

Overview

The following report concludes the contract between Dr. Rick Van de Poll of Ecosystem Management Consultants and Rockywold-Deephaven Camps, Inc. (RDC) pertaining to a general ecological assessment of the RDC lands and adjoining lands owned by the Howe family. The six tasks of this ten-month contract are summarized below:

- 1) Review of hazard trees on the RDC lands
- 2) Assessment of boat usage impacts on the shorelines at RDC
- 3) Assessment of erosion concerns on RDC lands
- 4) General ecological assessment of RDC and Howe family lands
- 5) Survey and recommendations on invasive species on RDC and adjacent family lands
- 6) Written report and maps illustrating fieldwork and integration with RDC activities

Between the months of October 2006 and May 2007, a field assessment was completed of the 208.4-acre study area, which was comprised of the 104.5-acre parcels belonging to Rockywold-Deephaven (5 lots), and the 103.9-acre parcels belonging to the Howe family (8 lots). Since the above tasks primarily focused on RDC concerns, more time was spent on the 3 main lots belonging to RDC. Limited field time was spent on the small, residential lots owned by the Howe family, and then only for the purposes of establishing the extent of invasive species (Task 5) or natural community elements (Task 4).

In November of 2006, the first status report was submitted to RDC, which contained updates on the field findings and included some recommendations of immediate concern. The latter involved sediment and erosion control concerns, especially regarding Maple Shade Road and Deep Dining Hall, and invasive plant concerns on the general campus. Erosion concerns were directly addressed with Eric Morse and Bill Sharkey, and invasive plant concerns were discussed on the campus with Carol Jowdy. This status report is attached herein as Appendix C1.

In March of 2007, a second status report provided the final data on hazard trees. It included a map of their location as well as a spreadsheet with GPS data on their location. Critical hazard trees were flagged in the field and reviewed with Eric Morse, where as trees with less imminent threat (“caution trees”) were only located by GPS. Both types are described in the attached data summary table. A total of 71 trees were thus identified, the details of which can be found in this report in Appendix C2.

The following report contains a summary of findings related to the above 6 tasks, with the greatest detail on the general ecological assessment (Task 4). Methods are briefly described within each task section, and digital photographs are included to highlight salient points. Appendix A contains the final maps that support the text, some of which have already been forwarded to RDC staff. Appendix B contains all species lists, tables, and charts. Appendix C contains the status reports as described above.



Typical mature pine stand near Honeymoon and We Two cabins

Task 1 – Hazard Tree Assessment

As stated above, Task I of the Ecological Inventory and Assessment of the Rockywold-Deephaven Camps included an identification of hazard trees on the campgrounds and building areas. Appendix C2 contains the March 2007 Status Report that describes in detail the findings of this effort. It includes a citation of previous work on hazard trees at RDC, the manner in which this work was updated, and a spreadsheet of findings. The latter contained GPS data for each “hazard” or “caution” tree, the species, diameter at breast height (dbh), the nearest human structure, whether the tree was living (L) or dead (D), notes about the specific tree, and approximate rating of risk (using the 12 point scale of the 1997 report). Trees rated from 1 to 6 generally were considered “caution” trees; those rated from 7 to 12, were considered “hazard” trees.

In summary, 48 hazard and 23 caution trees were identified on the 95-acre RDC campus, most of which were white birch (20) or white pine (18). Thirteen trees were given a risk rating of 10 or higher. The distribution of trees was fairly widespread, as indicated on the attached map. Diameter at breast height (DBH) ranged from 3 to 30 inches, and averaged 13 inches for all 71 trees. Thirty-eight trees were entirely dead (D), 16 trees contained significant dead portions to be considered both living and dead (L/D), 17 trees were mostly living (L). Only three hazard trees with a pre-existing aluminum tag were found (WB #328, RP #359 and WP #368). This testifies in part to the success of the previous hazard tree management program.

The following recommendations were included in the March 2007 Status Report:

- 1) While removing the “hazard” trees, locate and identify the “caution trees.”
[Note that this step was completed on March 15, 2007]
- 2) Continue the practice of feeding and pruning prominent individuals, particularly the oaks, as a way of protecting the existing shade trees in high use areas.
- 3) Continue to test for heart rot among tall white pines.
- 4) Remove all electrical wires from existing live or dead trees.
- 5) Consider rerouting old pathways that have caused prior damage to tree roots.
- 6) Encourage more shade tolerant trees.



Cracked bole of white pine near Nuthatch. Note that heart rot isn't always as visible as this, especially among several senescent pines along the shoreline. Although all suspected heart rot trees were "sounded," this was only done at the bole. More testing needs to be done to prevent unwanted downfall.

Task 2 – Boat Usage Impact Assessment

On November 7, 2006, Eric Morse and I inspected the entire shoreline of Rockywold-Deephaven in order to identify possible signs of erosion and/or sedimentation as a result of boat traffic around RDC. Results of this tour were included in the first Status Report, attached herein as Appendix C1. Minimal signs of human-caused erosion were recorded during this survey. It was noted that on all west and north-facing shorelines wind-borne waves were the dominant causal factor of any sand or rocky shore erosion. Deephaven Bight and the eastern shore of Deephaven were not as subject to such wave action, yet little to no sign of boat-caused erosion was noticed. Isolated evidence of erosion and siltation were noted around the main boat house, Deep Dining dock and the main Deep dock. The latter two structures were to be repaired and improved this past spring with the intention of improving dock structure and deep water access.



Canoeists off the east shore of Deephaven



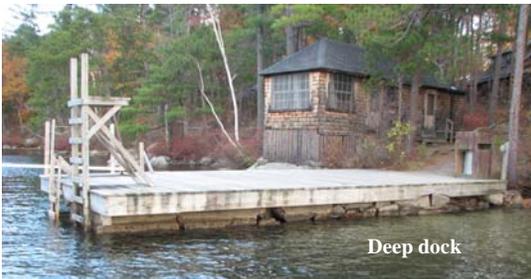
Motor boats are common at RDC in the summer

The only sign of direct damage from boat traffic was in the shallow cove from Easterleigh to Brae Cove. Several prop ruts were observed in the silty, vegetated bottom. Minimal shoreline erosion was also noted in this area between two of the summer docks near Easterleigh. It was difficult to determine whether or not this was a direct result of boat traffic, however.



“Flag” trees on Deephaven Point help indicate the dominant wind direction (north and west); signs of erosion on these shorelines appeared to be entirely from wind and ice. Leeward shorelines, such as near Easterleigh at right, may be more subject to periodic wave erosion from boats, although no definitive sign of boat damage was observed.

On the whole, Rockywold-Deephaven has kept lakeshore erosion and siltation to a bare minimum. Considering the amount of traffic and usage at the main docks, the boat house, and boat ramp, the shoreline has remained remarkably pristine.



Deep dock



Deep End inflow

Rockywold-Deephaven Final Report

Task 3 – Assessment of Erosion Concerns

Status Report 1 of November 30, 2006 contains a description of the erosion assessment work of the fall of 2006. Two areas of concern were noted in the report, namely, Deep Dining Hall and Maple Shade Road. After reviewing the two sites with RDC staff and coming up with several recommendations, work was begun immediately to remedy both situations. The result included a new drop basin and culvert at Deep Dining Hall that has effectively rerouted surface water and sediments away from washing onto Deep Dining Dock. The new culvert alignment moves water that drops into the drain in front of Deep Dining Hall onto a boulder-filled slope below the Hall.



Deep Dining Hall showing drop basin in center



Deep Dining Hall before construction of culvert

At Maple Shade Road, new ditch diverters were dug, a pavement waterbar was repaired, and the north side ditch was cleaned out and repaired down to the Sugarbush driveway. The lateral roadside ditch below the woodshed drive was also cleaned out by RDC staff. Although I have not been back since late winter to determine if other repairs were made, it was suggested that deeper roadside ditches be dug, a lateral diversion ditch be dug just below the woodshed drive, and a water bar, diversion underdrain, or road crown be emplaced at the bottom of Maple Shade in order to divert surface sheet flow from directing water into Haskell trails. A drop-basin was also suggested just above Shore Edge to dissipate the energy of a culvert under the driveway to Sugarbush.



Maple Shade from below showing sheet flow evidence; (R) Maple Shade from above looking to lake



Left: cleaned out ditches on north side of Maple Shade Rd. Right: recent rainwater siltation above We Two that requires single water bar.



Other erosion concerns were more localized. Some evidence of sheet flow and surface water accumulation was noted above We Two as depicted above right. A single water bar should take care of this problem by redirecting water away from the social trail that leads to We Two. Additional sedimentation was noted along the drive below Park. Water running down this drive has accumulated at the bend and made for soft ground that has been impacted by heavy equipment. Channelizing this ditch may improve surface integrity during high water table times of year. Very limited erosion and sedimentation was noted along several trails leading to the water on the west shore of RDC, such as below Sugarbush and at the steps above Ardenwood. Since no significant inflows of sediment were noted (except at Haskell as noted above below Maple Shade Road), it appears that the periodic accumulations into the lake are minor and do not require immediate attention. The same can be said of the Rock boat ramp area and the Deep Dock, although I have not inspected the latter since the dock footing was rebuilt.

In sum, the erosion concerns at RDC appear to be under control. The most pressing problems have been addressed, and all significant inflows into the lake have been reviewed and accounted for. Lesser inflows include the old dump below the Main Office that sits adjacent to the forested wetland and stream leading into the lake at Deep End. It appears that the wetland is currently providing the remediation necessary to prevent any downstream sediment or BOD problems. Salt run-off does not appear to be a problem anywhere on campus since it is not applied, and what little is used on Pinehurst Road runs off into forested wetlands prior to discharging into the lake. Aside from the brief suggestions mentioned above regarding localized erosion concerns, it is recommended that surface water inflows into the lake that pass through the RDC campus be tested periodically for the standard array of water quality indicators, such as pH, dissolved oxygen, biological oxygen demand (BOD), conductivity, chlorides, total nitrogen (TN), total phosphorus (TP), E. coli, and fecal coliform. This should be done on a 5-year basis unless conditions warrant more frequent testing.



A remarkably intact wetland system just feet away from one of the busiest sites at RDC

Task 4 – Ecological Assessment

The unique history of land use at Rockywold-Deephaven Camps has proffered a relatively intact ecological condition over time. This has had as much to do with the progenitors of RDC as with the prevailing attitudes of the Directors that have succeeded them. Beginning with the land clearing and agricultural activities of the late 18th and early 19th centuries, the land has followed the path of many shoreline properties on Squam Lake with one notable exception: it has been the summer home and vacation spot for thousands of *short-term* residents in the most densely populated residence facility on the lake. In contrast with some of the old family estates of Squam Lake, Rockywold-Deephaven has catered to residents who stay only brief periods of time in close proximity to one another. The design and planning required to maintain this level of land use in such a concentrated area has been remarkably astute and attentive. The single greatest testament to this feat is the way in which the natural ecology of the landscape has been allowed to flourish within and around the Camp itself.

Nowhere is this more evident than within the lakeshore zone as demarcated on the attached map. The number and stature of mature white and red pines within the areas designated as the “Lakeshore Pine Forest/Woodland” is impressive. In spite of thousands of residents’ feet trampling these areas over 110 years time, most of the canopy has remained intact without significant root zone compaction. The major difference, as depicted below, is the amount of understory vegetation, which has either been suppressed by foot traffic or kept out by regular maintenance activities. Since white and red pines live to over 250 years old, and since most of the pines date back to the beginning of the

camp or perhaps a little earlier (110 – 130 years old), it appears that this condition of stately pines along a rocky shoreline should remain for many decades to come.



Park-like pine stand near Deep Point

More congested but 'natural' understory at Needle Point

Most of the adjacent Howe family lands have also undergone relatively minor alterations since initial settlement and pasturage. Open fields have been maintained on the northwest slopes of West Rattlesnake, although most of the prior pasture areas have reverted to woodland. This is particularly true for the wetland areas as depicted on the attached natural communities map. Other areas have been logged for post-pasture white pine, some of which had attained sub-mature size prior to harvest. More recent pasture release areas have only just come into sawlog size, such as on the northernmost lot owned by the Howe family.

A total of 7 natural community types were found on the Rockywold-Deephaven and Howe family lands. The most common type, as depicted on the attached map in green, is the **Hemlock-Beech-Oak-Pine** type. This forest community, as described above, has had a variety of land use activities subjected to it, and therefore is in a variety of successional states. Most of the forest on the main campus is mid-successional, and corresponds with the approximate age of the camp itself. Aside from the multitude of trails, parking areas, roads, and cabins that dot the campus, this forest has sustained itself fairly well over time. The accompanying report on hazard trees indicates that a relatively small percentage of the forest is senescent, and that most of the indicators of age – e.g. the mature and dying white birch, are part of the natural cycle of succession rather than human-cause stand degradation.

The **Hemlock-Beech-Oak-Pine** forest varies from hemlock dominance in cooler, wetter soils that have a high water table, to a red oak forest on dry, stony, shallow soils. The beech component tends to associate well with hemlock, although they prefer slightly drier soils, and the pine element associates well with oak, although pines prefer coarser (sandy) soils, such as along the lakeshore. On the drier side of this very common forest type in New Hampshire, the forest becomes a **Dry Pine-Oak Forest/Woodland** as is apparent on the mid and upper slopes of West Rattlesnake (see attached map). On the cooler and wetter side, this forest becomes a pure **Hemlock Forest** (as at the end of Deephaven Bight), or a mixed wetland forest such as the one behind Rock Office.



Typical Hemlock-Beech-Oak-Pine forest on the RDC campus near Montvert

The second most common natural community on the RDC and Howe lands was the **Dry Oak-Pine Forest/Woodland**. In the *Natural Communities of New Hampshire* Guide by Spurduto and Nichols (2004), the forest is separated from the woodland by the amount of canopy closure – i.e. canopies that exceed 60% closure are defined as **forests** and those that are less than that are called **woodlands**. On the RDC lands most of the Dry Oak-Pine natural community is in the forested state, although not far away on the lower slopes of West Rattlesnake this community is in the woodland state. The latter includes the 4-acre patch of old growth woodland that is comprised of 250+ year-old red oaks and 175 – 200 year old white pines. Several red pines of venerable age also mix in with the white pines, especially near the boundary between two of the Howe family lots.

The old growth area that lies on West Rattlesnake does not enter RDC land proper, although the Ramsey Trail bisects it nicely for those wishing to see an excellent example of a **Dry Oak-Pine Woodland** in a late successional state. Along this trail are several areas where this community grades into a **Red Oak-Pine Rocky Ridge** community where even less canopy and more shrubs and herbaceous plants are present. In certain areas on this slope, calcium-rich soils sport an enriched plant community where rare plants abound. The **Semi-Rich Appalachian Oak-Sugar Maple Forest** is rare in the state, and the old growth condition as is present on West Rattlesnake occurs in only a handful of sites. Some of the plant indicators for this community are shown below. The hepatica was the indicator species for the single semi-rich natural community on the RDC property near Sugarbush. In this case, toe slope seepage of calcium-rich groundwater has created a small pocket of nutrient-loving plants. This is the primary reason for the occurrence of sugar maple in this vicinity, hence the need for a sap house and a properly named cabin nearby.



Round-leaved campanula (harebell) on left, growing from a syenite outcrop along Pinehurst Road in October. This uncommon plant is an excellent indicator of soil enrichment by calcium. Round-leaved hepatica (right) also occurs on 'sweeter' soils, and occurs in the semi-rich plant community just behind Sugarbush. Both are common on West Rattlesnake and can be seen along the Ramsey Trail.



Old growth red oak woodland (L) and red pine (R) at the Howe property boundary.

Wetlands occur on approximately 7% of the RDC and Howe family properties. This is below average for the area, but not unexpected given the fairly steep side slopes below West Rattlesnake. Most of the wetlands are forested, and occur in shallow drainageways that lead into Squam Lake. The largest is on the Thomas A. Howe lot south of Pinehurst Road. This drainage contains some enrichment from the surrounding slopes and therefore has a lot of white ash mixed in with red maple. Prior pasturage has also altered the soil chemistry by the introduction of earthworms in the upper soil horizons. Fine textured, mesic soils such as occurs here tend to regenerate to white ash and red maple along

otherwise stony drainageways. The proliferation of the invasive, Morrow's honeysuckle is another good indicator for this condition being present.

The second principal drainageway in the study area bisects Rockywold itself and runs from the sewage treatment area down towards the old dump and then onto Deep End near the eastern property boundary on Squam Lake. This drainage has been significantly altered by past land use activities, and is perhaps the most impaired natural community on the RDC properties. It has a very high dominance of invasive plant species such as the aforementioned Morrow's honeysuckle as well as the largest stand of Japanese knotweed. The upper part has been excavated for a tertiary treatment pond below the main sewage pool, and the mid-section has been filled in part for (now) staff dormitories. The impoundment along the delivery entrance road is choked with duckweed in the summer, and strong evidence of water quality impairment is in evidence in the forest wetland downstream. Remarkably, the water running in to Squam Lake has been filtered of most sediments and bacteria by the time it passes through this wetland, although I did not complete any water testing to determine if any other transparent nutrients of concern (such as phosphorus or nitrogen) is being carried through this wetland.



Sewage treatment pool at the head of the main drainageway that bisects RDC property

Over 80% of the RDC land contains natural communities in a mid to late successional state. In spite of some of the areas of impairment as noted above, this was a surprising finding of this investigator. The quality of the lakeshore forest, the remnant natural area on Needle Point, and the old growth communities on the toe slopes of West Rattlesnake were impressive. On RDC property campus management has been sensitive to leaving a well-developed canopy intact and special emphasis has been placed on retaining the residual forest. Whereas this has spawned a few problems such as remnant white birches that are being shaded out by the taller white pines and red oaks, on the whole the grounds management has been effective for meeting the spirit and principle of the camp itself. On the Howe family lands, this has been adhered to as well, although younger forests, scattered field and woodlands, and post-pasture wetlands have yielded more of the typical “trademarks” of previous commerce-based silviculture and agriculture. Both sites have been subject to repeated and regular disturbance by humans, however, and as a result, both areas contain a high percentage of non-native and invasive plant species. The following section addresses this concern.

Task 5 – Invasive Plants

Most of the initial data on invasive plant species has been already presented in Status Report #1. The accompanying map of invasive plant locations on the RDC properties has been modified somewhat from the original one that was submitted in November of 2006, and illustrates the presence of 12 invasive plant species at 131 locations as noted by GPS. The clear “winner” of this parade of invasive plant species was **Morrow’s Honeysuckle**. Located at 55% of the invasive plant stations, this woody shrub can be seen from nearly any locale on the RDC campus. In fact, the only location where this plant was not in evidence was in the Natural Area on Needle Point. (With the exception of a single trail out to Needle Point, this natural area lacks any immediate disturbance and is a testament to how these invasives require disturbance in order to proliferate).



Morrow’s honeysuckle in typical form. At right, note its presence at the edge of a wetland

Keystone features of this plant is its indifference to soils conditions, its ability to set fruit at an early age, its attractiveness to birds that act as dispersal agents, and its ability to stump sprout after being damaged. This European native has been in the United States for nearly two centuries and is widespread throughout the East. At RDC it occurs throughout the campus and ranges in height from a few inches to several feet. The most impressive plant is found next to Rock Housekeeping. About the only redeeming quality of this plant (aside from its sweet nectar that bee’s love), is its ability to be root-pulled as a means of control.

Root pulling is not easily accomplished with the second-most common invasive plant species at RDC – **autumn olive**. With 29 separate stations, it is also widespread throughout the campus (as it is in the East), and it also gets spread quite easily by birds that are drawn to the juicy sweet pulp of the fruit. The most “impressive” stands of this plant were found near the woodshed/burn pile and along the trail back from Deephaven behind Mutt and Jeff. Individual plants exceed 15 feet in height in these instances, with stems exceeding 3 inches in diameter. Backhoe removal and continual pulling of resultant suckers is the recommended approach for control. With the exception of the above two locales, many of the autumn olive stations can be managed by root pulling the entire plant.



Autumn olive (*Eleagnus umbellata*) at the woodshed opening off Maple Shade Road. Limb cutting and backhoe pulling is required for such large individuals. Smaller ones can be hand-pulled, but resistant roots will take hold again if left alone.

The remaining invasive plant species were much less common, although in some cases no less pernicious. **Bittersweet** is perhaps the most aggressive vine in the New England woods. It has taken off from its Eurasian origins to become the most dominant roadside plant in southern New England and the central Appalachian states. Another widely planted ornamental that has gone well beyond the landscapes of intention, this weedy vine has roots that are bright orange (therefore very easy to see when pulling) but which penetrate very deeply into the soil. Root-pulling this plant is nearly futile as the roots break off easily and resprout for years even after repeated pulling. As stated in the first Status Report, chemical treatment of the cut stems is about the only way to ensure permanent demise. Fortunately, larger individuals seem to outcompete smaller ones and after several years only a few ground to canopy stems will remain in a particularly locale.

This makes the job of cutting and painting with Round-up™ a little easier. At Rockywold, many of the 9 bittersweet station recorded involve small to medium size patches so single stem cutting is not as easily accomplished. While the smaller, more numerous stems are more difficult to isolate at the ground level, their root systems are smaller and will react more positively to chemical treatment.



Bittersweet (*Celastrus orbiculatus*) near the RDC entrance

Several of the other invasive plant species observed were probably more common than recorded. This was likely true of **European barberry** (*Berberis vulgaris*) and **Japanese barberry** (*Berberis thunbergii*). Both plants occur in semi-shaded woodlands where prior disturbance was slight to moderate. This includes places where simple pasturing of livestock and selective harvesting of timber took place. Whereas European barberry was largely eradicated in the last century as an intermediate host of the wheat rust, it has come back with increasing regularity alongside its look-alike cousin of eastern Asia, Japanese barberry. The latter tends to occur in more developed and highly disturbed landscapes and can be separated from European barberry by its more lustrous, chestnut-colored stems, more compact growth habit, mostly unbranched thorns, and smaller fruit clusters. Both species can be root-pulled with much greater effectiveness than bittersweet. Like the latter plant, the roots are quite visible (bright yellow), but unlike bittersweet, the roots do not persist as long after pulling, especially if the plant is small.



Areas of high disturbance correlate well with the occurrence of invasive plant species. Certain locales at RDC have had invasive species growing for quite some time, as indicated by the size and frequency of the several species. The regularly cut electric and telephone line corridor (above left) has a solid understory of bittersweet, Morrow's honeysuckle and autumn olive. The Rock Housekeeping cottage (above right) has the largest and apparently oldest honeysuckle on the property.

Coltsfoot (*Tussilago farfara*) is also likely more common than detected. A very common roadside plant, this European species is perhaps best known as a former remedy for coughs and colds (aka the *tuss* part of *Pertussin*). Its large, palmately lobed leaves are bright green above and felty white beneath. It was found along the delivery road and behind the relatively new residence halls nearby. It prefers disturbed wetlands, particularly in sandy soils. With a deep rootstock, this plant is very difficult to get rid of by pulling or chemicals. Since it usually inhabits open ground with little vegetation, the best treatment is often to let other taller plants outcompete it over time. In small populations, such as behind the residence dorms, repeated pulling may be effective for eradication.

Japanese knotweed (*Falopia japonica*) was only located in three locales, but in one locale it appears to be a permanent fixture. The small population at the parking lot edge above We Two could be removed with a backhoe and possibly eliminated from that site. The two discrete populations at the old dump site south of the delivery road is another matter, however. This very vigorous stand sits atop untold amounts of debris dating back

probably one hundred years (Bill Sharkey p.c.) and cannot easily be removed by root pulling. Chemical applications have also proven temporary for this species; besides, the application of even a 3-day half-life chemical like Round-Up™ is not advised so near a waterway that feeds directly into Squam Lake. In this particular case, no action is recommended except for the old dump site to naturally succeed to a forest that will hopefully eliminate the populations by shading.

Garlic mustard (*Alliaria petiolaria*), **black locust** (*Robinia pseudoacacia*), **multiflora rose** (*Rosa multiflora*), and **tall sweet clover** (*Melilotus alba*) were all found in sparse amounts on the RDC property. With good fortune, these populations can be eradicated from the RDC campus by hand-pulling and/or chemical treatment. Garlic mustard was only located in the compost leaf piles behind the maintenance garage and could be hand-pulled, particularly *before* the flowers develop and set seed. Black locust was found in



two isolated locales near the dump pile up behind the residence dorms near Pinehurst Road. These saplings could be cut at the base and treated with Round-up©. The single multiflora rose was at the edge of the woodshed opening and could be pulled by backhoe and/or by hand. The tall sweet clover, a fairly non-persistent invasive common along road and trail sides, was found in one locale behind High Pines at a small dump pile. This population was hand-pulled at the time of discovery and has not yet returned.

Garlic mustard still green in November.

The only other species recorded as an invasive was **reed canary grass** (*Phalaris arundinacea*). This very widespread, weedy grass from South America has proliferated open wetlands, roadsides, and dumping grounds for several decades. It grows rhizomatously, and is very difficult to eradicate either by pulling or by chemical treatment. The small populations at RDC may be able to be hand-pulled, but will require repeated pulling over several years time. This plant also reproduces by seed that is wind and animal dispersed, making it very difficult to control once a vigorous population has become established. Sometimes surface scraping and planting of vigorous native groundcover can eliminate a population of this species. Like knotweed, it will be outcompeted by developing shade-loving plants over time.



Howe family meadow in winter

Although the focus of the invasive plant effort was on the RDC campus, the Howe Family lands were also surveyed for invasive species occurrences. As with Rockywold, this landscape has been altered for over 200 years and shows these effects through the presence of several invasive plant species. All of the above 12 species of invasives were noted on these parcels, with the notable occurrence of dense stands of Morrow's honeysuckle in the floodplain wetland on the Thomas A. Howe lot south of Pinehurst Road. The combination of sweeter, fine-textured soils and prior agricultural disturbance has created a perfect growing medium for this pernicious plant. This is perhaps the best locale to witness the dramatic effects of an exotic plant outcompeting native groundcover.

Similarly, several of the hedgerows along the main field north of Pinehurst Road exhibit an unprecedented growth of bittersweet vine. This species is present all the way along the roadside to Route 113, and makes appearances on the south side of the road as far as the main entrance to Rockywold. Whereas roadside occurrences of this plant provide good cover for wildlife and does not appear to eliminate shade-tolerant tree growth beneath it, dense stands of this vine will creep into the main canopy, take it down with successive weight loads and thereby create more habitat for itself in the new edge it has created. Without eradication it will eventually look like the interstate system in most of Pennsylvania, New York, Connecticut, Rhode Island and Eastern Massachusetts.



Mt. Webster from the open ledges and old growth area on the northwest slope of West Rattlesnake

Some Findings Relative to Wildlife

The period of winter snow was conducive for tracking the sign of wild mammals at the RDC and Howe family lands. This was a period of relative inactivity for RDC residents, and the return of cold weather and icy conditions likely brought back the larger mammal species that are otherwise thwarted by intense summer activity. **Red fox** probably outnumbered all of the other carnivores 2:1, and tracks, scat, scent marks, tunneling, and den excavations were found in a wide area. Red fox trails tended to follow existing roads and trails that were infrequently used by humans. A regular scouting path also followed the main shoreline and associated cabins where red squirrels, chipmunks, mice and other

small rodents had taken up residence. While RDC is well-known for its small mammal population support (over 100 cabins to choose from!) this past year has been a bumper year for all microtines and cricetids. Related studies in nearby areas on the Squam Range yielded a record number of track intercepts of deer mice, white-footed mice, red-backed voles, masked shrews, short-tailed shrews, chipmunks, red squirrels and gray squirrels. By rough estimates, it appears that virtually all of the small rodentia benefitted from the mild winter, abundant food supply, lack of early snow cover, and slightly depressed predator numbers.



Red fox tracks next to deer browse – West Rattlesnake along boundary



Fisher tracks along Undercut Trail. Note typical 1-2-1 pattern



Coyote tracks along Howe driveway. [6" rule for scale]

Coyotes traveled throughout the RDC campus area and Howe Family parcels. Trails that followed deer were common along the north and west base of Rattlesnake, and the Undercut Trail and Arthurs Way were used regularly. Although there were fewer tracks in the busier locales near the winter office, inshore ice always contained sign of this wide-ranging predator. At least two individuals reside in the study area and use these lands as part of their regular hunting and breeding territory.

Gray fox was only recorded during one day near Rock Office and on Arthur's Way, although I suspect that they regularly visit the "mouse palaces" by night throughout the year. This woodland species has enough broken habitat on the Rattlesnakes to supply them with ample feeding, rearing and roaming territory. Some competition is likely

afforded by the resident domestic canine population in winter, although most dog activity is by day and not by night. Other competitors for the small mammal prey base included **raccoons**, whose evidence was found along all of the main wetland drainages and near most dumping grounds. A skull was found by one of the local canine residents near Kilkare, perhaps a previous trapping victim. **Fisher**, whose numbers were lower than usual this past winter, were regularly found at the base of West Rattlesnake near the RDC boundary. The mix of hemlock, pine and oak cover near talus boulder dens provided excellent habitat for hunting their favorite prey, **porcupine**. The latter species was resident under the House of Tudor, and natural den evidence was noted in the old growth area (see above photo Page 11). It is likely that several other individuals inhabit the RDC grounds, since there are ample opportunities for shelter at least on a temporary basis.

This survey was not completed when breeding bird species were present on the grounds, however, several of the typical winter resident species were noted, such as blue jay, black-capped chickadee, tufted titmouse, brown creeper, golden-crowned kinglet, red-breasted nuthatch, white-breasted nuthatch, hairy woodpecker, downy woodpecker, common raven, and American crow. Given the mildness of the winter, an unusually high number of American robins were present well into January. Brown-headed cowbird was also heard well into December, and on January 6th, a red-bellied woodpecker offered its characteristic call from an oak near the main entrance. This 'southern' bird has been increasing in recent years, and has made it onto the regional Christmas Bird Count several times in the last decade. Cedar waxwings, winter wrens, and a singing **spring peeper** also made the 58 degree F. day on January 6th a day to remember!



Hairy woodpecker on white ash near Rock Dining. "Shelter" at right = mouse palace?

SUMMARY & CONCLUSIONS

A great deal of anecdotal information has been gathered about Rockywold-Deephaven over the years, some of which supports the above general assessment that I have completed about RDC and the adjacent Howe Family lands. Most notably, visitors have remarked to me numerous times how pristine and quiet they find the RDC campus and surrounding area. Indeed, the old growth forest that sits adjacent to the RDC lands, the 160+ year-old pasture regrowth area of Five Finger Point, and the unfettered open expanse of Squam Lake seem enough to cast a visible façade of “untrammelled nature” for the immediate area. Late successional forests of stately pines, ancient hemlocks and sugar maples, wind-swept red pines that cling to lichen-studded boulders all have the appearance of a place that ‘time forgot.’



Needle Point in winter

Yet Rockywold is hardly a place that is “forgotten,” and thousands of visitors every year have brought the above concerns about erosion, sedimentation and invasive species to light. It is clear that Rockywold-Deephaven, having undergone over a century of intensive land use, exhibits a few minor but persistent signs of disturbance and overuse.

Whereas the above report summarizes the specific concerns, a few more generalized comments are warranted. The campus itself sits within a maturing forest of pines, hemlocks, and mixed hardwoods. The natural aging of this forest will continue to see the demise of a few understory and/or shade-intolerant species such as white and gray birch. Even the white and red pines are not as long-lived as the hemlocks and oaks, and over time they will senesce and fall, to be replaced by more shade tolerant species. The continued use of pathways between the camp buildings will accelerate this aging process, by compacting soils and preventing the absorption of water and nutrients. This has already occurred in several locations, although on the whole, it has been a minor problem



to date. The only locale where pines will likely continue to dominate the canopy is along the lakeshore as described above and as depicted on the enclosed map of natural communities. In these areas, natural wind “pruning” and root stress caused by severe soil desiccation will actually strengthen the root systems beneath small stems and canopies. Eventual loss of these lakeshore individuals will likely be replaced by similar species – i.e. red or white pine. Careful monitoring of the forest areas of Rockywold will be required on a yearly basis in order to maintain vigor and eliminate hazardous trees that threaten life or property.

Left: Needle Point showing red pines gnarled by wind

Annual maintenance of the grounds will also be required for the eventual elimination of invasive or weedy plant species. Some species, as described above, will require yearly root-pulling, while others will require yearly cutting and careful applications of herbicide. For most of the 12 species discussed above under Task 5, complete elimination is possible with persistent and conscientious effort. For a few, however, “management” is the best solution, that is, careful control of individual populations to prevent further spread onto RDC lands. The latter is true for bittersweet, Japanese knotweed, and reed canary grass. Given the tremendous source population for Morrow’s honeysuckle on the adjacent Howe family lands, this may also be true for this species as well.

The general ecology of RDC and the surrounding area is one of remarkable diversity and richness. The adjacent ring dike remnant of syenite on West and East Rattlesnake has endowed the soil fraction with above-average nutrients in which “sweet soil” loving plants thrive. The presence of hepatica, Back’s sedge, columbine, and wood betony



testifies to the presence of sub-acidic to slightly calcareous bedrock and soils. A secondary consequence of this uncommon condition is a tremendous growth potential among woody plants. The towering sugar maples along the Undercut Trail and the vigorous maple stems behind Sugarbush are responding to this condition. It would be of interest to watch as these vigorous trees respond to changing climatic conditions that portend a rapid demise of sugar maples in the Northeast.

Schist (below) and granite contact ledge beneath Peter Pan. The lower formation contains high amounts of plagioclase feldspar, a mineral rich in calcium.



Left: Bruce Whetmore at Carl Hansen’s ‘state-of-the-art’ water collection and distribution system. Right: The ‘Sugar Shack’ environmental education building is a collaborative facility that serves both RDC and the Squam Lakes Natural Science Center.

Lastly, it is only appropriate to recognize and honor the continuing careful management of the Rockywold-Deephaven lands by previous and current owners and staff. Clearly this very public resource has had a unique history of thoughtful and deliberate management, yet its success has been carried by individuals, and not simply the management plans that Directors or Board members have crafted on paper. The pride with which the campus was described to me during the initial field surveys was both palpable and evident in the condition of the grounds and adjacent forest. Whether it was the largest and most innovative sewage treatment system on Squam, or the food waste composters, or the under-sized boat ramp, or the well-run boat house and dock maintenance regimes, each aspect of the RDC campus bore the signs of “intelligent tinkering.” It is in this spirit that I wish for the above results and data to be of use to future ‘Rockywolders’ so that the existing high quality habitat and ecology can persevere throughout the next 100 years of use and appreciation.



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