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A New Method to Describe Seagrass Habitat Sampled During Fisheries-Independent Monitoring

JERED B. JACKSON[1,]* and DOUGLAS J. NEMETH[2]

[1] *Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Senator George G. Kirkpatrick Marine Lab, 11350 S.W. 153rd Court, Cedar Key, Florida 32625*

[2] *U.S. Fish and Wildlife Service, Red Bluff Fish and Wildlife Office, 10950 Tyler Road, Red Bluff, California 96080*

ABSTRACT: We explain a new method of quantifying seagrass cover and describing seagrass species composition during fisheries-independent monitoring. This new method is similar to a point-intercept method developed to estimate arboreal crown cover, but it uses an aquascope designed for shallow water. The method does not require a diver. Seagrass cover (cover ratio) distinguished different percentage cover categories in 0.25-m^2 seagrass plots. Estimates of species composition determined by using the new method were most similar to those obtained by using estimates of aboveground biomass. Within each 141-m^2 area sampled with a 21.3-m fish seine, we accurately estimated seagrass cover ratio and species composition with six observations that typically required less than 6 total minutes. Within such areas, 42 trials were conducted to evaluate the precision with which different observers estimated seagrass cover ratio and species composition. In 98% of the trials, observers attained statistically similar estimates of cover ratio, and in 100% of the trials in areas with multiple seagrass species, observers attained statistically similar estimates of species composition. We conclude that the new method provided efficient and reasonably accurate means to quantify seagrass cover and species composition.

Introduction

Seagrass meadows provide critical spawning, nursery, and refuge habitats for a wide variety of fishes and crustaceans (Bell and Pollard 1989; Heise and Bortone 1999). Ample evidence exists showing that fish assemblages found in seagrass communities differ from those found in other estuarine habitats (Weinstein and Brooks 1983; Blaber et al. 1989; Sogard and Able 1991; Jenkins et al. 1997; Tuckey and DeHaven 2006). Fish species diversity, abundance, and production decrease in seagrass beds as canopy structure, percentage cover, shoot density, and biomass decrease (Hughes et al. 2002), principally because of the high level of refuge that seagrass beds offer fishes (Stoner 1982; Edgar and Shaw 1995; Heise and Bortone 1999).

Species composition of seagrass meadows also affects fish assemblages and survival of juveniles. A decrease in seagrass bed complexity has been shown to shift fish assemblages from benthic species to pelagic species (Wyda et al. 2002). Monospecific seagrass beds will often support different fish assemblages than will adjacent monotypic beds of another seagrass species (Martin and Cooper 1981; Jenkins et al. 1997). Newly settled *Sciaenops ocellatus* (red drum) recruits have greater abundance in monospecific beds of *Halodule wrightii* (shoal grass) than in beds of *Thalassia testudinum* (turtle grass) and increased survival in beds with greater percentage cover (Rooker and Holt 1997). Juveniles of species such as *Cynoscion nebulosus* (spotted seatrout) and *Lutjanus griseus* (gray snapper) are more abundant in beds with more than one seagrass species present (Chester and Thayer 1990).

The fisheries-independent monitoring (FIM) program at the Fish and Wildlife Research Institute (FWRI; formerly the Florida Marine Research Institute) of the Florida Fish and Wildlife Conservation Commission monitors nekton populations in estuaries throughout Florida (FWRI 2006). The principal gear used is a 3.2-mm mesh, 21.3-m long haul seine, which is deployed in water < 1.5 m deep. Sample locations are chosen using a stratified random sampling design, and the presence or absence of seagrass is one of the strata used. During 2005, 1,834 deployments were made with this gear, and 499 (27%) of those were over seagrasses (FWRI 2006).

The FIM program documents habitat characteristics at nekton collection sites. Accurately describing seagrass from above the water is difficult because of variations in factors such as water turbidity, tidal stage, time of day, and weather conditions. Standard methods of seagrass assessment, such as core sampling and using percentage cover estimates (Braun-Blanquet 1932; Mueller-Dombois and Ellenberg 1974), are impractical during nekton sampling because they are time consuming and require a diver. We developed

* Corresponding author; tele: 352/543-9200; fax: 352/543-6958; e-mail: Jered.Jackson@MyFWC.com

a new method that would accurately describe seagrass habitat encountered during FIM sampling without inhibiting the primary objective of monitoring fishery resources.

Typical FIM sampling trips are long and labor intensive. To ensure that the method would neither hinder nekton sampling nor exhaust field personnel, we established specific criteria for the procedure. The first criterion was that diving would not be required. The method also should incorporate an easily manageable apparatus and protocol, and the method had to be time efficient. The procedure had to allow its user to objectively and accurately describe a broad range of seagrass cover and approximate species composition. Here we present evidence for the accuracy and applicability of a procedure designed to quantify seagrass rapidly and objectively during nekton sampling in shallow water.

Materials and Methods

Apparatus

We used an aquascope to view substratum and seagrass from the surface. The aquascope, called the submerged aquatic vegetation tube or SAV tube, was constructed by affixing a Plexiglass lens to the bottom of a 10.2-cm diameter, 1.2-m long PVC tube. The lens was etched with a 6 × 6 cm grid system that consisted of nine 2 × 2 cm squares (Fig. 1). The lines of the grid were 0.8 mm wide. Two 1.3-cm diameter PVC legs were attached to the base of the tube and extended 25 cm beyond the lens to anchor the SAV tube to the substratum. At 20 cm beyond the lens, the legs were tagged with cable ties so that when the tube was placed vertically in the water, the ties stopped the legs from penetrating the substratum and maintained a consistent lens-to-substratum distance of 20 cm. Numerous trials showed that this distance allowed observers to view substratum in turbid water (Secchi disc measurement ≥ 0.3 m) without unnecessarily disturbing the seagrass.

Holding the SAV tube in place, an observer looked into the apparatus to view the substratum through the etched lens. Where lines on the grid intersected, 16 total grid intersections in a 4 × 4 array, the observer recorded how many of the 16 intersection points were superimposed directly above each species of seagrass. From these data, cover ratio and species composition were calculated. The number of grid points that intersected seagrass blades, divided by 16, represented the cover ratio for each sample, and for each site was calculated as,

$$\text{Cover ratio} = \frac{\sum P}{16 \times S}$$

where P = number of grid points that intersected

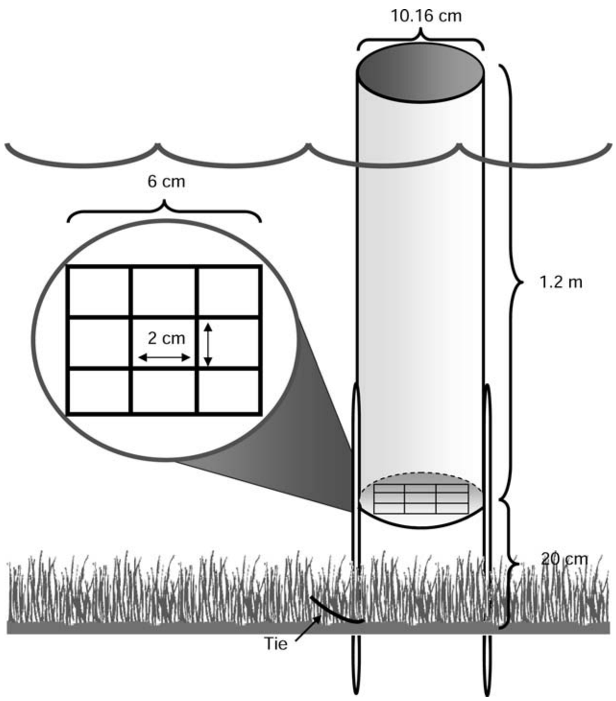

Fig. 1. Schematics of the submerged aquatic vegetation tube (SAV tube) and etched lens.

seagrass blades of all species in all samples at each site, and S = number of samples at each site.

This formula results in an exact cover ratio value between 0.00 and 1.00 (e.g., 0.52). Many researchers may prefer to present cover ratio results as ranges (e.g., 0.52 presented as 0.50–0.60).

The proportion of each seagrass species at a site was calculated as:

$$\text{Species composition} = \sum_{i=1}^{S} \frac{Gi}{Ai}$$

where S = number of samples at each site, i = sample observation, Gi = number of grid points that intersect seagrass blades of a given species in sample i, and Ai = number of grid points that intersect seagrass blades of all species in sample i.

Observers were instructed to follow five rules when making observations with the SAV tube. These rules were derived during preliminary tests of the method to help reduce overestimates of cover ratio and ensure that all species were included in species composition estimates. First, unless completely covered by vegetation, the substratum had to be visible through the lens. If this was not possible, the procedure was aborted. Second, a seagrass blade had to be directly beneath a grid point to be counted; blades closely adjacent to a grid point were not counted. Third, a single blade traversing multiple grid points along its length was to be recorded for each intersection. If two or more seagrass blades passed directly under the same grid point, only the uppermost seagrass blade was counted. Fourth, in cases of swaying seagrass blades, the observer focused on one grid point at a time and, on the count of two, determined if a seagrass blade was beneath the point at that instant. Finally, if a species was present in the viewing area but did not intersect any grid points, it was to be credited as having intersected a single grid point in the species composition formula, but not the cover ratio formula.

Accuracy Trials

Seagrass species encountered during our evaluations were *H. wrightii*, *Syringodium filiforme* (manatee grass), *T. testudinum*, and *Halophila engelmannii* (star grass). The green alga, *Caulerpa prolifera*, was also encountered and assessed. To determine if SAV tube cover ratio estimates could distinguish among different categories of seagrass cover, estimates were compared among 0.25-m^2 plots for which percentage cover categories were assigned by a diver using a 0.5 × 0.5 m quadrat (Braun-Blanquet 1932; Mueller-Dombois and Ellenberg 1974). Five percentage-cover categories were defined as: 1 = 0–5%, 2 = 6–25%, 3 = 26–50%, 4 = 51–75%, and 5 = 76–100%.

Each category was assigned to 6 plots apiece, resulting in a total of 30 plots that were examined. A diver first estimated percentage cover within a 0.25-m^2 plot. Not knowing the assigned category, a second participant then obtained an SAV tube cover ratio estimate at the center of that plot. To determine if mean SAV tube cover ratios differed significantly among percentage cover categories, F tests ($\alpha = 0.05$) were applied. For analysis, cover ratio data were arcsine-transformed to satisfy assumptions of normality and homogeneous variance. A Student-Newman-Keuls test was used to determine for which categories the mean cover ratio estimates were significantly different (Zar 1996).

Pearson's product-moment correlation was used to assess relationships between species-composition estimates derived from SAV tube cover-ratios and core-derived blade counts, shoot counts, and above-ground biomasses (Zar 1996). We performed two correlations, one using data from five replicate 0.25-m^2 plots consisting of *S. filiforme* and *T. testudinum* and one using data from five replicate 0.25-m^2 plots consisting of *H. wrightii*, *H. engelmannii*, *S. filiforme*, and *C. prolifera*. These data were based upon average cover-ratios, blade counts, shoot counts, and above-ground biomasses derived from five SAV tube estimates and five core samples within each of the plots. The coring sampler included seagrass shoots that originated only within the area of the core whereas, due to current, the SAV tube also often included seagrass blades that originated outside the viewing area. Five samples with the SAV tube and coring sampler were therefore made within the 0.25 m^2 plots to reduce species bias created by the length and alignment of sampled seagrass blades.

Seagrass cores were washed in a mesh bag to remove sediment and labeled for transport to the laboratory, where seagrass blades and shoots were counted by species. Blades and shoots of each species from each core were separated from their rhizomes, scraped of epiphytes and detritus, and dried in a drying oven at 60°C until constant weights were achieved (Creed 1999; Raposa and Oviatt 2000). When dry, seagrass was weighed to obtain the above-ground dry biomass (g dw 81 cm^{-2}) of individual seagrass species from each of the five cores.

Sample Size in a Fished Area

Using the SAV tube, we evaluated seven areas of different percentage cover and species composition characteristics in order to determine the minimum number of samples necessary to describe seagrasses within the area fished by the 21.3-m haul seine (141 m^2; 9.1 × 15.5 m) during standard FIM deployments. Seagrass densities in these areas ranged from relatively homogeneous to extremely heterogeneous. One hundred SAV tube observations were made in each of the seven areas. An actual mean cover ratio of seagrass in each area was determined from the 100 observations. For each of the seven data sets, a bootstrap procedure was performed in which subsamples ($n = 1$–12) were randomly selected from the 100 observations without replacement, and average cover ratio estimates were calculated from the subsamples. This was done 100 times for each value of n (Proc Surveyselect; SAS 1989). So that we could complement nekton collections with habitat data as rapidly as possible, we considered an acceptable level of accuracy to be a subsample estimate that was within 0.10 of the actual mean seagrass cover ratio at least 80% of the time. On the basis of this criterion, in all but one case, six samples were deemed sufficiently accurate and time efficient for evaluating cover ratio within the fished area (Fig. 2). Six samples were used to evaluate the reliability of observations made via the SAV tube by different personnel in a fished area (see next section).

Precision Trials

Having evaluated sample size requirements in a standard FIM collection area, we sought to determine if the method would give multiple users

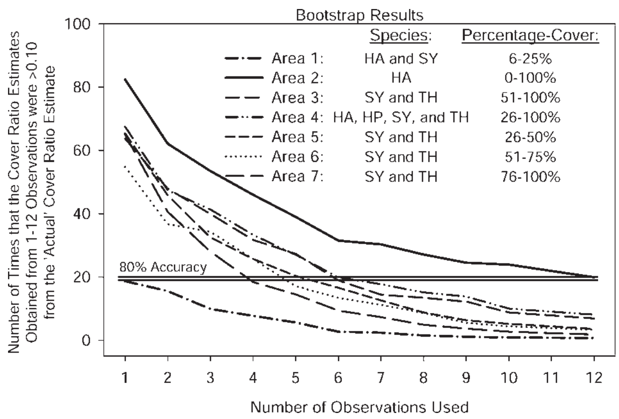

Fig. 2. The number of times, out of 100, that average cover ratio estimates obtained during 1–12 observations in seven 141-m^2 sample areas were > 0.10 from the actual mean estimates. An acceptable number of observations was one for which derived cover ratio estimates were within 0.10 of the actual cover ratio estimates at least 80% of the time (80% Accuracy line). Assessments took place in seven sample areas, each described by seagrass species present and range in percentage cover based upon six replicate 0.25 m^2 quadrats. HA = *Halodule wrightii*, HP = *Halophila engelmannii*, SY = *Syringodium filiforme*, TH = *Thalassia testudinum*.

statistically similar results. Observers new to the method participated in a standardization procedure prior to performing any repetitions. During standardization, rules for viewing the grid were discussed. The SAV tube was placed over seagrass and all participants took turns looking into the tube and independently counting seagrass blades that intersected grid points. Their counts were compared and, if all counts differed by three or fewer, the trial proceeded. If the difference was four or greater, the rules were discussed again and the standardization procedure was repeated over a different area of seagrass. Successful standardization was generally accomplished within two repetitions.

To determine the degree of expertise needed to implement the procedure, we included participants who had various levels of SAV tube experience. To test between-observer precision, 20 trials were conducted between July and October 2004 in the seagrass beds of the Suwannee River estuary near Cedar Key, Florida (29°9′N, 83°5′W). These trials took place in seagrass beds with various levels of patchiness, density, and species composition. Two observers each completed four replicate assessments of six observations within a 141-m^2 nekton sampling area. Observation points were chosen in a stratified random manner by blindly tossing a tethered bobber six times within the rectangular sampling area with three observations per half, at least one observation per quadrant. Each toss was made from the previous observation point. To determine if the estimates for mean cover ratios and species compositions differed between observers in each trial, F tests ($\alpha = 0.05$) were applied. To reduce the probability of Type I error, we used Bonferroni correction, which yielded new alphas of 0.0025 for cover ratio comparisons and 0.0038 for species composition comparisons (13 of 20 trials; Zar 1996). To verify that between-observer cover ratio estimates were accurate as well as precise, four 0.25-m^2 quadrats were tossed within the sample area, once in each quadrant, and percentage cover categories were assigned using the previously described ranges. An overall percentage cover category was calculated from the four assessments and the ranges were appropriately adjusted. For example, if the assessments included three category 3s and one category 4, then the category 3 range (26–50%) was increased a quarter range (6 units) higher to become 31–56%; two category 3s and two category 4s resulted in an average percentage cover range of 37–62%, etc.

In addition to this formal evaluation of precision, data collected during the developmental phase of the SAV tube methodology in the Indian River Lagoon (28°10′N, 80°35′W), Charlotte Harbor (26°55′N, 82°3′W), and Suwannee River estuaries were also analyzed. These data represented 22 trials between December 2003 and March 2004. Because these trials were completed during the technique's developmental phase, the numbers of replicates and observation points varied but still provided valid insight into the consistency of the method among observers. In 17 of the trials, two or more observers conducted three replicates of four observations within a sample area. Four replicates of four observations were conducted in the other five trials. The four observation points were randomly chosen as previously described, except only one observation was made per quadrant. To determine if the estimates for mean cover ratios and species compositions differed between observers in each trial, F tests ($\alpha = 0.05$) were applied. To reduce the probability of Type I error, we used Bonferroni correction, which yielded new alphas of 0.0022 for cover ratio comparisons and 0.0056 for species composition estimates (9 of 22 trials; Zar 1996). Percentage cover categories were not assigned to the sample areas assessed during these preliminary trials, so cover ratio estimates were not validated for accuracy.

Results

Accuracy Trials

The SAV tube produced cover ratio estimates capable of distinguishing among all five categories of seagrass percentage cover in 0.25-m^2 plots

TABLE 1. Estimates of seagrass cover ratio (± 1 SD) in replicate (n = 6) 0.25-m² plots assigned one of five percentage cover categories. Average cover ratio estimates were significantly different between all percentage cover categories (α = 0.05).

	Percentage cover category				
	0–5%	6–25%	26–50%	51–75%	76–100%
Cover ratio	0.07 (0.05)	0.26 (0.18)	0.41 (0.13)	0.72 (0.09)	0.88 (0.08)

(analysis of variance, $F_{5,30} = 95.85$, $p < 0.001$; Table 1).

Average seagrass species compositions estimated by using the SAV tube in plots of mixed *S. filiforme* and *T. testudinum* correlated significantly with species composition estimates derived from aboveground biomass (Pearson's r > 0.91, p < 0.028), but not with species composition estimates derived from blade or shoot counts (Pearson's r < 0.77, p > 0.131; Table 2). The species composition estimates derived via the SAV tube in plots of mixed *H. wrightii*, *H. engelmannii*, *S. filiforme*, and *C. prolifera* were not consistently correlated with any of the core-derived parameter estimates (Table 3). For the two combinations of seagrass species, and regardless of correlations, the average differences among estimates of species composition were lowest between those calculated from cover ratio and aboveground biomass (Fig. 3).

Sample Size in a Fished Area

Six sample observations within a 141-m² sample area were sufficient to accurately characterize seagrass abundance in all trial seagrass beds with the exception of Sample Area 2 (Fig. 2). The time required to complete the six observations depended upon the degree of suspended sediment, epiphyte cover, and water current but was typically less than 6 minutes. Percentage cover in Area 2 was the most heterogenous, spanning all five possible percentage cover categories and representing a worst-case scenario for making an accurate estimate. Even then, six observations still resulted in an estimate that was within 0.10 of the actual cover ratio more than 70% of the time.

Precision Trials

Eight observers participated in the 20 formal precision trials within the Suwannee River estuary. Estimated mean cover ratios differed significantly between observers in one of the trials. Estimated species compositions did not differ significantly between observers in any of the 13 trials conducted in sample areas with multiple species. Observer's cover ratio estimates fell outside the validating percentage cover range in only two trials, both of which occurred in seagrass beds of 100% *H. wrightii* composition.

Ten observers participated in the 22 preliminary precision trials in the Indian River Lagoon, Charlotte Harbor, and Suwannee River estuary. Estimated mean cover ratios were not significantly different between observers in any of these trials. Estimated species compositions did not differ significantly between observers in any of the 9 trials conducted in sample areas with multiple seagrass species. Combining both sets of trials, cover ratio estimates were statistically similar between observers in 98% of the 42 trials, and species composition estimates were statistically similar between observers in 100% of the trials. In 23 of the 35 trials that involved observers with different levels of experience, less experienced observers reported higher mean cover ratio estimates than their more experienced counterparts.

Discussion

Point-intersect is an established method of quantifying cover in ecological studies, and has long been used to describe communities as diverse as forests, grasslands, and coral reefs (Kent and Coker 1992; English et al. 1994; Rogers et al. 1994; Belnap et al. 2001; Segal and Castro 2001). The point-intersect method used here is similar to one developed more than 50 years ago for estimating arboreal crown cover (Garrison 1949), which is still used in forestry research (Brown et al. 2000; Englund et al. 2000; Brosofske et al. 2001).

TABLE 2. Correlation matrices of mean species composition estimates derived from cover ratio, blade count, shoot count, and aboveground biomass in mixed 0.25-m² seagrass plots of two species using Pearson's product-moment correlation coefficient (r) above the diagonal and Fisher's r to p below the diagonal. Asterisks (*) denote significant correlations (α = 0.05).

	Syringodium filiforme and *Thalassia testudinum*			
	Cover ratio	Blade count	Shoot count	Aboveground biomass
Cover ratio	1	0.77	0.62	0.92
Blade count	0.13	1	0.94	0.94
Shoot count	0.27	0.02*	1	0.80
Aboveground biomass	0.03*	0.02*	0.11	1

TABLE 3. Correlation matrices of mean species-composition estimates derived from cover-ratio, blade count, shoot count, and aboveground biomass in mixed 0.25-m^2 seagrass plots of four species using Pearson's product-moment correlation coefficient (r) above the diagonal and Fisher's r to p below the diagonal. Asterisks (*) denote significant correlations ($\alpha = 0.05$).

	Cover ratio	Blade count	Shoot count	Aboveground biomass
Syringodium filiforme				
Cover ratio	1	0.94	0.95	0.93
Blade count	0.02*	1	0.99	0.99
Shoot count	0.01*	0.01*	1	0.99
Aboveground biomass	0.02*	0.01*	0.01*	1
Halodule wrightii				
Cover ratio	1	0.94	0.82	0.82
Blade count	0.02*	1	0.95	0.92
Shoot count	0.09	0.01*	1	0.98
Aboveground biomass	0.09	0.03*	0.01*	1
Halophila engelmannii				
Cover ratio	1	0.78	0.75	0.77
Blade count	0.12	1	0.99	0.99
Shoot count	0.14	0.01*	1	0.99
Aboveground biomass	0.12	0.01*	0.01*	1
Caulerpa prolifera				
Cover ratio	1	0.42	0.54	0.72
Blade count		1	0.98	0.91
Shoot count	0.35	0.01*	1	0.97
Aboveground biomass	0.17	0.03*	0.01*	1

The area that could be viewed through the SAV tube (81 cm^2) was an important consideration, and we adhered to the general rule that all species present in a sampled area should be sufficiently represented in the sample (Mueller-Dombois and Ellenberg 1974; Barbour et al. 1999). Seagrass beds are usually homospecific, and we never encountered more than four species within a single sample area (141-m^2 area; 9.1 × 15.5 m) during any trial. All of the seagrass species present could be simultaneously observed within the SAV tube's 81-cm^2 viewing area. During multiple-observer precision trials, we never encountered an instance when a seagrass species was observed by a diver using the validating percentage cover quadrat but was not observed by an observer using the SAV tube.

The trials described in this paper demonstrate that the SAV tube allowed observers, in a timely

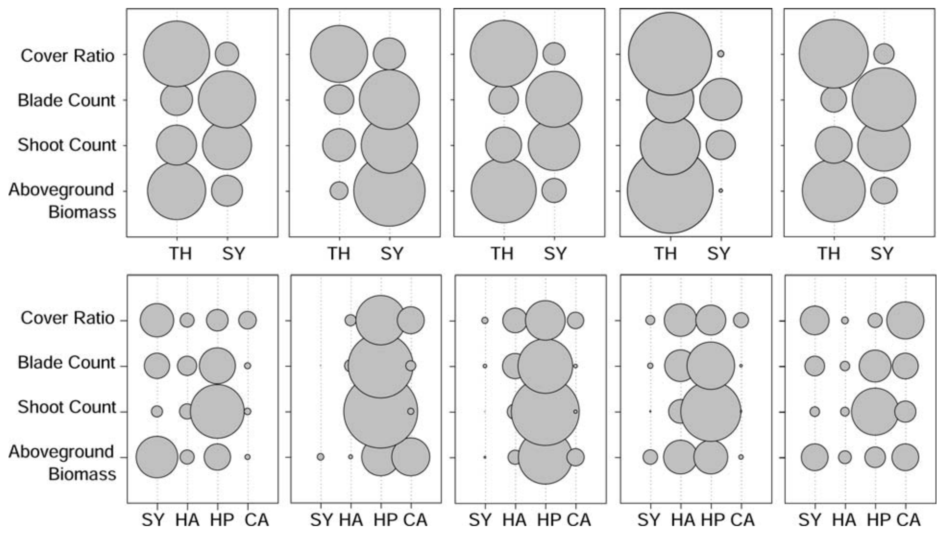

Fig. 3. Bubble volumes representing percent species-composition of five plots of *Syringodium filiforme* (SY) and *Thalassia testudinum* (TH); and five plots of *Caulerpa prolifera* (CA), *Halophila engelmannii* (HP), *Halodule wrightii* (HA), and *Syringodium filiforme* (SY) derived from estimates of cover ratio, blade count, shoot count, and aboveground biomass. Within each of the ten plots, each row of bubbles sums to 100% composition.

manner, to determine reasonably accurate estimates of seagrass coverage to enhance data collected during nekton sampling. Within 0.25-m^2 plots, cover ratio estimates derived via the SAV tube clearly distinguished among five predefined percentage cover categories (Table 1).

In mixed seagrass plots of *T. testudinum* and *S. filiforme*, species composition estimates derived from cover ratios were significantly correlated only with those derived from aboveground biomass (Table 2). In mixed plots of *T. testudinum* and *S. filiforme*, as well as in plots of *S. filiforme*, *H. wrightii*, *H. engelmannii*, and *C. prolifera*, the average species composition estimates derived from cover ratio were most similar to those derived from aboveground biomass. The similarity between these two variables is evident in Fig. 3, and was equaled only by the predictably high similarity between estimates derived from blade and shoot counts. Per shoot, larger seagrass species cover more area than do smaller species, thereby intersecting a greater proportion of SAV tube grid points than smaller species of equal density. Species composition estimates based upon biomass therefore would be more similar to those derived from cover ratio than would estimates based upon blade or shoot counts. Pending further evaluation, it is conceivable that species composition estimates derived from the SAV tube may provide an acceptable and time efficient surrogate for estimates derived from aboveground biomass measurements.

Based upon the trials in our study, six stratified-random observations in a standard FIM 141-m^2 sample area effectively allowed variations in seagrass cover and species composition to be accurately detected. One criticism of using six observation sites within such a sampled area is that patchiness would not be adequately assessed. We suggest that if patchiness was an objective for assessment, it could quickly and easily be evaluated by using the SAV tube to make multiple observations in a grid-like pattern across the fished area. Frequency of seagrass occurrence could be calculated by dividing the number of observations that included seagrasses by the total number of observations made.

The procedure involving the SAV tube was simple to teach, simple to use, and produced objectively accurate results regardless of the observer's experience. The observers involved during the precision trials ranged in experience from those with complete procedural naivety, including one trial that included two juveniles ages 11 and 14, to those who had exhaustive experience with the apparatus. For the one trial in which cover ratio estimates differed significantly, the actual mean cover ratio estimates differed by only 0.10. The maximum difference in mean cover ratio estimates was 0.17. The only two trials in which the observers' cover ratio estimates were shown to fall outside the validating percentage cover range occurred in two sample areas composed entirely of *H. wrightii*. In both cases, the observers overestimated *H. wrightii* cover.

Combining the formal and preliminary precision trials ($n=42$), 22 trials occurred in sample areas with multiple seagrass species. There were no trials for which species composition differed significantly, although there were a few wide discrepancies in some observers' estimates. It appeared that the largest discrepancies occurred when *H. wrightii* and *S. filiforme* were both present. We noticed that when *H. wrightii* and *S. filiforme* blades became densely covered with epiphytes, the two species' blades looked quite similar. This may have resulted in occasional misidentifications and inaccurate composition estimates. In 13 of the 22 trials that included multiple species, the observers obtained species composition estimates that were within at least 10 percentiles of each other.

During testing, the only condition that prohibited the use of the SAV tube was extreme turbidity that prevented seeing the substratum. Turbidity was usually localized, created by fine sediment or epiphytes suspended as the observer approached an observation point. In nearly all such cases, this turbidity was associated with lack of water current and lingered for such duration that it became unreasonable to wait for acceptable water clarity.

We encountered two scenarios that challenged the reliability of estimates derived from the SAV tube. The first occurred when the blades of one seagrass species were of sufficient height and width to completely cover those of another species at an observation site, causing the observer's estimate to underrepresent the covered species. One such occasion resulted in the oversight of sporadic *H. engelmannii* when other taller species were densely present. *H. engelmannii* was similarly unnoticed by the standard percentage cover procedure in this case and was detected only in cores. The second scenario occurred when short blades of *H. wrightii* and *S. filiforme* were both covered with dense epiphytes, making it difficult to distinguish the two species. This problem may also be extrapolated to other morphologically similar seagrasses.

This new apparatus and protocol provide accurate, objective, consistent, rapid, and inexpensive means for quantifying seagrass coverage and species composition. The method demonstrated great potential for describing key seagrass variables that would complement other data gathered during nekton sampling. While this paper presents support for its specific use in quickly estimating seagrass cover and species composition during fish monitoring, the procedure possesses inherent versatility for implementation in a wide variety of applications.

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