**Supplementary Material 2.**

**Table 1.** Summary of studies documenting negative and positive ecological responses to flow alteration due to naturally occurring droughts and floods. Each study could potentially report both positive and negative relationships; thus, the sum of positive and negative relationships may be greater than the total number of papers.

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|  |  |  |  |  |  |  | **Ecological Response** |
| **Source of Flow Change** | **Total No. of Papers** | **No. of positive responses** | **No. of negative responses** | **Primary Flow Component** | **Primary change in flow** | **No. of papers** | **Increase** | **Decrease** |
|  |  |  |  |  |  |  |  |  |
| Drought | 14 | 4 | 13 | Magnitude | decreased magnitude (baseflows/waterlevels) | 11 | Fish abundance, richness, diversity, and herbivore abundance. Primary productivity. Algae habitat. | Fish and macroinvertebrate survival. Fish habitat, size, richness, abundance. Altered estuarine fish trophic structure. Altered behavior and migration. |
|  |  |  |  |  | decreased magnitude (non-flooding during drought) | 1 |  | Organic matter decomposition. |
|  |  |  |  | Frequency | decreased high flow frequency | 1 | Fish abundance and richness. |
|  |  |  |  | Duration | intermittency | 1 |  | Macroinvertebrate abundance. Alterations in macroinvertebrate community composition. |
|  |  |  |  |  |  |  |  |  |
| Flood | 24 | 15 | 13 | Magnitude | increased magnitude from flooding | 13 | Fish richness, diversity, eveness. Fish migration into floodplain. Macroinvertebrate drift into and out of floodplain. Riparian vegetation habitat. Flood-tolerant tree growth. Organic matter export and nutritional quality.  | Non-native fish occupancy. Fish abundance. Flood-intolerant tree growth. Altered nutrients, salinity, and organic matter input to estuaries. |
|  |  |  |  | Frequency | increased frequency of flooding | 1 | Organic matter decomposition and nutritional quality.  |
|  |  |  |  |  | decreased frequency of flooding | 2 |  | Organic matter export and decomposition. |
|  |  |  |  | Duration | decreased duration of flooding/hydroperiod | 3 | Crayfish abundance. Contamination levels (Mg) in fish. | Fish and crayfish abundance. |
|  |  |  |  |  | increased duration of flooding | 4 | Growth of flood tolerant trees. Riparian tree density. | Growth of flood intolerant trees. Alterations in fish and riparian community composition.  |
|   |  |  |  | Timing | flood occurrence during late spring | 1 |   | Fish reproduction |

**Table 2.** Summary of studies documenting negative and positive ecological responses to flow alteration due to general natural variation and due to improvements in reservoir operations (e.g. flow restoration). Each study could potentially report both positive and negative relationships; thus, the sum of positive and negative relationships may be greater than the total number of papers.

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|  |  |  |  |  |  |  | **Ecological Response** |
| **Source of Flow Change** | **Total No. of Papers** | **No. of positive relationships** | **No. of negative relationships** | **Primary Flow Component** | **Primary Change in Flow** | **No. of papers** | **Increase** | **Decrease** |
|  |  |  |  |  |  |  |  |  |
| General Variation | 57 | 42 | 23 | Magnitude | increase magnitude of baseflows | 24 | Fish abundance, growth, richness, diversity, biomass, and dispersal. Macroinvertebrate abundance. Estuarine algal abundance. Mammal habitat. Organic matter export. Pool habitats. | Fish occupancy. Macroinvertebrate diversity. Riffle habitats. |
|  |  |  |  |  | decreased magnitude of baseflows | 9 | Non-native macrophyte abundance. Fish dispersal. Shallow pool habitats. Primary production. | Endemic estuarine macrophyte abundance. Fish abundance, habitat, reproduction. Alterations in fish behavior. Mammal abundance.  |
|  |  |  |  |  | increases in high flow magnitude | 11 | Fish spawning habitat and dispersal/migration. Organic matter export. | Fish abundance and reproduction. Fish dispersal/migration. Alteration in fish behavior. |
|  |  |  |  |  | increased variability (increases/decreases from moderate flows). | 5 |  | Fish abundance. Riparian tree growth. |
|  |  |  |  | Frequency | increased frequency of high flows | 2 |  | Mussel growth. Fish IBI scores. |
|  |  |  |  | Duration | increased duration of flows | 3 | Riparian vegetation habitat. Juvenile and adult fish occupancy. | Juvenile fish abundance and occupancy.  |
|  |  |  |  |  | decreased duration of flows | 1 |  | Fish diversity, biomass, richness. |
|  |  |  |  | Timing | increase in constancy | 2 | Fish IBI and reproduction. |
|  |  |  |  |  |  |  |  |  |
| Improve Reservoir Op | 12 | 10 | 5 | Magnitude | increase magnitude of flows | 10 | Fish abundance, biomass, richness, and habitat. Macroinvertebrate abundance and richness. | Fish abundance, diversity, and habitat. Macroinvertebrate richness. Nuissance algae abundance. |
|   |   |   |   | Duration | increased duration of hydroperiod and high flows. | 2 | Fish abundance and growth. |

**Table 3.** Summary of studies documenting negative and positive ecological responses to flow alteration due to agriculture, climate change, and channelization. Each study could potentially report both positive and negative relationships; thus, the sum of positive and negative relationships may be greater than the total number of papers.

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|  |  |  |  |  |  |  | **Ecological Response** |
| **Source of Flow Change** | **Total No. of Papers** | **No. of positive relationships** | **No. of negative relationships** | **Primary Flow Component** | **Primary Change in Flow** | **No. of papers** | **Increase** | **Decrease** |
|  |  |  |  |  |  |  |  |  |
| Agriculture | 2 | 1 | 1 | Magnitude | increase in stormflow magnitude | 1 |  | Fish species richness and density of non-guarders. |
|  |  |  |  | Rate of Change | decrease in rise rate | 1 | Macroinvertebrate density |   |
|  |  |  |  |  |  |  |  |  |
| Climate Change | 1 | 1 | 2 | Magnitude | increase in winter/spring flows | 1 | Harmful algae.  | Endemic macrophytes. Alteration in fish trophic structure. |
|  |  |  |  |  |  |  |  |  |
| Channelization | 7 | 1 | 7 | Magnitude  | Stabilized hydrologic extremes. | 1 |  | Riparian species richness. Alterations in riparian community. |
|  |  |  |  |  | increased magnitude of freshwater inflows. | 3 |  | Estuarine fish and macroinvertebrate abundance. Altered estuarine community composition.  |
|  |  |  |  |  | decreased magnitude of freshwater inflows | 1 |  | Estuarine fish reproduction and egg survival. |
|   |   |   |   | Duration | Shorter hydroperiods | 2 | Riparian coverage in floodplain swamps |  Riparian species diversity. |

**Table 4.** Summary of studies documenting negative and positive ecological responses to flow alteration due to reservoir operations, urbanization, and withdrawals. Each study could potentially report both positive and negative relationships; thus, the sum of positive and negative relationships may be greater than the total number of papers.

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  | **Ecological Response** |
| **Source of Flow Change** | **Total No. of Papers** | **No. of positive relationships** | **No. of negative relationships** | **Primary Flow Component** | **Primary Change in Flow** | **No. of papers** | **Increase** | **Decrease** |
| Reservoir Operations | 35 | 0 | 35 | Magnitude | Increased magnitude of high flows | 14 |  | Fish and macroinvertebrate abundance, richness, and habitat. Alterations in fish diet. Gross Primary Production. |
|  |  |  |  |  | Decreased magnitude of flooding | 5 |  | Riparian flooplain habitat, riparian survival, community composition. Endemic fish abundance and habitat. |
|  |  |  |  |  | Altered baseflows (min and max) | 7 |  | Fish habitats, larval fish abundance, and larval fish survival. |
|  |  |  |  |  | Increased variability in sub-daily flows | 3 |  | Larval fish abundance, fish species richness, and fish habitat persistence. |
|  |  |  |  | Frequency | Increased frequency of high flows (peaking) | 3 |  | Larval and adult fish abundance. Macroinvertebrate habitat. |
|  |  |  |  | Duration | Increased duration of high flow releases. | 3 |  | Fish reproduction, larval abundance, and fish survival. |
|  |  |  |  |  |  |  |  |  |
| Urbanization | 8 | 2 | 8 | Magnitude | Decreased magnitude of baseflows | 3 | Algal abundance. | Organic matter decomposition. Macroinvertebrate diversity.  |
|  |  |  |  | Frequency | Increased frequency of storm flows. | 3 |  | Fish richness and diversity. Alterations in fish community composition. |
|  |  |  |  | Duration | Decreased duration of storm flows (flashiness) | 2 | Macroinvertebrate community biomass. | Macroinvertebrate diversity. Diversity of fish diet. |
|  |  |  |  |  |  |  |  |  |
| Withdrawal | 22 | 3 | 20 | Magnitude | Decrease in baseflow magnitude or water level. | 20 | Algae abundance. Macrophyte coverage. | Fish and macroinvertebrate abundance, richness, and habitat. Macroinvertebrate growth and survival. Riparian richness. Organic matter export.  |
|  |  |  |  | Duration | Decrease in duration of floodplain inundation. | 1 |  | Fish floodplain habitat. |
|   |   |   |   | Duration | Intermittency | 1 |   | Fish abundance and richness. |