Enhancing Seed Availability for the Hard Clam, Mercenaria mercenaria, Aquaculture Industry Through Application of Remote Setting Techniques

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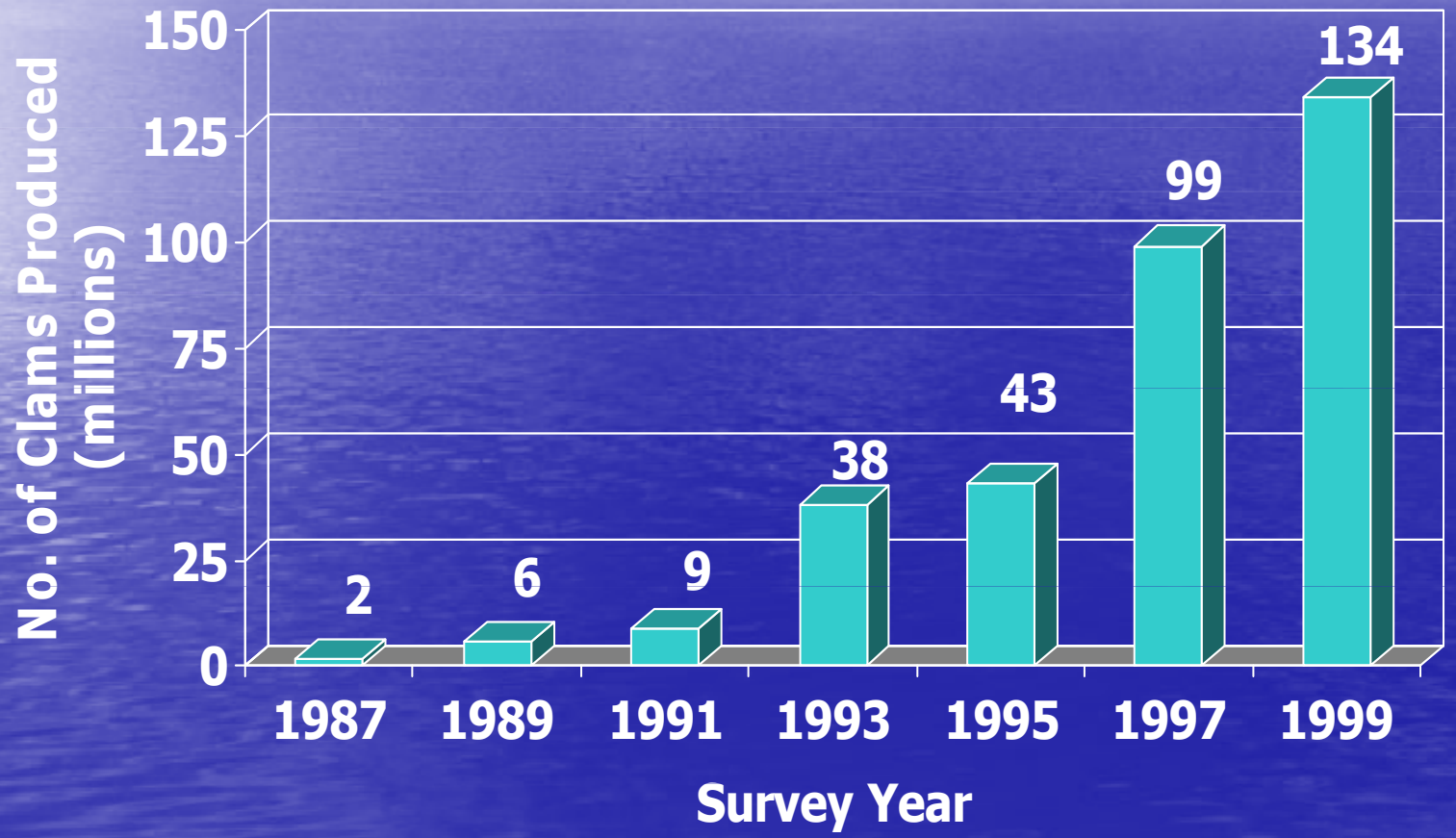
Florida Hard Clam Aquaculture Development

- Industry developed rapidly over past decade due to:
  - Successful job retraining programs for fishermen
  - Excellent leasing program & regulatory framework
  - Almost year-round growing conditions

Florida Hard Clam Aquaculture Status

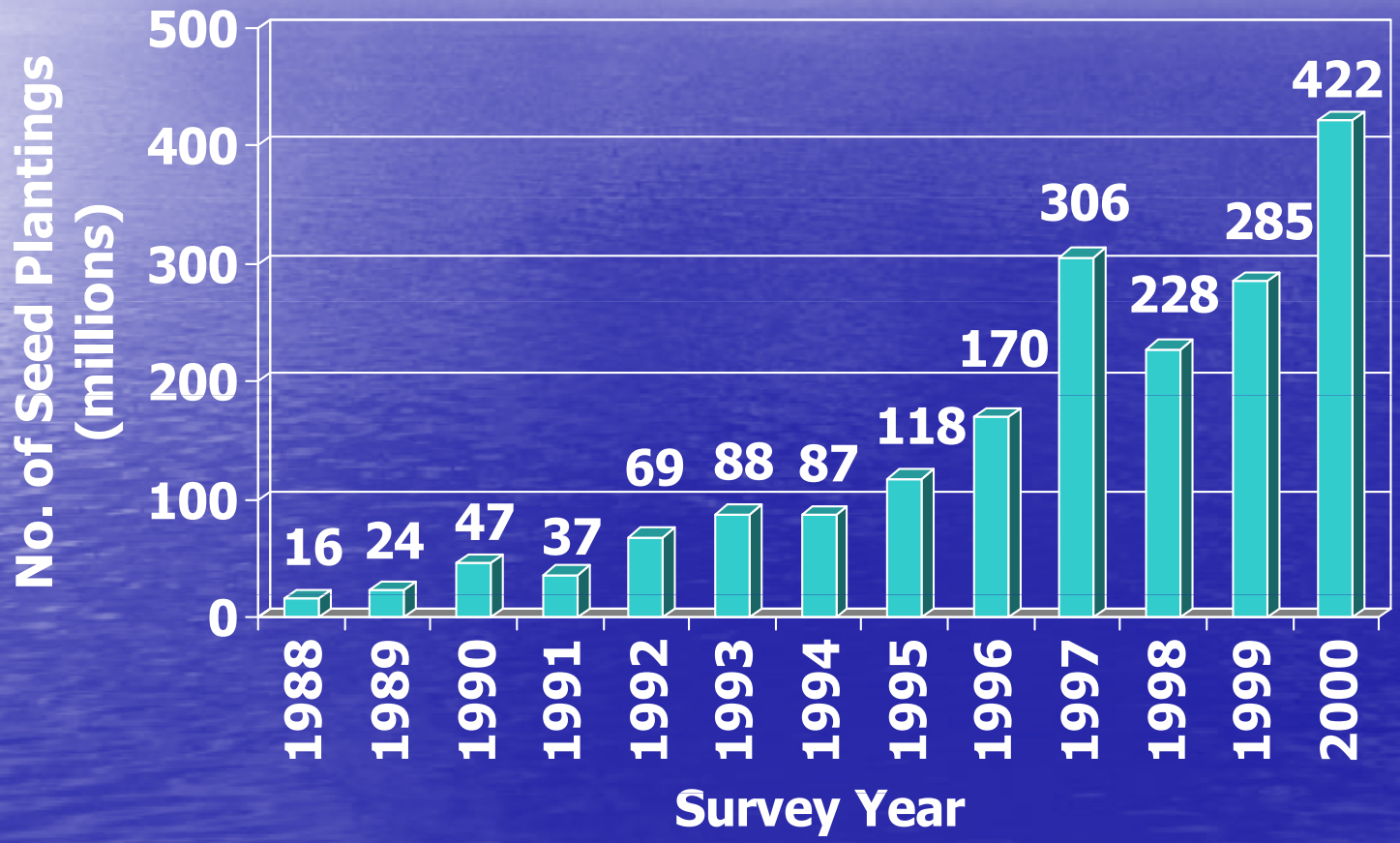
- 450 small-scale growout businesses located on over 1700 acres of state-owned submerged lands
- $16M farm gate sales reported for 1999
- $34M economic impact estimated for 1999

Florida Hard Clam Aquaculture Production, 1987 - 1999*



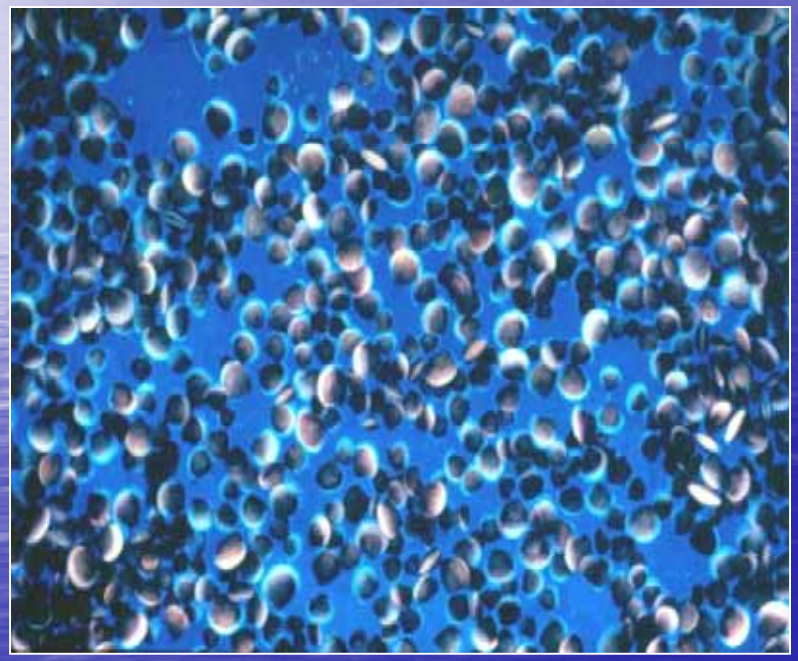
*Source: Florida Aquaculture Surveys, Florida Agricultural Statistics Service, 1988 - 2000

Florida Hard Clam Aquaculture Seed Plantings, 1988 - 2000*



*Source: Florida Aquaculture Surveys, Florida Agricultural Statistics Service, 1990 - 2000

Application of Remote Setting Techniques Rationale



- Adequate seed availability a major industry concern
- Critical seed shortages in recent years coupled with increased prices
- Growers become less dependent upon traditional seed sources
- Greater chance of success by incorporating another step into existing businesses

Florida Land-Based Clam Nurseries Status

- About 90 nurseries operational statewide
- Simple in design and operation
- 1 mm seed obtained from hatcheries nursed to a field plantable size of 4-6 mm SL

Florida Land-Based Clam Nurseries Status

- Lowers initial seed cost
- Added costs of equipment, electricity, and labor
- Increases availability of seed
- Helps alleviate seed shortages

Remote Setting Techniques Status

- Established in Pacific Northwest during 1970s
  - Pacific oyster
  - Manila clam
- Competent pediveliger larvae mass produced in hatcheries
- Shipped to growers for setting at "remote" locations

Application of Remote Setting Techniques Objectives

- Determine feasibility of transferring remote setting technology from Pacific Northwest molluscan shellfish industry to hard clam aquaculture industry in Florida
- Develop and demonstrate technical procedures for remote setting of hard clams
- Compare costs to nursery operation of producing 1 mm clam seed in a remote set facility as opposed to purchasing 1 mm seed from hatchery

Clam Pediveliger Larvae Hatchery Production

- Pediveligers obtained from commercial hatcheries
  - 1 out-of-state
  - 2 in-state
- Competency determined by
  - Size (150-220 µm)
  - Presence of foot
  - Activity

Clam Pediveliger Larvae Preparation and Shipment

- Screened on 130 µm sieve
- Volumetrically subsampled and counted
- Placed on shipping material
  - moist coffee filters
  - paper towels
- Refrigerated (45°F) for 2-3 hours
- Packaged in shipping box with gel packs
- Shipped overnight

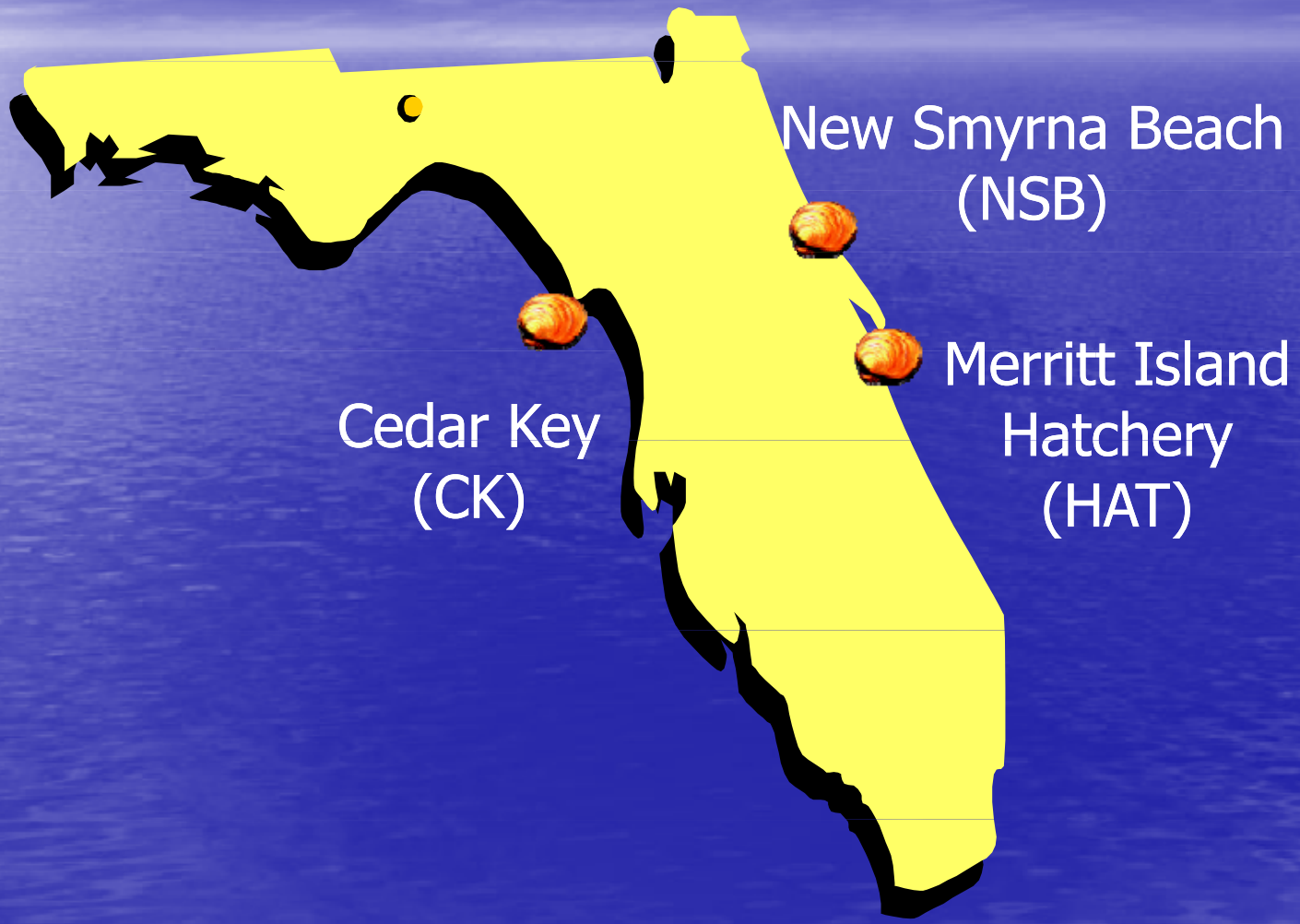
Remote Setting Facility

- Components:
  - Fiberglass tank
    - 250 gallons
  - Sand filter
  - Bag filters
    - 25 µm
    - 100 µm
  - Aeration
  - Airlift pumps

Remote Setting Facility

- Downweller sizes (24” diameter):
  - 120 µm
  - 200 µm
  - 425 µm
  - 710 µm
- Sieve sizes:
  - 230 µm
  - 500 µm
  - 780 µm

Remote Setting Field Trials
Florida Locations



Remote Setting Field Trials Procedures

- Stocking:
  - 3M PVs per tank, or 1M per weller (350/cm^2 of screen)
- Flow rates:
  - Water: 2-5 gpm
  - Airlifts: 1-2 lpm
- Cleaning:
  - Seed and tank: daily
  - Backflush filter: 1-2x daily
  - Change bag filters: 1-2x daily
  - Wellers: 2x weekly
- Sieving:
  - Weekly

Remote Setting Field Trials Measurements

- Water Quality:
  - Temperature: daily
  - Salinity: daily
  - Chlorophyll a: 2x weekly
- Sieving:
  - Volume by sizes: weekly
  - Estimate of seed ≥780 µm size: weekly
- Operation & Maintenance:
  - Man-hours

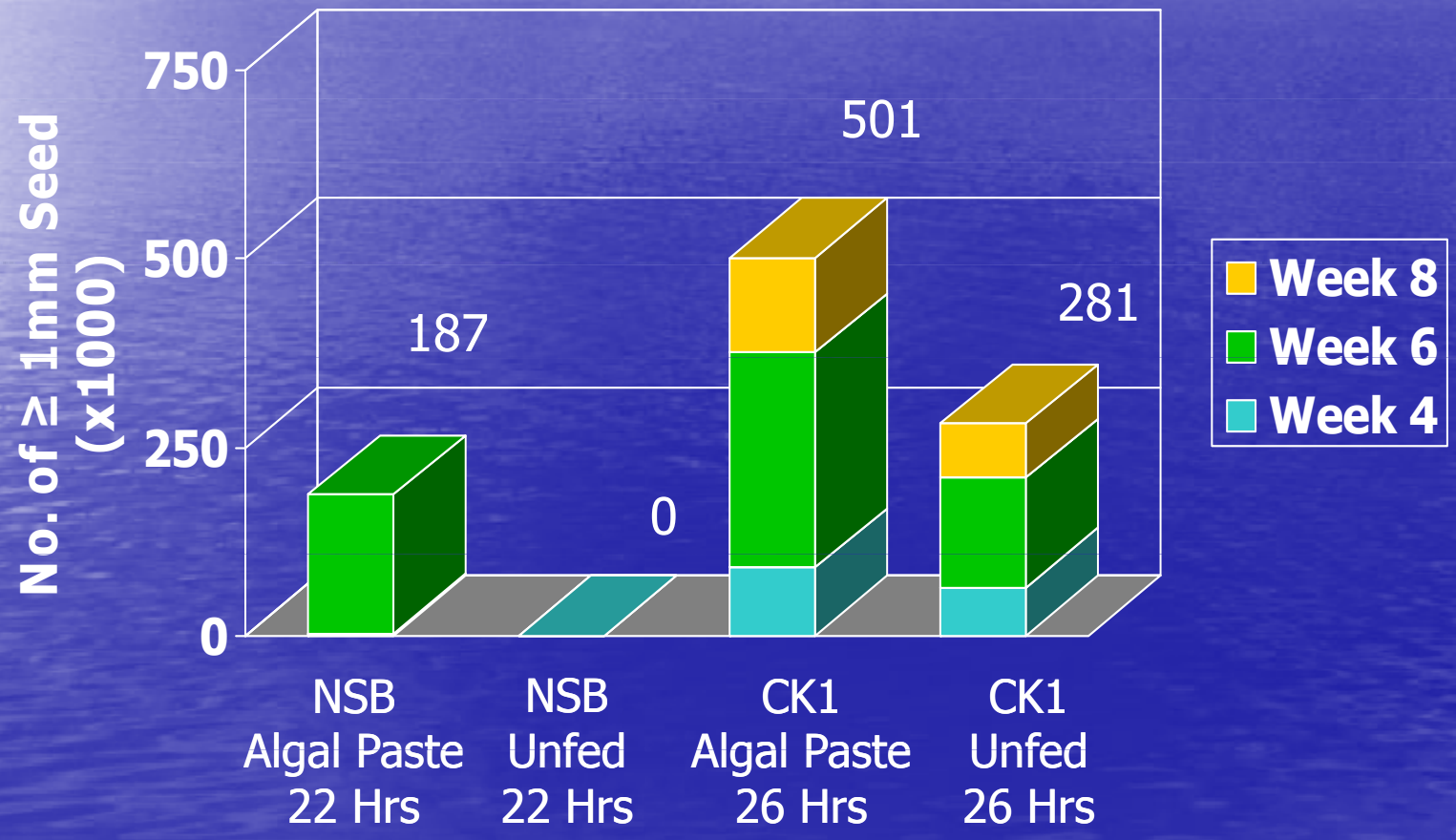
Remote Setting Field Trials Spring 2000

Site	Dates	Days	Management	
			Ship (hrs)	Feed
NSB	May 12 – Jun 22	41	22	Algal Paste
				None
CK1	May 12 – Jul 8	57	26	Algal Paste
				None

Remote Setting Field Trials
Water Quality – Spring 2000

Site	Min Temp (°F)	Max Temp (°F)	Salinity (ppt)	Chlor a (µg/l)
NSB	76.5 ± 2.3	85.3 ± 2.9	35.2 ± 1.7	5.7 ± 3.8
CK1	76.7 ± 2.6	81.7 ± 2.6	29.3 ± 2.9	11.7 ± 6.0

Remote Setting Field Trials
Sieve Results – Spring 2000



Remote Setting Field Trials
Production Results - Spring 2000

Site	Management		Survival to 1st Sieve* (%)	≥1mm Seed Production (%)
	Ship (hrs)	Feed		
NSB	22	Algal Paste	47	6
		None	39	0
CK1	26	Algal Paste	77	17
		None	50	9

*NSB = Day 21
CK1 = Day 28

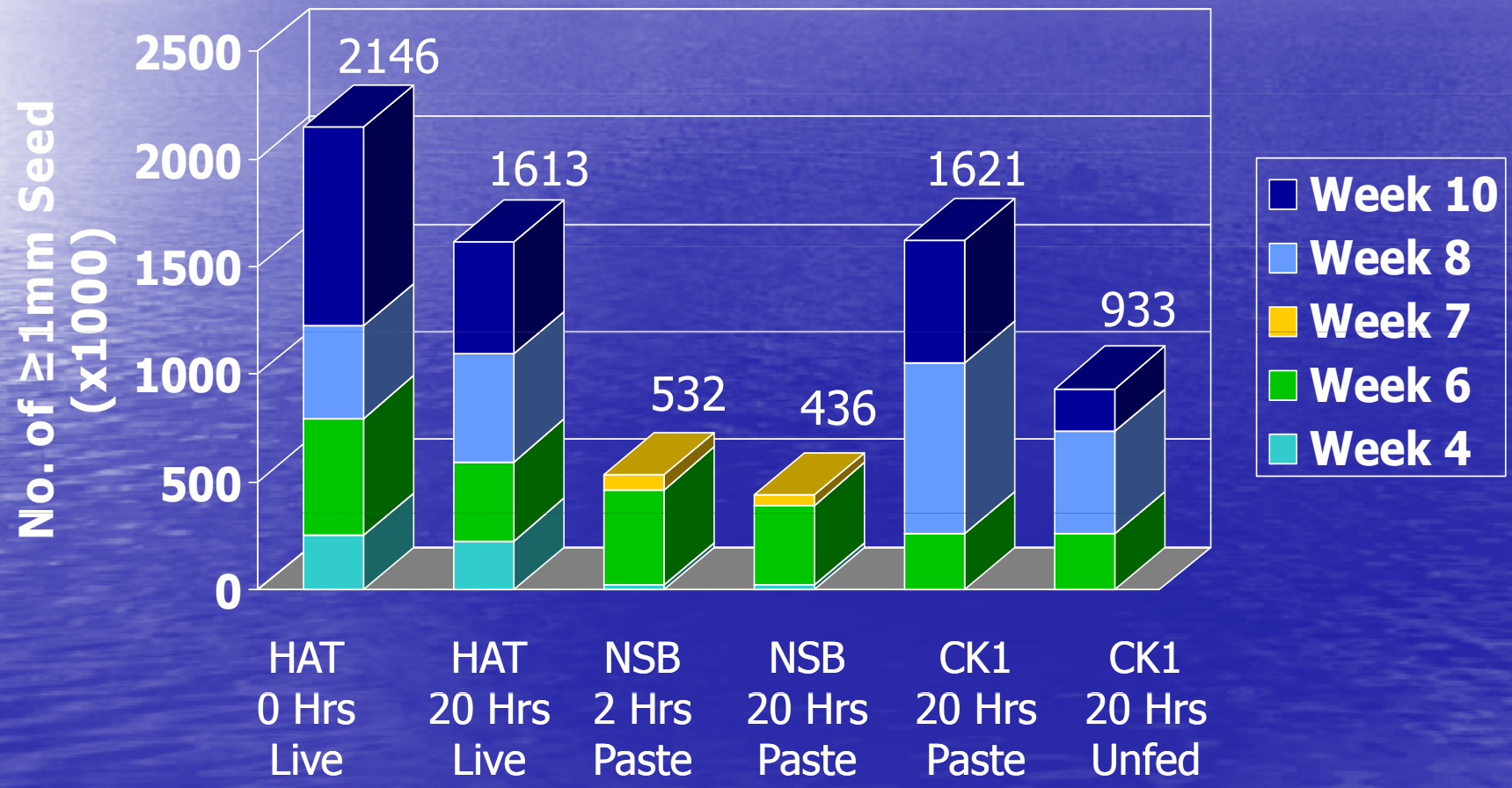
Remote Setting Field Trials
Spring 2001

Site	Dates	Days	Management	
			Ship (hrs)	Feed
HAT	Apr25–Jul5	72	0	Live Algae
	Apr26–Jul5	71	20	
NSB	Apr26–Jun14	50	2	Algal Paste
	Apr26–Jun14	49	20	
CK1	Apr26–Jul6	72	20	Algal Paste
				None

Remote Setting Field Trials
Water Quality - Spring 2001

Site	Min Temp (°F)	Max Temp (°F)	Salinity (ppt)	Chlor a (µg/l)
NSB	71.9 ± 1.8	77.4 ± 5.7	37.6 ± 2.5	8.4 ± 6.0
CK1	75.5 ± 5.7	83.4 ± 5.3	28.0 ± 2.3	9.4 ± 3.0

Remote Setting Field Trials
Sieve Results - Spring 2001



Remote Setting Field Trials
Production Results - Spring 2001

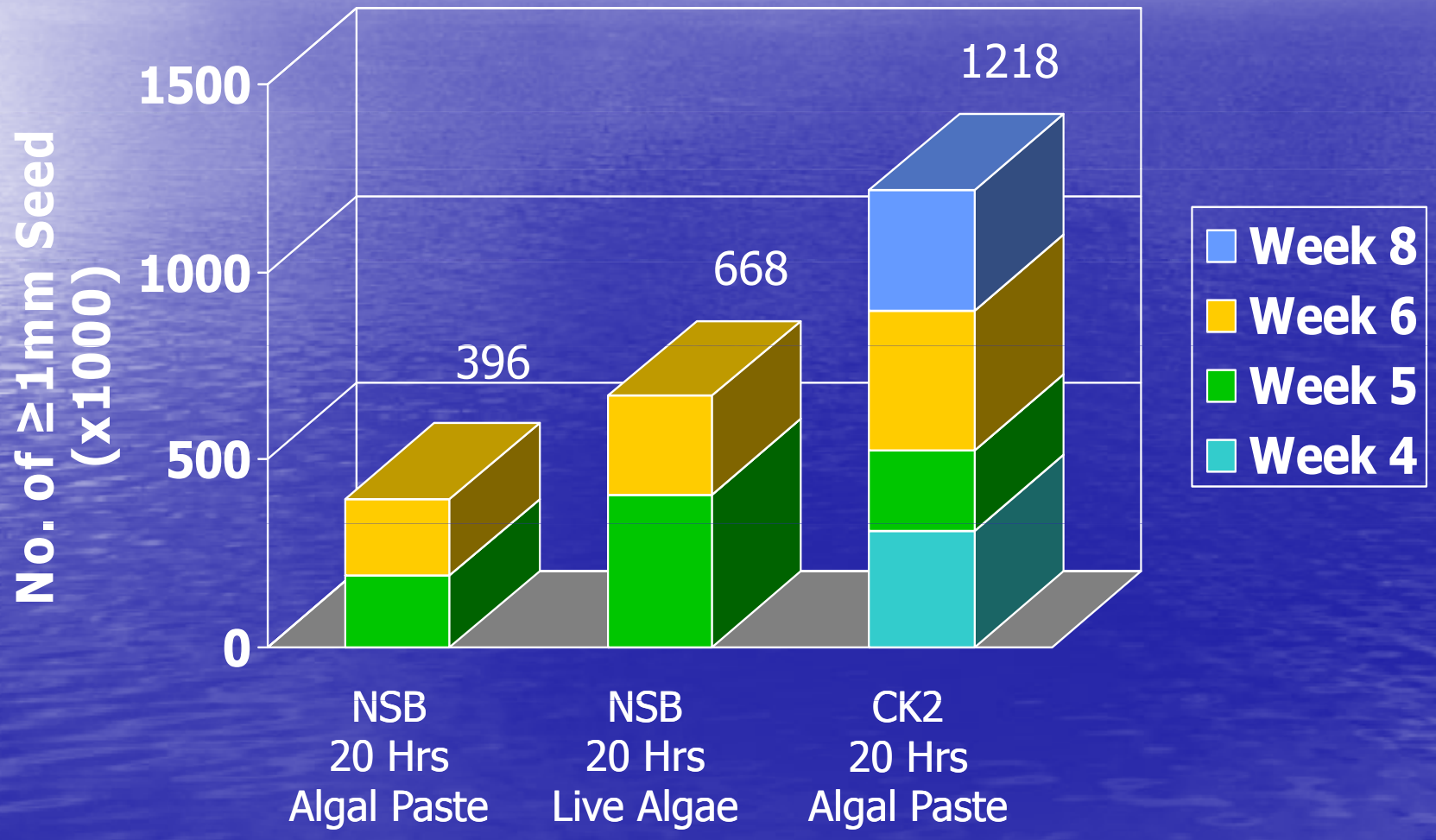
Site	Management		Survival to 1st Sieve* (%)	≥1mm Seed Production (%)
	Ship (hrs)	Feed		
HAT	0	Live Algae	---	71
	20		---	54
NSB	2	Algal Paste	67	18
	20		50	15
CK1	20	Algal Paste	65	54
		None	58	25

*NSB, CK1 = Day 16

Remote Setting Field Trials
Fall 2001

Site	Dates	Days	Management	
			Ship (hrs)	Feed
NSB	Sep18 – Oct15	37	20	Algal Paste
			20	Live Algae
CK2	Sep18 – Nov3	56	20	Algal Paste

Remote Setting Field Trials
Sieve Results - Fall 2001



Remote Setting Field Trials
Production Results - Fall 2001

Site	Management		Survival to 1st Sieve* (%)	≥1mm Seed Production (%)
	Ship (hrs)	Feed		
NSB	20	Algal Paste	70	13
		Live Algae	83	22
CK2	20	Algal Paste	88	41

*NSB = Day 23
CK2 = Day 12

Remote Setting Field Trials
Water Quality – Fall 2001

Site	Min Temp (°F)	Max Temp (°F)	Salinity (ppt)	Chlor a (µg/l)
NSB	73.7 ± 3.4	80.1 ± 4.0	26.6 ± 1.6	---
CK2	69.3 ± 6.0	78.7 ± 6.1	27.4 ± 2.31	15.2 ± 5.4

Remote Setting Technology Economic Analysis

- Production assumptions for remote setting system
  - One-tank system
  - Two runs per year
  - Stocking density ~3,000,000 per run
  - Supplemental feeding with algal paste
  - 37% to 1 mm size per run

Initial Capital Investment Requirements One-Tank Remote Setting System

Item	Cost
Fiberglass tank (250 gal) w/ support & plumbing	$475
Sand filter	$200
Bag filters and adapter	$122
Air compressor w/ plumbing & accessories	$360
Wellers	$1,020
Sieves	$120
Dissecting scope	$400
Refractometer	$165
Miscellaneous supplies	$145
TOTAL	$3,007

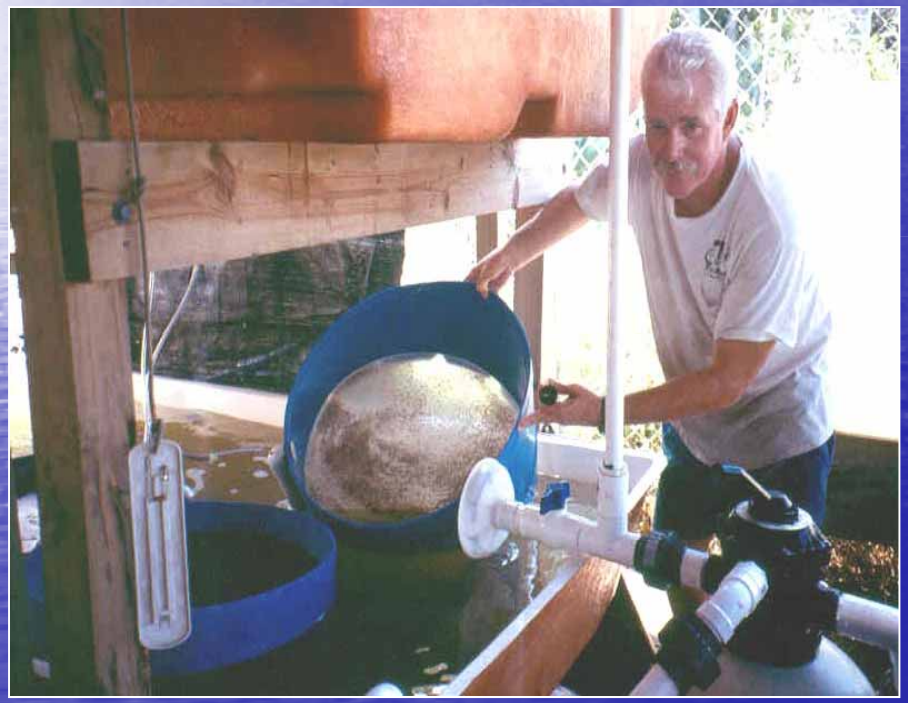
One & Two Annual Runs Operating Costs One-Tank Remote Setting System

Item	Units/Run	$/Unit	Runs per Year	
			One	Two
Algae paste	1 L	$145/L	$145	$290
Filter sand	100 lbs	$5 / 50 lbs	$10	$20
Filter gravel	25 lbs	$5 / 50 lbs	$3	$6
Air valves	15	$1 ea	$15	$30
Air stones	50	$0.55 ea	$28	$56
Airline tubing	100’ coil	$13/coil	$13	$26
TOTAL			$214	$428

Cost Budget
One-Tank Remote Setting System

Item	Units/Run	$/Unit	Runs per Year	
			One	Two
Larvae	3 million	$125/million	$375	$750
Supplies			$214	$428
Labor	104 hrs	$5.15/hr	$536	$1,072
Electricity	403 KwH	$0.085/KwH	$34	$68
Depreciation			$938	$938
TOTAL COST			$2,097	$3,256
1 mm seed produced (37%l)			1,110K	2,220K
Cost / 1000 seed (w/ labor)			$1.88	$1.47
Cost / 1000 seed (w/o labor)			$1.41	$0.97
Cost / 1000 seed to purchase			$3.00	$3.00

Application of Remote Setting Techniques Summary



- Hard clam pediveliger larvae refrigerated and shipped up to 26 hours without detrimental effects
- Setting success not fully determined, but survival estimated at first sieve exceeded 50%, ranging 53 - 80% per rearing trial
- Production to a 1 mm seed size averaged 20%, ranging 8 - 28% per rearing trial

Application of Remote Setting Techniques Summary

- Variability of results due to seed source, site location, and season
- Addition of food (cultured algae or algal paste) necessary to achieve adequate survival to 1 mm seed size
- Technical procedures for remote setting hard clams were developed and are not beyond the capabilities of most nursery operators

Application of Remote Setting Techniques Summary

- Potential cost savings based on $3.00/1,000 1 mm seed:
  - One run per year
    - 37% with labor
    - 53% without labor
  - Two runs per year
    - 51% with labor
    - 67% without labor
- Remote setting of hard clams may be viable alternative from a cost perspective

Acknowledgements

- Industry Cooperators - Hatcheries:
  - Sea-Ag, Vero Beach, FL
  - Sea Perfect, Charleston, SC
  - Southern Sea Cross Farms, Merritt Island, FL
- Industry Cooperators - Nurseries:
  - Big 'T' Clam Farm, Cedar Key, FL
  - Cedar Creek Shellfish Farms, New Smyrna Beach, FL
  - Cedar Key Raceways, Cedar Key, FL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