

An aerial photograph of a forested landscape in Southeast Alaska. The image shows a mix of dense evergreen forests and cleared areas, likely for logging. A road or trail winds through the landscape, and a river or stream is visible in the lower portion of the image. The terrain is hilly and rugged.

Status and Trends of Fish Habitat Conditions on Private Timberlands in Southeast Alaska

After 20 Years:

**What have we learned?
Are we meeting the primary goals of FRPA?**

**Board of Forestry
March 19, 2014**

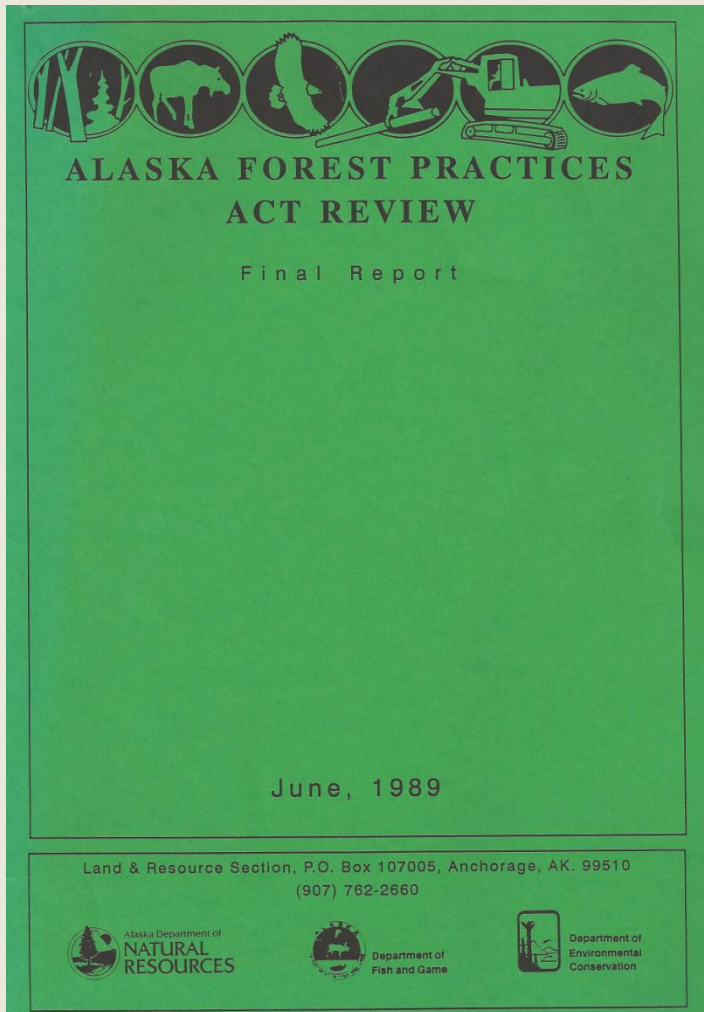
**Douglas Martin, Ph.D.
Martin Environmental**

An aerial photograph of a vast, green forested landscape. A river or stream flows through the lower portion of the image, surrounded by dense evergreen trees. In the background, rolling hills and mountains are visible under a clear sky. The text is overlaid on the upper portion of the image.

Alaska's Forest Resources and Practices Act (FRPA) Management of Riparian Areas (Sec. 41.17.115)

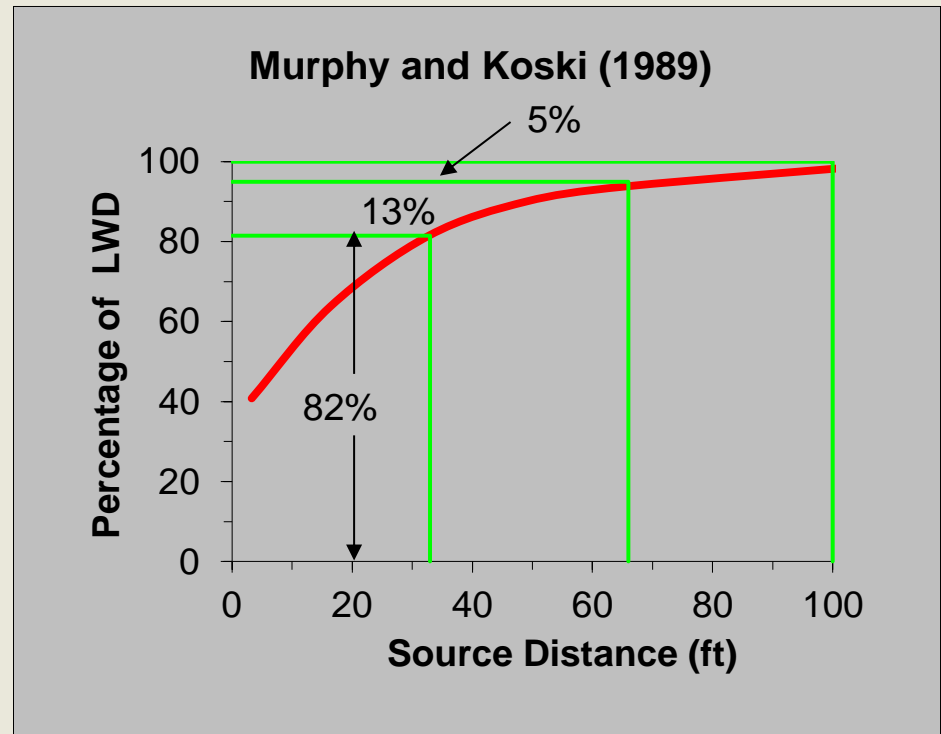
Goals/Objectives for Riparian Management

- The state forester shall protect riparian areas from the significant adverse effects of timber harvest activities on fish habitat and water quality.
- The management intent is the adequate preservation of fish habitat by maintaining a short- and long-term source of large woody debris, stream bank stability, channel morphology, water temperatures, stream flows, water quality, adequate nutrient cycling, food sources, clean spawning gravels, and sunlight.
- The regulations must take into consideration the economic feasibility of timber operations



Source Distance Concept

A major influence on rule development of buffer strip width

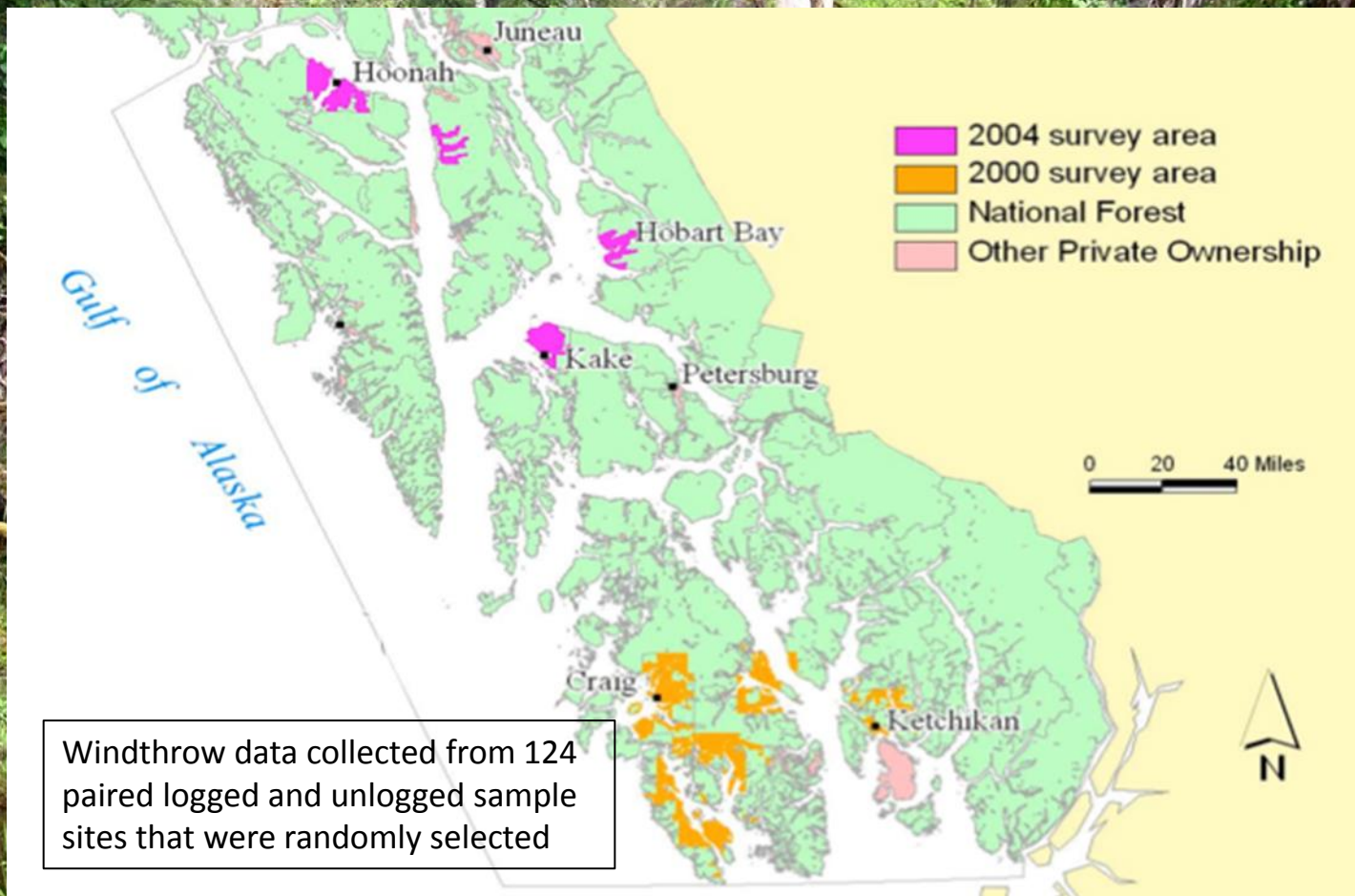


Up to 95 percent of large woody (LW) supply comes from riparian stands within 66 feet of the stream edge.

How does Windthrow affect Large Wood Recruitment to Streams and the Long-term Supply of LW in Riparian Stands?

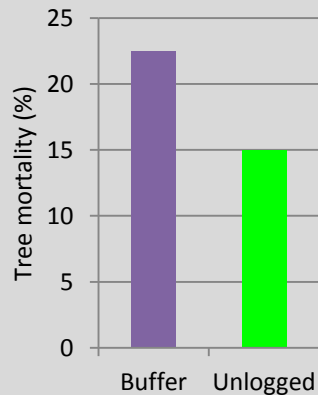


Windthrow Study on Private Timberlands

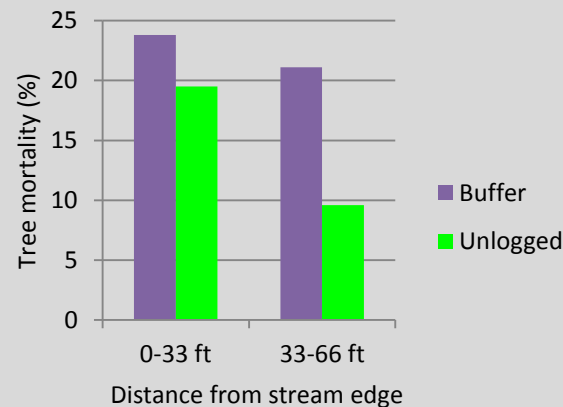


Windthrow in Buffer Strip Findings

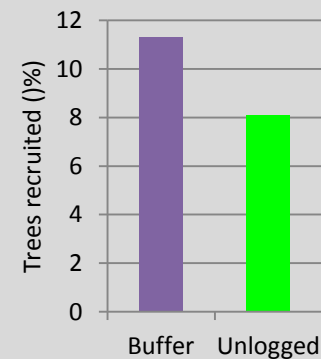
Tree Mortality in Buffer Strips Compared to Unlogged Areas



Tree Mortality by Distance From Stream



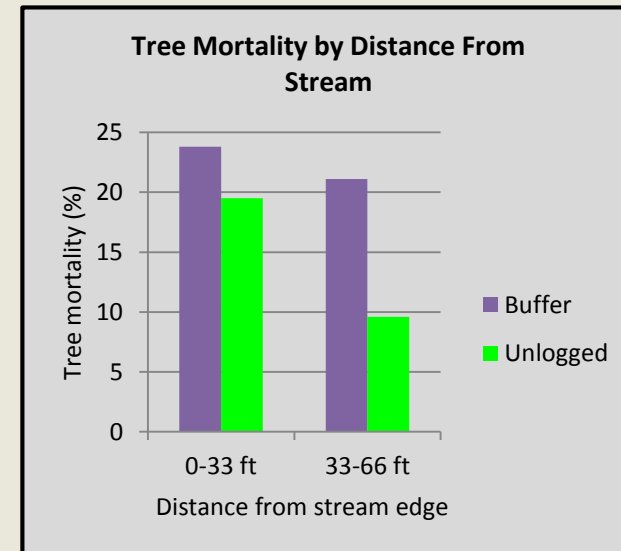
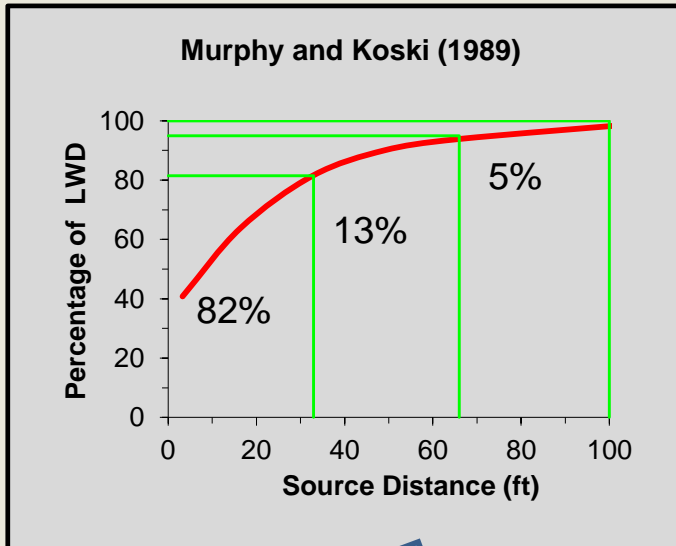
Treefall into Streams from Buffer Strips Compared to Unlogged Areas



Conclusions:

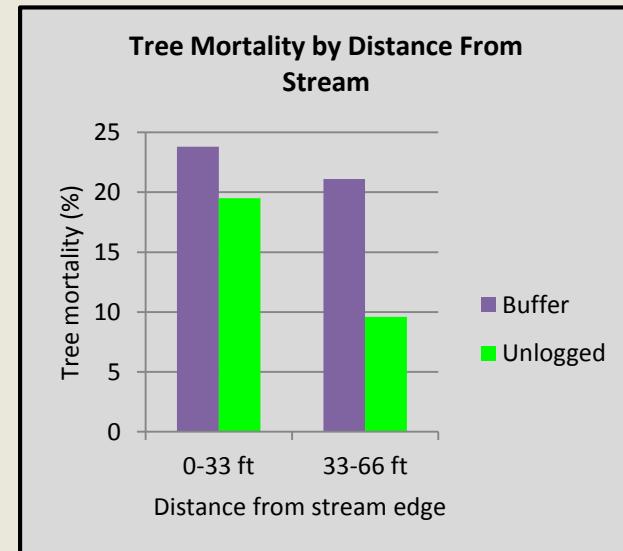
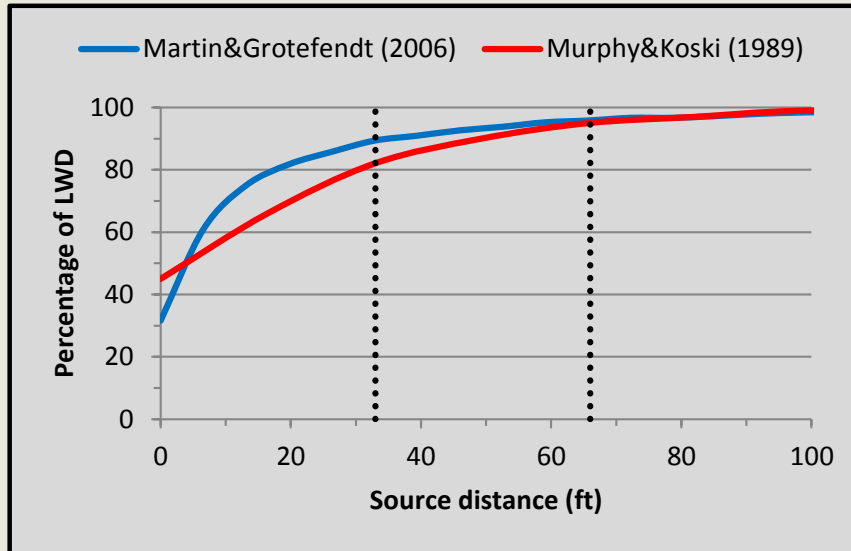
- 1) Windthrow increases riparian stand mortality.
- 2) Mortality increases are greatest in the outer portion of the buffer strip.
- 3) Windthrow increases wood recruitment to streams.

Windthrow and Future Long-term Supply of LW



Zone	Potential Supply (%)	Avg. Stand Loss	Future Supply (%)
0-33 ft	82	0.043	78.5
33-66 ft	13	0.115	11.5
>66 ft	5	1.000	0
	100		90.0

Windthrow and Future Long-term Supply of LWD



Zone	Potential Supply (Martin & Grotefendt) (%)	Avg. Stand Loss	Future Supply (%)
0-33 ft	89.4	0.043	85.6
33-66 ft	6.4	0.115	5.7
>66 ft	4.2	1.000	0
	100		91.2

Zone	Potential Supply (Murphy & Koski) (%)	Avg. Stand Loss	Future Supply (%)
0-33 ft	82	0.043	78.5
33-66 ft	13	0.115	11.5
>66 ft	5	1.000	0
	100		90.0

Large wood source distance findings are consistent among studies.

Trend Monitoring Sites and History

Buffer		Monitoring Schedule																		
Stream	Year	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
Cabin	1991	X	X		X						X	X	X					X		X
Eagle	1993	X	X	X	X						X	X	X	X	X	X	X	X		X
E. Eagle	1993	X	X	X	X						X	X	X		X	X	X	X		X
Game 6	1992	X	X	X	X	X						X	X					X		X
Raven	1999			X	X						X	X	X				X	X		X
Coco	2002	X	X	X	X						X	X	X	X	X	X	X	X		X
Caldera	2000		X	X	X						X	X	X					X		X
Game 3	2002	X	X	X	X	X					X	X	X					X		X
Game 4	2003	X	X	X	X	X					X	X	X					X		X
TroSec21	2007											X	X	X	X	X	X	X		X
TroSec26	2007											X	X	X	X	X	X	X		X
Gartina 2	2008										X	X	X	X	X	X	X	X		X
Fish Eye	2007											X	X	X	X			X		X
View Cove	2007											X	X	X	X			X		X
Estrella	---		X	X	X						X	X	X	X	X	X	X	X		X
Game 8	---				X							X	X	X	X	X	X	X		X
Gartina 1	---										X	X	X	X	X	X	X	X		X
Hetta	---											X	X	X	X			X		X
		Pre-harvest									Post-harvest									

Pre-harvest

Post-harvest

•Juneau

•Ketchikan

Source: USGS

Source: NASA, NGA, USGS

Source: ESRI, i-cubed, USDA FSA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGP

65km

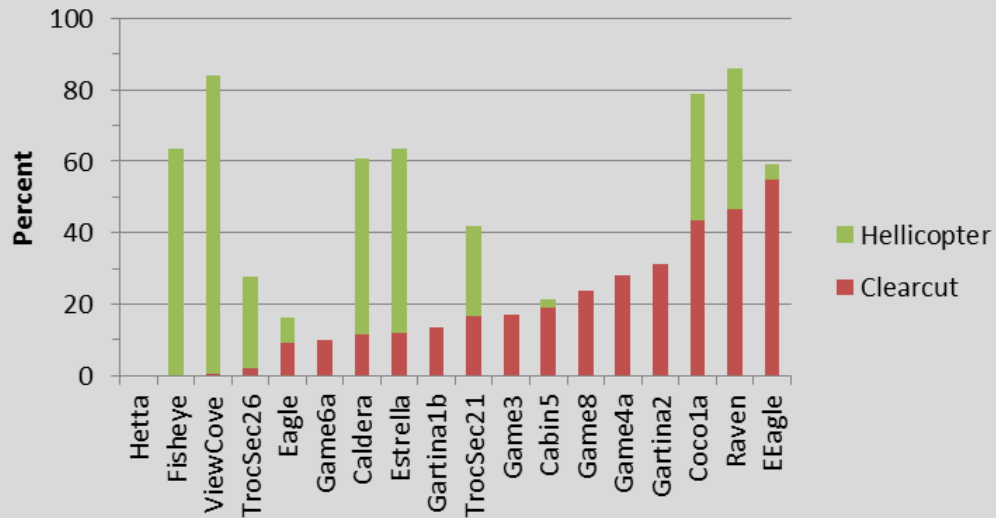
esri

Timber Harvest Intensity

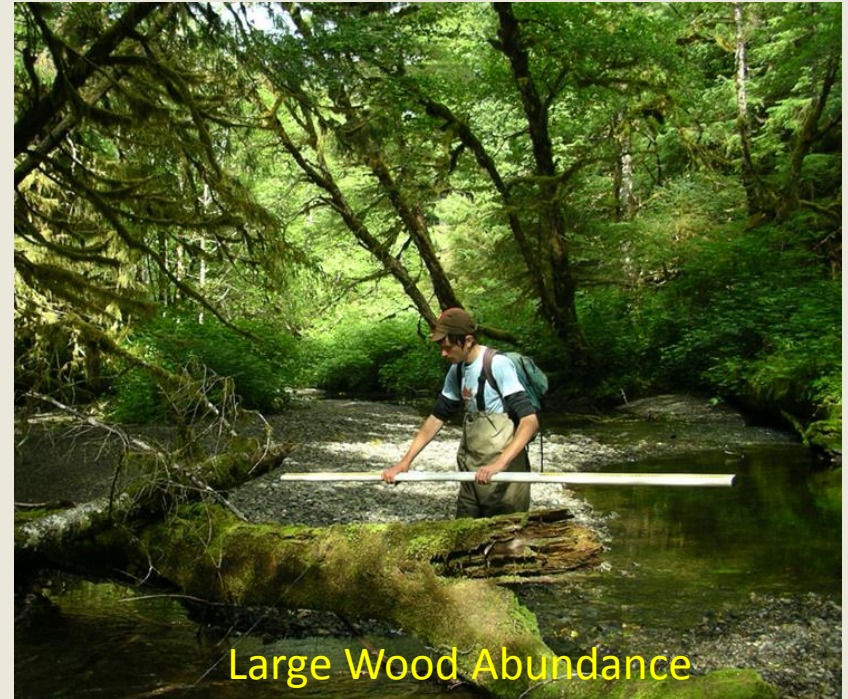
Raven Cr.

Caldera Cr.

Timber Harvest by Study Basin



Monitoring Habitat Characteristics

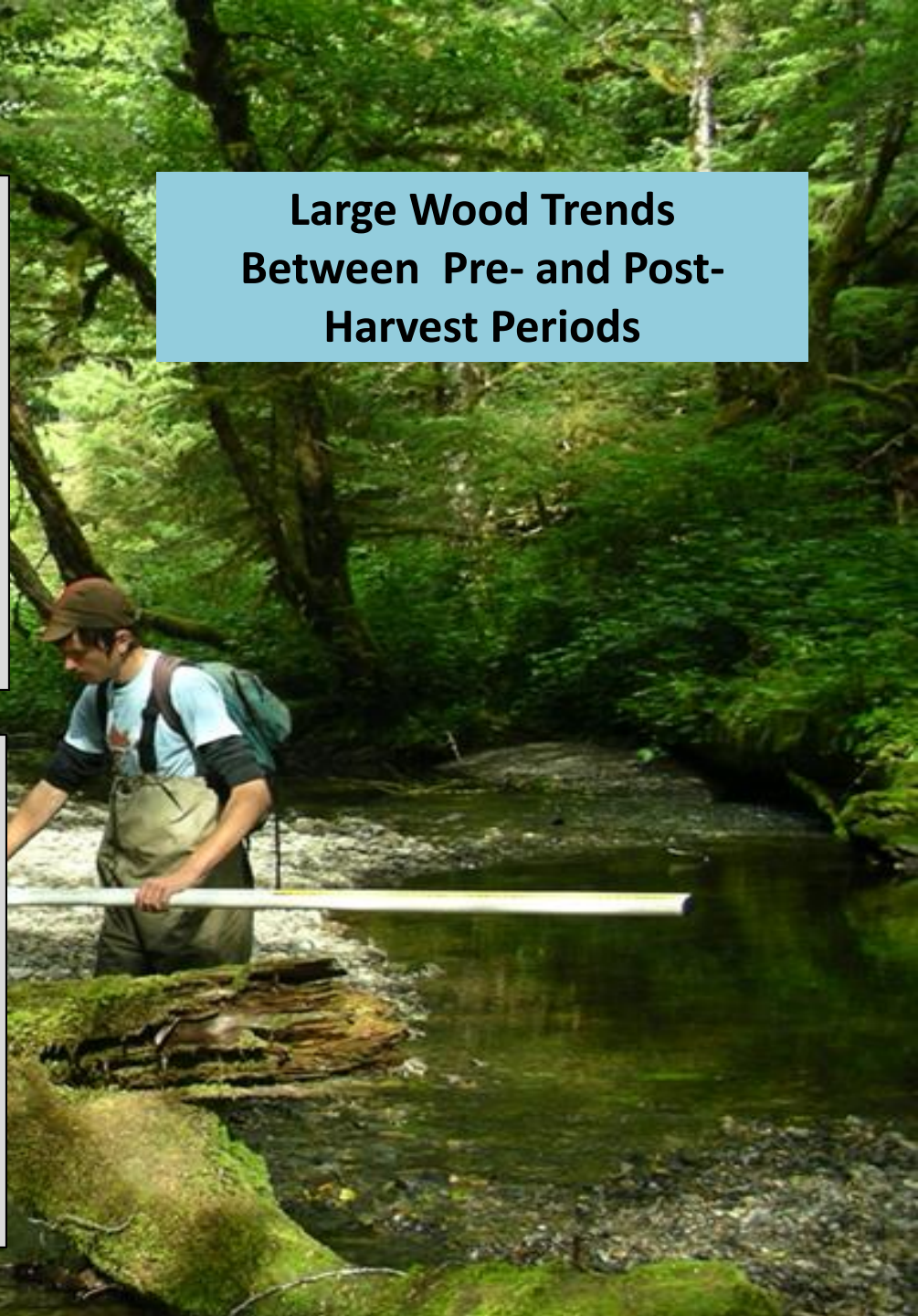
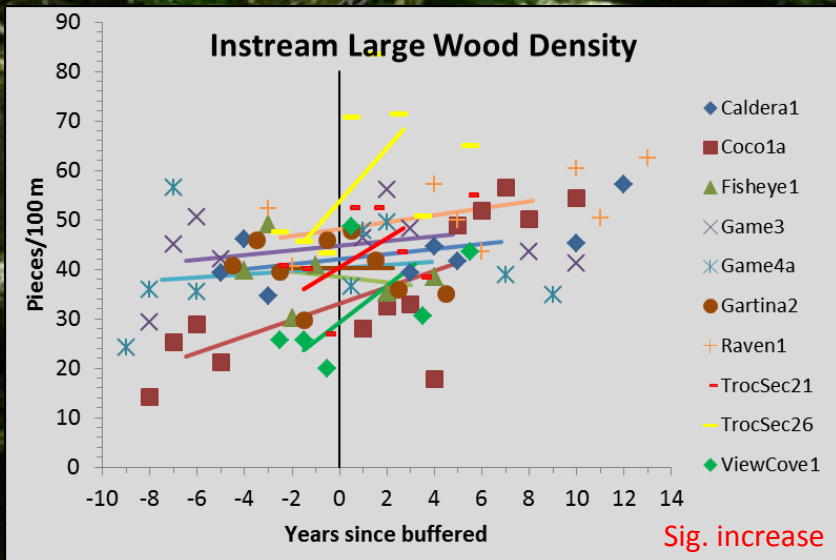
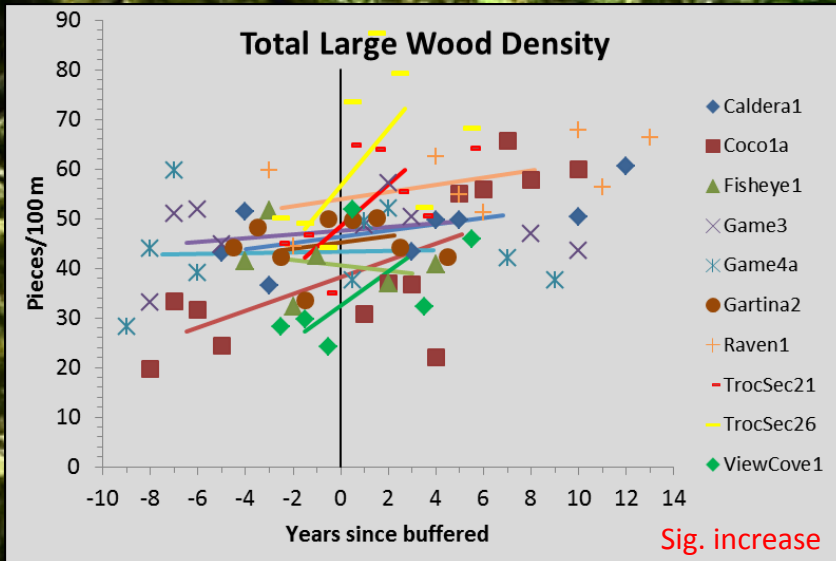


Buffer		Monitoring Schedule																			
Stream	Year	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	
Cabin	1991	X	X		X						X	X	X					X		X	
Eagle	1993	X	X	X	X						X	X	X	X	X	X	X	X		X	
E. Eagle	1993	X	X	X	X						X	X	X		X	X	X	X		X	
Game 6	1992	X	X	X	X	X	X					X	X					X		X	
Raven	1999				X	X					X	X	X					X	X	X	
Coco	2002	X	X	X	X						X	X	X	X	X	X	X	X		X	
Caldera	2000			X	X	X					X	X	X					X		X	
Game 3	2002	X	X	X	X	X					X	X	X					X		X	
Game 4	2003	X	X	X	X	X	X				X	X	X					X		X	
TroSec21	2007											X	X	X	X	X	X	X		X	
TroSec26	2007											X	X	X	X	X	X	X		X	
Gartina 2	2008										X	X	X	X	X	X	X	X		X	
Fish Eye	2007											X	X	X	X			X		X	
View Cove	2007											X	X	X	X			X		X	
Estrella	—			X	X	X					X	X	X	X	X	X	X	X		X	
Game 8	—					X						X	X	X	X	X	X	X		X	
Gartina 1	—										X	X	X	X	X	X	X	X		X	
Hetta	—											X	X	X	X			X		X	
		Pre-harvest										Post-harvest									

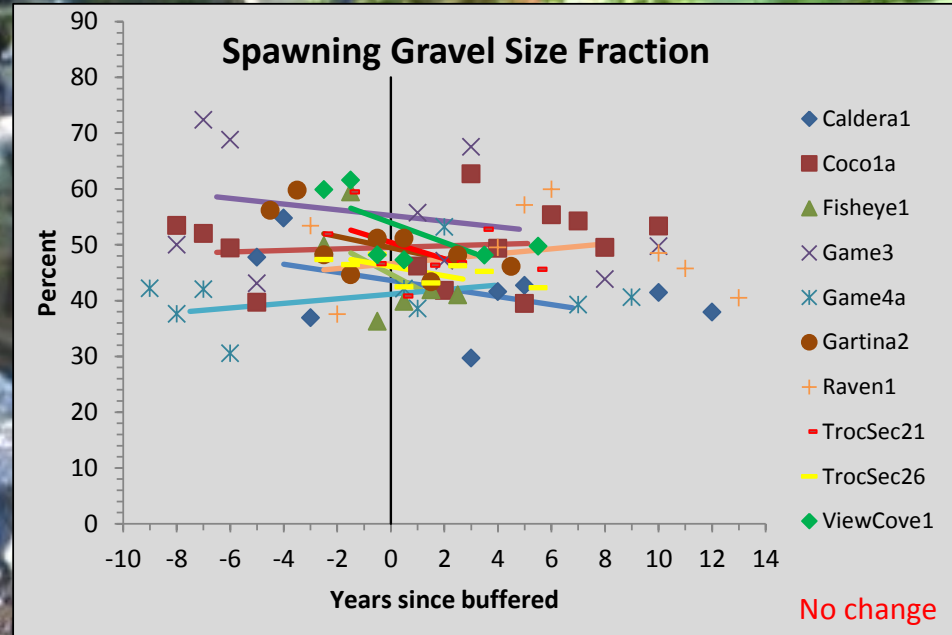
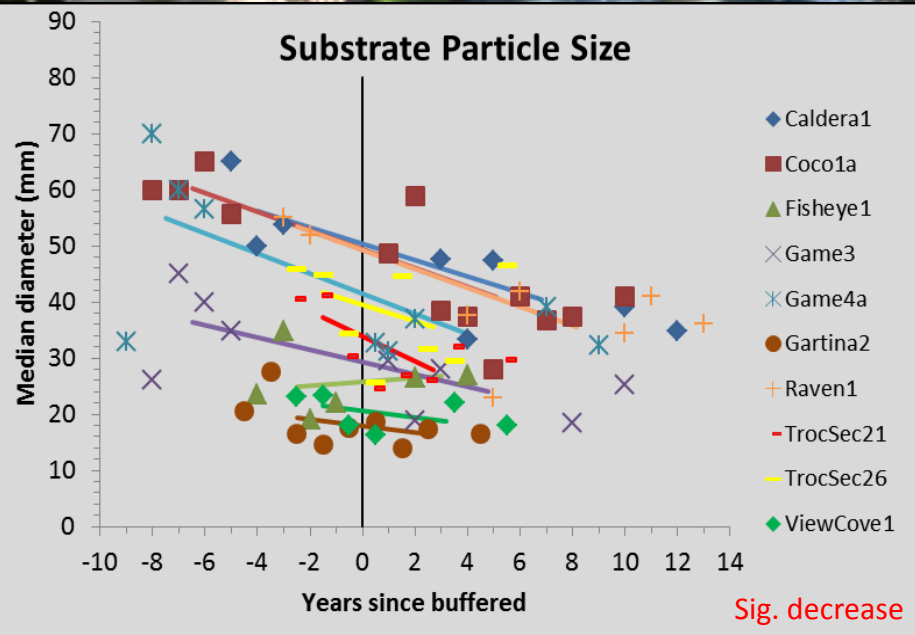
Test of Habitat Change Between Pre- and Post- Harvest Periods



Large Wood Trends Between Pre- and Post- Harvest Periods

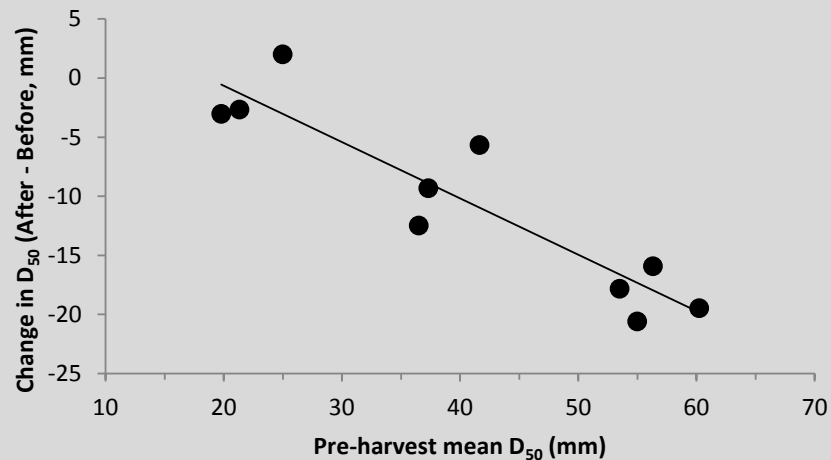


Substrate Size Trends Between Pre- and Post-Harvest Periods

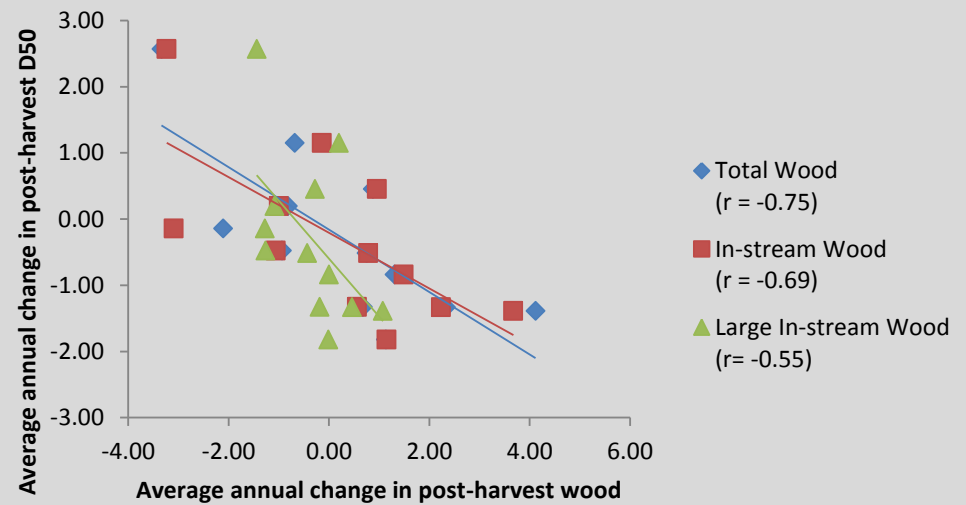


Correlations with Substrate Particle Size

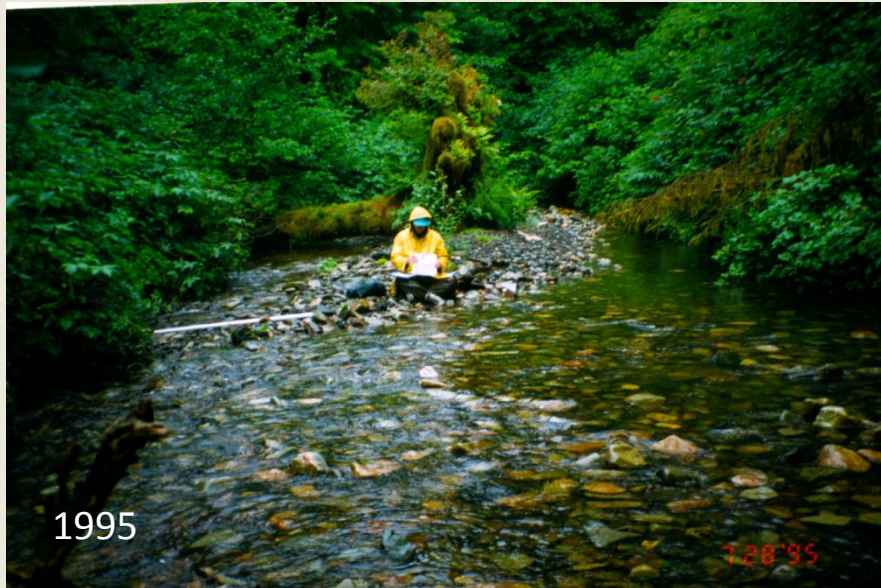
Post-Harvest Change in Substrate Size in Relation to Pre-Harvest Substrate Size



Substrate Size and Wood Correlation



Substrate Size
Changes Over Time in Association
with Large Wood Input



Beaver Dams

Create ponds, store sediment, and
reduce sediment transport



Landslides and Habitat

- Logging-related landslide occurred at one study site during monitoring period.
- Perkins (1999) study of Sealaska lands found:
 - Only a small proportion (11%) of landslides are logging-related.
 - In logged areas only 3 of 18 landslides delivered to streams and only 1 delivered to a salmon stream

- Landslide originated below road 3 years after logging



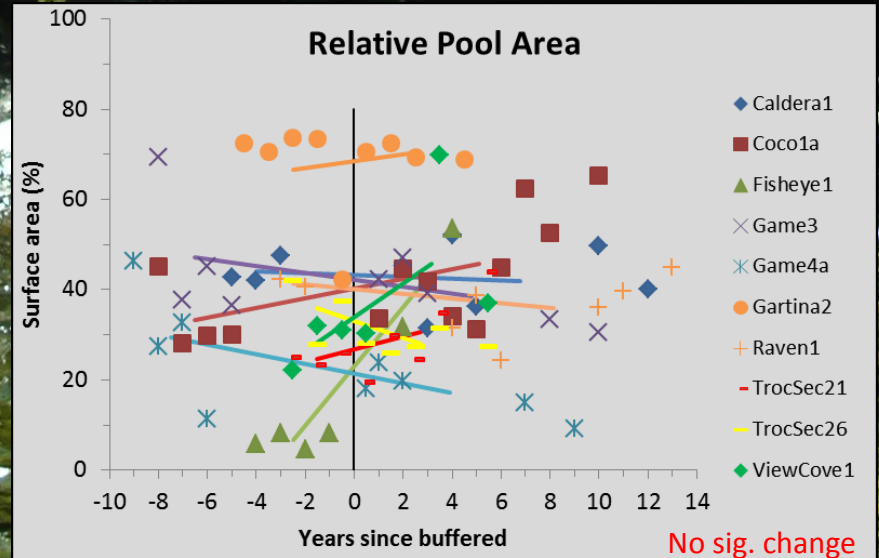
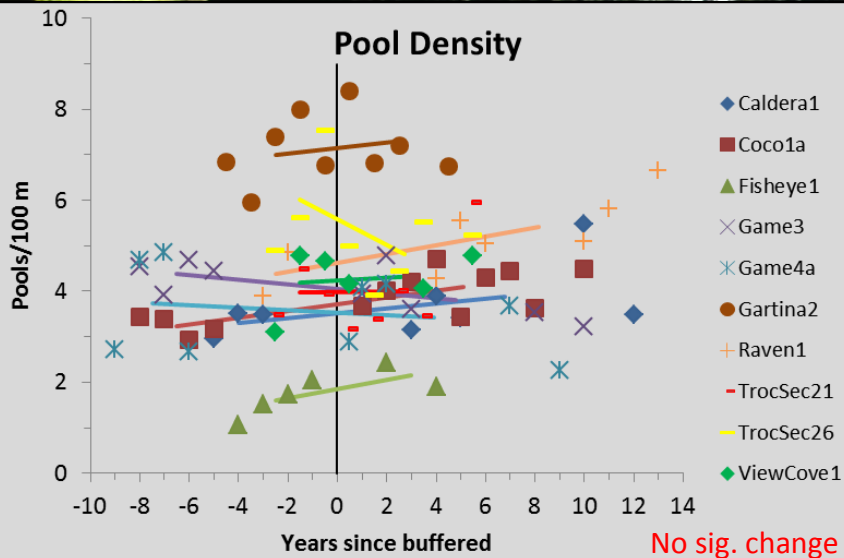
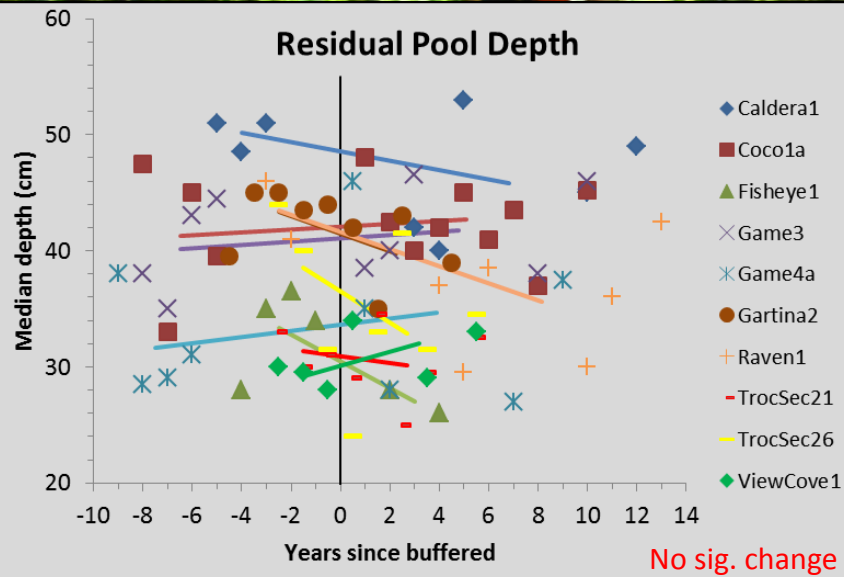
- Landslide fine sediment may reduce spawning habitat quality over short term.
- Landslide coarse sediment provides spawning gravel over long term.



- Two years after landslide occurred, debris forms pools, provides cover, and creates complex rearing habitat over long term



Pool Trends Between Pre- and Post- Harvest Periods



	Buffer	Monitoring Schedule																		
Stream	Year	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12
Cabin	1991	X	X		X						X	X	X					X		X
Eagle	1993	X	X	X	X						X	X	X	X	X	X	X	X	X	X
E. Eagle	1993	X	X	X	X						X	X	X		X	X	X	X	X	X
Game 6	1992	X	X	X	X		X					X	X					X	X	X
Raven	1999				X	X					X	X	X				X	X		X
Caldera	2000			X	X	X					X	X	X					X		X
Coco	2002		X	X	X	X					X	X	X	X	X	X	X	X	X	X
Game 3	2002		X	X	X	X	X				X	X	X					X	X	X
Game 4	2003		X	X	X	X	X				X	X	X					X		X
TroSec21	2007											X	X	X	X	X	X	X	X	X
TroSec26	2007											X	X	X	X	X	X	X	X	X
Gartina 2	2008										X	X	X	X	X	X	X	X	X	X
Fish Eye	2007											X	X	X	X			X		X
View Cove	2007											X	X	X	X			X		X
Estrella	---			X	X	X					X	X	X	X	X	X	X	X	X	X
Game 8	---					X						X	X	X	X	X	X	X	X	X
Gartina 1	---										X	X	X	X	X	X	X	X	X	X
Hetta	---											X	X	X	X	X		X		X
		Pre-harvest									Post-harvest									

Statistical Summary of Pre-Harvest to Post-Harvest Comparison

Statistic	Total LW density (no/100 m)	Instream LW density (no/100 m)	Median substrate (mm)	Residual Pool depth (cm)	Pool density (no/100 m)	Pool area (%)
Mean difference (post - pre)	9.7	9.0	-10.5	-2.0	0.14	3.9
Paired t-test p-value	0.0081	0.0085	0.0023	0.1541	0.5255	0.4282
Min. Detectable Difference 80% Power, alpha=0.10	7.7	7.3	6.8	3.5	0.59	12.6

Post-Harvest Examination of Longer-Term Trends

Buffer		Monitoring Schedule																			
Stream	Year	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	
Cabin	1991	X	X		X						X	X	X					X		X	
Eagle	1993	X	X	X	X						X	X	X	X	X	X	X	X		X	
E. Eagle	1993	X	X	X	X						X	X	X		X	X	X	X		X	
Game 6	1992	X	X	X	X	X					X	X						X		X	
Raven	1999				X	X					X	X	X					X	X	X	
Caldera	2000			X	X	X					X	X	X					X		X	
Coco	2002		X	X	X	X					X	X	X	X	X	X	X	X		X	
Game 3	2002		X	X	X	X	X				X	X	X					X		X	
Game 4	2003		X	X	X	X	X				X	X	X					X		X	
TroSec21	2007											X	X	X	X	X	X	X		X	
TroSec26	2007											X	X	X	X	X	X	X		X	
Gartina 2	2008										X	X	X	X	X	X	X	X		X	
Fish Eye	2007											X	X	X	X			X		X	
View Cove	2007											X	X	X	X			X		X	
Estrella	---			X	X	X					X	X	X	X	X	X	X	X		X	
Game 8	---					X						X	X	X	X	X	X	X		X	
Gartina 1	---										X	X	X	X	X	X	X	X		X	
Hetta	---											X	X	X	X			X		X	
		Pre-harvest										Post-harvest									

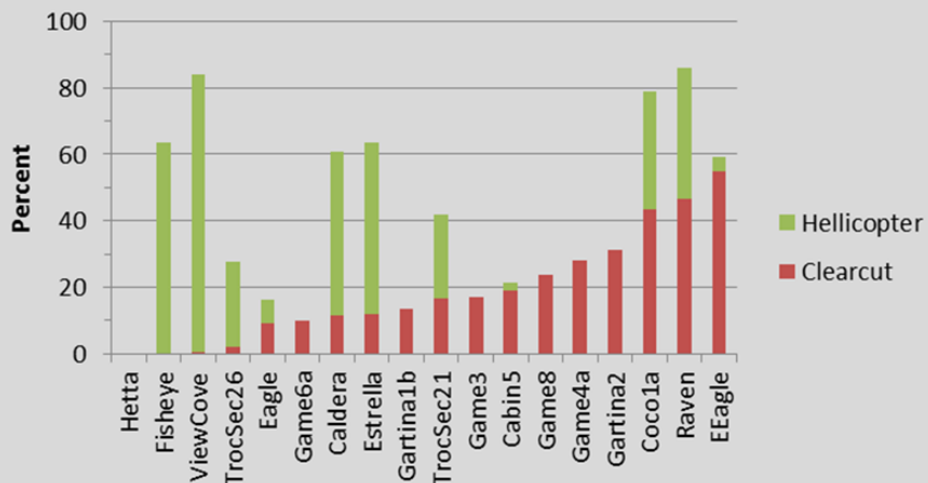
Pre-harvest

Post-harvest

Metric	Total LW density (no/100 m)	Instream LW density (no/100 m)	Median substrate (mm)	Spawning gravel (%)	Residual Pool depth (cm)	Pool density (no/100 m)	Pool area (%)
Mixed-Effects Modeling	Increasing trend	Increasing trend	Decreasing trend	Decreasing trend	Increasing trend	Increasing trend	No change
slope	1.2	1.1	-1.4	-0.55	0.5	0.06	---

How do findings from study
basins relate to other basins?

Timber Harvest by Study Basin



Juneau

Ketchikan

Source: USGS

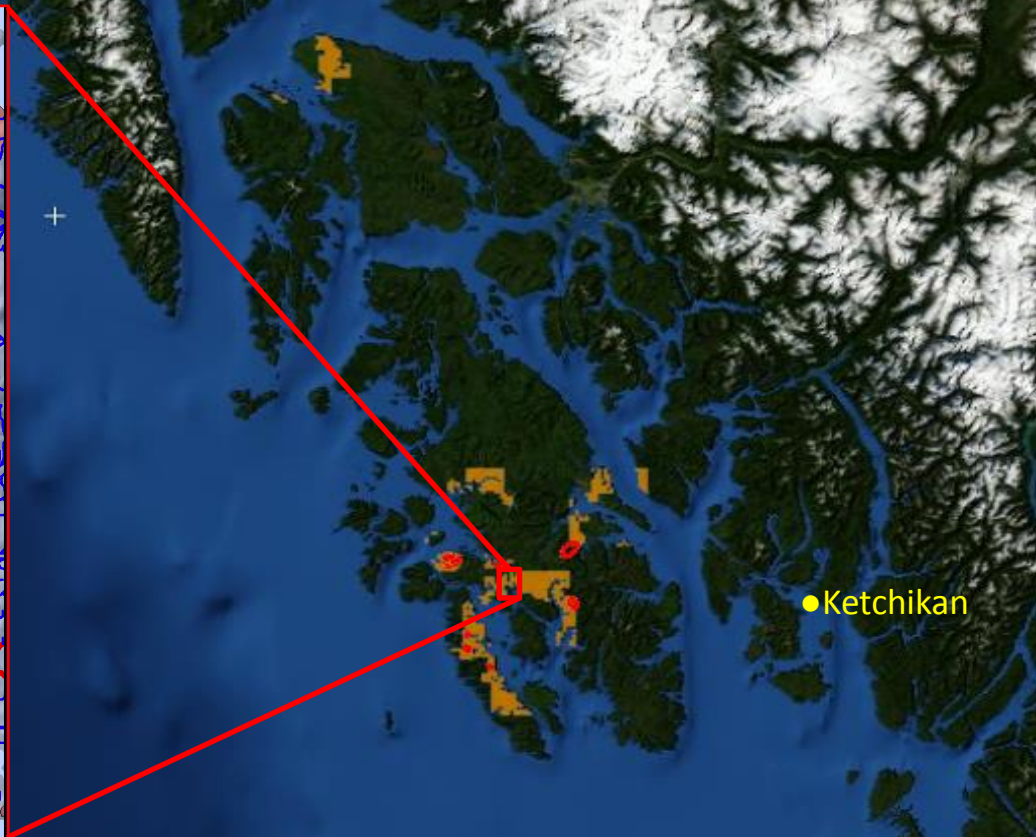
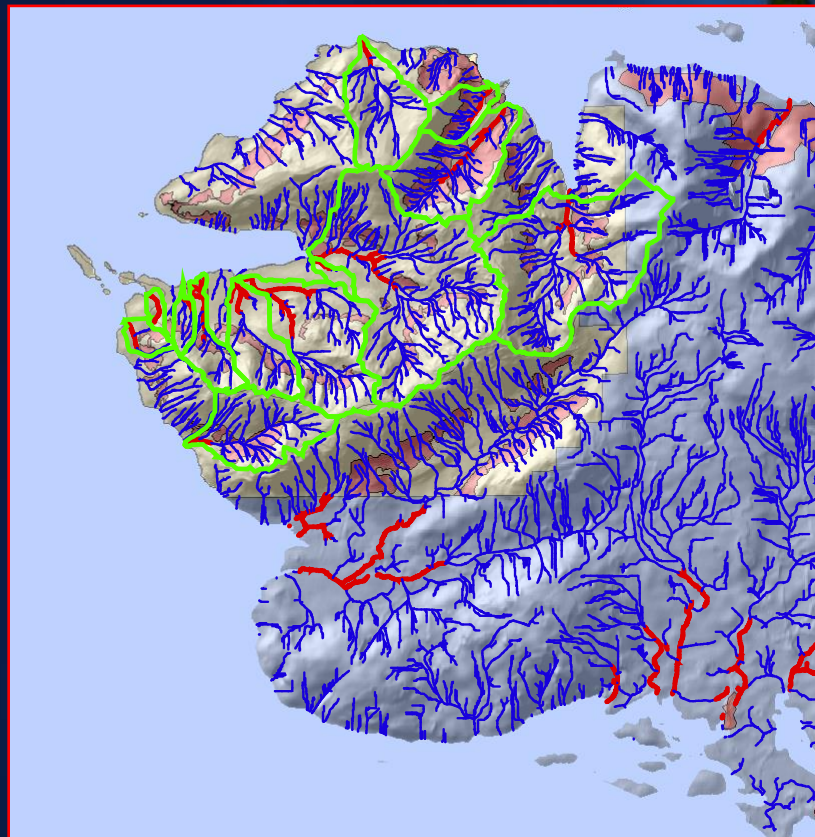
Source: NASA, NGA, USGS

Source: ESRI, Incubated, USDA, ESA, USGS, AEF, GeoEye, Getmapping, AeroGRID, IGB

65km

esri®

Sealaska Lands Include 297 Basins with Salmon

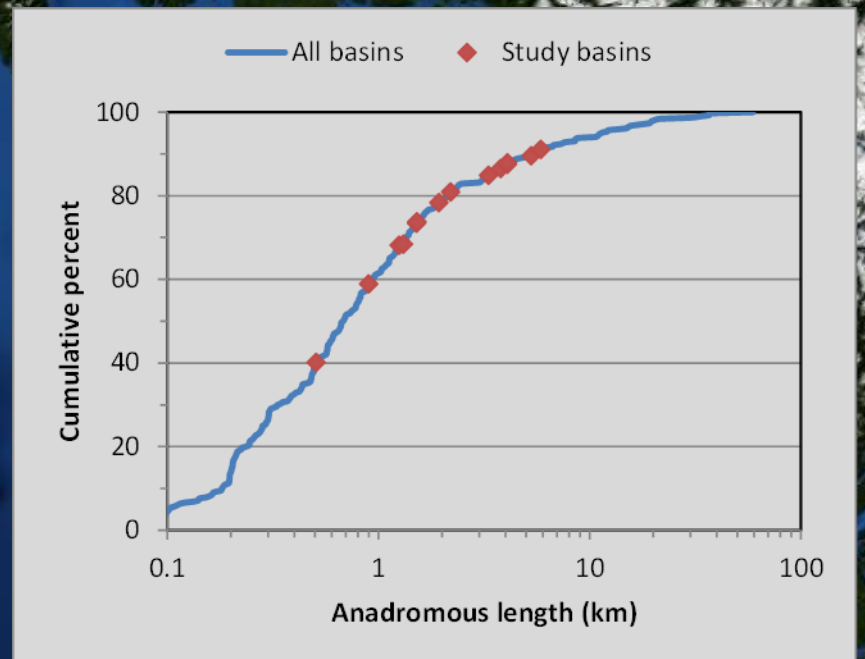
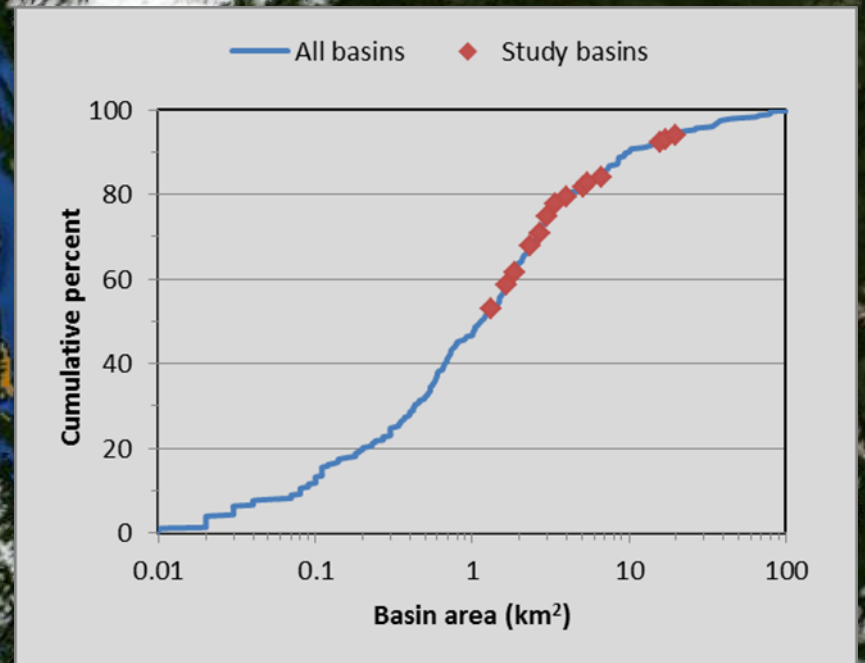
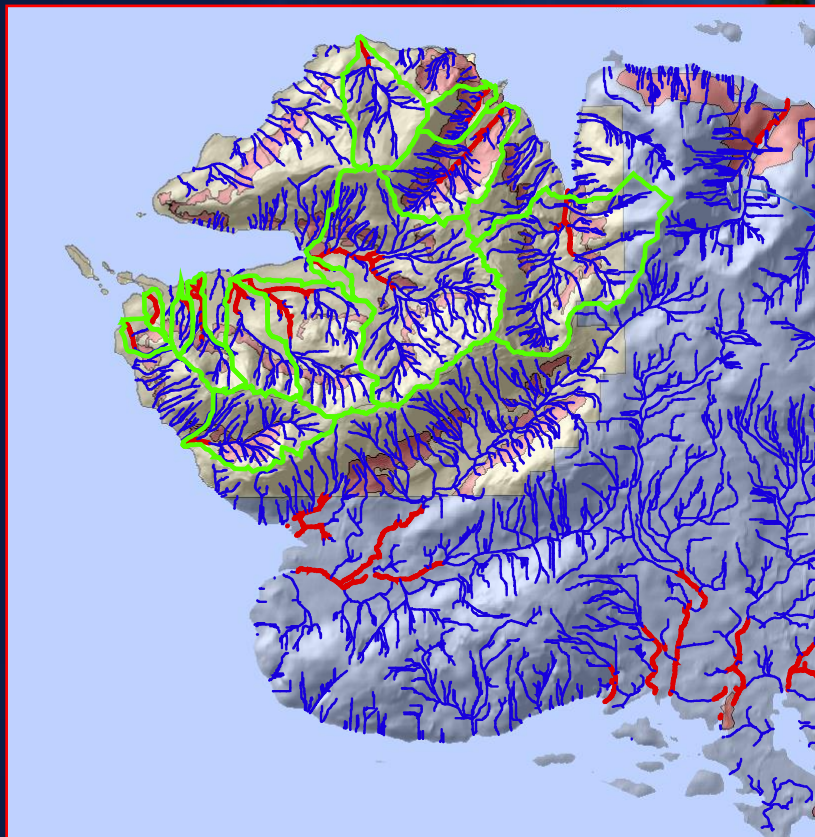


Source: USGS
Source: NASA, NGA, USGS

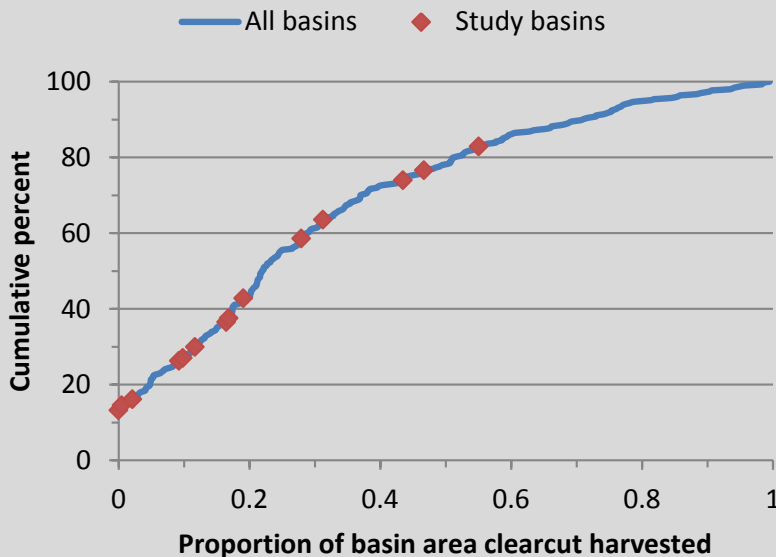
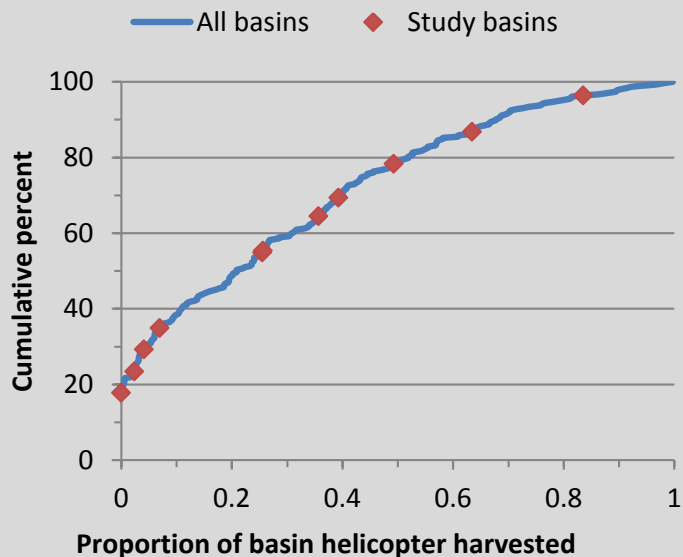
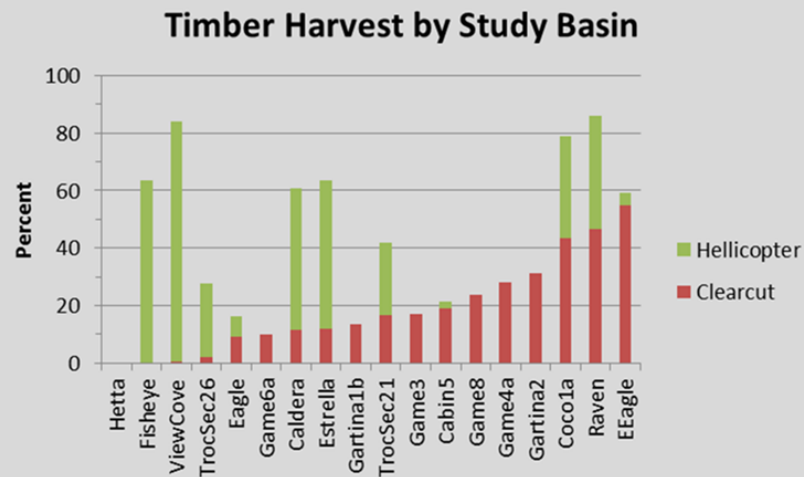
65km

esri®

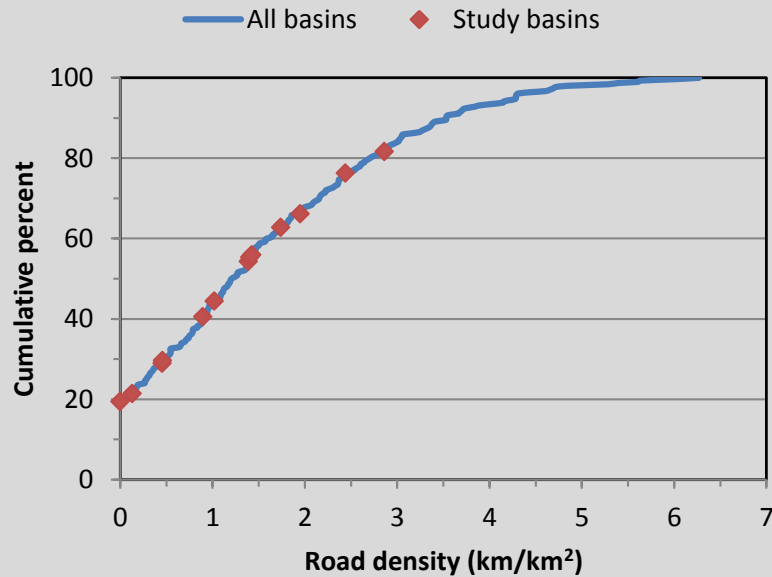
Attributes for study basins are compared to all 297 basins using cumulative frequency distributions



Timber Harvest Levels at Study Basins Compared to all Basins with Salmon



Road Density at Study Basins Compared to all Basins with Salmon



● Juneau

● Ketchikan

Source: USGS

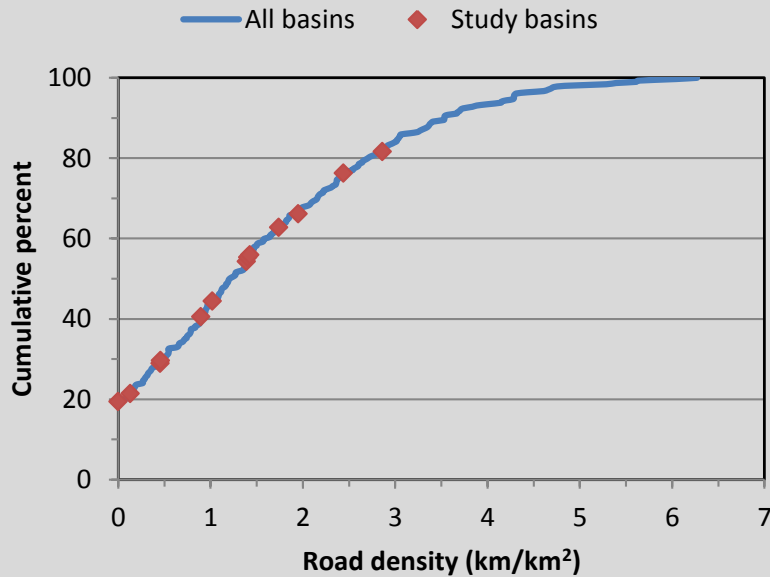
Source: NASA, NGA, USGS

Source: ESRI, Incubed, USDA FSA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGR

65km

esri

Road Density at Study Basins Compared to all Basins with Salmon



Roads and Sediment

- DNR Road Conditions Status Report (2010) - “We found that the FRPA, regarding road construction, road maintenance, crossing structure maintenance and road closure are, in most cases, working well to protect fish habitat and water quality.”
- No significant correlation between Road Density and trends in Substrate Size

● Juneau

● Ketchikan

Source: USGS

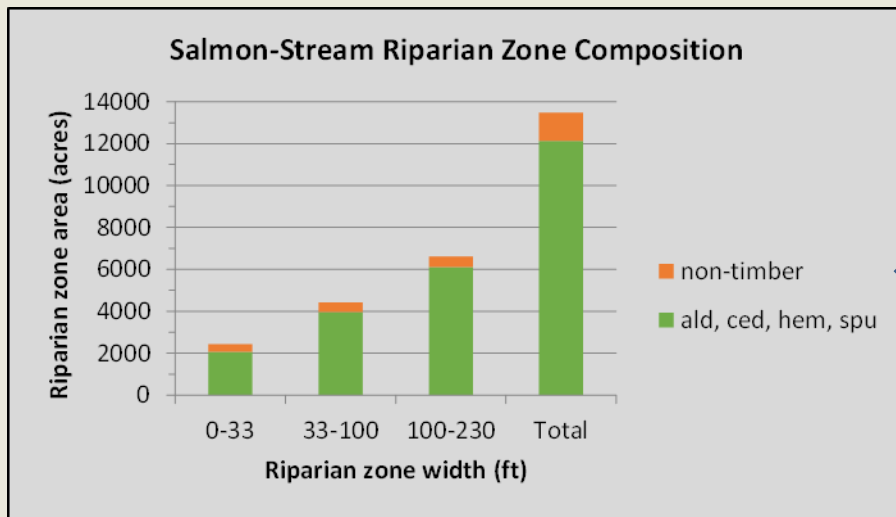
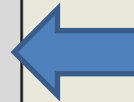
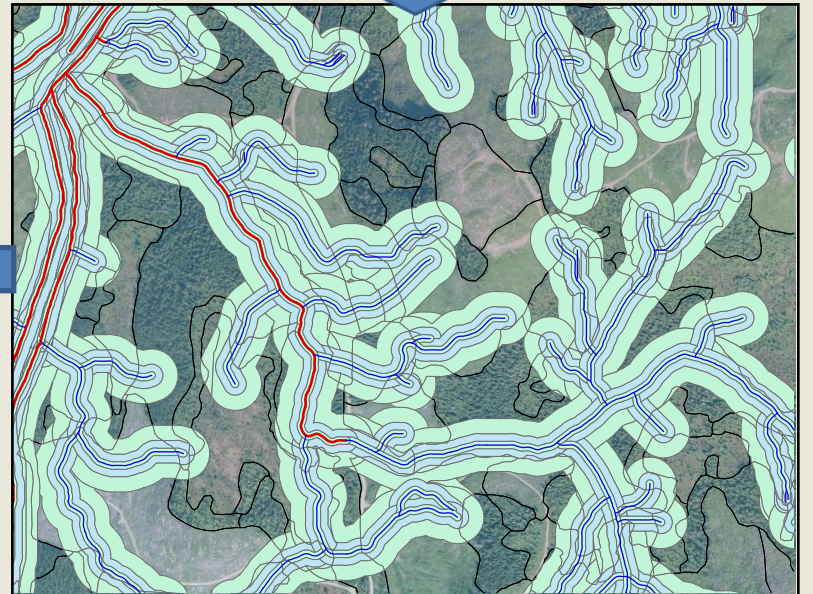
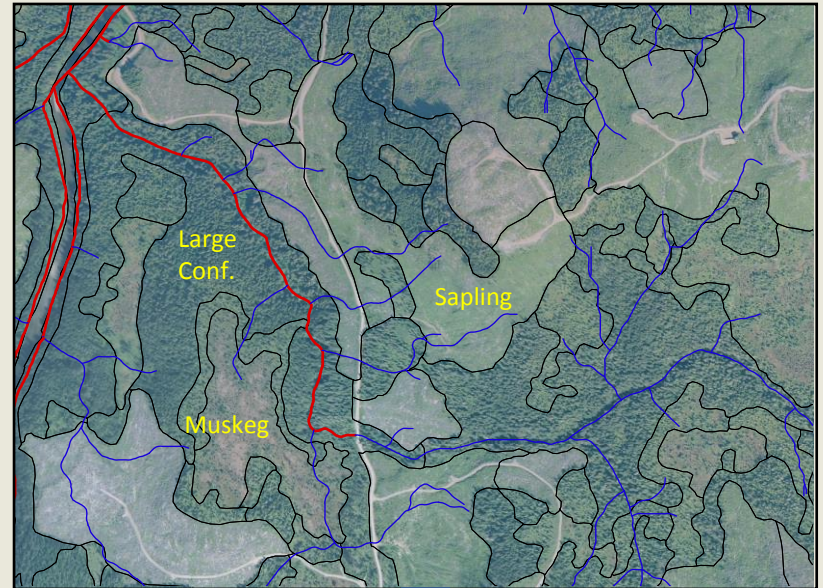
Source: NASA, NGA, USGS

Source: ESRI, Incubed, USDA FSA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGR

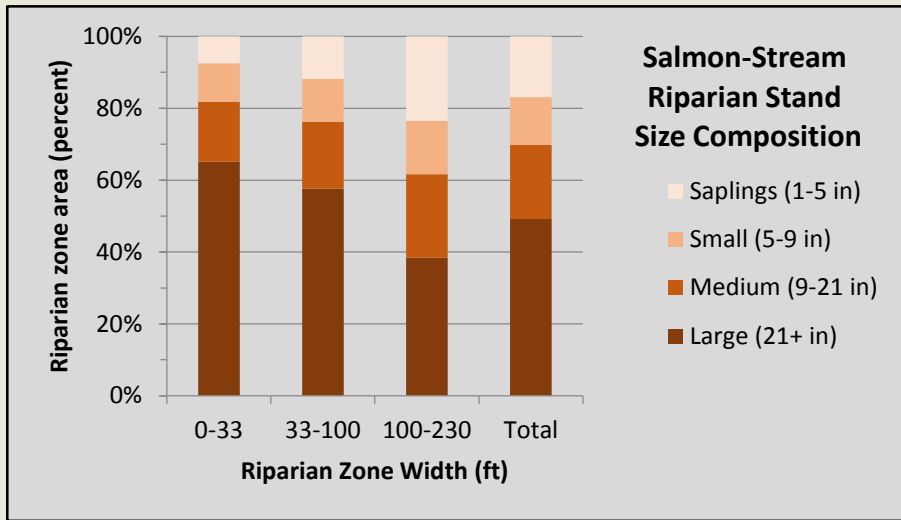
65km

esri

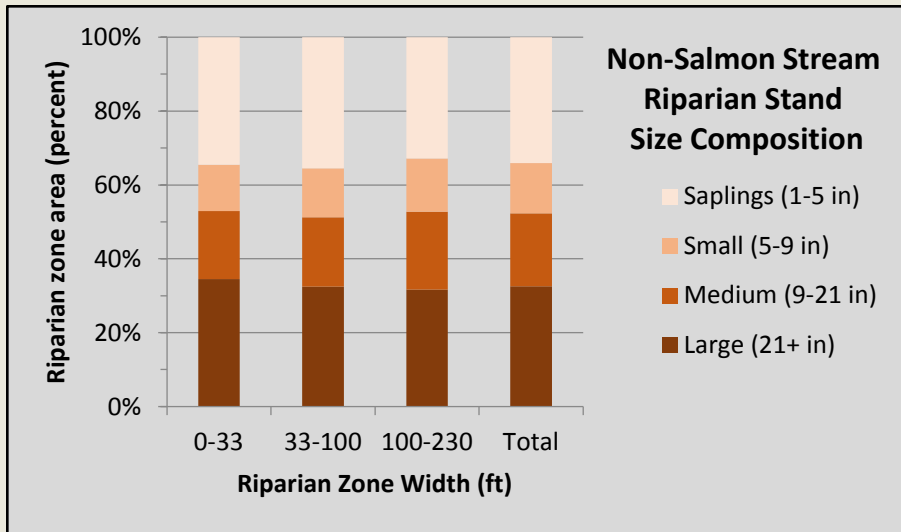
Inventory of Riparian Stand Composition on Sealaska Lands



Riparian Stand Size Composition

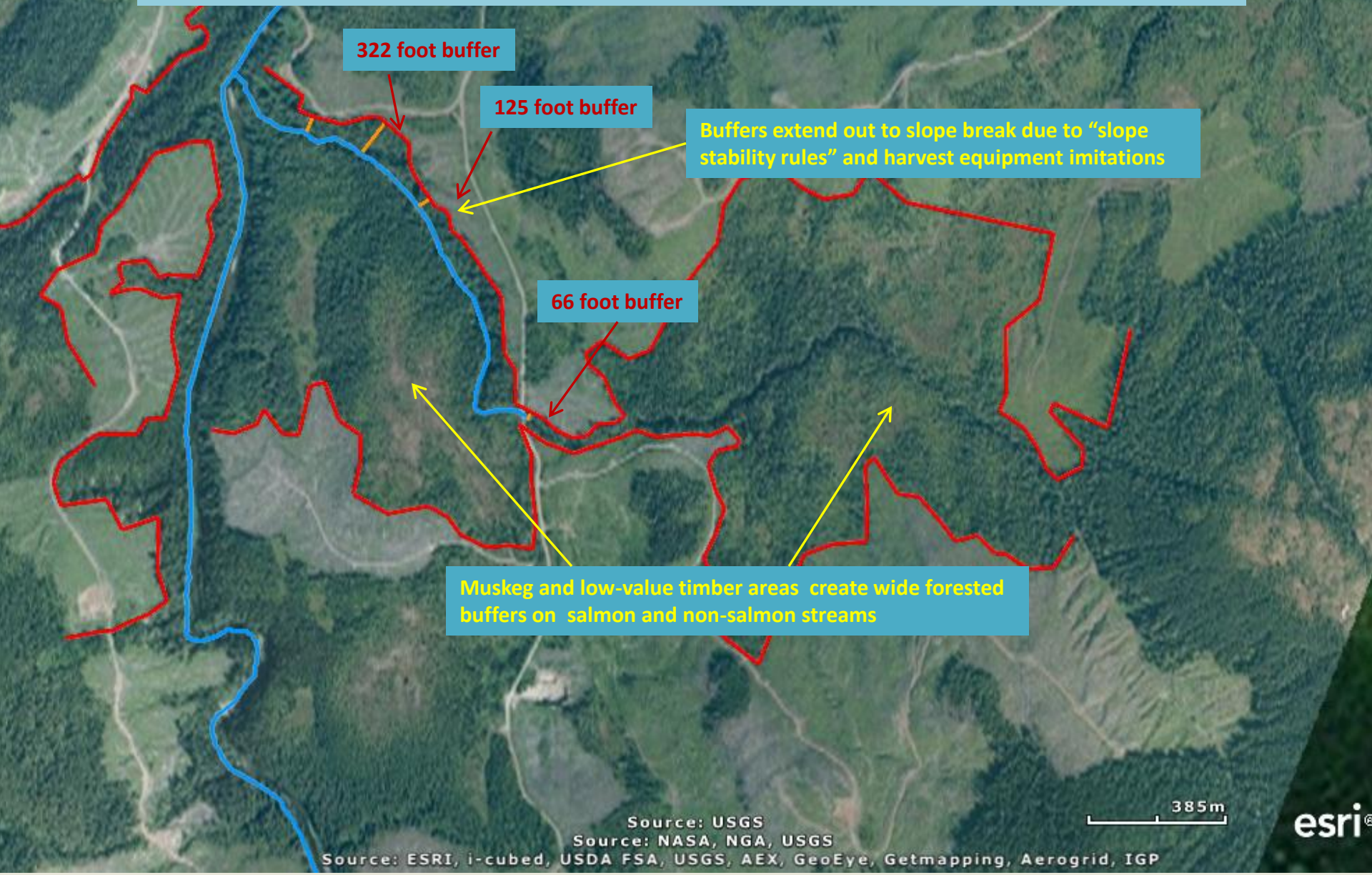


- ❖ Most of the FRPA buffer zones (66-ft wide) on salmon streams are composed of medium to large conifer stands.
- ❖ A large percentage of buffer zones on salmon streams are wider than 66 ft. and are composed of medium to large conifer stands.



- ❖ At least one-half of the riparian areas on non-salmon streams are composed of medium to large conifer stands.

Buffer Width is Influenced by Topography, Harvest Machine Limitation, and Timber Market Value



What Have We Learned

1. Riparian management under FRPA has not significantly diminished the future potential supply of large wood in salmon streams.

What Have We Learned

1. Riparian management under FRPA has not significantly diminished the future potential supply of large wood in salmon streams.
2. Riparian timber stands on salmon streams are mostly stocked with medium to large timber and many buffer strips are wider than 66 ft; also, many non-salmon streams are buffered by retained stands.

What Have We Learned

1. Riparian management under FRPA has not significantly diminished the future potential supply of large wood in salmon streams.
2. Riparian timber stands on salmon streams are mostly stocked with medium to large timber and many buffer strips are wider than 66 ft; also, many non-salmon streams are buffered by retained stands.
3. Substrate particle size has declined after harvest in association with increased large wood inputs and associated channel adjustments; no evidence linking substrate changes to roads and logging related landslides (except one site).

What Have We Learned

1. Riparian management under FRPA has not significantly diminished the future potential supply of large wood in salmon streams.
2. Riparian timber stands on salmon streams are mostly stocked with medium to large timber and many buffer strips are wider than 66 ft; also, many non-salmon streams are buffered by retained stands.
3. Substrate particle size has declined after harvest in association with increased large wood inputs and associated channel adjustments; no evidence linking substrate changes to roads and logging related landslides (except one site).
4. There were no changes in the percentage of spawning gravel size substrate initially after harvest, however there is a small decline in the percentage of gravel size substrate over the longer term; effects on the quantity of spawning gravel are unclear.

What Have We Learned

1. Riparian management under FRPA has not significantly diminished the future potential supply of large wood in salmon streams.
2. Riparian timber stands on salmon streams are mostly stocked with medium to large timber and many buffer strips are wider than 66 ft; also, many non-salmon streams are buffered by retained stands.
3. Substrate particle size has declined after harvest in association with increased large wood inputs and associated channel adjustments; no evidence linking substrate changes to roads and logging related landslides (except one site).
4. There were no changes in the percentage of spawning gravel size substrate initially after harvest, however there is a small decline in the percentage of gravel size substrate over the longer term; effects on the quantity of spawning gravel are unclear.
5. There are no detectable changes in pool habitat initially after harvest, however trends in pool depth and density are increasing over the longer term.

A photograph of a person in a forest stream. The person is wearing a dark shirt, a cap, and a backpack, and is standing in the water. They are holding a long, thin object, possibly a measuring stick or a tool, and are looking down at it. The stream is surrounded by dense green foliage and trees. In the background, another person is visible, standing on the bank. The water is clear and reflects the sunlight. The overall scene is a natural, forested environment.

**Does Riparian Management under FRPA
Achieve the Primary Goals:**

“protect from significant adverse effects”

“adequate preservation of fish habitat”

**Current evidence indicates that the FRPA buffers and associated rules are
working to preserve anadromous fish habitat**

An aerial photograph of a forested landscape. A river flows through the lower portion of the image, with a road crossing it. The surrounding area is covered in dense green forest, with some cleared patches and a winding road visible in the upper half.

What Have We not Studied and What are New Concerns or Options for Adaptive Management Research

Other Questions

- quantity/quality of spawning habitat?
- shade and water temperature?
- salmon population response?

Riparian Restoration/Silviculture

- What is effectiveness of young-growth riparian stand thinning?
- What stream areas would benefit most from riparian restoration?
- What are riparian silviculture alternatives (e.g., site-specific management)?

Acknowledgements

Funding:

Sealaska Corporation
Alaska Department of Natural Resources
Alaska Department of Environmental Conservation
Alaska Clean Water Action Program
USDA State and Private Forestry Grant

Contributors:

Reviews from state & federal agencies
FRPA Monitoring Committee
Alaska Forest Association

Energetic and
hardworking field crew



Special Session

Forestry-Fisheries Sustainability: What Progress Have We Made?

Alaska Chapter-American Fisheries Society
Annual Meeting, October 20-24, 2014
Juneau Convention Center