

OFFSHORE RENEWABLE ENERGY: DOES ELECTROMAGNETIC FIELD NOISE IMPACT THE BEHAVIOR, MOVEMENT & DISTRIBUTION OF ELASMOBRANCHS?

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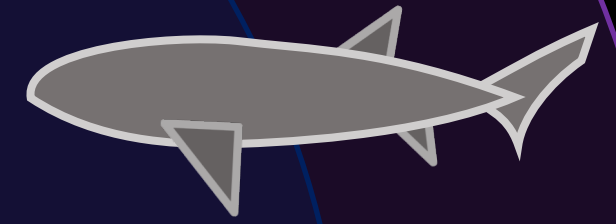
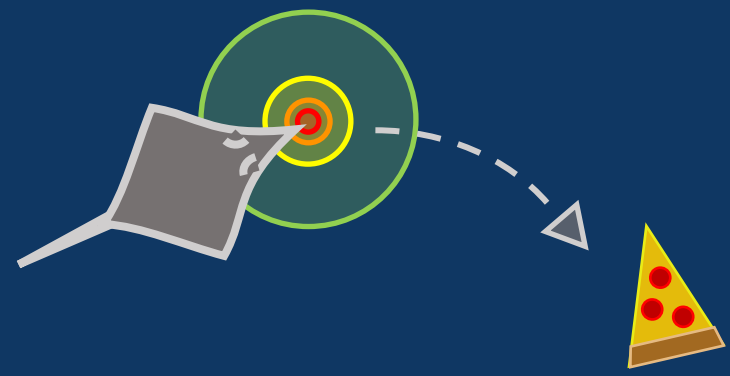
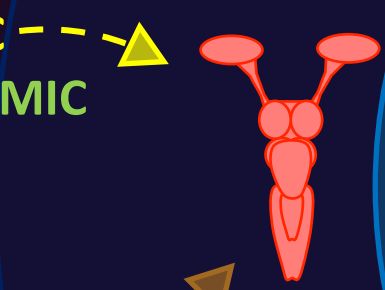
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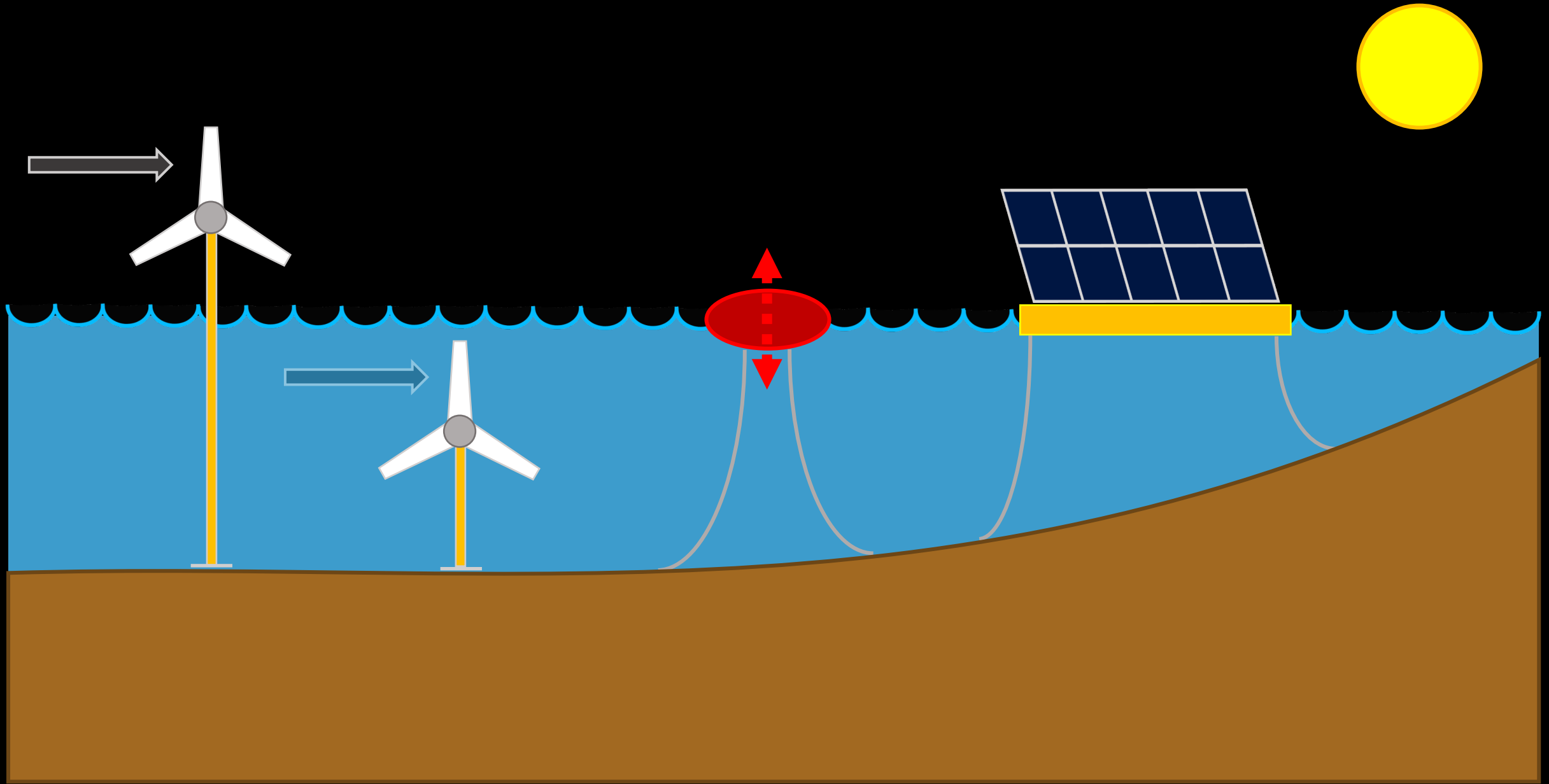
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SENSORY ECOLOGY

- GUSTATORY
- TACTILE
- BIOELECTRIC
- HYDRODYNAMIC
- VISUAL
- OLFACTORY
- ACOUSTIC
- GEOMAGNETIC

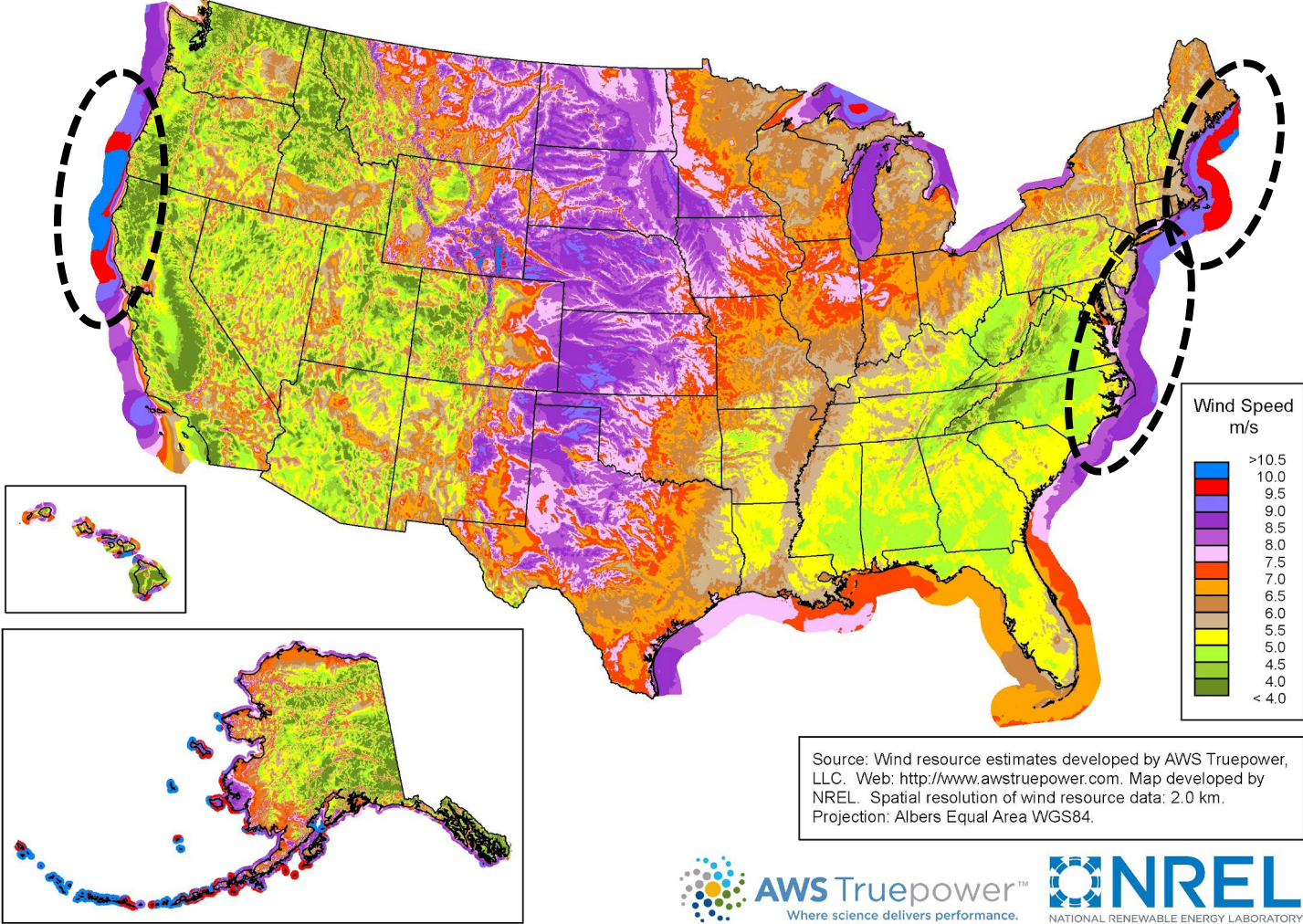


OFFSHORE RENEWABLE ENERGY = MITIGATE CLIMATE CHANGE?

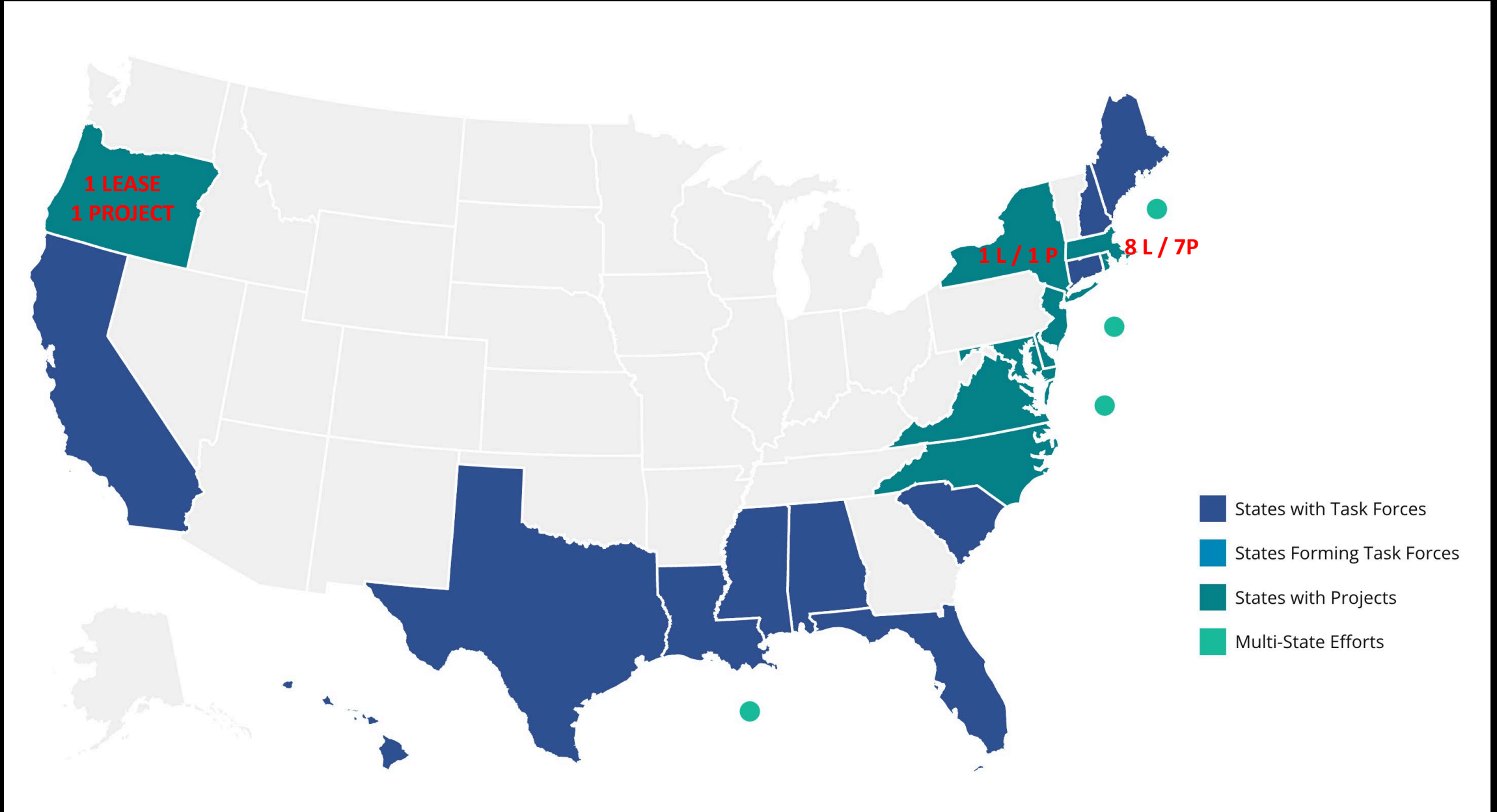


OFFSHORE WIND RESOURCES (WORST HEATMAP EVER ~ GOOD)

United States - Land-Based and Offshore Annual Average Wind Speed at 100 m



30 GW BY 2030 (THANKS OBAMA JOE!)



OSW FARM = HUGE HABITAT MODIFICATION

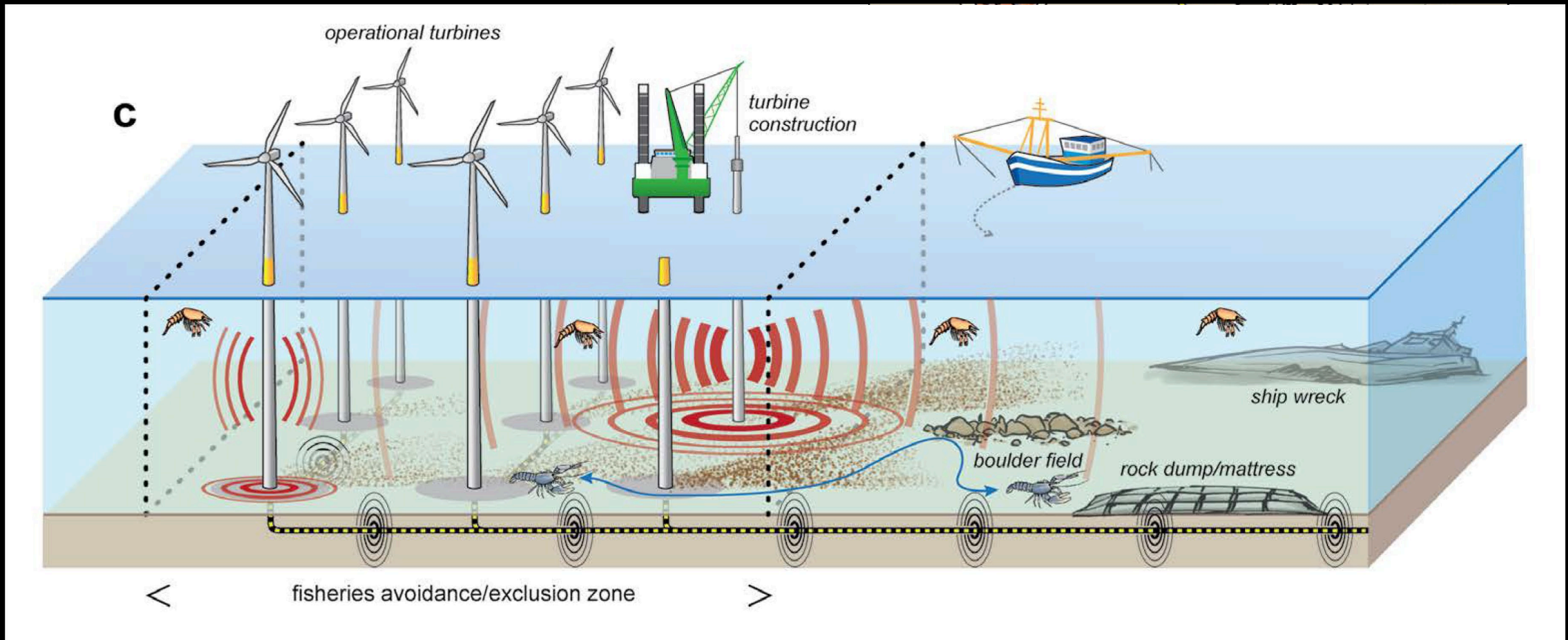


LOTS O' POTENTIAL STRESSORS

BENTHIC / PELAGIC HABITAT?

REEF? / FAD?

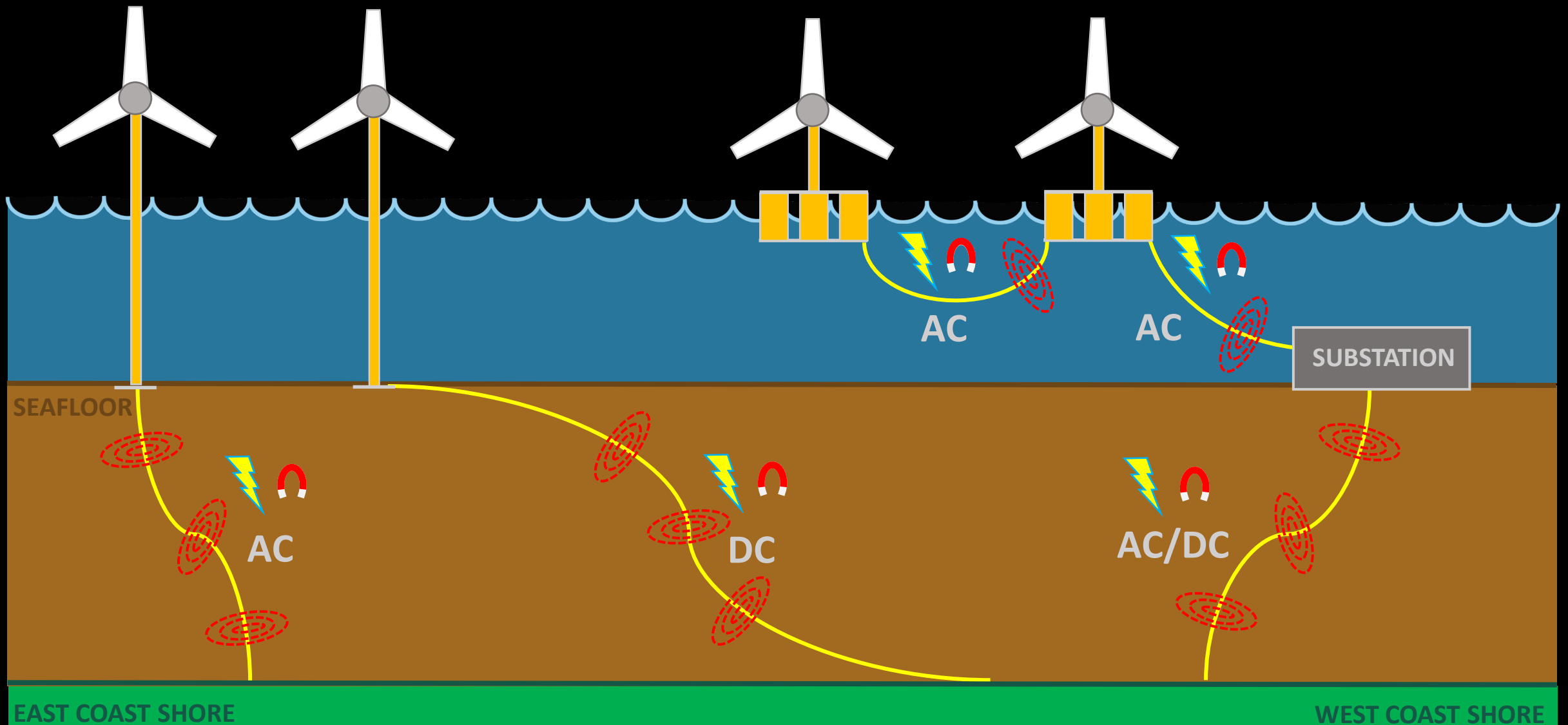
HYDRODYNAMICS?



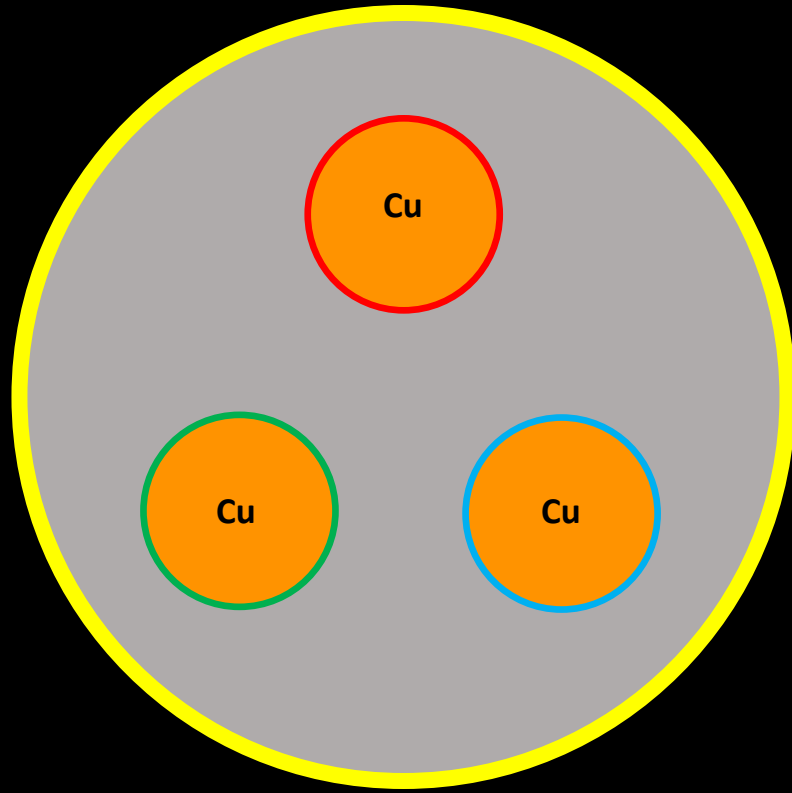
FISHERIES?

NOISE?: ACOUSTIC ELECTROMAGNETIC (EMF)

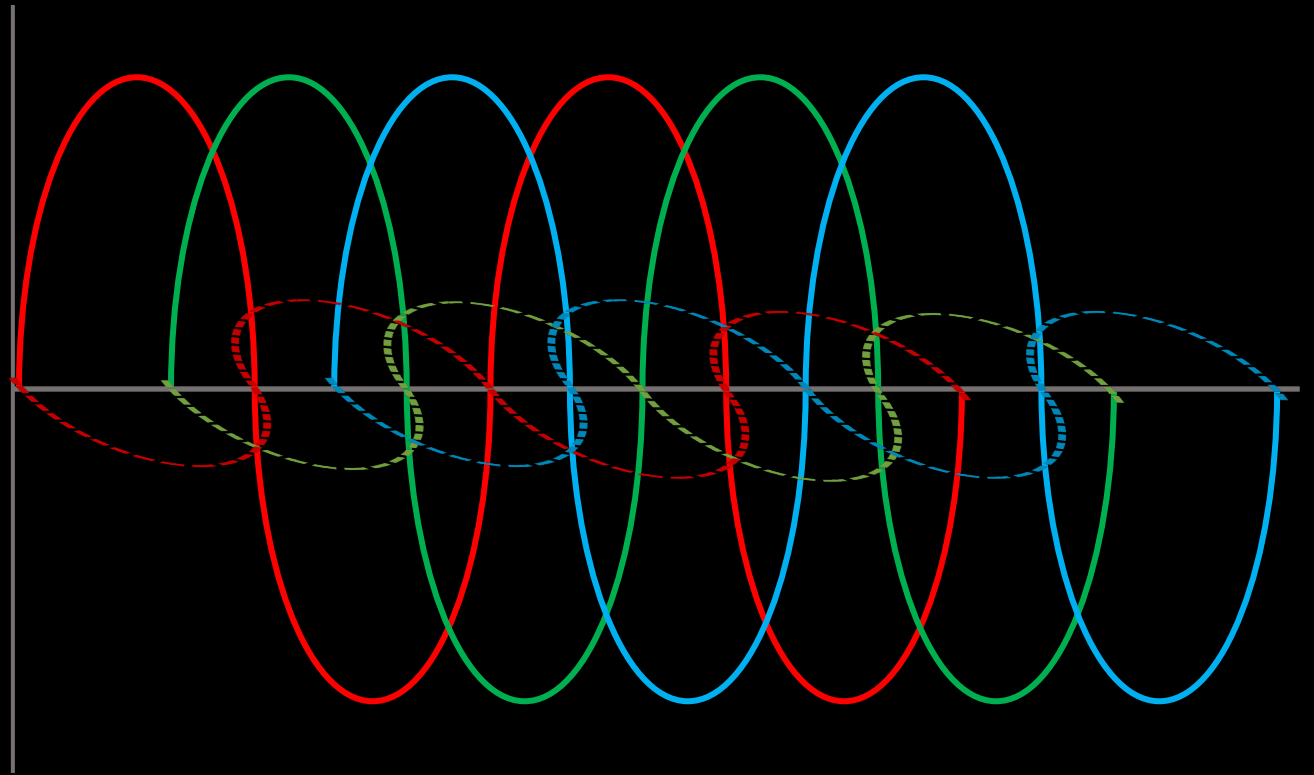
VARIOUS TYPES & SOURCES OF EMF NOISE



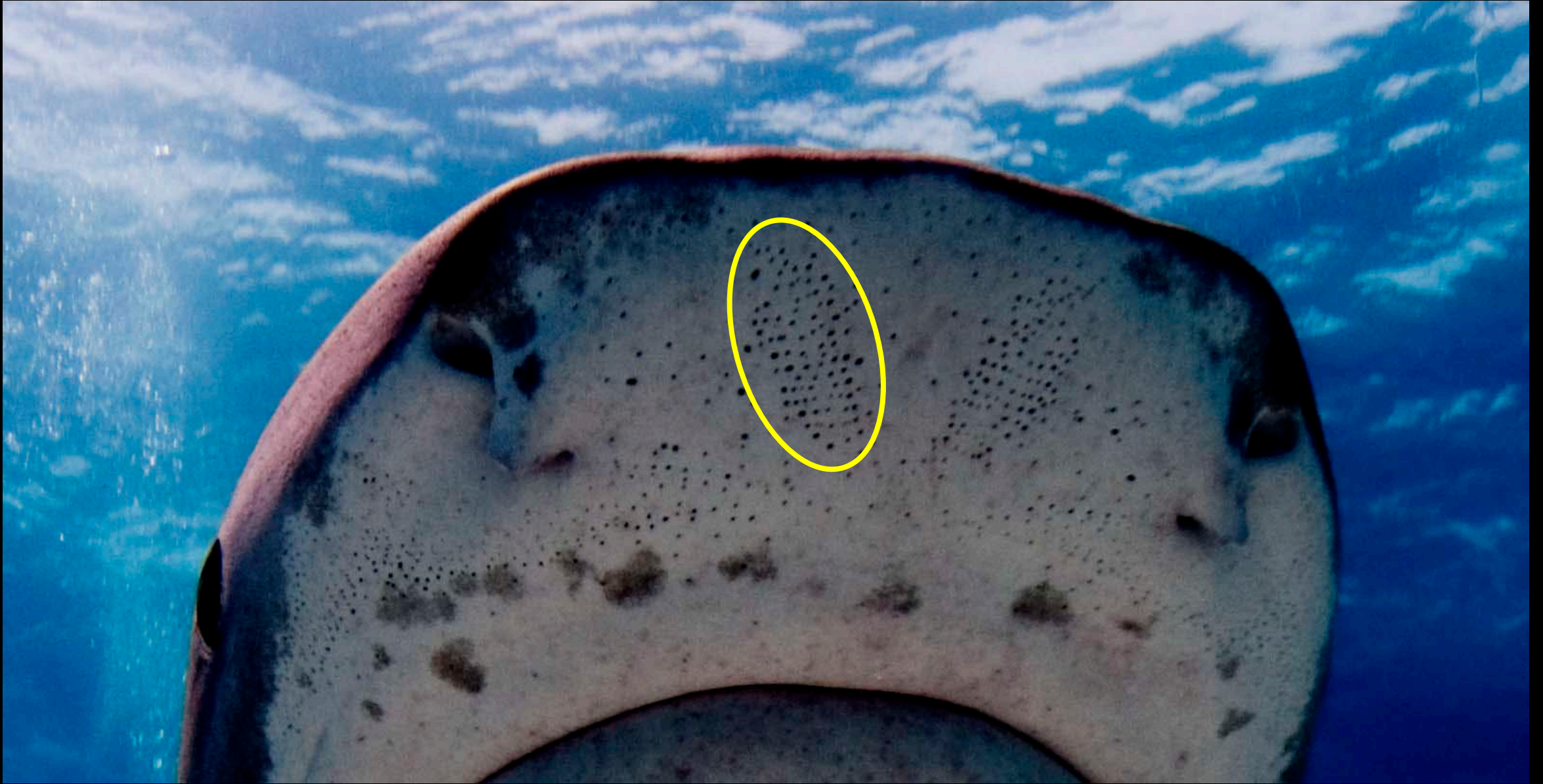
HIGH VOLTAGE CABLE: 3 PHASE AC @ 60 Hz (~ 10 - 120 Hz)



10 CM



WHY? CUZ **ELECTRORECEPTORS!**



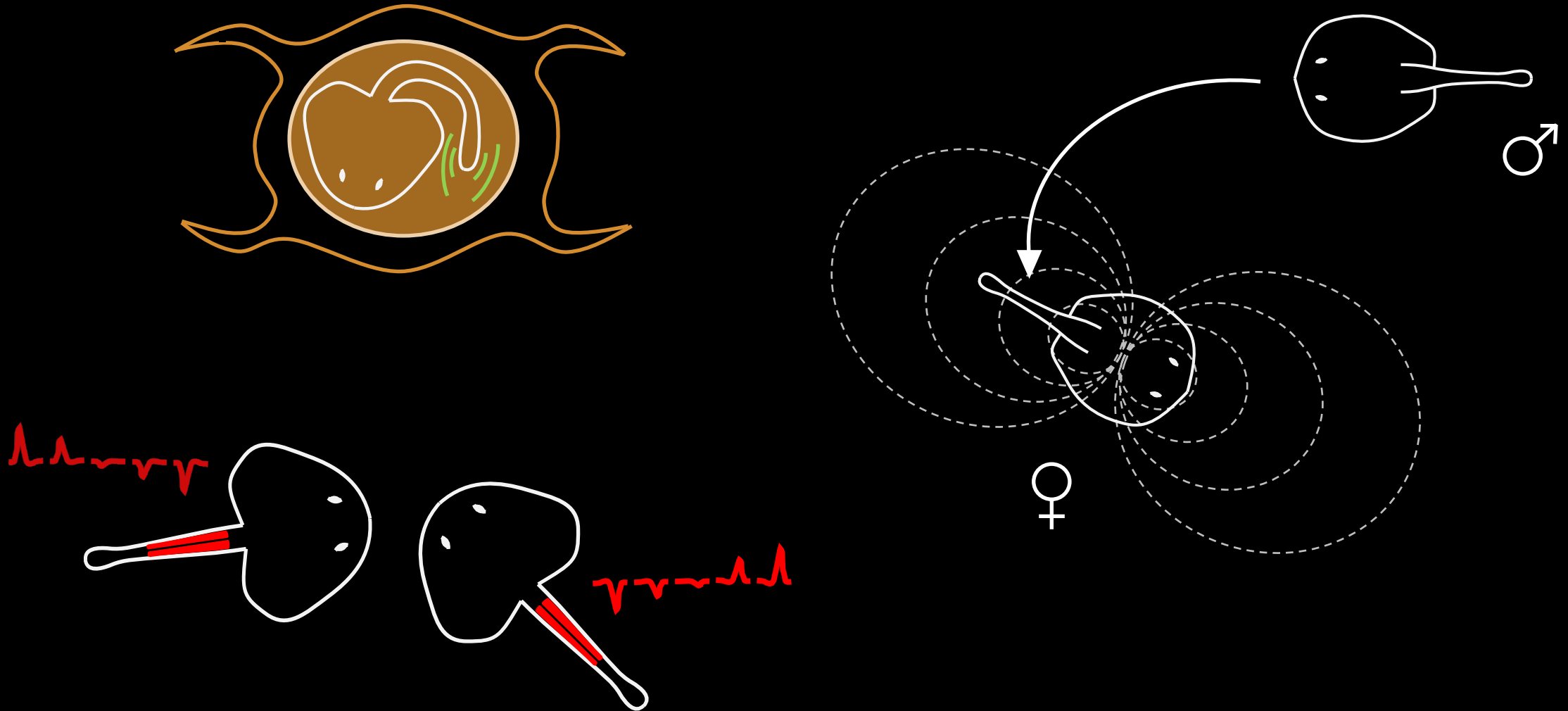
ACTUALLY . . . THESE ARE THE AMPULLAE OF LORENZINI



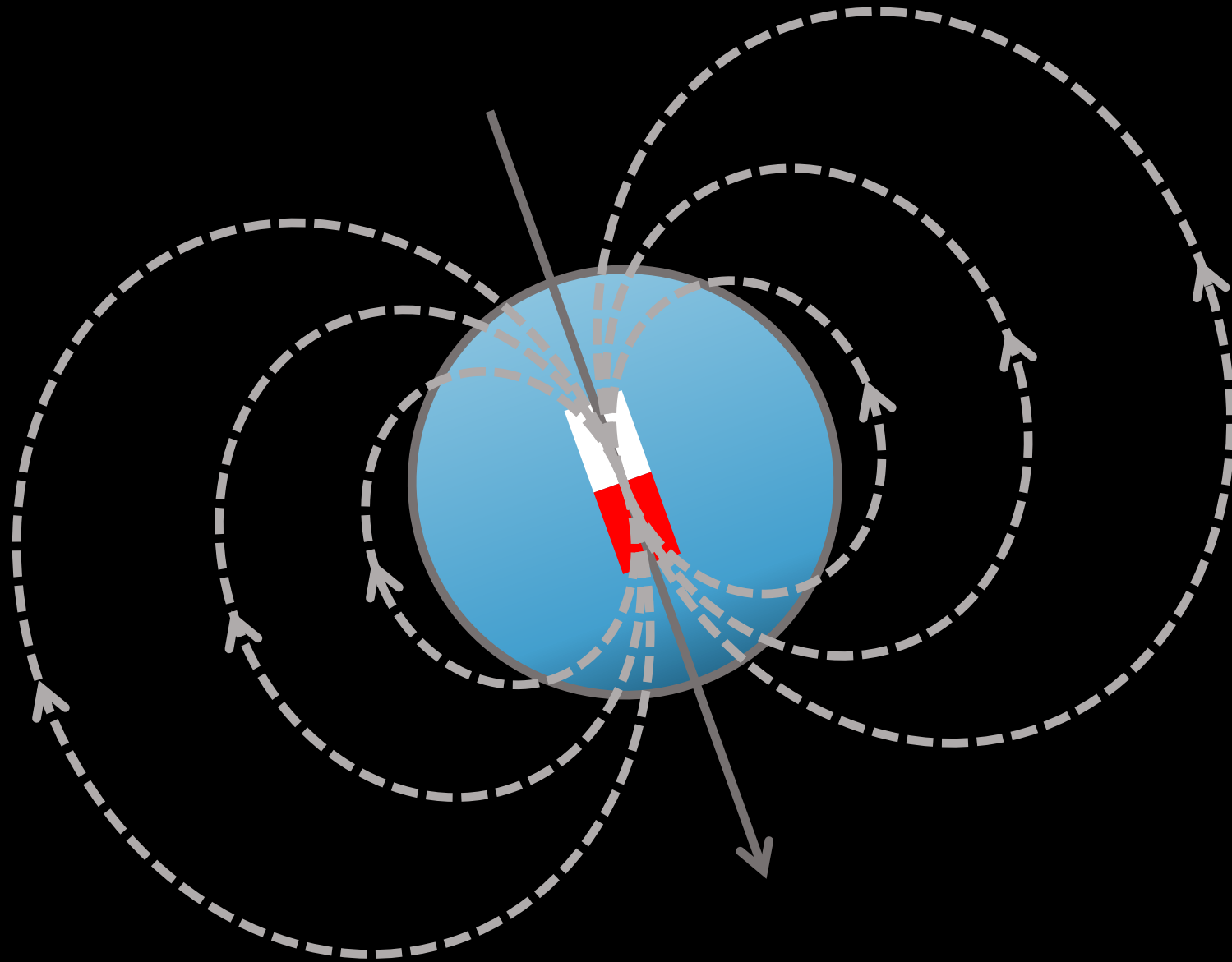
1° FXN = **FORAGING**: DETECT BIOELECTRIC FIELDS OF PREY



2° FXN = PREDATOR AVOIDANCE, MATING, COMMUNICATION



2° FXN = **NAVIGATION**: DETECT GEOMAGNETIC FIELDS?

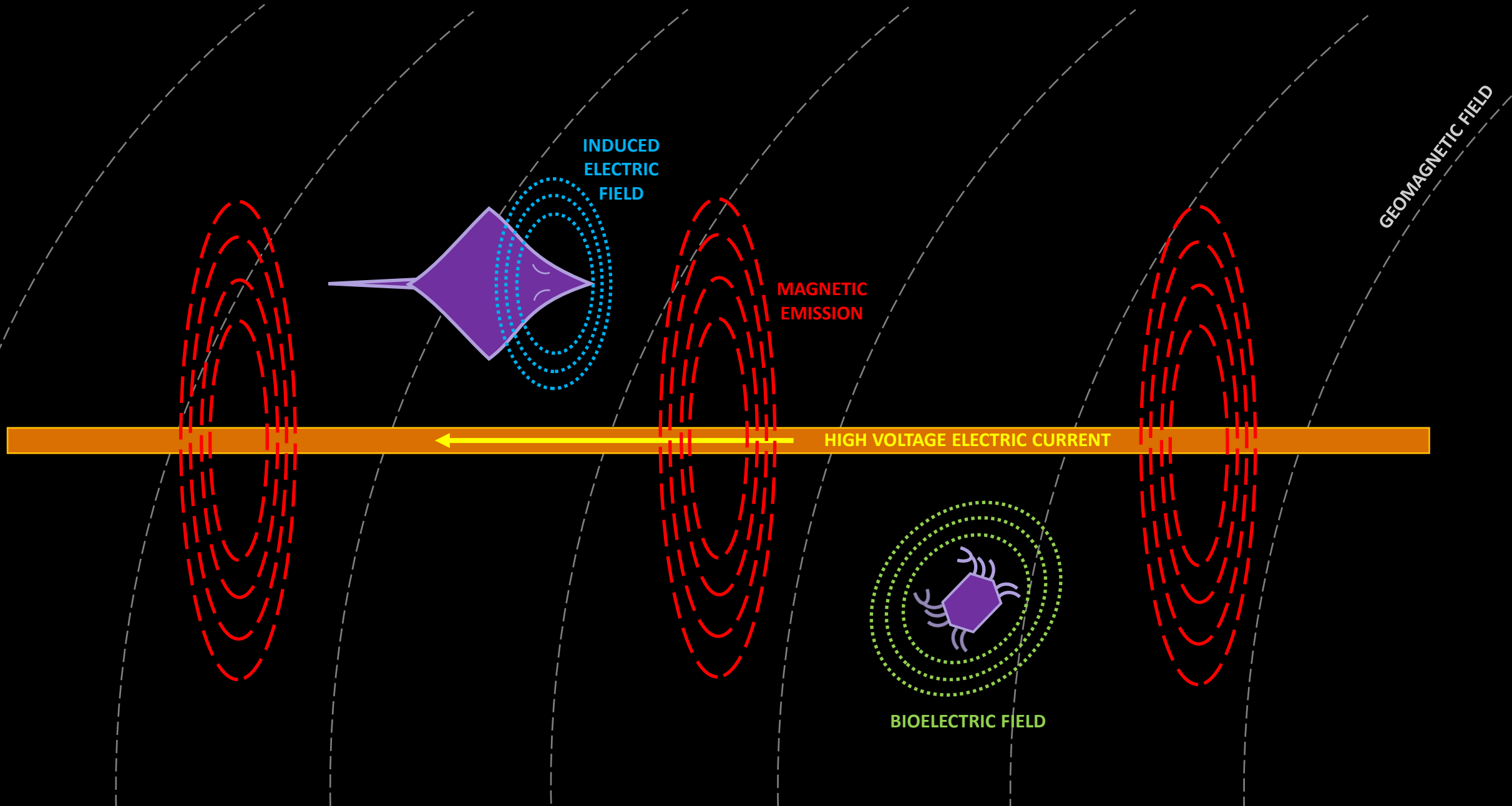


NON-SHARKY (LESS COOL) BUT MAGNETICALLY SENSITIVE SPECIES (KINDA COOL)

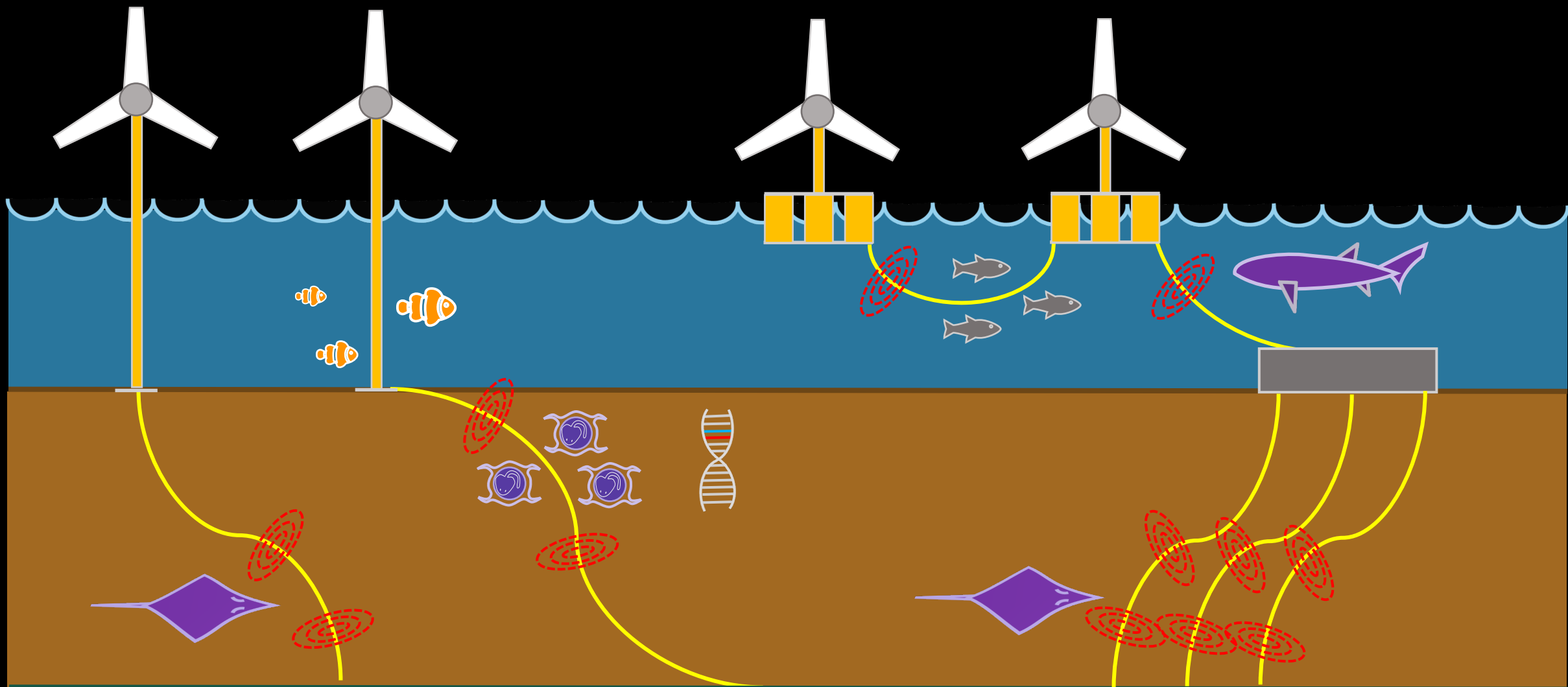


FORAGING OR NAVIGATION IMPACTS?

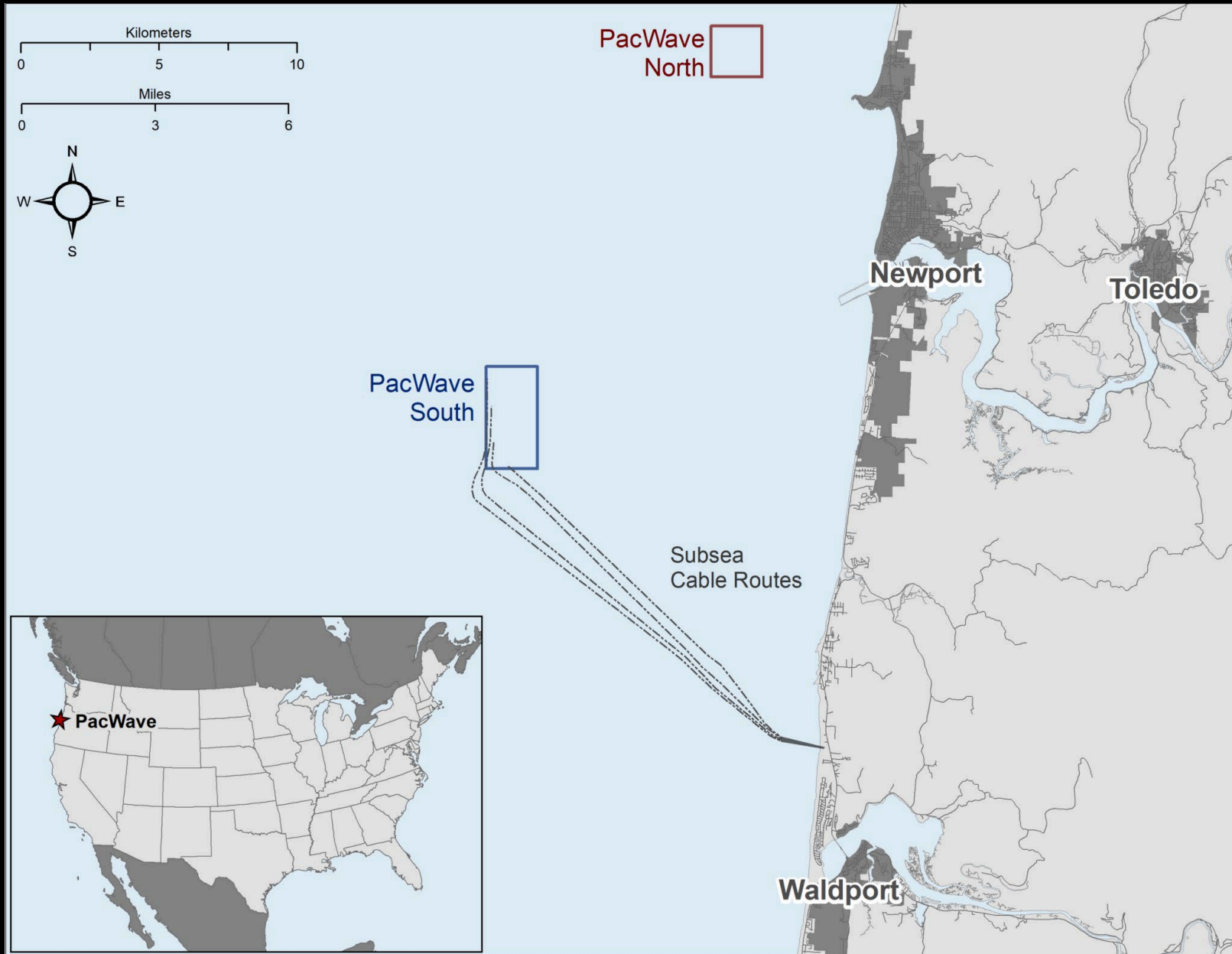
OVERHEAD VIEW



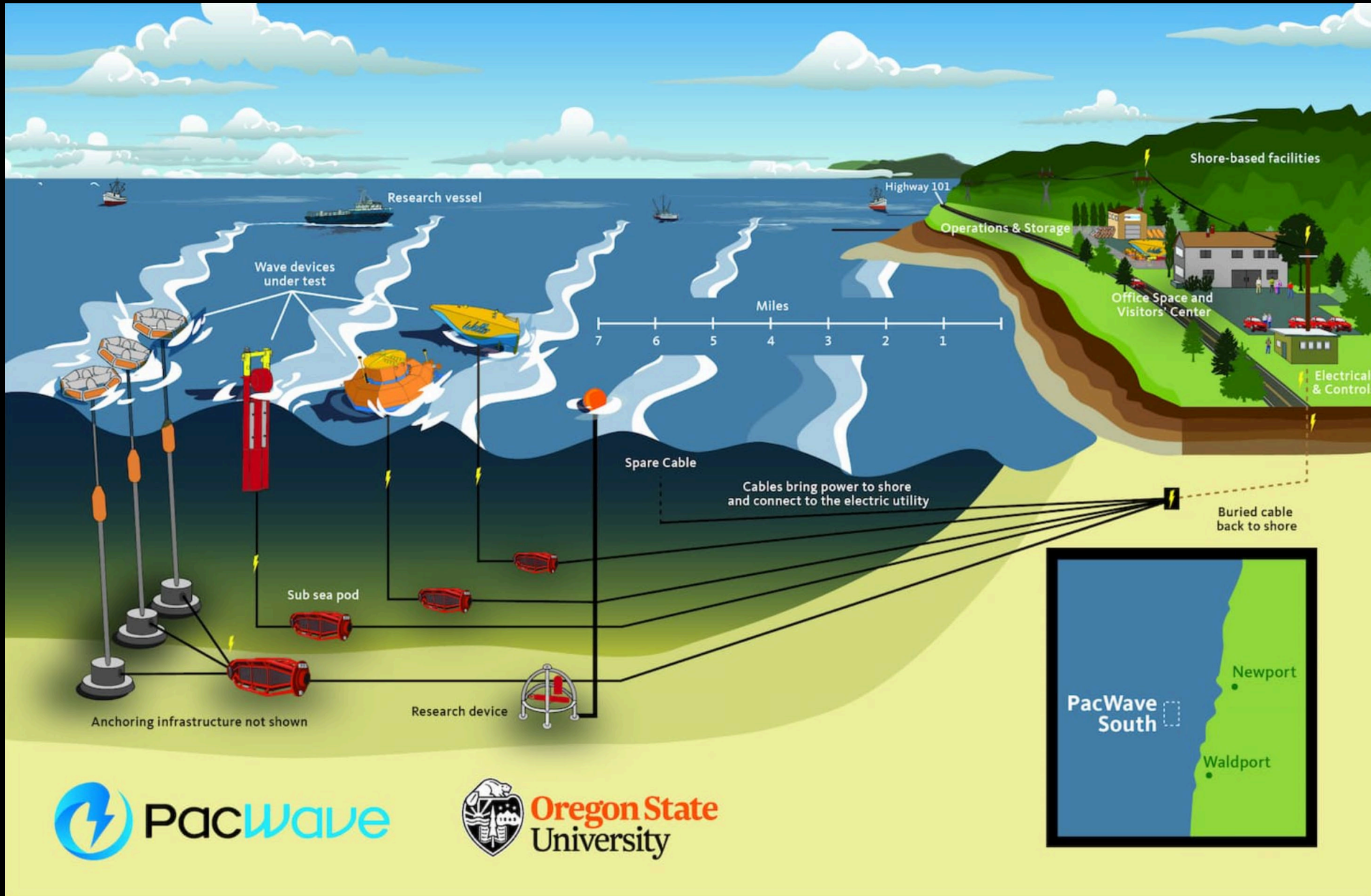
POTENTIAL EMF EFFECTS



PACWAVE TEST SITE



WAVE ENERGY CONVERTERS



20 WECs

4 BERTHS =
5 MW/CABLE

OPERATIONAL 2023

GRID TEST 2024

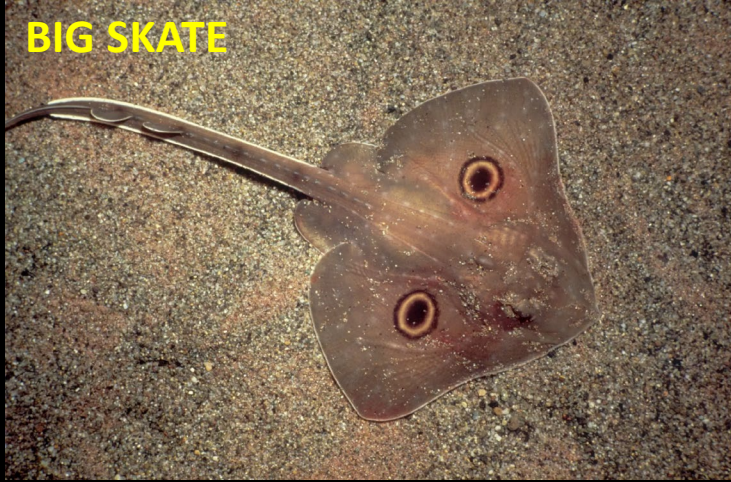


DOES **EMF NOISE** IMPACT ELECTRICALLY & MAGNETICALLY SENSITIVE FAUNA IN OREGON?



OREGON COAST AQUARIUM COLLABORATION?

BIG SKATE



LEOPARD SHARK



SEVENGILL SHARK



GREEN STURGEON



SPINY PUPPY DOGFISH



CALIFORNIA BATRAY

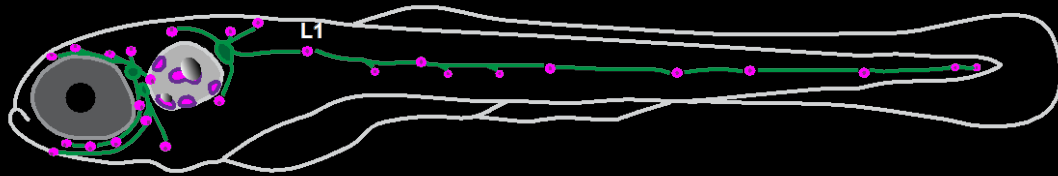


TOPE (SOUPFIN) SHARK



SIDE TRIP: DID SOME TIME IN THE MIDWEST

**LATERAL LINE CONTRIBUTION
TO RHEOTAXIS?**

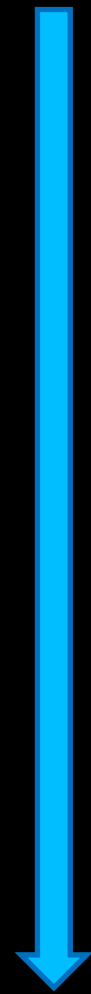


**MACHINE LEARNING:
IT CAN DO ALL THE THINGS!**



QUANTIFIABLE DIFFERENCE IN RHEOTAXIS BEHAVIOR

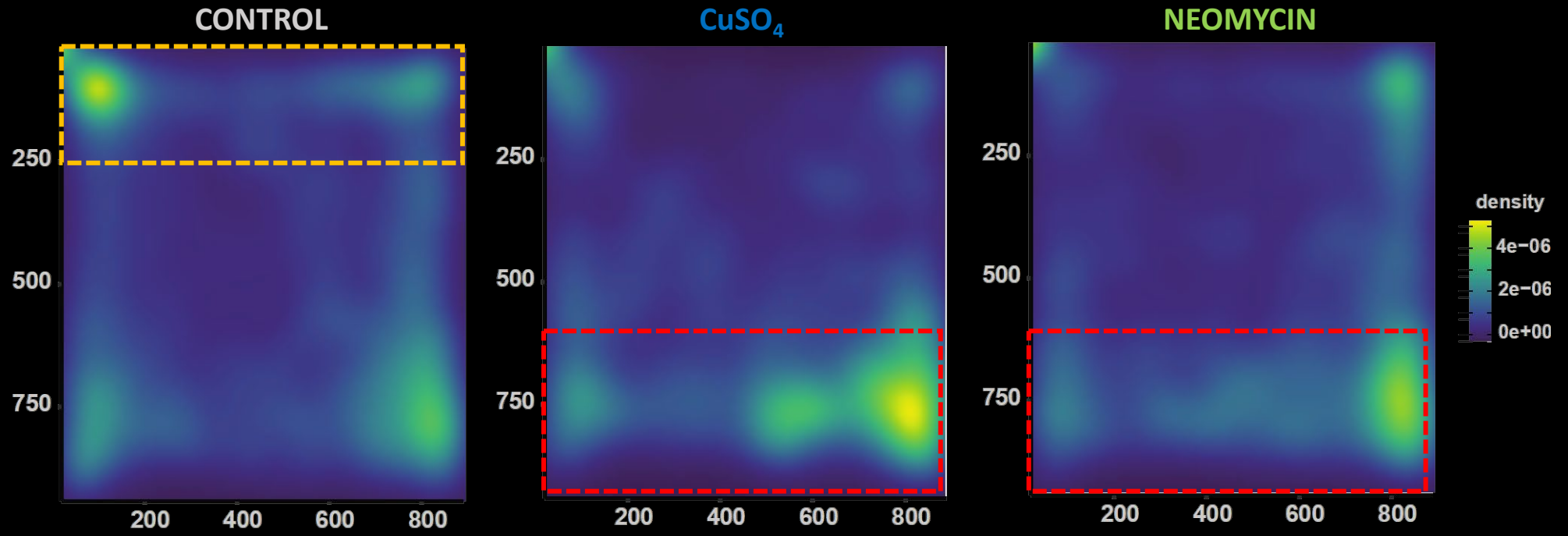
INTACT LATERAL LINE



ABLATED LATERAL LINE



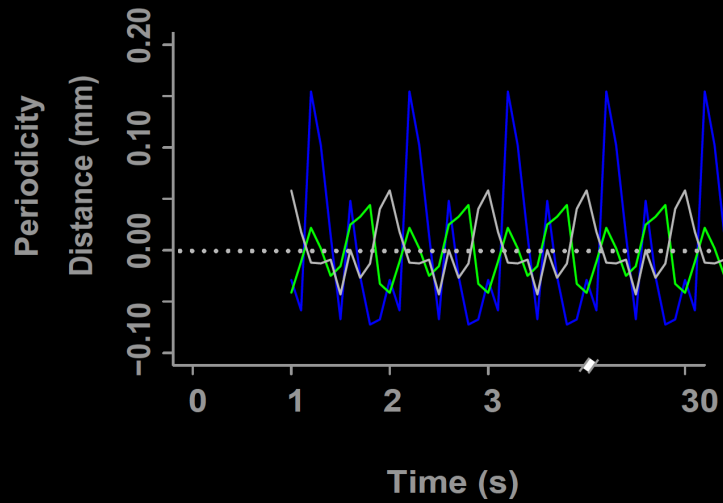
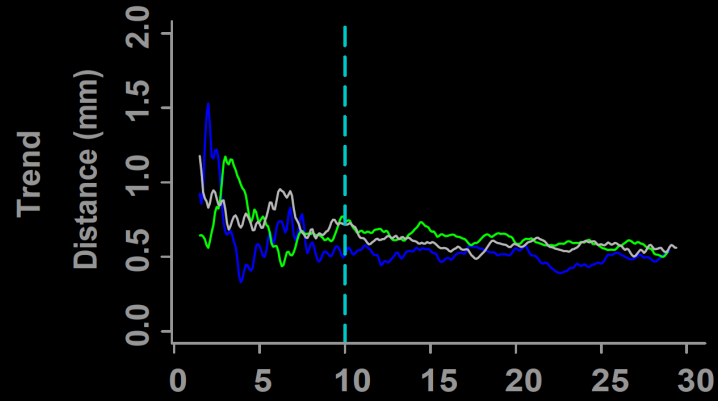
SPATIAL USE UNDER FLOW: CONTROL \neq ABLATED



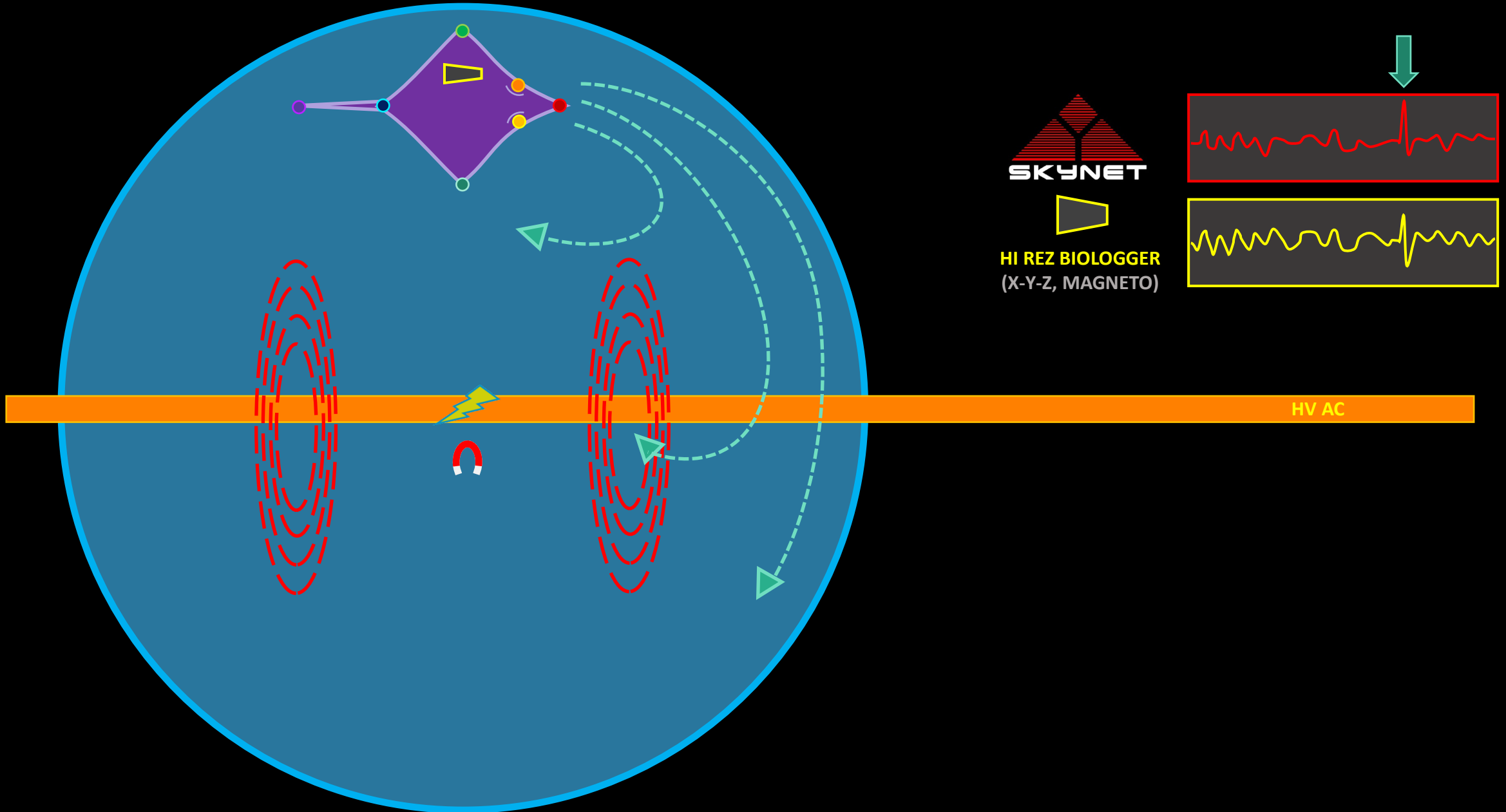
FLUCTUATIONS IN RHEOTAXIS KINEMATICS INDICATE TREATMENT TYPE

CONTROL
CuSO₄
NEOMYCIN

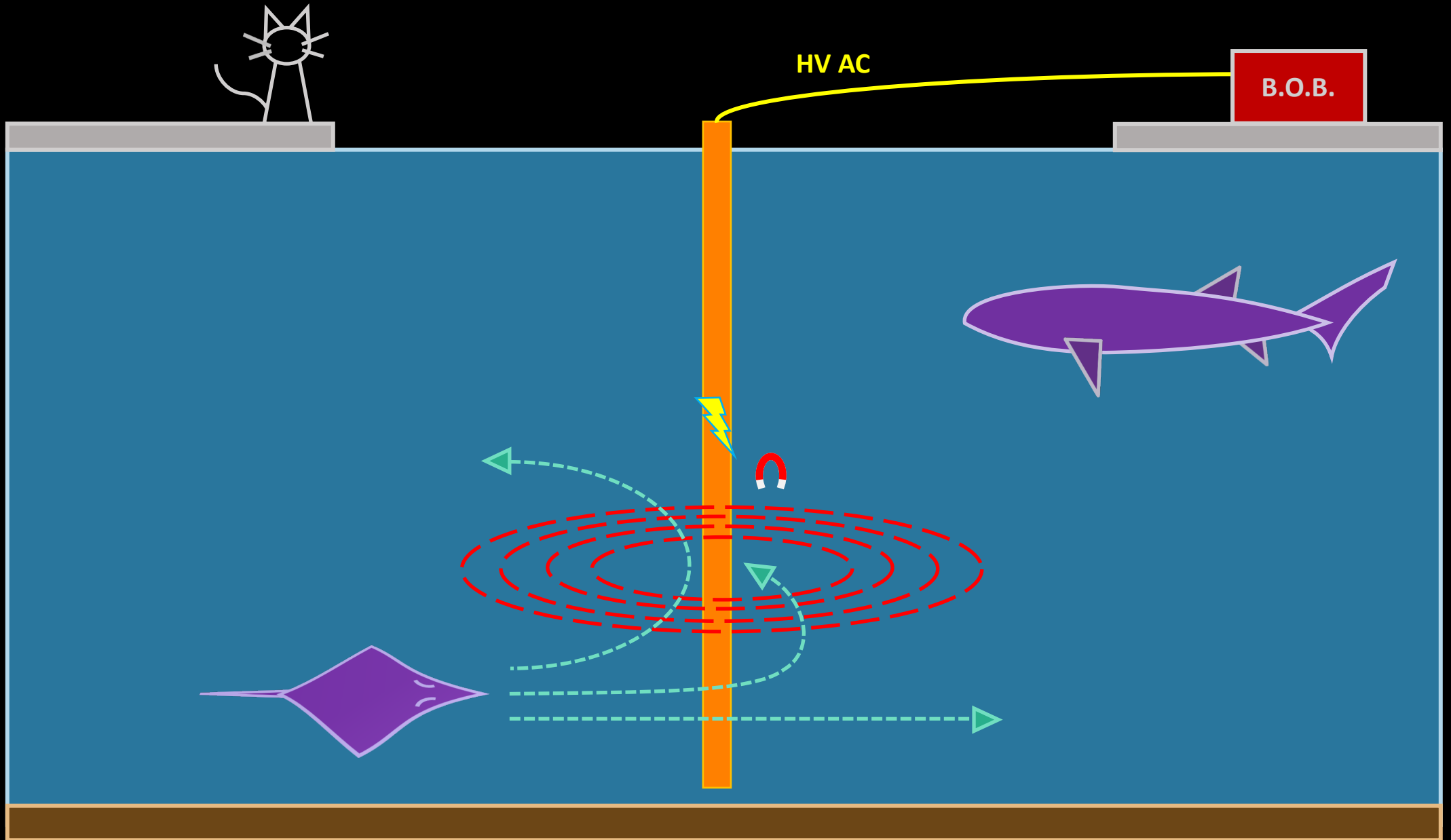
RELATIVE MOVEMENT



LAB (@ OSU): QUANTIFY / VALIDATE RESPONSE TO EMF



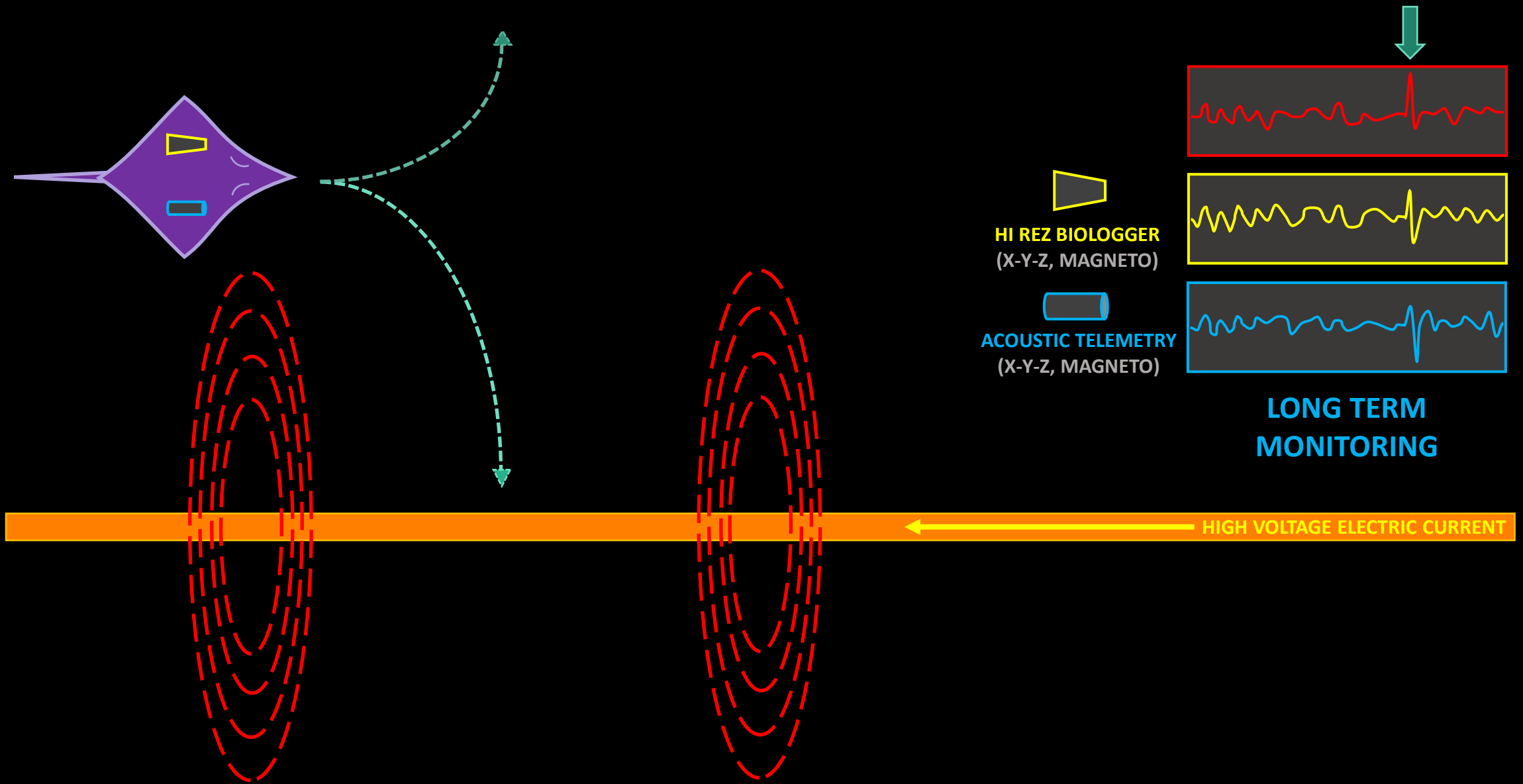
LAB (@ OCA/OSU): SEMI-NATURAL SETTING?



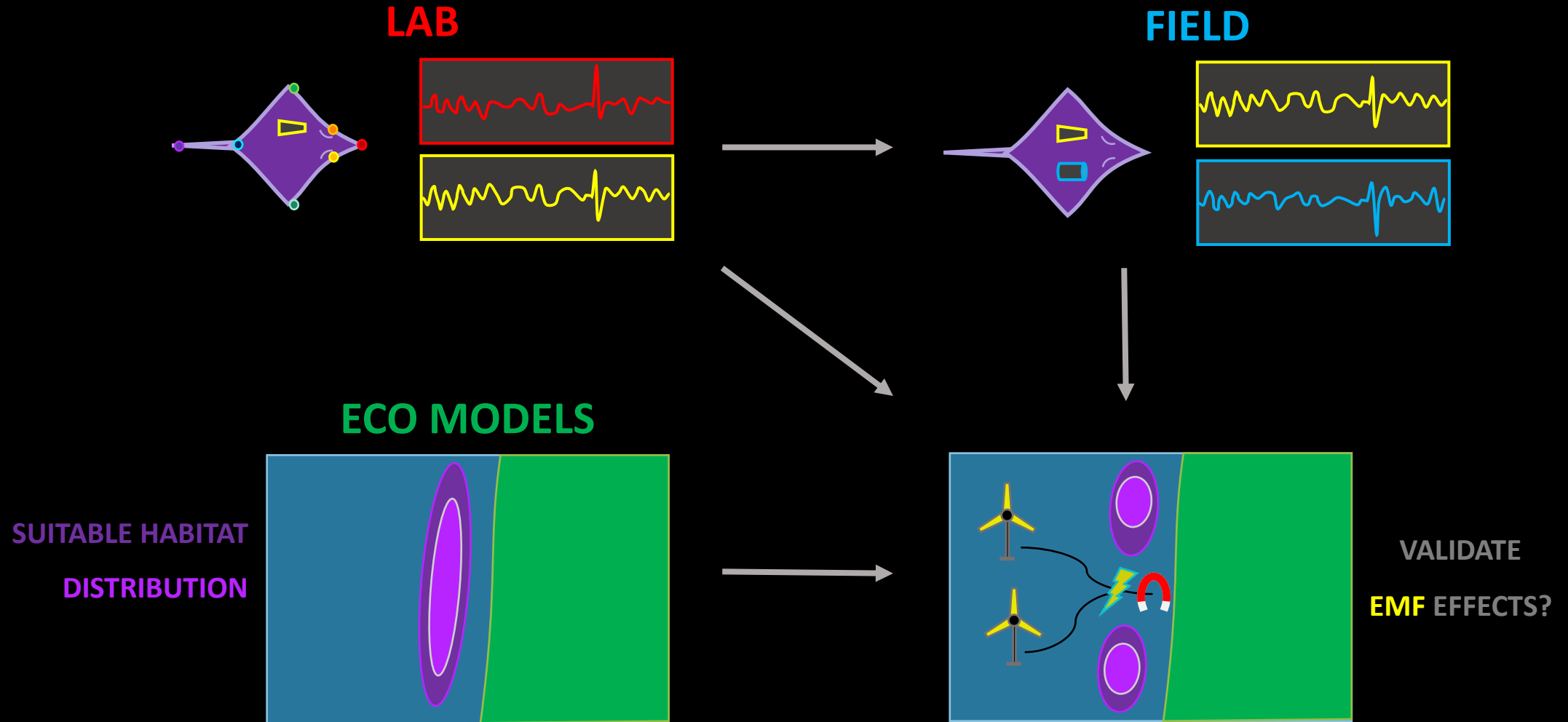
FIELD (@ SBU): NEW YORK BIGHT



FIELD (@ SBU): DETERMINE RESPONSE TO OFFSHORE EMF NOISE



MODELS (@ SBU): PREDICT IMPACTS OF EMF NOISE ON MARINE FAUNA?



GOALS

MULTI-INSTITUTIONAL COLLABORATION



LABORATORY & FIELD STUDIES



AUGMENT EXISTING DATA SETS



STANDARDIZED METHODS & PROTOCOLS



DATA SHARING & TRANSPARENCY

NEW TECHNOLOGIES (NOVEL APPLICATIONS OF EXISTING)



THE IDEA IS TO BRING TOGETHER A GROUP OF **EMF***'n** REMARKABLE PEOPLE



ACKNOWLEDGEMENTS

CHIEF OF SNACKS



TAYLOR CHAPPLE

SARAH HENKEL

TOBEY CURTIS

YONG CHEN

CLAIRE OBER

ALEX MCINTURF

MADDIE ENGLISH

BRADEN VIGIL

JOSH BOWMAN

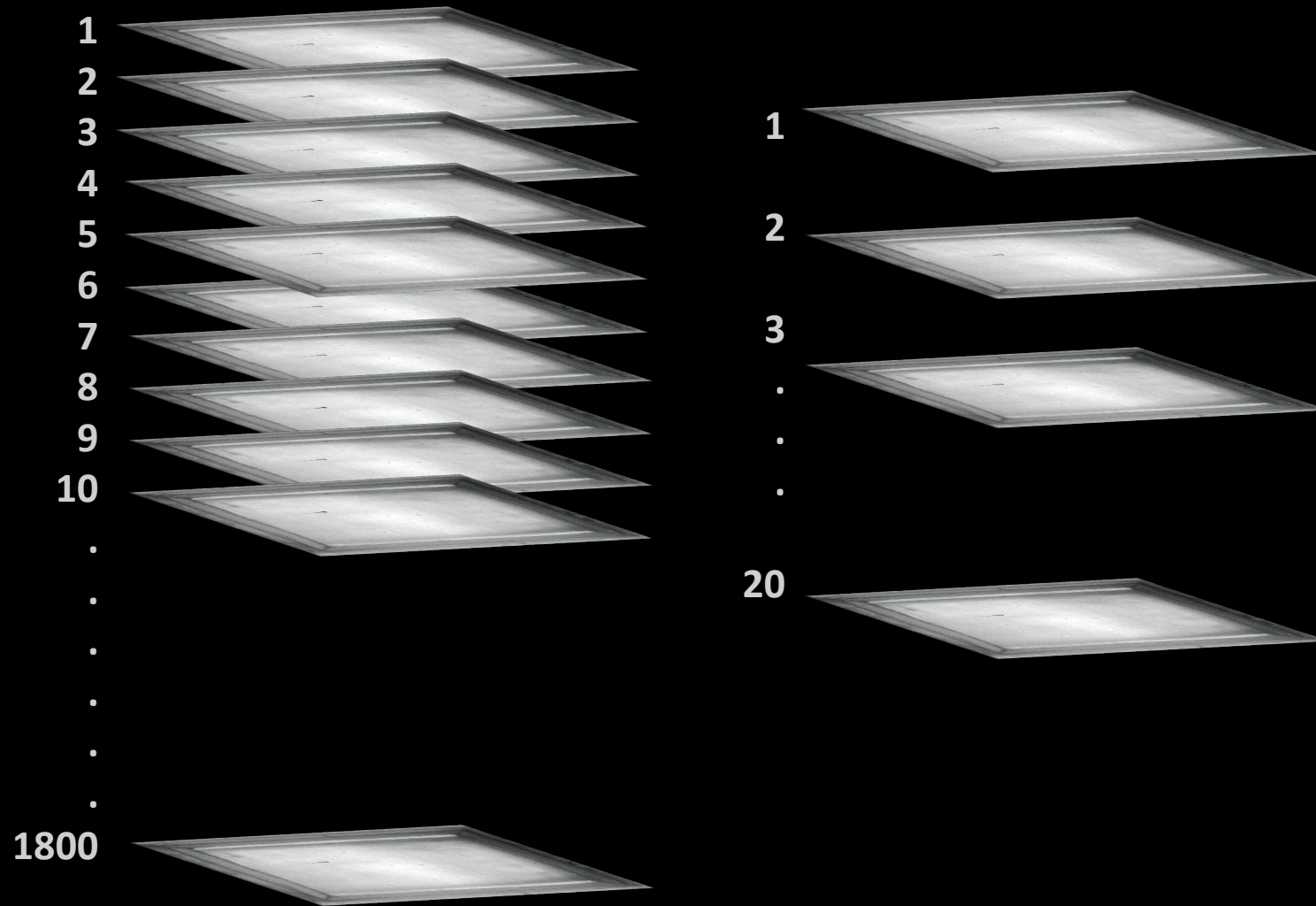
JESS SCHULTE



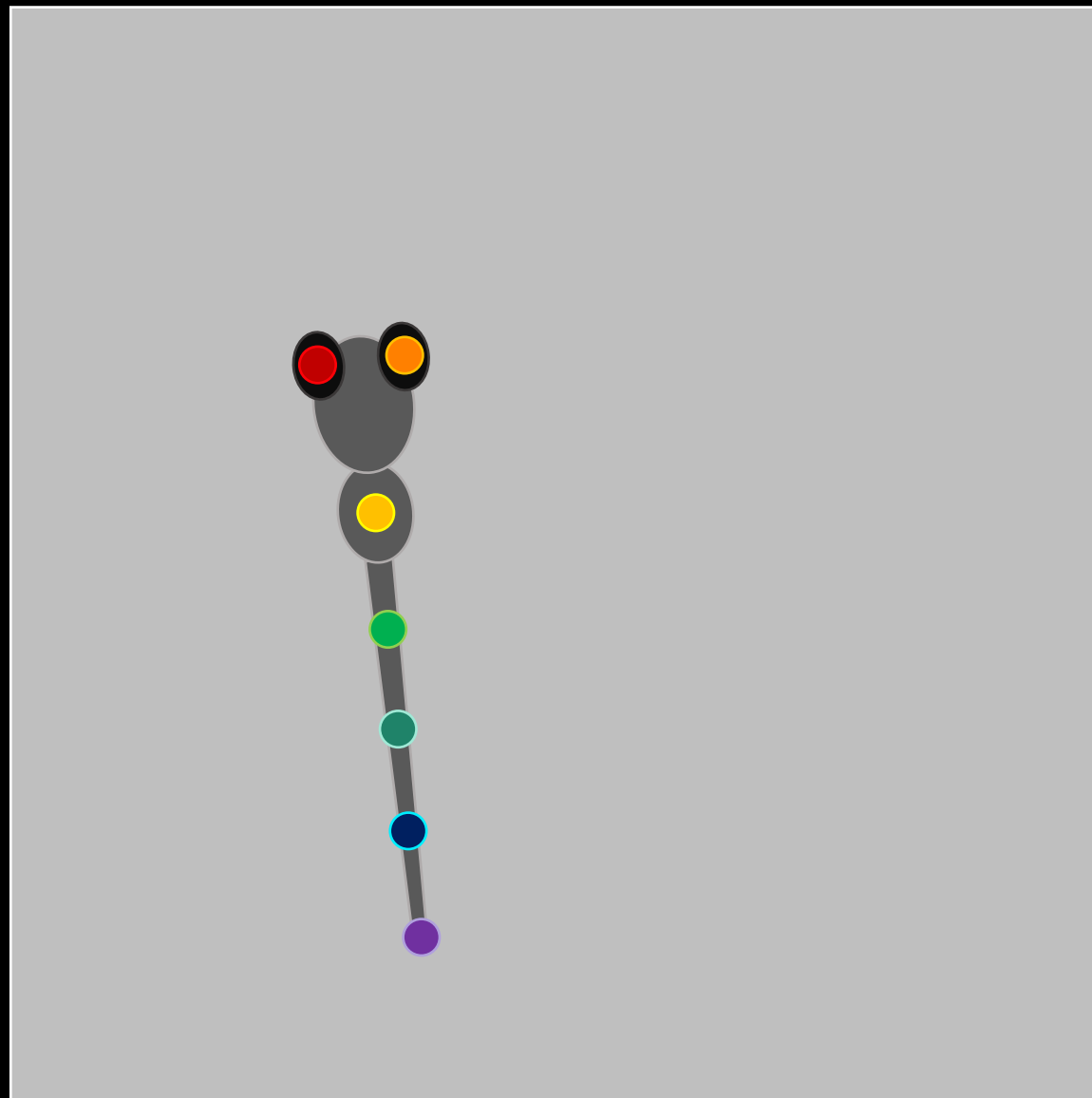
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DeepLabCut: EXTRACT FRAMES FROM VIDEO



DeepLabCut: LABEL BODY PARTS



LEFT_EYE

RIGHT_EYE

SWIM_BLADDER

TAIL_1

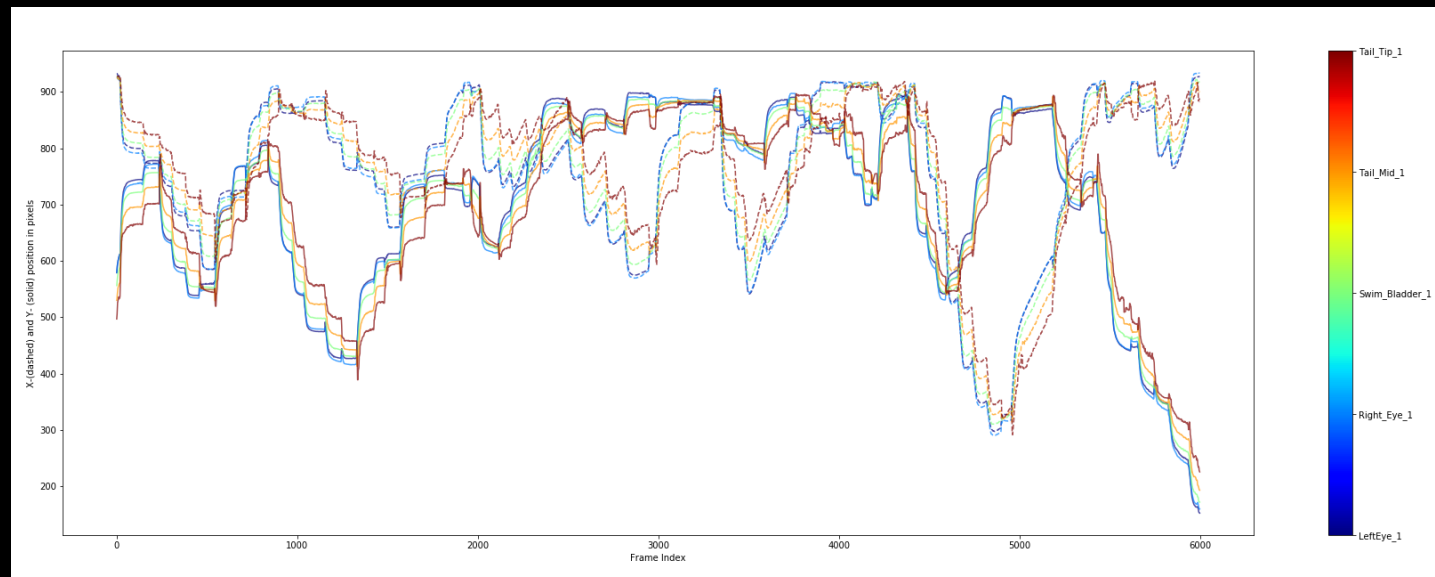
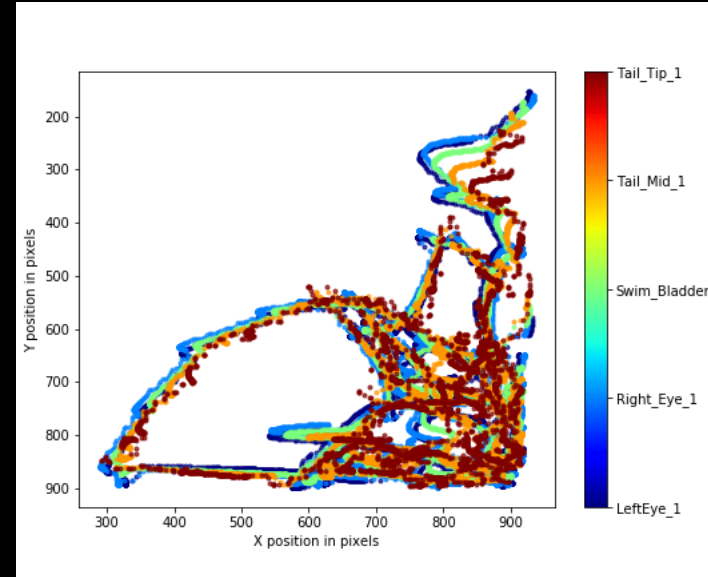
TAIL_2

TAIL_3

TAIL_4

DATA & VISUALIZATION OUTPUT

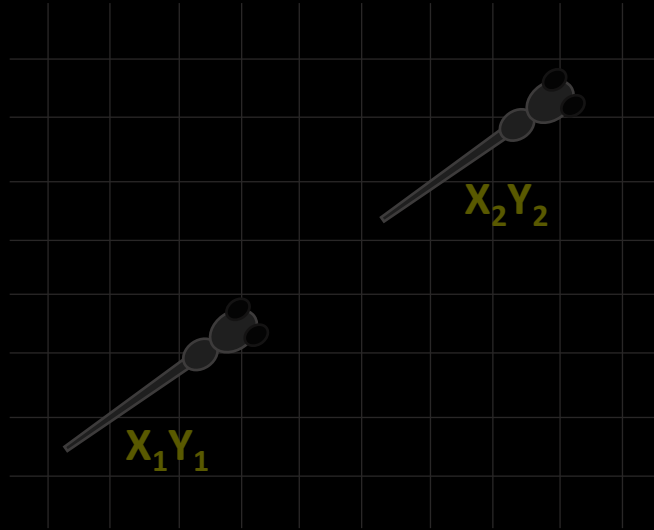
X	Y	X	Y	X	Y	X	Y	X	Y
1	6	3	6	2	7	2	8	2	9
1	5	3	5	2	6	2	7	2	8
1	4	3	4	2	5	2	6	2	7
1	3	3	3	2	4	2	5	2	6



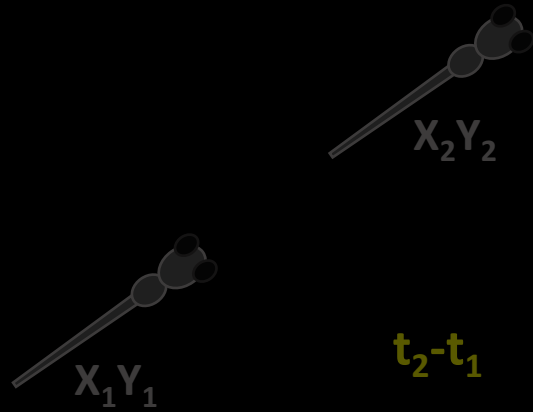
RELATIVE MOVEMENT PARAMETERS

LINEAR

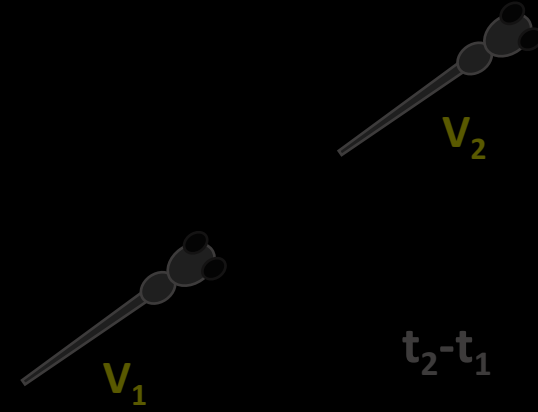
DISTANCE MOVED



VELOCITY

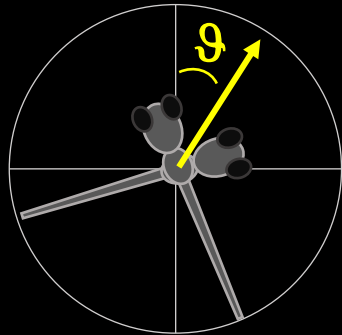


ACCELERATION

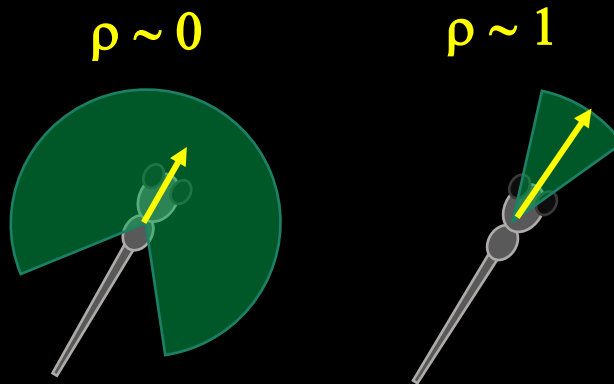


ANGULAR

BODY ANGLE



ANGULAR VARIANCE



FLUCTUATIONS IN RHEOTAXIS KINEMATICS INDICATE TREATMENT TYPE

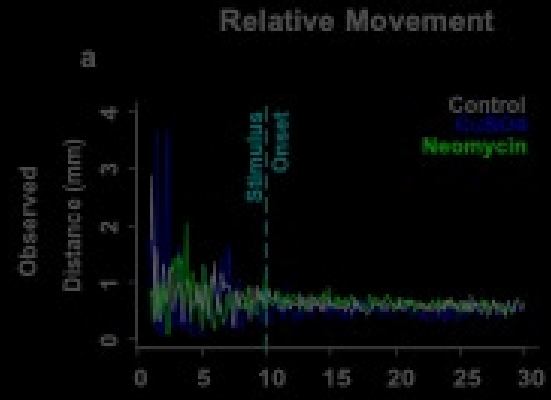


Figure 1. Relative movement of the control and neomycin groups during the experiment.