POSEIDON WATER

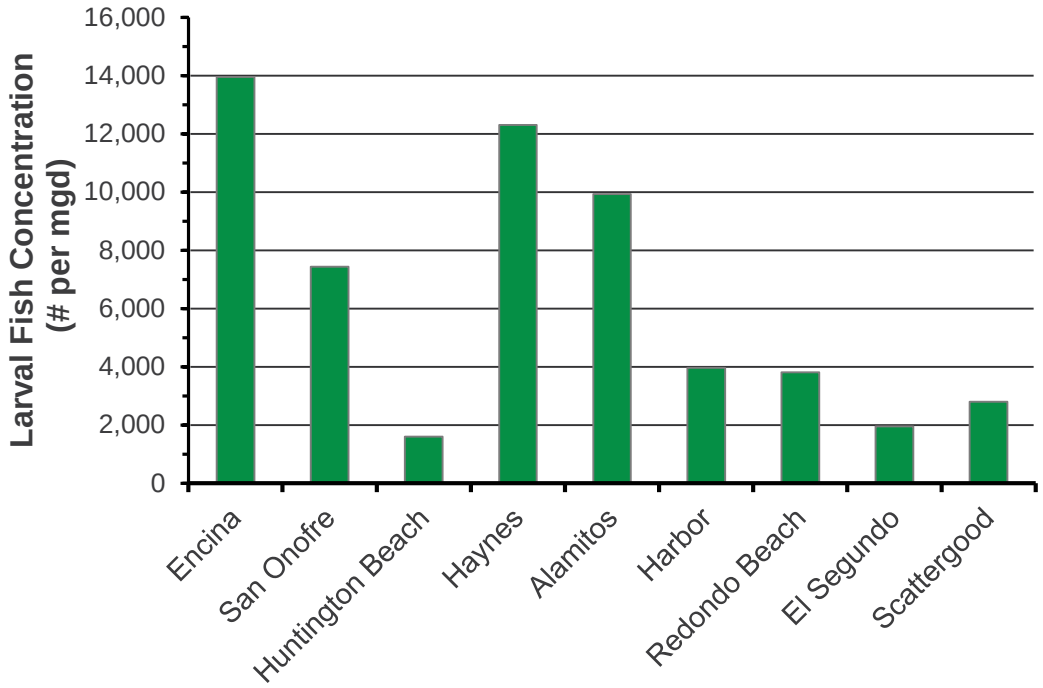
Huntington Beach Desalination Project

Intake Location Analysis Meeting III
September 27, 2018

Meeting's Purpose

- Review and discuss Dr. Raimondi's multiple lines of evidence (MLE) white paper (white paper)
- To review the results of analyses of existing data consistent with Dr. Raimondi's white paper
- Quantitative and qualitative lines of evidence

Did Southern California Edison's Engineers Get It Right 60 years ago?



Data from Appendix E – Entrainment and Impingement Estimates (Steinbeck, July 2008) in Final Substitute Environmental Document for Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling, May 4 2010.

- Lowest larval fish concentrations of any of the intake locations studied in southern California
- Low abundances at HB are consistent with other locations with offshore intakes in sandy coastal areas such as El Segundo and Scattergood
- Diversity of taxa also lower at HB when compared to El Segundo and Scattergood
- Low impact location due to the absence of a diversity of habitats in vicinity of intake, and low abundances and diversity of larval fishes

1. QUANTITATIVE MLE METRIC PROCESS

Common Quantitative MLE Metrics

- 1. Empirical Transport Model/Area of Production Forgone (ETM/APF)
  - White paper recommends use four taxa common to most stations with sufficient data
- 2. Mean Larval Concentration
  - Mean concentration of the total concentration of identified and counted larvae from each net by station
    - 96 individual nets (samples) per station
- 3. Standardized larval concentration
  - Proposed by Dr. Raimondi as way to weigh each taxa equally and reduce the impact of extraordinarily abundant taxa
  - White paper proposes calculating mean concentration across all 96 nets before standardizing
  - Addresses OPA Section M.2.b.(4) requirements

Poseidon Proposed Supplementary Quantitative MLE

- Standardized larval concentration
  - Poseidon proposed alternative approach to standardize taxa across all 96 nets per station
  - More accurately captures the variability in the data than is achieved by only standardizing the annual mean concentrations by taxa and station
- Mean larval concentration excluding *Emerita*
  - More accurately evaluates patterns in station-specific concentration of the larval community by eliminating numerically dominant *Emerita* (27% of sum total concentration)

Significance Determination

- For all MLE Metrics other than APF, we need to determine if the differences in the values are ecologically significant
  - If there is not an ecologically significant difference between the proposed intake site (Station E) and alternative intake sites under consideration, then there is no basis for moving the intake.
- Dr. Raimondi recommended using a “floating alpha” to determine if the differences in the values are ecologically significant
  - Used in the CCC compliance monitoring for the San Onofre Nuclear Generating Station’s Wheeler North Artificial Reef mitigation project
  - Uses the effect size calculated between the two stations as the critical p-value to determine statistical significance
  - Incorporating the effect size as the critical value incorporates ecological value in the assessment of statistical differences
    - Effect size is a measure of how different the two data sets are. The ttest is a traditional significance test. The combination helps to overcome the problems of larger or small sample sizes and high variability that is common in ecological data sets. The result can be considered an ecological significance test as ecological data sets do not readily conform to standard statistical methods.

Synthesize Values

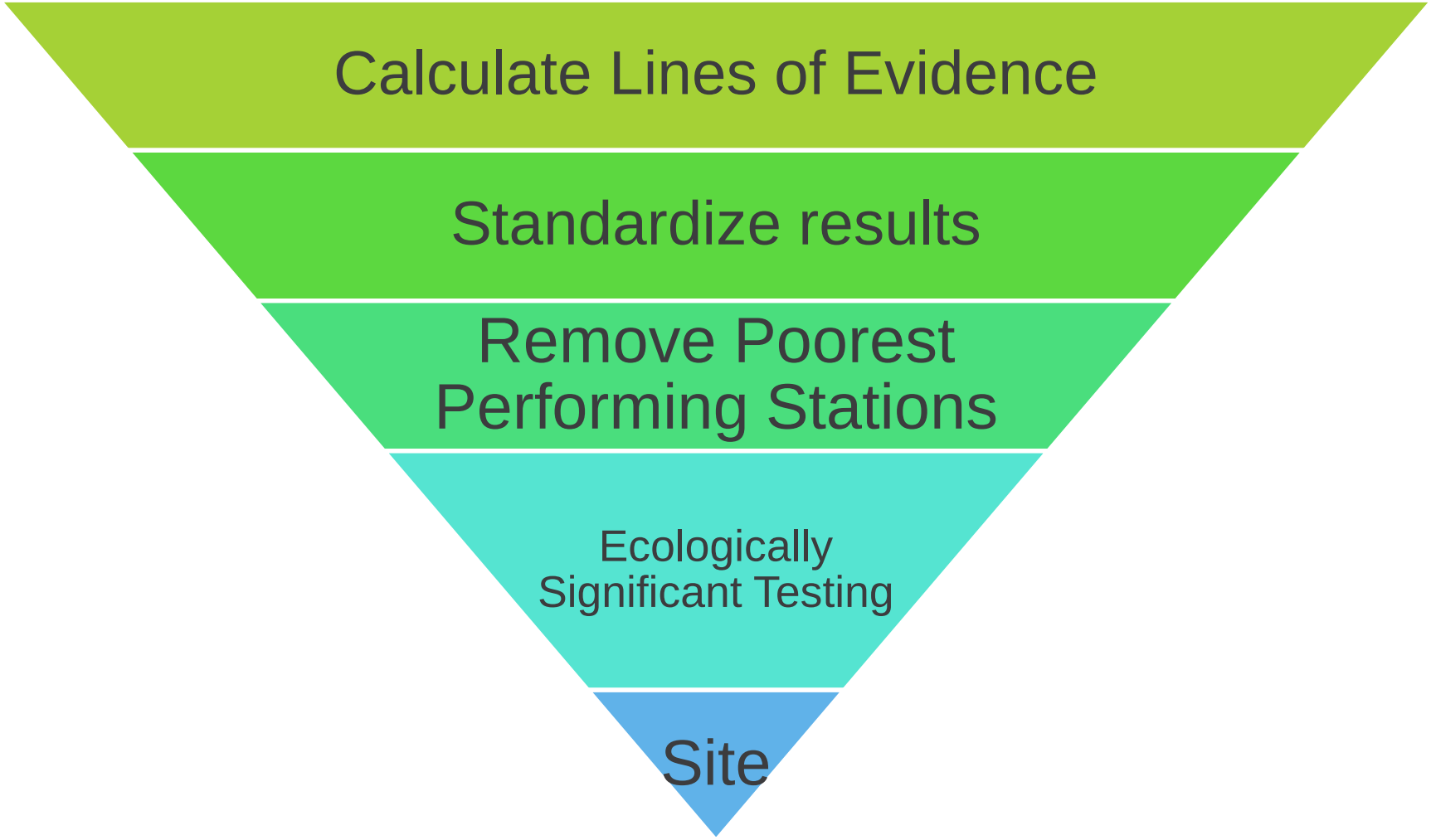
Options for synthesizing MLE metrics to one value to compare stations:

- Ranking individual results within each metric then averaging or summing the ranks across metrics for each station
- Standardizing each station's result within the metric as a percentage of the maximum value

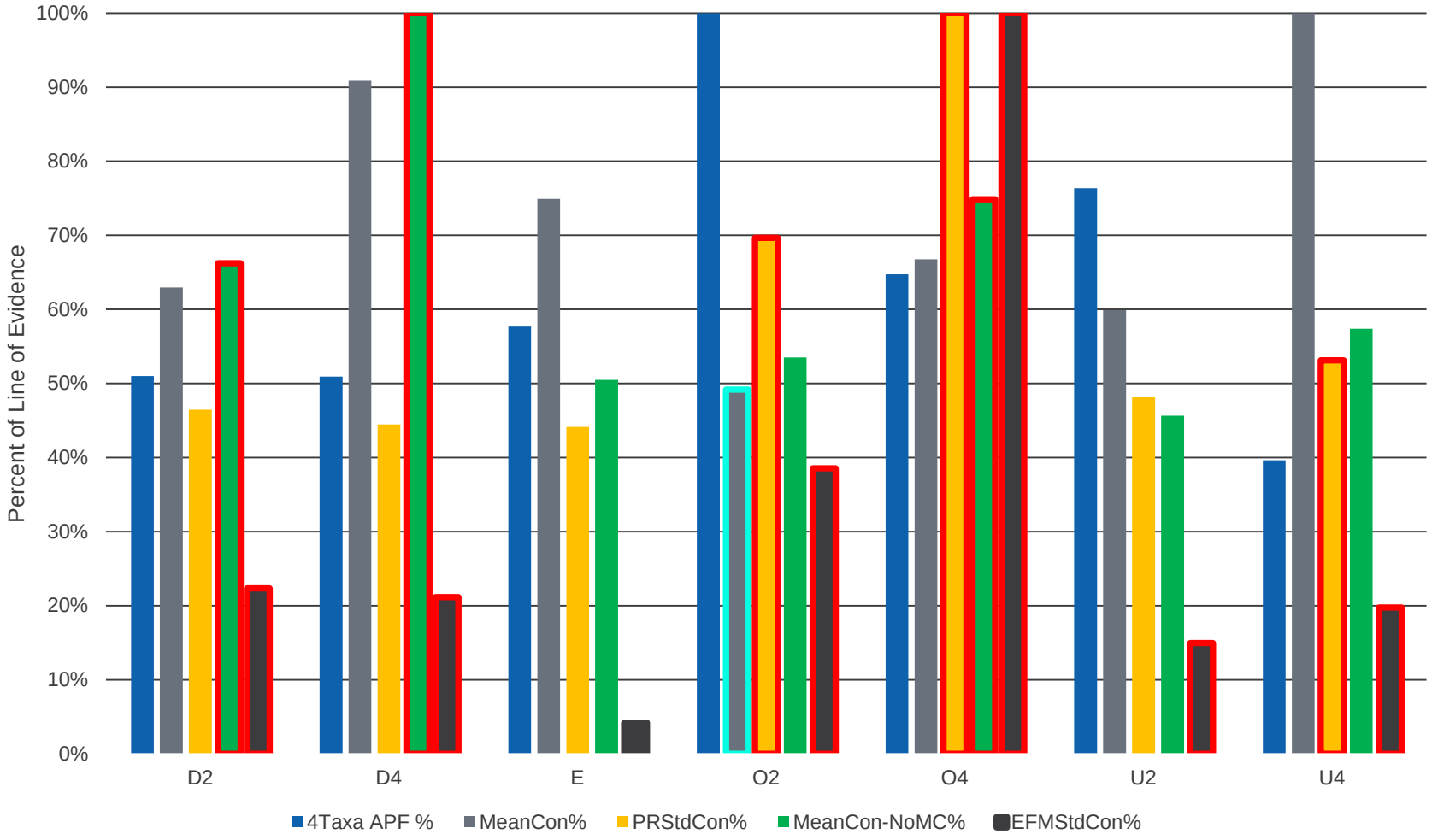
Other considerations:

- Determine if there is an ecologically significant difference between the values
- Evaluate qualitative factors to ensure compliance with OPA Section M.2.b.

Analytical Process



Lines of Evidence Examined



Initial Screening Results

- Stations that scored ≥90% of the maximum value for any of the three common quantitative MLE were removed from further consideration
  - Stations D4, O2, O4, and U4 all had ≥90% of the maximum value in at least one of the common quantitative MLE and were removed from further consideration
  - Stations D2, E, and U2 remain as candidate intake sites subject to further analysis

ETM/APF - Results

Station	Number of Taxa In Analysis	ROMS AHL APF	ROMS Alamitos Bay APF	Regional Current (99-00 & 07-08) AHL APF	Regional Current (99-00 & 07-08) Alamitos Bay APF	Grand Mean
D2	4	148	147	172.6	172.5	160
E	4	213	213	148.8	148.8	181
U2	4	213	213	266.1	266.0	239

- Four taxa included in the ETM/APF analysis for each station
- All APFs are the full, 95th confidence interval estimates
- Grand mean column is the average of all four estimated APFs for each station row to try and summarize the four estimates
- Station D2 had smallest grand mean APF, followed by Station E

Mean Concentration – All taxa included

Station	Mean #/m3	Std Err	# of samples>2/m3	Effect Size	p-value	Sig Diff from E
D2	0.57	0.07	4	0.07	0.30	No
E	0.68	0.20	3			
U2	0.54	0.25	9	0.09	0.27	No

- Effect Size – each station's data compared against E
- P-value – each station's data compared against E
- No ecologically significant difference between the mean concentrations at Stations E, D2 and U2

Mean Concentration – Emerita excluded from all stations

Station	Mean #/m3	Std Err	# of samples>2/m3	Effect Size	p-value	Sig Diff from E
D2	0.50	0.06	3	0.23	0.04	Yes
E	0.38	0.05	1			
U2	0.34	0.04	1	0.08	0.33	No

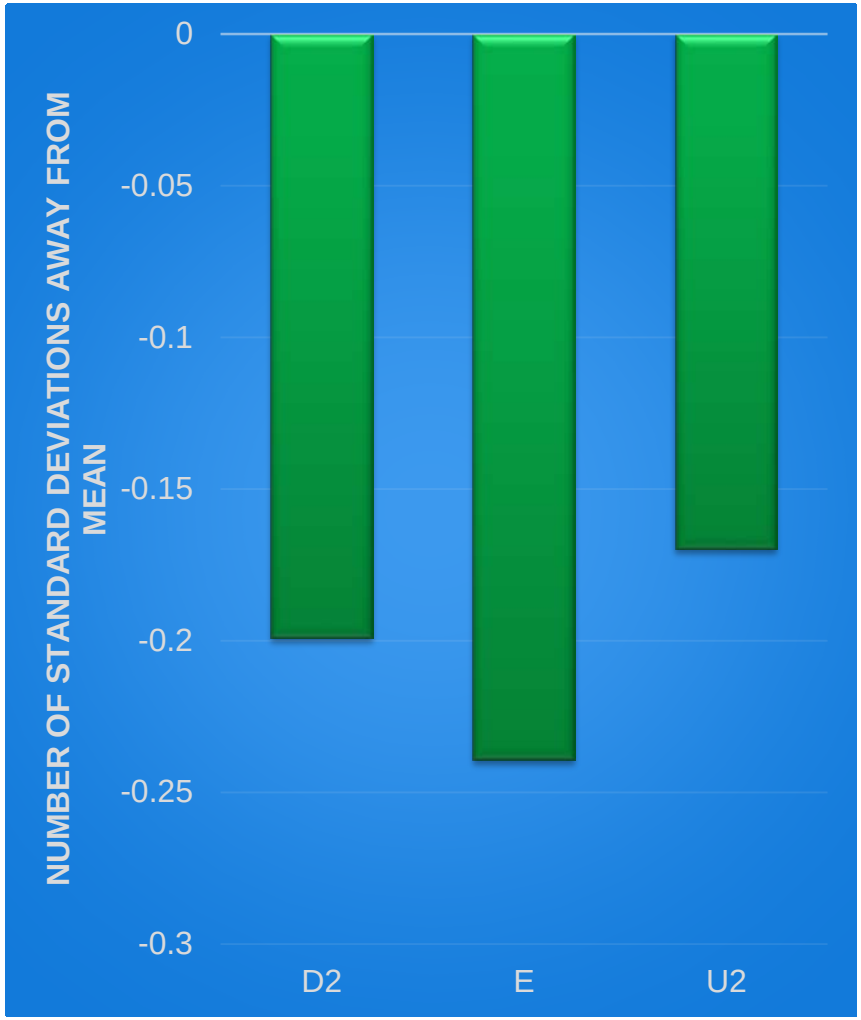
- Effect Size – each station's data compared against E
- P-value – each station's data compared against E
- Excluding Emerita from all stations unmasked differences that were obscured by the shear abundance of Emerita overwhelming the abundance patterns in the remaining taxa
- Ecologically significant higher concentrations at Station D2 versus Station E
- No ecologically significant difference between Stations U2 and E

Mean Concentration – Standardized (White Paper Method)

Standardized Concentration treats all taxa equally and the results better measure impacts to all forms of marine life rather than just the abundant taxa.

Station	Mean	StdDev (Sta+E)	Effect Size	pvalue	p - ES	Sig Diff
D2	-0.20	0.83	0.05	0.37	0.32	No
E	-0.24					
U2	-0.17	0.81	0.09	0.28	0.19	No

- Effect Size – each station's data compared against E
- P-value – each station's data compared against E
- No ecologically significant difference between the three stations standardized concentrations using the method described in the white paper

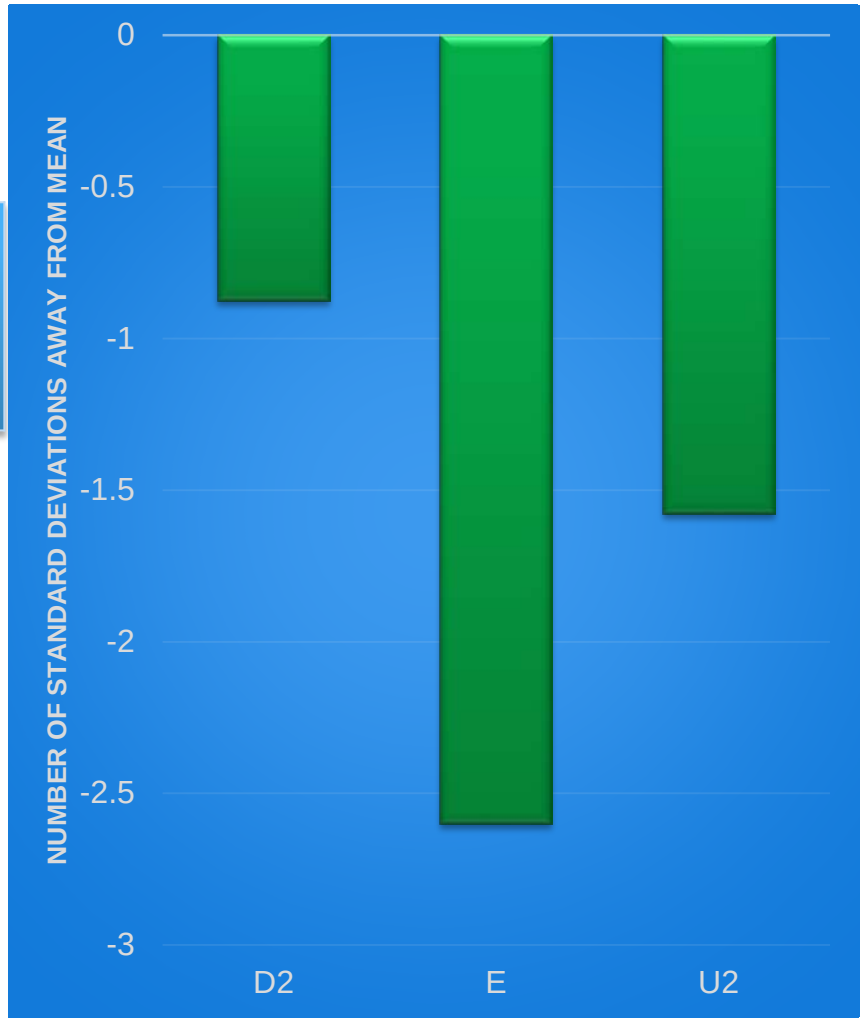


Mean Concentration – Standardized (Poseidon Method)

Standardized Concentration treats all taxa equally and the results better measure impacts to all forms of marine life rather than just the abundant taxa.

Station	Mean #/m3	Std Err	# of samples>2/m3	Effect Size	p-value	Sig Diff
D2	-0.88	1.52	4.35	0.20	0.18	Yes
E	-2.60	0.99				
U2	-1.58	0.79	3.01	0.52	0.21	Yes

- Effect Size – each station's data compared against E
- P-value – each station's data compared against E
- Including all samples over the year rather than annual totals softens the effect of a single large catch
- Using all data, there is an ecologically significant difference between the standardized densities at Station E and both Station D2 and Station U2



Quantitative MLE Interpretation

MLE	Station	More or Less Impact Than Station E	Ecologically Significant Different from Station E
APF	D2	Less	NA
	U2	More	NA
All Taxa Mean Concentration	D2	Less	No
	U2	Less	No
No Emerita Mean Concentration	D2	More	Yes
	U2	Less	No
Standardized Concentration (White Paper Method)	D2	More	No
	U2	More	No
Standardized Concentration (Poseidon Method)	D2	More	Yes
	U2	More	Yes

- In comparison to Station E, there is no ecologically significant difference in the marine life impacts associated with either of the remaining candidate intake sites for the common quantitative MLE metrics

Habitat Homogeneity

- Coastal, surfzone, subtidal habitat offshore of the proposed HBDP is homogenous
  - Soft-bottom habitat
  - No vertical complexity
  - No biogenic habitat
  - Hard substrate with vertical relief restricted to
    - Huntington Beach Pier
    - Existing armoring rock surrounding the existing HBGS intake

Station E is the most equidistant point from MPAs, sensitive areas, and sensitive species

See Appendix AAAAA – Presentation from July 26, 2018 meeting for more details

Station	Distance to BC Wetland (mi)	Distance to HB Wetland (mi)	Distance to Giant Sea Bass Nursery (mi)
U2	3.1	2.5	4.9
E	4.4	1.4	3.7
D2	5.5	0.0	2.4

Biogeographic Analysis Results

- Moving the intake from Station E upcoast will move it closer to sensitive habitats
  - Bolsa Chica MPAs
- Moving the intake downcoast from Station E will move it closer to sensitive habitats
  - Mouths of multiple wetlands
  - Submarine Canyon
  - Larval sink (see biological analysis)
  - Giant Sea Bass nursery
- Moving offshore will relocate intake closer to Barred Sand Bass spawning grounds
  - Fishery has collapsed (Erisman et al. 2010, Miller and Erisman 2014)
  - Dramatic fishing regulation changes implemented in response by CA Fish and Game Commission in 2013

Harvested Species And MPA Beneficiaries

Descending Rank of table above. 1 = least and 7 = most abundant

Taxa	D2	U2	E	Fished (App D.)	MPA (Table C-1)
Emerita analoga (zoea)	4	5	6	NO	YES
Gobiidae unid.	6	3	5	NO	NO
Engraulis mordax	2	7	6	YES	NO
Seriphus politus	5	1	4	YES[1]	NO
Genyonemus lineatus	1	3	2	YES	NO
Sciaenidae unid.	3	4	1	YES	NA
Hypsoblennius spp.	3	4	2	NO	NO
Paralichthys californicus	3	5	2	YES	NO
Paralabrax spp.	**4**	**3**	**2**	**YES**	**YES**
Paralabrax clathratus	**3**	**5**	**2**	**YES**	**YES**
Atherinopsis californiensis	3	7	5	YES	NO
larvae, unidentified yolksac	3	4	2	NA	NA
Sardinops sagax	1	4	3	YES	NO
Sphyraena argentea	5	4	1	YES	NO
Chromis punctipinnis	**1**	**1**	**1**	**YES**	**YES**
Engraulidae	7	1	5	NA	NA
Hypsopsetta guttulata	5	7	1	YES	NO
Citharichthys stigmaeus	3	2	4	YES	NO
Cancer gracilis (megalops)	1	6	5	YES	NO
Cancer anthonyi (megalops)	**5**	**7**	**6**	**YES**	**YES**
Cancer antennarius (megalops)	**1**	**6**	**2**	**YES**	**YES**
Lepidogobius lepidus	4	3	2	NO	NO
larval fish fragment	2	6	5	NA	NA
Leuresthes tenuis	7	5	4	NO	YES
Pleuronichthys ritteri	3	4	1	YES	NO
Remaining Taxa - Sum	3	2	1		
Number of Taxa ID'd	51	58	54		
Sum of Ranks	88	109	80		
Rank of Sum of Ranks (of the 3 candidate intake sites)	2	3	1		

Sum of ranks = lowest sum is the station where each taxon is least abundant

- Ranking represents across all seven stations, but truncated here to the three candidate intake sites based on harvested species take and potential impacts to species likely to benefit from MPAs
- This table addresses issues raised in OPA M.2.b.(4) to include impacts to MPAs and adding pressure to species under pressure from other anthropogenic activities

Conclusion – Dr. Raimondi MLE Guidance

- **Utilizing Dr. Raimondi's guidance the quantitative Multiple Lines of Evidence analysis concludes:**
  1. **Intake site E is environmentally superior to intake site D4, U4, O2 and 04.**
  2. **There is no ecologically statistical difference between the remaining intake sites: E, D2, and U2.**

- **Intake site D2 is directly offshore of a sensitive habitats and/or species nursery and intake site U2 which is closer to the Bolsa Chica MPAs than intake site E, both conditions do not comply with OPA guidance:**
  - ***M.2.b: "To the extent feasible, surface intakes shall be sited so as to maximize the distance from a MPA or SWQPA."***

- **There is no scientifically defensible justification for re-locating intake site E.**
  - **No difference in the seafloor topographic or geologic conditions and no ecologically statistical difference = no benefit in moving intake site.**

2. APPENDIX SLIDES WITH DETAILED RESULTS

ETM/APF - Results

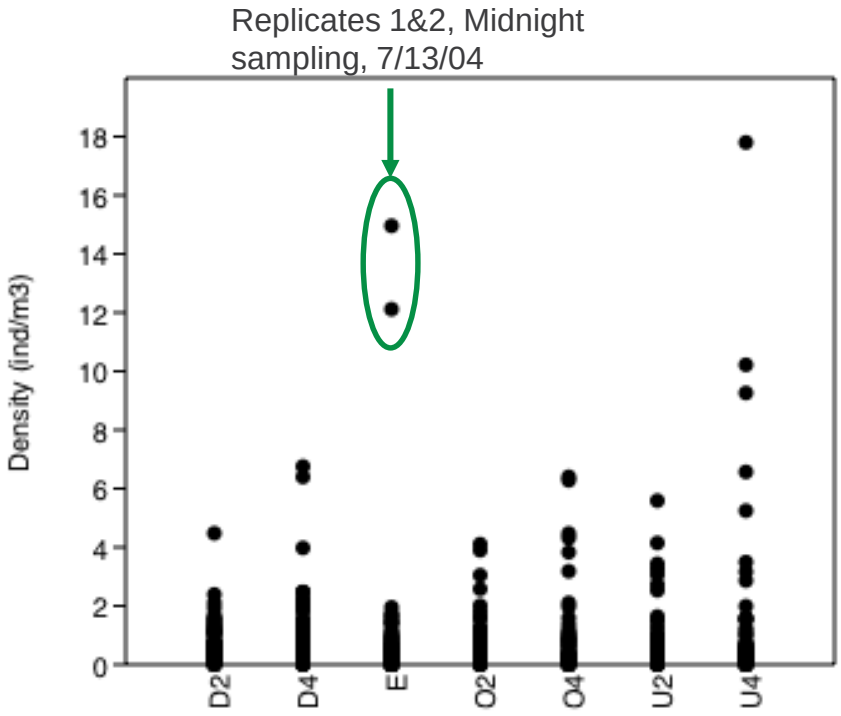
Station	Number of Taxa In Analysis	ROMS AHL APF	ROMS Alamitos Bay APF	Regional Current (99-00 & 07-08) AHL APF	Regional Current (99-00 & 07-08) Alamitos Bay APF	Grand Mean
U4	4	161	161	87.7	87.25	124
D4	4	139	139	180.41	180.345	160
D2	4	148	147	172.55	172.45	160
E	4	213	213	148.8	148.75	181
O4	3	272	272	133.98	133.98	203
U2	4	213	213	266.05	265.9	239
O2	4	286	286	341.25	341.25	314

- Number of taxa included in the APF listed for each station
- All APFs are the full, 95th confidence interval estimates
- Grand mean column is the average of all four estimated APFs for each station row to try and summarize the four estimates

Mean Concentration – All taxa included

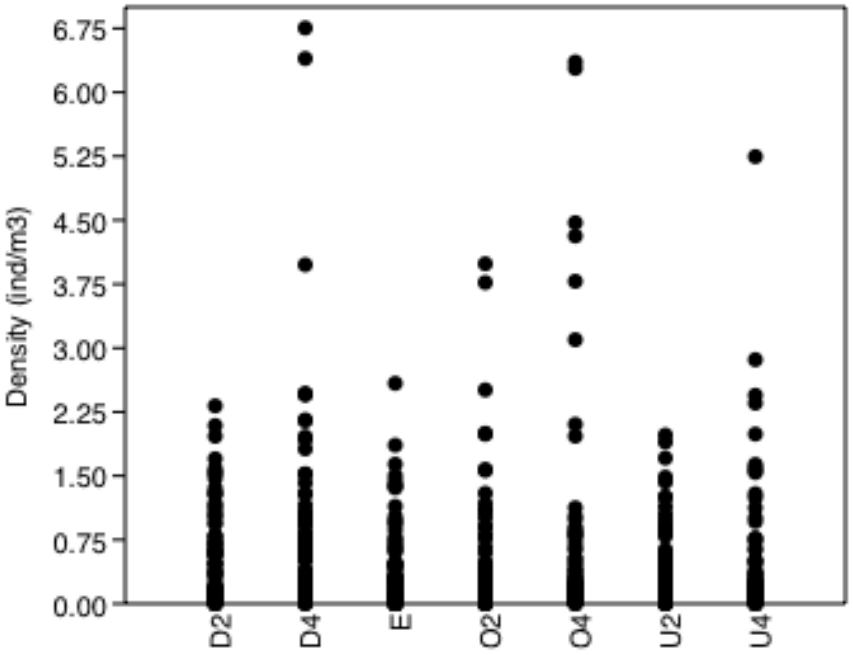
Station	Mean #/m3	Std Err	# of samples >2/m3	Effect Size	p-value	Sig Diff
D2	0.57	0.07	4	0.07	0.30	No
D4	0.82	0.11	11	0.09	0.27	No
E	0.68	0.20	3			
O2	0.45	0.08	5	0.16	0.14	Yes
O4	0.60	0.12	8	0.05	0.38	No
U2	0.54	0.25	9	0.09	0.27	No
U4	0.91	0.10	7	0.10	0.24	No

- Effect Size – each station's data compared against E
- P-value – each station's data compared against E



Mean Concentration – Emerita excluded

Station	Mean #/m3	Std Err	# of samples>2/m3	Effect Size	p-value	Sig Diff
D2	0.50	0.06	3	0.23	0.06	Yes
D4	0.75	0.11	10	0.43	0.00	Yes
E	0.38	0.05	1			
O2	0.40	0.07	5	0.04	0.40	No
O4	0.56	0.12	8	0.20	0.08	Yes
U2	0.34	0.04	1	0.08	0.29	No
U4	0.43	0.08	5	0.08	0.29	No



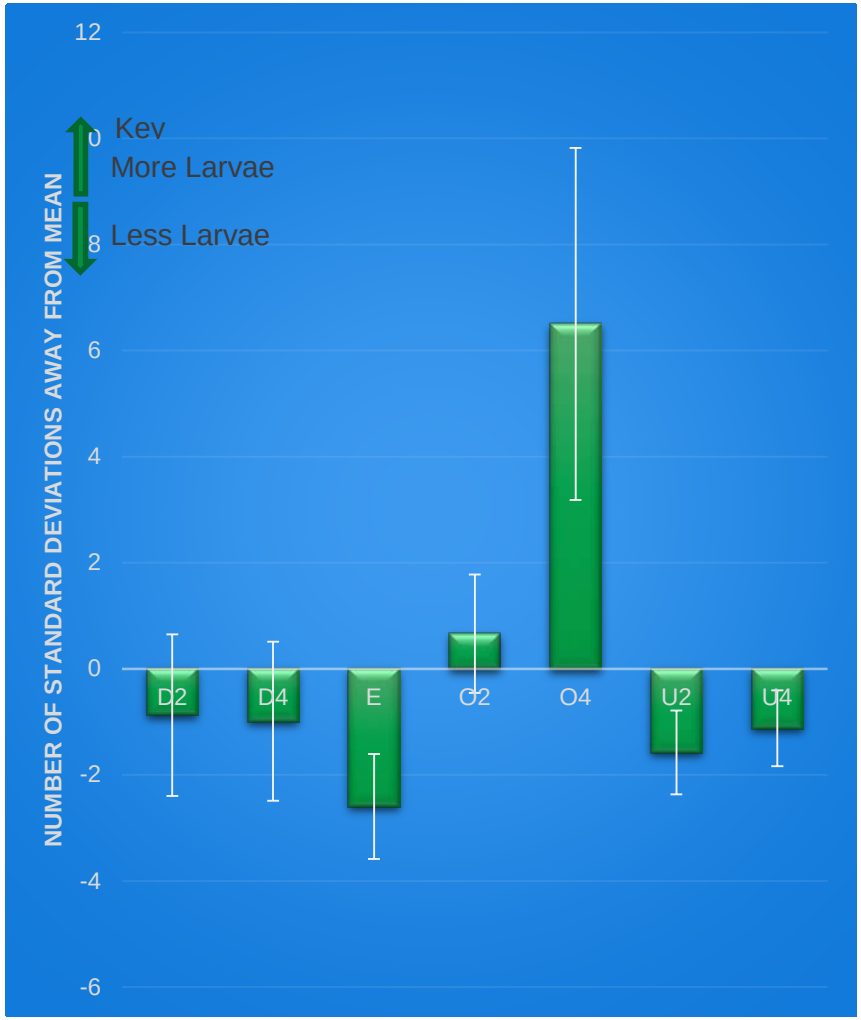
- Effect Size – each station's data compared against E
- P-value – each station's data compared against E

Mean Concentration – Standardized (Poseidon Method)

Standardized Concentration treats all taxa equally and the results better measure impacts to all forms of marine life rather than just the abundant taxa.

Station	Mean #/m3	Std Err	# of samples>2/m3	Effect Size	p-value	Sig Diff
D2	-0.88	1.52	4.35	0.20	0.18	Yes
D4	-0.99	1.50	4.29	0.23	0.19	Yes
E	-2.60	0.99				
O2	0.66	1.12	3.86	0.17	0.02	Yes
O4	6.50	3.32	9.31	0.70	0.01	Yes
U2	-1.58	0.79	3.01	0.52	0.21	Yes
U4	-1.12	0.72	2.96	0.38	0.12	Yes

- Effect Size – each station's data compared against E
- P-value – each station's data compared against E
- Including all samples over the year rather than annual totals softens the effect of a single large catch

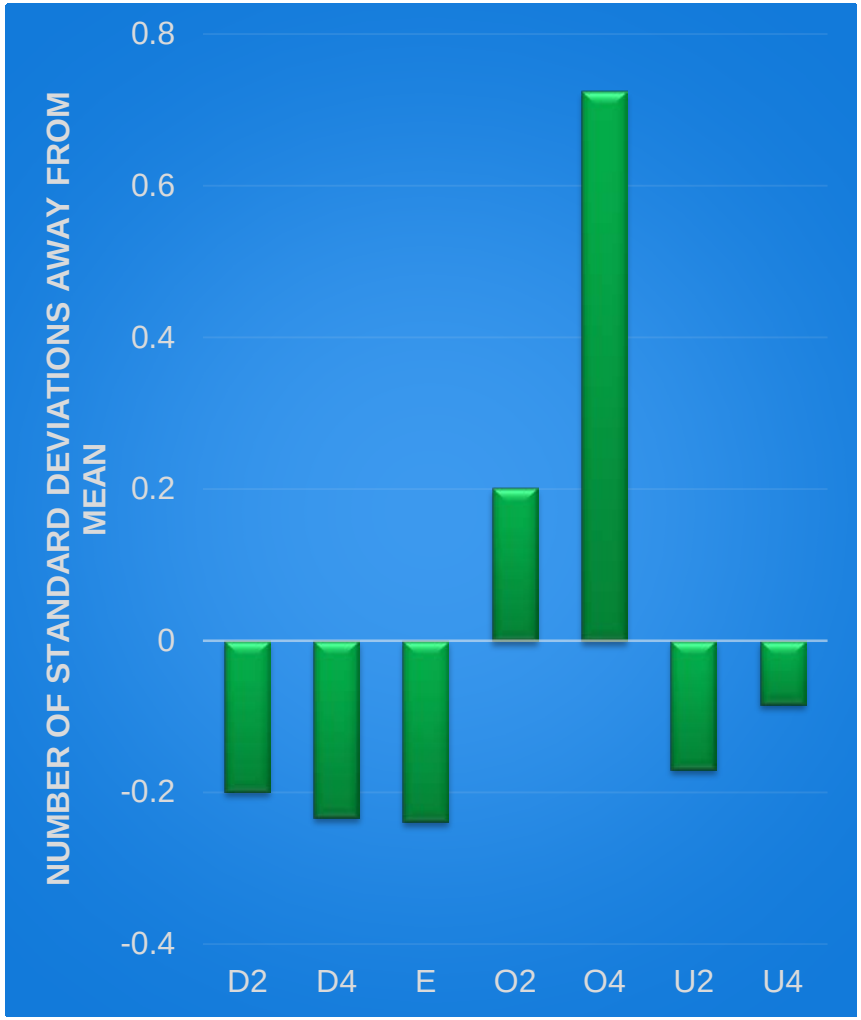


Mean Concentration – Standardized (White Paper Method)

Standardized Concentration treats all taxa equally and the results better measure impacts to all forms of marine life rather than just the abundant taxa.

Station	Mean	StdDev (Sta+E)	Effect Size	pvalue	p - ES	Sig Diff
D2	-0.20	0.83	0.05	0.37	0.32	No
D4	-0.23	0.84	0.01	0.48	0.47	No
E	-0.24					
O2	0.20	0.93	0.47	0.00	-0.47	Yes
O4	0.72	1.21	0.79	0.00	-0.79	Yes
U2	-0.17	0.81	0.09	0.28	0.19	No
U4	-0.08	0.86	0.18	0.11	-0.07	Yes

- Effect Size – each station's data compared against E
- P-value – each station's data compared against E



Harvested Species And MPA Beneficiaries

Descending Rank of table above. 1 = least and 7 = most abundant

Taxa	O4	O2	D2	D4	U2	E	U4	Fished (App D.)	MPA (Table C-1)
Emerita analoga (zoea)	1	2	4	3	5	6	7	NO	YES
Gobiidae unid.	1	2	6	7	3	5	4	NO	NO
Engraulis mordax	4	3	2	1	7	6	5	YES	NO
Seriphus politus	2	3	5	7	1	4	6	YES[1]	NO
Genyonemus lineatus	6	7	1	4	3	2	5	YES	NO
Sciaenidae unid.	7	6	3	2	4	1	5	YES	NA
Hypsoblennius spp.	7	5	3	1	4	2	6	NO	NO
Paralichthys californicus	7	6	3	1	5	2	4	YES	NO
Paralabrax spp.	**7**	**6**	**4**	**1**	**3**	**2**	**5**	**YES**	**YES**
Paralabrax clathratus	**7**	**6**	**3**	**1**	**5**	**2**	**4**	**YES**	**YES**
Atherinopsis californiensis	1	2	3	6	7	5	4	YES	NO
larvae, unidentified yolksac	6	7	3	1	4	2	5	NA	NA
Sardinops sagax	7	6	1	1	4	3	5	YES	NO
Sphyraena argentea	7	6	5	2	4	1	3	YES	NO
Chromis punctipinnis	**7**	**6**	**1**	**1**	**1**	**1**	**5**	**YES**	**YES**
Engraulidae	6	2	7	4	1	5	3	NA	NA
Hypsopsetta guttulata	3	4	5	2	7	1	6	YES	NO
Citharichthys stigmaeus	7	6	3	1	2	4	5	YES	NO
Cancer gracilis (megalops)	4	7	1	2	6	5	3	YES	NO
Cancer anthonyi (megalops)	**3**	**4**	**5**	**2**	**7**	**6**	**1**	**YES**	**YES**
Cancer antennarius (megalops)	**5**	**7**	**1**	**3**	**6**	**2**	**4**	**YES**	**YES**
Lepidogobius lepidus	6	7	4	5	3	2	1	NO	NO
larval fish fragment	7	4	2	1	6	5	3	NA	NA
Leuresthes tenuis	1	3	7	2	5	4	6	NO	YES
Pleuronichthys ritteri	7	6	3	2	4	1	5	YES	NO
Remaining Taxa - Sum	7	6	3	4	2	1	5		
Number of Taxa ID'd	77	74	51	52	58	54	55		
Sum of Ranks	133	129	88	67	109	80	115		
Rank of Sum of Ranks	7	6	3	1	4	2	5		

Sum of ranks = lowest sum is the station where each taxon is least abundant

Criteria in OPA – M.2.b. (Biological Points Only)

- *(3) Analyze the feasibility of placing intake, discharge, and other facility infrastructure in a location that avoid impacts to sensitive habitats* and sensitive species.*
  - **Moving the intake from Station E to any of the alongshore stations (U4, U2, D2, and D4) move the intake closer to one of the sensitive habitats and/or species nursery in the area**
  - **Moving the intake from Station E to an offshore station would move the intake closer to sensitive spawning grounds for a depressed species**
- *(4) Analyze the direct and indirect effects on all forms of marine life* resulting from facility construction and operation, individually and in combination with potential anthropogenic effects on all forms of marine life* resulting from other past, present, and reasonably foreseeable future activities within the area affected by the facility.*
  - **No difference in the seafloor topographic or geologic conditions = no benefit in moving intake**
  - **Construction-related environmental impacts (temporary and permanent) on marine life from moving the intake is still to be analyzed**
- *(5) Analyze oceanographic geologic, hydrogeologic, and seafloor topographic conditions at the site, so that the siting of a facility, including the intakes and discharges, minimizes the intake and mortality of all forms of marine life.**
  - **We will look at each of these in the context of the lines of evidence examined over the following slides**

Lines of Evidence Examined

Below are the percentage of the maximum value for each metric by station.

Station	4-Taxa APF %	Mean Concentration - Without Emerita %	Mean Concentration - All Taxa Included %	Standardized Concentration - White Paper Method %	Standardized Concentration - Poseidon Method %	Standardized Concentration – CCC Method %
D2	47%	66%	63%	47%	22%	26%
D4	51%	100%	91%	45%	21%	22%
E	58%	50%	75%	47%	4%	5%
O2	100%	54%	49%	69%	39%	45%
O4	65%	75%	67%	100%	100%	100%
U2	71%	46%	60%	51%	15%	18%
U4	40%	57%	100%	52%	20%	18%