SEWALL FORESTRY
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REPORT

Maine Wood Volume and Projection Study 2021 Update

Prepared for:

FOR/Maine

Prepared by:

Ernest Bowling

Gary Mullaney

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1. UPDATED DEMAND ESTIMATES

In 2018 FOR/Maine contracted with Sewall to produce an analysis of the current demand for Maine forest products and potential future supply. In 2020, the Maine Forest Products Council (MFPC) contracted with Sewall to provide an update of this study. The tasks were to update the demand estimates based on current market conditions and more recent Wood Processor Report data, update the wood supply projections based on the updated demand data, make wood supply projections assuming both light and heavy spruce budworm outbreaks, and refine the harvest prescriptions for forest management by small landowners.

Anticipated Consumption of Timber Resources in Maine as of Late 2020
The original report was issued in spring, 2018. The modeling runs used estimates of consumption rates effective as of late 2017. Particularly in the case of hardwood and spruce-fir, the estimates were well below the FIA-observed average harvest levels for the prior decade because of then-recent significant contraction in the pulp industry in Maine. Here are the estimates from the original report:

Table 1.1. Assumptions in the Original Report, Spring 2018

Species Group	Annual Average 2008-16		Ratio WPR/FIA	WPR 2016	Sewall Estimate 2017
	FIA	WPR			
Aspen	1,192	619	0.52	705	900
Cedar	288	83	0.29	72	200
Hardwood	7,410	5,263	0.71	5,439	5,200
Other Softwood	1,093	861	0.79	612	750
Pine	1,116	1,322	1.18	1,107	1,100
Spruce-fir	3,763	3,000	0.80	2,737	3,200
Total	14,862	11,148	0.75	10,672	11,350

Just over a year later, in June of 2019, a number of announcements by pulp mills in Maine had occurred that meant a net increase in the consumption of timber compared to late 2017. MFPC requested that Sewall adjust the consumption estimates to reflect these changes, which were:

Sappi – modest shift from softwood to hardwood
Pixelle (Jay) – some reduction in hardwood, large increase in softwood consumption
ND Paper (OT) – restart using significant quantities of softwood
Taken together, these changes amounted to:

Spruce-fir pulpwood	+300,000 tons/year
Pine & hemlock pulpwood	+1,000,000 tons/year
Hardwood pulpwood	+50,000 tons/year

As a result, the new estimates were:

Table 1.2. Changes to Estimates in July 2019

Species Group	Sewall Estimate 2017	Change	Sewall Estimate 2019
Aspen	900	-	900
Cedar	200	-	200
Hardwood	5,200	50	5,250
Other Softwood	750	405	1,155
Pine	1,100	595	1,695
Spruce-fir	3,200	300	3,500
Total	11,350	1,350	12,700

Since July of 2019, yet more changes have occurred or been announced:

- An industrial accident at Pixelle (Jay) in April 2020 led to the cessation of pulp production there.
- Capacity expansion of Spruce-fir sawmills at Jackman and Dover-Foxcroft.
- Startup of a new Spruce-fir sawmill at Enfield.

Taken together, these changes mean:

Pine & hemlock pulpwood	(990,000) tons per year
Hardwood pulpwood	(450,000) tons per year
Spruce-fir	+ 715,000 tons per year

Table 1.3. Proposed New Estimates as of August 2020

Species Group	Sewall Estimate 2019	Change	Sewall Estimate 2020
Aspen	900	-	900
Cedar	200	-	200
Hardwood	5,250	(450)	4,800
Other Softwood	1,155	(396)	759
Pine	1,695	(594)	1,101
Spruce-fir	3,500	715	4,215
Total	12,700	(725)	11,975

The Wood Processor Report (WPR) typically includes "noise" from year to year –random weather and inventory fluctuations that do not indicate lasting trends. It is more meaningful to look at three-year (or longer) averages as in Table 1.4, below.

Table 1.4. New Estimates in Comparison to Recent WPR Data

Species Group	FIA 2008-16	WPR Avg 2008-16	WPR Avg 2016-18	Sewall Estimate 2020	Comment
Aspen	1,192	619	554	900	WPR reports only pure loads
Cedar	288	83	124	200	WPR does not capture all harvests
Hardwood	7,410	5,263	5,034	4,800	Jay shutdown
Other Softwood	1,093	861	697	759	Jay shutdown, OT full production
Pine	1,116	1,322	1,014	1,101	Jay shutdown, OT full production
Spruce-fir	3,763	3,000	2,632	4,215	OT full production + sawmill capacity
Total	14,862	11,148	10,055	11,975	

As expected, the WPR average for hardwood declined. We expect further declines if Jay remains shutdown. Due to a combination of circumstances, the harvest level for pine and other softwood for 2016-18 aligns well with our estimate for 2020 and beyond. For Spruce-fir, the 2016-18 period was prior to the resumption of pulp production at Old Town and prior to the expansion of two Pleasant River sawmills and the startup of Enfield. As a result, total mill capacity and anticipated harvest levels by 2021 are sharply higher.

Our 2020 estimate is based on the assumption of zero pulp production at Jay. It may be that Pixelle will rebuild the pulp production line at some point. It would be prudent for the study of future wood supply in Maine to include scenarios with and without pulpwood consumption at Jay, as shown in Table 1.5.

Table 1.5. "A" and "B" Estimates, Depending on Pixelle at Jay

Species Group	Sewall Estimate 2020 "A"	Jay	Sewall Estimate 2020 "B"
Aspen	900	-	900
Cedar	200	-	200
Hardwood	4,800	450	5,250
Other Softwood	759	396	1,155
Pine	1,101	594	1,695
Spruce-fir	4,215	-	4,215
Total	11,975	1,440	13,415

2. UPDATED WOOD SUPPLY PROJECTIONS

The wood supply model used in the original project was based on USFS FIA data from 2012 to 2016. The projections were assumed to have started in 2016. Since approximately 5 years have passed from the original study to this update, harvest levels for the first 5-year period (2016 to 2021) were fixed at the levels used in the first period for the original study (harvest levels were fixed at what is assumed to be the actual consumption during that period). The model was then allowed to optimize harvest levels starting in period 2 of the projection.

Projections were made using Sewall estimates "A" and "B" from Table 1.5 above. Both models predicted harvest levels in excess of the assumed consumption (there was no difference in the projections since both solved for the same higher harvest levels). Therefore, runs using Sewall estimate "A" were discarded and work proceeded using Sewall estimate "B" as the baseline.

For the improved forest management on small private landowner runs, new yield projections using FVS were made based on input from Tom Doak (Executive Director, Maine Woodland Owners). He suggested modeling "Heavy" and "Light" forest management regimes. The "Heavy" regime assumed a 50% removal with re-entries scheduled every 35 years. The "Light" regime assumed a 15% removal with re-entries scheduled every 20 years. We assume that the "Heavy" regime is applied to 80% of the small owner category and the "Light" regime is applied to the remaining 20%.

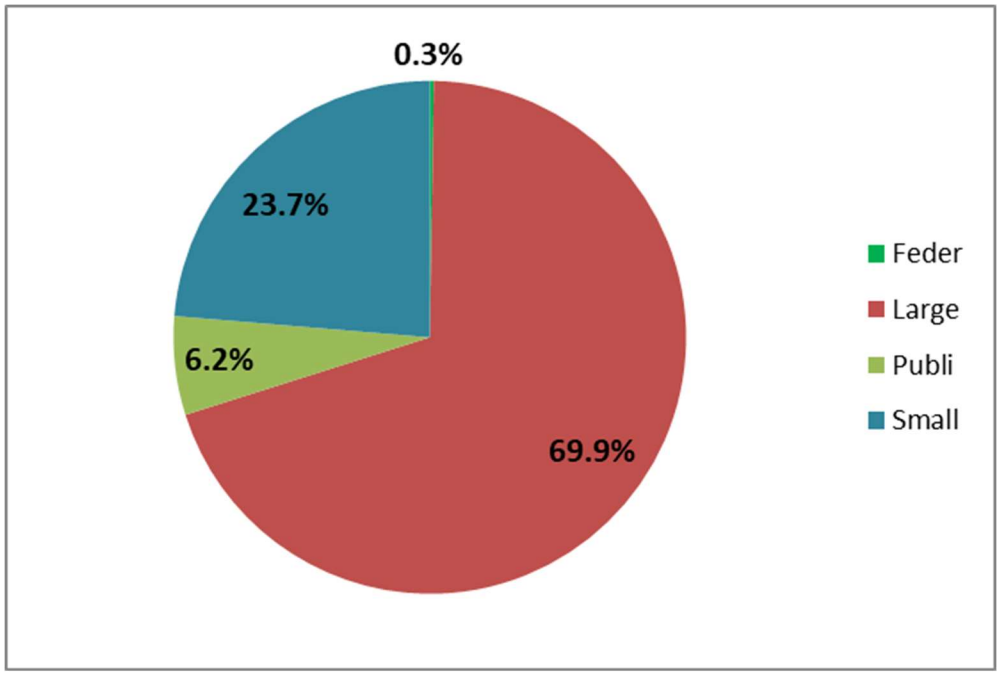
For the spruce budworm runs we collaborated with Jereme Frank (Maine Forest Service). Jereme has made forecasts of future conditions with and without a spruce budworm outbreak. Jereme provided inventory estimates of spruce and fir with and without a spruce budworm outbreak. We sought to make our yield forecasts mimic those that Jereme provided assuming a heavy budworm outbreak. We did this by applying scaling factors to our yield curves. We assumed that outbreaks would begin during the 2025-2029 projection period and end by the end of the 2030-2034 period. We were able to mimic Jereme's predicted budworm loss by scaling by 28.5% in the 2025-2029 period and by 47% in the 2030-2034 period. Yield projections after 2034 were assumed to track parallel to the yield curves without budworm. For the light budworm outbreak we assumed budworm loss at 25% of the loss assumed for the heavy outbreak.

We chose to use projections using Sewall estimate "B" as base level consumption (Table 1.5) with the updated small landowner yield projections in place as the new "Base" run.

SPRUCE-FIR PROJECTIONS

In the "Base" scenario approximately 70% of the potential spruce-fir harvest (for the 50-year projection) comes from large landowners, with approximately 24% coming from small landowners, 6% from Other Public Lands, and less than 1% from Federal lands (Figure 2.1). The largest volumes of spruce-fir removals are predicted in the northern and eastern parts of the state where large landowners are prevalent.

Figure 2.1. Base Run, Distribution of Average 50-year Modeled Harvest of Spruce-fir Across Landowner Types



Modeled harvest levels by megaregion appear in Figure 2.2. Potential harvest levels are approximately 5.7 million tons for periods 2 to 5, increasing to roughly 8.2 million tons by period 7. The vast majority of spruce-fir removals are predicted in the North and East Megaregions.

Figure 2.2. Base Run, 50 year Harvest of Spruce-fir by Megaregion

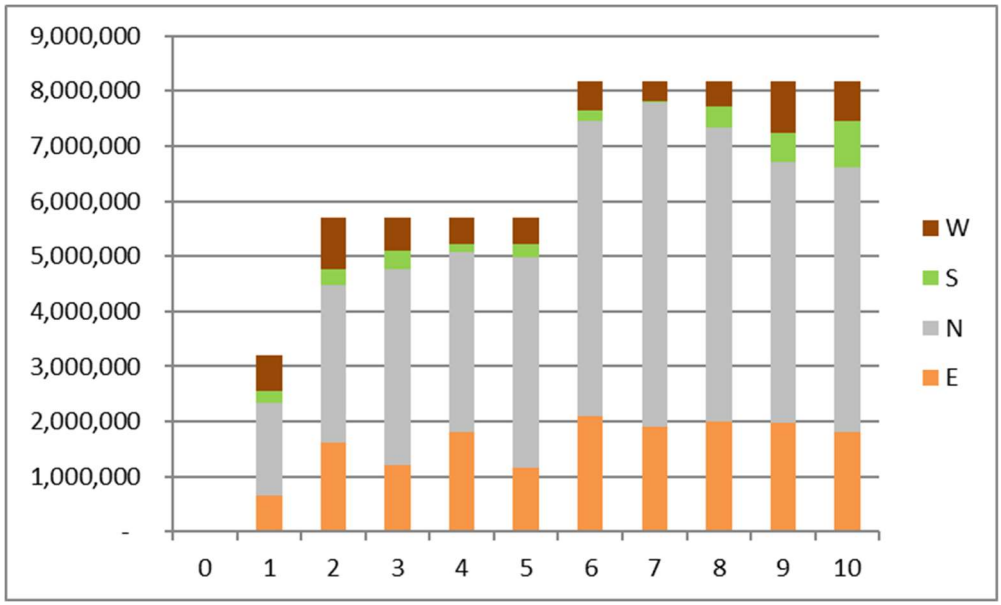
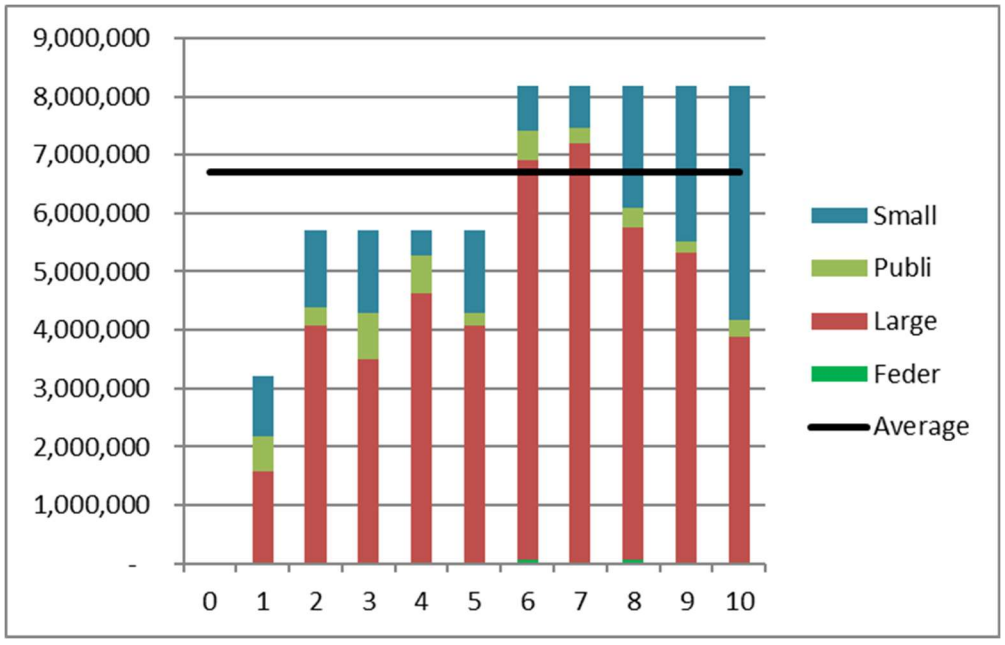


Figure 2.3 displays the modeled spruce-fir harvest levels by landowner type for the 50-year projection. Most of the potential spruce-fir harvest comes from large and small landowners.

Figure 2.3. Base Run, 50-year Harvest of Spruce-fir by Landowner Type



Inventory levels by landowner type that result from these harvest projections appear in Figure 2.4. Spruce-fir inventory is projected to increase from approximately 160 million tons at the start of the run to approximately 250 million tons by periods 6 and 7. Inventory then declines somewhat to approximately 230 million tons by period 10. Figure 2.4 shows spruce-fir inventory on large landowners remaining roughly constant at about 100 million tons on large landowners and increasing over time on small landowners.

Inventory levels by megaregion are shown in Figure 2.5. Most projected spruce-fir inventory is in the north and east megaregions. Increase in spruce-fir inventory is most pronounced in the northern megaregion.

Spruce-fir projected harvest by landowner type after applying the discounts appear in Figure 2.6. With discounts applied harvest levels are approximately 5.5 million tons in periods 2 to 5, rising to approximately 8 million tons by period 7.

Figure 2.4. Base Run, 50-year Projected Spruce-Fir Inventory by Landowner Type

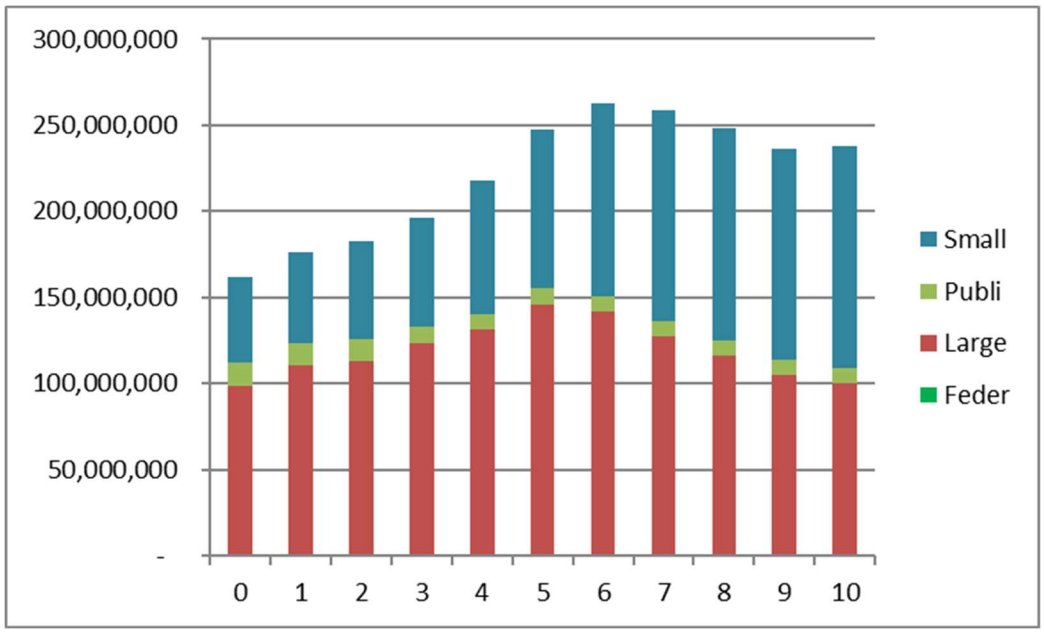


Figure 2.5. Base Run, 50-year Projected Spruce-Fir Inventory by Megaregion

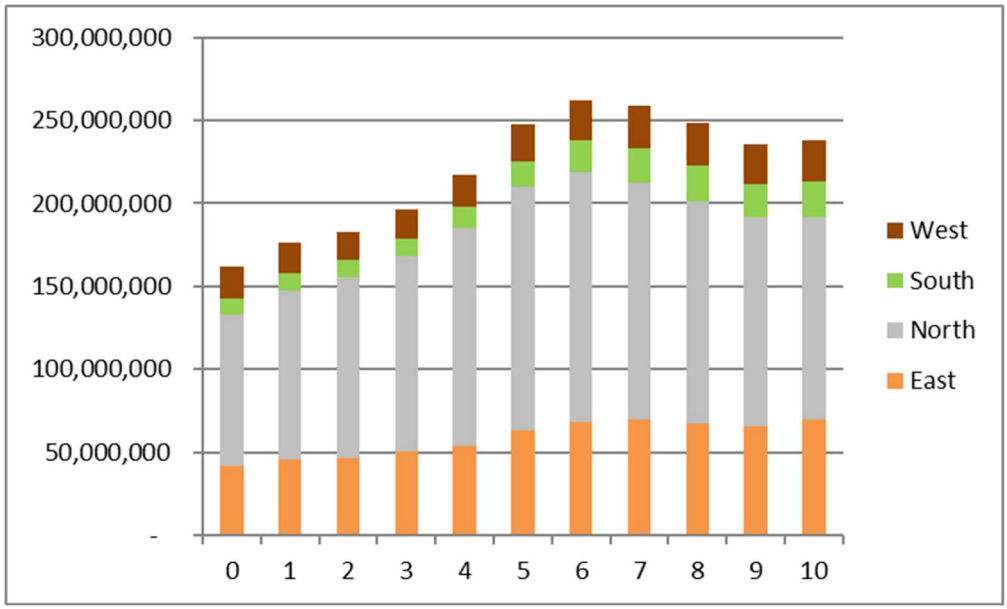
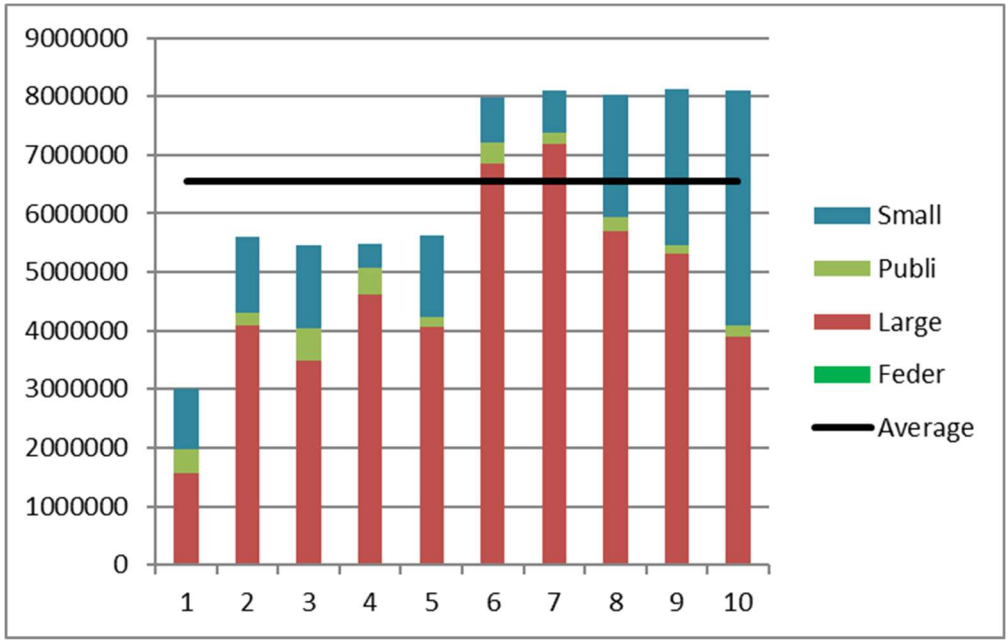


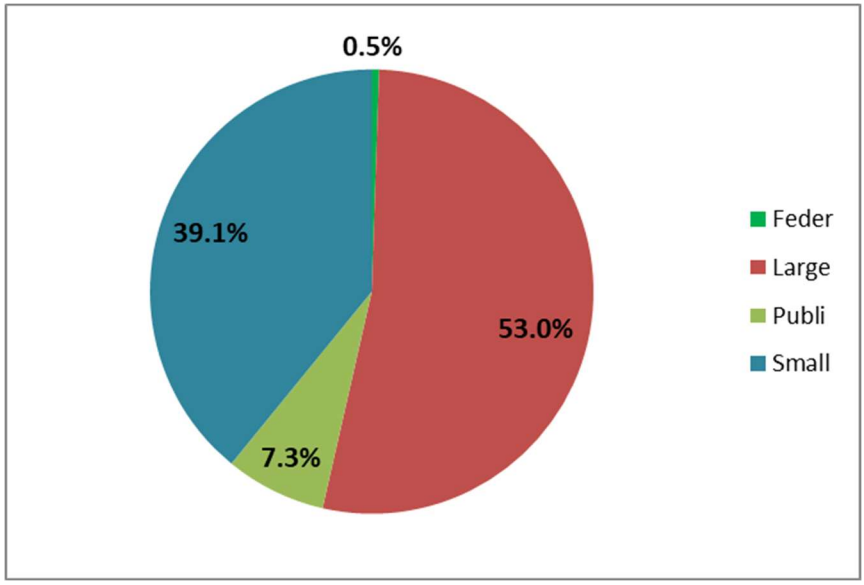
Figure 2.6. Base Run, 50-year Harvest of Spruce-fir by Landowner Type, With Discounts



MIXED DENSE HARDWOOD PROJECTIONS

In the "Base" run 53% of the mixed hardwood harvest is from large landowners (Figure 2.7). 39% is from small landowners, 7% from other public, and less than 1% from Federal lands.

Figure 2.7. Base Run, Distribution of 50-year Projected Harvest of Mixed Dense Hardwood by Landowner Type



The projected harvest by megaregion appears in Figure 2.8. Harvest levels rise to approximately 8.5 million tons in period 2 and remain constant for the remaining periods. Harvest levels by megaregion are fairly constant from period 2 onward (with some swapping back and forth between west and south).

Figure 2.8. Base Run, 50-year Modeled Harvest of Mixed Dense Hardwood by Megaregion

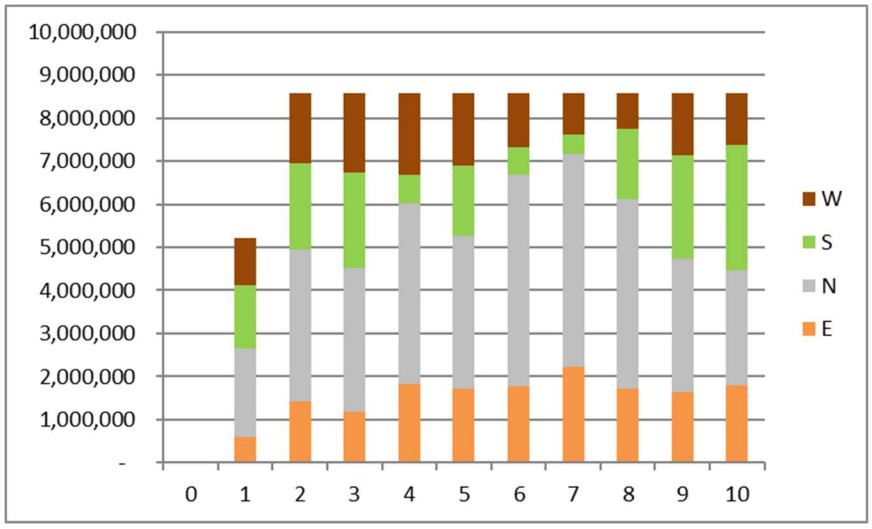
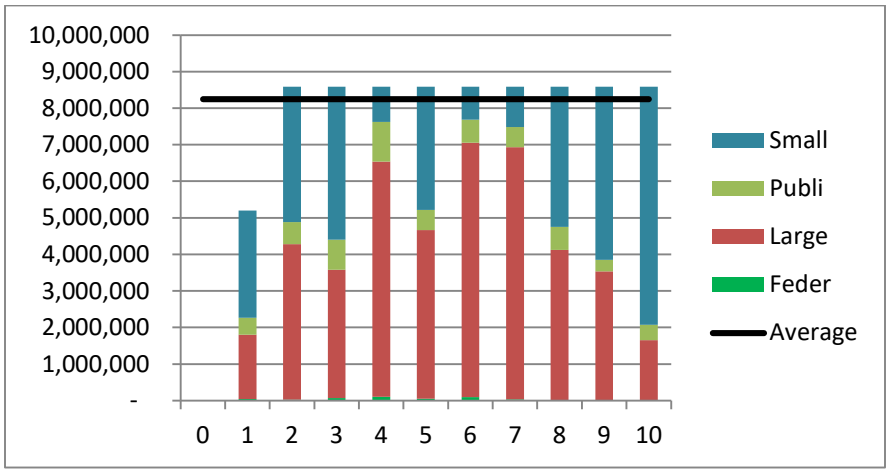


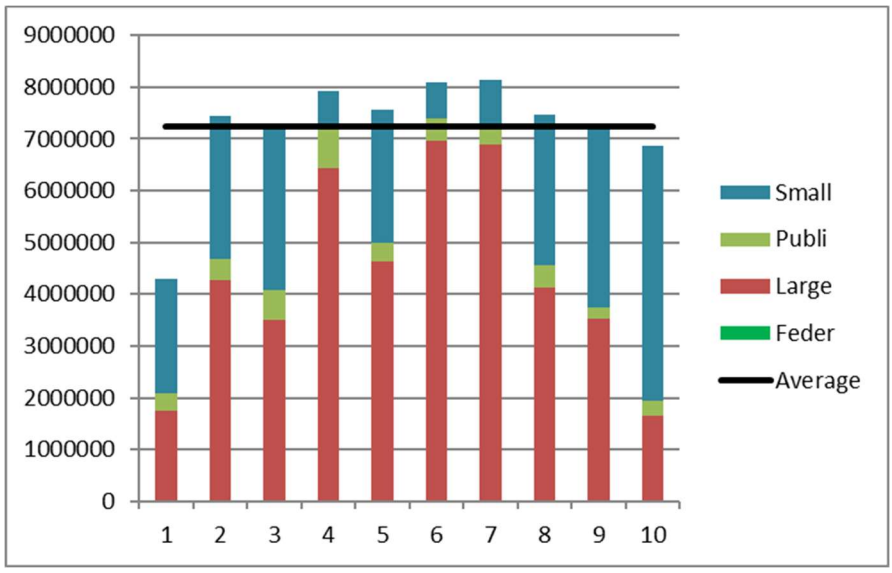
Figure 2.9 displays the 50-year modeled harvest of mixed dense hardwood by landowner type. Harvest from Other Public is fairly constant from period to period. There is some fluctuation between large and small landowners from period to period. However, this may be an artifact of modeling since there was no control used in the model to smooth flow by landowner from period to period.

Figure 2.9. Base Run, 50-year Modeled Harvest of Mixed Dense Hardwood by Landowner Type



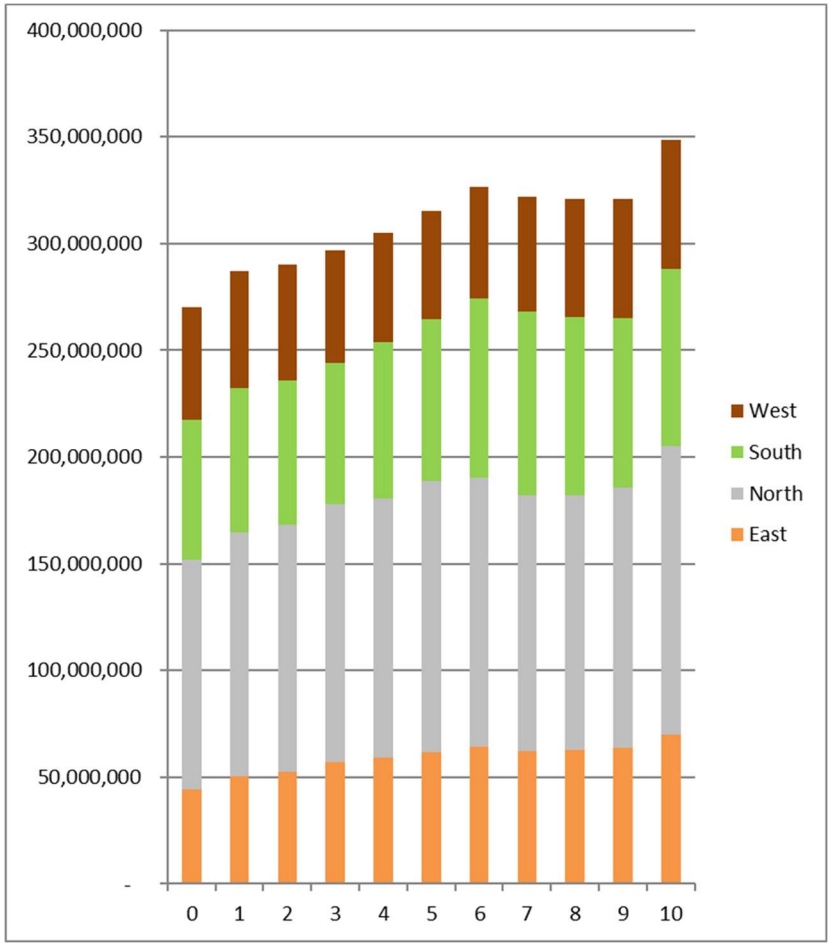
The 50-year projected harvest of mixed dense hardwood by landowner type with discounts applied appears in Figure 2.10. Average modeled harvest from period 2 to 10 is approximately 7.2 million tons.

Figure 2.10. Base Run, 50-year Modeled Harvest of Mixed Dense Hardwood by Landowner Type, With Discounts



Projected inventory levels of mixed dense hardwood by megaregion appear in Figure 2.11. Inventory is predicted to rise from approximately 270 million tons to nearly 350 million tons by the end of period 10.

Figure 2.11. Projected Inventory of Mixed Dense Hardwood by Megaregion



PINE PROJECTIONS

For the "Base" run 59% of the potential pine harvest comes from small landowners, with 33% from large landowners, 7% from Other Public, and less than 1% from Federal ownership (Figure 2.12).

Projected pine harvest by megaregion appears in Figure 2.13. Harvest periods 2 to 10 is roughly 1.9 million tons. Pine harvest is concentrated in the south to a great extent, but there is some swapping with north and east in some periods. This may be an artifact of modeling since no control over flow by megaregion from period to period was exerted in the model.

Figure 2.14 displays pine harvest by landowner type. Harvest is highly concentrated on small landowners in most periods.

Figure 2.15 displays pine harvest by landowner type with discounts. Average modeled harvest for periods 2 to 10 is 1.76 million tons.

Figure 2.12. Base Run, Distribution of 50-year Projected Harvest of Pine by Landowner Type

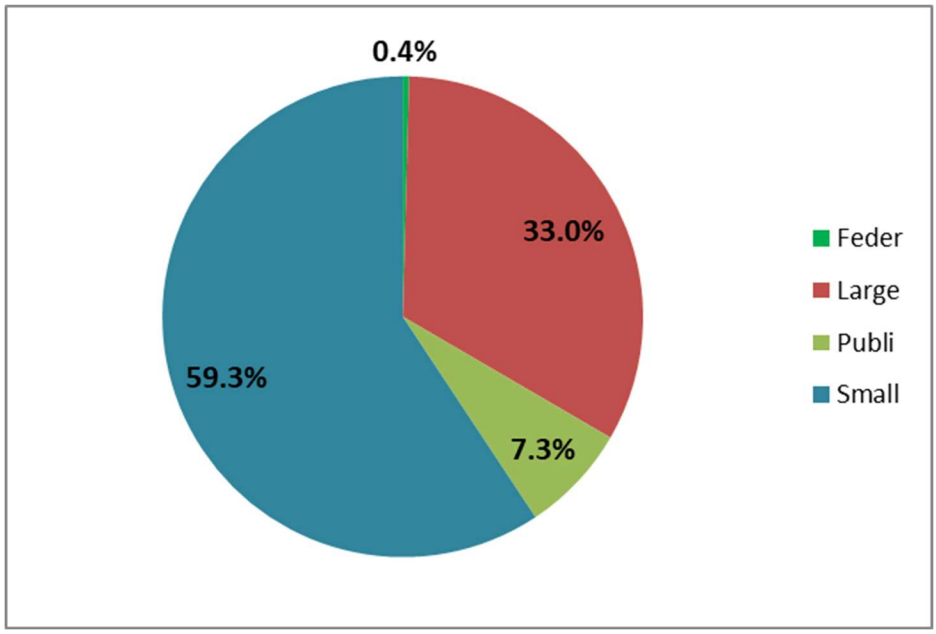


Figure 2.13. Base Run, 50-year Modeled Harvest of Pine by Megaregion

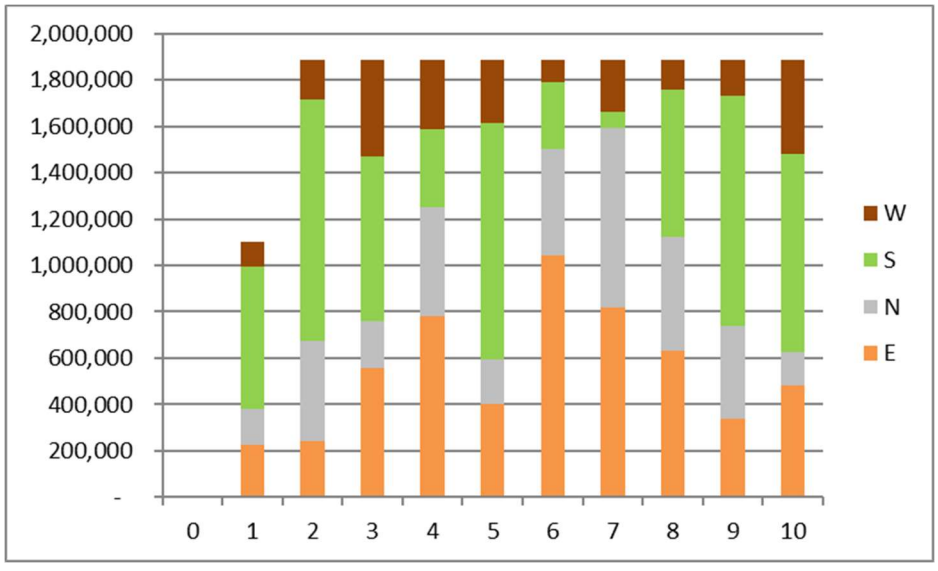


Figure 2.14. Base Run, 50-year Modeled Harvest of Pine by Landowner Type

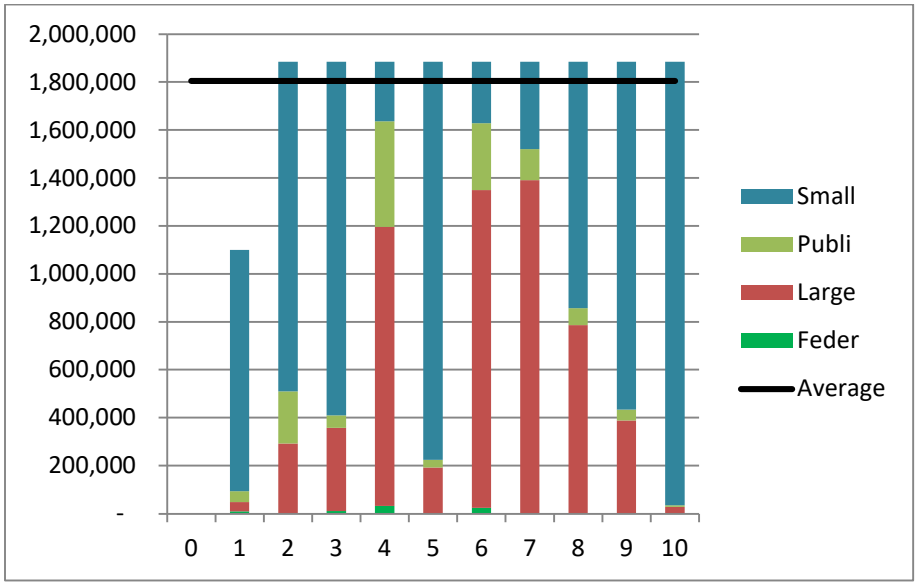
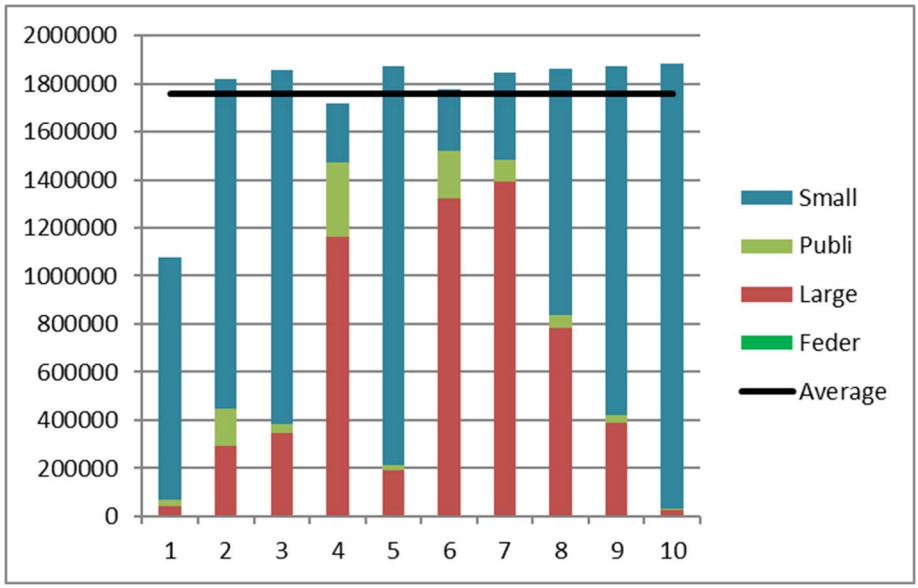


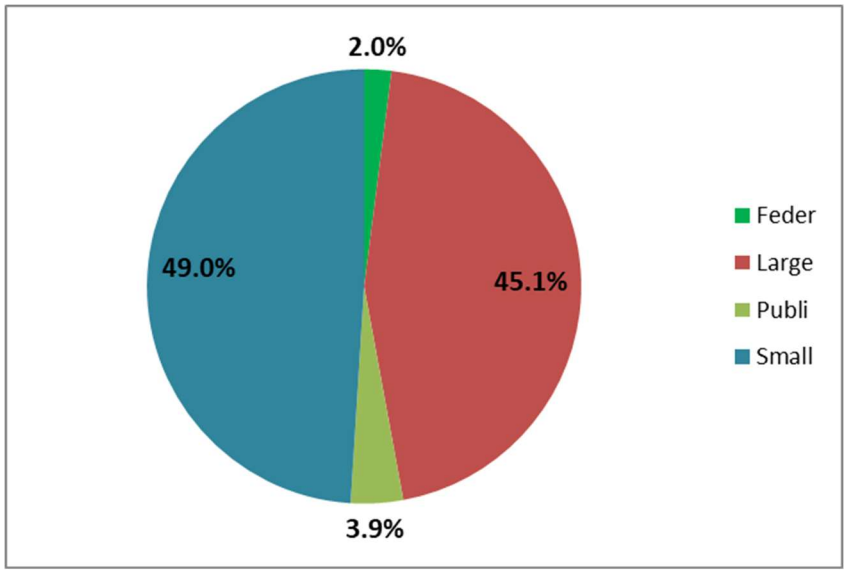
Figure 2.15. Base Run, 50-year Modeled Harvest of Pine by Landowner Type, With Discounts



OTHER SOFTWOOD PROJECTIONS

For the "Base" run 49% of the potential other softwood harvest comes from small landowners, with 45% from large landowners, 4% from Other Public, and 2% from Federal ownership (Figure 2.16).

Figure 2.16. Base Run, Distribution of 50-year Projected Harvest of Other Softwood by Landowner Type



Projected other softwood harvest by megaregion appears in Figure 2.17. Harvest from periods 2 to 10 is approximately 1.46 million tons. There is fluctuation period to period by megaregion.

Projected other softwood harvest by landowner type appears in Figure 2.18. Harvest of other softwood is primarily on large and small landowners.

Projected other softwood harvest by landowner type with discounts appears in Figure 2.19. Projected harvest for periods 2 to 10 is approximately 1.34 million tons.

Figure 2.17. Base Run, 50-year Modeled Harvest of Other Softwood by Megaregion

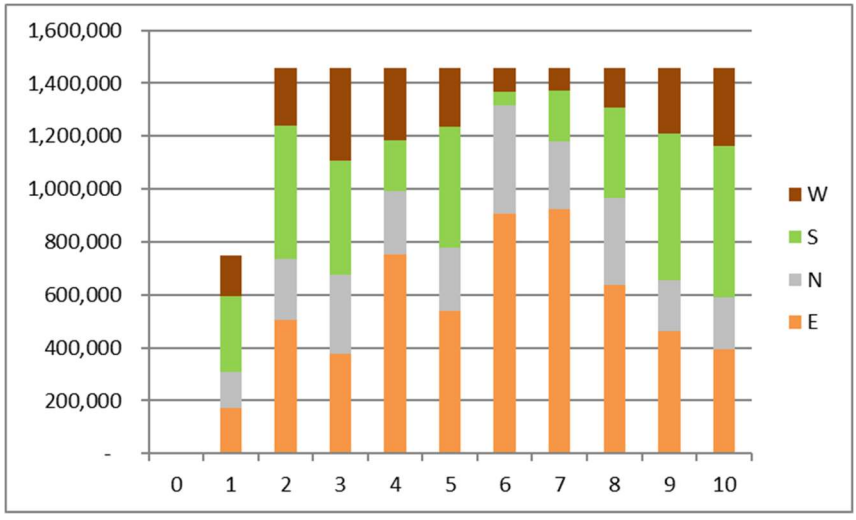


Figure 2.18. Base Run, 50-year Modeled Harvest of Other Softwood by Landowner Type

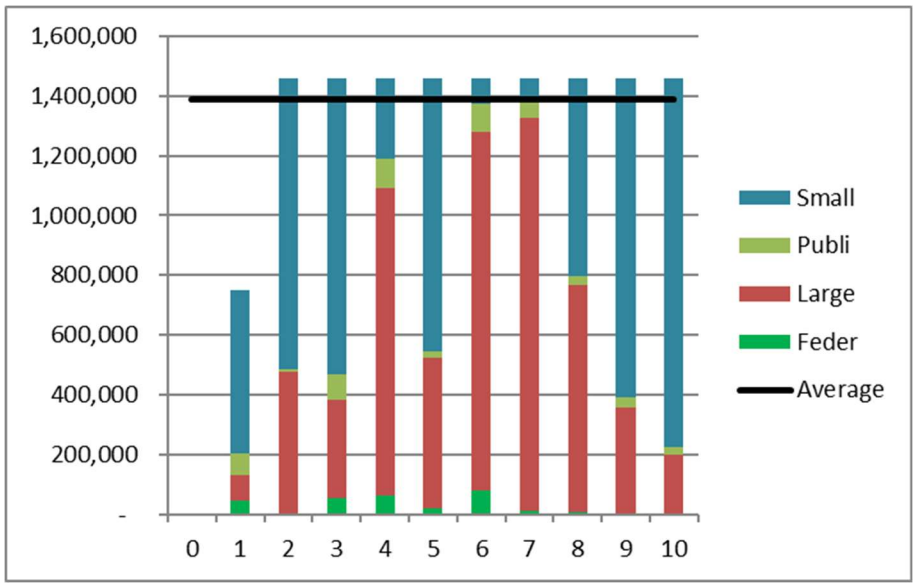
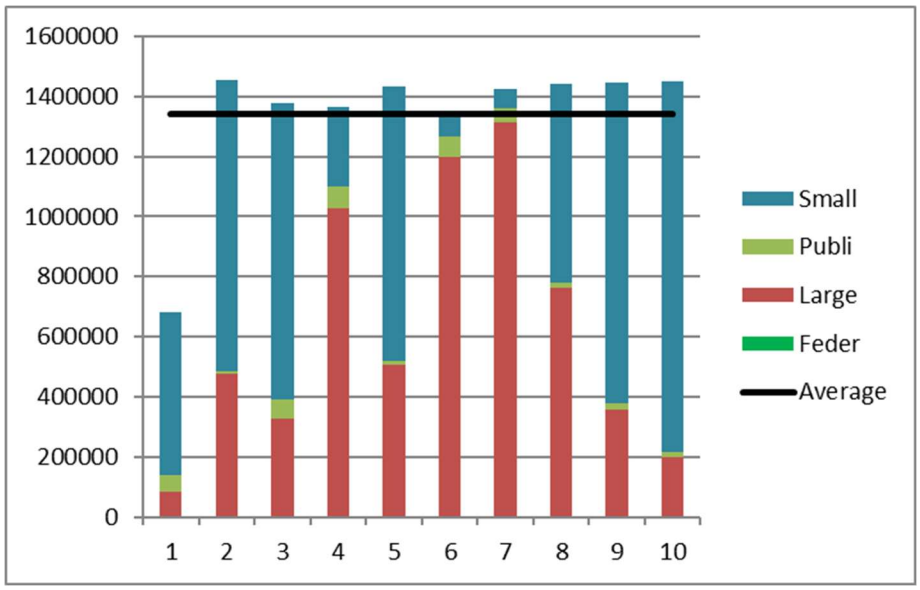


Figure 2.19. Base Run, 50-year Modeled Harvest of Other Softwood by Landowner Type, With Discounts



ASPEN PROJECTIONS

For the "Base" run 54% of the potential other softwood harvest comes from small landowners, with 40% from large landowners, 5% from Other Public, and less than 1% from Federal ownership (Figure 2.20).

Aspen harvest by megaregion appears in Figure 2.21. Projected harvest levels are 918,000 tons in periods 2 to 6, then rises to 963,000 tons in periods 7 to 10.

Aspen harvest by landowner type with discounts appears in Figure 2.22. Harvest for periods 2 to 10 averages approximately 916,000 tons in periods 2 to 10.

Figure 2.20. Base Run, Distribution of 50-year Projected Harvest of Aspen by Landowner Type

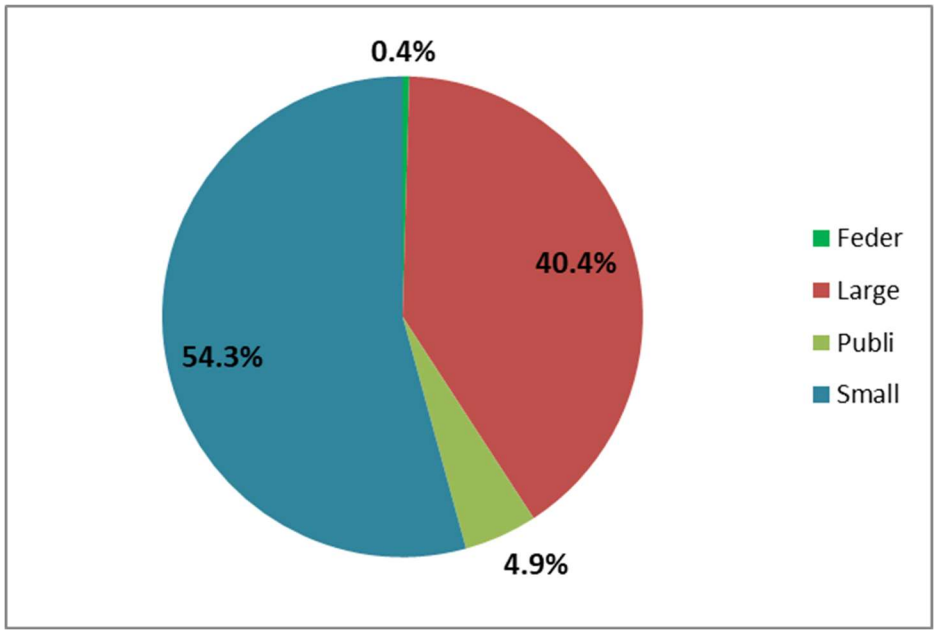


Figure 2.21. Base Run, 50-year Modeled Harvest of Aspen by Megaregion

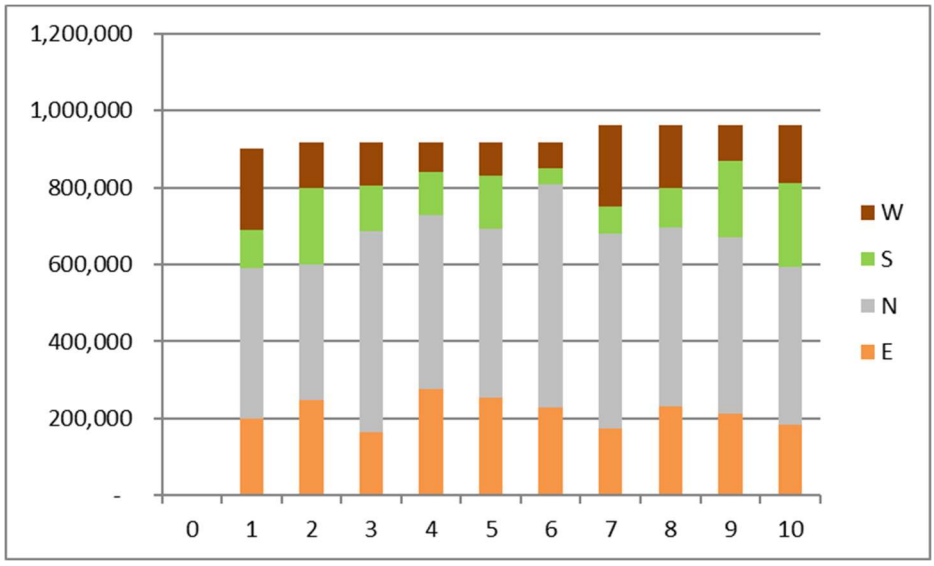
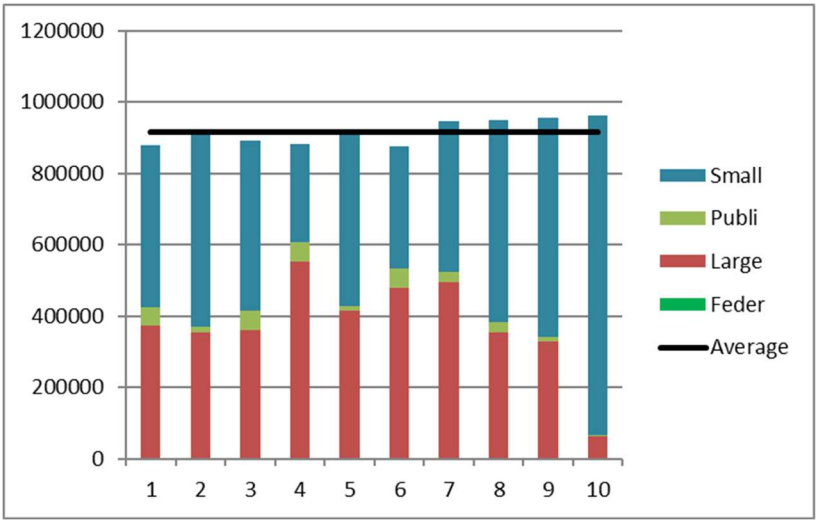


Figure 2.22. Base Run, 50-year Modeled Harvest of Aspen by Landowner Type, With Discounts



CEDAR PROJECTIONS

For the "Base" run 50% of the potential other softwood harvest comes from large landowners, with 34% from small landowners, 16% from Other Public, and 0% from Federal ownership (Figure 2.23).

Projected harvest levels of cedar by megaregion appear in Figure 2.24. The vast majority of cedar harvest comes from the north and east megaregions, with very little in the south and west.

Figure 2.23. Base Run, Distribution of 50-year Projected Harvest of Cedar by Landowner Type

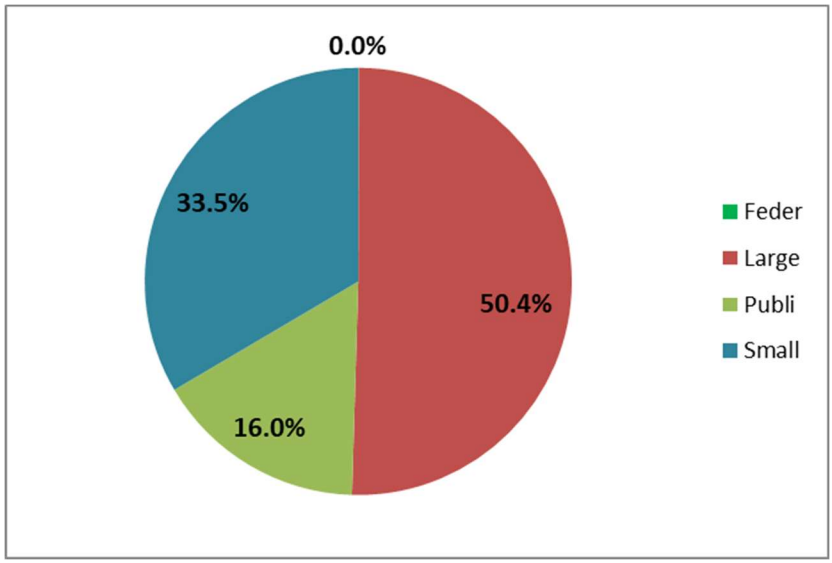
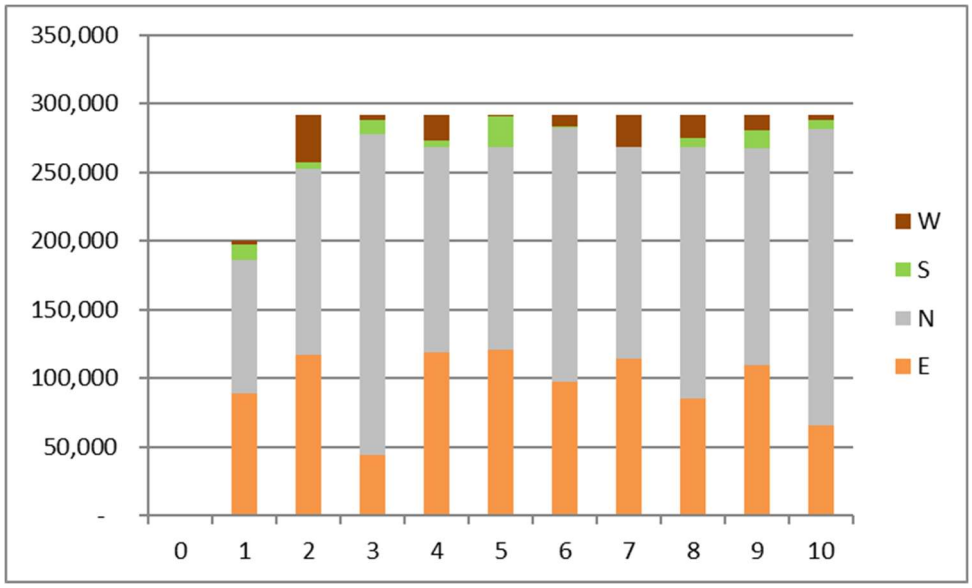
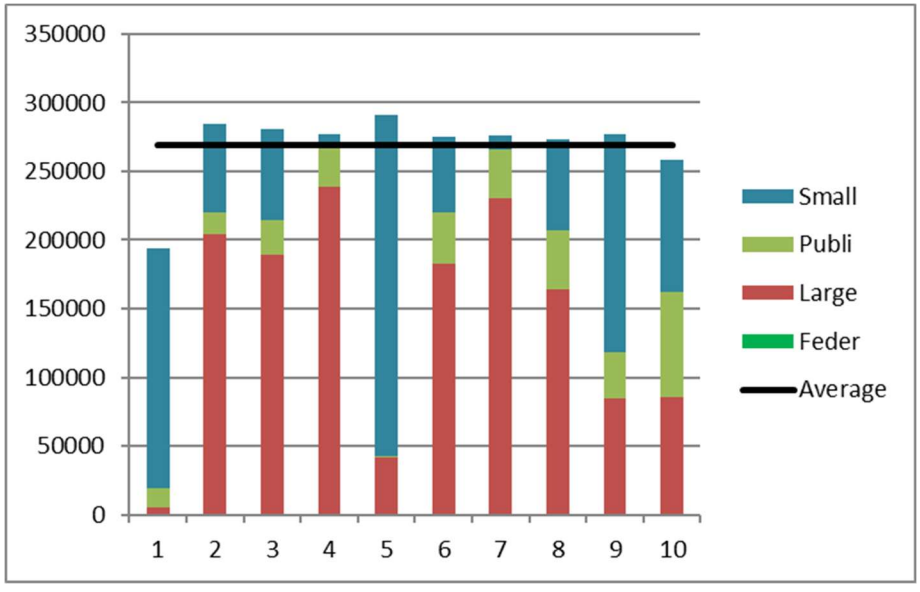


Figure 2.24. Base Run, 50-year Modeled Harvest of Cedar by Megaregion



Projected harvest levels of Cedar by landowner type with discounts appears in Figure 2.25. Projected harvest for periods 2 to 10 average approximately 269,000 tons.

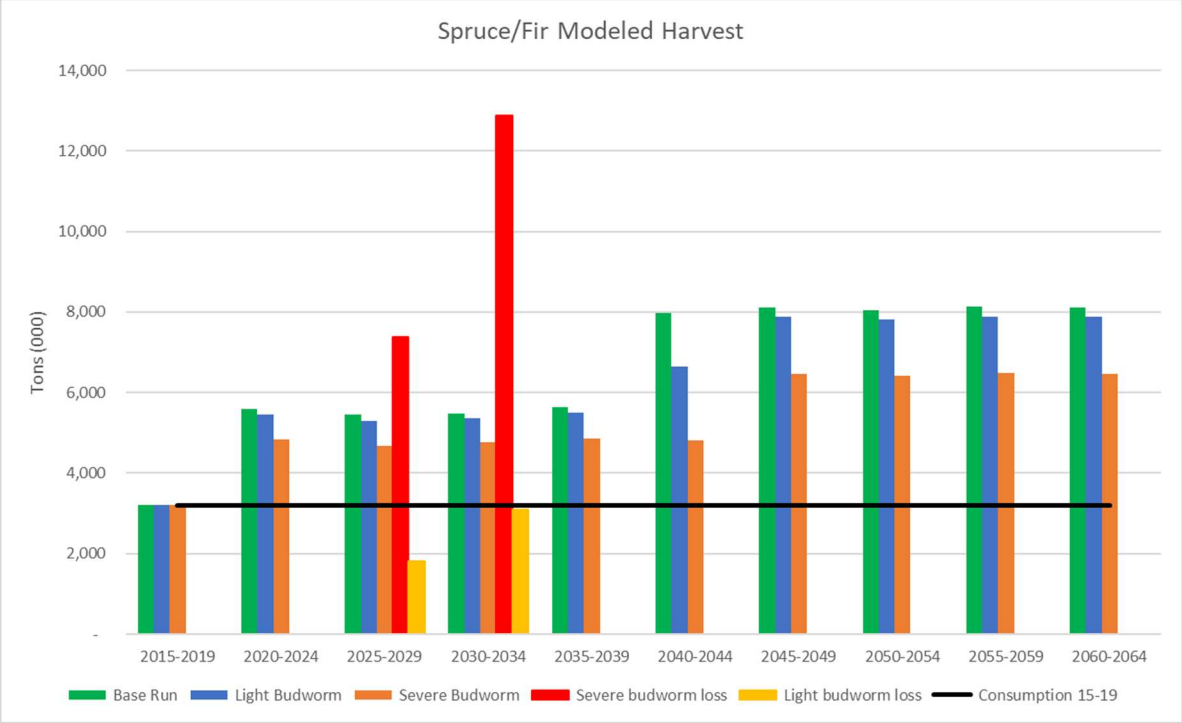
Figure 2.25. Base Run, 50-year Modeled Harvest of Cedar by Landowner Type, With Discounts



3. SPRUCE BUDWORM PROJECTIONS

A summary of spruce-fir harvest levels for the spruce budworm runs appears in Figure 3.1. The base run produces the highest projected harvest level, followed by the light budworm and heavy budworm levels. The greatest difference is in the 2040-2044 period where the light budworm run is 16% below the base run and the heavy budworm is 40% below the base run. In later periods the light budworm run approaches the base run, with the heavy scenario 20% lower than the base run for 2045-2064.

Figure 3.1. Summary of Spruce-fir Harvest Levels for Spruce Budworm Scenarios



A summary of spruce-fir inventory levels for the budworm scenarios appears in Figure 3.2. Maximum differences between the budworm runs and the base case occur in 2034 at the end of the projected outbreaks. In 2034 inventory for the light outbreak is 7% lower than the base case; for the heavy outbreak inventory is 26% lower than the base case.

The projected budworm loss in 2025-2029 and 2030-2034 appears in Figure 3.1. This value represents the potential salvage volume that could be recovered in these periods if landowners chose to do so (there was no salvage assumed in the models).

Figure 3.2. Summary of Spruce-fir Inventory Levels for Spruce Budworm Scenarios