

2013 Eastern Strait of Juan de Fuca Marine Sediment



Sediment Quality Triad Data Summary

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Results

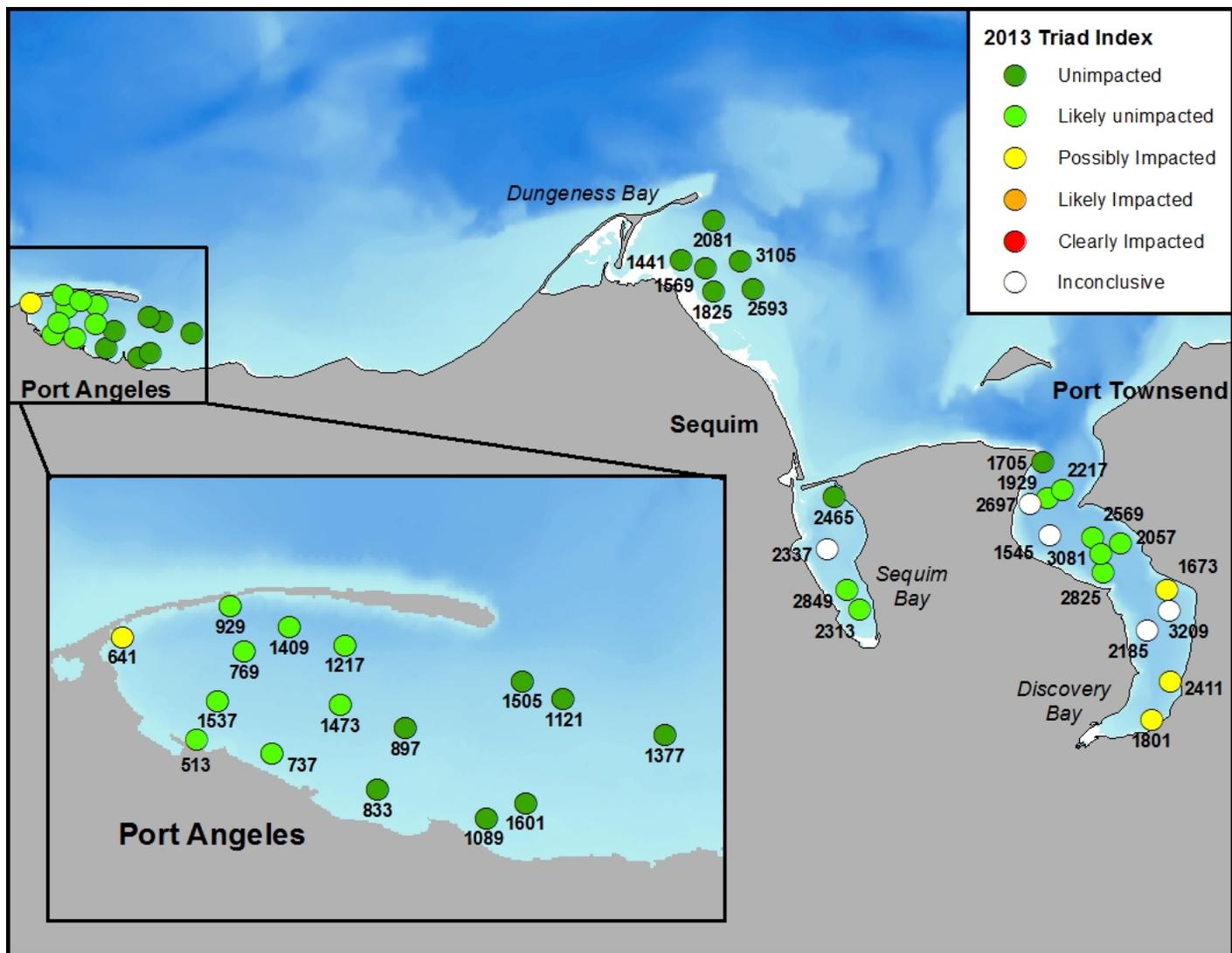
Sediment Triad Quality Index categories (Dutch et al., 2014) identified for stations in the 2013 Eastern Strait of Juan de Fuca survey.

Sample	Location	Chemistry Category	Toxicity Category	Benthic Category	Triad Category
513	Port Angeles (inner harbor)	Minimum exposure	Non-toxic	Adversely affected	Likely unimpacted
641	Port Angeles (inner harbor)	Low exposure	Low	Adversely affected	Possibly impacted
737	Port Angeles (inner harbor)	Low exposure	Non-Toxic	Adversely affected	Likely unimpacted
769	Port Angeles	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
833	Port Angeles	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
897	Port Angeles	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
929	Port Angeles (inner harbor)	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
1089	Port Angeles	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
1121	Port Angeles	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
1217	Port Angeles	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
1377	Port Angeles	Minimum exposure	Low	Unaffected	Unimpacted
1409	Port Angeles	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
1441	Dungeness Bay	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
1473	Port Angeles	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
1505	Port Angeles	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
1537	Port Angeles	Low exposure	Non-Toxic	Adversely affected	Likely unimpacted
1545	Discovery Bay	Minimum exposure	Low	Adversely affected	Inconclusive
1569	Dungeness Bay	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
1601	Port Angeles	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
1673	Discovery Bay	Minimum exposure	Moderate	Adversely affected	Possibly impacted
1705	Discovery Bay	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
1801	Discovery Bay	Minimum exposure	Moderate	Adversely affected	Possibly impacted

Sample	Location	Chemistry Category	Toxicity Category	Benthic Category	Triad Category
1825	Dungeness Bay	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
1929	Discovery Bay	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
2057	Discovery Bay	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
2081	Dungeness Bay	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
2185	Discovery Bay	Minimum exposure	Low	Adversely affected	Inconclusive
2217	Discovery Bay	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
2313	Sequim Bay	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
2337	Sequim Bay	Minimum exposure	Low	Adversely affected	Inconclusive
2411	Discovery Bay	Minimum exposure	Moderate	Adversely affected	Possibly impacted
2465	Sequim Bay	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
2569	Discovery Bay	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
2593	Dungeness Bay	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
2697	Discovery Bay	Minimum exposure	Low	Adversely affected	Inconclusive
2825	Discovery Bay	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
2849	Sequim Bay	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
3081	Discovery Bay	Minimum exposure	Non-Toxic	Adversely affected	Likely unimpacted
3105	Dungeness Bay	Minimum exposure	Non-Toxic	Unaffected	Unimpacted
3209	Discovery Bay	Minimum exposure	Low	Adversely affected	Inconclusive

Spatial extent of Sediment Chemistry, Toxicity, Benthic, and Triad Index categories (Dutch et al., 2014) for the 2013 Eastern Strait of Juan de Fuca survey.

Chemistry Index	Toxicity Index	Benthic Index	Triad Index	% of Area
Minimum exposure	Low	Unaffected	Unimpacted	36%
Low exposure	Non-toxic	Adversely affected	Likely unimpacted	36%
Minimum exposure	Low		Possibly impacted	11%
	Moderate		Inconclusive	17%
	Low			



Spatial patterns of sediment condition in the 2013 Eastern Strait of Juan de Fuca survey.

The numbers on the map are the station identifications.

Incidence and spatial extent of sediment condition in the 2013 Eastern Strait of Juan de Fuca survey.

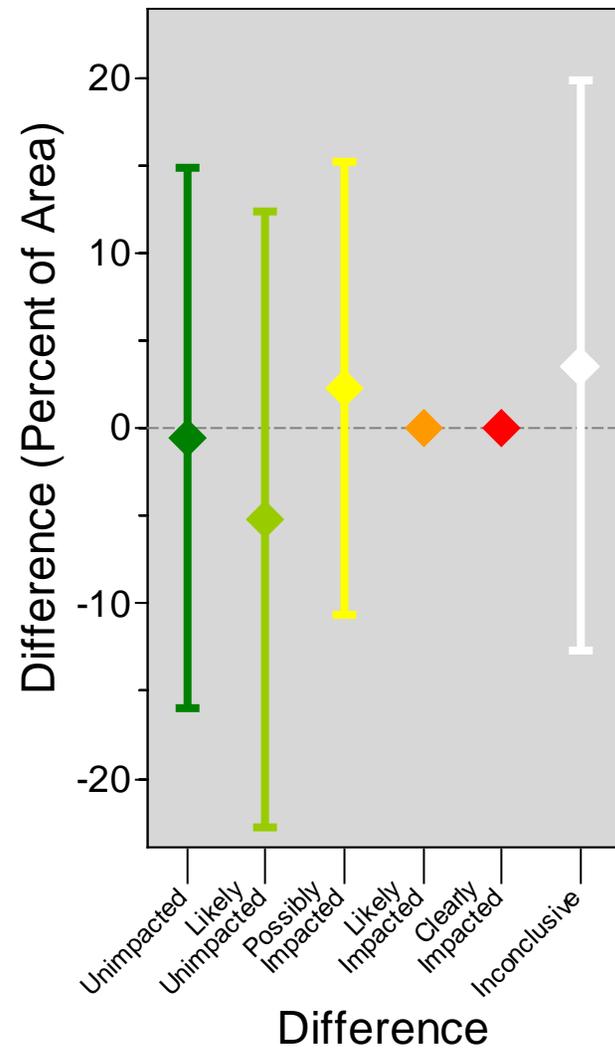
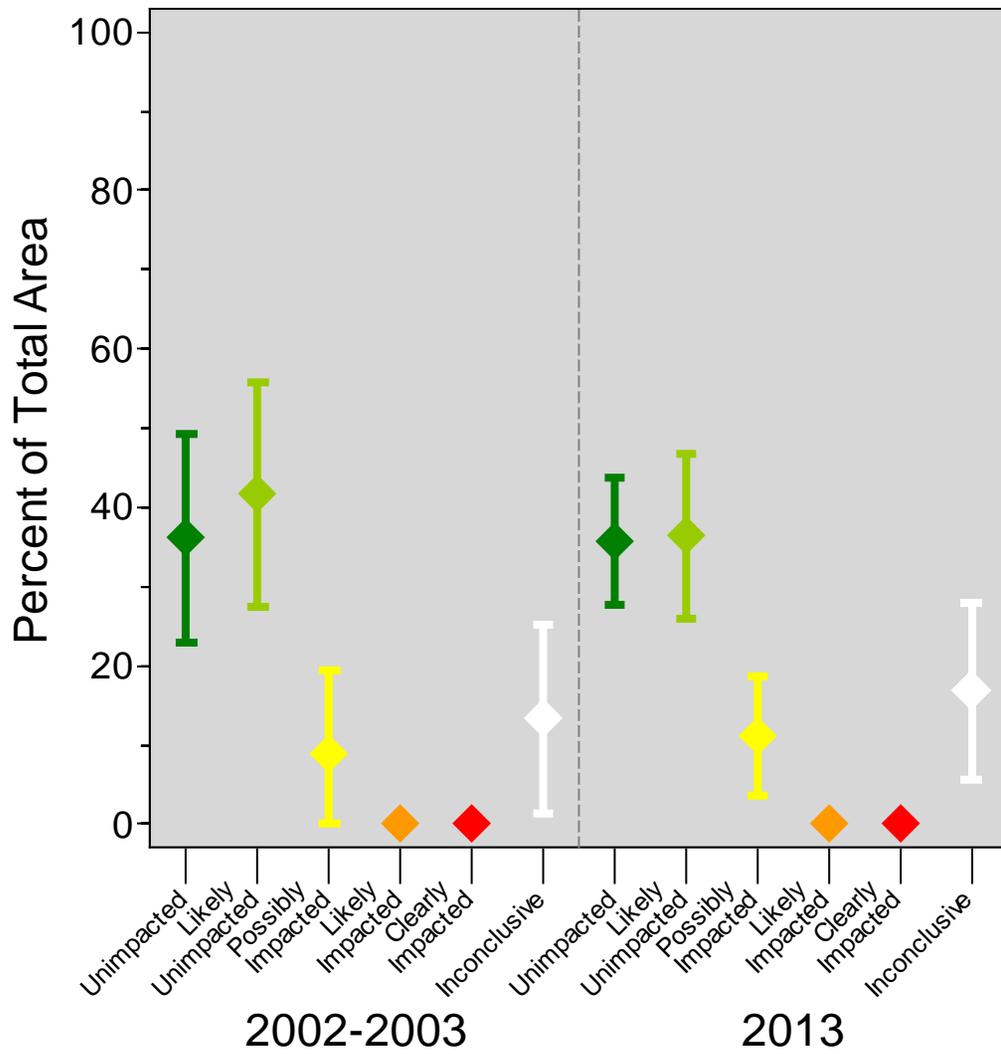
Sediment Triad Index Category	Stations		Area	
	No.	(%)	km ²	(%)
San Juan Islands	40	(100.0)	67.8	(100.0)
Unimpacted	15	(37.5)	24.2	(35.6)
Likely unimpacted	16	(40.0)	24.7	(36.4)
Possibly impacted	4	(10.0)	7.6	(11.1)
Likely impacted	0	(0.0)	0.0	(0.0)
Clearly impacted	0	(0.0)	0.0	(0.0)
Inconclusive	5	(12.5)	11.4	(16.8)

Comparison of Sediment Quality Triad Index Categories by Year

Estimated spatial extent (percent of area) and 95% confidence intervals for each of the Sediment Quality Triad Index categories (Dutch et al., 2014) for the Eastern Strait of Juan de Fuca monitoring region in 2013, compared to the 2002-2003 Baseline.

Sediment Quality Triad Index Category	2002-2003 (Baseline)			2013			Difference (2013 – Baseline)			Significantly different*
	Estimate (% area)	Confidence Limit		Estimate (% area)	Confidence Limit		Estimate (% area)	Confidence Limit		
		Lower	Upper		Lower	Upper		Lower	Upper	
Unimpacted	36.20	23.02	49.37	35.63	27.64	43.62	-0.56	-15.97	14.85	no
Likely unimpacted	41.67	27.52	55.82	36.43	26.02	46.83	-5.24	-22.81	12.32	no
Possibly impacted	8.85	0.00	19.47	11.13	3.69	18.56	2.27	-10.69	15.23	no
Likely impacted	0.00	n.a.	n.a.	0.00	n.a.	n.a.	n.a.	n.a.	n.a.	n.a
Clearly impacted	0.00	n.a.	n.a.	0.00	n.a.	n.a.	n.a.	n.a.	n.a.	n.a
Inconclusive	13.28	1.43	25.13	16.82	5.70	27.93	3.53	-12.72	19.79	no

* Kincaid (2015), $\alpha = 0.05$



Comparisons with Other Regions

Incidence and spatial extent of sediment condition in the eight sediment monitoring regions and all of Puget Sound.

Sediment Triad Index Category	Baseline				Second Round			
	Stations		Area		Stations		Area	
	No.	(%)	km ²	(%)	No.	(%)	km ²	(%)
Strait of Georgia	61	(100.0)	386.9	(100.0)	40	(100.0)	360.6	(100.0)
Unimpacted	51	(83.6)	327.5	(84.6)	21	(52.5)	201.6	(55.9)
Likely unimpacted	7	(11.5)	54.6	(14.1)	9	(22.5)	82.5	(22.9)
Possibly impacted	3	(4.9)	4.8	(1.2)	2	(5.0)	1.0	(0.3)
Likely impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Clearly impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Inconclusive	0	(0.0)	0.0	(0.0)	8	(20.0)	75.6	(21.0)
San Juan Archipelago	30	(100.0)	80.7	(100.0)	40	(100.0)	79.5	(100.0)
Unimpacted	10	(33.3)	26.9	(33.3)	17	(42.5)	33.8	(42.5)
Likely unimpacted	18	(60.0)	48.4	(60.0)	20	(50.0)	39.7	(50.0)
Possibly impacted	1	(3.3)	2.7	(3.3)	0	(0.0)	0.0	(0.0)
Likely impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Clearly impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Inconclusive	1	(3.3)	2.7	(3.3)	3	(7.5)	6.0	(7.5)
E. Strait of Juan de Fuca	30	(100.0)	61.8	(100.0)	40	(100.0)	67.8	(100.0)
Unimpacted	15	(50.0)	22.4	(36.2)	15	(37.5)	24.2	(35.6)
Likely unimpacted	10	(33.3)	25.8	(41.7)	16	(40.0)	24.7	(36.4)
Possibly impacted	2	(6.7)	5.5	(8.8)	4	(10.0)	7.6	(11.1)
Likely impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Clearly impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Inconclusive	3	(10.0)	8.2	(13.3)	5	(12.5)	11.4	(16.8)
Admiralty Inlet	30	(100.0)	69.2	(100.0)	43	(100.0)	66.5	(100.0)
Unimpacted	28	(93.3)	66.1	(95.5)	33	(76.7)	51.1	(76.8)
Likely unimpacted	2	(6.7)	3.1	(4.5)	8	(18.6)	11.6	(17.5)
Possibly impacted	0	(0.0)	0.0	(0.0)	1	(2.3)	2.8	(4.2)
Likely impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Clearly impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Inconclusive	0	(0.0)	0.0	(0.0)	1	(2.3)	1.0	(1.5)
Whidbey Basin	39	(100.0)	338.1	(100.0)	40	(100.0)	353.3	(100.0)
Unimpacted	10	(25.6)	104.8	(31.0)	20	(50.0)	167.7	(47.5)
Likely unimpacted	19	(48.7)	213.0	(63.0)	17	(42.5)	165.7	(46.9)
Possibly impacted	2	(5.1)	0.1	(0.0)	1	(2.5)	11.5	(3.3)

Sediment Triad Index Category	Baseline		Second Round					
	Stations		Area		Stations		Area	
	No.	(%)	km ²	(%)	No.	(%)	km ²	(%)
Likely impacted	6	(15.4)	0.6	(0.2)	1	(2.5)	0.3	(0.1)
Clearly impacted	1	(2.6)	0.1	(0.0)	0	(0.0)	0.0	(0.0)
Inconclusive	1	(2.6)	19.6	(5.8)	1	(2.5)	8.2	(2.3)
Central Sound	128	(100.0)	683.9	(100.0)	80	(100.0)	667.4	(100.0)
Unimpacted	86	(67.2)	636.5	(93.1)	53	(66.3)	480.6	(72.0)
Likely unimpacted	24	(18.8)	40.2	(5.9)	16	(20.0)	126.9	(19.0)
Possibly impacted	11	(8.6)	5.1	(0.7)	4	(5.0)	7.5	(1.1)
Likely impacted	6	(4.7)	1.9	(0.3)	4	(5.0)	5.7	(0.9)
Clearly impacted	1	(0.8)	0.1	(0.0)	0	(0.0)	0.0	(0.0)
Inconclusive	0	(0.0)	0.0	(0.0)	3	(3.8)	46.7	(7.0)
Hood Canal	21	(100.0)	331.7	(100.0)	30	(100.0)	294.8	(100.0)
Unimpacted	7	(33.3)	106.1	(32.0)	7	(23.3)	64.6	(21.9)
Likely unimpacted	11	(52.4)	186.8	(56.3)	18	(60.0)	178.1	(60.4)
Possibly impacted	3	(14.3)	38.8	(11.7)	2	(6.7)	18.5	(6.3)
Likely impacted	0	(0.0)	0.0	(0.0)	3	(10.0)	33.7	(11.4)
Clearly impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Inconclusive	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
South Sound	42	(100.0)	341.6	(100.0)	55	(100.0)	317.7	(100.0)
Unimpacted	24	(57.1)	211.2	(61.8)	30	(54.5)	210.2	(66.2)
Likely unimpacted	14	(33.3)	120.2	(35.2)	12	(21.8)	52.7	(16.6)
Possibly impacted	2	(4.8)	9.8	(2.9)	7	(12.7)	19.9	(6.3)
Likely impacted	2	(4.8)	0.5	(0.2)	1	(1.8)	2.1	(0.7)
Clearly impacted	0	(0.0)	0.0	(0.0)	0	(0.0)	0.0	(0.0)
Inconclusive	0	(0.0)	0.0	(0.0)	5	(9.1)	32.8	(10.3)
Total Study Area	381	(100.0)	2294.1	(100.0)	368	(100.0)	2207.6	(100.0)
Unimpacted	231	(60.6)	1501.4	(65.4)	196	(53.3)	1233.6	(55.9)
Likely unimpacted	105	(27.6)	692.1	(30.2)	116	(31.5)	681.9	(30.9)
Possibly impacted	24	(6.3)	66.7	(2.9)	21	(5.7)	68.7	(3.1)
Likely impacted	14	(3.7)	3.0	(0.1)	9	(2.4)	41.7	(1.9)
Clearly impacted	2	(0.5)	0.2	(0.0)	0	(0.0)	0.0	(0.0)
Inconclusive	5	(1.3)	30.5	(1.3)	26	(7.1)	181.6	(8.2)

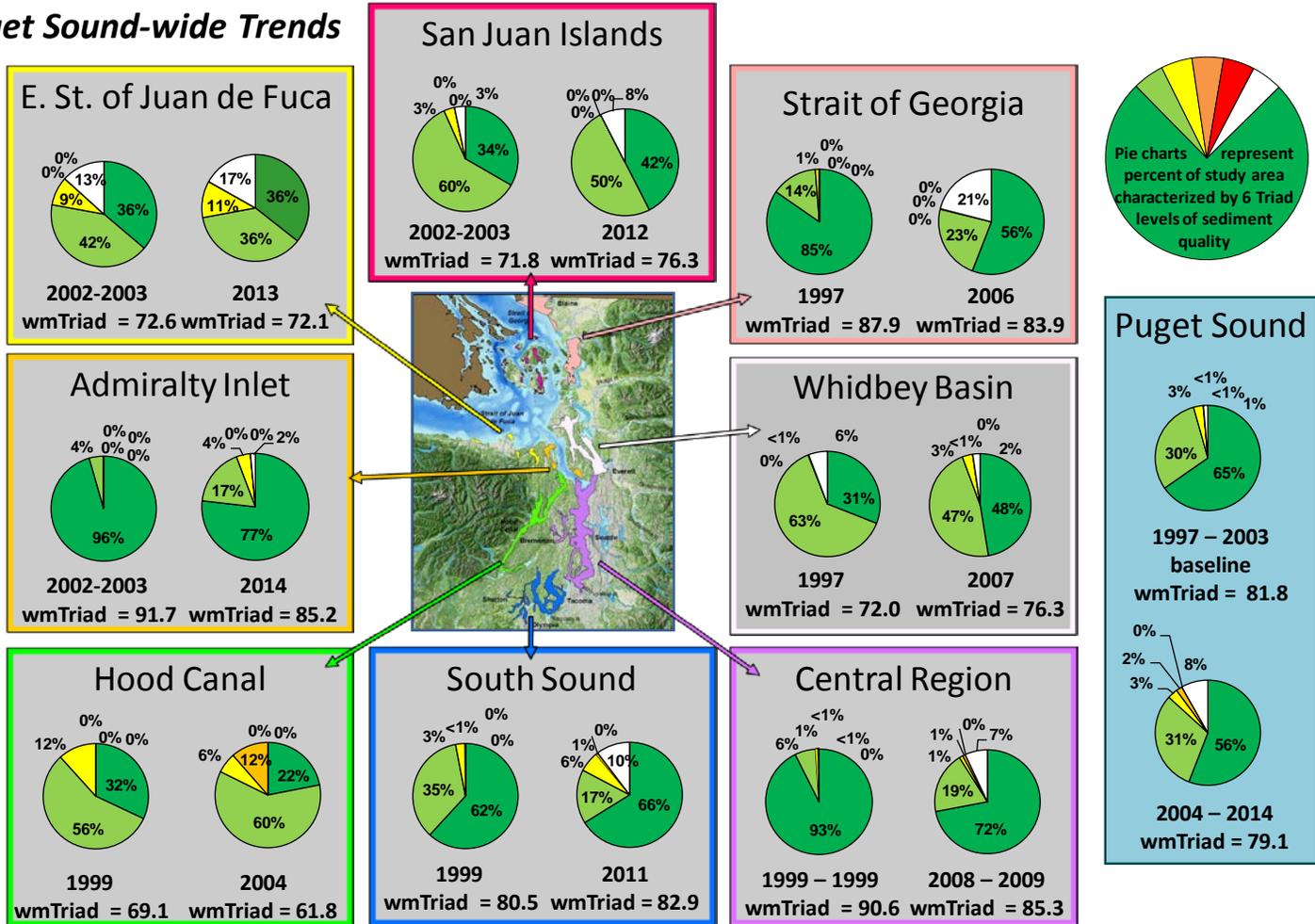
Puget Sound Sediment Triad Index (Triad)

Regional & Puget Sound-wide Trends

Regional sediment quality baseline comparison to Puget Sound-wide:

- So. Sound most similar
- Admiralty Inlet has the greatest area of *unimpacted* sediments
- Area of *unimpacted* sediment declined in St. of Georgia, Central, and Hood Canal
- Overall sediment quality increased in the Whidbey Basin and South Sound

Triad Index	
Category	Score
Unimpacted	>81-100
Likely unimpacted	>57-81
Possibly impacted	>35-57
Likely impacted	>5-35
Clearly Impacted	0-5
Inconclusive	



Spatial patterns of sediment condition in the eight sediment monitoring regions and all of Puget Sound.