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Summary

The fisheries Grant R G 99-20 to Study Oyster seed Growth using a FLUPSY (floating upweller system) vs. traditional bag/float system was a very successful project. We were able after two years to reach interesting and informative conclusions. A "Report Summary "section is attached following this narrative.

The study began with the purchase of an "off the shelf" FLUPSY rather than constructing one of our own design. It is our impression that "home – made" FLUPSY 's have tendency to frequently breakdown. This would have been unacceptable during our study.

We also used standard "Taylor floats" which are used only in Virginia for raising oysters on both the Eastern and Western shores. Our methodology followed standard industry practices for handling small seed. This includes using "Window Screen" bags held within the floats. Seed oysters came from a Northern Crassotrica Virginia hatchery with a very good track record. The seed was from brood stock, which had survival exposure to Dermo thus, providing the seed with some potential (hopefully) natural resistance to disease. Seed was purchased at 3.2 millimeters. In year, one the seed was 2,800 milliliters (ml) individual per ml or 110 for a total seed count of 250,000. In year two the seed was the same size and volume.

As an experienced oyster farmer it should be noted that through the grow-out process if a farmer gets 50% of his seed to market he has done well. Generally no one event causes a loss of (+ -) 50% but rather a series of small events seizing errors, bags ripping, mud crabs, biofouling etc. account for the losses.

The seed used was placed/received on April 6th 2000 and April 7, 2001. It arrived via Fed Ex and was immediately placed adjacent to each other in the (Saltwater brackish) Whites Creek at Rob Bloom Jar's "seaside" Eastern Shore Property. This site was chosen for several reasons. We have previously had success-growing oysters here and there was a source of electricity for the FLUPSY. It was also convenient for the daily inspection, maintenance and for, measuring environmental parameters. Another of the advantages of the FLUPSY is that it doubles as a dock and work platform.

The purpose of this project was to compare seed growth rate and not to follow the seed to full grow out size. Therefore each year the project date collection ended when the seed reached field grow- outsize. This would be seed able to hold on a ¾" sieve thus enabling it to be placed in regular shellfish grow out bags (ADPI stage II bags).
Due to location, seed quality, maintenance and a bit of luck (all aquaculturalists need some luck) we were able to shut down our FLUPSY and float system in 8 weeks both years. Refer to the "Result Summary" for detailed growth information.

During the first year of our study, we placed seed into bags/floats at a rate/density of 5000 per window screen bag. As they grew they were changed into new/clean bags and thinned to a density of 2,800/bg. This was done both years. In addition, during both years two of the eight FLUPSY silas were stocked at the same density as the bags/floats. This was done for data comparison purposes.

A major change from year one to two was stocking densities of the FLUPSY. There was no appariable difference in growth per silo at the end of year one. In year one, we tried several different densities/seed per silo. As the FLUPSY has eight silos, we thought it would be a good idea to try varying densities.

In year, two we kept the two control silos (5000 seed per) for data purposes. We also evenly stocked the other six silos with seed thereby using the FLUPSY in a much more realistic "commercial" way. Again, there was no appreciable difference in growth per silo. After 8 weeks each silo held (+ -) 90 liters of uniform ("Beautiful") seed while the Taylor/bag system provided "fair" seed with big variations in size (see Result Summary).

This study shows an Oyster farmer that there are pros and cons to both seed nursery methods. The biggest advantage to floats / bags are there low initial cost and the ability to place them almost anywhere (if VMRC permitted). The bigger disadvantages are the large variation in seed size and the unavailability of an easy / conveniently work platform to tend equipment and seed.

The disadvantages to a FLUPSY are its his/her initial cost (you must be a serious grower) and its reliance on waterfront property and electricity. The

advantages of the FLUPSY are its convience (location and working platform) and its ability to grow uniform seed, which means reduced time, is needed to sieve/sort seed by size. It should be noted that personal experience and in discussions with numerous shell fish farmers over the years sieving is perhaps the hardest/least liked part of the job. I should also say that after the initial cost of the FLUPSY the electricity used to run the pump is the only expense (+ -), and it is $ 40.00 per month.

After two years of USING a FLUPSY, we have reached several economic conclusions based on our experiences. The FLUPSY is very capable of paying for itself in a short period. It could be used simply as income provider through seed sales only or for a grower's exclusive source of high quality seed (no sales). We used the FLUPSY for both purposes.

Oyster seed was purchased early in the year for less than one cent per seed. The seed was then sold in early summer for two cents per seed and in the early fall for five cents per seed. Some of the seed was put on our lease for final grow out.

Keeping in mind that all aquaculture is incredibly sit specific and that quality seed sources are essential we can state our seed survival rate was + - 95% (through the first fall). Oysters diseases should be anticipated during the following year at all Virginia grow out sites and that will be the determining factor on the percentage of oysters to actually cash market site. We do feel confortable making an estimate of 50% survival to market if seed is tended properly and grow out site has a good history.

Conclusion:

It would be our recommendation to any serious oyster farmer that they use a FLUPSY to "Jump Start" their seed. The ease in which seed growth can be monitored and maintenance can be done is amazingly easy when compared to the bag/float method. One FLUPSY (20 X 10 Dock) can hold the equivalency of approx. 20 –40 floats. These numbers are estimates, as it should be emphasized that all Aquaculture techniques are very site specific.

It is with great appreciation that Rob Bloxom Jr. And Jeffrey Gardner thank Francis O'Bien, P G ROSS and Mark Luckenbach from VIMS, and Jake Taylor, Eastern Shore Laboratories, Mike Oesterling from VMRC Virginia Sea Grant and Tom Murray, for their invaluable assistance in both data collection and project formation.

OUTREACH:

FLUPSY SHOWN / DEMONSTRATED TO:

1. *World Aquaculture Conference Orlando Florida*
   VIMS Poster w/Scientist

2. *Chesapeake Bay Foundation*
   Tommy Lygitt Field Manager

3. *Numerous Hatchery Owners/ Mangers*

   R.G.PARKS
   Kevin Mason
   Walker Brothers
   Folley Creek Hatchery
   VIMS
   VMRC

4. *Numerous Oyster Growers*
   Tom Mason
   Jeff Hammer
   Rudy Cashwell
   Eastern Shore Growers

5. *Perhaps the best evidence for the success of this project and its outreach efforts are the numerous FLUPSY'S that have been built or purchased by other Virginia Farmers after seeing our FLUPSY and discussing our results.*

FLUPSY Fisheries Grant Project # RG-99-20

(Jeff Gardner & Rob Bloxom)

Results Summary
Prepared by P.G. Ross, VIMS-Eastern Shore Lab

During both years of this study, oyster growth differences were evident between the FLUPSY and float-bay system; however, mortality was similar (1%). Oysters grew to a larger size and were less variable in size in a given period when nurseried in the FLUPSY.

Table 1 summarizes mean shell height with several measures of variance (including variance and standard deviation) for both years of the study. In year 1 the "Reg. Silo" equates to silos with 5,000 oysters per silo, which simulates a total FLUPSY unit density of 40,000 oysters (this density was comparable to the density of oysters per surface area stocked in individual spat bags in floats). "HD Silo" equates to high-density silos with 28,000 oysters per silo, which simulates a total FLUPSY unit density of 224,000 oysters (this density approximated a "commercial" density). In year 2, FLUPSY silos were stocked at densities that produced 250,000 oysters while spat bags were stocked at their "commercial" density of 2,500 oysters per bag and 5 bags per float.

Table 2 relates that both means and variances differed statistically between techniques in year 1 when oyster densities were similar. Table 3 shows similar results for year 2 when oyster densities approximated the relative commercial densities for each individual technique. In both years, oysters were larger and less variable in size in the Flupsy.

Figures 1A and 1B graphically depict oyster growth as measured by shell height (mm) over the course of year 1 season; both as mean size and the variance of size. Differences between techniques tend to increase 4-6 weeks into the nursery stage.

Figures 2A and 2B graphically depict oyster growth as measured by shell height (mm) over the course of the year 2 season, both as mean size and the variance of size. Again, differences between techniques tend to increase 4-6 weeks into the nursery stage. Similar trends are seen in both years of the study. Although we did not replicate with the same densities each year of the study, the similarity of these trends lends a high level of confidence to the data.

Table 4 is an amalgamation of actual costs provided by J. Gardner and estimates provided by J. Taylor, M.Luckenbach and P.Ross.

FLUPSY Fisheries Grant Project -- Jeff Gardner and Rob Bloxom

Table 1. Summary Data

2000 -- Oysters in float/bag system and two different densities of oysters in silos of FLUPSY
2001 -- Oysters in float/bag system and one (commercial) density of oysters in FLUPSY

Year 1

Mean Shell Height (mm)

Date	Reg. Silo	HD Silo	Bags	
4/5/00	3.08	3.08	3.08	
4/12/00	2.92	3.15	3.01	
4/19/00	3.41	3.34	3.15	
4/26/00	3.96	3.6	3.68	
5/3/00	4.67	4.96	4.19	
5/10/00	6.94	6.57	6.51	
5/17/00	11.25	9.95	10.55	
5/24/00	14.16	12.48	12.44	
5/31/00	17.09	15.73	16.46	
6/7/00	20.99	18.51	18.87	Project officially ended for the season on this date
6/20/00	25.08	21.77		

Variance of Shell Height (mm)

Date	Reg. Silo	HD Silo	Bags
4/5/00	0.13	0.13	0.13
4/12/00	0.17	0.15	0.2
4/19/00	0.19	0.32	0.2
4/26/00	0.3	0.39	0.34
5/3/00	0.53	0.6	0.51
5/10/00	1.87	1.72	1.84
5/17/00	2.77	2.72	3.9
5/24/00	4.04	6.25	7.41
5/31/00	6.72	4.67	7.95
6/7/00	9.19	8.88	16.95

Year 2

Mean Shell Height (mm)

Date	Reg. Silo			Bags		
	Mean	SD	SE	Mean	SD	~~1/2 SD~~ SE
4/7/01	3.30	0.44	0.06	3.30	0.44	0.06
4/27/01	5.47	0.65	0.08	4.94	0.79	0.10
5/10/01	8.59	1.26	0.16	7.07	1.80	0.23
5/23/01	14.16	2.79	0.36	12.19	3.14	0.40
6/5/01	19.84	3.60	0.46	15.36	5.40	0.70

Var. Shell Height (mm)

Date	Reg. Silo	Bags
	Var	Var
4/7/01	0.20	0.20
4/27/01	0.43	0.63
5/10/01	1.59	3.23
5/23/01	7.76	9.84
6/5/01	12.94	29.11

Table 2

FLUPSY Fisheries Grant Project
Oyster Nursery Techniques – Results

2000 Growth Measured as Shell Height (mm)
After 63 Days in Nursery Phase[1]

Treatment	N	Mean (mm)	SD (mm)
Forced Upweller (FLUPSY)	90	21.0*	3.0**
Float/Bag System	90	18.9	4.3

[1]Oyster entered both systems at 3.08 mm
* Means significantly different (Kruskal-Wallis, Pr>F 0.0002)
** Variances heterogeneous (Hartley's Fmax, P<0.05)

Table 3

FLUPSY Fisheries Grant Project
Oyster Nursery Techniques – Results

2001 Growth Measured as Shell Height (mm)
After 59 Days in Nursery Phase[1]

Treatment	N	Mean (mm)	SD (mm)
Forced Upweller (FLUPSY)	60	19.8*	3.6**
Float/Bag System	60	15.4	5.4

[1]Oyster entered both systems at 3.3 mm

* Means significantly different (Kruskal-Wallis, Pr>F 0.0001)

** Variances heterogeneous (Hartley's Fmax, P<0.01)

FLUPSY Grant Project
2000 - Floats vs. Low Density FLUPSY

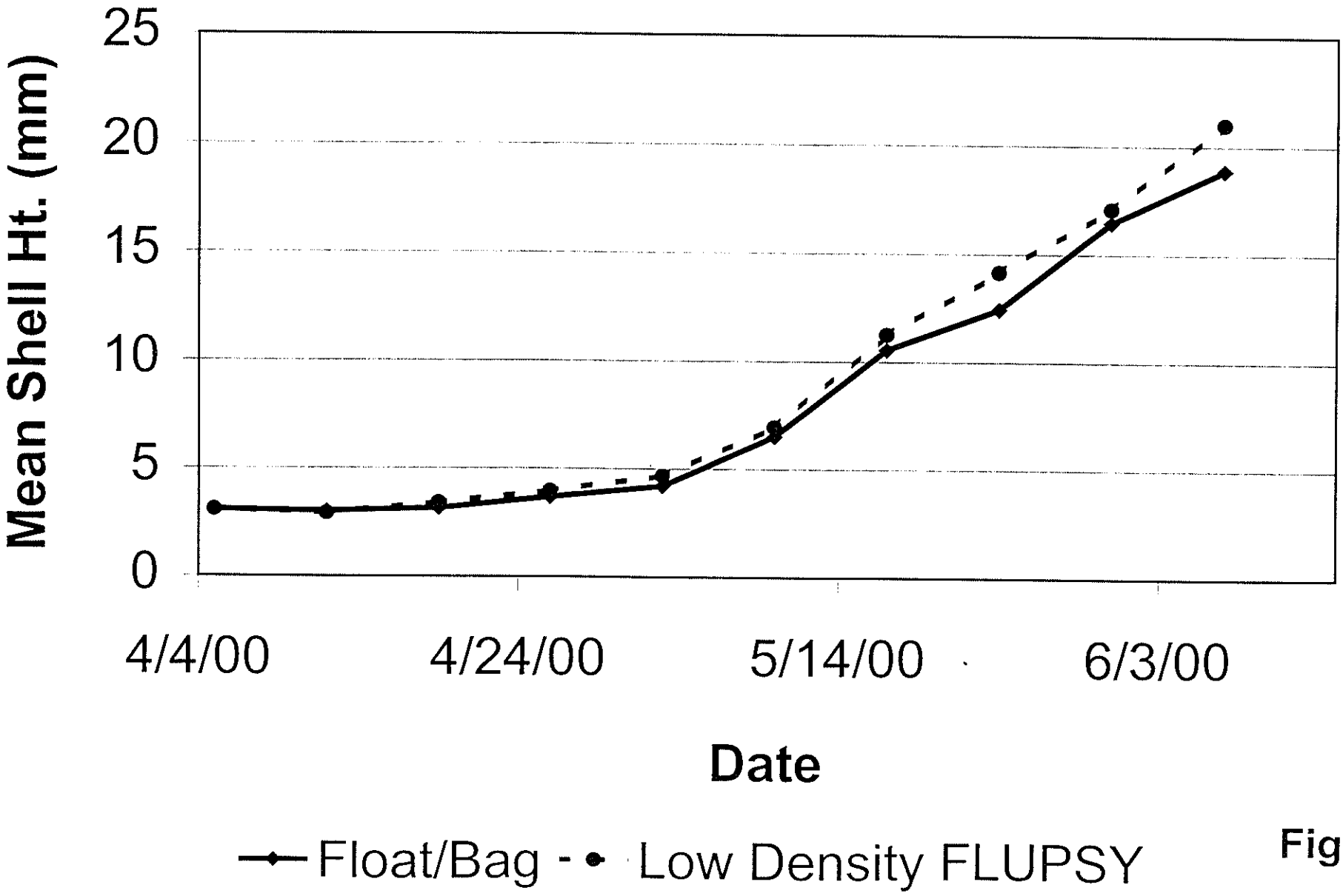

Fig. 1A

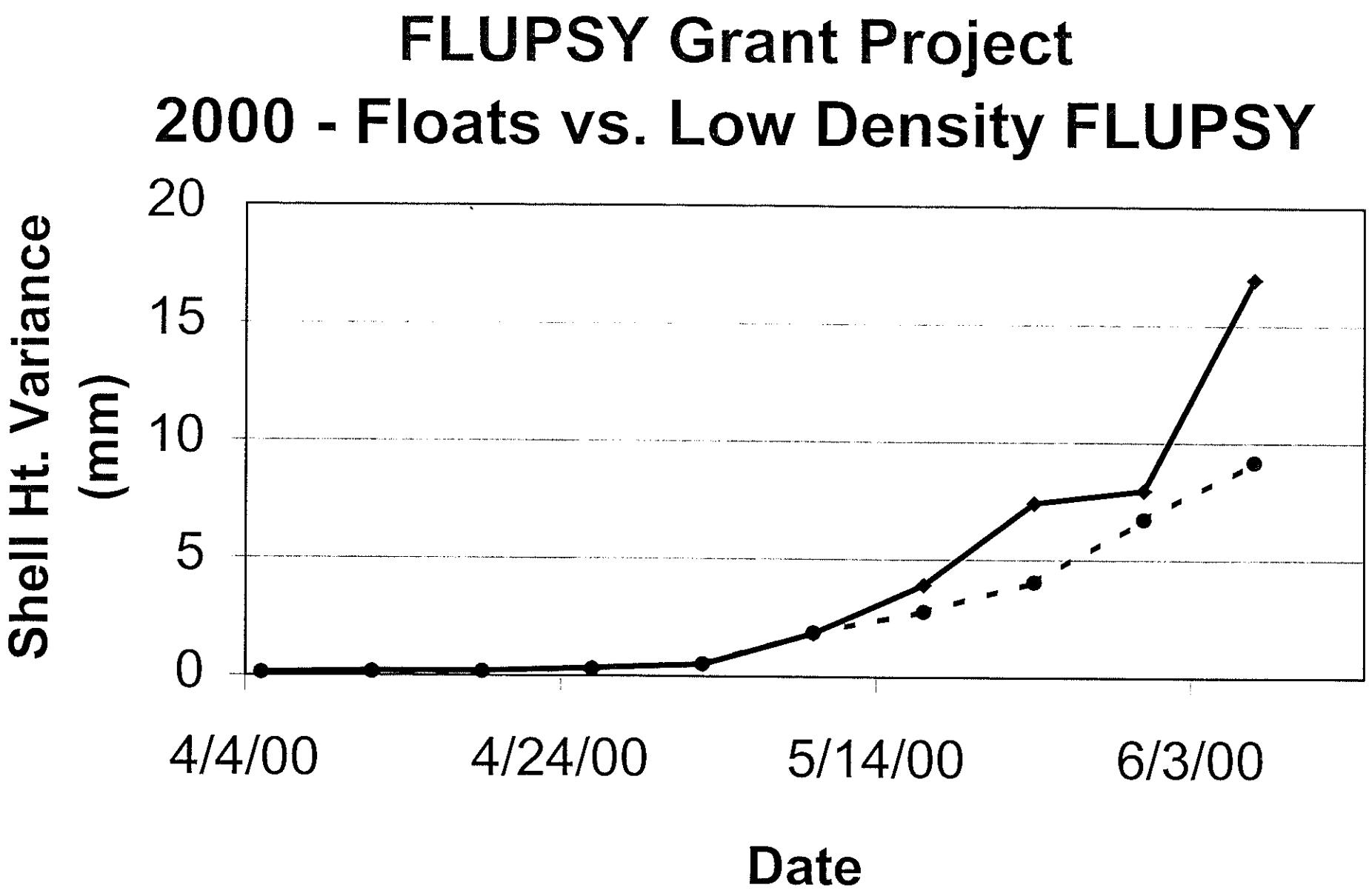
FLUPSY Grant Project
2000 - Floats vs. Low Density FLUPSY
Shell Ht. Variance (mm)
20
15
10
5
0
4/4/00
4/24/00
5/14/00
6/3/00
Date
Float/Bag
Low Density FLUPSY

Fig. 1B

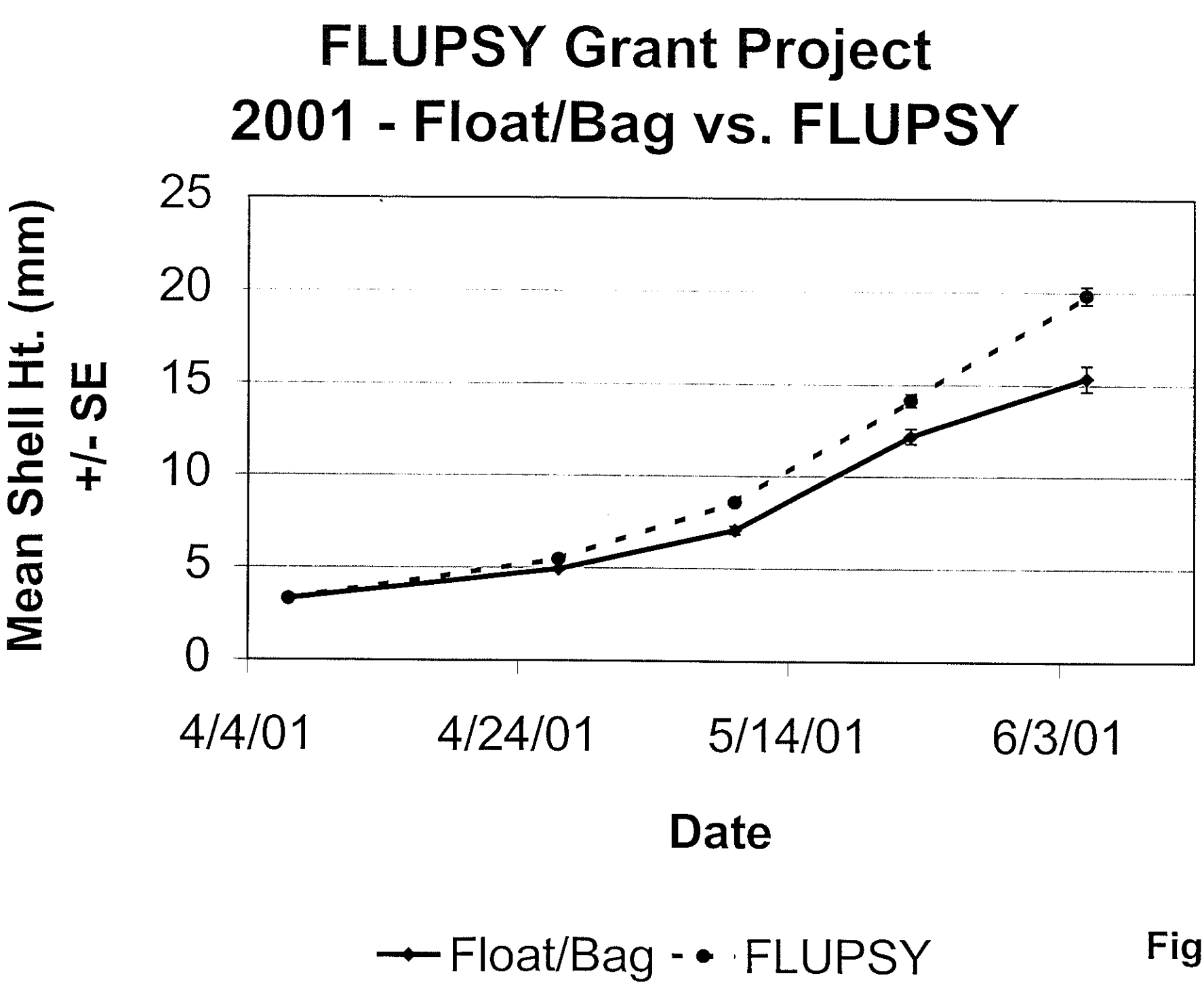
FLUPSY Grant Project
2001 - Float/Bag vs. FLUPSY
Mean Shell Ht. (mm)
+/- SE
25
20
15
10
5
0
4/4/01
4/24/01
5/14/01
6/3/01
Date
Float/Bag
FLUPSY

Fig. 2A

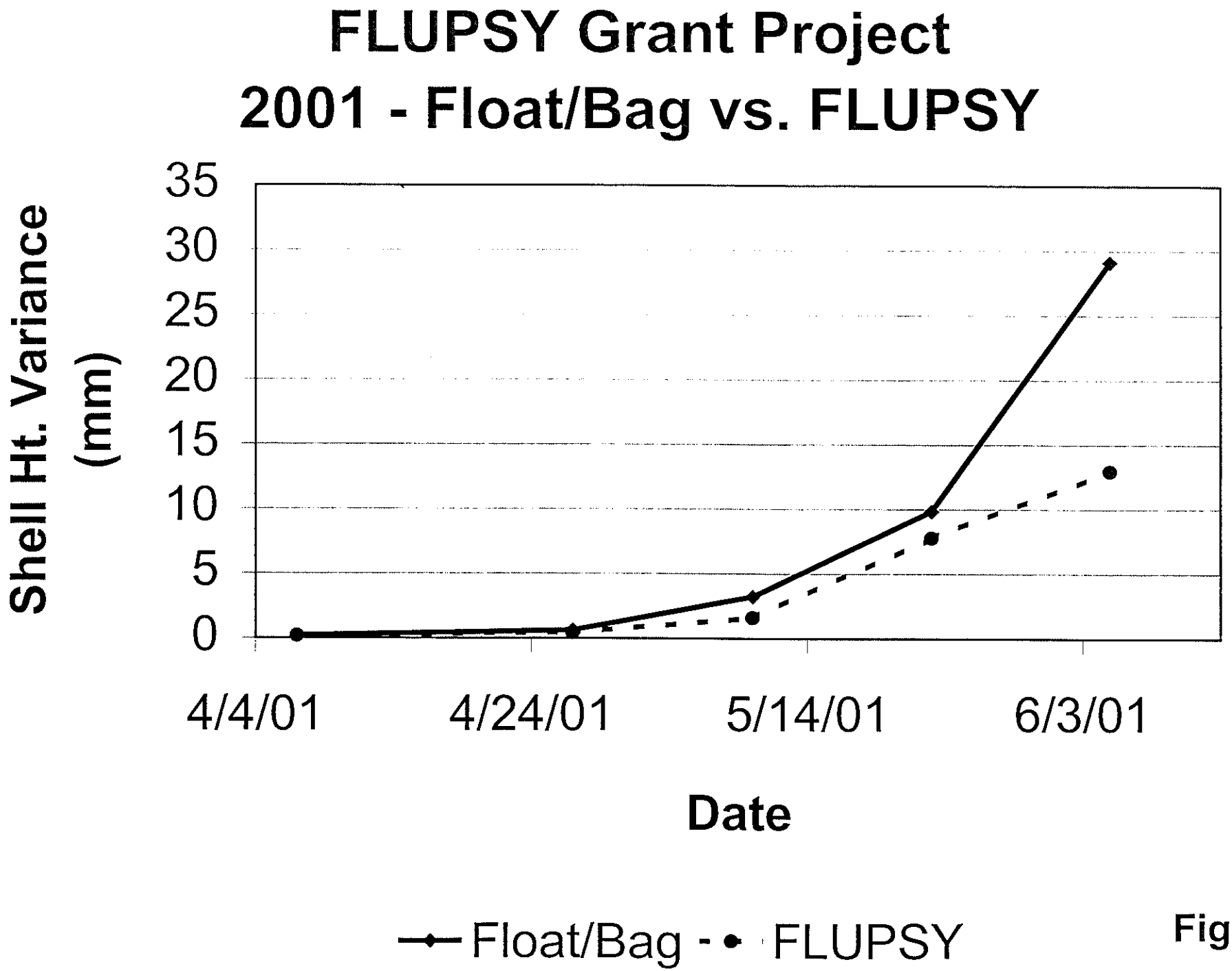
FLUPSY Grant Project
2001 - Float/Bag vs. FLUPSY
Shell Ht. Variance (mm)
35
30
25
20
15
10
5
0
4/4/01
4/24/01
5/14/01
6/3/01
Date
Float/Bag
FLUPSY

Fig. 2B

Table 4. Cost per week of growing ~250,000 3 - 18 mm oysters. Assumes needing one FLUPSY unit vs. 20 float-bag units.

Description	FLUPSY	Bag-Float
Construction: Materials/plans	$7,100	$1,400
Labor[1]	$400 (20 hr)	$400 (40 hr)
Total	$7,500	$1,800
Life Expectancy	10 yr. [2]	4 yr.[3]
Construction Cost per week	$16	$7
Maintenance: Boat per week[4]	$0	$3
Labor per week	$40 (4 hr.)	$40 (4 hr.)
Elec. per week	$4	$0
Total	$44	$43
COST PER WEEK prorated construction+maintenance	**$60**	**$50**

[1]Labor valued @ $20/hr. for FLUPSY construction and $10/hr. elsewhere, [2]Includes 2x$400 motors over 10 yrs., [3]+/- based on situation, location and maintenance, [4]Boat value estimates fuel, wear & tear etc. of small skiff.