

GEO130 FALL 2013

FILM STUDY GUIDE

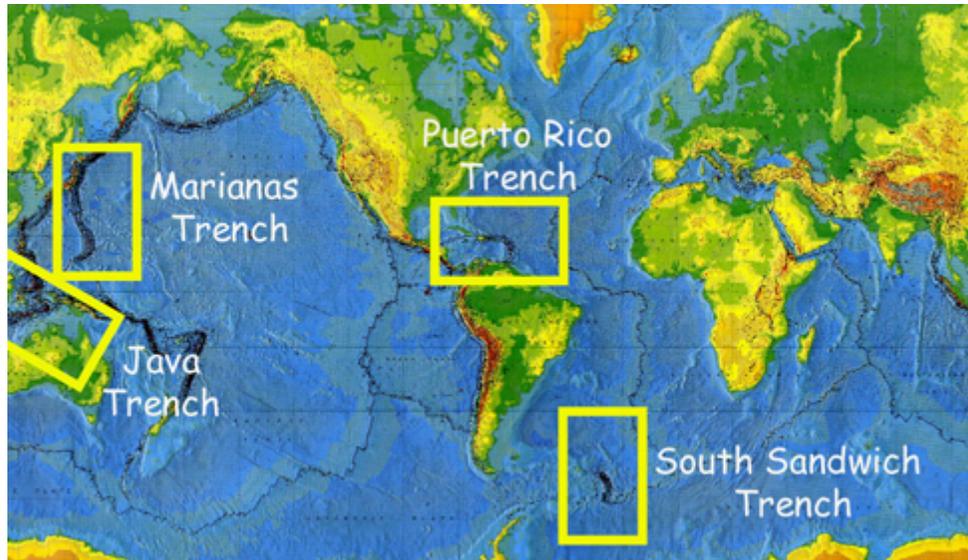
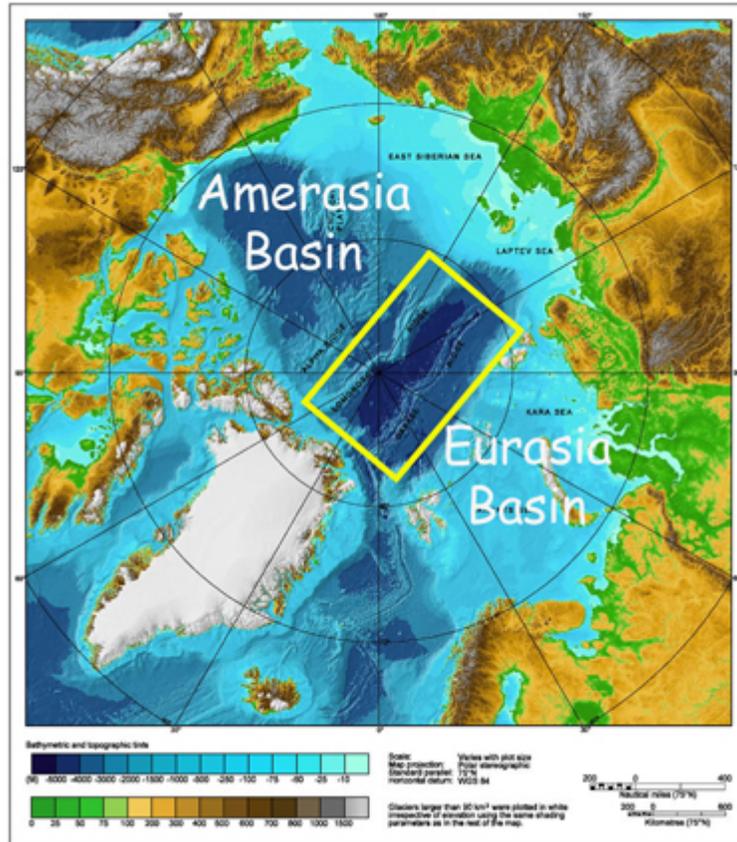
Title: *Blue Planet, Seas of Life Episode III: Open Ocean*,  
BBC/Discovery Channel

**Synopsis:** Most of Earth's surface is open ocean, far from coasts and remote from any source of mineral nutrients. Much of the open ocean is tropical and because the ocean water is heated from above by the sun much of the ocean has a distinct **pycnocline**. The pycnocline is caused by the warmer (**thermocline**) and thus less dense surface water overlying cooler and more dense subsurface water. The warm surface water acts as a cap isolating cooler, CO<sub>2</sub> and O<sub>2</sub> rich water from many primary producers in the photic zone. The result is little primary productivity over a large portion of Earth's surface.

The open ocean is the realm of plankton, floating plants and animals that drift with currents and the traveling predators for whom life is a constant search for food. That search takes place over thousands of miles.

This is the second film that has emphasized **limiting factors**. Like a chain, only as strong as its weakest link, **primary productivity is only as prolific as the most restrictive limiting factor allows**. In *Blue Planet, Seas of Life Episode II: The Deep*, the main limiting factor to primary productivity was light. Below 150m in the open ocean photosynthesis is impossible. The photic zone is much shallower in more turbid waters. In the open ocean the main limiting factors are the availability of nutrients and the availability of the dissolved gasses, CO<sub>2</sub> and O<sub>2</sub>.

**Geography:** Look at the maps and you get an idea of how much ocean area is open ocean with limited primary productivity. In the Arctic Ocean primary productivity is limited by ice formation during winter and lack of sunshine along with distance from mineral sources.



**Major concepts and related information:**

1. Blue tropical waters are **oceanic deserts**. There is plenty of light but life is limited by nutrients (no large landmasses nearby) and dissolved gasses (warm water holds less dissolved gas).

2. Life is plentiful around islands, sea mounts and coral reefs and in some **convergence zones** (where currents converge), Why? Because the islands force deep currents rich in nutrients to rise (**upwelling**). Water that rises to the surface is cold and therefore contains more dissolved  $CO_2$ . It also contains nutrients.
3. The open ocean is the realm of the traveling hunter, tuna, sharks, etc. **Eat → Move On → Eat Again - Move On →→ ad infinitum** .
4. **Timing in the open ocean is crucial** - a consumer must arrive at a feeding location when food is plentiful and predators are scarce. In the polar oceans (Arctic and Antarctic) food is plentiful in spring when nutrients are plentiful and when the lengthening hours of daylight allow phytoplankton blooms that support incredible production of biomass. During summer when day length is maximum the limiting factor is nutrient levels. The blooms have consumed most and though light is available, nutrients are becoming scarce.
5. **Predators** - Striped marlins, tuna, sei whales, dolphins, sail fish, blue sharks (hunt squid in the depths re-heat at the surface).
6. **Plankton** feeders - sardines, manta ray,
7. The mating rituals of some fish (surgeon fish) is a feeding opportunity for others. Large clouds of protein and fat rich surgeon fish eggs are swept up by manta rays in the open ocean near a remote island.
8. Plankton (**phytoplankton and zooplankton**) is the basis of all life on the open ocean.
9. Predators from the depths rise at sundown to feed on the plankton under the cover of darkness.
10. Jelly fish are effective hunters with sticky tentacles and other capture mechanisms.
11. Yellow fin tuna hatchlings are at first plankton, drifting with the currents until they are strong enough swim and determine their own routes. They are then nekton.
12. **Currents - transport plankton, nutrients and gasses carried up from the depths many miles across the surface**. Immense schools of plankton feeding fish follow the currents. Fish filter water through their gills and trap the plankton.
13. Dolphins are skilled predators using sonar to locate dense schools of fish that follow converging currents. The dolphins cooperate to "herd" prey into dense groups for easy capture.

14. Sharks can sense very low concentrations of oils from excited fish and find them for food. Like all open ocean predators to survive they must travel.
15. Some species breed in one area, give birth or lay eggs in another and feed in others all separated by thousands of miles.
16. Flotsam and jetsam (floating debris accidentally in the surface waters and jettisoned debris) are important to many species as a shelter for developing fry and eggs in the open ocean. Sea weed is an example of naturally floating debris.
17. Where floating debris is plentiful large communities may be supported, even in the remotest parts of the open ocean.
18. New land, in volcanoes emerging from the deep are quickly colonized and complex communities develop.
19. Though the open ocean is a biological desert in the Pacific alone there are 23,000 islands that force deep currents to surface.
20. Many predators (sunfish, hammer head sharks) look for reef fish not for food but for cleaning. Many open ocean fish survive by cleaning parasites from the traveling predators.
21. Large numbers of diving sea birds are also supported in the open ocean by surface based plankton communities. Some sea birds can dive as deep as 50 meters (164 feet) the depth limited by how long they can hold their breath.