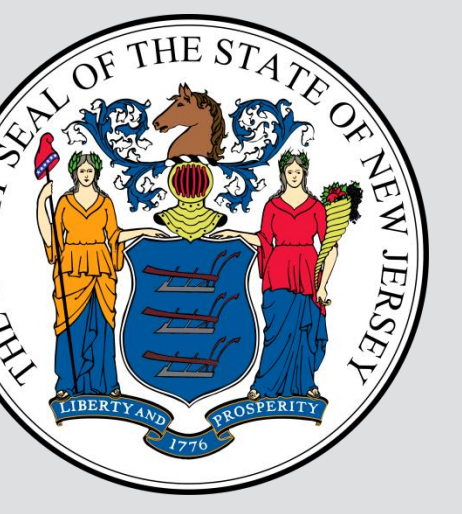




Fish community variation and trends at sentinel sampling locations as evidence of environmental change



Introduction

The New Jersey Bureau of Freshwater and Biological Monitoring (BFBM) has been conducting Fish Index of Biotic Integrity (FBI) monitoring on rivers and streams (with drainage area >12.95 km²) in the Northern part of the state since 2000. Fish are used as biological monitors for the following reasons: they are long lived and good indicators of long term disturbances, they are easily collected and identified, they have readily available information on life history, environmental requirements, and distributions, and aquatic life uses are typically characterized in terms of fisheries. In an effort to assess environmental changes, natural variability through time, and to evaluate trends in NJ streams, the FBI program began monitoring sentinel sites in 2012. Sentinel sites are considered high quality waterbodies which contain sensitive fish taxa and are located in fully or partially protected watersheds. The FBI program presently has a total of 11 sentinel sites located throughout the state, each of which is sampled every two years. Since multiple rounds of sampling have been conducted, data is beginning to provide preliminary insight into trends occurring at these high quality NJ waters. Several sentinel sites, including Buckhorn Creek (FBI048), Passaic River (FBI095), and Vancampens Brook (FBI039), have exhibited noticeable changes in fish assemblages; while sites such as the Pequannock River (FBI077) have had fish communities remain relatively unchanged. Additionally, sites such as Mulhockaway Creek (FBI053) and Capoolong Creek (FBI088b) show wide variations in IBI scores overtime. This evidence suggests that some other type of watershed disturbance and/or possible environmental change could be occurring in the state.

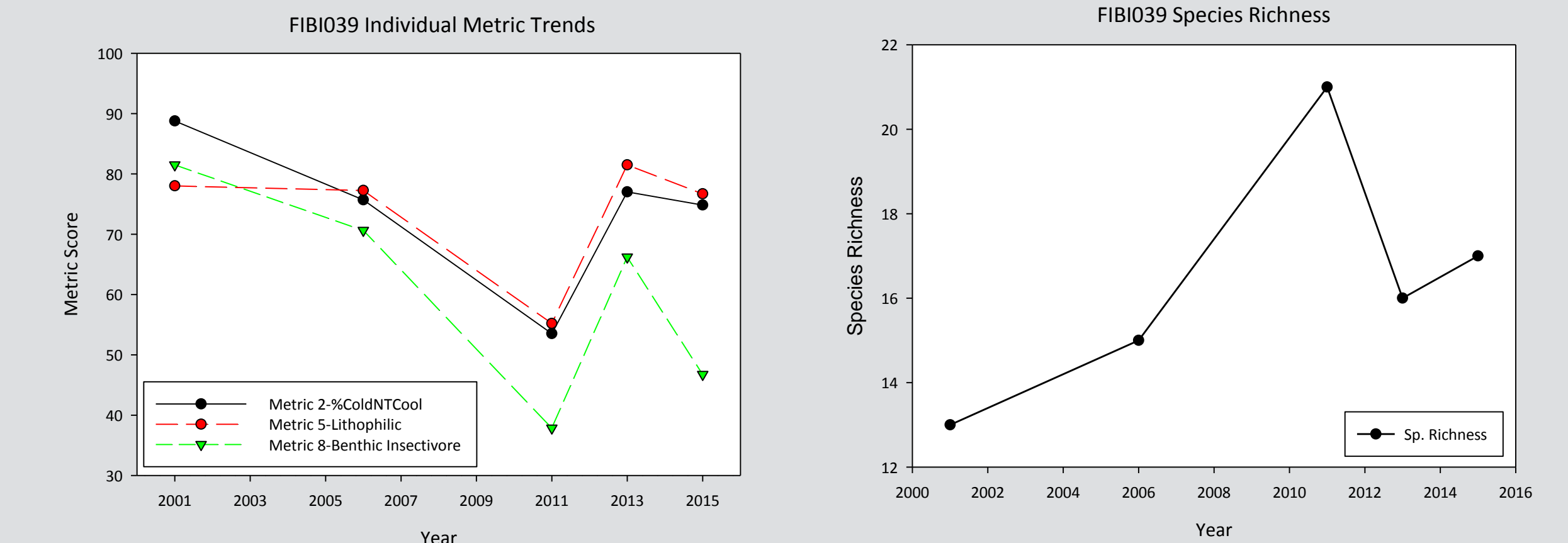
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Results

- Large variation in FBI scores at some sentinel locations (ex. FBI039: 64-89).
- Possible emerging trend in decreasing percent abundance of sensitive species at sentinel locations.
- Evidence for changing fish assemblages at multiple sentinel locations including Passaic River (FBI095), Buckhorn Creek (FBI048), and Vancampens brook (FBI039), however; some sentinel locations such as the Pequannock River (FBI077) have stability in fish assemblages over time.
- Land use/ land cover at sentinel locations has remained consistent over the sampling years, with only minimal changes at some sites.
- Summer temperature logger deployments at Buckhorn Creek in 2011 and Passaic River in 2015 indicated temperatures exceedances above NJ FW2-TP daily maximum of 22° C for 24% (Buckhorn) and 20% (Passaic) of all temperature readings.

FBI039 - Vancampens Brook

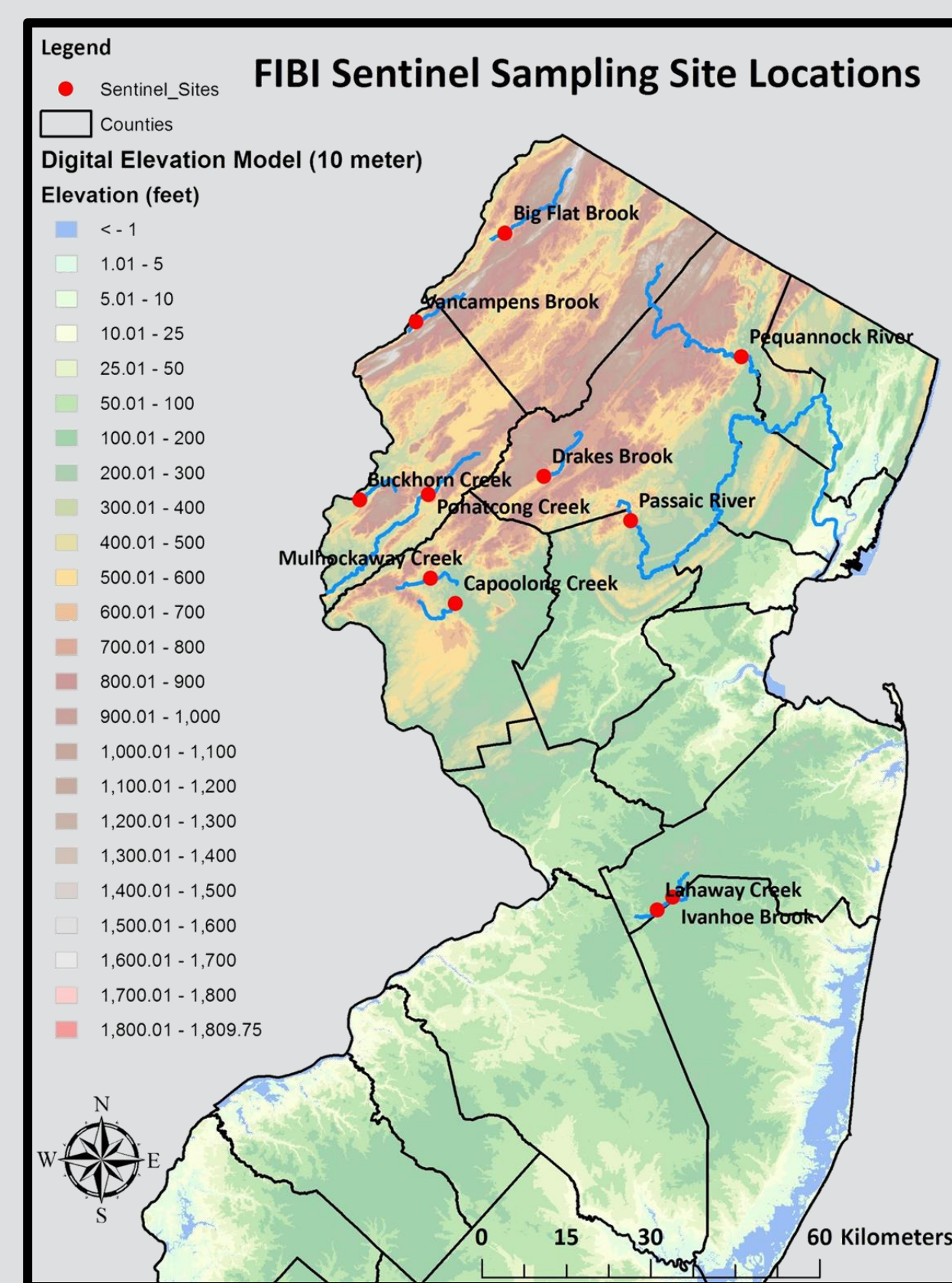
Year	% Agriculture	% Barren	% Forest	% Urban	% Water	% Wetland
2012	0.0	0.0	94.0	1.5	1.4	3.1



- Highly protected, forested watershed exhibiting large variability in fish community and IBI scores
- Observed abundances of warmwater/ larger river fish species that should not be present in a coolwater trout stream. Possibly seeking thermal refuge? Why?
- Several individual metrics from the Northern Fish IBI indicate a change in the fish community during the summer of 2011.

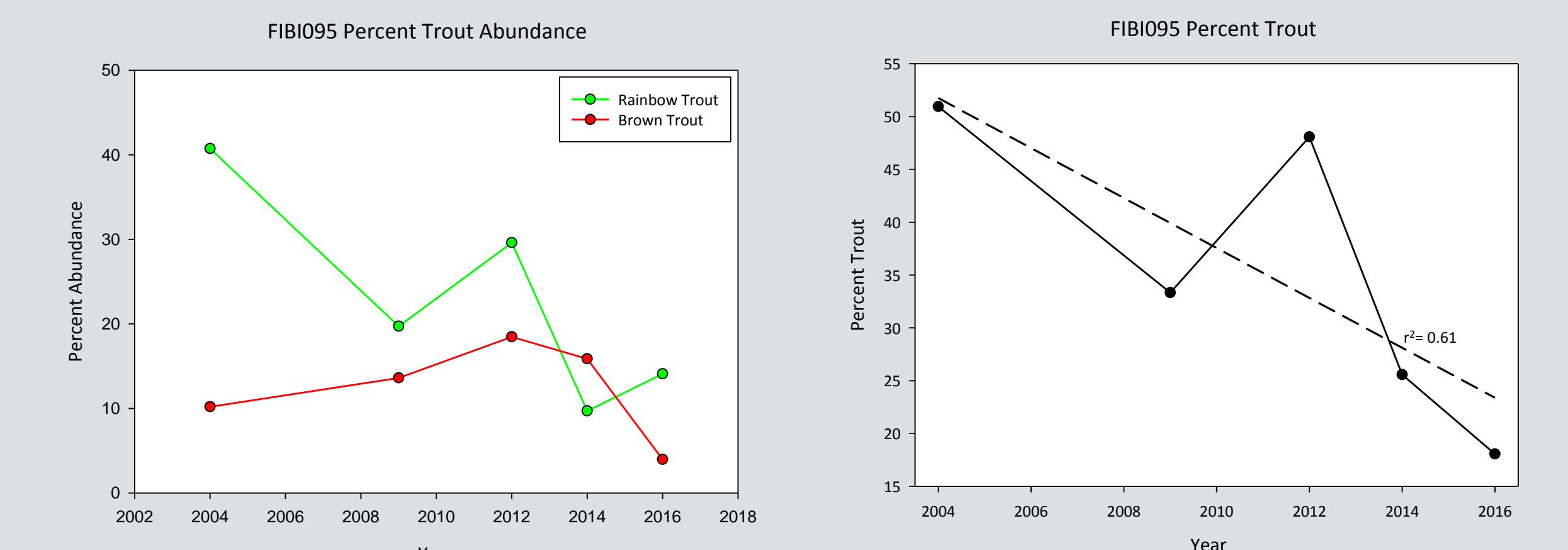
Sentinel Site Land Use % Change (2002-2012)

Site	% Agriculture	% Barren	% Forest	% Urban	% Water	% Wetland
FBI008b	0.8	0.2	-0.6	-0.5	-0.4	-0.5
FBI033	-0.3	-0.2	-1.2	2.3	0.1	-0.6
FBI037	-0.7	0.7	-3.0	3.0	0.3	-0.2
FBI039	0.0	-0.1	-0.1	0.1	0.1	0.0
FBI048	-0.2	0.0	-2.0	1.2	0.9	0.0
FBI053	-1.1	0.0	2.7	-0.1	0.1	-1.6
FBI066a	0.2	0.0	0.9	0.1	-0.4	-0.8
FBI077	0.0	-0.1	-0.6	0.4	0.0	0.3
FBI095	-1.3	-0.3	-1.9	3.2	0.4	-0.1



FBI095 - Passaic River

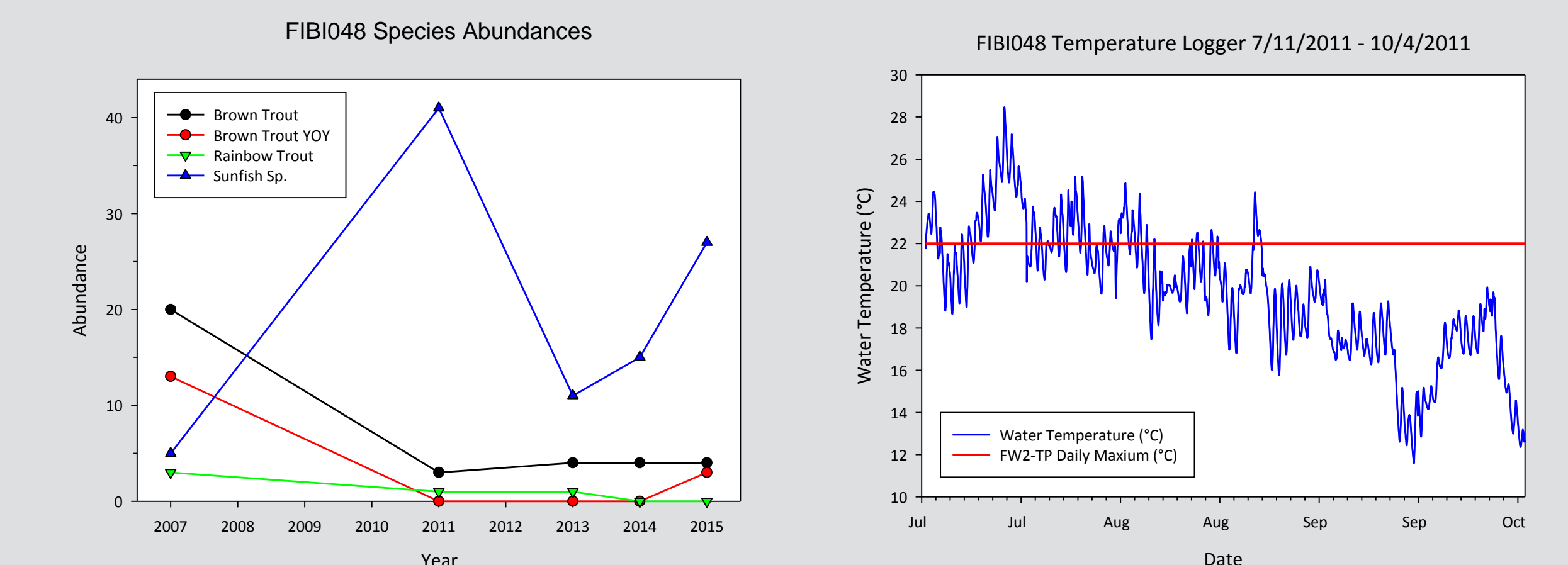
Year	% Agriculture	% Barren	% Forest	% Urban	% Water	% Wetland
2012	7.0	0.3	47.7	39.3	1.1	4.7



- A distinct shift has been observed in the trout community from wild rainbow to wild brown trout, as well as increasing abundance of warm water species.
- Additionally, the proportional abundance of wild trout has declined over time.
- In 2015, summer water temperatures frequently exceeded the FW2-TP daily max.

FBI048 - Buckhorn Creek

Year	% Agriculture	% Barren	% Forest	% Urban	% Water	% Wetland
2012	24.4	1.2	58.5	9.7	1.1	5.1



- Loss of trout abundance, coupled with increase in sunfish abundance (2011). Trout have yet to recover.
- Water temps during summer of 2011 frequently exceeded FW2-TP daily max.
- Additionally, other species such as fallfish and sea lamprey have exhibited considerable variation in abundance over time.

What is a Sentinel Site?

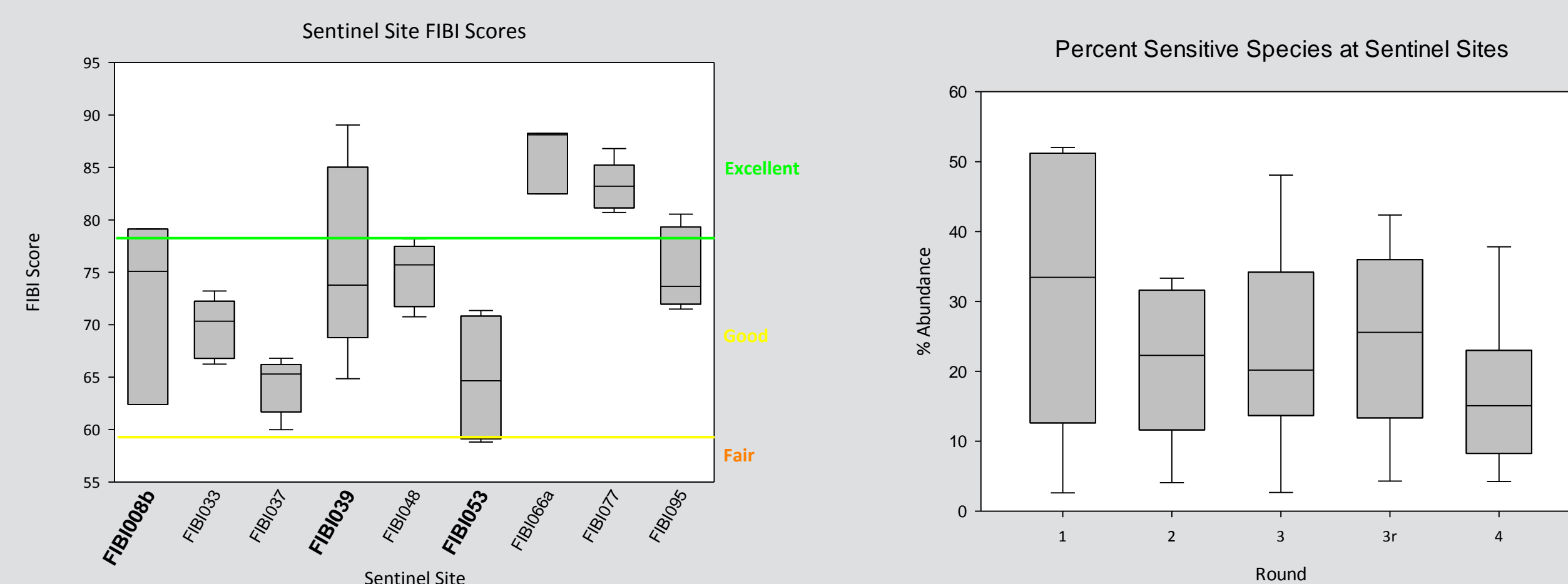
Sentinel sites are considered high quality waterbodies located in fully or partially protected watersheds that are sampled on a routine basis to assess environmental changes, natural variability through time, and evaluate trends in NJ streams. Northern and southern IBI sentinel sites are sampled every other year using the following site selection criteria:

- Sites must have scored in the "good" or "excellent" Fish IBI rating range
- Recent data must contain at least two intolerant species (hatchery raised trout are not included)
- The most recent habitat score must be above 150
- If stocked trout were collected at the site, wild trout must have also been collected at that site
- Percent urban land use must be less than 20%
- Site should have some level of protection i.e. Wildlife Management Area

Methods and IBI Scoring

- Sampling period occurs between June and early October
- Backpack or barge electrofishing with a crew of 4-7 people
- A 150-m stretch of stream is sampled
- Sample sites are representative of the habitat of the reach being sampled, and will have a riffle, run, and pool sequence where possible
- Fish are identified to the species level, counted, examined for disease and anomalies, measured (game fish), released and recorded on fish data sheets in the field
- An IBI score is calculated using the appropriate Northern IBI or Southern IBI metrics, which is calibrated to the major physiographic regions of the State
- The IBI incorporates the zoogeographic, ecosystem, community and population aspects of the fish assemblage into a single ecologically based index designed to measure the health of a stream
- Each site sampled is scored based on its deviation from reference conditions (i.e., what would be found in an un-impacted stream) and is subsequently classified as "very poor", "poor", "fair", "good" or "excellent"

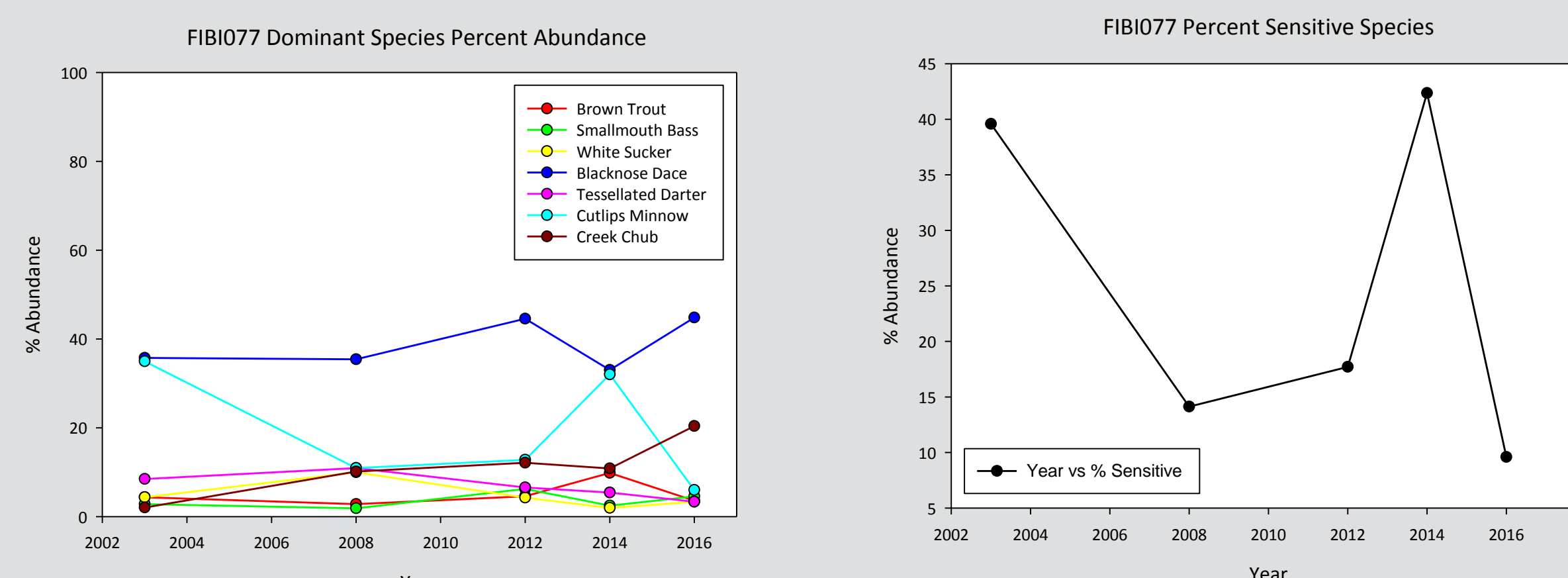
Overall Sentinel Site Trends



- Some sentinel sites (FBI008b, FBI039, and FBI053) show large/variable ranges in IBI scores while other sites (FBI033, FBI037, FBI048 and FBI077) are more consistent over time.
- However, just because IBI scores are not changing, it does not mean fish communities are remaining static.
- Slight decreasing trend in abundance of sensitive species over time (p=0.58).

FBI077 - Pequannock River

Year	% Agriculture	% Barren	% Forest	% Urban	% Water	% Wetland
2012	0.4	0.2	67.9	13.9	6.2	11.5



- Proportional abundance of fish community remains relatively stable
- However, one sensitive species, the cutlips minnow exhibits some yearly variation

Conclusions

- Observed unexpected variation, and change in fish communities and IBI scores in some of NJ's highest quality rivers and streams.
- In some cases, fish assemblages over time seem to indicate improving conditions, while others remain consistent, and others seem to show large fluctuations.
- Occasionally, IBI scores do not reflect the intricacies and change in the fish community present. IBI scores look more at fish from an ecological function: one fish may become absent in a fish community, however another could move in, fulfill that role, and still maintain a similar metric score despite losing the abundance of a critical species.
- Further data is necessary to pin point possible causes. Land use at sentinel sites have remained relatively consistent, so it is possible that, environmental or some other watershed disturbance could be a factor in the observed variation and changes.
- This preliminary data will provide insight to where the Bureau should focus additional research and monitoring efforts.