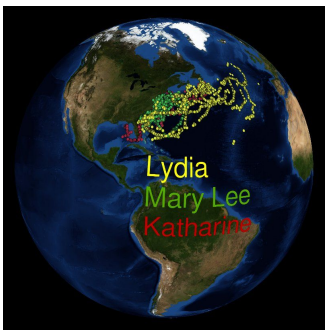
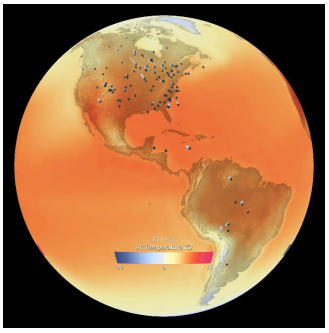
**Animals on the Move:** Stories of migration and dispersal over land and under sea

**Live program script and storyboard**

| # | Thumbnail | Dataset title/URL | Objective / Script / Actions |
|---|---|---|---|
| 1 |  | N. Atlantic Shark Tracks (part of Shark Tracks live program; ftp://public.sos.noaa.gov/extras/live_programs/shark_tracks/Shark_MaryLee) | **Opening dataset on SOS when people enter the room- Animals on the Move**<br>● Shark tracking technology and efforts have increased our understanding of the migration patterns of sharks. Three great white shark tracks, from 2012-2016 have been shared with SOS by fisheries scientist, Dr. Greg Skomal, Massachusetts Div of Marine Fisheries.<br>**Key Point: Animals move**<br>● What drives the movement of this keystone predator?<br>● What drives the movement of animals? |
| 2 |  | Human transportation (https://sos.noaa.gov/datasets/human-transportation/ ) [peoples movement by air, roadways, water] | **Objective: Get the audience thinking about how they move long distances**<br>● Many reasons why people and animals might move: trying to find food, to find mates, to find the right temperature, to find a place to settle down, or for many species, their movement is wherever the wind or water takes them;<br>● But any move, intended or by happenstance, does not guarantee success or stability in the new environment.<br>**Key Point: Rates Of Change**<br>● environments also change-- sometimes slowly over time and sometimes quite rapidly, even catastrophically.<br>● We're going to step our way into understanding some of the research questions scientists have about animals on the move--and perhaps about some animals you haven't considered! |
| 3 |  | Bird Migration Patterns - Western Hemisphere (https://sos.noaa.gov/datasets/bird-migration-patterns-western-hemisphere/) | **Objective: Seasonal Mig**<br>● Let's consider bird migration: how and why?<br>● Each dot represents the estimated center of each population of 118 different bird species' (mostly warblers) for each day of the year.<br>● The bird data comes from a citizen science project called eBird, launched by |

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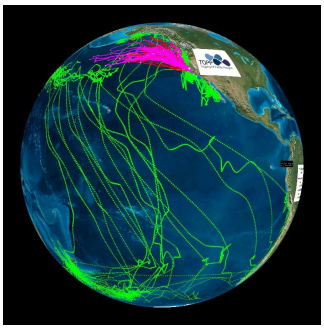
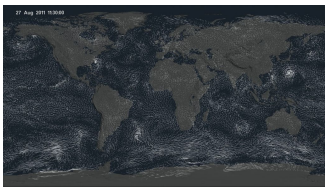
| | | 1 year, layered onto air temperature | Cornell Lab of Ornithology.<br>● The shifting colors represent the average daily surface air temperature (1981-2010).<br>● Seasonal migration patterns, typically leaving in the fall and returning in the spring, are distinctly noticeable.<br>● What birds can you think of that have similar seasonal migrations? |
| 4 |  <br>  | Seal and Seabird Tracks: Pacific Ocean (https://sos.noaa.gov/datasets/seal-and-seabird-tracks-pacific-ocean/)<br>*Operation: slowed down the animation, need to turn off legend pip in iPad* | **Key Point: Fast Migration**<br>● Let's step to another rate of movement, that of the marine birds like the Shearwater.<br>*Actions: Turn off legend/PIP*<br>● This dataset, on the sphere, from the TOPP program, follows Northern elephant seals (pink) and Sooty Shearwater seabirds (green).<br>● Sooty Shearwaters (green) are long distance fliers and fast. One of the longest moves of any animal (74,000 km/y) (46,000mi/y) and as you see here, they do this trek in a matter of weeks. (pretty fast compared to the butterflies and warblers) |
| 5 |  <br>  <br>https://www.pexels.com/photo/white-dandelion-under-blue-sky-and-white-cloud-39669/ | CCMP Surface Wind Vectors (NASA SVS)<br>*Operation: Manually overlay white continent borders; delay overlay and make 50% transparent, pip of dandelion seed dispersal]* | **Objective: Passive movement**<br>● Sooty shearwaters and other birds are navigating what we see here: a model of the surface winds around the globe.<br>*Overlay white cont borders*<br>● These are animals in flight. But what about other species that have less control and go where the wind takes them?<br>● Can you think of some examples? *wait*<br>● Dandelions disperse their seeds and the distance those seeds disperse and where they land depends on the winds of the day. |

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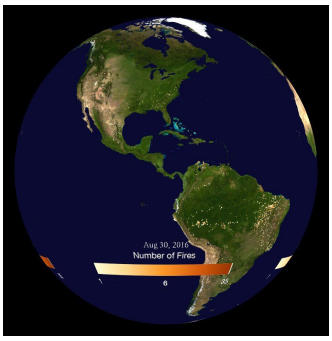
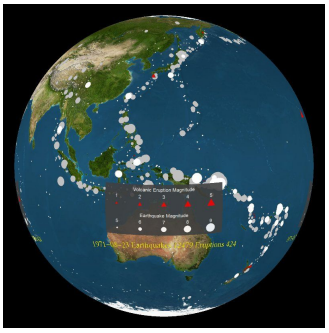
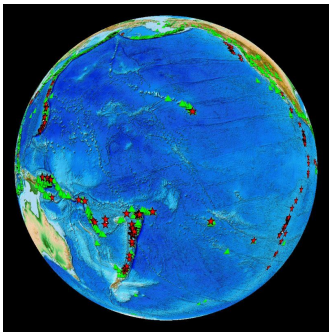
| 6 |  | Fires - Real-time (https://sos.noaa.gov/datasets/fires-real-time/)<br>1 year, ending about a week ago | **Objective: Abrupt Environ Change**<br>● We're going to take another step--to thinking about environments and change<br>● what about when an organism's environment abruptly changes? Maybe even catastrophically changes?This dataset shows the occurrence of fires over the past year.<br>● The communities in the Western US know all too well, that spreading wildfires result in notices to evacuate.<br>● Animals need to relocate too and must do it quickly to survive. |
| 7 |  | Earthquakes and Eruptions - 1960 - 2010 (https://sos.noaa.gov/datasets/earthquakes-and-eruptions-1960-2010/) | **Objective: Abrupt Change Due To Tectonics**<br>● What if there is a volcanic eruption or earthquake?<br>● Here we see 50 years of earthquakes (white circles) and volcanic eruptions (red triangles)<br>● Change is sudden, without warning, and can significantly change an environment for those living there.<br>● Notice how these events occur along the tectonic plate boundaries-- shown here in colors representing the different types of boundaries.<br>*Action: manually rotate, manually overlay plate boundaries color* |
| 8<br><br>9 |  <br>In this playlist, vent locations are overlayed on same background as Earthquakes and Eruptions | Deep-Sea Vent locations 2016 (https://sos.noaa.gov/datasets/deep-sea-vent-locations/) | **Objective: Abrupt change under water, animals location dependent**<br>● Along these boundaries, underwater, unique ecological communities thrive where you see each of the red stars. These deep sea vent communities get their energy from chemosynthetic bacteria.<br>● *Research question: When your food source is unique and exists only in very specific locations, how do you move? How do you survive a catastrophic event? Can you survive a catastrophic event?*<br>*Action: manually overlay plate boundaries color, stop rotation, split screen x 4* |

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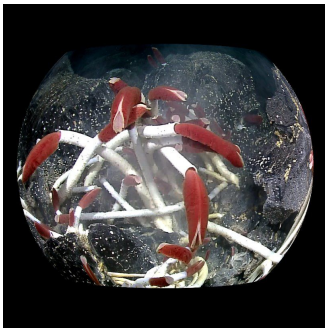
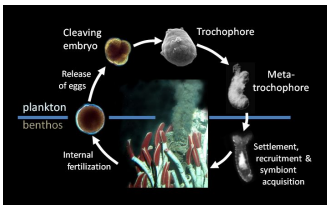
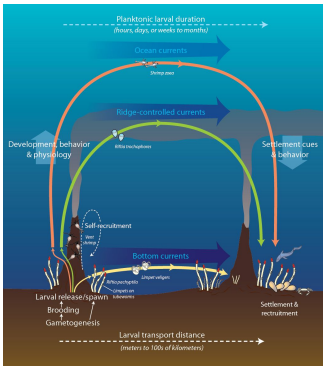
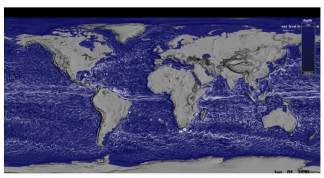
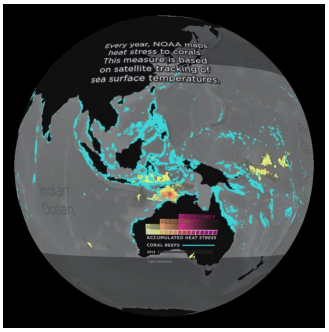
| 10 |  | Vent site movie from Galapagos Rift (ftp://public.sos.noaa.gov/extras/live_programs/vents/vent_site_Galapagos/)<br><br>*Operation: pause video to show spawning cloud* | Dive to Galapagos Rift<br>● The giant tube worms, Riftia, are found at several locations along the East Pacific Rise and Galapagos Rift.<br>● But as a sessile or stationary organism, attached to the bottom, how do they get to new locations or how do they re-establish themselves after an eruption? |
| 11 |  | Fig 1 in Adams et al. R2K Oceanography | **Objective: define larvae**<br>● life cycle involves adult fixed to bottom, dispersal in early life stage as larvae |
| 12 |  | Fig 2 in Adams et al. R2K Oceanography [on black background] | **Objective: define dispersal and link to modeling**<br>● how do we know they can disperse ~100 km? By modeling<br><br>● link to the NSF-funded project "develop new mathematical models to study the population dynamics of organisms that live at deep-sea hydrothermal vents" |
| 13 | **Ocean flows at surface and 2000 meters below sea level**<br>  | https://svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=4563 1st half is surface!; Second half is at 2000m, modeled | **Objective: also have to model deep-sea currents**<br>● [people don't know that ocean water moves except at the surface]<br>● The ocean is largely unknown and we seek to understand movement from one unique location to another<br>● Different species have different tolerances<br>● More familiar with coral reefs |
| 14 |  | Warm-forecast-for-coral-reefs - *clipped* (https://sos.noaa.gov/datasets/warm-forecast-for-coral-reefs/) | **Objective: Long-term change**<br>● Animals have all sorts of ways to move in response to different kinds of change, but some species may not be able to move in response as well as others<br>● Climate forecast models that give us a way to identify regions that are at risk; work to protect these organisms |

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| 15 | final image montage   | Scientists are studying to understand how pop'n distributions survive and move in response to changes in the environment | **Objective: Review rates of change and why its important to learn**<br>● Rates of change, review seasonal, abrupt, then longer-term change.<br>● By observing and modeling we seek figure out if populations are at risk<br>● We can take the steps to responsibly manage environments and populations to preserve and protect for future generations. |

We'd love for you to **submit learning feedback** for this live program.
Google Form: Animals on the Move - Learning Survey
If presenters would like to know the results, please contact Annette Brickley, abrickley.edu@gmail.com**,** with the time and date survey was conducted. Results are for feedback purposes only and may not be used for research purposes.

**For exploration online:**

**Over Land:**
eBird: http://ebird.org/ebird/subnational1/US-MA?yr=all
Journey North: https://www.learner.org/jnorth/monarchs

**Under Sea:**
Ocearch: http://www.ocearch.org/tracker/
Sharktivity: http://www.atlanticwhiteshark.org/sharktivity-map/
NOAA NEFSC: https://www.nefsc.noaa.gov/psb/surveys/
Wild Whales: http://wildwhales.org/sightings/
Robots4Whales: http://dcs.whoi.edu

**Both Land and Sea:**
NASA 20 Years of Global Biosphere: https://svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=4596

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"Metacommunity Dynamics at Hydrothermal Vents"
In this project, the researchers will develop new mathematical models to study the population dynamics of organisms that live at deep-sea hydrothermal vents.

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