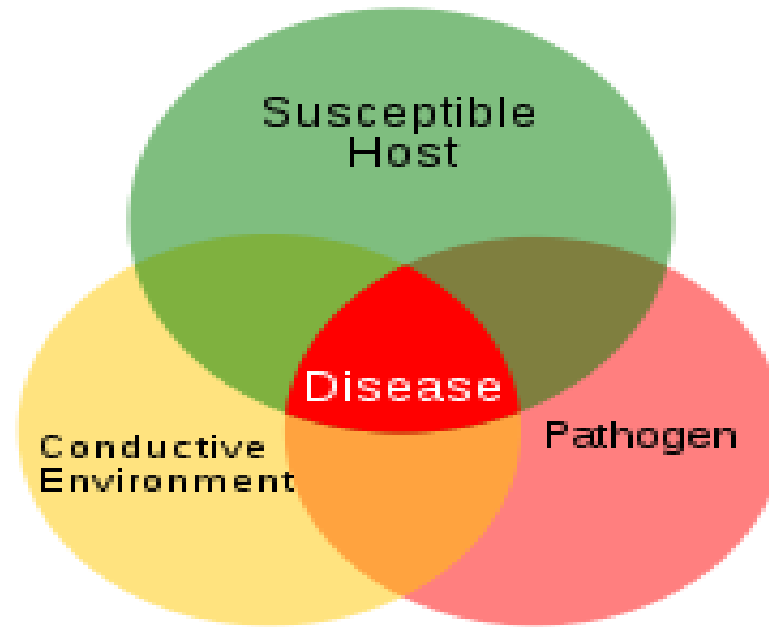


Host, pathogen and environment interaction

- Infectious diseases of fishes occur when susceptible fishes are exposed to virulent pathogens under certain environmental stress conditions.
- Disease is the end result of an interaction between a noxious stimulus and a biological system and to understand disease is to understand all aspects of the biology of the species.
- To know the role of environmental stress on outbreaks of infectious diseases of fishes, particularly those of bacterial etiology, one has to consider the relationship between the 'noxious stimulus' and outbreaks of disease.



Snieszko's model

- It is well known, from epidemiology, that an infectious agent causes a disease of the host if environmental conditions are right.
- The influence of each subset is variable-disease breaks out only if there is a sufficient relationship between them.

- The chemical and physical characteristics of water are variable and affected by natural factors and the noxious effects of human activities, called pollution.
- The inland aquatic environment and coastal areas are more affected than the open seas. In consequence, fishes in these areas are exposed to frequent stresses.
- If the occurrence of stress coincides with the presence of pathogenic microorganisms it is logical to assume that outbreaks of diseases are more likely to take place.
- Most of the present evidence is based on the coincidence of stress with outbreaks of infectious diseases.
- It is generally accepted that stress is a very important factor in outbreaks of infectious diseases of fishes

What is Disease?

- Disease is a process that is characterized by “any impairment that interferes with or modifies the performance of normal functions, including responses to environmental factors such as toxicants and climate, nutrition, infectious agents; inherent or congenital defects, or any combination of these factors”.
- This differs somewhat from more classical definitions as found in medical dictionaries but illustrates better the range of factors that may cause disease.
- Clearly numerous factors are causes of disease, but how all of them interact is a complex situation for which we have yet to develop a full appreciation.
- The causes of diseases can be grouped into those associated with environmental, nutritional, and genetic factors of the host or infectious agents (e.g., microbial pathogens).

Characteristics of the Pathogen, Host, and Environment

The Pathogen: Bacteria, virus, fungi, parasite etc.

- Many characteristics of pathogens are directly relevant to the outcome of their interaction with the host and environment.
- These include whether the pathogen is always associated with infection of the host (obligate) or whether it has the ability to survive in the absence of the host (facultative).
- The virulence or the ability of pathogens to cause disease depends on the strain, biotype, serotype, or genotype of the agent.
- Changes of simply a single amino acid in key proteins may greatly affect the virulence of the pathogen.
- The dose or the numbers of pathogens, how they are delivered to the host (route of entry), and duration of the exposure directly influence the severity of subsequent infection.

- **The Host:** finfish, shellfish, Zooplanktons etc.
- Several parameters associated with the host are directly related to the occurrence of disease upon interaction with the appropriate pathogen and environmental conditions.
- These include factors that are constantly present, or constitutive, such as the host species genotype, age, size, developmental stage, nutritional and reproductive statuses, and behavior and innate defenses related to immune competence.
- Additional factors that affect host susceptibility to disease include adaptive factors, which result from previous interactions with the pathogen or environment.
- Among the most important interactions is the acquisition of immunity after exposure to the pathogen.

- **The Environment**

- The environment is perhaps the least defined element of the host, pathogen, and environment paradigm.
- Certain components of the environment are evident; these chemical and physical characteristics can be measured, either continuously or more often at specific time points, often after a disease problem has arisen.
- The variables measured include, but are not limited to, dissolved gases, pH, temperature, flows, turbidity, and contaminants.
- The effects of biological processes, including those due to human intervention, must be considered because they will affect diversity and density of the biota, which may encourage certain hosts, pathogens, and other symbionts.
- Additional variables related to the geomorphology, limnology, and hydrology of the aquatic environment that are critical to fish health need to be evaluated as they change with time and with human intervention.

- Difficulties with changing our expectations and demands of our aquatic resources, however, often bring human activities in direct conflict with the health of our fish populations.
- Significant alterations of habitat due to power generation, flood control, irrigation, logging, grazing, mining, et cetera, have affected wild fish populations, often in a negative manner.
- Balancing the costs and benefits of these activities and human dependence on them with the health of our fish populations is the supreme challenge for fisheries managers.