results

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2024-10-28

We found standing willow biomass increases with height (P = 0) class with average availability being 4.8 ± 4.5, 8.6 ± 7.9, and 12.7 ± 12.6 g/m2 for the low, medium, and high heights, respectively. Willow twigs were an average of 6.1% CP and 53.9% NDF, with a remainder of 46% NDS. CP composition did not vary between heights (P = 0.66) whereas NDF decreased with willow height, so twig solubility (NDS) increased 4.38% from low to high height class (P = 0.001).

The maximum snow depth recorded was 90 cm in both winters. Maximum snow depth was reached on 2023-03-07 in 2022-2023 and 2024-03-16 in 2023-2024. Low twigs remained 100% available until snow began to accumulate, after which medium twigs became available followed by high twigs. The maximum availability, based on daily averages, was 67% and 21% for medium and high twigs, respectively. Low twigs became unavailable as winter progressed, while medium twigs became the most available proportion-wise. High twigs showed the least variation in availability, always remaining relatively less available over winter relative to other height classes.

GAMs that modeled willow availability in response to snow depth found that PTA behaved non-linearly in response to snow depth for all height classes (edf > 2; Table 1). Low PTA decreased exponentially with snow, as expected, becoming 0% available at roughly 50 cm of snow, or the maximum height of the low twig category (edf = 6.6, P < 0.001, R2 = 0.81). Medium twigs showed an inverted, quadratic response, increasing in availability up to 50% at 30 cm of snow, after which availability decreased until they became nearly 0% available after around 75 cm of snow (edf = 7.2, R2 = 0.36). PTA for the high height class was the most difficult to predict (R2 = 0.07). These branches were easily pushed down by snow, and then covered quickly as snow continued to accumulate. As snow melted, they would become available for a few days before springing back out of hare reach when enough snow melted (edf = 8.4). As a result, high twigs rarely surpassed 50% in availability.

After we converted predictions for PTAs in response to snow depth to total available biomass (g/m2), average solubility (%), we found that total biomass of willow available to hares decreased 68%, from 5.3 to 1.7 g/m2 over the range of snow depths observed (Figure 5). However, this trend was non-linear with available biomass peaking when snow was 27 cm deep. Specifically, we found that as snow increased from 0 to 10 cm, biomass available to hares increased by 44.5% to a maximum of 7.7g/m2. Available biomass remained high until 30 cm after which it declined steadily to a low 1.5 g/m2 at 83 cm of snow. Over the same increase in snow, twig solubility increased f 4.5% in a nearly linear fashion. The change in twig solubility was not great enough to produce a difference in shape of the responses between biomass and soluble biomass to snow (Figure 5).