# DEVELOPMENT OF WATER TRANSPARENCY CRITERIA FOR FLORIDA SEAGRASSES

*The Florida Department of Environmental Protection (DEP) is developing a new transparency standard for marine waters that will protect the seagrass species found throughout the state. The current transparency standard does not sufficiently protect seagrasses, and the new standard will help DEP identify waters in which transparency is too low for healthy seagrass beds. A workshop of experts was convened by DEP to determine what factors affect light in seagrass beds, and what transparency criteria have already been established for individual systems. This newsletter summarizes that workshop and discusses how DEP will use this knowledge to set transparency criteria for seagrasses in Florida.*

The objective of the workshop was for experts in seagrasses and water clarity to provide recommendations to DEP about how to make the criteria practical, scientifically justified, and protective of seagrasses in Florida.

Practical: Robust, economically feasible, and sustainable.
Scientifically justified: Consensus-based, use relevant expertise and data, and document methodology and results.
Protective: Multiple seagrass species, habitat value, wide spatial and temporal distribution.

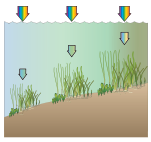
## Conclusions

## Recommendations

There are regional differences in species, species light requirements, and light attenuation processes. Each region has specific factors (e.g., salinity, sediment type, rainfall patterns, and freshwater influence) that determine seagrass distribution and light requirements (Figure 1).

Transparency criteria should be applied to regionally defined areas that have similar characteristics. Three major characteristics should be dominant seagrass species, major light attenuation components (e.g., turbidity, color, epiphyte load), and data and monitoring availability.

Some minimum amount of light must reach the seagrasses, and penetrate the epiphyte layer, to support seagrass communities. Once the light requirement for the predominant seagrass species is established, a goal for the depth at which that species should be present needs to be established.



Numeric transparency criteria based on depth goals for seagrasses would strengthen protection, although a strong narrative standard may be more appropriate. Numeric criteria should be developed in regions with sufficient data for the determination of depth goals and light requirements.

Mapping and monitoring are critical for the assessment of seagrass habitat. The Florida Fish and Wildlife Conservation Commission, DEP, and Water Management Districts are mapping and monitoring on a regular schedule throughout the state.

Assessment of current monitoring efforts is needed to determine where criteria can currently be developed. Compliance monitoring must occur over several years and at a sufficient spatial and temporal scale within each year to capture variability. Impairment should not be determined based on a single year of data.

Currently, there are transparency goals and monitoring programs to protect seagrasses in some systems. Sufficient data were collected and analyzed to determine light and transparency targets for the predominant species. Seagrass abundance or depth goals were then established based on "minimally disturbed" or historic conditions.


Regions with established transparency goals will serve as models for DEP in its efforts to develop criteria for other regions. With help from regional managers and stakeholders, DEP will determine regional light requirements and goals, and appropriate compliance monitoring.

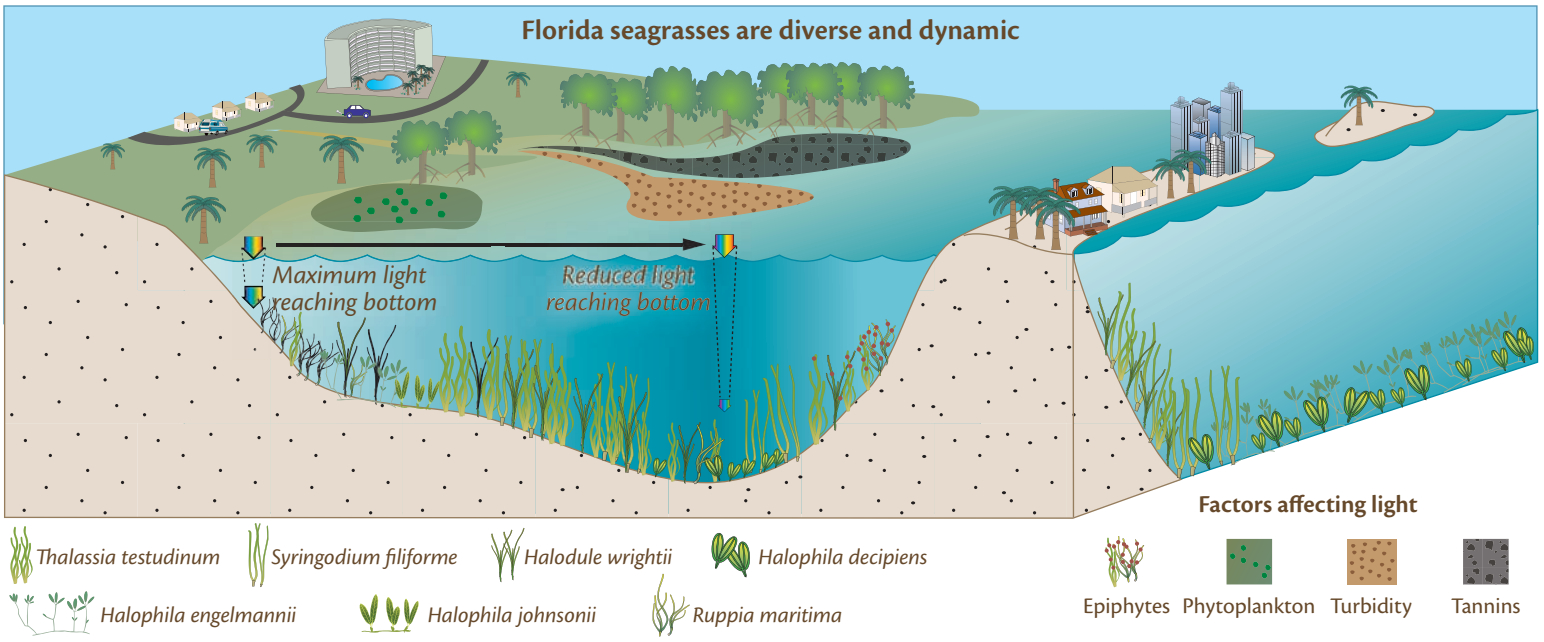



Figure 1: Seagrasses in Florida are diverse and dynamic. They are influenced by the amount of light they receive and the factors affecting light.

# REGIONAL DIFFERENCES AMONG SYSTEMS

Various factors influence the expected water clarity regime in marine waters around Florida. The amount and frequency of freshwater inputs and residence time, as well as nutrient and particulate loads that rivers carry, vary naturally around the state and influence the light regime under which seagrasses live. Some estuaries receive high levels of dissolved organic matter and/or nutrients from rivers (e.g., Apalachicola Bay, Tampa Bay), whereas other coastal areas receive relatively little freshwater inputs or water low in color or particulates (e.g., Biscayne Bay, Springs Coast). Some lagoons have a shallow and long morphology that causes frequent episodes of high turbidity and potential resuspension (e.g., Indian River Lagoon). Due to these regional differences in seagrass community composition, water quality constituents, and data and monitoring availability, it would not be appropriate or protective for the Florida DEP to set a single transparency criterion for the entire state of Florida. The best way to determine appropriate criteria for each area is to derive it from data collected in that region; if data are not available for that region, surrogate data from an area with similar characteristics could be used. General system characteristics, seagrass distribution, and light data can be compared to determine if criteria from one region can easily be transferred to another.

Based on dominant species, major influences on water clarity, dominant sediment type, and current data availability, DEP has divided Florida seagrass areas into seven preliminary regions (Figure 2). Some of the regions cover a large geographic area, and will need to be sub-divided in the future. Sub-divisions will likely be due to river versus oceanic influence, residence time for enclosed coastal water bodies, or differences in seagrass light requirements due to factors such as epiphyte abundance. If data are not available for one region, but are available for regions with similar characteristics, then these regions might be combined for the purpose of criteria development. Future refinement may be necessary for areas that are currently lacking data.


Duke University

Scientists monitoring seagrass beds in Florida Bay.

One thing to always keep in mind is that there is a large range of light requirements and characteristics of seagrasses. For example, *Thalassia testudinum* is a climax species with higher light requirements than *Halodule wrightii* and *Syringodium filiforme*, while *Halophila decipiens* is opportunistic. *Ruppia maritima* is part of the community but often overlooked as a seagrass because it occurs in lower salinity waters than true marine species. However, in some areas it will not be as ephemeral as the *Halophila* species, and therefore, may need to be incorporated into regionally specific guidelines.

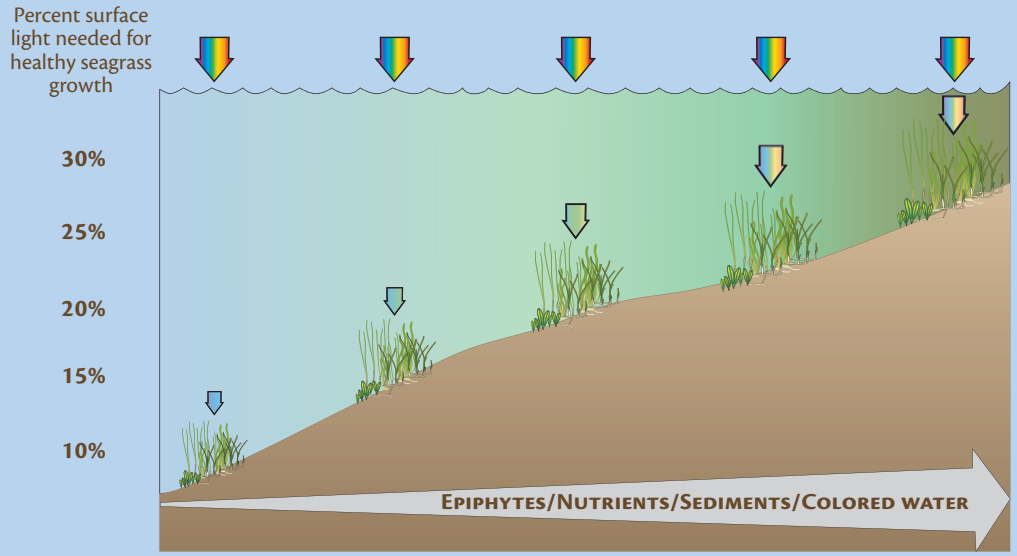
> *Syringodium filiforme* > *Halophila engelmanii*
- Colored water and chlorophyll *a* are major influences, epiphytes abundant, silicious sediments
- Goals and criteria developed for Tampa Bay and Charlotte Harbor, with refinement ongoing; data available for other areas. Tampa Bay and Charlotte Harbor possible sub-regions.

**4. 10,000 Islands region**
- *Halodule wrightii* ≥ *Thalassia testudinum* > *Halophila engelmanii*
- Turbid coastal environment with strong seasonal (wet vs dry) differences, silicious sediments
- Surveys currently underway to determine light and seagrass parameters

- Large amount of basic data and mapping, needs analysis and criteria

**6. Southeast Coast region**
- *Halodule wrightii* ≥ *Syringodium filiforme* > *Thalassia testudinum*
- High turbidity, some color from rivers, silicious sediments
- Goals and criteria developed for Indian River Lagoon, depth goals set for Lake Worth Lagoon

**7. Offshore deepwater region**
- *Halophila decipiens* = *Halophila engelmanii*
- Depth = 10–20 meters, mixture of silicious and carbonate sediments
- Need basic seagrass mapping and light data



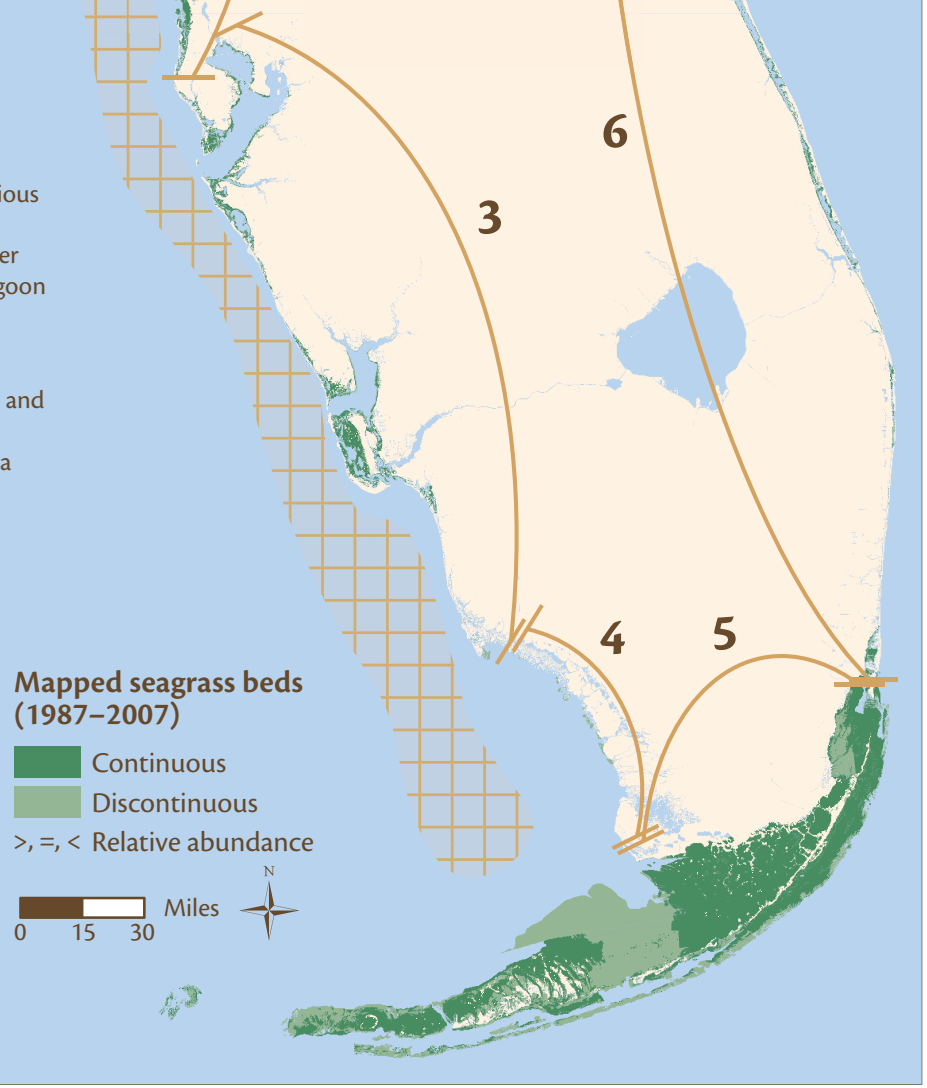




Figure 2: Florida's coast was divided into regions, based on seagrass species, physical characteristics, and current monitoring and criteria efforts. The seven regions may need to be divided into sub-regions, if high variability in characteristics are found. The diagram (inset) describes how physical characteristics diminish light to seagrasses, and therefore that seagrasses need a higher percentage of light when stressed by these parameters. Seagrass cover data provided by Florida Fish and Wildlife Research Institute.

## Well-developed monitoring programs with water transparency criteria

Resource managers in Tampa Bay recognized that seagrass populations were declining, and they were able to attribute the decline to reduced water clarity caused by excessive nitrogen loads that caused high chlorophyll *a* concentrations. The Tampa Bay Estuary Program (TBEP) established a goal for seagrass in the bay to be restored to 95% of levels estimated in the 1950's. To maintain *Thalassia testudinum* shoot density and biomass at the deepest edge of seagrass beds in Lower Tampa Bay, 20.5% of incident light is required. Based on that light requirement, transparency criteria have been set for five areas of Tampa Bay that differ in the amount and character of their freshwater input. Compliance depth varies among these areas in accordance with the *Thalassia* depth goals appropriate for each area. The goals and criteria were developed with full stakeholder involvement, and the TBEP annually reports monitoring results and progress toward restoration goals.

The St. Johns River Water Management District (SJRWMD) has been monitoring light and seagrasses in the Indian River Lagoon for decades. They sub-divided the lagoon into sub-lagoons and segments of similar salinity and turbidity regimes, and then established study plots within each sub-lagoon of seagrass beds that have been the most stable over 50 years. Data from these plots showed that an annual average of 20% ± 14% of subsurface light was necessary to maintain the deep edge of seagrass beds. Managers at the SJRWMD established water transparency criteria based on that light requirement and depth goals appropriate for each segment, and this criteria development has been peer-reviewed and widely seen as a successful effort.

# MONITORING LIGHT FOR CRITERIA COMPLIANCE

Compliance monitoring guidelines have not yet been established by Florida DEP. Several programs have already established monitoring protocols that can be adjusted to include monitoring for compliance. The following are considerations for future development of criteria compliance, based on workshop consensus.

***How***

Criteria compliance will be determined with light sensors. The relationship between Secchi depth and light attenuation is variable among regions, so light sensor measurements are preferred over Secchi depth. There are various types of light sensors and measurements that can be made. Differences among methods would have to be considered to determine that results are comparable and appropriate for compliance monitoring, but DEP would ultimately strive to use any existing data and methodology for compliance and would not want to hamper existing monitoring efforts. The following considerations were discussed at the workshop:

- Ideally, measurements should be made mid-day on clear days.
- Adjustments should be made for changes in light between measurements, by concurrent measurements by a deck sensor or a second subsurface sensor.
- Spherical ($4\pi$) sensors measure all light, whereas cosine ($2\pi$) sensors measure only down-welling light. In some regions, measurements by these two types of sensors are comparable, but in other regions, they can differ by up to 20%. Compliance monitoring should be conducted with the same type of sensors with which the criteria were developed. Compliance data collected by other methods will have to be evaluated in context.
- Possibly include a check of seagrass presence at target depths, as part of compliance monitoring.

***Where***

- Compliance will be measured at some depth in the water column and may or may not be measured over existing seagrass beds. Depths too shallow for PAR measurements will use an alternative method.
- Criteria will protect the dominant species in marine portions of Florida's waters, so compliance should be measured in areas with dominant species in marine (>15 ppt) portions of Florida waters. There can be great intra- and inter-annual variability in salinity, especially in estuaries, and light-controlling factors (e.g., water color, turbidity) can vary with salinity. DEP and stakeholders will determine an appropriate means of addressing this factor.
- DEP and regional managers will have to determine a minimum number of and area covered by sampling points for compliance.

***When***

- At a minimum, monthly sampling will be necessary to capture intra-annual variability and to assess the total amount of light seagrasses receive throughout each year.
- Light availability can change greatly based on rainfall and storm strength and frequency. Compliance will not be based on one year of data alone, but rather on several years of data, with assessment details yet to be determined.

If waterbodies are deemed to be impaired for light, based on criteria and compliance monitoring guidelines, then the pollutant will have to be determined and addressed, according to the Impaired Waters Rule (IWR). Furthermore, the new water transparency criteria does not replace the conditions in the IWR in which a waterbody can be deemed impaired due to loss of seagrasses.

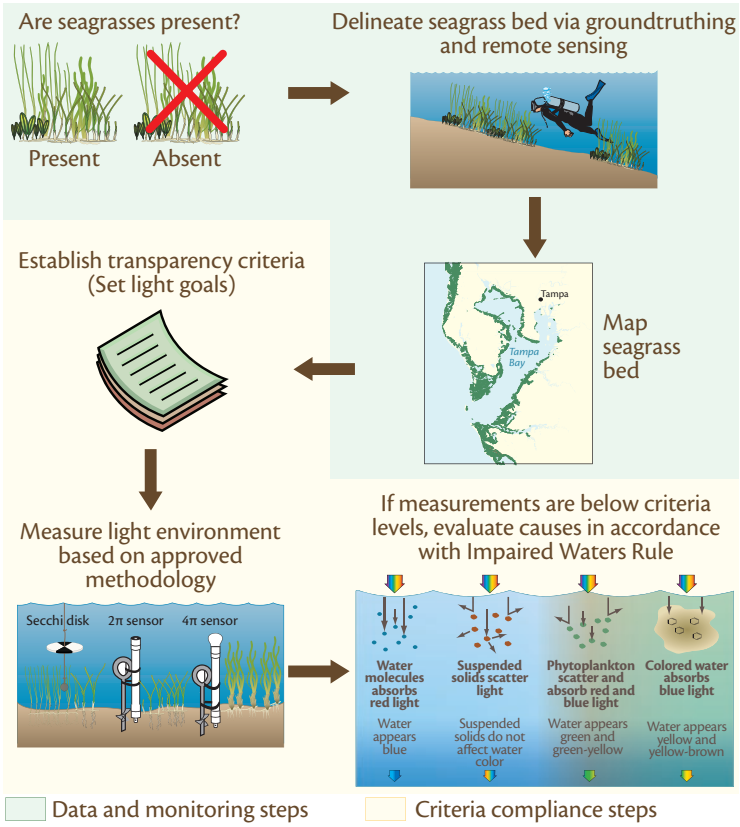



Figure 3: Decision tree incorporating monitoring data, transparency criteria, and management decisions.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