**Instructions:** Complete this worksheet to prepare for an in-class activity in which you will investigate the migration patterns of sicklefin redhorse.

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The sicklefin redhorse was recognized by the Cherokee people as Ugiidatli, which translates as “the fish that wears the red feather”. Describe the significance of this fish and other redhorses to the Cherokee people.

*The sicklefin redhorse was only recognized as a distinct species in 1992 but was known by the Cherokee many centuries prior. The fish represents part of the cultural heritage of the Cherokee people. Practically, redhorses were a valuable food fish for the Cherokee. During the redhorse migration, Cherokee constructed weirs (funneling traps) in rivers to trap many redhorses. This would provide an abundant food source, often supporting large gatherings of the Cherokee Nation in the spring.*

Provide a brief description of the sicklefin redhorse, including its range and any characteristics associated with its migration.

*The sicklefin redhorse is identified by its falcate dorsal fin and red coloration on the dorsal and caudal fins. It migrates upstream to the headwaters of the rivers that it inhabits in western North Carolina and north Georgia. Its migration begins in April and proceeds through early May around water temperatures of 12°C. Multiple species of redhorse migrate upstream to spawn, but the migration occurs at differing times to reduce competition among species for spawning habitat. A thorough review of sicklefin redhorse migration is described in:*

*Favrot, S.D. and T.J. Kwak. 2018. Behavior and reproductive ecology of the sicklefin redhorse: an imperiled southern Appalachian Mountain fish. Transactions of the American Fisheries Society 147:204 – 222.*

Review the assigned pre-class videos. These videos discuss sampling methods and some of the conservations actions that are being implemented to protect and restore sicklefin redhorse populations throughout their range.

Describe the methods being used to capture and study sicklefin redhorse.

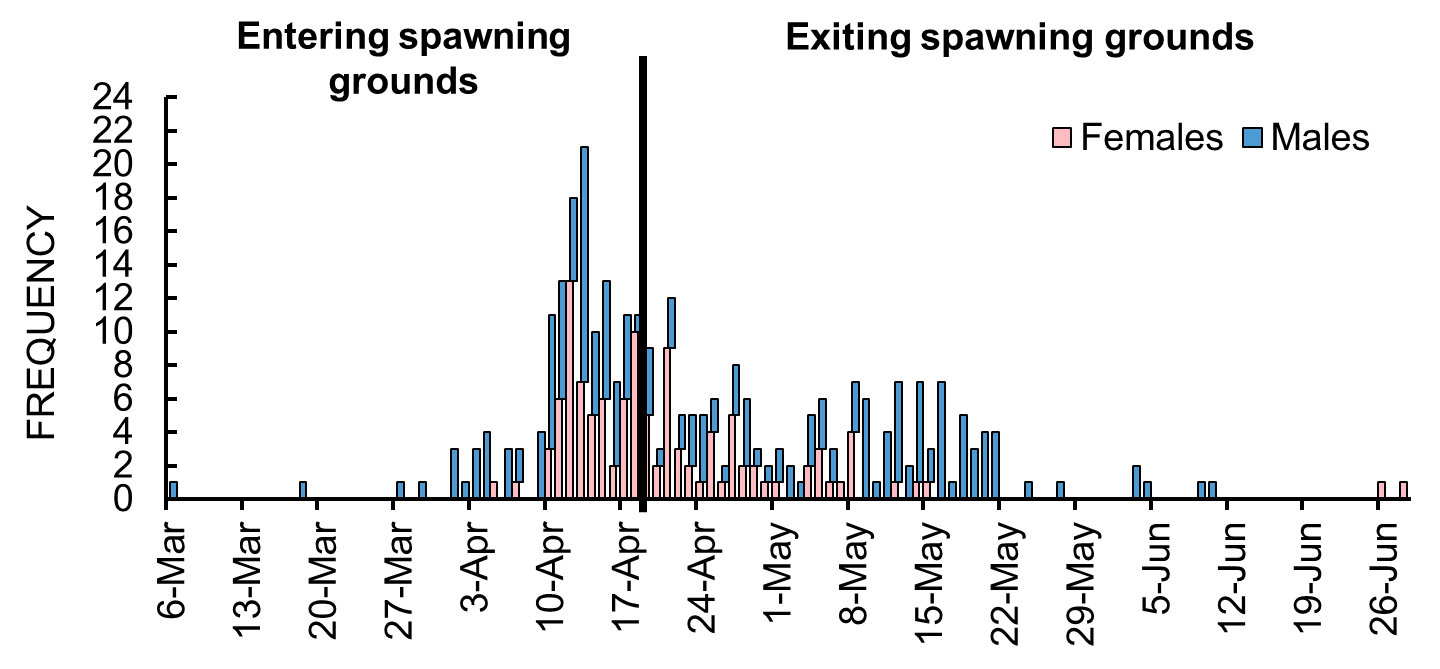
*Sicklefin redhorse are captured during their upstream migration with a fyke net (shown to the right) and tagged so that biologists can track their migration patterns and calculate population abundance.*

Describe the conservation actions being implemented to conserve the sicklefin redhorse.

*Biologists are collecting data on population abundance using tagged fish. They are able to determine survival rates as well based upon individuals returning to spawn each year. Several agencies have partnered together as part of a Candidate Conservation Agreement to take conservation actions that will prevent the listing of the sicklefin redhorse on the Endangered Species List. This includes collecting eggs and producing hatchery raised fish to reintroduce the species into rivers that they occurred in historically and augmenting existing populations. Partners are also working together to remove old dams in rivers that are barriers to the migration of redhorses.*

Review the dataset that has been provided on the movement of sicklefin redhorse in Brasstown Creek. The data set was based upon sicklefin redhorse that were capture in a fyke net and tagged with a passive integrated transponder (PIT) tag. An antenna was deployed along the stream bottom during the spawning season that detected individuals moving upstream and downstream. The data set contains the following columns of data:

* **Individual** – A unique number assigned to each individual fish
* **First Date** – The first date that an individual was detected by the antenna, representing when the individual migrated into the spawning grounds.
* **Last Date** – The last date that an individual was detected by the antenna, representing when the individual migrated back downstream.
* **Year** – The year of the detection, being either 2017 or 2018.
* **Residence Time** – The number of days between the first date of detection and the last date of detection, representing the time of residency in the spawning grounds.
* **Total Length** – The size (mm) of the sicklefin redhorse as measured from the tip of the snout to the tip of its caudal fin (or tail).
* **Sex** – The biological sex of the individual (male or female) based upon the expression of spawning tubercles on the fins.

The figure above shows the migration pattern of the sicklefin redhorse in Brasstown Creek. This data was constructed based upon the movement of tagged fish across an antenna that detected their movement patterns. Detections to the left of the black line mostly demonstrate “first detections” of individuals migrating upstream and entering the spawning grounds. Detections to the right represent the “last detections” of individuals fish, representing downstream movement of fish migrating out of the spawning grounds.

What patterns are observed in the spawning migration of the sicklefin redhorse based upon the figure shown above?

*Migratory individuals are observed from as early as 6-Mar to as late as 26-Jun. It appears males enter the spawning grounds ahead of females and reside in the spawning grounds longer. Most females enter into the spawning grounds over the course of a week and then leave before males. As suggested by Hudson et al. (2023), the characteristic of redhorses remaining in the spawning grounds and delaying their downstream migration enhances the nutrient contribution to the stream. Astute students may notice that the timing of the sicklefin migration occurs slightly earlier than the peak migration period reported in Hudson et al. (2023) and reviewed in the previous lesson. Black redhorse and golden redhorse are much more abundant than sicklefin redhorse and migrate later, generally in early May.*

Based upon the figure and the data set, propose two hypotheses to test related to the sicklefin redhorse migration and construct a prediction for each hypothesis. Propose a method of statistical analysis for each hypothesis.

*Many hypotheses can be generated. Examples may include whether there are differences in residence time among years, sex, or fish size (based upon total length). An example is provided.*

*Hypothesis: Residency time of sicklefin redhorse is related to the total length of a fish.*

*Prediction: As total length of a fish increases, the residency time of the fish will decrease.*

Identify the independent and dependent variable for each hypothesis. Suggest a statistical analysis that can be used to test the hypothesis.

*A comparison of mean residency time between Year or Sex can be conducted with a t-test. A comparison among residency time and total length can be conducted with regression analysis.*

Construct a graph that supports each hypothesis and prediction.

*A box-and-whiskers plot is recommended for group comparisons of residency time. A scatter plot is recommended for visualizing the relationship between residency time and total length. Some students may suggest separating out the relationship based upon sex as shown below.*

