PT 9/2012.

- "*Restore naturally reproducing brook trout populations in headwater streams by*
    - *improving 58 sub-watersheds from 'reduced" classification (10-50% habitat loss) to healthy (less than 10% of habitat loss)*
    - *by 2025*."

My thinking on revising the goal statement.

The original goal statement states habitat loss. The EBTJV document refers to reduced and intact with definitions of occupancy.

- Reduced means 50-90% inhabited in EBTJV text while the goal refers to reduced as 10-50% stated habitat loss.
- The implication may have been to be the same meaning but to me these are different statements.
    - You can have good habitat that is unoccupied because of accessibility reasons. Habitat loss suggests less than suitable conditions for growth and survival.
    - Similarly intact means >90% inhabited (EBTJV) but the goal states <10% of habitat loss).
    - I interpret the statement as being meant to reflect a need to increase area of occupancy by Brook Trout.

Back to the goal statement text: "…improving brook trout status in 58 subwatersheds by 2025." Let's bound the target for translation here.

- 58 subwatersheds is 10.7% of all reduced condition watersheds identified (N=542).
- 58 subwatersheds is 7.5% of all reduced + intact watersheds (N=542+266=768)
- Note, the sum of intact (226) + reduced (542) + extirpated (290) = 1058. If there are 1443 subwatersheds as stated in the Hudy white paper, this leaves 385 unclassified. Using the ratio of intact:reduced:extirpated (1:2.4:1.3) to estimate the condition distribution in the unclassified watersheds it would be 82 intact, 197 reduced and 117 extirpated.
    - Hypothetically, we now have 308 intact populations, 739 reduced, and 407 extirpated watersheds as the baseline for Chesapeake Bay basin.
    - 58 subwatersheds is now 7.8% of hypothetical reduced watersheds.
    - 58 subwatersheds is now 5.5% of hypothetical reduced + intact subwatersheds.
- So, no matter how you want to slice and dice it, we are talking about a window of change to target for enhancement as between 5.5 and 10.7% improvement in brook trout habitat.
    - Assumption – no loss of intact population acreage.
    - Assumption – the 58 subwatersheds represent a random sample of the universe of

reduced + intact condition watersheds and therefore have a similar average size as the total population (in a statistical sense) of subwatersheds. That allows us to use count as a rough translation to area or acreage.

- Therefore - Let's take the mid-point of all those targets and call it 8%.
  - Increase brook trout habitat acreage by 8% as the expectation for improvement.
    - Distribution matters less than total acres of occupancy, call it safeguarding for inevitable climate change impacts.
    - Distribution shifts are therefore allowable given the flexibility of the goal statement language.

- We can translate further using the patch metric as the goal basis now
  - Change goal language to
  - "…increase the patch area by 8% over the existing patch area by 2025 ."

So, some additional conversions using the basic information available in the Hudy et al overview provided:

- A translation to patches and catchments might look something like this:
  - Sustain/Maintain intact population patches area (patches defined as collection of occupied brook trout catchments per Hudy et al.)
  - Increase total patch acres 8% per the goal statement conversion -
    - According to the latest assessment, by some basic math manipulation of the available information, there should be 2.43 million acres of occupied brook trout catchments per the following statement: "In the Chesapeake Bay there are 868 patches of brook trout habitat with an average patch size of 2,800 ha" (Hudy et al.).
      1. (Acreage math: 868 patches X an avg patch of 2800 acres gives us 2.43M acres as the baseline).
         1. To bound the uncertainties here, if we want to jump ahead and estimate the unknown NY contribution, NY is about 10% (6250 mi2 of 64,000=9.7%) of the Chesapeake Bay watershed. If you want to add 10% to the baseline then a back of the envelope estimate of the Chesapeake Bay total acres of brook trout habitat (assuming NY has a similar habitat distribution to the rest of the basin on a % basis) is perhaps closer to 2.67M acres.
    - An 8% increase would be 213,600 additional acres of occupancy.
      1. With an average patch size of 2800 acres, you need the equivalent of 76 more patches of the same size by 2025 OR, since there are an average of 5.4 catchments per patch (4719 catchments allopatric + sympatric populations/868 patches), you need 410 new catchments as part of patches to be occupied (= 76 x 5.4).
         1. There are many metrics that can be tracked about the health of a catchment population
         2. The Management Board agreed to the Patch Metric.

3. Patch is a collection of contiguous occupied catchments
4. Therefore, ***total occupied acres as the sum of patch areas*** should be the tracking indicator.
    1. This metric, 'total occupied acres in patch areas' then lends itself to more detailed characterizations according to valued parameters to inform managers using genetic status assessments of population size, population persistence, age distribution, etc. within catchments and patches for as much detail as people want to put into refining the characteristics of patches.

- Over 10 years, the 213,600 acre goal amounts to a restoration rate of about
    1. 21,360 acres of habitat per year
    2. 7.6 patches with a total of 41 catchments per year in effort
    3. distributed over 5 states (WV, VA,MD, PA, NY), that's on average about 9 catchments and just over 1 patch restored per year per partner for 10 years to get to about 213,600 acres ahead of 2025.
        1. Just on the surface from having done stream stocking as one example that it seems like a manageable bite to efforts and budgets across the watershed. (In Maryland alone over 150 sites a year are stocked with trout for put-and-take purposes. We are talking about less than 10% of that sort of effort by comparison with one state in this system).
        2. With a mix of dam removals, transplanting, etc – again thinking this is a manageable bite site bit of targeting with these back of the envelope translation calculations.

Restatement – long form for the moment per PT and being real I think: ☺

Restore naturally reproducing brook trout populations with an 8% increase in total cumulative brook trout patch area by 2025 in headwater streams of the basin by "appropriate management options and actions".

My thinking about a long form to spell out "appropriate management options and actions":

1) *populating unoccupied suitable habitats*
    a. *removing barriers to natural population movements*
    b. *transplanting wild stock brook trout from catchments with large wild populations to populate nearby suitable habitat*
    c. *stocking first generation brook trout derived from working with wild stock brook trout in modern hatchery setting within the patch region containing suitable but otherwise unaccessible habitat*

    d. *removing invasive species competitors in suitable reaches that have excluded brook trout, and reintroducing brook trout or from sympatric catchments being reconnected with allopatric catchments.*

2) *improve instream habitat in regions with occupied but 'less than intact' populations by*
    a. *treating pH issues,*
    b. *increasing riparian buffer shading to lower instream temperatures,*
    c. *improving reuse of waters in suburban watersheds to limit impacts to groundwater resources and reduce risk of low flow period issues.*
    d. *Improve additional BMPs for increasing infiltration and maintaining groundwater resources that feed headwater streams.*
    e. *Reduce invasive plant species populations that risk high evapotranspiration stress on improving habitats.*
3) *Sustain/preserve integrity of headwater habitats where intact populations persist*
    a. *Manage landscape conditions*
    b. *Ensure harvest regulations are suitable for population maintenance*
    c. *Enforce harvest regulations, land management policies, air quality conditions.*
    d. *Designate allopatric streams as off limits to stocking of exotic species (brown trout, rainbow trout, cutthroat trout)*

Final thoughts.

This should not be in conflict with states wishing to sustain put-and-take fishery waters for trout fishing in most cases.

Work on redistribution of improved catchment occupancy to lower risk areas while accepting sites at to high risk of climate change (i.e. temperature) are likely to continue to be lost. Stem the tide of loss. If gain occurs you can say you are ahead of the goal ☺.

Existing BT occupancy will be overlaid with projected vulnerability to climate risk on the landscape to assess projected suitability of catchments to lethal BT temperature thresholds.

Areas with high quality habitat and low risk near occupied patches will be targeted for restoration. Areas with high risk of climate change impacts will be removed from the restoration catchment universe.

Patches with the fewest number of barriers to establish free flowing connections between occupied and unoccupied habitat will be given highest priority