Subclass Protobranchia
Order Nuculida
Family Nuculidae

1. **Taxodont dentition**
2. **Umbos opisthogyrate, beak pointing posteriorly**
3. **Ligament amphidetic, internal**
4. **Hinge teeth V-shaped, on both sides of beaks; separated by deep resilifer**
5. **Inner ventral margin with or without crenulations**

Acila

1. Shell ovate to quadrate, equivalve
2. Posterior end truncate
3. Sculpture of divaricate radial riblets
4. Resilifer large, projecting anteriorly
5. Ventral shell margin crenulate

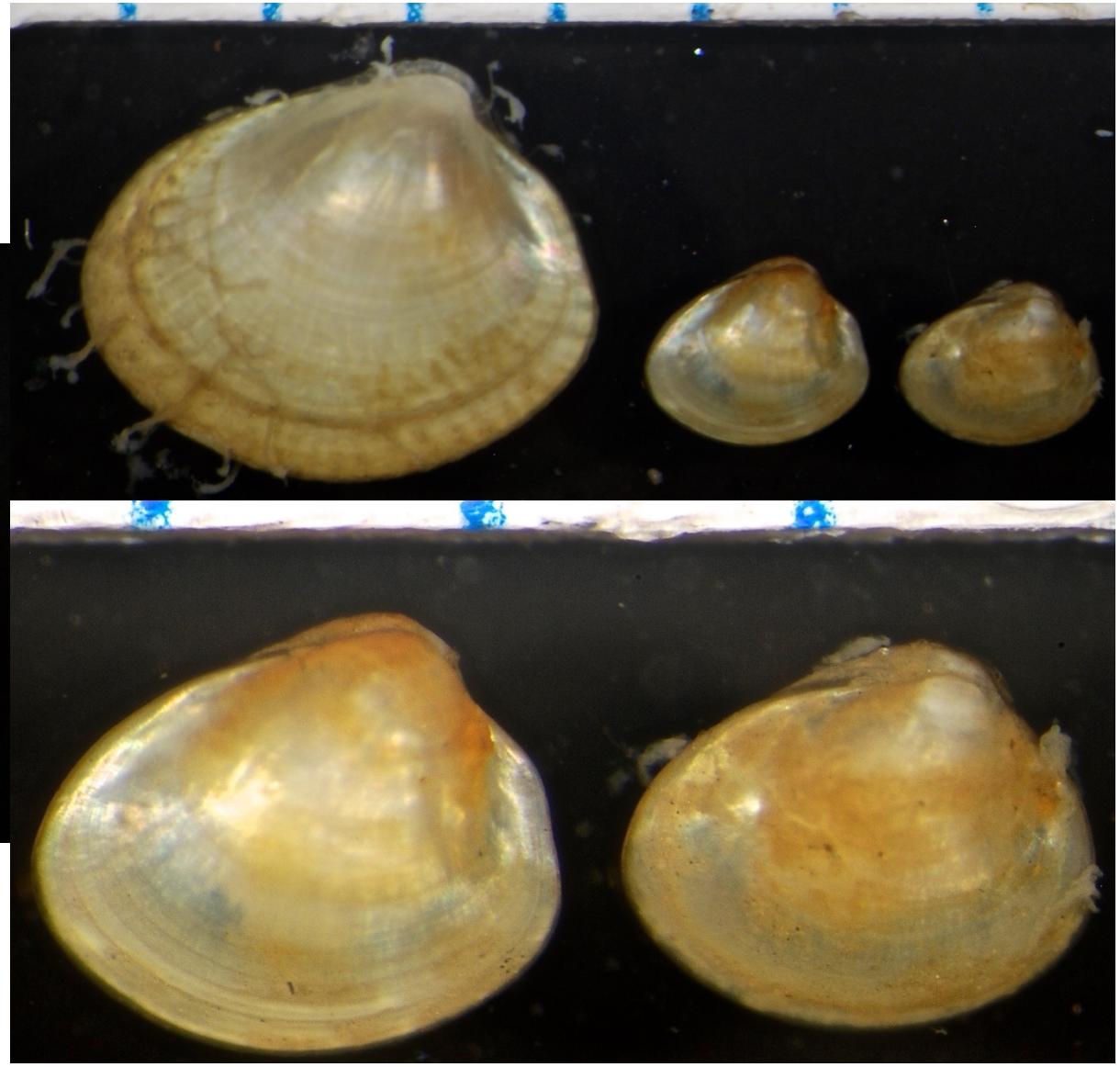
Acila castrensis (Hinds 1843)

Adult – NCCA15 Puget Sound 2015

Juvenile - NCCA15 Puget Sound 2015

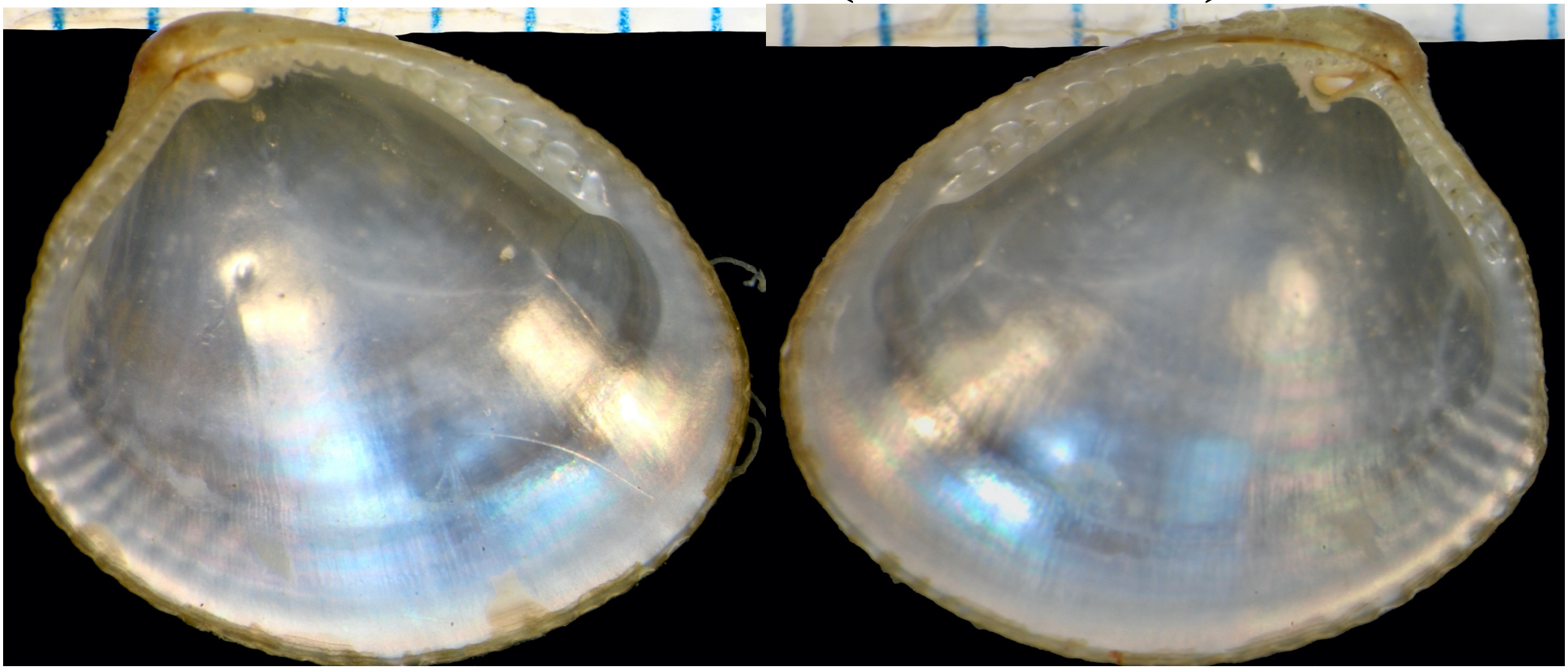
Acila castrensis (Hinds 1843)

MMS Hard Bottom 017A/B 190m 1984



Specimens courtesy of Carol Paquette MBC

Acila castrensis (Hinds 1843)



MMS Hard Bottom 017A/B 190m 1984

left valve

right valve

Specimen courtesy of Carol Paquette MBC

Ennucula

1. **Shell subovate to subtrigonal**
2. **Posterior end not quadrate**
3. **Sculpture of commarginal striae**
4. **Resilifer large, projecting anteriorly**
5. **Ventral shell margin not crenulate**

Ennucula linki (Dall 1916)

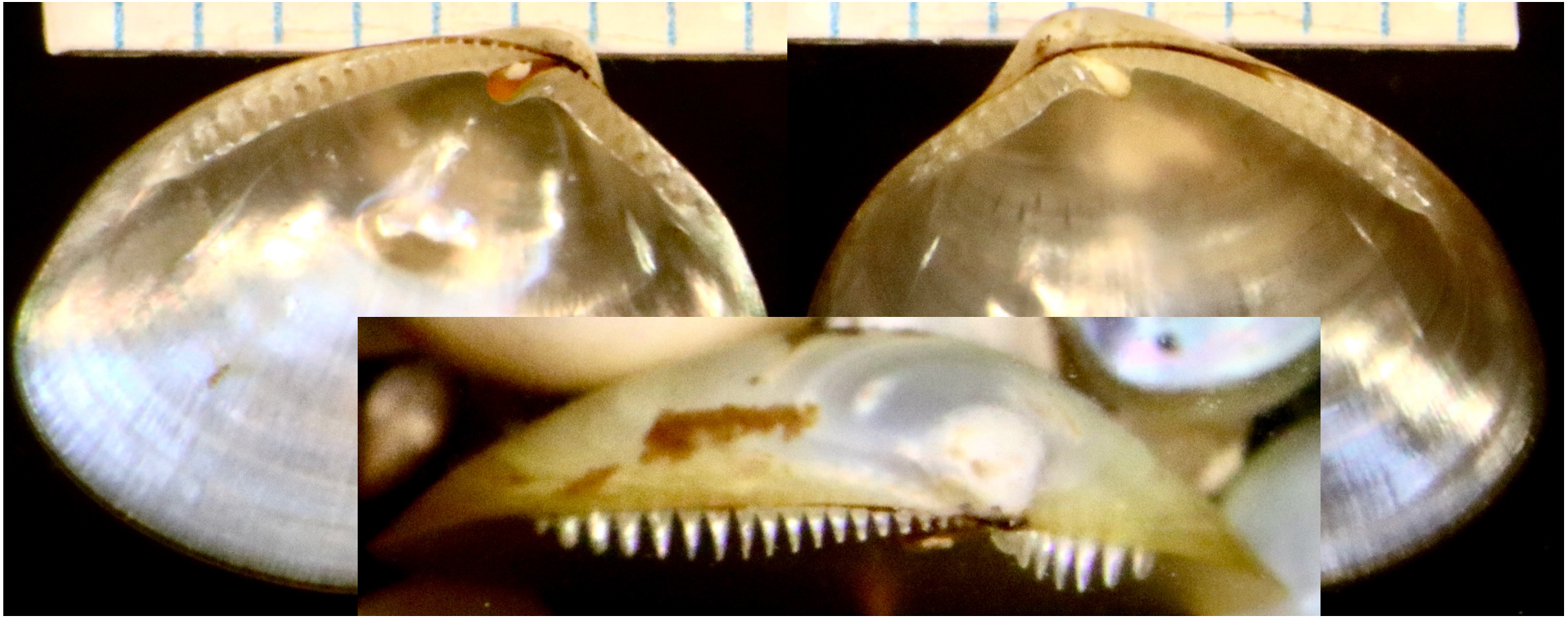
Cascadia Slope EB5-64 950m 5 July 1975

Specimen courtesy of Kelvin Barwick via Don Cadien

Ennucula linki (Dall 1916)

Cascadia Slope EB5-64 950m 5 July 1975

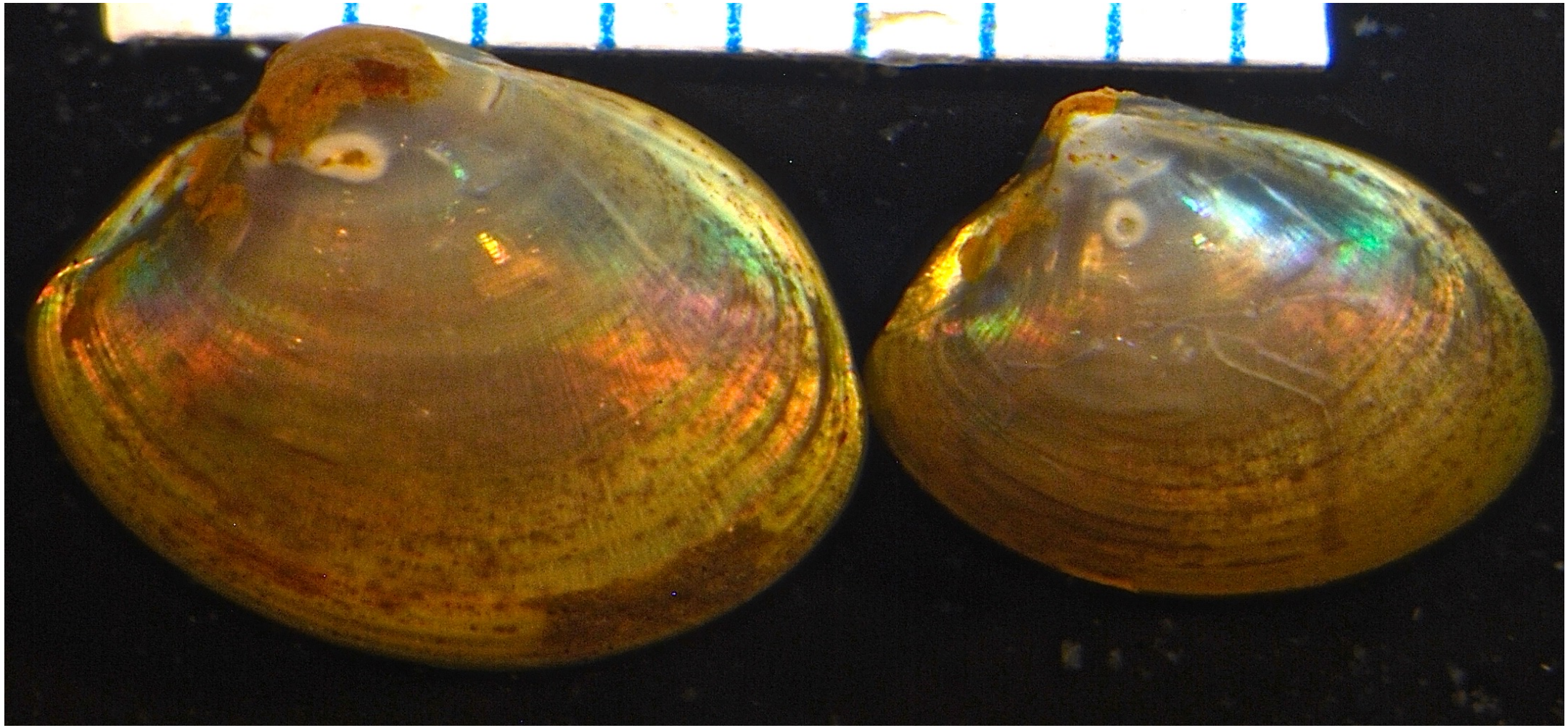
Ennucula linki (Dall 1916)



Cascadia Slope EB5-64 950m 5 July 1975

Specimen courtesy of Kelvin Barwick via Don Cadien

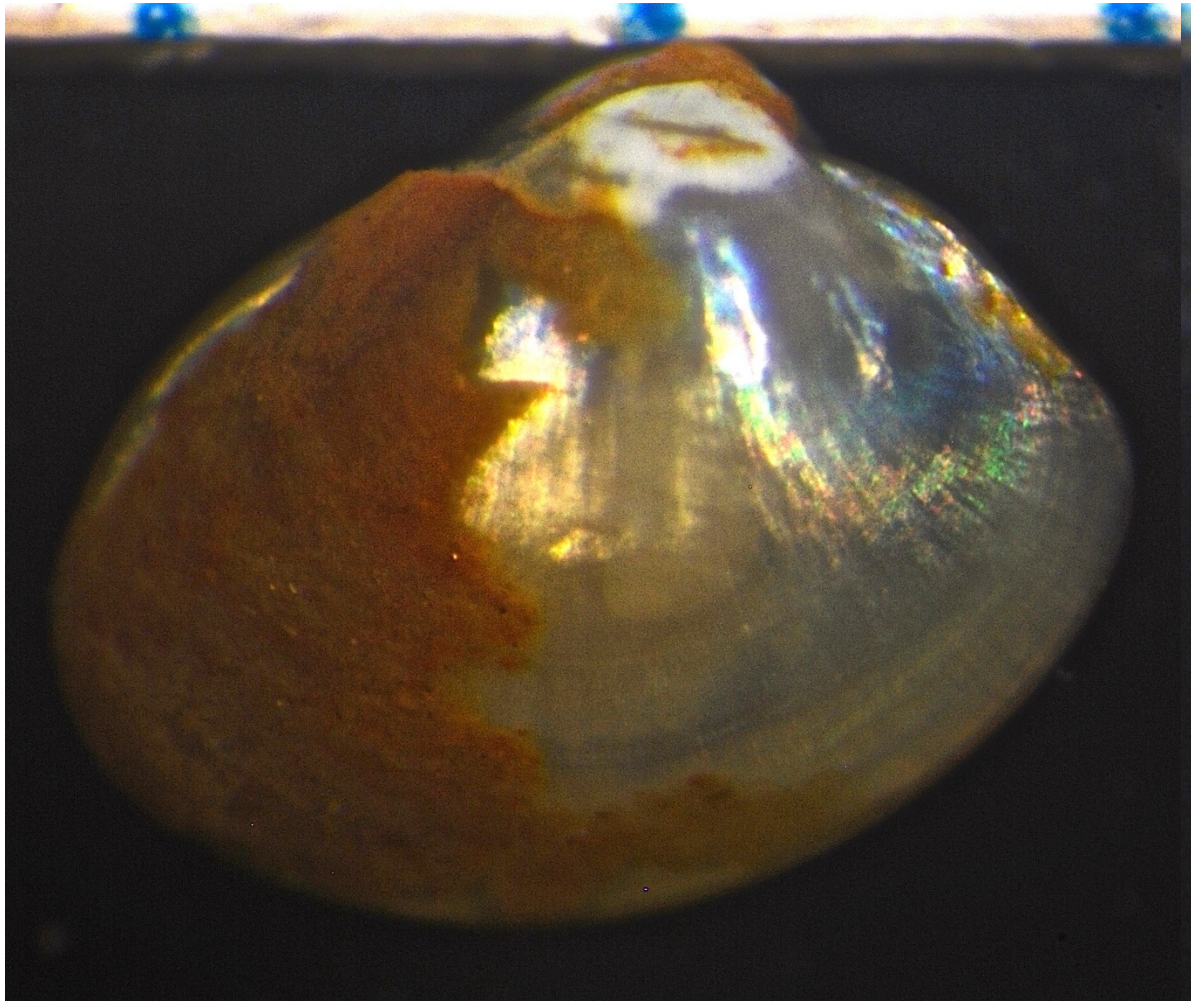
Ennucula tenuis (Montagu 1808)



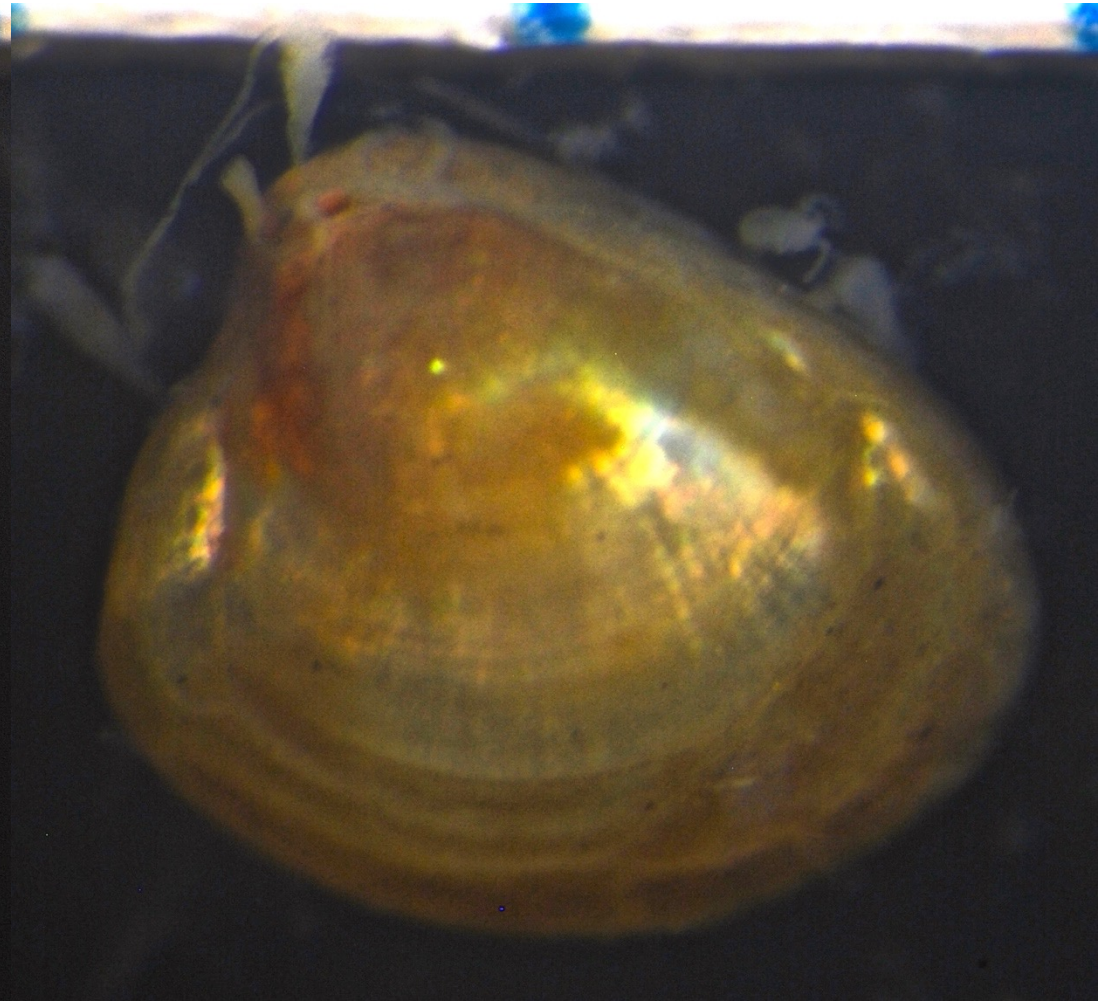
City of San Diego E9 114m 2019

Specimens courtesy of Wendy Enright City of San Diego

Ennucula tenuis (Montagu 1808)

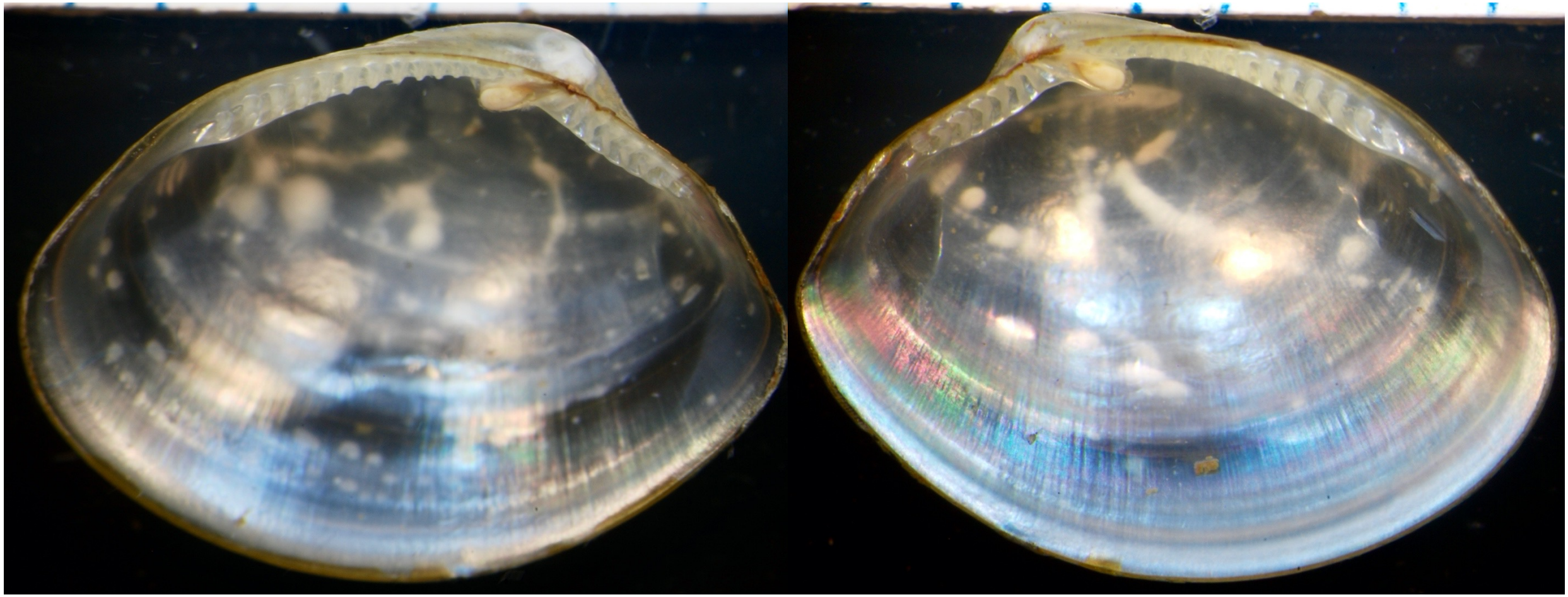


City of San Diego B9 101m 2019
Specimen courtesy of Wendy Enright City of San Diego



City of San Diego E9 114m 2019

Ennucula tenuis (Montagu 1808)



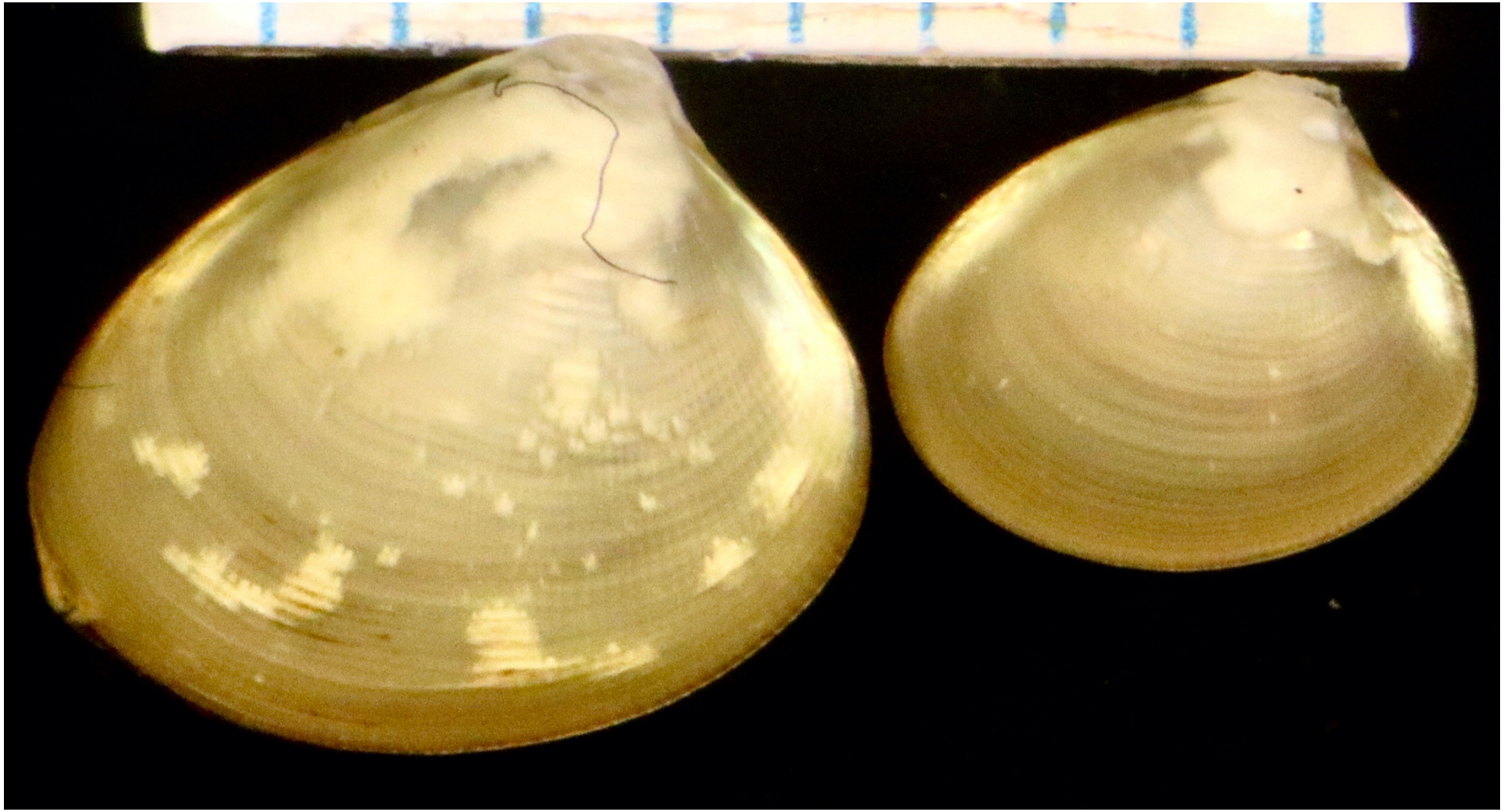
B’18 10246 East Santa Barbara Channel 44m

left valve right valve

Nucula

1. **Shell subovate to subtrigonal**
2. **Posterior end not truncate**
3. **Sculpture usually cancellate or only with commarginal riblets**
4. **Small resilifer, not projecting**
5. **Ventral shell margin crenulate**

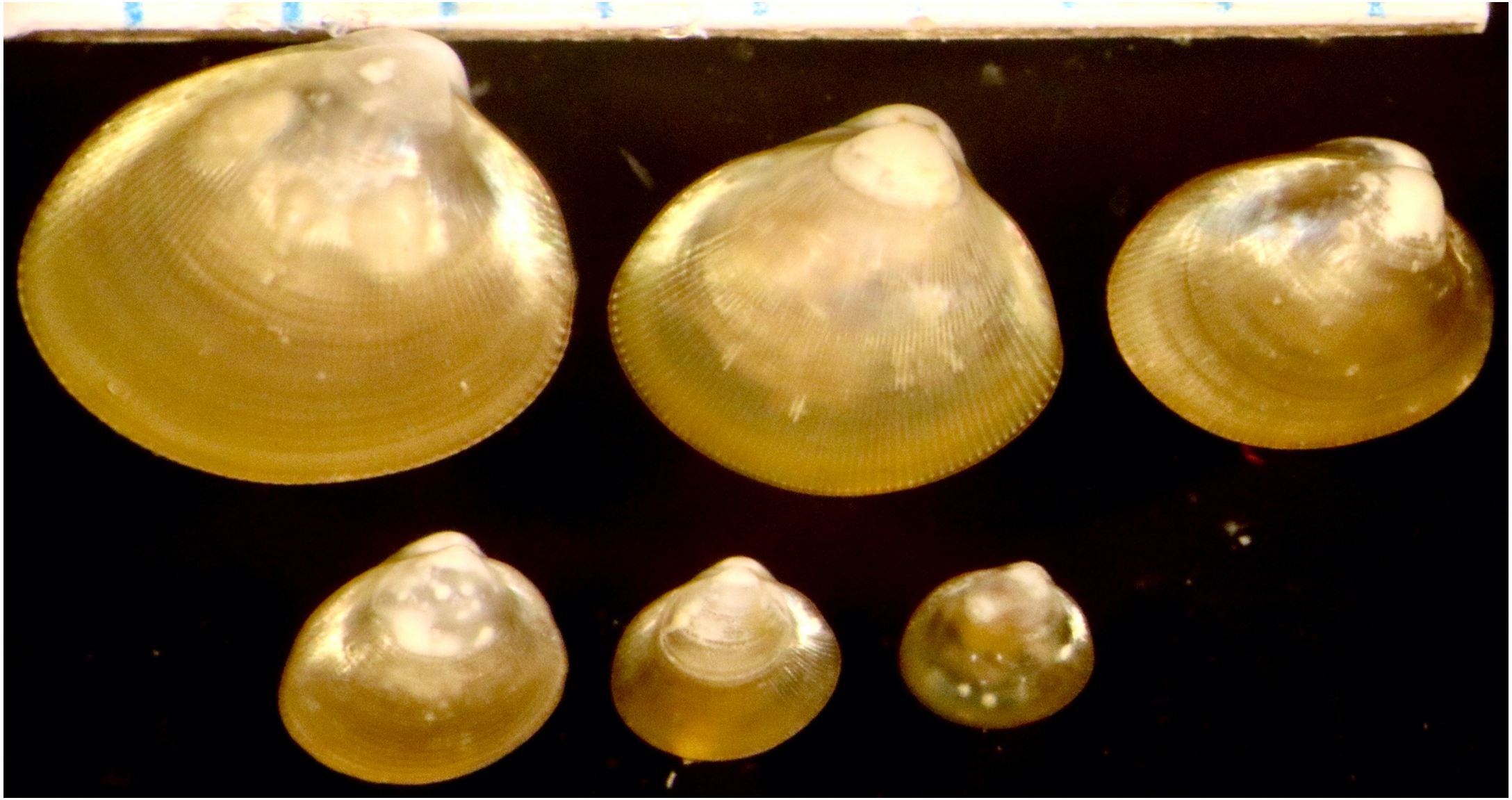
Nucula carlottensis Dall 1897



Cascadia Slope EB5-64 950m 5 Jul 1975

Specimens courtesy of Kelvin Barwick via Don Cadien

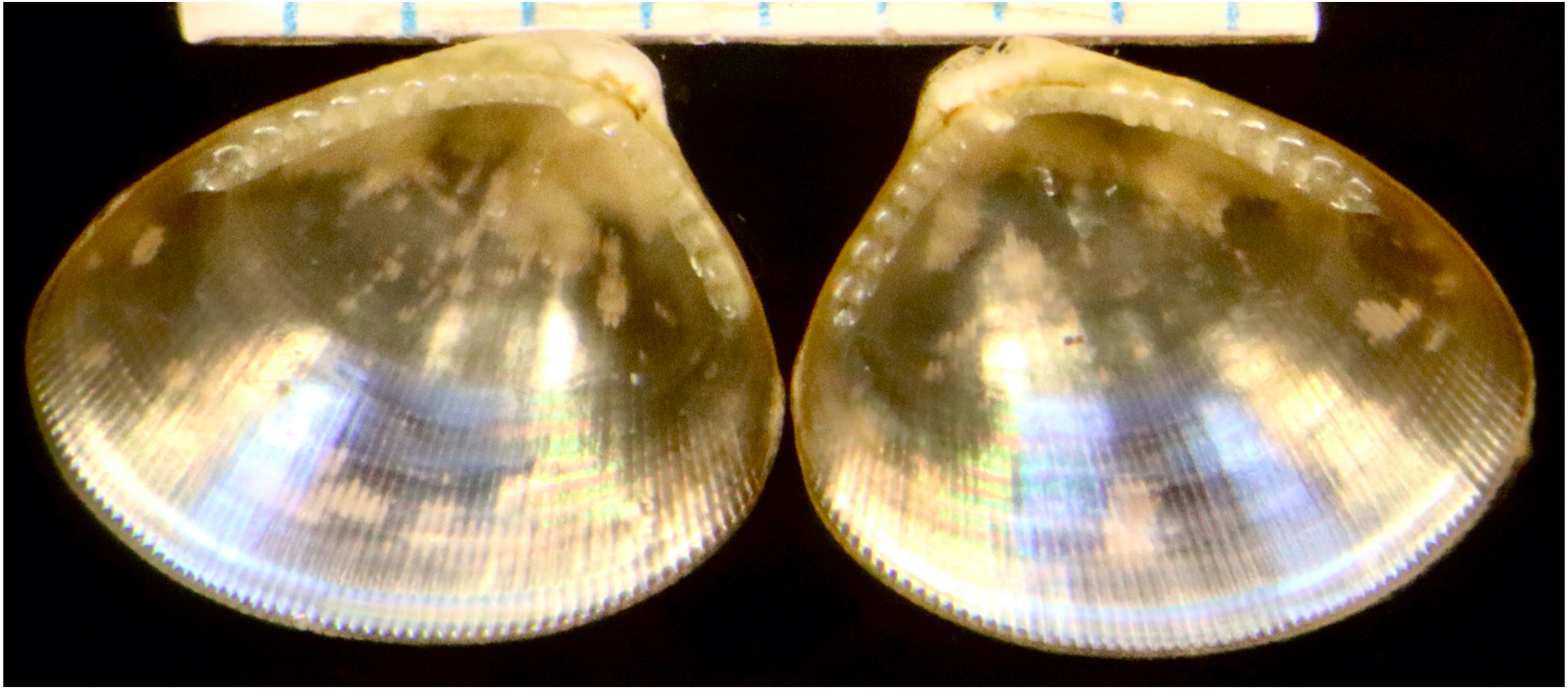
Nucula carlottensis Dall 1897



Cascadia Slope EB5-64 950m 5 Jul 1975

Specimens courtesy of Kelvin Barwich via Don Cadien

Nucula carlottensis Dall 1897



Cascadia Slope EB5-64 950m 5 Jul 1975

Specimen courtesy of Kelvin Barwick via Don Cadien

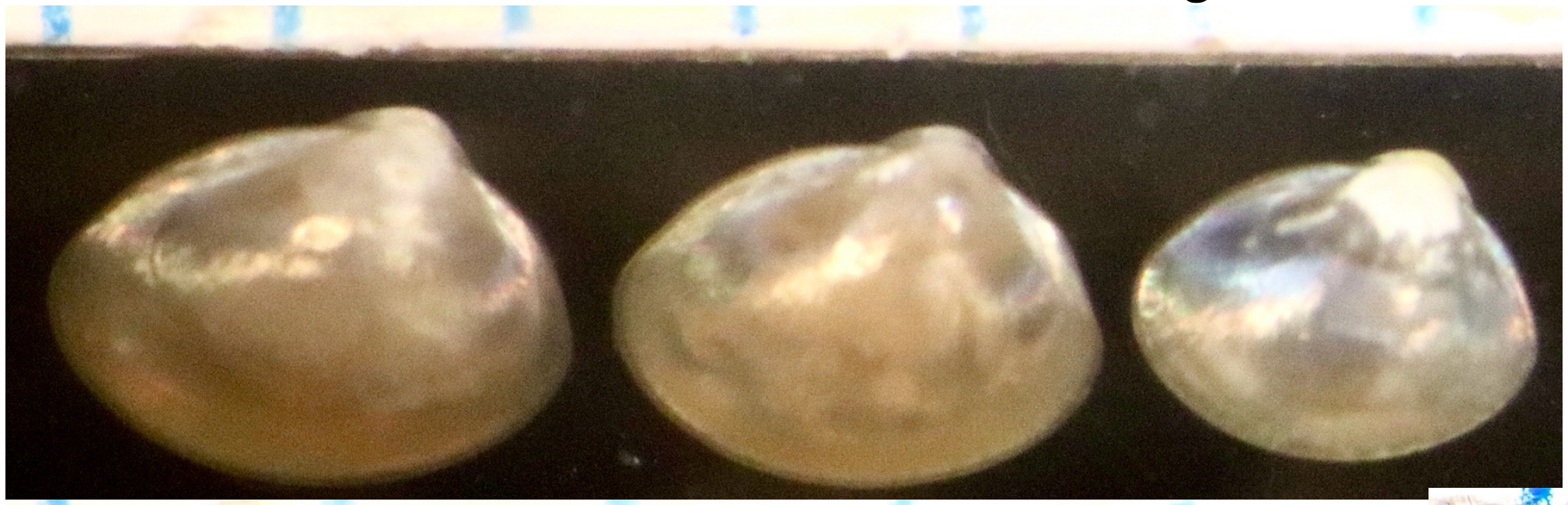
Nucula exigua G.B. Sowerby I 1833

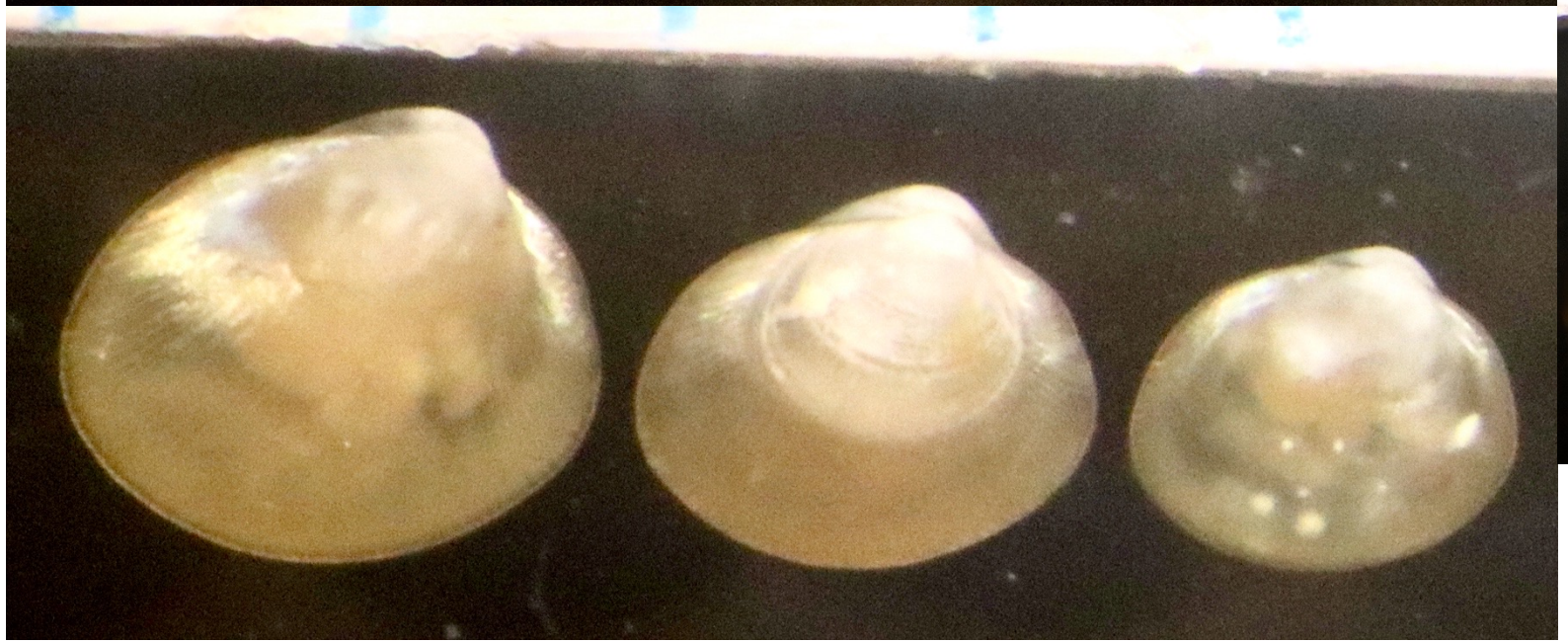
Chevron B8N (3) 7m 2017

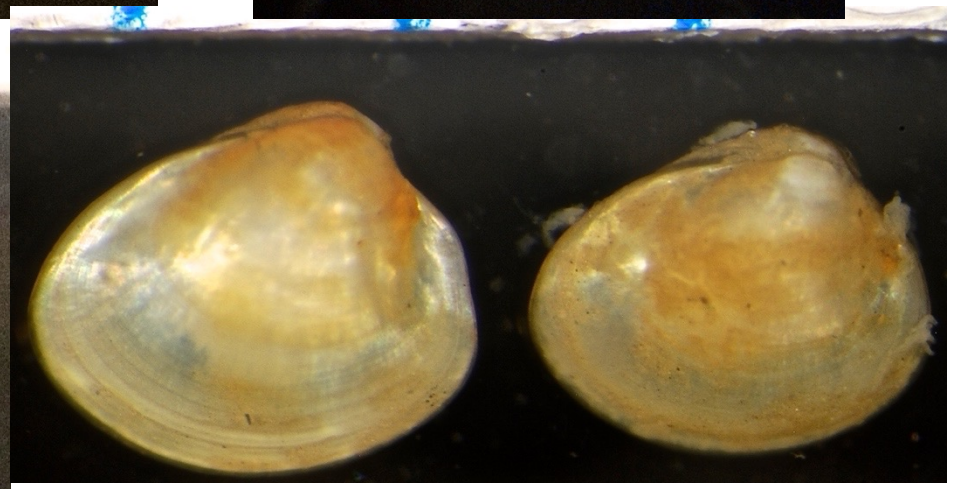
left hinge

right hinge

Nuculidae juveniles







Upper – *Ennucula tenuis*

Lower – *Acila castrensis*

Upper – *Ennucula linki* Lower – *Nucula carlottensis*

Order Solemyida
Family Solemyidae

1. **Hinge edentate; ligament external or internal**
2. **Chondrophore present or absent**
3. **Posterior end rounded or subquadrate**
4. **Periostracum light brown to black, silky to shiny, with projections**

Acharax

1. **Ligament external, projecting, attached to nymph**
2. **Chondrophore absent**

Acharax johnsoni (Dall 1891)

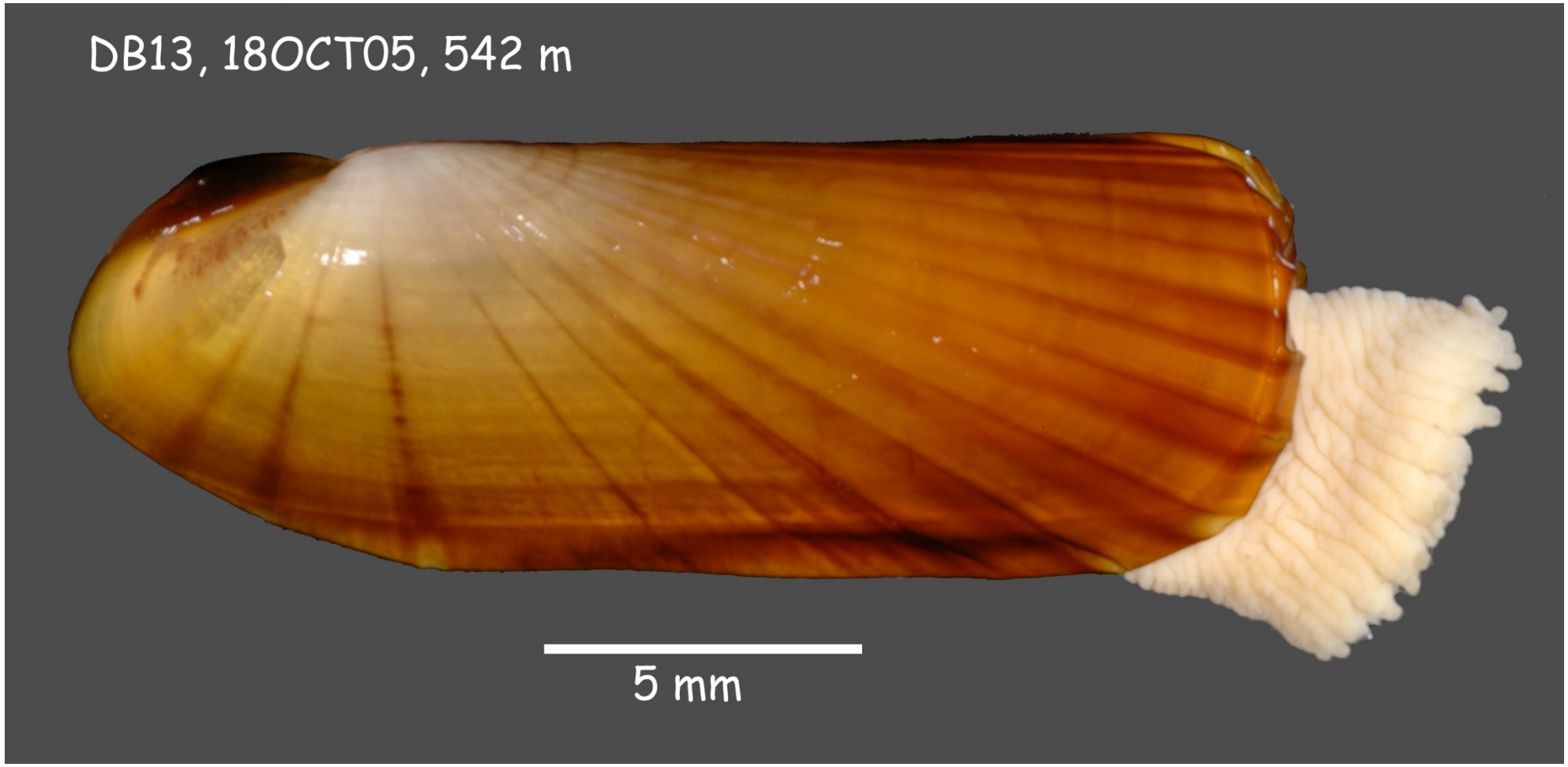
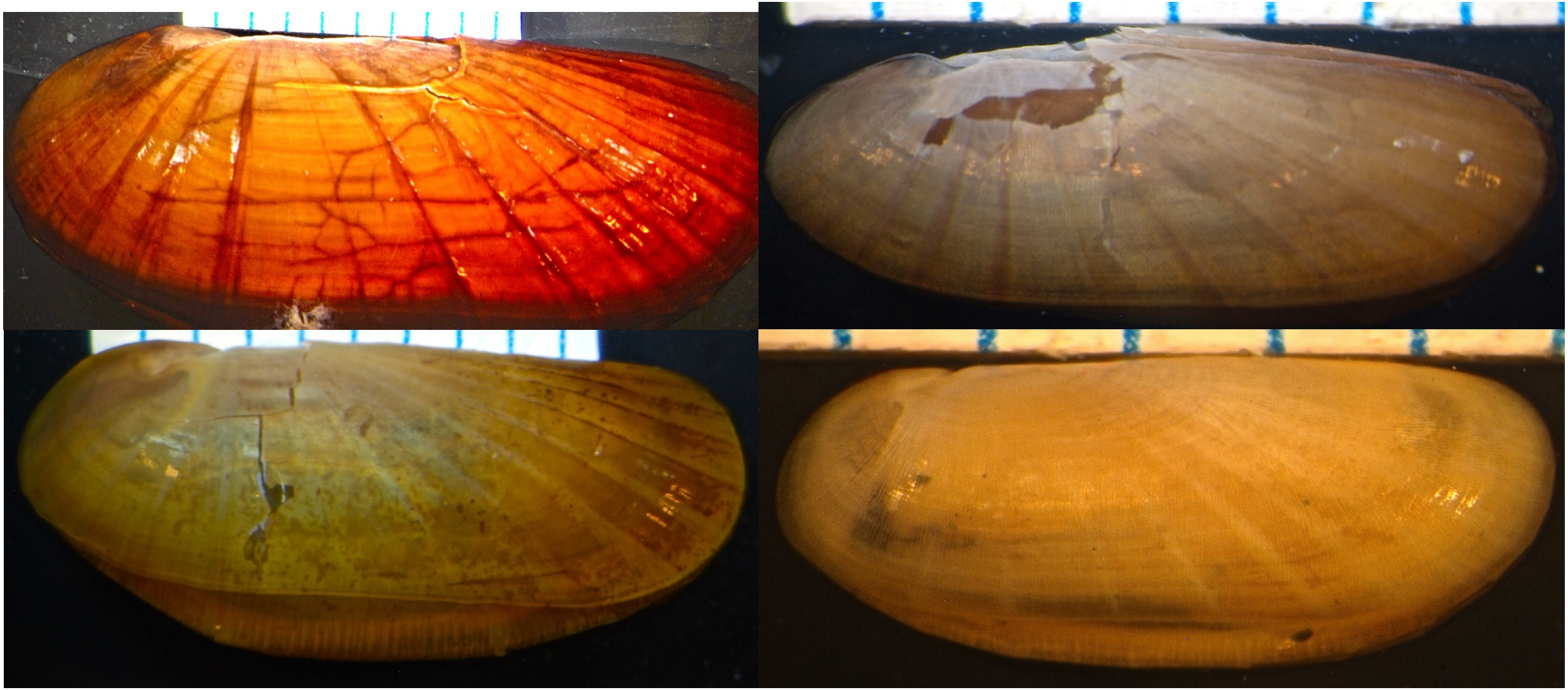


Photo courtesy of Kelvin Barwick

Petrasma

1. **Ligament internal, with ovate lateral extension**
2. **Chondrophore present, anterior to internal ligament**

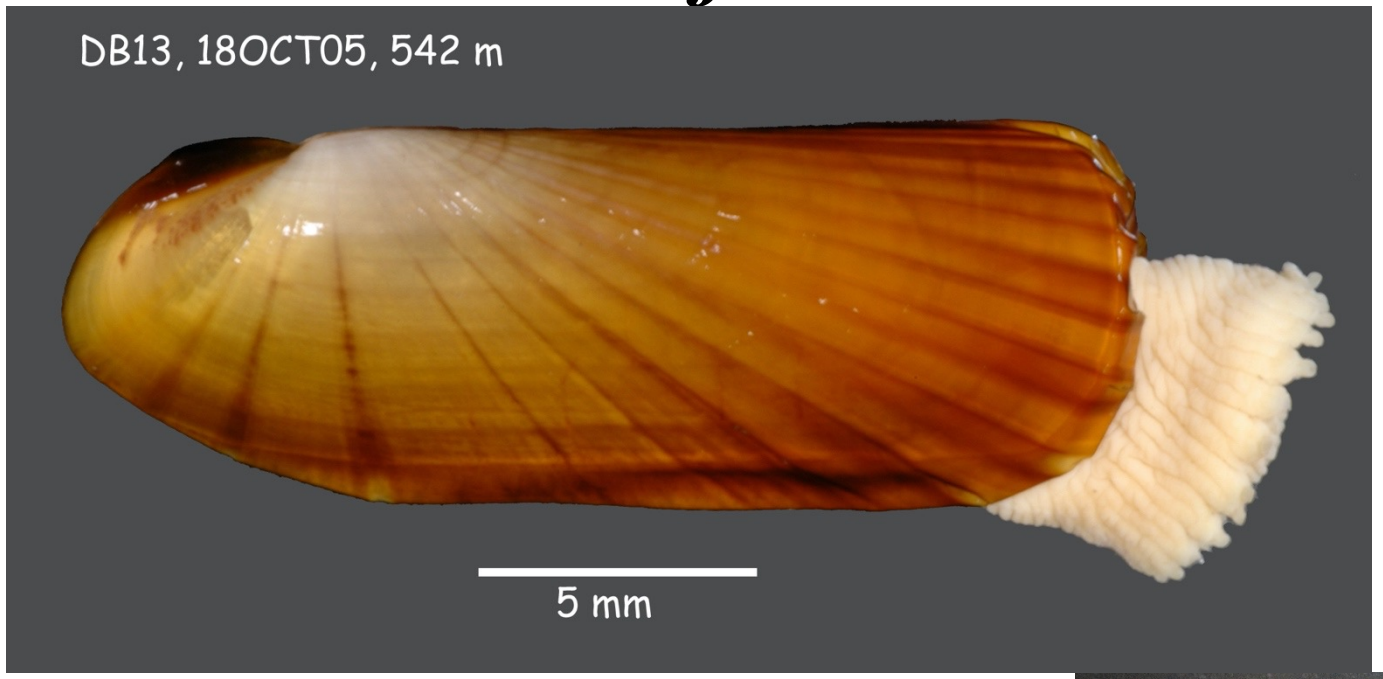
Petrasma pervernicosa (Kuroda 1948)



Upper – Santa Monica Bay E6 153m 1976
Lower – B’94 Santa Monica Bay 1052 220m

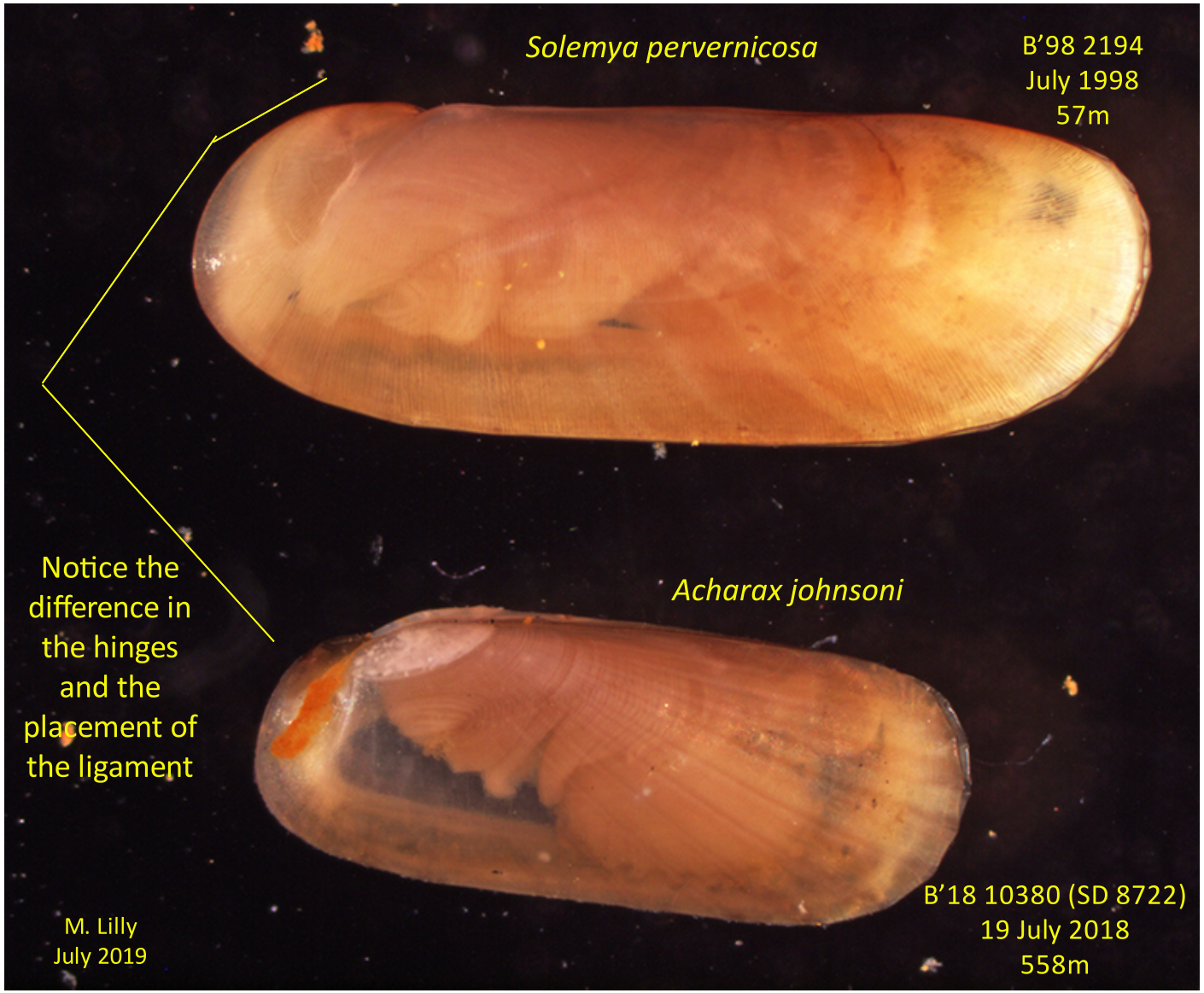
Upper – Santa Monica Bay E6 153m 1976
Lower – B’13 San Pedro Shelf 31m

Acharax johnsoni/Petrasma pervernicosa



Santa Monica Bay E6 153m 1976

Acharax johnsoni/Petrasma pervernicosa

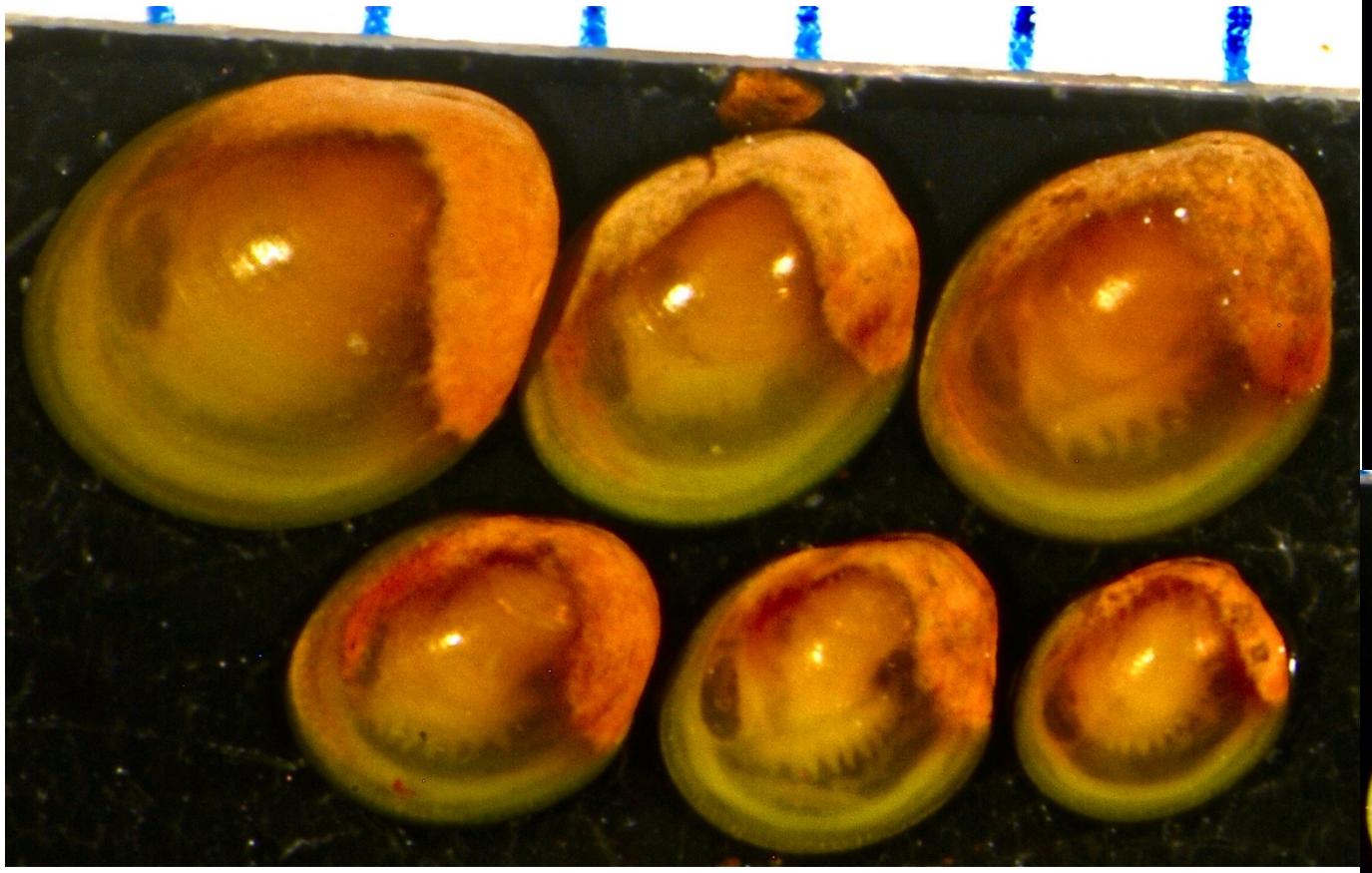


PDF courtesy of Megan Lilly

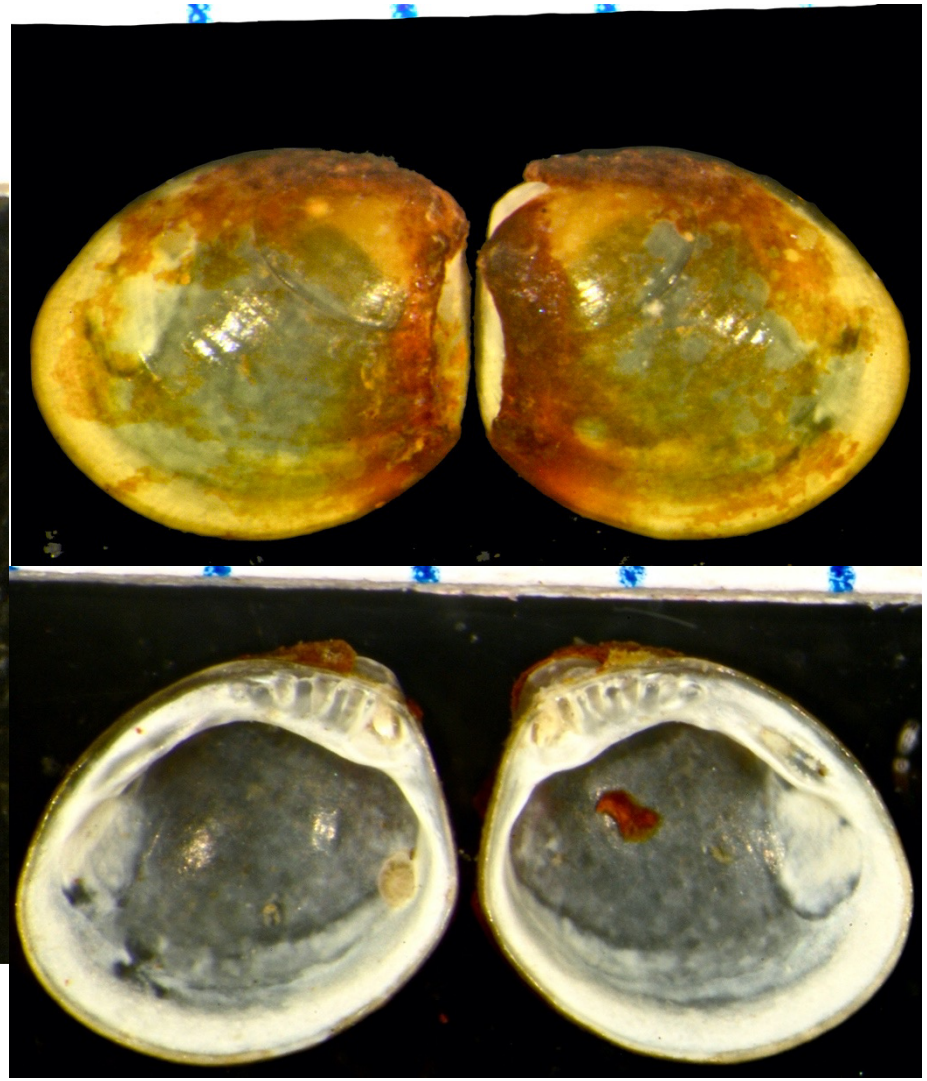
Family Nucinellidae

1. Ligament internal
2. Hinge teeth 6 or fewer, mostly on one side of beak

Huxleyia munita (Dall 1898)



B’13 Station 9357 75m Northern Channel Islands



External (upper) and Internal (lower) valves

Order Nuculanida
Family Bathyspinulidae

1. **Taxodont dentition, separated by small resilifer**
2. **Ligament external, amphidetic, small internal resilium**
3. **Hinge teeth V-shaped, on both sides of beaks, unequal**

“Tindariopsis” grasslei (J.A Allen 1993)

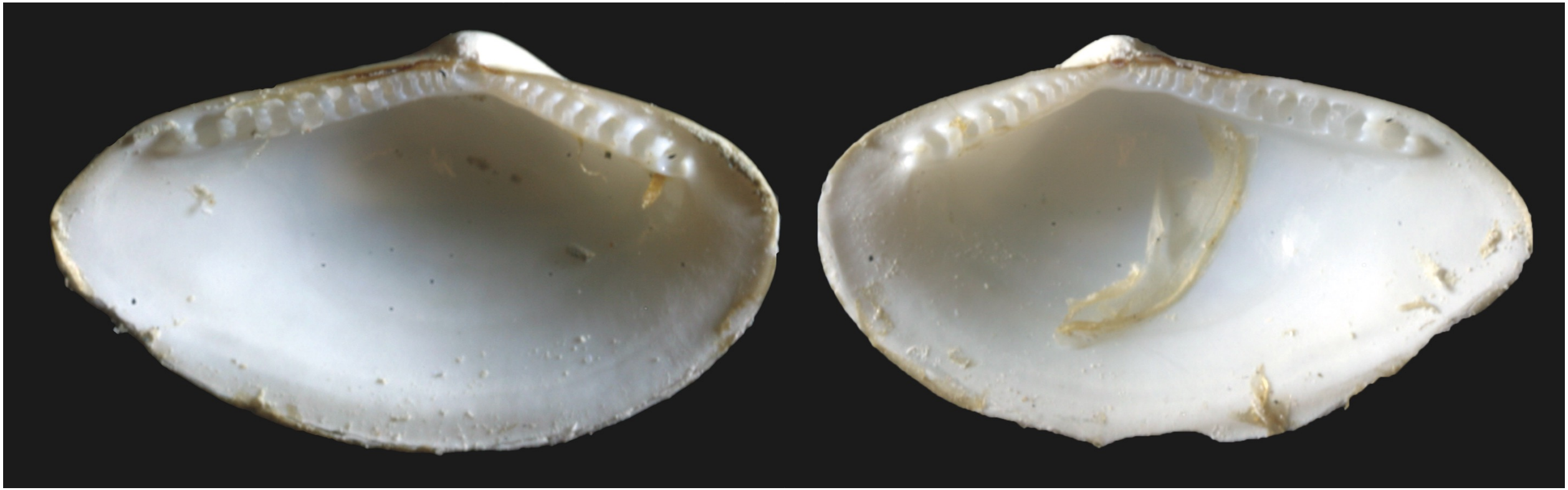
Left valve

Right valve

Holotype USNM 859482

Photos courtesy of Dr. Paul Valentich Scott

“Tindariopsis” grasslei (J.A Allen 1993)



Left valve Right valve

Paratype USNM 859481

Photos courtesy of Dr. Paul Valentich Scott SBMNH

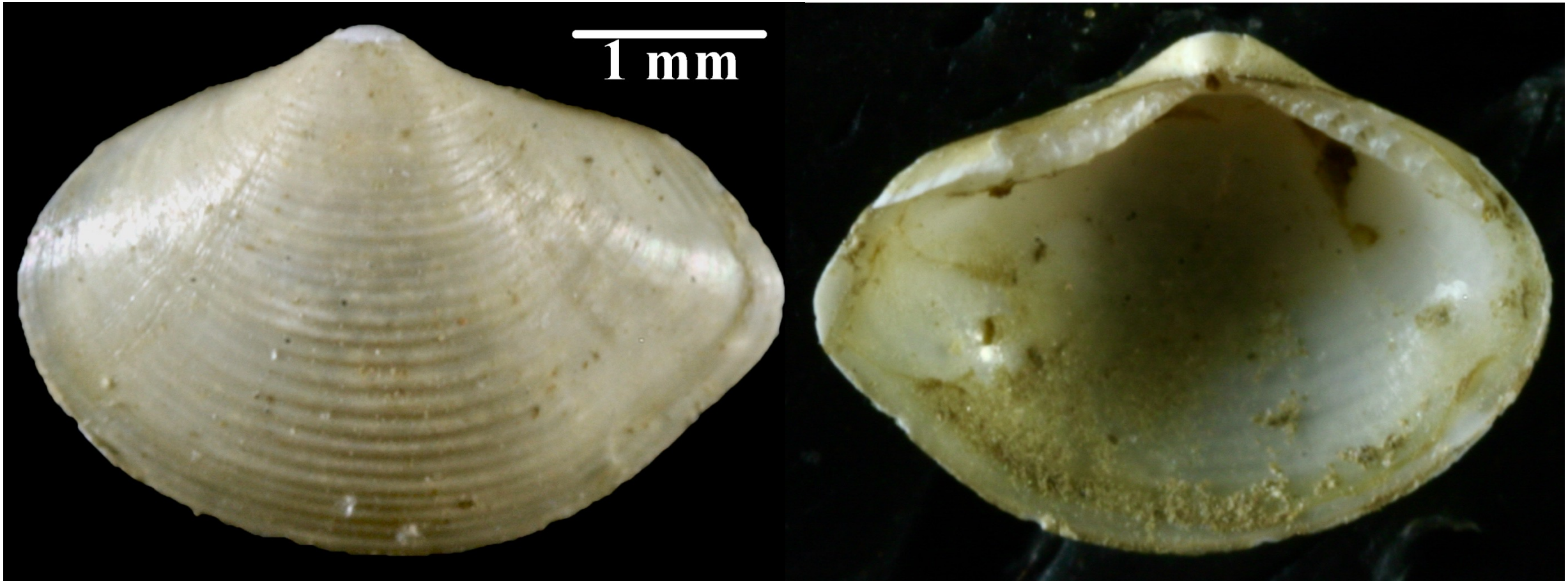
Family Nuculanidae

1. **Taxodont dentition, separated by small resilifer**
2. **Ligament amphidetic, mainly internal**
3. **Hinge teeth V-shaped in most, on both sides of beaks, unequal**
4. **Inner ventral margin without crenulations**
5. **Pallial sinus absent, shallow or moderate**

Ledella

1. **Posterior end produced, set of by shallow radial fold**
2. **Umbos prominent**
3. **Sculpture of commarginal ribs or striae**
4. **Ligament internal, within minute resilifer**
5. **All teeth V-shaped, anterior and posterior nearly equal in length**

Ledella fiascona (Dall 1916)



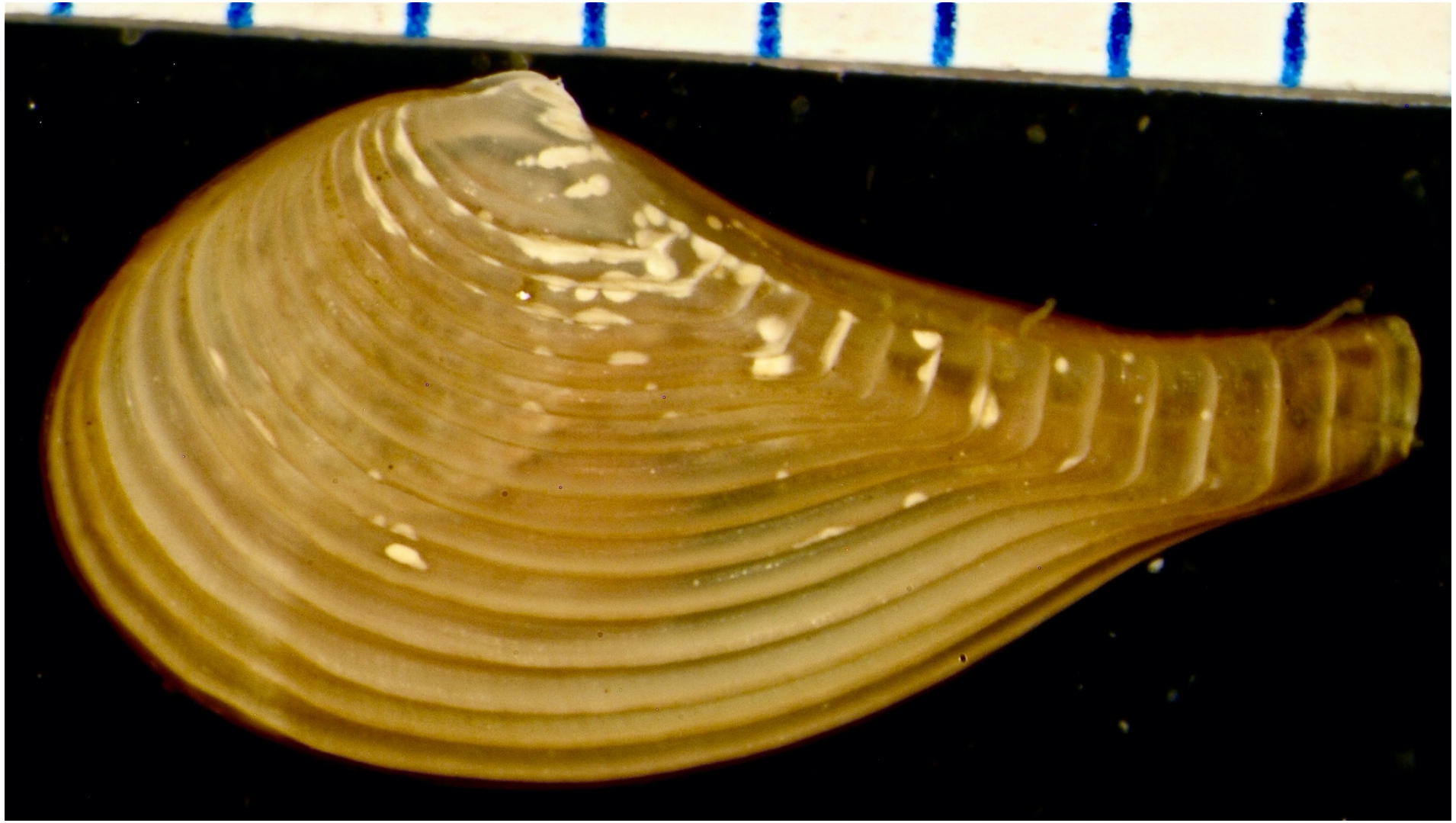
USNM 211424

Photos courtesy of Dr. Paul Valentich Scott SBMNH

Nuculana

1. **Posterior end strongly rostrate**
2. **Umbone small, opisthogyrate**
3. **Strong to weak commarginal ribbing**
4. **Escutcheon well-defined, lunule smooth**
5. **Ligament internal, with small resilifer**
6. **All teeth V-shaped**

Nuculana hamata (Carpenter 1864)



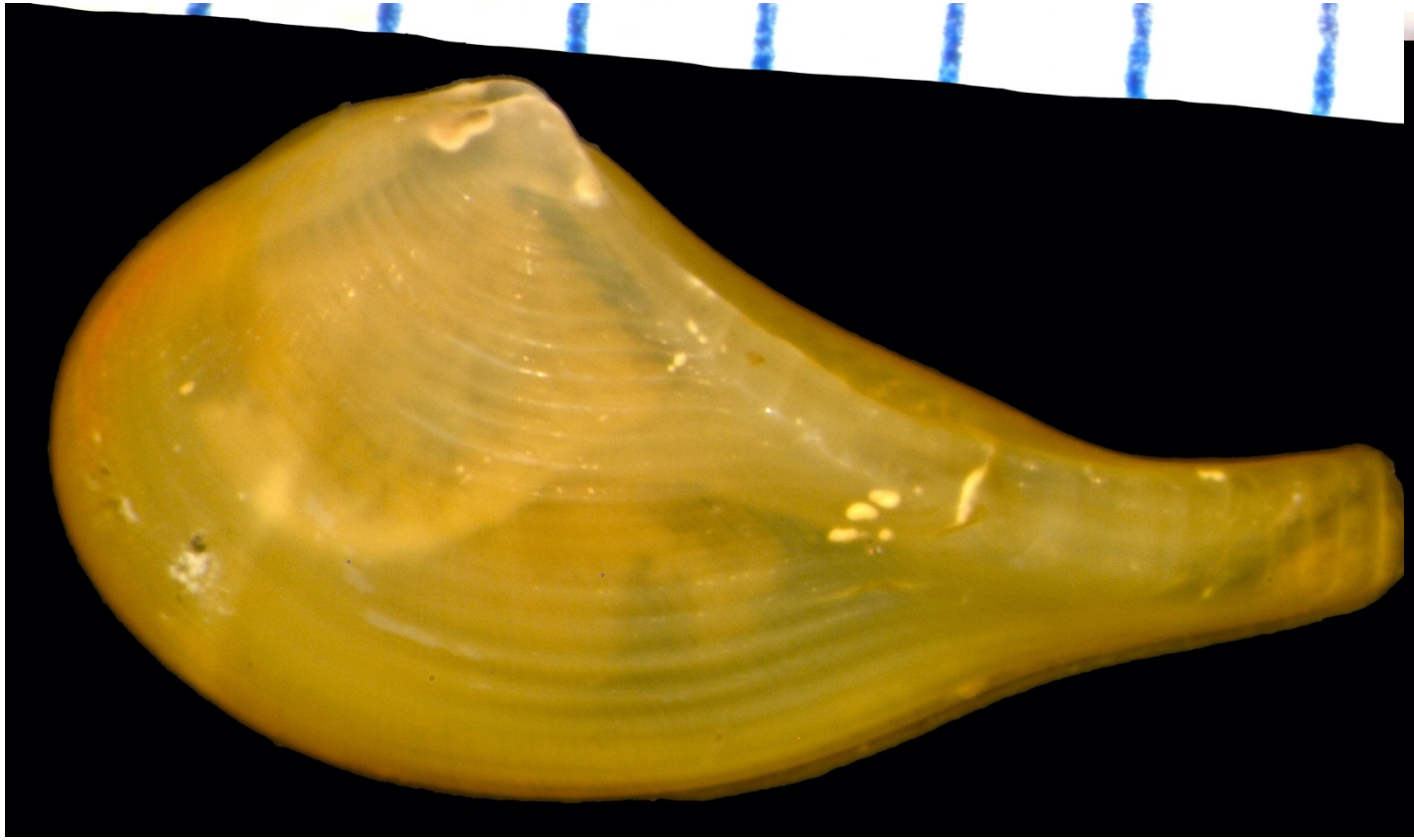
B’13 9360 Northern Channel Islands 88m

Nuculana hamata (Carpenter 1864)

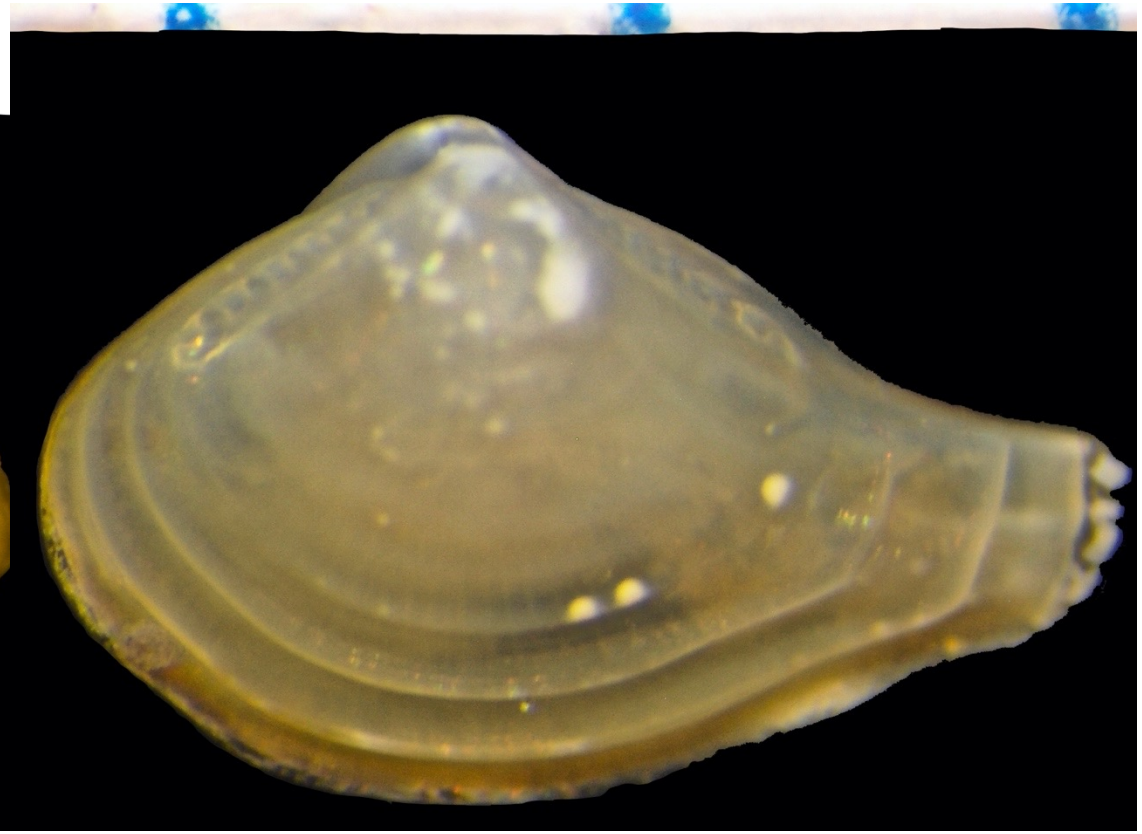
Santa Monica Bay NB5 57m 2014

BNOYOA Central R-21 93m 1982
Specimen courtesy of Carol Paquette MBC

Nuculana hamata (Carpenter 1864)

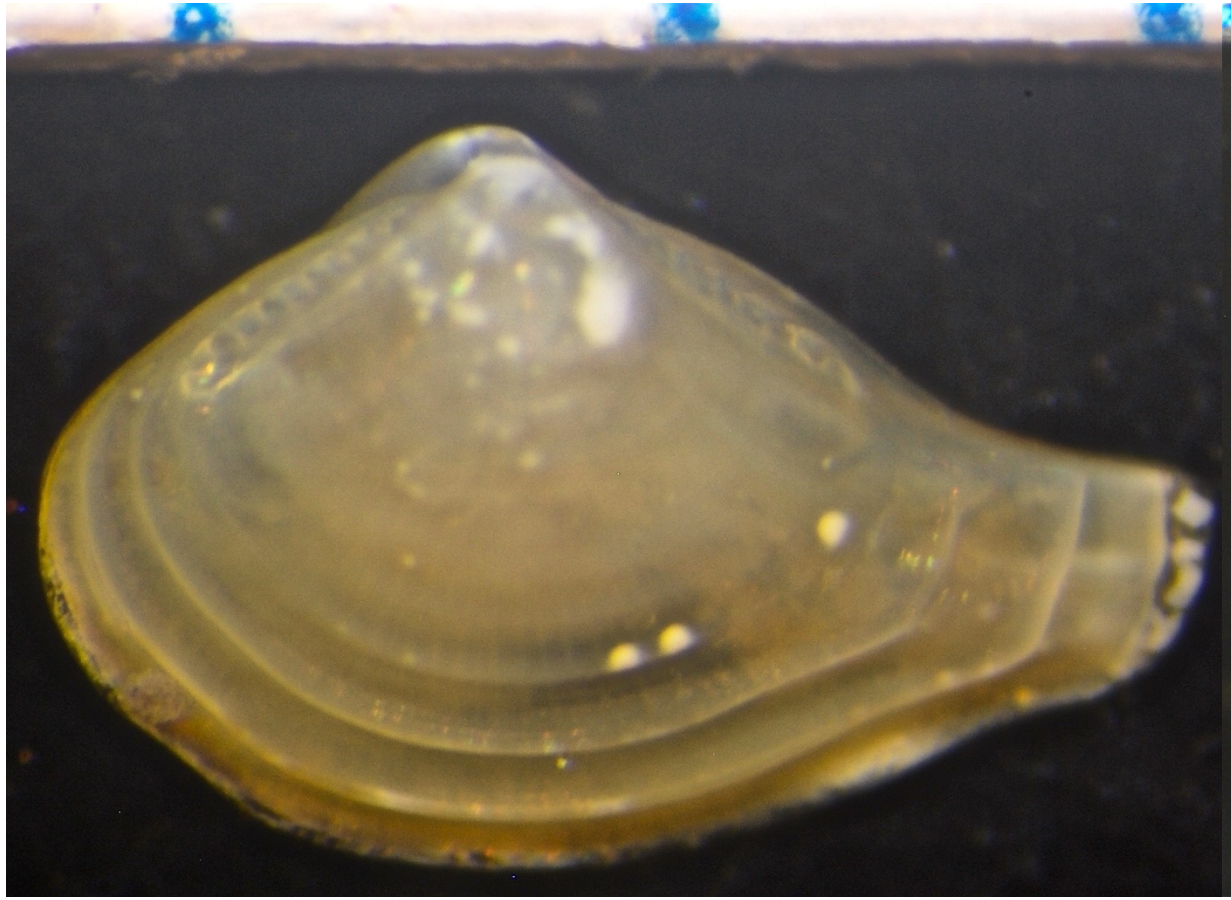


B’13 9274 Northern Channel Islands 72m

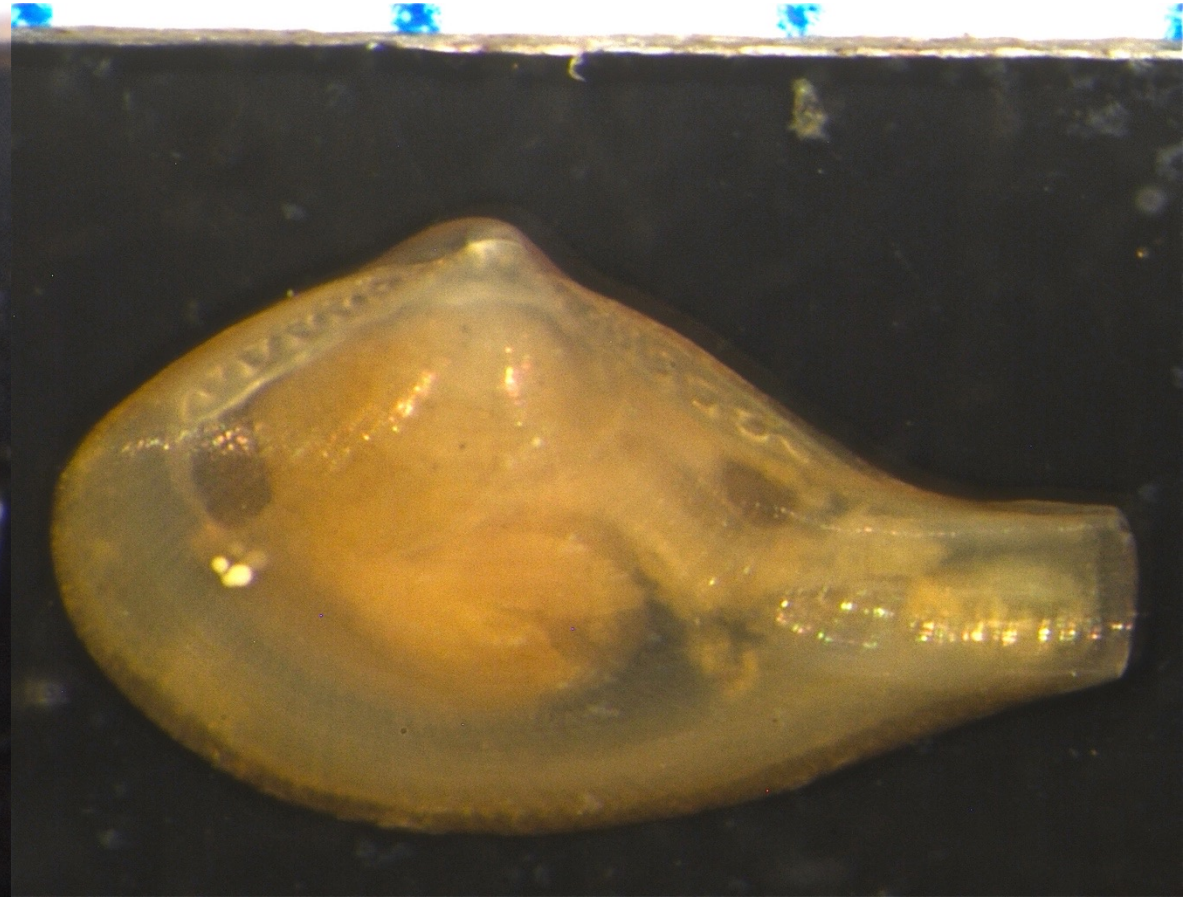


B’18 10244 Oxnard 81m

Nuculana hamata juv/*Nuculana* sp juv

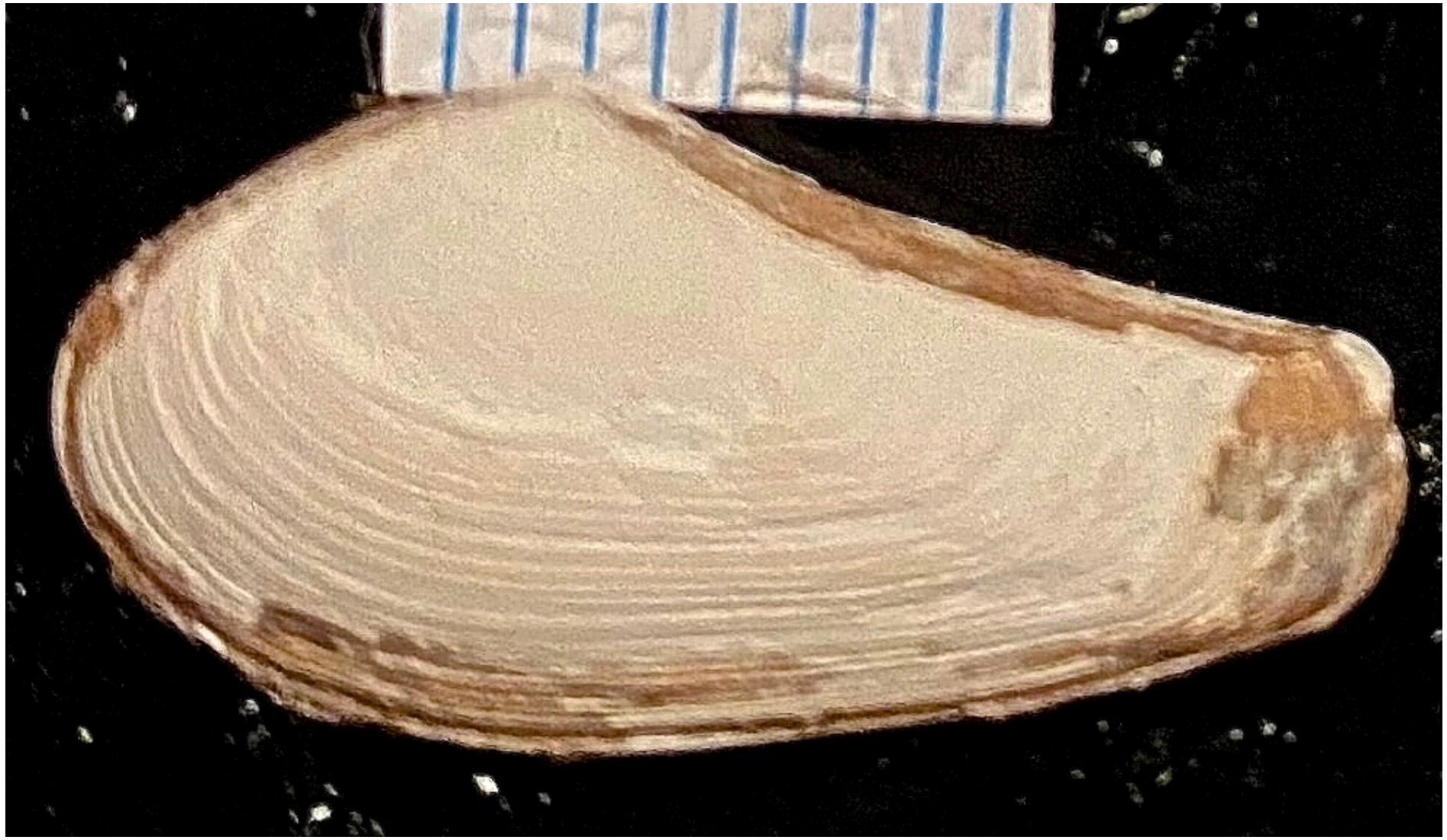


B’18 10244 East Santa Barbara Channel 81m



B’13 9376 Northern Channel Islands 110m

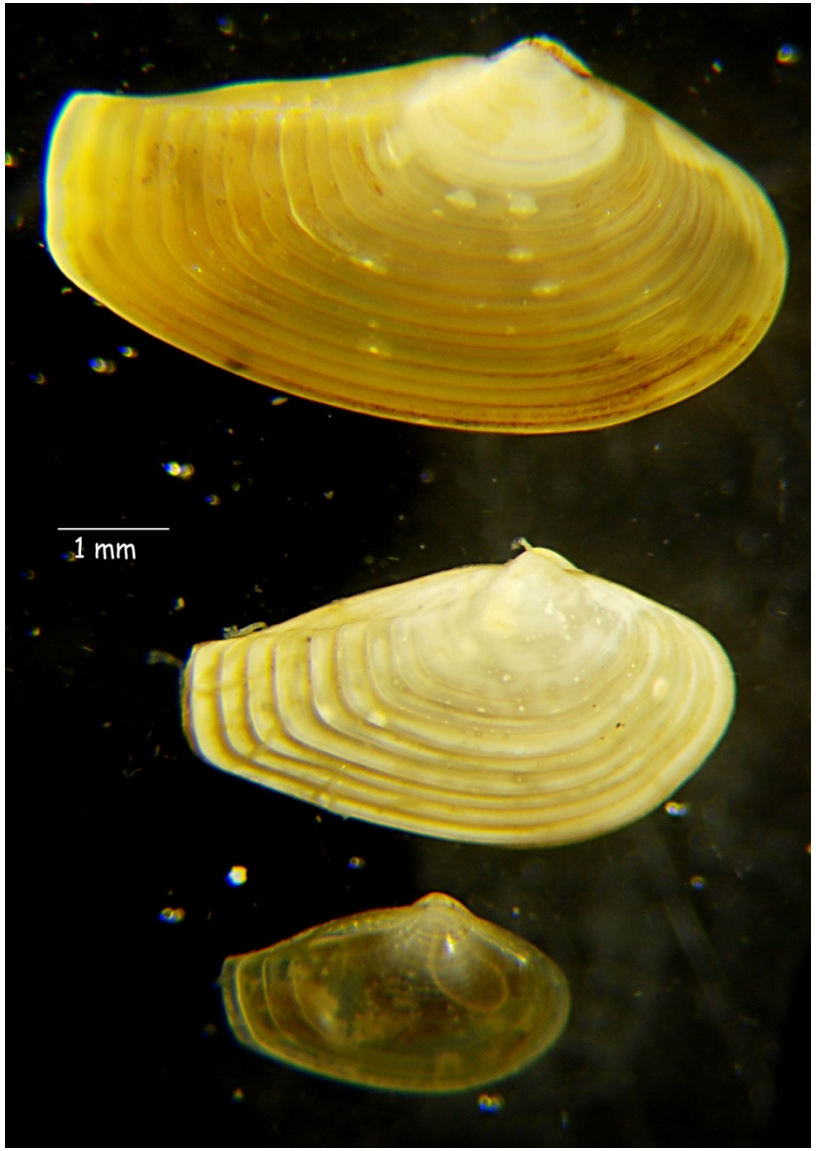
Nuculana leonina (Dall 1896)



Farallon Islands 370m 1977

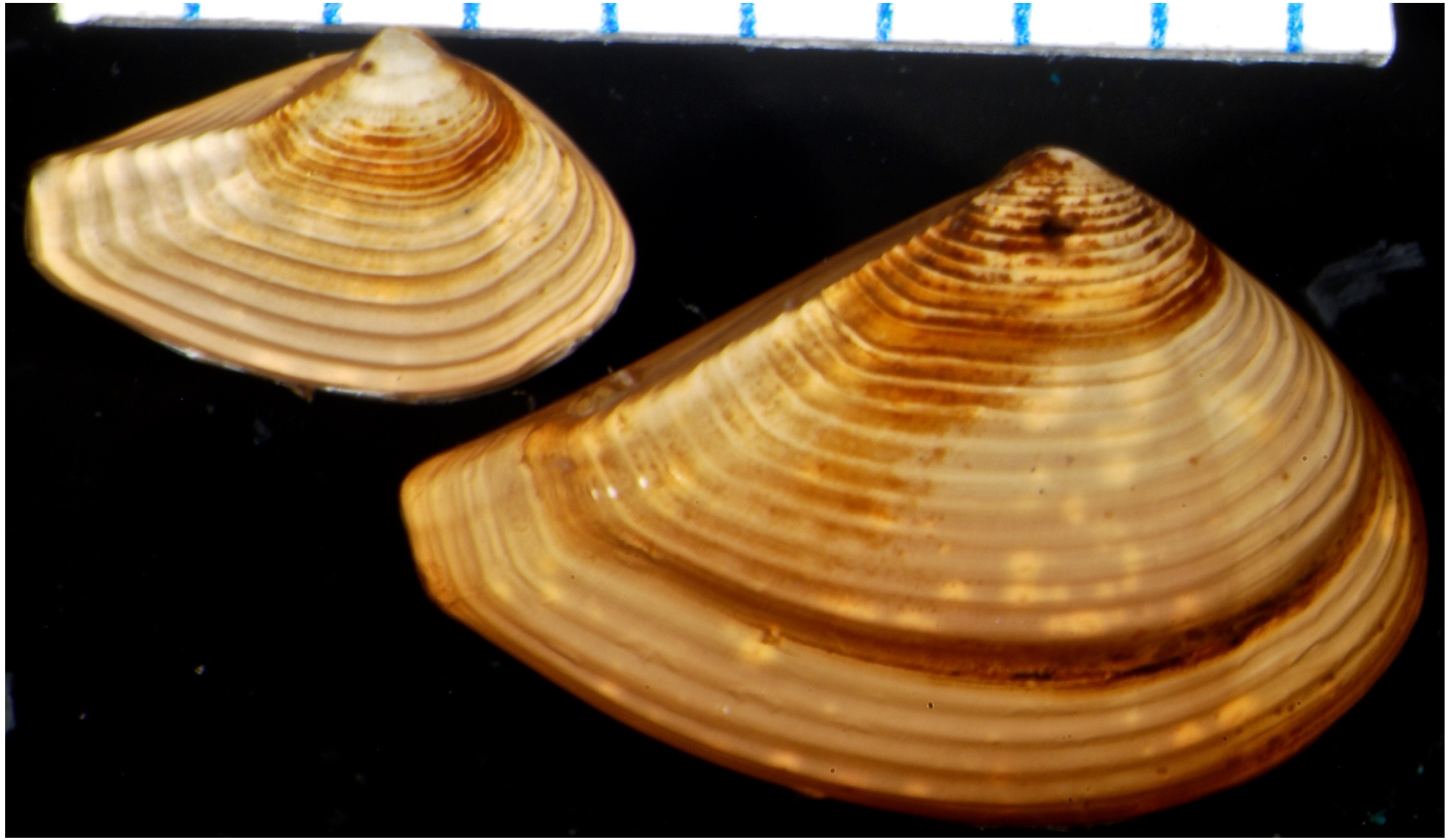
Specimen courtesy of Carol Paquette MBC

Nuculana leonina (Dall 1896)



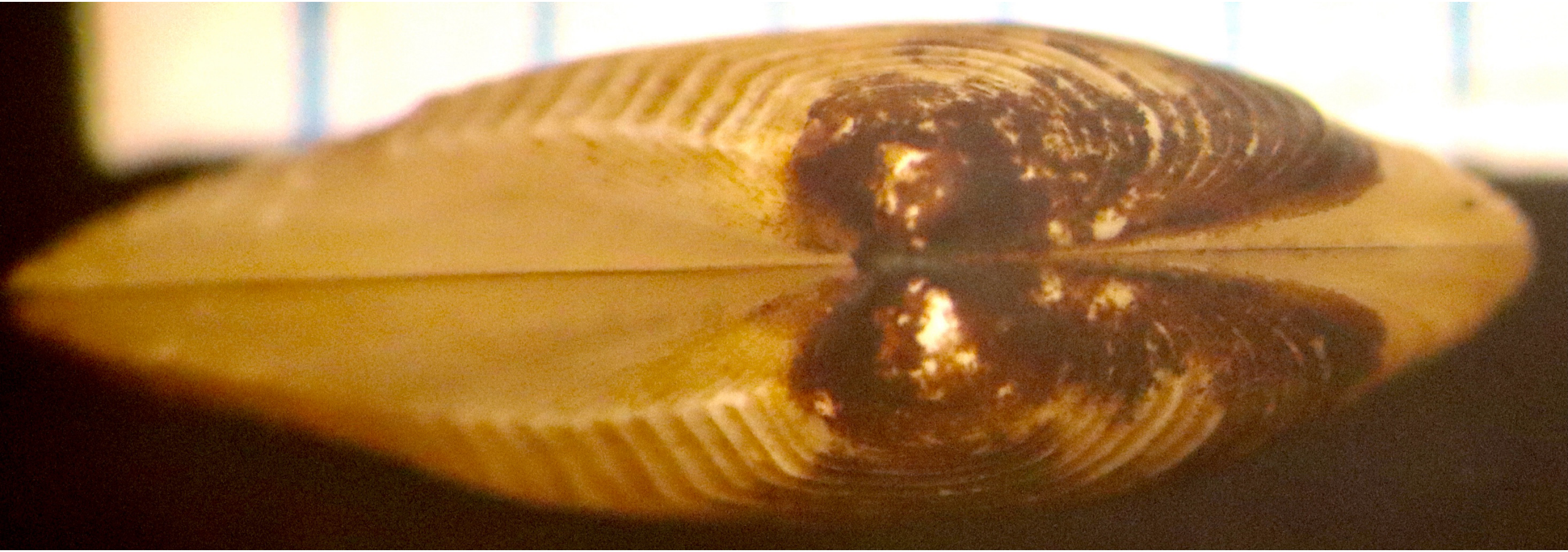
Cascadia Slope Oregon 950m
Photo courtesy of Kelvin Barwick

Nuculana minuta (Muller 1776)



Willapa Bay, Puget Sound 25m NCCA15 TetraTech 2015

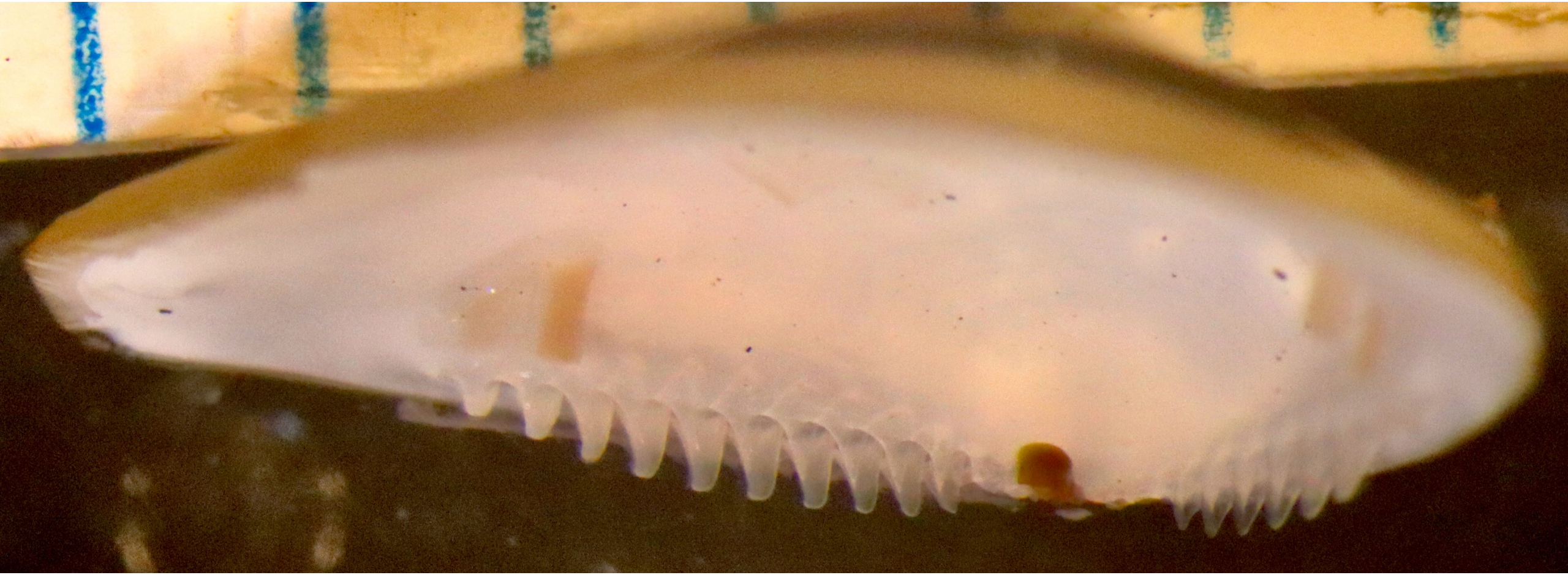
Nuculana minuta (Muller 1776)



Puget Sound 10m NCCA20 TetraTech 2020

escutcheon lunule

Nuculana minuta (Muller 1776)



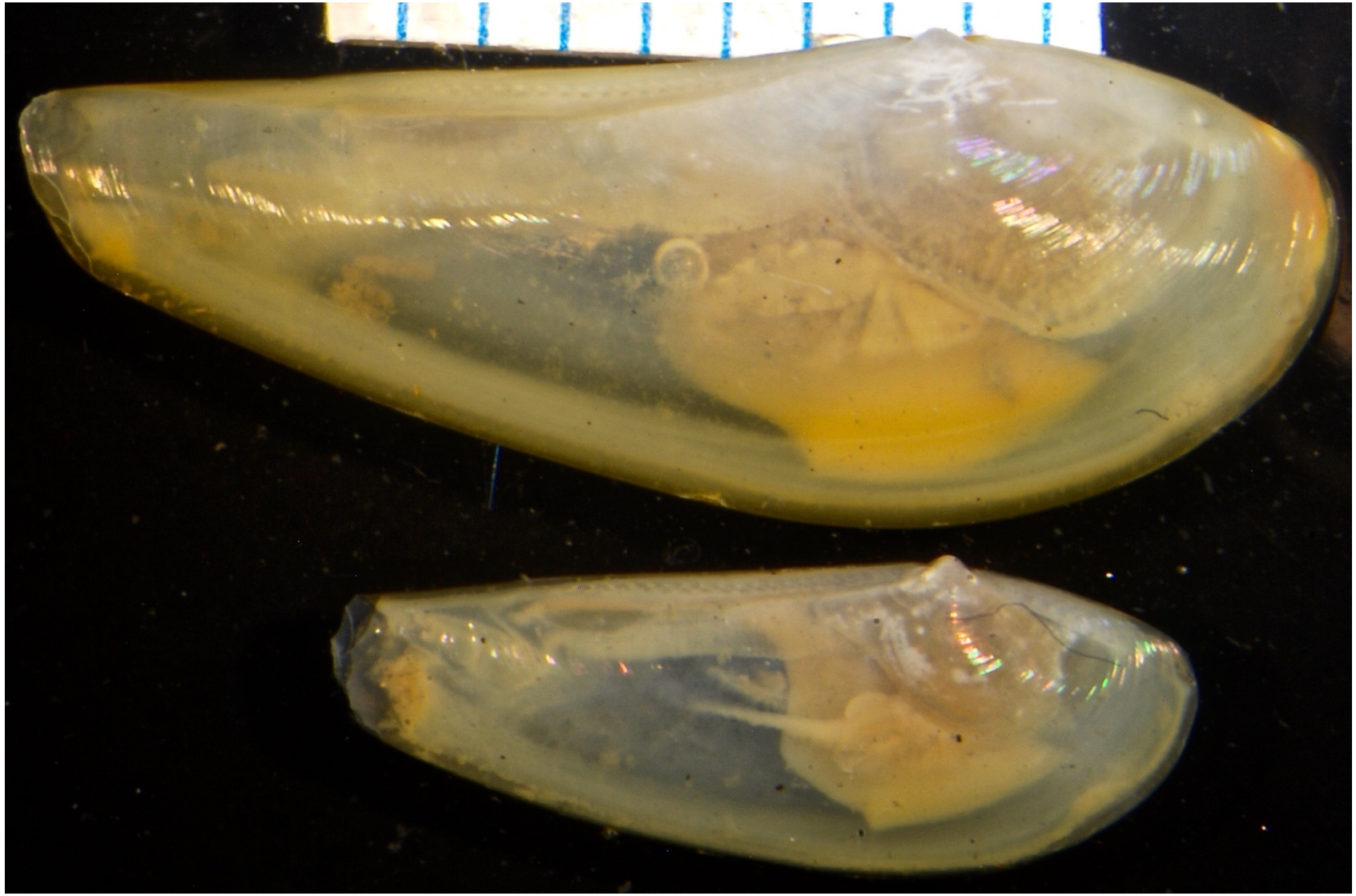
Puget Sound 10m NCCA20 TetraTech 2020

posterior anterior

Propeleda

1. Shell “club shaped”
2. Rostrum long
3. Prodissoconch with net-like sculpture
4. Escutcheon well defined by ridge, lunule poorly defined
5. Sculpture of commarginal ribs or striae
6. Lamellar teeth, few in number, on both sides of umbos; all other teeth V-shaped
7. Long internal ridge running from umbo to posterior margin

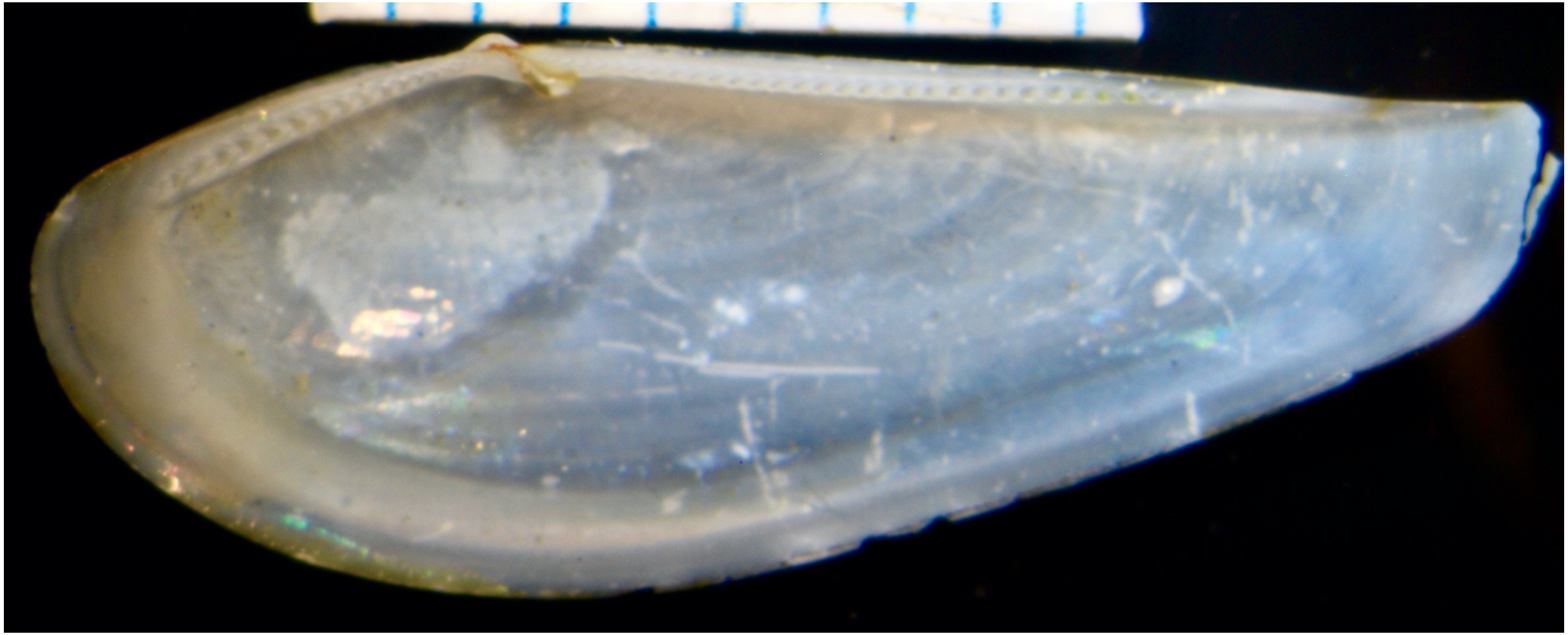
Propeleda conceptionis (Dall 1896)



MMS Phase I 025-B2R-01-TX 433 m 1984

Specimens courtesy of Carol Paquette MBC

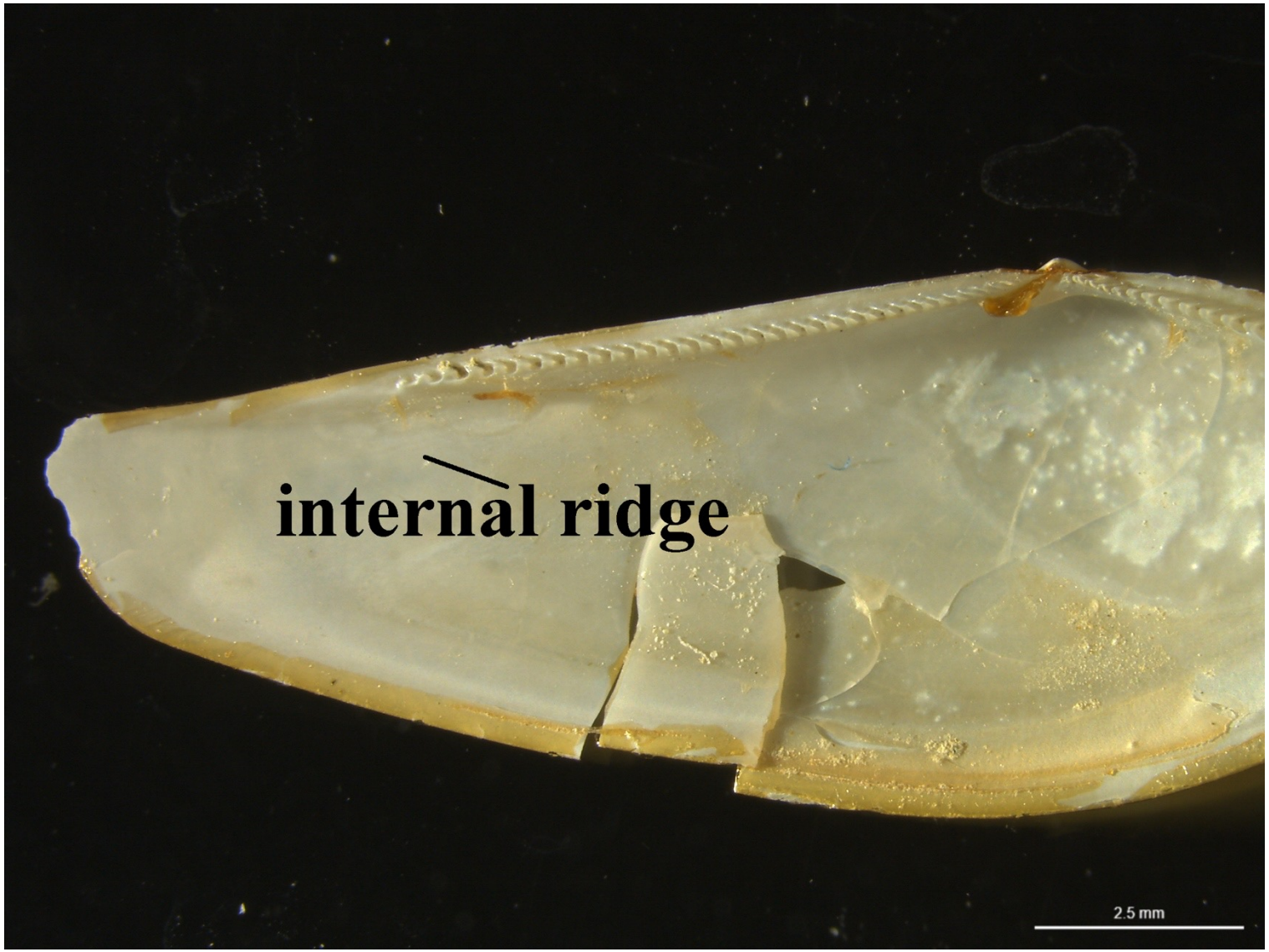
Propeleda conceptionis (Dall 1896)



Orange County Deep G-6 trawl 1983

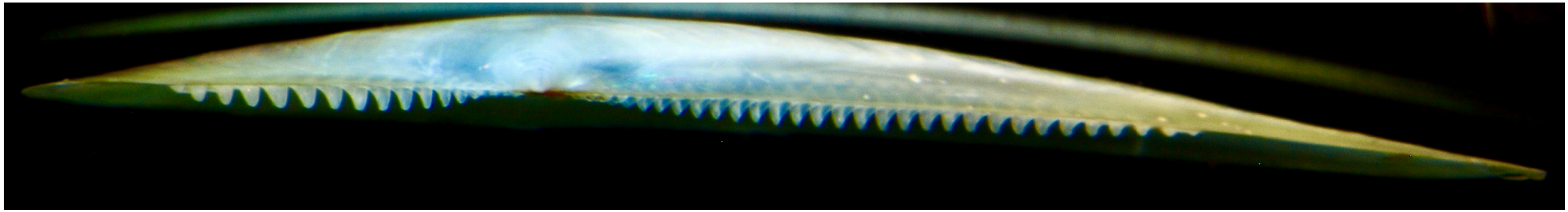
Specimen courtesy of Carol Paquette MBC

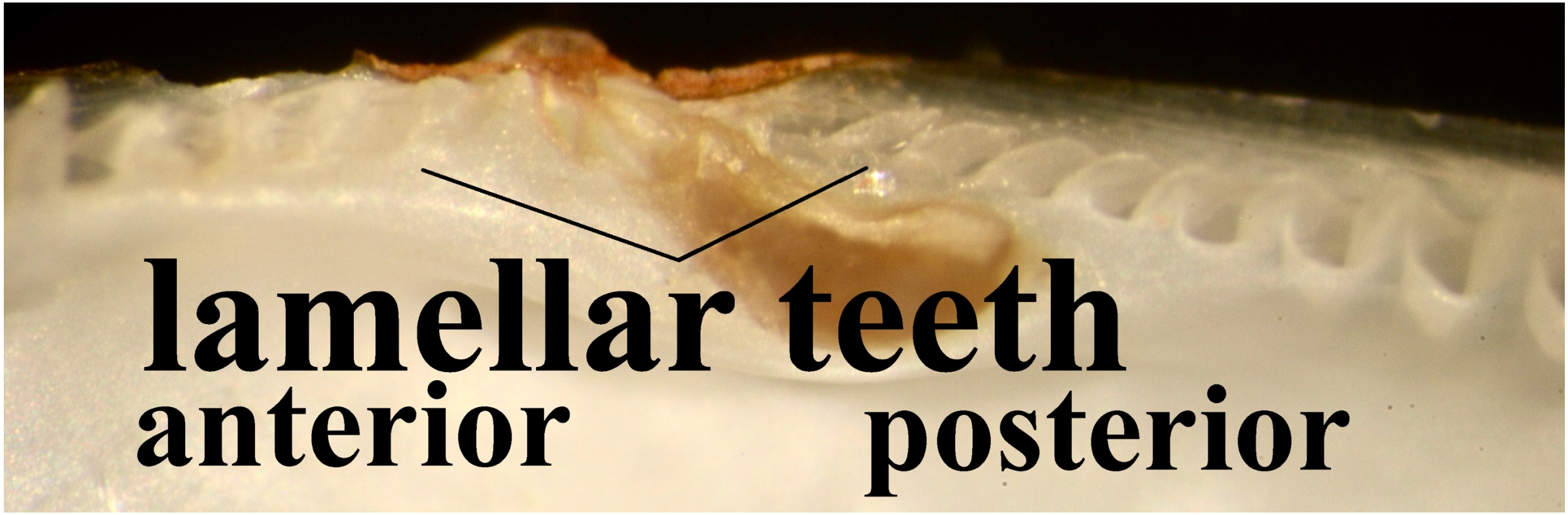
Propeleda conceptionis (Dall 1896)



Orange County Deep G-6 trawl 1983
photo courtesy of Kelvin Barwick

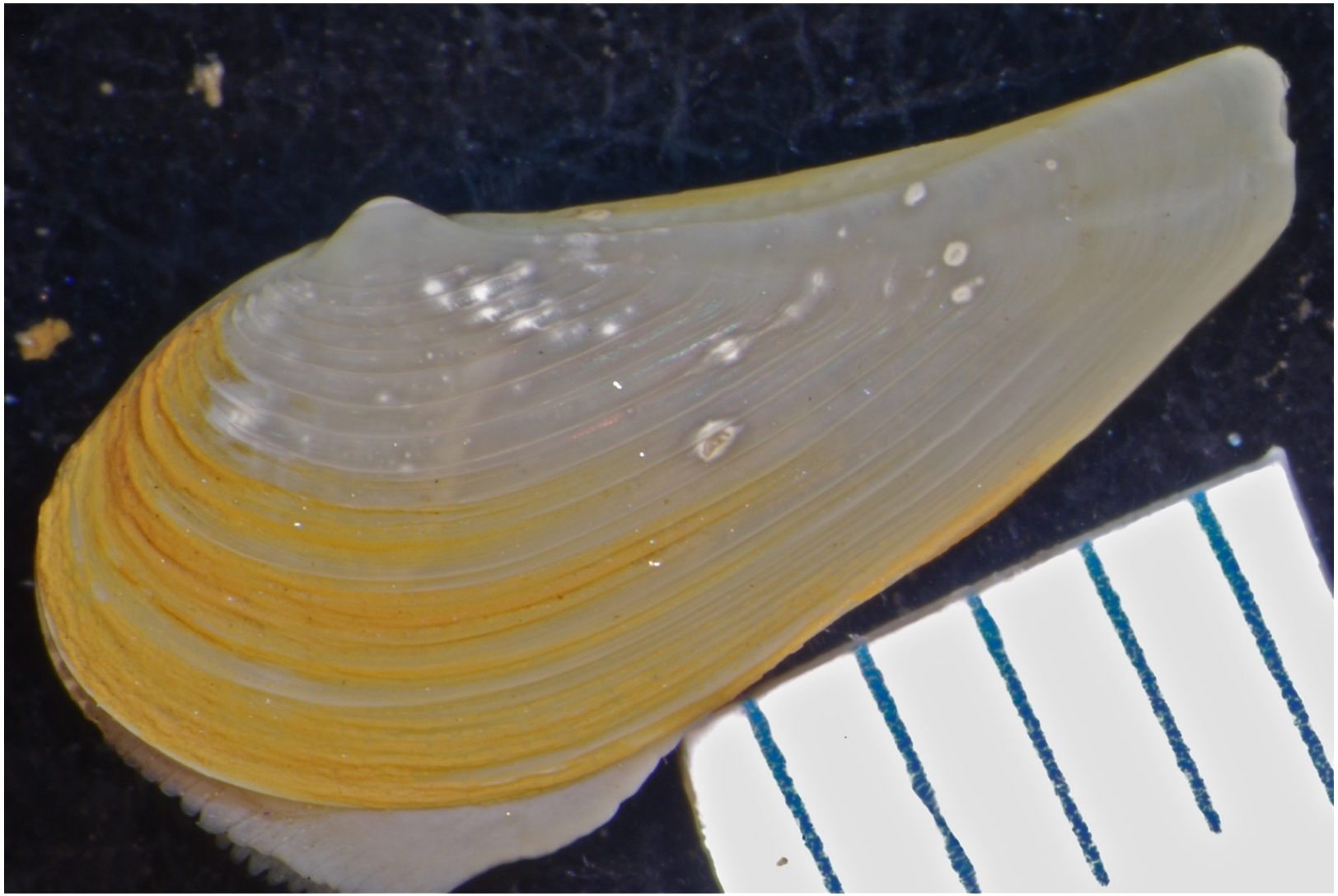
Propeleda conceptionis (Dall 1896)





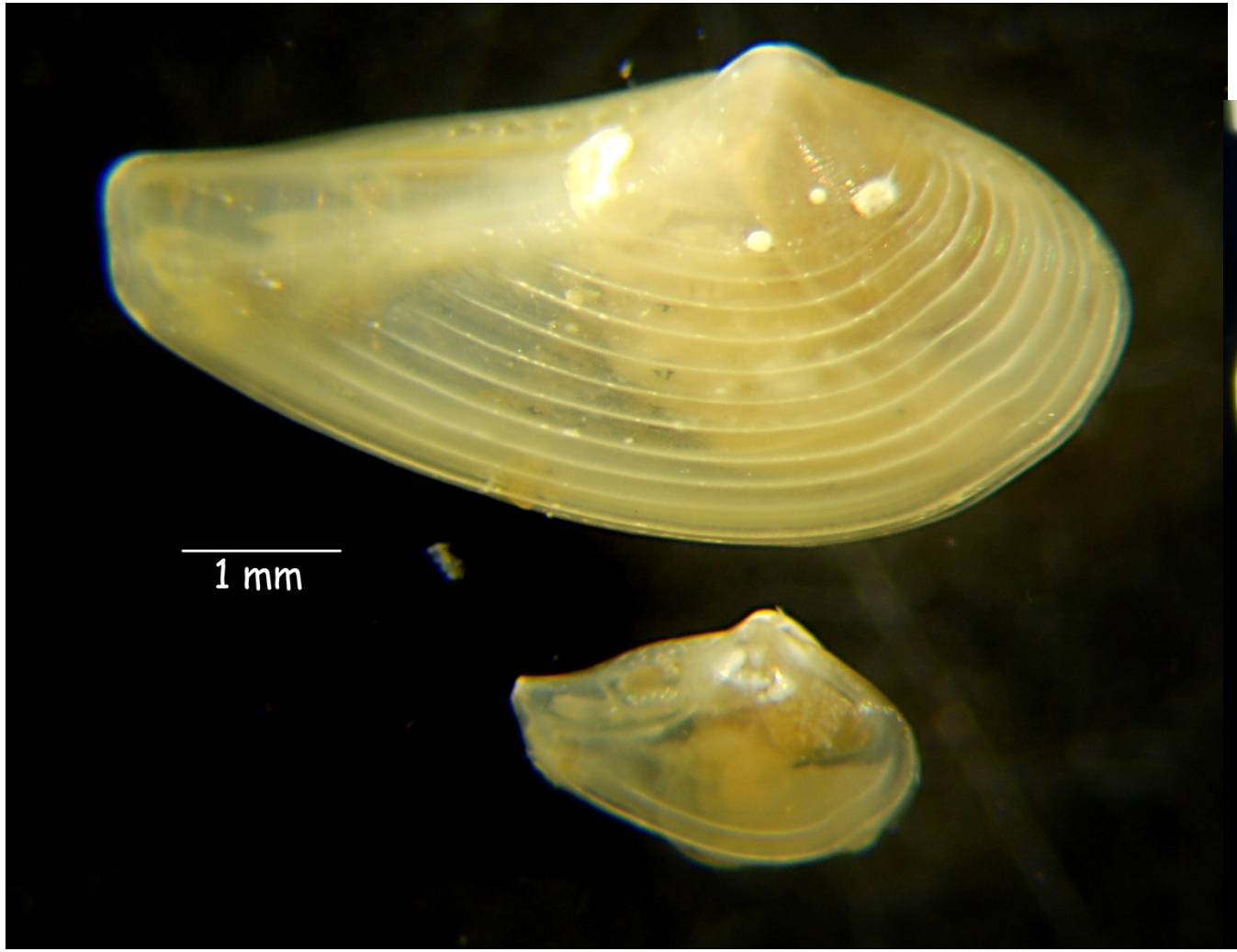
Orange County Deep G-12 trawl 1983

Propeleda sp B (SCAMIT 2013)

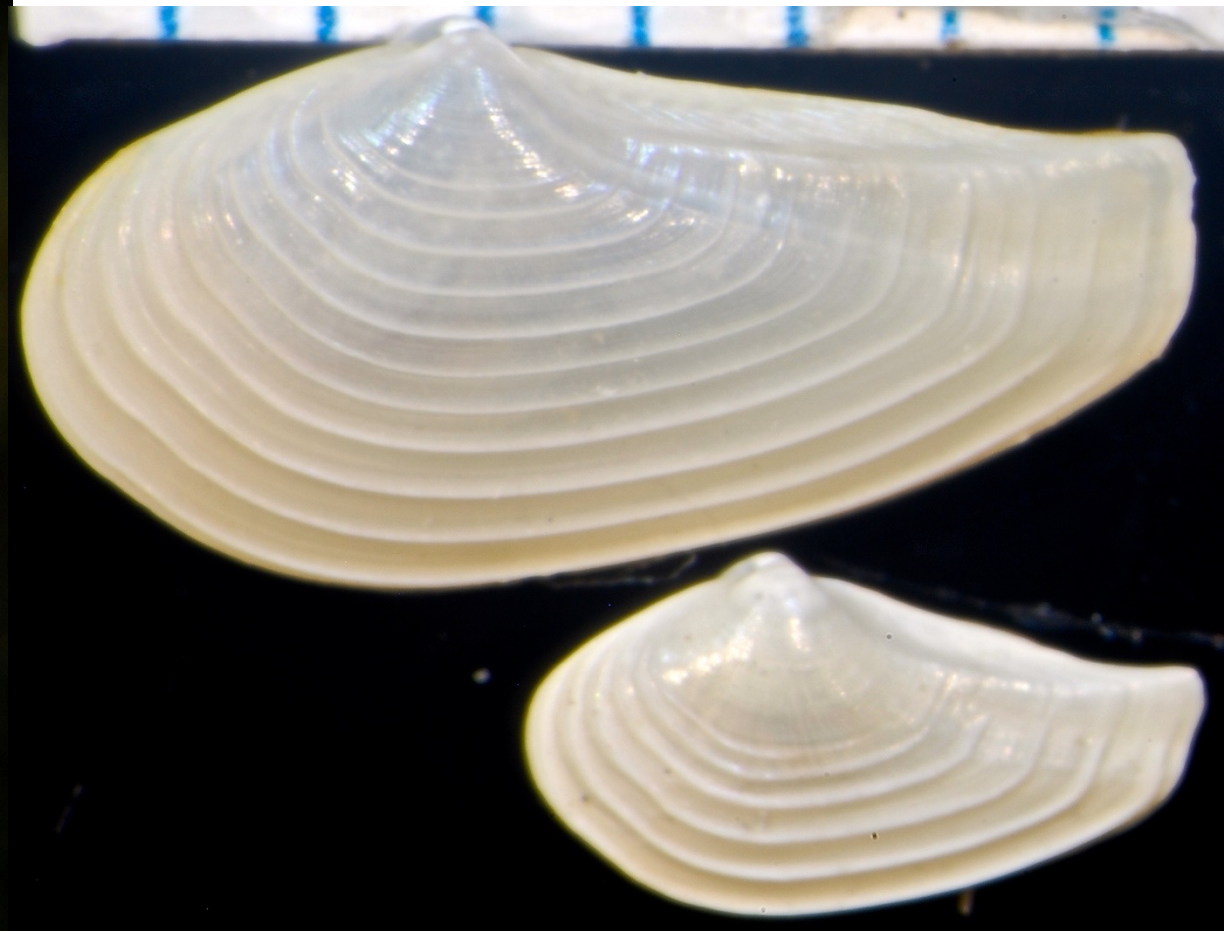


B’13 9281 Santa Monica Canyon 448m

Propeleda sp B (SCAMIT 2013)

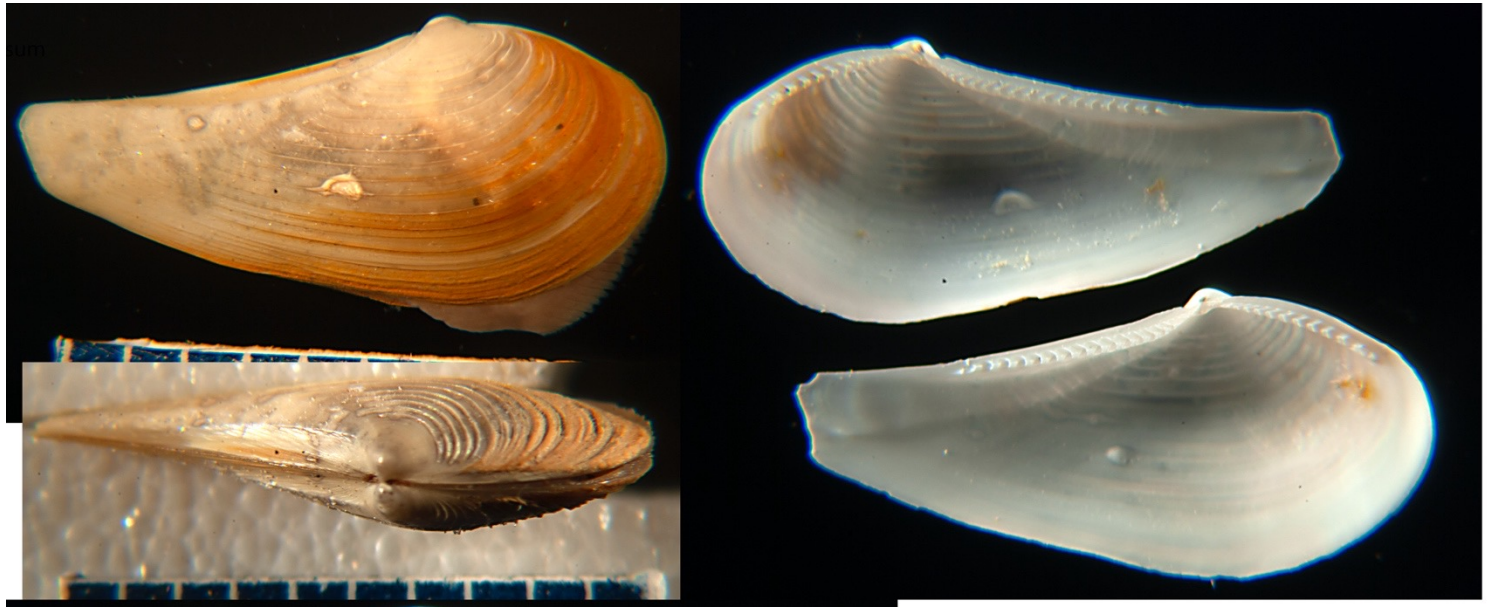


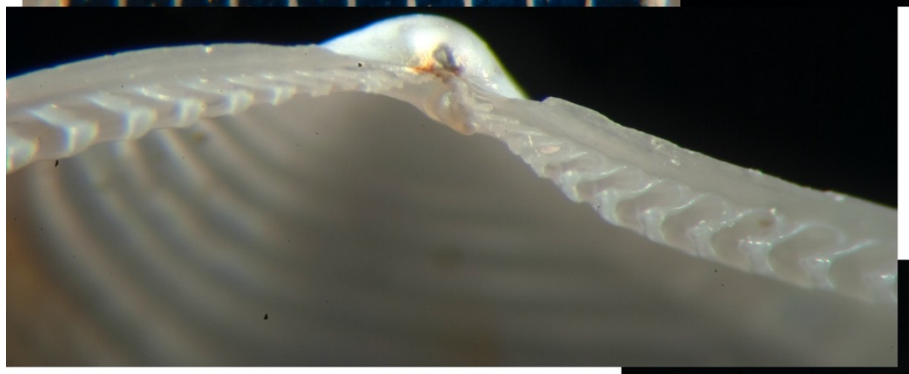
B’03 5034 394m (photo courtesy of Kelvin Barwick)



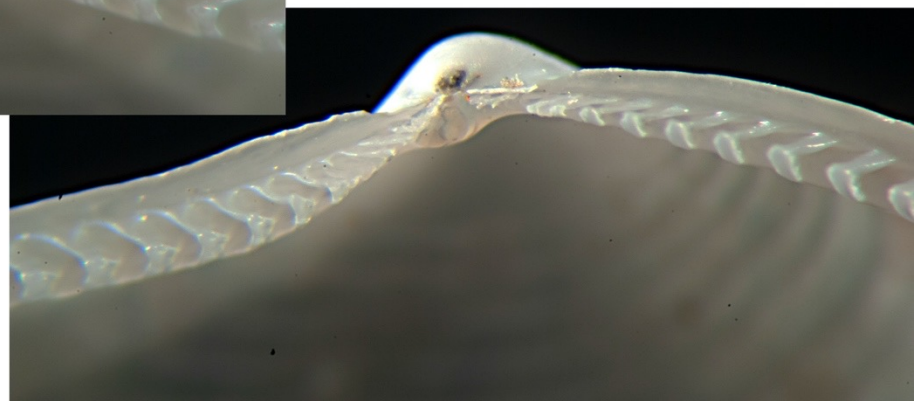
B’08 7428 Santa Monica Bay 400m

Propeleda sp B (SCAMIT 2013)



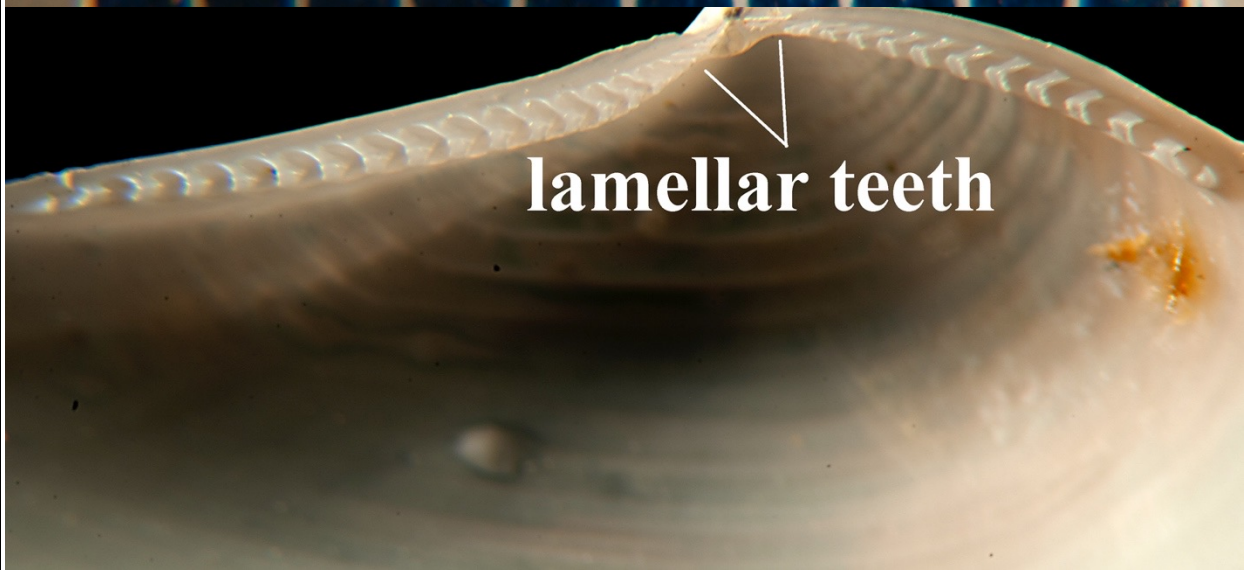


OCSD
Voucher #2373
Sed. Map. Sta. 157
27JUN2012
280 m
T. Phillips 2JUL2013
Nuculana sp B SCAMIT2010



Photos courtesy
Kelvin Barwick

Propeleda sp B (SCAMIT 2013)

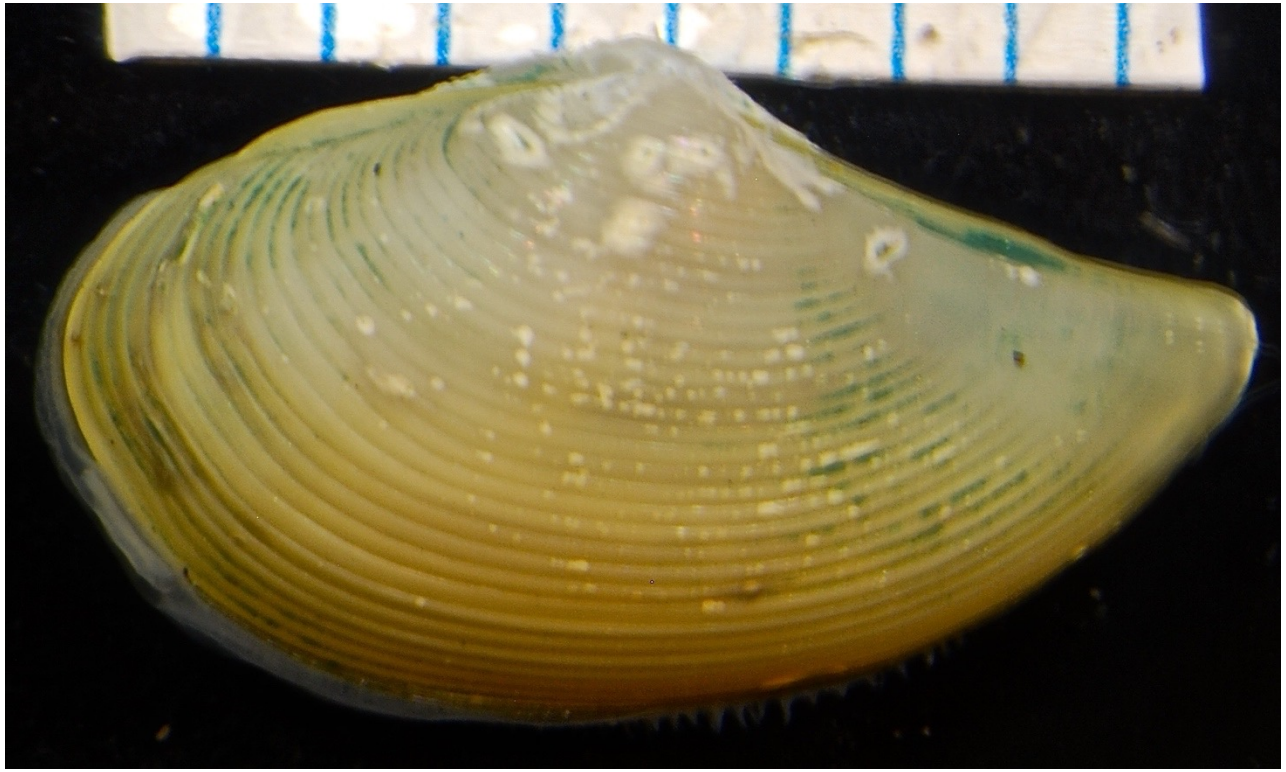


OCSD Voucher #2373 Sediment Mapping Station 157 280m 27June 2012
Photos courtesy of Kelvin Barwick

Saccella

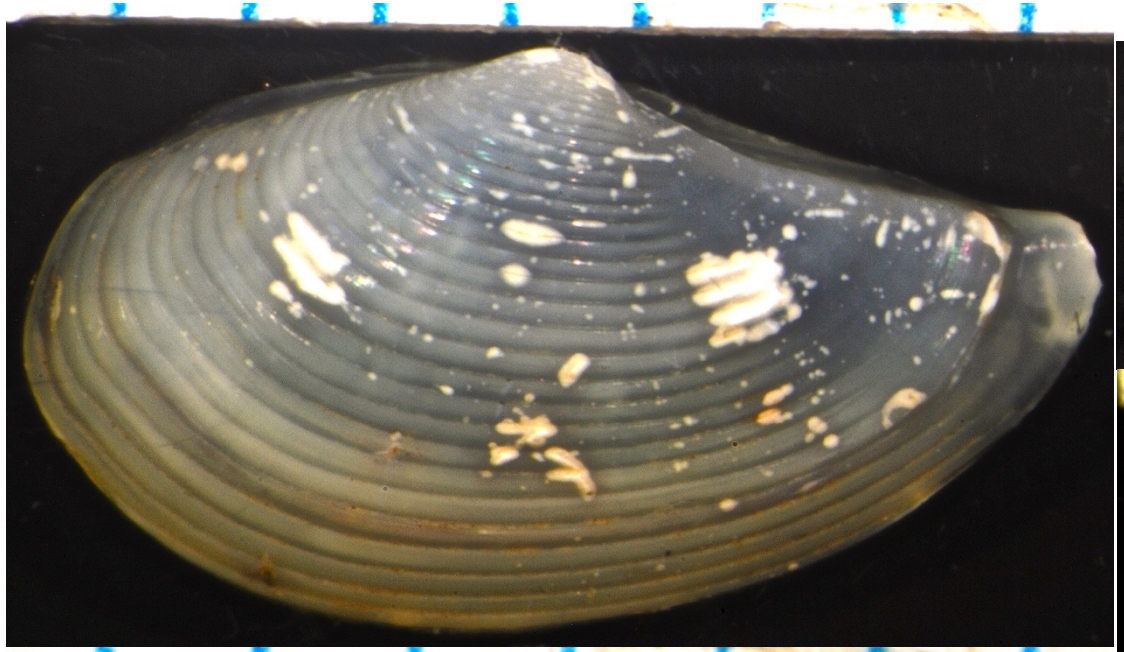
1. Shell subovate-elongate to subtrigonal, moderately inflated
2. Rostrum rounded to bluntly pointed
3. Escutcheon sunken with medial ridge, lunule weakly defined
4. Sculpture usually of strong commarginal ribs
5. Teeth all V-shaped
6. Prodissoconch with net-like sculpture

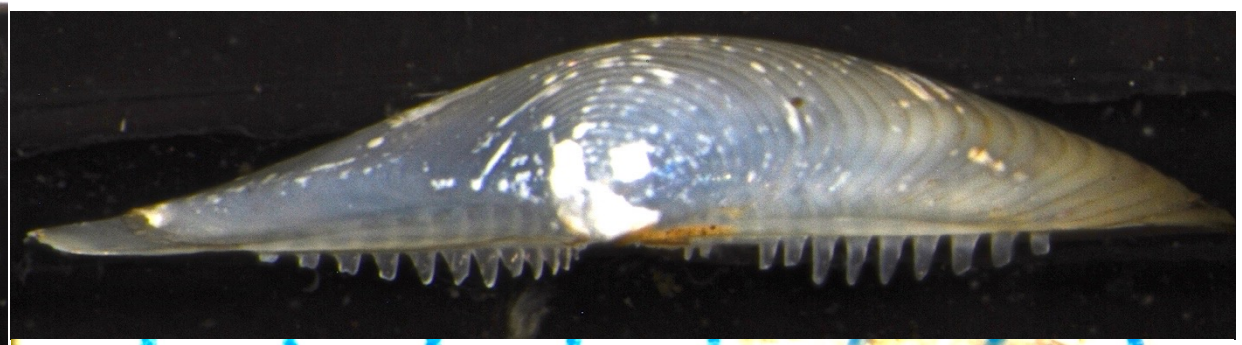
Saccella taphria (Dall 1896)

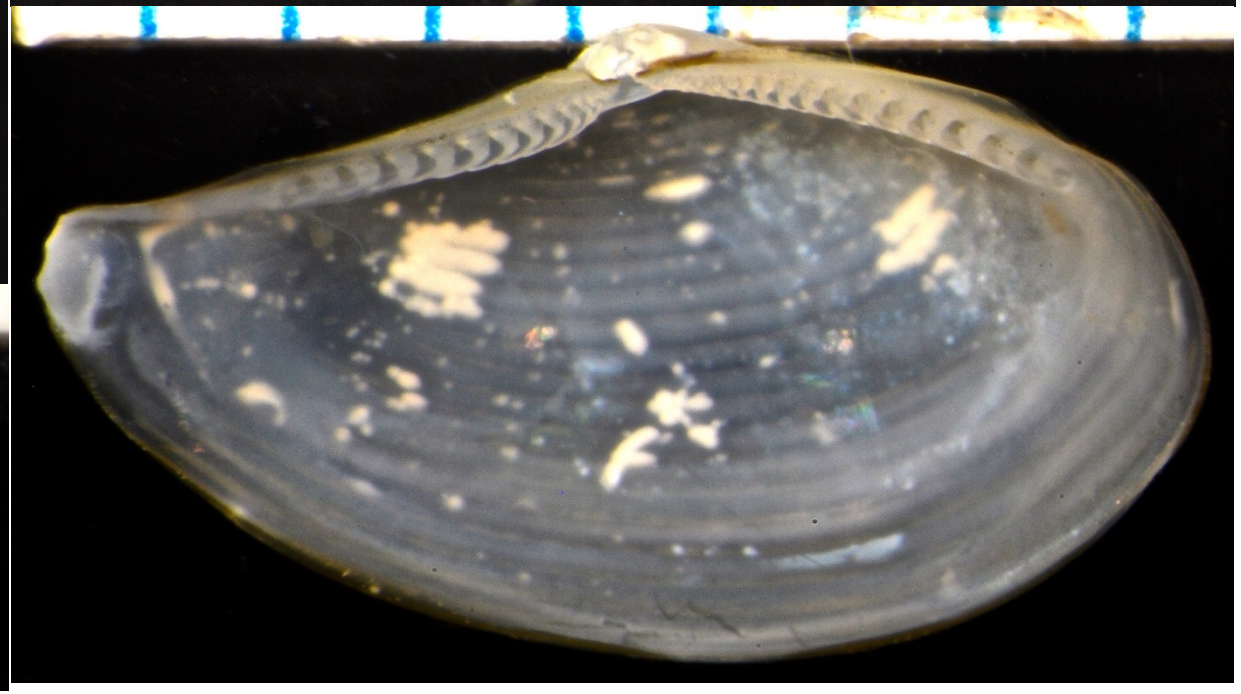


Long Beach Harbor Anchor GWMA LB12 10m 2018

Saccella taphria (Dall 1896)

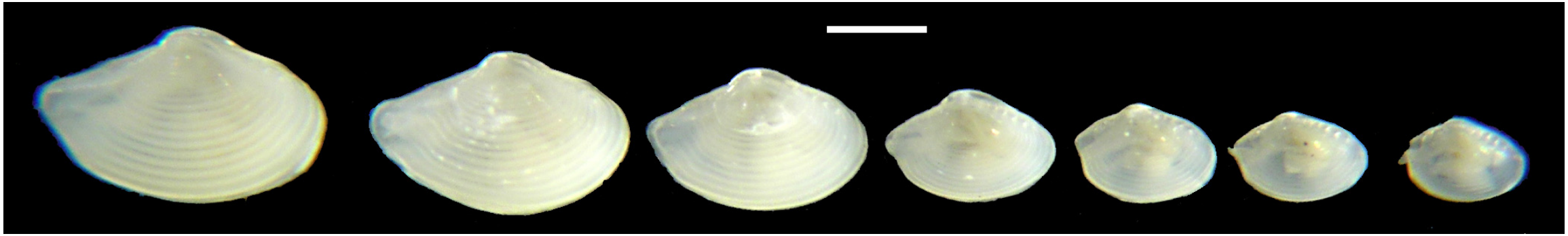




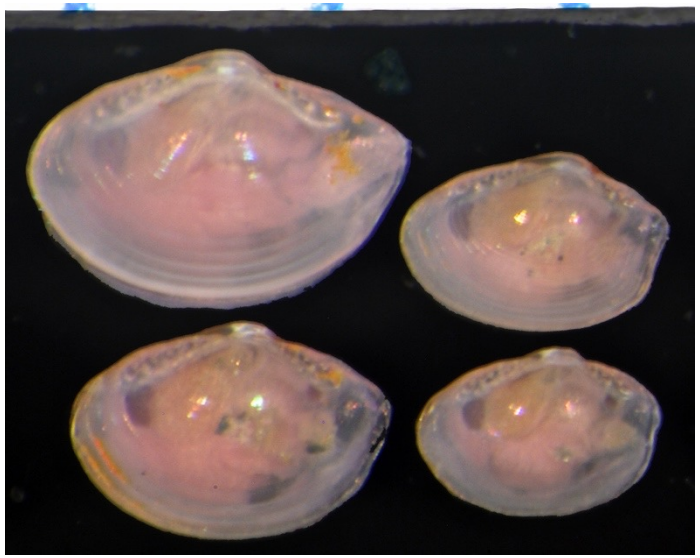


Goleta B1(3) 30m 2019

Saccella taphria (Dall 1896)

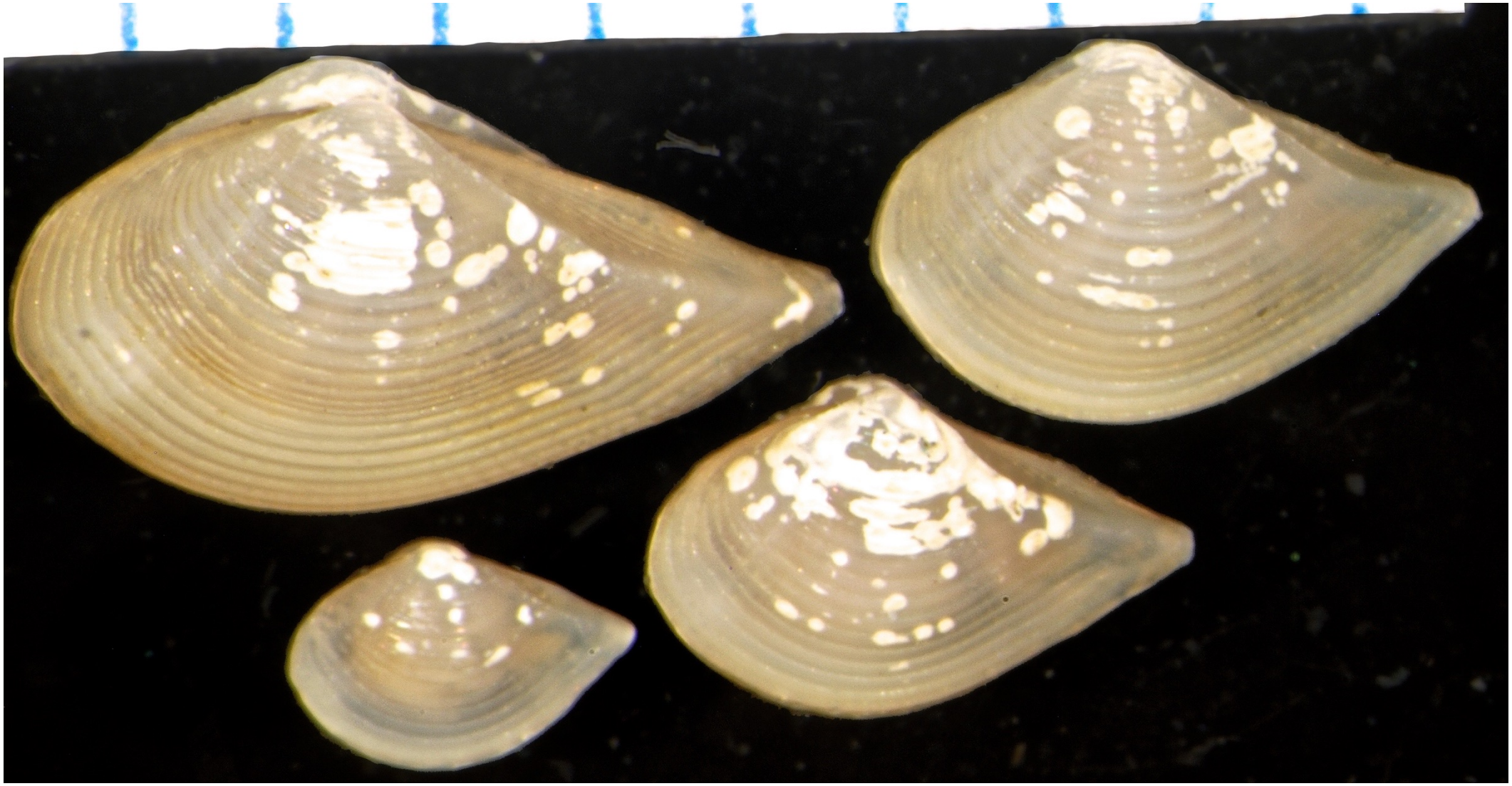


San Francisco PUC Stn 63 29m Photo courtesy of Kelvin Barwick



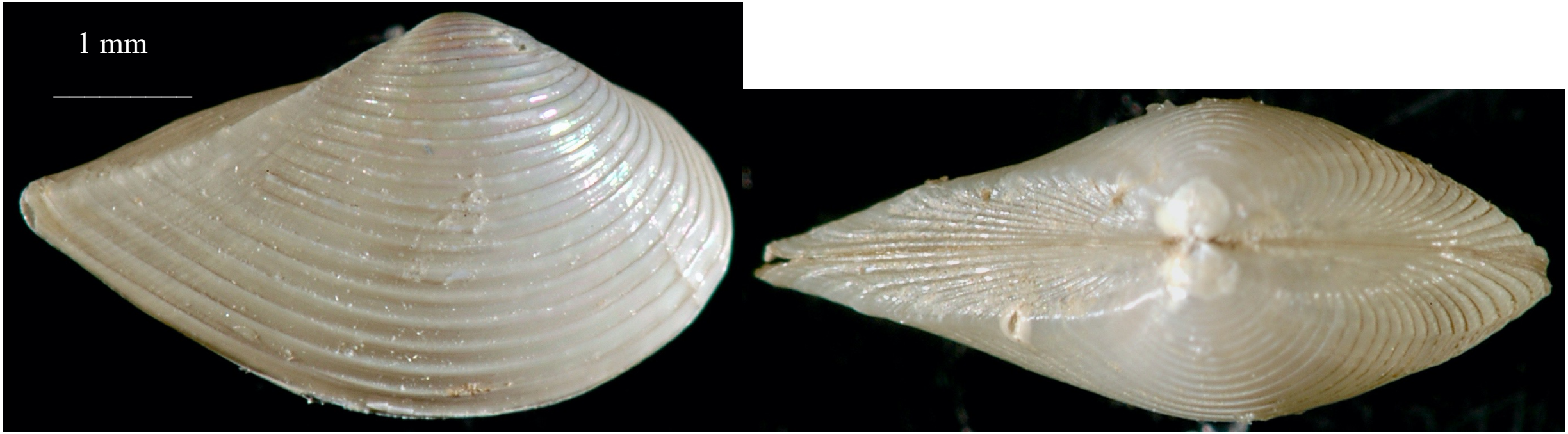
San Pedro Bay 15m 2015

Saccella sp A SCAMIT 2006



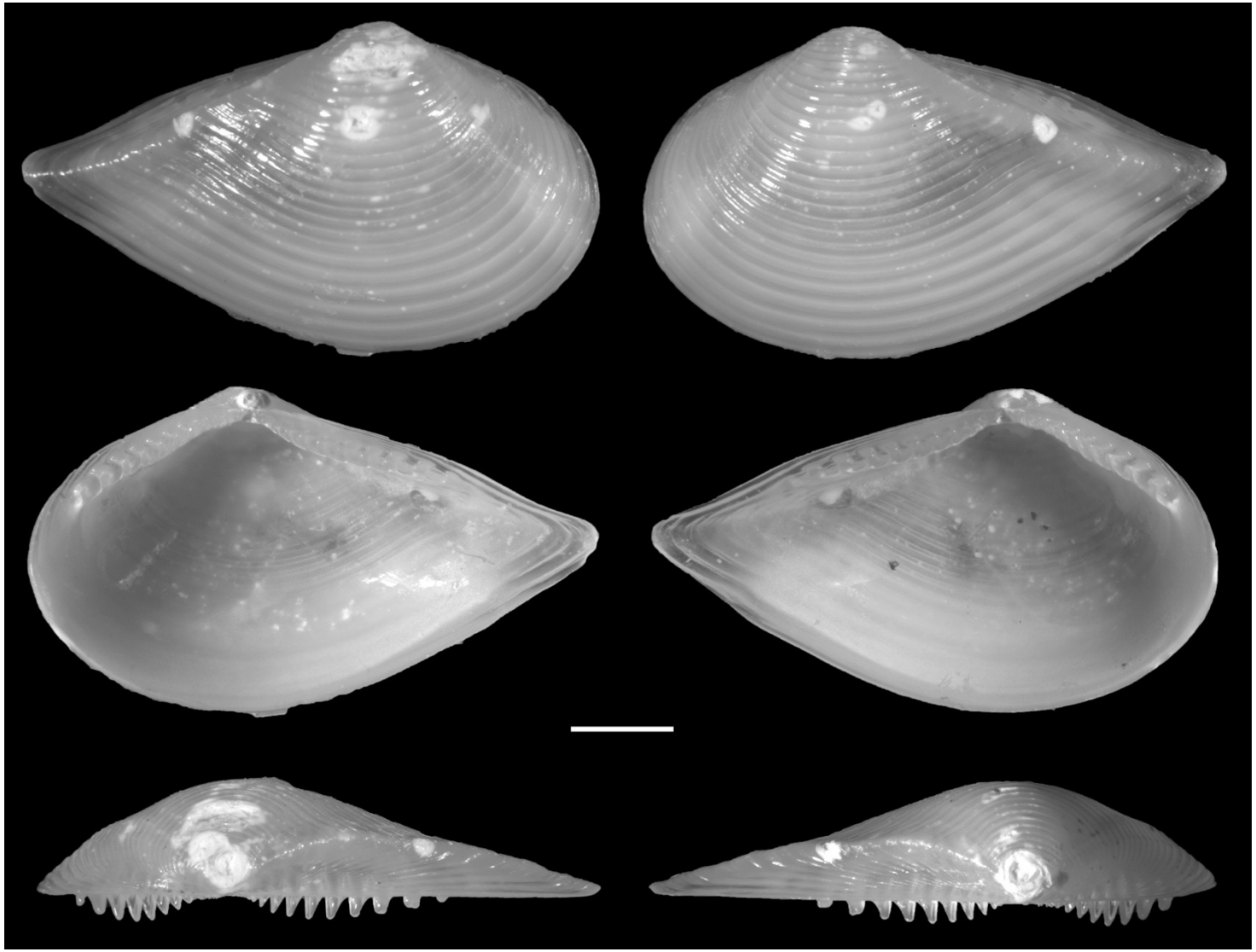
Santa Monica Bay 89m 2016

Saccella sp A SCAMIT 2006



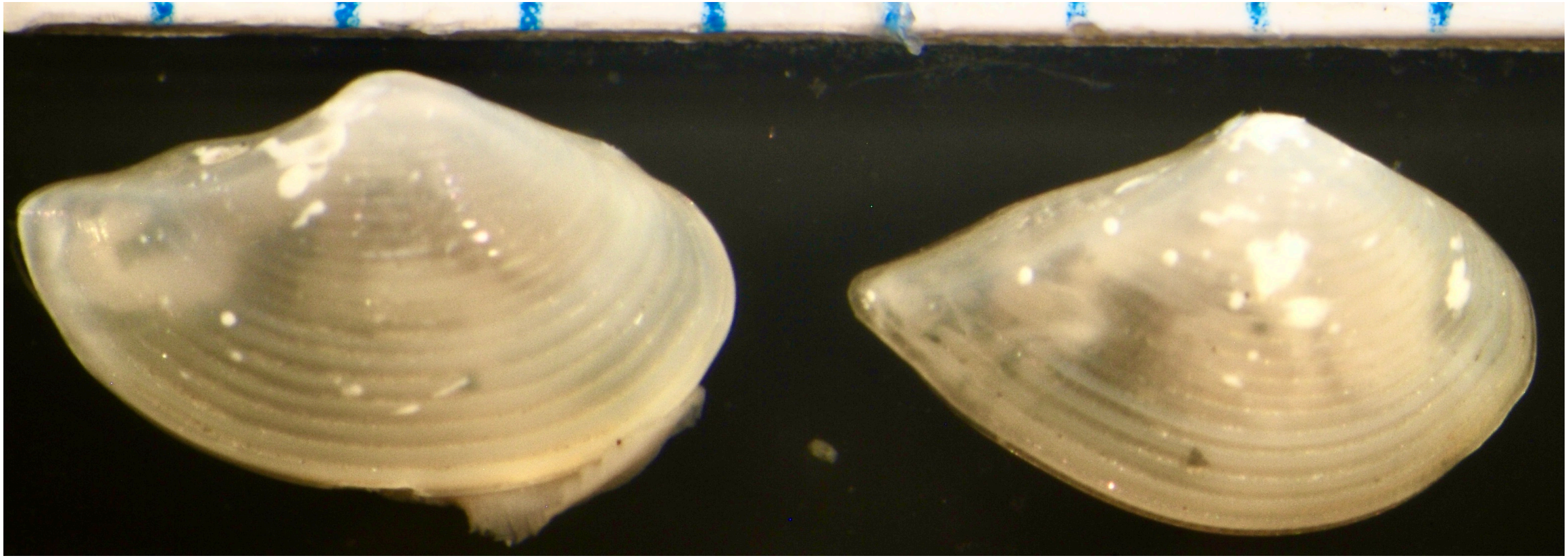
Photos courtesy of Kelvin Barwick

Saccella sp A SCAMIT 2006



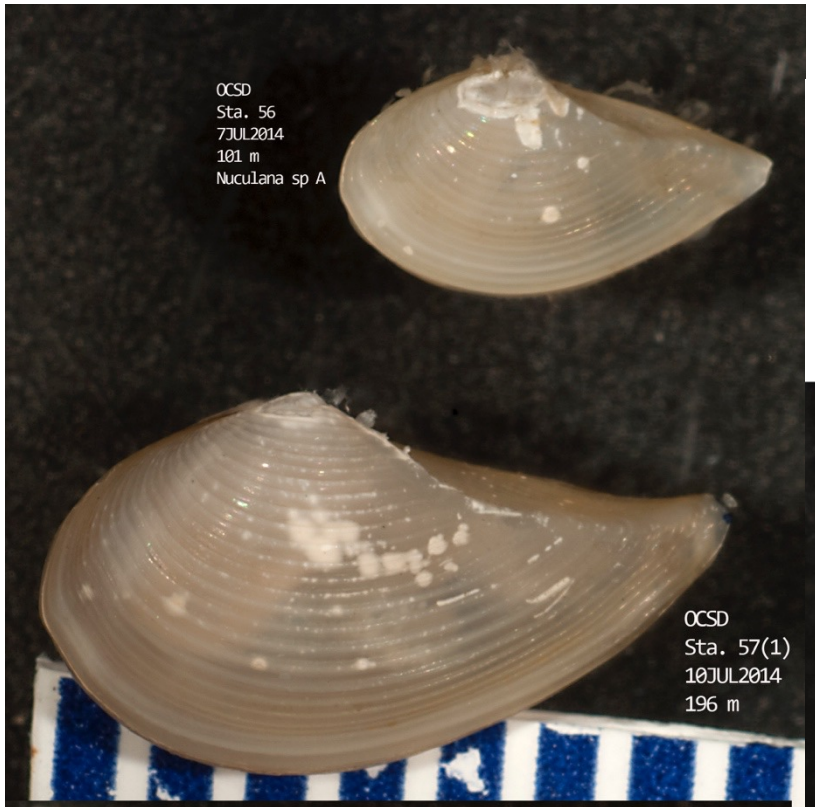
Photos courtesy of Kelvin Barwick

Saccella taphria/Saccella sp A (juvenile)



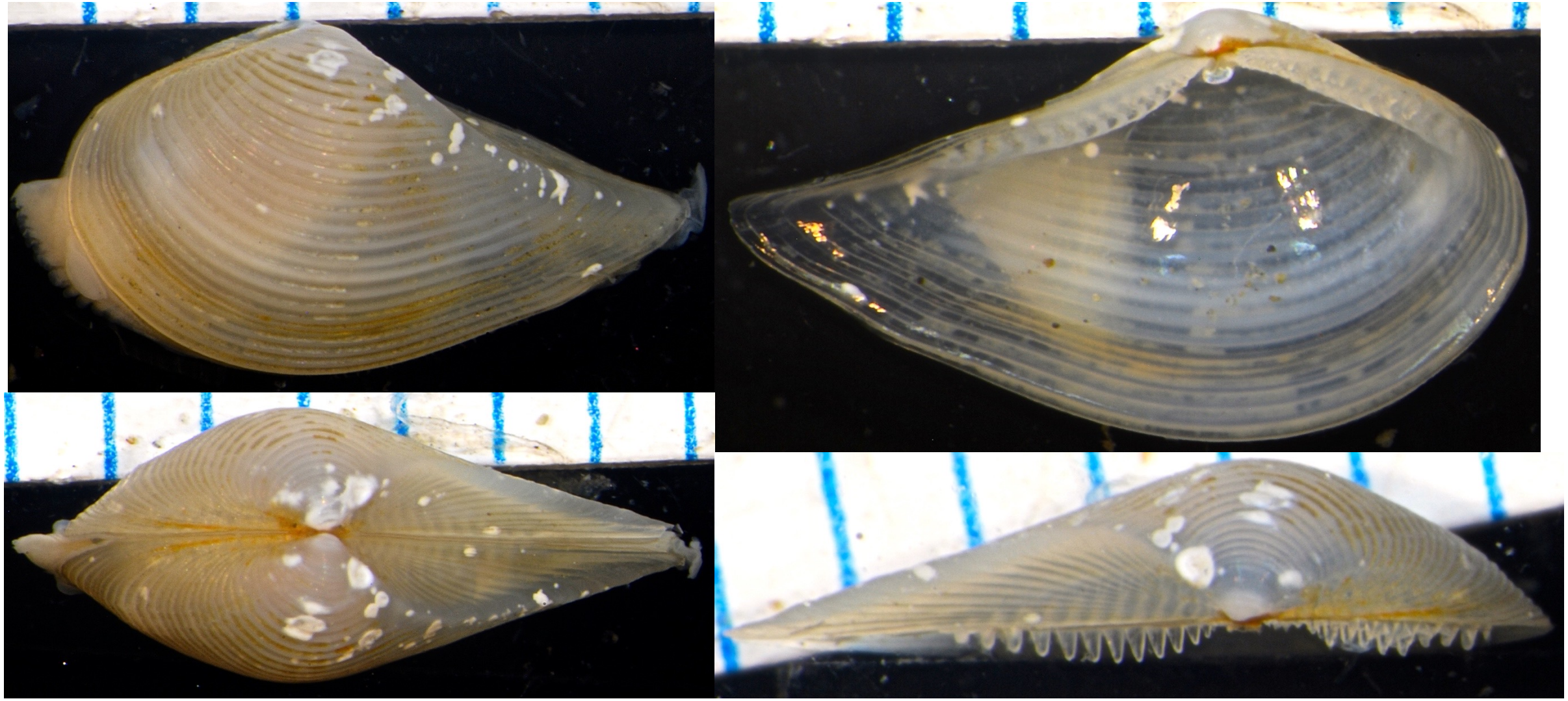
OCSD Station 9 61m July 17, 2019

Saccella sp OC1 Barwick 2015



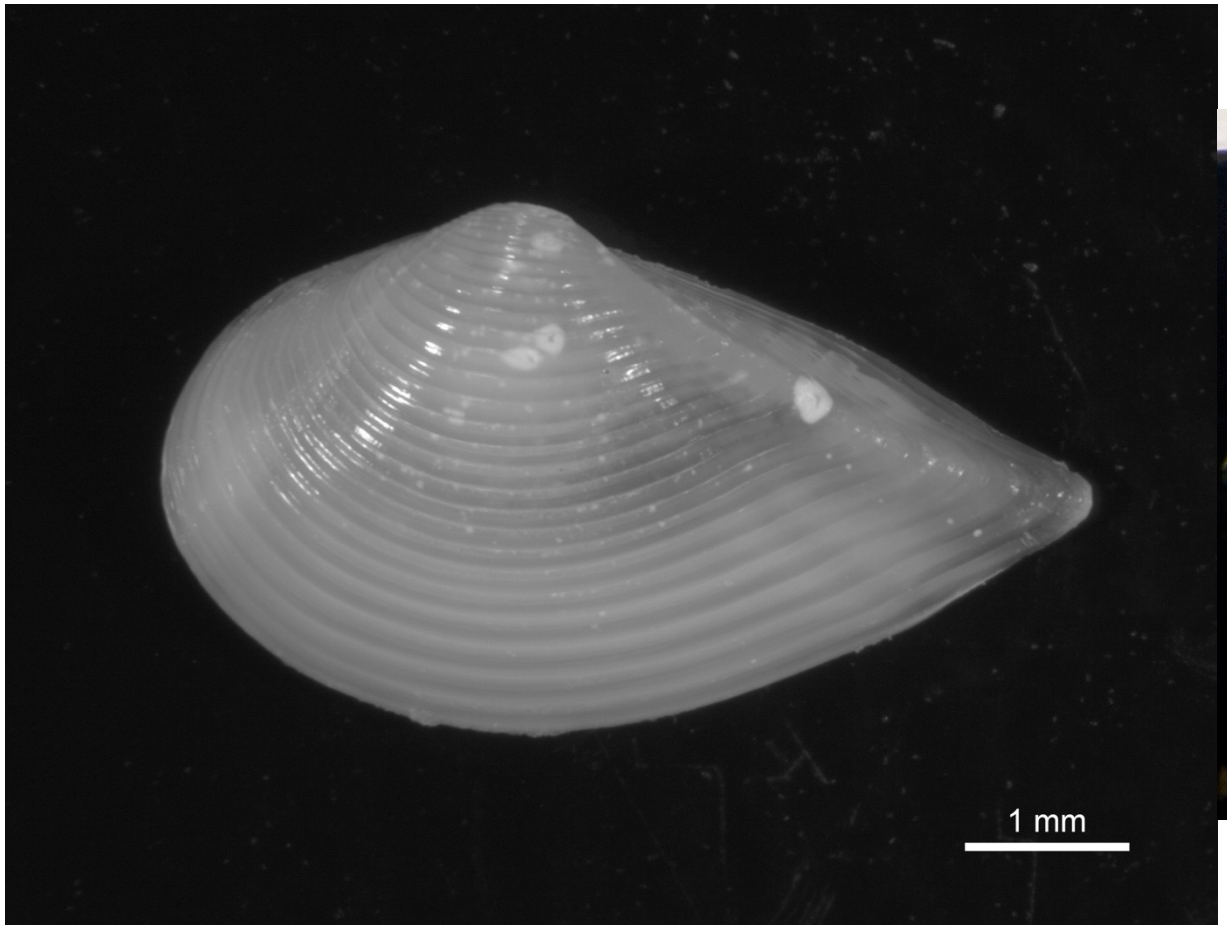
Photos courtesy of Kelvin Barwick

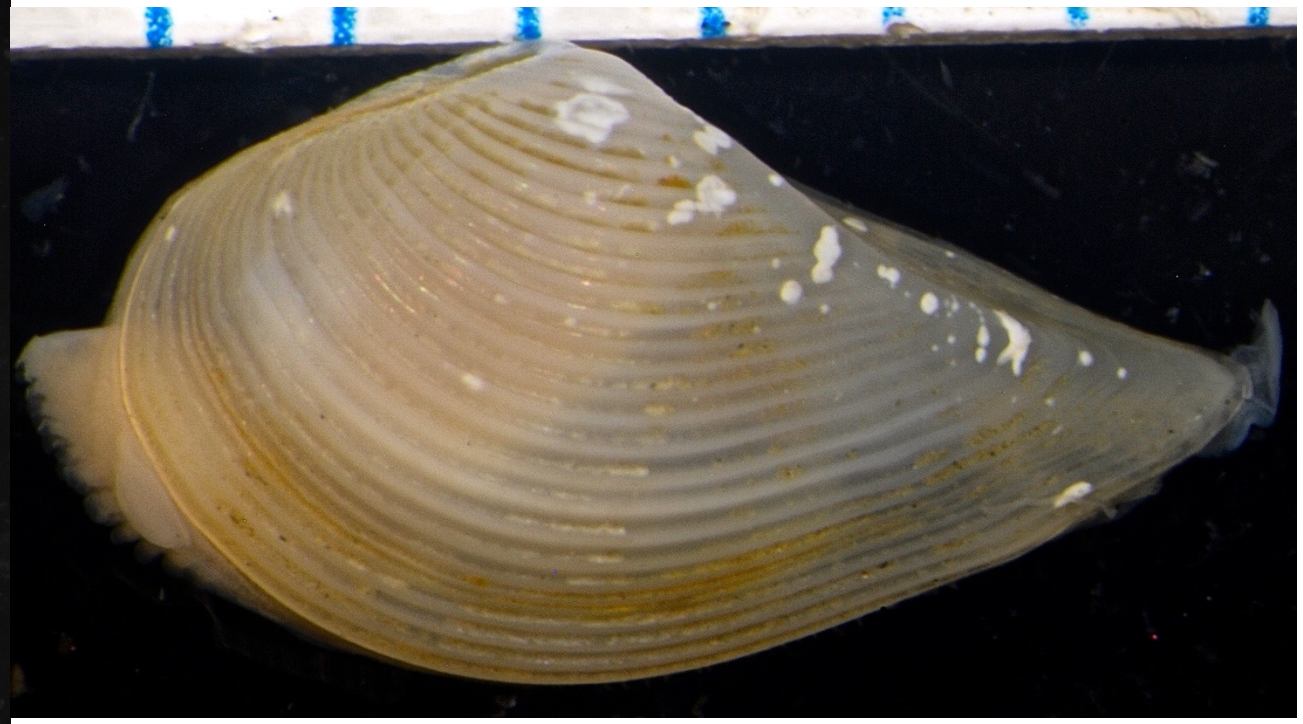
Saccella sp OC1 Barwick 2015



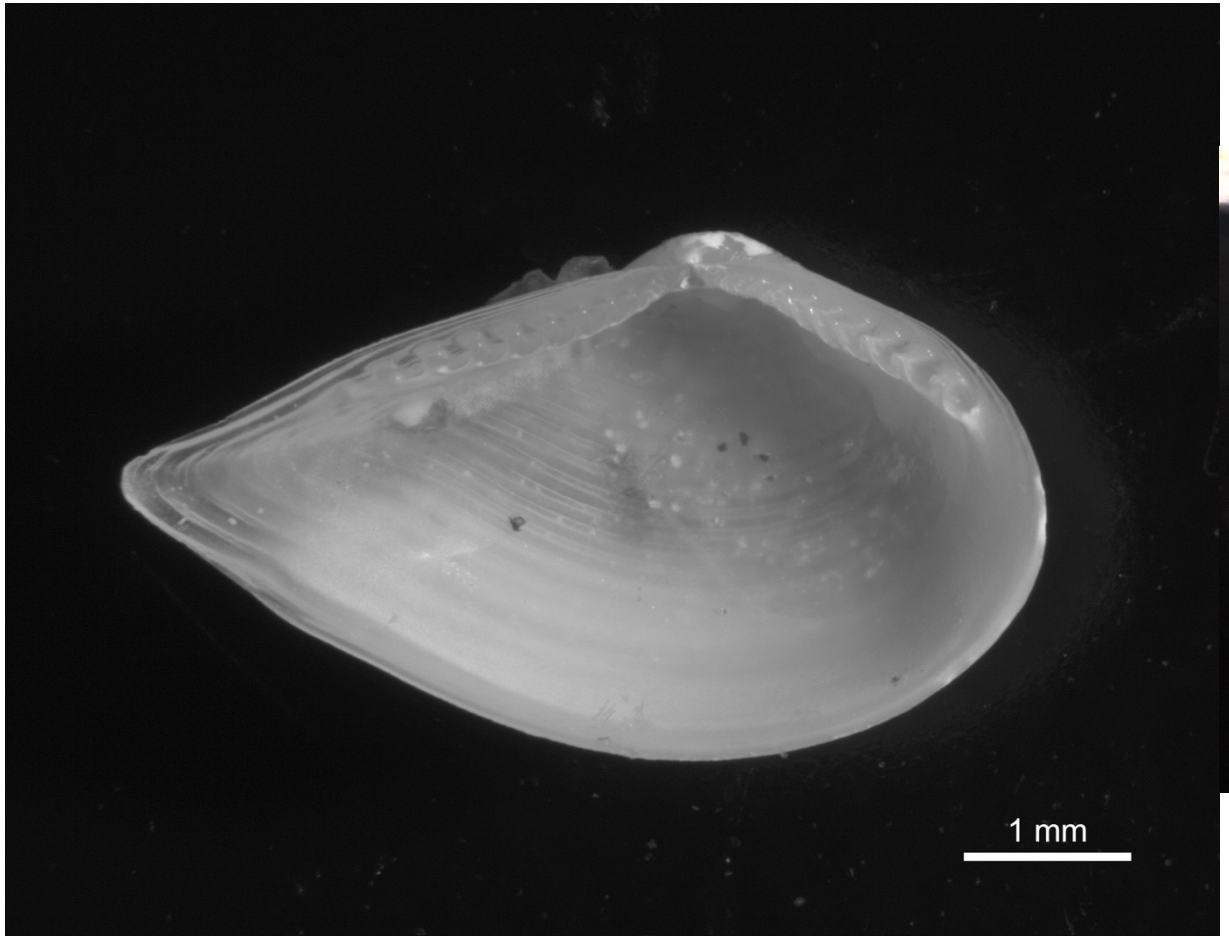
Santa Monica Bay E10 151m 2015

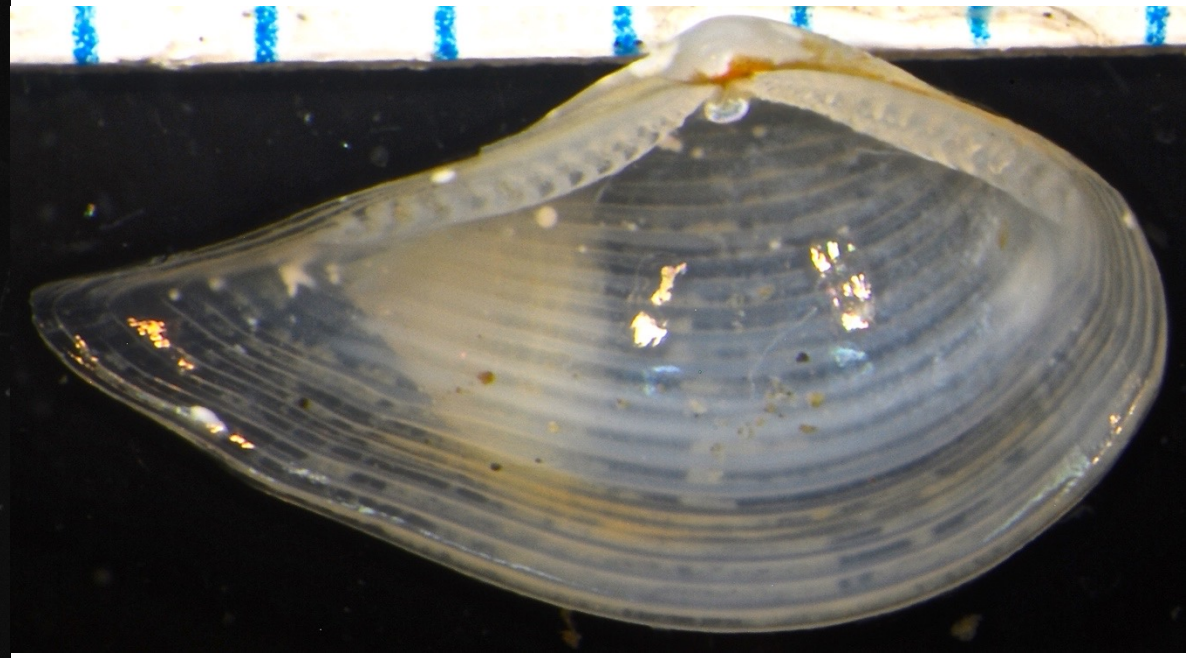
Saccella sp A/*Saccella* sp OC1



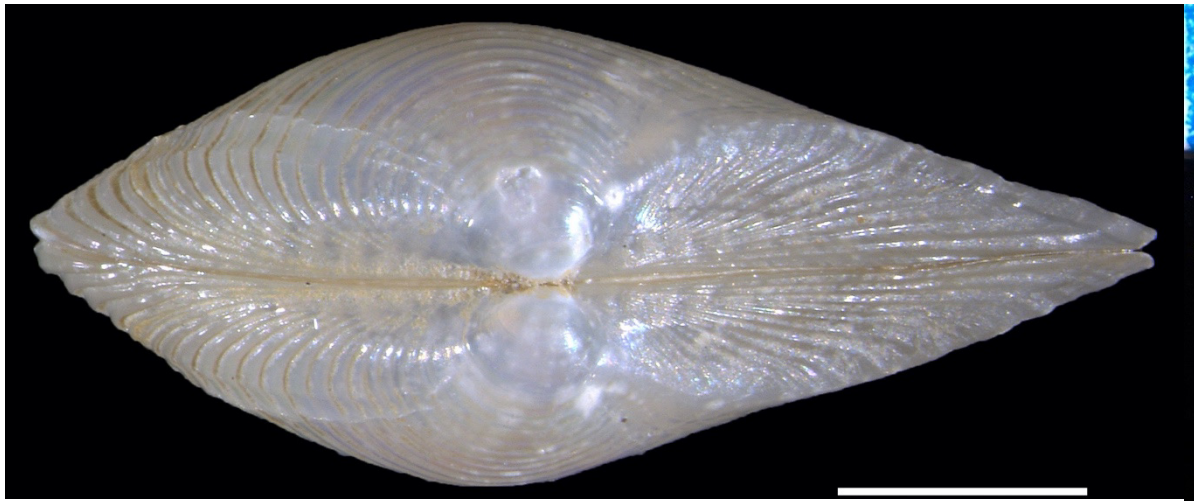


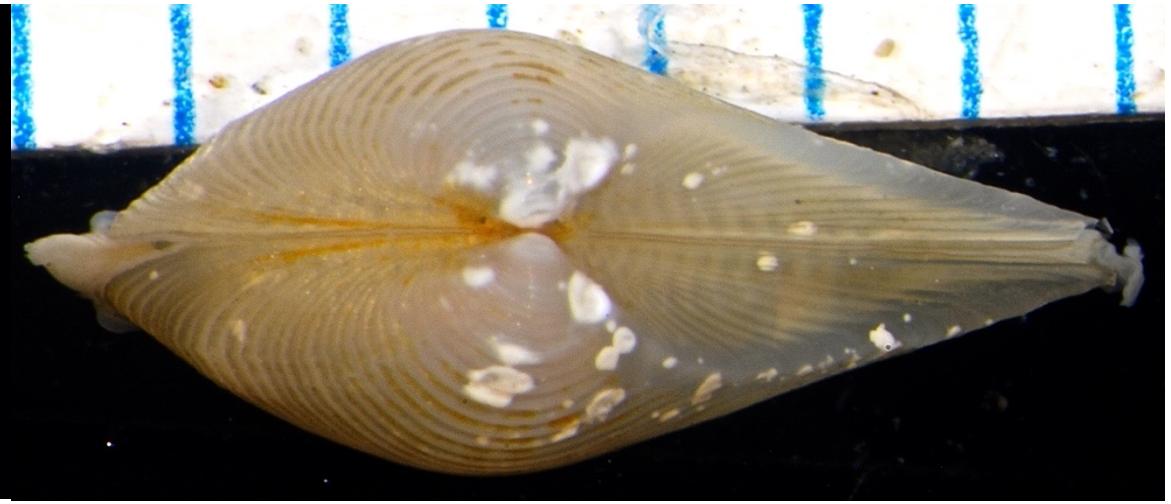
Saccella sp A/*Saccella* sp OC1



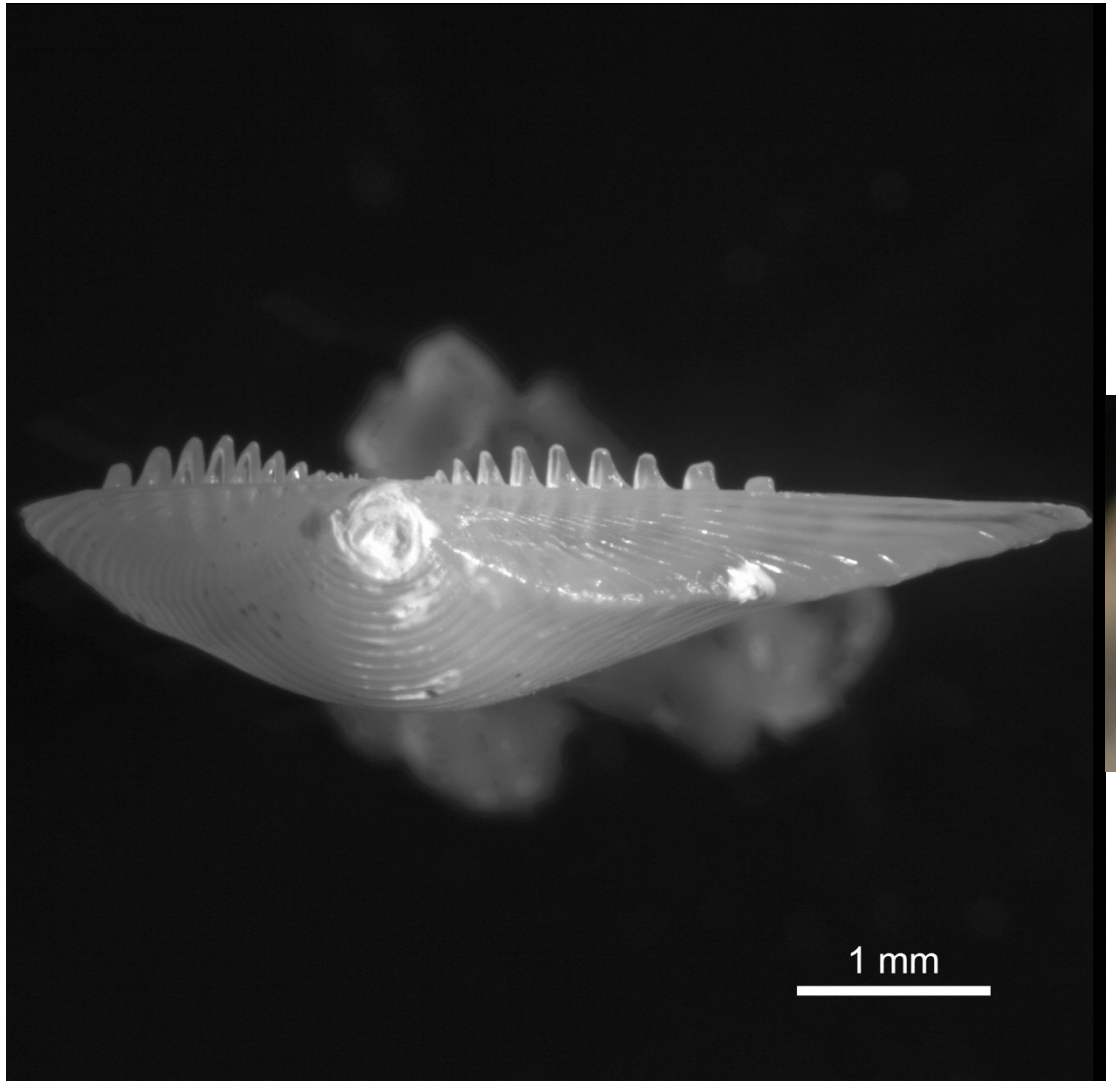


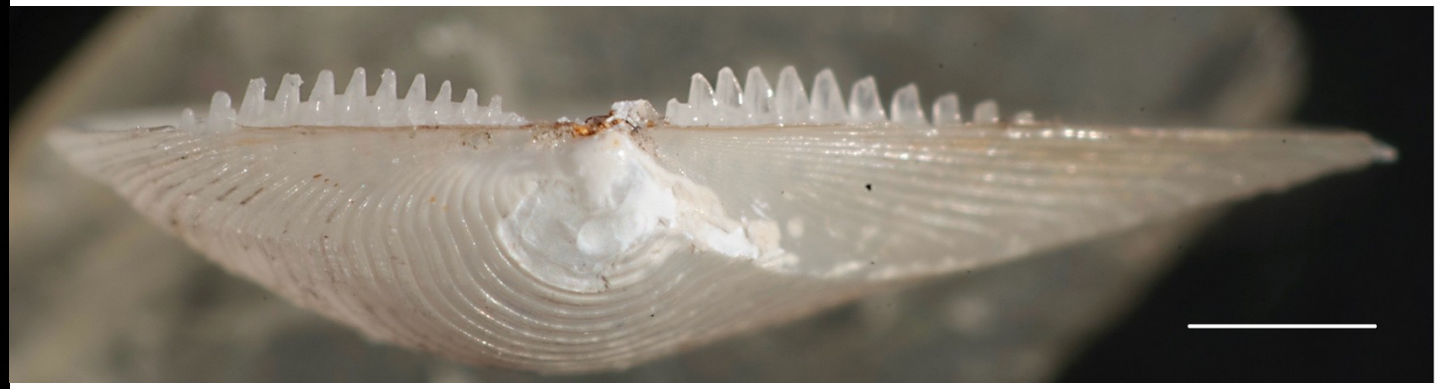
Saccella sp A/*Saccella* sp OC1



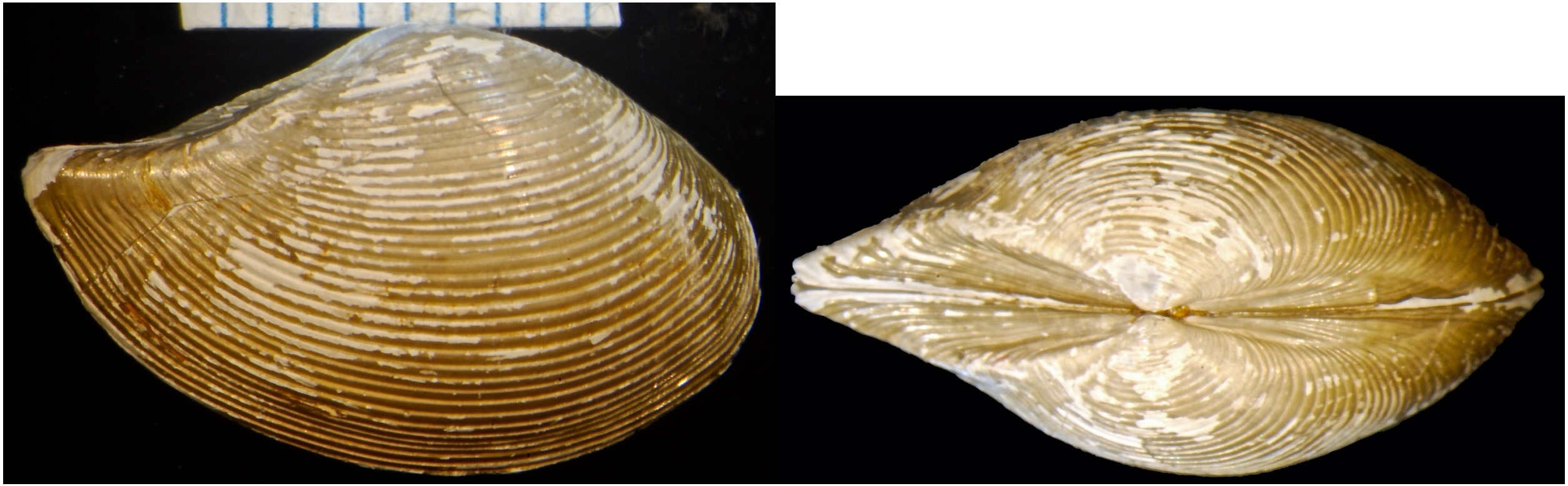


Saccella sp A/*Saccella* sp OC1





Saccella cf *penderi* (Dall & Bartsch 1910)

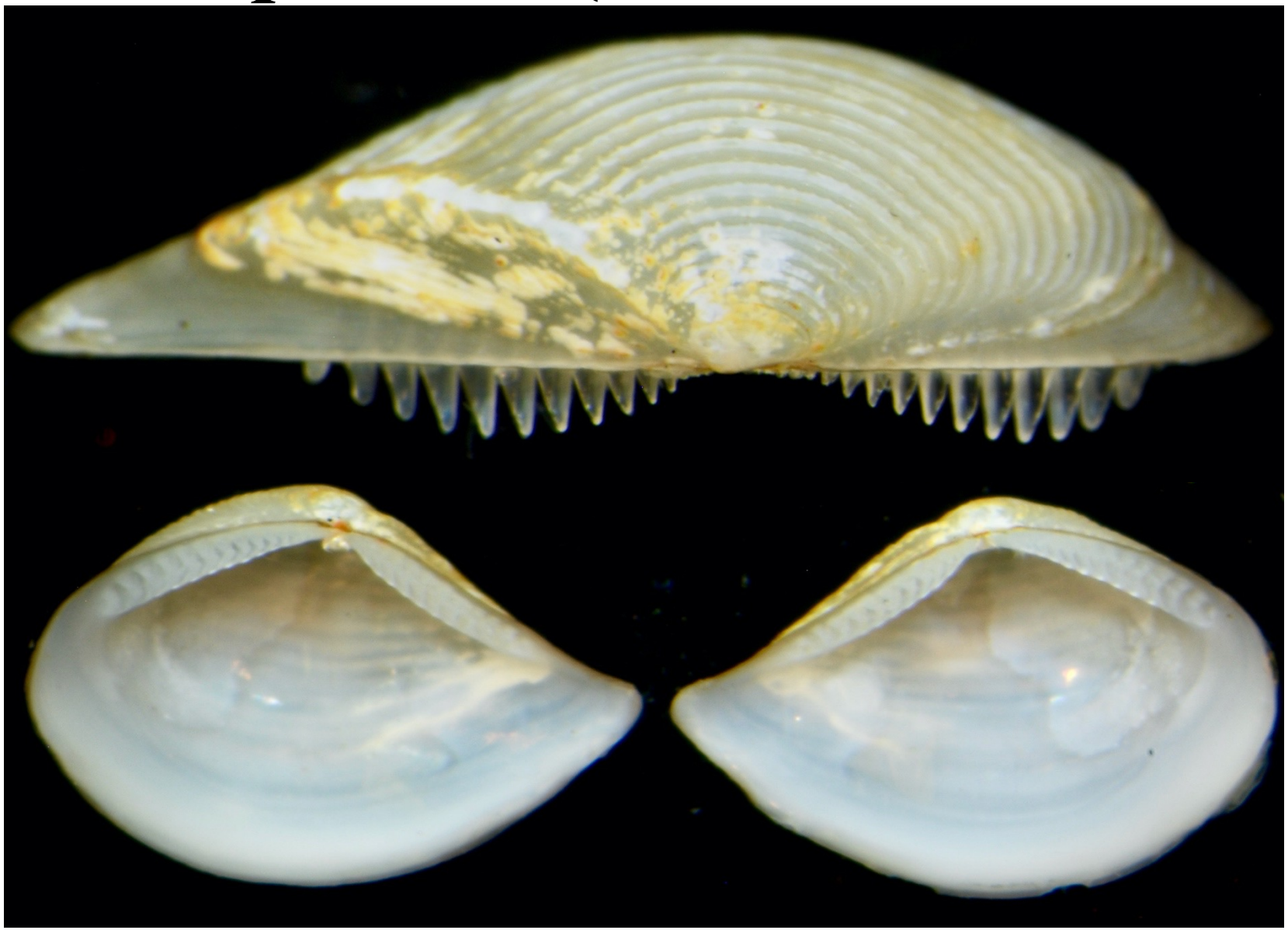


AGSS off San Gabriel River 13m 1991
Specimen courtesy of Carol Paquette MBC

Saccella cf *penderi* (Dall & Bartsch 1910)

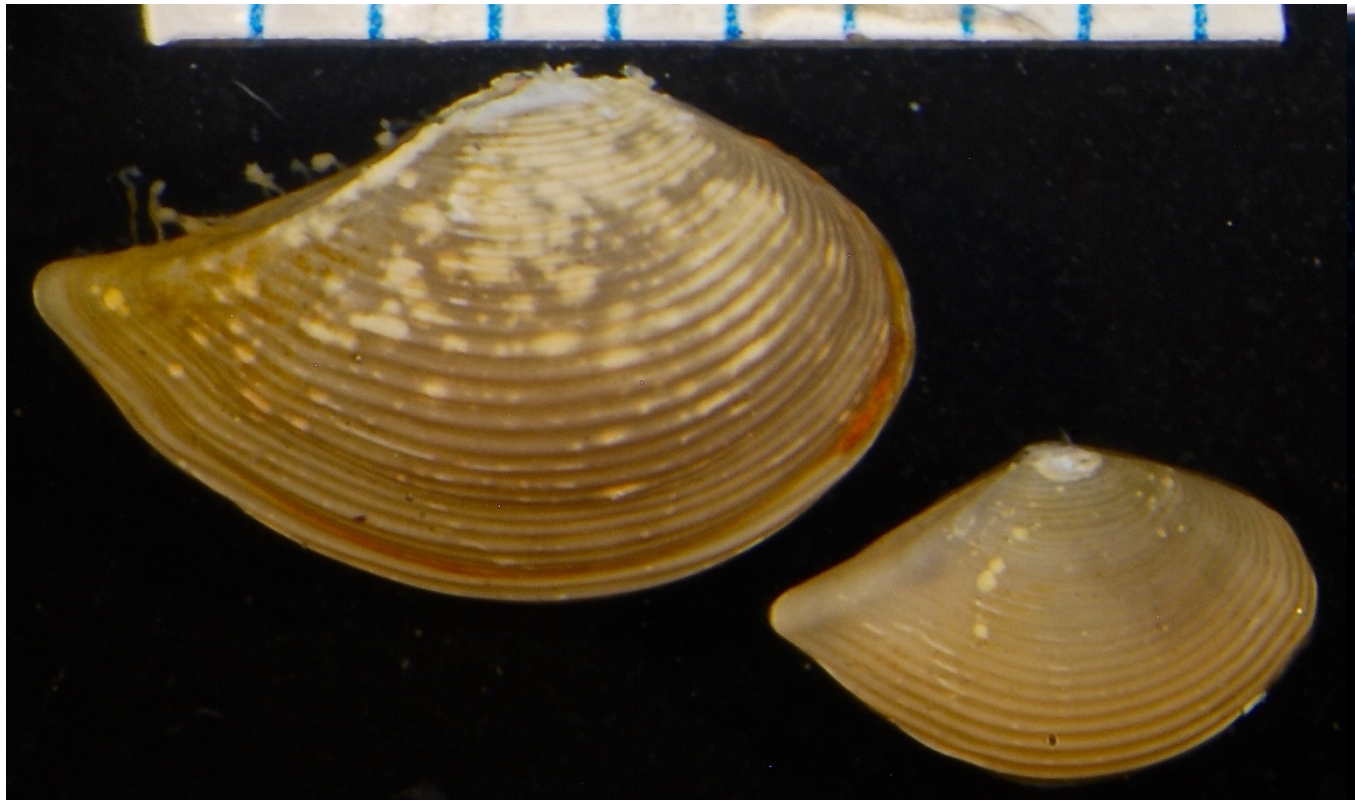
CSD Voucher M292 A12 50m 1990

Saccella cf *penderi* (Dall & Bartsch 1910)

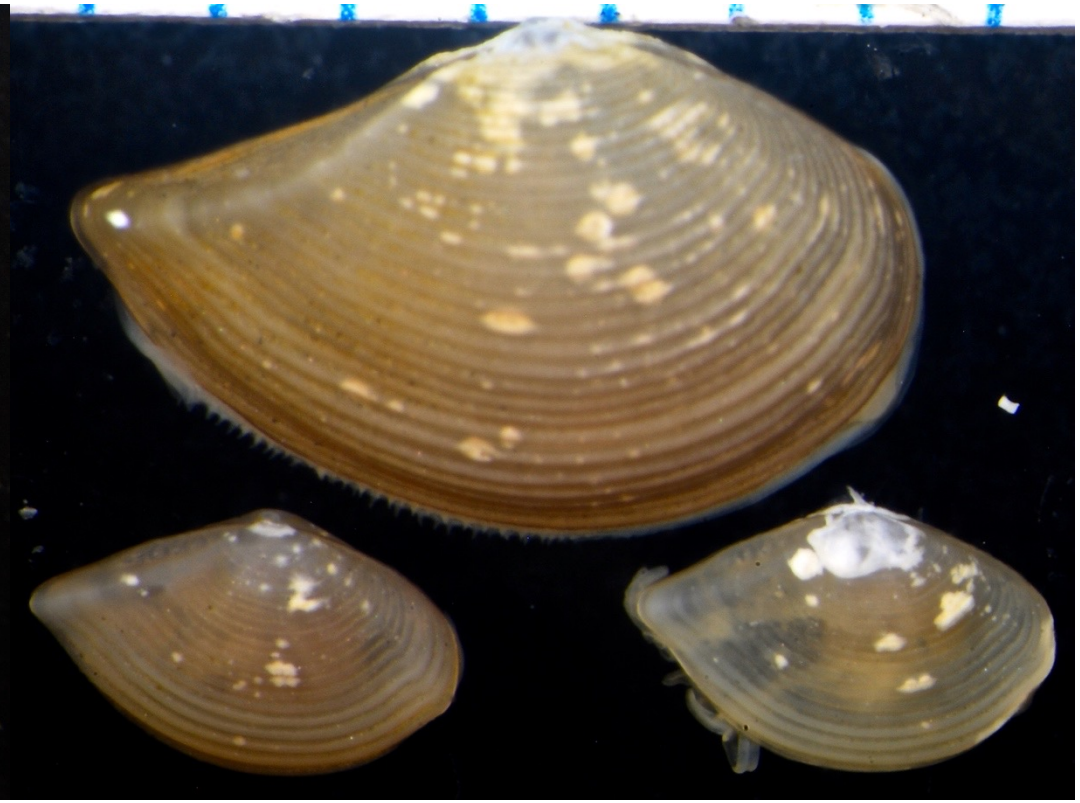


CSD Voucher M292 A12 50m 1990

Saccella cf *penderi* (Dall & Bartsch 1910)

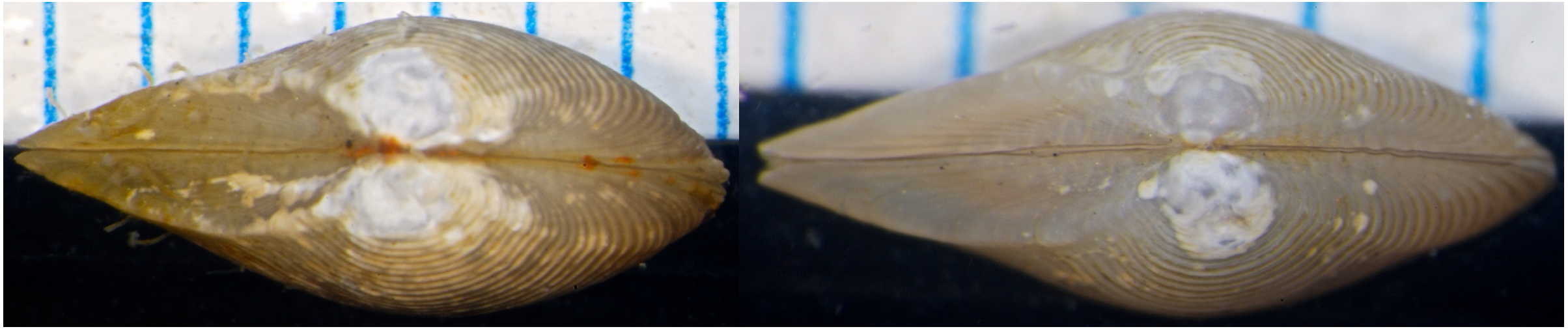


Santa Monica Bay C7 60m 2014



Santa Monica Bay C7 59m 2015

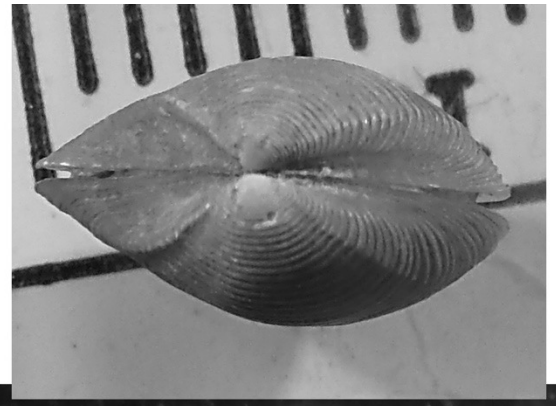
Saccella cf *penderi* (Dall & Bartsch 1910)



Santa Monica Bay C7 60m 2014

adult escutcheon/lunule juvenile

Saccella penderi (Dall & Bartsch 1910)

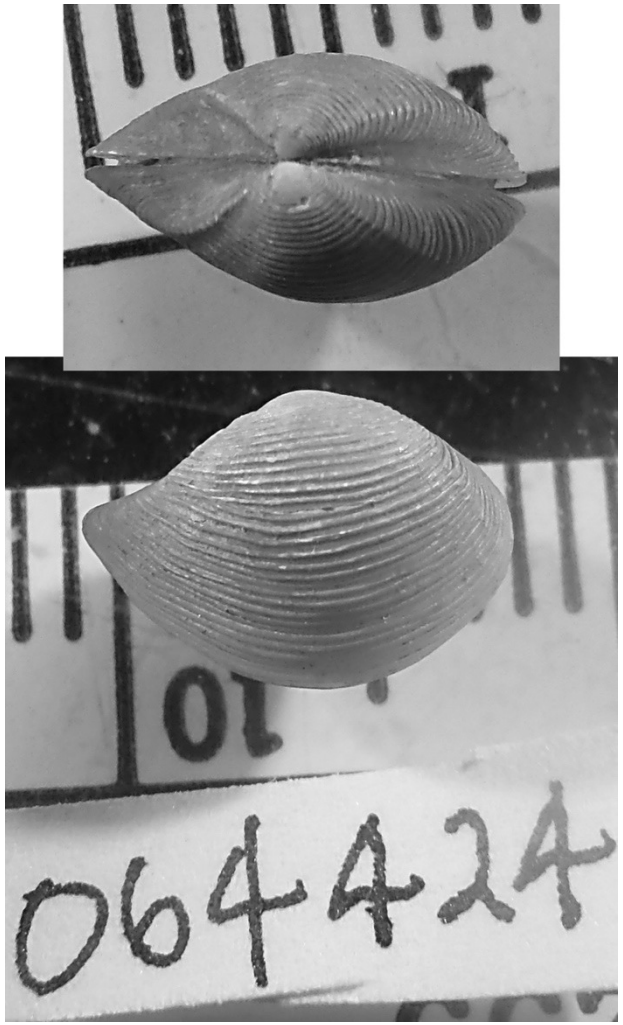


Photos courtesy of Kelvin Barwick

Paratype (CAIZ0644424)

Syntype (USNM 211606)

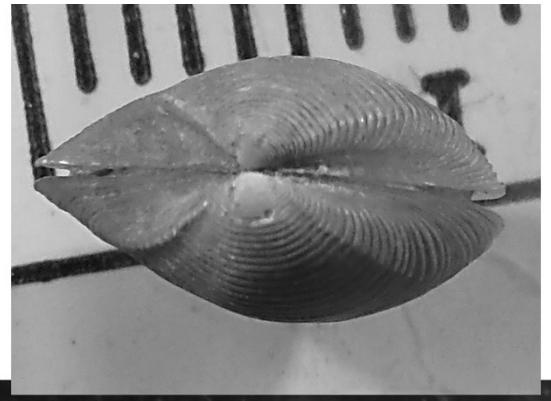
Saccella penderi (Dall & Bartsch 1910)/ *Saccella* cf *penderi* (Dall & Bartsch 1910)

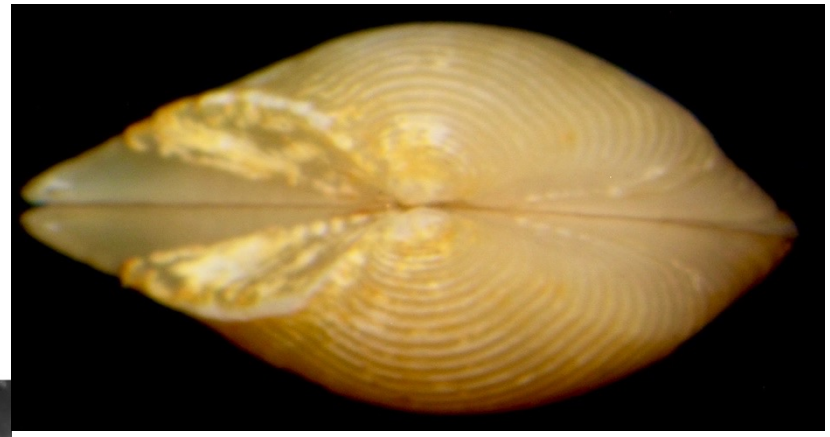


Paratype (CAIZ0464424)

AGSS offshore San Gabriel River 13m 1991

Saccella penderi (Dall & Bartsch 1910)/ *Saccella* cf *penderi* (Dall & Bartsch 1910)





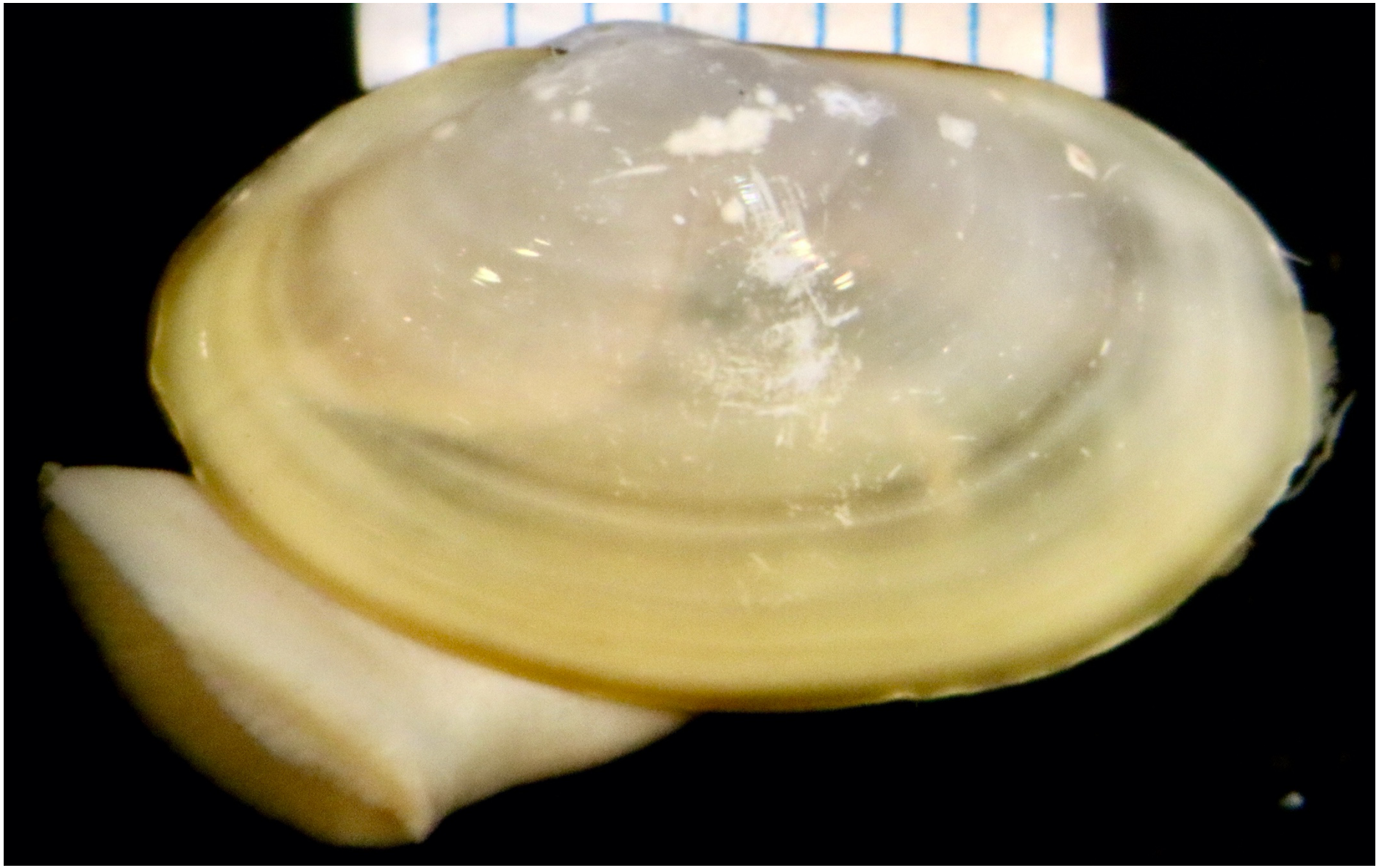
CSD Voucher M292 A12 50m 1990

Paratype (CAIZ0644424)

Family Malletiidae

1. Taxodont dentition, resilifer absent
2. Ligament opisthodetic, external in groove
3. Hinge teeth V-shaped, on both sides of beaks, uneven
4. Inner ventral margin without crenulations
5. Shell irregular in outline, very thin

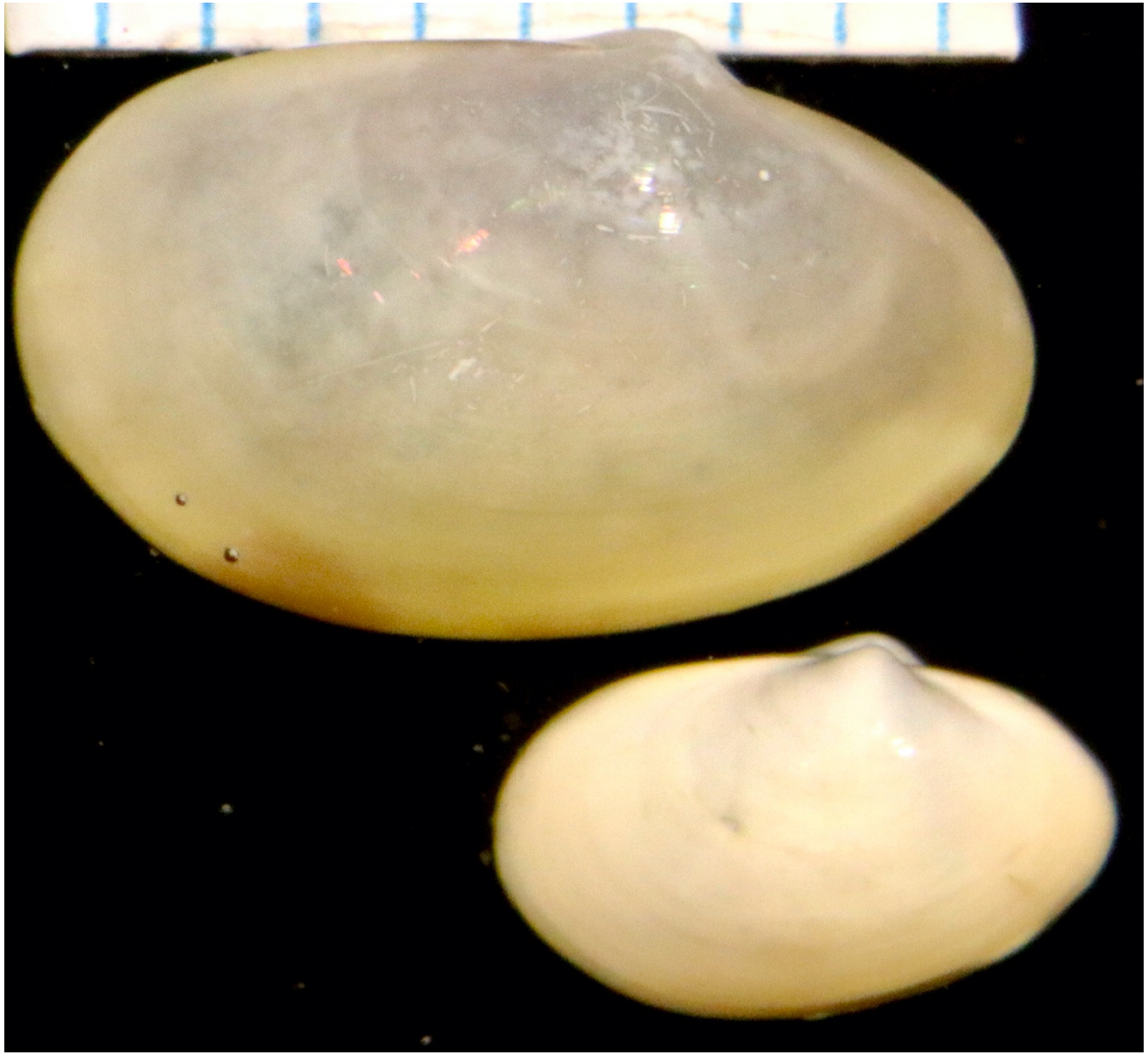
Malletia faba Dall 1897



City of San Diego DB07 401m 2005

Specimen courtesy of Wendy Enright City of San Diego

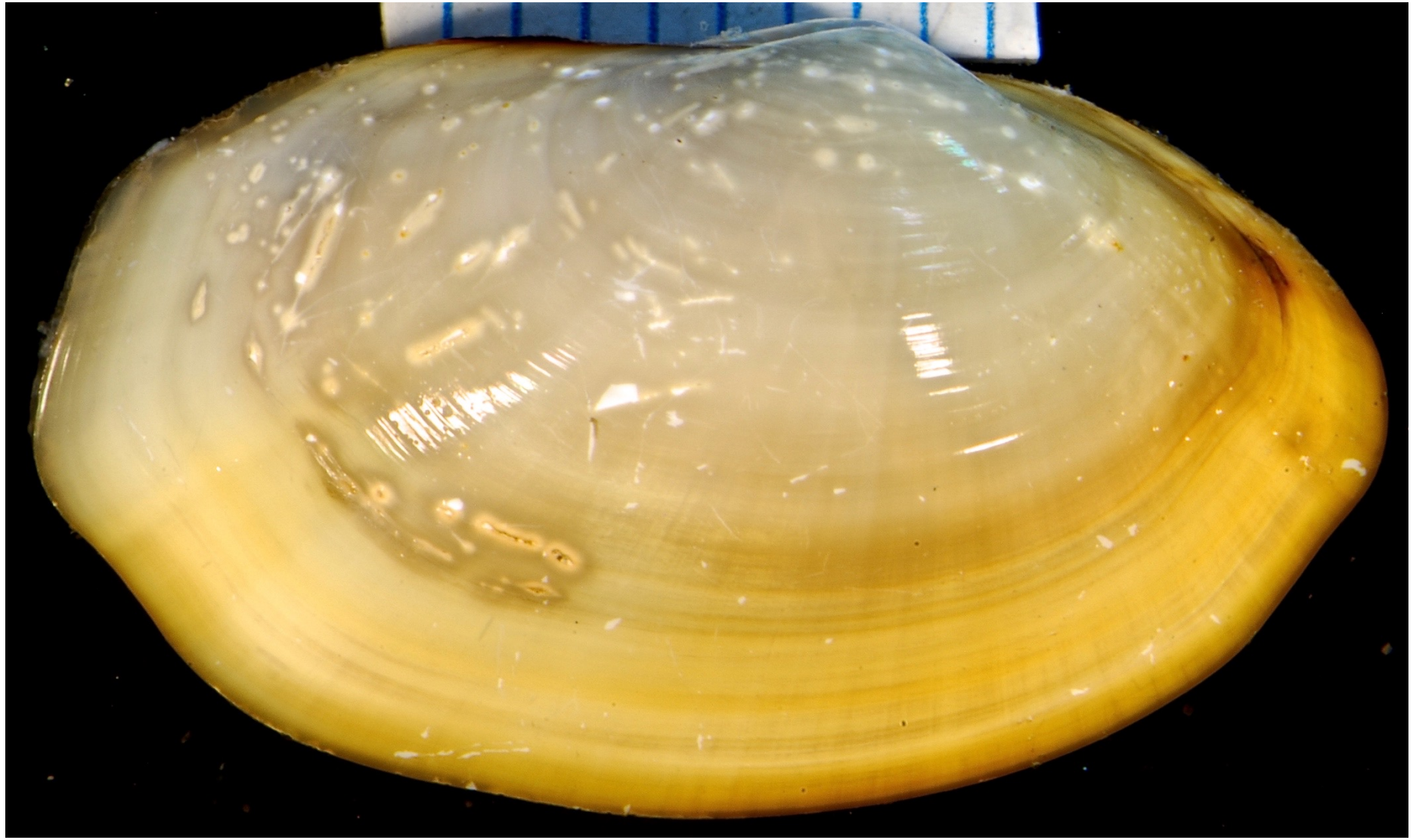
Malletia faba Dall 1897



Specimens courtesy of Kelvin Barwick via Don Cadien

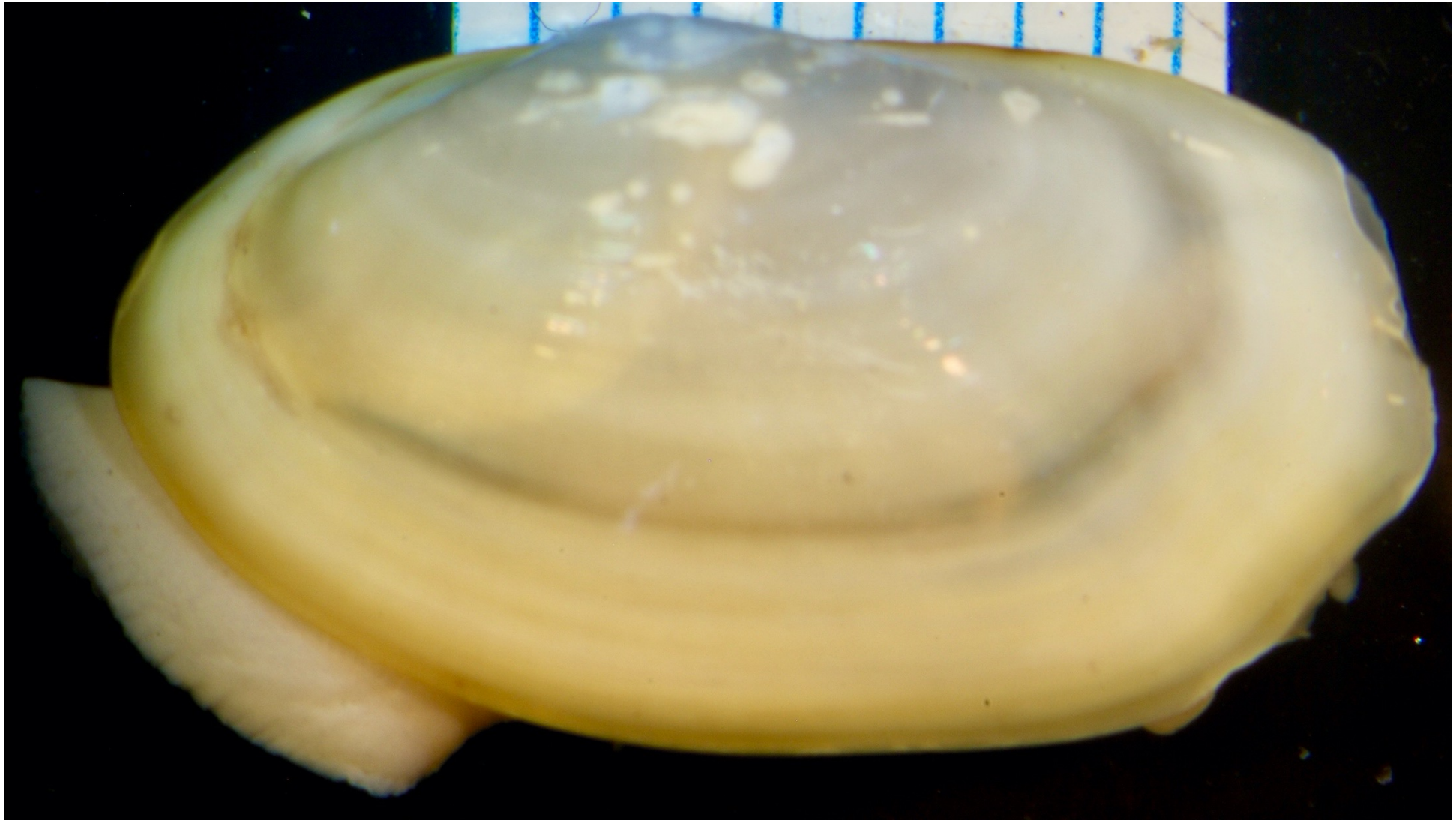
Cascadia Slope EB5-64 950m 5 Jul 1975

Malletia pacifica Dall 1897



B’08 7479 Santa Monica Bay 397m

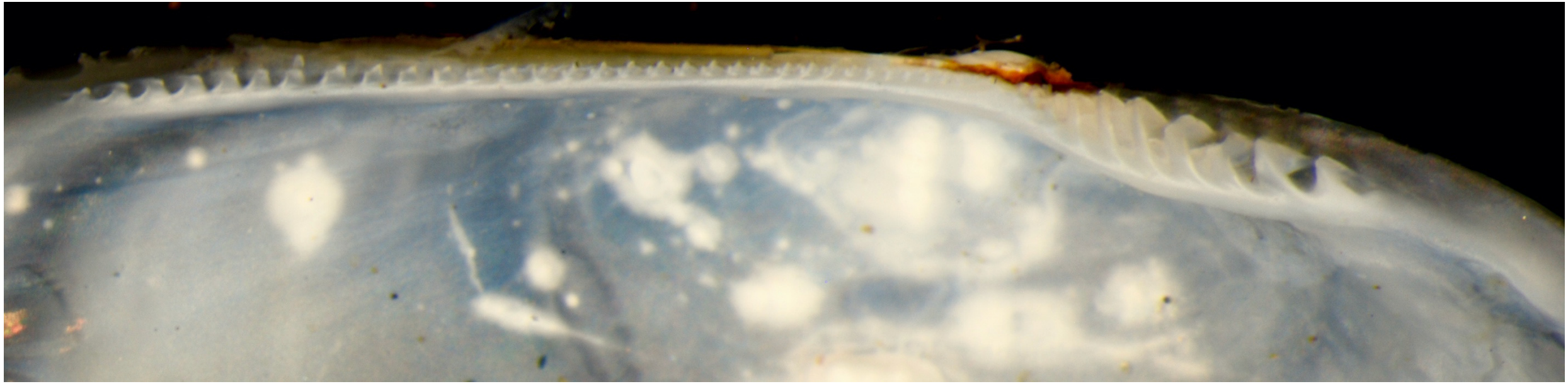
Malletia pacifica Dall 1897



CSD Voucher M361 DB07 401m 2005

Specimen courtesy of Wendy Enright City of San Diego

Malletia pacifica Dall 1897



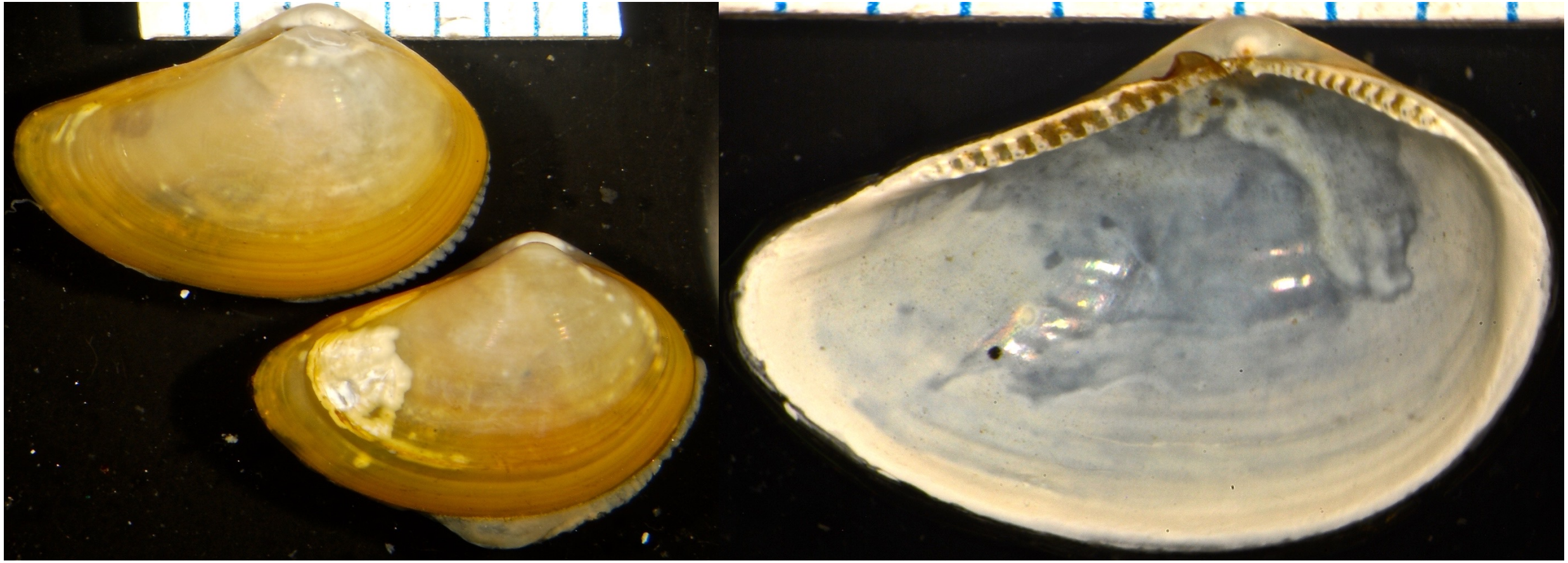
CSD Voucher M361 DB07 401m 2005

Specimen courtesy of Wendy Enright City of San Diego

Family Neilonellidae

1. Taxodont dentition, gap between teeth, resilifer absent
2. Ligament opisthodetic, external in groove
3. Hinge teeth V-shaped, on both sides of beaks, uneven
4. Pallial line obscure, pallial sinus unclear
5. Inner ventral margin without crenulations

Neilonella ritteri (Dall 1916)

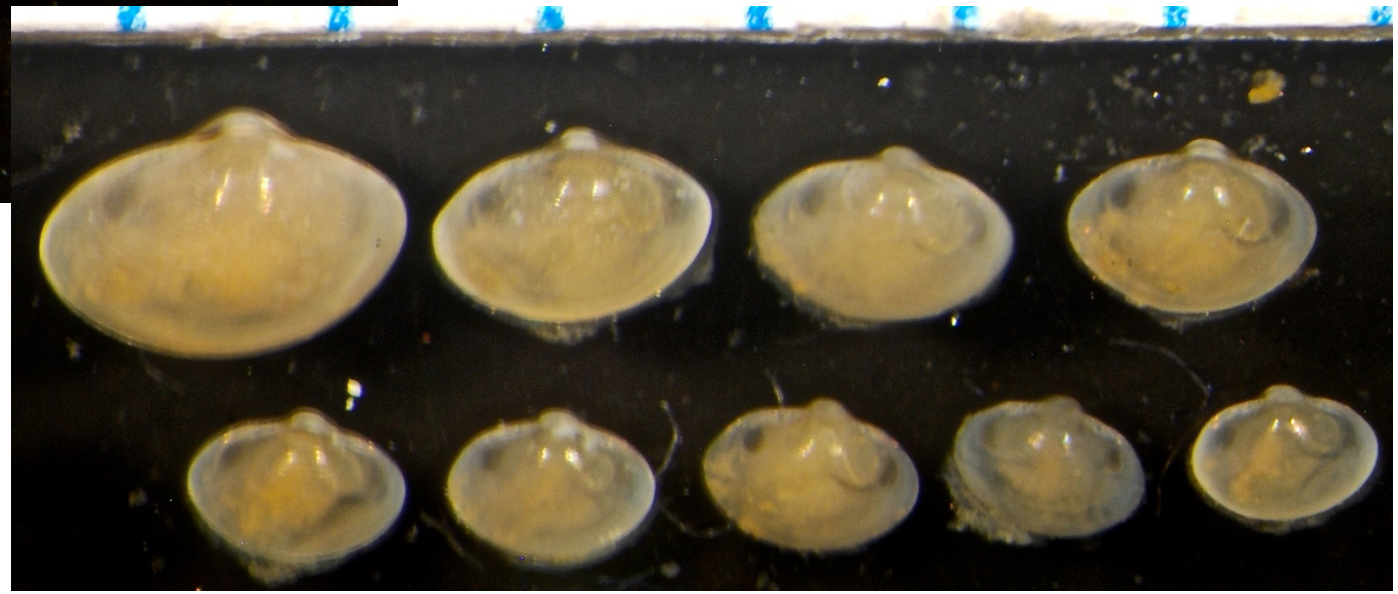


SCCWRP ORCOSAN SLUDGE STUDY 630m 1983

Specimens courtesy of Carol Paquette MBC

Neilonella ritteri (Dall 1916)

SCCWRP ORCOSAN SLUDGE STUDY
630m 1983



Specimens courtesy of Carol Paquette MBC

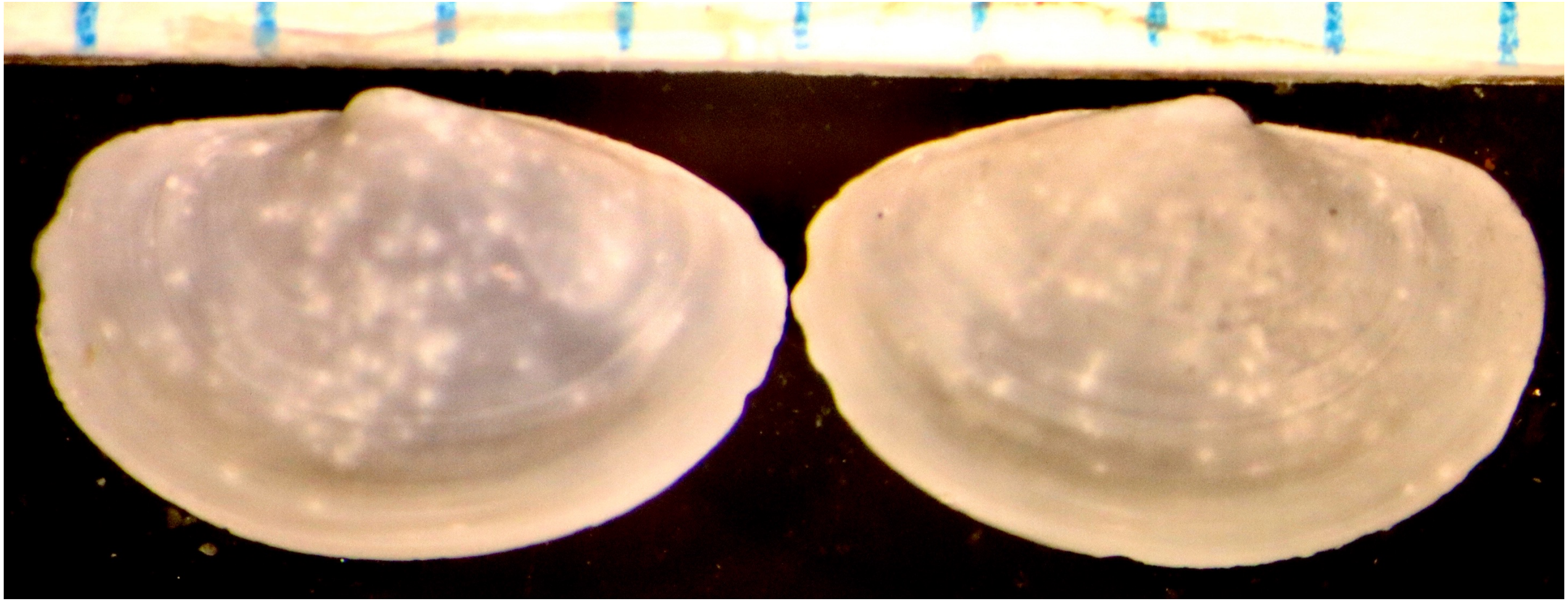
Family Yoldiidae

1. Taxodont dentition in two unequal series, separated by large resilifer
2. Ligament amphidetic, partly internal, in resilifer
3. Hinge teeth V-shaped, on both sides of beaks
4. Inner ventral margin without crenulations
5. Pallial line with sinus

Megayoldia

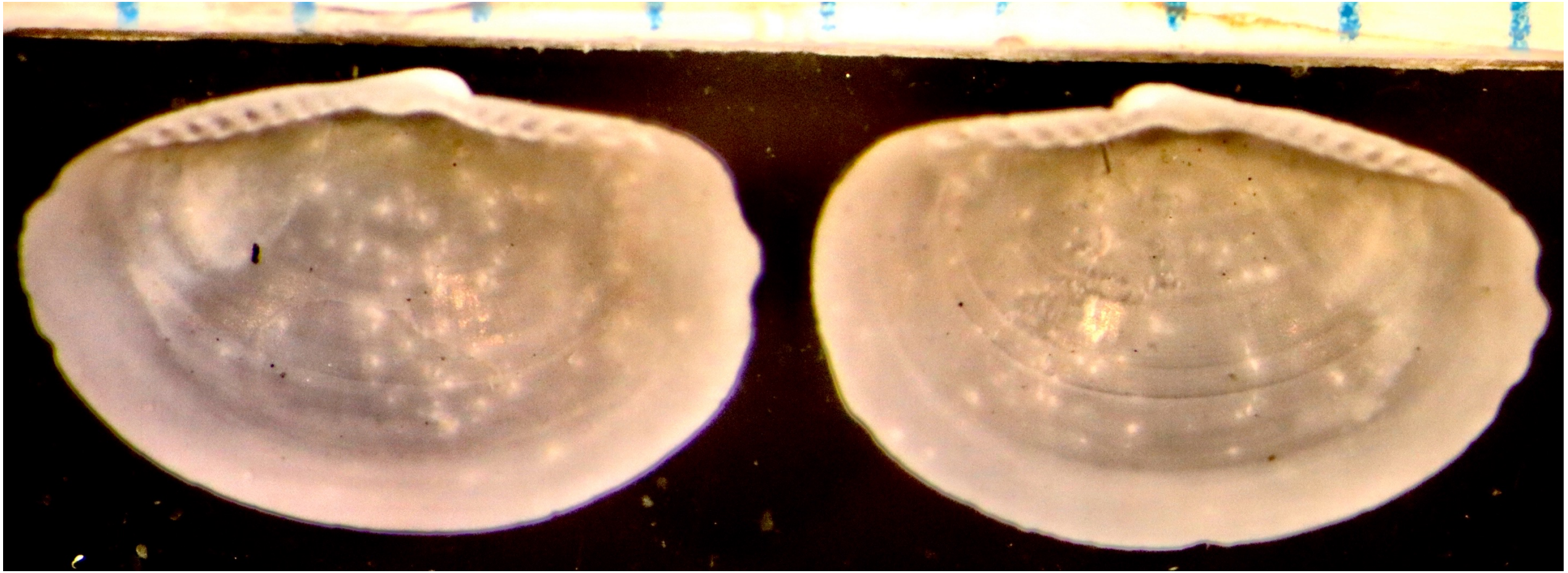
1. **Shell inequilateral**
2. **Posterior end expanded, rostrate to truncate**
3. **Posterior margin produced, with inflected dorsal edge**
4. **Sculpture absent, or incremental striae**
5. **Escutcheon delimited, lunule absent**

Megayoldia thraciaeformis (Storer 1838)



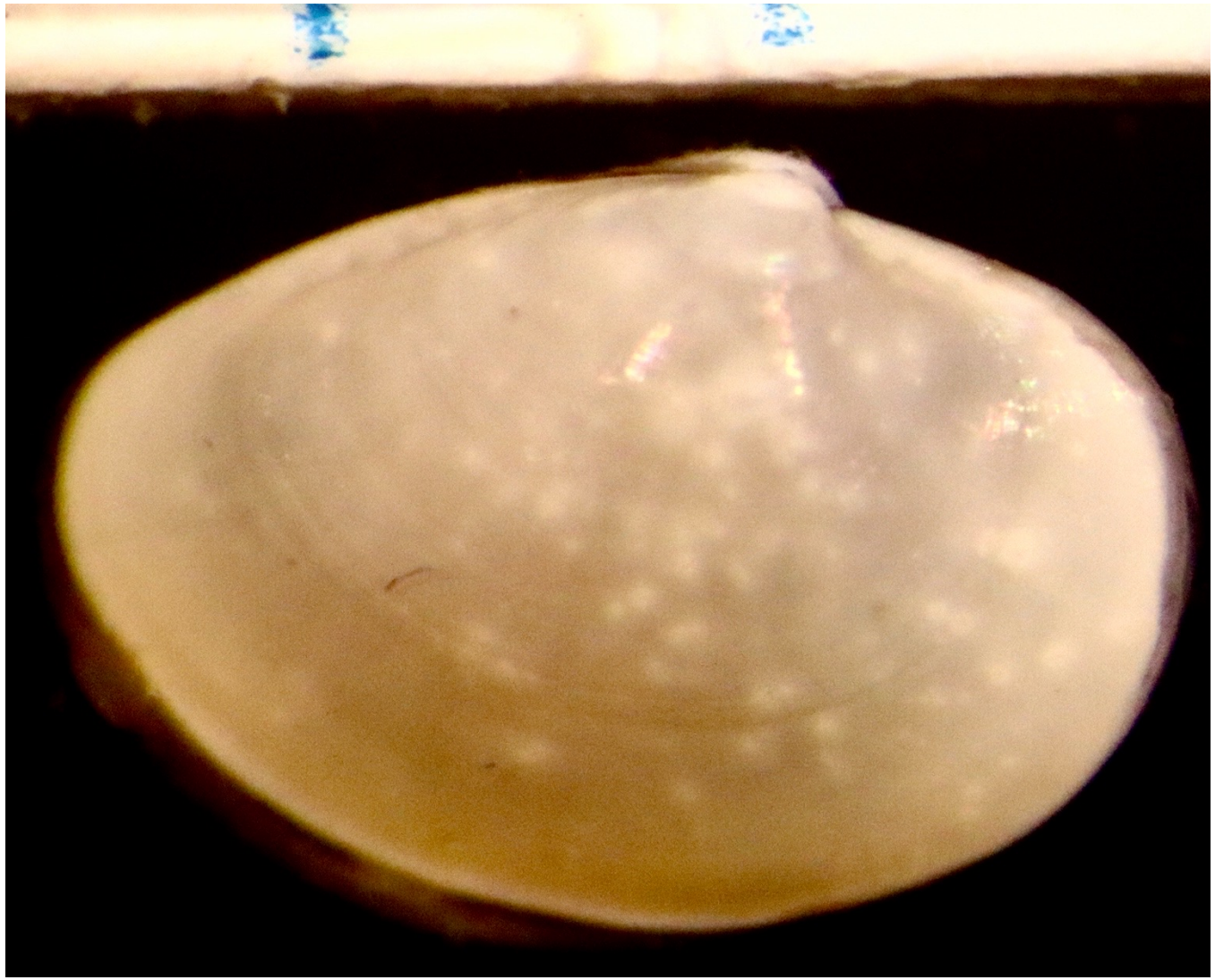
MMS CARP T7 SB28 600m 11/24/87
Specimen courtesy of John Ljubenkov voucher colletion

Megayoldia thraciaeformis (Storer 1838)



MMS CARP T7 SB28 600m 11/24/87
Specimen courtesy of John Ljubenkov voucher colletion

Megayoldia thraciaeformis (Storer 1838)



MMS CARP T7 SB28 600m 11/24/87
Specimen courtesy of John Ljubenkov voucher colletion

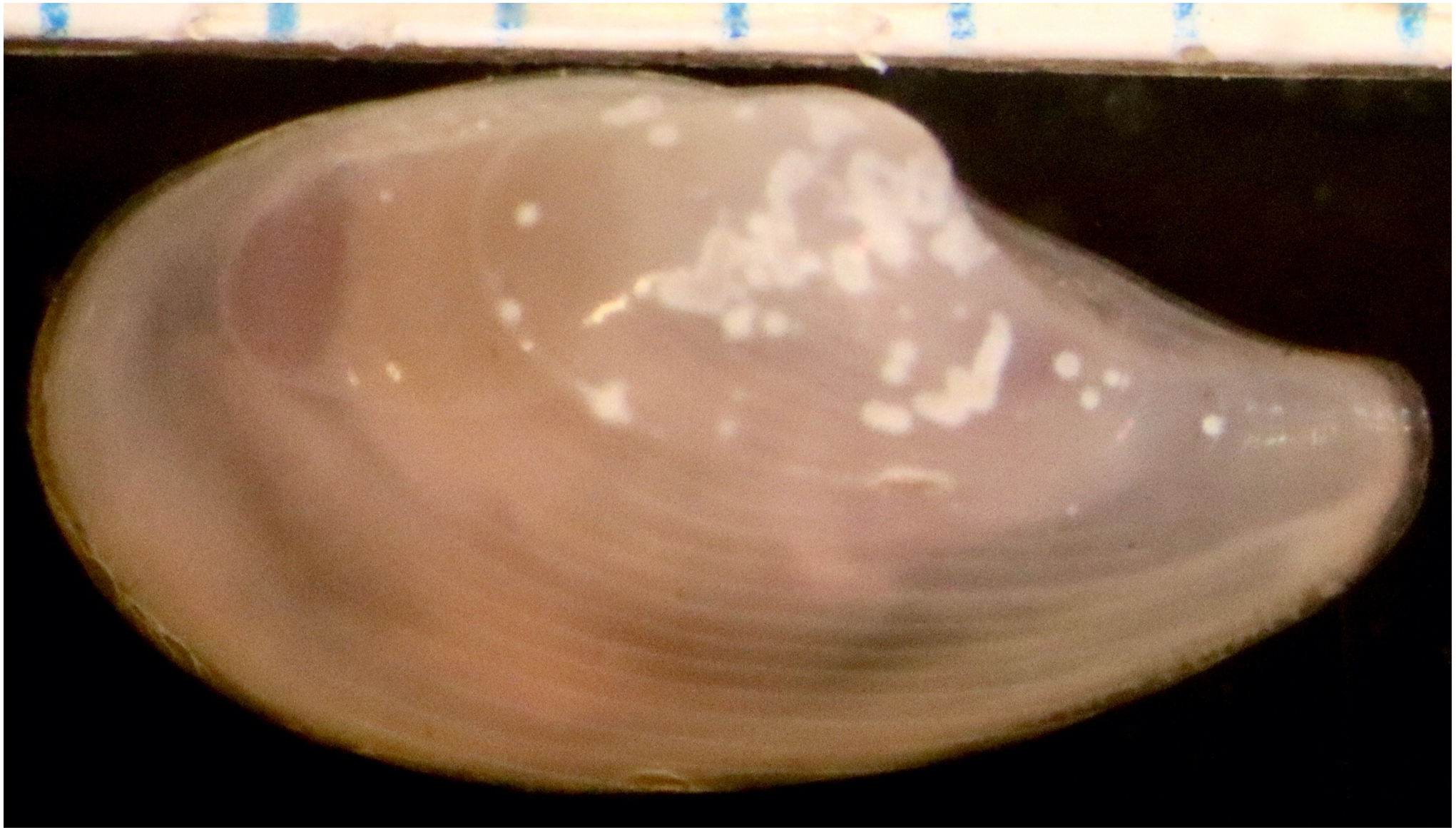
Megayoldia thraciaeformis (Storer 1838)

MMS CARP T7 SB28 600m 11/24/87
Specimen courtesy of John Ljubenkov voucher collection

Yoldia

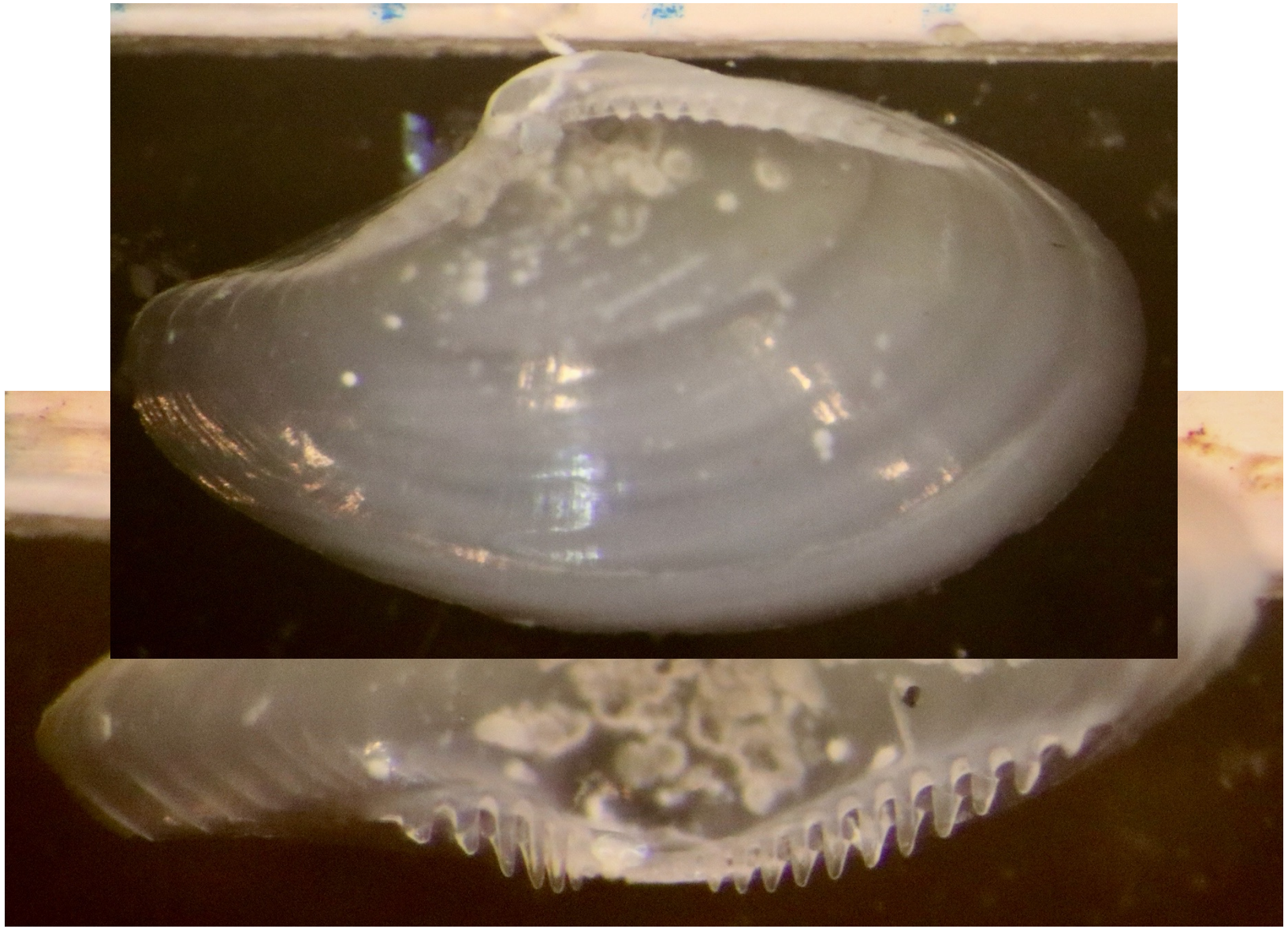
1. **Shell inequilateral**
2. **Posterior end expanded, rostrate to truncate**
3. **Posterior margin produced, with inflected dorsal edge**
4. **Sculpture absent, or concentric ribbing**
5. **Escutcheon delimited, lunule absent**

Yoldia cooperi Gabb 1865



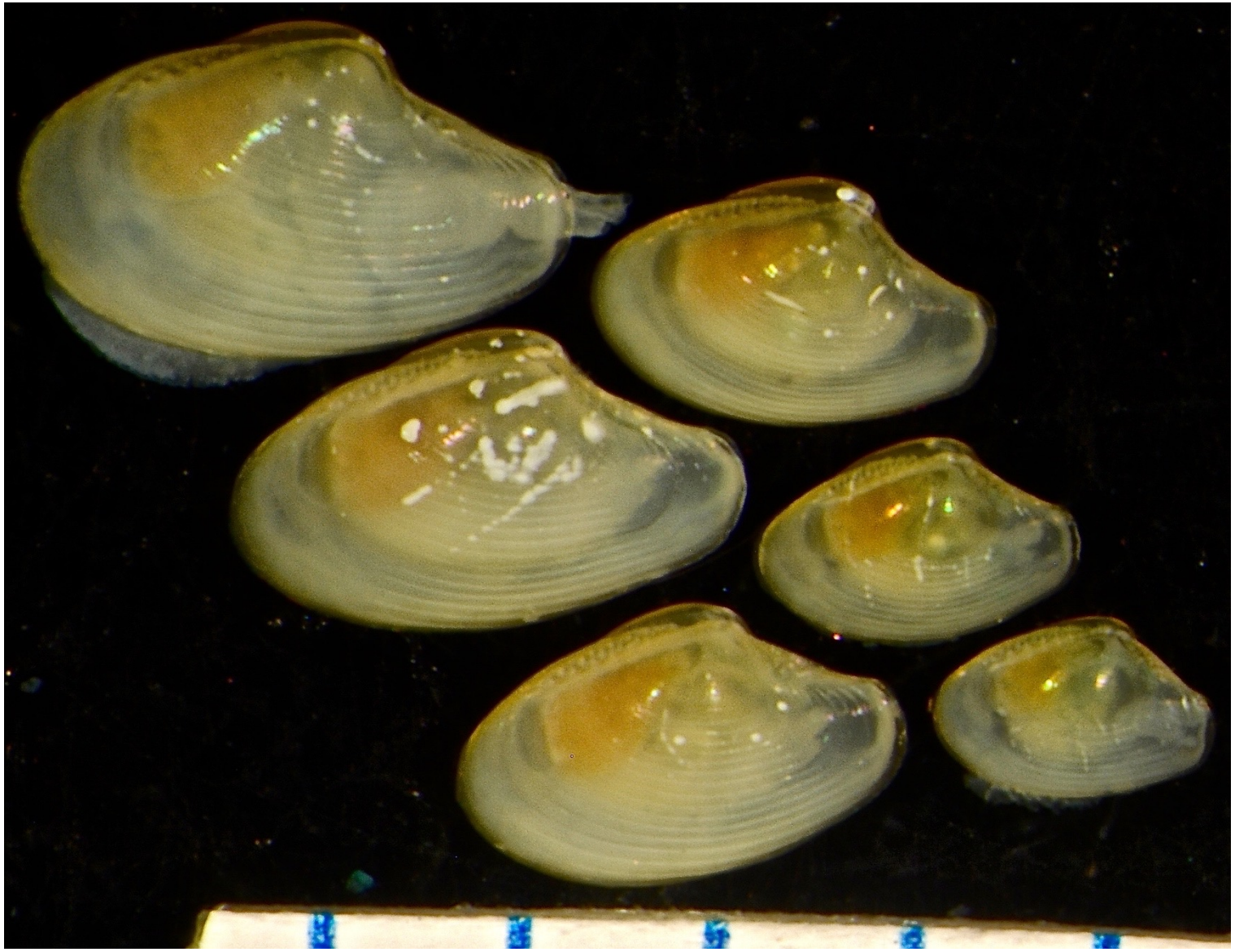
ISS Point Reyes 0220QX13 9/9/2004

Yoldia cooperi Gabb 1865



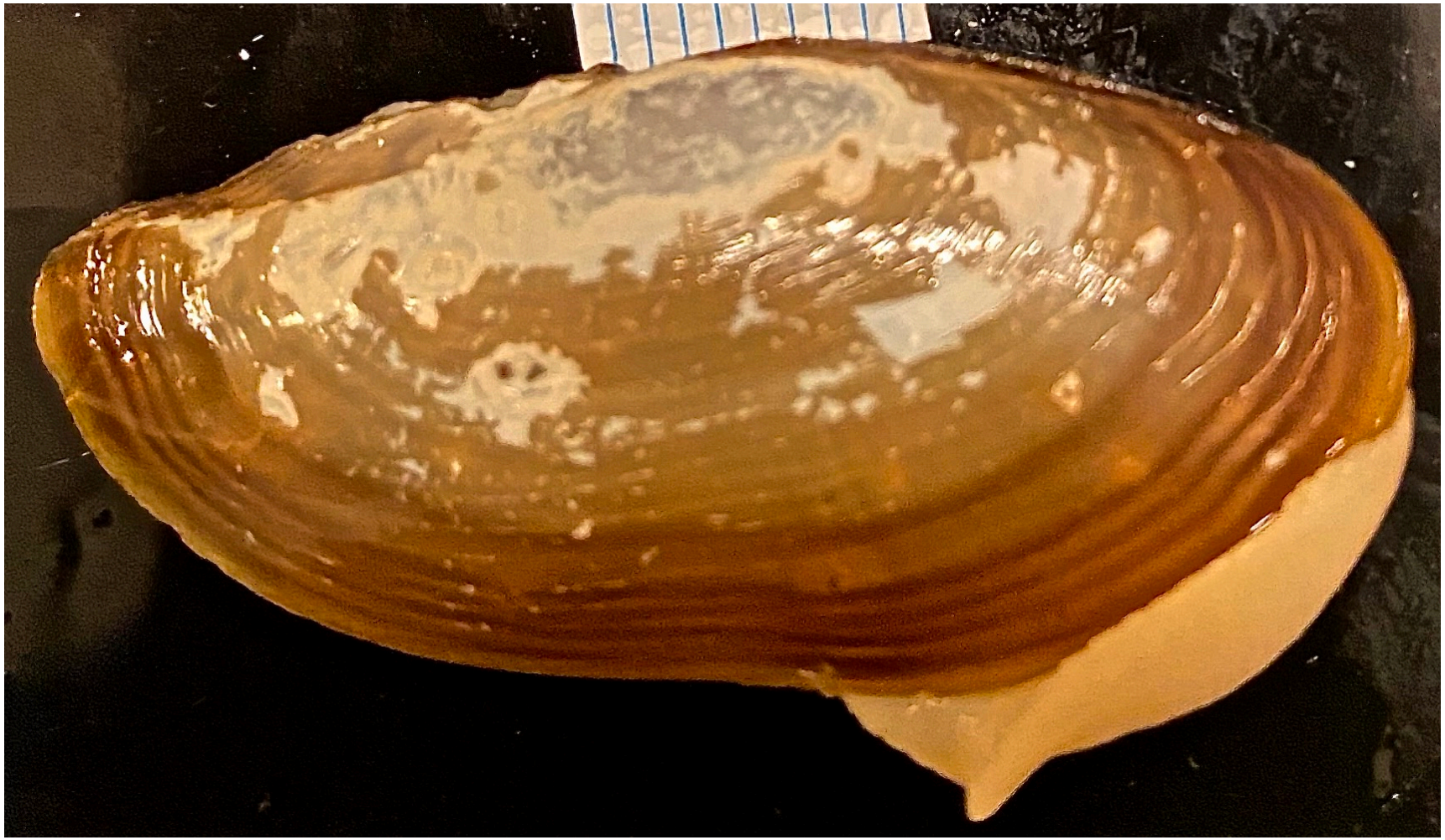
ISS Point Reyes 0223QX13 9/9/04

Yoldia cooperi Gabb 1865



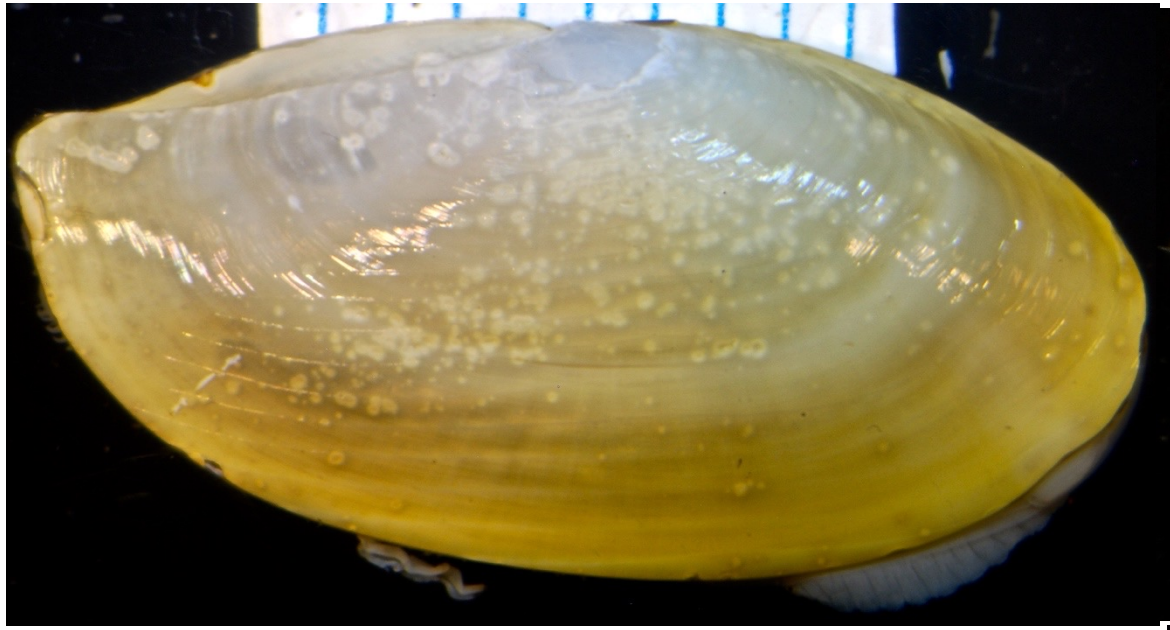
Avila Beach 10m 2012

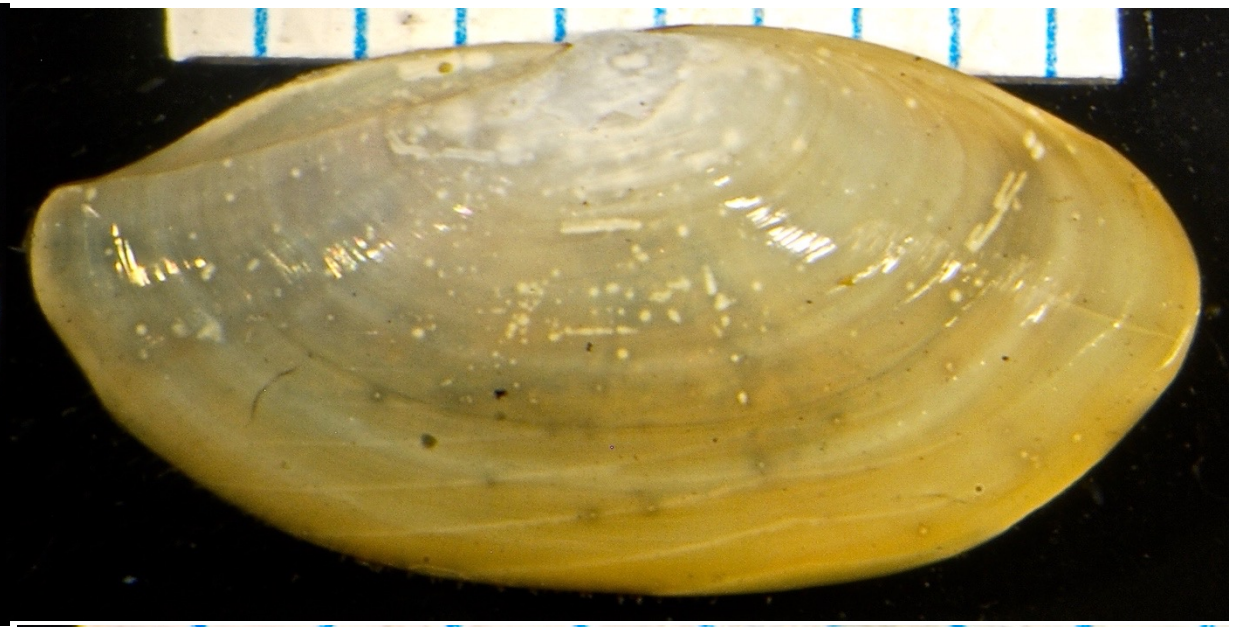
Yoldia seminuda Dall 1871



B’18 10322 West Santa Barbara Channel 288m

Yoldia seminuda Dall 1871

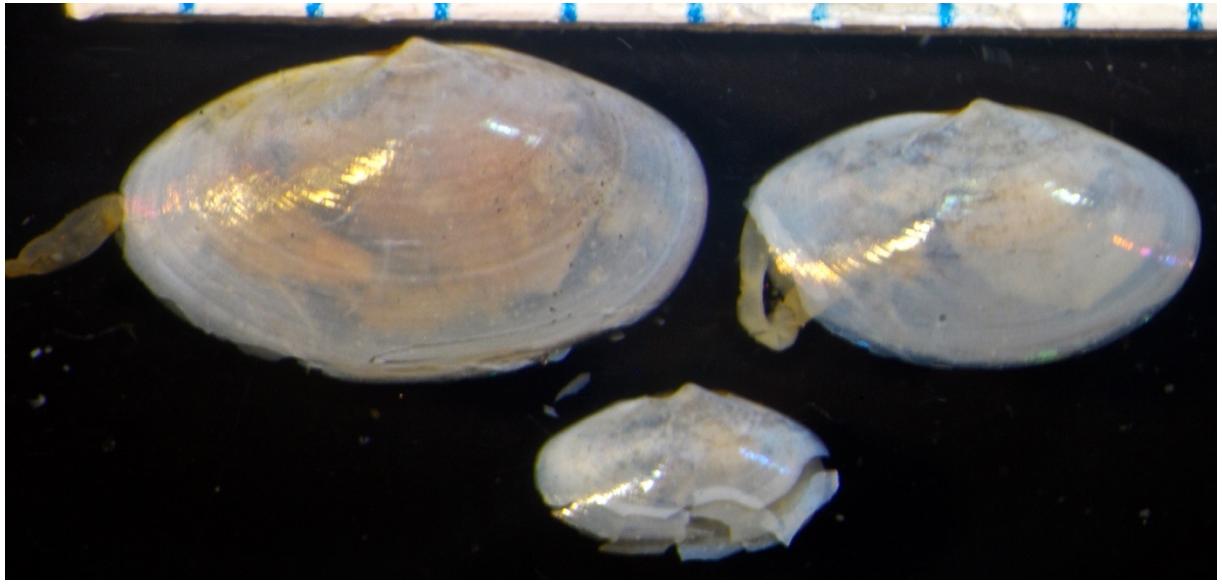




LACSD 5A 305m 2015 (above)

MMS CARP T3 198m 1987 (upper right)

LACSD Z4D 30m 1984(right)

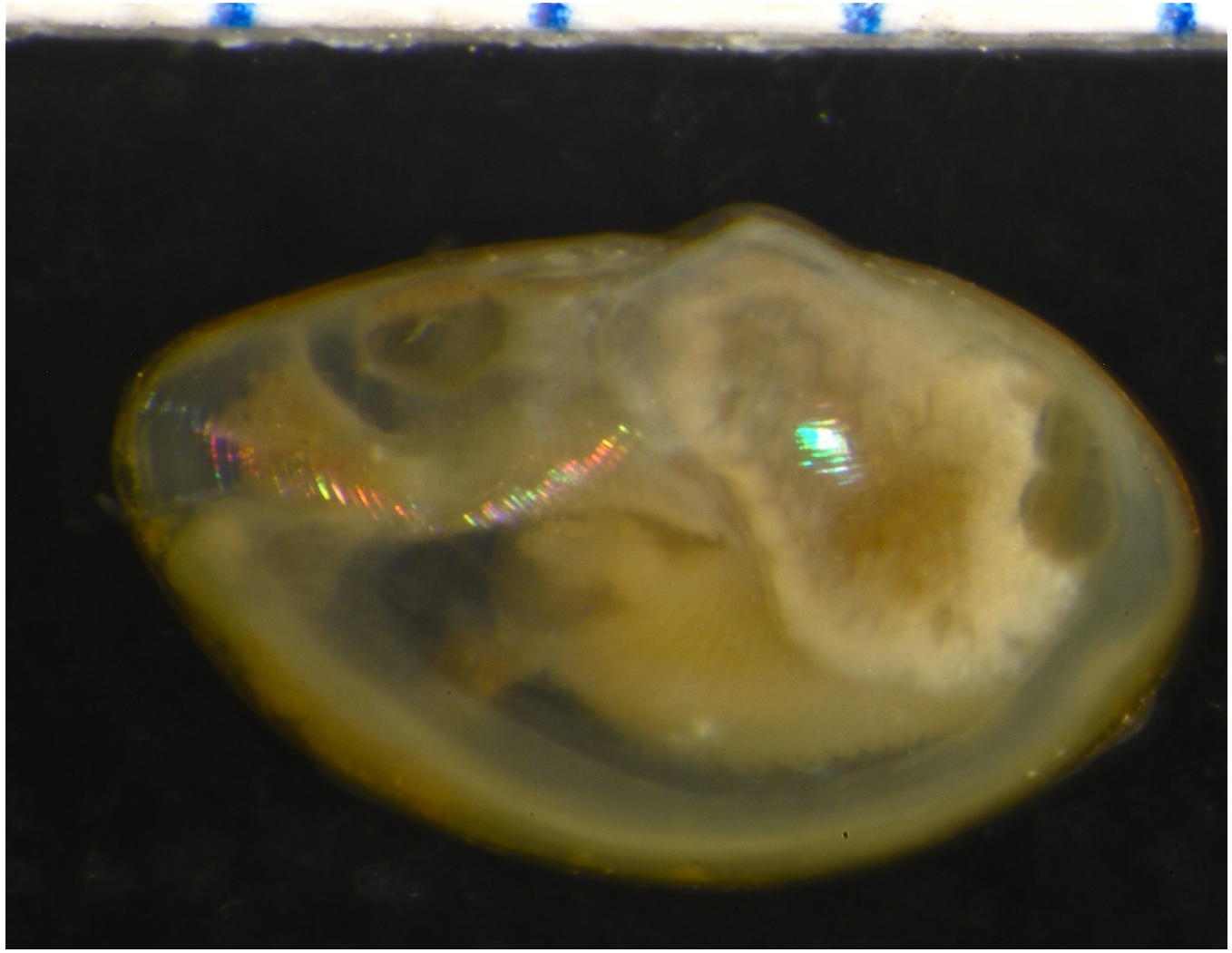


LACSD specimens courtesy of Don Cadien
MMS specimen courtesy of Carol Paquette MBC

Yoldiella

1. **Shell inequilateral to subequilateral**
2. **Periostracum polished**
3. **Sculpture absent, or with weak commarginal striae**
4. **Escutcheon and lunule weak**
5. **Teeth separated by elongate resilifer**
6. **Ligament amphidetic**

Yoldiella nana (M. Sars 1865)

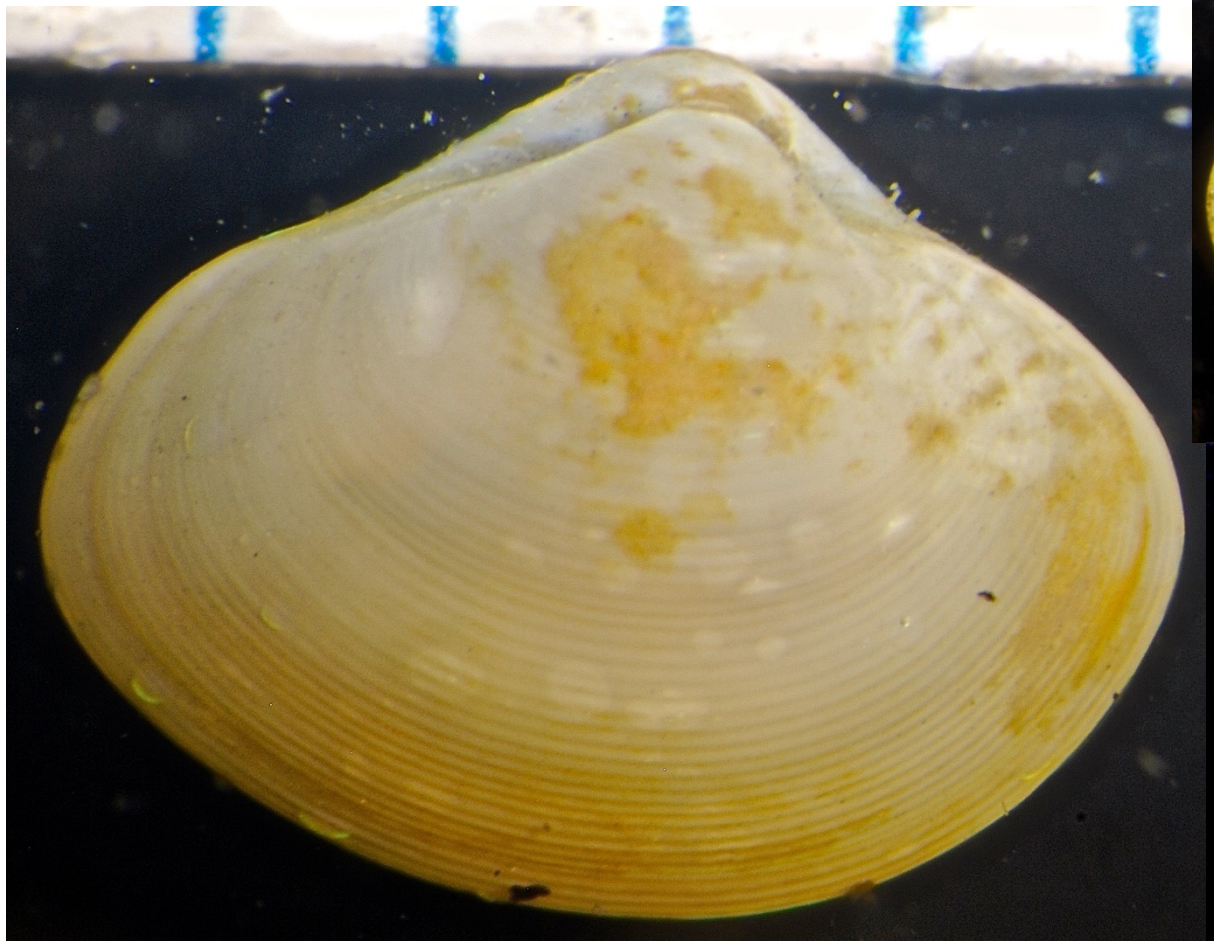


B13 9309 Hueneme to Dume 499m

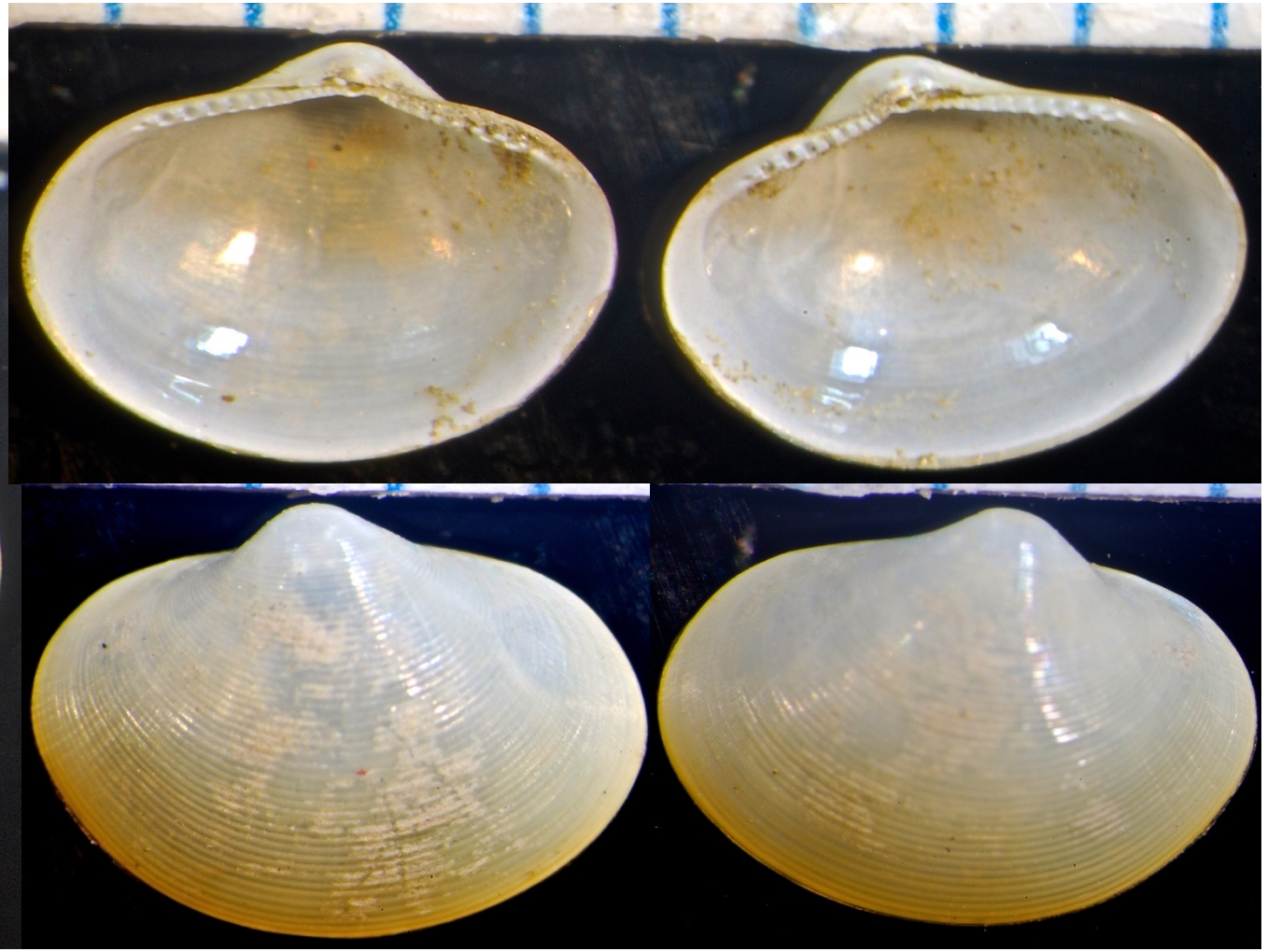
Family Tindariidae

1. Taxodont dentition, continuous with no gap, resilifer absent
2. Ligament opisthodetic, external, partly sunken in groove
3. Hinge teeth V-shaped, on both sides of beaks
4. Inner ventral margin without crenulations

Tindaria kennerlyi (Dall 1897)



MMS I 055-BSS-01-TX 656m 1984

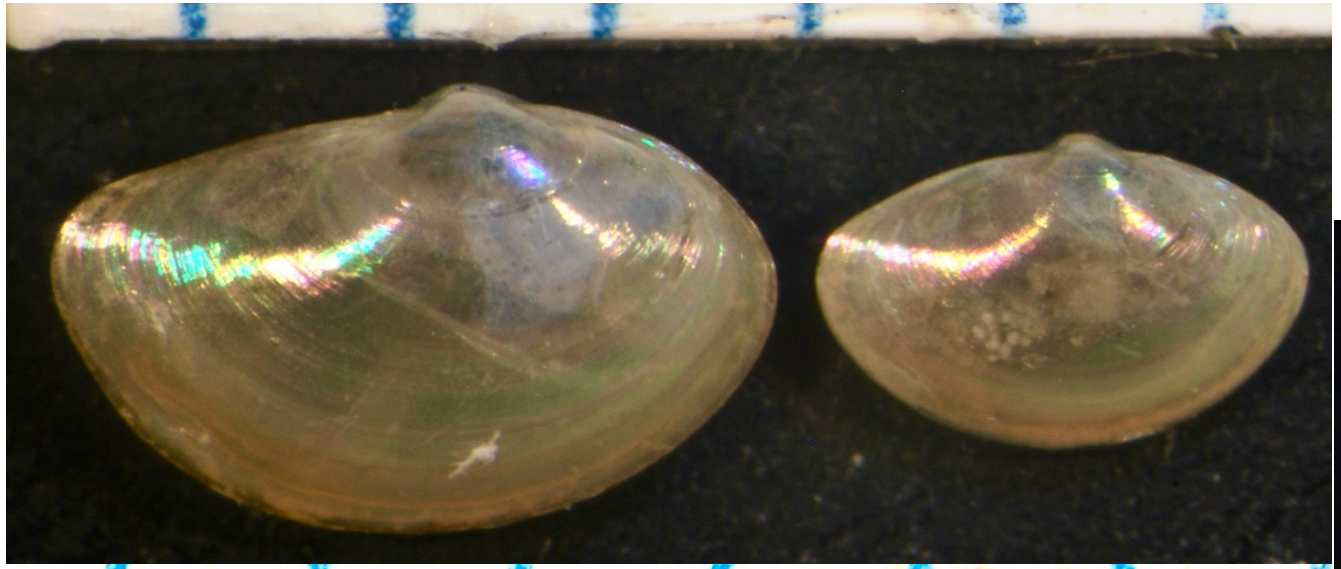


OCSD S-8 600m 1983

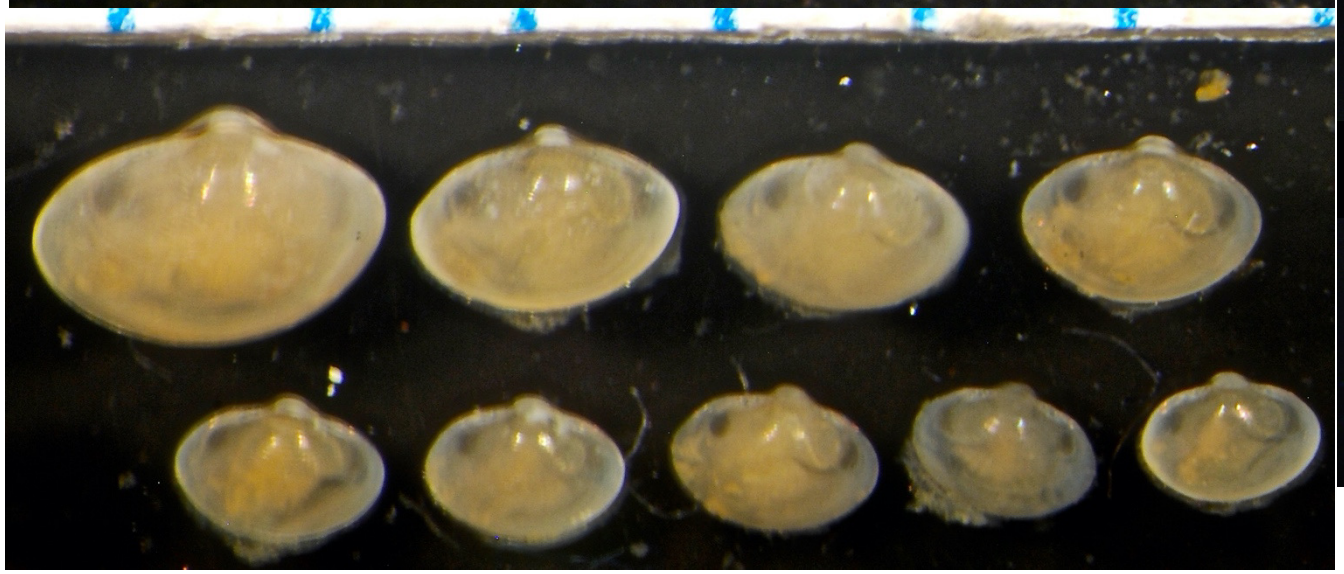
left valve right valve

Specimens courtesy of Carol Paquette MBC

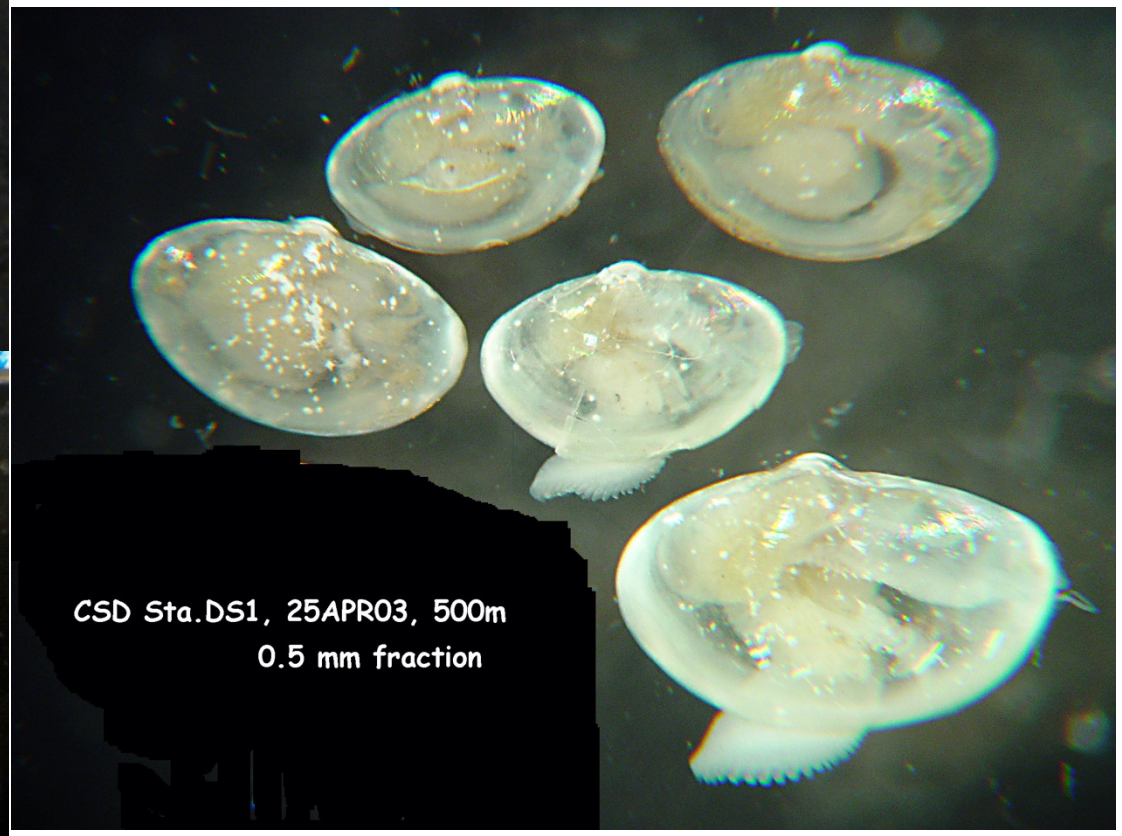
Nuculanida (juvenile)



Yoldiidae *Yoldiella*



Neilonellidae *Neilonella*

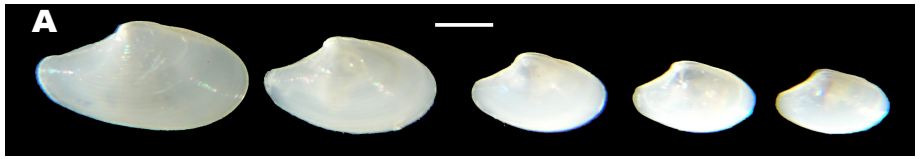


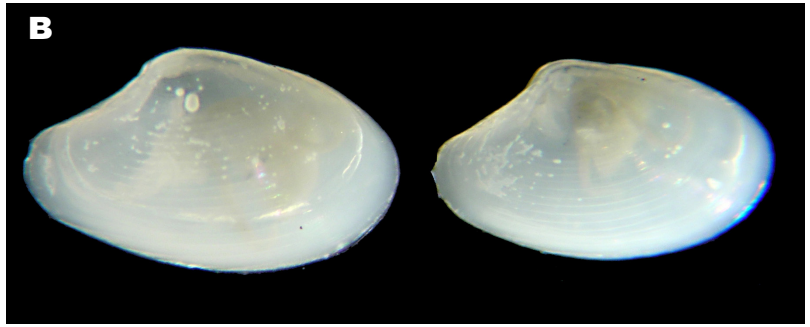
Yoldiidae *Megayoldia*

Nuculanida (juvenile)

Nuculana taphria vs *Yoldia cooperi*

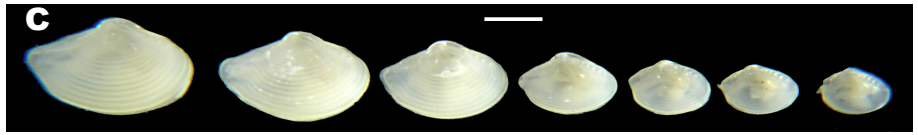
K. Barwick, 2008 (revised 13SEP2021)





Yoldia cooperi Gabb, 1865 - **A**. Juvenile growth series (scale bar = 1 mm), **B**. Detail of smallest specimens in series. (CCSF voucher BSSW, C091,Sept. 1987)

PDF courtesy of Kelvin Barwick



Nuculana taphria (Dall, 1896) - **C**. Juvenile growth series (scale bar = 1mm), **D**. Detail of smallest specimens in series.(CCSF voucher SWOO A134, St. 63 (0.5-1.0mm), 9-23-99)