SUPPLEMENTARY MATERIAL

A low-cost, durable, submersible light trap and customizable LED design for pelagic deployment and capture of fish parasite *Salmincola* sp. copepodids

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Table S1. List of materials used to construct light traps and deployment strings. The brands and suppliers used are included for ease of component identification and do not represent endorsement. Components were often available locally for lower prices. Because traps deployed at depths < 30 m can be less expensive to construct, materials are designated as *deep* or *shallow* when they differ for the two designs. Cost is approximate per trap based on online ordering (as of 2019) and may represent bulk pricing (see notes). Non-consumable equipment used in construction is listed below*.

Component	Quantity	Description	Cost	Brand / Supplier	Notes
Light housing - shallow					
Canning jar with metal lid	1	Wide mouth 8 oz (237 cc)	$1.08	Kerr / Amazon.com	Sold in pack of 12
Silicone ring	1	Wide mouth silicone sealing rings	$0.67	Amazon.com	Both ring and circle designs work
Light housing - deep					
Canning jar with glass lid	1	250ml Le Parfait Super Jar glass lid jar with stainless snap closure	$6.67	Le Parfait / Amazon.com	Sold in pack of 6
Light source					
LED and heatsink	1	445-450nm LED pre-mounted on star heatsink	$0.55	Led World / Amazon.com	Sold in pack of 10
Resistor	1	8.2 Ohm resistor	$0.04	uxcell / Amazon.com	Sold in pack of 100
Heatshrink	1	3 mm x 30 mm length	$0.02	uxcell / Amazon.com	Sold in pack of 240
Wire set and battery holder	1	4 x 1.5V AA battery holder with 9V I type snap connector	$2.49	LampVPath / Amazon.com	Sold in pack of 3
Batteries	4	High capacity (2800mAh) Ni-MH rechargeable AA battery	$6.17	Bonai / Amazon.com	Sold in pack of 24
Solder wire	-	Electrical solder	~$0.01	Amazon.com	To connect wires and lights, any electrical solder will work
Top lid – shallow					
Flexible PVC lid with metal strap	1	4-inch Plastic DWV Flexible Cap	$4.78	Fernco / Home Depot	
Eye screws	4	Small metal eye screws	$0.25	Amazon.com	Exact size not important, should avoid piercing lid
Wire piece	4 x 6” (0.15 m) length	18 gauge copper hobby wire	$0.46	OOK / Home Depot	Sold in 25 ft roll
Top lid – deep					
Flexible PVC lid with metal strap	1	4-inch (10.16 cm) Plastic DWV Flexible Cap	$4.78	Fernco / Home Depot	
Bottom lid					
ABS, rigid PVC or flexible PVC lid	1	4-inch (10.16 cm) PVC cap	$2.27	NDS / Home Depot	Rigid PVC/ABS lids are less prone to funnel detachment. Flexible PVC lid requires a metal strap.
Glass funnel	1	75 mm short stem glass funnel	$2.50	Cole-Palmer	Sold in pack of 6

Silicone	-	Aquarium grade silicone	~$0.25	Loctite / Amazon.com	To secure glass funnel to bottom lid
Trap body					
PVC	1 x 7” (0.18 m) length	Schedule 40 PVC	$1.30	Home Depot	Sold in 10’ length (17 traps)
Metal band strap	1	4” (10.16 cm) worm gear clamp	$1.67	Home Depot	Must adjust to at least 4.5”
Rope	3 x 20” (0.5 m) length	¼” (0.6 cm) double braid polyester	$0.45	Sea-Strand / E-Rigging.com	Sold in 600’ reel, any rope type with minimal stretch and sufficient strength would work
Carabiner	1	6 cm aluminum clip	$0.50	Michael Josh / Amazon.com	Sold in pack of 20
Trap weight					
Bike tube	1 x ~21.5” (0.55 m) length	Used bike tube (diameters vary)	$0.00	-	Available for free from bicycle repair shops
Duct tape	Approx. 12” (0.3 m)	Gorilla tape	$0.17	Gorilla / Home Depot	Any water resistant tape should work
Sand	Approx. 350 g	Play sand	$0.07	Quikrete / Home Depot	Sold in 50 lb bags
TOTAL COST PER TRAP *SHALLOW / DEEP*			**$25.70 / $29.91**		
Anchor					optimal anchor design will vary with substrate
Concrete	1	35 lb	$1.86	Quikrete / Home Depot	Sold in 80 lb bags
Eyebolt with nut	1	¼” (.6 cm) or larger, zinc plated with nut	$0.48	Home Depot	Nut keeps bolt in place in concrete
Concrete form	1 x 6” (0.15 m) length	8” (20.3 cm) x 6” (15.2 cm) tube	$1.88	Quikrete / Home Depot	Sold in 48” length. Cut to 6” for 35 lb anchor
Deployment supplies					
Buoy	1	Polyform A-0	$27.99	Polyform / Amazon.com	
Rope with attachment loops	1	25 m of rope with 6 loops, ¼” (0.6 cm) double braid polyester	$8.57	Sea-Strand / E-Rigging.com	Sold in 600’ reel, any rope type with minimal stretch and sufficient strength would work
Bucket or tub	1	20 gallon (75 L) storage tote	$5.98	HDX / Home Depot	Any container over 9” deep should work well
Appropriate mesh filter / sieve	1	106 um test sieve	$19.99	KimLab / Amazon.com	Use to remove plankton from water when filling traps for placement
Bait / deterrent (optional)	-	Trout fin clips	$0.00	-	We placed fin clips in unbleached tea bags
Screw driver	1	5/16 socket screwdriver	$6.99	Greenlee / Amazon.com	For tightening metal straps (worm gear clamps), including securing lid after filling
ASSOCIATED COSTS FOR STRING DEPLOYMENT (may be used to deploy multiple traps)			**$73.74**		

***Non-consumable equipment used in construction:** Drill press with 2 ¾” hole saw (for bottom lid hole), handheld jig saw (for notch in deep trap bodies), miter saw (for cutting PVC to length), metal file (for cutting the stems off of funnels), 5/16 socket screwdriver (for metal bands), funnel (for filling tubes with sand)

Table S2. Laboratory captures in light trap development. LED S1A and S1B wiring diagrams can be found in Figure S1.

Trial	Tank	Light color	Light style	Light notes	Trap notes	Set date	Pull date	Copepodids (# captured)	Water Temp (°C)	Position in tank	Notes
1	Aquarium	white	flash	LED w/ arduino S1B	opaque PVC	1/23/2019	1/25/2019	0	5.5		
1	Aquarium	white	solid	LED dive light	opaque PVC	1/23/2019	1/25/2019	1	5.5		
2	Aquarium	white	pulse (bright-dim)	LED w/ arduino S1B	opaque PVC	1/25/2019	1/28/2019	25	5.2		
2	Aquarium	white	solid	LED dive light	opaque PVC	1/25/2019	1/28/2019	41	5.2		
3	Aquarium	white	pulse	LED w/ arduino S1B	opaque PVC	1/28/2019	1/30/2019	41	5.2		
3	Aquarium	white	solid	LED dive light	opaque PVC	1/28/2019	1/30/2019	63	5.2		
4	Aquarium	white	solid	LED dive light	opaque PVC	2/7/2019	2/9/2019	28	5.1		
4	Aquarium	white	solid	LED dive light	clear acrylic	2/7/2019	2/9/2019	30	5.1		
5	Aquarium	white	solid	LED dive light	opaque PVC	2/9/2019	2/12/2019	37	5.1		
5	Aquarium	white	solid	LED dive light	clear acrylic	2/9/2019	2/12/2019	17	5.1		
6	Aquarium	white	flash	LED w/ arduino S1B	opaque PVC	2/13/2019	2/15/2019	28	5.1		
6	Aquarium	white	solid	LED dive light	opaque PVC	2/13/2019	2/15/2019	54	5.1		
7	Aquarium	white	solid	LED dive light	opaque PVC	2/15/2019	2/18/2019	86	5.1		
7	Aquarium	none	none	none	opaque PVC	2/15/2019	2/18/2019	3	5.1		
8	Aquarium	none	none	none	opaque PVC	2/18/2019	2/20/2019	0	5.1		
8	Aquarium	white	solid	LED dive light	opaque PVC	2/18/2019	2/20/2019	214	5.1		
9	Aquarium	white	solid	LED S1A	opaque PVC	2/20/2019	2/22/2019	15	5		
9	Aquarium	white	solid	LED dive light	opaque PVC	2/20/2019	2/22/2019	8	5		
10	Aquarium	white	solid	LED S1A	opaque PVC	2/25/2019	2/27/2019	36	5		
10	Aquarium	white	solid	LED dive light	opaque PVC	2/25/2019	2/27/2019	30	5		
11	Aquarium	white	solid	LED S1A	opaque PVC	3/1/2019	3/4/2019	151	5		
11	Aquarium	blue	solid	LED pool light	opaque PVC	3/1/2019	3/4/2019	161	5		battery died
12	Aquarium	white	solid	LED S1A	opaque PVC	3/6/2019	3/8/2019	32	5		
12	Aquarium	blue	solid	LED pool light	opaque PVC	3/6/2019	3/8/2019	29	5		battery died
13	Smith Farm tank	UV	solid	LED S1A	opaque PVC	3/29/2019	4/1/2019	0	12-13	Left	
13	Smith Farm tank	blue	solid	LED S1A	opaque PVC	3/29/2019	4/1/2019	5	12-13	Right	
13	Smith Farm tank	white	solid	LED S1A	opaque PVC	3/29/2019	4/1/2019	3	12-13	Center	
14	Smith Farm tank	UV	solid	LED S1A	opaque PVC	4/1/2019	4/2/2019	0	12-13	Center	

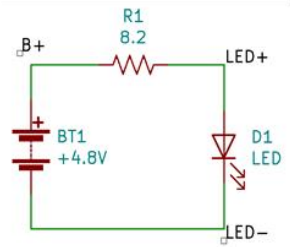
14	Smith Farm tank	blue	solid	LED S1A	opaque PVC	4/1/2019	4/2/2019	2	12-13	Left	
14	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/1/2019	4/2/2019	6	12-13	Right	
15	Smith Farm tank	UV	solid	LED S1A	opaque PVC	4/2/2019	4/4/2019	2	12-13	Right	
15	Smith Farm tank	blue	solid	LED S1A	opaque PVC	4/2/2019	4/4/2019	5	12-13	Center	
15	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/2/2019	4/4/2019	4	12-13	Left	
16	Smith Farm tank	red	solid	LED pool light	opaque PVC	4/4/2019	4/5/2019	0	12-13	Right	battery died
16	Smith Farm tank	blue	solid	LED S1A	opaque PVC	4/4/2019	4/5/2019	1	12-13	Left	
16	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/4/2019	4/5/2019	3	12-13	Center	
17	Smith Farm tank	yellow	solid	LED pool light	opaque PVC	4/5/2019	4/8/2019	0	12-13	Left	battery died
17	Smith Farm tank	blue	solid	LED S1A	opaque PVC	4/5/2019	4/8/2019	10	12-13	Right	
17	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/5/2019	4/8/2019	4	12-13	Center	
18	Smith Farm tank	green	solid	LED pool light	opaque PVC	4/8/2019	4/9/2019	0	12-13	Center	battery died
18	Smith Farm tank	blue	solid	LED S1A	opaque PVC	4/8/2019	4/9/2019	0	12-13	Left	
18	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/8/2019	4/9/2019	0	12-13	Right	
19	Smith Farm tank	yellow	solid	LED pool light	opaque PVC	4/9/2019	4/12/2019	0	12-13	Right	battery died
19	Smith Farm tank	blue	solid	LED S1A	opaque PVC	4/9/2019	4/12/2019	0	12-13	Center	
19	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/9/2019	4/12/2019	6	12-13	Left	
20	Smith Farm tank	red	solid	LED pool light	opaque PVC	4/12/2019	4/15/2019	0	12-13	Center	battery died
20	Smith Farm tank	blue	solid	LED S1A	opaque PVC	4/12/2019	4/15/2019	3	12-13	Left	
20	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/12/2019	4/15/2019	7	12-13	Right	
21	Smith Farm tank	green	solid	LED pool light	opaque PVC	4/15/2019	4/16/2019	1	12-13	Right	battery died
21	Smith Farm tank	blue	solid	LED S1A	opaque PVC	4/15/2019	4/16/2019	0	12-13	Center	
21	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/15/2019	4/16/2019	1	12-13	Left	
22	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/16/2019	4/19/2019	6	12-13	Right	
22	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/16/2019	4/19/2019	6	12-13	Center	
22	Smith Farm tank	violet	solid	LED S1A	opaque PVC **+ fish bits**	4/16/2019	4/19/2019	10	12-13	Left	fish bits
23	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/19/2019	4/22/2019	3	12-13	Left	

23	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/19/2019	4/22/2019	14	12-13	Right	
23	Smith Farm tank	violet	solid	LED S1A	opaque PVC + **fish bits**	4/19/2019	4/22/2019	12	12-13	Center	fish bits
24	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/22/2019	4/25/2019	0	12-13	Center	
24	Smith Farm tank	violet	solid	LED S1A	opaque PVC	4/22/2019	4/25/2019	2	12-13	Left	
24	Smith Farm tank	violet	solid	LED S1A	opaque PVC + **fish bits**	4/22/2019	4/25/2019	1	12-13	Right	fish bits
25	Smith Farm tank	violet	solid	LED S1A	opaque PVC	5/21/2019	5/24/2019	5	12-13	Right	
25	Smith Farm tank	violet	solid	LED S1A	opaque PVC	5/21/2019	5/24/2019	6	12-13	Left	
26	Aquarium - non-target taxa	violet	solid	LED S1A	opaque PVC	5/23/2019	5/24/2019	na	5		796 non-target taxa
26	Aquarium - non-target taxa	violet	solid	LED S1A	opaque PVC	5/23/2019	5/24/2019	na	5		700 non-target taxa; fish bits
27	Aquarium - non-target taxa	violet	solid	LED S1A	opaque PVC	5/24/2019	5/25/2019	na	5		520 non-target taxa
27	Aquarium - non-target taxa	violet	solid	LED S1A	opaque PVC	5/24/2019	5/25/2019	na	5		196 non-target taxa; fish bits
28	Smith Farm tank	violet	solid	LED S1A	opaque PVC	6/11/2019	6/14/2019	7	12-13	Right	
28	Smith Farm tank	420 nm	solid	LED S1A	opaque PVC	6/11/2019	6/14/2019	2	12-13	Left	
29	Smith Farm tank	violet	solid	LED S1A	opaque PVC	6/14/2019	6/17/2019	15	12-13	Left	
29	Smith Farm tank	420 nm	solid	LED S1A	opaque PVC	6/14/2019	6/17/2019	19	12-13	Right	

Table S3. Additional materials used for microcontroller programmed lights in series (costs as of 2019).

Arduino	ELEGOO for Arduino Nano V3.0	Amazon.com	4.29	sold in 3 piece
Mosfet	60V, 500mA	Amazon.com	0.65	sold in 10 piece
USB Cable	for programming the Arduino	Monoprice	0.77	can also provide power for testing
PCB Board	with header connectors	Amazon.com	~0.50	sold in multipiece kits
Additional cables and breadboard		as needed		

A. Single constant LED diagram



B. Microcontroller LED diagram

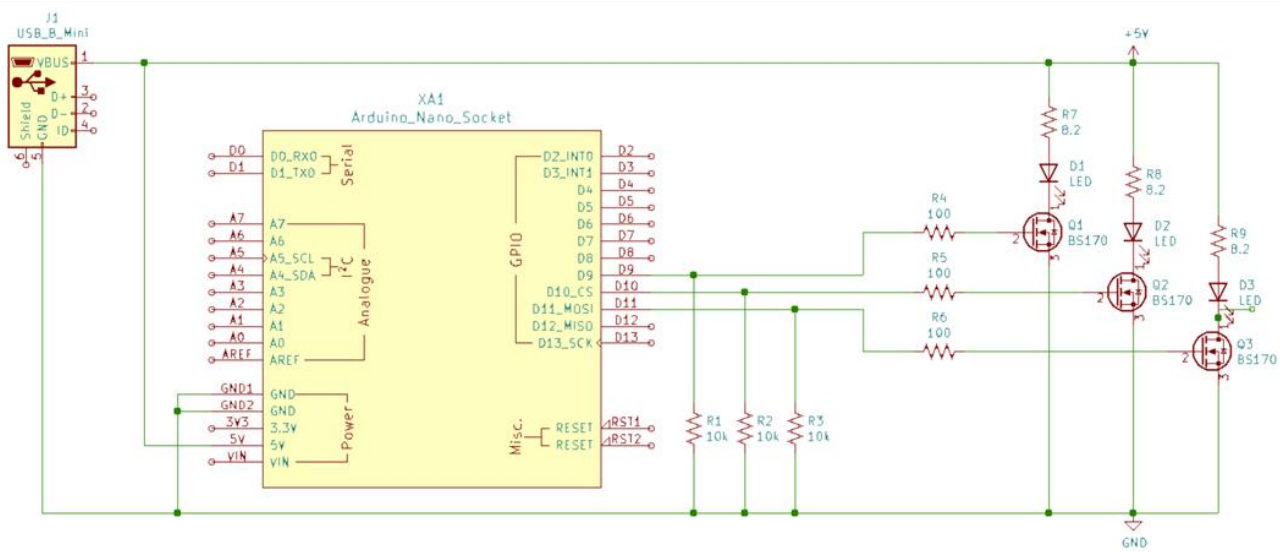


Figure S1. Wiring diagrams for **A.)** a single solid LED (left) and **B.)** a microcontroller array with 3 LEDs (right).

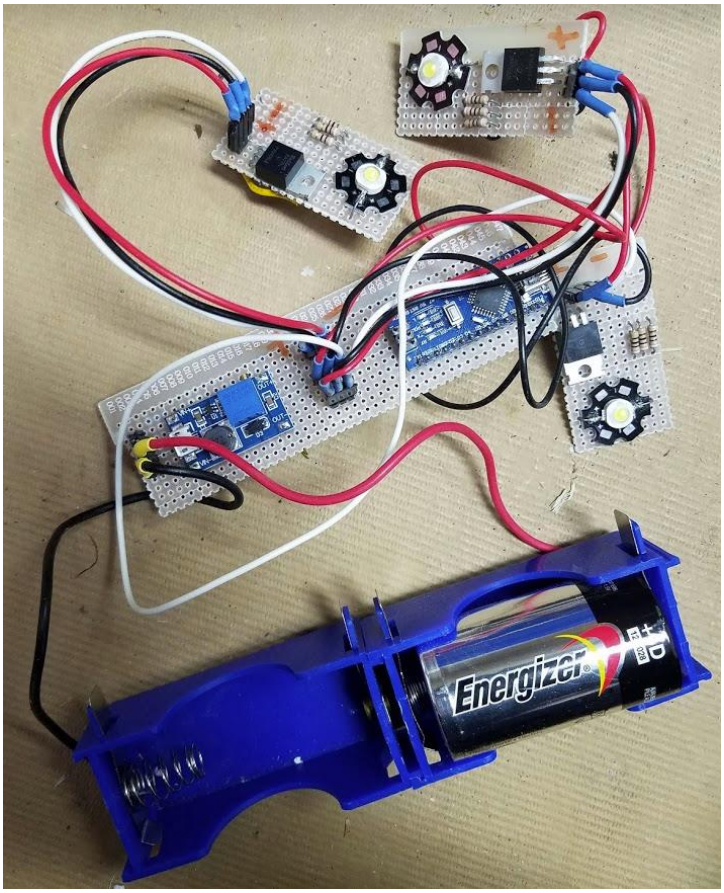


Figure S2. Prototype light configuration with Arduino.

Firmware code (.ino) for varying the light intensity in series:

```
/*
Varies the intensity of of three LEDs in a sine wave pattern, using pulse width modulation (PWM)
*/

int ledPin1 = 9; // LED connected to digital pin 9
int ledPin2 = 10; // LED connected to digital pin 10
int ledPin3 = 11; // LED connected to digital pin 11

int period = 3000; // period in milliseconds
int nsteps = 100;
int delay_time = period/nsteps;
float t_step = 2*PI/nsteps;

// offset between the sine wave patterns for each LED, in radians
float offset = 2*PI/3;

int fadeValue(float t){
        return min(max((int) 128*sin(t)+128, 0), 255);
```

```
	//return 255;
}

void setup() {
	// nothing happens in setup
}

void loop() {
	for (float t1 = 0 ; t1 <= 2*PI ; t1 += t_step){
		float t2 = t1 + offset;
		float t3 = t2 + offset;
		analogWrite(ledPin1, fadeValue(t1));
		analogWrite(ledPin2, fadeValue(t2));
		analogWrite(ledPin3, fadeValue(t3));
		delay(delay_time);
	}
}
```