| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| **Species 1 – *Elliptio complanata*** | | | | | | | | |
| Bogan and Proch 1997, Cummings and Cordeiro 2011, Strayer 1993; USACE 2013 | Eastern elliptio | Permanent body of water: large rivers, small streams, canals, reservoirs, lakes, ponds | | | | | | |
| Harbold et al. 2014; LaRouche 2014; Lellis et al. 2013; Watters 1996 | Eastern elliptio | Presence of fish host species (American eel [*Anguilla rostrata*], Brook trout [*Salvelinus fontinalis*], Lake trout [*S. namaycush*], Slimy sculpin [*Cottus cognatus*], and Mottled sculpin [*C. bairdii*]) | | | | | Environmental stressors on fish species, migratory blockages | Diminished reproductive success; local extirpation |
| Sparks and Strayer 1998 | Eastern elliptio (juveniles) | Rivers | Interstitial DO > 2-4 mg/L | | | Reduced dissolved oxygen caused by sedimentation, | | Behavioral stress responses (surfacing, gaping, extending siphons and foot), increased |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| | | | | | | nutrient loading, organic inputs, or high temperatures | | exposure to predation |
| Gelinas et al. 2014 | Eastern elliptio | Freshwater | | | | Harmful algal blooms, algal toxins | | Compromised immune system, reduced fitness |
| Ashton 2009 | Eastern elliptio | Multiple environmental variables (pH, mean daily water temperature, conductivity, DOC, TP, N-N, TN, mean wetted width, fish-IBI, benthic-IBI, % agriculture, channel gradient) | | 20-24°C | | Land cover conversion in upstream drainage area, elevated nutrients, acidification, sedimentation, general channel alteration (=decreased physical complexity) | | Decreased frequency of observation, lower numbers of individuals |
| Chittick et al. 2001 | Eastern elliptio | Freshwater streams | | | | Infection with gastrointestinal bacteria, trematodes | | Digestive gland atrophy and inflammation, reduced fitness |
| Kat 1982 | Eastern elliptio | Substrate particle size | | | | Soft/muddy bottoms | | Elevated energy expenditure, reduced growth rates, diminished fecundity, clogging of filter tissue, irritation of mantle |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| | | | | | | | | tissue |
| Archambault et al. 2014 | Bivalvia | Freshwater streams | | LT50 (lethal temp.) range=33.3–37.2°C; mean=35.6°C | | Dewatering (prolonged) | Increased exposure to predation | Mortality |
| **Species 2 – *Pyganodon cataracta*** | | | | | | | | |
| Ashton 2009 | Eastern floater | Multiple environmental variables (pH, mean daily water temperature, conductivity, DOC, TP, N-N, TN, mean wetted width (MWW), fish-IBI, benthic-IBI, % agriculture, channel gradient) | | pH, ~6.8-7.4; nitrite and TN <5mg/L; ammonia ~0.04-0.09 mg/L; MWW, 4-6m; % agriculture, | | Land cover conversion in upstream drainage area, elevated nutrients, acidification, sedimentation, general channel alteration (=decreased physical complexity) | | Decreased frequency of observation, lower numbers of individuals |
| Bogan and Proch 1997 | Eastern floater | Small ponds, quiet backwaters of creeks, occasionally in larger streams and | | | | | | |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| | | rivers; bottom materials mud, sand, and/or gravel | | | | | | |
| Cummings and Cordeiro 2012 | Eastern floater | Freshwater river systerms | | | | | | |
| Dimock and Wright 1993 | Eastern floater (juveniles) | pH>4.5 (96h LC50 pH ~4.5) | Anoxic | >33°C (96h LT50 33°C) | | | | Mortality |
| Strayer 1993; Strayer and Jirka 1997 | Eastern floater | Small lowland or piedmont streams; marshes, lakes, and ponds | | | | | | |
| Tankersley and Dimock Jr 1993 | Eastern floater (brooding) | Water column particulates | | | | Increased variability of substrate particle sizes | | Reduced fitness; altered capacity for acquiring nutritional resources |
| van Snik Gray et al. 1999; NatureServe 2015 | Eastern floater (glochidia) | *Amploplites rupestris* (Rock bass), *Catostomus commersoni* (White sucker), *Cyprinus carpio* (Common carp), *Gasterosteus aculeatus* | | | | | Environmental stressors on fish species, migratory blockages | Diminished reproductive success; local extirpation |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| | | (Threespine stickleback), *Lepomis gibbosus* (Pumpkinseed), *Lepomis macrochirus* (Bluegill), *Perca flavescens* (Yellow perch) | | | | | | |
| Strayer and Malcom 2012 | Eastern elliptio | Interstitial water chemistry | | | | Un-ionized ammonia >0.02 mg/L | | Recruitment failures |
| **Taxon 3 - "Selected anodontine species": Dwarf Wedgemussel (*Alasmidonta heterodon*), Green Floater (*Lasmigona subviridis*), Brook Floater (*Alasmidonta varicosa*)** | | | | | | | | |
| Burch 1973 | All three | Rivers and streams, freshwater, nontidal | | | | | | |
| Swartz and Nedeau 2007 | Brook floater | Relatively low gradient streams, consistent flows, low nutrients, low calcium (soft waters) | | | | | | |
| Strayer and Ralley 1993; Strayer 1993 | Brook floater, Dwarf Wedgemussel | Relatively low gradient streams, consistent flows, low | | | | Flashy, scouring flows; water pollution that increases nutrients | | Local extirpation |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| | | nutrients, low calcium (soft waters); medium sand (0.25-1.0mm), water depth (mean 27.7cm, range 0.4-104 cm) and current speed (mean 11.8 cm/s, range 0.0-65.0 cm/s). | | | | and/or calcium | | |
| NatureServe 2015; Watters 1996 | Brook floater | Host fish species (laboratory): Longnose dace (*Rhinichthys cataractae*), Golden shiners (*Notemigonus crysoleucas*), Pumpkinseed (*Lepomis gibbosus*), Marginated madtom (*Noturus* | | | | | Environmental stressors on fish species, migratory blockages | Diminished reproductive success; local extirpation |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| | | *insignis*), Yellow perch (*Perca flavescens*), Blacknose dace (*Rhinichthys atratulus*), and Slimy sculpin (*Cottus cognatus*) | | | | | | |
| Campbell 2014 | Dwarf Wedgemussel | Flows, water quality (Calcium, water temperature) | | Stable temp. regime; max..<29° C | | Aragonite precipitation ($CaCO_3$), elevated water temperature | | Mortality, local extirpation |
| Strayer 1993 | Dwarf Wedgemussel, Green Floater | Freshwater, nonotidal streams, flows | | | | Unstable hydrology (flashiness) | | Mortality, local extirpation |
| Michaelson and Neves 1995; Watters 1996 | Dwarf Wedgemussel | Substrate particle sizes, water velocity; host fish species (laboratory): *Etheostoma nigrum, Etheostoma olmsteadi, Cottus bairdii* | | | | Unstable hydrology (flashiness)/preference for finer substrate particle sizes | Environmental stressors on fish species, migratory blockages | Diminished reproductive success; local extirpation |
| Clarke 1981 | Dwarf Wedgemussel | Gravel, sand, or muddy | | | | | | |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| | | bottoms, sometimes associated with SAV beds; water depth 12-18” | | | | | | |
| Strayer et al. 1996 | Dwarf Wedgemussel | Population density | | | | Any factor diminishing suitable habitat | | Lowered rates of fertilization |
| **Species 4 – *Micropterus dolomieu*** | | | | | | | | |
| Davis 1975; Spoor 1984 | Smallmouth bass (larvae) | | >6.5 mg $l^{-1}$ | | | | Eutrophication | Eutrophication results in hypoxic areas in tidal regions and reservoirs. |
| Helmus and Sass 2008; Sechnick et al. 1986; Todd and Rabeni 1989 | Smallmouth bass | Structure (logjams, rootwads, boulders) | | | | Riparian forest removal; stream clearing; siltation | | Removal of forest deprives stream of woody debris, as does direct removal of instream structure. |
| Brown et al. 2009; Davis 1975; Jones and Hoyer 1982; Murdy et al. 1997; Pease and Paukert 2014; Schmidt and Stillman 1998 | Smallmouth bass (adult) | | >6 mg $l^{-1}$ >7 mg $l^{-1}$ (spawning) | $13^{o}$ – $27^{o}$C | <5 ppt | | Eutrophication; climate change | Decreased oxygen availability, particularly in reservoirs; increased temperatures. Growth rate increased (with temperature), and therefore may be prey-limited. |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| **Species 5 – *Micropterus salmoides*** | | | | | | | | |
| Meador and Kelso 1989; Stuber et al. 1982 | Largemouth bass (fry) | Slow moving water | >5 mg $l^{-1}$ | > 15$^{o}$ C | 0 ppt | Climate change | Precipitation changes, influencing flow changes to salinity and temperature | Loss of suitable parameters for growth and recruitment to fishery |
| Love 2011; Meador and Kelso 1989; Murdy et al. 1997; Rose et al. 2009 | Largemouth bass (adult) | Slow moving water; | >3.5 mg $l^{-1}$ | 5-28$^{o}$ C | < 5ppt | Climate change, hypoxia | | Low oxygen results in low fitness; compresses habitat availability |
| Batiuk et al. 2000; Love 2011 | Largemouth bass (Adult) | SAV | | | | | Eutrophication | Loss of SAV habitat due to poor light attenuation |
| **Species 6 – *Esox niger*** | | | | | | | | |
| Armbruster 1959; Coffie 1998; Kerr et al. 2009; Murdy et al. 1997 | Chain pickerel (adult) | | | 2-23$^{o}$ C | < 5 ppt | Warming (Climate change) | | Reduced fitness at increased temps |
| Armbruster 1959; Dennison 1987; Li et al. 2007; Murdy et al. 1997; Scott and Crossman 1973 | Chain pickerel (adult) | SAV | | | | Dredging, loss of SAV | Eutrophication | Loss of SAV habitat |
| Benke et al. 1985; Jenkins and Burkhead 1994 | Chain pickerel (adult) | Snags, woody debris | | | | Dredging; removal of snags | | Loss of feeding habitat |
| Jenkins and Burkhead 1994; Meixler and Bain 2011; Moring and | Chain pickerel | Slow moving water | | | | Unknown | Unknown | Unknown |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| Nicholson 1994 | | | | | | | | |
| **Species 7 – *Morone americana*** | | | | | | | | |
| Marguiles 1988; Roessig et al. 2004; Setzler-Hamilton 1991; Stanley and Danie 1983 | White perch (larva) | | >5.0 mg $l^{-1}$ | 15-20$^{o}$ C | 0-13 ppt | | Climate change | Increased water temperatures can stress larvae and increase mortality rates, depending on food availability |
| Breitburg 2002; Hanks and Secor 2011 | White perch (juvenile) | | >40% saturation | | <18 ppt, but tolerant of 0-35 ppt | | Eutrophication | Eutrophication results in hypoxic conditions which affects fish fitness. |
| Able and Fahay 1998 | White perch (juvenile) | Level bottoms of compact silt, mud, sand or clay | | | | Dredging | | Dredging directly alters level bottoms; may also remove substantial amounts of sand |
| Batiuk et al. 2000; Kraus and Jones 2012 | White perch (adult) | SAV | | | | Dredging | Eutrophication | Dredging directly removes SAV habitat; eutrophication creates reduced water clarity, thereby inhibiting plant growth |
| Breitburg 2002; Campbell and Rice 2014; Kerr et al. 2009; Newhard et al. 2012; Setzler-Hamilton 1991; | White perch (adult) | | >4.0 mg $l^{-1}$ | 12-14$^{o}$ C (spawning)<br><br>10-27$^{o}$ C | 0-30 ppt | | Eutrophication; Climate change | Eutrophication will result in hypoxic areas that will reduce the amount of habitat white perch can utilize; |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| Stanley and Danie 1983 | | | | | | | | climate change may result in a water temperature increase, creating less than ideal conditions for spawning |
| **Species 8 – *Anchoa mitchilli*** | | | | | | | | |
| Houde and Zastrow 1991; Olney 1983 | Bay anchovy (Larva) | | >4.0 mg $l^{-1}$ | 17-27$^{o}$ C | 0-15 ppt | | Eutrophication; climate change | Hypoxia (reduced habitat volume; higher temperature creates physiological stress |
| Batiuk et al. 2009; Houde and Zastrow 1991; Olney 1983; Roessig et al. 2004; Zhang et al. 2014 | Bay anchovy (adult) | | >4.0 mg $l^{-1}$ | 5-30$^{o}$ C | 0-32 ppt | | Eutrophication; climate change | Hypoxia (reduced habitat volume; higher temperature creates physiological stress |
| **Species 9 – *Leiostomus xanthurus*** | | | | | | | | |
| Brady and Targett 2013; Uphoff et al. 2011 | Spot (juvenile) | | >3.0 mg $l^{-1}$ | | | hypoxia | Urbanization (impervious surface) | Reduced fitness and survival |
| Able et al. 2007; Bilkovic and Roggero 2008; Seitz et al. 2006; Szedlmayer and Able 1996; Zapfe and Rakocinski 2008 | Spot (juvenile) | Salt marsh | | | | Development (marsh destruction) | | Loss of habitat results in loss of fish productivity |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| Buchheister et al. 2013; Horodysky et al. 2008 | Spot (adult) | Water column (demersal) | | | | Hypoxia; water clarity | Eutrophication; Water clarity | Decreased feeding; |
| **Species 10 – *Macoma balthica*** | | | | | | | | |
| Birchenough et al. 2015; Jansson et al. 2015; Philippart et al. 2003 | Macoma (juvenile) | pH | >3.0 mg $l^{-1}$ | | | Ocean acidification; increased temps | Climate change | Acidification weakens $CaCO_2$ deposition in bivalves, reducing fitness. Increasing water temperatures will likely adversely affect phenology and create mis-match with food sources |
| Hiddink 2003a; Hiddink 2003b; Powers et al. 2002; Seitz et al. 2006 | Macoma | Tidal and intertidal mudflats | | | | Dredging; shoreline development | Contaminants (oil in particular) | Reduction in infaunal populations; mortality or reduced fitness due to contaminants |
| Dauer et al. 1987; Lippson et al. 1981; Long et al. 2008; Long et al. 2014; Philippart et al. 2007; Sturdivant et al. 2014 | Macoma (adult) | | >3.0 mg $l^{-1}$ | | 5-28 ppt | Hypoxia | Eutrophication | Disruption in coastal food webs, including phytoplankton availability; decreased burial (greater susceptibility to predation); Reduced reproductive output |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| **Species 11 – *Menidia menidia*** | | | | | | | | |
| Austin et al. 1975; DePasquale et al. 2015; Eby and Crowder 2004; Fay et al. 1983 | Atlantic silverside (larva) | | >7.9 mg $l^{-1}$ | 15°-20° C | 30 ppt (optimal growth) | | Eutrophication | Eutrophication creates hypoxic regions, leading to mortality or unusable habitat |
| Gilmurray and Daborn 1981 | Atlantic silverside (adult) | Water clarity | | | | Increased runoff | Eutrophication | Evidence that high levels of turbidity prevents feeding |
| Batiuk et al. 2000; Orth and Heck Jr. 1980; Schein et al. 2012 | Atlantic silverside (adult) | Seagrass | | | | Dredging | Eutrophication | Loss of seagrass habitat directly from dredging activities; dieback of seagrasses as eutrophication creates poor water quality conditions |
| Fay et al. 1983 | Atlantic silverside (adult) | | | 5°-30° C | 7-8 ppt (preferred); 5-33 ppt | Climate change | | Increased water temperatures will reduce fitness and increase mortality rates |
| Balouskus and Targett 2012; Bilkovic and Roggero 2008; Seitz et al. 2006 | Atlantic silverside (adult, spawning) | Salt marsh, in association with *Enteromorpha* | | | | Salt marsh destruction (shoreline hardening; development) | | Destruction of spawning habitat |
| **Species 12 – *Paralichthys dentatus*** | | | | | | | | |
| Brady and Targett 2010; Eby et al. 2005 | Summer flounder (juvenile) | | >4.2 mg $l^{-1}$ | | | Hypoxia | | Low DO reduces available habitat |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| Buchheister et al. 2013; Eby et al. 2005; Murdy et al. 1997; Sackett et al. 2008 | Summer flounder (adult) | | 6.5 mg $l^{-1}$ | 20.5 °C | Polyhaline | Ocean warming; hypoxia | | Rising temperatures result in less available habitat; rising temperatures result in lower DO concentrations |
| Packer and Hoff 1999; Rountree and Able 2007; Smith and Daiber 1977 | Summer flounder (juvenile) | Demersal; polyhaline; Seagrass beds; salt marsh dominated creeks; | | | | Dredging | Eutrophication; | Reduced water quality can eliminate seagrass habitat; Dredging can directly reduce seagrass habitat; |
| Eby et al. 2005; Sackett et al. 2008 | Summer flounder (adult) | Deeper water (>6.0m); | | | | | Climate change; hypoxia | Increasing water temperatures and hypoxia will reduce reduce demersal habitat; |
| **Species 13 – *Centropristis striata*** | | | | | | | | |
| Drohan et al. 2007 | Black sea bass (larvae) | | | 22° C | | | | |
| Arve 1960; Coen et al. 1999; Lehnert and Allen 2002 | Black sea bass (juvenile and adult) | Oyster reef | | | | Habitat destruction; disease | Loss of prey items | Decrease in black sea bass productivity from loss of foraging area |
| Berlinsky et al. 2000; Drohan et al. 2007; Schwartz 1964 | Black sea bass | | >4.0mg $l^{-1}$ | 2° C (death) 8° C (stop feeding) | > 11 - 15ppt | | Eutrophication-induced hypoxia | |
| Lehnert and Allen 2002; Orth et al. 2010; Stephan and Lindquist 1989; | Black sea bass (adult) | Seagrass; wrecks; | | | | | Eutrophication | Eutrophication causes declines in seagrass distribution, |

| Study reference | Fish/shellfish species | Habitat Requirements | | | | Threat/Stressor | | Fish/Habitat Response |
|---|---|---|---|---|---|---|---|---|
| | | Type | DO | Temp | Salinity | Direct | Indirect | |
| Weinstein and Brooks 1983 | | | | | | | | thereby reducing available habitat |

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