TRACKING CRABS IN DIFFERENT HABITATS

Sarah K. Henkel
Hatfield Marine Science Center
Oregon State University

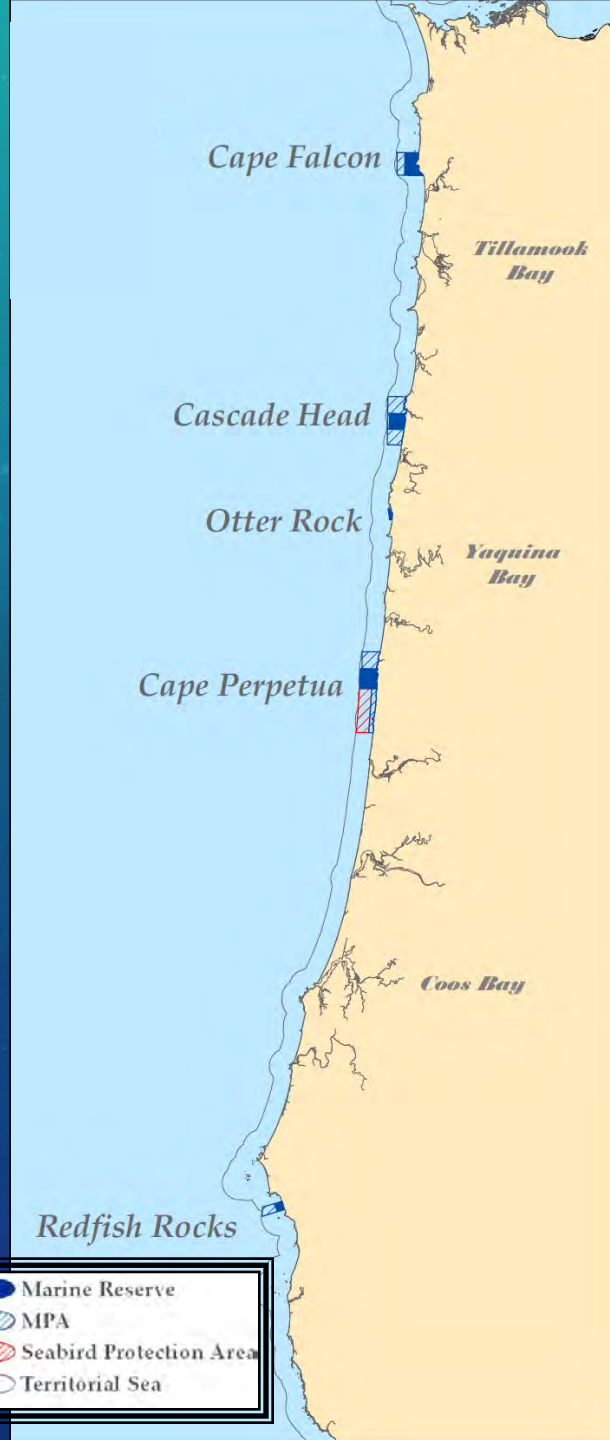
G. Curtis Roegner
Point Adams Research Station
Northwest Fisheries Science Center

Place-based Ecological/Fisheries Issues: Marine Reserves & Offshore Energy

Overview of Oregon Marine Reserves

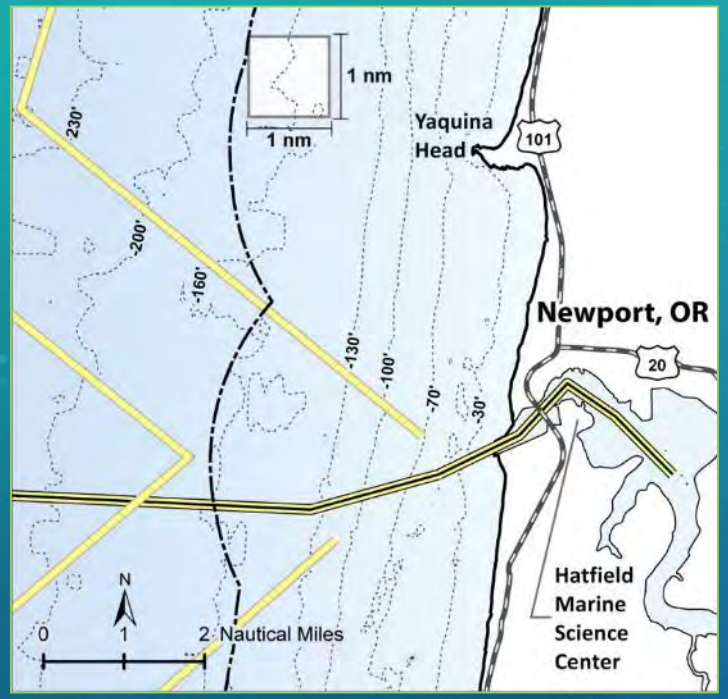
- 5 sites in place
- Site management and review
- Ecological and human dimensions monitoring
- Compliance and enforcement
- Outreach and community engagement
- Report to Legislature in 2023

https://oregonmarinereserves.com



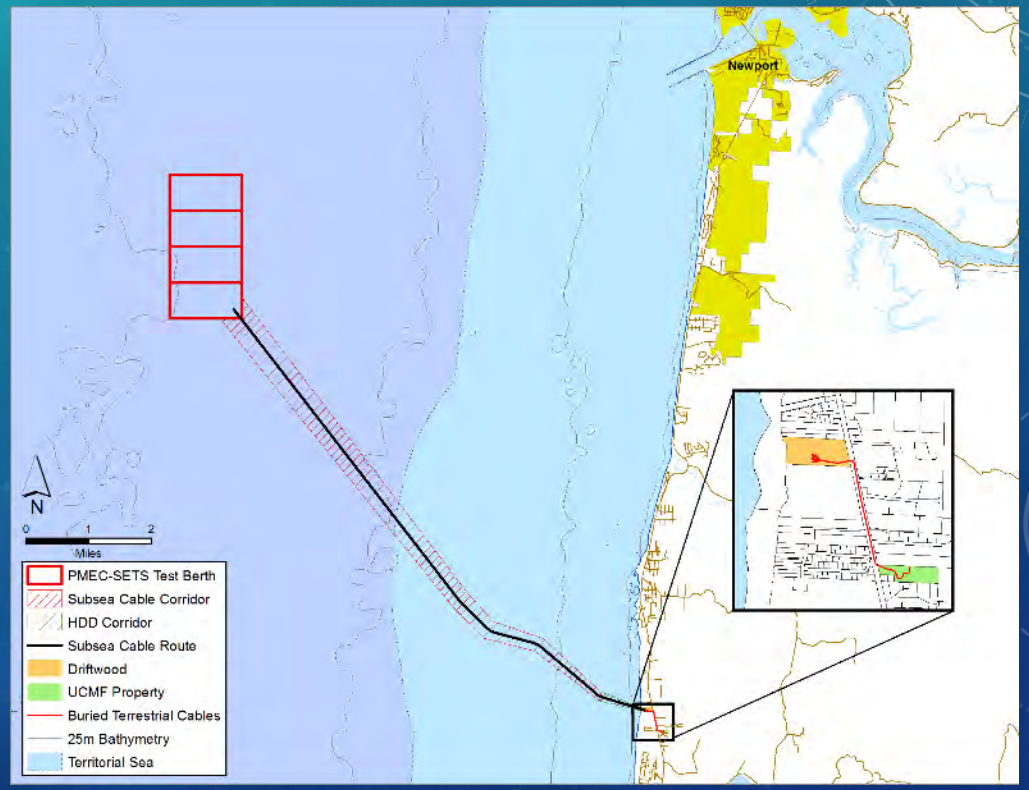
Marine Energy Sites in Oregon

PacWave North and South



Autonomous 'North' site (NETS): 1 nm^2

~5 km offshore; ~10 km NW from port of Newport, Oregon



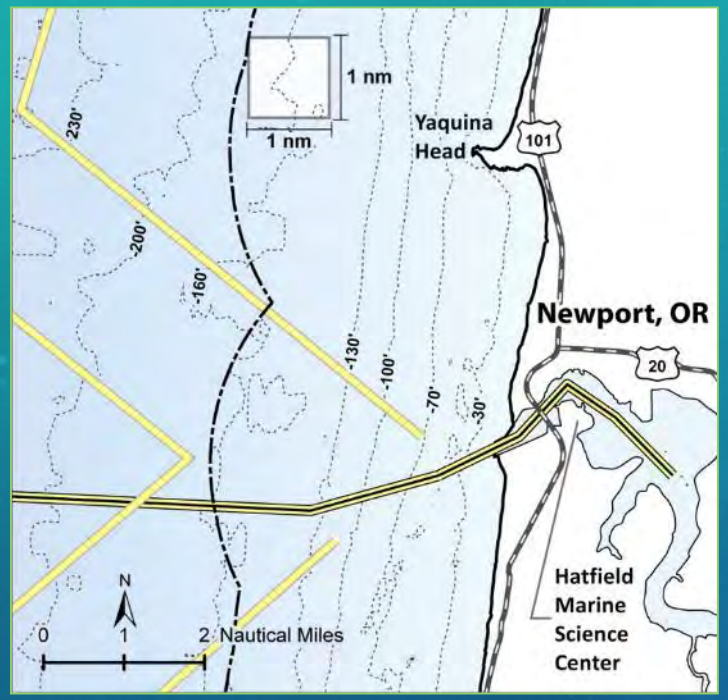
Grid-connected 'South' site (SETS): 2 nm^2

~12 km offshore; ~16 km SW from port of Newport, Oregon

PacWave
TESTING WAVE ENERGY FOR THE FUTURE

Marine Energy Sites in Oregon

PacWave North and South



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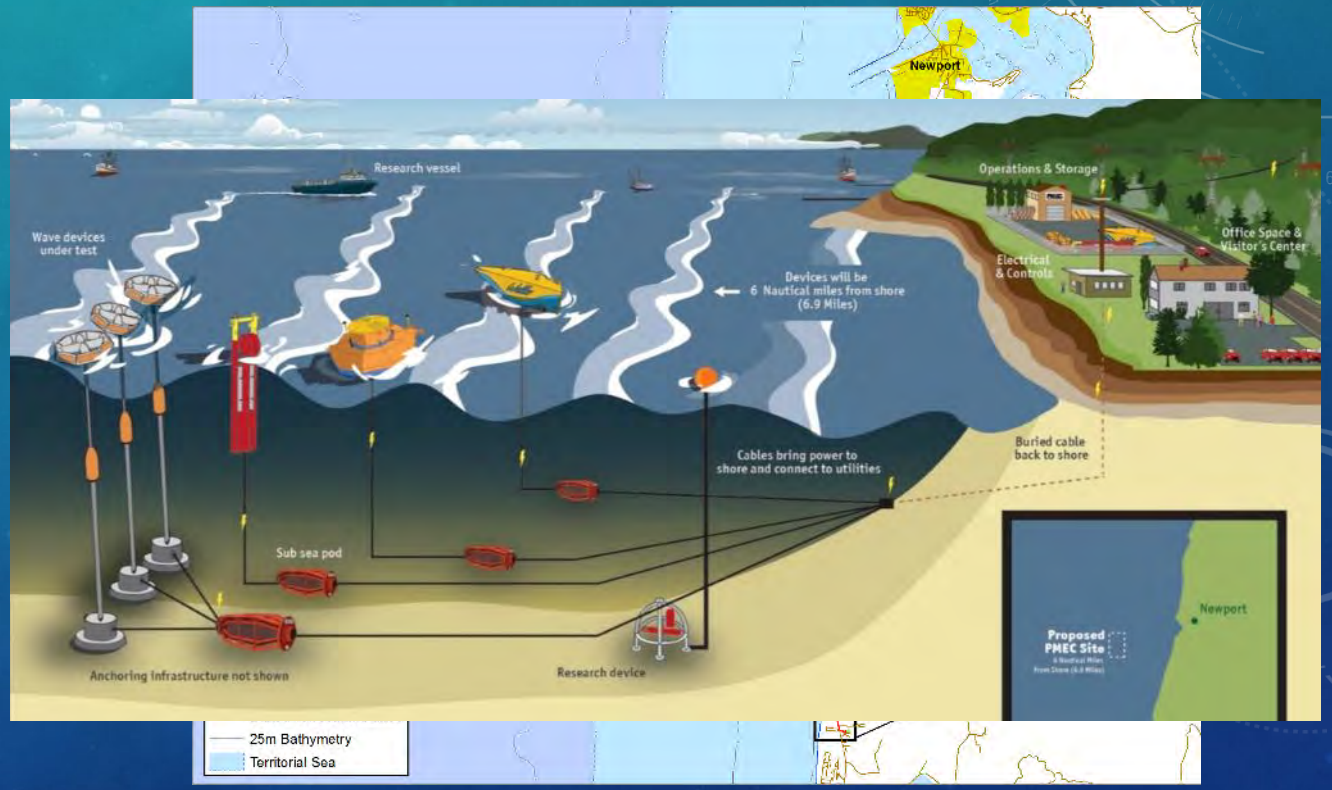

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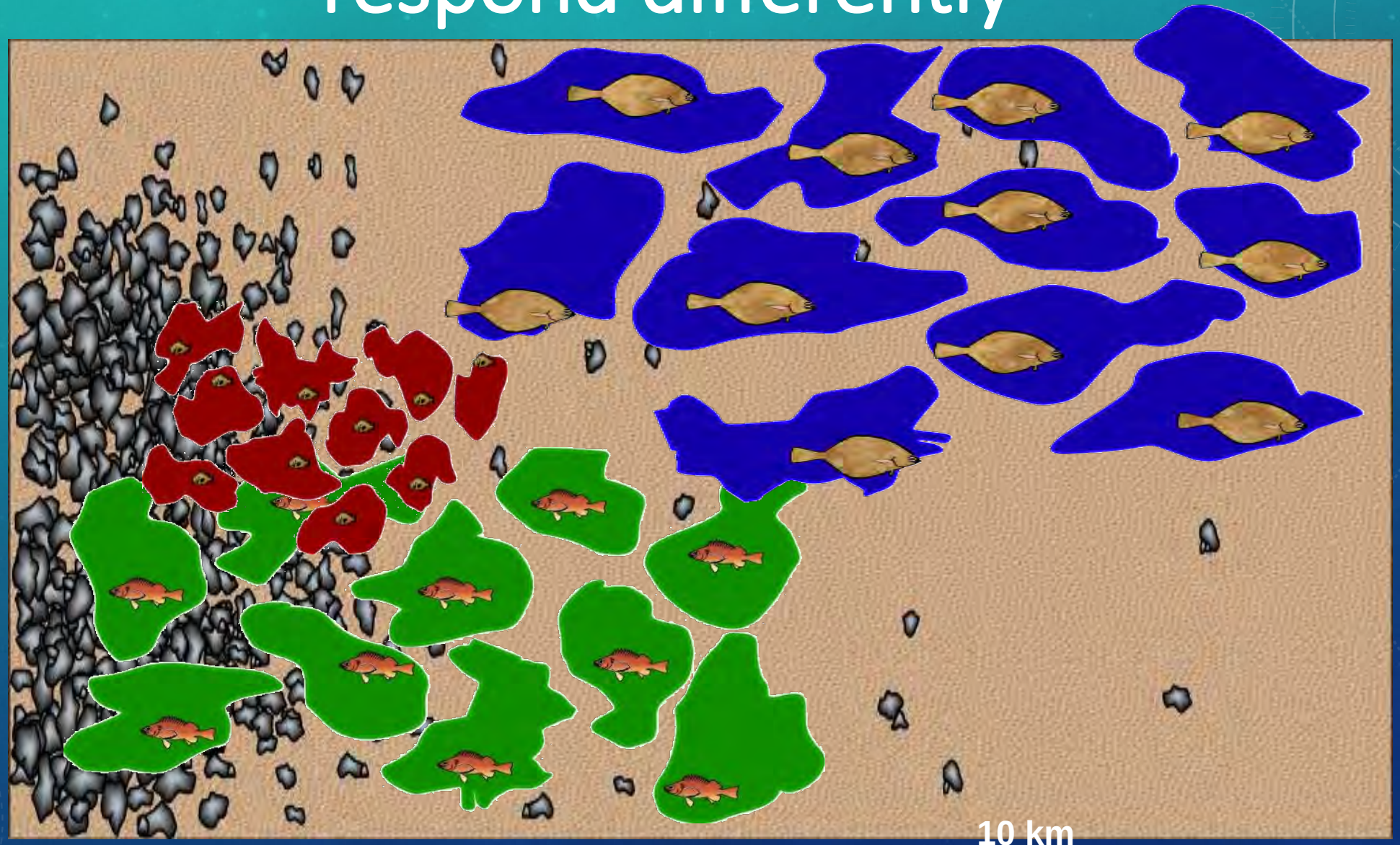
PacWave
TESTING WAVE ENERGY FOR THE FUTURE

What are the fisheries-relevant issues?

- Access
  - How much fishing area will be lost?
  - How much money will have to be spent to travel to other fishing grounds potentially further away?
- Enhancement
  - Will species protected from harvest inside the site spill over to enhance nearby areas?

We expect different species will respond differently



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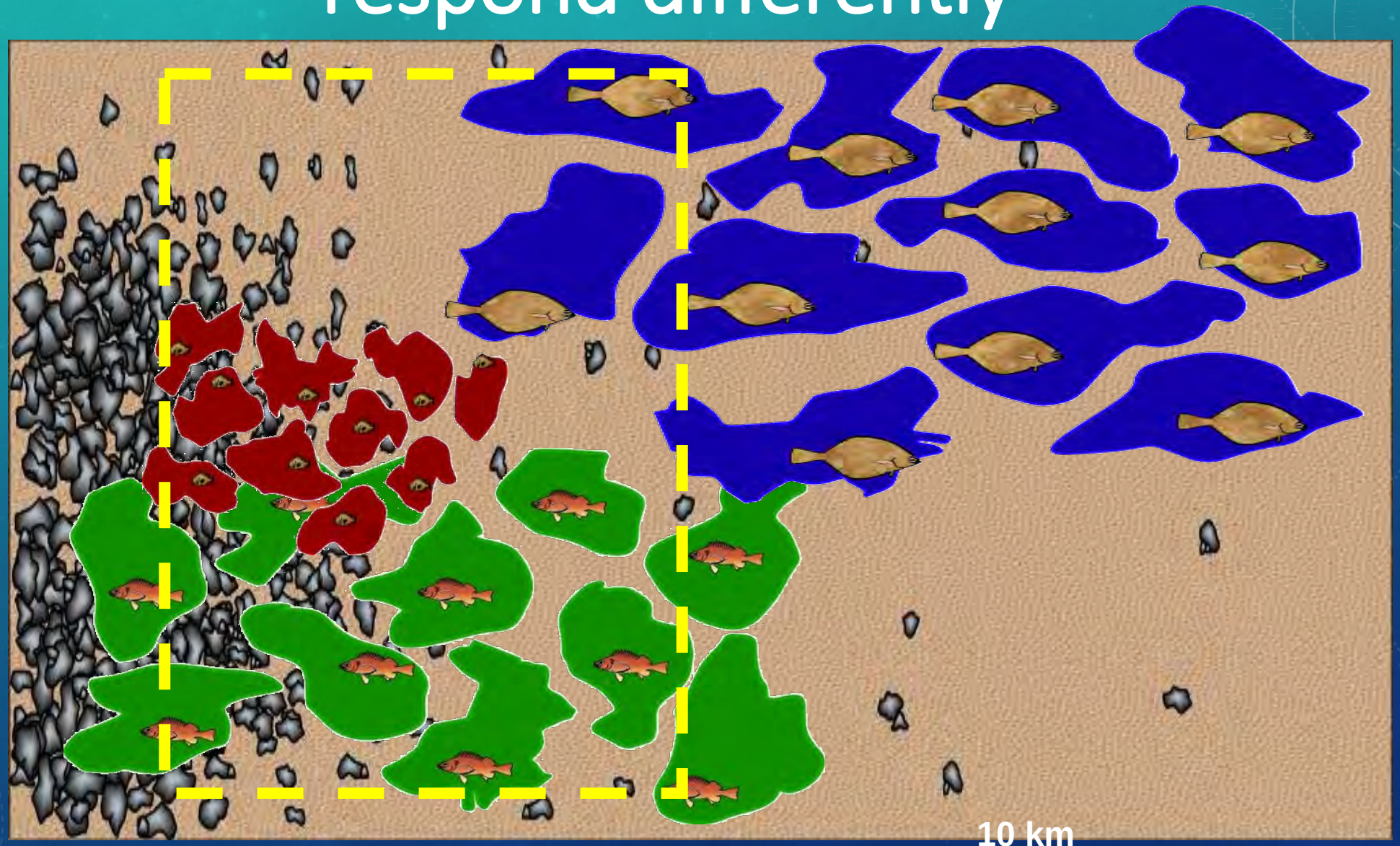
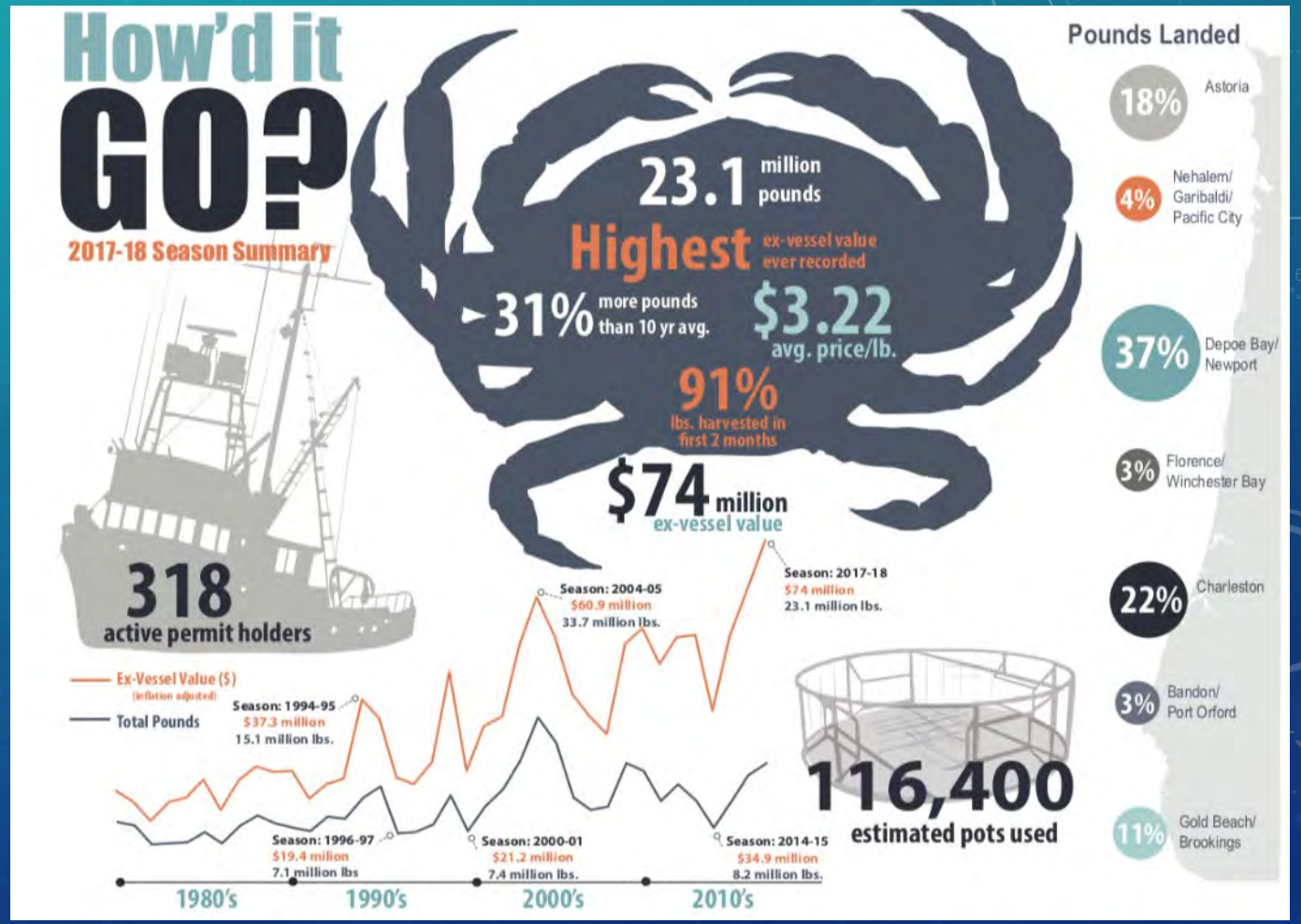


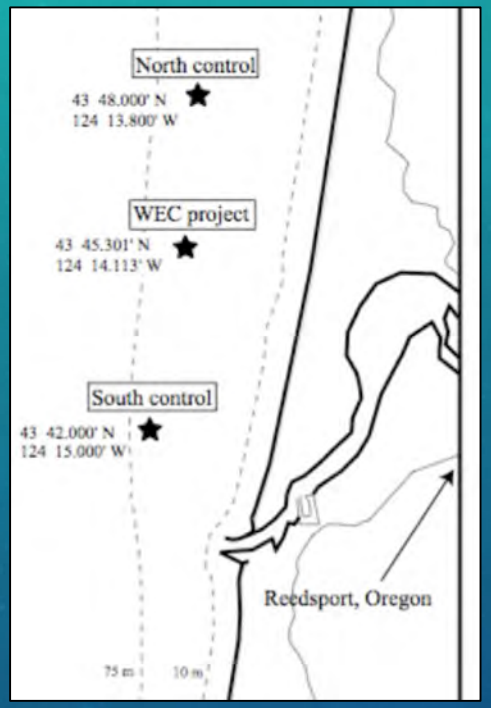
SPECIES OF INTEREST: DUNGENESS CRAB



HOW FAR DO DUNGENESS MOVE?

Site	Males	Females	Notes	Source
Fritz Cove, Alaska	2.13 - 7.24 km (n = 8)	0.38 - 4.23 km (n = 10, 16)	No female crabs left the bay	Stone and O'Claire 2001, 2002
British Columbia	288 m/day 95% would be in radius of 9.5 km (n = 4038/930) (n = 4 acoustic)	419 m/day 95% would be in radius of 13.9 km (n = 1246/103) (n = 6 acoustic)	Tagged crabs were tracked for 21 to 86 days. Estimated after one year of random dispersal, distance from the point where they were one year previous	Smith & Jamieson 1991
Oregon	Average 15.3 km (n > 4000/1485)		In an average of 80 days from the time of release to recapture with some distances exceeding 92 km. Crabs tagged within bays tended to travel shorter distances that those tagged offshore, averaging only 7.8 km	Waldron 1958
California		54% had moved >2 km	~1 year later One crab was recovered 80 km away	Diamond and Hankin 1985

“Recent” Study: Will crabs that live at wave energy sites be unavailable for harvest?

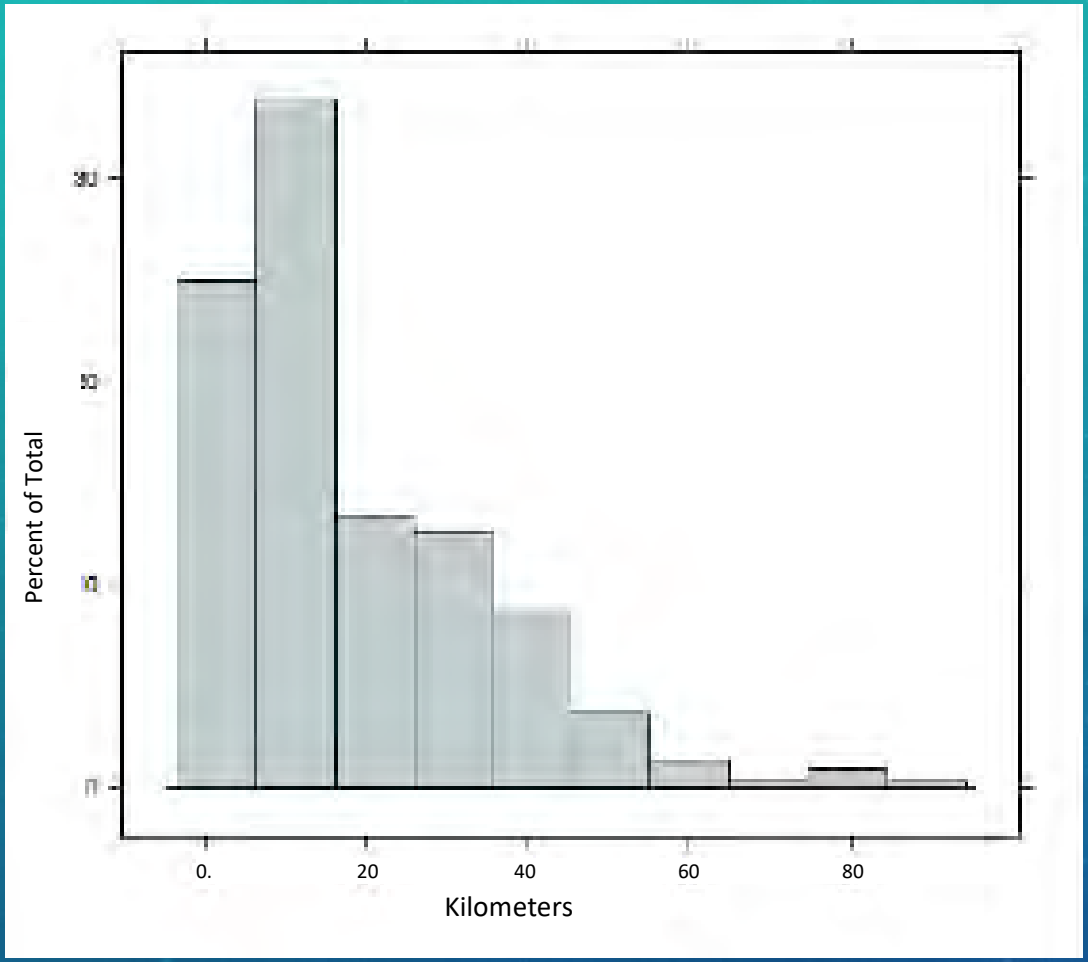


Crab pots were deployed at a proposed wave energy demonstration site off Reedsport and at control sites North and South.

Legal size adult males (2788) were tagged and released in October and November 2009.

H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS

Reedsport, Oregon, Crab Movement Results



The recapture effort was conducted during normal operations of the commercial Dungeness crab fleet from Dec 1st 2009 until August 15th 2010.

952 tags returned! 626 tags returned with location data of sufficient detail for analysis.

Sea Grant Oregon | Oregon Wave Energy Trust | Oregon Dungeness Crab Commission

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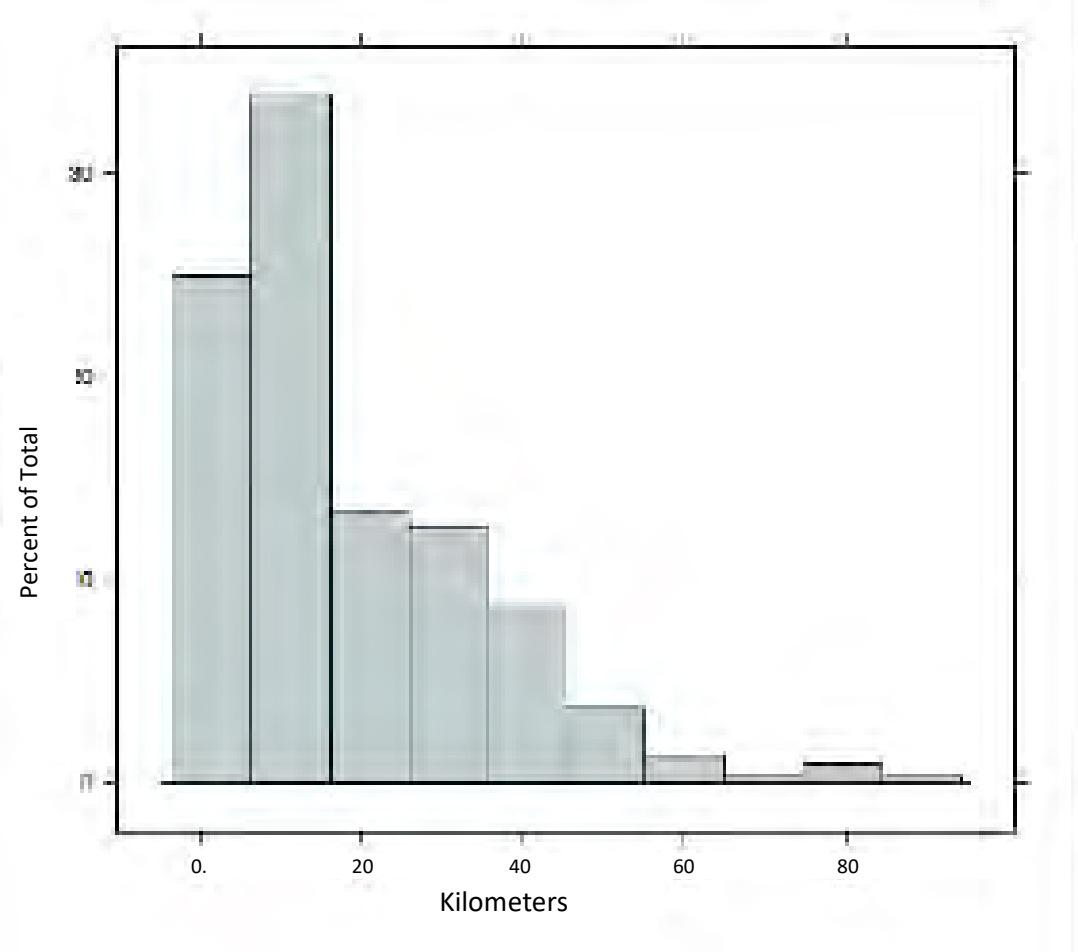

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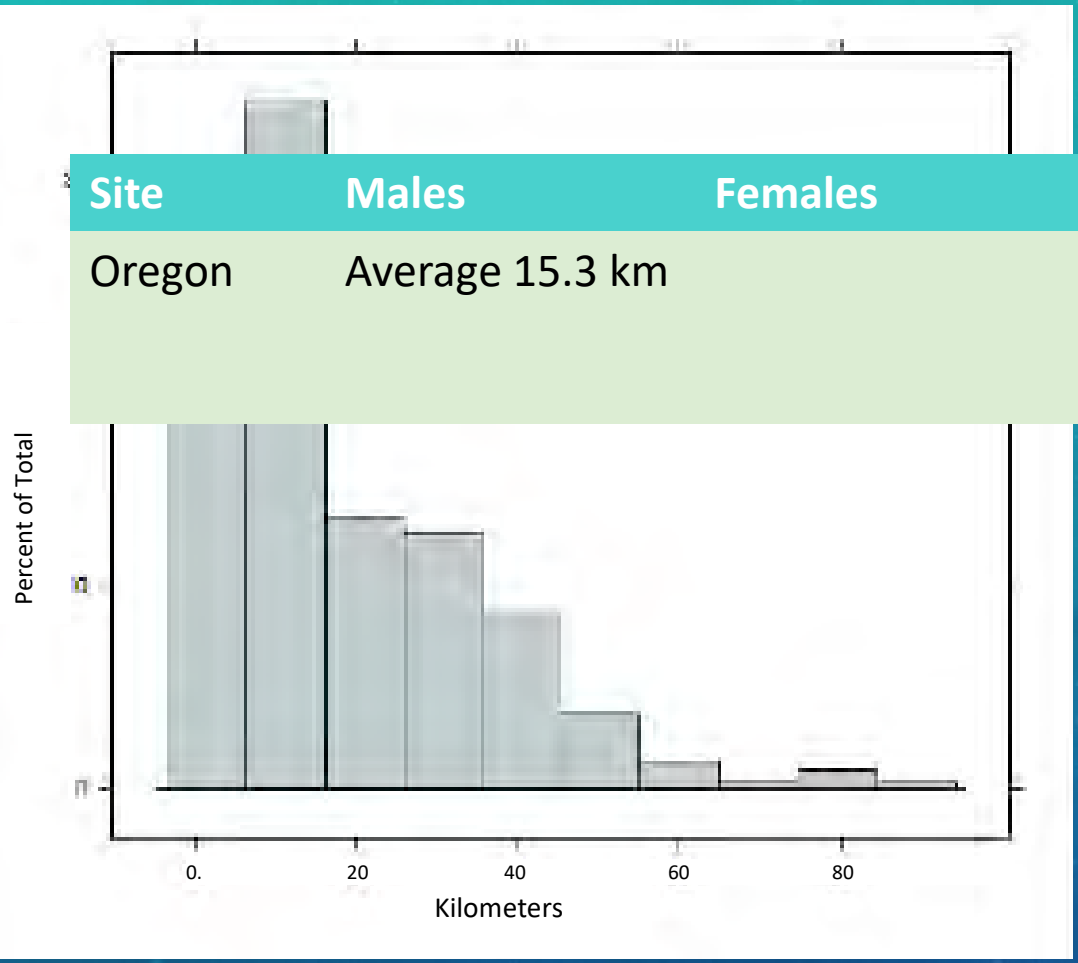
Sea Grant Oregon

OregonWaveEnergy TRUST

Oregon Dungeness Crab Commission

Reedsport, Oregon, Crab Movement Results



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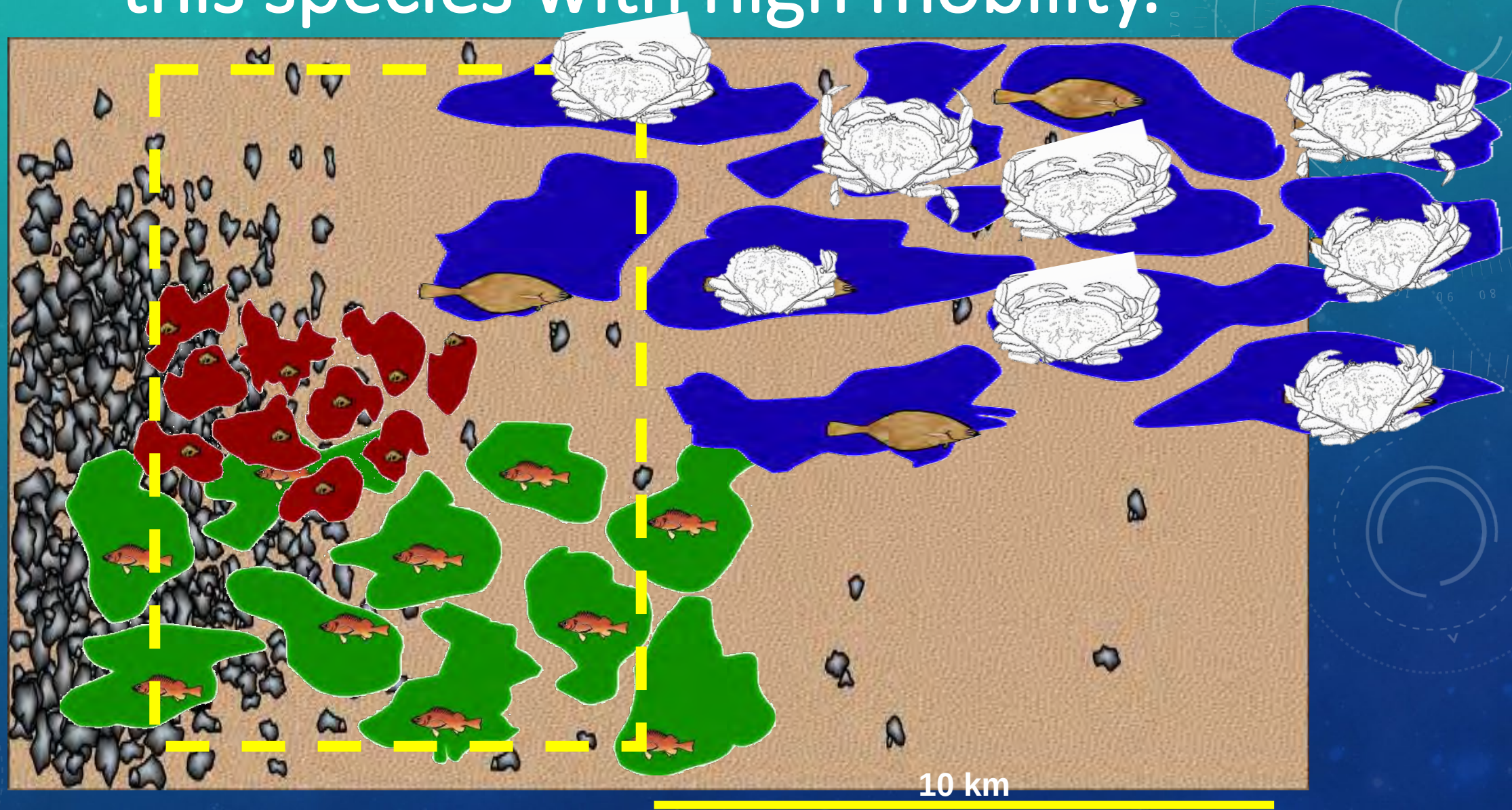
Expect the “local effect” to be low for this species with high mobility.



WHY DO THEY MOVE SO MUCH?

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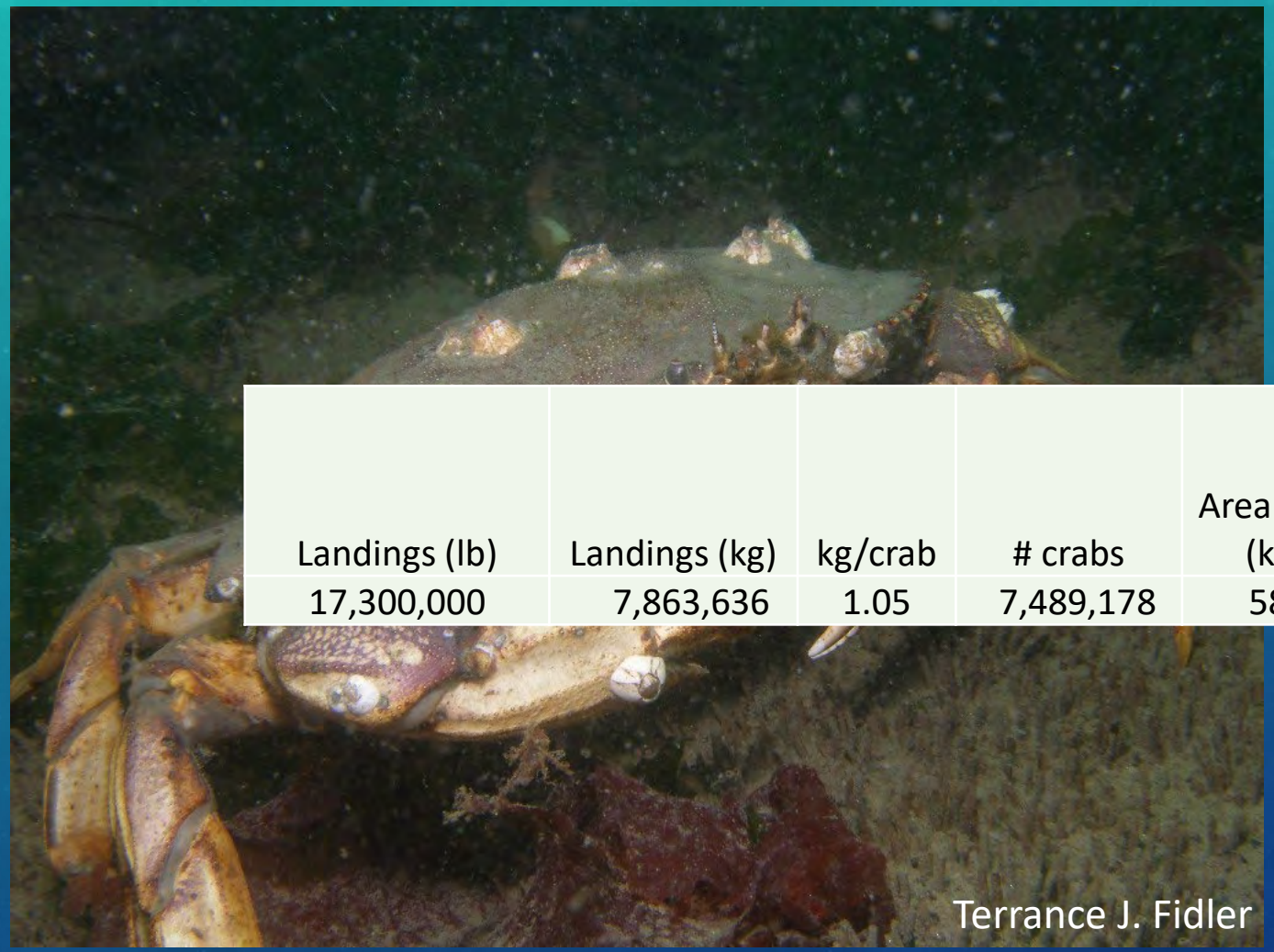


Benthic biomass in preferred habitat does not appear to be sufficient to meet metabolic demands of the population.

Landings (lb)	Landings (kg)	kg/crab	# crabs	Area fished (km^2)	Crabs/km^2	Energetic req (kJ/crab/day)	Energy density needed for landed crabs (kJ/km^2/day
17,300,000	7,863,636	1.05	7,489,178	5830	1,285	25	32,115

Macrofauna, mysid & Crangon shrimp, and small flatfish *standing stock*
230,837 kJ/km^2

WHY DO THEY MOVE SO MUCH?

- Maybe they move so much because they are foraging.
- What if they lived near a richer food source?

In California, sea stars and *Pandalus* shrimp dominated shell mound megafauna, with rock crab and Dungeness crab observed on shell mounds around platforms. (Goddard & Love 2010)

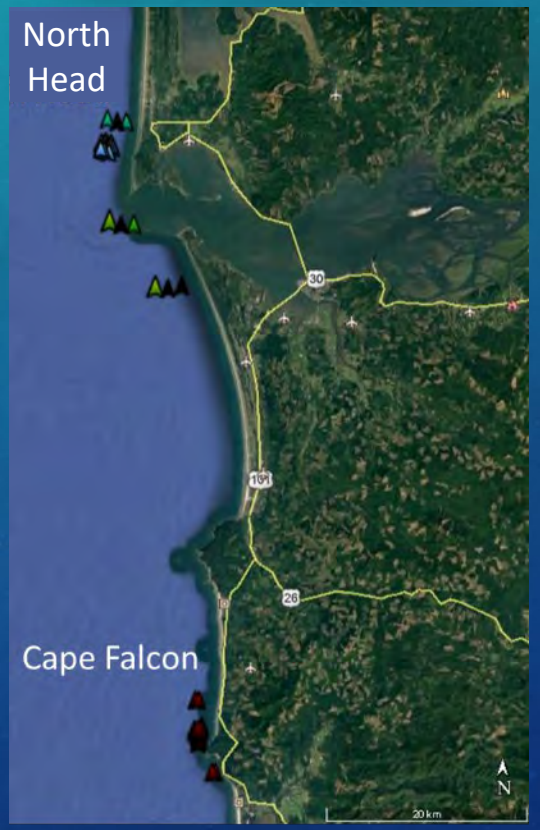
ROV observations of the 10-meter-diameter Ocean Power Technology anchor off Reedsport documented Dungeness crab & sea stars associated with the structure. (OPT 2016)

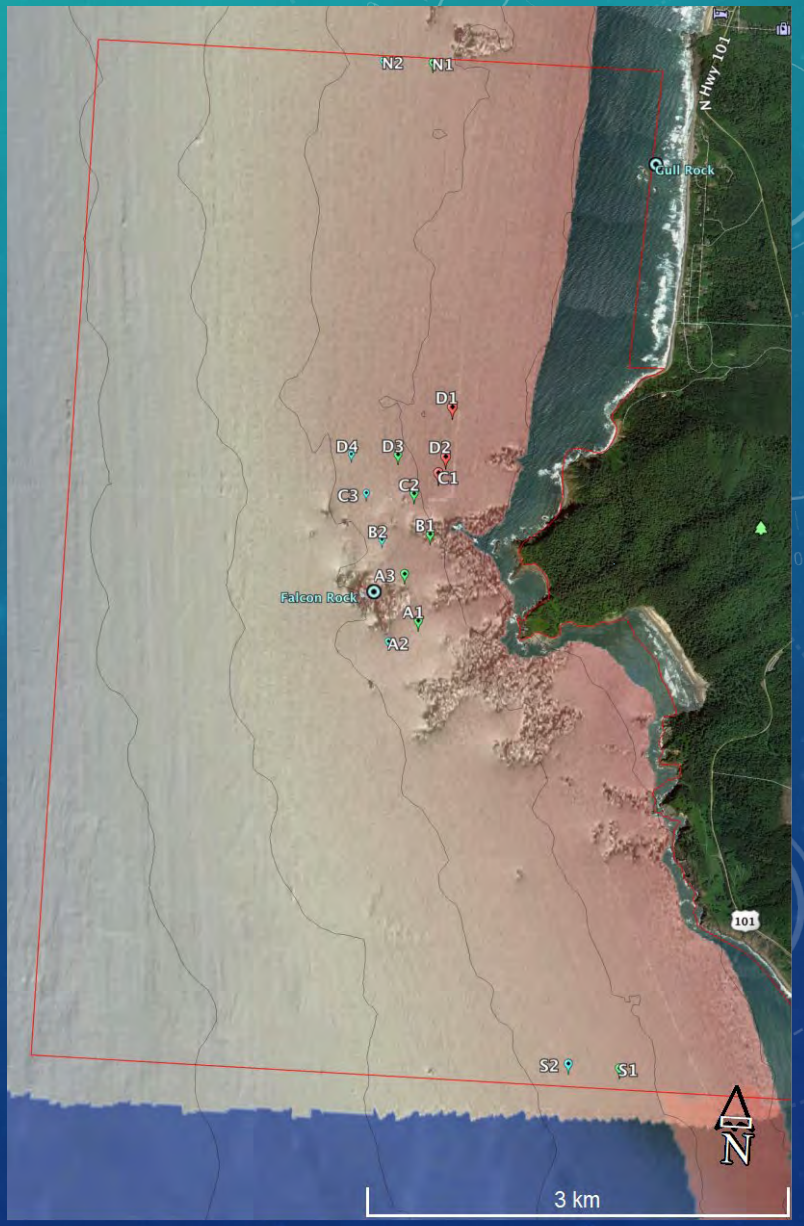
DUNGENESS MOVEMENT/RESIDENCY

Will Dungeness crabs living near a natural reef (like in a marine reserve) move less than those in open sand habitats?

Presumably because they have more local foraging success.

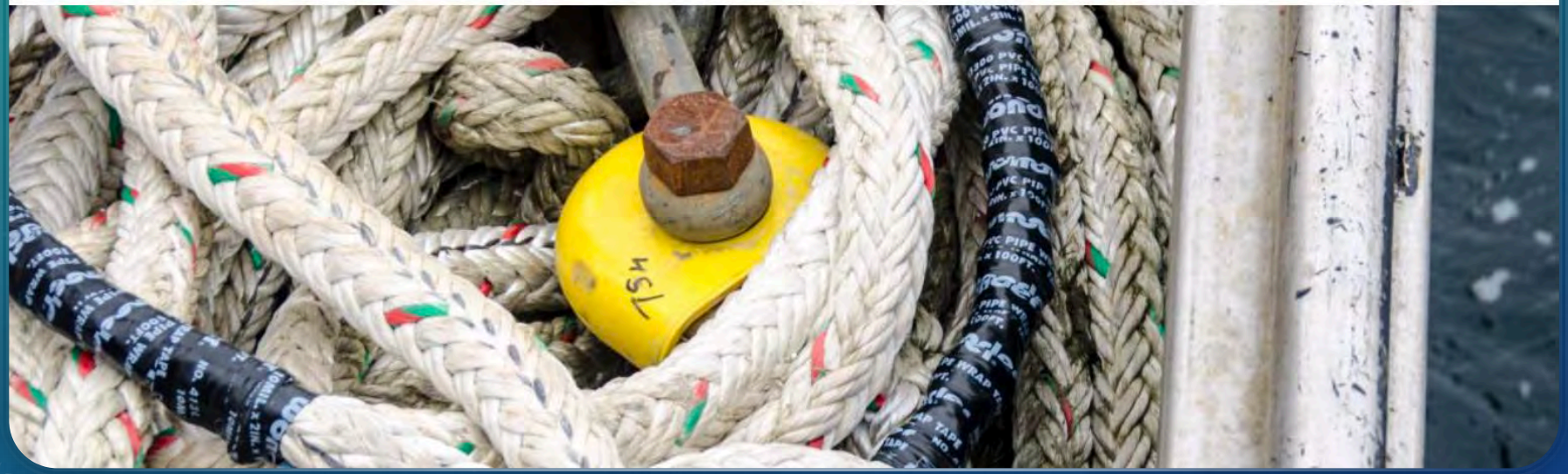

Long Beach
Seaview
Ilwaco
Ruby Island
Sand Island
Sand Island
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2018 Google
5 km
N


North
Head
Cape Falcon
20 km
N


N2
N1
N Hwy 101
Gull Rock
D1
D4
D3
D2
C1
C2
C3
B2
B1
A3
Falcon Rock
A1
A2
S2
S1
101
3 km
N

FIND FUNDING & MORE COLLABORATORS

Eder Family Dungeness Crab Research Fund



FIND FUNDING & MORE COLLABORATORS

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LISTEN CHECK!

LISTEN CHECK! WAIT…

	Sex	Size
A69-1602-11380	M	180
A69-1602-11381	M	163
A69-1602-11382	M	188
A69-1602-11383	M	160
A69-1602-11384	M	174
A69-1602-11385	M	182
A69-1602-11386	M	186
A69-1602-11387	M	164
A69-1602-11388	M	190
A69-1602-11389	M	170
A69-1602-11390	F	170
A69-1602-11391	F	162
A69-1602-11392	F	164
A69-1602-11393	F	150
A69-1602-11394	F	148
A69-1602-11395	F	156
A69-1602-11396	F	158
A69-1602-11397	F	148
A69-1602-11398	F	148
A69-1602-11399	F	134
A69-1602-65167		✓

45 45.971 123 59.718

LISTEN CHECK! WAIT…

NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

HOME | FORECAST | PAST WEATHER | SAFETY | INFORMATION | EDUCATION

Go

View Location Examples

News Headlines

- Fall Weather Spotter Training Schedule

Your local forecast office is
Portland, OR

En Español | Share

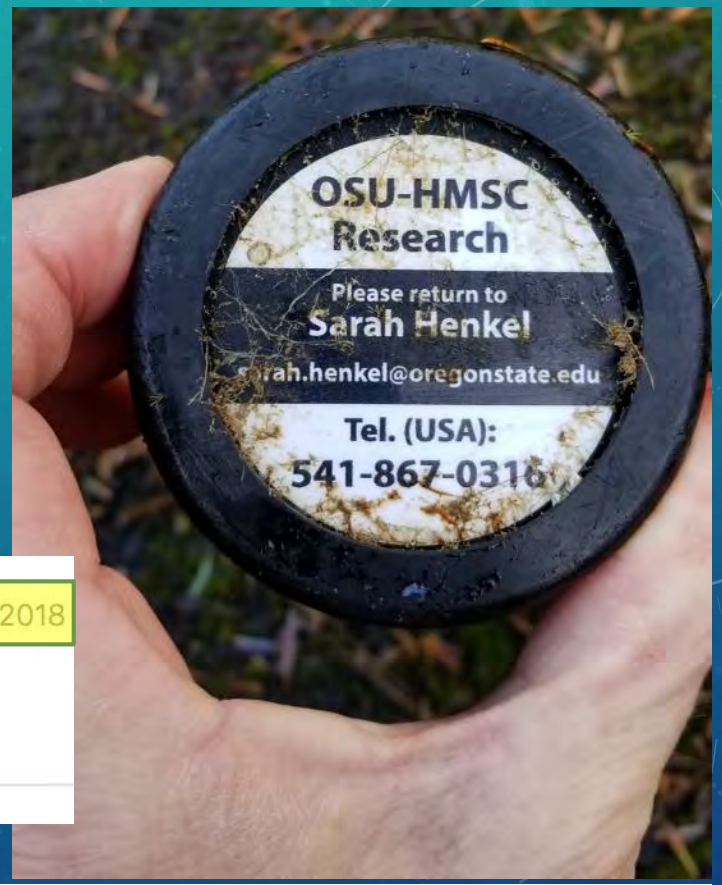
Hazardous Weather Conditions

- Gale Warning in effect from September 17, 03:00 AM PDT until September 17, 02:00 PM PDT

6NM W Cape Lookout OR
Marine Point Forecast
[NOTICE]

This Afternoon	Tonight	Tuesday	Tuesday Night	Wednesday
S 15kt 7ft	↑SSW 23kt 6-8ft Gale Warning	SSW 31kt↓ 8-9ft Gale Warning	SW 15kt 8ft	S 8kt 8-9ft

ENGAGED LOCAL COMMUNITY!



OSU Voicemail EderFoundation December 24, 2018

Voice Message from Tel: 5037396062

To: Sarah Henkel

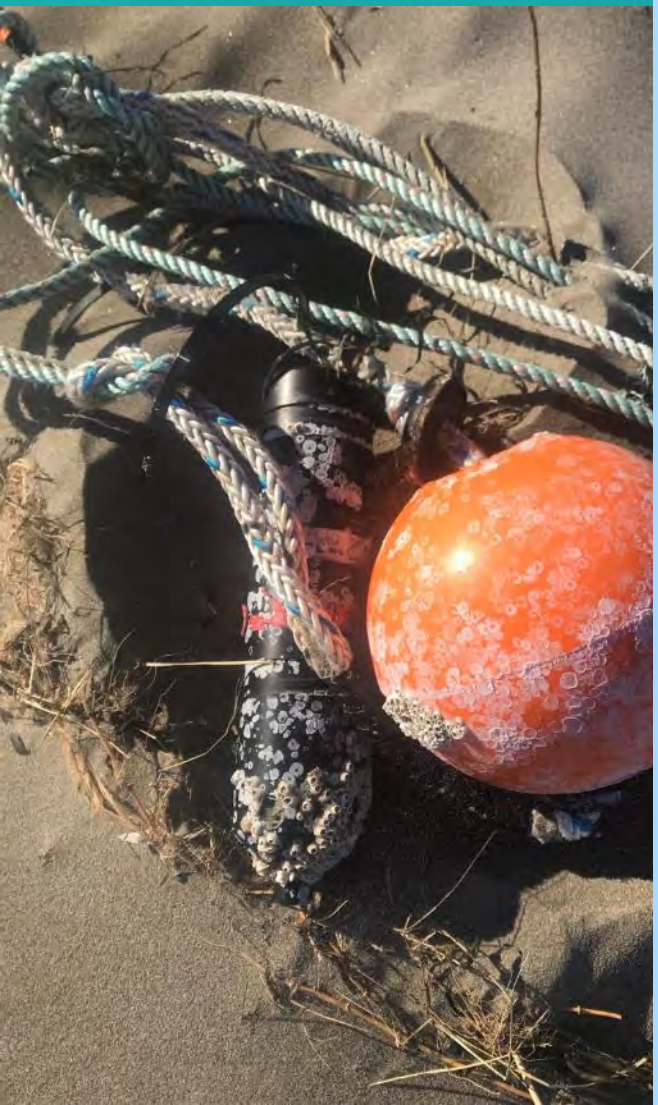
Jeff EderFoundation December 25, 2018

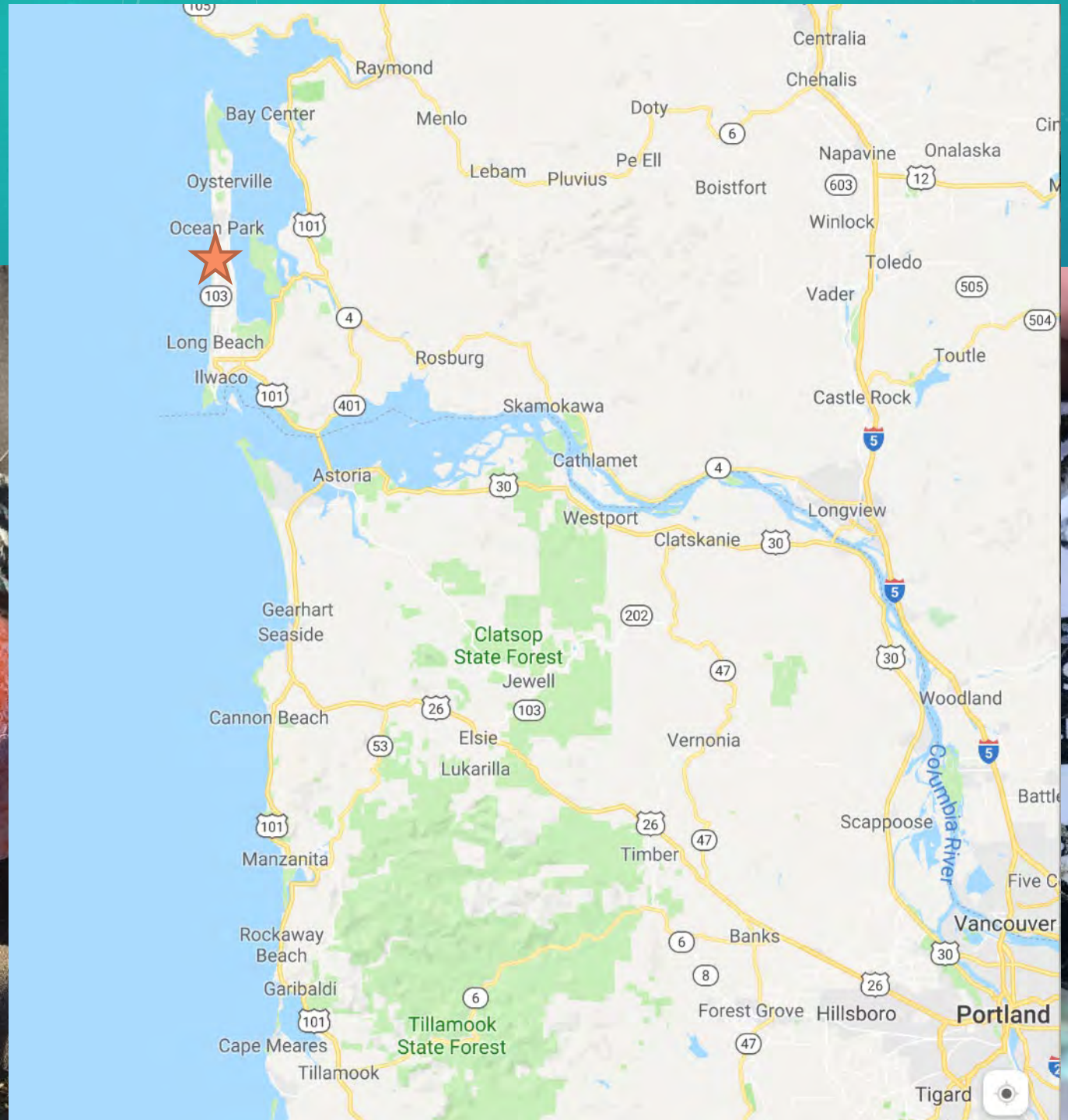
Receiver found

To: Sarah Henkel

Hi this washed up on my beach. If you would like it back let me know and we can figure out how to get it to you.

ENGAGED NOT-SO-LOCAL COMMUNITY




Centralia
Chehalis
Raymond
Bay Center
Menlo
Doty
Napavine
Onalaska
Lebam
Pe Ell
Pluvius
Boistfort
Oysterville
Winlock
Ocean Park
Toledo
Vader
Long Beach
Rosburg
Toutle
Ilwaco
Skamokawa
Castle Rock
Cathlamet
Astoria
Longview
Westport
Clatskanie
Gearhart
Seaside
Clatsop
State Forest
Jewell
Woodland
Cannon Beach
Elsie
Vernonia
Lukarilla
Columbia River
Scappoose
Manzanita
Timber
Vancouver
Rockaway
Beach
Banks
Garibaldi
Forest Grove
Hillsboro
Portland
Tillamook
State Forest
Cape Meares
Tillamook
Tigard


OSU-HMSC
Research
Please return to
Sarah Henkel
henkel@oregonstate.edu
Tel (USA):
541-867-0316

WHAT DID WE DETECT?

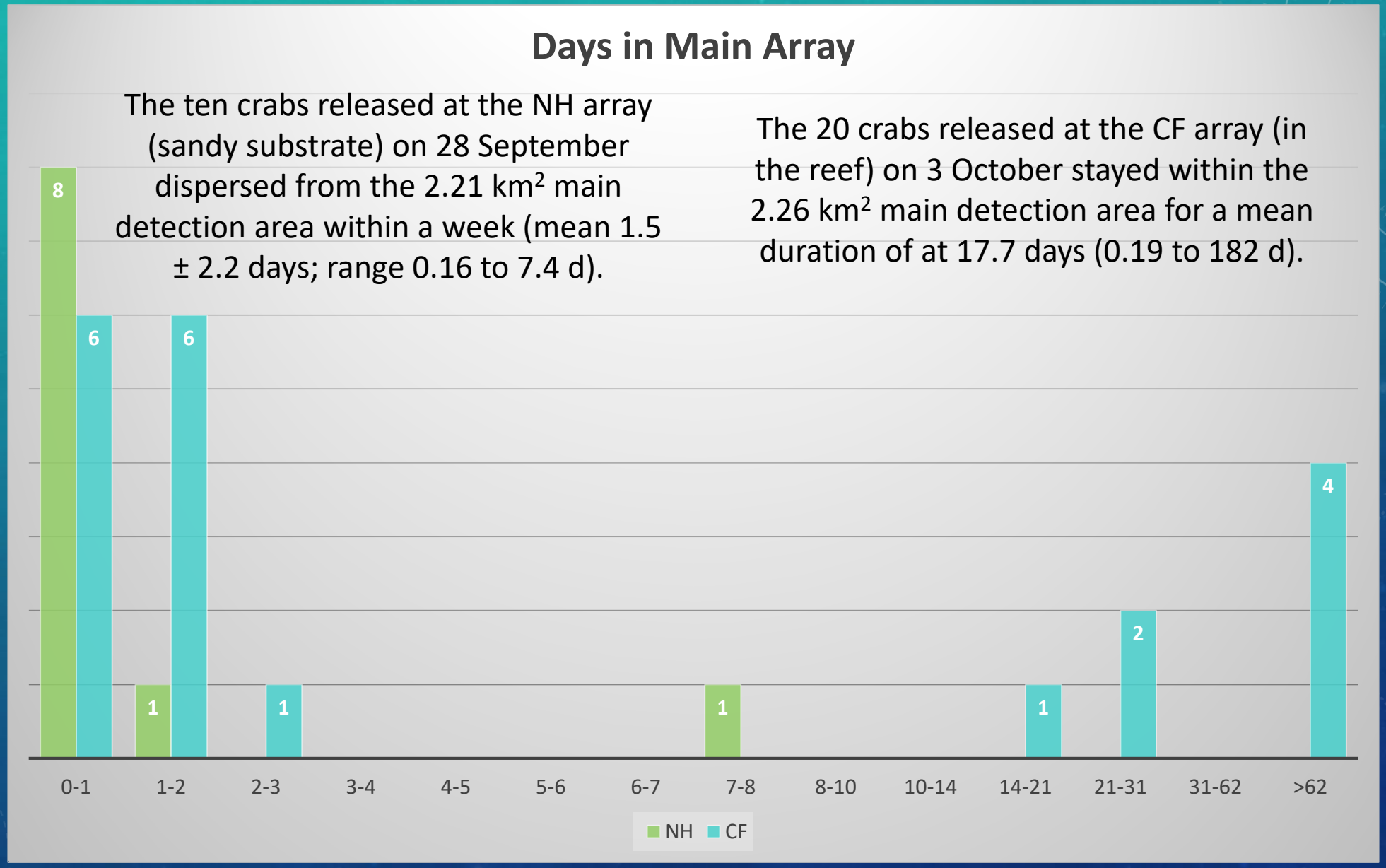
Tag #	Oct	Nov	Dec	Jan	Feb	Mar	Apr
A69-9001-12052				135	43		
A69-9001-12053				156	47		
A69-1303-6165				11	39		
A69-1303-6167			33				
A69-1303-32529			2	4			
A69-1303-32531					5		
A69-1303-32538		8	13				

- All 20 Dungeness released in the Cape Falcon Marine Reserve
- All 30 Dungeness released in the MCR Comparison Areas
- 35 green sturgeon in the Cape Falcon Marine Reserve
- 25 green sturgeon in the MCR Comparison Area
- 7 great white sharks in the Cape Falcon Marine Reserve
- 2 great white sharks in the MCR Comparison Area

WHAT DID WE LEARN ABOUT CRABS?

NH

CF



WHAT HAPPENED WHEN MCR CRABS LEFT THE ARRAY?

Three of ten MCR crabs were subsequently detected at gate receivers:

- Two crabs travelled north to the NL gates after 2 and 12 days, respectively (mean rate 0.56 ± 0.53 km/d)
- The later crab was subsequently collected by a fisherman at the mouth of Willapa Bay. This crab was at liberty for 113.8 d and traveled a straight-line course of 31.1 km at a rate of 0.27 km/d.
- One crab moved south and was detected at the SJ line after 34 d for an average migration rate of 0.24 km/d.

WHAT HAPPENED WHEN CAPE FALCON CRABS LEFT THE ARRAY?

8 of 20 Cape Falcon crabs were subsequently detected at gate receivers:

- Six crabs travelled north to the North Gates after 0.5 to 55 days
- Two crabs were detected at the South Gate after 2 and 52 d.
    - But, they didn’t necessarily leave the marine reserve for good

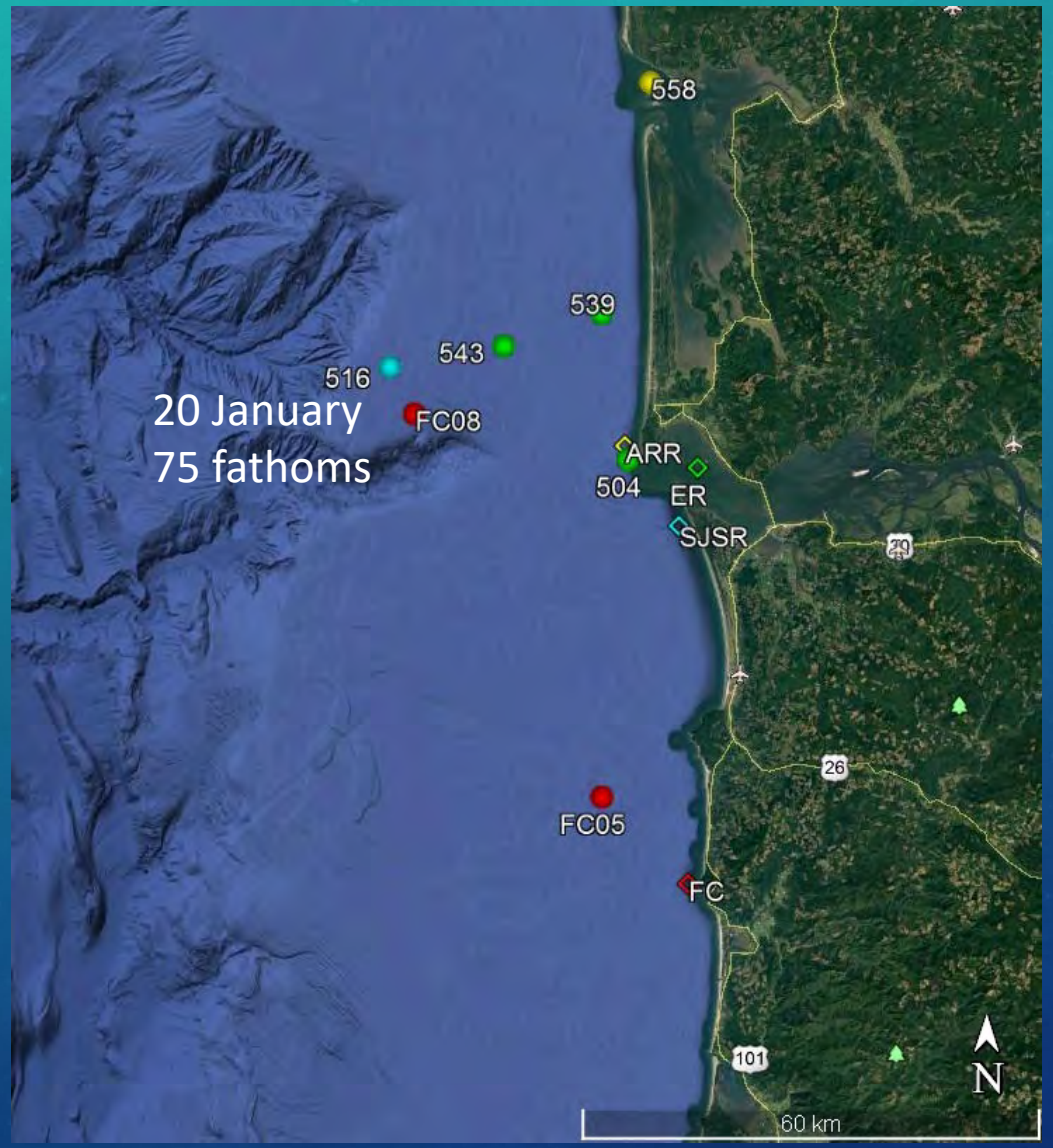
WHAT HAPPENED WHEN CAPE FALCON CRABS LEFT THE ARRAY?

Northbound Crabs

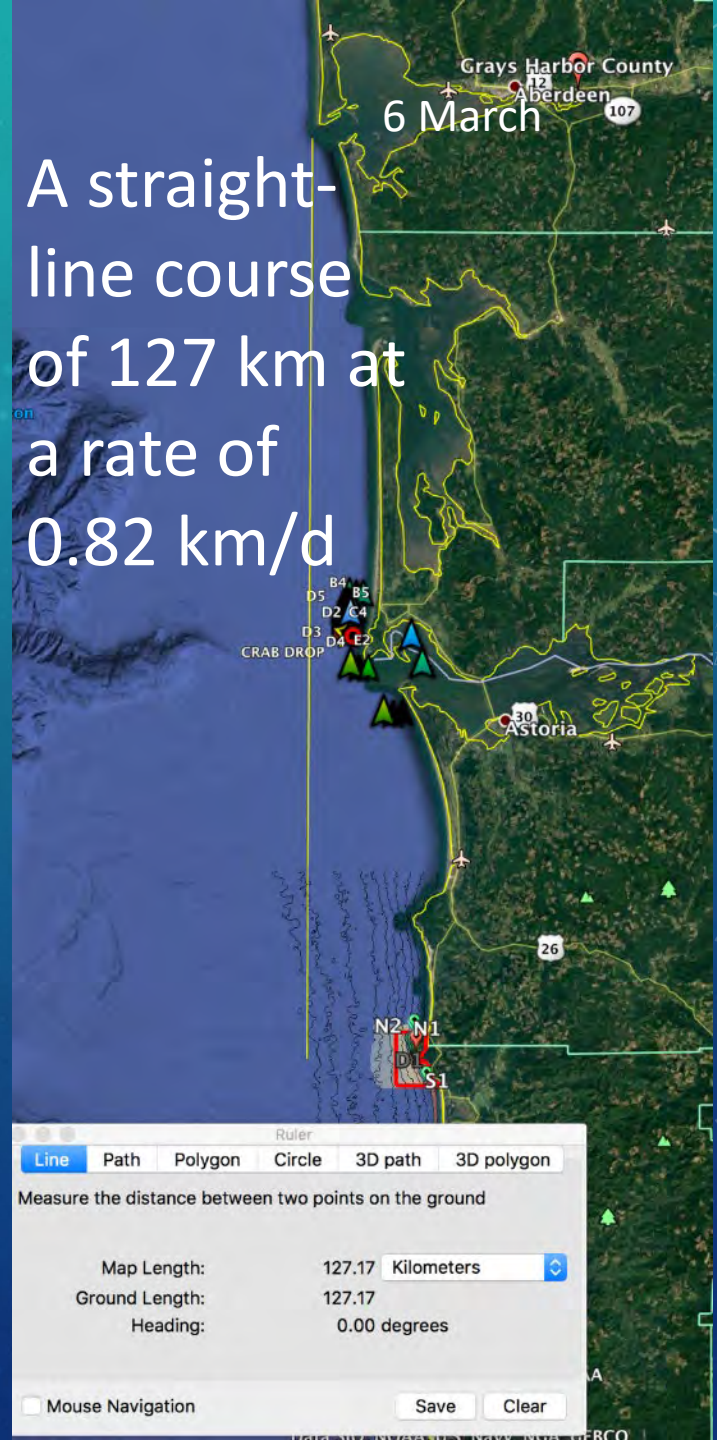
Crab	Duration in Array (d)	Travel Time to Gate (d)	Migration Rate (km/d)	Duration at Edge (d)
11381 (M)	1.79	0.51	6.84	16.94
11386 (M)	0.63	1.59	2.20	0.62
11388 (M)	0.95	4.15	0.84	0.73
11389 (M)	1.80	55.51	0.06	8.84
11393 (F)	*1.06*	*0.55*	*6.32*	*1.27*
11395 (F)	*1.75*	*8.68*	*0.40*	*0.31*

ONE WENT REALLY FAR!

Three additional crabs moved north and were caught and reported by fishermen.



A straight-line course of 127 km at a rate of 0.82 km/d

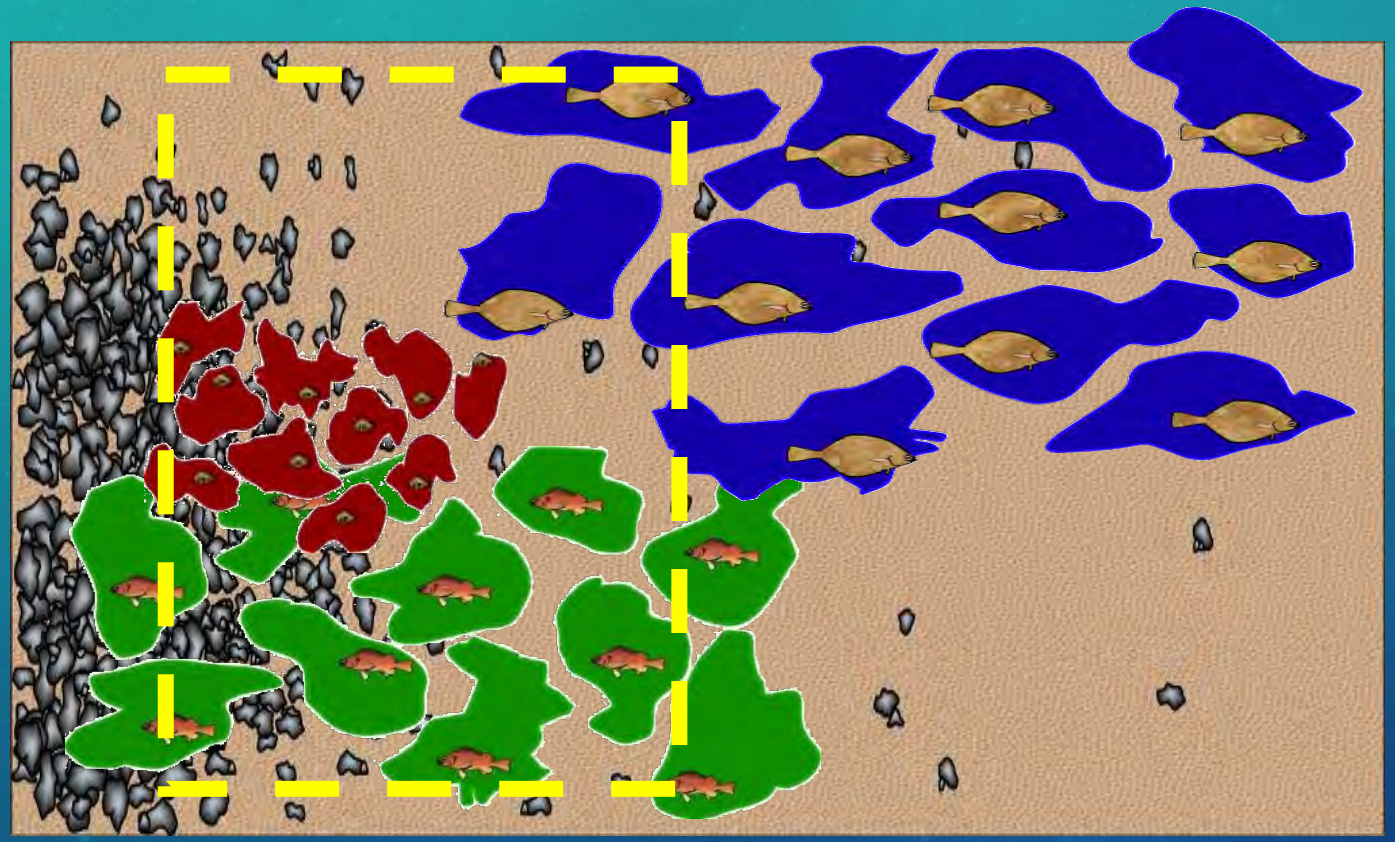


WHAT HAPPENED WHEN CAPE FALCON CRABS LEFT THE ARRAY?

Southbound Crabs

Crab	Duration in Array (d)	Travel Time to Gate (d)	Migration Rate (km/d)	Duration at Edge (d)	Walk-about Time (d)	Second Visit (d)
11390 (F)	*24.60*	*52.42*	*0.07*	*0.002*	*31.80*	*8.50 (array)*
11392 (F)	*1.11*	*1.98*	*1.77*	*19.04*	*48.63*	*0.37 (gate)*

IT SEEMS HABITAT DOES INFLUENCE CRAB MOVEMENT



- Marine Reserves may offer more protection to crabs than we thought.
- If Offshore Energy projects function as artificial reefs, crabs may move into the area and be less accessible for fishers.
- But…if “reef” crabs are more successful at foraging, their increased reproductive capacity could spill over to fishable areas in either case.

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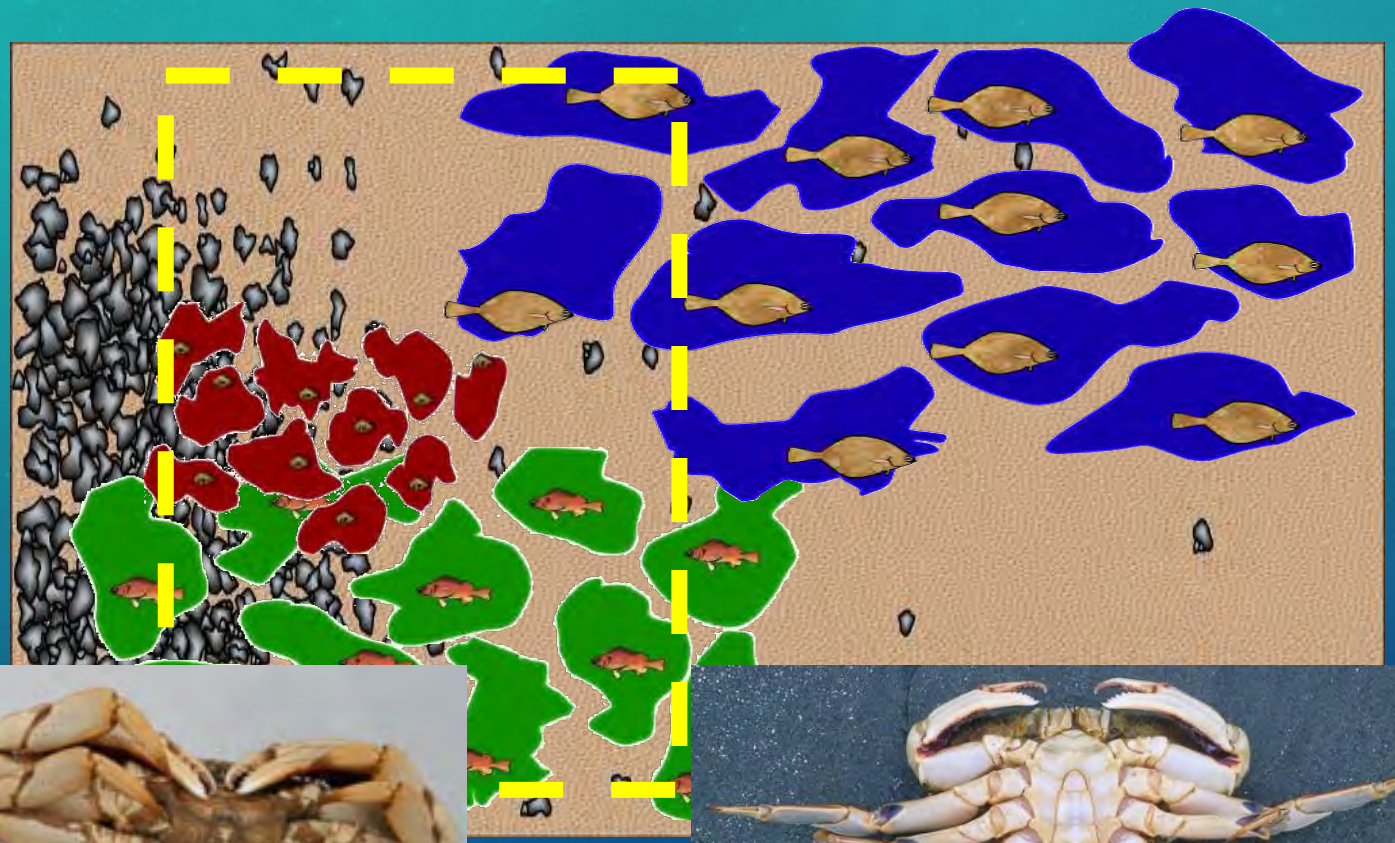

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COLLABORATORS & FUNDING

- Bob Eder
- The Eder Family Foundation via MSI
- John Chapman (OSU)
- Brian Kelly (NOAA)
- Jack Barth (OSU)
- Lindsay Aylesworth (ODFW)
- Kelly Corbett (ODFW)
- Troy Buell (ODFW)
- Bob Browning (F/V Lady Lee)
- Logan Browning (F/V Lady Lee)
- Kaety Jacobson (Sea Grant)
- Amanda Gladics (Sea Grant)
- Angelina Skowronski (Fish People)
- Jason Phillips (OSU)

Special thanks for Phil, John, and Jeff who found receivers on various beaches in December 2018 and took them to the Cannon Beach police department. Thanks to Doug McMahon who returned one to the Multnomah County Sheriff's office in January and John Weldon who found one on the beach in Long Beach, WA, at the end of January and shipped it to me. And finally Forrest who reported finding one *in his crab pot* and returned it.