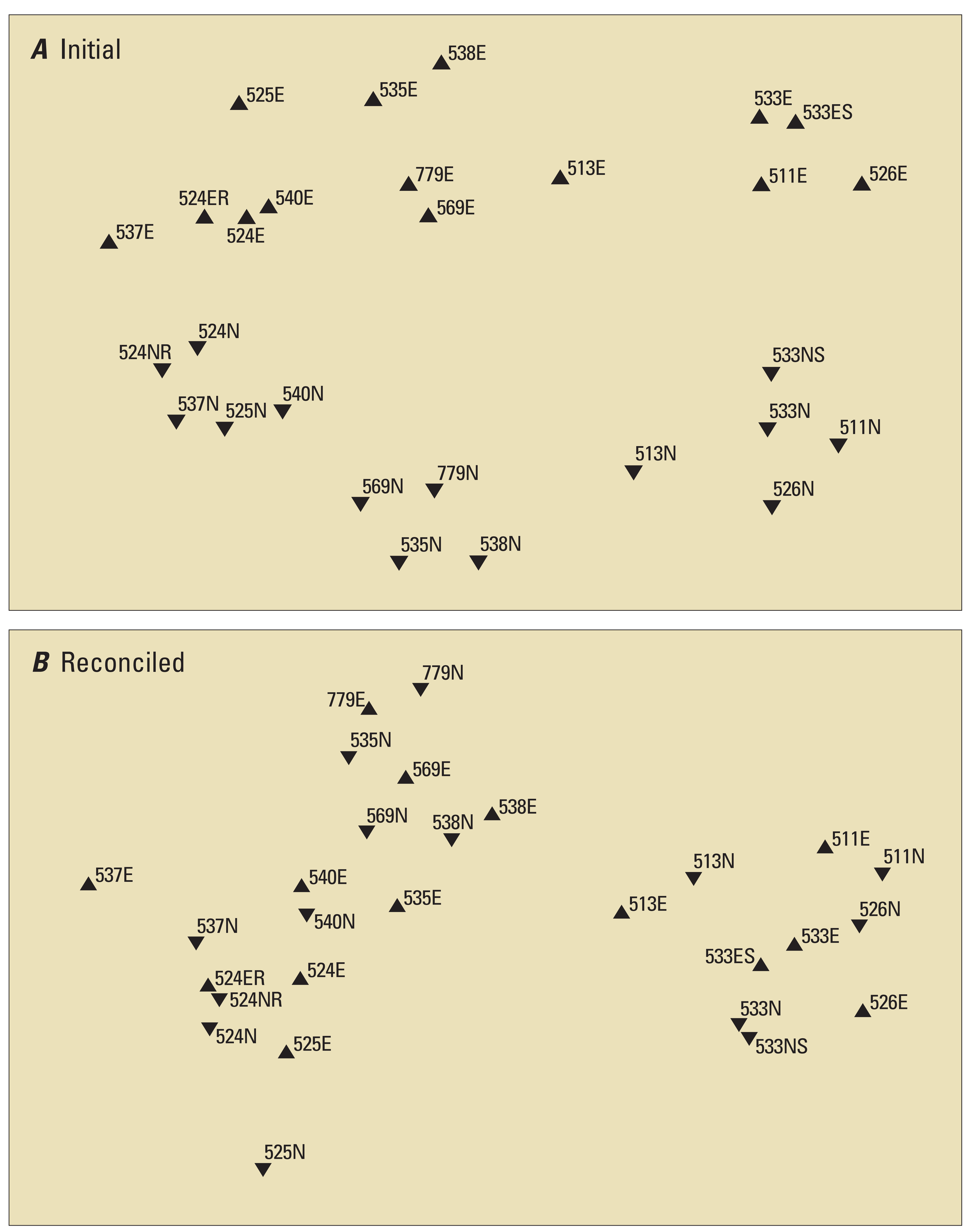
Big Creek (site 526), Wyoming.
Photograph by Ron Zelt, USGS.



EXPLANATION

▲526	Sampling site and number	N	National Water-Quality Assessment Program (NAWQA) sample
R	Replicate	E	Environmental Monitoring and Assessment Program (EMAP) sample
S	Split		

Figure 4. Non-metric multi-dimensional plots of macroinvertebrate community structure.

Habitat

NAWQA and EMAP protocols both specify habitat measurements at 11 transects, but NAWQA spaces transects over a reach length of 20 wetted channel widths (WCW), whereas EMAP uses 40 WCW. For this study, NAWQA habitat data generally were collected at 6 EMAP transects, corresponding to 20 WCW. Three of the five habitat variables selected for comparison between the NAWQA and EMAP data sets were significantly different ($p < 0.05$) (table 2) between the data sets.

Table 2. Comparison of selected habitat variables from the NAWQA and EMAP data sets, using the Wilcoxon Signed-Rank Test.

Habitat Variable	*p*-value
Depth of water, mean (m)	0.0309
Depth of water at thalweg, mean (m)	0.7334
Bank angle, mean (degrees)	0.0365
Substrate embeddedness, mean (percent)	0.2036
Canopy closure, mean (percent)	0.001

Water Depth

The average water depth was significantly different between the two protocols, as determined from three depth measurements at each transect (fig. 5). NAWQA protocol requires the field person to first find and measure the depth of water at the thalweg and then measure depth at two other equally spaced points within the wetted channel. The EMAP protocol requires measurement of water depth at both edges of the wetted channel (not included in this analysis) and at three equally spaced points between those edges. The water depth data collected as part of the EMAP protocol may or may not include the deepest part of the stream, and on average, was less than the NAWQA depth at 10 of 12 sites (fig. 6).

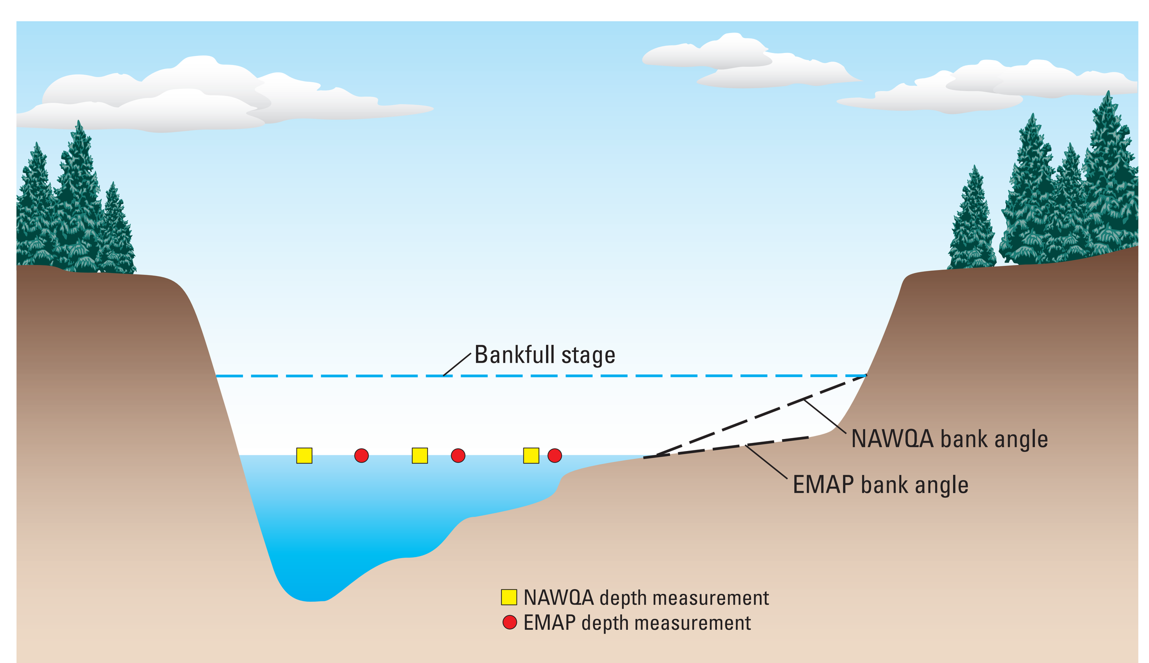


Figure 5. Schematic diagram of NAWQA and EMAP measurement points for water depth and bank angle.

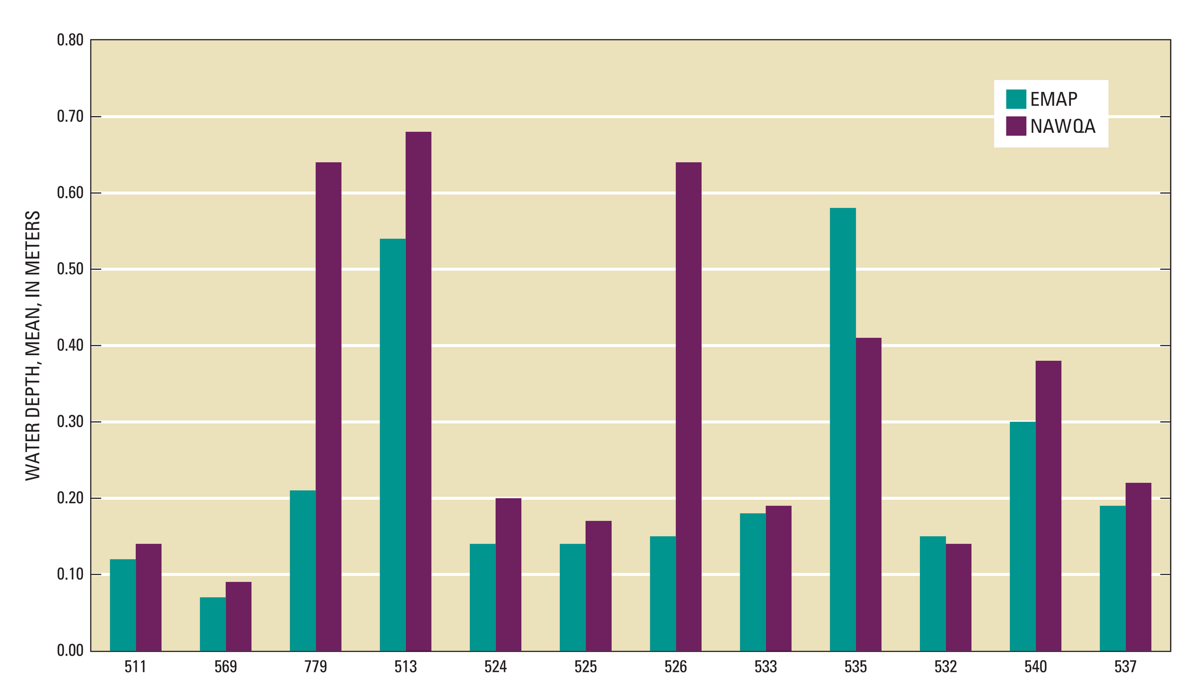


Figure 6. Water depth, as measured according to NAWQA and EMAP protocols.

Stonefly *Calineuria californica* (Plecoptera: Perlidae). Photo courtesy of James L. Carter, National Research Program, USGS.

Thalweg Depth

Mean thalweg depth was not significantly different between the protocols, in spite of a large difference in the number of data points collected. The NAWQA protocol specifies measurement of thalweg depth once at each of the 11 transects, whereas the EMAP protocol specifies measurement of thalweg depth at either 10 or 15 points, depending on stream width, spaced evenly along the thalweg between each of the 11 transects. The additional 94 to 144 thalweg measurements as part of EMAP are also used to determine variables such as residual pool volume, stream size, channel complexity and the relative proportion of habitats (riffle, pool, run) in the reach, whereas other measurements are collected to determine those features under the NAWQA protocol.

Fivemile Creek (site 540), Wyoming.
Photograph by Greg Boughton, USGS.

Bank Angle

Bank angles are measured differently between the two protocols and the mean bank angles were significantly different between the data sets. Both protocols specify that a surveyor's rod or meter stick is laid down against the bank, and a clinometer is used to measure the angle from the horizontal. The difference in protocols is that the NAWQA protocol allows for up to 3 readings to be collected and averaged if the height and shape of the bank are such that more than one angle is evident from the stream bottom to bank full height, whereas EMAP measures the first angle of the bank at the water's edge. Bank angles determined by the NAWQA protocol tended to be steeper than those from the EMAP protocol (fig. 5).

Salt Creek (site 524), Wyoming.
Photograph by Ron Zelt, USGS.

Embeddedness

Embeddedness is a percentage (to the nearest 10 percent) of the surface area that a particle (generally fine gravel and larger) is covered by fine sediment. Both NAWQA and EMAP use a visual estimate of embeddedness for particles found at transect points. For the NAWQA protocol 5 particles (gravel to boulder) are examined at each transect point and an average percentage is recorded. As part of the EMAP protocol, the particle located at the bottom of a meter stick at each depth measurement point is selected for substrate measurement and embeddedness is estimated as a percentage for particles within a 10 cm circle around the meter. Although these methods seem to differ in practice, the mean values were not significantly different ($p > 0.05$) between the data sets.

Canopy Cover

Mean canopy cover measurements were significantly different between the data sets, probably because the NAWQA protocol uses a concave spherical densiometer, whereas the EMAP protocol specifies a convex spherical densiometer. Both protocols require the mirrored surface of the densiometer modified with tape so that only 17 of the 37 possible intersections are used to collect measurements. A densiometer measurement is taken at the water's edge along both sides of the stream for both protocols. EMAP-WP protocol has an additional four measurements mid-channel, collected while facing left, right, up and downstream, but those additional measurements were not included in this analysis, in order to compare the data sets fairly. The convex spherical densiometer used in the EMAP protocol samples a larger area and mean values were always equal to or greater than NAWQA canopy closure measurements (fig. 7).

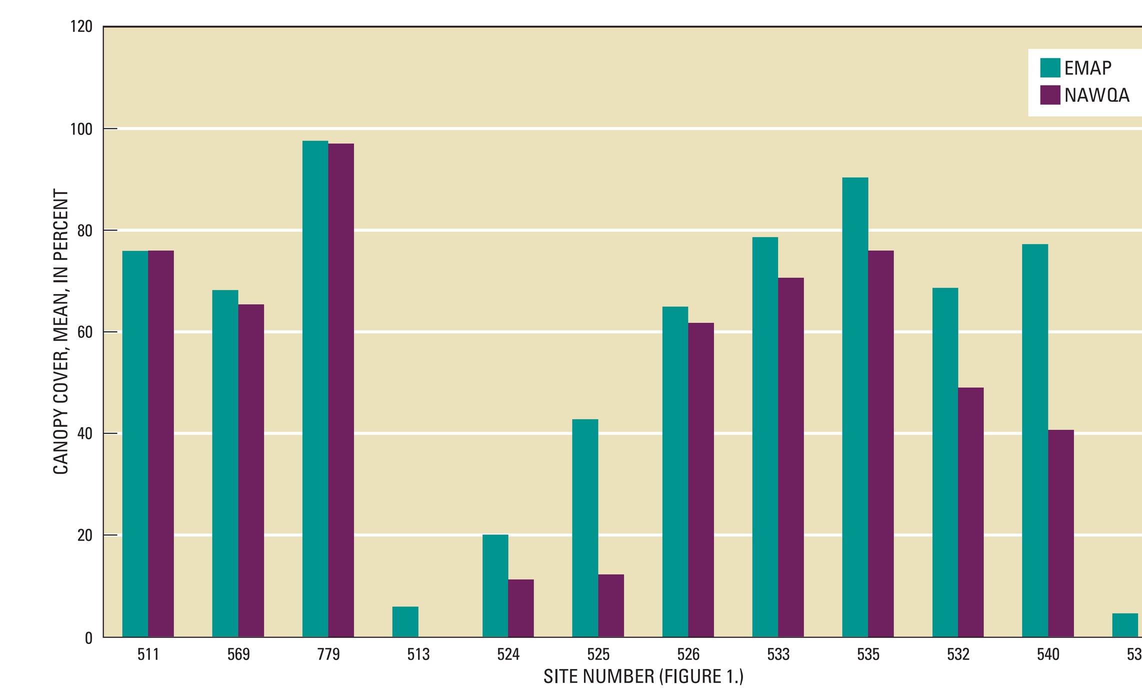


Figure 7. Canopy cover, as measured according to NAWQA and EMAP protocols.

Mayfly *Rhithrogena* (Ephemeroptera: Heptageniidae) Photograph courtesy of James L. Carter, National Research Program, USGS.

Application

The ultimate goal of most comparative studies is to test the feasibility of combining data sets from different sources or protocols. This poster presents methods that can be used to help resolve differences between NAWQA and EMAP macroinvertebrate data prior to combining the data sets, but the advantages of a larger data set need to be weighed against the loss of species-level and abundance data. Habitat data were comparable between the data sets in some cases, and not in others, largely due to differences in measurement procedures. The small sample size and geographic area of this study limit the ability to extrapolate the results to other areas without additional study and further testing.

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