FISHES AND INVERTEBRATES pdf

1: Vertebrates and Invertebrates Animals - GK for Kids | Mocomi

Want to meet our fish and invertebrates up close? Book an encounter now and come by the aquarium.

Omnivore; algae and a variety of invertebrates. Larger species of fish and humans. This is because there are no documented population decline of this species in nature. Shrimp, clams, lobsters, fish Lifespan: Sharks, large fish and sometimes seals and sea lions Conservation Status: Their population numbers are unknown but it is feared that they may be suffering from high pollution levels. Insect larvae, crayfish, snails, and small fish Lifespan: Males live to about 50 years, while females can live up to years Range: Lake sturgeons are intentionally stocked in lakes in Vermont and Wisconsin. Humans for caviar Conservation Status: Lake sturgeon are born at a hatchery and then placed under our care until they are strong enough to be released into Lake Ontario to help the lake sturgeon population. Crabs, small fish, and various shrimp Lifespan: Native to the Indo-Pacific near shore area and around coral reefs. Due most likely to release by hobbyists, the red lionfish is now found from Long Island to Florida in bays, estuaries and harbors as well as along beaches and coral reefs. This invasive species has also been reported off the San Francisco coastline. Predators of adult red lionfish are unknown. Sharks, especially sand tigers, may eat them, as they have been known to eat venomous fish. It is not likely that the introduction of this fish to United States waters can be reversed. The lionfish is an invasive species and with their increasing population, they are destroying ecosystems. There is a huge push to hunt lionfish and eat them, there are countless cookbooks on how to cook and eat lionfish. Chevron down Poison Dart Frog Size: The most common prey of the poison arrow dart frog is an ant but they also eat a variety of soil mites, springtails, tiny beetles, fly larvae, fruit flies and small spiders. Rainforests of Central and South America Predators: They have one natural predator, the fire-bellied snake, Leimadophis epinephelus. The poison arrow dart frog is labeled to be of least concern, but their natural habitats are destroyed by humans when deforestation occurs. Fish, fruits, nuts, dead or injured animals and crustaceans. Red-bellied piranhas have few predators, except for river otters and the alligator-like reptile, the caiman. Lengths of 8 to 10 inches Diet: Omnivore; aquatic plants and animal matter Lifespan: Raccoons, minks, otters, foxes, and other smaller mammals. This species does unfortunately suffer from destruction of their natural habitats by humans. Chevron down Seahorse Size: This species will use its snout, like a straw, to capture small crustaceans and various other small aquatic creatures. Coasts of both North and South America. They range as far north as Cape Cod and as far south as Uruguay. The lined seahorse has excellent camouflage and so has few predators. Populations have been declining partially due to commercial harvesters over collecting this species. Lengths of 3 to 6 inches Diet: Crustaceans, mussels, clams, and oysters Lifespan: Seagulls, bottom-dwelling fish, and crabs. Populations of the Forbes sea star are currently thriving in their natural habitats. This is occurring without any help from human intervention. Chevron down Softshell Turtle Size: Female softshell turtles can grow to 24 inches, while the considerably smaller males usually only grow to 12 inches Diet: Fish, snails, insects, amphibians and crayfish and some plant materials. They actively hunt for food and are considered ambush predators Lifespan: Some species have been introduced and become well established in the southwestern United States, in Colorado and Utah. Alligators, black bears and the Florida panther Conservation Status: The Florida softshell turtle is neither threatened or endangered. However, softshells are exploited for trade to Asian commercial food markets. Octopus, squid, small fish Lifespan: Near the equator, tropical salt water Predators: Sharks, barracudas Conservation Status: Least concern, no major threats Chevron down Size: Crabs, various shrimp, and small fish Lifespan: Larger sharks Conservation Status: It is more likely to become threatened, because it is fished extensively in China, Indonesia and Thailand. They are reef fishes that are dependent on a healthy reef ecosystem. Global warming, pollution and the impact of humans have affected coral reefs and the animals that live on them.

FISHES AND INVERTEBRATES pdf

2: Triassic Period - Invertebrates | www.enganchecubano.com

This is a list of various species of marine invertebrates, animals without a backbone, that are commonly found in aquariums kept by hobby www.enganchecubano.com species are intentionally collected for their desirable aesthetic characteristics.

The class is one of the two great groups of living fishes, the other being the osteichthians, or bony fishes. The name Selachii is also sometimes used for the group containing the sharks. Rays are distinguished from sharks by a flattened, disklike body, with the five gill openings and the mouth generally located on the underside. Rays are further distinguished from sharks by their greatly enlarged, winglike pectoral fins, which extend forward along the sides of the head above the gill openings. Many rays swim and breathe differently from sharks, propelling themselves with their pectoral fins and taking in water for respiration through large openings spiracles on the upper surface of the head, rather than through the mouth. Many are slow-moving bottom dwellers. Manta rays feed on plankton and small animals; others take various fishes and invertebrates, sometimes damaging commercially valuable shellfish beds. Other than skates, most or possibly all rays bear living young. Fertilization is internal, the male introducing sperm into the female by means of special copulatory organs claspers that are the modified edges of the pelvic fins. Rays can be classified into the following groups: The electric rays suborder Torpedinoidei are distinguished by large paired electric organs between the pectoral fins and the head, with which they can give powerful shocks either for defensive purposes or to kill prey. The electric rays have a smooth and naked skin; the head and trunk with the pectoral fins form a circular disk, and the tail is short and stout. About 20 species are known to inhabit warm seas, with some reaching a weight of pounds 90 kg. All other types of rays, which lack electric organs, generally have a rough skin, often bearing strong spines. The sawfishes family Pristidae have a snout that is modified into a long blade possessing a series of strong teeth on each side. About six species are known from warm seas, frequenting sandy shores and estuaries. In the skates suborder Rajoidei , the large pectoral fins extend to the snout and backward, stopping abruptly at the base of a slender tail. In contrast to other rays, skates produce eggs; these are large and oblong in shape with dark, leathery shells having a tendril at each corner by which they become fastened to seaweed or other objects. Skates lack the long, slender barbed spine that distinguishes stingrays. The most widespread skates belong to the genus Raja of the family Rajidae. The remaining rays comprise the suborder Myliobatoidei and consist of whip-tailed rays family Dasyatidae , butterfly rays Gymnuridae , stingrays Urolophidae , eagle rays Myliobatidae , manta rays or devil rays; Mobulidae , and cow-nosed rays Rhinopteridae. Common to the rays of all these families is a long, slender, whiplike tail that usually has a barbed spine connected with a poison gland; this spine is capable of inflicting serious wounds and is a dangerous weapon when the tail is lashed. Almost all of these rays are inhabitants of warm seas, except for a few species of stingray that live in the rivers of South America. For more information on species and groups of rays, see manta ray ; electric ray ; guitarfish ; sawfish ; skate ; stingray. Learn More in these related Britannica articles:

FISHES AND INVERTEBRATES pdf

3: Ray | fish | www.enganchecubano.com

Animals with a spinal column and an elaborate skeletal structure are vertebrates and invertebrates are animals without a spine and they have no vertebrae.

Invertebrates The difference between Permian and Triassic faunas is most noticeable among the marine invertebrates. At the Permian-Triassic boundary the number of families was reduced by half, with an estimated 85 to 95 percent of all species disappearing. Ammonoids were common in the Permian but suffered drastic reduction at the end of that period. Only a few genera belonging to the prolecanitid group survived the crisis, but their descendants, the ceratitids , provided the rootstock for an explosive adaptive radiation in the Middle and Late Triassic. Ammonoid shells have a complex suture line where internal partitions join the outer shell wall. Ceratitids have varying external ornamentation, but all share the distinctive ceratitic internal suture line of rounded saddles and denticulate lobes, as shown by such Early Triassic genera as Otoceras and Ophiceras. The group first reached its acme and then declined dramatically in the Late Triassic. In the Carnian Stage the first stage of the Late Triassic there were more than ceratitid genera; in the next stage, the Norian, there were fewer than , and finally in the Rhaetian Stage there were fewer than In the Late Triassic evolved bizarre heteromorphs with loosely coiled body chambers, such as Choristoceras, or with helically coiled whorls, such as Cochloceras. These aberrant forms were short-lived, however. A small group of smooth-shelled forms with more complex suture lines, the phylloceratids, also arose in the Early Triassic. They are regarded as the earliest true ammonites and gave rise to all post-Triassic ammonites, even though Triassic ammonoids as a whole almost became extinct at the end of the period. Other marine invertebrate fossils found in Triassic rocks, albeit much reduced in diversity compared with those of the Permian, include gastropods , bivalves , brachiopods , bryozoans , corals , foraminiferans , and echinoderms. These groups are either poorly represented or absent in Lower Triassic rocks but increase in importance later in the period. Most are bottom-dwellers benthos , but the bivalve genera Claraia, Posidonia, Daonella, Halobia, and Monotis, often used as Triassic index fossils , were planktonic and may have achieved widespread distribution by being attached to floating seaweed. Colonial stony corals became important reef-builders in the Middle and Late Triassic. For example, the Rhaetian Dachstein reefs from Austria were colonized by a diverse fauna of colonial corals and calcareous sponges , with subsidiary calcareous algae, echinoids, foraminiferans, and other colonial invertebrates. Many successful Paleozoic articulate brachiopod superfamilies those having valves characterized by teeth and sockets became extinct at the end of the Permian, which left only the spiriferaceans, rhynchonellaceans, terebratulaceans, terebratellaceans, thecideaceans, and some other less important groups to continue into the Mesozoic. The brachiopods, however, never again achieved the dominance they held among the benthos of the Paleozoic, and they may have suffered competitively from the adaptive radiation of the bivalves in the Mesozoic. Daonella of Triassic age. Courtesy of the trustees of the British Museum Natural History ; photograph, Imitor Fossil echinoderms are represented in the Triassic by crinoid columnals and the echinoid Miocidaris, a holdover from the Permian. The crinoids had begun to decline long before the end of the Permian, by which time they were almost entirely decimated, with both the flexible and camerate varieties dying out. The inadunates survived the crisis; they did not become extinct until the end of the Triassic and gave rise to the articulates , which still exist today. Vertebrates Fishes and marine reptiles Vertebrate animals appear to have been less affected by the Permian-Triassic crisis than were invertebrates. The fishes show some decline in diversity and abundance at the end of the Paleozoic, with acanthodians spiny sharks becoming extinct and elasmobranchs primitive sharks and rays much reduced in diversity. Actinopterygians ray-finned fishes , however, continued to flourish during the Triassic, gradually moving from freshwater to marine environments , which were already inhabited by subholostean ray-finned fishes genera intermediate between palaeoniscoids and holosteans. The shellfish-eating hybodont sharks, already diversified by the end of the Permian, continued into the Triassic. Fossils of marine reptiles such as the shell-crushing placodonts which superficially resembled turtles and the fish-eating nothosaurs occur in the Muschelkalk, a rock formation of Triassic marine sediments in central Germany. The nothosaurs, members of the sauropterygian order, did not

survive the Triassic, but they were ancestors of the large predatory plesiosaurs of the Jurassic. The largest inhabitants of Triassic seas were the early ichthyosaurs , which were distantly related to lepidosaurs the taxonomic group containing lizards and snakes, their direct ancestors, and their close relatives but bore a superficial resemblance to dolphins in profile and were streamlined for rapid swimming. These efficient hunters, which were equipped with powerful fins, paddle-like limbs, a long-toothed jaw, and large eyes, may have preyed upon some of the early squidlike cephalopods known as belemnites. There also is evidence that these unusual reptiles gave birth to live young. The production of live young among marine reptiles was not limited to the ichthyosaurs, however. One of the oldest known reptiles to give birth to live young was Dinocephalosaurus , an archosauromorphâ€”a member of a group that includes all of the forms more closely related to archosaurs dinosaurs, pterosaurs [flying reptiles], crocodiles, and birds than to lepidosaursâ€”that lived about million years ago.

FISHES AND INVERTEBRATES pdf

4: Examples of Vertebrate and Invertebrate Animals

The lack of essential vitamins and minerals in the diets of freshwater and saltwater fishes and invertebrates can lead to health problems, a common one in fish being head and lateral line erosion disease.

How are animals classified? What are vertebrate animals? The main characteristic of this group of animals is that they possess vertebrae. Commonly known as a spine, this is a highly specialized bone-type which joins together to compose a backbone. Its function is to protect and sustain the spinal cord and connect it to the nervous system. These animals are distinguished by their bilateral symmetry, and the fact that they have a skull to protect their brain. The bodies of vertebrate animals are divided into head, trunk and limbs, while some species also have a tail. Another important feature is that vertebrates have different sexes. There are approximately 62, animal species that belong to this group, so we have a wide range to choose our examples. One of the important ways to differentiate between vertebrates and invertebrates are their skeletons. Vertebrates will have some kind of endoskeleton. This means a skeleton which is on the inside of the body, either under the skin or further under tissue. This skeleton is not always made up of bone. Some fish and marine animals, for example, mainly have cartilage to support their frame. One fish, known as the hagfish, has some debate over whether they are a vertebrate. Although they have a cranium skull , they do not actually have vertebrae. Instead they have a notochord, similar to vertebrae in that it runs the length of their body, but which much more flexible and supple. This allows them to curl easily. However, there are vertebrates which also have part of their skeleton on the outside an exoskeleton [1]. These animals such as a turtle which have the bones inside their body, but also have a hard shell which is used for protection. Other reptiles have large scales on the outside of their skin which are used for protection. The vertebrae is very important in housing the central nervous system of vertebrates. This system sends signals up and down the vertebrae to relay messages about movement, pain or any physical response the body might need. If the vertebrae is damaged, then these signals may not be able to transmit, resulting in incapacitation. Grouping any animal, whether vertebrate or invertebrate, requires a very complicated taxonomic organization. The taxonomy grouping of the animal kingdom starts with all living organisms, subdividing into different parts from major groups into individual species. One stage in this subdivision is the phyla which can be loosely described as being grouped according to body structure. Whether or not an animal has a backbone is a very important aspect because it affects so many aspects of how they live. What are invertebrate animals? Invertebrates are characterized by their lack of vertebrae, i. This is not true, of course. They just exist in a different way and are adapted to their environment differently. Examples of invertebrates and their habitat include jellyfish which live in the sea, bees which fly in the air and earthworms which live underground. No invertebrate will have a spine, but they can have a skeleton, i. Many insects such as the grasshopper seen in the picture below have exoskeletons which they may even shed. This supports and protects their body. A common example of an invertebrate with an exoskeleton is a cockroach which is infamous to humans for being resilient. However, there are invertebrates which have an endoskeleton. An octopus has an endoskeleton, although it is very soft and not made from bone like many vertebrates. As there are so many more invertebrate species than vertebrates, their taxonomic groups are vast. There are different types of land animals such as insects and worms. However, these too are very broad groups and there are many different types of worms with various body structures. This is not to mention other fascinating parts of their body structure such as tentacles [3] and the slime like substance which constitutes most of their body. Whether the invertebrate lives in the ocean or the desert, there are various examples which we can provide below. Examples of vertebrate animals Vertebrate animals can be categorized into 5 main groups: Mammals, birds, fish, amphibians, and reptiles. The following are examples of vertebrate animals, some of them given by their generic names; when we say "deer", we mean that all the species of deer are vertebrates, for instance. Many of these animals we only know from fossils as they are currently extinct. We can give you a list of vertebrates which are well-known to give you an idea of what we mean.

FISHES AND INVERTEBRATES pdf

5: Division of Aquatic Resources | Freshwater Fish and Invertebrates

Invertebrates have no backbone, while vertebrates have a well-developed internal skeleton of cartilage and bone and a highly developed brain that is enclosed by a skull. A nerve cord is enclosed by vertebrae â€" individual bones that make up a vertebrate's spine.

Contact Fish and Invertebrates Fish and invertebrates are not normally considered to be nuisance organisms in ponds except for a select few species. Considering that fish and invertebrates are some of the most species rich of all of the groups of animals, there is no way that this page can cover the biology and control of all of these animals. It must be noted, however, that most fish and invertebrates are either beneficial or benign to stormwater ponds or are not adapted to survive well in these artificial aquatic environments. That being said, there are a few fish and invertebrates that may become nuisances if released into a stormwater pond. Also, exotic animals pose a significant threat to native species and ecosystems. Because stormwater ponds discharge to rivers, wetlands, and other natural aquatic systems, exotic animals that are introduced to stormwater ponds are likely to spread and colonize other natural systems. What fish are nuisances in stormwater ponds? The most problematic fish in stormwater ponds is the Common Carp or Israeli Carp. The common carp Cyprinus carpio is sometimes mistakenly stocked in ponds to control aquatic weeds or as an ornamental fish. Unlike the sterile grass carp, these fish can reproduce quickly in small ponds and affect water quality and the health of other fishes. The most significant problem common carp cause is muddy water. They have a tendency to root in the bottom and stir bottom sediments as they bed and feed. This can be a problem for stormwater ponds whose purpose it is to trap sediments coming from the development. Muddy water may affect the health of other fish in the pond and may result in water quality impairments downstream. It is recommended that common carp be completely removed from stormwater ponds. Other introduced fish may become problems as well. No aquarium animals should ever be released into stormwater ponds! Oscars, pacus, suckers, goldfish, koi, golden shiners, and many other fish have the potential to cause significant problems in ponds and receiving waters downstream. Do not allow your stormwater pond to be their point of entry! Stormwater ponds should be stocked with fish to help maintain biological services and the ecological balance of the pond. How are nuisance fish controlled? The only absolute control for common carp and other nuisance fish in stormwater ponds is to drain the pond and harvest the fish. Though this may seem drastic and aggressive, this will protect the ecological integrity of the pond in the long run. Other fishes bream, bass, triploid grass carp can be restocked and will rebound rapidly once the nuisance fish are removed. What invertebrates cause problems in stormwater ponds? Until recently there has been little concern over invasive invertebrates in stormwater ponds, that is until the Island Apple Snail was released into a stormwater pond near Myrtle Beach, SC where it quickly spread to neighboring ponds and into the Intracoastal Waterway. Its introduction has drawn attention to the threat of other freshwater invertebrates, which may be moved via the aquarium trade and mistakenly released into a pond by a well-meaning but misguided resident. Other freshwater invertebrates such as zebra mussels are not established in South Carolina yet, but have officials on the lookout. How are invasive invertebrates controlled in stormwater ponds? They may be able to assist you with control.

FISHES AND INVERTEBRATES pdf

6: Fish & Invertebrates | Aquarium of Niagara

Fish and Invertebrates volunteers assist with the maintenance of exhibits and the daily care of the collection's native freshwater and marine fish, invertebrates, and plants. For more information please visit out Volunteer and Internship pages.

Reproductive systems[edit] Nearly all vertebrates undergo sexual reproduction. They produce haploid gametes by meiosis. The smaller, motile gametes are spermatozoa and the larger, non-motile gametes are ova. These fuse by the process of fertilisation to form diploid zygotes , which develop into new individuals. Inbreeding[edit] During sexual reproduction, mating with a close relative inbreeding often leads to inbreeding depression. Inbreeding depression is considered to be largely due to expression of deleterious recessive mutations. In several species of fish, inbreeding was found to decrease reproductive success. Numerous inbreeding avoidance mechanisms operating prior to mating have been described. Toads and many other amphibians display breeding site fidelity. Individuals that return to natal ponds to breed will likely encounter siblings as potential mates. Although incest is possible, Bufo americanus siblings rarely mate. Advertisement vocalizations by males appear to serve as cues by which females recognize their kin. In guppies, a post-copulatory mechanism of inbreeding avoidance occurs based on competition between sperm of rival males for achieving fertilization. Active selection of sperm by females appears to occur in a manner that enhances female fitness. Outcrossing[edit] Mating with unrelated or distantly related members of the same species is generally thought to provide the advantage of masking deleterious recessive mutations in progeny [52] and see Heterosis. Vertebrates have evolved numerous diverse mechanisms for avoiding close inbreeding and promoting outcrossing [53] and see Inbreeding avoidance. Outcrossing as a way of avoiding inbreeding depression, has been especially well studied in birds. For instance, inbreeding depression occurs in the great tit when the offspring are produced as a result of a mating between close relatives. In natural populations of the great tit Parus major , inbreeding is avoided by dispersal of individuals from their birthplace, which reduces the chance of mating with a close relative. However, there are ecological and demographic constraints on extra pair matings. The first is through dispersal, and the second is by avoiding familiar group members as mates. Within their group, individuals only acquire breeding positions when the opposite-sex breeder is unrelated. Cooperative breeding in birds typically occurs when offspring, usually males, delay dispersal from their natal group in order to remain with the family to help rear younger kin. Parthenogenesis[edit] Parthenogenesis is a natural form of reproduction in which growth and development of embryos occur without fertilization. Reproduction in squamate reptiles is ordinarily sexual, with males having a ZZ pair of sex determining chromosomes, and females a ZW pair. However, various species, including the Colombian Rainbow boa Epicrates maurus , Agkistrodon contortrix copperhead snake and Agkistrodon piscivorus cotton mouth snake can also reproduce by facultative parthenogenesis -that is, they are capable of switching from a sexual mode of reproduction to an asexual mode- resulting in production of WW female progeny. Mole salamanders are an ancient 2. As a result, the mature eggs produced subsequent to the two meiotic divisions have the same ploidy as the somatic cells of the female salamander. Synapsis and recombination during meiotic prophase I in these unisexual females is thought to ordinarily occur between identical sister chromosomes and occasionally between homologous chromosomes. Thus little, if any, genetic variation is produced. Recombination between homeologous chromosomes occurs only rarely, if at all. However, meiosis may have been maintained during evolution by the efficient recombinational repair of DNA damages that meiosis provides, an advantage that could be realized at each generation. The capacity for selfing in these fishes has apparently persisted for at least several hundred thousand years.

FISHES AND INVERTEBRATES pdf

7: Fishes and Invertebrates | Aquascapers

Fish and invertebrates are not normally considered to be nuisance organisms in ponds except for a select few species. Considering that fish and invertebrates are some of the most species rich of all of the groups of animals, there is no way that this page can cover the biology and control of all of.

The Water Fleas Daphnia And Their Relatives These tiny crustaceans belong to the class Brachiopoda, and are commonly found in ponds, streams and small lakes during the summer months. They swim with very jerky movements similar to that of copepods discussed below , which often stimulates the feeding response of even the most picky of plankton feeding fishes. They can be easily cultured in a small wading pool in the backyard, or collected by net from a local pond or stream. They are also usually devoured by coral reef invertebrates such as cleaner shrimps, gorgonians, soft and hard corals, brittle stars and sea cucumbers as well, making them a highly desirable food item. Although marine copepods are not easily available as a commercial food product, freshwater copepods can be harvested from local ponds or lakes, and there are a couple of commercial sources for either frozen or freeze-dried copepods as well. Fortunately, even if the fish do not naturally feed on copepods, many plankton feeders even picky feeders like pipefishand Anthias in the sea readily accept freshwater copepods as a suitable alternative. But remember, that I said there were two important things to consider for any food: Well, it turns out that copepods are one of the most nutritious plankton foods in the ocean, and a variety of studies have shown that feeding them can significantly decrease the rate of disease and death among juvenile fishes raised in captivity. For example, a recent presentation by Todd Gardner at the International Marine Aquarium Conference IMAC in Chicago showed that feeding baby seahorses on a diet of copepods for a few days before switching them onto enriched babybrine shrimp led to dramatic increases in the rate of survival compared to treatments in which the juvenile seahorses were fed only on enriched brine shrimp. Results such as Todd reported Gardner are becoming more common, both in the hobby and in aquaculture efforts. In fact, copepods are so highly sought-after that many commercial aquaculture facilities are actively pursuing techniques to raise copepods in sufficient numbers to use as a reliable food supply for juvenile fishes. There are also a number of popular fishes such as the Mandarin Goby or Scooter Blenny that actually specialize on these little crustaceans. Unfortunately, there are currently no commercial sources of live copepods for either the aquaculture or aquarium industries, but there are a couple of suppliers of freshwater copepods in frozen or freeze-dried forms. In addition, there is always the tried-and-true method of going out to harvest your own, and whether fresh- or saltwater, adding copepods to thefeeding regimen of your marine aquarium is sure to be a benefit to many of your pets. Although not quite as simple to culture in your backyard, they are often locally abundant and easily collected with a dip net throughout most of their range. They swim more quickly, and in a much smoother manner than either the water fleas or copepods, and are therefore not quite as useful as the first two groups that I just discussed. Because they are freshwater, they do not survive for long in a marine environment, and because they are relatively quick swimmers that will head directly for the cover of a rock, coral or macroalga when introduced to the tank, there is a reasonable chance that they will find cover and hide until they die from the salt stress of being tossed into a marine tank. This is both because of the fact that the exact nutritional profile of mosquito larvae is unknown, and also because there is an increased chance of overfeeding. Any larvae added to the tank that are not immediately eaten will die due to the osmotic shock of being tossed into saltwater, and then quickly begin to rot in your tank. As with any uneaten food, excess that begins to rot leads to a rapid decrease in water quality and usually leads to health issues as well. The advantage of mosquito larvae is that, unlike gammarid amphipods, they float freely around the aquarium when not actively swimming, and should bob to the surface quickly if they were not immediately eaten. Photo by Gary Lange Clam. Photo by Gary Lange Squid. Photo by Gary Lange Shrimp. Photo by Gary Lange 8 Ghost Shrimp And Crayfish As I mentioned earlier in the section about goldfish, I would suggest these freshwater and brackish crustaceans as a better choice for feeding live foods to a marine predator. Ghost shrimp are a euryhaline able to acclimate to water of various salinities ranging from fresh to full-strength saltwater shrimp that is frequently imported for sale as feeder in many petshops. These tiny clear shrimps are

one of my favorite choices for feeding to large marine predatory fishes such as grouper, snapper and lionfishes that are picky about eating. Crayfish are not nearly so tolerant of saltwater as are ghost shrimp, but if you live in an area that has an abundance of crayfish and can easily collect your own, this may be a cheaper and easier alternative for you than going to the local petshop and buying ghost shrimp. In addition, the larger size of the crayfish makes it possible to feed larger predators such as adult grouper or octopuses. The primary advantage to using these prey is that the addition of live food usually stimulates even the most fussy of eaters into gorging themselves. As outlined above in the feeder goldfish section, ghost shrimp or small crayfish allow you to feed your animals on a live food other than goldfish while slowly training them onto a healthier alternative. In addition, with both ghost shrimp and crayfish, the nutritional value can be enhanced by feeding an enriched flake or frozen food that includes a reasonable amount of HUFA. I have spoken to several people who were having little success with getting fertilized eggs from some reef tank fish or invertebrate that they were trying to breed, but after regularly incorporating fresh whole mussels or clams into the diet, their success rate suddenly increased dramatically. Fresh whole seafood whether squid, shrimp, clams, mussels, snails or whatever else is available is really THE food on which your animals feed naturally. So, including some fresh or live seafood into the diet of your aquarium is almost always a good idea from time-to-time. However, these same ingredients are usually the staple of most commercially available frozen foods on the market. In fact, that is probably the best advice that I can offer you: So vary your feedings. Many coral reef fishes specialize on algae of various sorts this is called herbivory , and without sufficient greenery in their diet, they are subject to a variety of malnutrition maladies. This may be because of an excess of animal fats in their diet, or it may be because many trace nutrients and vitamins for these animals are found in highest concentration, or almost exclusively in algae. Without the carefully controlled experiments necessary to determine exact nutritional requirements, the best we can do is to mimic the variety found in the natural diet to as great a degree as possible. There are a number of great books out there nowthat detail the natural history of coral reef fishes, aquarium corals and other invertebrates, and I encourage anyone who is really interested in the hobby to track down some of these texts. However, the nutritional value of the food certainly is a concern. Many, if not most petshops recommend using leafy lettuce, broccoli, or some other green vegetable to supplement the diet of grazing marine fishes such as tangs, rabbitfishes, and surgeons. The simple fact is that we know nothing about how such foods affect the digestive system of coral reef fishes, and to date no controlled studies have been published that compare growth, health or survival on diets of terrestrial versus marine greens. Traditionally, they were the onlyeasily available source of plant matter to include in the diet of our herbivorous pets, but that is no longer the case. Unlike the terrestrial greens which provide unknown nutritional value, we can be pretty confident that these natural seaweeds are providing some nutritional benefit to our herbivorous pets. However, having said that, drying seaweed also has a variety of effects on the structure and nutritional value as a food. For example, researchers at the Bamfield Marine Station found that growth and survival rates of juvenile urchins fed on air-dried kelp were significantly lower than siblings raised on fresh kelp De Jong-Westman et al. I realize that few people have ready access to fresh kelp, and for most of us, the dried red, green and brown algae available from the petshop is the best that we canoffer. However, it is a concern that dried kelp may not be equally nutritious as fresh kelp at least so far as we have data now , and so when possible, I usually recommend that people supplement the diet of their herbivores with some fresh preferably live, but frozen will work macroalgae as well. Some people have luxurious growth of various types of macroalgae in their refugium or algal scrubbers, and are usually happy to give some away from time-to-time. However, there is more to providing your surgeonfish with suitable food than simply dropping it into the tank. Researchers have shown that different species of algae-grazing fishes can have very different dietary preferences and feeding habits in the wild. For example, Acanthurus chirurgus actively seeks out sand and brown and green algae, and A. When dissected, the researchers found that the stomachs of these fish matched their diets: You may wonder why I am explaining these details, but there is a very important reason to do so. Tangs, particularly when young, must feed almost continuously to gain sufficient nutrition, because they are relatively inefficient at digesting their algal food reviewed by Tilghman et al. The typical habit of marine aquarists to feed their fishes sparsely every day or two is highly counter-productive for herbivorous reef species. These fishes are adapted

to nipping at a variety of algae on a continuous basis as they cruise the reef all day, and have a nutritional requirement for frequent and varied feeding Tilghman et al. Anyone who has been diving on a natural reef will immediately be struck by how fat these fish appear in nature relative to in the aquarium. These fish are the cows of the reef, and should appear plumply stuffed at all times when they are healthy: Furthermore, the types of food these fish require, and the wayin which they break up their food so that they can digest it varies among species even within the closely-related group used as an example above. Despite what your local petshop tries to tell you, there are no simple generalizations that can be made about the nutritional requirements of all the surgeons, rabbitfishes and tangsâ€¦ Lastly, to come back to the issue of feeding these fish veggies, species with a long thin-walled intestine are well-suited to absorbing nutrition from crushed algal cells, but are poor at handling cellulose which is a large component of terrestrial greens such as broccoli and lettuce. Species with a thick, muscular gut, on the other hand, may do a better job of handling high cellulose foods such as the terrestrial greens provided that they are given the opportunity to properly grind them up. Let me explain what I mean by properly grinding up food. Herbivorous marine fishes are not known to produce cellulose or any other enzyme to digest the cell wall of plants or algae Lobel However, they can digest and absorb the materials contained inside plant cells, if they are able to break open the cells and release the contents. Species with thin-walled stomachs usually rely on very thorough chewing hence the cow comparison , together with strong acidic secretions of thestomach, to release the contents of cells for subsequent digestion Lobel However, species with thick-walled, gizzard-like stomachs often ingest sand particles of a specific size for the purpose of grinding plant and algae fragments in order to break cell walls to allow the fish to absorb the cellular contents of their food Lobel These types of fish rely on the action of their stomach, combined with the grinding activity of the fine sands that they swallow, to break apart the algae they ingest and gain nutrition from it. Thus, the first type of fish thin stomachs would probably not gain much nutritional benefit from high cellulose foods such as terrestrial greens, while the second type of fish thick stomachs may be able to grind these high cellulose foods and gain some nutritional benefit from them. This difference among fishes may explain why some species of tang have traditionally fared well in the aquarium while others with apparently similar needs haveconsistently withered. However, even if your surgeonfish, rabbitfish or tang had a thick stomach, they will not be gaining much nutritional benefit from any plant matter in their diet unless also provided with fine calcareous reef sand to use as a grinder in their muscular gut Tilghman et al. This may one of the reasons that some species appear to be showing increased success since the widespread use of sandbeds has come into greater favor. So, what I am basically trying to tell you here is that it not only matters that you provide the right food for your fish, but you provide it on an almost constant basis, and for many species of herbivorous marine fishes, that you also provide them with some fine reef sand so that they can break up the food they ingest and gain some nutritional benefit from that food. What I can do is tell you the generalization that young fishes need to feed almost continuously throughout the day, whereas older fishes can survive on more periodic feedings. Also, the fish themselves are excellent at choosing the foods that they require, and so the more varied the diet, the morelikely your fish are to be long-lived and healthy. Regardless of these matters, if you keep herbivorous reef fishes in your aquarium, you should make a serious attempt to provide them with a consistent source of algal food for grazing throughout the day if you want to maintain a healthy animal. Although it was very difficult at one time to get anything other than flake food for our pets, there are now a wide variety of alternatives on the market, and by offering a diverse and varied diet to the inhabitants of your reef aquarium, you should increase the health and vigor of your animals. Together with a suitable environment in terms of the tank conditions and maintenance , a well-rounded and proper diet should ensure many years of enjoyment from your aquarium. Effects of dietary protein level and other additives on egg quality, larval morphometrics, and larval survival in the green sea urchin, Strongylocentrotus droebachiensis. Canadian Journal of Zoology Journal of the World Aquaculture Society Journal of Shellfish Research Journal of Fish Biology Relation to dietary essential fatty acids. Aquarium Sciences and Conservation 3:

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