

Appendix

Background to Ecological Resources and Stewardship

The first management plan for the Andrews Community Forest was created in 2018. Knowledge of the forest was limited to relatively brief ecological surveys conducted by Vermont Land Trust, Audubon Vermont, and a five-town inventory project called “Science to Action.” Since then, the ACF’s ecological resources have been further studied and detailed by the UVM Field Naturalist Program, Arrowwood Environmental and several botanists, wildlife biologists and naturalists. This new information has helped shape this latest management plan.

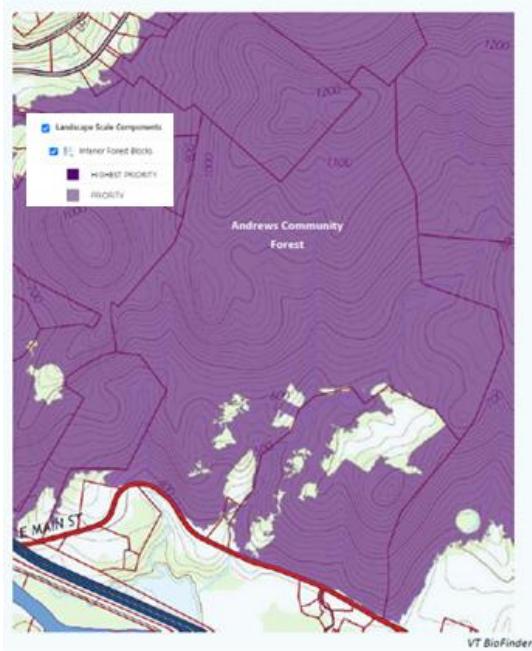
This plan also makes use of recent research into ways to avoid the adverse impacts that even seemingly benign human activities can have on a forest's health. This plan's use of the former VAST trail to mark two zones with differing recreational intensity reflects that research, and aims to adhere to the Conservation Easement and still enable expansion of ACF recreational opportunities for a broad span of residents. More information on this line of research can be found in these references:

- [Understanding and Managing the Effects of Trail Use on Wildlife.](#) 2021. Meredith Naughton. UVM Field Naturalist Program, for VT's Fish & Wildlife Department and Department of Forests, Parks, and Recreation.
- [Trails for People and Wildlife.](#) New Hampshire Department of Fish & Game.
- [Recreation effects on wildlife: a review of potential quantitative thresholds.](#) 2021. Dertien JS, Larson CL, Reed SE. *Nature Conservation* 44: 51-68.
- [An assessment of non-consumptive recreation effects on wildlife: current and future research, management implications, and next steps.](#) John Baas, Kari Dupler, Audrey Smith, And Rachael Carnes, *California Fish and Wildlife*, Recreation Special Issue; 62-73; 2020.

Landscape-Level Elements

Contiguous Forest

One of the most outstanding features of the Andrews Community Forest is what it lacks – roads, buildings, driveways, agricultural land and other forms of development and disturbance. Because of the integrity of the ACF’s interior forest and its contiguity with other largely undisturbed, the State of Vermont’s Vermont Conservation Design designates nearly all of the ACF as part of a “High Priority” conservation landscape.



Large expanses of intact forest such as that found in most of the ACF support the biological requirements of many native plants and animals, including those sensitive to human disturbance. They create the large, intact landscapes critical to the continuing survival of Vermont's widest ranging animals, species such as black bear, bobcat, moose and others known to frequent the ACF. They serve the needs of interior-nesting birds, who in a more fragmented landscape would suffer excessive predation. The ACF provides them and other wildlife with vital feeding habitat and space to roam, find mates and promote genetic diversity.

Contiguous interior forests like the ACF also buffer species against the negative consequences of forest fragmentation, climate change and human disturbances elsewhere. They give wildlife new places to thrive in should previous territory turns untenable.

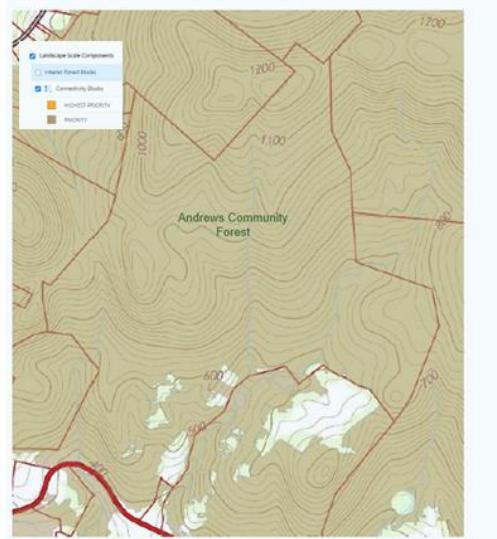
51 Habitat Connectivity

52 The ACF Conservation Easement notes the ACF's location in an
 53 area "important for regional landscape connectivity." The State of
 54 **the** Vermont recently bolstered this assessment by assigning
 55 "Priority" conservation status to much of the ACF for its
 56 connectivity features, primarily its northern area. Along with
 57 neighboring forests, ecologists recognized the ACF for its
 58 contributions to plant and wildlife connectivity across Vermont
 59 and into adjacent states and Quebec.

60 As such, the ACF assists bear, bobcat, moose, turkey and others in
 61 moving from place to place to meet season-by-season and other
 62 survival needs. Connectivity and contiguity combine to foster
 63 species intermixing and breeding, making for healthier
 64 populations across the landscape. And as climate change
 65 continues, the ACF is another link in enabling animals to adjust their ranges in response to warmer
 66 weather creeping northward.

67 Enduring Elements

68 The ACF's enduring features are those that resist change, even over millennia, and play fundamental,
 69 long-standing roles in shaping and sustaining the landscape.





Rocky, creviced terrain in and around the ACF shelters far-ranging mammals from bobcats to bats.

For example, south-facing slopes created millions of years ago host different sets of flora and fauna than those with less exposure to sunlight. Minerals and seeps in the ACF's rocky ledges nurture plant communities unique from those found in looser, lower elevation soils. Crevices in rocky terrain shelter far-ranging mammals from bobcat to bats.

Bedrock and surficial geology

The ACF spans lowland and high elevation terrain, with its bedrock geology generally split on a north-to-south line. Both help account for the forest's

81 biodiversity. In the southern areas, the meltwaters of glacial Lake Vermont deposited sand, gravel and
82 clay formations. Above, the soil is built upon formations primarily of Underhill and Pinnacle bedrock 500
83 or more million years old.

84 Underhill bedrock dominates the forest from its northernmost point to its western edge. Along with the
85 neighboring Pinnacle bedrock, it has dense, metamorphic, sedimentary rocks with visible cracks and
86 fractures. Underhill's more distinctive silvery-green rocks combine phyllite and schist, with the minerals
87 chlorite, muscovite, and quartz.

88 To the east, the Pinnacle Formation features finer-grained, gray-to-buff schistose greywacke rock. Its
89 layers show the formation's metamorphic origins from bits of rock, mud, and debris. The minerals
90 present are quartz, sericite, biotite, and chlorite.

91 Over the eons, wind, water and glaciers deposited loose materials across the ACF, which combined with
92 glacial till – boulders, stones, pebbles and fine silt deposited by glaciers at the end of the last ice age,
93 about 14,000 years ago. On roughly half of the ACF's elevation range, up to 600 feet, soil particles
94 deposited by post-glacial Lake Vermont can also be found.

95 *Elevation*

96 The ACF rises from an elevation of about 400 feet above sea level at the parking lot to 1240 feet along its
97 northern ridgeline. This gives it the greatest elevation range among conserved properties in Richmond,
98 with soil and temperature diversity to match. In contrast, most of Vermont's conserved land lies above
99 2000 feet, where biodiversity is the least. Protecting the ecological functioning of lower areas like the
100 ACF is important to conserving the state's overall biodiversity.

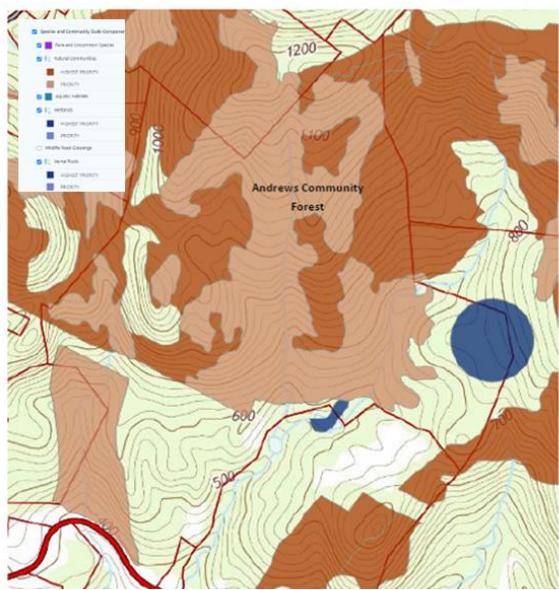
101 *Climate*

102 Though it appears to be in a period of unprecedented rapid change, a forest's climate is also considered to
103 be another enduring element. The ACF is part of the Northern Green Mountains biophysical region,
104 which is cooler and wetter than other portions of the State. However, life in the ACF is also influenced by
105 its proximity to the warmer Champlain Valley biophysical region as well as its south-facing slopes. The
106 result is a forest dominated by tree species adapted to warm, dry sites – with poorer soils on upper
107 elevations, and slightly richer forest soils on lower elevations (thanks to the glacial deposits).

108

109 Community-Level Elements

110 Natural Communities



The ACF's natural communities, generally clustered above the powerlines, are rated "Highest Priority" and "High Priority" by Vermont Conservation Design.

A natural community is an interacting assemblage of plants and animals, their physical environment, and the natural processes that affect them. While named for their common plants, natural communities encompass the full, non-hierarchical interaction of plants, animals, soils, bedrock, and ecological processes, from fungi and microbes to mammals and trees.

To date 97 natural communities have been found across Vermont. The ACF has at least 10, ranging from small patches of wetland to a multi-hundred-acre stand of Northern Hardwood Forest and its Mesic Red Oak, White Pine and Hemlock associated communities.

Conserving the ACF's natural communities offers a practical way to understand and maintain the Forest's biodiversity. Otherwise, we would be faced with the task of trying to conserve tens of thousands

129 of individual species.

130 *Upland Natural Communities*

131 Three upland natural communities comprise most of the forest: Mesic Red Oak-Northern Hardwood
132 Forest, White Pine-Northern Hardwood Forest and Hemlock-Northern Hardwood Forest. The White Pine-
133 Northern Hardwood Forest occupies much of the southern portion of the forest, indicative of areas
134 formerly in pasture or cultivated. In the northern part of the forest, roughly north of the VELCO
135 transmission line, red oak and northern hardwoods dominate, extending well beyond the ACF's borders
136 into its surrounding forest block. Patches of hemlock on secluded, south-facing slopes throughout the
137 Forest offer vital wintertime shelter for deer and dozens of other species.

138 The northern ACF's Dry Oak and Red Pine Forest communities are excellent examples of uncommon
139 community types, occupying the Forest's droughty ridges and south-facing summits and featuring
140 shallow soils and frequent bedrock outcrops. As diseases claim the Forest's few remaining sources of
141 beechnuts and butternuts, Dry Oak acorns will become even more critical food sources for black bears,
142 wild turkeys, coyotes, corvids and other species.

143 The small size of these stands makes them especially vulnerable to disturbances. The Conservation
144 Easement protects the trees in the ACF's Dry Oak forests from harvesting, including those that might
145 develop on previously cut ground. The Easement also require protection of ecological processes,
146 including those that sustain Dry Oak Forests. Accordingly, the ACF Management Plan avoids new trail
147 construction within **100 meters** of Dry Oak areas to allow wildlife to forage undisturbed for food within
148 them.

149 *Wetland Natural Communities*

150 Though the ACF is primarily a landscape of upland
151 natural communities, wetlands can be found in low areas,
152 narrow benches and areas of groundwater discharge.

153 Though their total acreage is relatively small, their rarity
154 in the ACF makes them much more important.



An owl watches over one of the ACF's wetlands.

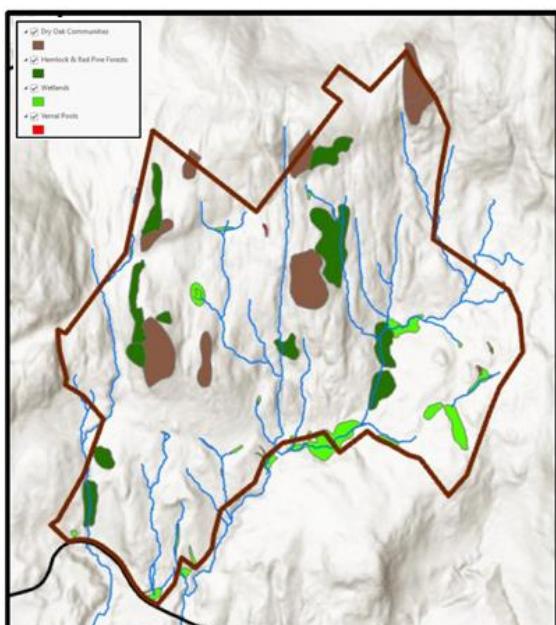
155 Two of the ACF's three Shallow Emergent Marshes are
156 on its southern border and continue off-property. Each is
157 a beaver-influenced wetland with a diverse mixture of
158 open water, herbaceous vegetation, and occasional
159 shrubs. The northern marsh sits in a scenic low area
160 surrounded by upland forests. These marshes are
161 significant for a wide range of functions and values including water quality, erosion control, and
162 floodwater attenuation. Being part of a public, conserved parcel, they also offer opportunities for
163 education and research.

164 Perhaps the most important function that they serve is that of wildlife habitat. The mosaic of open water
165 and herbaceous vegetation in a forested matrix is ideal for a wide variety of songbirds, raptors, mammals,
166 reptiles, and amphibians, especially as surrounding areas are kept relatively undisturbed by human
167 activity.

168 Seeps are small, wet areas of groundwater discharge that often form the headwaters of streams. Their
169 year-round flow of groundwater makes them among the first areas in spring to harbor green vegetation,
170 making them important for black bears and other wildlife seeking sustenance after winter's privations.
171 Certain amphibians also rely on them, including spring and two-lined salamanders. They are also
172 important for providing a cold, clean source of water for downstream surface waters and the life they
173 harbor.

174 Three seeps have been mapped to date in the ACF, but more are likely to exist. Their size and tree cover
175 make them difficult to find using aerial and satellite photography, and direct field observation remains the
176 best way to locate and assess them.

177 Also difficult to map are the Forest's vernal pools. Four have been identified to date, with two confirmed
178 and described in the Baseline Report (Diamond, 2017) while two others **still await field confirmation**. The
179 two identified to date are likely to be state-significant examples of their natural community type. Each
180 contained many hundreds of wood frog and spotted salamander eggs in what appeared to be a stable
181 breeding habitat for these and many other species. The surrounding upland landscape, though parts were
182 harvested before the Town acquired ownership, provides valuable year-round habitat for the pool's
183 breeding amphibians. **This has earned the pools special protection in the Conservation Easement, with a**
184 **100' undisturbed buffer surrounded by a 500' secondary protection zone where harvesting aimed at**
185 **enhancing amphibian habitat is allowed. The Easement also allows foot paths in the outer, 500' ring.**



The ACF's streams and wetlands, along with Hemlock (green) and Dry Oak (brown) natural communities.

The Andrews Community Forest is located within the Winooski watershed. Water from forests, fields and streams runs off into the Winooski River, which flows into Lake Champlain. Surface waters on the property include wetland natural communities (described above), three headwater streams, and two confirmed vernal pools. Maintaining forested riparian cover adjacent to these resources is vital for the protection of water quality and conservation of important aquatic habitats.

Several streams arise on and meander through the property on their way to the Winooski River and, eventually, Lake Champlain and points north to the Atlantic Ocean. Streams may flow perennially or intermittently. The ACF has three perennial streams, including the central one dropping 500 feet from a saddle on the northern boundary to the southern edge, and identified by Arrowwood as one of the Forest's major wildlife movement corridors.

205 Streams feature channels with defined beds and banks that confine low or moderate flows. Beginning at
206 the tops of stream banks are riparian areas – typically undisturbed zones of trees, shrubs, ground cover
207 plants, a duff layer, and an uneven ground surface.

208 Forested streamside riparian habitats such as those in the ACF offer a suite of ecological benefits. They
209 anchor shorelines, limit streambank erosion and filter soil and silt from stormwater run-off. This greatly
210 limits water-quality degradation during heavy rains while filtering silt from run-off that does seep
211 through. Riparian areas serve as plant and animal habitat, too, providing organic matter, nutrients, shade
212 and coarse woody debris that shelters and feeds insects, fish and amphibians.

213 Terrestrial food chains depend on streams and riparian areas as well. For example, their flowing waters
214 create microclimates that often host the first plant life to emerge in the spring. Black bears will sometimes
215 seek out these plants even while ice can still be found along the stream edges. Mink, fisher, bobcat and
216 owls follow soon behind to seek out the frogs and salamanders endemic to these areas.

217 The ACF's Conservation Easement contains strict protections for riparian areas to safeguard water quality
218 even beyond the ACF's borders. Due to their importance to many types of wildlife, this Management Plan
219 recognizes the vulnerability of riparian areas to nearby human disturbances. Avoiding construction of new
220 trail construction within **100 meters of streambanks** extends protections to the broad ecological services
221 riparian areas provide.

Species typical of the ACF's natural communities

Natural Community	Northern Hardwood Forest	Heath & A. Hardwood Forest	Heath Forest	Chlorophyll Forest	Dry Hardwood & Pine Forest	Shrub/scrub/Ham.	Scrub/scrub Forest	Scrub Forest	Natural Community	Northern Hardwood Forest	Heath & A. Hardwood Forest	Heath Forest	Dry Oak Savann.	Dry Hardwood & Pine Forest	Shrub/scrub Forest	Scrub Forest	
Associated Species									Associated Species								
American woodcock	*								N. red-sided salamander					*	*		
Barn owl	*	*	*						N. water thrush					*	*		
Black bears	*		*	*	*	*			N. leopard frogs					*		*	
Blair's vireo	*	*							N. saw-whet owl								
Blue-faced blue wrens	*								Pine warbler				*	*	*		
Blue-headed vireo	*								Poecile	*	*	*			*	*	
Birds	*	*	*	*	*	*	*	*	Raccoon					*		*	
Broad-winged hawk	*								Red squirrel					*			
Bulldogs					*				Red-breasted nuthatch								
Canada warbler						*	*		Red-eyed vireo	*							
Chipping sp.			*						Red-shouldered hawk								
Eastern red-backed salamander	*								Red-winged blackbird					*			
Eastern wood-peewee			*	*					Scarlet tanager	*							
Fishers	*		*						Spotted salamander	*	*	*					
Gray bats	*								Spring peeper				*	*			
Gray squirrels			*	*					Spring salamander					*	*		
Great blue heron			*						Swamp sparrow					*			
Green frogs			*						Turkey				*	*	*		
Hermit thrushes	*								Vireo					*	*		
Jefferson salamander			*						White-tailed deer	*			*	*	*		
Hawks			*	*					Winter wrens					*	*		
Huskies			*						Wood frogs					*			
N. dusky salamander			*	*					Wood thrushes					*			

222

223 Species-Level Elements

224 Some features of a forest that are important to its ecological integrity and biodiversity do not fit neatly into either landscape- or community-level classification. They are vital to the survival of certain species, and critical to include in any conservation plan.



Rare, Threatened and Endangered Species

To date only one such species, the broad-beech fern (left), has been found in the ACF. A patch of them was discovered during a fine-scale assessment of the proposed route for a new trail.

Bobcats, evidence of which has been found in several parts of the forest, are not considered rare, threatened or endangered, but are listed by the State of Vermont as a Species of Greatest Conservation Need. On a broader scale, they are on the list of Regional Species of Greatest Conservation Concern in the Northeastern U.S.¹ Protecting these wide-ranging species amounts to protecting forest contiguity and connectivity, and their need for wide-ranging, undisturbed places and sheltered habitat to raise their young. (See

243 Outcrops and Ledges, below.)

244 Wildlife Wintering Areas

245 Much of ACF is listed on state maps as “potential” whitetail deer
246 wintering areas, due to the extent of the forest that faces south
247 and is covered by thick stands of hemlock that ward off wind and
248 heavy snow accumulations. East- and west-facing slopes can
249 serve as wintering areas as well. To save energy when food is
250 scarce, deer will often survive by congregating in these areas
251 when snow reaches depths of 15 inches or more. These winter
252 habitats also attract bobcat, coyote, and scavenging bear and
253 fisher looking to scavenge weakened and dead deer. Other
254 animals such as conifer-nesting birds, porcupines, and fox also
255 utilize these habitats.



Hemlock grove and forest road.

256 Mast Sands

257 The seeds of shrubs and trees that provide food for wildlife are known as “mast.” “Hard mast” refers to
258 nuts such as acorns, beech nuts and butternuts, while “soft mast” is defined as berries from a variety of
259 species. Hard mast provides high-calorie food for black bears, turkey, fisher and other wildlife, and soft
260 mast such as blueberries and huckleberries are a particular favorite of black bears and birds alike.

261 As a food source for bears, *Conserving Vermont’s Natural Heritage* emphatically states in bold italics,
262 **“Simply put, these stands of beech and oak used by black bear are absolutely essential for the survival
263 and reproduction of this species in Vermont!”²** It cites research by Elowe and Rogers that found a direct

¹ Terwilliger, 2013

² Austin et. Al. P. 89

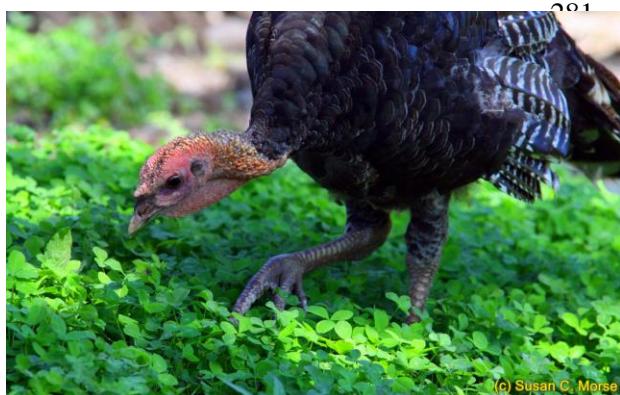
264 correlation between the availability of hard mast in the fall and the minimum reproductive age of bears,
265 productivity rates and cub survival.

266 Black bears are ecologically important to the ACF and any large forest. By spreading seeds through their
267 scat for dozens of square miles in their wanderings they are a key agent in forest regeneration and
268 diversity. (Fishers are another.)³ However, beech stands in the ACF are suffering from fatal beech bark
269 disease, along with other stands across the state. This greatly raises the importance of acorns as mast,
270 which, to provide the same amount of nutrition, must be consumed in greater quantities than beech nuts.

271 Outcrops and Ledges

272 The ACF's outcrops and ledges support a variety of natural communities and associated
273 wildlife, depending on their geological composition and aspect. Their crevices can shelter
274 porcupines, winter wrens, insects, bats and snakes. Bobcats favor ledges and small caves for
275 courting, breeding and keeping their young safe from less-nimble predators. Evidence of
276 bobcats in the ACF is not hard to come by, including, predictably, in the ledgy terrain below a
277 Dry Oak natural community no doubt rich with squirrels, chipmunks and other prey. Beyond the
278 ACF but well within bobcat range are known denning areas – among the westernmost of the
279 ACF's forest block.

280 Early Successional Forest and Shrubland



281
Wild turkey feeding on clover in sunny patch of forest. 291

Healthy forests feature trees of a variety of edges, each providing their own ecological services to the landscape as a whole. Heavy cutting, such as was conducted decades ago in the ACF, can rob forests of this diversity. Fortunately, the ACF's Forestry Plan is designed to restore this age diversity faster than wind, fire and disease would eventually accomplish on their own. Careful harvesting and patch cuts are designed to restore young forests and the food and other services they offer wildlife.

Among the beneficiaries are ruffed grouse, American woodcock, and scarlet tanagers – the

293 latter which have entertained springtime birding groups in the ACF. Another significant area of such
294 growth is found beneath the powerlines, where the utilities' regular maintenance keeps tree heights down,
295 although the methods and materials used may limit the results for some wildlife and ecological processes.

296 Wildlife Connectivity Corridors

297 The ACF's permanent and intermittent streams and its riparian areas serve as safe, convenient
298 and often food-rich routes for travel up and down a 500-foot elevation span. In unprotected
299 forests such corridors are vulnerable to fragmentation, blockage or outright destruction,
300 highlighting the importance of safeguarding the viability of those within the ACF.

³ Morse. 2023.