

APPENDIX F

**RISK LEVELS OF
NON-NATIVE AQUATIC SPECIES IN
GLEN CANYON NATIONAL RECREATION AREA AND
GRAND CANYON NATIONAL PARK**

The following table presents information about non-native aquatic species known to occur or with a potential to be present in Glen Canyon National Recreation Area and Grand Canyon National Park. It identifies the level of threat posed by each of the species to other resources, identifies potential management and control options that may be applicable and documents current information about locations of occurrence. In order keep this information up-to date, the table should be reviewed on an annual basis and revised as appropriate.

2021 Update

In 2021, updates to the species-specific risk levels and distributional information were completed based on the best available science and new information gleaned from studies completed since the completion of the EA. Consistent with the EA, threat levels were updated based on their potential for predation, competition, or other adverse interactions with native and federally listed species as well as to the recreational rainbow trout fishery. Laboratory or mesocosm experiments are in progress by the U.S. Geological Survey – Grand Canyon Monitoring and Research Center (GCMRC) to understand the relative piscivory risk of additional warmwater small- and large- bodied (e.g., common carp) non-native fishes. Preliminary laboratory study results indicate potential for important impacts to humpback chub eggs and larvae by common carp. Field studies are in progress to gain a greater understanding of the potential impacts of invasive brown trout (*Salmo trutta*) on rainbow trout populations in GCNRA, and rainbow trout impacts to native fish communities in tributaries in GCNP. Additional research is needed related to the threat of some warmwater species, including plains killifish (*Fundulus zebrinus*), that may be occasionally be found in high numbers when conditions allow.

TABLE F-1. Risk Levels of Non-Native Aquatic Species in Glen Canyon National Recreation Area and Grand Canyon National Park. Intended to Be Re-evaluated Annually.

| Common Name* | Scientific Name | Occurrence in GCNRA | Occurrence in GCNP | Level of Threat ¹ | Threat to Native Species | Threat to Rainbow Trout Fishery | Preference for Warm or Cold Water | Candidate for Releasing Small Numbers if Incidentally Caught ² | Candidate for chemical treatment ³ | Candidate for chemical rapid response | Candidate for targeted electro-fishing or trapping? | Candidate for mechanical rapid response under CFMP | Threat Notes | Location Documentation |
|-------------------------|-----------------------------|---------------------|--------------------|--------------------------------|--------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------|---------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------|-----------------------------------------------------|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fish⁴ | | | | | | | | | | | | | | |
| Smallmouth bass | <i>Micropterus dolomieu</i> | Present | Present | (1) Very High | (1) Very High | Yes | Warm | No | Yes | Yes | Yes | Yes | Highly piscivorous and considered a high threat should they begin reproducing below the dam and moving downstream into endangered fish habitat. Preys upon, and competes with native fish (AZGFD 2009; Fuller, Cannister, and Neilson 2014; NPS and FWS 2014). | Present in Lake Powell and Lake Mead and small numbers discovered below Glen Canyon Dam during AIS monitoring (NPS 2014b; Anderson 2015). Present in GCNP, exact locations unspecified (GCMRC 2014). Significant increases in SMB abundance observed in Lake Powell (Pennock and Gido 2021). |
| Walleye | <i>Sander vitreus</i> | Present | Present | (1) Very High | (1) Very High | Yes | Warm | No | Yes | Yes | Yes | Yes | Highly piscivorous and considered a very high threat should they begin reproducing below the dam and moving downstream into endangered fish habitat. Preys upon and competes with native fish (Fuller and Neilson 2012f; NPS and FWS 2014). | Present in Lake Powell and Lake Mead and small numbers discovered below Glen Canyon Dam during AIS monitoring (NPS 2014b; Anderson 2015). Present in GCNP, exact locations unspecified (Gloss and Coggins 2005; NPS 2015i; GCMRC 2014). Numbers increasing in Lake Powell with gizzard shad as new forage fish (Pennock and Gido 2021). |
| Flathead catfish | <i>Pylodictis olivaris</i> | Potential | Potential | (1) Very High | (1) Very High | No | Warm | No | Yes | Yes | Yes | Yes | Highly piscivorous and large bodied, Potential to consume large portions of native fish in similar thermal range as Colorado River in GCNP (Hedden et al. 2016). Higher piscivory rates on native fish may occur in turbid areas including river inflows to reservoir, potentially important for native fish rearing (Ward and Vaage 2018). | Present in Colorado River basin (e.g., Gila River), not currently present in GCNP or GCNRA or upstream. Occasional periods of cold water releases from GCD may prevent long term survival and recruitment in GCNP and GCNRA |
| Brown trout | <i>Salmo trutta</i> | Present | Present | (1) Very High | (1) Very High | Yes, via whirling disease = increased incidence and pathology; piscivory or competition | Cold | No | No in GCNRA, Yes in GCNP | No in GCNRA, yes in GCNP if a new source area) | Yes | No in GCNRA, yes in GCNP if a new source area) | Highly piscivorous and considered a very high threat. Competes with and preys on native fish (Fuller, Larson, et al. 2014; NPS and FWS 2014; Yard et al. 2011; Whiting et al. 2014), with population-level negative impacts to native fish (Healy et al. 2020b). Brown trout dominate (e.g., Gatz et al. 1987; Van Zwol et al. 2012) and prey upon (Tabor and Wurtsbaugh 1991) rainbow trout outside their native ranges – impacts are condition dependent (Fausch et al. 2001). | Found to be successfully reproducing in GCNRA below Glen Canyon Dam and in GCNP (reviewed in Runge et al. 2018). In GCNP, primary spawning locations for brown trout include Bright Angel Creek, and potentially, Tapeats Creek (NPS unpublished data). |
| Rainbow trout | <i>Oncorhynchus mykiss</i> | Present | Present | (2) High in GCNP, Low in GCNRA | (2) High in GCNP, Low in GCNRA | N/A | Cold | Yes | Yes in GCNP, no in GCNRA | Yes in new areas in GCNP, no in GCNRA | Yes in GCNP | No in GCNRA, yes in GCNP if a new source area) | Prey upon and likely compete with native fishes resulting in population-level responses in native fish (Whiting et al. 2014; Spurgeon et al. 2015; Yackulic et al. 2018; Healy et al. 2020b). Negatively related to | Self-sustaining below Glen Canyon Dam (McKinney et al. 2001), found throughout much of the mainstem in GCNP (Rogowski and Boyer 2019), and tributaries (Shinumo, Spurgeon et al. 2015; |

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| | | | | | | | | | | | | | distribution/abundance of native fish in Bright Angel (Healy et al. 2020b). | Havasu, Healy et al. 2020a, Bright Angel, 2020b; Tapeats, NPS unpublished data). |
| Northern pike | <i>Esox lucius</i> | Present | Potential | (2) High | (2) High | No | Cold | No | Yes | Yes | Yes | Yes | Highly piscivorous and considered a high threat should they pass through the dam, and begin reproducing and moving downstream into endangered fish habitat | Present in Lake Powell. Not found below Glen Canyon Dam to-date (NPS 2014b; Anderson 2015) |
| Green sunfish | <i>Lepomis cyanellus</i> | Present | Present | (2) High | (2) High | No | Warm | Adults-No Juveniles (<80mm) Yes up to 20 | Yes | No in RM-12, Yes in other areas | Yes | No in RM-12, Yes in other areas | Prolific and competes with and preys upon native fish and preys upon native amphibians (Fuller, Cannister, and Neilson 2012b). Competes with and preys upon native fish and preys upon native amphibians (Fuller, Cannister, and Neilson 2012b,(Ward and Vaage 2018)). | Present in Lake Powell and discovered reproducing in a small backwater below Glen Canyon Dam in August 2015-2017 (NPS 2014b; Anderson 2017). GCNP - Individual occurrences previously recorded in the Colorado River within GCNP (NPS 2015); USGS 2014b), and evidence of reproduction was found in Kanab Creek (Healy et al. 2020c) and at River Mile 243. Reproducing population discovered in GCNRA below Glen Canyon Dam in 2015. High potential for the species to expand under aridification and decreased flooding (Rogosch et al. 2019). |
| Striped bass | <i>Morone saxatilis</i> | Present | Present | (2) High | (2) High | No | Warm/Cool | No | Yes | Yes | Yes | Yes | Highly piscivorous and considered a high threat should they begin reproducing below the dam and moving downstream into endangered fish habitat, or moving up from Lake Mead in large numbers. Preys on small native fish (Fuller and Neilson 2014b). | Present in Lake Powell and small numbers discovered below Glen Canyon Dam during AIS monitoring (NPS 2014b; Anderson 2015). Present in GCNP (reviewed in Valdez and Leibfried 1999), recent locations unspecified (NPS 2015). Present in Lake Mead |
| White sucker | <i>Catostomus commersonii</i> | Potential | Potential | (2) High | (2) High | No | Cool | No | Yes | Yes | Yes | Yes | Outcompetes native suckers in impoundments (Wiltzius 1978). Hybridizes with native bluehead and flannelmouth suckers, potentially increasing native species decline (Quist et al. 2009), passthrough possible. Lake Powell generally too warm but occurs upstream in all rivers | Documented upstream in upper basin drainages (Trammell 2015). |

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| Common Name* | Scientific Name | Occurrence in GCNRA | Occurrence in GCNP | Level of Threat ¹ | Threat to Native Species | Threat to Rainbow Trout Fishery | Preference for Warm or Cold Water | Candidate for Releasing Small Numbers if Incidentally Caught ² | Candidate for chemical treatment ³ | Candidate for chemical rapid response | Candidate for targeted electro-fishing or trapping? | Candidate for mechanical rapid response under CFMP | Threat Notes | Location Documentation |
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| Burbot | <i>Lota lota</i> | Potential | Potential | (2) High | (2) High | Yes | Cold | No | Yes | Yes | Yes | Yes | Competes with and preys upon native fish (Fuller 2014, Bestgen and Jones 2015). | Present in northeast Utah, in the Flaming Gorge Reservoir and Green River below Flaming Gorge Dam(UDWR 2009; Fuller 2014). Occurs upstream of Lake Powell |

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| Common Name* | Scientific Name | Occurrence in GCNRA | Occurrence in GCNP | Level of Threat ¹ | Threat to Native Species | Threat to Rainbow Trout Fishery | Preference for Warm or Cold Water | Candidate for Releasing Small Numbers if Incidentally Caught ² | Candidate for chemical treatment ³ | Candidate for chemical rapid response | Candidate for targeted electro-fishing or trapping? | Candidate for mechanical rapid response under CFMP | Threat Notes | Location Documentation |
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| | | | | | | | | | | | | | | in Flaming Gorge Reservoir (Trammell 2015). |
| Largemouth bass | <i>Micropterus salmoides</i> | Present | Present | (3) Medium-High | (3) Medium-High | No | Warm | No | Yes | Yes | Yes | Yes | Highly piscivorous and considered a possible threat should they begin reproducing below the dam and moving downstream into endangered fish habitat Preys upon and competes with native fish and preys upon native amphibians (Fuller and Neilson 2012c). | Present in Lake Powell though not in large numbers. (NPS 2014b; Anderson 2015). Present in GCNP, exact locations unspecified (NPS 2015i; GCMRC 2014). |
| Black bullhead | <i>Ameiurus melas</i> | Present | Present | (4) Medium | (4) Medium | No | Warm | No | Yes | Yes | Yes | Yes | Competes with and preys upon native fish (Fuller and Neilson 2014a). | Present in Lake Powell. Present in GCNP, including Little Colorado River, other exact locations unspecified (NPS 2015i; GCMRC 2014). |
| Yellow bullhead | <i>Ameiurus natalis</i> | Present | Present | (4) Medium | (4) Medium | No | Warm | No | Yes | Yes | Yes | Yes | Preys upon and competes with native fish (Fuller and Neilson 2012g; NPS and FWS 2014). | Present in GCNP, exact locations unspecified (NPS 2015i; NPS 2015f) |
| Channel catfish | <i>Ictalurus punctatus</i> | Present | Present | (4) Medium | (4) Medium | No | Warm | No | Yes | No (unless in new area as a source) | Yes | No (unless in new area as a source) | Preys upon and competes with native fish can cause death of Colorado pikeminnow that prey upon catfish (NPS and FWS 2014). | Common in the Colorado River within GCNP (NPS 2015i; GCMRC 2014; Trammell 2015). |
| Blue tilapia and other cichlids | <i>Oreochromis aureus</i> | Potential | Potential | (4) Medium | (4) Medium | No | Warm | No | Yes | Yes | Yes | Yes | Competes with native fish and alters aquatic ecosystems (NMAISAC 2008; Nico, Fuller, and Neilson 2013a). | Previously recorded in Arizona (Lake Havasu, Colorado River) (Nico, Fuller, and Neilson 2013a). Rare or not present in GCNP, exact locations unspecified, occurs in Lake Mead (Gloss and Coggins 2005). |
| Grass carp | <i>Ctenopharyngodon idella</i> | Potential | Potential | (4) Medium | (4) Medium | Possible habitat disruption | Warm | No | Yes | Yes | Yes | Yes | Competes with and disturbs habitats of native fish. May forage on moss/algae/aquatic grasses in Glen Canyon reach thereby disrupting insect reproduction | Discovered to be reproducing in the upper reaches of Lake Powell in 2016 |
| Asian carps (silver carp, bighead carp). | | Potential | Potential | (4) Medium | (4) Medium | Yes, competition | Cool | No | Yes | Yes | Yes | Yes | Competes with and disturbs habitats of native fish. May forage on moss/algae/aquatic grasses in Glen Canyon reach thereby disrupting insect reproduction | Not present in Utah or Arizona, listed in top 50 invasive species in the west by Western Governor's Association (WGA 2018) |
| Black crappie | <i>Pomoxis nigromaculatus</i> | Present | Present | (5) Medium-Low | (5) Medium-Low | No | Warm | No | Yes | Yes | Yes | Yes | Preys upon native fish (Fuller, Cannister, and Neilson 2012a). | Present in Lake Powell. Present in GCNP, exact locations unspecified (Gloss and Coggins 2005; GCMRC 2014). |
| Redear sunfish | <i>Lepomis microlophus</i> | Potential | Potential | (5) Medium-Low | (5) Medium-Low | No | Warm | No | Yes | Yes | Yes | Yes | Prefer snails, but are opportunistic feeders eating dreisinnid mussels, aquatic insect larvae, small clams, crayfish, and fish eggs. Young redears feed exclusively on | Being considered by State of Utah for introduction into Lake Powell as a biocontrol for quagga mussels |

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| | | | | | | | | | | | | | zooplankton. May compete with native fish. | |
| Bluegill | <i>Lepomis macrochirus</i> | Present | Present | (5) Medium-Low | (5) Medium-Low | No | Warm | No | Yes | TBD | Yes | TBD | Competes with native fish and preys upon rare amphibians (Fuller and Cannister 2013). | Present in Lake Powell. Present in GCNP, exact locations unspecified (Gloss and Coggins 2005; NPS 2015I; GCMRC 2014). |
| Common carp | <i>Cyprinus carpio</i> | Present | Present | (5) Medium-Low | (5) Medium-Low | No | Warm | Yes | No | No | Yes | No | Competes with native fish and alters aquatic ecosystems (NPS and FWS 2014; Nico et al. 2014). May eat eggs and larvae of native fish (Moyle 2001). | Previously recorded in Lake Powell (USGS 2014b). Common in the Colorado River within GCNP (Gloss and Coggins 2005; NPS 2015I; GCMRC 2014; Trammell 2015). |
| Red shiner | <i>Cyprinella lutrensis</i> | Present | Present | (5) Medium-Low | (5) Medium-Low | No | Warm | Yes | No | No | No | No | Competes with native fish (Nico, Fuller, and Neilson 2015), and preys upon larval native fishes (Ruppert et al. 1993). | Abundant in the Colorado River in GCNP (Gloss and Coggins 2005; GCMRC 2014). |
| Mosquitofish | <i>Gambusia affinis</i> | Present | Present | (6) Low | (6) Low | No | Warm | Yes | Yes | Yes | No | No | Preys upon and competes with native fish and preys upon native amphibians (UDWR 2009; Nico et al. 2015). | Present in GCNRA rivers, inflows, and perennial tributaries (NPS 2014b). Common in the Colorado River within GCNP (Gloss and Coggins 2005; NPS 2015I; GCMRC 2014). |
| Brook trout and other salmonids other than rainbow or brown | <i>Salvelinus fontinalis</i> | stocked in past but not extant | Present | (6) Low | (6) Low | No | Cold | Yes | Yes | No in mainstem, but yes in tributaries if new | Yes | No in mainstem, but yes in tributaries if new | Competes with and preys upon native fish (Fuller and Neilson 2012a). | Previously stocked, but not currently present in park (Gloss and Coggins 2005; Trammell 2015). |
| Fathead minnow | <i>Pimephales promelas</i> | Present | Present | (6) Low | (6) Low | No | Warm | Yes | No | No | No | No | Preys upon native fish and amphibians (Nico, Fuller, and Neilson 2012a). | Present in GCNRA rivers, inflows, and perennial tributaries (NPS 2014b). Common in the Colorado River within GCNP (Gloss and Coggins 2005; NPS 2015I; GCMRC 2014). |
| Gizzard shad | <i>Dorosoma cepedianum</i> | Present | Present | (6) Low | (6) Low | No | Warm | Yes | Yes | Yes | No | Yes | Competes with native fish and alters aquatic ecosystems (UDWR 2009; Fuller and Neilson 2013). Increasing in Lake Powell after fairly recent infestation. | Previously recorded in Lake Powell (USGS 2014b). Previously recorded in the Colorado River within GCNP (USGS 2014b). |
| Golden shiner | <i>Notemigonus crysoleucas</i> | Potential | Present | (6) Low | (6) Low | No | Warm | Yes | No | No | No | No | Competes with native fish (Nico 2011). | Previously recorded in Arizona and Utah (USGS 2014b). GCNP - Previously recorded, exact locations unspecified (Gloss and Coggins 2005; NPS 2015I). |
| Plains killifish | <i>Fundulus zebrinus</i> | Present | Present | (6) Low | (6) Low | No | Warm | Yes | No | No | No | No | Impacts to native fish are unknown (Fuller 2015). | Previously recorded in the Colorado River within GCNP (Gloss and Coggins 2005; NPS 2015I; USGS 2014b). |

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| Threadfin shad | <i>Dorosoma petenense</i> | Present | Present | (6) Low | (6) Low | No | Warm | Yes | No | No | No | No | Preys upon native fish and larvae (Fuller and Neilson 2012e). | Present in GCNP, exact locations unspecified (Gloss and Coggins 2005; NPS 2015l). |
| Amphibians | | | | | | | | | | | | | | |
| American bullfrog | <i>Lithobates catesbeianus</i> | Present | Potential | (4) Medium | (4) Medium | No | Warm | Yes | Yes | TBD | No | TBD | Competes with native amphibians, preys upon native fish and amphibians (NMAISAC 2008; AZGFD 2011). | Present in the Hite area (NPS 2014b). |
| Plains leopard frog | <i>Lithobates blairi</i> | Present | Potential | (6) Low | (6) Low | No | Warm | Yes | No | No | No | No | Not native, associated with UDWR fish hatchery, rare in Wahweap Creek (Anderson 2015). | Present, but rare in Wahweap Creek (Anderson 2015). |
| Reptiles | | | | | | | | | | | | | | |
| Red-eared slider | <i>Trachemys scripta elegans</i> | Potential | ? | (5) Medium-Low | (5) Medium-Low | No | Warm | Yes | No | No | No | Yes | Alters aquatic ecosystems, and carries salmonella (Somma, Foster, and Fuller 2009; Anderson 2015). | Present in Arizona and the pet trade (Anderson 2015). |
| Invertebrates | | | | | | | | | | | | | | |
| Rusty crayfish | <i>Orconectus rusticus</i> | Potential | Potential | (2) High | (2) High | Possible habitat disruption and reduced egg survival | Either | No | Yes | Yes | Yes | Yes | Alters aquatic ecosystems (UDWR 2009; Sorenson 2010). A very active crayfish that feeds on a variety of aquatic plants, benthic invertebrates (aquatic worms, snails, leeches, clams, aquatic insects, and crustaceans), detritus, fish eggs, and small fish. (UMN Seagrant, 2016) | Present in Colorado and aquaculture (Anderson 2015). Not Present in Arizona, present upstream in the Yampa River in Colorado (Sorenson 2016). |
| Australian redclaw | <i>Cherax quadricarinatus</i> | Potential | Potential | (4) Medium | (4) Medium | No | Warm | No | Yes | TBD | Yes | TBD | Alters aquatic ecosystems (Anderson 2015). | Present in aquaculture trade, but not documented in Utah (USGS 2013; Anderson 2015). Present in Arizona, exact locations unspecified (AZGFD 2011). |
| Red swamp Louisiana crayfish | <i>Procambarus clarkii</i> | Potential | Present | (4) Medium | (4) Medium | No | Warm | No | Yes | TBD | Yes | TBD | Preys upon native aquatic fauna, vector of crayfish plague, impacts agricultural and fishing industry (UDWR 2009). | Present in Utah, in Tooele County's western basin drainage near St. John (UDWR 2009). Present in, Arizona, exact locations unspecified (Anderson 2015). Found below Diamond Creek (D. Rogowski, AZGFD, pers. comm.) and Lake Mead (Peck et al. 1987, Leavitt et al. 1989). |
| Northern crayfish | <i>Faxonius virilis</i> | Present | Present | (6) Low | (6) Low | No | Either | Yes | No | No | Yes | Yes | Alters aquatic ecosystems (NMAISAC 2008). | Present in Lake Powell (Anderson 2015), and found in Glen Canyon (D. Rogowski, AZGFD, pers. comm.). Noted that crayfish present below Diamond Creek in tributaries and in LCR drainages (Trammell 2015). |

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| Signal crayfish | <i>Pacifastacus leniusculus</i> | Potential | ? | (6) Low | (6) Low | No | Either | Yes | TBD | TBD | Yes | Yes | Competes with native fauna, reduces water resource bank stability (UDWR 2009). | Present in Utah, in Salem and Spring Ponds (UDWR 2009). |
| Water nymph crayfish | <i>Orconectes nais</i> | Potential | ? | (6) Low | (6) Low | No | Either | Yes? | Yes | Yes | Yes | Yes | Alters aquatic ecosystems (UDWR 2009; Sorenson 2010). | Present and expanding in Colorado. |
| New Zealand mudsnail | <i>Potamopyrgus antipodarum</i> | Present | Present | (4) Medium | (4) Medium | Yes | Cold | Yes | TBD | TBD | No | No | Alters aquatic ecosystems and competes with native invertebrates (UDWR 2009; AZGFD 2011; CPW 2016). | Currently found downstream, below Glen Canyon Dam and outside of GCNRA (NPS 2014b; Anderson 2015). |
| Red-rim melania | <i>Melanooides tuberculatus</i> | Potential | ? | (4) Medium | (4) Medium | No | UNK | No | No | No | No | No | Competes with native fauna, hosts a trematode that infects native fish (NMAISAC 2008; UDWR 2009). | Present in Arizona (Anderson 2015) and Utah (UDWR 2009), exact locations unspecified. |
| Quagga mussel | <i>Dreissena bugensis</i> | Present | Present | (5) Medium-Low | (5) Medium-Low in river, (2) high in lake | Yes | Either | N/A | Yes | Yes | N/A | TBD | Alter aquatic ecosystems, filters much of zoo and phyto plankton from lake waters thereby reducing available foods in lake & riverine food chain, clogs pipes, reduce recreational opportunities (UDWR 2009; A. J. Benson, Richerson, et al. 2014). | GCNRA - Present and has spread to all areas of Lake Powell (NPS 2014b). Present below Glen Canyon Dam. GCNP - Present in GCNP, near river marker 209 (Nelson 2015) |
| Asian clam | <i>Corbicula fluminea</i> | Present | Potential | (6) Low | (6) Low | No | Either | Yes | No | No | No | No | Competes with native bivalves, alters aquatic ecosystems, clogs pipes, reduces recreational opportunities (NMAISAC 2008). | Present in Lake Powell (Anderson 2015). |
| Channeled golden applesnail | <i>Pomaceo spp.</i> | Potential | Potential | (6) Low | (6) Low | No | Warm | No | TBD | TBD | Yes | Yes | Alters aquatic ecosystems, competes with native aquatic fauna (NMAISAC 2008). | Present in Arizona exact locations unspecified (AZGFD 2011). |
| Zebra mussel | <i>Dreissena polymorpha</i> | Potential | Potential | (6) Low | (6) Low in river, (2) high in lake | Yes | Either | N/A | Yes | Yes | N/A | No | Alters aquatic ecosystems, clogs pipes, reduces recreational opportunities (UDWR 2009; A. J. Benson, Raikow, et al. 2014). Doesn't compete well with quagga mussels. | Previously recorded in Arizona, Colorado, Nevada, and Utah (Benson et al. 2014). Previously recorded in Utah and Colorado (USGS 2014b). |
| Plants | | | | | | | | | | | | | | |
| Curly pondweed | <i>Potamogeton crispus</i> | Potential | Present | (4) Medium | (4) Medium | No | Either | N/A | TBD | TBD | N/A | TBD | Competes with native plants (UDWR 2009). Clogs waterways, inhibits aquatic recreation, and can cause algal blooms and fish die offs (Thayer et al. 2016). | Present in Arizona and Utah (UDWR 2009; Anderson 2015). Present in GCNP, exact locations unspecified (NPS 2015). |
| Water hyacinth | <i>Eichhornia crassipes</i> | Potential | Potential | (6) Low | (6) Low | No | Either | N/A | TBD | TBD | N/A | TBD | Competes with native plants, clog canals and other waterways, alters aquatic ecosystems, interferes with recreation (NMAISAC 2008). | Present in Arizona, exact locations unspecified (AZGFD 2011). |
| Water naiad | <i>Najas marina</i> | Present | ? | (6) Low | (6) Low | No | Either | N/A | TBD | TBD | N/A | TBD | Has been found to compete with and replace native vegetation in the Great Lakes (Cao and Berent 2014). | Submerged aquatic – occupied new niche as lake developed (Anderson 2015). |

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| Brazilian elodea | <i>Egeria densa</i> | Potential | Potential | (6) Low | (6) Low in river, (4) Medium in lake | No | Either | N/A | TBD | TBD | N/A | TBD | Competes with native plants, impedes fish migration, alters aquatic ecosystems (NMAISAC 2008; AZGFD 2011). | Present in Glen Canyon reach. |
| Eurasian water-milfoil | <i>Myriophyllum spicatum</i> | Potential | Potential | (6) Low | (6) Low in river, (4) Medium in lake | No | Either | N/A | TBD | TBD | N/A | TBD | Competes with native plants, impedes fish foraging, obstruct recreational and subsistence activities, alters aquatic ecosystems (UDWR 2009). | Present in Arizona and Utah, exact locations unspecified (UDWR 2009; AZGFD 2011). |
| Giant salvinia | <i>Salvinia molesta</i> | Potential | Potential | (6) Low | (6) Low in river, (4) Medium in lake | No | Either | N/A | TBD | TBD | N/A | TBD | Competes with native plants, impedes fish foraging, obstructs subsistence activities, alters aquatic ecosystems (NMAISAC 2008). | Present in Arizona, exact locations unspecified (AZGFD 2011). |
| Hydrilla | <i>Hydrilla verticillata</i> | Potential | Potential | (6) Low | (6) Low in river, (4) Medium in lake | No | Either | N/A | TBD | TBD | N/A | TBD | Competes with native plants, impedes fish foraging, obstruct recreational activities, alters aquatic ecosystems (NMAISAC 2008; AZGFD 2011). | Present in Arizona, exact locations unspecified (AZGFD 2011). |
| Algae | | | | | | | | | | | | | | |
| Didymo (rocksnot) | <i>Didymosphenia geminata</i> | Present | Potential | (4) Medium | (4) Medium | Yes | Either | N/A | N/A | N/A | N/A | N/A | Alters aquatic ecosystems, reduces recreational activities (UDWR 2009; AZGFD 2011). | GCNRA - Present in Utah (NMAISAC 2008). One cell identified from the gut of black fly larva from below the Glen Canyon Dam (Anderson 2015). |
| Golden Alga | <i>Prymnesium parvum</i> | Potential | Potential | (4) Medium | (4) Medium | (4) Medium | Either | N/A | Yes | TBD | N/A | TBD | Causes fish die offs, can be particularly toxic in phosphorus and nitrogen limited systems such as Colorado River below GCD (NMSU 2010; AZGFD 2011). | Present in Arizona in Apache Lake and downstream rivers and urban lakes in Phoenix (AZGFD 2011). |
| Fungi | | | | | | | | | | | | | | |
| Chytrid fungus | <i>Batrachochytrium dendrobatidis</i> | Potential | Potential | (4) Medium | None to fish, (2) High to native leopard frogs | No | Either | N/A | TBD | TBD | N/A | N/A | Causes amphibian die offs (NMAISAC 2008; UDWR 2009). | Present in Utah and Arizona, exact locations unspecified (AZGFD 2011; Anderson 2015). |
| Parasites | | | | | | | | | | | | | | |
| Anchor worm | <i>Lernaea cyprinacea</i> | | Present | (4) Medium | (4) Medium | Yes | Either | N/A | N/A | No | N/A | No | Can directly kill native fish or cause secondary infections that irritate or kill native fish (Steckler and Yanong 2013). | Found in GCNRA, and in GCNP, primarily in LCR and possibly other unspecified locations (Trammell 2015). |
| Asian fish tapeworm | <i>Bothriocephalus acheilognathi</i> | Potential | Present | (4) Medium | (4) Medium | No | Warm | N/A | Yes | No | N/A | No | Can cause die-offs in young fish, reduces condition and survival (Hansen et al. 2006; NMAISAC 2008). Chemical treatment could include a veterinary treatment to treat at the LCR (praziquantel). | Present in Utah and Arizona (NMAISAC 2008). Present in GCNP and GCNRA |

Table F-1 (Continued)

| Common Name* | Scientific Name | Occurrence in GCNRA | Occurrence in GCNP | Level of Threat ¹ | Threat to Native Species | Threat to Rainbow Trout Fishery | Preference for Warm or Cold Water | Candidate for Releasing Small Numbers if Incidentally Caught ² | Candidate for chemical treatment ³ | Candidate for chemical rapid response | Candidate for targeted electro-fishing or trapping? | Candidate for mechanical rapid response under CFMP | Threat Notes | Location Documentation |
|------------------|-----------------------------|---------------------|--------------------|------------------------------|--------------------------|---------------------------------|-----------------------------------|---------------------------------------------------------------------------|-----------------------------------------------|---------------------------------------|-----------------------------------------------------|----------------------------------------------------|--------------------------------------------------------------------------------------------------|---------------------------|
| Whirling disease | <i>Myxobolus cerebralis</i> | Present | Present | (4) Medium | none | Yes | Cold | N/A | N/A | No | N/A | No | Causes 'Whirling Disease'. Very harmful to rainbow trout, but brown trout are resistant/carriers | Present in GCNP and GCNRA |

¹ Threat levels should be re-evaluated annually. Species may be added to the list or threat levels may be changed annually based on new research, new presence or abundance changes

² Releasing small numbers rather than lethal in places like RM-12

³ N/A in this column means no known chemical treatment available

⁴ Rainbow trout is managed for a quality recreational rainbow trout fishery in GCNRA, but the NPS controls this species in Grand Canyon with the goal of protecting native species. Actions in this EA may be applied to rainbow trout in GCNP using the threat levels determined previously under the CFMP and the LTEMP.

TBD=To be determined, N/A= Not applicable

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