Action Effectiveness Monitoring Research (AEMR)

Prey transport from wetlands and potential benefits to mainstem migrants

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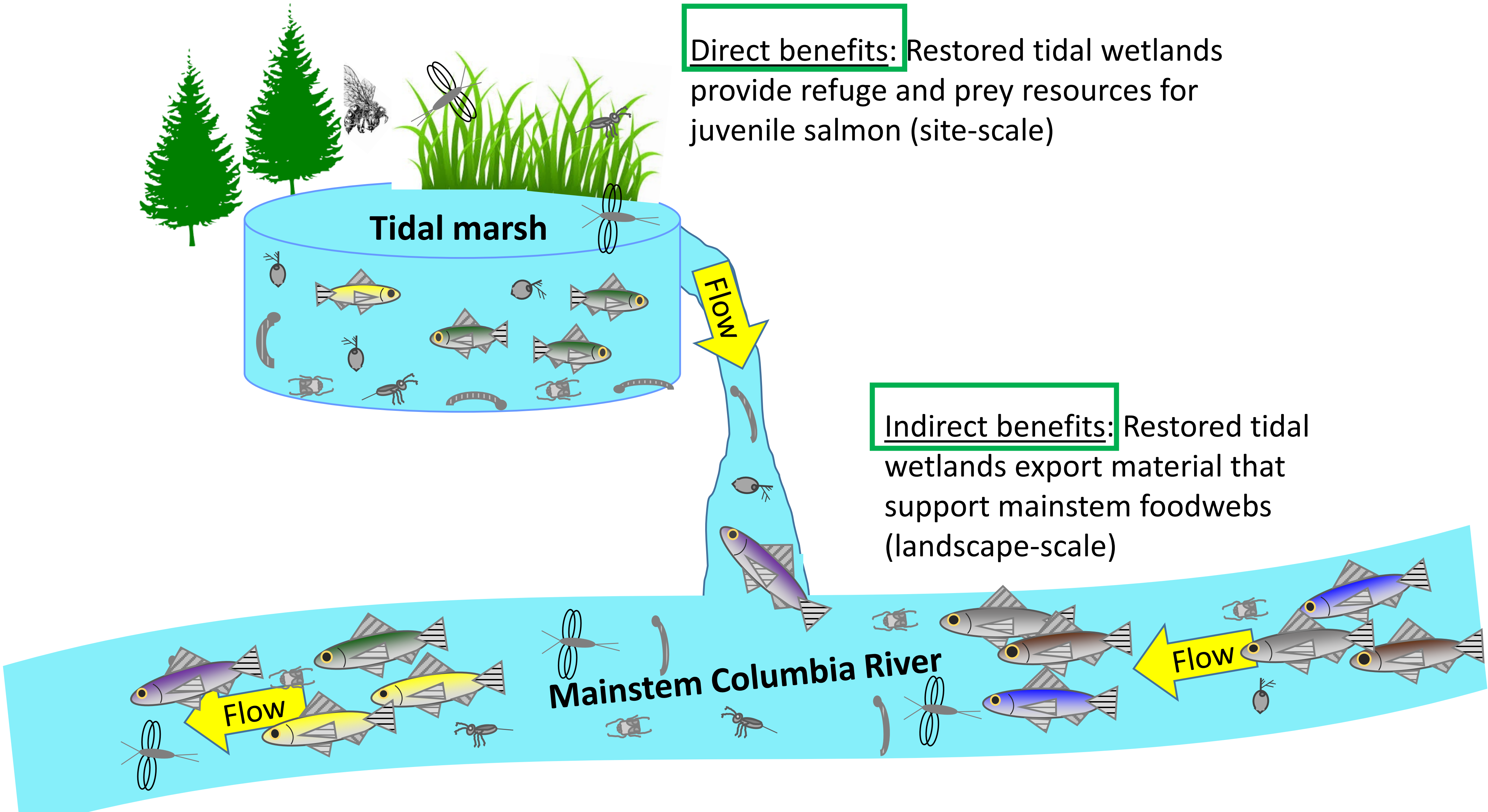
Willamette Fisheries Science Review

13 March 2019
Corvallis, OR

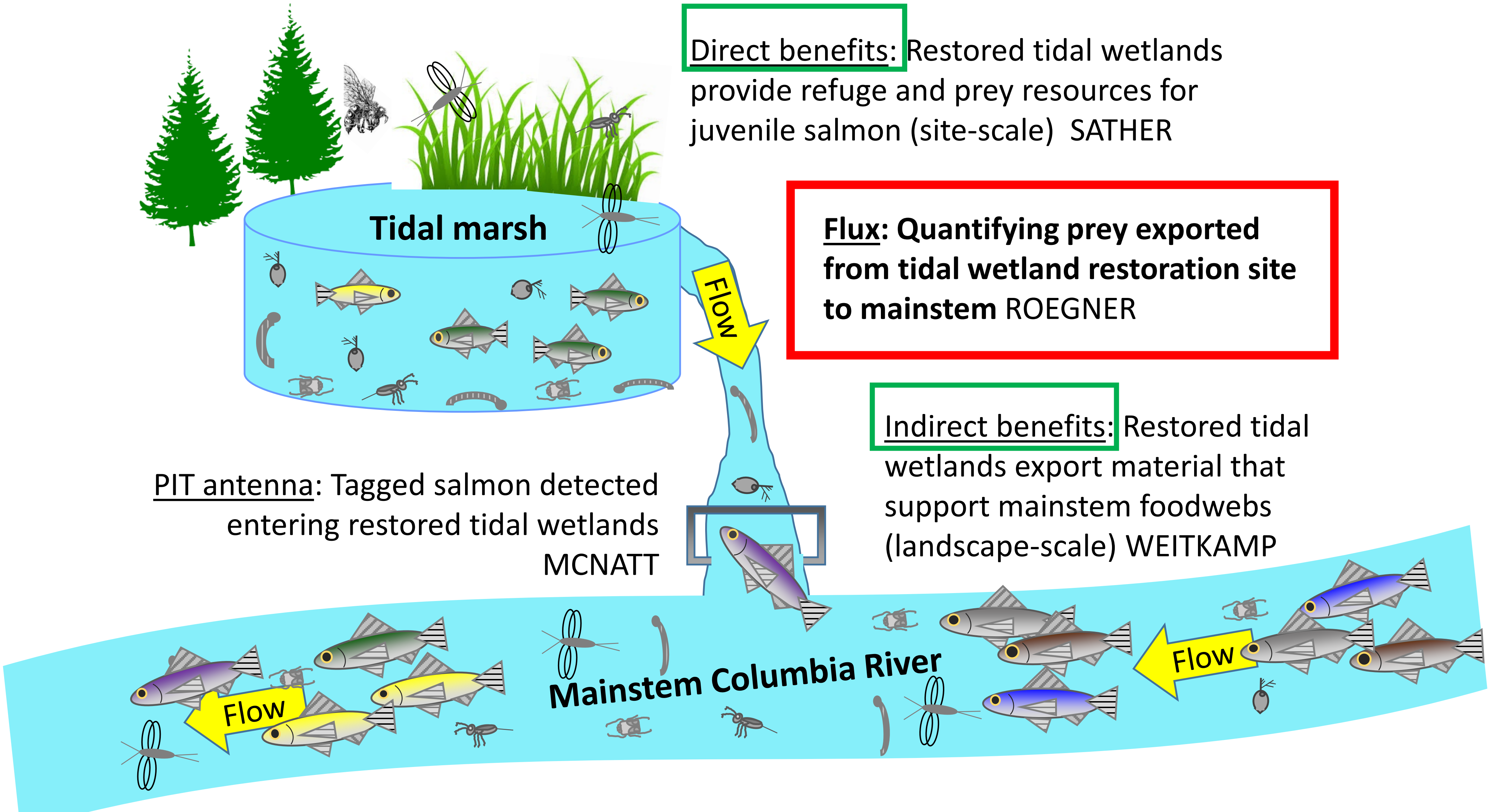
AEMR Conceptual model: Prey production in restored tidal wetlands benefit juvenile salmon directly onsite and indirectly offsite



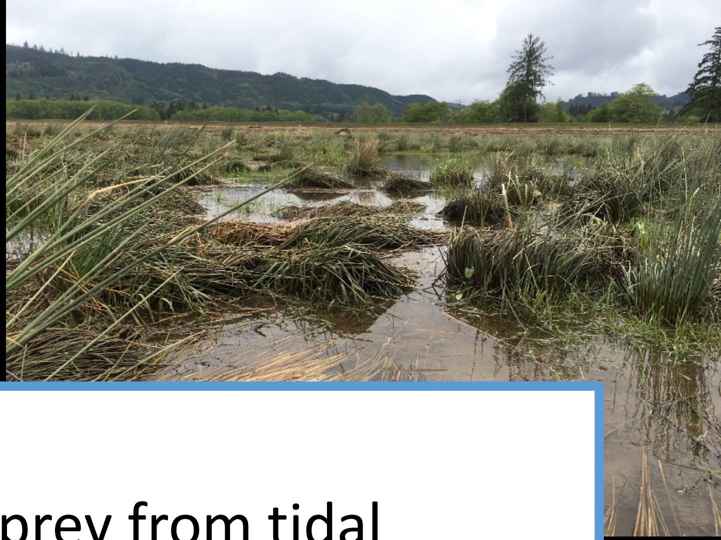
Direct benefits: Restored tidal wetlands provide refuge and prey resources for juvenile salmon (site-scale)

Indirect benefits: Restored tidal wetlands export material that support mainstem foodwebs (landscape-scale)

AEMR Conceptual model: Prey production in restored tidal wetlands benefit juvenile salmon directly onsite and indirectly offsite

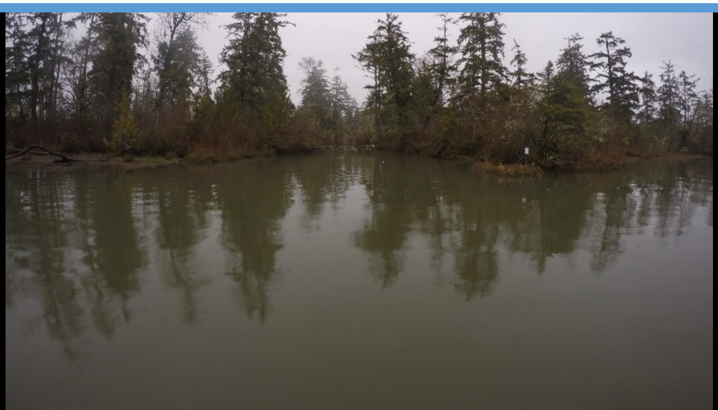




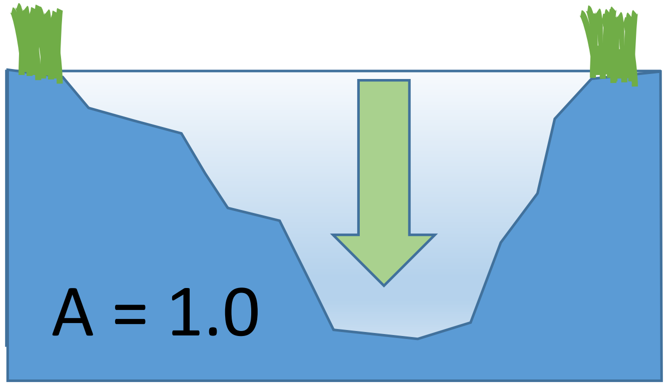


OUTLINE:

1. Provide methods for <u>quantifying transport</u> of insect prey from tidal wetlands to mainstem river
2. Introduce a metric to evaluate potential <u>benefit</u> of prey to yearling salmon
3. Review preliminary results for select <u>reference</u> and <u>restoration</u> wetlands
4. Explore methods for scaling to <u>regional scale</u> (work in progress)
5. <u>Management</u> implications


1. Contribution of salmon insect prey from tidal wetlands



WHAT WE WANT TO KNOW:

Tidal Transport $T_T = \int_{ebb} T = \text{ind}$ } By spp & energetic content

WHAT WE HAVE TO MEASURE:

Discharge = Velocity x Area
U (m/s) x A (m^2) } Q (m^3/s)

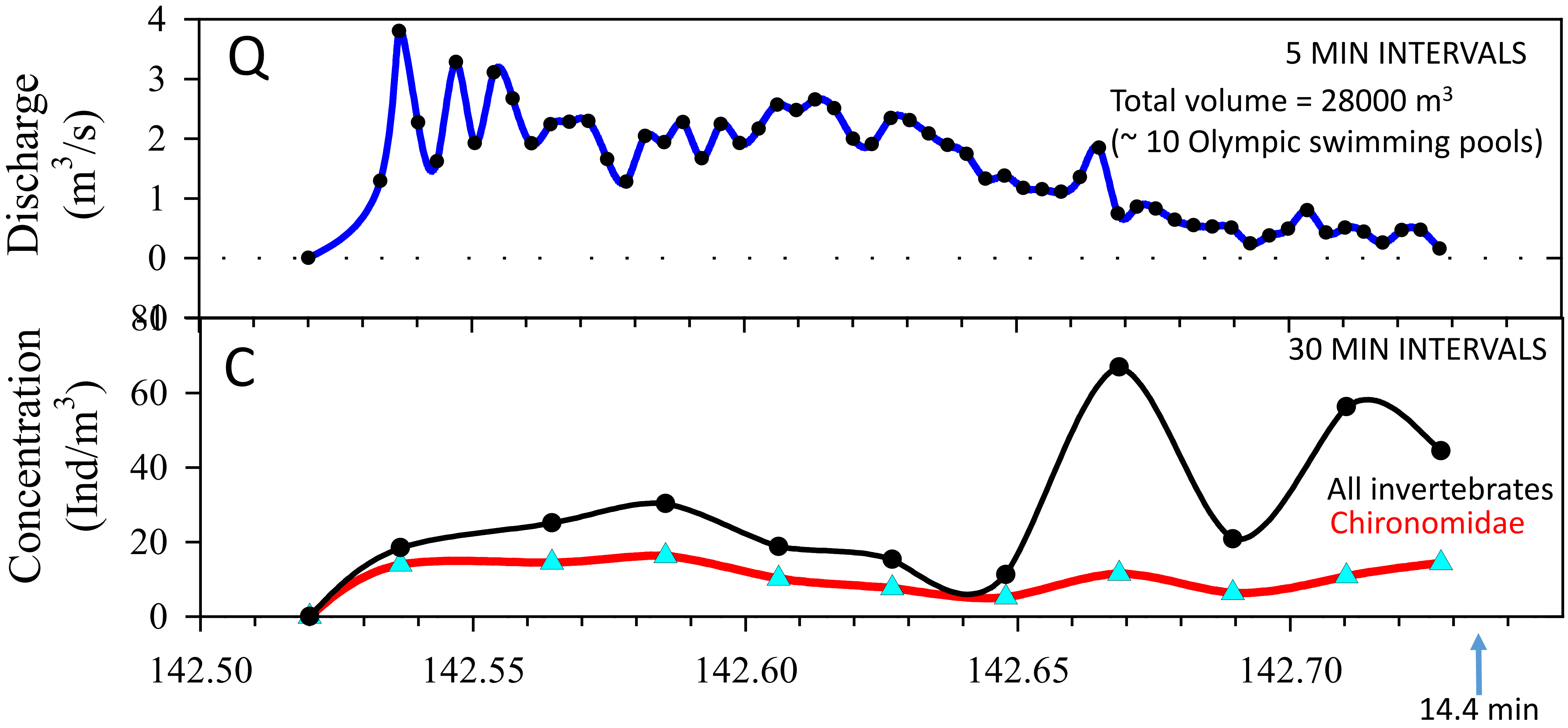
Prey Concentration C (ind/m^3)

} Each is time varying

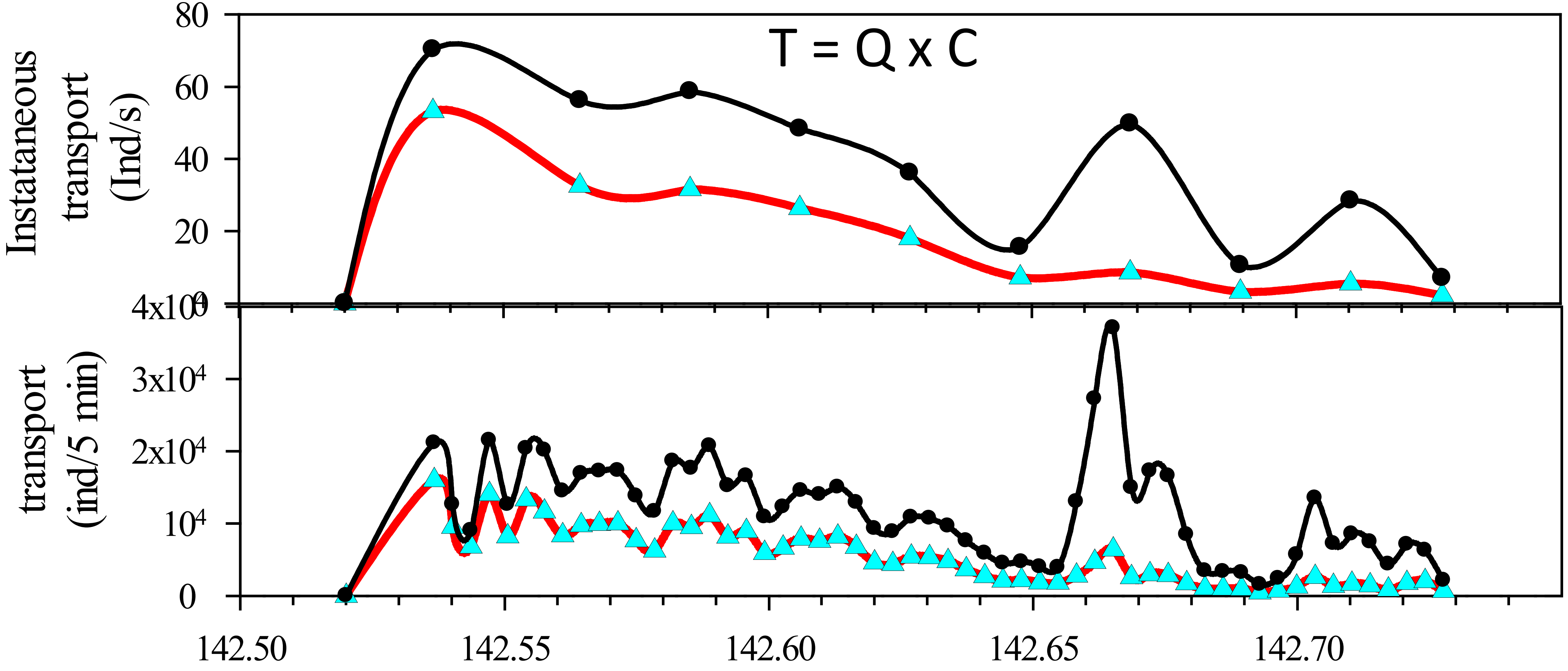
Instantaneous Transport Q x C = T (ind/s)

MEASUREMENTS

SB-PC-02

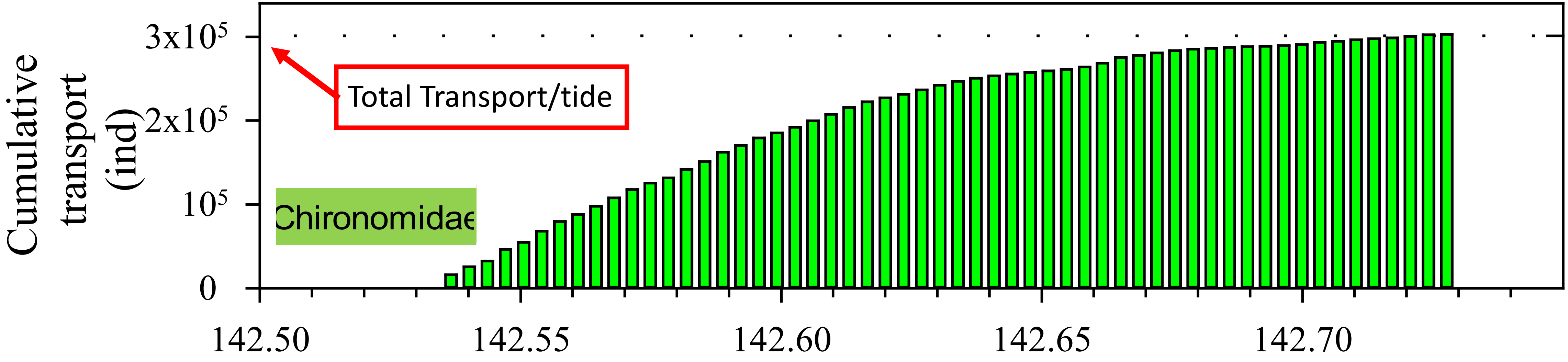


CALCULATIONS



CALCULATIONS

WHAT WE WANT TO KNOW: Tidal Transport $T_T = \int_{ebb} T$

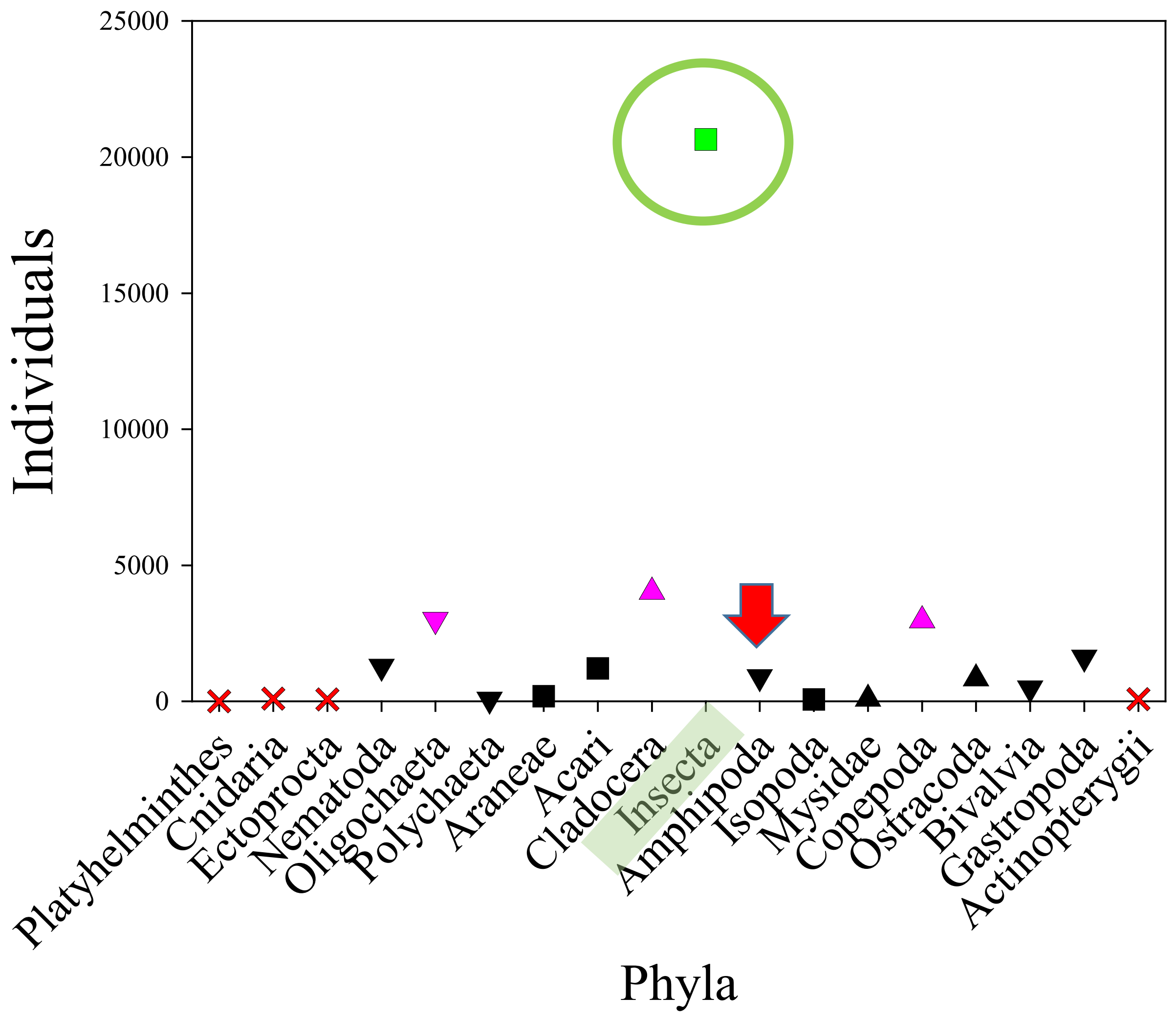


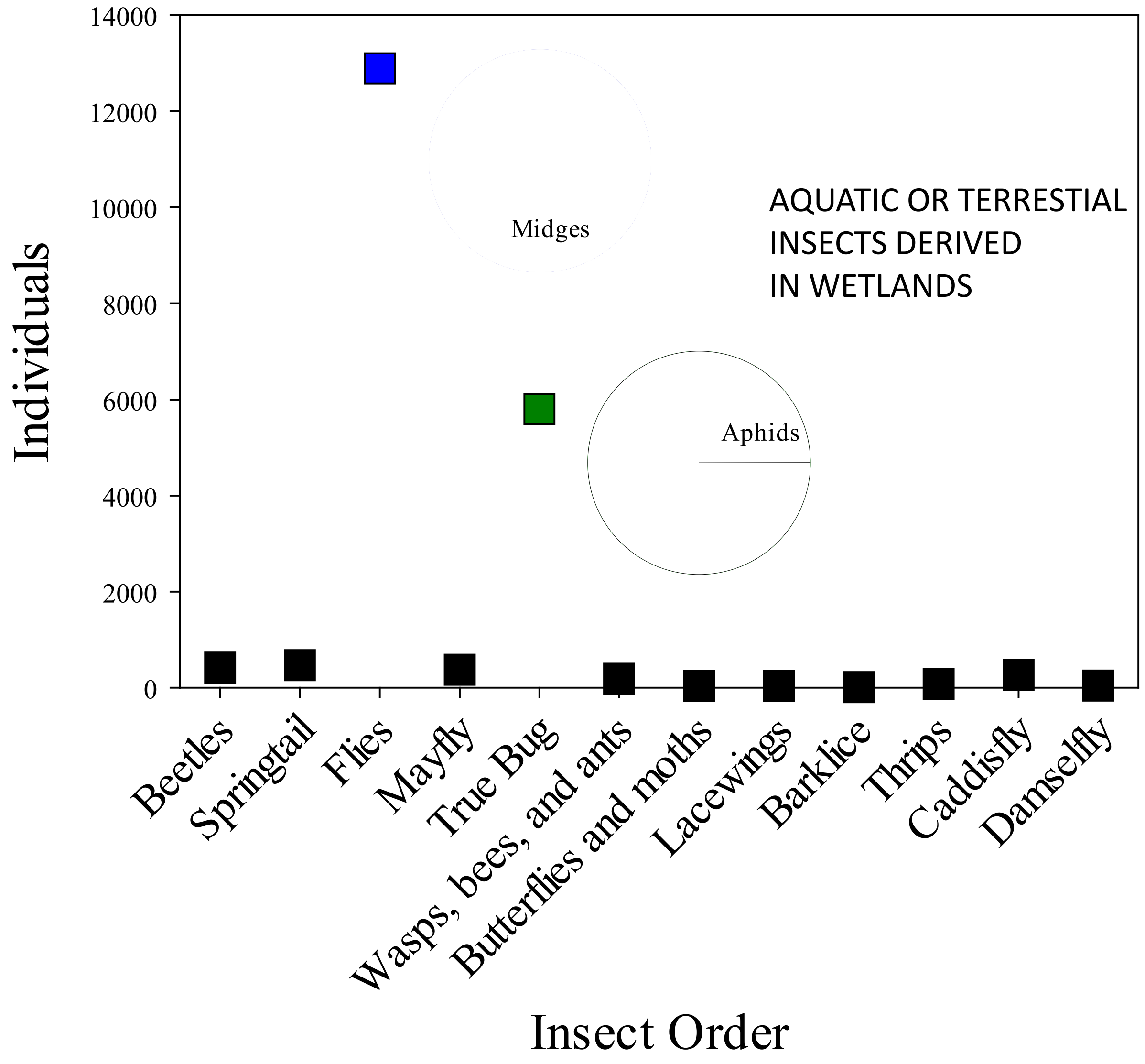
Reality check:

- If C = 1 ind/m^3 and Q = 1 m^3/s, T = 1 ind/sec.
- In 1 hr, 3600 ind would be transported; in 6 h ebb tide, Total T = 2.16×10^4 ind

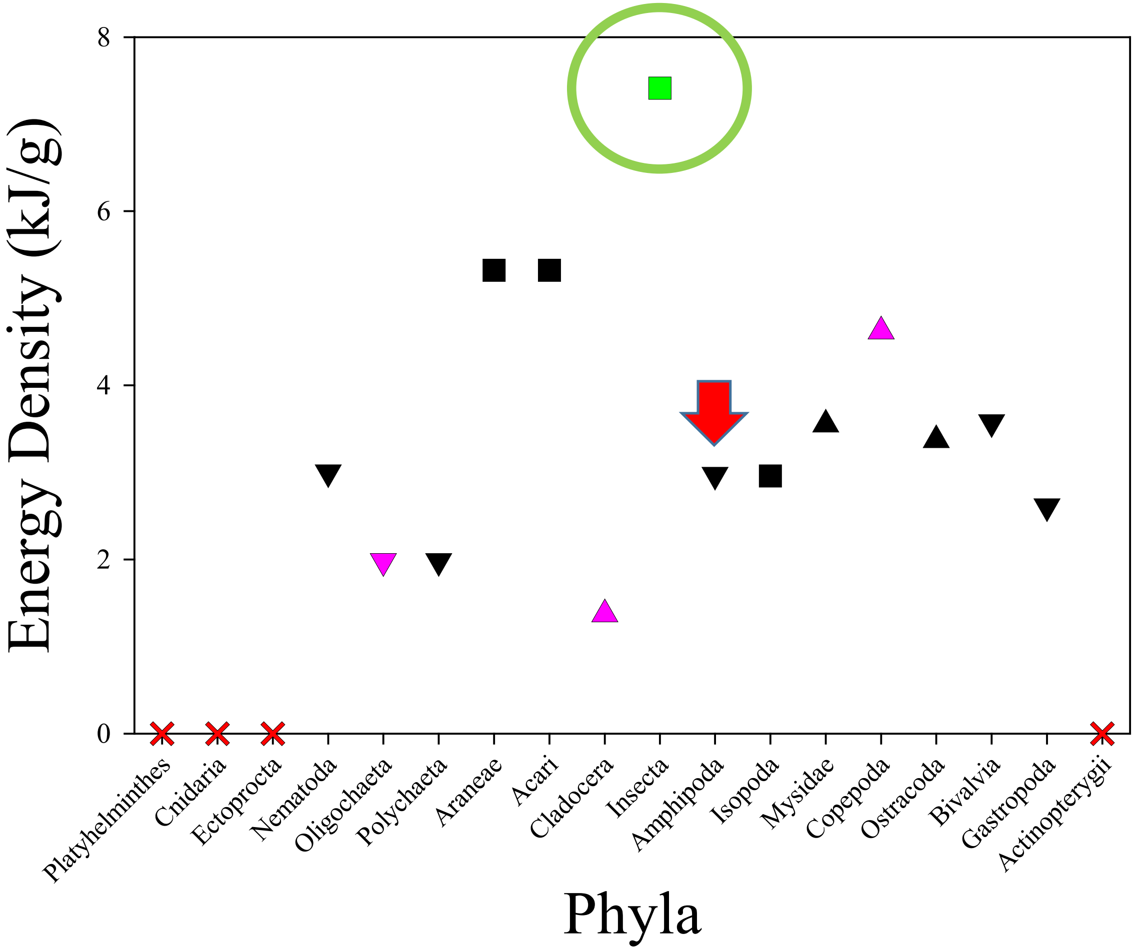
➔ Relatively high numbers of prey are exported/tide

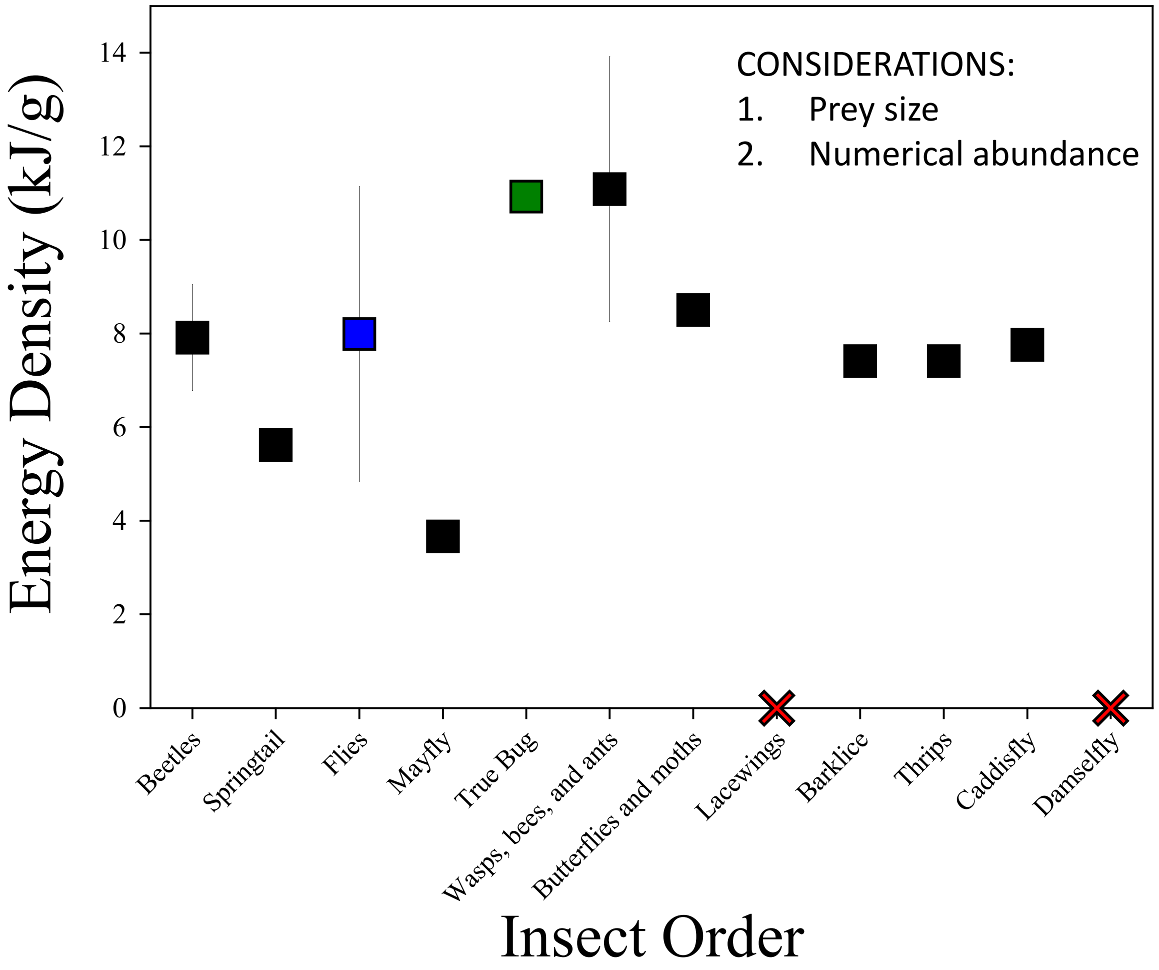
WHAT IS GETTING EXPORTED?





WHAT ARE THE PREY ENERGY EQUIVALENTS?





2. WHAT IS BENEFIT FOR YEARLING SALMON?

<u>Salmon Energy Equivalents (SEE)</u> =
number of salmon supported at basal metabolic level by exported prey
➡ kJ prey transported / kJ per day for standard salmon.

1. Convert prey abundance to energy

- For chironomids: 1 ind = 10^{-3} g; ED = 3.83 kJ/g
- Prey energy = ΣT ind x 10^{-3} g/ind x 3.38 kJ/g = kJ

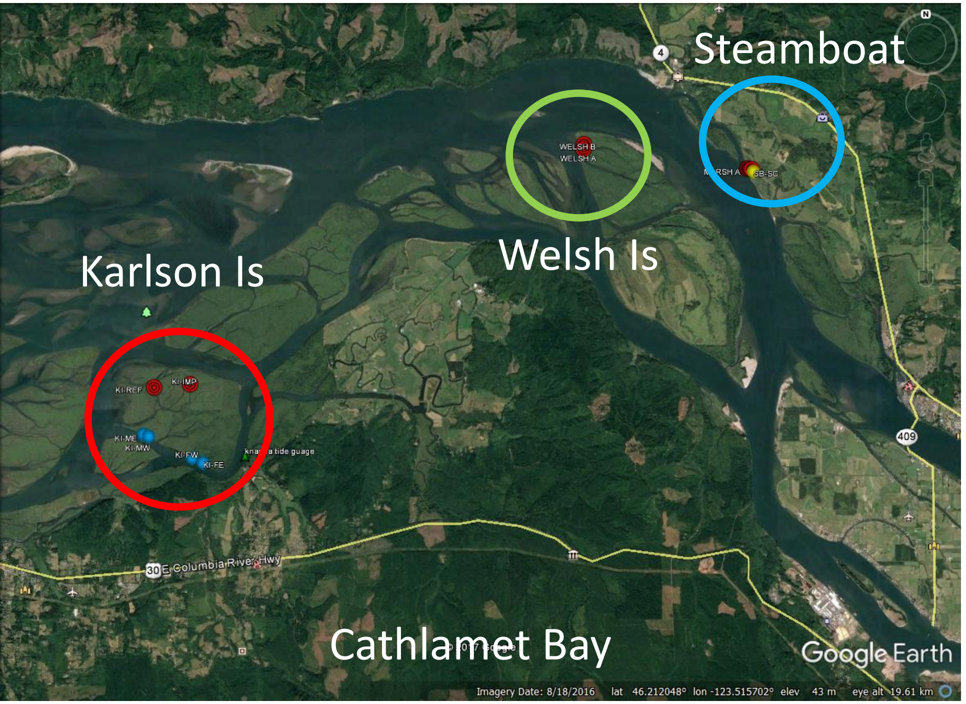
2. Standard energy requirements for 180 mm yearling salmon

- 50 kJ/kg/d x 0.060 kg = 3.0 kJ/d

Note: Standard energy requirements for 80 mm subyearling salmon

- 50 kJ/kg/d x 0.005 kg = 0.25 kJ/d ➔ 12 x subs for every yearling

SAMPLES COLLECTED 2016-2017



Location	Site	Habitat	TRT	Dates	Neuston
Steamboat	Main Ch	Mouth	RES	3	35
	Primary Ch*	Emergent	RES	2	24
	Secondary Ch	Emergent	RES	3	18
Karlson	Res	Emergent	RES	4	27
	Ref inside	Emergent	REF	5	40
	Marsh E	Emergent	REF	3	23
	Marsh W	Emergent	REF	6	33
	Forested E	Forested	REF	3	26
	Forested W	Forested	REF	3	31
Welsh	Ref	Emer/Shrub	REF	3	18
	Primary Ch*	Emer/Shrub	REF	2	15
		11		37	290

Long term ADCP deployments

DATE	DOY	SITE ID	STATION	TRT	Duration
18-Apr-17	108	Karlson	FORESTED E	REFERENCE	13
4-May-17	124	Karlson	FORESTED W	REFERENCE	12
2-Jun-17	153	Karlson	MARSH W	REFERENCE	24
20-Jun-17	171	Steamboat	PRIMARY	IMPACT	38
24-Jul-17	205	Karlson	FORESTED E	REFERENCE	22
24-Jul-17	205	Karlson	MARSH E	REFERENCE	22

3. PRELIMINARY RESULTS FOR REFERENCE AND RESTORATION WETLANDS

Site characteristics								Yearling SEE by insect				
Habitat	CODE	DOY	Dur (h)	dH (m)	dV (m3)	T Inverts	T Insecta	SEE from Ceratop.	SEE from Chiron.	SEE from Corix.	SEE from Aphid.	Total Yrlgs /tide
Forested	KI-FE-01	94.4	4.2	1.4	25030.7	45151.1	23541.6	0.0	15.9	0.0	3.2	19.1
Forested	KI-FE-02	124.5	3.3	1.1	20762.0	49956.6	30763.2	0.0	25.9	0.0	1.5	27.4
Forested	KI-FE-03B	151.3	3.9	1.8	10361.8	120622.8	93132.6	45.2	26.2	78.3	7.5	157.3
Forested	KI-FW-01	95.4	4.2	1.4	17289.2	9881.6	7489.4	0.0	5.9	0.0	0.0	5.9
Forested	KI-FW-02	123.4	4.3	1.5	52110.4	105880.3	102638.3	8.3	54.1	0.0	1.7	64.1
Emergent	KI-ME-02	129.6	4.1	1.0	24254.6	85253.0	61853.5	15.7	36.4	0.0	0.0	52.1
Emergent	KI-ME-03	150.4	2.2	0.9	NA	30197.1	15698.5	4.4	11.0	1.9	0.0	17.3
Emergent	KI-MW-01	108.4	3.0	1.0	10807.3	154908.6	75440.24	0.0	72.6	0.0	0.0	72.6
Emergent	KI-MW-02A	122.4	1.3	0.5	7193.1	122217.0	35872.9	0.0	39.1	0.0	0.0	39.1
Emergent	KI-MW-2b	125.6	1.9	0.6	8454.6	330742.6	118472.2	12.3	96.6	0.2	0.0	109.1
Res/Emerg	SB-PC-02	142.5	4.7	1.1	26729.3	664747.1	387991.3	62.9	384.2	0.9	1.9	449.9
Res/Emerg	SB-PC-03	170.5	4.2	1.0	NA	507252.0	312983.6	8.0	363.2	0.0	0.7	371.9
Res/Emerg	SB-SC-01	114.6	3.0	1.0	5584.6	9023.0	5134.4	0.1	6.0	0.0	0.0	6.1
Res/Emerg	SB-SC-02	137.4	3.3	0.7	4121.5	57821.6	33876.9	2.9	40.2	0.0	0.0	43.1
Res/Emerg	SB-SC-03	170.5	3.8	0.8	5806.9	37784.4	20013.6	21.1	22.5	0.0	0.0	43.5

- Differences in SEE by insect type, habitat, and time
- But relatively high numbers of yearlings potentially supported

4. SCALING TO LOCAL SCALE (WORK IN PROGRESS)

<u>Scaling over time</u>

Combine SEE per day per habitat type for June

- SEE / tide x 2 tides / day
  - → 828 SEE /d
- For month of June
  - → 2.5 x 10^4 yrlg salmon

<u>Scaling by channel metrics</u>

- Additional channels
  - → 250 SEE/d
- For month of June
  - → 7.5 x 10^3 yrlg salmon

Total for June = 3.25 x 10^4

STEAMBOAT

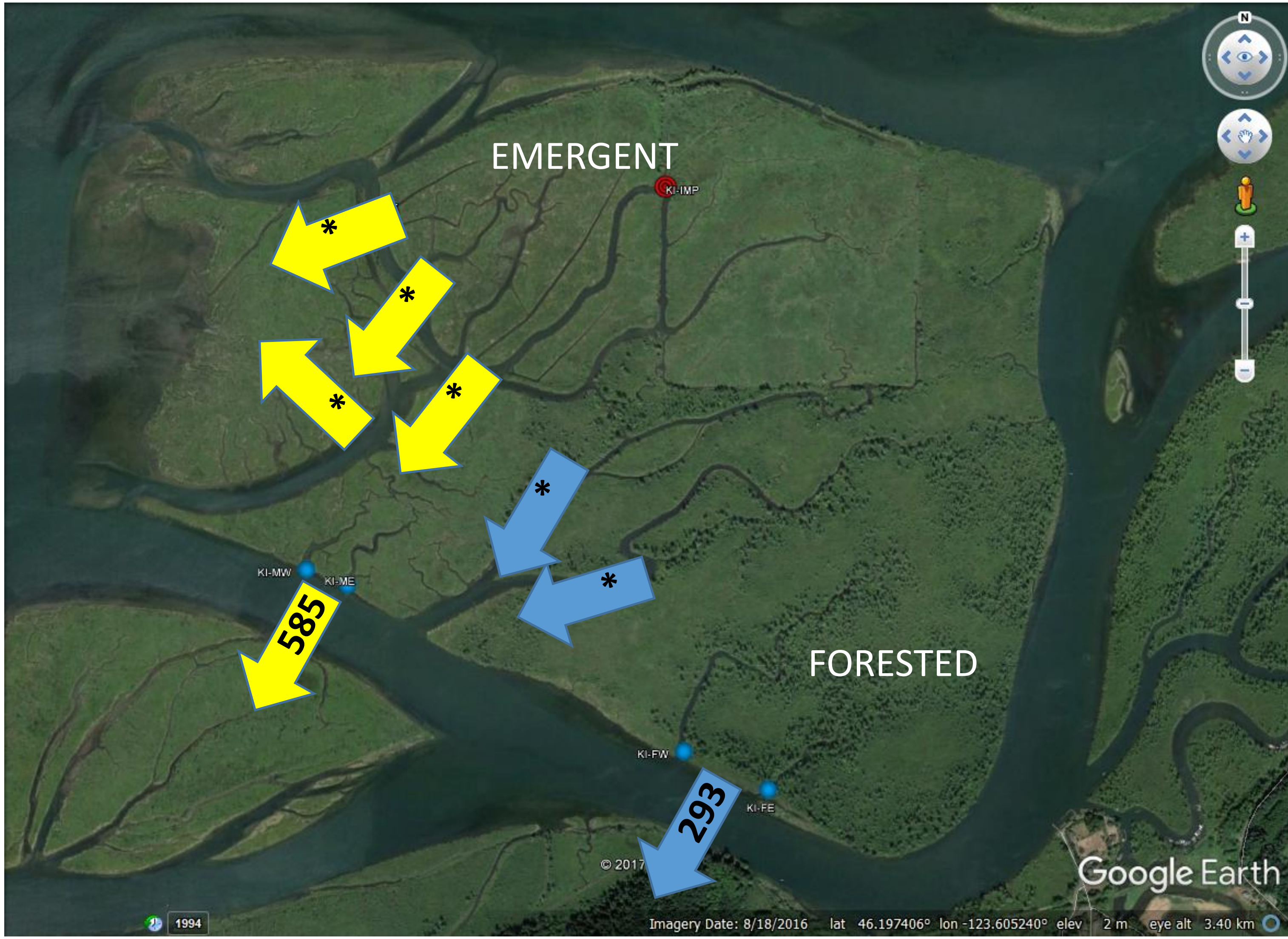
4. SCALING TO LOCAL SCALE (WORK IN PROGRESS)

Scaling* by habitat

- Wetland type –vegetation type
  - Emergent Marsh
  - Forested
  - Scrub/shrub
- Restoration / Reference
  - Restoration trajectory

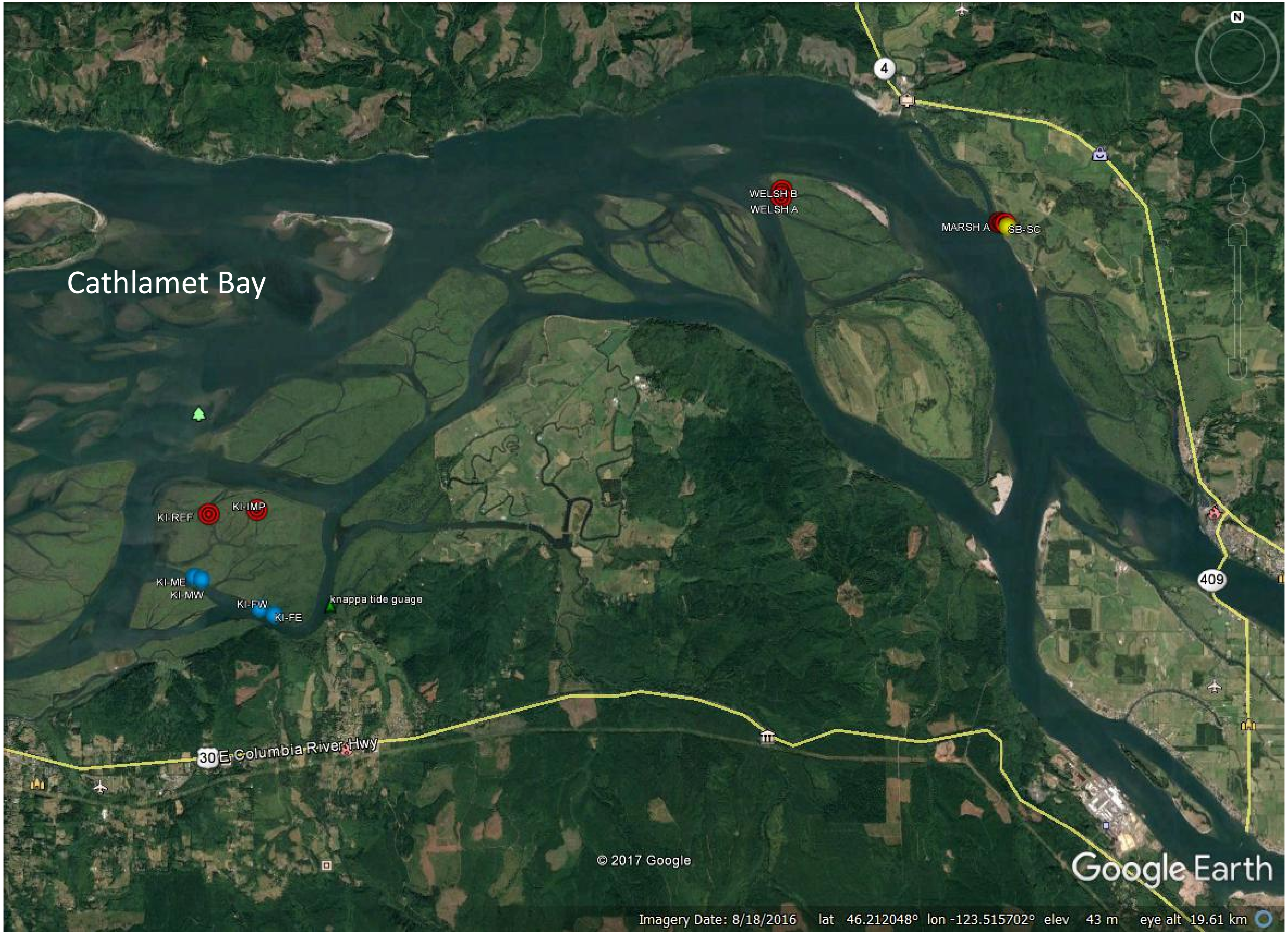
Other factors to consider in scaling model

- Different hydrogeomorphic reaches
- Spring / Neap cycle
- Seasonal effects
  - Temperature
    - salmon metabolic rate & run time
    - insect production & type

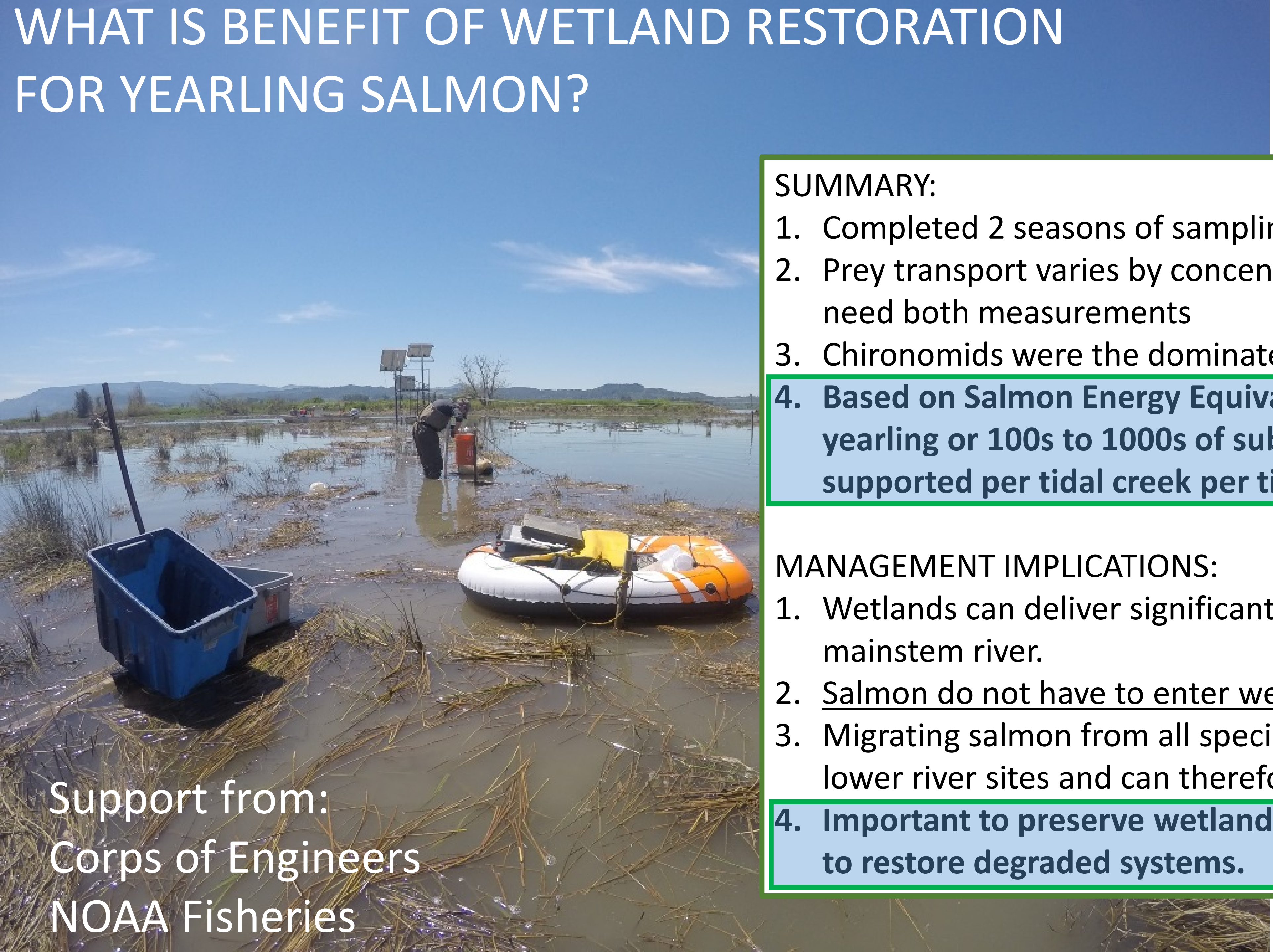


KARLSON

4. SCALING UP TO REGIONAL SCALE



WHAT IS BENEFIT OF WETLAND RESTORATION FOR YEARLING SALMON?



SUMMARY:

1. Completed 2 seasons of sampling from 11 tidal channels
2. Prey transport varies by concentration and volume flux – need both measurements
3. Chironomids were the dominate prey exported
4. **Based on Salmon Energy Equivalents, 10s to 100s of yearling or 100s to 1000s of subyearling salmon could be supported per tidal creek per tide**

MANAGEMENT IMPLICATIONS:

1. Wetlands can deliver significant prey resources to the mainstem river.
2. Salmon do not have to enter wetlands to access prey.
3. Migrating salmon from all species and stocks traverse lower river sites and can therefore benefit.
4. **Important to preserve wetland foodwebs and continue to restore degraded systems.**

Support from:
Corps of Engineers
NOAA Fisheries