#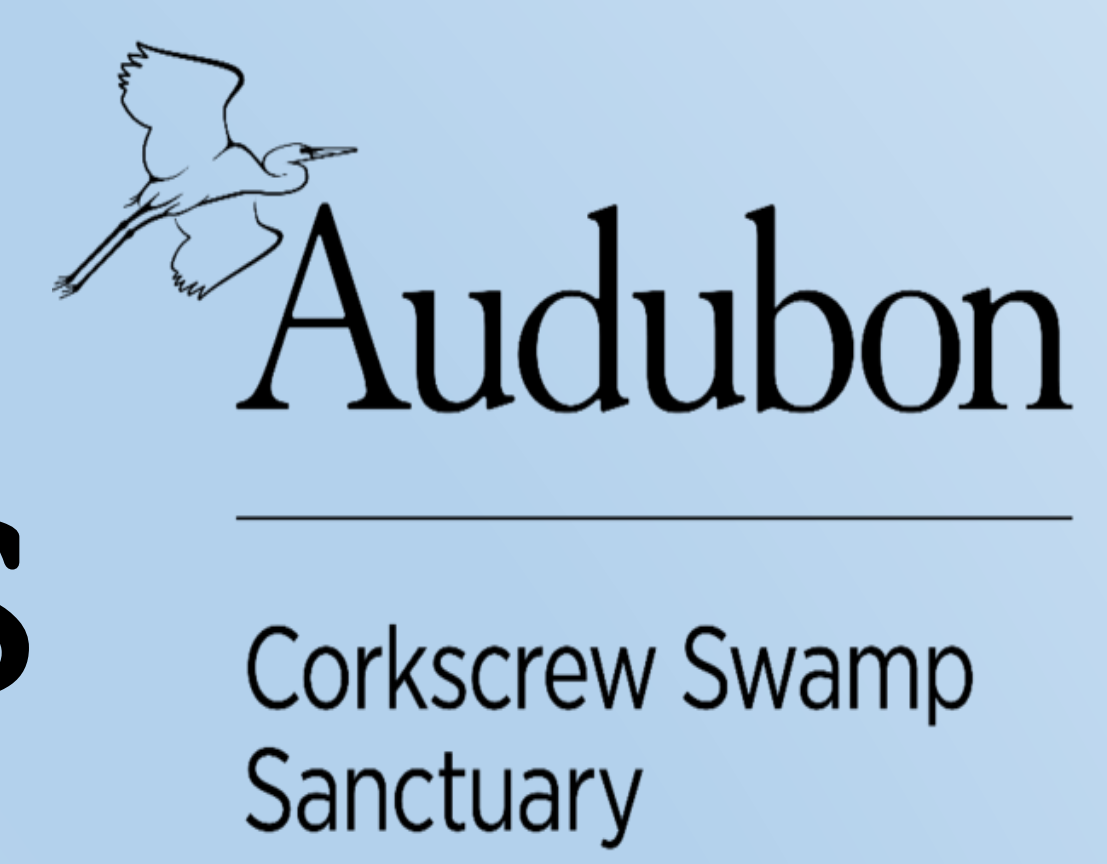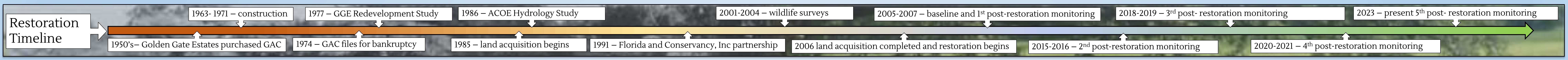 MONTORING THE PICAYUNE STRAND RESTORATION PROJECT: PROGRESS REPORT BASED ON AQUATIC MACROINVERTEBRATE, ANURAN, AND FISH COMMUNITIES

Charley Vance[2], David W. Ceilley[1], Shawn Clem[3], Phoebe E. Clark[2], Tiffany K. Gaglia[2], and Edwin M. Everham III[2]

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Restoration Timeline

- 1950's– Golden Gate Estates purchased GAC
- 1963- 1971 – construction
- 1974 – GAC files for bankruptcy
- 1977 – GGE Redevelopment Study
- 1985 – land acquisition begins
- 1986 – ACOE Hydrology Study
- 1991 – Florida and Conservancy, Inc partnership
- 2001-2004 – wildlife surveys
- 2005-2007 – baseline and 1st post-restoration monitoring
- 2006 land acquisition completed and restoration begins
- 2015-2016 – 2nd post-restoration monitoring
- 2018-2019 – 3rd post- restoration monitoring
- 2020-2021 – 4th post-restoration monitoring
- 2023 – present 5th post- restoration monitoring

HISTORY

- The Picayune Strand Restoration Project (PSRP) is a 55,000-acre hydrologic restoration which was the first project in the Comprehensive Everglades Restoration Plan (CERP) and one of the Acceler-8 projects initiated in 2004.
- Gulf America Corporation initiated a project in the 1960s to create *Southern Golden Gate Estates* in Collier County Florida: 22,000 ha of land drained through the creation of 4 canals totaling 77 km and with 467 km of raised, paved roads intended to provide home sites for thousands of residents.
- As the result of this development, the water table fell a meter or more, estuaries suffered due to the lack of freshwater inputs, and fire frequency increased.
- Gulf America went bankrupt in 1974. The project was abandoned with its canals, roads, and street signs intact. In 1985, the PSRP was initiated, when the state began to buy back individual parcels of land from people all over the U.S. and the world. Restoration began in 2006 by back-filling the canals to return the landscape to its historic hydrology.

RESTORATION PLAN

- Remove the asphalt and level roads.
- Plug the four canals leaving deep water refugia (started in 2006, three completed).
- Three pump stations with spreader marshes.
- The goal is to restore hydrology – "*and the rest will follow*".

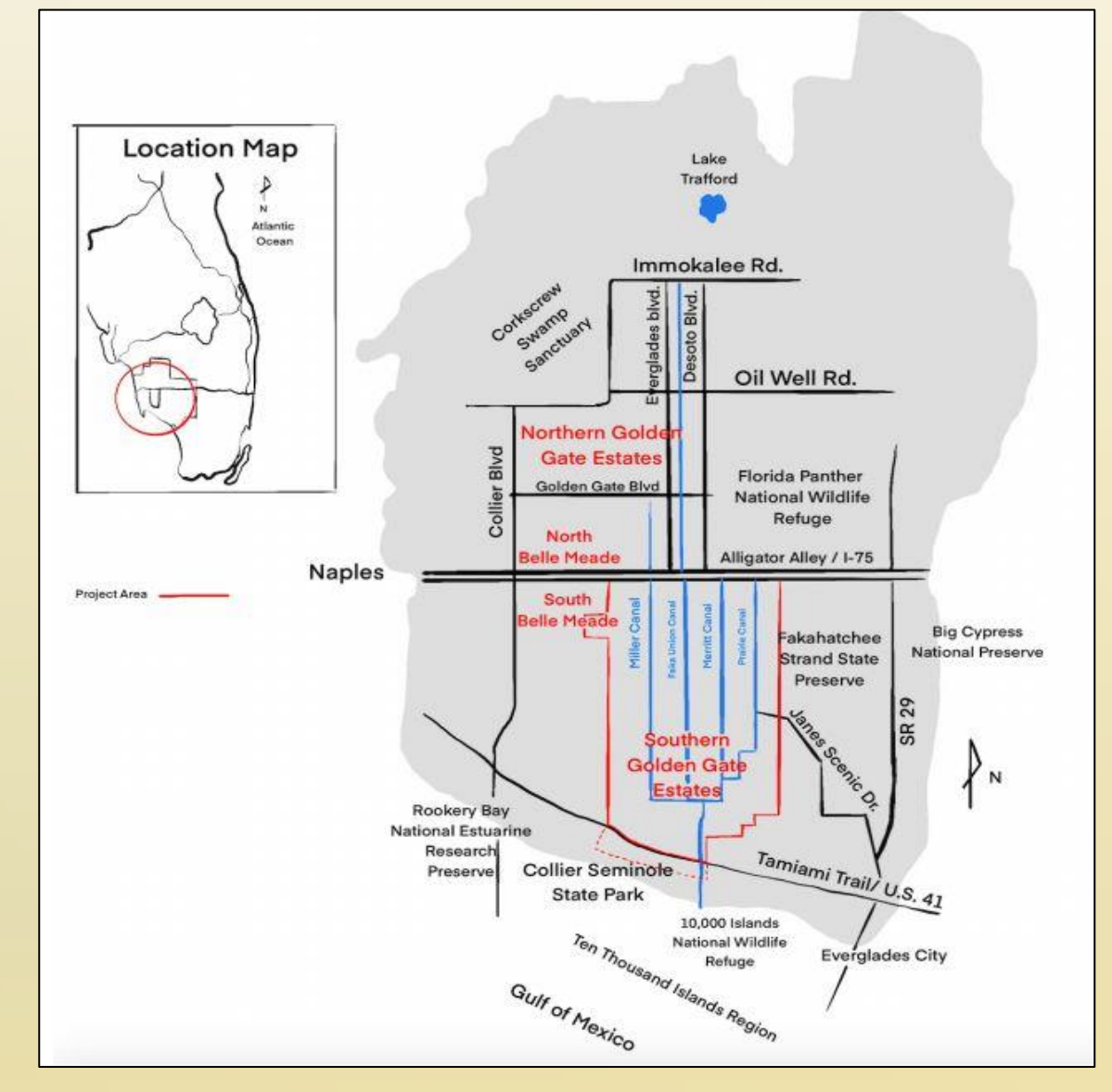*Figure 1- Picayune Strand State Forest, Canal System*

Figure 2- Restoration site, Picayune Strand State Forest (Gaglia 2022)

MONITORING PLAN

- Establish a network of ground and surface water monitoring stations.
- Vegetation transects associated with wells and reference sites.
- Reference sites in both the Fakahatchee Strand Preserve State Park and the Florida Panther National Wildlife Refuge.
- Biotic sampling on restored and reference sites across habitats including: graminoid prairie (G), hydric pine (Ph), and cypress (C).
- Sampling fish (Breder traps), anurans (refugia pipes), and aquatic macroinvertebrates (dip netting).

Adaptive monitoring
- Inclusion of unrestored sites for additional comparison.
- Focus on macroinvertebrates as exotic invasion of fishes and frogs has obscured restoration signal in those taxa.
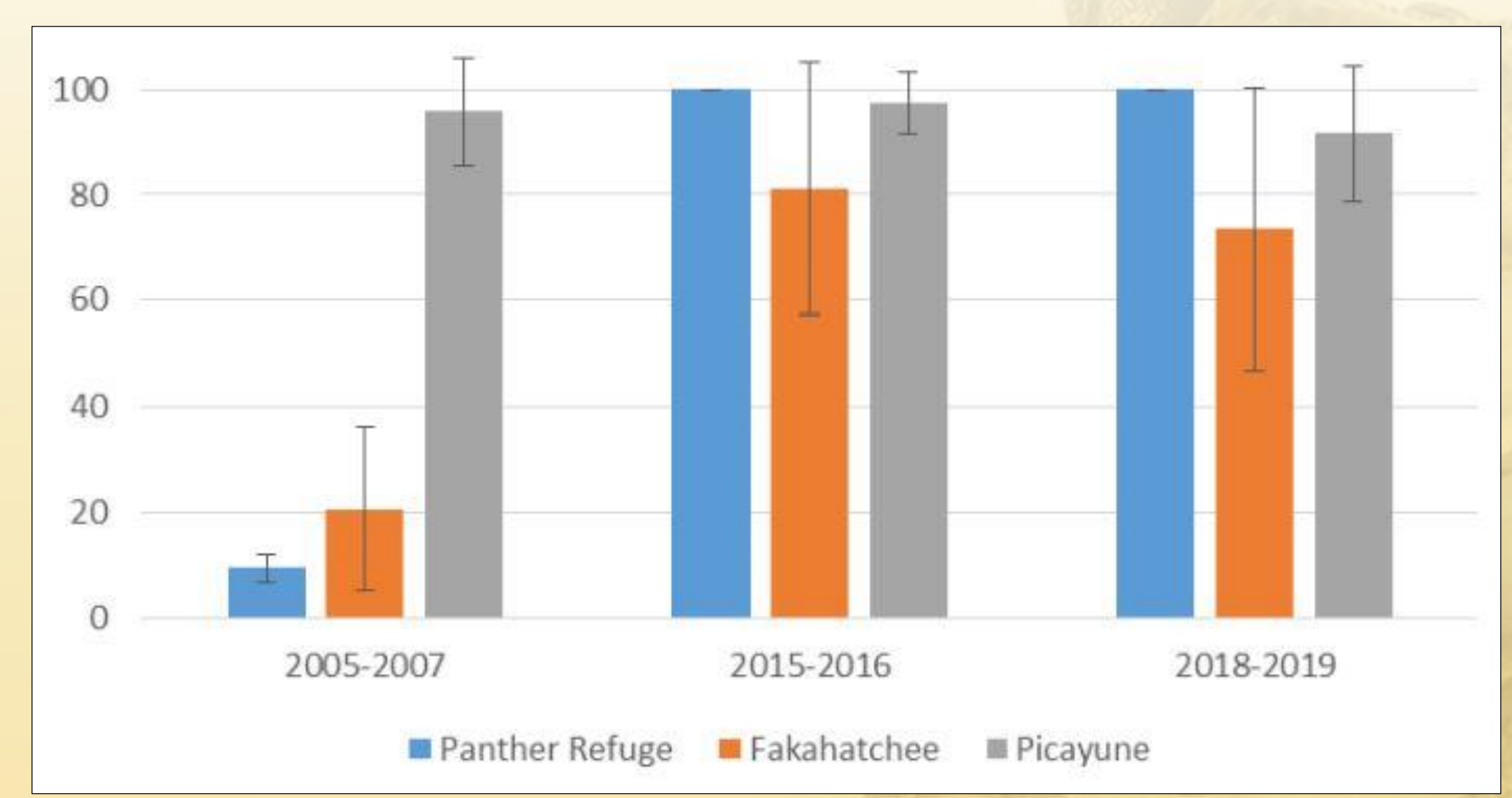
MONITORING RESULTS

Figure 3 - Anuran community invasion from exotics through time, as sampled in refugia pipes as indicated by percent exotics. Note the loss of diversity in the Panther Refuge reference sites - frog community was exclusively the exotic Cuban tree frog (Clark 2020)
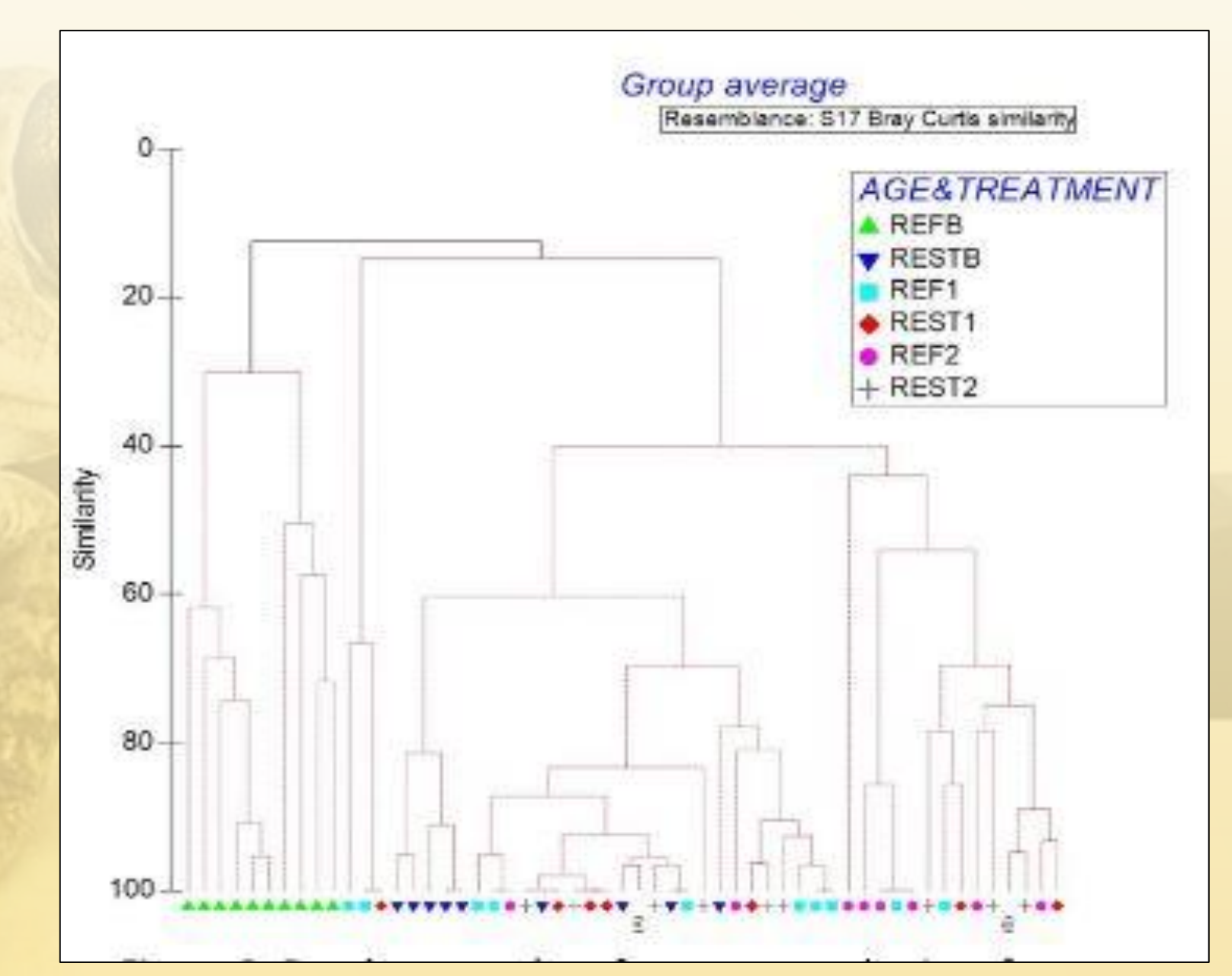

Figure 4 - Cluster analysis of anuran communities in reference and restored sites for baseline, second post-restoration and third post restoration (Ceilley et al. 2020)
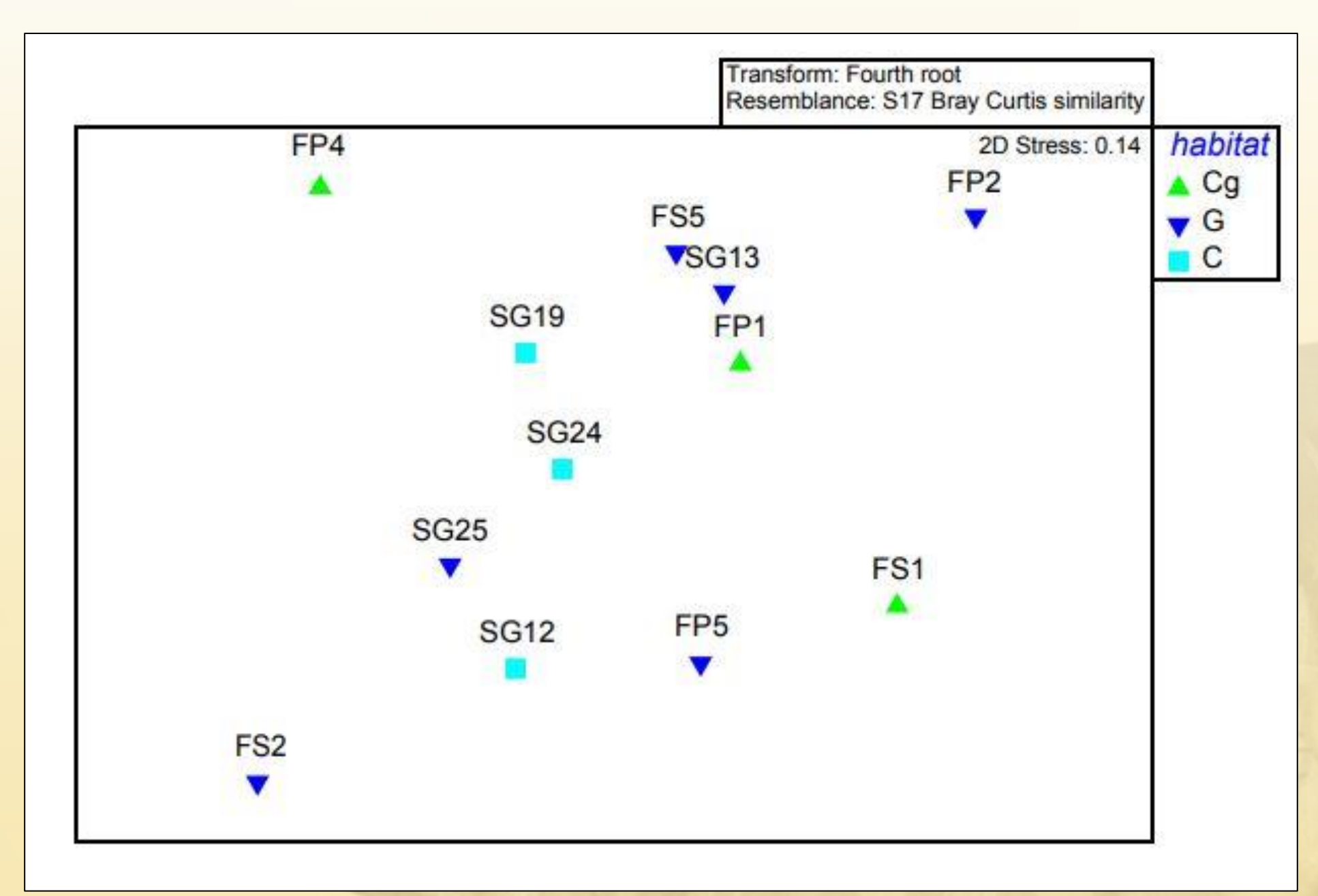

Figure 5 - Non-metric Multidimensional Scaling (nMDS) ordination of fish communities sampled with breeder traps in the second post-restoration monitoring, coded by habitat type (Gg cypress graminoid, G graminoid, and C cypress) and restoration (SG) or reference (FS or FP) (Ceilley et al. 2020)
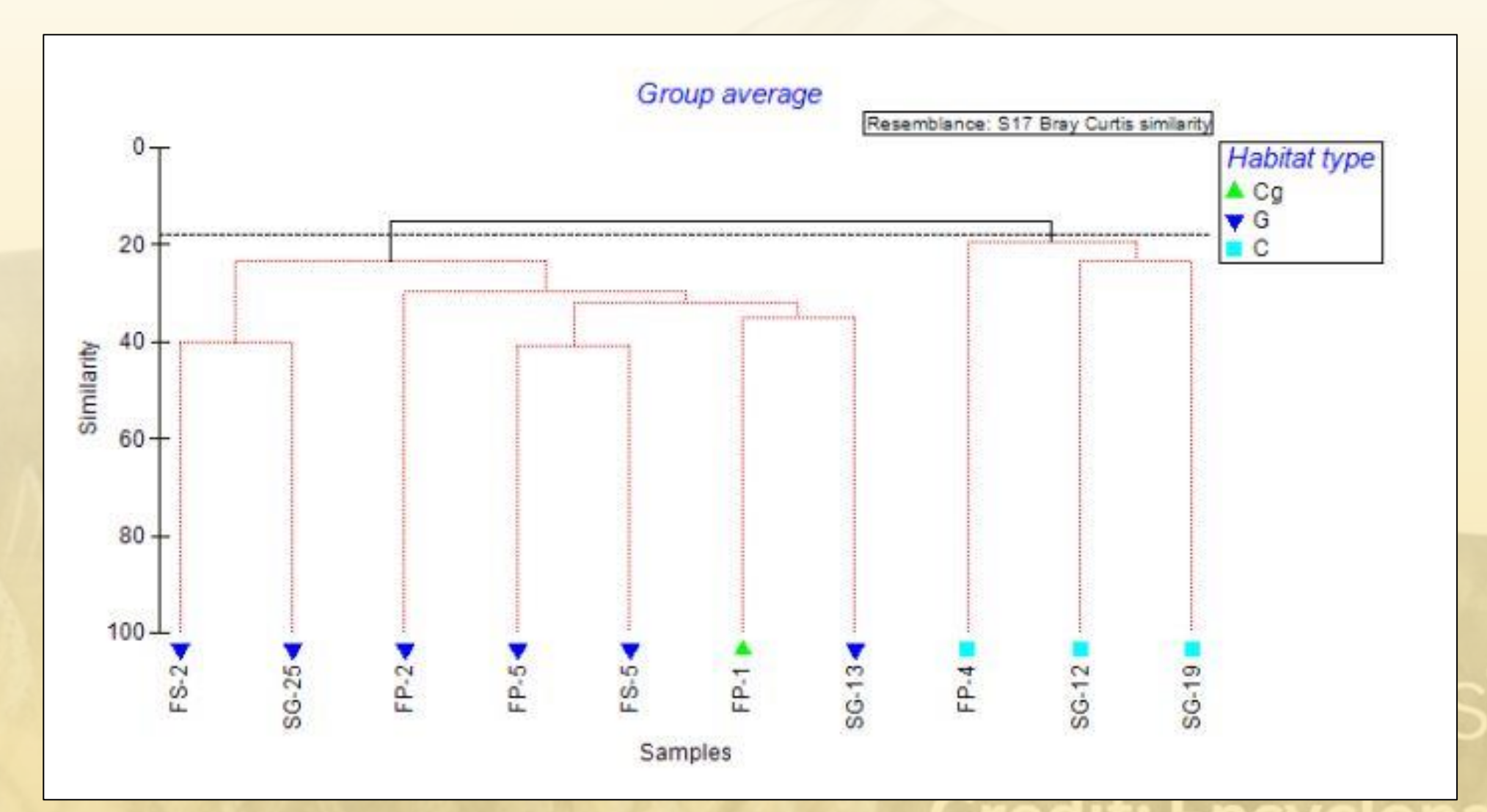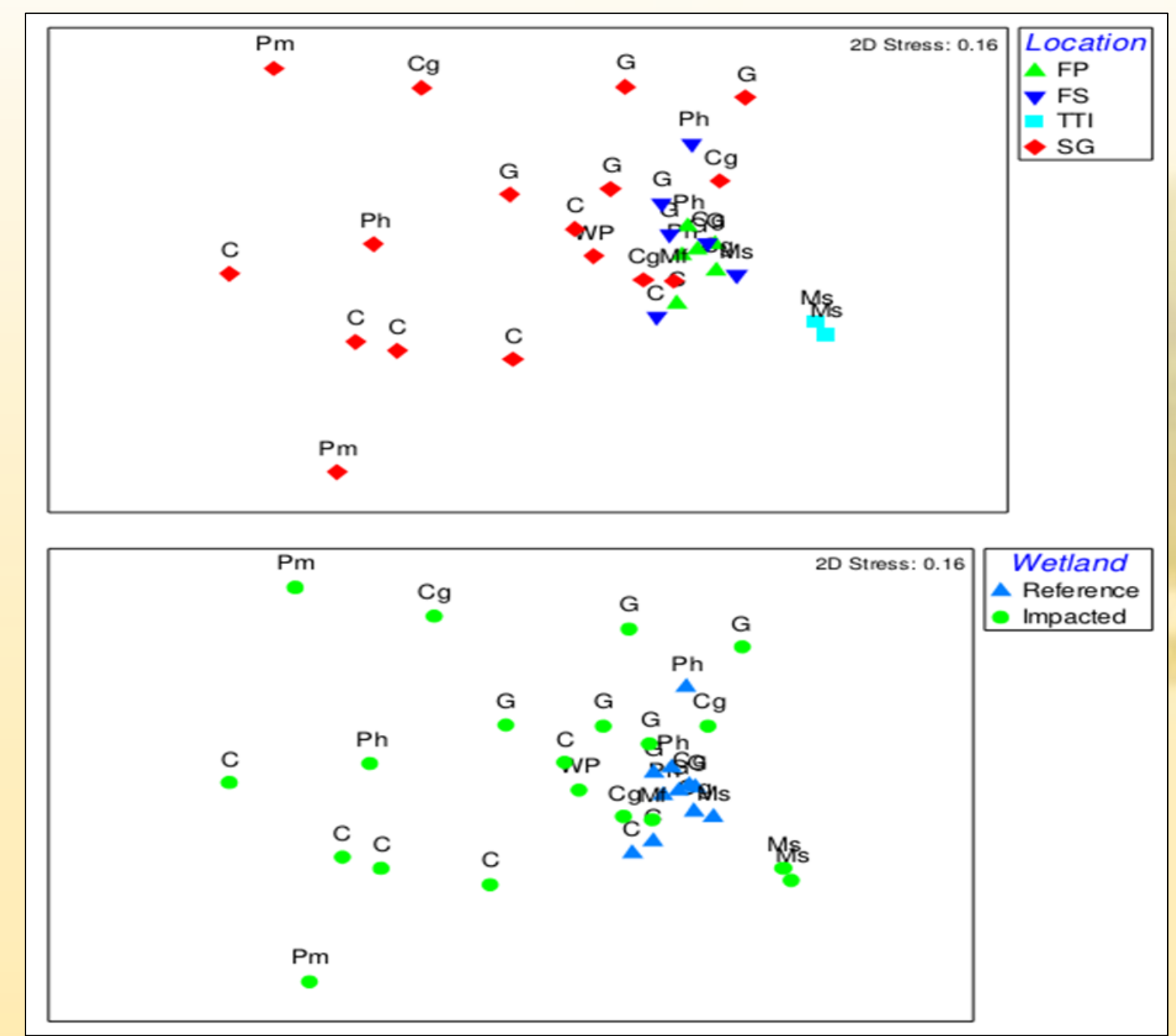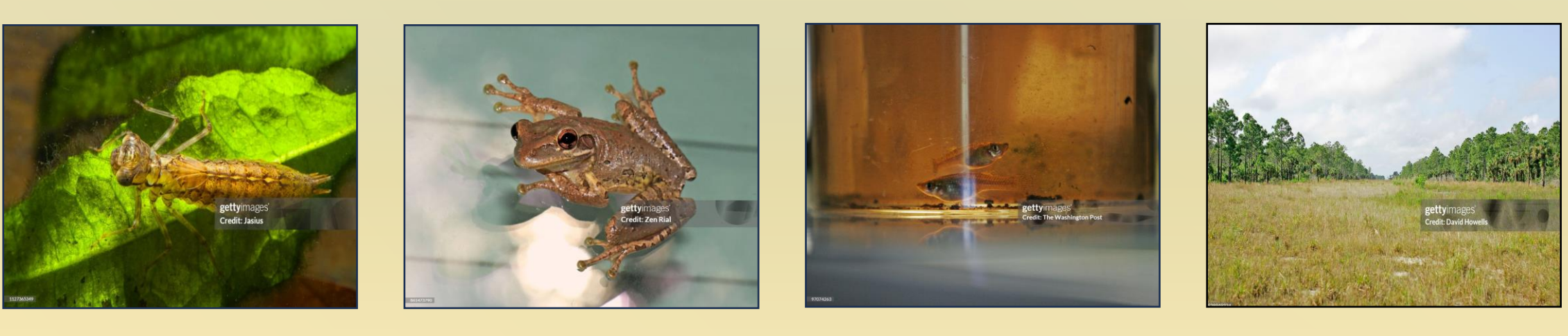

Figure 6 – Cluster analysis of all taxa (plants, fish, anurans, and macroinvertebrates) from second post-monitoring. Habitats are Gg cypress graminoid, G graminoid, and C cypress. Sites are restoration (SG) or reference (FS or FP). Solid lines are significant groups (p<0.05) (Clark 2020)

Figure 7 – Baseline (2008) MDS ordination of macroinvertebrate communities in Panther Refuge (FP), Picayune (SG), Fakahatchee (FS). Bottom MDS ordination by habitat type.
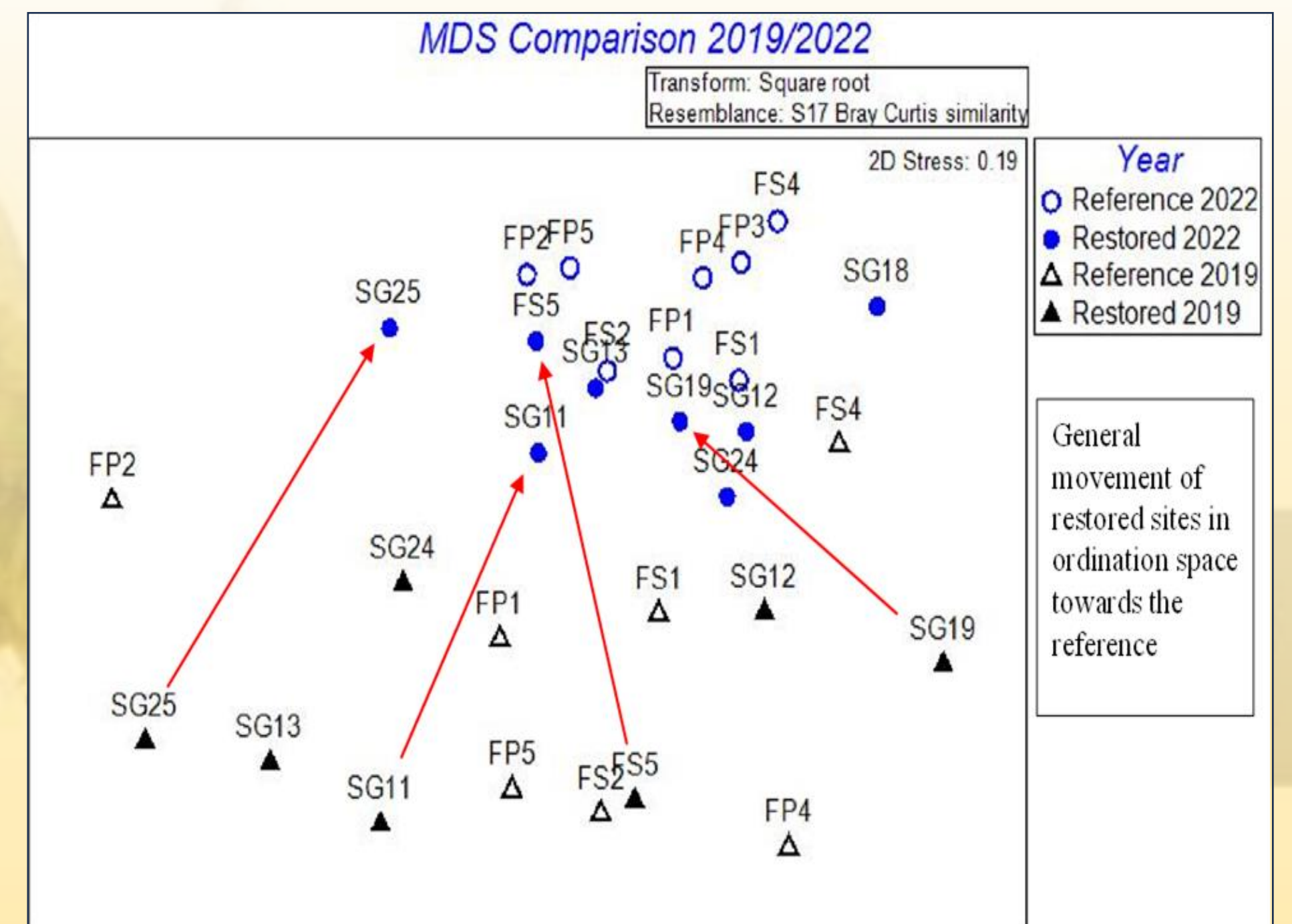

Figure 8 – Ordination of macroinvertebrate communities in the third and fourth monitoring cycles. Note the movement of restored sites toward reference sites through time (Gaglia 2002)

DISCUSSION and NEXT STEPS . . .

- All taxa indicate trends of moving from pre-restoration baseline towards reference sites, but are not yet fully restored.
- The multivariate community analysis indicated that patterns of change through time were impacted by changing the contractors for monitoring - suggesting that consistency of monitoring personnel may be important in long-term restoration monitoring.
- The restoration signal from fish and anuran monitoring has been obscured by invasion of exotic species: African jewelfish (*Hemichromis bimaculatus*) and Cuban tree frog (*Osteopilus septentrionalis*).
- The monitoring plan may need to expand fish sampling beyond exclusively passive techniques (Breder traps) to include alternative trapping or electrofishing; and the Anuran sampling may need to include the use of audio recorders instead of refugia pipes alone.
- The monitoring plan has evolved to include unrestored sites in comparison to restored and reference sites.
- Current pump station management, which prioritizes inland flood protection, may need to be modified to ensure minimum flows that support longer downstream hydro-periods.
- Expand habitat monitoring to include novel ecosystems of canal refugia pools, spreader canals, and remnant road beds.
- New acoustic technology approaches suggest a possible multi-taxonomic analysis of sound as a measure of ecosystem health and restoration.
- Any multi-decadal landscape restoration must consider additional disturbance impacts, for the PSRP these include fire (both wild and prescribed), drought, hurricanes, exotic species invasion, and the overarching impacts of climate change.
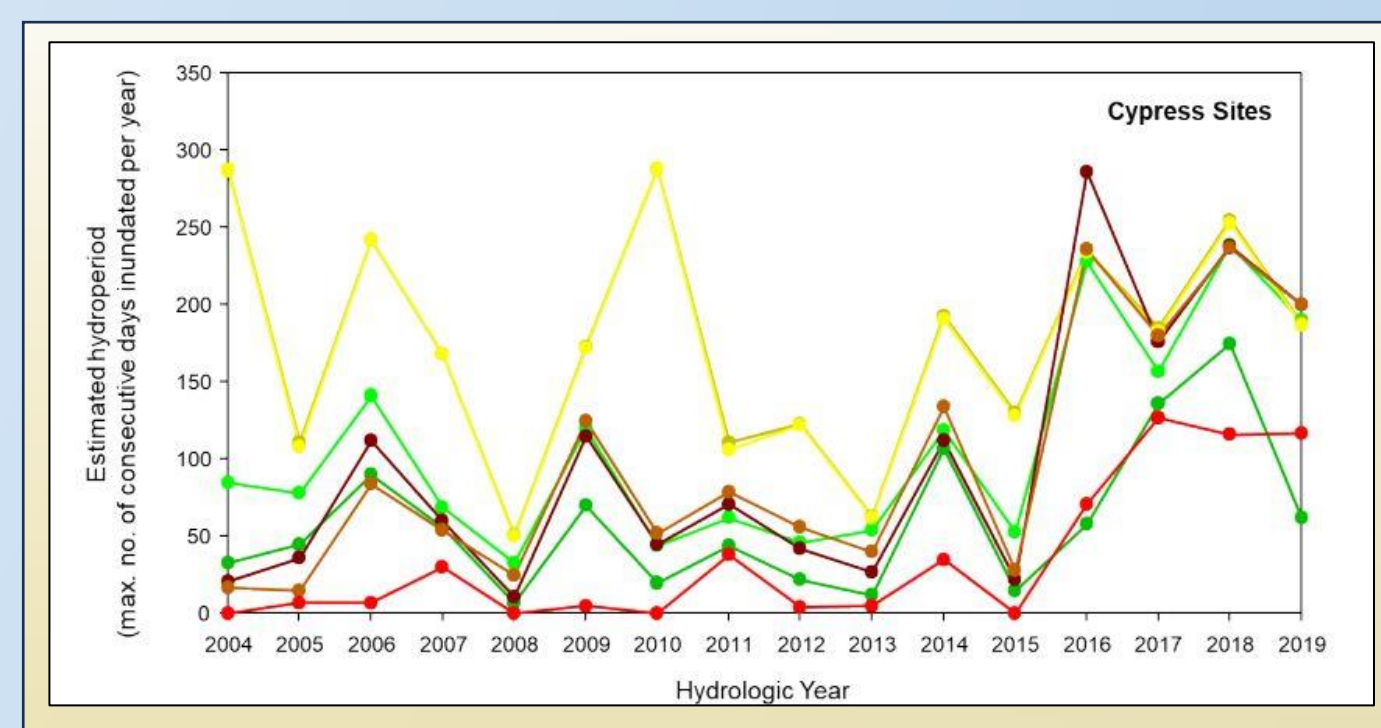

Figure 9 - Estimated hydroperiod (maximum number of days continuously inundated per year) of cypress aquatic fauna monitoring sites WY2004-2019 (Ceilley et al. 2020)
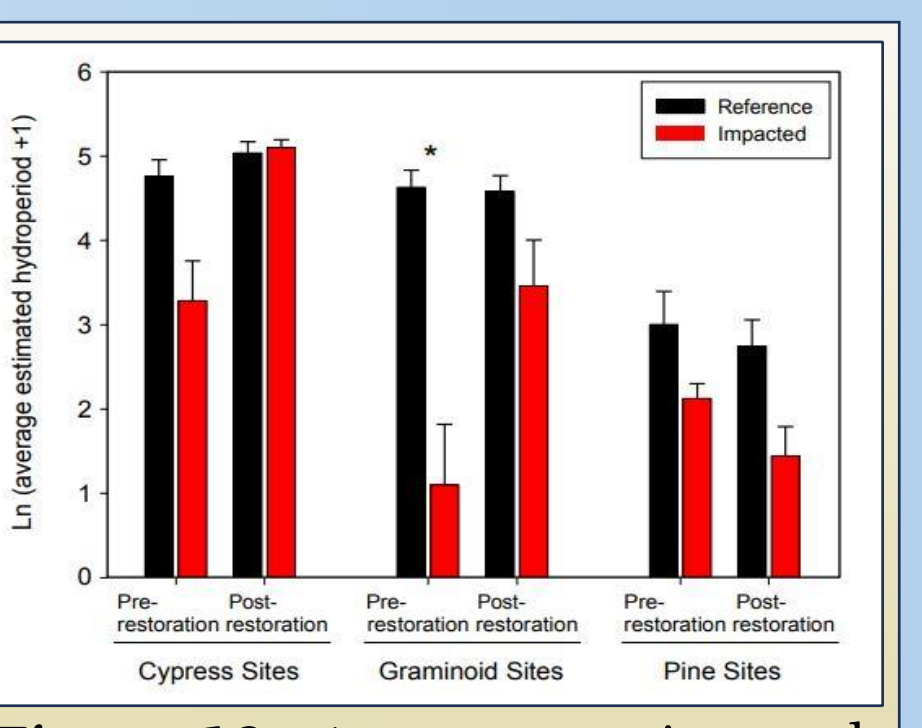

Figure 10 - Average estimated hydroperiod of reference and impacted sites before/after hydrologic restoration (Ceilley et al. 2020)

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