Lecture 24:

-King of herrings:

- The Orefish

-Found in all oceans

-Up to 40 ft

-Feeds on small fish and krill

-Giant Isopod

-Looks like a pill bug

-Up to 14 in

- You can adopt them as the national deep-sea animal

-Abyssal Gigantism

-The tendency for deep sea organisms to be far bigger than their shallower counterparts

-Unknown cause

-Scarcity of food means longer life and slower growth

-Greater Pressure

-Higher oxygen levels

-Less Gravity

-Japanese Spider Crab

-Bigger than a human being

-Can live up to 100 years

-Sea Worms

-Nemertea is a phylum of invertebrate animals also known as ribbon worms or proboscis worms

-Giant Antarctic Marine Worms

-Extremely large

-Have a Proboscis that shoots out and poisons/ digests the food

-Have a pH of 3.5 so they don’t get eaten

-Polychaetes

-Segmented worms (Usually microscopic)

-One found in an aquarium, extremely large

-Started eating all the large fish which raised curiosity.

-Squid

-Most are small 60 cm long

-They are mollusks

-Have a pen with is their internal shell

-8 legs 2 tentacles

-Eat up to 30-60% if their body weight per day

-Have chromaticity

-Giant Squid

-Up to 13m long

-Mantle is 2m and the foot takes up the rest

-Suction cups have teeth surrounding them which attach firmly

-Spends most of their time in the 3000-5000ft range

-Eaten by Sperm whales

-Beak made of Chitin

-Predators have beaks gathered in their stomachs

-Colossal Squid

-Even bigger up to 50 ft

-Hang out around Antarctica

-Has sharp hooks instead of suckers

-Huge mantle

-Largest eyes of the animal kingdom

-Smaller Beak not found in sperm whales

-Produce many many eggs

-Sleeper sharks

-Eat giant squid

-Octopus

-Bilateral Body symmetry

-Prominent Head

-Set of tentacles which act as a tongue

-Have no internal bones

-Beak is the only hard part of their body

-Super duper smart

-“bag of muscle with arms that is wicked smart”

-Will steal fish from boats

-Break out of aquariums and play with toys

-Giant Pacific Octopus

-Up to 165 pounds

-Giant Jellyfish

-There are way more now and are causing problems for fishermen

-Phronima

-Pinky nail size

-Finds a salp and climbs into it and eats the insides and has its babies inside of it then leaves

-Skeleton Shrimp

-They will bite

-Will eat males after mating

-Tongue eating louse

-Goes into the mouth of the fish and eats the tongue and then stays there and eats bits of what the fish eats

Lecture 25:

-Mammal: Warm blooded, breath air, bear live young, have hair or fur at some stage of development, produce milk.

-116 marine mammals

-Carnivora

-pinniped

-Siniria

-Cetacea

-Odontoceti

-Mysticeti

-Seals, Sea lions, and walrus

-Pinniped (fin-footed)

-Preditors eating fish and squid

-Streamline bodies

-Thick layer of blubber for insulation, buoyancy, and food reserves

-Differences

-Seals

-Earless

-Rear flippers cannot move forward

-No external ear flap

-Claws and fur on flippers

-Short neck

-Shy and quiet

-Only social during mating and resting

-Globally distributed

-Sea Lions and Fur Seals

-Have ear flaps

-Don’t have nails

-Long neck

-Posterior flippers can be moved forward

-Exterior testicles

-Opportunistic Feeders

-Territorial in breeding season

-Social and live in big groups

-Found on the California coast and the Galapagos

-Elephant Seals

-Northern and southern Elephant seals

-Very Big

-Largest member of Carnivora

-Eat just about anything

-Leopard Seal

-Keystone Predator in Antarctica

-Can unhinge their jaw

-Fur Seal

-Solitary except when mating and nursing

-Long hind flippers

-Spend most of their time in the water

-Walrus

-Two large tusks for defense and getting onto ice

-Benthic Feeders

-Sirenia

-Manatees: costal areas of tropical Atlantic oceans

-Dugongs: tropical Indian and western Pacific Ocean

-Only Vegetarian Marine Mammal

-Very Dumb

-Happy in brackish water

-Threatened by human activity

-Stellar Sea Cow

-Hunted to extinction within 30 years of discovery

-Carnivora

-Prominent Canine teeth

-Skin covered flippers

-Sea Otters: no blubber, dense fur, eat various shellfish and crustaceans, live in kelp beds

-Almost hunted to extinction

-Densest fur of all animals

-Live in near shore environments

-Eat a lot

-Wrap kelp around themselves so they don’t float away

-Don’t pet them they will kill you

-Keystone Species because they eat urchins that would otherwise overgraze kelp.

-Polar Bears: Black skin, aggressive

-Semi aquatic

-Found in arctic

-Feed on seals

-Stalk seals at breathing holes

-Thick blubber, Translucent Fur, Black skin

-Threatened by lack of sea ice

-Evolved most recently of all bears

-POLAR BEARS AND SEALS DO NOT LIVE IN THE SAME POLE!!!!

-POLAR BEARS: NORTHERN HEMISPHERE

-PENGUINS: SOUTHERN HEMISPHERE

Lecture 26: Whales!!!!

-Defining Characteristics

-Elongated Skull

-Blowholes at top of skull

-Very Few Hairs

-Horizontal tail fin

-Swim fast

-Dive deep

-Toothed Whales (Odontoceti)

-Smaller

-Social

-Most are not migratory

-Chase and capture individual prey

-Use sound for communication and echolocation

-Baleen whales (Mysticeti)

-Larger

-Solitary

-Long annual migrations

-Feed on aggregations of krill, copepods, small fish

-Use sounds to communicate

-Deep Diving

-Deepest skin dive

-Herbert Nitsch

-214 m

-Deepest aided dive

-Ahmed Gabr

-332m

-Mammals are not ideal deep divers

-Pressure: deeper you go more pressure is on you

-As you go back up if you go too fast bubbles would form which is the “Bends”

-Oxygen storage

-Best free divers about 5 min up to 9

-Marine Mammals can stay down for up to 90 minutes

-Nitrogen Narcosis

-Too much nitrogen gas dissolved in your blood causes drunken like conditions, disorienting and eventually toxic

-Cold

-Heat leaves your body 20x faster in water than in air

-Mammals float easily

-Sperm Whale

-Deepest divers of marine mammals

-Stay under water for over 90 minutes

-Dives over 3000 m

-How??

-Pressure:

-No sinuses and external ears so there is no compression and exhale removing 90% of air from their lungs

-Oxygen Storage:

-Store more O2 in their blood and muscles

-More red blood cells

-Slower heart rate through “Mammalian diving reflex”

-Decompression sickness:

-Exhale before dive so they can’t get it

-Cold:

-Low surface to volume ratio that means less skin exposure to water

-Blubber

-Buoyancy:

-Exhale air out of lungs making them less buoyant

-Porpoise vs Dolphin (odentoceti)

-Both have single blowholes and teeth

-Dolphin have a pointed nose

-Porpoise rounded

-Teeth are also shaped different

-Narwhals

-Up to 4m

-Up to 1600kg

-Eat Fish

-Have one large tusk on their face

-Tusk have pores that may be used to detect chemicals.

-Orca/ Killer whale

-Up to 26 ft

-Up to 45 tons

-Eat a lot

-Rage of fish, Mammals, birds, sharks, polar bears

-Majority of their day is spent looking for food

-Found everywhere

-Three general groups

-Residents:

-Most commonly sighted and stay in one area consistently

-Live in pods

-Eat mostly fish

-Less aggressive towards Humans

-Transients

-Smaller groups that are less persistent

-Eat mostly Marine Mammals

-Roam wildly

-Offshore

-Live in open water

-Feed on schooling fish and some other unknown prey that left scars

-There are in fact different species genetically despite looking similar

-Risks

-Vessel Disturbance

-Fishing

-Pollution

-Really good at Communicating and Working together

-Mysticeti

-No Teeth

-Two Blow Holes

-Baleen made of Keratin

-Holds food and smells really bad

-Three main ways of feeding

-Gulpers:

-Collect a bunch of water with food in it then spit out the water through the baleen collecting the food on the inside

-Skimmer:

-Swim with mouth open and catch fish on outside and then move lips to eat it

-Benthic Feeders:

-Collect mud from sediment and collect the animals in it and spit out mud

-Sei Whale

-Skimmers

-Right Whale

-Skimmers

-Atlantic and pacific populations

-Where the “right” whales to hunt

-Females larger than males

-Whale Lice stays on whales and is used to identify characteristics and interactions

-Blue Whales

-Skimmer

-Can consume up to 4 tons of food per day

-Grey Whale

-Can live up to 60 years

-Live off the coast of California down and up

-Spend winters in the tropics and summers in the arctic.

-Would Attack Boats

-Humpback Whales

-Gulpers

-Use Bubble net feeding

-Group of whales

-Blow bubbles in a circle to surround a group of fish

-Leader signals to go up and feed and they all go together

-Work together very well and have a pattern of positions that they follow every time.

Lecture 27:

-Deep Sea

-As low as -3˚C

-No sun light No photosynthesis

-Hydrothermal Vents discovered in 1977

-Black Smokers, chimneys can be up to 400˚C

-Lots of life stemming from them

-Found everywhere

-Clues to Hydrothermal vents

-“Hot Brines”

-Red Sea

-Pockets of water found over 44˚C

-Metal Rich Sediment Cores

-Deep sea drilling project discovered it everywhere

-Layers of sediments rich in metals

-There must be chemical reactions for this to be happening

-Unusual rocks

-Pathways forming in rocks

-Rocks exposed to chemical changes

-Ophiolites

-Ocean crust on land

-Brought up by tectonic movement

-Missing Heat

-Theoretically:

-Warmest at midocean ridge and tapers off after

-Observed:

-Temperature goes up and down as you move away from the ridge

-Hydrothermal circulation happens and heat is lost in cracks.

-1977

-Woods Hole Oceanographic Institution

-Sub Full of Geologists

-Made one of the most exciting biological phenomenon

-How do HVs work

-Black smokers hotter than White smokers

-Black smokers release iron

-White smokers release silica and aluminum

1. Cold water seeps into the ocean floor through cracks

a. Heats because of hot core

2. Extreamly hot water reacts with crust

a. oxygen removed

b. becomes acidic

c.Picks up dissolved metals (Fe,Cu,Zn)

d. Picks up Hydrogen Sulfide (H2SO4)f

3. Hot liquid rises and metals are carried with it

4. Heavier metals settle quickly then build up into the chimney shape

-Chemosynthetic Bacteria and Archaea use the chemicals found in vents to produce energy

-H2O+CO2+H2S+O2🡪CH2O+H2SO4

-All life in vents thrive off of these bacteria

-HV Organisms

-Tubeworm:

-Bacteria live in gut of worm

-Plume filter out oxygen and chemicals for the bacteria to use for chemosynthesis, which the worm then eats

-Has Hemoglobin

-Made of Chitin

-Life span of vent fields is dependent on level of activity of ridge

-Heatloss in rocks: Decades

-Isotopes: 15-60 years

-Clam ages 4-40 years

-Yetti Crabs

-Furry and covered in bacteria

-Mats of them in vent systems

-Cold seeps (Hypersaline seeps and Hydrocarbon seeps)

-Cold and super salty water

-Support chemosynthesis and different organisms

-Whale Fall

-1-3% of whale falls reach the bottom on the ocean and support rich life

-Stages

-Mobile-scavenger stage: Lasting months to years where scavengers eat soft tissue and spread matter as they move away

-Enrichment opportunist stage: crustaceans and polychaetes eat bones

-Sulphophilic stage: bacteria finish the job and turn it into a vent system

-Not just whales but any large organic matter

-Chemosymbiosis:

-Found in many different kinds of systems including shallow water systems

-HVs are the possible origin of life on earth

Lecture 28:

-Nitrogen is essential for life

-3% of your body is nitrogen

-Nothing can be alive without nitrogen

-Too much nitrogen can be detrimental to the oceans

-Catagories of nitrogen:

-Reactive Nitrogen: Biologically stable Nitrogen

-Ammonium, nitrate, nitrite

-Unreactive Nitrogen: Biologically unstable nitrogen (little bit of a lie)

-N2🡪80% of atmosphere

-1% of organisms that can use Unreactive nitrogen

-Nitrogen Fixation turns it into ammonium

-Nitrogen fixing bacteria

-Malthuseian: Human population grows exponentially and one day there will not be enough food for the population.

-Really big deal

-Was even in the Christmas carol

-Liebigs law of the minimum

-Limiting nutrient in the ocean and on land is nitrogen

-Mountain of Guano (bird poo) had lots of nitrogen

-We used it all up then we started to flip out again

-We shipped 600,000 tons from 1840-1870

-Crookes “The wheat problem”

-If we could tap into N2 we would be ok again.

-Haber-Bosch process

-WE DID IT!!!

-Lots of pressure and temperature = N2🡪 ammonium

-50% of the worlds population is alive today because of this process

-1860 pre Haber Bosch: 15 tg N y-1

-2010 post Haber Bosch: 210 tg N y-1 1300x more

-Fate of Haber-Bosch Nitrogen

-Produced (100%)🡪N fertilizer consumed (94%)🡪 N in Crop (47%)🡪 N Harvested (31%)🡪 N in Food (26%)🡪 N Consumed (14%)

-14% if you are vegetarian

-Eutrophication: an increase in the supply of organic matter to a system

-Often Nitrogen induced

-Effects:

-Increases phytoplankton productivity

-Harmful algal blooms

-Formation of nuisance algal mats

-Loss of submerged aquatic vegetation

-Low Oxygen conditions

-Fish kills

-Loss of biodiversity

-Economic loss.

-Low oxygen zones have increases since the 1960s

-We only started looking for it in the 1960s

-There is a correlation with high-populated areas.

-Causes metabolic system of some phytoplankton to produce nitrosoxide

-How to fix this!

-Increase fertilizer use efficiency

-Increase plant nitrogen use efficiency

-Augment the natural process of denitrification

-Increase WWTP N removal

-Don’t be a BIG FOOT

-Eat less meat

-Reduce fossil fuel use

Lecture 29:

-Weather vs Climate

-Weather is day to day short tem variation

-Climate is long term (30 years)

-IPCC: intergovernmental panel on climate change

-The UN of climate change

-Representatives from all around the world

-Likelihood scale

-Virtually certain

-Very likely

-Likely

-About as likely as not

-Unlikely

-Very unlikely

-Exceptionally unlikely

-Global Warming

-Not correct, not everywhere will get warmer, they could get colder, wetter, or dryer

-Best data has yearly variability

-Long-term global average temperature trend is an increase

-Where is our heat going?

-The Ocean!

-Lower levels of the ocean is taking in the most heat

-Thermohaline circulation

-93% of heat is going into the ocean

-Ocean has been warming for the past 50 years

-Larges increase found in the winter

-Snow cover trend is decreasing

-Less albedo

-Snow cover protects roots of trees and plants

-Increase by about 0.6-0.7˚C in the past 50 years

-Scientists agree and are certain that climate change exists

-Sea Level rise

-The height of the ocean with a specific reference point

-Eustatic- global

-3.5mm/year

-Isotatic- Local

-In some places there will be lower sea levels and in others it will rise by a lot

-Thermal Expansion

-Increase in heat= increase in volume

-Upwards of 55% of mean sea level rise

-Melting glaciers and ice caps

-Imputing water into the ocean

-Sea Ice

-Not a factor because its already in the ocean however it is bad for animals

-Islands are going to be under water

-5 million people in the US will be displaced due to sea level rise

-What do we do?

-Decrease use of personal vehicles

-Decrease use of electricity

-Eat local

-Recycle

-Compost

-Consume less

-Use less water

-Spread the word

-Reach out to the government