2019-2021 Wisconsin DNR Division of Forestry Research Agenda

February 12, 2019

Statement A. Some tree species are not successfully regenerating and, as a result, are becoming less common on the landscape. Information is needed on factors influencing natural and artificial regeneration, as well as urban plantings, to ensure that regeneration and planting efforts are successful.

a. Mechanical scarification, chemical site preparation, and prescribed fire are increasingly used to regenerate tree species that require frequent or intense disturbance regimes. What are the most successful techniques and tools to regenerate Wisconsin forest tree species? What are the ecological impacts of using such techniques systems on ground flora and soil nutrients?

b. Some species are proving difficult to regenerate (e.g. oak, tamarack, white cedar, yellow birch, and eastern hemlock). What factors allowed these species to regenerate historically? What conditions are needed for them to survive in the future? What techniques can be used for reliable regeneration in the future?

c. What methods/tools can be used to regenerate oak in the presence of invasive species, deer, shade-tolerant competition, interfering vegetation, and other factors in Wisconsin?

d. What methods can be used to successfully regenerate bottomland hardwood stands, especially in light of invasive species (e.g. RCG and EAB) and altered hydrological cycles along Wisconsin river systems?

e. What factors influence the implementation of urban tree planting and pruning specifications, and recommendations to improve the likelihood for planting success and long-term health?

f. What factors influence natural jack pine and red pine regeneration and maintenance?

g. What factors have the most impact on seedling survival in artificial regeneration plantings, such as stock type, browse damage, planting methods, site preparation, planting depth, competition, lift date, shipping date?

h. How can state nurseries, urban forestry and private industry work together to expand and implement food forests in Wisconsin communities? What factors contribute to the success of food forests (location, species etc.)?

i. Does a planting plan or forester involvement positively impact regeneration success?

j. Do different harvesting techniques lead to different regeneration success? If so, what can be done to ensure sufficient regeneration with all techniques?

Statement B. Public attitudes and engagement are important factors that affect urban forest management and the practice of sustainable forestry in Wisconsin, yet our understanding is limited on the public's attitudes, behaviors and how to best engage the public in forest management and into the workforce.

a. What is the current public opinion, awareness, knowledge level, attitude and values on Wisconsin forests, forestry and forest products? Have the results changed since the last survey, nearly 15 years ago?

b. What urban forestry and tree care messages are stakeholders delivering to the public, and which messages are most effective for engaging audiences from diverse socioeconomic backgrounds? How do diverse audiences respond to and act on urban forestry messages?

c. What are the trends, opportunities and challenges to entry in the urban forestry and arboriculture workforce?

d. Are the current funding limits and priorities of the DNR Urban Forestry grant program meeting the needs of Wisconsin communities? What is the impact of Urban Forestry Grant dollars on Wisconsin communities and how does the funding affect private business? Is there a correlation in grant dollars and and increase in private business activity?

e. How does engagement with the Champion Tree Program build advocacy among participants for sustainable forest management across urban and rural landscapes?

f. How do stakeholders perceive the benefits of the "walkable community" and how do their perspectives impact management and planning for urban trees?

g. What are the long-term impacts of urban non-profit/municipal partnerships to increase canopy cover in low income areas?

Statement C. Deer have an impact on forest regeneration and successional trends, which affects the sustainable management and health of Wisconsin's forests.

a. What practices are most effective in providing adequate stocking in regenerating stands under a range of deer densities?
b. What practices can be economically implemented to reduce deer browse to a level where it is possible to achieve desired forest management goals?
c. How do deer densities and browsing effect native and invasive herbaceous plants, woody shrubs, and tree seedlings?
d. What are effective methods for communicating the impact of deer on tree planting and reforestation goals and the need for managing the deer herd? How does the public perceive the impacts of deer on forests?
e. What are the impacts of deer browsing on forest productivity, native and invasive understory plant abundance, bird and mammal populations, and forest ecosystem functions?
f. Can ecological carrying capacities of deer be established for spatially and ecologically distinct ecosystems? Can socially and biologically acceptable deer densities be established to minimize deer impacts and enhance biodiversity?
g. Can deer habitat health and suitability be modelled using current data sources (for example deer population, land cover and forest monitoring data)?
h. What tree species are preferred by deer and under what circumstances?

Statement D. Wisconsin's forest products industry operates within both a local and global marketplace. Information is needed on forest industry, including supply and demand for markets, to inform, among other things, business plans for forest industries in Wisconsin.

a. What factors impact the long-term viability of the forest products industry in Wisconsin? What are the barriers and incentives to capital improvements and business start-up? What is the current and anticipated forest products workforce, and what factors influence the long-term viability of this workforce?

b. What is the potential for developing new markets (foreign and domestic) for the forest products industry in Wisconsin, such as markets for species infected by forest pests or for new products such as cross-laminated timber?

c. What impacts do limited markets for small diameter and poor-quality wood have on silvicultural practices in southern Wisconsin? How can markets be developed for underutilized tree species or products (e.g. white pine, tamarack, softwood pulp)?

d. What information is needed for a company to evaluate global markets and access to those markets?

e. What is the supply and market for certified wood? What amount of certified wood is being produced? How is market access affected by possible shortages of source material, market preferences, development of primary and secondary manufacturing facilities, and impacts of the certification?

f. What effect do land management changes, guidelines, and regulations have on the forest products industry in Wisconsin?

g. How is material infected with pests or pathogens being removed? How is it being utilized? What can forest industry and communities do to minimize cost of tree removal and maximize use of wood supply?

h. What are the most effective tools and communication methods to build markets and demand for traditional and urban wood sourced products among various buyer groups, such as architects, interior designers and individual consumers? What are the barriers to these buyer groups to the use of wood products?

i. What are the current economic impacts of urban wood use? How could current urban tree planting decisions (e.g. smaller-stature trees) impact future urban wood markets and use of urban wood for value-added products?

Statement E. Invasive non-native species and aggressive native species are posing increasing threats to the environmental, social, and economic benefits of forests, including forest regeneration and ecosystem functions.

a. Are winter cut stumps susceptible to HRD infection during spring thaw? Does applying herbicide to stumps prevent infection by HRD? What is the efficacy of RotStopC in preventing infection by HRD in the Lake States?
b. Determine the best options for diversifying ash dominated riparian forests in WI, MN, MI: both silvicultural techniques and species.
c. Can remote sensing be used to detect and monitor invasive plants populations?
d. What are the potential management options for Amynthas and related worms?
e. What is the impact of invasive species and "novel ecosystems" on ecosystem processes?
f. What silvicultural techniques can be used to help restore native forest vegetation where invasive plants are established?
g. What is the most cost-efficient and effective methods to control the spread of invasive species? (species of interest change over time).
h. Oak Wilt:
    - Does applying herbicide or Cellu-Treat to a cut stump prevent infection by oak wilt through the freshly cut stump surface? Compare with to the proven method of preventing infection, applying wound paint.
    - Can oak wilt infect an oak through a cut stump and from there move into the root system to spread though root grafts?
    - What is the minimum width of a band of healthy oaks that must be harvested to contain an oak wilt infection, assuming stumps are treated to prevent overland transmission of oak wilt?
    - Does treating an oak wilt infected tree with herbicide prevent the spread of OW through root grafts? Is the effect dependent on how advanced the infection is within the tree?
    - What are effective education and outreach strategies to encourage landowners to prevent HRD and oak wilt infection?
i. Emerald Ash Borer:
    - To what degree has EAB impacted the awareness of, and motivations to address, potential invasive pest infestations, among citizens and units of government?
    - How are communities handling inspection and abatement programs and procedures to handle EAB-infested private ash trees?
    - To what degree does EAB provide feasible and profitable urban wood projects, from the perspective of wood utilization companies?
    - Does removal of the quarantine regulation on emerald ash borer change camper awareness of the risk of moving firewood, their motivation to avoid moving firewood, and their actual movement of firewood?

j. What are the long-term population dynamics of herbaceous non-native plant species?

k. What is the relationship of fruit production by woody invasive shrubs to forest canopy and basal area changes during timber stand improvement and how can it be manipulated to reduce invasive plant fecundity?

l. What are the potential impacts, including environmental persistence, of the use of chemicals that are commonly used in tree care, including the potential impact on bee colonies? How do citizens and other stakeholders view the costs and benefits of these chemicals?

m. What species can benefit from resistance breeding to develop resistance to pests and diseases and maintain those tree species on the landscape?

n. Research needed on Phytoplasma: species identification, regional survey, host range, host impacts, and how it is spread.

o. What are the costs, benefits and effectiveness of wood product quarantines when a pest or disease is detected in or near the state? What are the advantages and disadvantages of no quarantines versus partial (county) quarantines versus statewide quarantines?

p. Is there an effect of changing crop field herbicide application on tree health and forest regeneration (ex. acetochlor, dicamba)?

q. What is the public's opinion on invasive species movement and resulting behavior to prevent dispersal of invasive species?

r. Are best management practices for reducing the impacts of insects and diseases effective?

Statement F. The demographics of private landowners and the challenges they face (e.g. pests and disease, invasive species, climate, markets, ecological shifts) are continuously evolving, creating novel situations that affect their management decisions and the implementation of sustainable forestry on private lands in Wisconsin.

a. How do outreach programs, personal social networks and local opinion leaders influence the behavior of property owners to effectively maintain and expand the urban tree canopy? What resources, tools, information and message sources most effectively promote behaviors that maintain and expand the urban tree canopy?

b. What outreach approaches and training methods most effectively foster positive, long-lasting relationships between service foresters and private landowners? What strategies effectively increase landowner awareness of the role and services provided by service foresters?

c. What are the costs, benefits, and short and long-term impacts of our innovative outreach and education programs on woodland owner pathways to action (including small and large actions on their land)?

d. What are the motivations, barriers and management decisions of different demographics of landowners regarding forest management, including new landowners and women landowners? What resources and outreach strategies are most effective for engaging these landowner groups in sustainable forest management?

e. How can the state manage forests at a landscape-scale in coordination with privately owned lands in or near state forest boundaries? What are communication and management strategies that interest and engage private landowners in contributing toward landscape-scale goals?

f. What are the trends in urban tree species demand, public awareness of the importance of diverse tree species, availability of nursery stock, and impact on the urban canopy lifecycle? What mechanisms can incentivize tree nurseries to grow and cultivate a wider variety of tree species?

g. What factors impact management of the urban canopy across property boundaries and ownerships? What tools or mechanisms can be used to increase cross-property landscape, watershed and other broad-scale management?

h. What factors influence a landowner's decision to renew or not renew participation in the MFL Program (e.g. third-party certification, property tax deductions, cost share availability for management plans)? If a property is not renewed, does it come back later?

i. What forest management practices are occurring on private woodlands, and how do these practices differ on MFL versus non-MFL lands?

j. Among dual property owners with homes in both municipalities and on forested parcels, what are the most effective tools to communicate with these individuals to motivate sustainable tree care, management, and planning in their yards and in their woods? What are the tools, resources and partnerships needed to provide sustainable forest management support and planning to small acreage landowners (less than 10 acres) who are not being served by traditional programs (e.g. MFL, WFLGP, EQIP)?

Statement G. Forest management decisions are closely tied to shifting economic values of forest lands and the services they provide to communities, yet more tools and methods are needed to understand these dynamics.

a. What is the economic impact to local communities from increased harvests on National Forests in Wisconsin due to the Good Neighbor Authority?

b. What is the role of forested lands, both rural and urban, in local economies, including direct and indirect use values, such as woody biomass, outdoor recreation, ecosystem function, and their underlying natural resource stocks? What are their economic contributions to local and statewide regional delineations?

c. How can ecological services be valued? What are the strengths and weaknesses of various valuation methods? What is the valuation outcome for forestlands under varying management strategies and across different ownerships?

d. How do species, age, stand structure, site quality, tree quality, landowner goals, silviculture guidelines, economics, product considerations and other factor influence harvest decisions in hardwood stands? How can financial performance, long-term sustained yield, and ecosystem functions be best balanced?

e. What physical and socio-economic constraints limit the amount timber that is harvested? How can this data be used to improve estimates of volume of timber available for harvesting from FIA?

f. What is the impact of sales of industrial forestlands on employment, public access, development, cost of services, and various economic indicators?

g. What are the most inclusive and efficient ways to integrate both long-term and short-term economic concerns into sustainable forest management?

h. What is the value and cost of public lands to local governments, including taxes and costs of services? What are the costs, such as infrastructure and services, of private forestlands to local governments compared to other land uses?

i. What are the monetary values of providing public access on privately owned forestlands, including fixed term and perpetual easements? What are the barriers for NIPF landowners to providing public access on privately owned forestlands? What mechanisms can encourage public access?

j. How do we quantify a fair market value for acquiring motorized vehicle access on Forest Legacy easement lands? What is the state's willingness to pay for the benefits of this access for the public and the landowners' willingness to sell for the cost of allowing motorized vehicle access on their land in perpetuity?

Statement H. The ability to accurately model fire behavior, predict/monitor fire weather and fuel conditions as well as understand public information needs can lead to efficient use of resources to prevent, suppress, and control forest fires while simultaneously improving the use of prescribed fire as an important land management tool.

a. What are the prescribed burn windows for fire dependent communities that will permit land managers more opportunities to accomplish management objectives with increasing climate variability?

b. What are the prescribed burn intervals required for the restoration and maintenance of fire dependent communities? What are the short and/or long-term impacts on forest products?

c. There are 53 standard fire behavior fuel models including the original 13 described by Anderson (1982), plus the forty defined by Scott and Burgan (2005) in the United States Fire Behavior System. What is the accuracy of these 53 standard fuel models and the Canadian Forest Fire Behavior Prediction System (FBP) fuel models to fuel conditions found in Wisconsin? Do the models accurately predict actual fire behavior observed in Wisconsin throughout the year?

d. What are the benefits of introducing fire into fire dependent communities across Ecological Landscapes and what is the most efficient and effective method to communicate this information to the public?

e. What is the cost/benefit of investments in: a) response based on fire danger rating (including staffing levels and efficiencies), b) hazard mitigation fuel reduction projects, and, c) Community Wildfire Protection Plans (CWPP) in preventing losses of life, property and resources during Wisconsin forest fires?

f. What is the cost/benefit of mechanical, chemical and prescribed burn applications to accomplish land management objectives for fire dependent communities? What is the best way to assess public perceptions (landowners, community leaders, local government, citizens, homeowners) to improve the success and utility of these applications?

g. Does the cost of investment in wildfire prevention efforts outweigh the benefits that are difficult to measure, such as how to measure the number of fires prevented? What other metrics could be used to prove fire prevention efforts are successful and/or show a return on the investment?

h. Do the components utilized in the development of the fire landscape system used in the Fire Program Assessment continue to be the best metrics? Can fire suppression efforts, when compared to actual fire losses incurred, be used to strengthen the overall fire risk map used in Wisconsin?

i. How should post-fire assessments for large, intense forest fires be conducted and information should be gathered? What is the effectiveness of fuel breaks and impacts on forest regeneration, soil conditions, water quality and terrestrial impacts? What best management practices are needed to rehabilitate areas impacted by such fires?

j. Following a large forest fire, under what scenarios should landowners consider immediate reclamation versus allowing for natural regeneration to occur? Under what circumstances does under-planting prove successful?

Statement I. Forest management impacts forest ecosystem functions (e.g. forest productivity, wildlife habitat, water quality protection, air quality protection), but it is unclear how. We need more information on what the impacts are to develop, evaluate, and refine forest management, recommendations, and guidelines.

a. What are the characteristics (e.g., age structure, species diversity, % canopy) of a sustainable urban tree canopy?

b. Northern hardwood forests are exposed to a number of stressors that are limiting regeneration success, including deer, earthworms, sedge, competing vegetation, poor harvesting practices and altered disturbance regimes. How can regeneration of northern hardwoods be improved?

c. How does urban tree canopy impact storm water runoff quality and quantity in Wisconsin communities? How can these data be incorporated into DNR storm water models, including WinSLAMM?

d. Are there silvicultural alternatives to single tree selection as an uneven-aged natural regeneration system in northern hardwood forests?

e. What are the impacts and effectiveness of various forest management guidelines, including silviculture practices, BMPs, forest health guidelines, species guidance, and other recommendations? Are they achieving their intended results? Is there the opportunity for more flexibility in the implementation of the guidelines and what are the consequences of not following the guidelines? How can this information be used to develop, evaluate, and refine guidelines?

f. What are the costs and benefits of current trends and projected changes in the urban tree canopy, including impacts related to the spread of invasive pests and pathogens, and other stressors, such as land use change?

g. What is the effect of management on landscape-scale forested ecosystems, including cumulative and indirect effects, on things such as habitat for interior songbirds?

h. What effect does landscape restoration principles and practices, including the role of fires and other disturbance regimes, have on landscape processes, function, and resiliency?

i. What are possible landscape level planning goals by forest type, seral stage, and forest production that can maintain sustainable forest ecosystems? What is our desired future condition for Wisconsin's forests?

j. What are the ecological effects of rutting? Are there different effects based on different soil types?

k. How can Wisconsin improve forest connectivity and habitat corridors to maintain ecosystem functions?

l. What is the environmental damage associated with various motorized uses, including trail erosion, illegal trail creation, off-trail use, and spread of non-native invasive plants? What is the extent and magnitude of these impacts? How can they be mitigated?

m. What forest management techniques can be used to mitigate impacts to endangered or threatened bat species such as northern long-eared bat?

n. Can forest productivity be better quantified especially in forest types with lower growth potential?

Statement J. Applied tools, such as growth models, economic value calculators, etc., are important assets for field managers. However, some of these tools do not incorporate the best available research, and therefore it does not translate into current forest management practices.

a. What forest regeneration monitoring systems, including the use of new technology, can be utilized to improve regeneration management decisions?
b. What landscape ecology tools can be utilized to look at local landscape patterns and guide management decisions beyond the stand level?
c. What tools can be utilized to inform economic management decisions based on landowner goals and site conditions?
d. How can LIDAR technology be used to improve forest assessment and management for multiple objectives in both rural and urban settings?
e. How can the public health benefits of urban forests be better quantified, and those benefits optimized?
f. What methodologies and tools are most effective for calculating the status and trends of the urban tree canopy at the state and local levels in Wisconsin?
g. What are the best methodologies to assess environmental equity in Wisconsin's communities? How can inequities be prioritized and addressed?

Statement K. Climate change is affecting forest ecosystems. Forest management can increase resiliency and the ability to adapt through mitigation actions if we have a better understanding of how species and ecosystems will adjust to future variability.

a. Is assisted migration of species a viable adaptation strategy for climate change? Under what conditions would it be beneficial to maintain species in their current locations (refugia, high-quality sites, etc.)?
b. What is the effect of changes in forest cover on hydrology with rising temperatures and increasingly intense precipitation events?
c. Regionally, what species should be grown (or no longer grown) for urban tree plantings based on observed or expected climate change trends?
d. How will rising winter temperatures and increasing number of snow-free days affect the ability to harvest and remove timber from forests?
e. Will harvesting equipment and winter road preparation need to change with warmer winters to harvest timber without causing soil disturbance?
f. How can we better quantify and maximize the beneficial effects of forests on climate change related impacts (i.e. flooding, rising temperatures, air quality)?
g. Will large wildfires become more frequent within a changing environment?
h. What is the genetic variability of tree species native to Wisconsin? What species and genotypes should be grown in the state based on observed or expected climate change trends?
i. How will fire risk and/or fire use change with increasing climate variability?
j. What are the carbon emissions that result from various types of burning?
k. Is climate change affecting flowering, pollen production and fruit/nut production of trees and shrubs?
l. What impacts are more intense weather events having on Wisconsin's forests?
m. Climate change may affect forest ecosystems by affecting trees directly, (i.e., by exceeding tree species climatic tolerances), and through exotic diseases and pests (i.e., emerald ash borer), or affecting essential ecosystem processes such as decomposition and nutrient cycling. What are potential effects of these combined impacts to Wisconsin forest types?
n. What are the carbon emission and sequestration outcomes of current silvicultural techniques and rotations? How might these change under potential climate change scenarios?