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11 Cooperating with the wild

Past and present auxiliary animals assisting humans in their foraging activities

Edmond Dounias

mo è jɛɛ mbɛlɛkɔ yiê pɔkì kɔ
If you hear the lesser honeyguide singing, honey is near!
(Baka proverb in southeastern Cameroon expressing evidence)

Introduction

Ethnozoological literature has continually documented the incredible diversity of relationships that human beings have woven with other sentient creatures within the animal kingdom. Following a wide spectrum of scenarios that elapsed over extremely variable periods of time, some of these relationships have led to particularly achieved forms of domestication,[1] whereas others were more fleeting and opportunistic. Some have probably persisted a certain amount of time without leading to domestication, whereas some were rapidly abandoned and forgotten in the meanders of the evolution of human societies. Some are motivated by practical and material uses, whereas others are carried by considerations of a spiritual, artistic or psycho-cultural nature. Intrigued by the fact that early hominids had already begun to establish privileged relationships with certain animals (for instance, scavenging vertebrates such as vultures and hyenas), many scientific disciplines – archeology, history, linguistics, population biology, functional ecology, behavioral sciences and cultural anthropology, just to name a few – have combined their efforts to try and understand the diverse trajectories that took animals from a free-living wild state to states that engaged them in diversely constrained partnerships with humans.

So far, attempts to cross domestication trajectories, on one hand, with functional categories of human-animal interactions, on the other hand, have not received the attention they deserve (Clutton-Brock 1981). The aim of this chapter is to consider a particular category of interactions between humans and animals – the use of animals as assistants for foraging activities – and to look at how these animals, hereafter qualified as 'auxiliaries', are situated along the broad spectrum of relationships between humans and animals. A prominent feature of this category of human-animal interactions is that the auxiliary function eventually addresses a limited number of domesticated animal species. The majority of contributions

as assistants are in fact fullfilled by wild-born animals that are purposedly tamed in captivity to become auxiliaries. Furthermore, this category includes a smaller number of cases of human cooperation with wild, non-captive and non-tamed animals. In spite of their natural avoidance of humans, these animals deliberately assist (or assisted) humans in very specific foraging activities. Emphasis will be placed on these cases of wild auxiliary animals – be they kept captive or in the wild – in order to consider how they can enlighten our views of the history and prehistory of animal domestication.

Auxiliary animals

The term 'auxiliary', derived from *auxiliārius* (assisting, aiding, helping), implies a wide range of capacities to refer to animals that assist, serve as an aid or function in a supporting capacity to humans in their production activities. 'Auxiliary' does not encompass situations where animals are trained as vectors of a proximate profit-making activity, such as animals in a circus or for racing, fighting, gambling, exhibiting, dressage and other competitions or contests. Nor does 'auxiliary' refer to signal guides that incidentally inform humans about the presence of a given resource, without any formal intention to attract the attention of humans. For instance, whereas dogs (*Canis familiaris*) and pigs (*Sus scrofa*) are truly auxiliaries of truffle (*Tuber melanosporum*) harvesters (Chazoule 2004), *Suillia* flies and leiodid beetles that also track the mushroom in order to lie their eggs inside it and whose presence is accordingly observed by the same truffle harvesters (Pérez Andueza et al. 2015) are not auxiliaries.

Tamed auxiliary animals – be they domesticated or wild-born captives – intervene in a vast spectrum of usages:

- carrying loads and doing heavy labor (horse, donkey, camel, dromedary, elephant, yak, onager, mule, llama);
- serving as mounts (horse, donkey, camel, reindeer, elephant);
- serving as draught animals for farming and transport (dog, horse, water buffalo, donkey);
- keeping and protecting livestock (dog);
- aiding and rescuing humans (dog);
- assisting disabled persons (dog);
- serving as therapeutic companions (all kinds of pets);
- clearing of water bodies (manatee);
- hunting (dog, cheetah, caracal, raptors, chinkara, blackbuck);
- fishing (otter, cormorant);
- gathering (macaque, baboon, pig, dog).

The last three categories of usages – hunting, fishing, gathering – are what we group under the term 'foraging', which refers to the acquisition from the wild of edible resources, be they of animal or vegetal origin (Danchin et al. 2008). Foraging activities have been carried out without interruption from the time of early hominids

up until today; they have been consubstantial of *Homo sapiens* evolution, both in its biological and sociocultural dimensions, over the past 200,000 years. Foraging activities remain predominant among the last modern-day hunter-gatherer societies. As will be further discussed later in the chapter, a few of these activities – to be counted on the fingers of one hand – are carried out in collaboration with non-domesticated auxiliary animals.

It is worth briefly mentioning warfare, which throughout the history of humankind has been a propitious context for the training of auxiliary animals, to respond to offensive as well as defensive purposes. Historians report that during the First World War alone, 14 million mammals were pressed into service, 10 million were killed and 120,000 were decorated for exploits of war (Lasserre 2014).

Auxiliary domesticates for foraging activities

Animal domestication occurred along variable trajectories that were contingent on various locally-shaped biological and cultural parameters. According to Zeder (2012), these various trajectories can, however, be grouped in three domestication pathways that seem to encompass the broad range of known situations: the commensal pathway, the prey pathway and the directed pathway.[2]

Zeder's commensal pathway addresses animals that came into contact with humans to feed on refuse or to prey on other animals attracted to human settlement. At some point, these animals developed with their human hosts close social or economic bonds that brought them into a domestic partnership with humans. Very few animals that help as auxiliaries were domesticated along this pathway, but they include the most important and ubiquitous of all auxiliary animals: the dog. In all types of human societies, the dog is mostly used as an assistant for hunting. But it also intervenes in almost all categories and is even the sole auxiliary in several domains of intervention (for instance, aid and rescue, or assistance to disabled persons).

The prey pathway proposed by Zeder likely began when humans developed hunting strategies designed to increase prey availability. Over time and under certain circumstances, these game management strategies developed into actual herd management and, eventually, the controlled breeding of managed animals. The wether (*Ovis aries*) trained to lead a sheep flock (Tani 1989) and the reindeer (*Rangifer tarandus*) that initially served as mount in hunting activities (Clutton-Brock 1981) before becoming a major source of meat (Stépanoff et al. 2017), are prominent examples of auxiliary animal species that were domesticated along this pathway.

The directed pathway is viewed by Zeder as a fast track to domestication that begins when humans use knowledge gained from the management of already domesticated animals to domesticate a wild species that possesses a desirable resource. Good examples of auxiliary animals that were domesticated following this pathway are equids – the horse (*Equus caballus*), the donkey (*Equus asinus*) and the onager (*Equus hemionus*) – that are used as mounts during hunting expeditions, even though their service as mounts is far from being limited to foraging activities.

Auxiliary animals among tamed wild-born captives

Many more auxiliary animals are found among wild-born animals that are tamed in captivity. These animals are captured and deliberately trained following a human-directed conditioning to become tolerant of humans and to respond favorably to their human master during their activities as auxiliaries. But, by contrast to domesticated animals, these tamed captives are not bred and have not undergone any genetic modification aiming to foster the inheritance of favorable predispositions towards humans, even though there is increasing evidence that a potential for domestication may occur as a by-product among wild animals being bred in captivity (O'Regan and Kitchener 2005).

Several birds of prey, ungulates, elephantids and felid carnivores have been trained as hunting assistants. Traced back in Central Asia to the 2nd millennium BC (Soma 2012), horseback falconry is still actively performed today. Golden eagle (*Aquila chrysaetos*), northern goshawk (*Accipiter gentilis*), European buzzard (*Buteo buteo*) and several falcon species (*Falco cherrug*, *F. peregrinus*, *F.vespertinus*) are obligate partners used by Kyrgyz and Kazakh equestrian hunters to track various mammal prey including hares (subgenus *Eulagos* of the genus *Lepus*), red and corsac foxes (*Vulpes vulpes*, *V. corsac*) and gray wolves (*Canis lupus*).

Tamed blackbucks (*Antilope cervicapra*) and chinkaras (*Gazella bennettii*) assisted Indian hunters as decoys, following a somewhat unusual yet clever technique: a tame antelope was sent into the wild herd with nooses attached to its horns. This unwanted guest would inevitably be provoked in fight and hunters would easily capture the wild fighter whose horns were entangled with those of the tamed fighter (Menon 2000).

African elephants (*Loxodonta africana*) and Asian elephants (*Elephas maximus*) were tamed predominantly as mounts for war, for the carriage of heavy loads and, in the early 20th century, for serving as draught animals in colonial farms (Bannikov and Popov 2014). This practice, still vivid in Asia (Lainé, this volume), has been abandoned in the African continent. Although attested in the Congo Basin (Bennett 1957), taming of elephants in Africa was predominantly located in the northern part of the continent. Elephants were rarely used for foraging activities, except maybe as log carriers in artisanal logging. As mentioned earlier for blackbucks and chinkaras, tame female elephants serve as decoys in Sri Lanka, India, Myanmar, Cambodia and Thailand, to attract wild individuals into places where they can more easily be trapped (Baker and Manwell 1982).

Hunting with the help of felids is no longer practiced. The asiatic cheetah (*Acinonyx jubatus venaticus*) – now declared critically endangered in the International Union for Conservation of Nature (IUCN) red list of threatened species – has been extirpated from nearly all of its range (Nowell and Jackson 1996). A major cause advanced for this extirpation is the live capture of cheetahs to be trained for sport hunting of deer and gazelle or to be kept as pets (Divyabhanusinh 2000). This has also been the fate of the caracal (*Felis caracal*), which was similarly tamed for hunting in India and ancient Egypt (Sunquist and Sunquist 2002).

In most cases, tamed mammal captives assisting the hunts were luxury goods that only rich members of the aristocracy and monarchy – in ancient Egypt and Assyria, the Mogul Empire of Central Asia, African kingdoms, medieval European elites – could possess. The fall of each of these various dynasties at some point in history naturally caused the subsequent loss of these collaborations.

In contrast to hunting, fishing activities benefited from the assistance of tamed captive animals that were not in the exclusive hands of the elites. Their accessibility to poorer traditional fishers may explain why these partnerships have more frequently persisted until today. Two major auxiliaries tamed for fishing are worth mentioning. The first remarkable one is the smooth-coated otter (*Lutrogale perspicillata*), whose use as an assistant in fishing is still in vogue in southern Bangladesh (Feeroz et al. 2011). The oldest records of this practice are situated in the Yangtze River in China during the Tang dynasty, 6th century AD (Simoons 1990). In India, otter fishing was practiced in the Indus and Ganges river basins, in Bengal and in southern India along the Coromandel Coast. Otter fishing is reported to have existed in Central and South America (Gabriel et al. 2008); it was also known in Europe (Svanberg et al. 2016) from as early as the 15th century, with a first mention in the British Isles that is dated 1480 (Walton 1653).

The second astonishing fishing auxiliary is the great cormorant (*Phalacrocorax carbo*). The first scientific records of this partnership were published in the late 1920s, and according to Laufer (1931), the earliest historical mention of the use of tame cormorants is dated AD 607. Great cormorants were bred and reared in captivity. The eggs of captive cormorants were rapidly taken away from their mothers, transferred for brooding to domestic fowl, and the young birds benefited from a special diet. Their intensive training could take up to eight months before they became fully obedient and docile. Auxiliary cormorants have a ring placed around the base of their neck that prevents the deglutition of large fish. After catching a fish, the bird is forced to disgorge it. Egremont and Rothschild (1979), who provide the first detailed description of the fishing procedure, evoke, however, a curious and yet unexplained limitation to the cormorant's total submission to their fisher master: as if they were able to count, the cormorant will refuse to obey after having captured seven fish, if its master does not remove the ring and let the bird have access to a reward (by letting it eat the eighth prey or fish for itself).

The sole case currently known of gathering activity in which a tamed captive animal operates as an auxiliary is that of coconut harvesting from the tops of planted coconut palm trees with the help of the southern pigtailed macaque (*Macaca nemestrina*). A salient aspect of this Southeast Asian activity – practiced mainly in Indonesia, Malaysia and Thailand – is its strong integration into commerce of a globally important commodity. The coconut market is so lucrative that coconut-picking monkeys have acquired a commercial value *per se*. In Thailand, the price for a trained coconut-picking macaque is nowadays negotiated between $1,450–2,900 US (Florescu 2014).

A past gathering activity also involving a primate as auxiliary animal is depicted on a few Egyptian tombs by paintings that illustrate the use of Hamadryas baboons (*Papio hamadryas*) as harvesters of figs (*Ficus sycomorus*) and

doum palm nuts (*Hyphaene thebaica*). However, evidence that the baboon was purposely trained to accomplish this fruit picking for a human master remains questionable (Gudger 1923).

Non-captive wild auxiliary animals

The functional category of auxiliary animals provides rare but enlightening cases in which the animal partner is neither a domesticate nor lives under human care in captivity. Although not tamed, these animals may have developed some tameness predispositions, in the sense that they may occasionally be welcoming towards the presence of humans or even towards an interaction with them (Geist 2011). We have been able to identify only four attested cases: two concern marine and riverine mammals that belong to the sub-order of toothed whales (Odontoceti) and that are represented by the Iniidae (a family of nearly extinct river dolphins) and the Delphinidae (the family of currently persisting orcas and dolphins); the two other cases concern bird species belonging to two very distinct orders: Passeriformes (the raven, *Corvidae*) and Piciformes (the honeyguide, *Indicatoridae*).

Marine and riverine mammals: dolphins and orca

Dolphins

Several species of marine and riverine dolphins of the genera *Inia*, *Tursiops*, *Sotalia* and *Orcaella* collaborate with fisherfok. This collaboration has been reported in distinct parts of the world:

- with the bottlenose dolphin (*Tursiops truncatus*) along the Mauritanian coast (Busnel 1973; Pelletier 1975), in the Mediterranean Sea as described very early by Pliny the Elder (Bostock and Riley 1855), and in Laguna (Pryor et al. 1990; Peterson et al. 2008) and Barra de Imbé/Tramandai (Zappes et al. 2011) in southern coastal Brazil;
- with the tucuxi dolphin (*Sotalia fluviatilis*) in Santa Catarina, Brazil (Monteiro-Filho 1995);
- with the Amazon river dolphin (*Inia geoffrensis*) in the Araguaia River, state of Tocantins, Brazil (Gravena et al. 2008);
- with the Irrawaddy dolphin (*Orcaella brevirostris*) in Myanmar (Smith et al. 2009; D'Lima et al. 2014).

Collaboration with marine, bay and estuary dolphins is mainly related to the seasonal migrations of mullets, a family of fishes (Mugilidae) that share the behavior of leaping out of the water to escape predators. The massive and dense concentration of fish following a typical 'predator satiety' strategy (Holling 1965) is a strong incentive for top predators to converge and merge their forces in order to catch a maximum number of prey in a minimal amount of time. The collaboration between fishers and dolphins is fleeting, and both sides react promptly to the signs

sent by their ephemeral partners. In these opportunistic situations, both partners participate in numbers. The fishers possess an extensive panel of techniques to emit acoustic signals and attract the attention of the dolphins. In return, dolphins use various gestural signs to alert the fishers when a school of fish is entrapped.

River dolphins (*Inia geoffrensis* in Brazil, *Orcaella brevirostris* in Myanmar) take part in more regular collaborations to capture a much broader range of fishes and crustaceans. River dolphins generally live as single individuals or couples, more rarely as small groups. They are also more territorial than their marine relatives. For these various reasons, the partnership with the fishers is more intimate and is backed up by a more sophisticated communication between partners (cf. Table 11.1). Dolphins come into closer contact with the fishers and their boats. Individual dolphins are more frequently personified with a name and can easily be recognized by the shape of their fins, skin pigments and scars, or their personal behavior. Some dolphins really act as pets, seemingly appreciating direct physical contact with their fishers. In Myanmar, the proximity between river dolphins and their human partners even led to situations in which river fishers claimed exclusive associations with particular dolphins. Some fishers would even bring conflicts into native courts to recover a share of the fish captured by a rival fisher with the alleged help of the claimant's dolphin.

Collaborations with dolphins have shaped positive perceptions of the cetaceans by the local fisher communities with whom they interact. The intelligence and sense of sharing of dolphins are strongly put forward and mediated by local mythologies that frequently cast dolphins as symbolic emissaries between humans and supranatural forces (Patel 1994). The fact that resources are shared with dolphins has also contributed to draw visions of the world in which shared spaces between humans and non-human sentient creatures strongly drive local cultural identity.

Nevertheless, collaboration between dolphins and fishers is globally unstable and uncertain, particularly with marine dolphins. Sometimes, dolphins do not respond to the calls of the fishers; in other occasions, their unwanted presence will disturb fishers and even compromise their fishing success. When it is effective and successful, this joint exploitation of fish resources fluctuates between an opportunistic commensal relationship and an interspecific collaboration.

Orcas

The orca is one of earth's most intelligent animals. It has remarkably sophisticated hunting methods, languages and cultures, and even long-term memories (Neiwert 2015). Not surprisingly, orcas play a pivotal role in the mythology and contemporary popular culture of sea-mammal hunting peoples. This role reflects a close relationship of mutual exchange between humans and orcas, especially in Norway and the Chukchi Peninsula (Bering Strait between Alaska and Russia). Holzlehner (2015), who has traced human-orca relationships along the Pacific Rim, gathered distinctive epistemologies among whaler communities, which draw, however, on surprisingly similar mythological substrates in places as diverse as Tierra del Fuego (Argentina), Peru, Alaska, Okhotsk Sea (Russia) and Hokkaido (Japan).

Collaboration of humans with orcas as auxiliaries for whale hunting was less frequent than that with dolphins for mullet fishing, and certainly less resisted change, but it was based on a more solid partnership and greater involvement of the non-human partner. It is in Twofold Bay (southeastern Australia) that Clode (2002) compiled the most detailed descriptions of the peculiar behavior of orcas as whale-hunting auxiliaries. Between 1840 and 1930, orcas would prowl the entrance of the bay, and ambush migrating humpback (*Megaptera novaeangliae*), blue (*Balaenoptera musculus*), southern right (*Eubalaena australis*) and minke (*Balaenoptera acutorostrata*) whales. Working in groups, with individuals taking on different roles, orcas would shepherd the whales into the bay. Ripping at fins and diving over the whales' blowholes, they would take advantage of the bay's unique geography and force the whales into shallower waters. While the pack kept the whales cornered, one of the orcas would station itself at the mouth of the river near the whaling station and would attract the whalers' attention by breaching and lashing the water with its tail. The whalers would finish the whales off with harpoons. Some witnesses report how the predators towed the whaleboats to the flailing whales by tugging ropes with their teeth. Once a whale was dead, whalers would let orcas feast on the lips and tongue, before hauling the carcass ashore. Some of the orcas would even grab the ropes in their teeth and aid the whalers in hauling. The orcas would then also feed on the many fish and birds that congregated.

The partnership always involved the same pod of orcas, most of which could easily be recognized by the shape of their dorsal and caudal fins. In Twofold Bay, all orcas were personified by names given after whalers who had died. The most popular orca, named 'Old Tom', was the very distinctive male in charge of alerting the whalers.

Terrestrial birds

Ravens

Corvids (jays, jackdaws, magpies, crows, rooks and ravens) are large-brained social animals that understand their physical and social worlds (Marzluff and Angell 2005). They are capable of causal reasoning, flexibility, imagination and prospection, and elaborate solutions to social and physical problems. They share these complex cognitive abilities with monkeys and apes, which have for long been the preferred subjects of studies of the evolution of intelligence because of their close evolutionary relationship to humans (Seed et al. 2009).

Ravens (*Corvus corax*) are ubiquitous and omnipresent year-round human settlements in the North Pacific. They are generalist feeders and predators of small animals, as well as scavengers on carcasses of salmon and large mammals. Ravens also have kinship-based social systems: they are monogamous and live in extended family groups that show complex networks of cooperation and strong social hierarchy (Heinrich 1999).

Ravens' vocalizations and gestural playfulness are the most immediately perceptible expressions of a sophisticated language (Pika and Bugnyar 2011) that is

used not only to communicate with conspecifics, but also with mammal partners. In its intelligence and its faculties for communication and social interactions, the raven appears very humanlike and is cast as a central mythological figure by North Pacific first nations (Munday 2013; Nelson 1983). It symbolizes mystical connections between native peoples of northwestern North America – The Koyukon, the Tlingit, the Haida – and their natural world, and is a pivotal element of the vibrant Inuit ontological system, their understanding of animals in relation to the wider environment and the cultural substance of being a hunter. For the Inuit, the raven has many social roles: as creator of the present world, as trickster and possessor of knowledge, and as a creature that can be helpful at times, but dangerous at others (Laugrand and Oosten 2015). According to myths of the Chukchi and the Koryak, it is the raven that brought fire to humans (Bogoras 1904; Serov 1988). Among the Yukaghirs of Siberia (Russian Republic of Sakha), the raven is considered as a person (Willerslev 2007). This prominent cultural value attributed to the raven is probably a long story: the burial conditions of two raven skeletons that were excavated from Charlie Lake Cave (British Columbia) clearly suggest that the two birds were deposited deliberately by the Paleoindian occupants, whose presence was dated at about 10,500 BP and 9,500 BP (Driver 1999).

Besides hunting cooperatively in groups with each other, especially for small prey such as squirrels (Heinrich 1999), the raven is a prominent scavenger of ungulate kills made by gray wolves (*Canis lupus*). Ravens call wolves to dead animals so they will make the carcasses more accessible to the birds (Zahara and Hird 2015). They are also quick to locate and harass an injured wapiti (*Cervus elaphus*) and draw the attention of wolves (Stahler et al. 2002). This relationship seems not to be just an incidental and proximate by-product of the presence of fresh meat. Instead, ravens seem to look for the companionship of wolves independently of the presence or the absence of food (Kaczensky et al. 2005). Vucetich et al. (2004) demonstrate that the presence of scavenging ravens leads to an increase in gray wolves' group size and to higher *per capita* gains in the largest observed packs. Inuit hunters also reported that ravens lead polar bears (*Ursus maritimus*) to dead seals (Phocidae) (Heinrich 1999): as they do with gray wolves, ravens accompany the bears and scavenge leftovers from the carcasses.

In the Pacific Northwest of North America, the raven is the most easily visible animal *in natura*. But it is also the most highly salient in local culture, and has often formed complex relationships with hunters. The Koyukon say that ravens bring luck if sighted during a hunt and will lead hunters to their prey by dipping a wing. Koyukon hunters look to the flight of a passing raven as a sign of whether the hunt will be successful (Nelson 1969; Heinrich 1999)[3]. Among the Inuit, newborn boys are clothed in raven skin to help them become successful hunters (Munday 2013). The Inuit also mimic the raven's dance to attract polar bears in hunting (Munday 2013).

Wolves are said to exploit types of prey similar to those exploited by humans. Interestingly, where wolves are abundant, ravens are not considered to have close relationships with humans or to be equivalent to humans. Conversely, ravens more often assist humans in locating prey and are more embedded with mystical functions in places where wolves are less abundant (Pierotti 2011). This gives

credence to Heinrich's assumption (1999) that humans, as later-arriving predators who also usually hunt in packs, were probably just surrogate wolves, and have become substitute partners to wolves in areas deserted, or never occupied, by the canid predators.

Honeyguides

Honeyguides comprise the bird family Indicatoridae, which counts four genera and 16 species, 14 of which are from sub-Saharan Africa and two from Southeast Asia. Some African honeyguides are involved in an astounding collaboration with humans. They live in forests and woodlands, but also in streamside trees near desert areas of Namibia and Botswana.

The English term 'honeyguide' and the Latin root of the family name Indicatoridae clearly reflect the unique habit observed in a few species, which consists in leading honey hunters to honeybee nests. This habit concerns only some African honeyguides of the genus *Indicator*. The guiding behavior is motivated by the fact that honeyguides have specialized in consuming beeswax. African bees often nest in inaccessible cavities and fortify the entrances to their hives, making access nearly impossible for the bird. Honeyguide species that have developed a specialized diet by feeding almost exclusively on wax must team up with a partner that can calm down the bees and that is equipped to break into the hives. Only humans meet these requirements.

There is so far no evidence of guiding behavior by either of the two Southeast Asian species of *Indicator* nor by any species of the other three genera, *Melichneutes*, *Melignomon* and *Prodotiscus*. These all have more generalized diets. Although they eat beeswax, all these honeyguides also eat small scale insects[4] as well as other insects such as caterpillars, flies, bugs, termites, ants, beetles, aphids, grasshoppers and butterflies. Partnerships between honey hunters and some honeyguide species are thus highly conditioned by the predominance of beeswax in the bird's diet.

Wax-eating by honeyguides is apparently made possible by the bird's mutualistic relationship with bacteria located in its gut. Friedmann and Kern (1956) suspected *Micrococcus cerolyticus* and *Candida albicans* to be the symbionts facilitating wax digestion, but this assumption was later questioned (Downs et al. 2002) and is currently still debated.

Guiding behavior has been most frequently described in the greater honeyguide (*I. indicator*). Friedmann (1955) reports that the East African scaly-throated honeyguide (*I. variegatus*) displays a similar guiding behavior, but other authors contest this assertion (Short and Horne 2001). Guiding behavior has also thus far not been documented, apart from our own observations (Dounias 2009), in the Congo Basin rainforest species of *Indicator*, the lesser honeyguide (*I. minor*) and – with less certainty – the least honeyguide (*I. exilis*) and/or Willcocks's honeyguide (*I. willcocksi*). The two latter species are peculiar in feeding on sticky wax exudates produced by stingless bees (Apidae: Meliponinae), and the Baka hunter-gatherers of southern Cameroon will look for hives of stingless bees when they hear the call of this bird that they name *'stingless bee honey bird'*. Least and Willcocks's honeyguides are regularly confused with each other, and data are lacking to clarify which of these two birds, if not both, is the right guide. Nevertheless, since these two birds are generalized in their diet, their accidental collaboration with honey hunters may only reflect an opportunistic commensal relationship.

Numerous and detailed descriptions of greater honeyguide behavior are available in the literature to ascertain the sophistication of the efforts made by the bird to gently guide the honey hunters. These efforts combine cyclic vocalizations, undulating flight, tail feather spreading, and perching in trees in order to wait for the human followers. They are modulated according to distance to the hive and difficulties imposed by the terrain. Hunter-gatherer and pastoralist societies such as the Maasai, the Borana, the Yao, the Hadza and so-called 'Pygmy' and 'San' societies have each developed their own mode of communication with the honeyguides of their territories. Interestingly, the sounds produced by these various human societies differ significantly – the Borana use calling devices made of clasped fists, snail shells or doum palm nuts (*Hyphaene thebaica*); the Maasai, the Hadza and the San whistle, the Yao emit a loud trill followed by a grunt, the Baka shout; in each case, the bird has adapted its capacity to respond to the specific calling procedure. None of these honey-hunter societies try to reproduce in any way the vocalization of the honeyguide. Instead, they have engaged in elaborating a communication system that is specific to them. Spottiswoode et al. (2016) demonstrate that the bird will less efficiently guide the Yao honey hunters if these hunters emit a sound that differs from their usual call. The help of honeyguides multiplies the probability of locating a bees' nest by a factor of four or five for the Borana of Kenya (Isack and Reyer 1989), the Hadza of Tanzania (Wood et al. 2014), and the Yao of Mozambique (Spottiswoode et al. 2016).

Discussion

Figure 11.1 synthesizes per category of use the various auxiliary animals – domesticates as well as non-domesticated – that we managed to census, according to the various domestication pathways. However, a few animal species may have escaped our attention.

Interspecific communication

While it is far from our intention to minimize the importance of communication in the relationships between humans and their domesticated animals, it certainly also plays a prominent role in the interspecific cooperation between humans and their non-domesticated auxiliary animals. It is highly likely that the wild auxiliary animal took the leading role in engaging in the partnership and was the more active in establishing the first terms of communication that transformed the simple converging exploitation of the same resource into a more elaborate cooperation. The necessity that the auxiliary animal takes the first step may help explain why such elaborate partnerships between humans and wild animals are extremely rare.

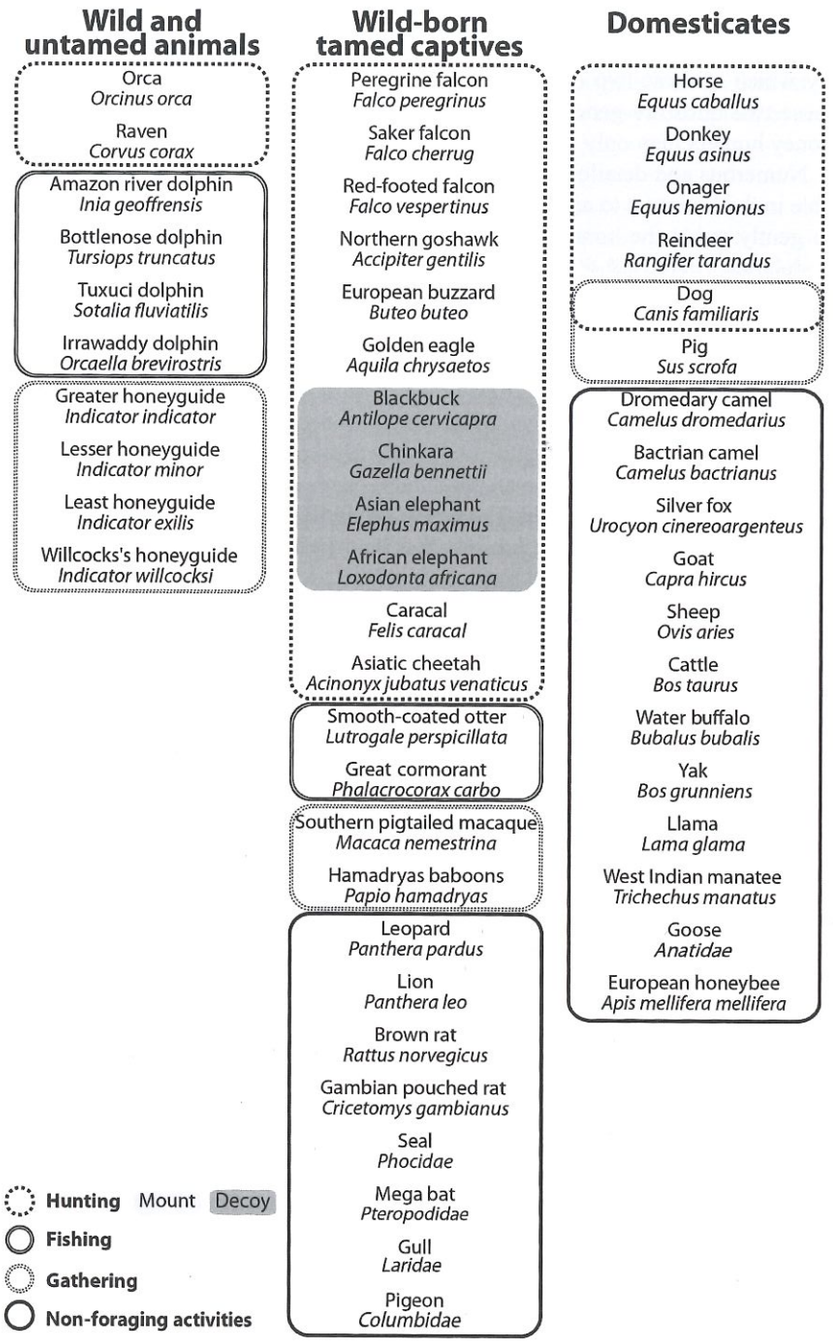

Figure 11.1 Domesticated and non-domesticated auxiliary animals assisting humans in their foraging activities.

Credit: Edmond Dounias.

Birds are likely candidates for wild species apt to initiate communication with humans. They combine the capacities to sing, to fly and to interact with a great diversity of life forms (Terashima 2007). In most nature-dependent human societies, birds have a privileged position in cosmogonies and folk beliefs: the combination of the three capacities mentioned previously inevitably cast birds as emissaries between humans and the supra-natural forces that are the masters of natural resources (Ichikawa 1998). In animist religions, gaining the good will of these spirits is a prerequisite before capturing or killing a wild creature.

The presence of dolphins and orcas among the few wild auxiliary animals certainly has to do not only with their capacity for echolocation, which is nothing short of a sixth sense (Neiwert 2015), but also with their ability to perform very explicit gestural dances – nodding head, shaking fins, leaping out of the water. Although not evoked in the descriptions of these partnerships, the capacity of toothed whales for vocal sounding and teeth chattering should also not be ignored.

As summarized in Table 11.1, hunter-gatherers and fishers of mullet are quite proactive in their communication with honeyguides and dolphins, respectively, whereas whale hunters and North Pacific ungulate hunters are much more passive vis-à-vis orcas and ravens, respectively, which spare no effort explicitly to catch the attention of their human partners. The degree of reciprocal communication is not correlated with the degree of sophistication of the interactions, although the most sophisticated honeyguide-honey hunter partnerships are also those in which reciprocal signaling is the best developed. While communication between mullet fishers and dolphins appears seemingly advanced, their collaboration never reaches the level of symbiosis abusively reported by Busnel (1973) and Cousteau and Diolé (1975), and rightly contested by Robineau (1995).

Solitary versus grouped partners

A corollary aspect to communication that is worth considering is the solitary *versus* group habits of the wild partners and the incidence of this distinction on the degree of interactions. Dolphins, orcas and ravens are certainly acknowledged for their high level of intelligence and for their sophisticated social relations, but they are surpassed by the honeyguide in terms of intricacy of relationships with the human partner.

The most elaborate mutualistic relationships with a wild animal auxiliary occur when the animal contributes as an individual, not as a member of a pack. Dolphins perfectly illustrate the contrast between isolated *versus* in pack assistance: marine dolphins that are collectively engaged in mullet fishing in cooperation with groups of humans are not always trustworthy partners in comparison to the riverine Irrawaddy and Amazon dolphins, which have more personalized ties with individual fishers. Honeyguides are always solitary when they interact with honey hunters. The situation is more equivocal for orcas and ravens: although orcas always operate in packs, one member of the pack is in closer thus more individualized interaction with humans when it comes near the whale station to catch the attention of the whalers; although the scavenging birds always hunt in

Table 11.1 Profiles of wild and untamed auxiliary animals assisting humans in their foraging activities.

	Wild untamed auxiliaries	*Number of involved species**	*Geographic location of reported cooperation*	*Foraging activity*	*Target resource*	*Payoff (P), Reward (R)*	*Intervention by auxiliary*	*Communication mode by animal*	*Communication mode by humans*	*Personification of animal partner*	*Resilience of cooperation*
Aquatic mammals	Marine/ estuarine dolphins	2	Atlantic coasts, Mediterranean Sea, Bay of Bengal, Coral Sea	Gillnet and cast net fishing	Mullet	P Mullet	Group	Gestural	Shouting/Water drumming or slapping/Boat side tapping	+	Persisting only in Brazil and Mauritania
	Riverine dolphins	2	Amazon and Ayeyarwady rivers	Gillnet and cast net fishing	Various fishes and crustaceans	P + R Various fishes and crustaceans	Individual or small group	Gestural	Shouting/ Guttural calling/Water drumming or slapping/Boat side tapping	+++	Almost extinct in Amazon; Receding in Irrawady
	Orcas	1	Pacific Rim	Hunting	Whales	P Whale lips and tongue	Individual Group**	Gestural	None	+++	Extinct
Birds	Ravens	1	Northern Pacific	Hunting	Ungulates	R Carcass	Individual Group**	Gestural & vocal	None/Gunshot	+++	Persisting
	Honeyguides	3 or 4	Sub-Saharan Africa	Gathering	Wax (bird); Honey (human)	P + R Wax and bee larvae	Individual	Gestural & vocal	Whistling/ Shouting/Wood knocking/ Calling device	++	Receding

* See Figure 11.1 for species names

** Hunting in packs, but communicating individually with human partners

great flocks, engagement into communication with the hunters is most of the time performed by individual birds. The fact that orcas and ravens hunt in groups but individualize communication with their human allies deserves further investigations. In both cases, however, communication is a one-way dialogue in which hunters seldom 'exchange' with the cetaceans and the bird.

Exception made of human-marine dolphin interactions that occur in groups, individualized partnerships are often reflected in a personification of the animal partner through the attribution of a name. Naming reinforces the psycho-cultural bonds that sometimes result in friendship, complicity, mutual respect and exclusivity of service between allies. Personhood of wild animals is a common cultural trait among hunter societies of the North Pacific and Siberia (Willerslev 2007), and is accordingly more pronounced for ravens and orcas.

Payoffs and rewards

In the relationships between marine dolphins and orcas auxiliaries and humans, the animal partners directly receive a benefit from performing the activity: dolphins eat mullets while pushing them to the fishers' nets; orcas devour the tongue and lips of the freshly harpooned whale. In these cases, the payoff is a by-product benefit: there is no cost to cooperating with a partner, and therefore no selective incentive to cheat (Mayer et al. 2014).

Benefits obtained are slightly different for auxiliary honeyguides, ravens and river dolphins. Honeyguides and ravens will get their share only after humans have finished taking their part: honeyguides gain a direct benefit by their capacity to take advantage of fire and smoke that keep the bees calm or distant, and to penetrate into the nest cavity left open by the honey hunters. But in supplement, they will also receive honeycombs as a gift that is decided and controlled by the human partner. We term this gift 'reward' by distinction with 'by-product benefit' defined previously. Ravens will feed on the carcass that is deliberately left behind by the hunters. This is again a reward that is 'offered' to the animal partner, since the hunters can easily decide to withhold access to a carcass. River dolphins also receive a reward as a supplement to the by-product benefit they obtain in the course of cooperative fishing: when the catch of fish is over, auxiliary dolphins come in close contact with the boats to receive extra fish from the hands of the fishers. Long after the fishing, dolphins may also obtain leftovers of fish being cut and eviscerated on the shore by women processing fish for cooking.

This distinction between by-product benefit of the mutualistic partnership and reward is reflected in mutualism theory (Bronstein 1994). A significant proportion of the total benefits gained by the wild animal auxiliary often remains under the arbitrary decision of the human partner. Mutualism theory predicts that under such circumstances, the 'controlling' partner may reduce the cost of the relationship by withholding or reducing rewards, i.e., by 'cheating'. However, this risk is mitigated by cultural safeguards: wild animal auxiliaries occupy a pivotal position in the cosmogony of the human societies that they interact with, and humans

believe they will be exposed to sanctions by supernatural entities if they do not reward their animal partner.

Among hunter-gatherer and pastoralist societies that attribute great value to honey, similar due respect for the honeyguide is an intangible rule, and rewarding the honeyguide with a gift of honeycomb is a constant concern. The Maasai exhibit a reverential attitude when they deposit portions of combs for the bird. For the San, honey that is obtained with the help of the honeyguide provides power for taming the animal world and ensuring rain. The San believe that not thanking the bird may lead its follower to a lion, bull elephant, or venomous snake as punishment (McGovern 2009). Similar tales of misfortune befalling honey hunters who do not repay the honeyguide are found among various Pygmy groups (Bergier 1941). Although not explicitly reported, it is likely that fishers and hunters who see dolphins, orcas and ravens[5] as imbued with specific cultural attributes similarly believe they will be exposed to punishment if they offend these animals.

Interestingly, rewarding the honeyguide has become a critical yet revealing issue among the Hadza. These hunter-gatherers of Tanzania were observed to thank the greater honeyguide in the past[6]. They used to explicitly throw the combs onto the ground in the direction of the bird perched in a nearby tree and waiting for its share. Today, they no longer reward their honeyguides. Worse, they even withhold by-product benefits by purposely burning the comb leftovers as a means to keep the bird hungry and consequently ensure its collaboration (Wood et al. 2014). Clarifying the reasons for such a change in Hadza attitude and the consequences of withholding reward (and even by-product benefits) on the fate of this mutualistic cooperation requires further investigation.

Rewarding is present in the cooperation with auxiliary domesticates, and is even a strong incentive for tamed captives that assist in foraging activities. It is a key component of the training stage during which humans establish their mastership. However, as evoked with the great cormorant, the reward may sometimes be demanded by the tamed partner, otherwise it may no longer obey its master. The only attested case of a tamed auxiliary that is engaged in a foraging activity without being rewarded is that of the southern pigtailed macaque for coconut picking. Distinct sources concur to describe the macaque training as coercive in Malaysia and Thailand, where it is based exclusively on punishment and avoidance of punishment (Bertrand 1967).

A tritrophic interaction

Another important yet poorly explored aspect of the interspecific partnership between humans and a non-domesticate auxiliary animal is that it constitutes a tritrophic interaction. This three-poled relationship requires further investigation because one out of the three interactions is generally overlooked: the relationship between the human forager and the coveted resource is generally well documented; lesser known are the links that tie human foragers with their auxiliary animals; most ignored in the triptych is the relationship between the auxiliary animal and the resource that it helps humans obtain. Beyond the trivial acknowledgement

of a predator-prey link between orcas and whales, between dolphins and mullets, between ravens and the scavenged dead or weakened animal, between the honeyguides and honeybees, much still needs to be explored to better clarify the motivation of the auxiliary animal for initiating a partnership with humans.

In the case of the best developed human-honeyguide partnership, the capacity to use fire confers a decisive advantage to human honey hunters in comparison to the few other mammals that look for honey (genet, mongoose, baboon, chimpanzee, bonobo, honey badger), and that could thus be potential candidates for a partnership. Non-human honey consumers generally enhance the honeybees' aggressiveness, and this is counterproductive for the honeyguide, which is sensitive to bee stings. Fire and the smoke it produces keep the honeybees distant and reduce their aggressiveness.

A final interesting aspect of the more elaborate cooperation between honey hunters and honeyguides is the fact that the humans and the birds are not interested in exactly the same resource. Honeybees constitute the third member of the tritrophic relationship, and they are not directly sought as prey, but rather for what they produce. And whereas humans are interested in honey, the honeyguide is focused on wax. The mutualistic relationship is facilitated by the absence of direct competition between the two partners: each obtains a resource that is of minor interest for their ally.

Do cases of wild and untamed auxiliary animals prelude domestication processes?

The possibility that domesticated animals serving as auxiliaries could originally cooperate with humans prior to their domestication should not be excluded. Many herder societies of tundra reindeer acknowledge that wolves help keeping together their flocks and tolerate in return wolf-kills of the weakest reindeer (Stépanoff et al. 2017 and references herein). Such auxiliary-sounding scenarios may possibly have taken place around wild reindeer flocks towards the Pleistocene and accordingly influenced the dog domestication process: as pointed out by Germonpré et al. (this volume), wolves assisted to drive scared game to the hunters. Similarly, the concomitant appearance of cats and rodents around grain silos during the Middle Ages is probably not neutral in the process of cat domestication as a means to control pests in an emerging context of crop storage. One may wonder, however, what benefits non-domesticates could conceivably gain in voluntarily collaborating with humans outside of a captive situation. Domesticated reindeer provide a good illustration of such benefits: they are adamant to breeding in captivity and most traditional herders, like the Tozhu of the Sayan Mountains (southern Siberia), do not watch their herds. Reindeer find a secure advantage in staying and collaborating with herders who satisfy their fondness for salt and human urine. In the absence of this payoff, bred reindeer would refuse to be drown back to the camp and would instead join wild herds (Stépanoff et al. 2017).

Nevertheless, none of the cooperation with wild and untamed auxiliary animals detailed previously should be considered as a vestige of domestication attempts

or as a state of domestication in progress. Instead, the cases described should be viewed as remarkably well-developed exceptions that have survived the passing of time and persisted until recently.

Three out of the four cases – dolphins, orcas, ravens – concern animals that are remarkably intelligent, live in kin-based social groups and have acquired the capacity to hunt in socially organized bands and flocks. The fourth case is unique in that honeyguides have conquered a specific dietary niche based on eating wax. They have no competitors for this resource, which can only be digested by specialists, and have developed two mutualistic relationships to achieve such exclusivity: one with bacteria hosted in their gut to facilitate wax digestion; the other one with humans as a means to gain access to wax, taking advantage of this partner's interest in a resource associated with wax: honey.

Conclusion

Animals that assist foraging human societies as auxiliaries provide new insights into the history of domestication processes but more importantly into human relationships with wild-born animals, whether these are kept in captivity or not. The category of tamed wild-born captives has provided the largest diversity of auxiliary animals. Captivity concerns just a few individuals taken out of a wild population. These tamed individuals never alter the behavior of their wild relatives vis-à-vis humans, even after their eventual release from captivity. None of the animal species that formerly served as captive auxiliaries have conserved vestiges of their servile assistance to humans.

The major targets of this chapter have been the few existing cases of wild and untamed animals that assist humans. These mutualistic interactions were initiated and evolved independently of domestication processes. The rare wild and untamed animal species involved as auxiliaries are remarkable for their intelligence, socialization faculties and sophisticated communication system, or for their very atypical diet. They most likely were the instigators of these partnerships. In return for their help, these animals obtain by-product benefits, sometimes supplemented by a reward, from their human partners. They legitimately occupy a lead position in the cosmogony of the foraging societies with which they interact, and these interactions thrive on an obligation of mutual respect. Unfortunately, most of these interspecific collaborations between humans and wild auxiliary animals are declining nowadays because of dramatic environmental – and sometimes social and cultural – changes.

There is no evidence of recent mutual collaboration between whalers and orcas, and the fairly recent ban of whale hunting has encouraged many orca populations to adapt to new sources of food (Parsons et al. 2013). Today, it is only off the Pacific coast of North America that pods of transient orcas are still reported to attack migrating gray whales (Barrett-Lennard et al. 2011).

Most marine dolphins dropped their partnership with fishers because of the rarefaction of mullet schools, the intensification of industrial fishing, the arrival of new fishing instruments replacing traditional cast-nets, increasing marine pollution and other causes. The partnership with riverine dolphins is apparently

more resilient to change. This partnership has influenced the emergence of taboos against killing dolphins, and has positively engaged the human partner in preserving these aquatic animals. However, many freshwater dolphin species are nearly hunted to extinction by fisher communities that are not involved in such cooperation (Gravena et al. 2008).

The interactions between honeyguides and honey hunters has developed over millennia, possibly as far back as our distant hominid ancestors, and constitute the most elaborate mutualistic relationship so far established with a wild and untamed animal. However, some troubling signs indicate that this relationship is receding. On the honey-hunter side, hunter-gatherer and pastoralist societies are forced to become sedentary; they are losing their land rights or are not allowed to circulate in lands declared to be protected areas. On the honeybee side, sub-Saharan African colonies are increasingly affected by the Colony Collapse Disorder, which is a major cause of worldwide decline of honeybees. On the honeyguide side, species that are highly specialized on wax eating are more incidentally impacted by the various environmental threats affecting honeybees. The changing behavior of Hadza honey hunters who have decided to keep their guiding birds hungry is one more worrying sign that the survivorship of the bird is probably compromised.

Only ravens seem to find efficient new solutions for maintaining their scavenging strategy with the help of wolf or human partners. Ravens display an apparent fear response to large carcasses that were not killed by wolves (Heinrich 1988). This fear behavior is characterized by a cautious approach to a carcass and retreating without feeding. Stahler et al. (2002) suggest that this fear response is inhibited upon discovering large carcasses attended by wolves. Although not documented when they interact with humans, the suppression of ravens' innate fear when they are in the company of their mutualistic partner could be a means to broaden their access to novel food sources and in adapting to a changing environment. As stated by White (2005), ravens have also learned the usefulness of gunshots and now react positively to this new stimulus, by contrast to wildlife prey that typically avoid gunshots, which to them are signs of danger.

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Notes

1 In this chapter, animal domestication is understood as a permanent genetic modification of a bred lineage that leads to an inherited predisposition toward humans (Driscoll et al. 2009).
2 These pathways should not be viewed as mutually exclusive. For instance, horse and reindeer domestications may be considered concomitantly along the prey and directed pathways.

3 Tuvan hunters of southern Siberia (Russia) similarly reported to C. Stépanoff that the raven alerts them on the presence of the game by whirling in the sky before eventually perching in a nearby tree. Among the Even people of Kamchatka in eastern Siberia (Russia), hunters told Stépanoff that the raven guides them by croaking in a special manner (Charles Stépanoff, personal communication, 2017).
4 Numerous scale insects produce wax as a protective covering (Doyle McKey, personal communication, 2017). Although data are lacking concerning the part that scale insects represent in honeyguide diet, the phylogenetic distribution of honeyguide diets (Friedmann 1957) suggests the hypothesis that eating wax produced by scale insects (and possibly other sources) was the primitive condition, and that some *Indicator* species may have specialized on a much more concentrated wax source, honeybees' nests.
5 After the hunt, the Tuvan hunters ritually deposit meat in the trees to the ravens, saying "Let this be the part of the birds of the mountain country!" (Charles Stépanoff, personal communication, 2017).
6 As shown in the film by Hudson and Woodburn (1966) and confirmed by James Woodburn (personal communication, 2015).

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