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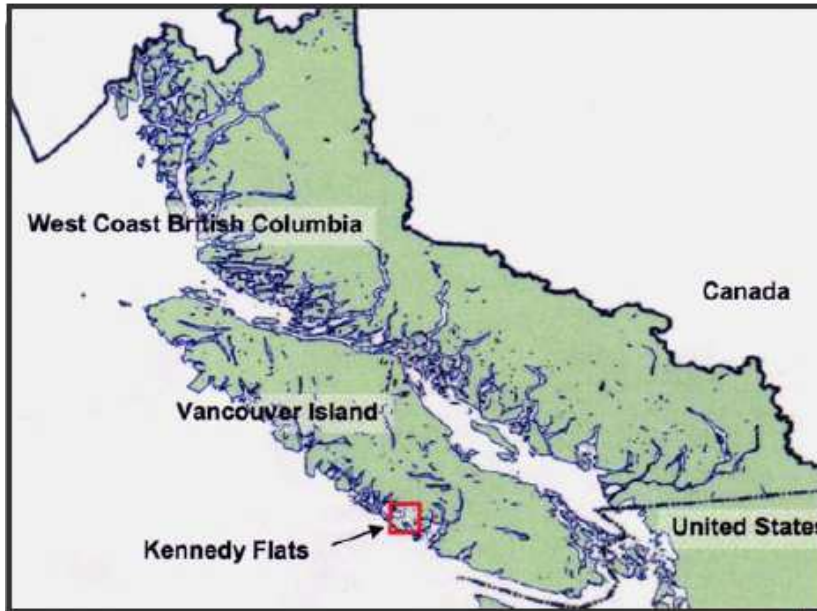
**DESIGN OF RIPARIAN ZONES: RESPONSE OF SECONDARY PRODUCTIVITY TO
STREAM GEOMORPHOLOGY AND CLASSIFICATION.**

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Riparian forests make up a significant component of the productive forest in B.C. that is protected at some level from harvesting. Given that these areas are known for their unusually high levels of biodiversity, such protection likely serves a crucial role to retain biodiversity. This project examined the site-level biodiversity of riparian reserves as affected by geomorphic characteristics of streams. Specifically, we wished to determine whether buffers in alluvial systems appear to retain greater wildlife values/secondary productivity than non-alluvial systems, and if so, whether this would suggest that riparian reserve zones should be increased for the more valuable, sensitive systems. Wildlife value was assessed using carabid beetles, an invertebrate indicator species that has been used in numerous studies of forest biodiversity.

Pitfall trapping was used to examine the epigaeic (ground-dwelling) carabid fauna in 20 riparian sites associated with 15 different streams (3 non-alluvial, 7 alluvial, 3 semi-alluvial and 2 old-growth) between June and September 2008. All 13 streams are located in coastal western hemlock forests in TFL 54 and 57, in the hyper-maritime CWH zone, and vh subzone. These sites were all in the Kennedy Lake Flats region and several were located within the park boundary of the Pacific Rim National Park.

Location of Kennedy Flats:



Carabid beetles were trapped using pitfall traps placed at 10 m intervals along transects that ran perpendicular to the stream course, starting at the stream edge, and extending through the riparian buffer and a further 75 m into the adjoining forest or adjoining clearcut. On the 7 alluvial streams, a total of 9 sites were set up (3 sites with transects extending into old growth, 5 into 2nd growth and one into a recent clearcut). Six semi alluvial riparian sites were set up, with transects from riparian areas extending into 4 adjoining clearcuts and two 2nd growth sites. Three non-alluvial sites were set up, with transects from riparian areas extending into the adjoining 2nd growth forest. Thus, a total of 18 sites were set up and a total of 347 traps were sampled monthly between June and September.

Pitfall trap with lid removed:



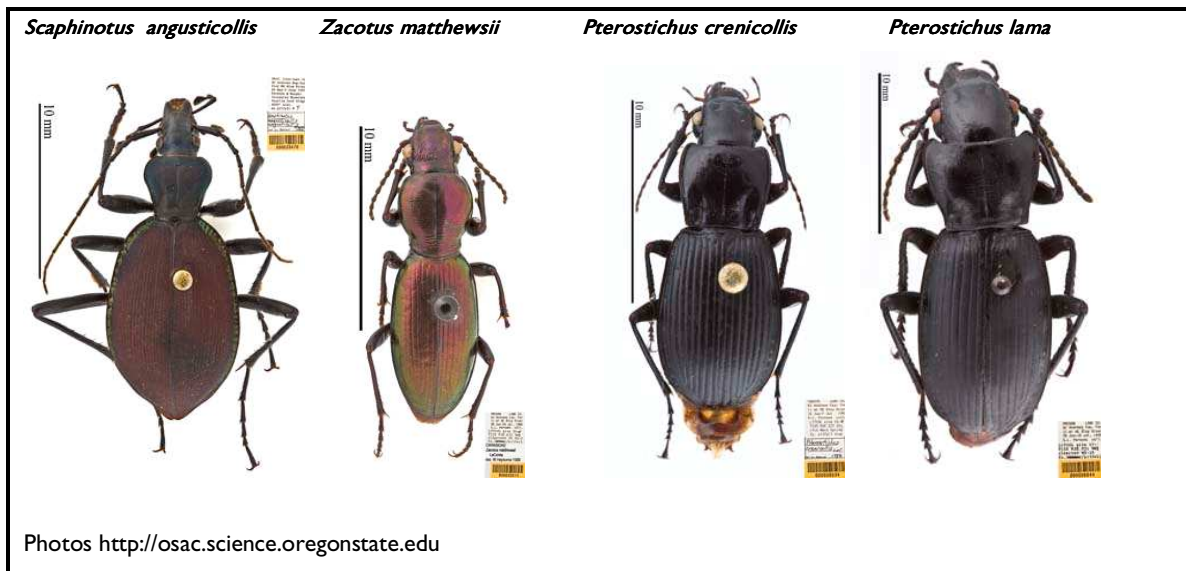
Sampling a pitfall trap:



Carabid beetles were identified to family or genus, and the by-catch was identified only to order. 14 carabid beetle species with a total of 3906 individuals were collected in the alluvial sites, 14 species with a total of 1542 individuals were collected in the semi-alluvial sites, 13 species with a total of 3230 individuals were collected in the non-alluvial sites, and 10 species with a total of 3785 individuals were collected in the old-growth sites. A total of 8258 carabids were trapped overall, from a total of 20 species.

In the alluvial sites, the most abundant species captured was a forest specialist, *Pterostichus crenicollis* Le Conte, while in the semi-alluvial sites both *P. crenicollis* and another forest specialist, *Scaphinotus angusticollis* (Fischer von Waldheim) were similarly common. In the non-alluvial sites, the most common species caught was also *P. crenicollis*, but there were also high numbers of *Pterostichus lama* (Menetries) and relatively high catches of *P. algidus* caught. These latter species have been identified as generalists in previous studies. In the old-growth sites, *P. crenicollis* was most abundant. *Zacotus matthewsii* Le Conte, identified as an old-growth specialist, was only found associated with the old-growth control sites and one of the alluvial sites.

Beetle species:



Other species were also found restricted to one or two site “types”: *Agonum affine* Kirby and *A. ferruginosum* Dejean are both very hygrophilous species and were found only in alluvial sites; additionally *Leistus ferruginosus* Mannerheim, another species

associated with moist ground, was also found only in alluvial sites; *Amara littoralis* Mannherheim, a more open country or meadow species was found only in semi-alluvial sites; while *Agonum piceolum* LeConte and *Harpalus cordifer* Notman were both found only in non-alluvial sites. The former species is often found on bare soil or under leaves.

Using non-metric multidimensional scaling, I examined how the sites differed in terms of “species-space”. There appeared to be a clear separation of the alluvial, semi-alluvial, and non-alluvial communities. Indicator species analysis showed that four species: *Pterostichus lama*, *P. algidus* LeConte, *P. crenicollis* and *Z. matthewsii* have high indicator value. The first two species are most commonly associated with the non-alluvial site type, while *P. crenicollis* is most commonly associated with the alluvial riparian strips, and *Zacotus matthewsii* has a high indicator value for old-growth sites.

Differences in biomass amongst site types were examined. Larger carabids such as *Cychrus tuberculatus*, *Omus dejeani*, *Pterostichus lama*, and the *Scaphinotus* genus had the highest biomass, and thus abundance of these species affected overall biomass in any one location. Highest biomass was noted in the non-alluvial sites, then the alluvial sites, and lowest average biomass for the season was seen in the semi-alluvial sites. Biomass for the adjoining clearcuts or immature sites was always much lower than that found in the adjacent riparian buffers. In alluvial sites, approximately 70% of the biomass was made up of *P. crenicollis*, while in the semi-alluvial sites, *P. crenicollis*, and *S. angusticollis* made similar contributions (42 and 38%, respectively). In non alluvial sites, approximately 46% of the biomass was made up by *P. lama*, while in the old-growth sites most of the biomass (54%) was made up by *P. crenicollis*.

The invertebrate communities of the riparian sites sampled in this study showed differences to the communities of many of the sites that have been sampled on Vancouver Island in previous studies (Pearsall, 2002-2007). For most Vancouver Island forests, whether in dry or wet variants, the dominant species has always been *Scaphinotus angusticollis*, which is a forest specialist and makes up a very high abundance in most forested blocks. Although this species was the second most commonly captured

species in the Kennedy Flats, catches of *P. crenicollis* far surpassed the catches, with almost 5000 *P. crenicollis* versus 1500 *S. angusticollis* caught for all sites overall. Additionally, there did appear to be some hygrophilous species associated with the riparian buffers that we have not captured in previous communities. Finally, abundance of *P. lama* was much higher in the non-alluvial sites of this study than we have seen in sites at any other location on the island.

Diversity was highest in the non-alluvial sites, then the semi-alluvial sites, and then the alluvial sites. Both diversity and evenness were particularly low in the alluvial sites A2, A3 and A4 and the old-growth site R2. Diversity of the clearcuts adjacent to the alluvial and semi-alluvial riparian strips was much higher than within the adjoining buffers. This is in accord with results from previous work that has shown that older communities generally have lower species richness and diversity than younger communities. This is often the result of the dominance of the forest specialist, *S. angusticollis* in control sites, while clearcuts and younger sites tend to receive an influx of small, winged species that are open-habitat specialists, such as *Harpalus* and *Amara* species. In the Kennedy flats region, the loss of evenness and diversity was more associated with the dominance of *P. crenicollis* rather than *S. angusticollis* in the riparian buffers of the alluvial and old-growth sites, however.

In summary, there appear to be relatively distinct communities found in the different types of buffers, and associated with the geomorphology of the streams. Riparian buffers appear to be able to retain distinct communities of carabids which are not lost or degraded when the adjoining forest blocks are harvested. Although clearcuts and immature sites adjacent to the buffers do lose biomass, species and diversity, this did appear to recover in time, and forest species were not entirely lost from these blocks.

However, placing values on these distinct communities is somewhat a subjective decision. All the communities in the different site types were dominated by the forest specialist, *P. crenicollis*, but in the non-alluvial sites, there was also a particularly high abundance of forest generalists, *P. lama*, and *P. algidus*. Thus we may suggest that there

is a greater “richness” associated with alluvial areas as compared to non-alluvial areas given the differences in species composition. However, this did not result in higher biomass values in the alluvial sites, since the common generalist found in the non-alluvial sites, *P. lama*, is also one of the largest species that we collect.

Future monitoring will be vital, to examine how the carabid assemblages change over time in the riparian buffers and the adjoining blocks. At this time, the direction of carabid species succession is uncertain, since we do not know the possible extent of competitive interactions and whether the size of buffers is adequate for long-term survival of beetles at any of the sites. Although we did find *Zacotus matthewsii*, an old-growth species, and somewhat of a “flagship” species, in the old-growth and one of the alluvial sites, we did not find it in any of the alluvial riparian buffers that were adjacent to areas that had been cut since 1995, when the Forest Practices Code came into effect and was augmented by recommendations from the Clayoquot Sound Scientific Panel (CSSP). It would be very interesting to examine alluvial riparian buffers that had retained *Zacotus* prior to harvest, and assess the changes post-harvest in this species. In addition, we chose only to examine buffers on S3 streams during 2008: future studies aim to extend this to S1 and S2 streams so that we can compare the impacts of buffer size.

Keywords: riparian strategy, reserve zone width, stream geomorphology, stream classification, biodiversity indicator, carabid beetles, invertebrate response