Chapter 15
The Owls of Mexico

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Abstract Mexico has 34 owl species, but little is known about their ecology particularly for tropical species. Of the 12 genera of owl species in the country, the genera *Megascops* and *Glaucidium* are the most diverse with eight species each. *Strix* has five species and *Asio* four. Four species are extensively distributed in the country, while others have distributions restricted to only one state in the country: *Megascops lambi* (endemic to the Pacific slope in the state of Oaxaca), *M. barbarus* (endemic to the highlands of Chiapas and Guatemala), and *G. hoskinsii* (endemic to the highlands of South Baja California). Another distributional pattern is altitudinal, where species with a wide latitudinal distribution also have a wide altitudinal distribution (e.g., *Tyto furcata, Bubo virginianus*). Thirteen species are distributed below 1500 m above sea level, and only seven species have a distribution over an altitude greater than 1500 m. The majority of owl species are forest species, and then the loss of these environments strongly affects their survival. Currently, secondary forests and ecotones have been considered important areas for owls. All of the owl species are included in Appendix II of CITES, and three species are listed on BirdLife International as near threatened (*Megascops barbarus*, *M. seductus*, and *S. occidentalis*). The Mexican Official Norm (NOM-059) currently considers 18 owls in a risk category, the majority is endangered, and three are at risk of extinction. Although these are national categories, there is little empirical information about the population trends or status of these species. The different impacts on and threats to owl populations are local, but also regional. The principal threats are habitat loss, degradation, and fragmentation; introduction of exotic species; pesticide contamination; illegal trafficking; and superstitious beliefs of bad luck. Empirical knowledge about this group has been increasing in recent years, primarily for species with species distributed in temperate zones. However, more effort in research should be considered necessary to improve our understanding from descriptive approaches but also functional and evolutionary ones.

Keywords Owl distribution • Endemic species • Threatened owls • Conservation strategies

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Stygian Owl (*Asio stygius*)

15.1 Introduction

A few more than 1000 species of birds have been recorded in Mexico; this number varies by source: 1026 (Escalante-Pliego et al. 1998), 1050 (Howell and Webb 1995), and 1076 (Ceballos and Márquez-Valdelamar 2000). Given this high diversity, Mexico contains the 12th most bird species in the world, making it an important geographic location where two regions (Nearctic and Neotropical) converge, which allows for a center of diversification and evolution of different species (Navarro-Sigüenza and Sánchez-González 2003).

Although birds are one of the best-known terrestrial vertebrate groups, some bird groups have received very little attention, as is the case with nocturnal birds that include the Caprimulgiformes and Strigiformes. The lack of knowledge of these species is primarily due to the characteristics of the group. The majority of them are largely nocturnal; although some species are crepuscular and a few are diurnal, most of them live in forests or jungles, most of them are rare or uncommon species, and their behavior is very vigilant and secretive. It is a challenge to study them because

of all of these characteristics. The objective of this work is to present the knowledge about the distribution and natural history of the owls in Mexico, as well as to analyze their threats and conservation strategies. The taxonomic nomenclature we use was König et al. (2008).

15.2 Study Area

The Mexican Republic (Mexico) is found in the northern hemisphere of the American continent and is bounded by its outermost coordinates: 32°43′06″ to the north with the border with the United States of America and 14°32′27″ to the south with the border with Guatemala. The area extent of the country is 1,964,375 km^2 which is politically divided into 31 states and one Mexico City.

Mexico's topography is very hilly with various mountains, plains, valleys, and plateaus that resulted from tectonic activity during the Cenozoic era, so that approximately 65% of the national territory is above 1000 m above sea level (de Alba and Reyes 1998). The highest altitude found are volcanoes such as Pico de Orizaba in Veracruz (5636 masl). Mexico contains two peninsulas (Baja California and the Yucatan); the Mexican Plateau, which is composed of two main mountain chains, the western Sierra Madre and the eastern Sierra Madre; and a Neovolcanic Transversal, the southern Sierra Madre, which derives the Sierra Madre of Chiapas, which extends through Central America (Fig. 15.1).

The Sierra Madre Occidental covers all of western Mexico (paralleling the Pacific coast) and has a length of 1500 km that runs through Arizona, part of Sonora, Chihuahua, Sinaloa, Durango, Zacatecas, Nayarit, and part of Jalisco where it joints the Neovolcanic Transversal. The Sierra Madre has a length of 1350 km that extends from the south of Rio Bravo and parallels the Gulf of Mexico until it joins with the Neovolcanic Transversal. The transverse volcanic axis is a chain of volcanoes that are a part of the Pacific ring of fire, which is characterized by its large volcanic activity and where some of the tallest mountains in the country are located, like Pico de Orizaba or Citlaltepetl, Popocatepetl, and Iztaccihuatl.

Between these two mountain chains and the transverse volcanic axis is the Mexican Plateau, which reaches an altitude of 1200 masl. The Chihuahua and Bolson de Mapimí deserts are located on this plateau and contain small mountains known as the transverse volcanic mountains. The Balsas Depression is located to the south of the Neovolcanic Transversal which is the lowest region in the entire country. The southern Sierra Madre mountain chain, which ends in the Isthmus of Tehuantepec, is located between the Balsas Depression and the Pacific Ocean. The Sierra Madre de Oaxaca (Sierra de Juárez) is located in the east which runs from the north of Oaxaca and ends in Veracruz, where it joins the Sierra Madre de Chiapas and the mountains of Soconusco, which form the central Plateau of Chiapas.

There are 2800 islands in Mexico, including rocks, keys, reefs, islets, and islands, of which most of them are in the Caribbean (667). Only 5% of these islands are inhabited.

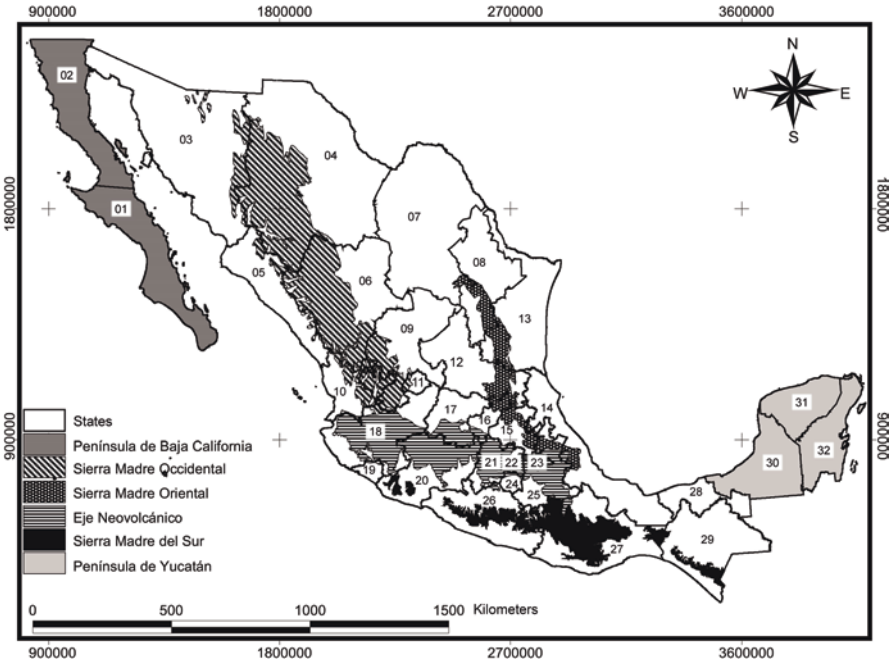

Fig. 15.1 Topography of Mexico and its states (*1* Baja California Sur, *2* Baja California, *3* Sonora, *4* Chihuahua, *5* Sinaloa, *6* Durango, *7* Coahuila, *8* Nuevo León, *9* Zacatecas, *10* Nayarit, *11* Aguascalientes, *12* San Luis Potosí, *13* Tamaulipas, *14* Veracruz, *15* Hidalgo, *16* Querétaro, *17* Guanajuato, *18* Jalisco, *19* Colima, *20* Michoacán, *21* México, *22* Mexico City, *23* Tlaxcala, *24* Morelos, *25* Puebla, *26* Guerrero, *27* Oaxaca, *28* Tabasco, *29* Chiapas, *30* Campeche, *31* Yucatán, *32* Quintana Roo)

15.3 Climate

Due to the particular characteristics of local geography, topographic complexity, ocean temperature and currents, trajectories of summer storms, and polar fronts in winter, Mexico has a great diversity of weather and environments, which includes practically all possible climatic groups and subgroups, from arid and semiarid climates to humid and subhumid climates (del Alba and Reyes 1998).

Approximately 56% of the country's territory contains very arid and semiarid zones located in the north and center of Mexico. Some 37% of the subhumid climate zones are located in the coastal plains (Gulf and Pacific) and the northeast of the Yucatan peninsula. The remaining 7% of the territory is humid, located in the foothills of the mountains (UNAM 1990). The precipitation in the country is highly variable. The annual rainfall in the north averages 100 mm, but 2000–4000 mm falls annually on average in the southeast and southern Pacific coast.

15.4 Environmental Diversity (Types of Vegetation)

Mexico has almost all different ecosystems, from deserts to tropical vegetation and from wild mountains to pasturelands of different types (Rzedowski 2006). All of this high diversity of vegetation and environmental types is because of the physiographic, geologic, and climatic conditions in the country, as well as the combination and influence of tropical South American environments with the boreal North American environments. The vegetation types vary by source. For example, Rzedowski (2006) considers ten vegetation types: forest or tropical evergreen forest, semi-deciduous, deciduous, thorn, xerophytic, oak, conifer, montane mesophytic, and aquatic and semiaquatic vegetation. Other vegetation types considered are mangroves, popales, tulares, palms, petenes vegetation, and chaparral.

15.5 Taxonomic Diversity and Distribution

The regional diversity and patterns of species richness have been discussed extensively (Wittaker et al. 2001) and many variables and mechanisms have been proposed to explain these patterns. Besides historic factors, recent factors like climate and topography also determine environmental heterogeneity. This determines the great variety of environments and conditions that permit diversity. The diversity of owl species in Mexico is 34 species, which represents 42.5% of the species distributed in the neotropics (König et al. 2008). While they have been considered as 32 species, a recent taxonomic revision by König et al. (2008) has proposed two more species in the country (i.e., *Glaucidium californicum* for the north of Sonora and *G. cobanense*, a species distributed in Chiapas).

This species richness of owls in Mexico is composed of 12 genera, of which the genera *Megascops* and *Glaucidium* are the most represented, with eight species in each. Following these two genera are *Strix* with five species, *Asio* with four, and *Aegolius* with two. Three genera are monospecific (*Psiloscops* (*Otus*) *flammeolus*, *Lophostrix cristata*, and *Micrathene whitneyi*). The rest of the genera (four) contain only one species in the country (Appendix 15.1). Of the most represented genera, *Megascops* is distributed in the Yucatan Peninsula only with one species, and two species are found in the Baja Peninsula. Only one species of *Glaucidium* is represented in each of the Peninsulas, *G. ridgwayi* in the Yucatan, and *G. hoskinsii* in Baja California.

The four most widely distributed species in the country are barn owl (*Tyto furcata*, previously *Tyto alba*), great horned owl (*Bubo virginianus*), burrowing owl (*Athene cunicularia*), and short-eared owl (*Asio flammeus*; Fig. 15.2). These species present a wide continental distribution. Meanwhile, there are six species with a distribution restricted to only one state in the country, some of which are endemic to Mexico, like Oaxaca screech owl (*Megascops lambi*, endemic in the Pacific slope in the state of Oaxaca), bearded screech owl (*M. barbarus*, endemic to the highlands

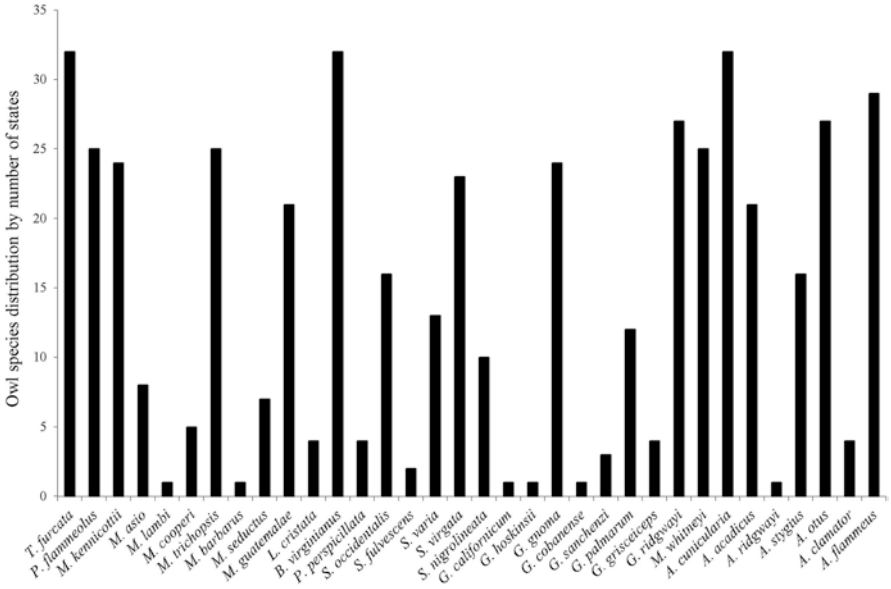

Fig. 15.2 Distribution of owl species by number of states of Mexico

Fig. 15.3 Bearded screech owl (*Megascops barbarus*) pair with two phases of color (gray and rufous). El Huitepec Ecological Reserve, San Cristóbal de Las Casas, Chiapas, 29 April 2004. Photograph José Luis Rangel-Salazar

of the state of Chiapas, Fig. 15.3), and cape pygmy owl (*G. hoskinsii*, endemic to the mountains of Baja California Sur), and the three remaining species are northern pygmy owl (*Glaucidium californicum*, distributed to the south of its range in the state of Sonora), Guatemalan pygmy owl (*G. cobanense*), and unspotted saw-whet owl (*Aegolius ridgwayi*; Fig. 15.4) (both species distributed to the northern of their range in Chiapas state; Fig. 15.2).

Of all the owl species distributed in Mexico, seven are endemic, of which three are *Megascops* species (*M. lambi*, *M. seductus*, and *M. barbarus*), three are *Glaucidium* (*G. hoskinsii*, *G. sanchezi*, *G. palmarum*), and *Micrathene* (Appendix 15.1). Two of these species are considered quasi-endemic (i.e., *M. barbarus* with a distribution in Chiapas, but shares its distribution with Guatemala, and *Micrathene*

Fig. 15.4 Unspotted saw-whet owl (*Aegolius ridgwayi*) in a cloud forest. El Huitepec Ecological Reserve, San Cristóbal de Las Casas, Chiapas, 13 March 2004. Photograph José Luis Rangel-Salazar

whitneyi, which although it presents the widest distribution in the country, it is only distributed in Mexico and the United States; Appendix 15.1).

Various species (21) present subspecies, of which only three species have subspecies with populations restricted to islands or islets:

- *Bubo virginianus mayensis*, which is distributed along the coasts of the Yucatan Peninsula.
- *Micrathene whitneyi graysoni* with a distribution on Socorro Island which is a volcanic island located in the Revillagigedo archipelago in the Pacific Ocean. The state of Colima controls this archipelago. However, it has not been observed since 1931 and is therefore considered extinct (BirdLife International 2012).
- *Athene cunicularia rostrata* with a distribution on Clarion Island also located in the Revillagigedo archipelago (Appendix 15.1).

Although the political/geographic borders of the states are more a political characteristic than a biological one, the species distribution does not follow these limits, and we can expect that the number of species increases according to the area of the state. The average owl species richness in each state is 15 ± 4.05. The state with the fewest reported species is Campeche with seven and Yucatan, Baja California, and

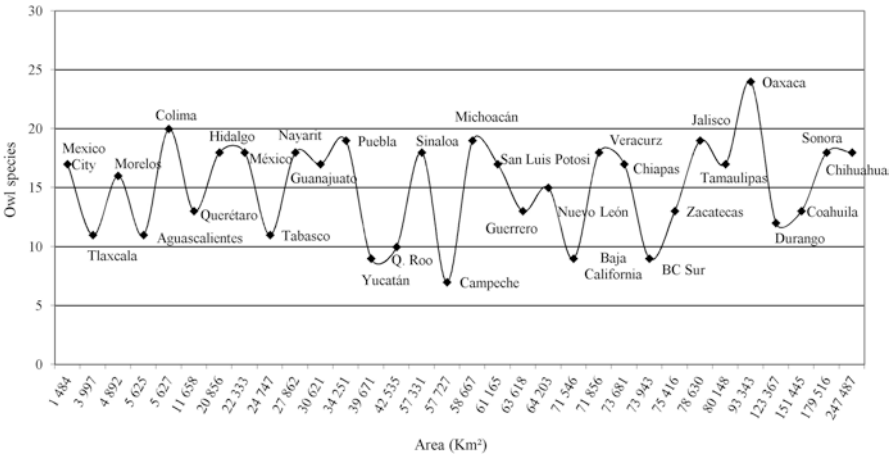

Fig. 15.5 Number of owl species registered by state. The order of the states is by area size, from smallest to largest area

Baja California Sur with nine species each. The se states are in the Peninsulas. On the other hand, the states with the highest species richness are Oaxaca with 24 species, Colima with 20, and Jalisco, Michoacán, and Puebla with 19 species in each state. There is no relation between the owl species richness in a state and its area (Fig. 15.5). Many of the records of owl species by state are accidental or occasional; therefore the species richness of a state will increase if the research with this group increases. Furthermore, the distributions of species are dynamic and in constant flux.

Five owl species distributed in Mexico migrate latitudinally, *Psiloscops* (*Otus*) *flammeolus*, *Micrathene whitneyi*, *Athene cunicularia*, *Asio otus*, and *A. flammeus*, but there are resident populations in the country (Appendix 15.1). Another pattern of distribution is altitudinal. Some species with a wide latitudinal distribution have a wide altitudinal distribution (i.e., *Tyto furcata*, *Bubo virginianus*; Fig. 15.6). Others, like *Strix occidentalis* and *Megascops kennicottii*, also have a wide altitudinal distribution from sea level until 2500 masl or greater. Thirteen species are distributed below 1500 m, and only seven species are distributed around 1500 masl; 25 species reach a distribution limited (maximum or minimum) at 1500 masl (Fig. 15.6).

The owl communities that are in temperate highland zones or tropical lowland zones generally have species of genera *Megascops*, *Glaucidium*, *Strix*, and *Asio*. In some communities there can be species congeneric that coexist, for example, *Megascops barbarus* and *M. trichopsis* are both found in temperate zones in Chiapas, but differ in habitat selection; the first uses environments that are more conserved and humid, while the latter uses environments that are more disturbed or forest edge habitat (pers. obs., Enríquez and Cheng 2008). For example, mottled owl (*Strix virgata*; Figs. 15.7 and 15.8) and black and white owl (*S. nigrolineata*) in tropical zones live in the same habitat coexisting in the same environments, but in distinct sites (Enríquez and Rangel-Salazar 2001, 2007). Depending on the altitude, other species can integrate into the community; in tropical regions lower than 1500

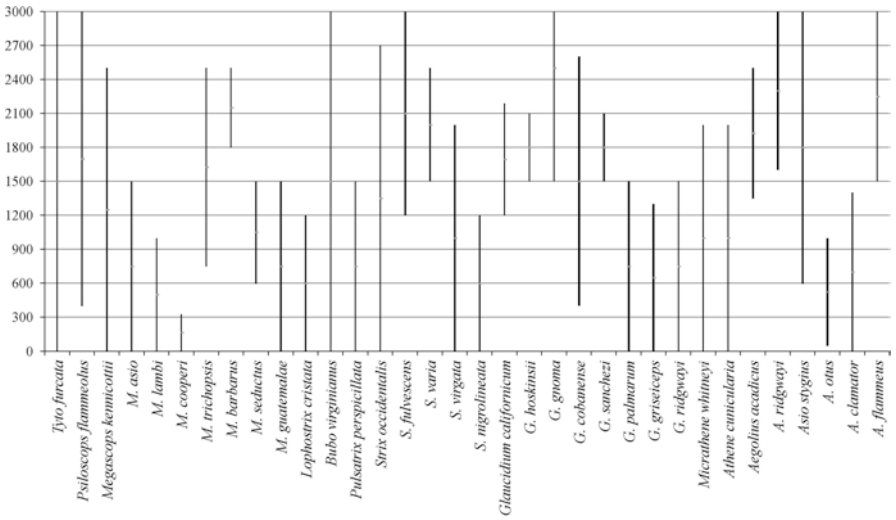

Fig. 15.6 Altitudinal distribution (masl) of 34 species that are distributed in Mexico

Fig. 15.7 Mottled owl (*Strix virgata*) in El Canelar Reserve, Acala, Chiapas, Mexico, 19 November 2008 (Photograph José Raúl Vázquez Pérez)

masl, crested owl (*Lophostrix cristata*) or spectacled (*Pulsatrix perspicillata*) can be found, while *Aegolius* species can be found in temperate zones higher than 1500 masl (Fig. 15.4). In the case of *Micrathene whitneyi* and *Athene cunicularia* that are distributed altitudinally up to 2000 masl, they use environments very specific to their ecological needs. *Micrathene whitneyi* is distributed in arid or semiarid environments with bushes, scrub, and chaparral. Primarily with saguaros, while *A. cunicularia* also inhabits arid and semiarid environments, it is found in pastures,

Fig. 15.8 Juvenile of mottled owl (*Strix virgata*) in El Silencio Reserve, Suchiate, Chiapas, 25 April 2014 (Photograph Noé Jiménez Lang)

agricultural areas, deserts, and savannas, but also in airports, cemeteries, and residential or industrial areas, to differentiate the rest of the owl species, it is an owl terrestrial and diurnal (Valdez-Gómez and Enríquez 2005).

15.6 Habitat Association

The majorities of owl species inhabit forests or jungles and are almost always associated to humid habitats and water bodies. The environments are not static and generally are heterogeneous in where they provide clearings or open areas promoting secondary growth and ecotones that are important occupation environments for raptor species, including owls (Enríquez and Rangel-Salazar 2007). While species inhabit old or mature forest environments and are important elements for their reproduction, secondary forests contain other elements for their survival, such as food or resting sites (Enríquez and Cheng 2008). Currently, secondary forests dominate the countryside landscape due to an increase of deforestation and fragmentation of mature forests; therefore they are considered important environments for the conservation of biodiversity in general and nocturnal birds in particular (Sekercioglu 2010; Dent 2010; Feely 2010; Chazdon 2014). A proposal is to develop a

management in environments with secondary vegetation or acahuales with different levels of maturity, with an agroforestry system or model in which parcels are enriched with planted trees (Soto et al. 2011). These agroforestry systems are important for various animal species and particularly raptors which find most of their food in these environments (e.g., *Megascops guatemalae*, *Lophostrix cristata*, and *Strix virgata* use abandoned cacao agroforests; Enríquez and Rangel Salazar 2007).

The process of habitat fragmentation has caused the change in the distribution and abundance of species. Some nocturnal raptor species have been adapting to the new changes, and we can find them in environments modified by humans, in areas that are partially urban, depending on factors like vegetation, food availability, and nesting sites. However, other species have been extirpated locally and are joining international and national lists of at risk species (Enríquez et al. 2006).

15.7 State of Conservation at a National Level

One of the main threats for raptor species and particularly for owl species is the loss or fragmentation of forests for multiple reasons (Thiollay 1985a; Marcot 1995; Enríquez et al. 2006) which already have negatively affected the function and structure of these ecosystems. This has caused that various species are at risk. Raptors in Mexico are one of the most threatened groups of birds (NOM-059, SEMARNAT 2010). And, particularly for species of nocturnal raptors, all are found on the international CITES Appendix II, which means that they are species that are not necessarily at risk, but could become at risk if they continue to be sold without being regulated. BirdLife International (2016) considers various species of least concern, but two species are considered near threatened, *Megascops seductus* and *Strix occidentalis*, and one vulnerable, *Megascops barbarus* (Appendix 15.1).

On the other hand, the US Fish and Wildlife Service considers five species of owls in some risk category, which also have populations in Mexico. These species are *Strix occidentalis* which is considered at risk of extinction, *Glaucidium ridgwayi* which is considered threatened, *Tyto furcata* and *Athene cunicularia* which are considered threatened in some states, and *Asio flammeus* which is considered of special concern.

The Official Mexican Law NOM-059 (SEMARNAT 2010) currently considers 18 species of owls in some category of risk, which represents 53% of the species in the country and four subspecies. Four species have special protection, 11 species are threatened, and three are in danger of extinction (Appendix 15.1). Of the subspecies, *Bubo virginianus mayensis* is threatened, *Athene cunicularia hypugaea* has special protection, *A.c. rostrata* is threatened, and *Micrathene whitneyi graysoni* is considered apparently extinct (SEMARNAT 2010; BirdLife International 2016). These categories are generally for the country, and few studies have been completed to determine the populations of these species. The impacts or threats to the populations are local and perhaps at times regional, but little information exists about the population trends for these at risk species.

15.8 Threats

The main threats to the conservation of owls in Mexico, as in the rest of the world, are the loss, degradation, and fragmentation of habitat. It has been estimated that Mexico has the second highest deforestation rates in the world (FAO 2007), which is already occurring at a rate of 350,000 ha/year (FAO 2010), while these rates vary by vegetation type, the region, and period (Ochoa-Gaona 2001). The levels of threats to owl populations and communities vary in frequency and intensity depending on the species, state, region, and locality and are strongly determined by the human cultures, natural resource uses, and the politics of management in each region (Enríquez et al. 2006).

The main factors that cause this degradation and loss of habitat are extraction of natural resources, expansion of pastures and farms, as well as urban expansion. The natural events like hurricanes, tropical storms, and droughts also are factors that modify and fragment environments. During the last 50 years, Mexico has seen drastic changes in soil use due to rapid urbanization and industrialization, which has been poorly planned. This has eroded the natural environments and has increased the degradation and loss of biological diversity in the country. However, information about the direct impacts of these threats on the population loss and changes in distribution and abundance on species in long term is nonexistent.

Another important threat is the introduction of exotic species, some of which are domestic and have become feral populations with invasive behavior which displace native species and then drastically affect the entire ecosystem. Mexico established a National Strategy for Invasive Species in 2010 that aims to prevent, control, and eradicate this grave threat and plans to strengthen in 10 years (Comité Asesor Nacional sobre Especies Invasoras 2010). The invasive species are considered important threats and their consequences established, but the environmental impacts have not been widely studied. These invasive species have reached islands and eradicated native species, for example, in islands of Mexico, 12% of the endemic birds and 20% of the endemic mammals have disappeared due to introduced species (Aguirre-Muñoz et al. 2009). We know little about owl populations on islands, but two subspecies are distributed in the Revillagigedo archipelago where various exotic species have been reported, like sheep (*Ovis* sp.), pigs (*Sus scrofa domestica*), rabbits (*Sylvilagus* sp.) which destroy habitat, cats (*Felis domesticus*), and rats (*Mus* sp.) which prey on birds and eggs in nests. This site has been considered of extreme importance because of the endemic species or subspecies it supports; in the case of the birds on the island Socorro, one encounters a high level of endemism among birds (SEMARNAT 2016).

Other threats that have been little studied in Mexico are contaminants like pesticides (insecticides and rodenticides) and their effect on forest fauna. The wide use of pesticides as organochlorides is their persistence, because it remains active for a long time and is slowly degraded; those are very harmful. The second cause of their use is that they are economic. Mexico manufactured the majority of the organochlorides that were consumed for more than 30 years in the country; Mexico also was the principal exporter of DDT (Calva and Torres 1998). Currently, they continue to

Fig. 15.9 Ridgway's pygmy owl (*Glaucidium ridgwayi*) in El Silencio Reserve, Suchiate Chiapas, 25 April 2014 (Photograph Noé Jiménez Lang)

be used and of the 90 pesticides that are prohibited or restricted in the United States, 30 continue to be used in Mexico (INEGI 1992). Twelve of those are prohibited at an international scale. The use of pesticides in the country is a common practice, and the quantities and concentrations that are applied to crops are unknown (Ortiz et al. 2014). And while Mexico and international conventions regulate the use of these substances and limit their effects on populations and ecosystems, a better coordination between all institutions needs to be achieved (Ortiz et al. 2014).

Studies on the effects of organochloride pesticides on raptors in Mexico have been few. However, they have identified and discovered concentrations of organochlorides in chickens of Osprey (*Pandion haliaetus*; dieldrin 0.969 ± 0.724 pg/ul, DDE 0.922 ± 0.895 pg/ul), which represents a risk to the health of these organisms (e.g., Rivera-Rodriguez and Rodriguez-Estrella 2011). A study in the Delta of the Colorado River in Sonora found that such concentrations of organochlorides (biphenyl polychlorides #8 PCB 126) in eggs of burrowing owls (*Athene cunicularia)* are highly toxic and can affect the hatching of the eggs (García-Hernández et al. 2006). Recently, concentrations of organochlorides have been found in Ridgway's pygmy owl (*Glaucidium brasilianum*; now *G. ridgwayi*) in Chiapas (Arrona-Rivera 2015; Arrona-Rivera et al. 2016, Fig. 15.9).

The illegal market of wildlife species is one of the principal factors that contribute to the population declines of species. Mexico is considered one of the ten main countries that have this type of illegal market (Rangel-Salazar et al. 2013). In this case, birds compose 50% of the animal species that are illegally trafficked. The important groups are parrots and parakeets, but also raptors. The important raptor species are the Harris's hawk (*Parabuteo unicinctus*) and the prairie falcon (*Falco mexicanus*). In the case of owl species, the illegal market sells *Bubo virginianus*, *Strix virgata*, *Athene cunicularia*, *Glaucidium gnoma*, and *Micrathene whitneyi* (Sosa-Escalante 2011). Also small owls of the genus *Megascops* and *Glaucidium* have been reported (PLE pers. obs.).

The origin of the specimens is often unknown, but in the market of Sonora in Mexico City, specimens of *Strix virgata* are sold from Las Choapas, Veracruz, at a cost of 2000 pesos, around 130 USD (2013, PLE pers. obs.). Generally, the illegal sale is for pets, but also for homeopathic remedies. In indigenous communities,

ritual cures use feathers and bones; therefore there are dissected organisms or animal parts of *Bubo virginianus* or some species like *Strix virgata* and *S. nigrolineata* and owls of the genus *Megascops* in esotericism markets (PLE pers. obs.).

The illegal trafficking of specimens, parts, and derivatives of forest plants and animals is a crime established in article 420 parts IV and V of the Federal Penal Code, which threatens a sentence of 1–9 years in prison or for an equivalent of 300–3000 days of minimum wage. Several illegal trafficking routes have been identified, and El Charco Cerrado in San Luis Potosi is one of the most important, but currently installed posts have been destroyed, and those responsible for this activity have been subject to legal proceedings (Sosa-Escalante 2011). In Mexico City, the Federal Attorney for Environmental Protection (PROFEPA) has established a permanent zero-tolerance policy for illegal trafficking of forest animals and plants and in 2013 has rescued more than 2569 specimens of plants and animals (Méndez 2013). Despite these strategies, birds are not exhibited publicly in markets but can be obtained illegally by request. Another problem is after the rescue of these specimens, it is difficult to release them in a forest environment because their origin is unknown.

Another important threat for those species that are little known is that we have created attitudes of fear or mystery due to their appearance, coloration, and nocturnal habits; there are diverse beliefs, legends, or myths relating them to death or bad luck. A common story in Mexico says that "when an owl sings, an Indian dies" and is associated with this happening. Other countries in Latin America also associate them with messengers of death or witches (Enríquez and Rangel-Salazar 2006; Restrepo Cardona and Enríquez 2014). Due to these beliefs, myths, and superstitions, owls are sacrificed. Also owls are hunted because they are associated with domestic damage (i.e., sometimes hunt poultry). However, these damages have not been quantified. Another motive for killing them includes target practice with rifles or slingshots (PLE pers. obs.).

Other evident, but unquantified, threats are deaths due to collisions with automobiles, high-voltage wires, or on barbed wire fences which trap and kill them. But also stochastic events like tropical storms, hurricanes, or forest fires (natural or human-caused) that modify structurally vegetation also influence in those owl population's decreases. However, they are global threats but not evaluated. Every species and population is exposed to different intensities of threats. For example, *Athene cunicularia* is threatened by habitat loss due to pasture expansion, which destroys their burrows, or poisoning due to agricultural chemicals in Chihuahua and Sonora (Chávez-Ramírez 1990; Rodríguez-Estrella and Granados 2006; García-Hernández et al. 2006).

15.9 Conservation Strategies

Mexico is a country with a large territory, resulting in high levels of biodiversity and a great variety of heterogeneous environments. These characteristics make conservation challenges difficult and complex. Thus, the establishment of conservation areas is not sufficient to protect owl species in particular and biological diversity in

general. It is necessary to include social and economic aspects to conservation strategies. However, there are diverse concepts and methodologies regarding conservation among academics, managers, and administrators to establish the understanding of conservation of biological diversity (Rangel-Salazar et al. 2005).

Protected natural areas are considered important elements and provide knowledge of the function and conservation of ecosystems (Arcese and Sinclair 1997). The establishment of an important number of these areas is necessary. The most consolidated instrument of biodiversity conservation in Mexico is the National System of Protected Areas administered by the National Commission of Protected Natural Areas (CONANP) which includes 174 federal natural areas which represents more than 254,552.5 km^2, but only protects 13% of the national territory (CONANP 2014b). These areas are classified into six categories. Biosphere reserves cover the main part of the protected area, with a total of 41 reservations, and only cover 6.4% of the national area (Table 15.1). This National System of Protected Natural Areas is found in all of the states of the country, but the representation of each of the six categories varies in the states. For example, Chiapas is the only state with six categories; the majority of states have more than one category, including biosphere reserves, national parks, monuments, and protected natural resource areas, and four states (Tamaulipas, Zacatecas, Guanajuato, and Tabasco) only have one or two protected areas.

Categories and definitions are:

1. Flora and Fauna Protected Area: These areas allow exploitation of natural resources in accordance to the management program. This type covers 67,868.9 km^2 of the national territory.
2. Natural Resource Protected Area: These are areas for soil, watershed, and forest natural resource conservation and protection. Currently 45,359 km^2 is in this management category.
3. Natural Monument: These are areas that contain one or many important national natural elements. These areas are established for their beautiful scenery: educational, scientific, recreational, or historic value. Generally, these are small areas because they cannot be included in other management categories. They cover 162.7 km^2 of the national territory.
4. National Park: Natural areas of interest for conservation, but also considered potential sites for tourist development. These areas are for public use and, where it is permitted, the exploitation of natural resources in accordance to the management program. Currently 14,101.6 km^2 of the national territory is in this category of national protected area.
5. Biosphere Reserve: These areas are representatives of one or more environments undisturbed by humans that need to be conserved. The area of these reserves must be more than 100 km^2 and contains two zones (nucleus and buffer). At a national level, Biosphere Reserves protect 127,032 km^2 of the national territory.
6. Sanctuary: These are areas established in sites characterized by their rich plant and animal communities or because of the presence of species with restricted ranges. Some examples are glens, relics, caves, caverns, cenotes, cove, or other geographic formations that need to be conserved. These areas protect an area of 27.4 km^2.

Table 15.1 The categories and territorial extension (Km^2) of Natural Protected Areas (ANPs) in Mexico. Information from shapefile (CONANP 2014b)

ANP categories	States	Number of ANPs	Extension (km^2)
Flora and fauna protected area	Quintana Roo, Yucatán, Campeche, Baja California Sur, Baja California, Oaxaca, Chihuahua, Sonora, Chiapas, Tabasco, Estado de México, México City, Morelos Coahuila, Colima, Sinaloa, Jalisco, Tamaulipas, Michoacán, San Luis Potosí, Zacatecas, and Veracruz	38	67,868.9
Natural resource protected area	Aguascalientes, Zacatecas, Coahuila, Nuevo León, Jalisco, Durango, Nayarit, Colima, Chiapas, Hidalgo, Puebla, México State, and Michoacán	8	45,359.9
Natural monument	Chiapas, Nuevo León, Chihuahua, Oaxaca, and Coahuila	5	162.7
National park	Baja California, Yucatán, Quintana Roo, Baja California Sur, Michoacán, Oaxaca, Veracruz, Puebla, Chiapas, Chihuahua, México City, Querétaro, Nuevo León, Coahuila, Estado de México, Yucatán, Hidalgo, San Luis Potosí, Morelos, Guerrero, Nayarit, Tlaxcala, Zacatecas, Jalisco, and Colima	65	14,101.6
Biosphere reserve	Sonora, Colima, Quintana Roo, Baja California, Hidalgo, Campeche, Jalisco, Chiapas, Baja California Sur, Nayarit, Chihuahua, Durango, Veracruz, Coahuila, Nayarit, Tabasco, Campeche, Yucatán, Morelos, Puebla, Guerrero, San Luis Potosí, Tamaulipas, Guanajuato, Querétaro, Oaxaca, Michoacán, Hidalgo, and México State	40	127,032.0
Sanctuary	Jalisco, Sinaloa, Oaxaca, Yucatán, Quintana Roo, Michoacán, Chiapas, Tamaulipas, and Guerrero	16	27.4
Total (Km^2) = 254,552.5			

Despite the fact that Mexico has formed a National Commission of Protected Natural Areas, the number of protected areas is insufficient, but at the same time the number of personnel assigned to the management of these areas is limited as is the budget. Furthermore, the management and conservation effort is not acceptable for the objectives for each category. While some reserves like Biosphere Reserves have received much attention, others, like national parks or flora and fauna protected areas, could be in an abandoned state.

Another important tool for conservation of biological diversity is the Official Mexican Law (NOM-059 SEMARNAT 2010). The Official Mexican Law is elaborated by the National Consulting Committee of Normalization of Regulation and Promotion of Sanitation which establishes rules, attributes, and directives applicable to a product, process, system, or activity. The Official Mexican Law NOM-059-SEMARNAT-2010, which refers environmental protection of at risk forest plant and animal species native to Mexico, lists the species that have a conservation problem.

Furthermore, representatives and investigators from various universities, government agencies, associations, and nongovernmental organizations participate. They consider for categories of risk (E, probably extinct in wildlife; P, in peril of extinction; A, threatened or at risk; and Pr, special protection, SEMARNAT 2010). This law currently includes 22 species and subspecies of owls of which 5 have special protection, 13 are threatened, three are in peril of extinction, and one is probably extinct (Appendix 15.1). Of these, five are subspecies (SEMARNAT 2010, Appendix 15.1).

Another species and ecosystem conservation strategy or tool which is used in Mexico is the identification of priority sites with different criteria. Starting from 1995, they developed a national map of priority areas (terrestrial and marine) for the conservation of biodiversity; this map was developed by La Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO); 152 terrestrial priority regions currently exist that cover an area of 515,558 km^2, which corresponds to more than a quarter of the national territory (Arriaga et al. 2000). In recent years, Mexico has acquired various compromises with international community related with conservation of natural ecosystems through international conventions, agreements, and compromises. Particularly for Mexican bird conservation, 263 important areas for conservation of birds have been identified (AICAS; Arizmedi and Márquez-Valdelamar 2000). These areas are having a set of criteria of species richness, abundance, and seasonality. The proposal of this initiative, among others, is that it is a tool that can help prioritize resources for conservation.

All of these efforts are at an ecosystem or community level. Plans for recovery only exist for certain species where US initiatives include Mexico when the species are distributed in Canada, the United States, and Mexico or have neotropical migratory populations. For example, the Recovery Plan for the Spotted Owl (*Strix occidentalis lucida*) considers a recovery strategy of habitat management and species monitoring. The recovery strategy has five components: (1) protect current populations, (2) manage habitat for the future, (3) manage threats, (4) monitor populations and habitat, and (5) establish collaborations to facilitate the reestablishment of this species (US Fish and Wildlife Service 2012).

Besides this initiative, a lack of biological and ecological information still exists for populations in Mexico, and management strategies need to be developed at a large scale for the survival of this species.

15.10 State of Biological and Ecological Knowledge

The biological and ecological knowledge of different raptor species in tropical areas is very limited. In general, the distribution and basic aspects about their abundance are known. However, population trends and other information about their life history are little known. Since the article by Thiollay about the community composition of tropical forest raptors, which is 30 years old (1985a, 1994) and does not include owls because of a lack of information, it was mentioned that perhaps many of the raptor species will disappear before we learn about them, because there are very little information about their natural history.

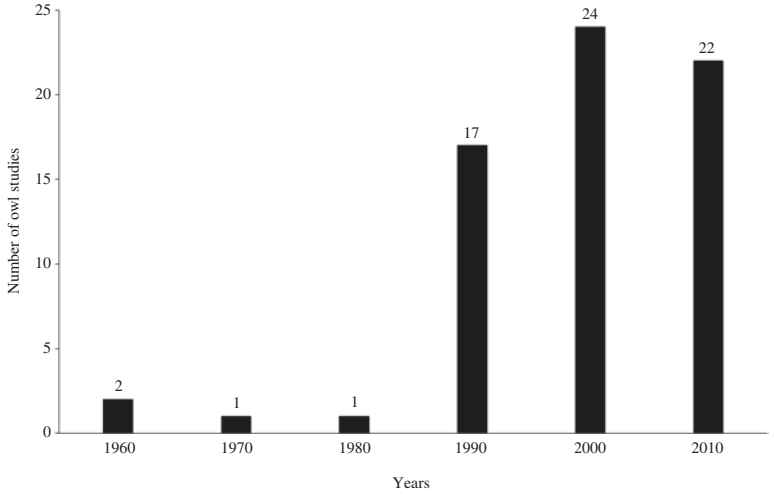

Fig. 15.10 Number of owl studies in Mexico for decades

Since this time, the situation has not changed significantly. Although there is more information about the distribution and ecology of species in certain areas, biological and ecological information is still limited in many areas (Enríquez et al. 2006, 2012). A factor that influences which birds are studied less is that they are difficult to study given their behavior, which is generally nocturnal and also cryptic, secretive, and stealthy, and many are rare. The information that exists about owls in Mexico are found on general bird lists or new registers of distribution or sightings, and only recently have studies begun that are aimed specifically at this group (Enríquez et al. 2006, Fig. 15.10). However, some studies are theses and have been not published and several are unavailable, and others are reports. Only few have been published.

Of the 34 owl species reported in Mexico, only 25 have been studied (Table 15.2). The Nearctic species show more information like *Strix occidentalis*, *Bubo virginianus*, *Tyto furcata*, *Psiloscops flammeolus*, and *Aegolius acadicus*. For the rest of the species, information are isolated or are only in lists (e.g., protected natural areas). After a revision of owl species publications, the states that have more studies are Hidalgo, Durango, Chiapas, and Tlaxcala (Table 15.2). On the other hand, there is a lack of information for nine species, which include *Megascops lambi*, *Glaucidium hoskinsii*, and *Asio clamator*, among others (Table 15.2, Fig. 15.11). In general, the studies about Mexican owls are grouped into the following topics: distribution, abundance, habitat use, reproduction, diet, and vegetation association.

The study of abundance and species distribution relationship is a basic topic of ecology (Krebs 2001). The descriptive approximation is the basis of ecology that still is limited for this group. The studies that have estimated the abundance of some species are Young et al. (1997), Garza (1999), Palacios et al. (2000), Enríquez (2002), Márquez (2005), González-Rojas et al. (2006), Flesch (2008), Alba-Zuñiga et al. (2009), Vázquez-Pérez et al. (2011), Rivera-Rivera et al. (2012), Fernández (2013), Ramírez (2014) and Ortiz-Pulido and Lara (2014). In total, these studies

Table 15.2 List of owl species with biological and ecological information produced in Mexican states

Species	Distribution	Abundance	Vegetation/landscape	Habitat use	Breeding	Diet	States
Tyto furcata (alba)	X	X	X		X	X	Tlaxcala, Oaxaca, Chiapas, Hidalgo, Chihuahua, Durango, Baja California, Baja California Sur, Jalisco, Michoacán, State of México
Psiloscops (Otus) flammeolus	X	X	X			X	Tlaxcala, Hidalgo, Durango, Nuevo León
Megascops kennicottii	X	X	X			X	Tlaxcala, Hidalgo, Baja California
Megascops asio	X						Hidalgo
Megascops lambi							
Megascops cooperi							
Megascops trichopsis	X	X	X				Chiapas, Hidalgo, Durango, Tlaxcala, Puebla
Megascops barbarus	X	X	X		X	X	Chiapas
Megascops seductus		X		X			Morelos
Megascops guatemalae	X	X	X	X			Chiapas, Hidalgo
Lophostrix cristata		X	X				Chiapas
Bubo virginianus	X	X	X		X	X	Tlaxcala, Hidalgo, Veracruz, Quintana Roo, Durango, Baja California, Oaxaca

Table 15.2 (continued)

Species	Distribution	Abundance	Vegetation/landscape	Habitat use	Breeding	Diet	States
Pulsatrix perspicillata		X	X			X	Chiapas, Oaxaca
Strix occidentalis	X	X	X			X	Zacatecas, Aguascalientes, Chihuahua, Durango, Sonora
Strix fulvescens	X	X					Oaxaca, Chiapas
Strix varia							
Strix (Ciccaba) virgata	X	X	X	X			Chiapas, Hidalgo, Oaxaca
Strix (Ciccaba) nigrolineata	X	X	X			X	Chiapas, Hidalgo
Glaucidium californicum							
Glaucidium hoskinsii							
Glaucidium gnoma	X	X					Hidalgo, Durango, Tlaxcala
Glaucidium cobanense							
Glaucidium sanchezi	X						Hidalgo
Glaucidium palmarum							
Glaucidium griseiceps							

Glaucidium ridgwayi	X	X	X	X	X		Chiapas, Campeche, Hidalgo, Sonora, Oaxaca
Micrathene whitneyi	X	X					Hidalgo, Oaxaca, México, Puebla, Guanajuato, Michoacán, Guerrero, Morelos
Athene cunicularia	X	X	X		X	X	Hidalgo, Durango, Baja California, Baja California Sur, Nuevo León, Jalisco, Chihuahua, Sonora, Tlaxcala, Puebla
Aegolius acadicus	X	X	X			X	Tlaxcala, Hidalgo, Oaxaca, Durango, Puebla
Aegolius ridgwayi	X	X	X				Chiapas
Asio stygius	X						Tamaulipas, Hidalgo
Asio otus	X						Hidalgo, Chihuahua
Asio clamator							
Asio flammeus	X					X	Hidalgo, Yucatán, Jalisco

Fig. 15.11 Striped owl (*Asio clamator*) in Villaflores, Chiapas, 23 October 2014 (Photograph José Raúl Vázquez Pérez)

have estimated the abundance of 20 owl species (e.g., *Tyto furcata*, *Megascops kennicottii*, *M. barbarus*, *Lophostrix cristata*, *Bubo virginianus*, *Pulsatrix perspicillata*, *Aegolius ridgwayi*, Table 15.2). These were realized in Tlaxcala, Hidalgo, Chihuahua, Durango, Chiapas, and Morelos, among others. The study areas have been very local and are generally done in protected natural areas like biosphere reserves. Recently the distribution and abundance of *Micrathene whitneyi* in Oaxaca has been studied (Flores-Dimas 2016).

The studies about the distribution of owl species have been done at different scales. Some studies have focused on only a level spatial (e.g., country, state, landscape, ecosystem) or temporal (e.g., monthly, seasonal) scale. The species that have been studied at different scales of distribution are *Megascops kennicottii*, *M. seductus*, *M. trichopsis*, *M. guatemalae*, *Bubo virginianus*, *Glaucidium gnoma*, *G. brasilianum*, *Micrathene whitneyi*, *Athene cunicularia*, *Strix occidentalis*, *S. virgata*, and *A. flammeus*, among others (Cirett-Galan and Díaz 1993; Arámbula 1994; Enríquez 1997; Peláez 1998; Garza 1999; Palacios et al. 2000; Valdez-Gómez and Holroyd 2000; Enríquez 2002; Rodríguez-Estrella and Careaga 2003; Martínez-Ortega 2009; Enríquez et al. 2010; Vázquez-Pérez et al. 2011; Rivera-Rivera et al. 2012; Valencia-Herveth et al. 2012; Fernández 2013; Ortíz-Pulido and Lara 2014, Fig. 15.12). Short communications have been published about new observations or changes in the distribution of *Psiloscops flammeolus*, *Aegolius acadicus*, *Asio flam-*

Fig. 15.12 Middle American screech owl (*Megascops guatemalae*) individuals in Biosphere Reserve Selva El Ocote, Ocozocoautla, Chiapas, 28 March 2014 (Photograph José Raúl Vázquez Pérez)

Fig. 15.13 Fulvous owl (*Strix fulvescens*) in El Triunfo Biosphere Reserve, Ángel Albino Corzo, Chiapas, 20 May 2013 (Photograph Pedro Ramírez Santos)

meus, *A. stygius*, *A. otus*, *Bubo virginianus*, *Strix fulvescens, Megascops trichopsis*, and *Athene cunicularia* (Contreras-Balderas 1991; McAndrews et al. 2006; Rodríguez-Ruiz and Herrera-Herrera 2009; Lavariega et al. 2011; Ramírez-Julián et al. 2011; Rueda-Hernández et al. 2012; Ruvalcaba-Ortega et al. 2014; Estay-Stange et al. 2015, Fig. 15.13).

Studies about the diet or feeding habits are of the topics that have been much studied for some species. Generally the species form pellets that they deposit below their roosts or nests; pellets are collected and analyzed. In temperate environments, pellets can remain for more time before they disintegrate. Therefore, most of the species whose diets have been studied have temperate distribution and include *Tyto furcata*, *Psiloscops flammeolus*, *Megascops kennicottii*, *Bubo virginianus*, *Strix occidentalis*, *Athene cunicularia*, *Aegolius acadicus*, and *Asio flammeus* (Anderson and Nelson 1960; Anderson and Long 1961; López-Forment and Urbano-V 1977; Babb-Stanley et al. 1991; Llinas-Gutierrez et al. 1991; Mejia-Zavala et al. 1991; Ibañez et al. 1992; Arámbula 1994; Morales 1997; Rodríguez-Estrella 1997; Young et al. 1997; Peláez 1998; Roman 1999; Gaona et al. 2000; Aragón et al. 2002;

Márquez 2002; Rodríguez-Vázquez 2002; Valdez-Gómez 2003; Velásquez 2003; Álvarez-Castañeda 2004; Bravo-Vinaja et al. 2005; González-Rojas et al. 2006; Santos-Moreno and Alfaro 2009; Medina-Romero et al. 2008; Valencia-Herveth et al. 2008; Valdez-Gómez et al. 2008; Enríquez et al. 2010). There are very few studies for tropical owl species (*Pulsatrix perspicillata*; Gomez de Silva et al. 1997, and *S. nigrolineata*; Ibañez et al. 1992). The diet of *Megascops barbarus* was determined by studying its feces, not its pellets (Enríquez and Cheng 2008). These studies about diet were done in 14 states (Table 15.2). The species most studied for this topic are *Tyto furcata* and *Strix occidentalis*.

Studies about habitat use have only been done for *Megascops seductus* (Alba-Zuñiga et al. 2009), *M. guatemalae*, *Strix virgata*, and *Glaucidium ridgwayi* (Vázquez-Pérez et al. 2011). These studies were done in Morelos and Chiapas, respectively. The study areas were in the regions of the Sierra de Huautla Biosphere and Selva El Ocote Biosphere Reserve. On the other hand, there is information about vegetation association for 16 owl species, most of which are temperate species like *Strix occidentalis*, *Bubo virginianus*, *Psiloscops flammeolus*, *Aegolius acadicus*, and *Tyto furcata* (Tarango 1994; Tarango et al. 1997; Young et al. 1998; Garza 1999; Tarango et al. 2001; Márquez-Olivas et al. 2002; González-Rojas et al. 2006; Ruiz-Ayma 2010; Fernández 2013). Other species which have been analyzed for such associations are *Megascops kennicottii*, *M. trichopsis*, *M. barbarus*, *M. guatemalae*, *Lophostrix cristata*, *Pulsatrix perspicillata*, *Strix virgata*, *S. nigrolineata*, *Glaucidium ridgwayi*, and *Aegolius ridgwayi* (Rodríguez-Estrella and Careaga 2003; Balan et al. 2008; Enríquez and Cheng 2008; Martínez-Ortega 2009; Vázquez-Pérez 2011; Rivera-Rivera et al. 2012; Fernández 2013). The majorities of these studies were done in protected natural areas and generally were short-term studies completed in less than a year.

Another theme of study in Mexico about owls is reproductive aspects, but there are few and in general for species with temperate distributions. Studies for *Tyto furcata*, *Megascops barbarus*, *Bubo virginianus*, *Glaucidium ridgwayi*, and *Athene cunicularia* have been realized (Rodríguez-Estrella and Hiraldo 1985; Rodríguez-Estrella and Ortega-Rubio 1993; Enríquez and Rangel-Salazar 1996; Enríquez and Cheng 2008; Hernández and Bonilla 2008; Ruiz-Ayma and González-Rojas 2008). These studies were done in the states of Chiapas, Oaxaca, Quintana Roo, Tlaxcala, Nuevo Leon, Jalisco, and Durango, among others (Table 15.2). Other studies on the relationships of environment factors (i.e., illumination, moon phase) associated to the owl vocalization have been considered (Vázquez-Pérez and Enríquez 2017). While we conducted an intensive search for studies about owls completed in Mexico, more unpublished information that is not available could exist.

15.11 Conclusions

Mexico is a country with a high number of owl species, but also with many threats that affect their survival. However, we know little about their ecology and how these threats influence population trends. The majority of the studies in Mexico have been

done with Nearctic species, and few have been done with tropical species. Although studies about this group have increased recently, there still exists a lack of information. Following the Official Mexican Law (NOM-059), more than 50% of the species are found at some category of risk. Although protected natural areas are important for species conservation, these areas are insufficient and only cover 13% of the country's area. The increase in open areas and secondary growth has occurred in important areas for raptor conservation. In the case of owl species, many do use these environments. We suggest an increase in the population-level ecological studies, as well as the community level for these raptors in long term to understand ecological patterns, their function, and evolution.

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Ridgway´s Pygmy Owl
(*Glaucidium ridgwayi*)

Appendix 15.1

Owl Species and Subspecies of Mexico

No.	Species	Subspecies	English name	Spanish name	SD	E	ST	NOM-059 (2010)	BirdLife 2012	USFWS	CITES	Distribution
1	*Tyto furcata (alba)*	*pratincola*	Barn owl	Lechuza de campanario	L				LC	E″	Appendix II	H
2	*Psiloscops (Otus) flammeolus*	*flammeolus*	Flammulated screech owl	Tecolote ojioscuro, Tlalquipatli	H		MLD*		LC		Appendix II	M
3	*Megascops kennicottii*	*aikeni, yumanensis, cardonensis, xanthusi, vinaceus*	Western screech owl	Tecolote occidental, Tecolotito chillón	L				LC		Appendix II	H
4	*Megascops asio*	*mccalli*	Eastern screech owl	Tecolote oriental	L			Pr	LC		Appendix II	R
5	*Megascops lambi*		Oaxaca screech owl	Tecolote de Oaxaca		E					Appendix II	R
6	*Megascops cooperi*		Pacific screech owl	Tecolote de Cooper, Tecolotito manglero	M			Pr	LC		Appendix II	R
7	*Megascops trichopsis*	*trichopsis, aspersus, mesoamericanus*	Whiskered screech owl	Tecolote rítmico, Tecolotito manchado, Tecolotito chillón, Zumaya, Ah-coo-akab, Kulte	H				LC		Appendix II	H
8	*Megascops barbarus*		Bearded screech owl	Tecolote barbudo, Tecolotito ocotero, Tecolotito bigotón	M	E*		P	VU		Appendix II	R

9	*Megascops seductus*		Balsas screech owl	Tecolote del Balsas	M	E		A	NT		Appendix II	R
10	*Megascops guatemalae*	*guatemalae, hastatus, cassini*	Middle American screech owl	Tecolote vermiculado, Tecolotito guatemalteco, Tecolotito maullador, Guía de León, Kulte	M				LC		Appendix II	M
11	*Lophostrix cristata*	*stricklandi*	Crested owl	Búho cuerno blanco, Tecolote cuerniblanco, Tecolote crestado	H			A	LC		Appendix II	M
12	*Bubo virginianus*	*pacificus, pallescens, elachistus, mayensis*	Great horned owl	Búho cornudo, Gran duque, Buho grande, Buho real, Ikim, Tunculuchu	L			A*	LC		Appendix II	H
13	*Pulsatrix perspicillata*	*saturata*	Spectacled owl	Búho de anteojos, Lechuza de anteojos	M			A	LC		Appendix II	M
14	*Strix occidentalis*	*lucida*	Spotted owl	Búho manchado	M			A	NT	T	Appendix II	M
15	*Strix fulvescens*		Fulvous owl	Búho lenonado, Lechuzón, Tecolote listado guatemalteco	H			P	LC		Appendix II	R
16	*Strix varia*	*sartori*	Barred owl	Búho listado	M			Pr	LC		Appendix II	M

(continued)

No.	Species	Subspecies	English name	Spanish name	SD	E	ST	NOM-059 (2010)	BirdLife 2012	USFWS	CITES	Distribution
17	*Strix (Ciccaba) squamulata (virgata)*	*squamulata, tamaulipensis, centralis*	Mottled owl	Búho café, Mochuelo rayado, Mochuelo llanero, Lechuza café	M				LC		Appendix II	M
18	*Strix (Ciccaba) nigrolineata*		Black and white owl	Búho blanquinegro, Mochuelo zarado, Lechuza listada	M			A	LC		Appendix II	M
19	*Glaucidium californicum*		Northern pygmy owl	Mochuelo norteamericano, Mochuelo californianio							Appendix II	
20	*Glaucidium hoskinsii*		Cape pygmy owl	Tecolote del Cabo		E		A			Appendix II	R
21	*Glaucidium gnoma*	*gnoma*	Mountain (northern) pygmy owl	Tecolote serrano, Picametate, Tecolotillo duende, Tlalquipatli, Toj-caj-xnuk	M				LC		Appendix II	H
22	*Glaucidium cobanense*		Guatemalan pygmy owl	Tecolote guatemalteco, Mochuelo guatemalteco								R
23	*Glaucidium sanchezi*		Tamaulipas pygmy owl	Tecolote tamaulipeco		E		P	LC		Appendix II	R
24	*Glaucidium palmarum*		Colima pygmy owl	Tecolote colimense		E		A	LC		Appendix II	M

25	*Glaucidium griseiceps*		Central American pygmy owl	Tecolote mesoamericano				A	LC		Appendix II	M
26	*Glaucidium ridgwayi*	*ridgway, cactorum*	Ridgway's pygmy owl	Tecolote bajeño, Tecolotillo rayado, Tecolotillo cuatrojos, Tecolotito rayado, Vieja, Maclovio, Aurorita, Toj-caj-xnuk					LC	E	Appendix II	H
27	*Micrathene whitneyi*	*whitneyi, idonea, sanfordi, graysoni*	Elf owl	Tecolote enano	M	E*	MLD*	E*	LC		Appendix II	H
28	*Athene cunicularia*	*hypugaea, rostrata*	Burrowing owl	Tecolote llanero, Lechucilla llanera, Lechuza de ojo, chicuate, chicuatotol, zacatecolotl	M		MLD*	Pr*, A*	LC	E″	Appendix II	H
29	*Aegolius acadicus*	*acadicus, brodkorbi*	Northern saw-whet owl	Tecolote afilador, Tecolotito cabezón, Lechuza cabezona	M				LC		Appendix II	M
30	*Aegolius ridgwayi*		Unspotted saw-whet owl	Tecolote canelo	M			A	LC		Appendix II	R
31	*Asio stygius*	*robustus*	Stygian owl	Búho cara oscura, Tecolote fusco, Lechuza estigia	M			A	LC		Appendix II	M
32	*Asio otus*	*wilsonianus*	Long-eared owl	Búho cara café, Lechuza barraquera	M		MLD*		LC		Appendix II	M

(continued)

No.	Species	Subspecies	English name	Spanish name	SD	E	ST	NOM-059 (2010)	BirdLife 2012	USFWS	CITES	Distribution
33	*Asio clamator*	*forbesi*	Striped owl	Búho cara clara, Tecolote gritón, Búho cornudo	L			A	LC		Appendix II	M
34	*Asio flammeus*	*flammeus*	Short-eared owl	Búho cuerno corto, Tecolote orejas cortas, Mochuelo	L		MLD	Pr	LC	SC	Appendix II	M

List in taxonomic order follows the American Ornithologists' Union (AOU 1998) y supplements and König et al. (2008). Spanish names follow Birkenstein and Tomlinson (1981) and Escalante-Pliego et al. (1996)
ST = seasonality refers to migratory species where *MLD* = latitudinal migratory and MLD* = with resident populations
SD = sensitivity to disturbed for human activities where *H* = high, M = media, and *L* = low follow Stotz et al. (1996). Blank species are not considered by Stotz et al. (1996)
Endemic species in the country (E) or quasi-endemics (E*) with distribution in Chiapas and Guatemala or Northern Mexico and the United States. Subspecies underlined are endemic to islands
NOM, Mexican Official Norm (NOM-059 ECOL 2010) where *E* = species possible extinct, *P* = peril of extinction, *A* = endangered, *Pr* = special protection and with *, subspecies considered in that category (SEMARNAT 2010)
BirdLife International: *LC* least concern, *NT* near threatened, *VU* vulnerable (BirdLife 2016)
USFWS: *T* threatened, *E* endangered, *E* endangered in some states, *SC* special concern (USFWS 2007)
CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora): All the owl species are listed in the Appendix II, which are species not threatened with extinction, but may become so unless trade in specimens is subject to strict regulation in order to avoid utilization incompatible with the survival of the species in the wild
Distribution in Mexico: *R* (restricted to two or three states), *M* (medium, distributed less of 50% of the country), *H* (high, wide distribution in the country)

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