



THE LARCH COMPANY

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TO: Interested Parties
FROM: Andy Kerr
RE: Estimated Extent and Types of Mature and Old-Growth Forests
DATE: 1 February 2023

***Top Line:* Approximately 60 to 66 million acres of mature and old-growth (MOG) forests are found on Forest Service and Bureau of Land Management holdings. Some MOG forest acreage is already adequately protected from logging, but approximately 47 to 51 million acres should be subject to an enduring administrative rule to protect MOG forests for reasons of climate, biodiversity, watershed health, and recreation for the benefit of this and future generations.**

(Note: A companion Larch memorandum entitled “Defining Mature and Old-Growth Forests” of the same date should be read in conjunction with this memorandum.)

President Biden’s Executive Order (EO) [14072](#) (“Strengthening the Nation’s Forests, Communities, and Local Economies”) directs the USDA Forest Service and USDI Bureau of Land Management (BLM) to “develop policies . . . to institutionalize climate-smart management and conservation strategies that address threats to mature and old-growth forests on Federal lands.”

The EO raised the questions of:

- what is a “mature” and “old-growth” forest or tree,
- how much is left of Forest Service and Bureau of Land Management holdings; and
- where is it?

Two recent papers (free to download) address these (and other) questions.

- DellaSala, D. A., B. Mackey, P. Norman, C. Campbell, P. J. Comer, C. F. Kormos, H. Keith, and B. Rogers. 2022. [Mature and old-growth forests contribute to large-scale conservation targets in the conterminous United States](#). *Front. For. Glob. Change* 5:979528. doi: 10.3389/ffgc.2022.979528

• Barnett, K., G. H. Aplet, and R. T. Belote. 2023. [Classifying, inventorying, and mapping mature and old-growth forests in the United States](#). *Front. For. Glob. Change* 5:1070372. doi: 10.3389/ffgc.2022.1070372

Hereafter, the papers are referred to as “DellaSala” and “Barnett.”

The what is “mature” question is addressed in a companion memorandum (see note above). This memorandum examines the amount of MOG forest on Forest Service and Bureau of Land Management (BLM) holdings.

Analysis

Both DellaSala and Barnett limit their analysis to the continental/contiguous forty-eight US states. Each paper estimates the amount of mature and old-growth (MOG) forest. Barnett notes:

The 38.7% of the forest estate in mature and old-growth stages, combined, is remarkably close to the 35.9% estimated by DellaSala et al. (2022), despite the use of very different classification and mapping methods.

Both papers make important contributions to inventorying the amount and types of mature and/or old-growth forests on US lands under every type of ownership in the forty-eight states. Barnett distinguishes four forest types (early seral, young, mature, and old growth). DellaSala distinguishes three forest stages (young, intermediate, and mature), lumping old growth in with mature since the Biden EO calls for protecting both and not one more than the other. (The differences among how DellaSala, Barnett, and Birdsey et al.¹ define MOG forests is the subject of a companion Larch memorandum.)

Some MOG is already adequately protected from logging. DellaSala relies on the US Geological Survey GAP categories to determine if a forest is protected (GAP 1 and GAP 2) or unprotected (GAP 3 and GAP 4, along with a category it calls GAP 2.5—Forest Service inventoried roadless areas somewhat protected by the roadless area conservation rule but in fact GAP 3 to the USGS). Barnett relies on the “reserved” and “unreserved” categories used in the Forest Service Forest Inventory and Analysis (FIA) database.

For purposes of complying with the Biden EO, the fundamental question is this: How many acres of Forest Service and Bureau of Land Management lands are home to mature and old-growth forest and are also unprotected (potentially open to logging) and therefore in need of an enduring administrative rule protecting them?

DellaSala breaks out MOG forests by USGS GAP classes. While the GAP framework is sound, the underlying decisions as to which lands are in which GAP category can be problematic. Misclassifications abound.² Nonetheless, DellaSala found that on Forest Service and BLM forested holdings, 14.5 million acres are protected (GAP 1 or 2), while 51.3 million acres of MOG forest are not protected (GAP 2.5, 3, or 4), for a total of 65.8 million acres (Table A).

¹ Birdsey R. A., D. A. DellaSala, W. S. Walker, S. R. Gorelik, G. Rose, and C. E. Ramírez. 2023. [Assessing carbon stocks and accumulation potential of mature forests and larger trees in U.S. federal lands](#). *Front. For. Glob. Change* 5:1074508. doi: 10.3389/ffgc.2022.1074508

² Kerr, Andy. 2022. [Forty-Four Conservation Recipes for 30x30: A Cookbook of 22 Administrative and 22 Legislative Opportunities for Government Action to Protect 30 Percent of US Lands by 2030](#). The Larch Company, Ashland, OR, and Hancock, ME.

Barnett comes up with 59.7 million acres of MOG forest on Forest Service and BLM holdings (Table C). Barnett didn't include the redwood and western white pine forest types (rejected due to data issues with the model employed), so the actual total is a bit higher. However, Barnett doesn't tell us how much Forest Service and BLM land is protected ("reserved") from logging.

Are Forests in Forest Service Inventoried Roadless Areas Adequately Protected?

In 2001, the Forest Service's roadless area conservation rule (RACR) extended a significant—but insufficient—level of protection to inventoried roadless areas (IRAs). "Inventoried" means depicted on a set of maps incorporated by reference into the RACR. Setting aside that tens of millions of acres of de facto roadless lands are not covered by the RACR,³ loopholes in the RACR allow the "cutting, sale, or removal of generally small diameter timber" for specified exceptions to the general rule.⁴ The Forest Service has deemed, and courts have upheld (though the decision is being appealed),⁵ that trees up to 21 inches in diameter at breast height fall into the category of "generally small diameter timber," although in all likelihood these are mature trees. Over the decades, the agency has attempted, and often succeeded in, logging roadless areas using questionable applications of the exceptions.

The Forest Service Forest Inventory and Analysis (FIA) program recognizes USFS IRAs as "roadless" but does not count them as "reserved" ("forest land withdrawn from timber utilization through statute, administrative regulation, or designation without regard to productive status").

Forest Service IRAs total ~56 million acres,⁶ of which 30,522,000 acres are "forest land,"⁷ of which 11,358,700 acres are mature and old-growth (MOG) forest.⁸

While the RACR affords some level of protection to MOG forests in Forest Service IRAs, it does not substitute for an enduring administrative rule to protect mature and old-growth forests for the benefit of this and future generations.

DellaSala et al. 2022

Overview

The paper is a "spatially explicit MOG assessment based on three structural development measures—canopy height, canopy cover, and aboveground living biomass to assess relative maturity." The paper considered all ownerships and major forest type groups.

³ Kerr, Andy. 2020. [The National Wilderness Preservation System in Oregon: Making It Bigger and Better](#). Larch Occasional Paper #11.3. The Larch Company, Ashland, OR.

⁴ 36 CFR Subpart B—Protection of Inventoried Roadless Areas, as published in the *Federal Register*, Vol. 66, No. 9, Friday, January 12, 2001, pages 3244–3273. (Protracted yet ultimately unsuccessful litigation against the rule has resulted in the rule not yet being codified in the *Code of Federal Regulations*.)

⁵ *Los Padres ForestWatch, et al. v. United States Forest Service*. November 7, 2022. Order DENYING Plaintiffs Motion for Summary Judgement (Doc. No. 108). Case No. 2:19-cv-05925-VAP-KSx. US District Court: Central District of California.

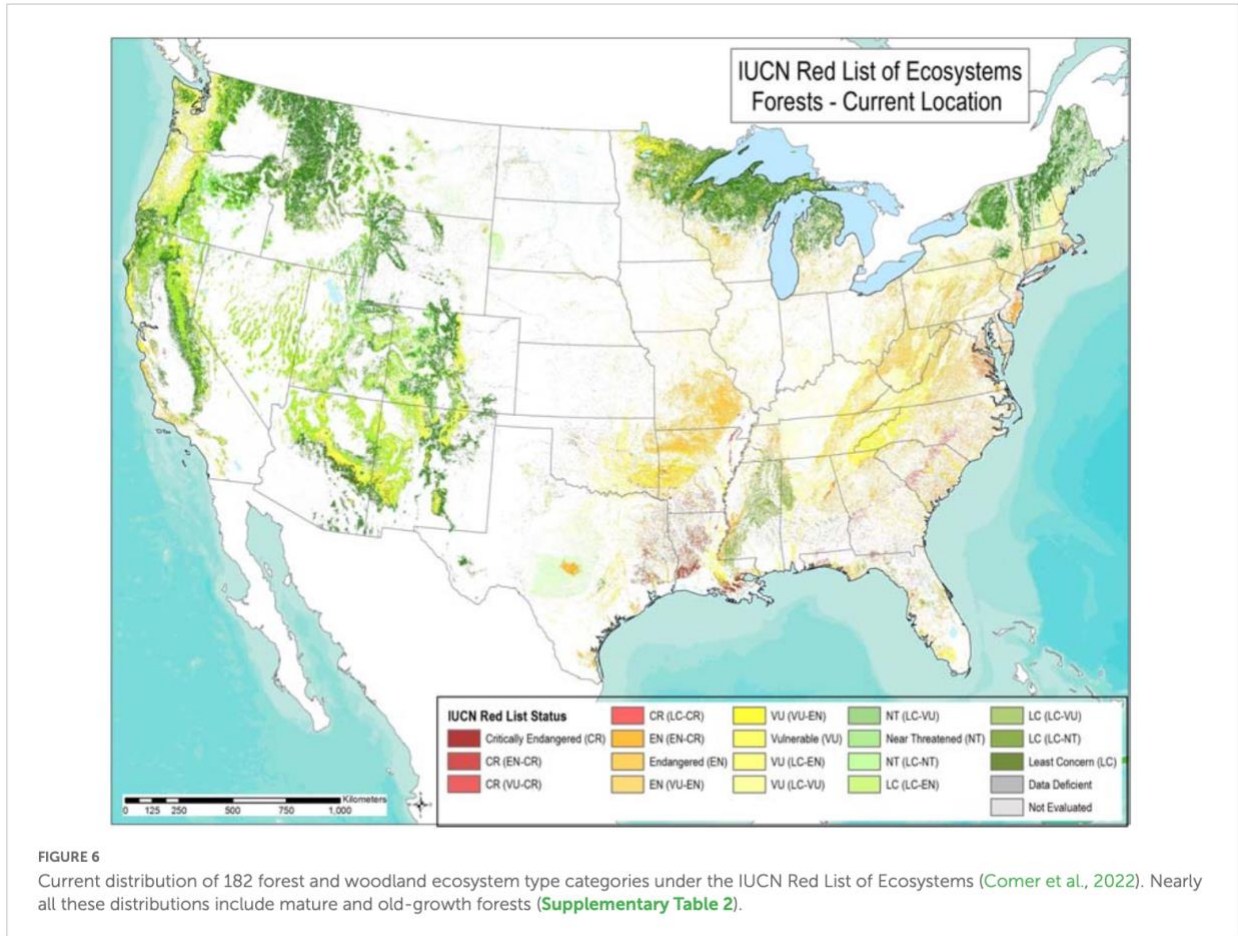
⁶ Protection of Inventoried Roadless Areas, page 3244.

⁷ Oswalt, S. N., W. B. Smith, P. D. Miles, and S. A. Pugh. 2019. [Forest Resources of the United States, 2017](#). USDA Forest Service Gen. Tech. Rep. WO-97. Washington, DC.

⁸ DellaSala, D.A., B. Mackey, P. Norman, C. Campbell, P. J. Comer, C. F. Kormos, H. Keith, and B. Rogers. 2022. [Mature and old-growth forests contribute to large-scale conservation targets in the conterminous United States](#). *Front. For. Glob. Change* 5:979528. doi: 10.3389/ffgc.2022.979528

Maps

The data can generate maps at a 30x30-meter-resolution scale. Map A is a small-scale map from the paper.



Map A. Figure 6 from DellaSala et al. 2022.

<i>Table A. Total Area of Mature and Old-Growth Forests (×1000 acres) in the Conterminous United States by GAP Status and Ownership</i>						
Ownership and Tenure	GAP 1	GAP 2	GAP 2.5	GAP 3	GAP 4	Total Per Owner
National parks	2,031.9	60.5	1.7	8.2	10.9	2,113.2
National forests	7,401.0	5,739.0	11,799.5	34,892.5	339.0	60,171.1
BLM	398.1	974.8	73.9	4,217.8	0.2	5,664.9
State	28.4	5,155.4	12.1	5,077.8	1,062.6	11,336.2
Federal	9,921.0	7,182.6	11,752.8	37,984.0	994.4	67,834.8
Corporate private	33.4	532.3	7.4	574.3	1,594.3	2,741.6
Family private	80.3	731.4	12.8	864.9	2,638.3	4,327.8
Tribal	1.0	32.6	0.5	18.8	3,660.1	3,713.0
Total per GAP Category	19,895.2	20,408.6	23,660.8	83,638.1	10,299.8	157,902.6
<i>National forests and BLM</i>	<i>14,513.0</i>		<i>51,323.0</i>			
<i>All ownerships</i>	<i>40,303.8</i>		<i>117,598.8</i>			
	<i>Reserved*</i>		<i>Unreserved*</i>			

* These two terms have a specific meaning in Forest Service FIA database used here to be approximate to the GAP categories. Forested lands that are permanently unavailable for logging (reserved) and those that can be logged (unreserved).

Source: DellaSala et al. 2022, Table 4, converted from hectares to acres and summarized

Extent

Table A is adapted from Table 4 in DellaSala, converted from hectares to acres and summarized. It identifies 51.3 million acres of mature and old-growth forests that should be subject to an enduring regulation to conserve and restore mature and old-growth forests.

Types

Table B is Table 3 from DellaSala, converted from hectares to acres.

Forest Type Group	GAP 1	GAP 2	GAP 2.5	GAP 3	GAP 4	Outside GAP	Total
Alder/maple	2.7	14.6	2.0	107.0	19.5	262.9	408.7
Aspen/birch	209.5	1,555.5	712.4	2,136.2	546.8	3,777.7	8,938.3
California mixed conifer	458.9	144.3	345.7	1,937.1	26.4	753.4	3,665.8
Douglas-fir	1,616.8	537.7	2,750.0	9,753.0	580.9	2,075.7	17,314.2
Elm/ash/cottonwood	28.9	345.7	2.5	113.9	185.3	1,825.9	2,502.2
Fir/spruce/mtn hemlock	3,232.6	382.5	3,208.7	6,644.4	213.3	450.2	14,131.7
Hemlock/Sitka spruce	313.8	39.0	136.6	710.7	30.9	101.3	1,332.4
Loblolly/shortleaf pine	102.5	1,373.4	24.0	1,388.7	566.6	13,563.6	17,018.9
Lodgepole pine	1,021.8	250.6	1,684.8	3,110.3	94.6	167.8	6,329.8
Longleaf/slash pine	47.7	222.4	7.9	762.8	179.6	3,374.2	4,594.7
Maple/beech/birch	162.1	2,146.4	72.2	1,294.1	746.3	8,609.9	13,030.8
Oak/gum/cypress	313.6	985.0	3.7	749.0	267.4	5,284.8	7,603.4
Oak/hickory	693.9	2,900.8	378.6	4,473.3	3,369.0	30,694.6	42,510.2
Oak/pine	57.1	364.7	17.5	414.1	163.8	4,228.0	5,245.3
Other western hardwoods	69.4	12.9	78.3	152.7	13.6	48.2	375.2
Other western softwood	214.7	37.1	252.3	294.8	41.3	22.5	862.6
Pinyon/juniper	1,002.0	855.0	1,195.0	5,130.9	1,365.0	1,199.2	10,747.1
Ponderosa pine	324.0	254.5	430.5	4,490.6	1,019.6	1,824.1	8,343.3
Redwood	17.5	20.5	0.2	17.3	28.9	104.0	188.5
Spruce/fir	77.6	772.7	41.8	653.6	379.6	1,954.4	3,879.5
Tanoak/laurel	29.7	42.5	14.1	114.9	57.1	263.4	521.6
Tropical hardwoods	2.5	11.6	0.0	18.3	0.7	18.5	51.6
Total	9,999.4	13,269.3	11,358.7	44,467.8	9,896.3	80,604.4	169,595.9

Source: DellaSala et al. 2022, Table 3, converted from hectares to acres

Barnett et al. 2022

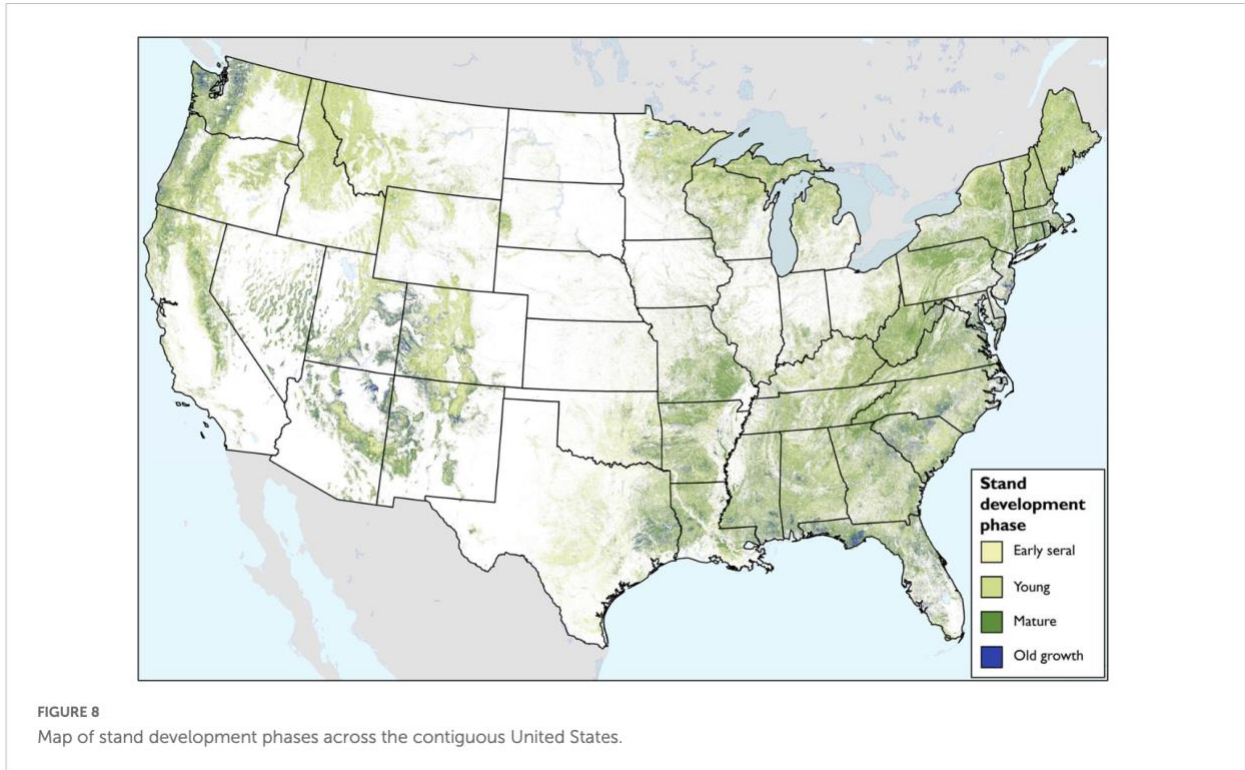
Overview

Forest Service Forest Inventory and Analysis (FIA) data was analyzed and then merged with TreeMap to develop maps. The paper considered all ownerships and major forest type groups (except for redwood and western white pine, which created data issues due to their minor extent).

Maps

Barnett produced an example map based on merging USDA Forest Service FIA data and TreeMap to produce a map that could be 30x30-meter resolution, depicting “locations throughout the nation where concentrations of old-growth and mature forest may be high.” The

authors “view our map as suggestive rather than authoritative” and urge a “thorough field-based accuracy assessment.”



Map B. Figure 8 from Barnett et al. 2023.

Extent

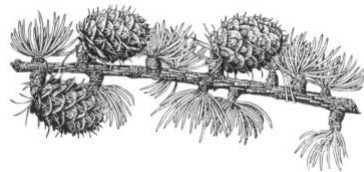
Table C is adapted from Table S2 in Barnett, converted from hectares to acres. It does not distinguish between FIA reserved and unreserved forest.

<i>Table C. Forest Development States by Major Landowner Category (acres)</i>				
Ownership	Early Seral	Young	Mature	Old Growth
Bureau of Land Management	6,548,059	7,066,140	8,789,444	6,413,131
Non-federal public	15,039,069	16,232,226	23,960,955	3,781,866
National Park Service	2,241,291	2,640,683	3,207,172	1,029,757
Other federal	2,745,311	2,344,670	3,504,378	1,622,551
Private/Native American	129,296,877	130,502,321	137,145,609	18,451,894
Forest Service	39,522,379	45,786,608	34,718,445	9,739,656
Total acres	195,392,986	204,572,648	211,326,003	41,038,855
Total percentage	30%	31%	32%	6%
<i>Forest Service and BLM</i>	<i>46,070,438</i>	<i>52,852,748</i>	<i>43,507,889</i>	<i>16,152,787</i>
<i>Total Forest Service and BLM</i>			<i>59,660,676</i>	
Note: Redwood and western white pine forest type groups not included due to too-small data set.				
Source: Barnett et al. 2023, Table S2, converted from hectares to acres and summarized				

Types

Table D is adapted from Table 4 in Barnett, converted from hectares to acres. It does not distinguish between FIA reserved and unreserved forest.

<i>Table D. Forested Area Outside and Within Congressionally Designated Reserved Lands Across Forest Type Groups (acres)</i>								
Forest Type Group*	Forested Area Outside Congressional Reserves (acres)				Forested Area Inside Congressional Reserves (acres)			
	Early Seral	Young	Mature	Old Growth	Early Seral	Young	Mature	Old Growth
Oak/hickory	51,669,297	30,175,504	65,470,465	829,628	890,015	271,603	2,885,759	114,217
Loblolly/shortleaf pine	13,578,437	10,783,823	24,024,663	13,688,441	29,549	10,369	51,195	437,018
Pinyon/juniper	15,554,469	11,430,763	19,081,861	11,419,864	993,829	242,032	1,958,095	1,855,289
Maple/beech/birch	18,688,986	4,891,886	19,549,806	67,546	768,776	104,016	2,779,378	79,177
Douglas-fir	7,227,554	24,493,618	2,597,696	731,171	922,890	1,988,565	557,971	188,566
Woodland hardwoods	2,861,607	32,131,837	895,328	12,158	287,559	624,785	170,725	--
Fir/spruce/mtn hemlock	6,735,689	13,598,826	1,472,877	189,127	3,291,315	4,803,716	1,321,859	192,337
Oak/pine	7,219,400	7,679,962	10,418,149	1,396,331	180,836	72,535	271,284	102,880
Elm/ash/cottonwood	10,876,307	7,092,025	7,919,144	158,268	308,016	221,814	398,926	17,080
Oak/gum/cypress	6,427,881	5,640,041	11,068,221	543,018	446,422	417,239	899,237	46,169
Aspen/birch	6,851,404	12,494,160	2,569,385	12,961	667,302	754,972	255,460	--
Ponderosa pine	10,117,237	4,086,815	6,760,264	557,202	376,993	92,521	662,666	129,621
Spruce/fir	4,531,879	3,168,440	6,431,283	645,510	273,985	150,124	753,512	91,290
Lodgepole pine	3,914,321	5,178,886	976,888	38,269	1,362,913	1,829,990	791,593	34,832
Longleaf/slash pine	2,335,861	2,162,609	4,077,635	3,856,884	10,304	18,367	166,700	327,565
White/red/jack pine	3,084,026	1,848,711	4,311,001	164,500	130,701	75,681	328,084	64,751
California mixed conifer	2,710,893	1,536,677	1,698,946	323,784	485,260	79,728	675,877	171,721
Other western softwoods	716,634	4,867,803	86,072	10,082	353,541	900,213	103,324	73,074
Western oak	2,070,928	2,264,609	392,395	21,753	310,579	277,536	124,855	171
Hemlock/Sitka spruce	1,345,932	1,456,699	907,893	515,765	104,864	49,935	244,706	362,876
Other hardwoods	1,355,250	1,835,298	630,481	29,344	76,400	104,706	150,890	--
Alder/maple	735,604	443,427	1,099,481	428,846	24,236	13,067	52,888	49,530
Other eastern softwoods	986,283	509,617	1,217,528	61,161	20,181	2,869	25,654	--
Tanoak/laurel	577,872	331,234	570,051	173,381	72,510	137,848	162,773	142,174
Western larch	171,745	491,830	688,160	288,087	5,597	32,356	65,839	68,132
Exotic hardwoods	329,342	380,821	425,339	327,288	--	--	5,594	--
Tropical hardwoods	186,095	185,719	88,044	--	137,479	134,418	32,104	--
Total	182,860,932	191,161,639	195,429,058	36,490,368	12,532,054	13,411,006	15,896,947	4,548,469
Mature and Old Growth					20,445,416			
Total Mature and Old Growth					252,364,842			
* Redwood and western white pine forest type groups not included due to too-small data set.								
<i>Source: Table 4, Barnett et al. 2023, converted from hectares to acres</i>								



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