Characterizing movement patterns of native and non-native fishes in the Stanislaus River

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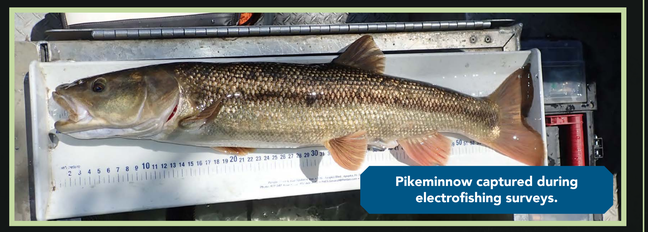
Introduction and background:

- Limited information is available on movement patterns of native and non-native fishes in the San Joaquin River Watershed.
- Capture-recapture and resighting data from Stanislaus River studies* conducted from 2018-2024 were used to fill in this knowledge gap.
- Study area included the lower 64 km of the Stanislaus River (**Figure 1**).
- Boat electrofishing was used to capture black bass, striped bass, catfish, sunfish, Sacramento Pikeminnow, and hardhead.



Pikeminnow captured during electrofishing surveys.

- Surveys were performed 4-6 times from February to June of each year.
- Data also included PIT-tagged fish detections at the Stanislaus River weir and fyke traps on the San Joaquin River, both operated by FISHBIO, as well as two stream-width antennas operated by Cramer Fish Sciences.
- **Findings from this study can provide important context for abundance estimates and are a first step to characterize movement patterns of both native and non-native fishes in the Stanislaus River.**

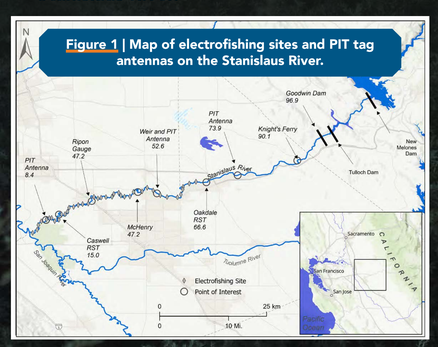


Figure 1 | Map of electrofishing sites and PIT tag antennas on the Stanislaus River.

*Visit fishbio.com/stanislaus-native-fish-plan or **Scan the QR Code** to learn more about our studies on the Stanislaus River.

Research questions

1. What proportion of recaptures occurred within versus between seasons?
2. How far, and in what direction (upstream/downstream) did recaptured fish move, and were differences evident among target species?
3. Is there evidence of PIT tagged fish in the Stanislaus leaving the study reach either in an upstream or downstream direction? If so, how many fish and what species have been observed outside of the study reach?

Data Analyses:

For recaptured and resighted fish, the following information was summarized for each detection event:

1. The number of days at large (the number of days between tagging and recapture event(s).
2. The distance of movement (km)
3. The direction of movement.
4. Recaptures were divided into two categories; 'within-year'(WY) and 'between year'(BY). WY fish were recaptured in the same year they were tagged. BY fish were recaptured in the year following tagging.

Checking for potential recapture.

Key Findings (1): Overall recapture and resighting patterns

- Total **9,023 fish tagged** from 2018-2023.
  - 1,728 total detections from 2018-2024.
- In general, there were more within year detections than between year detections **(Figure 2).**
- Most commonly tagged predator: Black bass – 5,177 tags.
  - 1,065 total detections; accounts for 57% of detections across all species and groups.
- Least commonly tagged predator: Catfish – 158 tags.
  - Only 12 detections; lowest detection rate.
- Highest detection rate by species/group: Hardhead (23% were detected again after initial capture)

(Note: "detections" include both recaptures during electrofishing and resightings at antennas)

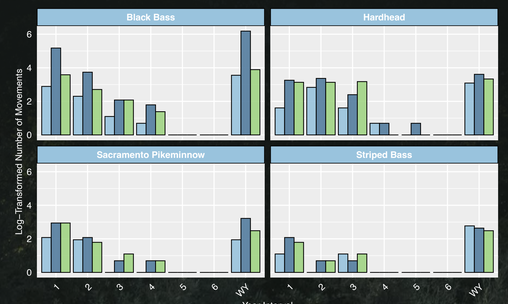


Figure 2 | Summary of number and direction of movements for four groups of species at different year intervals between tagging and recapture. WY (within year) represents movement data from fish that were recaptured in the same year they were tagged.

3. PIT tag antenna (center of image) at the Stanislaus River weir where tagged fish can be detected.

4. Boat electrofisher used for recapture of tagged fish during the next sampling event.

Methodology

1. Cataraft electrofisher used to capture fish.

2. Fish tagged with PIT tag.

Key Findings (2): Days at Large

- One black bass and one Sacramento pikeminnow were detected **~6 years after initial tagging**, the longest of any other study fish.
- Hardhead, sunfish, striped bass, and catfish were at large for 5, 3.5, 4, and 3 years, respectively.

Catfish

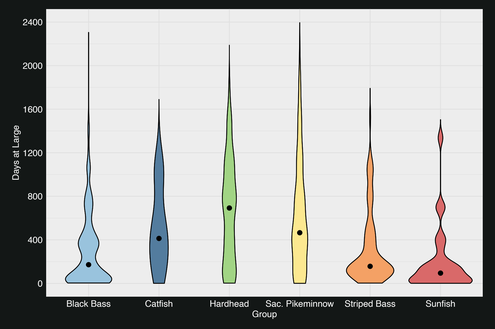


Figure 3 | Plot of the distribution of number of days at large for all species (or groups) with recaptures during electrofishing surveys and detections at PIT tag antennas on the Stanislaus River (2018 – 2024). Black points indicate the median for each species or group.

Key Findings (3): Direction and distance of movements

1. **71% of black bass movements** (759 out of 1,065 total movements) were **categorized as "no movement"** indicating the fish was detected in the same location it was tagged (14% were upstream; 15% downstream).
2. Less data was available on striped bass movements (n = 103 total movements), but no major differences in movement direction were observed (32% no movement, 35% downstream, 33% upstream).
3. The **longest recorded movement** during the study was by a striped bass, which traveled upstream over a period of 38 days from river kilometer (rkm) 0.3, where it was captured, to rkm 73.9, where it was detected at the Orange Blossom Bridge (OBB) antenna.
4. All groups/species except for catfish had individuals that were detected upstream of the study reach at the OBB antenna. Very few fish were recaptured downstream outside of the study area in the San Joaquin River fyke traps: 1 black bass, 4 striped bass, and 1 catfish.
5. **Sacramento pikeminnow had the highest number of movements upstream**, outside of the study area (n = 81 upstream movements). Hardhead were also frequently detected moving upstream out of study area at the OBB antenna (n = 113 upstream movements).

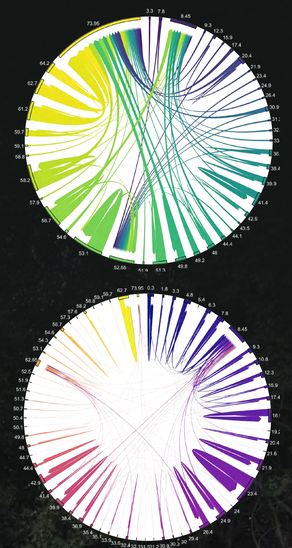


Figure 4 | Diagrams depicting movement patterns of Sacramento pikeminnow (top) and black bass (bottom) in the Stanislaus River. The base of the arrow indicates the capture locations (rkm) of the fish and the point of the arrow indicates the last known location of the fish.

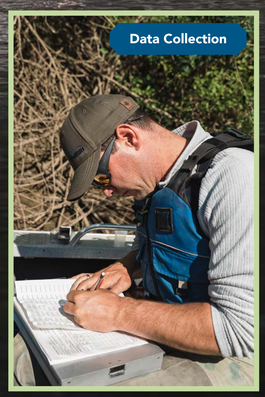
Key Takeaways

- Movement patterns of black bass were best characterized due to an abundance of data.
- Black bass displayed apparent high site fidelity with a majority of detections in the same location.
- Limited data availability hindered movement characterization of other species.
- Data from independently operated PIT Tag antennas suggest that striped bass, Sacramento pikeminnow, hardhead, and sunfish made longer distance movements,occasionally outside of the study area.
- Sacramento Pikeminnow detections at the OBB PIT Tag antenna from 2021-2024 suggest a pronounced movement pattern upstream of the study area.

Black Bass

Future Analyses

- Use detection data to estimate black bass survival over the study period.
- Conduct analysis of annual growth rates for black bass using sizes of bass at capture and recapture.



Data Collection

Acknowledgements

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