

Chapter 2

From Past to Present: Medicinal Animals in a Historical Perspective

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Abstract Interactions with animals constitute one of the oldest forms of connection between mankind and nature. In general, connections that people establish with nature can be driven by different aspects of their lives, either material (e.g., food), or spiritual (e.g., myths). In this sense, the use of animals in medical practices by various human societies can be perceived as a persisting ancient relationship, either through mainstream medicine (e.g., use of animal toxins) or via complementary, and alternative medical systems. This chapter presents an overview of medical systems used by different peoples, and emphasizes the role played by historical ethnozoology as a discipline focusing on the relationships between animals and culture over time.

2.1 Introduction

The World Health Organization defines the broad range of characteristics and elements which make traditional medicine as “health practices, approaches, knowledge and beliefs incorporating plant, animal and/or mineral based medicines,

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spiritual therapies, manual techniques and exercises applied singularly or in combination to maintain well-being, as well as to treat, diagnose or prevent illness” (Gray 1997). This working definition reflects, among other aspects, the fact that human health and biodiversity have been inextricably connected for thousands of years, and that cultures all over the world have developed characteristic ways of interacting with different components of the biota over time. For instance, until around 12,000 years ago humans derived food and raw materials from wild animals and plants (Serpell 1996), and as recently pointed out by Waters et al. (2011), humans engaged in Mastodon hunting since at least 13,800 years ago.

Animals have long been used by humans, reportedly initially for alimentary purposes; research suggests that humans evolved from a vegetarian lifestyle to the one including meat in their diets around 2.5 million years ago, at the dawn of the genus *Homo* (Holzman 2003; Larsen 2003). Nonetheless, just how much of the prehistoric diet included animals is difficult to tell from archeological evidence (Wing 2000).

At the dawn of recorded history it is known that man often ate, or wore on his person, some portion of an animal that was thought to have a healing or protecting influence (MacKinney 1946), and this aspect highlights that the origin of the medicinal use of faunal elements is intertwined with their use as food. In this same direction, Chemas (2010) remarked that treatment of illnesses using animal-based remedies is an extremely old practice, whose most remote ancestor is a carnivore diet, closely followed by the ritual ingestion of deceased persons (e.g., close relatives, warriors) as a means to absorb their virtues (e.g., courage, virility), and subsequently by a true medicinal use indissociable from magic religious elements. Those observations are in line with the view of nature as a provider of many things for humankind, including the tools for the first attempts at therapeutic intervention (Nakanishi 1999a).

We tend, of course, to brand as pure magic and superstition, primitive customs such as devouring the heart or drinking the blood of a defeated enemy, or eating an animal’s testicles, liver, spleen, or brain to strengthen the corresponding human organs; or imbibing human and animal excrement, saliva, teeth, ground bones, and the like (MacKinney 1946). This disconnection may be attributed, among other aspects, to the fact that there is more known about prehistoric man’s diseases than about earliest random and desperate efforts to use natural resources as “drugs,” given that the latter left scarcely an enduring trace. Equally relevant was the gradual placement into separate categories of magical religious practices and medicine, which happened in our millennium (Kremers and Urdang 1951).

On the other hand, the use of the grease of a poisonous animal as a preventive of poison, suggests that our remote ancestors may have stumbled on a valid principle of immunization. Nor is the use of poultices containing dung, grease, urine, etc., or of potions containing internal organs or secretions, to be dismissed as mere nonsense. A modern age of scientific medicine which has suddenly discovered medical values in all sorts of queer substances, and marvelous qualities in liver, kidneys, snake virus, and maggots, should be slow in condemning as pure magic and superstition the organ therapy, and similarly primitive practices of past

(MacKinney 1946). As pointed out by Kramers and Urdang (1951), given that ancient cultures must be considered from the standpoint of their outlook on life afforded by their spiritual, geographic and economic connotations, it would be unfair to accept as proof of an “unscientific” spirit the fact that Babylonian–Assyrian, ancient Egyptian, and the early past of Greek medicine contained a great deal of “magic,” as for those peoples, magic was a part of systematized “science”.

The antiquity in the use of medicinal animals and its persistency through times are a testimony to the importance of those therapeutic resources to mankind. Understanding the historical context in which those uses took place is central for tracking the knowledge base associated with the vast array of local or traditional medical practices involving animals throughout the centuries, either through diffusion among cultures, or via colonizers, who often brought with them medical practices which were imposed or integrated into local medical systems.

In this thematic review we survey existing sources and research papers on the medicinal use of animals to provide a summary of knowledge and highlight the contributions made by the field of ethnobiology, aiming to increase our understanding of the connection between humans and nature, and particularly, of traditional medical systems worldwide.

2.2 Sources and Avenues to Explore Past Relations Between Humans and Animals

The use of medicinal animals may be found in any historical source that contributes to filling in the complex mosaic of the history of human–animal interactions and the implications of this association constitute a valuable object for studies of historic ethnozoology. Evidences for studies focusing on a historical perspective can be gathered from various sources; for instance, rock paintings and archeological inscriptions can attest the antiquity in the use of animals by humans (Martínez 2008; Sutton 1995), though written documents have more precisely recorded information about the interactions of ancient humans groups with their regional fauna and their uses of those animals (Alves and Souto 2010; Martínez 2008). This vision is corroborated by Sneader (2005), who highlights that ancient paintings on the walls of caves to early use of drugs that had a pronounced effect on the mind. However, it is only the written accounts that communicate something of the reasoning that led our ancestors to seek out remedies for treating disease, such as those compiled by inhabitants of Ancient Egypt, Mesopotamia, and particularly Greece.

Valuable information can be obtained through historical texts produced by chroniclers, writers, doctors, naturalists, as well as by other historic subjects, which contain evidence of the ancient relationships between animals and people (Alves and Souto 2010). Equally important are the iconographic documents which

may reveal novel aspects the fauna, and in some cases even assist in the identification of species cited in encyclopedic works.

On delimitation of the research's theme and scope (both temporally and spatially), a search for sources can be conducted, after which analytical and critical readings of the material should clarify the main points related to the central questions of the research. Whenever feasible, this exercise of reading and transcribing should be based on first editions of the works, so that the information and spelling can be best analyzed, and then compared with other sources (Medeiros 2010).

In general, focus should be placed on the identification, documentation, characterization and understanding of the role played by animals in past, and current social contexts. Through this exercise of narrative construction it is possible to fill in gaps in knowledge about the processing of a given animal species, as well as to put forth an analysis of the document's author viewpoint (Albuquerque 1997; Nascimento and Carvalho 2006). Clearly, an important development of historical research in ethnobiology is the contextualization of the document. Consideration of aspects such as authorship, the existence of sponsorship, and the sociocultural context of the period in which the text was produced is pivotal to better apprehend the issues involving use of animals in accordance to style of the examined document. Keeping those facets in mind is crucial to come as close as possible to a synchronicity between interpretation and analysis.

This way of accessing the information provided by the author of the analyzed document makes possible to revisit a particular memory layer in a broader way, thus leaving room for reflections on the ideological and thematic bases of the works under examination. Perhaps this constitutes the greatest challenge of such approach, as the data need to be contextualized in light of the period in which they were produced, thus leading to an additional effort on the part of the researcher. Additionally, a central compartment of the methodological and analytical procedures lies in the taxonomic discussion of the findings, as not all documents accessed by the researcher provide clear clues about the taxon under consideration. In that case, the researcher must resort to an ample arsenal of information to solve the problem.

Historical ethnozoology highlights the fact that the interrelationships between people and animals are determined by ecological and cultural conditions, factors that in turn are dynamic and have suffered both qualitative and quantitative changes through time. This way, the formulation of in-depth inferences about the interfaces involving people and animals should consider a historiographical approach, which should also serve as the starting point for the ethnozoological study.

Nonetheless, it should be noted that the historical ethnozoology intends not only to point out animals which have been useful at a given period of time, but also to characterize a sociocultural community, by accessing its shared set of values and knowledge, and its collective imaginary.

2.3 Historical Evidence of the Use of Medicinal Animals

Interest in natural sources to provide treatments for pain, palliatives, or curatives for a variety of maladies or recreational use reaches back to the earliest points of history (Spainhour 2005). In that context, the medicinal use of natural products precedes recorded human history probably by thousands of years (Ji et al. 2009). Surveys of the medicaments used in the past show that, whereas compounders of medicines have invariably used vegetable, animal, and mineral substances, animals are less prevalent than herbs, and more prevalent than minerals (MacKinney 1946). Whole animals, animal parts, and animal-derived products (e.g., urine, fat etc.) have been constituted important elements of the *materia medica* in different regions of the world (Alakbarli 2006; Alves and Rosa 2005; Lev 2003; Unnikrishnan 2004).

Some of the first records on the use of natural products in medicine were written in cuneiform in Mesopotamia on clay tablets and date to approximately 2600 B.C. (Cragg and Newman 2001a, b; Nakanishi 1999a, b). Others of the earliest known written records of healing with medicinal substances were recorded in Egypt. The ancient Egyptians of 3,000–6,000 years ago are credited with developing an elaborate and effective pharmacological collection of numerous curing materials obtained from natural resources (Halberstein 2005). Nunn (2002 p.137) states: “By far the most common form of treatment recommended in the medical papyri was the use of drugs, drawn from a very wide range of animal, mineral, and vegetable substances and administered in a variety of ways.”

Our understanding of Egyptian medicine and pharmacology is based on inscriptions on monuments and graves and papyrus rolls, the most important one being Papyrus Ebers. It is thought to have been written around 1550 B.C. (Lidgard 2005) and includes 800 or more prescriptions comprising various herbs, animals, and minerals, a considerable number contain matter derived from birds and beasts both wild and domestic, from insects, reptiles, and fish. From these animals, a variety of *materia medica* was derived, ranging from the natural products (milk, eggs, etc.) and excrements of living animals, to the bones, blood, flesh, fat, marrow, and hide of carcasses, and in certain cases special substances such as the feathers of birds, the shell of the tortoise, the quills of the porcupine, the slough of snakes, and dirt from under human fingernails. In the case of insects, worms, and small animals, often the entire body was used; of ordinary animals, only small portions were used: the head, hair, horns, brain, eyes, teeth, jawbone, heart, liver, spleen, gall, uterus, vulva, testicles, legs, feet, hoofs, etc. By all odds the most favored substance was the grease, or fat, particularly of the goose and ox. In over a hundred recipes greasy substances were employed; in some cases, however, as a vehicle, rather than as the active ingredient. Second importance was the excrements which were employed in about half as many prescriptions (MacKinney 1946).

Other evidence of zootherapy has been found in archives of several civilizations of ancient Mesopotamia, mainly the Assyrian, and the Babylonian (Lev 2003). These contain descriptions of fish oil, bee wax and honey, mongoose blood, turtle

shell, goat's skin, gazelle sinew and even sheep, deer, and bird excrement and animal fat (Powell 1993; Ritter 1965; Thompson 1923).

In ancient China, various animal substances were used for therapeutic purposes (Gordon 1949). Research on medicinal uses of earthworms has a history of nearly 4,000 years (Zhang et al. 1992). *Compendium of Materia Medica* written by Li Schizhen in 1578 A.D. was a comprehensive summary of pharmacological knowledge accumulated in China up to his time. The use of bear fat as a medicine dates to 3494 B.C. (Ma 1986). Bear gallbladder may have entered the Chinese pharmacopeia as many as 3,000 years ago. Prescriptions for bear gall first appeared in writing in the seventh century (Bensky and Gamble 1986). The medicinal use of rhino horn is recorded from China as early as 2600 B.C. (Nowell et al. 1992), spreading in later years to Western Asia and the Roman Empire (Hirth and Rockhill 1911; Schafer 1963). Elasmobranchs are also employed in traditional Chinese medicine and Read (1939) lists shark flesh, skin, and bile among animal *materia medica*.

In India, since times immemorial, investigations focused on various zootherapies and traditional medicines, documented in the ancient texts of the *Ayurveda* and *Charaka Samhita* (Jharna et al. 1797; Mahawar and Jaroli 2008). Ancient literature of Ayurveda is full of medicines or formulations made of animal products. *Sharaka Samhita*, the first treatise devoted to the concepts and practice of Indian Ayurveda, was written around 900 B.C. and contains references to nearly 380 types of animal substances (Unnikrishnan 1998). The next landmark in Ayurvedic literature was the *Sushruta Samhita* (−600 B.C.) (Majumdar 1971), which has special emphasis on surgery. It described 395 medicinal plants, 57 drugs of animal origin, and 64 minerals and metals as therapeutic agents (Dev 1999). Substances which are used in medicine and are derived from animals are grouped under the head of *Jangama dravya* (material derived from animals). There are hundreds of such formulations in Ayurveda, which utilize a variety of animal products. These animal products are much diverse in their habitat of origin and comprise marine, aquatic, terrestrial, or avian species. Regarding terrestrial animals, the products from wild as well as from domestic animals are also used in medicine. Among a wide variety of products derived from animals and used in medicine, commonly utilized substances are honey, milk and its derivatives, bile, fat, bone marrow, blood, flesh, feces, urine, skin, semen, ligaments, bones, shell, horn, and feathers (Rastogi and Kaple 2008).

The Bible and other Jewish sources, mainly the Mishna (First to third centuries CE) and the Talmud (Fourth to fifth centuries CE), that is, the literature of the Jewish Sages, mention several animals and their medical uses: honey was used to treat bulimia and goat milk to cure coughing (Lev 2003). Snakes, human urine, pearl, mammal's glands, and several other substances were used for different medical conditions (Preuss and Rosner 1993).

Historical documents also reveal that the use of medicinal animals is directly associated to the history of medicine. Taylor and Tweed (1975) drew attention to the fact that the word medicine owes its origin to insects or at least to the honeybee. The first part of the word medicine has the same root as the word

“mead” which is an alcoholic beverage made from honeycomb, which was often consumed as an elixir and thought to possess healing or medicinal powers. Another important taxon associated with the history of medicine are the snakes.

From very ancient times, the snake was a constant companion of medicine men and magicians. In mythical stories, snakes were often said to have knowledge of healing or life restoring plants, and there was a widespread belief that wisdom and medical knowledge could be obtained from the snake in various ways. Asklepios, the Greek god of medicine (better known by his Latin name, Aesculapius), like all Greek healing heroes was closely associated with the snake. Even in later times, when he was portrayed as a man, with snake staff as his emblem, he was said to manifest himself in serpent form and the snakes kept at his temple in Epidaurus were therefore approached with awe by their attendants. Asklepios appeared in 293 B.C. in form of a snake at Rome, where the pestilence was ranging. The outbreak of the plague was arrested and a temple built in his honor (Morris and Morris 1965). The snake became a sign of medicine and healing both by virtue of its godly associations, and also through the metaphorical immortality represented by the shedding of its skin. References to snakes—both actual animals and artistic representations thereof—abound in the healing temples, and it was the snake as cult object that was used to symbolically transfer the power of the healing god from its original geographic locus to the site of a new temple—this was true both of the entrance of Asclepius to Athens during the late fifth century plague (Edelstein and Edelstein 1975), as well as his introduction to Rome in 291 B.C. (King 4). The *caduceus*—the snake (and later, two symmetrically opposed snakes) curled around a long staff—is perhaps the best known representation of the Greek sacred snake, one that persists as a symbol of the art of medicine to this day (Retief and Cilliers 2010).

Classical medical literature also indicates animals as remedies (Lev 2003); as an example, Voultsiadou (2010) found records of medicinal uses of marine invertebrates in 40 works of 20 classical authors, covering a period of time of eleven centuries (5th B.C. to 7th A.D.); Riddle (1987) mentioned a number of animal substances (e.g., cattle milk, chicken’s eggs, and mammal’s horns) cited in the work of Hippocrates, who left a long list of opotherapeutic medications, of which very few have been preserved in modern times. Nonetheless, the combination of bull’s bile with honey, a classical Hippocratic remedy for intestinal constipation, remains functional to this day (Chemas 2010).

Ancient Greeks used various animal-based remedies, as exemplified by Homer’s narrative tale of the centaur Chiron, who strengthened Ulysses by giving him lion’s bone marrow to ingest, and by the priests at the temples of Aesculap, who recommended the ingestion of snake meat by lepers.

The works of Dioscorides, a Greek soldier and traveler who wrote in the age of the Roman Emperor Nero, provide our most detailed collection of Greek *materia medica*. In about A.D. 65, after much direct observation of plants in their native habitats and careful practical experience on the medicinal uses of herbs, as well as those derived from animals and minerals, Dioscorides wrote *De Materia Medica* (as the original work in Greek is known in Latin) in five books “on the preparation,

properties, and testing of drugs” (Preface, I), each chapter dealing with a single substance, its description, preparation, and therapeutic properties (Stockwell 1988).

Although the greater portion of his five book treatise concerns vegetable substances, almost half of book II is devoted to materia medica from animals. Starting with aquatic creatures, Dioscorides discussed the medical properties of each of a number of fish, shell fish, insects, domestic animals, birds, and larger animals; this is followed by a description of the uses of milk, cheese, butter, wool, wax, honey, fat, and of animal substances such as marrow, gall, blood, and the excrements. In the case of insects, worms, and certain smaller animals, often the entire body was crushed, dried, burned, or cooked and applied in the form of a powder, salve, poultice, or potion. Noteworthy among the remedies for both external and internal use, were those made from cantharid beetles, grubs, earthworms, millipedes, roaches, and bugs of various sorts. For example, cockroaches ground up in oil were applied for ear ache. Millipedes, taken internally with wine, were recommended for epilepsy and kidney trouble, with honey for throat trouble, and when ground up with certain herbs and applied directly, they were supposed to cure tooth ache (MacKinney 1946).

Various portions of larger animals were used in equally varied fashion; among them the brain of a chicken, the tusk of an elephant, the hoof of an ass or goat, or internal organs such as the liver, gall bladder, bones or marrow, and testicles. More prominent, however, are substances such as grease, and to a lesser degree blood, excrement, sweat, and other such matter from man or beast (MacKinney 1946). About 10% of the substances mentioned in Dioscorides’s *Materia Medica*; (Gillispie 1970–1978) were body parts and products of animals (Gunther 1959; Riddle 1985). Such uses on a smaller scale were common in the Byzantine Empire (Francis 1846).

Among the Roman writers on medicine two are outstanding: Celsus and Pliny the Elder. From the standpoint of animal materia medica Pliny the Elder’s *Natural History* has been more influential than most of the works considered thus far. In fact it is one of the most comprehensive of all sources of information concerning the materia medica of the ancient world. Pliny wrote in Rome, at about the middle of the first century A.D. Out of eighteen books in his *Natural History* which deal with materia medica, books XXVIII, XXIX, XXX, XXXI and XXXII are devoted to animal substances. Pliny’s *Natural History* marks a high point in the history of animal materia medica in that it records more substances and in greater detail than any extant work prior to the invention of printing. For well over a thousand years after Pliny, the materia medica of animals (along with other medical practices) diminished in quantity and quality (MacKinney 1946).

Even in the eleventh, twelfth, and thirteenth centuries, when Arabic and Salernitan writers introduced progressive ideas in many lines of medicine, materia medica continued to be dominated by the superstition and magic that had been handed down from classical times. Abundant evidence of this assertion can be found in the *Speculum Naturale* of Vincent of Beauvais, a worthy example of the great encyclopedists of the thirteenth century. The *Speculum* is strikingly similar to

Pliny's *Natural History*, so far as animal *materia medica* is concerned. It is a rather loose and unscientific compilation of material from various sources. A separate section is devoted to each animal, with abstracts of information from classical and Arabian sources. For example, in the treatment of the cantharid beetle, one finds a general description, a brief account of the medical properties, three specific uses, and brief citations of material from Dioscorides, Haly (an Arab writer), and Pliny. In similarly stereotyped fashion, Vincent treats the various animals, large and small, wild and domestic, and also the time honored substances derived there from, and methods of application. In general, Vincent, like his predecessors and contemporaries, placed great faith in animal substances of all kinds. In one passage he asserted that the blood of all animals was medicinal (XXI, 65). His English contemporary, Bartholomew of Glanville, in an encyclopedia of similar character, held that "nothing in a beast's body is devoid of medical value" (XVIII, 1) (MacKinney 1946)

Animal-based medical products were common among Amerindians (Almeida 2007, 2010; Alves et al. 2007; Silva et al. 2004), as described by various travelers who reached the New World; these provided novel information on indigenous groups, their illnesses and treatments. The settlement of the Americas by Europeans in the sixteenth and seventeenth centuries made little fundamental change in the use of animals, or any other substances in *materia medica*. Just as it was in Europe after the Renaissance, in Central and South America after the coming of the Conquistadores, traditional medical practices persisted (MacKinney 1946), nonetheless the European system came to dominate, relegating local systems to a folk category outside mainstream medicine.

Specifically in the case of Brazil, various writings contain information on the discovery of the fauna, the first ones being texts (e.g. letters) sent to European kings, such as the and letter of Pero Vaz de Caminha to the king D. Manuel I of Portugal, written in 1500 (National Archive, Torre do Tombo, Portugal, 2009); the documents produced by chroniclers such as Hans Staden (1510–1576), whose writings (published in Europe in 1557) contained the description of species he became familiar with through the native Tupinambás. Additional sources are the reports prepared by missionaries, such as the work *História dos Animais e Árvores do Maranhão*, by fray Cristóvão de Lisboa (1583–1652), or documents produced by noblemen and settlers. As pointed out by Miranda (2004), the main concern of those who initially recorded the diversity of the Brazilian fauna was to identify, to described possible uses and treats to humans.

Following colonization (second half of the sixteenth century) Jesuitic medicine and physicians trained in European universities—who represented mainstream medicine—came to Brazil, Jorge Valadares being the first physician to arrive in the country (Scliar 2005). The epithet "Jesuitical medicine" reflects the medical practice of that period, during which the priests of the Society of Jesus served as physicians, nurses and pharmacists, both to natives and settlers. In fact, their infirmaries constituted the first hospitals of the inhabitants of the colony (Duniau 2003; Santos Filho 2005).

Amalgamation of knowledge related to European medicine with indigenous medical practices allowed the Jesuits to describe prescriptions and effects related to the medicinal use of native species of animals and plants, which became incorporated into a global pharmacopaea (Santos Filho 2005). The Society of Jesus therefore played a role in the process of interculturality, given its presence in various parts of the world, which allowed a comparative systematisation of knowledge gathered in the Americas, Africa and Asia. Among the Jesuits of the sixteenth century based in Brazil, José de Anchieta stands out, according to Santos Filho (2005), as “the best and most important figure in Brazil’s sixteenth century medicine. Father Anchieta produced various works, some of them dedicated to the description of the Brazilian fauna (Miranda 2004).

Between the years 1637 and 1644, during the Dutch occupation of NE Brazil, the naturalists William Piso and George Marcgrave explored the states of Pernambuco, Paraíba and Rio Grande do Norte’s hinterland, where they collected specimens from flora and fauna. The writings of Piso and Marcgrave were compiled in 12 books grouped as *Historia Naturalis Brasiliae*, first edited in 1648 (Piso and Marcgrave 1648; Piso 1957). *Historia Naturalis Brasiliae* constitutes one of the first comprehensive works dedicated to various aspects of Brazil: flora, animals, illnesses, sugarcane mills, and customs of native indians (van den Berg 1993; Marques 1999; Nogueira 2000). Reviews of the works produced by Piso and Marcgrave revealed that from 43 zootherapeutical prescriptions involving different zoological groups, 30 were recorded by Piso, three by Marcgrave and nine by Joannes de Laet (organizer and editor of the 1648 edition of the *Historia naturalis Brasiliae*). It is worth noting that some of the zootherapeutical prescriptions recorded by Piso are still used in popular medicine—a testimony to their endurance and reproduction power (Almeida 2007).

2.4 Final Remarks

Animal substances, although not as numerous as those of vegetable origin, have played (and continue to do so) an important role in healing. Records of the use of animals as remedies can be found in historical sources worldwide, and these highlight that an ample spectrum of animal taxa, from sponges to mammals, have been used as a therapeutic alternative throughout history. In fact, many of the animals prescribed in the past are still in use (being recommended either for the same illness as originally described or for distinct conditions) in traditional medical practiced in different localities.

Increased understanding of medical systems in a historical context can potentially bring new insights into the medical significance of fauna in the past, as well as open new therapeutic perspectives in the future—the historic and sustained use of naturally occurring compounds often has a scientific under-pinning, and the persistence of use of animal resources may indicate the presence of biologically active components.

Nonetheless, perhaps the greatest contribution of a historical approach resides in the possibility of drawing parallels with other disciplines and/or approaches: for instance, medicine, as a means to understanding the evolution of medical practices over time and how these practices have been incorporated into academia (e.g., the use of animal toxins), and of those which have been systematized as complementary or alternative medicine; ecology, as a means to increase our comprehension about species' historical use, management and conservation; anthropology/ethnobiology, as a way for shedding new light into an ancient form of connection between humans and nature.

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