Center for Advanced Forestry Systems (CAFS) Update and Plans for Phase III

Agenda

1) IAB Approval of Bylaws, Membership Agreement, and Strategic Plan
2) Update on Phase III proposals
3) June IAB meeting
4) Open Discussion

Meeting materials available online: https://crsf.umaine.edu/research-2/center-for-advanced-forestry-systems/

New CAFS Leadership

- After 10+ years of service as CAFS Director, Dr. Barry Goldfarb stepped down
- Dr. Aaron Weiskittel agreed to provide Phase III leadership and started in 2017
  - Oregon State grad
  - Prior industry experience
  - University of Maine Center for Research on Sustainable Forests Director since 2016
- University of Maine is now CAFS Lead Site
  - Meg Fergusson is CAFS Program Manager

Membership Agreement

- Defines relationship between CAFS and IAB members
- Revised existing membership agreement
  - Additional language on IP
  - Publication procedures
- IAB members should be willing to sign document

Center for Advanced Forestry Systems Membership Agreement

This Agreement is made this ENTER DAY day of ENTER MONTH,YEAR by and between University (hereinafter called "UNIVERSITY") and ENTER COMPANY NAME (hereinafter called "COMPANY") for the Center comprising and acting through the Industry & University Cooperative Research Center for Advanced Forestry Systems (CAFS), which is defined as all CAFS Research Sites funded by the Industry & University Cooperative Research Center Program of the National Science Foundation.

WHEREAS, the parties to this Agreement intend to join together in a cooperative effort to support an Industry & University Cooperative Research Center for Advanced Forestry Systems (hereinafter called "CENTER") led by the UNIVERSITY to maintain a mechanism whereby the UNIVERSITY environment can be used to perform research toward the area of forestry.

WHEREAS, University of Maine and UNIVERSITY have entered into an Inter-Institutional Agreement, in a cooperative effort to establish and support the CENTER, and the CENTER intends to maintain a mechanism whereby the CENTER environment can be used to perform research for the CENTER at existing and/or future universities (hereinafter collectively called the "COLLABORATING UNIVERSITIES") in the area of CAFS.

WHEREAS, UNIVERSITY was responsible for recruiting COMPANY to the CENTER.

The parties hereby agree to the following terms and conditions:

A. CENTER will be operated by certain faculty, staff and students at the UNIVERSITY and other Research Sites at the other COLLABORATING UNIVERSITIES.

B. Any COMPANY, Federal Research and Development organization, or any Government-owned Contractor Operated laboratory may become a sponsor of the CENTER, consistent with applicable state and federal laws and statutes.

C. COMPANY agrees to contribute annually to the UNIVERSITY in support of the CENTER and thereby becomes a member.

Because research of the type to be done by the CENTER takes time and research results may not be obvious immediately, COMPANY should join CENTER with the intention of remaining a fee paying member for at least two years. However, COMPANY may terminate this Agreement by giving UNIVERSITY 90 day's written notice prior to the termination date. Fees paid by COMPANY as a member are not refundable.

UNIVERSITY can terminate this Agreement upon at least thirty (30) days prior written notice to COMPANY if: (a) COMPANY is in breach of this Agreement and fails to cure the breach within this 30-day timeframe; or (b) UNIVERSITY decides to discontinue its involvement in the CENTER; provided, however, that UNIVERSITY agrees that the CENTER will continue to exist, upon mutual agreement of each member, so long as the CENTER has a funding agreement in place with NSF. Termination or cancellation of this Agreement shall not affect the rights and obligations of the parties accrued prior to termination.

ByLaws

- Define center policies and operations
  - Organization
  - Roles & Responsibilities
  - Membership
  - Voting Procedures
- Should be presented and approved by IAB

Center for Advanced Forestry Systems Bylaws

ARTICLE I – Introduction

The following operating procedures will be used to govern the Center for Advanced Forestry Systems (CAFS), a National Science Foundation (NSF) Industry & University Cooperative Research Center (IUCRC). Currently, CAFS is compromised of the following affiliated universities/sites: (1) University of Maine (lead institution); (2) University of Georgia; (3) University of Idaho; (4) Auburn University; (5) Oregon State University; (6) Purdue University; (7) University of Washington; and (8) Virginia Tech University. Additional universities and members may join CAFS as specified below.

ARTICLE II – Purpose

The mission of CAFS is to optimize genetic and cultural systems to produce high-quality raw forest materials for new and existing products by conducting collaborative research that transcends species, regions, and disciplinary boundaries. CAFS is a multi-university center that works to solve problems through multi-faceted approaches and questions on multiple scales, including molecular, cellular, individual-tree, stand, and ecosystem levels.

Research focal areas include, but are not limited to: biological sciences (biotechnology, genomics, ecology, physiology, and soils), management (silviculture, planning, optimization), and data analysis/synthesis (bioinformatics, modeling, remote sensing, and spatial analysis).

ARTICLE III – Organization

CAFS will have the following organization that includes a Center Director, Site Directors, Project Scientists (individuals with a CAFS approved research project), a Director's Board (CAFS Director and each Site Director), Industry Advisory Board (IAB) composed of representatives from each CAFS members, IAB Executive Committee (appointed IAB member representative from each site), and a Center Assessment Coordinator appointed by the National Science Foundation. University membership into CAFS requires the member university to adopt and sign the University Memorandum of Understanding (Appendix A). Industrial membership into CAFS is through an Industrial Membership Agreement (Appendix B).

The Center Director will report to their affiliated university's appointed supervisor, while Site Directors will be chosen by the participating university. Project Scientists can be any faculty member affiliated with a CAFS site. IAB representatives can be any individual formally affiliated with a CAFS member.

ARTICLE IV –Roles and Responsibilities

- Center Director
  - Reports annual operations and research budget to IAB
  - Assist the Center Assessment Coordinator to complete necessary annual evaluation requirements set by the National Science Foundation
  - Make final allocation of CAFS research funds to member universities
  - Coordinate with the IAB Executive Committee to address any center business

Strategic Plan & Technology Roadmap

Vision

Support the US forest industry by solving problems with targeted, applied, and collaborative research coordinated across multiple universities

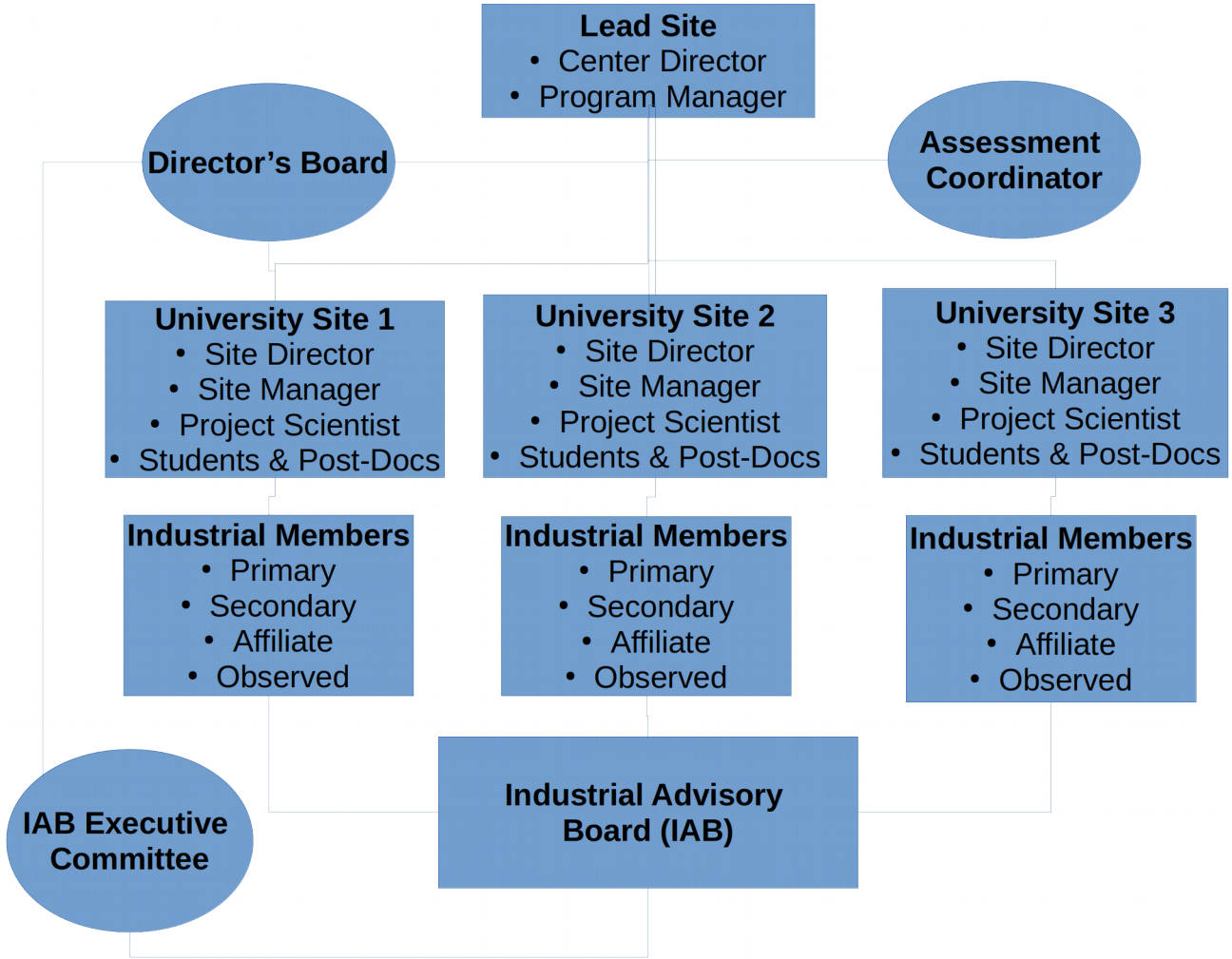
Mission

Optimize genetic and cultural management regimes to produce high-quality raw forest materials for new and existing products by convening scientists from different disciplines to define and conduct collaborative applied research on specific and compelling issues relevant to industry that transcend species, regions, and disciplinary boundaries

Objectives

1. Serve as national organization for R&D relevant to the forest industry
2. Coordinate and perform national research activities across multiple sites that align with the prioritized needs of forest industry
3. Document and communicate key research outcomes to relevant stakeholders
4. Provide a long-term strategic vision for research needs of forest industry
5. Convene leading scientists from academia and industry who are prepared to address new/unforeseen challenges to the forest industry, such as changing markets.
6. Create national networking opportunities for universities and forest industry

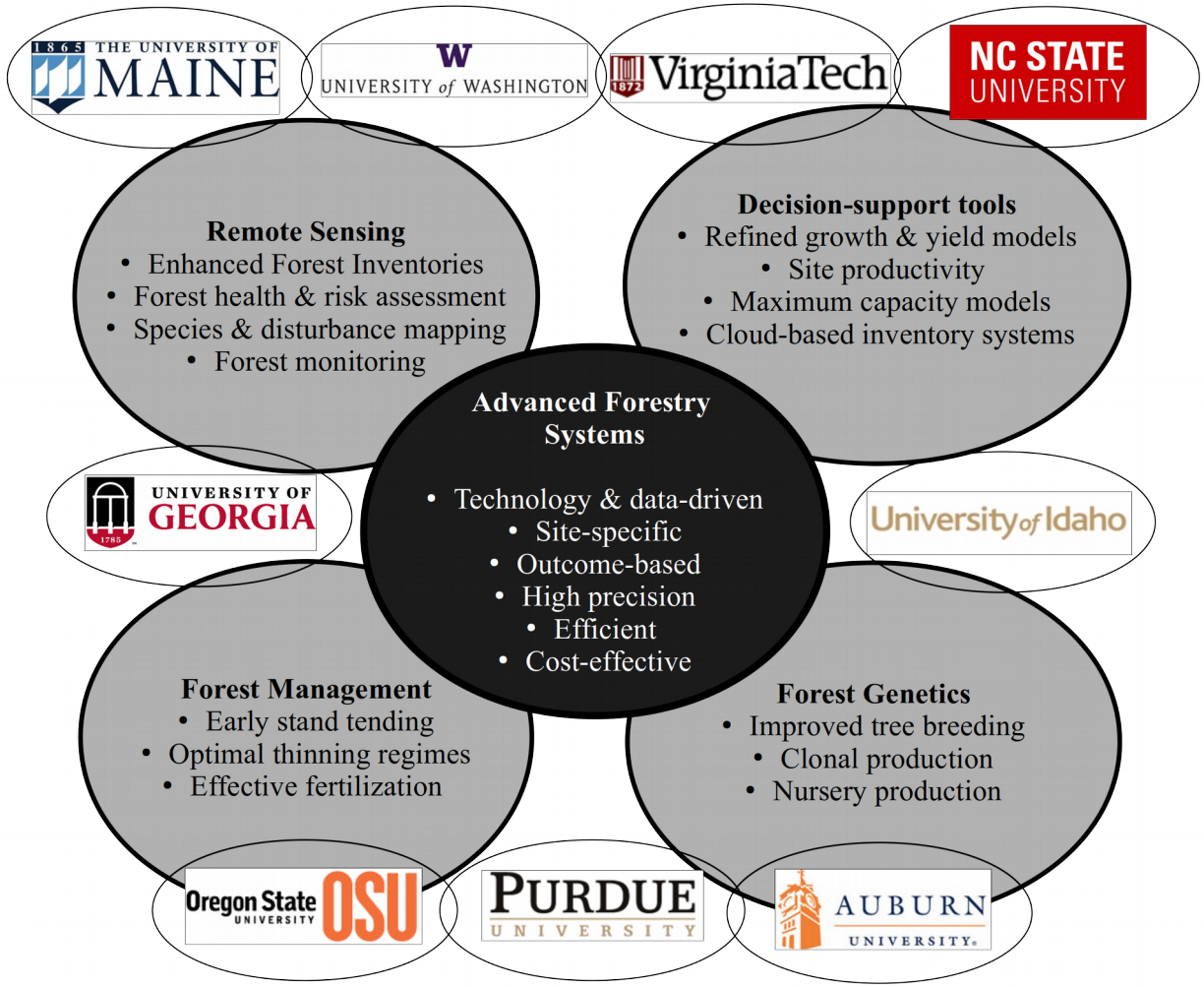
General Center Organization



Leadership

- Center Director (Associated with the Lead University Site)
  - Oversee and allocate resources; Provide annual outcomes and budget
- Site Directors (Associated with Partner University Sites)
  - Serve as a liaison between CAFS and the appropriate academic units of their member universities; Work with Site Project Scientists
- Industry Executive Committee (Comprised of selected members of the Industry Advisory Board with at least one nominee from each Site)
  - Advise, assist, and approve all administrative and policy matters affecting the functioning of CAFS; Promote and publicize CAFS accomplishments to key stakeholders
- Director's Board (Comprised of Center Director, Site Directors, and Industry Executive Committee)
  - Define the mission, objectives, and guiding principles of CAFS; Maintain and update CAFS Strategic Plan and Technology Roadmap

Research Focal Area



University Sites

University	Expertise
Auburn University (AU)	Nursery technology, pine plantation management
North Carolina State University (NCSU)	Forest soils, pine plantation management, productivity modeling
Oregon State University (OSU)	Douglas-fir plantation management, growth and yield modeling, genetics, remote sensing
Purdue University (PU)	Genetics, central hardwoods management, nursery technology
University of Georgia	Genetics, pine plantation management, wood quality, remote sensing, growth and yield modeling
University of Idaho	Mixed-species management, natural regeneration, productivity modeling, remote sensing
University of Maine (UM; lead site)	Mixed-species management, natural regeneration, growth and yield modeling, remote sensing
University of Washington	Douglas-fir plantation management, wood quality, remote sensing, productivity modeling
Virginia Tech	Growth and yield modeling, productivity modeling, pine plantation management, genetics

Membership

Membership Type	Membership Fee	Vote	IP Property Access
Primary	$25,000/yr	10 votes per membership	Yes
Secondary	$10,000/yr	5 votes per membership	Upon Approval
Affiliate	$5,000/yr	0	No
Observer	In-kind (<$10,000k)	0	No

Members

Membership	AU	NCSU	OSU	PU	UGA	UI	UM	UW	VT	Total
Primary	0	5	4	8	2	8	7	8	8	50
Secondary	16	5	14	0	19	2	8	12	12	88
Affiliate	4	3	0	2	0	0	2	0	3	14
Total	20	13	18	10	21	10	17	20	23	152

Diversified membership with strong variation across sites due to the regional and highly specific nature of the forest industry as well as land ownership partners

Governance

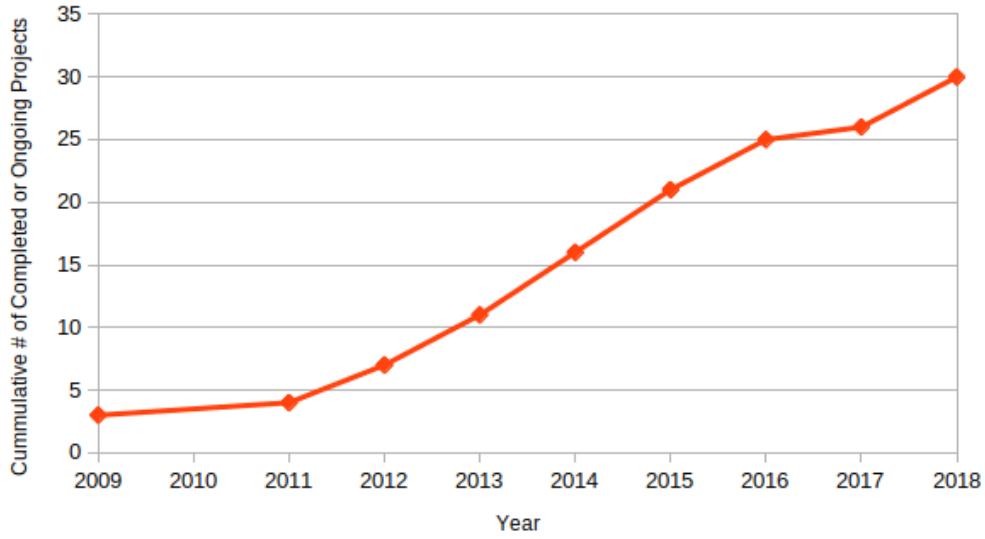
- Bylaws annual assessed and approved
- Standard agreements maintained and adhered
  - Inter-institution MOUs for university
  - Industry membership agreements for IAB members
- Research projects and bylaw amendments require majority approval
- Reporting and center business conducted at biannual meetings or as needed

Primary Metrics of Success

- Return on investment (% return on member dues)
- # of successfully completed research projects
- # of outputs from research projects
  - Publications, presentations, students trained
- # of collaborative grant proposals among universities
- $ of additional funding for Center activities
- % of total center budget from member dues (<70%)
- # of alumni employed by industry members
- # of members (>30% Primary)

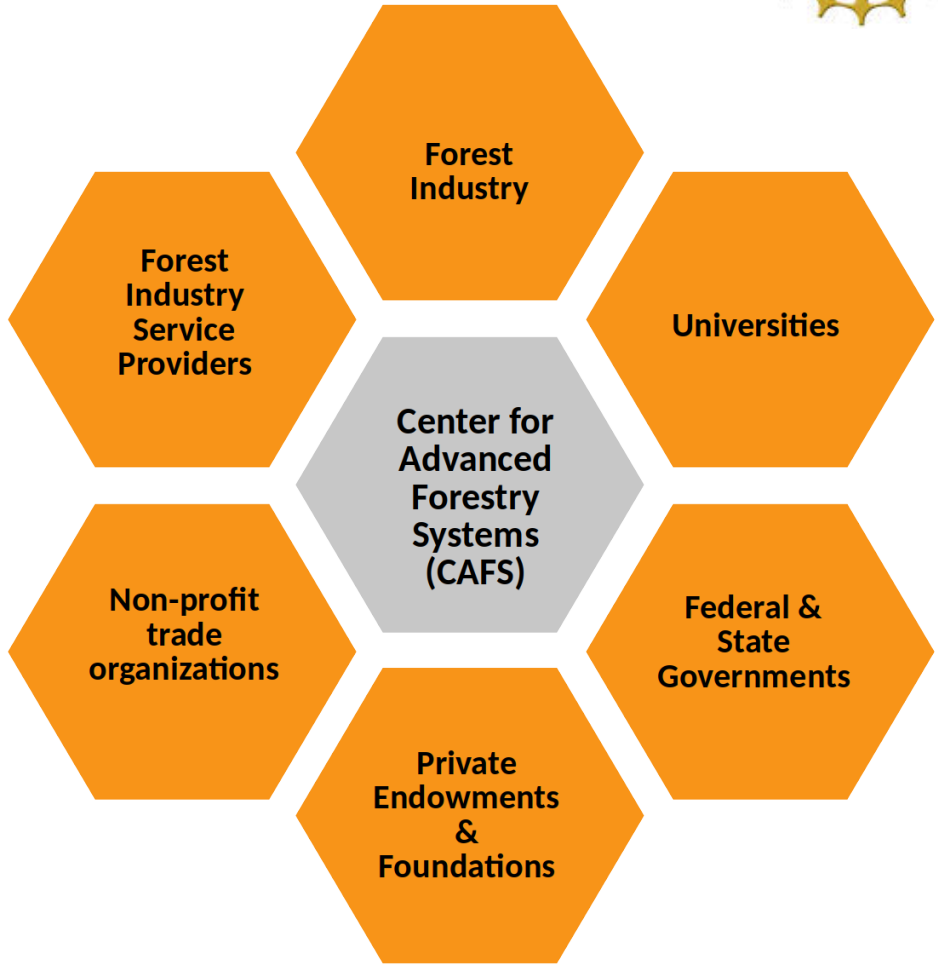
Accomplishments

- 30 completed or ongoing research projects including two multi-site fundamental research grants
- Strong and growing industry participation
- Several alumni working for industry members
- Diversified and productive staff
  - 9 Site Directors, 7 Administrative Staff, 6 post-docs, 25 undergraduate students, and 40 graduate students



Potential Future Partners

- **Non-profit trade organizations**
  - National Council of Air & Stream Improvement
  - American Forest Foundation
  - Sustainable Forestry Initiative
  - Climate Action Reserve
- **Private Endowments & Foundations**
  - U.S. Endowment for Forestry & Communities, Inc.
- **Service Providers**
  - ESRI Inc.
  - Sanborn
  - SilviaTerra
  - LimGeomatics



Sustainability

- Multi-faceted approach to future sustainability
  - Continue to recruit new members, particularly foundations
  - Seek private support
  - Federal research grants and contracts
  - Explore international memberships and partnerships
  - Direct site contributions

Phase III Timeline & Milestones

Milestone	Fiscal Year				
	18-19	19-20	20-21	21-22	22-23
Apply for & secure NSF Phase III funding	■				
Approve bylaws, strategic plan, & technology roadmap	■				
Initiate research projects identified on technology roadmap	■	■	■		
Revise and refine bylaws, strategic plan, & technology roadmap		■	■	■	■
Secure additional partners including industry, academia, and non-profit sectors.	■	■	■	■	■
Integrate center research and education activities that effectively train and benefit undergraduate and graduate students	■	■	■	■	■
Survey, document, and prioritize industry member research needs	■	■	■	■	■
Plan and host biannual meetings	■	■	■	■	■
Annually report progress, outcomes, and finances	■	■	■	■	■

Phase III Research Roadmap

	2019	2020	2021	2022	2023	Outcomes
Theme 1: Forest Modeling & Decision-Support Tools **Primary IAB Partners: American Forest Management, Green Diamond, and Campbell Global**						Provide IAB members with improved tools that allow better and more precise forest management and planning
Project 1: Assessing and mapping regional variation in potential site productivity Lead Partners: NCSU, UI, UGA, UW, PU	■	■	■			Better understand how potential site productivity differs across the key forest regions in the US, the most influential factors, and produce high-resolution maps for IAB members to aid planning
Project 2: Assessing and mapping regional variation in site carrying capacity Lead Partners: UI, UM, OSU, VT, UGA, UW	■	■	■			Derive consistent estimates of maximum stand density index, evaluate most influential factors, and provide high-resolution maps to aid management
Project 3: Evaluation and refinement of regional GY models Partners: UM, VT, UGA, OSU, PU			■	■	■	Using the outcomes from Projects 1 and 2, evaluate regional growth and yield behavior and refine as possible
Theme 2: Effective Use of Remote Sensing Technologies **Primary IAB Partners: JD Irving, Rayonier, and Weyerhaeuser**						Evaluate and leverage emerging remote sensing technologies to improve planning
Project 4: Mapping species composition and past disturbance using optical sensors Partners: UI, UM, UGA	■	■	■			Optimal sensors like Landsat and Sentinnel-2 offer the ability to annual map species composition and past disturbance, but have yet to be tests across the US
Project 5: Improving efficiency and accuracy of Enhanced Forest Inventories derived from LiDAR Partners: UW, OSU, UGA, UM	■	■	■	■	■	LiDAR is becoming increasingly used to produce Enhanced Forest Inventories, but uncertainties on ground data, necessary metrics, and modeling method remain.
Project 6: Using hyperspectral imaging to evaluate forest health risk Partners: VT, NCSU, OSU, UM			■	■	■	Forest health risks are extensive and difficult to detect. Hyperspectral imaging from terrestrial and/or airborne sensors can help detection and quantification

Phase III Research Roadmap

	2019	2020	2021	2022	2023	Outcomes
Theme 3: Improved Silvicultural Practices **Primary IAB Partners: Hancock Forest Management, International Forest Company, and Molpus Timberlands**						Forest managers have a variety of silvicultural regimes to select from, but it is often unclear on selecting the best practices for each site
Project 7: Quantifying long-term gains using advanced genetics Lead Partners: PU, UGA, OSU, NCSU	■	■	■			Tree genetics has seen significant advances in recent years due to better breeding practices and cloning, but a synthesis of the long-term potential effects of these practices across multiple species has yet to be presented
Project 8: Modeling forest response to early stand treatments Lead Partners: UW, UI, NCSU, VT	■	■	■			Vegetation management is critical to successful rotations, but its prediction is complicated by a variety of factors such as the type and extent of competing vegetation. Leveraging long-term datasets, the outcomes of contrasting treatments would be assessed and modeled.
Project 9: Identifying type and level of response to forest fertilization Lead Partners: UW, UI, NCSU, PU			■	■	■	Forest fertilization is a widely used silvicultural practice that is difficult to predict. Using long-term and newly available data, methods to improve predictions of forest responsiveness would be evaluated.
Project-wide activities informed by Research Plan	• **Incorporation of advanced and emerging technologies** • **Delivery of multi-platform, decision-support tools** • **Harmonization, and synthesis of available regional datasets to generalize trends** • **Multi-disciplinary, knowledge to action, and stakeholder-drive framework**					

IAB meetings, evaluation, undergraduate education, publications, attendance at national meetings, securing of additional research support

Logic Model

Things as They Stand Now (Prior to Phase III)

- Over decade of history
- Existing partnerships & recognized national reputation
- Past/ongoing multi-site research projects
- Supportive and engaged membership
- Continuity across US
- Available & diverse regional datasets
- Changes in Key Site Directors and Lead Site
- Support from NSF

Strategies for Moving Things Forward

- More integrated & nationally relevant research projects
- Build upon & expand partnerships
- Improved communications & reporting
- Additional IAB meeting
- Stronger leadership & engagement of Executive Committee
- Better leverage of NSF contributions (e.g. REU)

Achieved/Desired Outcomes

- Strong, engaged, & diversified members across the entire US
- Long-term organizational sustainability
- Influential research outcomes that guide forest management
- Vision that continues research partnerships
- A more robust forest industry that leverages developed technology
- Increased funding

Broader Impacts

- Forests provide numerous ecosystem services, particularly sustainably managed forests
- Train next generation of forest managers and scientists
- Secure and broaden the national forest-based economy
- >2.7 million jobs dependent on forests with total payroll over $110 billion[1]
- ~$100 billion economic impact or >5% of manufacturing GDP[1]

- [1]Forest2Market. 2016. The Economic Impact of Privately-Owned Forests in the United States. Online: https://www.forest2market.com/hubfs/Blog/Forest2Market_Economic_Impact_of_Privately-Owned_Forests_April_2016.pdf

Phase III Proposals

- Phase III proposals due to NSF from each Site on 12/19/18
- Provide another 5-years of funding from NSF
  - $85-100k/yr per site
- Can leverage other NSF programs if successful
  - REU
  - INTERN

A. Project Overview

Center Need & Technical Focus: The Center for Advanced Forestry Systems (CAFS) was established in 2007 to address challenges facing the wood products industry, landowners, and managers of the nation's forestland. CAFS was originally formed by the North Carolina State University (NCSU), Oregon State University (OSU), Purdue University (PU), and Virginia Tech (VT). Since then, CAFS expanded to nine distinct university sites that currently include Auburn University (AU), University of Georgia (UGA), University of Idaho (UI), University of Maine (UM), and University of Washington (UW). UM has been part of CAFS since 2009 and has benefited from both Phase I (2009-2013) and Phase II (2014-2019) investments from the National Science Foundation (NSF). Since 2017, UM has served had the lead site.

The need for CAFS-related research and training has become more urgent as the forest industry remains in transition after the 2008 US housing crisis. In addition, Federal funding of forest-related research has declined from $1.1 billion in 1962 to <$700 million in 2015 [1]. Following the Great Recession, there have been multiple mill closures, land sales, and bankruptcies as well as sharp reductions in harvests and acres planted along with decreased investments in intensive management practices while pressure for forest conservation have become greater. Additional pressures include the reduction in demand for wood pulp, evolving product markets, lack of skilled labor, the spread of invasive pests, land use/ownership changes, increased wildfires, and greater variability in weather patterns. Despite these challenges, several opportunities exist for the forest industry. These include emerging products (e.g. nanofibers, cross-laminated timbers), new markets for nontraditional forest products (e.g., carbon, water), and growing global demand for wood fiber. Coupled with these opportunities, advances in key technologies and improved forest management techniques offer substantial promise in allowing the forest industry to overcome current challenges. For example, increases in productivity and shortened rotations have occurred in the southern US where pine productivity has increased from 2 to 20 m3 ha-1 year-1 in the last three decades alone [2].

This order-of-magnitude increase in productivity is due to the implementation of several management practices including fire control, soil preparation, improved genetics, fertilization, vegetation control, and density manipulation. To increase these yields further, the forest industry must harness emerging technology and develop precision forest management regimes in which the trees, soil, and other vegetation are actively managed at the necessary resolution to optimize value. Implementation of these regimes requires knowledge concerning how a tree's genetic composition interacts with the environment to affect productivity, stem quality, wood quality, and resistance to insects and diseases. In addition, a site-specific understanding of what factors limit production (temporally and spatially) and how contrasting treatments can be used to address these limitations is required. In many respects, intensive and high precision forest management is much like modern agriculture, but it is still firmly based on forestry's strong ecological and physiological foundations. In addition, unlike the annual production cycle of agriculture, sustainable and high-value forest management requires long-term planning, which creates the need for highly robust decision-support tools and refined technologies for monitoring, modeling, and forecasting current as well as future yields across multiple decades.

Given the diversified ownership of commercially managed forests that vary from high investment, single-species plantations of the Southeast and Pacific Northwest to naturally regenerated, mixed species forest widespread throughout the Inland Northwest and Northeast, forestry research and development has tended to be regional in scope, including several long-term university-industry cooperatives (Table 1). This regionalization is also reflected in the evolution of CAFS over the last decade. A primary objective of CAFS was to unify regional cooperatives under a consistent structure and function. This was achieved in Phase I of CAFS with key partnerships established and potential cross-site synergies identified. In Phase II, CAFS continued regional integration of research projects and completed a second multi-site collaborative fundamental research effort. Phase III will have even greater integration of research efforts and a more nationally-relevant focus. For Phase III, all of the original and current sites will continue with

June IAB Meeting

- Next IAB meeting is June 4-5, 2019
- Hotel Indigo in Athens, GA
- Indoor session and field tour
- Held in conjunction with Manomet's Climate Smart Land Network
  - Joint field tour

Questions/Comments?

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https://crsf.umaine.edu/research-2/center-for-advanced-forestry-systems/