Dromedary Pearlymussel
(*Dromus dromas*)

Status Review:
Summary and Evaluation

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U.S. Fish and Wildlife Service
Southeast Region
Tennessee Ecological Services Field Office
Cookeville, Tennessee

February 2026

STATUS REVIEW
Dromedary Pearlymussel (*Dromus dromas*)

GENERAL INFORMATION

Current Classification: Endangered

Lead Field Office: Tennessee Ecological Services Field Office (TNFO), Cookeville, TN, (931) 528-6481

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Reviewers:

Lead Regional Office: Atlanta Regional Office, Carrie Straight

Cooperating Field Office(s): Alabama Ecological Services Field Office, Jenna King; Kentucky Ecological Services Field Office, Taylor Fagin; Virginia Ecological Services Field Office, Kimberly Maison

Cooperating Regional Office(s): Northeast Region, Sarah Furtak

Date of original listing: July 14, 1976 (41 FR 24062)

Associated Rulemakings:

Establishment of Nonessential Experimental Population Status for 16 Freshwater Mussels and 1 Freshwater Snail (Anthony's Riversnail) in the Free Flowing Reach of the Tennessee River below the Wilson Dam, Colbert, and Lauderdale Counties, AL, Final Rule, July 16, 2001, 66 FR 32250; Correction to Final Rule, August 21, 2001, 66 FR 43808.

Establishment of Nonessential Experimental Population Status for 15 Freshwater Mussels, 1 Freshwater Snail, and 5 Fishes in the Lower French Broad River and in the Lower Holston River, Tennessee, Final Rule, October 15, 2007, 72 FR 52434.

Methodology used to complete the review:

In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened species or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants (50 CFR 424.11). The U.S. Fish and Wildlife Service (Service) evaluated the biology, habitat, and threats of the dromedary pearlymussel to inform this status review.

We announced initiation of this review in the Federal Register on June 6, 2024 (89 FR 48437) with a 60-day comment period and received one comment letter from the National Council for Air and Stream Improvement, Inc. The comment described best management practices for silviculture and their benefit, when employed, to water quality. These comments

were reviewed and incorporated into the discussion of threats, below. New information received from partners has been incorporated into this review. The primary sources of information used in this analysis were the final listing rule (41 FR 24062); the recovery plan (Service 1984); peer-reviewed reports; agency reports; unpublished information, survey data, and reports from conservation partners; and personal communication with recognized experts. This review was completed by the U.S. Fish and Wildlife Service, Tennessee Ecological Services Field Office, Cookeville, Tennessee. All literature and documents used for this review are on file at the Field Office. All recommendations resulting from this review are made by thoroughly reviewing the best available information on the dromedary pearlymussel.

FR Notice citation announcing the species is under active review:
June 6, 2024 (89 FR 48437)

Species' Recovery Priority Number at start of 5-year review (48 FR 43098):

4C. Dromedary pearlymussel is a species with a high degree of threat and a low potential for recovery; C indicates conflict with construction or other development; the taxonomy is a monotypic genus.

Review History:
Previous 5-year reviews recommending no change in status were signed on August 19, 2011 (Service 2011) and April 29, 2020 (Service 2020).

REVIEW ANALYSIS

Listed Entity

Taxonomy and nomenclature
We are not aware of any changes to the taxonomy of this entity, and it is still considered valid. The nomenclature is consistent with and follows that listed in the Integrated Taxonomic Information System (2025) and the Freshwater Mollusk Conservation Society (FMCS 2023).

Recovery Criteria

The Recovery Plan for the Dromedary Pearlymussel (*Dromus dromas*) was published on July 9, 1984.

Recovery plans are not regulatory documents; rather, they serve as guidance for the Service, States, and other partners on strategies to minimize threats to listed species and on the criteria that may indicate successful recovery. Achieving these recovery criteria suggests that the species may no longer need protections under the Act. However, in making recommendations regarding the delisting of a species, we are required to consider the factors in section 4(a) of the Act (84 FR 45020).

We will consider the dromedary pearlymussel for delisting when the following criteria are met:

(1) A viable population[1] of D. dromas exists in the Clinch River from the backwaters of Norris Reservoir upstream to approximately CRM 226 and in the Powell River from the backwaters of Norris Reservoir upstream to approximately PRM 130. These two populations are dispersed throughout each river so that it is unlikely that any one event would cause the total loss of either population.

(2) Through reestablishments and/or discoveries of new populations, viable populations exist in three additional rivers. Each of these rivers will contain a viable population that is distributed such that a single event would be unlikely to eliminate D. dromas from the river system.

(3) The species and its habitat are protected from present and foreseeable human-related and natural threats that may interfere with the survival of any of the populations.

(4) Noticeable improvements in coal-related problems and substrate quality have occurred in the Powell River, and no foreseeable increase in coal-related siltation occurs in the Clinch River. If the Cumberland River, including its tributaries, is selected for transplants or new populations are discovered, then these improvements in coal-related problems and substrate quality also apply to these streams.

We believe these criteria to be both appropriate and relevant; however, they remain unmet.

Biology and Habitat Summary

Range and Distribution

Natural populations of dromedary pearlymussel are currently found in two river systems: the Clinch River (TN and VA) and the Powell River (TN and VA) (Figure 1). Reintroduction efforts have taken place with a small number of dromedary pearlymussels that were translocated from the Clinch River in Tennessee into the designated nonessential experimental populations in the Tennessee River below the Wilson Dam at Muscle Shoals in Alabama in 2003 and the upper Big South Fork Cumberland River in Kentucky in 2008 (Figure 1). Although observations since the last status review demonstrate that a few released individuals persist at the relocation sites, no recruitment has been observed since the releases, and these are not considered viable populations. Also, based on new information, there may be an extant population of unknown size and viability in the Tennessee River (TN) mainstem, but more investigation would be needed to confirm this and/or determine viability. Details of the current range and distribution of dromedary pearlymussel are discussed below.

Since the last status review, both wild and captive-reared dromedary pearlymussels have been observed in the Clinch (TN and VA) (Carey and Ostby 2024a; Lane et al. 2023a) and Powell Rivers (VA) (Lane 2025, pers. comm.). All observations of live wild dromedary pearlymussels occurred within the limits of the known natural range of the species. A relic dromedary

[1] The recovery plan defines a viable population as: "*a reproducing population that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural habitat changes. The number of individuals needed to meet this criterion will be determined as one of the recovery tasks.*"

pearlymussel shell found near Artrip, VA, may be a new upstream extent for the natural range of the species in the Clinch River (Lane 2025, pers. comm.). Observations of dromedary pearlymussel remain limited to the immediate release sites within the Big South Fork (KY) and at Muscle Shoals in the Tennessee River (AL).

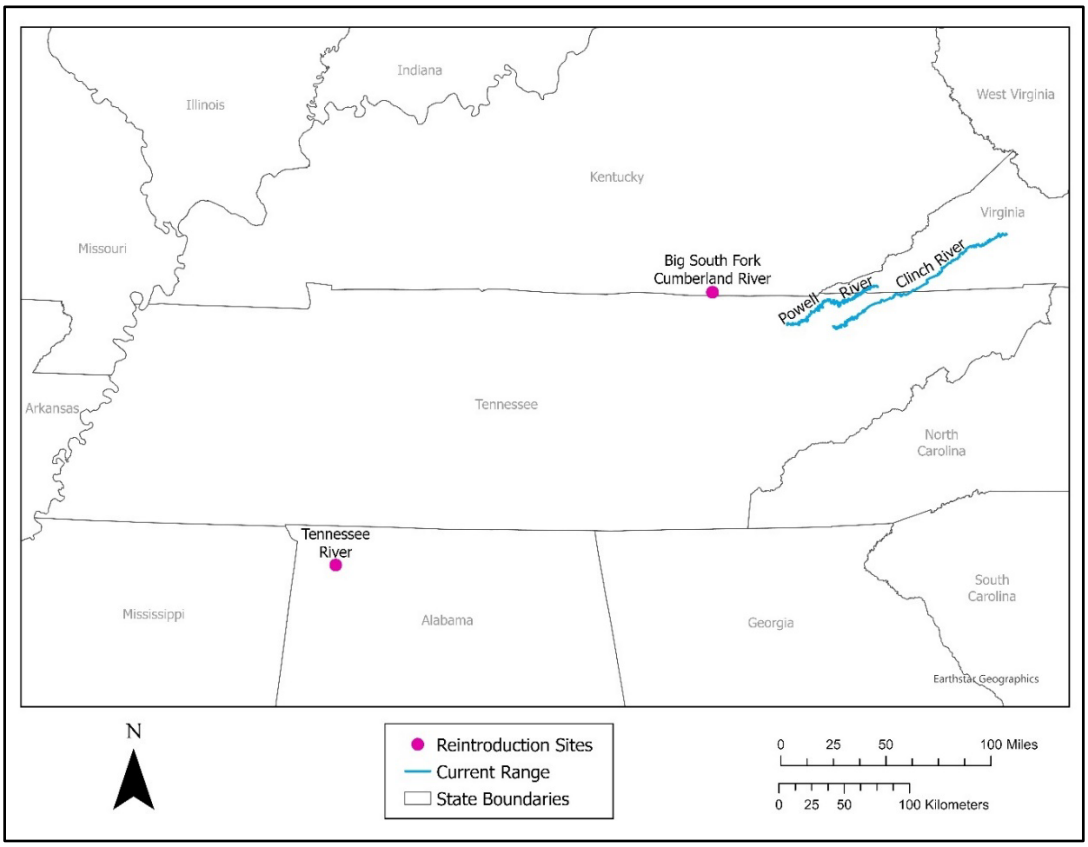

Figure 1. Map of the current range and reintroduction sites of dromedary pearlymussel.

A weathered dead shell of dromedary pearlymussel from the Tennessee River near the mouth of the Duck River (Humphreys County, TN) was recently discovered in early 2025 and sent to the North Carolina Museum of Natural Science for identification. This shell is thought to have been dead one to two years when found (Bajo-Walker 2025, pers. comm.). The previous status review mentioned that the populations of dromedary pearlymussel in the mainstem Tennessee River, as well as the Cumberland River, are of unknown status, but may be either non-viable or extirpated with the last record dating to the mid-1980s. This recent record may suggest that the Tennessee River population is not extirpated. However, this record needs to be further investigated with additional surveys and genetic work so that the range, extent, and viability of this species in the Tennessee River mainstem can be verified and better understood.

Population Demographics

Clinch River

Since 2004, long-term monitoring of mussels has occurred at four sites in the Tennessee portion of the Clinch River population (Hancock County, TN): Swan Island (RM 172.2), Frost Ford (RM

181.3), Kyles Ford (RM 189.6), and Wallen Bend (RM 192.4). Since the last status review, dromedary pearlymussels have been observed at all four long-term monitoring sites (Ostby 2020, 2021, 2022, 2023; unpublished data) (Table 1). Densities have been estimated for dromedary pearlymussels at the four long-term monitoring sites in all surveyed years since 2004 (Carey and Ostby 2024b) (Table *2*) and trends seem to indicate that these population densities have remained low, but stable.

Table 1. Numbers of dromedary pearlymussel observed at long-term quantitative monitoring sites in the Clinch River, Hancock County, TN 2020-2023 (Ostby 2020-2023, unpublished data).

Site	2020	2021	2022	2023
Swan Island	15	13	11	6
Frost Ford	12	16	27	19
Kyles Ford	9	4	5	9
Wallen Bend	0	1	0	2

Table 2. Summary of dromedary pearlymussel densities, and estimated populations within survey areas, at four long-term monitoring sites on the upper Clinch River, TN (2004-2023). Densities are reported as individuals per square meter (individuals/m^2) (Carey and Ostby 2024b).

Year	Swan Island Densities	Frost Ford Densities	Kyles Ford Densities	Wallen Bend Densities
2004	0.35	0.13	0.01	0.02
2005	0.20	0.13	NS	0.00
2006	0.30	0.15	NS	0.00
2007	0.23	0.20	NS	0.00
2008	0.20	0.20	NS	0.02
2009	0.19	0.15	NS	0.00
2010	0.47	0.20	NS	0.00
2011	0.22	0.16	NS	0.00
2012	0.33	0.26	NS	0.00
2013	0.16	0.14	NS	0.00
2014	0.21	0.13	NS	0.00
2015	NS	NS	NS	NS
2016	NS	NS	0.04	NS
2017	0.09	0.06	0.03	0.00
2018	0.09	0.09	0.03	0.00
2019	0.16	0.07	0.04	0.01
2020	0.14	0.12	0.06	0.00
2021	0.11	0.13	0.02	0.01
2022	0.08	0.18	0.03	0.00
2023	0.06	0.13	0.06	0.01
Estimated Mean Population Size	3954	7945	1862	94

In addition to the long-term monitoring sites, naturally occurring dromedary pearlymussels have been observed, or collected, at four additional sites in the Clinch River since the last review: Slant and Starnes Bend (Scott County, VA); and Horton Ford and Honey Hole (Hancock County, TN) (Table 3). The Virginia Department of Wildlife Resources' (VDWR) Aquatic Wildlife and Conservation Center (AWCC) also monitors sites where they released small numbers of captive-reared dromedary pearlymussels for the purpose of augmentation between 2006 and 2022. Recapture of tagged mussels since the last status review occurred at two release sites: Bennett Property (Russel County, VA) and Speers Ferry (Scott County, VA) (Colletti 2024, pers. comm.)

Table 3. Observations of naturally occurring dromedary pearlymussel in the Clinch River outside of long-term monitoring sites 2020-2023 (Ostby 2020, unpublished data; Lane et al. 2023a; Lane 2025, pers. comm.).

Date	Site	Number Found	Condition	Density (individuals/m^2)	Survey Type
09/17/2020	Horton Ford	1	Live	NA	Qualitative Search
10/28/2020	Honey Hole	12	Live	NA	Broodstock Collection
09/22/2021	Slant	1	Live	NA	Qualitative Search
02/15/2022	Honey Hole	9	Live	NA	Broodstock Collection
09/13/2023	Starnes Bend	1	Live	.03/m^2	Quadrat Survey

Overall, efforts since the last status review indicate that the Clinch River population continues to persist at various sites and collection of a juvenile dromedary pearlymussel at Frost Ford provides evidence of recruitment in this population (Dikun 2023, personal observation). The long-term monitoring sites continue to demonstrate the highest densities within the population and across the species' range, with Swan Island and Frost Ford being the most robust sites. For the purposes of augmentation, limited numbers of dromedary pearlymussels have been released in the Clinch River since 2006. Although the number of dromedary pearlymussels released into the Clinch River augmentation sites has been low, continued recapture of individuals at two release sites demonstrates continued survival of released individuals.

Powell River

Dromedary pearlymussels continue to be observed in the Powell River. In October 2019, surveys in Claiborne County, TN, located 13 dromedary pearlymussels at Brooks Bridge (RM 153) and one individual downstream of Brooks Bridge (RM 152.6) (Ostby 2019, unpublished data). During a qualitative search on September 14, 2022, Virginia Department of Wildlife Resources detected two dromedary pearlymussels at Fletcher Ford (Lee County, VA) (Lane 2025, pers. comm.). Prior to 2022, dromedary pearlymussels had not been recorded at Fletcher Ford since 2009. These observations indicate that the population in the Powell River continues to persist; however, there have been no indications of reproduction or recruitment within this population.

Reintroduced Populations

A small number of dromedary pearlymussels were translocated from the Clinch River to the Tennessee River at Muscle Shoals, Alabama (n=80) in 2003 (Williams et al. 2008), and to the upper Big South Fork, Kentucky (n=19) in 2008 (McGregor et al. 2008). Survey efforts since the last status review demonstrate that dromedary pearlymussel continues to persist in both systems in small numbers. One dromedary pearlymussel was detected in the Big South Fork in 2023 (McGregor 2024). Surveys conducted below the Wilson Dam at Muscle Shoals, AL, recorded three dromedary pearlymussels in June 2020 and five in June 2024 (Garner 2025, pers. comm.). Despite the continued survival of these individuals, no recruitment has been observed since translocation in either system.

Propagation

Propagation efforts for dromedary pearlymussel were started in 2004 by Virginia Tech's Freshwater Mollusk Conservation Center (FMCC) and their efforts continued until 2013. In 2006, Virginia Department of Wildlife Resources' Aquatic Wildlife and Conservation Center also began propagation efforts which continued through 2023. Since efforts began in 2004, a total of 285 captive-reared dromedary pearlymussels have been released across 7 sites in the Clinch and Powell Rivers (Lane et al. 2023a) – only 42 were greater than 6 months in age. In 2022, the Tennessee Wildlife Resources Agency's Cumberland River Aquatic Center also began propagating dromedary pearlymussel, however these efforts have not yet resulted in any releases (Hua 2022, 2023). Despite some success, propagation of this species remains difficult. Although juveniles can be produced in large numbers, very few survive to grow out or survive to an age suitable for release. For example, over 11,000 juveniles were produced by Aquatic Wildlife and Conservation Center in 2021, however only 17 survived to an age for release (Lane et al. 2023). These difficulties have limited efforts to augment or introduce populations to increase resilience of populations or redundancy of the species.

Threats (Five-Factor Analysis) Summary

The status of a species is determined from an assessment of factors specified in section 4 (a)(1) of the Act. A summary of these threats is below.

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

The present or threatened destruction, modification, or curtailment of the habitat or range for dromedary pearlymussel remains a threat to the species. Non-point source pollution from land surface runoff can originate from virtually any land use activity that does not enact appropriate best management practices to prevent impacts to receiving waters. Contamination from current and legacy mining operations in the Clinch and Powell drainages seems to be a leading threat to the dromedary pearlymussel. Timpano et al. (2023) examined trace elements within both surface (water-column) and pore (substrate interstitial) water at 9 sites over 157 river kilometers in the Powell River (VA and TN) in areas impacted by coal mining. Trace elements in pore water samples containing fine sediment particles (measuring less than 300 micrometer) exceeded chronic water quality criteria (Environmental Protection Agency 2024) for all toxic elements except arsenic (Timpano et al. 2023). Freshwater mussels are typically very sensitive to

contaminants that alter the chemical, physical, and biological characteristics of a stream resulting in lethal and sub-lethal effects to mussels and their hosts (Wang et al. 2017). These toxic elements have the potential to affect the health (e.g., growth, filtration rates, recruitment) and survival of mussels. Additionally, trace element concentrations exhibited seasonal temporal variation, with increases in concentrations observed in summer through autumn when many mussels are in critical life cycle phases (e.g., reproduction, recruitment, and increased growth) (Timpano et al. 2023). These results indicate that toxicity from trace elements associated with past and current coal mining within the watershed likely continue to impact mussels within this watershed.

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

We have no new information that overutilization for commercial, recreational, scientific, or educational purposes poses a significant threat to the species.

Factor C. Disease or predation:

Disease and predation were not considered a threat at the time of listing. However, a die-off of mussels in the Clinch River was documented in 2016, and hundreds of fresh-dead dromedary pearlymussels were collected at five locations within the Clinch River at that time. The cause of the die-off is uncertain, but disease is considered a possible cause, and recent studies have associated elevated loads of viruses and bacteria, particularly *Yokenella regensburgei* and *Aeromonas salmonicida*, with dead and dying mussels (Richard et al. 2020, 2021, 2022; Da Silva Neto et al. 2024). Since the last status review, investigations of the role of disease in mussel die-offs have not detected further die-offs of dromedary pearlymussel at long-term monitoring sites in the Clinch River (Da Silva Neto 2025). However, unobserved or unreported die-offs at unsampled sites cannot be ruled out. Although the role of disease in the die-off is still being investigated, because of the potential impacts of large-scale die-offs, we believe that disease may be a continued threat to the dromedary pearlymussel. Further research would be needed to understand the role and impact of disease on dromedary pearlymussel populations and to determine if populations are still being affected.

A recent study has reported muskrat (*Ondatra zibethicus*) predations on freshwater mussels in the Clinch River at Kyles Ford and included some predation on dromedary pearlymussel (Hicks et al. 2025). Predation rates were found to be 0.14 dromedary pearlymussels per day, or roughly 2.30% of the estimated population/abundance within the study area over the course of the study (75 days) (Hicks et al. 2025). While there is not enough evidence to conclude that predation at this rate is at a level that should be considered a threat to this species, the authors found that predation by muskrats may demonstrate species-specific size-selectivity, with selection of larger individuals of small species, and smaller individuals of large species. Under certain conditions, selection of large individuals of reproductive age may lead to an impact on breeding populations given significant predation pressure (Hicks et al. 2025). At this time, it is uncertain how muskrat predation may influence dromedary pearlymussel. More study over multiple seasons or years, and across a larger geographic range would likely be needed to better understand if predation should be considered a threat to dromedary pearlymussel.

Factor D. Inadequacy of existing regulatory mechanisms:

Although federal laws such as the Clean Water Act of 1972 (CWA) [33 U.S.C. 1251 et seq.] and the Surface Mining Control and Reclamation Act of 1977 [30 U.S.C. 1234–1328], along with state laws like the Tennessee Water Quality Control Act (TWQCA), have contributed to improvements in water quality and habitat conditions, they have not fully mitigated the threats to the dromedary pearlymussel and its habitat, based on current data. Rivers that support this species continue to be classified as impaired (TDEC 2022; VDEQ 2024) and recent studies have documented persistent levels of trace metals in fine sediments (Timpano et al. 2023), highlighting that current federal and state regulations—individually or collectively—are not adequate to eliminate threats to the species.

The Clean Water Act provides the foundational framework for regulating pollutant discharges into navigable waters and establishing surface water quality standards. However, it primarily addresses point source pollution and does not sufficiently regulate non-point source pollution. These gaps are particularly problematic for sensitive species like freshwater mussels. Similarly, while the Surface Mining Control and Reclamation Act governs the environmental impacts of coal mining, mining remains a major source of contamination within the dromedary pearlymussel's range (Johnson et al. 2014; Phipps 2019). Land use practices such as mining, agriculture, and urban development can lead to increased sedimentation, altered hydrology, and contamination that fall outside the scope of direct regulatory enforcement.

The Tennessee Valley Authority (TVA) has also adopted policies that support aquatic conservation. Its 2021 Biodiversity Policy reflects Tennessee Valley Authority's commitment to minimizing adverse impacts on ecosystems and federally listed species. Complementing this, Tennessee Valley Authority's2020 Natural Resource Plan outlines a comprehensive approach to resource management, including strategies to improve water quality, restore aquatic and riparian habitats, and address the projected impacts of changing environmental conditions on freshwater ecosystems. These efforts align with Tennessee Valley Authority's stewardship responsibilities under the TVA Act (16 U.S.C. §§ 831 et seq.) and contribute to broader conservation goals within the Tennessee River Basin.

States also play a key role in regulating water quality through their own legal and administrative frameworks. Tennessee and Virginia implement the Clean Water Act through state programs such as state-authorized National Pollutant Discharge Elimination System (NPDES) permitting, water quality standards development, and waterbody assessments.

Tennessee administers these responsibilities through the Tennessee Department of Environment and Conservation (TDEC), which also oversees the Tennessee Water Quality Control Act (TWQCA) (Tennessee Code Annotated §69-3-101 et seq.), which not only provides a state framework for implementing the Clean Water Act but also provides a broader scope of protection to state waters. Tennessee Water Quality Control Act offers protection to a broader array of waterbodies than federal law and emphasizes proactive and long-term planning strategies for addressing state water quality, including the designation of Exceptional Tennessee Waters and the development of Total Maximum Daily Loads for impaired waters.

Virginia implements the Clean Water Act through the Virginia Pollutant Discharge Elimination System (VDPES), managed by the Virginia Department of Environmental Quality. This program issues permits for point source discharges, stormwater systems, and industrial activities, ensuring compliance with state water quality standards.

Both states also manage source water protection programs under the Safe Drinking Water Act (42 U.S.C. § 300f et seq.), and publish annual reports detailing water quality trends, program effectiveness, and areas of concern (TDEC 2024, TDEC 2025 a & b, VDEQ 2024, VDEQ 2025). While state-level laws and programs address threats to aquatic species, such as the dromedary pearlymussel, their effectiveness is often limited by resource constraints and the need for sustained funding.

States such as Tennessee, Alabama, and Virginia have implemented permitting systems to regulate the take of individual mussels (Tennessee Code Annotated §§ 70-8-101–112; Virginia Code Annotated §§ 29.1-563–570; Alabama Administrative Code 220-2-.98). However, these regulations typically do not address broader threats such as habitat degradation from non-point source pollution, which continue to impact aquatic species like the dromedary pearlymussel.

The limitations of current laws are underscored by recent findings from Timpano et al. (2023), which indicate that levels of trace metals in fine sediments from the Powell River exceed Environmental Protection Agency criteria, highlighting the persistent risk that toxic exposure poses to freshwater mussels. Research has shown that trace metals rarely contaminate freshwater systems in isolation (Timpano et al. 2022); rather, the synergistic effects of multiple metals can exacerbate the harmful impacts on freshwater mussels. Regulatory measures focused solely on the toxicity of individual metals may not fully account for the combined effects of multiple contaminants, which have shown to increase risk to freshwater mussels.

Regarding other Endangered Species Act listing factors:

- Overutilization (Factor B): There is no evidence that overutilization poses a threat to the dromedary pearlymussel. No commercial, recreational, or educational use is known, and scientific collection is limited and regulated.
- Disease or Predation (Factor C): Whereas disease and predation have been documented as potential threats to freshwater mussels generally, there is no conclusive evidence that either currently poses a significant threat to the dromedary pearlymussel.
- Other Natural or Manmade Factors (Factor E): The species remains vulnerable to a combination of stressors, including habitat fragmentation, small population size, and environmental variability. Changes in temperature and precipitation patterns, such as increased drought frequency and extreme rainfall events, may exacerbate existing threats. Whereas some agencies have begun incorporating long-term environmental trends into planning efforts, these considerations have not yet been fully integrated into enforceable regulatory protections for the species.

Whereas existing federal and state regulatory mechanisms provide a foundation for water quality protection, available data indicate that they have not fully mitigated the threats posed by

sediment-bound contaminants, non-point source pollution, and legacy mining impacts within the species' range. The persistence of impairment listings and elevated trace metal concentrations in fine sediments suggests that current frameworks may not be sufficient to address all relevant stressors affecting the dromedary pearlymussel. Continued evaluation of regulatory effectiveness, combined with voluntary conservation efforts and adaptive management, may help address these challenges over time.

Factor E. Other natural or manmade factors affecting its continued existence:

The previous status review discussed the species' limited range and isolated populations as an additional threat to the species. There are only two extant populations of dromedary pearlymussel and these continue to be isolated by dams and impoundments. Also, both populations continue to be vulnerable to extirpation from threats such as toxic chemical spills, habitat modification, progressive degradation from land surface runoff (nonpoint-source pollutants) and natural stochastic events (e.g., floods, drought). We therefore consider population isolation to be a continued threat to the species.

Within the range of the dromedary pearlymussel, models predict increases in temperature; drought frequency, duration, and intensity; as well as incidents of extreme temperatures (heat and cold waves) and extreme precipitation (days with 2 inches or more of precipitation) (Runkle et al. 2022a, b, c). These changes are projected to exacerbate water quality issues through reductions in water availability, altered temperatures, and increased runoff from surrounding lands during extreme precipitation events. Additionally, Tennessee Department of Environment and Conservation's 2024 report on the Protection of Potable Water Supplies in Tennessee watersheds indicates increasing risks to Tennessee's water resources, intensifying challenges such as drought and increased rainfall variability (TDEC 2024b). These alterations directly impact both water quality and quantity, necessitating proactive management to protect water systems for the benefit of people, fish, and wildlife. Furthermore, stream temperatures in the Southeast have already increased roughly 0.2°C to 0.4°C per decade since the 1950s and are expected to continue rising as air temperatures climb (Kaushal et al. 2010). While the specific thermal tolerance for dromedary pearlymussel is not fully understood, many freshwater mussels may already be living close to their upper thermal tolerances in some systems, putting them at risk from rising environmental temperatures (Pandolfo et al. 2010). Species with limited ranges, fragmented distributions, and small population sizes, such as the dromedary pearlymussel, are particularly vulnerable to temperature, drought, and precipitation effects (Byers and Norris 2011). Collaborative efforts will be essential in enhancing resilience against these challenges for the dromedary pearlymussel while ensuring the sustainability of Tennessee's drinking water supplies, and for these reasons, we consider these to be significant threats to the species.

Synthesis

Dromedary pearlymussel is a rare freshwater mussel with naturally occurring populations remaining in only two river systems, the Clinch River (TN and VA) and the Powell River (TN and VA). While the species persists in both systems, only the Clinch River population exhibits reproduction and recruitment. However, based on a weathered dead shell found in 2025, there may be an extant population of unknown size and viability in the Tennessee River mainstem. Propagation in the species is difficult, as very few individuals survive to an age/size suitable for

release which has hindered efforts to effectively augment or introduce new populations. Relocations of dromedary pearlymussel have occurred in the Big South Fork Cumberland River, KY, and Tennessee River, AL, but lack of recruitment and small numbers of persisting individuals indicate these have not resulted in established, viable populations in either system. Multiple threats, particularly habitat degradation and water quality issues remain throughout the species' range and are compounded by inadequate regulatory protections. Because the species remains in small populations isolated by impoundments, the risk of extinction due to threats is exacerbated and may be further compounded by increases in temperature and drought intensity. For these reasons, we believe the dromedary pearlymussel continues to meet the definition of endangered by remaining a species at risk of extinction throughout its range and recommend the species maintains its current listed status of endangered.

RECOMMENDED FUTURE ACTIVITIES

To facilitate recovery, a detailed discussion of recovery actions and criteria are presented in the Dromedary Pearlymussel Recovery Plan (Service 1984). Achieving recovery criteria for dromedary pearlymussel will entail maintaining and/or improving resiliency of current populations, as well as increasing redundancy by reintroducing new populations. Below we describe priority activities.

To increase resilience of existing populations, activities supporting recovery action 1: *preserve populations and presently used habitat of D. dromas* would be needed. Priority activities in the next five years should include:

- Landowner engagement to address habitat quality concerns for the species (Recovery Activity 1.4.4). The importance of landowner engagement is also highlighted in the Tennessee State Wildlife Action Plan (Tennessee State Wildlife Action Plan Team 2015), as the following action has been listed as a priority action for species of greatest conservation need: "*Utilize government funded incentive programs (e.g. FLEP* [Forest Land Enhancement Program]*, WHIP* [Wildlife Habitat Incentives Program]*, CRP* [Conservation Reserve Program]*, EQIP* [Environmental Quality Incentives Program]*, LIP* [Landowner Incentive Program]*) to encourage private landowners to protect water quality for target species in critical units of aquatic, subterranean, or terrestrial habitats*" (Tennessee State Wildlife Action Plan Team 2015).

- Investigation and inventory of factors negatively impacting the species and its environment (Recovery Activity 1.3.2). Research and monitoring pertaining to mussel die-offs in the Clinch River and investigation into the potential role of disease in these die-offs may be the most immediate need in the short-term.

- Continued utilization of existing legislation and regulations to protect the species and its habitat (Recovery Activity 1.1). Efforts should be made to integrate habitat protection policies alongside existing water quality regulations to more effectively address non-point source pollution resulting from land use changes such as agriculture, mining, and development. Efforts should also be made to incorporate adaptive management practices

into regulatory frameworks to address the increasing risks posed by changes in temperature and precipitation, including altered flow regimes, temperature extremes, and more frequent storm events

To increase redundancy, activities that support and advance recovery action 2: *determine the feasibility of introducing the species back into rivers within its historic range and introduce where feasible* would be needed. In the next 5 years, efforts should focus on achieving or advancing recovery activity 2.4: *Introduce the species within the historical range where it is likely to become established*. Effective gains may be made by implementing activities identified in state wildlife action plans that aim to advance dromedary pearlymussel reintroduction efforts through propagation or translocation efforts, such as:

- Promoting research efforts on juvenile and diet and metabolism (Wood et al. 2015) - this might be a key step in overcoming current difficulties in propagating this species.

- Developing culture and propagation methods for dromedary pearlymussel (Kentucky Department of Fish and Wildlife Resources 2023b)

- Utilizing ex-situ conservation methods (e.g., captive breeding) to conserve populations of target species on the verge of range wide extinction or local extinction of unique genotypes (Tennessee State Wildlife Action Plan Team 2015)

- Reintroducing extirpated and historic populations of priority species to appropriate habitats across the state in Tennessee (Tennessee State Wildlife Action Plan Team 2015)

- Establishing two or more reproducing populations in Alabama (Wood et al. 2015)

- Propagating and releasing the species in Virginia (Virginia Department of Game and Inland Fisheries 2015)

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RESULTS / SIGNATURES

U.S. Fish and Wildlife Service
Status Review of Dromedary Pearlymussel (*Dromus dromas*)

Status Recommendation:

On the basis of this review, we recommend the following status for this species. A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the Act.

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist:
____ *The species is extinct*
____ *The species does not meet the definition of an endangered or threatened species*
____ *The listed entity does not meet the statutory definition of a species*
_X___ No change needed

New Recovery Priority Number (48 FR 43098):

The species' original Recovery Priority Number (RPN) was 4C, indicating the species has a high degree of threat and a low potential for recovery, and has a conflict with construction or other development. Our new recovery number, 4, indicates the species has a high degree of threat and a low potential for recovery, however it does not have a conflict with construction or other development. We are not aware of any development or economic projects within the current range of the species currently, so we believe it is appropriate to remove the "C" designation.

FIELD OFFICE APPROVAL:

Field Supervisor, Tennessee Ecological Services Field Office, Fish and Wildlife Service

Approve DANIEL ELBERT Digitally signed by DANIEL ELBERT Date: 2026.02.19 17:32:41 -06'00'

COOPERATING REGIONAL OFFICE APPROVAL:
We emailed this 5-year review to the Northeast Regional Office for their concurrence prior to finalizing the document. We will retain any comments that we received, as well as verification of concurrence from other regions, in the administrative record for this 5-year review.