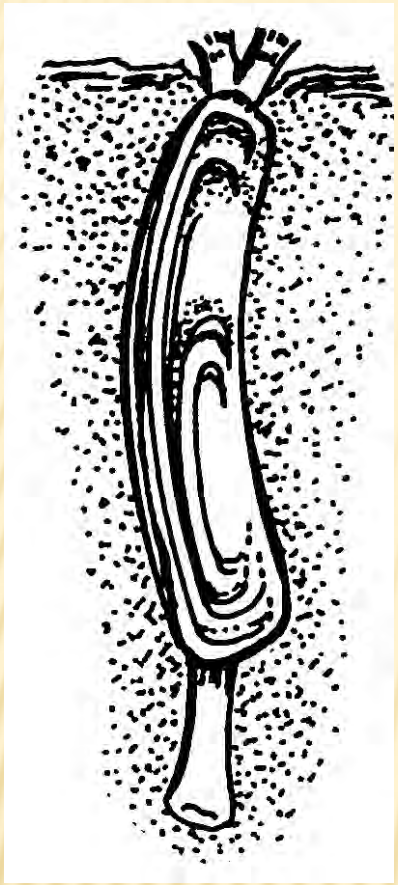


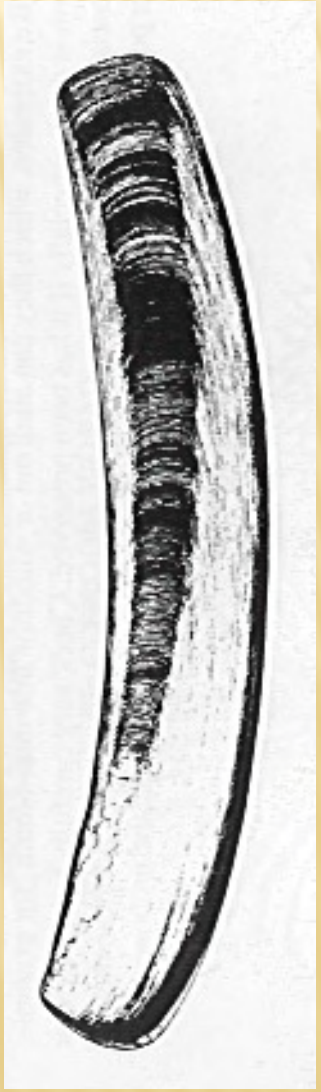
Dale Leavitt, Bill Burt & Diane Murphy

PRIOR WORK IN RAZOR CLAM CULTURE ~MASSACHUSETTS & BEYOND~

IDIOSYNCRASIES & CULTURE CONSIDERATIONS

Need to consider:

- **Lack of knowledge about species** – from basic biology to culture technology
- **Mobility** – have to contain clam from escaping via digging, crawling, and swimming
- **Predators/disease** – protection & prevention
- **Over-wintering (-summering) mortality** – may be a function of tidal exposure
- **Poor shelf-life** – can they survive up to a week out of sediment?



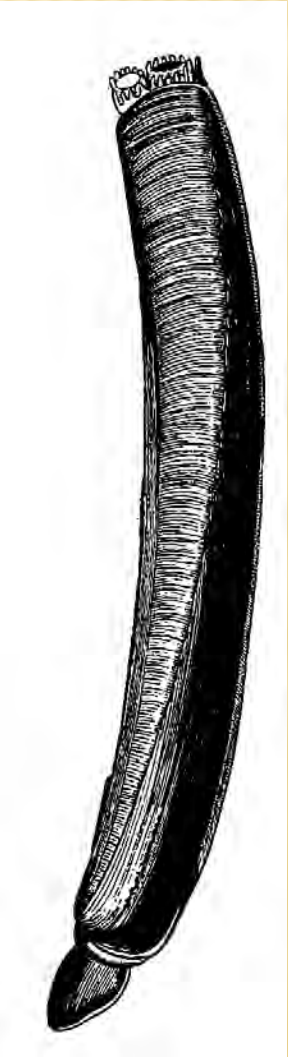
DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

The objectives of the project are:

- Contract with a commercial hatchery to produce juvenile (5mm) razor clams
- Solicit proposals from the shellfish culture industry to develop techniques for razor clam culture (ME, MA, RI, NY & NJ)
- Provide selected growers with seed razor clams to experimentally culture
- Provide selected growers with funds to construct/develop their proposed culture technology
- Track the razor clam market and provide economic evaluation of culture techniques tested

DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- Contract with a commercial hatchery to produce juvenile (5mm) razor clams
  - Aquaculture Research Corporation, Dennis, MA
  - Broodstock from Duxbury Harbor & Nauset Marsh.
  - Spawned $4x10^6$ razor clam larvae
  - Survival poor through setting and nursery
  - Received app. 150,000 on 24 July 2001 to hold in our upwellers at MMA



DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- Solicit proposals from growers to develop techniques for razor clam culture
  - 16 proposals received
  - 11 growers selected
    - MA, RI, CT, NY, & NJ
  - 2 subsequently dropped out

DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- Provide selected growers with seed razor clams to culture
  - 10–15,000 seed distributed to growers between 1 and 10 September, 2001
  - Mean length: 19.45mm (±2.24)

DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- Provide selected growers with funds to construct/develop their proposed culture technology
  - A variety of techniques were tested
    - Bottom netted raceways

DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- Provide selected growers with funds to construct/develop their proposed culture technology
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    - Bottom netted raceways
    - Boarded raceways

DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- Provide selected growers with funds to construct/develop their proposed culture technology
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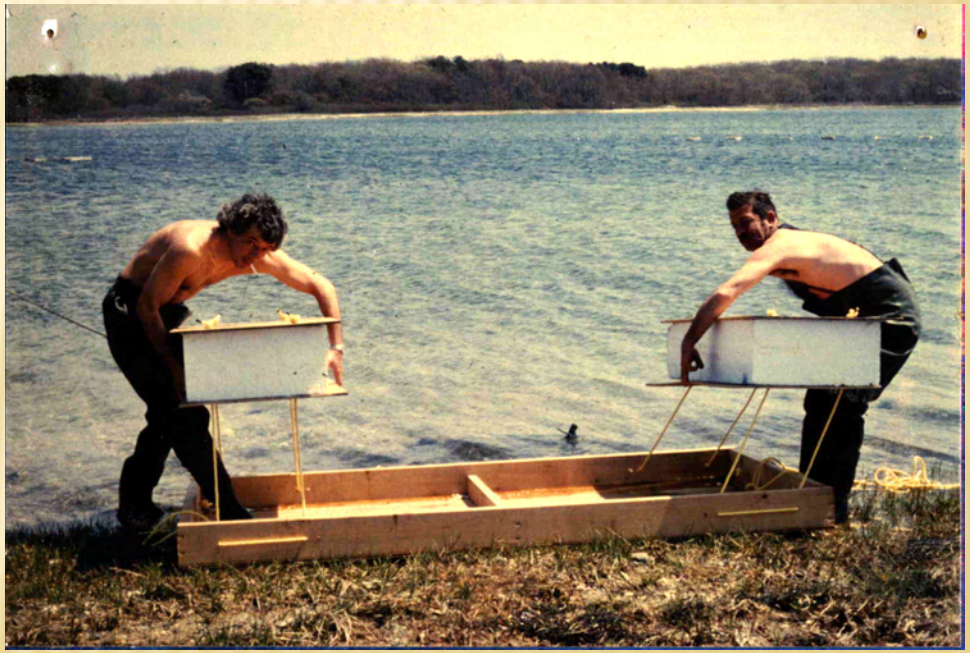
    - Bottom netted raceways
    - Boarded raceways
    - Bottom tents

DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- Provide selected growers with funds to construct/develop their proposed culture technology
  - A variety of techniques were tested
    - Bottom netted raceways
    - Boarded raceways
    - Bottom tents
    - Floating trays



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    - Boarded raceways
    - Bottom tents
    - Floating trays
    - Bottom trays
    - Bottom cages

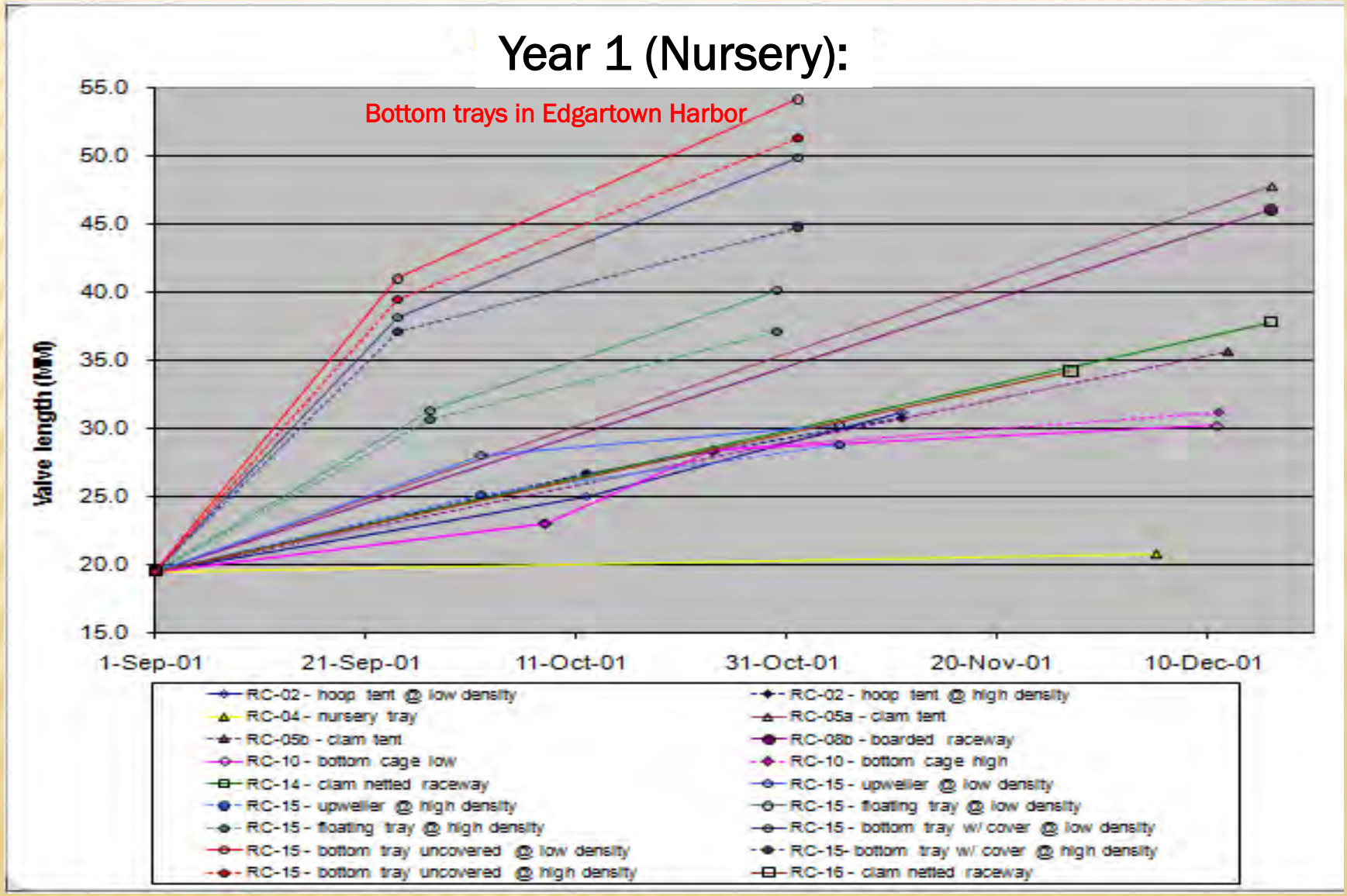
DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- Provide selected growers with funds to construct/develop their proposed culture technology
  - A variety of techniques were tested
    - Bottom netted raceways
    - Boarded raceways
    - Bottom tents
    - Floating trays
    - Bottom trays
    - Bottom cages
    - Upweller

DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

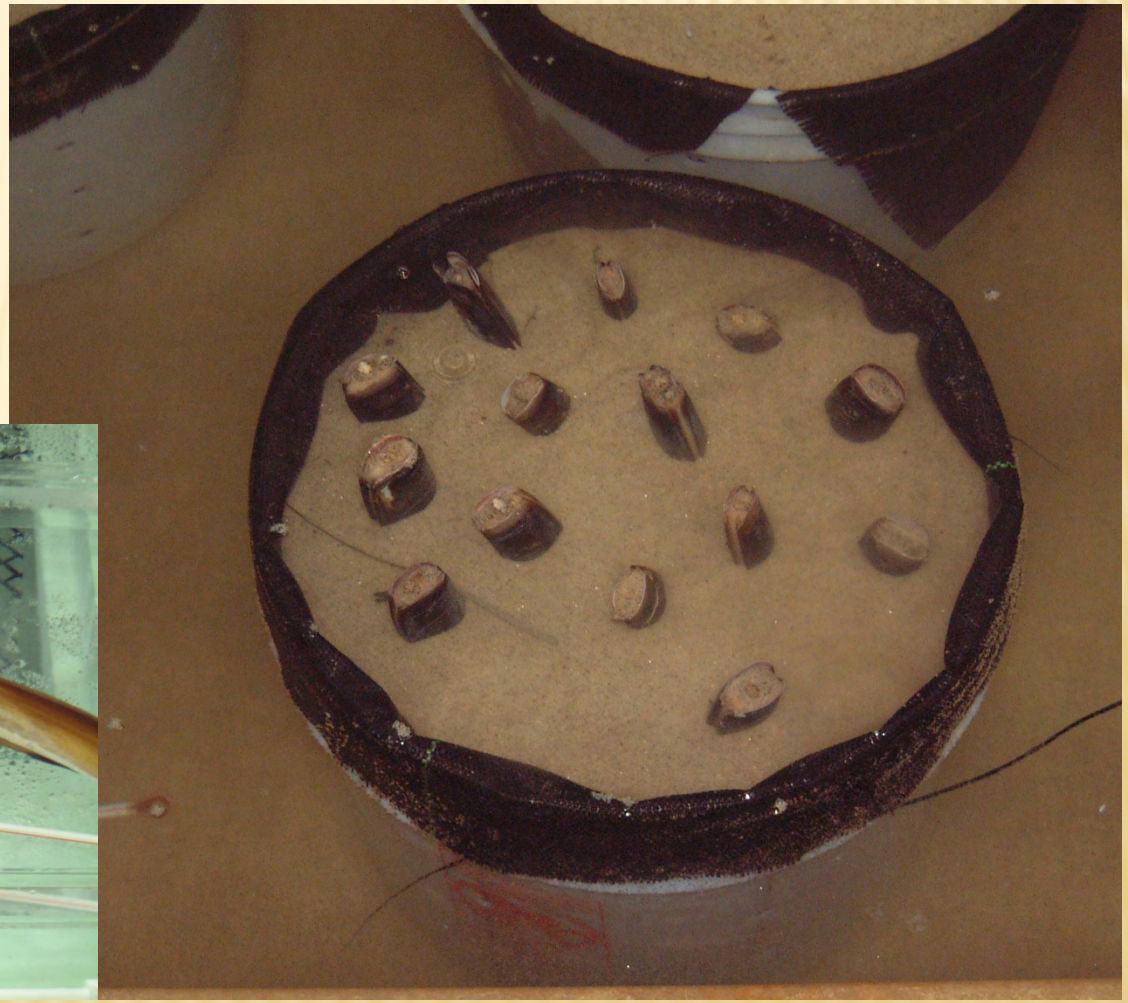
- Evaluate survival and growth in the various nursery systems
  - Survival
    - Ranged from 0 to greater than 100%!
  - Growth
    - Growth interval of app. 3 months
    - Grew from 20 mm at beginning of September to 40-50 mm by end of November

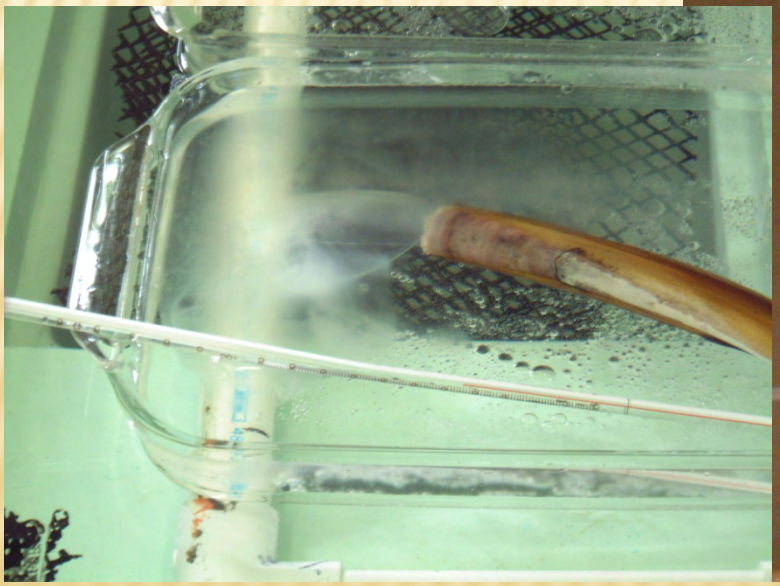
DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM



DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- Collected broodstock
- Conditioned & spawned at three hatcheries





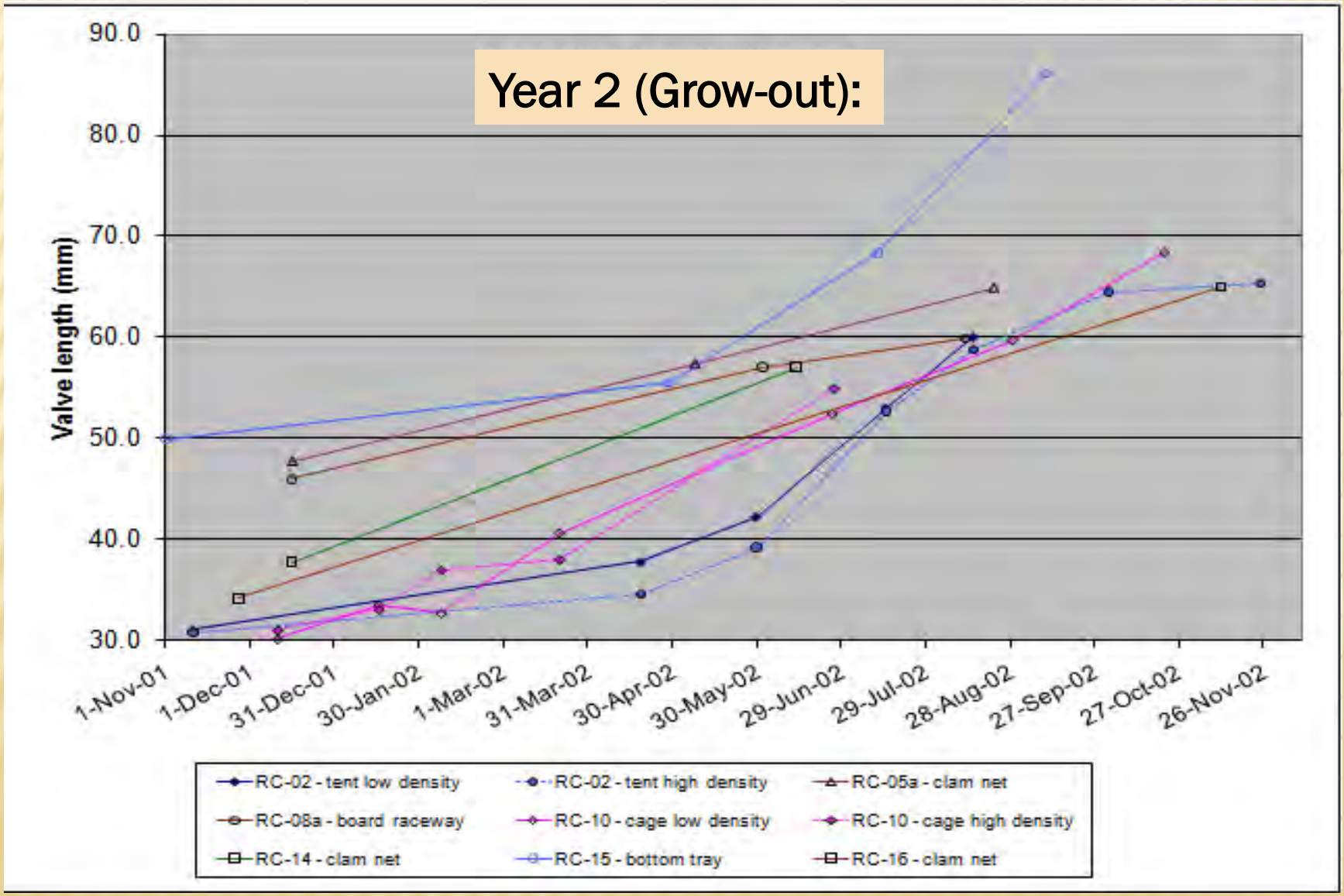
DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- Hatchery attempts in Year 2
  - Spawn in December @ MMA
    - Succumb to *Vibrio* infection
  - Spawn in January @ MMA
    - Succumb to *Vorticella* infestation
  - Spawn in January @ ARC
    - Succumb to neglect due to illness
  - Spawn in March @ MMA with ½ to ARC
    - Slowly lost due to unknown reasons
    - Water temperature?
  - Spawn in March @ Cape May (NJ)
    - Lost to unknown reasons
- Hatchery attempts in Year 3
  - Spawn @ARC
    - Lost
  - Spawn at Eastham (small number)
    - Successfully set on sand tray
- Bottom Line
  - No razor clam seed for Years 2 or 3 due to hatchery failure

DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- Status of Year 1 seed in Year 2
  - New Jersey
    - Seed arrived in poor condition and didn't survive through Year 1
  - Connecticut
    - Doing well – alive & growing
  - Rhode Island
    - Lost seed during first summer due to containment problem
  - Massachusetts
    - Barnstable
      - Lost most immediately after deployment = containment?
    - Wellfleet
      - Lost 4 inch razors in intertidal in August
      - Overheated?
    - Martha's Vineyard
      - Alive and doing well

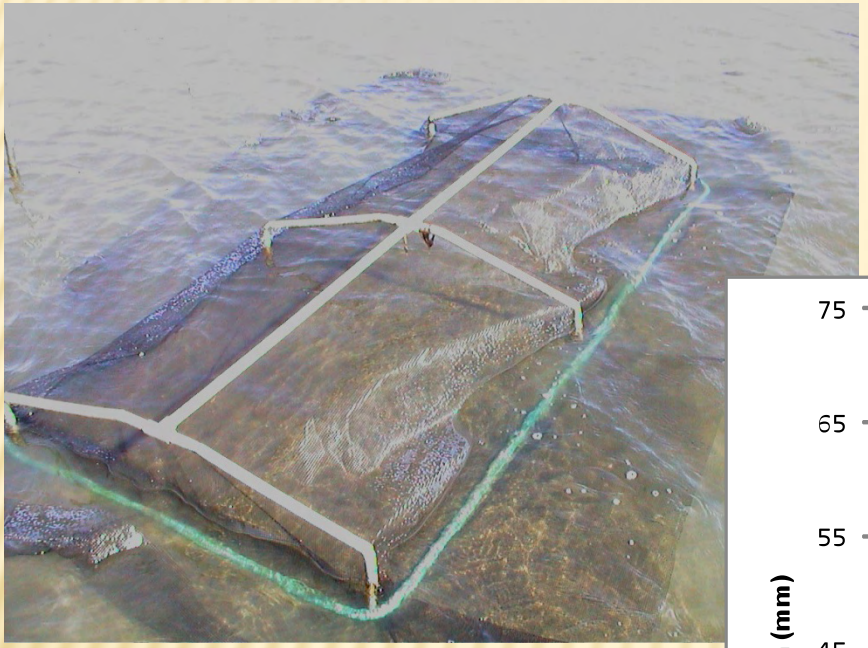
DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM



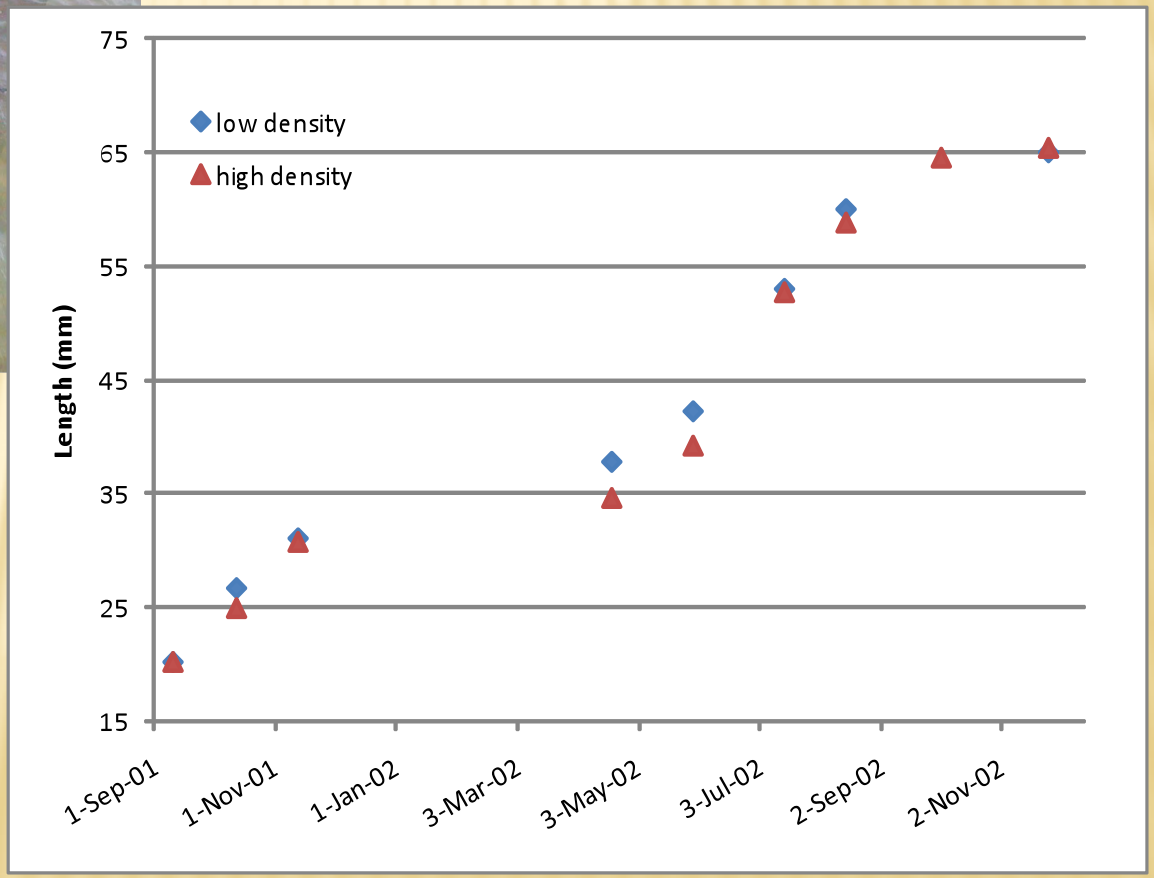
DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- Disposition of clams in the study
  - Gradually lost all of Year 1 seed due to a variety of reasons by winter between Year 2 & 3
  - Larval rearing in Year 3
    - Attempted at Mass Maritime hatchery
    - Unsuccessful due to bacterial problems in post-set nursery (similar to Year 2)
  - Had to terminate project due to failure to produce seed within proposed timeframe

DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

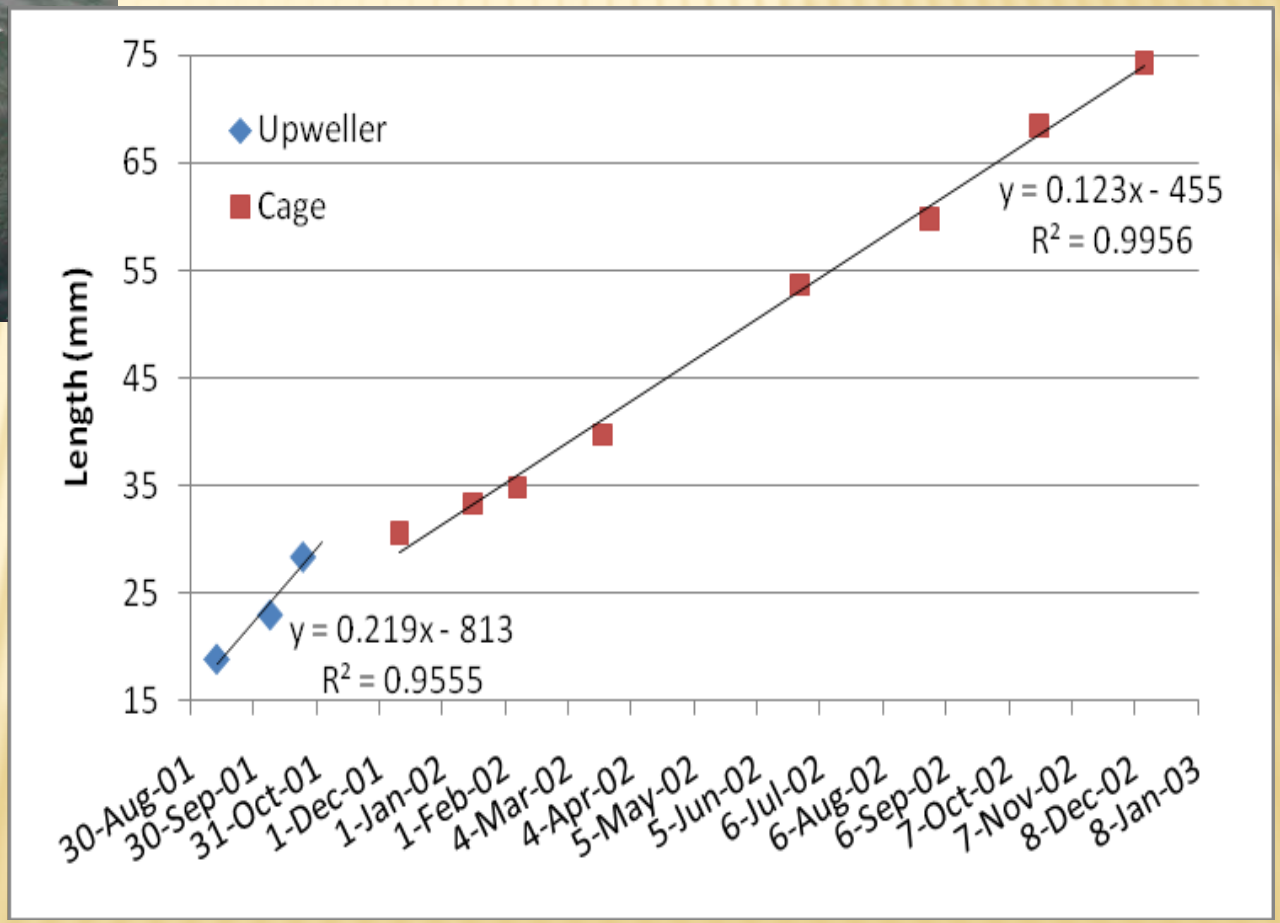


Tented grow-out – Long Island, NY



DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

Cage grow-out – Waterford, CT



DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

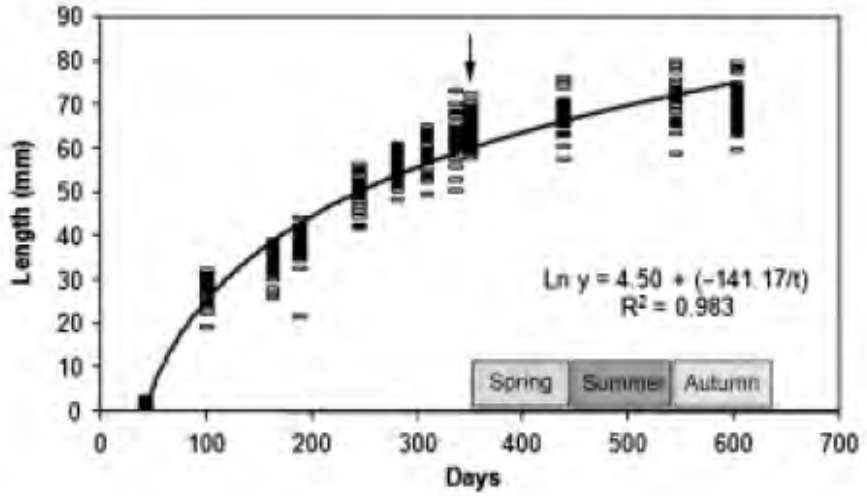


Figure 4 Growth in length of razor clams reared in the hatchery and on-grown in cages. Arrow: moment when the animals were moved from the hatchery to natural beds.

(daCcosta *et al.* 2010)

Growth data from farmed *E. arcuatus*

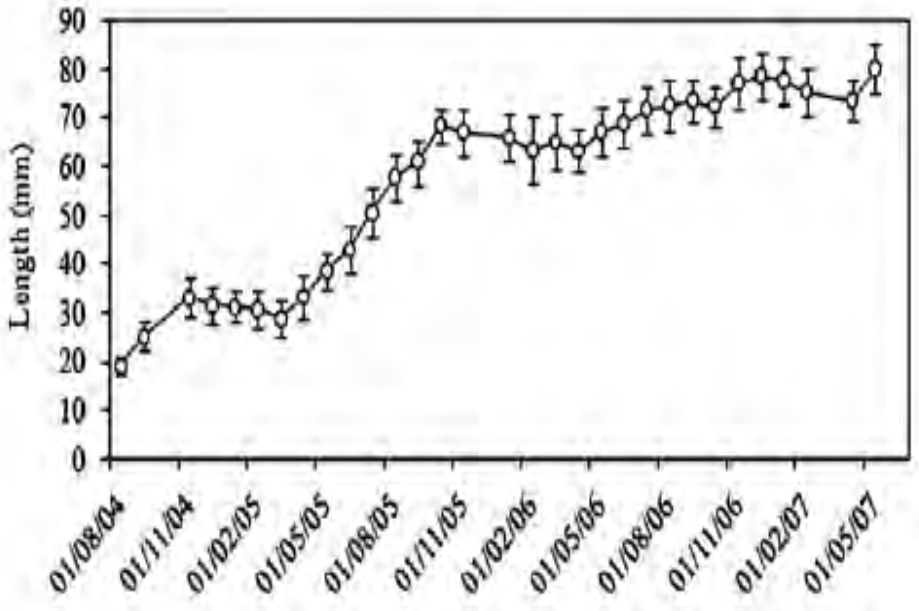
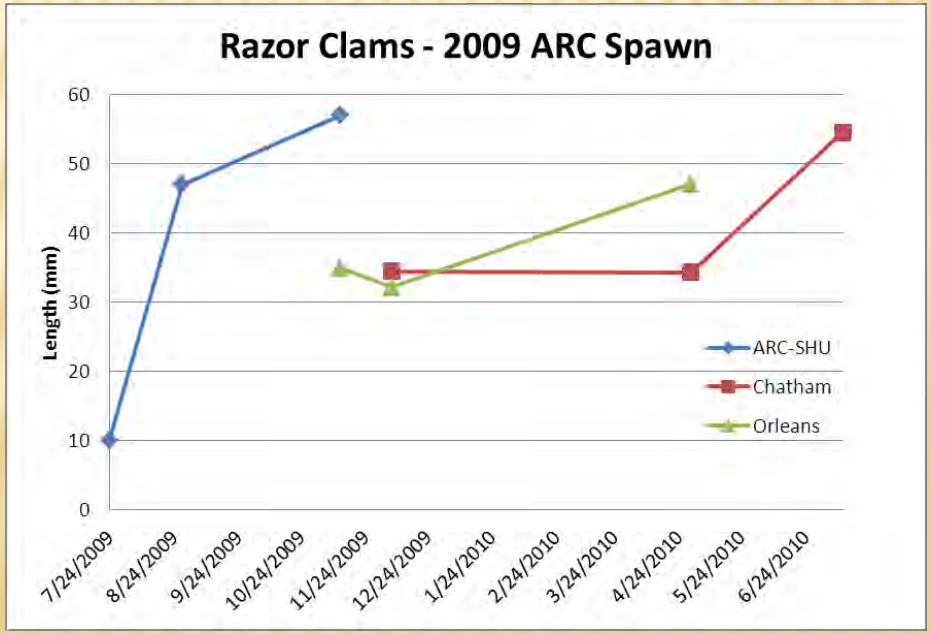


Fig. 5. Growth in length of juveniles on-grown in cages.

(daCosta & Martinez-Patino, 2008)

DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- May 1, 2009 hatchery production in MA
  - Distributed 120,000 10mm seed to 4 growers
    - on July 24th
  - 200 retained in hatchery sand containers
    - Filled with ~7" fine sand (seed 52 – 63mm on 11-12-09)
    - Initially larger seed (>11mm) did not dig in but <10mm dug in quickly



Note: particularly poor growing period at Chatham upweller in 2009.

DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- The final word!
  - Hatchery stage
    - Razors can be held and handled in a similar manner to surf clams and other “cold-water bivalves”
    - Spawning, larval culture and setting are straightforward and easy to accomplish
  - Nursery stage
    - They grow like weeds (ADG >0.5mm/day)!!
    - Early post-set juveniles are highly susceptible to microbial problems when held in conventional downwellers
    - Require high maintenance with excessively clean rearing conditions
    - A quick and dirty experiment (@ EATTC) indicated that immediate planting in sediment may be a viable alternative to post-set downwelling (cannot be “sharp” sand).

DEVELOPMENT OF CULTURE PRACTICES FOR THE RAZOR CLAM

- The final word!
  - Growout stage
    - The growth rate is on a par with (and potentially better than) the growth of wild razors in the North Sea and *E. arcuatus* in Spain
    - Razors will grow through the winter under some conditions
    - Market size individuals (app. 3-4 inches) can be harvested in two growing seasons following “field-planting”
    - Emigration and overheating of sediment (in the intertidal) are two problems that need to be considered in selection of site and technology used
      - Probably cannot grow in intertidal zone from Cape Cod to south
    - Best technology includes effective containment to prevent emigration => bottom trays or boarded raceways.

THE FINAL FINAL WORD

- We are convinced that the razor clam is a viable alternative species for shellfish farmers in the northeast.
  - Good price/market
  - Encouraging growth rate
  - Relatively simple (and common) culture technology
- Still have some bugs to work out in post-set nursery to achieve adequate seed supply for growers.
- That is the purpose of this new study