1) Read the summary article Gray Whales As Ecosystem Sentinels", by Michelle Kinzel, 2015.

2) Complete the following chart based on the information provided in the article, "Gray Whales As Ecosystem Sentinels", by Michelle Kinzel, 2015.

Question: How do changes in the physical environment affect the biology (reproductive success) of polar bears in the Arctic?

Increasing atmospheric and ocean temperatures lead to more absorption of heat by ocean water, glaciers and ocean ice melt at a rapid rate, and there is a loss of habitat (sea ice) for the polar bears. With reduced habitat, adult bears have less access to prey, and less reproductive success (fewer cubs survive).

Scientific Study	Observation/Facts	Interpretation of Observation (Scientific reason related to Climate Change)	Life Cycle of Whale Most Affected
1) Southbound Migration	1 week delay in southbound migration	Regime Shift in North Pacific	Migration
2) Calf Production	Increase in calf production coincident with ice-free Chirikov Basin in early spring	Pregnant females accessing prime feeding areas	Feeding
3) Calf Numbers and Lagoon Occupancy	Reduction in calf numbers and changes in timing of occupation of breeding lagoons	1997-98 El Nino perturbation of the North Pacific ecosystem	Breeding
4) Feeding in July	Fewer gray whales feeding in July in Chirikov Basin, starving whales	Benthic prey decline in the Chirikov Basin and enhancement of prey base in southern Chuckchi Sea	Feeding
5) Feeding Year Round	Feeding year round offshore at Kodiak Island	Availability of localized prey along migration route	Feeding
6) Gray Whale Calls	Gray whale calls detected in western Beaufort Sea over winter of 2003-04	Reduction in sea ice, providing access to Artic areas over winter	Feeding/Wintering Habits

Question: What physical/environmental factors affect gray whales?

Regime Shifts, El Nino, Pacific Decadal Oscillation, prey availability, reduction in sea ice.

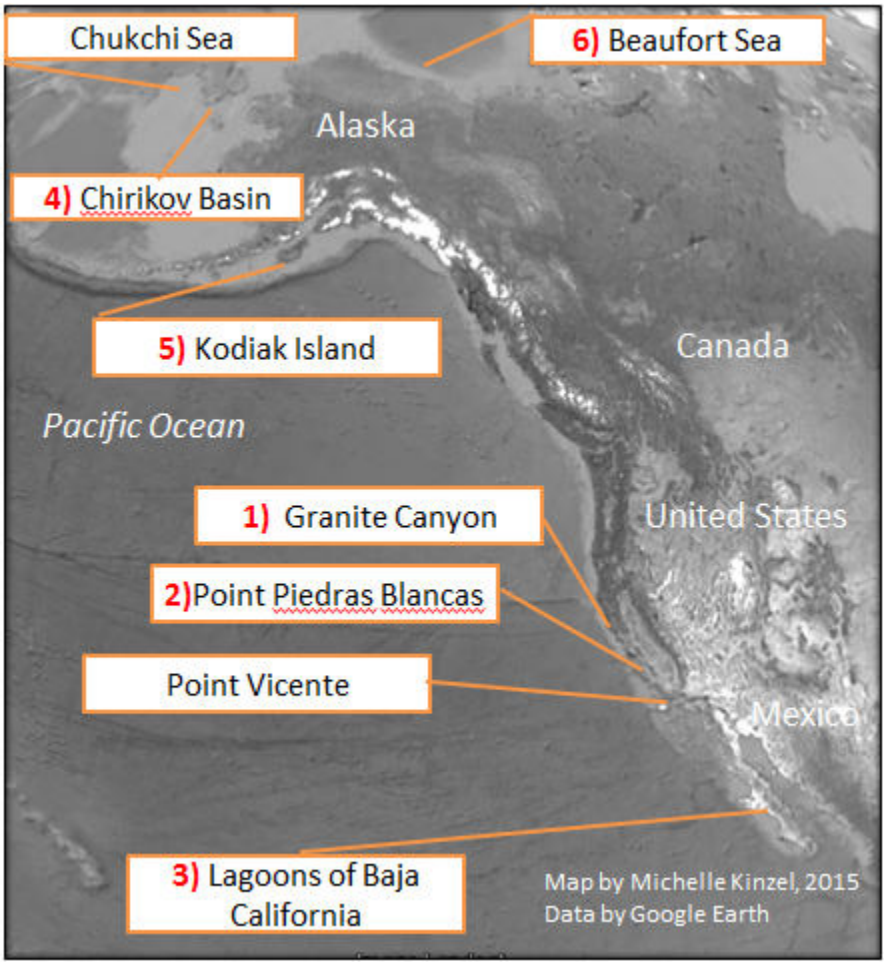
Question: How do these factors affect the biology of the gray whale?

Regime Shifts, El Nino, Pacific Decadal Oscillation affect timing of migration and reproductive successes of the gray whales.

Prey availability affects the geographic distribution of the whales and reproductive success of the whales.

Reduction in sea ice provides access to areas for overwintering, affects geographic distribution of gray whales.

3) Label the following map with Scientific Study numbers. Use the Article "Marine Mammals As Ecosystems Sentinels" to determine which geographic location correlates with which Scientific Study, #1- #6. Place the number of the scientific study on the map in the correct geographic location



Answer key with locations of scientific studies from article labeled.