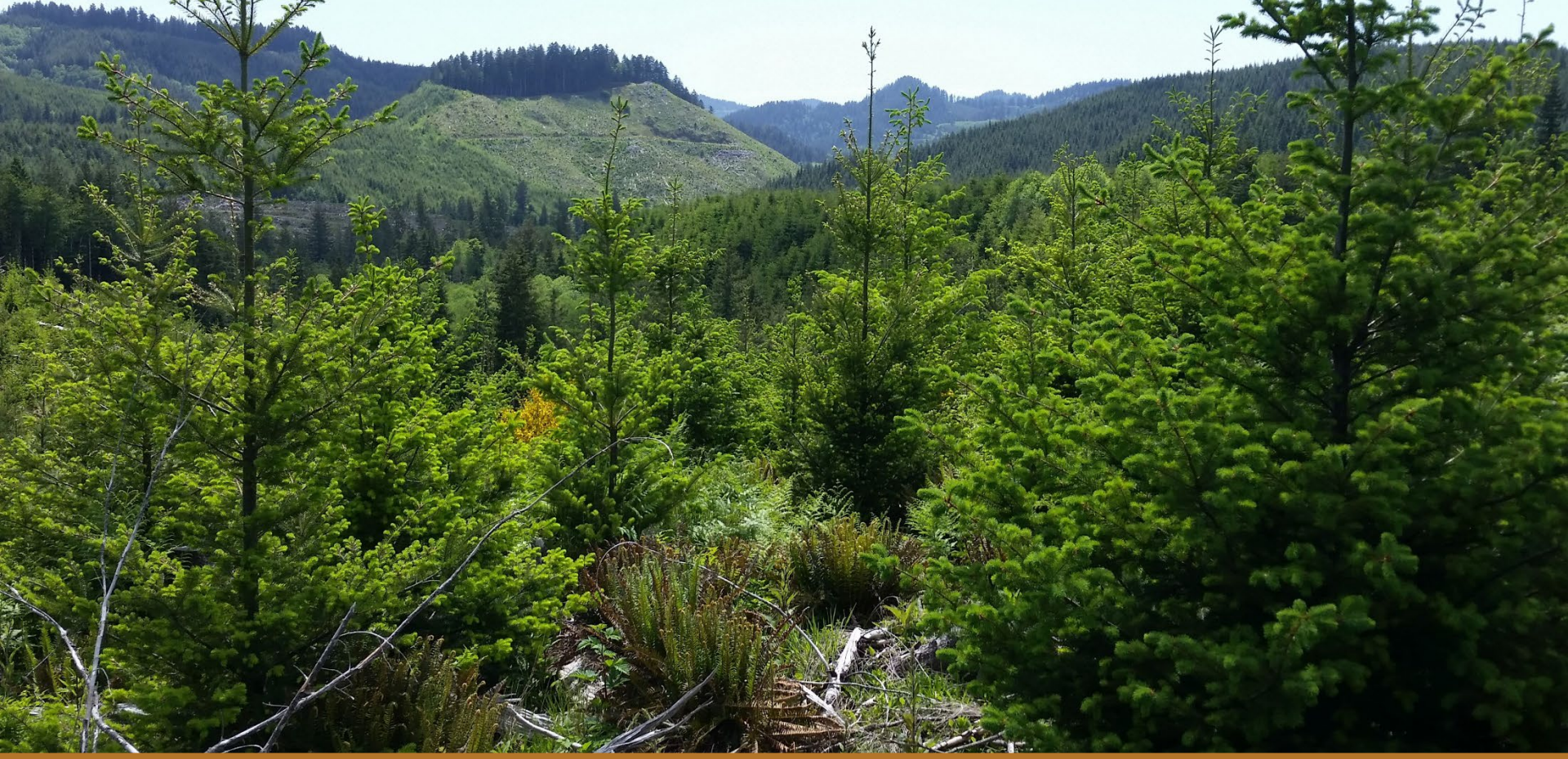

Beyond Averages, Transforming Data Into Information

March 4th, 2019

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Beyond Averages
Transforming Data Into Information.

What do I mean by "Beyond Averages"?

Manager: How are our plantations doing?

Forester: Great! We have the best plantations in the industry!

Here's some data…

Plantation 1 has 260 TPA and the 2 year survival is 72%

Plantation 2 has 225 TPA and the 2 year survival is 57%

…

Manager: What about the whole program?

Forester: Let me get back to you on that… (months go by…)

Ok, I walked some it and it all looks good!

So how much information have we provided? Not much really

Certainly not enough to understand how to measure success, detect trends, or identify key indicators of success or failure.

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What are we going to talk about?

- Define the problem, what's a plantation?
- What have traditional survey programs looked like?
- What kinds of data do they normally provide?
- Where do current systems come up short?
- What could a better system look like?
- Feedback from REAL users
- How to make the change: The Roadblocks
- Potential Roles for Remote Sensing
- Conclusions: Developing actionable information

Starting point: Planted, Natural, Hybrid?

Does the starting point matter? I'd tell you "No"
Well designed systems should be able to describe these accurately
What are we trying to estimate? Counts…

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Plantations: Monitor Development?

What's our goal:

- Evaluating change
- Certify compliance at a specific point in time
- Providing a reference for prescribing a value

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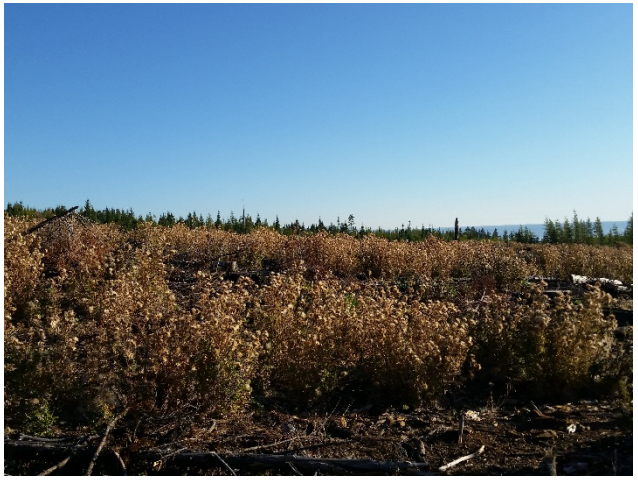
Plantations: OR… Monitor Development?

Face Reality:

- Not all regeneration events are successful, planted, natural, or a hybrid.
- If everyone says that they have the “best plantations” someone is lying.
- Even if you are the best, what’s your current trend?



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Plantations: What's the goal?

Maximizing productivity for your desired product

1. **Capture the site productivity**
2. **Stock each productive spot at a product appropriate density**

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Traditional Regeneration Surveys

Types of Data Provided

Collected and stored in Excel

PLOT	TREE	COUNT	TYPE	SPECIES	HEIGHT	CON 1
1	1	0				
2	1	3	R	DF	25	
	2	1	R	GF	4	
3	1	5	P	DF	1	
	2	2	R	WL	20	
4	1	4	P	DF	1	
5	1	5	R	DF	4	
	2	2	N	WL	3	

What information do we have?

- Total TPA
- Planted TPA
- Natural TPA
- Species Breakdown

Typical Data Summary

REGENERATION CRUISE SUMMARY REPORT	
Unit Name	Bob
Cruise Date	10/20/2010
Cruiser	them
Acres	76
Seedlings Planted Per Acre	295
Total TPA	260
Planted TPA	168
Natural TPA	92
Percent Seedling Survival	57%
Plantable Acres	29.25
Percent Plantable	45%
Average Height	0
Stocking Percentage by Species	
DF	92%
WL	8%
PP	0%
RC	0%
GF	1%

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Traditional Regeneration Surveys

How are they stored? Likely as individual workbooks

Here is an example of 3 years of data

Year 1- 53 Spreadsheets

Year 2- 77Spreadsheets

Year 3- 74Spreadsheets

49er.xlsx
Addy Gifford.xls
Animal Planet.x
Bad Adam.xlsx
Bobcat.xlsx
Boomerang.xlsx
Bruce Creek.xls
Caterpillar.xlsx
Contorta Sorta.
Cooney High.xl
Cops Closure.xl
Cornstalk Repla
Currant Divide.
Dead Deer.xlsx
East Harvey.xlsx
Fry Pan.xlsx
Gold Nugget.xls
Ham Sandwich

ABE-new.xlsx
Addy Cedonia r
Bigfoot-new.xls
Biscuit Wheel-n
Black Crow-new.
Boot Hill-new.xls
Boyer Bugle-new
Buffalo Replant-r
Bull-new.xlsx
Burnt Valley Revis
Burnt Valley-new
Camp Creek II-ne
Camp Hafer-new
Copper Toe-new.
Day Night-new.xl
Dead End-new.xls
Deer Martin-new.
Early Riser-new.xl
El Corazon-new.x
Famous Hunter-r
Fast Freddie-new
First-new.xlsx
Red Gate-new.xlsx
Repeater Ridge-new.xlsx
Republican Seed-new.xlsx
Rossco Pico-new.xlsx
Tea Cup-new.xlsx
The Puzzle-new.xlsx
The Thicket-new.xlsx
Thinker Replant-new.xlsx

49er.xlsx
Ant Elbow.xlsx
ArmageddonUpdated.xlsx
BettsRidge.xlsx
Big Jim.xlsx
Bitterfoot.xlsx
Bohanan.xlsx
Border Reworked.xlsx
Burnt SandReworked.xlsx
Carr Farm Reworked.xlsx
Cheweka Scott.xlsx
Colburn.xlsx
Columbia Divide.xlsx
Copper Nickel.xlsx
Corner.xlsx
Coyote.xlsx
Crucible.xlsx
Dragon Slayer.xlsx
Dragoon.xlsx
Draper Thicket.xlsx
Ebridge.xlsx
ElevenMileUpdated.xlsx
Empey Hollow.xlsx
Falls Creek.xlsx
Four Mile.xlsx
Genesis Reworked.xlsx
Gold Nugget.xlsx
Gold Ridge Hollow.xlsx
Grand Simpson.xlsx
Hallam Creek.xlsx
Harrier Lookout.xlsx
Hawkeye.xlsx
HemlockCreek.xlsx
Hesseltine Flats.xlsx
Honey hole.xlsx
Huckleberry Falls.xlsx
Huckleberry Hound.xlsx
Hungry Hunter.xlsx
Irregulotze.xlsx
K Corner.xlsx
Little Jim.xlsx
Magic.xlsx
Malloy.xlsx
Middle colburn.xlsx
Mr Yuck.xlsx
No Comment.xlsx
No Name.xlsx
North Colburn.xlsx
Northie.xlsx
PawPrintUpdated.xlsx
Rally Cap.xlsx
Red Quarry Reworked.xlsx
Rina Flats.xlsx
Roaring Lion.xlsx
Rogers Saddle.xlsx
RoundTheBendCorrected.xlsx
Royalty.xlsx
Silver Meteor.xlsx
Simpson Lakes.xlsx
Single Fin.xlsx
Sleepy Head.xlsx
SlimPickens.xlsx
Small Smack.xlsx
SmokeyBandit.xlsx
Southie.xlsx
SouthMain.xlsx
Spear tip.xlsx
Sunset Reworked.xlsx
Tomsha.xlsx
Tree Fort.xlsx
Turn Lane Reworked.xlsx
Upper Harvey.xlsx
Vertigo.xlsx
War Club.xlsx

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Traditional Regeneration Surveys

Where do current systems come up short?

- **L-o-n-g on opinion / Short on information**
- **Information is hidden, no flexibility to easily interrogate the data**
- **QA/QC is inefficient, data errors are buried in each sheet**
- **No single authoritative source of the "truth"**
- **Very limited reporting, especially in terms of spatial reporting**
- **It can be months before all data is fully available**
- **The only real solution to address most of these issues is brute force, which is very common and very inefficient.**

What a Better System Might Look Like

Characteristics of a better system

- Sample design would be simple
- Plots would be revisited at least once for actual survival
- Users would not have to compile data
- Analytical data is easily available
- Data would keep spatial awareness

Data Collection

- ✓ Simple field design
- ✓ Electronic collection
- ✓ Data validation
- ✓ Focus on measured data not subjective

Data Compilation

- ✓ Data sync would be simple
- ✓ Automated compilation
- ✓ Automate QC when possible

Data Analysis

- ✓ More than TPA
- ✓ Multi-level analyses using same metrics
- ✓ Maintain spatial integrity

A Better System: Multiple Summary Levels

The same tool can summarize at multiple levels

User learns how to use one tool

All levels of detail are available for the whole program

Region	Status	Cycle	pSpp	SampleName	Acres	Plots	TPA	pTPA	pSurv	Below	Target	Above	LCL	UCL
Lochsa					5,108	5,114	334	176	68%	18%	40%	42%	241	395
Salmon					5,747	5,181	377	188	69%	15%	39%	46%	267	439
Selway					5,631	5,434	340	171	68%	18%	40%	42%	230	381

Region	pSpp	Status	Cycle	SampleName	Acres	Plots	TPA	pTPA	pSurv	Below	Target	Above	LCL	UCL
Lochsa	WL				1,209	1,400	338	185	70%	15%	41%	44%	245	387
	PP				977	1,350	315	169	65%	21%	40%	39%	230	381
	DF				1,580	1,239	342	176	70%	19%	38%	44%	243	399
	RC				1,342	1,125	342	173	67%	17%	41%	42%	246	416
Salmon					5,747	5,181	377	188	69%	15%	39%	46%	267	439
Selway					5,631	5,434	340	171	68%	18%	40%	42%	230	381

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	PP				977	1,350	315	169	65%	21%	40%	39%	230	381
	DF	0			1,580	417	367	211		11%	40%	49%	268	412
		1				405	335	196	85%	12%	43%	46%	261	409
		2				417	322	120	57%	33%	31%	36%	201	375
	RC				1,342	1,125	342	173	67%	17%	41%	42%	246	416
Salmon					5,747	5,181	377	188	69%	15%	39%	46%	267	439
Selway					5,631	5,434	340	171	68%	18%	40%	42%	230	381

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A Better System: Basic Statistics

Provide some simple statistics to help understand sample variance

Project Statistics For: Multiple Treefarms

Project Alpha	Max Degrees Freedom
0.20	20

								Base Allowable Error		More Allowable Error		Less Allowable Error	
								Confidence @20%		Confidence @30%		Confidence @10%	
Region	Species Count	Count	Plots	AvgTPA	cvTPA	sdTPA	ciTPA	Error (Base)	Sample	Error (+)	Sample (+)	Error (-)	Sample (-)
3	12		15,729	352	59%	225	80	70	21	105	6	35	144

Division (All)

Status (All)

Values

Region	Species	SampleID	Plots	AvgTPA	cvTPA	sdTPA	ciTPA	Error (Base)	Sample	Error (+)	Sample (+)	Error (-)	Sample (-)
Lochsa	WL		1400	338	58%	213	71	68	18	101	5	34	123
	PP		1350	315	66%	220	75	63	31	94	9	31	208
	DF		1239	342	59%	200	78	68	19	103	5	34	128
	RC		1125	342	56%	207	85	68	18	103	5	34	119
Salmon	DF		1408	375	55%	215	80	75	16	113	5	38	108
	PP		1399	393	61%	224	79	79	24	118	7	39	162
	RC		1248	402	54%	244	87	80	16	121	5	40	112
	WL		1126	334	62%	274	99	67	31	100	9	33	210
Selway	RC		1512	326	63%	230	73	65	22	98	6	33	150
	WL		1386	301	54%	177	62	60	16	90	5	30	108
	PP		1318	335	65%	243	79	67	25	100	7	33	173
	DF		1218	415	58%	258	89	83	20	125	6	42	133

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A Better System: Sample Distribution

Provide tools to help users interrogate the detailed information

Sample Distribution For: Multiple Treefarms

Regions	SampleIDs	P WL Ht	P WL %	DF Ht	DF %	PP Ht	PP %	WP Ht	WP %	N Ht	N %	Total Ht	Total %
4	1	2	39%	3	16%	1	17%	1	2%	5	27%	3	100%

Division (All)

TreeType Species Values

Region	SampleID	Plot	Cycle	P WL Ht	P WL %	DF Ht	DF %	PP Ht	PP %	WP Ht	WP %	N Ht	N %	Total Ht	Total %
Lochsa				2.8	34%	2.9	18%	1.7	19%	1.0	4%	7.9	26%	3.3	100%
Salmon				2.5	34%	3.0	18%	1.6	19%	1.1	3%	5.4	25%	2.8	100%
Selway				2.7	42%	3.1	16%	1.5	11%	1.0	2%	5.7	30%	3.1	100%

Sample Distribution For: Multiple Treefarms

Regions	SampleIDs	P WL Ht	P WL %	DF Ht	DF %	PP Ht	PP %	WP Ht	WP %	N Ht	N %	Total Ht	Total %
4	355	3	39%	3	17%	1	18%	1	3%	6	23%	3	100%

Division (All)

TreeType Species Values

Region	SampleID	Plot	Cycle	P WL Ht	P WL %	DF Ht	DF %	PP Ht	PP %	WP Ht	WP %	N Ht	N %	Total Ht	Total %
Lochsa	Abigail				-	4.0	83%		-		-	9.4	17%	4.2	100%
	Thomas			2.4	87%		-		-		-	1.3	13%	2.3	100%
	August				-	4.0	65%		-		-	7.4	35%	4.8	100%
	Adeline				-		-	4.0	84%		-	16.4	16%	5.7	100%
	Samuel			1.0	14%	1.0	72%		-		-	19.0	14%	5.5	100%
	Damian			1.9	100%		-		-		-		-	1.9	100%
	Ryker			4.0	67%		-		-		-	20.1	33%	7.3	100%
	Easton			4.0	1%	4.0	93%		-		-	4.0	6%	4.0	100%
	Micah			4.0	78%		-		-		-	21.1	22%	6.2	100%

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A Better System: Survival Information

Survival by many different factors

			Species Values									
			DF		WL		PP		RC		Total %	Total Acres
Cycle	Stocktype	PlantQualityGroup	%	Acres	%	Acres	%	Acres	%	Acres		
2	2+1		74%	61	-	0	-	0	-	0	74%	61
	412A		61%	181	73%	149	52%	118	54%	91	58%	539
	415C		-	0	42%	93	-	0	-	0	42%	93
	415D		50%	803	66%	463	59%	375	66%	358	60%	1,999
	515A	70%	-	0	30%	12	72%	22	-	0	51%	34
		75%	-	0	33%	42	-	0	-	0	33%	42
		80%	85%	5	90%	53	61%	112	37%	70	67%	241
		85%	-	0	-	59	40%	67	74%	114	57%	240
		90%	68%	112	8%	20	-	0	65%	48	47%	181
		95%	51%	4	-	15	50%	112	-	0	50%	132
		100%	60%	4	-	7	-	0	-	0	30%	11
	P+1		90%	71	79%	152	-	0	69%	20	79%	243
	S4		-	0	77%	89	-	0	72%	476	75%	565
Grand Total			**59%**	**1,241**	**60%**	**1,155**	**55%**	**806**	**62%**	**1,178**	**59%**	**4,380**

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Feedback From Real Users

- **What is the number 1 result from implementing a new program?**
  - ✓ Spatially explicit, statistically backed data
  - ✓ Amazing analytical tool for comparing stock sizes, species, nursery…
  - ✓ Better data summaries, and data is more quantitative
- **One thing you've learned that you didn't know?**
  - ✓ I have a better handle on actual survival and not just stocking
  - ✓ Planted tree survival is more variable than I expected
- **One thing you've changed to improve your program?**
  - ✓ Not one thing but the reporting stability is allowing for continuous improvement.
  - ✓ I improved stock type selection. I replaced a specific poorly performing stock type and replaced it with stock types that have consistently had better performance.
  - ✓ My knowledge about specific stock types and nursery's has improved

How to make the change: The Basics

1. Decide what is important
2. Carefully decide what attributes to collect
3. Avoid collecting attributes because they might be interesting
4. Keep your sample as simple as possible, use one design
5. Smaller plots are ok… your stats will tell you how you are doing

Current Assumption	Reality
Your survival is very good	It's not…
Not many trees die year 2	They do…
Naturals will bail me out	They might, but probably wont
	Naturals are poorly distributed
Survival isn't affected by stock type	It probably is…
Survival isn't affected by nursery	It probably is…

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How to make the change: The Roadblocks

1. Culture
2. You already know the answers, sometimes before planting…
3. Culture
4. "My" region is completely different, that won't work here
5. That might work for DF but it can't work for "my" species
6. *We don't have a fancy database system like you*
7. *We don't know how to program*
8. *We don't have the experience to build a system*
9. *<Fill in your own rationalization here>*

Potential Roles for Remote Sensing

- **Could we use the remote sensed data with this design? Yes**
- **Can the current technology provide enough accurate data? No**
- **There are limits to current remote sensing technology**
  - What about drones? — Drones are just a platform
  - What about LiDAR? — Not Yet
  - What about 6” imagery? — Not Yet
  - What about 1” imagery? — Not Yet
- **Could all of these technologies be used with trees that were just a bit bigger? Yes**
- **How big? That depends…**

Conclusions: Developing Actionable Data

- **Simple data will tell you a bit about what you have now but it does not provide much depth.**
- **Developing a system that provide actionable information does not need to complicated.**
- **Actionable information should help you:**
  - ✓ Avoid the trap of trying to understand complex problems by only looking at high level summary data.
  - ✓ Understand your problem from the highest summary levels down to the lowest level of detail
  - ✓ Help you identify the most important factors leading to success or failure
  - ✓ Allow you to make decisions based on data rather than opinion