Northwest Forest Plan -The First 15 Years (1994-2008)

Watershed Condition Status and Trend

Results for the Gifford Pinchot National Forest

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The Northwest Forest Plan Aquatic and Riparian Effectiveness Monitoring Program (AREMP) assesses watershed condition status and trend at two different scales, inchannel and upslope/riparian. Inchannel condition is based on stream surveys in watersheds randomly selected from the Northwest Forest Plan (NWFP) area; it describes current condition for fish and other aquatic biota. Watershed wide (upslope/riparian) condition is evaluated based on GIS and remote sensing data, and it represents more of a risk assessment, i.e., what is the likely impact of upslope and riparian conditions on the future state of aquatic organisms?

Further documentation of the methods and NWFP results can be found in our full 15-year NWFP monitoring report (Lanigan et al. 2012), which is available at www.reo.gov/monitoring/reports/watershed/AREMP%2015%20yr%20report.pdf

AREMP vs. National Watershed Condition Class

The evaluation models used by AREMP and the Forest Service (FS) National Watershed Condition Class (WCC) are quite different and therefore produce different results. The most fundamental reason for these differences is that AREMP is charged with evaluating trend (not just status) and so only uses indicators for which regional datasets representing 1994 are available. In contrast, the WCC incorporates many indicators which rely on expert judgment or for which no regionally consistent data are available. A white paper with a detailed comparison and discussion is available (Lanigan and Gordon 2012). This report does not consider data used for the WCC.

Stream Surveys

Methods

AREMP crews surveyed the Clear Creek 6th-field watershed (tributary to the Muddy River) during 2012 (fig 1), and collected data at seven sites that ranged from 160-480 meters in length. Each survey collected information on substrate (D50), large wood, invasive species, amphibians, bankfull width to depth ratio, sinuosity, pool frequency, pool tail fines and shade.

The data collected at these seven sites will be evaluated using the AREMP watershed condition assessment model (WCAM). Each attribute will be evaluated and scored from -1 (“poor”) to 1 (“good”). The WCAM is aggregated into three components: 1) water temperature; 2) physical, which includes wood and pool frequency; substrate (D50 and % fines), floodplain connectivity; and 3) biological, which

consists of macroinvertebrate and amphibian metrics. The attribute evaluation scores are averaged for each of the three model components and then these components are averaged together to form a final inchannel reach score for each site. A watershed level inchannel condition score is calculated by taking the average inchannel reach score for all sites surveyed within a watershed.

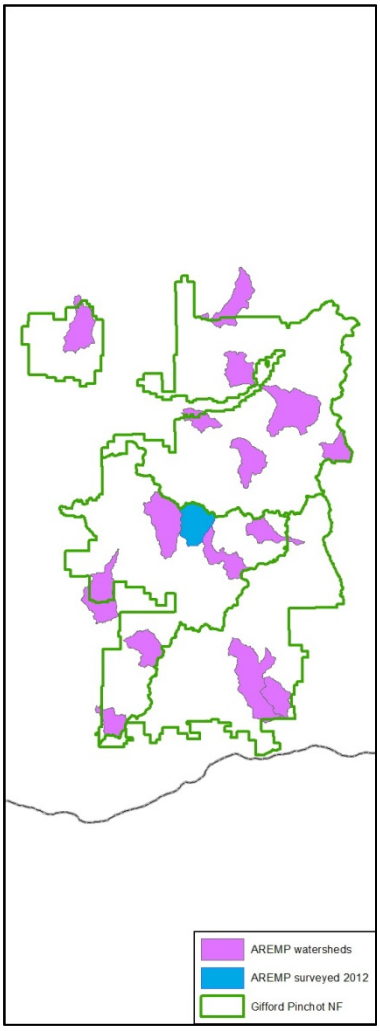

Figure 1. Sixth-field watersheds that are part of the Aquatic and Riparian Effectiveness Monitoring Program stream sampling domain (table 1). Stream sites within these watersheds are sampled to determine stream condition status and trend. Stream sites in only one watershed (Clear Creek - shown in blue) were sampled in 2012.

Table 1. Sixth-field watersheds within the Gifford Pinchot National Forest that are part of the Aquatic and Riparian Effectiveness Monitoring Program stream sampling domain and the percentage of federal land (Forest Service, Bureau of Land Management, and National Park Service) within each 6th-field watershed. USGS HUC = US Geological Survey hydrologic unit code

USGS HUC	Watershed name	Subwatershed name	Federal Land (percent)
170701051004	Little White Salmon River	Middle Little White Salmon River	38.13
170800020202	Muddy River	Clearwater Creek	100.00
170800040402	Upper Cispus	Walupt Creek	100.00
170800020503	East Fork Lewis River	Copper Creek	89.77
170800040205	Upper Cowlitz River	Johnson Creek	99.03
170800020203	Muddy River	Elk Creek	100.00
170800020108	Upper Lewis River	Alec Creek	100.00
170800020102	Upper Lewis River	Twin Falls Creek	100.00
170800040307	Cowlitz Valley Frontal	Siler Creek	65.18
171100150110	Upper Nisqually River	Little Nisqually River	88.38
170800020401	Yale Reservoir	Upper Siouxon Creek	100.00
170800020404	Yale Reservoir	Cougar Creek	43.73
170800040409	Upper Cispus River	Blue Lake/Cispus River	100.00
170800040302	Cowlitz Valley Frontal	Willame Creek	98.96
170701051002	Little White Salmon River	Big Lava Bed Frontal	89.29

Results

We will report on inchannel status and (preliminary) trend results in our 20-year assessment of watershed condition [note: this will be completed in 2014]. To prepare for this assessment and to help AREMP become more closely aligned with the WCC, the following efforts are being done:

- Revising existing inchannel condition models into a unified model that uses appropriate contextual information to evaluate inchannel attributes.
- Analyzing 13 years of AREMP data and confer with scientists how best to define inchannel attribute evaluation criteria particularly in the context of high and low gradient streams.
- Examining the use of landtype association data as contextual information when evaluating inchannel attributes.
- Developing macroinvertebrate bioassessment indices for multiple spatial scales for streams throughout the NWFP area. This computional work and supporting documentation is being done by the National Aquatic Monitoring Center at Utah State University. The models are being developed using data collected throughout the Pacific Northwest from various organizations including AREMP, state, Environmental Protection Agency, and US Geological Service.

Upslope and Riparian Conditions

Methods

AREMP's most recent effort to describe upslope/riparian condition status and trend is the Northwest Forest Plan 15-year report (Lanigan et al. 2012). Upslope/riparian condition was based on mapped data e.g., road density based on FS and BLM geographic information system road layers, and vegetation data,

e.g., tree canopy cover, derived from satellite imagery. Only federal lands (Forest Service, Bureau of Land Management, and National Park Service) within the watersheds were evaluated, and watersheds had to have greater than 25% of their 1:100,000 stream layer within federal land ownership to be considered. Watershed condition was evaluated using the AREMP Western and High Cascades inchannel condition assessment models (see Lanigan et al. 2012 appendix 4). The standardized model scores range from -1 to +1, with watersheds in good condition having higher scores than those in poor condition. Scores were calculated for 1994 and 2008, and the difference in these scores was used to represent trend.

Results - Status

Overall watershed condition scores of the 95 watersheds intersecting the GPNF ranged from a low of -0.96 to a high of +0.79, with a mean score of -0.05. Figure 2 presents a view of the distribution of scores by status category. The largest percentage fell into the moderate category (29 percent). Slightly more fell in the low (26 percent) and very low (12 percent) categories than in the high (23 percent) and very high (9 percent).

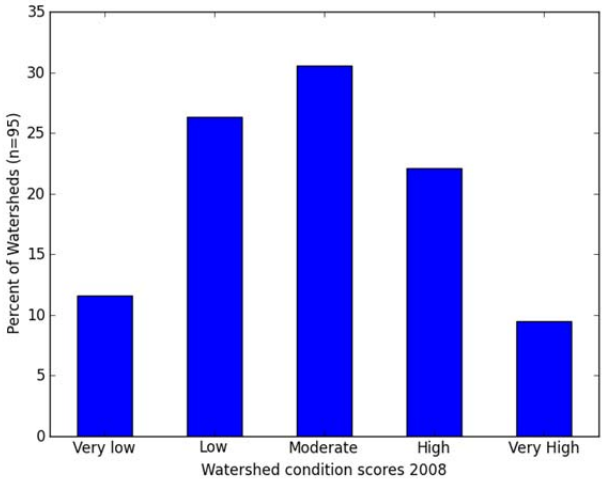

Figure 2—Gifford Pinchot NF watershed condition scores by status category (2008).

The spatial distribution of watershed scores and major sub-scores (vegetation and roads) can be seen in Figure 3. Roads had the largest negative impact on scores, with 47% of watersheds receiving a very low (≤ -0.6) roads score as compared to 20% scoring very low on vegetation attributes.

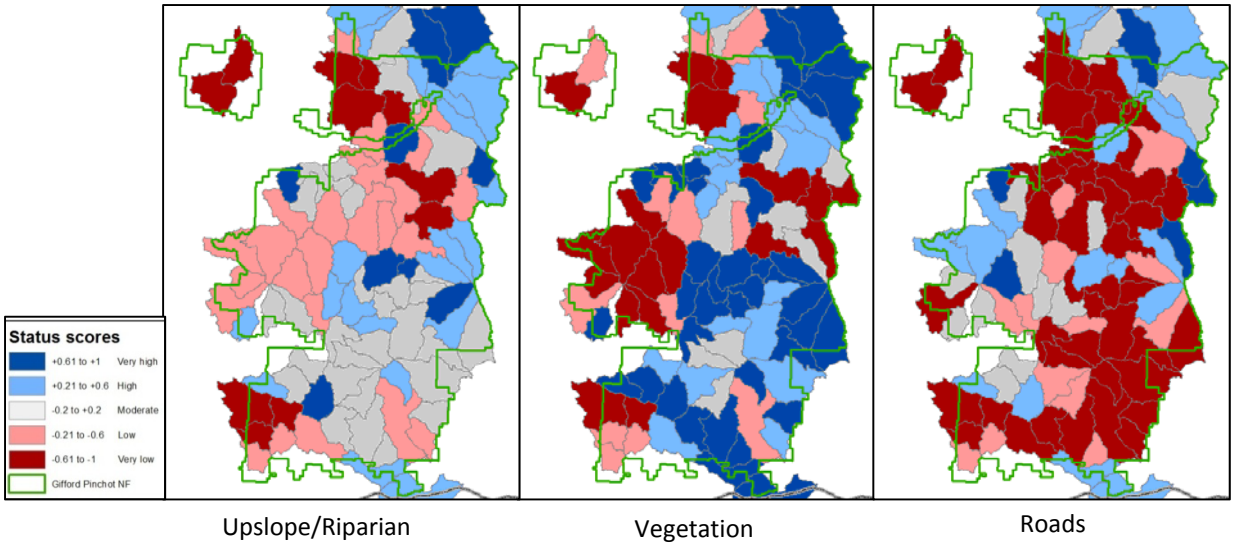

Figure 3. Watershed condition (upslope/riparian) status scores (2008) and major components (vegetation and roads) for the Gifford Pinchot National Forest.

Results - Trend

Overall, there was a positive change in watershed scores, from a mean score of -0.11 in 1994 to -0.05 in 2008 (as compared to a NWFP-wide change of +0.14 to +0.17). Figure 4 displays the spatial configuration of score changes. The watershed condition trend map uses seven categories instead of five, and the central categories also have a smaller interval (0.2) than the extremes (0.5) for better discrimination because changes in scores tended to be more tightly grouped than the status scores.

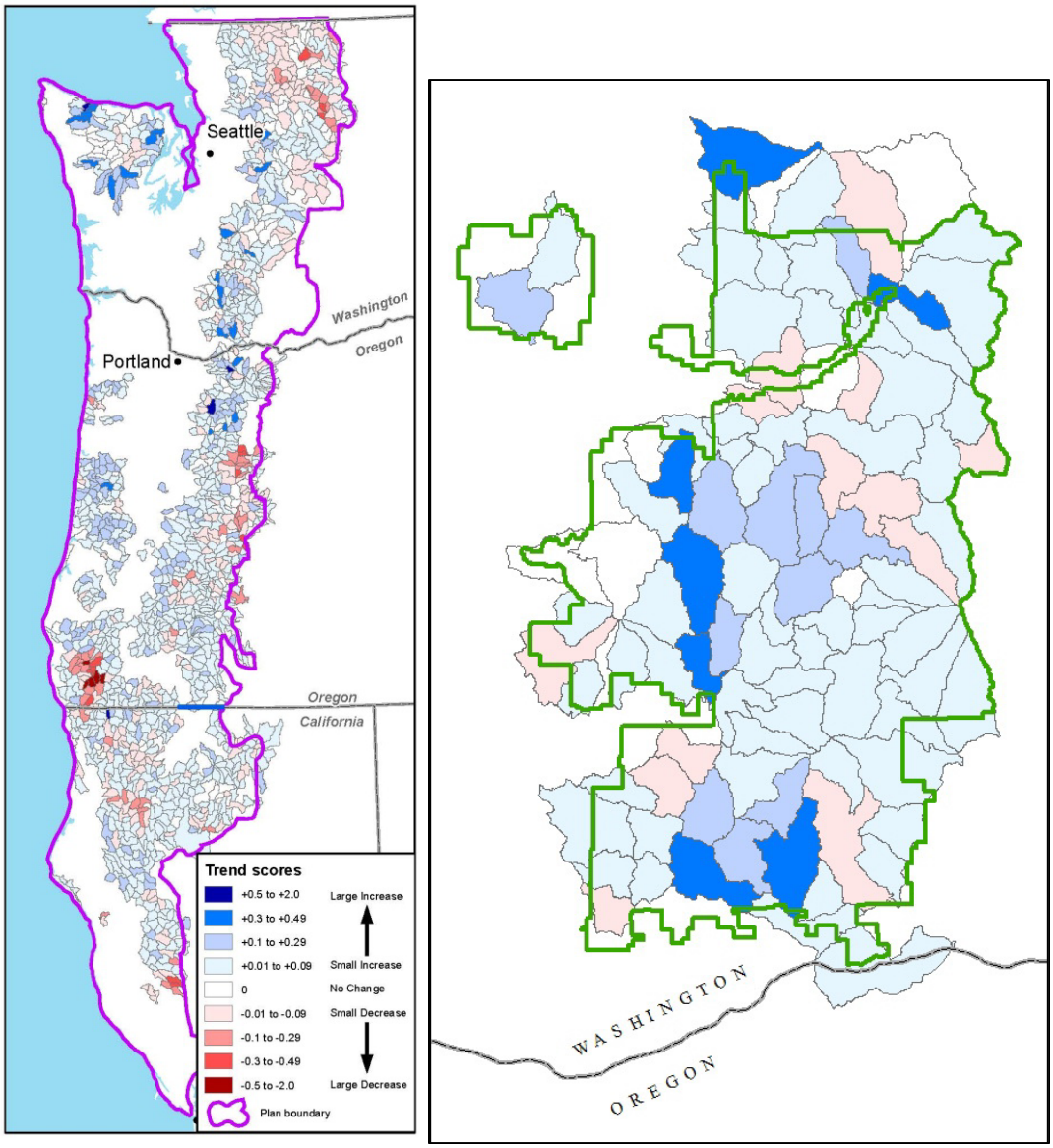

Figure 4. Change in watershed condition score, 1994 to 2008 for the Northwest Forest Plan area (left), and the Gifford Pinchot National Forest (right).

Looking at the histogram distribution of watershed condition score changes (Figure 5), scores increased for 79 percent of watersheds versus 15 percent showing declines. Most score changes (75%) were relatively small (± 0.1 in model score or 5% of possible change from -1 to +1), and a portion of these small shifts is likely due to errors inherent in the satellite imagery vegetation classification process. In contrast to the NWFP area, the GPNF had no score declines greater than -0.1. Such larger declines in other areas were typically due to large fires, and no large fires were recorded on the GPNF between 1994 and 2008 (MTBS database). The GPNF also showed a greater percentage of larger increases in scores (greater than +0.3) than the NWFP as a whole, mostly due to road decommissioning efforts.

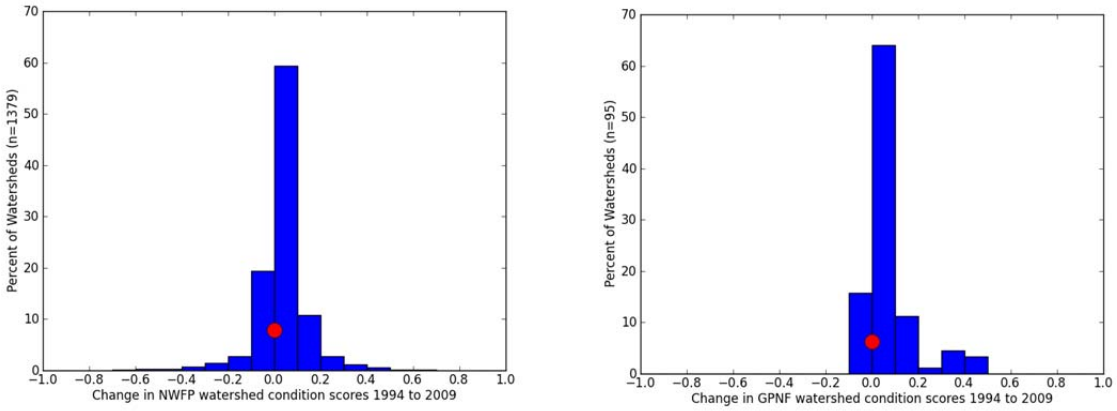

Figure 5. Distribution of changes in watershed condition scores between 1994 and 2008 for the entire Northwest Forest Plan area (left) and for the Gifford Pinchot National Forest (right). Red dot shows percentage of watersheds with no change in score.

Table 2 shows the percentage contribution of roads, vegetation, and landslide risk to the different levels of score changes. No large declines (less than -0.1) in condition occurred. Scores declined by 0.1 or less in 15% of watersheds, and this portion of the distribution was driven almost entirely by vegetation scores (99%). Six percent of watersheds showed no change in score (dot on Figure 5). There were two reasons why a score might not change, either 1) there were no changes in any of the underlying attributes between the sampling dates, or 2) an increase in one or more attributes was cancelled out by declines in others (generally these increases/decreases were quite small). Sixty percent of the watersheds had score increases between 0 and +0.1; increases in vegetation scores were the dominant driver (65%) for this range, but with some contribution from roads (24%) and landslide risk (11%). Higher trends were driven mainly by road decommissioning and associated reductions in landslide risk contribution. Positive trends in the +0.1 to +0.3 range were mostly due to road decommissioning (48%) but with a fair contribution from vegetation (30%) and landslide risk (28%). Reduced landslide risk was the dominant driver of improvement above the +0.3 level (72%). Road decommissioning in landslide prone areas drove this change and also contributed through a general increase in road scores (28%).

Table 2—Attribute influences on watershed condition score changes between 1994 and 2008

	All Watersheds (n = 95)		Attribute Influences (%)		
Score Change Categories	**Count**	**Percentage**	**Roads**	**Vegetation**	**Landslide Risk**
-0.5 to 2.0					
-0.3 to -0.49					
-0.1 to -0.29					
-0.09 to <0	14	15	0	99	1
0	6	6			
>0 to 0.09	57	60	24	65	11
+0.1 to 0.29	11	12	48	6	46
+0.3 to 0.49	7	7	28	0	72
+0.5 to 2.0					

Watershed Trend by Land Use Category

The magnitude of changes did differ somewhat by land use allocation (Figure 6). Although the majority of changes were small (< ±0.1) for all categories, the reserved and LSR classes experienced more of the larger positive changes (> +0.1) than the matrix. Changes in key and nonkey watersheds were more pronounced, with key watersheds showing fewer declines and more of the larger positive changes (> +0.1). Figure 7 shows the trend map with key watersheds highlighted.

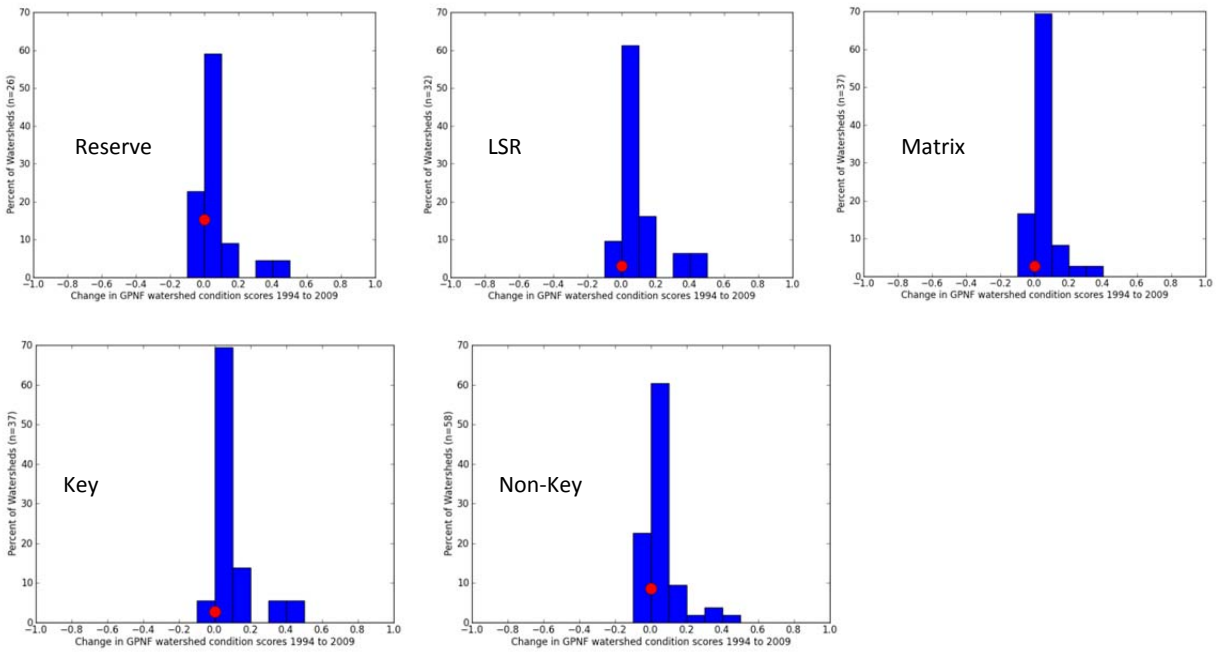

Figure 6. Watershed trend by land use allocations (each sixth-field HUC was classified to the largest land use allocation). Red dot shows percentage of watersheds with no change in score.

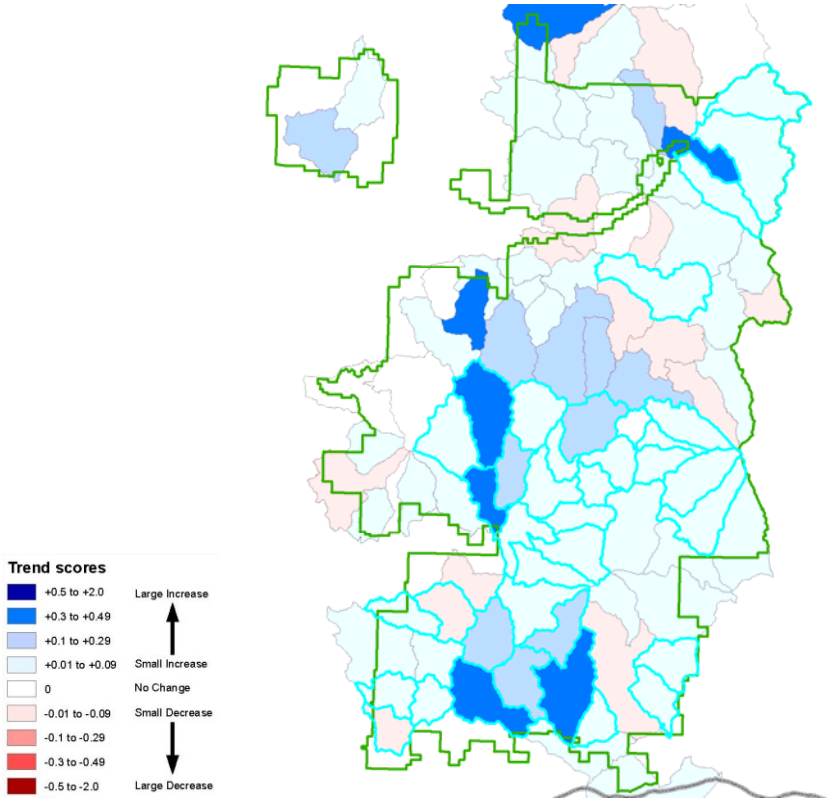

Figure 7. Watershed trend with key watersheds highlighted (light blue).

Conclusions

Not all watersheds can be expected to be in good condition at any one time as watersheds are naturally dynamic systems and individual watersheds will cycle through conditions of high and low habitat quality (Naiman et al. 1992, Reeves et al. 1995). Therefore, the most important product of AREMP's monitoring program is the trend in the overall distribution of individual watershed ratings in a given area. Implementing the Aquatic Conservation Strategy should result in an overall distribution of watershed condition scores that improves or at least stays the same over time" (Lanigan et al. 2012). Based on AREMP's monitoring results, this is happening on the Gifford Pinchot National Forest.

A 20-year assessment of upslope/riparian condition status and trend will be done in 2014.

References

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Naiman, R.J.; Beechie, T.J.; Benda, L.E. [et al.]. 1992. Fundamental elements of healthy watersheds in the Pacific Northwest coastal ecoregion. In: Naiman, R.J., ed. Watershed management: balancing sustainability and environmental change. New York: Springer-Verlag: 127–188.

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