- **PARASITIC DISEASES OF FISH**
  - Protozoan
  - Arthropod
  - Helminths
  - Trematoda
  - Cestoda
  - Nematode
  - Hirudinea
  - Acanthocephala

Protozoan Parasites

cont.

APISOMA

- ***Apisoma*** are ciliated Protozoans
- Their bodies can be described as inverted pear shaped, bowling pin shaped or vase shaped.
- Parasites have the ability to contract. Sometimes they can pull inward and be formed a more rounded shape. Sometimes they go out and get a typical bowling pin form.
- The ciliums are found in the uppermost part, sometimes in the vicinity of the ring.
- They are usually fed with small microorganisms.
- There are sometimes thin lines on the cuticles.
- The proliferation is divided longitudinally and transversely.
- They are usually 50-100 μm in size, with varying sizes.
- They are either transparent or slightly yellowish in color.
- They attach to the fish skin or gills with the help of a foot (disc).

- In fish, they parasitize in the gills, on the skin, and on the fins.
- They are sessile and attach to the skin, gills and fins of fish living in infested environment.
- They are found commonly in ponds only and affect or marine fish rarely.
- **Symptoms** include decreased appetite, flashing, hyperplasia of infested gill tissues, compromised osmoregulation and respiration.
- It is mostly located on the upper part of the gill with the lower part of the fins.
- In infected fishes, a bluish or greyish layer of light and blooms on the body and fins.
- Poor water quality and high fish stocking densitites are factors when it comes to the parasite's impact on the population.
- The disease is often suddenly formed.
- The **diagnosis** is made by examining gills or skin scarring and seeing agents.
- **Treatment,** particularly of heavily infestated ponds is recommended using one of the following: formalin, copper sulfate, potassium permanganate, or a salt bath.

EPISTYLIS

- It's very similar to *Apisoma*.
- The biggest difference is the branched structure.
- It is live in the gills and in the skin of fish.

TRICHOPHORA (SUCTORIA)

- They are usually 30-40 µm in size, but they can also be larger.
- The body form resembles a small pincushion.
- A variety of objects and fish hold onto the gills with a non-contractile handle or gripping disc.
- It's actually a *Ciliata*. However, ciliums disappeared in adult forms.
- Ciliums are replaced by sensory organs called "tentacles".
- The number and size of tentacles may vary.
- Cytostomy is absent. Tentacles help to feed.
- In some species, tentacles have a duty to hold.
- The cytoplasm contains the macronucleus, micronucleus, nutrient vacuoles and contractile vacuole.
- Floating creatures can be parasitized in the gills and multiply in the gill tissues.
- However, they usually do not cause severe infections.
- In **treatment;** ectoparasite baths are used.
- **Diagnosis;** is easily diagnosed by the presence of the factor in the gill excavations due to its typical morphological structure.

COSTIA

- 15-20 µm in size and one of *flagellata*.
- Body form varies from oval to kidney shape. Also oval, while free, looks like a vase after grip.
- They are colorless transparent protozoons.
- The most common species is ***Costia necatrix.***
- The nucleus is located in the middle of the body.
- There are two whips. It is seen as four whales near the division.
- They move very quickly. They are immediately removed from the microscope to Native preparations.
- For this reason, the necessary preparations to be examined should be keep waiting. Slower motion is easier to investigate.
- They also form a cyst as they multiply by division.
- In fish, it is settle to skin and gills.
- Despite having small protozoons, it is the most destructive.
- The parasite, located in the epithelial cells, breaks down the cells.
- Although the parasites are small, the electro-microscopic studies made show that their localizations are not superficial.
- **Diagnosis;** it happens with the appearance of the agents on the examination of the scrape.
- However, the formation of a bluish-grayish cloudiness in the fish (stratification) is characteristic for the disease.

HEXAMITA (OCTOMITUS)

- one of *Flagellata*.
- The most common types are ***Hexamita salmonis*** and ***H. intestinalis***.
- They are small protozoans (Their size is 7-10 µm).
- Body form is elongated and oval or pear shaped.
- 2 nuclei and 2 parabasal bodies.
- There are 4 pairs (8) of flagellum, 3 pairs on the front and 1 pair on the back.
- It moves very quickly thanks to the whips.
- They escape from the microscope field as they move rapidly during excavations or content controls taken from the intestines.
- They are easier to see because they move slower in the preparations that are being held.
- It is a protozoan that parasitises in many freshwater fish, especially in the intestines of trout. (Endoparasite)
- It is mostly located in the end section of the intestines.

- ✓ It is important in aquaculture.
- ✓ It has been reported that mucous membranes are largely destroyed, leading to enteritis in the intestines of young trout and salmon during severe infections.
- ✓ For this reason, the intestinal contents become bloody and mucous
- ✓ It is also localized at the liver and bile occlusion at advanced stages (often seen in aquarium fish).
- ✓ The causative cyst brings it to the field. Proliferation occurs through simple division.
- ✓ The cause of the infection is to take the agents together with the feed and water.
- ✓ Because the factors that are taken with the external fish of infected fishes maintain their long life in water.
- ✓ In infected fish, sudden swimming movements, excess water in the bottom of the water, failure, retraction and darkening of the color are observed.
- ○ In **necropsy**; agents are found in the bowel, liver and gall bladder.
- ▪ The diagnosis also requires control of the scraping contents taken from them.
- ❖ The **treatment** utilizes the Furalozide-Furaltadon-Nitrofuran compound and Metronidazole, which we have mentioned in the treatment of endoparasites.

Giardia sp.

- It's in the *flagellata* group.
- There are a total of 8 whipers, three in the front and one in the back.
- It has a pear-like body structure.
- Their sizes are 20-30 µm.
- They are found in the intestines. However, it is often recorded as commensal.
- There are no pathogens, so they do not cause economic loss.

TRYPANASOMA

- Small colorless *flagellata*.
- Its length varies between 10-15 µm and 20-30 µm.
- Body forms are the same as ***Trypanasoma*** in mammals.
- The body is in the form of an elongated leaf or shuttle (the two ends are tapered).
- Usually there are single nuclei in the middle.
- The wavy membrane emerging from the kinetoplast extends across the body, ending in the front. Again, the whip from the kinetoplast follows the wavy outer edge of the membrane and exits the front of the body. The body is found free on the tip.
- Their movement is zig zag (right, left, and forward).
- They live in blood.
- "Sleeping sickness" is the cause but the pathogenicity is not fully known.
- Various leeches play a role from fish to other fish (*Piscicola* etc.).
- There are periods of development in the leeches (diverticulae).
- Then they come to the proboscisine (hose). During leech blood sucking, the factors go into fish blood.
- There are many species of ***Trypanasoma*** in fish. These are two main groups:
- Those with small kinetoplasts (eg T. tincae)
- Those with a large kinetoplasty (eg T. remaki)

TRYPANOPLASMA (CRYPTOBIA)

- In these, the body form is extended. The rear end is sharp.
- The body is slightly wider than the *Trypanasoma*.
- There are 2 flagellum. Anterior flagellum is free. The posterior flegellum is partially attached to the body.
- These movements are different from *Trypanasoma* (Important to diagnosis).
- They usually act randomly, in a churning manner. There is no progress towards a certain direction.
- The leeches play a role from fish to other fish.
- There are periods of development in the stomach (diverticula) in leeches. Then they come to the horn and go to the fish during blood sucking.
- ***Trypanoplasms*** also live like *Trypanasoma*.

TRYPANASOMA TRYPANOPLASMA

- ***Trypanoplasma*** is more pathogen than *Trypanasoma* (It is reported that ***Trypanoplasma*** causes sleeping disorder, usually in fish).
- Severe anemia is observed in infected fish.
- The gills are paled.
- The blood has become more juicy/watery.
- With regard to the anemia, respiration is also faster than normal (this can be observed from the movement of the gills operculums).
- The kidneys can not do their job properly either.
- Activity in fish is reduced.
- Sometimes when you swim your abdominal region is turned upwards.
- There is weight loss. The eyes usually collapse inward or on the contrary devoleped the exophthalmos.
- Commonly disease is seen more carp and velvet fish and trout.
- If the environmental conditions are not good and bad nutrition is the case, the disease is more severe.
- When water temperature falls below 10°C, deaths increase because antibody formation decreases.
- *Trypanoplasma* has many types. They live in the stomach and the gills. Criptobia branchialis (*T. branchialis*) is frequently found in Cyprinidae preparations prepared from gills. These lead to degeneration of the epithelium in the gill filaments. They provide the basis for the formation of thrombosis.
- In diagnosis, blood is also seen when the agents are seen in native or dyed (giemsa) preparations.
- In the treatment, prophylaxis is more important.
- "Mazotene" can be used against leeches which transporting the agent.
- Pool disinfection is also important.

COCCIDIA (EIMERIA)

- Coccidiosis is also seen in fish.
- They can sattle to the intestine, liver, kidney, air sac and other organs.
- They are found intracelullary.
- Their development is similar to mammal's *Eimeria* species.
- Infection occurs by oral administration of sporulated oocysts (each of which has 4 sporocysts and 2 sporozoites).
- Oocysts are often sporulated in the small intestines of *Eimeria* species in fish.

- There are three important species in the fish that bring disease to the intestines.

- *Eimeria subepithelialis* (Cyprinidae)
- *Eimeria carpelli* (Cyprinidae)
- *Eimeria truttae* (Salmonidae)

- **-Development of *Eimeria carpelli***

- 1 * Schizogoni
- 2 * Macrogamet formation
- 3 * Microchemocytocyte micrograms formation
- 4 * Fertilization
- 5 * Oocyst shaping and spors
- 6 * Oocyst
- s Sports
- sp Sporozoites
- etc. Vestigal body

- ***Eimeria subepithelialis*** are more common in carp in spring and autumn.
- Ulcers in the bowel/gut are up to 1 mm in diameter.
- Fish have cachexia. The eyes have escaped the eyehol. Activity has decreased.
- The anus is red and protruding outward.

- ***Eimeria subepithelialis*** and other species cause intestinal inflammation in fish.
- The stool is yellow. The consistency is gelatinous (mucous) or watery.

- **At necropsy;** when the intestines are opened; normally the fish bowel appears black dotted but has become hemorrhagic.
- Acanthopods are found in yellowish-white schizonts or gametocytes (called yellow bodies) in the middle and end portions of the intestine. Observation of these developmental stages is of diagnostic importance in cases where oocysts are not encountered in faeces.

- **Diagnosis;** occurs with the appearance of oocytes in the stool.
- Developmental stages are seen in intestine scrape at **necropsy**.
- Common coccidiostatics (mainly sulfonamide preparations) are used in the **treatment**.
- Pool disinfection (Calcium cyanamide or quicklime) may be required.

MYXOSPORIDIA

- Parasites are usually seen during spors stage/phase.
- The spores are opaque and their cysts are often noticeable to the naked eye.
- In various tissues (gills, on skin, intestines)
- gall bladder
- in urinnary bladder
- kidneys are the most common.
- Generally they are harmless but when they are in large numbers, some species and genus cause significant damage.
- ***Myxosporidia*** usually multiply by sporification.
- Trophozoids move with their pseudo-legs like amiplo.
- They are then rounded to form a cyst.
- In some species, cysts have a large number of spores.
- When the cysts are in the gills, they appear as white fluffy spots,
- İf when the cysts are in the skin similar to small skin tumors.
- It is the direct transmission of parasites from fish to fish.
- There are many species belong to this group.

Ceratomyxa

- It is mostly reported from sea and aquarium fish.
- There are also species found in trout and salmon.
- This microscopic myxosporean protozoan parasite causes hemorhaging and necrosis of the intestine of salmon and trout.
- ***Ceratomyxa shasta*** is the most pathogenic species in trout after *Myxosoma cerebralis.*
- In diseased trout, the anus is swollen around.
- Swelling is also observed in the abdomen.
- Internally affects entire digestive tract, liver, gall bladder, spleen, gonads, kidney, heart, gills, and muscle (vary by salmonid species and life stage)
- Small intestine, bill gladder and other organs that enter the spors are encountered.
- Cold temperatures and salinity may reduce progress of disease, but not eliminate infection • Progression of infection and mortality is temperature dependent (higher temperature yields increased disease progression / quicker mortality)
- Treatment is unknown (water filtration ??).

Sphaerospora

- The most common species is ***Sphaerospora tincae***.
- In the velvet fish (Tinca tinca) it is localized in the kidneys.
- The kidney tissue grows abnormally due to the mass of cysts.
- Normal appearance of glomerulus and tubulun was lost in histological sections or crushed preparations.
- Due to renal localization, the back of the fish has enlarged.
- Infection occurs when the spores in the water are taken.
- The agents that pass through the intestines from the lumen first settle in the front kidney.
- They then settle in the heart's membrane, the back of the kidney, the liver, and the spleen.
- Ovaries also become infected in females.
- Usually the factors do not occur in the intestine.
- The parasites form large masses in the anterior part of the body displacing the head kidney.
- They seem to be host specific for tench and are not found in the excretory part of the kidney.
- Mortalities caused by rupture of the abdomen may reach 100%, but usually appear to be low.

Myxidium

- The sports are shuttle-shaped, their tips/ends sometimes pointed and sometimes rounded.
- There are polar capsules at both tips/ends.
- Polar filaments are relatively thin and long.

- It is live in most commonly in the kidney, urinary bladder and gall bladder.

- There are many species.
- ***Myxidium lieberkühni*** (Turna-urinary bladder)
- ***M.girardi*** (Snake fish-kidney)
- It causes the formation of white cysts in the kidney.

Hoferellus

- Myxozoans are metazoan parasites whose traditional spore morphology-based taxonomy conflicts DNA based phylogenies.
- Spors are 10-12 µm long, 8 µm wide.
- There are tail-like extensions (at the side)
- It looks like a helmet.
- ***Hoferellus cyprini*** is the most important species.
- It is found in the kidneys of carp (kidney tubules are found in both epithelium and lumen).
- It causes degeneration and growth in the kidneys.
- Exophthalmos is frequently observed in infected fish.
- Crushed preparations made from the kidneys are frequently encountered.

Hennuguya

- Spors have 1-2 extensions like tail.
- There are 2 polar capsules.
- They are parasites in many tissues such as kidney, ovary, gill, muscle, eye, connective tissue.
- The most important species are:
- ***Hennuguya psorospermica*** - White cysts in the gills in sea bass and pike.
- ***Hennuguya salmincola*** - Salmonidae'de deep down to the muscles makes boils.

Myxobolus

- Spors are oval or close the round.
- There are 2 arctic capsules the front.
- ***Myxobolus oviformis*** causes the formation of white nodules in the fins, gills, kidneys and spleen in various freshwater fish.
- ***Myxobolus pfeifferi*** - Causes the disease in fish such as Barbus and the like (Myxoboliasis tuberoulcerosa).
- Large blooms occur in various parts of the body (their size varies from hazelnut size to chicken egg)
- Sometimes they open out and ulcers occur.
- It is observed that the diseased fish are gradually weakened.
- Generally the color is opened and there is spillage in the scales.
- The meat of the fish looks like it is yellowish, as if painted with bile.
- At the same time, there is relaxation, softening the meat.
- When the preparation is prepared from swellings, there are spors of billions of numbers.
- There are agents on every side of the body (from connective tissue to ovary).
- The disease is usually observed in hot seasons.
- ***Myxobolus luciopercae*** - In some freshwater fish (Lucioperca sandra) it causes white crystals to form in the gills.

Myxosoma

- The front view of the spor is oval, usually lentil shaped.
- There are 2 polar capsules on the front.
- Myxosoma have a wide variety of species that settle in the gills of the various freshwater fish, the blood vessels of the brain, the nervous system and cartilaginous tissue.
- ***Myxosoma cerebralis*** is the most important species.
- It causes "Rotational Disease" in trout.
- The agents are found in the non-osseous cartilaginous parts of the young trout and on its backbone.
- It is a notifilable disease in Europe.
- Swimming in the diseased fish is abnormal. The diseased fish move in circles floating.
- They get tired very quickly and fall to the bottom.
- In this disease, deformation occurs in the jaw/chin of the fish (The chin is similar to the parrot gag. The upper jaw is shorter than the lower jaw).
- Shrinkage and deformation are seen in the tail. At the same time, blacken in the tail attracts attention.
- In general, the color of the patient is also darkening the color.
- In addition, various deformations are observed in the spine/vertebra.

Myxosoma causes "Rotational Disease" in trout

Shrinkage and deformation are seen in the tail

In this disease, deformation occurs in the jaw/chin of the fish (The chin is similar to the parrot gag. The upper jaw is shorter than the lower jaw).

various deformations are observed in the spine/vertebra

Myxosoma

- If the factors are much and they settle in brain, the trout will die immediately.
- The deformed body forms continue when they ilness off the disease (they go to the portal state).
- Because they carry spores in their tissues and after they die, the spores are spread around.
- Diagnosis a) The head of the fish is sectioned. Agents in fish cartilage and bone tissues are investigated.
- b) Or meat parts of suspicious fish are boiled away.
- -Decalified.
- -Mechanically fragmented
- - Afterwards, trypsin is applied to release the spores from the tissues.
- There isn't treatment.
- Patient fish must be removed quickly.
- Pools must be absolutely disinfected.
- The sports are very durable. It should not let infections run as much as possible the managenents. For this reason prophylaxis is even more important.
- There are no active isolation also been reported in Turkey.

GLUGEA (Microsporidia)/ Protozoa

- It is the smallest of the protozoons found in fish.
- The sizes are 2-10 µm.
- Spors can be in oval-round-comma-tubular-cylindrical forms.
- Typical cytosolic parasites.
- They multiply with schizogony and sporogony in the host, and bring numerous sports to the host cell.
- Due to this excessive proliferation, fish have hypertrophic cells and cysts.
- There are 1 polar filament in sports with a membrane covered (but not easy to see).
- ***Glugea anomala*** is the most important specimen species.
- 2-4 mm long swelling occurs in the skin connective tissue.
- These cysts are found in the cornea, swimmer, intestine, testicles and scales.

HAPLOSPORIDIA

- **It's a different group.**
- ***Dermocystidium* is the most common genus.**
- **In various species of fish, bubbles form in the skin and gills.**
- **When you are blown, the spores will come out.**
- **They range from 3 -4 µm to 10 -15 µm.**
- **Their development is unknown.**
- ***Dermocystidium percha* is the most common species.**
- There is no known **treatment.**

Dermocystidium nodules

Non-Infectious Diseases of Fish

1) Nutritional diseases
2) Traumatic lesions
3) Poisoning
4) Genetic anomalies

Nutritional diseases

- It is important that fish are given balanced and adequate food.
- Nutrition is effective in the vitality, reproduction, development and color of the fish.
- Disorders are seen with little or no protein, carbohydrate, fat, minerals and vitamins in fish feeds.
- Deficiencies over time, either weakened the immune system by creating a direct effect on the deficit.
- Feeds should be given at regular intervals.
- Feeds must be consumed completely by the fish and must be hungry until the second feed.

1.Protein, Amino acid

- It is an important source of energy for fish.
- Protein requirement is 25-56% according to fish species and size.
- While most fish species use vegetable protein (soy), some require a certain amount of animal protein.
- Salmonids (carnivorous) need more protein than omnivorous/herbivor fish.
- It is difficult to detect protein deficiency. Weight reduction, growth retardation, weight loss, reduced resistance to diseases, increased expectations for fish deaths.
- Essential A.A. 's lack of tryptophan, skewness/body distortion in the body, also the other a.a. carrying the tryptophan, methionine, cystine and sulfur.

2.Fat

- The first energy source for fish is fat and protein.
- Some fatty acids are essential for fish health, growth and normal appearance of the fish.
- According to the fish species, the fat requirement ratio is 3-15%.
- When the metabolism slows down and movement is restricted in cold seasons, there is also grease.
- Excessive oil ingestion leads to fatty liver and obesity.
- Lipidation in the liver causes renal impairment and hence the organs also pay for it.
- In It is common in trout.
- fish, color darkening, lack of appetite, stagnation, swimming near the surface of the water, wilting gills can be seen.
- Liver color and gastrointestinal contents are light yellowish color.
- It also causes infertility.

3.Carbohydrate

- Fish quickly digest simple sugar molecules.
- Larger and more complex sugars are less digestive (less).
- Glucose, starch and sucrose are better digested than lactose.
- This is particularly noticeable in cold water fish (trout).
- The carbohydrate ratio in carnivorous fish feeds is low.
- The maximum digestible carbohydrate ratio in trout should not exceed 20% of the diet. In other fish species this rate changes.
- In herbivor fish, carbohydrates are better digested.
- Abundance of carbohydrate in feed is caused that hyperglycemia, hyperglycemia in liver, growth in liver and pathological disorders in some fish.
- This liver anormalities leads to kidney disorders. Deaths can be seen.
- In trout and salmon, the calorie glucose level is 70-120 mg / dL.
- Hyperglycemia in fish causes lethargy, swimming near the water surface, darkening of color and loss of appetite.

4.Vitamin

- Fish require 15 vitamins.
- These are D, C, E, K, B1, B6, B12, P pantothenic acid, folic acid, biotin, choline and inositol A.
- All of these do not have to be on a diet. The need for vitamins depends on the species and size of the fish.
- If vitamin deficiency is not corrected in a short time, it will cause mortality and decrease in fish resistance.
- **Vit A:** Provitamin carotene is found in green plants (algae) and diatoms (water algae).
- The fish take it directly or by eating copepods eating it.
- In the absence of liver fat degeneration, retinal disorders, exophthalmos, edema, hemorrhage in the fins, development deficit is seen.

- **Vit B1 = Thiamin:** found in the algae.
- In the absence, gastrointestinal, nervous system failures, poor development, loss of appetite, atrophy in muscles, convulsions, dysbalance, edema and death are seen.
- Increase in **vit B1** requirement for carbohydrate intake in feed (required for carbohydrate metabolism).
- **Vit B2 = Riboflavin:** found in the algae.
- It has an important role in the growth of fish.
- **Vitamin B2** deficiency in feed has retardation, imbalance, anorexia, anemia, vascularization in the cornea, blurred lens, blood in the eye, abnormal pigmentation in the iris.
- **Pantothenic acid:** Pantothenic acid deficiency in fish-feed can cause fish to show abnormalities and swelling in the gills, loss of appetite, lack of growth, stagnation and dermatitis.

- **Vit B6 = Pyridoxine:** Protein metabolism is affected by vitamin B6 deficiency in feeds.
- **Vit B12 =** Cyanocobalamin is necessary to mature red blood cells.

Macrocyclic anemia, anorexia and developmental retardation are seen in the absence.

- **Biotin:** In the biotin deficiency of fish feed, trout convulsions, poor growth, loss of appetite, muscular atrophy, skin lesions, mucoid secretion, blue mucus disease are seen.

BLUE MUCUS DISEASE

- It is a disease related to food.
- It is seen in biotin deficiency.
- Especially in trout, the body is covered with a layer of blue mucoid.
- Over time, this layer peels off and the fish skin looks like a patchwork.
- Beef liver, beer yeast can be added to fish feed to prevent this disease.

- **Vit C:** Required for mature fish. It is found in fish eggs.
- In the absence, scoliosis, collagen and cartilage tissue deformation, muscle and deep hemorrhages are seen.
- **Vit D =** Calciferol: It is found in algae and zooplankton, but it is absolutely necessary to take it from the outside because it is low in availability.
- **Folic acid:** In the absence, there is deterioration of the tail side, lethargy and development deficiency.
- **Vit K:** Important for blood clotting. Hematocrit value falls in the absence.

- **Vit E = Tocopherol:** Deficiency in fish-feed, sterility and decreases of hematocrit value are seen in fish.
- Herbivorous fish take vitamin E from green algae and other green herbal organisms.

- **Inositol:** has antianemic significans for trout.
- In deficiency; skin lesions, anemia, tooth imperfection, loss of appetite, sudden movements are seen.

- **Vit P = Niasin =** Nicotinic acid: Important for trout.
- Muscle spasm, loss of appetite and sudden movements are seen when resting in the deficiency.

- **Cholin:** In the absence of cholin; kidneys hemorrhage, developmental deficiency and metabolic disorders are seen.

5.Mineral

- The requirement of fish for minerals is varied and their metabolism is more effective.
- Most minerals are supplied from water.
- Some mineral ions can pass through the gill.
- These are chlorine, carbonate, sodium, calcium, phosphorus, potassium and iodine.
- Apart from these metals, such as copper, magnesium, iron, zinc and aluminum are very low in absorption, so extra addition of food is necessary.
- In the majority of natural waters, phosphorus and calcium are insufficient and must be added to the diet.
- Fish use inorganic ions to maintain their osmotic pressure balances and to adapt to environmental conditions.
- The presence of some minerals also affects the activity of others.
- Growth can affect Mg, K, Cu, I, Se, Zn and Fe in the feed.

- **Iodine (I): Cataract occurs in the rainbow trout in its absence or deficiency. (15 mg of zinc (ZnSO4 / kg)**

Iron (Fe): Decrease in blood hemoglobin and hematocrit in the absence or deficiency, increase in immature red blood cell count, anemia occurs.

Calcium (Ca) / Phosphorus (P): skeletal deformation in the absence, growth retardation in the skull.

Magnesium (Mg): Lack of appetite, slow motion, relaxation in the muscles, deaths in the absence/deficiency.

Necessary measures

- One-way feeding should not be done.
- Diet also needs to make diversity (change diet, give fresh food ..).
- The feed contains the necessary vitamins and minerals.
- The feed formulation should be redesigned according to the needs of fish species.
- It should not be given more carbohydrate, fatty food.
- A place should not be fed until it is full, it should be felt a little hungry between feeding (feed is more beneficial).

Traumatic lesions

- Aggression
- Hunting
- Kanibaliz
- Closed area on-hold
- Light
- Electricity

1. Aggression

- Aggression, is the cause of injury or even death in aquarium fish.
- Aggression is not instinct in fish, but some fish (chewing gum) tend to be aggressive.
- Aggression can occur as a ritual of exchange rate among some species of fish.
- The broadcast fish is not aggressive before it reaches sexual maturity.
- Many aquarium fish species have hierarchical dominance.
- Fish are kept at low density for hierarchical dominance in tanks.
- Salmonids are particularly fins when there is insufficient nutrition in overcrowded areas.
- This aggression can cause open injury in the back of the fins.
- Lesions are usually small hemorrhagic foci.
- In salmonids, dorsal fin injuries may appear the same as sunburn lesions.

2. Canibalism

- Many fish are fed as canibalism and, when appropriate, take other juvenile fish (due to their size) in the tank pool.
- This situation is genetically and behaviorally irresponsible.
- Behavioral structure is also caused by environmental factors (Broadcast, sea bass, sea trout, snakes, pike ...)
- Canibalism can be overlooked when feeding in tanks.
- However, this should be taken into account in the decline in the number of unexplained fish in healthy populations.

3. Closed area on-hold

- Fish can be injured as a result of when collected in a net or transport.
- Puncture wounds can occur with abrasions of sharp pinnacles resulting in close contact with the narrow area.
- Some fish have idiopathic (uncertain cause) corneal edema after transport.
- Corneal ulcers and abrasions are a result of trauma, especially in large fish.
- This situation may occur not only in the fight, but also in the cliffs formed in rocky, coral regions.

4. Light

- Intense UV light can cause sunburn in salmonids and trout.
- Commonly this is seen during the movement of juvenile fish (5-8 cm) outdoors from the open halfway in the middle of the summer in the northern half-sphere.
- The mortality rate is low.
- It is characterized by a thickening of the deep color on the back, and then a deep peeling. Low-lying deaths occur, but the disease rate in fish increases.
- In addition, when the fish are suddenly exposed to bright light, the skin and lower parts may go and damage the skin.

5. Electricity

- Electric shock can damage the fish.
-
- The application with the instrument can cause serious damage such as spinal stenosis, fracture and hemorrhage in the muscles in many species of fish.
- There is a relationship between the amount of electroshock applied in a given time period and the number of injured fish.
- For ovulation or where the offspring are present, the procedure may damage the developing embryos and offspring.

General Suggestions

- Traumatic lesions may resemble infectious lesions.
- The history of the event is very important in revealing whether or not it is traumatic.
- There are no pathogenic effects in the lesions in fresh cases, but secondary lesions often develop secondary infections.
- Treatment includes infection-specific treatment (topical treatment with antibiotics).
- Fish density should be reduced.

Intoxication

- CO2 Hypercarbia / Hypercapnia
- O2 Inadequacy Hypoxia / Anoxia
- Chlorine
- chloramine
- Ammonia
- Metal poisoning

CO^2 Hypercarbia/Hypercapnia

- CO2 is dissolved in water and its abundance can be much higher than atmospheric.
- This may be especially when groundwater is used (pH is low, CO2 is high-100 mg / lt).
- The amount of CO2 per day in the pool and small ponds varies.
- This is especially true in O2 low lakes, which are rich in plants.
- In these fishes, hypoxia (decrease in body O2) can be exacerbated and CO2 level is further increased by the death of phytoplankton.
- In the flowing system the CO2 level is highest in the least outflow in the water flow.
- The CO2 level is the most near the bottom.

- The increased amount of CO_2 in the water prevents the blood from giving out O_2, the pH is lowered, which reduces hemoglobin O_2 transport.

- Chronic CO_2 increase in salmonids causes nephrocalcinosis, systemic granuloma, kidney lime accumulation, gastro-renal-muscle mineral accumulation.

- If the amount of CO_2 exceeds 10-15 mg / lt (algae deaths), the amount of excess CO_2 can be reduced by adding slaked lime to the pools or by strong ventilation of the pool.

O^2 Poisoning-Hypoksi/Anoksi

- The amount of O2 required for each fish species is different.
- The carp is tolerant to the lack of O2.
- When there is not enough O2 dissolved in water, anoxia (low O2) occurs.
- When salmonids stop water flow, fish mouth is open, air swallowing, rapid respiration, accumulation on the surface of water and death afterwards.
- The main clinical finding is the growth of growth.
- In broodstock, it affects the development of the offspring with fertility (embryonic developmental disorder, anemia).
- O2 deficiency in water (hypoxia) is the cause of mass death in aquarium tanks. This is due to the fact that the fish are extremely dense, the ventilation is low, the bottom feed debris is broken down, the oxygen is used, and the oxidation over 25 ° C is accelerated and the oxygen consumption is increased.
- The ventilation must be increased by decreasing the water temperature.

Chloramine (humik asit)

- Chloramine is very toxic for fish.
- However, it is also used as a disinfectant in the treatment of some pathogens in both skin and gill.
- It causes both respiration and acid-base balance and causes mucus increase due to gill irritation.
- Chloramine can not be easily removed by ventilation of the water.
- Heating up near the water boiling point removes chloramine and some chemicals can neutralize it.

Ammoniac

- Ammonia is the main excretion product of fish and is a major potential for the diseases caused by the environment.

- When the limit is exceeded (0.02 mg / l for carp, 0.006 mg / l for young, 0.01 mg / l for adult), there is a risk of developing illnesses, failure to benefit from feed and developmental disability.

- Sudden deaths occur in large numbers. The ammonia in the water reaches the blood and tissues through the gills and skin and acts on the respiratory, blood and nervous system.

- Muscle contraction, deterioration of the eye's rotational reflex, spinning and irregular swimming, and gill necrosis occur.

❑ **GILL NECROSIS**

✓ It can be seen in trout, freshwater snake fish and larvae of fish with 1-2 summer carp with symptoms.

✓ The disease occurs with pH rising above 8 and ammonia accumulation.

Metal Poisoning

- Waters contaminated with metal ions are harmful to the aquatic life.
- The most alkaline is toxic because it is dissolved more in the water.
- Metal salts such as lead, copper, iron, mercury, lead to poisoning.
- Usually, the clinical symptoms are similar.
- Increased hardness of the water also increases the toxicity of heavy metal salts, while O2 in the environment increases the toxicity of poisoning.
- In fish, restlessness, increased respiration rate, increased mucus, drowsiness, side-lying, drowning and deaths due to accumulation of CO2 in fish.
- If the fish are lying side-by-side, even fresh clean water cancers are unlikely to recover.

Genetic Anomalies

- **BENIGN TUMORS**

a) Skin tumors (epitheliomas)

b) Pigmented tumors (Melanomas)

c) Connective tissue tumors (Fibromas)

d) Muscle tissue tumors (Myomas)

e) Glandular tumors (Adenomas)

f) Bone tumors (Osteomas)

g) Cartilage tissue tumors (Chondromas)

h) Nerve tissue tumors (Neuroms)

- **MALIGN TUMORS**

a) Carcinomas (common in thyroid gland, kidneys)

b) Hepatoms

c) Melanosarcomas

OTHER DISEASES RUNNING IN FISH

- **ACUT INTESTINAL SNUFFLE (Enteritis catarrhalis acuta):**
- The disease is closely related to feed and feeding and brings significant losses to juvenile fish.
- It is more frequent at the beginning of spring when the temperature is rising.
- Good and non-hygienic feeding (bad, moldy) to fish, feeding with dry and only one type of feed.
- Clinically, fish are without appetite, movements are disturbed, and a stately white feces appears.
- In necropsy, is the disorder's bowel.
- The bowels are empty or the mucus has increased. Fill the biliary sac.
- The feeding style and the quality of the feed should be corrected.

Exophtalmus

- It can occur in one or both eyes.
- In some cases, the eye can come out of the place and mushrooms can be placed as a seconder in the area.
- It comes from a variety of reasons: In bacterial and viral infections
- In case of eye parasites.
- Nitrogen in excessively aerated water accumulates in the vicinity of the eye and pushes the eye out.
- Fluid collection in the body cavity.
- In anoxic conditions.
- Regarding various genetic factors.

CATARACT

- The reason for the traumatic has not been fully understood. The eye is completely white. It is usually unilateral.

- In parasitic cases (such as Diplostomum) it is possible to identify factors in the eye.

- EYE FUNGUS
- In fish, fungi are often found in the sea.

- The parasitic, mechanical, chemical damage that occurs in cornea occurs here, and fungus are located here.

ANEMIA

- It manifests itself with pale gills.
- There is a significant reduction in the amount of erythrocytes.
- The reasons are: Liver fat degeneration
  Bacterial, viral, parasitic infections,
  feeding with food that does not contain enough vitamins.
- Riboflavin-Pentothenic acid-Pridoxan is added to the fish's diet to prevent it.
- In addition, higher quality feed are organized.

BLUE BLADDER DISEASE (Hydrocele Embriyonalis)

- It is seen in fish that newly emerged from egg.
- It is characterized by the fact that the eggshell greens are so large that they can not go out to the surface because of their weight.
- Sometimes the pouch explodes.
- It is the accumulation of excessively bluish serous fluid in the abdominal cavity between the inner and outer walls of the yellow vein, which is the cause of the growth.
- Oil globules may be found in the liquid.
- In such cases, the normal parts of the egg yolk are absorbed and the fish continue to grow.

- **GAS BUBBLE DISEASE:**
- Depending on the excess nitrogen in the water, gas-filled bubbles arise around the eyes, on the deep fins, in the body cavity.
- It can be removed by water ventilation.

- **SUNBURN DISEASE:**
- Salmon and trout are characterized by a deep peeling of the back, back, and back.
- First, the deep color in these parts is settled, then stripped and the corium layer emerges.
- The cause is not known exactly.

- **METABOLIC DISORDERS:**
- Balanced and sufficient food should be given to the fish.
- Fish feed should contain carbohydrates, proteins, fats, vitamins and minerals as well as warm blooded animals.

VITAMIN DEFICIENCY

- **Vitamin A:** carotenes are found in many green plants. Carotenoids, intestinal mucosa and liver it turns into Vita A. In the absence; fat degeneration is observed in liver.
- **Vitamin B1 and B2:** found in the active muscles of vertebrates and green plants (algae).
- Vitamin B1 deficiency, digestive and nervous system disorders, loss of appetite, atrophy in muscles
- In Vitamin B2 deficiency growth retardation, loss of appetite, anemia, imbalance, abnormal pigmentation in iris is observed
- **Pantothenic acid:** impairment in gills, retardation in development, dermatitis
- **Folic acid:** deterioration of the tail face, numbness, developmental disorders
- **Vitamin B6:** necessary for protein metabolism. Nervous disorders in absence, anemia, loss of appetite.
- **Vitamin B12:** It is necessary for the ripening of erythrocytes. Macrocytic anemia, loss of appetite and retardation in development.
- **Biotin:** Developmental deficiency, muscular atrophy, skin lesions, mucoid rash disorder.
- **Vitamin C:** It is found in fish eggs. Degeneration of scoliosis, collagen and cartilage formation, hemorrhages in the deep and muscles.
- **Vitamin D:** Fish try to get this vitamin from algae and zooplankton. However, there are few in them. For this reason, they must be added to the bait.
- **Vitamin E:** Deficiency in fish leads to sterility and blood disorders. It is found in green algae and plant organisms.
- **Vitamin K:** Kanda brings disorder to the field. It is necessary for clotting.
- **Inositol:** It is important as antianemic factor. Skin lesions and loss of appetite are observed.
- **Niacin:** Required for trout. Spasms in the muscle, loss of appetite
- **Cholin:** Hemorrhage in kidneys, growth retardation, metabolic disorders

- **BLUE MUCUS DISEASE**
- Especially in trout, the body is covered with a layer of blue mucoid.
- Over time, this layer peels off and the fish skin looks like a patchwork.
- It's about food.
- It is seen in biotin deficiency.
- To prevent fish fodder, beef liver, beer yeast can join.

- **LIVER FAT DEGENERATION:**
- The accumulation of lipids in the liver results in a yellowish appearance in the liver.
- It is seen frequently in trout.
- Patient fish have darkening of color, lack of appetite and stagnation.
- Otopside is filled with a pale yellow substance in the stomach and intestines.
- The liver is light yellow, sometimes over petal.
- The disease is about feeding with fatty and carbohydrate foods.
- There is no cure.
- However, new rations are arranged and prevented from progressing.

TUMORS IN FISH:

- They have good and bad-tempered ones.
- The benign ones: a-skin tumors (epitheliomas)
- b- pigmented tumors (melanomas)
- c-connective tissue tumors (fibroma)
- muscle tissue tumors (myomas)
- tumors (adenomas)
- bone tumors (osteomas)
- cartilaginous tissue tumors (chondromas)
- nerve tissue tumors (neuromas)
- malignant: Carcinomas (common in the thyroid gland and kidneys)
- hepatomas
- Melanosarkom