Appendix B14: Comparison of surveys in the Nantucket Lightship Access Area during 2009.

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In 2009, three projects were funded by the sea scallop research set-aside program to intensively survey the Nantucket Lightship Access Area. One goal was to allow an effective comparison of density and shell height composition estimates. The three surveys were conducted by the Virginia Institute of Marine Science (VIMS), SMAST, and the HabCam team. The NEFSC lined dredge and SMAST drop camera "broad-scale" surveys, which are routinely carried out over the entire stock area, also covered the Nantucket Lightship Access Area, albeit less intensely. This analysis compares size-frequencies and abundance estimates from each survey.

Methods

The VIMS survey used two dredges towed side by side: a lined (38 mm) survey dredge (which is also used on the NEFSC survey) and a commercial dredge with 4" rings. The SMAST survey used the drop camera system used on their broad-scale survey including the primary "large" and secondary "small" cameras. The small camera gives better resolution because it is closer to the sea floor but covers less area (~0.8 sqm/drop). The HabCam survey used a towed digital camera system, towed at ~5 kts, taking overlapping digital images, each covering about 1 m^2 and with overlap between adjacent frames (Appendix B9). Table 1 gives more details on each survey.

The Nantucket Lightship Access Area was closed to scallop fishing in December 1994. It was reopened to fishing during portions of 2000 and 2004-2008. Previous surveys have observed three recent strong year classes: 1999, 2001, and 2004. The 1999 and 2001 year classes have been heavily fished. The remaining scallops from these year classes were expected to be around 150 mm shell height in 2009 (near their asymptotic size). The 2004 year class was lightly fished in 2008 only, and would be expected to be around 120+ mm shell height. All surveys were conducted in late spring or early summer in 2009, when the area was closed to fishing.

Results

Estimated shell height size-frequency (> 40 mm SH) from each survey were normalized to sum to one prior to the analysis. The VIMS survey dredge catches are used as a baseline for the size-frequencies analysis because the survey dredge is an important standard and shell height data collected by dredge surveys are relatively accurate (Jacobson et al. 2010).

The VIMS survey dredge showed the expected year class peaks at 120 and 150 mm SH, plus an incoming recruitment peak at 50 mm SH (Figure 1). The commercial dredge showed a similar size distribution for large scallops, but had reduced catchability for scallops less than 100 mm SH.

HabCam shell-height distributions were wider than the survey dredge shell height composition, probably due to less precise shell height measurements from photographs (Jacobson et al. 2010). Nonetheless, HabCam and the survey dredge are in reasonable agreement with no indication of dredge size-selectivity. The HabCam survey was conducted before the

VIMS survey, and the difference in timing may explain the differences between HabCam and VIMS in shell height distributions for smaller scallops that grow quickly.

The large drop camera survey suggests there is a much higher fraction of scallops in the 70-90 mm range than either the survey dredge or HabCam. The large camera size-frequencies are relatively noisy, with some evidence of reduced size-selectivity for small scallops. The divergence between the surveys may be due to the low sample size of the drop camera (315 scallops measured) and imprecision in shell height measurements (Jacobson et al. 2010). The small camera is intended to allow full detectability of small scallops, and indeed a higher proportion of small scallops were detected than with the large camera. However, the small camera data are noisier that the large camera data, due to the small number of scallops measured (76).

The NEFSC broad-scale survey had only 14 tows in the area. It found similar modes as the VIMS survey dredge, but in different proportions, likely due to the small sample size. The SMAST broad-scale large camera survey had a noisy shell height distribution, likely because of the small number of scallops measured (87).

Estimates of abundances are compared in Table 2. The dredge surveys were assumed to have an efficiency of 0.44 (see Appendix B4), whereas the optical surveys were assumed to have an efficiency of one. The individual 95% confidence intervals for each survey contain the inverse-variance weighted mean calculated for the abundance estimates from all of the surveys (205 million scallops). The three intensive dedicated surveys all had lower coefficients of determination (CV) than the broad-scale surveys.

Discussion and Conclusions

This study demonstrates the utility of fine-scale surveys for rotational area management in areas of relatively small size. Both abundance and the shell height composition data from the broad scale surveys are too imprecise because of the small sample sizes. It appears that the VIMS survey dredge gave the best estimate of shell height composition, as was assumed in the analysis. Both optical surveys showed evidence of shell height measurement errors. The SMAST survey did not measure sufficient scallops to estimate size-frequencies precisely. On the other hand, the optical surveys (SMAST and HabCam) had the lowest CVs for abundance. The HabCam survey had a remarkably low CV, due to its large sample sizes. Optical and dredge sampling have complementary attributes, and the ideal survey would probably include both types of sampling.

References

Jacobson, L.D., Stokesbury, K.D.E., Allard, M.A., Chute, A., Harris, B.P., Hart, D., Jaffarian, T., Marino, M.C., Nogueira, J.I., and Rago, P. 2010. Measurement errors in body size of sea scallops (*Placopecten magellanicus*) and their effects on stock assessment models. Fish. Bull. 108: 237-247.

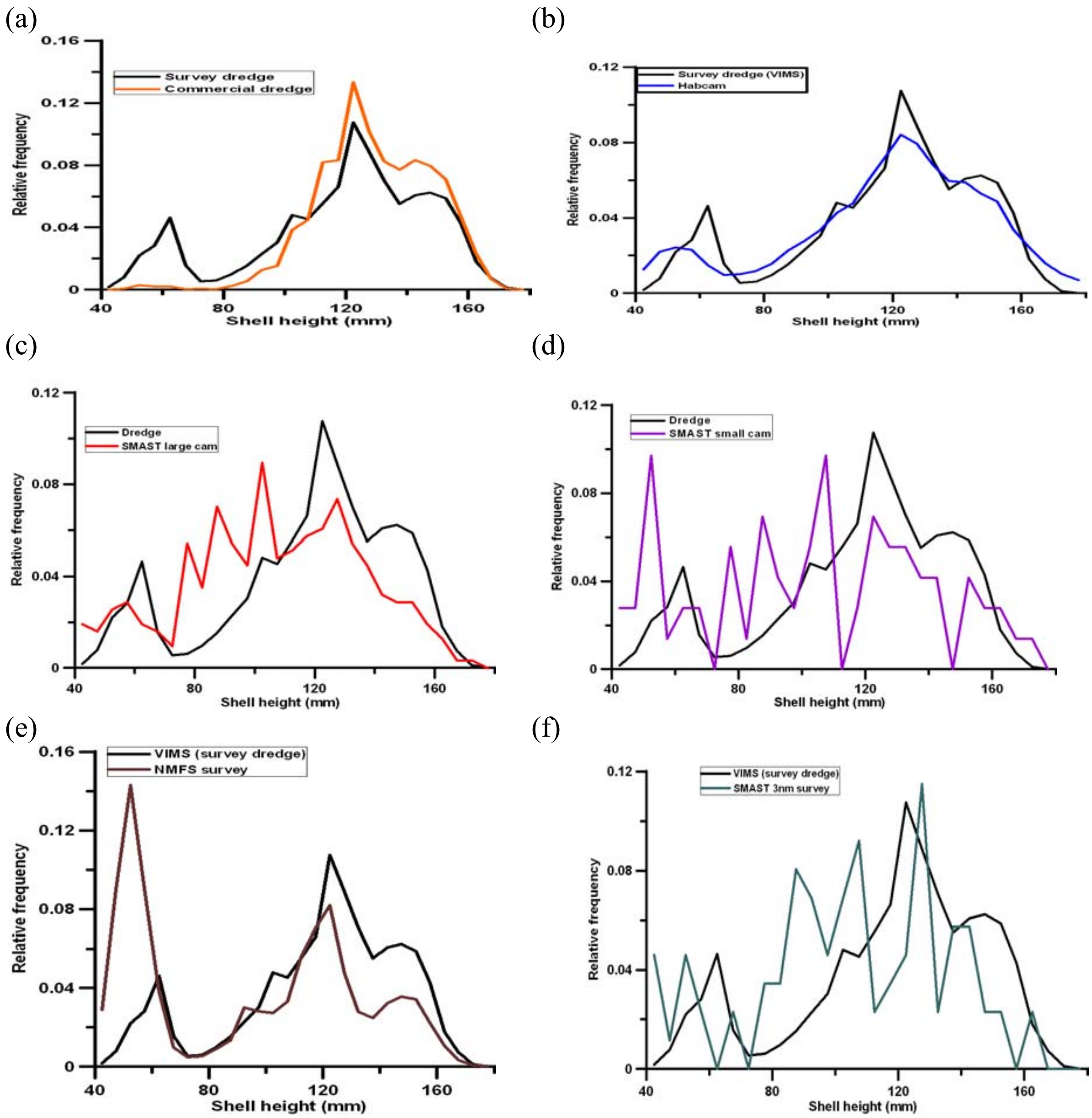
Appendix B14-Table 1. Basic characteristics of the surveys.

Survey	**Gear**	**Design**	**Number of stations**	**Area swept (m^2)**	**Sea days**	**Number of scallops measured**	**Post-processing resources required**
VIMS	Survey dredge	Systematic grid	91	409,500	4	13149	Low
VIMS	Commercial dredge	Systematic grid	91	767,813	4	16300	Low
SMAST	Large drop video camera	Systematic grid	164	1,940	2	315	Moderate
SMAST	Small drop video camera	Systematic grid	164	510	2	76	Moderate
Habcam	Towed digital still camera	Continuous transect	N/A*	123,500**	3	13644	High

*1.235 million images were collected, of which 1/10th were processed
**Processed images only

Appendix B14-Table 2. Abundance and biomass estimates from the surveys

Survey	Method	Assumed efficiency	Estimated abundance (millions)	CV	95% CI (millions)	Mean meat weight (g)	Estimated biomass (mt)
VIMS	survey dredge	0.44	259	0.14	192 to 334	34.0	10752
SMAST	large drop camera	1	240	0.13	183 to 305	25.0	5991
SMAST	small drop camera	1	234	0.16	166 to 313	24.6	5749
Habcam	towed camera	1	198	0.04	182 to 214	32.9	6782
NMFS broad-scale	survey dredge	0.44	100	0.45	32 to 206	32.5	3965
SMAST broad-scale	large drop camera	1	241	0.24	141 to 367	24.5	5902
Grand mean (inverse-variance weighted)		NA	207	0.035	193 to 231	34	7038
Broad-scale combo mean (inverse-variance weighted, NMFS and SMAST broad-scale surveys only)		NA	178	0.22	110 to 263	32.5	5798



Appendix B14-Figure 1. Plots of observed normalized shell heights for each survey. The VIMS survey dredge size-frequencies (black line) are included for reference on each plot. (a) VIMS commercial dredge. (b) HabCam. (c) SMAST large camera. (d) SMAST small camera. (e) Lined survey dredge. (f) SMAST broad-scale large camera survey. The NEFSC broad-scale survey data are not shown.