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Customized habitats for aquatic and marine life Habitats aquacoles paramétrés en circuit fermé Controlador de ambientes acuáticos y marinos

# MULTI-STRESSOR INSTRUMENTS

AN UNIQUE LINE OF COMPACT, ADAPTABLE AQUATIC HABITATS WITH ADVANCED ENVIRONMENTAL SIMULATIONS

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AQUABIOTECH 936 route 141, Coaticook (Qc) CANADA J1A 2S5

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sunmatch™

# MULTI-STRESSOR™ INSTRUMENTS

***Understanding how marine animals cope with ecological-relevant changes***

## DESIGNED FOR DOING MULTI-PARAMETER RESEARCH ON AQUATIC AND MARINE LIFE

"Welcome to AQUABIOTECH's new catalogue of Multi-Stressor Instruments". We are proud to present this advanced family of Multi-tank systems for which environmental controls (pH, temperature, dissolved oxygen, salinity and toxicants), are incorporated "à la carte". These unique and polyvalent instruments are the happy outcome of over 10 years research and development at AQUABIOTECH's head quarter in Quebec, CANADA. By associating an aquatic unit with specific controls you customize your own multi-parameter fish habitats.

We hope that these sophisticated instruments will help propel the scope of your work.

Each unit in the following pages is presented with a brief description and a cost. Please consider the indicated price as a guideline.

Sincerely,

**Hélène Drouin,**
senior biologist President

**P.S. Call us at 1-819-849-4440, (1-888-933-0303 US and Canada) or Email at info@aquabiolab.com. I'll be happy to discuss your equipment needs with you!**

**"Right from the first contact I had with AQUABIOTECH, I've been satisfied that I was doing business with super competent people. "**

**Dr. Remy Rochette,** University of New-Brunswick in St-John

**FEATURES COMMON TO ALL OUR MULTI-STRESSOR™ UNITS**

# FEATURES COMMON TO ALL OUR MULTI-STRESSOR™ UNITS

## GENERAL

A multi-stressor unit (MSU) is always composed of a bank of tanks **and** a water recycling system.

- All fish tanks within a Multi-stressor unit **share the same water** and are exposed to the same environmental and experimental conditions. The reuse of water allows keeping uniform, and stable environmental conditions for all animals exposed to a specific treatment. Depending on the tank size, a specific treatment may include from 6 to16 tanks.
- Frames are made of plastic resistant to seawater corrosion. FDA-approved for direct contact with food, they will never rust or leach chemicals.

## PLASTIC FRAMES

Fish tanks are located on a corrosion and mould resistant fiberglass and plastic stand. The high-strength legs and stand are inert, easy to clean. The stand is NSA-approved for direct contact with food and does not leach any chemical, thanks to the unique Microban® protection an antibacterial & mould resistant built-in agent. The full shelves provide a full barrier protection between levels, making tank handling easier. It also limits the amount of ambient light passing through from level to level, providing a grey background, limiting stress for the fish as tanks below are moved in and out of the shelves.

## SAFER FISH HABITAT

- These fish habitats meet and sometimes exceed the Canadian Council for Animal Care (CCAC) guidelines for the care and use of fish in research, teaching and testing.[1]
- Rearing tanks are self-cleaning Zebrafish-type tanks (1, 3, or 9-L), all interchangeable. The swift water exchange rate through rearing tanks (8-9/h) carries food particles, keeping tanks self-cleaning. For flexibility, flow rate to rearing tanks can be manually adjusted by the operator. In most cases, a row of tank contains 6 x 9-L, 12 x 3-L or 14 x 1.5-L tanks.

## LOW WATER REQUIREMENTS AND MORE PRECISION

- Most multi-stressor systems are designed for closed-circuit operation. No more than 5-10% of the water volume needs to be replaced per day. Compared to flowthrough systems, the environment is more stable and the precision in maintaining a given parameter (pH, oxygen, temperature) is greatly improved. Plus, the operating costs for heating, chilling or applying any controls are considerably reduced. Yet, all units can operate on a semi-open mode, as for ecotoxicology studies, and still maintain the experimental conditions stable. A maximum of one to three complete water renewal(s) per day is than acceptable, depending on the type of control applied.

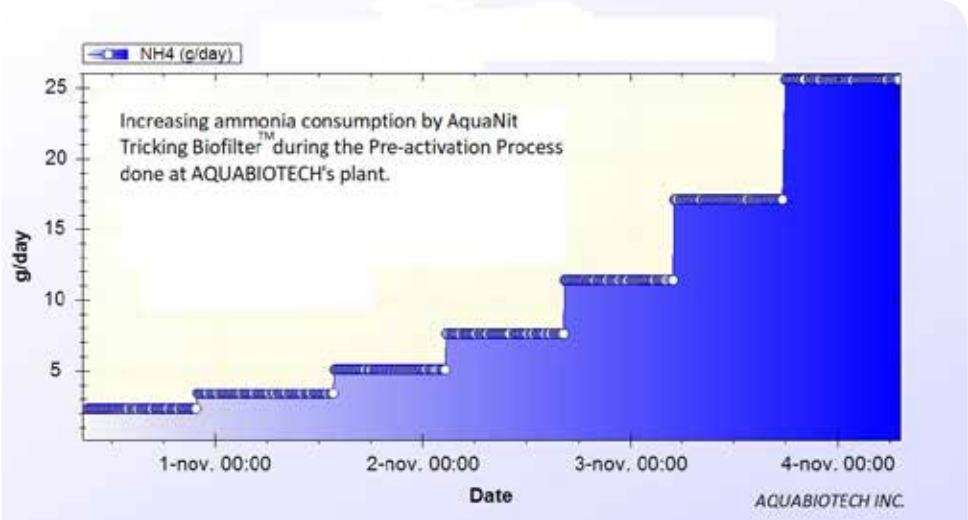
## WIDE RANGE OF WATER TEMPERATURE IN OPTION

- Water temperature in our standard insulated Multi-stressor systems ranges from 4°C to 35°C ± 0.3°C (room at 20 C). Water chilling is done via a very quiet/compact freon chiller. For cold-water studies, racks are enclosed with insulated panels reducing chilling requirements, operating costs and condensation. This covered habitat automatically includes photoperiod control. Warmer water studies do not require insulation panels. Water temperature in non-insulated racks ranges from 15°C to 35°C ± 0.3°C (room temperature at 25°C).
- Please note that water temperature chilled down to 0°C ± 0.2°C in full seawater can also be obtained. This is done via technical adjustments such as the use of a glycol chilling system (in options).

## AN OUTSTANDING WATER RECYCLING AND BIOFILTRATION (REBF) SYSTEM

- Each Multi-stressor unit contains a REBF (water REcycling with BioFiltration) system set on its own shelving, adjacent to the fish habitat rack. This six-stage REBF system is design to maintain water clear and clean, while 100 % or so of the water is recycled. It includes filtration down to 20 µm, bio-filtration, aeration, $CO_2$-degassing; carbonate to help stabilize pH, and activated carbon to remove dissolved organics. Thanks to the excellent degassing capacity of the AquaNit biological filter, the risk of nitrogen supersaturation is eliminated. With this water treatment mix, ammonia spikes, oxygen deficits, turbidity and $CO_2$ accumulation are prevented for the wellbeing of aquatic and marine life.

- Unique feature in the industry, our AquaNit™ biofilters come pre-coated with freshwater or seawater nitrifying bacteria, keeping nitrogen levels stable as recommended by the Canadian Council for Animal Care (CCAC). This active bacterial population saves months of biofilter maturation, preventing the ammonia spikes generally seen as fish is initially introduced in a new system.




- Again, unique in the industry, our biofilter media is now packed into fine mesh bags that fit tidily into the biofilter casing. Once a test is completed, the bag can be removed and replaced with a fresh one, adding protection against cross contamination between experiments. Plus, should you purchase a biofilter inoculation station (BIS), this low cost media can be automatically pre-coated with active nitrifying bacteria directly in your lab.

- In most cases, the optional equipment necessary to expose the animals to multiple stressors (e.g. hypoxic conditions, salinity simulation, pH control...) is located on the REBF rack, adjacent to the fish rack.

## ELECTRICAL PROTECTED AGAINST CORROSION

- Unless specified, all electrical components are CSA-approved.

- Every unit features IP67-certified[1] waterproof electrical plastic connectors and Marine grade FT4 shielded cables CSA-certified[2]. These should still be replaced every 3 years when located in humid / saline environment.

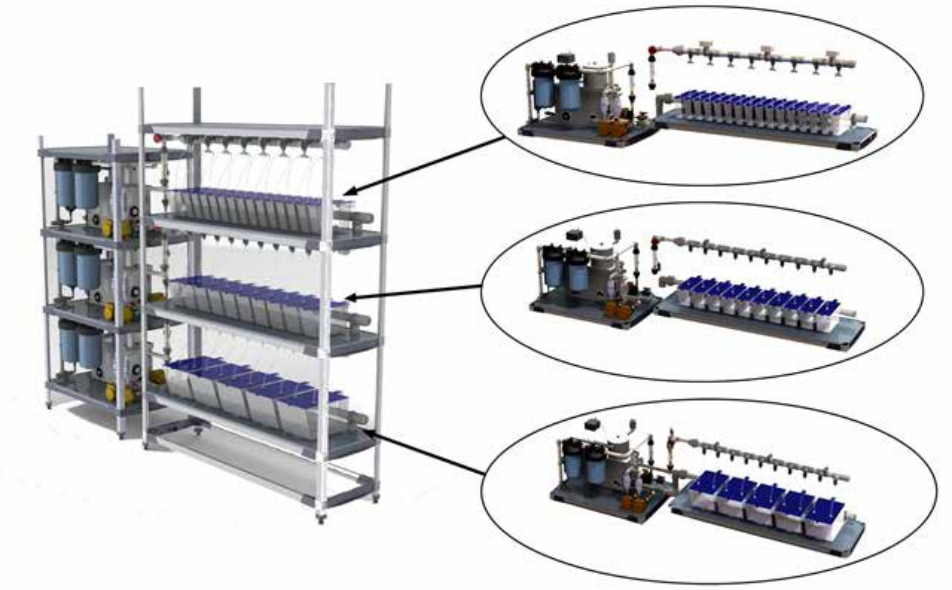
[1] Protected against water penetration when submerged 1 m deep for half an hour.
[2] Fire retardant (FT4) tinned wire to prevent corrosion (marine grade) and covered with an overall aluminum foil shield to prevent interference.

MULTI-STRESSOR

# MULTI-STRESSOR

## UP TO THREE MULTI-STRESSOR UNITS COMBINED ON A SINGLE RACK

This drawing illustrates three independent Multi-stressor units (MSU) on a rack. Each unit is a completely operational closed water recycling system whose fish tanks share the same water. The water flows swiftly through them (minimum of 8 water exchange/h) maintaining a stable, uniform environment at all times.



**Better than a technology: an expertise!**

| Aquarium Dimensions | | | | | |
|---|---|---|---|---|---|
| Internal dimensions LxlxH (in) | | | External LxlxH cm (in) | | |
| 1L | 3L | 9L | 1L | 3L | 9L |
| (9.3 x 2 x 4.75) | (9.3 x 3.65 x 4.75) | (11.7 x 7.9 x 6.1) | 33 x 7 x 17 | 33 x 12 x 17 | 39 x 23 x 20 |
| | | | (13 x 2.8 x 6.8) | (13 x 4.8 x 6.8) | (15.5 x 9 x 7.8) |
| Volume (calculated) | | | | | |
| 1.45 L (0.38 gal) 2.64 L | | 9.24 L (2.44 gal) | | | |

“The equipment and workmanship is of good quality and the service is personal. They take responsibility for the whole system, they put it all together. And they don’t just come here once and the disappear forever. ”

Each Multi-stressor unit (MSU) is composed of a Fish Habitat, a Water Filtration with Biofiltration (REBF) system, each located on a distinct seawater-resistant plastic shelf, and a control panel. The equipment for the control of dissolved oxygen, pH, salinity, toxicants... is optional and purchased "à la carte". Each unit will then be custom-built with a specific mix of controls.

A basic MSU includes the racks, 6 x 9 L tanks with the water and air distribution lines, the REBF system, a CSA-certified control panel, and an Enviro-Monitron™.

For cold water applications, the Fish Habitats are enclosed into an Insulated cabinet with sliding doors to widen the water chilling range. A light-emitting diodes (LED) assembly for photoperiod control is then included *de facto*.

### CSA-APPROVED CONTROL PANEL

- NEMA 4X enclosure for humid environments;
- Automatically starts back-up pump (fish habitat);
- Automatic On/off switch with overload for critical components;
- Quick plug IP68 connectors for each device.

### WATER RECYCLING & CONTROL MODULE

- Includes quiet pumps & chiller;
- Quality-selected water filtration equipment;
- Dedicated filtration pump;
- Biofilter pre-activated with live nitrifying bacteria;
- Automatic control of the make-up water flow.

### FISH HABITAT.

- Dedicated fish habitat pump;
- Insulation panels are standard for cold water operation (≤15°C) with independent photoperiod simulation;
- Flow rate to habitat is adjustable.

| Foot print[3] | | Habitat rack | Filtration rack | Space between racks set in line |
|---|---|---|---|---|
| Height is variable (approximately 199 cm) | Non-insulated | 159 CM X 46 cm | **137 cm X 61 cm** | **32 cm** |
| | Insulated | 159 CM X 53 cm | | |
| | The filtration rack can be located in line (I shape) with habitat rack, at the back(U) or in L. | | | |

MODES OF CONTROL

# MODES OF CONTROL

Three modes of controlling the water parameters are currently available for most water parameters: static, dynamic or cyclic.

| MODE | DEFINITION | HOW IT IS ACHIEVED |
|---|---|---|
| **STATIC CONTROL** | Implies a stable set point, actively maintained via a probe and the electronic system. | The operator enters the wanted value of the parameters to be controlled in the Enviro-Monitron™;<br>The parameter reaches the set point at its maximum rate and automatically remains at that set point – via constant monitoring. |
| **DYNAMIC CONTROL** | The parameter drops or rises at a given rate (ex. 1.0°C/h), then stabilizes in a plateau. | To set in a dynamic mode, the operator enters:<br>• Wanted set point<br>• Wanted rate (ex. 1.0°C/hour) |
| **CYCLIC CONTROL** | The parameter drops or rises, and stabilizes in a plateau for the wanted period of time. After this period, the parameter increases or decreases automatically at the same rate to reach and maintain a second plateau;<br>The cycle repeats itself;<br>Square wave. | To set in a cyclic fluctuation, the operator enters:<br>• The first level wanted;<br>• Time to reach and maintain that level;<br>• The second level wanted;<br>• Time to reach and maintain that level. |

Note: Dynamic control over the drop and rise phases of the cycle can be incorporated with Cyclic Control by setting a given rate (ex: 1.0°C/h). Otherwise, the rise and drop phases occur as fast as the system can go (2.5°C/h).

# INDIVIDUAL WATER PARAMETERS

## TEMPERATURE

### Static, dynamic and cyclic control (± 0.3°C).

#### Ranges and rates

- Standard insulated units: 4-35°C ± 0.3°C (room at 20°C).
- Standard non-insulated units: 15-35°C ± 0.3°C (room at 25°C).
- Maximum rate of change: -3.5°C/hour +3.7°C /hour (dynamic and cyclic control).

#### Components

- Includes a salinity-resistant temperature probe, quiet chilling compressor with titanium heat exchanger, water heater and controls.

Note: Water temperature down to 0.1°C is available in option for marine systems, as well as customized rates of temperature rise/drop.

## DISSOLVED OXYGEN

### Static, dynamic and cyclic control

#### Method

- Normoxic and hypoxic conditions are created through the controlled injection of nitrogen gas mixed with air at 35 PSI. A swift water turn-over rate through fish tanks compensates for the oxygen consumed by the organisms, keeping dissolved oxygen stable.
- Oxygen-enriched air is required if dissolved oxygen levels above 90 - 95 % saturation (hyperoxia) need to be created.
- The DO-controlled assembly includes the Monitron software, an aquaculture grade galvanometric DO probe, gas mixing column, pressure regulators, and associated equipment.
- Oxygen and nitrogen generators are provided in option. We also offer 100 psi oil-free compressors selected for your application.

**Note:** The purity of nitrogen gas influences the process of hypoxia creation. For instance, with a nitrogen gas purity of 99%, dissolved oxygen drops within about one hour from 10 to 1.5 mg/L at 5°C in freshwater, and from 10 to 1.0 mg/L in seawater. When lower oxygen levels or faster hypoxia rates are needed, 99% + pure nitrogen gas is required. Nitrogen purity of 99% + is obtained with oil and water-free 100 PSI compressed air.

#### DO range and rates

| | | Conditions used for factory testing |
|---|---|---|
| Maximum range | 1.5 mg/L to 9.0 mg/L ± 0.1 mg/L | Obtained at 10°C with 99% purity $N_2$, and no water make-up. In fresh and seawater. |
| Maximum drop rate | Drop of 9 mg/L per hour | Obtained at 10°C with at least 99% $N_2$ purity and no water make-up. In fresh and seawater. |
| Hyperoxia (in option) | Above saturation values | Obtained with the addition of oxygen-enriched air |

**Note:** Note: Oxygen control can be incorporated in all multi-stressor units, including specialized units such as our Tide Chambers and Artificial Rivers.

# pH

## Static and dynamic control

### Method

- The pH level in our MSU can be lowered with the controlled injection of $CO_2$ gas or a weak acid. It is raised via aeration or a weak base in both seawater and freshwater. Aeration will be sufficient in most cases, but to raise pH above the normal pH of given water, a weak base is necessary.
- The pH control system features an industrial pH probe with transmitter linked to a Monitron™ controller, associated with precision equipment.

### pH range and rates

| | |
|---|---|
| Maximum range | 6.0 through 9.0 |
| Maximum rate (drop/rise) | 1 pH unit per hour (in fresh and seawater) |

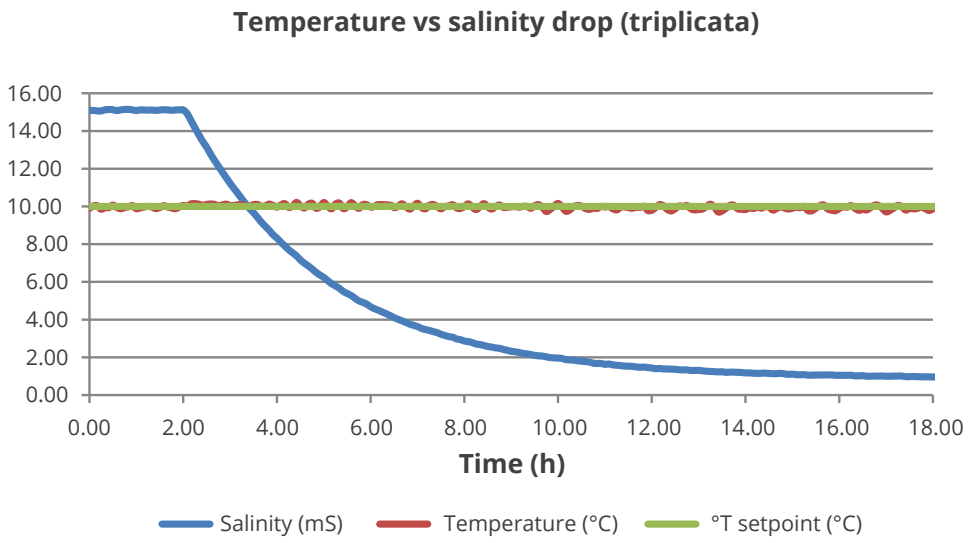
### Examples of controls with conditions

| Means of control | Outcome | Conditions used for tests |
|---|---|---|
| Range pH drop with $CO_2$ | Down to 6.0<br>Precision: ± 0.1 | Obtained in freshwater and seawater; water 100% recycled |
| Range pH drop with a weak acid | Down to 5.0<br>Precision: ± 0.1 | Obtained with HCl 0.1 N solution in freshwater; water 100% recycled |
| Drop rate - Maximum with $CO_2$ | 1 pH unit/h | In freshwater/sea water; water 100% recycled |
| Drop rate - Maximum with a weak acid | 1 pH unit/h | In freshwater/sea water; water 100% recycled |
| Rise rate – Maximum with air | 0.3 pH unit/h | Obtained in seawater to raise pH within the ambient pH range; 10°C; water 100% recycled;<br>in freshwater/sea water. |
| Rise rate - Maximum with a weak base | 0.1 pH unit/h<br>To and above normal seawater pH | Obtained in seawater; water 100% recycled; 10°C; in freshwater/sea water. |

## SALINITY

### Static control

Maximum range: 0.5 and 30 PSU ± 0.5 PSU




### Method

- Done via a steady flow of freshwater and concentrated salt water.
- The equipment includes conductivity probe, transmitter, salinity control Monitron software, salt-water production system, head tanks, and the instrument mix to modulate the level of salinity individually in each MSU.
- The salt water production system consists of two 250-L reservoirs with float valves, tubing and pumps to blend and store the ultra-concentrated seawater necessary for the control, and keep the salt water head tank of each MSU full.
- Requires a steady input of fresh water.

## MAKE-UP WATER

### Static control

Multi-stressor units are closed water recycling systems with biofiltration. One can adjust the water renewal rate of the system via the Monitron. From 0 to 100 % of the total water volume of a given MSU can be gradually replaced over a 24 hour period

### Method

New water enters the MSU via a float valve from a pressurized water outlet provided by the client. A precision pump, controlled by the Monitron, withdraws water from the system. Client can choose any water as makeup such as freshwater, salt water, distilled water, or diluted effluent water.

## AQUABIOTECH'S EQUIPMENT & EXPERTISE FOR ENVIRONMENTAL CONTROL


# ENVIRO-MONITRON™

While the industry offers excellent water quality monitoring equipment, it is difficult to find equipment that offers the flexibility of controlling water parameters in the precise and flexible manner needed for research on fish biology.

So, 10 years ago, Aquabiotech developed the **Enviro-Monitron™**, a unique control and monitoring system that can be tailored to very specific research-oriented applications.

The Monitron can currently control and monitor water temperature, dissolved, oxygen, pH, salinity, water velocity, water level, and photoperiod. It has the flexibility to monitor and control additional parameters. It is capable of creating dynamic and cyclic fluctuations of a given parameter, while maintaining the others at a stable value.

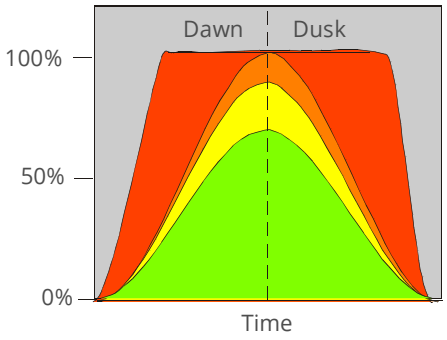
Because precision is important in maintaining environmental parameters, the Monitron features Proportional Integral and Derivative (PID) regulation for:

- Gas (e.g. dissolved oxygen)
- Motors (e.g. water velocity in flumes, water level in tide simulators).

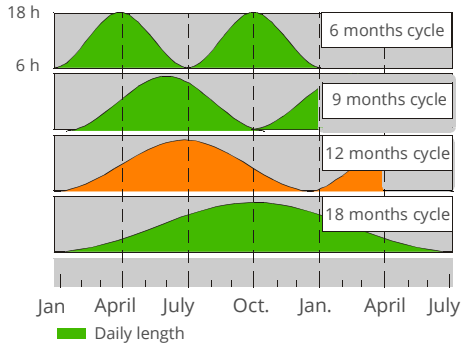
Every Monitron can be linked to our convenient Central Server via a Network. Registered data is stored daily and can be downloaded into Excel files. Accessible via Internet and generating alarms, the Monitron Network protects the precious environmental data monitored by the Enviro-Monitrons.

The **Aquabiotech Automatic Water Sampler** was developed to read more reliable pH values when UV light is being requested by a client. The water sampler collects water samples at a fixed rate from the aquatic system, reads and pH and returns the water to the system. By isolating the pH probe from the main body of water, the probe is electrically isolated from UV-generated electrical interferences and pH readings are considerably more stable and reliable.

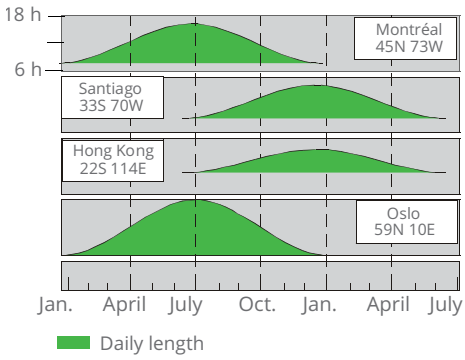
### LIGHT DIMMING




### ASTRAL CYCLE




### EXPANDS OR SHORTENS SEASONS




# GENTLE PHOTOPERIOD CONTROL WITH THE MONITRON SYSTEM

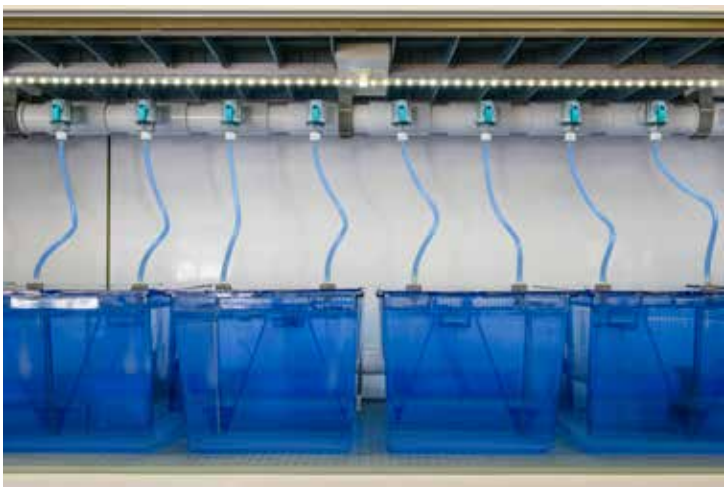
Our Enviro Monitron™ features all the photoperiodic control capacity of our SunMatch™ which controls DC lights in rooms.

The Monitron controls 24-VDC light circuit independently, modulating light intensity within each MSU. The gentle light ramping generated significantly reduces light stress created by the sudden turned on/off of lights. Circadian rhythms can be simulated or modified.

Series of light emitting diodes (LED) enclosed into water-tight plastic fixtures are fastened above each row of tanks and connected directly to the Monitron. Each LED tube provides 240 LUX and comes in the standard white color. Each rearing tank receives the same amount of light. The open space left between the lid of the 9L tanks and the LED fixture is 9 cm.

A natural photoperiod is created for any chosen geographical position (longitude, latitude) and date.

You can increase or shorten seasons and modify the duration of the year. For example, a year can be made with a short winter, followed by a long spring.



A string of Light Emitting Diodes (LED) is fastened to the structure above each row of tanks. The photoperiod is controlled by the local Monitron.

# CONVENIENT CONTROL PANEL

### A CSA-approved Electrical Power Panel that insures peace of mind

Most of our REBF units include a CSA-approved Electrical Power Panel. Made of polyester and certified NEMA 4X it may include the following features (depending on the application);

- Main operation light (LED);
- On/off switch with overload and operation LED for each pump;
- Automatic start of the back-up pump in case of mechanical failure of the pump servicing rearing tanks;
- Auto/off switch with overload and operation LED for the heater;
- Automatic interruption of the heater in case of low flow in the filtration circuit;
- Automatic interruption of the chilling system in case of low flow in the filtration circuit;
- Quick plug IP68 connectors for each device.

# SPECIALITY MULTI-STRESSOR UNITS

## FOR TOXICOLOGY STUDIES

### Creates hypoxic conditions at a constant temperature under a continuous flow of toxicant

Dissolved oxygen control system (10 to 90% DO saturation ± 0.1 mg $O_2$/L)

Four MSUs that generate hypoxic conditions and maintain (heating) water temperature between 20 and 30°C. These are semi-open systems with a constant renewal of water, operating at two complete water exchanges (200%) per 24 hour. Minimized, the filtration equipment is reduced to simple screens to prevent clogging of the valves. Hypoxic conditions are created down to 2 mg/L for long-term studies.

An additional rack of tanks was added providing a total of 10 x 9-L tanks per unit (treatment)

## ONE MULTI-STRESSOR UNIT ON A FULL RACK

### Photoperiod and very cold temperature.

This unit features four shelves of tanks, all sharing the same water.

Closed-circuit operation with full REBF system

- Designed for parasitology studies on cold water marine species (2°C).
- Full water recycling with bio-filtration (REBF) system.
- Filtration of recycled flow down to 20 µm
- 35-50%% is filtered to 5 µm and 1 µm (nominal).
- Unit is insulated with photoperiod control.
- UV sterilization

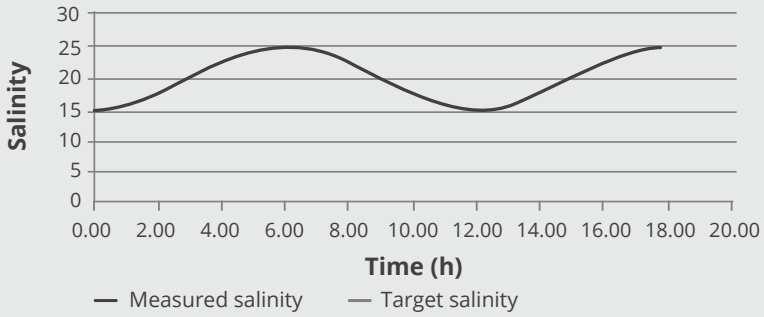
## Cyclic salinity Modulator

### TWO MSUs, EACH ON A FULL RACK, SHARING A COMMON WATER FILTRATION/CONTROL RACK

Each MSU includes static and cyclic control of salinity.

5 shelves of 3L or 10L tanks per MSU.

**Aquabiolab Unit with Sinusoidal Salinity Control**
(S=15 to 25, T=6h)



# MULTI-STRESSOR UNITS THAT MEET THE SPACE REQUIREMENTS OF LARGER FISH.

Four double-drain 150-L self-cleaning tanks.

**IN THESE SYSTEMS, REARING TANKS SIT ON THE FLOOR, AND ARE LINKED TO ONE REBF SYSTEM.**

Krescel-Plus tanks connected to an REBF system. Controls are available *à la carte*.

- Tanks can be insulated for cold water rearing;
- LED are inserted into lids for photoperiod control.

- Tank arrangement is variable;
- System available with 70 or 150-L self-cleaning Krescel type tanks.

**Download our questionnaire to tailer these Multi-stressor units to you application!**


aquabiotech

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