Minimal introduction

- Interested in communication in A. leptorhynchius (Gymnotiform, wave-type, South America)
- In the lab: Much work on chirps and rises (fast and slower frequency increases)

Introduction

- Weakly electric fish actively produce electric field around body.
- Used for electrolocation (navigation, foraging) and **communication**. Pulse-type produce pulses, wave-type have a continuous discharge, never stops (straight area in spectrogram). Each fish has its own characteristic EODf, can be used to distinguish individuals.

Main question

- Field recordings: Chrips and rises, but sometimes also other, much longer, more diverse modulations.
- When looking at spectra: In some cases two fish do this at the same time, with the same modulation.
- This is new: There are reports of more gradual modulations, but not in synchrony.

Questions

What are fish doing when they syncmod?

1. Are they close during modulations?
2. Could this be jamming avoidance or a signal?
3. Do their spatiotemporal behaviors (movement patterns) change with modulations?

Methods

- Dataset recorded in Colombia 2016.
- Grid of electrodes, covered 3.5 x 3.5 meters.
- Comibining all electrodes gives us all communication signals of all fish on the grid.
- Triangulating between electrodes for estimated positions for each fish.
- Allows us to estimate where fish are and what they say at all times - in a natural population - without tagging (in fact we don't even see the fish!)
- Dataset consists of continous recs over 2 weeks!
- To detect syncmod: Covariance based approach (want to know more about event detection?).
- To detect spatial interactions: Use proximmity, velocity and heading direction.

What we found

Some examples

- As expected: Diverse syncmod (spectra).
- Lasted up to 10 minutes, very long compared to known communication signals.
- Then looked at positions during syncmod, found they are close!
- What do they do? First looked at videos of fishpos (QR code!)

Some results

- Lab suggests: Close fish shift their frequency to increase electrolocation capabities (**JAR**)
- Δ EODf: Does it increase or decrease? Does not change much, if so, it decreases. Not JAR!
- In most cases, one initiates, i.e. starts first. Who changes EODf the most?
- Here results are not as clear, but seem to suggest initiators increase more.

- Distance: Estimated distribution of dyad distances for all, interactors, interactions. Fish are close during interactions, but distr has a long tail.
- On the videos: During events, fish are closer, sometimes faster, swim towards each other. How does this relate to the start of a syncmod.
- Most important figure: Time centered around onset of syncmod.
- Rasterplot: Interaction events.
- Blue line: KDE for 'interaction events'
- Interaction events increase **after** the onset of syncmod! This also explains long tail in distro: Fish approach each other after syncmod started!
- Indicates that modulations are not JAR or side-effect of interactions, but initiate interaction!

Context

- First analysis that looked at this behavior
- Indicates that there might be more to communication than just chirps and rises.