

5th Annual International Zebrafish Husbandry Course

Environmental Conditions and Plant Management 2016

Erik Sanders & Gregory Paull

Environmental Conditions - Overview

- Lighting
- Noise and Vibration
- Temperature
- Humidity
- Air Exchanges
- Pest Control
- Security
- Sanitation
- Water resources

USER
ANIMAL
EQUIPMENT

DESIGN?
COMPROMISE?
CONTROL!

Environmental Variables can have significant impact on animal welfare -
Constructed to provide an environment which takes into account the
physiological and ethological needs of the species being kept!

Environmental Conditions - Noise & Vibration



- Guidance
 - Noise levels shall not adversely affect animal welfare and where possible, equipment causing noise or vibration, such as filtration systems shall be separate from fish holding rooms
 - Establishments shall have alarm systems that sound outside the sensitive hearing range of the animals, where this does not conflict with their audibility to human beings
 - Holding rooms shall, where appropriate, be provided with noise insulation and absorption materials
 - USERS? – seek relevant HSE/Building regulations

Environmental Conditions – Noise & Vibration

- What are actual recommended levels for animals?
- Where in the literature?
- **Key is to avoid elevated or sudden noise & vibration** - room layout major factors influencing acoustic environment
- Intermittent noise invoke startle response
- Ultrasound?
- Don't forget entrainment/conditioned to an environment



Environmental Conditions – Temperature, Humidity & Air Exchanges

- Temperature maintained within optimal range for the fish species and kept as stable as possible. Changes in temperature shall take place gradually
 - Balance of animal needs, equipment requirements & user comfort
 - Temperature (fish rooms)
 - Set point 74-78F (23.3-25.5C)
 - Fish water 28C
 - Ectotherms, physiology, growth, sex ratios, experimental consequences?
 - Humidity
 - Less than 50% is desirable – no legal requirement (40-70% office env.)
 - Air Exchanges
 - 6 air changes/hour (minimum fresh air provision - 8L/second/person)
 - Determined by the room usage– holding room versus workstations
 - Pressure (-/+)
 - + main fish rooms
 - - quarantine

Environmental Conditions – Pest Control/Biosecurity & Sanitation



- People cause most of the problems!
High footfall & many hands
- Facility Layout Design can help
 - Separation of quarantine from main holding room(s); plant room from tank rooms; food preparation & live food culture; chemical preparation & researcher sampling spaces
 - Also separation within those spaces - primary & secondary water, filters from different systems, clean and dirty areas for spawning chambers
 - Facility Access – clean shoe policy, step over/barrier system, restricted access
- Implement User Policy (Induction process)
 - Control movement (users, animals and equipment) between holding rooms – **only takes 1!**
 - Set different management levels for different users, e.g. undergraduate versus PhD



Environmental Conditions – Pest Control/Biosecurity & Sanitation

- Implement appropriate sanitation programme
 - Floors, walls, ceilings, work surfaces
- Establishments shall have a regular and efficient cleaning schedule for the rooms and shall maintain satisfactory hygiene standards
 - Common chemicals
 - Bleach
 - Virkon Aquatic
 - Paracetic Acid
 - Iodophor
 - Quaternary Ammonia
- Tanks, nets, filters.....
 - Animal safe disinfectants, safe4, ethanol?
 - Filters - compatible with maintenance of optimal microbial conditions
- Separate tanks/nets between quarantine & holding rooms
- Use of gloves/marbles/plastic plants
- Daily check sheet for room condition as well as the more obvious....

Environmental Conditions – Pest Control/Biosecurity & Sanitation

- Health monitoring programme in place
 - Regular health monitoring of all animals should be carried out, comprising daily checks, plus ongoing monitoring and evaluation to enable prompt interventions. Animals undergoing scientific procedures should be inspected at a frequency commensurate with the severity!
 - » NACWO, NVS.....**BUT** actually also all users of the facility
- Set time each day to ensure completion of health checks
 - **NOT ADHOC!**
- Reference material for less experienced staff to check against
- Reporting process in place/database to pick up trends
- Behaviour, pathology and molecular screening

Environmental Conditions – Water Resources

– Supply

- Where is it coming from? Lake? River? Aquifer? Etc.
- Who (authority) is in charge of your water supply?
- Register for alerts regarding quality reports, source change, treatment changes, etc
- Ensure that interruptions don't occur unless scheduled
 - Alternative sources if failure?



Environmental Conditions – Water Resources

– Treatment

- Where is it?
- Who maintains it?
- Spare filters?
- What is normal service interval?
- Is there a PM agreement?
- Who sanitizes?



Environmental Conditions – Water Resources

– Waste

- Where are drains and mains?
- Are you treating with enzyme etc?
- Are you required to have mechanical means of preventing escape?



- Must you have full-kill assurance before drains?
 - Bleach
 - Heat
- Are you getting \$\$ benefits where possible?

Environmental Conditions – Water Resources

- Water Supply
 - St. Louis, MO Quality Report

DATA FOR 2015 WATER QUALITY REPORT - City of St. Louis Water Division - MO6010715

Detected Contaminants (units)	MCL	MCLG	Maximum Level Detected	Range	Major Sources of Contaminants
Inorganic Compounds					
Barium (mg/L)	2	2	0.0226	0.0178 – 0.0226	Erosion of natural deposits
Chromium (Total, µg/L)	100	100	1.50	1.42 – 1.50	Erosion of natural deposits, Industrial discharge
Nickel (mg/L)	2	2	0.0013	0.0013	Erosion of natural deposits, Industrial discharge
Fluoride (mg/L)	4	4	0.69	0.49 – 0.69	Water additive for dental health
Nitrate+Nitrite (as N mg/L)	10	10	1.58	1.36 – 1.58	Natural Deposits; Fertilizer runoff
Lead (µg/L)*	AL = 15	0	90 th Percentile = 1.55	Number of samples above AL=0	Corrosion of household plumbing
Copper (mg/L)*	AL = 1.3	1.3	90 th Percentile = 0.0437	Number of samples above AL=0	Corrosion of household plumbing
Organic (Synthetic) Compounds					
Atrazine (µg/L)	3	3	0.66	N.D. – 0.66	Herbicide runoff from row crops
Methoxychlor (µg/L)	40	40	0.45	N.D. – 0.45	Herbicide runoff from row crops
Disinfectant/Disinfection Byproducts					
Chloramine (mg/L)	MRDL = 4	MRDLG = 4	3.54	1.97 – 3.54	Disinfectant used to treat water
Total Trihalomethanes (µg/L)	80	N/A	20.7	6.8 – 20.7	By-product of disinfection
Haloacetic Acids (5) (µg/L)	60	N/A	41.5	9.9 – 41.5	By-product of disinfection
Microbiological Data					
Total Coliform Bacteria (% positive samples)	5% of monthly samples positive	0	Highest Month: 0.00% Annual Average: 0.00%		Naturally present in the environment
Total Organic Carbon (mg/L)	TT (Required min. 15% TOC removal from source water)	N/A	3.58	2.61 – 3.58	Naturally present in the environment
			Annual Avg. Percent removal = 30.1%		
Turbidity (NTU)**	TT (1NTU)**	N/A	Highest Level = 0.10		Soil runoff
	TT = 95% of monthly samples <0.3NTU		Percentage of samples below 0.3NTU = 100%		
Radioactive Contaminants					
Gross Alpha Particle Activity, Total (pCi/L) Year 2013*	15	0	Not Detected	N/A	Erosion of natural deposits
Total Uranium (µg/L) Year 2013*	30	0	Not Detected	N/A	Erosion of natural deposits

Environmental Conditions – Water Resources

- Water Supply
 - St. Louis, MO Quality Report

Optional Monitoring (not required by EPA)

Secondary Contaminants	MCL	Average Level Detected	Range
Alkalinity, Total (mg/L)	N/A	56	20 - 112
Calcium (mg/L)	N/A	27.5	3.2 - 80
Chloride (mg/L)	250	23.7	16.6 – 34.0
Conductivity (μ S/cm)	N/A	472	263 - 930
Hardness, Total (mg/L as CaCO ₃)	N/A	131	65 - 259
Iron (mg/L)	0.3	0.008	0.0015 – 0.028
Magnesium (mg/L)	N/A	14.1	5.0 – 20.9
Non Carbonate Hardness (mg/L as CaCO ₃)	N/A	78	48 - 96
pH	N/A	9.36	8.19 – 10.00
Potassium (mg/L)	N/A	4.41	2.92 – 5.46
Sodium (mg/L)	N/A	38.5	18.9 – 61.0
Solids, Total Dissolved (TDS) (mg/L)	500	302	194 - 383
Sulfate (mg/L)	250	130	68.6 – 183.8

Overview – Plant Management

– HVAC

- Intake
- Air-handling
- Heating
- cooling

– Electricity

- Main
 - Conditioning (inversion/transformers/UPS)
- Emergency

– Water

- Source (a.k.a mains, municipal, etc.)
- Purified
- Waste

– Compressed Gas

- Breathing air
- O2
- N2

Plant Management - Air

– HVAC

- Intake: where is it?
- Air-handling
 - Service intervals and responsible party
- Temperature
 - What are set-points and ranges and alarms?
 - Who monitors?
 - Response Procedure in place for failures
- Heating
 - Is it gas? Electric? Steam?
- Cooling
- Dedicated or shared systems? If shared, who with? what are the 'pinch points'?
- Understand your down time!
 - What does it mean for your facility? Identify critical zones, mitigation steps – be prepared

Plant Management - Electricity

– Electricity

- Where are panels/breakers
 - Do you have a key?
 - Do you have spare breakers/fuses?
 - » What are you allowed to do?
 - » Response Procedures for Failures – point of contact
- What voltages supply your area?
 - Critical when equipment is spec'd or replaced
- Is there generator backup?
 - How is it powered?
 - Who is responsible for testing?
 - When was it last tested?
 - Is your critical equipment *really* on emergency power?
- Uninterrupted Power Supply (UPS)
 - Life support IT – how many hours do you need?

Plant Management – Water

– Water (Primary supply)

- Temperature
 - How is it heated/Cooled?
 - How does it interface with your life support plant?
 - What are set-points and ranges and alarms?
 - Who monitors primary supply and condition of heat exchangers, solenoids, actuators?
 - Response Procedure in place for failures
- Dedicated or shared systems? If shared, who with? what are the 'pinch points'?
- Understand your down time!
 - What does it mean for your facility? Identify critical zones, mitigation steps – be prepared
- Hot water supply to sinks for sterilization
- Water supply to tank washers
- DI Water supply – who maintains?

Plant Management – Service contracts and reporting

- Service contracts
 - How often? What's covered? & Who controls them?
- Maintenance Schedules
 - How much is reactive vs preventative?
 - Maintenance and Emergency reporting routes and contact lists
 - Priority for BSU emergencies agreed & communicated college wide
 - Estate Services Team with local knowledge
- In house SOPs for daily maintenance tasks
 - Refresher training during service contracts?
- BSU technical working group reports to AWERB
 - Ensures actions are completed – they impact animal welfare!
 - Ensures regular updates with maintenance teams