Factors Affecting Fish Community Structure at Babcock Ranch, Charlotte and Lee Counties, Florida

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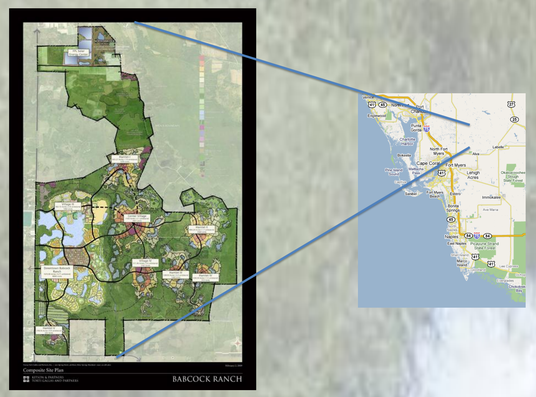
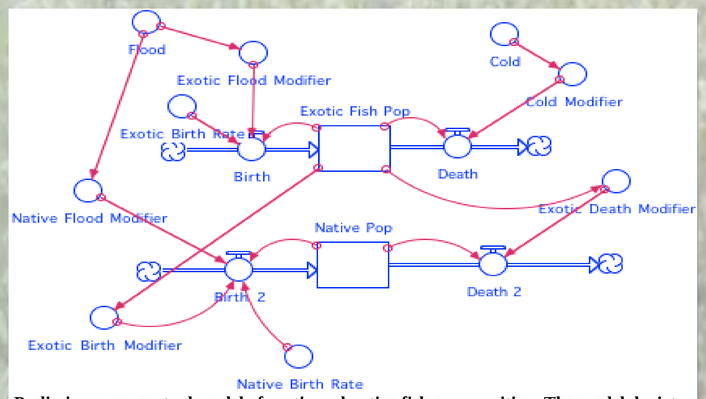


Abstract

Fish and aquatic macroinvertebrate communities were monitored across the 91,000+ acre Babcock Ranch between October 2006 and February 2010. A total of 31 sites, 24 of which are water quality sampling stations, were sampled three times per year to assess aquatic fauna and document seasonal fluctuations in community structure. Sites included: cypress strands, cypress domes, marshes, drainage canals, and small streams. Sampling methods were adopted from the baseline assessment of aquatic fauna for the Picayune Strand Restoration Project (Ceilley 2008). Ten clear plastic fish traps (Breder 1960) were deployed for one hour at each site to sample fish communities. Supplemental fish sampling was also conducted using dip nets, seines, modified crayfish traps, and cast nets in order to build a complete species list for each site. A total of 26 fish species, representing 14 families have been collected including seven non-indigenous (exotic) fish species from four families. The most dominant species in terms of total abundance and overall percent composition were the native eastern mosquitofish (*Gambusia holbrooki*; Poeciliidae) (>60%) and the invasive exotic African jewelfish or jewel cichlid (*Hemichromis letourneuxi*; Cichlidae) (>21%). As an invasive non-native species, *H. letourneuxi*, relies on stochastic events, such as floods for migration and spawning activity and to expand its distribution. Over decades, anthropogenic activities including construction of canals and agricultural drainage systems at Babcock Ranch have altered natural hydro-patterns and facilitated the expansion of invasive fishes, especially the jewelfish. While disturbance and other factors aid the invasive species, others environmental factors limit their distribution and abundance. These environmental factors include 1) limited cold tolerance of tropical and subtropical species that ultimately limits their northern distribution in peninsular Florida and 2) seasonal dry-down in wetland habitats. To better understand patterns of invasive fish movements and distribution across the Babcock Ranch watershed we are modeling the effects of hydrologic and cold weather events and their effects on fish community structure and distribution. The model is currently being field calibrated using fish sampling data collected prior to and immediately after floods, seasonal dry-down, and extended cold weather events between 2007-2010. Based on our monitoring of pre-post cold events in 2009 and 2010, we found that invasive exotic fishes (mainly *H. letourneuxi*) were extirpated from natural streams and utilized canals as thermal refugia. Conversely, native fishes appear to thrive in natural streams post cold events and are less dependent on canals for survival during dry-down and during cold events based on our study.

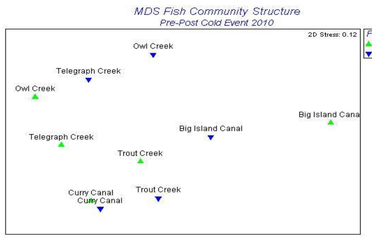
Methods

- Of 31 sites monitored for aquatic fauna since 2008, five sites were chosen based on habitat types (stream, impacted stream & canal) and observed differences in fish communities (Ceilley and Johnson Eng. 2010).
- Ten clear plastic fish traps (Breder 1960) were deployed for one hour at each site. Qualitative sampling with other methods was also conducted.
- Sampling took place in 2009 and 2010 to evaluate seasonal changes in fish community structure –and- the response to two separate cold events.
- Multivariate analysis of the data was conducted using Primer v6 (Clarke and Gorley 2006).
- Over time, results will be used to develop and calibrate a simulation model for the response of native and invasive non-native fishes to seasonal flooding and cold events.

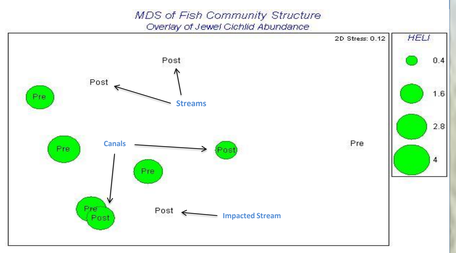


Preliminary conceptual model of exotic and native fish communities. The model depicts interactions between native and exotic fish and their response to random stochastic events (i.e. seasonal flooding and infrequent cold events).

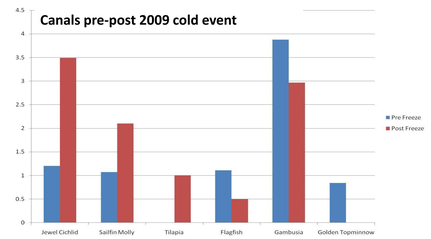
Results

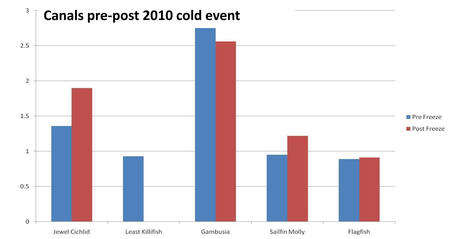


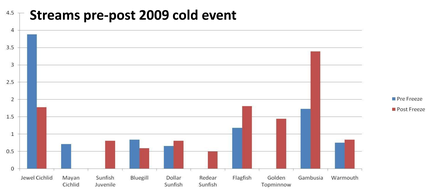
MDS ordination of fish communities from all stream, impacted stream, and canal sites pre-post 2010 prolonged cold event.

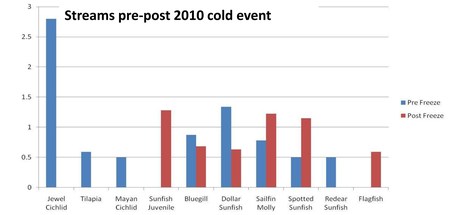


MDS ordination with overlay of Jewel cichlid abundance (4th root). Note the mortality of Jewel cichlids in stream and impacted stream habitats but survival in canals.

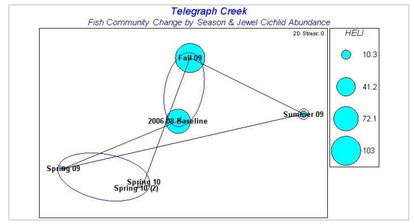


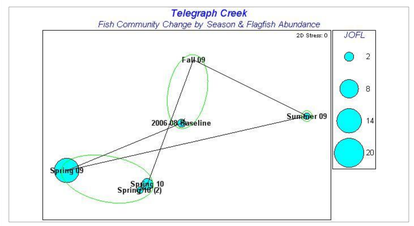


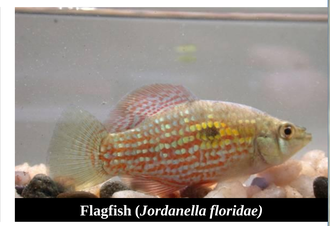


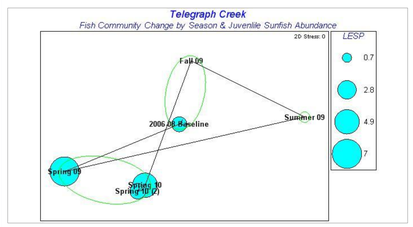


Bar graphs represent change in fish species abundance (4th root) in canals (top) and streams (bottom) in response to cold events in 2009 and 2010. Species include only those that contributed to ≥ 90% of the dissimilarity between pre-post cold event fish communities. Note: higher species richness in the stream habitat and disappearance of non-natives following 2010 cold event.









MDS ordinations of fish community change seasonally at Telegraph Creek (natural stream) including the affects of cold events in 2009-2010 with overlays of the abundance of non-native Jewel cichlids (top), native Flagfish (middle) and juvenile sunfish (bottom). Note the reduction (2009) and disappearance (2010) of Jewel cichlids and increase in native fishes following cold events.

Discussion

As an invasive exotic species, *H. letourneuxi* relies on stochastic events such as flooding to migrate, spawn, and ultimately expand in distribution. Babcock Ranch with decades of anthropogenic influences (canals and agriculture drainages) have altered the natural hydrology of the aquatic ecosystem. Disturbances and environmental factors, such as floods, aid these exotic species while other environmental factors limit their abundance and distribution. These environmental factors include (1) limited cold tolerance and (2) seasonal dry-down of wetlands. Our findings indicate that a prolonged cold event resulting in stream water temperatures of 11-15^0 C with canal water temperatures of 21-24^0 C severely restricted *H. letourneuxi's* distribution.

The results show the presence/absence and abundance of *H. letourneuxi* both before and after the freeze and survival only in canals with massive die-offs in natural stream habitats. Canals provide thermal refugia for *H. letourneuxi* (and other exotic fish) as a result of greater depth, volume, and exposure to direct sunlight compared to the shallow, narrow, and shaded natural systems. Native fishes appear to use natural streams as dry season refugia and to respond favorably to cold events in the absence of *H. letourneuxi*. With the restoration of natural hydrologic conditions and removal of drainage canals in conjunction with occasional cold events, the distribution and abundance of *H. letourneuxi* should be greatly restricted at Babcock Ranch.

Literature Cited

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Acknowledgements

Special thanks to Kendra Willet and Church Roberts of Johnson Engineering Inc. for partnering with FGCU in the aquatic fauna monitoring program and to Kitson & Partners, LLC, owners of Babcock Ranch Community for funding and allowing us to present results at GEER. Thanks to Nicole Packard for design of the Inland Ecology Research Group logo.
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