Noel's amphipod (*Gammarus desperatus*), Koster's springsnail (*Juturnia kosteri*), Roswell springsnail (*Pyrgulopsis roswellensis*), and Pecos assiminea (*Assiminea pecos*)

5-Year Review: Summary and Evaluation

Noel's amphipod

Roswell springsnail

Koster's springsnail

Pecos assiminea

Photos by Brian Lang, New Mexico Department of Game and Fish

U.S. Fish and Wildlife Service
Southwest Region
Albuquerque, New Mexico
May 2020

5-YEAR REVIEW
Species reviewed: Noel's amphipod (*Gammarus desperatus*), Koster's springsnail (*Juturnia kosteri*), Roswell springsnail (*Pyrgulopsis roswellensis*), and Pecos assiminea (*Assiminea pecos*)

1.0 GENERAL INFORMATION

1.1 Listing History:

Species: Noel's amphipod (*Gammarus desperatus*), Koster's springsnail (*Juturnia kosteri*), Roswell springsnail (*Pyrgulopsis roswellensis*), and Pecos assiminea (*Assiminea pecos*)

Date listed: August 9, 2005

FR citation(s): 70 FR 46304

Classification: All four species are considered Endangered.

Critical habitat/4(d) rule/Experimental population designation/Similarity of appearance listing: 70 FR 46304

1.2 Methodology used to complete the review:

The U.S. Fish and Wildlife Service (Service) conducts status reviews of species on the List of Endangered and Threatened Wildlife and Plants (50 CFR 17.12) as required by section 4(c)(2)(A) of the Endangered Species Act (Act). We provided notice in the Federal Register (84 FR 36113) on July 26, 2019. The current recovery plan was a collaborative effort by the Service's New Mexico Ecological Services Field Office, Regional Office, Bitter Lake National Wildlife Refuge (NWR), and other partners. The Final Recovery Plan for Four Invertebrate Species of the Pecos River Valley: Noel's amphipod (*Gammarus desperatus*), Koster's springsnail (*Juturnia kosteri*), Roswell springsnail (*Pyrgulopsis roswellensis*), and Pecos assiminea (*Assiminea pecos*) Recovery Plan (Recovery Plan) is the most current source of information, and should be referenced in conjunction with this review.

In accordance with section 4(c)(2) of the Act, the purpose of a 5-year review is to review each listed species and determine whether its listing status should be reclassified or if the species should be removed from the Lists of Threatened and Endangered Wildlife and Plants. The Service evaluated the biology and status of Noel's amphipod (*Gammarus desperatus*), Koster's springsnail (*Juturnia kosteri*), Roswell springsnail (*Pyrgulopsis roswellensis*), and Pecos assiminea (*Assiminea pecos*) as part of the recent Recovery Plan for these species to inform this 5-year review.

The initial 5-year review of these species was completed in 2010 (Service 2010). Designation of Critical Habitat was completed in June of 2011 (Service 2019a). Critical Habitat is located in Chaves County, New Mexico, and Pecos and Reeves Counties, Texas.

The Final Recovery Plan for the Four Invertebrate Species of the Pecos River Valley was completed in October of 2019, and should be referenced in conjunction with this review (Service 2019a). Additional information regarding each of the four listed invertebrates is found on their respective pages within the Service's Environmental Conservation Online System (ECOS) website (Service 2019a).

Reviewers:

Lead Regional Office: Interior Regions 6/7/8 (Albuquerque) Office, Janess Vartanian

Lead Field Office: New Mexico Ecological Services Field Office, Vance Wolf, Fish and Wildlife Biologist, (575) 627-0206; and Debra Hill, New Mexico Energy Streamlining Program Coordinator, (505) 761-4719

Cooperating Field Office(s): Austin Ecological Services Field Office, Michael Warriner, (512) 490-0057; National Wildlife Refuge staff: William Johnson, Matthew Butler, and Jeffrey Beauchamp

1.3 FR Notice citation announcing the species is under active review:

84 FR 36113; 5-Year Status Reviews of 36 Species in Arizona, New Mexico, Texas, Utah, and Mexico; Notice of initiation of reviews; request for information. July 26, 2019

2.0 REVIEW ANALYSIS

2.1 Application of the 1996 Distinct Population Segment (DPS) policy:

The DPS policy does <u>not</u> apply to the four invertebrate species. DPS listings are restricted to vertebrate species.

2.2 Is there relevant new information for this species regarding the application of the DPS policy?

N/A

2.3 Recovery Criteria:

The Recovery Plan contains recovery criteria for Noel's amphipod, Koster's springsnail, Roswell springsnail, and Pecos assiminea (Service 2019b, p 46-49). Downlisting and delisting criteria have been developed for the four invertebrate species (Service 2019b, page 48-52).

None of the recovery criteria have currently been met. Each species should be considered individually for downlisting or delisting when the following objectives and criteria from the Recovery Plan have been met.

Objective 1 – Secure and maintain the long-term survival of each species with the appropriate number, size, and distribution of resilient management units.

Downlisting Criterion 1: Maintain the presence of each species in the occupied management units as of the start of this plan, with a stable or increasing average trend in density over 10 years at currently monitored management units (1 and 3).

Delisting Criterion 1: Maintain the presence of each species in the occupied management units as of the start of this plan, with a stable or increasing average trend in density over 20 years in management units (1 and 3).

Objective 2 – Protect water quantity

Downlisting Criterion 2: Develop, implement, and fulfill a water management plan or equivalent conservation agreement, supported by the local irrigation district and other partners, that ensures adequate surface and groundwater levels to 1) sustain downlisting criteria measured by Criterion 1 above, and 2) meet or exceed Bitter Lake NWR's minimum federally reserved water right flow (0.0042 m^3/s (0.15 cfs) for 10 years.

Delisting Criterion 2: Develop, implement, and fulfill a water management plan or equivalent conservation agreement, supported by the local irrigation district and other partners, that ensures adequate surface and groundwater levels to 1) sustain delisting criteria measured by Criterion 1 above, and 2) ensure that the flows in Bitter Creek as measured at the Bitter Creek Flume are greater than 0.007 m^3/s (0.25 cfs) for 20 years.

Objective 3 – Protect water quality

Downlisting Criterion 3a: Long-term commitments (Conservation Agreements etc.) are in place and will continue to maintain sufficient water quality protections for 10 years, and water quality sustains each species as measured by Criterion 1 above.

Delisting Criterion 3a: Long-term commitments (Conservation Agreements etc.) are in place and will continue to maintain sufficient water quality protections for 20 years, and water quality sustains each species as measured by Criterion 1 above.

Downlisting Criterion 3b: Long-term commitments (Conservation Agreements etc.) are in place that would specifically address the four invertebrates and reduce the risk of a catastrophic spill occurring within a drainage or recharge area occupied by any of the four invertebrates for 10 years.

Delisting Criterion 3b: Long-term commitments (Conservation Agreements etc.) are in place that would specifically address the four invertebrates and reduce the risk of a catastrophic spill occurring within a drainage or recharge area occupied by any of the four invertebrates for 20 years.

Objective 4 – Protect and restore habitat that supports invertebrate populations

Downlisting Criterion 4: A habitat management plan is developed and implemented that ensures that the environment remains as suitable habitat that sustains each species for 10 years.

Delisting Criterion 4: A habitat management plan is developed and implemented that ensures that the environment remains as suitable habitat that sustains each species for 20 years.

2.4 Updated Information and Current Species Status

For a complete 5-factor analysis and discussion of the species status including biology and habitat, threats, management efforts, and recovery criteria, please refer to the final Recovery Plan, signed July 26, 2019.

2.4.1 Biology and Habitat:

Noel's amphipod, Koster's springsnail, Roswell springsnail, and Pecos assiminea are associated with desert grassland spring systems within southeastern New Mexico and west Texas. There is little new information on the biology and life history of these species, although recent efforts have attempted to monitor habitat associations and population responses to drought or other fluctuating conditions. Bitter Lake and regional National Wildlife Refuge (NWR) staff collaborated to develop a monitoring methodology for use at Sago Springs, Bitter Creek, Snail Unit, and subsequently for the Rio Hondo translocation site (Johnson et al. 2019). This work supported implementation of the endemic invertebrate monitoring program currently in use at Bitter Lake NWR.

Population Trends

Population trends for the four invertebrate species are difficult to determine. Population abundances may fluctuate dramatically among seasons. Environmental factors such as drought may further exacerbate intra-annual population variation, and alter species distributions.

Considering seasonal variation, the four invertebrate species exhibited an overall stable trend in each management unit from 2014 to 2017 (Johnson et al. 2019, page 154-159). Roswell and Koster's springsnails have been translocated to the Rio Hondo system, and have improved the redundancy of both springsnails by increasing their number of populations and spatial distribution on Bitter Lake NWR.

Pecos assiminea population densities are not well understood due to low detection probabilities and difficulties in finding individuals. Populations in all of the management units are considered to be similar to past abundance levels (NMDGF 2007, pages 7-8: NMDGF 2008, pages 7-8). However, this species needs more research on effective and efficient monitoring techniques within Bitter Lake NWR, at East Sandia Springs, and at Diamond Y Springs in Texas.

Bitter Lake NWR staff conducted survey and detection trials for Pecos assiminea using wooden tiles and visual quadrats. Roesler (2015; 2016, pages 30, 59) compared survey methods using wooden tiles (passive survey method) and visual quadrats (active survey method) to evaluate the feasibility of each technique for monitoring species presence and abundance. Wooden tiles may overestimate Pecos assiminea due to attraction, and it does not appear to be feasible to model detection probabilities using wooden tiles (Roesler 2016, page 50). Wooden tiles may be a useful method for evaluating species presence/absence, although the interaction of tile placement on moist soils, vegetation growth, and plant litter may influence detectability of snails (Roesler 2016, pages 6, 37). The second method (visual quadrats) may provide more accurate density estimates, but must account for detectability (Roesler and Grabowski 2017, page 2). Visual quadrats are also labor intensive and time consuming. Neither of the two methods is ideal, but may be used in combination or modified to develop a new method for monitoring occupancy and densities of Pecos assiminea.

Genetics

There is no change in taxonomic status. All four invertebrates are classified as full species.

Research on Noel's amphipod suggests that there may be two lineages of *Gammarus* on the Refuge (Walters and Berg 2017, page 1). However, further studies are needed to determine whether the lineages having diverged sufficiently to be considered distinct species.

Berg (2010, pages 1-3) sequenced several mitochondrial genes (cytochrome oxidase subunit 1 and 16 rRNA) from amphipods n Bitter Lake NWR, and the study found that there are two distinct lineages of *Gammarus desperatus*. Recent research on Noel's amphipod suggests that there may be more diversification of the species on the refuge, and describes the diversity among amphipods at Bitter Lake NWR from lineages that include *Gammarus desperatus* and *Gammarus lacustris* (Walters and Berg 2017, page 1). Further studies are needed to determine whether genetic differentiation is due to contemporary isolation resulting from refuge waterfowl management.

Amphipods (*Gammarus* sp.) at Hunter's Marsh are distinct from Noel's amphipods (Walters and Berg 2017, page 1). With more than one amphipod species present, refuge management prescriptions must consider the distribution of amphipod species and populations. Additional surveys and refined monitoring techniques will support better understanding of amphipod diversity on the refuge.

Spatial Distribution

Translocations from Sago Springs (the management unit where springsnails are most abundant) to the south tract Rio Hondo spring system is an ongoing project. A total of 10,500 Roswell and Koster's springsnails have been translocated. The translocated sub-population creates redundancy, and appears to have a stable to increasing population based on periodic monitoring. Data collection and population monitoring is ongoing.

Current Conservation Measures
Recovery implementation is underway for all four listed invertebrate species. Invasive species eradication efforts for non-native plants are ongoing, using spraying, mechanical, or prescribed fire methods. An endemic invertebrate monitoring protocol has been established, and Bitter Lake NWR staff are conducting surveys in winter and summer months (Johnson et al. 2019). Monitoring of the four listed invertebrate species is assumed to be the best method to understand biotic or abiotic changes that may occur, and how the invertebrates respond to those stressors. Translocations of Roswell and Koster's springsnails have been conducted, with over 10,000 individuals translocated to date. More translocation sites are being considered, both on refuge and by working with surrounding neighbors. Opportunities for research are being developed and funding opportunities pursued.

Future Conservation Measures
A field guide is needed to differentiate between *Gammarus* species present on the refuge. Any amphipods of unknown or questionable genetic origin, such as those from Hunter's Marsh, must be analyzed to confirm species identification before being considered for translocations. This will help ensure that the differentiated amphipod lineages on the refuge remain intact.

Similar genetic considerations exist for the listed snail species. Any springsnails collected from unknown genetic sources must be examined prior to use in species translocations. Secure replicate populations of the four invertebrates will help maintain viable populations that are resilient to future stochastic events.

The United States Geological Survey (USGS) and the Service have partnered to conduct a pilot diet study of the four listed invertebrates and other rare endemic species on Bitter Lake NWR. The USGS study objective is to assess feasibility of stable isotope methods for conducting food web analyses on the refuge, and whether these techniques can inform management decisions (Service 2019c, page 1-2). The research will improve understanding of ecological relationships and limiting factors in species abundance. Environmental parameters associated with the species, once understood, should enhance species management. Results will elucidate potential threats such as effects to foraging niches from invasive species, enhance management for necessary food sources, and inform habitat restoration that supports the listed invertebrate populations.

Additionally, Bitter Lake NWR staff and the Southwestern Native Aquatic Resource and Recovery Center are collaborating on an environmental DNA (eDNA) study of the four invertebrates. The project goals are to 1) enhance the knowledge of the distribution of the endangered invertebrates and 2) identify the environmental parameters associated with species presence/absence that limit the distribution and occupancy of these rare species. Data from this eDNA project will help identify target restoration sites and potential translocation areas.

2.4.2 Threats Analysis (threats, conservation measures, and regulatory mechanisms):

The Recovery Plan provided a detailed discussion of the current threats to the species the magnitude of each threat (Service 2019b, page 14). A brief overview of the threats to the four listed invertebrates is as follows.

Listing Factor A. The present or threatened destruction, modification, or curtailment of its habitat or range.

Water Quantity
- Groundwater pumping
- Drought

Water Quality
- Oil and gas development
- Urban development
- Train derailment
- Golden algae (not a current threat, only potential)

Nonnative species
- Terrestrial plants
- Aquatic invertebrates

Listing Factor B. Overutilization for commercial, recreational, scientific, or educational purposes.

This factor has not been documented as a threat to these species at this time.

Listing Factor C. Disease or predation.

Disease
- Infestation of trematodes

Predation
- Predation by nonnative fish

Listing Factor D. The inadequacy of existing regulatory mechanisms.
- Inadequate protection under Clean Water Act
- Inadequate protection under State Law

Listing Factor E. Other natural or manmade factors affecting its continued existence.
- Historical Bitter Lake NWR management
- Wildfire (could also have a positive impact if properly implemented)
- Localized range, limited mobility, fragmented habitat
- Climate adaptation

The dependable supply of water (quantity/quality) is the greatest magnitude threat to the four invertebrates, and is the largest current impediment to recovery of the species. Continued expansion of oil and gas development north from the Carlsbad/Artesia area is expected, creating an increased need for water for hydraulic fracturing. Other water supply demands include a growing human population and agricultural and livestock

uses, further straining surface and groundwater supplies that may influence the spring water quality and quantity at Bitter Lake NWR. Prolonged drought and increased temperatures could exacerbate the scarcity of water.

2.5 Synthesis:

The four listed invertebrates are constrained to karst water features including sinkholes and springs, and are reliant on suitable groundwater sources, in localized areas of New Mexico and Texas. Noel's amphipod, Koster's springsnail, and Roswell springsnail are narrow endemic species that survive only in isolated locations in Chaves County, New Mexico, on Bitter Lake NWR. Pecos assiminea is also a rare, endemic snail that is found in Chaves County, New Mexico, and Pecos and Reeves Counties, Texas. Total population numbers across the range of each species are unknown, although the species has remained stable at occupied sampled sites.

Noel's amphipod is currently found in five management units in New Mexico; Koster's springsnail is present in five units in New Mexico; Roswell springsnail is present in three units in New Mexico; and Pecos assiminea is currently found in three units in New Mexico and Texas. The distribution of each species among management units has remained stable over the past 5 years. All management units in New Mexico are located on Bitter Lake NWR.

Water quantity and water quality are the greatest threats to these species. Groundwater withdrawal needed to supply an array of water uses could alter hydrologic characteristics of the spring systems that support these endemic species. This is based on imminent threats of water withdrawals within the immediate area of the four invertebrates' habitat (Balleau Groundwater, Inc. 1996, 1999; Butler and Tashjian 2016). Potential for increased impacts from drought and climate change exists, based on predictions of decreasing precipitation and increasing temperatures into the future for this region (Niraula et al. 2017). Climate-related effects including prolonged droughts and decreases in spring discharge could further exacerbate the impacts to water quantity and quality.

Since completing the Recovery Plan for the four invertebrate species, current recovery implementation consists primarily of developing and refining methods to document achievement of delisting and downlisting criteria under Objective 1 (Secure and maintain the long-term survival of each species with the appropriate number, size, and distribution of resilient management units). Because these species occur only in isolated locations where they could easily be extirpated by biological or environmental threats, we recommend that Roswell springsnail, Koster's springsnail, Noel's amphipod, and Pecos assiminea remain listed as Endangered.

3.0 RESULTS

3.1 Recommended Classification:

Given your responses to previous sections, particularly section 2.5 Synthesis, make a recommendation with regard to the listing classification of the species

____ **Downlist to Threatened**
____ **Uplist to Endangered**
____ **Delist** (*Indicate reasons for delisting per 50 CFR 424.11):*
____ *The species is extinct*
____ *The species does not meet the definition of an endangered species or a threatened species (i.e., is recovered, or new information on status and threats indicate species does not meet definitions)*
____ *The listed entity does not meet the statutory definition of a species.*
_X_ **No change is needed**

3.2 **New Recovery Priority Number:**
No change (remain at 8)

Brief Rationale:
The Recovery Plan changed the recovery priority number for each of the four species from a 14, indicating a low degree of threat, a high potential for recovery, and a taxonomic category of full species; to an 8, representing a full species with a moderate degree of threat and a continued high potential for recovery.

3.3 Listing and Reclassification Priority Number:
N/A

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

(a) Continue investigations of survey and monitoring techniques for Pecos assiminea to better approximate density and distribution.

(b) Further investigate to quantify the extent and implications gene flow between populations of Roswell and Koster's springsnail.

(c) Understand the flow-ecology relationships between spring discharge and population dynamics to better understand snail movements and distribution, including seasonal variation.

(d) Develop monitoring protocol for surveying for *Gammarus lacustris* or other amphipod species at Bitter Lake NWR. Create a field key for monitoring that will differentiate between *Gammarus desperatus* and other *Gammarus* species.

(e) Identify potential translocation sites on and off Bitter Lake NWR.

(f) Explore alternative conservation methods with landowners surrounding occupied habitat for the four listed invertebrates to protect water quantity/quality and improve habitat management.

(g) Further investigate Noel's amphipod population genetics to determine the species status on

the Bitter Lake NWR.

(h) Monitor and assess the effects of fire on the Pecos assiminea to help determine the best methods of burning an occupied area while minimizing loss.

(i) Reduce invasive plant species.

(j) Continue monitoring springsnails and amphipods to determine abundance relationships among habitat characteristics, stream discharge, and groundwater levels.

5.0 REFERENCES

Balleau Groundwater, Inc. 1999. Source-water protection zones for Bitter Lake National Wildlife Refuge. Report to the U.S. Department of Justice.

Berg. D.J. 2010. Status of the Rio Hondo population of Noel's amphipod (*Gammarus desperatus*). Miami University Hamilton, Ohio. Report to the U.S. Fish and Wildlife Service.

Butler, M.J., and P.L. Tashjian. 2016. Association of Bitter Creek discharge with groundwater and drought in the Roswell Basin, New Mexico, USA. Technical Memorandum. National Wildlife Refuge System, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Johnson, W.P., M.J. Butler, J.I. Sanchez, and B.E. Wadlington. 2019. Development of Monitoring Techniques for Endangered Spring Endemic Invertebrates: An Assessment of Abundance. Natural Areas Journal 39(2):150-168. https://doi.org/10.3375/043.039.0203.

New Mexico Department of Game and Fish [NMDGF]. 2007. Macroinvertebrates of Bitter Lake National Wildlife Refuge. Project E-56-5 submitted to the U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 20 pp.

New Mexico Department of Game and Fish [NMDGF]. 2008. Macroinvertebrates of Bitter Lake National Wildlife Refuge. Project E-56-6 submitted to the U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 28 pp.

Niraula, R., T. Meixner, F. Dominguez, N. Bhattarai, M. Rodell, H. Ajami, D. Gochis, and C. Castro. 2017. How might recharge change under projected climate change in the Western U.S.? Geophysical Research Letters 44:407-418.

Roesler, E.L. 2016. Development of habitat use data, detection, and survey methods for the endangered gastropod, Pecos assiminea (*Assiminea pecos*) at Bitter Lake National Wildlife Refuge. M.S. Thesis, Texas Tech University, Lubbock.

Roesler, E.L., W.P. Johnson, and T.B. Grabowski. 2015. Development of habitat associations and monitoring methods for the endangered gastropod, Pecos assiminea *Assiminea pecos*,

at Bitter Lake National Wildlife Refuge. Report to the U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Roesler, E.L., and T.B. Grabowski. 2017. Estimating factors influencing the detection probability of semiaquatic freshwater snails using quadrat survey methods. Hydrobiologia (2018) 808: 153. https://doi.org/10.1007/s10750-017-3415-9.

U.S. Fish and Wildlife Service [Service]. 2010. Noel's amphipod (*Gammarus desperatus*), Koster's springsnail (*Juturnia kosteri*), Roswell springsnail (*Pyrgulopsis roswellensis*), and Pecos assiminea (*Assiminea pecos*) 5-year review: Summary and evaluation. New Mexico Ecological Services Field Office, Albuquerque.

U.S. Fish and Wildlife Service [Service]. 2019a. Environmental Conservation Online System (ECOS). Available from:
Noel's amphipod-https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=K023
Koster's springsnail-https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=G04C
Roswell springsnail-https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=G03T
Pecos assiminea-https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=G03K
(accessed February 24, 2020).

U.S. Fish and Wildlife Service [Service]. 2019b. Recovery Plan for Four Invertebrate Species of the Pecos River Valley: Noel's amphipod (*Gammarus desperatus*), Koster's springsnail (*Juturnia kosteri*), Roswell springsnail (*Pyrgulopsis roswellensis*), and Pecos assiminea (*Assiminea pecos*). New Mexico Ecological Services Field Office, Albuquerque.

U.S. Fish and Wildlife Service (Service) 2019c. Understanding the Aquatic Food Web Structure to Guide Habitat Management at Bitter Lake NWR. Bitter Lake NWR, Roswell, New Mexico.

Walters, A. and D.J. Berg. 2017. Genetic and morphological assessment of gammarid amphipods of New Mexico. Report to the U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of Noel's amphipod (*Gammarus desperatus*),
Koster's springsnail (*Juturnia kosteri*),
Roswell springsnail (*Pyrgulopsis roswellensis*), and
Pecos assiminea (*Assiminea pecos*)

Current Classification: All four species are considered *Endangered*.

Recommendation resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: N/A

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service, New Mexico ESFO

Approve SETH WILLEY Digitally signed by SETH WILLEY Date: 2020.05.05 12:41:16 -06'00'