Birds in High Places

Special Report by Pete Davidson, Scott Wilson, Heather Bears, Alaine Camfield, & Kathy Martin

Photo: Scott Wilson

Surfbird/Bécasseau du ressac Photo: Scott Wilson

Mountains cover about 20% of the Earth's surface and store and release water for more than half of the world's human population. High mountain habitats worldwide cover about four million square kilometres, an area nearly half the size of Canada, and in British Columbia, almost one quarter of the land area is above the treeline. Yet these alpine environments are among the most understudied ecosystems in the world. They are commonly perceived to be little more than unproductive areas of rock and ice with low biodiversity, minor conservation value, and cushioned from human impacts. Recent research in the Pacific Northwest by Kathy Martin and her students and colleagues at the Centre for Applied Conservation Research at the University of British Columbia has highlighted the importance and fragility of alpine and sub-alpine regions, helping to dispel some of the myths about these high mountain environments.

Conditions at the Top

Mountains are land masses that dramatically alter weather patterns and the environment. The word alpine, as widely used by biologists and geographers, is derived from the Alps, and refers to the bare and partially vegetated zone above the natural treeline. Below the treeline, but above closed canopy forest, is a distinctive sub-alpine zone of open (often stunted) forest and meadows. The altitude of the treeline varies markedly with geographic regions. In BC, it is fairly low on the Pacific coast (less than 900 m in places), and gets lower as one proceeds north.

High mountain habitats are places of extremes and are subject to major seasonal and daily fluctuations in weather conditions. They are characterized by high winds, prolonged snow cover, steep terrain, summertime daily temperature fluctuations of as much as 50°C, and intense ultraviolet radiation. Alpine and sub-alpine areas are effectively ecological islands, and present a considerable challenge to almost anything trying to live in, and travel to or between them.

It is perhaps surprising then that about one third of all wildlife species in the Pacific Northwest are connected to alpine and sub-alpine habitats at some point during their annual cycle. About 240 bird species have been observed in high-elevation habitats in North America, impressive for such 'unproductive' landscapes. While high mountain systems generally support lower species diversity than many lower elevation ecosystems, species richness increases markedly in late summer and fall. In addition, high mountain systems often support a high proportion of endemic plants and animals.

Avian Use of the Alpine

High mountain systems are used by birds in three major ways: i) year round resident high-elevation specialists, of which there are only a few (e.g. ptarmigan); ii) breeding visitors, chiefly songbirds and some shorebirds, some of which nest in alpine habitats exclusively (e.g. Golden-crowned Sparrow, Wandering Tattler), and others that breed from sea-level to alpine and sub-alpine habitats (e.g. Dark-eyed Junco and Savannah Sparrow); and iii) fall migrants, which form by far the largest, but the least well known group of alpine and sub-alpine users, and include songbirds, raptors, waterbirds, and others.

Fall Migration

The few studies that have been conducted in Canadian high mountain zones show the period of greatest bird use (in terms of both density and diversity) is from late July to early October, peaking around early to mid-September. A study in central and southern British Columbia found 120 species of songbirds, raptors, shorebirds, and others foraging or resting in high elevation habitats at this time; of these, about 80% do not breed at high elevations. Fall migrants most commonly observed at

White-tailed Ptarmigan/Lagopède à queue blanche Photo: Scott Wilson

high elevations tend to breed in structurally similar landscapes, including grasslands (e.g. Savannah Sparrow) and shrubby habitats (e.g. White-crowned Sparrow, Wilson's Warbler). Medium- and long-distance migrants account for the majority of birds in the alpine during fall migration (up to 70%). The remainder comprises local breeders and altitudinal migrants moving upslope from lower elevations to capitalize on the late season larder of insects, flowers, and fruit. This group includes pigeons, nuthatches, woodpeckers, creepers, and siskins.

There are several reasons why alpine and sub-alpine habitats are suitable for fall migrants. The delayed onset of spring and summer at high elevations means that alpine and sub-alpine habitats produce a rich store of food between late July and early September, when much of the land below has passed its peak production period. In North America, most mountain chains run north to south, providing connectivity between structurally similar habitats from the arctic into the southern warm temperate zone.

Several very familiar species that breed at lower elevations move upslope during the post-breeding period. By late summer, relatively few American Robins in BC are observed on their lower elevation breeding grounds, because large numbers have moved up into berry-rich alpine and sub-alpine habitats. Rufous Hummingbirds also disappear from lower altitudes by mid-summer, when favoured food plants have ceased flowering, to move up to sub-alpine areas where they defend territories around patches of flowering paintbrush and columbine. From mid-August to early September, some alpine grasslands support large numbers of grasshoppers that are eaten by American Kestrels, Mountain Bluebirds, and others, and the air column is rich in insects that attract flycatchers (such as Townsend's Solitaire) and sallying insectivores (such as Yellow-rumped Warbler, one of the most common migrant passerines at high elevations in mid-late September). The increased abundance of prey attracts Sharp-shinned Hawks, Northern Goshawks, Prairie Falcons, and other migrating raptors, which take advantage of the open terrain to hunt for landbirds and small mammals, exploiting updrafts along cliff faces and ridges to assist their southerly migration. Some species such as Band-tailed Pigeon may make daily altitudinal migrations to sub-alpine areas to feed on late summer fruits such as huckleberry, crowberry, and bearberry, to compensate for the seasonal wane of fruiting shrubs at lower elevations.

Live High and Prosper – Slowly!

Only a few North American bird species breed exclusively in alpine habitats. In southern alpine regions, these include White-tailed Ptarmigan, American Pipit, Gray-crowned Rosy Finch, the *alpinus* subspecies of Horned Lark, and Golden-crowned Sparrow. Farther north in the Yukon and Alaska, the Surfbird, Wandering Tattler, and American Golden-Plover are all conspicuous members of the alpine bird community, and Rock and White-tailed ptarmigans co-exist, the former selecting lower alpine meadows and the latter favouring steep, rocky slopes. In addition, 70-90 species are alpine- and sub-alpine tolerant, and able to breed from low to high elevations.

Various life history, behavioural, physiological, and morphological adaptations enable birds to persist in high altitude environments. Alpine and sub-alpine songbirds typically have large body sizes to improve thermo-regulation and cope with temperature extremes, and can adjust their stress hormone levels to allow breeding in weather conditions that would cause nest abandonment in low elevation birds.

The Dark-eyed Junco is a great example of a species that has evolved several intriguing adaptations to maximize breeding success across a range of elevations. Sub-alpine breeders (at 2000 m altitude) in the Canadian Rockies begin egg-laying more than 6 weeks later than juncos breeding just 1000 m lower. This allows them to conserve energy during the harsher, colder, spring period, increasing both adult and juvenile survival rates. Sub-alpine juncos construct nests in underground burrows to buffer against temperature fluctuations and strong winds, and to reduce the risk of predation. Juncos have also adapted elevation-specific life history strategies; high elevation juncos produce half the number of offspring per season, but live longer, healthier lives with fewer parasites than juncos at lower elevations. Similarly, Horned Larks breeding in alpine habitats have a much shorter breeding season, lay larger clutches with shorter re-nesting intervals, and appear to have higher juvenile survival and longer-lived adults compared to their counterparts breeding at lower elevations.

In an experiment in which hatchling Dark-eyed Juncos were raised in

Horned Lark/Alouette hausse-col Photo: Ralph Hocken

identical conditions, differences between high and low elevation birds remained. For example, higher elevation birds have longer flight feathers. Populations may be genetically different – or fixed for life – due to very early exposure to their elevation of origin.

Some birds time their arrival to the alpine in June, because even when snow cover is still extensive, there can be plentiful food from an unexpected source. Vast quantities of flying insects fall to the snowfields when the warm air they are swept up on from lower elevations meets cold air at higher altitudes. In Smithers, BC, robins breeding below the treeline regularly feed their nestlings by travelling into the alpine zone in June to collect the numbed insects that fall on the high slopes.

Staying on Top – What Does the Future Hold?

The value of alpine and sub-alpine habitats for wildlife may be increasing as changes to habitats and processes accelerate at lower elevations. This 'upward shifting' phenomenon is already well advanced in parts of Europe (especially the Alps), and has been noted in parts of the Pacific Northwest in resident species such as Sooty and Ruffed grouse, which have experienced reductions in their lower elevation range partly because of habitat loss. Horned Lark is declining throughout much of its North American range, but at least one population that breeds in alpine habitat in British Columbia appears to be increasing and acting as a source population for the surrounding area. Alpine and sub-alpine habitats may also become increasingly important for long-distance migrants, as the quantity and quality of low elevation riparian habitats in North America decrease. There is a clear need to conduct much more research and monitoring in high elevation areas, much like Bird Studies Canada does in its High Elevation Landbird Program (HELP) in Atlantic Canada.

The viability of alpine plant and animal populations depends on their ability to disperse successfully between these

Dark-eyed Junco/Junco ardoisé Photo: Ralph Hocken

habitat islands. Birds are better adapted than most groups to achieve this, but for some, such as plants and butterflies, it is a major challenge and already a serious conservation concern.

In parts of the Pacific Northwest, the treeline is rapidly rising, probably the result of the combined effects of climate warming – enabling tree seedlings to establish at higher elevations – and suppression of fires that would otherwise periodically lower the treeline. The rising treeline is reducing the size of alpine habitats and increasing their isolation. A recent study of potential climate-change impacts on vegetation types across British Columbia indicates that we might experience a 60% reduction in the area of alpine habitat over the next 20 years through colonization by trees and shrubs, and a near total loss (97%) in about 80 years.

These are alarming predictions, particularly when applied across large geographic areas, but the way that climate change plays out could be quite different from one alpine region to the next. Evidence from the Colorado Rockies from 1975-2000 suggests that there is a growing disjunction between phenology (the seasonal timing of ecological events) at low and high altitudes, with migrants arriving in the alpine significantly earlier, despite no change in the start of the alpine growing season. This pattern of mismatched phenology could already be affecting some migratory bird populations that nest at high altitudes.

Experimental studies suggest that rising temperatures may lead to changes in habitat quality, with certain key components of the alpine community that are well adapted to the extreme conditions (e.g. lichens and species of dwarf shrubs) being replaced by more dominant grass, sedge, and woody shrub species. In some lower alpine areas, it may not be long before the high elevation species run out of habitat as they are marched toward the mountaintops.

Quite apart from its impact on biodiversity, long-range and upslope transport of airborne pollutants (such as nitrogen from car exhausts) to mountain habitats poses a concern to large urban areas, particularly places like Vancouver that tend to receive a lot of rain. From a socio-economic perspective, the ecological integrity of alpine and sub-alpine environments is also important to maintain, given the increasing popularity of these areas as recreational destinations. So, while you enjoy the skiing events at the Winter Olympics at Whistler in 2010, give some thought to how crucial those snow-clad slopes are to both humankind and the birds and mammals that live in and visit those high places.

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Les oiseaux des hautes altitudes

Photo: Scott Wilson

Bruant à couronne dorée/Golden-crowned Sparrow Photo: Ralph Hocken

Les montagnes couvrent environ 20% de la planète. Elles emmagasinent et déversent de l'eau à plus de la moitié des humains. La superficie des habitats en haute montagne s'élève à environ quatre millions de kilomètres carrés. Les habitats alpins comptent parmi les habitats les moins étudiés du monde. Dans la région Nord-Ouest Pacifique, les recherches menées par Kathy Martin et ses collègues du Centre for Applied Conservation Research de l'Université de la Colombie-Britannique montrent l'importance et la fragilité des zones alpines et sub-alpines.

Le terme alpin désigne la zone nue et partiellement couverte de végétation qui s'étend au-dessus de la ligne des arbres. Au-dessous, entre la ligne des arbres et les forêts à la voûte fermée, s'étend la zone sub-alpine, constituée de prés et de forêts aux arbres clairsemés et souvent rabougris.

En haute montagne, les habitats sont soumis aux fluctuations abruptes du temps de jour en jour comme de saison en saison. Des vents forts, un couvert de neige de longue durée, un écart quotidien de température de presque 50°C en été et un rayonnement ultraviolet intense caractérisent les zones alpines et sub-alpines. En dépit de ces conditions sévères, environ le tiers de la faune du Nord-Ouest Pacifique est relié d'une façon ou d'une autre durant leur cycle annuel aux zones alpines et sub-alpines. En l'Amérique du Nord, environ 240 espèces d'oiseaux ont été observées dans les habitats de haute montagne.

Trois groupes principaux d'oiseaux fréquentent les écosystèmes de haute montagne : 1) des nicheurs résidants, adaptés aux altitudes élevées; 2) des nicheurs migrateurs, des passereaux avant tout et quelques limicoles; 3) des migrateurs de passage en automne, par exemple des passereaux, des rapaces, des oiseaux aquatiques et d'autres.

C'est entre la fin de juillet et le début d'octobre que la densité et la diversité des oiseaux sont à leur maximum, le sommet étant atteint vers le début ou la mi-septembre. Selon une étude en Colombie-Britannique, 120 espèces d'oiseaux fréquentent les zones alpines et sub-alpines à cette période, dont environ 80% n'y nichent pas. Les migrateurs de moyenne et longue distance comptent pour jusqu'à 70% des oiseaux présents durant la migration d'automne.

En raison d'un printemps et d'un été tardifs à ces altitudes, les habitats alpins et sub-alpins constituent pour les migrateurs un garde-manger bien garni de la fin de juillet au début de septembre. Étant donné que la plupart des chaînes de montagnes s'étirent du nord au sud en Amérique du Nord, elles représentent une continuité entre des habitats dont la stratification végétale est assez semblable de l'Arctique jusque loin au sud dans la zone tempérée.

Plusieurs espèces familières qui nichent à plus basse altitude se dispersent vers les sommets en période post-nuptiale. De la mi-août au début de septembre, les habitats alpins regorgent d'insectes, dont se nourrissent les tyrannidés et les oiseaux insectivores qui saisissent leurs proies en vol, et le nombre plus élevé d'oiseaux présents attirent des rapaces migrateurs. D'autres oiseaux peuvent compenser la diminution de la production de petits fruits aux basses altitudes en gagnant chaque jour les habitats sub-alpins afin de tirer profit des fructifications de fin d'été.

Peu nombreux sont les oiseaux nord-américains qui nichent uniquement dans les habitats alpins, mais de 70 à 90 espèces peuvent se reproduire aux basses comme aux hautes altitudes. Des adaptations comportementales, physiologiques et morphologiques leur permettent de vivre en haute altitude. Les habitats alpins et sub-alpins peuvent devenir de plus en plus importants pour des espèces résidantes affectées par les pertes d'habitat aux altitudes plus basses, ainsi que pour migrateurs de longue distance en raison de l'appauvrissement, autant en quantité qu'en qualité, des habitats riverains en Amérique du Nord.

Dans certains secteur de la région Nord-Ouest Pacifique, les habitats alpins deviennent de plus en plus isolés et diminuent en superficie à mesure que la ligne des arbres gagne en altitude, probablement à cause du réchauffement du climat et de la suppression des feux. Selon une étude récente en Colombie-Britannique, les habitats alpins auront diminué de 60% dans 20 ans et de près de 97% dans environ 80 ans. Dans certains bas secteurs alpins, ce ne sera pas long avant que les espèces des hautes altitudes manquent d'habitat à mesure qu'ils sont refoulés vers les sommets.

Le suivi et la conservation des hautes altitudes, comme le programme High Elevation Landbird Program (HELP) d'ÉOC les poursuit deviendront de plus en plus importants – pour la biodiversité comme pour les grandes agglomérations humaines.

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