BEFORE THE SECRETARY OF THE INTERIOR

EMERGENCY PETITION TO LIST THE ARIZONA WETSALTS TIGER BEETLE (*Cicindela haemorrhagica arizonae*) AND THE MACDOUGAL'S YELLOWTOPS (*Flaveria macdougalii*) AS ENDANGERED OR THREATENED UNDER THE ENDANGERED SPECIES ACT

MAY 1, 2015
CENTER FOR BIOLOGICAL DIVERSITY

NOTICE OF PETITION

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PETITIONER

The Center for Biological Diversity (Center) is a non-profit, public interest environmental organization dedicated to the protection of native species and their habitats through science, policy, and environmental law. The Center is supported by more than 825,000 members and activists throughout the United States. The Center and its members are concerned with the conservation of endangered species and the effective implementation of the Endangered Species Act.

CENTER for BIOLOGICAL DIVERSITY Because life is good.

Submitted this 1st day of May, 2015

Pursuant to Section 4(b) of the Endangered Species Act (ESA), 16 U.S.C. § 1533(b); section 553(e) of the Administrative Procedure Act (APA), 5 U.S.C. § 553(e); and 50 C.F.R. § 424.14(a), the Center for Biological Diversity, Tara Easter and Robin Silver hereby petition the Secretary of the Interior, through the U.S. Fish and Wildlife Service (FWS or Service), to list the wetsalts tiger beetle (*Cicindela haemorrhagica arizonae*) and the McDougall's yellowtops (*Flaveria macdougalii*) as threatened or endangered under the Endangered Species Act. The tiger beetle and the flower are at immediate risk of extinction and we request that protection be enacted on an emergency basis.

FWS has jurisdiction over this petition. This petition sets in motion a specific process, placing definite response requirements on the Service. Specifically, the Service must issue an initial finding as to whether the petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A). FWS must make this initial finding "[t]o the maximum extent practicable, within 90 days after receiving the petition." *Id.*

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EXECUTIVE SUMMARY

The Arizona wetsalts tiger beetle (*Cicindela haemorrhagica arizonae*) and MacDougal's yellowtops (*Flaveria macdougalii*) are endemic species to the Grand Canyon ecosystem found nowhere else on Earth. These species are highly dependent on the fragile and variable seeps and springs of the canyon which are under enormous pressures from groundwater mining, development, climate change, and invasive species. Without Endangered Species Act protection, there are no regulatory mechanisms in place to prevent the extinction of these two rare species.

The Arizona wetsalts tiger beetle and MacDougal's yellowtops warrant immediate listing as threatened or endangered species. The Endangered Species Act states that a species shall be determined to be endangered or threatened based on any one of five factors (16 U.S.C. § 1533 (a)(1)). These species are threatened by at least three of these factors-- the modification or curtailment of habitat or range, the inadequacy of existing regulatory mechanisms to ensure their survival, and other factors.

Petitioners request emergency listing of the Arizona wetsalts tiger beetle and MacDougal's yellowtops because of high magnitude, imminent threats to the springs and seeps upon which these two species depend. They are at risk of extinction due to Redwall/Muav aquifer groundwater pumping resulting from planned massive development in the town of Tusayan which will dry up their habitat. No mitigation measures are in place to safeguard the tiger beetle and Macdougal's yellowtops.

INTRODUCTION

Endemic plants and invertebrates are often given little conservation priority. It is often the case that little to no information exists on the population statuses or life histories of rare invertebrates and plants even though the health of those populations may be jeopardized by uninformed or insensitive land management practices (Species of Consern Ad Hoc Committee 2011, p. 8 [hereafter referred to as the working group, "TWG 2011"]). In many of the nation's great landscape parks, a substantial number of native taxa have been extirpated, and unfortunately this has occurred in the Grand Canyon (Minckley 1991, Newmark 1995, Stevens et al. 2001, Stevens and Gold 2003, cited in TWG 2011, p. 7). Grand Canyon National Park is at risk of continuing to lose irreplaceable endemic species unless immediate action is taken to protect them.

In the Grand Canyon, much of the species restoration focus has been on native fish or charismatic birds and mammals, with the assumption that these listed taxa will serve as umbrella species for other native species. But for tiger beetle and yellowtops this is not the case as they are at risk of falling through the cracks unless protections are put into place for them (Roberge and Angelstam 2004, cited in TWG 2011, p. 7).

Ecosystem function depends largely on the interactions of native taxa. The Arizona wetsalts tiger beetle and MacDougal's yellowtops are two endemic, rare, and specialized species. They are highly vulnerable to habitat changes and to encroaching non-native species as they survive only in the springs and seeps of the Grand Canyon.

Arizona wetsalts tiger beetles and MacDougal's yellowtops are in need of immediate protection from developments that threaten to dry up the springs on which they depend for survival. In the longer term and especially in conjunction with water withdrawals for development, they are threatened by climate change. Though their life history and population status are not fully known, what is clear is that they are in imminent danger of extinction absent the effective protection of the Endangered Species Act.

RANGE

The wetsalts tiger beetle and MacDougal's yellowtops (also known as Grand Canyon flaveria) are both endemic to the Grand Canyon (Stevens 2012, p. 184, 185). Most endemic taxa in the Grand Canyon are considered to be rare and typically exist in harsh but evolutionarily persistent habitats (TWG 2011, p. 22).

The wetsalts tiger beetle occurs only in the eastern basin of the inner Grand Canyon (Stevens 2012, p. 184) from Nankoweap Creek (Mile 52R) downstream to Stone Creek (Mile 132R) (TWG 2011, p. 19). It presently ranges from a small riparian zone near Cliff Dwellers Lodge at the upper end of Badger Creek (Rkm 13R, M.Cazier, 2 July 1967,21 specimens, ASU), in Buck Farm Canyon (Rkm 66R), at Upper Triple Alcoves Spring (Rkm 74R), in Nankoweap Creek (Rkm 85R), in the lower Little Colorado River drainage (Rkm 98L, M.Douglas, 14 km up ftom mouth, 16-30 May 1989,40 specimens), and along Hermit (Rkm l53L, 16 specimens), Boucher (Rkm 154L), Crystal (Rkm 158R), and Stone (Rkm 212R) creeks (Stevens and Huber 2004, p. 50). It is rarely found on the main stream Colorado River (Stevens and Huber 2004, p. 49), but was once discovered there in 2013 (Stevens, pers. comm. 2015). In the 2014 progress report of TWG, the beetle was detected at the mouth of Granite Creek, one of the few springfed tributaries in which it occurs (TWG 2014, p. 2).

MacDougal's yellowtops occur in the tributaries and main Colorado River corridor of western Grand Canyon (AGFD 2005, p. 2). They are very narrowly restricted to the seepages and springs along the Colorado River between river miles 135 to 177 (Stevens 2012, p. 185).

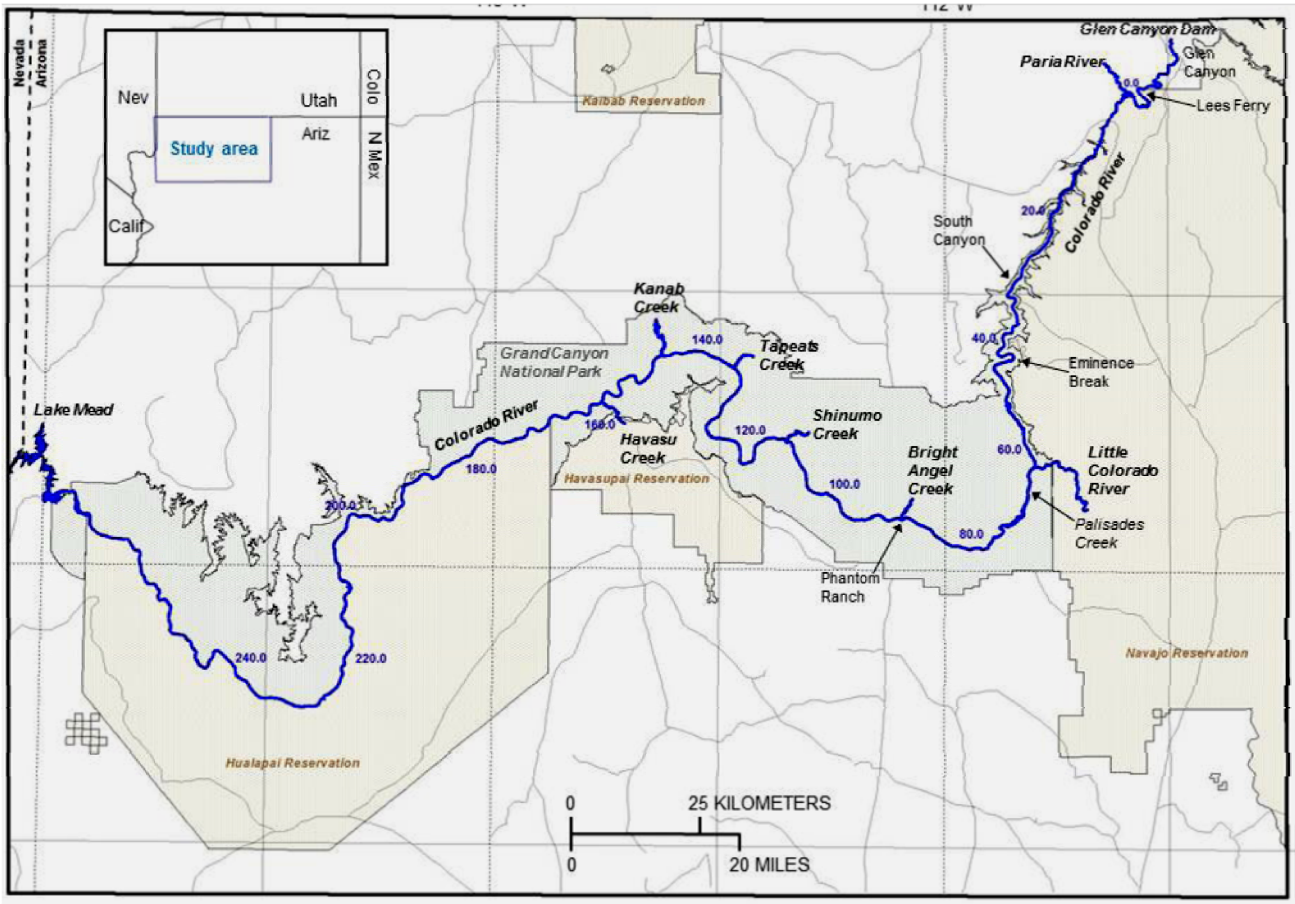


Figure 1: Grand Canyon map with river miles (Davis 2009, http://pubs.usgs.gov/ds/780/)

GLOBAL STATUS

MacDougal's yellowtops has a NatureServe G2 rank – globally imperiled (NatureServe 2005), while the Arizona wetsalts tiger beetle has not been assessed. Neither species has been assessed for the IUCN red list. In Arizona, neither species is listed on the state's threatened or endangered lists, but both are "taxa of management concern" (TMC) (TWG 2011).

This lack of listing does not reflect a stable status of populations but rather a lack of knowledge on them. Their location alone makes them difficult to study, and their rarity has only been recently discovered, especially for the beetle.

NATURAL HISTORY

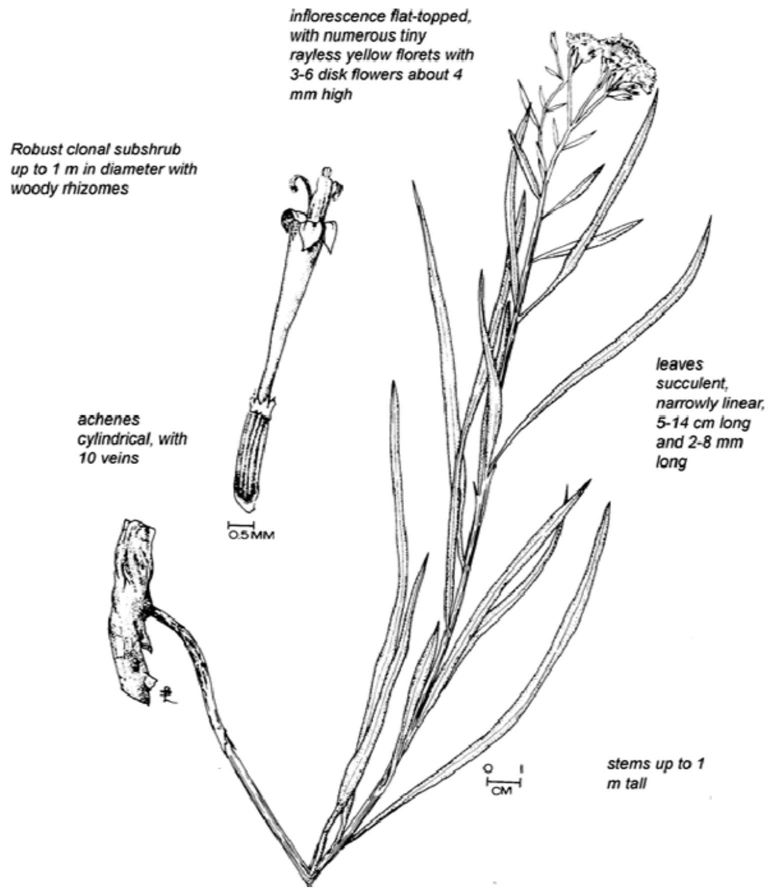
Taxonomy and Description

a. ***Flaveria macdouglii***

MacDougal's yellowtops (*Flaveria macdouglii*) is one of eight species of *Flaveria* (AGFD 2005, p. 1). It is a dicot in the aster, or the sunflower, family (Asteraceae/Compositae) (Kartesz, USDA Plants Database).

The Arizona Game and Fish Department (AGFD) provides this description:

> Herbaceous perennial, robust clonal subshrub up to 1 m (3.2 ft) in diameter with woody rhizomes. Stems up to 1 m (3.2 ft) tall, with narrowly linear, succulent leaves, 2-8 mm to 5-14 cm (2-5.5 in) long. The flat-topped inflorescence has numerous tiny rayless yellow florets with 3-6 disk flowers about 4 mm high. Achenes are cylindrical with 10 veins. (Falk and Jenkins et al. 2001) (2005, p. 1).



Flaveria mcdougallii, courtesy of the Arizona Rare Plant Field Guide (http://www.aznps.com/rareplants.php)

MacDougal's yellowtops has no closely related species that are sympatric. In fact, morphological differences and experimental hybridization studies suggest that *F. mcdougallii* may even make up its own genus (Yarborough and Powell, Flora of North America). They are distinguishable by their long, liner, flat, succulent leaves (Ibid.). They flower in late September to November and fruit in late fall (AGFD 2005, p. 2).

b. *Cicindela hemorrhagica arizonae*

Tiger beetles are in the Coleoptera order and form their own suborder, Adephaga (Pearson 1988, p. 123). This suborder evolved in the mid-Triassic and was well diversified by the mid-Cretaceous (Ibid.). Today there are an estimated 2,600 tiger beetle species (Encyclopedia Britannica 2015). They belong to family Carabidae and genus *Cicindela* (Bug Guide, Iowa State University Dept. of Entomology, online). Adult forms vary widely, but long, sickle-shaped mandibles, relatively thin and long cursorial legs, and eyes and head that together are wider than the thorax are characteristics they generally share (Pearson 1988, p. 123-124). Larval forms are more uniform, with chitinized heads and pronotums and hooks on their fifth abdominal segment (Ibid.).

The Arizona subspecies of the wetsalts tiger beetle (*Cicindela hemorrhagica arizonae*) is one of seven endemic tiger beetles in the Grand Canyon Ecosystem (Stevens and Huber 2004, p. 57). Genetic analyses are ongoing, but is expected that the Arizona wetsalts tiger beetle will be elevated from subspecies to species' status (Stevens and Huber 2004, p. 51). Arizona wetsalt tiger beetles have a distinctively green dorsum (Stevens and Huber 2004, p. 58), and their striking wing pattern can be seen in the picture below.

The Wetsalts Tiger Beetle, courtesy of the Species of Concern Ad Hoc Committee

Adults are typically abundant from July to late September (Stevens and Huber 2004, p. 51). Most will fly away when disturbed, but some populations will run instead (Ibid.).

Behavior and Life History

Little is known about the Arizona wetsalts tiger beetle or MacDougal's yellowtops besides their rarity and habitat type, but there have been quite a few studies on tiger beetles in a general sense. Pearson (1988) compiled a literature review to explain the biology of tiger beetles. We summarize his findings below for context.

Most tiger beetles are diurnal and live in hot habitats (p. 129). They maintain high body temperatures just below their lethal limits at about 47 to 49°C (p. 130). Water loss rates in dry air are a concern for some beetles, especially those living in more arid landscapes such as the Arizona wetsalts tiger beetle. Some tiger beetles lose vastly more water under the same conditions than others (p. 131).

Larval forms of tiger beetles live in tunnels until adulthood, slowly widening their tunnels with each molt (p. 131). There, they wait for arthropod prey to approach, which is largely indicated by a change in light (p. 132). Adults also prey on other arthropods, searching for them immobilized or moving. Sometimes they will scavenge as well (Ibid.).

Reproduction begins soon after adults emerge from their tunnels. A male will sprint back and forth towards a female and then leap onto her back to mate (p. 132). This isn't always successful as males will often attempt this with other males and even other species of the same size. Even when choosing the appropriate female, she may try to remove him by rolling on her back, lurching, and running out into intense sunshine (p. 133). This behavior may have evolved to ensure that only the strongest male mates (Ibid.).

Thermoregulation is highly important for tiger beetles. Larval forms achieve this in their tunnels, but behavior is the primary method for adults (p. 134). Over half of their day is spent regulating their temperature by basking to gain heat or stilting on their long legs to get away from the warm surface to cool down (Ibid.). Adults will also seek out wet substrates, dig burrows in cooler substrates, and become inactive in shaded areas (Ibid.). Some species are nocturnal to avoid such strains, while others will drastically reduce their activity period during the hottest part of the season (Ibid.). Body size, volume-to-surface area ratio, maculations on the elytra, and extensive ventral setae are also variations in morphology that may help beetle species thermoregulate (Ibid.).

Food and oviposition sites are the two most important limiting factors for tiger beetles (p. 138). The rate of food intake has a direct affect on the beetles size, fecundity, and mortality (Ibid.). Fecundity is affected in terms of the number of eggs, not necessarily the quality. Lab experiments and field observations showed that maximum fecundity was reached only in years of exceptionally high rainfall when prey was abundant (Ibid.). Mandible size is also directly correlated with prey species of different tiger beetles to reduce competition among species inhabiting the same area (p. 139).

Habitat Requirements

MacDougal's yellowtops can be found in hanging gardens or terrace ledges in perennial alkaline or saline seeps, in Muav Limestone and at Muav Limestone Bright Angel Shale interface from elevations of 1,750 to 4,000 feet. They live in partly sunny to nearly fully exposed seeps (AGFD 2005, p. 2), and their occurrence is largely dependent on the amount of available moisture in the seeps (Falk and Jenkins 2001, cited in AGFD 2005, p. 2).

MacDougal's yellowtops are associated with *Adiantum capillus-veneris* (maidenhair fern), *Brickellia longifolia* (longleaf brickellia), *Epipactis gigantean* (giant helleborine), *Maurandya antirrhiniflora* (blue snapdragon vine), *Mentzelia pumila* (stick-leaf), *Mimulus cardinalis* (monkey flower), *Muhlenbergia asperifolia* (scratchgrass), *Petrophytum caespitosum* (rock mat), *Rhamnus betulaefolia* (birchleaf buckthorn), and *Sporobolus airoides* (drop-seed) (Phillips, Phillips and Brian, 1982, cited in AGFD 2005, p. 2).

The wetsalts tiger beetle occurs at elevations between 600 and 1,230 feet (Stevens and Huber 2004, p. 49). They are generally restricted to the banks of perennial streams that run over bedrock and cobble gravel, though they have been found in small numbers in lower riparian zones of the Colorado River (Stevens and Huber 2004, p. 50). Their range is sympatric with that of Aaron-Ross's euphorbia (*Euphorbia aaron-rossii*) and the Grand Canyon rattlesnake (*Crotalus viridis abyssus*), both of which are endemic to the upper basin of Grand Canyon. Physiological constraints, habitat and dispersal limitations, and/or competition restrict the ranges of these taxa (Stevens and Huber 2004, p. 58).

So far, this beetle has only been found in perennial streams dependent on baseflow discharge from springs in the Redwall/Muav aquifer, with the exception of the small population near Cliff Dwellers, which receives its water flow from Permian strata (Stevens 2014, unpub. report). Springfed stream baseflow is required for the wetsalts tiger beetle's survival because it emerges along wetted shorelines at the height of the southwestern early summer drought (Ibid.). One site that seemed like the type locality for the wetsalts tiger beetle but had no perennial flow resulted in the presumed extirpation of the beetle in that location (Stevens and Huber 2004, p. 50).

POPULATION STATUS

MacDougal's yellowtops exists in fewer than ten locations in a small geographic area (Falk and Jenkins 2001, cited in AGFD 2005, p. 2). Only five populations were known along the Colorado River and its side tributaries as of 1982 (Phillips, Phillips and Brian 1982, cited in AGFD 2005, p. 2).

Little is known about the wetsalts tiger beetle except that it is endemic and that it exists in a small, isolated population (TWG 2011, slide 14; 2014, slide 5). Similar to numerous endemic insect populations in the Grand Canyon, its status remains unknown and there is currently no monitoring of the populations (TWG 2011, p. 19).

THREATS

The Endangered Species Act states that a species shall be determined to be endangered or threatened based on any one of five factors (16 U.S.C. § 1533 (a)(1)). The Arizona wetsalts tiger beetle and MacDougal's yellowtops are threatened by at least three of these factors-- habitat degradation, inadequacy of existing regulatory mechanisms, and other factors, and thus qualify for federal protection. Petitioners request emergency listing for these species to ensure that mitigation measures are put in place to prevent their extirpation due to proposed Redwall/Muav aquifer mining-dependent developments and increasing water use against a background of prolonged drought and climate change.

A. MODIFICATION OR CURTAILMENT OF HABITAT OR RANGE

The Grand Canyon ecosystem and its endemic species face many challenges now and in the foreseeable future. The Colorado River was recently named America's most endangered river due to past hydrologic manipulation and future development, water use, and pollution (American Rivers 2015, p. 3). Springs in the Grand Canyon make up less than 0.01 percent of the Canyon's landscape (NPS 2015, online), but they are the lifeblood for its native organisms. The springs and seeps are widely recognized as being threatened by regional groundwater pumping, and external use of regional aquifers will affect the discharge of the springs and render spring-dependent species without water and suitable habitat (TWG 2011, p. 8). Additional stressors on water resources created by climate change will further exacerbate threats to the tiger beetle and yellowtops' habitat.

1. **Tusayan Development**

The Arizona wetsalts tiger beetle and MacDougal's yellowtops are threatened by water withdrawals for proposed developments that will lower the aquifers that feed the springs that they depend on for survival. A massive new development project is planned for the South Rim of the Grand Canyon in the town of Tusayan. A foreign company, Gruppo Stilo USA, plans to build lodging, a pedestrian-oriented retail village, an educational campus, a Native American Cultural Center, a conference hotel and other services on their 65 hectare Kotzin Ranch property. In addition, they plan to construct a residential community including single-family homes, apartments, condominiums and townhouses, a recreational vehicle park, a spa hotel and a dude ranch on their 78 hectare TenX Ranch property. They also plan to construct an additional camper village in the center of Tusayan which will also include lodging, retail, restaurants, and other commercial development, see:(http://www.gruppostilousa.it/UNITED_STATES.html).

Development of the TenX Ranch and Kotzin Ranch properties as adopted by the Mayor and Council of the Town of Tusayan on April 16, 2014 will result in up to 3.5 million square feet of commercial space and up to approximately 2,200 new residential dwellings (http://tusayan-az.gov/general-plan/). This represents a 1,000 percent expansion of the current regional population (American Rivers 2015, p. 4). In addition, the State of Arizona Department of Transportation (ADOT) owned Grand Canyon National Park Airport, also in the Town of Tusayan, plans massive new groundwater-dependent expansion. ADOT already specifically budgets the very large amounts of federal money secured from FAA for the expansion of its Grand Canyon National Park Airport (ADOT 2010-2014). Grand Canyon National Park Airport expansion is intimately interrelated to and interdependent with the proposed massive Tusayan/Stilo development (Montgomery and Associates 1998; Kessler 2002; Bills et al. 2007; Tusayan Area Planning Committee 1995, amended 1997).

The increased water demand that would result from these massive developments would put further pressure on the already struggling Grand Canyon freshwater ecosystem. These large new developments would decrease the water in the aquifer and likely suck dry the seeps and springs of the South Rim, jeopardizing the endemic Grand Canyon species that depend on these springs for their continued global existence (Montgomery and Associates Inc. 1998; USGS 2007, p. 10). The Arizona wetsalts tiger beetle and MacDougal's yellowtops depend on springs that are at high risk of being desiccated by increased water usage for development.

The Coconino Plateau is a 13,000 square kilometer plateau that houses the Redwall-Muav aquifer that supplies water to local residents and to the South Rim springs (NPS 2015, online; Bills and Flynn 2002, p. 1). It contains two aquifers: the C aquifer and the primary Redwall-Muav aquifer that underlies the C-aquifer (Bills et al. 2005, p. 1; Kessler 2002, p. ii). The Redwall-Muav aquifer is the only one in the region capable of producing large quantities of water for wells and springs (BLM 2011, p. 3-74).

The Cambrian Bright Angel Shale, Cambrian Muav Limestone, Devonian Temple Butte Formation, and Mississippi Redwall Limestone are the primary water-bearing rock units that constitute the Redwall-Muav Limestone aquifer of the Coconino Plataeu within the Grand Canyon (Monroe et al. 2004, p. 6). Water-bearing units in the Grand Canyon are recharged primarily by precipitation from higher altitudes of the Coconino Plataeu (Johnson and Sanderson 1968, cited in Monroe et al. 2004, p. 7). Said groundwater in the Coconino Plateau then flows to the South Rim and discharges at springs and seeps (Metzger 1961, cited in Monroe et al. 2004, p. 7). Most of the major springs and seeps of the South Rim discharge from the Muav Limestone, the Temple Butte Limestone, or the Redwall Limestone (Monroe et al. 2004, p. 7). Some of the principal drains of the Redwall-Muav aquifer include the Little Colorado River, Havasu Springs, Tapeats Creek, Thunder River, Kanab Creek, Bright Angel Creek, Deer Creek, Shinumo Creek, the Fence Fault complex, and Vasey's Paradise (BLM 2011, p. 3-80). These springs are critical to the maintenance of the Grand Canyon ecosystems and the survival of MacDougal's yellowtops and the wetsalts tiger beetle (Kessler 2002, p. ii; Stevens 2014, unpub. report; AGFD 2005, p. 1-3).

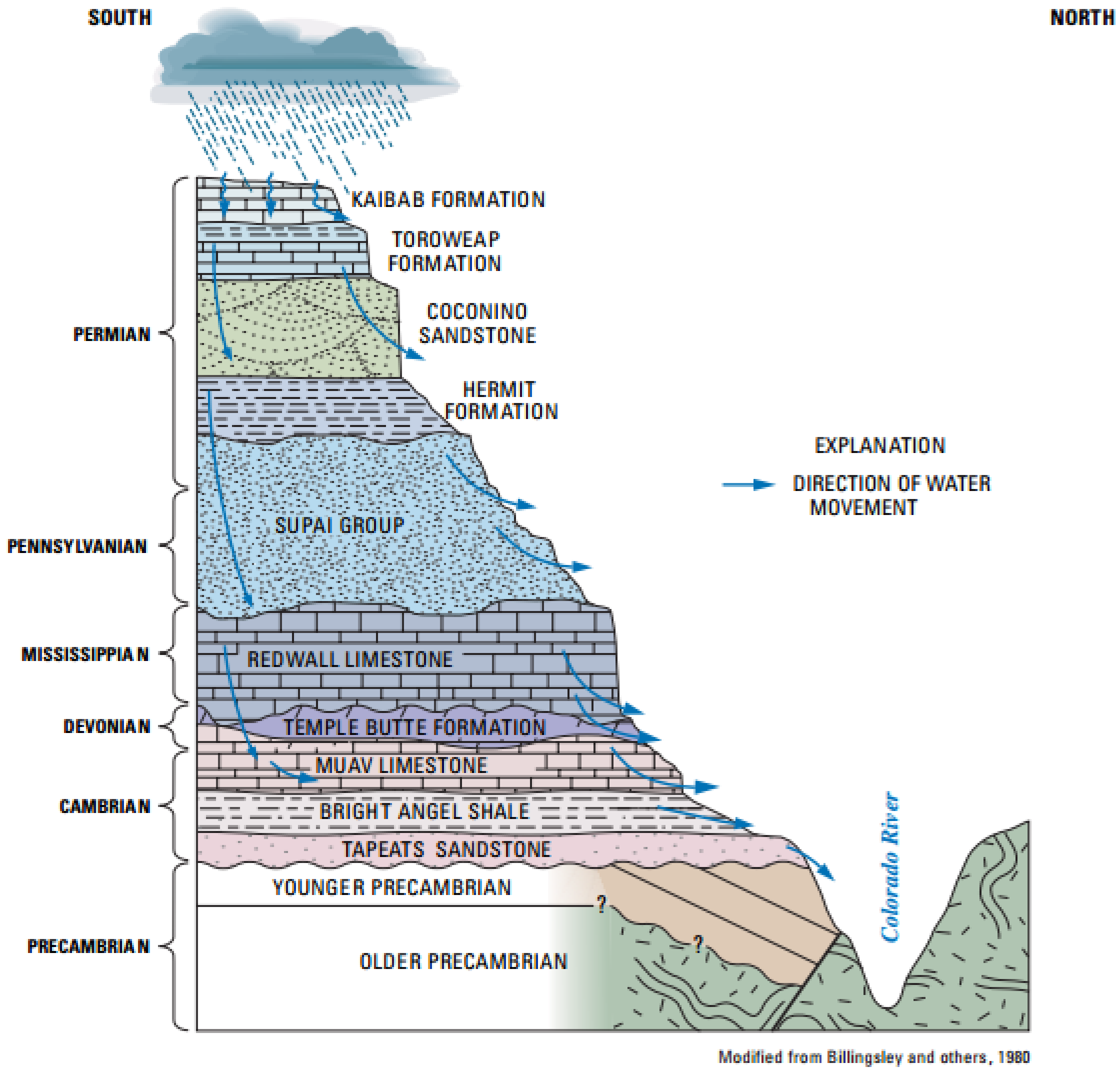


Figure 2: Stratigraphic section of the South Rim of Grand Canyon, Arizona (Monroe et al. 2004, p. 6, Fig. 2).

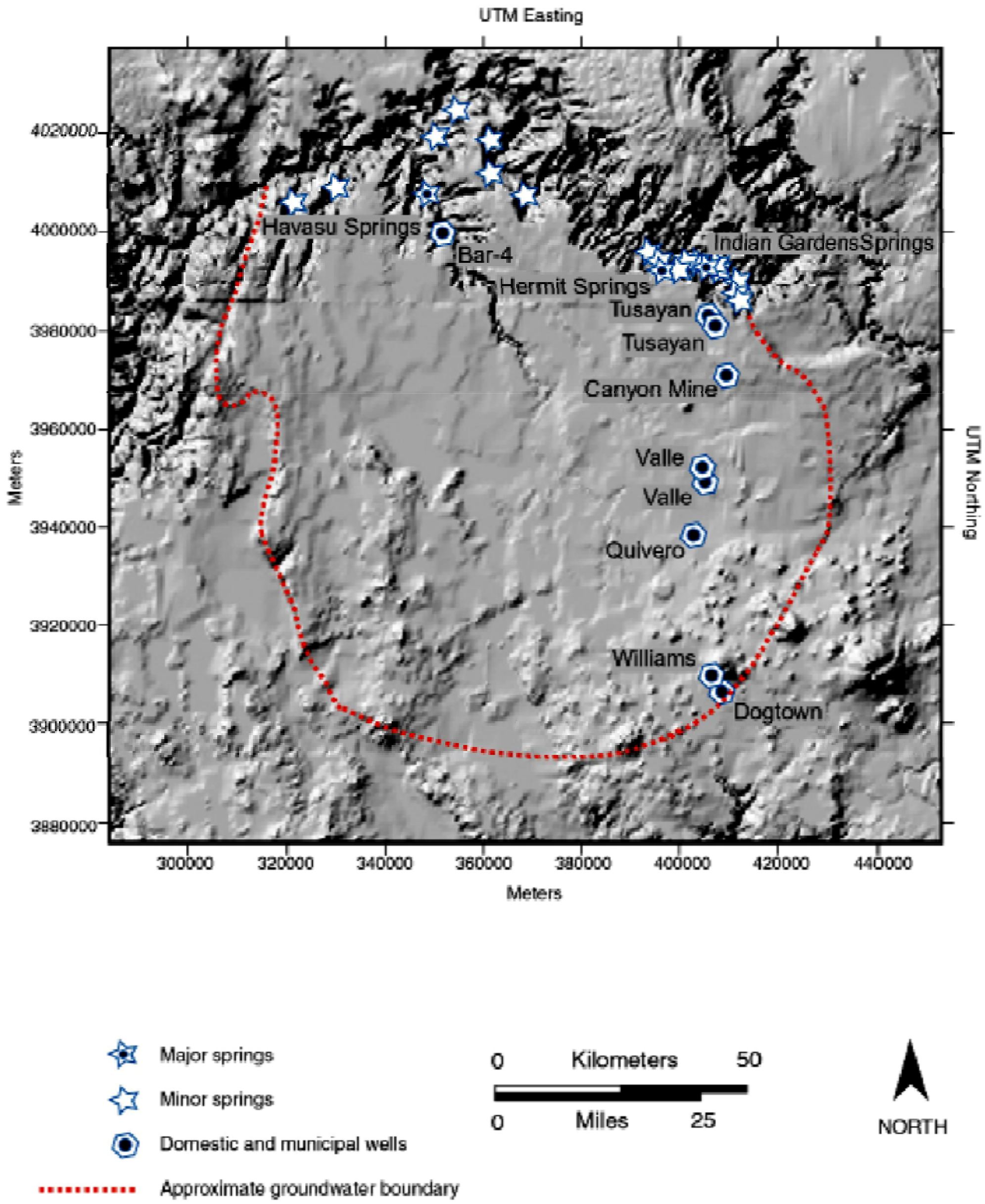


Figure 3: Springs and wells (as of 2002) in relation to groundwater boundaries in the Grand Canyon (Kessler 2002, p. 3, Fig. 2)

In the past, about two thirds of the groundwater withdrawal came from the shallower C aquifer and supplied Flagstaff, while one third was drawn from the Redwall-Muav aquifer to supply Verde Valley (Bills et al. 2005, p. 1). But in recent years, increased demand due to population expansions and drought has forced extraction from the deeper Redwall-Muav aquifer (Bills et al. 2005, p. 1; NPS 2015, online). Rihs et al. (2004) already noted that several of the springs fed by the Redwall-Muav aquifer have a significant decreasing trend in discharge that could be due to drought and water use in Tusayan since 1989 (cited in Northern Arizona Proposed Withdrawal FEIS 2011, p. 3-80). In addition to the millions of visitors to the Grand Canyon area, the rate of population growth on the Plateau has been equal to or has exceeded that of the rest of Arizona, and it has been projected to more than double by 2050 (Bills and Flynn 2002, p. 10). Such dramatic population expansions and developments will require substantial withdrawal from groundwater from the already-declining aquifer in an increasingly drought-stressed area of the country (American Rivers 2015, p. 4).

The USGS in 2007 states that:

> Riparian habitats exist at springs, seeps, and short stream segments fed by springs. These riparian areas are among the least affected such areas remaining in Arizona, have national significance, and are linked to important components of Native American culture. Many of the springs issue from waterbearing zones in the Redwall and Muav Limestones into canyons of the greater Grand Canyon area that are approximately 3,000 ft below the mean altitude of the Coconino Plateau. These habitats support a species diversity that is about 100 to 500 times greater than that of the surrounding landscape (Grand Canyon Wildlands Council, 2004). Several of the riparian areas have national significance because of their location in Grand Canyon National Park (GCNP), yet little is known about the variability and sustainability of spring flows that sustain these areas. These springs and seeps, and the diverse biological habitat that they support, are a critical aspect of GCNP operations. Springs and seeps that discharge along the Mogollon Rim to the south also are critical to the health and maintenance of riparian habitat in these areas. Continued development of water resources and changes in climatic conditions in the study area threaten to upset the regional ground-water flow systems and the riparian areas that they support… (p. 10)

Most springs in the South Rim, such as those that the wetsalts tiger beetle and MacDougal's yellowtops depend on, only have small discharges (USGS 2007, p. 43-44). Some streams on the south rim only have perennial flow because of these ground-water discharges from the Redwall-Muav aquifer in the Coconino Plateau where stream channels intersect rock units of the aquifer creating seeps in the lower rock units (USGS 2007, p. 63; Kessler 2002, p. 4). Only a few streams currently have sufficient volumes to sustain perennial flow (Ibid.).

Spring ecosystems in the Grand Canyon are already naturally fragile and may be more sensitive to changes in ground-water flow than was previously recognized (Wilson 2000, Kessler 2002, cited in USGS 2007, p. 15). Hydrology studies have shown that additional pumping of groundwater from the Redwall-Muav aquifer will significantly impact the seeps and springs below the South Rim (Montgomery and Associates, Inc. 1998, 1999; Kessler 2002; USGS 2007, p. 10).

The Bureau of Reclamation predicts that the region will be unable to meet its water demands by 2025, and the future of springs and seeps in the canyon and the species that depend on them looks more than grim (Kevin Black, written communication, 2006, cited in USGS 2007, p. 15). The Tusayan development will draw enormous amounts of water. A predicted increase in water usage from 175 acre feet per year (AFY) to 681 AFY by 2024 for the town of Tusayan based on current development proposals would far exceed the 2050 North Central Arizona Water Supply Study, Report of Findings projection of 425 AFY (BOR 2006).

Expansions to the airport alone to accommodate the Tusayan development will withdraw unsustainable amounts of water from the Redwall-Muav aquifer of the Coconino Plateau. The Arizona Department of Transportation’s (ADOT) groundwater well(s) would have the capacity to produce 30 gallons per minute (gpm) to meet an expected increase in use from 10,000 gallons per day to 20,000 (GCNP comments to ADOT 2012, p. 2). For comparison, the sum flow of all major springs on the South Rim between Garden Creek and Cottonwood Creek equals 30 gpm (Ibid.). Well withdrawal for the airport will likely reduce available groundwater for Tusayan, requiring them to further deepen their wells.

2. Climate Change

Global climate change is happening at an unprecedented rate and threatens numerous species and their habitats. The IPCC, the world’s leading authority on the assessment of climate change, published in its Fifth Assessment Report (AR5) “Summary for Policy Makers,” which states:

> Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased (see Figures SPM.1, SPM.2, SPM.3 and SPM.4) (IPCC 2013, p. 2.2, 2.4, 3.2, 3.7, 4.2–4.7, 5.2, 5.3, 5.5–5.6, 6.2, 13.2).

Major changes in ecosystem structure and function are predicted if temperatures increase 1.5 to 2.5°C. Changes are expected in species’ ecological interactions and geographical ranges, with predominately negative effects on biodiversity. The IPCC states with “virtual certainty” that there will be more frequent hot and fewer cold temperature extremes, and heat waves will occur in higher frequencies and duration (IPCC 2013, p. 20).

The Southwest is already experiencing amplified difficulties due to climate change. From 2001 to 2010, the region experienced its warmest and driest decade in the last 110-year instrumental record (Garfin et al. 2014, p. 464; MacDonald 2010, p. 21256). Regional temperatures are expected to continue rising by 2.5°F to 5.5°F by 2041-2070 and by 5.5°F to 9.5°F by 2070-2099 with continued growth in global emissions, and heat waves are expected to become hotter and longer (Ibid.).

The Southwest is expected to experience less snow in the winter and less rainfall in the spring, which will reduce flow to its rivers, streams, and springs in the summer (Garfin et al. 2014, p. 465). In the last 50 years, there has been less late-winter snowfall, earlier snowmelt, and earlier arrival of the year’s streamflow. Projections show that this trend will continue and intensify (Ibid.; IPCC 2014, p. 14). Droughts, which the Southwest is already quite familiar with, will likely become longer and hotter, putting severe strain on the region’s water supply, especially in the Colorado River basin (Garfin et al. 2014, p. 465; Cayan et al. 2010, p. 21275).

Climate models predict the Colorado basin will experience water deficits that exceed any in the observational record by 60 to 70 percent (Cayan et al. 2010, p. 21275). Both groundwater levels and river flows will be impacted by these severe droughts. The region’s aquifers are threatened because they are dependent on precipitation recharge and snowmelt (USGS 1993, report 93-642; Monroe et al. 2004, p. 7).

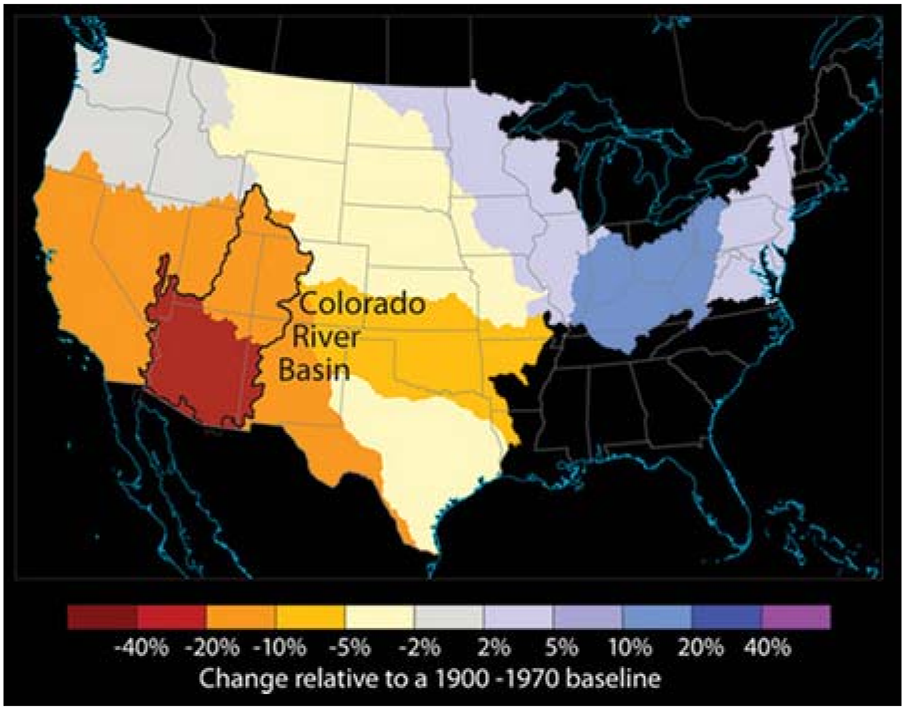


Figure 4: Average projected changes in annual runoff from 2041-2060 (Milly et al. 2005).

Average precipitation measured at Grand Canyon Village from 1941 to 1970 was about 14.5 inches per year (Northern Arizona Proposed Withdrawal FEIS 2011, p. 3-72). Normal annual precipitation from 1961 to 1990 in the southern part of the Coconino Plateau was 21.17 inches (Owenby and Ezell 1992, cited in Northern Arizona Proposed Withdrawal FEIS 2011, p. 3-72), and the estimated annual recharge to the Redwall-Muav aquifer accounted for about 3.5 percent of this precipitation (Bills et al. 2007, cited in BLM 2011, p. 3-72). Most precipitation is lost due to evaporation, transpiration and runoff which will be exacerbated by higher temperatures and drought.

3. Grand Canyon Dams

Two of the largest reservoirs in the United States exist upstream of the Grand Canyon: Lake Powell, created by the Glen Canyon dam, and Lake Mead, created by the Hoover dam (Stevens and Huber 2004, p. 56). The ecological consequences of these two massive dams have been well documented among fish populations in the Grand Canyon (Minckley 1991, cited in Stevens 2012, p. 198), but little attention has been given to the degraded connectivity on plant colonization and the interruption of range for tiger beetles (Stevens 2012, p. 198). The two reservoirs have inundated much of the riparian habitat that undoubtedly previously supported cicindelids, further isolating tiger beetle populations in the Grand Canyon (Stevens and Huber 2004, p. 56). NatureServe (2005) states that the MacDougal’s yellowtops may also be threatened by dam flooding (cited in AGFD 2005, p. 3).

4. Escalade Project

Another development planned for the Grand Canyon could potentially pose a threat to the Arizona wetsalts tiger beetle. The Escalade project is a proposal to build a two million square foot development near the east end of the canyon that includes a tram to transport thousands of visitors down to the bottom of the Grand Canyon at the confluence of the Colorado and Little Colorado River. The Escalade project is within the range of the Arizona wetsalts tiger beetle. The project plans to build a restaurant, gift shop, and restrooms that would accommodate an estimated 10,000 visitors a day to this remote wilderness (American Rivers 2015, p. 4). This project could damage wetsalts beetle habitat and greatly increase foot traffic and the potential for trampling and erosion in the area.

For all these reasons, the Arizona wetsalts tiger beetle and MacDougal's yellowtops are imminently threatened with extinction due to habitat degradation and range curtailment.

B. OVERUTILIZATION

These species are not known to be threatened by overutilization and are generally protected by National Park rules.

C. DISEASE AND PREDATION

Neither disease nor predation is a documented threat to the Arizona wetsalts tiger beetle or MacDougal's yellowtops, though predation could become a threat for the beetle in the future in conjunction with habitat loss as populations become smaller and more isolated.

Birds, ants, and provisioning wasps are minor predators on tiger beetle larvae, but a larger threat is parasitoids (Pearson 1988, p. 136). Different species of parasitoids that are wide-ranging are specialists for different species of tiger beetles; for example:

> Species of the nearly worldwide genus of antlike wasps Methocha (Tiphiidae) are specialists on tiger beetle larvae. The small, wingless female wasp stings and paralyzes the larva. She deposits her egg on the larva, plugs the chamber, and fills the top part of the tunnel with soil. The larval wasp ecloses in 4-5 days and consumes the beetle larva. Other tiphiid species in the genera Karlissa and Pterombrus are specialists on ground-dwelling and arboreal tiger beetle larvae (Pearson 1988, p. 136).

Adult tiger beetles are preyed upon by a wide range of species, the most significant being robber flies, lizards and birds (Pearson 1988, p. 136). More research is needed to know which parasitoids and other predators threaten the Arizona wetsalts tiger beetle.

D. INADEQUACY OF EXISTING REGULATORY MECHANISMS

The wetsalts tiger beetle and MacDougal's yellowtops are rare, endemic species that fortuitously survive in a national park and United Nations World Heritage site. They are protected from collection because the Arizona Native Plant Law of 1993 restricts the salvage of MacDougal's yellowtops, and because national park rules state that nothing may be taken from the park. Occurrence within in the park's boundaries however is not sufficient to protect these two endemic species from the loss of their spring habitat due to increasing water demand, development, and global climate change.

Unfortunately, as many as 29 native vertebrate taxa have been extirpated from the Grand Canyon region already, including top predators and ecologically interacting species which likely has had a lasting impact on the stability of the ecosystem (Stevens 2012, p. 198). The populations of insects and plant taxa are poorly known and some have only been recently detected (Stevens 2011, cited in Stevens 2012, p. 198) and no existing regulatory mechanisms adequately protect these imperiled invertebrate and plant species. The Bureau of Reclamation has composed a committee to study species of concern, but no funding is available to aid species restoration efforts (TWG 2011, p. 28). The Arizona wetsalts tiger beetle and MacDougal's yellowtops need the specific protection of the Endangered Species Act to safeguard their continued existence.

E. OTHER FACTORS

1. Unique Biogeography and Small Population Size

Deep canyons act as refugial habitats for many rare and endemic species, but they also differentially facilitate or restrict gene flow (Stevens 2012, p. 169). Due to their specific microhabitat requirements and the unique geography of the Grand Canyon, a range expansion is not possible for the wetsalts tiger beetle or MacDougal's yellowtops. Further, they already have extremely small population sizes which puts them at high risk of deleterious effects from reduced genetic diversity.

2. Non-native Species

Exotic species brought in from the Canyon's many visitors compete for resources with Canyon endemics. A shocking 10.7 percent of all flora in the Grand Canyon are native to the United Kingdom (Stevens 2012, p. 199). They have proliferated in a post-dam world and strongly alter the form and function of the Colorado River ecosystem (TWG 2011, p. 23). Most concentrated efforts of understanding and eradicating invasive species revolve around restoring endangered native fish species, but many others are harming other Grand Canyon endemics potentially including the wetsalts tiger beetle and MacDougal's yellowtops.

Over 200 species of plants dominate the list of non-native species which strongly preempt colonization space, increase fire frequency, and affect food resources and pollinator populations (e.g., *Tamarix* spp., *Bromus* spp.) (TWG 2011, p. 23). Unfortunately, hotspots that support native plant taxa such as springs, seeps, and riparian areas, are also the locations where non-native plants flourish (Stevens 2012, p. 199).

Non-native invertebrates such as the predatory ladybird beetles (*Anatis lecontei*) and the New Zealand mudsnails (*Potomopyrgus antipodarum*) may compete over resources with the wetsalts tiger beetle. Predatory birds and mammals such as the European starling (*Sternus vulgaris*), house sparrow (*Passer domesticus*), house mouse (*Mus musculus*), and the Norway rat (*Rattus norvegicus*) all exist in high numbers in the Grand Canyon and may reduce may reduce their survival as well (Stevens 2012, p. 200).

3. Grand Canyon Recreation

Although extensive measures are taken to protect this natural resource, the sheer volume of visitors inevitably impacts the environment of the Grand Canyon. It is the second most visited park in the United States and received 4.5 million visitors in 2013 (NPS 2014, online). AGFD (2005) stated that visitor recreation may be a threat to MacDougal's yellowtops and should be monitored (p. 3). Should the Escalade Project be completed, there is no doubt that the influx of more people than ever accessing the bottom of the canyon will degrade its habitat.

REQUEST FOR CRITICAL HABITAT

Critical habitat designation would provide significant conservation benefits to the Arizona wetsalts tiger beetle and McDougal's yellowtops, and we urge the Service to propose critical habitat designation as soon as possible. The critical habitat designation should not only protect existing, known habitat areas, but should also protect currently unoccupied areas that could be important for facilitating habitat movement and expansion for the tiger beetle and yellowtops in response to development and climate change.

CONCLUSION

For all the reasons discussed above, Petitioner Center for Biological Diversity requests that the FWS take emergency actions to list the Arizona wetsalts tiger beetle and MacDougal's yellowtops as threatened or endangered species because they are in danger of extinction or likely to become so in the foreseeable future in all or a significant portion of their ranges. These species are threatened by habitat degradation, climate change, and invasive species. No existing regulatory mechanisms are adequate to ensure the survival of the wetsalts tiger beetle or MacDougal's yellowtops. Based on this information, these species qualify for protection and should be listed under the Endangered Species Act.

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