A Review of PLP Environmental Baseline Documents: Aquatic Macroinvertebrates (Bristol Bay Drainages)

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EXECUTIVE SUMMARY

Due to their ecological importance and utility as bioindicators, the Pebble Limited Partnership (PLP) embarked on an effort to characterize aquatic insect communities in streams that would be impacted by development of mining claims (the North Fork Koktuli, South Fork Koktuli, and Upper Talarik Creek). Methodology, resulting data, and interpretation are presented in two chapters of the resulting Environmental Baseline Document (Chapter 15, and Appendix E). This report reviews and critiques the information provided based on criteria standard for the scientific peer review process including organization and clarity, repeatability of methods, the degree to which conclusions are supported, and general scientific soundness.

The methodology used by PLP consultants relied on well tested, standard protocols (Major and Barbour 2001). However, site selection and low sample sizes may have been insufficient to characterize temporal and spatial variability, and to establish reliable reference sites. Further, over 10% of non-Chironomid taxa were erroneously identified, raising considerable concerns regarding the accuracy and value of that data for measuring freshwater habitat impacts from potential mine development.

INTRODUCTION

Aquatic insects (i.e., freshwater macroinvertebrates) are a critical component of freshwater ecosystems (Covich et al. 1999), forming a link between the base of stream foodwebs and top consumers both in aquatic (e.g., fish) and adjacent terrestrial systems (e.g., spiders, birds and bats). Insects process organic matter, influencing stream chemistry, and consume primary producers (algae and other diatoms; Allan and Castillo 2007). In turn, macroinvertebrates are consumed by fish (Allan and Castillo 2007), making insects ultimately responsible for converting plant material into animal tissue in lotic systems. Aquatic insects are important food items for salmon and other fish species, as well as other macroinvertebrates. They comprise the majority of juvenile coho and Chinook salmon diets (up to 80%) as well as Dolly Varden diets (up to 100%) in some rivers (Higgs et al. 1995, Eberle and Stanford 2010).

In addition to the importance of aquatic insects to the survival and maintenance of salmonid populations (Higgs et al. 1995, Quinn 2005), aquatic insects are a good indicator of overall stream health (Karr and Chu 1999). Biological assemblages (e.g., aquatic insects) respond to stresses of all degrees over time and, therefore, offer information on perturbation not always obtained with "snap shot" water chemistry measurements (Karr and Chu 1999). Due to their sensitivity to temperature changes (Vannote and Sweeney 1980), pollutant—including copper and other toxic chemicals (Eisler 2000, Lee et al. 2000, Smolders et al. 2003), and increased sedimentation (Culp et al. 1983, Zweig and Rabeni 2001, Relyea et al. 2012), characterizing and monitoring species assemblages can indicate adverse effects of pollutant stressors, thus providing an overall measure of aggregate stressor impact (Karr 1993). For example, heptageniid mayflies were reduced by more than 75% in southern Colorado headwater streams contaminated by heavy metals (Clements et al. 2000), while some species of chironomids may increase in abundance in polluted freshwaters (Karr and Chu 1999). Biomonitoring has been employed to evaluate water quality for over a century (Kolkowitz and Marsson 1909) and is now used widely by various state water resource agencies in the United States and other countries (Barbour et al. 1999, Merritt et al. 2008).

Despite their utility as bioindicators, samples of aquatic insects can be highly variable due to the complex nature of stream and river systems (Milner et al. 2006). For example, substrate disturbance during high flow events can change aquatic insect populations. Because of high temporal variability, it is necessary to sample over a sufficient time period to determine baseline condition. Sites and methods must be consistent to reduce potential introduced variation. Additionally, a sufficient number of sites nearby--but outside--of potentially impacted areas must be characterized to distinguish natural variability from development impacts. Without accurate baseline, or reference, characterization prior to and away from the introduction of pollutant stressors via development, declining habitat conditions cannot be measured (Karr and Chu 1999). Consequently, Pebble Limited Partnership (PLP), a mineral extraction company currently in advanced stages of exploration in Bristol Bay, included baseline biomonitoring in their recently released Environmental Baseline Document (EBD; PLP 2012). This document reviews and critiques their biomonitoring methods and results based on criteria standard for the scientific peer review process, including organization and clarity, repeatability of methods, the degree to which conclusions are supported, and general scientific soundness (ESA 2012).

METHODS

Using the USEPA's nationally accepted Rapid Bioassessment Protocols modified for Alaskan streams (Major and Barbour 2001), PLP consultants collected samples in 2004 (18 stations in June and 13 stations in August), 2005 (6 stations in June), and 2007 (9 stations in June) in streams that would be impacted by mine development (North Fork Koktuli, South Fork Kotuli, and Upper Talarik Creek). Two stations were sampled from watersheds outside of the potential project area in 2004 (Kaskanak and Chulitna creeks). To collect one sample, 20 subsamples were composited from representative habitats in 100-m reach sites using a D-Frame, 363 µm mesh kick net. Surber sampling was additionally conducted in 2005 and 2007. A minimum of 300 specimens from each composite sample were randomly selected and identified to the lowest taxonomic resolution possible (generally genus), and several common metrics were calculated based on the results including: percent Ephemoptera, Plecoptera, and Trichoptera (EPT); percent Chironomidae; percent other Diptera taxa; percent dominant taxon; and Community Tolerance Index (CTI).

RESULTS

Between 2004-2007, 235 insect taxa were identified in streams in and around Pebble mining claims (PLP 2012). Taxa richness varied between years and sampling methods. Diptera (including the Family chironomidae) was generally the dominant taxon (PLP 2012). Although the EBD notes that this indicates "a more stressful aquatic habitat for macroinvertebrate survival," this is contradicted by the statement that "conditions in the mine study area are pristine, and high numbers of Chironomidae are considered normal for this region and elsewhere in Alaska."

CTI values also varied between years. Percent Ephemoptera, percent Diptera, percent other order and percent EPT taxa varied among and within rivers (Table 2). With respect to water quality, all sites provided good to optimal levels of dissolved oxygen, temperature, dissolved constituents (conductivity), and pH. Additional results indicated:

- Percent EPT taxa exhibited an inverse relationship with dissolved oxygen,
- One site with low pH supported low percent EPT, and
- Taxonomic richness decreased with increasing temperature.

In general, consultants concluded that "habitat parameters at each site fall within ranges considered good to optimal for aquatic habitat…The sites sampled…were located in a pristine area with few to no human-caused effects."

DISCUSSION

While sampling methods were generally of sufficient rigor, site selection, numbers of samples, and taxonomic identification appear questionable. Of the 18 stream sites sampled, only two sites could serve as reference sites because they were located outside the area potentially affected by mine development (PLP 2012). However, both are within areas currently being explored for other mineral development projects. One is in a stream that does not support salmon (Chulitna Creek), and both are in creeks (Chulitna and Kaskanak) with higher organic material loads and more metals than the North and South Forks of the Koktuli River and Upper Talarik Creek

(Brabets 2002). Further, the two potential reference sites were sampled just once in 2005, precluding the ability to characterize inter-annual variability. These sites could be crucial for distinguishing natural variability from variability caused by mining and should be chosen based on long term expectations of development as well as comparability to streams near the Pebble prospect. Five of the eighteen sites were sampled consistently in all three years of PLP consultant sampling efforts; the number of sites may be insufficient to characterize spatial and temporal variability of aquatic insect communities, and may overlook some species (Li et al. 2001, Monk et al. 2008).

Of the 171 non-Chironomid taxa reported, over 10% (18) have not been documented in the state of Alaska (Table 1). The range of several genera is not known to occur outside of eastern North America (e.g., Allocapnia, Nemocapnia, Ironoquia, Leptotarsus, and Acentria; Merritt et al. 2008). Others (Entomobryidae) range from the Southern California coast, to Northern Mexico and Hawaii. Questionable taxa were not found by independent analyses in Bristol Bay watersheds (Appendix 1). The apparent errors in identification raise questions about the reliability of the associated analyses. Without proper taxonomic identification, results reported for overall taxa richness, percent EPT, percent other Diptera taxa, percent dominant taxon, and CTI may also be erroneous. Inaccurate identification additionally raises the question of overlooking species. Fewer than half of Alaska's streams have been surveyed for fish (ADFG 2012) and likely even fewer for macroinvertebrates, indicating a possibility that many of Alaska's aquatic insects remain to be documented. Consequently, failure to accurately identify insects may neglect endemic and/or other species previously unknown to occur in the region. Methodology described did not indicate any effort was made to search for large or rare taxa outside of the 300 organism subsample.

Table 1. Macroinvertebrate taxa reported by Pebble Limited Partnership (PLP 2012) that were not previously documented in the State of Alaska.

Order	Family	Genus	North American Distribution
Ephemoptera	Oligoneuriidae	Lachlania	West[1], Gila River drainage (New Mexico), and from Alberta and Saskatchewan south to Mexico including Montana, Colorado, Nebraska, North Dakota, New Mexico, and Utah[2]
Plecoptera	Capniidae	Allocapnia	East[1,3]
Plecoptera	Capniidae	Nemocapnia	East[1,3]
Plecoptera	Capniidae	Paracapnia	West, East[1,3]
Plecoptera	Leuctridae	Moselia	Pacific Northwest[1], Western North America, British Columbia[3]
Plecoptera	Chloroperlidade	Sweltsa	East, West[1,3]
Plecoptera	Nemouridae	Malenka	West[1,3]
Plecoptera	Perlodidae	Isogenoides	East, North, West[1,3]
Trichoptera	Brachycentridae	Amiocentrus	West[1]
Trichoptera	Brachycentridae	Eobrachycentrus	West (Mt. Hood Area) [1], British Columbia, Washington[4]
Trichoptera	Limnephilidae	Ironoquia	East[1], from Nova Scotia to Louisiana and Wisconsin[4]
Trichoptera	Limnephilidae	Moselyana	Oregon and Washington[1]; endemic to Oregon[4]
Trichoptera	Limnephilidae	Pedomoecus	West[1], California, Oregon, Washington (adults from British Columbia, Alberta)[4]

Trichoptera	Odontoceridae	Namamyia	Oregon, California[1,4]
Diptera	Tipulidae	Leptotarsus	Eastern United States[1]
Collembola	Entomobryidae	(Unidentified)	Southern California Coast, Northern Mexico and Hawaii (and possibly southern Florida), Eastern United States[1]
Collembola	Hypogastruridae	(Unidentified)	East Coast, Gulf Coast, Florida, New York coast, California, Northern Mexico, Washington Coast[1]
Lepidoptera	Pyralidae	Acentria	Canada and eastern US west to Nebraska[1]

[1]Merritt et al. 2008
[2]Lugo-Ortiz and McCafferty 1994, McCafferty et al. 1997, Guenther and McCafferty 2005
[3]Stewart and Oswood 2006
[4]Wiggins 1996

Few independent analyses of aquatic insect communities have been conducted in the region, and due to high variability of communities, comparison may be spurious. In general, however, the EBD reports lower taxa richness from 2004-2007 than independent scientists found from 2008-2011 (Table 2; Bogan et al. 2012). Both groups found similar dominance by Chironomidae across all sites (63% and 60% for PLP and the University of Alaska Natural Heritage Program, respectively) for samples collected using ASCI methodology. This is similar to patterns observed in interior Alaska (Oswood 1989).

Table 2. Average (and range) of taxonomic richness by sub-watershed collected using ASCI methodology in streams by Pebble Limited Partnership Consultants (PLP) from 2004-2007 and by University of Alaska's Natural Heritage Program (UAA) from 2008-2011.

Sub-watershed	**Total sites**		**Richness (no. of taxa)**	
	PLP	UAA	PLP	UAA
Lake Iliamna	14	17	21 (16-26)	23 (13-35)
Mulchatna	19	34	21 (9-28)	27 (9-37)

CONCLUSION

Due to their value as biological indicators, aquatic insect communities are important to accurately characterize both within and outside of a project area prior to development in order to measure future impacts. While the methodology used by PLP consultants relied on well tested, standard protocols (Major and Barbour 2001), site selection and low sample sizes may have been insufficient to characterize temporal and spatial variability, and to establish reliable reference sites. Further, aquatic insect identification was erroneous, raising considerable concerns regarding the accuracy and value of that data for measuring freshwater habitat impacts from potential mine development.

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Appendix 1. Macroinvertebrate taxa found documented in and around the Pebble study area, and throughout North America.

Order	Family	Genus	North American Distribution
Collembola (sub-class)	(Unidentified)	(Unidentified)	North and South Fork Koktuli Rivers and Upper Talarik Creek[1]
Ephemeroptera	(Unidentified)	(Unidentified)	Upper Talarik Creek[1], Lake Clark National Park[2]
Ephemeroptera	Baetidae	(Unidentified)	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Mulchatna River[4], Lake Clark National Park[2]
Ephemeroptera	Baetidae	Acentrella	South Fork Koktuli River and Upper Talarik Creek[1], Mulchatna River[4], Lake Clark National Park[2], Wood River[5], Widespread[6],
Ephemeroptera	Ameletidae	Ameletus	Wood River[5], Widespread[6]
Ephemeroptera	Baetidae	Baetis	North and South Fork Koktuli Rivers[1,3], Mulchatna River[4], Lake Clark National Park[2], Wood River[5], Widespread[6]
Ephemeroptera	Baetidae	Centroptilum	Mulchatna River[4], Widespread[6]
Ephemeroptera	Ephemerellidae	(Unidentified)	North and South Fork Koktuli Rivers and Upper Talarik Creek[1], Lake Clark National Park[2]
Ephemeroptera	Ephemerellidae	Drunella	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Lake Clark National Park[2] Wood River[5], Widespread[6]
Ephemeroptera	Ephemerellidae	Ephemerella	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Mulchatna River[4], Lake Clark National Park[2], Wood River[5], Widesrpread[6]
Ephemeroptera	Ephemerellidae	Serratella	South Fork Koktuli River[1], Widespread[6]
Ephemeroptera	Heptageniidae	(Unidentified)	North and South Fork Koktuli Rivers and Upper Talarik Creek[1], Lake Clark National Park[2]
Ephemeroptera	Heptageniidae	Cinygmula	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3] Lake Clark National Park[2], Wood River[5], and West, Northeast, Southeast[6]
Ephemeroptera	Heptageniidae	Epeorus	North and South Fork Koktuli River and Upper Talarik Creek[1,3], Lake Clark National Park[2], Wood River[5], Widespread[6]
Ephemeroptera	Heptageniidae	Heptagenia	Mulchatna River[4], Widespread[6]
Ephemeroptera	Heptageniidae	Rhithrogena	Mulchatna River[4], Widespread[6]
Ephemeroptera	Metretopodidae	Metretopus	Mulchatna River[4], Canada, Alaska, upper Midwest, Maine[6]
Ephemeroptera	Siphlonuridae	Siphlonurus	Mulchatna River[4], Widespread[6]

[1]Unpublished data, Kate Miller, Alaska Department of Fish & Game
[2] Brabets and Ourso 2006
[3] O'Neal et al. 2012
[4]Unpublished data, Jack Stanford, Flathead Lake Biological Station, University of Montana
[5]Moore and Schindler 2010
[6]Merritt et al. 2008
[7]Stewart and Oswood 2006
[8]Wiggins 2009

Appendix 1 (cont'd.). Macroinvertebrate taxa found documented in and around the Pebble study area, and throughout North America.

Order	Family	Genus	North American Distribution
Lepidoptera	(Unidentified)	(Unidentified)	North and South Fork Koktuli Rivers and Upper Talarik Creek[1]
Plecoptera	(Unidentified)	(Unidentified)	Upper Talarik Creek[1]
Plecoptera	Capniidae	(Unidentified)	Lake Clark National Park[2]
Plecoptera	Capniidae	Eucapnopsis	South Fork Koktuli[3], Alaska[7], West[6]
Plecoptera	Chloroperlidae	(Unidentified)	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Lake Clark National Park[2], Wood River[5]
Plecoptera	Chloroperlidae	Alloperla	North and South Fork Koktuli Rivers and Upper Talarik Creek[3], Mulchatna River[4], Bristol Bay[7], East, West[6]
Plecoptera	Chloroperlidae	Plumiperla	South Fork Koktuli River and Upper Talarik Creek[3], Alaska[7], West[6]
Plecoptera	Chloroperlidae	Suwallia	North and South Fork Koktuli Rivers and Kvichak River[3], Mulchatna River[4], Lake Clark National Park[2], Alaska[2], Bristol Bay[7], East, West[6]
Plecoptera	Nemouridae	(Unidentified)	South Fork Koktuli River[1], Lake Clark National Park[2]
Plecoptera	Nemouridae	Nemoura	South Fork Koktuli River[1], Alaska[7], West, North, Northeast[6]
Plecoptera	Nemouridae	Podmosta	South Fork Koktuli River[3], Alaska[7], West, Northeast[6]
Plecoptera	Nemouridae	Zapada	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Lake Clark National Park[2], Wood River[5], Alaska[7], West, East[6]
Plecoptera	Perlodidae	(Unidentified)	Upper Talarik Creek[1,3], Mulchatna River[4], Lake Clark National Park[2]
Plecoptera	Perlodidae	Isoperla	North and South Fork Koktuli Rivers, Kvichak River[3], Mulchatna River[4], Wood River[5], Bristol Bay[7], Widespread[6]
Plecoptera	Perlodidae	Skwala	Lake Clark National Park[2], British Columbia[7], West[6]
Plecoptera	Pteronarcyidae	(Unidentified)	Lake Clark National Park[6]
Plecoptera	Pteronarcyidae	Pteronarcella	North and South Forks Koktuli River and Upper Talarik Creek[1,3], Mulchatna River[4], Lake Clark National Park[2], Alaska[7], West, Southwest[6]
Plecoptera	Taeniopterygidae	(Unidentified)	Upper Talarik Creek[1], Lake Clark National Park[2]
Trichoptera	(Unidentified)	(Unidentified)	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Mulchatna River[4], Lake Clark National Park[4], Wood River[5]

[1]Unpublished data, Kate Miller, Alaska Department of Fish & Game
[2] Brabets and Ourso 2006
[3] O'Neal et al. 2012
[4]Unpublished data, Jack Stanford, Flathead Lake Biological Station, University of Montana
[5]Moore and Schindler 2010
[6]Merritt et al. 2008
[7]Stewart and Oswood 2006
[8]Wiggins 2009

Appendix 1 (cont'd.). Macroinvertebrate taxa found documented in and around the Pebble study area, and throughout North America.

Order	Family	Genus	North American Distribution
Trichoptera	Apataniidae	Apatania	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Mulchatna River[4], Widespread (primarily North and higher elevations)[6,8]
Trichoptera	Brachycentridae	(Unidentified)	Lake Clark National Park[3]
Trichoptera	Brachycentridae	Brachycentrus	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Mulchatna River[4], Lake Clark National Park[2], Widespread[6,8]
Trichoptera	Brachycentridae	Micrasema	South Fork Koktuli River[1], Widespread[6,8]
Trichoptera	Gossosmatidae		Lake Clark National Park[2]
Trichoptera	Gossosmatidae	Glossosoma	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Lake Clark National Park[2], Alaska[8], Widespread[6]
Trichoptera	Hydropsychidae	(Unidentified)	North Fork Koktuli River[1]
Trichoptera	Hydropsychidae	Arctopsyche	Mulchatna River, North and South Fork Koktuli Rivers[1,3], Widespread[6,8]
Trichoptera	Hydroptilidae	(Unidentified)	South Fork Koktuli River[1]
Trichoptera	Hydroptilidae	Hydroptila	North and South Fork Koktuli Rivers[1], Widespread[6,8]
Trichoptera	Hydroptilidae	Oxyethira	South Fork Koktuli River[3], Widespread[6,8]
Trichoptera	Leptoceridae	(Unidentified)	Lake Clark National Park[2]
Trichoptera	Leptoceridae	Mystacides	Lake Clark National Park[2], West[8], Widespread[6]
Trichoptera	Limnephelidae	(Unidentified)	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Lake Clark National Park[2]
Trichoptera	Limnephelidae	Ecclisocosmoecus	Upper Talarik Creek[3], Alaska[8], Northwest[6]
Trichoptera	Limnephelidae	Ecclisomyia	North and South Fork Koktuli Rivers and Upper Talarik Creek[3], Lake Clark National Park[2], Alaska to California[8], West[6]
Trichoptera	Limnephelidae	Hydatophylax	Lake Clark National Park[2], Alaska[8], West[6]
Trichoptera	Limnephelidae	Limnephilus	Lake Clark National Park[2], Widespread[6,8]
Trichoptera	Limnephelidae	Nemotaulius	Mulchatna River[4], Alaska[8], Widespread in North[6]
Trichoptera	Limnephelidae	Onocosmoecus	North and South Fork Koktuli Rivers and Upper Talarik Creek[3], Mulchatna River[4], Alaska[8], Widespread[6]
Trichoptera	Limnephilidae	Psychoglypha	Mulchatna River[4], Lake Clark National Park[2], Alaska[8], North, West[6]

[1]Unpublished data, Kate Miller, Alaska Department of Fish & Game
[2] Brabets and Ourso 2006
[3] O'Neal et al. 2012
[4]Unpublished data, Jack Stanford, Flathead Lake Biological Station, University of Montana
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[8]Wiggins 2009

Appendix 1 (cont'd.). Macroinvertebrate taxa found documented in and around the Pebble study area, and throughout North America.

Order	Family	Genus	North American Distribution
Trichoptera	Rhyacophilidae	Rhyacophila	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Widespread[6,8]
Coleoptera	Dytiscidae	Oreodytes	Mulchatna River, Widespread[1]
Diptera	(Unidentified)	(Unidentified)	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3]
Diptera	Ceratopogonidae	(Unidentified)	Mulchatna River[6], Lake Clark National Park[2]
Diptera	Ceratopogonidae	Probezzia	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Widespread[6]
Diptera	Dolichophodidade	(Unidentified)	Mulchatna River[4]
Diptera	Empididae	(Unidentified)	Mulchatna River[4], Lake Clark National Park[2]
Diptera	Empididae	Metachela/ Chelifera	North Fork Koktuli River and Upper Talarik Creek[1,3], Lake Clark National Park[2], Widespread[6]
Diptera	Psychodidae	(Unidentified)	Lake Clark National Park[2]
Diptera	Psychodidae	Pericoma	North and South Fork Koktuli Rivers and Upper Talarik Creek[1], Lake Clark National Park[2], Widespread[6]
Diptera	Simuliidae	(Unidentified)	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Mulchatna River[4], Lake Clark National Park[2]
Diptera	Simuliidae	Metacnephia	North and South Fork Koktuli Rivers[3], Western U.S. and Canada, Alaska[6]
Diptera	Simuliidae	Prosimulium	South Fork Koktuli River and Upper Talarik Creek[3], Widespread[6]
Diptera	Simuliidae	Simulium	North and South Fork Koktuli Rivers and Upper Talarik Creek[1,3], Lake Clark National Park[2], Widespread[6]
Diptera	Tipulidae	(Unidentified)	South Fork Koktuli River[1]
Diptera	Tipulidae	Dicranota	South Fork Koktuli River, Upper Talarik Creek[1,3], Lake Clark National Park[2], Widespread[6]
Diptera	Tipulidae	Hexatoma	North and South Fork Koktuli Rivers[3], Mulchatna River[4], Widespread[6]
Diptera	Tipulidae	Rhabdomastix	Mulchatna River[4], Lake Clark National Park[2], Widespread[6]
Diptera	Tipulidae	Tipula	South Fork Koktuli River[3], Mulchatna River[4], Lake Clark National Park[2], Widespread6

[1]Unpublished data, Kate Miller, Alaska Department of Fish & Game
[2] Brabets and Ourso 2006
[3] O'Neal et al. 2012
[4]Unpublished data, Jack Stanford, Flathead Lake Biological Station, University of Montana
[5]Moore and Schindler 2010
[6]Merritt et al. 2008
[7]Stewart and Oswood 2006
[8]Wiggins 2009