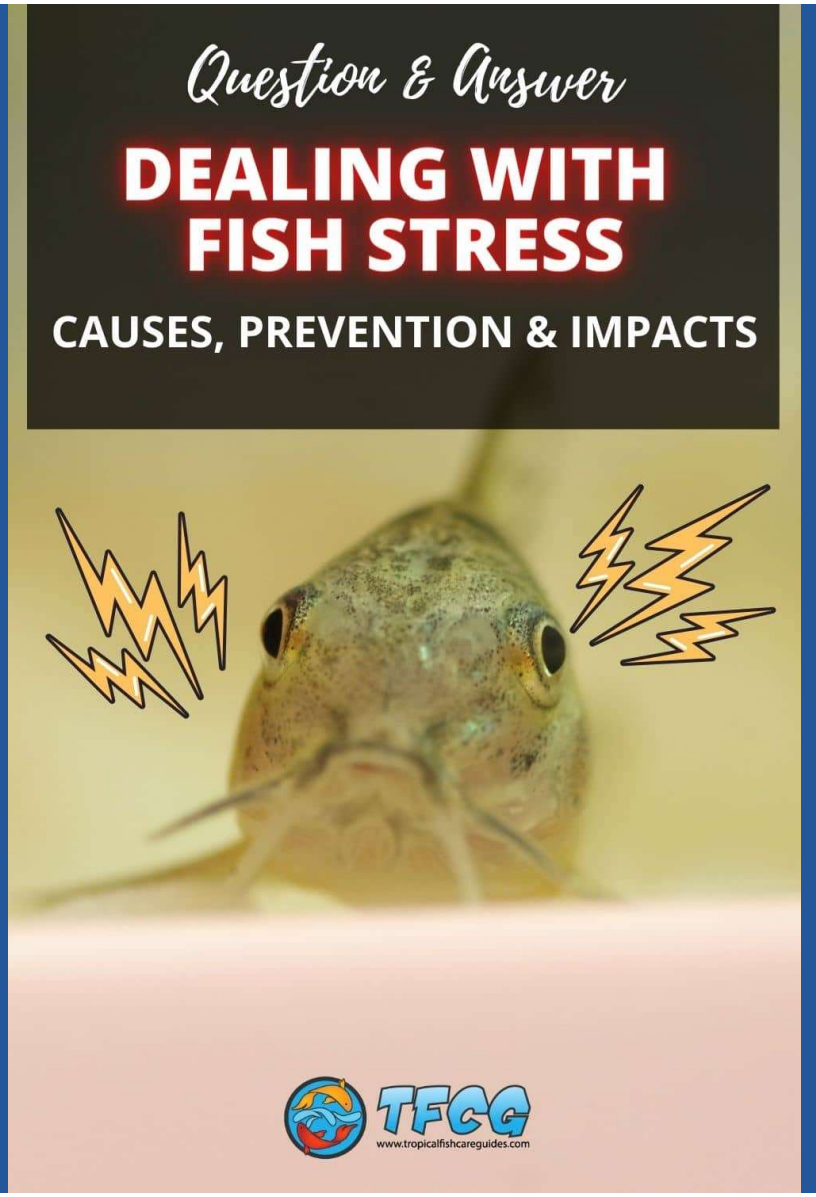
Stress and Handling of Fish

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Aquaculture

- World aquaculture now accounts for slightly mor than 46% of the world's food fish
- Fastest growing (6.8% annually) segment of worldwide animal production
- Worldwide aquaculture production is 110.2 million tons by quantity and US$243.5 billion by value when aquatic plants are included

Wisconsin Aquaculture

* Facts and image taken from the Northern Aquaculture Demonstration Facility (UW – Steven's Point) home page.

- 330 Type 2/3 Farms in WI
- 125 Farms with sales >$1000/annually
- Production of yellow perch for food in WI dropped 16% between 2005 – 2013 (USDA census of Aquaculture 2013)
- In 2013, we imported more wild perch than were produced in the entire US (NOAA CURRENT FISHERY STATISTICS annual report, 2013)

But let's talk stress…

In humans, stress is easily described… it's a feeling of being overwhelmed or unable to cope

In fish, it's a bit harder to describe

The best description is a physiological response to a threatening situation

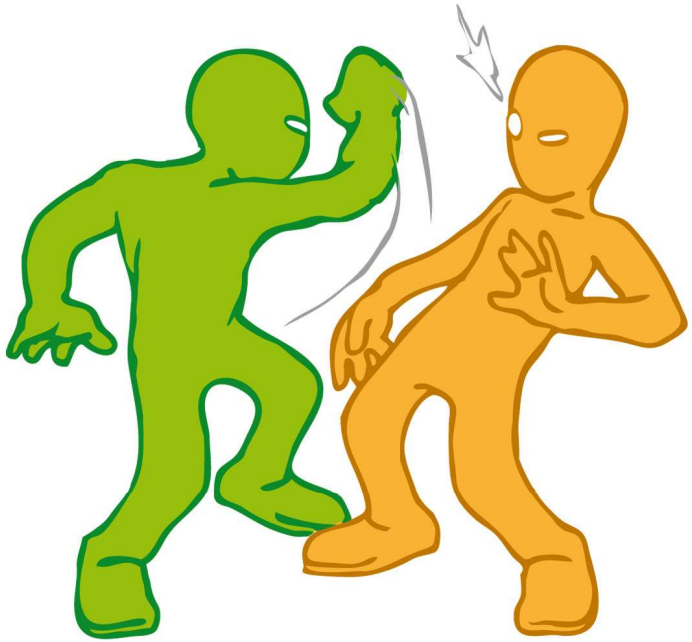
Stress in Fish

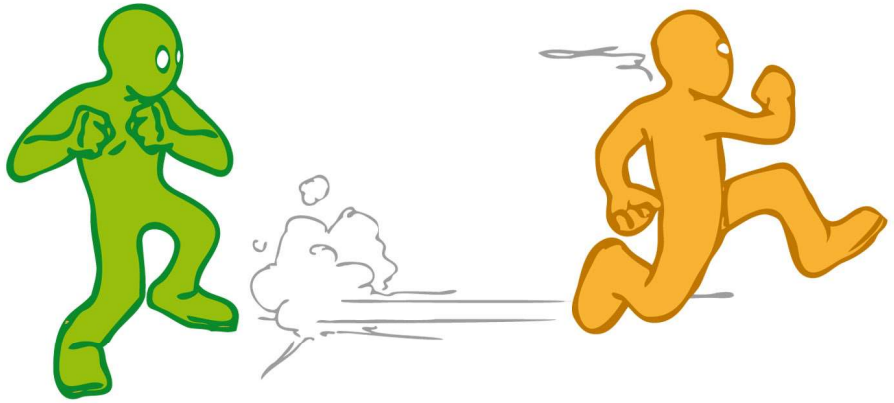
But what constitutes a threat?

- Predators
- Environmental con
- Poor / Bad food
- Density issues
- Others

But what is stress?

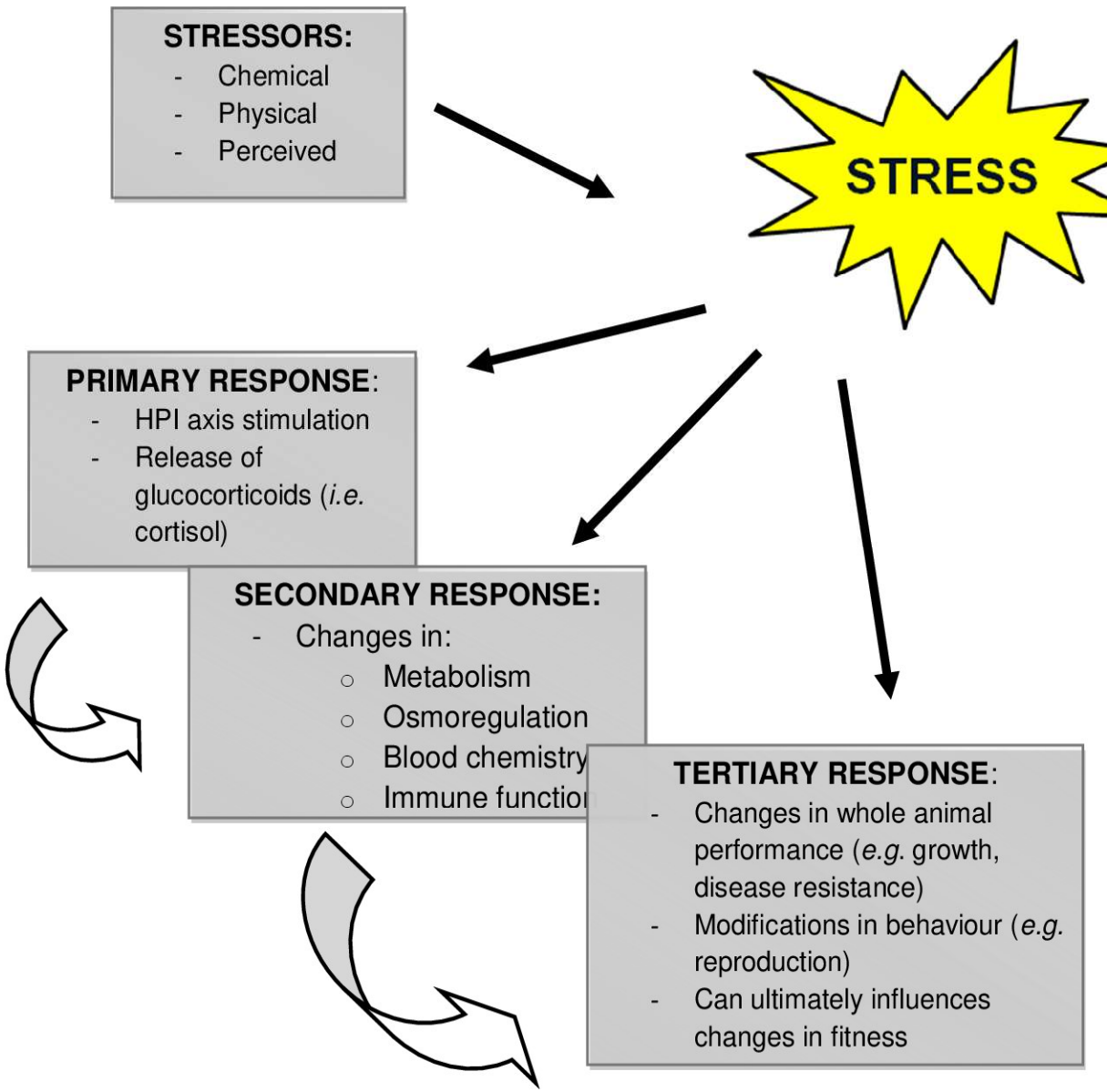
The simplest description is that stress is the mechanism that primes you for “fight or flight”





But what is stress?

A more descriptive explanation is that stress is a physiological response that increases the chance for an individual to survive



But what is stress?

Stress occurs in three distinct phases:

Primary stress response

- the initial stress response
- Focuses on preparing the body to respond to a stressor
- Cortisol and catecholamines shut down “unimportant” functions and prioritize oxygen transport, muscle readiness, and heart rate
- Prolactin (freshwater) and Growth Hormone (saltwater) prepare the fish to deal with an osmotic challenge

But what is stress?

Stress occurs in three distinct phases:

Secondary stress response

- Once the initial surge response is over
- Includes physiological and behavioral responses to adapt to the stressor
- Metabolism is often accelerated increasing need for oxygen and flushing of wastes
- Acid-Base balance is altered to affect the transport of gases
- Immune function is often heightened

But what is stress?

Stress occurs in three distinct phases:

Tertiary stress response

- Sometimes referred to as adaptive response
- Includes things link decreased (or increased) growth
- Can affect reproductive performance
- Often results in long-term down regulation of immune function
- Can lead to severely changed behavior

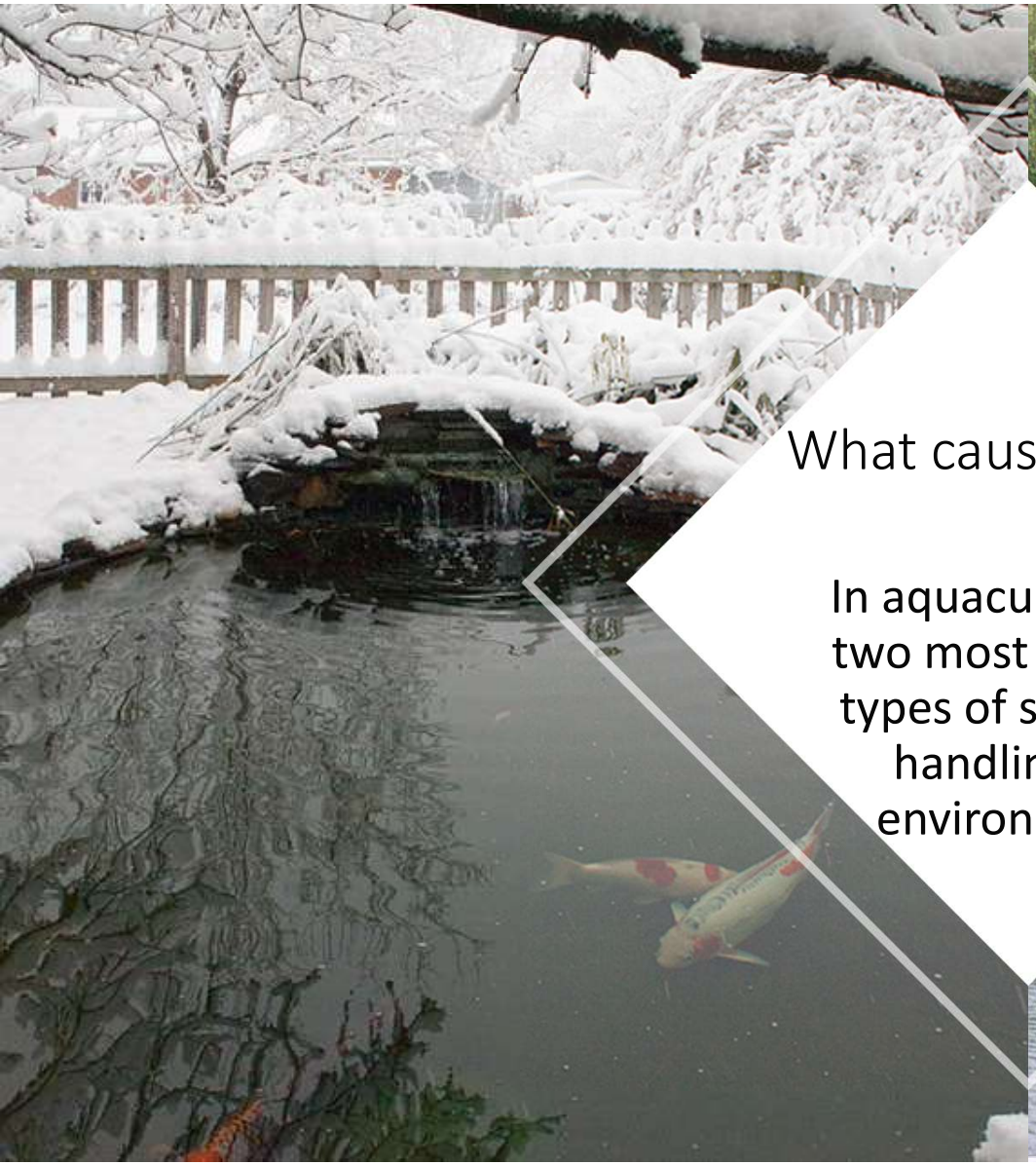
What is the net effect of stress?

The effect of stress varies considerably, but in general:

- Stressed fish are often very fragile in terms of temperature, DO, salinity, and/or disease challenge

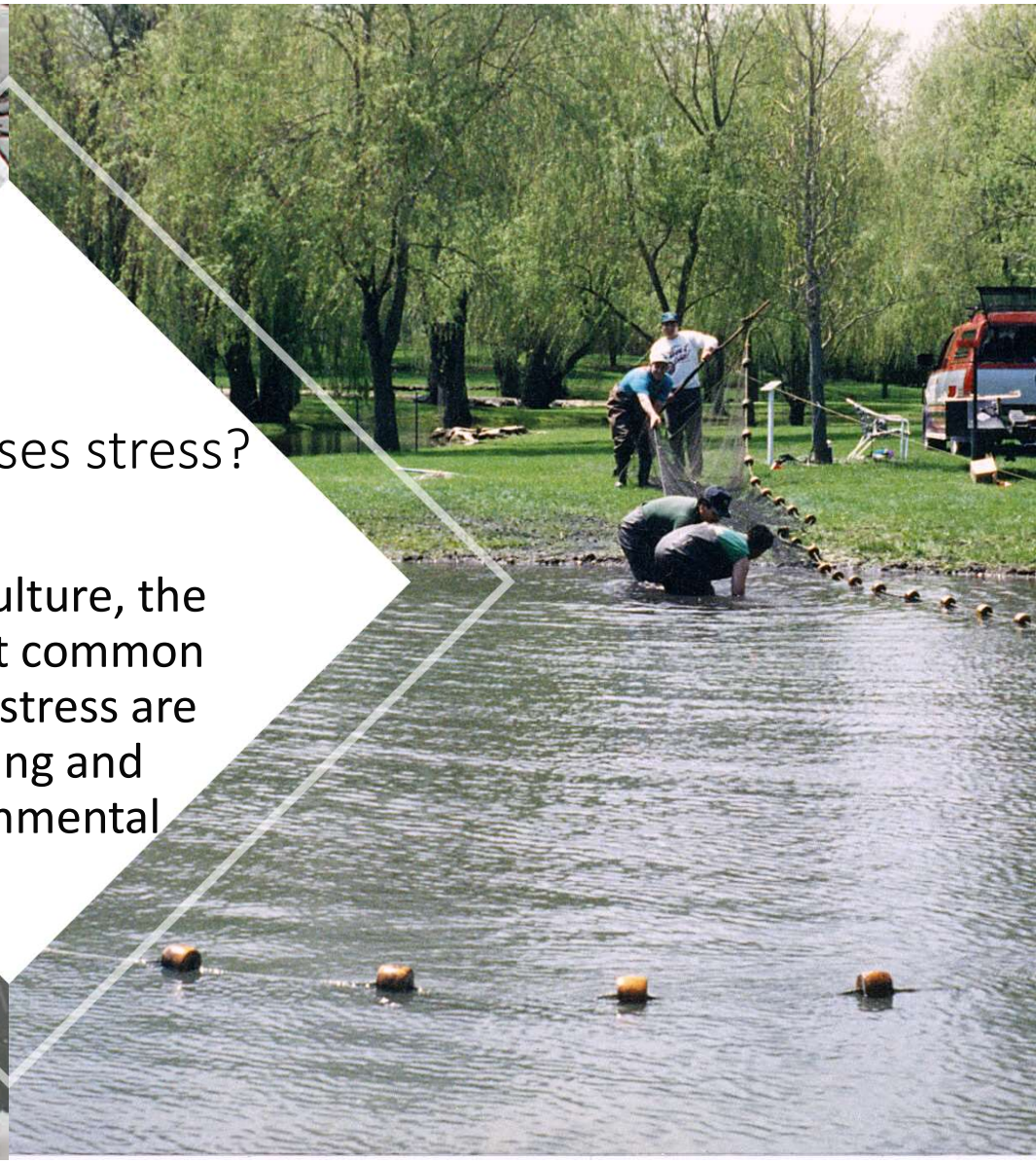
- Utilization of feed is often reduced resulting in decreased FCR and PER, often with increased consumption

- Oddly growth rate can either increase or decrease



What causes stress?

In aquaculture, the two most common types of stress are handling and environmental



General Tricks to Minimize Stress…

There are several general rules to minimizing stress in fish..

1. Avoid loud noises
    - Noise is transmitted to fish through their water quite well

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1. Avoid loud noises
   - Noise is transmitted to fish through their water quite well
   - Fish “feel” noise more than they hear it
   - Fish can be habituated to constant noise

General Tricks to Minimize Stress…

2. Avoid bright / direct lights
   - Even fish who are not harmed by bright lights don't like them shining directly into the tank
   - Some fish are phototactic
   - Growing evidence that wavelength of light can induce / reduce stress in fish

General Tricks to Minimize Stress…

3. Water Quality
   - Routine water quality testing is mandatory
   - Stress goes way beyond just DO, Ammonia, and Nitrite
   - Temperature and pH should be checked routinely as well
   - Hardness / Alkalinity, Nitrate, Copper, and others should be checked infrequently but routinely

General Tricks to Minimize Stress…

4. Just Leave them Alone
   - Most fish are from non-domesticated stocks and react negatively to the constant presence of people
   - Unless you need to be in the tank, just keep people away
   - Covers are fantastic

Quick Sidenote…

Ever notice how most public aquariums are quite dark inside? That's because if the tank is lit and the other areas are dim, fish don't notice you as much

Sometimes… you just gotta stress ‘em

There are times when you have to stress your fish…

- Grading
- Tank maintenance
- Transport
- Feeding
- Inspection / sampling
- Strip spawning
- etc

When you are forced to stress your fish, there are really two different scenarios:

- In-system / Return to system

- Transport / Transfer

To reduce stress:

1. Have absolutely everything you will need or might need already at hand and tested
   - Reducing the time when fish are penned into high density or being actively handled is the most important thing you can do

To reduce stress:

2. Always make sure that fish have not eaten in the past 24 – 48h
   - Fish with food in their guts will evacuate during netting, penning, and transport
   - Waste will add to the BOD (Biological Oxygen Demand), dropping your DO
   - Waste will also add ammonia directly to the system
   - Forced regurgitation and defecation add stress to the fish

To reduce stress:

3. Handle during the coolest part of the day
   - Lowering the temperature slightly increases DO, slows the metabolic rate of the fish, and slows the bacterial activity in the system
   - In outdoor systems, fish should be handled early in the morning (cooler and less light)
   - If moving fish to a new water source, make sure receiving water is COOLER than transport / source water

To reduce stress:

4. Ensure water is saturated with DO but not supersaturated
   - Stressed fish have increased metabolic rates and will use DO far more rapidly than you expect
   - With bottled oxygen, it is extremely easy to over-saturate the water
   - Either use a continuous monitoring DO probe or check DO frequently
   - When fish are confined, make sure that you are testing oxygen where the fish are not somewhere else in the system

To reduce stress:

5. When grading:
   - Use passive crowder / graders when possible instead of bar graders
   - Don’t overload grader!
   - Split fish as rapidly as possible
   - Make sure not to handle fish with dry hands

Picture from Advances in fish harvest technologies for circular tanks, 2009

To reduce stress:

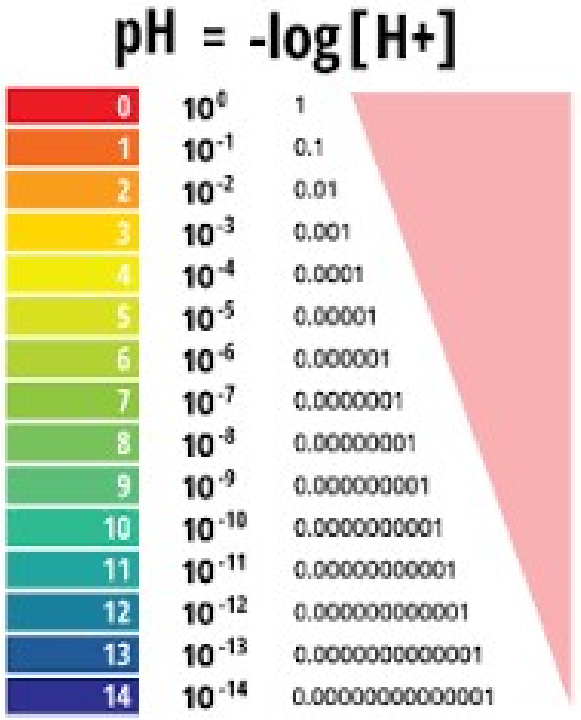
6. Use anesthetic
   - Use of anesthetics are strictly regulated by USDA
   - Particularly when handling broodfish, anesthetics can dramatically decrease stress related mortalities
   - The ***ONLY*** anesthetic approved for food fish is MS-222 (Tricaine methanesulfonate, Syndel) and it has a 21-day clearance requirement
   - Whatever anesthetic you use, you need to have a recovery tank immediately at hand

To reduce stress:

7. During long-term confinement such as transport it is important to reduce osmoregulatory stress
   - Isosmotic point: the point at which the fish and the water have the same osmotic pressure
   - For most fish, this means you should add salt (stock salt works fine) to about 8-9ppt
   - Too little salt is fine, too much is a problem

To reduce stress:

8. Also during long-term confinement, you should buffer pH changes
   - This is typically only possible in smaller systems if you are using a buffer like Tris (Tris base or Tris HCl can easily be purchased for small water volumes)
   - Sodium Bicarbonate (baking soda) can be used as a buffer and in most species it also has a mild sedative effect due to the CO_2 released but you need to test it on your fish for correct dosing at temperature
   - Water with higher hardness (higher levels of dissoved Ca or Mg) is more resistant to pH change



To reduce stress:

9. Finally, during long periods of crowding you need to either routinely flush fresh water through the system or you need to bind the ammonia produced by the fish
   - Flushing water is the best as it removes contaminants but it may be impractical due to a lack of tempered, de-chlorinated water
   - For long distance transport, AMMO-Lock (API) can be used to bind ammonia into a non-toxic form (this is a mix of Sodium Thiosulfate and “aliphatic amine salts”

Post-Handling

Once you've finished handling your fish, you should always monitor them for trouble

Give them time and good water and they should recover from any handling stress

You should always wait at least 24h post-handling before trying to feed the fish → Feeding adds stress, not reduces it

Questions?