

DUNGENESS CRAB

ACOUSTIC TAG RESEARCH

PART I: RESPONSE TO DREDGED SEDIMENT DEPOSITION

PART II: MARINE RESERVES & OFFSHORE ENERGY



PACIFIC STATES
MARINE FISHERIES
COMMISSION

CURTIS ROEGNER



SARAH HENKEL



STEVENSON, WA
24 SEPTEMBER 2019

MOTIVATION:

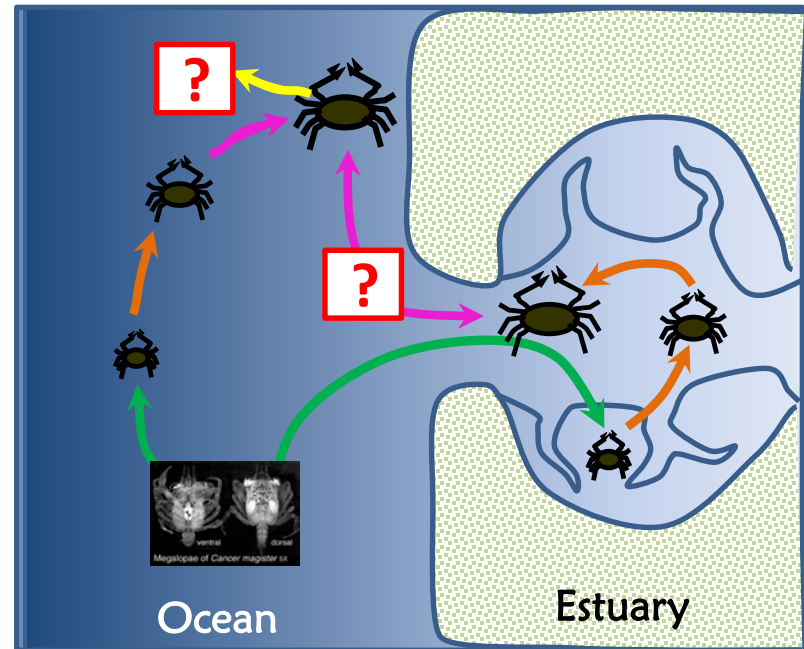
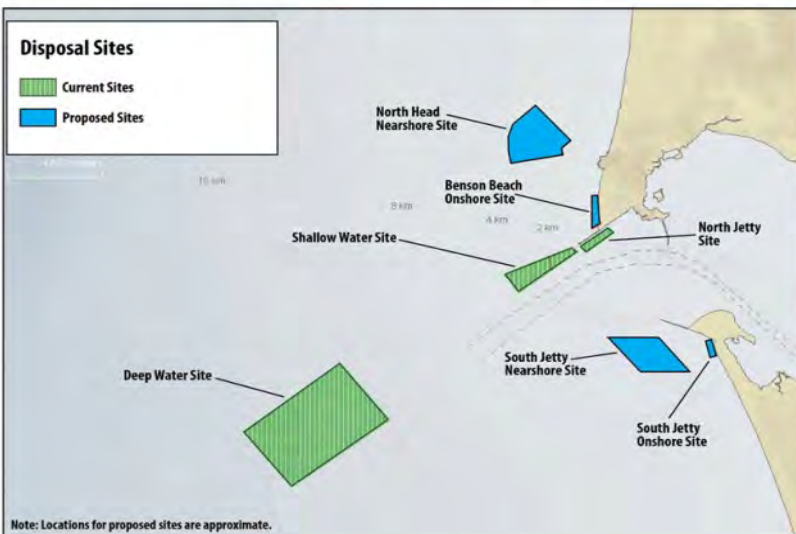
Channel maintenance operations

- Beach erosion mitigation
- Impact by dredging/sediment deposition

Unresolved aspects of crab ecology

- Habitat use in estuary and near shore
- Migration timing & triggers
- Location of brooding females

Network of Regional Disposal Sites



OUTLINE

- Findings from Beneficial Use Program
- Summarize crab movements around the MCR



Mouth of Columbia River Sediment Management Plan

Partners: NOAA Fisheries, Army Corps of Engineers, EPA, WDFW, ODFW, OSU, CRCFA

Monitoring Approaches



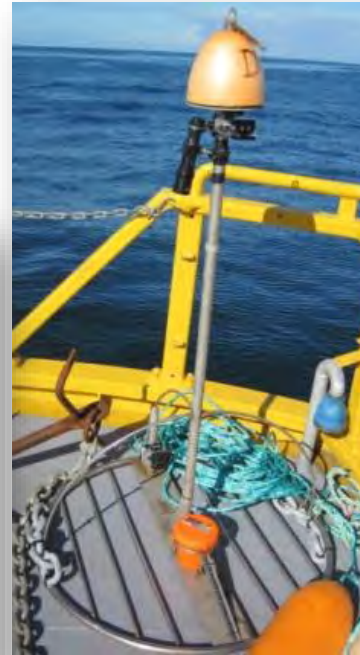
Crab pots

Abundances of crab (traditional tool)



Video Sled

Densities in control and impact areas
(Fields et al. 2019. Envir Monit Assess)



Video Lander

Impact dynamics and crab abundances before and after disposal events



Acoustic Tags

Acute and long term movements of crabs in response to disposal events³

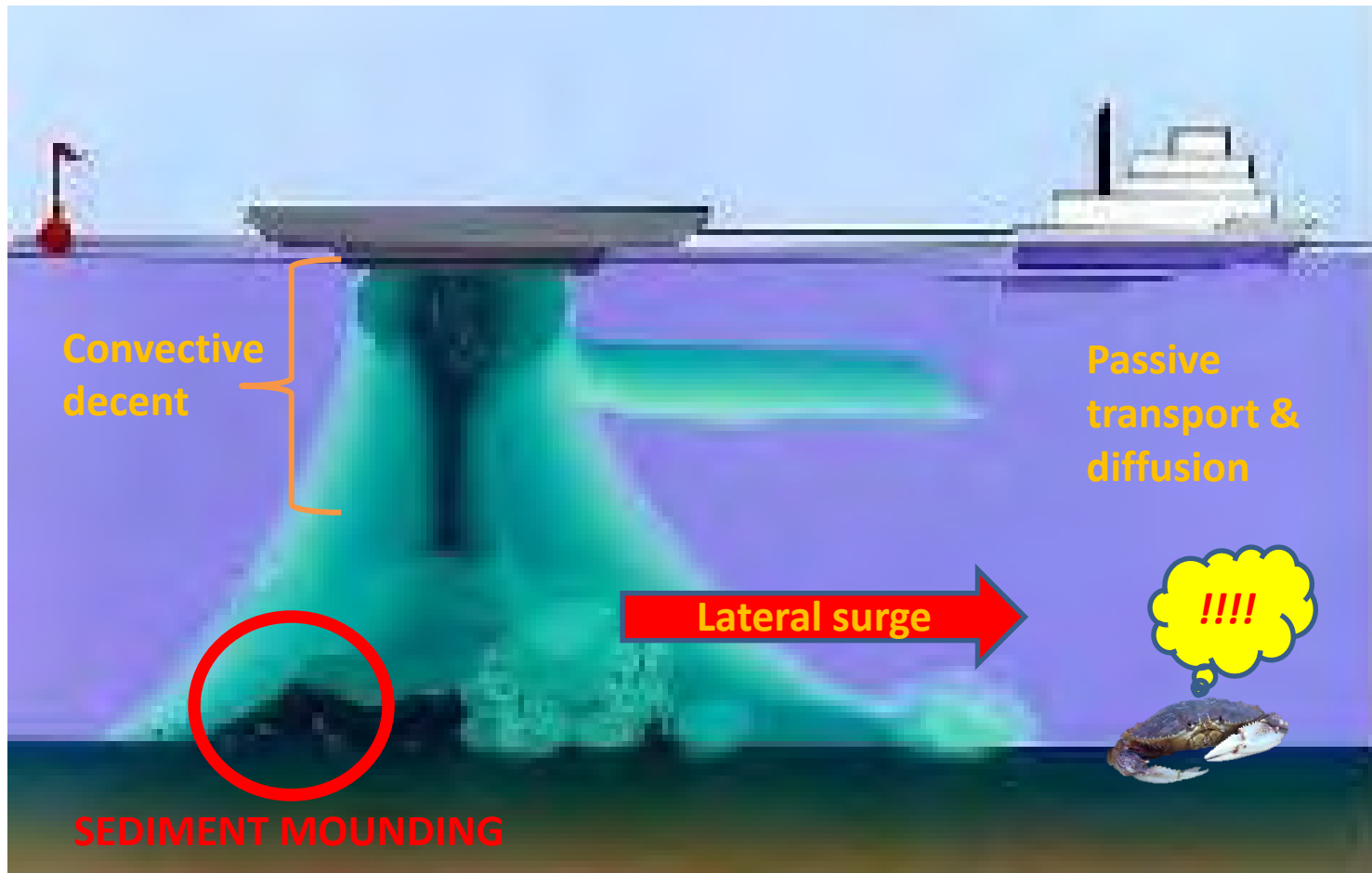
SEDIMENT DEPOSITION PLUME

MAJOR CONCERNS:

- SEDIMENT MOUNDING
- IMPACT OF LATERAL SURGE

MITIGATION PLAN

- THIN LAYER DEPOSITS
- DISPERSE OVER WIDE AREA

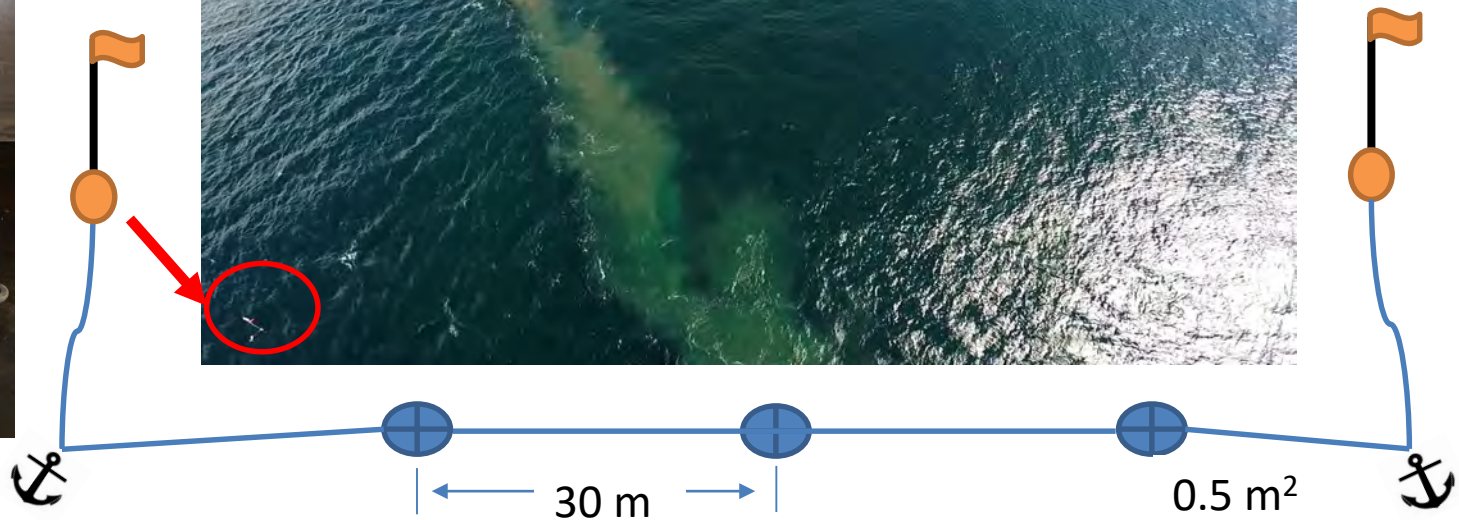


SEDIMENT DEPOSITION EVENT

BENTHIC VIDEO LANDER



DRONE'S EYE VIEW OF DEPOSITION

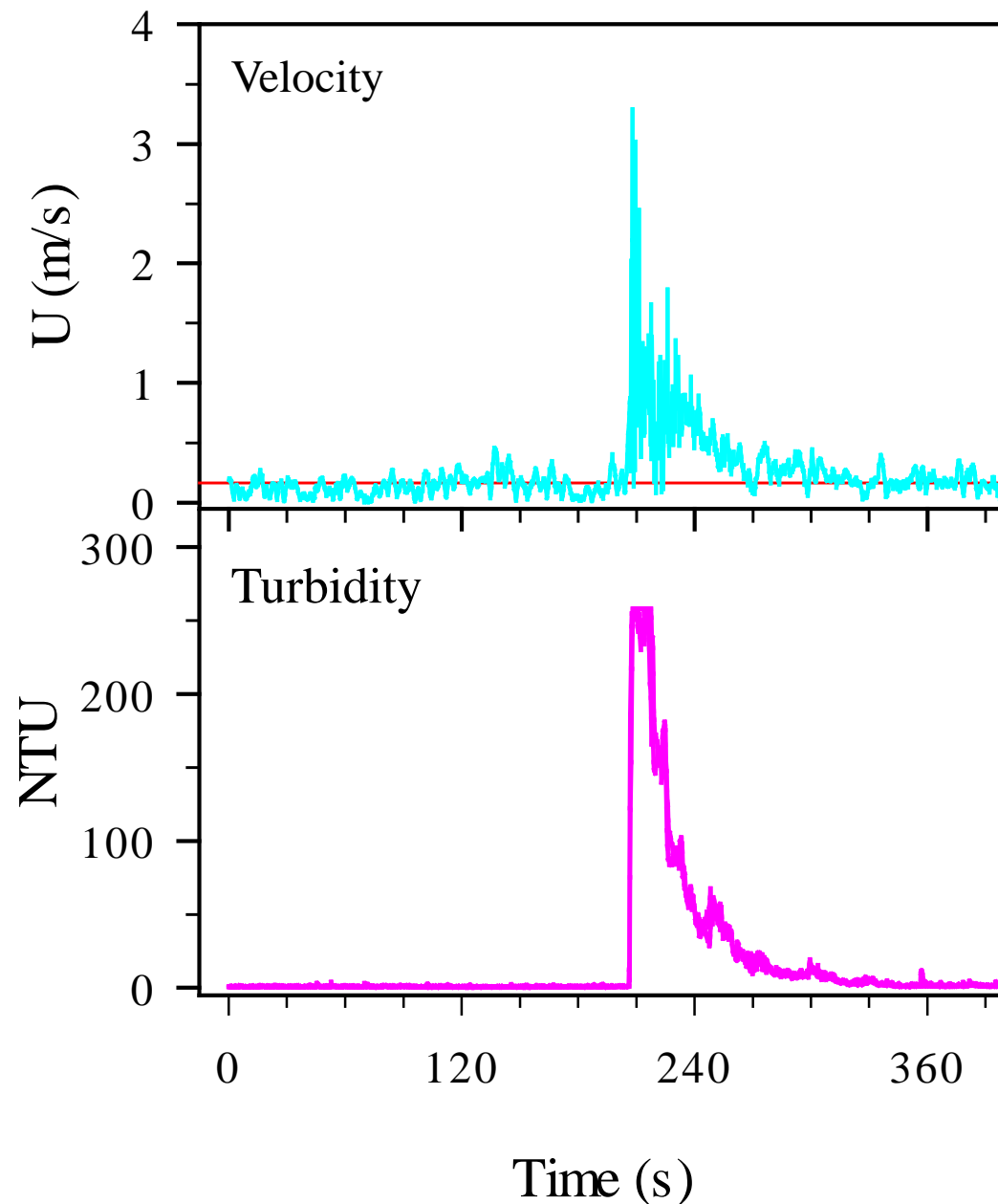


Benthic Video Lander daisy chain

DEPOSITION EVENTS



BOTTOM CURRENTS AND TURBIDITY



Lateral surge:

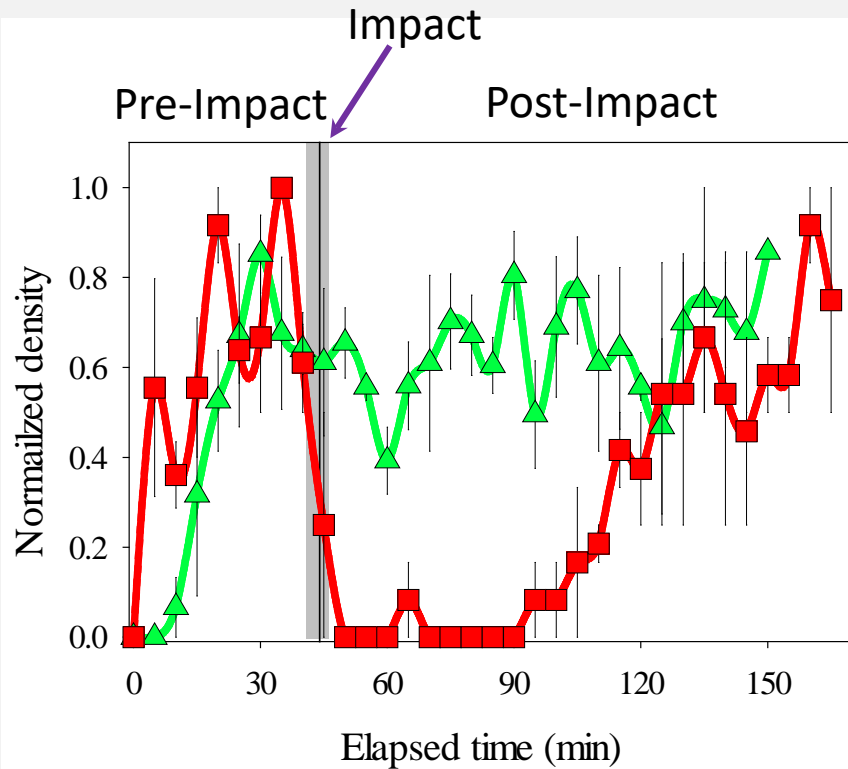
- Extremely energetic!
- Very high turbidity levels!
- But very short lived

Sediment deposition:

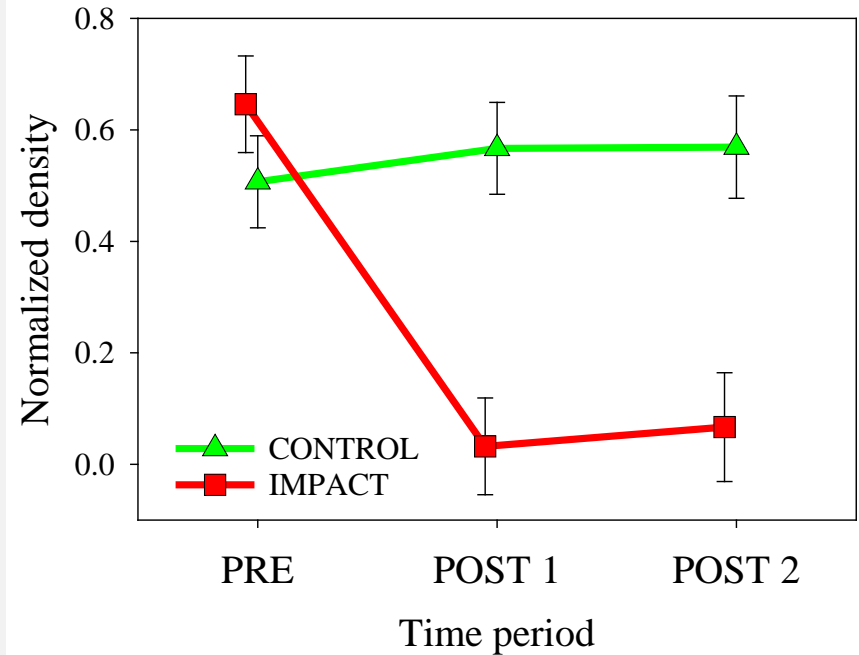
- 70-100% cover
- < 4 cm depth
- Burial not a concern

BVL: RESULTS

Time series example



BACI results



Conclude: Negative acute affect on crab, but impact is ephemeral

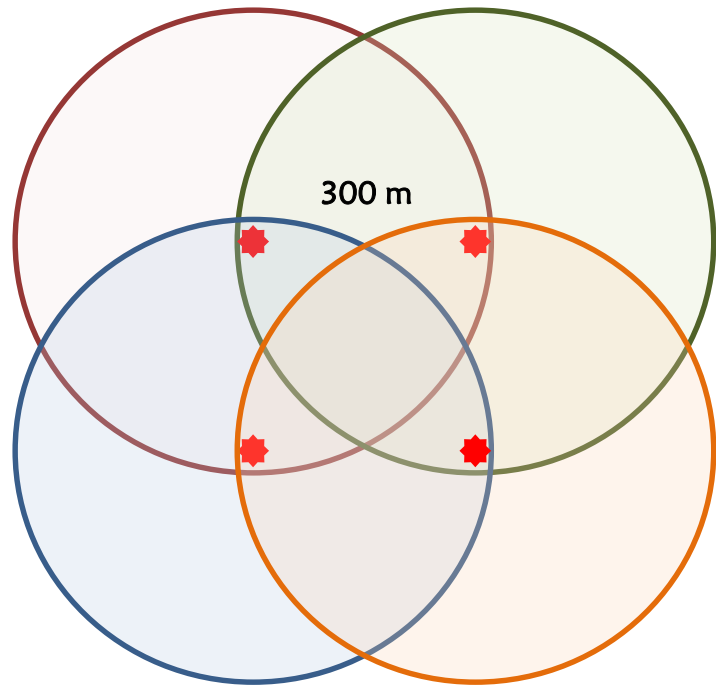
ACOUSTIC TELEMETRY



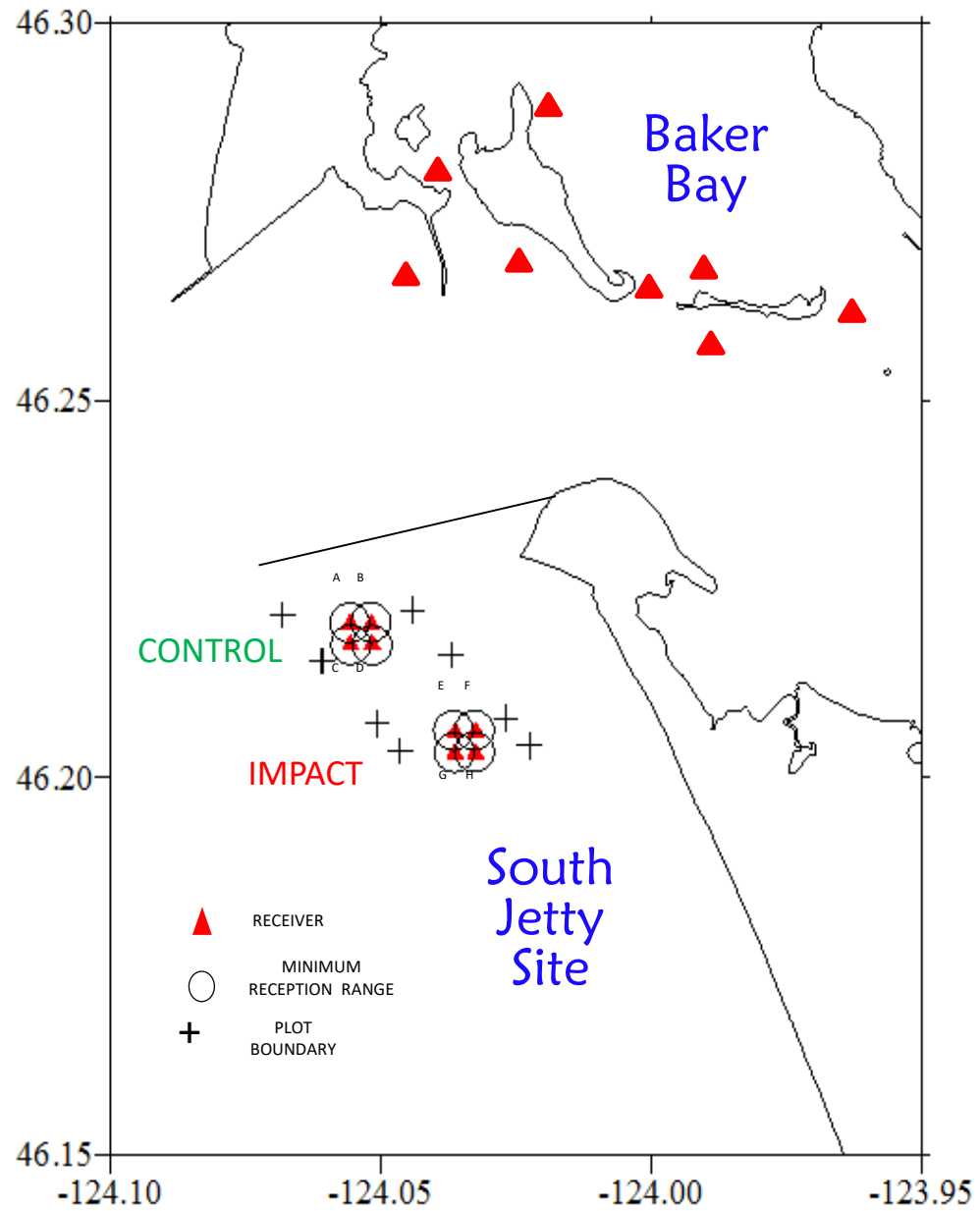
RECEIVER



TAGGED CRABS

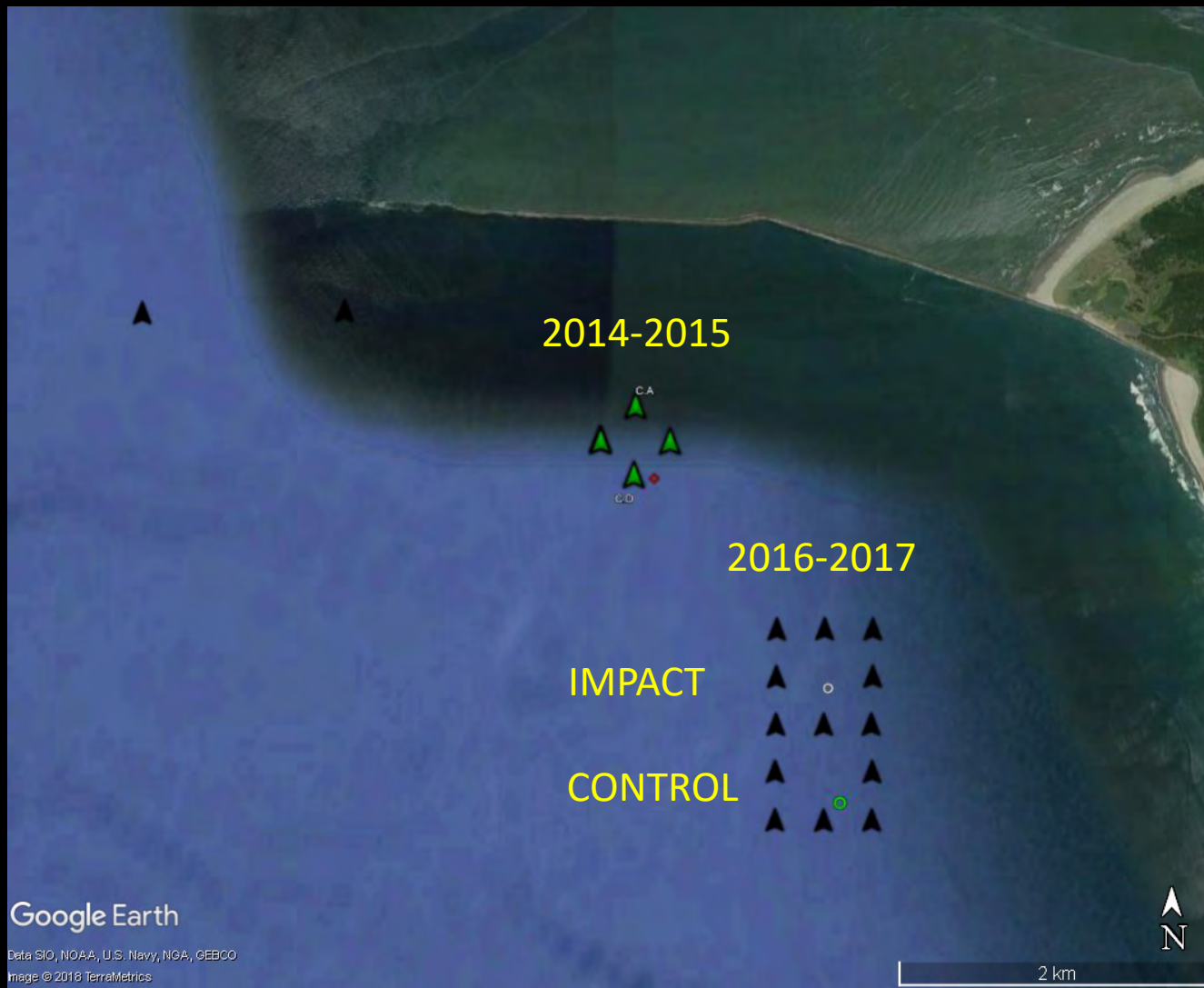


RECEPTION RANGE

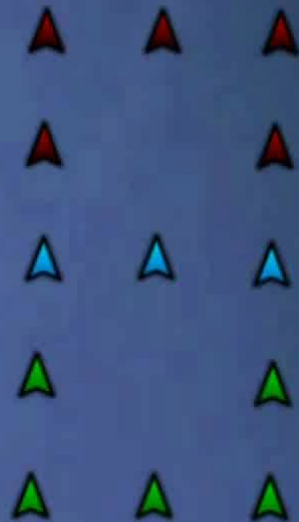


MOVEMENT OF TAGGED CRABS



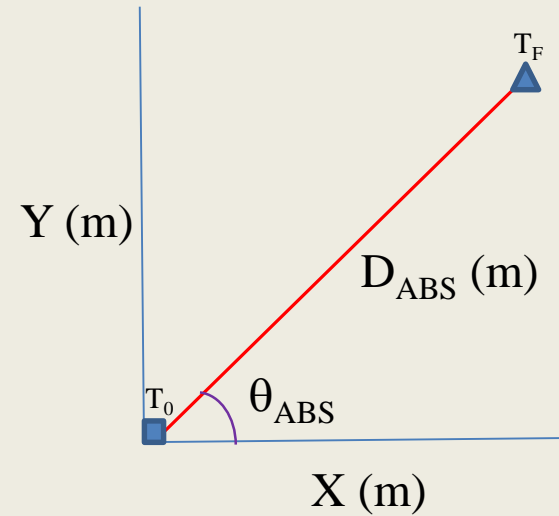


2016 TAG RELEASES

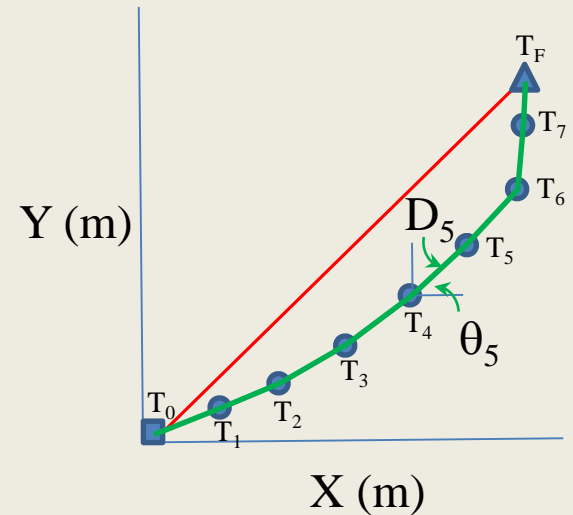


Movement metrics

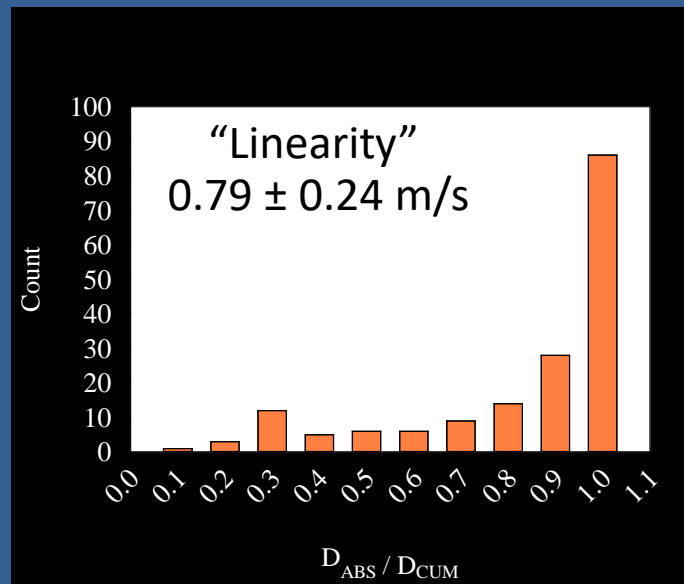
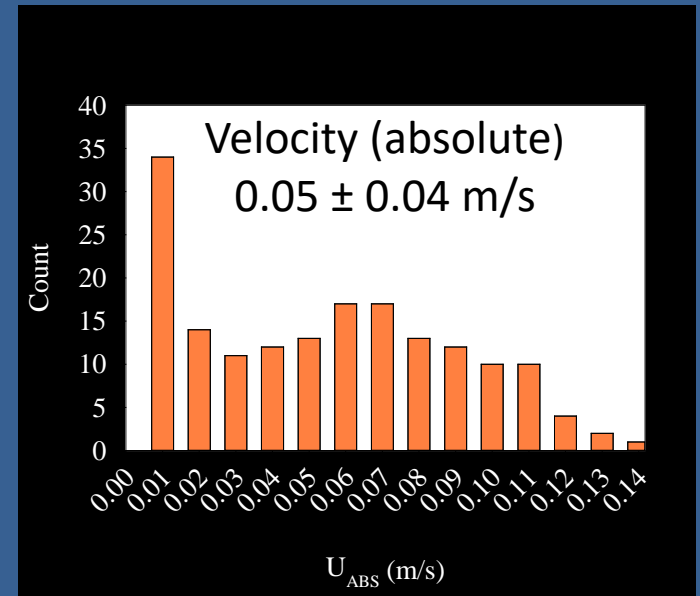
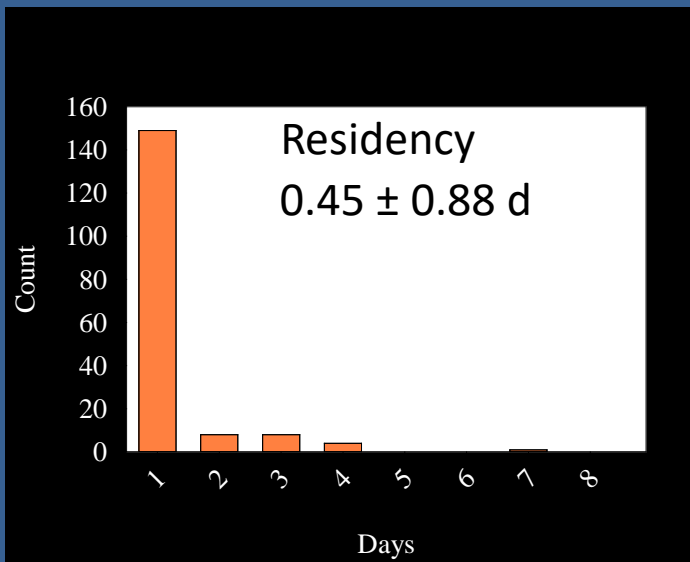
1. Residence in array (days) ✓
2. D_{ABS} = Absolute distance (m)
3. D_{CUM} = Cumulative distance (m)
4. U_{ABS} = Absolute velocity (m/s) ✓
5. U_{AVE} = Average velocity (m/s)
6. θ_{ABS} ; θ_{Ti} = angles (radians)
7. “Linearity” D_{ABS} / D_{CUM} ✓



“Linearity” Values range from 0 to 1.0,
with 1.0 = straight line



MOVEMENT METRICS (N=170)

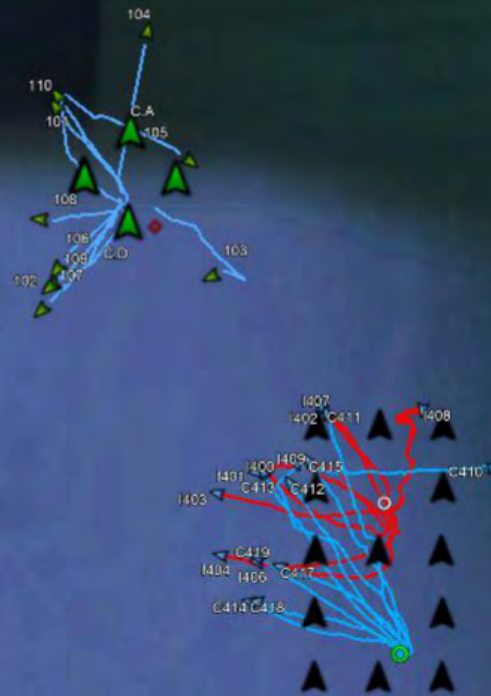


2015 & 2016

SJS

Movement characteristics

- Few differences between impact and control
- Low residence time in arrays (hours to days)
- Extremely linear tracks
- Little evidence of mortality
- Crabs that return to arrays also have linear movements



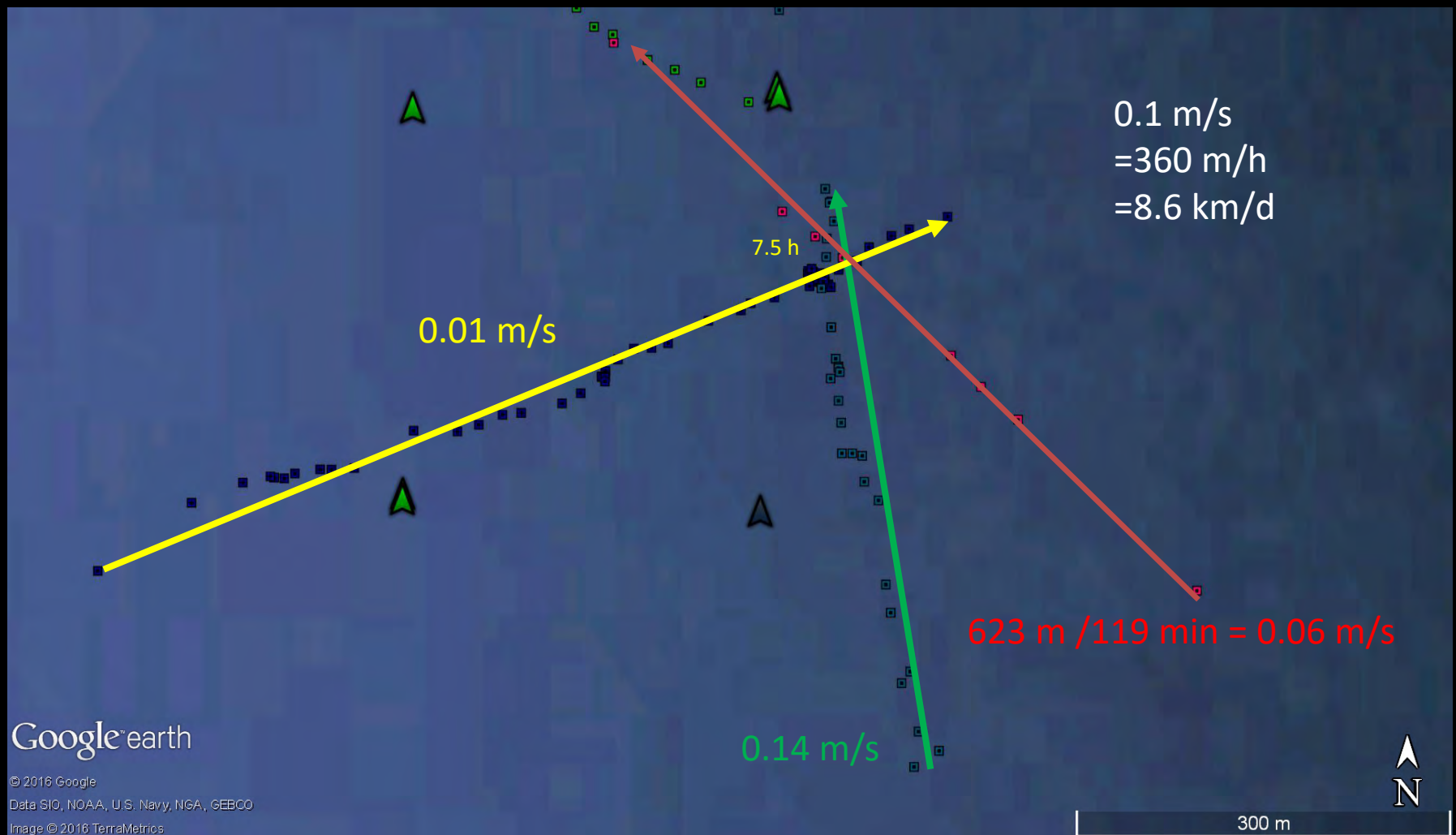
Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2018 TerraMetrics

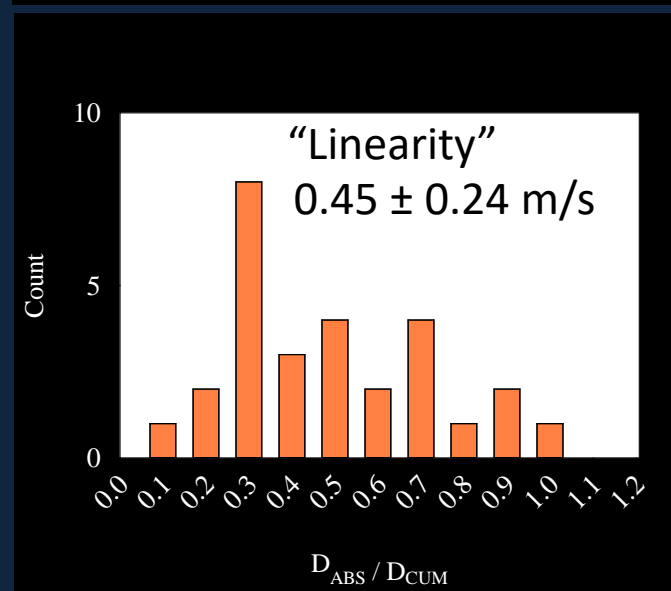
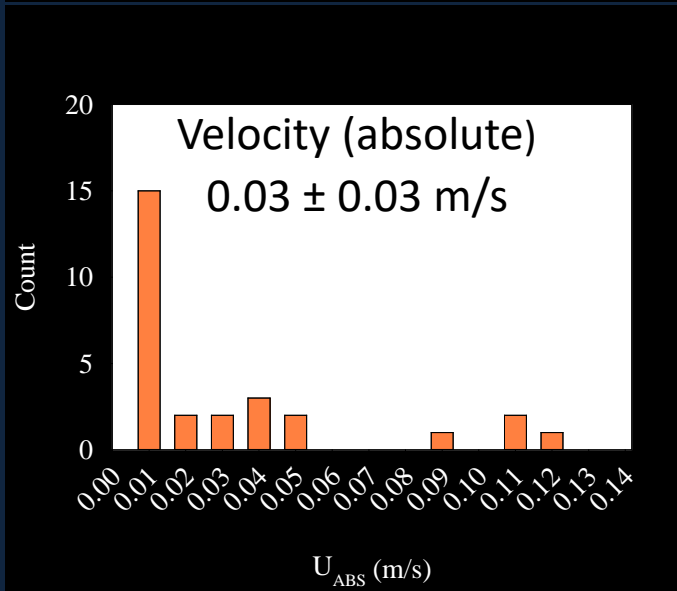
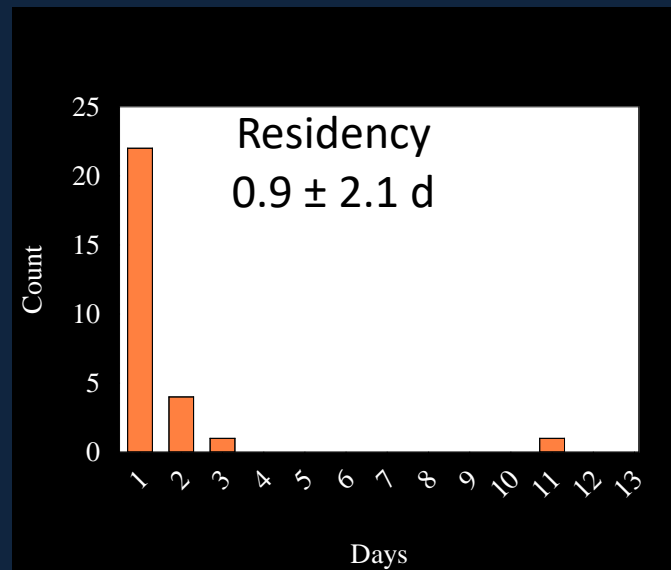
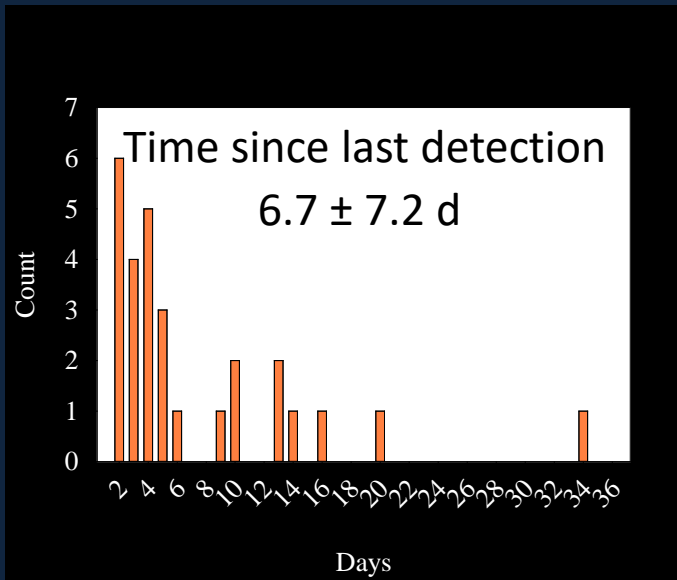
2 km

CRAB SURVIVAL

SECONDARY TRACKS



MOVEMENT METRICS (N= 28)



OTHER SPECIES

<u>sps</u>	<u>Dur (h)</u>	<u>D_{ABS} (m)</u>	<u>U_{ABS} (m/s)</u>
GWS	1.04	1261.4	0.841
GS1	1.02	1120.0	0.306
GS2	0.75	840.0	0.311

Green Sturgeon

Great White Shark

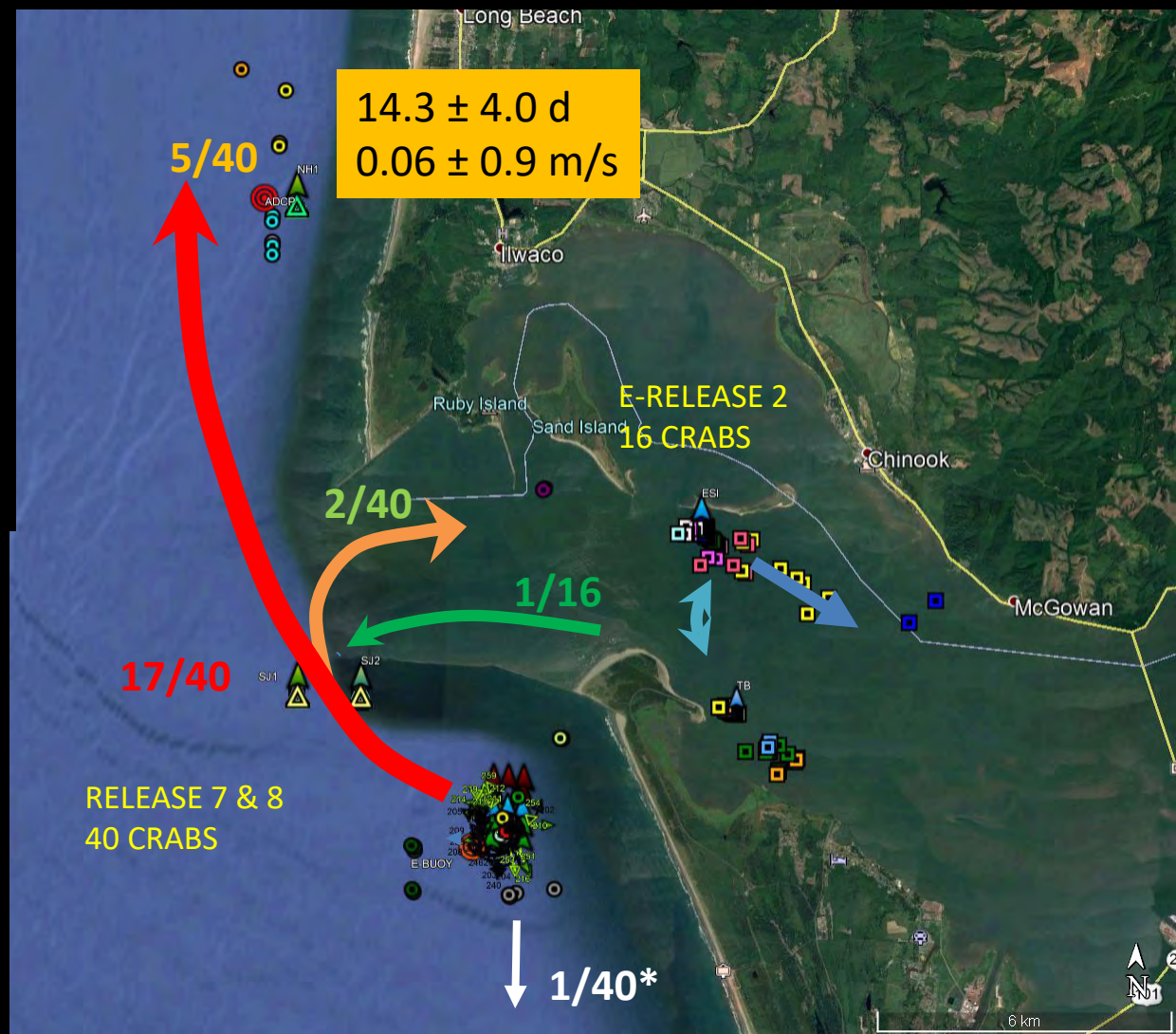
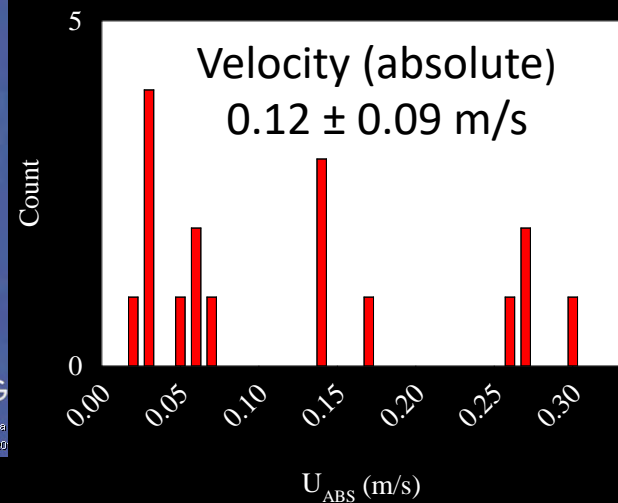
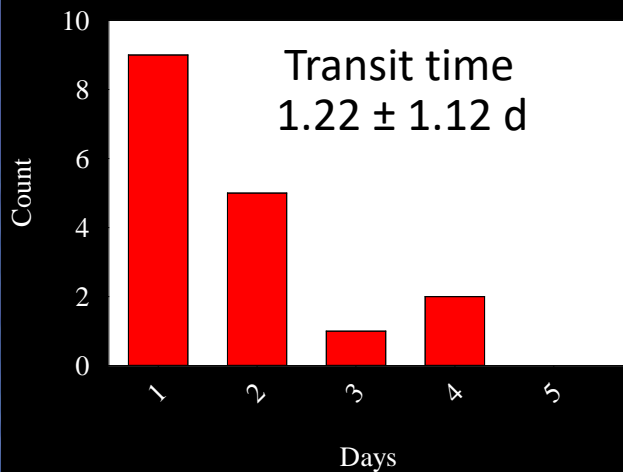


REGIONAL MOVEMENTS

2016
SJS

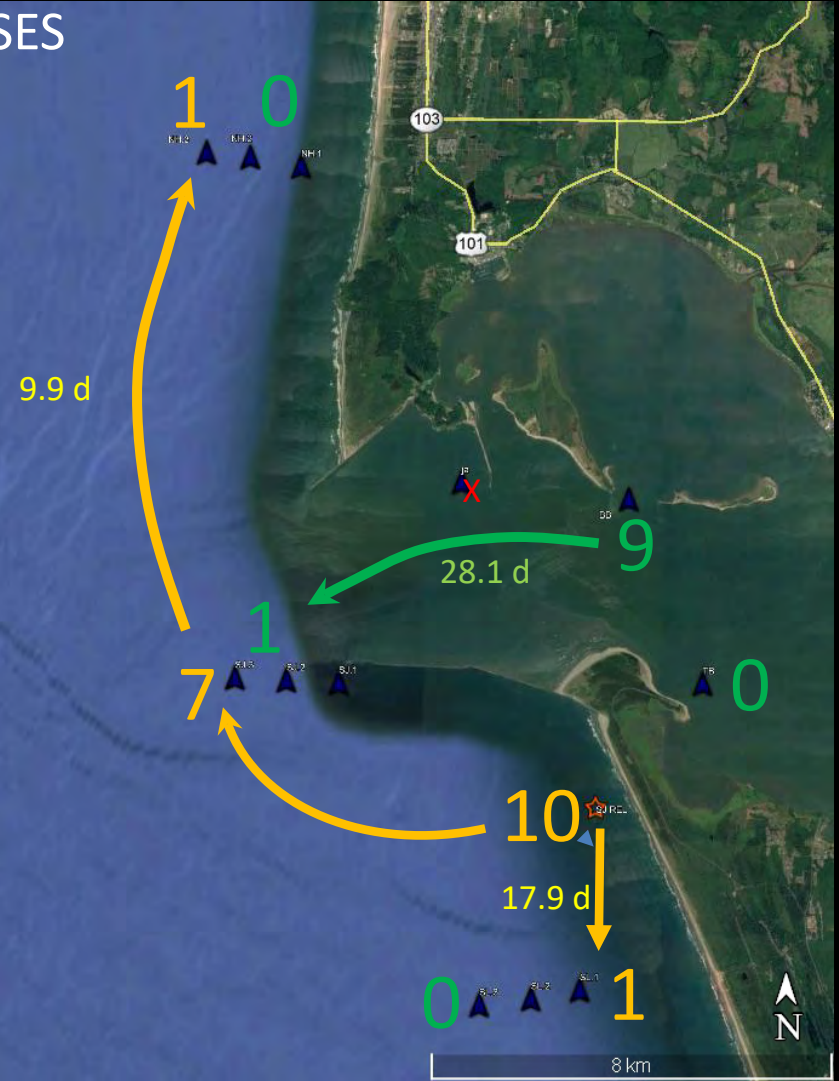
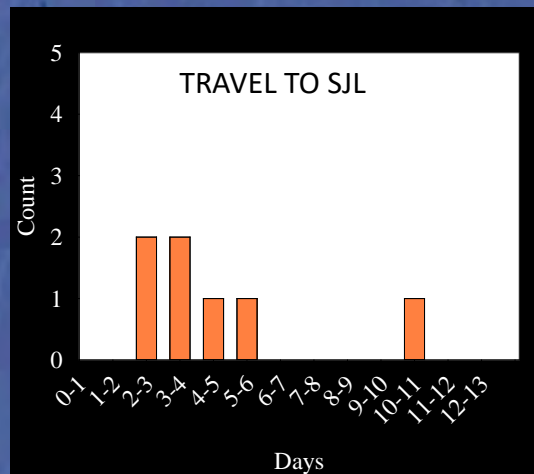


2016 SJS



2018 OCEAN AND ESTUARY RELEASES

22-23 AUGUST



Google Earth

©2018 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

2016 RECOVERIES

CRAB	TRANSIT (d)	DISTANCE (km)	Uabs (m/s)	Uabs (KM/D)
205	141.4	96	0.008	0.68
206	162.4	24	0.002	0.15
217	136.0	96	0.008	0.71
219	138.3	194	0.016	1.40
245	142.4	51	0.004	0.36
247 NO DATA		76		
249	85.4	14.13	0.002	0.17

RELEASE

LaPUSH 219

205

247

217

245

249

SEASIDE 206

Google Earth

Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Image Landsat / Copernicus

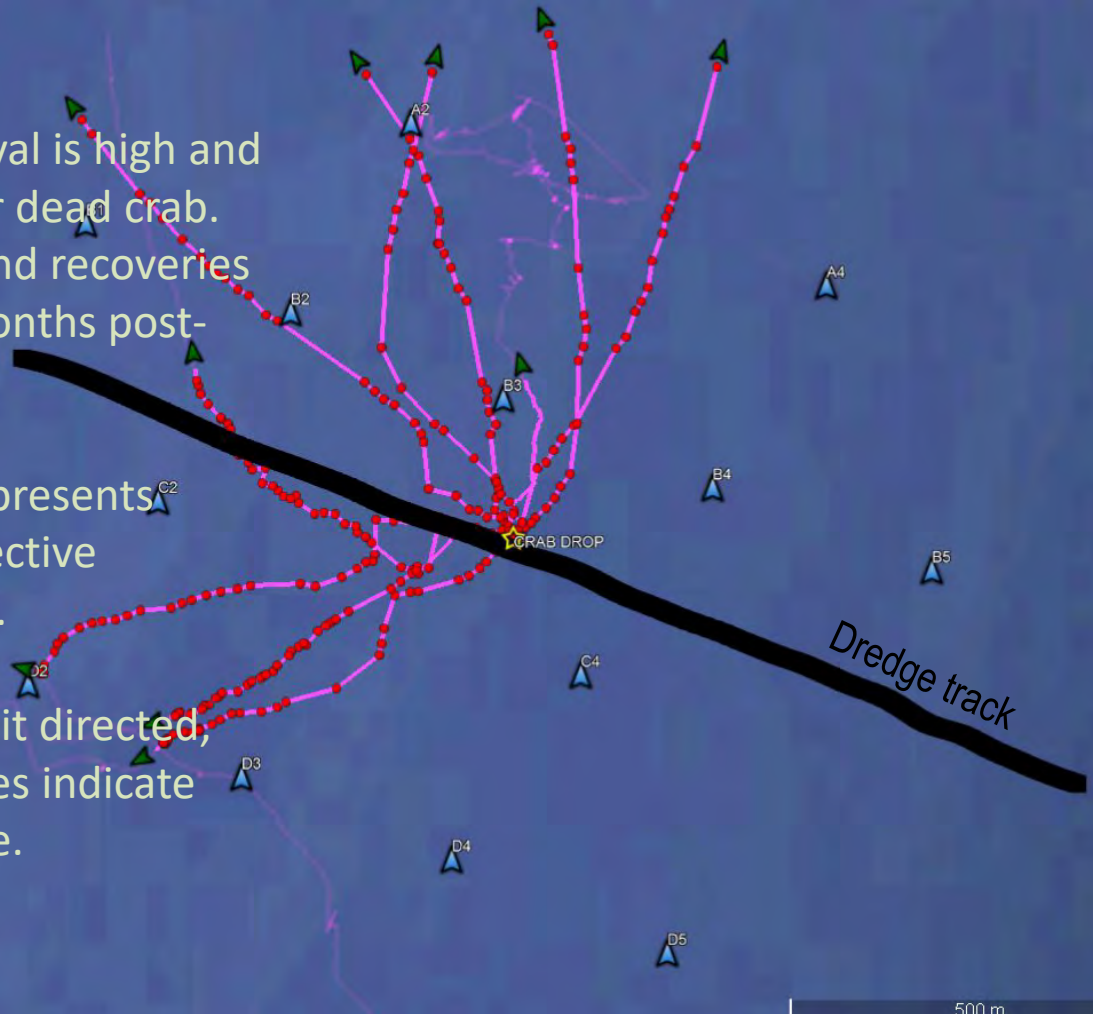
Data LDEO-Columbia, NSF, NOAA

100 km

N

Summary

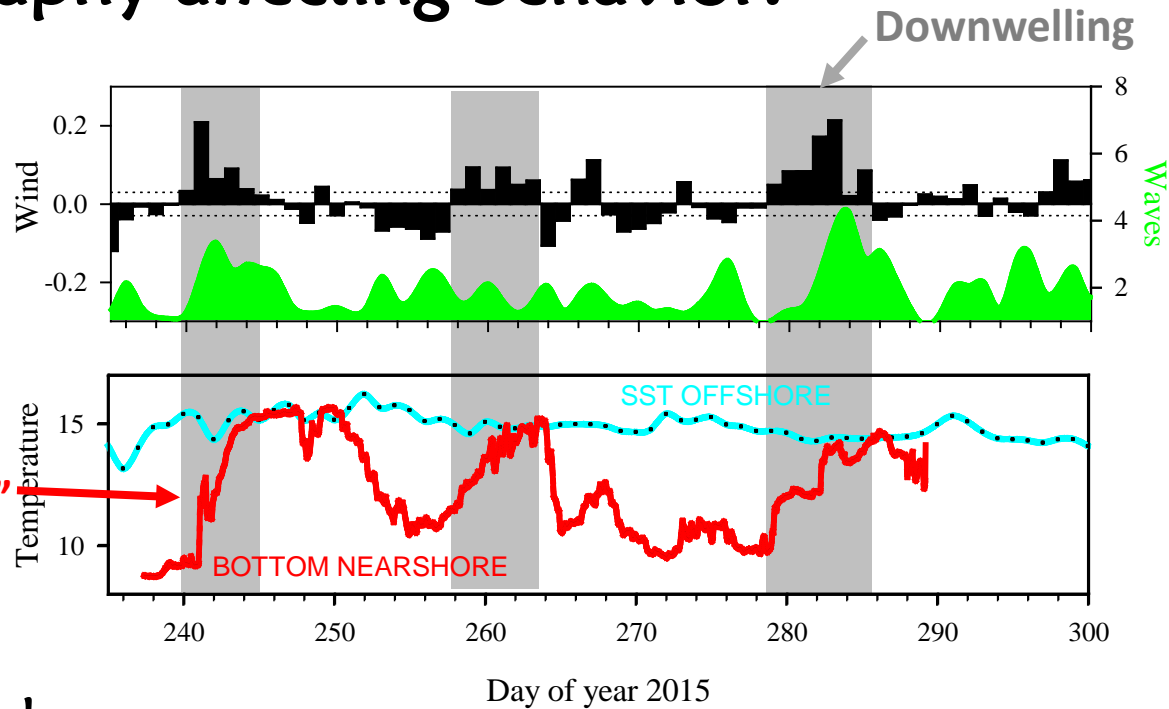
- Conducted Control-Impact experiments to investigate sediment deposition on crab and learn more about crab movements.
- Underwater video revealed structure of lateral surge and impact on crabs – acute but ephemeral.
- Acoustic data reveals acute survival is high and little evidence of incapacitated or dead crab. Evidence from sentinels, gates, and recoveries indicates survival for weeks to months post-release.
- Conclude the thin layer disposal presents limited risk to crabs and is an effective management tool for this system.
- Crabs are highly motile and exhibit directed, often linear movements. Velocities indicate rates exceeding 20 km /d possible.



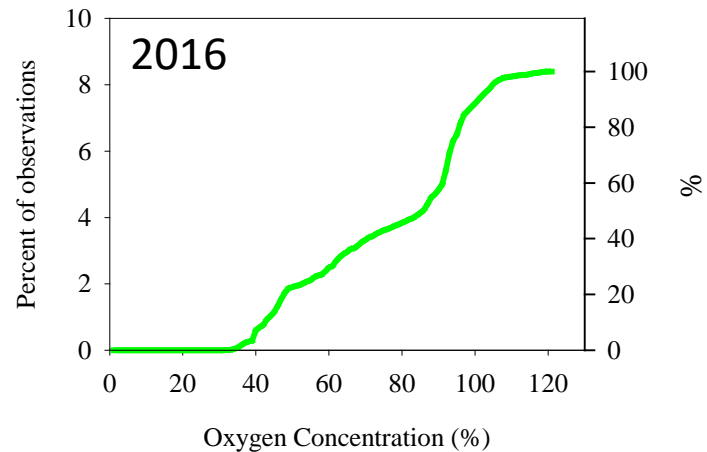
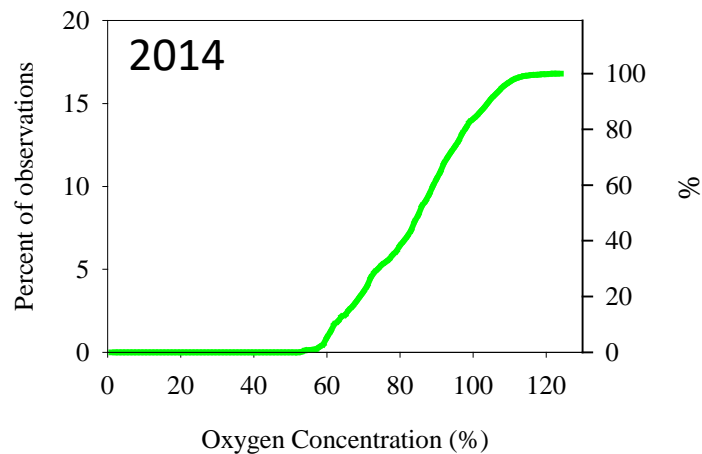
Oceanography affecting behavior?

Ocean
Heat Wave

Warm "blob"



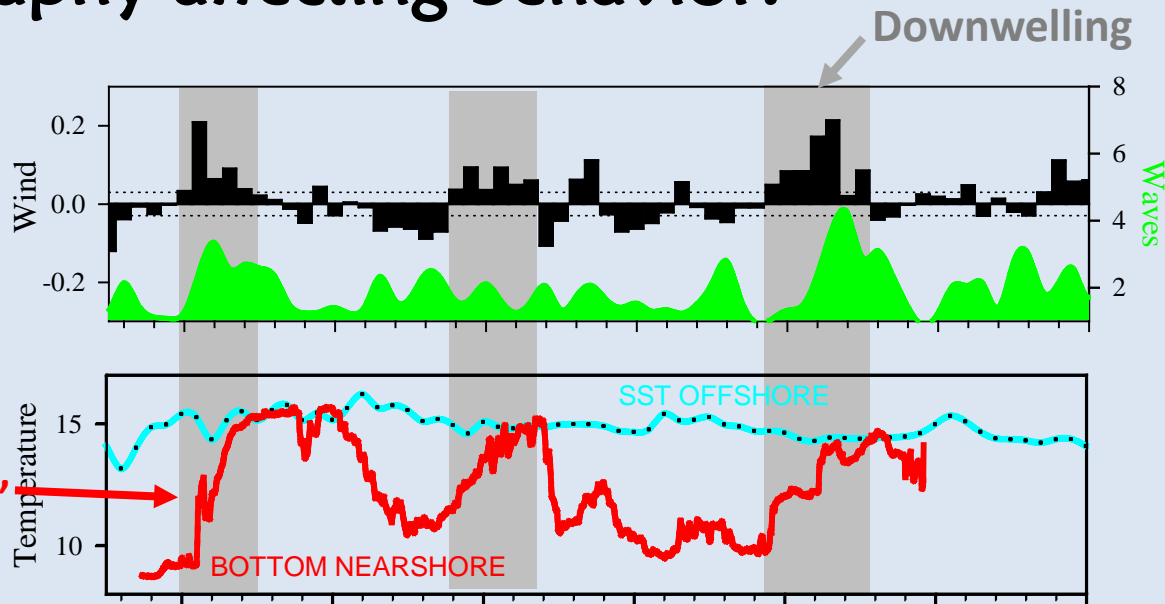
Low Dissolved
Oxygen



Oceanography affecting behavior?

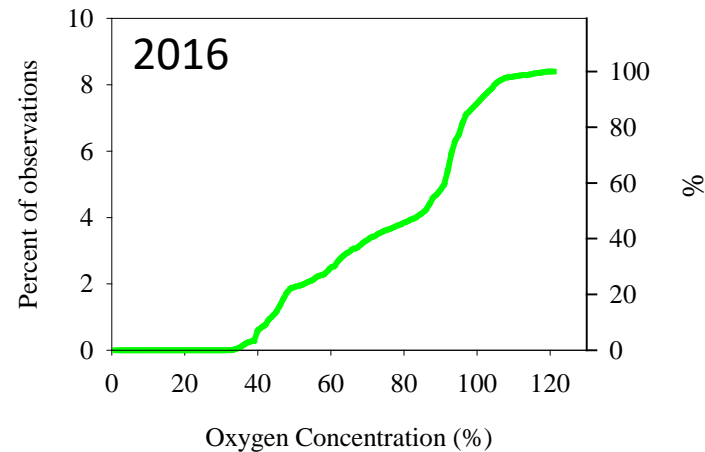
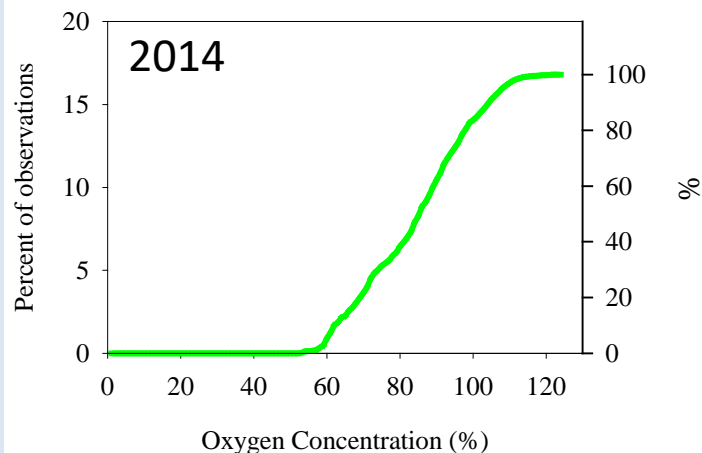
Ocean
Heatwave

Warm "blob"



Low Dissolved
Oxygen

- High temperatures and low DO are already at levels inducing stress, especially if food is limiting.



ACKNOWLEDGEMENTS:

- CORPS / EPA
- ODFW & WDFW
- CRCFA / Oregon Dungeness Crab Commission
- LCSG

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