

The Economic and Environmental Impacts of Moorage Marinas on the West Coast

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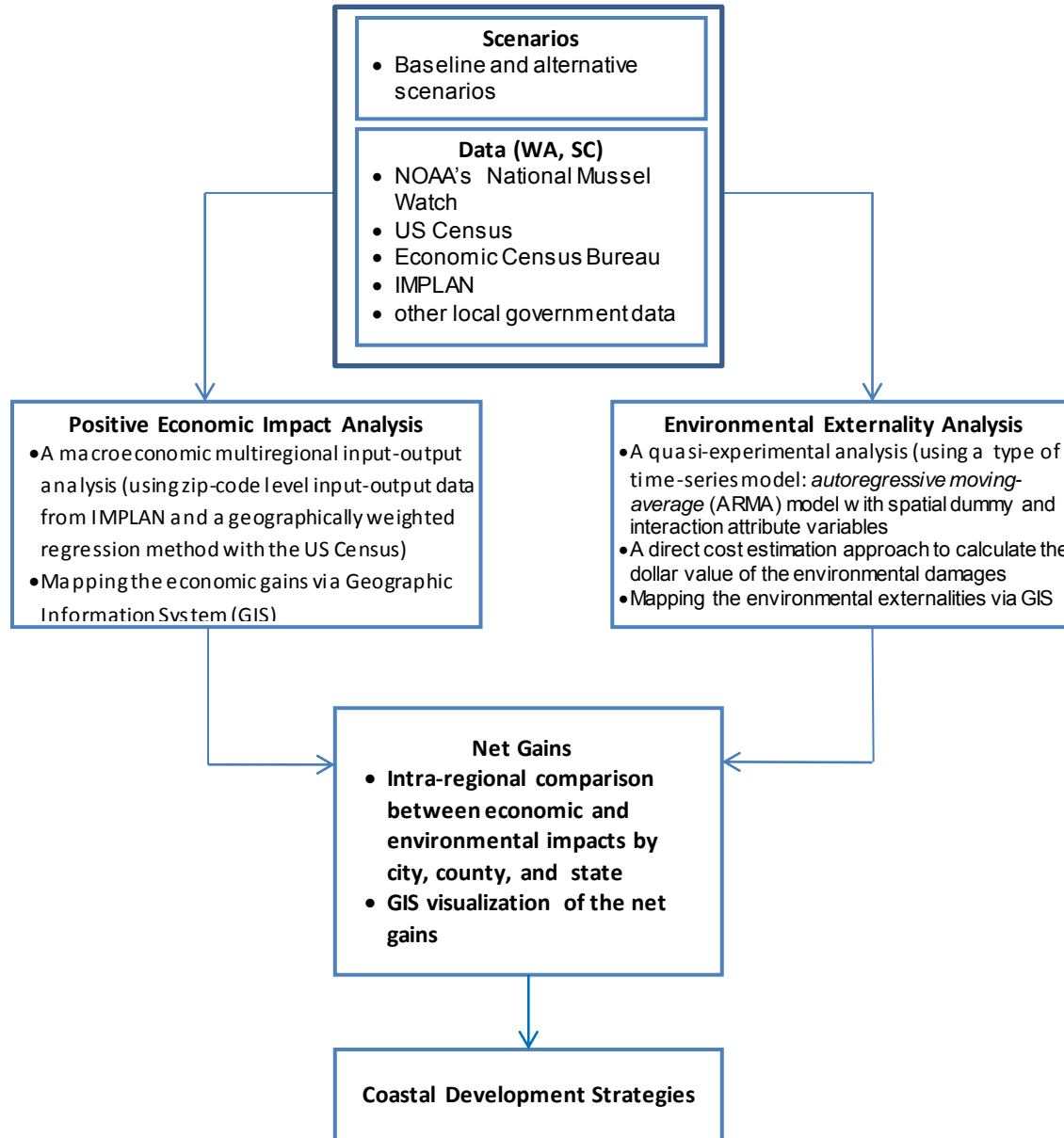
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Research Synopsis

- What benefits do marinas bring to different level economies and how marinas affect other industries and economic factors?
- Annual spending related to recreational boating activities is **\$51.4 billion**, and total number of boats reaches more than **1.2 million** in the United States (National Marine Manufacturers' Association: NMMA, 2012).
- The Marina Economy plays an ever more significant role in California, based on increasing demand for marine recreations because weather allows year round access to ocean activities.

Research Framework



Part I: Synopsis of Economic Impact Analysis

- This study investigates the economic impacts of marinas with a zip-code level multiregional input-output (MRIO) model.
- Based on existing economic impact reports that were largely related to port activities in Southern California (SC), 19 out of 440 IMPLAN Sectors were identified.
- These sectors were aggregated to 2-digit NAICS sectors, where 10 MRIO sectors were defined for input values of the SC MRIO.
- To obtain more detailed marina-specific economic activities, 20 zip-codes that include salt-water boating marinas in SC were defined.
- In this study, a null model that uses IMPLAN without any specific zip-code level activities was applied to understand how a one-region SC demand-based IO model can be different from the supply-based MRIO model.

Economic Impact Modeling

- Economic impact models of marinas: a one-region IO vs. Southern California MRIO models.
- As a null model, we have provided a traditional, demand-based IMPLAN approach to estimating hypothetical economic impacts for Southern California.
- IMPLAN provides zip-code level information, but it cannot fully provide such MRIO impacts with various zip-code level inputs.
- Further, it only provides demand-based results.
- For the null model analysis, we aggregated the zip-code information of SC to one region.
- Consistent to other economic impact studies conducted previously but with minor modification, we selected 19 industry sectors associated with marina activities (California Economic Forecast, 2014).

Economic Impact Modeling

- The supply-side MRIO models for SC provides the economic impacts of a specific marina, which are transferred to other regions.
- As input data sources for the impact analysis of marina activities using the supply-side SC MRIO model at the zip-code level, IMPLAN's zip code level total value added information by 19 marina-related industry sectors were collected.
- It was assumed that marina locations be covered by business activities at the zip code level, including Employee Compensation, Proprietor Income, Other Property Income, and Taxes on Production and Imports net of subsidy.

SC MRIO Model

- Base year: 2010
- Target region: Southern California
 - 7 counties (Los Angeles, Orange, San Bernardino, Riverside, Ventura, Imperial and San Diego); and
 - 627 zip-codes
- 21 industry sectors consistent with the North America Industry Classification System (NAICS) 2-digit level.

SCAG Region



Source: http://www.scag.ca.gov/eMap/images/scag_region04.jpg

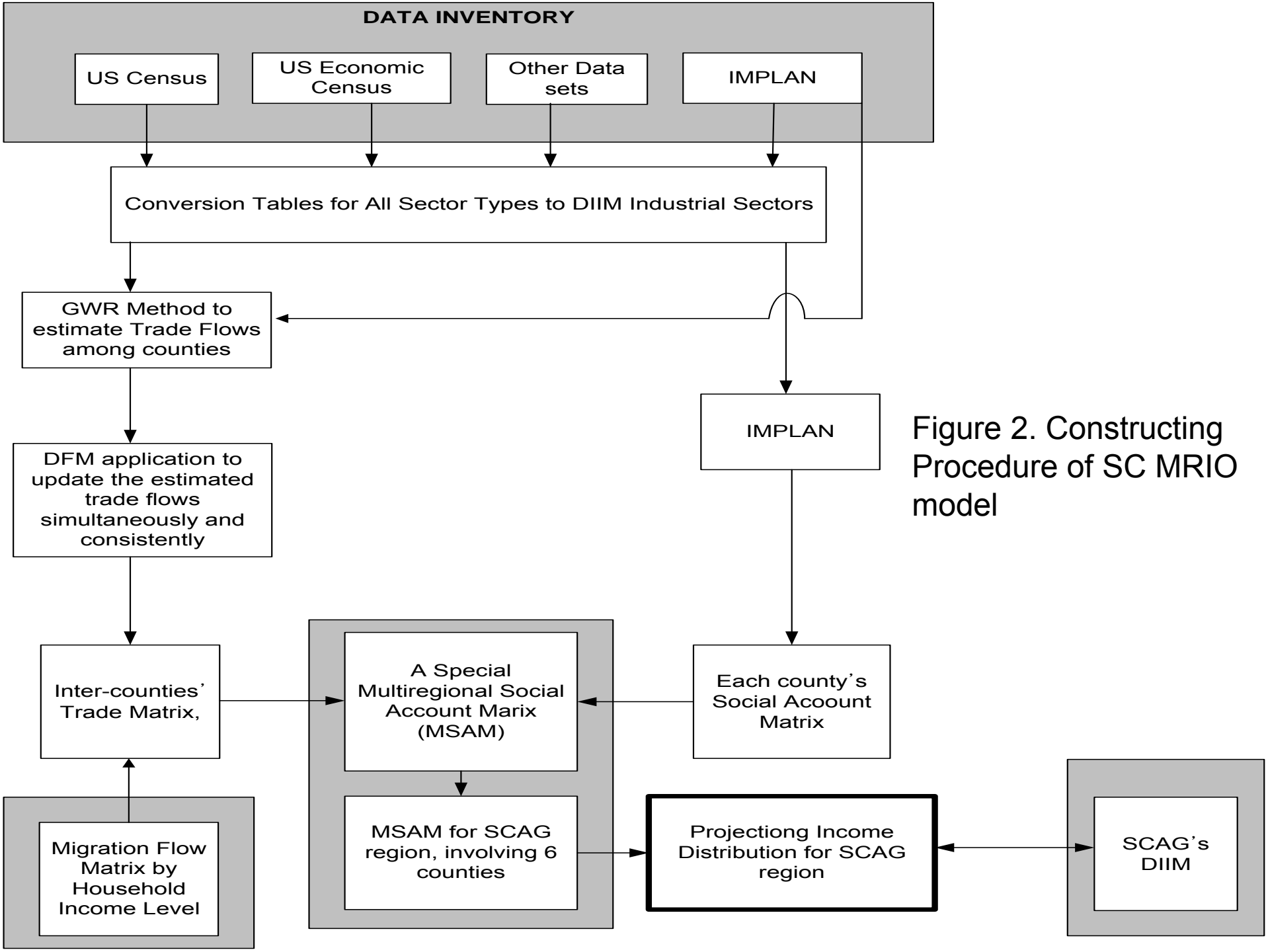


Figure 2. Constructing Procedure of SC MRIO model

Economic Impact Modeling

- Developed a hypothetical scenario that assumed 10% increase in final demand factors
- The analyses conducted on the basis of a hypothetical 10% increase in final demand of the recreational-boat activity related sectors are similar to the sectors conducted by the California Economic Forecast (2014). With this null model, we tried to clarify how both economies are stimulated by the recreational-boat activities. For total impact estimates that include indirect and induced impacts, a Type SAM multiplier also has been applied. The total economic impacts accounted for 1.09% for Southern California with the hypothetical economic impact analyses.

Economic Impact Analyses (one region)

Table 1. IMPLAN industrial sectors applied for economic impact analyses

IMPLAN Industry Code	Description
17	Commercial Fishing
291	Boat building
320	Retail Stores - Motor vehicle and parts
324	Retail Stores - Food and beverage
326	Retail Stores - Gasoline stations
327	Retail Stores - Clothing and clothing accessories
329	Retail Stores - General merchandise
334	Transport by water
340	Warehousing and storage
363	General and consumer goods rental except video tapes and discs
374	Management, scientific, and technical consulting services
386	Business support services
406	Museums, historical sites, zoos, and parks
409	Amusement parks, arcades, and gambling industries
410	Other amusement and recreation industries
413	Food services and drinking places
422	Other personal services
425	Civic, social, professional, and similar organizations
439	Employment and payroll only (federal govt, non-military)

Economic Impact Analyses (one region)

Table 2. Economic information on selected IMPLAN industrial sectors, Southern California (2010)

IMPLAN Industry Code	Employment	Total Output (\$M)	Employee Compensation (\$M)	Tax on Production and Imports (\$M)
17	2,394	136.17	15.03	3.24
291	447	85.50	20.46	1.30
320	108,325	11,101.33	5,292.23	1,244.91
324 (Retail:Food/Bev)	200,809	13,321.82	6,181.07	2,204.80
326	28,612	4,233.66	791.26	786.59
327	128,019	8,107.96	2,811.60	1,441.31
329 (Retail: Gen Merch)	167,983	10,146.28	4,941.37	1,746.53
334	3,881	1,731.05	259.56	59.60
340	45,404	4,275.26	2,238.87	41.36
363	18,314	1,763.08	502.96	159.75
374	80,707	9,683.75	4,477.09	82.70
386	46,801	2,956.01	1,738.89	39.79
406	8,091	1,059.90	343.04	35.55
409	74,957	7,306.12	1,945.37	849.74
410	28,156	1,746.20	630.89	125.65
413 (Food/Drink'g)	697,362	42,482.25	13,850.07	3,093.35
422	48,368	7,020.35	857.79	257.59
425	77,048	6,615.04	3,264.10	175.73
439	109,911	13,778.05	12,549.08	0.00
Total	1,875,591	147,549.81	62,710.73	12,349.49

Note: Highlighted rows indicate top three IMPLAN industry codes measured with the number of employment.

Economic Impact Analyses (one region)

Table 3. Direct economic impact on selected IMPLAN industrial sectors of Southern California (2010).

IMPLAN Industry Code	Southern California (\$M)
17	0.472
291	0.383
320	1,035.692
324	1,097.313
326	402.138
327	580.381
329	974.195
334	35.095
340	9.767
363	104.319
374	60.578
386	43.448
406	85.055
409	460.818
410	152.394
413	2,940.917
422	327.050
425	458.993
439	1,377.805
Direct impact total	10,146.82

Economic Impact Analyses (one region)

Table 5. Economic impact summary (2010)

Total Output (\$M)						
	Direct Impact	Indirect Effect	Induced Effect	Total Effect	Multiplier (Type I)	Multiplier (Type SAM)
Southern California	10,146.8	2,859.6	5,730.4	18,736.9	1.28	1.85
Washington	3,540.5	1,091.0	1,961.3	6,592.8	1.31	1.86
Jobs						
	Direct Impact	Indirect Effect	Induced Effect	Total Effect	Multiplier (Type I)	Multiplier (Type SAM)
Southern California	131,827	18,474	41,336	191,638	1.14	1.45
Washington	48,725	7,526	15,180	71,432	1.15	1.47

Economic Impact Analyses (SC MRIO)

Table 7. The supply-side Southern California MRIO model industry sector system

MRIO Sectors	Sector Description
11	Total Farm
21	Natural Resources and Mining
22	Utilities
23	Construction
31	Manufacturing
42	Wholesale Trade
44	Retail Trade
48	Transportation and Warehousing
51	Information
52	Finance and Insurance
53	Real Estate and Rental and Leasing
54	Professional, Scientific and Technical Services
55	Management of Companies and Enterprises
56	Administrative and Support and Waste Services
61	Educational Services
62	Health Care and Social Assistance
71	Arts, Entertainment, and Recreation
72	Accommodation and Food Service
81	Other Services
92	Public Administration
93	Not an industry

Economic Impact Analyses (SC MRIO)

Table 8. Total Economic Impact of the supply-side Southern California MRIO model at the zip-code level by industry sector (2010)

MRIO Sectors	Direct Impact	Indirect Impact	Total Impact	
11	5.82	0.60	6.42	(0.1)
21	0.00	4.54	4.54	(0.1)
22	0.00	3.77	3.77	(0.1)
23	0.00	6.79	6.79	(0.1)
31	1.75	798.34	800.09	(16.8)
42	0.00	9.26	9.26	(0.2)
44	957.57	13.09	970.66	(20.4)
48	164.97	17.81	182.78	(3.8)
51	0.00	44.99	44.99	(0.9)
52	0.00	20.48	20.48	(0.4)
53	18.58	150.79	169.36	(3.6)
54	257.88	217.48	475.36	(10.0)
55	0.00	93.97	93.97	(2.0)
56	88.44	28.44	116.88	(2.5)
61	0.00	15.20	15.20	(0.3)
62	0.00	68.97	68.97	(1.4)
71	264.93	77.72	342.65	(7.2)
72	765.66	81.94	847.60	(17.8)
81	176.74	31.23	207.97	(4.4)
92	0.00	5.33	5.33	(0.1)
93	286.77	77.04	363.81	(7.6)
Total	2,989.11	1767.76	4756.86	
Type 1 Multiplier				1.5914

Note: 1. Unit - million dollars

2. The value in parenthesis is a percentage value to the total.

Findings from SC MRIO

- With \$2,989 million of the direct impact, the estimated result shows that marina activities in the Southern California create \$4,757 million of total economic impact on the Southern California economy.
- Most affected top 3 industry sectors are Sectors 44 (Retail Trade), 72 (Accommodation and Food Service), and 31 (Manufacturing).
- These three sectors account for 55% of total economic impact. Sectors 54 (Professional, Scientific and Technical Services) and 93 (Not an industry) are followed as 10% and 7.6% of total economic impact, respectively.

Conclusions

- Economic Impact analyses have been conducted using one traditional IMPLAN model for Southern California and a supply-side Southern California multiregional input-output model at the zip-code level to apply for a local economic activity impact analysis.
- Consistent to other economic impact studies conducted previously but with minor modification, we selected 19 industry sectors associated with marina activities.
- Developing a hypothetical scenario that assumed 10% increase in final demand factors, we conducted simple economic impact analyses for the SC region relying on IMPLAN software.
- For total impact estimates that include indirect and induced impacts, a Type SAM multiplier has been applied.

Conclusions

- The main element absent from this analysis is an estimation of economic impacts that are different by marina facility. Marina facility size and development level vary, and the economic contributions to each region will be different.
- To address the different geographical contribution by moorage facility location in Southern California, an MRIO-type model were developed.
- A new MRIO model has a NAICS code system. Developing spatial econometric models for each sector with IMPLAN's zip-code datasets for Southern California could figure out geographical ripple impacts.
- These results applied with the zip-code MRIO models are expected to be visualized with ArcGIS software to comprehensively present geographical differences in economic impacts for the target region.

Future Work

- Validation and sensitivity test
- Dynamic modeling
- Connecting to a land use/transportation demand model, or to an integrated land use transportation model
- Projecting future demands on a region's local issues , therefore, requires detailed understanding of the current characteristics and predicting future changes that will appear in the region.
- These results applied with the zip-code MRIO models can also be visualized with ArcGIS software to comprehensively present geographical differences in economic impacts for the SC region in an extended study.



Part II: Environmental Impacts of Marinas

Progress (2014-15)

- Established partners
- Research meetings
- Literature search
- Data collection & analyses
 - Marinas in WA and So Cal
 - Mussel data (NOAA & WA DFW)
- Mapping pollutants
- Website in progress
(depts.washington.edu/sgmarina)

U.S. Department of Commerce | National Oceanic and Atmospheric Administration | National Ocean Service



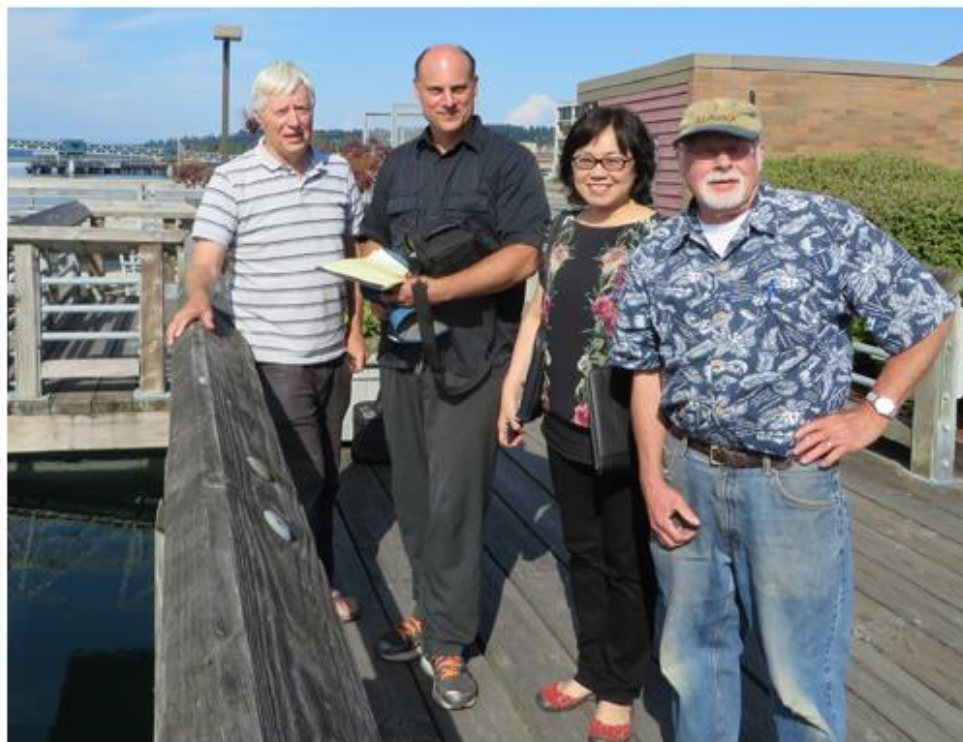
Office of Response and Restoration

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Economic Benefits vs. Environmental Impacts of Marinas and Boat Harbors

On August 18, 2014, OR&R Senior Scientist Alan Mearns met with two professors funded by NOAA Sea Grant to evaluate the economic benefits vs. environmental impacts of marinas and boat harbors.

Dr. Christine Bae, Department of Urban Planning at the University of Washington, and Dr. Nathaniel Trumbell, Department of Geography at University of Connecticut, along with economic researchers at the University of Southern California are applying an economic model to marinas. They are also seeking data and information on



Lincoln Loehr, Nat Trumbell, Christine Bae and Alan Mearns at Edmonds Marina. (NOAA)

On Our Radar

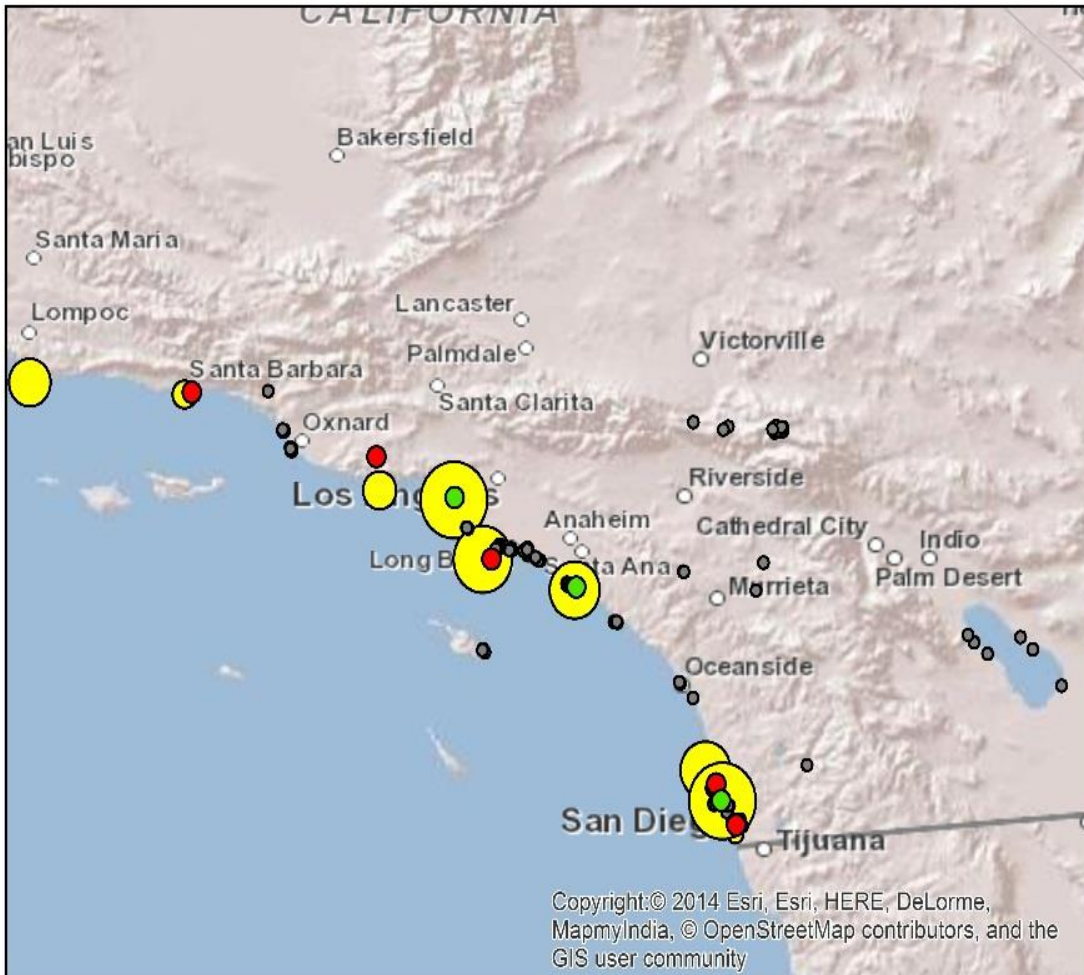
Response Tools for Spills



How Big Is the Pacific Garbage Patch?



Concentration of Copper among NOAA Mussel Watch Sites and Marinas in So. Cal

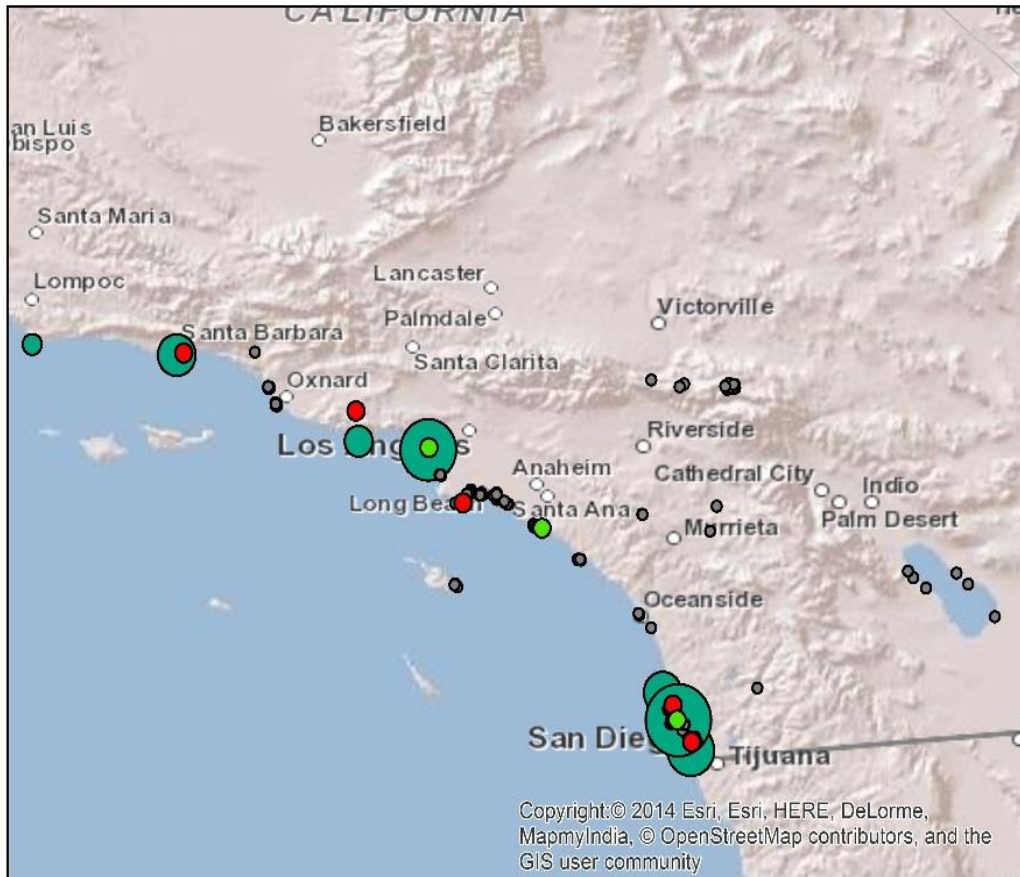


- Marinas Within 2km of MW sites(3)
- Marinas Within 5km of MW sites(9)
- All Marinas in SoCal (224)

NOAA Mussel Watch Copper Data(2012, 9 sites) ($\mu\text{g}/\text{dry g}$)

- 8.93
- 8.94 - 9.73
- 9.74 - 10.50
- 10.51 - 11.10
- 11.11 - 11.40
- 11.41 - 12.90
- 12.91 - 24.00

Concentration of PAHs among NOAA Mussel Watch Sites and Marinas in So. Cal

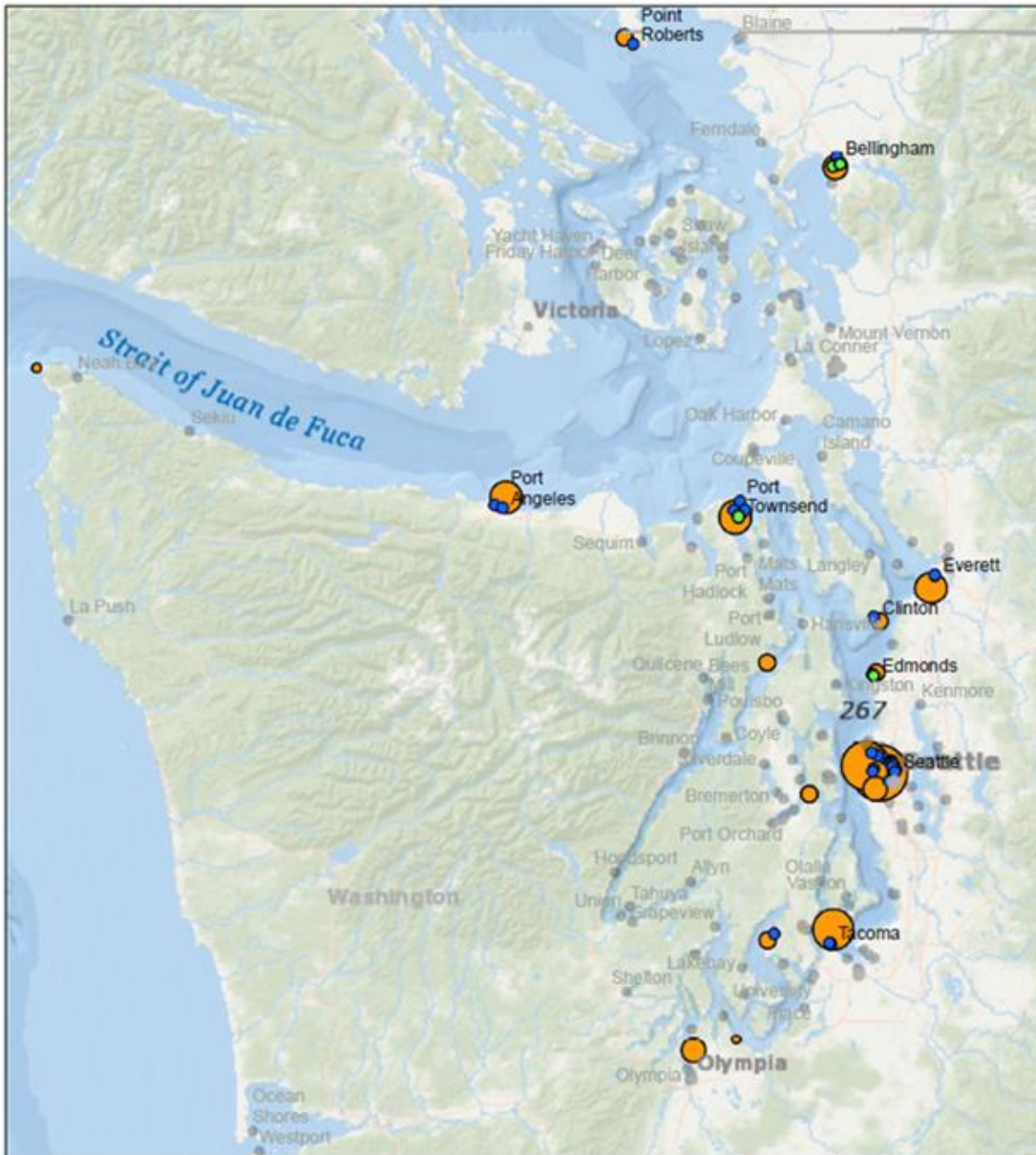


- Marinas Within 2km of MW sites(3)
- Marinas Within 5km of MW sites(9)
- All Marinas in SoCal (224)

NOAA Mussel Watch PAHs Data(2012, 9 sites)
Sums of 68 PAHs (ng/dry g)

- 139.57 - 141.07
- 141.08 - 165.96
- 165.97 - 191.15
- 191.16 - 290.25
- 290.26 - 521.86
- 521.87 - 1687.84
- 1687.85 - 3006.06

Concentration of PAHs among NOAA Mussel Watch Sites and Marinas in Seattle MA



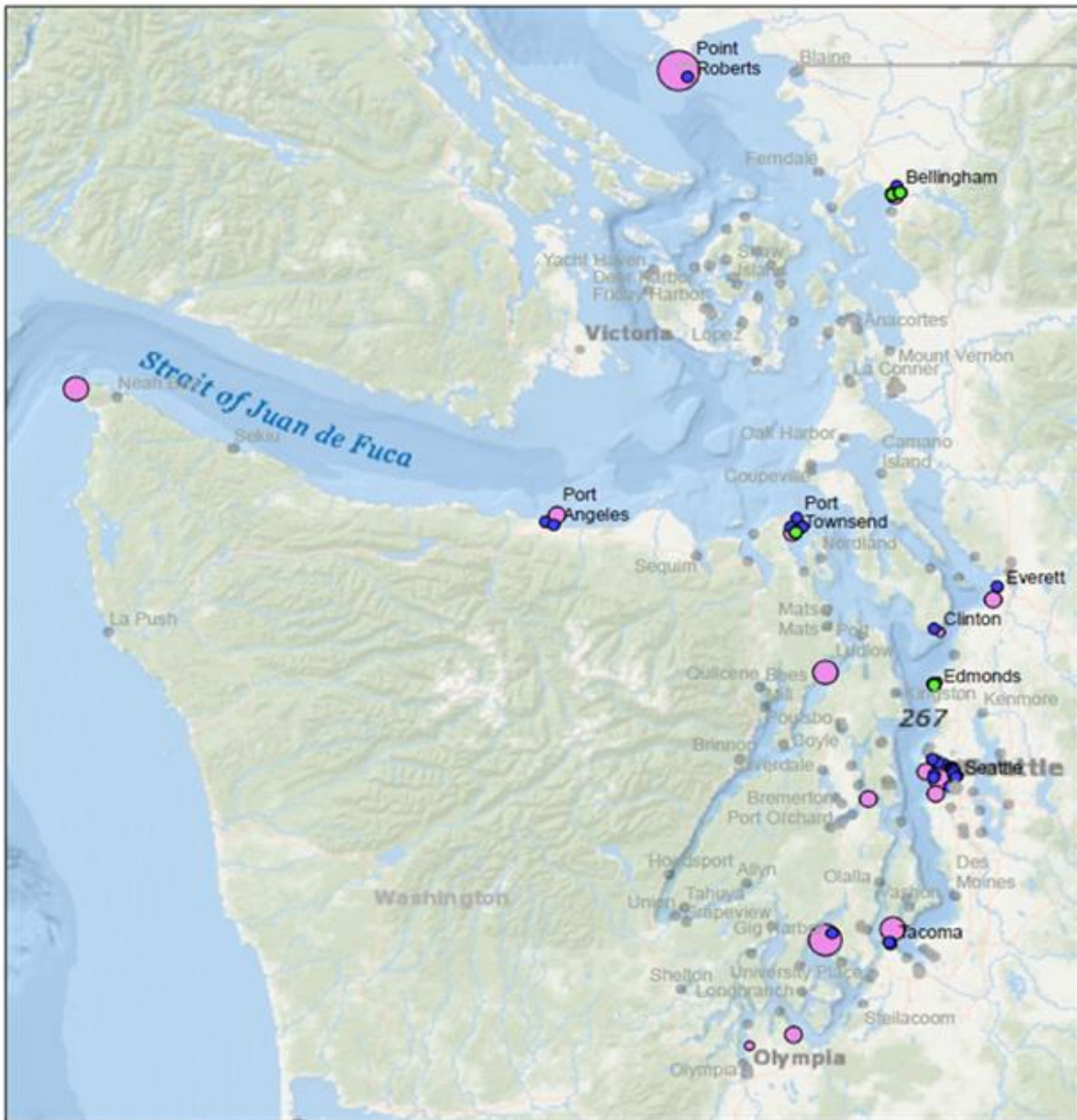
- Marinas - 2km from PAH MW sites (8)
- Marinas - 5km from PAH MW sites (47)
- Total Marinas in WA (246)

NOAA Mussel Watch (18 sites)

Sum of 68 PAHs (ng/g, dry wt.)

- 149.69 - 321.36
- 321.37 - 1342.54
- 1342.55 - 2076.17
- 2076.18 - 2889.19
- 2889.20 - 5637.10
- 5637.10 - 12484.49
- 12484.50 - 52553.52

Concentration of Copper among NOAA Mussel Watch Sites and Marinas in Seattle MA



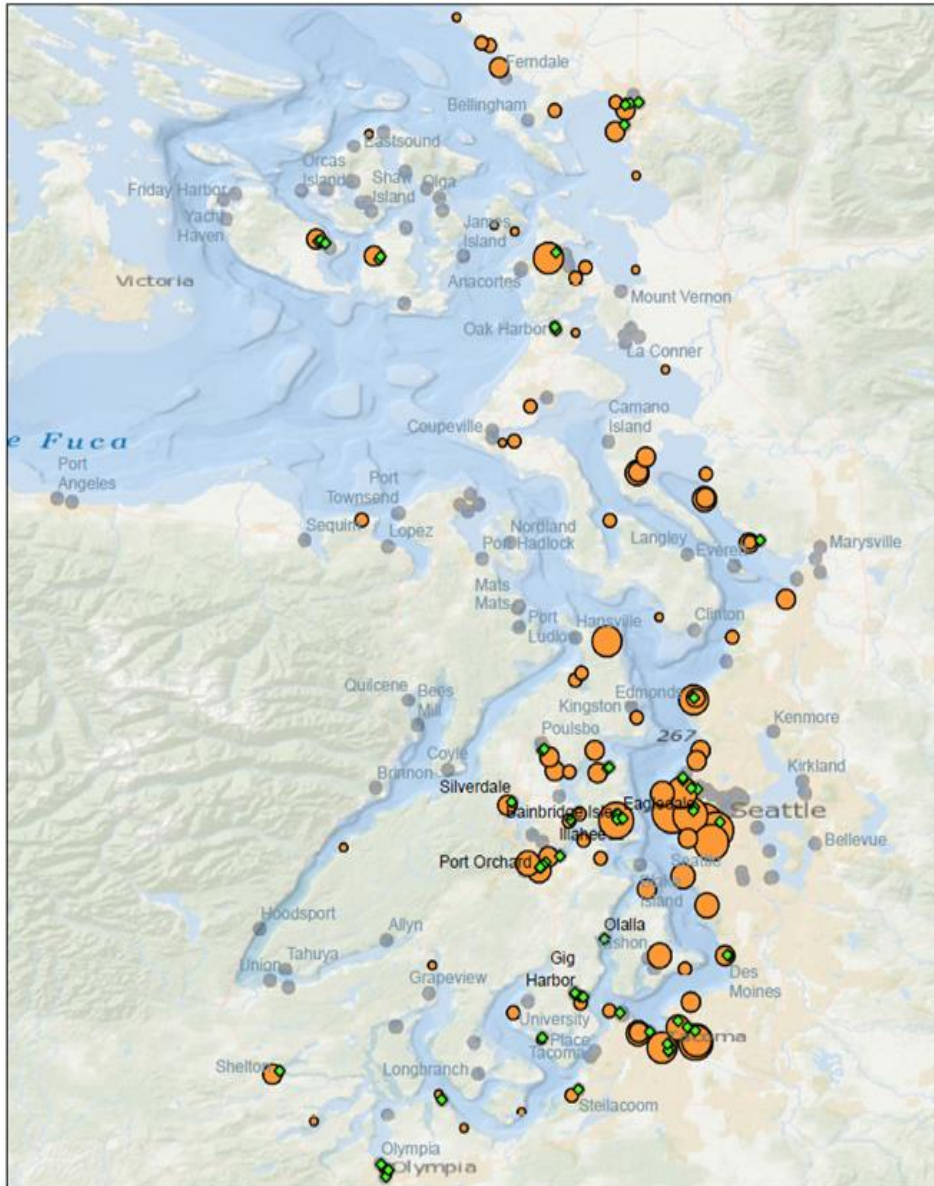
- Marinas - 2km from Copper MW sites (8)
- Marinas - 5km from Copper MW sites (47)
- Total Marinas in WA (246)

NOAA Mussels Watch (18 sites)

Copper (µg/g, dry wt.)

- 6.77 - 7.93
- 7.94 - 12.40
- 12.41 - 20.10
- 20.11 - 41.80
- 41.81 - 63.60

Concentration of PAHs among WA DFW Mussel Watch Pilot Expansion Sites



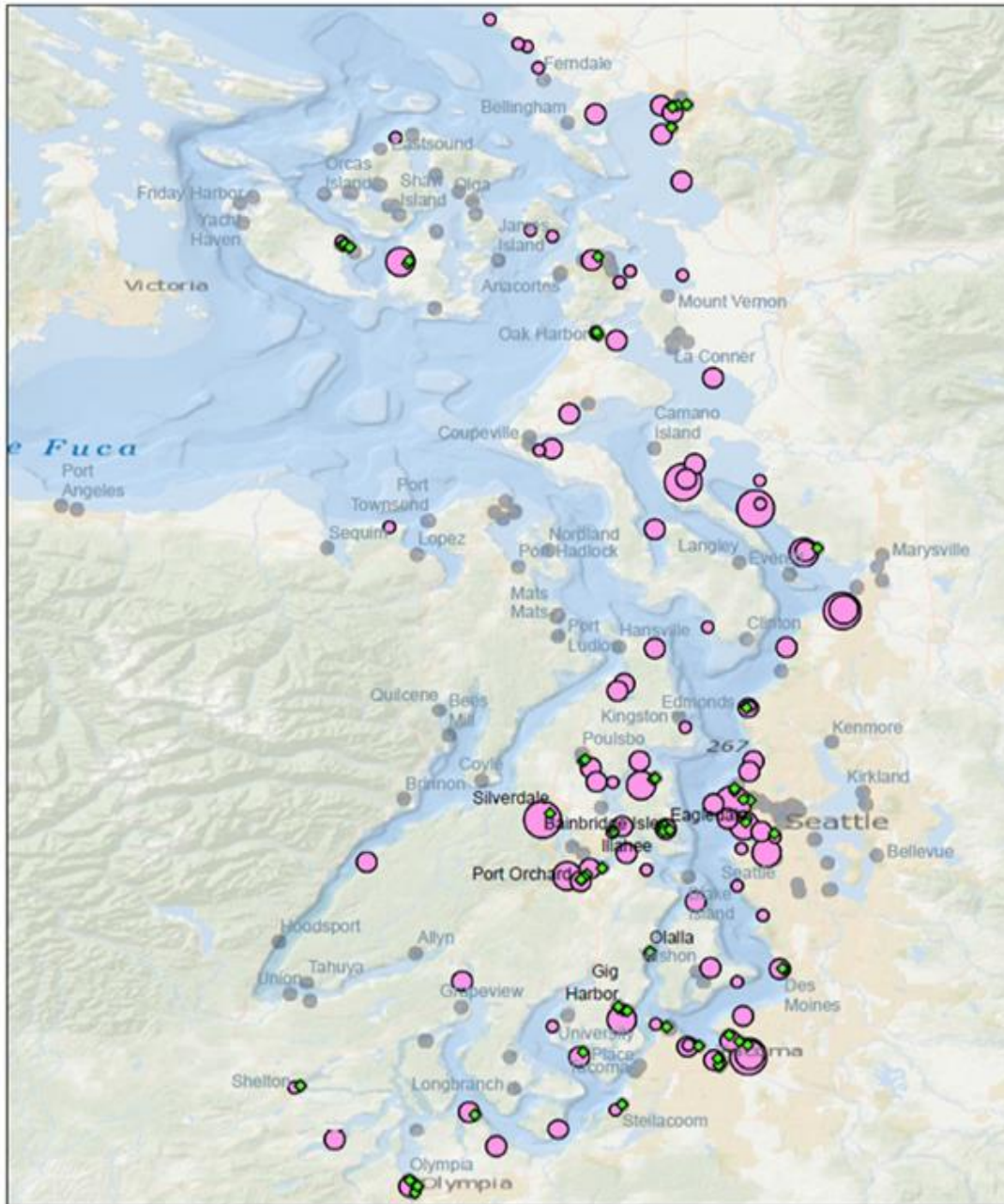
- WA Marinas_All (246)
- ◆ WA Marinas_2km from Lanksbury Site (74)

DFW Mussels Watch Data (96 sites)

Sum of 42 PAHs (ng/g, dry wt.)

- 0 - 130.90
- 130.91 - 312.30
- 312.31 - 557.50
- 557.51 - 912.80
- 912.81 - 1584.95
- 1584.96 - 3154.90
- 3154.91 - 5030.10

Concentration of Copper among WA DFW Mussel Watch Pilot Expansion Sites



- WA Marinas_All (246)
- ◆ WA Marinas_2km from Lanksbury Site (74)

DFW Mussels Watch Data (96 sites)

Copper ($\mu\text{g/g}$, dry wt.)

- 0.00
- 0.01 - 5.43
- 5.44 - 6.80
- 6.81 - 8.72
- 8.73 - 13.90

We proposed to use NOAA Mussel Watch Data
We also identified WA Department of Fish and
Wildlife's *Mussel Watch Pilot Expansion* (20



Differences in mussel databases

NOAA

- 18 sites during the winter
 - Several wild mussels (*Mytilus sp.*)
- 3 sites within 2 km from marinas
- Sum of 69 PAHs
- Sample sites are close to the surface
 - Intertidal zone: +3 to 6 ft
- The range of PAHs levels much greater than those of DFW's. (150~52,554 ng/g)

WA DFW (Dept of Fish and Wildlife)

- 96 sites during the winter
 - Single mussel types (*Mytilus trossulus*)
- 74 sites within 2 km from marinas
- Sum of 48 PAHs
- Sample sites were 0 to 1.5 feet MLLW (Mean lower low water), where mussels actually grow
- 130~5,030 ng/g

Source Activities	Pollutants/Pollution Effects
Anti-fouling	Copper, zinc, trivutyltin
Fuel additives	arsenic, zinc, aluminum
Bottom paint	copper, tributyltin
Sewage/fish cleaning/food waste/pumpout	BOD, SOD
Oil spill/refueling/leaky outboard motors/oily bilges	Hydrocarbon, fish embryos, oiled birds feather
Impervious structures (jetties, parking lots, pavement, roofs)	Turbidity of sediments, runoff
Dock structure	marine, benthic life
Washwater	metals, organics, oil and grease
Boat sinking	fuels, oil spills, debris
Fires	

PAHs

- Higher concentration of PAHs in/around marinas and ferry terminals
 - Boats/vehicle engines
- PAHs concentrated more in vicinity of urbanized areas
 - Highest level: Elliott Bay
 - Medium level: Puget Sound
 - Lowest level: North and South of Puget Sound

Copper

- Copper is the most frequent chemical identified with marinas and boats
- Copper paint will be banned in WA in 2018
- Copper in the *Marina del Rey* sediment contamination is a significant issue. In So Cal, the copper concentration is much higher than TMDL.
 - Mussels cannot live in MdR



Methodological challenges

- Mussel Watch data set is uneven, spatially and temporally
- A number of determinants complicate the measure of possible correlation between marinas' environmental impact and mussel data

Marinas' potential environ. impacts

Negative

- Anti-fouling paint
- Fuel spills
- Washing/cleaning of boats
- Shading

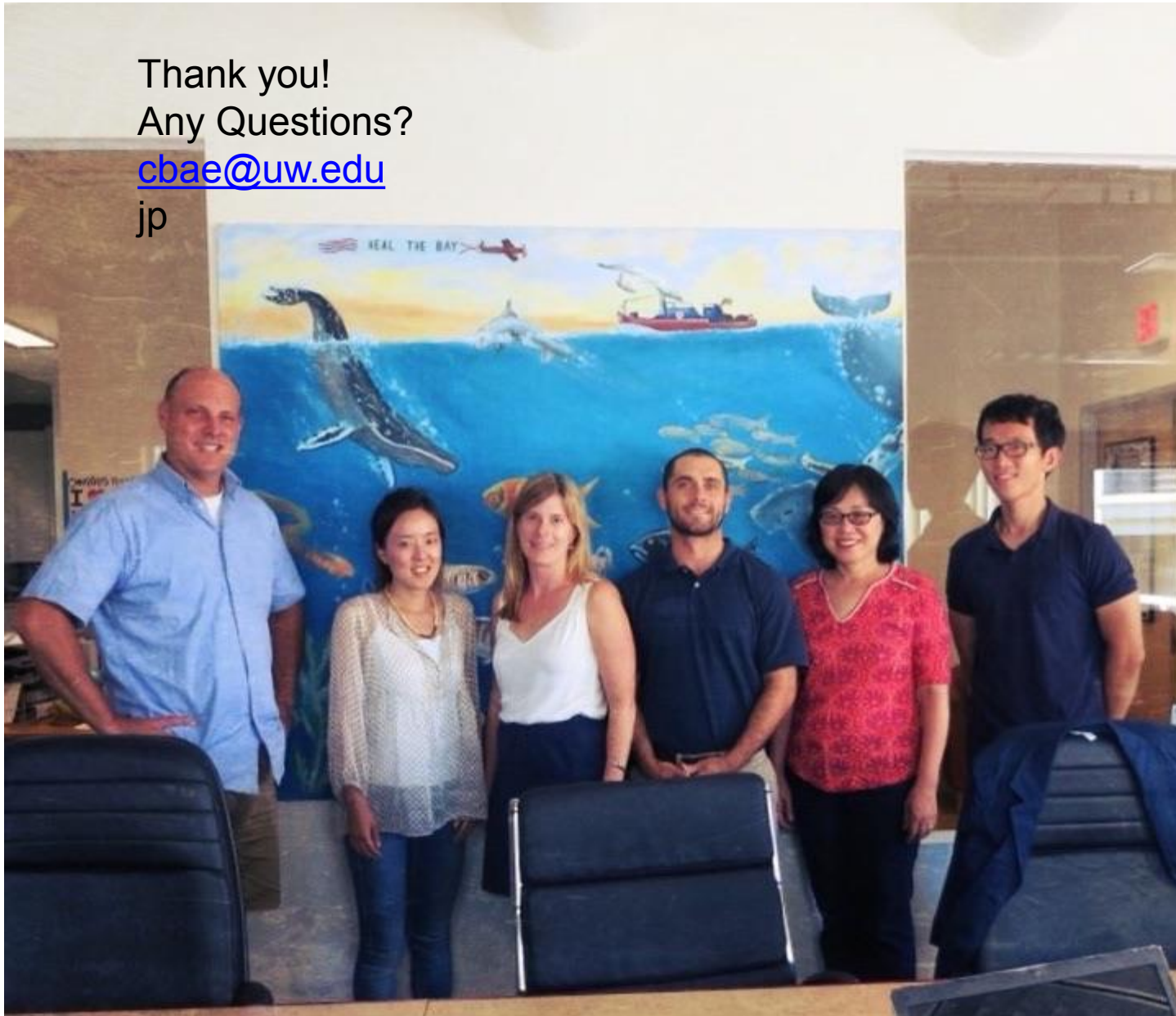
Positive

- Increased habitat on structures
- Increased environ. observation

Upcoming major tasks

- Inclusion of environmental data beyond mussel data
- How to quantify environmental cost to economic impacts
 - Investigate the costs of mitigation measures (environmental clean up costs)
 - Contingent valuation survey
 - Allocation of pollution levels

Thank you!
Any Questions?
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Primary analytes related to marinas

Organic Chemicals

- PAHs
- PBDE
- PCBs
- DDTs

•PAHs	polycyclic aromatic hydrocarbons	boat/vehicle engines
•PBDE	Polybrominated diphenyl ethers	flame deterrant
•PCBs	Polychlorinated biphenyls	boat bottom paint, electrical equipment
•DDTs	dichloro-diphenyl-trichloroethane	insecticide

Metals

- Copper
- Lead
- Zinc: hull protection
- Tributiltins (TBTs): antifouling paints, bioaccumulation, killing barnacles, algae, enters food chain