Anales Inst. Biol Univ. Nac. Autón. México, Ser. Bot. 69(1): 37-69. 1998

URBAN WEEDS OF MEXICO CITY. FLORISTIC COMPOSITION AND IMPORTANT FAMILIES

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RESUMEN

Se documentó la vegetación ruderal urbana de la ciudad de México con 311 relevés según Braun-Blanquet, ubicados en una manera sistemática. Se encontraron 256 especies; un número bajo, comparado con ciudades europeas y considerando la alta diversidad de la vegetación natural de los alrededores. La lista incluye 26 nuevos registros para el valle de México. El alto número en nuevos registros posiblemente se puede explicar por un cambio cualitativo del clima urbano, sobre todo la ausencia de heladas. La composición florística se analiza a nivel de familia y se compara con la vegetación de cultivos de maíz en la región de Puebla y Tlaxcala. En ambos tipos de vegetación destaca Asteraceae. Poaceae, Brassicaceae y Chenopodiaceae son más importantes en la vegetación ruderal que en la arvense, mientras que Fabaceae contribuye relativamente poco a la vegetación urbana, en contraste con la arvense. Aparentemente, las familias con muchas especies polinizadas por insectos están en desventaja en la ciudad, mientras que las anemófilas o autógamas son más frecuentes y dominantes. Las datos de frecuencia muestran que las cuatro familias más importantes representan dos terceras partes de los registros individuales en el ambiente urbano, mientras que en las milpas sólo representan la mitad.

Palabras clave: vegetación urbana, vegetación ruderal, plantas invasoras, ciudad de México, inmigración, cambio climático, Asteraceae, Poaceae, Brassicaceae, Chenopodiaceae, Fabaceae

ABSTRACT

The urban ruderal vegetation of Mexico City was documented with 311 Braun-Blanquet relevés placed systematically. A total of 256 species was found, a low

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number when compared with European cities and considering the high diversity of the surrounding natural vegetation. The list includes 26 new records for the valley of Mexico. The high number of new records may be partly explained by a qualitative climatic change in the urbanized area, notably the absence of frosts. The botanical composition is analyzed at family level and compared to maize field weed communities in the high basin of Puebla and Tlaxcala, a near-by maize-growing region. Asteraceae are most important in both types of weedy habitats; Poaceae, Brassicaceae and Chenopodiaceae are more important in the ruderal vegetation than in the agrestal type, whereas the Fabaceae contribute relatively little to the urban vegetation. Apparently, the insect-pollinated families are at a disadvantage in the city, whereas the wind-pollinated and autogamous species are more frequent and dominant. Frequency data show that the four most important families account for two thirds of all individual occurrences in the urban environment and in maizefields only for one half.

Key words: urban vegetation, ruderal vegetation, Mexico City, invasive plants, plant immigration, climatic change, Asteraceae, Poaceae, Fabaceae, Brassicaceae, Chenopodiaceae.

INTRODUCTION

Urban vegetation has become a significant subject of scientific research only in the last 25 to 30 years. In the nineteenth and early twentieth century there was some interest in immigrant plants, which tend to congregate in urban environments (see historical references in Wittig, 1991 and Brandes, 1989). Since the 1970s there has been an upsurge of interest in Europe (Wittig, 1991; Gilbert, 1991; Sukopp and Wittig, 1993), Japan (Numata, 1982), the United States (Rowntree, 1984; 1986; 1988) and some other regions (Gutte, 1978; Mielcarek, 1983; Corlett, 1992). But, as Wittig and Sukopp (1993) point out, "urban ecology" initiated from quite different starting-points in these regions. In continental Europe, the initial interest lay in flora and vegetation, and then went on to include urban zoology, climatology, edaphology and social sciences. In the United States the social sciences, particularly sociology, started viewing the city as a special type of environment, and slowly included other social and natural sciences. In the United States there has been particular interest in the role of the "urban forest", but less interest in floristics, weed communities and phytogeography.

Mexico City is an especially interesting site to study urban botany. Parts of the high valley have been settled and disturbed by humans on a considerable scale for at least 3000 years, and there has been an intensive commercial interchange with other parts of the Americas since prehispanic times, with Europe for 500 years and with the United States for about 200 years. The urban area of the metropolis covers approximately 1200 km2 (Graizbord and Salazar-Sánchez, 1987) and is home to about 20 million inhabitants. It is situated in the upland marginal tropics, an important human habitat type.

In Mexico, a number of unpublished bachelors' theses and a few publications have dealt with aspects of urban botany (Rapoport and López-Moreno, 1987; López-Moreno, 1991, 1993; Martínez and Chacalo, 1994). In the most important of these (Rapoport, Díaz-Betancourt and López-Moreno, 1983), 100 plots of 1 ha were surveyed for spontaneous and cultivated plants, giving a species list of 417 spontaneous species and 147 cultivated species, distribution maps and a phytogeographical analysis. Additional information on urban plants can be found in the *Flora Fanerogámica del Valle de México* (Rzedowski and Rzedowski, 1979, 1985, 1990), which is also the most important tool for identifying species and new immigrants. Further information on the weeds of the region, mainly of cultivated fields, can be obtained from Villegas (1970, 1979) and Espinosa and Sarukhán (1997).

The purpose of the present project is to identify the species of the spontaneous inner-urban vegetation of Mexico City, to determine how important the contribution of each species is to the urban vegetation, where, when and under which circumstances it grows, and what its geographical origin is. It complements the work of Rapoport *et al.* (1983), as it concentrates on inner-city vegetation (those authors included the suburbs), uses the relevé method, distinguishes vegetation types and introduces a semiquantitative element through visual cover estimates for each species in every relevé. Also, Rapoport *et al.* did their fieldwork 15 years ago, and did not yet have Rzedowski and Rzedowski's *Flora fanerogámica del Valle de México* at their disposal.

This is the first of a series of communications of results of the study. The species list itself contains standardized information on the distribution and putative origin of the plants, which will serve as a reference for the phytogeographical analysis, currently under preparation.

THE STUDY AREA

The study area, covering approximately 315 km^2, consists of the central part of the Mexico City metropolis (19° 19'-19° 31' N and 99° 03'-99° 12' W). All sample plots lie within the Federal District, though the State of Mexico line is near some of the northern and eastern study sites.

Most of the study sites lie on the flat floor of the valley, the former lake bottom, between 2230 and 2250 m above sea level. The western and southern quadrats contain some hilly terrain. The highest point reached by study sites is 2300 m (cerro de la Estrella).

Most soils are originally alluvial and derive from volcanic material, mainly andesites and basalts. These types of soils tend to have fine grain sizes. However, soil analysis for this project showed few outright clay soils (at four of 192 analyzed sites) under the urban vegetation, and those are distributed over the whole study area. There are also a few (n=6) sandy places, and those are not clustered either. Most Mexico City soils have a medium to slightly heavy texture, probably reflecting the efforts of gardeners, largescale soil removals, exchanges and mixtures, as well as the widespread practice of dumping construction and other debris anywhere where protest is not likely.

The soil pH-values measured in the study plots are somewhat more differentiated than the textures. All pH-values under six are in the western half of the study area; those over eight are concentrated in the eastern half. But the majority of sites in the study area have pH-values near neutral, the average being 7.2.

The climate is semihumid and temperate, typical of the marginal highland tropics (Lauer, 1973; Jáuregui, 1988). There is a rainy season dominated by trade winds from May to October, and winter is the dry season. In winter, cold northern airmasses may intrude suddenly into the central highlands. The daily temperature oscillates with an amplitude of 15 to 18° C, whereas monthly averages differ little between the coldest (January, monthly average 11-13° C) and warmest (April, 15-17°) months (Jáuregui, 1973, 1987).

Precipitation generally falls as torrential rains in the afternoons of the rainy season. The average amount varies from 400 mm/a at the eastern limit of the study area, to 800 mm/a in the western part (Jáuregui, 1987). The total rainfall may differ strongly from year to year (2.6 times more in wet years than in dry years, Jáuregui, 1973). Evaporation is high because of relatively high insolation and low air humidity. Hail is common during the rainy season and may cause serious damage to plants.

METHODS

To provide an overview of the vegetation in Mexico City, a combination of systematic study site selection and the Braun-Blanquet relevé method was used. The basis for study site selection was the central map of the Guía Roji (1990), the most exact city map. The edition consists of five maps, one for the Northwest, one for the Northeast etc., and one for the center. This central map is divided into 12 large, numbered quadrats with a side length of approximately 5.4 km, each of which is subdivided into 6 x 6 small quadrats (side length about 0.9 km). In each large quadrat, the subquadrats once removed from the extreme NW and SE corners were selected, a diagonal was drawn on the map, and a path charted along the streets in such a way that it kept as close as possible to the diagonal. These paths were approximately 1.7 km long each. Figure 1 shows the study area and illustrates the study site selection.

All sites fulfilling minimum requirements (see below) along these previously determined paths were sampled with a Braun-Blanquet relevé (Dierssen, 1990; Westhoff and van der Maarel, 1978). Sites directly along the paths and up to 10 m

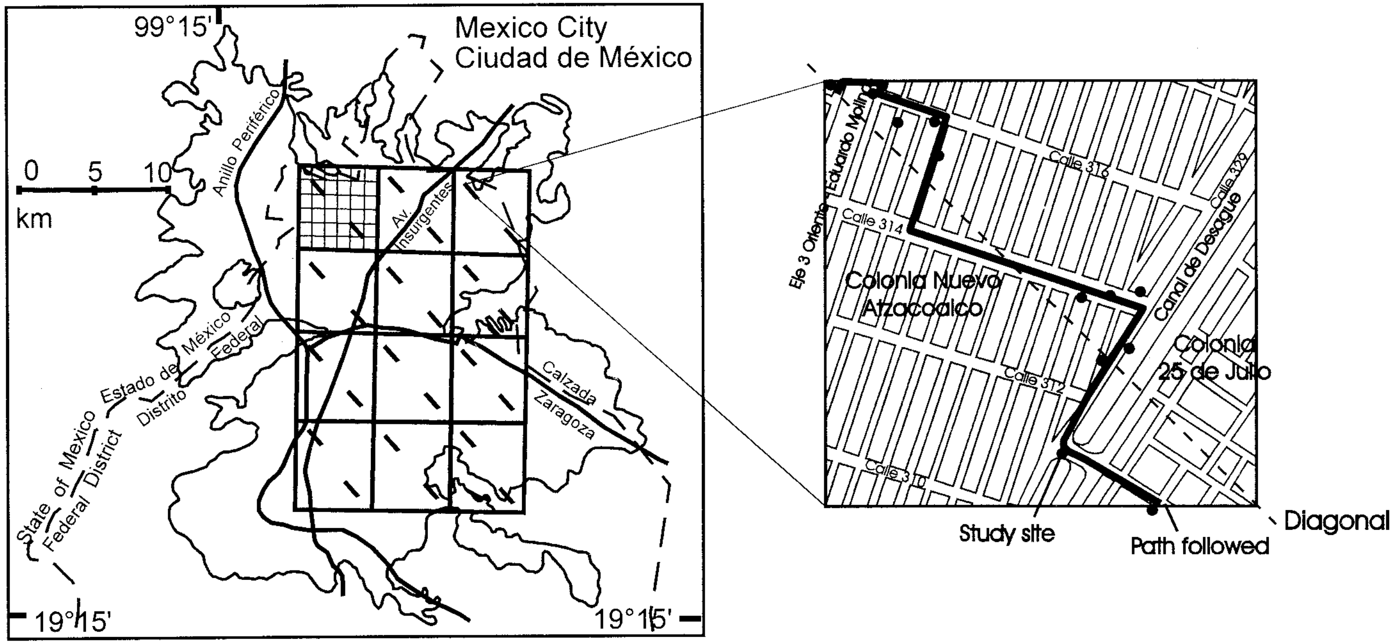

Fig. 1. Study area and location of transect paths. The map shows the outline of the urban area, a few main thoroughfares, the border between the Federal District and the State of Mexico and the outline of the study area (large rectangle). The study area is divided in 12 large square subdivisions; each large one is subdivided in 6 x 6 small squares. The diagonal lines within the squares give the approximate location of the transects; B2 (see Appendix1, Quadrat number) is the upper left-hand corner transect and E5 the lower right-hand corner one. The part on the right of the illustration shows a map of the quadrat 51/B2 (Nuevo Atzacoalco), the pathway charted as close as possible to the diagonal and the study sites of that quadrat.

into the side streets were considered. If the paths ran across larger and varied areas, such as parks and university campuses, every visually distinguishable vegetation type along the diagonal was documented. The number of sites was unequal for the quadrats and varied from seven to 17; the total number of relevés was 311. All relevé sites were first visited in the second half of the rainy season of 1993 (August to November) and again in the dry season of 1994 (January to March). Each relevé included, among other data not relevant to the presentation of a species list, a description of the locality and a complete list of species found.

The minimum requirements for considering a site were the following:

- the vegetated surface had to have an area of at least 1.5 m^2. In the case of tree rings, there had to be at least five rings with spontaneous plants along a 200 m line, either on one side of the street or in two parts on both sides. Crevice vegetation had to have 5 m of plant growth along a 20 m line (which may be divided among street corners of one crossing, for example).
- there had to be at least two species present (this only excluded a few lawns)
- the site had to be accessible. This excluded most private gardens; the time required to obtain permissions made sampling them impossible.

Approximately 500 numbers of voucher specimens were collected for this project. A complete set is at the National Herbarium (MEXU); sets go to the herbarium of the Colegio de Postgraduados and other national and international herbaria. Most of the common ruderal weed species were familiar to the author at the beginning of the study. Those that were doubtful or unknown were identified with the *Flora fanerogámica del Valle de México* (Rzedowski and Rzedowski, 1979, 1985, 1990) and compared with the collections at the National Herbarium (MEXU). If the species was not found in that Flora, other floras were used, particularly the *Flora Novo-Galiciana* (McVaugh, 1983-1992), the *Flora of Guatemala* (Standley and Steyermark, 1952-1974), the Flora Europaea (Tutin *et al.*, 1964-1980), the *Illustrierte Flora von Mitteleuropa* (Hegi 1975-1986), the weed floras of the United States (Agriculture Research Service, 1971) and Argentina (Marzocca, 1976). Some species were determined by specialists (*Cucumis melo* - Rafael Lira, *Guizotia abyssinica* - José-Luis Villaseñor, *Solanum pseudocapsicum* - Sandra Knapp, *Digitaria wallichiana* - Hildemar Scholz). Doubts on the identity of some of the new records not available at MEXU were cleared by visits to the Berlin and Gray (Harvard) Herbaria.

One dilemma in this study was the classification of the most dominant plant, the kikuyu grass (*Pennisetum clandestinum*) as spontaneous or cultivated. Swads of turf of this grass are widely used to establish lawns; on the other hand, if one purchases seeds (English rye grass, *Lolium multiflorum*, is sold in garden stores and supermarkets) and tries to establish a different species, it is overgrown by *Pennisetum*, often within months. I did not see one single lawn, public or private, that was dominated by another species, even though *Poa annua*, *Cynodon dactylon*, *Eleusine multiflora* and *Lolium multiflorum* will grow with *Pennisetum*. Obviously, the results of aggressive invasion and deliberate planting look quite the same. Because of its aggressiveness, the species is treated as spontaneous in this study.

Description of the quadrats

The description of the quadrats is divided into two parts (Appendices 1 and 2). The first part lists the quadrat number, quadrat name, relevé field numbers, number of relevés, types of relevés, dates of field work (rainy season date in fall of 1993/ dry season date in winter of 1994). The second part gives a description of the pathways followed within each quadrat, including an estimate of the socio-economic level of the neighborhoods crossed. This estimate is my own, as official data are available only for larger areas. Most study sites are classified either as lower-middle-class or middle class. The western slope of the valley, where most of the upper-class suburbs are located (Lomas, Pálmas, San Ángel), was not included in the study area. Lower income families generally either live in tenements in some central parts of the city, or in the northern, eastern or southern periphery, not included in this study. I classified areas where most people own their houses and take care of them and their streets as lower middle class, even if the houses are not large, the income variable and living conditions somewhat cramped.

RESULTS AND DISCUSSION

Floristic composition. In the course of this study 42 families, 165 genera and 256 species of higher plants were found (Appendix 3). The table includes frequency, that is the number of relevés in which the species was present, the life form of the species and a standardized phytogeographical information. In the case of American species their present distribution on the continent is given; in the case of naturalized plants from the Old World, the probable area of origin. No spontaneous ferns or wild-growing gymnosperms were encountered.

Of the 256 species found, 10% (26) are new records for the valley of Mexico and five species are apparently new for the country as a whole (*Amaranthus muricatus, Bellis perennis, Chenopodium giganteum, Digitaria wallichiana, Guizotia abyssinica*).

Species richness. In contrast to the 256 species reported here, Rapoport *et al.* (1983) registered 417 wild-growing species, but based upon a much larger area which also included suburbs (988 km^2). These numbers may seem high at first sight, but they are not when compared with absolute and relative species numbers of better-studied cities in Europe. Most intensive surveys in European cities show much higher absolute species numbers (Klotz, 1989). In Berlin, 380 species of spontaneous ferns and spermatophytes were found in areas with dense construction, and 1396 species in the whole metropolitan area (481 km^2). The metropolitan area of Rome, with a surface area similar to that of this study (300 km^2, but only about one fourth as many inhabitants) contained 902 wildgrowing species (Celesti *et al.*, 1989). Indeed, a close relationship has been found between number of inhabitants and species number (almost linear in a double-logarithmic graph) (Brandes, 1989) and "city areas of more than 100 km^2 can be expected to contain 900 species or more; these species numbers are reached in cities from 200 000 inhabitants onwards" (Klotz, 1989; translation by author).

In Europe, urban areas tend to contain more spontaneous species than surrounding rural or natural areas (Brandes, 1989; Gilbert, 1991, Wittig, 1991, 1993). This is usually explained by a stronger environmental variability within cities than outside of them.

The phenomenon cannot be confirmed for Mexico City, where the inner-urban vegetation is quite impoverished when compared to its surroundings. For example, the Pedregal de San Ángel, a recent lava flow in the south of the valley (today surrounded by the city) was found to contain 538 species on 80 km^2 in the early 1950´s (Rzedowski, 1954). Recently it still supported 301 species on only 124.5 ha (Valiente and de Luna, 1990). In the region of Huehuetoca in the north of the valley of Mexico, 579 species of vascular plantas were found on 98 km^2 (Romero and Rojas, 1991). 2071 species are known from the whole high basin of Mexico (on 7500 km^2; Rzedowski and Rzedowski, 1989). An intensive survey of 9 km^2 of an agricultural village with mainly anthropogenic vegetation in the state of Tlaxcala, also in the central highlands of Mexico, yielded 396 species of vascular plants (Vibrans, 1997).

There are several possible explanations for this poverty in species:

- The explosive growth of the urban area did not allow sufficient time for migration of adapted plants. This is supported by the large number of new records (see below).
- The density of buildings is much higher in Mexico City than even central areas of European cities; the historical patrician gardens and private and public parks with unatended corners, which are very species-rich in Europe, are almost completely absent in Mexico city; those gardens that exist (for example in Coyoacán) are intensively weeded. Historically, the living space in Mexico City has always been very limited (its predecessor, the Aztec Tenochtitlan, was founded on islands in a lake).
- Public and private gardeners alike prefer perennial ornamental plants, thus depriving native annual weeds of an appropriate habitat.
- An intolerant, exotic invader (*Pennisetum clandestinum*) tends to dominate all but the driest or most humid ruderal surfaces.

Some of these factors may act in other tropical cities, too. For example, Mielcarek (1983) found only 287 species in Havana, Cuba.

Newly recorded species. Table 1 resumes the new records for the valley of Mexico. Additional information is given on the probable immigration date (within the last 20 years, that is after the main phase of collecting for the Rzedowski and Rzedowski's *Flora fanerogámica del Valle de México*, or earlier, based on the presence or absence of herbarium specimens, the size and distribution of the populations today, the probability of being overlooked and interviews with local people), the immigration status (naturalized or casual, that is, apparently not yet well established), area of origin and type of climate in the area of its main distribution. References are cited for more extensive information on the species. Details on each new record have already been published (Vibrans 1995, 1996) or will be shortly.

The fact that 10% of the species registered in this list have not been encountered before this proyect is rather surprising, as the valley of Mexico is one of the best-known areas of the country. This may be due partly to the lack of attention given to weed vegetation by professional botanists. For example, the newly recorded and common *Polycarpon tetraphyllum,* a very inconspicuous, small plant, grows in crevices of the entrance to the office building of the Botanical Garden of the National University. *Bidens pilosa* was confused with *Bidens odorata* (and vice versa) for a long time (Vibrans, 1995); the same probably happened with *Parthenium hysterophorus,* whose presence is documented by herbarium specimens at MEXU for the beginning of the century; and *Parthenium bipinnatifidum.* But some species (*Kochia scoparia, Melampodium divaricatum, Chenopodium giganteum* and others) appear to be recent introductions, as they are too large and conspicuous to be overlooked for a longer period. One might argue that urban environments are always rich in casuals or ephemerophytes. But of the 26 newly registered species, at least 17 appear well established (see Table 1), and some are common (*Melampodium divaricatum, Amaranthus lividus, Bidens pilosa, Digitaria wallichiana*) and even abundant (*Kochia scoparia, Cynodon nlemfuensis*) in parts of the city. In contrast, no new immigrants were found among 317 maize field weeds in the high valley of Puebla and Tlaxcala on 8000 km^2 (Vibrans, 1998).

The new records can be divided into three groups (Table 1): 1) species that are common in the warm-tropical areas surrounding the valley of Mexico, for example *Calyptocarpus vialis, Digitaria ciliaris* and *Brachiaria plantaginea.* These are the majority: 13 of the 22 recent immigrants belong to this group; 2) tropical species that have their origin in faraway areas and that may be using Mexico City as a port of entry to the central Mexican tropics, for example *Digitaria wallichiana, Amaranthus viridis* or *Solanum pseudocapsicum,* the last two known from Chiapas. Five species are classified here; and 3) four species that are common in the southwestern United States and northern Mexico, that is, semiarid zones, and presumably arrived from there, for example, *Datura quercifolia* and *Kochia scoparia* (*Kochia* came from Eurasia originally, but is common in the American West).

The only new species from temperate regions, *Bellis perennis,* has probably been overlooked, as herbarium specimens and information gathered from municipal gardeners indicate that it has been present in Mexico City since the beginning of the century (Vibrans, 1996).

The data of a survey like that on which this study is based show a situation of a given moment; they generally do not permit definite conclusions on how it became the way it is. However, they can help to formulate hypotheses that can later be tested with different experimental and observational data. In the following an explanation is proposed for the large number of new records together with their ecological affinities, though direct proof is not possible at this point.

The relatively large number of new records —together with a lack of such in a

Table 1. Species newly recorded for the Valley of Mexico during the project

Specie	Probable immigration date*	Inmigration status	Origin	Climate of area of main distribution	Immigration group **	References
AMARANTHACEAE						
Amaranthus lividus	recent	naturalized	Mediterranean Europe	semiarid	1	Marzocca, 1976; Tutin *et al.*, 1964-1980
Amaranthus muricatus	recent	naturalized	South America	semiarid	2	Marzocca, 1976; Tutin *et al.*, 1964-1980
Amaranthus viridis	recent	naturalized	tropical America	semiarid	2	Marzocca, 1976
ASTERACEAE						
Bellis perennis	old	naturalized	Europe	temperate	-	Vibrans, 1996
Bidens pilosa	old	naturalized	tropical Mexico	tropical	1	Vibrans, 1995
Calyptocarpus vialis	recent	casual	tropical Mexico	tropical	1	Vibrans, 1996
Guizotia abyssinica	recent	casual	East Africa	semiarid	2	Vibrans, 1996
Melampodium divaricatum	recent	naturalized	tropical Mexico	tropical	1	Vibrans, 1996
Parthenium hysterophorus	old	naturalized	tropical Mexico	tropical	1	Vibrans, 1996
BRASSICACEAE						
Diplotaxis muralis	recent	naturalized	Mediterranean Europe	semiarid	3	Kearney and Peebles 1960; Rollins, 1981; Villarreal, 1983
Hirschfeldia incana	recent	casual	southeastern Europe	semiarid	3	Marzocca, 1976; Rolrins, 1981; Tutin *et al.*, 1964-1980
CARYOPHYLLACEAE						
Polycarpon tetraphyllum	old?	naturalized	Mediterranean Europe	semiarid	?	Tutin *et al.*, 1964-1980
CHENOPODIACEAE						
Chenopodium giganteum	recent	naturalized	India	semiarid	2	Tutin *et al.*, 1964-1980
Kochia scoparia	recent	naturalized	steppes of eastern Europe	semiarid	3	Anonymous 1971; Marzocca 1976; Tutin *et al.*, 1964-1980; Villareal 1983

*recent= after 1980; old: before 1980

**1: common in the warm-tropical areas surrounding the Valley of Mexico; 2: probable origin in more distant tropics; 3: probable origin in the southwestern United States and northern Mexico.

Table 1, continues

Specie	Probable immigration date	Inmigration status	Origin	Climate of area of main distribution	Immigration group	References
COMMELINACEAE						
Tinantia glabra	recent	casual	tropical Mexico	tropical	1	Standley and Steyermark, 1952-1974
CUCURBITACEAE						
Cucumis melo var. *chito*	recent	casual?	Africa	tropical	1	pers. comm., Rafael Lira
POACEAE						
Brachiaria plantaginea	recent	naturalized	tropical Mexico	tropical	1	Davidse, Sousa and Chater, 1994
Cynodon nlemfuensis	recent	naturalized	Africa	tropical	1	Davidse, Sousa and Chater, 1994
Digitaria ciliaris	recent	naturalized	Asia	tropical	1	Tutin *et al.* 1964-1980
Digitaria horizontalis	recent	casual	tropical America	tropical	1	Davidse, Sousa and Chater, 1994; Hitchcock, 1971
Digitaria wallichiana	recent	naturalized	southern Asia	tropical	2	Veldkamp, 1973
Leptochloa uninervia	recent	naturalized	America	tropical	1	Davidse, Sousa and Chater, 1994
Panicum sphaerocarpon	recent	casual	America	tropical	1	Davidse, Sousa and Chater, 1994; Hitchcock, 1971
SOLANACEAE						
Datura quercifolia	recent	casual?	northern Mexico	semiarid	3	Kearney and Peebles, 1960
Physalis nicandroides	recent	casual?	tropical Mexico	tropical	1	Standley and Steyermark, 1952-1974
Solanum pseudocapsicum	recent	naturalized	tropical Mesoamerica	tropical	1	Marzocca 1976; Tutin *et al.*, 1964-1980

weed survey in a different environment— suggests that the Mexico City urban environment may be unsaturated with plant species and that there is an immigration wave going on at present. This immigration wave could be related to the above-mentioned relative poverty in species, when compared with other cities, and an ongoing arrival of adapted species. However, there is a second factor that may be accelerating the successful establishment of new species.

Mexico City has, of course, an urban climate. It has a higher average temperature, especially at night, than a similar rural area, as all cities do. Nightly frosts would be common in the whole valley in winter nights, if it were not urbanized. However, today the center of Mexico City hardly ever experiencies below-zero temperatures (Jáuregui, 1973, 1987, 1988). The outlying areas of the study area still may have over 50 frost nights a year (Fig. 2). The figure shows that parts of the inner city started to be frost-free approximately from 1980 onwards —that is, after the conclusion of the previous floristic projects.

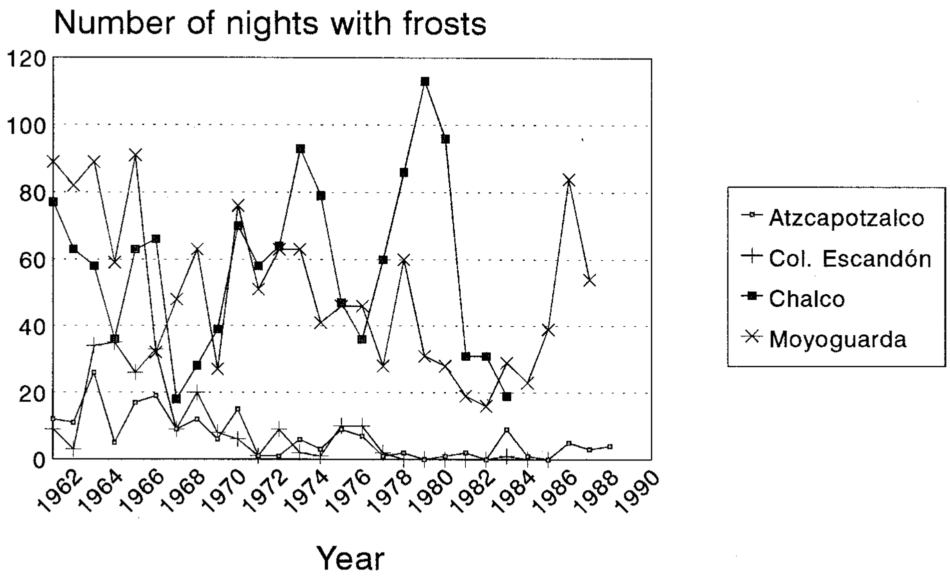

Fig. 2. Number of frost nights in the Mexico City metropolitan area from 1961 to 1988. Four stations are shown, two inner-city stations (Atzcapotzalco and Colonia Escandón), as well as two stations in the outskirts of the metropolitan area (Chalco and Moyoguarda). Data obtained from the National Meterorological Service; more recent data were unavailable.

Below-zero temperatures are of particular importance for the vegetation cover, as they are usually an impediment to the establishment of tropical taxa (Groups 1 and 2 above). I suggest that the immigration wave is related to a qualitative climate change with respect to minimum night temperatures. The absence or rarity of frosts in large parts of the metropolitan area has made the city warm-tropical for plants. This is supported by the fact that, among the cultivated plants, not only subtropical species such as figs and bougainvilleas thrive in the city, but also tropical species like bananas (*Musa* spp.) and guavas (*Psidium guajava* L.) are frequently cultivated.

Absences. There are some striking absences in the urban weed flora. It is not surprising that the species-rich families Orchidaceae, Liliaceae and Amaryllidaceae are not represented, for they contain few species with weedy tendencies. However, the absence of Verbenaceae, Rosaceae, Ranunculaceae and Juncaceae is unexpected, especially since they contain numerous agrestal and ruderal species of rural habitats. Also, one would expect the stray *Opuntia*. Some very common countryside ruderal taxa, such as *Heterotheca inuloides* Cass., *Cosmos bipinnatus* Cav., *Achillea millefolium* L., *Artemisia* spp., *Castilleja* spp., *Sabazia humilis* (H.B.K.) Cass. and *Muhlenbergia* spp. are also missing.

Genera. There are 20 genera represented by three or more species (*Amaranthus, Atriplex, Bidens, Chenopodium, Conyza, Cyperus, Eragrostis, Euphorbia, Gnaphalium, Lepidium, Malva, Melampodium, Oenothera, Physalis, Plantago, Polygonum, Setaria, Sisymbrium, Solanum* and *Trifolium*). All of them are taxa well-known to include weedy species (Holm *et al.*, 1977; Holzner and Numata, 1982; Hanf, 1984).

They represent a mixture of temperate (*Plantago, Polygonum, Oenothera*) and tropical (*Cyperus, Melampodium, Setaria*) affiliations, but the temperate genera are in the majority.

Families. The families found are listed in Table 2 below according to their species number. The important families, Asteraceae and Poaceae, are dominant in open and weedy habitats worldwide; Brassicaceae and Chenopodiaceae are known to be important weedy families of temperate cities (Klotz, 1989), whereas the families which contain many tropical weed species, such as Euphorbiaceae, are relegated to the following ranks. The relative unimportance of the Fabaceae is surprising, as they are generally in second or third place, both in tropical and temperate weed floras (United States: Muenscher, 1955; Europe: Holzner and Immonen, 1982; Southern Spain: Pujadas and Hernández, 1988; South Africa: Wells and Stirton, 1982; Peru: Müller and Müller, 1977).

Figure 3 shows the relative importance of the seven most important families, according to number of species and according to frequency in a pie graph. These data are compared with those obtained by this author with similar methods in a study of maize field vegetation in Puebla and Tlaxcala, Mexico (Vibrans, 1998).

It is obvious that the relative number of species is similar for the most important families, Asteraceae and Poaceae, in both vegetation types. However, if frequency is considered, the share of Poaceae grows in the ruderal vegetation and decreases in the maize fields.

Table 2. List of families according to importance

	# species	frequency
Asteraceae	56	1685
Poaceae	40	1246
Brassicaceae	21	684
Chenopodiaceae	14	346
Solanaceae	14	204
Malvaceae	12	147
Fabaceae	10	104
Euphorbiaceae	9	77
Caryophyllaceae	7	32
Onagraceae	7	60
Amaranthaceae	6	299
Lamiaceae	5	19
Polygonaceae	5	99
Apiaceae	4	7
Commelinaceae	3	17
Convolvulaceae	3	67
Cucurbitaceae	3	24
Cyperaceae	3	24
Plantaginaceae	3	36
Aizoaceae	2	6
Geraniaceae	2	3
Hydrophyllaceae	2	5
Loganiaceae	2	27
Oxalidaceae	2	140
Papaveraceae	2	16
Scrophulariaceae	2	5
Urticaceae	2	3
Acanthaceae	1	4
Anacardiaceae	1	6
Araliaceae	1	4
Boraginaceae	1	19
Cannabinaceae	1	1
Linaceae	1	8
Lobeliaceae	1	1
Loranthaceae	1	-
Nyctaginaceae	1	14
Phytolaccaceae	1	8
Portulacaceae	1	57
Primulaceae	1	2
Resedaceae	1	24
Rubiaceae	1	1
Tropaeolaceae	1	1
43 families	256	5532

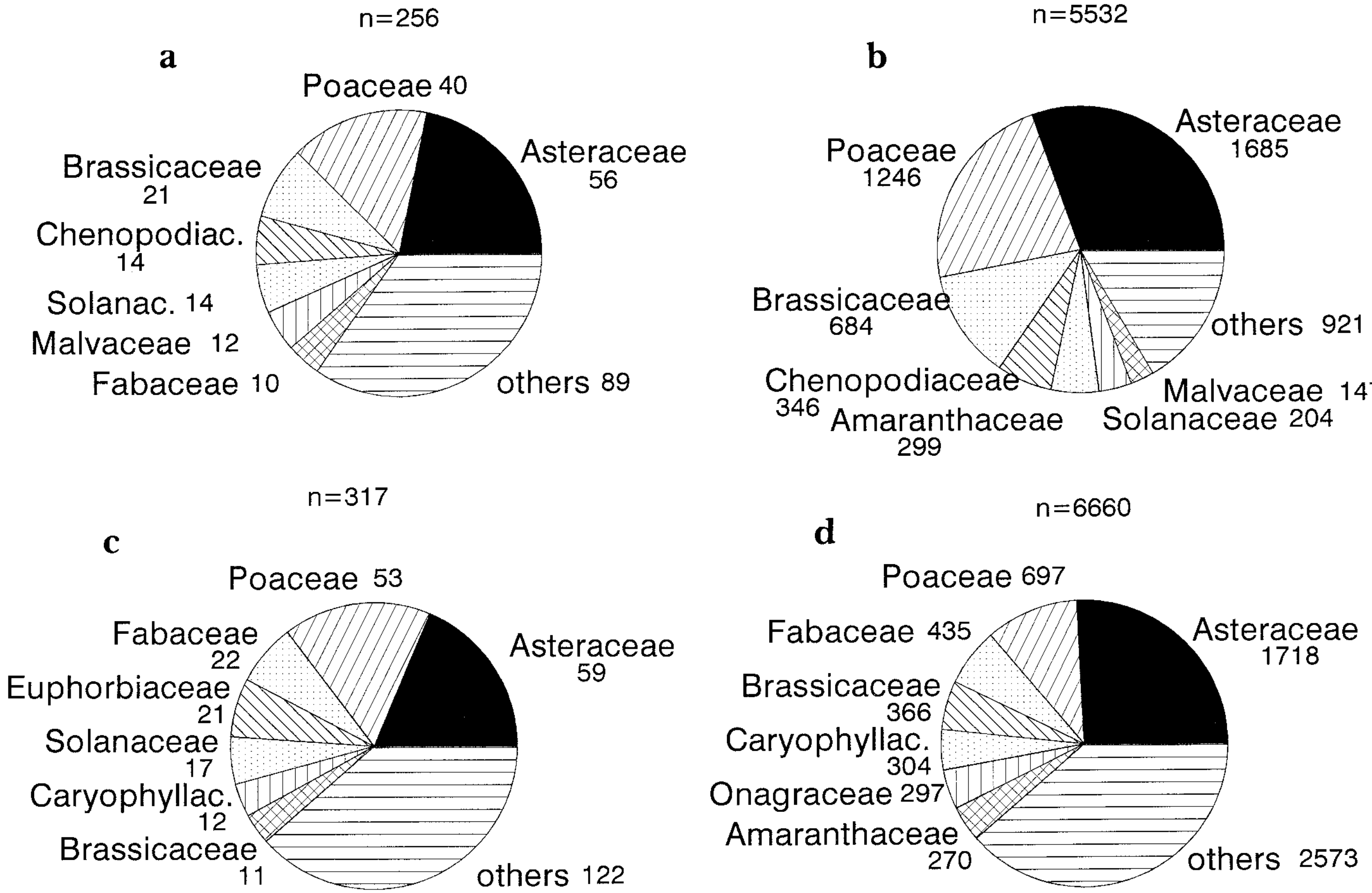

Fig. 3. Relative importance of families. a. Composition of the urban flora by species number per family. b. Composition of the urban flora by frequency (number of occurrences in relevés). c. Composition of the maize field flora of Puebla and Tlaxcala by species number. d. Composition of the maize field flora by frequency.

The taxa following in the third and fourth place differ between ruderal and segetal vegetation. In the maize fields, Fabaceae are in third place, and the Euphorbiaceae (number of species) and Brassicaceae (frequency) in fourth. In the urban vegetation, Brassicaceae and particularly the Chenopodiaceae are more frequent, occupying the third and fourth places respectively (the Chenopodiaceae are in fourth place together with the Solanaceae).

The relative prominence of Poaceae and Chenopodiaceae, and the lesser importance of other families in urban vegetation, could be related to the scarcity of appropriate insect pollinators, thus giving a competitive advantage to wind-pollinated taxa. Poaceae, Chenopodiaceae and Amaranthaceae are mainly wind-pollinated (Connor, 1987; Townsend, 1993; Kühn, 1993), whereas Asteraceae, Fabaceae, Brassicaceae, Euphorbiaceae and Caryophyllaceae are mainly insect-pollinated (Leppik, 1977; Bittrich, 1993; Faegri and van der Pijl, 1979). However, until we know more about the reproductive biology of the species that are successful in the Mexico City urban environment and those that are not, this proposal is open to discussion.

In urban vegetation, the four most important families contribute almost three quarters of all individual records. This is a very high value, as the 10 most species-rich families of entire floras generally only contribute 30-65% of the total species number (Tolmatshev, 1971). In the maize fields, the four most frequent families only contribute less than one half of all individual occurrences.

On the whole, Mexico City possesses a species-poor, temperate weed flora, quite distinct from the rural weed vegetation. A change could be underway due to the mentioned qualitative change of the urban climate. Study of this phenomenon ought to be rewarding, as it can provide understanding of the velocity and ecology of vegetational change under the influence of global warming.

ACKNOWLEDGEMENTS

The project "Vegetación urbana de la Ciudad de México" is a subproject of a line of research into the ecology of native and introduced species in the spontaneous vegetation of the valley of Mexico (IN-207892, DGAPA, UNAM), headed by Alma Orozco, Instituto de Ecología, Universidad Nacional Autónoma de México. I thank her, Daniel Piñero and Robert Bye for obtaining the financial support for the field work phase and for their help throughout. The Herbario Nacional (MEXU) and its staff were, as always, very helpful. Hildemar Scholz, Berlin, checked some Poaceae and determined *Digitaria wallichiana*; José Luis Villaseñor, Hilda Flores, Rafael Lira and Oswaldo Téllez, all at MEXU, helped with plant identifications. Edith Garay Serrano gathered the data for figure 2 with help from Ernesto Jáuregui. Hugh Drummond corrected the manuscript and offered useful advice; I also thank Víctor Barradas and the reviewers for their comments.

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Appendix 1. Location and characteristics of study quadrats

Number in map used	Quadrat[1] name	Relevé field numbers	No. of relevés	Relevé types[2]	1st field date (1993)	2nd field date (1994)
49 B2	UAM-Azcapotzalco	713-726	14	la,vl,ta,cr,sb, fb, tr	17 Sep	4 Feb
49 E5	Ceylán/Euzkadi	643-651	9	sb,tr,fb,ta	29 Aug	19 Mar
50 B2	IPN-Lindavista	739-753	15	sb,la,cr,fb,ta	24 Sep	4 Feb
50 E5	Talismán	703-712, 780-785	16	tr,sb,ta,cr,tt, fb,vl	16 Sep	17 Oct, 19 Mar
51 B2	Nuevo Atzacoalco (Gran Canal)	594-605	12	sb,tr,cr,vl,ta	16,20 Aug.	30 Jan
51 E5	Vergel de Guadalupe	754-760, 777-779	10	sb,fb,ta,vl,tt	24 Sep, 17 Oct	13 Mar
58 B2	Tacuba	612-618	7	tr,sb	22 Aug	16 Jan
58 E5	Reforma	582-585, 620-625	10	tr,sb,fb,cr	13, 22 Aug	11 Mar
59 B2	Tlatelolco	586-593, 606-611	14	sb,cr,ta,tr,la,fb,tt,vl	15, 20 Aug	10 Feb
59 E5	TAPO	787-789, 808-817	13	sb,cr,tt,la	18, 24 Oct	19 Mar
60 B2	Aragón	626-642	17	sb,cr,ta,fb,la	28 Aug	30 Jan
60 E5	El Arenal	773-774, 835-846	14	sb,cr,tr,vl	26 Sep, 31 Oct	13 Mar
67 B2	Observatorio	652-654, 847-858	15	sb,la,cr,tr,fb,vl	29 Aug, 1 Nov	16 Jan
67 E5	Del Valle	655-663, 859-861	12	sb,cr,fb	6 Sep 1 Nov	6 Mar
68 B2	Viaducto	550-559, 577-581	15	sb,tr,cr,fb	1,2, 13 Aug	10 Feb
68 E5	Trabajadoras Sociales	761-772	12	sb,cr,tr,la	29 Sep	11 Mar
69 B2	Ciudad Deportiva	799-804, 830-834	11	la,ta,fb,cr,vl	21, 29 Oct	10 Feb
69 E5	Leyes de Reforma	728-738	11	tr,cr,vl,sb	19 Sep	27 Mar
76 B2	San Ángel	560-576	16	sb,cr,ta,fb,vl, tr,la	9 Aug	29 Jan
76 E5	Santo Domingo	664-675, 775-776	14	vl,sb,cr,ta	7 Sep, 12 Oct	11 Mar
77 B2	Churubusco	790-798	9	sb,cr,la,tr,vl	19 Oct	29 Jan
77 E5	Culhuacán	690-702 , 818-821	17	la,sb,cr,ta,vl, fb	13 Sep,	6 Mar
78 B2	Cerro de la Estrella	676-689	14	vl,cr,ta,sb	12 Sep	6 Feb
78 E5	Reclusorio Oriente	805-807, 822-829	11	vl,sb,tr,ta	22, 26 Oct	27 Mar

[1] See Appendix 2
[2] **cr** - crevice, **fb** - flower bed, **la** - lawn, **ls** - loose soil, **sb** - street border, **ta** - trampled area, **tr** - tree rings, **tt** - train track, **vl** - vacant lot.

Appendix 2. Description of pathway followed within each quadrat

49 B2 - UAM-Azcapotzalco. The quadrat starts on a vacant lot adjacent to train tracks, continues across a university campus (Universidad Autónoma Metropolitana), runs along a larger street (San Pablo) and continues into a lower-middle-class neighborhood along the Av. de los Ángeles. The university campus was inaccessible on Feb. 4, 1994, because of a strike.
49 E5 - Ceylán/Euzkadi. The quadrat starts in front of a large post office building, runs along the Avenida Ceylán, turns into a lower-middle-class neighborhood along the Avenida Central, Calle Kioka, Calle 15, Av. Jardín and Calle 9.
50 B2 - IPN-Lindavista. The quadrat consists of another university campus (Instituto Politécnico Nacional, Unidad Profesional Zacatenco-Lindavista). The path runs across some sports facilities, along a large parking lot, between some buildings, along another parking lot and to a broad division of the Av. Instituto Politécnico Nacional.
50 E5 - Talismán. The quadrat starts in the Calle Cuauhtémoc of the «colonia» Aragón, south of a small hill of volcanic origin, the Cerro Tepeyac. It turns into Calle Fausto Romero and again into Calle Nezahualcóyotl through a lower-middle-class neighborhood, then runs along a larger thoroughfare, the F.C. Hidalgo (Eje 1 Oriente), along train tracks. It turns into the Avenida Talismán (Eje 4 Norte), which has a wide, park-like middle strip, passes an underground station (Talismán) and again turns into a modest neighborhood along the Calle Patambán.
51 B2 - Nuevo Atzacoalco (Gran Canal). The quadrat starts on the western side of the Avenida Eduardo Molina, near Calle Palmira. The wide middle strip is now occupied by a school; the path runs along 3 sides of it, then into a relatively new, lower-middle-class area, along Calle 316. It proceeds along Calle 309 and Calle 314, which is wide and has a somewhat neglected middle strip, then along the main Mexico City sewage canal, the «Gran Canal», then crosses into the Calle Ejido and ends in a little square with a school and some administrative buildings.
51 E5 - Vergel de Guadalupe. This is a newly settled, lower-middle-class area north of the Aragón Park. The quadrat starts in the Avenida Independencia, turns into Calle Campeche one block, then again east along the Calle Morelia, south along the Calle Jalapa to a local market, along Avenida México, then it crosses train tracks and turns into a major artery, the Av. Central or Av. Hank González. The latter has a wide middle strip which is used as dumping ground.
58 B2 - Tacuba. This quadrat zigzags through an older, lower-middle-class colonia with very little free space, in the triangle south of the Calzada Legaria-Avenida Marina Nacional-Calzada México-Tacuba-interchange. It runs along the following streets: Lago Michigan, Golfo de Adén, Lago Espiridino, Felipe Carillo Puerto, Lago Constanza, 2o. Callejón Lago Mayor, Lago Mayor, Lago Garda, Av. Marina Nacional.
58 E5 - Reforma. This quadrat crosses a middle-class commercial and touristic zone, the colonia Juárez, with well-kept greenery and few weeds. It starts in the Plaza Necaxa, goes south along Calle Río Sena, turns east at the corner of the British embassy into Calle Río Lerma, crosses the big downtown avenue, Paseo de la Reforma along the Calle Río Rhin, turns into Calle Hamburgo and then Havre, and ends in the Av. Chapultepec.
59 B2 - Tlatelolco. This quadrat crosses a large-scale housing development of the 1960's, consisting mainly of highrises, passing an archeological area and a colonial church at the «Plaza de las Tres Culturas». It starts in Calle Lerdo, runs along Av. Manuel González (Eje 2

Norte), turns into the Eje Central, crosses the above mentioned plaza, goes on between some highrises, crosses Paseo de la Reforma and enters a lower-income area in the Calle Carbajal. Most of the relevés are situated along Eje 2 Norte and Eje Central.

59 E5 - TAPO. The quadrat starts at the western exit of one of the large bus stations (Terminal de Autobuses del Oriente, popularly known as TAPO) on Av. Eduardo Molina. It then passes the new Congress buildings on Ignacio Zaragoza (with disused train tracks and an underground line), crosses the Av. Francisco del Paso, and turns into a middle-class neighborhood along Calle Manuel Rivera Gambas.

60 B2 - Aragón. The quadrat is situated in a middle-class area north of the airport. It starts along Av. 506 (Eje 3 Norte), turns south into Calle 551, which passes a market, a small park, two schools and a church, turns into Calle 504, crosses an urban highway (Oceanía) and runs into a sports park (Deportivo Oceanía).

60 E5 - El Arenal. This quadrat is mainly located in a recent housing development for lower-income families, on a former runway of the airport. It starts on the edge of the airport, along Calle Río Churubusco, then turns into the Calle Mixtla, which runs diagonally southeast into Av. Río Churubusco.

67 B2 - Observatorio. The quadrat starts in a small «privada» west of the Delegación Miguel Hidalgo, an administrative center. It goes uphill up to the urban highway Periférico, turns east into the Cerrada las Huertas, crosses the small and very well-kept park «Parque Lira» (hardly any weeds present), takes the southern exit of the park into Av. Observatorio, then turns southeast on Av. Parque Lira and ends in another park, the Alameda Tacubaya.

67 E5 - Del Valle. The quadrat runs across an established middle-class neighborhood. It starts in the Av. Amores just south of Eje 3 Sur, turns east into Matías Romero, south along the Parque de las Arboledas on Heriberto Frías, east on Pilares, crosses Av. Universidad and turns south again on Av. Cuauhtémoc (Eje 1 Poniente).

68 B2 - Viaducto. The quadrat crosses a lower-middle-class and commercial district, as well as two main traffic arteries. It starts in the Calle Hernández Dávalos in the colonia Algarín, goes south one block on Isabel la Católica, then east on Toribio Medina. It crosses the Viaducto, a major urban highway, on Calle 5 de Febrero, turns into Coruña, crosses another urban highway, the Calzada de Tlalpan, continues on four blocks, turns into C. José Antonio Torres and ends on Calzada Santa Anita.

68 E5 - Trabajadoras Sociales. The quadrat contains a recent, lower-middle-class to lower-income section. It starts on the Av. Apatlaco, turns into Calle Independencia, continues four blocks east on Av. Purísima, turns south on Calle Francisco Villa, east on Calle Xólotl, southeast on Calle Santa María and east on Calle Trabajadoras Sociales up to the intersection with Av. Federico del Paso.

69 B2 - Ciudad Deportiva. The quadrat is located on a large sports facility, an Olympic site, the «Ciudad Deportiva Magdalena Mixhuca». It starts east of the main entrance, just north of the autodrome, and continues across sports fields and lawns to its limit with Av. Río Churubusco.

69 E5 - Leyes de Reforma. The quadrat is located in a recently urbanized area; some of the settlements are not contained in the map. It starts in Calle 27, now named Calle 16 de marzo, turns east on Calle 12 (Batalla de Casa Blanca), south on Calle 33 (24 de marzo), east again on Calle 10 (Batalla de Loma Alta), crosses a large vacant lot and continues along a large Avenue, still unmarked in the map, towards the colonia Renovación. There is a new housing project on the southern side of the avenue; the northern side was a fenced vacant lot in summer where 60 species were found; in winter a supermarket was being constructed there.

76 B2 - San Ángel. The quadrat crosses a mainly high-income area of the colonia Campestre and the Guadalupe Inn with attractive cobbled streets and plenty of old trees. It starts in the Callejón Corregidora, turns south on Calle Corregidora, passes the small colonial church of Tlacopac, turns east on Calle Tlacopac, crosses the Av. Revolución, runs along Fernando Villalpando, turns south on Av. Insurgentes, and ends in the small park between the two directions of Av. Vito Alessio Robles.
76 E5 - Santo Domingo. Parts of this area were settled only recently and sewage construction and pavement of streets was going on during the study. It is inhabitated by lower income and lower-middle income families. The quadrat starts in the Calle Pipizahua, turns east on Calle Escuinapa, south again on Av. Papalotl, east on Calle Azulco and ends in the Calle Toltecas.
77 B2 - Churubusco. The quadrat consists mainly of the premises of the Churubusco Country Club. But those where unaccessible, therefore the path runs along the Av. Río Churubusco, an urban highway, then turns south into Av. Canal de Miramontes, east on Calle Cerro de Loreto and south for one block on Calle Cerro de la Estrella.
77 E5 - Culhuacán. The quadrat is occupied by lower-middle-class housing developments and an university campus (Instituto Politécnico Nacional, Unidad Profesional Culhuacán). It starts in the Calle Cahitas, turns south on Arneses along the campus, turns east on Av. Santa Ana, goes into the Cerrada de Sta. Ana, then east again along Calle Mariquita Sánchez until it meets Calle Catalina Buendía.
78 B2 - Cerro de la Estrella. The quadrat covers a relatively recent lower-middle-class settlement, together with a few squatter housings. It is situated to the north of a nature preserve at the hilltop and encroaching into it. It is also the site of a famous Easter Via Crucis procession every year. The pathway starts in the Calzada Ermita Iztapalapa, goes uphill on the Calle Estrella, crosses an empty lot, turns east on San Marcos, downhill again on Sta. Mónica, turns southeast on Maple, south on Mina and east again on Nogal, where it ends.
78 E5 - Reclusorio Oriente. The quadrat covers a recent settlement, which still includes some squatter camps, north of a large jail. It starts in the Calle Nautla under a high tension line, crosses a larger avenue, the Canal de Garay into the Calle Coatzacoalcos, turns south on the Av. Santa Cruz and east again on Calle Río Churubusco; it then crosses a large vacant lot to Calle Valentín Gómez Farías, turns north one block and then into Calle Emiliano Zapata; in Calle Arroyo Frío it goes south one block and ends in Calle Insurgentes.

Appendix 3. Species list of Mexico City ruderal plants, with frequency and phytogeographical data

Frequency is the number of times a species was found in 311 relevés; - indicates it was found outside of relevés. Distribution/origin gives the present distribution for presumably American species, and region of origin for immigrants from the Old World. Afr - Africa, Am - America, Aust - Australia, c - central, Can - Canada, circbor - circumboreal, cosm - cosmopolitan, origin uncertain, e - east, Eu - Europe, Eu med - Mediterranean Europe, Mx- Mexico, n - north, s - south, w - west, US - United States. Life form: a - annual herb, b - biannual herb, p - perennial herb, s - shrub, t - tree.

Species name	Frequency	Lifeform	Distribution/origin
ACANTHACEAE			
Dicliptera peduncularis Nees	4	a/p	Mx
AIZOACEAE			
Sesuvium portulacastrum L.	2	p	sUS-sAm
Trianthema portulacastrum L.	4	a/b	sUS-sAm
AMARANTHACEAE			
Alternanthera caracasana H.B.K.	105	p	sUS-sAm
Amaranthus hybridus L.	178	a	Am
+*Amaranthus lividus* L.	8	a	Eu med
+*Amaranthus muricatus* (Moq.) Gillies ex Hicken	2	a	sAm
+*Amaranthus viridis* L.	1	a	Am
Guilleminea densa (Willd.) Moq.	5	a/p	sUS-sAm
ANACARDIACEAE			
Schinus molle L.	6	t	Mx-sAm
APIACEAE			
c *Apium graveolens* L.	2	b/p	Eu
Apium leptophyllum (Pers.) F. Muell. (= *Ciclospermum leptophyllum* (Pers.) Sprague)	3	a/p	Am
Conium maculatum L.	1	b/p	Eu
Hydrocotyle ranunculoides L.f.	1	p	Am
ARALIACEAE			
c *Hedera helix* L.	4	p	Eu

* new record for the Valley of Mexico, may be only casual
\+ new record for the Valley of Mexico, naturalized
c - most populations probably escapes from cultivation

Appendix 3, continues

Species name	Frequency	Lifeform	Distribution/origin
ASTERACEAE			
Ambrosia psilostachya DC.	30	p	Can-Mx
Aphanostephus ramosissimus DC. var. *ramosus* (DC.) Turner & Birds.	1	a/p	Mx
Aster subulatus Michx.	61	a	Am
Baccharis conferta H.B.K.	1	s	Mx
Baccharis salicifolia (Ruiz & Pav.) Pers.	1	s	swUS-sAm
+*Bellis perennis* L.	1	p	Eu
Bidens aurea (Aiton) Sherff	1	a/p	swUS-cAm
Bidens odorata Cav.	76	a	Mx-cAm
+*Bidens pilosa* L.	35	a	Am
* *Calyptocarpus vialis* Less.	—	p	swUS-Mx
c *Chrysanthemum coronarium* L.	—	a	Eu med.
c *Chrysanthemum parthenium* (L.) Bernh.	16	p	Eu
Conyza bonariensis (L.) Cronquist	247	a	Am
Conyza canadensis (L.) Cronquist	57	a	Am
Conyza coronopifolia H.B.K.	34	a	Mx-sAm
Conyza sophiifolia H.B.K.	14	a	swUS-sAm
Cotula australis (Siebold) Hook. f.	41	a	New Zealand
Dyssodia papposa (Vent.) Hitchc.	6	a	Can-cAm
Erigeron longipes DC.	4	p	Mx-cAm
Eupatorium adenophorum Spreng.	1	p/s	Mx
Euphrosyne partheniifolia DC.	—	a/p	Mx
Flaveria trinervia (Spreng.) C. Mohr	20	a/p	sUS-sAm
Florestina pedata (Cav.) Cass.	4	a	Mx-cAm
Galinsoga parviflora Cav.	185	a	Am
Galinsoga quadriradiata Ruiz & Pav.	101	a	Am
Gnaphalium americanum Mill.	1	a	Am
Gnaphalium conoideum H.B.K.	1	a	Mx
Gnaphalium luteo-album L.	18	a	Eurasia
Gnaphalium stagnale I. M. Johnst.	1	a	Mx
Gnaphalium stramineum H.B.K.	1	a	wUS-cAm
**Guizotia abyssinica* (L. f.) Cass.	1	a	Afr
Heterosperma pinnatum Cav.	5	a	swUS-cAm

Appendix 3, continues

Species name	Frequency	Lifeform	Distribution/origin
Jaegeria hirta (Lag.) Less.	1	a	Mx-sAm
c *Matricaria recutita* L.	27	a	Eu
+ *Melampodium divaricatum* (Rich.) DC.	2	a	Mx-sAm
Melampodium perfoliatum (Cav.) H.B.K.	1	a	Mx-cAm
Melampodium repens Sessé & Moc.	3	a	Mx
Parthenium bipinnatifidum (Ortega) Rollins	50	a	Mx
+*Parthenium hysterophorus* L.	3	a	Am
Picris echioides L.	57	a	Eu med
Sanvitalia procumbens Lam.	1	a	Mx-cAm
Schkuhria pinnata var. *virgata* (LaLlave) Heiser	9	a	Am
Senecio salignus DC.	1	s	swUS-cAm
Senecio vulgaris L.	26	a	Eu
Simsia amplexicaulis (Cav.) Pers.	37	a	Mx-CAm
Sonchus asper (L.) Hill	19	a	Eurasia
Sonchus oleraceus L.	198	a	Eurasia
Spilanthes oppositifolia (Lam.) D'Arcy	11	p	seUS-sAm
c *Tagetes erecta* L.	9	a	Mx
Tagetes lunulata Ortega	11	a	Mx-cAm
Tagetes micrantha Cav.	2	a	swUS-Mx
Taraxacum officinale Wiggers	216	p	Eu
Tithonia tubiformis (Jacq.) Cass.	21	a	Mx-cAm
Verbesina virgata Cav.	1	s	Mx
Viguiera dentata (Cav.) Spreng.	6	p/s	swUS-cAm
Xanthocephalum centauroides Willd.	1	a/p	Mx
BORAGINACEAE			
Heliotropium curassavicum L.	19	a/p	sUS-sAm
BRASSICACEAE			
Brassica nigra (L.) Koch	1	a/p	Eu
Brassica rapa L. (= *B. campestris* L.)	49	a	Eu
Capsella bursa-pastoris (L.) Medik.	41	a	Eu
Cardamine hirsuta L.	5	a	Eu
Coronopus didymus (L.) Sm.	78	a/b	Am
Descurainia impatiens (Cham. & Schltdl.) O. E. Schultz	8	a	Mx-Guat

Appendix 3, continues

Species name	Frequency	Lifeform	Distribution/origin
Descurainia virletii (E. Fourn.) O. E. Schulz	8	a	Mx
+*Diplotaxis muralis* (L.) DC.	—	a	Eu
Eruca sativa Mill.	18	a	Eu
* *Hirschfeldia incana* (L.) Lagr.-Foss.	1	a	Eu
Lepidium draba L.	1	p	Eu
Lepidium latifolium L.	1	p	Eu
Lepidium oblongum Small	4	a	US-cAm
Lepidium virginicum L.	216	a/b	Am
c *Lobularia maritima* (L.) Desv.	10	a	Eu
Raphanus raphanistrum L.	2	a	Eu
Rapistrum rugosum (L.) All.	2	a/b	Eu med
Rorippa mexicana (Moc. & Sessé) Standl. & Steyermark	2	a/p	Mx-cAm
Sisymbrium altissimum L.	5	a	Eu
Sisymbrium irio L.	232	a	Eu
Sisymbrium officinale (L.) Scop.	—	a	Eu
CANNABINACEAE			
c *Cannabis sativa* L.	1	a	Asia
CARYOPHYLLACEAE			
Cerastium glomeratum Thuill.	1	a	Eu
+*Polycarpon tetraphyllum* (L.) L.	9	a/p	Eu med
Sagina procumbens L.	1	a/p	circbor
Silene gallica L.	1	a	Eu
Spergula arvensis L.	1	a	Eu
Stellaria cuspidata Willd.	3	a/p	swUS-sAm
Stellaria media (L.) Vill.	16	a/p	Eu
CHENOPODIACEAE			
Atriplex linifolia Humb. & Bonpl.	4	a/p	Mx
Atriplex patula L. var. *hastata* (L.) Gray	1	a	Eu
Atriplex semibaccata R. Br.	11	p	AUST
Atriplex suberecta Verd.	15	a	Aust,sAfr
Beta vulgaris L.	8	a/b	Eu
Chenopodium ambrosioides L.	95	a/p	Am

Appendix 3, continues

Species name	Frequency	Lifeform	Distribution/origin
Chenopodium berlandieri Moq.	31	a	Am
+*Chenopodium giganteum* D. Don	1	a	Asia
Chenopodium glaucum L.	5	A	EURASIA
Chenopodium graveolens Willd.	2	a	sUS-sAm
Chenopodium murale L.	161	a	Eu med.
c *Chenopodium nuttalliae* Saff.	2	a	Mx
+*Kochia scoparia* (L.) Roth	5	a	Eurasia
Suaeda torreyana Watson	2	a/p	wUS-Mx
COMMELINACEAE			
Commelina diffusa Burm. f.	10	a/p	cosm
Tinantia erecta (Jacq.) Schltdl.	6	a	Mx-sAm
Tinantia glabra (Standl. & Steyerm.) Rohweder	1	a	Mx-cAm
CONVOLVULACEAE			
Dichondra argentea Humb. & Bonpl.	2	p	swUS-sAm
Dichondra sericea Sw.	12	p	swUS-sAm
Ipomoea purpurea (L.) Roth (=*Pharbitis purpurea* (Roth) Bojer)	53	a	Am
CUCURBITACEAE			
c *Citrullus lanatus* (Thunb.) S. Matsum. & Nakai	1	a	Afr
* *Cucumis melo* var. *chito* (Morren) Naud.	4	a	Old World
Sicyos deppei G. Don	19	a	Mx
CYPERACEAE			
Cyperus esculentus L.	4	p	Eurasia
Cyperus hermaphroditus (Jacq.) Standl.	18	p	swUS-sAm
Cyperus rotundus L.	2	p	Eurasia
EUPHORBIACEAE			
Acalypha indica var. *mexicana* (Müll. Arg.) Pax & K. Hoffm.	19	a	Mx-cAm
Acalypha phleoides Cav.	1	p	Mx-cAm
Euphorbia dentata Michx.	1	a	Am
Euphorbia graminea Jacq.	1	a	Mx-sAm
Euphorbia nutans Lag.	7	a/p	Am

Appendix 3, continues

Species name	Frequency	Lifeform	Distribution/origin
Euphorbia ophtalmica Pers. (=*E. hirta* var. *procumbens* (DC.) N. E. Brown)	19	a/p	sUS-sAm
Euphorbia peplus L.	19	a	Eurasia
Euphorbia prostrata Aiton	1	a/p	sUS-sAM
c *Ricinus communis* L.	9	s	Afr?
FABACEAE			
Astragalus micranthus Desv. var. *micranthus*	1	p	Mx
Crotolaria pumila Ortega	3	a	sUS-sAm
Dalea leporina (Aiton) Bullock	1	a	Am
Medicago lupulina L.	20	a	Eurasia
Medicago polymorpha L.	27	a	Eu
Melilotus indicus (L.) All.	27	a	Eu med
c *Phaseolus coccineus* L.	2	a/p	Mx-cAm
Trifolium amabile H.B.K.	3	p	swUS-cAm
Trifolium goniocarpum Lojac.	1	p	Mx
Trifolium repens L.	19	p	Eurasia
GERANIACEAE			
Erodium cicutarium (L.) L'Hér.	1	a/b	Eu med.
Geranium seemannii Peyr.	2	a/p	Mx-Guat
HYDROPHYLLACEAE			
Phacelia platycarpa (Cav.) Spreng.	2	a/p	Mx-Guat
Wigandia urens (Ruiz & Pav.) H.B.K.	3	s	Mx-sAm
LAMIACEAE			
c *Leonotis nepetifolia* (L.) R. Brown	1	a/p	Afr
Marrubium vulgare L.	9	p	Eu
Salvia polystachya Ortega	1	p/s	Mx-cAm
Salvia tiliifolia Vahl	3	a	Mx-sAm
Stachys agraria Cham. & Schltdl.	5	a/p	sUS-cAm
LINACEAE			
c *Linum usitatissimum* L.	8	a	Eu
LOBELIACEAE			
Triodanis perfoliata (L.) Nieuwl. (=*Specularia perfoliata* A. DC.)	1	a	Am

Appendix 3, continues

Species name	Frequency	Lifeform	Distribution/origin
LOGANIACEAE			
Buddleja cordata H.B.K. subsp. *cordata*	25	s	Mx
Buddleja sessiliflora H.B.K.	2	s	swUS-Mx
LORANTHACEAE			
Cladocolea loniceroides (Tiegh.) Kuijt	—	s	parasite; Mx
MALVACEAE			
Anoda cristata (L.) Schltdl.	11	a/p	sUS-sAm
Kaernemalvastrum lacteum (Aiton) Bates	1	p	Mx-cAm; Colomb.
Malva nicaeensis All.	6	a/p	Eu med
Malva parviflora L.	86	a/p	Eu
c *Malva sylvestris* L.	3	a	Eu med
Malvastrum coromandelianum (L.) Garcke	1	a/p	sUS-sAm
Modiola caroliniana (L.) G. Don	7	a/p	Am
Sida rhombifolia L.	2	p	Am
Sphaeralcea angustifolia (Cav.) G. Don	3	p	US-Mx
Tarasa antofagastana (Phil.) Krapov.	1	a	Mx; sAm
Urocarpidium jacens (S. Wats.)Krapov.	10	a/p	Mx-Guat
Urocarpidium limense (L.) Krapov.	16	a/p	Mx; sAm
NYCTAGINACEAE			
c *Mirabilis jalapa* L.	14	a/p	Am
ONAGRACEAE			
Epilobium ciliatum Raf.	3	p	Can-cAm
Gaura coccinea Pursh.	1	p	Can-Mx
Lopezia racemosa Cav.	6	a/p	Mx-cAm
c *Oenothera elata* Kunth	3	a	Mx-cAm
Oenothera kunthiana (Spach) Munz	1	p	swUS-cAm
Oenothera pubescens Willd. ex Spreng.	1	a/p	sUS-sAm
Oenothera rosea L'Hér. ex Aiton	45	a/p	swUS-sAm
OXALIDACEAE			
Oxalis corniculata L.	126	a/p	circbor
Oxalis latifolia H.B.K.	14	p	Am
PAPAVERACEAE			
Argemone ochroleuca Sweet subsp. *ochroleuca*	15	a/p	Mx

Appendix 3, continues

Species name	Frequency	Lifeform	Distribution/origin
Argemone platyceras Link & Otto	1	a/p	Mx
PHYTOLACCACEAE			
Phytolacca icosandra L.	8	a/p	Mx-sAm
PLANTAGINACEAE			
Plantago australis Lam. subsp. *hirtella* (H.B.K.) Rahn	1	p	swUS-sAm
Plantago lanceolata L.	1	a/p	Eu
Plantago major L.	34	a/p	Eu
POACEAE			
Agrostis semiverticillata (Forssk.) C. Chr. (= *Polypogon viridis* (Gauen) Breistr.)	2	p	Eurasia
Avena fatua L.	1	a	Eurasia
c *Avena sativa* L.	5	a	Eurasia
+*Brachiaria plantaginea* (Link) A. Hitchc. (=*Urochloa plantaginea* (Link) R. Webster)	2	a	Mx-sAm
Bromus carinatus Hook. & Arn.	12	a/p	wUS-cAm
Bromus catharticus Vahl	77	a/p	Am
Chloris submutica H.B.K.	5	p	swUS-sAm
Chloris virgata Sw.	20	a	Am
Cynodon dactylon (L.) Pers.	156	p	Afr
+*Cynodon nlemfuensis* Vanderyst	6	p	Afr
+*Digitaria ciliaris* (Retz.) Koeler	4	a	Asia
* *Digitaria horizontalis* Willd.	—	a	Am
+*Digitaria wallichiana* (Wight & Arnold) Stapf	5	a	Asia
Distichlis spicata (L.) E. Greene	1	p	Am
Eleusine indica (L.) Gaertn.	89	a	Afr
Eleusine multiflora Hochst. ex A. Rich.	223	a	Afr
Eragrostis cilianensis (All.) Vign. ex Janchen	1	a	Eu
Eragrostis intermedia A. Hitchc.	17	p	sUS-cAm
Eragrostis mexicana (Hornem.) Link	59	a	Am
Eragrostis pectinacea (Michx.) Nees	37	a	Am
Hordeum jubatum L.	17	a/p	nAm-Mx
Leptochloa fascicularis (Lam.) A. Gray	1	a	Am

Appendix 3, continues

Species name	Frequency	Lifeform	Distribution/origin
+*Leptochloa uninervia* (J. S. Presl) A. Hitchc. & Chase	2	a	Am
c *Lolium multiflorum* Lam.	21	a/p	Eu med
* *Panicum sphaerocarpon* Elliott (=*Dichanthelium sphaerocarpon* (Elliott) Gould)	1	a	US-sAm
Paspalum dilatatum Poir.	1	p	Am
c *Pennisetum clandestinum* Hochst. ex Chiov.	258	p	Afr
Pennisetum villosum R. Br.	4	p	Afr
Phalaris canariensis L.	8	a	Eu med
Poa annua L.	138	a/p	Eu
Poa conglomerata Rupr.	1	p	Mx-cAm
Rhynchelytrum repens (Willd.) C. E. Hubb.	1	a/p	Afr
Setaria adhaerans (Forssk.) Chiov.	10	a	cosm
Setaria geniculata (Lam.) P. Beauv.	3	a/p	Am
Setaria grisebachii E. Fourn.	4	a/b	swUS-cAm
Sorghum halepense (L.) Pers.	5	p	Eu med
Sporobolus indicus (L.) R. Br.	33	p	Am
Sporobolus pyramidatus (Lam.) A. Hitchc.	9	p	Am
Vulpia myuros (L.) C. C. Gmel.	3	a	Eu
c *Zea mays* L.	4	a	Am
POLYGONACEAE			
Polygonum aviculare L.	82	a/b	Eurasia
Polygonum lapathifolium L.	1	a/p	Eurasia
Polygonum punctatum Elliot var. *eciliatum* Small	—	a/p	sUS-cAm
Rumex crispus L.	5	p	Eurasia
Rumex obtusifolius L.	11	p	Eu
PORTULACACEAE			
Portulaca oleracea L.	51	a	Am and Eu
PRIMULACEAE			
Anagallis arvensis L.	2	a	Eu
RESEDACEAE			
Reseda luteola L.	24	a/b	Eu

Appendix 3, continues

Species name	Frequency	Lifeform	Distribution/origin
RUBIACEAE			
Bouvardia ternifolia (Cav.) Schltdl.	1	p/s	swUS-Mx
SCROPHULARIACEAE			
c *Cymbalaria muralis* Gaertn.	4	a/p	Eu
Veronica peregrina subsp. *xalapensis* Kunth	1	a	Am
SOLANACEAE			
**Datura quercifolia* H.B.K.	1	a	from NAm
Datura stramonium L.	15	a	Am
Jaltomata procumbens (Cav.) J. L. Gentry	4	a	swUS-sAm
c *Lycopersicon esculentum* Mill.	35	a	Am
Nicotiana glauca Graham	27	s	Am
Petunia parviflora Juss.	4	a	sUS-Mx
**Physalis nicandroides* Schltdl.	1	a	Mx-cAm
c *Physalis philadelphica* Lam.	51	a	US-cAm
Physalis sordida Fernald	2	a/p	Mx
Solanum americanum Mill.	—	a/p	Am
Solanum nigrescens Martens & Galiotti	20	a/p	sUS-sAm
+*Solanum pseudocapsicum* L.	2	p	sUS-sAm
Solanum rostratum Dunal	40	a	US-Mx
Solanum stoloniferum Schltdl.	1	a	Mx
TROPAEOLACEAE			
c *Tropaeolum majus* L.	1	a	sAm
URTICACEAE			
Parietaria pensylvanica Muhl.	1	a	Can-Mx
Urtica dioica var. *angustifolia* (Ledeb.) Wedd.	2	p	Mx