208-8001 Oregon Plan Effectiveness: Effects of Contemporary Forest Harvest on Aquatic Ecosystems in Trask, Hinkle and Alsea Watersheds

OWEB Progress Report for work completed November 2007 through October 2008

Arne Skaugset
Oregon State University
Department of Forest Engineering, Resources and Management
Corvallis, OR 97331
arne.skaugset@oregonstate.edu
(541) 737-3283

The Oregon Watershed Enhancement Board (OWEB) has funded the project *Effects of Contemporary Forest Harvest on Aquatic Ecosystems in Trask, Hinkle and Alsea Watersheds*. This project is comprised of three watershed studies (Trask River, Hinkle Creek and Alsea Revisited). They are evaluating the question "Are contemporary forest management strategies adequate to sustainably meet Oregon Plan goals for this state's forested watersheds?" During the first year of OWEB funding, these projects have purchased instrumentation, supplies and labor to support previously stated goals. Data has started being collected with the new instrumentation.

Monies spent between November 2007 to October 2008 are presented in Table 1.

Table 1: OWEB Funds used November 2007 to October 2008

		WATERSHED		
		Trask	Alsea	Hinkle
Discipline				
Fisheries-Equipment		$4,066	$63,436	-
Hydrology-Equipment		$64,061	$23,523	-
Hydrology-Labor		$18,600	-	
Habitat and Nutrients-Equipment		$39,596	-	-
Total by project		$126,323	$86,959	-

Trask Watershed Study

Hydrology: In the Trask Watershed study the OWEB funding was used to meet hydrology goals in two ways: to purchase equipment to monitor stream conditions and to pay labor for installation of flumes and related infrastructure.

Major equipment purchased includes Montana flumes, Campbell Scientific data loggers, pressure transducers, specific conductance/water temperature sensors, stream gaging accessories, and equipment shelters. A contractor was paid to install flumes at six

headwater stream locations (Figure 1). Instrumentation will be used to measure water discharge, stream temperature, and specific conductance in accordance with United States Geological Survey approved methods. Hydrology data is continuously collected on a 10-minute time interval. This dataset will provide important background information for all other research groups within the Trask Watershed Study.

During the summer of 2008, flumes and sensors were successfully installed at the 6 stream locations. Data from all sensors is now being collected.

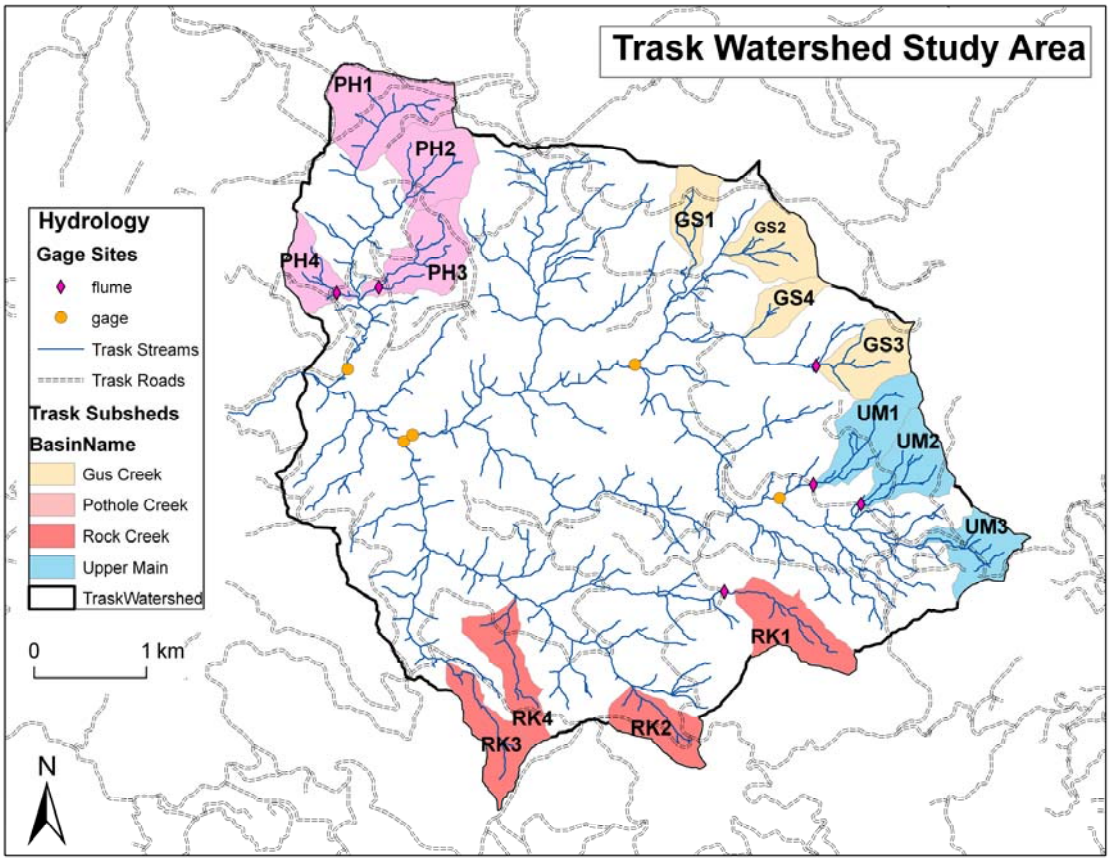

Figure 1 Trask Watershed Study Area. Hydrology Sites. Flumes were installed at six subshed locations.

Fisheries: OWEB grant monies were used to buy both full- (FDX) and half- (HDX) duplex, pit tags and associated handheld and swim through antenna readers and two Smith-Root Electrofishers.

Fisheries data collection is centered on 200-300 m sections of stream bound by weirs with two-way fish traps located adjacent to hydrologic gauging stations at four of the downstream effects sites (Figure 2). Each set of weirs will bracket a 200-300 m section of stream. Annual electrofishing surveys will be conducted each summer at the weir sites and will include the area of stream channel enclosed by the weirs plus approximately 50

m buffer section immediately up and downstream from the weirs. A combination of mark-recapture and removal techniques will be used to generate a precise non-biased estimation of abundance for each taxon. All captured fish and amphibians will be identified to lowest taxonomic level possible in the field and length and weight data will be collected.). All captured coastal cutthroat trout ≥ 100 mm receive 23 mm HDX tags. A portion of fish from other species and age-classes will receive 8.5 mm FDX tags and all captured fish receive a fin clip. The two-way traps at each weir will be checked daily. Weirs will operate for approximately six weeks beginning in early August and ending in late September. During this time period, a combination of passive capture techniques, including minnow traps, seining, and mobile pit tag antennae, will be used to evaluate growth, survival, movement, and habitat

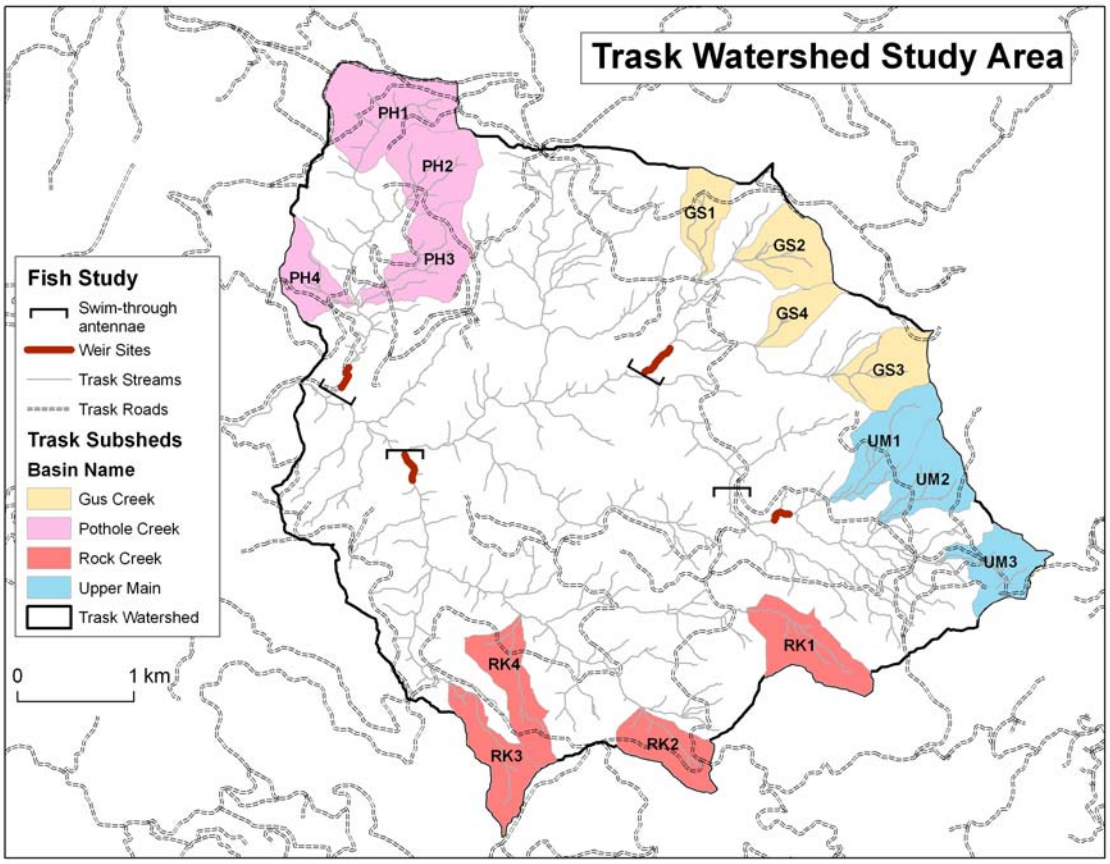

Figure 2 Trask Watershed Study Area. Fisheries research sites are represented by the solid red line. Swim-through passive integrated transponder antennas are located downstream form each research site.

selection of tagged individuals within the study areas. In addition, swim through antennas are located downstream of each study section at either the confluence of the tributary and the mainstem of at the boundary of a geomorphic reach break (upper mainstem site only). Antennas will operate during the late spring, early summer and from late September until the first heavy rains of fall.

Nutrients and Habitat: We used the OWEB funding for two separate purposes: purchase of equipment needed for the long-term measurements in the Trask Watershed Study, and salary support for a temporary three person field survey crew to provide study-wide, consistent measurements of stream and riparian conditions.

Major equipment purchases included instrumentation for measurement of dissolved oxygen, temperature and specific conductance in streams. We purchased a total of eight meters, four of which can be deployed for extended periods of time. Additional funds were used to purchase small battery powered pumps for use in stream tracer studies. This past summer we performed the first basin-wide measurements of primary production in both headwater and downstream locations. In addition to estimates of the spatial variability in productivity, we were able to quantify hydrologic characteristics of all these sites based on the tracer studies. The purchase of a digital hemispherical camera (and analytic software) will allow us to examine pre- and post-harvest changes in riparian canopy structure and light penetration, which can also affect these parameters.

We also purchased 40 programmable temperature sensors (and software). These small units were installed to monitor water and air temperatures throughout the study basin. The sensors were deployed in early spring (as soon as the snow had melted), and remained in place until early winter. We will repeat this series of measurements throughout the study to obtain profiles of both air and water temperatures pre- and post-treatment.

We hired an experienced field crew to perform basin wide surveys of stream channel morphology and to characterize the riparian area. The crew visited each of the headwater and downstream sites, and monumented the survey reaches to ensure repeat measurements in the same locations. Among the parameters measured were stream widths, depths, and substrate size; large wood in the channel and 30 meters into the riparian forest; tree species and size; plant understory structure and composition. In addition, a series of hemispherical photos were taken at each of the sites. These data will be used by other research teams (e.g., fish, amphibian, benthic macroinvertebrate, bird) in the Trask Watershed Study, and provide a common dataset for all to use.

ALSEA WATERSHED STUDY REVISITED

The Alsea Watershed Study Revisited provides a unique opportunity to compare water resource responses to current forest practices with responses to logging practices of the 1960s. The original Alsea Watershed Study assessed the effects of timber harvesting on water, aquatic habitat, and salmonid resources using a paired watershed approach. Flynn Creek was the undisturbed control watershed, and remains an undisturbed Research Natural Area under management by the USDA Forest Service. Deer Creek was partially cut and demonstrated the effectiveness of streamside management zones. Needle Branch was clearcutting and slash burned with no streamside vegetative buffer. It experienced dramatic water quality changes in temperature and dissolved oxygen. Changes in discharge, sediment, nutrients, and cutthroat trout populations were also measured. The regenerated forest in the Needle Branch watershed is again ready for commercial timber

harvest. The proposed timber harvesting plan involves two harvest entries and will allow us to examine the effects of current forest practices on water resources and to assess cumulative effects. We hypothesize that timber harvesting under the current Forest Practices Act rules will maintain higher water quality compared to past practices. We also hypothesize that additions of wood (part of current forest practices) can enhance fish habitat through increased cover (protection from predation in small headwater streams) and, possibly, creation of additional pools to maintain habitat during low flows. OWEB support has helped to fund water quality and fish monitoring in this study.

Progress on the Alsea Watershed Study Revisited

Hydrology and Water Quality Monitoring: Prior to 2008 we instrumented the watersheds to measure flow and water quality. Additional instruments were installed last year to identify water sources and residence times at the Needle Branch catchment. Its monitoring network includes six streamflow gauging stations, a throughfall sampler, soil lysimeters, and a micrometeorological station. This extensive gauging network allows us to close the catchment water and tracer mass balance at different scales. This is especially important as we assess downstream transport of water, materials, and energy. The approach is novel in the context of paired watershed studies in that we will be able to break the treatment watershed into its component parts and isolate differing responses to treatment based on assemblages of slope angle, slope, aspect, soil depth, and slope length.

In 2008 we also installed a network of groundwater wells to allow investigation of groundwater-surface water interactions. Additionally, a combined instrumentation-sampling methodology was designed and employed to measure the spatial extent of vegetation water use influence on streamflow generation during the growing season. Little is known about how deep groundwater contained in fractured sandstone bedrock influences streamflow in the Oregon Coast Range. Two deep wells (~38 and 61 m) installed in August 2008 along the ridge in the upper section of Needle Branch enable measurements of groundwater table dynamics and allow geochemical and isotopic characterizations of this water source. These characterizations enable application of mixing models to quantify the magnitude of contributions to streamflow from various sources. Transects of shallow groundwater wells installed during September 2008 in the steep, colluvial reach and lower alluvial floodplain reach of Needle Branch not only allow access for geochemical and isotopic sampling, but also provide information on how shallow, subsurface response varies by geomorphic position. Understanding how stream discharge is influenced by different geomorphic components is paramount to extending our ability to predict runoff responses across a range of scales.

Collection of storm runoff samples at five gauging locations within Needle Branch was initiated in October 2008 to assess the time-source components of runoff (pre-event versus event water) at multiple scales and across a range of wetness conditions. This methodology will enable us to infer dominant runoff generation mechanisms and flowpaths under differing ambient conditions and at increasing scales. Additionally, by sampling both before and after harvest, we expect to gain insights into how forest harvest impacts stream runoff processes and how such impacts change with scale.

An instrumentation-sampling methodology was implemented beginning in late May 2008 to investigate the coupling of forest vegetation water use and streamflow during the growing season. A sapflow sensor network installed in June 2008 allows estimation of transpiration flux rates and direct measurement of flux timing. To further explore how vegetation water use varies by landscape position and soil moisture status and how this relates to stream discharge, soil water (stratified by depth), vegetation water, and stream water were sampled for isotopic composition throughout the 2008 growing season. Volumetric soil water content was measured continuously at four depths in two plots (one shoulder slope and one toe slope) with soil moisture sensors. Gravimetric soil water content was analyzed for every soil sample collected. Pre-dawn moisture potential measurements were made to assess vegetation drought status at each plot sampled for soil and vegetation water (six plots).

Synoptic sampling of nutrients and turbidity threshold sampling of suspended solids continue, along with summertime monitoring of stream temperatures using a temperature probe network. Dissolved oxygen sampling was expanded to two additional sites using funds provided by OWEB. Results from 2007 and 2008 show tremendous variability for streamflows and water quality. Needle Branch experienced frequent and widespread low oxygen conditions during the summer and fall of 2007. With higher flows in 2008, depressed oxygen conditions were much less frequent and severe. OWEB funds have also been used to support contractor development of a web-accessible database for managing and archiving the water quality data being collected at the Alsea Watersheds.

Fish and Aquatic Organisms: Electronic gate readers, mobile trackers, and passive integrated transponder (PIT) tagging of fish are being used to monitoring fish populations. Data are being collected before and after harvest in Needle Branch, and population patterns are being compared with those in the control watershed (Flynn Creek). PIT tags allow additional research accomplishments, including bioenergetic modeling and detection of hiding cover use by cutthroat trout. Additional monitoring to assess macroinvertebrate populations was carried out by Oregon State University scientists last year. Benthic, emergent, and drifting macroinvertebrates were sampled, paralleling approaches used at Hinkle Creek. In addition, a team from the Oregon Department of Environmental Quality collected macroinvertebrate data to examine its impact assessment methods.

OWEB grant monies were used to purchase Mezura Palm computers. Mezura Palms are hardened field computers which use the Palm OS operating system making them compatible with Oregon Rfid data loggers. These computers were purchased to replace failing non-hardened palm pilot computers originally purchased through the Hinkle Creek Paired Watershed Study (HCPWS). The mobile passive integrated transponder antennas are used in all three of the watershed studies but most frequently in NAWS where they are used every other month. During each sampling occasion, the entire fish bearing portion of Needle Branch and Flynn Creek is scanned (Figure 3 solid blue line). During summer low-flow, a habitat inventory is completed in each watershed followed by fish sampling in which each pool is subjected to single-pass electrofishing. All captured coastal cutthroat trout ≥ 100 mm receive a 23 mm HDX PIT tag. Each watershed is

bound on the downstream end (Figure 3) by a pair of swim-through antennas. These antennas operate 12 months per year and monitor the movement of tagged fish into and out of the watersheds.

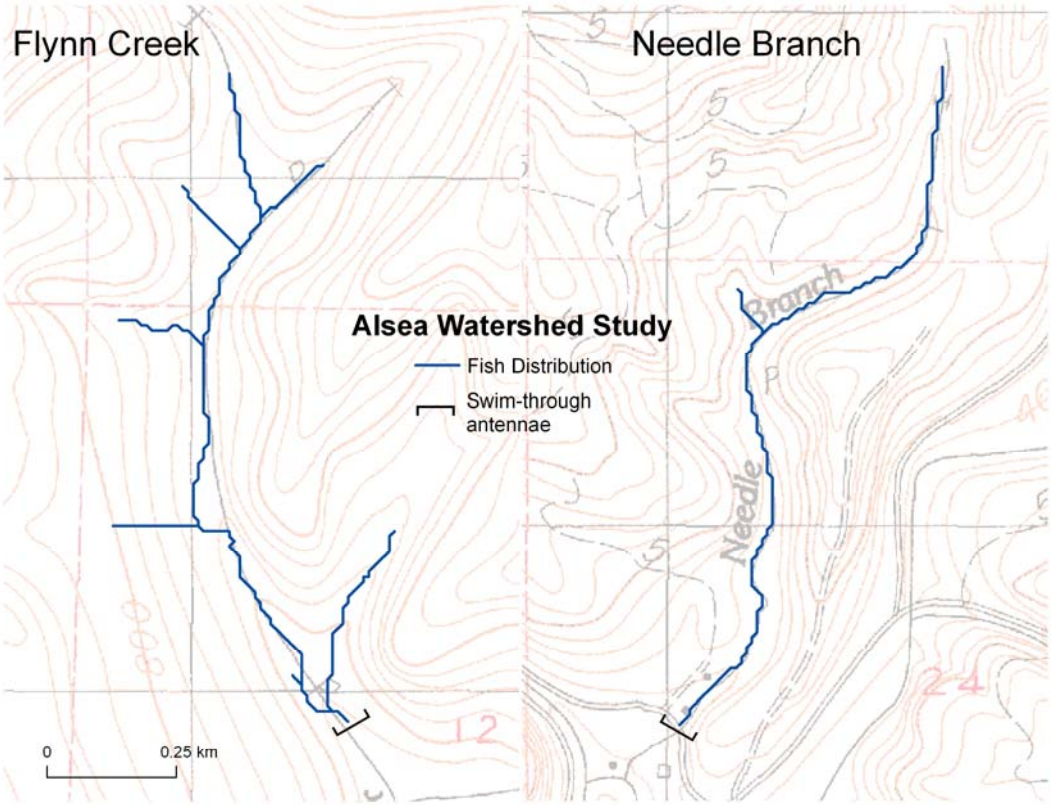

Figure 3 (not to scale) New Alsea Watershed basins. Flynn Creek, the reference and Needle Branch the treatment watershed. Fish bearing portion of the drainage network is denoted by the heavy blue line. A pair of swim-through antennas is located at the downstream end of each watershed.

Hinkle Creek Paired Watershed Study

During November 2007 to October 2008, no OWEB funding was spent on the Hinkle Creek study.