Appendix A. Tongass-wide Watershed Restoration Effectiveness Monitoring (WREM)

Summary

Selected reaches will be incorporated into the Tongass-wide Watershed Restoration Effectiveness Monitoring (WREM) program aimed at detecting trends in biota and channel conditions over time using an extensive reach-scale, post-treatment, experimental design (EPT) within a strategic sampling panel stratified by regional channel types. Initial stream habitat assessment data and pre- and post-treatment data are collected during project design and project-level monitoring and will be available for long-term comparisons. The objectives of effectiveness monitoring are to answer the following monitoring questions:

1. Does large wood placement improve habitat in the restored reaches?
    a. Does large wood placement increase frequency, areal extent, and quality of pools?
    b. Does large wood placement increase channel complexity?
    c. Does large wood placement improve stream bank stability?
2. What are the fish characteristics (composition, relative abundance, diversity, and condition) in restored reaches?

A suite of physical habitat and biotic metrics will be used to quantify trends and results will be compared to conditions in similar unmanaged (reference) and managed but untreated reaches to evaluate Tongass-wide trends. This experimental design is preferable to the before-after-control-impact (BACI) design because it is less expensive and time intensive. Additionally, many Tongass restoration projects occur on a reach-scale, and are therefore well-suited to a reach-based design.

Restoration Goals

Large wood placement in streams

- Maintain and increase pool habitat
- Maintain and increase habitat complexity
- Accelerate recovery of riparian areas and function; reduce timeframe for future input
- Improve stream bank stability

Scale/Sites

Forest-wide, alluvial stream process groups (FP, MM, stable AF), reaches 20 x channel bed width stratified by channel size. Annually, six randomly selected treatment reaches (from a pooled set) are paired with control and reference reaches based on similarities in morphological features such as length, width and gradient as well as proximity to one another as much as possible.

Design

The design is an 8-year, rotating panel of three categories, six reaches of each category, stratified by channel size (Tables 1 and 2). Sampling design is based on two coho salmon life cycles. One annually sampled fixed trio will allow for the assessment of trends more rapidly, as well as provide information on natural variability. Additionally, each year a total of five new sites of each category will be sampled. In year 5, the year 1 reaches will be re-sampled.

Category

- Treated (< 1970s riparian harvest, large wood placement > 2006)
- Managed Control (< 1970s riparian harvest, not restored but suitable for restoration > 2018)
- Reference (un-managed watershed)

Channel size

- Small (bed width 3 to 10 meters)
- Medium (bed width greater than 10 meters to 20 meters)
- Large (bed width greater than 20 meters, wadeable)

WREM Table 1. FY2013 Watershed restoration effectiveness monitoring sites

Category	Channel Size	Location	Site
Treated	Large	POW	Twelvemile Phase I
Treated	Medium	POW	Snipe
Treated	Small	POW	Orpheus
Treated	Small	Kuiu	Martin
Treated	Small	Kuiu	Kadake 2
Treated	Small	Kuiu	Kadake 3
Managed Control	Large	POW	Maybeso
Managed Control	Medium	POW	Shaheen
Managed Control	Small	POW	Hydra
Managed Control	Small	Kuiu	Stone
Managed Control	Small	Kuiu	SF Saginaw
Managed Control	Small	POW	Tye
Reference	Large	POW	Big Creek
Reference	Medium	Kupreanof	Towers Dehydration
Reference	Small	Kuiu	Hiller
Reference	Small	Kupreanof	Towers ZZTop
Reference	Small	Kupreanof	Towers Rising Stream
Reference	Small	Kupreanof	Tunaheen SlowCole

WREM Table 2. FY2014 Watershed restoration effectiveness monitoring sites

Category	Channel Size	Location	Site
Managed Control	Small	POW	Falls Creek Tributary
Managed Control	Small	Kuiu	Spike Buck
Managed Control	Small	Baranof	Suntaheen
Managed Control	Medium	Chichagof	Sitkoh Creek
Managed Control	Medium	POW	Otter/Cable
Treated	Small	POW	Yellowlegs
Treated	Small	Kuiu	Hemloop
Treated	Small	Baranof	Starrigavan

Category	Channel Size	Location	Site
Treated	Small	Baranof	Katlian
Treated	Medium	Chichagof	Sitkoh Creek
Treated	Medium	POW	Fubar Phase1
Reference	Small	Baranof	Indian River Tributary
Reference	Small	Chichagof	Last Ditch
Reference	Small	Kuiu	Fairyland
Reference	Small	POW	Newlundberry 2
Reference	Medium	Baranof	Salmon Creek
Reference	Medium	POW	Elevenmile

Physical Metrics

All measurements follow protocols described in FSH 2090.21 unless noted, Table 2. Some data will be coordinated during project-level monitoring for efficiency.

WREM Table 3. Physical metric data collection

Metric	Restoration Monitoring Objective	Notes
Thalweg profile	Measure habitat complexity	Thalweg points referenced to centerline tape. Water depth added to thalweg profile mid-season 2013. Points collected at defining habitat unit features (pool tail crests and max depths), or every 5 meters using an auto-level (Kaufmann and Faustini 2011, Mossup and Bradford 2006). Determine mean squared error (MSE) of thalweg profile (topographic variation about the mean slope; complexity).
Cross section	Measure streambank stability, width/depth ratio	Aim for one every 5 channel widths (at next riffle upstream)
Substrate	n/a	Once only to characterize channel, restoration response not anticipated
Habitat units	Measure/calculate relative pool area (pool area per total wetted area), pool frequency (Pools per km), and average residual pool depth per average channel bed width	Wetted widths measured for all units concurrent with fish sampling (3 per habitat unit) to determine surface area (m^2)
Undercut banks	Measure streambank stability	Measure presence of undercut banks deeper than 0.3 meter and longer than 1 meter on either bank. Sum for each bank and divide by the reach length to calculate total undercut bank per meter of channel
Large wood	Measure wood counts, clusters, correlate with fish data	Paper data form Count by Tier IV size classes, clusters

Biotic Metrics

Captured fish will be anesthetized with Aqui-S before measuring fork length to the nearest millimeter and wet mass to the nearest 0.01 grams. All fish are identified to species and data recorded on datasheets. Metrics and data collection procedures are summarized in Table 4.

WREM Table 4. Biotic metric data collection

Biotic metric	Notes
Summer relative juvenile fish abundance	Based on one 90-minute minnow trapping event in small and medium channels; based on snorkel count in large channels. Fish/m^2 (relative abundance or density).
Summer fish size and structure	Based on minnow trap event to sample subset of fish in reach. Length frequency distribution.
Fish species composition (diversity)	Based on above sampling. Number/percent of total species per area measure.
Fish species condition factor	Quantitative comparison of the condition of fish between categories based on weight and length by species. Fulton's K (condition).