

Supplementary Material

Figure S1. Information about the golden mussel on the website of the California Department of Fish and Wildlife—
<https://wildlife.ca.gov/conservation/invasives/species/golden-mussel>.

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See also: [Marine Invasive Species Monitoring Program](#)

Announcements

- New Invasive Mussel rack card and "Clean, Drain, Dry" poster - see [Outreach Materials](#), below, to request
- [Golden Mussel Response Framework \(PDF\)](#) published

Overview

- The first North American detection of golden mussel (*Limnoperna fortunei*) was in October 2024. Although this mussel is similar in appearance and impacts to quagga and zebra mussels, it can establish in waters with wider temperature and salinity ranges.
- Environmental impacts include loss of native and game fish through competition for the same food sources and as a contributor to harmful, fish killing algal blooms.
- Recreational impacts of this mussel include waterbody closures, mandatory inspections, increased launch and/or entry fees, and reduced numbers of fish and shellfish for consumption.
- Economic impacts range include costly repairs and maintenance (boats, water infrastructure, hydroelectric facilities), reduced water flow affecting food production, water delivery to homes, and flood control.
- For more information, review our [Golden Mussel Fact Sheet \(PDF\)](#).



Golden Mussel shells collected in October 2024 at a water quality station at Rough and Ready Island near Stockton in San Joaquin County, California, USA. Photo: Elizabeth Wells, Ph. D. (DWR).

Figure S2. Information about the golden mussel on the website of the California Department of Water Resources—<https://water.ca.gov/mussels>.



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Invasive Mussel Mitigation



California Department of Water Resources Senior Environmental Scientist Specialist Brienne Sakata, with the Division of Operations and Maintenance, works with California State Parks staff to collect plankton samples to study alongside invasive golden mussels from buoys in O'Neill Forebay in Merced County, California. Photo November 13, 2024.

Invasive species such as golden, quagga, and zebra mussels can thrive in the California State Water Project as they can survive in a wide range of environmental conditions, posing negative impacts to water delivery systems and the environment. Once these invasive mussel populations are established, they are difficult to control.

Golden mussels were first discovered in North America in October 2024 at the Port of Stockton when DWR discovered the mussels while conducting routine water quality monitoring. The same month, golden mussels were discovered at O'Neill Forebay in Merced County.

Unlike quagga and zebra mussels, the golden mussel (*Limnoperna fortunei*) can tolerate brackish water and low calcium levels, which means that more waterbodies are vulnerable to infestation. These invasive mussels can:

- Alter aquatic ecosystems by filter-feeding on planktonic algae and changing the habitat structure
- Impact water delivery systems by clogging small-diameter pipelines, screens, and filters
- Impact recreation by fouling boat hulls and motors, and clogging intakes and cooling lines

To prevent these damaging mussels from spreading, DWR routinely monitors for these species and acts to prevent their spread to non-infested waters. DWR partners with agencies such as the California Department of Fish and Wildlife (CDFW) and California State Parks' Division of Boating and Waterways (DBW) to inform boaters to always remember to clean, drain, and dry their boats before entering and leaving lakes, rivers, and other waterways. DWR also works with partner agencies to routinely sample for adult and juvenile mussels at 18 SWP locations.

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Tags

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Figure S3. Videos about the golden mussel on the YouTube playlist of the California Department of Water Resources—<https://youtube.com/playlist?list=PLeod6x87Tu6cILDddBTgWfoEToVFi8saU&si=LtvER6WDa4i-IpuW>.

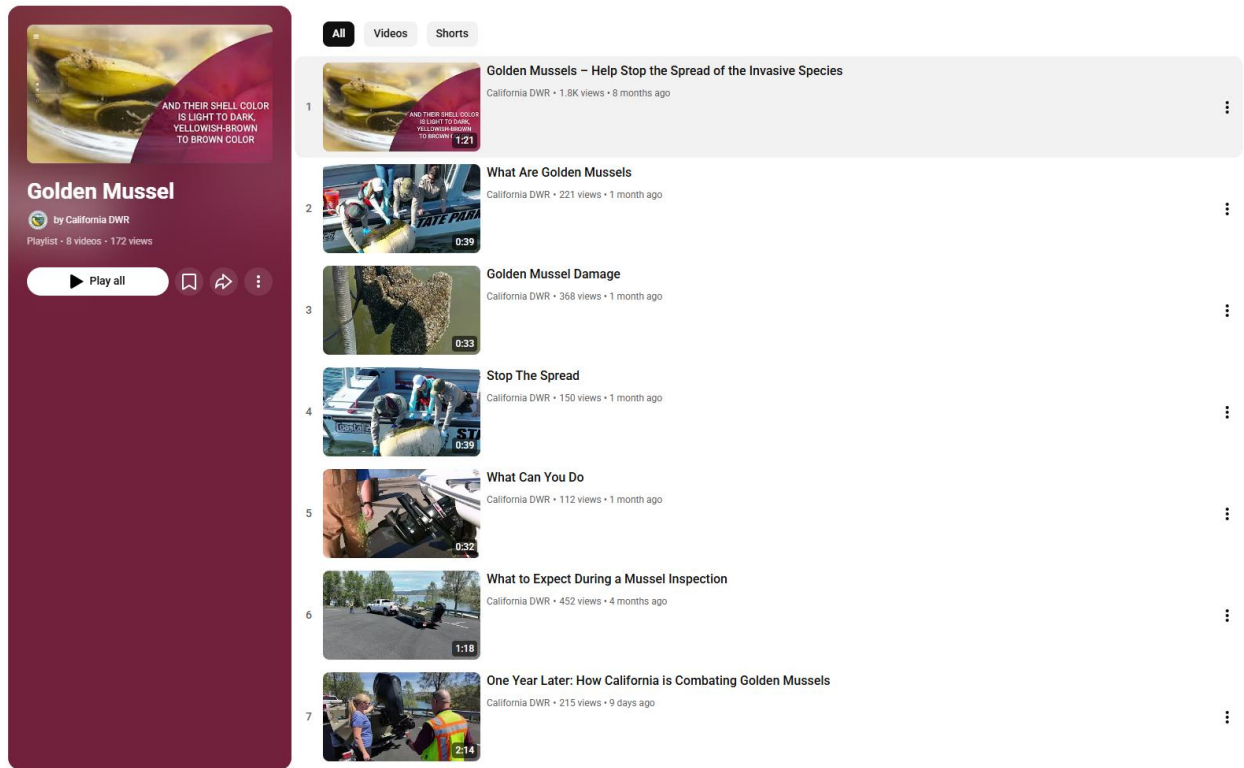


Table S1. Elasmobranchii and Teleostei species preying on the golden mussel *Limnoperna fortunei* (Dunker, 1857), ranked by Order and Family, and highlighting some of the main observations described in several studies.

Chondrichthyes, Elasmobranchii				
Order	Family	Scientific and vernacular names	Observations	References
Myliobatiformes	Potamotrygonidae	<i>Potamotrygon falkneri</i> Castex & Maciel, 1963 Largespot river stingray	0.9%-4.4% feeding index	[229]
Osteichthyes, Teleostei				
Atheriniformes	Atherinopsidae	<i>Odontesthes humensis</i> de Buen, 1953 Peixe rei	Index of Relative Importance – 13.7	[46]
Characiformes	Acestorhamphidae	<i>Astyanax lacustris</i> (Lütken, 1875) Lake tetra	Index of Relative Importance – 0.1	[46]
		<i>Leporinus friderici</i> (Bloch, 1794) Threespot leporinus	23%-58% feeding index	[229]
		<i>Leporinus lacustris</i> Amaral Campos, 1945 Piava de lagoa	14%-18% feeding index	[229]
		<i>Leporinus striatus</i> Kner, 1858 Striped leporinus	Biomass derived from golden mussels - 65.7% (49.1–89.5%)	[46]
		<i>Megaleporinus elongatus</i> (Valenciennes, 1850) Piau verdadeiro	100% feeding index	[229]
		<i>Megaleporinus macrocephalus</i> (Garavello & Britski, 1988) Piauçu	37% feeding index	[229]
			91-99% feeding index	
			The mouth apparatus can remove mussels of various sizes from rigid substrates and break their shells.	
	Anostomidae		Biomass derived from golden mussels - 60.1% (50.7–69.2%)	
		<i>Megaleporinus obtusidens</i> Valenciennes, 1847 Piapara	Mussels 15-20 mm in length are the most common in the digestive tract.	[46,185,187,188, 229]
			High prevalence in the digestive tracts of a population (72%)	
			Maximum number of golden mussels ingested – 77	
			Index of Relative Importance – 49.6	
		<i>Schizodon borellii</i> (Boulenger, 1900) Piava	≤0.1%-1.7% feeding index	[229]
	Characidae	<i>Schizodon nasutus</i> Kner, 1858 Taguara	Index of Relative Importance – 0.6	[46,229]
		<i>Galeocharax humeralis</i> (Valenciennes, 1834) Saicanga	Index of Relative Importance – 1.0	[46]
	Cynodontidae	<i>Rhaphiodon vulpinus</i> Spix & Agassiz, 1829 Biara	Index of Relative Importance – 1.4	[46]
	Erythrinidae	<i>Hoplias</i> aff. <i>malabaricus</i> (Bloch, 1794) Traira	1.5% feeding index	[229]
	Parodontidae	<i>Apareiodon affinis</i> (Steindachner, 1879) Darter characine	Herbivorous fish that consume golden mussel byssus because they have spatula-like teeth, to	[46]

			remove the byssus when grazing on epilithic periphyton.	
	Prochilodontidae	<i>Prochilodus lineatus</i> (Valenciennes, 1837) Streaked prochilod		[46,119]
		<i>Piaractus mesopotamicus</i> (Holmberg, 1887) Pacu		[119]
	Serrasalminidae	<i>Serrasalmus maculatus</i> Kner, 1858 Catirina	0.1% feeding index	[229]
		<i>Serrasalmus marginatus</i> Valenciennes, 1837 Pirambeba	0.001% feeding index	[229]
Cichliformes	Cichlidae	<i>Crenicichla missioneira</i> Lucena & Kullander, 1992 Joaninha	Biomass derived from golden mussels - 56.7% (23.7–92.9%). Large and protractile mouth and strong pharyngeal teeth.	[46]
		<i>Geophagus</i> cf. <i>proximus</i> (Castelnau, 1855) Acaratinga	0.8% feeding index	[229]
Gymnotiformes	Sternopygidae	<i>Eigenmannia</i> sp. D. S. Jordan & Evermann, 1896 Knifefish		[46]
Siluriformes	Aspredinidae	<i>Pseudobunocephalus</i> sp. Friel, 2008 Banjo catfish		[46]
	Auchenipteridae	<i>Auchenipterus nuchalis</i> (Spix & Agassiz, 1829) Mampará legítimo		[46]
	Callichthyidae	<i>Hoplosternum littorale</i> (Hancock, 1828) Atipa	<0.1% feeding index	[229]
		<i>Pterodoras granulosus</i> (Valenciennes, 1821) Granulated catfish	1%-27% feeding index	[46,229]
	Doradidae	<i>Rhinodoras dorbignyi</i> (Kner, 1855) Armado		[46]
		<i>Trachydoras paraguayensis</i> (Eigenmann & Ward, 1907)	<0.03% feeding index	[229]
		<i>Pimelodella australis</i> Eigenmann, 1917 Mandi-chorão		[46]
	Heptapteridae	<i>Pimelodella gracilis</i> (Valenciennes, 1835) Graceful pimelodella		[46]
		<i>Rhamdia quelen</i> (Quoy & Gaimard, 1824) South American catfish		[119]
	Loricariidae	<i>Brochiloricaria chauliodon</i> Isbrücker, 1979 Orchid leather neck whiptail		[46]
		<i>Hypostomus commersoni</i> Valenciennes, 1836 Cascudo panaque		[46]
		<i>Loricariichthys anus</i> (Valenciennes, 1835) Cascudo-chicote	Biomass derived from golden mussels - 29.7% (0.0–59.3%)	[46]
		<i>Loricariichthys melanocheilus</i> Reis & Pereira, 2000 Without a common name		[46]
		<i>Paraloricaria vetula</i> (Valenciennes, 1835) Cascudo-viola	Biomass derived from golden mussels - 59.5% (40.8–78.4%)	[46]
		<i>Ricola macrops</i> (Regan, 1904) Vieja de agua		[46]
	Pimelodidae	<i>Iheringichthys labrosus</i> (Lütken, 1874) Mandi-beiçudo	Biomass derived from golden mussels - 38.1% (23.3–52.4%)	[46]
		<i>Parapimelodus valenciennes</i> (Lütken, 1874) Bagarito	Planktivorous fish that consume the veligers of golden mussels.	[46]
		<i>Pimelodus absconditus</i> Azpelicueta, 1995 Mandi-pintado	Biomass derived from golden mussels - 50.6% (34.7–66.1%)	[46]
		<i>Pimelodus albicans</i> (Valenciennes, 1840)		[46]

Bagre branco

≤ 1% feeding index

Pimelodus maculatus Lacepède, 1803
Spotted pim

Generalist omnivore that
now primarily feeds on
golden mussel (González-
Bergonzoni et al. 2020;
López-Rodríguez et al.
2019)

[46,188,229]

On average, 56% of the
biomass is derived from
golden mussels (40–72%)

Pimelodus maculatus Lacepède, 1803
Mandi-amarelo

[46]
