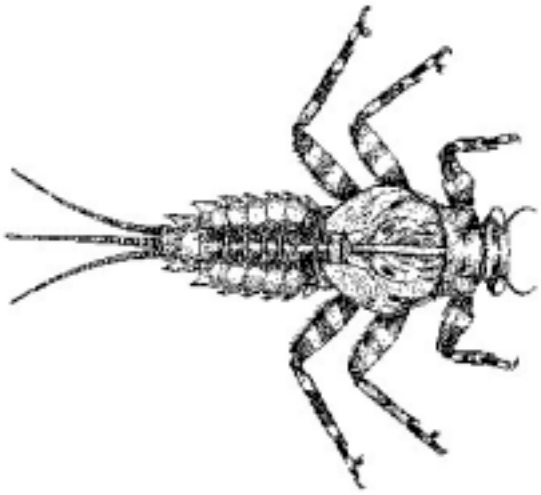
Oregon Coast Range Macroinvertebrate Analysis and Monitoring Status 1991 - 1997



George Canale
Oregon Department of Environmental Quality
Laboratory Division
Biomonitoring Section
1712 S.W. Eleventh Avenue
Portland, Oregon 97201

Introduction

This report examines macroinvertebrate data collected from three monitoring programs covering the Oregon Coast Range over the period 1991 to 1997. Its principle objective is to present an overview of biological data currently held by the DEQ Laboratory for this ecoregion. Because information has been drawn from projects with somewhat differing objectives, as well as differing collection protocols, some of the analysis presented below should be viewed cautiously. In the text that follows the reader will find a number of caveats to keep in mind.

Projects, Survey Sites and Sampling Schedules

Table 1 presents a list of sites and their locations grouped according to watershed. Also indicated in the table is the sites' project membership, descriptions of which are given below. Site locations are mapped in Figure 1.

Oregon Coast Range Subecoregion Reference Site Study

The main objective of this study was to locate and characterise the condition of reference streams in the Oregon Coast Range following the ecoregion stratification approach developed by Omernick (EPA Research Laboratory). Thirty four reference sites were sampled over a three year period (1992 - 94). An additional set of sites not necessarily considered to be in reference condition were also sampled in 1994. For the most part, sampling was conducted in the months of July and August. A handful of sites were sampled during October (see Table 1).

Data collected in 1992 cannot be used in a numerically meaningful fashion due to a change in macroinvertebrate subsampling method that took place the following year. If a need arises, qualitative interpretation of the 1992 data set is possible but this is not undertaken here. The Subecoregion study forms the core of the current macroinvertebrate assessment model known as BORIS (Benthic evaluation of ORegon rIverS. Canale, 1999). BORIS is a predictive multivariate model which follows the RIVPACS approach (see Moss et. al., 1987 & Wright et. al., 1984 for a description of RIVPACS) .

REMAP - Coast Range

The Regional Environmental Monitoring and Assessment Program for the Oregon Coast Range was an EPA funded assessment of stream macroinvertebrate, vertebrate and habitat status. Fifty eight wadable first through third order streams were randomly selected and visited in 1994 and 95. A subset of streams has been incorporated as reference sites into BORIS. The REMAP sites were resampled in 1996 in response to the extensive flood events that occurred in late winter/early spring of that year. Data from 1996 has not yet been analysed and so is not considered in this report. Sampling in all years took place during the months of July through September.

Tillamook NPS

In June 1997, ten stream reaches were selected in the Tillamook basin for biological assessment and evaluation. The streams were selected to provide a range of conditions from agricultural and urban influenced areas. The objective was to gather an initial set of background data from low gradient valley streams and determine if differences in BMP’s and land use would be reflected in the biological condition of the streams.

Table 1. Site Locations

Site Name	Storet	Elev (ft)	County	USGS HUC	Latitude	Longitude	Project	Watershed	Date[1]				Ref Cat[2]	Ref Grp[3]
BIG CREEK AT RM 2.9	405098	100	Clatsop	17080006	46 09 04	123 35 08	REMAP	Lower Columbia	8-Sep-94					
S.F. GOBLE CREEK AT RM 0.9	405270	250	Columbia	17080003	45 59 30	122 53 47	REMAP	Lower Columbia	21-Jul-95	6-Sep-95				
LOOWIT CREEK - LOWER	405060	600	Clatsop	17080006	46 01 18	123 49 31	Subecoregion	Lewis & Clark (L. Columbia)	23-Aug-94					
LOOWIT CREEK - UPPER	405061	600	Clatsop	17080006	46 01 17	123 49 31	Subecoregion	Lewis & Clark (L. Columbia)	25-Aug-94					
SHWEEASH CREEK	405062	600	Clatsop	17080006	46 01 12	123 50 32	Subecoregion	Lewis & Clark (L. Columbia)	24-Aug-94					
Fox Creek - Lower	405065	525	Clatsop	17080006	46 00 04	123 42 09	Subecoregion	Youngs (Lower Columbia)	25-Aug-94					
Fox Creek @ RM 0.6 (upper site)	405624	600	Clatsop	17080006	45 59 57	123 42 04	Subecoregion	Youngs (Lower Columbia)	25-Aug-94					
Rock Creek - Lower	405064	720	Clatsop	17080006	45 59 30	123 44 32	Subecoregion	Youngs (Lower Columbia)	24-Aug-94					
Rock Creek - Upper	405063	800	Clatsop	17080006	45 59 16	123 44 53	Subecoregion	Youngs (Lower Columbia)	24-Aug-94					
DART CREEK AT RM 3.7	405027	360	Columbia	17090012	45 53 23	123 51 44	REMAP	Lower Willamette	18-Jul-94	19-Aug-94	9-Sep-94			
DART CREEK AT RM 3.7	405027	360	Columbia	17090012	45 53 23	123 51 44	REMAP	Lower Willamette	22-Jun-95	28-Jul-95				
Roaring Cr. 300 ft U/S City water intake	404950	480	Washington	17090010	45 34 02	123 15 14	Subecoregion	Tualatin	24-Oct-94				A	1
Clear Cr. U/S Thomas Cr.	404531	360	Washington	17090010	45 33 57	123 14 15	Subecoregion	Tualatin	28-Sep-92	30-Aug-93			B	1
WILLIAMS CANYON CREEK AT RM 1.8	405274	270	Yamhill	17090010	45 24 47	123 11 36	REMAP	Tualatin	19-Sep-95					
FISHHAWK CREEK AT RM 1.7	405073	505	Columbia	17100202	46 00 32	123 21 16	REMAP	Nehalem	7-Sep-94					
UNAMED TRIB ENTERING NEHALEM R AT RM 70.5[4]	405275	530	Columbia	17100202	45 59 54	123 16 39	REMAP	Nehalem	18-Sep-95					
N.F. NEHALEM RIVER AT RM 13.1	405276	310	Clatsop	17100202	45 48 28	123 44 02	REMAP	Nehalem	20-Sep-95					
Salmonberry Rv. @ mouth	404538	581	Tillamook	17100202	45 45 01	123 39 06	Subecoregion	Nehalem	29-Sep-92					
Lousignot Cr. @ RM 3.0	404532	1181	Washington	17100202	45 44 02	123 20 20	Subecoregion	Nehalem	29-Sep-92					
E. Foley Cr. @ RM 2.5	404533	321	Tillamook	17100202	45 40 00	123 48 43	Subecoregion	Nehalem	30-Sep-92	31-Aug-94			B	1
Kilchis Rv. @ RM 8.5	405022	140	Tillamook	17100203	45 34 02	123 47 40	REMAP	Kilchis	7-Jul-94					
CLEAR CREEK AT SECOND BRIDGE	405587	110	Tillamook	17100203	45 31 16	123 40 02	Tillamook	Kilchis	19-Jun-97					
MURPHY CREEK AT CURL ROAD (D/S LANDOLT FARM)	412250	35	Tillamook	17100203	45 30 32	123 50 05	Tillamook	Kilchis	19-Jun-97					
FALL CREEK AT RM 0.7	405021	400	Tillamook	17100203	45 29 42	123 35 18	REMAP	Wilson	6-Jul-94					
Little Nth Fk Wilson Rv @ RM 1.5	404534	249	Tillamook	17100203	45 28 52	123 43 56	Subecoregion	Wilson	30-Sep-92					

Table 1. Site Locations (cont.)

Site Name	Storet	Elev (ft)	County	USGS HUC	Latitude	Longitude	Project	Watershed	Date[1]				Ref Cat[2]	Ref Grp[3]
BEAVER CREEK 1/4 MILE UP WESTWOOD DRIVE	405578	100	Tillamook	17100203	45 28 52	123 47 49	Tillamook	Wilson	25-Jun-97					
BEAVER CREEK AT BARKER DAIRY (D/S CULVERTS)	405584	20	Tillamook	17100203	45 28 37	123 47 59	Tillamook	Wilson	19-Jun-97					
M.F./N.F. TRASK RIVER AT RM 3.0	405278	1120	Washington	17100203	45 27 54	123 26 09	REMAP	Trask	26-Sep-95					
HOLDEN CREEK AT MCCORMACK LOOP ROAD	412194	35	Tillamook	17100203	45 27 15	123 48 00	Tillamook	Trask	18-Jun-97					
HOLDEN CREEK AT MILLER STREET	412196	15	Tillamook	17100203	45 26 59	123 50 15	Tillamook	Trask	18-Jun-97					
Mill Cr. @ RM 1.0	405096	20	Tillamook	17100203	45 25 31	123 47 33	REMAP	Trask	19-Sep-94					
MILL CREEK NEAR ALCOVE (JUST D/S ELK CR.)	405583	60	Tillamook	17100203	45 25 15	123 47 05	Tillamook	Trask	17-Jun-97					
MILL CREEK AT BRICKYARD ROAD	412224	75	Tillamook	17100203	45 25 00	123 46 39	Tillamook	Trask	18-Jun-97					
ANDERSON CREEK @ HWY. 101	405648	15	Tillamook	17100203	45 25 10	123 49 29	Tillamook	Tillamook	17-Jun-97					
DRAINAGE DITCH AT SO. PRAIRIE SCHOOL- PORT OF TB	405582	35	Tillamook	17100203	45 24 33	123 48 59	Tillamook	Tillamook	17-Jun-97					
BEWLEY CREEK AT RM 0.3	412212	10	Tillamook	17100203	45 24 12	123 49 48	REMAP	Tillamook	20-Sep-94					
East Cr. U/S @ East Cr. Rd.	404537	472	Tillamook	17100203	45 18 43	123 39 51	Subecoregion	Nestucca	2-Oct-92	31-Aug-94			B	1
Bear Cr. @ RM 1.8 (upper)	404450	1200	Tillamook	17100203	45 18 25	123 34 57	Subecoregion	Nestucca	10-Sep-91	9-Apr-92	27-Oct-92	27-Oct-93		
Bear Cr. @ RM 0.15 (lower)	404451	800	Tillamook	17100203	45 16 14	123 34 27	Subecoregion	Nestucca	10-Sep-91	9-Apr-92	2-Oct-92	27-Oct-93		
JOES CREEK AT RM 0.5	405279	1320	Tillamook	17100203	45 18 06	123 32 47	REMAP	Nestucca	27-Sep-95					
Powder Cr. @ RM 0.95 (lower)	404456	561	Tillamook	17100203	45 14 38	123 40 18	Subecoregion	Nestucca	18-Sep-91	17-Apr-92	27-Oct-92	26-Oct-93	B	1
Powder Cr. @ RM 1.45 (upper)	404455	600	Tillamook	17100203	45 14 35	123 40 40	Subecoregion	Nestucca	18-Sep-91	27-Oct-92	26-Oct-93		A	1
Neskowin Cr. U/S Hwy 12	404535	79	Tillamook	17100203	45 03 31	123 53 38	Subecoregion	Neskowin (Nestucca)	1-Oct-92	1-Sep-94			A	1
UNAMED TRIB ENTERING PANTHER CREEK AT RM 14	405272	1260	Yamhill	17090008	45 17 46	123 22 38	REMAP	Yamhill (North Fork)	28-Sep-95					
CEDAR CREEK AT RM 0.6	405273	470	Yamhill	17090008	45 05 31	123 41 46	REMAP	Yamhill (South Fork)	20-Jul-95	31-Aug-95				
AGENCY CREEK AT RM 0.2	405041	340	Polk	17090008	45 04 32	123 37 08	REMAP	Yamhill (South Fork)	22-Aug-94					
Rock Cr. @ RM 1.4	405023	350	Polk	17090008	45 03 17	123 37 14	REMAP	Yamhill (South Fork)	11-Jul-94	11-Aug-94	14-Sep-94			
Unnamed Trib entering Rock Cr.[4]	405039	440	Polk	17090008	45 02 54	123 36 15	REMAP	Yamhill (South Fork)	11-Aug-94					

Table 1. Site Locations (cont.)

Site Name	Storet	Elev (ft)	County	USGS HUC	Latitude	Longitude	Project	Watershed	Date[1]				Ref Cat[2]	Ref Grp[3]
Deer Cr. U/S experimental forest HQ	404536	358	Lincoln	17100204	45 02 06	123 54 30	Subecoregion	Salmon (Siletz)	1-Oct-92	1-Sep-94			B	1
SALMON RIVER AT RM 21.0	405280	1500	Polk	17100204	45 00 55	123 43 18	REMAP	Salmon (Siletz)	7-Aug-95	22-Sep-95				
Steer Creek - Upper	405056	720	Lincoln	17100204	44 44 14	123 37 37	Subecoregion	Siletz	17-Aug-94					
Steer Creek - Lower	405057	400	Lincoln	17100204	44 43 35	123 39 29	Subecoregion	Siletz	18-Aug-94					
Brush Creek	405059	440	Lincoln	17100204	44 40 54	123 39 56	Subecoregion	Siletz	19-Aug-94					
Yaquina R. @ Harmsen Rd	405058	751	Benton	17100204	44 43 36	123 39 34	Subecoregion	Yaquina	18-Aug-94				B	1
YAQUINA RIVER U/S OF EDDYVILLE RM 34.1	405072	90	Lincoln	17100204	44 39 08	123 45 13	REMAP	Yaquina	31-Aug-94					
YAQUINA RIVER AT EDDYVILLE RM 32.0	405044	60	Lincoln	17100204	44 38 07	123 46 29	REMAP	Yaquina	30-Aug-94					
TROUT CREEK AT RM 0.2	405281	70	Lincoln	17100205	44 28 08	123 57 34	REMAP	Alsea	8-Aug-95				B	1
DRIFT CREEK AT RM 7.3	405282	20	Lincoln	17100205	44 27 16	123 57 50	REMAP	Alsea	9-Aug-95					
Lint Cr. @ RM 3.1[4]	405043	40	Lincoln	17100205	44 23 52	123 03 32	REMAP	Lint (Alsea)	26-Aug-94					
HONEY GROVE CREEK AT RM 1.2	405093	500	Benton	17100205	44 23 13	123 33 48	REMAP	Alsea	12-Sep-94					
Peak Cr. @ RM 3.5	404542	1181	Benton	17100205	44 21 22	123 29 03	Subecoregion	Alsea	30-Sep-92					
Cummins Cr. D/S trailhead	404541	30	Lane	17100205	44 16 02	124 06 01	Subecoregion	Cummins (Alsea)	30-Sep-92	16-Aug-93			A	1
TENMILE CREEK AT USFS TENMILE CREEK CAMPGROUND	405283	310	Lane	17100205	44 12 50	124 00 40	REMAP	Tenmile (Alsea)	19-Jul-95	30-Aug-95			B	1
Ten Mile Cr. 300 m U/S campground	404540	426	Lane	17100205	44 12 47	124 00 26	Subecoregion	Tenmile (Alsea)	29-Sep-92					
CULLEN CREEK AT RM 0.3	405042	1040	Lane	17100205	44 12 11	123 56 57	REMAP	Tenmile (Alsea)	25-Aug-94					
Rock Cr. @ RM 1.5	404539	98	Lane	17100205	44 11 12	124 06 21	Subecoregion	Rock (Alsea)	29-Sep-92					
Greenleaf Cr. @ RM 4.0	404544	899	Lane	17100206	44 09 40	123 38 13	Subecoregion	Siuslaw	1-Oct-92	17-Aug-93			B	1
Fish Cr. @ RM 2.5	404543	850	Lane	17100206	44 08 32	123 33 38	Subecoregion	Siuslaw	1-Oct-92	18-Aug-93			B	2
EAMES CREEK AT RM 4.8	405285	1040	Lane	17100206	43 58 53	123 25 47	REMAP	Siuslaw	10-Aug-95					
UNAMED TRIB ENTERING BERNHARDT CREEK AT RM 3.0	405284	180	Lane	17100206	43 57 48	123 58 16	REMAP	Siuslaw	16-Aug-95					
Whittaker Cr. U/S Whittaker Cr. Rd.	404820	1575	Lane	17100206	43 57 37	123 41 30	Subecoregion	Siuslaw	30-Jul-93				C	2
UNAMED TRIB ENTERING WOLF CREEK AT RM 13.5	405286	640	Lane	17100206	43 56 09	123 30 34	REMAP	Siuslaw	17-Aug-95					
Haskins Cr. @ RM 0.1	404865	580	Lane	17100206	43 53 48	123 35 22	Subecoregion	Siuslaw	19-Aug-93				C	2
Hawley Cr. two miles up Hawley Cr. Rd.	404866	770	Lane	17100206	43 51 23	123 11 57	Subecoregion	Siuslaw	20-Aug-93				B	2
SOUTH FORK SIUSLAW RIVER AT RM 2.3	405034	680	Lane	17100206	43 48 20	123 13 41	REMAP	Siuslaw	3-Aug-94					

Table 1. Site Locations (cont.)

Site Name	Storet	Elev (ft)	County	USGS HUC	Latitude	Longitude	Project	Watershed	Date[1]				Ref Cat[2]	Ref Grp[3]
LONG TOM RIVER AT RM 48.5	405271	510	Lane	17090003	44 08 20	123 26 22	REMAP	Long Tom(Upper Willamette)	14-Sep-95					
FOX HOLLOW CREEK AT RM 1.3	405033	540	Lane	17090003	43 55 17	123 13 60	REMAP	Long Tom(Upper Willamette)	2-Aug-94					
N.F. SMITH RIVER AT RM 23.0-1500' U/S NF FALLS	405288	980	Douglas	17100303	43 56 02	123 48 49	REMAP	Smith (Lower Umpqua)	24-Aug-95					
SMITH RIVER AT RM 81.3	405038	760	Douglas	17100303	43 47 01	123 25 34	REMAP	Smith (Lower Umpqua)	10-Aug-94					
Harvey Cr. @ RM 0.5	404861	35	Douglas	17100303	43 41 24	123 56 39	Subecoregion	Lower Umpqua	17-Aug-93				A	2
Franklin Cr. @ RM 1.0	404860	40	Douglas	17100303	43 40 09	123 54 34	Subecoregion	Lower Umpqua	16-Aug-93				A	2
UNNAMED TRIB OF WEST FORK LAKE CREEK AT RM 1.0	405037	440	Douglas	17100303	43 31 00	123 51 45	REMAP	Lower Umpqua	9-Aug-94					
Yellow Cr. @ RM 3.9	404864	550	Douglas	17100303	43 30 47	123 25 52	Subecoregion	Lower Umpqua	19-Aug-93				B	2
COX CREEK AT RM 0.3[4]	405036	850	Douglas	17100303	43 37 57	123 12 41	REMAP	Elk (Lower Umpqua)	4-Aug-94					
ELK CREEK AT RM 34.2[4]	405035	380	Douglas	17100303	43 37 39	123 13 08	REMAP	Elk (Lower Umpqua)	3-Aug-94					
CABIN CREEK AT RM 5.6	405289	570	Douglas	17100303	43 30 06	123 19 04	REMAP	Calapooya (Lower Umpqua)	27-Jul-95					
Bachelor Cr. @ RM 2.6	404863	520	Douglas	17100303	43 28 53	123 13 59	Subecoregion	Calapooya (Lower Umpqua)	19-Aug-93				B	2
OLALLA CREEK AT RM 11.6	405287	750	Douglas	17100302	43 02 36	123 32 22	REMAP	South Umpqua	31-Jul-95	13-Sep-95				
BEALS CREEK AT RM. 0.6	405024	820	Douglas	17100302	42 56 38	123 10 12	REMAP	South Umpqua	12-Jul-94					
BENSON CREEK AT RM 5.0	405290	180	Coos	17100304	43 34 28	124 01 26	REMAP	Tenmile Lake (Coos)	15-Aug-95					
ELK CREEK AT RM 3.0	405032	1120	Coos	17100304	43 33 36	123 56 25	REMAP	West Fork Millicoma (Coos)	28-Jul-94	18-Aug-94	13-Sep-94			
ELK CREEK AT RM 3.0	405032	1120	Coos	17100304	43 33 36	123 56 25	REMAP	West Fork Millicoma (Coos)	3-Aug-95	29-Aug-95				
WEST FORK MILICOMA R ST RM 22.5	405031	680	Coos	17100304	43 33 17	123 57 32	REMAP	West Fork Millicoma (Coos)	27-Jul-94					
Palouse Cr. U/S of old beaver dam (RM 6.7)	404826	80	Coos	17100304	43 30 59	124 06 35	Subecoregion	Coos Bay	30-Jul-93				B	2
METTMAN CREEK AT RM 0.5[4]	405045	15	Coos	17100304	43 26 14	124 09 51	REMAP	Coos Bay	26-Jul-94					
MORGAN CREEK AT RM 1.5	405291	60	Coos	17100304	43 20 00	124 04 16	REMAP	South Fork Coos	2-Aug-95					
PANTHER CREEK AT RM 4.6	405030	2040	Douglas	17100304	43 15 28	123 35 44	REMAP	South Fork Coos	21-Jul-94					
WILLIAMS RIVER AT RM 19.2	405025	1400	Douglas	17100304	43 12 20	123 38 02	REMAP	South Fork Coos	13-Jul-94					
HONCHO CREEK AT RM 1.2[4]	405040	1060	Coos	17100305	43 15 59	123 53 33	REMAP	North Fork Coquille (Coos)	17-Aug-94					
MIDDLE CREEK AT RM 1.6[4]	405029	29	Coos	17100305	43 09 48	124 02 46	REMAP	North Fork Coquille (Coos)	20-Jul-94					
EAST FORK COQUILLE R. TRIBUTARY @ RM 0.8	405028	1580	Coos	17100305	43 09 39	123 48 17	REMAP	East Fork Coquille (Coos)	19-Jul-94					
Camas Cr. U/S Camas Cr. Rd (lower)	404819	640	Coos	17100305	43 08 55	123 49 27	Subecoregion	East Fork Coquille (Coos)	29-Jul-93				C	2

Table 1. Site Locations (cont.)

Site Name	Storet	Elev (ft)	County	USGS HUC	Latitude	Longitude	Project	Watershed	Date[1]				Ref Cat[2]	Ref Grp[3]
Camas Cr. @ RM 3.6 (upper)	404862	1080	Coos	17100305	43 07 08	123 48 05	Subecoregion	East Fork Coquille (Coos)	18-Aug-93				B	2
EAST FORK COQUILLE RIVER AT RM 26	405026	980	Coos	17100305	43 08 49	123 46 42	REMAP	East Fork Coquille (Coos)	14-Jul-94				B	3
FISHTRAP CREEK AT RM 1.4	405292	20	Coos	17100305	43 06 58	124 12 54	REMAP	Lower Coquille	18-Jul-95	23-Aug-95				
Butler Cr @ RM 2.1	405293	830	Curry	17100306	42 44 55	124 16 41	REMAP	Elk (Sixes)	12-Sep-95				A	3
ELK RIVER AT RM 24.0	405294	550	Curry	17100306	42 43 07	124 16 30	REMAP	Elk (Sixes)	25-Jul-95				B	3
TWOMILE CREEK AT RM 0.2	405014	200	Curry	17100310	42 36 50	124 03 59	REMAP	Lower Rogue	22-Jun-94					
LOBSTER CREEK AT RM 6.2	405295	290	Curry	17100310	42 34 31	124 15 32	REMAP	Lobster (Lower Rogue)	12-Jul-95	22-Aug-95			B	3
Shasta Costa Cr. Sth USFS Rd. #23	404824	160	Curry	17100310	42 34 15	124 02 22	Subecoregion	Lower Rogue	29-Jul-93				B	3
Quosatana Cr. U/S USFS Rd. #33	404825	80	Curry	17100310	42 29 17	124 13 53	Subecoregion	Lower Rogue	29-Jul-93				B	3
Lawsen Cr. west of USFS Rd. #400	404823	600	Curry	17100311	42 29 16	124 05 18	Subecoregion	Illinois (Lower Rogue)	28-Jul-93				A	3
Horse Sign Cr. D/S Pine Flat Cr.	404818	1400	Curry	17100311	42 27 28	124 02 58	Subecoregion	Illinois (Lower Rogue)	28-Jul-93					
Windy Cr. U/S USFS Rd. #1376	404822	2400	Curry	17100312	42 19 36	124 08 58	Subecoregion	Pistol (Chetco)	27-Jul-93					
S.F. CHETCO RIVER AT RM 2.5	405296	320	Curry	17100312	42 11 26	124 05 27	REMAP	Chetco	11-Jul-95				A	3
EMILY CREEK AT RM 7.1	405013	1200	Curry	17100312	42 06 40	124 05 38	REMAP	Chetco	21-Jun-94					
E. Fk. Winchuck Rv. U/S Wheeler Cr. Rd.	404821	1500	Curry	17100312	42 02 56	124 05 24	Subecoregion	Winchuck (Chetco)	26-Jul-93				B	3
Nth Fk Smith Rv U/S Chrome Cr.	404817	1240	Curry	18010101	42 02 40	123 58 57	Subecoregion	Smith (Chetco)	27-Jul-93				B	3

[1] Sites visited prior to 1993 not included in macroinvertebrate analysis due to incompatible subsampling procedure

[2] Sites with an entry in this category form the Macroinvertebrate Reference Site Pool used in the model BORIS. Codes reflect the following best professional judgement assessment:

- A Ideal watershed and stream condition, a wilderness area or watershed with virtually no human disturbance.
- B Good watershed and stream condition, some human disturbances but not widespread and/or best management practices are well implemented.
- C Marginal watershed and stream condition for a reference site. Considerable human disturbance but the site was the best we could find. May replace these streams if better quality reference sites are located.

[3] Three Reference Community zones are identified in the BORIS model. They are:

- 1 North Coast Reference Group
- 2 Mid Coast Reference Group
- 3 South Coast Reference Group

[4] No riffle sample collected at this site

Figure 1. Site Location

Methods

Macroinvertebrate Collections

In all cases apart from REMAP samples, macroinvertebrates were collected using the standard Level 3 DEQ assessment protocol (Hafele et. al., 1998). Samples were taken using a D-frame kick net of 500 µm mesh size. Two random kick samples were collected from each of two riffles. These samples were composited, preserved in alcohol and returned to the laboratory where a 300 count sub-sample was sorted from the debris. In the case of REMAP samples, macroinvertebrates were collected at randomly laid transects (for a complete description of REMAP protocols see Hayslip et. al., 1994). The kicks from each transect were composited and 300 count subsamples removed from the debris. Identification of macroinvertebrates was taken to best practical level, genus/species in most cases with certain groups such as the Chironomidae left at a higher taxonomic level.

Approximately 8 square feet of total stream bottom is disturbed using the standard Level 3 protocol. In the REMAP approach between 2 and 22 square feet can be disturbed. This unequal level of effort presents some problems for data analysis, a situation most critical for sites where the collection effort fell below the four kick level of the standard protocol. Preliminary analysis indicates that a minimum of three kicks (i.e. three transects), are required for a valid comparison to be made against BORIS. REMAP sites not meeting this three transect minimum are so noted below.

In almost all cases both riffle and pool habitats were sampled. This report, however, only considers the riffle data set. Pool data are available if required but for general assessment purposes only riffle data are used (in the case of REMAP this means that seven of the fifty eight sites cannot be assessed as no riffle collection was taken at that time - see Table 1).

Statistical Analysis

Ordinations

All ordinations and were generated using the software program PATN (Belbin, 1995). This included both the development of the BORIS model and correlation analysis with environmental variables. Ordinations were based upon Bray/Curtis dissimilarity measures generated from log transformed species data. Correlations were identified through the PATN module Principal Components Correlation (PCC), whereby an overlay of vectors representing each parameter is placed over a species based ordination. The direction and strength of these vectors is calculated through multiple regression of the environmental data in multidimensional species space. A different protocol for stream habitat and water quality sampling was used with each of the projects outlined above. Correlation analysis was thus confined to a common subset of available parameters. A list of these parameters is given in Appendix 1.

Benthic evaluation of **OR**egon r**I**ver**S** (BORIS)

The current version of BORIS distinguishes three broad Coast Range biological zones based upon the macroinvertebrate taxa collected at the reference sites listed above. These three zones can be thought of in terms of a North, Mid and South Coast reference community (Figure 2). As more reference site data are added to the model it is envisaged that further communities might be distinguished based upon environmental parameters such as stream size, elevation and gradient or even specific basins. For the moment these three reference zones fall out around the 44.5 & 43rd latitude.

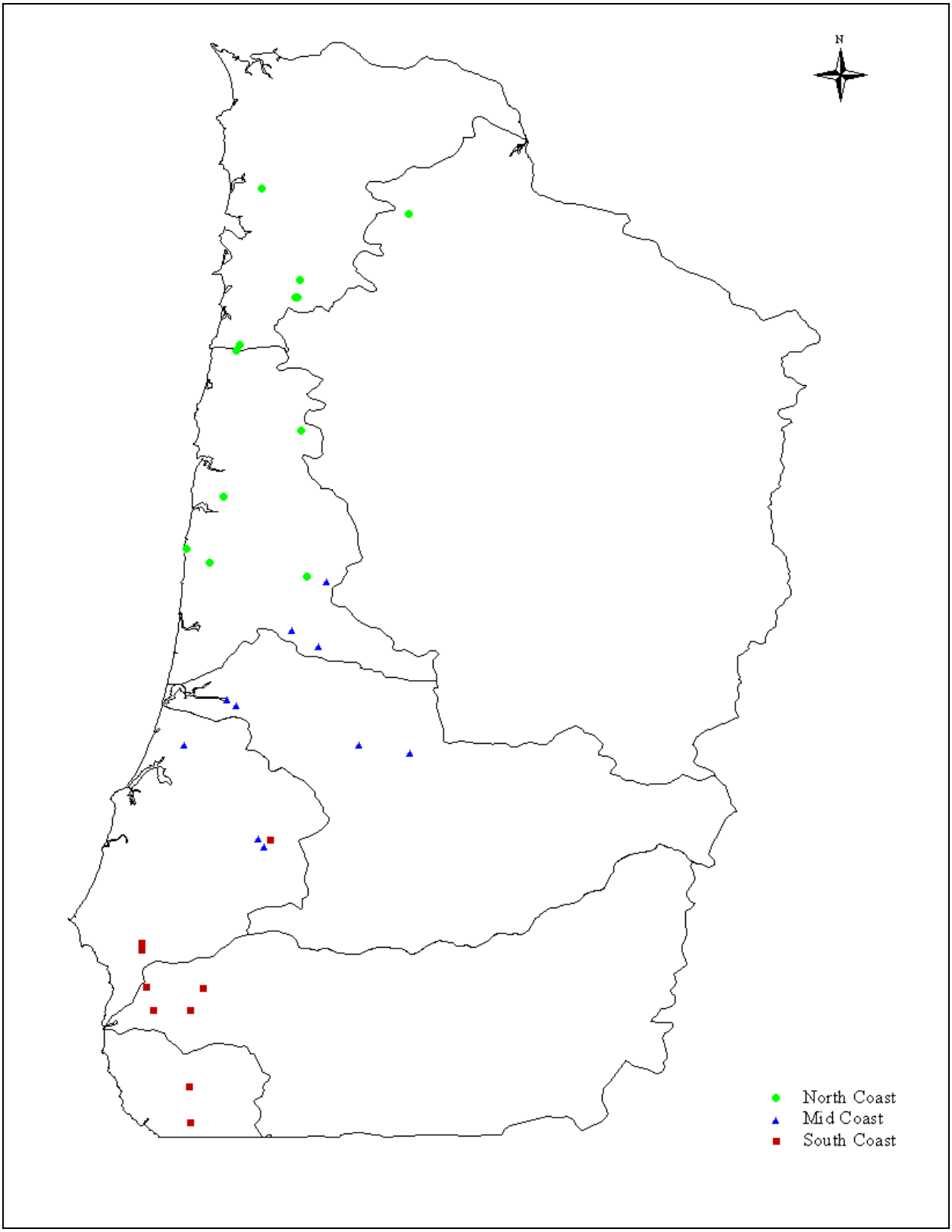


Figure 2. Oregon Coastal Reference Sites

When a site is assessed using BORIS, its taxa are compared directly against a reference condition. Computationally, all reference sites from all groups are used in the comparison, however, a series of probability based weights are used to attenuate the influence of each reference site such that the reference group to which the site would most likely belong (in the absence of impairment), dominates the assessment. In most cases a single reference group dominates the comparison while in a few cases two reference groups might be used sub-equally when the site falls transitionally between two zones. For a detailed description of the development and application of BORIS see Canale (1999).

The score a site receives is simply the ratio of taxa that was actually found to that predicted by the model. The mean score of reference sites in the model is 1.0 and this is used as a benchmark or target level, indicative of reference condition. Assessment scores typically range from 0.0 to 1.0, although it is possible for a site to score greater than 1.0. This would rate it in better biological condition than the mean of reference sites. A sample list of predicted taxa is given in Appendix 2.

Progressive deviations from 1.0 indicate progressive levels of impairment. In BORIS, a confidence limit of 95% (1.96 X standard deviation of reference site scores) is used for a determination of impairment. Further levels of impairment are assigned incrementally. Impairment categories for the current model are presented in Table 2. This approach follows Reynoldson et. al. (1997), and aims to incorporate normal variation in reference condition into decision criteria.

Table 2. Impairment Categories (BORIS)

Category	Score	
No impairment detected	>0.72	(< 1.96 X Std. dev. ref. site scores)
Moderate impairment	0.44 - 0.72	(1.96 - 3.92 X Std. dev. ref. site scores)
Severe impairment	<0.44	(> 3.92 X Std. dev. ref. site scores)

An examination of replicate samples taken from the Grande Ronde basin suggests that at a confidence interval of 95%, an error of ±0.08 should be applied to scores generated by the current version of BORIS (Canale, 1998). A similar replicate data set does not exist for the Coast Range and so the Grande Ronde work is used as a guide to overall precision of the current model.

The impairment categories shown in Table 2 represent a conservative approach to macroinvertebrate community assessment. Given the broad based approach employed for reference site selection (whereby, in certain circumstances, even sites under obvious human influence were included in the reference pool), it is more likely that a site will be incorrectly assigned as unimpaired than the reverse case.

Results & Discussion

As indicated above, BORIS is a predictive model. To score well a sample must contain a high proportion of the predicted taxa. For a site to fail to be assigned to the "No Impairment Detected" category, it must score 0.72 or less (i.e. 72% or less of the taxa predicted by the model was actually found at the site). For the most part there is a high degree of consistency in the taxa found at sites with similar scores. That is, the same type of taxa tend to be absent in areas with similar levels of disturbance. For example, it is the more sensitive Stoneflies which tend to be the taxa absent at sites showing slight impairment, followed by Caddis and Mayflies and then other taxonomic groups as conditions continue to deteriorate. An examination of the predicted taxa missing from a site can lead to an appreciation of the environmental factors causing the decline.

In the discussion which follows, sites are grouped according to "most likely" reference zone membership (as indicated above, a few sites may actually be transitional between reference zones). Furthermore, within each assessment category, certain sites are flagged to indicate that they may in fact belong to the category directly above or below given the ±0.08 precision level discussed above. For sites with no specific sampling date, only a stated year, scores represent an average of two or more visits for that year. Figure 3 presents all sites grouped according to assessment category.

North Coast Reference Zone

Sites with No Impairment Detected

Of the 57 sites located within this reference zone, 35 have been assigned to this category (Table 3). This includes 13 sites that form the North Coast Reference Group within the BORIS model.

Seven sites that meet the No Impairment Detected criteria have scores close enough to the cut off level that they could possibly be more correctly assigned to the Moderately Disturbed group. A perusal of taxa from these sites finds that the following, although commonly found at more highly scoring sites, tend to be rare or not found at all amongst these seven sites: *Drunella doddsi*, *Cinygmula*, *Ironodes*, *Capniidae*, *Zapada Oregonensis Grp.*, *Doroneuria*, *Hesperoperla*, *Rhyacophila Brunnea Grp.* and, *Rhyacophila Hyalinata Grp.* These taxa are all EPT (belonging to one of the following orders of Mayflies - **E**phemeroptera; Stoneflies - **P**lecoptera; or Caddisflies - **T**richoptera), and are indicative of streams in good condition.

Moderately Impaired Sites

Fourteen sites have been assigned to this category, (Table 4). Taxa predicted by the model but not found at these sites continue to be centered on the EPT group and include: *Diphetor hageni*, *Rhithrogena*, *Rhyacophila blarina*, *Hydropsyche* and, *Glossosoma*.

Severely Impaired Sites

Eight sites have been assigned to this category, (Table 5). These sites are so significantly impaired that even relatively tolerant taxa such as *Simulium*, *Optioservus*, *Zaitzevia* and, *Paraleptophlebia* were not collected there.

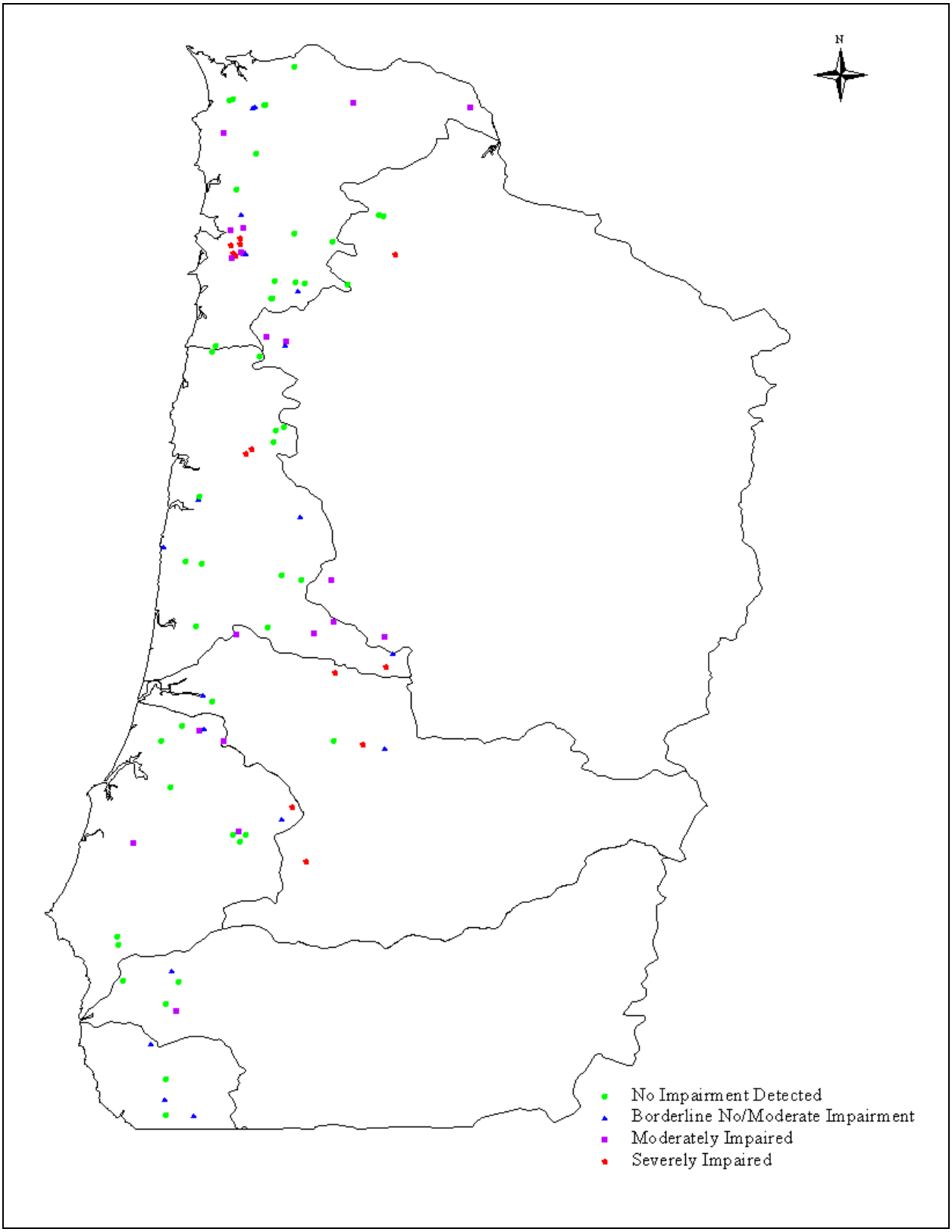


Figure 3. Stream Assessment using BORIS Model

Table 3. Sites with No Impairment Detected - North Coast Reference Zone

Site Name	Storet	Elev (ft)	Project	Watershed	Year	Score
Fox Creek @ RM 0.6 (upper site)	405624	600	Subecoregion	Youngs (Lower Columbia)	25-Aug-94	0.94
Fox Creek - Lower	405065	525	Subecoregion	Youngs (Lower Columbia)	25-Aug-94	0.91
Shweeash Creek	405062	600	Subecoregion	Lewis & Clark(Lower Columbia)	24-Aug-94	0.85
BIG CREEK AT RM 2.9	405098	100	REMAP	Lower Columbia	8-Sep-94	0.82
Louit Creek - Lower	405060	600	Subecoregion	Lewis & Clark(Lower Columbia)	23-Aug-94	0.82
Rock Creek - Upper[1]	405063	800	Subecoregion	Youngs(Lower Columbia)	24-Aug-94	0.79
LOOWIT CREEK - UPPER[1]	405061	600	Subecoregion	Lewis & Clark(Lower Columbia)	25-Aug-94	0.77
Rock Creek - Lower[1]	405064	720	Subecoregion	Youngs (Lower Columbia)	24-Aug-94	0.76
Roaring Cr. 300 ft U/S City water intake[2]	404950	480	Subecoregion	Tualatin	24-Oct-94	1.09
Clear Cr. U/S Thomas Cr.[2]	404531	360	Subecoregion	Tualatin	30-Aug-93	0.88
E. Foley Cr. @ RM 2.5[2]	404533	321	Subecoregion	Nehalem	31-Aug-94	0.88
N.F. NEHALEM RIVER AT RM 13.1	405276	310	REMAP	Nehalem	20-Sep-95	0.82
FALL CREEK AT RM 0.7	405021	400	REMAP	Wilson	6-Jul-94	0.85
M.F./N.F. TRASK RIVER AT RM 3.0	405278	1120	REMAP	Trask	26-Sep-95	0.88
Neskowin Cr. U/S Hwy 12[2]	404535	79	Subecoregion	Neskowin(Nestucca)	1-Sep-94	1.15
Powder Cr. @ RM 1.45 (upper)[2]	404455	600	Subecoregion	Nestucca	26-Oct-93	1.06
Bear Cr. @ RM 1.8 (upper)	404450	1200	Subecoregion	Nestucca	27-Oct-93	1.03
Powder Cr. @ RM 0.95 (lower)[2]	404456	561	Subecoregion	Nestucca	26-Oct-93	1.00
East Cr. U/S @ East Cr. Rd.[2]	404537	472	Subecoregion	Nestucca	31-Aug-94	0.97
JOES CREEK AT RM 0.5	405279	1320	REMAP	Nestucca	27-Sep-95	0.88
Bear Cr. @ RM 0.15 (lower)[1]	404451	800	Subecoregion	Nestucca	27-Oct-93	0.79
UNAMED TRIB ENTERING PANTHER CREEK AT RM 14	405272	1260	REMAP	Yamhill (North Fork)	28-Sep-95	1.03
Rock Cr. @ RM 1.4[1]	405023	350	REMAP	Yamhill (South Fork)	1994	0.80
Steer Creek - Lower	405057	400	Subecoregion	Siletz	18-Aug-94	1.15
Deer Cr. U/S experimental forest HQ[2]	404536	358	Subecoregion	Salmon(Siletz)	1-Sep-94	1.09
Steer Creek - Upper	405056	720	Subecoregion	Siletz	17-Aug-94	1.03
SALMON RIVER AT RM 21.0	405280	1500	REMAP	Salmon(Siletz)	1995	0.96
Brush Creek	405059	440	Subecoregion	Siletz	19-Aug-94	0.94
Yaquina R. @ Harmsen Rd[2]	405058	751	Subecoregion	Yaquina	18-Aug-94	1.25
CULLEN CREEK AT RM 0.3	405042	1040	REMAP	Tenmile(Alsea)	25-Aug-94	1.06
TENMILE CREEK AT USFS TENMILE CREEK CAMPGROUND[2]	405283	310	REMAP	Tenmile(Alsea)	1995	0.98
TROUT CREEK AT RM 0.2[2]	405281	70	REMAP	Alsea	8-Aug-95	0.88
Cummins Cr. D/S trailhead[1,2]	404541	30	Subecoregion	Cummins(Alsea)	16-Aug-93	0.76
DRIFT CREEK AT RM 7.3[1]	405282	20	REMAP	Alsea	9-Aug-95	0.73
Greenleaf Cr. @ RM 4.0[2]	404544	899	Subecoregion	Siuslaw	17-Aug-93	1.03

[1]Possibly a Moderately Impaired Site.
[2]Reference Site.

Table 4. Moderately Impaired Sites - North Coast Reference Zone

Site Name	Storet	Elev (ft)	Project	Watershed	Date	Score
DART CREEK AT RM 3.7	405027	360	REMAP	Lower Willamette	1994/95	0.64
S.F. GOBLE CREEK AT RM 0.9[1,2]	405270	250	REMAP	Lower Columbia	1995	0.56
FISHHAWK CREEK AT RM 1.7[1,2]	405073	505	REMAP	Nehalem	7-Sep-94	0.48
Kilchis Rv. @ RM 8.5[3]	405022	140	REMAP	Kilchis	7-Jul-94	0.70
CLEAR CREEK AT SECOND BRIDGE	405587	110	Tillamook	Kilchis	19-Jun-97	0.63
MURPHY CREEK AT CURL ROAD (D/S LANDOLT FARM) [1]	412250	35	Tillamook	Kilchis	19-Jun-97	0.48
BEAVER CREEK 1/4 MILE UP WESTWOOD DRIVE	405578	100	Tillamook	Wilson	25-Jun-97	0.63
MILL CREEK AT BRICKYARD ROAD[3]	412224	75	Tillamook	Trask	18-Jun-97	0.70
MILL CREEK NEAR ALCOVE (JUST D/S ELK CR.) [1]	405583	60	Tillamook	Trask	17-Jun-97	0.48
Mill Cr. @ RM 1.0[1,2]	405096	20	REMAP	Trask	19-Sep-94	0.48
BEWLEY CREEK AT RM 0.3[1,2]	412212	10	REMAP	Tillamook	20-Sep-94	0.45
AGENCY CREEK AT RM 0.2	405041	340	REMAP	Yamhill (South Fork)	22-Aug-94	0.60
CEDAR CREEK AT RM 0.6	405273	470	REMAP	Yamhill (South Fork)	1995	0.59
HONEY GROVE CREEK AT RM 1.2[3]	405093	500	REMAP	Alsea	12-Sep-94	0.68

[1]Site did not meet 3 transect minimum. Use score cautiously.
[2]Possibly a Severely Impaired Site.
[3]Disturbance possibly falls within acceptable reference range.

Table 5. Severely Impaired Sites - North Coast Reference Zone

Site Name	Storet	Elev (ft)	Project	Watershed	Date	Score
WILLIAMS CANYON CREEK AT RM 1.8[1]	405274	270	REMAP	Tualatin	19-Sep-95	0.24
BEAVER CREEK AT BARKER DAIRY (D/S CULVERTS)	405584	20	Tillamook	Wilson	19-Jun-97	0.27
HOLDEN CREEK AT MCCORMACK LOOP ROAD	412194	35	Tillamook	Trask	18-Jun-97	0.21
HOLDEN CREEK AT MILLER STREET	412196	15	Tillamook	Trask	18-Jun-97	0.09
DRAINAGE DITCH AT SO. PRAIRIE SCHOOL-PORT OF TB	405582	35	Tillamook	Tillamook	17-Jun-97	0.12
ANDERSON CREEK @ HWY. 101	405648	15	Tillamook	Tillamook	17-Jun-97	0.03
YAQUINA RIVER AT EDDYVILLE RM 32.0[1]	405044	60	REMAP	Yaquina	30-Aug-94	0.30
YAQUINA RIVER U/S OF EDDYVILLE RM 34.1[1]	405072	90	REMAP	Yaquina	31-Aug-94	0.06

[1] Site did not meet 3 transect minimum. Use score cautiously.

Mid Coast Reference Zone

Sites with No Impairment Detected

Of the 31 sites located within this reference zone, 15 have been assigned to this category (Table 6). This includes 11 sites that form the Mid Coast Reference Group within the BORIS model.

In a similar situation to that described in the North Coast zone, four sites meet the No Impairment Detected criteria but their scores are close enough to the cut off level that they could possibly be more correctly assigned to the Moderately Disturbed group. Taxa that tend to be absent from these four sites are all part of the important EPT orders and include: *Cinygmula*, *Ironodes*, *Epeorus albertae, Zapada Oregonensis Grp., Hesperoperla, Sweltsa, Malenka, Glossosoma* and, *Neophylax Rickeri.*

Moderately Impaired Sites

Ten sites have been assigned to this category, (Table 7). Taxa predicted by the model but not found at these sites continue to be centered on the EPT group and include: *Nixe/Leucocruta Rhithrogena*, *Rhyacophila blarina*, *Rhyacophila Betteni Grp., Rhyacophila Brunea Grp., Hydropsyche* and, *Wormaldia.* Non-EPT predicted taxa not found at these sites include *Simulium* and *Zaitzevia*.

Severely Impaired Sites

Six sites have been assigned to this category, (Table 8). These sites continue the trend of losing key EPT taxa that were found even at moderately impaired sites, such as *Diphetor hageni, Sweltsa, Zapada cinctipes* and *Calineuria*. Furthermore, tolerant taxa such as *Sialis* and *Sphaeriidae* begin to dominate.

Table 6. Sites with No Impairment Detected - Mid Coast Reference Zone

Site Name	Storet	Elev (ft)	Project	Watershed	Date	Score
Haskins Cr. @ RM 0.1[1]	404865	580	Subecoregion	Siuslaw	19-Aug-93	1.26
Fish Cr. @ RM 2.5[1]	404543	850	Subecoregion	Siuslaw	18-Aug-93	1.14
Whittaker Cr. U/S Whittaker Cr. Rd.[1]	404820	1575	Subecoregion	Siuslaw	30-Jul-93	1.11
UNAMED TRIB ENTERING BERNHARDT CREEK AT RM 3.0	405284	180	REMAP	Siuslaw	16-Aug-95	0.98
Hawley Cr. Two miles up Hawley Cr. Rd.[1,2]	404866	770	Subecoregion	Siuslaw	20-Aug-93	0.78
Yellow Cr. @ RM 3.9[1]	404864	550	Subecoregion	Lower Umpqua	19-Aug-93	1.11
Franklin Cr. @ RM 1.0[1]	404860	40	Subecoregion	Lower Umpqua	16-Aug-93	0.95
Harvey Cr. @ RM 0.5[1,2]	404861	35	Subecoregion	Lower Umpqua	17-Aug-93	0.78
Bachelor Cr. @ RM 2.6[1,2]	404863	520	Subecoregion	Calapooya (Lower Umpqua)	19-Aug-93	0.78
Camas Cr. U/S Camas Cr. Rd (lower)[1]	404819	640	Subecoregion	East Fork Coquille (Coos)	29-Jul-93	1.11
Camas Cr. @ RM 3.6 (upper)[1]	404862	1080	Subecoregion	East Fork Coquille (Coos)	18-Aug-93	1.10
Palouse Cr. U/S of old beaver dam (RM 6.7)[1]	404826	80	Subecoregion	Coos Bay	30-Jul-93	0.95
MORGAN CREEK AT RM 1.5	405291	60	REMAP	South Fork Coos	2-Aug-95	0.95
BENSON CREEK AT RM 5.0	405290	180	REMAP	Tenmile Lake (Coos)	15-Aug-95	0.85
ELK CREEK AT RM 3.0[2]	405032	1120	REMAP	West Fork Millicoma (Coos)	1994/95	0.75

[1] Reference Site.
[2] Possibly a Moderately Impaired Site.

Table 7. Moderately Impaired Sites - Mid Coast Reference Zone

Site Name	Storet	Elev (ft)	Project	Watershed	Date	Score
UNAMED TRIB ENTERING WOLF CREEK AT RM 13.5	405286	640	REMAP	Siuslaw	17-Aug-95	0.54
EAMES CREEK AT RM 4.8[1]	405285	1040	REMAP	Siuslaw	10-Aug-95	0.47
LONG TOM RIVER AT RM 48.5	405271	510	REMAP	Long Tom(Upper Willamette)	14-Sep-95	0.64
FOX HOLLOW CREEK AT RM 1.3[1]	405033	540	REMAP	Long Tom(Upper Willamette)	2-Aug-94	0.47
UNNAMED TRIB OF WEST FORK LAKE CREEK AT RM 1.0[1]	405037	440	REMAP	Lower Umpqua	9-Aug-94	0.51
N.F. SMITH RIVER AT RM 23.0-1500' U/S NF FALLS[1]	405288	980	REMAP	Smith (Lower Umpqua)	24-Aug-95	0.47
WILLIAMS RIVER AT RM 19.2[2]	405025	1400	REMAP	South Fork Coos	13-Jul-94	0.71
EAST FORK COQUILLE R. TRIBUTARY @ RM 0.8[2]	405028	1580	REMAP	East Fork Coquille (Coos)	19-Jul-94	0.64
WEST FORK MILICOMA R ST RM 22.5	405031	680	REMAP	West Fork Millicoma (Coos)	27-Jul-94	0.58
FISHTRAP CREEK AT RM 1.4	405292	20	REMAP	Lower Coquille	1995	0.58

[1] Possibly a Severely Impaired Site.
[2] Disturbance possibly falls within acceptable reference range.

Table 8. Severely Impaired Sites - Mid Coast Reference Zone

Site Name	Storet	Elev (ft)	Project	Watershed	Date	Score
SOUTH FORK SIUSLAW RIVER AT RM 2.3	405034	680	REMAP	Siuslaw	3-Aug-94	0.37
CABIN CREEK AT RM 5.6	405289	570	REMAP	Calapooya (Lower Umpqua)	27-Jul-95	0.37
SMITH RIVER AT RM 81.3	405038	760	REMAP	Smith (Lower Umpqua)	10-Aug-94	0.34
OLALLA CREEK AT RM 11.6[1]	405287	750	REMAP	South Umpqua	1995	0.41
BEALS CREEK AT RM. 0.6[1]	405024	820	REMAP	South Umpqua	12-Jul-94	0.41
PANTHER CREEK AT RM 4.6	405030	2040	REMAP	South Fork Coos	21-Jul-94	0.24

[1] Possibly a Moderately Impaired Site.

South Coast Reference Zone

At the present time there are too few sites to make meaningful interpretation of South Coast sites possible. Of the fourteen sites in this reference zone, twelve have been assigned to the No Impairment Detected category and of these, ten are reference sites (Table 9). The remaining two sites are classed as moderately impaired (Table 10).

Table 9. Sites with No Impairment Detected - South Coast Reference Zone

Site Name	Storet	Elev (ft)	Project	Watershed	Date	Score
EAST FORK COQUILLE RIVER AT RM 26[1]	405026	980	REMAP	East Fork Coquille (Coos)	14-Jul-94	0.92
Butler Cr @ RM 2.1[1]	405293	830	REMAP	Elk (Sixes)	12-Sep-95	0.99
ELK RIVER AT RM 24.0[1]	405294	550	REMAP	Elk (Sixes)	25-Jul-95	1.07
Shasta Costa Cr. Sth USFS Rd. #23[1]	404824	160	Subecoregion	Lower Rogue	29-Jul-93	1.01
Lawsen Cr. west of USFS Rd. #400[1]	404823	600	Subecoregion	Illinois (Lower Rogue)	28-Jul-93	0.99
LOBSTER CREEK AT RM 6.2[1]	405295	290	REMAP	Lobster (Lower Rogue)	1995	0.96
Quosatana Cr. U/S USFS Rd. #33[1,2]	404825	80	Subecoregion	Lower Rogue	29-Jul-93	0.80
E. Fk. Winchuck Rv. U/S Wheeler Cr. Rd.[1]	404821	1500	Subecoregion	Winchuck (Chetco)	26-Jul-93	1.22
S.F. CHETCO RIVER AT RM 2.5[1]	405296	320	REMAP	Chetco	11-Jul-95	1.04
Windy Cr. U/S USFS Rd. #1376[2]	404822	2400	Subecoregion	Pistol (Chetco)	27-Jul-93	0.77
EMILY CREEK AT RM 7.1[2]	405013	1200	REMAP	Chetco	21-Jun-94	0.76
Nth Fk Smith Rv U/S Chrome Cr.[1,2]	404817	1240	Subecoregion	Smith (Chetco)	27-Jul-93	0.76

[1] Reference Site.
[2] Possibly a Moderately Impaired Site.

Table 10. Moderately Impaired Sites - South Coast Reference Zone

Site Name	Storet	Elev (ft)	Project	Watershed	Date	Score
TWOMILE CREEK AT RM 0.2[1]	405014	200	REMAP	Lower Rogue	22-Jun-94	0.72
Horse Sign Cr. D/S Pine Flat Cr.	404818	1400	Subecoregion	Illinois (Lower Rogue)	28-Jul-93	0.46

[1]Disturbance possibly falls within acceptable reference range.

Other Biologic Measures of Impairment

In the absence of a full assessment against the BORIS model, other useful measures of macroinvertebrate community status include various taxa richness and relative abundance metrics. While not a comprehensive assessment of stream biologic condition, these measures are easily calculated from taxonomic lists and give an immediate feel for the site. Three measures in particular, Total and EPT Taxa Richness and % Dominant Abundance (top three taxa), can be usefully applied to a taxonomic list for a quick appraisal of a site and for raising warning flags about its macroinvertebrate community status.

As indicated above, the South Coast Reference Zone does not have sufficient data points to make a meaningful interpretation possible. For this reason the following discussion is limited to the North and Mid Coast data sets. Also note that any discussion of taxa richness requires close agreement between sites in terms of their respective levels of taxonomic identification. The data sets discussed here have all had their taxa lists standardised to make such a comparison valid.

Figures 3 and 4 present BORIS scores plotted against values of the two richness measures for the North Coast data set. From these plots it seems that a richness of less than 30 and 18 for Total Taxa and EPT Taxa respectively, represent a critical level below which impairment can be confidently assigned. There seems to be considerably more noise associated with the % Dominant measure (Figure 5), but certainly values above 65% can be confidently assigned as being indicative of impairment.

Figures 6 through 8 present Total Taxa and EPT Taxa richness, and % Dominant information for the Mid Coast. Critical levels for these three measures also seem to be around 30, 18 and 70% respectively.

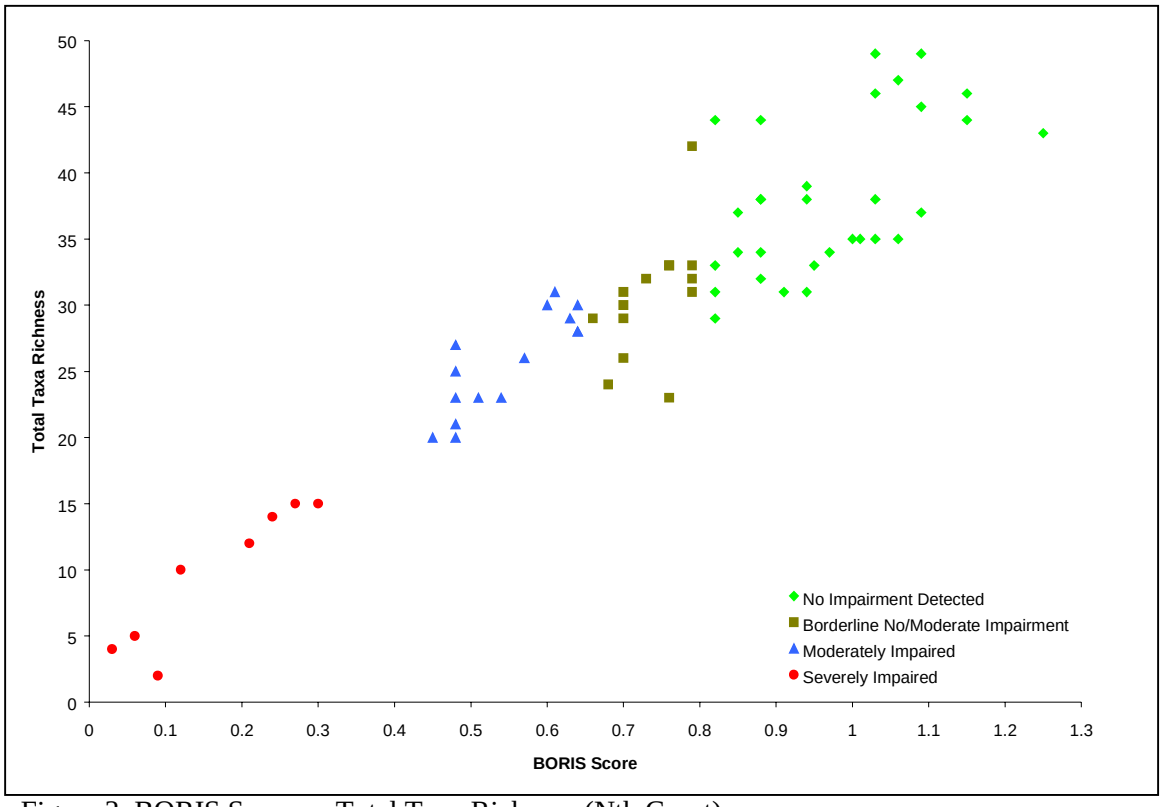


Figure 3. BORIS Score vs Total Taxa Richness (Nth Coast)

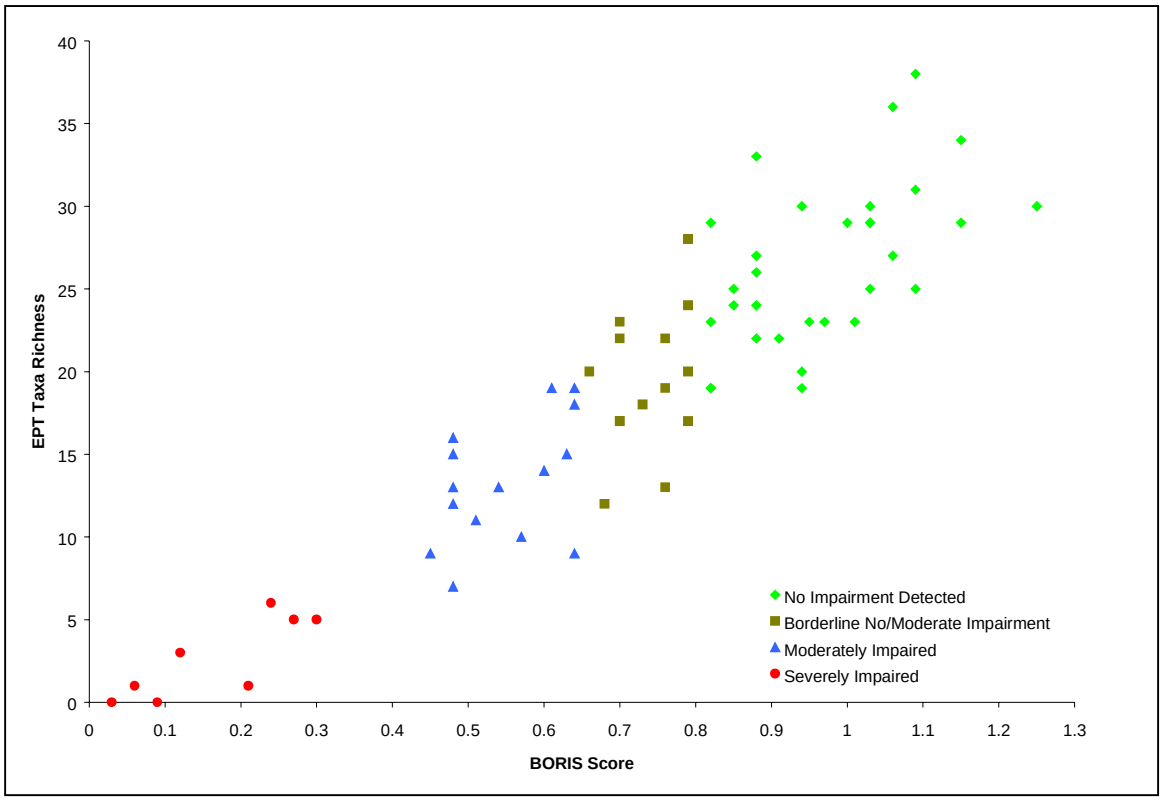


Figure 4. BORIS Score vs EPT Taxa Richness (Nth Coast)

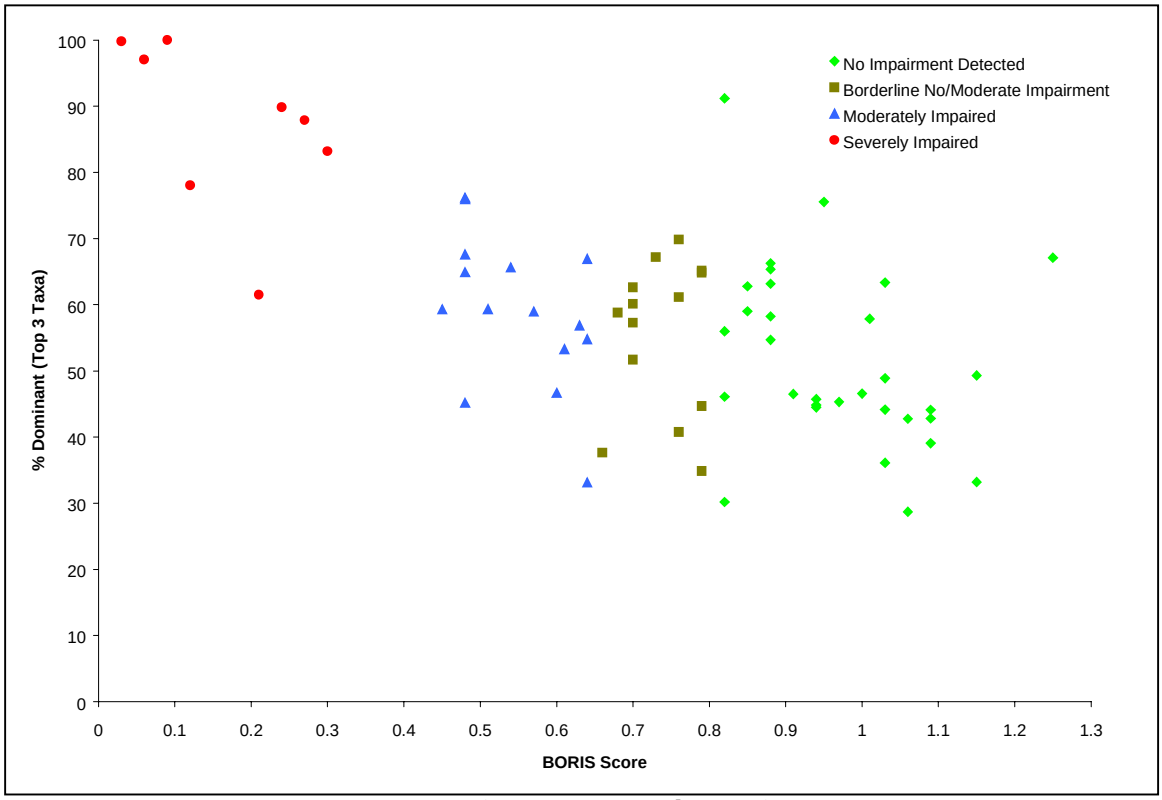


Figure 5. BORIS Score vs %Dominant (Top 3 Taxa - Nth Coast)

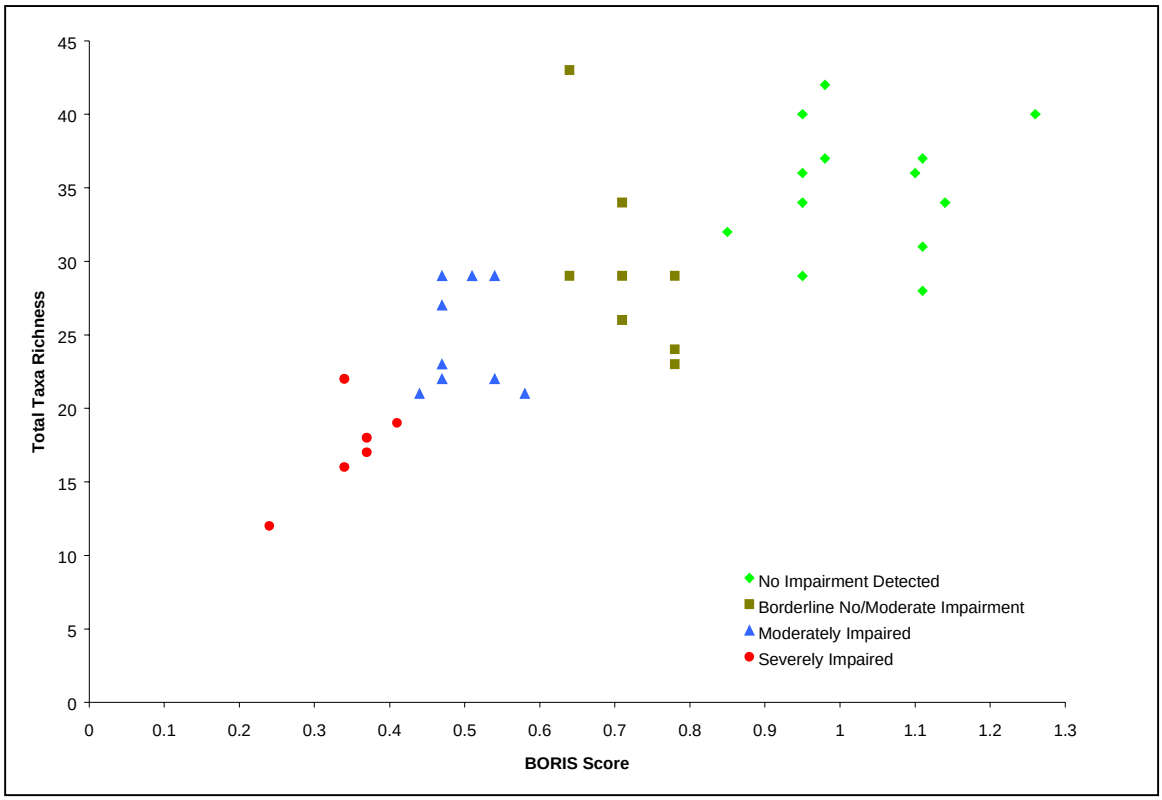


Figure 6. BORIS Score vs Total Taxa Richness (Mid Coast)

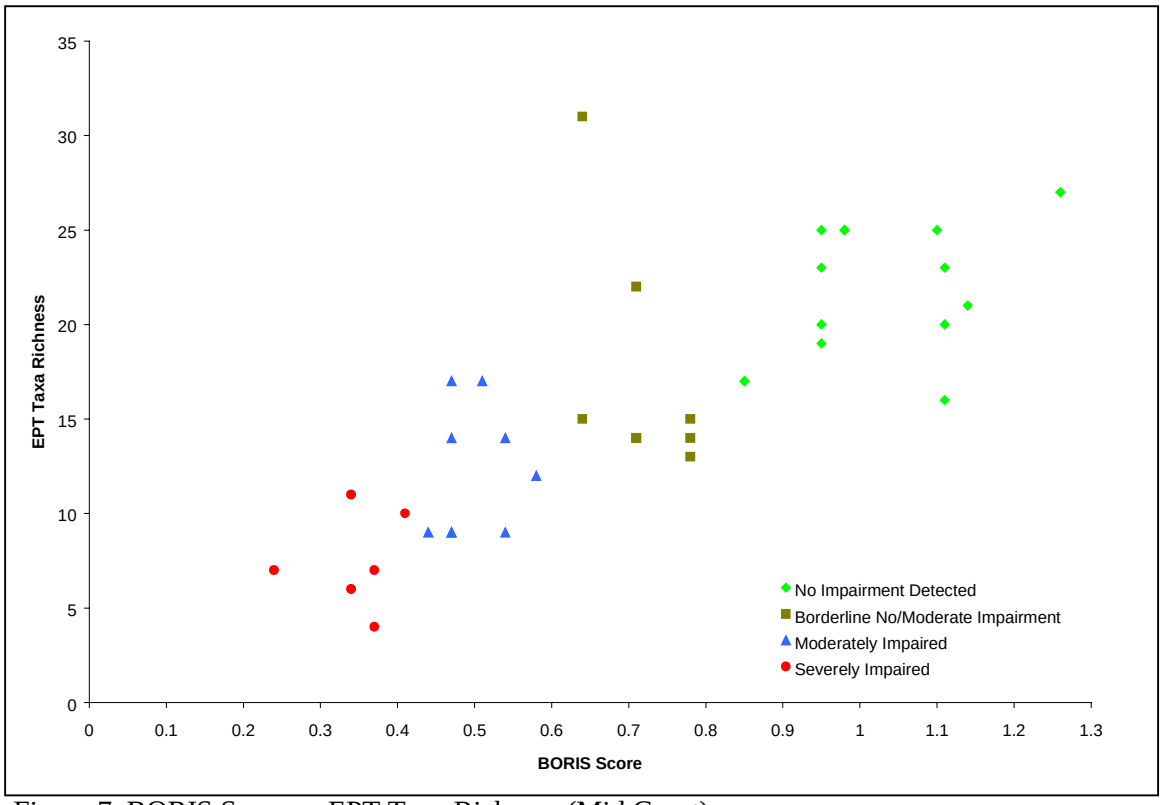


Figure 7. BORIS Score vs EPT Taxa Richness (Mid Coast)

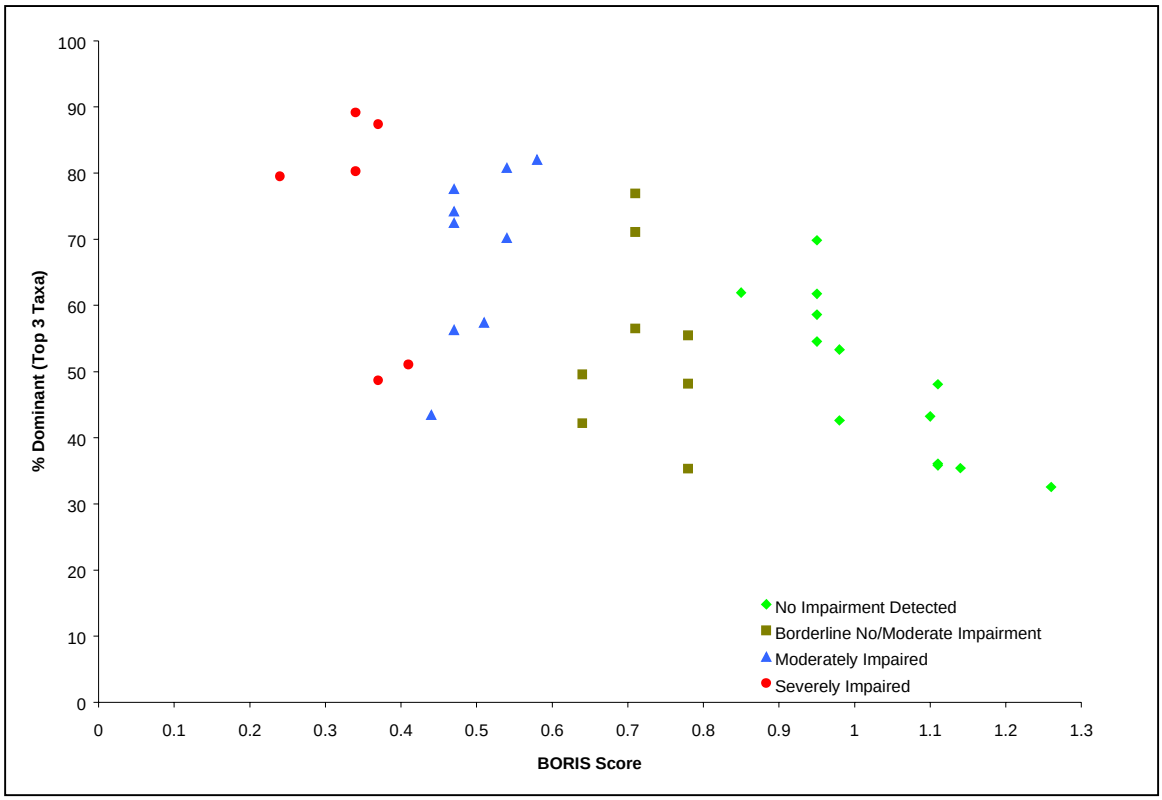


Figure 8. BORIS Score vs %Dominant (Top 3 Taxa - Mid Coast)

Correlation between Biologic Assessment and Environmental Parameters

Correlations within the North Coast data set reveal positive relationships between stream biologic condition and levels of Dissolved Oxygen (DO) and presence of Coarse Substrates (Figure 9). Both of these were identified as being important parameters in an analysis using the complete suite of REMAP habitat variables (Drake, 1998). In this report a reduced set of habitat measures were used because sampling protocols differed across projects. Poorly scoring sites display elevated levels of nutrients (Orthophosphate and TKN), Total Organic Carbon, Chemical Oxygen Demand and Temperature. All of these parameters received a correlation coefficient (r^2), in the range 0.5 to 0.7. A complete list of coefficient values is given in Appendix 1.

Interestingly, stream size has also correlated well with the species based ordination. The two vectors Wetted Width and Watershed Area run perpendicular to the human influenced environmental gradient outlined above. Larger streams at low elevation and low gradient of both reference quality (Cummins Cr. el. 30ft., slope 1.0; Trout Cr. el. 70 ft., slope 1.7; Tenmile Cr. el. 310 ft., slope 1.2) and a few identified as being moderately disturbed are located along this axis. It is therefore likely that an important stream size stratification component is lacking in the reference model. For the moment, not enough reference sites exist to be able to further divide the reference sites along this gradient.

Correlations were not as strong within the Mid Coast data set (Figure 10 and Appendix 1). The fewer number of sites within this group may be responsible for this to some extent. Turbidity was the only parameter that displayed a strong negative correlation with biologic condition. Most of the streams in this data set are located within the sedimentary sub-ecoregion.

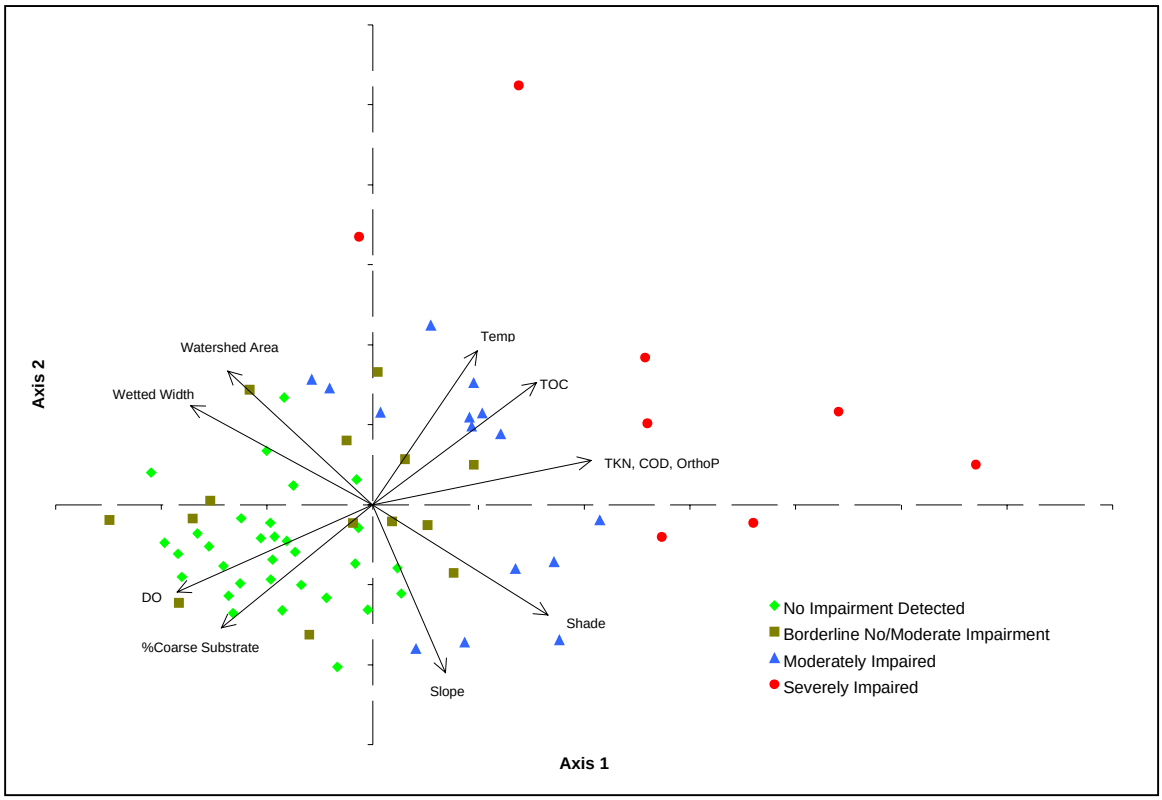


Figure 9. Correlation between Sites and Environmental Variables (North Coast)

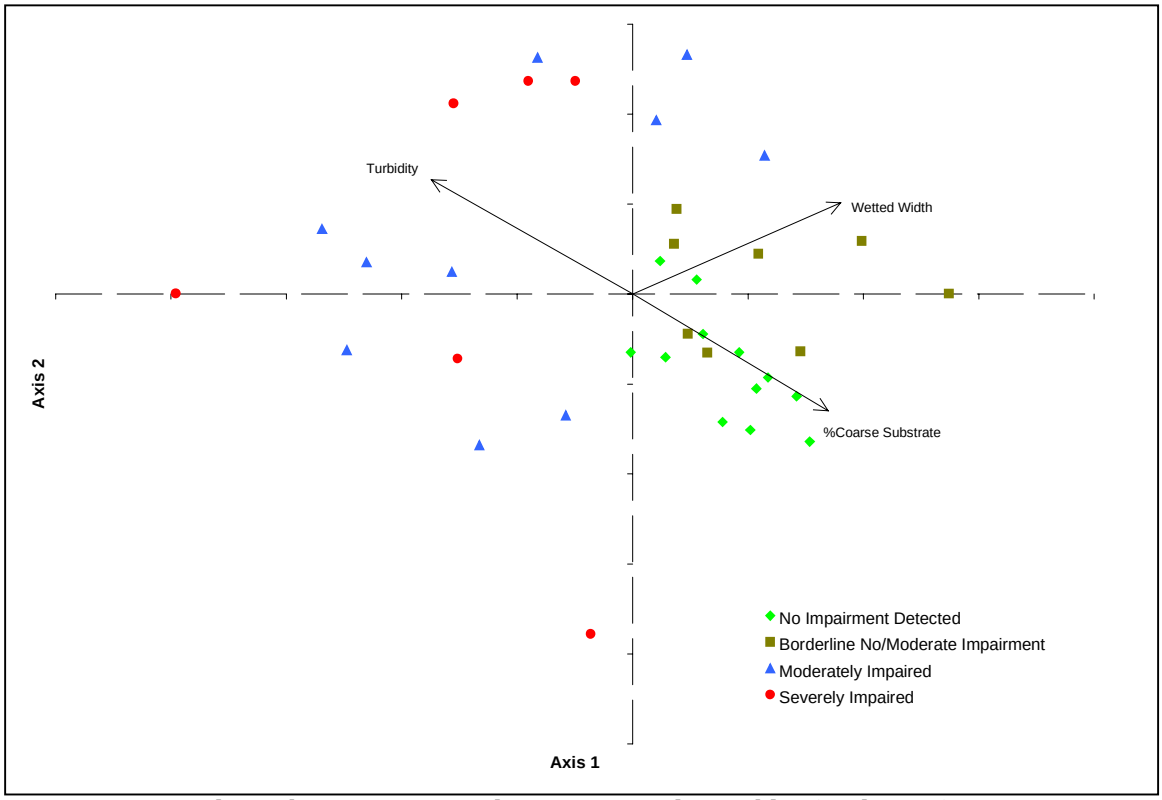


Figure 10. Correlation between Sites and Environmental Variables (Mid Coast)

Overall Status of Streams in the Oregon Coast Range

By applying the weighted probabilities of the random site selection process used in the REMAP project (see Hayslip et. al. 1994), an overall assessment of condition across all stream miles of 1st through 3rd order streams within the Oregon Coast Range can be extracted from this data set. Figure 11 presents the percentage of stream miles that fall under each impairment category. Fourty three percent of stream miles in the Oregon Coast Range display a macroinvertebrate community that is within the range of reference condition variability. A further 8% are borderline between the unimpaired and moderately impaired categories. That is, although some level of impairment is apparent, their condition is sufficiently close to the reference range to make a precise designation of impairment a difficult prospect. Of the remaining 49% of stream miles, 34% are moderately impaired and 15% severely impaired.

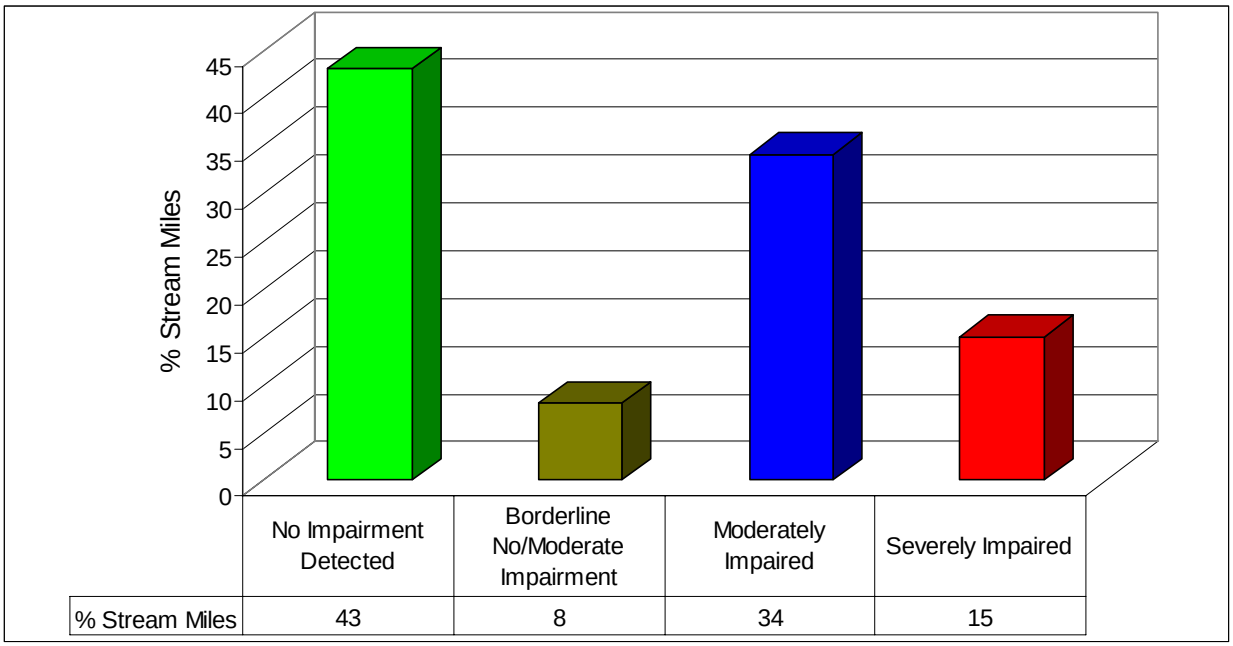


Figure 11. Percentage of Stream Miles in the Oregon Coast Range within each Impairment Category (1st through 3rd order streams only).

References

Belbin, L. 1995. PATN - Pattern Analysis Package. CSIRO Division of Wildlife & Ecology. Canberra, Australia.

Canale, G. 1998. Analysis of Macroinvertebrate Data from the Long Term 319 Grande Ronde NPS Project 1993 - 1996. Oregon DEQ Laboratory. BIO98-003

Canale, G. 1999. BORIS - Benthic evaluation of ORegon rIverS. Draft report - Oregon DEQ Laboratory. BIO99-008.

Drake, D. 1998. Oregon Coast Range REMAP Study - Stream Habitat Index Development and Site Results. Oregon DEQ Laboratory. BIO98-006.

Hafele, R. & M. Mulvey. 1998. Stream Macroinvertebrate Protocol. Oregon Plan for Salmon and Watersheds. Draft report - Oregon DEQ.

Hayslip, G., D.J. Klemm & J.M. Lazorchak. 1994 Pilot Field Operations and Methods Manual for Streams on the Coast Range Ecoregion of Oregon and Washington and the Yakima River Basin. Environmental Monitoring Systems Laboratory. U.S.E.P.A.

Moss, D., M. T. Furse, J. F. Wright, and P. D. Armitage. 1987. The prediction of the macro-invertebrate fauna of unpolluted running-water sites in Great Britain using environmental data. Freshwater Biology, 17: 41-52.

Reynoldson, T.B., R.H. Norris, V.H. Resh, E. Day & D.M. Rosenberg. 1997. The reference condition: a comparison of multimetric and multivariate approaches to assess water-quality impairment using benthic macroinvertebrates. Journal of the North American Benthological Society, 16(4): 833-852.

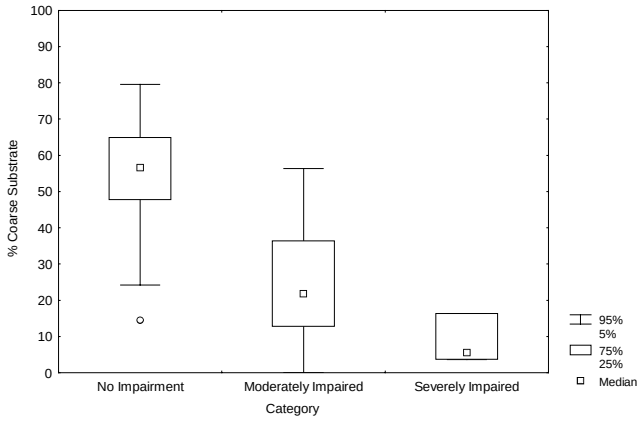
Wright, J. F., D. Moss, P. D. Armitage, and M. T. Furse. 1984. A preliminary classification of running-water sites in Great Britain based on macro-invertebrate species and the prediction of community type using environmental data. Freshwater Biology, 14: 221-256.

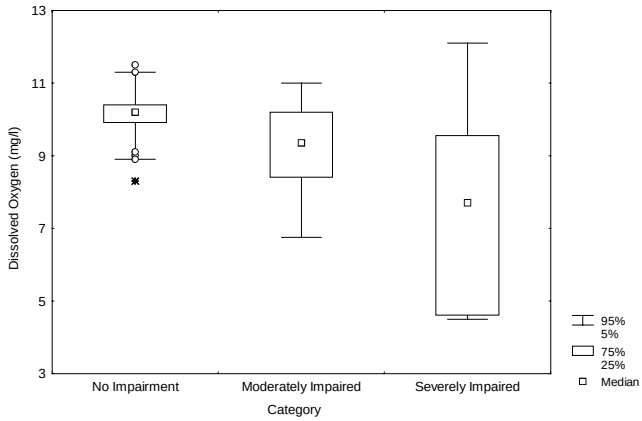
APPENDIX 1 - Parameters Used for Correlation Analysis

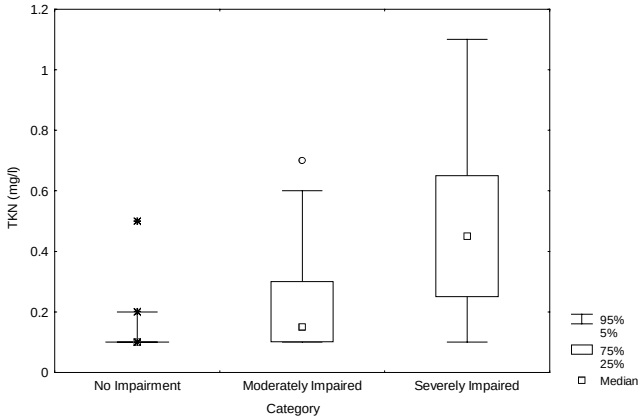
Parameter	r^2 North Coast	Mid Coast
%Coarse Substrate	0.7007	0.6352
Alkalinity	0.3528	0.2984
Watershed Area (Hectares)	0.692	0.4102
Biochemical Oxygen Demand (BOD)	0.0326	0.1241
Conductivity	0.3815	0.3608
Chemical Oxygen Demand (COD)	0.5265	0.1707
Latitude	0.3079	0.0564
Longitude	0.2511	0.2619
Discharge (ft^3/sec)	0.524	0.3495
Dissolved Oxygen (DO)	0.6337	0.4208
% Saturation-Dissolved Oxygen	0.5789	0.4174
Elevation (ft)	0.4678	0.3178
Slope	0.5689	0.4361
NH3+NH4	0.4847	0.1007
NO2 + NO3	0.381	0.2655
%Shade	0.6052	0.4121
pH	0.1288	0.429
Orthophosphate	0.626	0.1202
Total Phosphorus	0.4477	0.4077
Total Residue	0.4079	0.3285
Suspended Solids	0.491	0.3651
Temperature	0.5437	0.3133
Total Kjeldahl Nitrogen (TKN)	0.6617	0.2297
Total Organic Carbon (TOC)	0.5565	0.1651
Turbidity	0.344	0.5055
Wetted Width	0.701	0.5308

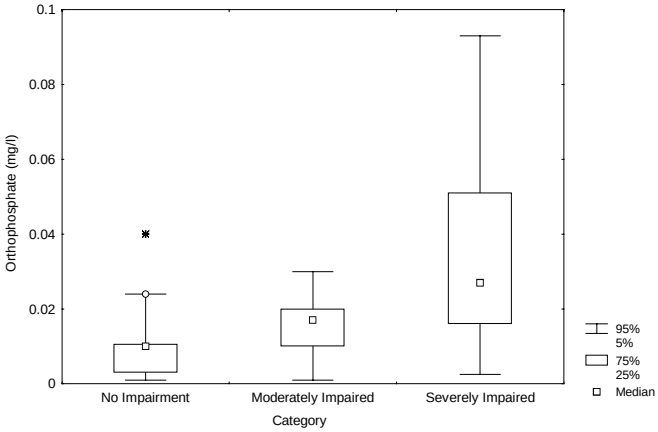
Box plots for parameters with $r^2 > 0.5$ are shown over page.

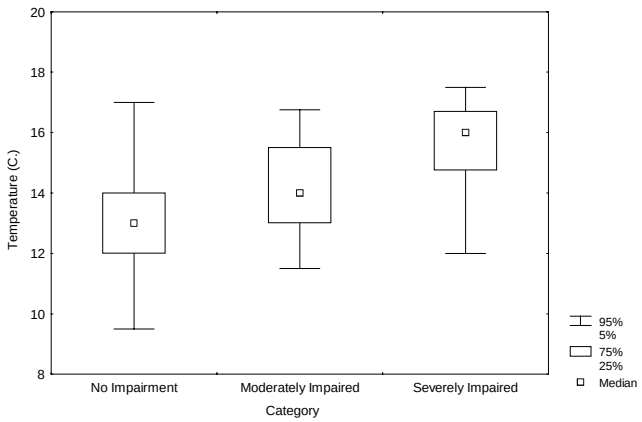
North Coast Sites

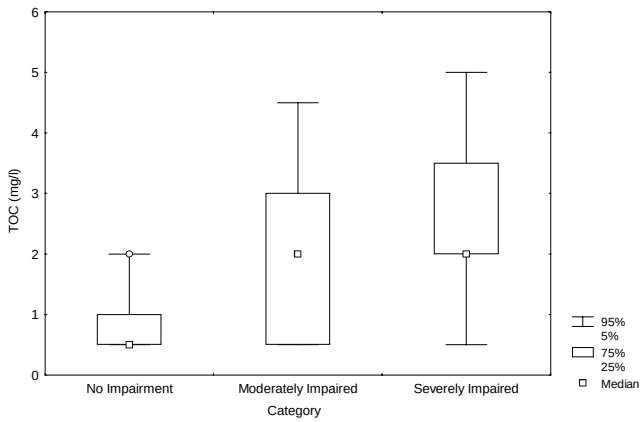


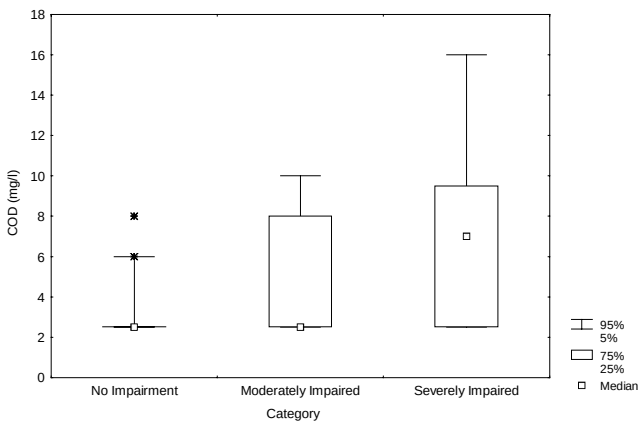




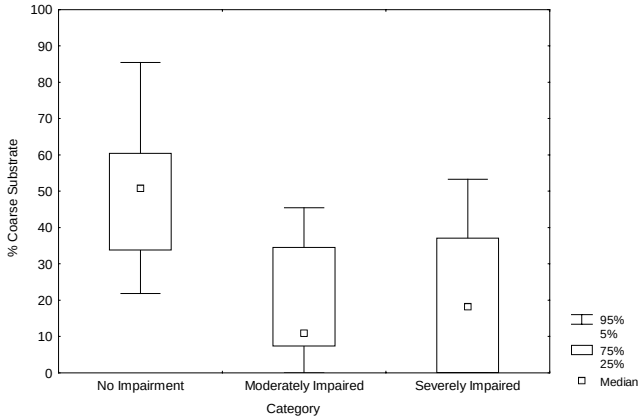


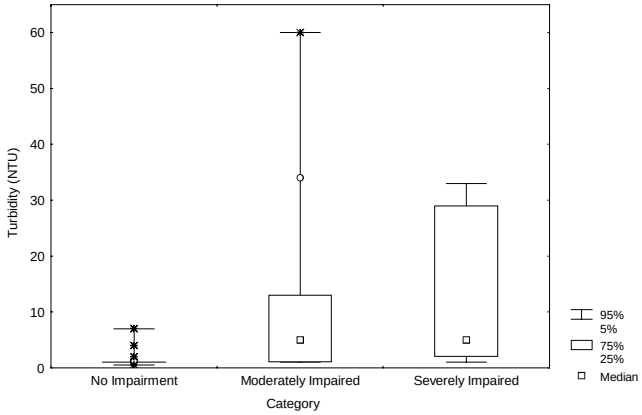






Mid Coast Sites





APPENDIX 2 - Sample list of Predicted Taxa output from BORIS model

	Site Code	Taxon_Code_B	SCIENTIFIC_NAME	TaxaProb
1	BrushC94	CHI010	Chironominae	0.92
2	BrushC94	CHI020	Diamesinae	0.30
3	BrushC94	CHI030	Orthocladiinae	1.00
4	BrushC94	CHI060	Tanypodinae	0.47
5	BrushC94	COL225	Heterlimnius	0.83
6	BrushC94	COL240	Narpus	0.46
7	BrushC94	COL250	Optioservus	0.32
8	BrushC94	COL290	Zaitzevia	0.70
9	BrushC94	DIP051	Glutops	0.53
10	BrushC94	DIP210	Ceratopogoninae	0.31
11	BrushC94	DIP310	Dixa	0.45
12	BrushC94	DIP400	Empididae	0.30
13	BrushC94	DIP520	Pericoma	0.38
14	BrushC94	DIP620	Simulium	1.00
15	BrushC94	DIP910	Antocha	0.45
16	BrushC94	DIP940	Hexatoma	0.46
17	BrushC94	EPH112	Baetis tricaudatus	1.00
18	BrushC94	EPH140	Diphetor hageni	0.77
19	BrushC94	EPH310	Attenella	0.23
20	BrushC94	EPH332	Drunella doddsi	0.76
21	BrushC94	EPH340	Ephemerella	0.30
22	BrushC94	EPH350	Serratella	0.45
23	BrushC94	EPH360	Timpanoga	0.23
24	BrushC94	EPH520	Cinygmula	0.92
25	BrushC94	EPH531	Epeorus albertae	0.23
26	BrushC94	EPH534	Epeorus grandis	0.23
27	BrushC94	EPH550	Ironodes	0.61
28	BrushC94	EPH560	Rhithrogena	0.92
29	BrushC94	EPH620	Paraleptophlebia	0.92
30	BrushC94	EPH750	Ameletus	0.23
31	BrushC94	GAS610	Juga	0.55
32	BrushC94	HYD000	Hydracarina	0.46
33	BrushC94	OLI000	Oligochaeta	0.69
34	BrushC94	PLE100	Capniidae	0.23
35	BrushC94	PLE200	Chloroperlidae	0.68
36	BrushC94	PLE220	Paraperla	0.30
37	BrushC94	PLE250	Sweltsa	0.92
38	BrushC94	PLE300	Leuctridae	0.38
39	BrushC94	PLE331	Moselia infuscata	0.45
40	BrushC94	PLE430	Malenka	0.32
41	BrushC94	PLE491	Zapada cinctipes	0.70
42	BrushC94	PLE494	Zapada Oregonensis Gr.	0.46
43	BrushC94	PLE511	Calineuria californica	0.85
44	BrushC94	PLE530	Doroneuria	0.38
45	BrushC94	PLE541	Hesperoperla pacifica	0.61
46	BrushC94	PLE620	Isoperla	0.23
47	BrushC94	PLE670	Skwala	0.84
48	BrushC94	TRI035	Lepidostoma	0.31
49	BrushC94	TRI1130	Rhyacophila Betteni Gr.	0.70
50	BrushC94	TRI1140	Rhyacophila Brunnea Gr.	0.76
51	BrushC94	TRI1170	Rhyacophila Hyalinata Gr.	0.61
52	BrushC94	TRI1210	Rhyacophila Sibirica Gr.	0.84
53	BrushC94	TRI130	Micrasema	0.46
54	BrushC94	TRI230	Glossosoma	1.00
55	BrushC94	TRI311	Arctopsyche grandis	0.53
56	BrushC94	TRI340	Hydropsyche	0.99
57	BrushC94	TRI780	Wormaldia	0.70
58	BrushC94	TRI967	Neophylax rickeri	0.32

Sum of Probabilities: 32.95

Required number of Taxa to achieve Score of 1.0: 33 of 58