Abstract

Beavers (*Castor canadensis*) are very important contributors to the creation and maintenance of North America's wetland areas. Beavers select a specific home range boundary which they live, forage, and raise their young within. The selection of their home range must be done with specific requirements in mind. This work reviews published literature regarding the specific requirements that a habitat must meet for beavers to select it as a home range. The foraging related preferences by beavers and the physical characteristics of the water bodies that they inhabit are the primary factors of focus. These factors are put in context for improving the habitats and the wellbeing of captive beavers. These environmental factors are also put in context as starting points when artificially selecting an area in the wild for releasing beavers to increase the success of these releases.

Introduction

Figure 1: North American Beaver
(Wikimedia Commons)

Beavers (*Castor canadensis*) are important ecosystem engineers who largely contribute to the creation and maintenance of many wetland areas like beaver meadows and ponds, which many organisms depend on (Johnson, 2012). Beavers can alter up to 15% of an area turning it into a much more fertile and diverse landscape with numerous beneficial impacts to species diversity (Johnson, 2012). Central place foragers like beavers forage within a specific home range boundary and bring food and construction material back to their central lodge before using (Raffel et al., 2009; Gerwing et al., 2013). Due to this constraint, when beavers select a specific habitat, it is largely influenced by foraging considerations that need to be met for them to be able to sustain a colony in that specific home range (Raffel et al., 2009). These environmental considerations are recorded scientifically in the literature through observational studies assessing the distribution, size, and species of beaver cut trees, and by observing the physical water body characteristics of sites that beavers frequently inhabit.

Environmental factors like those affecting foraging, influence how beavers select a habitat and are important to consider when constructing captive habitats for beavers, to ensure that their specific needs are met, prevent escape attempts, and ensure adequate enrichment (Campbell-Palmer & Rosell, 2015). These factors are also important when considering releasing beavers into the wild due to animal relocation needs, as selecting the right environment for release is integral to ensuring the success of the released animal, while also preventing them

from moving into less desirable nearby locations like near agricultural areas (Scrafford et al., 2017).

Forage Environmental Needs

Beavers are slow moving and less efficient when on land and are especially vulnerable to predation along with wasting more energy transporting materials when they forage far from the water's edge (Salandre et al., 2017). Beavers tend to select a home range with sufficient resources near the water as this is essential to ensure the survival of the colony (Salandre et al., 2017; Wang et al., 2019). When foraging beavers typically only select trees as far as 13m-20m from the water, but they will sometimes forage up to 80m from the water only selecting very specific trees at these extreme distances (Salandre et al., 2017). The preferred food species for beavers varies based on those available, but the species considered the most preferred are aspen and willow (Barela & Frey, 2016). Other highly nutritious species such as cottonwood, downy birch, hop-hornbeam, black oak, red oak, shingle oak, hackberry, Russian olive, sassafras, and speckled alder are also considered preferred foods (Barela & Frey, 2016; Raffel et al. 2009; Salandre et al. 2017). More specifically, Raffel et al. (2009) found that beavers preferred intermediate-sized trees (2.0-6.9cm in diameter) and were neutral to larger-intermediate trees (6.9-9.9cm in diameter), avoiding the small and large extremes (under 2.0cm and larger than 9.9cm in diameter). Overall, as the distance from the shore or their lodge increases beavers cut

Figure 2: North American Beaver cutting a large tree. (Wikimedia Commons)

significantly less trees and significantly select larger trees of their more preferred species (Raffel et al., 2009; Salandre et al., 2017).

These foraging preferences influence beaver habitat selection behavior in large part due to energy requirements (Salandre et al., 2017). When foraging at long distances from the water a beaver must carry trees back over long distances, which costs much more energy than when they are traveling by water, as the buoyancy of the wood reduces the effort required to move the cut trees (Salandre et al., 2017). To minimize the expenditure, it is more beneficial for beavers to select trees close by the central place and when at distance select larger trees higher in nutrients (e.g., aspen) to offset the energy loss from travel (Gerwing et al., 2013; Salandre et al., 2017).

Figure 3: Beaver carrying a stick through the water
(Creative Commons)

While not significantly evident in the research predation risk may also influence the preferred foraging distances of beavers, as the further from water the beaver is the harder it is for them to escape to safety (Salandre et al., 2017). This is further supported by the observations that beavers do not consume their food on site but instead opt to carry it back to the safety of the water/lodge before consuming despite the added cost of transportation (Salandre et al., 2017).

Physical Environmental Needs:

Due to predation risks and energy loss from foraging on land beavers prefer to travel in the water, making them dependent on the presence of water bodies for their foraging and lodges (Scrafford et al., 2018). However, the presence of water alone does not guarantee beaver inhabitancy at a site as the distribution of preferred food resources is still of great importance for beaver habitat selection (Barela & Frey, 2016; Wang et al., 2019). Water bodies vary in many ways and the type and characteristics of the water body impacts the beaver's ability to forage and avoid predation (Gerwing et al., 2013; Scrafford et al., 2018). Factors like lodge proximity to streams, marshes, swamps (Scrafford et al., 2020), sinuous (winding) stream reaches, and deep water on secondary channels (Scrafford et al., 2018) are all preferred by beavers. Other specific factors such as river flow speed, river width, bank slope, elevation, type of water body, water depth, bank substrate (Gerwing et al., 2013), and wide river channels (John et al., 2010) were also factors beavers took into consideration when selecting a habitat.

Figure 4: Wetland Area
(Creative Commons)

These physical environmental preferences likely influence beaver habitat selection in a similar way to food preferences, with certain water body characteristics reducing the energy expenditure when going from water to land (Salandre et al. 2017). These preferences may also further act to help beavers escape from their terrestrial predators (Salandre et al. 2017). Some of the factors beavers take into consideration like water body width may also be correlated with the other significant variables important to beavers such as water depth and overall water body size (Barela & Frey, 2016). This means that the beaver preferences for physical characteristics may simplify to just a few major factors that are important for beavers (i.e., a wide river may not be preferred by beavers if it has a shallow depth as depth may be the more important factor). These preferred water body characteristics may also coincide with beaver foraging preferences, as specific types such as marshes and swamps may be selected for due to the herbaceous plants that naturally grow in and near these water body types (Wang et al. 2019). Other preferred water body characteristics like sinuous (winding) streams and secondary channels may also be preferred by beavers due to them providing enough room for multiple beaver colonies to survive in the area (Scrafford et al., 2017). Less obvious habitat specifications like the composition of the substrate are also important to beavers, as they perform lots of burying and digging behaviours, with some substrates (i.e., sandstone) not allowing this behaviour and thus habitats with these characteristics are selected less frequently (Campbell-Palmer & Rosell, 2015).

Captive Habitat

Outside of their natural habitats beavers are difficult animals to keep in captivity due to the very complex habitats and sociality that they require, and captive habitats should mimic their natural habitat as closely as possible to best meet their needs (Campbell-Palmer & Rosell, 2015). Ideal enclosure size differs between captive born and wild caught beavers. A recommended enclosure size for captive born beavers is 20 m^2 (additional 4 m^2 per individual), with 12 m^2 of water area, while for wild caught beavers the area doubles to 40 m^2 and water area to 24m^2 (Campbell-Palmer & Rosell, 2015). These recommended captive habitat sizes coincide with the typical foraging ranges of up to about 20m from a central place seen in wild beavers (Salandre et al., 2017). Having a large enclosure that has sufficient preferred food species growing within the enclosure allows for normal foraging behaviours that are necessary for the animal's wellbeing and helps increase the success of reintroductions to the wild (Campbell-Palmer & Rosell, 2015). As one of the top preferred food species, willow is a good example of a preferred food that could be grown in a captive environment. In the wild beaver foraging on willow has been noted to increase the overall growth of willow in the area (Johnson, 2012). Planting lots of willow would then reduce the need for constant replanting of food species in a captive setting, as a 20kg captive beaver can consume about 1.2–1.9 kg of willow a day (Campbell-Palmer & Rosell, 2015).

Figure 5: A beaver in a zoo chewing on what appears to be a carrot (Creative Commons)

Along with the foraging related requirements, beavers also require sufficient water body conditions to further meet their needs. In captivity beavers require a large enough and deep enough water area so that they can hide on the bottom when they feel threatened (Campbell-Palmer & Rosell, 2015). Having sufficient water body size of at least 12 m^2 in area and a depth of over 1m allows beavers to perform natural swimming and diving behaviours like those they can do in their preferred habitats in the wild (Campbell-Palmer & Rosell, 2015). The edges of the water should have gentle slopes to aid movement in and out of the water as riverbank slope is another important consideration that beavers assess themselves when picking a habitat in the wild (Campbell-Palmer & Rosell, 2015; Gerwing et al., 2013).

If the captive environment enables beavers to perform all their natural foraging, burrowing, social, and building behaviours then these conditions should be able to mimic those of their preferred habitats in the wild (Campbell-Palmer & Rosell, 2015). Through reviewing the literature if mimicking their preferred habitat can be achieved then the likelihood of beavers trying to escape captivity should decrease, in turn keeping the beavers happier and reducing the difficulty of keeping them contained. As a last aside it should also be noted that while beavers do have strong family social bonds and should be housed with definitive family members, they will be very aggressive towards non-family individuals if housed together (Campbell-Palmer & Rosell, 2015).

Release Considerations

In the past beaver populations have seen large declines due to trapping and habitat

destruction and have only recently begun to rebound in North America (Scrafford et al. 2018).

To counteract these declines beaver reintroductions have been necessary and have proven

successful in many areas in North America and Europe (John et al., 2010; Scrafford et al., 2018).

In other areas some beaver populations are thriving at or near carrying capacity and may become

seen as pest species when their expansion conflicts with humans, creating a need for some

beavers to be relocated to more isolated areas (Johnson, 2012). The presence of beavers has also

been found to improve the conditions of some sites they inhabit and therefore they can be used

for the purpose of restoring certain wetland areas (Scrafford et al., 2017). However, this purpose

for reintroduction will require more detailed research to assess the full environmental impact of

reintroducing beavers (Scrafford et al., 2017). The success of the recovery of these areas by

beaver remediation is dependent on multiple factors like the local climate, competition with other

species, and the available vegetation (Scrafford et al., 2017).

Figure 6: Beaver lodge in Fish Creek Provincial Park, Alberta.
(Wikimedia Commons)

When colonizing new areas, ideal locations (e.g., willow rich) are colonized first, but when the population is near carrying capacity beavers begin to colonize fewer ideal areas like those nearer human settlements (John et al. 2010). Which means, when considering releasing beavers, it is important to consider the current population of beavers in the area to prevent overpopulating the area, encouraging the beavers to spread into human altered areas or even push the population over carrying capacity. Other previously mentioned foraging and physical environmental preferences described in the literature should also be met in these perspective release locations as these are needed for the released beavers to stand a chance of survival in the wild.

Conclusion

Multiple factors influence the habitat selection of beavers, the most important being those related to the foraging needs of the animal. Beavers require a habitat with abundant preferred foraging species such as willow and aspen available for their consumption (Barela & Frey, 2016). The specific parameters of these tree species are also very important to beavers with them preferring medium sized trees over very large or very small ones (Raffel et al., 2009). The distance of the trees from the water is an important consideration for beavers as they will typically only select trees as far as 13m-20m from the shore (Salandre et al., 2017). This means that an ideal habitat for beavers will need to contain enough ideal foods of the appropriate sizes within a specific distance from the water's edge. An ideal habitat for beavers will further need to follow some specifications for the water body type that they will inhabit. The water body should be close to streams, marshes, swamps, or sinuous (winding) stream reaches and have deep water with a gentle slope (Scrafford et al., 2018; Scrafford et al., 2020).

When housing beavers in captivity these preferences should be incorporated into the

habitat to best ensure that the beavers' requirements are met while also making them feel more

comfortable in captivity (Campbell-Palmer & Rosell, 2015). Review of the literature shows that

before releasing beavers into the wild these considerations should be used to find an appropriate

location with as many of the preferences met before settling on an area for release. This will help

ensure a successful release that will help the beaver population to grow and help deter them from

moving back into human altered areas.

Figure 7: Welcome sign for the Town of Castor, Alberta (est. 1910).
Named after the French word for beaver.
(Garrett Lapp, 2020)

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