Chapter 7
Herpetofauna Used in Traditional Folk Medicine: Conservation Implications

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Abstract This chapter provides an overview of the global use of herpetofauna in traditional folk medicine and the implications for conservation. The results indicate that 331 species (284 reptiles and 47 amphibians) are used in traditional folk medicine around the world. Among the species recorded, 182 reptiles and 42 amphibians are listed in the IUCN Red List. Additionally, 93 reptiles are in some of the appendices of CITES. These numbers demonstrate the importance of understanding such medicinal uses in the context of reptile conservation as well as the need for considering sociocultural factors when establishing management plans directed toward the sustainable use of these reptiles.

7.1 Introduction

Amphibians and reptiles (collectively known as herpetofauna) represent one of the most important groups of vertebrates. The herpetofauna and human societies have interacted for millennia, virtually wherever they have been in contact. Thereby, amphibians and reptiles are one of the fundamental ethnozoological entities, and

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people interpret their relationship with these animals differently depending on culture, environment, and personal experience (Alves et al. 2010a).

Ethnoherpetology, a subdivision of ethnozoology, examines the relationships between human cultures and reptiles/amphibians (Bertrand 1997; Das 1998; Goodman and Hobbs 1994; Speck 1946). Ethnozoological studies can aid in the evaluation of the impacts human populations have on native animal species and in the development of sustainable management plans, and thus, they are essential to conservation efforts (Alves and Souto 2011).

Evidence from a variety of sources has shown that humans have long exploited the eggs, meat, blood, oil, shells, skin, bones, and other parts of reptiles and amphibians to provide food and materials for making tools, ornaments, and religious objects (Alves 2006; Alves et al. 2006, 2008; Alves and Pereira Filho 2007; Alves and Santana 2008; Fitter 1986; Fitzgerald et al. 2004; Franke and Telecky 2001; Frazier 2005; Mohneke et al. 2009; Tyler et al. 2007; Zhou and Jiang 2004). In addition to these uses, the herpetofauna is used for medicinal and cultural purposes (e.g., as totem or fetish or in particular ceremonies), as well as in day-to-day activities (Alves et al. 2008, 2009; Boll 2004; Mohneke et al. 2011; Myers et al. 1978; Morris and Morris 1965).

People have relied on medicinal products derived from natural sources for millennia, and animals have long been an important part of that repertoire (Adeola 1992; Alves and Rosa 2005; Angeletti et al. 1992; Lev 2003). The pharmacopeias of folk societies as well as of traditional (such as those of the Chinese, Ayurvedic, Unani) and Western medical systems contain thousands of uses for medicines made from leaves, herbs, roots, bark, animals, mineral substances, and other materials found in nature (Gesler 1992). Ingredients derived from wild plants and animals are not only widely used in traditional remedies, but are also increasingly valued as raw materials in the preparation of modern medicines and herbal preparations.

Increased demand and the growth of human populations have led to increased and often unsustainable rates of exploitation of natural resources, and some wild species are already threatened with extinction for this reason (Lee 1999). Discussions concerning the links between traditional medicine and biodiversity are therefore becoming imperative, particularly in view of the fact that folk medicine is the source of primary health care for 80% of the world's population (Alves and Rosa 2005; Alves et al. 2007a).

Despite the intensive use of the herpetofauna for medicinal purposes, there is a general lack of detailed information concerning the magnitude of this harvesting and its impact on the species involved (Alves and Pereira Filho 2007; Alves et al. 2008; Mohneke et al. 2011). Demands on the wild sources of traditional medicinal products are increasing as human populations grow inexorably and poorer countries are forced to decrease spending per capita on Western health systems. On the other hand, Western populations are turning to more traditional and homeopathic products, and their demand for natural remedies is increasing (IUCN 2000). Additionally, some species are in danger of extinction due to a combination of factors independent of the growing global demand for traditional medicines and other natural products.

Reptiles are among the animal species most frequently used in traditional folk medicine (Alves and Alves 2011; Alves et al. 2007a, 2008, 2009; Mahawar and Jaroli 2008; Vázquez et al. 2006; Zhou and Jiang 2004). This also applies to amphibians which are used for medicinal purposes in several countries (Alves et al. 2007b; Boll 2004; Mohneke et al. 2011), although to a lesser extent compared to reptiles.

The goal of this chapter is to provide an overview of the global use of the herpetofauna in traditional medicine, to identify those species used as folk remedies, and to discuss the implications of their harvesting. In this context, we address the following questions: (1) which reptile and amphibian species are used in folk medicine; (2) which medicinal species are endangered, and (3) what are the implications of the use of zootherapeutics for reptile and amphibian conservation? We hope to stimulate further discussions about this use of biodiversity and its implications for wildlife conservation.

7.2 Methods

In order to examine the diversity of reptiles used in traditional medicine, all available references or reports of folk remedies based on herpetofauna sources were examined. Only taxa that could be identified to the species level were included in the database. Scientific names provided in the publications were updated according to The Reptile Database (2011) and Amphibian Species of the World 5.5 (Frost 2011). The conservation status of the reptile species follows IUCN (2011) and CITES (2011).

The sources analyzed were: Branch and Silva (1983), Begossi (1992), Begossi and Braga (1992), Donadio and Gallardo (1984), Figueiredo (1994), China National Corporation of Traditional and Herbal Medicine (1995), Marques (1995), Freire (1996), Costa-Neto (1996, 1999a, b, c, 2000), SEMARNAP-PROFEPA (1998), Begossi et al. (1999), Sodeinde and Soewu (1999), Chen et al. (2000, 2006, 2009), El-Kamali (2000), Perry (2000), Seixas and Begossi (2001), Almeida and Albuquerque (2002), CITES (2002), Kakati and Doulo (2002), Apaza et al. (2003), Lev (2003), Fitzgerald et al. (2004), Silva et al. (2004), Almeida et al. (2005), Andrade and Costa-Neto (2005), Costa-Neto and Pacheco (2005), Smart et al. (2005), Ashwell and Walston (2008), Alakbarli (2006), Alves (2006), Alves and Rosa (2006; 2007a, b; 2010), Alves et al. (2007a, b), Ives (2006), Kakati et al. (2006), Mahawar and Jaroli (2006), Vázquez et al. (2006), Alves and Pereira Filho (2007), Barzyk (1999), Dharmananda (2007a; 2007b), El Din (2007), Negi and Palyal (2007), Fretey et al. (2007), Highfield and Bayley (2007), Highfield and Slimani (2007), IFAW (2007), Meiling et al. (2008), Quave et al. (2010), Rowley et al. (2010), Martínez and Barboza (2010), Mohneke et al. (2010), Mohneke et al. (2011), Shao-Ke et al. (2010), Alves and Alves (2011), Indian Traditional Medicinal Knowledgebase (2011) and Lohani (2011).

7.3 Results and Discussion

7.3.1 Medicinal Herpetofauna

The medicinal herpetofauna includes a total of 331 species, of which 284 are reptiles and 47 are amphibians. These species belonging to 202 genera and 57 families are used in traditional folk medicine.

Among the reptiles, the groups with the largest numbers of species used were snakes (123 species), followed by lizards (71), chelonians (76), and crocodilians (14) (Table 7.1). In relation to amphibians, the family with the largest number of species was Bufonidae (15 species). Of the total amphibians recorded, 42 species are included in the IUCN Red List (Fig. 7.1), but none are in the appendices of CITES. Among the reptiles recorded, a total of 182 species are listed in IUCN (Fig. 7.2) and 93 are found in some of the appendices of CITES. The order Testudines showed the highest number of species included in the IUCN Red List and in the appendices of CITES, with 22 species in the category vulnerable and 26 species in Appendix II, respectively (Fig. 7.3).

These numbers reveal the importance of the medicinal use of the herpetofauna from a conservationist perspective, even though this form of exploitation is not the main threat to the majority of the species of reptiles and amphibians used in traditional medicine. This is an additional factor that increases pressure on exploited species.

The high taxonomic diversity observed among reptiles used in traditional medicine is not surprising, as numerous workers have pointed out that reptiles are among the animals most frequently used in folk medicine (Alves and Alves 2011; Ashwell and Walston 2008; Kakati et al. 2006; Mahawar and Jaroli 2008). However, considering the relatively small number of published studies on this subject, it is possible that the number of medicinal reptile species used is greater than that recorded here.

Some widespread species are used in different countries, such as *Kinosternon scorpioides* (in Mexico and Brazil), *Varanus niloticus* (in India, Sudan, and China), *Varanus bengalensis* (in India and China), and *Dermochelys coriacea* (in Brazil, Mexico, Benin, Cameroon, and Togo). A given animal often has multiple medicinal uses and can be employed to treat more than one ailment, while different species of reptiles and amphibians can likewise be used to treat the same illnesses. Products derived from *Tupinambis merianae* and *T. teguixin*, for instance, are indicated for treating 8 and 18 conditions, respectively, in Brazil (Alves and Rosa 2007a); in India, products derived from the land monitor (*V. bengalensis)* are used to treat hemorrhoids, rheumatism, body pain, and burns, as well as spider and snake bites (Kakati et al. 2006); in Mexico, rattlesnake pills have been indicated for curing a wide variety of ailments, including: skin blotches, cancer, sores, rashes, pimples, welts, itching, rheumatism, varicose veins, face blotches, acne, blackheads, stress, heart disease, diabetes, hemorrhoids, and sexual impotence (Rubio 1998).

Table 7.1 Herpetofauna species used in traditional folk medicine and conservation status according to IUCN (2011) and CITES Appendix (2011)

Family/species
AMPHIBIA (47 species)
Caudata (2 species)
Salamandridae (2 spp): *Laotriton laosensis* (Stuart and Papenfuss, 2002), *Salamandra salamandra* (Linnaeus, 1758)^{LC}.
Anura (45 species)
Hyperoliidae (1 sp): *Kassina fusca* Schiøtz, 1967^{LC}
Arthroleptidae (1 sp): *Leptopelis bufonides* Schiøtz, 1967^{LC}
Pyxicephalidae (1 sp): *Tomopterna cryptotis* (Boulenger, 1907)^{LC}
Bufonidae (15 spp): *Bufo bufo* (Linnaeus, 1758)^{LC}, "Bufo" *pentoni* Anderson, 1893^{LC}, *Amietophrynus regularis* (Reuss, 1833)^{LC}, *A. maculatus* (Hallowell, 1854)^{LC}, *A. xeros* (Tandy, Tandy, Keith, and Duff-MacKay, 1976)^{LC}, *Nanorana liebigii* (Günther, 1860)^{LC}, *Rhinella schneideri* (Werner, 1894)^{LC}, *R. marina* (Linnaeus, 1758)^{LC}, *R. jimi* (Stevaux, 2002)^{LC}, *R. icterica* (Spix, 1824)^{LC}, *Incilius bocourti* (Brocchi, 1877)^{LC}, *I. valliceps* (Wiegmann, 1833)^{LC}, *I. macrocristatus* (Firschein and Smith, 1957)^{VU}, *Schismaderma carens* (Smith, 1848)^{LC}, *Duttaphrynus melanostictus* (Schneider, 1799)^{LC}.
Leptodactylidae (3 spp): *Leptodactylus labyrinthicus* (Spix, 1824)^{LC}, *L. vastus* Lutz, 1930, *L. troglodytes* Lutz, 1926^{LC}.
Dicroglossidae (3 spp): *Hoplobatrachus tigerinus* (Daudin, 1802)^{LC}, *Nanorana liebigii* (Günther, 1860)^{LC}, *N. polunini* (Smith, 1951)^{LC}.
Craugastoridae (2 spp): *Craugastor laticeps* (Duméril, 1853)^{NT}, *C. glaucus* (Lynch, 1967)^{CR}
Ranidae (8 spp): *Lithobates maculatus* (Brocchi, 1877), *L. berlandieri* (Baird, 1859)^{LC}, *L. montezumae* (Baird, 1854)^{LC}, *L. sylvaticus* (LeConte, 1825)^{LC}, *L. spectabilis* (Hillis and Frost, 1985)^{LC}, *Pelophylax perezi* (López-Seoane, 1885)^{LC}, *P.* ridibundus (Pallas, 1771)^{LC}, *Rana amurensis* Boulenger, 1886^{LC}.
Hylidae (8 spp): *Charadrahyla chaneque* (Duellman, 1961)^{EN}, *Trachycephalus typhonius* (Linnaeus, 1758), *T. resinifictrix* (Goeldi, 1907)^{LC}, *Phyllomedusa bicolor* (Boddaert, 1772)^{LC}, *P. burmeisteri* Boulenger, 1882^{LC}, *Hyla arborea* (Linnaeus, 1758)^{LC}, *H. cinerea* (Schneider, 1799) ^{LC}, *H. arenicolor* Cope, 1866 ^{LC}.
Microhylidae (1 sp): *Hypopachus barberi* Schmidt, 1939^{VU}.
Ceratophryidae (1 sp): *Telmatobius culeus* (Garman, 1876)^{CR}.
Calyptocephalellidae (1 sp): *Calyptocephalella gayi* (Duméril and Bibron, 1841).
REPTILIA (284 species)
Testudines (76 species)
Cheloniidae (6 spp): *Chelonia mydas* (Linnaeus, 1758)$^{VU/I}$, *Eretmochelys imbricata* (Linnaeus, 1766)$^{EN/I}$, *Caretta caretta* (Linnaeus, 1758)$^{VU/I}$, *Lepidochelys olivacea* (Eschscholtz, 1829)$^{VU/I}$, L. kempii Garman, 1880 $^{CR/I}$, *Natator depressus* Garman 1880$^{DD//I}$,
Dermochelyidae (1 spp): *Dermochelys coriacea* (Vandelli, 1761)$^{CR/I}$.
Emydidae (3 spp): *Trachemys scripta* (Schoepff, 1792)$^{LC/II}$, *Malaclemys terrapin* Schoepff 1793^{LC}, *Emys orbicularis* (Linnaeus, 1758)^{NT}
Chelidae(4 spp): *Phrynops geoffroanus* (Schweigger, 1812), *P. tuberosus* Peters 1870, *Mesoclemmys tuberculata* (Luederwaldt, 1926), *Chelus fimbriatus* (Schneider, 1783).
Trionychidae (5 spp): Lissemys punctata (Lacepède, 1788)$^{LC/II}$, *Pelochelys bibroni* (Owen 1853)$^{VU/II}$, *Pelodiscus sinensis* (Wiegmann 1835)^{VU}, *Palea steindachneri* (Siebenrock 1906)$^{EN/III}$, *Amyda cartilaginea* (Boddaert, 1770)^{VU}
Chelydridae (1 sp): *Platysternon megacephalum* Gray 1831$^{EN/II}$

(continued)

Table 7.1 (continued)

Family/species
Testudinidae (15 spp): *Testudo horsfieldii* Gray 1844[VU/II], *T. graeca* Linnaeus 1758[VU/II], *T. kleinmanni* Lortet 1883[CR/I], *Chelonoidis carbonaria* (Spix, 1824)[DD/II], *C. denticulata* (Linnaeus, 1766)[VU/II], *Geochelone platynota* (Blyth, 1863)[CR], *G. elegans* (Schoepff 1795)[LC], *Stigmochelys pardalis* (Bell, 1828)[LC], *Kinixys belliana* (Gray 1831)[LC], K. spekii Gray, 1863[LC,] *Indotestudo elongata* (Blyth 1854)[EN], *I. forstenii* (Schlegel & Müller 1844)[EN/II], *Manouria impressa* (Günther 1882)[VU], *Astrochelys radia*ta (Shaw, 1802)[CR,] Chersina angulata (Schweigger, 1812)[LC].
Kinosternidae (5 spp): *Kinosternon scorpioides* Linnaeus 1766, *K. integrum* (Le Conte 1854)[LC], *Pangshura tentoria* (Gray 1834)[LC], P. tecta (Gray 1831)[LC], *Staurotypus triporcatus* (Wiegmann 1828)[NT].
Podocnemididae (4 spp): *Podocnemis expansa* (Schweiger,1812)[LC/II], *P. unifilis* (Troschel, 1848)[VU/II], *P. sextuberculata* Cornalia 1849[VU/II], *Peltocephalus dumeriliana* (Schweigger 1812)[VU/II].
Geoemydidae: (33 spp): *Rhinoclemmys punctularia* (Daudin, 1802), *Cuora amboinensis* (Daudin 1802)[VU], *C. trifasciata* (Bell 1825)[CR], C. aurocapitata Luo & Zong, 1988[CR] *Cistoclemmys galbinifrons* (Bourret, 1939)[CR/II], *C. flavomarginata* (Gray 1863)[EN/II], *Leucocephalon yuwonoi* (Mccord, Iverson & Boeadi 1995)[CR/II], *Sacalia bealei* (Gray 1831)[EN], *S. quadriocellata* (Siebenrock, 1903)[EN], *Mauremys reevesii* (Gray, 1831)[EN/III], *M. mutica* (Cantor 1842)[EN], *M. leprosa* (Schweigger, 1812), *Ocadia sinensis* (Gray 1834)[EN], *Morenia petersi* (Anderson, 1879)[VU], *M. ocellata* (DumÉril and Bibron 1835)[VU/I], *Pyxidea mouhotii* (Gray 1862)[EN/II], *Geoemyda spengleri* (Gmelin, 1789)[EN/III], *Malayemys subtrijuga* (DumÉril and Bibron 1835)[VU/II], *Cyclemys dentata* (Gray 1831)[NT], *Geoclemys hamiltonii* (Gray 1831)[VU/I], *Hardella thurjii* (Gray 1831)[VU], *Heosemys depressa* (Anderson, 1875)[CR/II], *H. grandis* (Gray 1831)[VU/II], *H. spinosa* (Gray 1831)[EN/II], *H. annandalii* (Boulenger, 1903)[EN/II], *Chinemys nigricans* (Gray 1834)[EN/III], *Melanochelys trijuga* (Schweigger, 1812)[NT], *Notochelys platynota* (Gray 1834)[VU/II], *Callagur borneoensis* (Schlegel and Müller, 1844)[CR], *Pangshura smithii* (Gray 1863)[NT/II], *P. tecta* (Gray 1831)[LC/I], *Siebenrockiella crassicollis* (Gray 1831)[VU/II], Orlitia borneensis Gray, 1873[EN].
Platysternidae (1 sp): *Platysternon megacephalum* Gray 1831[EN/II]
Crocodylia (14 species)
Alligatoridae (7 spp): *Caiman latirostris* (Daudin, 1801)[LC/II], *C. crocodilus* (Linnaeus, 1758)[LC/II], *C. yacare* (Daudin 1802), *Paleosuchus palpebrosus* (Cuvier, 1807)[LC/II], *P. trigonatus* (Schneider, 1801)[DD/II], *Melanosuchus niger* (Spix, 1825)[LC/II], Alligator sinensis Fauvel 1879[CR/I]
Crocodylidae (6 spp): *Crocodylus niloticus* Laurenti 1768[LC/I], *C. siamensis* Schneider 1801[CR/I], *C. porosus* (Schneider, 1801)[LC/I], C. palustris Lesson 1831[VU/I], *C. moreletii* (Duméril & Bibron 1851)[LC/I], *C. acutus* (Cuvier 1807)[VU/II].
Gavialidae (1 sp): *Gavialis gangeticus* (Gmelin 1789)[EN/I]
Squamata—Lizards (71 species)
Phrynosomatidae (8 spp): *Sceloporus serrifer* Cope 1866[LC], *S. taeniocnemis* Cope 1885[LC], *S. acanthinus* Bocourt 1873, *S. spinosus* Wiegmann 1828[LC], *S. grammicus* Wiegmann 1828[LC], *Phrynosoma cornutum* (Harlan 1825)[LC], *P. modestum* Girard 1852[LC], *P. orbiculare* (Gmelin, 1789)[LC].
Anguidae (3 spp): *Abronia lythrochila* Smith & Alvarez Del Toro 1963[LC], *Mesaspis moreletii* Bocourt 1871[LC], Ophisaurus harti Boulenger 1899[LC].
Scincidae (3 spp): Acontias plumbeus Bianconi, 1849[LC], *Eutropis carinata* (Schneider 1801)[LC],Scincus scincus (Linnaeus 1758).

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Table 7.1 (continued)

Family/species
Cordylidae (4 spp): *Cordylus giganteus* Smith 1844[VU/II], C. tropidosternum (Cope 1869)[LC/II], C. vittifer (Reichenow, 1887)[LC], C. warreni (Boulenger 1908) [LC/II].
Helodermatidae (1 sp): Heloderma horridum (Wiegmann 1829)[VU/II].
Agamidae (9 spp): *Uromastyx hardwickii* Gray, 1827[II], *U. dispar* Heyden 1827[II], *U. aegyptia* (Forskal 1775)[II], *Agama agama* (Linnaeus 1758), *A. impalearis* Boettger 1874, *Calotis versicolor* Daudim 1802, *Laudakia nupta* (De Filippi 1843), *Trapelus mutabilis* (Merrem 1820), Acanthocercus atricollis (Smith, 1849)[LC].
Lacertidae (4 spp): Lacerta agilis Linnaeus 1758[LC], Timon lepidus (Daudin, 1802)[NT], Podarcis hispanicus (Steindachner, 1870)[LC], *Zootoca vivipara* (Von Jacquin 1787)[LC].
Liolaemidae (2 spp): *Liolaemus pantherinus* Pellegrin 1909, *L. alticolor* Barbour 1909.
Varanidae (5 spp): *Varanus niloticus* (Linnaeus 1758)[LC/II]. *V. bengalensis* (Daudin 1758)[LC/I], V. salvator (Laurenti 1768)[LC/II], *V. griseus* (Daudin 1803)[I], *V. albigularis* (Daudin 1802)[LC/II].
Teiidae (6 spp): *Tupinambis merianae* (Duméril & Bibron, 1839)[LC/II], *T. teguixin* (Linnaeus 1758)[II], *T. rufescens* (Günther,1871)[II], *Ameiva ameiva* (Linnaeus, 1758), *Cnemidophorus* gr *ocellifer* (Spix, 1825), *Kentropyx pelviceps* (Cope 1868).
Iguanidae (3 spp): *Iguana iguana* (Linnaeus, 1758)[II], *Ctenosaura pectinata* Wiegmann 1834, *C. similis* (Gray 1831)[LC].
Polychrotidae (3 spp): *Polychrus acutirostris* Spix 1825, *P. marmoratus* (Linnaeus 1758), *Anolis fuscoauratus* D'Orbigny, 1837
Tropiduridae (4 spp): *Tropidurus semitaeniatus* (Spix, 1825)[LC], *T. torquatus* (Wied, 1820)[LC], *T. hispidus* (Spix, 1825), *Uranoscodon superciliosus* (Linnaeus 1758).
Gekkonidae (4 spp): *Hemidactylus mabouia* (Moreau de Jonnes, 1818), *H. frenatus* Schlegel 1836[LC], *Gekko gecko* (Linnaeus 1758)[NT], G. chinensis (Gray, 1842)[LC].
Phyllodactylidae (1 sp): *Tarentola mauritanica* (Linnaeus 1758)[LC].
Sphaerodactylidae (1 sp): *Gonatodes hasemani* Griffin 1917[LC].
Chamaeleonidae (8 spp): *Chamaeleo senegalensis* Daudin 1802[LC/II], *C. chamaeleon* (Linnaeus 1758)[II], C. dilepis Leach, 1819,[LC] *Furcifer lateralis* (Gray, 1831), Bradypodion dracomontanum Raw 1976[II], B. nemorale Raw 1978[LR/II], B. setaroi Raw 1976[EN/II], B. thamnobates Raw 1976[LC/II].
Gerrhosauridae (2 spp): Gerrhosaurus major Duméril, 1851[LC], G. flavigularis Wiegmann, 1828[LC].
Squamata—Snakes (123 species)
Achrochordidae (1 sp): Acrochordus granulatus (Schneider, 1799)[LC].
Boidae (8 spp): *Boa constrictor* Linnaeus, 1758[II], *Corallus caninus* (Linnaeus, 1758)[DD/II], *C. hortolanus* (Linnaeus, 1758)[DD/II], *Epicrates assisi* Machado, 1945, *E. cenchria* (Linnaeus, 1758)[II], *Eunectes murinus* (Linnaeus, 1758)[II], *E. notaeus* (Cope, 1862), *Eryx johnii* (Russell 1801)[II].
Pythonidae (6 spp): *Python sebae* (Gmelin 1789)[II], *P. regius* (Shaw 1802)[II], *P. molurus* (Linnaeus 1758)[LC/I], *P. natalensis* Smith 1840[LC/II], P. bivittatus Kuhl, 1820, *Broghammerus reticulatus* (Schneider 1801)[II].

(continued)

Table 7.1 (continued)

Family/species
Viperidae (35 spp): *Lachesis muta* (Linnaeus, 1766), *Caudisona durissa* (Linnaeus, 1758)[DD/III], *C. molossus* (Baird & Girard 1853)[LC], *C. basiliscus* (Cope 1864)[LC], Crotalus. horridus Linnaeus 1758[LC], *C. scutulatus* (Kennicott, 1861)[LC], *C. viridis* Rafinesque 1818[LC], *Hoserea atrox* (Baird and Girard 1853)[LC], *Uropsophus lepidus* (Kennicott 1861)[LC], *U. triseriatus* Wagler 1830[LC], *Aechmophrys pricei* (Van Denburgh 1895)[LC], *A. willardi* (Meek 1905)[LC], *A. polystictus* (Cope 1865)[LC], *A. transversus* (Taylor 1944)[LC], *Deinagkistrodon acutus* (Günther 1888), *Atropoides nummifer* (Rüppell 1845)[LC], *Cerrophidion tzotzilorum* (Campbell 1985)[LC], *Protobothrops mucrosquamatus* (Cantor 1839)[LC], *Bothrops atrox* (Linnaeus 1758), *B. asper* (Garman 1883), *B. leucurus* Wagler, 1824, *B. lanceolatus* (Bonnaterre, 1790), *Bitis gabonica* (Duméril, Bibron & Duméril 1854), *B. arietans* (Merrem 1820), *Causus rhombeatus* (Lichtenstein 1823), *Agkistrodon contortrix* (Linnaeus, 1766)[LC], *Gloydius blomhoffi* (Boie 1826), *G. himalayanus* (Günther 1864), *Daboia russelli* (Shaw 1797), *Macrovipera lebetina* (Linnaeus, 1758), Vipera latastei (Bosca, 1878)[VU], Viridovipera stejnegeri (Schmidt, 1925), V. vogeli (David, Vidal & Pauwels, 2001), Cryptelytrops albolabris (Gray, 1842)[LC], C. macrops (Kramer, 1977).
Elapidae (25 spp): *Micrurus spixii* Wagler 1824, *M. surinamensis* (Cuvier 1817), *M. ibiboboca* (Merrem, 1820), *Bungarus multicinctus* Blyth 1861, *B. fasciatus* (Schneider 1801), B. candidus (Linnaeus, 1758), *Naja atra* Cantor 1842[II], *N. annulifera* Peters 1854, *N. naja* (Linnaeus 1758)[II], N. mossambica Peters, 1854[LC], N. kaouthia Lesson, 1831[LC], N. siamensis Laurenti, 1768[LC], Elapognathus coronata (Schlegel, 1837), *Ophiophagus hannah* (Cantor 1836)[VU/II]. *Hydrophis cyanocinctus* Daudin 1803[LC], H. melanocephala Gray, 1849[DD], Polyodontognathus caerulescens (Shaw, 1802)[LC], Pelamis platura (Linnaeus, 1766)[LC], Dendroaspis polylepis Günther, 1864[LC], D. angusticeps (Smith, 1849)[LC], Hemachatus haemachatus (Bonnaterre, 1789)[LC] Lapemis hardwickii Gray, 1834, Praescutata viperina (Schmidt, 1852)[LC], *Laticauda laticaudata* (Linnaeus, 1758)[LC], *L. semifasciata* (Reinwardt, 1837)[NT].
Dipsadidae (8 spp): *Oxyrhopus trigeminus* Duméril, Bibron & Duméril, 1854, *O. formosus* (Wied 1820), *O. melanogenys* (Tschudi 1845), *Tachymenis peruviana* Wiegmann, 1835, *Imantodes cenchoa* Linnaeus 1758, *Leptodeira annulata* (Linnaeus, 1758), *Philodryas olfersii* (Lichenstein, 1823), *Thamnodynastes strigatus* (Günther, 1858)[LC].
Homalopsidae (3 sp): Enhydris enhydris (Schneider, 1799)[LC], E. chinensis Gray 1842[LC], *E. plumbea* Boie 1827[LC].
Colubridae (28 spp): *Spilotes pullatus* (Linnaeus, 1758), *Leptophis ahetula* (Linnaeus, 1758), *Chironius carinatus* (Linnaeus, 1758), *C. grandisquamis* Peters 1869, *Mastigodryas bifossatus* (Raddi, 1820), *Lampropeltis triangulum* (Lacépède 1789), *Ptyas dhumnades* (Cantor 1842), *P. mucosus* (Linnaeus, 1758)[II], P. korros (Schlegel 1837), *Drymobius margaritiferus* (Schlegel 1837), *Dinodon rufozonatum* (Cantor 1842), *Orthriophis taeniurus* (Cope 1861), *O. moellendorffi* (Boettger 1886), *Pituophis lineaticollis* (Cope 1861)[LC], *Rhinechis scalaris* (Schinz, 1822)[LC], Dispholidus typus (Smith, 1828)[LC], Ahaetulla nasuta (Bonnaterre, 1790), A. prasina (Boie, 1827)[LC], Boiga multomaculata (Boie, 1827), Coelognathus radiatus (Boie, 1827), Dendrelaphis pictus (Gmelin, 1789), *Elaphe quatuorlineata* (Wagler, 1833) E. carinata (Günther 1864), *E. radiata* Boie 1827, E. schrenckii Strauch, 1873, E. bimaculata Schmidt, 1925, Euprepiophis mandarinus (Cantor, 1842), Oocatochus rufodorsatus (Cantor, 1842)[LC].
Cylindrophiidae (1 sp): Cylindrophis ruffus (Laurenti, 1768).
Natricidae (2 sp): Xenochrophis flavipunctatus (Hallowell, 1860), Sinonatrix annularis (Hallowell, 1856).

(continued)

Table 7.1 (continued)

Family/species
Lamprophiidae (3 sp): Malpolon monspessulanus (Hermann, 1804)[LC], Lamprophis aurora (Linnaeus, 1758)[LC], Pseudaspis cana (Linnaeus, 1758)[LC],
Psammophiidae (3 sp): Psammophis phillipsi (Hallowell, 1844)[LC], Psammophylax rhombeatus (Linnaeus, 1758)[LC], P. tritaeniatus (Günther, 1868)[LC].

Categories of IUCN red list: *CR* critically endangered, *EN* endangered, *VU* vulnerable, *LR* lower risk, *DD* deficient data. CITES Appendix (I, II and III)

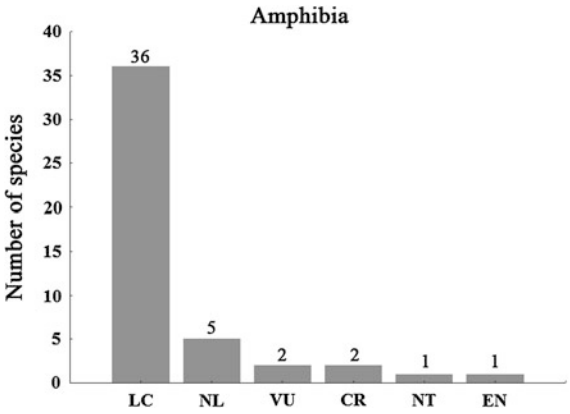

Fig. 7.1 Status of the conservation of amphibian species used in traditional folk medicine and conservation status according to IUCN (2011). Categories of IUCN Red List: *CR* critically endangered, *EN* endangered, *VU* vulnerable, *LR* lower risk, *DD* deficient data, *NL* not listed

Reptiles are one of the groups most closely associated with the history of medicine. The Greeks and Romans worshipped snakes and the god of medicine is represented holding a snake (Ziemendorff 2008). Historical documents indicated that reptiles have been used in traditional medicines since ancient times (Alakbarli 2006; Almeida 2007; Alves et al. 2007a; MacKinney 1946; Silva et al. 2004). In Brazil, for example, animal species (including reptiles) have been used medicinally by indigenous societies for millennia (Alves et al. 2007a).

In his Compendium of Materia Medica, Li Shizhen, a noted pharmacologist in the Ming Dynasty (1368–1644 A.D.) states that turtle helps "repair internal injury caused by overstrain, strengthens the yin and yang" and "replenishes vital essence, reduces fever, clam the liver and subdues yang, soften and resolve hard masses" (Li et al. 2000). Many ancient Chinese medical books described the therapeutic effects of treating rheumatism, hemiplegia, neuralgia, and muscle poliomyelitis with parts of snakes including gall bladder and liver (Guo et al. 1996).

Similarly, a historical review of the therapeutic uses of animals as described in medieval manuscripts from Alakbarli (2006) revealed a total of 12 species of reptiles with medicinal uses. According to these medieval manuscripts, these reptiles were successfully used to treat ailments that included sexual impotence and leprosy. Among the species mentioned were indigenous species still found in Azerbaijan, such as the Caucasian agama (*Agama caucasica*), the Levantine viper (*Vipera lebetina*), the Mediterranean tortoise (*Testudo graeca*), and the Moorish

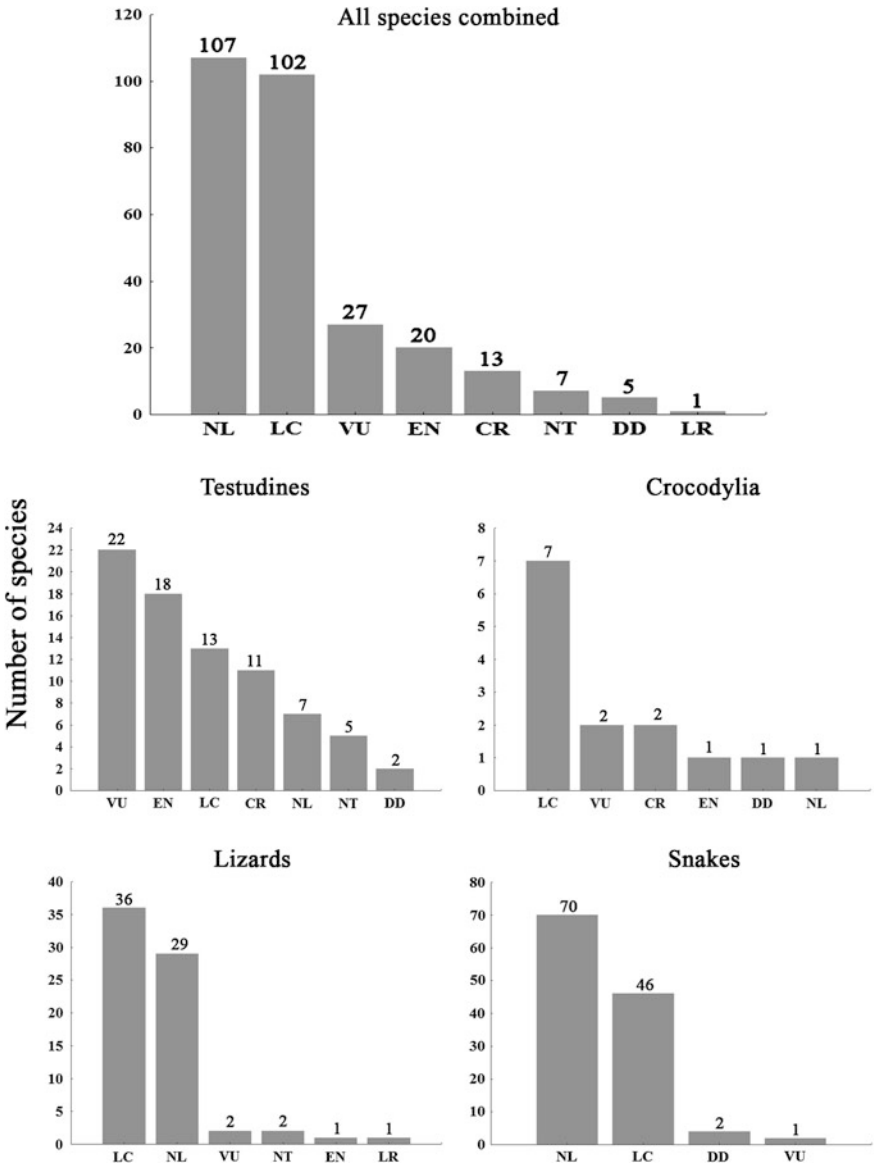

Fig. 7.2 Status of the conservation of reptile species used in traditional folk medicine and conservation status according to IUCN (2011). Categories of IUCN Red List: *CR* critically endangered, *EN* Endangered, *VU* vulnerable, *LR* lower risk, *DD* deficient data, *NL* not listed

gecko (*Tarentola mauritanica*). Exotic reptiles mentioned included the chameleon (*Chameleo chameleo*), the monitor lizard (*Varanus griseus*), and the crocodile (*Crocodylus niloticus*). The medicines prepared from these reptiles were imported into Azerbaijan from distant countries.

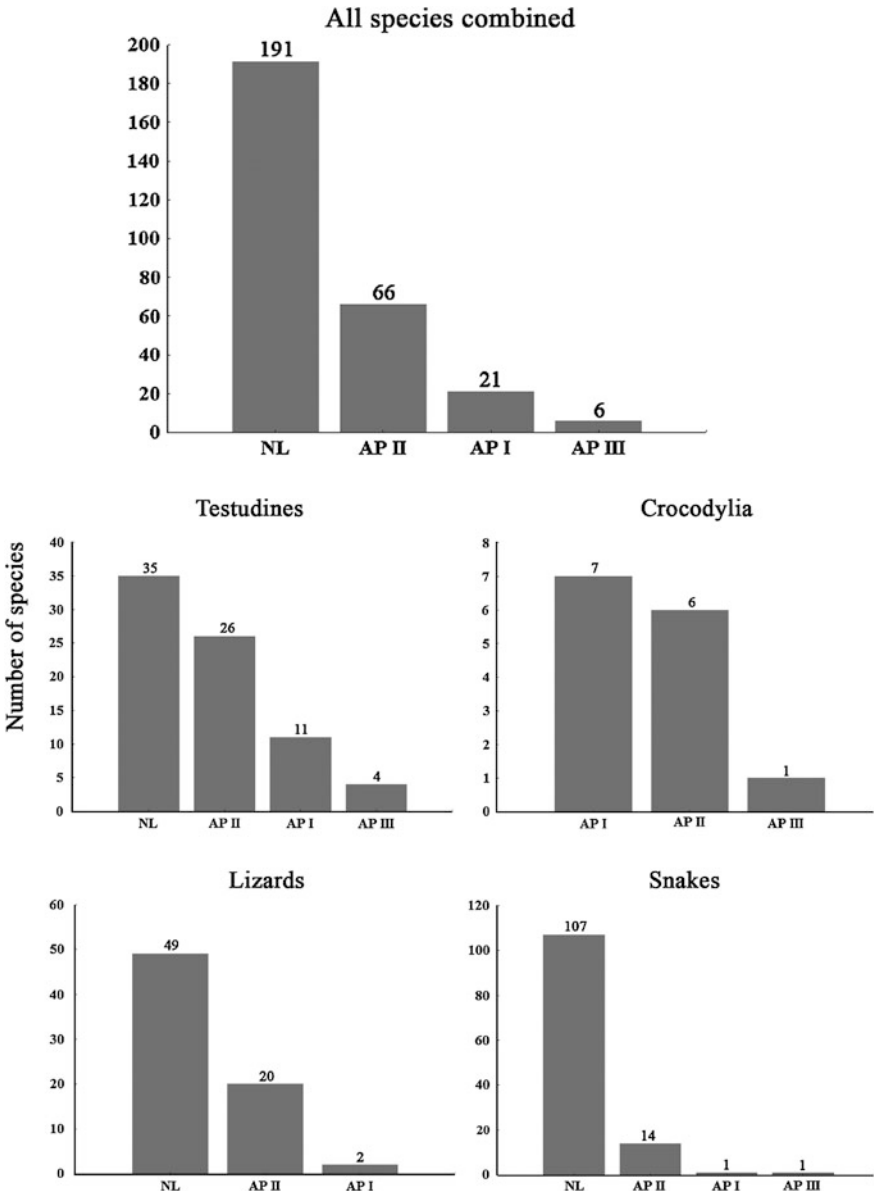

Fig. 7.3 Reptile species used in traditional folk medicine included in one of the appendices of CITES (2011) *NL* not listed, *AP* I appendix I, *AP* II appendix II, *AP* III appendix III

The medicinal use of amphibians is also very old. Gomes et al. (2007) pointed out that in many ancient cultures, amphibians were believed to possess medicinal properties. For instance, frog potions are used as aphrodisiacs and to prevent impotence and infertility; they are also used as contraceptives and to treat various

illnesses (Gomes et al. 2007). Fever could be treated with ground frog heads (Hendricks 1966, p. 44), and whooping cough with a soup made from nine frogs (Hendricks 1980, p. 109). Heart trouble was treated with ground-up toad skins (Hendricks 1980, p. 8). Also, newts are often burned to ashes and then used in medicinal formulas and concoctions since ancient times (Gomes et al. 2007). Alakbarli (2006), highlighted that amphibians were not used in medicine as widely as reptiles, but mentioned that four species of amphibians described in medieval sources have been identified. This group includes frogs, toads, salamanders, and tree-frogs (*Hyla arborea*).

Crocodilians, snakes, lizards, turtles, tortoises, and amphibians serve as important sources of protein for human populations around the world, and the consumption of reptile meat is often intertwined with cultural or medicinal beliefs (Alves et al. 2006, 2008, 2009; Angeletti et al. 1992; Klemens and Thorbjarnarson 1995). Likewise, various medicinal species of amphibians and reptiles are also hunted as food and represent important protein sources for the inhabitants of rural areas (as well as in urban areas where they are often sold), and include *Podocnemis expansa*, *P. unifilis*, *Chelonia mydas*, *Chelonoides denticulata*, *C. carbonaria*, *T. merianae, Paleosuchus palpebrosus, P. trigonatus, Melanosuchus niger, Naja naja, Bungarus fasciatus, Ptyas mucosus, P. korros*, *Bufo pentoni*, *Amietophrynus regularis*, *A. maculatus*, *Kassina fusca*, *Leptodactylus vastus,* and *Leptopelis bufonides,* among others (Alves and Alves 2011; Alves et al. 2006, 2008, 2009; Mohneke et al. 2010, 2011). Other studies have also recorded the use of animal species as foods/medicines (Alves and Rosa 2006, 2007a; Alves et al. 2007a; Pieroni et al. 2002).

Besides their role in healing, natural products often have magical-religious significance, reflecting the different views of health and disease that exist within different cultures. In this context, animal parts are used to prepare clinical remedies as well as to make amulets or charms used in magical/religious diagnoses.

Popular beliefs usually affect the way species are used in zootherapy (Alves and Rosa 2006). Reptiles and amphibians are commonly used in healing through the magical transfer of disease, one of the most engaging subjects in the whole field of folk medicine (Hand 1980). In some situations, it is believed that the mere contact with an animal is sufficient for the disease to pass from the victim to the animal. In Ontario, for example, the mere touching of a live frog to a goiter is sufficient to make the malady pass into the frog; however, final curing depends upon burying the hapless critter head down in the ground until it decays. When this happens the goiter will disappear. Tying or binding a live frog to the affected part will cure a felon, will cause chills to go out of the patient into the frog, will cure asthma, and, in a North Carolina example, spells resembling the hard ague. In the Blue Grass country a live toad is bound to the back to cure rheumatism, the pain passing from the back of the sufferer into the toad (Hand 1980). In Northeast Brazil, jabutis (*Chelonoidis carbonaria*) are usually bred as pets because it is believed that they protect the household from acquiring asthma (Alves et al. 2011).

Another form of spiritual treatment involves the use of amulets containing reptile parts to protect the user from the “evil-eye” or from diseases (Alves et al.

2010b; Alves and Pereira Filho 2007). An example is caiman teeth (*C. latirostris*, *M. niger*, and *P. palpebrosus*) used as protection against snake bites in Brazilian traditional medicine. Alves and Pereira Filho (2007) reported that snakes are sold for medicinal and magic-religious purposes in many Brazilian cities.

Various medicinal amphibians and reptiles are also sold as pets or souvenirs. Large numbers of iguanas (*I. iguana*), for example, are imported to well-established businesses in the United States from El Salvador and other Central American countries and then re-exported for the pet market in Europe and Asia (Gibbons et al. 2000). In many countries in Asia, Africa, and Latin America, amphibians and reptiles are collected for subsistence or local consumption (Altherr et al. 2011; Klemens and Thorbjarnarson 1995; Mohneke et al. 2009). These multiple uses (including medicinal) of the herpetofauna and their impact on animal populations must be properly assessed (Alves et al. 2007a) and taken into consideration when implementing recovery plans for these species, especially those that are highly exploited.

Traditional drugs and medicine in general will require more research and careful evaluations, and it is a well-established fact that many plant, animal, and mineral remedies used in traditional settings are capable of producing serious adverse reactions (Alves and Rosa 2005; De Smet 1991). At least 11 cases of serious extra-gastrointestinal infections by *Salmonella arizona* attributed to the ingestion of a rattlesnake folk remedy have been reported (Fainstein et al. 1982; Fleischman et al. 1989; McIntyre et al. 1982; Riley et al. 1988). In China, people were reported to be reverting to their habit of eating snakes, as the fear of SARS (severe acute respiratory syndrome) was fading (Zhou and Jiang 2005).

A thorough review of the biological risks associated with consumption of reptile products (Magnino et al. 2009) does not include incidents associated with medicinal snake wine, an alcoholic beverage produced by infusing whole snakes in rice wine or grain alcohol (Barzyk 1999). However, human sparganosis, caused by (among others) the ingestion of plerocercoid larvae in raw or insufficiently cooked meat of reptiles (or amphibians), has been reported from Vietnam (Beaver et al. 1984; Magnino et al. 2009). As such, it is essential that traditional drug therapies be submitted to appropriate risk/benefit analyses (De Smet 1991).

Unfortunately, little research has been done so far to prove the claimed clinical efficacy of animal products for medicinal purposes (Still 2003). Moreover, as pointed out by Pieroni et al. (2002), although the chemical constituents and pharmacological actions of certain animal products are known to some extent, more ethnopharmacological studies focusing on animal remedies are needed in order to better define the eventual therapeutic usefulness of this class of biological remedies.

Reptiles and amphibians have been used as sources of drugs for modern medical practices. Reptiles venoms are complex mixtures of bioactive molecules (Chen et al. 2006), and the venom of snakes belonging to the families Viperidae and Elapidae contain analgesic substances that are stronger than morphine and have been used to treat terminal cancer patients (Bisset 1991). These observations are corroborated by Brasil (1937) and Giorgi et al. (1993), who noted that

analgesic drugs have been extracted from the venom of *Crotalus durissus*. Batroxobin, extracted from the venom of *Bothrops atrox*, has been found to have significant therapeutic effects on ischemic-reperfused rats in vivo and in clinical trials, and batroxobin, as well as ancrod, is currently being commercially produced. Three other thrombin-like enzyme preparations are also commercially available: reptilase, crotalase, and an enzyme derived from *Agkistrodon contortrix* (Bell and Markland 1997). However, wider clinical use of thrombin-like enzymes has been impeded by immunologic reactions in patients, limited availability of snake venoms, and high production costs as well (Warkentin 1998).

Similarly, studies have demonstrated the enormous potential of amphibians as a source of natural products and drugs (Daly 1998). Amphibian skin has long been known to possess intriguing biological properties, and scientific examination of these secretions has revealed that their components possess a range of medical properties (Shaw 2009). The medicinal activity of various skin components has been confirmed by modern pharmacology as having great potential in ultimately helping to cure various diseases or at least being the basis for derivates and respective anticancer drugs, pain killers, or even agents to prevent cells from being invaded by HIV viruses (Alves et al. 2006; Daly 2003; Garg et al. 2008; Lu et al. 2008). As pointed out by Alves and Rosa (2006), further ethnopharmacological studies are necessary to increase our understanding of the links between traditional uses of faunistic resources, public health policies and sustainable management of natural resources.

It is important to note that behind the perceived efficacy by users, the popularity of animal-based remedies is influenced by cultural aspects, the relations between humans and biodiversity in the form of zootherapeutic practices are conditioned by the social and economic relations between humans themselves (Alves et al. 2008). It has been documented that people sometimes resort to traditional home remedies as a means of resisting urban modern medicine and of asserting their traditional culture (Alves et al. 2007b; Boltanski 1989; Ngokwey 1995). In China, for example, the demand of turtle in traditional medicine is fueled by deeply held cultural beliefs (Rubio 1998).

The medicinal use of the herpetofauna is important to both urban and rural populations, a result in line with Alves and Rosa (2007a, b), who suggested that zootherapeutic practices may function as a social conduit that (in conjunction with other factors) helps rural populations that have migrated to cities to maintain connections with their traditional cultures and values. More specifically, the use of folk remedies indicates an exchange of materials and information on illnesses and treatments between remote rural areas and urban communities.

The commercialization of reptiles and amphibians for medicinal and other purposes has been reported for many parts of the world (Alves et al. 2006; Alves and Rosa 2010; Angeletti et al. 1992; Barzyk 1999; Fitzgerald et al. 2004; Franke and Telecky 2001; Zhou and Jiang 2004). In several Brazilian cities, for example, snakes are widely traded in outdoor markets (that can even have designated stalls for medicinal animals and plants) or in small stores specifically dedicated to this activity (Alves and Pereira Filho 2007; Alves and Rosa 2010). In Mexico, natural

Fig. 7.4 Geckos (imported from Indonesia) for sale at a market in China. Photo: Anthony B. Cunningham

and traditional remedies derived from reptiles (such as dried rattlesnakes, rattlesnake pills, and rattles) are frequently offered for sale (Fitzgerald et al. 2004). Turtles, snakes, and lizards (especially monitor and gecko lizards—Fig. 7.4) are widely hunted and traded in Vietnam for food and as traditional medicines (Jenkins 1995; Le and Broad 1995; Nash 1997; Stuart 2004). Somaweera and Somaweera (2010) documented the use and trade of snakes in snake wine in four of the most touristic cities in Vietnam. He and Peng (1999) reported that the quantity of snakes consumed in the markets of Guangzhou, Guangdong Province of China, was about 1.4×10^7 kg each year. From 1990 to 1995, the annual demand for wild snakes from 13 factories producing traditional Chinese medicines (TCM) included 1,656.77 kg of *Zaocys dhumnades*, 234.75 kg of *Deinagkistrodon acutus*, and 20,300 heads and 32.1 kg of *Bungarus multicinctus* (Zheng and Zhang 2000). These examples illustrate the urgent need to increase our knowledge concerning the harvesting and trading of reptiles in traditional medicine and to assess the impacts caused by this commercial exploitation.

7.3.2 Implications for Conservation

Reptile populations are being seriously reduced throughout the world. Factors responsible for these observed declines include the alteration, destruction, or fragmentation of habitat, climate change, disease, impacts from non-indigenous

species, ultraviolet radiation, and xenobiotic chemicals (Gibbons et al. 2000). In addition, reptile populations are heavily harvested for human use. The observed population decreases due to human harvesting may be due to the direct physical removal of these animals or due to collection techniques that destroy the habitats used by these reptiles (Alves et al. 2008).

A similar trend is observed for amphibians, which are one of the most threatened groups of animals (Collins and Crump 2009; Stuart 2008; Stuart et al. 2004). Reasons for this are numerous, but besides habitat degradation and loss, disease and rapid enigmatic declines, overexploitation is mentioned as one of the main causes (Alves et al. 2006; Angeletti et al. 1992; Gomes et al. 2007; Halliday 2008). Amphibian species are harvested and used worldwide mainly as a food source, i.e., frog legs are thought to be delicacies in many regions of the world. However, frogs are also collected for leather production and souvenirs, for the pet trade and for cultural reasons including traditional medicine (Gomes et al. 2007; Oza 1990; Warkentin et al. 2009).

The collection of individual animals from the wild for subsistence or commercial and medicinal purposes has been invoked as a factor contributing to the decline of certain species (Alves et al. 2006, 2008; Angeletti et al. 1992; Gibbons et al. 2000), although there has not yet been a comprehensive evaluation of this potential link. The popularity of folk medicine certainly places pressure on these natural resources (Almeida and Albuquerque 2002).

Our results demonstrate that a substantial number of reptile and amphibian species ($n = 331$) are used in traditional medicine throughout the world and that the vast majority of these animals are collected from the wild. Of the medicinal species used, 224 (67.6%) are already included on endangered species lists. Of the species cataloged in this study, 93 (28%) are included in three CITES appendices (see Table 7.1), although the reasons for their inclusion are not necessarily related to medicinal use. These results demonstrate the need to assess the implications of the trade of reptiles used in traditional medicines on their wild populations, and the need for including such uses in discussions about herpetofauna conservation.

The trade of animals for medicinal purposes is a widespread phenomenon, with significant implications for their conservation and sustainable use (Alves and Rosa 2005). The demand for live snakes (and their body parts) for use in traditional medicine appears to have led to significant reductions in their populations in certain parts of the world (Fitzgerald et al. 2004).

Field reports have indicated the southeastern Asian medicinal trade as a growing threat to reptiles, especially turtles and snakes (Klemens and Thorbjarnarson 1995). Asia has a high diversity of turtle species, but its unique fauna is facing a perilous and uncertain future. The main reason for the Asian turtle survival crisis is Chinese demand for turtle products (van Dijk et al. 2000). Directly or indirectly, the medicinal value attributed to chelonians has been one of the main reasons for their trade and overexploitation. In China, turtles are sought as a delicacy because of widespread popular belief, inspired by Traditional Chinese Medicine, that turtle meat or shell possesses especially nutritious or curative properties (Lau and Shi 2000). Such situations demonstrate that cultural aspect

should be taken into consideration in the elaboration of conservation plans. A study conducted in China showed that the same (or better) nutritional benefits of turtles can be obtained with cheaper, common, and less-endangered food sources such as domestic animals (Rubio 1998). These authors concluded that given the financial and environmental cost of using turtle products, other options for obtaining the same nutrition should be promoted and that future challenges should involve balancing cultural practices with sustaining biodiversity.

More than one-half of all freshwater tortoise and turtle species from Southeast and Eastern Asia are currently endangered or critically endangered, largely because of overcollection by the food and traditional medicine industries (Garg et al. 2008; Hand 1980; Klemens and Thorbjarnarson 1995; Turtle Conservation Fund 2002). The high demand for crocodile skins, meat, and body parts for traditional medicine have certainly contributed to the observed decline in their populations in Nigeria (Ita 1994), as the demand for live rattlesnakes, skins, and body parts has reduced the populations of these reptiles in Mexico (Fitzgerald et al. 2004).

Many factors affect reptilian and amphibian populations in the world, and the use of these animals for medicinal purposes represents an additional pressure, whose impact varies depending on the species exploited and the cultural factors associated with their exploitation. The medicinal use of the herpetofauna must be considered together with other anthropogenic pressures, such as habitat loss. The depletion of medicinal resources not only poses a challenge for conservation but also represents a serious threat to the health of many human communities, and efforts to stabilize the status of these species are important not only to conservationists but also to millions of people whose health depends on the use of traditional remedies.

Ultimately, the most successful conservation programs are those that identify and deal with the reason a species is endangered and at the same time provide economic benefits to local people (Pough et al. 2004). Therefore, management strategies aimed at herpetofauna conservation need to be established to minimize the impact of the traditional populations that use several species as food and medicine or for other purposes (Alves et al. 2008, 2009).

An alternative proposal can be the creation of reptile breeder cooperatives in rural gatherer communities for raw material supplies and products for medicinal use. These cooperatives could be part of breeding sites of species such as *Podocnemis expansa*, *P. unifilis*, *Chelonia mydas*, *Chelonoidis denticulata*, *C. carbonaria*, *T. merianae, Paleosuchus palpebrosus, P. trigonatus, Boa constrictor*, *Uranoscodon superciliosus,* and *Tupinambis* spp, among others, with the appropriate authorization and regulation by competent governmental bodies, besides the presence of specialists in the area (biologists, veterinarians, and animal husbandry staff) (Alves et al. 2008, 2009). An example of a successful cooperative can be the snake collectors for poison extraction in India (Whitaker 1989).

Sustainable use programs for reptiles have had some success in the world (Pough et al. 2004; Vitt and Caldwell 2009), such as the snake collectors who extract venom in India (Whitaker 1989). Lizards (*Tupinambis*, and certain

iguanids) are harvested for local consumption and have experienced sharp population declines in many areas due to overhunting (Vitt and Caldwell 2009).

Breeding programs to raise iguanas for release into the wild have been developed in several countries, including Panama, Costa Rica, Guatemala, Nicaragua, Belize, Honduras, El Salvador, Colombia, and Venezuela (Eilers et al. 2002), and iguana farming has become an attractive economic alternative to cattle breeding and a significant source of food for local populations (Magnino et al. 2009). Managed harvests of crocodilians began about three decades ago to assist the recovery of species and populations that had been devastated by unregulated hunting. The success of managed harvests and captive rearing in Papua New Guinea, Venezuela, and a few other countries stimulated other governments to begin similar programs. These managed species have shown remarkable resilience in many countries, and their populations are no longer endangered. However, with more countries producing skins, supply began to exceed demand and was followed by a declining popularity of crocodilian leather (Vitt and Caldwell 2009).

In addition, the therapeutic indications of wild animals and plants and domestic or cultivated species also overlapped in many cases (Alves et al. 2007a). This aspect opens the possibility of replacing, where suitable, the use of threatened species with other species in traditional medicine formulas. Such substitution of products is of interest from a conservationist perspective, in the context of reducing the pressure on overexploited populations, or legally protected species (Alves and Rosa 2007a). Educational programs are also quite viable alternatives, mainly when focused on rural communities where inhabitants eat reptiles/amphibians and use them in traditional medicine and religious practices.

Projects seeking to train teachers in those communities and old hunters in sites nearby protected areas help to minimize the impacts on the herpetofauna. As pointed out by Pough et al. (2004), education is urgently needed at all levels to maintain viable populations of reptiles. Training in areas of habitat protection, wildlife management, and conservation biology is needed, especially in tropical countries where most species of reptiles are found. The success of conservation and management programs ultimately depends on how well the programs are tailored to the interests and needs of the people on whose land the threatened or endangered animal live.

The use of amphibians and reptiles is an integral part of many cultures (Alves et al. 2006, 2008; Angeletti et al. 1992; Gibbons et al. 2000). The great diversity of interactions between humans and the herpetofauna provide the foundations for the cultural, economic, emotional, intellectual, social, and spiritual motivations that determine how conservation and management activities are designed, conducted, and assessed (Alves et al. 2008, 2009; Frazier 2005).

As described in this chapter, reptiles and amphibians are used globally in traditional folk medicine, which is thereby a form of exploitation that should be taken into consideration. This use of the herpetofauna represents an additional pressure for many species, and for others this has been indicated as an important cause of population decline. Thus, not only should one consider the use of these animals in popular medicine but also their exploitation by the pharmaceutical

industry. As pointed out by Shaw (2009), any pharmaceutical scientist who is involved in contemporary natural product research has to get involved in or at the very least become familiar with the global issues of species conservation and/or biodiversity.

Reptiles and amphibians have declined rapidly in both numbers and range in recent decades and their exploitation by humans is noted as an impacting factor for the decline of many species. Hence, an understanding of the cultural, social, and traditional roles of the herpetofauna is essential for establishing management plans directed toward sustainable use. As recorded in this work, medicinal use of the herpetofauna, despite being widely disseminated, has been studied little, limiting the evaluation of the impact of these practices on animal populations. Therefore, studies in ethnoherpetology are essential in conservation strategies and to record associated knowledge of such uses.

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