

Literature reviews of the environmental impacts of woody biomass utilization with focus on wildlife and biodiversity

Citation	Location	Topics covered	Conclusions/Notes about wildlife and biodiversity
Behan and Misek 2008	Oregon	Plants, wildlife, soil, water, and air resources	Conserving habitat heterogeneity also conserves biodiversity. Biomass harvesting may have effects similar to fuel reduction or thinning treatments (depending upon how such treatments are done). The impacts on wildlife are difficult to generalize as species use structural elements in the forest differently. Timing of treatments will determine the level of impact- avoid breeding and nesting seasons.
Hacker 2005	General	Soil nutrients, regeneration and stand development, wildlife and microorganisms	Impacts are highly site specific and dependant upon soils, moisture regimes, forest type, season of activity and intensity of removal. Impacts vary depending upon the species of interest. Amount and size of retained residues may influence soil-microbial activity and the availability of nutrients (nitrogen).
Kelty et. al. 2008	Massachusetts	Nutrient cycling and retention, soil physical properties, streamflow and water quality, carbon cycling and storage, wildlife habitat, forest fire risk	It is important to retain some vegetation, snags, and CWD for use by wildlife. Silvicultural treatments (proxy biomass harvests) analyzed for potential impacts on wildlife included: whole-tree clearcuts and overstory thinning with removal of small trees (shelterwood). Effects of treatments will depend upon wildlife species habitat needs- some may benefit, others will not.
Benjamin et. al. 2009	Maine, with a general discussion of issues	Soil productivity; water quality, soil disturbance; forest biodiversity and wildlife habitat	Site and landscape level impacts are of concern. Guidelines should be developed that protect forest structural elements that are important for biodiversity- wildlife trees, snags, cwd/fwd. The potential risk to biodiversity increase with the amount and type of woody biomass removed from a site, and the frequency of harvests.
Janowiak and Webster 2010	General	Soils and site productivity; hydrology; biodiversity and forest habitats	Use the “Range of Natural Variability” to determine levels of acceptable harvest- removal beyond what is natural will likely degrade biodiversity. Depending upon the previous land use (agriculture), SRWC may increase biodiversity. Structural heterogeneity is important for wildlife- retention of biological

			legacies and deadwood must be part of harvest guidelines (snags, green trees, CWD) Effects on wildlife will depend upon the level and pattern of harvest.
Lattimore et. al. 2009	General-European focus	Soils; hydrology and water quality; site productivity; forest biodiversity; greenhouse gas balances; global and supply-chain impacts	Concerns include reduced dead and down wood in managed forests, shorter rotations, land-use changes/conversions, increased forest use and invasive species spread. Recommendations- assessments and maintenance of biodiversity at the landscape level; using the umbrella species (species with large area requirements) management concept; adaptive management and monitoring.
Roser et. al. 2008	Nordic and Baltic regions	Short and long term site productivity; wood ash recycling; insect pests; biodiversity; guidelines/regulations, policy and economics	Effects of intensive forest management will become more obvious as stands get farther and farther away from natural conditions. It is necessary to identify critical thresholds in habitat quality for representative (umbrella) species that are dependant upon dead wood, snags, and green trees. Use adaptive management principles to inform decisions and harvest practices.
Walmsley and Godbold 2010	General	Stump harvest removal and its associated impacts on soil, carbon balances, erosion, biodiversity and habitats, disease and pest control	Stump harvesting is intensive forest management and is expected to increase the negative environmental impacts associated with forest operations. 100% removal of stumps should be avoided. The majority of studies focus on stump removals as part of pest/disease control- these sites have lower productivity than healthy forest stands.
Willyard and Tikalsky 2006	Wisconsin	Biodiversity, forest residues- cwd/fwd, plantations	The proportion and type of forest residues available for harvest will be limited by the ecological sensitivity of the site. Energy plantations, while not as biologically diverse as natural forests, will most likely support more species than agricultural lands. CWD and FWD are identified as important habitat elements- removal of these components must be done with caution so as to not negatively affect wildlife.