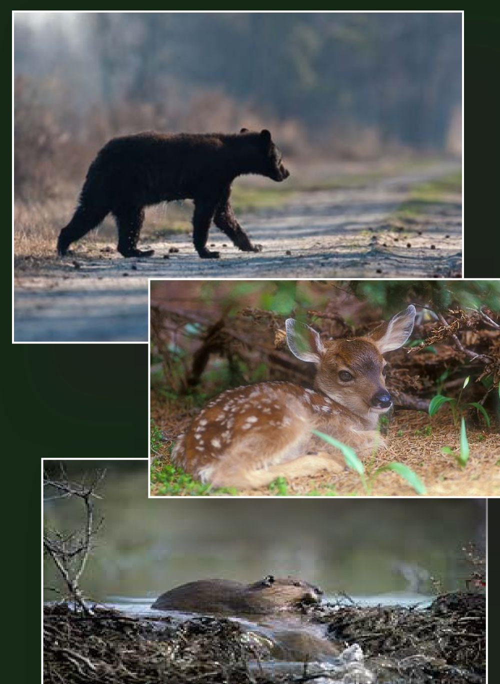
How the Local Effects of Climate Change Could Affect Mammals in the Lower Coos Watershed

Several climate-related changes have the potential to affect the abundance and distribution of mammals on the Oregon coast:

- *Changes to the composition and distribution of forest vegetation may affect predation rates, food availability, and fawn mortality in deer and elk.*
- *Mammals may modify their geographic distributions in response to climatic variation, a trend which could limit the overall fitness of some animals.*
- *The range expansion of diseases and parasites could increase the frequency of some pathogens in mammals.*



Photos: Black Bear: Mike Dunn; Black-tailed deer fawn: Bob Schillereff; Beaver: Steve Blizard

This data summary highlights general mammal responses to anticipated climate-related changes on the southern Oregon coast, citing specific examples where possible. Unfortunately, relatively little is known about the potential response of mammals to climate change. Most of the available research focuses on wild "ungulates" (i.e., hoofed mammals) in habitats in northern latitudes (e.g., Scandivinia and the Canadian arctic) and in the Mountain West region (i.e., Colorado, Wyoming, and Montana). Although the exact response of ungulates to climate change in Pacific Northwest is uncertain (ODFW 2008), the responses by deer and elk are expected to be similar (see the Shifting Geographic Distributions section below).

Climate change's overall effects on mammals in the Pacific Northwest will be influenced by a complex web of ecological responses to change at various scales (ODFW 2008). Some ecological responses will affect mammals' overall fitness and ability to survive by modifying the availability of food and cover, changing predator-prey relationships, and changing the likelihood of parasitic infection or disease. Mammal survival will depend on the ability of species to adapt to changing conditions in existing habitats or migrate into new, more hospitable areas.

Changing Habitat Conditions

Climate change may alter the characteristics of important habitat features. Mysterud and Ostbye (1999) explain that vegetation density affects many important aspects of ungulate behavior, including grouping tendencies (Hirth 1977, Lagory 1986), vigilance (Goldsmith 1990), alarm and flight responses (Lagory 1987), and circadian rhythms (Andersen 1989). Deer also rely on actively growing plants as a source of forage (ODFW 2008). Since climate change is expected to directly affect the abundance, distribution, and density of local vegetation, large mammals will need to adapt to changing habitat conditions (Chmura et al. 2011, Dalton et al. 2013).
In addition, decreases in vegetation density appears, not surprisingly, to be correlated to increased predation rates for both juvenile (Linnell et al. 1995, Aanes and Andersen 1996, Canon and Bryant 1997) and adult (Jedrzejewska et al. 1994) ungulate species. Similarly, alterations to plant phenology (e.g., reproductive timing) and the availability of forage may result in the redistribution of ungulate species with potential reproductive consequences (see Shifting Geographic Distributions section below). Deer and elk populations may also be affected if climate-related changes to habitat structure (e.g., increasingly open forest canopy) result in increased wintertime and springtime exposure to precipitation (see sidebar), because wet conditions may be associated with increased fawn mortality (Putman et al. 1996).

Mammals may also be affected by human-induced changes. For example, the introduction of new roads may limit the ability of large mammals (e.g., bears) to adapt to climate-related changes by impeding their movements (Brody and Pelton 1989, Noss 2001). Similarly, high density roads in the winter range of deer and elk may reduce food availability for large predatory mammals (e.g., cougars) while simultaneously increasing the potential for mortality of all large mammals as a result of non-hunting conflicts with humans (ODFW 2006).

Changes in Precipitation Timing, Frequency and Intensity

In the future, precipitation in coastal Oregon is expected to remain a predominately wintertime phenomenon (i.e., most precipitation will continue to occur in the winter). However, the extent to which precipitation timing, frequency and intensity on the Oregon coast may change remains uncertain. There is evidence that high-intensity storms are becoming more frequent, and that the frequency of weak to moderate-strength storms is declining.

Sources: Sharp 2012, OCCRI 2010, OSU 2005

Shifting Geographic Distributions

In Scandinavia, northern Canada, Colorado, Wyoming, and Montana, changes in wild ungulates' distribution in response to climatic variability are well-documented (Post and Stenseth 1999, Post et al. 1997, Inouye et al. 2000, Romme and Turner 1991, Wang et al. 2002). As mentioned above, changes in ungulate behavior may reflect climate-related changes in the growth patterns and reproductive timing of key forage plant species (Post

Uncertainty in Predicting Local Effects of Climate Change

There is inherent uncertainty in predicting what the local effects of climate change are likely to be. The uncertainties generally fall into three categories: 1) Natural variability of the earth's climate; 2) Climate sensitivity (how the earth's climate system responds to increases in future greenhouse gas levels); and 3) Future greenhouse gas emissions.

To manage for these uncertainties, climate scientists use multiple models ("multi-model ensembles") that incorporate the estimated range of possible natural variability, climate sensitivity, and future greenhouse gas emission values when investigating climate-related change. The models typically generate a range of values for potential future air temperatures, ocean surface temperatures, sea level rise, etc., which naturally become increasingly variable the longer into the future the model is asked to predict. This approach gives communities a range of projections to consider when developing climate change vulnerability assessments and adaptation plans.

Sources: Sharp 2012, Hawkins and Sutton 2009 and Stenseth 1999, Romme and Turner 1991). For example, changes in ungulate forage may affect the herd density and overall fitness of elk populations in Oregon (ODFW 2008), which in turn affect elk herd fecundity (reproductive success) since elk herd fecundity has been shown to be influenced by herd density (Stuart et al. 2005).

Similar to ungulates, there is some evidence to suggest that the North American beaver populations (*Castor canadensis*) are also likely to shift their ranges in response to climate-related changes. Research from Canada shows that beaver density is highly variable in response to increasing temperatures in southern Québec (Jarema et al. 2009).

Climate change may produce other important habitat modifications that could influence beaver population ranges in the Pacific Northwest. For example, some of the region's coastal freshwater marshes and swamps are expected to become more saline due to the intrusion of seawater as sea level rise continues (Glick et al. 2007, Scavia et al. 2002). Although there is currently no research about the potential effects of sea level rise on beaver populations (and specifically populations in the Coos estuary), it's possible that the slow conversion of freshwater to brackish habitats could result in the redistribution of beaver populations as key habitat features change (e.g., availability of food and materials for building structures). It should be noted that beavers currently inhabit brackish marshes in South Slough and the Coos estuary, so the extent to which salt water intrusion will affect beaver distributions will need to be monitored.

Diseases and Parasites

In recent years, diseases and parasites (especially Deer Hair Loss Syndrome and Adenovirus Hemorrhagic Disease) have resulted in the decline of deer populations in western Oregon (ODFW 2008; S. Love pers. comm., April 29, 2015). Hoberg et al. (2008) explains that temperature increases associated with climate change have "a substantial influence on the spatial and temporal distribution of pathogens and the emergence of disease [in wild ungulates]." In Oregon, the range of diseases and parasites, including the lice which contribute to Deer Hair Loss Syndrome, is likely to expand as climate change continues (ODFW 2008). However, the exact response of pathogens to climate change is likely to vary (Hoberg et al. 2008).

Role of Beaver Structures in Climate Change

A team of researchers in Colorado has recently discovered the importance of active beaver colonies in carbon sequestration (see sidebar). Wohl et al. (2012) estimate that although environments closely associated with beaver activity (i.e., low-gradient, broad valley bottoms with floodplains dominated by sediment and coarse wood) represent only 25% of mountain headwater habitats in Rocky Mountain National Park, they store about 75% of the system's total carbon. Since habitat "manufactured" by beavers appears to be an important carbon sink, it's possible that beaver activity may help to mitigate the effects of climate change by preventing greenhouse gases from entering the atmosphere and accelerating warming trends. However, beaver ponds are also sources of greenhouse gas emissions (carbon dioxide, methane and nitrous oxide gases)(Hauser 1999, Welsh 2013). More research is needed to determine the extent to which beaver ponds are net sinks or sources of carbon.

In-stream beaver structures trap and accumulate sediment, reduce stream velocities, and change the hydrologic characteristics of the surrounding environment (Butler and Malanson 2005). In some cases, beaver activity in the Coos estuary is known to promote the recruitment of a few non-native (and potentially invasive) plant species, including velvet grass (*Holcus lanatus*), trefoil (*Lotus corniculatus*), and reed canary grass (*Phalaris arundinacea*) (Cornu 2005). The failure of beaver dams and subsequent drainage of beaver ponds create unvegetated bare patches in marshes which invasive plants can colonize and ultimately dominate. If climate change results in conditions that cause increased numbers of abandoned beaver dams, it's possible the distribution of invasive vegetation will increase in project area freshwater marshes.

Carbon Sequestration in Coastal Estuaries

Vegetated tidal wetlands, including emergent marshes, forested and scrub-shrub swamps, and seagrass beds, play an important role in the global carbon cycle by sequestering carbon dioxide from the atmosphere continuously over many growing seasons, building stores of carbon in wetland soils high in organic content. Thus, wetlands that store carbon mitigate carbon dioxide emissions into the atmosphere and moderate climate change.

Source: Crooks et al. 2014

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