**Environmental Flow Components (EFCs)**

Five major components of flow are ecologically important: extreme low flows, low flows, high flow pulses, small floods, and large floods. These five components of flow regimes are known as “environmental flow components.”

The five flow components provide a heuristic framework for describing the ways in which an organism experiences river flow variability. For instance, low flows determine the amount and characteristics (e.g., temperature, flow velocity, connectivity, etc.) of aquatic habitat that is available for most of the year. From this seasonally-varying backdrop of low flows, several kinds of flow “events” may occur that typically trigger responses in aquatic organisms. EFCs reflect a full spectrum of flows to support a full spectrum of resources, and are not tailored to just one species. These events are further described as follows:

* **Extreme low flows** that occur during times of drought may alter water chemistry, concentrate prey species, dry out low-lying areas in the floodplain, and are often associated with higher water temperature and lower dissolved oxygen conditions. These very low flows can reduce connectivity, thereby restricting movement of some aquatic organisms. Because native species may be adapted to the extreme low flow events that naturally occur, these periodic events may allow natives to outcompete generalist invasive species that are not adapted to extreme low flows
* **High flow pulses** occur during rainstorms or brief periods of snowmelt. Water levels rise above low flow levels but do not overtop the channel banks. For many organisms, these short-term changes in flow may provide necessary respite from stressful low-flow conditions. These pulses of fresh water may relieve higher water temperatures and low dissolved oxygen availability typical of low flow conditions, flush wastes, and deliver organic matter that nourishes the aquatic food web. High flow pulses typically facilitate improved access to up- or downstream areas for mobile organisms.

* **Small floods** are river flows that overtop the main channel banks and occur frequently, e.g., every 2-10 years. These floods allow fish and other mobile organisms to access floodplains and habitats such as secondary channels, backwaters, sloughs, and wetlands. These areas can provide significant food resources allowing for fast growth ([Jeffres et al, 2008](http://development.carousel30.com/projects/cg-www/file/bibliography-freshwater-conservation-publications)), offer refuge from high-velocity, lower-temperature water in the main channel, or be used for spawning and rearing. Small floods may recharge shallow aquifers and the hyporheic zone important to macroinvertebrates and riparian plants.
* **Large floods** occur rarely but play a critical role in a river ecosystem. They can move significant amounts of sediment, wood and other organic matter, form new habitats, and refresh water quality conditions in both the main channel and floodplain water bodies. These floods can flush fine sediment from spawning beds, transport organisms downstream, and remove vegetation from bars, islands and banks, all of which can be advantageous for some species and problematic for others.

Each of these flow conditions plays an important role in the long-term health of a river ecosystem. Native organisms’ life histories are tied to the timing, magnitude, duration, and frequency of these events.

The following table lists key ecological roles of each of the environmental flow components (combining large and small floods):

|  |  |
| --- | --- |
| **Environmental Flow Component** | **Ecological Roles** |
| **Low (Base) Flows** | |  |  | | --- | --- | | **•** | Provide adequate habitat space for aquatic organisms | | **•** | Maintain suitable water temperatures, dissolved oxygen, and water chemistry | | **•** | Maintain water table levels in floodplain, soil moisture for plants | | **•** | Provide drinking water for terrestrial animals | | **•** | Keep fish and amphibian eggs suspended | | **•** | Enable fish to move to feeding and spawning areas | | **•** | Support hyporheic organisms (living in saturated sediments) | |
|  |  |
| **Extreme Low Flows** | |  |  | | --- | --- | | **•** | Enable recruitment of certain floodplain plants | | **•** | Purge invasive, introduced species from aquatic and riparian communities | | **•** | Concentrate prey into limited areas to benefit predators | |
|  |  |
| **High Flow Pulses** | |  |  | | --- | --- | | **•** | Shape physical character of river channel including pools, riffles | | **•** | Determine size of stream bed substrates (sand, gravel, cobble) | | **•** | Prevent riparian vegetation from encroaching into channel | | **•** | Restore normal water quality conditions after prolonged low flows, flushing away waste products and pollutants | | **•** | Aerate eggs in spawning gravels, prevents siltation | | **•** | Maintain suitable salinity conditions in estuaries | |
|  |  |
| **Floods** | |  |  | | --- | --- | | **•** | Provide migration and spawning cues for fish | | **•** | Trigger new phase in life cycle (e.g., insects) | | **•** | Enable fish to spawn on floodplain, provide nursery area for juvenile fish | | **•** | Provide new feeding opportunities for fish, waterfowl | | **•** | Recharge floodplain water table | | **•** | Maintain diversity in floodplain forest types through prolonged inundation (i.e., different plant species have different tolerances) | | **•** | Control distribution and abundance of plants on floodplain | | **•** | Deposit nutrients on floodplain | | **•** | Maintain balance of species in aquatic and riparian communities | | **•** | Create sites for recruitment of colonizing plants | | **•** | Shape physical habitats of floodplain | | **•** | Deposit gravel and cobbles in spawning areas | | **•** | Flush organic materials (food) and woody debris (habitat structures) into channel | | **•** | Purge invasive, introduced species from aquatic and riparian communities | | **•** | Disburse seeds and fruits of riparian plants | | **•** | Drive lateral movement of river channel, forming new habitats (secondary channels, oxbow lakes) | | **•** | Provide plant seedlings with prolonged access to soil moisture | |