Causes of diversity in organisms

In order to discuss why living organisms are so diverse it is firstly important to discuss what diversity actually is. By dictionary definition biodiversity, the diversity of living organisms, is “ the variety of plant and animal life in the world or a particular habitat.”(Compact Oxford English Dictionary, 2003 revised edition). However in 1992 the definition was clarified for scientific purposes by the United Nations Earth Summit in Rio de Janeiro. It defined biodiversity as “ the variability among living organisms from all sources, including ‘ inter alia’, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part: this includes diversity within species, diversity between species and of ecosystems.”(www. urbanecology. org. au/wikipedia) From this definition we can split biodiversity into three separate groups; intra-species and inter-species diversity as well as diversity between ecosystems.

Intra-species diversity can be due to two things; an acquired adaptation or a genetic adaptation. Organisms that have adapted to their environment are efficient in maintaining the fundamentals in the continuation of the species e. g. the ability to obtain water, food and nutrients. Other examples are the ability of the organism to reproduce, or cope with varying physical conditions such as heat and light intensity and respond to any of these changes in their environments.

Acquired adaptations are those in which the species changes in order to adapt to a change in the environment without any change in genetics e. g. a mutation. An example is the long neck in a giraffe. It is agreed that giraffes have a long neck because long necked giraffes have coped with their environment better then short necked giraffes. They have mated more

successfully and now all giraffes have long necks due to the continual mating of long necks and without a mutation occurring.

Genetic adaptations are much more complex. They occur from a mutation in the DNA which has allowed one member of the species to be more successful than the rest. This advantage has allowed them to survive and mate, passing on the trait to the next generation, which will also survive while the others die out. Since one in every ten million genes mutate there are many different types of mutations that can occur. A substitution is where a single base changes from one form to another e. g. from AGG to AGC. An insertion is when an extra base is added into the sequence meaning a change in the codon triplets for the rest of the chain. A deletion is when a section of DNA is lost completely again changing the codon triplets. The change in the codon triplets which results in a complete change in the proteins produced is termed a Frameshift.

Most mutations would lead to the death any offspring the organism may produce, as the mutation will inhibit the production of vital proteins. Some mutations however are beneficial to the organism, allowing it to gain an advantage over others and survive while the others die out. An example of this would be E. Coli. adaptation to high and low temperatures. E. Coli. was cultured for 2000 generations at 37C, the internal body temperature of Humans, where E. Coli. is most active. Three E. Coli. were then taken from this sample and one cultured at 32C, the second at 37C and the third at 42C. The new cultures where then compared to the older one by forcing them to compete with one another. It was found that the sample cultured at 32C was 10% fitter than the original(it out competed it by 10%) and that the culture

grown at 42C was 20 % fitter then the original. This experiment showed that new, beneficial mutations are capable of adapting to new environments in as little as 2000 generations.(Bennet, A. F., Lenski, R. E., &Mittler, J. E.(1992). Evolutionary adaptation to temperature I. Fitness responses of Escherichia coli to changes in its thermal environment. Evolution, 46: 16-30.)

These mutations can occur in many ways. Recombination is the formation of a new allele combination in a gamete, and new allele combinations lead to a mutation. It results from the swapping of genes at the chiasmata. This is where the chromatids are able to swap over, however it is a very delicate procedure as not a single difference in nucleotides can occur or frameshifting would occur. Independent assortment is the process of randomly pairing chromosomes to produce the widest variety of gametes possible during fertilisation. This increases the likelihood of an unusual pairing occurring which may turn out to be beneficial to the species. This may combine with chromosomal swaps to massively increase variation in species.

Outbreeding is when the species breeds with similar species from a different habit, to produce an offspring with the characteristics of both parents. The species from the new habitat may be resistant to diseases the original can not fight, or the old species may be able to survive conditions the new can not. When these mate, both of the new positive traits can be passed on, creating a stronger species than before, that can inhabit new environments. Gene flow is the term for the transfer of genes from one population to another.

Once all these mutations have occurred it becomes a case of survival of the fittest. If a disease comes along that kills most of the population, but not those that have mutated, then the mutated individuals will breed, creating a stronger version of the species than before. The weakest die and the strongest survive, even if this means 99% of the population dies to leave the few that have mutated. Over time the population will reach its former size, with every individual resistant to the disease. This decreases the gene pool but allows the species to survive and create a new gene pool which will grow.

From this example it is clear that the environment in which the organisms live controls the diversity. For example, if land forms and splits up a species into two different locations, then the two will evolve separately and form different characteristics. An example of this is Darwin’s Finches. These are 14 different, but closely related, species of finches. They are located on the Galapagos Islands and were discovered by Charles Darwin on his voyages. The Galapagos islands are very new islands, formed only 5 million years ago by volcanic action. A species of finch has inhabited each island, evolving from a single ancestor which would have landed on the original volcanic protrusion from the sea. Darwin noticed that each species of finch had evolved separately from the others, developing distinct features to cope with the different environments e. g. beak shape or length, depending on food available on the island.(Galapagosonline. com)