Evaluation of the Effectiveness of SAV Restoration Approaches in the Chesapeake Bay

Response to a program review requested of STAC by the SAV Workgroup

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Brief Background On Review

- Baywide SAV goal of 185,000 acres
- Primarily achieved through water quality improvements
- *Strategy to Accelerate the Protection and Restoration of Submerged Aquatic Vegetation in the Chesapeake Bay* called for 1,000 acres of **DIRECT** restoration to augment or "kick-start" recovery

Brief programmatic results

- **We met 15% of our direct restoration goal (~150 acres) from 2003 to 2008**
  - **No long-term survival in most areas**
  - **Good survival in the Potomac, 2004 to 2010**
  - **Some excellent long-term survival in areas from plantings prior to the 2003 to 2008 time**
    - **James and York Rivers, 1990s to present**
    - **Long Creek (near mouth of Back River, MD), 1998 to present**
    - **Shallow Creek (near mouth of Patapsco River), 1999 to present**

Request to STAC

The SAV workgroup requested a review through STAC, who established a Review Committee. STAC defined the following needs which were accepted by the RC:

1. **Develop criteria to define *successful* direct SAV restoration over short- and long- timeframes.**

2. **Evaluate the effectiveness of direct restoration to accelerate SAV recovery and protection through activities like seeding and transplanting.**

3. **Provide guidance on the desirability of continuing to employ direct SAV restoration and, if appropriate, how to improve its cost-effectiveness, probability of success, and potential for improved scientific understanding**

Members of the Review Panel

STAC Members:

- **Mark Luckenbach, Eastern Shore Laboratory, Virginia Institute of Marine Science**
- **Lisa Wainger, Chesapeake Biological Laboratory, University of Maryland**
- **Don Weller, Smithsonian Environmental Research Center, Smithsonian Institution**

Non-STAC Members (RC):

- **Susan Bell, Department of Integrative Biology, University of South Florida**
- **Mark Fonseca, National Ocean Service, NOAA**
- **Ken Heck, Dauphin Island Sea Lab, University of South Alabama**
- **Hilary Neckles, Patuxent Wildlife Research Center, USGS**
- **Mike Smart, Research and Development Center, USACOE**
- **Chris Pickerell, Cornell Cooperative Extension of Suffolk County**

Evaluation of success was broken into different components

- Operational success;
  - Acres planted
- Functional success
  - Sustainability of restored beds
  - SAV reproduction
  - provision of fish and shellfish habitat
  - water quality improvement capacity (e.g., filtering by seagrass) , and wave attenuation.
- Programmatic success
  - successful implementation of adaptive management
    - knowledge gained from monitoring applied to management outcomes
    - implementation of an iterative process that feeds this knowledge back into management decisions.

Results from RC

- **Operationally successful**
  - **Acres planted commensurate with funding**
- **Functionally UNsuccessful**
  - **Majority of planted areas did not persist**
    - **Exceptions in the James, York and Potomac Rivers**
- **Programmatically a mixed bag**
  - **A tremendous amount of knowledge was gained**
  - **Some adaptive management applied**
  - **Room for improvement in AM.**

Recommendations

1. **Discontinue efforts aimed at widespread direct restoration of SAV until environmental conditions improve**
2. **Continue targeted restoration efforts, both to establish viable beds and to further understand site selection criteria**
3. **Develop SAV restoration strategies that are responsive to climate change**
4. **Incorporate full adaptive management into restoration decision making**
5. **Build on the successful research into restoration techniques**

SAV Workgroup Response

- Yep

Ok, a little more detail

We concur with the RC's findings using the "operational, functional and programmatic" evaluations

1. We developed the capacity to perform restoration on the scale of 10's of hectares per year
2. There was low persistence in planted areas (<10% of sites), although there was some long-term (>5 years) persistence and expansion in a few locations
3. The program produced numerous technical notes and peer-reviewed articles that defined how to improve large-scale SAV restoration and identified key research needs
   - the SAVWG learned the difficulty in managing adaptively when it takes 3 to 5 years to assess success of restoration efforts whereas funding occurs on annual cycles

Outcomes from the Workgroup perspective

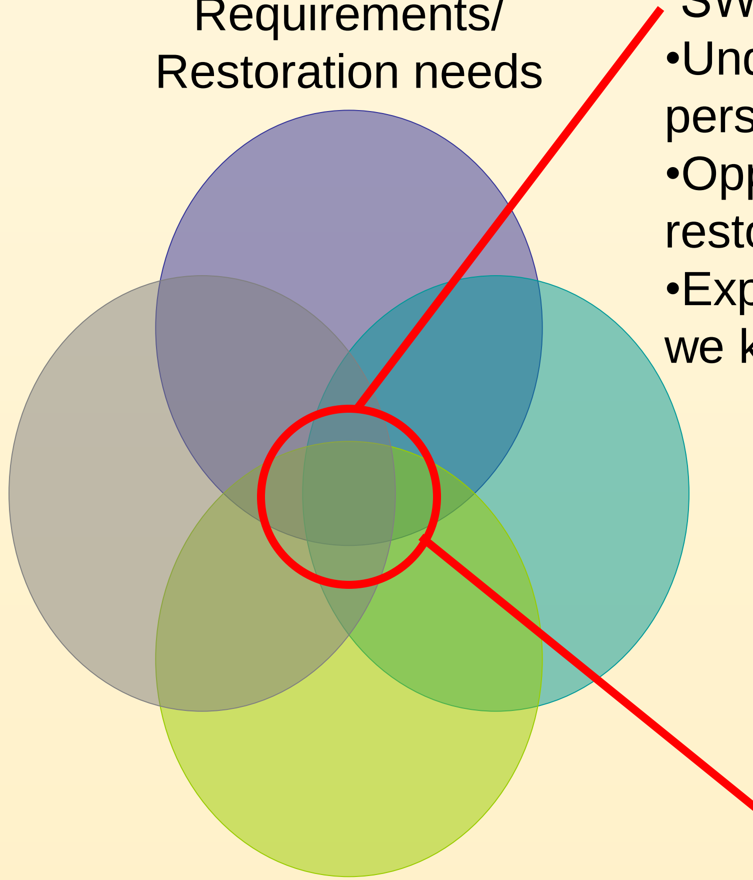
We feel that the below is a very relevant finding not only to our work, but to restoration in general

- **“Executive leadership and institutional structures should support iterations of restoration, evaluation, and learning that include flexibility to adjust restoration targets and reallocate efforts and funds as knowledge is gained.”**
- **This level of support was lacking in our original efforts, the short duration of funding didn’t allow for “closing the loop” on adaptive management or to transfer knowledge gained to other species**

Outcomes continued, knowledge needs ID'ed by the review

1. **Identifying the synergistic and cumulative effects on SAV of multiple stressors (temperature, salinity, turbidity, dissolved oxygen, sediments, waves and currents)**
2. **Quantifying SAV response to extreme events and habitat conditions**
3. **Determining SAV response to climate change**
4. **Developing SAV habitat requirements specific to restoration, by species and planting unit type (seed, whole plant, other propagule)**
5. **Examine the feedback effects of existing beds on physical and chemical SAV growth conditions**

Research Agenda framework



To break it out into specific research topics

- Multiple Stressors/Facilitators
  - SAV community had made a stab at this with the “Percent Light at Leaf” model which incorporated multiple water quality parameters
  - What are other synergistic parameters?
    - e.g. Temperature/turbidity/DO on eelgrass
    - Shoreline/watershed impacts
    - Freshets (increase turbidity, but can encourage germination (Ailstock))

- Extreme events
  - Most of our habitat requirements have dealt with chronic water quality conditions during the growing season
  - Develop thresholds for intensity and duration of extreme events
    - How fresh is too fresh for how long
    - Change “fresh” to “salty”, “hot”, “cold”, “turbid”
  - Can we predict or assign a probability to an extreme event?
  - Time-lags between the event and the biological response?
  - Critical periods (i.e TS Agnes in June, TS Lee in September)
- Influence of Global Change on these stressors (all the above; chronic, multiple and acute)
    - Heat bad for eelgrass, good for others?
    - Who is favored with inundation?

From the above, we hope to get to refined habitat requirements for SAV

- Explain observed patterns in abundance and communities
- Use in siting restoration projects
  - Physical habitat
  - Water quality
  - Difference between “Persistence habitat requirements” and “Restoration habitat requirements”
  - Influence of seed banks
  - Successional processes in restored beds

Quantify the ecosystem services provided by SAV (not part of the review conclusions)

- TMDL implications
- Fisheries/wildlife benefits
- Biogeochemical Processes
  - What happens to the biogeochemistry of an area when you gain (e. g. The Flats) or lose (Tangier Sound) SAV