Appendix A
Regional Summaries

Alaska

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Description of the Region

Alaska is a vast State covering 586,412 square miles, an area roughly one-fifth the size of the contiguous United States. It is the northernmost, easternmost, and westernmost State. Alaska has 318 different soil types and 100 volcanoes, more than 40 of which have been active in historic time, making up 80 percent of the active volcanoes in the United States.

Permafrost is thickest in the arctic, north of the Brooks Range, but it can be found in nearly 85 percent of the State. Glaciers, ice fields, high alpine tundra, moist coastlines, fjords, and rainforests limit the potential for agroforestry in much of Alaska. Forests cover approximately one-third of the total land area of Alaska (Parson et al. 2001), with 72 percent of the forest cover being in public ownership (Oswalt et al. 2014). The Federal Government is the largest owner of forest land: more than 10 million acres (ac) are within the boundaries of two national forests managed by the U.S. Department of Agriculture (USDA) Forest Service; 17 million ac are managed by the U.S. Department of the Interior, Bureau of Land Management; and 36 million ac are managed by other Federal agencies.

The State of Alaska manages 28 million ac of forest land (Oswalt et al. 2014). Only about 36 million ac of forest land are privately owned by individuals and another 33 million ac are owned by private corporations (Oswalt et al. 2014). Of the total forest acreage, 90 percent is interior boreal forest and the other 10 percent is in coastal temperate rainforest (Wolken and Hollingsworth 2012). Arable land suitable for crop production is extremely limited in Alaska; only 0.2 percent of the land is currently being actively farmed (USDA NASS 2014). For these reasons, the level of commercial forestry and commercial agriculture operations in Alaska is small when compared with many other States.

Alaska Natives have resided in the State "since time immemorial," determined to be more than 10,000 years. Today, many Alaska Natives continue to participate in traditional hunting, fishing, and gathering activities. Nonnative residents also have adopted the harvest and use of plants, animals, and fish as part of a natural resource-based lifestyle referred to in Alaska as subsistence (Berman et al. 1998). The gathering and harvesting of forest products provide an opportunity to perpetuate traditional ways; engage in recreational, social, and family activities; find spiritual connection; and acquire food and material goods to support a livelihood.

Three primary factors influence Alaska's climate. First, Alaska's high latitude, ranging from 51°N. to 71°N., results in extreme variations in solar radiation. Second, with 33,904 miles of tidal shoreline—more coastline than the contiguous United States—a significant portion of the State is influenced by ocean currents and, in the far north, by sea ice. Coastal locations are characterized by relatively small seasonal temperature variability and high humidity. Inland locations, not directly influenced by oceans, experience a climate more characterized by large daily and annual temperature fluctuations, low humidity, and relatively light and irregular precipitation (Alaska Climate Research Center 2014). The third factor, the elevation, which ranges from sea level to 20,320 feet above sea level, also influences the State's climate.

Glaciers cover approximately 5 percent of the State (29,000 square miles). Both commercial agriculture and commercial forestry are very limited compared with the same activities in many other States. As mentioned previously, forests cover only one-third of the land base (USDA NASS 2014).

Most farms in Alaska are in the Matanuska Valley northeast of Anchorage and the Tanana Valley east of Fairbanks. In 2014, 760 farms were operating on 830,000 ac (USDA NASS 2014). The top agricultural revenue producers are greenhouse and nursery products, with barley, hay, oats, and potatoes being the prevalent field crops. Having the benefit of long hours of summer sunlight, the Matanuska Valley produces world-record crops, such as a 19-pound carrot, a 76-pound rutabaga, and a 127-pound cabbage.

Agroforestry in Alaska

Very little agriculture is mixed with forestry at this time in Alaska. During fiscal years 2010 through 2014, only 20 completed or planned agroforestry activities were documented: 4 windbreaks/shelterbelts; 4 multistory croppings (forest farming); 8 riparian forest buffers; and 4 silvopastures (Western Forestry Leadership Coalition 2012). Several nontimber specialty crops are produced in Alaska that, depending on the level of management, could be considered forms of agroforestry. Brief discussions on each of these activities are included below.

Silvopasture

Grazing of understory vegetation in young forests and woodlands is not well documented. Although such grazing may occur on a limited basis in interior Alaska, no documentation of this activity was found, beyond the notation from the Western Forestry Leadership Coalition.

Riparian Forest Buffers

Riparian buffers are an increasing component of forest restoration efforts in southeast Alaska and may help offset some climate change impacts on aquatic health and fisheries. Riparian buffer standards are published in Alaska Department of Natural Resources (2007), but Alaska has not adopted the USDA Natural Resources Conservation Service (NRCS) Conservation Practice Standards on Riparian Forest Buffer, Windbreak/Shelterbelt Establishment, and Windbreak/Shelterbelt Renovation (Graham 2015).

Forest Farming

Many opportunities exist in Alaska for growing potentially high-value understory crops, including mushrooms, berries (Holloway 2006), medicinal plants, and plants used for tea and other products. DENALI BioTechnologies, Inc. (http://denalibiotech.com), located in Homer in southern Alaska, produces nutraceuticals—dietary supplements with health benefits. One product is made from wild blueberries and huckleberries harvested from around the State. Dandelions and rosehips are also harvested for other products. Many of the berries come from Kake in southeast Alaska, where Sealaska Corporation owns and manages 20,000 ac of forest land. Sealaska obtained USDA organic certification for its young growth forests and, subsequently, blueberry prices topped $3.10 per pound (Savell 2012).

At Starrigavan Creek Watershed in Sitka, also in southeast Alaska, the growth of wild berries is being encouraged through thinning and habitat improvement efforts (USDA NRCS 2014). Other plants are also harvested in the wild (see the Specialty Products section). An expansion of forest farming could provide an opportunity to increase the harvest and reliability of various crops while assuring the sustainability of the plants.

Alley Cropping

Four Alaska farms reported that they practiced alley cropping or silvopasture in 2012 (MacFarland 2014). The potential may exist for expansion in some locations.

Specialty Products

Spruce tips are harvested in Gustavus, in southeast Alaska, for use in a specialty beer produced in Juneau. Spruce tips are also used in jams and jellies.

Birch syrup is commercially produced in the interior of Alaska, with more than 1,500 gallons of syrup produced in 2013. In addition to producing spruce syrup, a wild medicinal Alaska tea made from Chaga mushrooms (*Inonotus obliquus*) that grow primarily on live birch trees in cold climates is also marketed.

Several studies have explored the feasibility of wood energy, including pellets and bricks, for residential heating (Nicholls et al. 2010). Wood-fired heating systems currently are being used in Juneau, Craig, and other communities and a pellet plant in Fairbanks produces wood pellets.

Threats and Challenges to Agricultural Production and Community Well-Being

Food insecurity is a significant and growing problem in Alaska, resulting from limitations in land suitable for food production, decreasing sources and harvests of traditional foods, and a heavy reliance on imported foods. Alaska is already a region that has experienced significant warming during the past 60 years, which has led to earlier spring snowmelt, warmer permafrost, widespread droughts, and extensive insect outbreaks and wildfire (Melillo et al. 2014). These effects are reducing the growth and availability of many of the traditional foods that historically have been heavily relied on. Impact on permafrost is expected to negatively affect transportation capabilities, further exacerbating food security issues. These impacts are expected to persist and worsen under climate change, with Native Alaska communities being especially vulnerable.

Developing Agroforestry Opportunities

Wild Alaska berries have long been important to Alaska Native people. The recognized and now documented health benefits of Alaskan berry resources are positive incentives for development of commercial production (Kellogg et al. 2011). Several opportunities exist for commercialization of berry harvest and production. A few small-scale operations around the State harvest berries and produce and sell jams, jellies, syrups, and other berry products (see the previous Specialty Products section). Expansion of a commercial berry industry would require striking "a strategic balance between the tribes

and the marketplace, extraction and preservation of resources, traditional activities and modern business practices and more investigation into the interplay of these factors" (Kellogg et al. 2011). It appears this balance has been effectively achieved with wild berry harvests in Kake.

The University of Alaska Fairbanks has developed agroforestry and demonstration projects at its Matanuska Experiment Farm and Delta Junction field research site to identify plants (e.g., berries, fruit trees, medicinal plants) with agroforestry potential (Western Forestry Leadership Coalition 2012). The NRCS has published a fairly comprehensive guide for managing wild berry stands (Holloway 2006).

The predicted warming of the subarctic and arctic areas in Alaska may afford opportunities to produce food crops locally. Work by Barbeau et al. (2015) in the subarctic region of Canada demonstrated that crops such as potato and bush bean could be grown and that their yield could be increased through the use of willow windbreaks. Willow is a common and diverse species in Alaska, which suggests resilient agroforestry systems for vegetable crop production and for other products from the willow (e.g., feedstock for heat or combined heat/power generation) can be a viable component in Alaska climate-smart strategies.

The State of Alaska is expanding green firebreaks near the community of Tok in east-central Alaska to help protect the community from wildfire, while providing a source of wood for bioenergy. According to Jeff Hermanns, the Tok Area Forester, a wood-chip boiler system heats the Tok School and a greenhouse, and it generates power. The project supplies 2,000 tons of wood energy per year, saving the community $80,000 to $100,000 per year (Hermanns 2015). The project was described in the TimberWest journal (TimberWest Publications 2012). In addition, more than 20 wood-energy systems are operating in Alaska. The Renewable Energy Alaska Project documents several wood-energy projects on its biomass Web page (http://alaskarenewableenergy.org/why-renewable-energy-is-important/alaskas-renewable-energy-projects/). The Alaska Energy Authority also tracks wood-energy projects and administers a renewable-energy fund (http://akenergyauthority.org/AEEE/Biomass/AWEDTG).

Key Information Needs

- Additional research is needed to help determine how agroforestry systems can be designed for use in Alaska to support the sustainable production of edible native foods and other crops and woody biomass for energy and also to maximize wildlife and fish habitat and provide other benefits.
- Locally adapted and diverse plant materials, both woody and herbaceous, need to be developed to build more climate-adapted agroforestry practices suited to Alaska's environment.

Literature Cited

Alaska Climate Research Center. 2014. There are three primary factors that contribute to Alaska's climate. http://akclimate.org/Climate. (18 October 2016).

Alaska Department of Natural Resources. 2007. Alaska forest resources & practices regulations. http://forestry.alaska.gov/Assets/uploads/DNRPublic/forestry/pdfs/reforestation/07JuneForestResourcesPracticesActRegulations.pdf. (18 October 2016).

Barbeau, C.D.; Oelbermann, M.; Karagatzides, J.D. [et al.]. 2015. Sustainable agriculture and climate change: producing potatoes (*Solanum tuberosum* L.) and bush beans (*Phaseolus vulgaris* L.) for improved food security and resilience in a Canadian subarctic First Nations community. Sustainability. 7(5): 5664–5681.

Berman, M.; Juday, G.; Burnside, R. 1998. Climate change and Alaska's forests: people, problems, and policies. http://www.besis.uaf.edu/besis-oct98-report/Forestry.pdf. (15 November 2016).

Graham, J. 2015. Personal communication. Forest Stewardship Program Coordinator. Alaska Division of Forestry, 550 West 7th Avenue, Suite 1450, Anchorage, AK 99501.

Hermanns, J. 2015. Personal communication. Tok Area Forester, Alaska Division of Forestry, Area Box 10, Tok, Alaska 99780.

Holloway, P.S. 2006. Managing wild bog blueberry, lingonberry, cloudberry, and crowberry stands in Alaska. Report for University of Alaska Fairbanks and Natural Resource Conservation Service, Fairbanks. 12 p.

Kellogg, J.; Higgs, C.; Lila, M.A. 2011. Prospects for commercialization of an Alaska Native wild resource as a commodity crop. Journal of Entrepreneurship. 20(1): 77–101.

MacFarland, K. 2014. Agroforestry: programs, policies, and trends. Presentation at the Agroforestry Workshop held by Oregon State University, Corvallis, OR. 21–22 October 2014. http://www.forestry.oregonstate.edu/sites/www.forestry.oregonstate.edu/files/agroforestry/AgroforestryUSDA.pdf. (18 October 2016).

Melillo, J.M.; Richmond, T.C.; Yohe, G.W., eds. 2014. Climate change impacts in the United States: the third national climate assessment. Washington, DC: U.S. Global Change Research Program. 841 p. http://nca2014.globalchange.gov. (30 October 2014).

Nicholls, D.L.; Brackley, A.M.; Barber, V. 2010. Wood energy for residential heating in Alaska: current conditions, attitudes, and expected use. Gen. Tech. Rep. PNW-GTR-826. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 30 p.

Oswalt, S.N.; Smith, W.B.; Miles, P.D.; Pugh, S.A. 2014. Forest resources of the United States, 2012: a technical document supporting the Forest Service 2015 update of the RPA assessment. Gen. Tech. Rep. WO-91. Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office. 218 p.

Parson, E.A.; Carter, L.; Anderson, P. [et al.]. 2001. Potential consequences of climate variability and change for Alaska. In: National Assessment Synthesis Team, eds. Climate change impacts on the United States: foundation report. Cambridge, United Kingdom: Cambridge University Press: 283–312.

Savell, S. 2012. Kake forests provide more than just trees. http://blogs.usda.gov/2012/12/05/kake-forests-provide-more-than-just-trees/. (18 October 2016).

TimberWest Publications. 2012. Heating up. TimberWest: Journal of Logging and Sawmills. May/June. http://forestnet.com/TWissues/may_june2012/heating_up.php. (18 October 2016).

U.S. Department of Agriculture, National Agricultural Statistics Service (USDA NASS). 2014. 2012 census volume 1, chapter 2: state level data. Washington, DC: U.S. Department of Agriculture, National Agricultural Statistics Service. http://www.agcensus.usda.gov/Publications/2012/Full_Report/Volume_1,_Chapter_2_US_State_Level/. (18 October 2016).

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NRCS). 2014. NRSC forestry projects in southeast Alaska. http://www.ak.nrcs.usda.gov/wps/portal/rrcs/main/ak/newwsroom/factsheeets/. (17 November 2016).

Western Forestry Leadership Coalition. 2012. Western agroforestry case studies: opportunity for agroforestry in a warming Alaska. http://wflcweb.org/news_pdf/417_pdf.pdf. (18 October 2016).

Wolken, J.M.; Hollingsworth, T.N. 2012. Appendix 1: regional summaries—Alaska. In: Vose, J.M.; Peterson, D.L.; Patel-Weynand, T., eds. Effects of climatic variability and change on forest ecosystems: a comprehensive science synthesis for the U.S. forest sector. Gen. Tech. Rep. PNW-GTR-870. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 205–242.