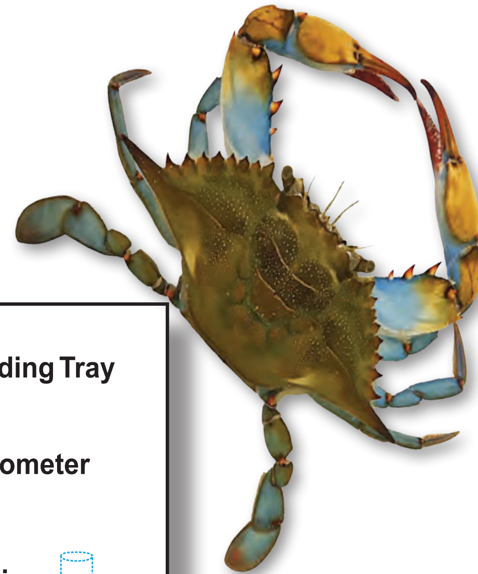
Blue Crab Shedding

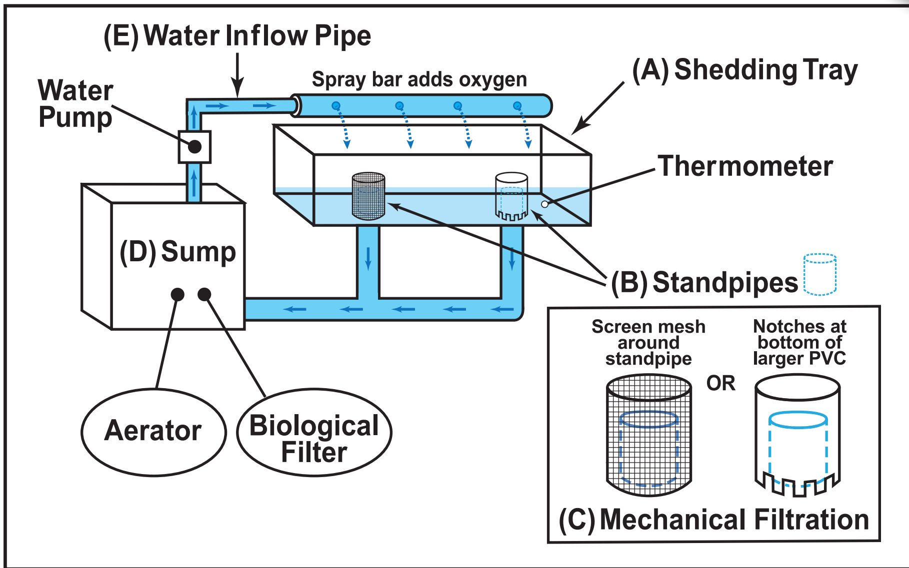
The Components of Recirculated Systems



Recirculated System Objectives:

1. Hold large number of crabs,
2. Prevent escape of crabs, and
3. Provide easy access and viewing for the operator.

Recirculated System Design



Recirculating System Descriptions

(A) Shedding Trays

The dimensions of common, commercial shedding trays are approximately 3 feet by 8 feet. Tank walls should be smooth and be at least 12 inches high to prevent the escape of crabs. The tank width should allow you to reach crabs anywhere in the tray. A shedding tray of this size can typically hold 150 crabs, depending on filtration.

Shedding trays are often constructed out of molded fiberglass or fiberglass coated wood. Fiberglass coated wood trays are less expensive, but usually require replacement after several years.

Shedding trays are often equipped with aerators to enhance dissolved oxygen in the water and thermometers to monitor water temperature. Water that is too low in oxygen and too high in temperature stresses crabs and increases mortality. If water flows back in through a spray bar, additional aeration is often not necessary.

(B) Standpipe

Standpipes are commonly made of PVC and are open at the top to regulate water height within the shedding tray and prevent complete accidental draining. Standpipes are joined to drainage pipes using threaded couplings to circulate water from the shedding tray to the sump. Do not seal or glue the standpipes to the couplings so that they can be removed for drainage of the shedding tray or flushing of the sump.

(C) Mechanical Filtration

Mechanical filtration involves the separation and removal of unwanted particulates such as crab waste (i.e., feces, broken shell pieces).

A screen mesh is often used to cover standpipes to prevent large pieces of waste (and crabs) from entering and clogging drainage pipes and pumps. A larger, second PVC pipe (2-4 inches larger in diameter and 2 inches longer than the standpipe) with a notched (or serrated) bottom can be used instead of mesh to prevent particulates from entering the standpipe. The notched end of this pipe should be placed along the bottom of the tank.

(D) Sump

A sump is a secondary tank that receives water from the shedding trays, filters and provides a source of water for the pump intake. The sump is any large container (i.e., water drums) to hold water and located below or next to a shedding tray. The size of the sump is dependent upon the number of shedding trays and the flow rate of water required in the shedding system. It is recommended that 3 foot by 8 foot shedding trays have a minimum flow rate of three gallons per minute. The sump for that one tray should hold at minimum enough water for the pump to run for five minutes. It is advantageous to use as large of sump as possible to help maintain temperature and water quality. Sumps should have a removable lid to prevent foreign matter from entering the system and a bottom drain to ease in sump cleaning and flushing.

If possible, it can be advantageous to plumb in two separate sumps. This allows you to have ample water on standby that you could switch to if water quality becomes a serious problem.

Water pumps are required to push water from the sump into the water inflow pipes and back into the trays. They are typically constructed from low-head centrifugal pumps, i.e., pool pumps. Pumps must be designed for continuous operation and be made of corrosive-resistant materials designed for saltwater. The pump output depends on the operational pressure of the system.

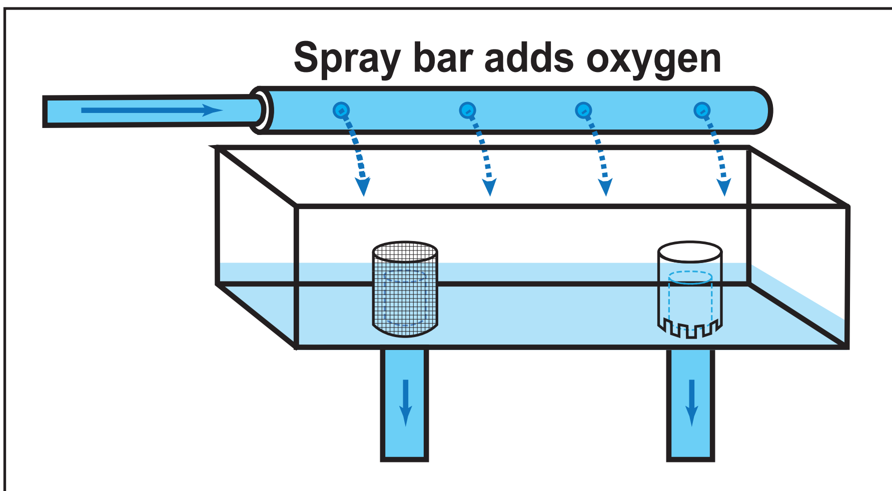
Biological filters are used to break down waste produced by blue crabs. The greater the surface area of filter media (e.g., oyster shell, bio balls, plastic forks, rock) the greater the population of bacteria available to convert nitrogenous waste. The bacteria break down the waste product of ammonia into nitrite and the less toxic form of nitrate. Oxygen is essential in the breakdown of nitrogenous waste. Aeration can be added to the sump to aid in bacterial growth and waste breakdown.

Note: It takes time to build up bacteria populations in a recirculating system. Before starting shedding operations, operators can jump start bacteria growth by placing a few adult blue crabs in their shedding tanks 4-6 weeks prior operation. Additional fact sheets on water quality and start up are available at *http://www.laseagrant.org/outreach/projects/soft-shell-crab/*

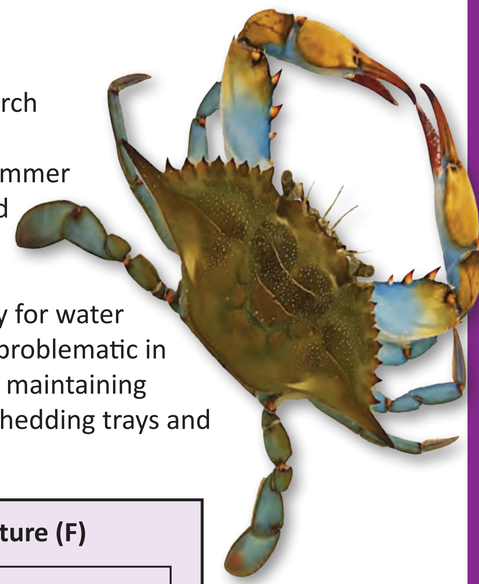
(E) Water Inflow Pipe

Water from the sump pump is transferred to the shedding trays through the water inflow pipe, often PVC. It is recommended that a spray bar is used to distribute water into the shedding tray. This helps oxygenate water and promotes water circulation throughout the tank reducing the occurrence of low-oxygen areas. Low oxygen conditions increase stress in blue crabs.

Note: The system, including the sump, should be in shaded or covered space to reduce water temperatures and algal growth.



http://www.laseagrant.org/outreach/projects/soft-shell-crab/
Authors: Elizabeth Robinson, Julie Lively, Carol Franze, Brian LeBlanc
Funding: This work was funded by National Sea Grant College Program (NOAA) Award NA18OAR4170355



Mortality During Summer Months

Soft shell crabs in Louisiana are generally available from March through November, with most productivity between May and September. However, crab mortality is also higher during the summer months, particularly July through August. This may be attributed to the overcrowding of crabs, high water temperature and low dissolved oxygen.

As crab density and water temperatures increase, the ability for water to hold oxygen decreases. Dissolved oxygen levels will be most problematic in systems with higher salinities. Monitoring dissolved oxygen and maintaining oxygen levels at or above 5 milligrams per liter (5 mg/L; in the shedding trays and sump) will reduce mortality due to low oxygen.

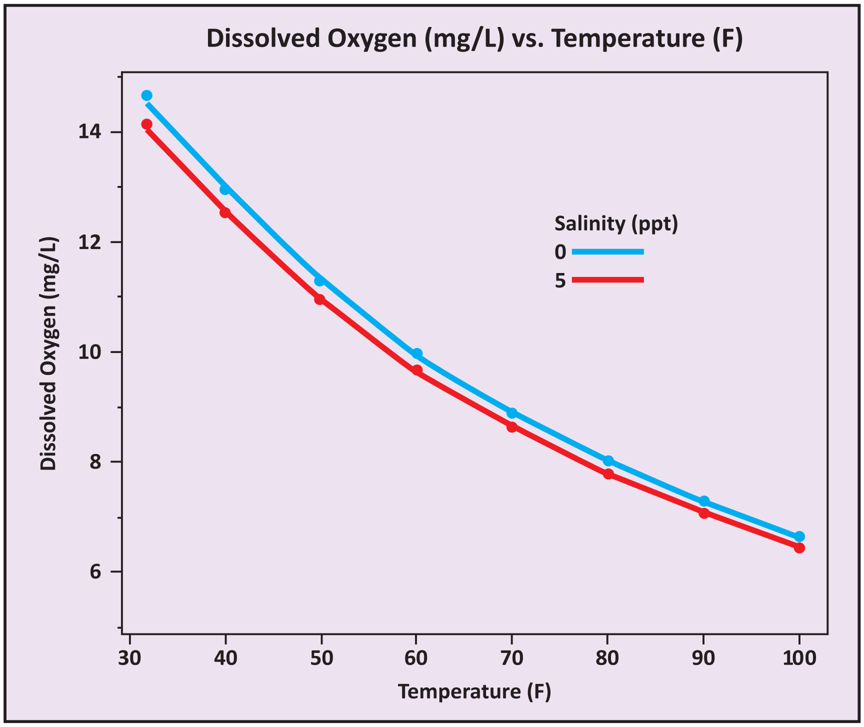


Figure 1: As temperatures increase, water cannot hold the same levels of dissolved oxygen.

Monitoring dissolved oxygen (DO) with a meter instead of a chemical test is more reliable and easier to use.

Monitoring dissolved oxygen with a meter

Using a spray bar in your shedding system will increase aeration. If low oxygen persists, adding an aerator to your sump will also increase oxygen concentration in your water. Refer to factsheet "The Components of Recirculated Systems" for more information.

A spray bar will increase aeration

Monitoring and maintaining stable temperatures in shedding systems also reduces mortality. Peeler crabs appear in crab harvests when water temperatures are above 65°F. Successful shedding operations typically maintain water temperatures between 70°F and 80°F. Temperatures above this range, or large daily temperature fluctuations, tend to stress peeler crabs, increasing mortality. To reduce high temperatures and temperature fluctuations, consider housing a shedding system under a shaded structure or indoors. Shedders can also increase the amount of water within their shedding system to reduce temperature fluctuations.

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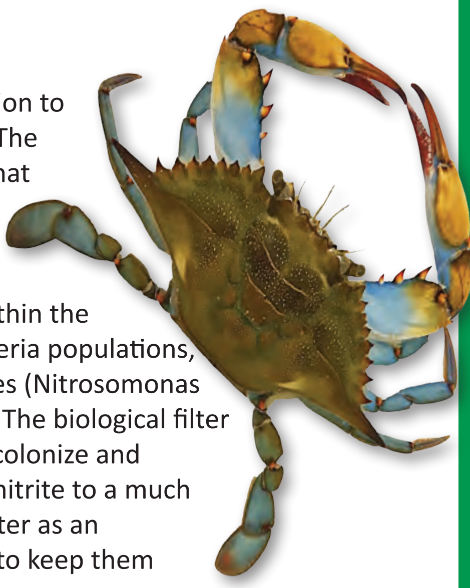


Biological Filtration

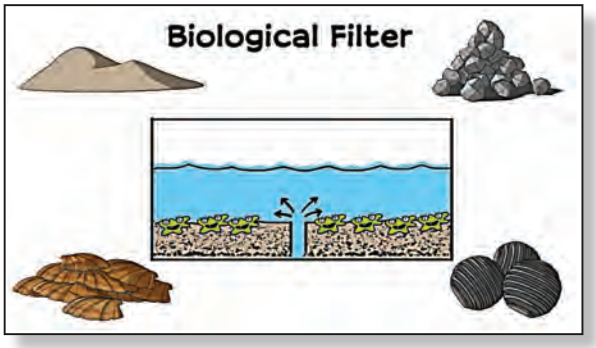
Recirculating crab shedding systems require biological filtration to be successful. The biological filter provides two basic functions. The first is trapping and containment of tank debris and sediments that make it past the mechanical filtration. The more important function is conversion of nitrogenous compounds from crab waste into safer compounds.

A functioning biological filter essentially provides an area within the recirculated flow of water where bacteria can thrive. These bacteria populations, known as nitrifying bacteria, are composed primarily of two types (Nitrosomonas and Nitrobacter), and both are found naturally in soil and water. The biological filter simply provides the bacteria a suitable location where they can colonize and multiply enough to convert toxic compounds like ammonia and nitrite to a much less toxic compound — nitrate. You can think of the biological filter as an in-system population of bacteria that must be cared for and fed to keep them happy and growing.

Basic requirements of biological filter bacteria populations:

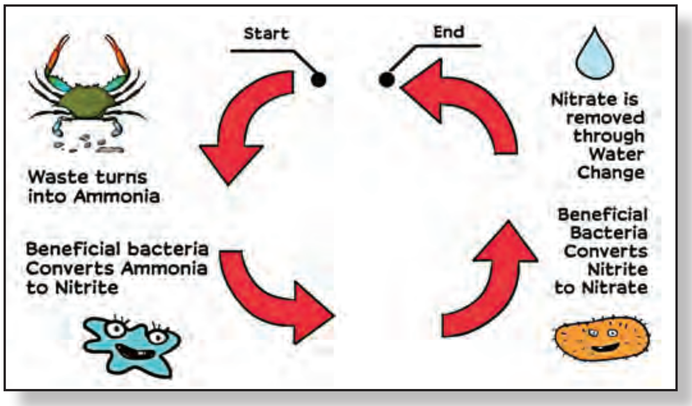
1. Substrate (a place to grow)

These single cell bacteria need a place to settle, adhere and grow. Nitrosomonas and Nitrobacter bacteria live and reproduce in areas when there is sufficient substrate (place for them to attach) within the recirculating system.



2. Food (ammonia and nitrite)

Like most living things, to grow and multiply, bacteria need to have food. As the water passes through the substrate, Nitrosomonas species feed on ammonia (from crab waste) in the recirculated



water and convert it to a nitrogen form called nitrite. Unfortunately for crabs and other aquatic species, high concentrations of nitrite are very toxic. However, the Nitrobacter species in the system will now feed on nitrite in the water and ultimately convert it to the less toxic nitrogen form — nitrate, which the crabs can tolerate.

Things like chlorine, chloramine or sudden temperature and salinity changes can kill the bacteria. To keep crabs and bacteria happy and healthy, water needs to be properly treated to current system conditions before adding it. If you bleach or disinfect your system, you will need to start over with bacterial populations.

Crab shedding publications often recommend shedders maintain a few hard crabs or fish in their recirculating systems while starting up a new system or between molting sessions. This is important because even though there may be no molting crabs to attend to, the bacteria in the system still need to be fed.

3. Warm water temperatures

Like molting crabs, nitrifying bacteria need warm temperatures to thrive. Temperatures suitable for molting crabs are also sufficient for bacterial metabolism and reproduction. Cool temperatures can reduce bacterial growth and slow the feeding on ammonia and nitrite.

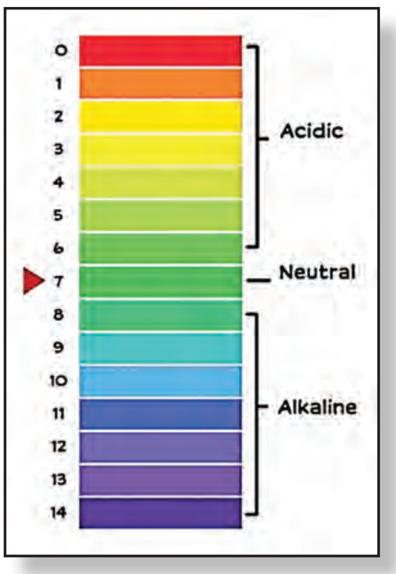
4. Oxygen in the water

Adequate oxygen is not only essential for crabs, it is also required for bacteria to consume, metabolize and convert toxic nitrogen compounds into less toxic forms. Nitrate contains more oxygen than nitrite, and researchers have proposed that during significant oxygen concentration drops in the water, nitrate is reduced back to the highly toxic form of nitrite. It is important to always maintain water flow or spray in running recirculating systems. Adding an airstone from an aerator into your sump can also ensure oxygen levels are not a problem.

5. pH

If pH drops too low in the sump, it can kill the bacteria or limit their growth. Adding baking soda can raise the pH.

Biofilters should be gently rinsed with treated water to remove large build up and debris and to reduce the possibility of killing bacteria. However, the film of slime on the biofilter is your bacteria. Do not scrub it off.



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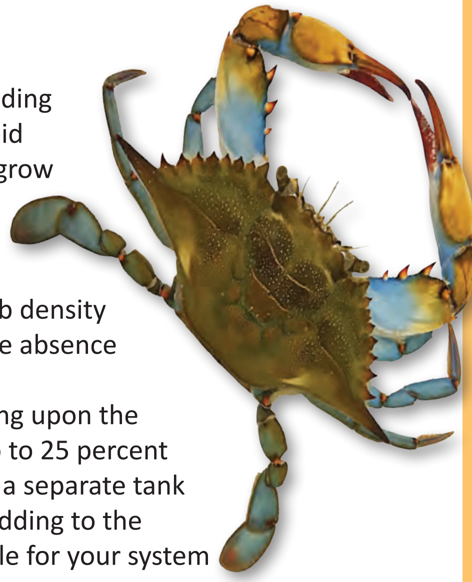


System Maintenance

Once nitrifying bacteria are established in recirculating shedding systems, crabs should be added gradually into the system to avoid shocking the system. The bacterial populations will continue to grow with the addition of crabs. Stocking densities in one 3-foot by 8-foot shedding tray can range between 50 to 300 crabs, depending on the health of your nitrifying bacteria.

Once the stocking density of crab has been reached, the crab density must be maintained to prevent bacteria from crashing due to the absence of crab waste.

Water quality should be monitored daily or weekly depending upon the parameter tested. If water parameters are outside the range, up to 25 percent of the system's water should be replaced. Storing extra water in a separate tank allows the water to be treated and adjusted for salinity before adding to the system, making water exchanges easier. The largest sump feasible for your system can also improve water quality.

Water Quality Parameter	Testing Frequency	Safe Range
Ammonia	Daily	Below 1.0 mg/l
Nitrate	Daily	Below 500 mg/l
Nitrite	Daily	0 to 0.5 mg/l
Temperature	Weekly	75 -80 °F
pH	Weekly	7.0 - 8.0
Alkalinity	Weekly	Over 100 mg/l
Dissolved Oxygen	Weekly	Greater than 5.0 mg/l
Salinity (see box, page 2)	Weekly	Up to 30 ppt
Chlorine	At Water Change	0

Additional testing can be performed if there is an increase in observed mortalities, abnormal crab behavior or if the color and/or smell of the system water changes.

To reduce mortality in systems due to cannibalism, crabs should be routinely graded and sorted by molting stage daily. White line crabs are still feeding and will cannibalize pink and red liners if not separated. Red lined crabs must be checked once a day for the appearance of cracks.

Example of a red lined crab.

For water changes, salinity should be kept within 5 ppt of the current system to keep bacteria happy. Many systems in Louisiana operate below 5 ppt.

The units mg/l and ppt are common in water quality.

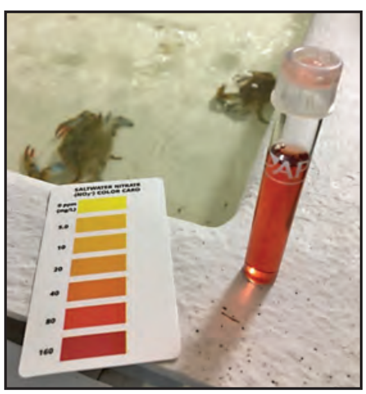
- mg/l = milligrams per liter
- ppt = parts per thousand

Cracked crabs should be checked every three to four hours to catch soft shelled crabs. Often, the cracked crab beginning to split their shell should be set apart to make it easier to locate and remove once it has molted. It is recommended to only hold red liners to increase shedding success. White liners might be too weak to successfully molt if held to long in the system.

Crab legs and miscellaneous parts should be removed from the trays to help maintain system performance and water quality.

Remove shedded parts from trays.

Molt Stage	Days from Shedding
White Liners	6 to 14 days
Pink Liners	4 to 6 days
Red Liners	1 to 4 days
Cracked Red Liner	Less than 1 day



Water quality test for nitrate.

A refractometer is used to measure salinity.

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SOFT SHELL CRAB WORD SEARCH

L	L	U	H	S	I	T	T	K	J	N	Q	J	K	R
R	L	H	N	H	E	P	I	D	A	L	O	E	N	R
K	E	E	K	E	F	L	S	E	F	O	V	F	A	E
T	H	F	H	D	F	O	C	W	O	R	G	Q	C	L
W	S	Q	M	S	T	A	O	Y	E	L	U	C	U	E
S	D	T	L	O	T	P	Q	G	C	A	G	F	R	E
V	R	E	R	S	L	F	Y	K	C	E	R	F	L	P
E	A	Y	U	T	X	T	O	U	R	E	F	E	G	O
H	H	R	C	R	A	B	L	S	T	T	B	I	E	X
Y	C	G	Z	S	H	T	R	A	L	F	E	S	L	D
Q	T	P	Z	T	U	K	W	D	E	C	A	P	O	D
M	D	R	D	R	L	I	G	J	A	X	W	P	F	D
V	G	N	E	V	T	Z	G	I	F	G	Z	R	Z	Z
K	P	H	B	A	Z	O	X	C	K	V	H	G	O	U
J	Y	N	Z	E	R	X	A	T	O	P	Q	O	U	M

AQUACULTURE
CRAB
CRUSTACEAN
DECAPOD
GROW
HARD SHELL
LIFECYCLE
MOLT
PEELER
SHED
SOFT SHELL
WATER

BLUE CRAB SHEDDING FACTS

Blue crabs must shed or molt their exoskeleton, or shell, in order to grow and replace lost legs.

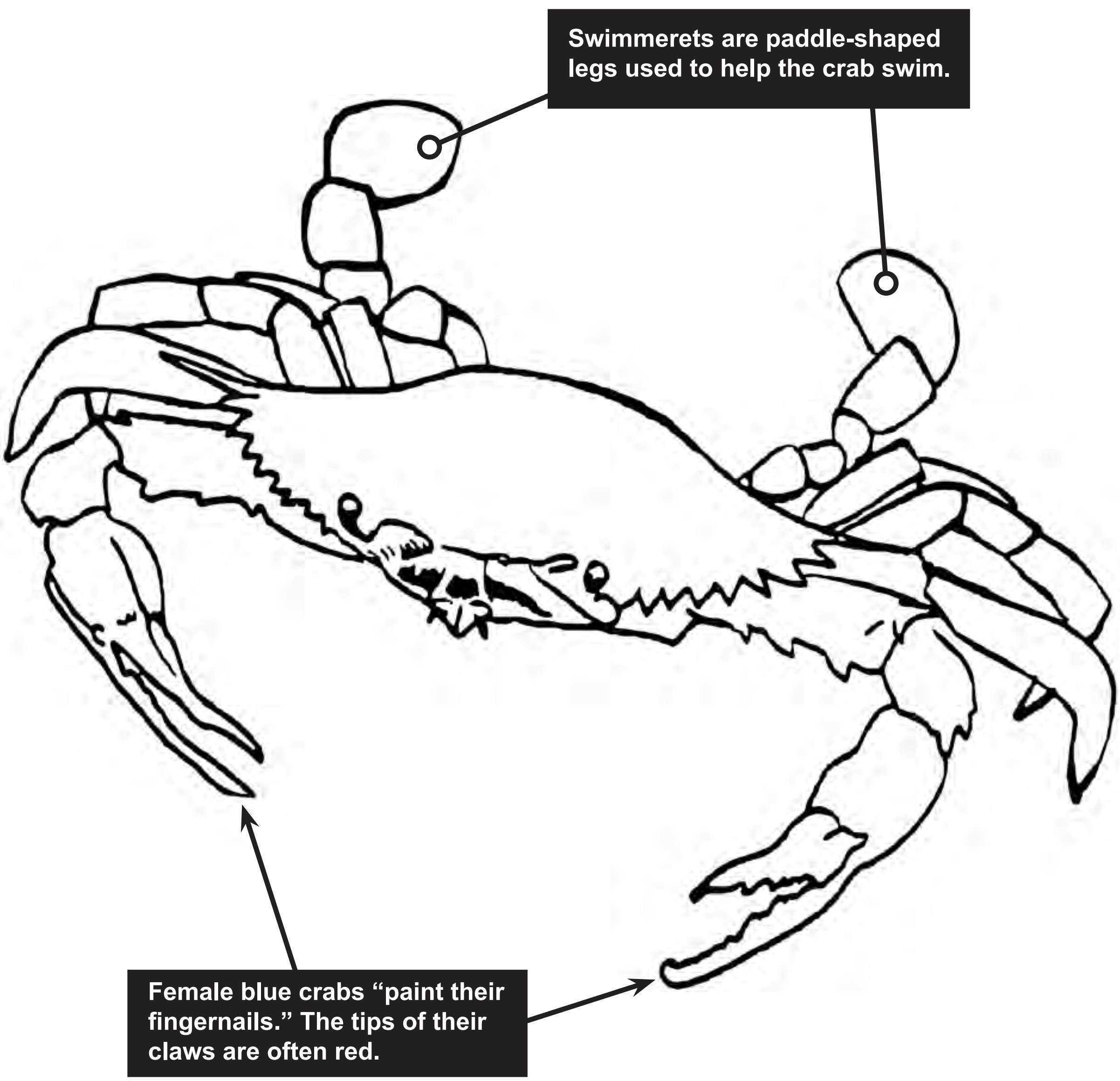
To shed their shell, the crab swells with water and breaks its old shell along the back edge.

The crab wiggles out through the back of the shell.

The new crab is soft and will re-harden in a few hours.

Crabs will molt every few days when they first hatch from eggs to a couple of times a year as they become adults.

Female blue crabs will not molt once they are adults.



Crab Shedding Water Quality: Weekly Worksheet

Date: March 5

Parameter	Trays	Sump
pH (7-8)	7.2	6.5
Alkalinity (>100 mg/l)	98	98
Dissolved Oxygen (> 5 mg/l)	12	12
Salinity	1.5	1.5

NOTES

Might need to add sodium bicarbonate to sump!

Date: March 12

Parameter	Trays	Sump
pH (7-8)	7.2	7
Alkalinity (>100 mg/l)	96	97
Dissolved Oxygen (> 5 mg/l)	8	8
Salinity	1.5	1.5

NOTES

Date: March 19

Parameter	Trays	Sump
pH (7-8)	7.2	7
Alkalinity (>100 mg/l)	94	96
Dissolved Oxygen (> 5 mg/l)	8	7
Salinity	1.5	1.5

NOTES

Date: March 26

Parameter	Trays	Sump
pH (7-8)	7.2	6.9
Alkalinity (>100 mg/l)	98	96
Dissolved Oxygen (> 5 mg/l)	9	9
Salinity	1.5	1.5

NOTES

Date: April 2

Parameter	Trays	Sump
pH (7-8)	7.2	7
Alkalinity (>100 mg/l)	98	98
Dissolved Oxygen (> 5 mg/l)	8	9
Salinity	1.5	1.5

NOTES

Crab Shedding Water Quality: Weekly Worksheet

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Crab Shedding Water Quality: Weekly Worksheet

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Crab Shedding Water Quality: Weekly Worksheet

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Date:

Parameter	Trays	Sump	NOTES
pH (7-8)			
Alkalinity (>100 mg/l)			
Dissolved Oxygen (> 5 mg/l)			
Salinity			

Crab Shedding Water Quality: Ammonia Worksheet

Ammonia (<1.0 mg/l)

Day	Date	Trays	NOTES
1			
2			
3			
4			
5			
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7			
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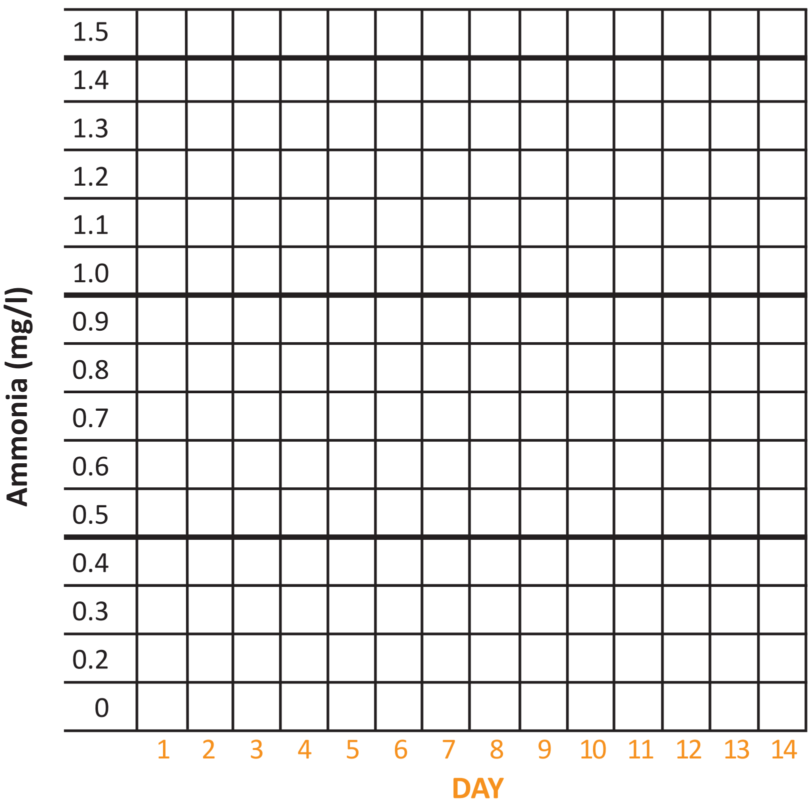
9			
10			
11			
12			
13			
14			



Crab Shedding Water Quality: Ammonia Worksheet

Ammonia (<1.0 mg/l)

Day	Date	Trays	NOTES
1			
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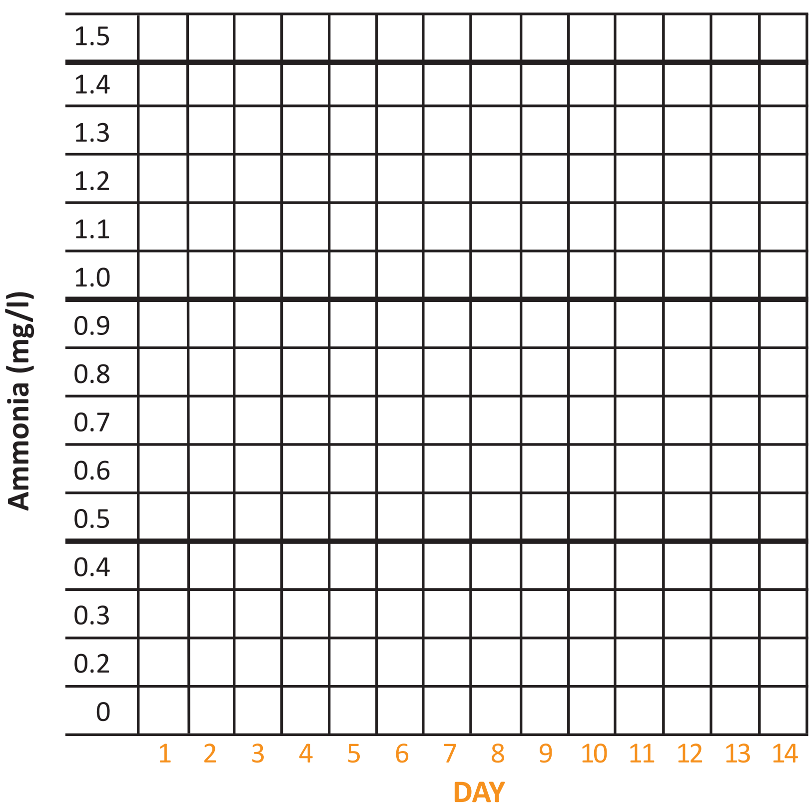

Crab Shedding Water Quality: Ammonia Worksheet

Ammonia (<1.0 mg/l)

Day	Date	Trays	NOTES
1			
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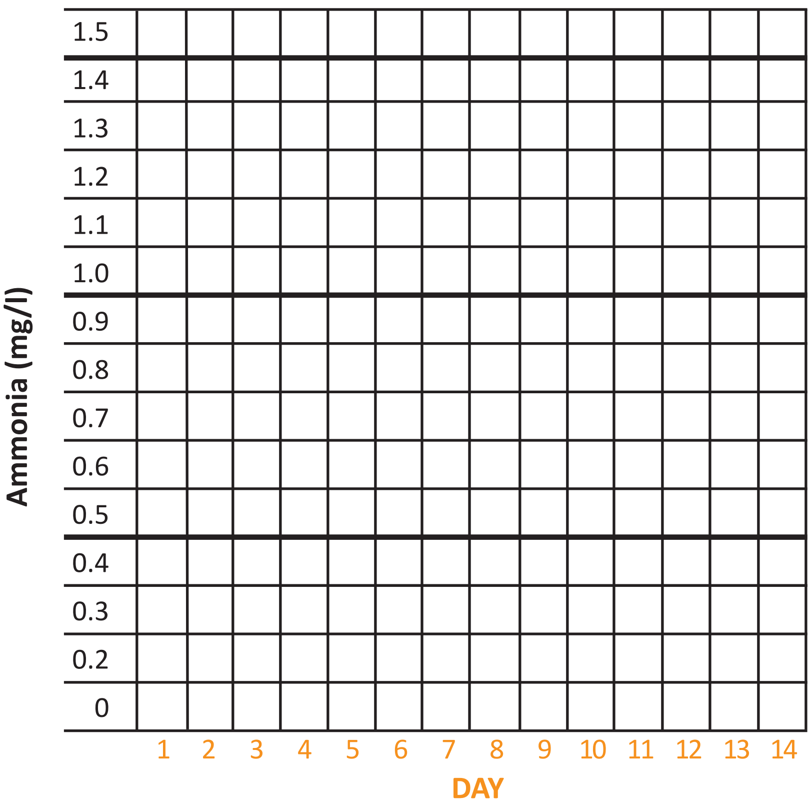

Crab Shedding Water Quality: Ammonia Worksheet

Ammonia (<1.0 mg/l)

Day	Date	Trays	NOTES
1			
2			
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4			
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7			
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9			
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11			
12			
13			
14			

Ammonia (mg/l)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.5														
1.4														
1.3														
1.2														
1.1														
1.0														
0.9														
0.8														
0.7														
0.6														
0.5														
0.4														
0.3														
0.2														
0														

DAY

Crab Shedding Water Quality: Nitrite Worksheet

Nitrite (<0.5 mg/l)

Day	Date	Trays	NOTES
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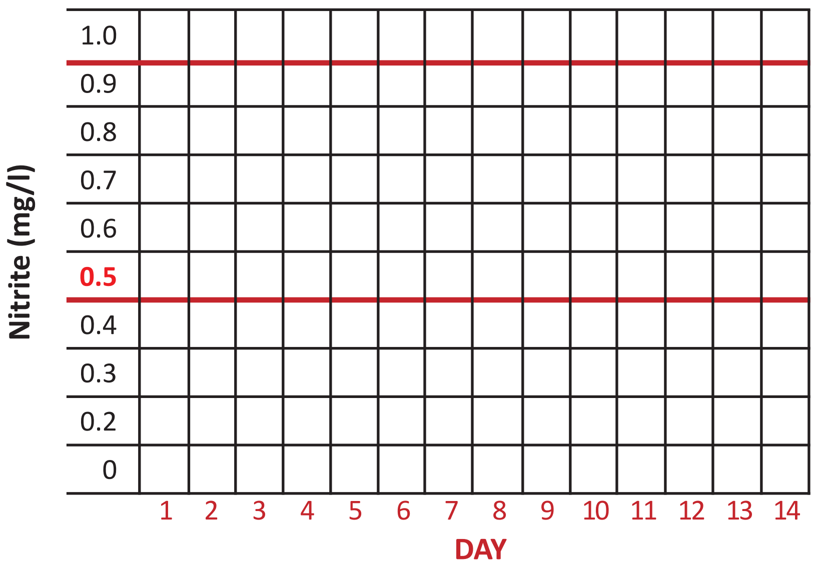
14			



Blue Crab Shedding

Water Quality: Nitrite Worksheet

Crab Shedding Water Quality: Nitrite Worksheet

Nitrite (<0.5 mg/l)

Day	Date	Trays	NOTES
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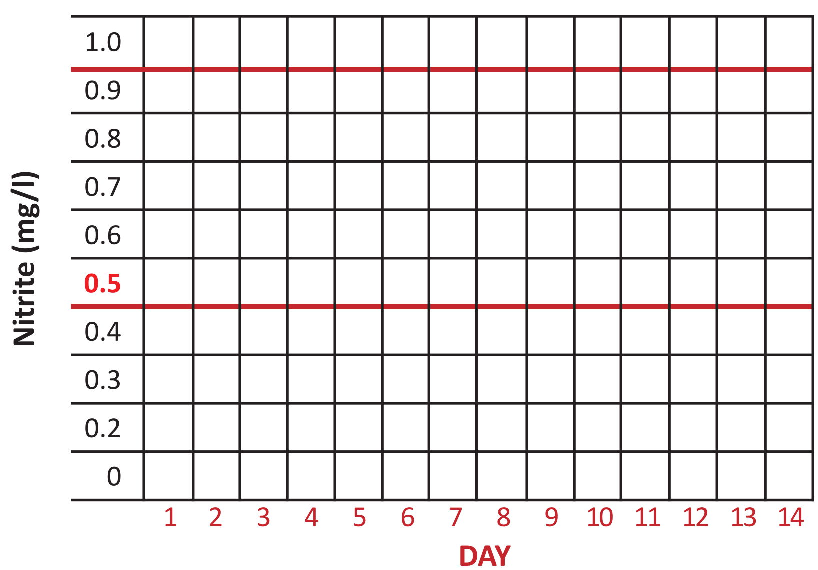

Crab Shedding Water Quality: Nitrite Worksheet

Nitrite (<0.5 mg/l)

Day	Date	Trays	NOTES
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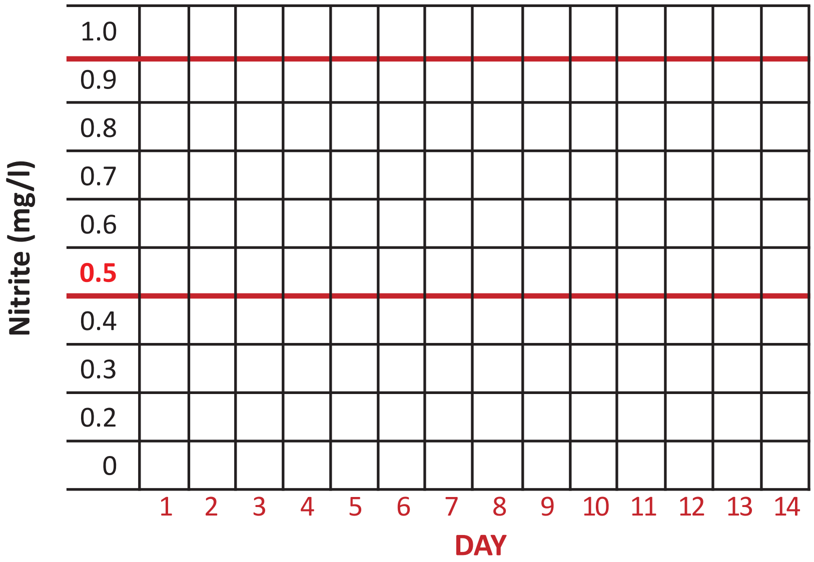

Crab Shedding Water Quality: Nitrite Worksheet

Nitrite (<0.5 mg/l)			
Day	Date	Trays	NOTES
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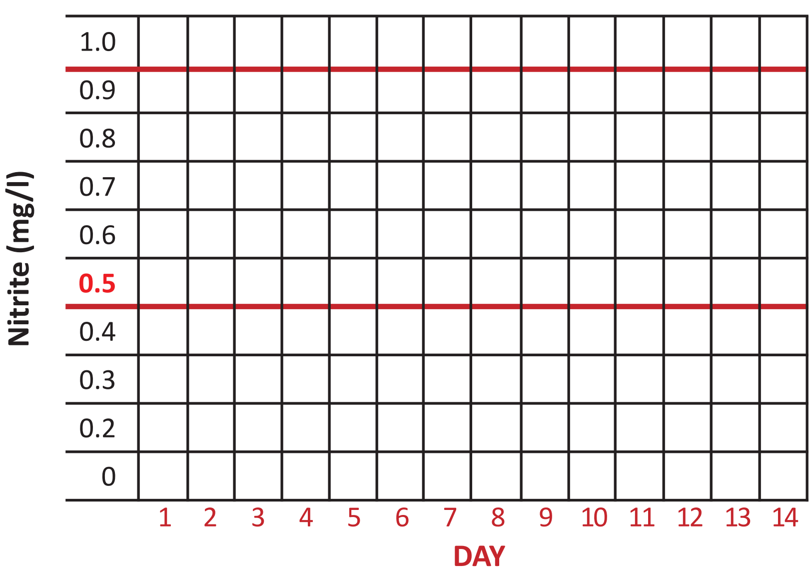
14			



Crab Shedding Water Quality: Nitrate Worksheet

Nitrate (<500mg/l)

Day	Date	Trays
1		
2		
3		
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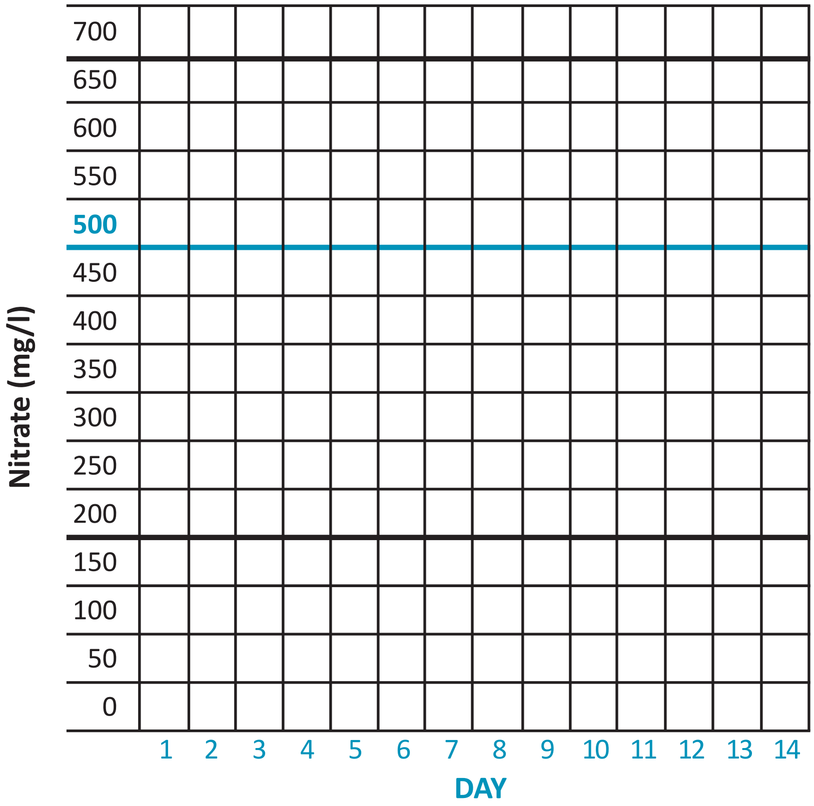
NOTES



Crab Shedding Water Quality: Nitrate Worksheet

Nitrate (<500mg/l)

Day	Date	Trays	NOTES
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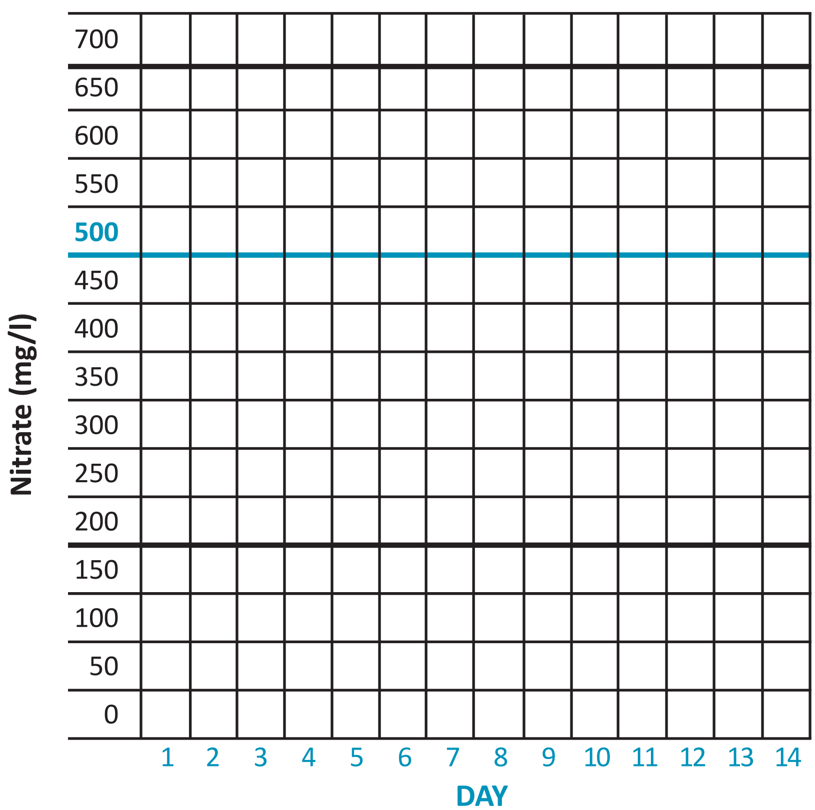

Crab Shedding Water Quality: Nitrate Worksheet

Nitrate (<500mg/l)

Day	Date	Trays	NOTES
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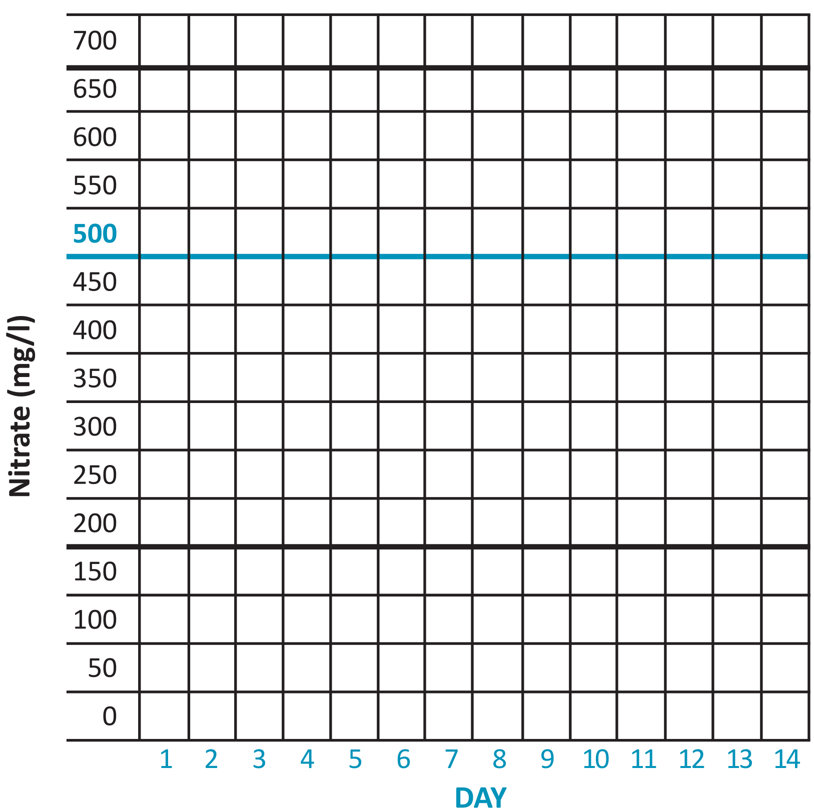

Crab Shedding Water Quality: Nitrate Worksheet

Nitrate (<500mg/l)

Day	Date	Trays	NOTES
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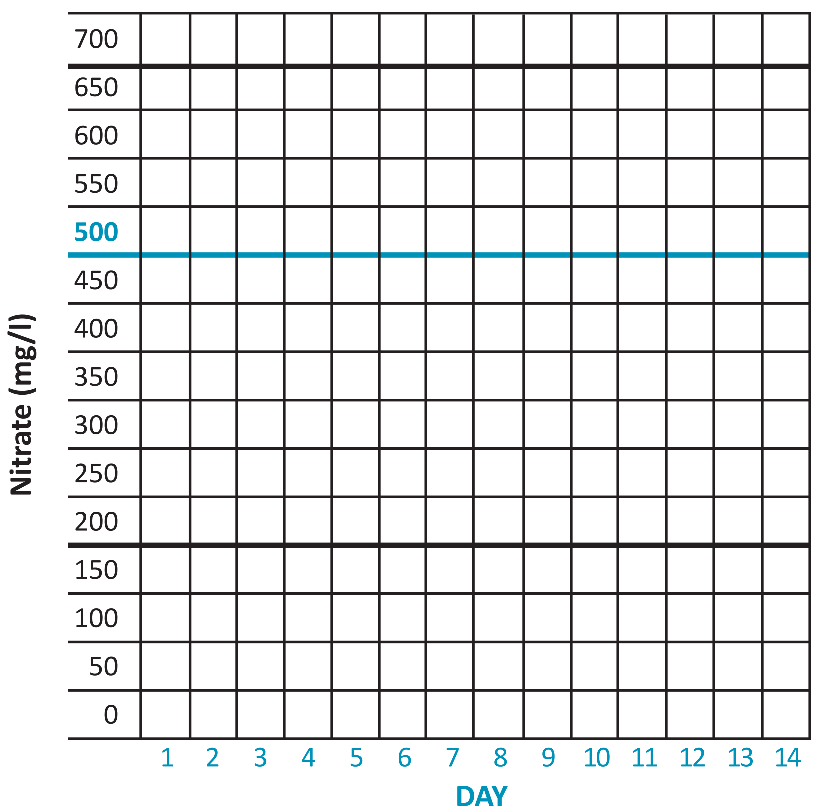

Parameter	Safe range	Location	Frequency
Total Ammonia	Below 1.0 mg/l	Trays/ Filter Outflow	Daily
Nitrate	Below 500 mg/l in sump	Trays/ Filter Outflow	Daily
Nitrite	0.0 to 0.5 mg/l	Trays/ Filter Outflow	Daily
Temperature	75 °F to 80 °F (avoid changes ± 5 °F)	Trays	Weekly
pH	7.0 to 8.0 (Sump above 7.5)	Trays/ Sump	Weekly
Alkalinity	Over 100 mg/l	Sump	Weekly
Dissolved Oxygen	5.0 mg/l (Tray & Sump) Over 2.0 mg/l (Outflow)	Trays/ Sump/ Outflow	Weekly
Salinity	0.1-30 ppt (±5 ppt of harvesting waters)	Sump	Monthly (Weekly if local water)
Chlorine/ Chloramines	0	Incoming water	Water Change