

UTF/077/ZAM: Technical Assistance to the Zambia Aquaculture Enterprise Development Project (ZAEDP)

Session 2:

Factors in disease development (Snieszko circle)

Diagnostic levels (I, II, III)

Melba B. Reantaso

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Outline of lecture

Factors in disease development (Snieszko circle)

- Health and aquatic animals: important considerations
- Diseases under aquaculture conditions
- Examples of infectious agents: viruses, parasites, bacteria, fungi
- Risk hierarchy
- Managing disease risks

Diagnostic levels (I, II, III)

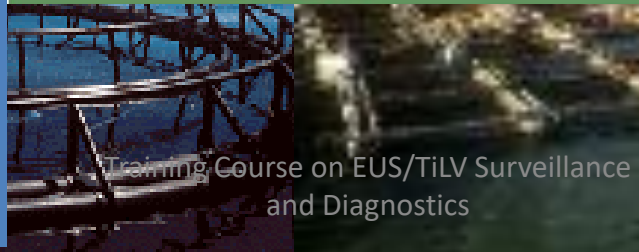
- Role of diagnostics/diagnosticians
- Levels of diagnostics
- General techniques
- Important elements of disease diagnosis

Health and aquatic animals: important considerations

Aquatic animals require more attention in order to monitor their health

- not readily visible except in tank holding conditions
- live in complex and dynamic environment
- feed consumption and mortalities are hidden under water

- Diseases not caused by a single event
- End result of a series of linked events involving the interactions between the host, the environment and the presence of a pathogen (Snieszko, 1974).



Range of diseases are also varied

- some disease with low or unknown specificity
- many with non-specific symptoms

Complexity of aquatic systems makes distinction between health, sub-optimal performance and disease obscure

Spread of disease from either cultured fish to wild fish or vice-versa

- presence of pathogen in both fish and water source;
- presence of susceptible host;
- viability, in terms of number and longevity, of pathogen in the environment;
- viable infection route.

Health and aquatic animals

- First and most important defenses against preventable diseases losses under a complex aquatic situation are:
 - Monitoring as regularly as possible
 - Appropriate action at the first sign(s) of suspicious behavior, lesions or mortalities
- These are fundamental approaches but still requires reinforcement in many aquatic animal production sectors
- Farmers sometimes are hesitant to act on first sign of health problem as this may reflect on their production capacity or that this will result in failure in the competitive market place
- Hiding or denying health problems can be destructive; disease is a challenge that everyone has to face

Diseases under aquaculture conditions

Host:

physiological, reproductive and development stage conditions, stocking density, host susceptibility & immunity

STRESS is an important factor

Environment

Water and its components (e.g. oxygen, pH, temperature, toxins, wastes, etc) and the kind of management practices (e.g. handling, drug treatments, transport procedures, etc.)



Snieszko
Circle (1974)

Pathogen

Viruses
Parasites
Fungi
Bacteria

Not caused by a single event; end result of a series of linked events involving the interactions between the **host** (including physiological, reproductive and developmental stage conditions), the **environment** and the presence of a **pathogen**

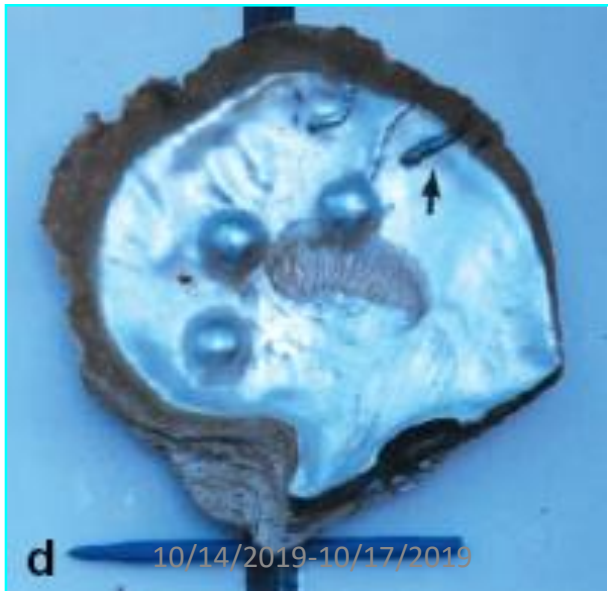
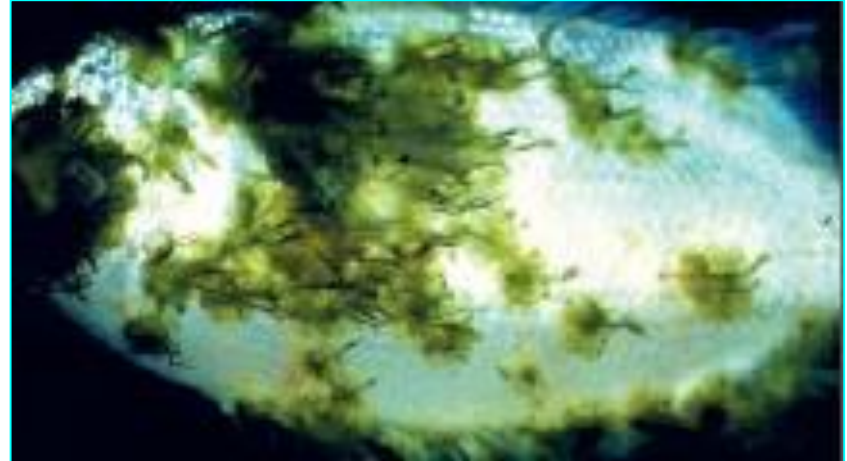
Viruses



Bacteria



Parasites



Fungi



Risk hierarchy (Dr Chris Baldock)

Fish is currently the most traded commodity

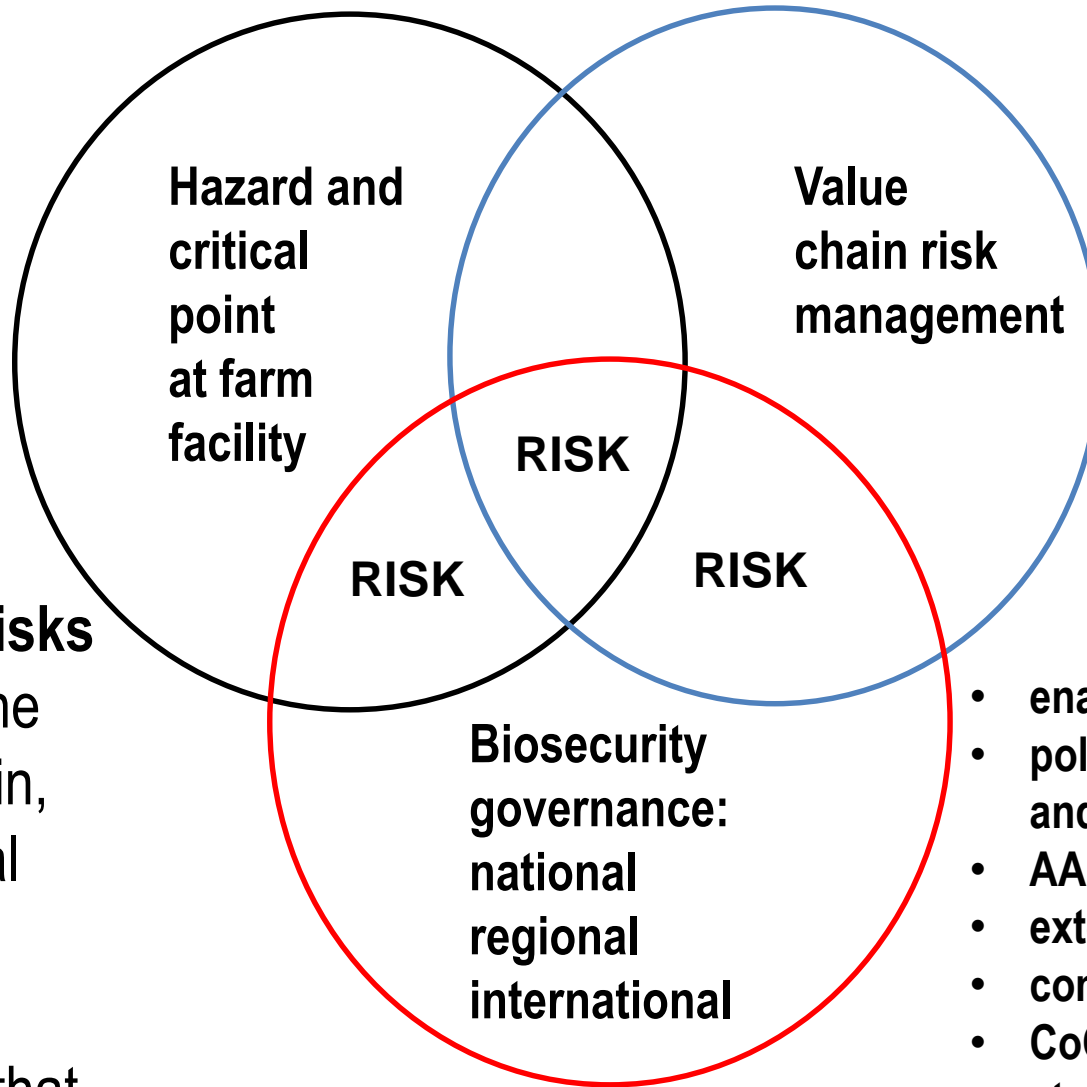
**Processed products;
fresh products**

Eggs and sperms

Live young animals

Live adult animals

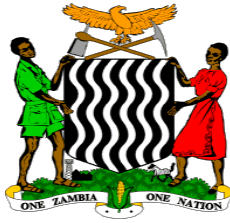
- hatchery
- nursery
- grow-out
- processing plants
- even markets



- risky areas in the value chain
- supplier of inputs and products
- trading practices

Managing the risks at all levels of the aquaculture chain, identifying critical points and introducing the interventions at that stage

- enabling environment
- policies, legislation and enforcement
- AAH services
- extension services
- compliance: GAP
- CoC, trading standards
- certification schemes
- fisheries/veterinary authorities



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Role of diagnostics/diagnosticians

First role: screen healthy animals to ensure that they are not carrying infection at sub-clinical levels by specific pathogens

- This is most commonly conducted on stocks or populations of aquatic animals destined for live transfer from one area or country to another.
- Such screening provides protection on two fronts: (i) it reduces the risk that animals are carrying few, if any, opportunistic agents, which might proliferate during shipping, handling or change of environment; and (ii) it reduces the risk of resistant or tolerant animals transferring a significant pathogen to a population which may be susceptible to infection

Role of diagnostics/diagnosticians

Second role: determine the cause of unfavourable health or other abnormality (such as spawning failure, growth or behavior) in order to recommend mitigating measures appropriate to the particular condition – this is the most immediate and clearly recognized, role of diagnostics in aquatic animal health

Role of diagnostics/diagnosticians

- Disease diagnosis is not solely a laboratory test. A laboratory test may confirm the presence of a specific disease agent, or it may exclude its presence with a certain level of certainty
- **Rely on a broad array of technique:**
 - ranging from gross observation to molecular probes and genetic sequencing.
 - choice of which tool to use for any diagnostic application relates to the *sensitivity* (ability to detect infections) and *specificity* (ability to distinguish one disease agent from another) of each technique; i.e., ‘fit for use, fit for purpose’.
- Diagnostic accuracy relies on a **solid case-history** starting with observations of feed-uptake, growth rates and behavior, water conditions, records of sources of animals introduced, feed sources, biosecurity measures in place, etc.

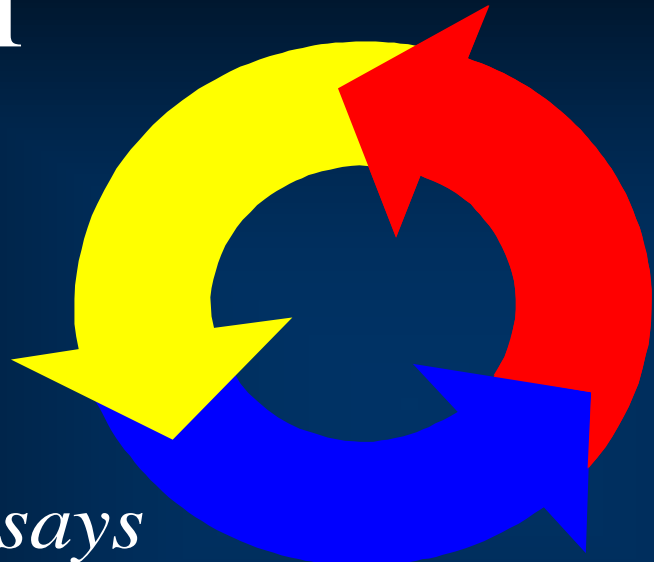
Role of diagnostics/diagnosticians

- Emergence of the disease in an area or population where it has not previously been observed warrants further investigation. In such a situation, gross observations would be considered *presumptive*, but require further analyses to be *confirmed* and considered as a *conclusive* diagnosis.
- Preliminary tests may produce conclusive results or trigger the need for more testing (repeat samples or different tests).
- Samples may need to be sent to laboratories with more specialized test equipment or experience with the disease of concern.
- Disease diagnosis should be made as a continuum of observations starting on the farm, and in fact commencing prior to the disease event. The different levels of diagnosis can be seen in the next slide.

Levels of Diagnostics: continuum of observations

Level III

Virology
EM
Molecular
and
Immunoassays



Level II

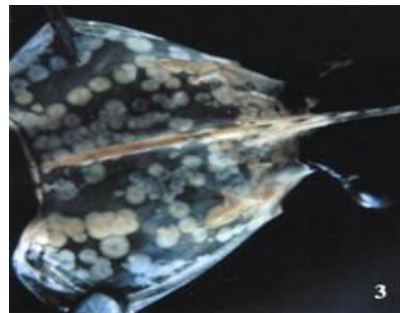
Parasitology
Bacteriology
Mycology
Histopathology

Level I

Observations of animal and environment
Gross clinical signs

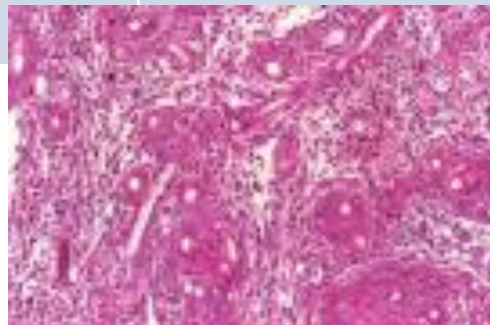
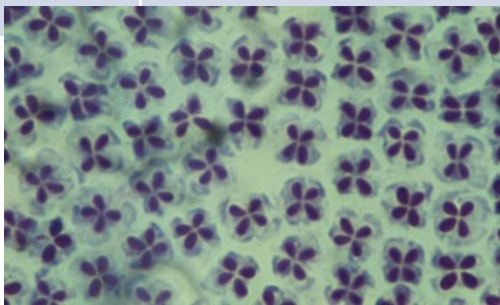
Diagnostic Levels, Associated Requirements and Responsibilities

Level	Activity	Work requirements	Responsibility	Technical requirements to support activities
I	Observation of animal and environment Gross clinical examination	Knowledge of normal (feeding, behaviour, growth) of stock. Frequent / regular observation of stock. Regular, consistent record-keeping and maintenance of records – including fundamental environmental information. Knowledge contacts for health diagnosis assistance (Levels II, III). Ability to submit and/or preserve representative specimens for optimal diagnosis (Levels II, III).	Farm worker/manager. Fishery extension officers. On-site veterinary support. Local fishery biologists.	Field keys. Farm record keeping formats. Equipment lists. Model clinical observation sheets. Pond/Site record sheets. Preservation/transportation Guidelines for Levels II/III diagnoses. Model job descriptions/skill requirements.



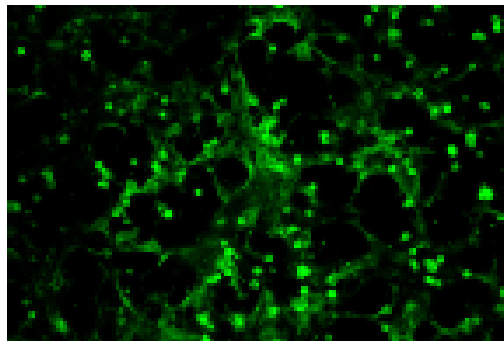
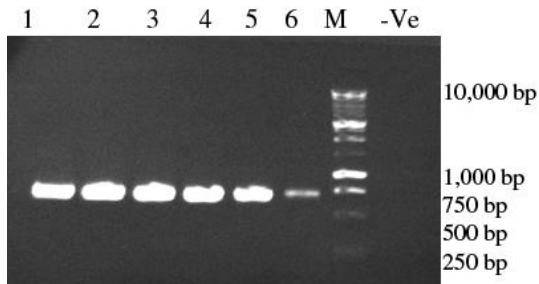
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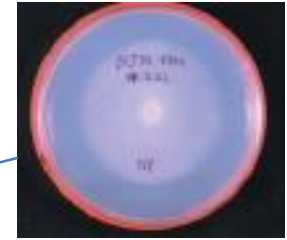
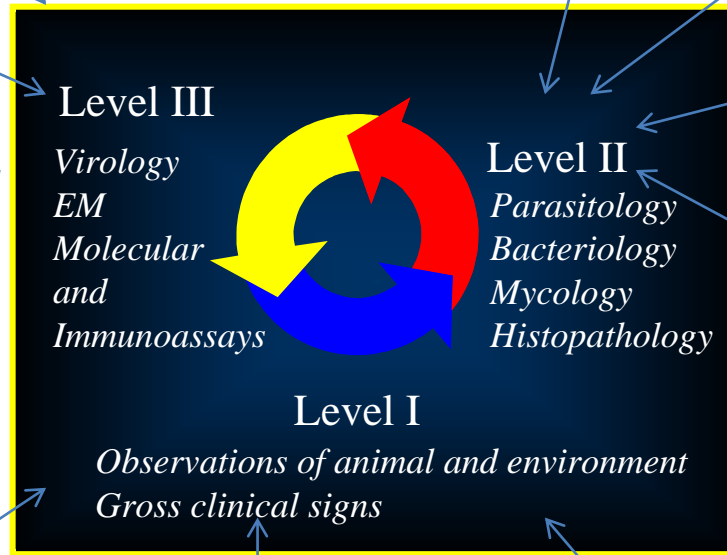
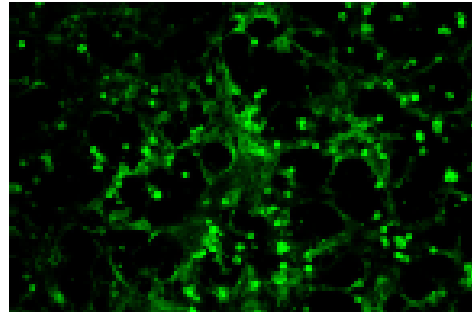
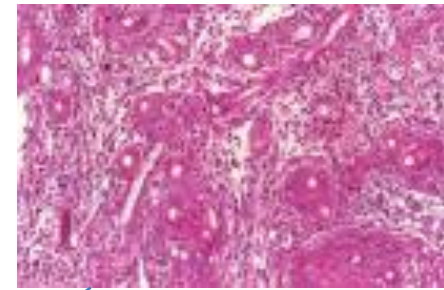
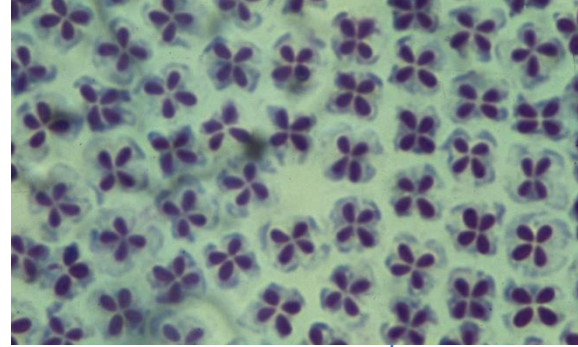
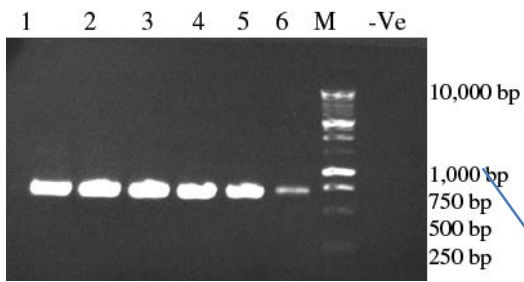
Level	Activity	Work requirements	Responsibility	Technical requirements to support activities
II	Parasitology Bacteriology Mycology Histopathology	<p>Laboratories with basic equipment and personnel trained/experienced in aquatic animal pathology.</p> <p>Keep and maintain accurate diagnostic and laboratory case records.</p> <p>Ability to preserve and store specimens for optimal Level III diagnoses.</p> <p>Knowledge of/ contact with different areas of specialisation within Level II.</p> <p>Knowledge of who to contact for Level III diagnostic assistance.</p>	<p>Fish biologists/ technicians.</p> <p>Aquatic Veterinarians.</p> <p>Parasitologists/ technicians.</p> <p>Mycologists/ technicians</p> <p>Bacteriologists/ technicians.</p> <p>Histopathologists/ technicians.</p>	<p>Model laboratory record-keeping system</p> <p>Protocols for preservation/ transport of samples to Level III</p> <p>Model laboratory requirements/ equipment/ consumables lists</p> <p>Model job descriptions/ skill lists</p> <p>Access to Level II and Level III specialist expertise</p> <p>Regional General Diagnostics Manuals</p>



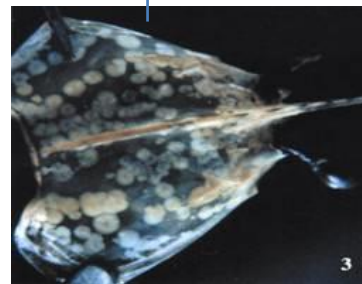
Diagnostic Levels, Associated Requirements and Responsibilities

Level	Activity	Work requirements	Responsibility	Technical requirements to support activities
III	<p>Virology</p> <p>Electron microscopy</p> <p>Molecular biology</p> <p>Immunology</p>	<p>Highly equipped laboratory with highly specialised and trained personnel.</p> <p>Keep and maintain accurate diagnostic and laboratory case records.</p> <p>Preserve and store specimens.</p> <p>Maintenance of contact with people responsible for sample submission.</p>	<p>Virologist/ technician.</p> <p>Ultrastructural histopathologist/ technicians.</p> <p>Molecular biology scientists/ technicians.</p>	<p>Model laboratory requirements/ equipment/ consumables lists</p> <p>Model job descriptions/ skill requirements</p> <p>Contact information for reference laboratories</p> <p>Protocols for preservation of samples for consultation/ validation</p> <p>Asian Diagnostic Guide for Aquatic Animal Diseases</p> <p>OIE Diagnostic Manual for Aquatic Animal Diseases</p> <p>General molecular and microbiology diagnostic references</p>





10/14/2019-10/17/2019



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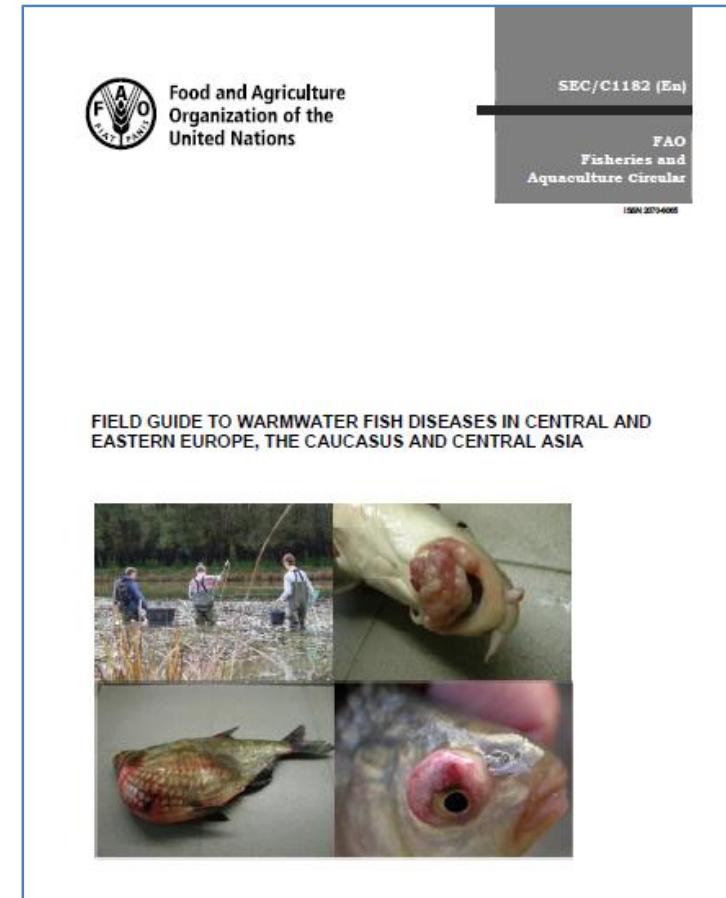
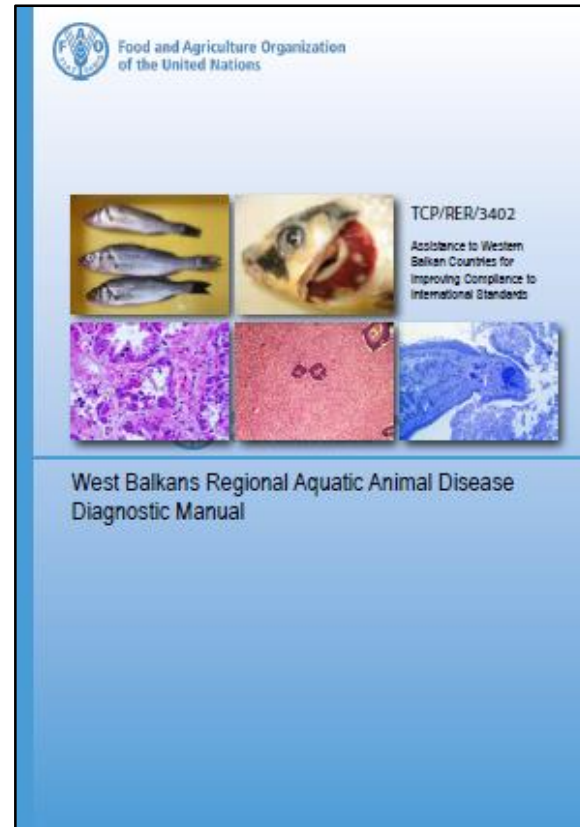
General techniques

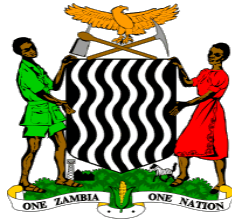
- **Gross observations:** behavior, surface observations, internal observations
- **Environmental parameters:** water quality, fluctuating environmental conditions; waste accumulation
- **General procedures:** pre-collection preparation, background information, sample collection for surveillance, sample collection for diagnosis; live specimen collection for shipping, dead or tissue specimen collection for shipping, preservation of tissue samples, shipping preserved samples
- **Record keeping:** gross observations, environmental parameters, stocking records

Disease diagnosis

- Causative agent
- Host range
- Geographic distribution
- Affected population (wild, farmed, both), and life stages; mortality rates
- Environmental information
- Economic importance
- Public health: zoonosis, food safety
- Clinical aspects
- Screening methods: presumptive, confirmatory
- Diagnostic methods: presumptive, confirmatory
- Modes of transmission: vectors, transmission to animals, spread between groups of animals
- Prevention and control measures

Suggested readings: examples of FAO illustrated diagnostic manuals





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Thank you for your attention