Cherry Shrimp (*Neocaridina davidi*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, March 2025
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Organism Type: Crustacean
Overall Risk Assessment Category: High

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1 Native Range and Status in the United States

Native Range

From Schoolmann and Arndt (2018):

"[…] *Neocaridina davidi* (Bouvier, 1904), native to China, Korea, Taiwan, and Vietnam (Cai, 1996; Karge and Klotz, 2013) […]."

From Jabłońska et al. (2018):

"The shrimp *Neocaridina davidi* (Bouvier, 1904) occurs naturally in fresh waters of South-East Asia (Cai 1996)."

Status in the United States

From Benson (2025):

"[As *Neocaridina denticulata sinensis*:] Found throughout O'ahu [Hawaii] (Englund and Cai, 1999)."

From Suen and Gillett-Kaufman (2020):

"[…] populations of *Neocaridina davidi* have been reported on the island of Oahu in Hawaii since 1991. Populations were found in multiple streams, springs, and reservoirs such as the Waikele Spring, Ho'omaluhia Reservoir, and the Nu'uanu Reservoir (Englund [and Cai] 1999)."

Neocaridina davidi is present in trade within the United States in various color morphs and sizes. The species may be sold in packs of ten or more individuals (e.g., Aqua Huna 2025; Aquatic Arts 2025; Jungle Aquashrimp 2025).

Regulations

No species-specific regulations on possession or trade were found within the United States.

Means of Introductions within the United States

From Mitsugi et al. (2017):

"Englund & Cai (1999) suggested that *N. davidi* (as *N. denticulata sinensis* in the original paper) that invaded Oahu Island in Hawaii had escaped or been released from aquaria."

Remarks

From Suen and Gillett-Kaufman (2020):

"Common morph names of *Neocaridina davidi*:
Red morph: cherry shrimp
Orange morph: orange sakura shrimp
Yellow morph: yellow sakura shrimp
Green morph: green jade shrimp
Blue morph: blue dream, blue velvet, and blue jelly
Striped morph: rili shrimp"

From Yang et al. (2024):

"Due to taxonomic difficulties, the genus *Neocaridina* has been constantly under revision and the validity of several species is currently questionable [Hung et al. 1993; Cai 1996; Shi and Cai 2007; De Grave and Fransen 2011; Han et al. 2019]. In Cai's [1996] revision of the genus *Neocaridina*, he described/redescribed eight subspecies of *N. denticulata*. However, most of these subspecies are not accepted today. To date, the two widely accepted subspecies of *N. denticulata* are *N. d. denticulata* and *N. d. sinensis*. […] Additionally, *N. davidi* Bouvier, 1904 has similar morphological features to *N. d. sinensis* […] Consequently, Shih et al. [Shi and Cai

2007; Shi et al. 2017] and Klotz et al. [2013] suggested that *N. davidi* was synonymous with *N. d. sinensis*. Nevertheless, the validity of *N. davidi* remains questionable as it is uncertain whether Liang [2004] examined the types of *N. davidi*. […] Based on integrative taxonomy (morphological characteristics, genetic variation and phylogenetic analysis), we contend that *N. davidi*, *N. denticulata denticulata*, *N. d. sinensis* and *N. heteropoda* should belong to the same species […]"

Some sources report *N. davidi* to be introduced to Israel (e.g., Suen and Gillett-Kaufman 2020; Prati et al. 2024). However, morphological and molecular analyses of Israeli specimens are inconclusive as to their identity within the *N. denticulata* species complex (Levitt-Barmats et al. 2019). *N. denticulata* and *N. davidi* (*=N. denticulata davidi, N. denticulata sinensis*) are recognized as separate, valid species by DecaNet editors (2025a,b), the selected taxonomic authority for this taxon according to Ecological Risk Screening Summary Standard Operating Procedure (USFWS 2024). Given this taxonomic uncertainty, the Israeli population of *Neocaridina* shrimp was not treated as a confirmed established population of *N. davidi* for this report.

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2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2025):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Protostomia
Superphylum Ecdysozoa
Phylum Arthropoda
Subphylum Crustacea
Superclass Altocrustacea
Class Malacostraca
Subclass Eumalacostraca
Superorder Eucarida
Order Decapoda
Suborder Pleocyemata
Infraorder Caridea
Superfamily Atyoidea
Family Atyidae
Genus *Neocaridina*
Species *Neocaridina davidi* (Bouvier, 1904)

According to DecaNet editors (2025a), *Neocaridina davidi* (Bouvier, 1904) is the current valid name for this species.

The following synonyms of *Neocaridina davidi* from DecaNet editors (2025a) were used to search for information for this report: *Caridina davidi*, *Neocaridina denticulata davidi*, *Neocaridina heteropoda*, *Neocaridina denticulata sinensis*.

Size, Weight, and Age Range

From Klotz et al. (2013):

"A small freshwater shrimp species, body size up to 40 mm (average size of females 25 mm; average size of males 20 mm)."

From Mitsugi and Suzuki (2018):

"The above-mentioned analysis [in source material] suggests that the life span of males is approximately 10 to 13 months and that of females is approximately 12 to 15 months. However, […] More samples are needed to accurately estimate life span in this species."

Environment

From Klotz et al. (2013):

"Its [*N. davidi*] habitats are small to medium-sized streams in East and Central China. Temperatures in water bodies of this region vary between 6–8 °C in the winter and nearly 30°C in the summer (W. Klotz, pers. observations); Oh et al. (2004) reported ranges in water temperature from 4 °C in January to nearly 20°C in July in a natural habitat of *N. denticulata* in Korea. The red colour morph of *N. davidi* reportedly proliferated over several years in an artificial pond near Hannover, Germany, covered by a thick layer of ice in the winter (G. Voss, pers. com)."

From Englund and Cai (1999):

"In O'ahu streams, the introduced atyid shrimp [i.e., *N. davidi*, as *N. denticulata sinensis*] was most abundant in high water velocity areas such as run and riffles but was also common in aquatic vegetation and stream side margins. In Waikele Stream *N. d. sinensis* were most common in areas of higher water velocities that averaged 33–52 cm/second but were also found in clear, cold spring areas with velocities as low as 10 cm/second (Englund & Filbert, [1999])."

"This species was also common in disturbed aquatic habitats such as the concrete channel raceways below Nu'uanu Reservoir."

From Bochini et al. (2024):

"[…] although the species has a life cycle entirely in freshwater, it is reportedly also tolerant in high salinity (Nur and Christianus, 2013), and investigators have cultivated newly hatched larvae in a slightly saline (5–10 ppt) environment."

From Prati et al. (2024):

"*Neocardina davidi* possesses high fecundity and environmental plasticity, with captive individuals successfully breeding in a wide range of conditions (14–30 °C, pH 6–8.2, gH 0–27 °C) (Namaei Kohal et al. 2018; Maciaszek et al. 2023)."

"[…] *N. davidi* were collected from waters containing as little as 3.1 mg/l dissolved oxygen, indicating they can thrive even in oxygen-poor environments."

Climate

From Prati et al. (2024):

"[…] low winter temperatures in temperate regions commonly prevent their survival and range expansion once released […]"

From Klotz et al. (2013):

"[…] *N. davidi* does however not originate from a tropical ecosystem […]"

Distribution Outside the United States

Native

From Schoolmann and Arndt (2018):

"[…] *Neocaridina davidi* (Bouvier, 1904), native to China, Korea, Taiwan, and Vietnam (Cai, 1996; Karge and Klotz, 2013) […]."

From Jabłońska et al. (2018):

"The shrimp *Neocaridina davidi* (Bouvier, 1904) occurs naturally in fresh waters of South-East Asia (Cai 1996)."

Introduced

From Prati et al. (2024):

"Permanent, self-sustaining feral populations of *N. davidi* are already known from thermal waters in Canada, Germany, Hungary, and Poland and even unheated waters in […] Japan, the French overseas territory of la Reunion […] (Klotz et al. 2013; PM 2017; Jabłońska et al. 2018; deBruyn 2019; Levitt-Barmats et al. 2019; Weiperth et al. 2019)."

"In Slovakia, *N. davidi* was first observed in 2021 by Martin Dobrota, a citizen scientist in the upper part of the Čepčínsky creek, a tributary of the River Turiec (Váh River Basin). The creek originates from a thermal spring […]"

Prati et al. (2024) refer to the occurrence in Slovakia as an established population.

From Klotz et al. (2013):

"Two species of Asian freshwater shrimps were identified in the samples collected at Gillbach [tributary to the river Erft in western Germany] and [the river] Erft in 2011–2013: The small and colorful *Neocaridina davidi* (Bouvier, 1904), and the considerably larger "Red Clawed Prawn" *Macrobrachium dayanum* (Henderson, 1893). Both species established proliferating populations. Especially *N. davidi* was present in considerable numbers at the time of sampling, in habitats characterized by submerged roots of trees at the upper Gillbach."

"The natural headwaters of the Gillbach, as well as parts of the Erft, have been destroyed by coal surface mining; to date, the Gillbach's major source is coolant water from Niederaußem, Germany's second largest coal power plant. These discharges cause major thermal pollution, up to 25.5°C (F.W. Miesen pers. observation); the Erft itself permanently receives additional warm waters from mining operations, and power plants, like the power station at Frimmersdorf."

From Mitsugi et al. (2017):

"In recent years, Fujita *et al.* (2011) reported that the Chinese *Neocaridina* shrimp, *N. davidi* (as *Neocaridina denticulata sinensis* in the original paper) invaded rivers in western Japan."

"Here, we report the finding of an alien freshwater shrimp of the genus *Neocaridina* in the Tomoe River of the Boso Peninsula, Tateyama City, Chiba Prefecture, eastern Japan. We conducted a taxonomic study of the collected specimens based on morphological characteristics and mitochondrial DNA sequence variations. […] Our specimens are most likely to be *Neocaridina davidi* (Bouvier, 1904) […]"

From Jabłońska et al. (2018):

"The species [*Neocaridina davidi*] was found in samples collected in 2003, 2013 and 2017 in the thermally polluted canal connected to the River Oder, south of Gryfino [Poland], in the vicinity of the Dolna Odra Power Plant. […] The findings spanning more than a decade suggest that *N. davidi* may have established a self-reproducing population at this site."

From Weiperth et al. (2019):

"We consider that the population of this species in [Miskolctapolca,] Hungary is now well-established and self-sustaining."

"Contrary to previous records from the European territory (Klotz et al., 2013; Jabłońska et al., 2018), we found this non-native decapod occurring not only in thermal or thermally polluted waters, but also in adjacent brook with seasonal fluctuations in water temperature."

From DeBruyn (2019):

"In December of 2015, a population of cherry shrimp was discovered in the Atlin Warm Springs [northwest British Columbia, Canada] (A. deBruyn, personal observation; Figure 3.2 [in source

material]). Photographic and observational records from October 2015 and earlier in 2008 (Taylor, personal communication) failed to indicate the presence of this species, thus placing their likely date of introduction into the two month period between October and December 2015."

"Since their arrival in the Atlin Warm Springs, the *N. davidi* have expanded their range steadily downstream and increased in observed abundance (A. deBruyn, personal observation)."

From Sidorovskyi and Shrestha (2024):

"In the fauna of Kharkiv region [Ukraine], two non-indigenous species were revealed: *Neocaridina davidi* […]"

No further information was found to confirm establishment of *Neocaridina davidi* in Ukraine.

From Bochini et al. (2024):

"A shrimp specimen of the genus *Neocaridina* Kubo 1938, originally from Asia, was collected for the first time in a natural marine environment in Pernambuco, Brazil. This represents the first record of this genus in the South American continent. Morphological characteristics and mitochondrial and nuclear DNA sequences (COI, 16S, 18S, and H3) of the specimen were compared with other species of *Neocaridina*, enabling its identification as *Neocaridina davidi*. Finding this freshwater species native to mainland China in a marine environment was surprising."

From Jamonneau et al. (2025):

"An established population of […] Cherry shrimp (*Neocaridina davidi*) has been observed in thermal waters in the Parc des Thermes of Juvignac, near Montpellier (Southern France)."

From Englund and Cai (1999):

"The occurrence of *N .d.* [sic] *sinensis* in Yunnan province in southwestern China may also be due to human introduction. Although it is now commonly found in most parts of Yunnan province, *N. d. sinensis* had not been recorded from this area until the 1980s."

Means of Introduction Outside the United States

From Englund and Cai (1999):

"It is likely that *N. d. sinensis* was introduced [to Yunnan province, China] when needle fish (*Neosalanx* sp.) from Taihu Lake in eastern China were introduced to the plateau lakes of Yunnan province (Y. Cai & Dai A.Y., unpubl.). Taihu Lake is the type locality of *N. d. sinensis*."

"Small feeder aquarium shrimp were purchased at Pet's Plus Petshop on Ward Avenue in Honolulu, and these specimens were identified as *N. d. sinensis*. This is strong evidence that *N. d. sinensis* was introduced to O'ahu streams as an escaped or released aquarium species."

From Mitsugi et al. (2017):

“This species may have entered Japan through intentional disposal or accidental escape from aquaria.”

From Onuki and Fuke (2022):

“The invasive species of the genus *Neocaridina* have been imported from China and Korea to Japan since the 1970s as fishing bait and ornamental species (Niwa 2010).”

From Prati et al. (2024):

“The geographic distribution of feral *N. davidi* [in central Europe], as evidenced by their haplotypes, primarily reflects what is available in the pet trade of the respective countries. […] the Slovakian *N. davidi* population may have escaped from the nearby aquaculture farm that supplies the Slovak, Hungarian, and Polish markets.”

Short Description

From Klotz et al. (2013):

“A small freshwater shrimp species […] Rostrum […] slender, moderately long, not reaching beyond distal end of third antennal segment, unarmed near tip, dorsally with 9–22 teeth, 2–3 of them are placed on carapace behind posterior margin of orbital cavity (postorbital teeth), ventral with 1–9 teeth. Carapace without supraorbital tooth, with well-developed antennal tooth and a small tooth on pterygostomial angle […]. Pereopods without exopods; first two pereopods chelate, first pereopod shorter then [sic] second, both with dense brushes of setae near tip of fingers typical for atyid shrimp; third pair of pereopods with distinct sexual dimorphism, propodus of male […] slightly curved, dactylus shorter, with stronger and more curved spines at posterior margin than in female […]. Endopod of first pleopod of male broad and pear-shaped, about 1.2 times as long as broad […]. Appendix masculina at second pleopod of male bean-shaped, with numerous strong spines, appendix interna reaching to about 80% of of [sic] appendix masculina.”

From Mitsugi et al. (2017):

“The body color was varied. The carapace and abdomen were translucent light brown, with dark brown stripes and speckles being present or absent […]. The carapace and abdomen were deep green, with a pale yellow longitudinal band on the dorsal surface. The carapace and abdomen were red-brown, with a pale yellow longitudinal band on the dorsal surface and speckles […]”

From Suen and Gillett-Kaufman (2020):

“Wild-type shrimp are generally transparent or greenish-brown; however, generations of selective breeding have produced a variety of colors and patterns […]”

Biology

From Mitsugi et al. (2017):

"All known *Neocaridina* species […] exhibit direct development, i.e., they hatch at the post larval stage, and do not have a planktonic larval stage (Hayashi, 2007; Asakura, 2011)."

From Klotz et al. (2013):

"Egg size 0.55–0.58 × 0.85–1.00 mm."

From Suen and Gillett-Kaufman (2020):

"The incubation time for the eggs ranges from 16 to 19 days. The clutch size a female can carry ranges between 43 to 60 eggs (Pantaleão et al. 2015)."

"Sexual maturity is reached at around 30 days."

From Prati et al. (2024):

"There was no clear evidence of a temperature-dependent sex ratio. Populations of *N. davidi* living at temperatures between 15 and 20 °C showed the highest proportion of ovigerous females (61.54%) and those living above 25 °C the lowest (14.63%)."

From Weber and Traunspurger (2016):

"Analysis of the stomach of the ornamental red cherry shrimp indicated a high degree of omnivory, consistent with the wide range of food sources available to freshwater shrimp, including *N. davidi*, as described in several studies (Heerbrandt and Lin, 2006; Lai and Shy, 2009; Pantaleao et al., [2015]). Detritus was the most common food item in the stomach of *N. davidi*, followed by algae, as previously reported (Heerbrandt and Lin, 2006; Lai and Shy, 2009)."

"This study clearly showed that *N. davidi* feeds on meiofauna [reported elsewhere in the source as including oligochaetes, microcrustaceans, and nematodes] as it picks through the sediment and detrital floc […]"

From Englund and Cai (1999):

"In areas where it has been introduced or is naturally found, *N. d. sinensis* occurs in large numbers, and it rarely occurs sympatrically with other atyid shrimp species (Y. Cai, pers. observ.)."

Human Uses

From Klotz et al. (2013):

"Its attractive colour morphs (Red Fire Shrimp, Yellow Fire Shrimp, Sakura Shrimp), its tolerance of varying water qualities, and its brooding ecology with females carrying the eggs until the nearly fully developed larvae hatch, has rendered *N. davidi* one of the most popular ornamental shrimp species (Karge and Klotz 2008)."

From Bochini et al. (2024):

"It is known that this species is commercialized in Brazil and Argentina (Pantaleão et al., [2015]) […]"

Diseases

No information was found associating *Neocaridina davidi* with any diseases listed by the World Organisation for Animal Health (2025).

From Prati et al. (2024):

"*Neocaridina davidi* hosts a wide range of commensals and parasites (Ohtaka et al. 2012; Liao et al. 2018; Bauer et al. 2021; Maciaszek et al. 2023), some of which have been co-introduced with *N. davidi* outside their native range (Niwa and Ohtaka 2006; Patoka et al. 2016; Maciaszek et al. [2021]; Kakui and Komai 2022). Among them, *Ecytonucleospora* (*=Enterocytozoon*) *hepatopenaei* (EHP) (Wang et al. 2023) has been detected using molecular tools in a German population of feral *N. davidi* (Schneider et al. 2022). EHP is a microsporidian parasite known to infect the hepatopancreas of shrimps, resulting in stunted growth and impaired immunity. Its transmission occurs directly via the oral-fecal route, cannibalism, or exposure to contaminated water (Tangprasittipap et al. 2013; Subash et al. 2022)."

From Klotz et al. (2013):

"Freshwater shrimps of the genus *Neocaridina* are known to host worms of the families Branchiobdellidae and Scutariellidae. Already in the first description of the only European representative, *Scutariella didactyla* Mrazek 1907, the author presumed based on stomach content that the worm feeds as a parasite on body fluids of the host, in this case *A. desmarestii*. Our own investigations on *N. davidi* from the aquarium trade infected with scutariellids support this assumption. Infected shrimps show brown-bordered holes in their pleurobranchies, which disappear with the next molt after removal of the worms (Klotz 2010)."

From Bauer et al. (2021):

"This study outlines a multifactorial disease outbreak in a population of the freshwater shrimp *Neocaridina davidi*, with the focus on a rarely described parasitic alga. Within this multifactorial disease outbreak, low but consistent mortality was observed. During microscopic examination, an infection of the shrimp with bacterial and fungal-like agents was diagnosed. Furthermore, the green alga *Cladogonium* sp. was found in pleopodal regions. The alga compromised the body

surface of the shrimp, and its rhizoids penetrated the chitin shell and reached into the subcutaneous tissue."

From Svoboda et al. (2014):

"Our results showed that the tested strain of *A*[*phanomyces*] *astaci* [causative agent of crayfish plague] did not cause mortality of studied freshwater shrimps [*N. davidi* and *Macrobrachium dayanum*] and suggest that frequent moulting might be an important factor responsible for the apparent resistance of the shrimps. The results suggest that the pathogen may grow in shrimp tissues, but it is not clear whether it can complete its life cycle in such hosts."

Threat to Humans

No information was found on threats to humans from *Neocaridina davidi*.

3 Impacts of Introductions

From Weber and Traunspurger (2016):

"[…] our study clearly showed that freshwater shrimp [*N. davidi*] decrease significantly the secondary production of meiofaunal communities by 20–28% (nematodes, oligochaetes, and microcrustaceans), although the impact of other avid consumers of meiofauna, such as benthivorous fish, is stronger and the decrease in meiofaunal secondary production are accordingly larger (Weber and Traunspurger, 2015). […] Despite the generally moderate predation pressure exerted by *N. davidi* on the meiofaunal community, its long-term effects on native invertebrate populations remain to be experimentally determined."

"In conclusion, our study provides the first experimental evidence that the presence of the freshwater ornamental red cherry shrimp *N. davidi* alters the structure of the meiofaunal community and depresses the overall density, biomass, and secondary production of meiofaunal assemblages."

From Englund and Cai (1999):

"We did not observe any native atyid shrimp in O'ahu streams where the introduced *N. d. sinensis* was found, despite these areas being suitable elevations and habitats for the native *A*[*tyoida*] *bisulcata.*"

"The introduction of *N. d. sinensis*, *Exopalaemon modestus* (Heller), and *Caridina aff. gracilipes* De Man, and exotic fish species into Dianchi Lake [Yunnan province], China is believed to be responsible for the disappearance of an endemic atyid shrimp species, *Caridina dianchiensis* (Liang & Yan). *Caridina dianchiensis* is now found only in rivers and mountain streams lacking *N. d. sinensis* (Liang & Yan, 1985)."

From Onuki and Fuke (2022):

"Based on preliminary observations, alien *Neocaridina* spp. were suspected to have been established in Lake Biwa [Japan] (Nishino 2017, [2020]). However, these populations were not identified, and it was unclear whether replacement of the native species by alien species occurred. Our results showed that *N. davidi* was established at 11 of the 19 sites in and around Lake Biwa, suggesting that the native species [*Neocaridina denticulata*] has been replaced by an invasive species at most sites in this region."

"*Neocaridina denticulata*, which inhabits coastal areas and shallow rivers, may have been strongly affected by development and pesticide use, leading to its extinction in some populations in and around Lake Biwa. *Neocaridina davidi* in and around Lake Biwa may have taken advantage of the vacant niche created by the drastic decrease in or extinction of the native population and became established."

4 History of Invasiveness

The History of Invasiveness for *Neocaridina davidi* is classified as High. Introductions outside the native range have led to established populations in several countries in Europe, as well as in Hawaii, Canada, Japan, and Réunion. *Neocaridina davidi* is common in the aquarium trade throughout the United States and internationally, which has likely contributed to many introductions. This species alters meiofaunal communities through predation, and there is some evidence of displacement of native shrimp in multiple locations where *Neocaridina davidi* has been introduced.

5 Global Distribution

Figure 1. Reported global distribution of *Neocaridina davidi*. Map from GBIF Secretariat (2023). Observations are reported from the United States in Hawaii and Florida, Canada, South Africa, Japan, Taiwan, China, South Korea, Ukraine, Slovakia, Hungary, Poland, Germany, France, Réunion (France), and Tenerife (Spain).

Occurrences located in Ukraine, South Africa, Tenerife (Spain), and Florida (United States) were excluded from the climate matching analysis because no information was found in the literature to suggest that these points represent established populations of *Neocaridina davidi*.

Established populations in thermal water environments were not included in the climate matching analysis because the environmental conditions experienced by these populations do not reflect the ambient climate in their location. Such populations are located in Canada, Germany, Hungary, Poland, Slovakia, and France. One location in Hungary was retained for the climate matching analysis due to the record of *Neocaridina davidi* in ambient-temperature waters (Weiperth et al. 2019).

Chinese occurrences mentioned by Englund and Cai (1999) in Dianchi Lake, Yunnan province, and Taihu Lake, Jiangsu province, were also included as source locations for the climate matching analysis.

No georeferenced occurrences were available to represent the native range of *Neocaridina davidi* in Vietnam.

6 Distribution Within the United States

Figure 2. Reported distribution of *Neocaridina davidi* in Hawaii. Map from Benson (2025). Observations are reported from central and southeastern O‘ahu.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Neocaridina davidi* to the contiguous United States was highest in the western Great Lakes region and north-central New Mexico. Other areas of high match were found in peninsular Florida, the southern Great Plains, and scattered through the Rocky Mountains. The Northern Plains and Mid-Atlantic to Southern Atlantic coast had a medium

match. Low match areas were found in the Great Basin, along the Pacific Coast, in the Northeast, and in the inland Southeast regions of the United States. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.564, indicating that Yes, there is establishment concern for this species. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/(count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024). However, there is taxonomic confusion surrounding the genus *Neocaridina*, raising some uncertainty in the distribution of *N. davidi* and, by extension, the results of the climate matching analysis. In particular, the lack of clarity around the identification of Israeli populations led to their exclusion from the climate match; if these populations are later confirmed as *N. davidi*, the climate match may increase in some otherwise-low-match regions. Additionally, many nonnative populations of *N. davidi* are established in thermal or thermally polluted waters and are not represented in the climate match, which matches to ambient climate conditions.

Projected climate matches in the contiguous United States under future climate scenarios are available for *Neocaridina davidi* (see Appendix). These projected climate matches are provided as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category.

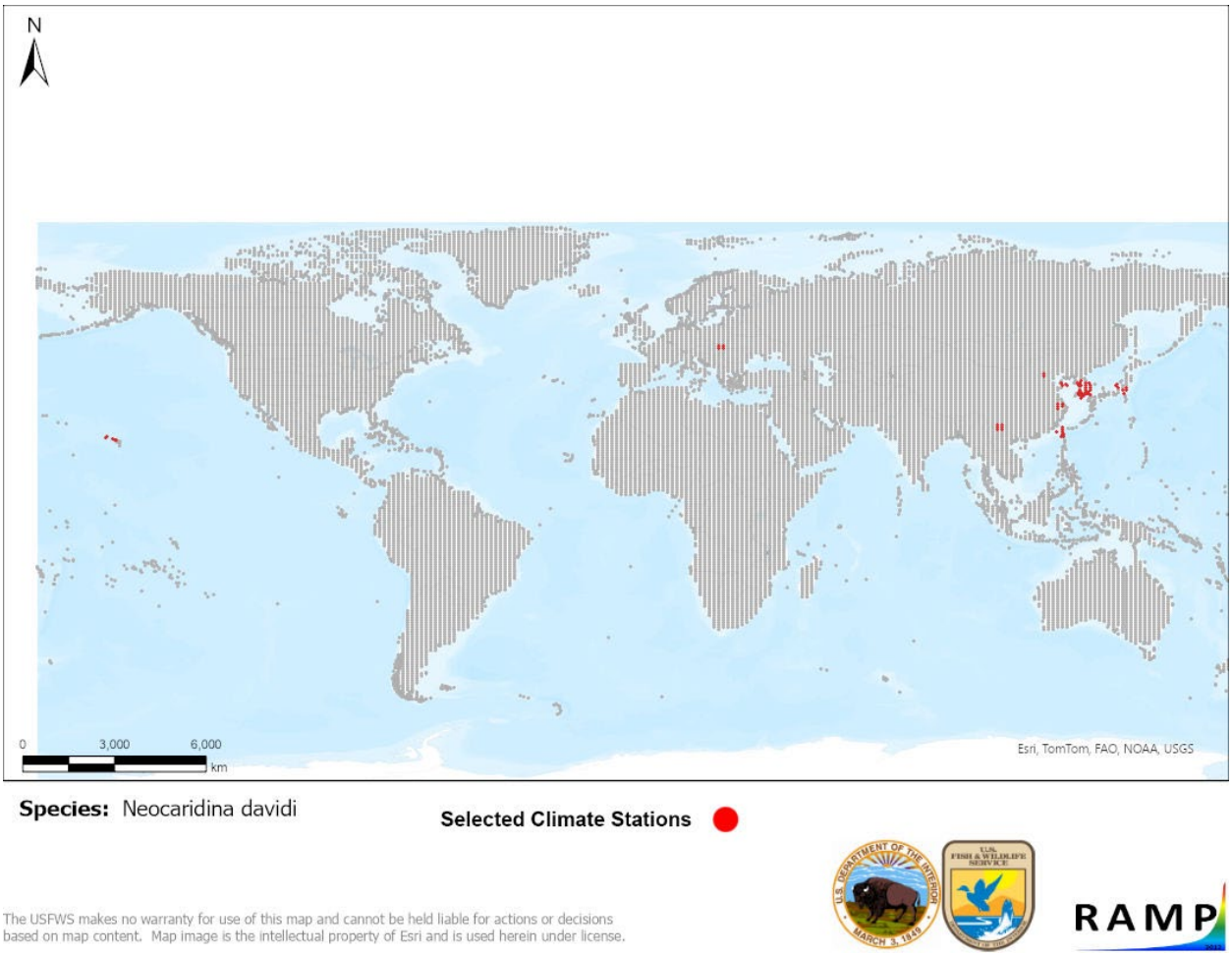

Figure 3. RAMP (Sanders et al. 2023) source map showing global weather stations selected as source locations (red; United States (Hawaii), Hungary, Slovakia, China, Japan, South Korea, Taiwan) and non-source locations (gray) for *Neocaridina davidi* climate matching. Source locations from GBIF Secretariat (2023) and Englund and Cai (1999). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

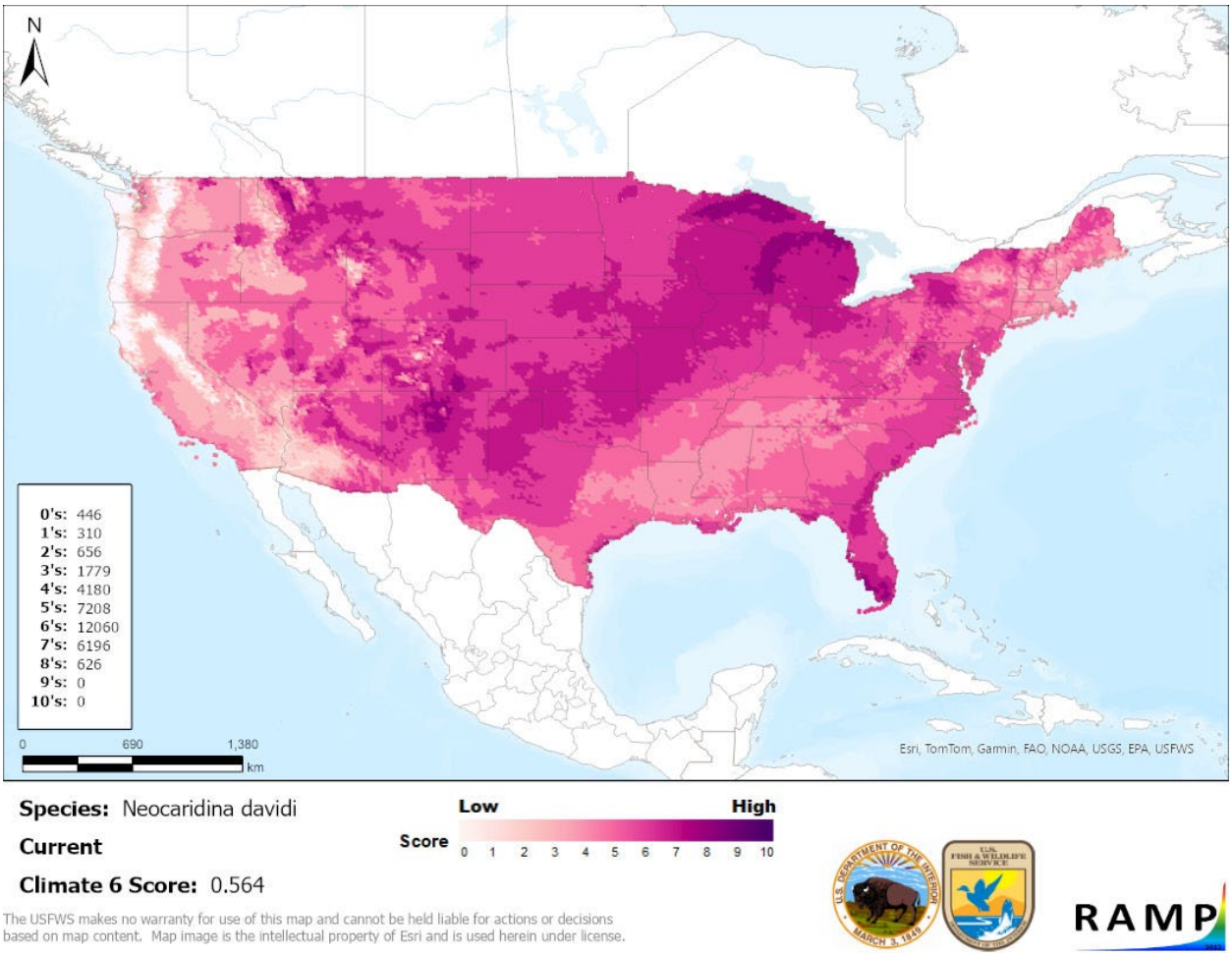

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Neocaridina davidi* in the contiguous United States based on source locations reported by GBIF Secretariat (2023) and Englund and Cai (1999). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

There is adequate information available on the biology and ecology of *Neocaridina davidi*. However, there is taxonomic confusion surrounding the genus *Neocaridina*, raising some uncertainty in the distribution of *N. davidi* and, by extension, the results of the climate matching analysis. Additionally, many nonnative populations of *N. davidi* are established in thermal or thermally polluted waters and are not represented in the climate match. There are peer-reviewed studies reporting impacts of introduction, but most are either correlative or associated with a group of several introduced species, reducing confidence that *N. davidi* is having direct negative impacts on native fauna. The Certainty of Assessment is Low.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Neocaridina davidi, Cherry Shrimp, is a small shrimp native to China, Korea, Taiwan, and Vietnam. It has been transported around the world via the aquarium trade as one of its most popular ornamental shrimp species. *N. davidi* is now established outside its native range in Hawaii, Canada, France, Germany, Hungary, Poland, Slovakia, Reunion, Japan, and China, with introductions also reported in Brazil and Ukraine. However, the population in Canada and many of those in Europe are restricted to thermal or thermally polluted waters. *N. davidi* alters meiofaunal communities through predation, and there is some evidence of displacement of native shrimp in multiple locations where *Neocaridina davidi* has been introduced. The History of Invasiveness for *Neocaridina davidi* is classified as High due to these established populations and negative impacts of introduction. The climate matching analysis for the contiguous United States indicates establishment concern for this species. The climate match results yielded a high match in the Great Lakes region, north-central New Mexico, peninsular Florida, the southern Great Plains, and scattered through the Rocky Mountains. Confusion regarding unresolved taxonomy of the genus *Neocaridina* reduced confidence in the accuracy of the reported distribution of *N. davidi*. Based on this uncertainty and the limited information available on negative impacts of introduction, the Certainty of Assessment for *Neocaridina davidi* is classified as Low. The Overall Risk Assessment Category for *Neocaridina davidi* in the contiguous United States is High.

Assessment Elements

- **History of Invasiveness (see Section 4): High**
- **Establishment Concern (see Section 7): Yes**
- **Certainty of Assessment (see Section 8): Low**
- **Remarks, Important additional information: The taxonomy of the genus *Neocaridina* is not resolved, reducing certainty in the accuracy of the reported distribution of *N. davidi*.**
- **Overall Risk Assessment Category: High**

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Appendix

Summary of Future Climate Matching Analysis

Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by GBIF Secretariat (2023) and Englund and Cai (1999).

Under the future climate scenarios (figure A1), no regions of the contiguous United States were projected to have a consistently high climate match for *Neocaridina davidi*. Areas of low climate match were projected to occur in the Northern Pacific Coast region, as well as much of California, the Great Basin, and the Southwest. The Rocky Mountains remained relatively consistent through all future climate scenarios as an area where both high and low climate matches were found. The area of higher match in the Great Lakes and Midwest contracted over time, especially under SSP5. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.153 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.510 (model: MRI-ESM2-0, SSP3, 2055). All future scenario Climate 6 scores were above the Establishment Concern threshold, indicating that Yes, there is establishment concern for this species under future scenarios. The Climate 6 score for the current climate match (0.564, figure 4) falls above the range of scores for future projections. The time step and climate scenario with the most change relative to current conditions was SSP5, 2085, the most extreme climate change scenario. Under the 2085 time step, areas within the Northeast and Western Mountains saw a moderate increase in the climate match relative to current conditions. No large increases were observed regardless of time step and climate scenarios. Under one or more time step and climate scenarios, areas within the Appalachian Range, Colorado Plateau, Great Basin, Great Lakes, Gulf Coast, Mid-Atlantic, Northern Plains, Southeast, Southern Atlantic Coast, Southern Florida, Southern Plains, Southwest, and Western Mountains saw a moderate decrease in the climate match relative to current conditions. Only the Southern Plains region had a substantial area of moderate decrease in climate match for time step 2050, but many regions had widespread moderate declines in climate match by time step 2085. Additional, very small areas of large or moderate change may be visible on the maps (figure A3).

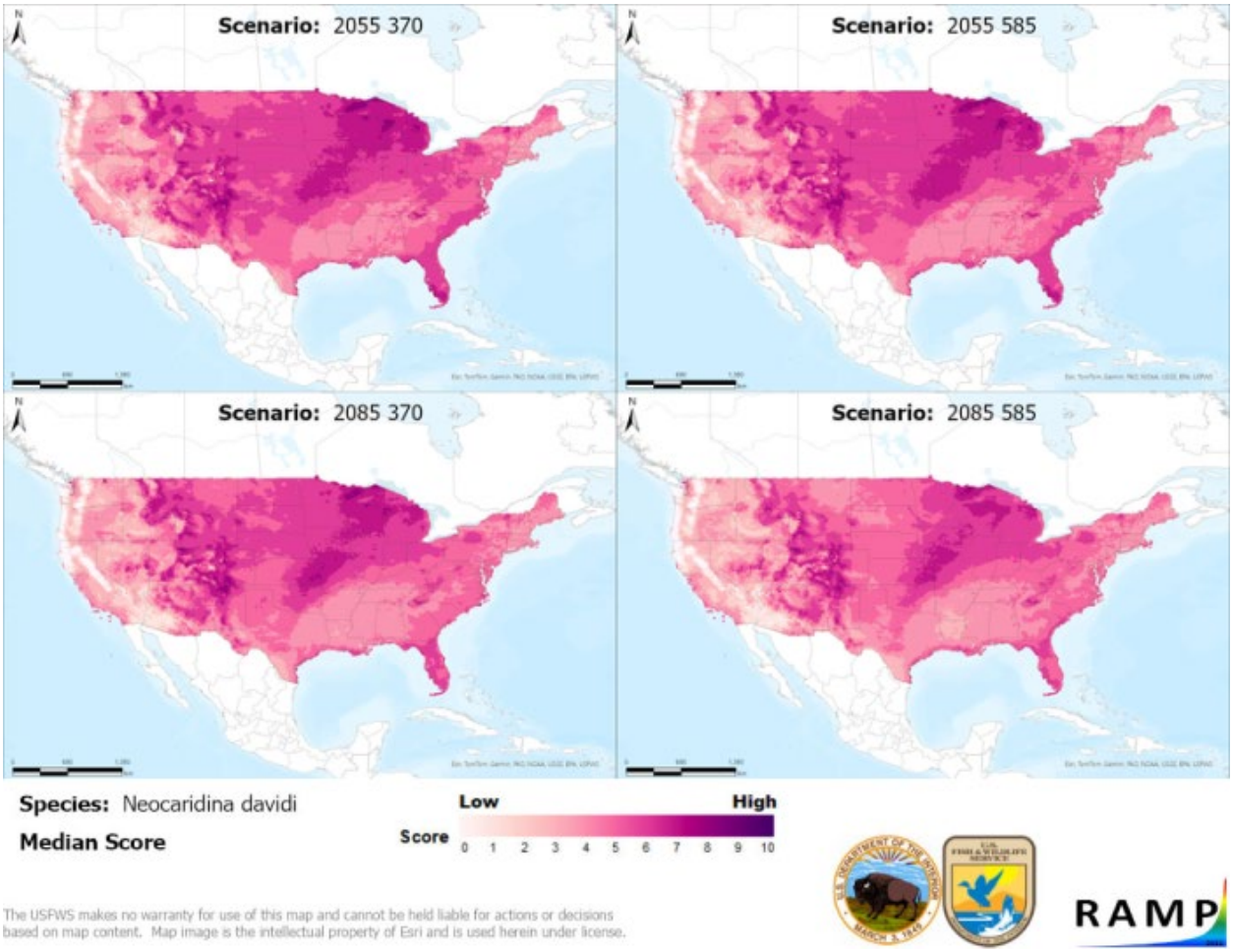

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Neocaridina davidi* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023) and Englund and Cai (1999). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

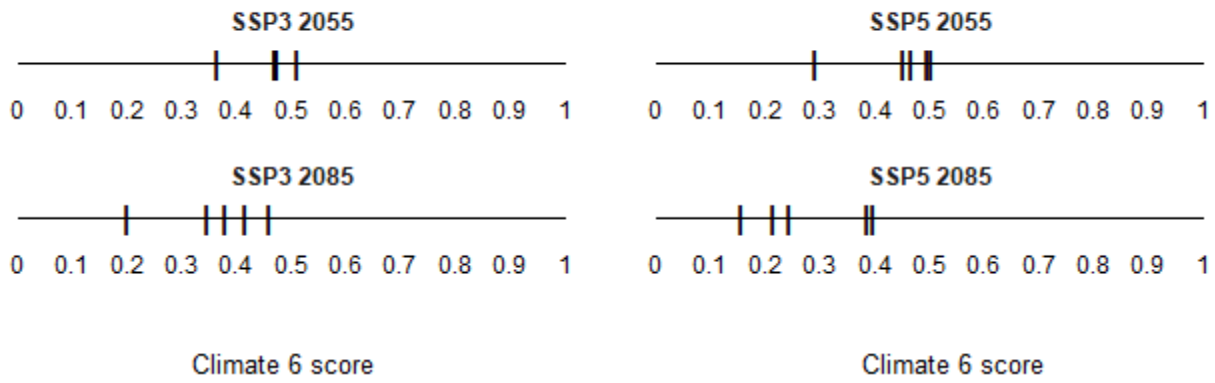

Figure A2. Comparison of projected future Climate 6 scores for *Neocaridina davidi* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0.

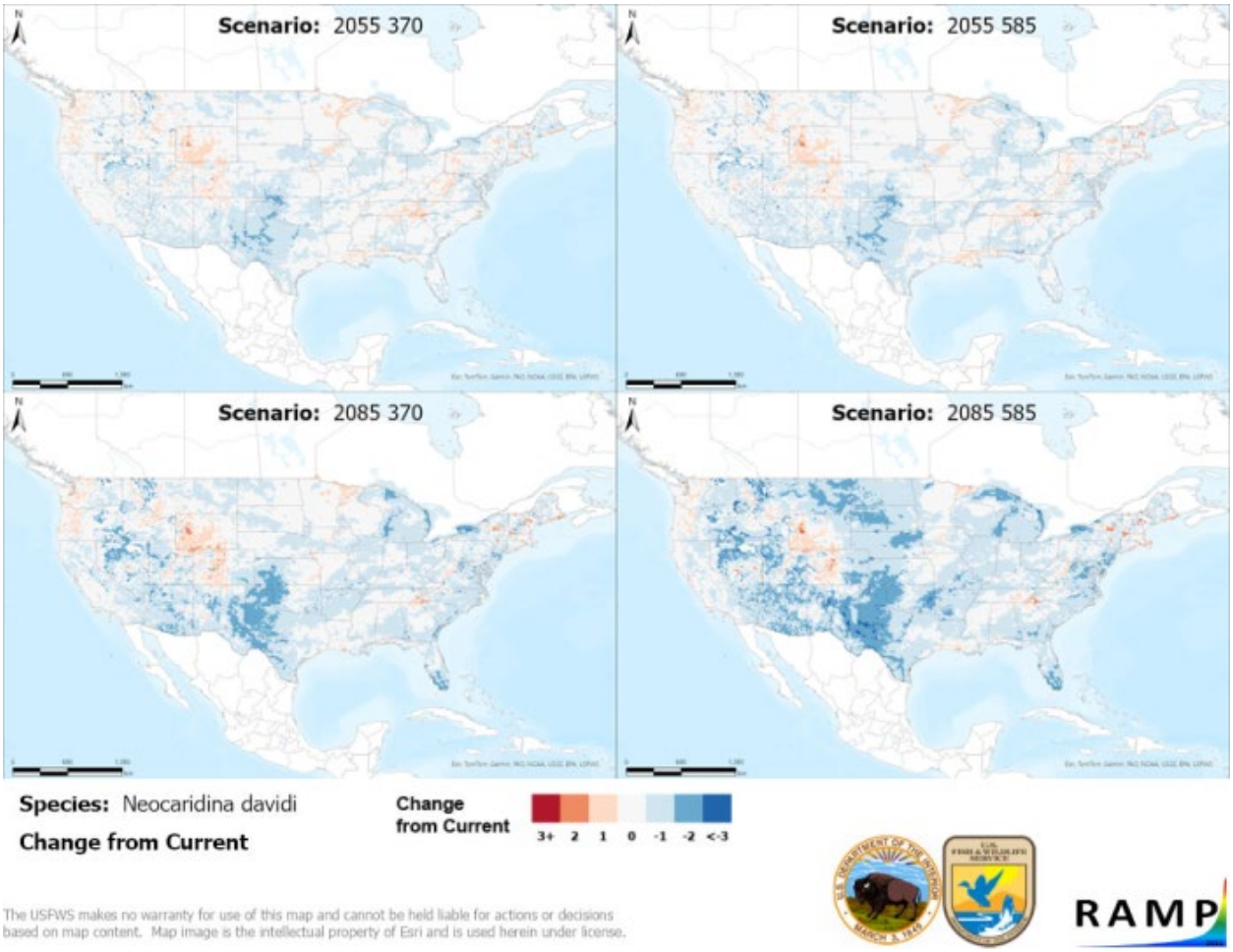

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Neocaridina davidi* based on source locations reported by GBIF Secretariat (2023) and Englund and Cai (1999). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. Shades of blue indicate a lower target point score under future scenarios than under current conditions. Shades of red indicate a higher target point score under future scenarios than under current conditions. Darker shades indicate greater change.

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