Soil and Water Question 3 - Watershed Health

Goal: Maintain and restore the biological, physical and chemical integrity of the Tongass National Forest waters.

Objectives: Complete Hydrologic Condition Assessments and Restoration plans for priority watersheds. Complete watershed restoration plans in conjunction with Integrated Resource Program.

Soil and Water Question 3: What is the ecological condition and trend of watersheds in terms of key characteristics (such as soil productivity, water quality and quantity, invasive species, etc.) of watershed health identified in the desired condition (aquatic ecosystem potential) of the plan area? How effective are management actions in improving watershed health (maintaining or moving watersheds toward Condition Class I)?

This was a new question in the 2008 Forest Plan. As part of the Forest Service National Watershed Condition Framework (USFS 2011), twelve core indicators were evaluated. Additional information on the national Watershed Condition Framework is at http://www.fs.fed.us/publications/watershed/.

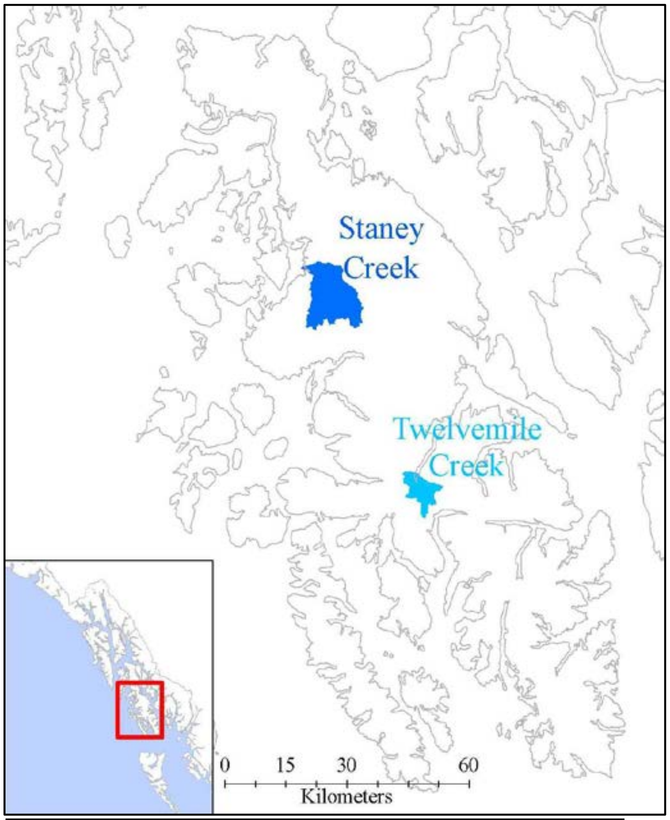
Most of the 900 watersheds within the Tongass are in near natural condition (Condition Class I). Sixty-eight watersheds were rated "at risk" for maintaining ecological functions and aquatic resources due to past management practices. Watershed health issues on the Tongass primarily result from historical timber harvest and road building that occurred between 1950 and 1979, prior to full understanding of the importance of watershed resources and processes. Measures are now in place (and incorporated into the Forest Plan) to protect and maintain watershed health.

The watershed condition ratings, along with use and aquatic value criteria, led to designation of candidate priority watersheds for restoration. Following a review by Tongass Staff, District Rangers and stakeholders, the Forest Supervisor formally established seven Priority Watersheds (Harris River, Twelvemile Creek, Staney Creek, Luck Lake, North Kuiu, Sitkoh River, and Sitkoh Creek). Restoration plans and activities to improve watershed health have been focused in these watersheds. Restoration work in the Harris River watershed concluded in 2011; it has been removed from the priority watershed list.

Evaluation Criteria

The Forest Plan states that the evaluation criteria for this question are "effects of management activities on Watershed Condition Class." A protocol was developed to evaluate the effects of forest management on streamflow; this effort has been deferred until a forest canopy density model has been developed for the Tongass NF. Refer to the Action Plan for recommendations on this topic.

In 2009, the Tongass NF and the Pacific Northwest Research Station began collaborating on a protocol for watershed restoration effectiveness monitoring. The objectives include developing and testing an integrated suite of monitoring tools to evaluate the effectiveness of management actions at improving watershed health. A specific goal is to identify meaningful surrogates for salmon responses to restoration by quantifying relationships between salmonid populations and other (lower-cost) metrics of ecosystem recovery. Demonstrating positive changes in characteristics of target salmon populations is difficult because of the complex life history and multiplicity of influences on salmon throughout their life cycle. The metrics used in the protocol are designed to augment information collected about fish populations (primarily population structure, diversity and condition) and physical stream habitat, to improve the interpretation of fish responses and ecosystem function. An experimental design was proposed to evaluate riparian forest and instream restoration treatments at small stream and whole-watershed scales.



Soil and Water 3 Figure 1. Watershed Effectiveness Monitoring Locations

A search for restoration sites failed to identify streams that met all study design criteria; ultimately some compromises were made to select six small stream reaches (three pairs) in two of the priority watersheds on Prince of Wales Island (Staney Creek and Twelvemile Creek – figure 1). Young growth riparian forest adjacent to these streams had previously been treated. As a result, metrics related to riparian young growth treatments were dropped from the initial study and instead a decision support tool for applying riparian thinning treatments in other project areas was developed and tested. Data collection within the study reaches focused on physical habitat measures, continuation of hydrologic connectivity measurements as part of ecological processes, and seasonal fish tracking through the use of Passive Integrated Transponder (PIT) tags and juvenile fish sampling to determine population and growth trends. Instream treatments (wood placement) proceeded in 2011 and monitoring continued in 2012.

Sampling/Reporting Period

Sampling period: biannual; reporting and evaluation period: five years

Monitoring Results

Data collected for watershed restoration effectiveness monitoring in 2012 included stream physical habitat, ecological processes, soil geomorphology and terrestrial riparian vegetation, and fish response.

Stream Physical Habitat

Post-treatment habitat surveys were completed in all six reaches. Key metrics include pool frequency, residual depth, and surface area; in-channel wood volume; and channel width-to- depth ratio. Surveys in August, 2012 confirm that the channels continue to respond to the wood placement as evidenced by scour and sediment retention associated with the restoration. These localized processes develop into measurable habitat features as a function of channel forming flows, commonly occurring several times a year.

Continuous stream stage and temperature instruments were maintained in all six study tributary streams to complement and aid interpretation of monitoring metrics. Stream discharge measurements were taken during site visits to create a rating curve for each site.

Ecological Processes

Light, litterfall, total chlorophyll, and hydrologic retention are ecological function metrics (EFM) influencing input and production of food in stream channels. The data collected on these ecological processes was intended to provide information on the major food delivery mechanisms to streams: riparian inputs of organic matter via litterfall and production of organic matter within the stream channel. These two pathways for organic matter input contribute most of the organic matter available to rearing fish, which in combination with physical habitat availability and structure determine the quality of salmon habitat. Along with improving the amount and quality of available physical habitat, instream manipulations also influence the production and retention of food resources within a reach. Stream hydrologic retention metric data were collected to provide complementary information to quantify the impact of instream structures on stream habitat complexity.

Understanding variation in these metrics within young-growth riparian forests may be useful in two ways: (1) developing relevant measures of stream food web production and (2) detecting changes resulting from stream restoration efforts aimed at improving stream ecological function. We assessed variability of EFM in thinned young-growth riparian forests of southeast Alaska. For the six stream sites, we assessed differences in light, litterfall, and total chlorophyll. For three of the six channels, we evaluated effects of in-stream wood placements on hydrologic retention by conducting salt tracer tests. Results of these assessments are currently being incorporated into two manuscripts: (1) a general technical report of study objectives, general methods, and summarized results, and (2) a detailed evaluation of litterfall content, nitrogen content, and terrestrial invertebrate content observed for second-growth riparian forests having a range of alder/conifer mixtures. The results are expected to be incorporated into the two manuscripts.

Soil Geomorphology and Terrestrial Riparian Vegetation

Regenerating riparian forest stands are thinned to enhance forest stand recovery to achieve a desired condition that provides for the acceleration of old-growth conditions including increase and diversification of understory plant communities, expansion of woody debris recruitment and enhancement of nutrient cycling. However, the trajectory of stand growth and differentiation among various soil landscape components of the terrestrial ecosystem adjacent to the stream channel is uncertain. The terrestrial component of the WREM project was designed to address the question of how terrestrial restoration measures (i.e. thinning) impact stand development and the functions associated with mixed species stands of diverse age and structure.

Fish Response

Fish monitoring was conducted at the six study stream reaches using a monitoring protocol designed to assess the effects of restoration on fish density and growth rates of the species in the fish community at the reach scale. During 2012, fish sampling was conducted December, March-April, July and August. It was our intent to resample all six sites during each period but high stream flows and/or snowload prevented sampling in all but a few sites during December 2011. Fish sampling followed the multiple removal methodology from Bryant (2000) using 1/8 inch minnow traps for capture to estimate fish abundance within each reach. This methodology has been proven to be an effective method to estimate the population of each fish species in reaches. General fish capture locations (riffle vs. pool) were recorded for each fish caught.

Trap efficiencies declined dramatically during the December sampling event due to lower water temperatures. To better assess overwinter use in one reach, a mark-recapture event was conducted a few days post depletion trapping. Minnow traps were set overnight for the initial capture and marking and reset and soaked for an additional night. This method proved much more effective at capturing fish, although the number of recaptured fish was not as high as expected. This suggests that fish were more active at night during colder water temperatures and reduced fish metabolic performance.

Fish movement and individual growth rates within sample reaches were monitored through the use of Passive Integrated Transponder (PIT) tags which gave fish an individual identification number.

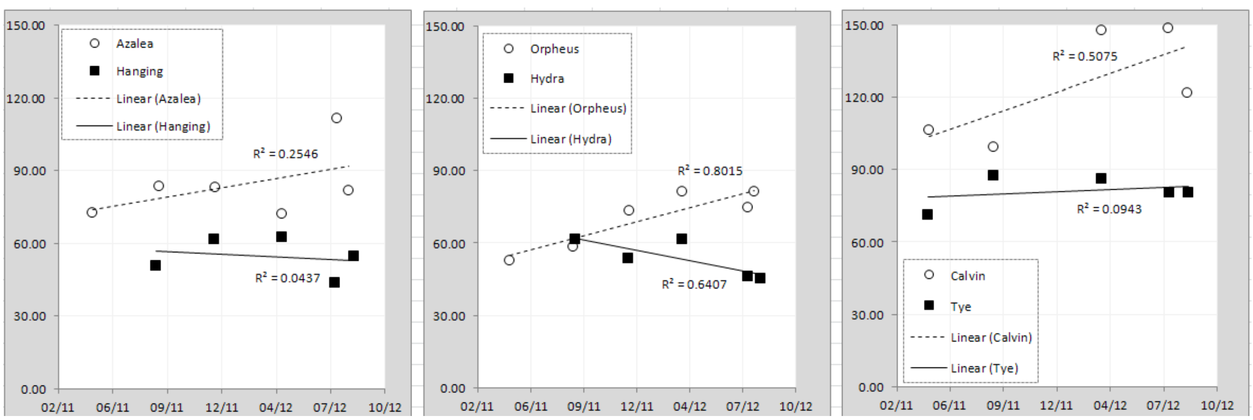
Secondary marks were used to assess tag loss and consisted of either removal of adipose fin or insertion of Visual Implant Elastomer (VIE) color depending on species per Fish Resource Permit stipulations.

Gastric lavage was conducted on a subset of fish captured during sampling events through non-lethal stomach pumping procedures as described in Meehan and Miller (1978) to provide a linkage to the food production metrics and riparian treatments. Samples were deliberately obtained and differentiated from both riffle and pool captured fish. To date, all study samples have been analyzed and raw data has been sent back to the Tongass from Michigan State University entomology lab. Data analysis and summarization is on-going and will be disseminated within the ecological processes manuscripts to be published by fall 2013. Fish sampling is planned to continue for a minimum period of four years post-treatment but will be conducted only in the summer and winter (two times annually). Discharge and water temperature will be used as covariates with the fish population data to help explain seasonal fish movements between tributary and mainstem habitat.

Evaluation of Results

Stream Habitat

To date, the primary physical metrics do not yet show clear trends. Pool Frequency (figure 2) shows the most change associated directly with the restoration efforts, and is presented here as an example of a preliminary trend-analysis comparison.



Soil and Water 3 Figure 2. Pool Frequency for three pairs of restored/unrestored channels

At the reach scale, we expect these changes to continue for the next several years as the channels continue to adjust to the added wood. Trend-analysis comparisons between pairs will be used to evaluate change over time for the full-suite of physical metrics.

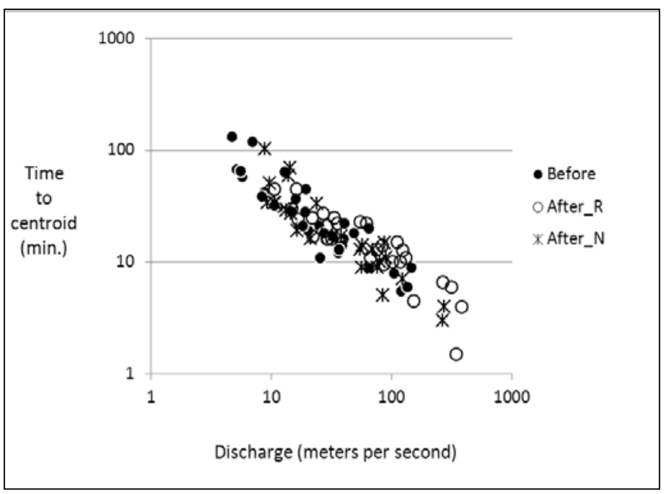
Ecological Processes

Light – A better understanding of photosynthetically active radiation (PAR) reaching the stream channel in thinned second-growth riparian forests was gained by this study. Azalea and Hanging Creeks within the Twelvemile Creek watershed, which contain greater than 60 percent alder, had greater percent PAR reaching the channel (PAR measured under canopy/ambient PAR) than Calvin, Tye, Orpheus, and Hydra creeks all within the Staney Creek Watershed, which had less than 25 percent alder ($p < 0.005$). Azalea and Hanging did not have significantly different levels of PAR ($p = 0.95$).

Chlorophyll – Estimated total daily chlorophyll accumulation on tiles, which was not significantly different between sites, averaged 29.96 ug m^{-1} d^{-1} overall. November and December chlorophyll accumulation was significantly lower than June, August, September, and October accumulations ($p < 0.03$). July chlorophyll was not significantly different than winter chlorophyll accumulation ($p > 0.35$). Azalea Creek, the stream with the highest light and chlorophyll levels also exhibited rapid and large responses to moderate rainfall. Major changes in stream discharge were observed on several occasions during peak flows with obvious movement of sediment as indicated by new depositional sites. This sediment transport was associated with scraping of algae off the tiles. Other streams like Azalea Creek having a history of disturbance (i.e. landslides on valley slopes), may also have greater alder, more light and periodically, greater chlorophyll levels than other streams lacking disturbance history. These streams are also expected to have variable chlorophyll levels associated with the period scouring off of algae.

Litterfall –We found significant differences in daily inputs of alder and conifer detritus between sites ($p < 2.2e^{-16}$). Azalea and Hanging Creeks had significantly greater alder inputs than Orpheus, Hydra, and Tye Creeks (705.89 and 574.07 versus 117.02, 151.83, 156.29 mg m^{-2} d^{-1}, respectively; $p < 0.002$). Orpheus Creek had significantly greater conifer detritus inputs than Azalea and Hanging Creeks (259.07, 43.22, and 67.14 mg*m^{-2}*d^{-1}, respectively; $p < 0.01$). Nitrogen input from alder leaves, sticks, and flower detritus was significantly greater than conifer detritus ($p < 0.0001$). There were significantly more worms by weight at high alder sites. Calvin Creek had significantly higher mean inputs of collembola individuals than Azalea or Tye Creeks ($p < 0.003$). Orpheus Creek had significantly higher mean inputs of spiders than Calvin ($p = 0.014$). In general, increased alder was associated with more nitrogen inputs and more invertebrate input by mass. No general conclusions can be made regarding alder/conifer trends in invertebrate number due to high temporal and spatial variation at the study sites.

Hydrologic retention – The time elapsed from salt tracer input to peak salt concentration found 100 m downstream was the most informative measure associated with salt tracer tests. This measure was least affected by subjective interpretation of salt tracer data. We found that in-stream placements of wood did not significantly change the time to maximum salt concentration ($p < 0.75$; Fig. 1).



Soil and Water 3 Figure 3. Salt tracer combined results for all six streams before restoration, after restoration, and after-no restoration (control).

Soil Geomorphology and Riparian Vegetation

A decision support tool for applying riparian thinning treatments in project areas that was developed and tested at Luck Lake and False Island during 2011 was evaluated at three sites in 2012: North Kuiu, Starrigavan Creek, and Noxon Creek. The landscape position, soil types and stand structural attributes at all these sites were consistent with the predicted attributes derived from resource maps. These field visits were also used to identify potential stream reaches consistent with the experimental units established on Prince of Wales Island. The stream reaches identified on these scouting trips provide a pool of candidate streams for the phasing of treatments and controls across the Tongass as described in the WREM study plan. The analysis of the WREM study reaches on Prince of Wales Island was completed and the manuscript is in preparation.

Key findings from this component of the project include several points. Pre-commercial thinning (~age 15y) increased basal area increment in remaining trees in stands located on terraces. The impact of this treatment was greatest in stands dominated by conifers and diminished in stands with inclusions of alder. Conifer release did not substantially influence the increase in stand BAI in measured stands. Field observations of conifer release in areas treated from 5-20 years ago confirm that this treatment is does not appear to be effective in individual tree release or as a means to increase stand BAI. This is, however, considered preliminary as only one individual tree release treatment site was evaluated as part of the retrospective study. Conifer diameter distributions were maintained at characteristic levels with the inclusion of alder in the stand. The alder did not appear to detrimentally influence the distribution of diameter classes or the overall volume of conifers in a stand. The thinned stands that are now dominated by conifers are overstocked at this point in stand development. This may be due to the robust growth of the conifers after treatment and/or due to the loss of alder by early thinning treatments. Lastly, in mixed alder-conifer stands, the spacing of conifers due to the presence of alders provides adequate room for crown expansion, diameter growth, and overall stand development. Note that this can be enhanced by thinning conifer dominated stands or allowing admixtures of alder-conifer stands to develop on terrace soils.

The information obtained from WREM terrestrial project provides initial guidance for assigning riparian treatments through an adaptive management approach in future project implementations. Treatments scheduled for implementation in 2013 and 2014 will utilize this guidance to array treatments in riparian forest stands by landform and stand structure to achieve desired future conditions in tree size and density. The intensive measurement protocol can be applied to evaluate the effectiveness of riparian stand treatments several years after treatment. The protocol can also be applied to sites that were treated in the past to expand the interpretive power and understanding of stand dynamics through a retrospective approach.

Fish Response

Analysis of the fish response to the stream restoration at each of the three paired sites is not complete to date. A preliminary and cursory review of fish abundance and growth does not suggest a clear or strong fish response to the restoration in the three tributary treatment locations.

Specific Growth Rate

The ability to evaluate growth as a response variable was hindered due to low tagged fish recapture rates within all six reaches (table 1). This was thought to be due primarily to substantial movement of fish. The greatest recapture rate were coho tagged in July and recaptured in August of the same year (table 1).

Specific growth rate (percent per day) was calculated for species and time periods with the greatest recapture rates. Coho parr and fry specific growth rates (SGR) for both Hydra and Orpheus were substantially less during the summer of 2012 than during the summer of 2011 (July – August of each year). Coho fry SGR at Azalea and Hanging reaches from December to March were very similar. Dolly Varden SGR from July 2011 to August 2012 at Calvin and Tye also were very similar (table 2). Statistical analysis will determine if significant differences exist.

Fish Recapture Rates - Number and Percent (%) of Recapture

Captured	Recaptured	Aug 2011					Sep 2011					Dec 2011					Mar/Apr 2012					Jul 2012					Aug 2012				
		Co0+	CoParr	DV	SH	SC	Co0+	CoParr	DV	SH	SC	Co0+	CoParr	DV	SH	SC	Co0+	CoParr	DV	SH	SC	Co0+	CoParr	DV	SH	SC	Co0+	CoParr	DV	SH	SC
Jul 2011	Orp	14(42)	43(70)	1(25)	3(27)	10(9)	0	2(3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1(1)	0	0	0	0	1(1)
	Hyd	5(26)	26(42)	0	2(29)	1(2)	1(5)	2(3)	0	0	0	n/a	n/a	n/a	n/a	n/a	0	1(2)	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cal	0	0	69(34)	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	0	12(6)	0	0	0	0	23(10)	0	0	0	0	22(11)	0	0
	Tye	1(20)	7(64)	30(42)	0	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	4(36)	3(4)	0	0	0	0	13(15)	0	0	0	0	13(15)	0	0
	Aza	26(74)	0	43(26)	0	0	n/a	n/a	n/a	n/a	n/a	3(9)	0	10(6)	0	0	0	1(3)	5(3)	0	0	0	0	15(9)	0	0	0	0	13(8)	0	0
	Han	0	0	6(23)	0	0	n/a	n/a	n/a	n/a	n/a	0	0	4(15)	0	0	0	0	2(8)	0	0	0	0	1(4)	0	0	0	0	0	0	0
Aug 2011	Orp						5(3)	3(1)	0	0	0	0	0	0	1(4)	0	1(0.6)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hyd						5(9)	2(2)	0	0	0	n/a	n/a	n/a	n/a	n/a	1(2)	1(1)	0	0	0	0	0	0	0	0	0	0	1(6)	0	0
	Cal						n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	7(17)	0	17(6)	0	0	0	0	35(12)	0	0	0	0	29(10)	0	0
	Tye						n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	4(11)	5(28)	8(7)	2(17)	0	0	0	24(20)	1(8)	0	0	0	23(20)	0	0
	Aza						n/a	n/a	n/a	n/a	n/a	16(19)	1(1)	7(4)	0	0	5(6)	0	5(3)	0	0	4(5)	0	13(7)	0	0	5(6)	0	10(6)	0	0
	Han						n/a	n/a	n/a	n/a	n/a	0	0	2(6)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sep 2011	Orp											0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hyd											0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cal	no sample										n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Tye	no sample										n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Aza	no sample										n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Han	no sample										n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Dec 2011	Orp																1(0.5)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Hyd	no sample															n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Cal	no sample															n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Tye	no sample															n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Aza																9(5)	0	4(2)	8(12)	0	5(4)	0	10(5)	0	0	2(1)	0	7(3)	0	0
	Han																13(35)	4(50)	4(9)	2(40)	0	1(3)	0	0	0	0	0	0	0	0	0
Mar/Apr 2012	Orp																					0	0	0	1(2)	0	0	0	0	1(1)	0
	Hyd																					0	0	0	0	0	1(1)	0	0	0	0
	Cal																					5(10)	0	11(4)	0	0	5(10)	0	6(2)	0	0
	Tye																					1(2)	0	5(4)	0	0	1(2)	0	4(3)	0	0
	Aza																					2(1)	0	7(3)	0	0	1(1)	0	4(2)	0	0
	Han																					1(2)	0	0	0	0	0	0	0	0	0
Jul 2012	Orp																										26(7)	54(13)	1(8)	2(3)	1(0.3)
	Hyd																										10(9)	19(11)	2(4)	2(3)	0
	Cal																										5(9)	41(91)	108(23)	0	0
	Tye																										1(2)	11(33)	64(34)	1(1)	0
	Aza																										49(35)	10(77)	53(19)	0	0
	Han																										8(13)	0	0	0	0

Red Highlighted cells have had Specific Growth Rates calculated.
Percent of recapture is percent of total tagged to that date.
Sculpin were not tagged after the December sample session due to poor tag retention with the exception of three in Orpheus during July and one in August of 2012.

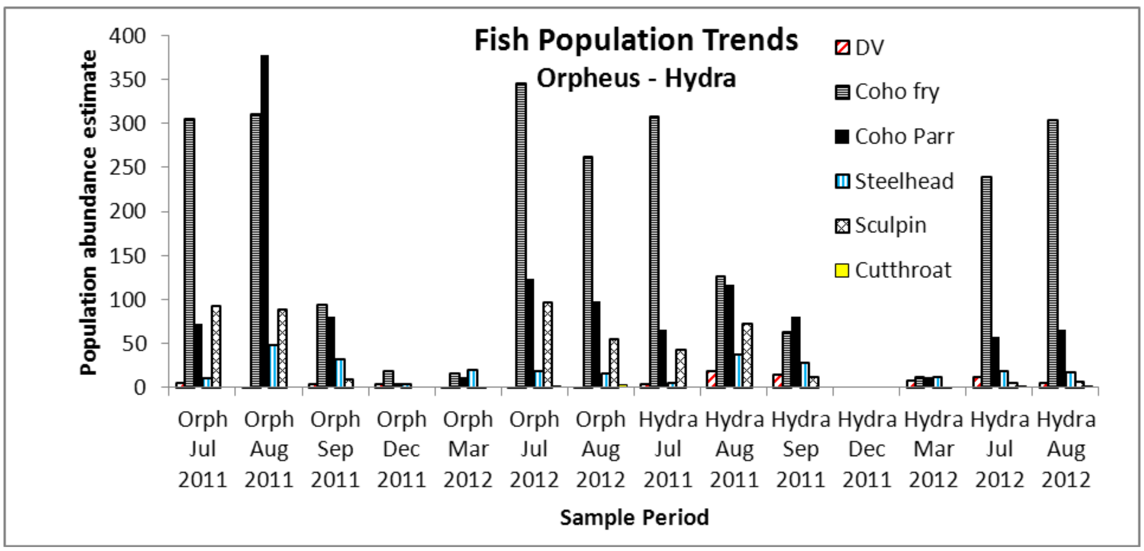
Soil and Water 3 Table 1. Fish Recapture Rates - Number and Percent (%) of Recapture

Soil and Water 3 Table 2. Specific Growth Rates – SGR (percent / day)

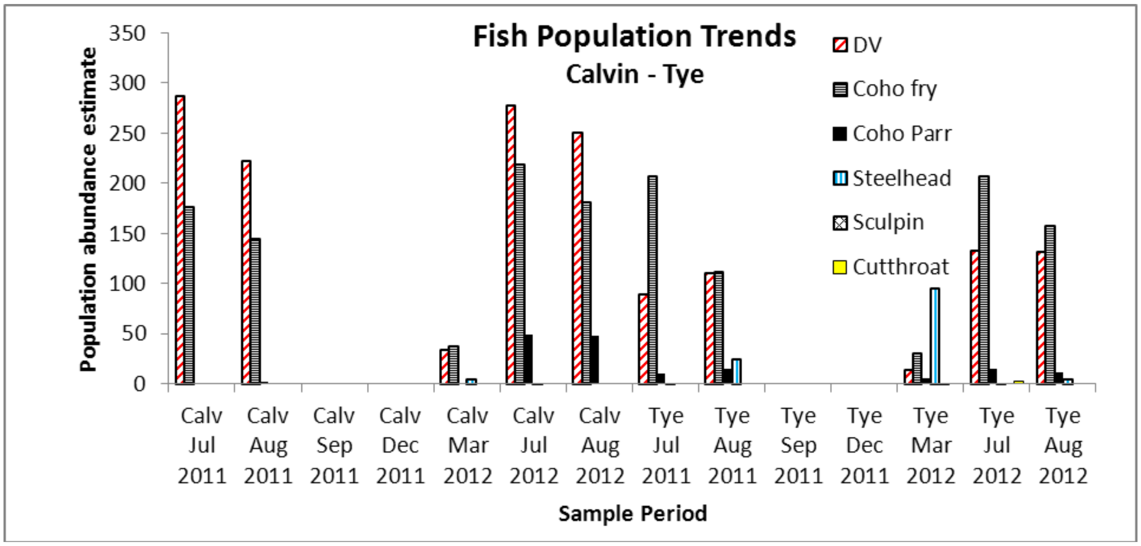
Species	Growth Period	Site	S.G.R.	S.E.
Coho Parr	July 2011 – August 2011 (1 month)	Orpheus	0.63	0.05
		Hydra	0.93	0.08
	July 2012 – August 2012 (1 month)	Orpheus	0.47	0.05
		Hydra	0.37	0.09
Coho Fry	July 2011 – August 2011 (1 month)	Orpheus	0.68	0.08
		Hydra	0.69	0.08
	July 2012 – August 2012 (1 month)	Orpheus	0.16	0.09
		Hydra	0.33	0.11
	December 2011 – April 2012 (4 months)	Azalea	0.12	0.04
		Hanging	0.10	0.02
Dolly Varden	July 2011 – August 2011 (1 month)	Calvin	0.30	0.05
		Tye	0.48	0.07
	July 2011 – August 2012 (13 months)	Calvin	0.26	0.01
		Tye	0.28	0.02
	July 2012 – August 2012 (1 month)	Calvin	0.17	0.07
		Tye	0.24	0.03

Fish abundance

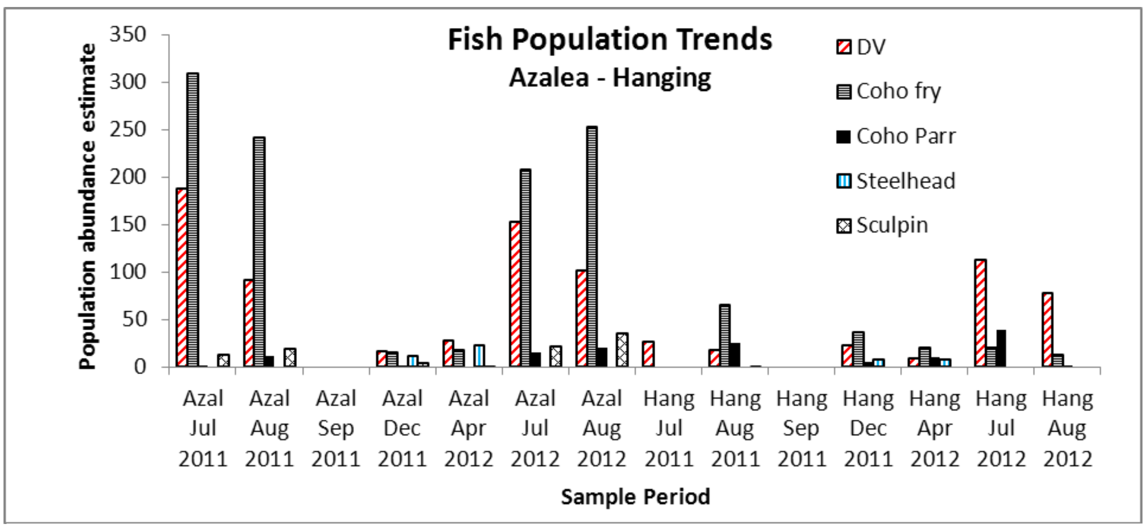
Population estimates were calculated using Pollack and Otto, 1983, variable population estimator. Population abundance and species composition change varied between sites (figures 3-5).



Soil and Water 3 Figure 4. Fish Population Trends: Orpheus - Hydra



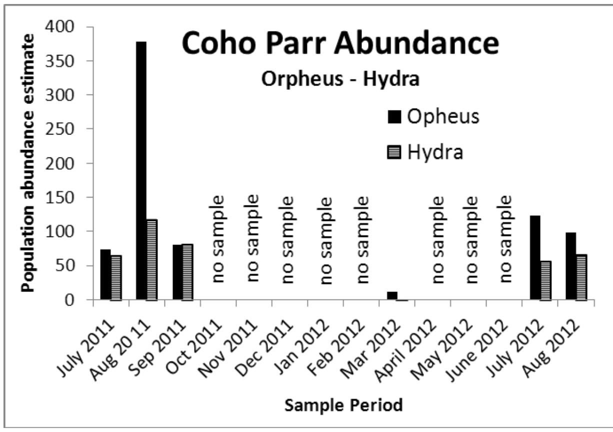
Soil and Water 3 Figure 5. Fish Population Trends: Calvin - Tye



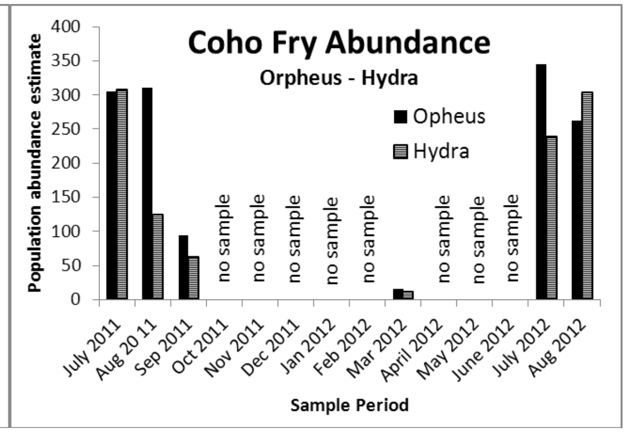
Soil and Water 3 Figure 6. Fish Population Trends: Azalea - Hanging

<u>Orpheus – Hydra paired sites</u>

Coho parr abundance at the Orpheus treatment reach had a 69 percent increase from July of 2011, to July 2012, or one year after restoration. During the same period, the Hydra control reach experienced a 12 percent decrease in coho parr. However, both Orpheus and Hydra had substantial reductions in coho parr abundance from August 2011 to August 2012. Orpheus coho parr abundance was reduced by 74 percent while Hydra parr abundance was reduced by 44 percent (figure 6).Coho fry abundance at Orpheus had less of a percentage change from one year to the next than that of the coho parr. There was an increase of 13 percent from July 2011 to July 2012 and a 15 percent reduction from August 2011 to August 2012. Unlike Orpheus, coho fry abundance at the Hydra reach decreased from July 2011 (22 percent) and increased from August 2011 (142 percent) (figure 7). There was a substantial reduction of Sculpin abundance (82 percent) at Hydra from the summer of 2011 to the summer of 2012 that was not observed at Orpheus.



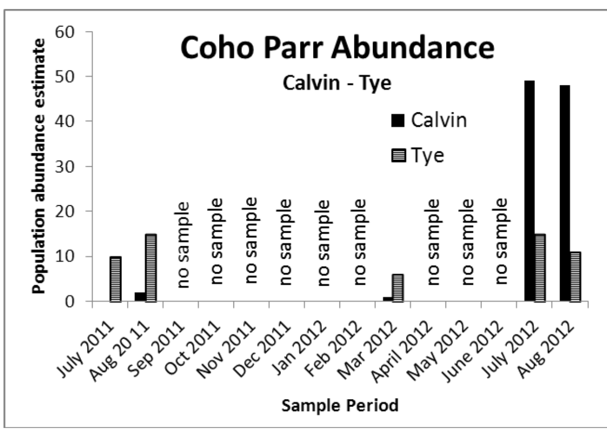
Soil and Water 3 Figure 7. Orpheus – Hydra coho parr abundance.



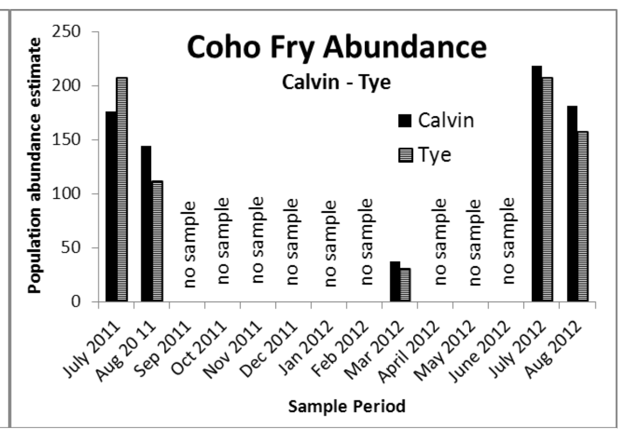
Soil and Water 3 Figure 8. Orpheus – Hydra coho fry abundance.

Calvin – Tye paired sites

Coho parr abundance increased very dramatically (2,300 percent) at the Calvin treatment site from the summer of 2011 to the summer of 2012. During the similar time period coho parr at Tye remained approximately the same (figure 6). Coho fry during this period moderately increased at both sites (figure 7). Dolly Varden abundance at both Calvin and Tye remained relatively consistent throughout the sample periods (figure 13).



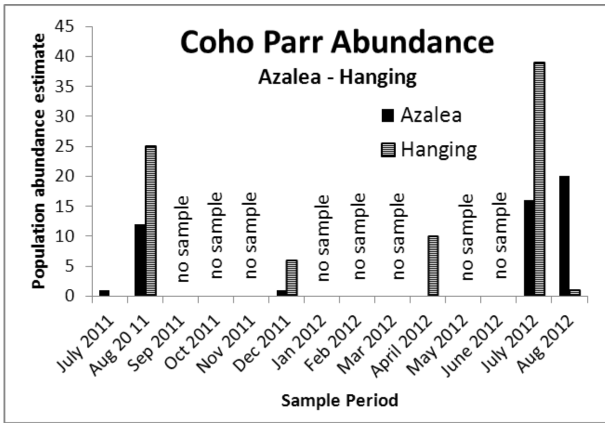
Soil and Water 3 Figure 9. Calvin - Tye coho parr abundance.



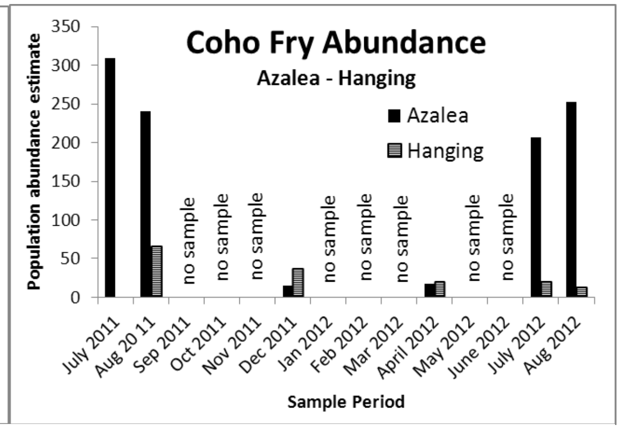
Soil and Water 3 Figure 10. Calvin - Tye coho parr abundance.

Azalea – Hanging sites

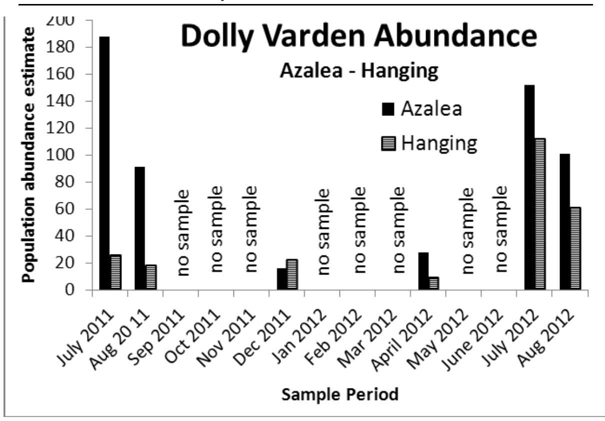
Very few coho parr were present in the Azalea and no parr were present in Hanging in July of 2011 but were more prevalent during July 2012. During August of 2011, coho parr were present at both sites. Coho parr abundance at Hanging was significantly less during August 2012 than during August 2011 (figure 10). Coho fry abundance remained relatively constant at both sites during the summer 2011 and 2012 (figure 11). Dolly Varden abundance was relatively similar in the summer of 2011 and 2012 at Azalea but increased at Hanging from 2011 to 2012 (figure 12). Steelhead trout were only present in Hanging and Azalea during winter and spring.



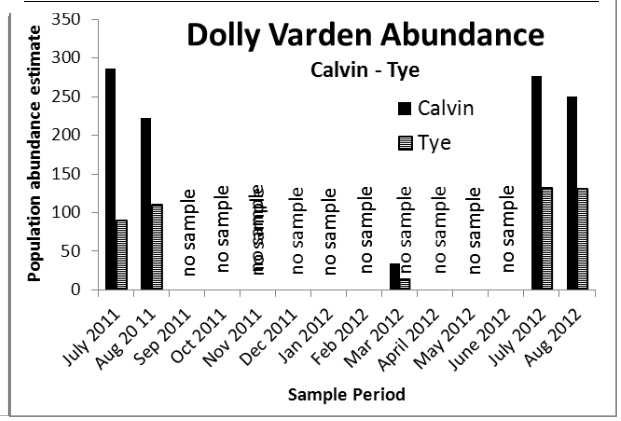
Soil and Water 3 Figure 11. Azalea - Hanging coho parr abundance.



Soil and Water 3 Figure 12. Azalea - Hanging coho fry abundance.



Soil and Water 3 Figure 13. Azalea - Hanging Dolly Varden abundance.



Soil and Water 3 Figure 14. Calvin – Tye Dolly Varden abundance.

Evaluation of Results

Program managers and monitoring principals met in November 2012 to review initial pre- and post-treatment data summaries (2011-2012) and discuss what has been learned since inception of the Watershed Restoration Effectiveness Monitoring program was initiated in 2010. Preliminary findings suggest that the effort to date, though informative with respect to protocol refinement and overall progress, is not on track to achieve monitoring objectives. Three key findings were identified to drive an adaptive change in the program. First, the cost and time spent to intensively sample the six small streams has prevented expansion of the program broadly across the Tongass to meet whole-watershed or forest level objectives. Second, the existing small sample size is not statistically rigorous, and the small streams sampled are not wholly relevant to broader scale and larger channel restoration treatments. Third, high variability in fish population data and tagging results between the six streams and from one sampling event to the next in the same stream will likely confound detection of responses to the restoration treatment.

Action Plan

At this time, no changes to the forest plan are recommended. The following recommendations should be considered in the context of the Five-Year Review of the Forest Plan. The Watershed Condition Framework provides a road map for collaborative watershed restoration activities on the Tongass. Continue restoration plans and activities in priority watersheds in collaboration with partners and stakeholders. Continue collaboration with Pacific Northwest Research Station and other interested entities to evaluate the effectiveness of restoration activities at both the reach and watershed scale in improving watershed health. Update the Tongass Riparian Young Growth strategy to reflect best science and recent/ongoing retrospective monitoring results of riparian stand treatments. When a forest canopy density model is developed for the Tongass NF, consider its utility for evaluating the effects of forest management on streamflow. Incorporate recent findings on throughfall (Prussian 2010) and analysis of long-term streamflow records (personal communication with Ed Neal 2010).

The following recommendations should be considered in the context of continued watershed restoration effectiveness monitoring in the Tongass NF. Continue annual core data collection in existing six study reaches through 2015 to complete evaluation of restoration through at least one coho salmon life cycle. Adapt the original study design to an approach with broader Tongass-wide scope, more focused metrics, and less intense sampling. A Forest-wide Restoration Effectiveness Monitoring Strategy with an aquatic and riparian vegetation focus has been drafted and is planned for extended review in spring 2013. Continue riparian treatment retrospective monitoring of conifer release from alder overstory to improve our understanding of the reasons for success and failures in conifer release treatments. Continue smolt production monitoring in one restored Tongass NF watershed to evaluate watershed scale effects of watershed restoration. This should be a long-term monitoring project lasting through two coho life cycles for best results.

Citations

Bryant, M.D. 2000. Estimating fish populations by removal methods with minnow traps in southeast Alaska streams. North American Journal of Fisheries Management. 20: 923-930.

Meehan, W.R., and Miller, R.A. 1978. Stomach flushing: effectiveness and influence on survival and condition of juvenile salmonids. J. Fish. Res. Board Can. 35: 1359.1363.

Neal, Ed (USGS). 2010. Personal communication to Steve Paustian (USFS) regarding updated comparative analyses of discharge data from Staney Creek (USGS station no. 15081497) and Old Tom Creek (USGS station no. 15085100) through the 2009 water year. December 2010.

Pollock, K.H., and Otto, M.C. 1983. Robust Estimation of Population Size in Closed Animal Populations from Capture-Recapture Experiments. Biometrics , Vol. 39, No. 4 (Dec., 1983), pp. 1035-1049.

Prussian, Katherine. 2010. Throughfall Monitoring – Prince of Wales Island, Alaska.