

# North Carolina Ecosystem Response to Climate Change: DENR Assessment of Effects and Adaptation Measures

DRAFT

## Successional and Ruderal Uplands

### Ecosystem Group Description:

This Ecosystem Group comprises semi-natural herb and shrub dominated communities that form in dry to mesic sites following disturbance, either natural or man-made (wetland counterparts are treated in the Successional Wetlands Group). Other types of semi-natural habitats associated with farmlands or “wastelands” including hedgerows, field-forest ecotones and groves, and road rights-of-way are also included.

Most of these habitats fall outside the scope of the [Schafale and Weakley] Natural Community classification, which primarily covers more-or-less permanent communities, including those maintained by recurrent natural disturbances such as fire or flood scour. While the communities included within this Ecosystem Group are characteristically much more transient, constantly coming and going across the landscape in response to disturbance, they are nonetheless composed primarily of native species. The niche they occupy, moreover, probably has always existed, once associated primarily with openings created by storms, floods, or fire. Many of the native species of annual plants, reptiles, small mammals, birds, and insects associated with early successional habitats are found nowhere else.

Although typically quite vagile or otherwise well adapted to colonizing new areas – i.e., “weedy” -- many are now declining due to pervasive changes in agricultural or silvicultural practices or to loss of both natural and ruderal landscapes to development. Such changes are likely to accelerate at least indirectly due to climate change, with more demand for biofuels or other forms of energy production utilizing “waste grounds”. Like other native ecosystems, early successional habitats are also likely to be affected by increased temperatures, prolonged droughts, more frequent fires and storms, and especially invasion of exotic species.

### Ecosystem Level Effects:

#### Predicted Impacts of Climate Change:

Climate Change Factor:	Likelihood:	Effect:	Magnitude:	Comments:
Increased Temperature	High	Mix	High	Increased temperature is likely to have a strong effect on the composition of the plant communities in this group. These changes are also likely to affect host-plant specialist insects but impacts to other animals are difficult to predict.
Drought	High	Mix	High	Increased frequency of severe droughts is likely to have a strong effect on the composition of the plant communities in this group. These changes are also likely to affect host-plant specialist insects but impacts to other animals are difficult to predict.

Increased temperatures and higher frequency of severe droughts are likely to have significant impacts on this habitat group, at least in terms of species composition. More localized perturbations, such as wildfires, are less likely to have an effect, at least where early successional habitats are abundant and well-connected. Other factors, such as increased severity of storms and flood events are less likely to affect the open, upland sites occupied by this habitat group.

**Predicted Ecosystem Responses:**

Ecosystem Response:	Likelihood:	Effect:	Magnitude:	Comments:
Exotic species invasion	High	Neg	High	
Compositional Change	High	Mix	Med	Species with more southerly ranges are likely to replace species with more northerly ranges

The plant communities of this group are primarily composed of annuals and other vagile, r-strategist species, whose composition is more likely to quickly shift with environmental change than communities composed primarily of k-strategist perennials. Changes in plant species composition may also have strong impacts on the composition of insect species, since many have narrow host plant preferences. The vertebrate fauna may show far fewer effects, however, since most, if not all, do not depend on a particular composition of plant species.

While most compositional changes are likely to have mixed effects, invasion by some exotic species can produce severe impacts, greatly reducing the diversity of both animal and plant communities. Two species that are likely to spread into new areas -- particularly at higher elevations -- due to increased temperatures are kudzu and fire ants, both of which have strong impacts on early successional and other ruderal habitats.

**Habitat Level Effects:**

**LHI Guilds:**

Guilds with Significant Concentration in Ecosystem Group:	Comments:
Semi-Natural Grasslands (Wet-Mesic Forest-Field Ecotones and Groves) (Early Succession Mixed Herb and Shrublands) (Dry-Wet Forest-Field Ecotones and Groves)	

Three of the guilds for this habitat group are still provisional -- not yet included in the LHI analysis, although defined in terms of a preliminary list of indicator species. All four of the guilds in this group are composed of species that occur widely throughout the state, although there are also some regional variations (e.g., Henslow's sparrows are restricted to the Coastal Plain and vesper sparrows breed only in the mountains).

## Species Level Effects:

### Terrestrial Animals

Species:	Element Rank:	Endemic	Major Disjunct	Extinction/ Extirpation Prone	Status: US/NC/WAP	Comments:
Pyrgus wyandot	G1G2Q/S1		Yes	Yes	FSC/SR/	Currently known from just a few sites in the Northern Mountains
Speyeria idalia	G3/SH			Yes	FSC/SR/	Believed extirpated from North Carolina
Hesperia leonardus	G4/S3S4				/W2/	
Vermivora chrysoptera	G4/S3B				FSC/SR/P	
Sylvilagus obscurus	G4/S3				FSC/SR/P	
Hesperia metea	G4G5/S3				/W2/	
Lanius ludovicianus ludovicianus	G4T4/S3B,S3				/SC/P	
Ammodramus henslowii susurrans	G4TU/S2B,S1		Yes	Yes	FSC/SR/	Restricted as a breeding species to just a few sites in the northern Coastal Plain
Ictinia mississippiensis	G5/S3B				/W2/P	Appears to be increasing in North Carolina
Icterus spurius	G5/S5B				//P	
Icterus galbula	G5/S3B,S3N				/W2/	
Hesperia sassacus	G5/S3				/W2/	
Eremophila alpestris	G5/S4B,S4N				//P	
Passerculus sandwichensis	G5/S2B,S5N		Yes	Yes	/SR/P	Rare as a nesting species in the Northern Mountains.
Dendroica pensylvanica	G5/S5B				//P	
Dendroica discolor	G5/S5B,S1N				//P	
Coragyps atratus	G5/S4				/SC/P	
Colinus virginianus	G5/S5				//P	
Chondestes grammacus	G5/S1B				/SR/P	
Ammodramus savannarum	G5/S3B,S1N				/W1,W5/P	
Falco sparverius	G5/S3B,S5N				/W1,W5/P	
Spizella pusilla	G5/S5B,S5N				//P	
Vireo gilvus	G5/S2B				/SR/	
Vermivora pinus	G5/S2B				/SR/P	
Tyto alba	G5/S3B,S3N				/W2,W3/P	
Tyrannus tyrannus	G5/S5B				//P	
Tyrannus forficatus	G5/SNA		Yes	Yes	//	Very rare as a nesting species in North Carolina.
Microtus pennsylvanicus	G5/S5				//P	
Sturnella magna	G5/S5B,S5N				//P	
Melanerpes erythrocephalus	G5/S4B,S4N				//P	
Spiza americana	G5/S2B				/W3,W5/P	
Scolopax minor	G5/S4B,S4N				//P	

Poocetes gramineus	G5/S2B,S2N			/SR/P	
Peromyscus polionotus	G5/S1			/SR/P	
Zapus hudsonius	G5/S3			/W2/P	
Ophisaurus attenuatus	G5/S3			/W1/P	
Thryomanes bewickii altus	G5T2Q/SHB	Yes	Yes	FSC/E/	The endemic Appalachian subspecies is believed to be extinct; possibly eliminated due to competition for nesting sites from starlings and English sparrows

Two species in this group, Bewick's wren and regal fritillary, are believed extirpated from North Carolina. Several other species are declining, with eastern Henslow's sparrow, golden-winged warbler, Appalachian cottontail, and grizzled skipper listed as Federal Species of Concern, and eight additional species tracked as Elements by NHP. Several (ten) of the species in this group that are of conservation concern are primarily northern species and are likely to be significantly affected by the effects of climate change.

## Combined Threats and Synergistic Impacts:

### Importance of Climate Change Factors Compared to Other Ecosystem Threats:

Threat:	Rank Order:	Comments:
Conversion to agriculture/sylvicu	1	
Pollution	2	
Invasive Species	2	
Climate Change	3	

The greatest threat to this habitat group is habitat loss due to development of more intensive agricultural and sylvicultural practices. Modern, industrialized farming leaves fewer unutilized areas in and adjoining fields such as hedgerows, groves of shade trees, and weedy forest-field ecotones. Fewer fields are left fallow for very long. Pastures and hayfields are more intensively managed, using heavier applications of herbicides, pesticides, and fertilizers. Mowing of hayfields is also now conducted much more frequently than it has been in the past.

Habitats used by this group are almost always in close proximity to areas that are commonly quite polluted. Farm fields and pine plantations are regularly sprayed with biocides or fertilizers; powerline rights-of-way are now routinely sprayed with herbicides to keep them open; roadside rights-of-way are subject to pollutant-laden runoff from the road surfaces as well as application of salt and other chemicals used to prevent icing in the winter; ruderal areas located near industrial areas are subject to both air- and water-borne pollutants emanating from the industrial plants. All of these pollutants can play a major role determining species viability within the semi-natural habitats used by this group.

Species in this habitat group are completely dependent on their ability to disperse from one habitat patch to another: their habitats themselves are normally very transient and the species associated with them need to keep constantly on the move to keep up with their shifting landscape. Although many of the species

associated with successional habitats are quite vagile, small mammals, reptiles and at least some birds and insects are less mobile and highly vulnerable to the effects of habitat fragmentation. At least some of the declines noted in this group of species is likely due to decreased connectivity between habitat patches, in addition to the decreased extent of these habitats overall.

Disturbed and artificially created/maintained habitats are particularly susceptible to invasion by exotic species, which in some cases can have significant impacts on the native species associated with early successional habitats -- the Appalachian Bewick's wren may have been extirpated from North Carolina due to competition with exotic house sparrows and European starlings, along with brood parasitism by brown-headed cowbirds, an exotic in this area from the Great Plains (Potter et al., 2006). Along with changes in agricultural practices, loss of some habitat patches or connections between them may be attributable to the smothering invasion of exotic species such as kudzu.

## Recommendations for Action:

### Interventive Measures:

Intervention:	Importance:	Feasibility:	Comments:
Preserve/restore traditional agricultural pract	1		
Eliminate/Prevent Pollution	2		
Control Invasive Species	2		

Protection of agricultural reserves that maintain traditional farming practices offers the best hope for protecting areas still supporting high quality examples of this habitat group, including populations of its rarer species. Unlike traditional nature preserves, where only natural disturbances such as fire are typically supported, agricultural reserves support the continuation of artificial disturbances, such as grazing, mowing, plowing, and timber harvest, that return habitats to the early successional state favored by this group. Intensive farming practices, on the other hand, are discouraged, including the use of pesticides, herbicides, and fertilizers. Fields are left fallow for longer periods of time, mowing and grazing are done less intensively, and old field habitats and weedy ecotones are more tolerated. In the short and medium term, the siting of these agricultural reserves should be influenced primarily by the current distribution of the wildlife species in this group, conserving habitats where the species are known to occur.

Long term stability of this group, however, depends on maintaining ecosystem integrity at the landscape level. Although well adapted to perturbation-created and maintained habitats, species in this group cope with environmental disturbances primarily through a meta-population strategy, constantly colonizing new areas as they become available and swift abandonment of older areas as they succeed to less suitable habitat types. Due to their particularly high turnover rates and low on-site resistance to disturbances themselves, species in this group may be difficult to maintain in perpetuity within small agricultural reserves, even with the most benign forms of management. With increased environmental perturbations expected as the result of climate change, small reserves are even less likely to offer sufficient protection.

Protection at the landscape level requires more widespread adoption of environmentally sustainable agricultural practices, including less reliance on chemicals. Best management practices for sustaining early successional habitats need to be developed, just as they have been for the protection of wetlands and other sensitive habitat types. Similar best management practices also need to be extended to non-agricultural land uses, including powerline, road, and railroad rights-of-way where the use of herbicides is increasingly taking

the place of traditional mowing or bush-hogging methods.

Integrated pest management practices should be preferred over more indiscriminate application of pesticides. While invasive species should be treated aggressively, with eradication as the goal wherever an exotic is just beginning to be established, control measures should always be carefully targeted, including the use of species-specific biological control agents.

## **Ecosystem Group Summary:**

Loss of habitat and fragmentation of landscapes are the most significant threats to this ecosystem group. While development of yet more intensive agricultural and silvicultural practices, and loss of still more areas to development, would continue even in absence of climate change, these impacts are likely to be exacerbated both directly and indirectly by the effects of climate change. More pressure will be placed on the utilization of marginal agricultural or silvicultural lands for energy production, including the development of otherwise "green" sources such as biomass, wind and solar energy. Increased frequency and severity of environmental perturbations may disproportionately affect ecosystems composed primarily of annuals or r-strategist species in general, particularly if landscapes continue to become more and more fragmented. These ecosystems are currently among the most heavily infested with exotic invasives. With increases in overall temperature, still more invasions are likely, especially from tropical and sub-tropical regions. Support for traditional or environmentally sustainable agricultural and silvicultural methods will help maintain this ecosystem group. Maintaining habitat connectivity across the landscape is also critical, both to maintain the resilience of these ecosystems in face of environmental perturbation and to allow shifts in range and species composition to take place.

## **References:**

Potter, E.F.; Parnell, J.F.; Teulings, R.P.; and Davis, R. 2006. Birds of the Carolinas. Second Edition. Univ. North Carolina Press; Chapel Hill, NC.

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