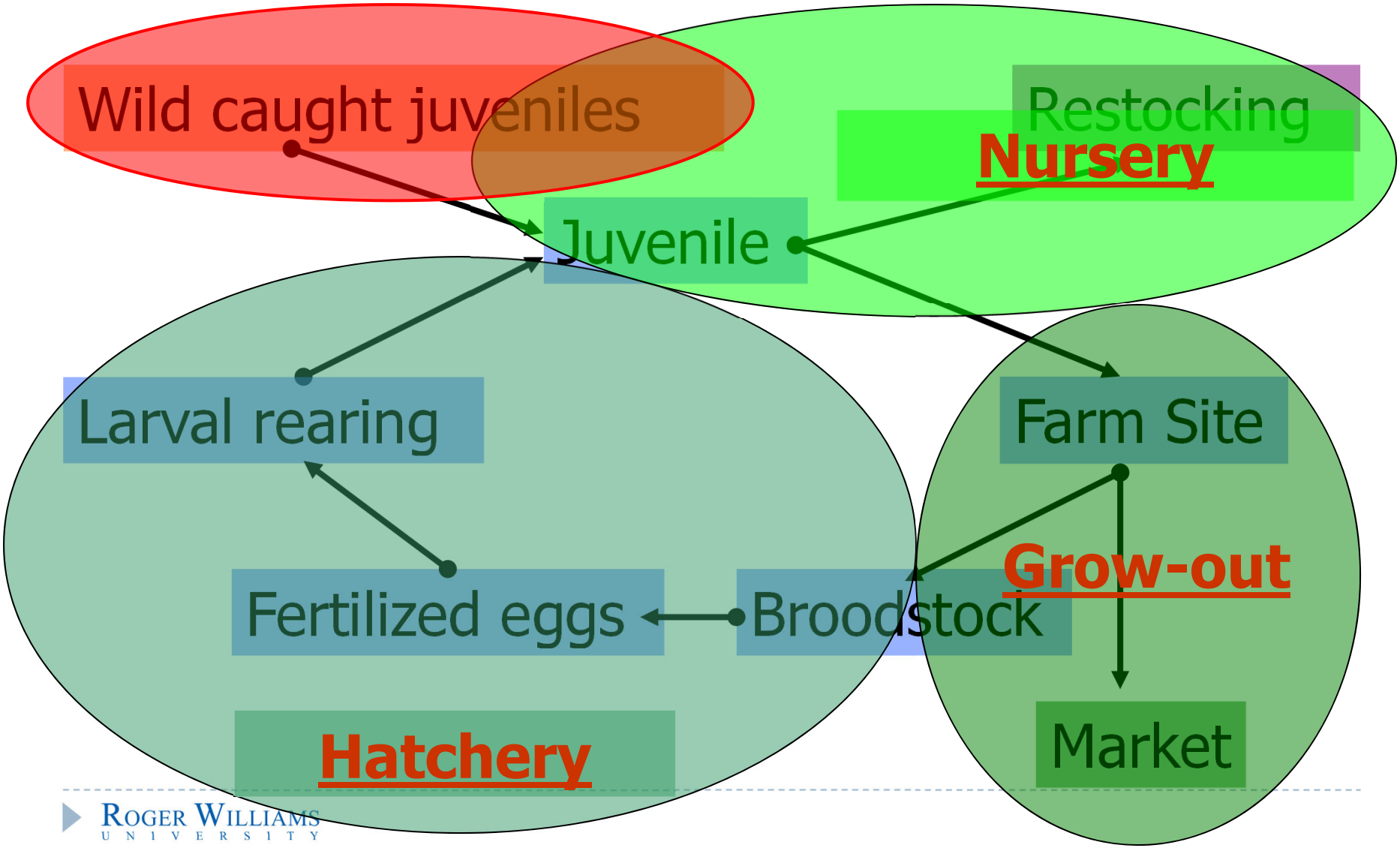
Shellfish Nursery Systems

ROGER WILLIAMS UNIVERSITY

Rob Hudson

Adapted from Dale Leavitt
Aquaculture Extension Specialist

Culture sequence

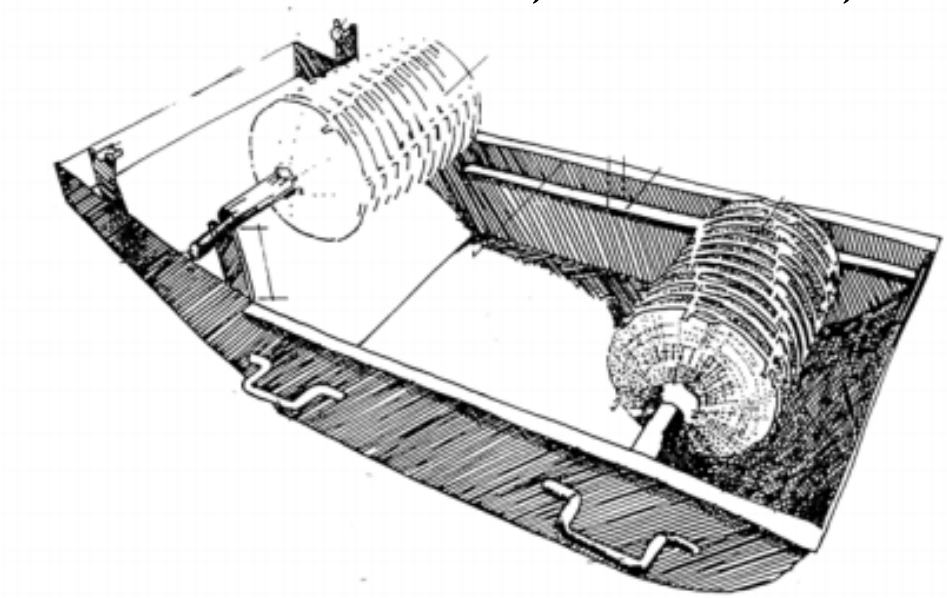


Before we talk about nurseries

Oyster Spat Collection

Cement for spat collection

- The mixture is made of equal volumes of cement, slaked lime, and moderately fine sand.
- To lime between 15 and 18 stacks of hats
  - A 23-kg bag of lime
  - A 40-kg bag of cement
  - An equal volume of sand
- Mix to a thin slurry
  - Enough water is added to give it the consistency of purée required to produce a uniform layer of about 2 mm.
- Dip hats in cement mixture and let drain

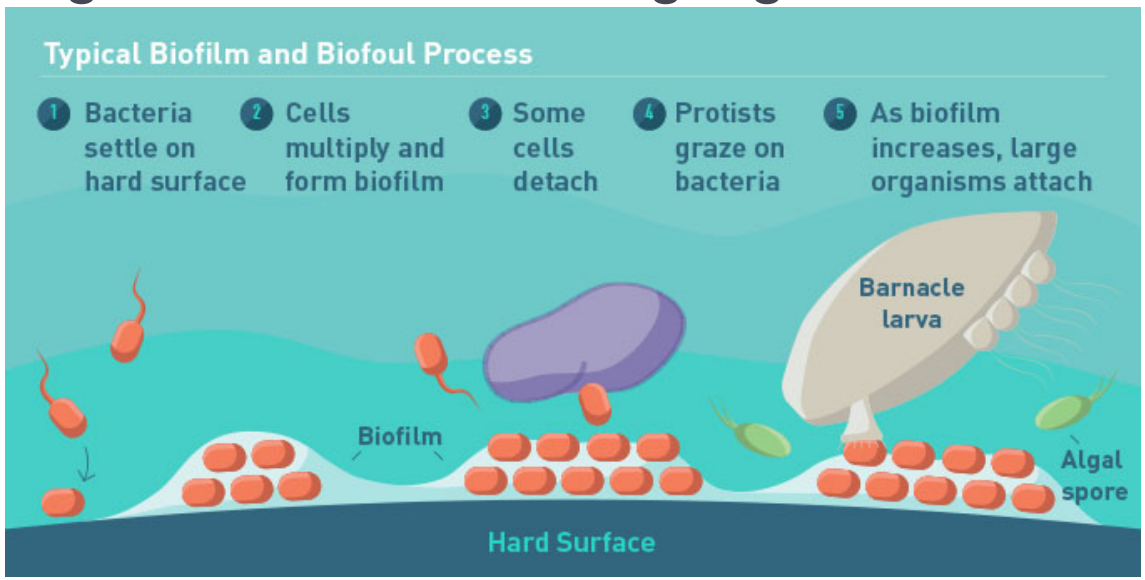


Curing the cemented hats

- To cure, the stacks of Chinese hats will have to be
  - Kept out of the wind and sun
  - Sprayed with water for three or four days after they are limed
    - This is necessary to prevent the mixture from hardening too fast, forming cracks, and being worn away by waves and currents
- After the cement has cured for three or four days
  - Allow the mixture to harden and to be washed by the rain outside
  - The stacks should be left a minimum of two weeks before they are used to collect spat

Schedule for spat collection

- Want to get the collectors out a few weeks before predicted spatfall
  - Allows for a biofilm to build up on the surface of the collector
  - But not enough time for other fouling organisms to block surface



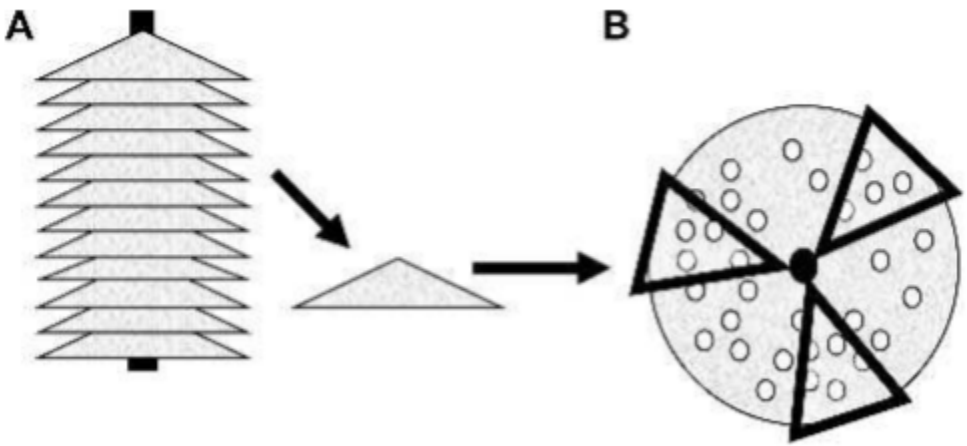
- Place in areas with known spatfall

Yield

- If in a location with good spatfall, one stack of Chinese hats can collect between 5,000 and 100,000 spat
  - When the spat are removed, a yield of 5,000 is considered acceptable
    - At that density, the spat can reach a size of more than 10 mm by the fall
  - Conversely, a collection of 100,000 spat per hat is problematic
    - There is competition for space and food
    - The final size in the fall will be only a few millimeters

Measuring Yield

- It is fairly easy to estimate the number of spat collected on Chinese hats
  - The area of the top of a hat is 900 cm^2
  - The oyster farmer has only to count the number of spat on small sections of 10 or so randomly selected hats and do the appropriate multiplications
  - The underside and top of the hat must be assessed separately since collection often varies considerably between the two surfaces

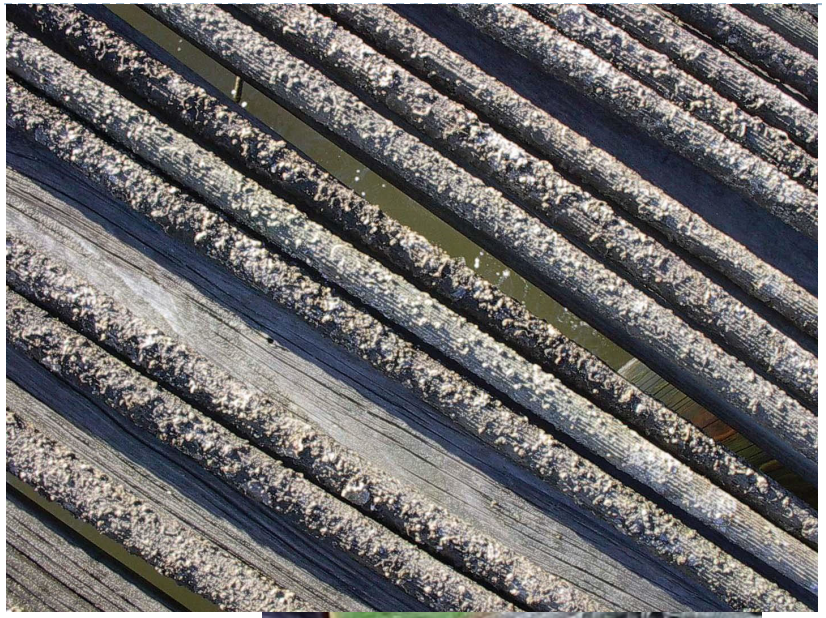


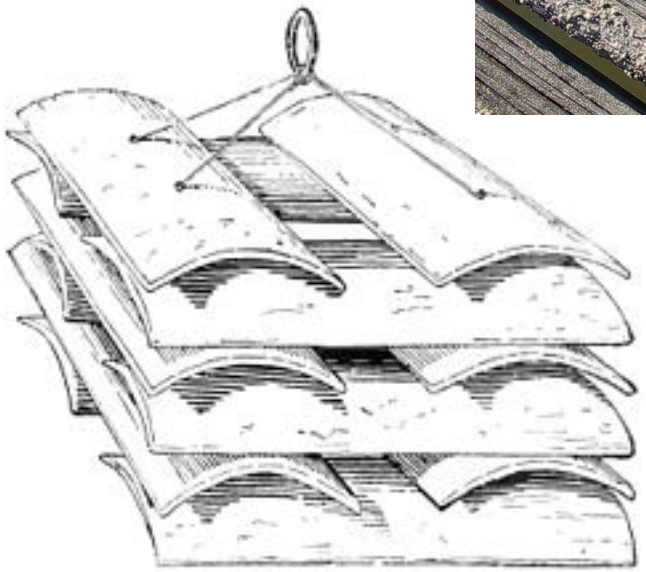
Spat removal

- An oyster farmer can dismantle the Chinese hats one by one manually and remove the spat from 25 stacks of Chinese hats in a day
- This method involves separating and flexing the hats to remove the oysters

Other oyster spat collectors

- French tubes
- French tiles
- Other apparatus?

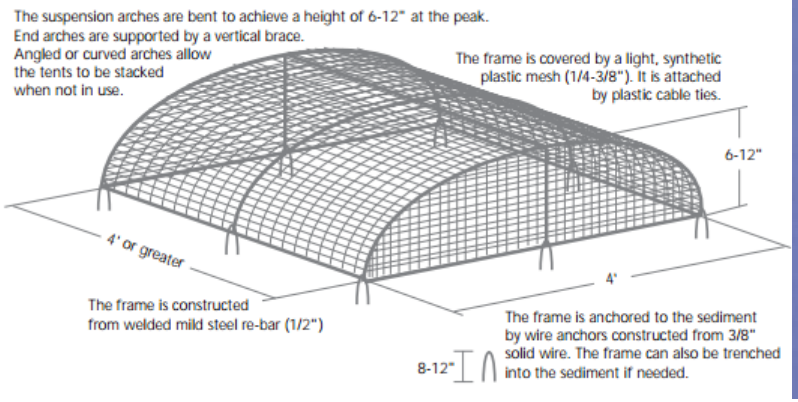


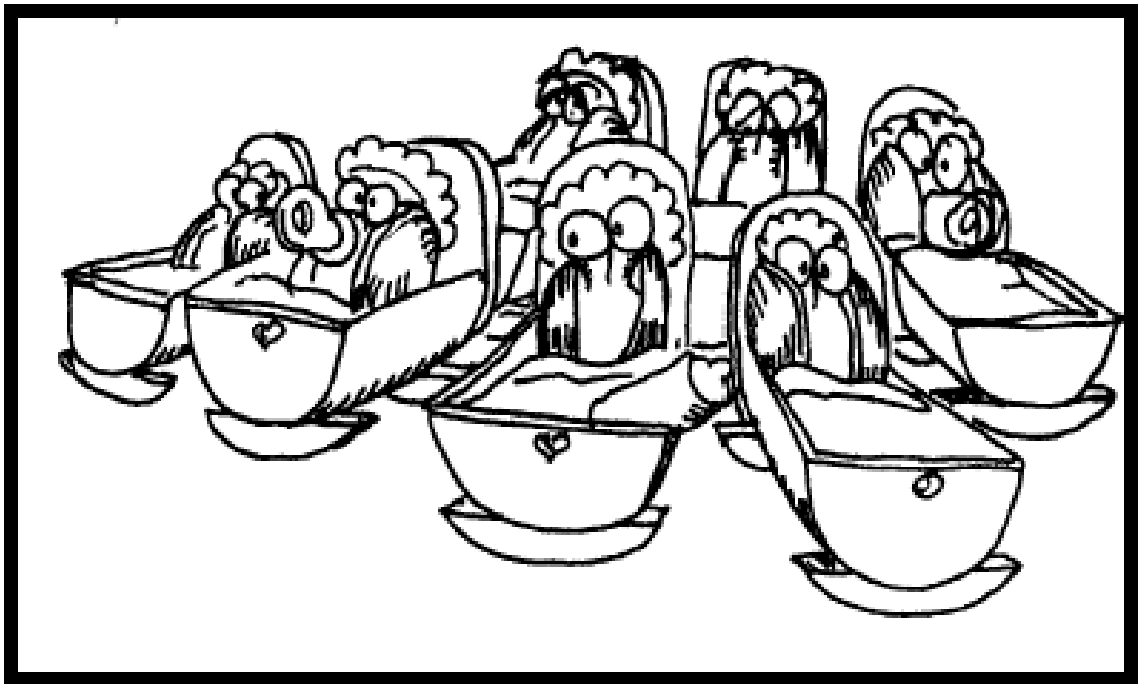


Spat collection – Oz style

Other shellfish seed collectors

- Bay scallops
  - Netron in mesh bags
  - Sea scallops also
- Soft shell clams
  - Clam tents
- Mussels
  - Fuzzy rope
- Quahogs
  - ?????





Everything you wanted to know about shellfish nurseries**

** but were afraid to ask!

The Nursery Stage

- Receive seed at a small size from the hatchery
  - Usually as post-set with a minimum size of 0.5 mm
  - More often at a size of 2-3 mm
    - Can hold seed on window screen material (~1.1 mm square)
- Rear it under controlled conditions to a size of:
  - Oyster = 19 mm (3/4") to 25 mm (1")
  - Quahog = 16 mm (5/8")
- At which point it gets transferred to the grow-out system

Nursery Absolutes

- Everything eats shellfish seed
- Fine screens foul quickly & tear easily
  - Loose a small volume of seed – major problem
- High metabolic needs – food and oxygen
- Flow and food becomes limiting fast
  - Food limitation leads to variation in growth => leads to more sieving
  - Stunted juveniles often never recover

Nursery timeline

- Normal timeline
  - Mid-late May = receive seed
    - Smallest at 2.5 – 3 mm seed
    - Retained on a window screen mesh
    - Pet screen is heavier than normal insect screening but has a larger mesh
      (~1 x 2 mm vs. 1 x 1 mm)
- Need to pay attention to two things
  - Fouling of mesh
  - Size grading

How does one develop a shellfish nursery system?

- Assess your needs
- Identify your location
- Decide on your general design strategy
- Obtain permits
- Purchase and install system
- Get seed

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Assessing your needs?

- What shellfish species are you growing?
- How many do you want to grow?
- What size seed will you purchase?
- How large do you want to grow them in the nursery?
- How much time can you spend maintaining the system?
- How much money do you have to invest in the system?

How does one develop a shellfish nursery system?

- Assess your needs
- Identify your location
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- Get seed

Identifying your location?

- What space do I have available?
- What are the water characteristics?
  - For shellfish to survive and grow?
- What utilities do I have on-site?
- What is my primary means to access the site?

Nursery Principle I

- Locate your nursery at a site that provides the best conditions for growing seed that you have available!
  - Not all sites are equal in supporting nursery growth

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- Identify your location
- Decide on your general design strategy
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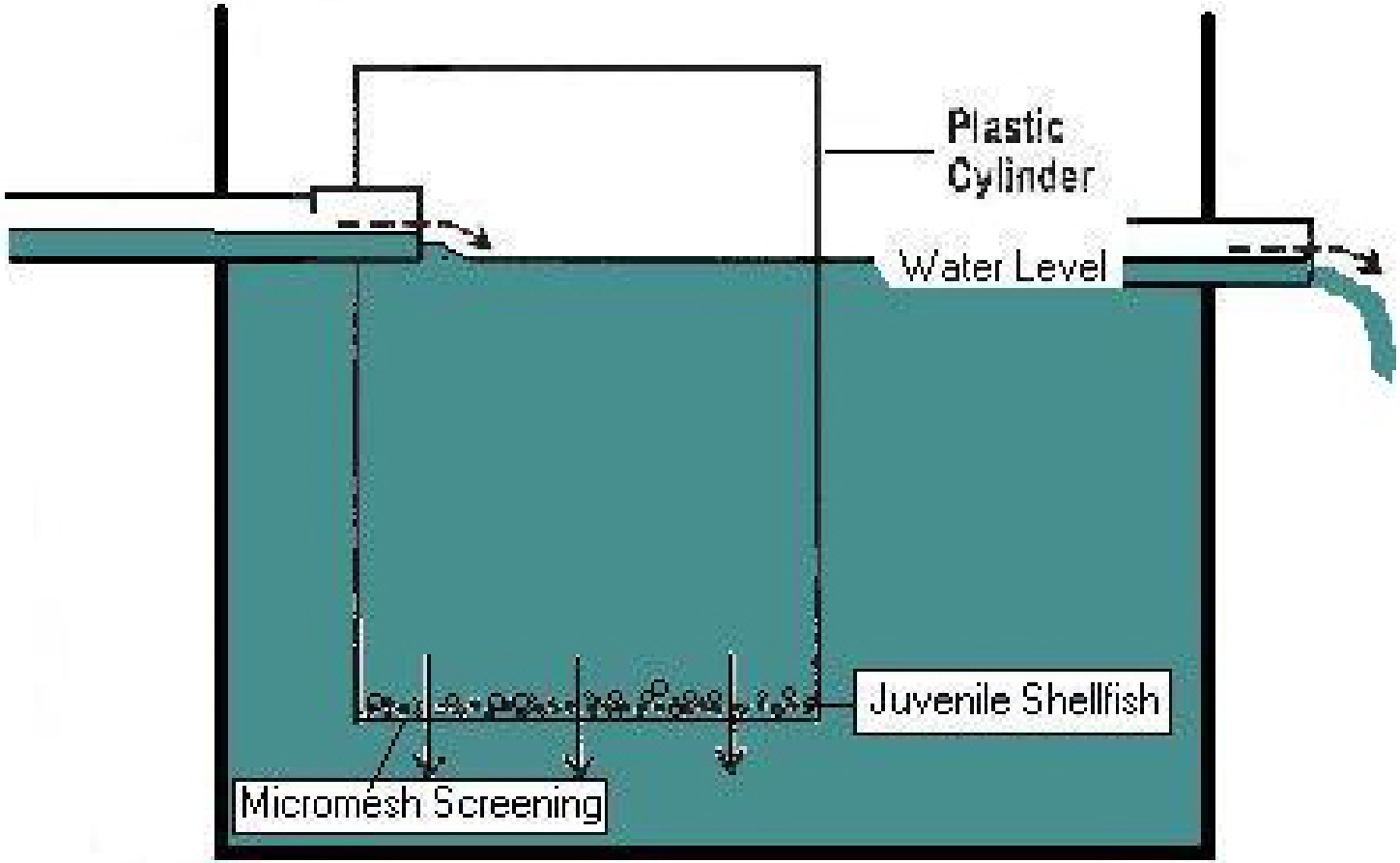
Design Strategy

- Based on
  - What you want to grow
  - What resources you have (space, time & money)
- Many variations on a theme are available
  - We will cover much of the technology
  - Only limited by your imagination

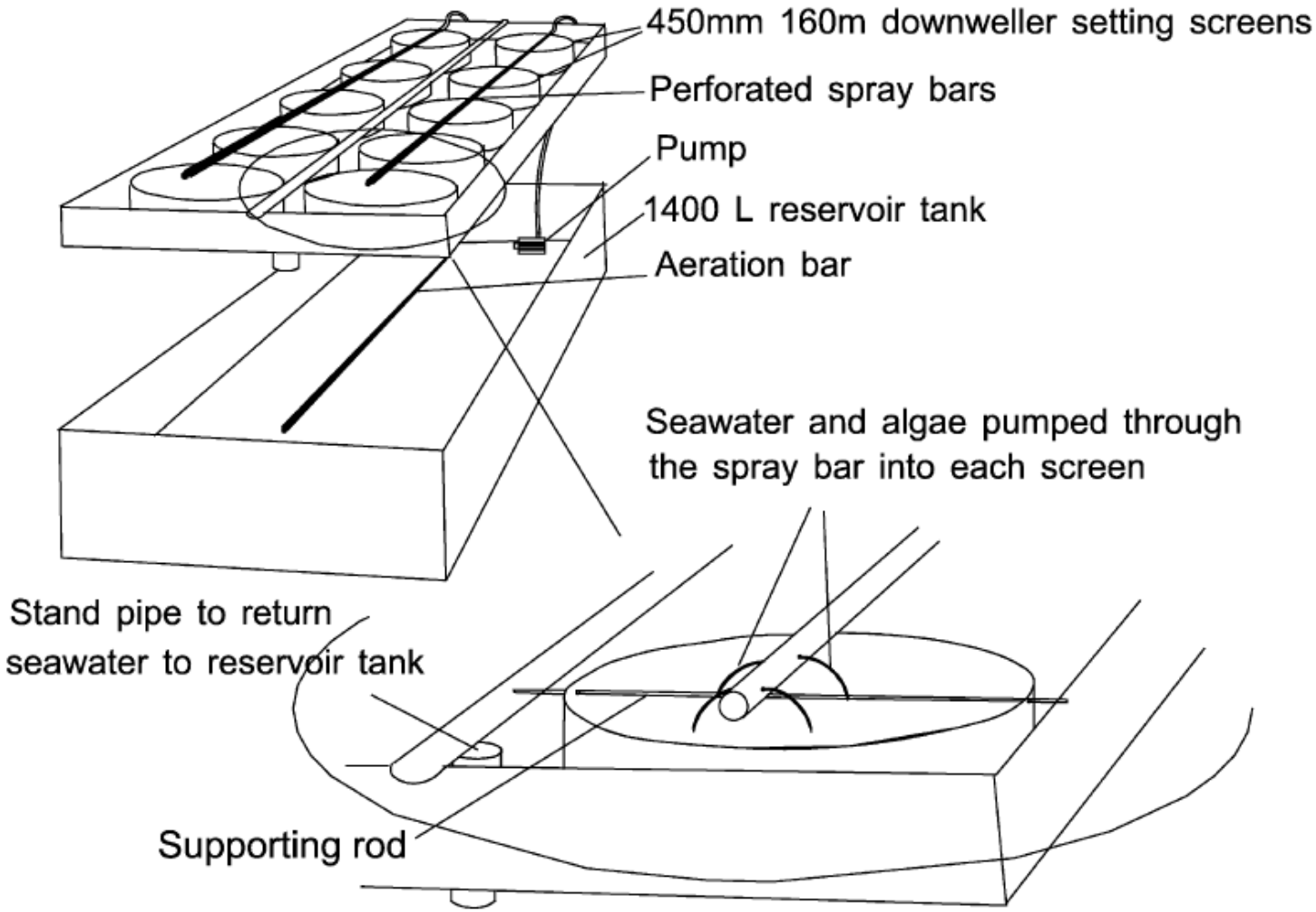
Developing a shellfish nursery – seed size

- System options
  - Downweller (175 to 500 μm)
  - Upweller (500 μm to 25 mm)
  - Raceway (3 mm to 25 mm)
  - Field nursery (>3 mm)

Downweller Nursery

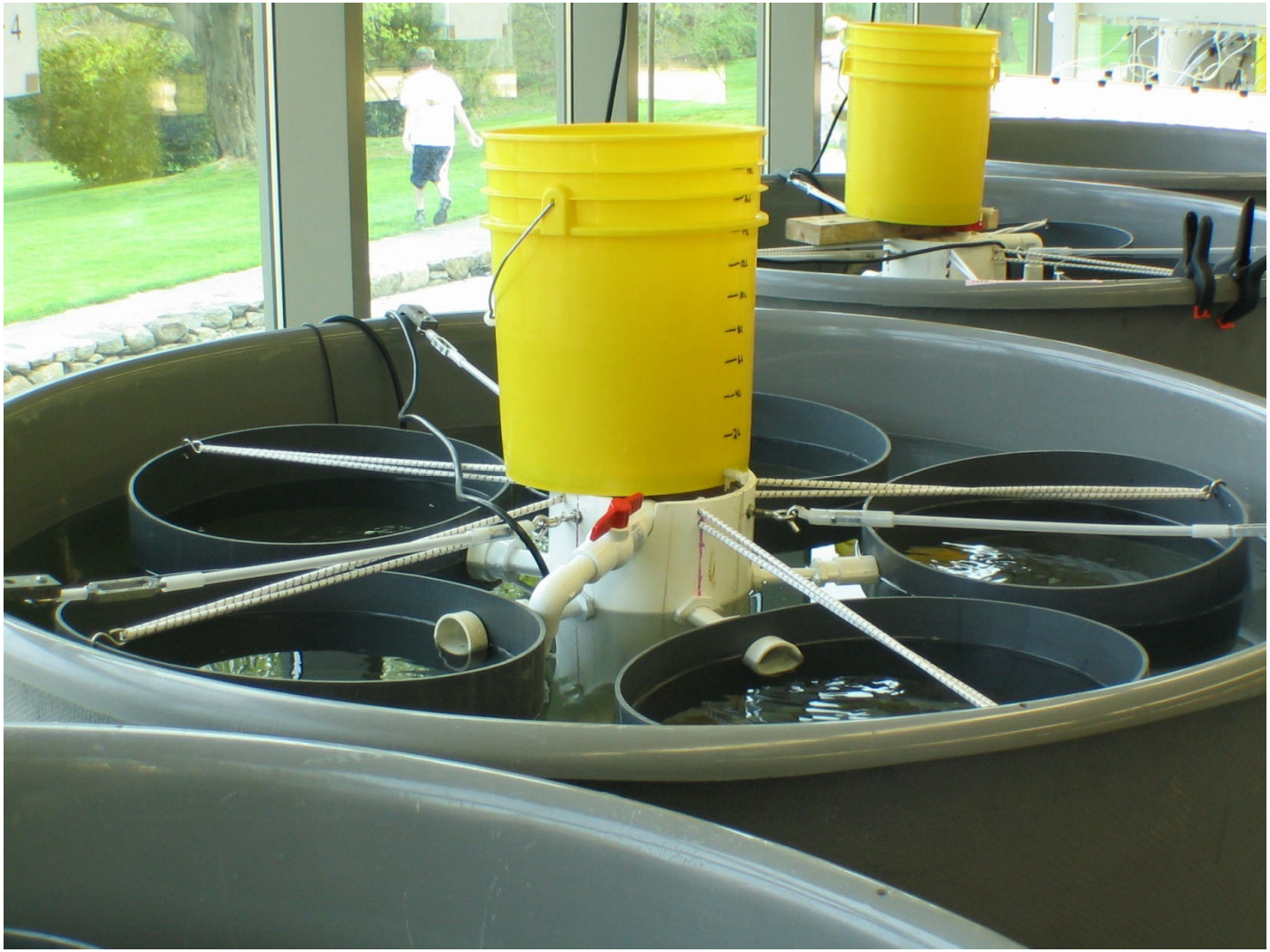


Downweller Nursery



Downweller Nursery

RWU Downweller



Downweller Stocking Density

- Based on surface area of the screen

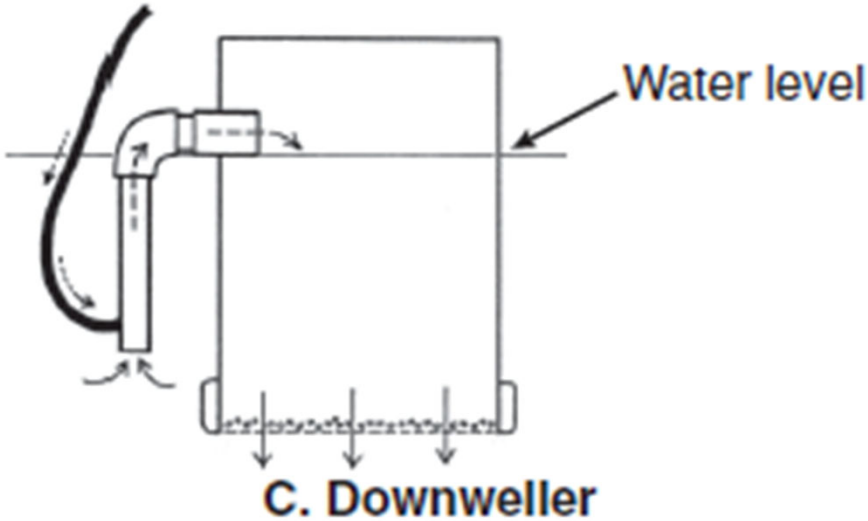
Quahog

Size	clams/cm²	ml/cm²
up to 600 µm	575	0.03
700 µm	285	0.03
1 mm	140	0.04

- Couldn't find equivalent data for oysters!
  - But probably very similar

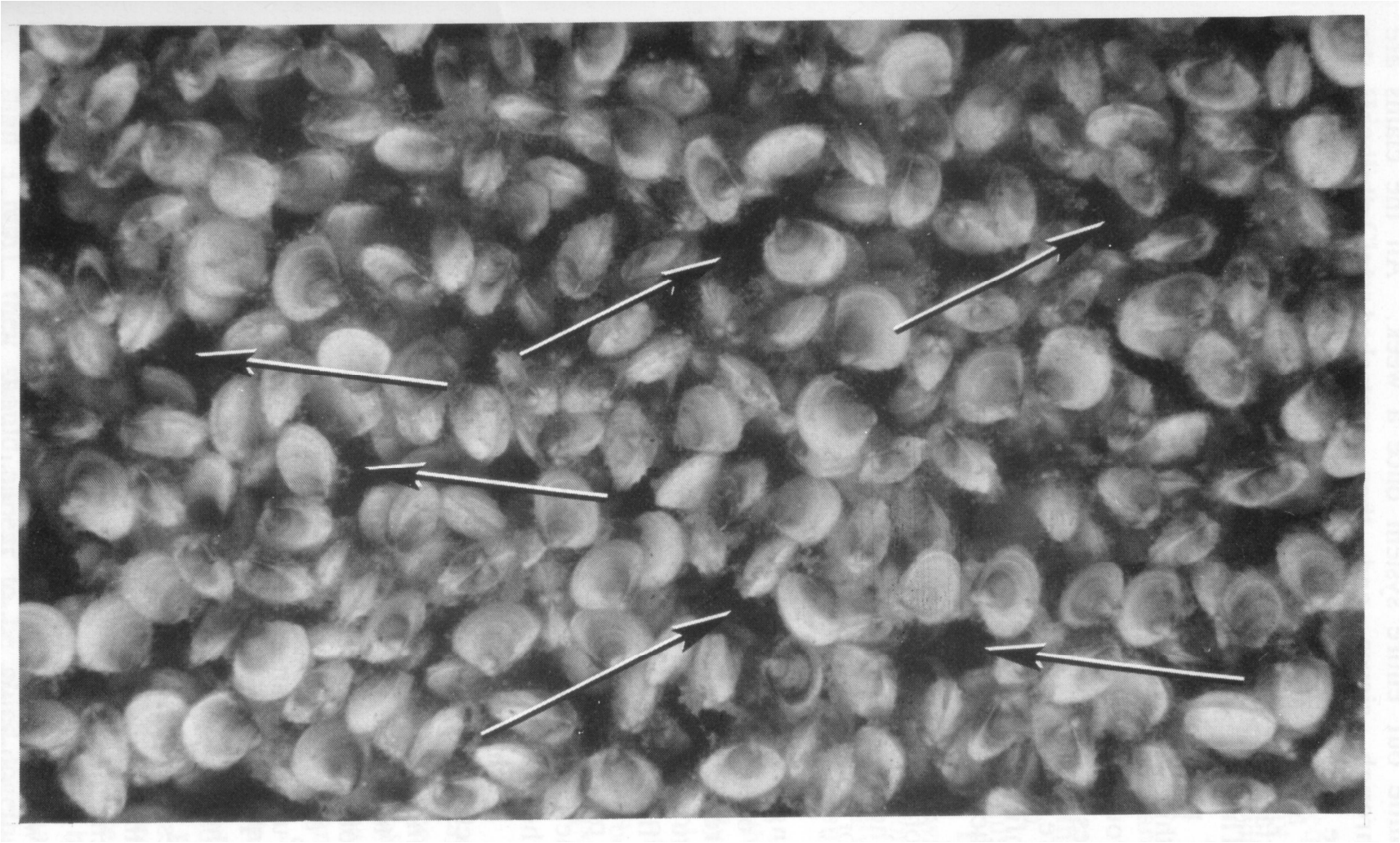
Downweller Nursery

- Advantages
  - Used for setting competent larvae
  - Can hold very small shellfish (post-set – 175-500 μm)

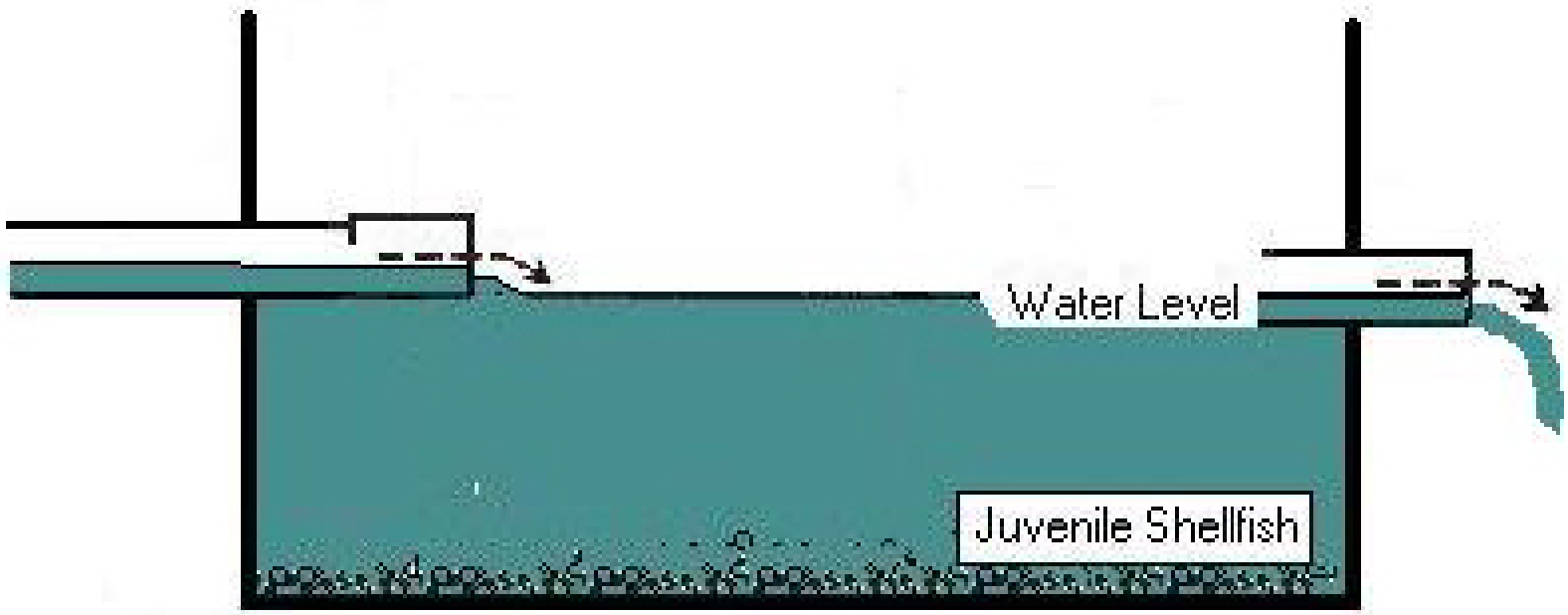


- Disadvantages
  - Medium stocking density
  - Flow limitations (packing & channelization)
  - Requires a land-based flowing water system

Channelization

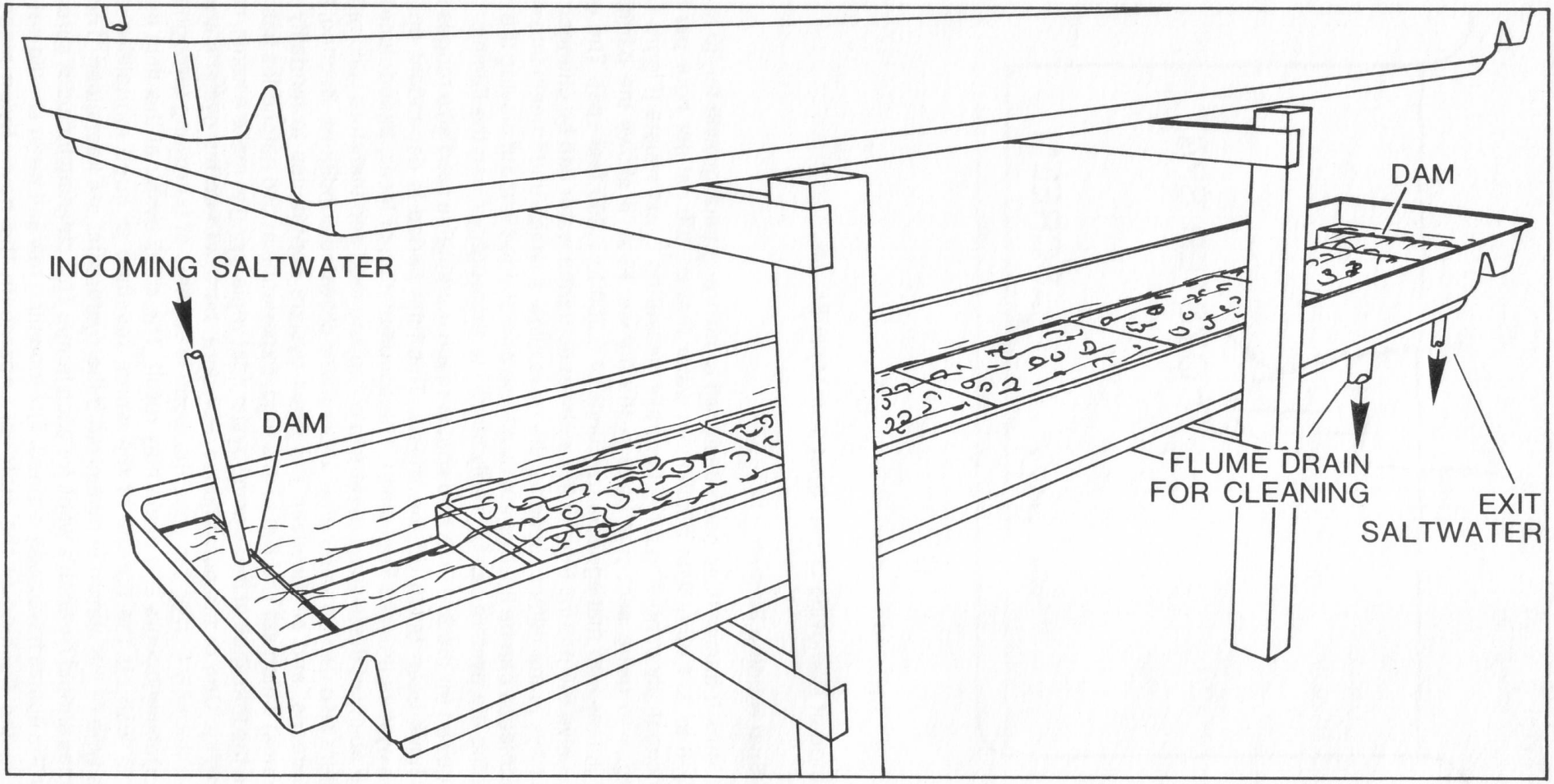


Raceway Culture System



Raceway Culture System

DupMo MarkII Flume with Nestier Trays



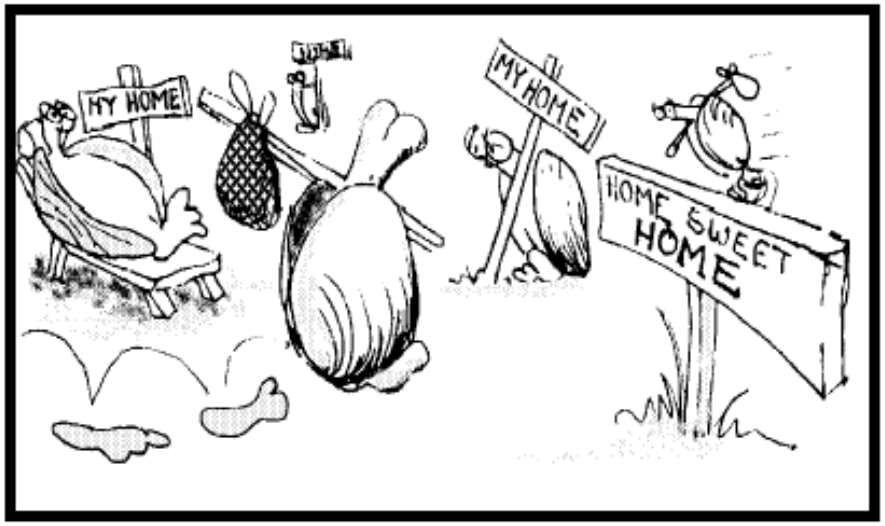
DupMo MarkII Flume with Nestier trays

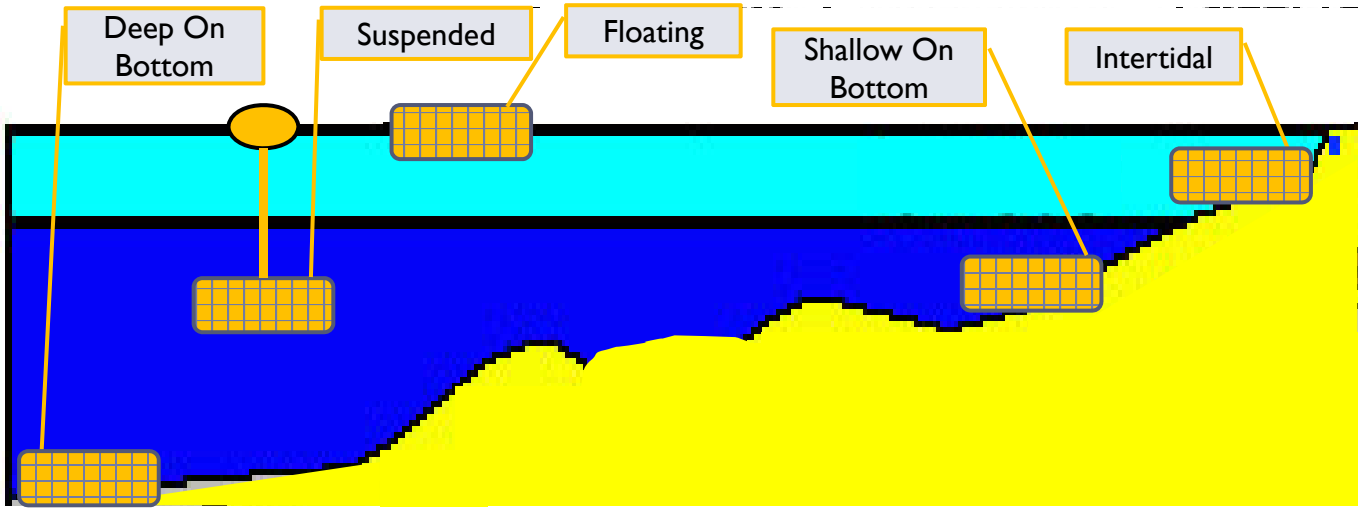
Raceway Nursery

- Advantages
  - Low maintenance
  - Shellfish can be held in sediment
  - Can be maintained in the field
- Disadvantages
  - Low stocking density (monolayer)
  - Need land-based flowing water system

Field Nursery Systems

- On Bottom
- Suspended
- Floating at Surface



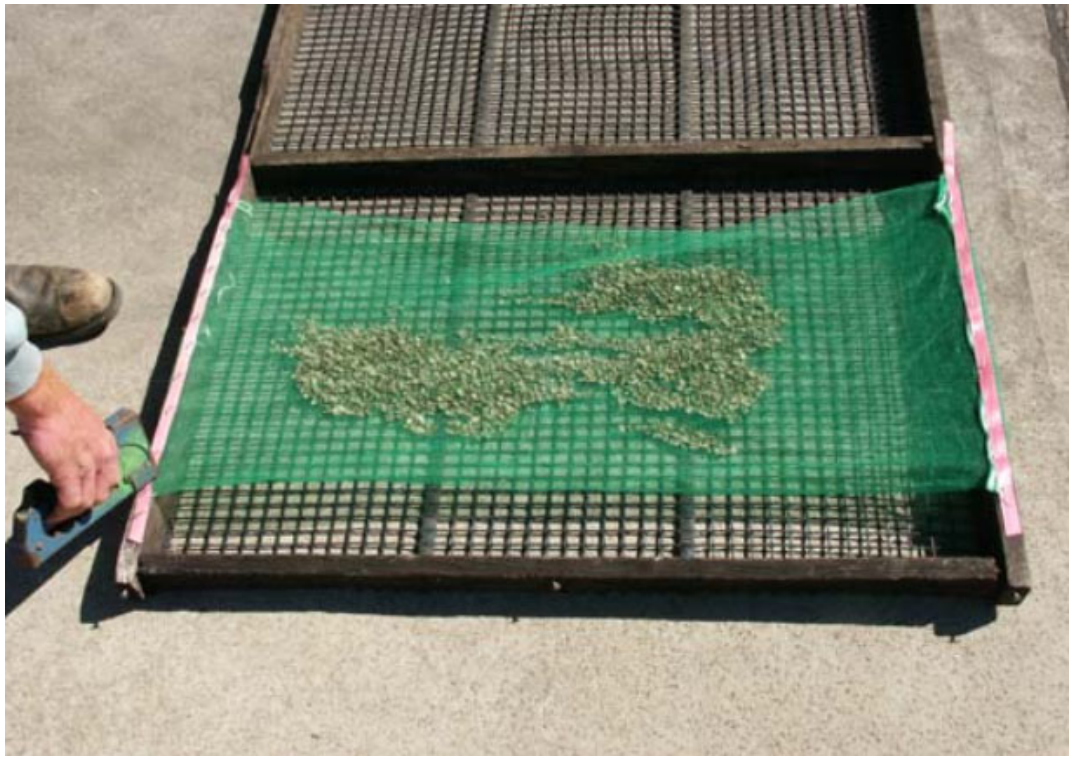


Field Nursery (Clams) – On Bottom

- Wire mesh tray
  - ~ 3' x 3'
  - Lined with silt cloth
- Filled with sieved sediment
- Covered with window screen
  - Float added
- Top screen clamped to wire frame and silt cloth with pipe clamps
- Stocked at ~10,000 clams per ft^2
  - 3 – 8 mm size

Field Nursery (Oysters) – On Bottom

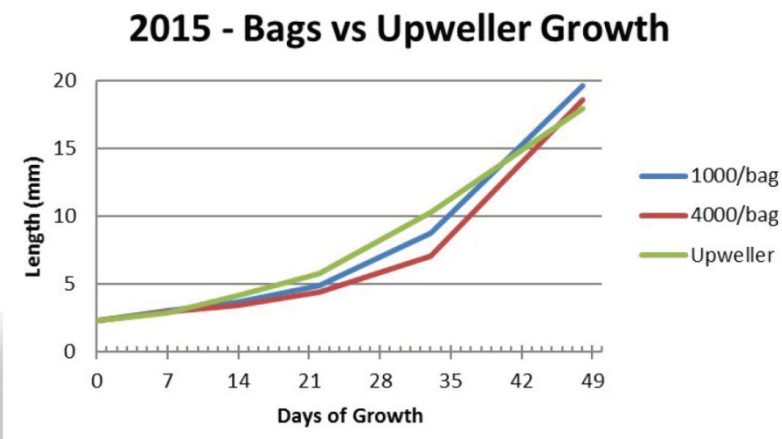
- Spat bag stretched in wire tray
  - Spat bags mesh - 0.75, 1.5 & 3.0 mm
  - Wooden slats at ends
- Be wary of fouling
- Never tried this so not sure of stocking density
  - I would guess around 1 liter might be okay



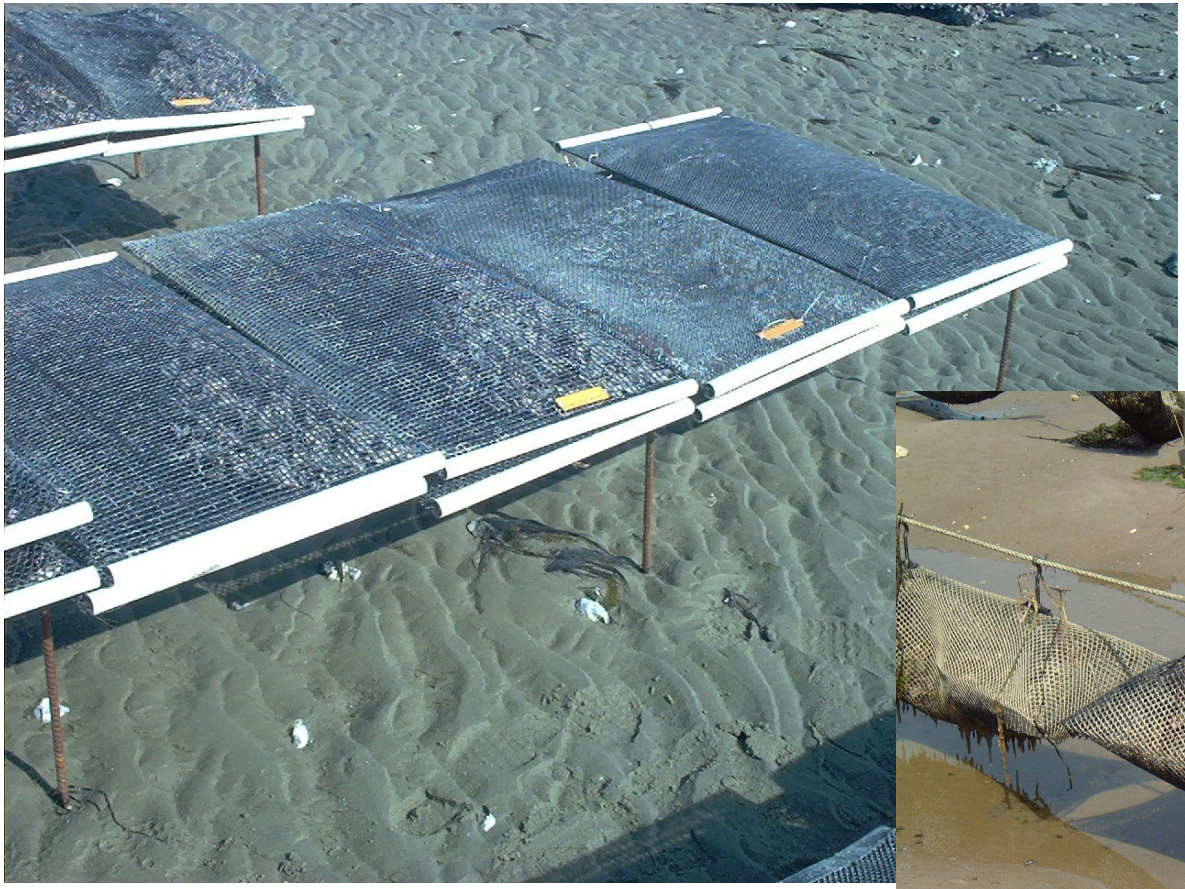
Experiences Starting Small Oyster Seed Without an Upweller

Josh Reitsma

- Recent SEMAC study
  - Do not exceed 2,000 oyster seed per spat bag
  - (1.11 oysters per cm2)

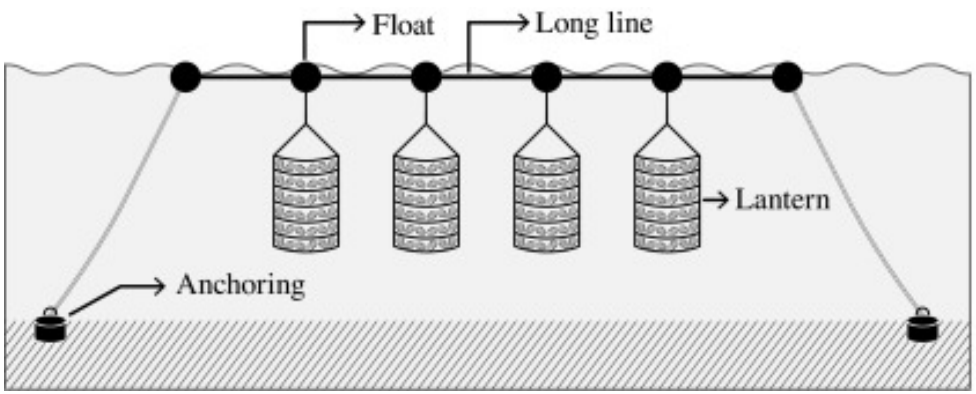


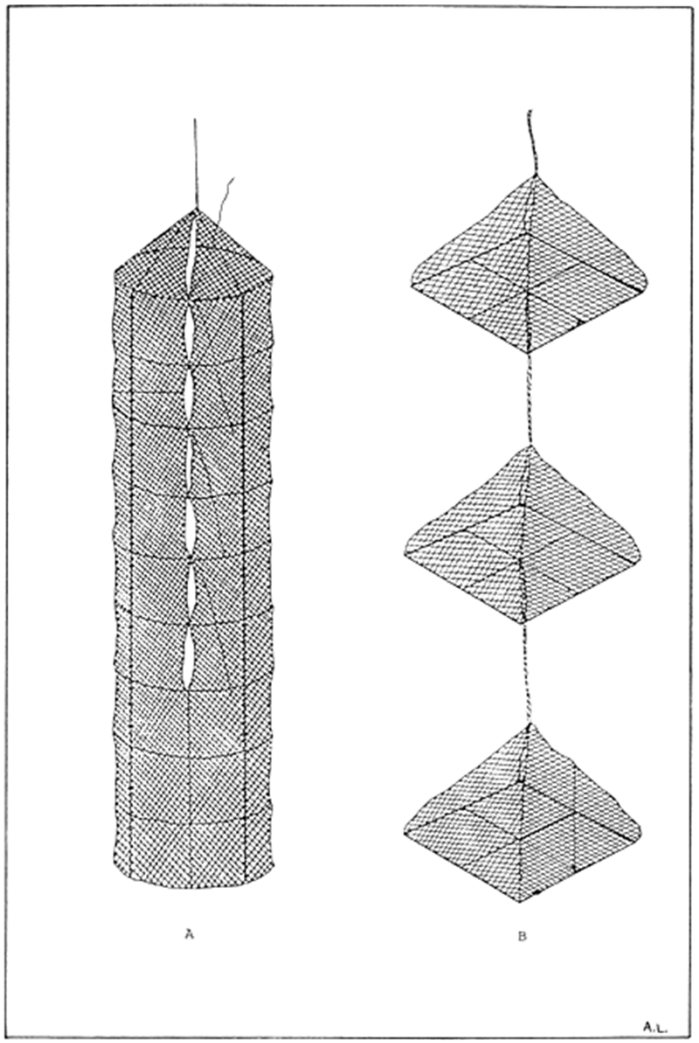
Near Bottom Nursery (Oysters)



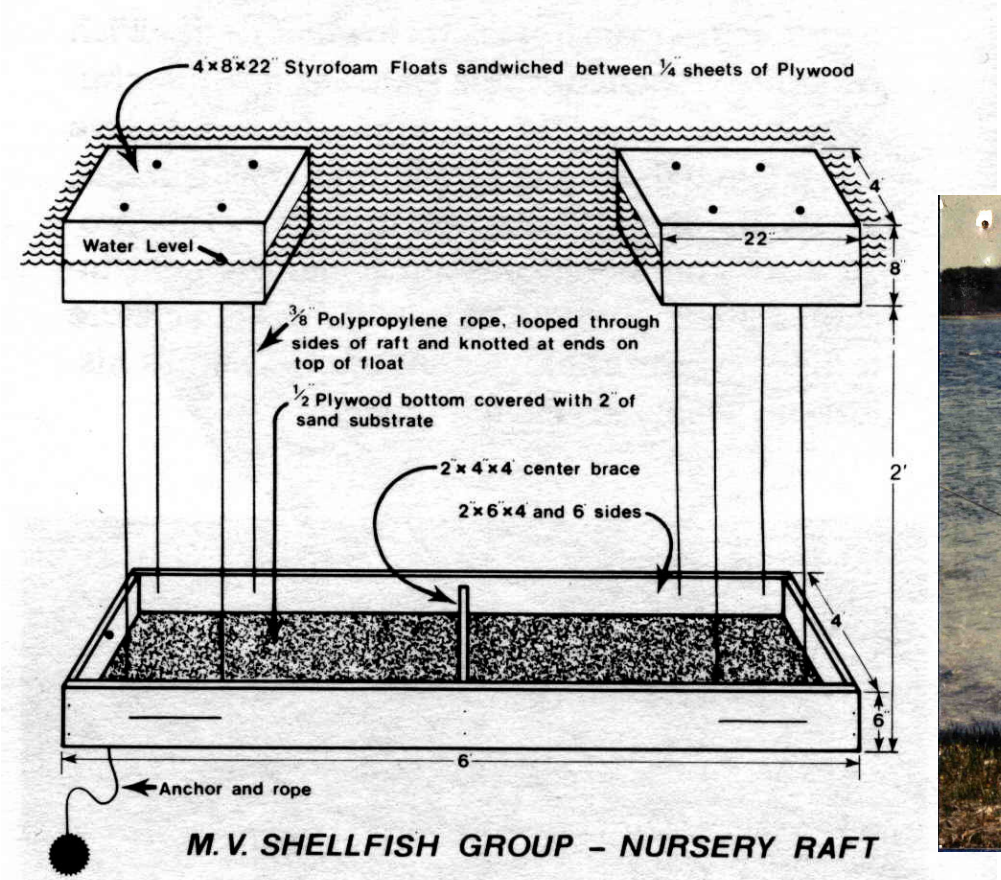
- ADPI Bag
  - Generally stock at ~2 liters with small seed (8 – 10 mm)

Field Nursery - Suspended

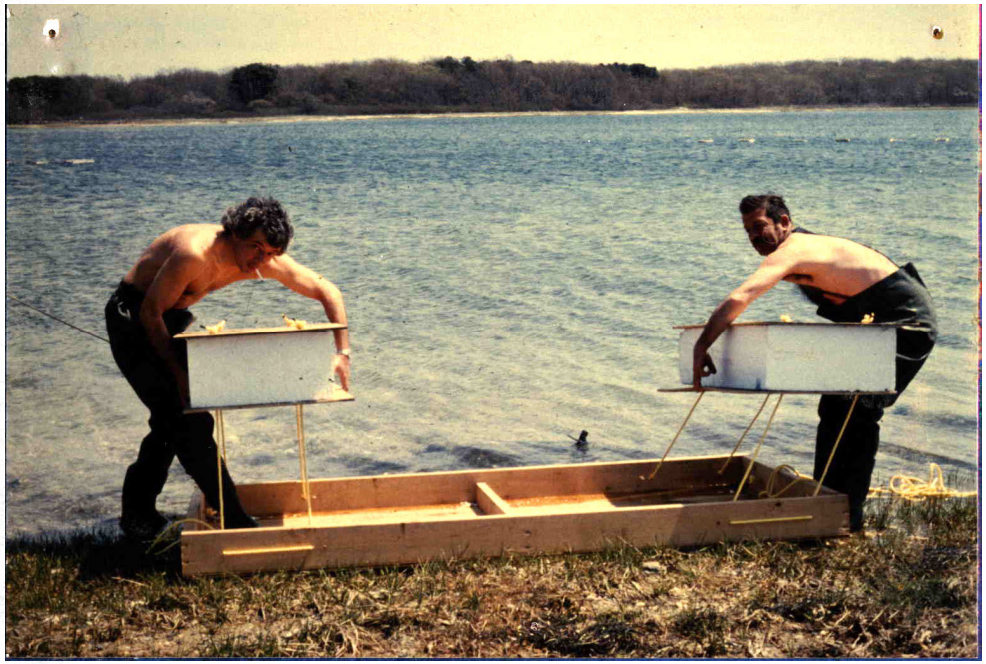




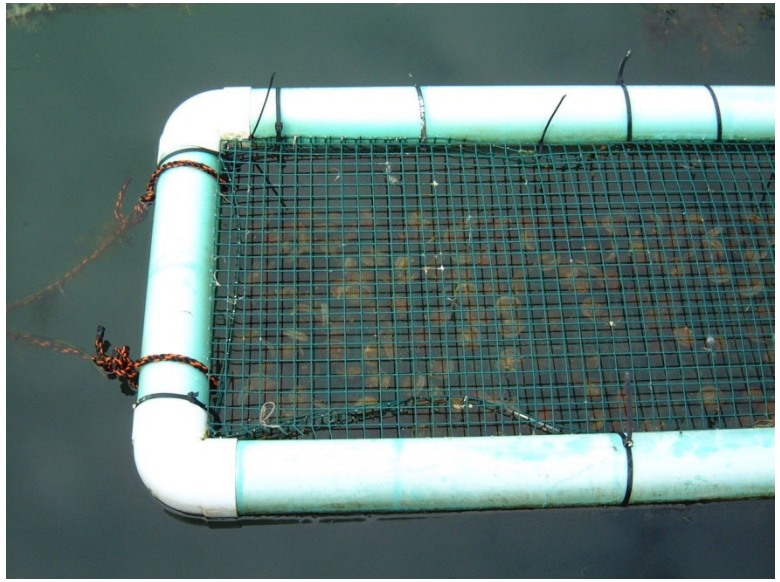
Field Nursery - Suspended



Tiny seed quahogs are protected from predators in nursery rafts.



Field Nursery - Floating



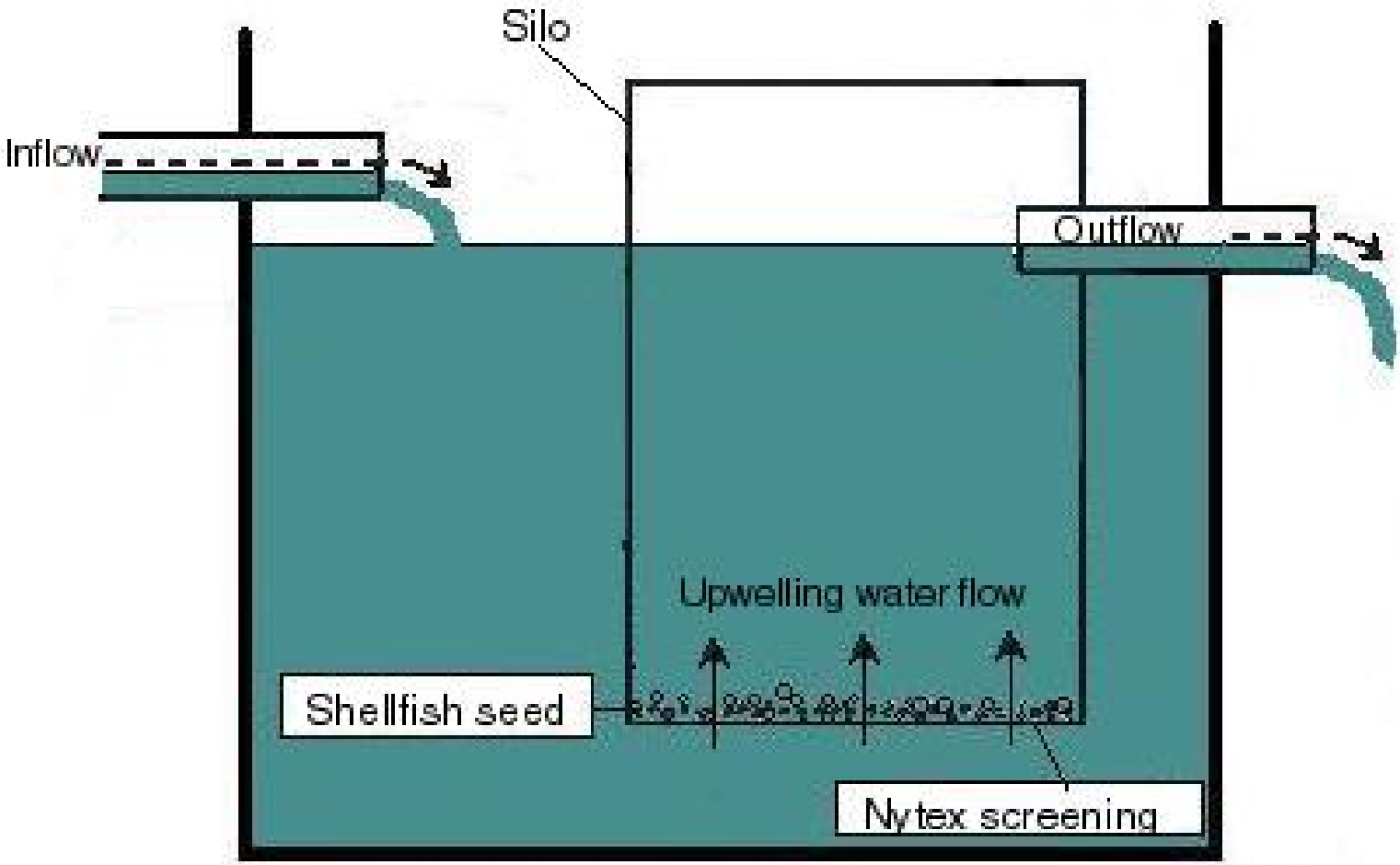
Field Nursery - Floating

- ADPI Bag
  - Generally stock at ~2 liters with small seed (8 – 10 mm)

Field Nursery

- Advantages
  - good water flow
  - high food flux
  - moderate stocking density
- Disadvantages
  - moderate to high maintenance (fouling)
  - predation risk
  - susceptible to Mother Nature

Upweller Nurseries (next week)



How does one develop a shellfish nursery system?

- Assess your needs
- Identify your location
- Decide on your general design strategy
- Obtain permits
- Purchase and install system
- Get seed

Permitting

- If land-based system
  - Permit through CRMC for shellfish
  - Need to consider a RIPDES permit that addresses water withdrawal and discharge
- If "in the water" system
  - Only permit through CRMC (RI) or Town/DMF (MA)
  - Does not have to be on primary lease area (RI & MA?)
  - Can be be operated in "prohibited" waters (RI & MA)
    - Size thresholds in effect
      - Quahogs 20mm (Approx. ¾")
      - Oysters 32mm (Approx. 1 ¼")

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Install your system!

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Dealing with Shellfish Seed

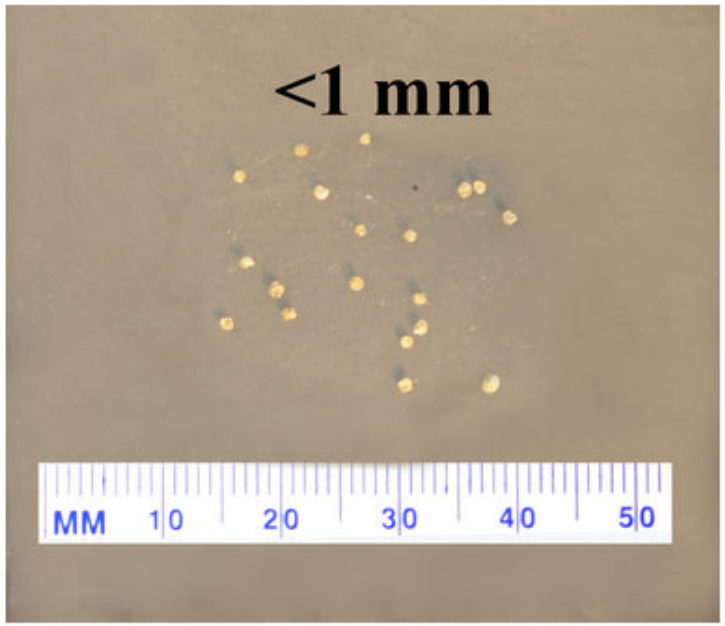
or

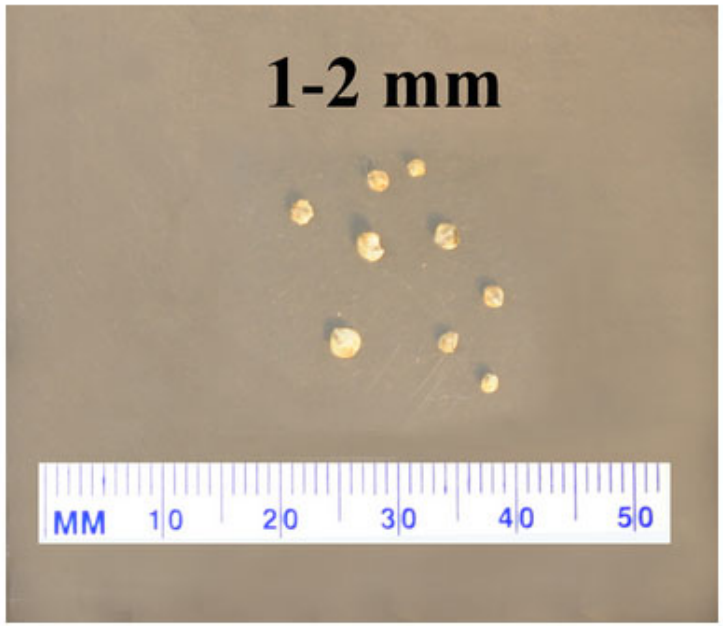
"How to buy seed without getting shucked!"

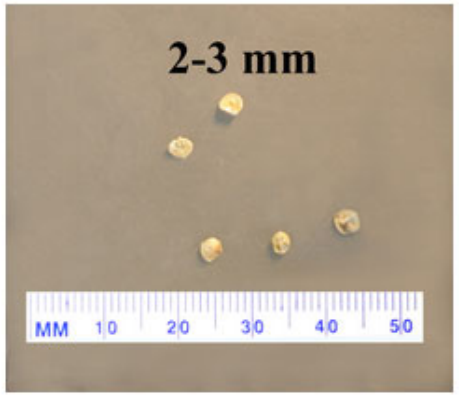
Ordering your seed

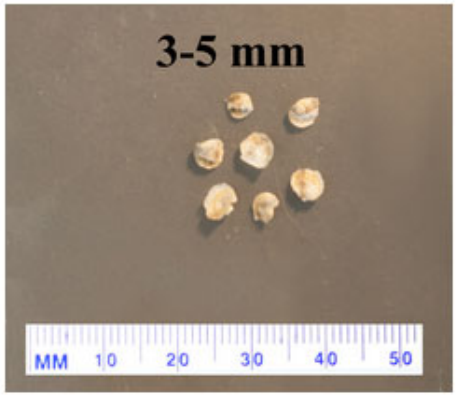
- Know your hatchery(ies)
  - Talk with them and discuss your seed purchase
  - Check out the hatchery seed performance with other growers in the area
- Place orders early
  - Usually orders are in by January (with down-payment)
- Spread purchase between a few hatcheries
  - To protect yourself in case of hatchery failure
- Order by size
  - Often referred to as the size screen the seed are retained on
    - R-1, R-1.5, R-2, etc.
  - Otherwise specified by actual seed size
  - Make sure you know how the hatchery measures their seed

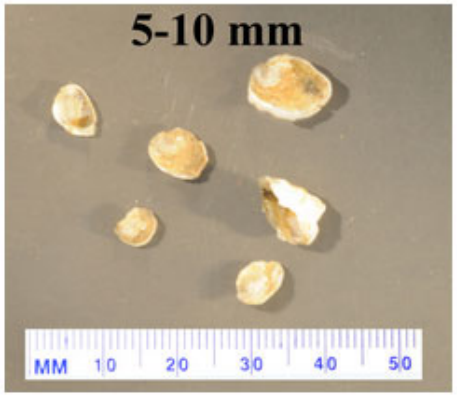
Seed size options











Ordering seed – things to think about

SCREEN SIZE: (Circle one)	1.00 mm	1.4 mm	1.6mm	2.0mm
PRICE PER 1,000:	$6.00	$9.00	$10.50	$12.00

GENETICS: (check preference) Diploid (Haskin NEH® Line) _____ Triploid (NEH®) _____
Triploid (Northern x VIMs) _____ Triploid (VIMs x VIMs) _____

QUANTITY*: _____ PREFERRED DELIVERY DATE _____

*Note: Minimum order is 50,000 oysters. See our website for further information: www.mookseafarm.com

- Size?
  - Buy the biggest seed you can afford – you can scale down the size as you gain experience
- Genetic lines?
  - Disease resistance
- Ploidy?
  - Diploid vs. Triploid
- How many?
  - Start small and scale up!
  - You can learn as much with killing 10,000 seed as killing 1,000,000 and it is much cheaper!
- Preferred delivery date
  - When will you be ready to receive them?

Seed purchase

- Shop around to see what the hatcheries are charging
  - Probably not a lot of difference – but you never know!

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
HORN POINT LABORATORY
OYSTER HATCHERY

Cultchless Seed Prices (per 1,000 oysters)

Size	Recommended Screen Size	Diploid Wild	Diploid Disease Resistant* or Triploid Disease Resistant**
2-3 mm	2 mm	$8.75	$11.00
3-5 mm	3 mm	$9.75	$12.25
5-10 mm*****	5 mm	$13.75	$17.25

2019

A.R.C Shellfish Seed Price List

Size Conversions

3mm ≈ 1/8" 6.3mm ≈ 1/4" 13mm ≈ 1/2" 19mm ≈ .75"

SIZE (mm)		PRICE (Per 1,000 SEED) – Includes Cash/Check Discount		
Sieve Size (mm)	**Size Range of Seed** Actual Size in Millimeters (mm)	**Quahog** *M.Mercenaria*	**Oyster *** *C.Virginica*	**Surfclam** *S.Solidissima*
R-1.5	2.0 – 3.2	$13.00	$11.25	$12.00
R-2	3.2 – 4.2	$15.50	$13.00	$15.00
R-3	4.2 – 5.3	$18.00	$18.00	$17.00
R-4	5.3 – 8.0	$22.50	$23.50	$22.00
R-6	8.0 – 11.0	$28.00	$31.00	$26.00
R-8	11.0 – 16.4	$35.00	$39.00	—
R-12	15.0 – 20.0	$52.00	$52.00	—
R-3/4	20.0 – 25.0	$65.00	$65.00	—

* There will be an additional charge of 15% for orders of **Triploid** and **DBY Oysters** to cover royalty fees associated with process licensing issued by the College of William and Mary and its affiliate, the Virginia Institute of Marine Science.

Example seed prices (2018)

Great Atlantic Shellfish Farms LLC. 2018 Price List

333 Bayview Avenue
East Islip NY 11730
631-224-1100
orders@gsbhatchery.com

Size (mm)	Oysters /1000	Clams / 1000
2.0 – 3.0	$11.00	$14.00
3.1 – 4.0	$13.00	$15.00
4.1 – 5.0	$15.00	$19.00
5.1 – 8.0	$20.00	$23.00
8.1 – 11.0	$24.00	$28.50
11.1 – 16.0	$31.00	$36.00
16.1 – 25.0	$39.00	

2019 East Coast Shellfish Hatchery and Nursery Directory

NEW YORK – CONTINUED

Great Atlantic Shellfish Farms, LLC – H, OY, HC
Contact: Douglas A. Winter/Marty Burns
333 Bayview Avenue
East Islip, NY 11730
Cell - 631-943-1208
orders@gsbhatchery.com
dwinter@gsbharchery.com
www.gsbhatchery.com

Harbor Lights Oyster Co. - OY
Contact: Ted Bucci
200 Harbor Lights Drive
Southold, NY 11971
Phone - 631-740-0985
ted@harborlightsoysterco.com

Hart Lobster - OY, H
Contact: Bill Hart
17 Amelia Place
West Sayville, NY 11796
Phone - 631-877-1694
hartlobster@aol.com

Town of Hempstead Shellfish Hatchery HC, OY
Contact: Stephen Naham
P.O. Box 180
Point Lookout, NY 11569
Phone - 516-897-4112
snaham@tohmail.org
www.hempsteadny.gov

Town of Islip Shellfish Culture Facility H, OY, HC
Contact: Martin Byrnes
333 Bayview Avenue

NORTH CAROLINA - CONTINUED

Mill Point Aquaculture - HC, OY, H, N
Contact: James Morris
223 Shell Hill Road
Sea Level, NC 28577
Phone - 252-342-7452
millpointaquaculture@gmail.com

RHODE ISLAND

Ocean State Oyster Hatchery - OY, H, N
Contact: Christian Durfee
1519 Commodore Perry Highway
Wakefield, RI 02879
Phone - 401-749-9941
ctdurfee@gmail.com

Roger William University - R, OY, HC, BS
Marine & Natural Sciences
Contact: Rob Hudson
One Old Ferry Road
Bristol, RI 02809
Cell - 401-254-3885
RHudson@rwu.edu

Salt Pond Oyster Company - H, N, OY
Contact: Dave Roebuck
221 Broad Hill Way
Wakefield, RI 02879
Phone - 401-741-5953
dave@saltpondoysters.com
www.saltpondoysters.com

SOUTH CAROLINA

Toogoodoo Oyster Co. - HC, EO
Contact: Andrew Speaker
4411 Cox Plantation Road

VIRGINIA- CONTINUED

Bay Watch Oyster Seeds, LLC - OY, N
Contact: Keith Rodgers
P.O. Box 535 - 271 Bay Watch Lane
Reedville, VA 22539
Phone - 804-453-4367
baywatchoysterseeds@nnwifi.com
www.baywatchoysterseeds.com

Cherrystone Aquafarms - HC, OY
Contact: Tim Rapine
P.O. Box 347
Cheriton, VA 23316
Phone - 757-331-1208
timr@littleneck.com
http://www.clamandoyster.com

JC Walker Brothers - HC, OY, BS, H
Contact: Tom & Wade Walker/Ann Gallivan
P.O. Box 10
Willis Wharf, VA 23486
Phone - 757-442-6000
Fax - 757- 442-7059
seasideclams@gmail.com
www.jcwalkerbrosclams.com

KCB Oyster Holdings, LLC - OY
Contact: A.J. Erskine/Liz Walker
755 Lake Landing Drive
Lottsburg, VA 22511
Phone - 804-529-6654
Fax - 804-529-7374
ajerskine@bevansoyster.com

Oyster Seed Holdings, Inc. - OY
Contact: Michael Congrove
P.O. Box 397


It is seed day!

Your seed has arrived!

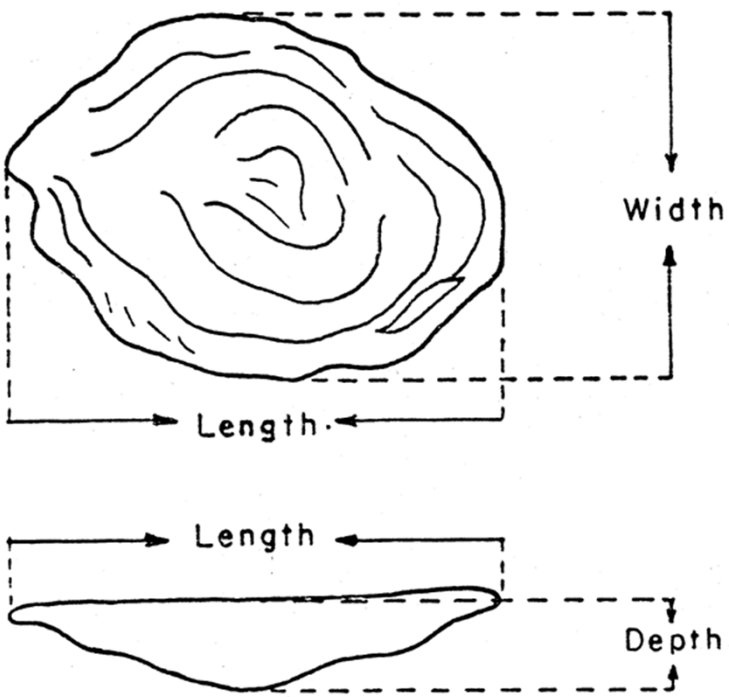
- Are they:
  - Moist?
  - Cool to the touch?
  - Gaping?
- Check the condition of the seed (i.e. is it alive?)
  - Tough to determine with very small seed
  - Smush some of them to see if there is tissue inside
    - If large enough, you can open them with a knife
  - Look to see if the stomach has food in it
- If in question
  - Place some in water and see if they start pumping in a short while

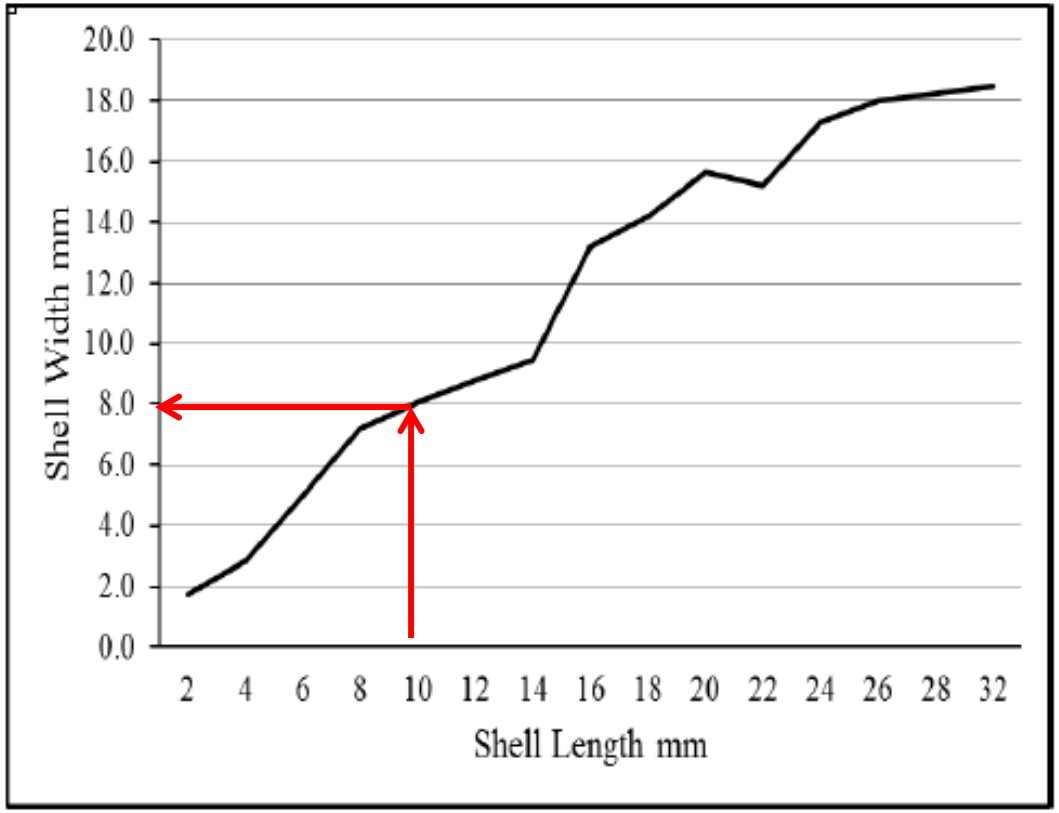
Checking the seed size

- Do not trust the hatchery to send you the size you asked for!
  - "Caveat emptor" or "let the buyer beware" has been a rule since Roman days and is as true now as it was then
  - i.e. don't assume it will lay on a specific screen until you test it
- Place some on the screen size you will hold them on – shake the hell out of it – see if any fall through
  - Make sure you have something under the screen to catch them

Mesh vs Size considerations

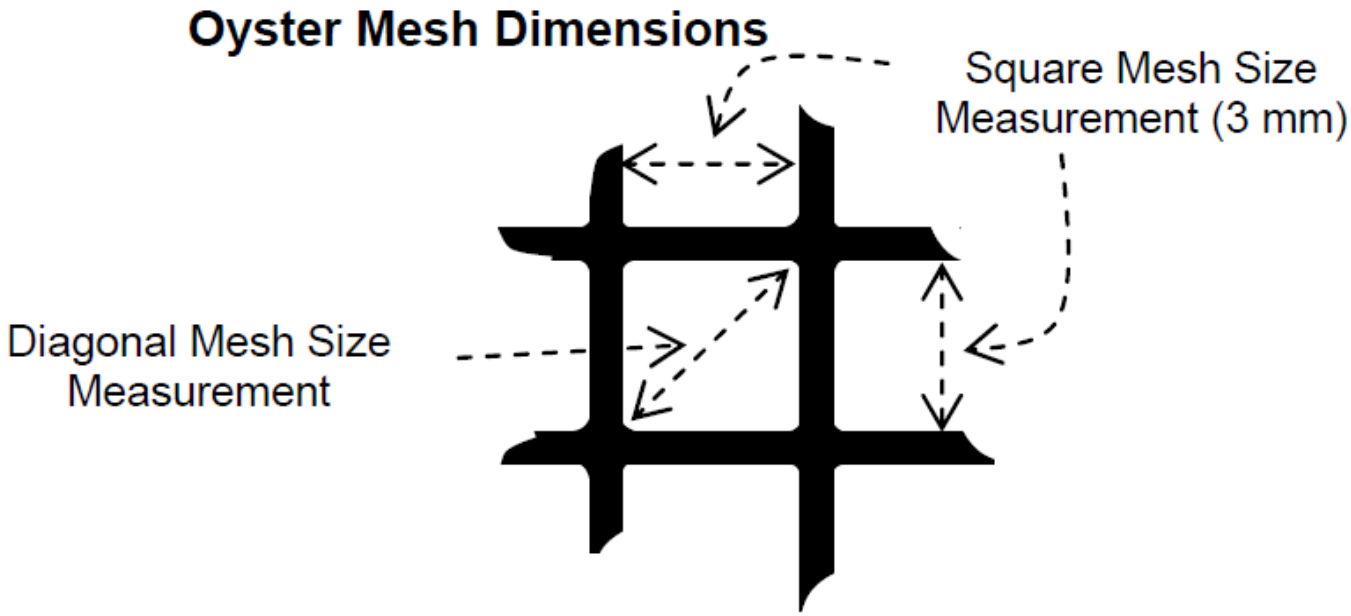
- Size described by length does not represent the narrowest dimension of the shell





Mesh vs Size considerations

- Also, the dimension used to describe the mesh is not the widest measurement



- A good rule of thumb might be to pick a mesh size about one-third the average shell length of your sorted oysters.

Oyster bag mesh dimensions

Mesh description	Mesh designation (mm)	Side dimension (mm)	Diagonal dimension (mm)
Spat Bag (Orange)	1.5	1.3	2.0
Spat Bag (Blue)	3	2.7	3.8
Spat Bag (Green)	2.7	1.7 x 2.2	3.1
Square - ¼"	6	6.4	7.7
¼" x 3/8"	6 x 9	4.8 x 6.4	7.1
3/8"	9	8.7	10.2
½"	13	12.7	15.6
¾"	19	17.3	22.7
Diamond – 1/16"	2	2.0	2.0
3/16" (OBC-1)	4		
¼"	6	6.4	7.7
3/8" (OBC-2)	9	8.5	10.2
½" – 5/8" (OBC-3)	13 - 14	12.8	15.7
¾"	18	18.6	23.5
7/8"	23	23.4	30.5

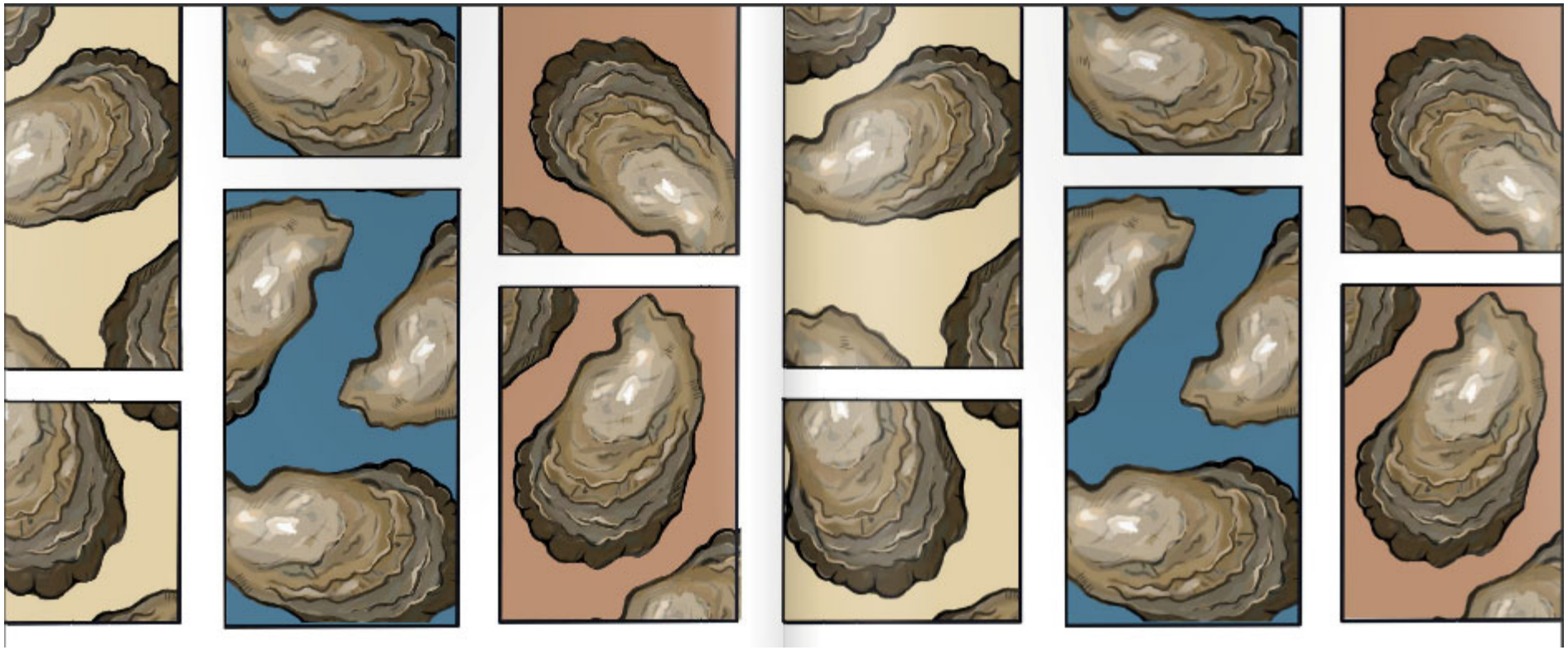
Clam size and sieve retention

Sieve Mesh Size	Approximate Clam Size Retained	Number of clams per ml
Initial	0.75	2,500
1.0 mm	1.50 mm	720
1.4 mm	2.50 mm	116
2.0 mm	3.30 mm	99
2.8 mm	3.90 mm	45
3.4 mm	6.00 mm	20
5.7 mm	8.30 mm	6

Quahog

Bag Mesh Size	Sieve Mesh Size (mm)	Seed Size (length, mm)	Seed Count (number/ml)
Nursery (3 mm)	3.3	5.0	15-20
Nursery (4 mm)	4.0	6.0	9-12
Growout (9 mm)	7.5	12.0	1-2
Growout (12 mm)	12.0	15.0	0.5-0.9

Counting Shellfish Seed



Why Is Counting Important?

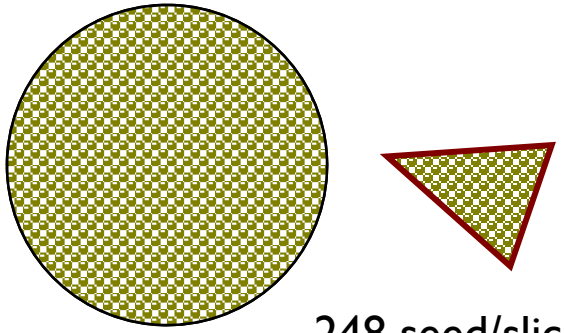
- **To confirm amount of seed purchased**
  - Normally buy in units of 1,000
- **Shellfish growth can be density dependent**
  - Bottom line is to **MAXIMIZE** growth
  - Lack of growth or slow growth
    - Overcrowding
    - Insufficient flow
    - Poor food availability
      - Competition (intra- or inter-specific)
  - Need to be able to plant seed at predetermined stocking density
- **Stocking density depends on several factors (unique to each site)**
  - Species cultured
  - Phytoplankton availability
  - Flow rate of system
  - Location of system
  - Maintenance of system

How many seed are there?

- Usually not practical to count each clam or oyster!
- Need to apply a system to estimate total number
- There are a variety of techniques to accomplish this:
  - Splitting methods
  - Weight
  - Volume displacement
  - Total volume

The Pizza Method

- Need to systematically reduce number down to a countable level
  - Do it in a way to estimate the total from a part
- Procedure
  - Spread pile of seed into a uniform circular pile
  - Split circular pile into multiple slices like a pizza or pie
    - Continue making even "slices" until one single slice is small enough to count
  - Count the number of seed in one "slice"
  - Multiply by number of slices

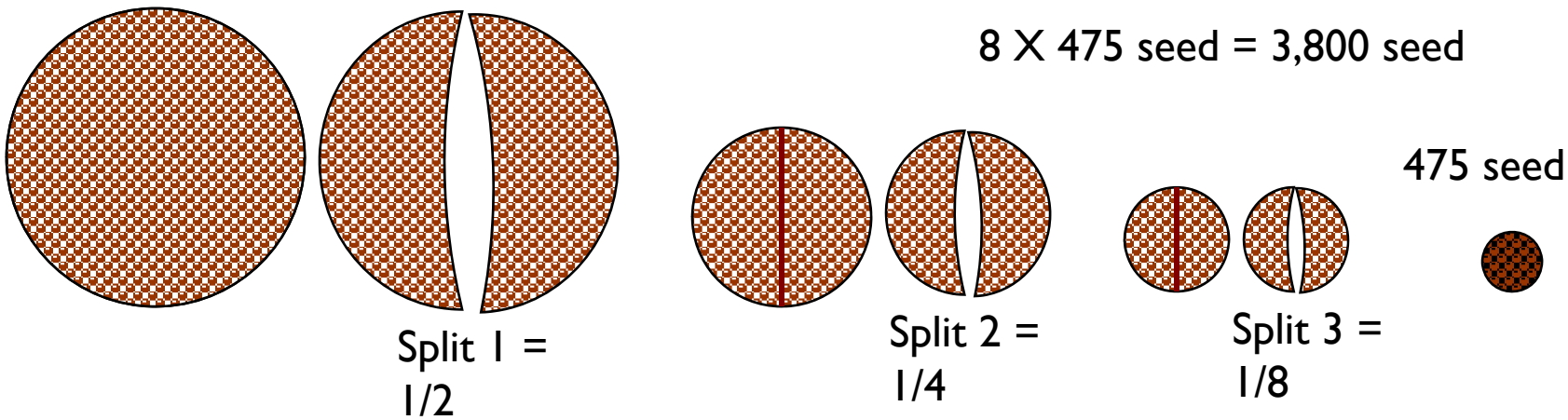


= 248 seed

248 seed/slice X 8 slices = 1,948 seed

The Splitting Method

- Procedure
  - Spread pile of seed into a uniform pile
  - Split pile in half
  - Reconfigure one-half into another uniform pile
  - Split again
  - Repeat until number of seed in a single pile is reasonable to count
  - Count seed in small pile
  - Multiply by the proportion you have reduced the pile



Splitting the pile

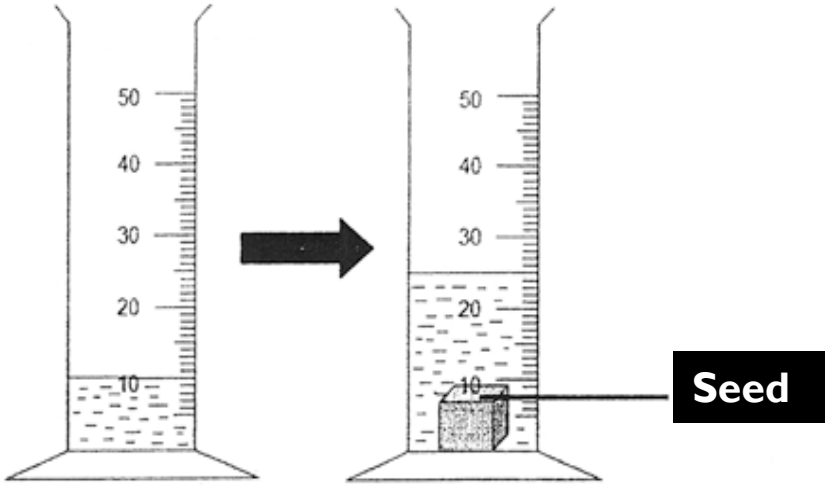
Estimate by weight

- Count 5 batches of 100 seed
  - Weigh each batch
  - Subtract weight of the container
  - Calculate average weight of a batch
    - Average weight for 100 seed = 28 grams
- Can calculate weight per 10,000 seed
  - 28 g/100 X 10,000 = 2,800 g
- Measure out aliquots of seed based on your calculated weight
- Ready to go into nursery trays

Batch #	Number of seed	weight (g)
1	100	28
2	100	30
3	100	29
4	100	26
5	100	27
	average	28

Volume Displacement

- Fill a graduated cylinder (or other calibrated container) with a known amount of culture water
- Add 100 seed to water and record the increase in volume
  - 100 seed = 24-10 ml



- Repeat 5 times and calculate average displacement for 100 seed
- Calculate total displacement to measure 10,000 seed
  - 10,000 seed x 14 ml/100 seed = 1,400 ml

Total dry volume – Procedure 1

- Measure volume of a small number of seed
  - e.g. 25 ml seed
- Count number of seed in the measured volume
- Repeat 5 times and calculate average
  - 300 seed per 25 ml
- Calculate total volume needed to measure a set count
  - Target number is 10,000 seed
  - 10,000 seed/300 seed X 25 ml = 833 ml

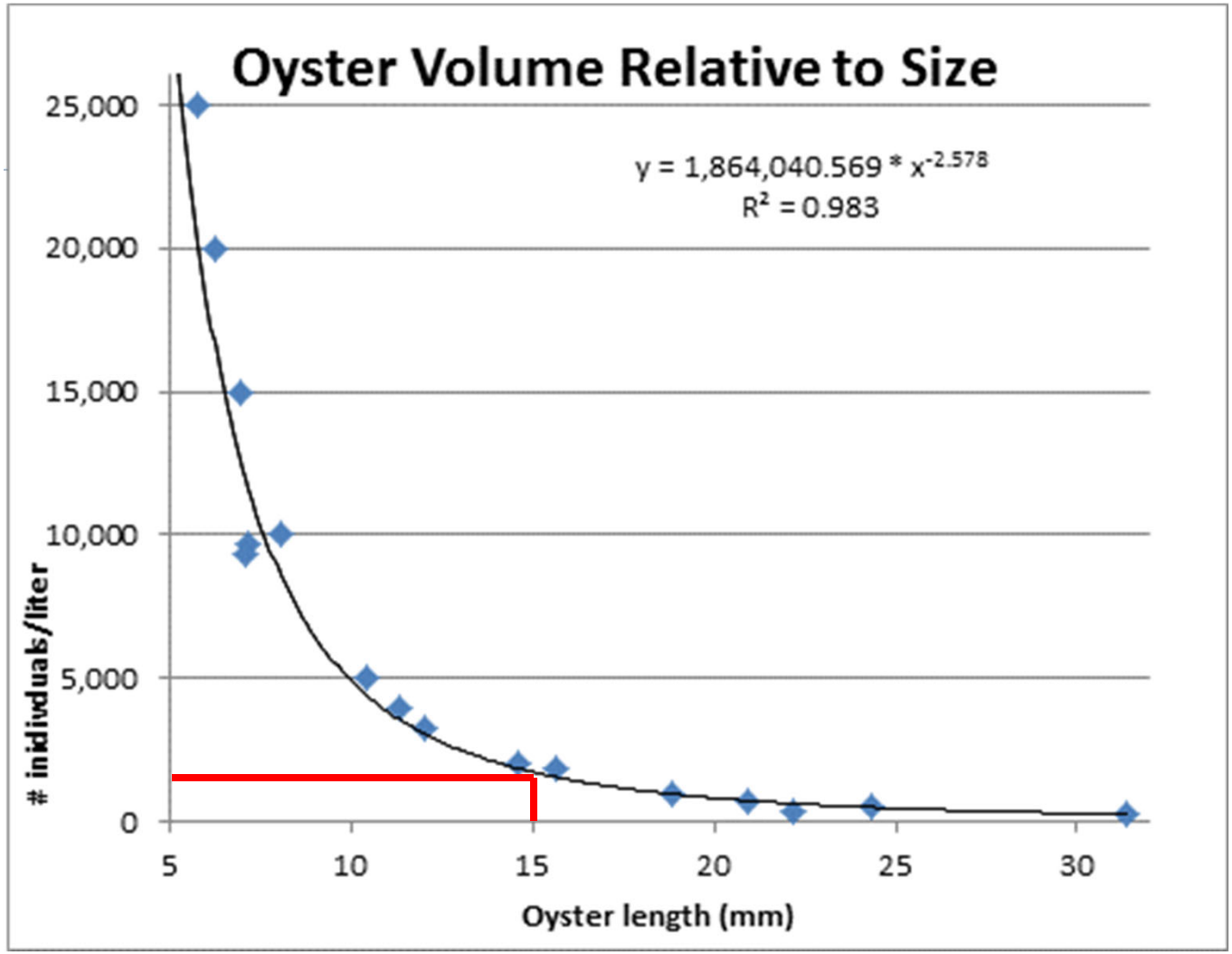
Adjust the volume depending on size of the seed to be accurate & efficient

Counting Guidelines

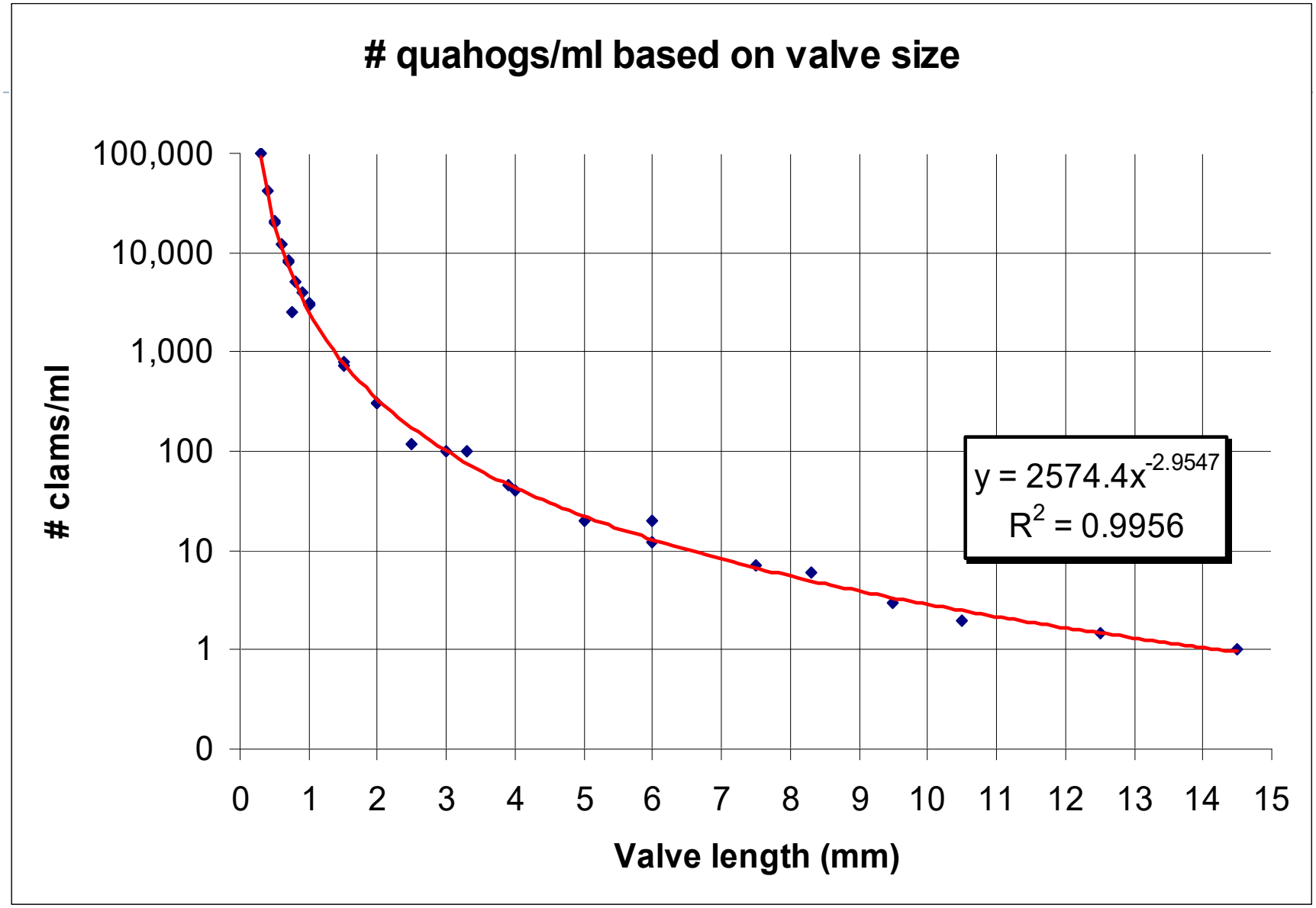
Seed size	count volume
1/4 inch	100 mls
½ inch	500 mls
¾ inch & larger	1 Liter

Total dry volume – Procedure 2

- Measure total volume of seed
  - Standard "Homer bucket" is ~ 20 liters
- Randomly remove 25 individual seed and measure for length
  - Calculate average length
- Using the following graphs
  - Determine the number of seed per liter based on the average size
- Calculate the total number of seed
  - Multiply number per unit volume by total volume



- You have 22 liters of 15 mm oyster seed
  - At 15 mm, 1 liter is 1,732 seed ($1{,}864{,}041 \times 15^{-2.578}$)
- 22 liters x 1,732 seed/liter = 38,100 seed


quahogs/ml based on valve size
100,000
10,000
1,000
100
10
1
0
clams/ml
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Valve length (mm)
y = 2574.4x^-2.9547
R^2 = 0.9956

Once you have everything sorted out - Plant them out ASAP!

Nursery Husbandry

Roger Williams University

Dale Leavitt

The 4 S's of Shellfish Nurseries

- Siting
- Stocking
- Scrubbing
- Sieving

Principles for Nursery Success

- Locate your nursery at a site that provides the best conditions for growing seed that you have available!
- Do not overstock your nursery containers!
  - Adjust seed volumes to site conditions and flow rate
- Keep the system clean!
  - Especially the flow-through screens
- Size grade the seed regularly!

Remember!

- Growing seed have high metabolic needs
  - Food and Oxygen
- Metabolic needs provided by
  - Water flow
  - Food flux (a function of food density and flow rate)
- Flow and food becomes limiting fast
  - In high stocking densities, oxygen will run out very quickly without flow
  - Food limitation leads to variation in growth => requires more sieving
  - Stunted juveniles often never recover
- It all boils down to food flux through the system!

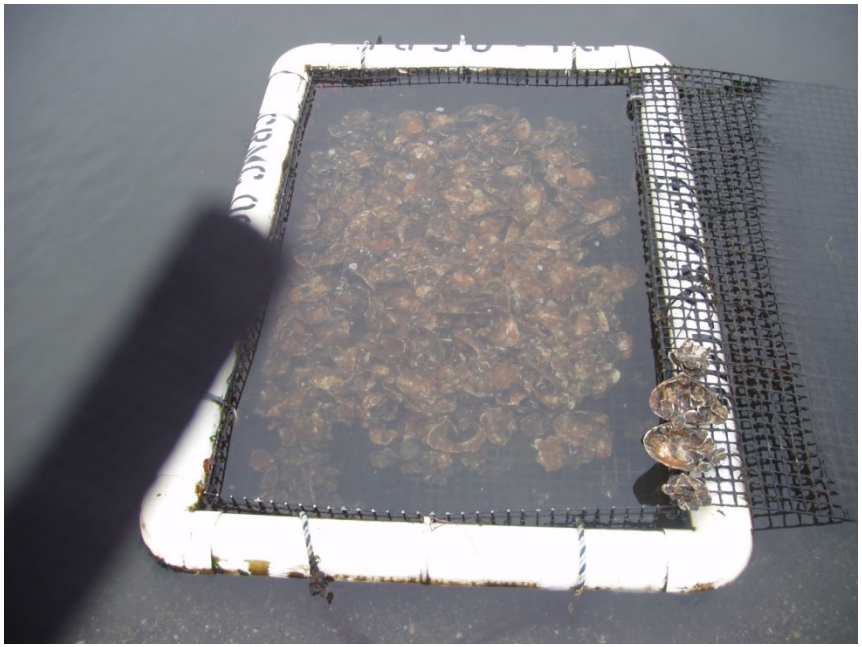
The 4 S's of upweller nurseries

- Siting
- Stocking
- Scrubbing
- Sieving

Water Supply

- Food flux
  - Food concentration x Flow rate
- Amount of food (phytoplankton) in the water
  - Not much control of this factor
    - Dependent on initial site selection
  - May want to filter incoming water
    - Food size between 5 and 25 micron

Site specific growth variability in oysters



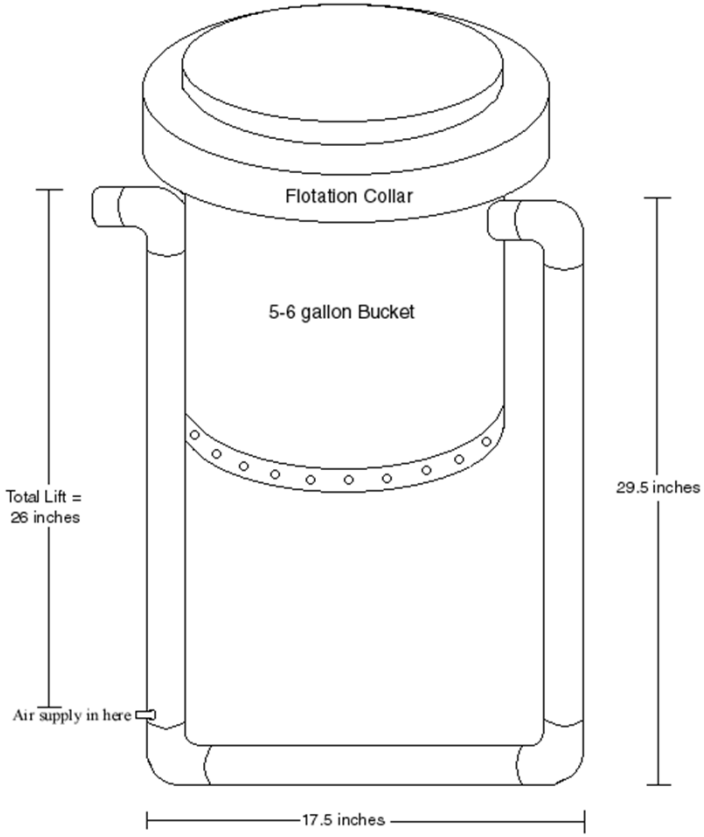
Siting

- What space do I have available?
- What are the water characteristics?
  - For shellfish to survive?
  - For shellfish to grow?
- What utilities do I have on-site?
- What is my primary means to access the site?

Upweller Principles

1. Locate your nursery at a site that provides the best conditions for growing seed that you have available!

If in doubt, run a small test!



The 4 S's of upweller nurseries

- Siting
- Stocking
- Scrubbing
- Sieving

Stocking

The question always arises: how many seed can you put in a nursery container?

- It is very site and technology specific!
- Need to calculate a starting point
  - Dependent on food flux
- You adjust your stocking density as you learn your system and your site
  - Trial & Error

Water Supply

- Food flux
  - Food concentration x Flow rate
- Amount of food (phytoplankton) in the water
  - Not much control of this factor
    - Dependent on initial site selection
  - May want to filter incoming water
    - Food size between 5 and 25 micron
- Rate of delivery of food to the seed
  - Dependent on flow rate of ambient water through system
  - Need to consider pump for supply water to facility

Clam Culture (SRAC Bulletin)

Size mm	Velocity cm/sec	Flow ratio L/min:L clams	Density ml/cm²	Density clams/cm²
1	0.6	240	0.15	450
2	0.6	90	0.4	120
2	0.5	100	0.3	90
2	0.4	110	0.2	60
3	0.4	70	0.3	30
3	0.2	80	0.15	15
4	0.2	40	0.3	12
5	0.2	30	0.4	8
6	0.2	20	0.6	7
7	0.2	15	0.8	7
8	0.2	12	1	7
9	0.2	10	1.2	6
10	0.2	9	1.4	4

Water Supply

- Pumping Guidelines
  - VIMS clam nursery guidelines

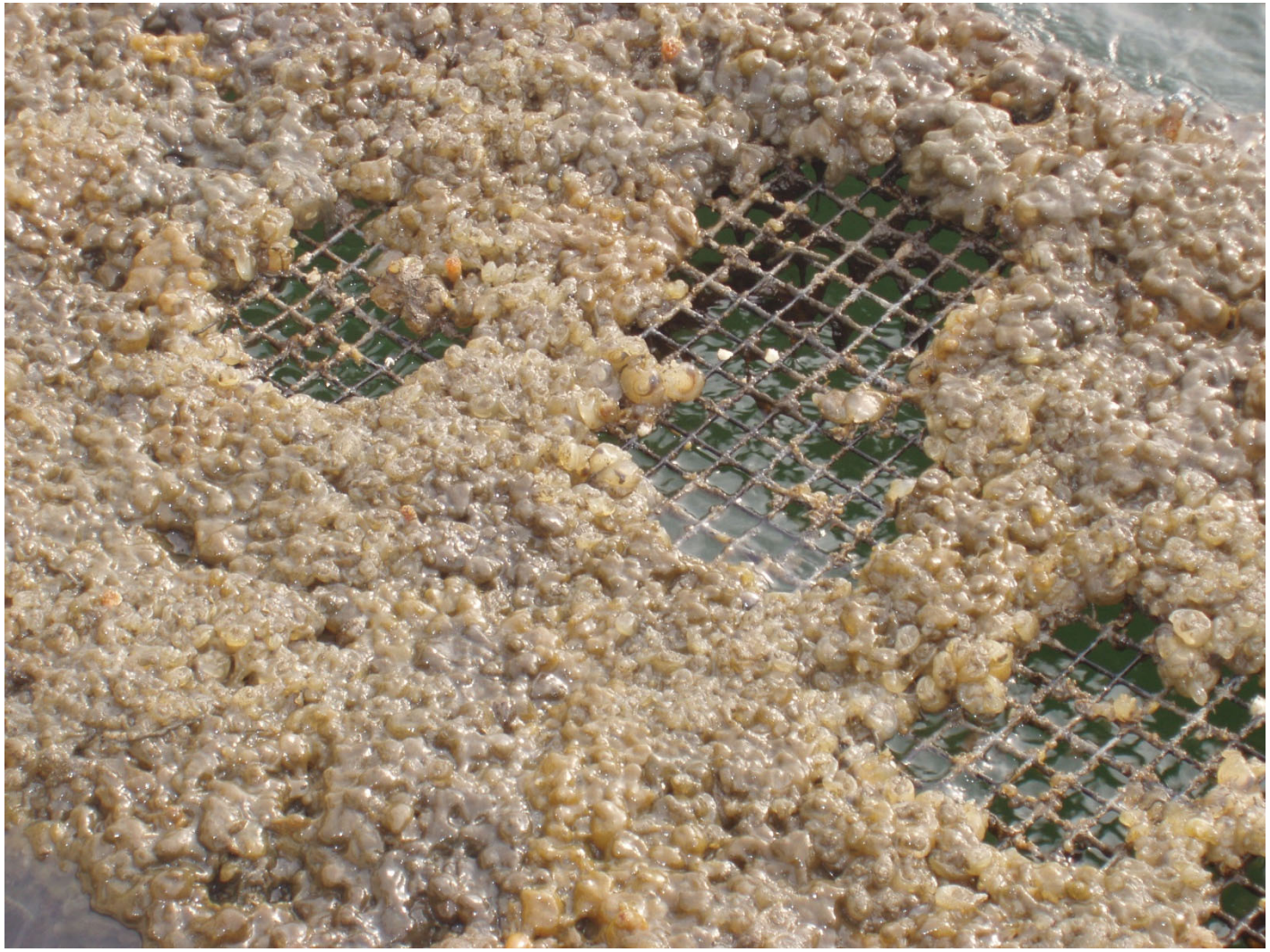
Size	#/ML	Flow (gal/min/L seed)
1-2 mm clams	800 clams/mL	50
3-4 mm clams	70 clams/mL	20
8 mm clams	7 clams/mL	4

  - FAO Shellfish Culture Manual (oyster)
    - 10-20 L/min per kg of spat
  - The bottom line
    - Trial and Error!!!!

The 4 S's of upweller nurseries

- Siting
- Stocking
- Scrubbing
- Sieving

How much water is getting through this screen?



Remember!

- It all boils down to water flow through the silo!
- What limits water flow through the silo
  - Stocking density (already discussed)
  - Mesh size of screen
  - Degree of fouling on the screens

Fouled pet screen

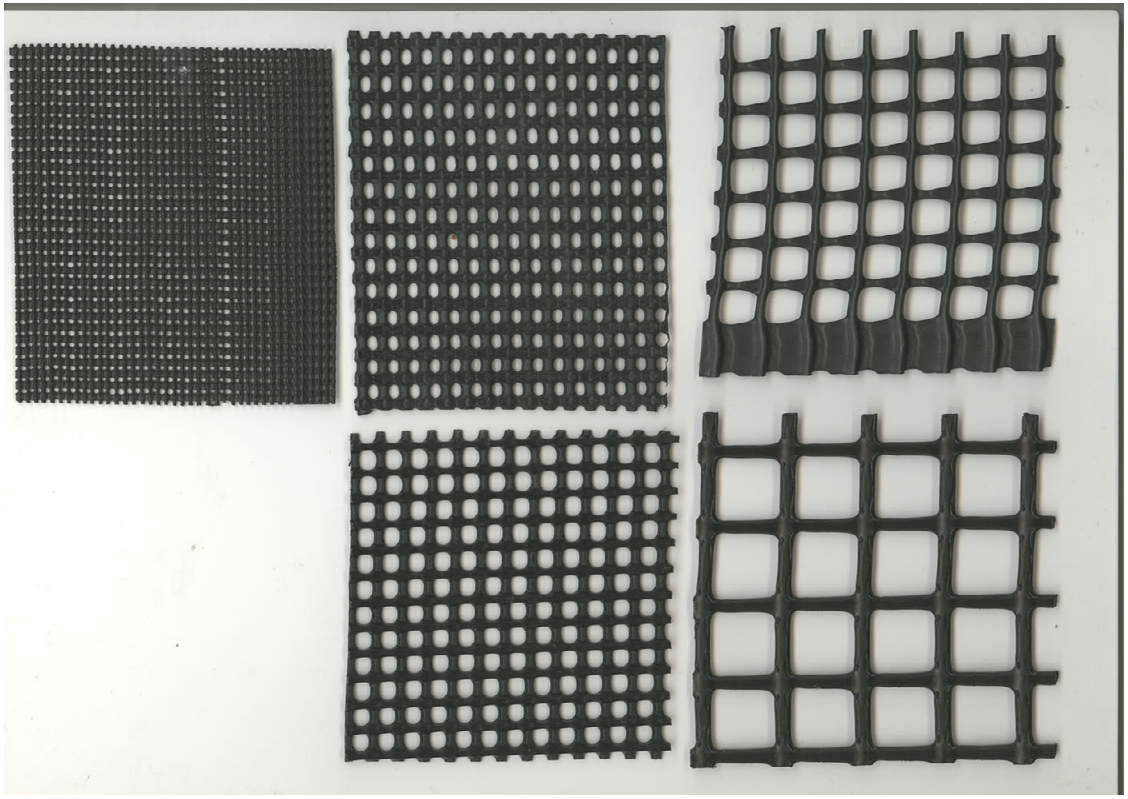
Mesh Size on the Containers

- Remember
  - The finer the mesh – the more it will restrict flow
  - The finer the mesh – the quicker it will foul
- Always use the largest mesh possible in your system
  - Without letting the smaller seed drop out of the system
  - Another reason to size grade (discuss later)

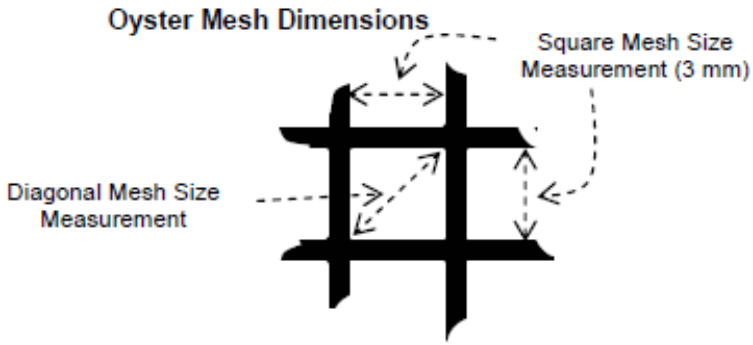
More Fouling

As they grow

- Always move to a larger mesh when you can
  - Reduces labor of cleaning



The 4 S's of upweller nurseries



Sieve Mesh Size	Approximate Clam Size Retained	Number of clams per ml
Initial	0.75	2,500
1.0 mm	1.50 mm	720
1.4 mm	2.50 mm	116
2.0 mm	3.30 mm	99
2.8 mm	3.90 mm	45
3.4 mm	6.00 mm	20
5.7 mm	8.30 mm	6

Sieve Mesh Size* (mm)	Seed Size (min. length, mm)	Seed Count (number/ml)
0.7	1.0	2500
1.0	1.5	800-1200
1.2	2.0	250-400
1.6	2.5	120-160
2.0	3.0	100
2.2	3.5	50-75
2.8	4.0	30-35
3.3	5.0	15-20
4.0	6.0	10-12
5.5	7.0	5-8
7.5	12.0	1-2
12.0	15.0	0.5-1

Nursery Maintenance Timeline

- Clean frequently
- Check daily – clean every other day
  - If needed
- Normal Monitoring/ Cleaning routine
  - Observe flow through each silo/container
  - Remove silo/container and hose down
  - Use pressurized freshwater (if available)

Nursery timeline

- Cleaning routine
  - Remove silo/container and empty contents into tote
  - Pressure wash fouling from mesh and sides

An alternate means to clean

Scrubbing – How Often?

- Site specific
- At my site (Warwick Cove - raising clams & oysters)
  - Rinse down every other day
  - About once every other week for full cleaning
  - Will grade every other time (once per month)

The 4 S's of upweller nurseries

- Siting
- Stocking
- Scrubbing
- Sieving

Why size grade frequently?

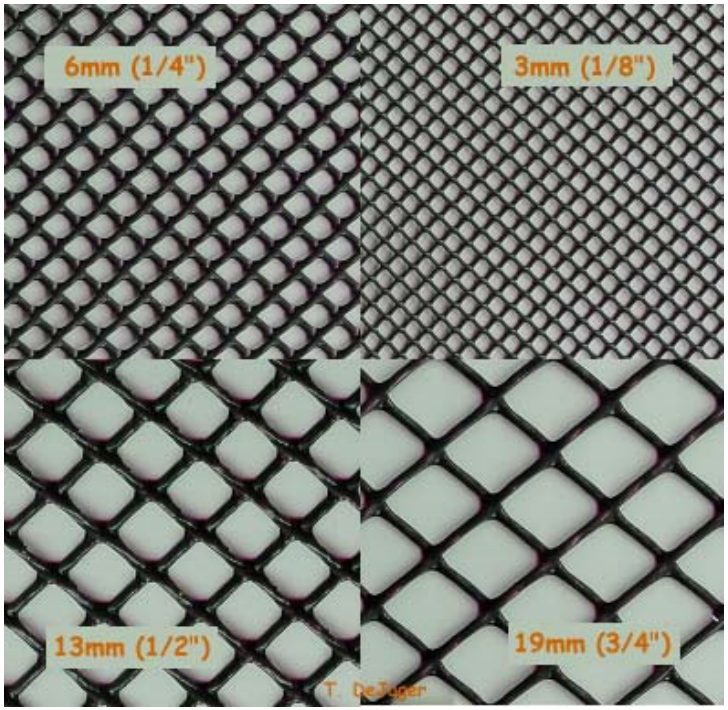
GROWTH RESULTS
IN A
FLOATING UP-WELLER SYSTEM

Nursery timeline

- Size grade – biweekly to monthly

Size Grading

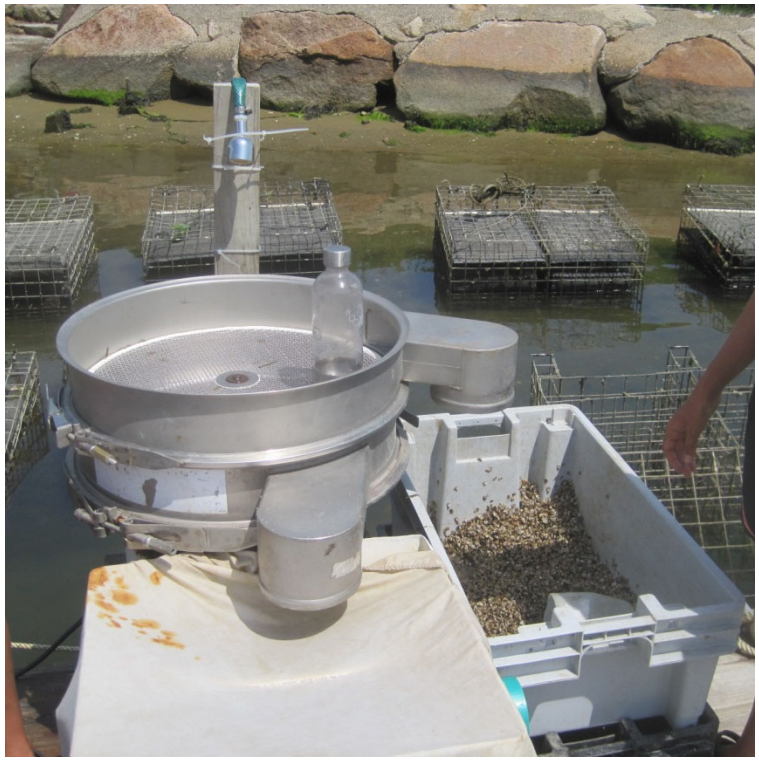
- Fabricate a series of graduated mesh size sieves
  - I use Tenax or hardware cloth
    - Mesh size gradation dependent on species
  - Make large enough to easily transfer seed from silo to sieve



Graduated sieves

Sieving

Mechanized seed grading



Vibrating graders better for seed

Oyster grading for serious growers

Final tidbits

- Larger mesh means better flow
  - but be careful not to lose animals
  - (length of critter vs. diagonal length of mesh)
- Cleaning
  - When you get a squirt set you have to get them out
  - If screens get clogged of fouled - flow will suffer
- Tripling volume weekly (or more) is expected
- Sieving
  - When you have seed of different size the larger ones will get all the food
  - Use the right size for the gear
- High tech solutions mean high tech problems
  - KISS