

SeaLens - SubCam

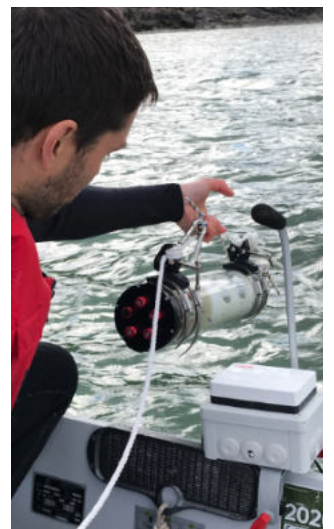
The SubCam has been developed to monitor underwater activity at seaweed and shellfish farms. Key processes that can be observed and validated using this unit are;

- Monitoring presence of wildlife at the sea-farm (due to new habitat creation)
- Grazing, epiphytes, disease, settlement
- Sea-farm rigging tangling up with adjacent lines, driftwood, or ocean plastic
- Sea-farm rigging failure due to storms
- Biomass growth rate of seaweed
- Build up of sediment on the sea-bed
- Detecting marine mammal entanglement (through direct or indirect observations at sea-farm)

Why not use existing off-the-shelf equipment?

Problem	Our Solution
Expensive: Submersible underwater cameras cost upwards of £2000	Low cost: Rental model reducing cost of ownership by 10x
Poor battery life: Action sports cameras ~4-6hrs, Research grade camera: ~12-24hrs	Long battery life: Up to 14 days of taking photos and videos on custom schedules
No customisation: Cannot be programmed to take images and videos periodically to monitor long-term changes	Fully programmable: Can be programmed using an app to enable custom camera settings and photo/video capture routines
No mounting: Are not suitable for mounting to sea-farm equipment	Ready-to-mount: Robust, easy-to-install mounting system suitable for sea-farm rigging

Parameter	Specifications
Camera	Raspberry Pi HQ 12.3 MP Sony IMX477 Photo max res: 3280 x 2464 Video res:1080p30, 720p60, 480p90
Custom settings through app	ISO, Shutter-speed, Focus distance Custom photo and/or video time-interval App developed by Clear Robotics Ltd.
Lens	Arducam 4-12mm Varifocal C-Mount Lens Aperture for different times of the day
On-board memory	256Gb, 512 Gb, 1Tb and 2Tb memory (USB)
Battery	12x or 24x Doublepow NiMH Battery, 3000 mAh, 1.2V, Rechargeable & Interchangeable
Housing	Clear acrylic tube, Aluminium cap Rated up to 60m depth 500x120mm, 3000g
CPU	4x ARM Cortex-A53, 1.2GHz.GPU:
GPU	Broadcom VideoCore IV
RAM	1GB LPDDR2 (900 MHz)
OS	Raspbian Jessie LINUX
Optional add-ons	Temperature & Depth (Integrated) Temperature (Higher accuracy)



SEALENS - LIFT

The LiFT unit has been developed to monitor Light Intensity, Flow (current speed) and Temperature underwater at seaweed and shellfish farms. Key processes that can be observed and validated using this unit are;

Light Intensity

- Ensuring that the cultivated species are getting sufficient light (are they positioned at the correct depth?)
- Light attenuation of water near sea-farm to determine potential effects on local habitats

Flow

- Sea-bed flow measurements to determine if sediment is likely to build up due to the sea-farm
- Surface flow to determine maximum load on sea-farm for assessing the suitability of rigging used
- Surface flow to determine site suitability for specific species

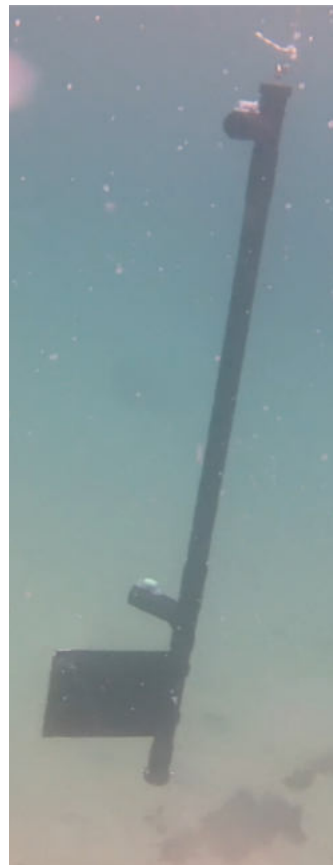
Temperature

- Ensuring seaweeds are harvested before critical temperatures are reached where fouling begins to occur
- Early identification of stratification (large temperature differences in depth) to prevent disease outbreak

Why not use existing off-the-shelf equipment?

Problem	Our Solution
Light Intensity: Light measurements are inaccurate due to motion of sensors in water	Light Intensity: Tilt data from accelerometer allows light data to be corrected to account for motion in water
Flow: Existing flow meters cost >£2000 and quickly deteriorate due to minor bio-fouling (reliable up to 2-3 weeks without cleaning)	Flow: Tilt-current method works reliably regardless of minor bio-fouling (reliable up to 3-4 months without cleaning)
Temperature: No low-cost high resolution sensors available for long-term monitoring	Temperature: Temperature sensor integrated with light sensor (same housing, controller and power supply) to reduce costs

Parameter	Specifications
Light Intensity	Range: 0 to 167,731 lux Accuracy: $\pm 10\%$ in direct sunlight 2x sensors 1m apart, offset by 90deg
Flow	3-axis Accelerometer Accuracy ± 0.075 g; 0.735 m/s ² at 25°C Resolution: 0.025 g; 0.245 m/s ² 1x sensor located at base of unit
Temperature	Range: -20° to 50°C in water Accuracy: $\pm 0.5^\circ\text{C}$ 2x sensors 1m apart
On-board memory	96,000 measurements for each sensor
Battery	CR2032 3V lithium, user replaceable 1 year at 25°C (77°F) with logging interval of 1 minute
Housing	Sensors: Polypropylene case, EPDM O-ring Housing: Water-safe PVC 1200x300x50mm, 2500g Collapsed to fit in case 600x400x300mm
Custom settings	Set logging intervals 1 second to 18 hours Schedule logging start time for each sensor Synchronise all sensors



SEALENS - WQ (alpha version)

The WQ unit has been developed to monitor Salinity, pH, Dissolved Oxygen and Temperature at seaweed and shellfish farms. Key processes that can be observed and validate using this unit are;

Salinity/Temperature

- Determine whether the site has sufficient mixing to minimise disease outbreak/chemical pollution events. (Drops in salinity due to terrestrial surface run-off can cause disease outbreaks especially in shellfish)
- Low salinity causes reduction of CO₂ uptake in Kelps, irreversibly reducing growth
- Temperature is required to get accurate Salinity reading

pH/DO

- Determine algal productivity in the area by observing pH/dissolved oxygen spikes (will ensure good bivalve growth)
- Demonstrate the ability for sea-farm (seaweed specifically) to provide a temporary refugia from acidification and deoxygenation

Why not use existing off-the-shelf equipment?

Problem	Our Solution
Cost: Existing individual Salinity, DO or pH loggers cost above £1000 per sensor	Cost: Lab-grade sensor probes are driven by low-cost micro-processors allowing cost reductions of up to 70% per sensor
Individual probes: There is currently no system that integrates all three key parameters at an affordable cost.	Any number of probes together: A single power supply and housing powers the device. Single or multiple probes can be added according to requirements and budget.

Parameter	Specifications
Salinity / Conductivity	Atlas Scientific Mini Conductivity K 1.0 Range: 5 - 200,000uS/cm Accuracy: ± 2%
pH	Atlas Scientific pH Lab Grade Range: 0 - 14 Accuracy: ±0.002
DO	Atlas Scientific DO Mini Lab Grade Range: 1 - 50 mg/L Accuracy: ±0.2 mg/L
On-board memory	32GB SD Card for up to 1,000,000 measurements for each sensor
Battery	4x Doublepow NiMH Battery, 3000 mAh, 1.2V, Rechargeable & Interchangeable ~ 14 days on single charge
Housing	Sensors: Polypropylene case, EPDM O-ring Housing: HDPE rigid housing 400x300x200mm, 500g Alpha version is only suitable for sheltered areas (Lochs, Inlets, Estuaries)
Custom settings	Set logging intervals 1 second to 18 hours Synchronise all sensors

