. Preferred vegetables were dried and conserved for off-season use. Knowledge is transmitted orally within families and acquired early (5 years). Despite increased preference for cultivated alternatives, there was renewed interest in wild plants because of their accessibility and the associated health benefits. The loss of ethnobotanical knowledge on the use of wild edible plants in the area is moderate at present.

1.2. INTRODUCTION

Wild and weedy plants are considered to be an important component inthe diet of many rural societies of the world. They are a relatively accessible and cheap (Santos-Oliveira and Fidalgo de Carvalho, 1975; Casas *et al.*, 2001; Machakaire *et al.,* 1998; Grivetti and Ogle, 2000; Murray *et al.,* 2001) and therefore help to alleviate the vitamin, mineral and fibre deficiencies of basic diets. Moreover, they add variety to otherwise monotonous diets. Rather than improve quantity (Packham, 1993), wild food plants enhance the quality of food.

Various investigations, however, have recorded a trend toward the loss of knowledge and use of wild plant resources despite their proven importance for local communities (Benz *et al.,* 2000; Given and Warwick, 1994; Machakaire *et al.,* 1998; Diaz-Betancourt *et al.,* 1999; Marshal, 2001; Grubben y Oyen 2004; Ratheesh Narayanan *et al.,* 2003; Reyes-Garcia *et al.,* 2005). This has been attributed to the breakdown of traditional cultures, westernization and modern agricultural methods. According to Asfan and Tadesse (2001), the use of these plants in Ethiopia, for example, has been restricted to times of famine and wars. Social transformations of traditional societies have also created the perception that poverty and use of wild edibles are linked, so using them is often frowned upon. In Zimbabwe (Campbell, 1987;

[1] Articulo en revisión: *Ecology of Food and Nutrition*, enviado septiembre 2007

Ndiripo, 1992) the reduction in use and knowledge of edible wild fruit has also been attributed to deforestation for cultivation and fuel wood.

The use of wild edible plants worldwide is known to be seasonal (Mertz *et al.*, 2001; Ratheesh Narayanan *et al.,* 2003). A number of previous studies in Zimbabwe have mentioned the seasonal consumption of edible wild plants, especially during periods when cultivated alternatives are scarce just before the harvest (Campbell, 1987; Zinyama *et al.,* 1990; Campbell *et al.*, 1991; Benhura and Chitsaku, 1992; McGregor, 1994). However, few quantify the amounts consumed, or document the transmission of ethnobotanical knowledge.

Our objectives in this study were to

- document local people's knowledge and perceptions on the use of wild edible plants according to different age and sex groups,
- study the transmission of knowledge within the community,
- list the edible flora of the area and,
- and quantify amounts consumed in a rainy season.

These data will serve to explain the persistence in the use of wild edible plants.

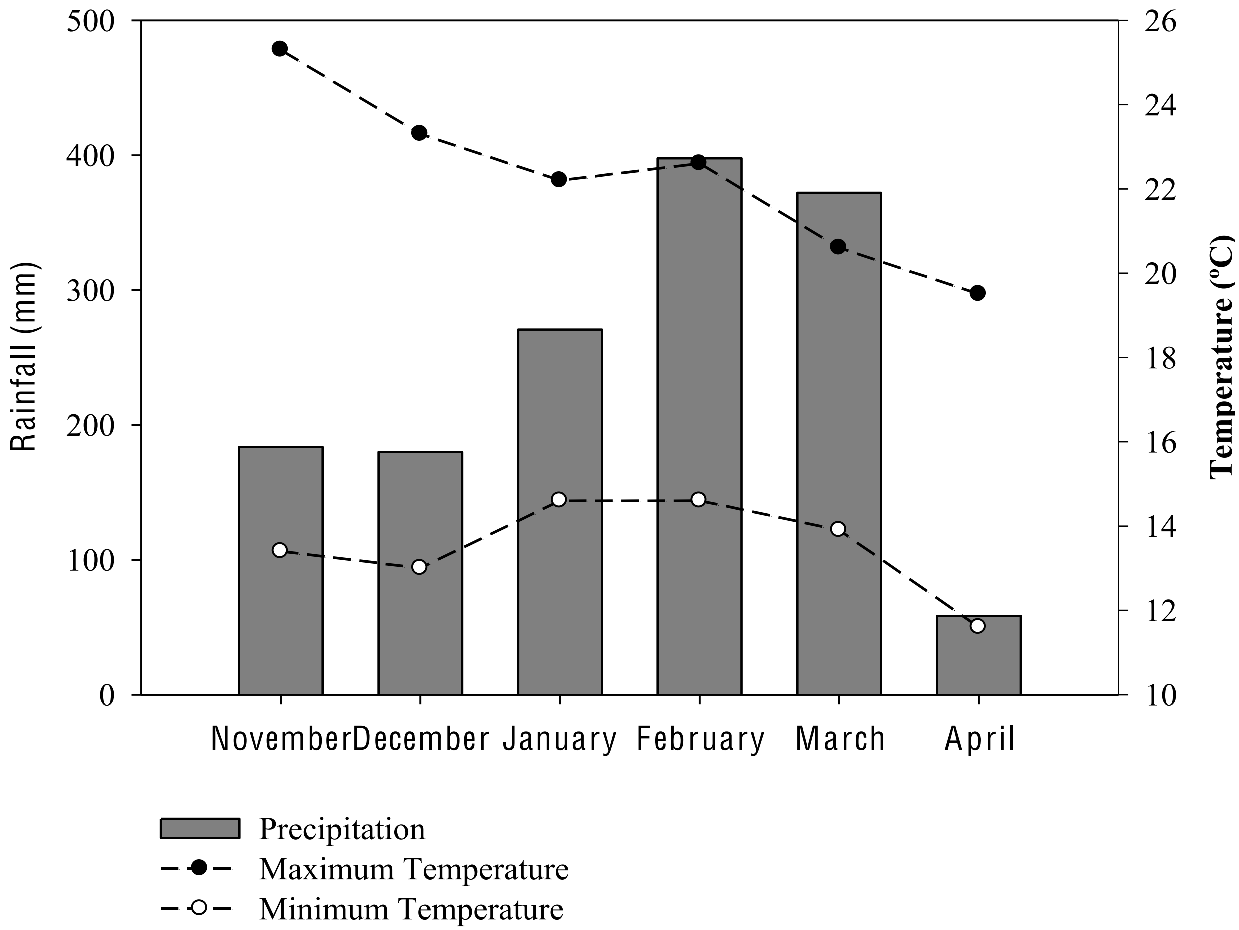
For the purposes of this study, we use the term "wild plants" for plants that grow spontaneously without the direct intervention of humans in woodlands, croplands, home gardens and along waysides.

The Study Area

This study was carried out during the November 2005 - April 2006 rainy season in two rural villages of Honde Valley, Manicaland Province of Zimbabwe. Chipupuri Village is located 18° 33' S, 32° 45' E and at an elevation of 952m. Maradzika lies at 1200 m, 18° 30' S and 32° 45' E. Total precipitation during the study period was 1462.4 mm at a weather station in Mukande near Honde Valley (Fig. 1). Observations indicate that Maradzika receives more rainfall than Chipupuri, but specific data are unavailable. The average monthly temperature ranged 11.6 °C (minimum) and 25.3 °C (maximum; Fig. 1.) while the average annual figures for the region range between 750 to 1000 mm and 13°C (Anderson *el al.*, 1993). The region is mainly of the "miombo" type of vegetation: a closed deciduous nonspinescent woodland dominated by the genera *Brachystegia*, *Julbernardia* and *Isoberlinia* (Fabaceae, subfamily

Caesalpinioideae), that generally occurs on geologically old, nutrient-poor soils (Campbell *et al.*, 1996). However, much of the land has been cleared for agriculture.

Figure 1. Climatic conditions (November 2005 - April 2006)



Taken at Mukande Meteorological Station, Zimbabwe. Source: Department of Meteorological Services, Bulawayo Zimbabwe.

The population consists principally of peasant subsistence farmers (also known as communal farmers in the Zimbabwean context) who speak the Chimanyika dialect of Shona. They grow a combination of maize-beans-squash, bananas, sweet potatoes, taro, coffee, cow peas, bambara ground nuts, finger millet and mangos on 1-3 ha plots. Bananas, beans, maize and onions have some economic value during good harvest years. People's diet is composed mainly of the staple *sadza* (thick maize meal porridge) accompanied by green vegetables (mainly *Brassica*), beans and occasionally meat. Previous personal observations indicated that wild foods are widely consumed in the region.

Although both villages have local health, education, religious and other social services Maradzika village is relatively isolated with poor roads due to rugged terrain. Villagers have to walk long distances to the business centre where these services are located. Moreover the centre lacks electricity so some services like the grinding mill for maize are located 2 hours down hill (approximately 3 hrs uphill). Chipupuri on the other hand is better communicated as it is located close to the main road and secondary roads that make the transportation of goods and services easier.

1.3. METHODS

Our study protocol was approved according to the Regulations for Academic Activities of by the Education Department of the Colegio de Postgraduados. Permission to work with the villagers was granted after following the traditional protocol by the local headman (traditional leader of the Samanga Clan in this case) and the respective village heads. Children were interviewed with the informed consent and in the presence of their parents or guardians.

As a first step, local social structures (schools, churches and clubs) were approached for group interviews by age and sex with villagers. Each group interviewed had approximately 10 people. This provided a preliminary list of edible wild plants of the area as well as their preparation methods. Local names (ethnospecies) were used as field names. Plants were collected from within a radius of approximately 5 km around the villages and voucher specimens were identified and deposited in the National Herbarium of Zimbabwe (SRGH).

In the second part of the study, ten households from each village were randomly selected from lists of "working kitchens" kept by the village heads. A kitchen represents a household that usually comprises a family of grandparents, parents and children. Households composed only of grandparents with grandchildren were also common due to migration to urban centres for work and also because a number of children had been orphaned.

After an orientation meeting, each household received a notebook, hereafter referred to as food diary, where they were asked to record the date, the wild plant and the quantities eaten. The quantities eaten were recorded according to local measurement units and these were weighed several times for quantification. For example, quantities recorded as "dishi" or "sosi" for leafy greens weighed approximately 150 g and 75 g respectively. The records were generally kept by the cook. They were kept by the male head of the family in only two households. The food diaries were revised during fortnightly visits. One case of overreporting (mentioning species out of season) was ignored and underreporting was detected in 3 instances by asking each member of the household if they had eaten anything away from home and forgotten to mention it to the person responsible for the food diary. The results coincide with direct observation during field work.

Individuals from the households were later asked in semi-structured interviews to list edible wild plants and general information about availability, location as well as their perceptions about the use of wild plants for food. Interviewees were also asked questions geared towards finding out how and when they learnt about new plants and who taught them about them.

1.4. RESULTS AND DISCUSSION

General use of edible wild plants

The villagers of Chipupuri and Maradzika reported a total of 92 ethnospecies of edible wild and weedy plants known to be found in the area (Appendix). The majority (67) of the ethnospecies correspond to botanical species while plants referred to as “bvumvu” and “goche” were 2 different botanical species respectively. The leaves and tubers of *Typhonodorum lindleyanum* were commonly referred to by different names. We could not identify about of a third of the plants to species level, especially fruit trees, because they were not availableor did not flower during the study period.

Of the wild species used, 46% provided fresh fruit and 35% relish. The roots or tubers of 3 species are eaten as a source of starch and the seeds of one plant were formerly used for oil extraction. Plants used in the in the confection of beverages make up 10%, while condiments and snacks contribute 8 % each. Some species like *Parinari curatellifolia* have multiple uses. Participants reported 63 ethnospecies that are common for both villages while 9 were reported only for Chipupuri and 14 were reported only in the more remote Maradzika Village.

Most of the plants recorded are found around the villages in crop fields, gardens, river banks, and the natural vegetation, except *Fadogia ancylantha, Berchemia discolor* and *Ziziphus mauritiana* which were mentioned by a number of interviewees. These are abundant in other provinces like Mashonaland East and are either brought to the area by visiting relatives or bought from the urban markets in Mutare. One Chipupuri househol had a *Z. mauritiana* growing in their homestead.

While some plants such as *Cleome, Corchorus* and *Amaranthus* reported for Honde Valley are commonly used throughout Africa, we found that the total number of edible species (92) is relatively high. Johns *et al.* (1996) documented 42 wild food plants for the Ngorongoro District of Tanzania. The Luo of Kenya use 69 edible plants (Johns and Kokwaro, 1991), and in South Ethiopia, 66 plants are used (Balemie and Kebebew, 2006). More plant species however, have been reported for other parts of the world like Kerala, India, where 139 edible wild plants have been documented (Ratheesh Narayanan *et al.,* 2003).

Knowledge and collection of wild edible plants: Gender roles

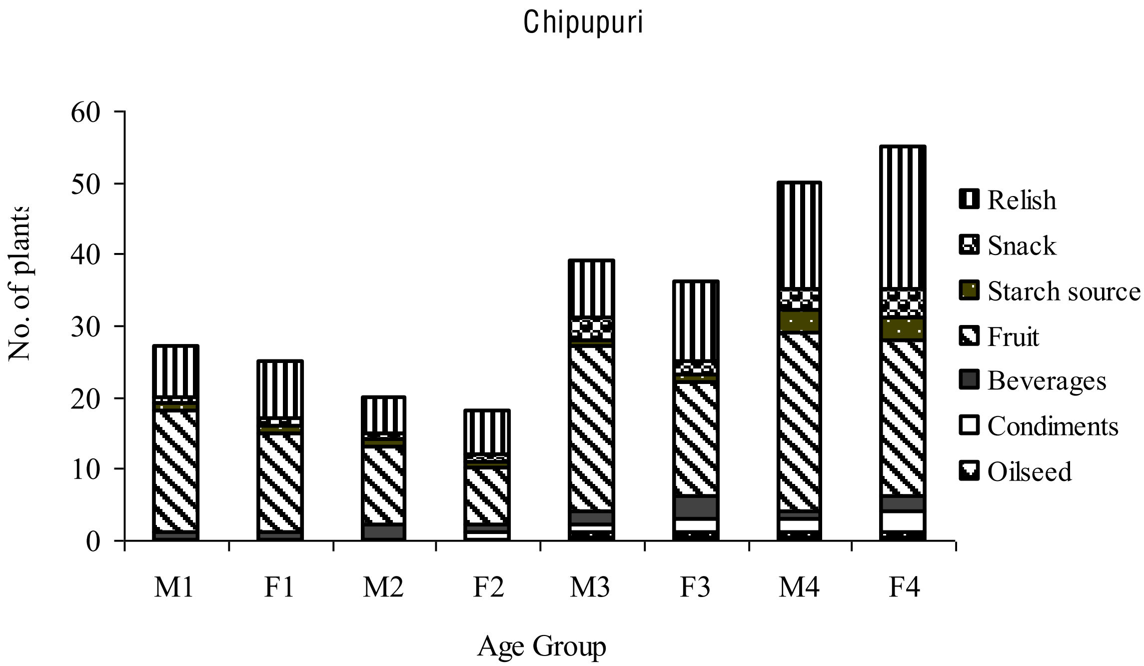
Group interviews showed that the older men and women (51+ years) were reservoirs of knowledge on edible wild plants in the area (Fig. 2). They listed more plants than the other age groups. Some species, like *Eriosema shirense, Acalypha villicaulis* and *Triumfetta* sp., were only mentioned by the older men and women. However, the general patterns of knowledge were quite similar in the two villages. There were statistically significant differences between the knowledge documented by individuals older than 50 years and the younger members of the community (Table 1).

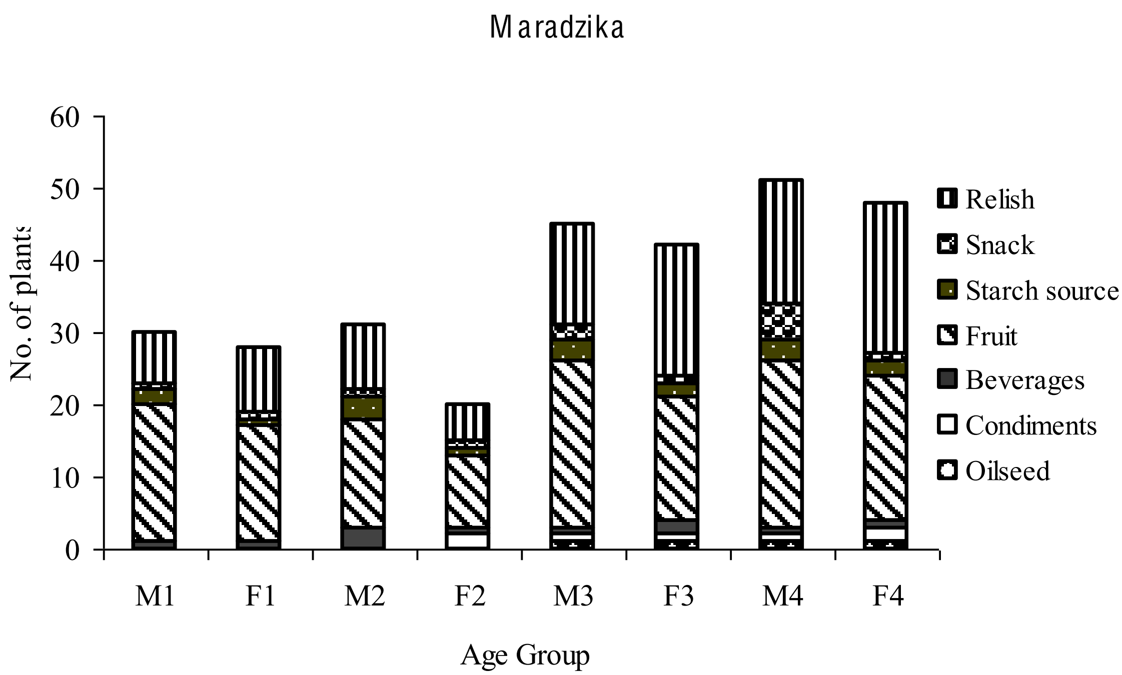
Table 1. Knowledge of edible wild plants (Mean number of plants mentioned per individual)

Age Group	Elders (n=21)	Adults (n=20)	Adolescents (n=23)	Children (n=12)
Relish	6.7 ^{a}	4.9 ^{b}	3.7 ^{bc}	3.2 ^{c}
Fruit	7.4 ^{a}	6.3 ^{ab}	4.7 ^{b}	4.6 ^{b}
Starch Source	0.3 ^{a}	0.1 ^{ab}	0.1 ^{ab}	0.0 ^{b}
Oilseed	0.2 ^{a}	0.0 ^{b}	0.0 ^{b}	0.0 ^{b}
Beverage	1.7 ^{a}	1.4 ^{ab}	1.0 ^{b}	0.9 ^{b}
Condiment	0.3 ^{a}	0.2 ^{a}	0.2 ^{a}	0.0 ^{a}
Snack	1.0 ^{a}	0.2 ^{b}	0.0 ^{b}	0.0 ^{b}
Total	17.6 ^{a}	12.6 ^{b}	9.8 ^{bc}	8.6 ^{c}

Means followed by the same superscript within the samerow are not significantly different at $P < 0.05$ (LSD test). Children = 5-12 years; Adolescents = 13-19 years; Adults = 20-50 years; Elders = 51+ years

Fig. 2. Group knowledge of edible wild plants





M = Males; F = Females; 1 = 5-12 years old (n=14); 2 = 13-19 years old (n=12); 3 = 20-50 years old (n=10); 4 = 51+ years old (n=10).

The ethnospecies that were common knowledge for the majority of the participants are shown in Table 2. These were usually species that were available closer to the homesteads or more abundant in each village. Some tree species like muhubva, muzhanje and mutsurungunyu were commonly found growing in the maize fields, or live fences around the homesteads. The five relish species that are common knowledge are weeds that can be collected easily.

Table 2. Species known to most participants (Proportion (%) of individuals)

	Ethnospecies	Chipupuri (n=41)	Maradzika (n=35)	Total (n=76)
Relish	*Bidens pilosa*	93	91	92
	Galinsoga parviflora	71	60	66
	Cleome gynandra	59	31	46
	Amaranthus spinosus	54	60	57
	Cleome monophylla	41	60	50
Fruit	*Annona senegalensis*	49	71	66
	Vitex payos	66	66	66
	Ximenia caffra	39	66	51
	Uapaca kirkiana	66	43	53
	Bridelia micrantha	5	66	33
Snack	*Mondia whitei*	85	69	78

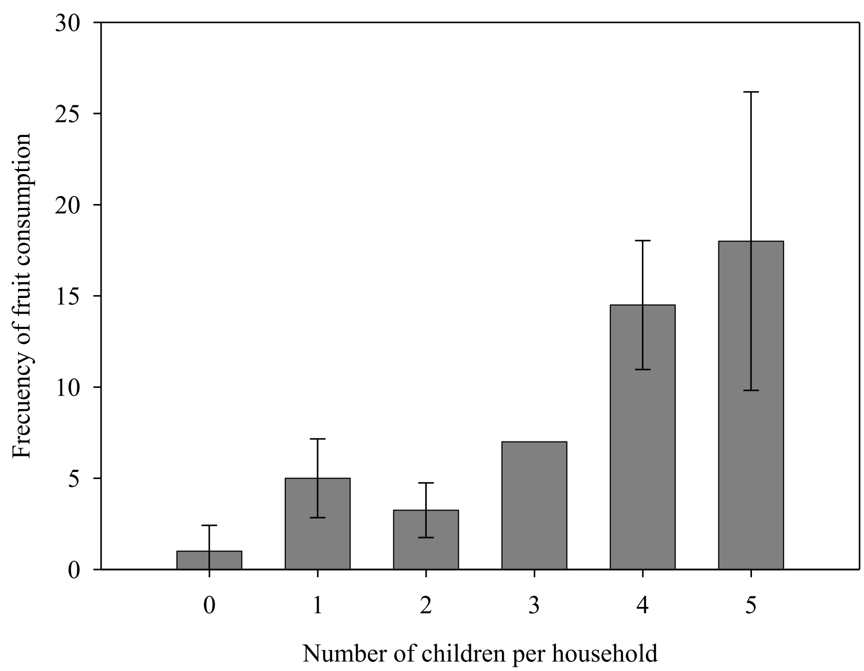
The male population generally listed and identified more plants than the females. They knew more about wild fruit while the females knew more about the wild vegetables. There are more fruit species than the leafy vegetables used as relish. In Honde Valley men work more in the natural vegetation where fruit are found than the women. Men occasionally ate wild fruit while hunting or during other activities carried out in the bush. It was not common for the men to bring home any collected food plants except in families with very young children. None of the men interviewed brought home any plants used as relish. It was simply not their responsibility. In contrast men in Mexico gather pot herbs, "quelites," when working in the maize fields (Vasquez-Garcia *et al.,* 2004).

This corresponds to the well-defined social roles assigned to the genders. As reported by Momsen (2007) and Ratheesh Narayanan *et al.* (2004), men and women tend to occupy different spaces in their surroundings and thus gain differentiated information about local environmental diversity.

In most cases women know more about the environment around the home. In the study area, this was clearly stated in response to the question "Who usually collects edible plants and why?" Women and adolescent girls of Honde Valley considered the collection of green leafy vegetables an important task, because they provide and cook food for the family. The role of women in the supply of plants for the home has also been documented for Mexico where women collect twice as many times as men (Vasquez-Garcia *et al.,* 2004). In the Western Ghats area of India, women also have a predominant role in the collection and processing of wild greens for consumption (Ratheesh Narayanan *et al.,* 2003 and 2004). It was interesting to note that young boys (5-12 year olds) knew a number of wild vegetables, probably because at this age boys spend more time with the female members of the family. The boys could identify various ethnospecies and gave detailed information on their preparation methods although none reported actually having prepared them.

Children generally collected wild fruits to eat as snacks. As has been reported for other regions in Zimbabwe (Bradley and Dewees, 1993; Packham, 1993; Campbell, 1987), the children from Honde Valley usually collected and ate wild fruits on the way to and from school, during stock herding activities (boys) and on the way to water wells and when looking for firewood (girls). Fruit are considered very important in the provision of nutrients for children (Bradley and Dewees, 1993). The informants were conscious of this and even men would collect fruit for young children who could not collect for themselves. Fruit consumption during the study period was higher in families that had more children (Fig 3).

Figure 3. Household fruit consumption in Honde Valley



Knowledge transmission and attitudes towards wild edible plants

Information is mainly passed on from parents to children. The majority (57.5%) of the respondents (n = 76) were taught about the plants by their parents and 25% by their grandparents; 7.5 % learnt from their friends, 5 % learned from church organisations and another 5 % was taught at school. This shows that information is still being passed on from generation to generation by oral tradition. Any loss of information is probably due to reduction in use due to changing preferences. People generally learned before or during early adulthood. Thereafter it is rare to learn to use new plants. The only people who had recently (in the previous three years) learned of new plants were generally young wives originally from different regions. For example one of the interviewees reported that she had only cooked *Bidens pilosa* once in her life and only because her husband had particularly asked her for it.

Comments during group and individual interviews showed a trend towards revival in the use of traditional and wild plants, because of the present economic and health (AIDS) environment. This was being encouraged by campaigns of various organizations such as churches and primary health care centres and Non Governmental Organisations. During the study period, some villagers from Maradzika attended a workshop held by the Seventh Day Adventist Church where they were encouraged to eat wild plants and were also taught new methods to prepare them. Those who attended the workshop later spread the information through other social organisations like their clubs and cooperatives. This trend in the use of wild plants, especially vegetables, has also been documented in the urban areas of Zimbabwe. Dhewa (2003) and Mutimutema and Mvere (2000) reported an increase in the consumption of wild and indigenous vegetables in urban settings.

Younger people (5-19 year olds) preferred cultivated plants (especially the green leafy vegetables) because they preferred the blander taste. Older community members reported an explicit preference for wild food plants, citing their nutritive and medicinal properties; the bitter taste is considered an indicator of these properties. Flyman and Afolayan (2006) also report the preference of wild vegetables over exotic cultivated ones because of their role as food and medicine in Botswana. Specifically, both *Cleome* species were reported to treat stomach problems and *Bidens pilosa* L. was cited for the treatment of hypertension. *B. pilosa* is reported to have rejuvenating properties in the Ghats region of India (Ratheesh Narayanan *et al.,* 2004).

The elders did not cite any disadvantages in the use of wild plants for food. They only mentioned that some fruits and vegetables had recently become harder to find because of the increase in the population and also regretted that the "modern" vegetables were replacing the traditional and "healthier" wild ones. The modern vegetables referred to were *Brassica juncea* and *B. napus.* Most disadvantages in the use of wild plants were cited by the younger people. The advantages and disadvantages associated with the consumption of wild food plants mentioned during the interviews, with proportion of participants as a percentage, are summarised below.

Advantages

1. Wild plants are usually easy to acquire - there is no labour involved in planting, weeding or watering them (26 %).
2. Wild plants help to prevent illness and some have therapeutic properties (14 %).
3. One gets wild plants for free - you do not need to buy them. No one owns them (13%).
4. They are nutritious and have body building properties (13 %).
5. They help to add variety to the diet (4 %).
6. Some vegetables are relatively easy to prepare as you can simply boil them and cooking oil is not essential. The villagers attribute the rise in the number of hypertension and diabetes cases to the abusive use of cooking oil (4 %).
7. They are useful in times of scarcity of other alternatives especially before the harvesting period (3 %).
8. Wild plants are no easily attacked by pests and diseases (1 %).

Disadvantages

1. Wild edibles are seasonal and are usually available only during the rainy season (11%).
2. Some plants, especially those used as leafy vegetables, have a bitter taste compared to the cultivated ones (8 %).
3. Adequate knowledge about the plant is required to avoid poisoning (7 %).
4. It is time-consuming to look for and collect the plants (5 %).
5. A number of the plants grow as weeds and are difficult to control (4 %).
6. Some have become scarce because of the increase in demand due to the increase in population (1 %). This perception may be incorrect; McGregor (1994) in Shurugwi, Zimbabwe, showed that the decline in consumption was related to changing

preferences rather than decreasing abundance of resources.

7. Some plants grow in unhygienic places (around cattle pens and rubbish pits) and may be health hazards (1 %).

Actual consumption of edible wild plants

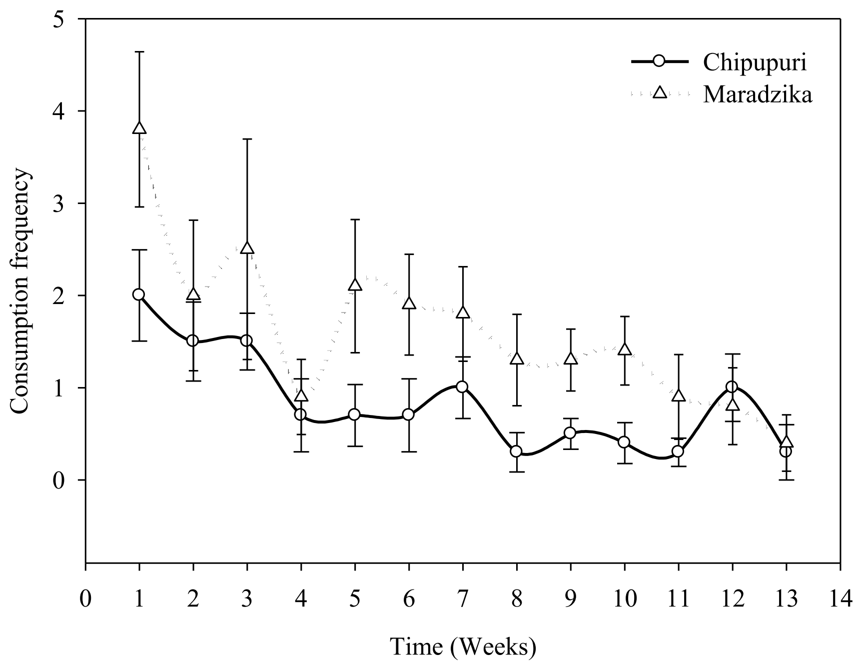
The use of 40 plants were recorded by the families in the food diaries: 20 species were eaten as fruit, 17 as relish, one tuber as a source of starch and two plants for snacks. Participating households from Chipupuri consumed approximately 26.2 kg of 22 species of wild plants (7.3 ± 2.9 species and 2.6 ±1.5 kg per family) during the season. Fruits formed 54.5% of the plants consumed and the rest were leafy vegetables used as relish. Maradzika households ate more plant species than those of Chipupuri. They recorded 38 wild plants and28.1 kg of fresh mass (10.3 ± 4.9 species and 2.8 ± 2 kg per household). Of the wild plants consumed in Maradzika, 47.4% were wild fruit and 44.7% were wild and weedy vegetables. Tubers (majo) of *Typhonodorum lindleyanum* and the pseudostem of *Ensete ventricosum* were also eaten. Table 3 shows the species reported most frequently in the food diaries.

Table 3. Most frequently consumed species between January and March in order of importance

Plant	Chipupuri			Maradzika		
	Frequency (village totals)	Number of households	Order of importance	Frequency (village totals)	Number of households	Order of importance
Relish						
Cleome gynandra	19	8	1		Not frequently consumed	
Corchorus olitorius	9	4	2	9	3	5
Amaranthus thunbergii	6	5	3	13	5	3
Bidens pilosa	6	6	4	22	9	1
Galinsoga parviflora	5	5	5	8	5	6
Justicia sp		Not frequently consumed		14	4	2
Cleome monophylla		Not frequently consumed		10	7	4
Fruit						
Annona senegalensis	13	5	1	15	6	2
Psidium guajava	10	10	2		Not frequently consumed	
Ximenia caffra	7	5	3	11	4	4
Syzygium guineense	5	3	4	23	5	1
Bridelia micrantha		Not frequently consumed		12	6	3

The use of edible wild and weedy plants was important during the first three months of the year. The consumption frequency was highest in January and declined towards March (Fig. 4.). Families consumed an average of 210 g (± 120 g) fresh mass of wild plants 0-5 times a week in season. Similar frequencies have been reported for South Africa during the summer months (Shackleton, 2003). In Veracruz, Mexico, Vazquez-Garcia *et al*, (2004) recorded high frequencies in consumption of uncultivated plant foods in September because of their association with rain-fed maize.

Figure 4. Household weekly consumption of wild plants (January - March 2006)



The vertical bars indicate the standard error of the mean (n=10).

The quantities of wild plants consumed in Honde Valley are lower than those of the Valley of Toluca, in Mexico where monthly consumption of pot herbs for families was 4.5 kg (Vieyra-Odilon and Vibrans 2001). Shackleton *et al.*, (2002) also reported high quantities of wild fruit (9.3 kg per month) and herbs/spinaches (8.6 kg per month) in rural households of South Africa. It is however important to note that the lower quantities of wild vegetables consumed (150 g per meal) are compensated by mixing the wild plants with other vegetables like pumpkin and cowpea leaves, a practice common in other parts of Africa (Johns and Kokwaro, 1991). We also weighed the fresh mass of the edible parts (usually leaves) just before cooking. This left out the stems and other plant parts and this may account for the low quantities recorded in our study.

The use of wild vegetables that we observed during this period was due to their availability during times when the cultivated *Brassica* species are scarce and more expensive to buy. Cultivated alternatives for leafy vegetables like cowpea, pumpkin and cassava leaves became available in February while the wild plants became too mature for use. Consumption of wild vegetables declined in the fourth week of January (Fig. 4), because of the availability of the leaves of cultivated *Cucurbita* sp. and *Vigna unguiculata* (L.) Walp. The availability of guavas from week twelve caused a slight increase in the consumption of wild plants. Although *Psidium guajava* is an exotic species, it has become naturalised in eastern Zimbabwe and is considered as a wild plant by the local people.

In January, young tender leaves of wild plants were eaten as relish and the surplus were blanched and sun dried for storage. These dried vegetables called "mufushwa" were used from late February onwards. Popular species for "mufushwa" were *Cleome gynandra* and *Amaranthus thunbergii*. The drying of products to compensate for seasonal unavailability is also reported from Buhera, Zimbabwe (Zinyama *et al.,* 1990) as well as in other parts of Africa (Grubben and Oyen, 2004) such as Burkina Faso (Mertz *et al.* , 2001), South Africa (Shackleton, 2003) and Botswana (Flyman and Afolayan, 2006). This practice is only common for medicinal plants in other regions of the world, for example in the Cumbres de Monterey National Park in Mexico where people dry and store their medicinal plants for later use (Estrada *et al.,* 2007).

1.5. CONCLUSIONS

The use of wild edible plants, especially wild greens and fruit, is important for the people of the Samanga area in Honde Valley, Zimbabwe during several months of the year. Wild vegetables are consumed while in season and dried for later use out of season. People are well aware of the benefits associated with the consumption of wild plants and there is indication of a renewal in their use. Though there is some loss of knowledge about edible wild plants in younger people, wild edible plants still form an integral part in the diet.

ACKNOWLEDGEMENTS

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1.7. Appendix. Edible wild plants of Honde Valley, Zimbabwe.

1 a. RELISH

The leaves[1] are cooked as spinach and served with the main staple "sadza." Tomatoes, onions and peanut butter may be added to make a sauce. These vegetables may be combined with other wild speciesor with cow pea and pumpkin leaves to neutralize the bitter taste and to increase quantities. Bicarbonate of soda is also used to soften the leaves. Bitter vegetables are not stired while cooking to lessen bitterness.

	SCIENTIFIC NAME	**ETHNOSPECIES**	**OBSERVATIONS**
ACANTHACEAE	*Justicia* sp.	Tapa	
AMARANTHACEAE	*Amaranthus hybridus* L.	Bowa sena	
	Amaranthus spinosus L.	Mowa	
	Amaranthus thunbergii Moq.	Mowa	
ARACEAE	*Typhonodorum lindleyanum* Schott.	Dowe remumvura	The leaves are boiled and washed several times to reduce toxicity.
ASTERACEAE	*Bidens pilosa* L.	Nhunginira	Has a bitter taste.
	Sonchus oleraceus L.	Rurimirwemombe	
	Galinsoga parviflora Cav.	Teketera	
BRASSICACEAE	*Rorippa nasturtium-aquaticum* (L.) Hayek	Hoto	
CAPPARACEAE	*Cleome monophylla* L.	Mutsemwatsemwa	Has a bitter taste.
	Cleome gynandra L.	Runi	
CONVOLVULACEAE	*Ipomoea plebeia* R. Br.	Muromoweshiri	
CUCURBITACEAE	*Cucumis anguria* L.	Mukakashangwe	
EUPHORBIACEAE	*Acalypha ornata* A. Rich.	Zumbu	
SOLANACEAE	*Solanum nigrum* L.	Musungusungu	
	NOT IDENTIFIED	Chinyowere	
		Darangande	
		Duruni	

		Juliwai	
		Mubhanzimana	
		Nhonhonho	
		Nyakajonga	
		Samwenda	
		Tswarinzwa	Has a bitter taste.
		Werera	Has a bitter taste.

1b. DERERE RELISHES

"Derere" is a Shona term used to refer to all vegetables that have a slimy consistency when cooked, e.g. okra. The leaves are cooked in water with bicarbonate of soda or "muteka" (Potash made from the ashes of burnt maize cobs). The vegetables are then beaten lightly until they become slimy. They are served with sadza and it is common to sprinkle some chilli pepper to improve the taste. These are usually mixed with other cultivated or wild "derere" species, but eaten alone in times of scarcity.

	SCIENTIFIC NAME	ETHNOSPECIES	OBSERVATIONS
COMMELINACEAE	*Commelina africana* L.	Goche	Considered as famine foods and are only eaten by the poorest families.
	Commelina zambesica C.B. Clarke	Goche	
PEDALIACEAE	*Dicerocaryum senecioides* (Klotzsch) Abels	Seso/Feso	
TILIACEAE	*Corchorus olitorius* L.	Nyenje	
	Corchorus tridens L.	Bupwe	
	Triumfetta pilosa Roth	Bvumvu	Considered as famine foods are only eaten by the poorest families.
	Triumfetta rhomboidea Jacq.	Bvumvu	

2. FRUITS

The fruits are eaten fresh as a snack.

	SCIENTIFIC NAME	ETHNOSPECIES
ANACARDIACEAE	*Sclerocarya birrea* (A. Rich.) Hochst.	Mupfura (mapfura)[2]
	Rhus chirindensis Baker f.	Musoso (masoso)
	Lannea edulis (Sond.) Engl.	Mutsombori (tsombori)
ANNONACEAE	*Annona senegalensis* Pers.	Muroro (maroro)
APOCYNACEAE	*Carissa edulis* (Forssk.) Vahl	Mutsambara (matsambara)
	Landolphia buchananii (Hallier f.) Stapf	Muungo (maungo)

CACTACEAE	*Opuntia ficus-indica* (L.) Mill.	Mudhorofia (madhorofia)
CHRYSOBALANACEAE	*Parinari curatellifolia* Benth.	Muchakata (Shakata)
CLUSIACEAE	*Garcinia huillensis* Oliv.	Mutunduru (matunduru)
EUPHORBIACEAE	*Antidesma venosum* Tul.	Mujaja (majaja)
	Bridelia micrantha (Hochst.) Baill.	Mutsurungunyu (tsurungunyu)
	Uapaca kirkiana Müll.Arg.	Muzhanje (mazhanje)
FABACEAE	*Piliostigma thonningii* (Schumach.) Milne-Redh.	Musekesa (masekesa)
FLACOURTIACEAE	*Flacourtia indica* (Burm.f.) Merr.	Munhunguru (nhunguru)
LAMIACEAE	*Vitex payos* (Lour.) Merr.	Muhubva (hubva)
LOGANIACEAE	*Strychnos madagascariensis* Poir.	Muhwakwa (hwakwa)
	Strychnos spinosa Lam.	Mutamba (matamba)
MALVACEAE	*Azanza garckeana* (F. Hoffm.) Exell & Hillc.	Mutohwe (matohwe)
MORACEAE	*Ficus sur* Forssk.	Muonde (muonde)
	Ficus sp.	Musamvu (masamvu)
MYRTACEAE	*Psidium guajava* L.	Muguavha (maguavha)
	Syzygium guineense (Willd.) DC.	Mukute (hute)
OLACACEAE	*Ximenia caffra* Sond.	Munhengeni (nhengeni)
RHAMNACEAE	*Berchemia discolor* (Klotzsch) Hemsl.	Munyii (nyii)[3]
	Ziziphus mauritiana Lam.	Musawu (masawu) [3]
ROSACEAE	*Rubus apetalus* Poir.	Rukato
RUBIACEAE	*Vangueria apiculata* K. Schum.	Munhenzvera (nhenzvera)
	Vangueria infausta Burch.	Munzviru (nzviru)
	Mussaenda arcuata Poir.	Mutosi (matosi)
	Fadogia tetraquetra K. Krause	Muzvimbira (mazvimbira)
SOLANACEAE	*Physalis peruviana* L.	Muguzubheri (maguzubheri)
VERBENACEAE	*Lantana camara* L.	Mugupa (magupa)
ZINGIBERACEAE	*Aframomum angustifolium* (Sonn.) K. Schum.	Mapenga
	NOT IDENTIFIED	Mhambadzamodhi

		Munhunguruduma (nhunguruduma) Musibango (masibango) Mutsoro (matsoro) Muumi (muumi) Ndeke Tsenja Tsiva Usvesve	

3. OIL SEED

The seeds can be ground to make cooking oil.

	SCIENTIFIC NAME	**ETHNOSPECIES**	**OBSERVATIONS**
CHRYSOBALANACEAE	*Parinari curatellifolia* Benth.	Muchakata (shakata / chakata)	A practice only known by the elders.

4. SOURCE OF STARCH

The tubers may be scraped and eaten fresh or may be boiled. They are eaten as a substitute for sadza or with tea for breakfast.

	SCIENTIFIC NAME	**ETHNOSPECIES**	**OBSERVATIONS**
ARACEAE	*Typhonodorum lindleyanum* Schott.	Majo	The tubers of the plant are boiled with several changes of water. The cook (usually the mother) has to eat first before the rest of the family to avoid poisoning the whole family.
CYPERACEAE	*Cyperus esculentus* L.	Pfende	
LAMIACEAE	*Plectranthus esculentus* N.E. Br.	Mubvumbe (mabvumbe)	

5 a. BEVERAGE

The juice is extracted from the fruit on purpose or accidentally while transporting the fruit in plastic bags by children.

	SCIENTIFIC NAME	**ETHNOSPECIES**	**OBSERVATIONS**
ANNONACEAE	*Annona senegalensis* Pers.	Muroro (maroro)	
CLUSIACEAE	*Garcinia huillensis* Oliv.	Mutunduru (matunduru)	
EUPHORBIACEAE	*Antidesma venosum* Tul.	Mujaja (majaja)	
MYRTACEAE	*Syzygium guineense* (Willd.) DC.	Mukute (hute)	
PERIPLOCACEAE	*Mondia whitei* (Hook.f.) Skeels	Mungurahwe	A few interviewees mentioned that a

			refreshing drink may be made from the root.
ROSACEAE	*Rubus apetalus* Poir.	Rukato	

5b. BEVERAGE

Infusions drunk as substitutes for tea.

	SCIENTIFIC NAME	**ETHNOSPECIES**	**OBSERVATIONS**
ARISTOLOCHIACEAE	*Aristolochia hepii* Merxm.	Changamire	The root is used.
RUBIACEAE	*Fadogia ancylantha* Hiern	Makoni tea [3]	Dried leaves are used.
VERBENACEAE	*Lippia javanica* (Burm.f.) Spreng.	Sumba / Zumbani	Dried or fresh leaves are used.

6. SNACK

	SCIENTIFIC NAME	**ETHNOSPECIES**	**OBSERVATIONS**
EUPHORBIACEAE	*Uapaca kirkiana* Müll.Arg.	Muzhanje (mazhanje)	Adolescent boys from Maradzika reported eating the tips of young sprouting branches to ward off hunger.
FABACEAE	*Eriosema shirense* Baker f.	Hungwa	The tuber is eaten fresh.
MUSACEAE	*Ensete ventricosum* (Welw.) E.E. Cheesman	Mutsundi (matsundi)	The pseudo-stem is peeled and chewed fresh.
OXALIDACEAE	*Oxalis semiloba* Sond.	Tsonjo	The tubers are eaten fresh.
PERIPLOCACEAE	*Mondia whitei* (Hook.f.) Skeels	Mungurahwe	The root is washed and eaten fresh or dried.
	NOT IDENTIFIED	Mutwi	The root is scraped clean and chewed as a snack.
		Nyawa	The roots are scraped and eaten fresh.

7. CONDIMENTS

Additional flavouring of food is not common in the area.

	SCIENTIFIC NAME	**ETHNOSPECIES**	**OBSERVATIONS**
LAMIACEAE	*Mentha sp.*	Minti/Minsi	Fresh or dried leaves are used to season meat.
SOLANACEAE	*Physalis peruviana* L.	Muguzubheri (maguzubheri)	Fresh fruit may be added to stews.
SOLANACEAE	*Solanum betaceum* Cav.	Musagaraga (masagaraga)	The fruit may be used as a substitute for tomatoes.
SOLANACEAE	*Solanum sp.*	Mharupwa	The fruit is used to flavour stews and vegetables.
SOLANACEAE	-	Mukuzungu (makuzungu)	The fruit is used to flavour stews and vegetables.

NOT IDENTIFIED	Nzanya	Dried fruit are crushed and used as a condiment.
	Utwiro	The leaves are used for flavouring.

[1]The underlined word refers to the edible part.
[2] The word in (brackets) is the name given to the fruit The prefix "ma" indicates plural terms.
[3] These plants are not found locally and may be bought from the markets in the nearby town of Mutare or sourced from relatives from other areas like Nyanga. A masau plant was found growing in one homestead of Chipupuri.

CAPÍTULO 2

KNOWLEDGE AND USE OF EDIBLE WILD PLANTS IN TWO RURAL COMMUNITIES OF OAXACA, MEXICO

2.1. INTRODUCTION

Knowledge within a society varies depending on a range of interrelated factors such as age, gender, literacy, education and occupation (Alexiades and Wood Sheldon 1996; Cotton 1996; Lozada et al. 2006). Despite this variation, general patterns in the distribution of knowledge exist (Berlin 1992) and these can be identified by comparing and analyzing agreement among informants (Reyes-Garcia 2001). The distribution of knowledge depends on a particular peoples' environmental setting, their history and customs. Patterns of knowledge are important in the implementation of agricultural and development policies that are suited to local conditions.

Indigenous knowledge of wild plant resources and their use, and its erosion, is a concern for the study of ethnobotany. Several scientific reports document the loss of information in traditional societies, as a result of various issues such as changing lifestyles and modernization (Shava 2005; Benz et al. 2000). These factors have brought about the modification of traditional cultures that previously ensured the transmission and retention of knowledge on plants and their specific uses. The inclusion of people's environmental knowledge has proved to be important in the management of natural resources. There have been efforts worldwide to record existing knowledge and integrate people's practices and perceptions (Ladio and Lozada 2003; Ghimire et al. 2004).

Wild plants form an integral part of the diet in many traditional societies. In this study we try to explain the persistence in the use of wild edible plants in two rural communities of Oaxaca, Mexico, by documenting the existing knowledge, the ways in which this knowledge is transmitted and the perceptions local residents have on their use. We also describe the patterns of use observed during the rainy season, when these plants are more abundant. We discuss differences in knowledge of and opinions on the use of wild plants according to gender and age groups. These differences influence the actual consumption of these resources. Knowledge loss is expected due to the ongoing cultural change.

We define wild plants, for this study, as non-domesticated plants that are usually gathered. Under this definition, wild plants can be found growing in the natural or secondary vegetation or as ruderal and agrestal weeds. They may be subject to a variety of management practices. Some plants are gathered directly from the natural vegetation and others are tolerated and even protected in agricultural spaces such as crop fields and home gardens. Farmers may encourage the growth or dispersal of the plants and may even occasionally cultivate them to increase their availability (Casas et al. 1994: Mapes et al., 1996). These practices have been referred to as incipient domestication and reflect the plant's cultural importance (Blanckaert et al. 2007; Casas et al. 1997).

The communities

Santa Catarina Roatina (Roatina) is located in the municipality of Miahuatlán de Porfirio Díaz in the Southern Sierra in the state of Oaxaca, Mexico (16º16' N and 96º 31' W), at an altitude of 1789 m (though village territory altitudes of approximately 1650 and 1860) It has a temperate sub-humid climate with rainfall (535.9 mm/year on average) during the summer months of May/June-October. Average annual temperature is 19.9 ºC. Secondary grasslands and oak-pine forest form the main vegetation types (INEGI 2004 y 2006; INAFED 2005). The Roatina community is made up of approximately 2000 people of Miahuatlán Zapotec origin (de la Fuente 1994), who no longer speak the native language. The people of Roatina are mainly farmers who grow maize, beans and squash on 0.5-1.0 hectare plots. Most of the villagers have electricity in their homes but lack running water and a sewage system. They generally rely on firewood for cooking and heating. There is a local primary and secondary school as well as a primary health care centre but most other services are found in the town of Miahuatlán, half an hour's drive on an unpaved road. About 40 % of the families have members that are employed in Miahuatlán, mainly as construction workers, and many young people have migrated to other cities in Mexico and the United States of America in search of employment opportunities.

The other community, Villa Talea de Castro (Talea) is found in the Northern Sierra of Oaxaca (17º 21' N, 96º15' W and 1700 m). It has a higher mean annual temperature of 20.9 ºC but temperatures fall drastically and frosts are common during winter (INEGI 2006). It lies in a relatively isolated montane forest region where the main agricultural activities are centered on the cultivation of maize, beans and squash, as well as coffee and sugar cane which are grown on privately owned 1-3 hectare plots. Plant resources from varying altitudes (1000-1750m) are used. There are 2237 Taleans who mostly speak the Rincón dialect of Zapoteco (de la Fuente 1994) as well as Spanish. The majority have running water, access to a sewage system, and electricity in their homes. Talea is the head of the municipality and has weekly markets held at the central plaza with traders from outside of the area. The small town is connected to the rest of the world through a paved road, telephone, postal, internet and courier services. Many people are employed in the commercial sector. Despite the low migration rates according to official figures (Sistema de Información sobre Migración Oaxaqueña 2000), migration is becoming increasingly significant.

2.2. METHODS

Permission to carry out the study was granted by the local authorities of Roatina and Talea. Field work was carried out mainly during the 2006 rainy season (May-October). We began by holding meetings with the general adult (male and female) population to present ourselves and the purposes of our study. We then selected our principal informants and guides based on recommendations by the local authorities (the municipal agent in Roatina and the municipal president in Talea) and their willingness to participate.

We approached local social organizations such as schools and churches where people usually assemble in order to hold group discussions and interviews in an effort to record information on edible wild plants (local names, when and where they are gathered and preparation methods). The different groups consisted of 8-12 children (males or females) of between 5 and 12 years of age, adolescents (13-19 years), young adults (20-50 years) and mature adults more than 50 years old. The group interviews contributed to a list of wild food plant species for each community and also provided a general overview of how much knowledge each group had according to age and gender. Voucher specimens of available plants were collected, documented and deposited in the Hortorio Herbarium (CHAPA) at the Colegio de Postgraduados.

For the purposes of this study, the uses of the gathered food plants were categorized into vegetables, fruits, beans, condiments, beverages and snacks, categories slightly modified from Cabrera Torres et al. (1998). These categories are based on how the wild plants are prepared and consumed. Free listing according to these categories was solicited during the group discussions and interviews with individuals.

Ten families from each community were then selected from community registers; we picked every tenth family on the lists. It was necessary that at least one family member could read and write. Each family received a food diary (Mertz et al. 2001) and was asked to record the date, the quantities and the name of all wild plants consumed during the study period (June to November 2006). Food diaries were collected and revised periodically, additional recall questions were asked so as to record actual consumption as accurately as possible. This provided complementary information on the plant food resources consumed during the study period.

Table 1 Individual participants in interviews

Age	**Roatina**		**Talea**	
	No. of female informants	No. of male informants	No. of female informants	No. of male informants
5-19 years	6	6	3	4
20-50 years	8	6	7	5
51+ years	5	6	6	4
Total	37		29	

The members of the families who had received food diaries were also interviewed individually on when, how and where they had learned about the wild plants they know Table 1 shows the age and gender of the people interviewed. In Roatina we interviewed 37 people aged between nine and eighty (mean age = 37.4 years) while 29 individuals between 12 and 70 (mean age = 40) were interviewed in Talea. We also focused on questions related to their preferences, opinions on the use of wild plants and the opportunities for exchange of information within and between families and communities. We solicited free lists (Quinlan 2005) for each food category and this information was used to determine plants that are culturally important. Participatory observation, facilitated by living with one of the families during field work, complemented records from the individual and group interviews as well as the food diaries.

2.3. RESULTS AND DISCUSSION

Gathered food plants

The residents of Roatina mentioned 67 wild food plants while the people of Talea reported the use of 71 plants. This is relatively higher that what is recorded (42 edible wild plants) in other ethnobotanical studies for traditional farmers such as the Ngorongoro of Tanzania (Johns et al. 1996), and the Popoloca of Zapotitlán, Puebla (Paredes-Flores 2007) and 51 consumed by rural people from Sao Paulo State in Brazil (Hanazaki et al. 2006). The number of food plants used in Roatina and Talea are also comparatively consistent with those used in similar environments like Honde Valley Zimbabwe, where farmers use about 70 species (see chapter 1) and is lower than the 139 species that Ratheesh Narayanan et al. (2003) reported for Kerala, India. In two communities of the Sierra Negra of Puebla, Mexico, a region relatively similar to Talea, wild plants form 44 % (57 species) of the edible flora (Mota-Cruz 2008). The number of gathered food plants used by a people depends on factors such as local cuisine, plant diversity and the availability of cultivated alternatives. In Honde Valley, for example some plants are famine foods and are only consumed in desperate times. None of the plants used in neither Talea nor Roatina were classified as famine foods.

Table 2. Use categories according to preparation and plant parts used for all recorded edible plant species

Part used	Roatina Number of species	Roatina Proportion (%)	Talea Number of species	Talea Proportion (%)
Leaves	28	42	37	53
Fruits	28	42	21	30
Flowers	5	8	7	10
Underground parts (Roots/tubers)	4	6.5	6	9
Others (Stems/bark)	3	4.8	2	4
Seeds	2	3.2	3	3
Preparation				
Vegetable	25	37	37	59
Fruit	19	28	16	23
Condiment	12	18	8	11
Beverage	7	10	7	10
Snack	5	7	3	4
Beans/Pulses	2	3	3	4
Total edible plants	**67**		**71**	

The leaves and fruit are the most used plant parts (Table 2). There are relatively more leaves used in Talea than in Roatina, probably because of the more humid conditions that prevail there. Most of the wild foods from plants are eaten fresh except for some vegetables and beans, which need to be cooked before consumption (Appendix 1). Some plants are used in more than one category. For example, the fruits of *Opuntia* sp. are eaten fresh or are used to make a refreshing drink (*agua de sabor*) and the stems are used as green vegetables in salads or stews. Most juicy fruits are also used to make *agua de sabor*. Plants that are used as pot herbs, "*quelites*," are quite important and form the largest category used. Fruit and plants used as condiments are also important in both Roatina and Talea.

Some of the wild food plants used in the two communities are gathered from the natural vegetation around the settlements, others occur as agrestal and ruderal weeds while others are bought from the weekly markets. In Roatina 52 % of the plants can be collected directly from the wild, 48% are tolerated or protected in pathways and other human-modified environments while 25% can also be planted. About 24% of the edible plants receive at least two forms of management, for example, most leafy vegetables such as *Crotalaria* sp. or *Amaranthus* sp. can be tolerated, protected and even planted. In Talea 49% food plants are from the wild, 58% are tolerated or protected, 30% are also planted and 35% may be subjected to at least two of these management practices.

Trees and shrubs like the *Annona* in Roatina, *Psidium* and *Erythrina* in Talea are sometimes left as natural fences around household plots or crop fields. Weeds such as *Amaranthus, Physalis* and *Solanum* species are also allowed to grow when densities do not affect the main crop. The tolerance of weeds by traditional farmers is a common practice in Mexico (Chacon and Gliessman 1982; Vieyra-Odilon and Vibrans 2001) and other regions of the world like Kenya (Marshal 2001). Some wild plants are cultivated to increase their availability. The two species called chepil, *Crotalaria pumila* and *C. longirostrata,* for example, grow as weeds in crop fields, and in household yards, but are sometimes grown as pot plants in the patios or cultivated in small plots (Fig. 1).

Figure 1. Management of *Crotolaria* spp.

Left: Talean woman in her plot of *Crotolaria pumila*. *Right*: A tolerated *Crotolaria longirostrata* plant in a homestead in Roatina.

Knowledge of edible wild plants and its transmission

Knowledge within a particular domain can be defined as agreement between informants (Reyes-Garcia 2001). This means that people of the same community share knowledge of plants that have the highest cultural significance. The Cognitive Salience Index which incorporates the frequency and the order of mention (Sutrop 2001; Quinlan et al. 2002; Hoffman and Gallaher 2007) was calculated for data obtained from the free lists for each category (vegetable, fruit, condiment, seed, snack and beverage). The most salient wild food plants and their score in each category in Roatina were the snack camote de agua (0.472), the vegetable *Amaranthus hybridus* (0.459), *Porophyllum tagetoides* (0.393) used as a condiment, the fruit of *Opuntia* sp. (0.277), the seeds of *Leucaena* sp. (0.252) and a beverage made from *Mentha* sp. (0.108). In Talea, *Chenopodium ambrosioides* (0.572 - condiment), *Amaranthus* sp. (0.295 - vegetable), *Ipomoea batatas* (0.214 - snack), *Vaccinium leucanthum* (0.188 - fruit), *Phaseolus coccineus* (0.071 - beans) and beverages made from *Psidium guajava* (0.128) were the most prominent.

Only seven edible wild plants were known by most (above 50%) of the people interviewed in Roatina. *Amaranthus hybridus*, *Crotalaria pumila*, *Porophyllum tagetoides*, camote de agua, *Tridax coronopifolia*, *Diphysa robinioides*, and *Ipomoea suffulta* were cited by 51-89% of the people. Three are used as vegetables, two are snacks and the other two are used as condiments. In Talea 59-89% of the interviewees cited *Chenopodium ambrosioides*, *Amaranthus* sp.*, Diphysa robinioides, Galinsoga parviflora* and *Portulaca oleracea.* Apart from *C. ambrosioides,* the plants that were most frequently cited in Talea are used as vegetables and are generally weeds (except *Diphysa robinioides*) characteristic of anthropogenic environments. On the other hand, the plants recurrently mentioned in Roatina included plants such as camote de agua, and *D. robinioides* and *Ipomoea suffulta* that are found in the natural vegetation. This may indicate a higher interaction with the natural vegetation in Roatina than in Talea.

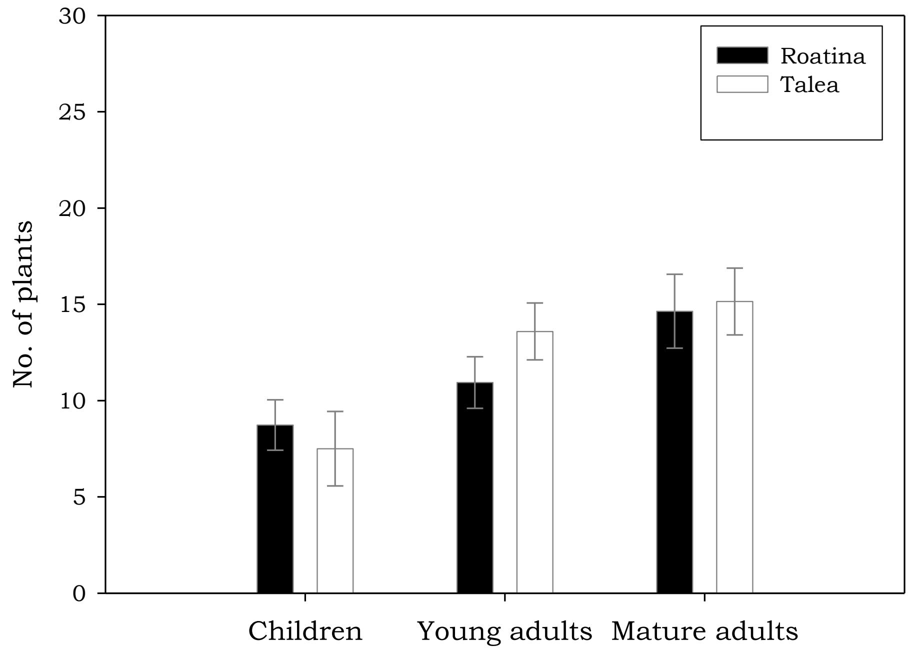
In both Roatina and Talea, the older members of the community cited more plants than the children and adolescents in group interviews (Table 3). Adolescent boys in Roatina and young boys (5-12 years old) in Talea free-listed the least number of plants during the group discussions. Figure 2 shows a similar trend in individual responses. There was a significant relationship between the age of an individual and their plant knowledge (Spearman's rank coefficient = 0.134; P = 0.023) in Roatina and a comparable pattern was observed in Talea which had a coefficient of 0.285; P = 0.0034.

Table 3. Total number of plants mentioned during group discussions

Group	Children		Adolescents		Young Adults		Mature Adults	
	Male	Female	Male	Female	Male	Female	Male	Female
Roatina	18	21	13	23	31	44	31	33
Talea	18	26	29	22	42	42	40	38

Although the composition of the edible wild flora known by the people from the two communities is different, there were 20 edible species common to both. Four of the species most cited in Roatina and Talea (*Amaranthus hybridus*, *Crotalaria pumila, Tridax coronopifolia,* and *Diphysa robinioides*) are shared of which *Amaranthus hybridus* and *Diphysa robinioides* were also cited by most (≤ 50 %) informants in both areas. Roatina and Talea also share a cuisine in which some dishes such as tamales made with *Crotalaria* species are prepared in a specific way. Moreover, processes of modernization and the resultant acculturation, albeit at different rates, are evident in both communities. These among other factors could explain the remarkable similarity in the number of plants known by individuals in each age group shown in Figure 2.

Figure 2. Individual knowledge of plants



Children aged 5-19; Adults aged 20-50; Mature adults aged 51+.

Bars indicate the standard error of the mean.

It may be expected that as people grow older they will gain additional knowledge. However, in traditional communities with functioning oral transmission of knowledge, 15-year-olds generally have most of the knowledge and skills required of adults, for example among the Tsimane' (Reyes-Garcia et al. 2005). Lozada et al. (2006) also reported that the Cuyin Manzano people of Argentina similarly acquire their ethnobotanical knowledge during their childhood. In our study, most interviewees indicated that most of their knowledge was gained in their childhood years and a few (mostly the newly married females) learned about new plants in adulthood. So, the considerable differences in knowledge between the younger and older members are of concern.

Most children and young adults are now involved in school, in construction work and other activities that are carried out in the settlements. In Roatina, their knowledge is therefore mainly limited to vegetation typical of disturbed environments, such as the common *quelites*; *Amaranthus* (82 %) and *Crotolaria* (73 %) as well as some commonly used condiments like

Tridax coronopifolia (64 %), *Porophyllum tagetoides* (55 %) and *Chenopodium ambrosioides* (55%). Most of the children in Talea also showed this tendency, mostly naming plants that are also cultivated, tolerated or protected such as *Psidium guajava*, mentioned by all children interviewed.

Most of the responses on how people gained knowledge of edible wild plants show that knowledge is passed on along the generations through family structures, especially from parents (57 % in Roatina and 70 % in Talea) or grandparents (22 % in Roatina and 37 % in Talea) to children. A few had learned from friends or their in-laws upon marriage. Knowledge was passed on during activities (weeding, collecting firewood and timber for construction and simply walking) in the environments where these plants grow.

The females, except the teenagers in Talea (see Table 2.), in each age group mentioned more plants than the males, however, contrary to expectations, this was not statistically significant for individuals according to the Kruskal-Wallis test (H= 0.002; P=0.964 for Roatina and H=2.84 P= 0.092).

But there were differences between the sexes. Women knew more of the edible plants used to prepare family meals. This was evident in Roatina where the most frequently mentioned plants were mainly those used as condiments and vegetables that are usually gathered from roadsides, crop fields and other areas close to their homes. On the other hand the most popular plants mentioned by the male interviewees from Roatina are those that are gathered some distance away from the home with the exception of *Amaranthus hybridus* and *Porophyllum tagetoides*. They mentioned two snacks and a fruit (Table 3) that may be consumed away from the home and may not necessarily be consumed by the whole family.

The plants most cited by the men and women of Talea on the other hand did not show this distinction. Women most frequently mentioned wild plants like *Vaccinium leucanthum* and *Rubus* sp. that are not usually found close to their homes while most of the men also included wild plants that are mainly used in family meals. In Talea, it is common that the men work for up to three days away from home at the "ranchos" where they have to prepare their own meals. This may explain why they mostly referred to vegetable species.

Table 4. Comparison of the plants known by most men and women in Roatina and Talea.

	Use	Agro-habitat	²Management	Women (%)	Men (%)
Roatina					
Tridax coronopifolia	condiment	crop field borders	1	63	
Porophyllum tagetoides	condiment	crop field borders	1	63	67
camote de agua	snack	natural vegetation	1	63	67
Solanum americanum; S. nigrescens	vegetable	crop fields; home gardens	1; 2	58	-
Crotalaria pumila	vegetable	crop fields; home gardens	1;2	69	-
Amaranthus hybridus	vegetable	crop fields; home gardens	2	95	83
Opuntia sp.	fruit	crop field borders; fences; home gardens	1;2; 3	-	61
Diphysa robinioides	vegetable	natural vegetation	1	-	56
Ipomoea suffulta	snack	natural vegetation; crop field borders	1	-	61
Talea					
Rubus sp.	fruit	natural vegetation	1	56	-
Portulaca oleracea	vegetable	crop fields, home gardens	2	81	-
Vaccinium leucanthum	fruit	natural vegetation	1	69	
Amaranthus hybridus; *A. spinosus*	vegetable	crop fields; home gardens; pathways	2	94	62
Galinsoga parviflora	vegetable	crop fields	2	81	62
Cestrum nocturnum	vegetable	home gardens; pathways	2; 3	50	-
Chenopodium ambrosioides	condiment	crop fields; home gardens; pathways	2, 3	94	-
Diphysa robinioides	vegetable	natural vegetation	1	69	69
Psidium guajava	fruit	natural vegetation;	1, 2, 3	-	62

²*Management*: 1=gathered, 2=protected/encouraged, 3=cultivated.

The difference in ethnobotanical knowledge between males and females, due to the social roles ascribed to each gender is a worldwide phenomenon in traditional societies. This variation has been documented, for example, in Brazil (Hanazaki et al. 2006) where women are more conversant with plants that are found in domestic surroundings while men have a profound knowledge of the plants they encounter further away from home because they have a higher mobility due to their economic activities. In India, Ratheesh Narayanan et al. (2004) described the gendered knowledge of edible wild greens. Women possess more knowledge due to their predominant role in the collection and processing of these plants. Our work in Honde Valley, Zimbabwe (see chapter 1) also shows similar trends with women naming more wild vegetables and men mentioning more wild fruit species. These differences emphasize the importance of gender sensitive interviewing in ethnobotanical work as males and females have different perspectives on the basis of their experiences and knowledge (Douma et al. 1994). These differences complement each other in the provision of complete information for inventorying purposes.

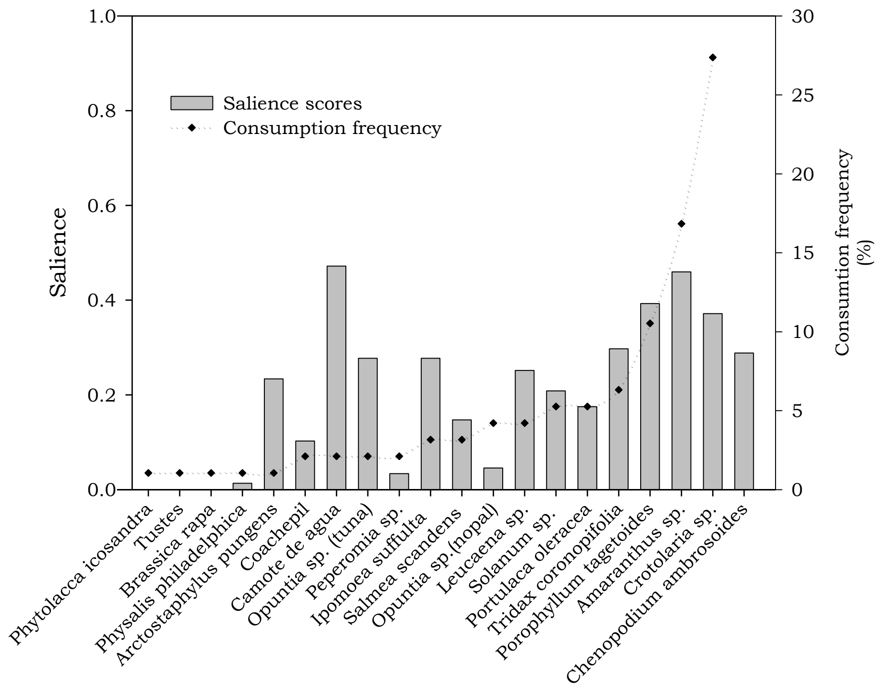
Actual consumption of wild food plants

Records from food diaries indicate that 20 wild species were consumed in Roatina in 95 events by eight families, while in Talea, six families consumed 23 species in 81 events in a period of three months. On average the families in Roatina ate wild plants 1.04 ± 0.12 (± se.) times a week with a maximum of four times a week. In Talea the consumption of edible wild plants was slightly lower, 0.91 ± 0.08 and a maximum of three times per week. This is quite low compared to Honde Valley, Zimbabwe (see chapter 1) and South Africa (Shackleton 2003) where use can be up to 5 times a week. Reports from Tarahumara Indians (Bye 1981), the Mixtecos of Guerero (Casas et al. 1994) both of Mexico, are much higher. They eat as much as 135 and 300 kg per family per season respectively. The consumption trend for Roatina and Talea is comparable to that reported for the mestizo inhabitants of Valley of Toluca (Vieyra Odilon and Vibrans 2001) and this can be interpreted as a symptom of cultural change and the consequent preferences for cultivated food sources.

The condiment, epazote (*Chenopodium ambrosoides*), was the most frequently consumed species. It is used almost on a daily basis but was not included in our frequency statistic because people from both communities did not consider it important to documenteach event when this plant was used. Its constant use was corroborated through participant observation and accounts for the wild plant consumption frequencies (up to three times a week) cited by most interviewees. The reference to the frequency of use of epazote also corresponds with assumptions that can be drawn from the salience scores of the plants listed in the individual interviews, especially for Talea where it was the most salient plant (Appendix 1b). Epazote was the sixth most salient plant in Roatina.

Figure 3 illustrates the relatively weak relationship between the salience scores and the actual use of wild plants in Roatina ($r^2 = 0.468$; $P = 0.00089$). Cultural importance plays a role but so do availability and local abundance. Scarcity explains the low consumption frequency of a culturally significant (salient) plant like *camote de agua*. The plant was said to have become more and more difficult to find in recent years and we even failed to collect a voucher specimen. On the other hand, plants like *Porophyllum tagetoides*, *Amaranthus* sp, *Crotolaria* sp. and *Tridax coronopifolia* are locally abundant, growing wildly, cultivated in the patios or bought from the weekly market in the nearby town ofMiahuatlán.

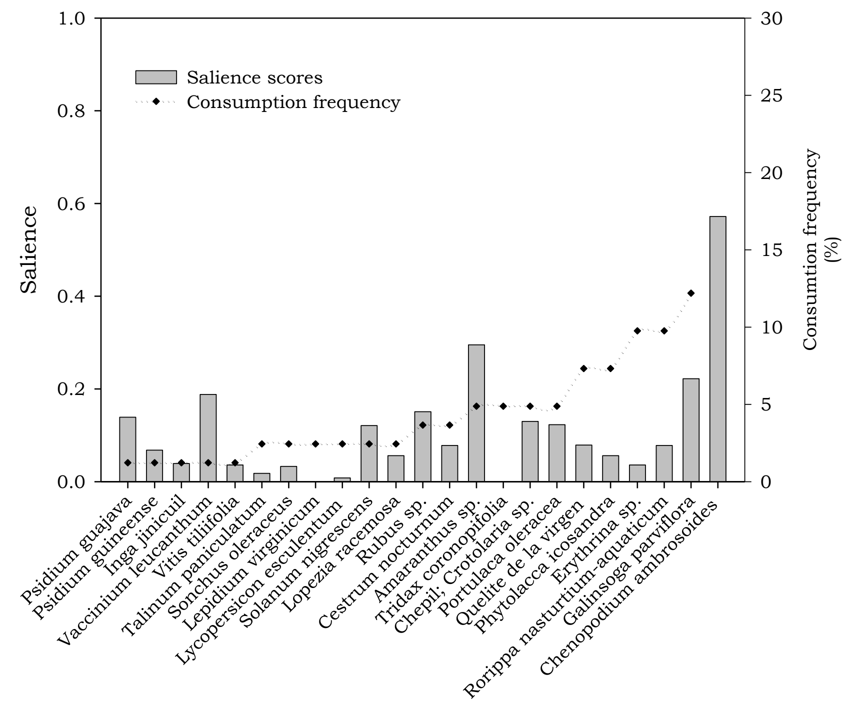
Figure 3. Salience scores and frequency of consumption of edible wild plants in Roatina



Common names are used for unidentified species

In Talea (Fig. 4) the actual utilization of wild plants did not yield a relationship with their salience scores. Gathered food plants were also eaten less often than in Roatina because of the availability of cultivated alternatives which are preferred. People grow a variety of domesticated fruits and vegetables close to their homes and in their coffee plantations. The local weekly market is also important in this respect. Wild plants are mostly eaten in the 'ranchos' where they are the only alternative for mostly adult men, who may stay overnight or for 2-3 days a week to tend their crops during the growing season.

Figure 4. Salience scores and frequency of consumption of edible wild plants in Talea



Common names are used for unidentified species

Recall methods such as the diary method can be criticized because of the danger of under- or over-recording (Blundell 2000) and because literacy is necessary. One of our families in Talea stopped recording during the study period because the only literate person in the family left for school in another area and prompting for recall was not productive. Similarly in Roatina, one couple separated and the husband who could read and write left the vllage with the diary. Despite these drawbacks, the food diaries did give an indication of the consumption patterns of gathered edible plants as well as the types of plants that are consumed. They have an advantage of being precise (Ogle 2001) and they provide data that can be quantified.

Within-family differences in consumption of wild plant foods between the adults and children were observed especially in Roatina. During the periodical revision of food diaries some parents mentioned that their children would not eat some of the meals because they did not like wild plants. One teenaged girl even stressed that the only wild vegetables she would eat are quintoniles (*Amaranthus* sp.) and "*only if it is fried.*" This may explain why the frequency of consumption is low, particularly because one would have to make two meals instead of one to accommodate all tastes in the family. These intrafamily differences also point towards changes in tastes and preferences for cultivated alternatives that influence actual pattens in wild plant use in these communities.

The plants that were consumed are also the commonly sold plants at the markets and therefore one no longer has to leave the village to find them. It is also much easier for the inhabitants of Roatina to take a truck-ride to the nearest town, Miahuatlán, and purchase from a wide variety of gathered produce from other regions than to actually gather them. Plants such as *Peperomia* sp. and *Salmea scandens* (Fig. 5) are plants from the coastal regions of Oaxaca and can be purchased from the weekly market in Miahuatlán.

Figure 5. Gathered food plants sold at the weekly market in Miahuatlán

Top left: *Crotolaria* sp., *Opuntia* sp., *Mentha* sp. Top right: *Peperomia* sp.
Bottom left: *Tridax coronopifolia*. Bottom right: *Salmea scandens*.

Likewise, Taleans buy plants from the local market or from venders who sell from house to house. Purchases are made possible by income from other non-agricultural activities such as salaried employment, from small shops as well from remittances sent by family members that have emigrated from the region. These sources of income are characteristic for subsistence farmers in other areas of Mexico (Pérez-Negrón and Casas 2007).

Perceptions on the benefits obtained from edible wild plants

Despite suggesting that most gathered food plants were consumed in the past because they were the only ones available, mature adults in both Roatina and Talea reported that they still prefer them to the cultivated alternatives. Wild edible plants are considered to be natural and therefore more nutritious and cleaner (generally because no agrochemicals are used on them) than cultivated ones. On the other hand, the younger generations in the two communities preferred the cultivated alternatives which they consider to be more nutritious, tasty and hygienic. Cultivated plants were reported to be safe to eat and generally available throughout the year. One young adult from Roatina preferred them because *"…it is always satisfying to eat the results of one's work.*" The women commonly indicated that they did not prefer one over the other because they were both important in order to add variety to the diet.

Local opinions on the cleanliness of wild plants compared to the cultivated ones are shared with other rural areas in Mexico. In Roatina and Talea the use of chemical herbicides is still limited and therefore people can safely collect weedy vegetables (*quelites*) from the maize fields. However, in other communities of Mexico like Nanacamilpa, Tlaxcala (Gonzales-Amaro 2008) and the Sierra de Santa Marta of Veracruz (Vázquez-García 2006), herbicide use is widespread. People, especially the poor, cannot collect *quelites* from the chemically treated crop fields, neither can they afford them at the local markets. Besides, they are skeptical about the products sold at the markets because they are irrigated with waste water.

All families interviewed indicated that they ate wild plants and individuals cited advantages and disadvantages related to agricultural, economic, health and nutritional factors (Table 5). The elders saw the seasonal availability as a major drawback while young people were concerned with the danger of poisoning because they lack thorough knowledge of some of the plants. Similar differentiated opinions and preferences by age were voiced by the residents of Honde Valley, Zimbabwe (see chapter 1.).

Table 5. Advantages and disadvantages related to the use of wild food plants cited by informants in Oaxaca, Mexico

	Roatina	Talea
Advantages		
1. They provide important nutrients.	14%	45 %
2. They are natural since they are not usually treated with fertilizers or herbicides.	16 %	41 %
3. No labor or special care is required (they do not need watering, fertilizers or weeding).	24 %	17%
4. They have medicinal properties.	X	14 %
5. One can sell them.	X	X
6. Meals are cheaper since you don not need to buy them.	16 %	14 %
7. They taste good.	8	7 %
8. Most wild plants are easy to prepare;you only need salt and water.	n m	X
9. They are available in distant places like the "ranchos" where there are no markets or stores.	n m	X
Disadvantages		
1. They are only seasonally available.	30 %	14 %
2. You need to know them well to avoid poisoning.	8 %	17 %
3. Good quality plants are not always guaranteed.	X	n m
4. One has to go all the way to the wild vegetation to find some of the plants.	X	n m
5. They may grow in contaminated places and therefore may be dangerous.	n m	X
6. Their cold ("*fría*") properties may cause problems for people with weak stomachs or if they are used excessively.	n m	X

X = only mentioned by one person; n m = not mentioned

Advantages five and six (Table 5) reflect the relative economic importance of wild food plants for local people. The sale of gathered edible products is relatively important in Talea where three families reported that they occasionally sell plants such as *Rorippa nasturtium-aquaticum* (berro), *Portulaca oleracea* (verdolaga), *Amaranthus* sp. (quintonil), quelite de la virgin, *Phytolacca icosandra* (cuan perla china), and *Talinum paniculatum* (verdolaga ancha) at the weekly market (held every Monday) or from improvised stalls on Wednesdays in the village square (Fig. 6). Prices range between two and seven pesos per bundle. The bundles may weigh anything between 120-350 grams. On the other hand, none of the families interviewed in Roatina were involved in the sale of these products. They would sometimes buy gathered food plants at the market.

Figure 6. Gathered *Amaranthus* and *Crotalaria* for sale in Talea

The advantages were generally perceived to outweigh the disadvantages and this may explain the continued use of this resource. The attitudes of the younger generations, especially the children and adolescents, indicate the loss of knowledge. This shows the importance of the documentation of local people's knowledge before it is completely eroded. The second and fourth disadvantages (Table 5) as well as comments during group interviews pointed out that this generation has less interaction with the vegetation around them. As mentioned before, school and employment commitments possibly keep them away from activities in the natural surroundings that would otherwise promote knowledge and use of wild food plants.

2.4. CONCLUSIONS

A considerable number of edible wild plants are known to the inhabitants of the villages studied. They are consumed on a regular basis during peak availability (rainy season), though not as frequently as reported in other regions and times, probably due to ongoing acculturation, insertion into the cash economy and the ready availability of cultivated alternatives. Only a relatively small subset of seven wild plants in Roatina and five in Talea are known by most people. The relationship between frequency of mention in free lists (salience index) and frequency of consumption in Roatina, though not very strong, was statistically significant while in Talea no relationship could be established.

However the knowledge and use of edible wild plants in Santa Catarina Roatina and Villa Talea de Castro, Oaxaca, Mexico is declining. The persistence in the use of these plants is attributed to the perceived benefits obtained from them and is largely limited to the older members of the society. The preferences of cultivated alternatives and the social commitments way from natural spaces of young people have decreased the opportunities for the transmission of knowledge and thus contribute to the erosion of traditional knowledge. We recommend continued efforts in the documentation of these resources and in their promotion in more formal settings (such as schools, NGOs and health centers) based on the principal advantages perceived by the communities (nutrition and availability) to counteract negative perceptions. Local perceptions related to the use of natural resources help to design and implement conservation and awareness programs.

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2.6. Appendix 1a. Edible wild plants of Santa Catarina Roatina, Oaxaca, México

[1]The plant parts used in each category are underlined. [2]Plants without Salience scores were only mentioned by one person or during the group discussions. [3]*Consumption frequency*: number of times consumed during the study period. [4]*Management*: 1=gathered, 2=protected/encouraged, 3=cultivated. Plants are listed according to their salience scores.

Vegetables/Quelites:

The leaves[1] can be fried with onions and tomatoes, steamed; boiled and seasoned with onions and a variety of chili sauces; used in a broth with squash, squash flowers and leaves or chayote leaves; boiled and mixed with scrambled eggs, chicken, beef or pork.

Scientific name	**Local name**	[2]**Salience score**	[3]**Consumption frequency**	[4]**Management**	**Observations**
AMARANTHACEAE *Amaranthus hybridus* L.	quintonil/quelite	0.459	16	2	
FABACEAE *Crotalaria pumila* Ortega	chepil de arena	0.372	26	2	Chepil leaves are also the main ingredient in chepil tamales.
PORTULACACEAE *Portulaca oleracea* L.	verdolaga	0.175	5	2	The leaves and tender stems are consumed.
SOLANACEAE *Solanum americanum* Mill. *Solanum nigrescens* M. Martens & Galeotti	bishate/hierba mora	0.154	5	2	
FABACEAE *Crotalaria longirostrata* Hook & Arn.	chepil de cerro	0.105		2,3	Chepil leaves are also the main ingredient in chepil tamales.
FABACEAE *Diphysa robinioides* Benth.	coachepil	0.103	2	1	The flowers are coated with eggs, used together with other vegetables in broths or used to make a chili sauce.
BRASSICACEAE *Rorippa nasturtium-aquaticum* (L.) Hayek	berro	0.070		1	The raw leaves are used to make a salad
CACTACEAE *Opuntia* sp.	nopalito del campo	0.046	4	1,3	The stems are scraped to remove the thorns and are eaten boiled, stuffed with cheese or in a salad with onions, carrots, chili and cilantro.

AGAVACEAE *Yucca* sp.	izote	0.039		1	The <u>flowers</u> are coated with eggs, fried and served with a chili sauce.
FABACEAE *Leucaena* sp.	gogollos de guaje	0.039		1,3	Tender <u>leaves</u> are eaten raw or boiled.
AGAVACEAE *Agave* sp.	quiote de maguey	0.019		1	The <u>scarp</u> is baked and mixed with beans or ground with maize meal to make tortillas.
SOLANACEAE *Physalis philadelphica* Lam.	miltomate	0.014	1	2	The <u>fruit</u> are used to make sauces for various dishes.
FABACEAE *Erythrina americana* Mill.	pipe	0.008		2,3	The <u>flowers</u> may be fried and served with onions and cilantro.
ARACEAE *Monstera deliciosa* Liebm.	piñanona			1	The <u>flowers</u> are coated with eggs, fried and served with a chili sauce.
ASTERACEAE *Galinsoga parviflora* Cav.	hierba de belatobe			2	
ASTERACEAE *Sonchus oleraceus* L.	lechiguilla			2	
BRASSICACEAE *Lepidium virginicum* L.	pierna de vieja			2	
BRASSICACEAE *Brassica rapa* L.	quelite mostaza		1	2	
CHENOPODIACEAE *Suaeda torreyana* S. Watson	romero			2	
PHYTOLACCACEAE *Phytolacca icosandra* L.	quelite de toro		1	2	
RUTACEAE *Ruta graveolens* L.	ruda			2	
SOLANACEAE *Lycopersicon esculentum* var. *leptophyllum* (Dunal) D'Arcy	tomatillo			2	The <u>fruit</u> are used to make sauces for various dishes.
CACTACEAE	chacha			1, 2	<u>Flowers</u>

-	hierba de negro			1	

Fruit:
The fruits are eaten fresh as a snack.

Scientific name	**Local name**	[2]**Salience score**	[3]**Consumption frequency**	[4]**Management**	**Observations**
CACTACEAE *Opuntia* sp.	tuna	0.277	2	1,3	
ERICACEAE *Arctostaphylos pungens* Kunth	manzanita de cerro	0.234	1	1	
ROSACEAE *Rubus* sp.	zarzamora	0.097		1	
CACTACEAE *Stenocereus* sp	pitaya	0.070		1,3	
ASCLEPIADACEAE *Matelea aenea* (Woodson) W.D. Stevens	guete	0.056		1,2	Boiled fruit eaten as a snack.
MALPHIGHIACEAE *Malpighia mexicana* A. Juss.	nanche	0.054		1	
ERICACEAE *Arbutus xalapensis* Kunth	madroño morado	0.041		1	
ANNONACEAE *Annona* sp.	anona	0.039		1, 3	
VERBENACEAE *Lantana camara* L.	xoberobe/ zapotillo	0.012		1	
SOLANACEAE *Jaltomata procumbens* (Cav.) J.L. Gentry	capulin/tonchiche/ chislabe			2	
SOLANACEAE *Lycianthes peduncularis* (Schltdl.) Bitter				2	
ANNONACEAE *Annona cherimola* Mill.	chirimoya			1, 3	
CACTACEAE *Mammillaria albilanata* Backeb.	chililllo			1	
ROSASEAE *Crataegus mexicana* Moc. & Sessé ex DC.	tejocote			3	
CACTACEAE	bitibishi			1	
CACTACEAE	biznaga			1	
SOLANACEAE	hualtomate			2	
MORACEAE	higo			1	

Ficus sp.					
	mora			1	
	piñon coquito			1	
	baboso				
	tuste negro		1	1	

Condiments:
Fresh or died leaves are used to flavor stews, beans and other dishes.

Scientific name	**Local name**	[2]**Salience score**	[3]**Consumption frequency**	[4]**Management**	**Observations**
ASTERACEAE *Porophyllum tagetoides* (Kunth) DC.	tepiche	0.393	10	1	
ASTERACEAE *Tridax coronopifolia* (Kunth) Hemsl.	hierba de conejo	0.297	6	1	
CHENOPODIACEAE *Chenopodium ambrosioides* L.	epazote	0.288	Almost daily	2	
ASTERACEAE *Salmea scandens* (L.)DC.	palo de chile	0.147	3	3	The stems are boiled and then the inner bark (endodermis) peeled of and chewed with food as a flavoring.
LAMIACEAE *Mentha* sp.	poleo	0.108		2,3	
LAMIACEAE *Mentha spicata* L.	hierba buena	0.061		2,3	
PIPERACEAE *Peperomia* sp.	oreja de león	0.034	2	1	
PIPERACEAE *Piper* sp.	hierba santa	0.030		3	
LAURACEAE *Litsea glaucescens* Kunth	laurel	0.022		1	
LAURACEAE *Persea* sp.	aguacatillo	0.018		1	
ASTERACEAE *Porophyllum ruderale* (Jacq.) Cass.	papalo			2,3	
SOLANACEAE *Capsicum annuum* L.	chile piquín			2,3	The fruit to make chili sauce with

					tomatoes or husk tomatoes

Beverages:

The <u>leaves</u> are usually used in infusions (teas) and the <u>fruit</u> are used to make a refreshing drink (flavored water). The teas are also therapeutic.

Scientific name	**Local name**	[2]**Salience score**	[3]**Consumption frequency**	[4]**Management**	**Observations**
LAMIACEAE *Mentha* sp.	poleo	0.108		2,3	It is also a therapeutic tea.
ERICACEAE *Arctostaphylos pungens* Kunth	manzanita	0.088		1	
CACTACEAE *Opuntia* sp.	tunas	0.069		1,2,3	
VERBENACEAE *Lantana camara* L.	zapotillo	0.054		1	
ASTERACEAE *Tagetes filifolia* Lag.	anis	0.054		2	It is also a therapeutic tea.
LAMIACEAE *Mentha spicata* L.	hierba buena			1	It is also a therapeutic tea.
Salvia tiliifolia Vahl	chía			2	
ASTERACEAE *Matricaria chamomilla* L.	manzanilla			2	It is also a therapeutic tea.
CATACEAE *Stenocereus* sp.	pitaya			1	

Snacks:

The underground parts are scraped clean and eaten fresh.

Scientific name	**Local name**	[2]**Salience score**	[3]**Consumption frequency**	[4]**Management**	**Observations**
	sabinito	0.472		1	
	camote de agua	0.277	2	1	
CONVOLVULACEAE *Ipomoea suffulta* (Kunth) G. Don	jícama de campo	0.277	3	1	
OXALIDACEAE *Oxalis nelsonii* (Small) R. Knuth	xocoyul	0.109		2	
AGAVACEAE *Agave* sp.	mezontle		1	1	The <u>stem</u> is boiled or roasted peeled and

					chewed in the same manner as sugar cane.

Beans:

Scientific name	**Local name**	[2]**Salience score**	[3]**Consumption frequency**	[4]**Management**	**Observations**
FABACEAE *Leucaena* sp.	gauje	0.252	4	1,3	The seeds are eaten raw.
FABACEAE *Phaseolus coccineus* L.	frijol tashene			1,2,3	The dried seeds are boiled and flavored with epazote, garlic and onions.

Appendix 1b. Edible wild plants of Villa Talea de Castro, Oaxaca, México

[1]The plant parts used in each category are underlined. [2]Plants without Salience scores were only mentioned by one person or during the group discussions. [3]*Consumption frequency*: number of times consumed during the study period. [4]*Management*: 1=gathered, 2=protected/encouraged, 3=cultivated. Plants are listed according to their salience scores.

Vegetables/Quelites:
The leaves can be fried with onions and tomatoes steamed; boiled and seasoned with onions and a variety of chili sauces; in a broth with squash,squash flowers and leaves or chayote leaves;boiled and mixed with scrambled eggs, chicken, beef or pork.

Scientific name	**Local name**	[2]**Salience score**	[3]**Consumption frequency**	[4]**Management**	**Observations**
AMARANTHACEAE *Amaranthus hybridus* L.; *A. spinosus* L.	quintonil	0.295	6	2	
ASTERACEAE *Galinsoga parviflora* Cav.	piojito (cuan beche)	0.222	9	2	
PORTULACACEAE *Portulaca oleracea* L.	verdolaga	0.123	4	2	
SOLANACEAE *Solanum nigrescens* M. Martens & Galeotti	hierba mora	0.121	2	2	
FABACEAE *Diphysa robinioides* Benth.	coachepil/flor de gallito	0.092		1	
SOLANACEAE *Cestrum nocturnum* L.	huele de noche/cuan zú	0.086	3	2,3	
	quelite de la virgen/cuan zhu naj	0.079	6	2	
BRASSICACEAE *Rorippa nasturtium-aquaticum* (L.) Hayek	berro	0.078	8	1	
ASTERACEAE *Sonchus oleraceus* L.	lechuga montés /cuan ngiti/endibia	0.059	2	2	
PHYTOLACACEAE *Phytolacca icosandra* L.	cuan perlachinna	0.056	6	2	
ONAGRACEAE *Lopezia racemosa* Cav.	diablito (ya len yú)	0.056	1	2	
AGAVACEAE *Agave* sp.	flor de maguey	0.052		1,2,3	Flowers.
AGAVACEAE *Yucca* sp.	flor de quiote	0.043		1,2	Flowers.

PORTULACACEAE *Talinum paniculatum* (Jacq.) Gaertn.	verdolaga ancha /oreja de torro/ quignag bedx	0.033	3	2	
CACTACEAE *Opuntia* sp.	nopal	0.020		2,3	
ARECACEAE *Chamaedorea tepejilote* Liebm. ex Mart.	tepejilote	0.017	1	1	
FABACEAE *Erythrina americana* Mill.	zompancle	0.016	8	2,3	The <u>flowers</u> may be fried and served with onions and cilantro. The <u>leaves</u> are also used as quelites.
AMARANTHACEAE *Alternanthera lanceolata* (Benth.) Schinz	cabeza de cuche	0.015		1,2	
FABACEAE *Crotalaria pumila* Ortega	chepil	0.013	4	2,3	
SOLANACEAE *Lycopersicon esculentum* var. *leptophyllum* (Dunal) D'Arcy	tomatillo	0.008	2	2,3	
SOLANACEAE *Physalis philadelphica* Lam.	miltomate	0.006		2	
ASTERACEAE *Taraxacum officinale* Wig.	diente de león			2	
BRASSICACEAE *Brassica oleracea* L.	col de hoja			2,3	
BIGNONIACEAE *Parmentiera edulis* Raf.	cuajilote			1	
ARACEAE *Monstera deliciosa* Liebm.	elote de monte			1	<u>Flowers</u>.
CACTACEAE *Stenocereus* sp.	flor de pitaya			1	<u>Flowers</u>.
FABACEAE *Leucaena* sp.	guaje (puntas tiernas)			1,3	
BRASSICACEAE *Brassica rapa* L.	mostaza			2	
BRASSICACEAE *Raphanus sativus* L.	mostaza/rabano silvestre			2	The <u>tuber</u> is sliced and eaten in salads and the <u>leaves</u> are used as a

					quelite.
BRASSICACEAE *Lepidium virginicum L.*	pierna de vieja		2	2	
ULMACEAE *Trema micrantha* (L.) Blume	yah chi din			3	
FABACEAE *Erythrina americana* Mill.	zompancle/ cuan ptsutsu			2,3	Care has to be taken when this plant is eaten because it induces sleepiness.
-	cuan doh			1	
-	cuan nag ba (quelite de oreja)			1	
	saramuya			1	

Fruit:
the fruits are eaten fresh as a snack.

Scientific name	Local name	[2]Salience score	[3]Consumption frequency	[4]Management	Observations
ERICACEAE *Vaccinium leucanthum* Schltdl.	rajuas	0.188	1	1	
ROSACEAE *Rubus cymosus* Rydb. *Rubus leibmannii* Focke	zarzamora	0.151	4	1	
MYRTACEAE *Psidium guajava* L.	guayaba	0.139	2	1,2,3	
ANACARDIACEAE *Spondias mombin* L.	obo	0.080		1	
MYRTACEAE *Psidium guineense* Sw.	guayabina	0.068	2	1,2	
ERICACEAE *Gaultheria chiapensis* Camp	cuása	0.044		1	
FABACEAE *Inga jinicuil* Schltdl.	cuajinicuil	0.039	1	1,3	
VITACEAE *Vitis tiliifolia* Humb. & Bonpl. ex Roem. & Schult.	uva montés	0.036	1	1	
CLUSIACEAE *Mammea americana* L.	zapote blanco	0.032		1	

ANACARDIACEAE *Spondias purpurea* L.	ciruela	0.018		3	
CACTACEAE *Opuntia* sp.	tunas	0.018		2,3	
MALPIGHIACEAE *Byrsonima crassifolia* (L.) Kunth	nanches	0.016		1,2	
ANNONACEAE *Annona* sp.	anona	0.011		1	
MORACEAE *Ficus* sp.	higo			1	
ACTINIDIACEAE *Saurauia serrata* DC.	moquito			1	
CACTACEAE *Stenocereus* sp.	pitaya			1	
ROSACEAE *Rubus* sp.	zarzaparilla			1	
SMILACACEAE *Smilax* sp.	zarzaparrilla			1	

Condiments:

Fresh or died leaves are used to flavor stews, beans and other dishes.

Scientific name	**Local name**	[2]**Salience score**	[3]**Consumption frequency**	[4]**Management**	**Observations**
CHENOPODIACEAE *Chenopodium ambrosioides* L.	epazote	0.572	Almost daily	2,3	
PIPERACEAE *Piper sanctum* (Miq.) Schltdl. ex C. DC.	hierba santa	0.214		2,3	
APIACEAE *Eryngium foetidum* L.	cilantro de espina	0.117		2,3	
LAMIACEAE *Mentha spicata* L.	hierba buena	0.088		2,3	
LAURACEAE *Litsea glaucescens* Kunth	laurel	0.064		1	
LAURACEAE *Persea* sp.	aguacatillo	0.040		1	
LAMIACEAE *Mentha* sp.	poleo	0.040		2,3	
APIACEAE *Coriandrum sativum* L.	cilantro			2,3	

ASTERACEAE *Tridax coronopifolia* (Kunth) Hemsl.	cuan conejo		4	2	

Beverages:
The leaves are usually used in infusions (teas) and the fruit are used to make a refreshing drink (flavored water).

Scientific name	Local name	[2]Salience score	[3]Consumption frequency	[4]Management	Observations
MYRTACEAE *Psidium guajava* L.	guayaba	0.128		1,2,3	Fruit and leaves
ERICACEAE *Vaccinium leucanthum* Schltdl.	rajuas	0.107		1	Fruit.
LAMIACEAE *Mentha spicata* L.	hierba buena	0.054		2,3	Leaves.
MYRTACEAE *Psidium guineense* Sw.	guayabina	0.036		1,2	Fruit.
ASTERACEAE *Tagetes filifolia* Lag.	anis			1,2	Leaves.
AGAVACEAE *Agave* sp.	maguey para mezcal			1,2	
LAMIACEAE *Mentha* sp.	poleo			2,3	Leaves.
ROSACEAE *Rubus cymosus* Rydb. *Rubus leibmanii* Focke	zarzamora			1	Fruit.
SMILACACEAE *Smilax* sp.	cocolmeca			1	The leaves are used in a refreshing cacao based drink called pozontle. They are said to cause the characteristic froth.

Snacks:
The underground parts are scraped clean and eaten fresh.

Scientific name	Local name	[2]Salience score	[3]Consumption frequency	[4]Management	Observations
CONVOLVULAVEAE *Ipomoea batatas* (L.) Lam.	camote morado	0.214		2,3	
	camote de palo de hormiga			1	
OXALIDACEAE	camote de trebol			2	

Oxalis latifolia Kunth					
CYPERACEAE *Cyperus esculentus* L.	coquillo/chufa			2	

Seeds:

Scientific name	Local name	[2]Salience score	[3]Consumption frequency	[4]Management	Observations
FABACEAE *Phaseolus coccineus* L.	frijol zatope	0.071		2,3	The seeds are cooked in the same way as beans.
FABACEAE *Leucaena* sp.	guaje			1,3	The seeds are eaten fresh or in meat stews.
FABACEAE *Inga jinicuil* Schltdl.	cuajinicuil			3	The seeds are cooked in the same way as beans.

CAPÍTULO 3
DIVERSITY OF COEVOLVED WEEDS IN SMALLHOLDER MAIZE FIELDS OF MEXICO AND ZIMBABWE[2]

3.1. ABSTRACT

Theory and empirical data suggest the areas of origin of a crop to be the general area of origin of its coevolved weeds. These longer-evolved weeds would have an advantage over species with a shorter evolutionary time and migrate more successfully. We seek to identify patterns by comparing two regions with a shared crop, similar physiographic traits, but little direct contact, one of which is the area of origin of the crop. We compared the diversity of maize weed flora and its edible components between two rural villages each of Oaxaca, Mexico, and Honde Valley, Zimbabwe, using vegetation sampling, interviews and participatory observation. The Mexican fields had higher species richness and diversity than the Zimbabwean ones. Species richness and densities were higher in the villages that receive more rainfall. Mexican fields had a mainly native weed flora with almost 80 % American species and very few of African origin, whereas Zimbabwe had 32 % of American and 50 % of African origin. The regions shared seven American species and one of African origin. American/Mesoamerican agrestal weeds appear to be more successful in maize. Subsistence farmers in both study areas consume about 19 edible weed species of which four were common to all villages. Our results also suggest that the presence of 3-4 species of edible weeds per field may be a general pattern in the maize-based systems, and that people not necessarily want or need more, so usefulness- at least as an edible plant - would have a limited influence on migration success.

Key words: weed diversity; weed evolution; biogeography; edible weeds

3.2. INTRODUCTION

Weeds are plants that grow entirely or predominantly in habitats disturbed by humans without being deliberately cultivated (Baker 1974). Another definition is plants that grow where they are not wanted. However, weeds, just like domesticated plants, are part of an experiment in rapid evolution: agrestals and other weeds may be quite distinct from the taxa they originated from. They have been exposed to natural selection, migration, hybridization and introgression in the unique ecosystem of the cultivated field, for just as long as their associated

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domesticated crops; many originated in this ecosystem by auto- and allopolyploidy and various hybridization mechanisms (Baker and Stebbins 1965; Baker 1974; Hairston et al 2005; Vibrans 2002).

The evolutionary history of weeds may be relevant to a modern problem: that of exotic invasive plants. Various explanations have been proposed for the notorious differences in proportions of exotic plants in different regional floras, and the differential success of introduced species. Explanations include the level of purposeful introduction and acclimatation (and the related propagule pressure), enemy escape, and diversity of the native vegetation. However, the recent evolutionary history of the taxa, the selection pressures under which weeds have evolved and thus their differing levels of preadaptation has been considered only very occasionally, mainly in Europe, where the weed flora is well known (Ellenberg 1996). Also, most research on invasive agricultural weeds is conducted in modern production systems that are far removed from the type of systems in which most weeds evolved originally.

As this hypothesis (Asa Gray 1879) predicts, some of the ancient areas of origin of agriculture appear to be centers of origins for weeds, and to have lower proportions of exotic weeds, though this is a poorly-studied subject (Dafni and Heller 1980; Vibrans 2002; Zohary 1973). Regions that have been recently transformed by agriculture, such as Canada, USA, Argentina and Australia, tend to have the highest proportions of naturalized exotic species, and most problems with exotic invasive species. There are also, indications that niches opened up by new disturbance types will be filled up by preadapted suites of plants (Moles et al. 2008): witness the "Africanization" of the neotropical grasslands with species coevolved with the large mammals of Africa, after the introduction of cattle ranching (Parsons 1970).

Weeds are generally considered to interfere negatively with agriculture and a large number of studies are dedicated to the development and application of technologies geared towards the eradication of weeds and their negative effects on crops (Chivinge 1990; Chatizwa and Vorage 2000; Gatsi et al. 2001; Rambakudzibga et al.2002; Musambasi et al. 2002). However, not all weeds are detrimental. Some weeds are 'friendly' (Kunkel 1981) or useful elements in the agricultural ecosystem. They provide food, medicines and fodder (Espinosa-Garcia and Diaz-Perez 1996; Vieyra-Odilon and Vibrans 2001), they are important in the prevention of soil erosion (Chacón and Gliessman 1982; Calderon de Rzedowski and Rzedowski 2004), can be used as biopesticides (Hillocks 1998) and may also play a role in controlling insect pests (Peñagos et al. 2003). According to Marshall et al. (2003) weeds are important in supporting biodiversity within agroecosystems, due to their association with other organisms such as birds and insects.

The favourable properties of some weeds are appreciated by traditional agriculturalists as evidenced by the 'relaxed' weeding they practice (Altieri et al. 1987); many farmers actually sponsor beneficial weeds. In the Valley of Toluca, Mexico, maize weeds increased the economic value of the useful biomass by 50% on average, without reducing the overall yield of the main crop (Vieyra-Odilon and Vibrans 2001). The economic benefits are derived from the sale of edible weeds and the use of weeds as fodder. More than 20 edible 'weeds' are cultivated in Mexico (Diaz-Betancourt et al. 1999). So, it is necessary to consider usefulness of species in the analysis of migration patterns.

Mexico is a centre of origin and domestication of maize, *Zea mays* L. (Piperno and Flannery 2001). It has a mainly native weed flora (Vibrans 1998) and is the area of origin of many tropical weeds. Maize was taken to Africa around 1500 and has now become Africa's dominant food crop (McCann 2005). As in Mexico, where the diet is based on maize consumption, the crop now forms the staple in Zimbabwe and is present in all meals; as a porridge for breakfast and as "sadza" (a thick version of the porridge) for lunch and supper. The weeds of maize are also an important part of the diet in both countries. They are considered a relish in Zimbabwe and 'quelites' (pot herbs) in Mexico.

In this paper, we compare species richness, species diversity, biogeographical components and abundance of weed vegetation from two regions with a traditional, weed-tolerant agriculture, the same crop and relatively similar physiographic characteristics. The crop is native to one of the regions and was adopted in the other, substituting agronomically similar crops, mainly various types of millets. This study is part of a larger ethnobotanical investigation on wild-growing food plants; the fields studied were selected because informants had indicated that they were good sources for wild food plants. In addition, the number of food plants in each study plot was also compared.

We expect to find higher weed species diversity and richness, as well as a higher number of edible species in Mexico than in Zimbabwe because of the longer coevolution among maize, weeds and humans. Also, we expect more migration of maize weeds from America to Africa than in the opposite direction.

The study areas and crop management

The study sites were chosen based on:

1. Maize as the staple food, and therefore its cultivation at subsistence levels in traditional, low-external-input systems.
2. Similar environmental physical factors in terms of soils (humic acrisols), average annual temperature (12-19° C), elevation (500-1900 m), latitude (16-18º) and annual rainfall (600 a 1200 mm). These characteristics are described for the Land Unit G7 in which the Zimbabwean villages are located by Anderson *et al.* (1993). All study areas are in the mid-altitude tropics. Exactly equivalent sites could not be found, especially because soils tend to be neutral or alcaline in Mexico, whereas in Africa they are acid; when choosing the sites we emphasized soil type (humic acrisols) somewhat at the expense of other characteristics.

We selected two rural villages each for Mexico and Zimbabwe. Chipupuri and Maradzika are located in Honde Valley, Manicaland Province, Zimbabwe. In Mexico we worked in Santa Catarina Roatina (Roatina) and Villa Talea de Castro (Talea), both in the state of Oaxaca. The characteristics of each study site are shown in Table 1.

Table 1. Environmental characteristics of the study sites

	Oaxaca, Mexico		Manicaland, Zimbabwe	
	Roatina	**Talea**	**Chipupuri**	**Maradzika**
Altitude[1]	1789 m Maize fields were sampled at altitudes between 1650-1860m	1600 m Maize fields were sampled at altitudes between 1000-1750m	952 m Maize fields were sampled at altitudes between 850-920m	1200 m Maize fields were sampled at altitudes between 1010-1225m
Latitude	16°16' N	17° 22' N	18° 33' S	18° 30' S
Longitude	96° 31' W	96°15' W	32° 45' E	32° 45' E
Mean annual precipitation	582.9 mm	1640 mm (INEGI)	>1000 mm (1462 mm during November 2005-April 2006) [2] Maradzika receives more rainfall than Chipupuri according to personal observations.	
Rainy season	Summer (May-November)		Summer (November-April)	
Mean annual temperature	19.9 ºC	20.6 ºC	19 ºC	
Vegetation	Pine Forest and grasslands	Moist Oak-Pine Forest and secondary vegetation used to shelter coffee plantations	Miombo woodland	
Soil type	Eutric Rigosols/ humic acrisols	humic acrisols	humic acrisols	
Soil pH of sampled fields	7.13-8.57	4.9-6.5	4-5.5	4-4.6
Main crops	grow maize, beans and squash	maize, beans, squash, coffee and sugar cane	Maize, beans, squash, peanuts, bananas, taro, mangos	Maize, beans, squash, peanuts, bananas, some coffee, taro, mangos

[1] Altitude measures were taken from the Municipal palace (Palacio Municipal) in Mexico and from the headman's residence in Zimbabwe. [2] Taken at Mukande Meteorological Station, Zimbabwe. (Department of Meteorological Services, Bulawayo, Zimbabwe.)

Field work was carried out during the November 2005-April 2006 rainy season in Zimbabwe. The crop field was generally prepared for planting by winter ploughing starting in August. Farmers with access to manure applied it at this stage. After the first significant rainfall in November, fields were ploughed again and planted. Most farmers used bought hybrid maize seed and planted it with some fertilizer. A top dressing of a fertilizer commonly known as Compound D was applied when the maize plants had reached knee height. Farmers used an ox-drawn cultivator for the first weeding and thereafter they weeded manually using hand-held hoes once or when necessary until the crop reached the reproductive stage. None of the farmers interviewed used herbicides. Two of the sampled maize fields in Maradzika were only weeded once because of labour shortages.

In Mexico, field work was done during the 2006 rainy season (May-October). In Talea field preparation began soon after the previous harvest by clearing the field of overgrown weeds and then the first ploughing. Farmers ploughed a second time in January/February and a third time a week or two before planting. Ploughing in Roatina was done twice; in February and before planting in May/June. Some farmers applied manure before planting and inorganic fertilizer 4-6 weeks after emergence. Fields were weeded 2-3 times until the crop had reached the reproductive stage. For the first weeding an animal-drawn (horse) cultivator was used; later weeds were pulled out manually or cut using machetes. Only one farmer used herbicides in his maize crop.

The farmers in Mexico plant local landraces of maize and they select seed from the previous crop. The maize varieties in Talea are planted according to differences in altitude and maturation period. For example, large white maize is planted on higher ground above the village where it is colder. This variety takes long to mature and is planted from late February and is harvested in October. We worked only in the fields with early-maturing varieties (small white and small yellow maize) to make our data comparable to Roatina and Zimbabwe where there is a shorter growing season (3-4 months).

3.3. METHODS

Interviews

We carried out age and sex group interviews using the local social structures (schools, churches and clubs). We interviewed 8 groups in each community (males and females in the age classes 5 -12, 13-19, 20-50 years and elders more than 50 years old). These interviews were aimed at creating floristic lists of edible wild plants from the combined effort of all group members and give insight into where plants are usually collected and general availability. All groups indicated the maize field as an important source ofedible weeds. Thereafter ten families in each village were selected randomly and for willingness to participate in the study. Each of the selected families was asked to indicate one maize field they considered to be the best source of edible weeds which we used for sampling. Food diaries gave additional names of species used.

Sampling

The selected maize fields were sampled when at least half of the weed flora was flowering to facilitate specimen identification. This was usually after the fields had been weeded at least twice. A 5 m x 5 m quadrat was placed at least 2 m from the margins of the field and from the pathway to the field. All weeds present were listed using local or field names and percentage cover for each species was visually estimated using a modified Braun-Blanquet scale (Vieyra-Odilon and Vibrans 2001). Two 1 m^2 quadrats were then placed over a diagonal line of the 25 m^2 quadrat and individuals were counted for each species within the quadrat. Voucher specimens were collected and deposited in the Hortorio Herbarium (CHAPA) of the Colegio de Postgraduados, Texcoco, and in the National Herbarium of Zimbabwe (SRGH), Harare, for the Mexican and Zimbabwean species respectively.

The Species diversity and richness program (Henderson and Seaby, 1998) was used to calculate Fisher's alpha, Shannon's and Simpson's diversity indices for the weed flora using the number of individuals for each species found in the two 1 m^2 quadrats. Similarity between the sampling sites (25 m^2) of Mexico and Zimbabwe was estimated using the Jaccard coefficient (NTSYSpc Version 2.10L) for species presence/absence data.

3.4. RESULTS

Species richness and diversity

The maize weed flora in the study sites of Mexico consisted of 93 species (Roatina = 47 and Talea = 56 species) from 32 plant families (Appendix). The 70 species of weeds in Zimbabwe (Chipupuri = 42 and Maradzika = 50 species) were from 29 families. The sampling plots (25 m^2) each had between 13 and 15 species with standard deviations between ± 1.9-3.8 species in the four villages. The families with the largest number of species in both countries were Asteraceae, Poaceae and Fabaceae. These three families combined had 40.4 % and 35.2 % of the species in Mexico and Zimbabwe, respectively.

Table 2 shows that weed diversity in the individual maize fields was generally higher in the maize fields of Mexico than in Zimbabwe according to Fisher's alpha, Shannon's and Simpson's inverse diversity indices. There were no significant differences between Talea and Roatina for Fisher's alpha (P = 0.652) and Simpson's D (P = 0.312) diversity measures, while

Roatina had significantly higher measures for Shannon's index (P = 0.027). Contrary to our expectations, Maradzika consistently presented the lowest figures for these indices (P < 0.002). Maradzika had higher species richness (50 species) than either Chipupuri or Roatina and the highest weed densities. Maradzika tended to have a high number of unique species with low abundance and a few species with a large number of individuals.This may have influenced in the low diversity. It also presented the lowest evenness figures (0.23).

Table 2. Weed diversity in the maize fields of Mexico and Zimbabwe

	Fisher's alpha				Shannon				Shannon evenness				Simpson's D			
Field	**R**	**T**	**C**	**M**	**R**	**T**	**C**	**M**	**R**	**T**	**C**	**M**	**R**	**T**	**C**	**M**
A	2.25	2.93	3.40	2.18	1.57	1.87	2.01	1.63	0.33	0.39	0.42	0.34	4.44	4.27	6.78	4.07
B	<u>6.92</u>	5.28	2.83	2.51	2.20	2.01	1.82	1.21	0.46	0.42	0.38	0.25	<u>10.32</u>	6.23	5.17	2.08
C	5.43	2.29	3.80	1.42	2.18	1.88	1.92	1.22	0.46	0.39	0.40	0.26	7.74	6.06	4.95	2.55
D	4.47	4.24	4.26	1.85	1.91	2.04	2.05	1.12	0.40	0.43	0.43	0.23	6.55	5.15	6.46	2.47
E	5.81	2.62	2.39	2.10	<u>2.22</u>	1.64	1.81	1.41	<u>0.47</u>	0.34	0.38	0.30	8.86	4.32	5.02	2.74
F	1.41	3.47	2.30	<u>1.27</u>	1.47	2.14	1.58	1.20	0.31	0.45	0.33	0.25	4.36	7.27	3.96	2.70
G	3.14	2.97	2.16	1.37	1.58	2.06	1.89	1.30	0.33	0.43	0.40	0.27	4.45	7.05	5.65	2.85
H	2.94	2.92	2.53	3.82	1.78	2.11	1.85	2.32	0.37	0.44	0.39	0.49	4.60	7.38	6.01	8.42
I	4.52	3.54	1.81	2.54	1.84	2.02	1.33	<u>1.08</u>	0.39	0.42	0.28	<u>0.23</u>	6.60	6.70	3.20	<u>1.85</u>
J	4.72	2.89	3.28	2.79	1.82	1.87	1.71	1.89	0.38	0.39	0.36	0.40	6.56	5.31	3.73	5.22

R = Roatina; T = Talea; C = Chipupuri; M = Maradzika;The highest and lowest values for each index are<u>underlined</u>.

Biogeography

Eight species, *Amaranthus hybridus, Euphorbia heterophylla, Euphorbia hirta, Galinsoga parviflora, Lantana camara, Tridax procumbens* and *Xanthium strumarium* (native to America) and *Melinis repens* from Africa were found in the maize fields of both Mexico and Zimbabwe. Table 3 shows the 20 genera (representing 18.5 % of 108 genera) occurring in both Mexico and Zimbabwe. Though they were not found directly in the sample plots, plants like *Cleome* sp. and *Triumfetta* sp. were also found growing around the maize fields in Mexico, increasing the similarity between the genera of weedy flora between Mexico and Zimbabwe.

Table 3. Genera of weeds found in both Mexico and Zimbabwe

Genus	Mexico	Zimbabwe
Ageratum	*A. houstonianum*	*A. conyzoides*
Amaranthus	*A. hybridus*	*A. hybridus; A. thunbergii*
Bidens	*B. odorata; Bidens sp.*	*B. pilosa*
Commelina	*C. diffusa*	*C. africana; C. zambesica*
Cyperus	*C. hermaphroditus*	*C. distans; C. esculentus*
Eleusine	*E. indica*	*E. coracana subsp. africana; E. coracana*
Euphorbia	*E. graminea; E. heterophylla; E. hirta; E. hyssopifolia*	*E. heterophylla; E. hirta*
Galinsoga	*G. parviflora*	*G. parviflora*
Ipomoea	*I. purpurea*	*I. plebeia*
Kyllinga	*K. pumila*	*K. intricata*
Lantana	*L. camara*	*L. camara*
Melinis	*M. repens*	*M. repens*
Oxalis	*O. corniculata; O. latifolia*	*O. semiloba subsp semiloba*
Richardia	*R. scabra*	*R. brasilensis*
Setaria	*S. geniculata*	*S. homonyma*
Sida	*S. haenkeana; S. rhombifolia*	*S. alba*
Spermacoce	*S. confusa; S. ocymoides*	*S. senensis*
Tagetes	*T. erecta; T. filifolia*	*T. minuta*
Tridax	*T. procumbens*	*T. procumbens*
Xanthium	*X. strumarium*	*X. strumarium*

Most of the maize field weed flora (80%) found in the sampling sites in Mexico were Mesoamerican or American elements while in Zimbabwe only 46 % of the weeds had an African origin (Table 4). Over thirty percent of the weeds sampled in the Zimbabwe were American species, but only 3% of the Oaxaca species were native to Africa. American weeds may not have been introduced directly to Africa with maize but could have accompanied humans during activities like commerce and migration. Eurasian species played a small role in these tropical areas.

Table 4. Biogeographical origin of the weeds of maize in Mexico and Zimbabwe

Native Region	Mexico No. of species	Proportion (%)	Native Region	Zimbabwe No. of species	Proportion (%)
America	55	59.1	Africa	8	11.4
Mesoamerica[1]	19	20.4	Tropical Africa[2]	24	34.3
Africa	3	3.2	America	23	32.9
Eurasia	5	5.4	Eurasia	-	-
Cosmopolitan/?	2	2.2	Cosmopolitan/?	5	7.1

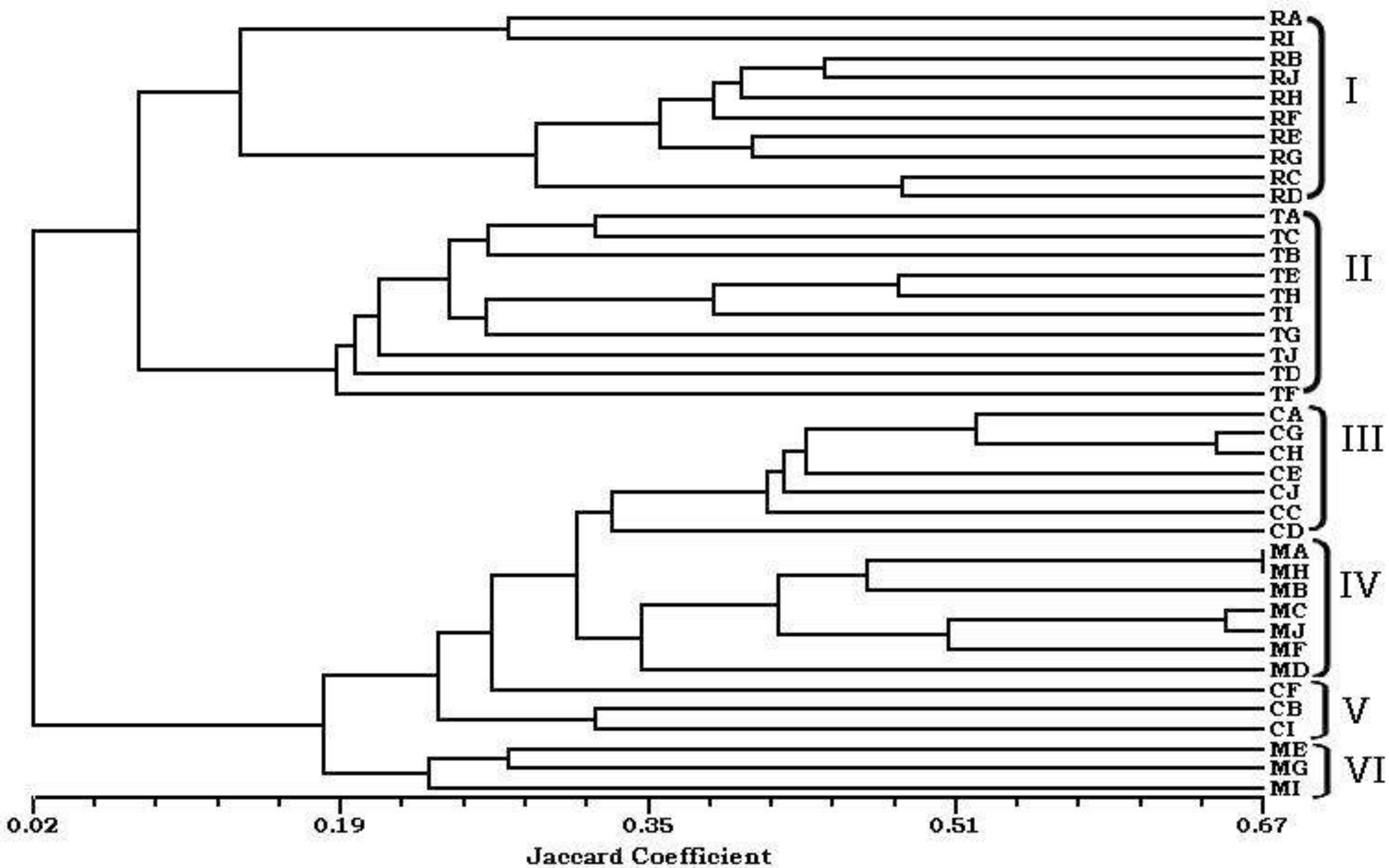
[1] Includes México; [2] Includes Zimbabwe; ? = Origin unknown

Eight weeds from Mexico and nine from Zimbabwe could not be identified to species level and were excluded from the distribution/origin statistic.

Similarity

According to the Jaccard coefficient for qualitative (presence/absence) data species similarity between agrestal weeds of maize in Mexico and Zimbabwe was relatively low, with sampling sites sharing 1-2 species (*Amaranthus hybridus* and *Galinsoga parviflora*). Figure 1 shows that the Mexican villages clearly formed two distinct clusters, I and II separated by differences in soil pH and precipitation. It is drier in Roatina and the soil pH ranged from 7.1 to 8.5; Talea is more humid, and soils are more acidic, ranging from 4.9 to 6.5. The similarity between Roatina and Talea was accounted for by 9 species found in both areas: *Amaranthus hybridus, Bidens odorata, Castilleja arvensis, Galinsoga parviflora, Ipomoea purpurea, Melampodium divaricatum, Melampodium perfoliatum, Tagetes erecta,* and *Richardia scabra*. In Zimbabwe the dendogram separated the maize field samples into 4 clusters. These were divided by soil pH as well as the age of the maize field. Cluster III is composed of maize fields from Chipupuri which had medium grained, sandy/clay/loamy and very strongly acid (pH 4) soils. The rest of the fields in this village formed a cluster (V) determined by the slightly acid (pH 5.5), medium-grained sandy soils.

Figure 1. Species similarity in Roatina and Talea, Mexico and Chipupuri and Maradzika, Zimbabwe



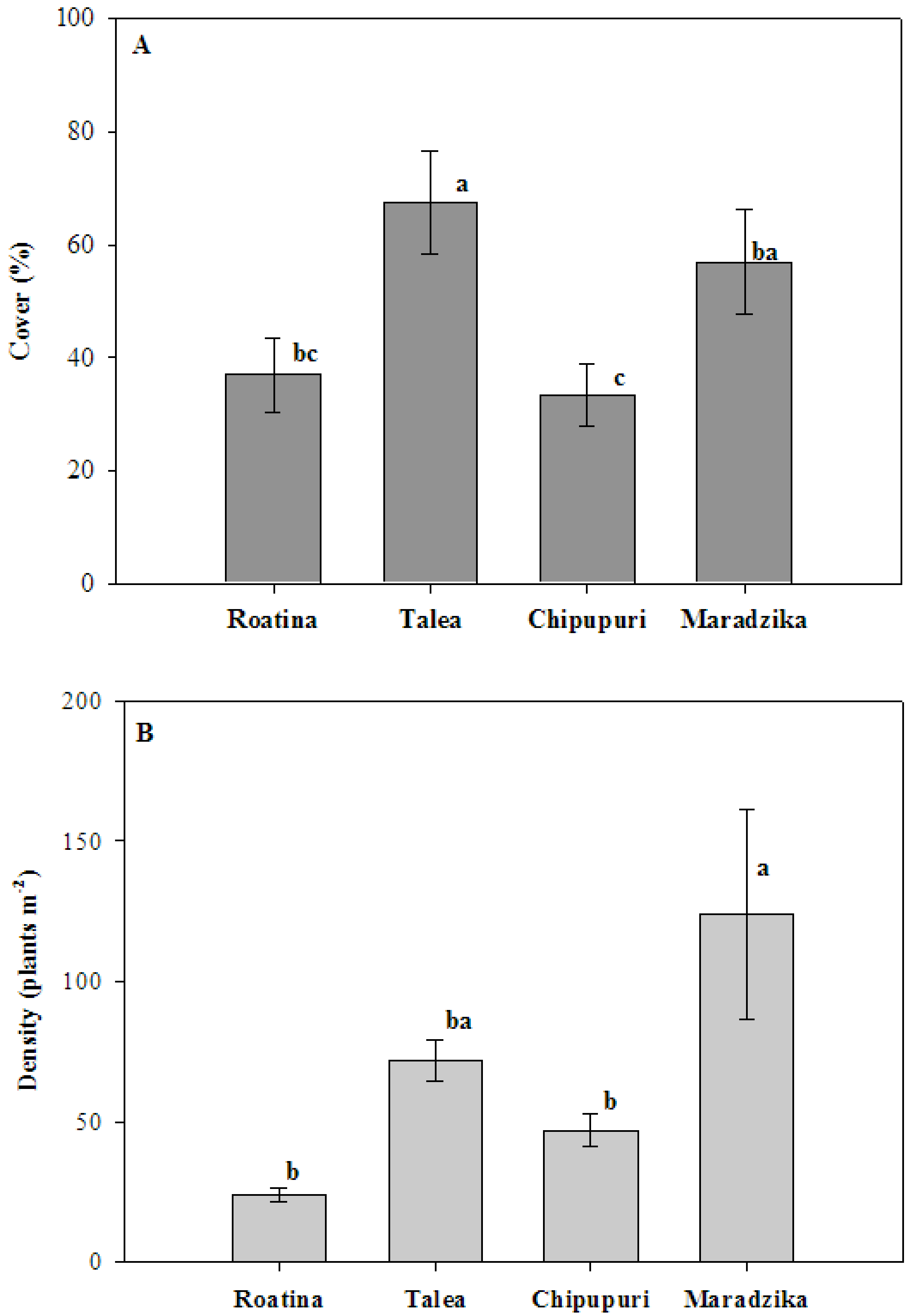
R = Roatina; T = Talea; C = Chipupuri; M = Maradzika

In Maradzika the maize fields separated into two groups mainly based on their relative age. Cluster IV is made up of fields that were established more than five years earlier whereas the fields in cluster VI had been cleared for cultivation in the previous 1-5 years. Cluster IV includes perennial species like, *Albizia antunesiana*, *Brachystegia spiciformis, Dodonaea viscosa* and *Fadogia tetraquetra*. These species were found growing in the surrounding vegetation and some were left as stumps.

Density

Figure 2A shows the percentage cover estimates of all weeds in the 25 m^2 quadrats in the four villages. The wetter regions (Talea and Maradzika) had greater densities and cover estimates. Weed densities ranged from 6 to 34 plants m^{-2} and from 19 to 100 plants m^{-2} in Roatina and Talea and from 23 to 74 and 39 to 487 plants m^{-2} in Chipupuri and Maradzika respectively (Figure 2B). The significantly high densities (P = 0.05) recorded for Maradzika resulted from two farmers failing to weed their fields for a second time due to labour shortages.

Figure 2. Mean percentage cover estimates and densities (± se)of maize weeds in Mexico and Zimbabwe.



Bars with the same letter are not significantly different at P = 0.05 (LSD test)

Gathered edible weeds

Local people in both Mexico and Zimbabwe listed 19 species of weedy edible plants that they usually gathered from the maize fields. Four species *Amaranthus hybridus, A. spinosus, Galinsoga parviflora* and *Sonchus oleraceus* were mentioned in all four communities. Farmers weeded selectively to maintain the edible species, only removing them when densities were too high and threatened the main crop during the critical stages. Table 5 shows the diversity of edible weed species found in the maize fields of the four study areas. There were on average 3-4 edible weed species in the 25 m^2 quadrats in all four villages.

Table 5. Edible weed species diversity in maize fields (n = 10)

	Roatina	Talea	Chipupuri	Maradzika
Total No. of weed species	47	56	42	51
Total No. of edible weed species	6	8	9	11
Proportion of edible species (%)	12.8	14.3	21.4	21.6
No. of edible weed species per plot ± se[1]	3.1 ± 0.46	4.1 ± 0.41	4.3 ± 0.4	4.4 ± 0.48
% cover of edible species ± se	1.1 ± 0.54	2.55 ± 0.47	2.08 ± 0.5	8.56 ± 1.8

[1] standard error

In Mexico the most frequent edible weeds were *Galinsoga parviflora* which occurred in 75 % of the fields sampled (n=20), followed by *Amaranthus hybridus* and *Lopezia racemosa* that were present in half of the maize fields. The most frequently present edible weeds in Zimbabwe were *Bidens pilosa, Commelina zambesica* and *Galinsoga parviflora*, which occurred in 90 %, 85 % and 65 % of the fields respectively. Except for *C. zambesica* (a famine food) in Zimbabwe and *L. racemosa* in Mexico, the most frequent species were also the most frequently consumed during the study periods in the four communities.

3.5. DISCUSSION

The high proportion of Mesoamerican weeds in both maize weed floras - and the low proportion of African weeds in Oaxaca - supports the hypothesis of predisposition of longer evolved weeds to migrate with their coevolved crop. The similarity in species and genera of weeds associated with maize between Mexico and Zimbabwe may be explained by preadaptation within taxonomic groups.

Total species richness in our study areas was comparatively low considering that we studied maize fields in rather weed tolerant environments. Most studies of agrestal weeds for a village area in Mexico cite more species than those found in this study (47, 56). This may be attributed to differences in the sampling effort. While we only sampled once in 25m^2 during the maize growing season, others have collected weeds at least twice or continuously throughout the season. For example, Perdomo et al (2004) documented 79 weeds in sugarcane in a small area in Morelos, Vieyra-Odilon and Vibrans (2001) found 74 species in a village of the Valley of Toluca, and Vibrans (1997) documented 88 agrestal weeds in a village in Tlaxcala, but these authors collected all the maize weeds they could find. There are no comparable data for Zimbabwe.

Species diversity is a community attribute that has not been frequently used in the evaluation of agrestal weeds. Most studies that have evaluated diversity in agrestal weeds have focused on the spatial and temporal variation in weed diversity as well as the effects of different management practices on weed species diversity (Perdomo et al 2004). Studies on species diversity of weeds in the context of traditional peasant agriculture are uncommon. Our study areas had relatively high diversity indices, compared with other studies, especially in Talea with H´ = 3.08. Hyvönen and Salonen (2002) and Tomita *et al.* cited by Perdomo (2004) reported diversity values of 1.52 *Secale cereale* L. and between 1.0 and 1.4 in *Oryza sativa* L. respectively. Unpublished data in maize fields of Jalisco (Gamboa-Ruiz 2004) and Tlaxcala (Gonzalez-Amaro 2008), respectively document H´ values of between 1.26-1.93 and 0.82-2.57. These measures are mostly influenced by the crop management practices practiced by the local farmers and by climate.

The edible components of the weed vegetation in maize fields are mostly used as green vegetables (potherbs, and relishes) to accompany the maize staple in both areas. This is an important practice as these plants provide vital micronutrients (Grivetti & Ogle 2000; Vieyra-Odilon and Vibrans 2001). Some have relatively high levels of lysine and thus increase the biological value of the staple (McGregor 1995). Moreover these resources have substantive economic value, either as food or as fodder (Vieyra-Odilon and Vibrans 2001).

Other studies in Mexico also indicate ranges of edible weed proportions similar to those reported in the present study. Vieyra-Odilon and Vibrans (2001) documented that 15 % of agrestal weeds of maize were considered edible and consumed as potherbs while in Tlaxcala farmers consume about 20 % of the weeds found in and around the maize crop (Gonzalez-Amaro 2008). The abundance of edible wild plants in arable areas is also reported for other areas of Africa (Dovie *et al.* 2007; Keding *et al.* 2007). Ethnobotanical studies of wild food plants in Ethiopia for example, indicated that 20 % of the wild food plants consumed in the country are found in cultivated places (Asfaw and Tadesse 2001). In Kenya, the *Piik ap Oom* Okiek, most commonly eat wild and weedy greens from gardens and maize fields (Marshal 2001). High and Shackleton (2000) report that in the Bushbuckridge region of South Africa, wild edible spinach-like vegetables are the most commonly found and used species (12 species out of 15) in home gardens. Modi *et al.* (2006) also reported that in KwaZulu Natal, South Africa wild leafy vegetables were comparatively more available in cropping fields than in the veld.

The proportions of edible weed components in our samples do not indicate the total usefulness of the weed flora as a source of food because several species that are known food species were not deemed edible in the localities studied. The local people in Roatina and Talea, Mexico, did not include in their diet some species considered edible in other regions. Some informants knew that *Anoda cristata* and *Malva parviflora*, for instance, are consumed in other Mexican states like Puebla but they had never tried them. *Lopezia racemosa* is used as a pot herb ('quelite') in Talea but is not considered edible in Roatina. Although edible species like *Portulaca oleracea* were not encountered in our sampling plots, it is a common weed in both areas, but is not consumed in the study communities of Zimbabwe, yet it is an important vegetable in other parts of Africa like Ethiopia (Asfaw and Tadesse 2001) and is even cultivated in Mexico (Linares and Bye 1992; Diaz-Betancourt et al. 1999). Similarly, *Bidens odorata* is a common weed that has potential as its leaves can be used as 'quelites' and to prepare tea (Gamboa-Ruiz 2004; Vibrans 2005). Furthermore, High and Shackleton (2000) document an average of 4.5 ± 2.15 herbs for each home garden in Bushbuckridge, South Africa, a number similar to our results. We suggest that a certain standard number of leafy green vegetables are considered sufficient by people to cover their dietary needs and desire for variation (see Schwartz 2004), and new introductions would not necessarily be successful because of this reason.

3.6. CONCLUSIONS

As expected, the Mexican weed communities had a higher proportion of native species, a richer weed flora and a higher diversity of weeds. Just as the American continent has contributed a large number of crops, including maize, to the African continent, it has also supplied a number of species that now form part of the weed flora. Our results support the hypothesis that weeds coevolve with crops, and that such coevolution leads to a higher probability of successful migration.

The comparison of the weed flora and the species used for food between the two countries that have had no direct contact showed some intriguing regularities that should be explored in a wider context:

- A relatively high proportion of shared genera between the weed floras suggest that there are predispositions for a weedy habit, in a similar way as some genera contain many domesticates.
- The number of species, densities and cover of agrestal weeds depend on the rainfall received during the season; they are higher in humid areas and rather similar in the areas with similar environments of the two continents.
- The number of edible weeds found in maize fields that were considered good sources of this type of vegetables was surprisingly similar, considering the contrasting cultural context. Three or four wild leafy vegetables from maize fields may provide sufficient choice for people to supplement local maize based diets. Usefulness as food then may not be a primary factor in plant migration.

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3.8. Appendix 1A: Maize Weeds of Oaxaca, Mexico

[a] = edible species; **Boldface** =considered native to Mexico; Frequency = number of times found in fields (n=20);- = lacks information; C= central; S = south; SW = south-western; Unidentified species: 1 Fabaceae and 1 Chenopodiaceae.

Scientific name	Life form	Native region/distribution	Frequency
AMARANTHACEAE			
Alternanthera lanceolata (Benth.) Schinz[a]	Herb	**C Mexico-Peru**	3
Amaranthus hybridus L.[a]	Herb	**America**; tropical and temperate regions worldwide	10
Gomphrena serrata L.	Herb	**Southern United States-Paraguay**;naturalized elsewhere	3
APIACEAE			
Spananthe paniculata Jacq.	Herb	**C Mexico-Bolivia**	5
ASTERACEAE			
Ageratum houstonianum Mill.	Herb	**Mexico-C America (Mesoamerica)**;naturalized in S USA and Australia	6
Aldama dentata Llave & Lex	Herb	**C Mexico-Venezuela**	6
Ambrosia psilostachya DC.	Herb	**Canada-Mexico**, naturalized elsewhere	1
Bidens odorata Cav.	Herb	**Mexico and Guatemala** (Mesoamerica); naturalized in S USA and South America	18
Bidens sp.	Herb	America	1
Dyssodia papposa (Vent.) Hitchc.	Herb	**Canada-C America**; South America	4
Dyssodia sanguinea (Klatt) Strother	Herb	**Mexico-C America**	2
Galinsoga parviflora Cav.[a]	Herb	**Mesoamerica**; widely naturalized elsewhere	15
Jaegeria hirta (Lag.) Less.	Herb	**Mesoamerica**; some areas in S America	4
Melampodium divaricatum (Rich.) DC.	Herb	**Florida, Mexico-northern S America**; secondary in Brazil and Myanmar	10
Melampodium perfoliatum (Cav.) Kunth	Herb	**Mexico-C America**; Cuba, California	6
Sanvitalia procumbens Lam.	Herb	**Mexico-C America**	4
Sclerocarpus uniserialis (Hook.) Benth. & Hook. f. ex Hemsl.	Herb	**Texas, Mexico-C America**	8
Spilanthes alba L'Hér. (=*Acmella alba* (L.´Hér.) J. K. Jansen)	Herb	**Mexico - S America**; some populations in the Old World	1

Scientific name	Life form	Native region/distribution	Frequency
Tagetes erecta L.	Herb	**Mexico-C America**	4
Tagetes filifolia Lag.	Herb	**Mexico-northern S America**	1
Tridax procumbens L.	Herb	**México to tropical S America**; naturalized in Old World tropics	1
Xanthium strumarium L.	Herb	**N America, possibly Mexico**; today worldwide	1
Zinnia peruviana (L.) L.	Herb	**SW United States-S America**	3
BRASSICACEAE			
Lepidium virginicum L. [a]	Herb	**America**, possibly North America; today worldwide	1
CAMPANULACEAE			
Diastatea micrantha (Kunth) McVaugh	Herb	**Mexico-Bolivia**	1
CARYOPHYLLACEAE			
Drymaria villosa Schltdl. & Cham.	Herb	**Mexico-Perú, probable origin Mesoamerica**	3
COMMELINACEAE			
Commelina diffusa Burm. f.	Herb	**Tropical & subtropical America**	6
Tripogandra purpurascens (S. Schauer) Handlos	Herb	**Mexico-northern S America**	3
CONVOLVULACEAE			
Ipomoea purpurea (L.) Roth	Herb	**America;** today worldwide	3
CYPERACEAE			
Cyperus hermaphroditus (Jacq.) Standl.	Herb	**SW United States-S America**	2
Kyllinga pumila Michx.	Herb	Temperate & tropical America, tropical Africa, origin uncertain.	1
EUPHORBIACEAE			
Euphorbia hyssopifolia L.	Herb	**Mexico-S America**; Old World tropics	1
Euphorbia graminea Jacq.	Herb	**Tropical America**; Florida, Hawaii, Oceania	1
Euphorbia heterophylla L.	Herb	**S United States-S America**; Old World tropics and subtropics	2
Euphorbia hirta L.	Herb	**Tropical America**; Oceania, Asia	2
FABACEAE			
Crotalaria longirostrata Hook. & Arn.[a]	Herb	**Mexico –C America**; Hawaii	1

Scientific name	Life form	Native region/distribution	Frequency
Crotalaria micans Link	Shrub	**Mexico-S America**	1
Crotalaria pumila Ortega [a]	Herb	**Mesoamerica** (**S USA to northern** S America); Oceania	1
Inga sp. [a]	Tree	-	1
Medicago polymorpha L.	Herb	Eurasia; worldwide in temperate climates	1
Mimosa pudica L.	Herb	S America; today in tropics worldwide	3
HAMAMELIDACEAE			
Liquidambar styraciflua L.	Tree	**United States-C America**	1
LAMIACEAE			
Hyptis atrorubens Poit.	Herb	**Mexico-Brazil and the Antilles**; Africa	1
Hyptis mutabilis (Rich.) Briq.	Herb	**Florida and Mexico-northern S America**	3
Marrubium vulgare L.	Herb	Europe and adjoining areas; today worldwide in temperate and subtropical regions	2
Salvia hyptoides M. Martens & Galeotti	Herb	**Mexico-S America**	2
Salvia tiliifolia Vahl [a]	Herb	**S USA, Mexico-northern S America**	8
Salvia sp.	Herb	-	2
LYTHRACEAE			
Cuphea aequipetala Cav.	Herb	**Mexico-Guatemala & Honduras**	1
MALVACEAE			
Anoda cristata (L.) Schltdl.	Herb	**Mesoamerica**; today from USA to south America	4
Malva parviflora L.	Herb	Europe; widespread in temperate and subtropical regions	6
Sida haenkeana C. Presl	Herb	**Mexico-Panama**	6
Sida rhombifolia L.	Herb	**Tropical and subtropical America**; Old World tropics	2
NYCTAGINACEAE			
Mirabilis jalapa L.	Herb	**Mexico-S America**; secondary in some other regions	2
ONAGRACEAE			
Gaura coccinea Pursh	Herb	**Canada-Mexico**	1
Lopezia racemosa Cav. [a]	Herb	**Mexico-El Salvador**	10

Scientific name	Life form	Native region/distribution	Frequency
OXALIDACEAE			
Oxalis corniculata L.	Herb	Unknown origin, possibly American; today worldwide	3
Oxalis latifolia Kunth	Herb	**Mesoamerica**; today from S USA - S America, naturalized in the Old World	2
PAPAVERACEAE			
Argemone ochroleuca Sweet	Herb	**Mesoamerica**; naturalized in the tropics of the Old World	1
PHYTOLACACEAE			
Phytolacca icosandra L. [a]	Herb	**Mexico-S America & the Antilles**; naturalized in some areas of Europe	1
PLANTAGINACEAE			
Plantago sp.	Herb	-	1
POACEAE			
Arthraxon quartinianus (A. Rich.) Nash	Herb	Africa and Asia; USA to C America, Antilles	3
Cenchrus echinatus L.	Herb	**S United States-S America**; widespread in tropics	2
Digitaria sanguinalis (L.) Scop.	Herb	Eurasia; widespread worldwide	2
Eleusine indica (L.) Gaertn.	Herb	Africa; widespread worldwide	2
Eragrostis mexicana (Hornem.) Link	Herb	**Mexico**; S America, Australia	2
Heteropogon contortus (L.) P. Beauv. ex Roem. & Schult.	Herb	**America**; Caribbean Islands and Old World Tropics	1
Hilaria cenchroides Kunth	Herb	**Mexico to Guatemala**	1
Melinis repens (Willd.) Zizka	Herb	Africa; tropics worldwide	1
Oplismenus burmannii (Retz.) P. Beauv.	Herb	Cosmopolitan, perhaps of Asian origin	2
Paspalum humboldtianum Flüggé	Herb	**Mexico to S America**	1
Setaria geniculata (Lam.) P. Beauv.	Herb	**America**; Old World tropics	2
PRIMULACEAE			
Anagallis arvensis L.	Herb	Eurasia; widespread in temperate and subtropical regions	1
PTERIDACEAE			
Pteridium aquilinum (L.) Kuhn	Herb	Cosmopolitan	1
RANUNCULACEAE			

Scientific name	Life form	Native region/distribution	Frequency
Ranunculus petiolaris Kunth ex DC.	Herb	**Mesoamerica (S USA to** northern S America)	1
RUBIACEAE			
Borreria latifolia (Aubl.) K. Schum.	Herb	**Tropical America**; invasive elsewhere	3
Borreria ocymoides (Burm. f.) DC. (= *Spermacoce ocymoides* Burm. f.)	Herb	Tropical Asia; Africa, Mexico-S America	2
Crusea calocephala DC.	Herb	**Mesoamerica**	3
Mitracarpus hirtus (L.) DC.	Herb	**S US-Brazil & the Antilles**; Old World tropics	5
Ricardia scabra L.	Herb	**S United States-northern S America**; Old World tropics	4
Spermacoce confusa Rendle ex Gillis	Herb	**Mexico-Brazil and the Antilles**; Hawaii and Africa	1
SCROPHULARIACEAE			
Castilleja arvensis Schltdl. & Cham.	Herb	**Mexico-S America**; Hawaii and Oceania	2
SMILACACEAE			
Smilax sp.	Herb	-	1
SOLANACEAE			
Lycopersicon esculentum Miller var. *leptophyllum* [a]	Herb	**Mexico-S America**	2
Physalis patula Mill.	Herb	**Mexico**	1
Physalis philadelphica Lam. [a]	Herb	**SW United States –C America**	7
Solanum nigrescens M. Martens & Galeotti [a]	Herb	**S United States-S America**	1
URTICACEAE			
Pilea hyalina Fenzl	Herb	**Mexico-S America**	3
VERBENACEAE			
Lantana camara L.	Herb	**S U.S.-S America**; in semiarid regions elsewhere	1
Lippia sp.	Shub	-	1
Verbena carolina L.	Herb	**SW United States –C America**	1

Appendix 1B: Maize Weeds of Honde Valley, Zimbabwe

[a] = edible species; **Boldface** = considered native to Africa; Frequency = number of times found in fields (n=20); - = lacks information; C = central; E = east; S; south; Unidentified species: 4 Poaceae and 2 undetermined families.

Scientific name	Life form	Native region/distribution	Frequency
AMARANTHACEAE			
Amaranthus hybridus L. [a]	Herb	Probably Mesoamerica; widespread in the tropics and temperate regions worldwide	5
Amaranthus thunbergii Moq. [a]	Herb	**C, E & S Africa**; introduced in USA, Europe and Australia	3
ANACARDIACEAE			
Lannea edulis (Sond.) Engl. [a]	Perennial herb	**Tropical Africa**	1
ANNONACEAE			
Annona senegalensis Pers. [a]	Shrub or tree	**W, E & S Africa, Madagascar**, **Cape Verde**	1
APIACEAE			
Steganotaenia araliacea Hochst.	Shrub or tree	**Tropical Africa**	1
ASPARAGACEAE			
Asparagus plumosus Baker	Herb	**Southern Africa**; naturalized in other continents	2
ASTERACEAE			
Acanthospermum australe (Loefl.) Kuntze	Herb	S America; naturalized in North America, Europe, Africa, Asia, Oceania	5
Acanthospermum hispidum DC.	Herb	C-S America; widely naturalized in other continents	13
Ageratum conyzoides L.	Herb	Neotropics, probably Mesoamerica; today widespread in tropics and subtropics	15
Bidens pilosa L. [a]	Herb	Mesoamerica; widespread in tropics worldwide	18
***Conyza* sp.**	**Herb**	**South America**	**2**
Crassocephalum sarcobasis (DC.) S.Moore	Herb	**Ethiopia-S Africa**	1
Galinsoga parviflora Cav. [a]	Herb	Mesoamerica; one of the most widespread weeds of tropical and temperate regions worldwide	13
Senecio pergamentaceus Baker	Herb	**Tanzania-Zimbabwe**	3
Tagetes minuta L.	Herb	S America; widely naturalized in the tropics worldwide	10
Tridax procumbens L.	Herb	Mesoamerica and northern South America; naturalized in tropics elsewhere	3

Scientific name	Life form	Native region/distribution	Frequency
Xanthium strumarium L.	Herb	N America; widespread in tropics and temperate regions worldwide	5
BORAGINACEAE			
Trichodesma zeylanicum (Burm.f.) R.Br.	Herb	**Paleotropics (Africa, Asia, Australia)**	1
CAPPARACEAE			
Cleome gynandra L. [a]	Herb	**Tropical Africa and Asia**; naturalized in the Neotropics	2
Cleome monophylla L. [a]	Herb	**Tropical & subtropical Africa**; India	2
CARICACEAE			
Carica papaya L. [a]	Tree	Tropical America	1
CHRYSOBALANACEAE			
Parinari curatellifolia Benth. [a]	Tree	**Tropical Africa**	1
COLCHICACEAE			
Gloriosa superba L.	Herb	**Tropical Africa and Asia**, naturalized elsewhere	1
COMMELINACEAE			
Commelina africana L. [a]	Herb	**Tropical & S Africa**	2
Commelina zambesica C.B. Clarke [a]	Herb	**Africa**	17
CONVOLVULACEAE			
Ipomoea plebeia R. Br. [a]	Herb	**Africa, South Asia and Oceania**	5
CUCURBITACEAE			
Cucumis anguria L. [a]	Herb	**Southern Africa**	1
CYPERACEAE			
Cyperus distans L. f.	Herb	Origin unknown; pantropical	4
Cyperus esculentus L. [a]	Herb	Variable species, pantropical	2
Kyllinga brevifolia Rottb. subsp. *intricata* (Cherm.) J.P. Lebrun & Stork (= *Kyllinga intricata* Cherm.)	Herb	Origin unknown, pantropical	2
Pycreus pelophilus (Ridl.) C.B.Clarke	Herb	**Tropical Africa**	1
EUPHORBIACEAE			
Euphorbia heterophylla L.	Herb	Tropical America, exact origin obscure, possibly Mesoamerica; widely distributed in tropics worldwide	1

Scientific name	Life form	Native region/distribution	Frequency
Euphorbia hirta L. (=Chamaesyce hirta (L.) Millsp.)	Herb	Tropical America, exact origin obscure, possibly Mesoamerica; widely distributed in tropics worldwide	1
Uapaca kirkiana Müll. Arg. [a]	Tree	**Tropical Africa**	1
FABACEAE			
Albizia antunesiana Harms	Tree	**Congo-Botswana, Tanzania-Mozambique & Zimbabwe**	1
Brachystegia spiciformis Benth.	Tree	**Tropical Africa**	1
Desmodium tortuosum (Sw.) DC.	Herb	Tropical America; today widespread in the tropics	1
Leucaena leucocephala (Lam.) de Wit	Shrub	Mesoamerica; today in tropics worldwide	1
Mucuna pruriens (L.) DC.	Liana	**Tropical Africa and Asia**; today worldwide	1
LAMIACEAE			
Leucas martinicensis (Jacq.) R.Br.	Herb	Probably tropical America; common in Old World tropics	14
Ocimum sp.	Herb	-	5
MALVACEAE			
Hibiscus cannabinus L.	Herb	**Africa**; widely naturalized elsewhere	6
Sida alba L. (= Sida spinosa L.)	Herb	Tropical America; widely naturalized elsewhere	6
Hibiscus sp.	Herb		1
MORACEAE			
Ficus sp. [a]	Shrub	-	1
MYRTACEAE			
Psidium guajava L. [a]	Tree	Tropical America, possibly Mesoamerica; widely naturalized elsewhere	1
OXALIDACEAE			
Biophytum petersianum Klotzsch	Herb	**Tropical Africa**; also in tropical Asia	1
Oxalis semiloba Sond. subsp *semiloba* [a]	Herb	**Tropical Africa**	6
POACEAE			
Eleusine coracana (L.) Gaertn. subsp. *africana*(Kenn.-O'Byrne) Hilu & De Wet	Herb	**Africa**	17
Eleusine coracana (L.) Gaertn. [a]	Herb	Africa; cultivated and sometimes escaped elsewhere	1
Melinis repens (Willd.) Zizka	Herb	**Africa**; naturalized in tropical Asia, America and some	3

Scientific name	Life form	Native region/distribution	Frequency
		temperate regions	
Setaria homonyma (Steud.) Chiov.	Herb	**Africa**; also in India	7
Sporobolus pyramidalis P.Beauv.	Herb	Tropical America; widespread elsewhere	1
RUBIACEAE			
Fadogia tetraquetra K.Krause [a]	Tree	**Tropical Africa**	3
Richardia brasiliensis Gomes	Herb	S America; today tropics worldwide	12
Spermacoce senensis (Klotzsch) Hiern	Herb	**Tropical Africa**	4
SAPINDACEAE			
Dodonaea viscosa Jacq.	Shrub	America; widely distributed in Old World tropics	2
SCROPHULARIACEAE			
Striga asiatica (L.) Kuntze	Herb	**Tropical-S Africa, Madagascar, Arabia, across India to SE Asia and China**; occasionally elsewhere	2
SOLANCACEAE			
Nicandra physalodes (L.) Gaertn.	Herb	Southern US-S America, Antilles, origin possibly Peru; Old World tropics and temperate areas	5
TILIACEAE			
Corchorus olitorius L. [a]	Herb	**Tropical Africa and Asia**	3
Corchorus tridens L. [a]	Herb	**Tropical Africa and Asia**, **exact origin obscure**; occasionally elsewhere	2
Triumfetta pilosa Roth [a]	Herb	**Tropical Africa and Asia**, occasionally elsewhere	3
Triumfetta rhomboidea Jacq. [a]	Herb	**Probably Old World** Tropics, today worldwide	4
VERBENACEAE			
Lantana camara L. [a]	Shrub	Southern US-S America, probably of Mesoamerica origin; today a world-wide weed	1

CAPÍTULO 4

COMPARATIVE ETHNOBOTANY OF WILD FOOD PLANTS IN MEXICO AND ZIMBABWE

4.1. INTRODUCTION

Comparative ethnobiology seeks to make cross-cultural generalizations by identifying inter and intra-cultural variation in the interaction of human societies with their natural resources. It searches for correlates and causes of the differences (Coley 2000). It documents the general features of similarities shared between cultures in order to give theoretical explanations for these universal phenomena (Berlin 1992). Studies of the variation or similarity in processes, patterns and trends in the use of resources are also important as they direct future conservation and development interventions (Ruiz-Pérez et al. 2004) such as the development of plant resources for wider use and commercialization. They have been particularly helpful in medicinal bioprospecting where comparative work has facilitated ethnomedically and taxonomically guided searches for medicinal plants that are biologically active (Bletter 2007).

Most comparative research carried out has been regional in nature and undertaken between 'related' areas. Examples include comparisons of communities within the same Biosphere Reserve in Mexico (Benz et al. 2000); between the Tsimane' of Bolivia (Reyes-Garcia 2001); between rural communities of the Patagonia of Argentina (Ladio and Lozada, 2003; Ladio et al. 2007); between different villages and provinces of South Africa (Shackleton et al. 2002), in different regions of Italy (Ghirardini et al. 2007), Spain (Rivera et al. 2007) and Palestine (Ali-Shtateh et al. 2008). Other research has covered wider ranges of peoples such as Moerman (1996) who compared medicinal and food flora for North America, while Leonti et al. (2006) and Hadjichambis et al. (2008) have compared Mediterranean societies.

These local or regional comparisons have shed light as to how the available local resources and environment, modernization, a peoples' socioeconomic status and other factors influence local knowledge and use of natural plant resources. There has also been indication of the communication of information between groups of people that may explain similar patterns of use (Bletter 2007), even in studies that are as extensive as that of Moerman et al. (1999) on medicinal floras of Chiapas (Mexico), North America, Korea, Kashmir (India) and Ecuador. They showed that people inhabiting the northern hemisphere use similar medicinal plant species/families and attributed this to the relatedness of the Northern Floras and to cultural transmission of knowledge over time and space (related to historical migrations from Asia to North America). Their results suggest global patterns in knowledge of medicinal plants. It is therefore important to evaluate these patterns between groups in wider ranges. For example, Bletter (2007) proposes that less related cultures that use similar medicinal plants to treat related diseases may have independently discovered the effectiveness of the plants, through experimentation without communication between them. The similarities between these groups would be more meaningful than similarities between related groups that may have exchanged information to varying degrees.

In this study we describe and compare the knowledge and use of wild food plants between subsistence farmers of Mexico and Zimbabwe, regions that have never had direct contact. The aim is to document local people's perceptions about the use and importance of these plants and to explain how the environment, the main crop and culture play a role in the knowledge and use of these resources.

People interact with food plants in various ways such as gathering, tolerance, protection and encouragement (Casas et al. 1996 and 2007), processes that have been defined as incipient management or incipient domestication (Bye 1979; Caballero and Cortés 2001). In traditional agricultural settings one species may receive combinations of these management practices. It can be gathered from the natural vegetation and also enhanced by collection, sowing and cultivation (Bye 1993; Ogle 2001). Therefore the use of the term 'wild' has been questioned. However, in the present paper the term 'wild' is used for plant species that do not depend on sustained human assistance for their survival as domesticated plants do (Cunningham 2001). It includes spontaneously growing plants that are gathered in the natural vegetation, plants that grow as agrestal and ruderal weeds, introduced and naturalised species and semi-domesticates.

4.2. METHODS

Selection of study areas.

We compared four rural communities, two from Oaxaca, Mexico and two from Manicaland Zimbabwe. The basis for the comparison was the subsistence cultivation of maize by indigenous peoples in traditional settings and its consumption as the staple as well as the use of gathered non crop foods to complement the maize basic. The participating villages

(Maradzika and Chipupuri) of Honde Valley, Zimbabwe were selected mainly for their accessibility and the local people's willingness to participate. The environmental characteristics of the Zimbabwean sites such as average annual temperatures (12-19 °C), annual precipitation (600-1200 mm), soil types (humic acrisols) and altitude (500-1900 m) were then used to map out similar areas in Mexico. The Mexican communities of Santa Catarina Roatina (Roatina) and Villa Talea de Castro (Talea) were also selected for their accessibility and people's interest in the study. A summary of the environmental conditions of the four sites is shown in Table 1.

Table 1. Environmental characteristics of the study sites

	Oaxaca, Mexico		**Manicaland, Zimbabwe**	
	Roatina	**Talea**	**Chipupuri**	**Maradzika**
Altitude[1]	1789 m Maize fields were sampled at altitudes between 1650-1860m	1600 m Maize fields were sampled at altitudes between 1000-1750m	952 m Maize fields were sampled at altitudes between 850-920m	1200 m Maize fields were sampled at altitudes between 1010-1225m
Latitude	16°16' N	17° 22' N	18° 33' S	18° 30' S
Longitude	96°31' W	96°15' W	32° 45' E	32° 45' E
Mean annual precipitation	582.9 mm	1640 mm (INEGI)	>1000 mm (1462 mm during November 2005 - April 2006) [2] Maradzika receives more rainfall than Chipupuri according to personal observations.	
Rainy season	Summer (May-November)		Summer (November-April)	
Mean annual temperature	19.9 °C	20.6 °C	19 °C	
Vegetation	Pine Forest and grasslands	Moist Oak-Pine Forest and secondary vegetation used to shelter coffee plantations	Miombo woodland	
Soil type	Eutric Rigosols/ humic acrisols	humic acrisols	humic acrisols	
Soil pH of sampled fields	7.13-8.57	4.9-6.5	4-5.5	4-4.6

[1] Altitude measures were taken from the Municipal palace (Palacio Municipal) in Mexico and from the headman's residence in Zimbabwe. [2] Taken at Mukande Meteorological Station, Zimbabwe. (Department of Meteorological Services, Bulawayo, Zimbabwe.)

Zimbabwe

In Zimbabwe the two villages, Chipupuri and Maradzika, are of the Mutasa Chiefdom under the traditional sub-chief Samanga and in the administrative Mutasa North District. This area forms part of the communal areas of the country, established under the Land Apportionment Act of 1930 (Anonymous 1994; Mudenge 2005). The population subsists on maize, beans and squash farming as well as the cultivation of bananas, mangos, sorghum, millet, taro, peanuts, bambara nuts, coffee and a variety of kales. Employment in the mines and urban centres of Zimbabwe and cross-boarder trading (with Mozambique and South Africa) sometimes contribute to household income.

Chipupuri has approximately 1200 inhabitants while Maradzika has about 800 inhabitants that speak the Chimanyika dialect of Shona. Most households lack electricity and running water. Fuel wood is used for daily cooking and heating and water is collected from communal boreholes or from several natural springs (these are more common in Maradzika). The nearest community services like grocery stores, primary school, and primary health clinic and transport services are located at Dumba Business Centre along the main paved road and about an hour's brisk walk away from Maradzika. This centre does not have electricity. Makunike Business Centre and the secondary school are much nearer to Chipupuri village. They have electricity and services such as the grinding mill (for maize meal) that also serves Maradzika and other villages is located here.

Mexico

The people of Roatina and Talea are generally referred to as Zapotecs, an ethnic group that comprises various cultures that inhabit the in the Mexican state of Oaxaca. According to de la Fuente (1994) who takes into consideration geographical, cultural, historical and linguistic characteristics, the people of Roatina have been described as the Miahuatlán Zapotecs while Taleans belong to the Rincón Zapotec group. Spanish has been incorporated into the local Zapotec language which is maintained in Talea, while it is no longer used in Roatina. The local people of both communities have incorporated the mestizo way of life.

Roatina is located in the Municipality of Miahuatlán de Porfirio Días, in the Southern Sierra of Oaxaca. It has a population of approximately 2000 people who mainly practice subsistence farming based on maize, beans and squash on privately owned land. Household income is supplemented by remittances from abroad and from family members who work in the nearby town of Miahuatlán or other Mexican cities. Households have electricity and piped water although none have drainage systems and indoor plumbing yet. Most cooking is done with firewood. Roatina has a pre-school, primary and secondary school, but most other community services are found in the municipal capital Miahuatlán.

Talea is a rural community immersed in the Northern Sierra of Oaxaca, a mountainous region that is seemingly isolated. However, it has communication with the rest of the world through telephone, postal and internet services as well as a relatively good paved road that connects it to the city of Oaxaca. Talea has a population of approximately 2200. Most households have electricity and some also have indoor plumbing. Public education is provided from kindergarten through to high school. The economy is based on the subsistence cultivation of maize, beans, a variety of squashes and sugarcane. Coffee is a very important cash crop. An increasing number of Taleans have found employment in the areas' construction industry and other commercial activities. As is the case for Roatina, there is also a high incidence of migration to the cities of Mexico and the United States of America. This is also a very important source of income.

Field work

Field work was carried out during the November 2005- April 2006 rainy season in Zimbabwe and the May to November 2006 rainy season in Mexico. The same procedure was followed in all four areas. When permission to work in the areas had been granted by the local authorities and the local people's willingness to participate had been established we proceeded to hold group interviews by age (6-12, 13-19, 20-50 and over 50 years old) and gender from which we gathered lists of edible local plants, their availability and general uses. Groups were organised though schools, churches, clubs and other social organizations. Voucher specimens of all edible plants that were available during the rainy season and within a 5 km radius of the village were systematically collected with the help of key informers/guides. In Mexico, the voucher specimens were deposited in the Hortorio Herbarium (CHAPA) of the Colegio de Postgraduados, Texcoco and the Zimbabwean species in the National Herbarium of Zimbabwe (SRGH), Harare.

Participating families

In each village, we selected every tenth name on local registers for a total of 10 families/households that farmed maize at subsistence levels and were willing to participate in the study. The families were allocated food diaries in which they recorded all the wild plants consumed during the study period. Family members were interviewed individually on their knowledge and perceptions on the use of wild edible plants. They freelisted plants in predetermined categories (vegetable, fruit, snacks, pulses/beans, condiment, beverage and source of starch) and discussed their preferences as well as the advantages and disadvantages associated with the use of wild edible plants. This together with participant observation complemented the information gathered from the group discussions and augmented the list of plants used in each community.

Sampling for edible maize weeds

One maize field per family was sampled for richness (number of species) and abundance (percentage cover estimates) of edible weed flora. A 5m x 5m quadrant was marked at least 2 m away from a maize field's entry point (pathway) and edges. All weed species were recorded using field names and percentage cover was estimated using a modifiedBraun-Blanquet scale (Vieyra-Odilon and Vibrans 2001). Two quadrants of 1m^2 each were placed on the diagonal of the larger 5m x 5m quadrant and individual plants were counted for each species within the quadrant.

Data analysis

Similarity between the taxa of the four areas was calculated with the Jaccard coefficient using ESTIMATES 8.0 program (Colwell 2006). The Family Importance Value (*FIV*) for the families was computed for the four study sites. For the purposes of this study this value is defined as the sum of the salience scores of each component of the family:

$$FIV = \sum Ss$$

where *Ss* equals the salience scores of each species within a particular family. Salience scores are calculated as follows:

$$Ss = F/(N\ mP)$$

where *F* equals the frequency of mention of a species, *N*: the number of informants and *mP*: the mean position in which the species is mentioned (Sutrop 2001; Quinlan 2002). Note that the *FIV* does not always correspond to the number of species that each family has since the number of edible species per family does not indicate their importance to the local people in the way that salience indices do.

The Spearman rank correlation was computed to see whether age and knowledge of gathered plants covary and the Kruskal Wallis test was used to test for intra and intercultural differences in knowledge. These tests were calculated using the SAS version 8 software. Shannon diversity and evenness indices were also used to test for homogeneity in knowledge of plants. The diversity indices were calculated for each plant and each different use category mentioned, therefore each time a different use for a plant was mentioned, it was recorded as a separate event. Principal components analysis was carried out using NTYSpc 2.1 software for the food consumption data for from dairy recordings.

4.3. RESULTS AND DISCUSSION

Edible Flora

The number of known gathered edible plants in all four communities was similar, with 67 in Roatina, 70 in Talea, 71 in Chipupuri and 72 in Maradzika. Table 2 shows the number of gathered food plant taxa mentioned in each of the study areas. Similarity in families, genera and species was highest between the Zimbabwean villages (Chipupuri and Maradzika) and was lowest between Talea and Maradzika according to the Jaccard coefficient. Nine families (Amaranthaceae, Annonaceae, Araceae, Asteraceae, Brassicaceae, Fabaceae, Moraceae, Rosaceae and Solanaceae) were recorded for all four communities. The seven genera that were shared between Roatina, Talea, Chipupuri and Maradzika were *Amaranthus, Ficus, Galinsoga, Physalis, Rorippa, Rubus and Sonchus.*

Table 2. Similarity of taxa between the four study communities

		Roatina	Talea	Chipupuri	Maradzika
Families	Roatina	**24**	0.583	0.277	0.256
	Talea	21	**33**	0.302	0.26
	Chipupuri	13	16	**36**	0.784
	Maradzika	11	13	29	**30**
Genera	Roatina	**50**	0.432	0.125	0.118
	Talea	32	**56**	0.129	0.11
	Chipupuri	11	12	**49**	0.709
	Maradzika	10	10	39	**45**
Species	Roatina	**67**	0.28	0.038	0.037
	Talea	30	**70**	0.044	0.036
	Chipupuri	5	6	**71**	0.554
	Maradzika	5	5	51	**72**

The diagonals (**boldface**) = number of taxa in each area; above the main diagonals = Jaccard similarity coefficient; below the main diagonals = number of shared taxa.

Table 3 shows that the most used plant parts in both Mexico and Zimbabwe are the fruit and leaves. Only one wild plant (*Parinari curatellifolia* Benth.) produced seeds that have a registered use in Zimbabwe. Flowers are not used by the people of Chipupuri and Maradzika. Most wild plants are prepared and used as vegetables or consumed as fresh fruit in both Mexico and Zimbabwe. Condiments are not an important part of Zimbabwean cuisine and plants such as *Lycopersicon esculentum* Miller and *Solanum betaceum* Cav. were considered condiments. In Mexico the same type of plants (*Lycopersicon esculentum* var *leptophyllum* (Dunal) D'Arcy and *Physalis philadelphica* Lam.) were categorized as vegetables by the local people.

Table 3. Plant parts used as food and preparation in Mexico and Zimbabwe (absolute numbers and proportion)

	Roatina (n=67)		Talea (n=70)		Chipupuri (n=71)		Maradzika (n=72)	
Part used								
Leaves	28	42%	37	53%	23	32%	28	39%
Fruits	28	42%	21	30%	37	52%	34	47%
Flowers	5	7%	7	10%	0	0	0	0
Underground parts	4	6%	6	9%	9	13%	4	6%
Seeds	2	3%	3	4%	1	1%	1	1%
Others	3	4%	2	3%	1	1%	2	3%
Preparation								
Vegetable	25	37%	37	53%	21	30%	24	33%
Fruit	19	28%	16	23%	34	48%	32	44%
Condiment	12	18%	8	11%	2	3%	5	7%
Beverage	7	10%	7	10%	7	10%	5	7%
Snack	5	7%	3	4%	6	8%	6	8%
Beans/Pulses	2	3%	3	4%	0	0	0	0
Oil extraction	0	0	0	0	1	1%	1	1%
Source of Starch	0	0	0	0	3	4%	1	1%

Cultural factors shape food patterns and influence the selection of foods. Cultural preferences that influence the choice of wild foods are based socio-economic factors, smell, taste, texture, visual characteristics, local perceptions of physiological effects and processing technologies needed (Messer 1989; Rivera et al. 2007). Mexican cuisine uses a lot of condiments and flavourings while Zimbabwean cooking employs much less flavouring, only using tomatoes, onions and occasionally chilli peppers to improve the taste of different relishes. This was reflected by most informants in individual and group discussions where Zimbabwean children were particularly quick to say that they do not eat any spices (see figure 2). Environmental factors also influence the kinds of foods available for consumption in a particular area. Miombo woodlands are known to have a high diversity of wild fruit trees (Campbell 1987; Clarke et al. 1996) and Chipupuri and Maradzika reflect this with 34 and 32 species respectively.

Plants used as a source of starch mainly as a substitute for the maize staple were only reported in Zimbabwe (table 3) where villagers reported the careful use of *Typhonodorum* *lindleyanum* Schott., a plant used during times of extreme food scarcity. The extraction of oil from the seeds was also only recorded in Zimbabwe (*Parinari curatellifolia*). However, the use of this seed oil has evidently lost its value as it was only remembered by the elderly members of the community. This emphasises the importance of basic inventorying in ethnobotany. This particular use of this plant may be rescued and local people may benefit from sustainable commercialisation of this product.

The botanical families that have the highest number of species are shown in Table 4. Asteraceae in all four areas and Solanaceae in Roatina, Talea and Maradzika are the most important families (considering the number of species) found in all study areas. They appear in the first three positions in both Mexico and Zimbabwe.

Table 4. Families represented by the most number of species of edible wild plants.

Position	Plant Families	Number of species
Roatina		
1	Asteraceae; Solanaceae	8
2	Cactaceae	7
3	Fabaceae	6
Talea		
1	Fabaceae	6
2	Asteraceae; Brassicaceae	5
3	Solanaceae	4
Chipupuri		
1	Euphorbiaceae; Rubiaceae	4
2	Amaranthaceae; Asteraceae	3
Maradzika		
1	Solanaceae	6
2	Rubiaceae; Euphorbiaceae; Tiliaceae	5
3	Amaranthaceae; Anacardiaceae; Asteraceae;	3

The use and importance of certain families has been described as a reflection of the relative size of these botanical families in the local flora (Moerman 1996; Caballero and Cortés 2001). According to Rzedowski (1993), Fabaceae (1800 species) is the second and Cactaceae (900) is the fifth largest among the phanerogamic families of Mexico. In Zimbabwe, Asteraceae (416 species), Euphorbiaceae (231) and Rubiaceae (218) are third, sixth and seventh largest botanical families (Mapaura and Timberlake 2004). The fact that some of the families shown in Table 4 are not amongst the best represented families in the national flora does not undermine their cultural significance and highlights the importance of indices such as the Family Importance Value (FIV).

Asteraceae and Amaranthaceae were among the 10 most salient families in all communities, thus highlighting their importance as food sources. Coincidentally for Roatina, Asteraceae also had the most species (eight) of which four are used as condiments, two make beverages and two are used as vegetables. Amaranthaceae was the most significant family in Talea but only had two species. In Chipupuri Amaranthaceae and Asteraceae ranked second in terms of the number of species used in each family. Despite its relative importance in terms of number of species, Solanaceae does not have much cultural significance and ranked 12th in Maradzika (Table 5).

Table 5. Botanical families of edible wild plants and their Importance Values (*FIV*)

	No. of species				No. of uses				Family Importance Value			
Family	R	T	C	M	R	T	C	M	R	T	C	M
Acanthaceae			1	1			1	1			0.057	0.129
Actinidiaceae		1				1				X[1]		
Agavaceae	3	3			2	2			0.058	0.107		
Amaranthaceae	1	3	3	3	1	1	1	1	0.459	0.605	0.322	0.449
Anacardiaceae		2	2	3		1	1	1		0.098	0.067	0.085
Annonaceae	2	1	1	1	1	1	2	2	0.039	0.011	0.151	0.223
Apiaceae		2				1				0.117		
Apocynaceae			2				1				X	
Araceae	1	1	1	1	1	1	2	2	X	0.017	0.051	0.057
Arecaceae		1				1				X		
Aristolochiaceae			1				1				0.109	
Asclepiadaceae	1				1				0.056			
Asteraceae	8	5	3	3	3	3	1	2	0.891	0.293	0.787	0.731
Bignoniaceae		1				1				X		
Brassicaceae	3	5	1	1	1	1	1	1	0.07	0.085	0.023	0.032
Cactaceae	7	3	1		3	4	1		0.462	0.038	X	
Capparaceae			2	2			1	1			0.292	0.332
Chenopodiaceae	2	1			2	1			0.288	0.572		
Chrysobalanaceae			1	1			2	2			0.078	0.186
Clusiaceae		1	1	1		1	2	2		0.032	0.152	0.081
Commelinaceae			2	2			1	1			0.026	0.037
Convolvulaceae	1	1		1	1	1		1	0.277	0.214		0.003
Cucurbitaceae			1	1			1	1			X	X
Cyperaceae		1	1			1	1			X	0.012	
Ericaceae	2	2			2	3			0.363	0.339		
Euphorbiaceae			4	4			4	4			0.282	0.435
Fabaceae	6	6	2	2	2	3	2	2	0.879	0.231	0.086	0.103
Flacourtiaceae			1	1			1	1			X	0.007
Lamiaceae	3	2	2	2	2	2	3	3	0.277	0.182	0.362	0.352
Lauraceae	2	2			1	1			0.04	0.104		
Loganiaceae			2	2			1	1			0.043	0.029
Malpighiaceae	1	1			1	1			0.054	0.016		
Malvaceae			1	1			1	1			0.128	0.061
Moraceae	1	1	2	1	1	1	1	1	X	X	0.003	0.035

Family	No. of species				No. of uses				Family Importance Value			
	R	T	C	M	R	T	C	M	R	T	C	M
Musaceae			1	1			1	1			X	0.065
Myrtaceae		2	2	2		2	2	2		0.371	0.218	0.197
Olacaceae			1	1			1	1			0.174	0.18
Onagraceae		1				1				0.056		
Oxalidaceae	1	1	1		1	1	1		0.109	X	0.016	
Pedaliaceae			1	1			1	1			0.006	X
Periplocaceae			1	1			2	2			0.827	0.568
Phytolaccaceae	1	1			1	1			X	0.056		
Piperaceae	2	1			1	1			0.064	0.214		
Portulacaceae	1	2			1	1			0.175	0.156		
Rhamnaceae			2				1				0.012	
Rosaceae	2	3	1	1	2	2	1	2	0.097	0.302	0.004	0.062
Rubiaceae			4	4			2	2			0.23	0.14
Rutaceae	1				1				X			
Smilacaceae		2				2				X		
Solanaceae	8	4	2	6	3	1	2	3	0.322	0.221	0.02	0.17
Tiliaceae			2	4			1	1			0.105	0.044
Ulmaceae		1				1				X		
Verbenaceae	1		2	2	2		2	2	0.066		0.326	0.274
Vitaceae		1				1				0.036		
Zingiberaceae			1	1			1	1				X

R = Roatina, T = Talea, C = Chipupuri, M = Maradzika; [1] The species in families without Family Importance Values (FIV) were only mentioned by one interviewee or only during the group interviews.

Four species, *Amaranthus hybridus* L., *Galinsoga parviflora* Cav., *Rorippa nasturtium-aquaticum* (L.) Hayek and *Sonchus oleraceus* L. are used in all communities. These plants are notably agrestal or ruderal weeds except *R. nasturtium-aquaticum*. They are all introduced and naturalised plants in Zimbabwe, the first two from America and the latter two from Eurasia (Jansen 2004; Schippers 2004; Vibrans 2005). *R. nasturtium-aquaticum* and *S. oleraceus* are also exotic to Mexico. They are all used as vegetables in all four communities. Preparation for consumption is similar for *A. hybridus* and *G. parviflora* in both countries. The leaves can be boiled and then fried with onions and tomatoes or added to stews. *R. nasturtium-aquaticum* and *S. oleraceus* are usually consumed raw in salads in Mexico while they are always cooked in the Zimbabwean villages.

While the similar uses of the same species may be taken to indicate some form of communication, there is no indication that culinary information may have been transmitted between our Mexican and Zimbabwean study groups. The similarities in the use of the above mentioned vegetables are probably independent discoveries. This argument is supported by different manner in which the staple of both regions, maize, is used. The centre of origin and domestication of maize is Mexico (Piperno and Flannery 2001). In the area of origin it is used mainly as tortillas after processing. The crop was introduced to Africa in the 16th century. In Zimbabwe maize is ground to maize-meal and cooked into a thick porridge (*sadza*) in much the same way as the traditional millet and sorghums. Maize was simply adapted to fit into the traditional culinary practices and the edible weeds were also incorporated in the same manner that the native ones were used.

Availability of wild edible plants in maize fields

The crop fields were considered an important source of edible wild plants (weeds) and selective weeding is carried out in both Mexico and Zimbabwe in to order to conserve them. The residents of each study area cited 19 food plants (Table 6) that they gather mainly from crop (principally maize) fields. The edible weeds are commonly used as vegetables in soups and relishes and as condiments. Sampling of maize fields revealed that edible components formed 13%, 14%, 21% and 22% of the weed flora in Roatina, Talea, Chipupuri and Maradzika respectively. The percentages in Zimbabwe were increased by the presence of fruit trees within the crop fields. There were on average 3-4 edible species in 25m^2 quadrants in all four villages. Percentage cover estimates of edible weeds were lowest in Roatina (1.1%) followed by Chipupuri (2.08%) and while the higher rainfall areas Talea and Maradzika had higher cover estimates of 5.5% and 8.56% respectively.

Maize is a crop whose agronomic characteristics make it ideal for multiple crop systems for example, the common maize-beans-squash combination. This is also extended to the cryptocrops (Hadjichambis et al. 2007), plants that are useful and do not affect the main crop (Vieyra-Odilon and Vibrans 2001). The gathering of edible weeds forms part of the subsistence strategies of the farmers of Mexico and Zimbabwe may have developed together with agriculture. Hillocks (1998) presents other benefits of weeds that confirm the importance of weed flora to small holder agriculture. These benefits especially for human consumption are under threat by the use of herbicides especially in Mexico and the transition to monoculture. This observation has also been documented by Marshal (2001) for the Piik Ap Oom Okiek of Kenya and for the Nahuas and Popolocas of Mexico (Vazquez-García et al. 2004; Vazquez-García 2008).

Table 6. Edible weed species in Mexico and Zimbabwe

Species	Roatina	Talea	Zimbabwe[1]
Alternanthera lanceolata (Benth.)Schinz		x	
Amaranthus hybridus L.[2]	x	x	x
Amaranthus spinosus L.		x	x
Amaranthus thunbergii Moq.			x
Bidens pilosa L.			x
Brassica rapa L.	x	x	
Chenopodium ambrosoides L.	x	x	
Cleome gynandra L.			x
Cleome monophylla L.			x
Commelina africana L.			x
Commelina zambesica C.B. Clarke			x
Corchorus olitorius L.			x
Corchorus tridens L.			x
Crotalaria pumila Ortega	x	x	
Crotalaria longirostrata Hook & Arn.	x		
Cucumis anguria L.			x
Cyperus esculentus L.		x	x
Galinsoga parviflora Cav.1	x	x	x
Ipomoea plebeia R. Br.			x
Jaltomata procumbens (Cav.) J.L. Gentry	x		
Lepidium virginicum L.	x	x	
Lopezia racemosa Cav.		x	
Lycianthes peduncularis (Schltdl.) Bitter	x		
Lycopersicon esculentum Miller var. *leptophyllum*	x	x	
Oxalis nelsonii (Small) R. Knuth.	x		
Oxalis semiloba Sond.			x
Physalis philadelphica Lam.	x	x	
Phytolacca icosandra L.	x	x	
Porophyllum tagetoides (Kunth) DC.	x		
Portulaca oleracea L.	x	x	
Solanum nigrescens Mart. & Gal.	x	x	
Solanum americanum Mill.	x	x	
Solanum nigrum L.			x
Sonchus oleraceus L.1	x	x	x
Taraxacum officinale Wig.		x	
Tridax coronopifolia (Kunth) Hemsl.	x	x	
Triumfetta pilosa Roth			x
Triumfetta rhomboidea Jacq.			x

[1] The two villages in Zimbabwe were combined because they use the same plant names; [2] Plants mentioned in all 4 study areas.

Knowledge of and peoples' perceptions in relation to the use of edible wild plants

The average number of wild food plants known by the residents of our study sites in Mexico and Zimbabwe are shown in Table 7. There were no significant differences in the average number of plants known per individual between the communities (Kruskal-Wallis test: H =

2.585; p = 0.46) although villagers from Talea and Maradzika (the more humid and isolated villages) generally listed more plants than those of Roatina and Chipupuri. The Shannon diversity and evenness indices computed from individual interviews were also similar in all four areas. Knowledge of plants amongst the individuals of all communities was fairly homogenous (Shannon's evenness measures). Chipupuri, Zimbabwe had the lowest scores in diversity and evenness whilst the highest were recorded for Talea, Mexico.

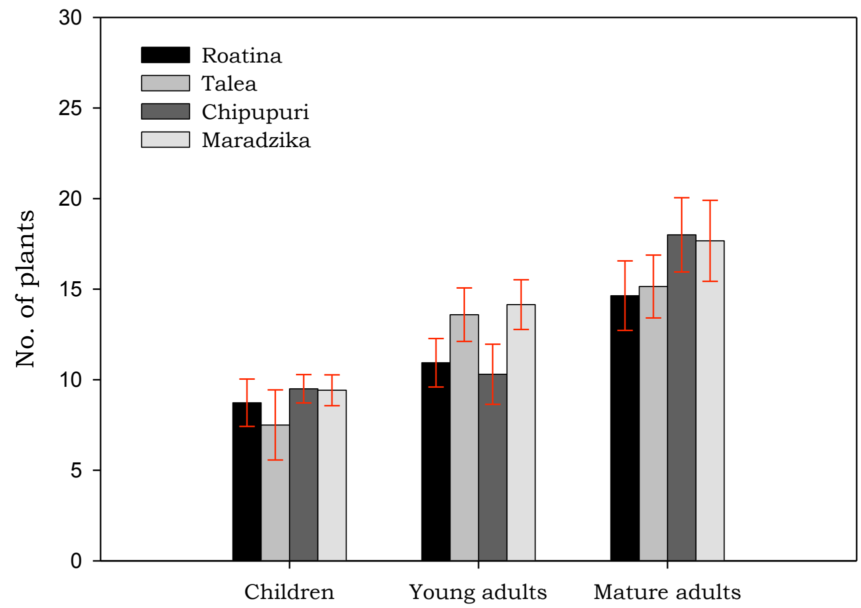
Table 7. Individual knowledge of wild food plants

	Roatina (n=37)	Talea (n=28)	Chipupuri (n=41)	Maradzika (n=35)
Shannon's diversity index	3.59	3.81	3.46	3.61
Shannon's evenness	0.88	0.90	0.87	0.89
Average No. of plants known/person	11.622	12.931	11.854	13.421
Spearman Correlation Coefficients	r = 0.373	r = 0.534	r = 0.423	r = 0.581
(Age and No. of plants known)	p = 0.023	p = 0.003	p = 0.006	p = 0.0003
Kruskal-Wallis test	H = 0.004	H = 2.724	H = 0.196	H = 0.836
(Average No. of plants by gender)	P = 0.951	P = 0.099	P = 0.658	P = 0.361

The number of plants that can be free listed at any time could depend on the season of the year and people may only list plants that are available. While this implies that not all resources can be remembered, the similarity in the average number of plants known between all communities and their homogeneity suggest that there may be widespread standards in the number of wild plants that are deemed sufficient (Schwartz 2004) by people to cover their dietary needs and desire for flavour variation at any one time. The high evenness measures found in each community indicate that the informants mentioned just the most important plants and may point out some loss ofknowledge (Begossi 1996).

The adults listed more plants than the children in both group and individual (Figure 1 and 2) interviews and age was correlated (Spearman Correlation) to the number of plants known in all our study sites. Most knowledge about wild food plants is gained during childhood although some is learned later on in life especially amongst newly married women who learn from their in-laws. Information is generally transmitted orally from parents or grandparents to children during activities in the environmental spaces where wild plants are gathered. Friends also play a role in the transmission of wild plant knowledge amongst adolescents.

Figure 1. Individual knowledge of wild food plants



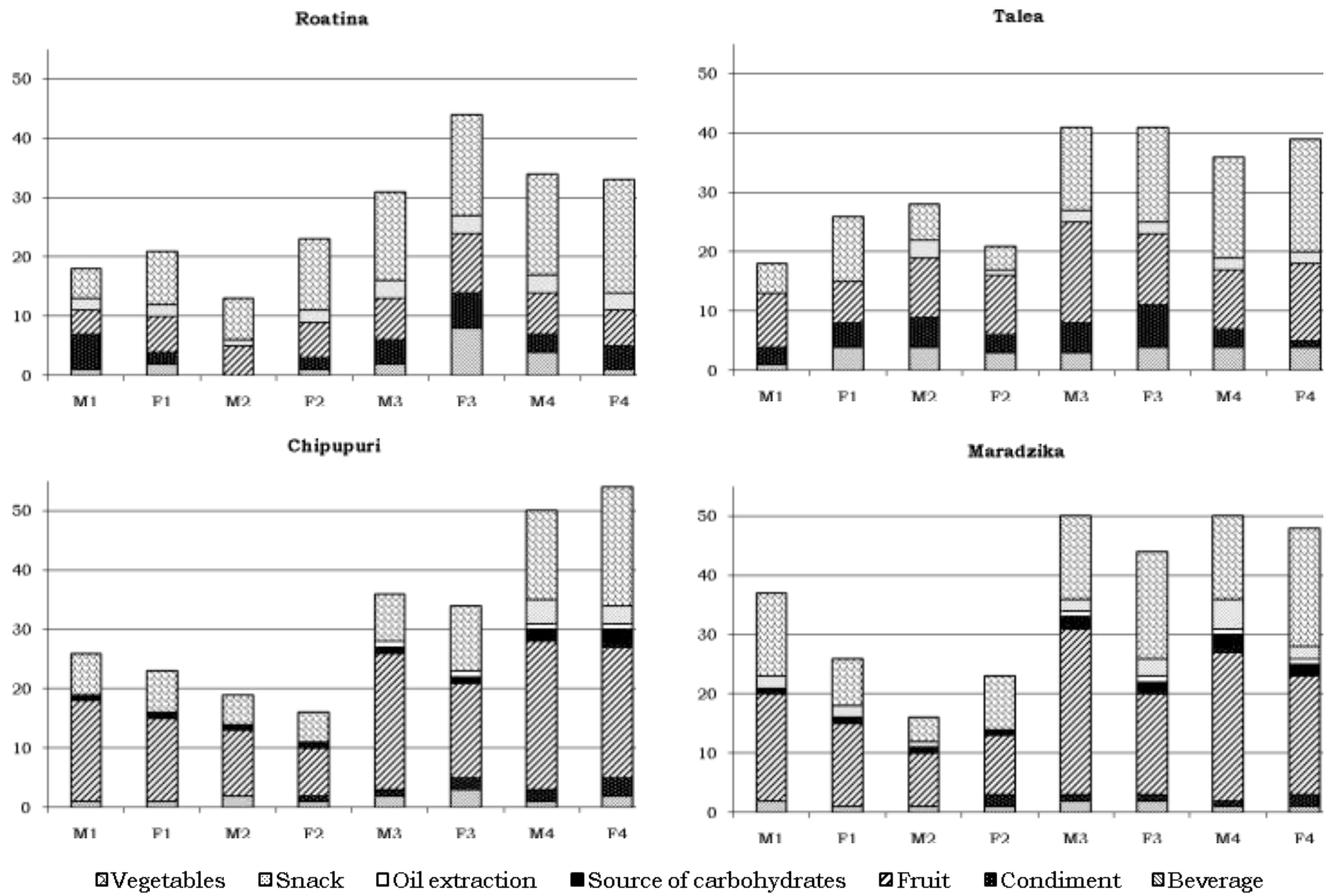
The differences in knowledge between the adults and the children are cause for concern as they indicate the loss of traditional knowledge in the study communities. Bearing in mind that most people learn about the use of plants before adulthood(Lozada et al. 2006) and taking the example of the Tsimane' (Reyes-Garcia et al. 2005) where most ethnobotanical knowledge is acquired by the age of 15, the adolescents of our study sites in Mexico and Zimbabwe may not get the opportunity to learn more. Written documentation of local knowledge is important because oral tradition is at risk of decay and transformation (Lozada et al. 2006).

The information contributed during discussions with people indicated a variation in knowledge between the genders. In Mexico, the female groups generally mentioned more plant species than the male groups, while in Zimbabwe the males generally mentioned more plants. However, these gender differences in all four communities were not significantly different according to the Kruskal-Wallis test applied to individuals (Table 7). There was also some differentiation between the males and females in terms of the food categories known. In Zimbabwe for example, the women could collectively name more plants used as vegetables, condiments and sources of carbohydrates than their male counterparts in the same age group. This was also observed in Mexico for the vegetable and condiment categories (Figure 3).

Knowledge and gathering patterns by age and gender in our study communities varied according to societal roles played individuals and the degree of contact with nature in everyday life. Women are also in charge of feeding the family and therefore gather vegetables and condiments for family meals. The women in both Mexico and Zimbabwe usually work near the home and thus generally gather plants that are associated with human-disturbed environments. This explains why women mentioned fewer fruits than men in the Zimbabwean villages for example. The male community members in Zimbabwe rarely gather food plants to bring home except fruit for children who are too young to do gather on their own. Vegetable gathering especially for married men is considered to be socially demeaning for men. On the other hand the men of Talea, Mexico, collect wild vegetables because they usually work far away from home where they may stay for various days without the womenfolk. They sometimes also gather for home consumption.

Women's gendered knowledge, especially for food and medicinal plants, is a worldwide trend (Clarke et al. 1996; Howard 2003; Henshall-Momsen 2007; Vazquez-García et al. 2004; Vazquez-García 2008). This global tendency in the gender division of labour, space and knowledge deserves to be considered in decisions and policies on resource management (Douma et al. 1994).

Figure 2. Group knowledge of edible wild plants



M = Males; F = Females; 1 = 5-12 years; 2 =13-19 years; 3 = 20-50 years; 4 = 51+ years

In terms of frequency of mention, a small proportion (11 %, 7 %, 8 % and 10 % for Roatina, Talea, Chipupuri and Maradzika respectively) of the food plant flora was cited by the majority of the people (over 50 %) in individual interviews. The plants known y most people in all areas are used as vegetables (Table 8). Condiments were also important in the Mexican communities while fruit were more important in Zimbabwe.

Table 8 Most frequently mentioned plants in individual interviews

Plant name	Freq (%)	Sal	Use	Part	Man
Roatina (n=37)					
AMARANTHACEAE *Amaranthus hybridus* L.	89	0.459	V	L	T
FABACEAE *Crotalaria pumila* Ortega	70	0.372	V	L	G, T, C
Camote de agua	65	0.277	S	T	G
ASTERACEAE *Porophyllum tagetoides* (Kunth) DC.	64	0.393	C	L	G,T
ASTERACEAE *Tridax coronopifolia* (Kunth) Hemsl.	57	0.297	C	L	G,T
FABACEAE *Diphysa robinioides* Benth.	51	0.103	V	L	G
CONVOLVULACEAE *Ipomoea suffulta* (Kunth) G. Don	51	0.277	S	T	G
Talea (n=29)					
CHENOPODIACEAE *Chenopodium ambrosioides* L.	89	0.572	C	L	T, C
AMARANTHACEAE *Amaranthus hybridus* L. & *A. spinosus* L.	78	0.295	V	L	T
FABACEAE *Diphysa robinioides*	70	0.092	V	L	G
ASTERACEAE *Galinsoga parviflora* Cav.	70	0.222	V	L	T
PORTULACACEAE *Portulaca oleracea* L.	59	0.123	V	L	T
Chipupuri (n=41)					
ASTERACEAE *Bidens pilosa* L.	93	0.488	V	L	T
PERIPLOCACEAE *Mondia whitei* (Hook.f.) Skeels	85	0.808	S	R	G, T
ASTERACEAE *Galinsoga parviflora* Cav.	71	0.299	V	L	T
LAMIACEAE *Vitex payos* (Lour.) Merr.	66	0.218	F	F	G, T
EUPHORBIACEAE *Uapaca kirkiana* Müll.Arg.	66	0.178	F	F	G, T
CAPPARACEAE *Cleome gynandra* L.	59	0.209	V	L	T
AMARANTHACEAE *Amaranthus spinosus* L. *Amaranthus thunbergii* Moq.	54	0.155	V	L	T
Maradzika (n=35)					
ASTERACEAE *Bidens pilosa* L.	91	0.480	V	L	T
ANNONACEAE *Annona senegalensis* Pers.	71	0.233	F	F	G, T
PERIPLOCACEAE *Mondia whitei* (Hook.f.) Skeels	69	0.540	S	R	G, T
LAMIACEAE *Vitex payos* (Lour.) Merr.	66	0.196	F	F	G, T
OLACCEAE *Ximenia caffra* Sond.	66	0.180	F	F	G, T
EUPHORBIACEAE *Bridelia micrantha* (Hochst.) Baill.	66	0.201	F	F	G, T
ASTERACEAE *Galinsoga parviflora* Cav.	60	0.187	V	L	T
AMARANTHACEAE *Amaranthus thunbergii* Moq. & *A. spinosus* L.	60	0.210	V	L	T
CAPPARACEAE *Cleome monophylla* L.	60	0.223	V	L	T

Freq = Frequency of mention; *Sal* = Salience score; *Part*: L = leaves, F = fruits, R = roots, T = tuber; *Man* =Management: G=gathered, T=tolerated, protected or encouraged, C=cultivated.

The plants that are known by most people are also those that are tolerated, protected or encouraged and some are agrestal and ruderal weeds (Table 7). These results corroborate McGregor's (1994) findings in Shurugwi, Zimbabwe, where there was an observed shift from foods gathered from woodlands towards weeds gathered from arable and disturbed spaces. This reiterates the importance of weedy vegetation in the local diets while on the other hand it indicates loss of knowledge of resources found in the natural vegetation.

Local perceptions on the use of edible wild plants

The participating families from both Mexico and Zimbabwe mostly coincided in the types of advantages they associate with the use of wild food plants. Most people were aware of their nutritional importance. This was reflected in the advantages mentioned for the use of wild vegetables and fruit. This was the reason children ate more wild fruit than adults in Zimbabwe. The presence of medicinal properties was a benefit also cited for some of the plants (*Chenopodium ambrosioides* L. in Mexico and *Lippia javanica* (Burm.f.) Spreng. in Zimbabwe). Economic benefits such as free or cheaper meals and the use of neither inputs nor much labour in the acquisition of these resources were recognised in both countries. Their availability when cultivated alternatives may not be available was also an advantage during the pre-harvest period in Zimbabwe and when the farmers were working far away from home in Mexico (Table 9).

The major drawbacks that were associated with the use of edible wild plants were that they tend to be only available seasonally, care has to be taken to avoid poisoning (especially if people lack sufficient knowledge) and that there may be dangers in consuming produce harvested from contaminated/unhygienic places. The quality of the plants could not be guaranteed.

Table 9. Advantages and disadvantages associated with the use of edible wild plants.

Advantages	Roatina	Talea	Chipupuri	Maradzika
No labour or other inputs are required to procure them	24[1]	17	39	57
They are free or meals are cheap	16	14	24	40
They have medicinal properties	x	14	22	31
Wild plants are nutritious	14	45	44	20
They are easy to prepare e.g. most vegetables can simply be boiled	-	7	-	17
Wild food plants add variety to the diet	-	-	-	14
They are available far from home and before harvest of the main crop	-	x	5	-
Wild plants rarely have pests and diseases	-	-	x	-
No chemicals are used on them and they are therefore natural	16	41	-	-
They taste good	8	7	-	-
Wild food plants can be sold	x	-	-	-
Disadvantages	**Roatina**	**Talea**	**Chipupuri**	**Maradzika**
Some vegetables taste bitter	x	-	-	29
Wild plants are seasonally available	30	14	7	20
Lack of knowledge of the plants or their preparation may cause poisoning	8	17	7	20
It is time-consuming to go all the way to the bush to find them	x	-	-	6
Good quality plants are not always guaranteed	x	-	15	x
They are sometimes unhygienic and there is risk of contamination if collected in polluted areas.	x	x	-	x
Increase in demand due to higher population reduces their availability	-	-	-	-
Useful weeds may become difficult to control	-	x	-	x
May cause stomach problems	-	x	x	-

[1]Numbers indicate the proportion (%) of people who mentioned each item; X = only mentioned by one person

The younger people in both countries preferred the cultivated alternatives to the wild foods and cited taste as the basis of their preferences. The wild plants, principally leafy vegetables, generally taste bitter as compared to the cultivated cabbages, kales and lettuce. On the other hand, adult women welcomed the occasional change from the normal diet that the wild plants provide.

Edible wild plants have important nutritional value. They contribute to the quality of the diet rather than the quantity. Wild fruits and vegetables for instance, have higher or equally high concentrations of vitamin C, carotenoids, calcium, folate and iron as cultivated alternatives (Santos-Oliveira and Fidalgo de Carvalho 1975; Packham 1993; Ogle 2001; Flyman and

Afolayan 2006a). The multiple roles of wild foods are also globally recognised. The dual function of foods is demonstrated in work by Etkin and Ross (1982) for the Hausa of Northern Nigeria, where 50% of the gastrointestinal treatments also form part of the diet. Other examples that mention the therapeutic functions of wild food plants include the work of Flyman and Afolayan, (2006b) for Botswana, Cruz-García in India (2006) and in the Mediterranean (Hadjichambis et al. 2008). It is important that people are aware of these nutritional and therapeutic attributes of wild food plants and may be an important determinant for the continued use of these resources.

Culture is dynamic and subject to change due to processes like modernization (availability of running water, electricity), better communications and information exchange. (Benz et al. 2000) These have an influence on the knowledge and use of wild plants and lead to the loss of traditional knowledge of these resources. In our study areas, exotic vegetables and fruit that are considered to taste better have substituted local wild ones. The availability of these alternatives has resulted in some loss of knowledge.

The availability of social services within the community and clustered settlements in Mexico means that many people, especially children and people who work in commerce or the construction industry (especially in Talea) do not need to work in the natural vegetation. This lack of contact with nature limits opportunities to learn about wild plants. In contrast the village settlements in Zimbabwe are more dispersed in space and the most community services are found some distance away from the homesteads. People therefore, must walk in the natural vegetation particularly when they use shortcuts to and from the grocery shops, from clinics, schools, and church.

In Zimbabwe, the people only mentioned the sale of *Uapaca kirkiana* (mazhanje) in November while the rest of the food plants were considered free and non commercial. On the other hand, there were some families in Mexico who saw wild food products as merchandise. In Talea for example, three families occasionally sold plants such as *Rorippa nasturtium-aquaticum* (berro), *Portulaca oleracea* L. (verdolaga), *Amaranthus* sp. (quintonil), quelite de la virgen, *Phytolacca icosandra* L. (cuan perla china) and *Talinum paniculatum* (Jacq.) Gaertn. (verdolaga ancha). The weekly market (*tianguis*) is important for the sale and purchase of gathered food plants as well as for bringing products form other regions. *Peperomia* sp. (oreja de leon) and *Salmea* *scandens* (L.) DC. (palo de chile), plants gathered from the costal regions of the Southern Sierra of Oaxaca, are purchased by the people of Roatina from the market in nearby Miahuatlán.

Plant management

In all study areas the wild food plants grow in the natural vegetation that forms part of the agroecosystems, along pathways, as weeds around homes, in crop fields and gardens and in Mexico, some are regularly bought from the market. These plants are managed to varying degrees that range from simple gathering, protection, encouragement and tolerance to cultivation, especially in Mexico. This interaction (unconscious or intentional) shows that domestication is an ongoing process. In Zimbabwe most wild plant foods are gathered directly from the wild while some are tolerated. The tolerance of preferred species applies even to large trees such as *Parinari curatellifolia* Benth. and *Uapaca kirkiana* Müll. Arg. that are left growing in crop fields. Edible plant species are also left as fences around homesteads and crop fields, just as in Mexico.

While the process of insipient domestication has been well documented in Mexico (Bye 1979; Casas et al. 1996; Casas et al. 1997a; Casas et al. 1997b), it deserves further attention Zimbabwe especially from an ethnobotanical viewpoint. Most research on plant management is limited to indigenous tree species where management practices such as pruning and planting of cuttings of species as live fences have been described (Clarke et al. 1996). Domestication of indigenous fruit tree species in Southern Africa was initiated in the latter part of the 1990's as part of an initiative to halt deforestation and enhance rural incomes by the International Centre for Research in Agroforestry (Mithöfer and Warbel 2003). Other research has been directed towards the cultivation of vegetables such as *Cleome gynandra* L. and *Corchorus tridens* L. and improve their nutritive quality and palatability (Machakaire et al., 1998). Clarke et al. (1996) attribute the lack of incipient domestication in Zimbabwe to substitution of species, by the consumption exotic alternatives which are easier to grow and taste better.

Farmers in Talea, Mexico and Maradzika, Zimbabwe sow a winter maize crop provided there is sufficient rainfall. This winter crop (*tonamilpa* in Talea) guarantees a continued supply of off-season leafy green vegetables that mostly add variety to the diet.In Zimbabwe the local people of Chipupuri and Maradzika generally gather directly from the wildand tolerate preferred wild plants in anthropogenic spaces. They preserve wild leafy vegetables for use offseason by drying. On the other hand, it is common for people in Roatina and Talea to collect seeds and seedlings to sow in plots near the home, in the patios or as pot plants. This cultivation of non-domesticates and the weekly markets also play a role in the continued supply offseason of local wild food plants and those of other regions.

Consumption of gathered wild plants

The early rainy season is very important for the consumption of leafy wild vegetables in both Mexico and Zimbabwe. Table 10 shows household wild plant consumption patterns collected from household food diaries. Maradzika village recorded the highest number of events and plant species used.

Table 10. Actual consumption of wild food pants in three months of the rainy season.

	Roatina	**Talea**	**Chipupuri**	**Maradzika**
No. of households	8	6	10	10
Total species consumed	20	23	22	38
Vegetables	10	14	10	17
Fruits	3	7	13	18
Condiments	5	2	-	-
Snacks	2	-	-	2
Source of starch	-	-	-	1
Beans/pulses	1	1	-	-
Total consumption events	95	81	111	212
Average per family ± se	11.9 ± 2.4	13.5 ± 1.5	11.1 ± 1.8	21.2 ± 4.4
Maximum household consumption /week	3	4	6	11
Average/family/week ± se	0.91 ± 1.15	1.04 ± 0.13	0.84 ± 1.15	1.62 ± 0.37

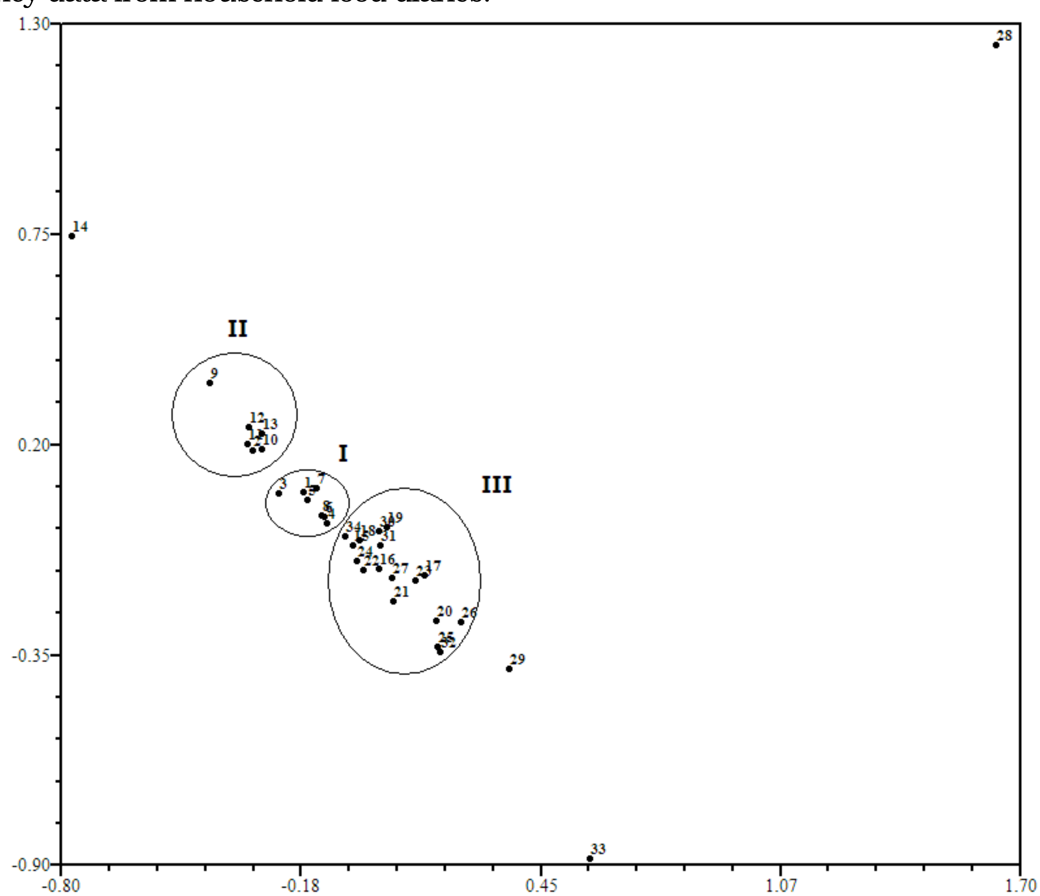
The average weekly consumption frequency was slightly higher in Maradzika than in the other three villages but there were no significant differences (P = 0.05) between the four villages. Even so, we observed differences within the families in Mexico. Many children in Roatina would not eat the wild vegetables and their mothers would have to prepare an alternative for the same meal. This discouraged them from preparing meals with wild vegetables. In Zimbabwe the differences between the families were based on the number of children in a family. The families with more children consumed more fruit than childless ones (Table 11).

Table 11. Consumption frequency of fruit in the Zimbabwean households

No of children	0	1	2	3	4	5
Mean	1	5	3.25	7	14.5	18
Maximum number of times	3	7	4	7	17	27

Principal component analysis of the frequency of consumption of plants during the study period separated household according to their location. The projection separated Roatina, Talea and the Zimbabwean villages into three: Groups I, II and III (Figure3). The Zimbabwean groups did not separate meaningfully, reflecting their shared food resources.

Figure 3. Dispersion of households in the first two components using species consumption frequency data from household food diaries.

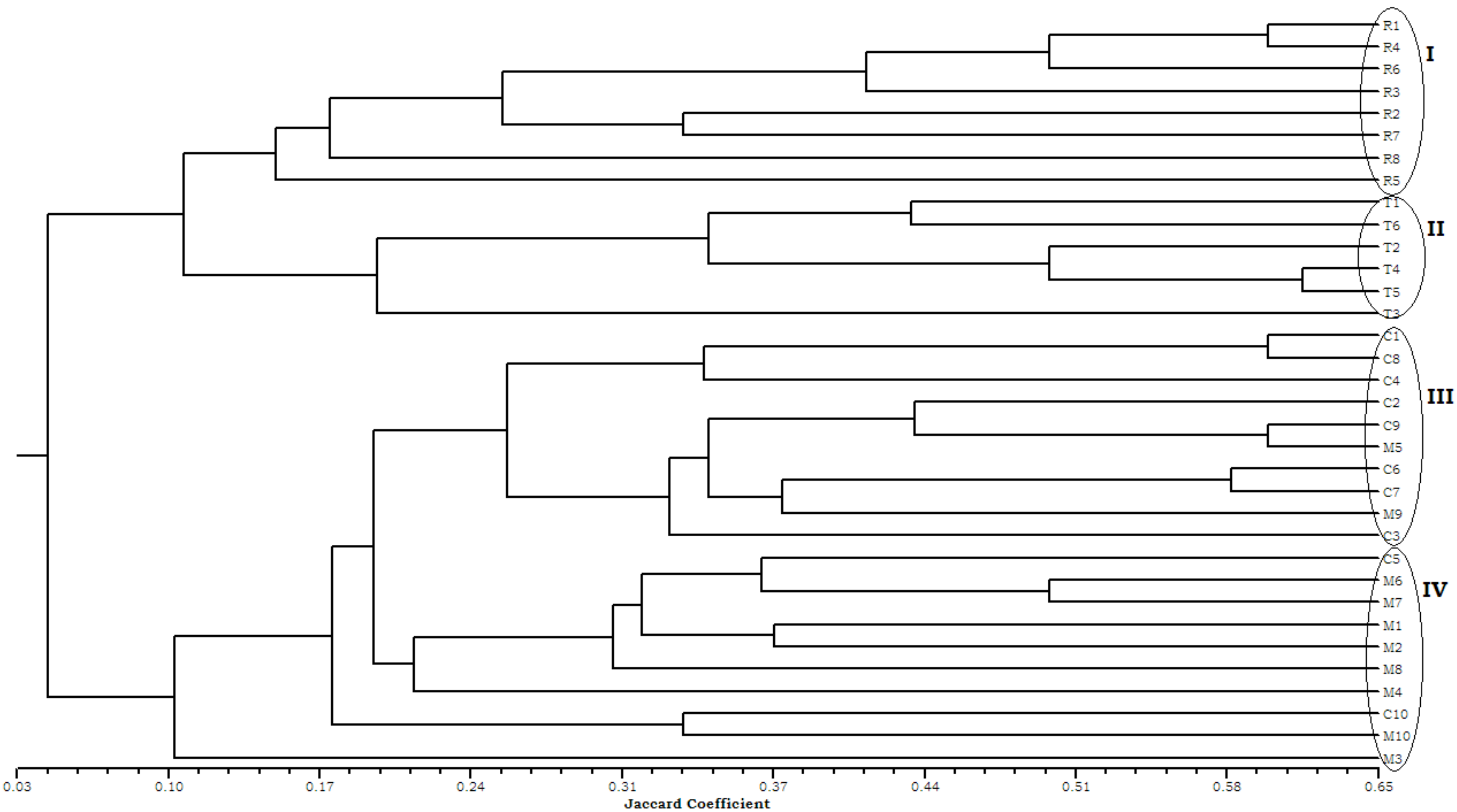


In a dendogram of similarity according to the Jaccard coefficient with incidence (presence/absence) data of species recorded in the food diaries, the communities were separated into four groups (Groups I-IV). The households from Roatina (Group I) and Talea

(Group II) clustered according to their community while most of the households from Chipupuri formed Group III and most from Maradzika formed Group IV. Two households from Chipupuri (C5 and C10) and Maradzika (M5 and M9) did not fall into their community's group.

The plants consumed and frequency depended on the plants that were available in the natural vegetation for all four communities and at the markets in Roatina and Talea. The presence of families from Maradzika in the Chipupuri cluster and vice versa (Figure4) is a reflection of a shared flora and proximity of the two communities.

Figure 4. Similarity of species consumed in four communities of Mexico and Zimbabwe



4.4. CONCLUSIONS

While environmental conditions influence the types (species) and abundance of plants available to a people, the differences encountered in this comparison of the ethnobotany of edible wild plants between Mexico and Zimbabwe, are essentially cultural. Local traditions in the designation of social activities by gender create inter and intra-cultural differences in knowledge; women know more about vegetables and condiments than the men because of their social function as care-givers. Culinary customs dictate the preferences of local people in the selection and use of food categories such as condiments and beverages.

But the results of our study also indicate global trends in the knowledge and consumption of wild food plants that are possibly more general. Species that provide vegetables and fruit are the most important and the most known components of edible wild plants flora in Mexico and Zimbabwe, showing the basic human need to satisfy nutritional requirements that these provide. A certain number (about a dozen) appears to be widespread average knowledge. The main crop (maize) permits a suitable multicrop system that reflects the changes in preferences towards weedy species that are found near domestic settlements. The coincidences in the advantages that local people, according to age and gender, perceive on the use of edible wild plants explain the continued use of edible wild plants despite the changing preferences towards cultivated and exotic alternatives. The disadvantages cited also give insight to the threats posed on the knowledge of plants and are useful in guiding policy such as the development of proposals to revive the use of some resources.

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DISCUSIÓN GENERAL Y CONCLUSIONES

1. DISCUSIÓN

El objetivo de ésta investigación fue comparar el conocimiento y el uso de plantas comestibles recolectadas entre México y Zimbabwe, en dos regiones con el mismo cultivo principal (el cual constituye la base la dieta), con poco contacto directo, e identificar patrones. Se detectaron varias similitudes y diferencias entre las comunidades bajo estudio que explican la influencia del ambiente, del cultivo principal y de la cultura, sobre el aprovechamiento de los recursos vegetales. Se anexa un resumen comparativo de los resultados principales del trabajo (vea Anexo).

Plantas comestibles recolectadas

Los informantes en cada uno de los cuatro pueblos estudiados mencionaron alrededor de 70 especies de plantas comestibles recolectadas en listados libres e entrevistas formales e informales. Considerando que México es un país mega diverso con más de 30 000 mil especies, y que Zimbabwe tiene alrededor de 6000 especies vegetales, se podría esperar una mayor riqueza de especies comestibles en las comunidades de México, pero no fue así. La similitud entre los pueblos en este aspecto, el número promedio de especies comestibles/m^2 en el cultivo de maíz (ver capítulo 3) y el promedio de plantas conocidos por individuo, sugieren que existen cantidades óptimos universales (para grupos pequeños) para satisfacer las necesidades de variedad de alimentos.

La selección de alimentos silvestres y su uso depende del ambiente en la que está inmersa la comunidad. El ambiente natural (el clima, la diversidad, etc.) determina la abundancia de los recursos disponibles. Por esta razón las familias botánicas con más especies útiles están parcialmente en función del tamaño de éstas familias en la región (Moerman 1996; Caballero y Cortés 2001) como lo confirman las familias Fabaceae y Cactaceae, en México y Asteraceae, Euphorbiaceae y Rubiaceae, en Zimbabwe. Estas familias botánicas se encuentran entre las más grandes (por número de especies) en ambos países. Se puede utilizar esta información en la planificación de programas de nutrición, en la conservación de recursos vegetales o en la búsqueda de nuevas fuentes de alimentos.

Pero, el número de especies útiles no predice la importancia cultural relativa de las familias. El conocimiento que una planta es comestible no necesariamente conduce a su consumo en la vida real (Rivera et al. 2007). Por lo tanto, es crítico el análisis mediante los índices de importancia cultural, como el Valor de Importancia Familiar (*Family Importance Value*). La selección de especies vegetales y su valor cultural están definidos por factores socioculturales que comprenden el sabor, la textura y factores simbólicos. Las dietas tradicionales están compuestas de elementos del ambiente local que se consideran culturalmente aceptables (Kuhnlien y Receveur 1996).

Las familias Asteraceae y Amaranthaceae son culturalmente salientes en México y Zimbabwe. La frecuencia y posición de mención de las especies de estas familias en listados libres muestran su importancia cultural; además llama la atención la coincidencia en el valor de ellas para las comunidades de México y Zimbabwe. Esto sugiere que algunas características como propiedades medicinales; sustancias químicas comunes (Moerman et al. 1999) y hojas grandes, las hacen más importantes que otras familias. Estas características pueden ser criterios en la selección de plantas comestibles que se comparten entre diferentes culturas. Además, muchas especies de estas familias son malezas que aprovechan lugares perturbados, por lo tanto son accesibles en lugares habitados por el ser humano. Se pueden tomar decisiones informadas sobre el manejo de recursos vegetales al conocer las especies y familias consideradas de gran valor, especialmente para la conservación y el mejoramiento de recursos genéticos.

El maíz es la base de la dieta en México y Zimbabwe y provee la mayoría de los carbohidratos. En ambos países el sistema de cultivo de maíz es tolerante a la presencia de arvenses útiles como forraje, medicinales y comestibles. Es notable el éxito de arvenses de origen americano en el cultivo de maíz tanto en México (80%) como en Zimbabwe (32%) lo cual sugiere que las plantas arvenses coevolucionan y migran con sus respectivos cultivos. Estos resultados contribuyen con información significativa para explicar el fenómeno de la migración e invasión de malezas. Otros estudios comparativos de este tipo con otros cultivos, por ejemplo, de origen africano, como el *Sorghum bicolor* (L.) Moench posiblemente confirmarían este planteamiento.

La presencia de especies de arvenses leñosas en las parcelas de maíz en las aldeas de Zimbabwe aumenta la riqueza de arvenses comestibles dentro del cultivo. En México, las plantas leñosas se encuentran en los bordes de la milpa. Futuros trabajos en este ámbito deben incluir los bordes en mediciones de la riqueza para determinar el total de especies vegetales asociadas al cultivo de maíz. La presencia de especies leñosas dentro de milpas ha sido documentada en otras partes de México (Chacon y Gliessman 1982).

El manejo incipiente de especies preferidas como el epazote (*Chenopodium ambrosioides* L. y el chepil (*Crotalaria* sp.), que se practica en Roatina y Talea, confirma la dinámica de la domesticación de especies útiles en México, como sucede con *Stenocereus stellatus* (Casas et al. 1998), por ejemplo. En Zimbabwe este fenómeno no se pudo documentar en este estudio, lo cual no significa que no exista. Hace falta hacer estudios para investigar la domesticación incipiente en Zimbabwe y documentar su dinámica.

El conocimiento etnobotánico de plantas comestibles recolectadas

El maíz puede ser el único punto de contacto (indirecto) entre los dos países. No existen evidencias de alguna trasmisión de información culinaria junto con él o las arvenses asociadas. Las formas de aprovechamiento son distintas y parecen ser descubrimientos independientes; señalan el papel importante que juega la cultura de cada comunidad. En Zimbabwe, la introducción de maíz no cambió la esencia de la preparación de alimentos, ya que se adaptó el maíz a las formas de preparación que ya existían para los granos como el mijo y el sorgo.

En ambas regiones persiste el conocimiento etnobotánico y el uso de plantas recolectadas comestibles que se transmite por tradición oral, aunque se documenta leve pérdida, especialmente entre las generaciones jóvenes en ambas países. Esto confirma una tendencia global debida a la introducción de cultivos que ofrecen alternativas a las plantas tradicionales y silvestres. Además, la cultura en transformación o en evolución influye en los conocimientos etnobotánicos. Algunas características de la modernización como provisión de servicios de comunicación (carreteras pavimentados, internet), comercio y educación básica y superior provoca que haya menos contacto directo con el medio ambiente y entre generaciones, y por lo tanto oportunidades para aprender de plantas comestibles silvestres. La educación formal y la integración al comercio nacional e internacional devalúa los conocimientos tradicionales y provee alternativas (McDade et al. 2007). El conocimiento normalmente se transmite mediante la instrucción. Por consiguiente, se recomienda la documentación de los conocimientos existentes y publicación en medios alcanzables para las comunidades, para atenuar la pérdida de información. Los jóvenes de ambos países citaron el sabor desagradable de algunas especies como causa que impide el aprovechamiento de éstas. Se recomienda la divulgación profusa recetas culinarias que podrían mejorar el sabor y aspecto detales alimentos.

A pesar de la preocupación de los jóvenes por aspectos como los riesgos de envenenamiento y del tiempo requerido para la recolecta de plantas comestibles, las opiniones de la gente en ambos países mostraron conocimientos conscientes de los beneficios que proporcionan estas plantas. Se considera que este aspecto motiva la persistencia del uso de plantas recolectadas en México y Zimbabwe. Muchos programas enfocados al rescate del manejo y consumo etnobotánico podrían basarse en las ventajas y desventajas percibidas por los lugareños.

Los conocimientos dependen del espacio de interacciones diarias, pero también de la fuerza del papel tradicional que juegan los géneros. Aunque no hubo diferencias significativas entre los hombres y las mujeres en el número promedio de plantas conocidas por persona, se observaron diferencias en los tipos de plantas conocidos por género. Las diferencias indican una especialización que depende de las labores que desempeña cada género. Los hombres y las mujeres hacen diferentes aportaciones al conocimiento basadas en sus experiencias y conocimientos (Douma et al. 1994). Las mujeres de ambas países destacaron como reservorios de información etnobotánica de plantas utilizadas como verduras y condimentos debido al papel tradicional como cuidadoras y cocineras de la familia. Se recomienda la perspectiva de género al solicitar y documentar información etnobotánica. La información diferenciada por género es realmente importante para administrar programas de desarrollo que se benefician del entendimiento de la realidad del manejo de diferentes recursos y que actualizados pueden ser dirigidas hacia las necesidades de cada grupo de personas.

Limitaciones y perspectivas para investigación posterior

Este trabajo se hizo en dos comunidades de un estado (México) y provincia (Zimbabwe); las posibilidades para una extrapolación son obviamente limitadas. Pero, la intención fue encontrar y sugerir explicaciones para generalidades sobre el conocimiento etnobotánico, los cuales se pueden comprobar con estudios en otras regiones. El trabajo sirve como base de referencia para estudios posteriores especialmente por la falta de estudios comparativos de regiones sin contacto directo y de planta comestibles. Los trabajos comparativos de este tipo publicadas en la literatura científica han sido enfocados sobre plantas medicinales.

Una de las limitaciones de esta investigación fue el tiempo dedicado a recolectar información. Los datos recopilados corresponden a la época de lluvias (verano) en cada país. Aunque la temporada de lluvias asegura la mayor disponibilidad y consumo de plantas recolectadas, no representa todo el año y no se pudo incluir plantas usadas en otras épocas. Esto se podría ver reflejado en los listados libres, debido a que las especies mencionadas fueron las que se encontraban en el periodo de estudio. Los listados libres tienen la desventaja de que la gente nombra más plantas de las que pueden reconocer en la naturaleza (Bernard 1994).

Este trabajo también examinó las diferencias de conocimiento en cuanto a edad y genero. Otros aspectos como estatus económico y nivel de educación se pueden incluir para elaborar y entender más la dinámica de la transmisión de conocimientos y su pérdida en sociedades en evolución cultural.

2. CONCLUSIONES

El conocimiento etnobotánico de plantas comestibles silvestres aún persiste en las comunidades de ambos países aunque se documenta leve pérdida ya que las generaciones jóvenes muestran un menor conocimiento.

La similitud en cuanto a la riqueza de plantas comestibles documentada para cada comunidad, el promedio de plantas conocidas por persona y las percepciones de los campesinos sobre el uso de ellas indican generalidades globales en conocimientos etnobotánicos.

Las diferencias en la composición de especies, géneros y familias botánicas así como las partes que se consumen dependen de los recursos disponibles en el medio ambiente. En las comunidades con climas más húmedos hay más aprovechamiento directo de hierbas silvestres, mayor conocimiento y más arvenses de maíz que en los ambientes más áridos.

En cuanto a las categorías de uso, los condimentos especialmente, reflejan las diferencias en la cultura culinaria.

Se acepta la hipótesis de la mayor riqueza y diversidad de especies de arvenses de maíz en México que en Zimbabwe, y se apoya la hipótesis que los arvenses migran con el cultivo con el cual coevolucionaron.

No se documentaron diferencias significativas en cuanto al número de plantas conocidas por persona entre los géneros. Sin embargo, se observó la especialización en plantas debido al papel que juegan los integrantes masculinos y femeninos de cada lugar y el espacio en el que laboran. Las mujeres conocen más de las plantas (verduras, condimentos, bebidas) que ocupan en la elaboración de los alimentos para la familia, mientras que los hombres conocen más sobre frutos y golosinas/botanas que consumen durantelas actividades fuera de casa. Se confirma la distribución diferencial del conocimiento por género y la importancia de llevar a cabo investigaciones con la perspectiva de género.

El conocimiento de plantas comestibles recolectadas es positivamente correlacionado a la edad de la persona. Los integrantes mayores de la comunidad conocen más que los jóvenes y se considera esto como indicador de la pérdida de conocimientos etnobotánicos en lasáreas de estudio. La pérdida de conocimientos se debe a la participación de los jóvenes y niños en actividades (por ejemplo la escuela) ajenos a los espacios donde se podrían adquirir conocimientos etnobotánicos, así como la preferencia de alternativas cultivadas. Los estudios etnobotánicos como el presente sirven para documentar los conocimientos para darles uso posterior en programas para la promoción del uso o la conservación de recursos vegetales,es decir, la transmisión de conocimiento más formal y afuera del ámbito familiar.

Se rechaza la hipótesis sobre mayor riqueza de especies de arvenses comestibles en México porque en Zimbabwe, ya que se encontraron números similares en ambas regiones. De hecho, en Zimbabwe se encontró una proporción mayor de plantas comestibles en los cultivos, debido a se dejan árboles frutales dentro de las parcelas y porque se incluyeron especies como *Commelina* sp. (goche) que se consumen solamente en tiempos de gran escasez.

Los resultados de esta investigación reiteran la importancia de estudios comparativos en la búsqueda de generalizaciones sobre la interacción del ser humano consus recursos vegetales.

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Anexo. Resumen comparativo de resultados de la investigación

	Roatina, México	**Talea, México**	**Chipupuri, Zimbabwe**	**Maradzika, Zimbabwe**
Plantas recolectadas comestibles **Especies**	67	70	71	72
Géneros	50	56	49	45
Familias	23	33	36	30
Familias importantes (no. de especies)	Asteraceae, Solanaceae, Cactaceae, Fabaceae	Fabaceae, Asteraceae, Brassicaceae, Solanaceae	Euphorbiaceae, Rubiaceae, Amaranthaceae, Asteraceae	Solanaceae, Rubiaceae, Euphorbiaceae, Tiliaceae, Amaranthaceae, Anacardiaceae, Asteraceae
Familias importantes (Valor de importancia cultural)	Asteraceae y Amaranthaceae			
Partes usadas	Hoja, frutos, partes subterráneas, semillas y otros (tallos, etc.)			
	También consumen flores.		No consumen flores.	
Preparación	Las plantas recolectadas se consumen en forma de verduras, fruta, condimentos, bebidas y botanas (golosinas) en ambos países.			
	Los frijoles silvestres son una categoría que no se encuentra en Zimbabwe.		Las categorías exclusivas a las comunidades de Zimbabwe son fuentes de carbohidratos y oleaginosas.	
Arvenses de maíz	47	56	42	50
Arvenses comestibles	13%	14%	21%	22%
Aseguramiento de disponibilidad	• La compra de productos en mercados y tianguis fuera de temporada; • El manejo incipiente de especies preferidas por ejemplo la siembra y la tolerancia de algunas especies (en los patios y en la milpa); • La siembra de tonamilpa (milpa de invierno) dependiendo de la disponibilidad de agua en Talea.		• La tolerancia de especies preferidas en parcelas de cultivos y jardines; • El secado de verduras para uso fuera de la temporada de lluvias; • El cultivo de maíz de invierno o de riego (en jardines) que provee plantas arvenses fuera de la temporada de lluvias.	
Conocimiento etnobotánico **Plantas/persona (promedio)**	11.6	12.9	11.9	13.4
Adquisición	• Se adquieren conocimientos etnobotánicos a temprana edad (5-12 años) en ambas países. Amigos y la familia política también juegan un papel importante, especialmente para adolescentes, adultos y mujeres recién casados respectivamente. • La información es trasmitida principalmente por tradición oral durante actividades en el campo o de la casa.			

<table>
<tr><th></th><th>Roatina, México</th><th>Talea, México</th><th>Chipupuri, Zimbabwe</th><th>Maradzika, Zimbabwe</th></tr>
<tr><td>Por edades</td><td colspan="4">Los miembros más grandes de la comunidad conocen significativamente más que los más jóvenes (Coeficiente de correlación de Spearman $p < 0.05$).</td></tr>
<tr><td>Por género</td><td colspan="4">Las mujeres conocen más de plantas que necesitan para hacer la comida para toda la familia (verdura, condimentos) aunque las diferencias entre géneros no son significativas ($p > 0.05$ de acuerdo a la prueba de Kruskal-Wallis).</td></tr>
<tr><td>Percepciones de la gente</td><td colspan="4">La gente conoce el valor nutricional y medicinal de las plantas comestibles silvestres.
Las personas mayores, especialmente las mujeres, les gustan las posibilidades de variar la dieta que ofrecen las plantas silvestres.
Los jóvenes prefieren alternativas cultivadas por su mejor sabor y por menores riesgos de envenenarse por falta de conocimientos.
Muchos valoran que las plantas recolectadas no requieren de trabajo laboral ni de insumos directos como fertilizantes, lo cual las hace una alternativa más accesible y barata.</td></tr>
</table>