Live Fish Handling

Dr. Abdel Rahman El Gamal

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Why this lecture?

In nature fish will manage their life the way they feel good for their survival and wellbeing

In aquaculture we manage fish's life and performance in a way we believe it is good for them.

We stock, sample, transport, grade and other husbandry practices

The challenge will remain: Can we do that with no or minimum stress?

Live Fish Handling

During

- Stocking
- Sampling
- Harvesting
- Grading
- Marking
- Anesthesia
- Hatchery operation
- Transportation

Note: Stress could be severe or sometimes overlooked

Stocking

- Usually carried out after a sort of stressful practice (harvest, transport, etc)
- Stocking success or failure indicate the efficiency of previous practices
- Good stocking eliminates doubts afterwards

Remember

- Carried out only once for each production cycle
- Mortality estimates should not be the first option in case of doubtful shipments

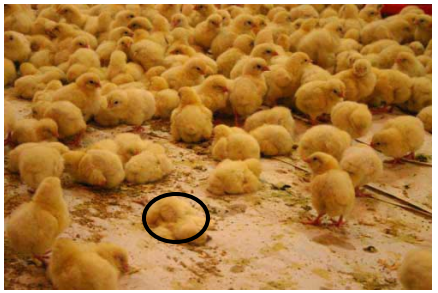
Doubtful Shipments

- Stressed fry most likely would not survive
- The whole shipment could be rejected (best action)
- If not, temporary stocking for enough time for treatment or recovery would be required
- Stock only healthy fish in production facilities

Dead & stressed fry

Stocking & unknowns

Mortality should be always expected even in good-looking shipments



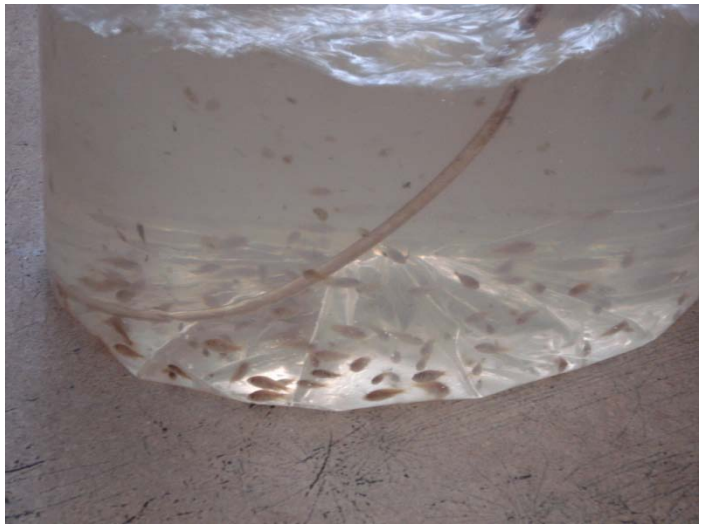
Easy to count dead chicklings – **But** fish are not chicklings

Estimating dead fish after stocking is questionable especially in the case of small fish or earthen ponds

How to estimate dead fish eaten by animals, picked up by birds, got lost in aquatic weeds or never surfaced

Stocking & minimizing unknowns

Handling upon stocking should be done as best as possible (acclimation, transportation, etc)



Mother Nature
(natural acclimation - Mullet)

Mullet (*Mugil* sp.) is a migratory fish:

Capable to tolerate a wide range of salinity

Fry swim from sea water (the place of its creation) to waters of various salinities

Stocking – Thermal Acclimation

More than 2 ^{o}C difference Fish Should Be Tempered

Higher temperature difference indicates:

possible handling problems (time of stocking, transport, etc)

Higher temperature difference could lead:

thermal shock or death

Rate > 5 ^{o}C per hour Not Recommended

Stocking – Salinity Acclimation - Osmosis

Salt concentration in vertebrate blood 10-12 g/l

Time and efficiency of acclimation to salinity difference depends on:

- Species (high tolerant [diadromous] – narrow tolerant)
- Salinity difference
- Other environmental/physiological factors

Fish would try to cope with salinity differences through **Osmosis**

Performing osmosis would require energy

Energy expenditure will be on the cost of other production traits such as growth

If energy requirement is beyond fish's ability, fish will be stressed or die

Stocking - pH Acclimation

pH of vertebrate blood –including fish- is about 7.4

Some marine species are sensitive to significant pH changes

Macrobrachium rosenbergii will need Acclimation for pH changes especially for significant differences (its favorite level is below 9)

Fish require longer periods for pH acclimation (the 20-min-acclimation) will not help

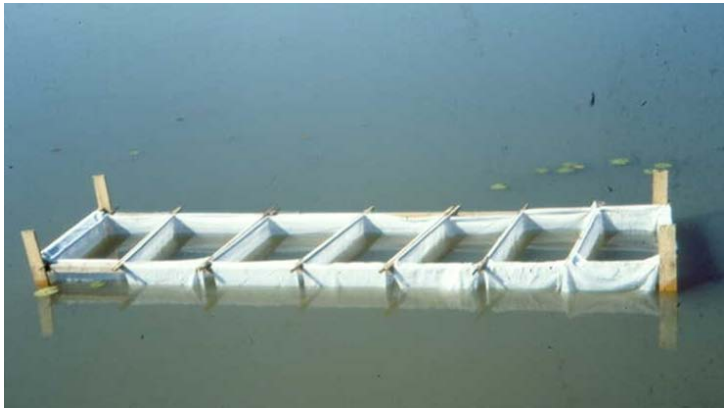
Stocking – Pre-acclimation

Acclimation period if gets long, it turns stressful

If differences in water quality are found beyond the ability to carry out on-dike acclimation, pre-acclimation would be required – More time could be made available

The acclimation of fry or fingerlings in hatcheries according to farm conditions (especially salinity and pH) is a good practice

Stocking – Survival/mortality assessment



Stock equal number in each compartment

Average survival/mortality is obtained after the test

Three compartment will be sufficient; two is the minimum

Even if handling practices were ideal

A simple field testing would:

Indicate efficiency of all actions taken prior to stocking

Provide realistic estimates about the mortality rates of stocked fish

The followings should be noted in the field test:

The test should not become a source of stress (location, stocking density)

2-3 days is sufficient for this test

Mortality estimates of this test is used to correct stocked numbers

Methods of Enumeration

No matter what methods are used it should lead to numbers

Enumeration methods include:

- Weighing
- Volumetric — Direct; water displacement
- Visual comparison — training is essential

Advanced technologies

(e.g. electronic counters). Used mainly for eggs/fry with high accuracy

Counting (practical – reasonably accurate)

Visual comparison

Few at a time

Volume/displacement

Samplers: soft & shallow

Enumeration of small fry (average weight)

Unless you have large number of fry;

A drop of water can make a difference

Length-weight Tables are commonly used

Example: Length-weight Table
Clarias batrachus

Total length (cm)	No. of fish	Range in weight (g)		Average empirical weight (gm)
		min	max	
5	5	1	1	1
9	19	4	8	5.8
15	31	22	36	29.1
23	32	92	128	110.5

Easier to measure length than weighing small fry

Sampling

Why sampling?

- just to get an idea about the condition of fish
- adjust feeding rates & quantities
- determine harvesting time
- others (e.g. shrimp molting)

Related facts

- sampling could be a stressful practice
- what we try to do is minimizing the stress
- sampling outcomes are estimates whether close to or far from reality
- better management of sampling minimizes the stress and enhance its outcomes

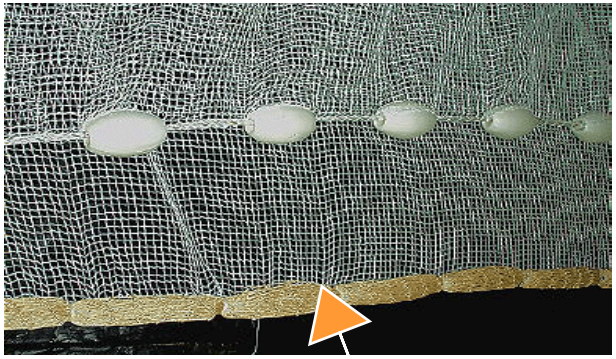
Sampling (sampling gears)

OK

Length

Short

Mesh size

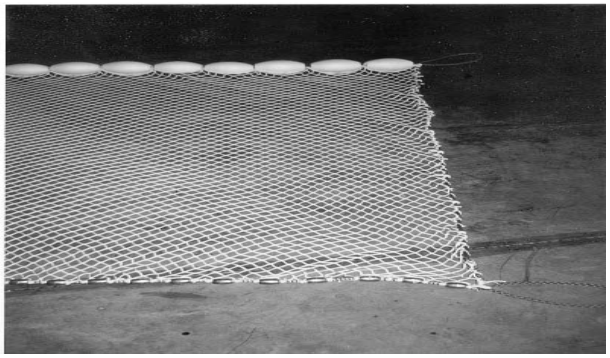


Strands of ropes bound together

Mud line (tilapia) seine

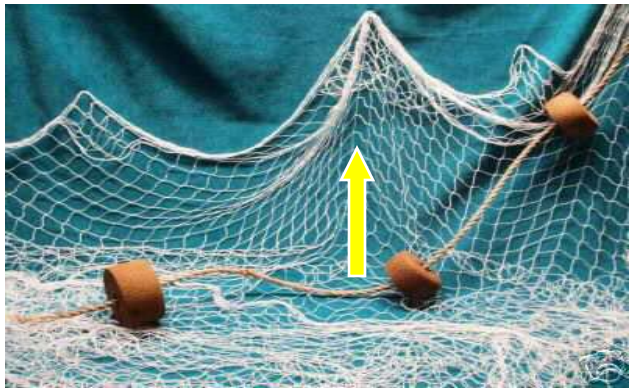
Stays on the top of the mud; eliminating digging of lead lines in the mud

What wrong gears can cause

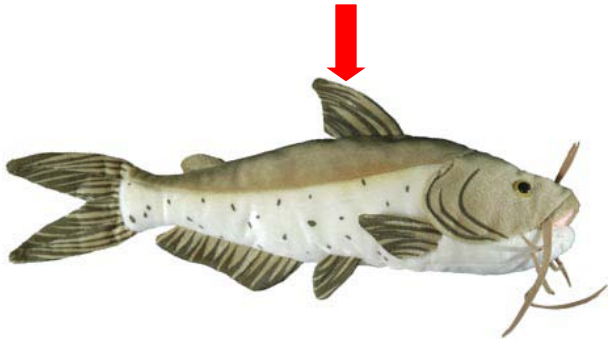


Traditional lead line seine

Nylon Seine Treatment



What to sacrifice with- spine/seine



Sampling (sampling gears – Cast net)

Limited sampling area

Freshwater prawn sampling
Thailand

Marine shrimp sampling
Egypt

Sampling management

Sampling frequency?

excessive sampling should be avoided

monthly sampling in grow-out is sufficient especially in earthen ponds

Remember –depending on means of sampling- feed may be withhold before sampling

Sampling management

Sampling Size **05%?** **10%?**

Absolute number of sampled fish is more important than (%)

unless one has a good reason, sampling of about 100 fish will be sufficient especially when applied to hard to catch fish in earthen ponds (e.g. tilapia – African catfish)

Notes:

Information obtained from sampling should be compared to possible stress which sampling may cause

Only sample what you can handle before stressing sampled fish

Harvesting

Rules:

Only harvest what you can handle

Fish react differently to harvesting (hardy, sensitive)

Sensitive species are sorted first (even as food fish)

Molting shrimp usually of less commercial value. Harvest is done if **less than 5% of the shrimp are molting**, less than 10% have soft shells, and most animals are at the end of a molting period (sampling is needed to determine that)

Stressed fish spoil faster (especially when held in warm water)

Harvesting methods

Vary according to:

Farming facilities (earthen ponds, tanks, cages)

Species (sensitive fish, hardy fish, shrimp, bivalve,…etc)

Harvest planning (selective – total)

Agree upon:

Higher efficiency

Lower post harvest losses

Best quality of the harvest

Better economic feasibility

Harvesting methods – Current method

For a 4-ha Pond, a catch pond of:

2.5 m High and
10 m Long and
2 m Wide

Bottom of catch pond is 80 cm below pond bottom

Water introduced @ 20 – 40 m^3/hr

Timing of water management is a key factor in the success of this method

This method utilizes the swimming behavior of fish harvested (against water current)

Fish produced is cleaner with minimum left over fish in water pockets here and there

Harvesting methods - Drainage (the sure means)

Earthen ponds are completely harvested only after drainage

Draining is of particular importance to fish which can survive in small water pockets or burrow into the mud (African catfish, tilapia)

Selective harvesting

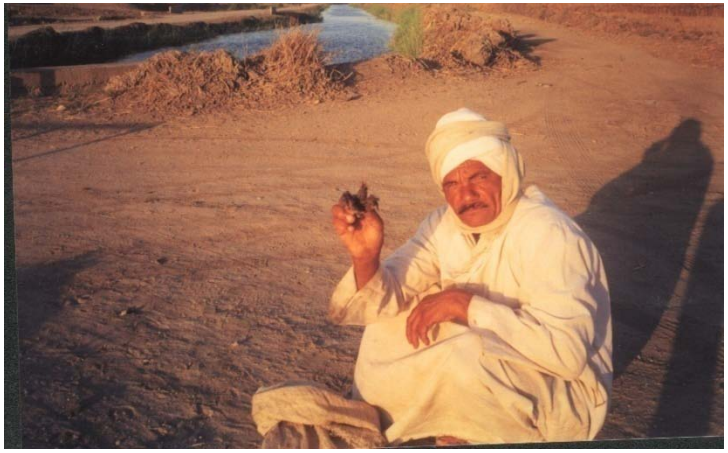
More efficient in mono-culture systems- harvest particular size leaving the rest to grow

Large mullet

Small tilapia

Using one seine in a polyculture system might catch the required size of slender species (e.g. mullet) but will catch smaller size of flat species (e.g. tilapia)

Harvesting and Biology



The burrowing behavior of crayfish favors trapping as a practical means of their harvest

Harvesting and swimming behavior

Collecting fish while swimming against water current

Electrofishing

Primarily used in freshwater

Electricity is used to stun fish not to kill them

For aquaculture, it could be used to get broodstock from deep waters when other sampling or harvesting methods cannot be used (e.g lakes)

Faulty equipment or operations can result in serious injury or death

Accredited training & licensing is essential to ensure safe operation to operators and fish

Many countries have developed operation and safety guidelines for electrofishing

Grading

Why grading?

Having uniform sizes would enhance management (e.g. nutrition in regard to pellet size, protein contents or feeding ratios)

Facilitate marketing & pricing

Reduce possibility of predation & cannibalism especially in predator fish

Reduce the possibility of competition for food or space among different sizes

Grading - rules

Graders can be fixed or adjustable

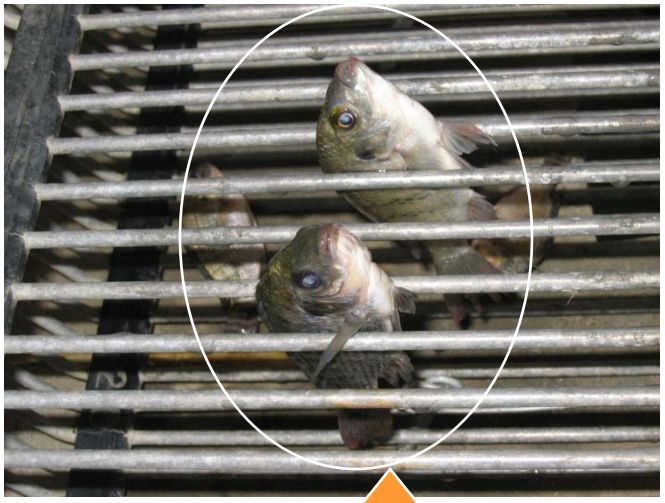
There is a biomass capacity for the grader

If the capacity of grader is exceeded, fish may die before having a chance to grade themselves

Grading should be done in the existence of water to reduce the friction damage

Simple graders can be constructed (example: layered seines, others)

Grading



Problem

Smooth

Fish should be allowed to grade themselves

Grading (Eels)

Q. Manual grading? Don't you use eel graders?

A. Graders are not as precise as hands.

Regardless preferences, grading of eels is a <u>Must</u>
to avoid cannibalism losses

Handy & Automated Graders

Grading is more practiced in intensive systems (management tool)

Hatcheries perform grading to:
•reduce cannibalism
•pricing tool

Automated grader - Italy

Marking

Marking is simply the identification of individuals or groups for various reasons including population dynamics, breeding, hatchery management

Marking should be:

- Fast and practical
- Minimum stressful to fish
- Adequate to marked fish (scaled, non-scaled, shrimp, changing color, etc.)
- Readable throughout the program (short, long)
- Some marking methods require anesthetizing (hot branding)

Types of marking

Marked fish:

Individuals (giving names)

Groups

Position:

External

Internal

In breeding programs

Losing a tag = losing a fish

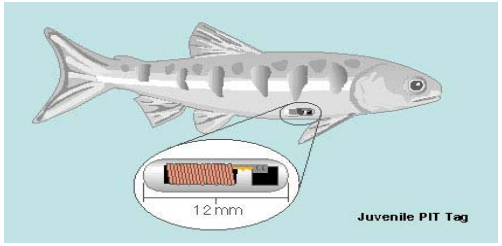
Individual marking

Branding:

Hot branding

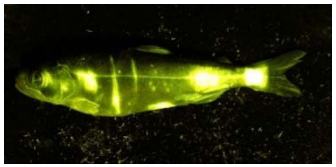
Cold branding: based on liquid nitrogen

Pit tag - scanning



Group marking

Require UV



Right pectoral fin clipped

fin clipping

Ink & dye

Marking: Biology of fish/crustaceans

~~8?~~

Straight lines

Size of the wire

Visible Implant Elastomer

Non-scaled fish & Branding
Shrimp molting and external tags

Anesthesia

Classification A **Levels of Anesthesia**	Classification B **Levels/responses to Anesthesia**
1. Light sedation	1. Sedation Reduced motion and breathing
2. Deep sedation	
3. Partial loss of equilibrium	2. Anesthesia Partial loss of equilibrium – reactive to touch stimuli
4. Total loss of equilibrium	
5. Loss of reflex reactivity	3. Surgical anesthesia Total loss of equilibrium - No reaction to touch stimuli
6. Medullar collapse	4. Death Breathing ceases-heart beat stops - death

No major difference in the classification systems except combining or detailing

Anesthesia

Done only if needed to save the fish & protect operators during:

- stripping or sampling of eggs
- branding
- transportation
- surgery

Doses vary according to:

- species & size
- level of anesthesia required
- could be used with other protocols

Only 1 approved anesthetic on food fish

Main anesthetics in aquaculture

MS-222 (tricaine methanesulfonate)

Rapid induction and recovery

Good safety margin

Requires 21-day withdrawal period

The only anesthetics approved by FDA

Clove oil

Has a very high margin of safety

Inexpensive

Requires relatively long recovery time

Carbon dioxide

Extremely soluble in water

Rated as “Low Regulatory Priority”

No withdrawal period is required

Difficult to adjust and control its level

Requires long induction time

Quinaldine

Effective anesthetic at low cost

An irritant to fish

Has an unpleasant odor

A carcinogen

Anesthetizing protocols

Done through immersion in anesthetic solution or spraying on gills

Fish should be fasted for enough time before being anesthetized

Anesthetic bath should be aerated

Fish should be carefully monitored and proper actions should be taken whenever required

Anesthetizing considerations

Not only consult product label but also consider other related factors (species, size, water quality, etc)

To avoid the accumulation of anesthetics in body, use the lowest effective dose

It is a good practice to test few fish first

Closely monitor fish till their recovery and act when necessary

Calming

Grapping from caudal peduncle

Covering eyes

Hatchery Operations

Acquisition of Broodstock

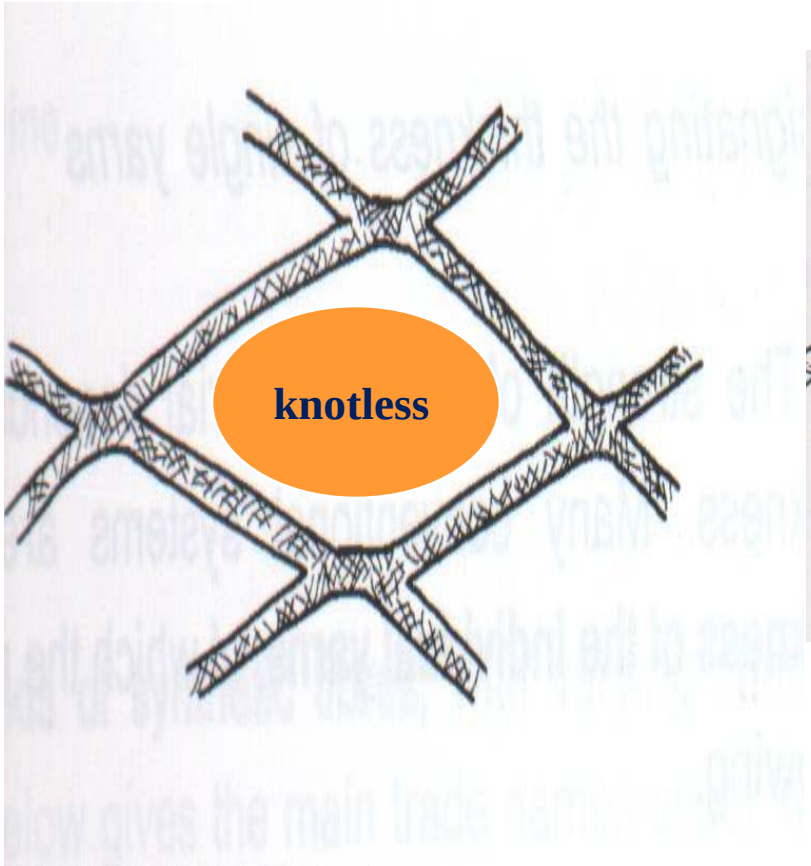
- Seining (Knotless Seine)
- Trapping
- Angling
- Electrofishing

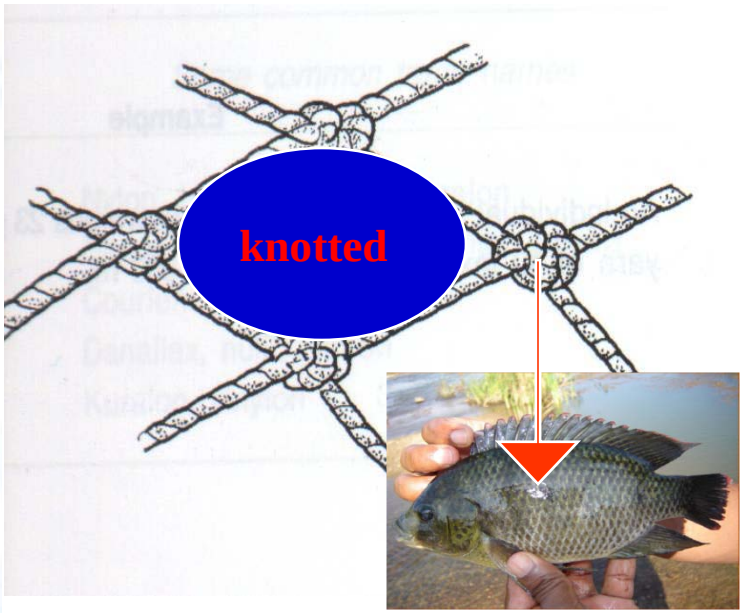
Spawning Operations

Acquisition of Broodstock

Fishing gears efficient in food fish fishery are not necessarily appropriate for broodstock acquisition –
broodstocks deserve better treatment or different fishing gears

Safer fishing gears – Knotless seine





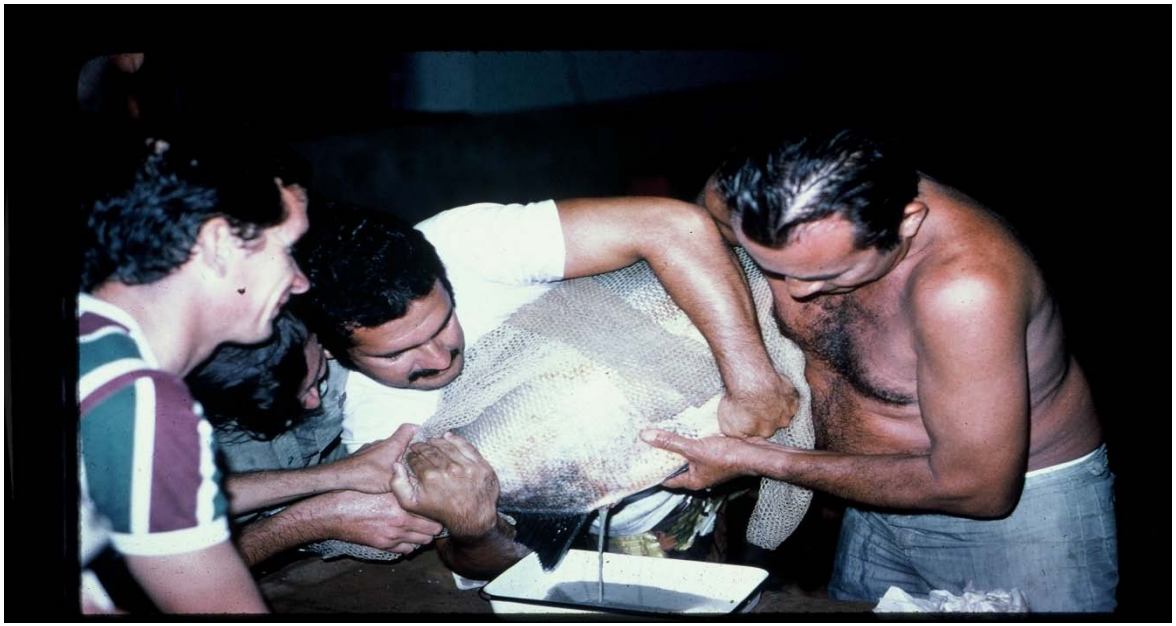
Spawning Operations

Care with females

When catheter is used for egg sampling, careful manipulation and minimum force is needed to avoid the damage of **sphincter muscles**.

If sphincter muscles got torn, eggs at the posterior end of the ovary will water-hardened, and the plug is formed.

Stripping (size, handling)



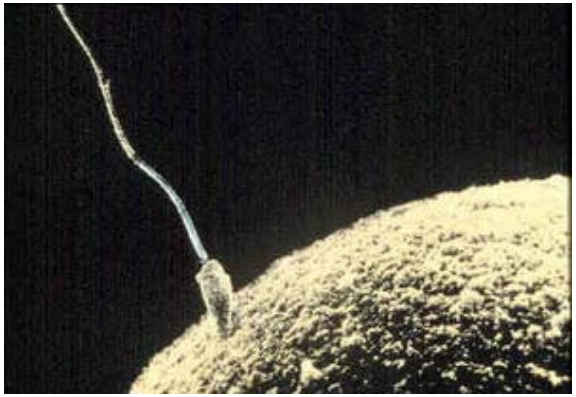
A size as such should be anesthetized
Watch for the effect of anesthesia on the sperm

Spawning Operations
Stripping

Blood or broken eggs resulting from improper handling will reduce the rate of fertilization.

Blood or protein from broken eggs will coagulate and plug the micropyle reducing the rate of fertilization.

Placing eggs in 0.6% salt solution (fertilization solution) makes the protein to go back into solution.



Extending Solution (Ringer)

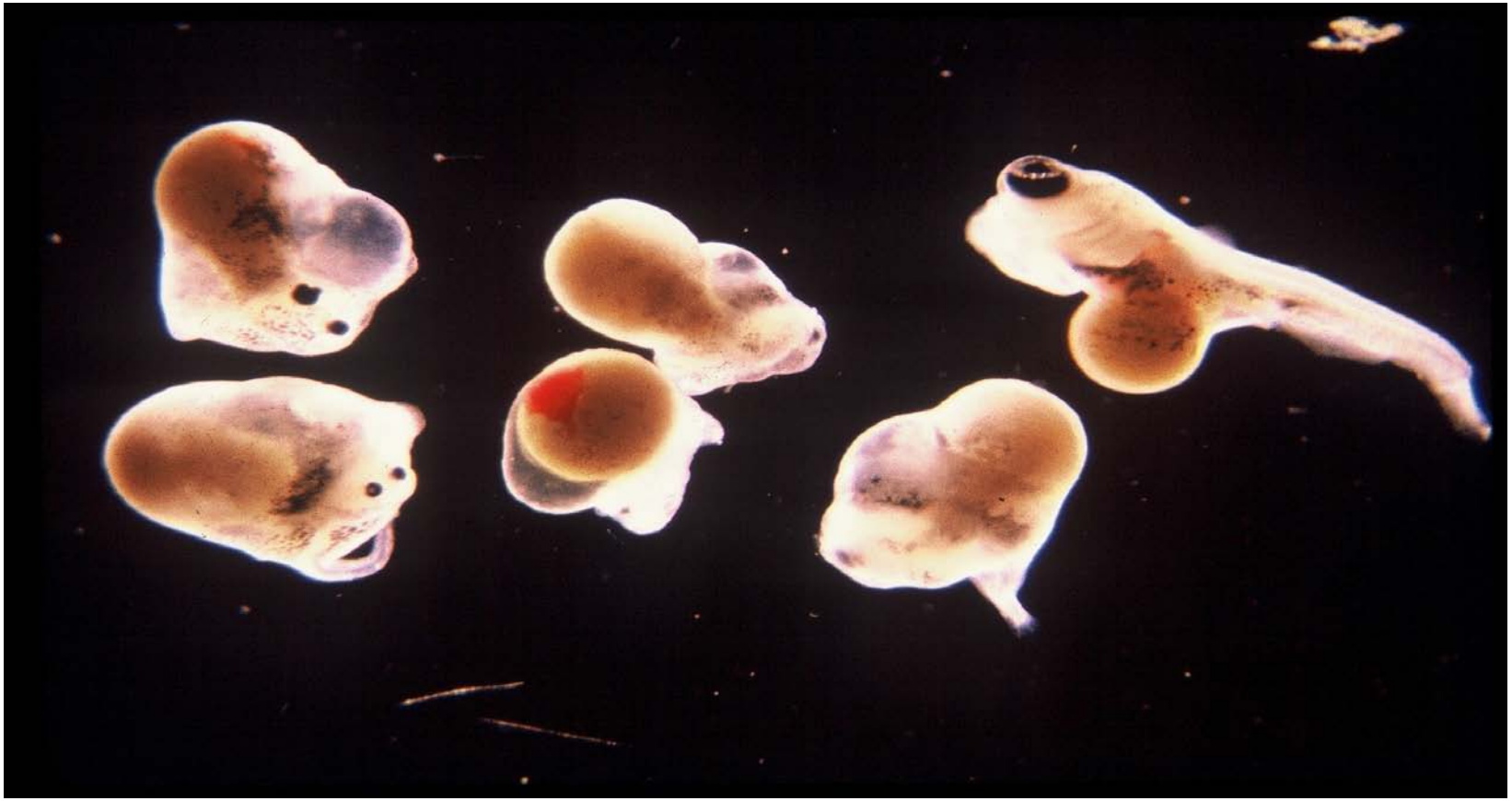
In 100 ml of water:

Sodium chloride	**592 mg**
Potassium chloride	**172 mg**
Calcium chloride	**079 mg**
Magnesium sulfate	**031 mg**

+

100,000 units of penicillin
100 mg of streptomycin

Deformity
(due to temperature fluctuation)



Deformity

Gas Bubble Disease

Pop Eyes

Check for Water Quality

Use de-aerating devices (can be simple)

Spawning operations

Synchronize Hatching

When artificial hatching is stimulated (by drastically reducing water flow for few minutes), a normal flow of water must be restored immediately.

The delay can lead to suffocation and loss of the hatched embryos.

Transportation

Transportation is one of the challenging handling procedures as the concept of transport usually is:

Transport as many fish as possible in

a little water as possible with

a little loss as possible

Transportation
Factors affecting transportation efficiency

Physiological condition of fish

fish should be healthy – transportation should be postponed in case of stress or disease

with the exception of small fry, fish should be given enough time to empty their stomachs before transportation (fish with full stomachs require larger amounts of oxygen for digestion)

Oxygen

the most critical factor in fish transport; most of problems are related to low or depleted of oxygen – mortality could be in mass and **observed**

in addition to **many other factors**, more oxygen will be consumed as fish gets excited (e.g. upon loading)

Transportation
Factors affecting transportation efficiency

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Oxygen

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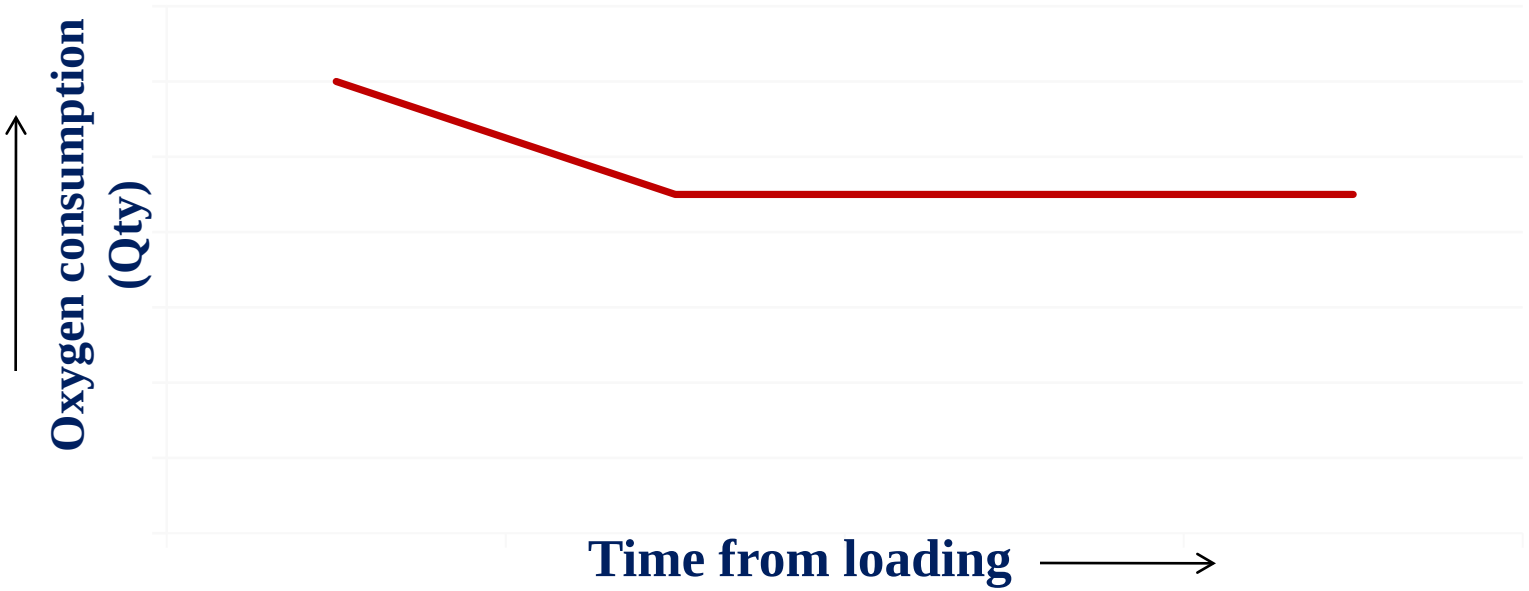
more oxygen is consumed as fish gets excited upon loading

Transportation

Mode of oxygen use



The immediate period after loading is the most critical moment regarding oxygen use

Aerate water before loading

Transportation
Factors affecting transportation efficiency

Carbon Dioxide

free CO_2 is a poisonous product

as free CO_2 increases, more oxygen is required.

since CO_2 reduces the affinity of blood to oxygen. 25 mg/l of CO_2 seems risky.

Ammonia

a major waste product especially at high temperature

if unionized ammonia (NH_3) reaches (about 1 mg/l), oxygen content of blood is reduced to 1/7 normal and CO_2 of blood is increased by 15% resulting in death by suffocation. (Bohr effect)

Transportation & temperature

The influence of temperature occurs influences through its impact on water quality parameters and fish physiology.

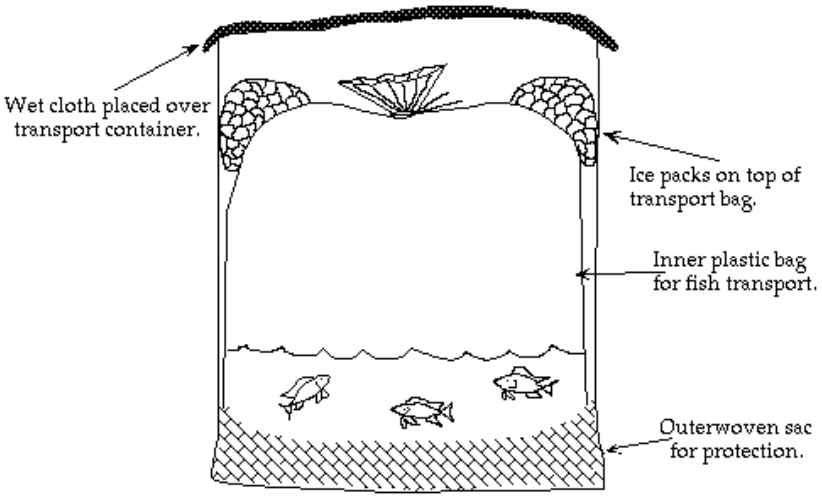
Lowering water temperature will lead to:

- reduce metabolic wastes (feces, ammonia, Co_2)
- reduce DO requirements
- increase the saturation level of water to DO

Fish species vary in regard to levels of temperature reduction

Various means to lower water temperature

Lowering water temperature



Direct means: Use of ice

Direct means: Refrigerated trucks

Lowering water temperature

Indirect means (insulation)

High insulation capacity

Poor insulation capacity

If a wet cloth is wrapped around the above container, water temperature will be reduced by evaporation

Insulation capacity is determined based on K Factor.

K Factor: The amount of heat in BTU transmitted in one hour through one square foot of material one inch thick for each Faryhrenhet degree difference between 2 surfaces of material.

Cork	k=0.29	Fiberglass	k=0.25
Styrofoam	k=0.28	Urethane	k=0.18 Best

Managing water temperature

Indirect means (management)

Timing of transportation is important in regard to temperature management

Late night/early morning is preferred

If transportation is done during optimum time, thermal acclimation on pond dike will be sufficient

Gentle release of fry

Why take the risk?

Flat tire or a traffic jam would destroy this shipment (mullet fry)

Transportation
Special arrangements (Shrimp)

Transportation

Plastic bags (Specifications)

Placing bags in boxes

Right thickness

0.04 mm (fry) – 0.06 mm (fingerlings)

0.1 – 0.15 mm (larger)

No trap ends for fry

Shipping rates

Will vary according to:

Duration of the trip

Temperature

Transportation method: (air, oxygen, insulation)

Species and size

It is a good practice to test before shipping

Examples of materials used in transportation

Adding salt

Adding salt up to 2 g/l will minimize energy spent in reducing salt loss from fish

Some have used up to 5 g/l successfully.

Tolerance limits of species should be considered

If common table salt is used, it should contain no iodine.

Use of anesthesia

Only if needed

Reduce excitement and so stress

Recommended level of anesthesia during transport should permit fish to be caught easily by hand **but not cause** total loss of activity or equilibrium.

MS-222 is used at 15 to 60 mg/l for 6 to 48 hours to sedate fish during transport.

Antibiotics	Acriflavin @ 2-3 ppm
Buffers	Tris hydroxymethyl amino methane 1-2 ppt

Finally

In order to handle fish better we should understand its: (biology, requirement, tolerance and sensitivity, etc)

Unlike other animals, aquatic environment is unique in a way that effects of improper handling may pass unnoticed before being discovered later

If protection is usually considered before treatment, in aquatic systems, protection should be **highly considered**

Thanks for your time. I hope you have found in this presentation some of what you were looking for

While welcoming you to use the contents of this presentation, thanks in advance for referring to it

If you have any comment about this presentation or you need clarification or elaboration, I would welcome your contact via my email address

www.fishconsult.org
aaelgamal@gmail.com
info@fishconsult.org