ROW Vegetation Changes Over Four Treatment Cycles, IVM Controls the Growth of Non-Compatible Trees

James Kooser, Kendra Gorski, Lana Khitrik, Donald Coogan, Lewis Payne, John Gwozdz, and Paul Breier

Since the late 1990's, the New York Power Authority (NYPA), assisted by staff from Gomez and Sullivan and Terrestrial Ecological Services, has used Integrated Vegetation Management (IVM) principles to guide their vegetation management program on their 1400 miles of transmission lines rights-of-way. We present the changes observed in plant communities across NYPA's transmission system following four cycles of IVM treatments. Data from the initial field surveys (1999 - 2002) showed medium to high density (1,000 - > 3,000 stems per acre). Non-compatible stands occupied 18%, while stands with low densities of non-compatibles (0 - 1,000 stems per acre) occupied 50%, of the total acreage. Data taken after four treatment cycles (2011 - 2014) indicate that medium to high density had been reduced to 6% while the percentage of low density non-compatibles had been increased to 70%. Reductions in the heights of non-compatible species have also been noted. Preliminary surveys showed 41% of the non-compatible tree heights to be 0-10ft; trees 11ft or greater occupied 26% of the acreage. After four treatment cycles, 68% of the acreage had non-compatible tree heights at 0-10ft, and the taller trees (11ft or greater) occupied only 8% of the total acres surveyed. Areal coverage of compatible plant species has increased, throughout the ROW corridors, a direct result of the application of IVM principles.

Keywords: Compatible density, Geographical Information System, Integrated Vegetation Management (IVM), New York Power Authority (NYPA), Non-compatible density, Right-of-Way (ROW), Vegetation Management.

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INTRODUCTION

ANSI (2006) defines Integrated Vegetation Management (IVM) as: "a system of managing plant communities in which compatible and incompatible vegetation is identified, action thresholds are considered, control methods are evaluated, and selected control(s) are implemented to achieve a specific objective. Choice of control methods is based on effectiveness, environmental impact, site characteristics, safety, security and economics". IVM is a strategy that uses a variety of techniques to manage the ecology of rights-of-way (ROW) in such a way that species not compatible with the purpose of the ROW are discouraged from growing. For high-voltage electric transmission lines, tall trees that may grow to encroach upon the wire security zone (generally an area of approximately 15 feet around the electric conductor) constitute the non-compatible species. IVM uses biological, physical, chemical and cultural techniques to control the growth of tall trees and encourage the growth of low growing species. The recognition that ROWs dominated by dense communities of native, low growing species safely and reliably transmit electricity and that the careful selective removal of non-compatible species can achieve the desired stable plant communities, has long been known (Egler 1953, Niering and Egler 1955, Niering 1958). New York State regulations have since 1980 included this selective vegetation management approach (Jackson 1997, McLoughlin 2002).

Clearly, implementing IVM requires a knowledge of the species that are compatible and not compatible with the reliable transmission of electricity (Nowack and Ballard 2005). A thorough inventory should identify the species, heights and densities of both the target, non-compatible species to be treated, and also identify the compatible species whose growth is to be encouraged. Treatment prescriptions must be tailored to these specific site conditions to meet the IVM goals (Alkiewicz et al. 2002).

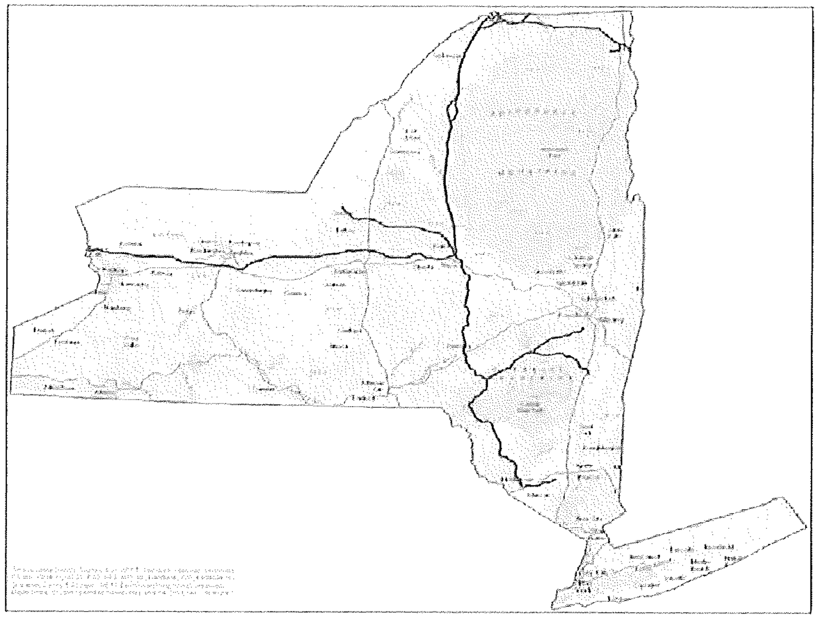

Figure 1. NYPA's Electric Transmission System.

Regularly repeated inventories also have the advantage of providing records of change over time along ROWs. In this paper, we present data gathered from 1999 through 2014 over the New York Power Authority's (NYPA) transmission system.

METHODS

STUDY AREA

NYPA operates 1400-mile electrical transmission right-of-way (ROW) corridor throughout New York State (Figure 1). New York is a large state, and terrain and therefore dominant plant communities vary widely across the system. Relatively flat glacial plains occur around Lakes Erie and Ontario, and along the St. Lawrence River. Major North to South lines skirt the edges of the Adirondack Mountains, and cut through the Catskill Mountains. Forest types range from northern hardwoods to forests dominated by more southern Appalachian species. Wetlands, rivers, lakes and streams abound.

DATA COLLECTION – VARIABLES, METHODS AND INSTRUMENTS

Since 1999, a collaborative team of ecologists has conducted annual inventories on roughly one quarter of NYPA's transmission lines each year. The team has surveyed the entire system four times between 1999 and 2014. The ROW environmental inventory consists of field evaluations, data collection, and mapping. The field crews are made up of two experienced ecologists who travel the length of the ROW to be studied using All Terrain Vehicles (ATVs). The data are collected on a field computer containing an ArcGIS field application and a GPS receiver. Field computers are loaded with digital orthophotos covering the lines being studied during the survey. Additional data on the computers include the following:

- ROW boundaries,
- roads,
- property boundaries and other planimetric data,
- special condition areas (these include steep slopes, areas where permission must be secured prior to entering the site, land owner

preferences, etc.),

- hydrography,
- National Wetland Inventory (NWI) and NY state wetland mapping,
- and the results of surveys from the last time the current line was surveyed.

The field crews map areas of uniform vegetation cover type, with cover type classified following New York's LUNR classification (New York State Office of Planning Services 1972). The individual sites are delineated by polygons based upon a combination of land use, cover type, and the densities and heights of non-compatible species. Table 1 shows the vegetation attributes collected for each site. The four dominant compatible and non-compatible species are recorded. Dominance is visually estimated by the field crews as the frequency of occurrence within the polygon. The density of non-compatible species is expressed in discrete categories indicating ranges in the number of stems per acre (Table 2), which are visually estimated by the field crews. In 1999 and 2000, field crews used only the High, Medium and Low densities. While analyzing the data from these two years, NYPA staff and the field crews realized that many polygons had densities much lower than 500 stems/acre. Two new categories, Very Low and Ultra Low were created in 2000, for use during the 2001 field work, to more precisely describe conditions seen in the field (Table 2). The average height of all non-compatible species is visually estimated. The density of compatible species is expressed in terms of percent cover visually estimated within the polygon being mapped. These are the primary data used to determine treatments required. Additional information collected during the surveys includes land use within an area 100 feet on either side of the ROW boundary, tall trees on the ROW, danger trees (trees growing off the ROW that are tall enough to cross the wire security zone should they fall), special conditions such as steep slopes or landowner preferences for access or treatment, the locations of utilities from other companies that cross the ROW, and other information requested by NYPA.

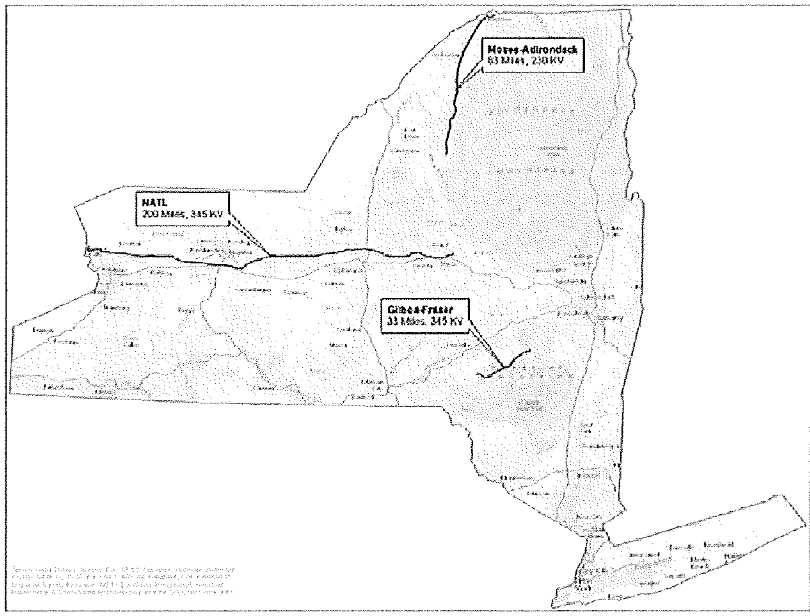

Figure 2. NYPA's NATL, MA and GF Transmission Lines.

DATA ANALYSIS

For this paper, we analyzed data from three major transmission lines operated by NYPA (Figure 2), and summarized data for the entire system (Figure 1). The three major lines analyzed were the following.

- Niagara-Adirondack Tie Line (NATL). Approximately 200 miles of a 300 foot wide ROW, mostly carrying two circuits on steel structures, transmitting 345 kV. The line runs east-west from near Niagara Falls to Marcy, NY, and crosses a large glacial plain with woodlands, wetlands, an abundance of farmland, rivers, streams and wetlands and large urban areas.
- Moses-Adirondack (MA). Approximately 83 miles of a 250 foot wide ROW, mostly carrying two circuits on wooden structures, transmitting 230 kV. The line runs generally north-south from Massena to Croghan, NY, and crosses broad, flat plains with numerous wetlands in the north, transition to hillier, wooded areas in the south.
- Gilboa-Frasier (GF). Approximately 33 miles of a 400 foot wide ROW carrying a single circuit on steel and wooden structures, transmitting 345 kV. The line runs east-west from Gilboa to Fraser, NY, crossing a rugged area of steep, wooded mountains.

We undertook this study to examine 14 years of data to determine the efficacy of four complete IVM treatment cycles on a state-wide transmission system. Clearly the most important measure of efficacy, and the most direct measurement of the effect of treatment, is the change in density of non-compatible species over time. We used ArcGIS to analyze changes in the total number of acres mapped in each density category. Data for all 14 years were sorted by survey year and by line, and the total acreage in each non-compatible density category was calculated for each of the three lines, and the entire system. We removed from the analysis all polygons where the non-compatible density was listed as NA. NA is a category assigned to polygons that lack non-compatible species. These typically include paved areas, natural barrens, and active agricultural fields. These areas are generally stable over time, and represent areas that NYPA does no need to treat during each cycle.

A reduction in the mean height of non-compatible species is a predictable consequence of IVM. Repeated treatments should logically reduce both the density and height of non-compatible species. For each line and the entire system, we calculated the mean non-compatible height for each survey year.

Finally, repetitive treatments might be expected to change the vegetative complexity of the ROW. In general, treatments are designed to remove areas of tall growing trees, and create a ROW dominated by lower growing species. Therefore, a reduction in the number of polygons might be predicted along each ROW. We calculated a total number of polygons for each line and for the entire system.

The analysis for the entire NYPA transmission system was conducted based on treatment cycles, because the time between surveys of some of the lines varied. This allowed us to compare surveys across the entire system based on each time the entire system was surveyed, rather than a specific year. Thus the first cycle represents all the data for the first time each line was surveyed, etc. NYPA treats on a 4 year cycle.

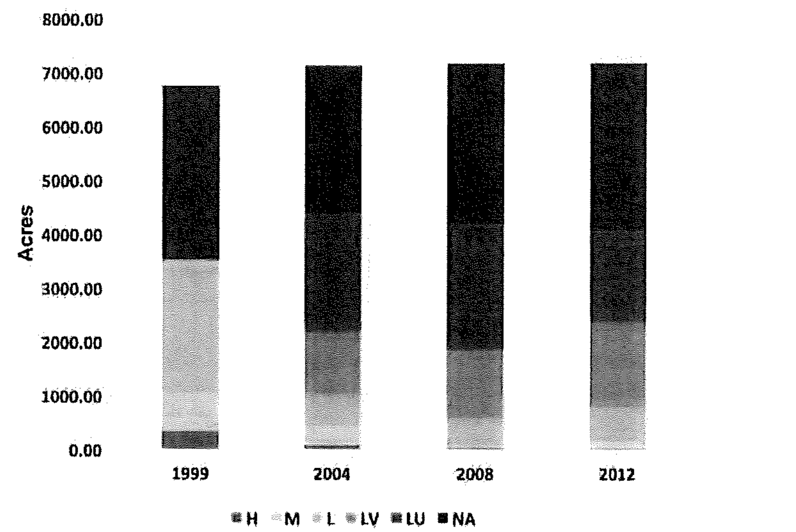

Figure 3. Number of acres in each non-compatible density category by year, NATL Line.

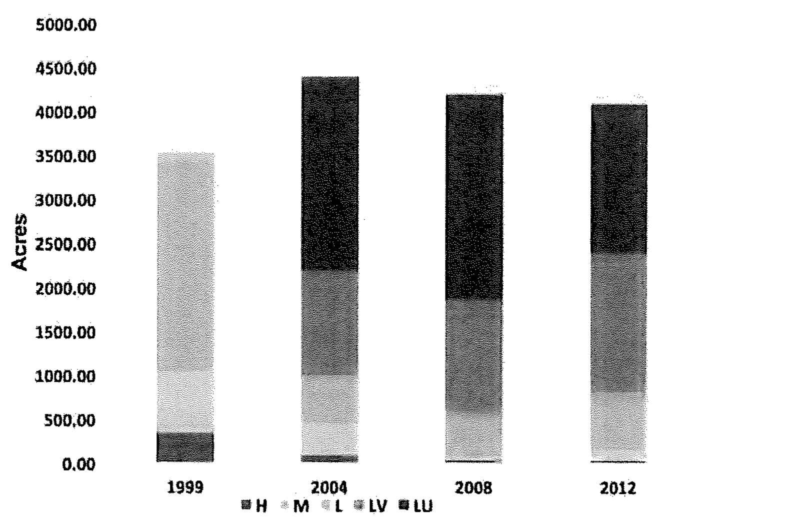

Figure 4. Number of acres in each non-compatible density category by year, with category NA removed, NATL Line.

RESULTS

CHANGES IN NON-COMPATIBLE DENSITIES

Figure 3 shows the changes in the density of non-compatible species over four survey years on NYPA's NATL. Roughly 25% of the NATL ROW had a non-compatible density of NA each survey year. The proportion of these areas varies across NYPA's system, but each transmission ROW has large areas mapped in this category. Since these areas are not actively managed by NYPA, the category was removed from subsequent analyses and figures.

Figure 4 shows results for the NATL with the NA category, a category indicating an area in which no non-compatible species are present, removed. In the first survey year (1999) high density of non-compatibles was mapped on just over 344 acres. By 2012, the acreage mapped as high density had been reduced to just over 30 acres. In 1999, there were just over 700 acres mapped at moderate non-compatible density. By 2008, there were only 46 acres mapped as moderate density, this rose to 128 acres in 2012. Low density in 1999 occupied 2,481 acres. Note that in 2001 the low density category was split into low, very low and ultra-low, to better reflect actual conditions on the ROW. Combined low densities (L, LV and LU) increased to 3,926 acres, with the majority of those acres in the low and ultra-low categories.

Similar changes in non-compatible densities were noted on the MA and GF lines. High density acreage was reduced on the MA line, from just over 144 acres in 1999 to 14 acres in 2011 (Figure 5). On the GF line, there were 60 acres mapped as high density in 1999, under 1 acre in 2013 (Figure 6). As with the NATL, both lines showed increases in the number of acres mapped as low, very low and ultra low non-compatible density (Figures 5 and 6).

Figure 7 shows the changes in density across the entire transmission system, in this case expressed in terms of the percentage of the total acreage mapped in each category for each treatment cycle. During the first treatment cycle, 49% of the system mileage was mapped as low, very low or ultra low non-compatible density. By the fourth cycle, 68% of the ROW was mapped in the three lowest density categories, with 58% of that area mapped as very low or ultra low. The decreases seen in medium and high density acreage system-wide mirror those seen on the three lines presented above.

CHANGES IN MEAN NON-COMPATIBLE HEIGHTS

Along the NATL, the mean height of non-compatible species decreased over the four survey years, from 11.57 feet in 1999 to 7.37 feet in 2012 (Figure 8). The vegetation on the MA and GF lines also showed similar decreases in mean height of non-compatibles (Figures 9 and 10). Note that overall heights were greater on the GF than on the other two lines. The mean non-compatible species height decreased across NYPA's entire system from roughly 15 feet during the first treatment cycle, to over 9 feet by the 4th cycle (Figure 11).

CHANGES IN THE NUMBER OF POLYGONS

Along the NATL, the number of polygons drawn to represent discrete patches of cover, non-compatible density and treatment changed from 2,163 in 1999 to 1,930 in 2012 (Figure 12), a

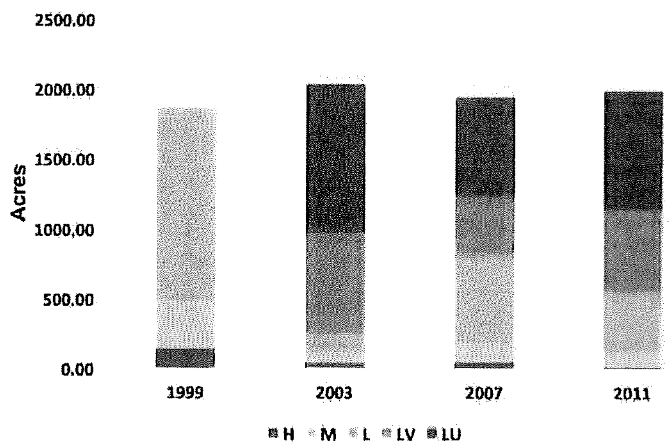

Figure 5. Number of acres in each non-compatible density category by year, MA Line.

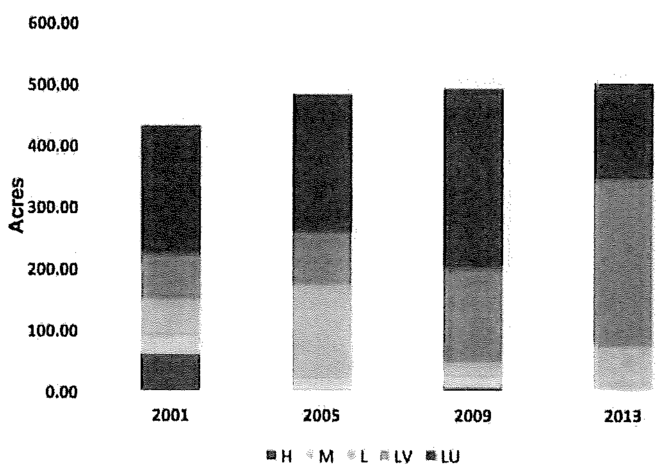

Figure 6. Number of acres in each non-compatible density category by year, GF Line.

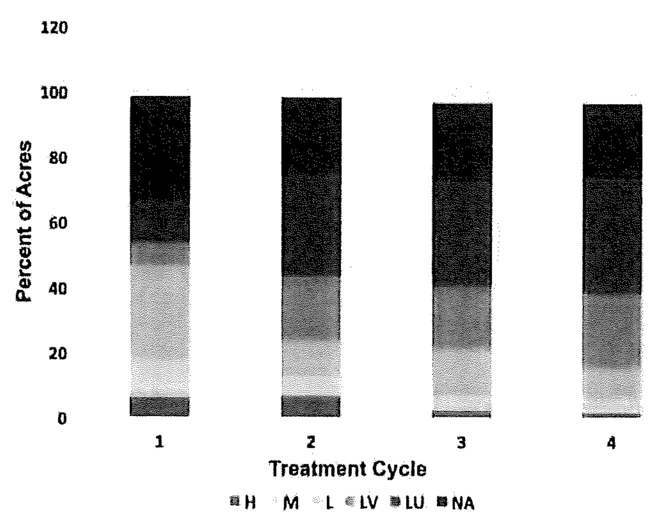

Figure 7. Percent of acres in each non-compatible density category by treatment cycle, entire NYPA system.

10% decrease. Along the MA line the crews mapped 488 polygons in 1999. In 2003 the number of polygons mapped increased to 684. In 2007 crews mapped 561 polygons along the MA, and found a slightly higher number (586) in 2011 (Figure 13).

In 2001 there were 367 polygons mapped along the GF line. The 2005 survey found a sharp decrease to 194. In 2009 and 2013, the number of polygons rose to 262 and 271 respectively, representing a 26% decrease over the study period (Figure 14).

The comparison of the number of polygons for the entire NYPA system was conducted over treatment cycle, rather than survey years. There were 6,405 polygons mapped system-wide during the first cycle. The number of polygons increased to 9,552 during the second cycle. In the third and fourth treatment cycles, the number of polygons was 7,338 and 7,607 respectively (Figure 15).

DISCUSSION

The idea that the systematic, targeted removal of non-compatible species, with the concomitant encouraging of the growth of compatible species, can alter the ecology of a ROW, and further discouraging the growth of tall trees with incrementally lower effort is traceable to Egler (1953). Since first proposed, IVM techniques have been used throughout the US.

Early evidence of the ability of IVM to develop a stable community of compatible species arose in the 1970's (Bramble and Byrnes 1976). Short term studies on the east coast showed that a stable community of compatible species could be developed and maintained, using IVM techniques, in as few as five years (Haggie et al. 2008). On the west coast, Nesmith et al. (2008) showed that stable communities of clonal-growing shrubs could form dense thickets along ROWs, discouraging the growth and development of tall trees.

Some studies have examined the long-term effects of IVM on ROWs. Notably, Bramble and Byrnes (1983)

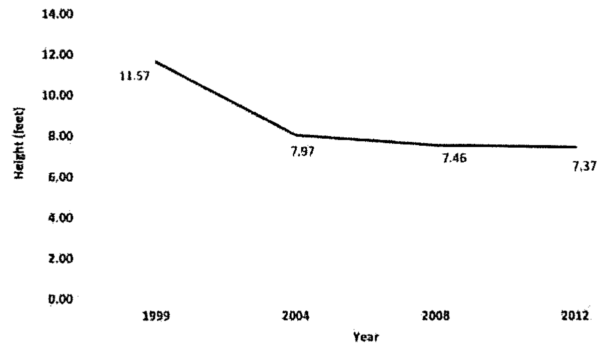

Figure 8. Change in mean height of non-compatible species, 1999 to 2012, NATL Line.

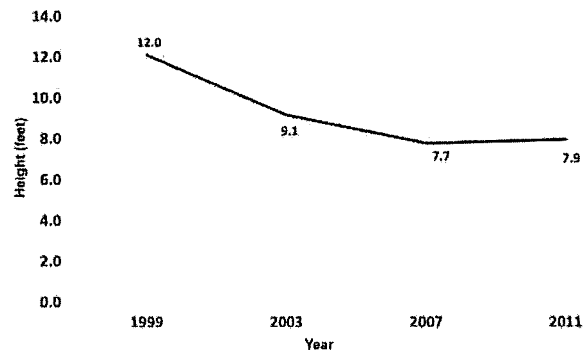

Figure 9. Change in mean height of non-compatible species, 1999 to 2011, MA Line.

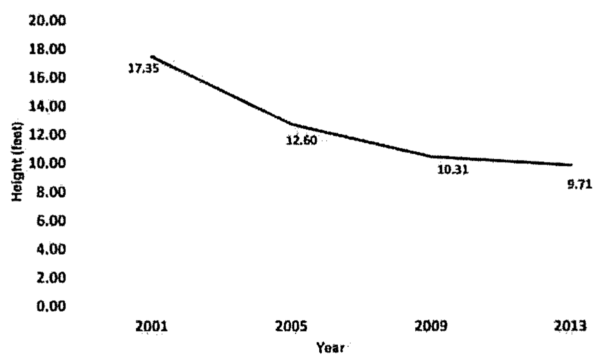

Figure 10. Change in mean height of non-compatible species, 2001 to 2013, GF Line.

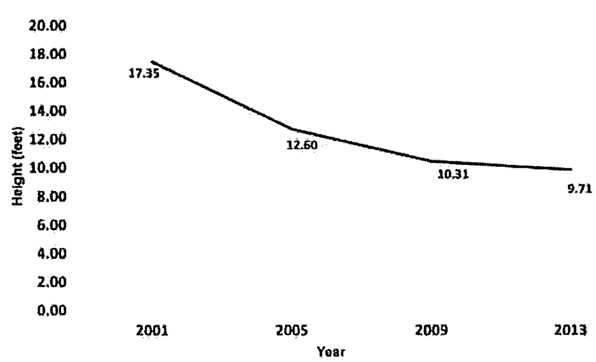

Figure 11. Change in mean height of non-compatible species, entire NYPA system, over 4 treatment cycles.

evaluated 30 years of data on the well-known State Games Lands 33 project. Their study area, one dominated by forest when cleared in 1951 to 1952, compared plots maintained by hand cutting to plots maintained by broadcast and selective herbicide applications. Ultimately, the broadcast treatment was dropped. Over 30 years, they reported the areas treated by hand cutting were dominated by "tree sprouts and seedlings with sparse forest shrubs and herbaceous plants", while areas treated with selective applications of herbicides were dominated by "shrubs and herbaceous plants of open areas plus shrubs and herbs of the forest with numerous seedling and sampling trees" (Bramble and Byrnes 1983).

Over the 14 years represented in this study, the number of transmission system acres mapped as low density or lower has increased. Control of non-compatible species worked so well that in 2000 NYPA created new density categories very low and ultra low. In general, from 1999 to 2012, the NATL ROW showed a decrease in areas mapped as high and moderate non-compatible density, with the vast majority of the ROW mapped as very low or ultra low non-compatible density by 2012. The mean height of non-compatible species decreased, as did the number of polygons mapped. Similar changes were seen along the MA and GF lines. After the completion of four, four year treatment cycles, NYPA has found that 70% of the total ROW acreage had non-compatible densities of low, very low or ultra low.

Polygons with non-compatible densities of high and medium have not been entirely eliminated, and they likely will not be. There are several areas along NYPA's transmission system where ROWs cross steep forested valleys and ravines, and where the conductor clearance is quite high. Forests in these areas are not likely to ever encroach upon the wire security zone, and treatments in these areas are unnecessary.

The height of non-compatible vegetation is a critical variable to control

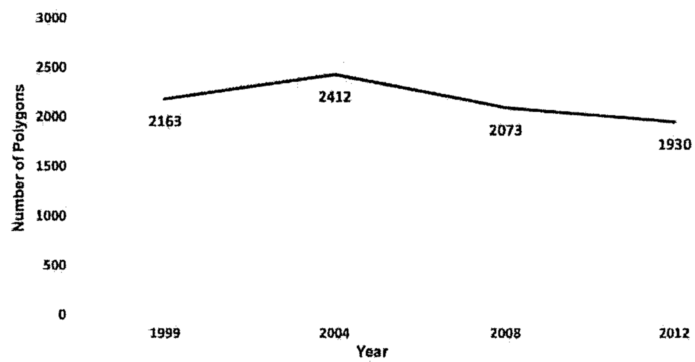

Figure 12. Change in the number of polygons mapped by year, NATL Line.

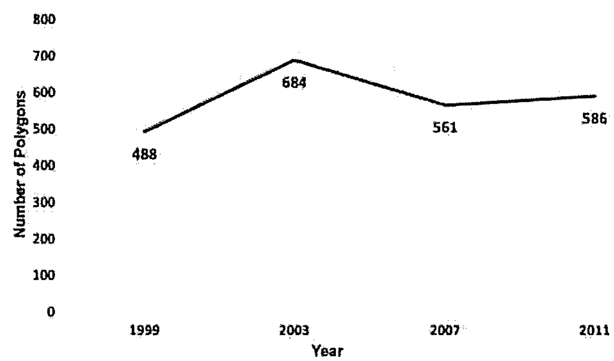

Figure 13. Change in the number of polygons mapped by year, MA Line.

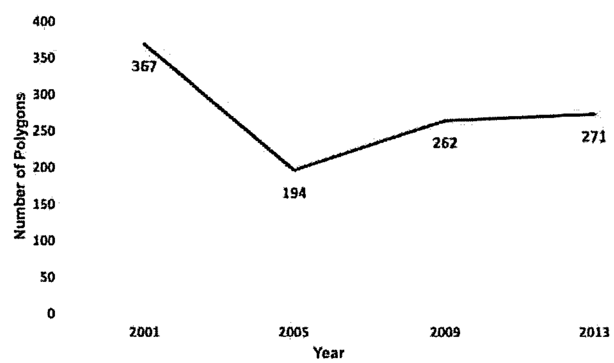

Figure 14. Change in the number of polygons mapped by year, GF Line.

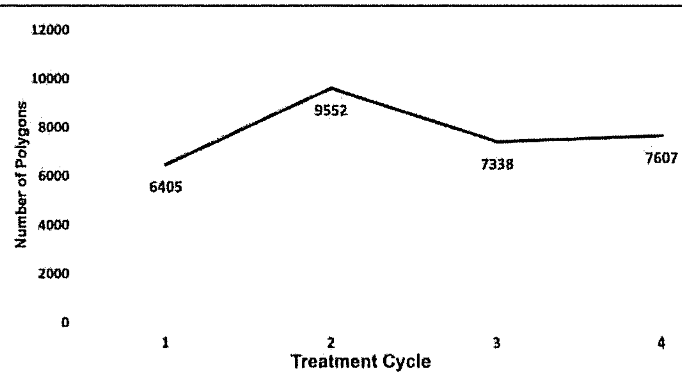

Figure 15. Change in the number of polygons mapped by treatment cycle, entire NYPA system.

in order to ensure the safe and reliable transmission of electricity. At a minimum, control must focus on preventing woody species from growing tall enough to encroach on the wire security zone. As a practical matter, treating small stature trees and shrubs is less expensive than treating taller trees, and label requirements for some herbicides limit the application to targets no taller than 10 feet (Dow Agrosciences 2008). Application of IVM has led to decreases in the mean height of non-compatible species over the three ROWs discussed here, and system-wide over the four treatment cycles.

The direction and magnitude of a change in the number of polygons along ROWs treated by IVM is difficult to predict, though the notion that the number should change seems logical. According to NYPA's vegetation management protocols, vegetation polygons should be drawn such that they are homogenous in terms of cover type, non-compatible density and non-compatible heights. Cover types are defined in these surveys rather broadly, any area dominated by shrubs and tree seedlings would be mapped as FN, or brush cover. Clearly, as IVM efforts progress, more areas should be mapped in this cover type, resulting in a simplification of the ROW landscape and a reduction in the number of polygons. In general, as shown in this study, the three attributes that define polygons, cover type, and the density and heights of non-compatible species, become more similar over time.

Data for the NATL and MA lines, and for the entire transmission system, show a pattern of an increase in the number of polygons from the first survey year or treatment cycle to the second. Some of this is due to the crews paying strict attention to areas where adjacent forest was encroaching on the ROW edges, as NYPA staff directed beginning in 2002. In these cases, crews carefully surveyed narrow areas where forest trees were beginning to grow slightly inside the ROW edge. This effect is illustrated by the data from the GF line (Figure 13), where the number of polygons decreased by almost half from 2001 to 2005. This line had a large number of forest encroachments along its edge. NYPA undertook efforts to re-establish these edges during subsequent cycles.

CONCLUSIONS

The application of IVM techniques over four treatment cycles of four years each during the period 1999 through 2014, has led to a sharp decrease in the acres of ROW mapped as high or medium non-compatible density, and a concomitant increase in ROW mileage mapped as low, very low and ultra low non-compatible densities. This major finding shows that the ecology of NYPA's ROW is changing. The targeted use of herbicide applications applied specifically to non-compatible species, cutting and mowing techniques and combined cutting and herbicide methods has greatly reduced the density of non-compatible species across the entire system. Overall, NYPA's ROWs are increasingly dominated by dense growth of compatible species. In areas where the conductor clearance is so high that treatments will never be necessary, some areas of high and medium non-compatible density will remain.

Four cycles of IVM have lowered the mean heights of non-compatible species. Across NYPA's system the mean non-compatible species heights are less than 10 feet. Most non-compatible species are therefore occurring at low densities and low heights, indicating that successive treatments should take less effort, and that IVM efforts are succeeding.

The direction and magnitude of any change in the number of polygons is still unclear. Despite an initial increase in the number of polygons, the number has decreased and may be levelling out. More study will be needed to determine the outcome.

This study illustrates that over 4 treatment cycles, dramatic reductions in the density and height of non-compatible species can be achieved and maintained through the use of IVM.

The question of whether NYPA has created a stable community still remains. Stability has been an oft-debated term in ecological literature. We have progressed from the idea of a rather rigid ecological climax community (Cowles 1899, Clements 1916), through Whittaker's (1953) notion of species sorting themselves along environmental gradients, to complex notions of the roles of disturbance and resilience in the sustainability and stability of plant communities (Ludwig et al. 1997). Whether or not plant communities are stable over time is clearly an open question, for plant communities on ROWs or in the greater ecosystem. Clearly, the application of IVM can lead to the development of a community characterized by desirable species which will work to help discourage the growth of species that are not compatible with the goal of reliable transmission of electricity. The question of whether these communities along NYPA's ROW will remain stable over time depends upon one's definition of stability. We strongly suspect that while IVM efforts, and herbicide use, will decrease over time, some IVM will likely always be required to ensure that tall woody species do not threaten operation of the transmission system.

LITERATURE CITED

Alkiewicz, E., J. Wingfield, D. Frazier, and L. Khitrik. 2002. Using GIS tools to conduct environmental and asset analyses along rights-of-way. In Proceedings of the 7th International Symposium on Environmental Concerns in Rights-of-Way Management, September 9–13, 2000, Calgary, AB, edited by Goodrich-Mahoney, J.W., D.F. Mutrie, and A. Guild, pp. 27-43, Elsevier Science, New York, NY.

ANSI (American National Standards Institute). 2006. ANSI A300 (Part 7)-2006 IVM. American National Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Integrated Vegetation Management a. Electric Utility Rights-of-Way). Washington, D.C., American National Standards, Inc.

Bramble, W.C., and W.R. Byrnes. 1976. Development of a stable, low plant cover on a utility right-of-way. First Symposium on Environmental Concerns in Rights-of-Way Management Pp:168-176.

Bramble, W.C., and W.R. Byrnes. 1983. Thirty years of research on development of plant cover on an electric transmission right-of-way. Journal of Arboriculture 9(3):67-74.

Clements, F. E. 1916. Plant Succession: An Analysis of the Development of Vegetation. Carnegie Institution of Washington, Washington, D.C.

Cowles, H. C. 1899. The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan. Botanical Gazette 27(2):95-117.

Dow Agrosciences. 2008. Specimen Label, Garlon 4 Ultra. Available at: http://ws.greenbook.net/Docs/Label/L85669.pdf (accessed September 2015).

Egler, F.E. 1953. Vegetation management for roadside and rights-of-way. Pp 299-322. In Smithsonian Institution 1953 Annual Report, Smithsonian Institution, Washington, D.C.

Haggie, M.R., R.A. Johnstone, and H.A. Allen, Jr. 2008. Tree, Shrub and Herb Succession and Five Years of Management Following the Establishment of a New Electric Transmission Right-of-Way through a Wooded Wetland. In Proceeding of the 8th International Symposium on Environmental Concerns in Rights-of-Way Management, eds. Goodrich-Mahoney, J.W., L.P. Abrahamson, J. L. Ballard, and S. M. Tikalsky, pp. 37-41, Electric Power Research Institute, Washington, D.C.

Jackson, L.W. 1997. A history of utility transmission right-of-way management in New York State. In Proceedings of the 6th International Symposium on Environmental Concerns in Rights-of-Way Management, February 24–26, 1997, New Orleans, LA, edited by Williams, J.R., J.W. Goodrich-Mahoney, J.R. Wisniewski, and J. Wisniewski, pp 103-110. Elsevier Science, New York, NY.

Ludwig, D., B. Walker, and C. S. Holling. 1997. Sustainability, stability, and resilience. Conservation Ecology [online]1(1):7. Available at: http://www.consecol.org/vol1/iss1/art7/

McLoughlin, K.T. 2002. Integrated Vegetation Management: The exploration of a concept to application. In Proceedings of the 7th International Symposium on Environmental Concerns in Rights-of-Way Management, September 9-13, 2000, Calgary, AB, edited by Goodrich-Mahoney, J.W., D.F. Mutrie, and C.A. Guild, pp. 29-45, Elsevier Science, New York, NY.

Nesmith, J.C.B., J.P. Shatford, and D.E. Hibbs. 2008. Stable Plant Communities in the Pacific Northwest. In Proceeding of the 8th International Symposium on Environmental Concerns in Rights-of-Way Management. (J. W. Goodrich-Mahoney, L. P. Abrahamson, J. L. Ballard, S. M. Tikalsky, Eds.). Electric Power Research Institute, Washington, D.C., pages 47-59.

New York State, Office of Planning Services. 1972. LUNR classification manual: land use and natural resource inventory for New York State. Office of Planning Services, Albany, NY.

Niering, W.A. 1958. Principles of sound right-of-way vegetation management. Economic Botany 12(2):140-144.

Niering, W.A., and F.E. Egler. 1955. A shrub community of *Viburnum lentago*, stable for twenty-five years. Ecology 36:356-360.

Nowack, C.A., and B.D. Ballard. 2005. A framework for applying integrated vegetation management on rights-of-way. Journal of Arboriculture 31(1):28-37.

Whittaker, R. H. 1953. A consideration of climax theory: the climax as a population and pattern. Ecological Monographs 23:41-78.

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Kendra Gorski is an Environmental Scientist for Gomez and Sullivan Engineers. She obtained a BS in Environmental Science and Forest Biology from SUNY-ESF-Syracuse. She is skilled in field biology and environmental field inventories. Ms. Gorski has worked on NYPA's electric transmission ROW vegetation surveys for the past 9 years.

Lana Khitrick
Gomez and Sullivan Engineers, D.P.C. 1961 Wehrle Drive, Suite 12, Williamsville, NY 14221. lkhitrik@gomezandsullivan.com

Ms. Khitrik is a civil/environmental engineer who specializes in Geographic Information Systems. She holds a BS in Civil Engineering from the Institute of Railway Transport Engineers in Leningrad, Russia. Her experience includes the integration of new technologies to more efficiently manage electric transmission ROWs and she played an integral part in assisting NYPA with the development of a comprehensive GIS for electric transmission vegetation mapping and analysis programs. Of particular note, her work has involved the creation of geospatial data relationships that allow ROW managers and real estate professionals to streamline their efforts with respect to vegetation management and land use.

Donald Coogan
Terrestrial Environmental Specialists Inc. 23 County Route 6, Suite A Phoenix, NY 13135. dcoogan@tesenvironmental.com

Donald Coogan has considerable experience on ROW projects, including specific experience with NYPA's transmission vegetation inventories. Don holds a BS in Environmental Science from SUNY-ESF. Mr. Coogan has conducted vegetation inventories and provided treatment recommendations for the majority of lines within NYPA's transmission network.

Lewis Payne
New York Power Authority, Clark Energy Center, 6520 Glass Factory Rd., Marcy, NY 13403. lewis.payne@nypa.gov

Lewis Payne is the Right-of-Way/Environmental Supervisor for the New York Power Authority in Marcy, NY and has been working in utility vegetation management for 30 years. He holds an AAS in Forest Technology from SUNY-ESF-Wanakena and a BS in

Forest Resources Management from SUNY-ESF-Syracuse. Payne is an ISA certified Arborist/Utility Specialist and a NY certified pesticide applicator. He is chairman of the NY Category Six Pesticide Training Committee. Under his leadership the New York Power Authority was accredited as a Right-of-Way Steward Utility Founder in 2013.

John Gwozdz
New York Power Authority, Robert Moses Power Dam, 830 Barnhart Island, Massena, NY 13662. john.gwozdz@nypa.gov

John Gwozdz is a Regional Staff Forester for the New York Power Authority in Massena, NY and has been working in vegetation management for 14 years. He holds an AAS in Forest Technology from SUNY-ESF-Wanakena and a BS in Forest Resources Management from SUNY-ESF-Syracuse. Gwozdz is an ISA certified Arborist/Utility Specialist and a NY certified pesticide applicator.

Paul Breier
Gomez and Sullivan Engineers, D.P.C. 1961 Wehrle Drive, Suite 12, Williamsville, NY 14221. pbreier@gomezandsullivan.com

Paul Breier is a proficient GIS professional with a strong background in geodatabase development. Paul holds an MA in Geography and a BS in Geology from the State University of New York in Buffalo. He has developed an efficient QA/QC process for our final GIS ROW submittals whereby advanced queries are used to efficiently assess potential inconsistencies in the data.