Spawning

Definitions:

Spawning- The process by which fish release eggs and sperm to reproduce, often in specific habitats under particular environmental conditions.

Pairwise Spawning- A reproductive strategy where one male and one female coordinate to release sperm and eggs simultaneously.

Broadcast Spawning- A reproductive strategy where multiple individuals release eggs and sperm freely into the water column, often with little direct coordination.

Homing- The behavior of returning to a specific spawning location, often the same site where the fish was born.

Semelparous- A reproductive strategy in which a fish spawns once in its lifetime and then dies shortly after.

Iteroparous- A reproductive strategy in which a fish can spawn multiple times over its lifespan, surviving and potentially returning to spawn in future.

Stress- a physiological response to a challenge or disturbance that disrupts the fish's internal balance, or homeostasis.

Description of Process:

Spawning is a key biological function that influences seasonal migration, habitat use, and species persistence. It often follows specific timing and location patterns, with different species using different strategies. Some reproduce through pairwise spawning, while others use broadcast spawning with group-based release of gametes.

Many anadromous fish are homing species, meaning they return to the same area where they were born to spawn. This can create localized hotspots of reproductive activity, but also increases sensitivity to habitat quality and access. Spawning success depends on environmental conditions such as temperature, salinity, flow velocity, depth, and in some cases substrate. When substrate data are unavailable, depth and velocity can serve as proxies for suitable habitat.

Spawning occurs only in mature individuals. Juveniles and early life stages do not participate in reproduction. The decision to spawn depends on species-specific maturity, energy reserves, environmental cues, and timing. After spawning, some species die (semelparous), while others survive and may spawn again in future years (iteroparous).

In modeling, spawning behavior should include readiness, location selection, species-specific strategies, and outcomes such as mortality, energy depletion, or recovery. Where and when spawning occurs can shape recruitment, contaminant exposure, and long-term population dynamics.

Little Facts:

- Spawning may be triggered by a combination of temperature, salinity, photoperiod, and discharge.
- Pairwise spawners may require close proximity and behavioral coordination between sexes.
- Broadcast spawners often rely on synchronous group behavior and favorable flow conditions.
- Homing increases site fidelity but can also make populations vulnerable to habitat loss.
- Post-spawning mortality is common in some species (e.g., semelparous fish like alewives), while others may survive and spawn again (iteroparous).
- Spawning in contaminated areas can expose eggs and larvae to pollutants, affecting survival.
- Overlapping spawning areas may lead to interspecific interference or increased competition for habitat.

Discussion Objectives:

- Is this function accurate and realistic to your knowledge?
- Which species in the model are spawning (iteroparous or semelparous?), and which are not?
- What strategy does each species use to spawn (pairwise or broadcast)?
- Where in the estuary or river system do you expect spawning to occur for each species, and what environmental conditions drive that?
- How should the model represent spawning readiness or timing?
- What kind of model outputs would reflect spawning accurately?
    - Does timing or location influence spawning success or overwintering?
    - Are some species more likely to experience spawning failure due to energy limitations, poor conditions, or contaminant exposure?