It’s Electric(sense)! boogie woogie woogie

Chris Galvin, Katrina Gertz & Maria Zapetis **Reed College Bio342**

Can black ghost knife fish learn? If so, can they use electric landmarks to navigate in a maze? We explore the implementation of this behavior.

(1)

Black Ghost Knife Fish (*Apteronotus albifrons*)

(2)

African weakly electric fish:

- use different sensory modes (i.e. electric, visual, and tactile) synergistically in spatial navigation(4).
- use electrolocation as the primary means of navigation(4).

South American weakly electric fish:

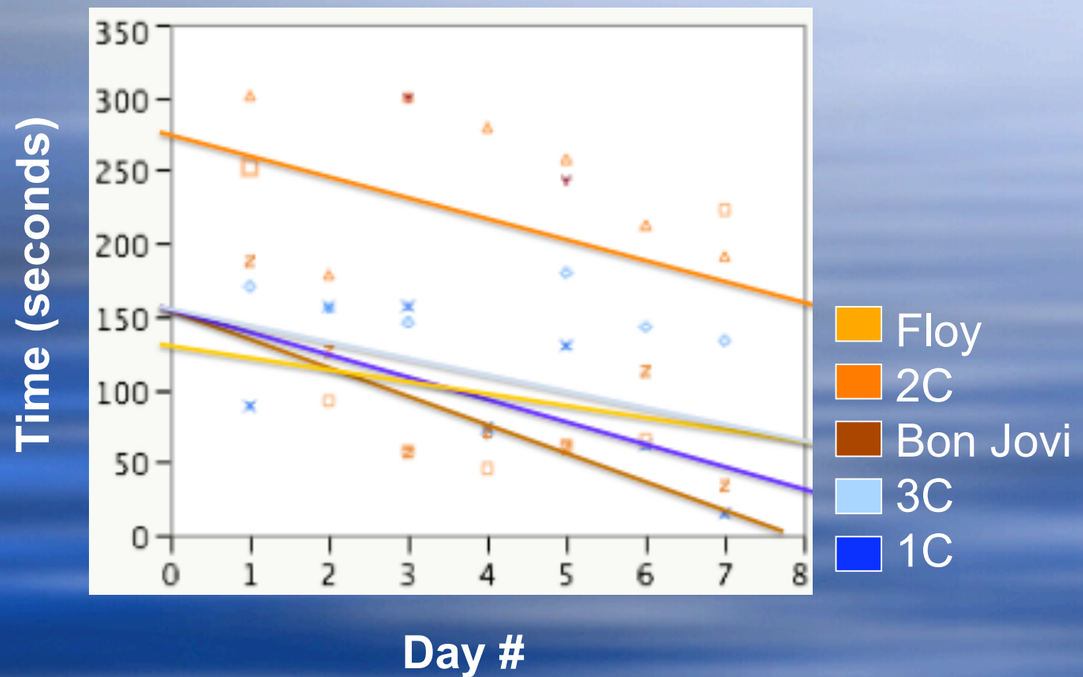
- use electrolocation as a piloting mechanism to navigate in the wild(3).
- little is known about how they use electric landmarks for spatial navigation.

We chose a representative of this group in our study in order to investigate this phenomena in a less studied species.

Maze Test: Path Acquisition

Fish were trained to seek a shelter in a maze consisting of an electric roadmap of alternating copper and PVC landmarks.

Hypothesis: Black ghost knife fish can learn over time.



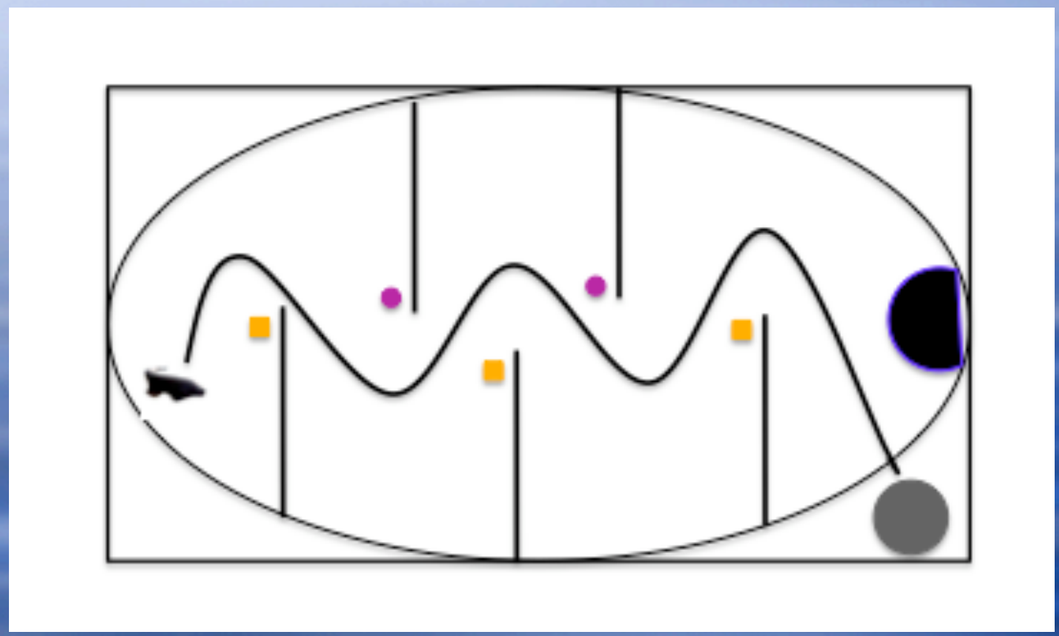


Figure 1. Learning curve for fish (N=5) over 8 days. The control group (3C, 1C) is shown in shades of blue; experimental group (2C, Bon Jovi, Floy) is shown in shades of orange. Graph and best fit line generated in JMP 7 but drawn into PowerPoint 2008.

Figure 2. Diagram of maze test. Orange squares symbolize cooper tubing (electroconductive landmarks) and purple circles symbolize PVC tubing (electroinductive landmarks).

Maze Test: Roadmapping

Hypothesis: Black ghost knife fish use electric landmarks to navigate in a maze.

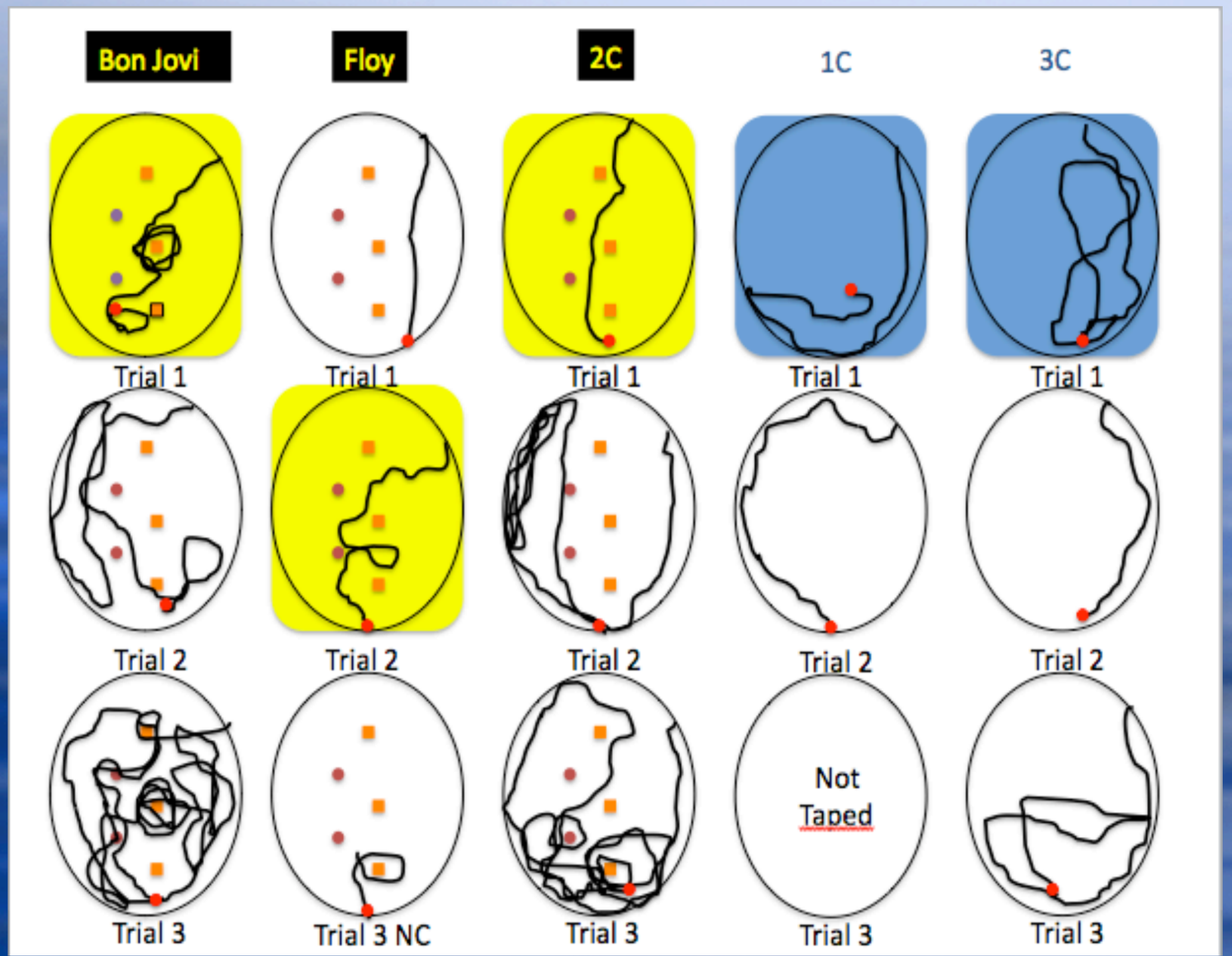


Figure 3. Path recall maps of both experimental (yellow) and control (blue) groups tested on day eight. The red dot indicates the start point in all trails; orange squares indicate copper (electroconductive) landmarks and purple circles indicate PVC pipe (electroinductive) landmarks in the experimental group. The highlighted trials indicate significant use of electric landmarks. Maps were created on Microsoft PowerPoint 2008 based on video recording of experimental trails.

We Conclude that:

Black ghost knife fish use electrolocation in maze navigation.

Future Directions:

To investigate how the ability to navigate using electrosense:

- develops over the lifespan of an individual fish.
- varies across different orders of weakly electric fish (e.g. African v. South American).
- aids in individual foraging and/or mating ability, and whether this contributes to or retracts from its lifetime reproductive fitness.

To investigate the role of other sensory modes (i.e. visual, tactile, and/or olfactory) on spatial navigation in weakly electric fish.

References:

(1) http://www.petazon.com/price/product/Ghost-Shrimp.html
(2) http://www.recipeapart.com/black-ghost-knife-fish/
(3) Cain, P. and Malwal, S. (2002). Landmark use and development of navigation behaviour in the weakly electric fish *Gnathonemus petersii*(Mormyridae; Teleostei). *J of Exp Biol*, 205: 3915-3923.
(4) Walton, A. G. and Moller, P. (2010). Maze Learning and Recall in a Weakly Electric Fish, *Mormyrus rume proboscirostris* Boulenger (*Mormyridae*, *Teleostei*). *Ethology*, 116: 904-919.

Acknowledgements:

Our sincere thanks to Suzy Renn for the direction and feedback, Peter Moller for inspiring our independent project and supplying us with his research, Laurel Oldach and Kelsey Wood for testing our water pH, Ammonia, & aiding us throughout of experimentation.