BEFORE THE SECRETARY OF THE INTERIOR

PETITION TO LIST THE CRATER LAKE NEWT (*TARICHA GRANULOSA MAZAMAE*) AS AN ENDANGERED SPECIES UNDER THE ENDANGERED SPECIES ACT

Photo: National Park Service

CENTER FOR BIOLOGICAL DIVERSITY

November 16, 2023

Notice of Petition

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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, 5 U.S.C. §553(e); and 50 C.F.R. §424.14(a), the Center for Biological Diversity ("Center") hereby petitions the Secretary of the Interior, through the United States Fish and Wildlife Service ("Service"), to protect the Crater Lake newt (*Taricha granulosa mazamae*) as endangered under the ESA.

The Service 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*. Petitioner also requests that critical habitat be designated for the Crater Lake newt concurrently with the species being listed, pursuant to 16 U.S.C. §1533(a)(3)(A) and 50 C.F.R. §424.12. We are requesting that this petition be considered **on an emergency basis** due to the imminent threat that introduced crayfish pose to the newt's continued existence. Emergency protections are needed to avert extinction.

The 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, supported by more than 1.7 million members and online activists. The Center works to secure a future for all species, great or small, hovering on the brink of extinction. We submit this petition on behalf of our staff and members who hold an interest in protecting the Crater Lake newt.

Submitted this 16th day of November, 2023

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Executive Summary

The Crater Lake newt (*Taricha granulosa mazamae*) ("newt"), also known as the Mazama newt, is a highly imperiled amphibian found only in Oregon's Crater Lake. The newt is closely related to the more widely distributed rough-skinned newt (*T. granulosa*) but is widely accepted as a subspecies due to a high degree of morphological, physiological, and genetic differentiation between them.

The newt's spatial distribution in Crater Lake has declined substantially due to the introduced signal crayfish (*Pacifastacus leniusculus*) ("crayfish"). Crayfish were introduced to the naturally fishless lake in 1915 as a food source for several species of previously introduced fish, which also prey on the newt. Crayfish distribution within the lake has increased from approximately 50% of the shoreline in 2008 to nearly 80% in 2020, virtually eliminating newts in these areas. According to the National Park Service, the agency charged with managing Crater Lake, crayfish may now occupy up to 95% of the shoreline, and scientists anticipate that warming lake temperatures will lead to complete crayfish invasion within two to five years. The newt is also threatened by climate change, as increased air temperatures produce a cascade of effects that alter the lake's natural ecology.

This petition seeks ESA protection for this nationally and globally imperiled species based on the best scientific information and in the context of the five listing factors. This petition also seeks to have the entirety of Crater Lake and its near-shore areas designated as critical habitat in light of the severity of the threats facing the newt.

Introduction

Crater Lake is one of the deepest and clearest lakes in the world, and the Crater Lake newt—which lives nowhere else on Earth—is the lake's top native aquatic predator. Adapted to living in the naturally fishless Crater Lake, and in contrast to its close relative the rough-skinned newt, the Crater Lake newt lacks any defense to introduced predators, which prey directly on newts at every life stage and alter their habitat. Signal crayfish are considered to be among the world's 100 most destructive invasive species and were introduced to Crater Lake in 1915 by park managers as a food source for previously introduced fish (Scordo et al. 2023, p. 2). Such species introductions—often by state fish and game agencies—have had devastating consequences for native species and ecosystems and play a significant role in amphibian declines and extinctions worldwide (Nunes et al. 2019, pp. 1, 9). And with lake temperatures warming as a result of climate change, crayfish populations in Crater Lake have exploded in recent years. Newts have disappeared where crayfish are present, and crayfish may now occupy up to 95% of the lake's shoreline. Scientists anticipate that crayfish will occupy 100% of the lake's shoreline in as soon as two years and, accordingly, the extinction of this unique amphibian is imminent.

Biology

Taxonomy:

The Crater Lake newt (*Taricha granulosa mazamae*), also known as the Mazama newt, is a distinct population of the rough-skinned newt (*T. granulosa)*. The rough-skinned newt is widely distributed throughout the Pacific Northwest, whereas the Crater Lake newt is a sub-species endemic to Crater Lake. The Crater Lake newt was first formally described in the 1940s and proposed as a subspecies characterized by unusually dark ventral pigmentation (Farner and Kezer 1953, p. 451–52). Genetic analyses of rough-skinned newts confirm that newts in Crater Lake are morphologically, genetically, and physiologically distinct from populations of newts outside of the lake. For instance, the Crater Lake newt is more aquatic, has distinct tail morphology and coloring of ventral surfaces, and has extremely low levels of tetrodotoxin ("TTX"), a potent neurotoxin, compared to *T. granulosa* (Buktenica et al. 2015, p. 2; Girdner et al. 2017, p. 722).

Species description:

The Crater Lake newt has a rounded snout, rough skin, and is dark in color on its dorsal surfaces. The ventral surfaces have orange-yellow coloration with dark pigmentation that may have a mottled appearance, and it is this darker ventral color that most clearly distinguishes it from *T. granulosa*. The Crater Lake newt's tail morphology also distinguishes it from *T. granulosa* (Girdner et al. 2017, p. 722).

Figure 1. *T. granulosa mazamae* (left), and *T. granulosa* (right) (Photo: NPS).

Life History:

The newt is more aquatic than *T. granulosa* according to recent observations (Girdner et al. 2017, p. 722), although it was reported to be historically common "under the rocks and driftwood along the shore" of the lake (Farner and Kezer 1953, p. 452). Adult newts feed primarily aquatically on items such as amphipods, snails, and other macroinvertebrates (Farner and Kezer 1953, p. 453).

Newt larvae likely consume zooplankton and other small aquatic invertebrates, as this is observed in *T. granulosa*. It reproduces in the lake, depositing eggs singly along the shore, likely among large blocks of lava (Farner and Kezer 1953, p. 451). Little is known about the newt's longevity, but marked specimens of *T. granulosa* have been recaptured after 17-18 years, indicating that the newt is likely long-lived (Ridenhour et al. 2007, p. 725). If similar to *T. granulosa*, the newt likely does not reproduce until age four or five (Lorenz 2008).

The newt historically filled the niche of top aquatic predator in Crater Lake, and the lake is naturally free of other predators. As such, it has extremely low, non-lethal levels of TTX. The newt's lack of TTX likely makes it highly vulnerable to predation by introduced fish and crayfish; it appears that its only defense to predation by crayfish is to flee, exposing it to predation by trout (Girdner et al. 2017, p. 733).

Habitat requirements:

The newt lives only in Crater Lake, one of the deepest and most pristine lakes in the world. Because it evolved as the lake's top aquatic predator, the newt lacks predator defense mechanisms; as such, newts require predator-free habitat to remain viable. Newts also require lake features that support prey availability, including adequate benthic macroinvertebrate mass and littoral habitats that are diverse in structure and production (Scordo et al. 2023, p. 2).

Newts also rely on climate factors that support the natural ecology of Crater Lake. Climate is the driving force for the lake's internal heating, cooling, mixing and circulation, which affects nutrient cycling, food webs, and other important characteristics that support the lake's flora and fauna, including the newt (NPS 2021, p. 15). In Crater Lake, air temperature strongly influences the timing of summer stratification, thermocline depth, surface water temperature, near-surface phytoplankton taxa, winter mixing, and vertical nutrient flux (NPS 2021, p. 15). Summer air temperature plays a particularly important role because it influences the thermal structure of the lake during stratification (NPS 2021, p. 16). Habitat alterations such as increased air and lake temperatures have deleterious effects on the newt; for example, studies show that warming lake temperatures improve crayfish survival, resulting in their expansion and subsequent decreases in newt distribution (NPS 2021, p. 5).

Range and Population Status:

The newt is ranked by NatureServe as a T1 Critically Imperiled Subspecies (NatureServe 2023). The newt was once abundant in Crater Lake, the only place it lives, but its numbers and distribution have declined substantially with the expansion of invasive crayfish. Crayfish distribution within the lake increased from approximately 50% of the shoreline in 2008 to 95% in 2020, completely replacing newts in these areas (NPS 2021, p. viii). Therefore, it is likely that the newt is now restricted to occupying just 5% of the lake's shoreline.

Because crayfish now occupy up to 95% of the lake's shoreline, and newts do not occupy invaded areas, it can be assumed that newt abundance has declined to a similar, if not greater extent as its distribution within the lake. Extensive and regular snorkel surveys indicate that newt populations that remain in the lake are relatively small (Figure 2).

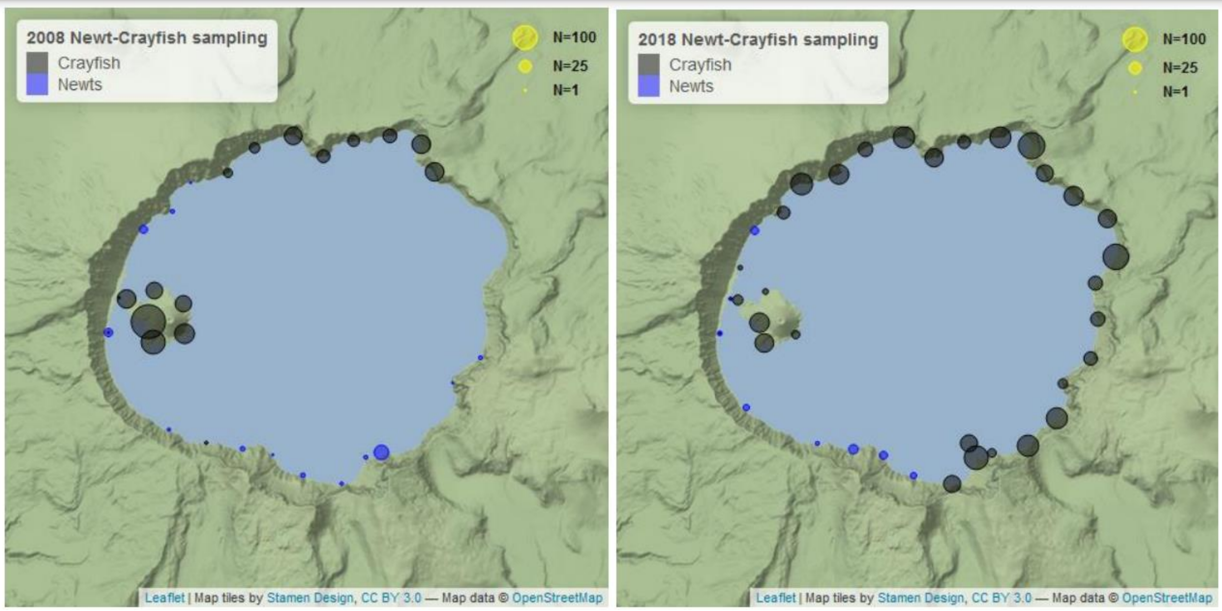

Figure 2. Spatial distribution and abundance of crayfish and newts at 40 locations around Crater Lake in 2008 and 2018. Circle size is relative to abundance (NPS 2021, p. 5).

Listing Factors

Disease or predation:

The newt's greatest threat is predation by multiple introduced species. Crayfish prey directly on newts, which lack any defense mechanisms, and also flush them from cover, exposing them to predation by introduced fish (Buktenica et al. 2015, p. 4). In other amphibian species, even when breeding continues in crayfish-occupied habitats, larval abundance appears to be inversely related to crayfish densities (Ficetola et al. 2011, p. 17). In laboratory experiments, Axelsson et al. (1997) found that amphibian egg masses and larvae were particularly vulnerable to crayfish predation (Girdner et al. 2017, p. 722). Therefore, it is very likely that crayfish prey upon the newt at every life stage.

Figure 3. Crater Lake newt (left) and signal crayfish (right) (NPS 2019).

Resource competition with crayfish likewise poses a significant threat to the newt. Studies at Crater Lake show that the presence of crayfish reduces biomass of bottom dwelling insects by more than 90% and macroinvertebrate grazers by 99%, resulting in trophic cascades and promotion of filamentous algae (Scordo et al. 2023, p. 9; Figure 5). Some insect taxa—which newts rely upon for food—are virtually eliminated when crayfish invade, especially snails and caddisflies (NPS 2021, p. 6). Competition with crayfish for food and cover also increases newt energy demands and exposure to ultraviolet radiation (NPS 2015, p. 3).

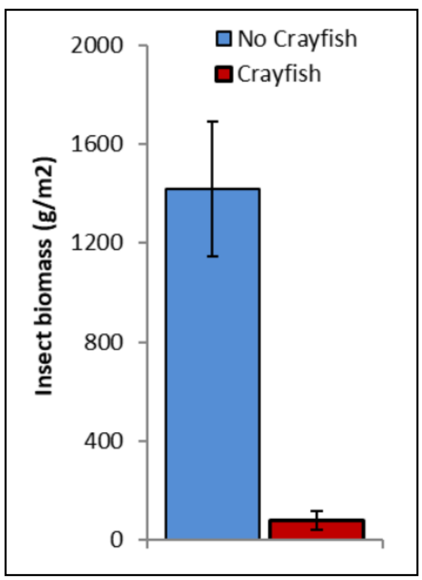

Figure 4. Average benthic insect biomass at locations
without crayfish (N=39) and with crayfish (N=63) (NPS 2021, p. 7).

Moreover, NPS (2021, p. 6–7) found that crayfish increase algae growth by eliminating benthic grazers, the effects of which in Crater Lake are under investigation but may include significant food web alterations that have negative consequences for aquatic species such as the newt (Vadeboncoeur et al. 2021, p. 1021–23; Figure 5). According to NPS, in late September of 2016 a bloom of phytoplankton algae turned the clear blue water of Crater Lake into a yellowish-green along the north shoreline, the first documented algal bloom event of its kind in the lake (NPS 2021, p. 9).

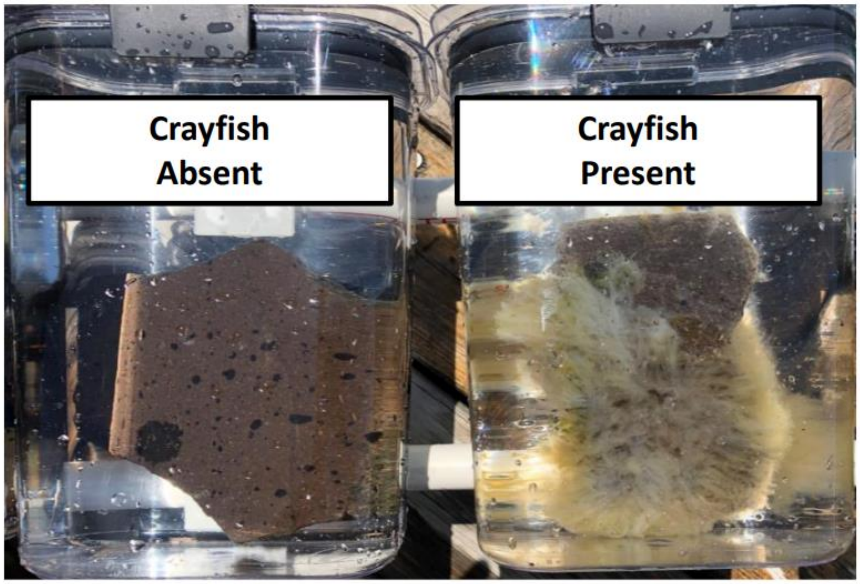

Figure 5. Rocks from the shoreline were placed in acrylic chambers and incubated in the lake to measure oxygen production of the attached algae. The rock from the crayfish present location covered in green filamentous algae is the most extreme example of attached algae observed in 2020 (NPS 2021, p. 6).

After a pilot crayfish removal study was conducted from 2012-2014, resulting in the removal of thousands of crayfish without any observed negative impact to crayfish densities, NPS scientists determined that "any meaningful crayfish control efforts will require significantly more resources than are currently available at Crater Lake National Park" (Buktenica et al. 2015, p. 5). And according to Girdner et al. (2017, p. 737),

> Given the limitations of [crayfish] suppression strategies, future projections for warming temperatures, and the continued contraction of newt distribution, there is growing need to develop a comprehensive management plan for Mazama newts in Crater Lake. […] Partnerships and long-term funding will be necessary to plan and execute the suppression and conservation work, monitor their progress, and evaluate successes.

Scientists predict that absent successful crayfish removal, complete crayfish invasion and the subsequent extinction of the newt will occur within two to five years (Scordo et al. 2023, p. 10).

<u>Inadequacy of existing regulatory mechanisms:</u>

Crater Lake is within Crater Lake National Park. This designation prevents many forms of habitat destruction, as it requires park managers to "conserve the scenery, natural and historic objects, and wild life in the System units," 54 U.S.C. §100101(a), but is not protecting the newt from the threats driving its extinction. NPS conducts regular monitoring of water quality, quantity, and crayfish distribution, and has also undertaken several crayfish removal efforts, none of which have been successful (NPS 2021; Girdner et al. 2017, p. 737).

Crater Lake is also designated by the state of Oregon as an Outstanding Resource Water, which requires the state to maintain and protect the ecological and recreational values of the lake. OAR 340-041-0185(6). This designation has also not alleviated the threats facing the newt. Moreover, no existing regulatory mechanisms currently exist to address climate change.

Listing under the ESA would provide the newt with a recovery plan and the long-term funding of conservation efforts that are called for by scientists and necessary for the newt to have any chance of persistence.

<u>Other natural or manmade factors affecting the continued existence of the species:</u>

As amphibians, newts are particularly vulnerable to the direct and indirect effects of environmental change, including climate change (Blaustein et al. 2010, pp. 281, 291; Hopkins 2007, p. 271). Average winter temperatures at Crater Lake have increased since 1965, and the length of summer, defined as warm water floating on the lake surface, is about 33 days longer (NPS 2021, p. 5). Surface temperature of the lake has also increased: during summer, temperatures have risen by 3.2°C (5.6°F) since temperature records began in 1965 (NPS 2021, p. 19). Crater Lake's warming temperatures are caused by higher air temperatures and impact the frequency of "deep water mixing," which is "one of the most important drivers of lake ecology" (Wood et al. 2023, p. 563-64, 578); USGS 2023, p. 1). NPS (2021, p. 15) projects that air temperatures will continue to increase in the future (Figure 6). Increasing lake temperatures also drive algae growth (NPS 2021).

Climate change-induced warming water temperatures can have deleterious effects on amphibians, increasing disease, altering food webs, and reducing survival rates (Blaustein et al. 2010, *see*, e.g., p. 281, 290; Vadeboncoeur et al. 2021, p. 1019). Climate change can also increase ultraviolet-B radiation, which has a wide array of effects on aquatic organisms and has been implicated in global amphibian declines (Belden and Blaustein 2001, p. 551). High rates of embryonic mortality in eggs exposed to UV-B were observed in a newt species of the same genus, *Taricha torosa* (Anzalone et al. 1998, p. 646, 650), and radiation exposure is also thought to decrease newt growth and increase energy expenditure (Blaustein et al. 2000, p. 227, 231–32). Therefore, it is possible that increased exposure to UV-B radiation as a result of climate change will impact the newt's survival at multiple life stages, further reducing its viability. These effects are exacerbated by competition with crayfish for cover, which exposes newts to additional UV-B radiation (NPS 2015, p. 3).

Perhaps most critical to the viability of the newt, warmer temperatures in Crater Lake facilitate crayfish expansion; warmer water temperatures in the winter allow more crayfish to survive, and longer summers allow the species more time to invade new portions of the lake (NPS 2021, p. 5; Figure 7). It is anticipated that warming temperatures will allow for complete crayfish invasion within two to five years (Scordo et al. 2023, p. 10) and, as explained above, NPS has found that "several emerging issues regarding the spread of crayfish have the potential to impact the long-term ecology of Crater Lake," such as excessive algal growth and reduced littoral biomass associated with crayfish-invaded areas (NPS 2021, p. 5–6).

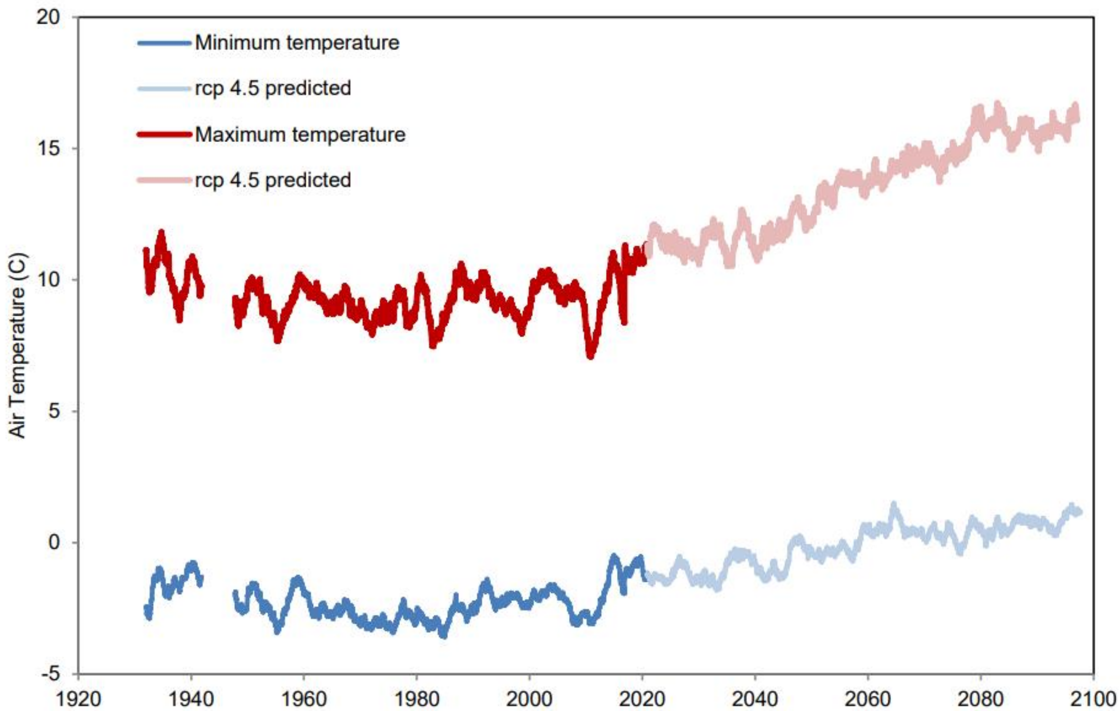

Figure 6. Observed and predicted maximum and minimum air temperatures at Crater Lake National Park headquarters (NPS 2021, p. 15).

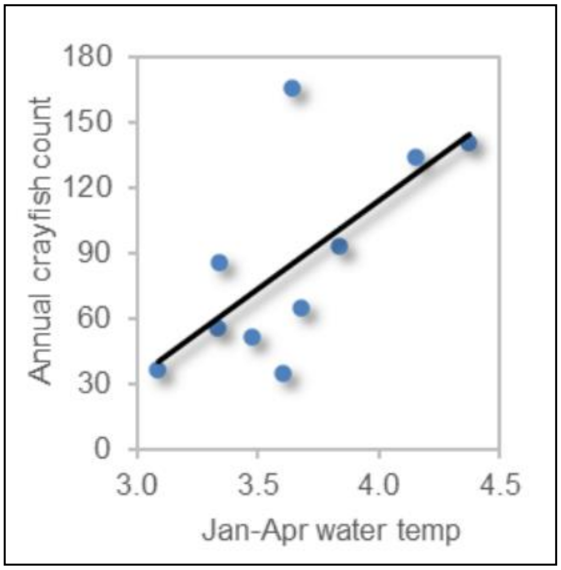

Figure 7. Relationship between annual crayfish density and previous winters' water temperature (NPS 2021, p. 5).

Other factors that threaten the newt include its small population size and highly restricted range. The newt's distribution in Crater Lake has declined by over 80%, and it is presumed that its population size has declined in tandem. Accordingly, the newt's effective population size has also declined. Reduced effective population size can lead to inbreeding depression and loss of genetic diversity, diminishing the ability of the species to adapt to environmental change and to respond to risks from diseases and pathogens (Wang et al. 2011, p. 911). Moreover, Hopkins (2007, p. 274) posits that populations subject to stress (for instance via predation) are more vulnerable to disease. Underlying the threat of population losses is the newt's inability to quickly recover from population losses due to its seemingly low fecundity—indeed, the newt is likely a long-lived amphibian that may not produce until four or five years old (Lorenz 2008).

Request for critical habitat:

We request and strongly recommend that Crater Lake and its near-shore terrestrial areas be designated as critical habitat concurrent with the newt's listing.

As required by the Endangered Species Act, the Secretary shall designate critical habitat concurrent with determination that a species is endangered or threatened (16 U.S.C. §1533(a)(3A)). Critical habitat is defined by Section 3 of the ESA as:

(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and

(ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species.

16 U.S.C. §1532(5).

XI. Conclusion:

The newt is a unique amphibian that exists only in Crater Lake, one of the world's deepest and clearest lakes. As the lake's top native aquatic predator, the newt lacks any defense to introduced predators such as crayfish, which have replaced newts in up to 95% of their range. The best available science indicates that crayfish may replace newts entirely, leading to their extinction, in as soon as two years. Climate change also threatens the newt because warming lake temperatures increase crayfish success and otherwise alter the lake's natural ecology. Accordingly, in the context of the five listing factors, the newt warrants ESA protection because it faces imminent extinction due to predation by and resource competition with introduced species, is threatened by climate change, and is particularly vulnerable to all the threats it faces due to its small population size and highly restricted range. There are no existing regulatory mechanisms that alleviate the threats facing the newt and without ESA protection its extinction looms. We urge the Service to propose the newt for listing as endangered and to designate critical habitat to ensure that it survives for future generations.

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