CHAPTER 18-3
LARGE MAMMALS – NON-RUMINANTS

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Figure 1. *Ursus americanus*, black bear cubs playing in mosses. Photo through public domain.

**Canidae – Dogs**

When we think of the impacts of dogs (*Canis lupus familiaris*) on bryophytes, we tend to think of their habit of urinating (Figure 2) to mark their territory and record their presence. This raises concerns about permitting dogs on nature trails.

I was surprised to find a statement in 2012 that "very little is known about the nutrient composition of dog urine and its impacts on habitats" (White *et al.* 2012). Instead, these researchers refer to the ability of urine to "scald" vegetation, while acknowledging that it provides some enrichment of soil nitrogen (Taylor *et al.* 2005). White and coworkers also stated that dog urine does more damage on dry soils because the salts are unable to disperse quickly. Gilbert (1989) reported that dog urine has significant effects on algal crusts and lichen communities at tree bases. Unfortunately, bryophytes were not mentioned.

Webb (2002) studied the effects of human traffic, including dog walkers, in Lye Valley, Oxford, England. She found that the effect of dog urine was especially damaging to plants in very low nutrient ecosystems, like the calcareous fen areas and the dry calcareous grasslands.

The implication is that these negative effects included damage to fen mosses. Some fast-growing grasses benefit.

Figure 2. *Canis lupus familiaris* marking territory. Photo by Daniel Mott, through Creative Commons.
In urban areas, it is mostly *Bryum argenteum* (Figure 3) that finds its way into the cracks in the sidewalks and along their borders (Sam Bosanquet, Bryonet 8 June 2011). But in natural areas, rarer species may be affected. Bosanquet asked if anyone knew of the impacts of dog urine and feces on bryophytes, citing the known negative impacts of human urine on the leafy liverwort *Lepidozia cupressina* (Figure 4) and the filmy fern *Hymenophyllum tunbrigense* (Figure 5), often killing both.

![Figure 3. *Bryum argenteum* in crack in parking lot. Photo by Paul Davison.](image)

In her moss gardens, Annie Martin (Bryonet 9 June 2011) has observed frequent visits from a St. Bernard who left sizeable deposits of feces. Fortunately, this does not seem to have caused any harm to the garden, even if left there for several days.

Rod Seppelt (Bryonet 8 June 2011) relays his own experience. Mosses such as *Eurhynchium* (*Kindbergia*; Figure 6) and *Brachythecium albicans* (Figure 7) are able to regrow rapidly after urine damage, probably initially through lack of competition from the grasses that die off, but later come back. But dog urine is concentrated, so some bryophytes are likely to experience toxic effects. What seems to be the worst component for plants is ammonia, particularly the high concentration of nitrogen.<www.dogster.com>. In the Arctic (Figure 8), urine enriches the nutrients, and if these nutrients are too high, seed plant vegetation benefits, to the detriment of the poorly competing bryophytes (see Chapter 18-1).

![Figure 4. *Lepidozia cupressina*, a species that is negatively impacted by dog urine. Photo by Michael Lüth, with permission.](image)

![Figure 5. *Hymenophyllum tunbrigense*, a fern that is negatively impacted by urine. Photo through Creative Commons.](image)

![Figure 6. *Eurhynchium praelongum*, a species that regrows quickly after being sprayed with urine. Photo by Juan Larrain, with permission.](image)

![Figure 7. *Brachythecium albicans*, a species that regrows quickly after being sprayed with urine. Photo by Michael Lüth, with permission.](image)
Bryophytes are known to require lower nutrient concentrations than that of tracheophytes. Cape and coworkers (2009) presented evidence that we should re-evaluate our perspective on the critical ammonia levels for plants. They suggested 1 µg NH₃ m⁻³ for bryophytes, whereas they suggested 3 ± 1 µg NH₃ m⁻³ was appropriate for herbaceous tracheophytes.

As I read these comments about the lack of response of bryophytes to dog urine, I must wonder about the impact of climate on this seeming lack of response. In a humid climate where bryophytes remain hydrated and rain is frequent, might the urine be washed away before enough of it enters the moss to harm it? On the other hand, might a dry climate result in concentration and dose the moss with lots of it at once when rehydration occurs, especially with fog or night-time dew? Would the urine convert to uric acid and hence be more harmful in that state?

Macropodidae – Wallabies and Kangaroos

Most wallabies don't seem to have a direct interaction with bryophytes, but they can have a major impact on them by damaging and browsing or grazing on competing vegetation. Unlike the damage done by deer and goats in other areas of New Zealand, the damage to vegetation on Kawau Island, New Zealand, is the result of four species of introduced Australian wallabies [Macropus eugenii – Dama wallaby (Figure 9), Macropus parma – parma wallaby (Figure 10), Petrogale penicillata penicillata – brush-tailed rock wallaby (Figure 11), and Wallabia bicolor – swamp wallaby (Figure 12)] (Wilcox et al. 2004). The activities of these wallabies in the forest damage the tracheophyte vegetation and create a lawn of bryophytes (Figure 13). This appears to be the result of greater tolerance on the part of bryophytes, rather than superior competition. The most common species are the mosses Campylopus clavatus (Figure 14), Dicranoloma billardiirei (Figure 15), Leucobryum candidum (Figure 16), and Ptychomnion aciculare (Figure 17), especially Dicranoloma billardiirei. A few patches of the large liverwort Chandonanthus squarrosus (Figure 18) are also present, with large areas of Cladina (Figure 19) and Cladia (Figure 20-Figure 21) lichens. The researchers consider this lawn to be the result of superior tolerance of stress by the bryophytes and lichens.
Figure 11. *Petrogale penicillata penicillata* (brush-tailed rock wallaby). This species, introduced to New Zealand, destroys the ground vegetation, and it becomes replaced by bryophytes. Photo by Roy at NatureMap, through Creative Commons.

Figure 12. *Wallabia bicolor* (swamp wallaby). This species, introduced to New Zealand, destroys the ground vegetation, which is replaced by bryophytes. Photo by Patrick K59, through Creative Commons.

Figure 13. Bryophyte lawn created by wallabies on Kawau Island, New Zealand. Photo courtesy of Mike Wilcox.

Figure 14. *Campylopus clavatus*, a common species of moss in forest bryophyte lawns of Kawau Island following invasion of Australian wallabies. Photo from Canberra Nature, through Creative Commons.

Figure 15. *Dicranoloma billardierei*, a common species of moss in forest bryophyte lawns of Kawau Island following invasion of Australian wallabies. Photo by Michael Lüth, with permission.

Figure 16. *Leucobryum candidum*, a common species of moss in forest bryophyte lawns of Kawau Island following invasion of Australian wallabies. Photo by Phil Bendle, through Creative Commons.
Figure 17. *Ptychomnion aciculare*, a common species of moss in forest bryophyte lawns of Kawau Island following invasion of Australian wallabies. Photo by Nathan Fell, through Creative Commons.

Figure 18. *Chandonanthus squarrosus*, a less common liverwort in forest bryophyte lawns of Kawau Island following invasion of Australian wallabies. Photo by David Trng, with permission.

Figure 19. *Cladina mitis*; the genus *Cladina* is common in forest lawns of Kawau Island following invasion of Australian wallabies. Photo by Triin Lillemets, through Creative Commons.

Figure 20. *Cladia retipora* lawn, in a common genus of lichen in forest lawns of Kawau Island following invasion of Australian wallabies. Photo by Chris Lindorff, through Creative Commons.

Figure 21. Close view of *Cladia retipora*, in a common genus of lichen in forest lawns of Kawau Island following invasion of Australian wallabies. Photo by Vanessa Ryan, through Creative Commons.

Sankaran et al. (2008) found that the eastern grey kangaroo (*Macropus giganteus*; Figure 22) and the common wombat (*Vombatus ursinus*; Figure 23), on the other hand, are more effective at increasing woody plant abundance than the introduced hog deer (*Axis porcinus*; Figure 24) or native swamp wallabies (*Wallabia bicolor*; Figure 12), both of which are browsers. The hog deer is the largest consumer of mosses (less than 0.01%) in southeastern Australia (Davis et al. 2008).

Hobbs (1996) likewise considered that browsing by herbivorous ungulates on grasses, forbs, and shrubs could give competitive advantage to trees, ferns, and mosses. This assumption is partly supported on Yanakie Isthmus (connecting Wilsons Promontory to mainland Victoria, Australia) by the observed increase in moss cover in their presence, while grass cover decreased (University of Ballarat 1999).
**Dendrolagus – Tree-kangaroo**

The Lumholtz tree-kangaroo (*Dendrolagus lumholtzi*; Figure 25) is known from the rainforests of Northeast Queensland, Australia. It is the smallest (~0.5m body length) of the tree-kangaroos and is somewhat territorial. It consumes mosses, as well as lichens, ferns, and flowers (Heise-Pavlov 2017).

Mosses seem to be more commonly consumed among the tree-kangaroos than among other wallabies. The Huon tree-kangaroo (*Dendrolagus matschiei*; Figure 26) is a generalist leaf eater, including leaves, fruits, and mosses in its diet (Betz 2001). In the rainforests of their native Papua New Guinea, they live where the forest floors are covered by a variety of moss species (Porolak 2008). Lichens and lianas (vines) are uncommon at the altitudinal range (1,000-3,000 m) where they live.

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*Figure 22. Macropus giganteus*, eastern grey kangaroo, a species in New Zealand that is responsible for increasing woody plant abundance. Photo by Danielle Langlois, through Creative Commons.

*Figure 23. Vombatus ursinus*, common wombat, a species in New Zealand that is responsible for increasing woody plant abundance. Photo by P. Baum, through Creative Commons.

*Figure 24. Axis porcinus*, a browser that also eats mosses. Photo by Simon J. Tonge, through Creative Commons.

*Figure 25. Dendrolagus lumholtzi*, a moss consumer. Photo by Kenneth Bader, through Creative Commons.

*Figure 26. Dendrolagus matschiei*, a generalist plant eater, including mosses. Photo by Cyndy Sims Parr, through Creative Commons.
**Macropus – Australian Wallabies (and others)**

Species of *Macropus* (Figure 27) make **hip holes** to use as resting sites, especially in hot weather (Eldridge & Rath 2002). **Hip holes** are shallow, kidney-shaped depressions these kangaroos construct next to trunks of many trees and shrubs in arid and semi-arid Australia. Although these hip holes average less than 10 cm deep (Eldridge & Rath 2002), that is enough digging to cause considerable destruction to the thin cryptogamic crust of lichens, bryophytes, and bacteria (Eldridge & Greene 1994).

Figure 27. *Macropus parma*, a species introduced to New Zealand, that destroys the ground vegetation, which is replaced by bryophytes. Members of this genus destroy bryophyte vegetation by digging hip holes. Photo by Mistvan, through Creative Commons.

**Vombatidae – Wombats**

Jones and Pharo (2009) questioned the importance of bryophytes in the buttongrass moorland in Australia following fire. Moss patches there become visible between the charred tussocks of grass. These researchers established twenty wire cages (30 cm x 30 cm x 20 cm) as exclosures that permitted insect access but not vertebrates. In addition, 20 patches with a minimum diameter of 10 cm of either of the mosses *Campylopus* spp. (Figure 14) or *Dicranoloma* spp. (Figure 15) were divided by a cage to test whether these mosses would become food to large herbivores after the fire. However, using stem length measurements, they were unable to find any differences in mosses inside and outside exclosures.

One possible reason for the absence of evidence is that suitable feeding grounds were close enough to the burned area that wombats did not need to rely on poor quality food sources such as mosses (Jones & Pharo 2009). For wombats, the mosses are hard to digest. They are hindgut fermenters (Hume 1999). Polyphenolic compounds in mosses can have antibiotic properties that inhibit the digestion of hindgut fermenters (Prins 1982). Interestingly, the Parks & Wildlife Service (2008) considered mosses to be a "particular delicacy" for the wombats, with native grasses being their primary food, as well as shrubs, roots, sedges, bark, and herbs. Triggs (1996) considered that some mosses provide the wombats with water when they are moist and green; they are ignored when they are dry.

Jones and Pharo (2009) also considered the possibility that the wombats might only consume the capsules, but no capsules were observed at the study site. However, in a different buttongrass moorland they had observed evidence of grazing on capsules of the moss *Tayloria tasmanica* (Figure 28). In another report, Lyn Cave (in Fife 2015) concluded that the primary habitat of *Tayloria tasmanica* is wombat dung. For some reason, little attention has been given to the potential of moss capsules as food.

When large herbivores live at high elevations with deep snow cover, they face a challenge getting enough of the right foods to balance their needs. This is further complicated by the slow regrowth of alpine plant species following disturbance. Thus, Green *et al.* (2015) hypothesized that responses of wombats (*Vombatus ursinus*; Figure 23) to disturbance by fire at high elevations would differ from those at low elevations. To test their hypothesis, they examined the winter diet of common wombats in the Snowy Mountains of Australia in the ten years following a fire. Optimal foraging theory predicts that these herbivores should respond to scarce food resources by widening their food choices. However, these wombats expanded their diet choices only slightly at the higher elevations compared to those at the lower elevations, with no expansion in number of food species. Rather, they are able to exploit the improved food quality resulting from nutrients released by fire.

Wombats may actually contribute to bryophyte diversity. I have observed *Mittenia plumula* (Figure 29) growing at the entrance (Figure 30-Figure 31) of a wombat burrow. The opening provided the disturbed soil and cave environment needed by this species.
Phalangeridae

Common Brushtail Possum – *Trichosurus vulpecula*

I doubt that the Australian possum uses bryophytes, but the moss uses it. I have seen the moss *Tayloria octoblepharum* (Figure 32) growing on the dung of the common brushtail possum (*Trichosurus vulpecula*; Figure 33) in Australia. Like other members of the *Splachnaceae*, this species uses dung as its substrate and the capsules smell like dung at maturity, attracting flies that disperse the spores.
Elephantidae – Elephants, Mammoths

Elephants – *Elephas*

One might expect elephants, the giants of the four-legged creatures, to be destructive of bryophytes, but in a *Sphagnum* (Figure 34) bog of Peninsula Malaysia, elephants (*Elephas maximus*; Figure 35) maintain the plant communities with their trampling (Yao *et al.* 2009).

![Figure 34. *Sphagnum orientale*, a moss that can be found in bogs of the Malaysian Peninsula. Photo by Blanka Shaw, with permission.](image)

![Figure 35. *Elephas maximus* (Asian elephant). Ancestors of this genus perished in the Wisconsinian era, perhaps due to the conversion of suitable pasture into bog habitat. Photo by Bernard Dupont, through Creative Commons.](image)

Mammoths – *Mammuthus*

The prehistoric woolly mammoth (*Mammuthus primigenius*; Figure 36) ate mosses – and became entombed in the ice with a meal of *Polytrichum* (Figure 37) and *Hypnum* (Figure 38) in its stomach (Bland 1971).

![Figure 36. Woolly mammoth (*Mammuthus primigenius*), a prehistoric moss consumer. Image from Flying Puffin, through Creative Commons.](image)

![Figure 37. *Polytrichum commune*, possibly food of the woolly mammoth. Photo by J. R. Crellin, through Creative Commons.](image)

On the other hand, van Geel *et al.* (2011) considered the mosses in the Palaeo gut sample from a mammoth calf from Yamal Peninsula, northwest Siberia, to be accidental. They considered that a one-month-old calf most likely ate fecal material that had been deposited on mosses and that associated mosses were consumed at the same time.
Ukraintseva (1981) similarly examined the gastrointestinal tract of large mammals from the Pleistocene, looking for possible causes of extinction. He found, using C\(^{14}\) analysis from the horse (Equus; Figure 39), mammoth (Elaphus; Figure 35), and bison (Bison; Figure 40), that these animals perished during the Wisconsin period, 45,000-30,000 BP. During that time period, bogs and forests spread while herbaceous communities (pastures) diminished, changing the quality of the food they consumed. Instead of their usual pasture food, they had to feed in water-logged sedge, cottongrass, grass, moss, and Sphagnum (Figure 34) communities. Hence their nutrient consumption changed, a change that Ukraintseva considered to be the cause of their extinction.

Iversen (2011; Iversen et al. 2013) studied the diet of polar bears (Ursus maritimus; Figure 43) from Svalbard. She reported 13 species of mosses in the feces, with Polytrichastrum alpinum (Figure 44) being the most frequent. Only 32.8% of the feces contained terrestrial vegetation. Of these, 27% contained mosses. Not only

**Ursidae – Bears**

Researchers have questioned whether bears consume bryophytes by choice. Elgmork and Kaasa (1992) contended that they are consumed only accidentally. But Dalen et al. (1996) reported that brown bear (Ursus arctos; Figure 41) feces contained 50-90% bryophytes, hardly an accidental percentage. Nevertheless, Dalen and coworkers found this only in May for a bear and her two cubs, again suggesting that bryophyte consumption was not a normal occurrence. At other times, some feces contained 15% Brachythecium reflexum (Figure 42), but it appeared that these mosses were consumed when the bears ate ants. Nevertheless, Wilson and Ruff (1999) noted that bears are omnivores, thus eating a variety of plant foods, including mosses.
were mosses relatively frequent, they also made up a significant portion of the biomass. Only two scats could be attributed to juveniles, but both contained mosses. On the other hand, Lønø (1970) found moss in only 2 of the 172 stomachs examined from Svalbard polar bears.

It appears that brown bears (Ursus arctos; Figure 41) have found another use for Sphagnum (Figure 48). The bears sometimes put peat mosses with carcasses that they cache, a behavior suggesting that the moss may be used to reduce bacterial and fungal attack on their food (Elgmork 1982). Hyvönen (1990) reported that bears often bury their prey in forests with mats of Polytrichum (Figure 37). Hyvönen reported on the Finnish coin that has a bear on one side and Polytrichum on the other side, suggesting that the association of these two organisms on the same coin related to the habit of the bears to bury their food in forests with Polytrichum ground cover.

Hyvönen (1990) reminds us that Linnaeus reported that bears (Ursus arctos arctos; Figure 41) gather Polytrichum (Figure 37) tufts to cushion their winter holes, whereas Dr. Erik Nyholm contends that bears are indiscriminate in choosing padding, using the more abundant species of Pleurozium schreberi (Figure 45) and Hylocomium splendens (Figure 46). They also seem to use bryophytes for napping, as I have seen in several photographs posted on the internet.

Grizzly bears (Ursus arctos ssp; Figure 47) are a subspecies of brown bears, but are carnivorous (Wilson & Ruff 1999). Nevertheless, they reputedly eat moss, especially when they come out of hibernation, a report I have been unable to verify. Storie (1973) and Compton (1993) reported that grizzly bears eat unidentified mosses (Figure 48). It seems these bears eat mosses along with ants and soil when they are desperate, which doesn't say much for a discriminating appetite at that time!

Bears could damage some of the epiphytic bryophytes. They at times rip bark off trees to find insects for food (Zyśk-Gorczyńska et al. 2015). If bryophytes are growing there, they will come off with the bark. This leads me to wonder if the bears ever attempt to get insects from the mats of bryophytes on trees, another potential source of bryophyte destruction.

Bears are also known to contribute to the nutrient regime of bryophytes, but not as you might expect. They catch fish, then transport them to land (Figure 49) before consuming them. The remainder of the carcass provides a nitrogen source (Wilkinson et al. 2005).
Figure 47. *Ursus arctos* ssp. (grizzly bear), a species that consumes mosses in an effort to get the ants. Photo by Gregory Smith, through Creative Commons.

Figure 48. *Sphagnum perichaetiale*, a potential food source for grizzly bears in the Arctic. Photo by Jan-Peter Frahm, with permission.

Figure 49. *Ursus americanus* (black bear) carrying fish to land. Photo by Aaron Huelsman, through Creative Commons.

Hominidae – Primates

Chimpanzees

Egdar (1997) examined the habitats of China's monkeys, past and present. The environmental changes in the last 50 million years forced the animals to adapt to changing food availability. Some remained in the "diminishing rainforests" where they could find enough fruits and protein to survive. But others adapted to new habitats. Among these adapters was the Yunnan snub-nosed monkey (*Rhinopithecus bieti*; Figure 50-Figure 51) that moved to the high-altitude pine forests (Figure 50). Here the most consistent food sources were hanging mosses and lichens on rocks.

Figure 50. Yunnan snub-nosed monkey (*Rhinopithecus bieti*), a species that eats hanging mosses and lichens when it is forced to move to the mountains. Photo from EOL China Regional Center, through Creative Commons.

Figure 51. Close view of the Yunnan snub-nosed monkey (*Rhinopithecus bieti*). Photo from EOL China Regional Center, through Creative Commons.
But monkeys are smarter than most other animals. Lamon et al. (2017) were studying the behavior of wild chimpanzees (Pan troglodytes; Figure 52) in Budongo Forest Reserve in Western Uganda and discovered an unusual tool use. They were using mosses as sponges! This was a new behavior that first appeared in the population in 2011. Three years later, they found that the sponging behavior was still present and had spread to some of the other members of the community. Hanging mosses are common in areas inhabited by chimpanzees (Figure 53-Figure 56). The moss species used were Pilotrictella cuspidata (Figure 54), Racopilum africanum, and Pinnatella minuta, as well as two leafy liverworts – Plagiochila strictifolia and Plagiochila pinniflora (Hobaiter 2014).

Figure 52. Pan troglodytes schweinfurthii in its natural habitat. Photo by Bernard Dupont, through Creative Commons.

Figure 53. Hanging moss from Riparian forest, home of chimpanzees, Chappal Hendu, border of Cameroon, Taraba State Nigeria at 2000 m asl. Photo courtesy of Bup-Olu Oyesiku.

Three years after the initial 2011 moss sponging behavior, Lamon and coworkers (2017) decided to experiment to see if the mosses were a preferred method to obtain water. Using the same population that had learned the behavior, they selected a site where a clay pit had two ground water holes at the bottom of two trees. These cavities contained rainwater enriched with minerals. The experimenters hung the moss Pilotrictella welwitschii (see Figure 54), collected in swamp areas within the natural range of the chimpanzees, in trees around the clay pit. A wide choice of leaves was available naturally. Of 40 chimpanzees included in the study, 33 used moss sponges during at least one of the experimental trials. Five of these were among the original 8 sponge users and 17 were new at this behavior. Those who had tried the mosses seemed to prefer that method, as 18 of those 22 used only moss sponges to obtain water. Furthermore, Hobaiter et al. (2014) had noted only 8 of 32 individuals using moss sponges; leaf sponging was the predominant technique, with 83% of the individuals using it at least once and 18 were exclusive leaf spongers, although 22 chimpanzees used the mosses at least once. Three years later, mosses seemed to be the preferred tool among those that had learned the behavior.

Figure 54. Pilotrictella sp., one of the mosses used by chimpanzees for moss sponges. Photo by Lena Struwe, through Creative Commons.

A similar sponging behavior occurred in chimpanzees (Pan troglodytes; Figure 55) in the Virunga National Park in the Democratic Republic of the Congo (Lanjouw 2002). When water was scarce, the chimpanzees gathered water from that collected in tree branches. When they could not access it directly, they prepared tools, including the use of sponges developed from mosses. The chimps collected mosses from trees. They then rolled them into a bundle about the size of a golf ball. These balls were inserted into the hollow of the branches. When the chimpanzees extracted the moss sponge, it had absorbed water. The chimpanzees sucked the water from the moss sponge, repeating this procedure to get additional drinks.

The chimpanzees are known for getting water from the many hanging mosses in the rainforests (Min Chuah-Petiot, pers. comm. 1 March 2018). Among these hanging water sources are Pilotrictella cuspidata, Squamidium brasiliense, and Papillaria africana (Figure 56).
Summary

Large vertebrates may use bryophytes or harm them – or both. Dogs can damage them with urine and feces, but we have little scientific knowledge of these effects. Wallabies and kangaroos can damage the leafy vegetation, making the habitat suitable for bryophytes. *Dendrolagus* species, the tree-kangaroos, eat mosses. On the other hand, *Macropus* species, Australian wallabies, make hip holes, damaging the bryophytes as they dig.

Wombats make burrows, and mosses like *Mittenia* are able to establish on the recently disturbed soil at the opening. Some researchers suggest that wombats might consume mosses for their adhering water. They also consume capsules of the dung moss *Tayloria tasmanica*.

The dung moss *Tayloria octoblepharum* grows on the dung of the common brushtail possum (*Trichosurus vulpecula*). Elephants can actually maintain some bryophyte communities through their trampling. And Pleistocene mammoths were preserved in ice with bryophytes in their gut. But a change from pasture habitats to boggy and mossy habitats may have led to their extinction.

Bears use the bryophytes to line the winter "nest." Others use growing bryophytes for napping. Bryophytes also occur in feces, but may be there through consumption of inhabiting ants. However, polar bears can eat large quantities of bryophytes. Brown bears also bury mosses with their food, presumably to help preserve the food. Bears can also drag fish into the forest to eat them, with the remains providing nutrients that benefit bryophytes.

The Yunnan snub-nosed monkey (*Rhinopithecus bieti*) subsists in a habitat where hanging mosses and rock lichens are the primary food source. Some chimpanzees (*Pan troglodytes*) in African rainforests have learned to use the pendent mosses as sponges to gather water from tree holes and other difficult to reach places.

Acknowledgments

Ron Porley kindly notified me of the publication on chimpanzees using mosses as sponges to drink. Jessica Beever provided me with the paper and helped me obtain the image of the moss lawn on Kawau Island, kindly provided by Mike Wilcox. Eileen Dumire critically reviewed the chapter.

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