Chapter 1 : Bioluminescence - Wikipedia

The Problems of The Deep Sea. The Contemporary Review (). Collected Essays VIII [37] On the 21st of December, , H.M.S. Challenger, an eighteen gun corvette, of 2, tons burden, sailed from Portsmouth harbour for a three, or perhaps four, years' cruise.

The deep sea is the largest habitat on earth and is largely unexplored. More people have traveled into space than have traveled to the deep ocean realm Though these zones contain an abundance of ocean life because sunlight is available for photosynthesis, they make up only a small fraction of the ocean biome. In fact, most of the ocean is cold, dark and deep. It is important to realize that photosynthesis occurs only down to about - m, and sunlight disappears altogether at 1, m or less, while the ocean descends to a maximum depth of about 11, m in the Mariana Trench! Until recently, the deep sea was largely unexplored. But advances in deep sea submersibles and image capturing and sampling technologies are increasing the opportunities for marine biologists to observe and uncover the mysteries of the deep ocean realm. Deep sea research is vital because this area is such an enormous part of the biosphere. Despite its depth and distance, it is still our backyard in comparison to outer space. And yet, human exploration has revealed more detail about the surface of the moon and Mars that it has about the deep sea! Consider that hydrothermal vents and their unique organisms, which revolutionized our ideas about energy sources and the adaptability of life, were only discovered in There may be yet other life-altering discoveries to be found at the bottom of the ocean. The oceans are divided into two broad realms; the pelagic and the benthic. Pelagic refers to the open water in which swimming and floating organisms live. Organisms living there are called the pelagos. From the shallowest to the deepest, biologists divide the pelagic into the epipelagic less than meters, where there can be photosynthesis , the mesopelagic - 1, meters, the "twilight" zone with faint sunlight but no photosynthesis , the bathypelagic 1, - 4, meters , the abyssopelagic 4, - 6, meters and the deepest, the hadopelagic the deep trenches below 6, meters to about 11, m or 36, feet deep. The last three zones have no sunlight at all. Benthic zones are defined as the bottom sediments and other surfaces of a body of water such as an ocean or a lake. Organisms living in this zone are called benthos. They live in a close relationship with the bottom of the sea, with many of them permanently attached to it, some burrowed in it, others swimming just above it. In oceanic environments, benthic habitats are zoned by depth, generally corresponding to the comparable pelagic zones: There are several types of deep benthic surfaces, each having different life forms. First, most of the deep seafloor consists of mud very fine sediment particles or "ooze" defined as mud with a high percentage of organic remains due to the accumulation of pelagic organisms that sink after they die. Rocky areas are found on the flanks of islands, seamounts, rocky banks, on mid-ocean ridges and their rift valleys, and some parts of continental slopes. At the mid-ocean ridges, where magma wells up and pushes seafloor tectonic plates apart, even flat surfaces are rocky because these areas are too geologically new to have accumulated much mud or ooze. Third, in some areas certain chemical reactions produce unique benthic formations. The best known of these formations are the "smoker" chimneys created by hydrothermal vents, which are described in detail below. Exploration of these zones has presented a challenge to scientists for decades and much remains to be discovered. However, advances in technology are increasingly allowing scientists to learn more about the strange and mysterious life that exists in this harsh environment. Life in the deep sea must withstand total darkness except for non-solar light such as bioluminescence , extreme cold, and great pressure. To learn more about deep-sea marine life, sophisticated data collection devices have been developed to collect observations and even geological and biological samples from the deep. First, advances in observational equipment such as fiber optics that use LED light and low light cameras has increased our understanding of the behaviors and characteristics of deep sea creatures in their natural habitat. Such equipment may be deployed on permanent subsea stations connected to land by fiber optic cables, or on "lander" devices which drop to the seafloor and which are later retrieved typically after a radio command activates the dropping of ballast so the lander may float up. Second, remotely operated vehicles ROVs have been used underwater since the s. ROVs are basically unmanned submarine robots with umbilical cables used to transmit data between the vehicle and researcher for remote operation in areas where diving is constrained by physical hazards. ROVs are often fitted with video and still cameras as well as with mechanical tools such as mechanical arms for specimen retrieval and measurements. Alvin is an American deep sea submersible built in that has been used extensively over the past 4 decades to shed light on the black ocean depths. Like ROVs, it has cameras and mechanical arms. This sub, which carries 3 people typically a pilot and 2 scientists , has been used for more than 4, dives reaching a maximum depth of more than 4, m. France, Japan and Russia have similar manned scientific submersibles that can reach somewhat greater depths, while China is currently building one to reach 7, m. The bathyscaphe Trieste at the National Museum of the U. Navy in Washington, D. Until , only one manned submarine device has ever reached the bottom of Mariana trench at almost 11, m: Don Walsh was invited to join the expedition. Physical Characteristics of the Deep Sea The physical characteristics that deep sea life must contend with to survive are: All these factors have led to fascinating adaptions of deep sea life for sensing, feeding, reproducing, moving, and avoiding being eaten by predators. Light The deep sea begins below about m, where sunlight becomes inadequate for photosynthesis. From there to about 1, m, the mesopelagic or "twilight" zone, sunlight continues to decrease until it is gone altogether. This faint light is deep blue in color because all the other colors of light are absorbed at depth. The deepest ocean waters below 1, m are as black as night as far as sunlight is concerned. And yet, there IS some light. People who dive deep in a submersible with its lights off are often mesmerized by an incredible "light show" of floating, swirling, zooming flashes of light. This is bioluminescence , a chemical reaction in a microbe or animal body that creates light without heat, and it is very common. And yet, this light is low compared to sunlight, so animals here â€" as well as those in the mesopelagic zone â€" need special sensory adaptations. Many deep-sea fish such as the stout blacksmelt have very large eyes to capture what little light exists. Other animals such as tripodfishes are essentially blind and instead rely on other, enhanced senses including smell, touch and vibration. Scientists think bioluminescence has six different functions not all used by any one species: Some swimming sea cucumbers even coat their attackers with sticky glowing mucus so the "police" predators can find them many minutes later. Most bioluminescence is blue, or blue-green, because those are the colors that travel farthest in water. As a result, most animals have lost the ability to see red light, since that is the color of sunlight that disappears first with depth. But a few creatures, like the dragonfish , have evolved the ability to produce red light. This light, which the dragonfish can see, gives it a secret "sniper" light to shine on prey that do not even know they are being lit up! Pressure increases 1 atmosphere atm for each 10 m in depth. The deep sea varies in depth from m to about 11, m, therefore pressure ranges from 20 atm to more than 1, atm. High pressures can cause air pockets, such as in fish swim bladders , to be crushed, but it does not compress water itself very much. Instead, high pressure distorts complex biomolecules â€" especially membranes and proteins â€" upon which all life depends. Indeed, many food companies now use high pressure to sterilize their products such as packaged meats. Life appears to cope with pressure effects on biomolecules in two ways. First, their membranes and proteins have pressure-resistant structures that work by mechanisms not yet fully understood, but which also mean their biomolecules do not work well under low pressure in shallow waters. Second, some organisms may use "piezolytes" from the Greek "piezin" for pressure. These are small organic molecules recently discovered that somehow prevent pressure from distorting large biomolecules. One of these piezolytes is trimethylamine oxide TMAO. This molecule is familiar to most people because it gives rise to the fishy smell of marine fish and shrimp. TMAO is found at low levels in shallow marine fish and shrimp that humans routinely eat, but TMAO levels increase linearly with depth and pressure in other species. Really deep fish, including some grenadiers which humans are now fishing, smell much more fishy! Animals brought from great depth to the surface in nets and submersible sample boxes generally die; in the case of some but not most deep-sea fishes, their gas-filled swim bladder adapted to resist high pressure expands to a deadly size. However, the vast majority of deep-sea life has no air pockets that would expand as pressure drops during retrieval. Instead, it is thought that rapid pressure as well as temperature changes kill them because their biomolecules no longer work well high TMAO does not help, as it appears to be too high in deep-sea life for biomolecules to work properly at the surface. Advances in deep sea technology are now enabling scientists to collect species samples in chambers under pressure so that they reach the surface for study in good condition. Pressure-adapted microbes have been retrieved from trenches down to 11, m, and have been found in the laboratory to have all these adaptations pressure-resistant biomolecules and piezolytes. However, pressure adaptations have only been studied in animals down to about 5, m. We do not yet know if the adaptations found at those depths work at greater depths down to 11, m. Temperature Except in polar waters, the difference in temperature between the euphotic, or sunlit, zone near the surface and the deep sea can be dramatic because of thermoclines, or the separation of water layers of differing temperatures. In most parts of the deep sea, the water temperature is more uniform and constant. However, water never freezes in the deep sea note that, because of salt, seawater freezes at If it did somehow freeze, it would just float to the surface as ice! Life in the deep is thought to adapt to this intense cold in the same ways that shallow marine life does in the polar seas. This is by having "loose" flexible proteins and unsaturated membranes which do not stiffen up in the cold. Membranes are made of fats and need to be somewhat flexible to work well, so you may be familiar with this adaptation in your kitchen. Butter, a saturated fat, is very hard in your refrigerator and would make a poor membrane in the cold, while olive oil â€” an unsaturated fat â€” is semi-solid and would make a good flexible membrane. However, as with pressure, there is a tradeoff: Oxygen The dark, cold waters of much of the deep sea have adequate oxygen. This is because cold water can dissolve more oxygen than warm water, and the deepest waters generally originate from shallow polar seas. In certain places in the northern and southern seas, oxygen-rich waters cool off so much that they become dense enough to sink to the bottom of the sea. These so-called thermohaline currents can travel at depth around the globe, and oxygen remains sufficient for life because there is not enough biomass to use it all up. However, there are also oxygen-poor environments in intermediate zones, wherever there is no oxygen made by photosynthesis and there are no thermohaline currents. These areas, called oxygen minimum zones , usually lie at depths between - 1, m in temperate and tropical regions. Here, animals as well as bacteria that feed on decaying food particles descending through the water column use oxygen, which can consequently drop to near zero in some areas. Biologists are still investigating how animals survive under such conditions.

Chapter 2 : Deep sea - Marine Biodiversity Wiki

Here are the seven biggest problems, plus some light at the end of the tunnel. 1. Overfishing Is Draining the Life From the Water Overfishing is having some serious impacts on our oceans.

Light[edit] Natural light does not penetrate the deep ocean, with the exception of the upper parts of the mesopelagic. Since photosynthesis is not possible, plants cannot live in this zone. Except for the areas close to the hydrothermal vents, this energy comes from organic material drifting down from the photic zone. The sinking organic material is composed of algal particulates, detritus, and other forms of biological waste, which is collectively referred to as marine snow. Pressure[edit] Because pressure in the ocean increases by about 1 atmosphere for every 10 meters of depth, the amount of pressure experienced by many marine organisms is extreme. With the advent of traps that incorporate a special pressure-maintaining chamber, undamaged larger metazoan animals have been retrieved from the deep sea in good condition. Salinity[edit] Salinity is remarkably constant throughout the deep sea, at about 35 parts per thousand. Temperature[edit] The two areas of greatest and most rapid temperature change in the oceans are the transition zone between the surface waters and the deep waters, the thermocline, and the transition between the deep-sea floor and the hot water flows at the hydrothermal vents. Thermoclines vary in thickness from a few hundred meters to nearly a thousand meters. Below the thermocline, the water mass of the deep ocean is cold and far more homogeneous. It continues to decrease to the bottom, but the rate is much slower. The cold water stems from sinking heavy surface water in the polar regions. There are no seasonal temperature changes, nor are there any annual changes. No other habitat on earth has such a constant temperature. Hydrothermal vents are the direct contrast with constant temperature. Deep sea community Regions below the epipelagic are divided into further zones, beginning with the mesopelagic which spans from to meters below sea level, where so little light penetrates that primary production becomes impossible. Below this zone the deep sea begins, consisting of the aphotic bathypelagic , abyssopelagic and hadopelagic. Instead of relying on gas for their buoyancy, many deep-sea species have jelly-like flesh consisting mostly of glycosaminoglycans , which provides them with very low density. They have elongated bodies with weak, watery muscles and skeletal structures. They often have extendable, hinged jaws with recurved teeth. Because of the sparse distribution and lack of light, finding a partner with which to breed is difficult, and many organisms are hermaphroditic. Because light is so scarce, fish often have larger than normal, tubular eyes with only rod cells. Their upward field of vision allows them to seek out the silhouette of possible prey. Prey fish however also have adaptations to cope with predation. These adaptations are mainly concerned with reduction of silhouettes, a form of camouflage. The two main methods by which this is achieved are reduction in the area of their shadow by lateral compression of the body, and counter illumination via bioluminescence. This is achieved by production of light from ventral photophores , which tend to produce such light intensity to render the underside of the fish of similar appearance to the background light. For more sensitive vision in low light , some fish have a retroreflector behind the retina. Flashlight fish have this plus photophores , which combination they use to detect eyeshine in other fish see tapetum lucidum. Larger food falls, such as whale carcasses , also occur and studies have shown that these may happen more often than currently believed. There are many scavengers that feed primarily or entirely upon large food falls and the distance between whale carcasses is estimated to only be 8 kilometers. They are extremely abundant between 5x and 1x phages per square meter in sediments around the world. One example is the symbiotic relationship between the tube worm Riftia and chemosynthetic bacteria. It is this chemosynthesis that supports the complex communities that can be found around hydrothermal vents. These complex communities are one of the few ecosystems on the planet that do not rely upon sunlight for their supply of energy.

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Chapter 3 : Marine Discovery Lesson

Deep below the ocean's surface is a mysterious world that takes up 95% of Earth's living space. It could hide 20 Washington Monuments stacked on top of each other. But the deep sea remains largely unexplored. Dive down feet (one monument or meters), and you notice that light starts.

ON the 21st of December, , H. No man-of war ever left that famous port before with so singular an equipment. The crew of the Challenger match her fittings. Captain Nares, his officers and men, are ready to look after the interests of hydrography, work the ship, and, if need be, fight her as seamen should; while there is a staff of scientific civilians, under the general direction of Dr. Professor of Natural History in Edinburgh University by rights, but at present detached for duty in partibus , whose business it is to turn all the wonderfully-packed stores of appliances to account, and to accumulate, before the ship returns to England, such additions to natural knowledge as shall justify the labor and cost involved in the fitting out and maintenance of the expedition. Under the able and zealous superintendence of the hydrographer, Admiral Richards, every precaution which experience and forethought could devise has been taken to provide the expedition with the material conditions of success; and it would seem as if nothing short of wreck or pestilence, both most improbable contingencies, could prevent the Challenger from doing splendid work, and opening up a new era in the history of scientific voyages. The dispatch of this expedition is the culmination of a series of such enterprises, gradually increasing in magnitude and importance, which the Admiralty, greatly to its credit, has carried out for some years past; and the history of which is given by Dr. Wyville Thomson in the beautifully-illustrated volume entitled "The Depths of the Sea," published since his departure: Carpenter, at that time one of the vice-presidents of the Royal Society, was with me in Ireland, where we were working out together the structure and development of the Crinoids. I had long previously had a profound conviction that the land of promise for the naturalist, the only remaining region where there were endless novelties of extraordinary interest ready to the hand which had the means of gathering them, was the bottom of the deep sea. I had even had a glimpse of some of these treasures, for I had seen, the year before, with Prof. Sars, the forms which I have already mentioned, dredged by his son at a depth of to fathoms off the Loffoden Islands. I propounded my views to my fellow-laborer, and we discussed the subject many times over our microscopes. I strongly urged Dr. Carpenter to use his influence at headquarters to induce the Admiralty, probably through the Council of the Eoyal Society, to give us the use of a vessel properly fitted with a dredging-gear and all necessary scientific apparatus, that many heavy questions as to the state of things in the depths of the ocean, which were still in a state of uncertainty, might be definitely settled. After full consideration, Dr. Carpenter promised his hearty cooperation, and we agreed that I should write to him on his return to London, indicating generally the results which I anticipated, and sketching out what I conceived to be a promising line of inquiry. The Council of the Royal Society warmly supported the proposal; and I give here in chronological order the short and eminently satisfactory correspondence which led to the Admiralty placing at the disposal of Dr. Porcupine, Captain Calver, E. Gwyn Jeffreys , in the summers of the years and Wyville Thomson, not being a cynic, should relegate the "Land of Promise" to the bottom of the deep sea; they may still more wonder what manner of "milk and honey" the Challenger expects to find; and their perplexity may well rise to its maximum, when they seek to divine the manner in which that milk and honey are to be got out of so inaccessible a Canaan. I will, therefore, endeavor to give some answer to these questions in an order the reverse of that in which I have stated them. Apart from hooks, and lines, and ordinary nets, fishermen have, from time immemorial, made use of two kinds of implements for getting at sea-creatures which live beyond tide-marksâ€"these are the "dredge" and the "trawl. Imagine a large bag, the mouth of which has the shape of an elongated parallelogram, and is fastened to an iron frame of the same shape, the two long sides of this rim being fashioned into scrapers. Chains attach the ends of the frame to a stout rope, so that when the bag is dragged along by the rope, the edge of one of the scrapers rests on the ground, and scrapes whatever it touches into the bag. The oyster-dredger takes one of these machines in his boat, and when he has reached the oyster-bed the dredge is tossed overboard; as soon as it has sunk to the bottom, the rope is paid out sufficiently to prevent it from pulling the dredge directly upward, and is then made fast while the boat goes ahead. The dredge is thus dragged along and scrapes oysters and other sea-animals and plants, stones, and mud into the bag. When the dredger judges it to be full he hauls it up, picks out the oysters, throws the rest overboard, and begins again. Dredging in shallow water, say ten to twenty fathoms, is an easy operation enough; but the deeper the dredger goes, the heavier must be his vessel, and the stouter his tackle, while the operation of hauling up becomes more and more laborious. Dredging in fathoms is very hard work, if it has to be carried on by manual labor; but by the use of the donkey-engine to supply power, [2] and of the contrivances known as "accumulators," to diminish the risk of snapping the dredge-rope by the rolling and pitching of the vessel, the dredge has been worked deeper and deeper, until at last, on the 22d of July, , H. Porcupine being in the Bay of Biscay, Captain Calver, her commander, performed the unprecedented feat of dredging in 2, fathoms, or 14, feet, a depth nearly equal to the height of Mont Blanc. The trawl is a sort of net for catching those fish which habitually live at the bottom of the sea, such as soles, plaice, turbot, and gurnett. The mouth of the net may be thirty or forty feet wide, and one edge of its mouth is fastened to a beam of wood of the same length. The two ends of the beam are supported by curved pieces of iron, which raise the beam and the edge of the net which is fastened to it, for a short distance, while the other edge of the mouth of the net trails upon the ground. The closed end of the net has the form of a great pouch; and, as the beam is dragged along, the fish, roused from the bottom by the sweeping of the net, readily pass into its mouth and accumulate in the pouch at its end. After drifting with the tide for six or seven hours the trawl is hauled up, the marketable fish are picked out, the others thrown away, and the trawl sent overboard for another operation. More than a thousand sail of well-found trawlers are constantly engaged in sweeping the seas around our coast in this way, and it is to them that we owe a very large proportion of our supply of fish. The difficulty of trawling, like that of dredging, rapidly increases with the depth at which the operation is performed; and, until the other day, it is probable that trawling at so great a depth as fathoms was something unheard of. But the first news from the Challenger opens up new possibilities for the trawl. Wyville Thomson writes Nature , March 20, Vincent at a depth of fathoms. The experiment looked hazardous, but, to our great satisfaction, the trawl came up all right, and contained, with many of the larger invertebrata, several fishes. After the first attempt we tried the trawl several times at depths of 1,, 1,, and, finally, 2, fathoms, and always with success. They, therefore, have recourse to a sort of frame, to which are fastened long bundles of loosely-netted hempen cord, and which is lowered by a rope to the depth at which the hempen cords can sweep over the surface of the rocks and break off the coral, which is brought up entangled in the cords. A similar contrivance has arisen out of the necessities of deep-sea exploration. In the course of the dredging of the Porcupine, it was frequently found that, while few objects of interest were brought up within the dredge, many living creatures came up sticking to the outside of the dredge-bag, and even to the first few fathoms of the dredge-rope. The mouth of the dredge doubtless rapidly filled with mud, and thus the things it should have brought up were shut out. To remedy this inconvenience Captain Calver devised an arrangement not unlike that employed by the coral-fishers. He fastened half a dozen swabs, such as are used for drying decks, to the dredge. A swab is something like what a birch-broom would be if its twigs were made of long, coarse hempen yarns. These dragged along after the dredge over the surface of the mud, and entangled the creatures living thereâ€”multitudes of which, twisted up in the strands of the swabs, were brought to the surface with the dredge. A further improvement was made by attaching a long iron bar to the bottom of the dredge-bag, and fastening large bunches of teased-out hemp to the end of this bar. These "tangles" brought up immense quantities of such animals as have long arms, or spines, or prominences which readily become caught in the hemp, but they are very destructive to the fragile organisms which they imprison; and, now that the trawl can be successfully worked at the greatest depths, it may be expected to supersede them; at least, wherever the ground is soft enough to permit of trawling. It is obvious that between the dredge, the trawl, and the tangles, there is little chance for any organism, except such as are able to burrow rapidly, to remain safely at the bottom of any part of the sea which the Challenger undertakes to explore. And, for the first time in the history of scientific exploration, we have a fair chance of learning what the population of the depths of the sea is like in the most widely-different parts of the world. And now arises the next question. The means of exploration being fairly adequate, what forms of life may be looked for at these vast depths? The systematic study of the Distribution of living beings is the most modern branch of Biological Science, and came into existence long after Morphology and Physiology had attained a considerable development. This naturally does not imply that, from the time men began to observe natural phenomena, they were ignorant of the fact that the animals and plants of one part of the world are different from those in other regions; or that those of the hills are different from those of the plains in the same region; or, finally, that some marine creatures are found only in the shallows, while others inhabit the deeps. Nevertheless, it was only after the discovery of America that the attention of naturalists was powerfully drawn to the wonderful differences between the animal population of the central and southern parts of the New World and that of those parts of the Old World which lie under the same parallels of latitude. So far back as Abraham Mylius, in his treatise "De Animalium origine et migratione populorum" argues that, since there are innumerable species of animals in America which do not exist elsewhere, they must have been made and placed there by the Deity: Buffon no less forcibly insists upon the difference between the Fauna? But marine animals, he thinks, obey no such law. The Arctic and Atlantic Seas, he says, are as full of fishes and other animals as those of the tropics. It is, therefore, clear that cold does not affect the dwellers in the sea as it does land animals, and that this must be the case follows from the fact that seawater, "propter varias quas continet bituminis spiritusque particulas," freezes with much more difficulty than fresh water. On the other hand, the heat of the Equatorial sun penetrates but a short distance below the surface of the ocean. Moreover, according to Zimmermann, the incessant disturbance of the mass of the sea, by winds and tides, so mixes up the warm and the cold that life is evenly diffused and abundant throughout the ocean. In , Risso, in his work on the Ichthyology of Nice, laid the foundation of what has since been termed "bathymetrical" distribution, or distribution in depth, by showing that regions of the sea-bottom of different depths could be distinguished by the fishes which inhabit them. There was the littoral region between tide-marks with its sand-eels, pipe-fishes, and blennies; the sea-weed region, extending from low water-mark to a depth of feet, with its wrasses, rays, and flat-fish; and the deep-sea region, from feet to 1, feet or more, with its file-fish, sharks, gurnards, cod, and sword-fish. More than twenty years later, MM. They divide the area included between high-water mark and low-water mark of spring tides which is very extensive, on account of the great rise and fall of the tide on the Normandy coast about St. Malo, where the observations were made into four zones, each characterized by its peculiar invertebrate inhabitants. Beyond the fourth region they distinguish a fifth, which is never uncovered, and is inhabited by oysters, scallops, and large starfishes and other animals. Beyond this they seem to think that animal life is absent. They suggest that, by this means, it will be possible to judge whether a fossiliferous stratum was formed upon the shore of an ancient sea, and even to determine whether it was deposited in shallower or deeper water on that shore; the association of shells or animals which live in different zones of depth will prove that the shells have been transported into the position in which they are found; while, on the other hand, the absence of shells in a deposit will not justify the conclusion that the waters in which it was formed were devoid of animal inhabitants, inasmuch as they might have been only too deep for habitation. On the coasts of the British Islands, Forbes distinguishes four zones or regions, the Littoral between tide-marks , the Laminarian between low-water mark and 15 fathoms , the Coralline from 15 to 50 fathoms , and the Deep sea or Coral region from 50 fathoms to beyond fathoms. Hence it appeared as if descent in the sea had much the same effect on life as ascent on land. Wyville Thomson, "fifty-seven hauls of the dredge were taken in the Atlantic at depths beyond fathoms, and sixteen at depths beyond 1, fathoms, and, in all cases, life was abundant. In we took two casts in depths greater than 2, fathoms. In both of these life was abundant; and with the deepest cast, 2, fathoms, off the mouth of the Bay of Biscay, we took living, well-marked, and characteristic examples of all the five invertebrate sub-kingdoms. And thus the question of the existence of abundant animal life at the bottom of the sea has been finally settled and for all depths, for there is no reason to suppose that the depth anywhere exceeds between three and four thousand fathoms; and, if there be nothing in the conditions of a depth of 2, fathoms to prevent the full development of a varied Fauna, it is impossible to suppose that even an additional thousand fathoms would make any great difference. Fishes came up from a depth of to more than 1, fathoms, all "in a peculiar condition from the expansion of the air contained in their bodies. On this relief from the extreme pressure, their eyes, especially, had a singular appearance, protruding like great globes from their heads. It is obvious that the Challenger has the privilege of opening a new chapter in the history of the living world. She cannot send down her dredges and her trawls into these virgin depths of the great ocean without bringing up a discovery. Even though the thing itself may be neither "rich nor rare," the fact that it came from that depth, in that particular latitude and longitude, will be a new fact in distribution, and, as such, have a certain importance. But it may be confidently assumed that the things brought up will very frequently be zoological novelties; or, better still, zoological antiquities, which in the tranquil and little-changed depths of the ocean have escaped the causes of destruction at work in the shallows, and represent the predominant population of a past age. It has been seen that Audouin and Milne Edwards foresaw the general influence of the study of distribution in depth upon the interpretation of geological phenomena. Forbes connected the two orders of inquiry still more closely; and, in the thoughtful essay "On the Connection between the Distribution of the Existing Fauna and Flora of the British Isles, and the Geological Changes which have affected their Area, especially during the Epoch of the Northern Drift," to which reference has already been made, he put forth a most pregnant suggestion. In certain parts of the sea-bottom in the immediate vicinity of the British Islands, as in the Clyde district, among the Hebrides, in the Moray Firth, and in the German Ocean, there are depressed areoe, forming a kind of submarine valleys, the centres of which are from 80 to fathoms, or more, deep. These depressions are inhabited by assemblages of marine animals, which differ from those found over the adjacent and shallower region, and resemble those which are met with much farther north, on the Norwegian coast. Forbes called these Scandinavian detachments "northern outliers. To explain the mystery, Forbes called to mind the fact that, in the epoch which immediately preceded the present, the climate was much colder whence the name of "glacial epoch" applied to it ; and that the shells which are found fossil, or sub-fossil, in deposits of that age are precisely such as are now to be met with only in the Scandinavian or still more arctic regions. Undoubtedly, during the glacial epoch, the general population of our seas had, universally, the northern aspect which is now presented only by the "northern outliers," just as the vegetation of the land, down to the sea-level, had the northern character which is, at present, exhibited only by the plants which live on the tops of our mountains. But, as the glacial epoch passed away, and the present climatal conditions were developed, the northern plants were able to maintain themselves only on the bleak heights, on which southern forms could not compete with them. And, in like manner, Forbes suggested that, after the glacial epoch, the northern animals then inhabiting: Thus depth in the sea corresponded, in its effect upon distribution, to height on the hind. The presence of the latter is essentially due to the law of representation of parallels of latitude by zones of depth , while that of the former species depended on their transmission from their parent seas during a former epoch and subsequent isolation. That epoch was doubtless the newer Pliocene or Glacial Era, when the Mya truncata and other northern forms now extinct in the Mediterranean, and found fossil in the Sicilian tertiaries, ranged into that sea.

Chapter 4 : Deep sea - Wikipedia

The deep sea is an extremely harsh environment. It is dark, below m the light levels are too low for photosynthesis (the twilight zone), and not a glimmer of sunlight remains beyond 1,m (the midnight zone).

Unlike asteroid mining, however, deep sea mining has already been undertaken through projects such as deep sea diamond mining. Actual mining for REEs has not been attempted because of environmental issues and cost. These issues are much more complicated and not as easily fixed as other concerns. Deep Sea mining would be an effective way to obtain a large amount of rare earths; in one specific section of the ocean floor, " However, the economic viability of deep sea mining is still questionable. If the environmental and financial factors were cleared, then deep sea mining would definitely be a feasible option for the long term. Implementation Details In order for deep sea mining to be implemented, suitable sites must be found. Deep sea remotely operated vehicles ROVs are able to obtain samples using drills and other cutting tools in order to analyze them for rare earth minerals. With the location of a suitable mining site, the ocean floor is ready to be harvested. Two technologies being considered for commercial mining of the ocean floor are continuous line bucket system CLB and hydraulic suction systems. CLB is the preferred method and transfers the mud up to the ship in a conveyor belt type system. Hydraulic suction has a pipe running the mud up from the ocean floor and another pipe that transfers the tailings back to the ocean floor Economist Hydrothermal vents are the primary source for deep sea mines. These magma below these vents heats the surrounding seawater, which causes metals within the sediment to leach into the water. The subsequent shock of the cold water causes the metals to precipitate and form as solids in the sediment surrounding the vents. Because of these high concentrations, most deep sea mining would occur in the chimneys above the vents. Vents themselves would be preserved undamaged, but the chimneys would be destroyed. These chimneys, however, can be built back over time, and is the equivalent of "cutting grass" on the ocean floor Begley, Cost Environmental cost is currently the biggest issue with deep sea mining. There are numerous controversies about whether or not testing deep sea mining is worth the damage it could cause to biodiversity in the ocean. The first step towards making deep sea mining into a feasible option would be to ensure the protection of "sensitive ecosystems and minimize the potential environmental impact of this industry" Terradaily. These environmental costs come primarily from the intrusive nature of mining. Deposits are located near deep sea thermal vents, which sustain very unique ecosystems. There are thousands of previously undiscovered species first seen around these vents, and many more presumably to be discovered. Many are filter feeders, and many fear that the sediment stirred up by mining activities may not allow them to obtain enough nutrients. However, this problem is not be nearly as troublesome as it may at first appear. Sea floor deposits are much more concentrated than those on land, meaning a significantly smaller volume of earth must be moved to extract the same amount of usable minerals. Less materials consequently have to be processed, which is what causes most of the environmental problems in the first place. Also, current technologies are able to minimize the actual sediment being thrown about, mitigating enough of the initial concern to justify further usage of these techniques Begley, The extremely rich deposits near these vents mean that mining in these areas is very economically viable, and the environmental costs are minimal enough to warrant a further application of deep sea mining. Case Study Very recently, a Canadian company called Nautilus Minerals was granted a year lease by the Papua New Guinean government to mine offshore and operate up to a mile underwater. The intentions of Nautilus Minerals were to harvest the high grade copper, gold, zinc, and silver deposits on the ocean floor. The coast of Papua New Guinea seemed very promising to the company, but only a few weeks ago news was released of the termination of their pioneering project due to undisclosed disputes with the local government and an unwillingness to pay for the full costs of the endeavor Milman, Interestingly enough, India has decided to follow suit under competitive pressure by other leading REE resource developers such as China. The Indian government seems dedicated to harvesting the resources found in the Central Indian Basin, an area rich in nickel, copper, cobalt and potentially rare-earth minerals found in nodules. As of now, India is building a rare earth mineral processing plant in the coastal state of Orissa and is investing to buy a new exploration ship and the recommissioning of another for deep water exploration. Exploratory mines are developed, as well as continual pursuit of new extraction technologies Strict restrictions are put in place by some countries mostly coastal nations to protect their environment and minimize ecological impact Further expansion of deep sea mines across the oceans focused on good sample areas. Pacific islands seek protection from deep-sea mining. SciDevNet Global, Retrieved from http: Case Study in Papua New Guinea. Mining the seafloor for rare-earth minerals. The New York Times. Experts skeptical about potential of rare earth elements in seafloor mud. Scientific american, Retrieved from http: India joins deep sea mining race. Treasure on the ocean floor. Economist, ,

Chapter 5 : The Deep Sea | Smithsonian Ocean

The sea-urchins of the deep sea, while none of them are specifically identical with any chalk-form, belong to the same general groups, and some closely approach extinct cretaceous genera.

Many assign an exact depth limit to this zone: However, conditions at exact depths vary from place to place, so deep-water ecologist Tony Koslow defines it as the area below which photosynthesis can function. In general, that means that anything below about feet m is considered the deep sea. In this short biome video we discuss the deep sea while going to 2, feet in a homemade submarine. The Zones of the Deep Sea The ocean is a vast body of water that stretches from tropical waters to frigid polar regions, from shallow seas to deep ocean trenches. This vast, pelagic area is further divided into Deep Sea Zones. Each zone has characteristic life and conditions. Below is a short description of each. Organisms here have adaptations to see and keep from being seen. Eyes of animals in this zone are often quite large, to collect any available light. Bioluminescence is prevalent here, helping creatures disguise their silhouettes from animals below them. Most sources give the depth range of this zone as meters down to or meters, but the exact depth is dependent on the clarity of the water, determining where photosynthesis can no longer take place. The Mesopelagic Zone becomes the Bathypelagic Zone when light no longer penetrates the water. It is a depth that in most open ocean systems is about meters, but can be much shallower along coastlines. For instance, in Honduras where Karl Stanley flies his submarine the depth is closer to meters, due to the proximity to land. This zone is also marked by very low temperatures 5 or 6 degrees Celsius and having a very low organismal biomass, a trend that will continue until reaching the ocean floor. The boundary between the mesopelagic zone and the bathypelagic zone contains The Deep Scattering layer â€" a layer of fish, squid, crustaceans etc, that migrate each day from the deep ocean to the shallows at night. Scientists noticed a huge, scattered sonar signal that was deep during the day and rose to shallower water as night fell. It was perplexing at first. The exact line between the Bathypelagic Zone and the Abyssopelagic Zone is difficult to define, but it is often defined as the area where the water hits 4 degrees Celsius. The average depth of the ocean is m about 2. The conditions of the Abyssal Zone are almost constant. It is dark and cold at all times averaging 2 degrees Celcius at meters. It is calm and unaffected by sunlight and turbulent seas, far above. The water is very still, and the oxygen in the water derives solely on the amount of dissolved oxygen it had when it left the polar regions, from which all Abyssal water originates. No photosynthesis takes place to replenish oxygen, but the creatures here do consume more than is provided. The nutrient salt concentration nitrogen, phosphorus and silica is uniform and higher than in the waters above because the Abyssal and Hadal Zones are the areas where dead biological materials settle to the floor. The composition of the sea floor varies with depth. In areas where the sea floor is shallower than meters, the floor is mainly composed of calcareous shells of foraminiferan zooplankton and phytoplankton, like coccolithophores. If the sea floor is deeper than meters, the shells tend to dissolve, and the sediment is mainly composed of brown clays, siliceous remains of radiolarian zooplankton and phytoplankton, such as diatoms. In spite of the fact that water near the sea floor is devoid of oxygen, there is a spike in biomass here. This is because the collection of sediment gives a food source. All major marine invertebrate phyla and many fish are represented at this depth, although there are few species and low numbers of each. Anything that lives here with a stalk must grow above that oxygen-poor layer, and anything with legs usually has long legs to walk above it. Fish at these depths often have huge, gaping, underslung jaws to sift through the sand and catch food. Some creatures, like the anglerfish use a combination of a huge mouth and bioluminescence to catch prey, though carnivores and scavengers are much less abundant here than animals that feed on sea-floor mud and suspended matter. Animals here must withstand pressures of up to 11, psi. They tend to be grey or black for camouflage and unstreamlined for energy conservation. Many are blind, and they are thought to reproduce very slowly. Some examples of deep sea life here are the tripod fish, anglerfish and giant squid. The Hadal Zone or the Hadalpelagic zone is the layer of the deep sea below meters. Its found almost exclusively in deep ocean trenches. More people have been to the moon than to the Marianas Trench â€" the deepest part of the ocean at approximately 11, meters 36, feet. The deeper you go, the more intense the pressure. At the surface, there is one atmosphere of pressure; for every ten meters you go underwater, the pressure increases by one atmosphere. Humans would be crushed at this depth imagine what it would feel like to put a a bucket of water on your head. Then picture the pressure of thousands of bucket of water pressing down on you. One way some animals have adapted to this pressure is that they have no air spaces. The deep sea has extremely low temperatures. In fact, the beginning of the Abyssal Zone is conveniently defined as the area where water plummets to 4 degrees Celsius. Below the Epipelagic Zone, there is not enough sunlight for photosynthesis, and below the Mesopelagic Zone no sunlight penetrates. Animals in these areas of low to no light have many adaptations. Some have very large eyes to catch any small amount of light. Other emit their own light with bioluminescence, disguising their silhouette, attracting food or attracting a mate. It is thought that 90 percent of all deep sea animals have bioluminescence. Many of the animals in very low light are transparent, red or black in color. In the deep sea, red and black look the same, hiding the animal in the darkness. There is large biomass at the surface where the variety of ocean creatures are typically observed. Descending through the water column, the biomass decreases to a very small amount. The small biomass stays relatively constant until reaching the ocean floor, where the number of organisms increases again. This occurs because the deep sea food web is fueled by dying plants and animals that sink through the water column. As the dead biological material sinks, it becomes food for bacteria and animals, but it is only a transient source of food, coming and going quickly. The final remains of the falling biological material settles on the sea floor, giving nourishment to the depths. This accumulation of dead organisms is greatly responsible for the spike in biomass here. While constancy may not seem like a challenge, it is a unique characteristic of the deep sea that has shaped the evolution of many deep sea animals. There are no diurnal or seasonal changes; day is night and summer is winter in the deep sea. The icy water of the very deep sea about feet originates at the poles and moves slowly to the sea floor. The conditions including temperature, salinity and amount of oxygen of the water at the poles are the conditions it maintains in the deep sea. Animals at these depths tend to move very slowly, have bulky and unstreamlined bodies, and require little oxygen. The Abyssal Zone retains several cubic centimeters of oxygen per liter because animals here require much less oxygen than is available. Bioluminescence Bioluminescence refers to the production of light via a chemical reaction. This is not to be confused with phosphorescence or florescence. Organisms that bioluminesce in the deep sea include marine hatchetfish, anglerfish, flashlight fish, pineconefish, gulper eels, many rattails, many sea pens, certain nudibranchs, the colossal squid and the Sparkling Enope Squid. Deep Sea Conservation We thought it was really important to wrap up our discussion of the deep sea by reminding you that the deep sea is still prone to some destruction. In fact, deep sea trawlers are causing huge problems right now all around the world. They scrape the bottom of the ocean and pull up all the corals and bottom fauna. To get a better feel for the deep sea conservation, watch this short video we made. Links to other good deep sea information and great books.

Chapter 6 : Deep Sea Dumping by on Prezi

The major health problems of the deep-sea fishermen were various types of neuroses (8%), arterial hypertencion (%), urolithiasis (%) and musculoskeleted system diseases. Do you want to read.

What Lives Here Diversity Giant eyes spot prey. Huge claws grab the prey, and a tiny mouth rips it to shreds. But researchers are discovering that thousands of fascinating animals â€"including fishes, corals, crustaceans , jellyfishes, and wormsâ€"have adapted to life in this challenging environment. Many of these animals look quite alien to us. Some have huge eyesâ€"or eyes on long stalksâ€"that capture the little existing light. Others seem to be all mouth. Their gaping jawsâ€"often filled with fanglike teethâ€"are always open, ready to capture whatever morsels fall from above. Still other deep sea animals have transparent bodies that you can see through, enabling them to blend right in to the waters. But the year-long Census of Marine Life project studied just that question. This network of scientists from more than 80 nations worked to document the diversity, distribution, and abundance of life in the oceansâ€"past, present, and future. So far researchers have discovered more than 5, new species. The Census explored ocean life from top to bottom, pole to pole , microbes to whales. Several field projects focused on deep ocean habitatsâ€" seamounts , hydrothermal vents , the ocean floor, and the waters around the Mid-Atlantic Ridge. Project results continue to play a critical role in deciding how to manage this valuable global resource. No other research ship has ever drilled that deep. It is the only ship in the world able to drill into earthquake zones. For example, scientists can steer remotely operated vehicles ROVs from ships at the surface. A cable links the ships to the ROVs, limiting their mobility. Autonomous underwater vehicles AUVs have no cable, but they need to be pre-programmed. They can have a surface operator, or drop the cable and go it alone. Smithsonian Collections The Case of the Mystery Squid A Smithsonian specimen helped identify a new family of deep sea squid with long spindly legs. Worldwide observations of remarkable deep-sea squids. Together with a slightly larger juvenile specimen in the collections and a paralarva baby from Hawaii, this odd-looking specimen led to the identification of a whole new family of squids: A few years later, researchers in deep-sea submersibles began spotting large and very strange squids. They had long spaghetti-like arms -- reaching 20 feet 7 meters -- that bent like elbows. With the help of long-dead specimens, a modern-day mystery was solved. Deep Ocean Corals Stephanocyathus A. Smithsonian Institution There are millions of animals in the Smithsonian collections. Many of the specimensâ€"including these solitary coralsâ€"came from the deep ocean. For example, as a quick glance at the collection cards shows, deep ocean specimens tell us where and at what depths particular species live. And because the collections were built over many years, they reveal changes in deep sea diversity. As human activities continue to impact the ocean, this knowledge will help us manage this fragile ecosystem. Vecchione has taken trips to the bottom of the sea and served as Chief Scientist on many deep ocean expeditions.

Chapter 7 : Deep Sea Mining

Science at FMNH - Exploring Unknown Deep Sea Ecosystems. Hydrothermal Vent and Cold Seep Communities. Life in the deep sea is relatively sparse compared to the epipelagic (euphotic) and intertidal zones, with two exciting, and relatively recently discovered exceptions â€" hydrothermal vent and cold seep communities.

Some corals form dense thickets, and others are in the form of "trees" as high as 10 metres. There are more coral species in cold and deepsea waters than tropical waters. Until quite recently, scientists were not aware that coral forests and sponge reefs are widespread in certain cold and deep ocean habitats. Deep ocean forests are the habitat of thousands of species, many of them unknown to science. It is a race in time for protection, as many coral and sponge ecosystems will be destroyed by commercial fishing before science can even find or identify them. Bottom trawling began more than two decades ago with a complete indifference to the habitat of the fish being caught. Deepsea fishing vessels drag massive nets that are weighted down, and are assisted across the seafloor by heavy rollers, picking up everything in their path. In the course of catching commercial seafood such as shrimp and orange roughy, corals, sponges and invertebrates are raked up or smashed, leaving the seabed barren like a ploughed field. Deepsea bottom trawling is the ocean equivalent of clearcutting terrestrial forests. It has an immediate double impact - depleting the fish population, and at the same time destroying their habitat and preventing sustainable recovery. Approximately 98 percent of ocean species live right above or in the seafloor. Corals and sponges on the rocky bottoms of continental slopes and seamounts, provide habitat for countless marine wildlife. Deepsea corals are the oldest known ocean animals. Some corals contain irreplaceable archives of global climate change. It is possible, through a greater public awareness, to recognize and appreciate the forests of the deep ocean, in the same manner as forests on land. The fishing industry is aware of the extent of coral from the amount that is caught in nets, and governments are aware from surveys. Unfortunately they have both concentrated on short-term fishing industry economic growth, rather than the longterm conservation of the biodiversity of a sustainable fishery. When coastal fisheries became depleted, bigger fishing vessels with heavier gear and sophisticated instruments moved into the deepseas, reaching as deep as two kilometres. Now as many ocean fisheries are already becoming over-fished, vessels are being equipped for the most remote seas on Earth, such as the Ross Sea in Antarctica. The New Zealand bottom trawl fishing fleet is one of the largest in the world, causing extensive damage to benthic communities. Surveys conducted by NIWA show damage by bottom trawling to a number of them. Deepwater coral species normally live well below the depth limit of human diving, however they are found in shallower waters in shady places such as within the fiords in Fiordland, and beneath the arches of the Poor Knights Islands. Seafloor off Northwest Australia had dense populations of corals and sponges top before trawling eliminated them bottom. There is a striking similarity of the two events - natural resources destroyed by exploitation for profit without consideration of conservation; and long-living, slow growing species destroyed without knowledge of their origin, age or growth characteristics. Cold water coral usually grows only 1. Coral forests will take thousands of years to recover from trawler damage, just as giant kauri forest will from logging. In Deep New Zealand, marine biologist Peter Batson from Otago University wrote "Anecdotal accounts of fishing virgin seamounts tell of trawl nets filled with coral trees, and of repeated hauls over the same seamount yielding progressively fewer and fewer coral fragments

Chapter 8 : Deep Sea Mining a New Ocean Threat | HuffPost

This station focuses upon the adaptations that deep-sea fish have developed in order to survive the harsh conditions found within the deep-sea environment. These adaptations include bioluminescence, pressure adaptations, feeding adaptations, and reproduction adaptations.

June 8, Photo: That kind of paradox could give anyone an identity crisis. We seem to think we can take all the goodies out and put all our garbage in, and then expect them to keep happily ticking away indefinitely. Here are the seven biggest problems, plus some light at the end of the tunnel. Not only does it work towards wiping out a species , but also the other species of marine animals that are dependent upon those fish for survival. It is also estimated that most seas already need long term fishing bans if certain species are to recover at all. There is much to be desired in the ways we fish. First, we humans use some pretty destructive methods in how we pull catches, including bottom trawling which destroys sea floor habitat and scoops up many unwanted fish and animals that are tossed aside. We also pull far too many fish to be sustainable, pushing many species to the point of being listed as threatened and endangered. Reasons for overfishing are obvious in some ways, in that there are a lot of people who like to eat a lot of fish. The more fish, the more money for the fishermen. However there are other elements at work that promote overfishing that are less obvious, such as promoting the health benefits of one fish over another, or the health of fish oils. But Just for the Fins Overfishing is an issue that extends beyond familiar species like bluefin tuna and orange roughy. Sharks are killed in the tens of millions each year, mainly for their fins. It is a common practice to catch sharks, cut off their fins, and toss them back into the ocean where they are left to die. The fins are sold as an ingredient for soup. And the waste is extraordinary. Sharks are top-of-the-food-chain predators, which means their reproduction rate is slow. On top of that, their predator status also helps regulate the numbers of other species. In other words, many species are going to be wiped out , from shellfish to corals and the fish that depend on them. A focus on how to protect the coral reefs is important considering coral reefs support a huge amount of small sea life, which in turn supports both larger sea life and people , not only for immediate food needs but also economically. Global warming is a primary cause of coral bleaching , but there are other causes as well. Science is working on ways , but it also is a matter of setting aside marine conservation areas. Figuring out ways to protect this "life support system" is a must for the overall health of the oceans. The number of dead zones is growing at an alarming rate , with over known to exist , and the number is expected to grow. Dead zone research underscores the interconnectedness of our planet. It appears that crop biodiversity on land could help prevent dead zones in the ocean by reducing or eliminating the use of fertilizers and pesticides that run off into the open ocean and are part of the cause of dead zones. Knowing what we dump into the oceans is important in being aware of our role in creating areas of lifelessness in an ecosystem upon which we depend. Mercury Pollution Going from Coal to Oceans to Fish to Our Dinner Table Pollution is running rampant in the oceans but one of the scariest pollutants is mercury because, well, it ends up on the dinner table. The worst part is mercury levels in the oceans are predicted to rise. So where does the mercury come from? You can probably guess. In fact, according to the Environmental Protection Agency, coal-fired power plants are the largest industrial source of mercury pollution in the country. And, mercury has already contaminated water bodies in all 50 states, let alone our oceans. The mercury is absorbed by organisms on the bottom of the food chain and as bigger fish eat bigger fish, it works its way back up the food chain right to us, most notably in the form of tuna. Taking a look at the Great Pacific Garbage Patch is a sobering way to realize there is no "away" when it comes to trash, especially trash that lacks the ability to decompose. The patch was discovered by Captain Charles Moore , who has been actively vocal about it ever since. Luckily, the Great Pacific Garbage Patch is getting a lot of attention from eco-organizations, including Project Kaisei, which is launching the first clean-up effort and experimentation, and David de Rothschild who will sail a boat made of plastic out to the patch to bring awareness to it. There are quite a few ideas floating around that claim will save us from ourselves - from ocean iron fertilization to fertilizing trees with nitrogen, from biochar to carbon sinks. But while these ideas hold a seed of promise, they also each hold a sizable nugget of controversy that may or may not keep them from coming seeing the light of day. Though, looking at the big picture and the extent of the effort required, it might take a lot of gumption to stay optimistic. But optimistic we should be! Records are even being set for how much marine area is being conserved.

Chapter 9 : The ocean has issues: 7 biggest problems facing our seas, and how to fix them | TreeHugger

After an Australian vessel, Ocean Shield, again detected deep-sea signals consistent with those from an airplane's black box, the official leading a multination search expressed hope Wednesday.

It ranges from the edge of the continental shelf at m to the bottom of the ocean. At the edge of the continental shelf is the shelf break , where the gradient of the floor increases down the continental slope. Below the continental slope lies the continental rise , which has a more gently slope. At around 4, meters depth, the ocean floor is reached and extends over the ocean basins at depths of 5, metres on average. This is called the abyssal plain. The zone between the continental shelf and the abyssal plain is the bathyal zone. In some places, the sea floor drops again into elongated trenches with depths of 10 to 11 kilometres. This region is the hadal region. The ocean floor is interrupted by mountain chain known as the mid-oceanic ridge system. Other features on the ocean floor are seamounts and hydrothermal vents. The lowest temperatures are found in the Antarctic Ocean and are about The salinity of the seawater is relatively constant. The oxygen concentrations are near saturation except in the oxygen minimum layer between 0. In enclosed basins such as the Black Sea, the water is anoxic below metres. When the deep water is further from its origin the oxygen concentration declines by metabolic processes. The most predictable physical variable is hydrostatic pressure. It is a dark environment and the organisms are adapted to it. The circulation in the deep sea is explained in the article ocean circulation. The deep sea bottom has some specific characteristics that can be found in the article about deep sea bottom. Adaptations For the animals of the deeper layers of the water column where there is no plant growth at all, finding food and avoiding predation are the main problems. Many mid-water animals have bizarre body shapes, because they never come into contact with a physical barrier. The most abundant for is more or less spherical, often with long and delicate extensions. Most animals do not need a rigid skeleton because they spend all their time suspended in water. An important adaptation is not to be seen too easily. In the upper parts of the mesopelagic zone, where there is still quite some sunlight, many animals have more or less transparent bodies. An alternative is to have silver sides that act as mirrors and light organs along their bellies. At the deeper layers, the organisms have a dark red, black or brown colour. These colours do not reflect the blue colour of most bioluminescence. In the mid-water, animals have mouths full of big teeth. In the deeper water, the anglerfish has a fishing rod with bioluminescent lures to attract preys. Many fishes also have large mouths to take up as much as possible. Another adaptation is dial vertical migration of many animals. The general pattern is that animals spend the daylight hours at depth and move upwards during the night. This is to avoid predation and to feed. Bioluminescence is another adaptation. Depending on the depth, organisms use it as camouflage to protect them from predators or to confuse or frighten predators rather than to hide from them. Other animals use it to look for a potential mate. A few deep-sea animals use it together with another light organ that produces deep red light. Other animals cannot see this red light, but the red light will be reflected very efficiently by the red bodies of the specific prey. The blue light is a recognition mark for other members of the same species. An example of such an organism is Malacosteus. Most of them have an average size in the range of centimetres. The dominant species are crustaceans, fish and a variety of animals with soft and jelly-like bodies such as jellyfish. Squid with many light organs [5] On the deep-sea floor, many mounds and depressions are formed by benthic animals such as worms, mollusks, crustaceans, starfish, brittlestars, shrimps, fishes sea cucumbers and sea urchins. Because the deep-sea floor is poor in food resources, it cannot support large populations of big animals. This causes bigger animals to be distributed over a greater range than elsewhere. This strategy means that the animals stay at one place and wait until food falls down on them or are carries to them in the currents. These animals are sponges, sea anemones, tube worms and barnacles. Smaller animals can also be found. Deep-sea bottom with fish [6] A gorgonian feeding on a basketstar [7] There are five groups that are dominated in terms of numbers.