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# Catalog of Otoliths of Select Fishes from the California Current System

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## Abstract

This catalog contains images and features of sagittal otoliths from 47 species belonging to 17 families of fish found in the California Current System. We focus primarily on mesopelagic species, which are ecologically important yet are less studied than other species. For each sagitta, two images are presented, one with the sulcus up and another with the sulcus down. The linear relationship between standard length (SL) of a fish and major axis length (MAL) of its sagitta is presented for 24 species. Significant variability in SL is explained by MAL for 22 of the 24 species ( $n = 5-61$ ,  $R^2 > 0.61$ ,  $p < 0.05$ ). Collection data and geometric shape features of all otoliths are also presented in tabular format. Our guide will assist researchers in the identification of sagittal otoliths of unknown origin and to estimate fish length from sagittal otolith size.

## Introduction

Otoliths are calcareous structures found in the inner ears of bony fish (Teleostei) and aid in hearing and orientation (Popper and Coombs, 1982; Popper and Lu, 2000). Sagittae, the largest of the three pairs of otoliths, are used in predator-prey and archaeological studies because their species-specific shape allows for the taxonomic classification of otoliths removed from either the guts of marine piscivores or the fossil record (Fitch, 1967; Fitch and Brownell, 1968; Pinkas et al., 1971; Tollit et al., 1997). Regional otolith catalogs are therefore valuable for aiding in taxonomic classification studies.

The size of fish otoliths and standard length (SL) are often linearly related within a species (Trout, 1954; Templeman and Squires, 1956). This relationship can be used to estimate fish size from otolith size (Jobling and Breiby, 1986; Harvey et al., 2000). Otolith and fish size

relationships are useful to researchers who rely on regional otolith catalogs to classify research specimens by allowing them to estimate original fish size from otolith size.

Mesopelagic fish are an important, and often understudied, component of marine ecosystems. In the Pacific Ocean, mesopelagic fish, including those from the families Bathylagidae, Myctophidae, Sternoptychidae, and Stomiidae are prey for ecologically important predators such as marine mammals (Fitch and Brownell, 1968; Treacy and Crawford, 1981), cephalopods (Markaida and Sosa-Nishizaki, 2003), and seabirds (Springer et al., 1999), as well as many commercially important fish, such as tuna, salmon, and billfish (Pinkas et al., 1971; Moteki et al., 2001; Potier et al., 2007; Glaser, 2010). The biomass of mesopelagic fish in the California Current System (CCS) ( $0.77 \times 10^6$  km<sup>2</sup>) has recently been estimated to be 18.5 million metric tons, far exceeding the combined biomass of the Pacific sardine and northern anchovy, the dominant pelagic fish species in the CCS (Hill et al., 2010; Davison, 2011). Mesopelagic fish are an important link in the marine carbon cycle by actively exporting carbon from surface waters to mesopelagic waters during their diel vertical migration (Davison et al., 2013). Given their relative abundance, ecological importance, and underrepresentation in previous otolith reference guides for the northeastern Pacific Ocean (Harvey et al., 2000; Lowry, 2011) and their apparent preponderance in the sediments of the Santa Barbara Basin (SBB; William Jones, unpublished data), mesopelagic fish are a focus of this catalog.

We present photographs of sagittal otoliths from pelagic and mesopelagic fishes of the CCS. Although the catalog was created to assist in classifying fossil otoliths recovered from SBB sediments (William Jones, in preparation), the catalog will be also be useful to researchers studying piscivorous trophic interactions and the archeology of the region. The catalog displays the intra- and inter-specific variation in sagitta morphology using photographs. The catalog also

reports on the variation in otolith shape by presenting a set of 11 different geometric shape features based on linear measurements including major axis length (MAL), minor axis length (mAL), area, and perimeter. Geometric measurements are useful in discriminating between different fish taxa, populations, and fish stocks (Campana and Cassleman, 1993; Felix-Uraga et al., 2005), and therefore a complete list of all 11 geometric shape features for all otoliths in the catalog is provided as well as cruise information, sampling dates, and location, in addition to fish SL and weight. Moreover, the relationship between fish SL and MAL is explored to facilitate estimation of SL from MAL for otoliths of fish of unknown origin.

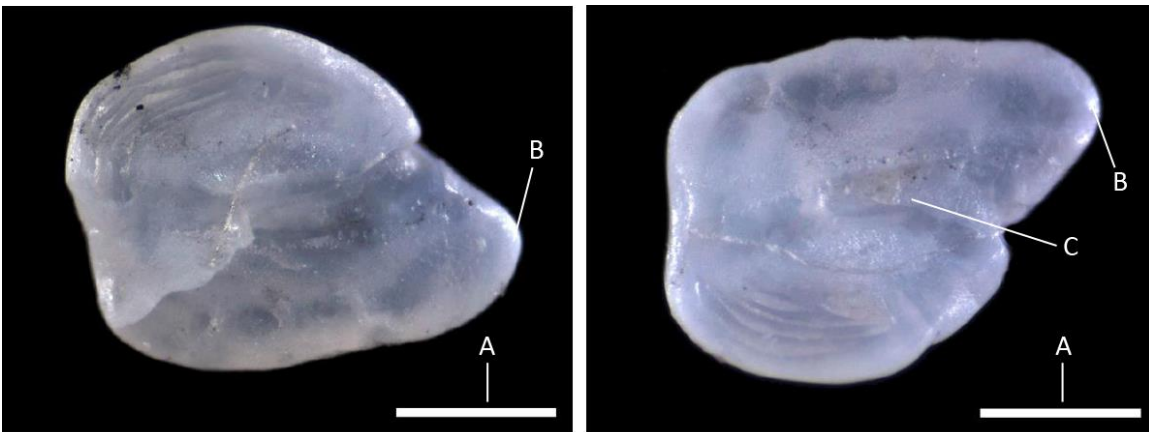
## **Methods**

### *Otolith Collection and Photographic Catalog*

Sagittae collected for this catalog are from common CCS pelagic and mesopelagic fishes. Otoliths were from several sources: (1) the Fitch Otolith Collection at the Natural History Museum of Los Angeles County (LACM), (2) the Scripps Institution of Oceanography Otolith Collection, (3) fish collected during California Cooperative Oceanic Fisheries Investigations (*CalCOFI*), California Current Ecosystem – Long Term Ecological Research (CCE-LTER) Program, National Oceanographic and Atmospheric Administration (NOAA), and Scripps Institution of Oceanography (SIO) research cruises, (4) fish caught off Scripps Pier (La Jolla, CA), and (5) fish from bait barges (San Diego and Oxnard, CA) (Table S1). The first and second sources provided otoliths already isolated and preserved. The third, fourth, and fifth sources provided live fish and therefore additional steps were taken for procuring the otoliths. Fish were stored frozen until thawing, after which sagittae were removed with forceps and a dissecting microscope. Extracted sagittae were soaked in 18 Milli Q water and any excess biological and/or membranous material removed. When possible, SL and weight of frozen fish were recorded

before otoliths were removed (Tables 2 and S1). Fish lengths from the LACM specimens were not available in most cases because several otoliths for each species were preserved in a single vial. On rare occasions, otoliths were held in separate vials enabling their association with the corresponding SL.

Otolith photographs were taken using a standardized approach. Dark field images were acquired using Zeiss compound and Wild dissecting light microscopes with a Spot 5.0 megapixel camera mounted on a trinocular head. For each sagitta, two images were obtained, one with the sulcus up and another with the sulcus down (Figure 1). Multiple otoliths per species were photographed to document variation in otolith structure among individuals and with fish age and size. Media Cybernetics Image-Pro Plus 7.0 software was used to acquire and save images as JPEG files. Adobe Photoshop CS4 was used to adjust JPEG image color, contrast, and orientation. All otoliths are oriented with the rostrum pointing right (Figure 1). Each image contains a 0.5-mm scale bar in the bottom right corner.



**ID: 38, MAL: 1.46 mm, SL: 47 mm**

Figure 1. Example otolith. Both medial surfaces are shown. The fish identification number (ID), otolith major axis length (MAL, mm), and fish standard length (SL, mm) are shown beneath the images. A. 0.5-mm scale bar. B. Rostrum. C. Sulcus.

In the catalog, otoliths are arranged by species and listed under their corresponding family using the Integrated Taxonomic Information System (ITIS) (<http://www.itis.gov>). Families and species are arranged in alphabetical order. We assigned each fish an identification number (ID). The ID, MAL, and SL are shown beneath each pair of images. The ID serves as a numerical link to relevant data contained in Tables 2 and S1.

### *SL-MAL Relationships*

We also investigate the relationship between fish SL and otolith MAL. We expand the number of species over which this relationship is considered by including mesopelagic species not previously investigated. We developed regression equations using a linear least-squares model,  $SL = a*(MAL)+b$ , where SL is fish standard length (mm), MAL is otolith major axis length (mm),  $a$  is the slope, and  $b$  is the intercept of the regression (Table 1).

To test for significance of the linear regression, an analysis of variance (ANOVA) was employed. Regression slopes were considered significantly different than zero (no relationship) for  $p < 0.05$ . Only species for which we had five or more otoliths from different individuals were used in this analysis. Harvey et al. (2000) showed that linear regressions for the left and right otolith did not differ significantly for 62 of the 63 species examined. We therefore assumed that use of a single otolith per fish is sufficient and present results from the use of only one otolith per specimen. All statistical analyses were conducted using R statistical software (<http://www.R-project.org/>).

Otolith length (OL) of a sagitta, the distance from the tip of the rostrum to the posterior edge, is traditionally used to develop the relationship between fish and sagitta sizes using

regression models (Harvey et al., 2000). We used MAL, the longest medial distance of the otolith, measured using computer-based image analysis.

### *Geometric Feature Extraction*

The following image analysis methods made use of MATLAB's Image Processing and Statistics toolboxes. To prepare images for feature extraction, a series of pre-processing steps were used on each original image. First, a color JPEG image was converted to grayscale using the 'rgb2gray' function. Next, a threshold technique was used to create a binary image by isolating the otolith object from the background. All pixels with grayscale intensities above 18 were defined to represent the otolith, while all those below were defined as the dark background. This threshold value worked well on most images, but in some cases, dark regions within or along the edge of an otolith object were falsely defined as background. Other objects were also sometimes identified within the background or touching the main otolith object and incorrectly included as part of the otolith. Images with false backgrounds touching the boundary of the main otolith object were re-processed using a lower threshold, typically eight. False boundary regions located entirely within the otolith boundary and appearing as 'holes' were filled using the 'imfill' function. False objects defined in the background and not connected to the main object were removed using the 'bwareopen' function. False objects found to be touching the main otolith object were removed from the original image using Adobe Photoshop before re-processing.

Once the images were binarized and corrected as described above, the function 'regionprops' was used to extract eight geometric features including area (A), perimeter (P), major axis length (MAL), minor axis length (mAL), equivalent diameter, extent, eccentricity, convex area, and solidity (for feature definitions see

<http://www.mathworks.com/help/images/ref/regionprops.html>). The features roundness

$(4\pi A/(P^2))$ , aspect ratio (MAL/mAL), and ellipticity  $((MAL-mAL)/(MAL+mAL))$  were independently calculated using geometric features extracted by the ‘regionprops’ function. The geometric features area, perimeter, major axis length (MAL), minor axis length (mAL), and equivalent diameter were converted from pixels to mm.

## **Results and Discussion**

### *Image Catalog*

The otolith catalog consists of images from 47 species belonging to 17 families. The mean number of specimens per species included in the catalog was eight (Table 1). Beneath each specimen is an image ID number corresponding to the features found in Tables 2 and S1.

To aid in the first steps of visual classification, a “Family Otolith Image Index” was created (page 22) by selecting otolith images from one or two individuals to represent the general shape of otoliths found within the fish family. The family name within the Family Otolith Image Index links directly to the page in the full otolith catalog where more otolith images of specimens in that family can be found. Family and species page numbers can be found in the “Otolith Image Catalog Contents” (page 25).

### *SL-MAL Relationships*

Not all of the 47 species in the catalog had more than five individuals, the minimum number of samples we required to perform the linear regression of MAL on SL (Table 1). More than half of the species (24) belonging to seven families met this criterion. Of these 24 species, 22 had a statistically significant linear relationship between SL and MAL. Correlation coefficients for *Clupea pallasii* and *Diogenichthys atlanticus* were not statistically significant. The linear models in Table 1 on average account for most of the variance (mean  $R^2 = 0.88$ ) in SL



for all species except for *Diogenichthys atlanticus*, which may be due to its small sample size (n=6). The regression models for other species with small sample sizes should be used with caution. Additionally, it is best to only estimate the fish body size from otoliths that are within the size range of otoliths included in each model (Table 1).

The primary objective of our guide is to assist researchers in the taxonomic classification of unidentified otoliths from the CCS, whether retrieved from marine sediments, Native American middens, or the stomachs and scats of marine piscivores. We expand upon previous catalogs of the Eastern Pacific (Harvey et al., 2000; Lowry, 2011) by including many common mesopelagic fishes found in the CCS, as they remain understudied relative to their importance in the CCS and marine ecosystems globally. In addition to fish and otolith size data, we also present data on collection source and geometric shape features, which may be used and compared to other otolith datasets.

This catalog was constructed in conjunction with the Ph.D. dissertation of William Jones. Jones is using the catalog to classify and reconstruct original fish size for a 2000-year fossil otolith record recovered from SBB sediments.

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**Table 1:** Linear relationships between standard fish length (SL, mm) and otolith major axis length (MAL, mm). For each species, the number of specimens cataloged ( $n_{\text{cat}}$ ), the number of otolith specimens used in regression ( $n_{\text{reg}}$ ), regression slope and intercept, coefficient of determination ( $R^2$ ), standard error of regression slope (SE), and SL range measured in millimeters are given. “nd” indicates no data.

Family	Species	$n_{\text{cat}}$	$n_{\text{reg}}$	slope	intercept	$R^2$	SE	range
Alepocephalidae	<i>Alepocephalus tenebrosus</i>	7	0	nd	nd	nd	nd	nd
Bathylagidae	<i>Bathylagus pacificus</i>	10	0	nd	nd	nd	nd	nd
	<i>Bathylagus wesethi</i>	12	33	50.79	-17.7	0.8	5.27	[28,76]
	<i>Leuroglossus stilbius</i>	9	22	26.23	10.53	0.96	4.71	[27,97]
	<i>Lipolagus ochotensis</i>	6	11	21.87	10.24	0.91	1.99	[31,48]
Clupeidae	<i>Clupea pallasii</i>	12	5	77	-101.54	0.53	27.09	[159,240]
	<i>Sardinops sagax</i>	9	0	nd	nd	nd	nd	nd
Engraulidae	<i>Engraulis mordax</i>	12	0	nd	nd	nd	nd	nd
Gonostomatidae	<i>Gonostoma elongatum</i>	4	0	nd	nd	nd	nd	nd
Melamphaidae	<i>Melamphaes parvus</i>	11	0	nd	nd	nd	nd	nd
	<i>Scopelogadus mizolepis bispinosus</i>	9	9	39.39	-18.17	0.9	6.38	[39,85]
Merlucciidae	<i>Merluccius productus</i>	8	9	24.05	-14.77	0.97	14.3	[32,271]
Myctophidae	<i>Ceratoscopelus townsendi</i>	12	28	18.87	3.4	0.98	1.22	[21,52]
	<i>Diaphus theta</i>	12	57	27.2	-10.02	0.76	3.71	[17,73]
	<i>Diogenichthys atlanticus</i>	12	6	14.86	5.78	0.62	1.66	[16,22]
	<i>Diogenichthys lanternatus</i>	8	5	15.83	5.86	0.88	1.32	[17,25]
	<i>Myctophum nitidulum</i>	12	0	nd	nd	nd	nd	nd
	<i>Nannobranchium regale</i>	12	0	nd	nd	nd	nd	nd
	<i>Nannobranchium ritteri</i>	11	47	56.21	-6.84	0.97	3.58	[21,93]
	<i>Parvilux ingens</i>	9	0	nd	nd	nd	nd	nd
	<i>Protomyctophum crockeri</i>	8	10	11.87	6.85	0.61	4.81	[16,35]
	<i>Stenobranchiu leucopsaurus</i>	12	61	40.55	0.83	0.98	3.22	[19,98]
	<i>Symbolophorus californiensis</i>	9	5	17.81	7.5	0.95	3.73	[27,61]
	<i>Tarletonbeania crenularis</i>	6	39	34.9	1.49	0.92	3.12	[25,72]
<i>Triphotorus mexicanus</i>	12	46	39.29	11.67	0.9	3.3	[23,68]	
Nemichthyidae	<i>Nemichthys scolopaceus</i>	11	0	nd	nd	nd	nd	nd
Notosudidae	<i>Scopelosaurus harryi</i>	11	5	17.77	24.97	847	1.51	[43,52]
Ophidiidae	<i>Chilara taylori</i>	1	0	nd	nd	nd	nd	nd
Paralepididae	<i>Arctozenus risso</i>	1	0	nd	nd	nd	nd	nd
	<i>Lestidiops ringens</i>	1	0	nd	nd	nd	nd	nd
Phosichthyidae	<i>Vinciguerria lucetia</i>	12	0	nd	nd	nd	nd	nd
Scopelarchidae	<i>Benthalbella dentate</i>	2	0	nd	nd	nd	nd	nd

Family	Species	n <sub>cat</sub>	n <sub>reg</sub>	slope	intercept	R <sup>2</sup>	SE	range
Scorpaenidae	<i>Sebastes goodei</i>	6	6	18.96	7.96	0.98	1.68	[26,50]
	<i>Sebastes hopkinsi</i>	6	6	20.77	8.64	0.95	1.55	[24,39]
	<i>Sebastes jordani</i>	6	6	16.92	16.14	1	0.8	[30,59]
	Unknown spp.	6	6	31.96	-61.58	0.96	5.37	[91,154]
Sternoptychidae	<i>Argyrolepecus affinis</i>	7	9	45.59	-9.48	0.96	2.97	[19,66]
	<i>Argyrolepecus lychnus</i>	3	0	nd	nd	nd	nd	nd
	<i>Argyrolepecus sladeni</i>	3	0	nd	nd	nd	nd	nd
	<i>Danaphos oculatus</i>	11	6	37.71	-3.64	0.97	1.11	[24,38]
	<i>Sternoptyx diaphana</i>	9	0	nd	nd	nd	nd	nd
	<i>Sternoptyx obscura</i>	9	5	53.74	-6.31	0.88	1.84	[20,31]
	<i>Sternoptyx pseudobscura</i>	1	0	nd	nd	nd	nd	nd
Stomidae	<i>Chauliodus macouni</i>	11	0	nd	nd	nd	nd	nd
	<i>Idiacanthus antrostomus</i>	12	0	nd	nd	nd	nd	nd
	<i>Stomias atriventer</i>	2	0	nd	nd	nd	nd	nd
	<i>Tactostoma macropus</i>	12	0	nd	nd	nd	nd	nd

**Table 2:** Fish standard length and geometric shape features of otoliths. For each otolith, a fish identification number (ID), standard length (SL) of fish, otolith area (A), perimeter (P), major axis length (MAL), and minor axis length (mAL) are provided. SL, P, MAL, and mAL are in millimeters and A in mm<sup>2</sup>. “nd” indicates no data.

Family	Species	ID	SL	A	P	MAL	mAL
Alepocephalidae	<i>Alepocephalus tenebrosus</i>	38	47	1.169	6.225	1.462	1.045
		1712	nd	2.668	6.956	2.296	1.518
		1713	nd	3.248	7.977	2.543	1.673
		1714	nd	3.232	7.743	2.569	1.644
		1715	nd	2.726	7.183	2.336	1.527
		1716	nd	5.57	10.389	3.463	2.113
		1717	142	5.555	10.373	3.512	2.077
Bathylagidae	<i>Bathylagus Pacificus</i>	1513	nd	4.018	11.338	3.384	1.612
		1515	nd	3.598	10.918	3.32	1.534
		1520	nd	3.822	11.156	3.34	1.551
		1521	nd	3.724	11.364	3.449	1.534
		1522	nd	3.05	10.896	3.039	1.446
		1524	nd	3.107	10.531	3.076	1.441
		1526	128	4.173	11.206	3.569	1.706
		1527	nd	3.318	10.334	3.513	1.314
		1528	nd	3.757	10.339	3.486	1.492
	1529	nd	5.313	12.023	3.826	1.914	
	<i>Bathylagus wesethi</i>	66	57	0.784	4.996	1.555	0.698
		76	55	0.794	5.48	1.425	0.747
		78	63	0.893	6.006	1.582	0.768
		80	37	0.399	3.605	0.982	0.544
		580	47	0.644	5.371	1.366	0.628
		582	45	0.547	4.362	1.184	0.628
		588	23	0.232	2.792	0.768	0.4
		601	44	0.613	4.006	1.282	0.647
		602	45	0.651	4.193	1.399	0.629
603		47	0.69	3.99	1.34	0.686	
605	nd	1.003	5.778	1.685	0.808		
628	52	0.632	3.815	1.249	0.667		
<i>Leuroglossus stilbus</i>	555	27	0.266	2.773	0.776	0.454	
	672	42	0.429	3.065	1.027	0.554	
	722	44	0.493	3.512	1.153	0.574	
	972	83	0.471	4.03	1.358	0.477	
	973	95	2.522	8.395	2.938	1.157	
	981	73	0.384	3.209	1.146	0.454	
	982	87	0.622	6.258	1.452	0.575	
	985	65	0.365	3.064	1.135	0.434	
	1757	nd	1.727	7.136	2.507	1.003	
<i>Lipolagus ochotensis</i>	454	45	0.83	5.004	1.635	0.683	
	455	48	0.88	5.646	1.735	0.706	

Family	Species	ID	SL	A	P	MAL	mAL		
		456	45	0.783	4.75	1.54	0.689		
		457	42	0.775	4.681	1.524	0.682		
		661	31	0.388	3.041	1.009	0.512		
		668	42	0.601	3.869	1.336	0.611		
Clupeidae	<i>Clupea pallasii</i>	2028	159	4.123	10.458	3.347	1.655		
		2029	159	4.058	10.596	3.39	1.618		
		2032	240	5.658	12.271	3.95	1.9		
		2033	168	4.999	11.919	3.738	1.785		
		2034	190	5.941	13.007	4.064	1.942		
		2035	nd	5.398	12.322	4.086	1.806		
		2036	nd	4.614	10.89	3.597	1.768		
		2041	nd	1.397	5.71	1.851	1.002		
		2043	nd	4.792	13.131	3.81	1.695		
		2048	nd	7.989	14.453	4.964	2.114		
		2051	nd	5.201	12.923	4.16	1.718		
		2055	nd	7.371	14.16	4.794	2.012		
			<i>Sardinops sagax</i>	1115	101.3	3.258	12.081	3.363	1.333
				1117	136.5	3.139	10.576	3.352	1.307
				1118	139.3	3.857	12.209	3.608	1.52
				1119	119.3	3.705	12.11	3.646	1.385
				1120	112.2	3.556	10.538	3.294	1.471
	2500	nd		0.933	5.142	1.579	0.785		
	2501	nd		1.218	6.537	1.888	0.869		
	2502	nd		1.275	6.223	1.941	0.882		
	2504	nd		0.961	5.741	1.624	0.806		
Engraulidae	<i>Engraulis mordax</i>	1301		109	3.929	16.422	3.097	1.657	
		1302	113	4.221	14.964	3.459	1.59		
		1319	114	4.331	15.638	3.407	1.633		
		1321	111	4.611	14.403	3.537	1.693		
		1324	120	4.672	15.557	3.515	1.727		
		1328	105	3.232	11.197	2.934	1.432		
		1346	112	4.223	15.489	3.438	1.6		
		1353	114	4.597	15.554	3.695	1.601		
		1368	119	3.637	10.105	3.293	1.442		
		1372	109	3.403	8.839	3.097	1.431		
		1373	103	11.175	14.833	5.64	2.552		
		1384	104	3.459	9.122	3.198	1.408		
		Gonostomatidae	<i>Gonostoma elongatum</i>	1907	160	0.354	2.993	0.941	0.534
1908	175			0.468	3.14	0.92	0.694		
1909	193			0.592	4.048	1.197	0.718		
1912	245			0.237	2.843	0.902	0.423		
Melamphaidae	<i>Melamphaes parvus</i>	1718	nd	5.111	11	3.578	1.835		
		1719	nd	4.663	10.692	3.397	1.763		
		1720	nd	4.479	9.629	3.371	1.705		
		1721	nd	5.018	11.031	3.578	1.801		

Family	Species	ID	SL	A	P	MAL	mAL
		1722	nd	4.163	9.585	3.254	1.64
		1723	nd	4.407	9.576	3.301	1.716
		1724	nd	5.046	10.735	3.555	1.818
		1725	nd	4.29	9.642	3.321	1.656
		1726	nd	4.863	10.32	3.543	1.76
		1728	nd	4.797	10.789	3.521	1.749
		1729	nd	4.779	10.344	3.506	1.749
	<i>Scopelogadus mizolepis</i>	69	39	1.212	5.468	1.349	1.148
		70	40	1.547	5.849	1.509	1.311
		71	48	2.61	8.226	1.989	1.675
		89	60	2.838	8.783	2.131	1.7
		550	85	4.206	10.391	2.411	2.226
		90	40	1.345	4.949	1.404	1.223
		91	42	1.671	5.906	1.525	1.4
		92	42	1.509	5.661	1.504	1.28
		137	83	4.383	10.694	2.491	2.246
Merlucciinae	<i>Merluccius productus</i>	1500	nd	14.878	19.732	7.069	2.739
		1503	nd	15.306	19.554	7.113	2.803
		1504	nd	14.768	19.949	7.102	2.708
		1506	nd	18.777	21.857	7.677	3.177
		1507	nd	15.756	19.851	7.188	2.844
		1508	nd	13.752	18.204	6.745	2.646
		1509	50	1.468	5.647	2.174	0.879
		1512	32	2.241	7.112	2.538	1.145
Myctophidae	<i>Ceratoscopelus townsendi</i>	14	52	2.743	8.78	2.539	1.395
		15	50	2.911	8.983	2.417	1.548
		16	26	0.803	4.913	1.241	0.83
		19	23	0.586	4.435	1.041	0.722
		20	23	0.581	4.021	1.053	0.708
		21	32	1.187	5.586	1.546	0.99
		24	23	0.576	4.03	1.038	0.715
		25	27	0.88	5.254	1.268	0.892
		26	27	0.909	5.074	1.326	0.88
		27	28	0.781	4.518	1.218	0.832
		28	23	0.594	4.361	1.05	0.726
		29	46	2.612	9.009	2.224	1.536
	<i>Diaphus theta</i>	39	45	3.125	8.791	2.194	1.838
		45	55	4.038	10.859	2.553	2.054
		108	31	1.706	6.939	1.654	1.334
		435	17	0.333	2.342	0.714	0.598
		442	24	0.902	4.729	1.183	0.99
		443	17	0.356	2.478	0.736	0.625
		652	40	2.175	6.461	1.891	1.504
		653	41	2.25	6.578	1.925	1.521
		657	40	2.124	6.365	1.848	1.49



Family	Species	ID	SL	A	P	MAL	mAL
		903	53	3.09	7.617	2.228	1.811
		904	63	4.299	9.864	2.658	2.11
		1043	59	3.702	8.471	2.487	1.933
	<i>Diogenichthys atlanticus</i>	22	21	0.556	3.119	0.892	0.8
		31	22	0.63	3.756	0.984	0.825
		93	16	0.365	3.022	0.737	0.634
		1664	nd	0.535	3.049	0.912	0.755
		1666	nd	0.701	3.529	1.008	0.894
		1667	nd	0.482	2.924	0.85	0.731
		1669	nd	0.694	3.485	1.006	0.886
		1670	nd	0.695	3.492	1.006	0.887
		1932	nd	0.706	3.524	1.022	0.887
		1941	17	0.451	2.945	0.81	0.716
		1942	18	0.432	2.846	0.8	0.693
		1943	20	0.775	3.796	1.08	0.926
	<i>Diogenichthys lanternatus</i>	1630	nd	0.933	3.941	1.181	1.016
		1638	nd	0.859	3.836	1.1	1.006
		1847	17	0.424	2.778	0.772	0.705
		1848	24	0.726	3.648	1.021	0.912
		1850	19	0.49	3.338	0.832	0.757
		1851	23	0.758	4	1.033	0.944
		1852	25	0.863	3.981	1.095	1.009
		1858	25	1.102	5.038	1.279	1.111
	<i>Myctophum nitidulum</i>	1802	nd	2.854	6.789	2.049	1.786
		1803	nd	4.604	8.697	2.635	2.233
		1804	nd	2.552	6.673	1.948	1.676
		1810	nd	3.976	8.047	2.405	2.118
		1882	52	3.91	8.718	2.319	2.169
		1884	nd	3.528	7.719	2.2	2.053
		1886	nd	3.86	8.181	2.282	2.17
		1888	nd	3.921	8.414	2.313	2.18
		1889	40	2.372	6.434	1.832	1.657
		1890	35	1.856	5.558	1.631	1.453
		1893	nd	2.088	6.118	1.698	1.581
		1896	nd	2.526	6.733	1.855	1.742
	<i>Nannobranchium regale</i>	47	23	0.276	2.181	0.62	0.571
		64	46	0.714	3.965	1.166	0.785
		434	33	0.333	2.76	0.711	0.603
		1531	nd	3.912	8.024	2.375	2.129
		1532	nd	2.398	6.28	1.951	1.588
		1533	nd	4.441	8.54	2.628	2.18
		1534	nd	2.522	6.391	1.99	1.631
		1536	nd	2.157	6.801	1.862	1.491
		1537	nd	3.797	8.17	2.578	1.906
		1538	nd	2.114	6.677	1.868	1.451

Family	Species	ID	SL	A	P	MAL	mAL
		1539	nd	2.649	7.573	2.067	1.668
		2507	nd	0.698	4.466	1.042	0.867
	<i>Nannobranchium ritteri</i>	140	93	1.745	6.106	1.713	1.319
		143	90	1.928	6.206	1.831	1.365
		146	78	1.503	5.481	1.502	1.294
		147	82	1.566	6.467	1.629	1.239
		444	40	0.456	3.192	0.857	0.684
		445	36	0.35	2.666	0.785	0.574
		446	37	0.446	3.317	0.868	0.662
		447	35	0.388	3.11	0.796	0.626
		448	59	0.842	4.219	1.194	0.914
		449	55	0.717	3.658	1.075	0.855
		450	51	0.606	3.643	1.09	0.723
	<i>Parvilux ingens</i>	1604	nd	0.744	3.507	1.06	0.906
		1607	nd	0.716	3.437	1.133	0.815
		1608	nd	0.734	3.581	1.151	0.825
		1612	nd	0.911	3.937	1.278	0.915
		1614	nd	0.738	3.593	1.062	0.895
		1866	nd	2.692	7.97	2.288	1.503
		1867	nd	3.016	7	2.324	1.679
		1868	nd	3.004	7.152	2.336	1.665
		1869	nd	0.891	3.839	1.183	0.968
	<i>Stenobranchius leucopsaurus</i>	13	62	1.62	6.837	1.621	1.295
		110	52	1.131	5.095	1.341	1.088
		468	54	1.021	4.71	1.234	1.066
		469	60	1.497	5.548	1.55	1.25
		472	57	1.208	5.255	1.371	1.135
		473	61	1.626	5.875	1.618	1.3
		475	47	0.827	4.017	1.158	0.917
		478	28	0.329	2.832	0.71	0.594
		821	29	0.302	2.289	0.673	0.577
		823	25	0.239	2.11	0.613	0.503
		825	31	0.379	2.597	0.764	0.637
		863	38	0.484	3.056	0.867	0.721
	<i>Symbolophorus californiensis</i>	107	43	2.916	9.164	2.19	1.704
		148	61	4.691	10.932	2.772	2.169
		551	28	0.657	3.44	1.045	0.804
		552	27	0.646	3.865	1.07	0.772
		691	73	0.476	3.581	0.892	0.684
		692	76	0.482	3.455	0.902	0.685
		694	77	0.457	3.23	0.879	0.667
		697	85	0.539	3.748	0.931	0.741
		699	86	0.534	3.416	0.976	0.702
	<i>Tarletonbeania crenularis</i>	711	26	0.433	3.963	0.808	0.689
		712	42	0.892	4.018	1.169	0.986

Family	Species	ID	SL	A	P	MAL	mAL
		713	27	0.431	3.025	0.797	0.693
		714	25	0.36	2.521	0.724	0.641
		715	49	1.496	5.179	1.485	1.301
		716	39	0.733	3.716	1.032	0.917
	<i>Triphoturus mexicanus</i>	12	52	0.749	3.879	1.029	0.936
		149	64	1.3	4.94	1.354	1.232
		150	66	1.174	4.729	1.288	1.174
		451	58	1.328	5.734	1.368	1.249
		452	51	0.694	3.99	0.978	0.912
		453	59	1.09	4.675	1.249	1.122
		533	68	1.331	5.151	1.427	1.198
		534	60	1.208	4.784	1.337	1.155
		535	53	0.855	3.951	1.142	0.961
		536	36	0.381	2.86	0.703	0.697
		537	23	0.131	1.661	0.427	0.394
		538	38	0.362	2.745	0.707	0.655
Nemichthyidae	<i>Nemichthys scolopaceus</i>	1579	nd	0.554	3.059	0.926	0.768
		1580	nd	0.335	2.38	0.713	0.602
		1584	nd	0.489	2.864	0.887	0.712
		1585	nd	0.648	3.375	1.013	0.818
		1586	nd	nd	nd	nd	nd
		1587	nd	0.519	2.994	0.943	0.706
		1588	nd	0.365	2.507	0.733	0.638
		1589	nd	0.614	3.312	0.979	0.804
		1590	nd	0.836	4.052	1.149	0.934
		1863	840	0.338	2.655	0.707	0.611
		1865	856	0.232	2.213	0.589	0.504
Notosudidae	<i>Scopelosaurus harryi</i>	40	43	0.262	2.9	1.012	0.336
		94	50	0.518	4.36	1.435	0.47
		96	48	0.48	3.914	1.387	0.452
		104	52	0.506	3.97	1.408	0.469
		105	48	0.459	4.113	1.298	0.46
		1899	129	2.473	7.799	3.051	1.054
		1900	nd	5.176	11.471	4.488	1.496
		1901	nd	1.558	6.251	2.411	0.844
		1902	nd	4.667	11.011	4.226	1.467
		1903	nd	4.581	10.865	4.202	1.43
		1905	nd	1.388	6.016	2.328	0.776
Ophidiidae	<i>Chilara taylori</i>	476	55	0.088	1.474	0.391	0.291
Paralepididae	<i>Arctozenus risso</i>	482	124	1.632	6.543	1.865	1.143
Paralepididae	<i>Lestidiops ringens</i>	73	85	0.518	3.355	1.078	0.616
Phosichthyidae	<i>Vinciguerria lucetia</i>	1671	nd	1.023	4.48	1.46	0.923
		1672	nd	0.792	3.949	1.292	0.811
		1675	nd	1.033	4.727	1.559	0.895

Family	Species	ID	SL	A	P	MAL	mAL
		1677	nd	0.946	4.305	1.436	0.869
		1679	nd	1.148	5.182	1.594	0.984
		1680	nd	1.426	5.478	1.732	1.096
		1681	nd	0.8	3.997	1.284	0.824
		1683	nd	0.941	4.233	1.415	0.873
		1684	nd	0.894	4.238	1.314	0.895
		1685	nd	1.011	4.806	1.544	0.896
		1686	nd	0.895	4.251	1.423	0.835
		1973	47	0.74	4.274	1.309	0.752
Scopelarchidae	<i>Benthalbella dentata</i>	87	36	0.126	1.701	0.443	0.362
		88	37	0.172	2.062	0.56	0.394
Sebastidae	<i>Sebastes goodei</i>	1150	26.4	0.573	3.474	1.07	0.709
		1151	32.79	0.784	4.537	1.255	0.824
		1152	49.62	2.299	7.119	2.293	1.314
		1153	49.47	2.069	8.621	2.097	1.294
		1154	37.61	1.181	5.068	1.548	1.004
		1155	32.18	0.777	3.872	1.245	0.819
	<i>Sebastes hopkinsi</i>	1156	24.93	0.256	2.181	0.745	0.443
		1157	24.44	0.313	2.494	0.842	0.481
		1158	38.31	0.846	4.161	1.385	0.796
		1159	28.62	0.381	2.702	0.904	0.551
		1160	39.15	0.909	4.266	1.439	0.817
		1161	33.78	0.747	3.772	1.3	0.745
	<i>Sebastes jordani</i>	1162	30.57	0.429	2.91	0.872	0.643
		1163	59.22	2.666	7.77	2.568	1.346
		1164	31.42	0.41	2.964	0.861	0.611
		1165	33.4	0.549	3.284	1.082	0.662
		1166	43.81	1.154	5.139	1.62	0.937
		1167	46.03	1.273	5.322	1.718	0.968
	<i>Sebastes Spp.</i>	2400	91	12.004	14.71	4.706	3.293
		2401	111	15.573	17.072	5.343	3.786
		2402	132	20.918	19.635	6.183	4.363
		2403	154	22.227	20.412	6.578	4.367
		2409	97	13.331	15.463	4.891	3.5
		2410	105	15.136	16.786	5.449	3.602
Sternoptychidae	<i>Argyropelecus affinis</i>	74	47	0.719	4.525	1.255	0.734
		119	nd	nd	nd	nd	nd
		120	44	0.67	3.959	1.233	0.697
		121	49	0.757	4.049	1.295	0.75
		139	55	0.903	4.805	1.48	0.782
		145	66	1.033	4.949	1.518	0.875
		594	29	0.356	3.208	0.861	0.529
	<i>Argyropelecus lychnus</i>	2508	nd	0.709	4.676	1.356	0.694
		589	22	0.195	2.257	0.638	0.393

Family	Species	ID	SL	A	P	MAL	mAL
		590	30	0.343	2.835	0.887	0.496
	<i>Argyropelecus sladeni</i>	117	41	0.459	4.051	1.087	0.541
		118	41	0.407	3.157	1.027	0.515
		439	29	0.312	3.126	0.83	0.486
	<i>Danophos oculatus</i>	101	36	0.684	3.321	1.054	0.83
		567	35	0.694	4.26	1.084	0.821
		568	23	0.313	2.918	0.718	0.557
		569	23	0.276	2.169	0.686	0.515
		570	21	0.21	2.177	0.575	0.466
		640	25	0.352	2.572	0.777	0.582
		641	28	0.374	2.556	0.797	0.601
		642	32	0.541	3.221	0.975	0.714
		643	24	0.327	2.346	0.746	0.559
		645	36	0.666	3.448	1.032	0.829
		646	38	0.766	3.78	1.105	0.892
	<i>Sternoptyx diaphana</i>	1554	nd	0.339	2.377	0.71	0.614
		1555	nd	0.287	2.21	0.674	0.55
		1556	nd	0.321	2.304	0.718	0.572
		1557	nd	0.499	2.896	0.927	0.695
		1558	nd	0.318	2.316	0.754	0.541
		1559	nd	0.327	2.278	0.723	0.579
		1561	nd	0.313	2.195	0.705	0.567
		1562	nd	0.279	2.282	0.652	0.558
		1563	nd	0.305	2.209	0.682	0.576
	<i>Sternoptyx obscura</i>	46	31	0.3	2.185	0.663	0.582
		85	30	0.26	2.104	0.654	0.516
		1650	nd	0.246	1.974	0.613	0.515
		1651	nd	0.245	1.949	0.615	0.51
		1653	20	0.163	1.625	0.505	0.414
		1654	nd	0.457	2.745	0.836	0.7
		1655	nd	0.422	2.644	0.811	0.666
		1656	30	0.31	2.403	0.718	0.555
		1657	30	0.3	2.313	0.672	0.572
	<i>Sternoptyx pseudobscura</i>	113	41	0.348	2.359	0.74	0.604
Stomiidae	<i>Chauliodus macouni</i>	115	38	0.027	0.78	0.198	0.172
		142	122	0.23	2.125	0.561	0.522
		1615	nd	0.451	2.71	0.839	0.689
		1616	nd	0.396	2.492	0.78	0.648
		1618	nd	0.513	2.934	0.86	0.767
		1619	nd	0.256	2.038	0.617	0.529
		1621	nd	0.621	3.192	0.977	0.816
		1623	nd	0.507	2.808	0.9	0.719
		1625	nd	0.514	2.923	0.909	0.722
		1627	nd	0.525	2.947	0.883	0.763
		1954	214	0.557	3.194	0.915	0.779

Family	Species	ID	SL	A	P	MAL	mAL		
	<i>Idiacanthus antrostomus</i>	106	91	0.118	1.564	0.447	0.336		
		135	329	0.581	3.821	1.142	0.656		
		1594	nd	0.495	2.886	0.96	0.664		
		1595	nd	0.347	2.525	0.88	0.507		
		1596	nd	0.51	2.979	1.045	0.626		
		1598	nd	0.354	2.542	0.9	0.509		
		1600	nd	0.555	3.234	1.15	0.618		
		1961	nd	0.564	3.298	1.158	0.632		
		1966	nd	0.416	3.268	0.901	0.588		
		1970	220	0.31	2.548	0.788	0.506		
		1971	257	0.381	2.944	0.933	0.522		
		1972	352	0.708	3.895	1.313	0.699		
			<i>Stomias atriventer</i>	141	187	0.476	3.159	0.816	0.744
				564	nd	nd	nd	nd	nd
	<i>Tactostoma macropus</i>	1645	nd	0.695	3.529	1.006	0.887		
		1646	nd	0.348	2.479	0.72	0.62		
		1647	nd	0.339	2.495	0.714	0.606		
		1648	nd	0.386	2.668	0.784	0.634		
		1649	nd	0.377	2.64	0.78	0.621		
		1875	nd	0.281	2.167	0.665	0.542		
		1876	148	0.302	2.442	0.664	0.58		
		1877	185	0.483	2.851	0.839	0.736		
		1878	nd	0.668	3.716	1.113	0.775		
		1879	nd	0.667	3.495	1.076	0.8		
		1880	nd	0.685	3.376	1.001	0.881		
		1881	nd	0.702	3.565	1.026	0.88		

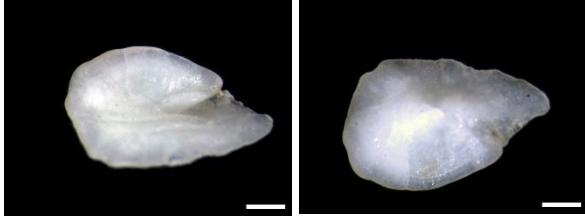
## Otolith Image Family Index

Images of examples of otoliths representing the 17 fish families in this catalog. Family names link directly to the page in the full otolith catalog where more otolith images of specimens in that family can be found. Family and species page numbers can be found in the otolith image catalog contents on page 25.

### Family, Example Species (Fish ID)

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[Alepocephalidae](#), *Alepocephalus tenebrosus* (ID: 1714)



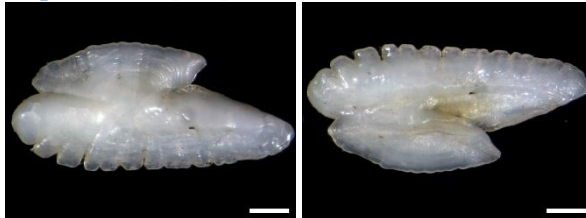
[Bathylagidae](#), *Bathylagus pacificus* (ID: 1515)



*Lipolagus ochotensis* (ID: 457)



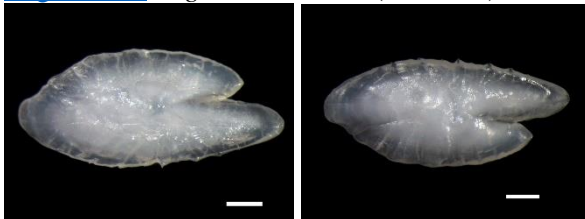
[Clupeidae](#), *Clupea pallasii* (ID: 2028)



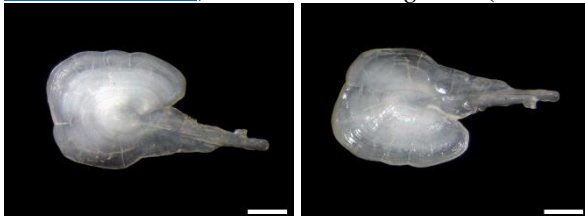
*Sardinops sagax* (ID: 1117)



[Engraulidae](#), *Engraulis mordax* (ID: 1321)

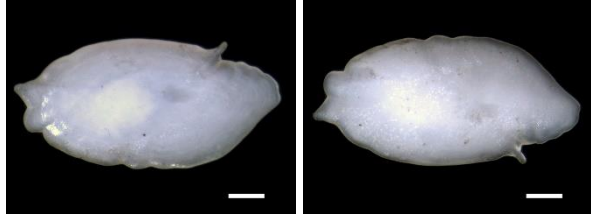


[Gonostomatidae](#), *Gonostoma elongatum* (ID: 1909)

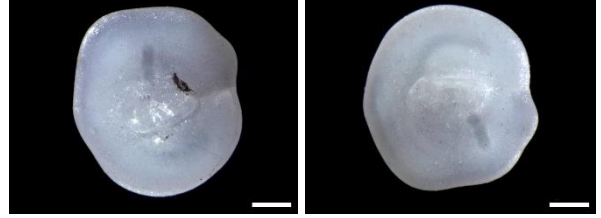


**Family, Example Species (Fish ID)**

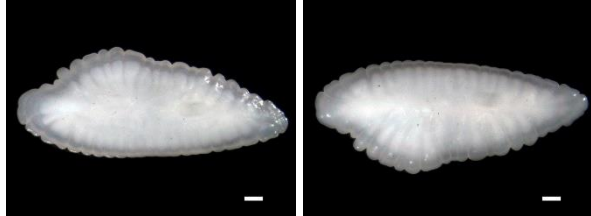
[Melamphaidae](#), *Melamphaes parvus* (ID: 1724)



*Scopelogadus mizolepis* (ID: 550)



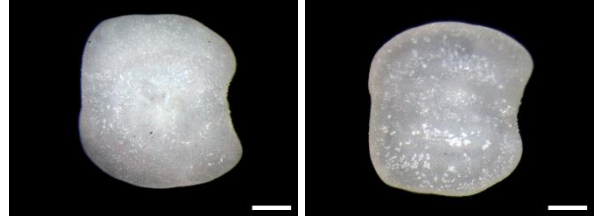
[Merlucciidae](#), *Merluccius productus* (ID: 1503)



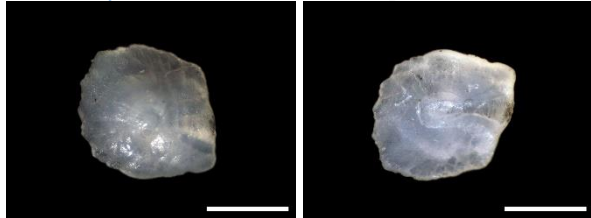
[Myctophidae](#) *Ceratoscopelus townsendi* (ID: 14)



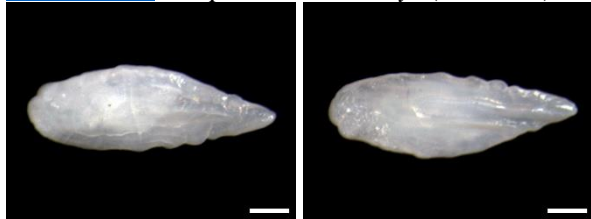
*Nannobranchium regale* (ID: 1531)



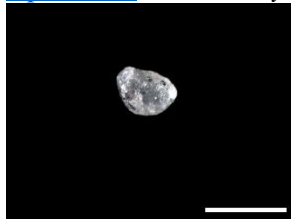
[Nemichthyidae](#), *Nemichthys scolopaceus* (ID: 1579)



[Notosudidae](#), *Scopelosaurus harryi* (ID: 1899)



[Ophidiidae](#), *Chilara taylori* (ID: 476)



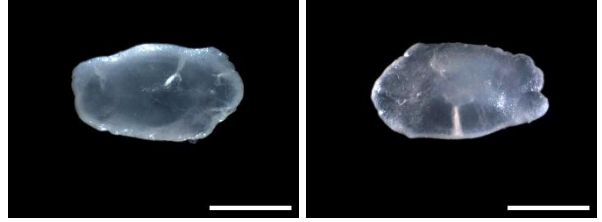


**Family, Example Species (Fish ID)**

Paralepididae, *Arcozenus risso* (ID: 482)



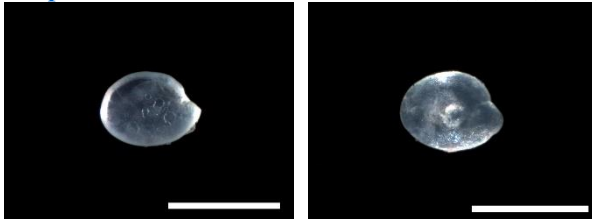
*Lestidiops ringens* (ID: 73)



Phosichthyidae, *Vinciguerra lucetia* (ID: 1685)



Scopelarchidae, *Benthalbella dentate* (ID: 87)



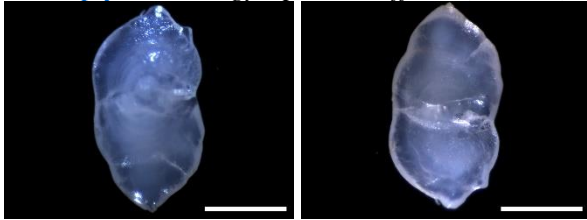
Scorpaenidae, *Sebastes goodie* (ID: 1150)



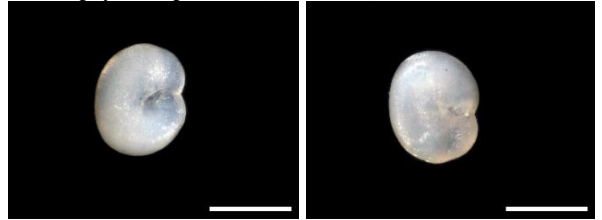
*Sebastes hopkinsi* (ID: 1158)



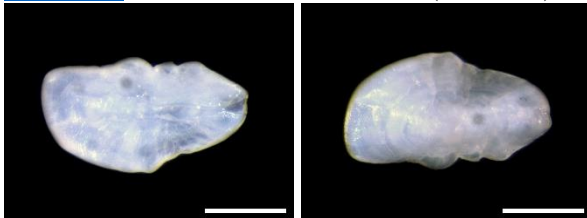
Sternoptychidae *Argyrolepecus affinis* (ID: 120)



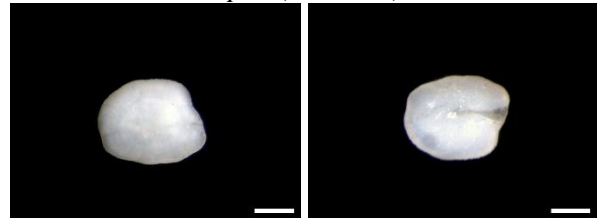
*Sternoptyx diaphana* (ID: 1561)



Stomiidae *Idiacanthus antrostomus* (ID: 1972)



*Tactostoma macropus* (ID: 1875)



## Otolith Image Catalog Contents

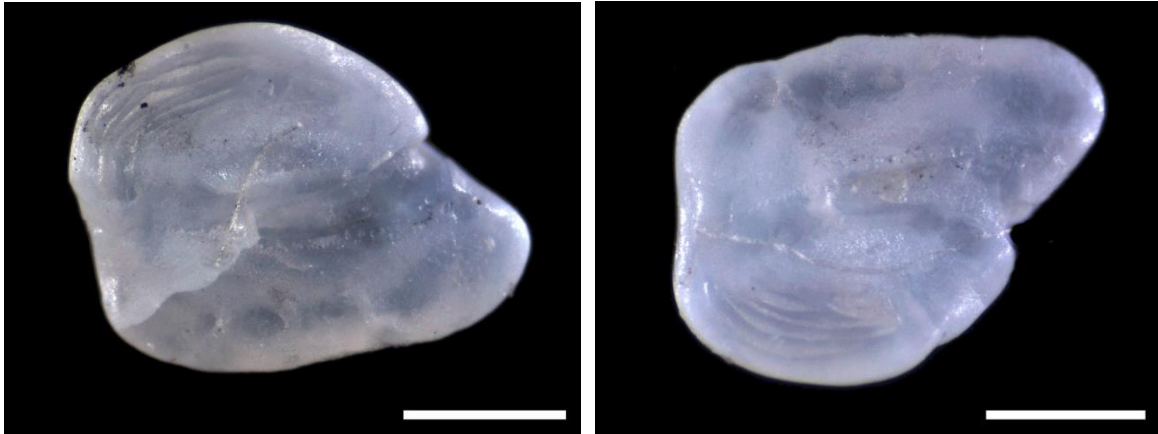
Family	Species	Common Name	Page(s)
Alepocephalidae	<a href="#"><i>Alepocephalus tenebrosus</i></a>	California slickhead	27-29
Bathylagidae	<a href="#"><i>Bathylagus pacificus</i></a>	Slender blacksmelt	30-33
	<a href="#"><i>Bathylagus wesethi</i></a>	Snubnose blacksmelt	34-37
	<a href="#"><i>Leuroglossus stilbius</i></a>	California smoothtounge	38-40
	<a href="#"><i>Lipolagus ochotensis</i></a>	Eared blacksmelt	41-42
Clupeidae	<a href="#"><i>Clupea pallasii</i></a>	Pacific herring	43-46
	<a href="#"><i>Sardinops sagax</i></a>	Pacific sardine	47-49
Engraulidae	<a href="#"><i>Engraulis mordax</i></a>	Northern anchovy	50-53
Gonostomatidae	<a href="#"><i>Gonostoma elongatum</i></a>	Longtooth anglemouth	54-55
Melamphaidae	<a href="#"><i>Melamphaes parvus</i></a>	Little bigscale	56-59
	<a href="#"><i>Scopelogadus mizolepis</i></a>	Flabby ridgehead	60-62
Merlucciidae	<a href="#"><i>Merluccius productus</i></a>	Pacific hake	63-65
Myctophidae	<a href="#"><i>Ceratoscopelus townsendi</i></a>	Dogtooth lampfish	66-79
	<a href="#"><i>Diaphus theta</i></a>	California headlightfish	70-73
	<a href="#"><i>Diogenichthys atlanticus</i></a>	Longfin lanternfish	74-77
	<a href="#"><i>Diogenichthys laternatus</i></a>	Diogenes lanternfish	78-80
	<a href="#"><i>Myctophum nitidulum</i></a>	Pearly lanternfish	81-84
	<a href="#"><i>Nannobranchium regale</i></a>	Pinpoint lightfish	85-88
	<a href="#"><i>Nannobranchium ritteri</i></a>	Broadfin lanternfish	91-92
	<a href="#"><i>Parvilux ingens</i></a>	Giant lampfish	93-95
	<a href="#"><i>Protomyctophum crockeri</i></a>	California flashlightfish	96-98
	<a href="#"><i>Stenobranchius leucopsarus</i></a>	Northern lampfish	99-102
	<a href="#"><i>Symbolophorus californiensis</i></a>	Bigfin lanternfish	103-105
	<a href="#"><i>Tarletonbeania crenularis</i></a>	Blue lanternfish	106-107
	<a href="#"><i>Triphoturus mexicanus</i></a>	Mexican lampfish	108-111
Nemichthyidae	<a href="#"><i>Nemichthys scolopaceus</i></a>	Slender snipe eel	112-115
Notosudidae	<a href="#"><i>Scopelosaurus harrisi</i></a>	Scaly waryfish	116-119
Ophidiidae	<a href="#"><i>Chilara taylori</i></a>	Spotted cusk-eel	120
Paralepididae	<a href="#"><i>Arctozenus risso</i></a>	White barracuda	121
	<a href="#"><i>Lestidiops ringens</i></a>	Slender barracuda	122
Phosichthyidae	<a href="#"><i>Vinciguerria lucetia</i></a>	Panama lightfish	123-126
Scopelarchidae	<a href="#"><i>Benthalbella dentate</i></a>	Northern pearleye	127
Scorpaenidae	<a href="#"><i>Sebastes goodei</i></a>	Chilipepper	128-129
	<a href="#"><i>Sebastes hopkinsi</i></a>	Squarespot rockfish	130-131
	<a href="#"><i>Sebastes jordani</i></a>	Shortbelly rockfish	132-133
	<a href="#"><i>Sebastes Spp.</i></a>	Unidentified rockfish	134-135
Sternoptychidae	<a href="#"><i>Argyropelecus affinis</i></a>	Pacific hatchetfish	136-138
	<a href="#"><i>Argyropelecus lychnus</i></a>	Lowcrest hatchetfish	139
	<a href="#"><i>Argyropelecus sladeni</i></a>	Tropical hatchetfish	140
	<a href="#"><i>Danaphos oculatus</i></a>	Bigeye lightfish	141-144

<b>Family</b>	<b>Species</b>	<b>Common Name</b>	<b>Page(s)</b>
Stomidae	<a href="#"><i>Sternoptyx diaphana</i></a>	Transparent hatchetfish	145-147
	<a href="#"><i>Sternoptyx obscura</i></a>	No common name	148-150
	<a href="#"><i>Sternoptyx pseudobscura</i></a>	Highlight Hatchetfish	151
	<a href="#"><i>Chauliodus macouni</i></a>	Pacific viperfish	152-155
	<a href="#"><i>Idiacanthus antrostomus</i></a>	Pacific blackdragon	156-159
	<a href="#"><i>Stomias atriventer</i></a>	Black-belly dragonfish	160
	<a href="#"><i>Tactostoma macropus</i></a>	Longfin dragonfish	161-164

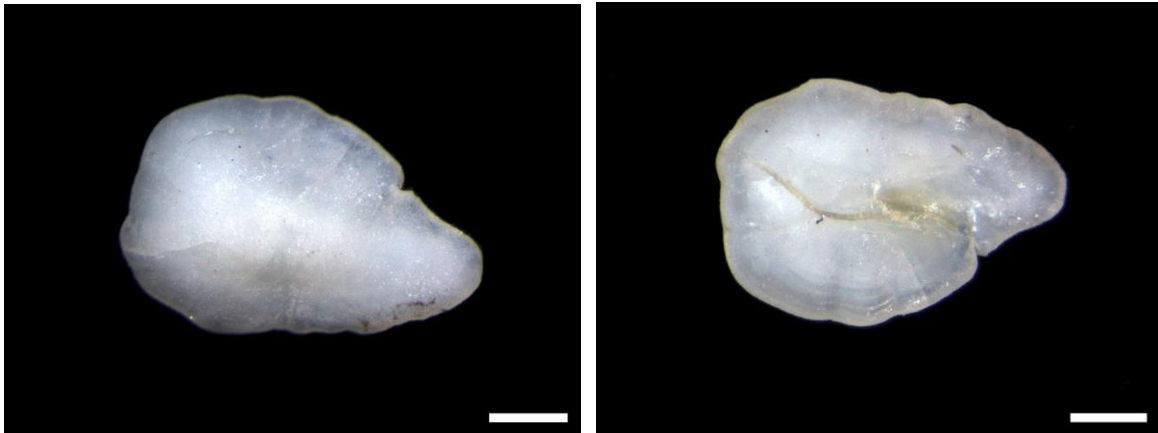
**Family: Alepocephalidae**

*Alepocephalus tenebrosus*

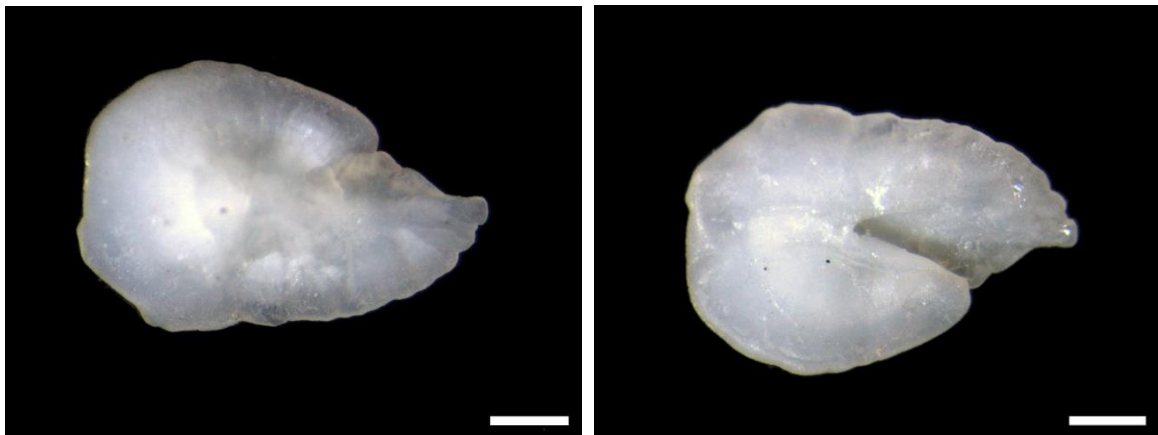
(California slickhead)



**ID: 38, MAL: 1.46 mm, SL: 47**



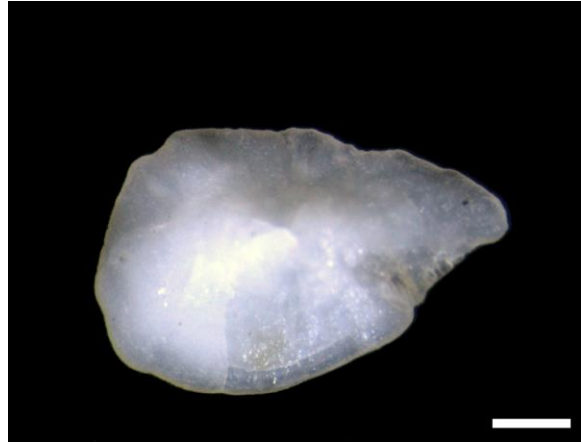
**ID: 1712; MAL: 2.30 mm; SL: nd**



**ID: 1713; MAL: 2.54 mm; SL: nd**

*Alepocephalus tenebrosus* (cont'd)

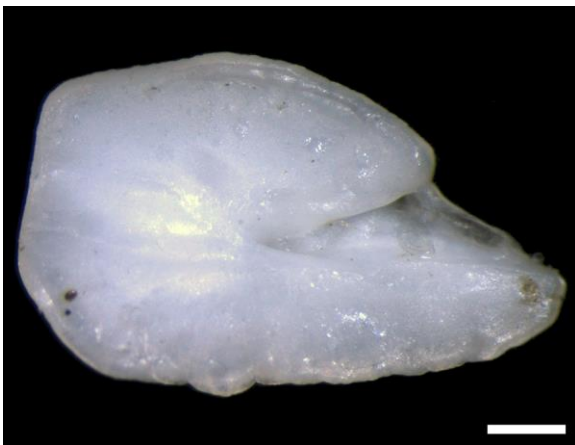
(California slickhead)



**ID: 1714; MAL: 2.57 mm; SL: nd**



**ID: 1715; MAL: 2.34 mm; SL: nd**



**ID: 1716; MAL: 3.46 mm; SL: nd**

*Alepocephalus tenebrosus* (cont'd)

(California slickhead)



**ID: 1717; MAL: 3.51 mm; SL: 142 mm**

## Family: Bathylagidae

*Bathylagus pacificus*

(Slender blacksmelt)



ID: 1513; MAL: 3.38 mm; SL: nd



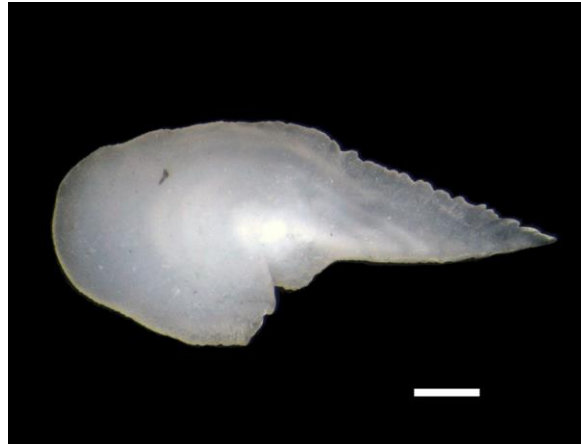
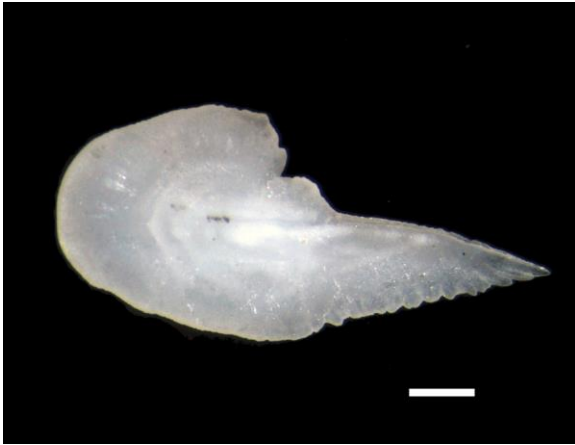
ID: 1515; MAL: 3.32 mm; SL: nd



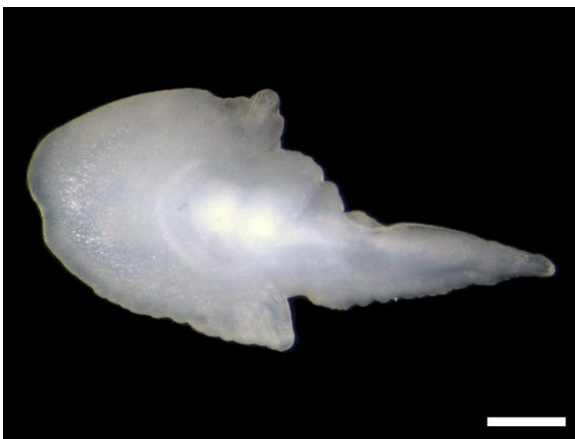
ID: 1520; MAL: 3.34 mm; SL: nd

*Bathylagus pacificus* (cont'd)

(Slender blacksmelt)



**ID: 1521; MAL: 3.50 mm; SL: nd**



**ID: 1522; MAL: 3.04 mm; SL: nd**

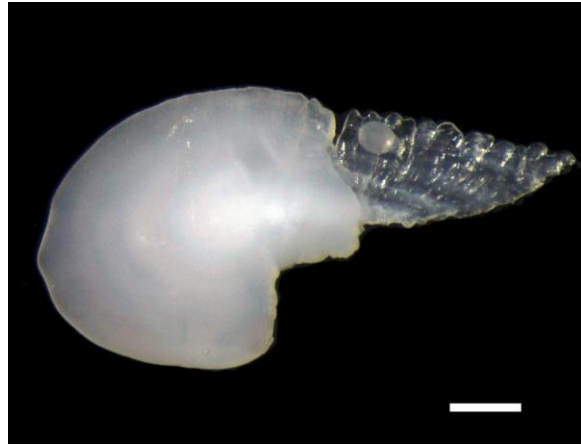


**ID: 1524; MAL: 3.08 mm; SL: nd**

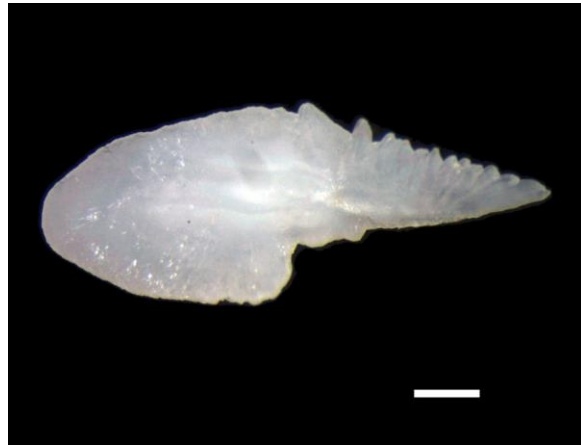


*Bathylagus pacificus* (cont'd)

(Slender blacksmelt)



**ID: 1526; MAL: 3.57 mm; SL: 128 mm**



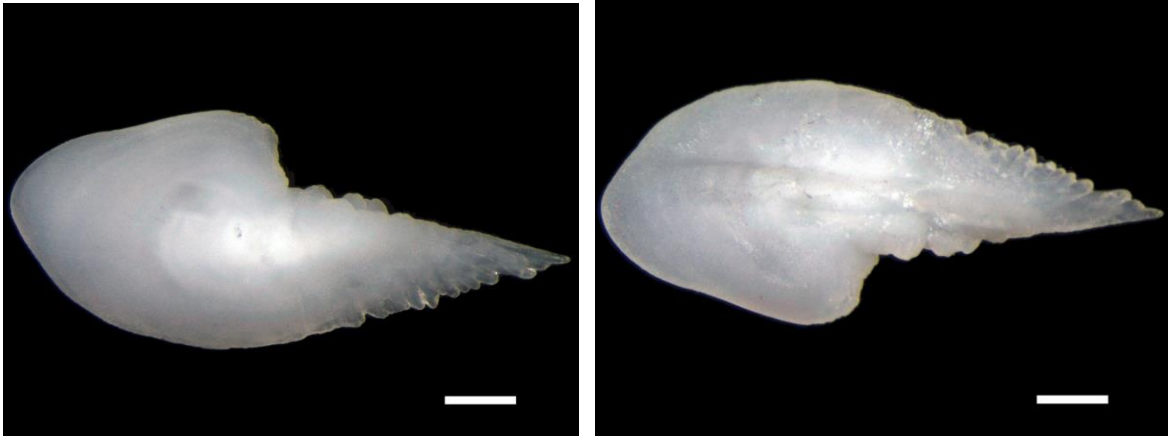
**ID: 1527; MAL: 3.51 mm; SL: nd**



**ID: 1528; MAL: 3.49 mm; SL: nd**

*Bathylagus pacificus* (cont'd)

(Slender blacksmelt)



**ID: 1529; MAL: 3.83 mm; SL: nd**

**Family: Bathylagidae (cont'd)**

*Bathylagus wesethi*

(Snubnose blacksmelt)



**ID: 66; MAL: 1.56 mm; SL: 57 mm**



**ID: 76; MAL: 1.43 mm; SL: 55 mm**



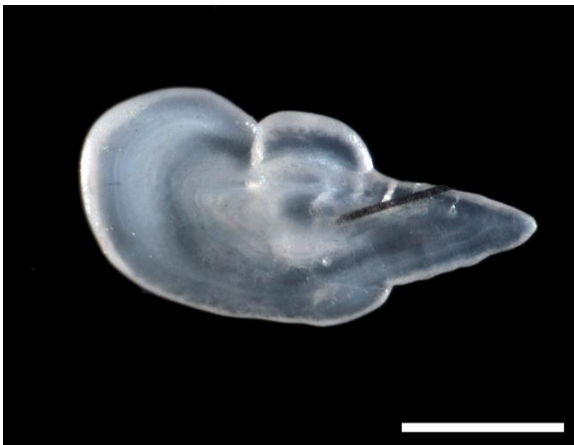
**ID: 78; MAL: 1.58 mm; SL: 63 mm**

*Bathylagus wesethi* (cont'd)

(Snubnose blacksmelt)



ID: 80; MAL: 0.98 mm; SL: 37 mm



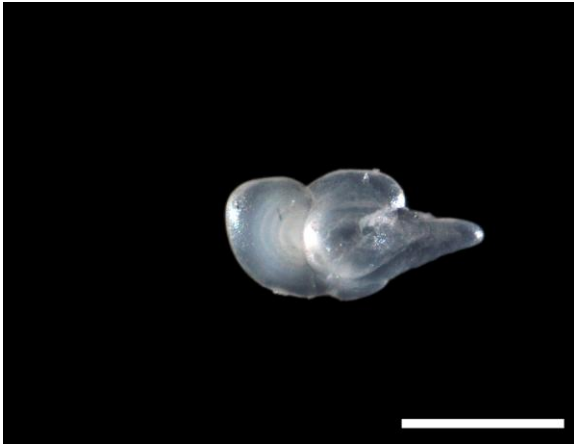
ID: 580; MAL: 1.37 mm; SL: 47 mm



ID: 582; MAL: 1.18 mm; SL: 45 mm

*Bathylagus wesethi* (cont'd)

(Snubnose blacksmelt)



**ID: 588; MAL: 0.77 mm; SL: 23 mm**



**ID: 601; MAL: 1.28 mm; SL: 44 mm**



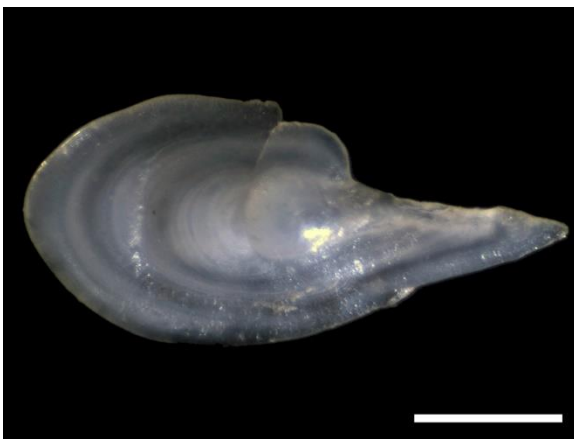
**ID: 602; MAL: 1.40 mm; SL: 45 mm**

*Bathylagus wesethi* (cont'd)

(Snubnose blacksmelt)



**ID: 603; MAL: 1.34 mm; SL: 47 mm**



**ID: 605; MAL: 1.69 mm; SL: nd**

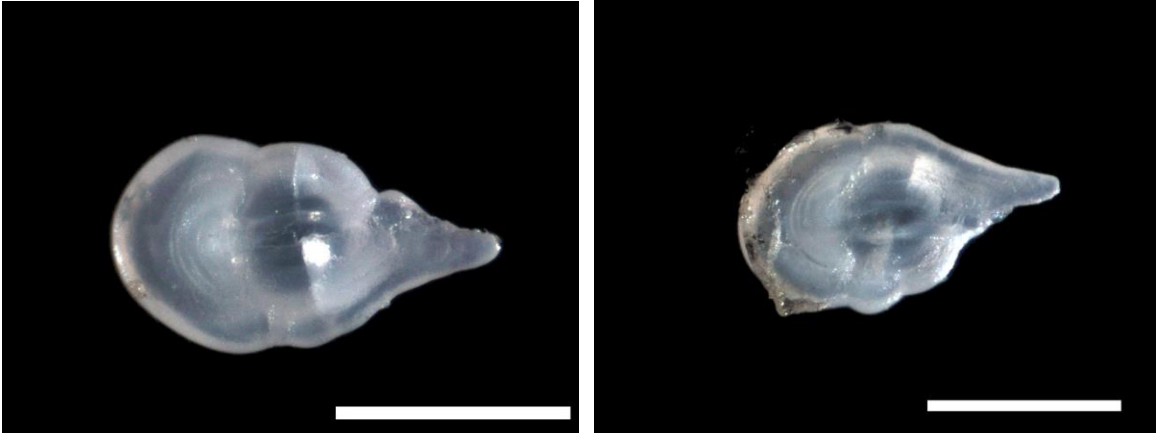


**ID: 628; MAL: 1.25 mm; SL: 52 mm**

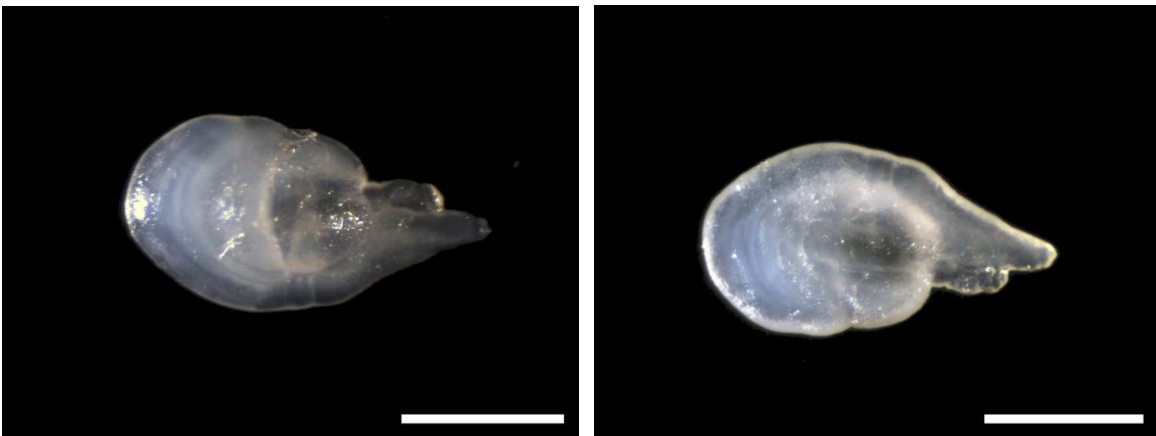
## Family: Bathylagidae (cont'd)

*Leuroglossus stilbius*

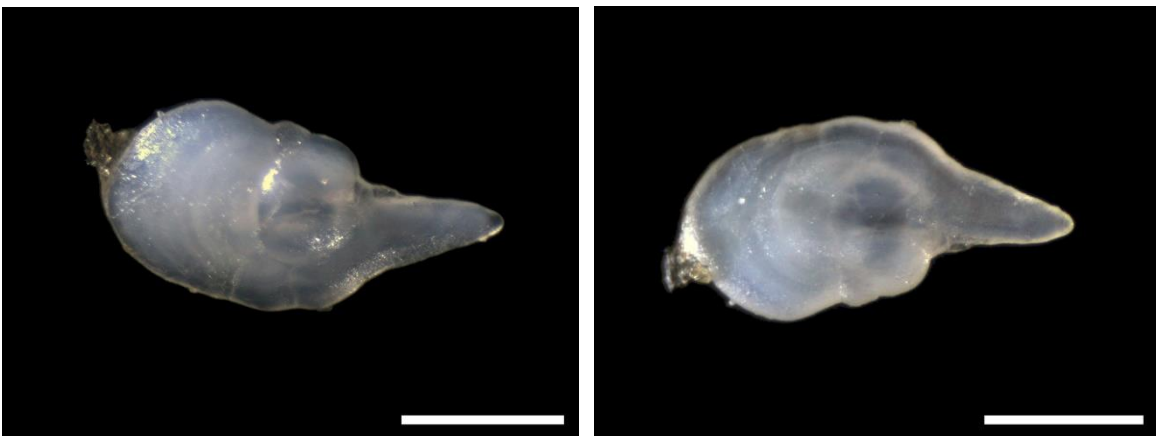
(California smoothtounge)



ID: 555; MAL: 0.78 mm; SL: 27 mm



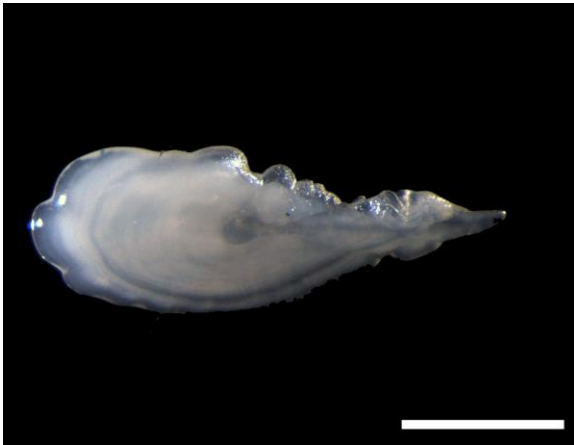
ID: 672; MAL: 1.03 mm; SL: 42 mm



ID: 722; MAL: 1.15 mm; SL: 44 mm

*Leuroglossus stilbius* (cont'd)

(California smoothtounge)



**ID: 972; MAL: 1.36 mm; SL: 83 mm**



**ID: 973; MAL: 2.94 mm; SL: 95 mm**



**ID: 981; MAL: 1.15 mm; SL: 73 mm**



*Leuroglossus stilbius* (cont'd)

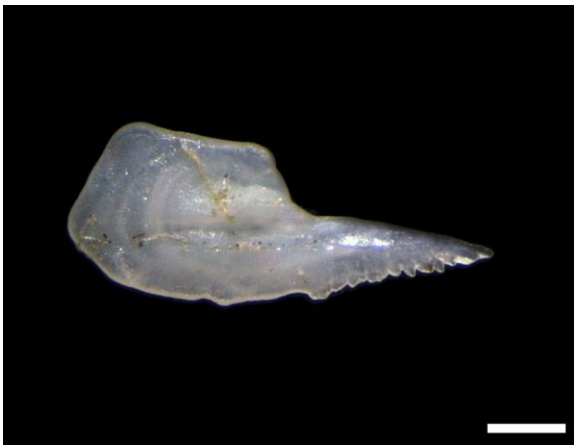
(California smoothtounge)



**ID: 982; MAL: 1.45 mm; SL: 87 mm**



**ID: 985; MAL: 1.14 mm; SL: 65 mm**



**ID: 1157; MAL: 2.51 mm; SL: nd**

**Family: Bathylagidae (cont'd)**

*Lipolagus ochotensis*

(Eared blacksmelt)



**ID: 454; MAL: 1.64 mm; SL: 45 mm**



**ID: 455; MAL: 1.73 mm; SL: 48 mm**



**ID: 456; MAL: 1.54 mm; SL: 45 mm**

*Lipolagus ochotensis* (cont'd)

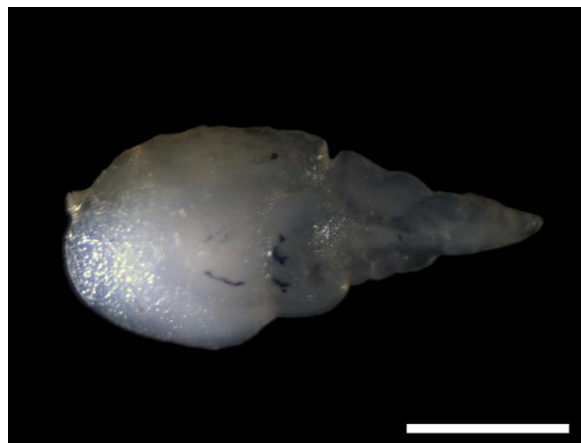
Eared blacksmelt



**ID: 457; MAL: 1.52 mm; SL: 42 mm**



**ID: 661; MAL: 1.01 mm; SL: 31 mm**



**ID: 668; MAL: 1.37 mm; SL: 42 mm**

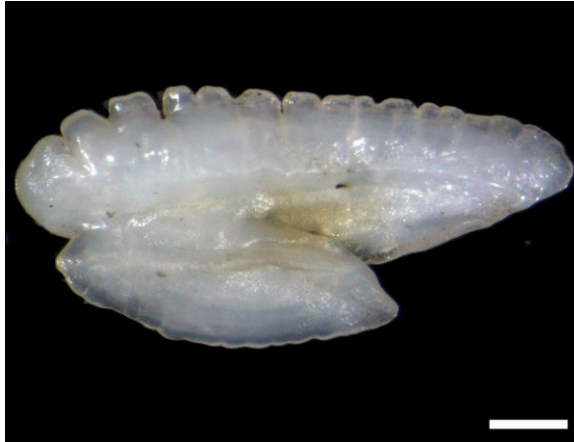
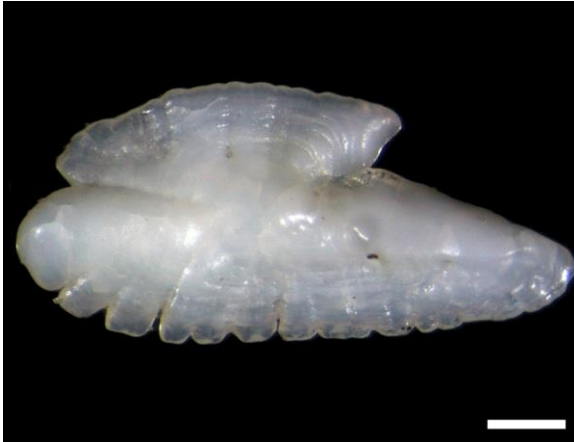
**Family: Clupeidae**

*Clupea pallasii*

(Pacific herring)



**ID: 2028; MAL: 3.35 mm; SL: 159 mm**



**ID: 2029; MAL: 3.39 mm; SL: 159 mm**



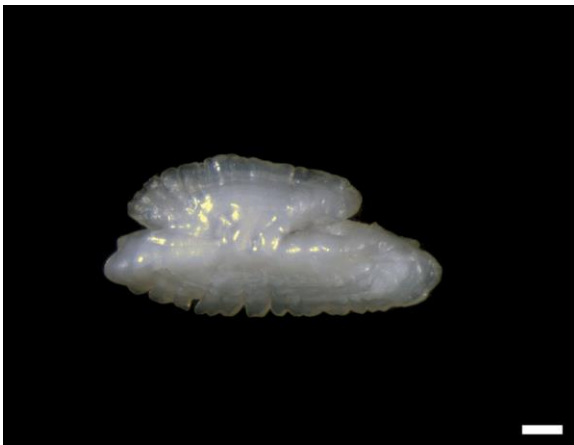
**ID: 2032; MAL: 3.95 mm; SL: 240 mm**

*Clupea pallasii* (cont'd)

(Pacific herring)



ID: 2033; MAL: 3.74 mm; SL: 168 mm



ID: 2034; MAL: 4.06 mm; SL: 190 mm



ID: 2035; MAL: 4.09 mm; SL: nd

*Clupea pallasii* (cont'd)

(Pacific herring)



ID: 2036; MAL: 3.60 mm; SL: nd



ID: 2041; MAL: 1.85 mm; SL: nd



ID: 2043; MAL: 3.81 mm; SL: nd

*Clupea pallasii* (cont'd)

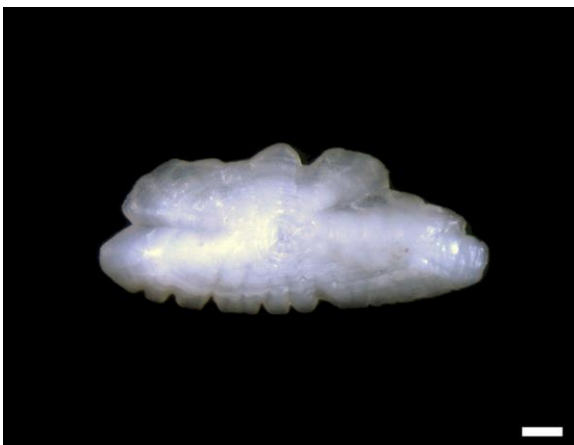
(Pacific herring)



**ID: 2048; MAL: 4.96 mm; SL: nd**



**ID: 2051; MAL: 4.16 mm; SL: nd**



**ID: 2055; MAL: 4.79 mm; SL: nd**

## Family: Clupeidae (cont'd)

*Sardinops sagax*

(Pacific sardine)



ID: 1115; MAL: 3.36 mm; SL: 101.3 mm



ID: 1117; MAL: 3.35 mm; SL: 136.5 mm



ID: 1118; MAL: 3.61 mm; SL: 139.3 mm

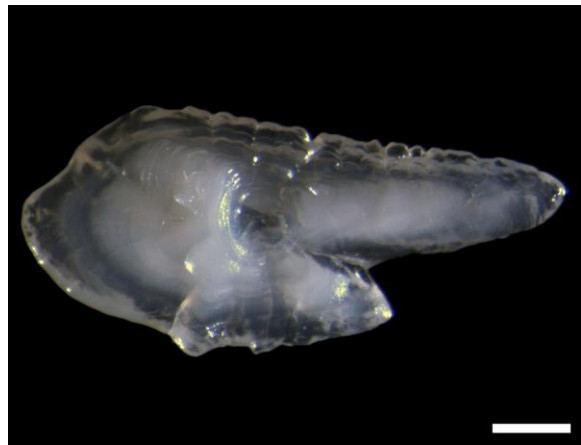


*Sardinops sagax* (cont'd)

(Pacific sardine)



ID: 1119; MAL: 3.65 mm; SL: 119.3 mm



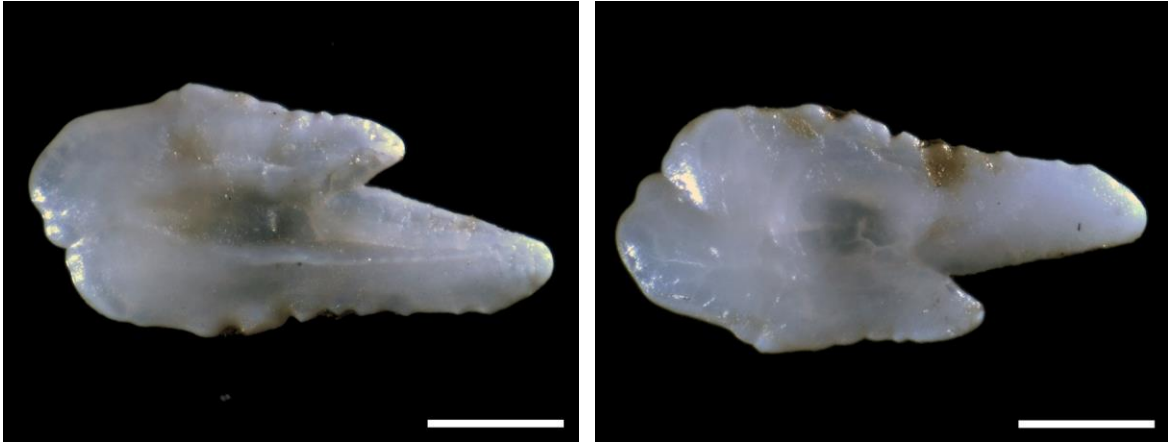
ID: 1120; MAL: 3.30 mm; SL: 112.2 mm



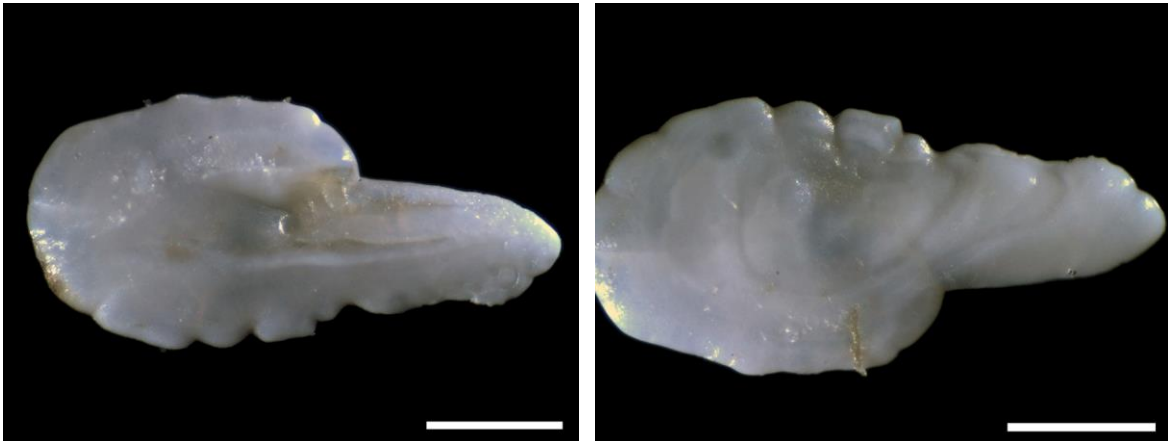
ID: 2500; MAL: 1.58 mm; SL: nd

*Sardinops sagax* (cont'd)

(Pacific sardine)



**ID: 2501; MAL: 1.89 mm; SL: nd**



**ID: 2502; MAL: 1.94 mm; SL: nd**

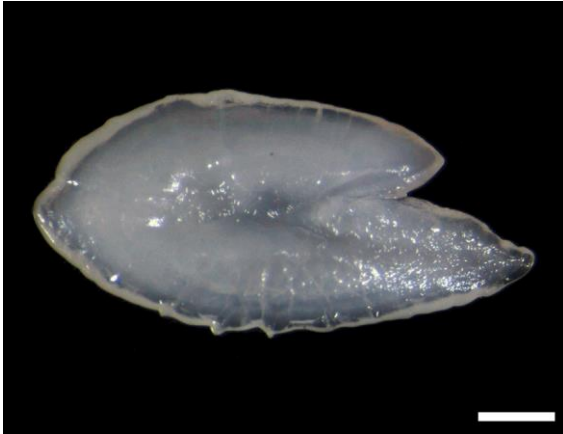


**ID: 2504; MAL: 1.62 mm; SL: nd**

**Family: Engraulidae**

*Engraulis mordax*

(Northern anchovy)



**ID: 1301; MAL: 3.10 mm; SL: 109 mm**



**ID: 1302; MAL: 3.46 mm; SL: 113 mm**



**ID: 1319; MAL: 3.41 mm; SL: 114 mm**

*Engraulis mordax* (cont'd)

(Northern anchovy)



**ID: 1321; MAL: 3.54 mm; SL: 111 mm**



**ID: 1324; MAL: 3.52 mm; SL: 120 mm**



**ID: 1328; MAL: 2.93 mm; SL: 105 mm**

*Engraulis mordax* (cont'd)

(Northern anchovy)



**ID: 1346; MAL: 3.44 mm; SL: 112 mm**



**ID: 1353; MAL: 3.69 mm; SL: 114 mm**



**ID: 1368; MAL: 3.29 mm; SL: 119 mm**

*Engraulis mordax* (cont'd)

(Northern anchovy)



**ID: 1372; MAL: 3.10 mm; SL: 109 mm**



**ID: 1373; MAL: 5.64 mm; SL: 103 mm**



**ID: 1384; MAL: 3.20 mm; SL: 104 mm**

**Family: Gonostomatidae**

*Gonostoma elongatum*

(Longtooth anglemouth)



**ID: 1907; MAL: 0.94 mm; SL: 160 mm**



**ID: 1908; MAL: 0.92 mm; SL: 175 mm**



**ID: 1909; MAL: 1.20 mm; SL: 193 mm**

*Gonostoma elongatum* (cont'd)

(Longtooth anglemouth)



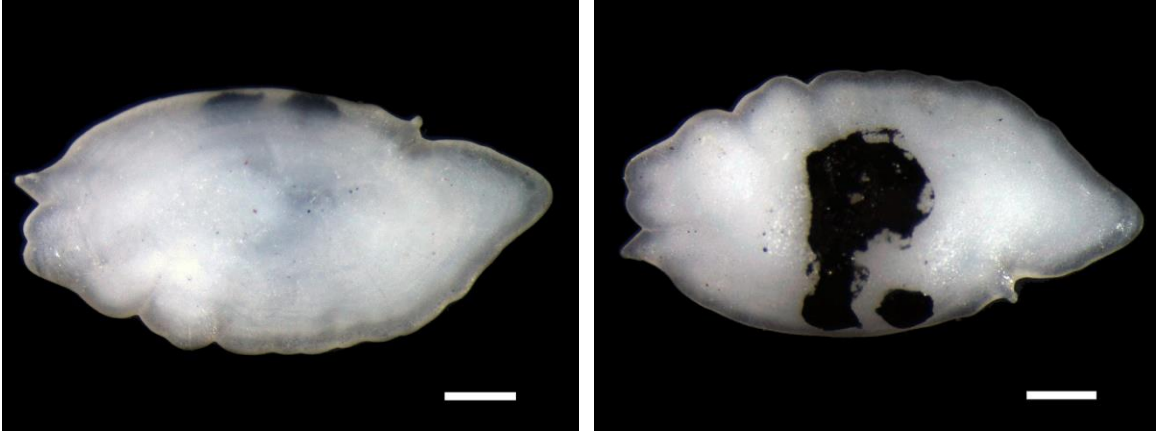
**ID: 1912; MAL: 0.90 mm; SL: 245 mm**



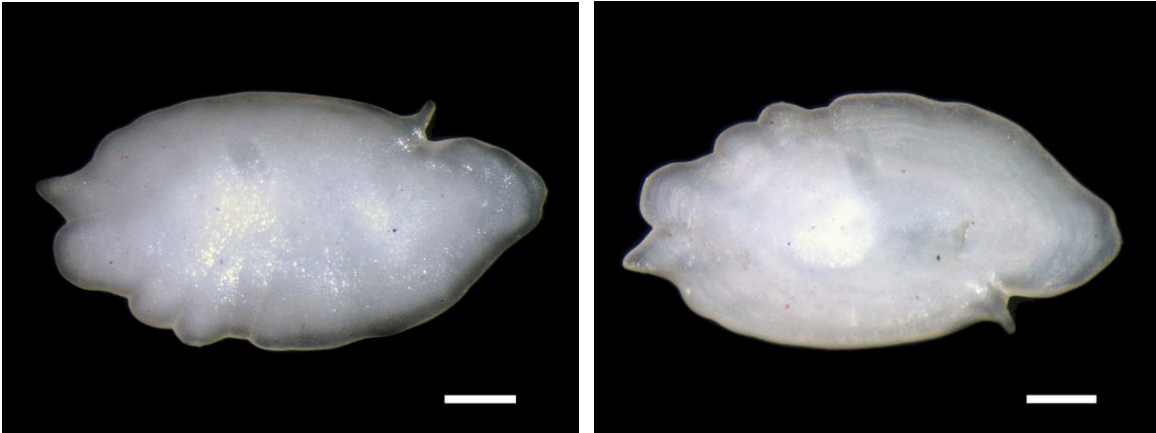
**Family: Melamphaidae**

*Melamphaes parvus*

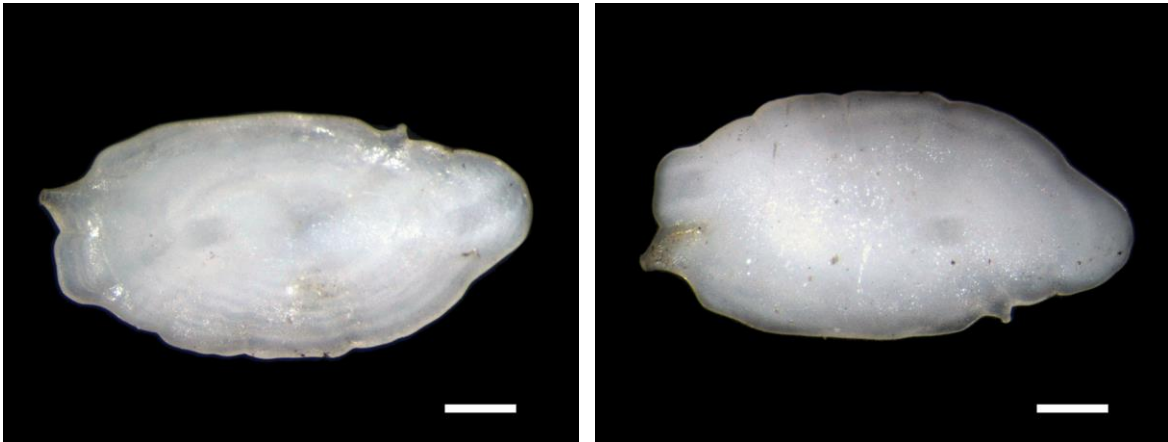
(Little bigscale)



**ID: 1718; MAL: 3.58 mm; SL: nd**



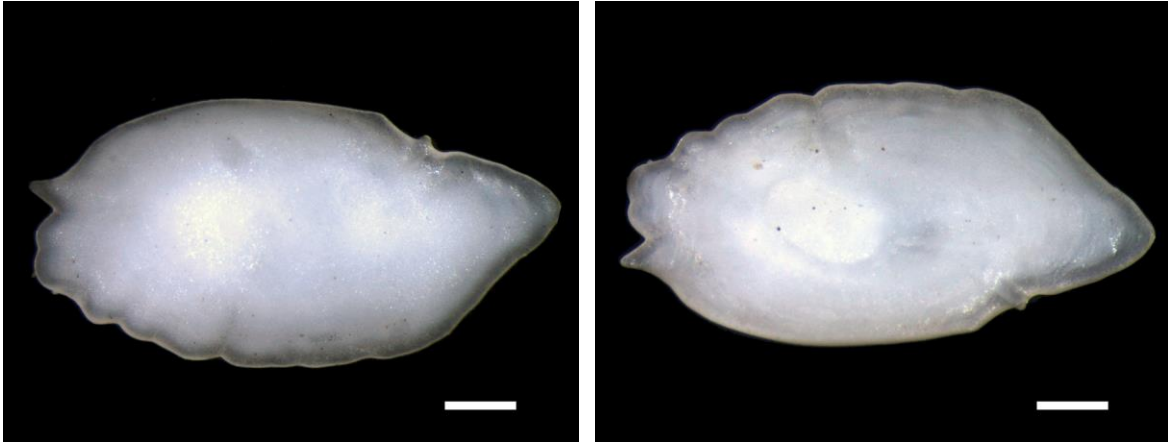
**ID: 1719; MAL: 3.40 mm; SL: nd**



**ID: 1720; MAL: 3.37 mm; SL: nd**

*Melamphaes parvus* (cont'd)

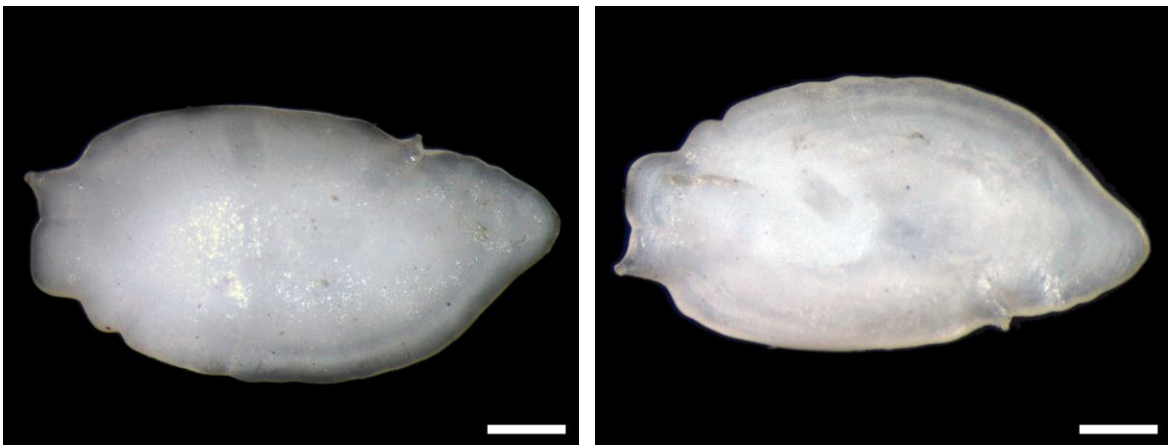
(Little bigscale)



ID: 1721; MAL: 3.58 mm; SL: nd



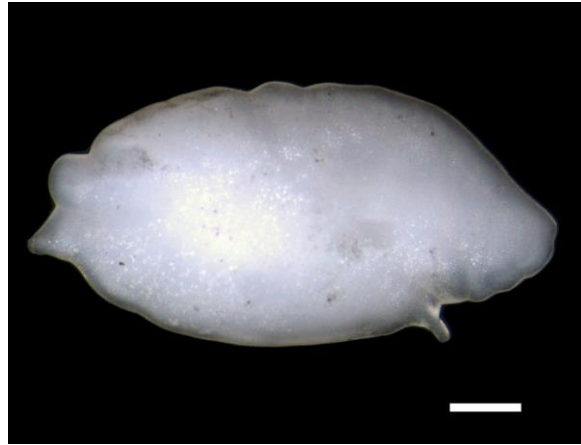
ID: 1722; MAL: 3.25 mm; SL: nd



ID: 1723; MAL: 3.30 mm; SL: nd

*Melamphaes parvus* (cont'd)

(Little bigscale)



**ID: 1724; MAL: 3.55 mm; SL: nd**



**ID: 1725; MAL: 3.32 mm; SL: nd**



**ID: 1726; MAL: 3.54 mm; SL: nd**

*Melamphaes parvus* (cont'd)

(Little bigscale)



**ID: 1728; MAL: 3.52 mm; SL: nd**

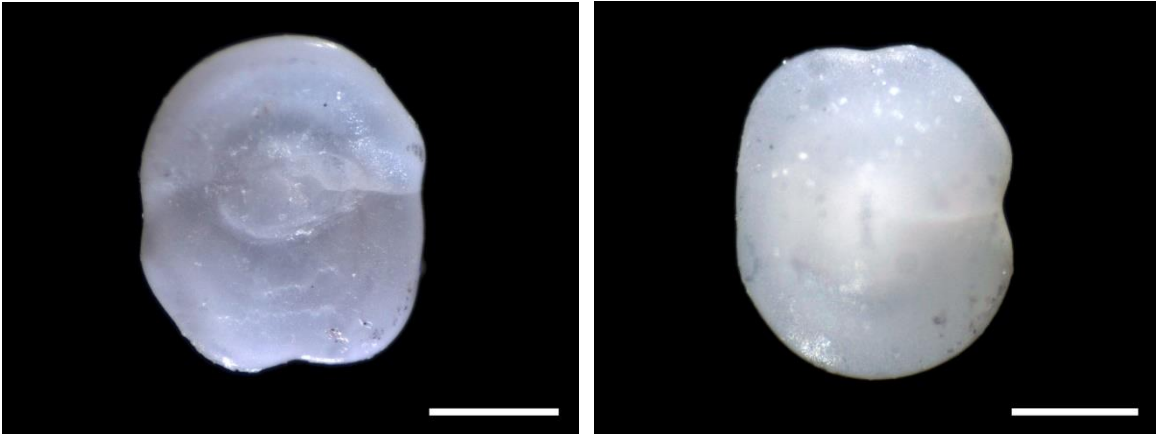


**ID: 1729; MAL: 3.51 mm; SL: nd**

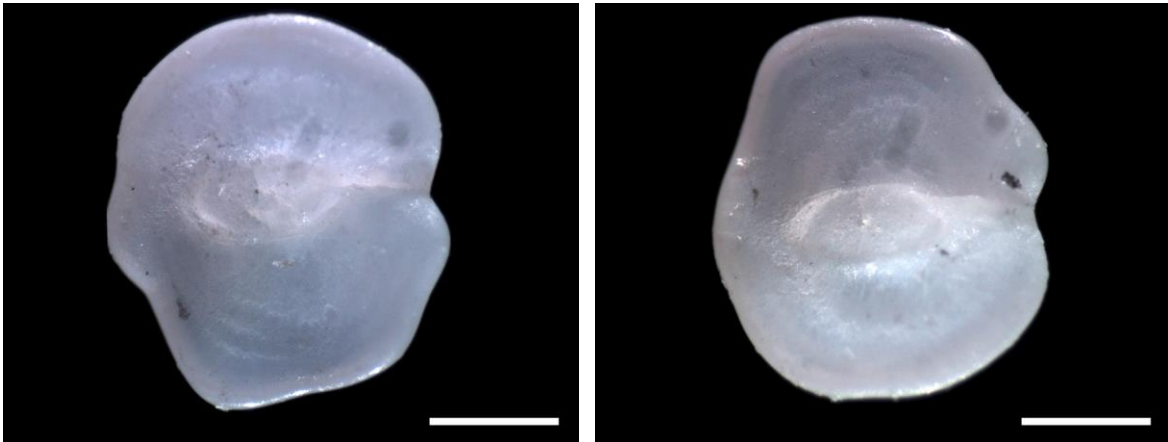
**Family: Melamphaidae (cont'd)**

*Scopelogadus mizolepis*

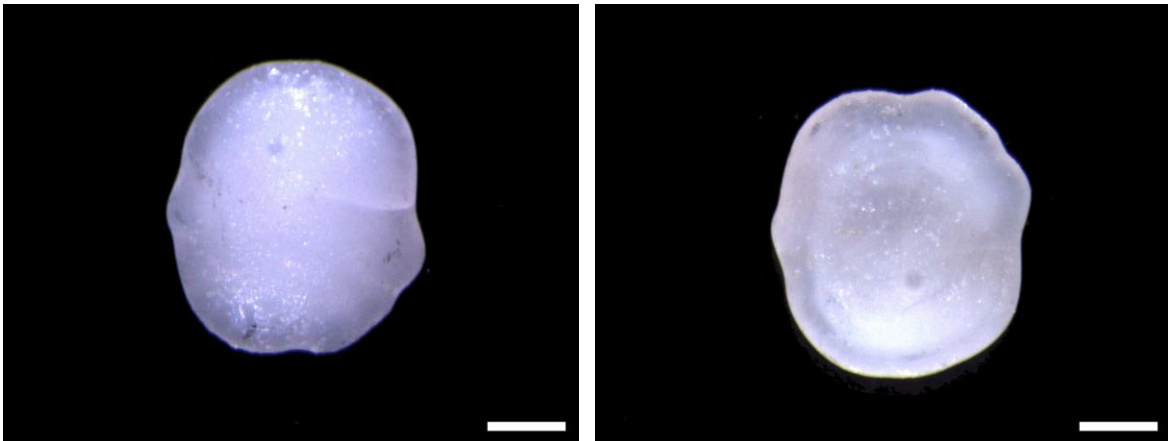
(Twospine bigscale)



**ID: 69; MAL: 1.35 mm; SL: 39 mm**



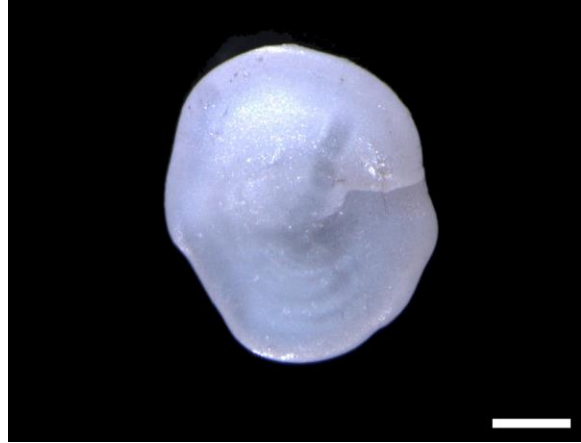
**ID: 70; MAL: 1.51 mm; SL: 40 mm**



**ID: 71; MAL: 1.99 mm; SL: 48 mm**

*Scopelogadus mizolepis* (cont'd)

(Twospine bigscale)



**ID: 89; MAL: 2.13 mm; SL: 60 mm**



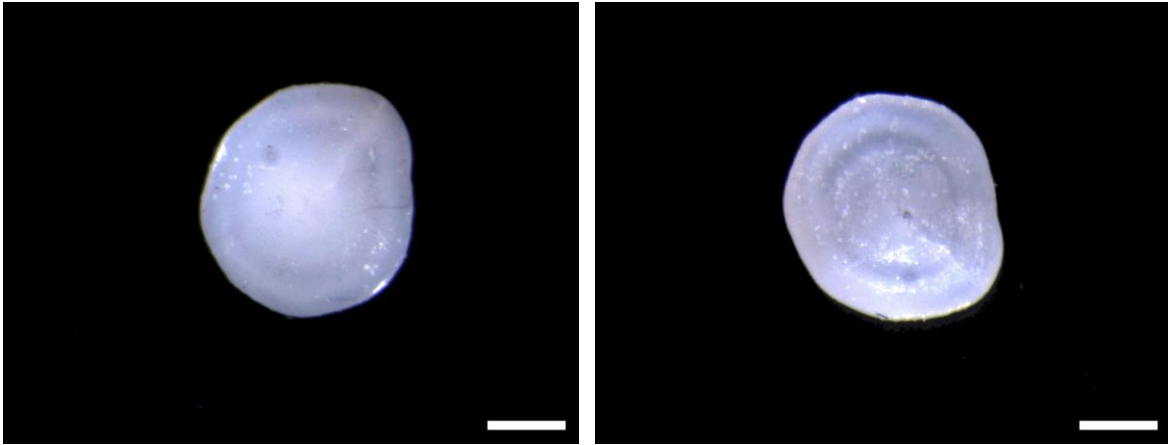
**ID: 550; MAL: 2.41 mm; SL: 85 mm**



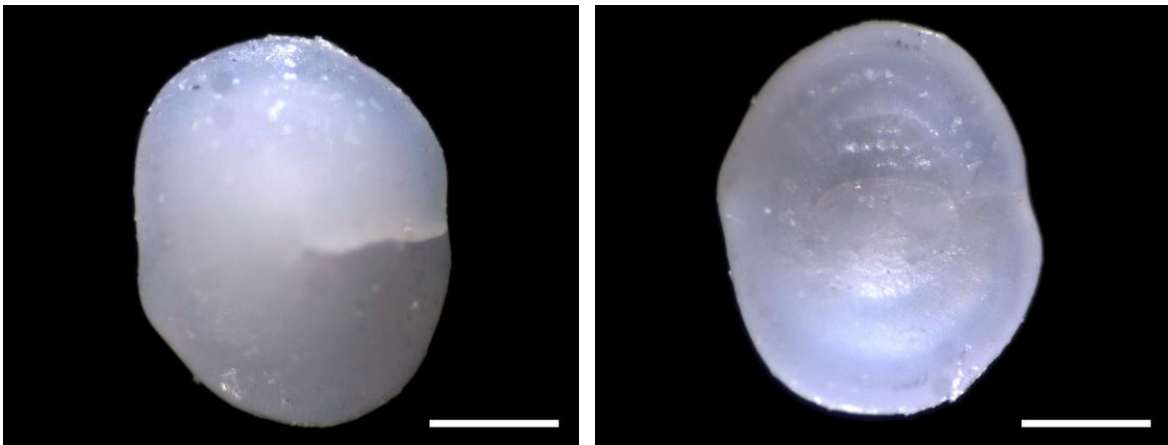
**ID: 90; MAL: 1.22 mm; SL: 40 mm**

*Scopelogadus mizolepis* (cont'd)

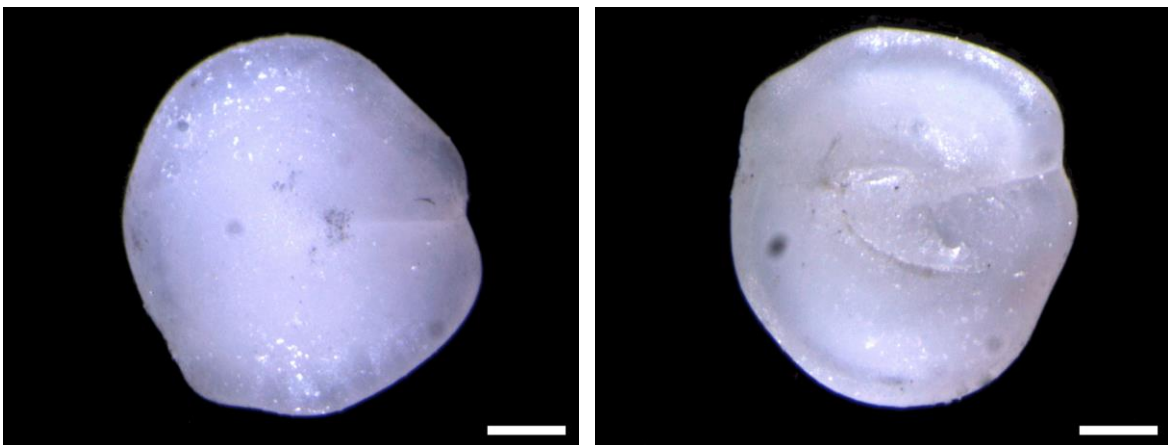
(Twospine bigscale)



**ID: 91; MAL: 1.52 mm; SL: 42 mm**



**ID: 92; MAL: 1.50 mm; SL: 42 mm**

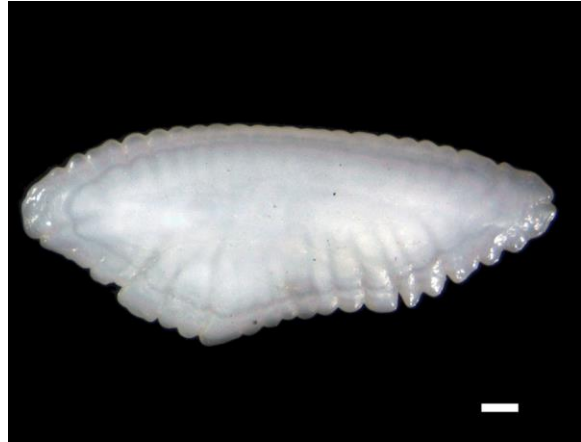
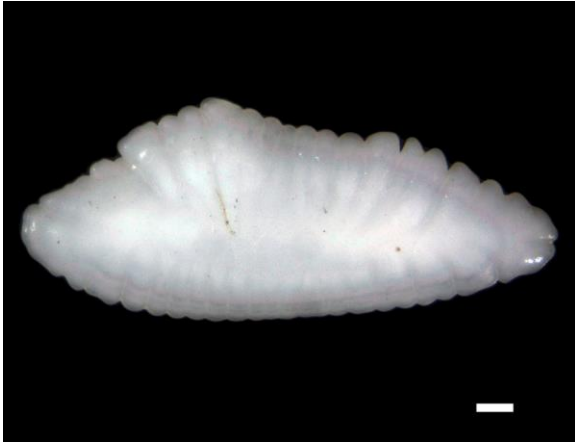


**ID: 137; MAL: 2.49 mm; SL: 83 mm**

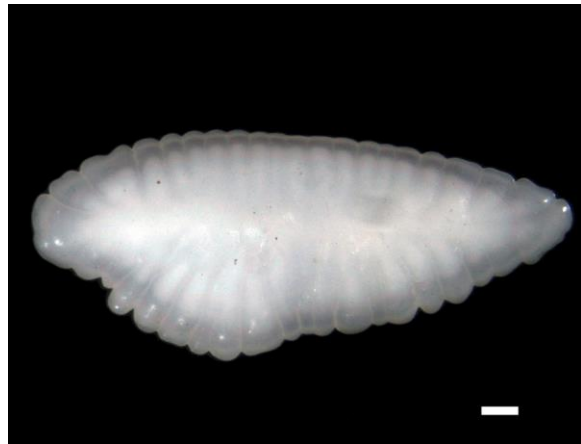
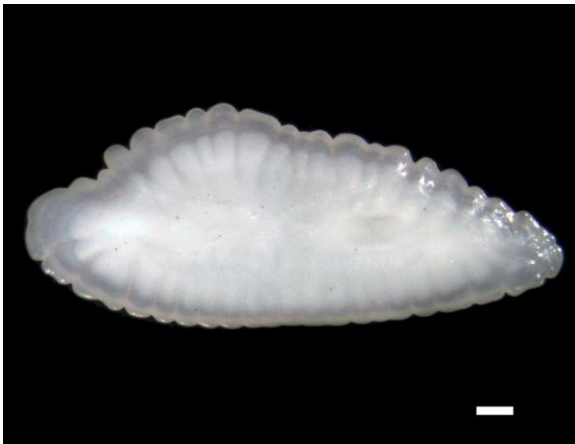
**Family: Merlucciidae**

*Merluccius productus*

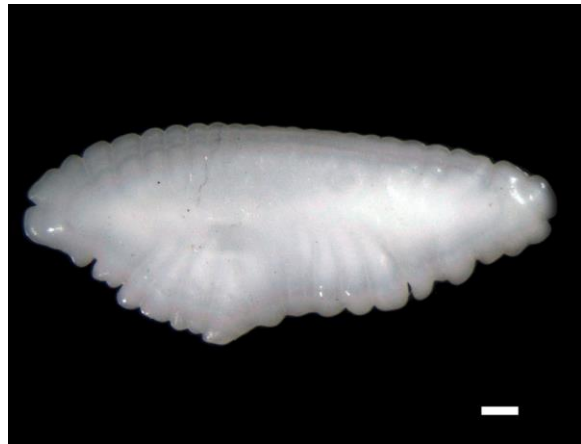
(Pacific hake)



**ID: 1500; MAL: 7.07 mm; SL: nd**



**ID: 1503; MAL: 7.11 mm; SL: nd**

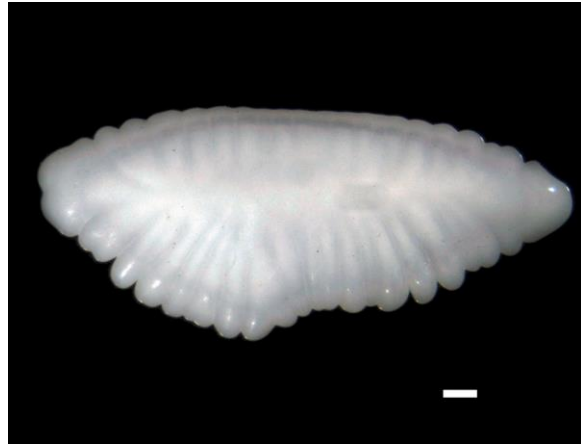


**ID: 1504; MAL: 7.10 mm; SL: nd**

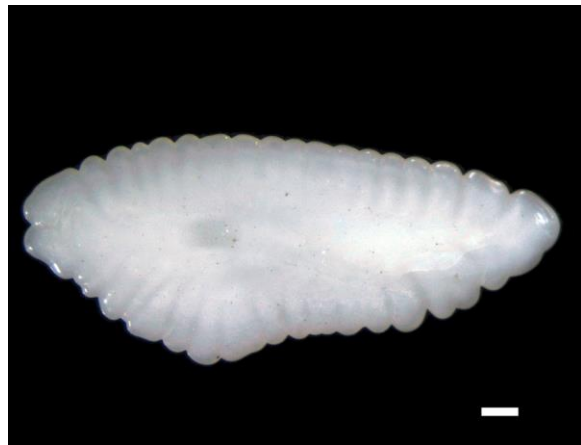
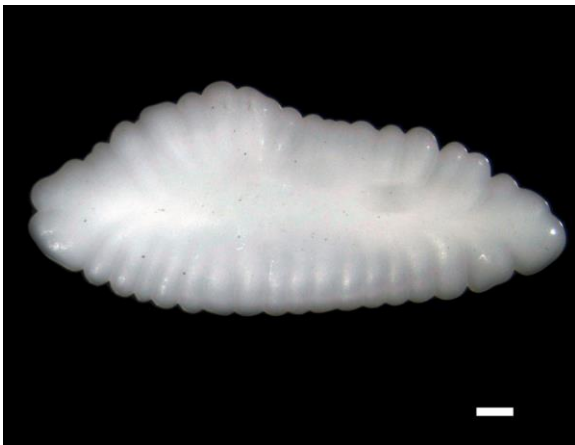


*Merluccius productus* (cont'd)

(Pacific hake)



**ID: 1506; MAL: 7.68 mm; SL: nd**



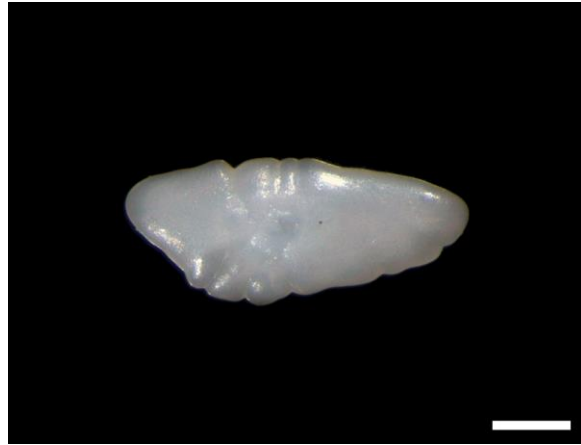
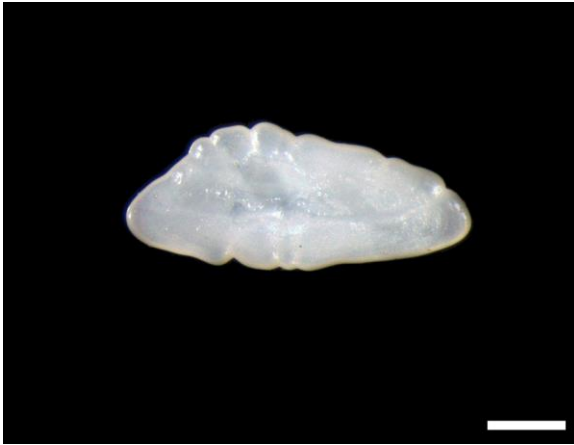
**ID: 1507; MAL: 7.19 mm; SL: nd**



**ID: 1508; MAL: 6.75 mm; SL: nd**

*Merluccius productus* (cont'd)

(Pacific hake)



ID: 1509; MAL: 2.17 mm; SL: 50 mm



ID: 1512; MAL: 2.54 mm; SL: 32 mm

**Family: Myctophidae**

*Ceratoscopelus townsendi*

(Dogtooth lampfish)



**ID: 14; MAL: 2.54 mm; SL: 52 mm**



**ID: 15; MAL: 2.42 mm; SL: 50 mm**



**ID: 16; MAL: 1.24 mm; SL: 26 mm**

*Ceratoscopelus townsendi* (cont'd)

(Dogtooth lampfish)



ID: 19; MAL: 1.04 mm; SL: 23 mm



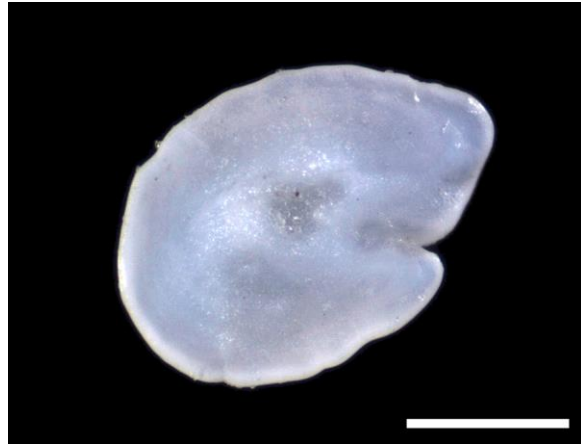
ID: 20; MAL: 1.05 mm; SL: 23 mm



ID: 21; MAL: 1.55 mm; SL: 32 mm

*Ceratoscopelus townsendi* (cont'd)

(Dogtooth lampfish)



ID: 24; MAL: 1.04 mm; SL: 23 mm



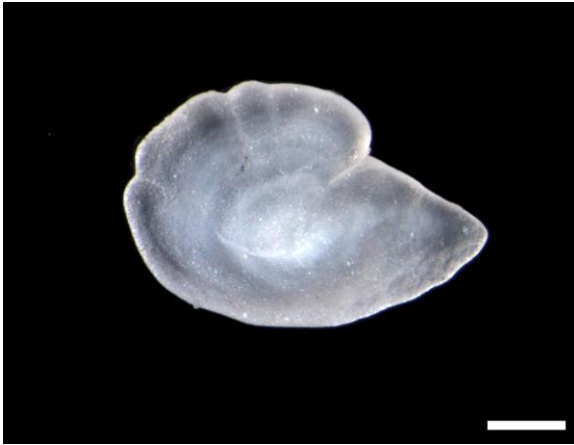
ID: 25; MAL: 1.27 mm; SL: 27 mm



ID: 26; MAL: 1.33 mm; SL: 27 mm

*Ceratoscopelus townsendi* (cont'd)

(Dogtooth lampfish)



ID: 27; MAL: 1.22 mm; SL: 28 mm



ID: 28; MAL: 1.05 mm; SL: 29 mm

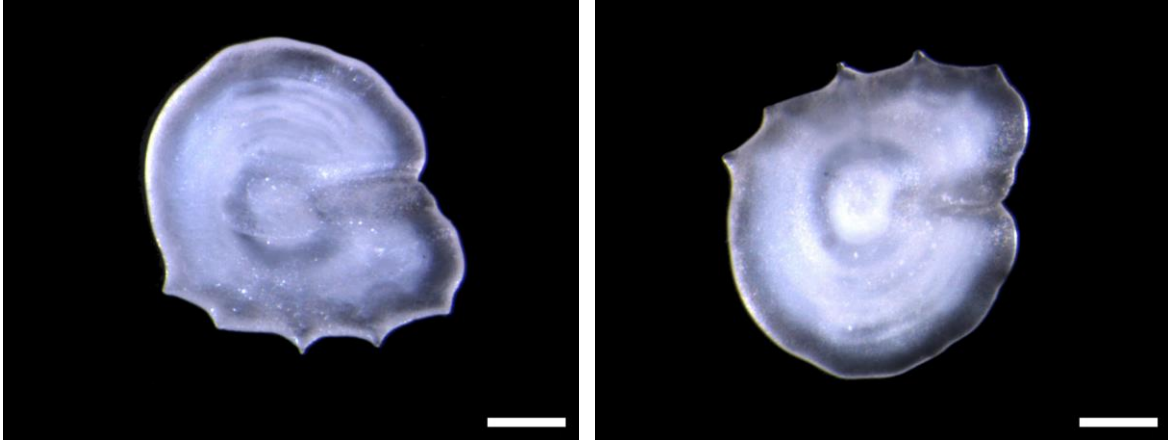


ID: 29; MAL: 2.22 mm; SL: 46 mm

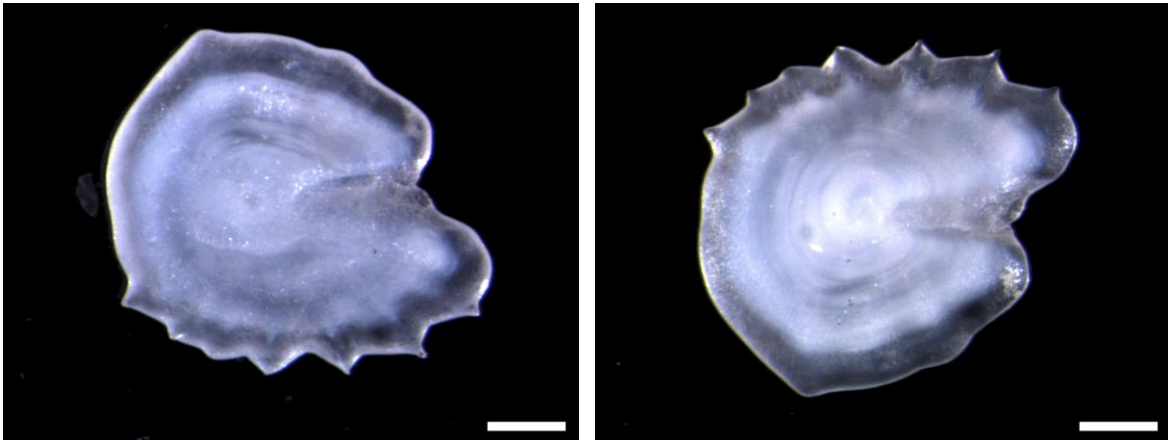
**Family: Myctophidae (cont'd)**

*Diaphus theta*

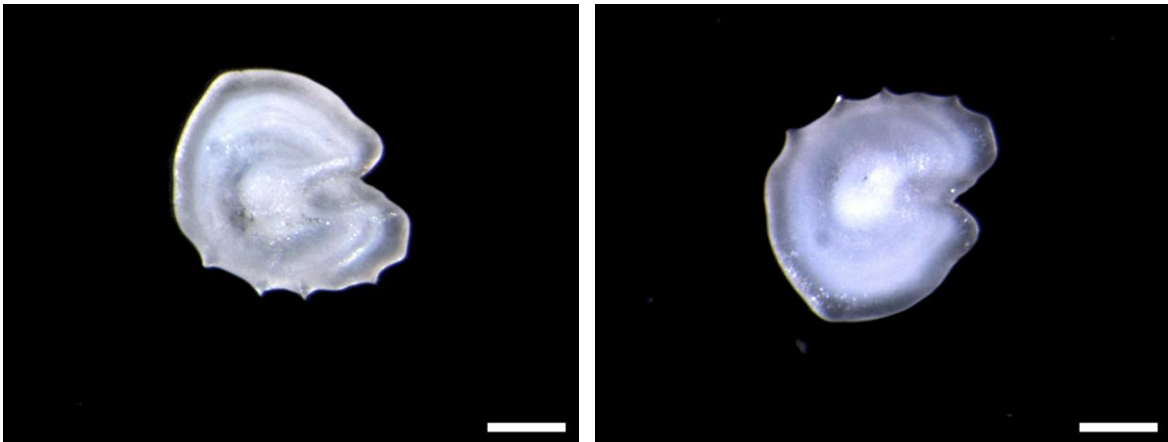
(California headlightfish)



**ID: 39; MAL: 2.19 mm; SL: 45 mm**

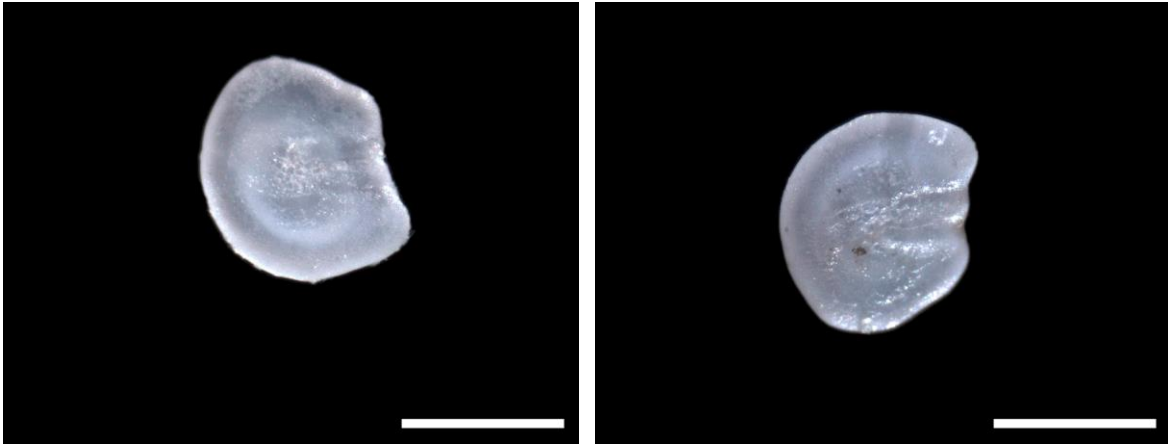


**ID: 45; MAL: 2.55 mm; SL: 55 mm**

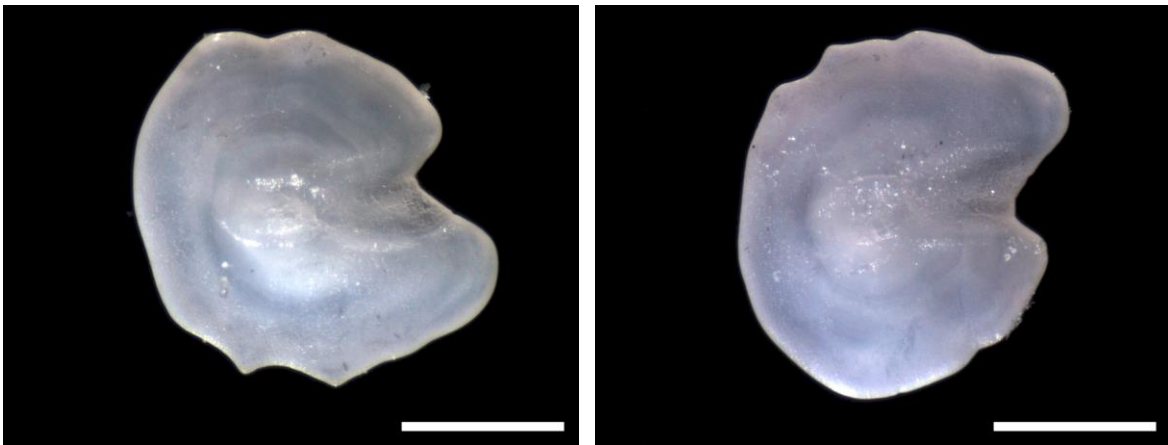


**ID: 108; MAL: 1.65 mm; SL: 31 mm**

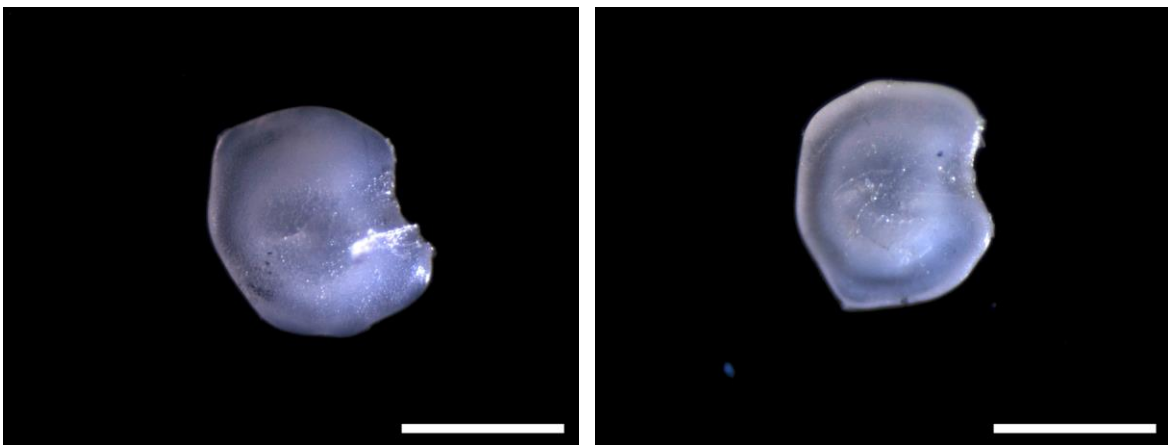
*Diaphus theta* (cont'd)  
(California headlightfish)



**ID: 435; MAL: 0.71 mm; SL: 17 mm**



**ID: 442; MAL: 1.18 mm; SL: 24 mm**



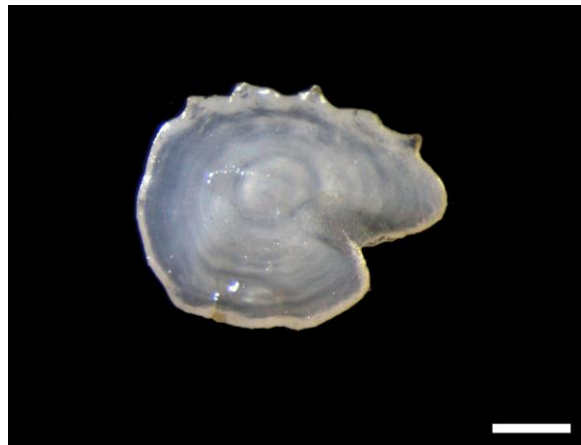
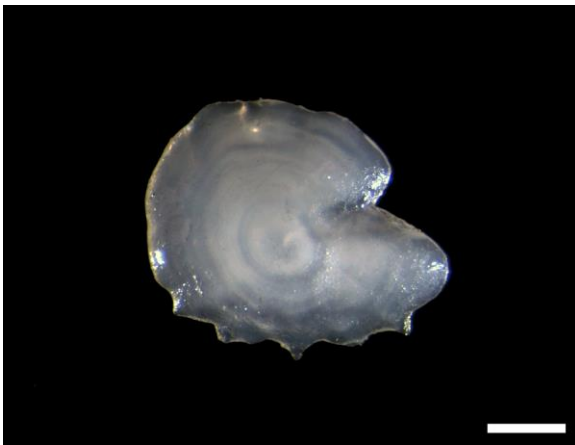
**ID: 443; MAL: 0.74 mm; SL: 17 mm**



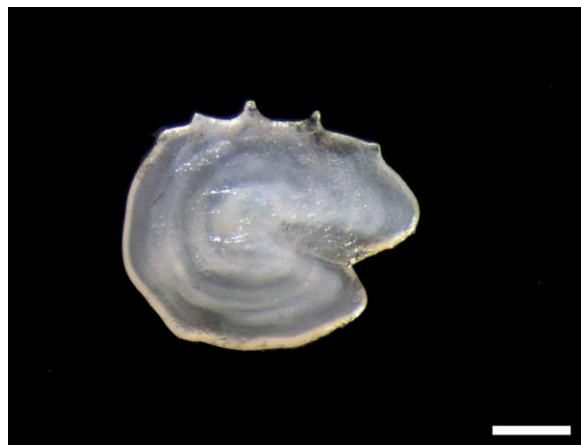
*Diaphus theta* (cont'd)  
(California headlightfish)



**ID: 652; MAL: 1.89 mm; SL: 40 mm**

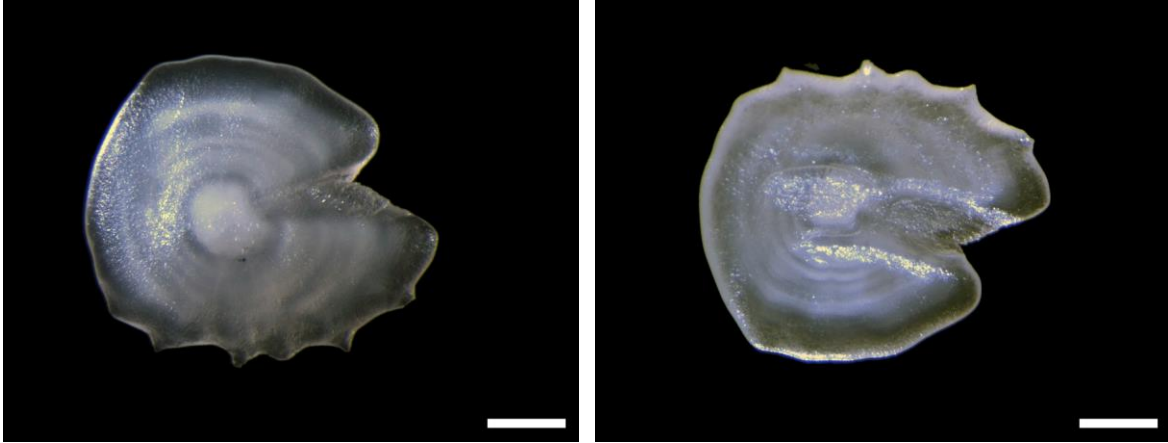


**ID: 653; MAL: 1.92 mm; SL: 41 mm**



**ID: 657; MAL: 1.85 mm; SL: 40 mm**

*Diaphus theta* (cont'd)  
(California headlightfish)



**ID: 903; MAL: 2.23 mm; SL: 53 mm**



**ID: 904; MAL: 2.66 mm; SL: 63mm**

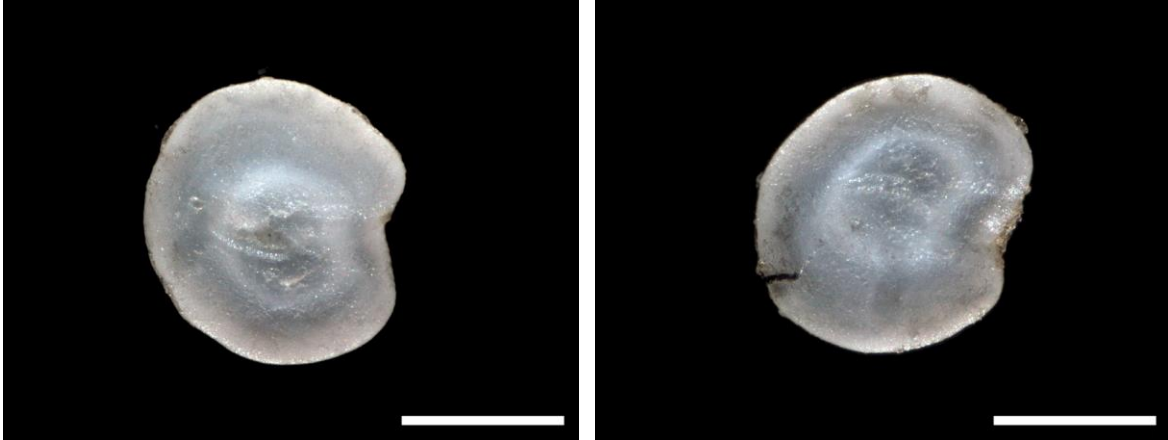


**ID: 1043; MAL: 2.49 mm; SL: 59mm**

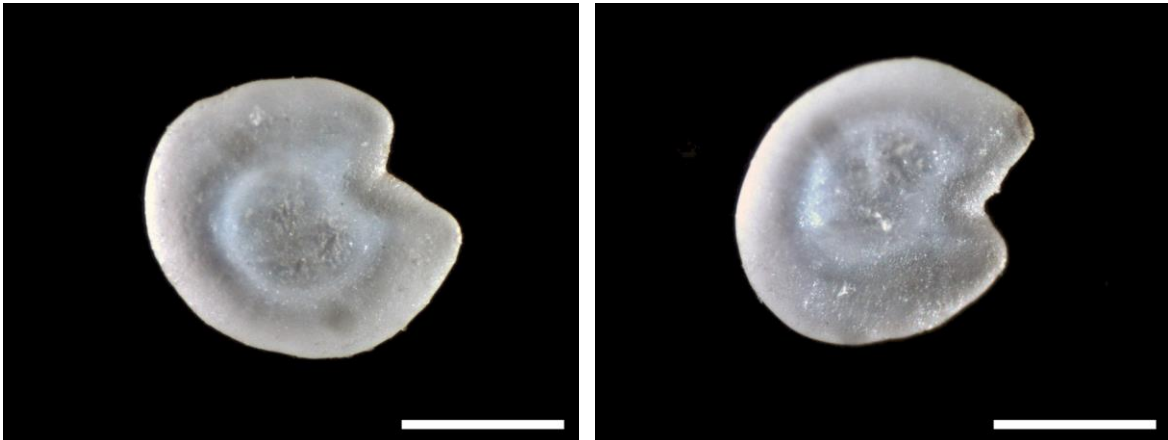
**Family: Myctophidae (cont'd)**

*Diogenichthys atlanticus*

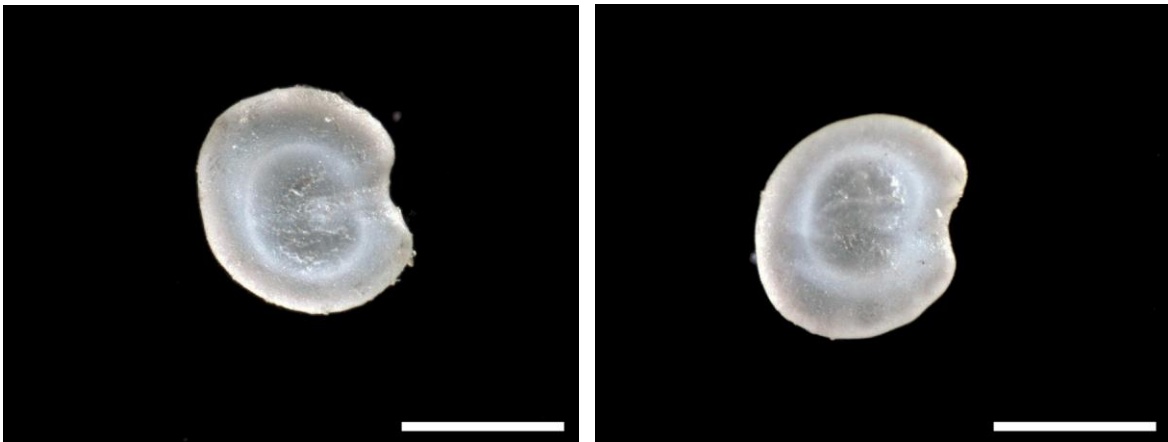
(Longfin lanternfish)



**ID: 22; MAL: 0.89 mm; SL: 21 mm**



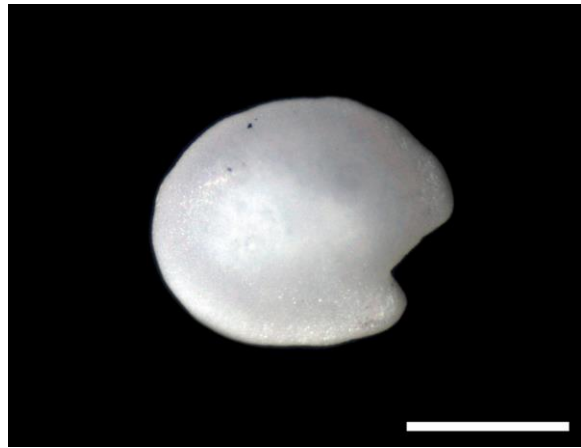
**ID: 31; MAL: 0.98 mm; SL: 22 mm**



**ID: 93; MAL: 0.74 mm; SL: 16 mm**

*Diogenichthys atlanticus* (cont'd)

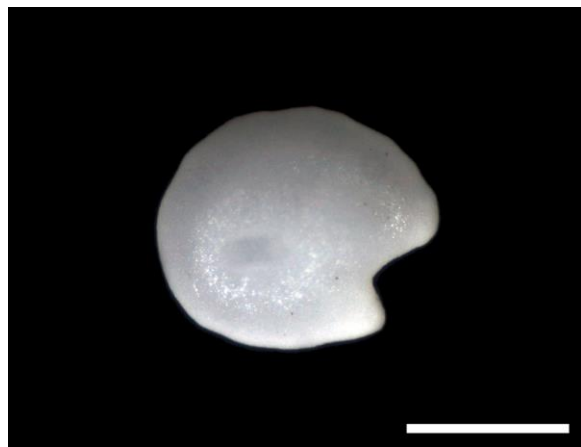
(Longfin lanternfish)



**ID: 1664; MAL: 0.912 mm; SL: nd**



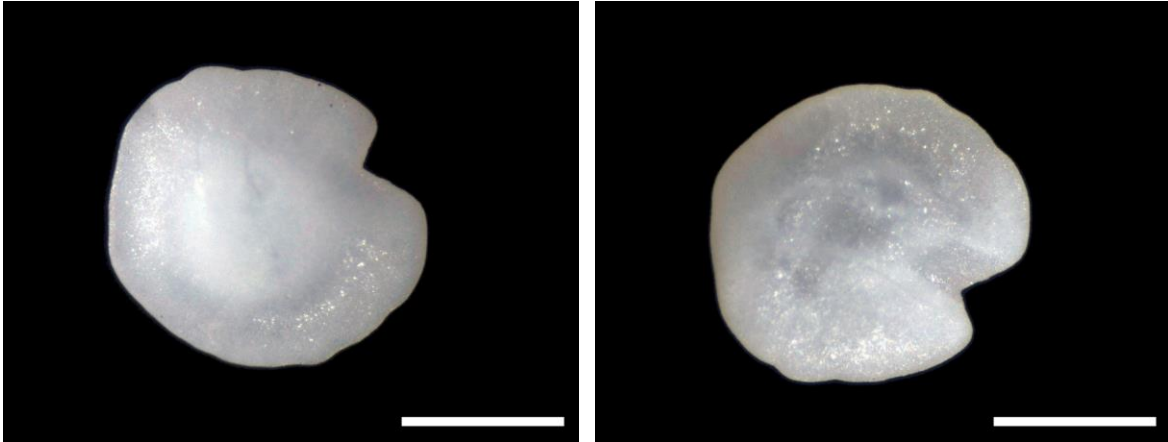
**ID: 1666; MAL: 1.01 mm; SL: nd**



**ID: 1667; MAL: 0.85 mm; SL: nd**

*Diogenichthys atlanticus* (cont'd)

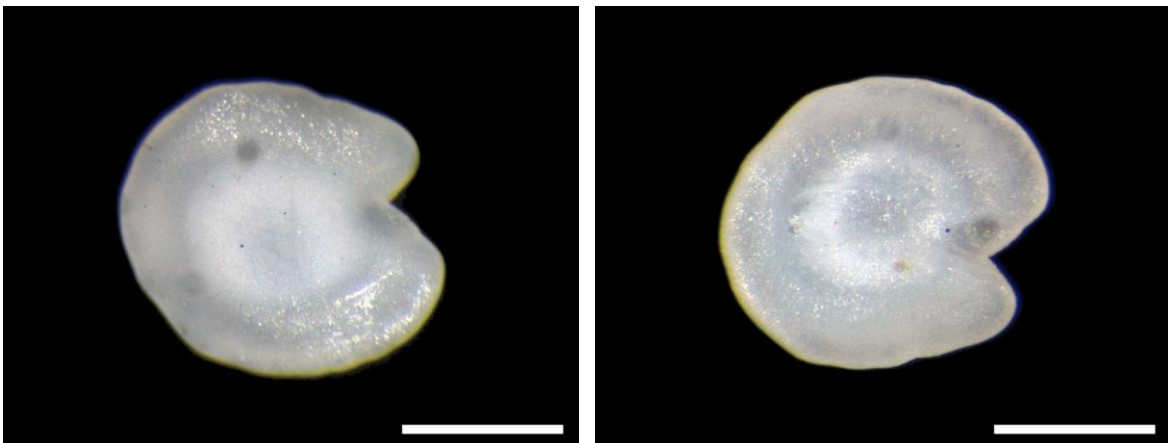
(Longfin lanternfish)



**ID: 1669; MAL: 1.01 mm; SL: nd**



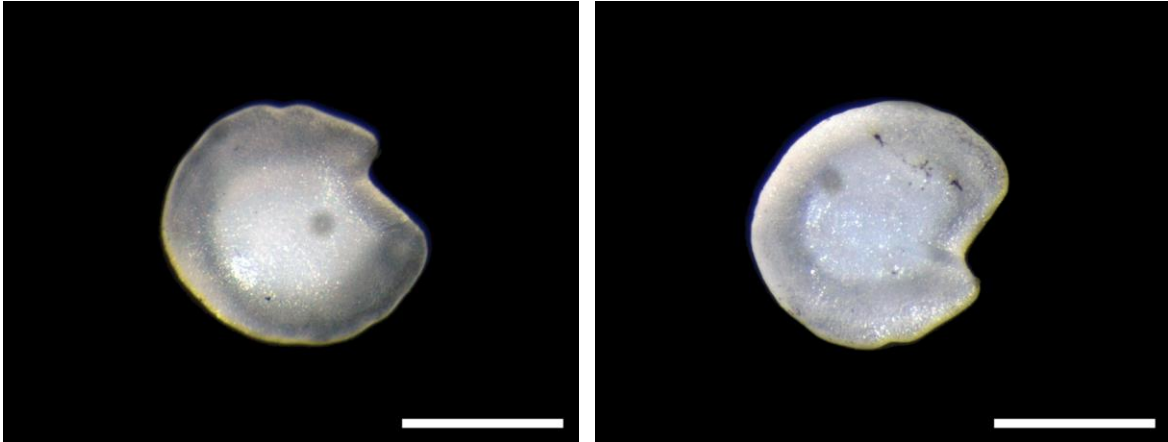
**ID: 1670; MAL: 1.01 mm; SL: nd**



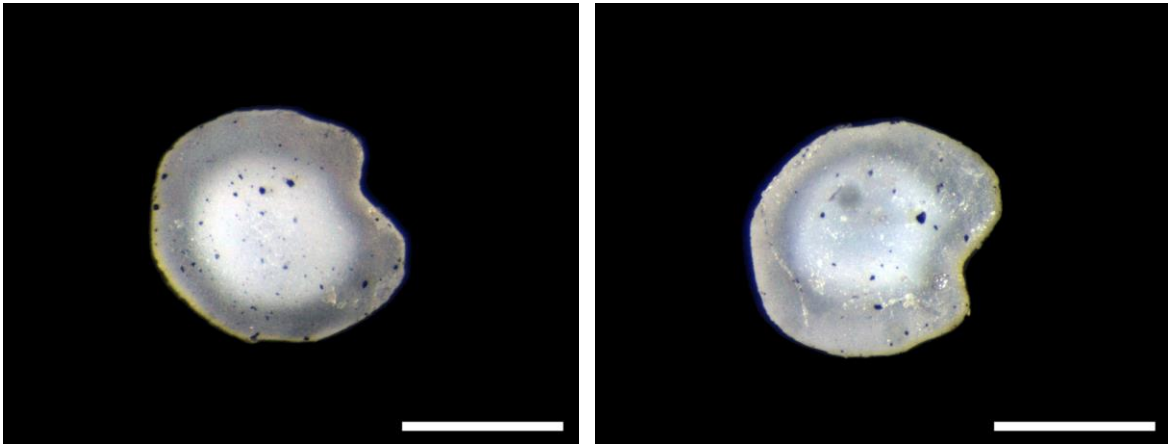
**ID: 1932; MAL: 1.02 mm; SL: nd**

*Diogenichthys atlanticus* (cont'd)

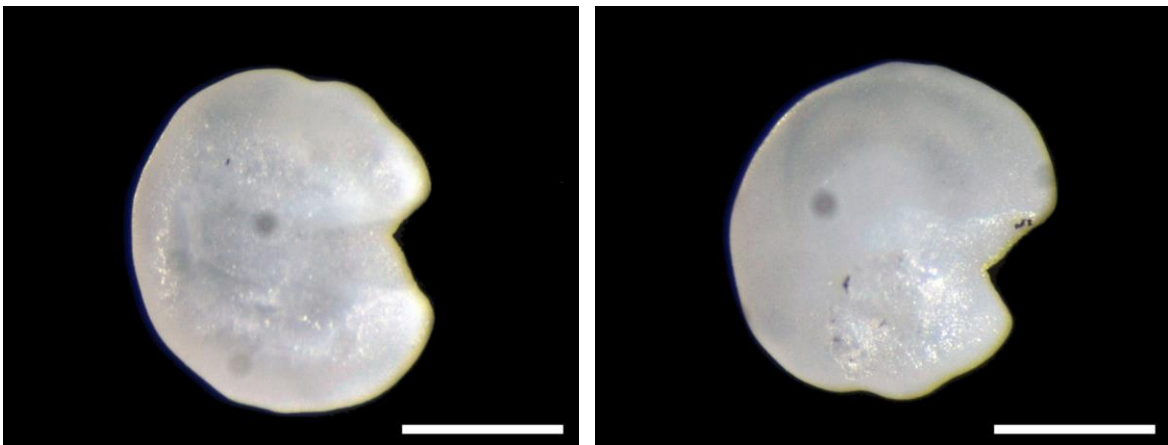
(Longfin lanternfish)



**ID: 1941; MAL: 0.81 mm; SL: 17 mm**



**ID: 1942; MAL: 0.80 mm; SL: 17.5 mm**

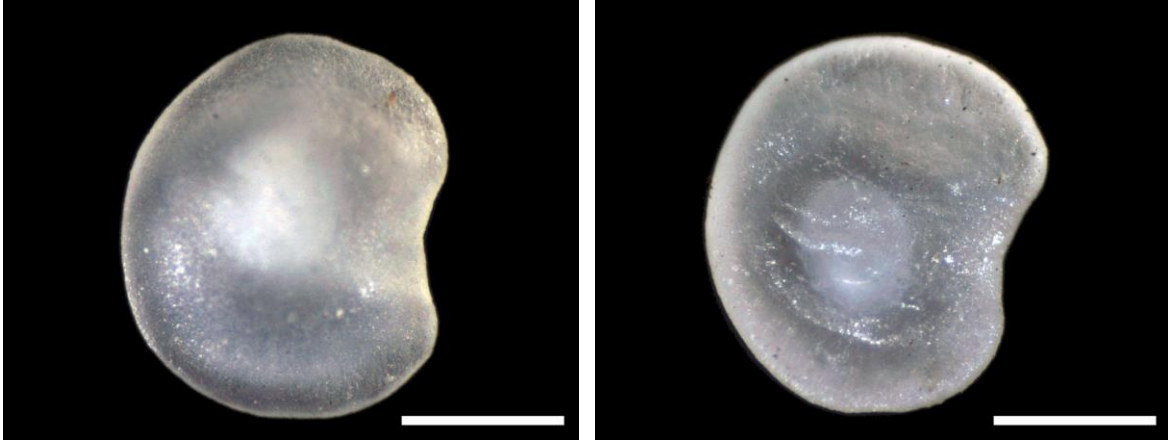


**ID: 1943; MAL: 1.08 mm; SL: 20**

**Family: Myctophidae (cont'd)**

*Diogenichthys laternatus*

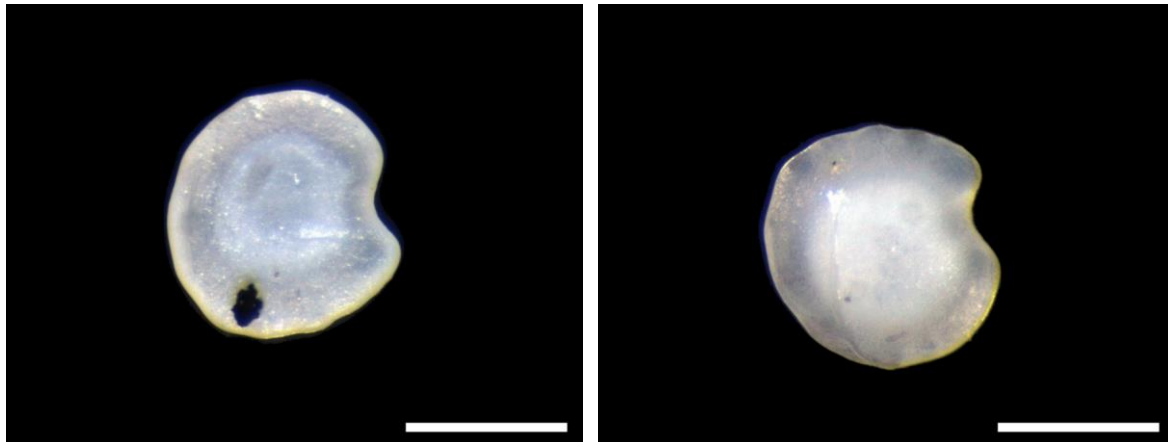
(Diogenes lanternfish)



**ID: 1630; MAL: 1.18 mm; SL: nd**



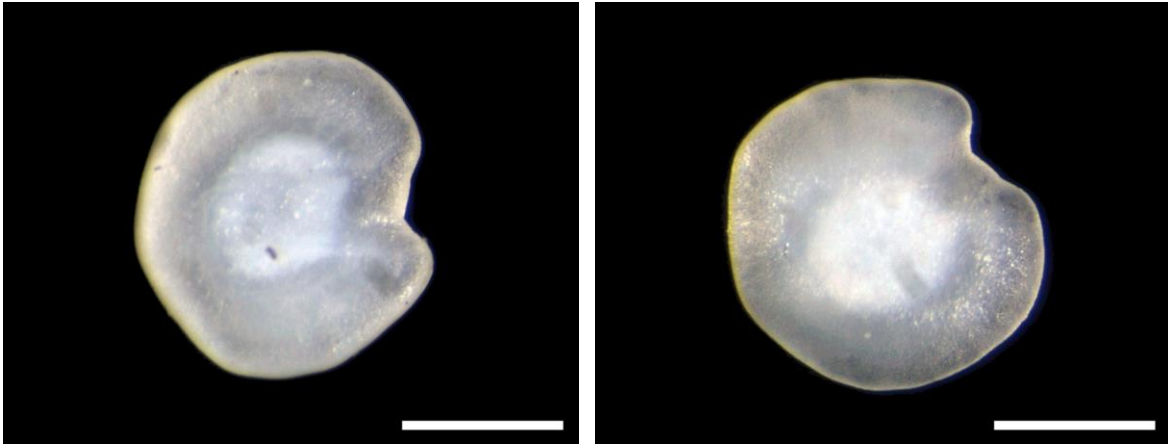
**ID: 1638; MAL: 1.10 mm; SL: nd**



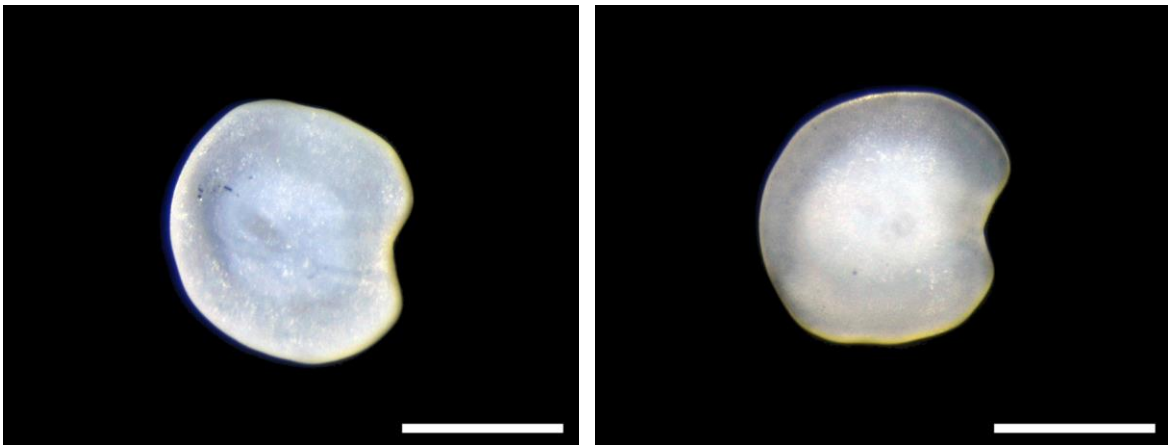
**ID: 1847; MAL: 0.77 mm; SL: 17 mm**

*Diogenichthys laternatus* (cont'd)

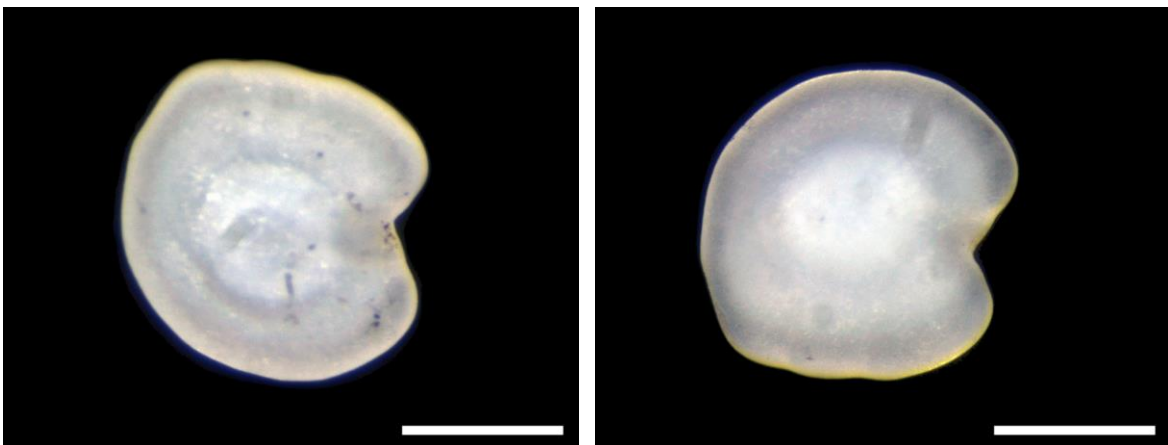
(Diogenes lanternfish)



**ID: 1848; MAL: 1.02 mm; SL: 24 mm**



**ID: 1850; MAL: 0.83 mm; SL: 19 mm**

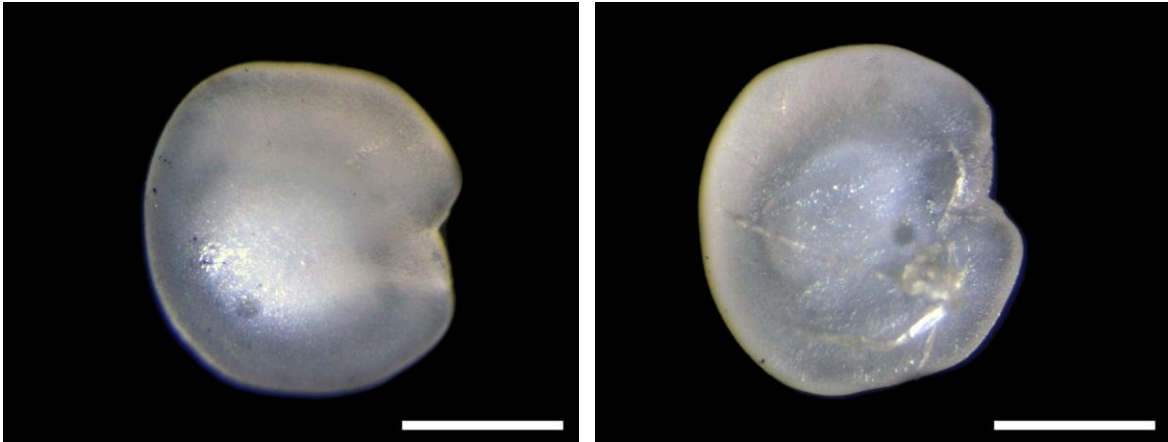


**ID: 1851; MAL: 1.03 mm; SL: 23 mm**

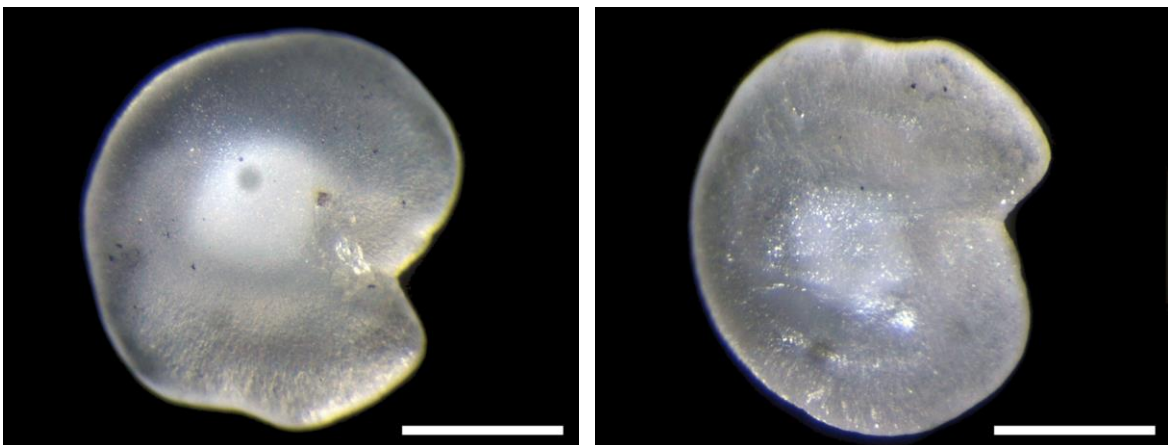


*Diogenichthys laternatus* (cont'd)

(Diogenes lanternfish)



**ID: 1852; MAL: 1.10 mm; SL: 25 mm**

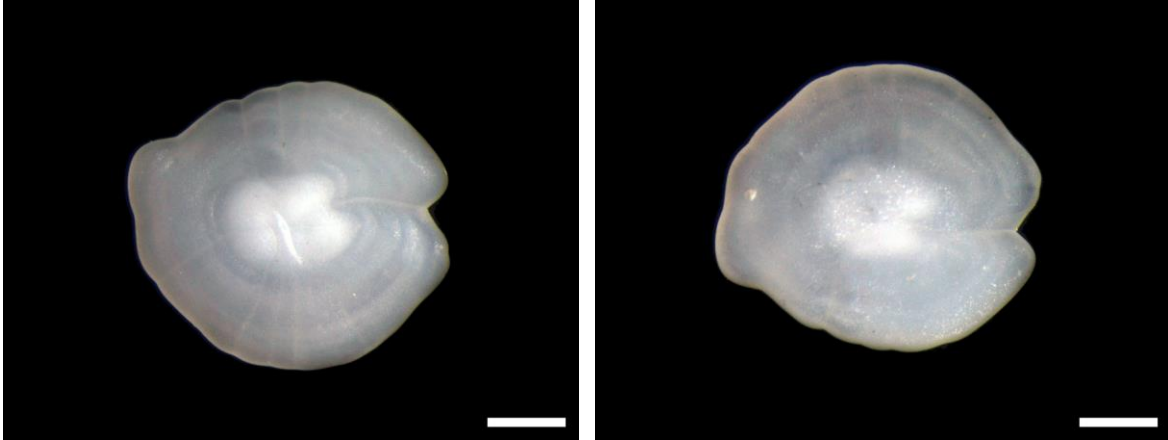


**ID: 1858; MAL: 1.28 mm; SL: 25 mm**

**Family: Myctophidae (cont'd)**

*Myctophum nitidulum*

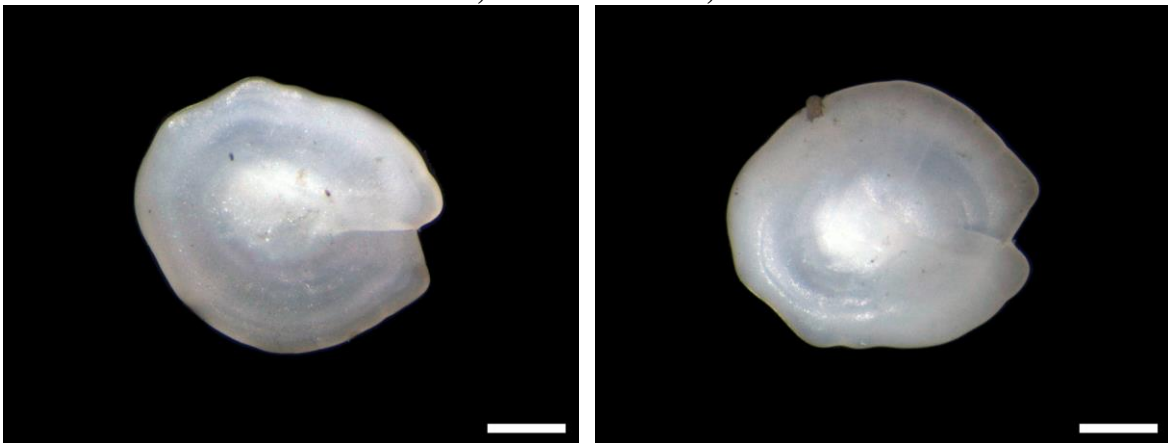
(Pearly lanternfish)



**ID: 1802; MAL: 2.05 mm; SL: nd**



**ID: 1803; MAL: 2.63 mm; SL: nd**



**ID: 1804; MAL: 1.95 mm; SL: nd**

*Myctophum nitidulum* (cont'd)

(Pearly lanternfish)



ID: 1810; MAL: 2.40 mm; SL: nd



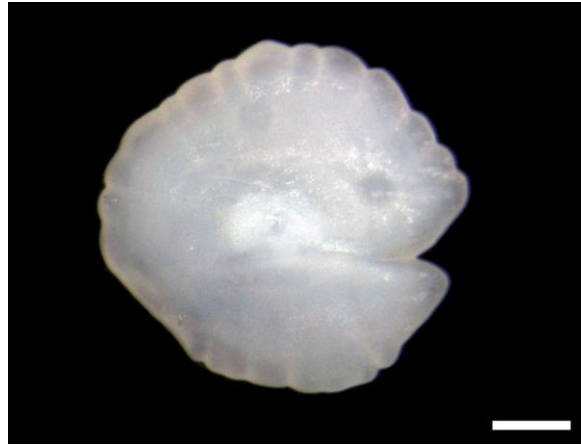
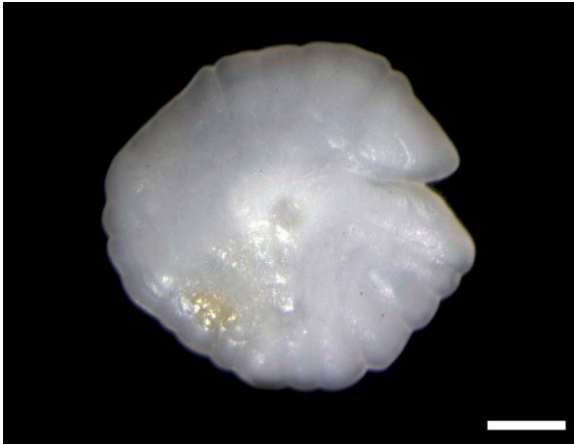
ID: 1882; MAL: 2.32 mm; SL: 52 mm



ID: 1884; MAL: 2.20 mm; SL: nd

*Myctophum nitidulum* (cont'd)

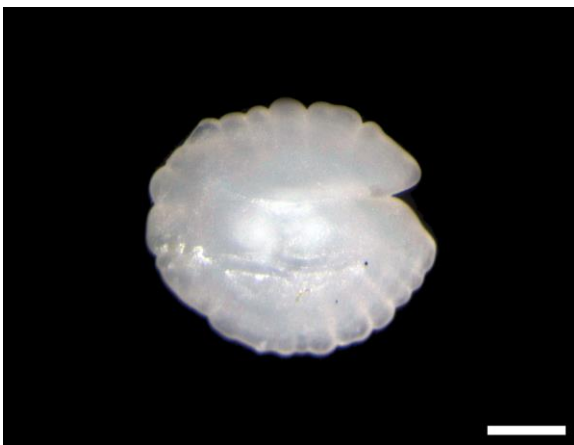
(Pearly lanternfish)



**ID: 1886; MAL: 2.28 mm; SL: nd**



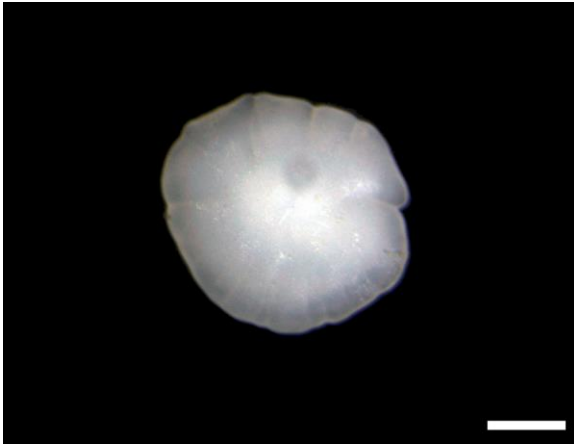
**ID: 1888; MAL: 2.31 mm; SL: nd**



**ID: 1889; MAL: 1.83 mm; SL: 40 mm**

*Myctophum nitidulum* (cont'd)

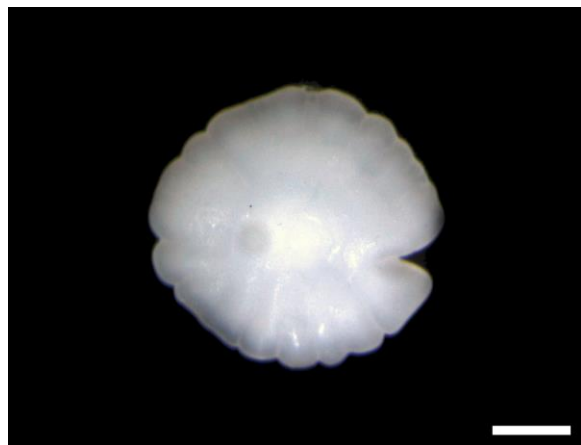
(Pearly lanternfish)



**ID: 1890; MAL: 1.63 mm; SL: 35 mm**



**ID: 1893; MAL: 1.70 mm; SL: nd**

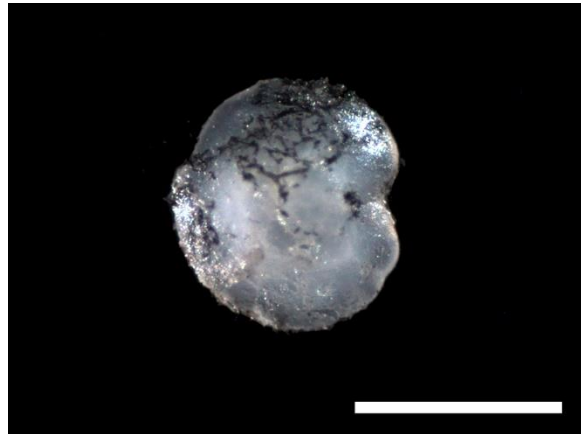


**ID: 1896; MAL: 1.85 mm; SL: nd**

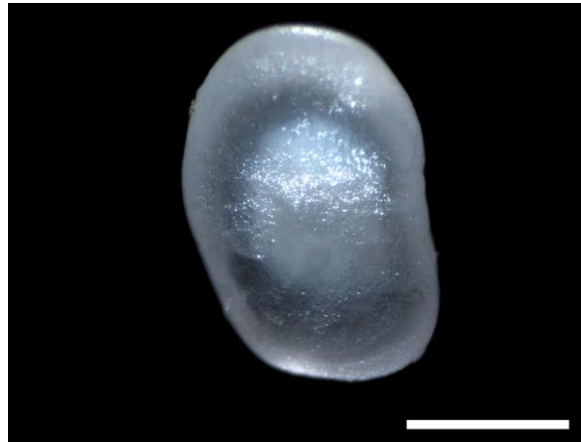
**Family: Myctophidae (cont'd)**

*Nannobrachium regale*

(Pinpoint lightfish)



**ID: 47; MAL: 0.62 mm; SL: 23 mm**



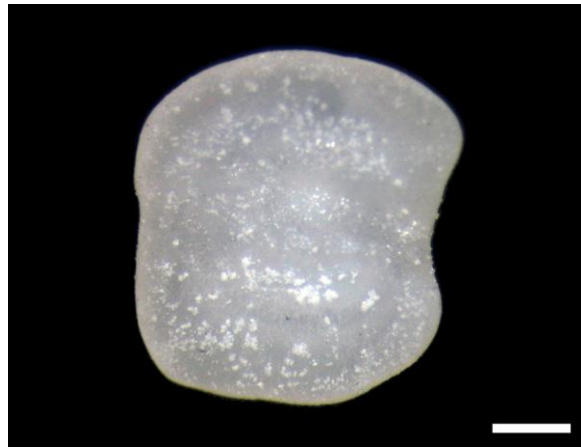
**ID: 64; MAL: 1.17 mm; SL: 46 mm**



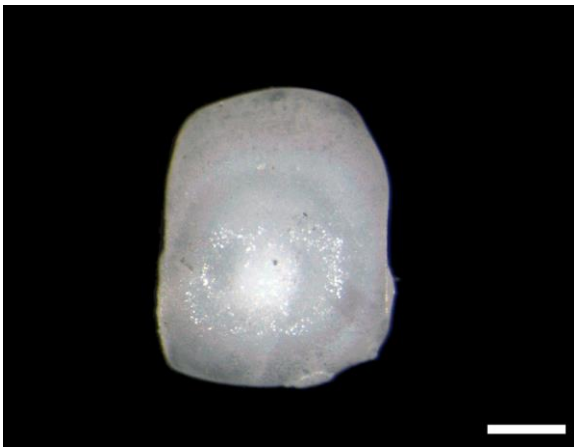
**ID: 434; MAL: 0.71 mm; SL: 33 mm**

*Nannobranchium regale* (cont'd)

(Pinpoint lightfish)



**ID: 1531; MAL: 2.37 mm; SL: nd**



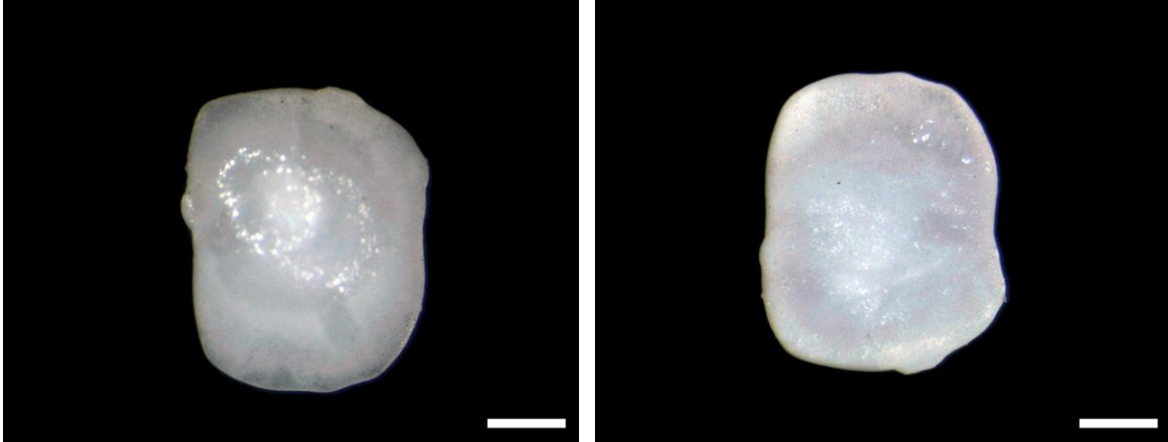
**ID: 1532; MAL: 1.95 mm; SL: nd**



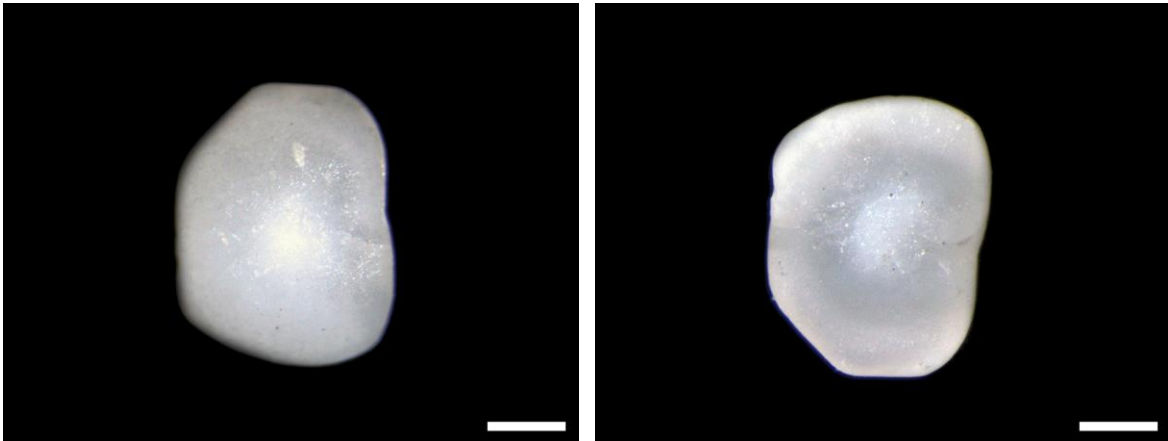
**ID: 1533; MAL: 2.63 mm; SL: nd**

*Nannobranchium regale* (cont'd)

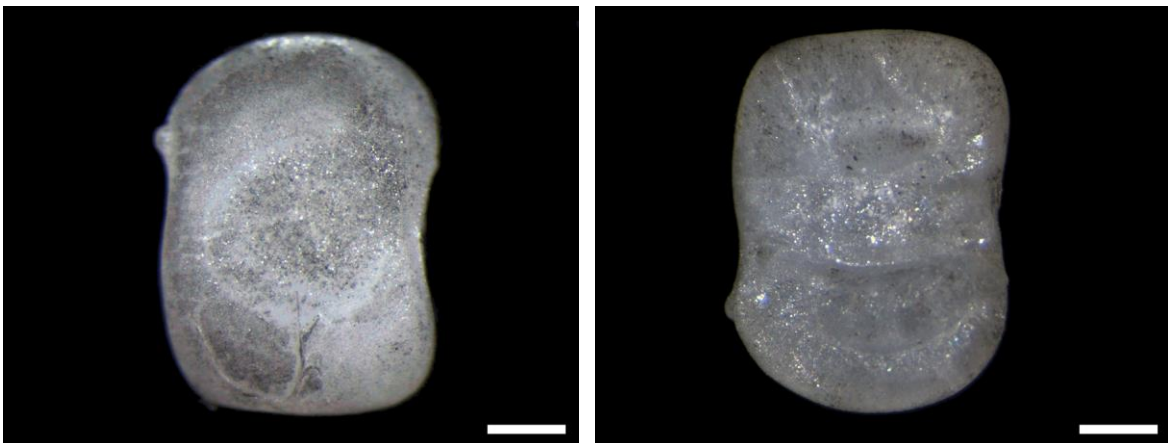
(Pinpoint lightfish)



ID: 1534; MAL: 1.99 mm; SL: nd



ID: 1536; MAL: 1.86 mm; SL: nd

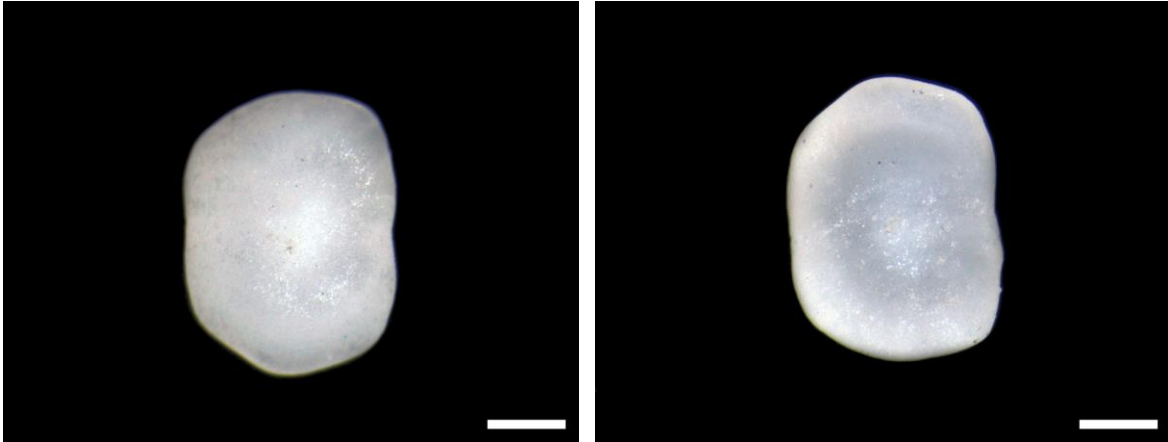


ID: 1537; MAL: 2.58 mm; SL: nd



*Nannobranchium regale* (cont'd)

(Pinpoint lightfish)



ID: 1538; MAL: 1.87 mm; SL: nd



ID: 1539; MAL: 2.07 mm; SL: nd

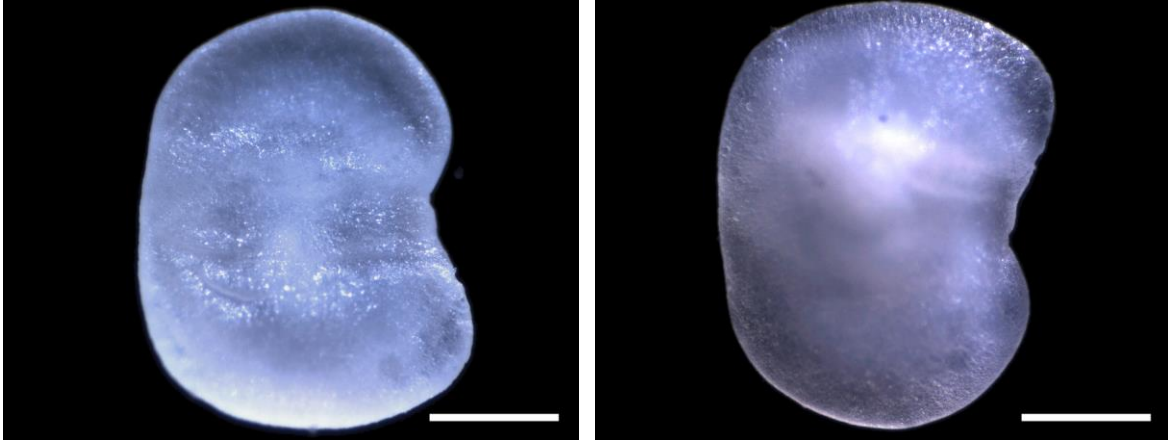


ID: 2507; MAL: 1.04 mm; SL: nd

**Family: Myctophidae (cont'd)**

*Nannobrachium ritteri*

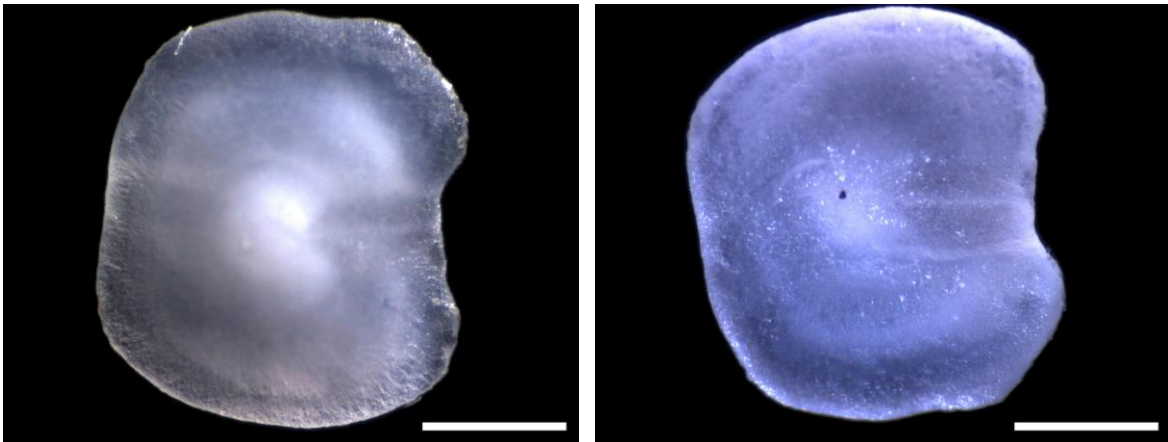
(Broadfish lanternfish)



**ID: 140; MAL 1.71 mm; SL: 93 mm**



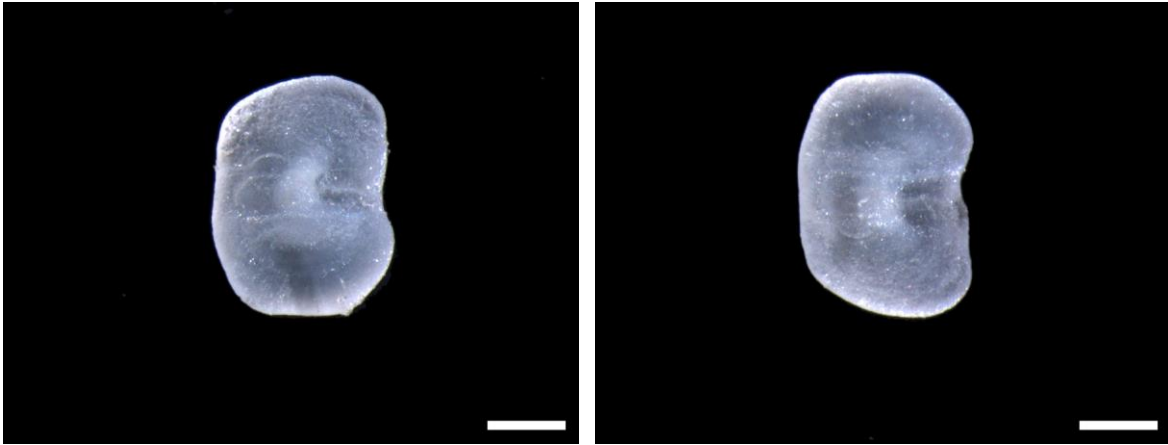
**ID: 143; MAL 1.83 mm; SL: 90 mm**



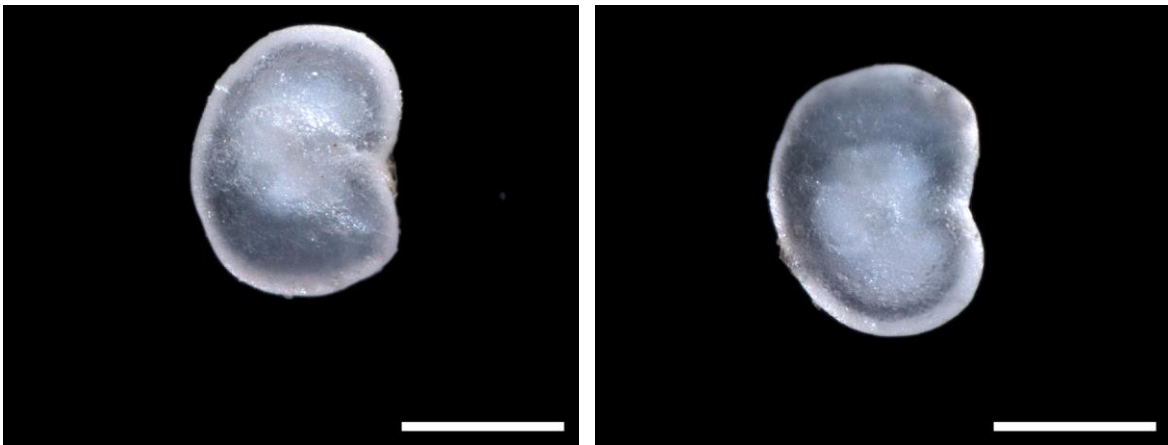
**ID: 146; MAL 1.50 mm; SL: 78 mm**

*Nannobranchium ritteri* (cont'd)

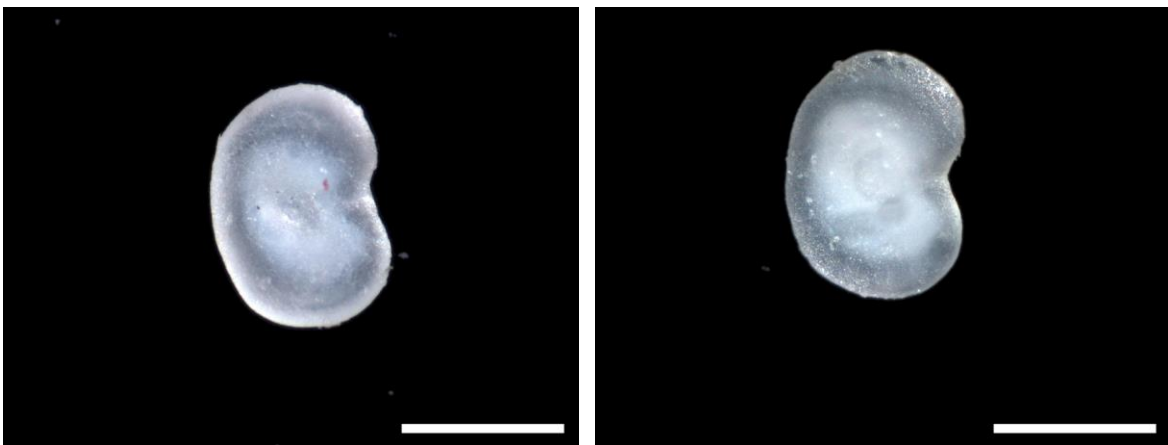
(Broadfish lanternfish)



**ID: 147; MAL 1.63 mm; SL: 82 mm**



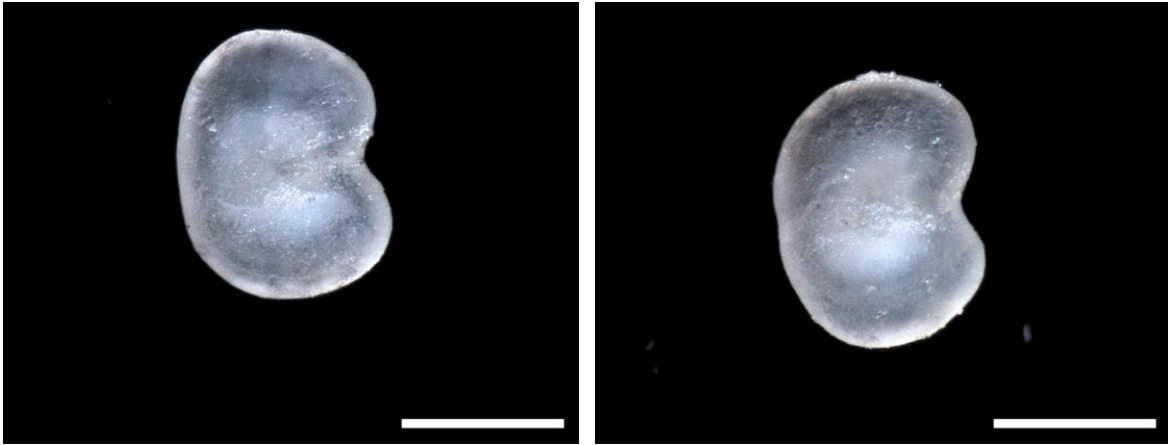
**ID: 444; MAL 0.86 mm; SL: 40 mm**



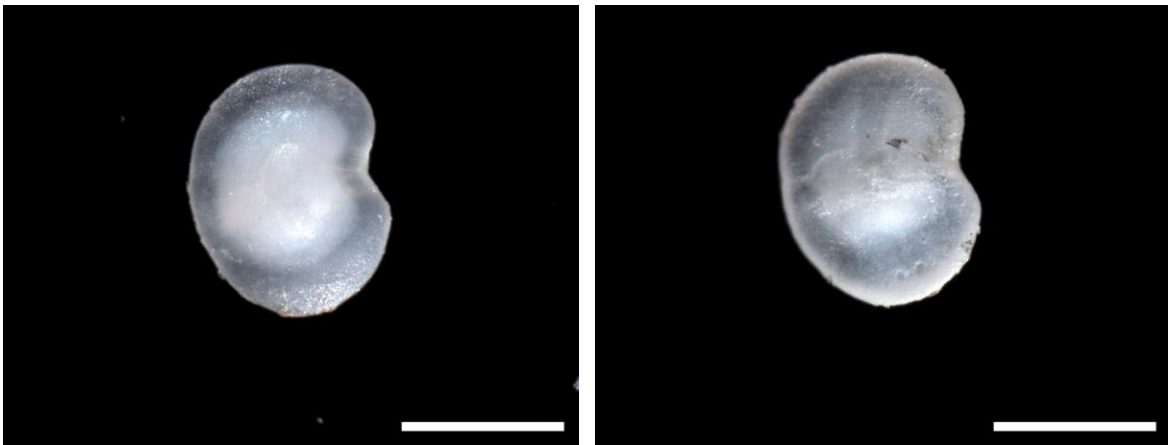
**ID: 445; MAL 0.78 mm; SL: 36 mm**

*Nannobranchium ritteri* (cont'd)

(Broadfish lanternfish)



ID: 446; MAL 0.87 mm; SL: 37 mm



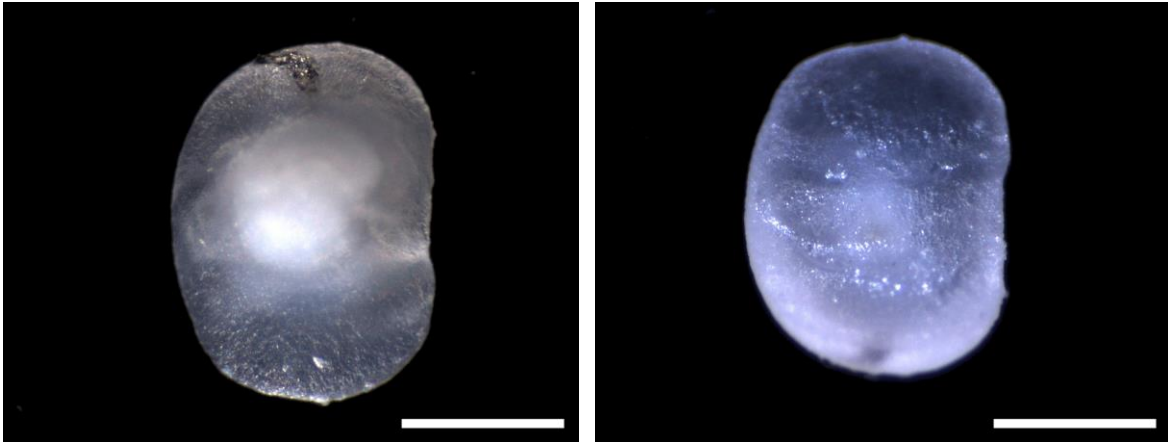
ID: 447; MAL 0.80 mm; SL: 35 mm



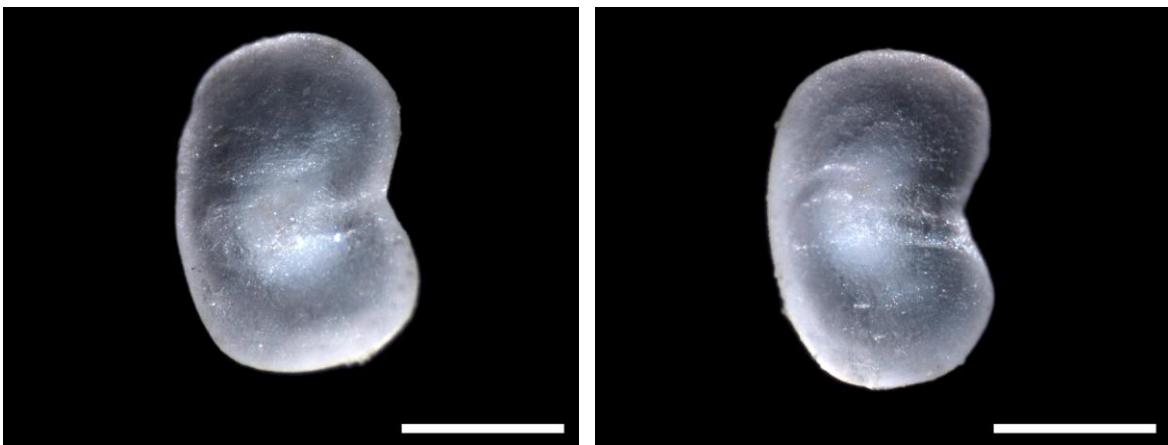
ID: 448; MAL: 1.19 mm; SL: 59 mm

*Nannobranchium ritteri* (cont'd)

(Broadfish lanternfish)



**ID: 449; MAL: 1.08 mm; SL: 55 mm**

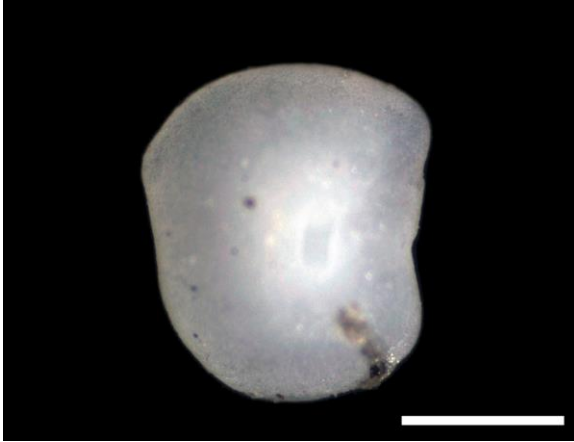


**ID: 450; MAL: 1.09 mm; SL: 51 mm**

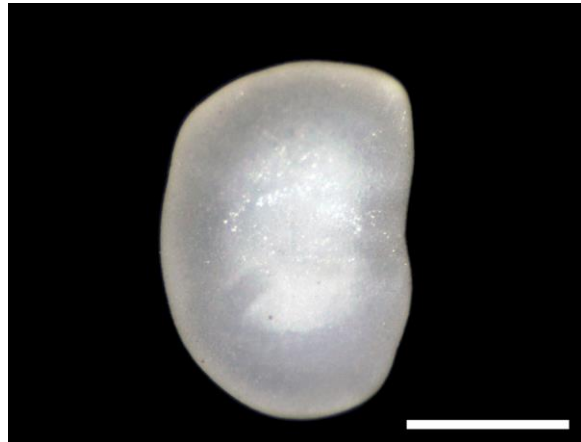
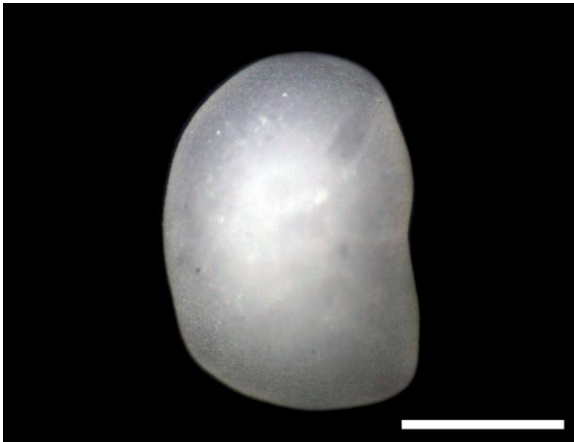
**Family: Myctophidae (cont'd)**

*Parvilux ingens*

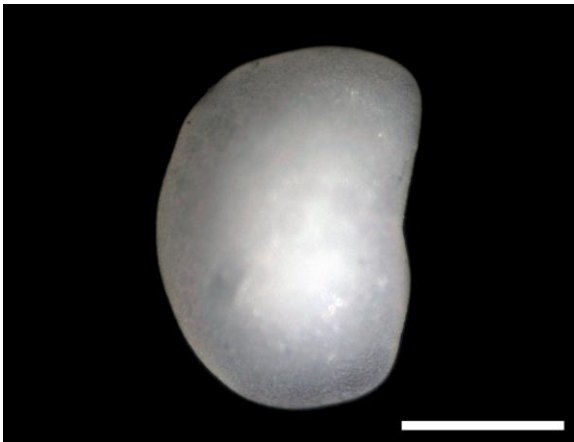
(Giant lampfish)



**ID: 1604; MAL: 1.06 mm; SL: nd**



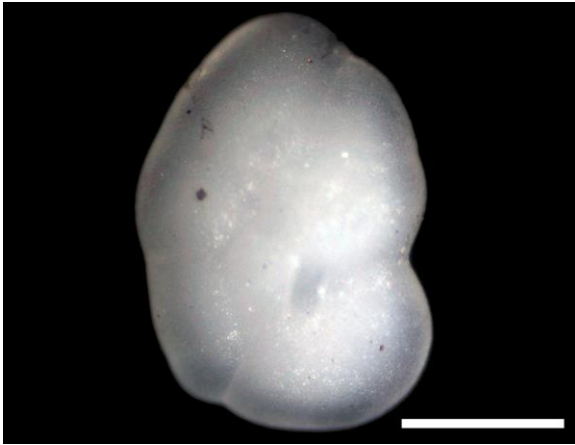
**ID: 1607; MAL: 1.13 mm; SL: nd**



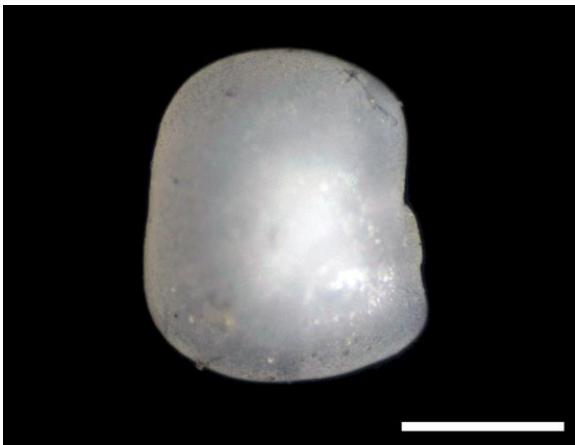
**ID: 1608; MAL: 1.15 mm; SL: nd**

*Parvilux ingens* (cont'd)

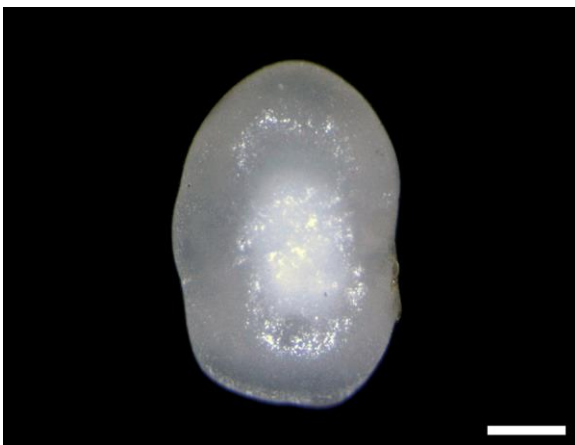
(Giant lampfish)



**ID: 1612; MAL: 1.28 mm; SL: nd**



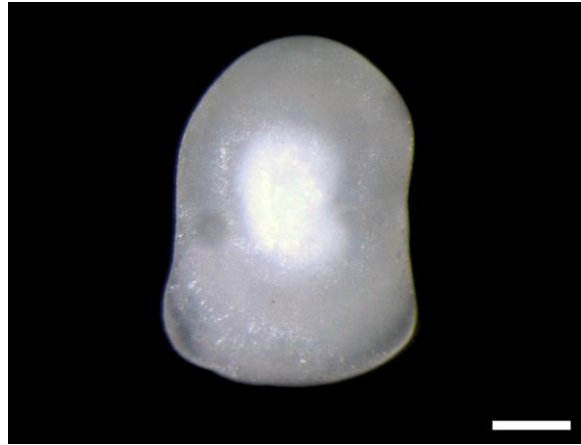
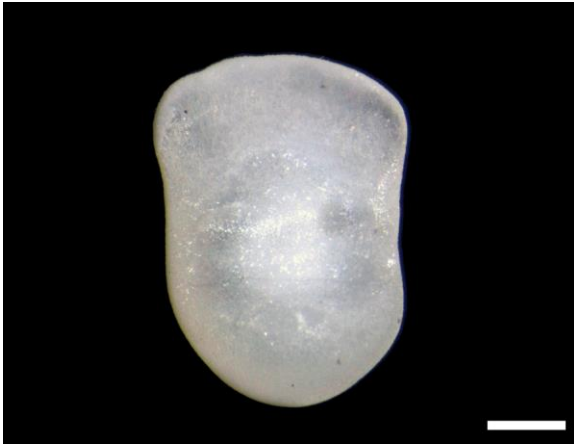
**ID: 1614; MAL: 1.06 mm; SL: nd**



**ID: 1866; MAL: 2.29 mm; SL: nd**

*Parvilux ingens* (cont'd)

(Giant lampfish)



**ID: 1867; MAL: 2.32 mm; SL: nd**



**ID: 1868; MAL: 2.34 mm; SL: nd**



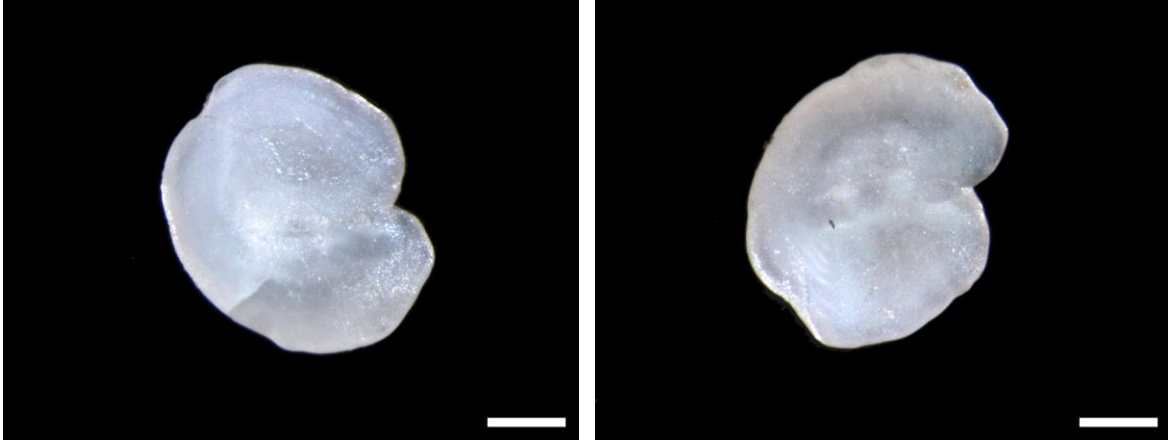
**ID: 1869; MAL: 1.18 mm; SL: nd**



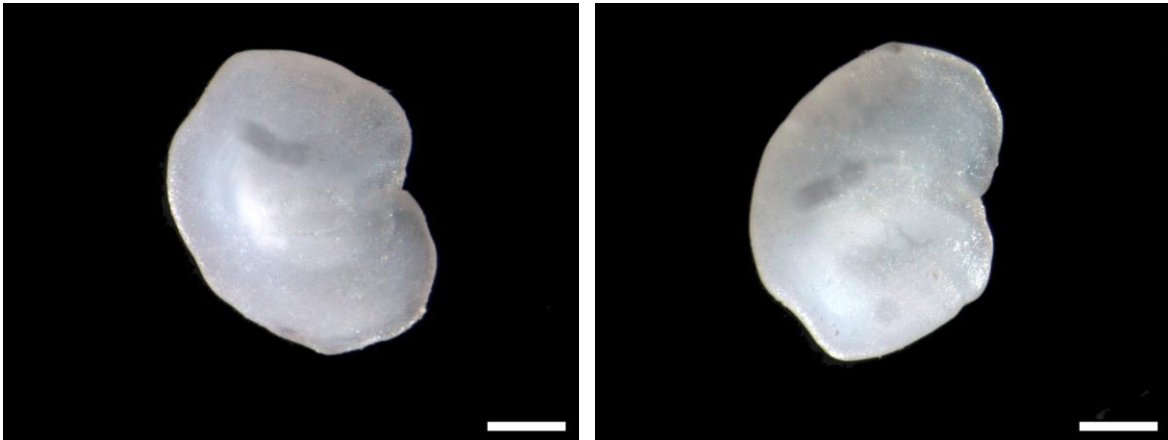
**Family: Myctophidae (cont'd)**

*Protomyctophum crockery*

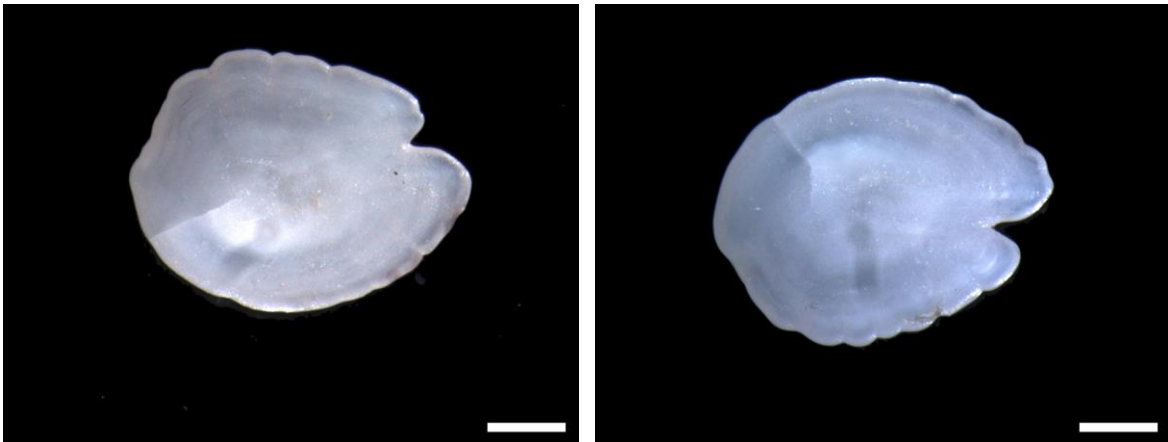
(California flashlightfish)



**ID: 41; MAL: 1.94 mm; SL: 33 mm**



**ID: 42; MAL: 2.10 mm; SL: 32 mm**



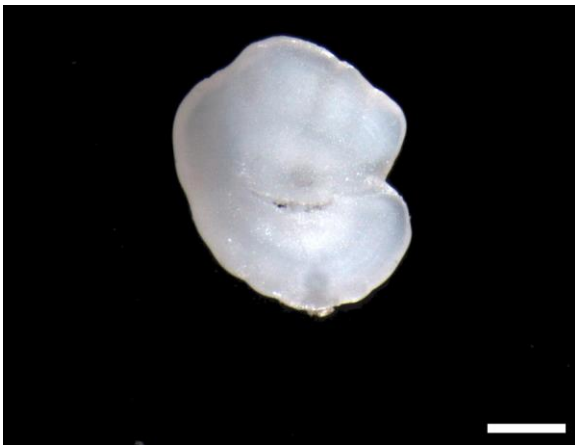
**ID: 48; MAL: nd; SL: nd**

*Protomyctophum crockery* (cont'd)

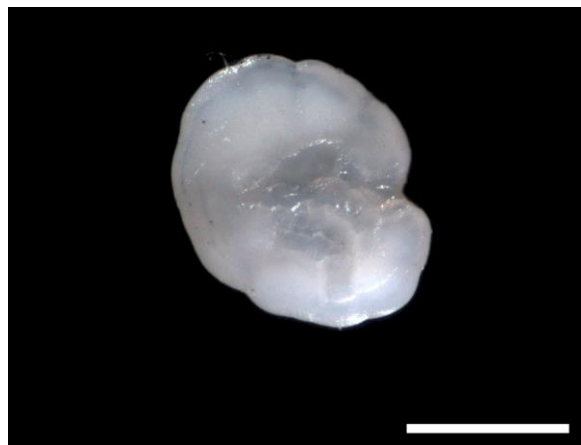
(California flashlightfish)



**ID: 83; MAL: 2.22 mm; SL: 35 mm**



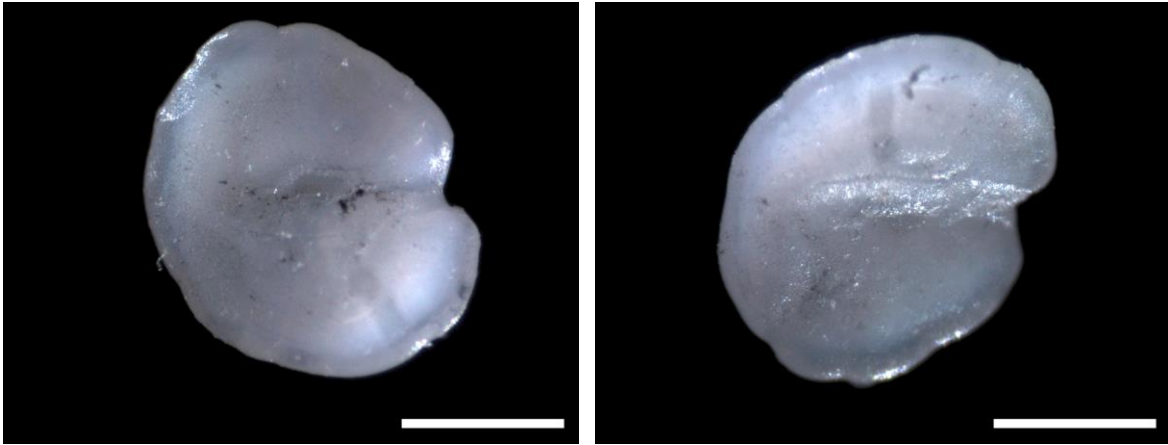
**ID: 111; MAL: 0.88 mm; SL: 28 mm**



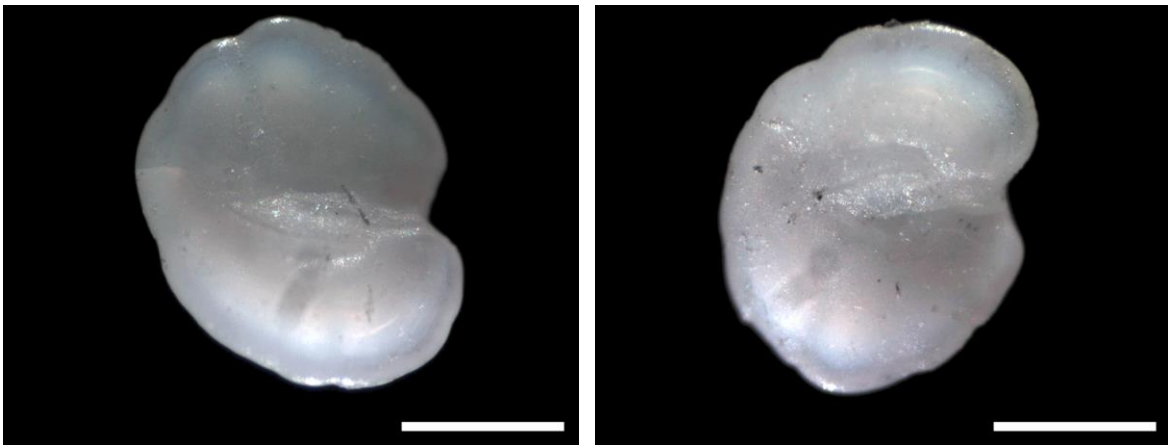
**ID: 501; MAL: 0.89 mm; SL: 17 mm**

*Protomyctophum crockery* (cont'd)

(California flashlightfish)



**ID: 502; MAL: 1.15 mm; SL: 16 mm**



**ID: 503; MAL: 1.19 mm; SL: 18 mm**

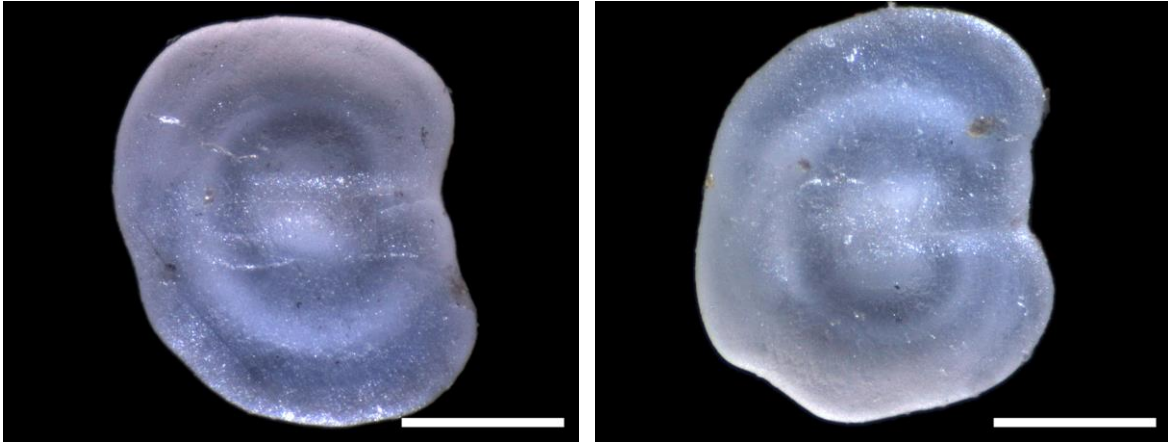
**Family: Myctophidae (cont'd)**

*Stenobrachius leucopsarus*

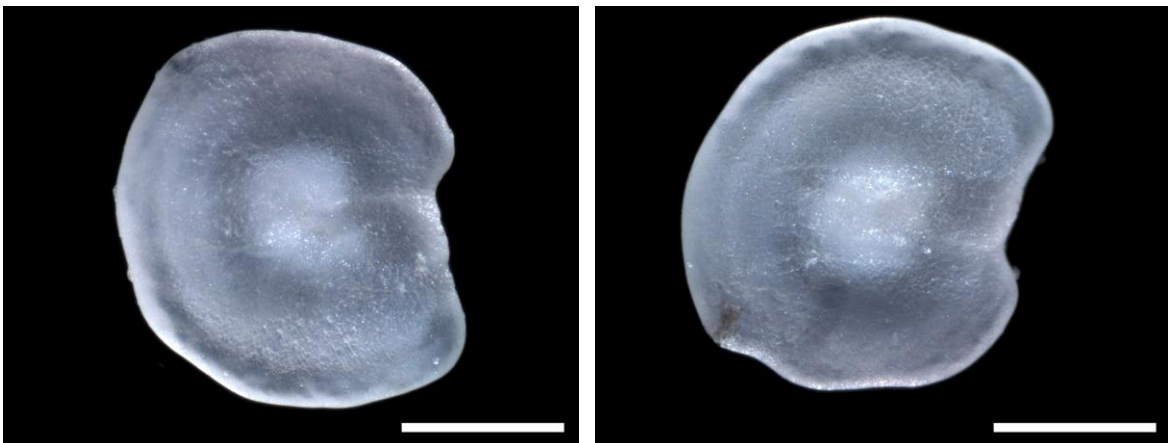
(Northern lampfish)



**ID: 13; MAL: 1.62 mm; SL: 62 mm**



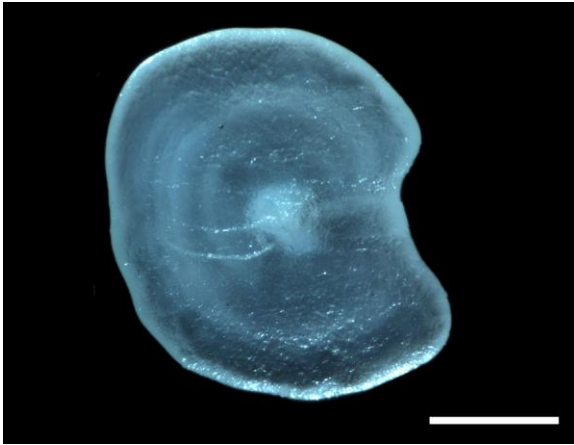
**ID: 110; MAL: 1.34 mm; SL: 52 mm**



**ID: 468; MAL: 1.23 mm; SL: 54 mm**

*Stenobranchius leucopsarus*

(Northern lampfish)



**ID: 469; MAL: 1.55 mm; SL: 60 mm**



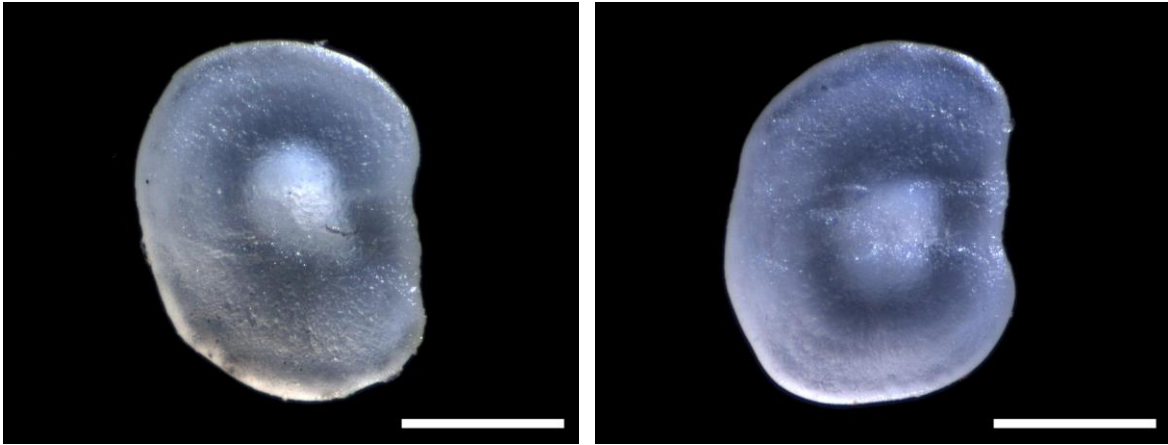
**ID: 472; MAL: 1.37 mm; SL: 57 mm**



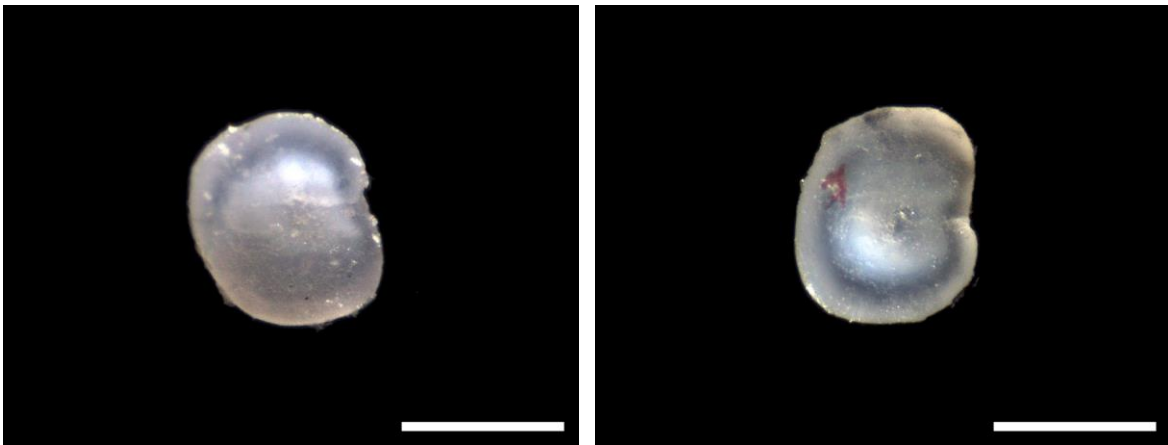
**ID: 473; MAL: 1.62 mm; SL: 61 mm**

*Stenobranchius leucopsarus*

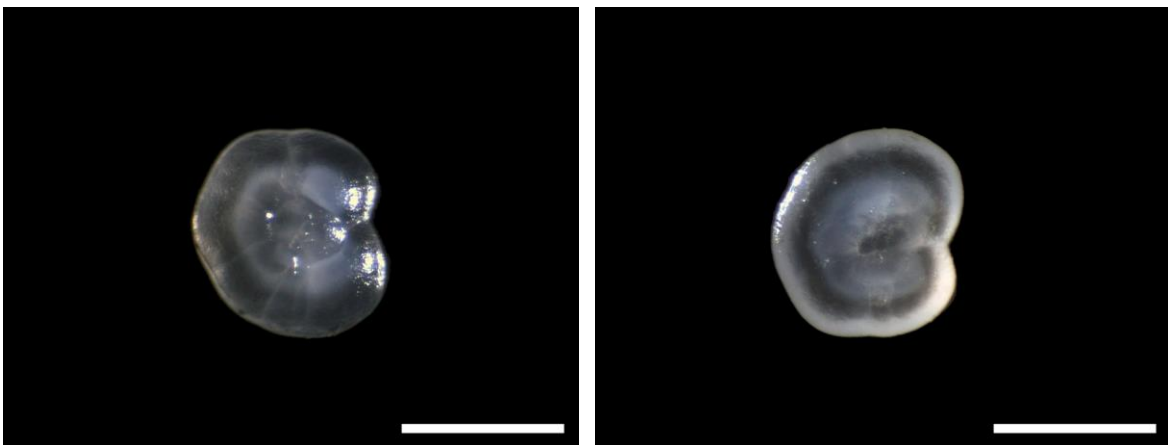
(Northern lampfish)



**ID: 475; MAL: 1.16 mm; SL: 47 mm**



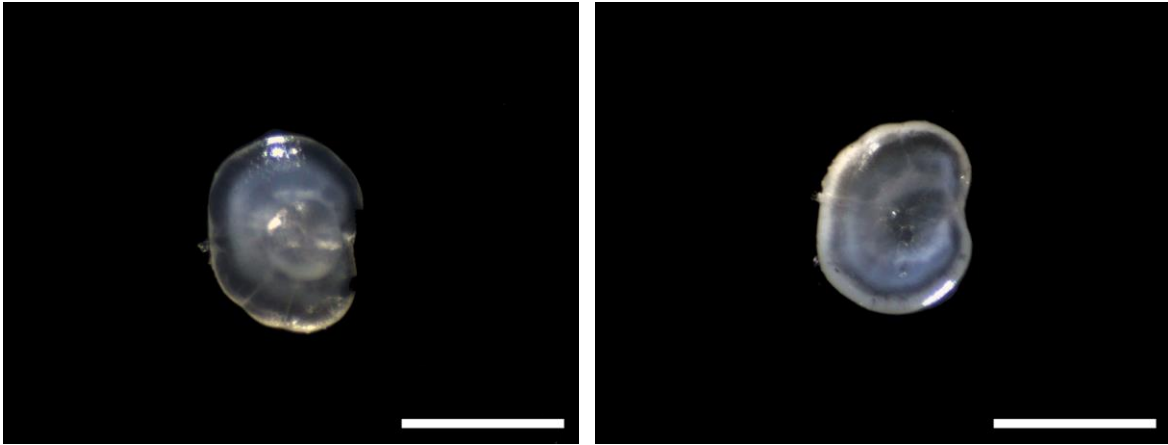
**ID: 478; MAL: 0.71 mm; SL: 28 mm**



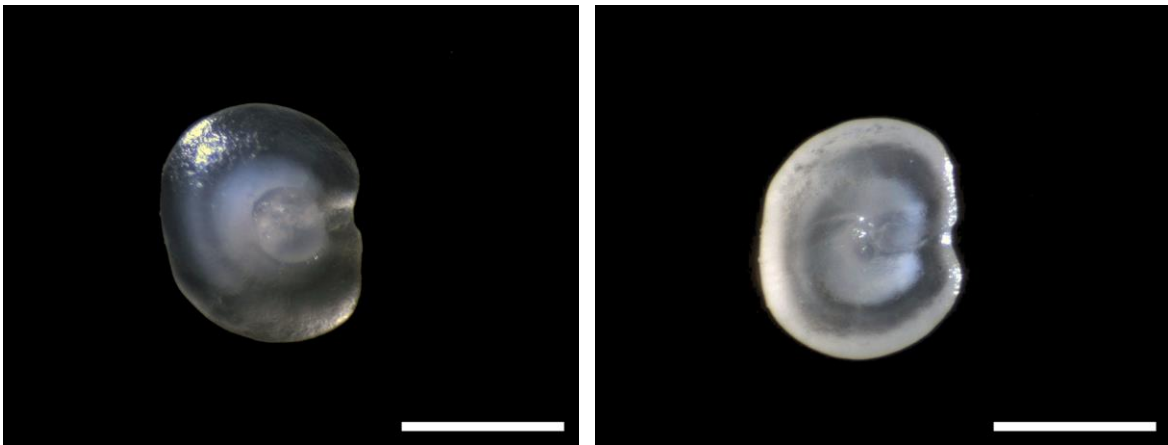
**ID: 821; MAL: 0.67 mm; SL: 29 mm**

*Stenobranchius leucopsarus*

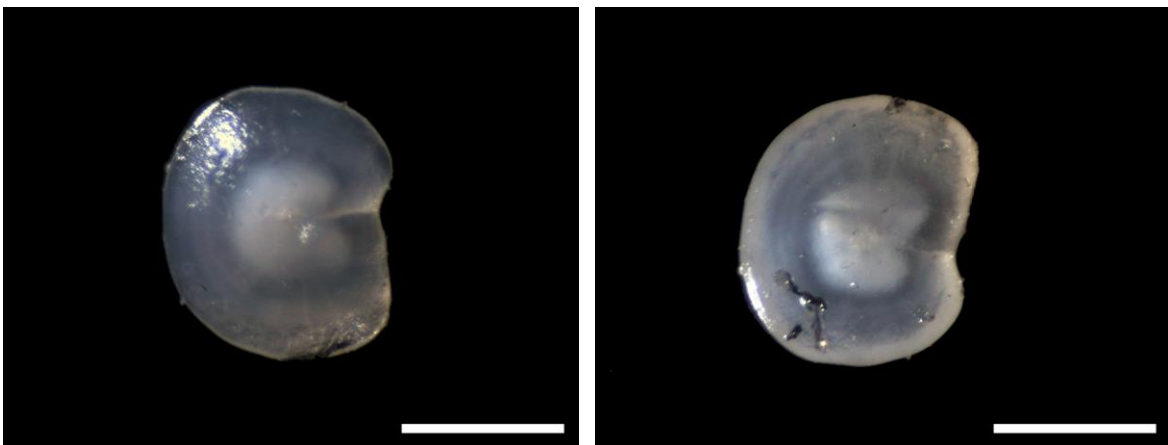
(Northern lampfish)



**ID: 823; MAL: 0.61 mm; SL: 25 mm**



**ID: 825; MAL: 0.76 mm; SL: 31 mm**

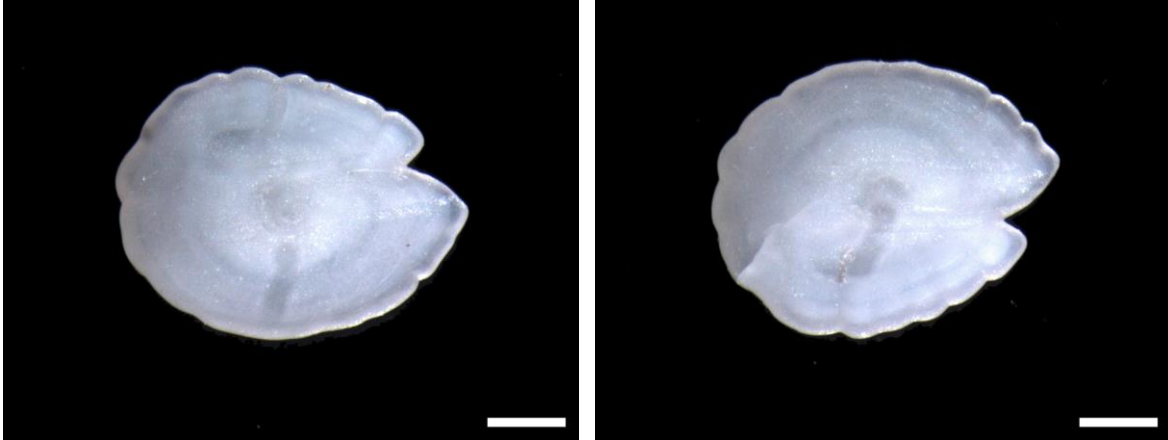


**ID: 863; MAL: 0.87 mm; SL: 38 mm**

**Family: Myctophidae (cont'd)**

*Symbolophorus californiensis*

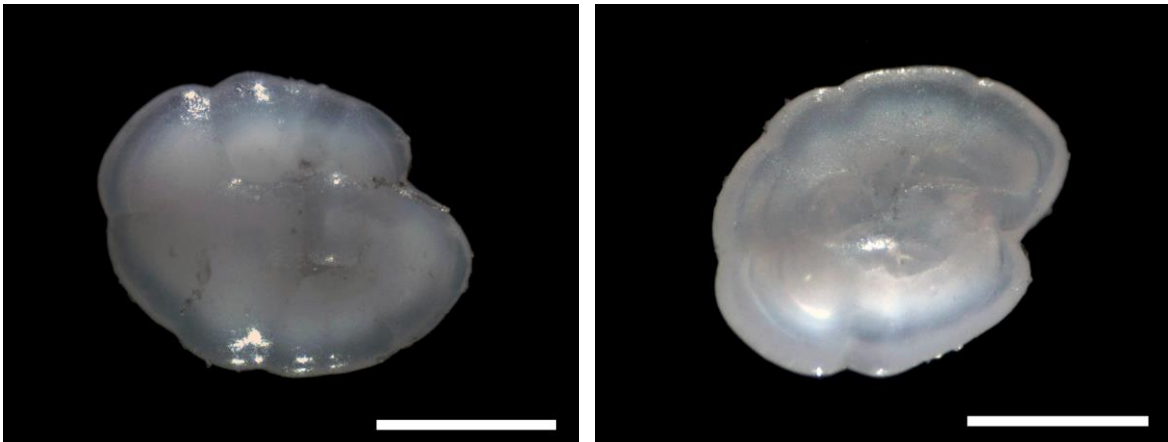
(Bigfin lanternfish)



**ID: 107; MAL: 2.19 mm; SL: 43 mm**



**ID: 148; MAL: 2.77 mm; SL: 61 mm**



**ID: 551; MAL: 1.05 mm; SL: 28 mm**

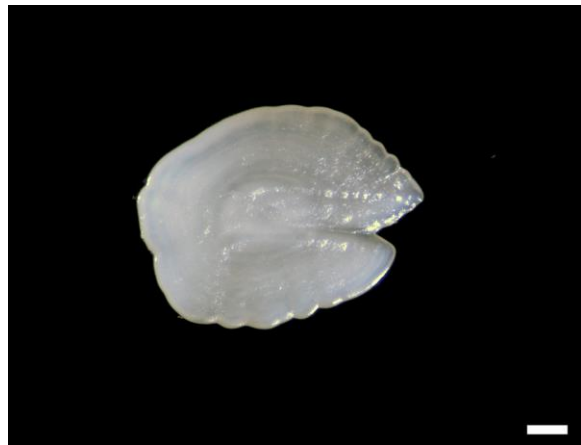
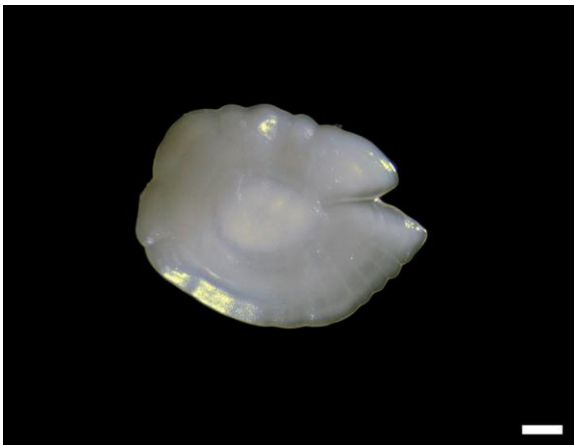


*Symbolophorus californiensis* (cont'd)

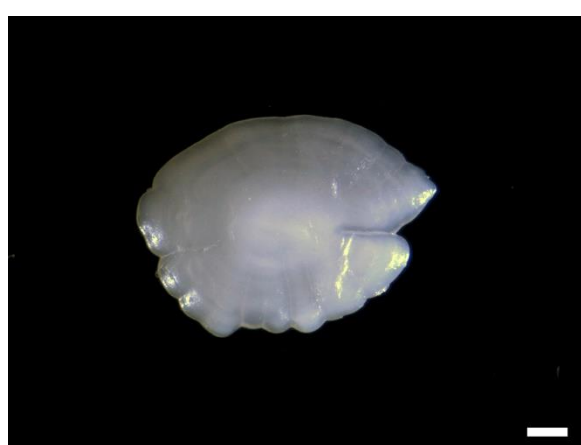
(Bigfin lanternfish)



**ID: 552; MAL: 1.07 mm; SL: 27 mm**



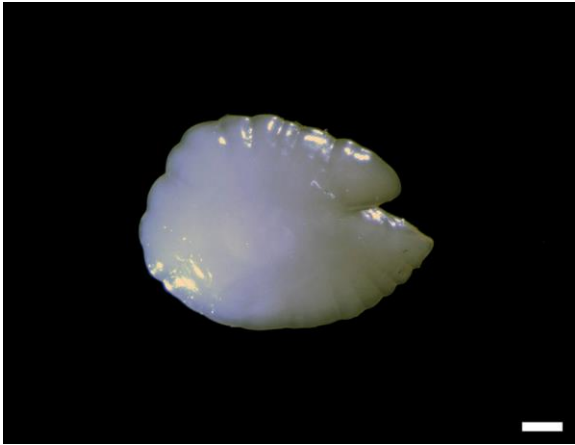
**ID: 691; MAL: 0.892 mm; SL: 73 mm**



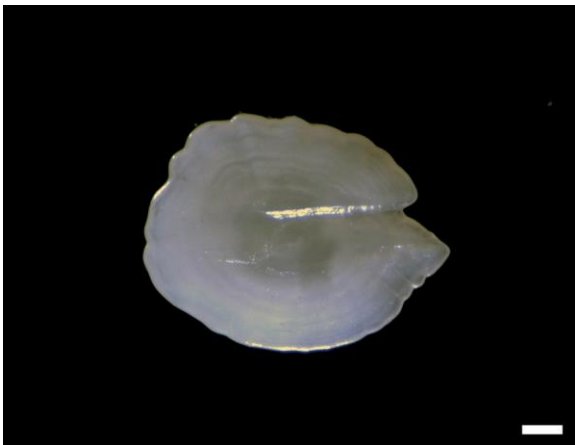
**ID: 692; MAL: 0.902 mm; SL: 76 mm**

*Symbolophorus californiensis* (cont'd)

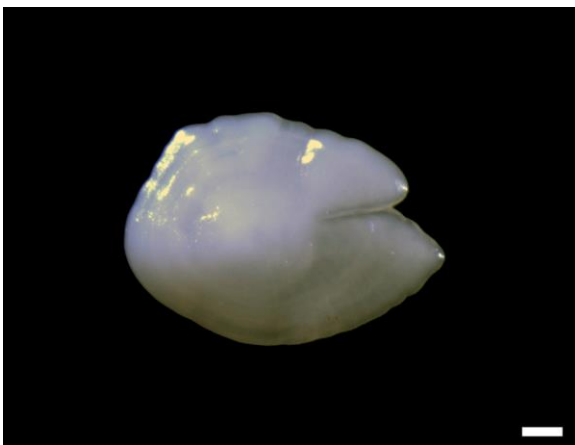
(Bigfin lanternfish)



**ID: 694; MAL: 0.879 mm; SL: 77 mm**



**ID: 697; MAL: 0.931 mm; SL: 85 mm**

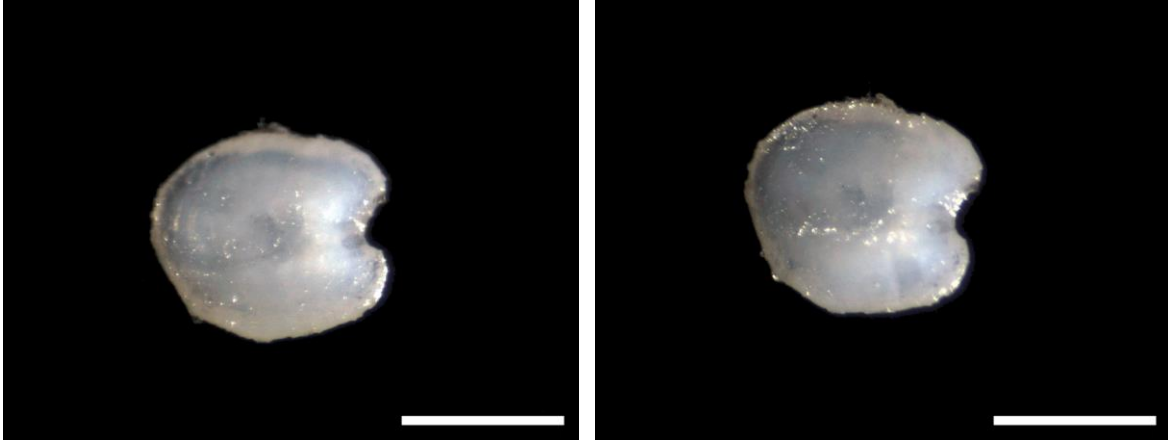


**ID: 699; MAL: 0.976 mm; SL: 86 mm**

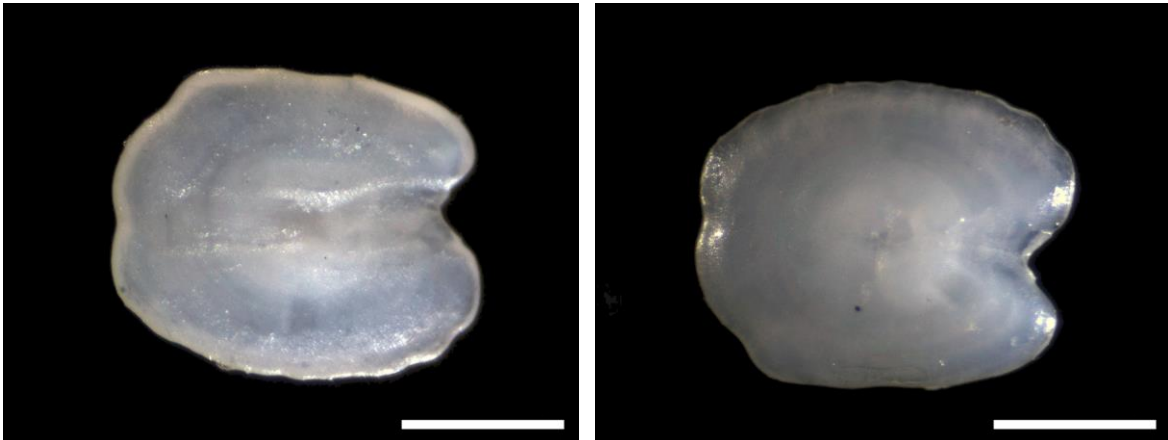
**Family: Myctophidae (cont'd)**

*Tarletonbeania crenularis*

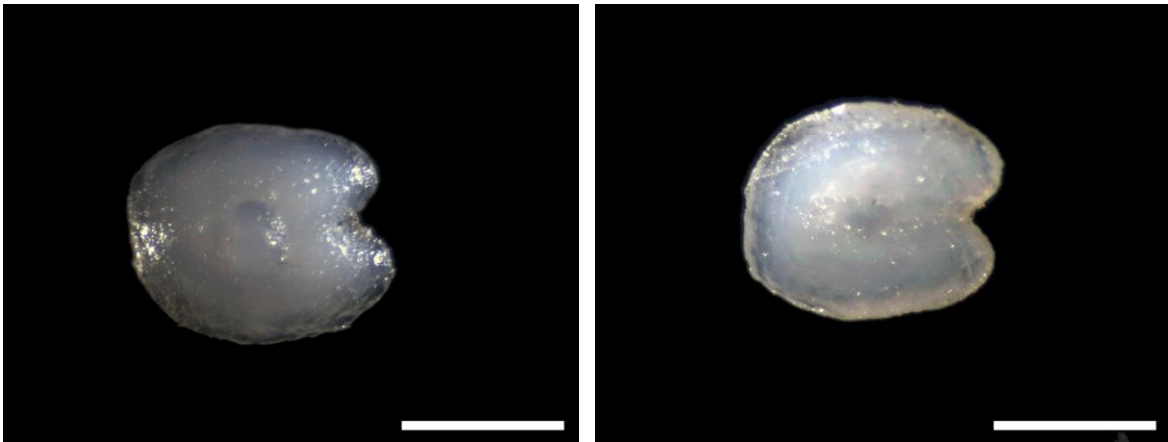
(Blue lanternfish)



**ID: 711; MAL: 0.81 mm; SL: 26 mm**



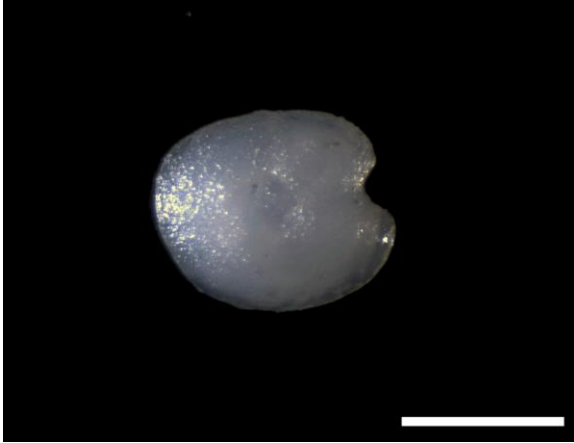
**ID: 712; MAL: 1.17 mm; SL: 42 mm**



**ID: 713; MAL: 0.80 mm; SL: 27 mm**

*Tarletonbeania crenularis*

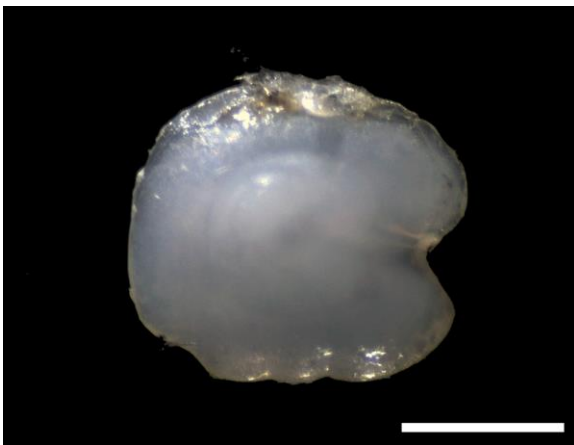
(Blue lanternfish)



**ID: 714; MAL: 0.72 mm; SL: 25 mm**



**ID: 715; MAL: 1.48 mm; SL: 49 mm**



**ID: 716; MAL: 1.03 mm; SL: 39 mm**

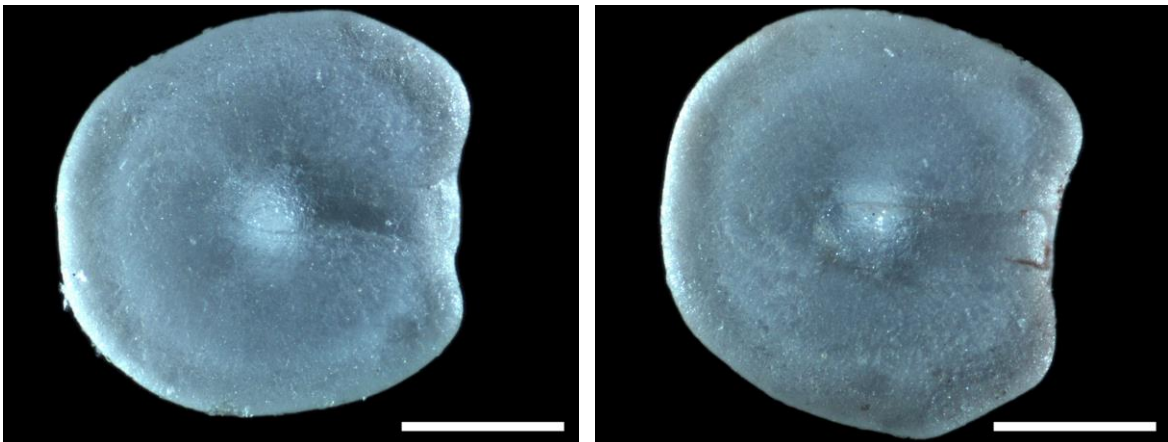
**Family: Myctophidae (cont'd)**

*Triphoturus mexicanus*

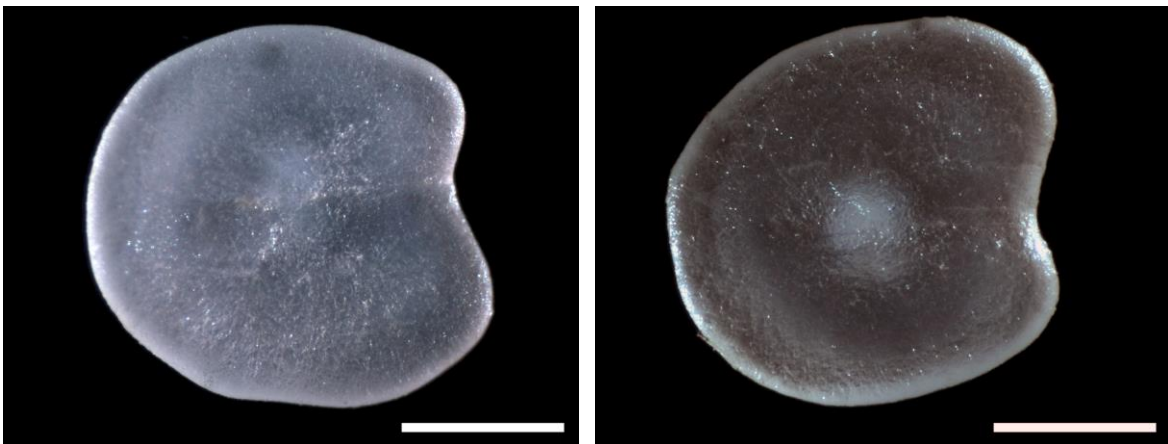
(Mexican lampfish)



**ID: 12; MAL: 1.03 mm; SL: 52 mm**



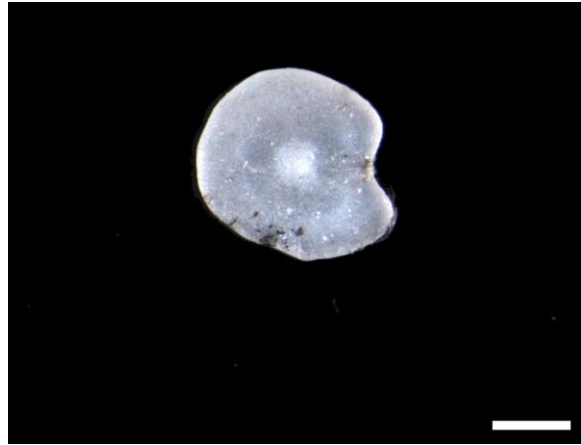
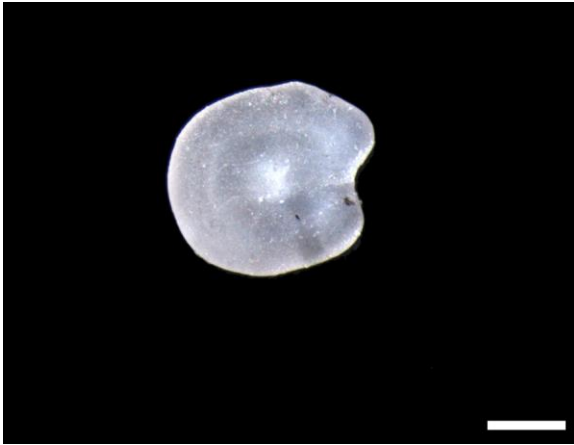
**ID: 149; MAL: 1.35 mm; SL: 64 mm**



**ID: 150; MAL: 1.29 mm; SL: 66 mm**

*Triphoturus mexicanus* (cont'd)

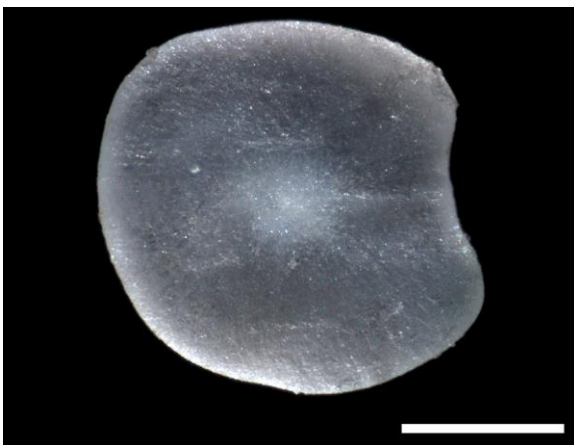
(Mexican lampfish)



**ID: 451; MAL: 1.37 mm; SL: 58 mm**



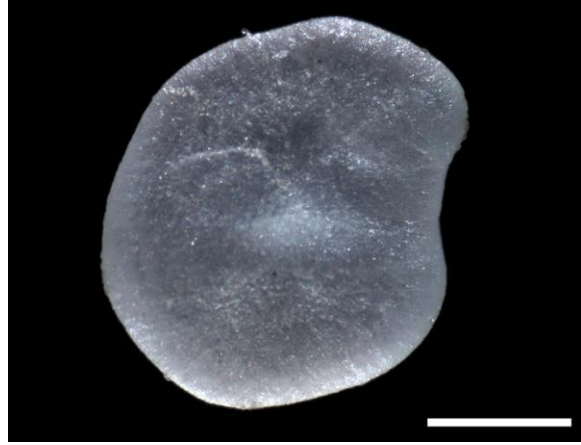
**ID: 452; MAL: 0.98 mm; SL: 51 mm**



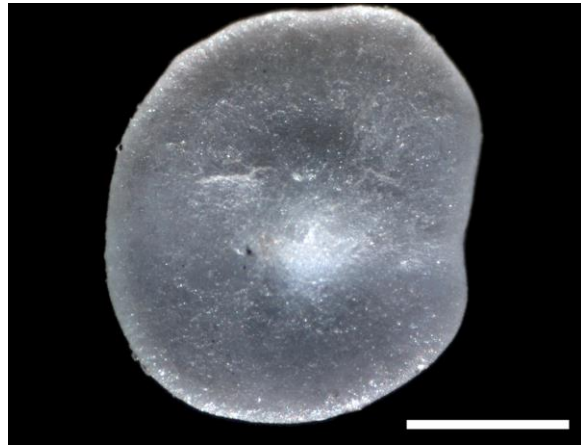
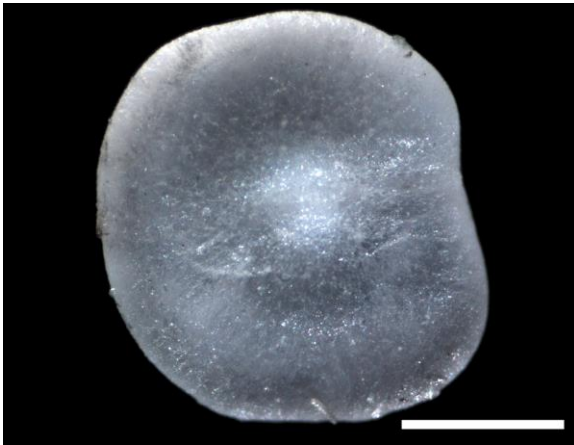
**ID: 453; MAL: 1.25 mm; SL: 59 mm**

*Triphoturus mexicanus* (cont'd)

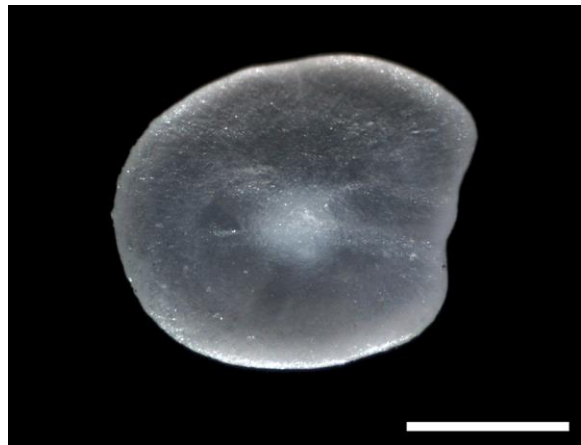
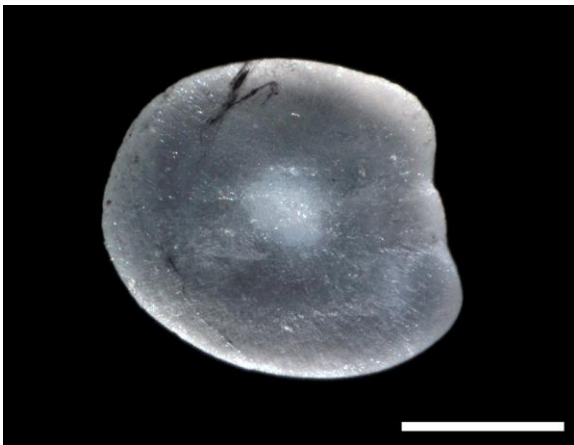
(Mexican lampfish)



**ID: 533; MAL: 1.43 mm; SL: 68 mm**



**ID: 534; MAL: 1.34 mm; SL: 60 mm**



**ID: 535; MAL: 1.42 mm; SL: 53 mm**

*Triphoturus mexicanus* (cont'd)

(Mexican lampfish)



**ID: 536; MAL: 0.70 mm; SL: 36 mm**



**ID: 537; MAL: 0.43 mm; SL: 23 mm**



**ID: 538; MAL: 0.71 mm; SL: 38 mm**



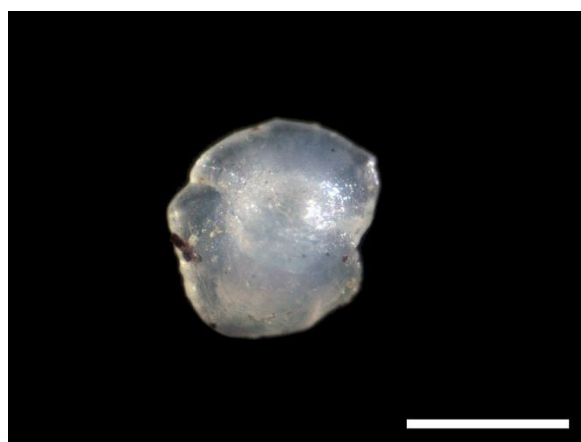
**Family: Nemichthyidae**

*Nemichthys scolopaceus*

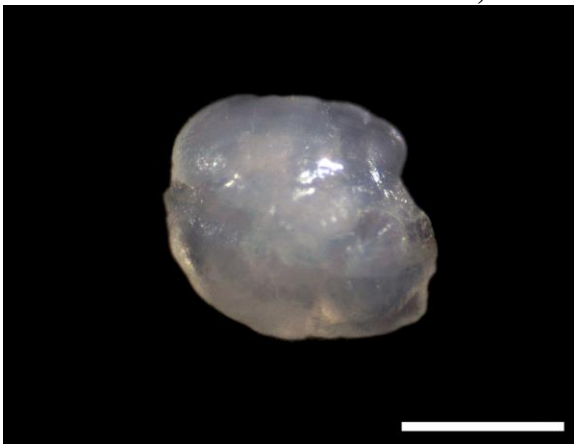
(Slender snipe eel)



**ID: 1579; MAL: 0.93 mm; SL: nd**



**ID: 1580; MAL: 0.71 mm; SL: nd**



**ID: 1584; MAL: 0.89 mm; SL: nd**

*Nemichthys scolopaceus* (cont'd)

(Slender snipe eel)



**ID: 1585; MAL: 1.01 mm; SL: nd**



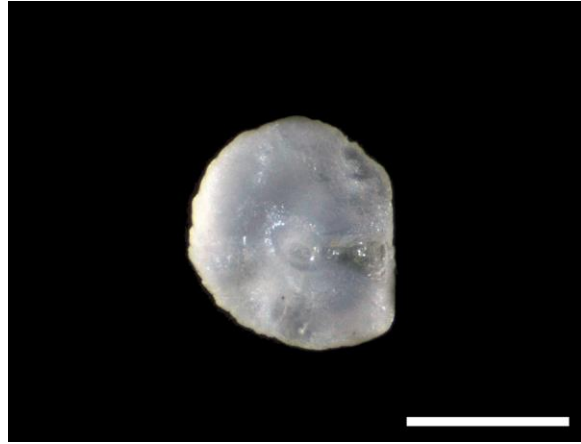
**ID: 1586; MAL: nd; SL: nd**



**ID: 1587; MAL: 0.94 mm; SL: nd**

*Nemichthys scolopaceus* (cont'd)

(Slender snipe eel)



**ID: 1588; MAL: 0.73 mm; SL: nd**



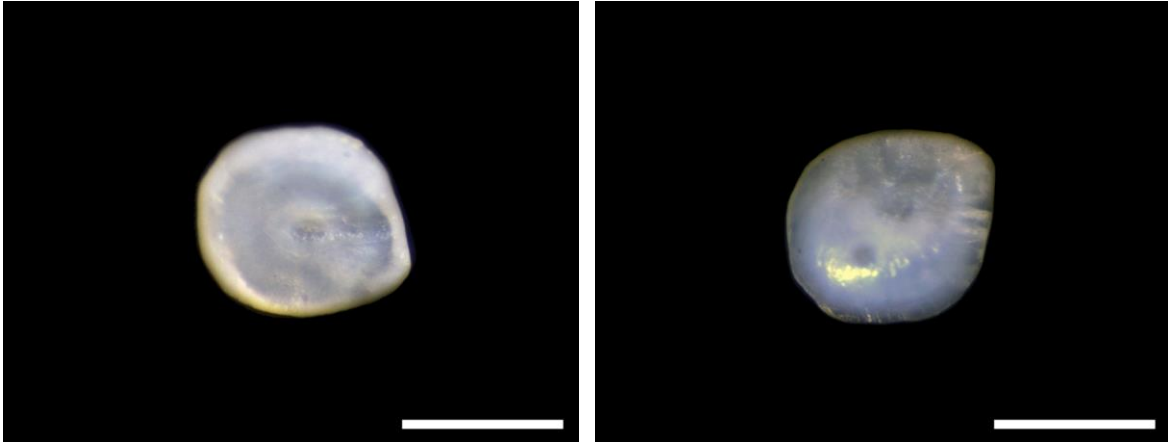
**ID: 1589; MAL: 0.98 mm; SL: nd**



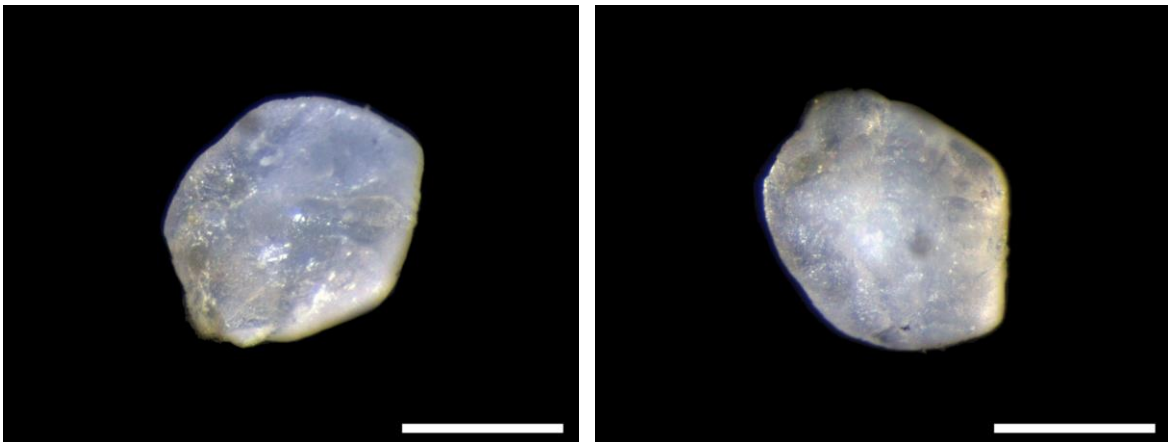
**ID: 1590; MAL: 1.15 mm; SL: nd**

*Nemichthys scolopaceus* (cont'd)

(Slender snipe eel)



**ID: 1863; MAL: 0.71 mm; SL: 840 mm**



**ID: 1865; MAL: 0.59 mm; SL: 856 mm**

**Family: Notosudidae**

*Scopelosaurus harryi*

Scaly waryfish



**ID: 40; MAL: 1.01 mm; SL: 43 mm**



**ID: 94; MAL: 1.44 mm; SL: 50 mm**



**ID: 96; MAL: 1.39 mm; SL: 48 mm**

*Scopelosaurus harryi* (cont'd)

Scaly waryfish



**ID: 104; MAL: 1.41 mm; SL: 52 mm**



**ID: 105; MAL: 1.30 mm; SL: 48 mm**



**ID: 1899; MAL: 3.05 mm; SL: 129 mm**

*Scopelosaurus harryi* (cont'd)

Scaly waryfish



**ID: 1900; MAL: 4.49 mm; SL: nd**



**ID: 1901; MAL: 2.41 mm; SL: nd**



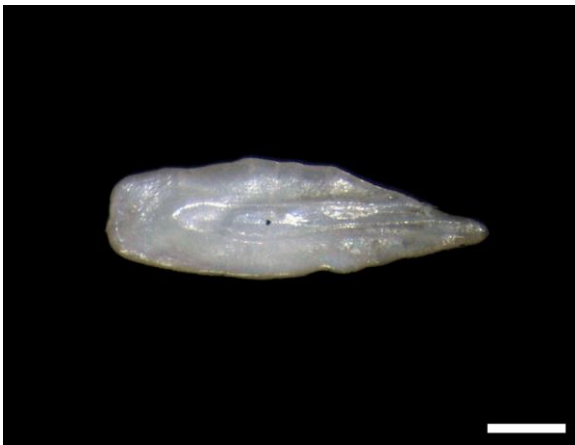
**ID: 1902; MAL: 4.23 mm; SL: nd**

*Scopelosaurus harryi* (cont'd)

Scaly waryfish



**ID: 1903; MAL: 4.20 mm; SL: nd**



**ID: 1905; MAL: 2.33 mm; SL: nd**



**Family: Ophidiidae**

*Chilara taylori*

(Spotted cusk-eel)

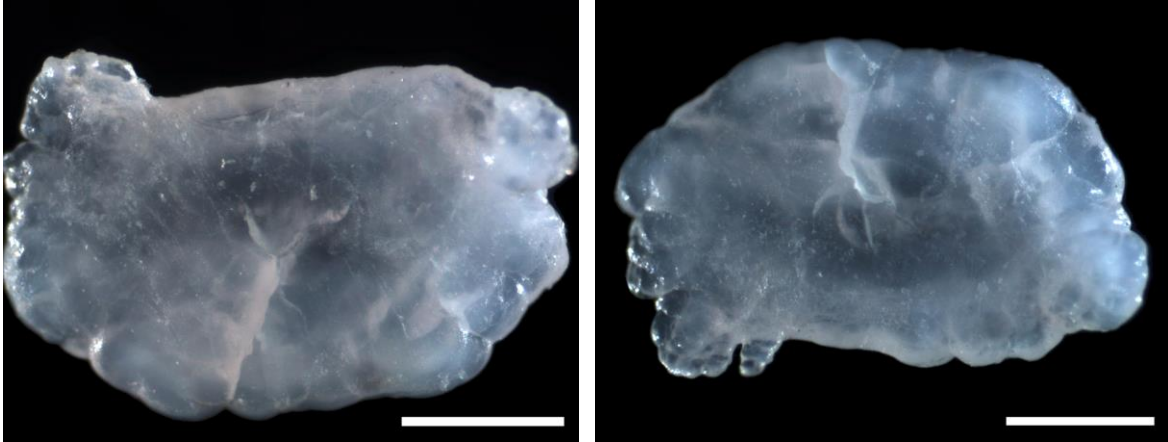


**ID: 476: MAL: 0.39 mm: SL: 55 mm**

**Family: Paralepididae**

*Arctozenus risso*

(White barracuda)

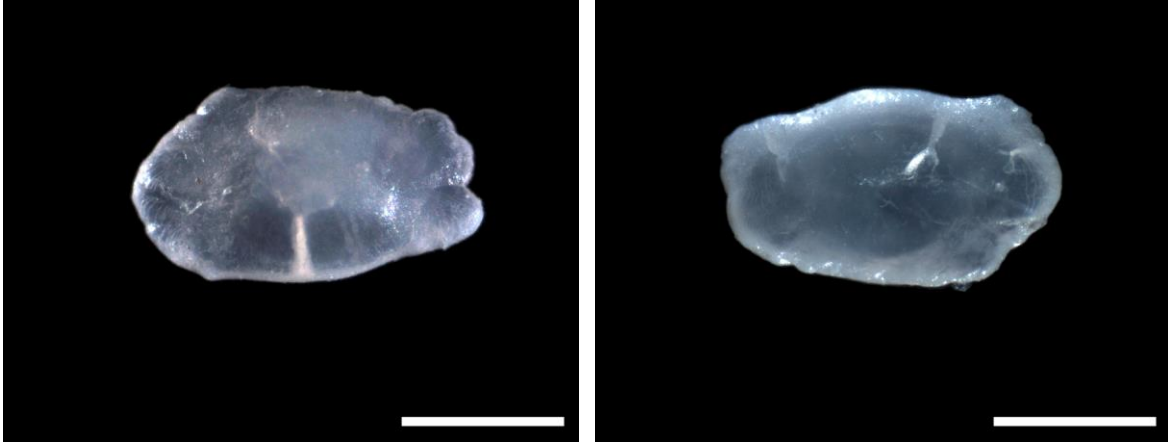


**ID: 482; MAL: 1.86 mm; SL: 124 mm**

**Family: Paralepididae (cont'd)**

**Lestidiops ringens**

**(Slender barracuda)**



**ID: 73; MAL: 1.08 mm; SL: 85 mm**

**Family: Phosichthyidae**

*Vinciguerra lucetia*

(Panama lightfish)



**ID: 1671; MAL: 1.46 mm; SL: nd**



**ID: 1672; MAL: 1.29 mm; SL: nd**



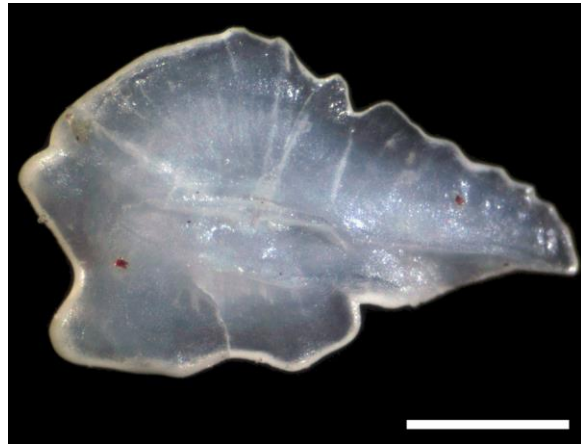
**ID: 1675; MAL: 1.56 mm; SL: nd**

*Vinciguerra lucetia* (cont'd)

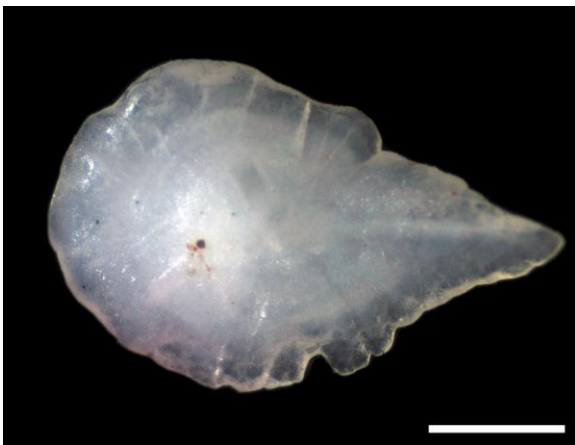
(Panama lightfish)



**ID: 1677; MAL: 1.44 mm; SL: nd**



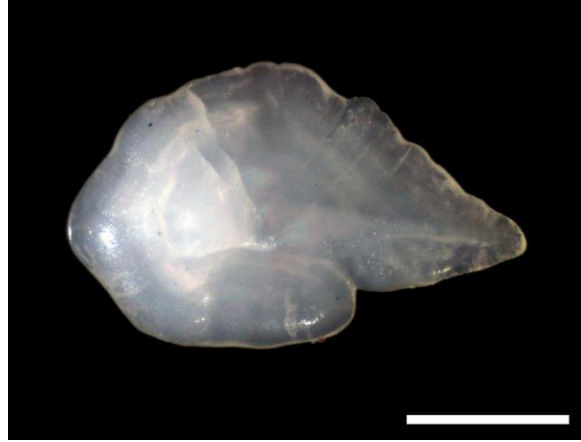
**ID: 1679; MAL: 1.59 mm; SL: nd**



**ID: 1680; MAL: 1.73 mm; SL: nd**

*Vinciguerra lucetia* (cont'd)

(Panama lightfish)



ID: 1681; MAL: 1.28 mm; SL: nd



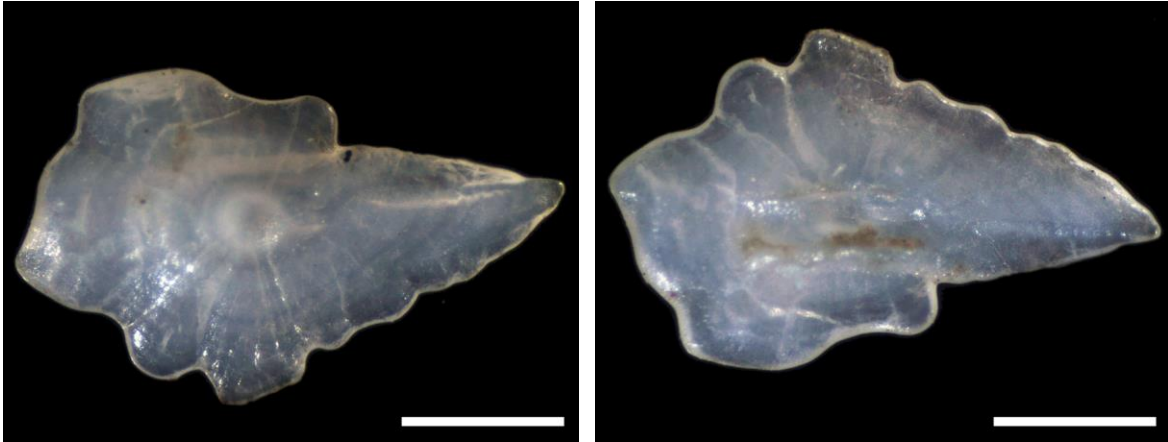
ID: 1683; MAL: 1.42 mm; SL: nd



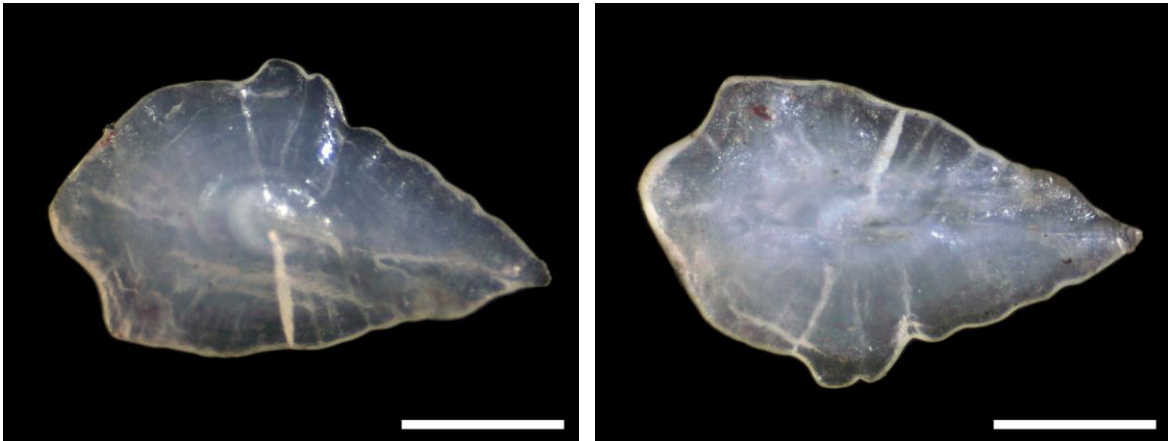
ID: 1684; MAL: 1.31 mm; SL: nd

*Vinciguerra lucetia* (cont'd)

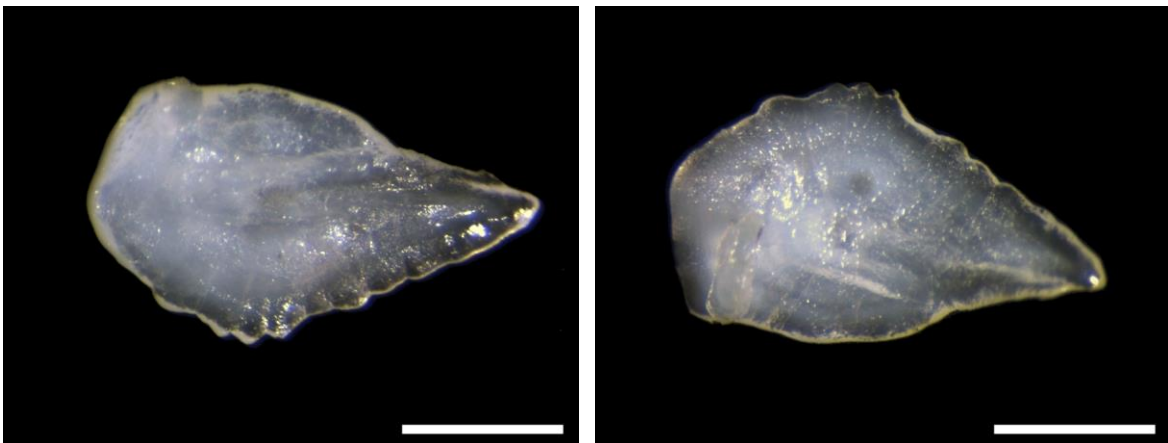
(Panama lightfish)



**ID: 1685; MAL: 1.54 mm; SL: nd**



**ID: 1686; MAL: 1.42 mm; SL: nd**

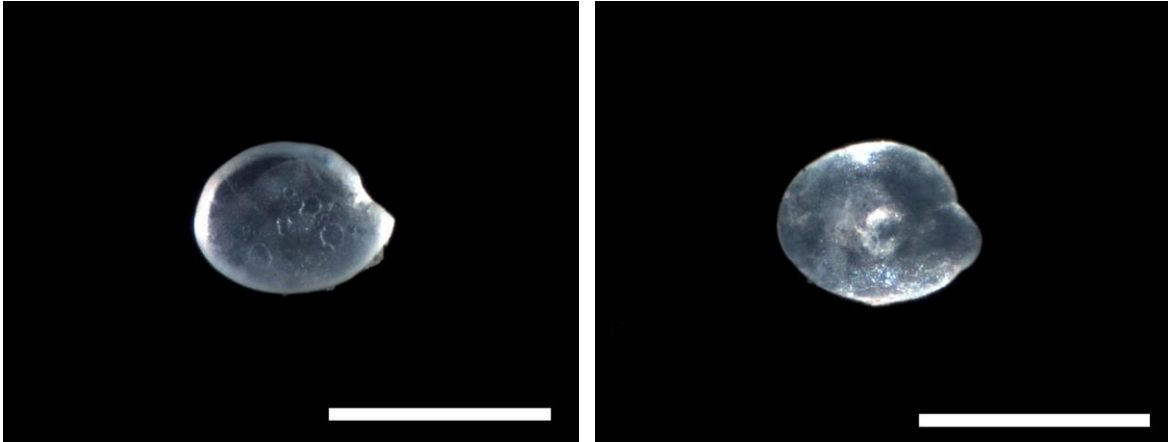


**ID: 1973; MAL: 47 mm; SL: nd**

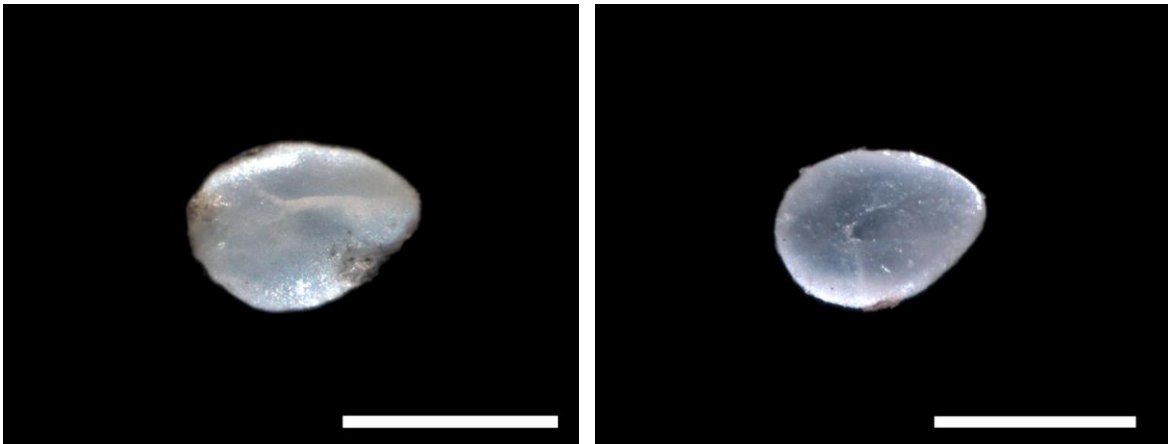
## Family: Scopelarchidae

*Benthalbella dentate*

(Northern pearleye)



ID: 87; MAL: 0.44 mm; SL: 36 mm



ID: 88; MAL: 0.56 mm; SL: 37 mm



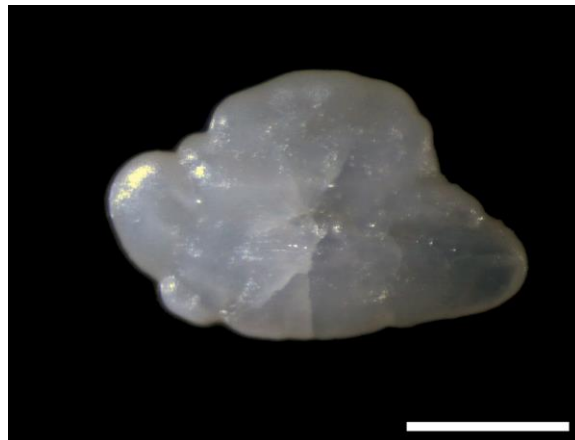
**Family: Scorpaenidae**

*Sebastes goodei*

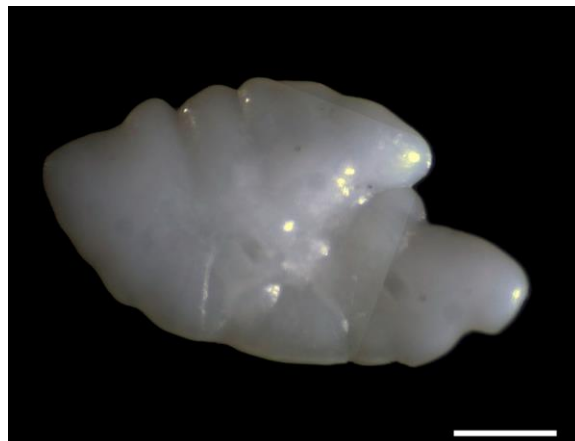
(Chilipepper rockfish)



**ID: 1150; MAL: 1.07 mm; SL: 26.4 mm**



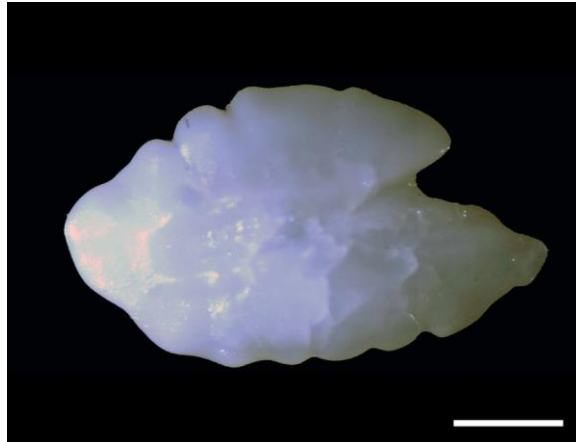
**ID: 1151; MAL: 1.25 mm; SL: 32.8 mm**



**ID: 1152; MAL: 2.29 mm; SL: 49.6 mm**

*Sebastes goodei* (cont'd)

(Chilipepper rockfish)



**ID: 1153; MAL: 2.10 mm; SL: 49.5 mm**



**ID: 1554; MAL: 1.55 mm; SL: 37.6 mm**

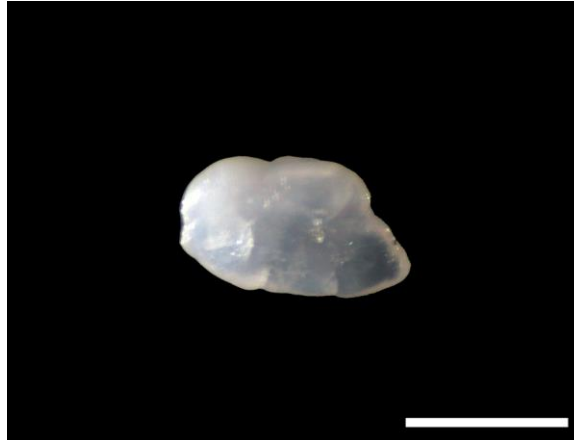


**ID: 1555; MAL: 1.25 mm; SL: 32.2 mm**

**Family: Scorpaenidae (cont'd)**

*Sebastes hopkinsi*

(Squarespot rockfish)



**ID: 1556; MAL: 0.74 mm; SL: 24.9 mm**



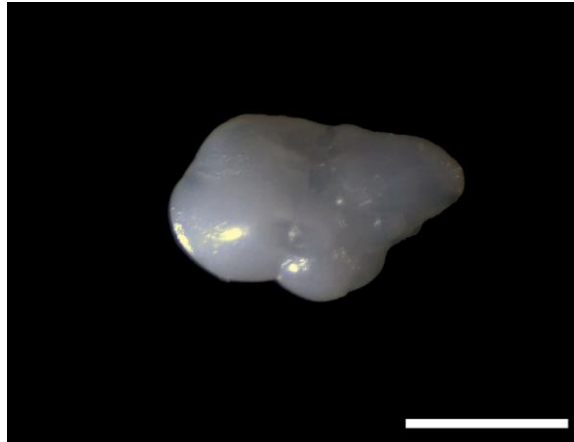
**ID: 1157; MAL: 0.84 mm; SL: 24.4 mm**



**ID: 1158; MAL: 1.39 mm; SL: 38.3 mm**

*Sebastes hopkinsi* (cont'd)

(Squarespot rockfish)



**ID: 1159; MAL: 0.90 mm; SL: 28.6 mm**



**ID: 1160; MAL: 1.44 mm; SL: 39.2**



**ID: 1161; MAL: 1.30 mm; SL: 33.8**

**Family: Scopaenidae (cont'd)**

*Sebastes jordani*

(Shortbelly rockfish)



**ID: 1162; MAL: 0.87 mm; SL: 30.6 mm**



**ID: 1163; MAL: 2.57 mm; SL: 59.2 mm**



**ID: 1164; MAL: 0.86 mm; SL: 31.4 mm**

*Sebastes jordani* (cont'd)

(Shortbelly rockfish)



**ID: 1165; MAL: 1.09 mm; SL: 33.4 mm**



**ID: 1166; MAL: 1.62 mm; SL: 43.8 mm**

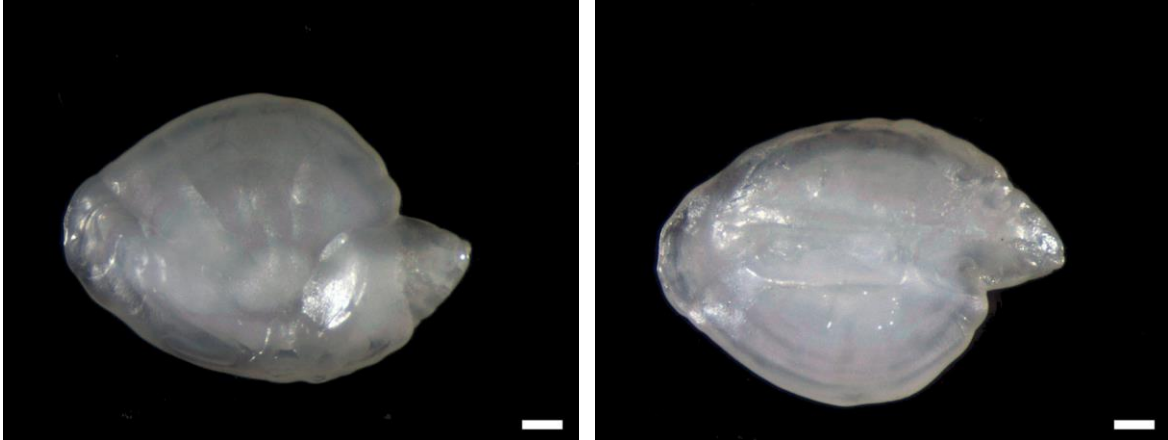


**ID: 1167; MAL: 1.72 mm; SL: 46 mm**

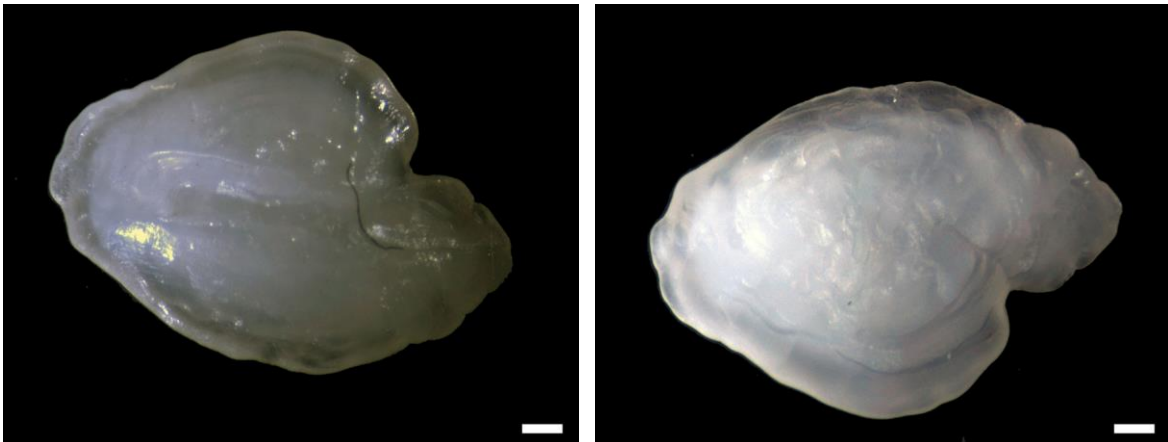
**Family: Scopaenidae (cont'd)**

*Sebastes spp.*

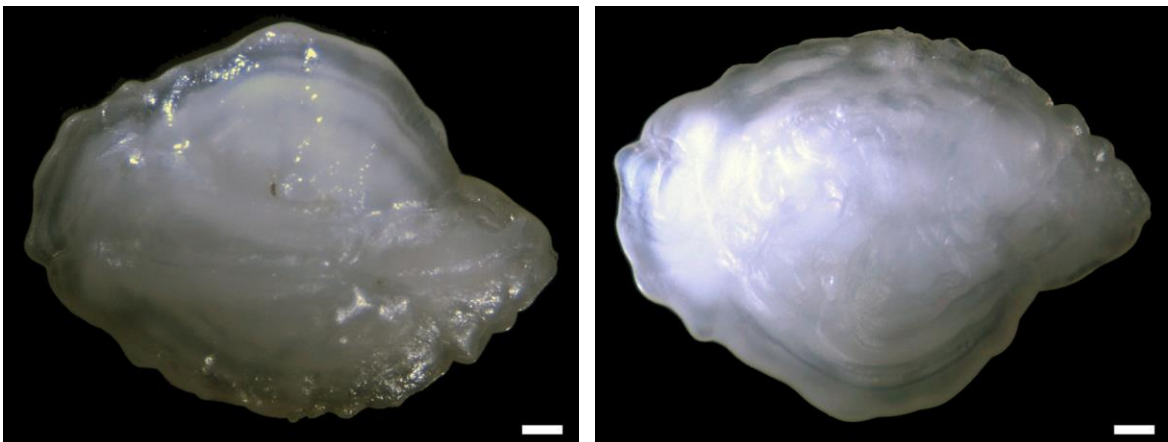
(Unidentified rockfish)



**ID: 2400; MAL: 4.71 mm; SL: 91 mm**



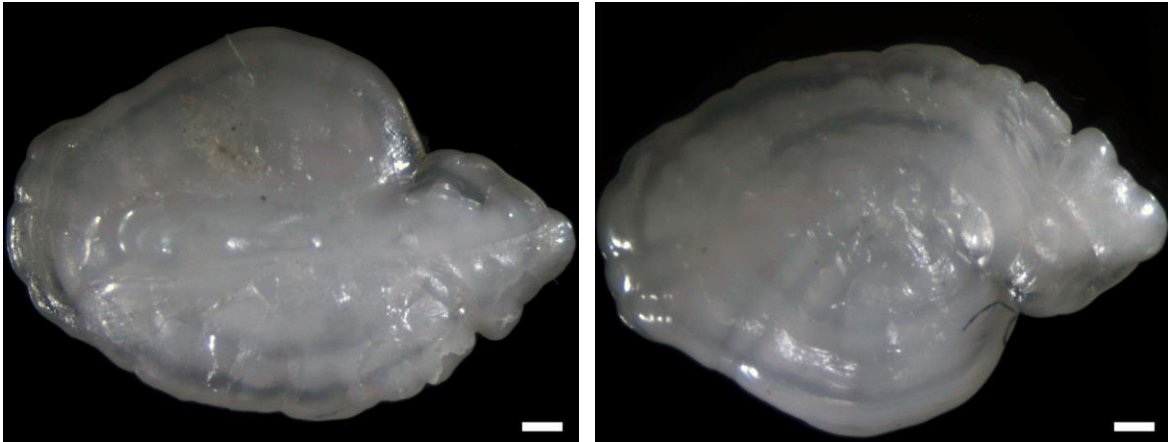
**ID: 2401; MAL: 5.34 mm; SL: 111 mm**



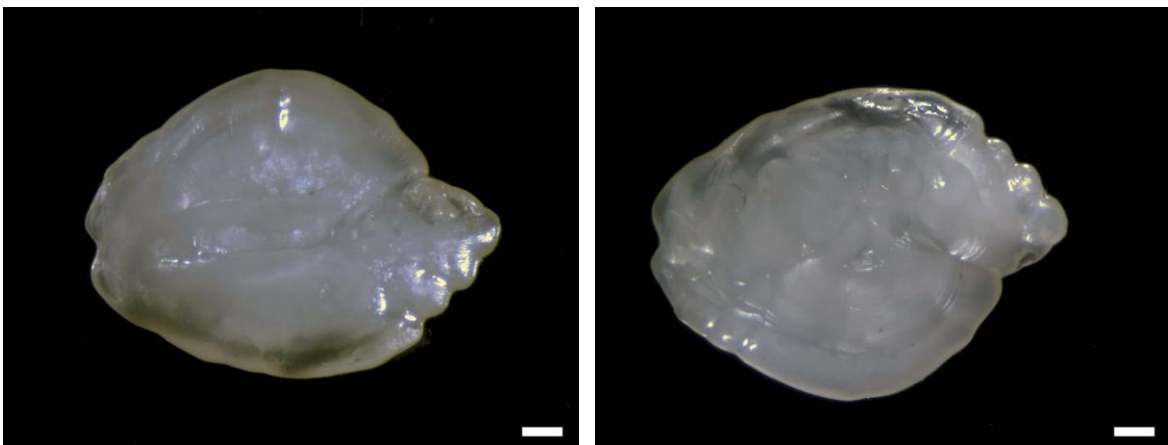
**ID: 2402; MAL: 6.18 mm; SL: 132 mm**

*Sebastes spp.* (cont'd)

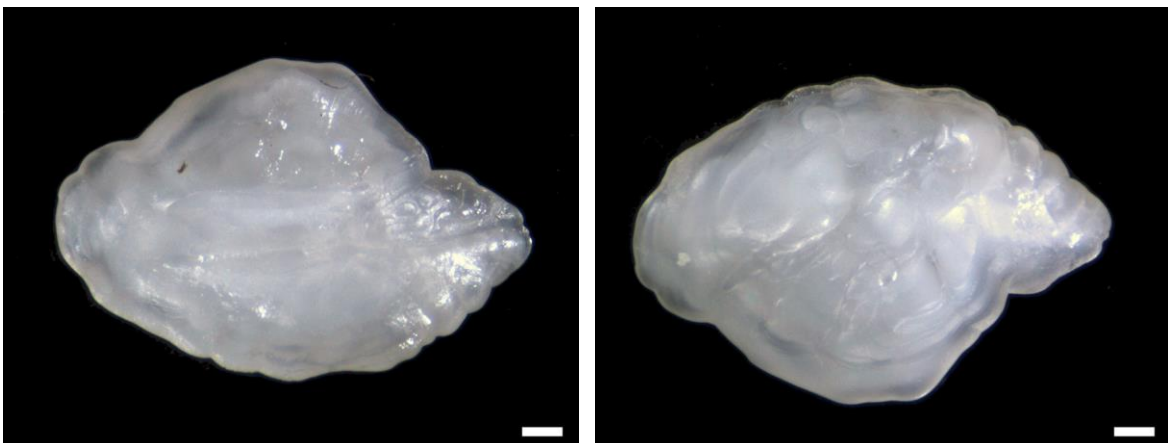
(Unidentified rockfish)



**ID: 2403; MAL: 6.58 mm; SL: 154 mm**



**ID: 2409; MAL: 4.89 mm; SL: 97 mm**



**ID: 2410; MAL: 5.45 mm; SL: 105 mm**



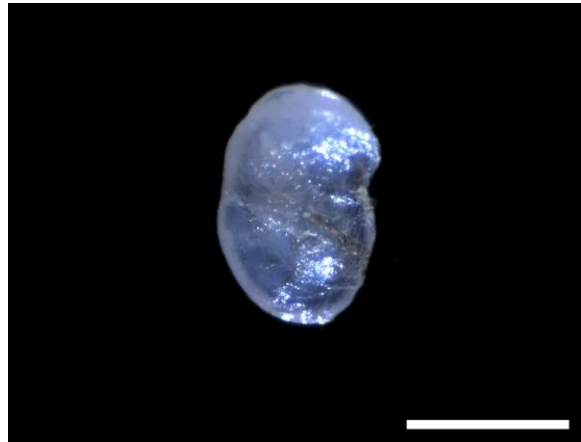
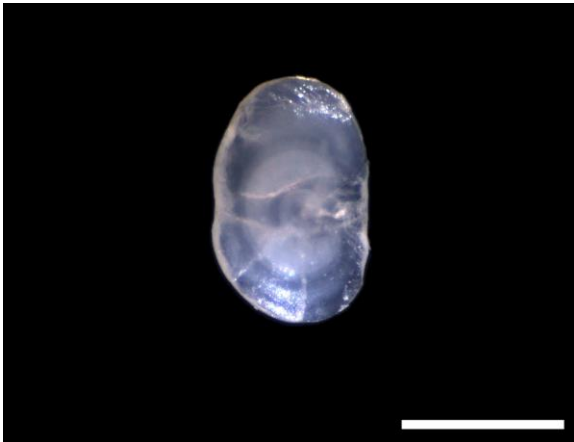
**Family: Sternoptychidae**

*Argyropelecus affinis*

(Pacific hatchetfish)



**ID: 74; MAL: 1.26 mm; SL: 47 mm**



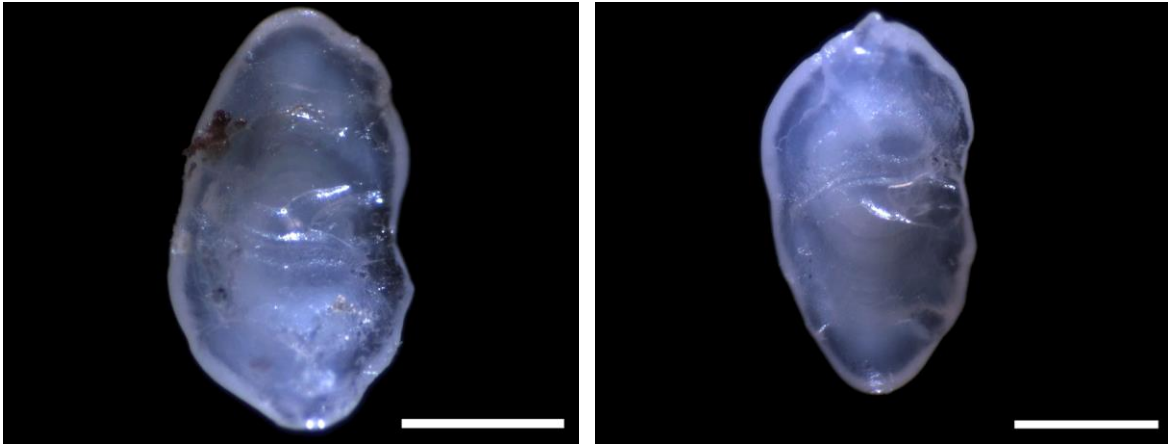
**ID: 119; MAL: nd mm; SL: nd**



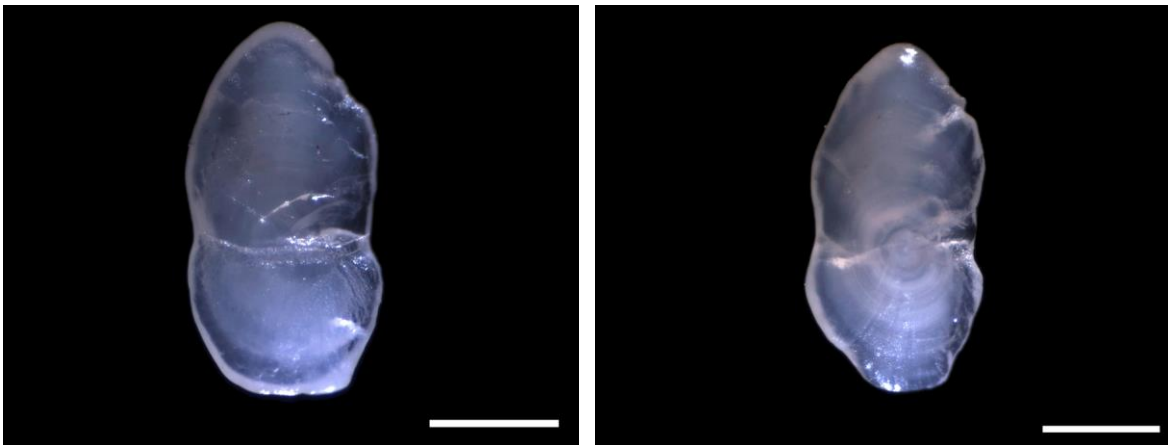
**ID: 120; MAL: 1.23 mm; SL: 44 mm**

*Argyropelecus affinis* (cont'd)

(Pacific hatchetfish)



**ID: 121; MAL: 1.29 mm; SL: 49 mm**



**ID: 139; MAL: 1.48 mm; SL: 55 mm**



**ID: 145; MAL: 1.52 mm; SL: 66 mm**

*Argyropelecus affinis* (cont'd)

(Pacific hatchetfish)

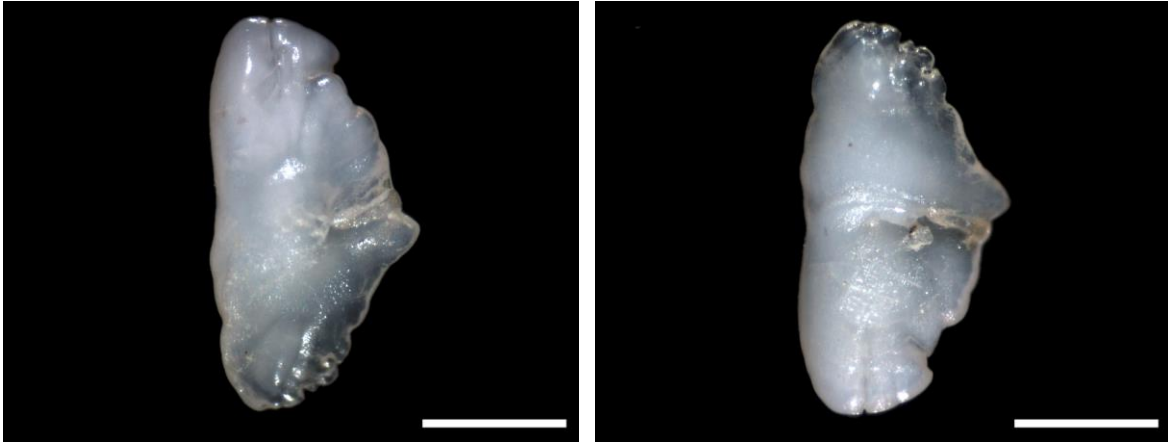


**ID: 594; MAL: 0.86 mm; SL: 29 mm**

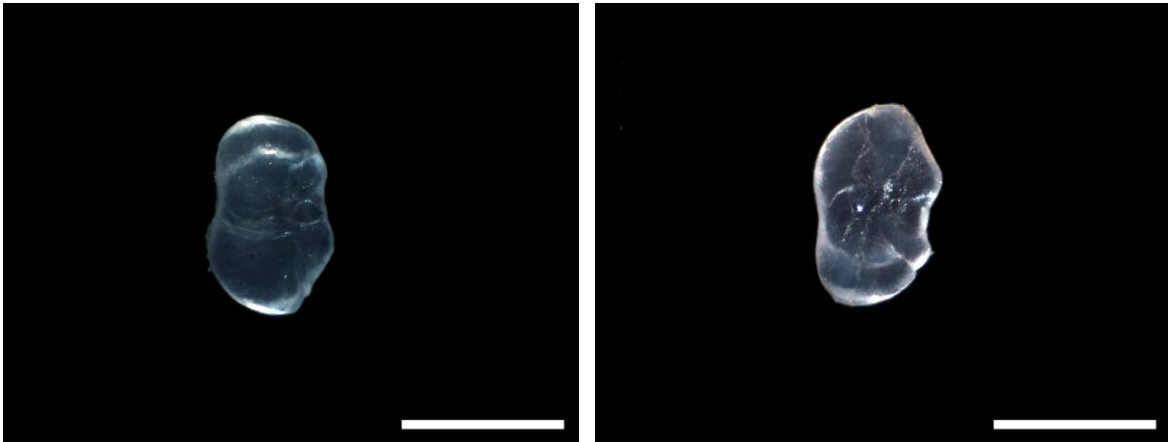
**Family: Sternoptychidae (cont'd)**

*Argyropelecus lychnus*

(Tropical hatchetfish)



**ID: 2508; MAL: 1.36 mm; SL: nd**



**ID: 589; MAL: 0.64 mm; SL: 22 mm**

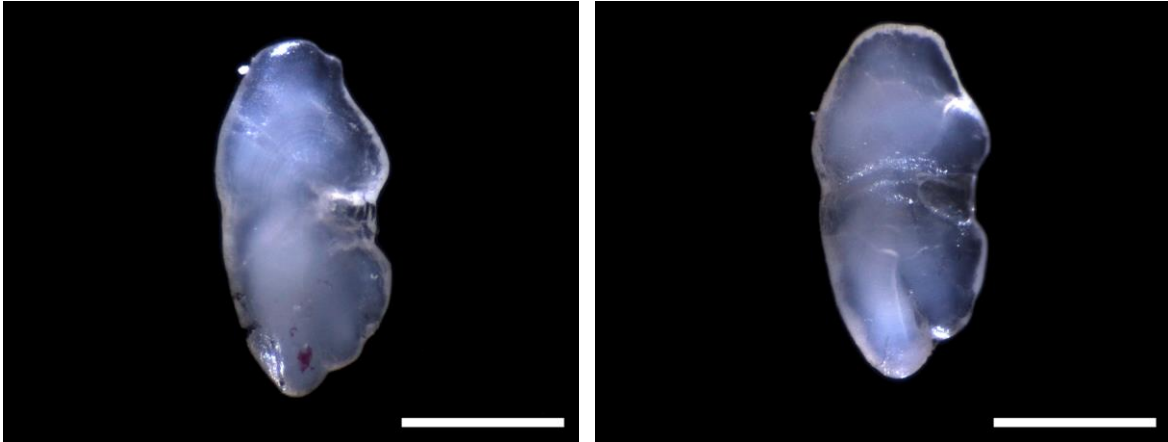


**ID: 590; MAL: 0.89 mm; SL: 30 mm**

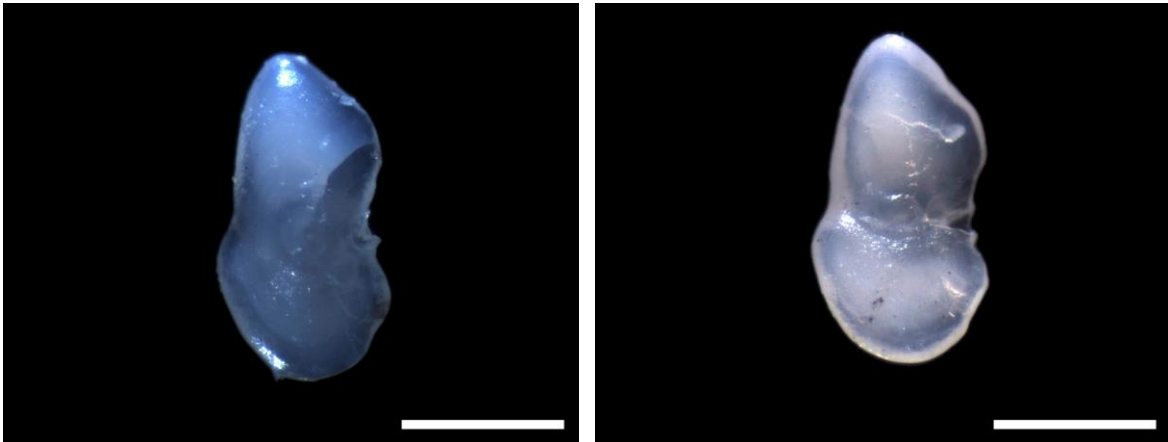
**Family: Sternoptychidae (cont'd)**

*Argyropelecus sladeni*

(Lowcrest hatchetfish)



**ID: 117; MAL: 1.09 mm; SL: 41 mm**



**ID: 118; MAL: 1.03 mm; SL: 41 mm**



**ID: 439; MAL: 0.83 mm; SL: 29 mm**

**Family: Sternoptychidae (cont'd)**

*Danophos oculatus*

(Bigeye lightfish)



**ID: 101; MAL: 1.05 mm; SL: 36 mm**



**ID: 567; MAL: 1.08 mm; SL: 35 mm**



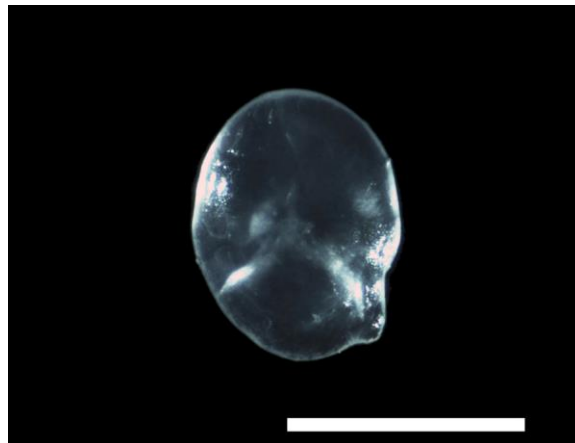
**ID: 568; MAL: 0.72 mm; SL: 23 mm**

*Danophos oculatus* (cont'd)

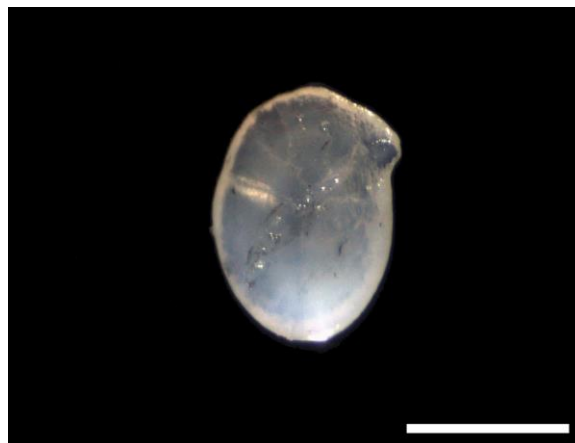
(Bigeye lightfish)



**ID: 569; MAL: 0.69 mm; SL: 23 mm**



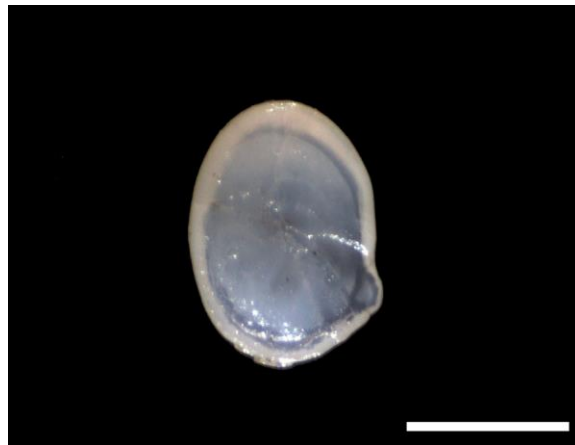
**ID: 570; MAL: 0.58 mm; SL: 21 mm**



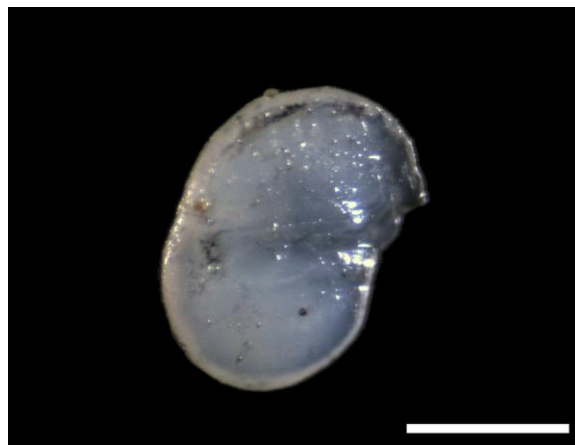
**ID: 640; MAL: 0.78 mm; SL: 25 mm**

*Danophos oculatus* (cont'd)

(Bigeye lightfish)



**ID: 641; MAL: 0.80 mm; SL: 28 mm**



**ID: 642; MAL: 0.97 mm; SL: 32 mm**



**ID: 643; MAL: 0.75 mm; SL: 24 mm**



*Danophos oculatus* (cont'd)

(Bigeye lightfish)



**ID: 645; MAL: 1.03 mm; SL: 36 mm**

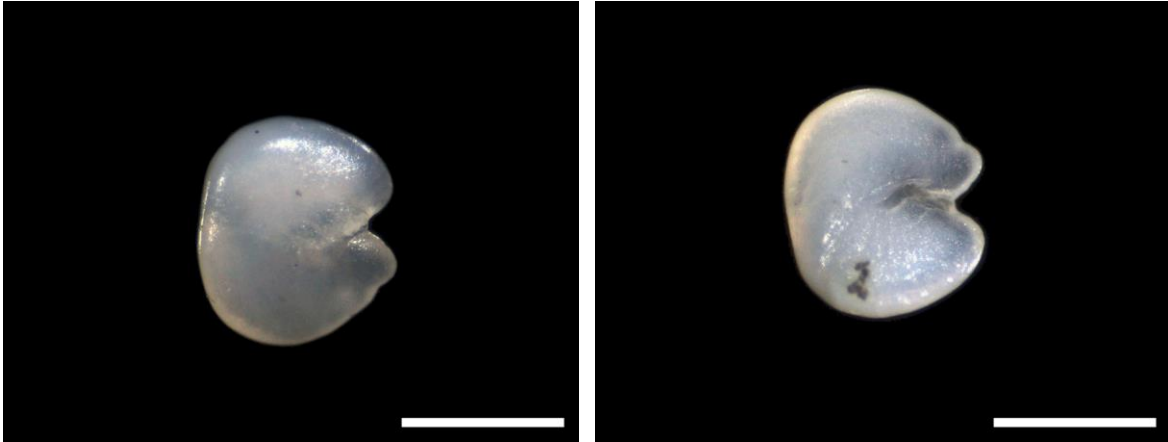


**ID: 646; MAL: 1.10 mm; SL: 38 mm**

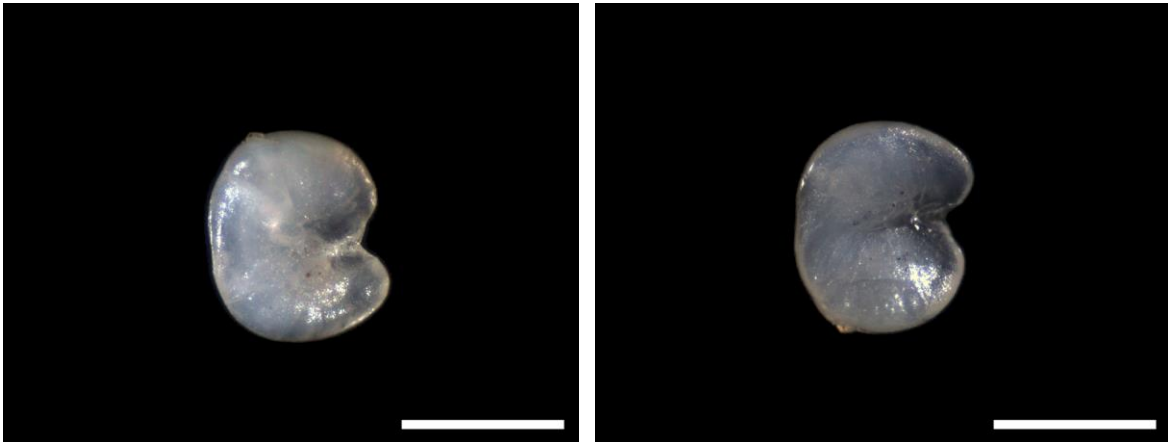
**Family: Sternoptychidae (cont'd)**

*Sternoptyx diaphana*

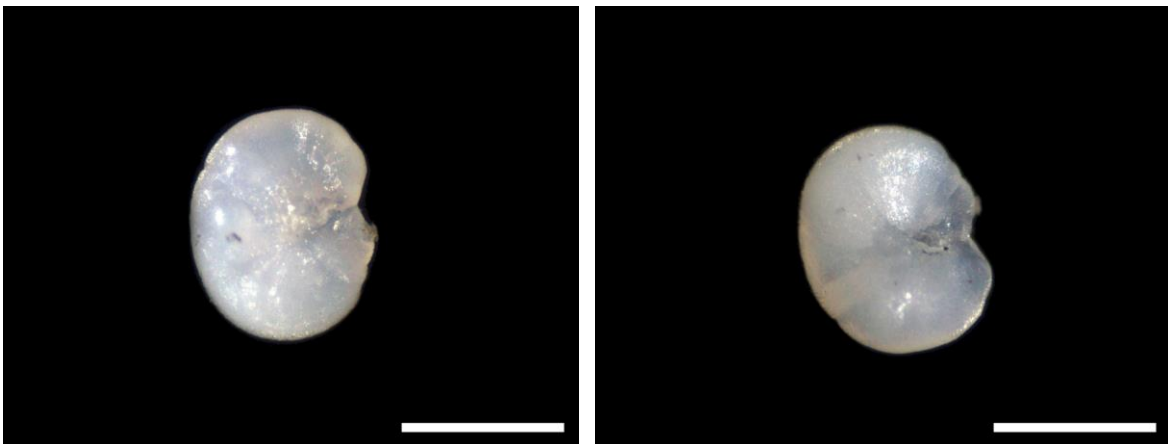
(Transparent hatchefish)



**ID: 1554; MAL: 0.71 mm; SL: nd**



**ID: 1555; MAL: 0.67 mm; SL: nd**



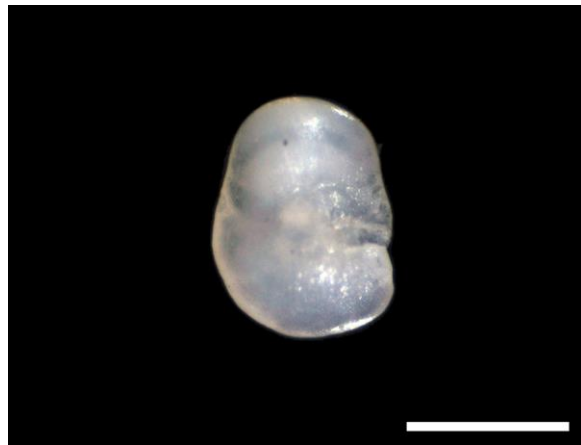
**ID: 1556; MAL: 0.72 mm; SL: nd**

*Sternoptyx diaphana* (cont'd)

(Transparent hatchefish)



**ID: 1557; MAL: 0.93 mm; SL: nd**



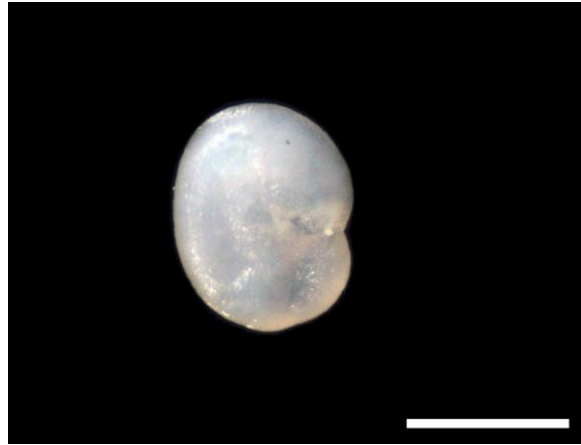
**ID: 1558; MAL: 0.75 mm; SL: nd**



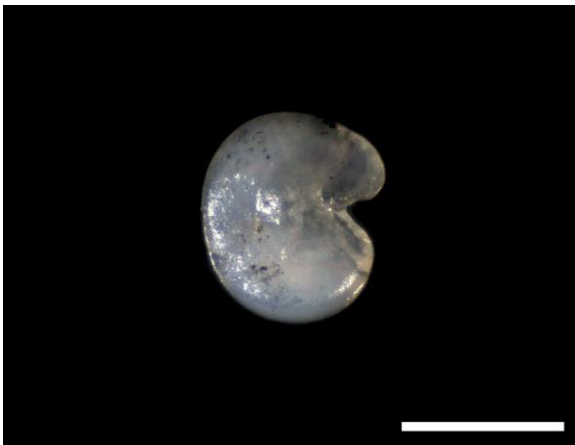
**ID: 1559; MAL: 0.72 mm; SL: nd**

*Sternoptyx diaphana* (cont'd)

(Transparent hatchefish)



**ID: 1561; MAL: 0.71 mm; SL: nd**



**ID: 1562; MAL: 0.65 mm; SL: nd**

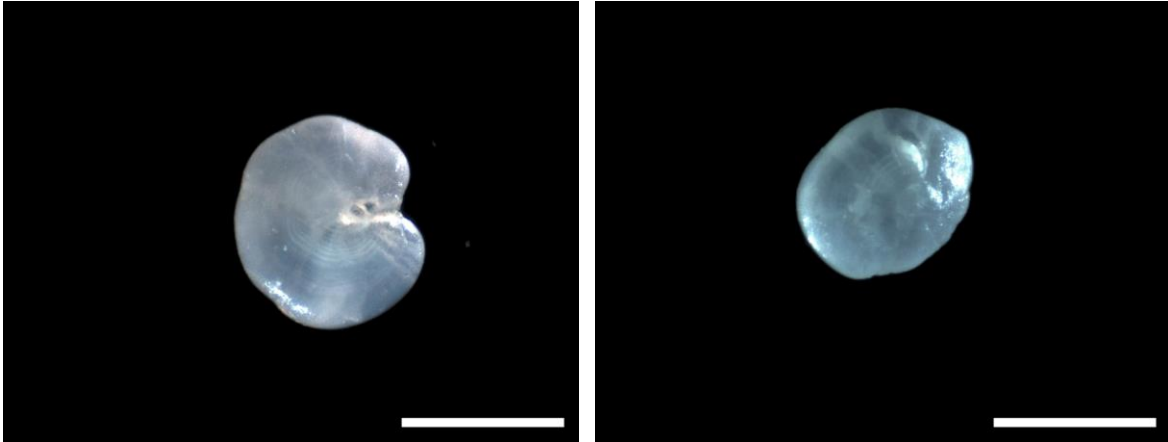


**ID: 1563; MAL: 0.68 mm; SL: nd**

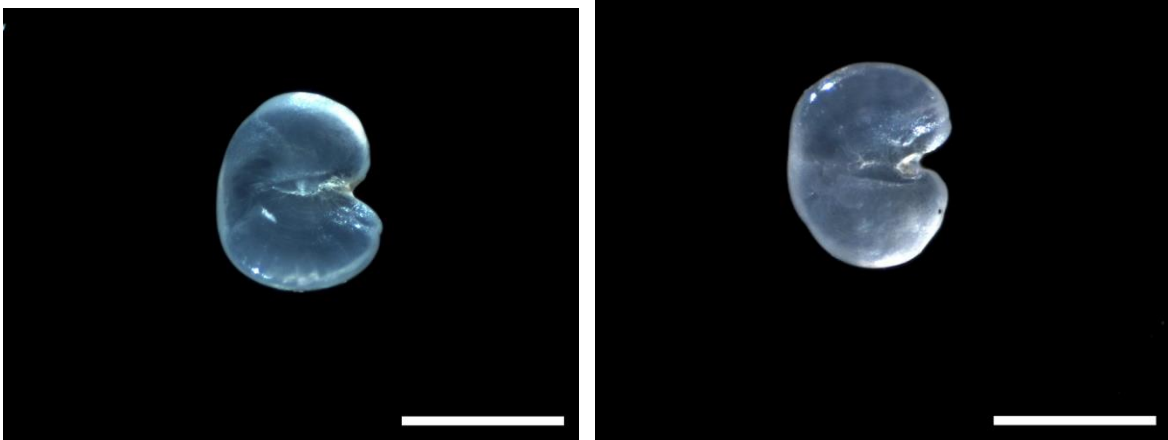
**Family: Sternoptychidae (cont'd)**

*Sternoptyx obscura*

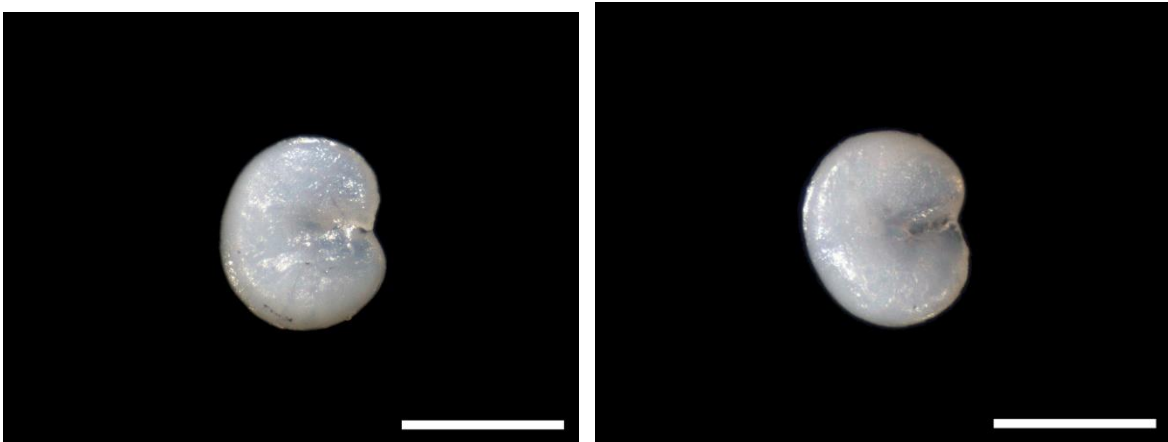
(No common name)



**ID: 46; MAL: 0.66 mm; SL: 31 mm**



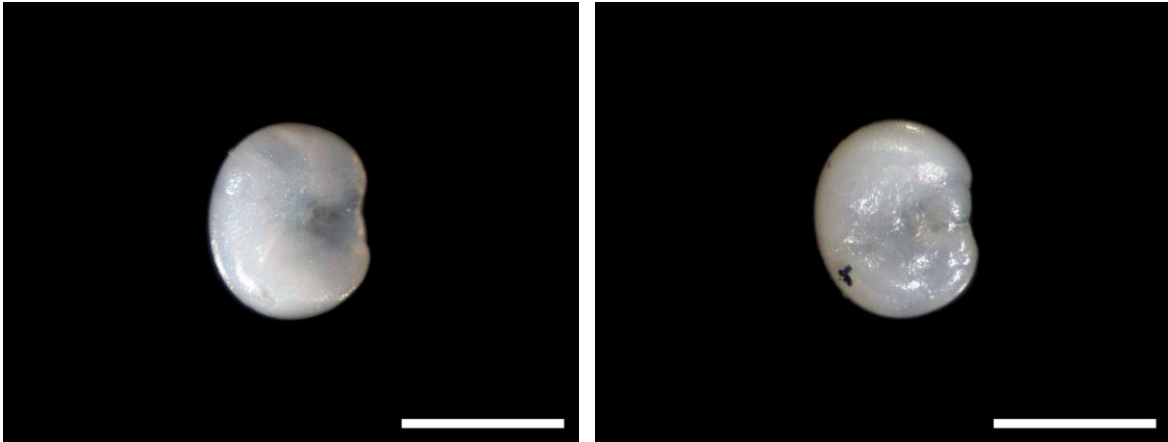
**ID: 85; MAL: 30 mm; SL: 30 mm**



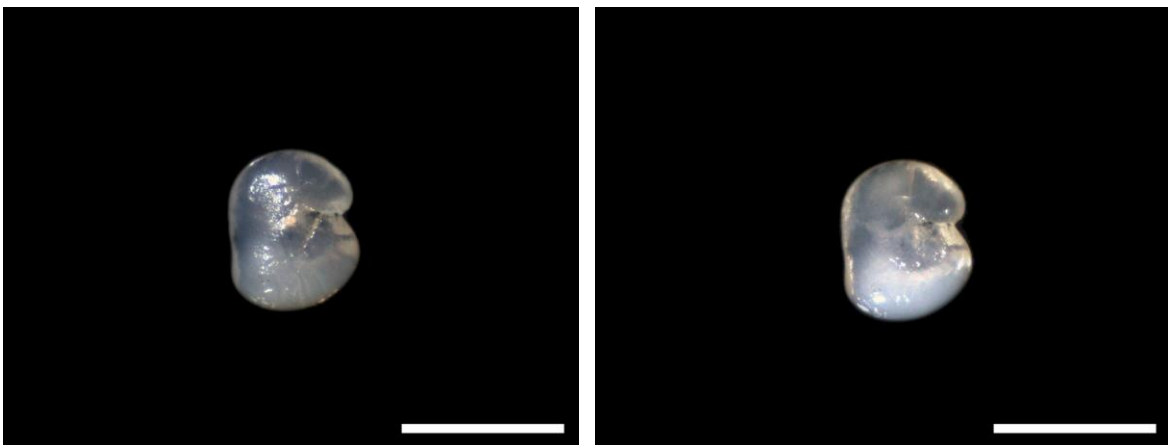
**ID: 1650; MAL: 0.61 mm; SL: nd**

*Sternopyx obscura* (cont'd)

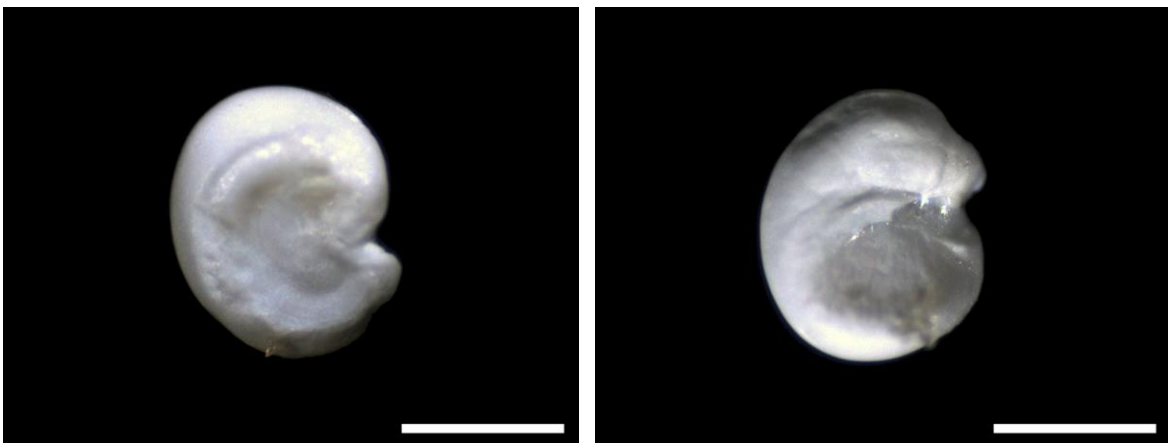
(No common name)



ID: 1651; MAL: 0.61 mm; SL: nd



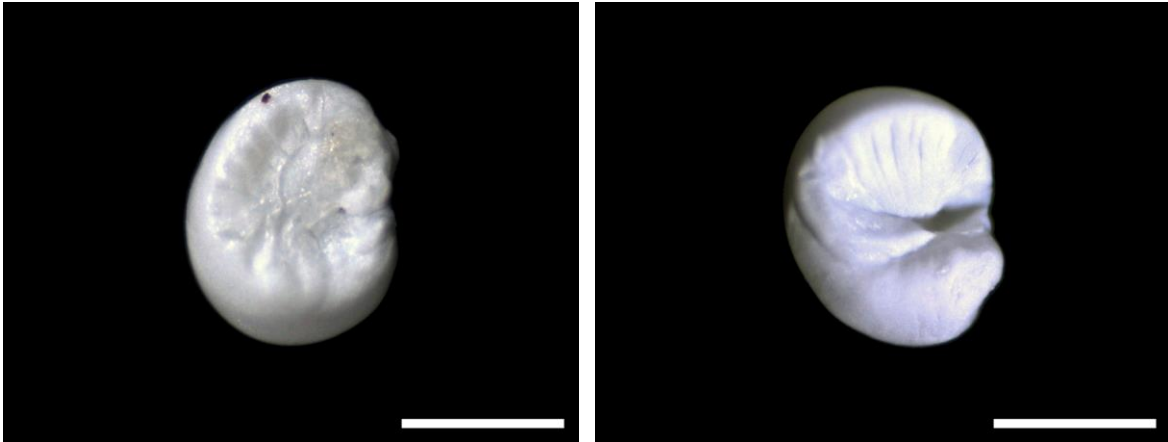
ID: 1653; MAL: 0.51 mm; SL: 20 mm



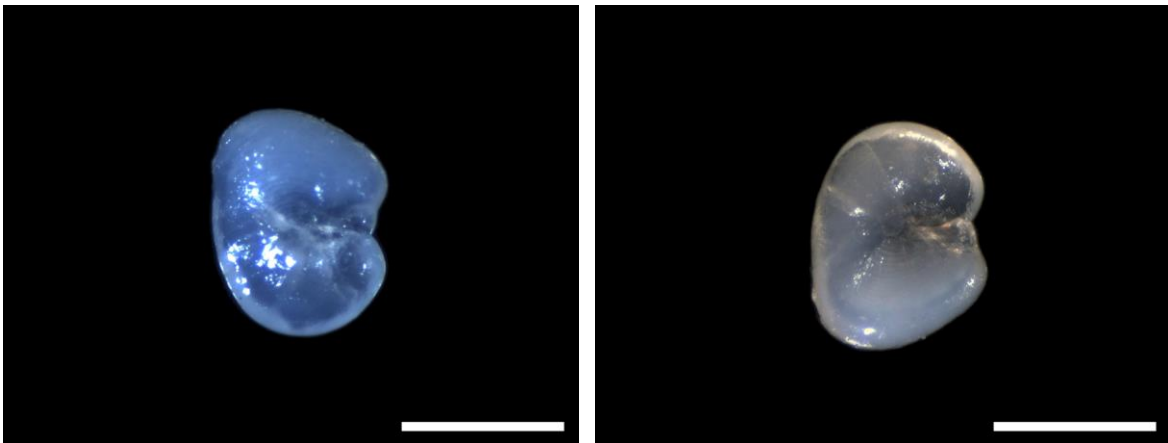
ID: 1654; MAL: 0.84 mm; SL: nd

*Sternoptyx obscura* (cont'd)

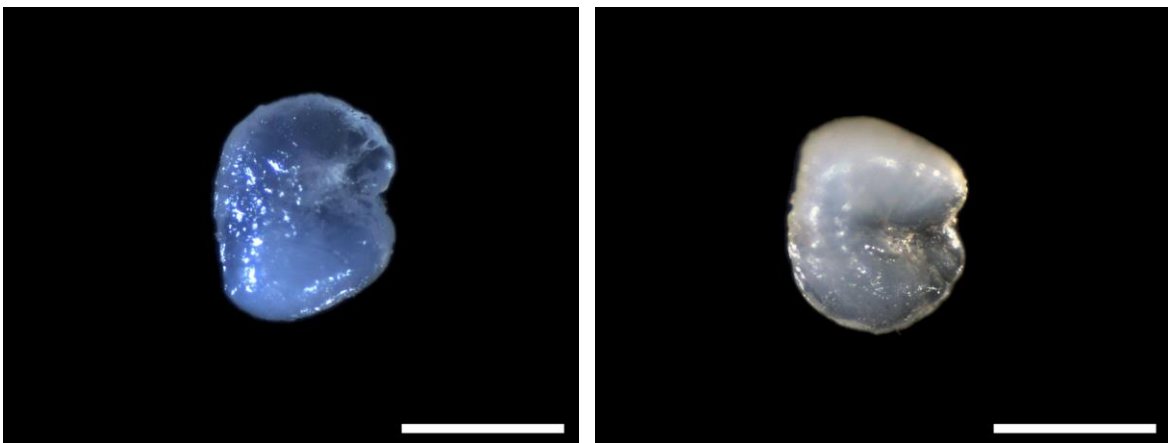
(No common name)



ID: 1655; MAL: 0.81 mm; SL: nd



ID: 1656; MAL: 0.72 mm; SL: 30 mm

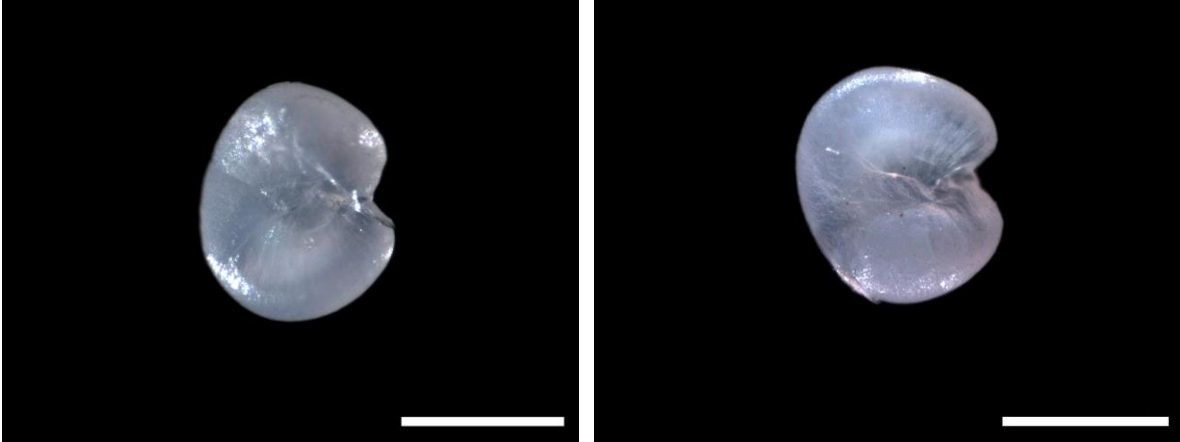


ID: 1657; MAL: 0.67 mm; SL: 30 mm

**Family: Sternoptychidae (cont'd)**

*Sternoptyx pseudobscura*

(Highlight hatchetfish)



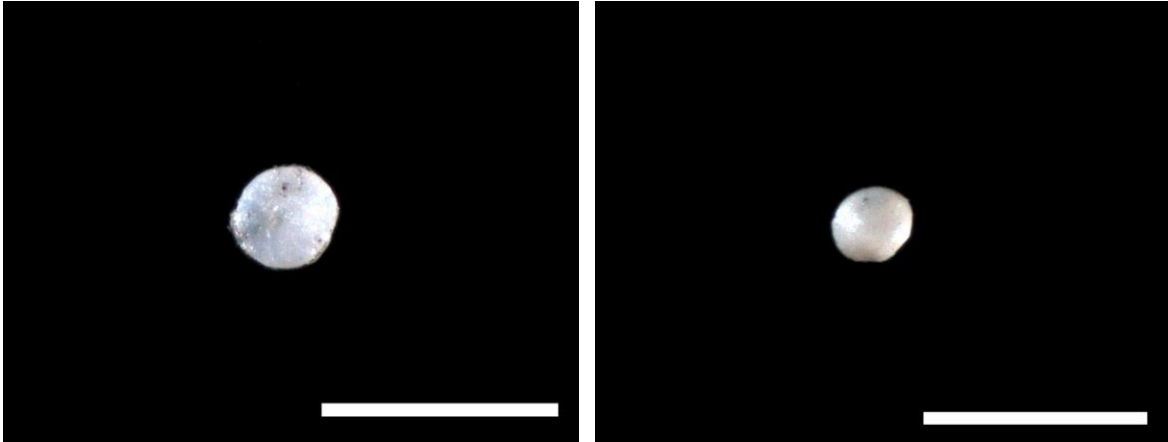
**ID: 113; MAL: 0.74 mm; SL: 41 mm**



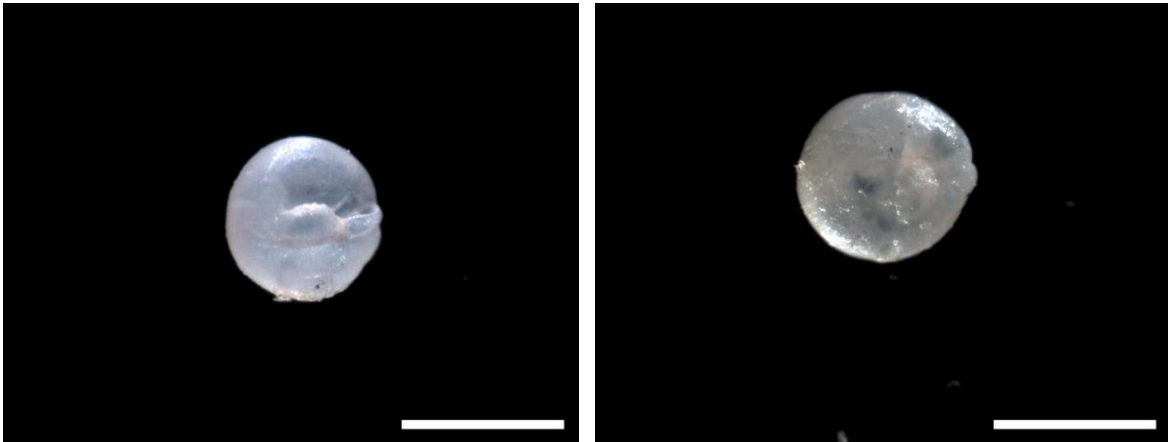
**Family: Stomiidae**

*Chauliodus macouni*

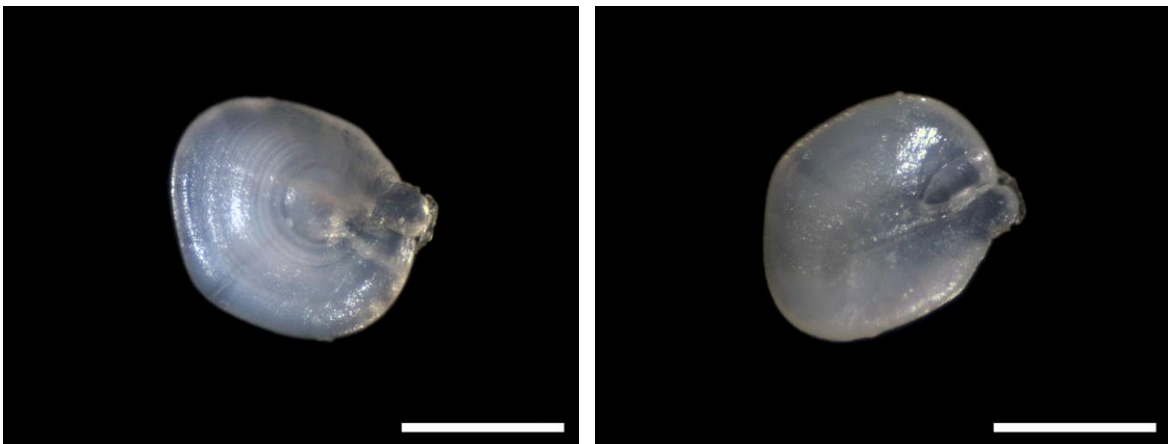
(Pacific viperfish)



**ID: 115; MAL: 0.20 mm; SL: 38 mm**



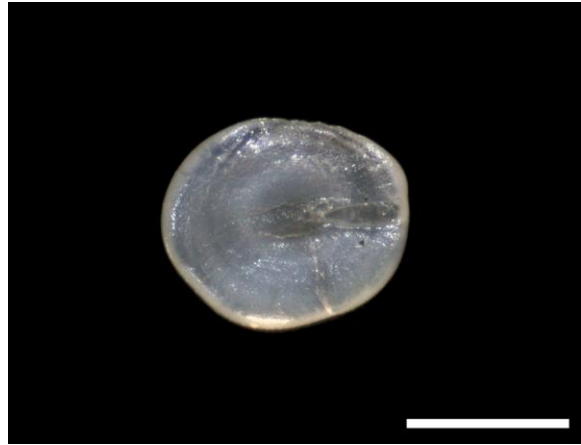
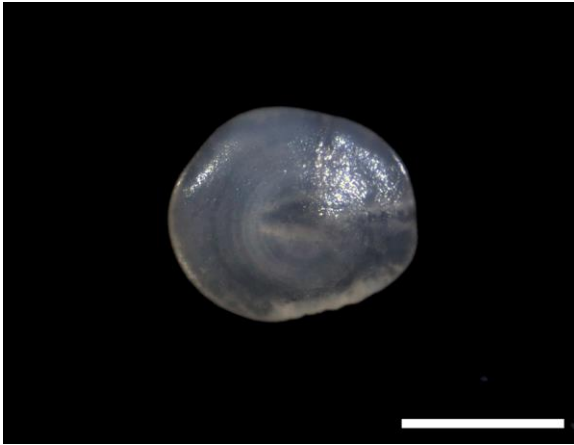
**ID: 142; MAL: 0.56 mm; SL: 122 mm**



**ID: 1615; MAL: 0.84 mm; SL: nd**

*Chauliodus macouni* (cont'd)

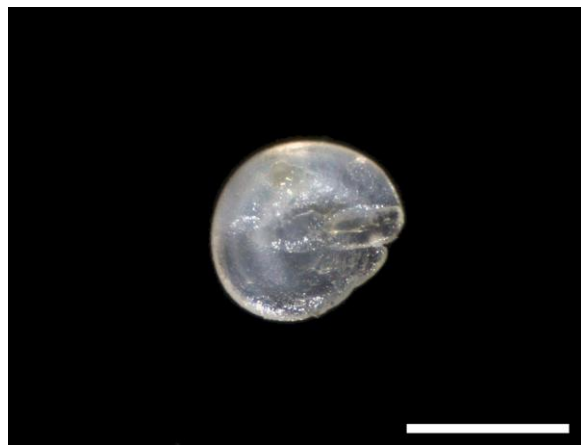
(Pacific viperfish)



**ID: 1616; MAL: 0.78 mm; SL: nd**



**ID: 1618; MAL: 0.86 mm; SL: nd**



**ID: 1619; MAL: 0.62 mm; SL: nd**

*Chauliodus macouni* (cont'd)

(Pacific viperfish)



**ID: 1621; MAL: 0.98 mm; SL: nd**



**ID: 1623; MAL: 0.90 mm; SL: nd**



**ID: 1625; MAL: 0.91 mm; SL: nd**

*Chauliodus macouni* (cont'd)

(Pacific viperfish)



**ID: 1627; MAL: 0.88 mm; SL: nd**

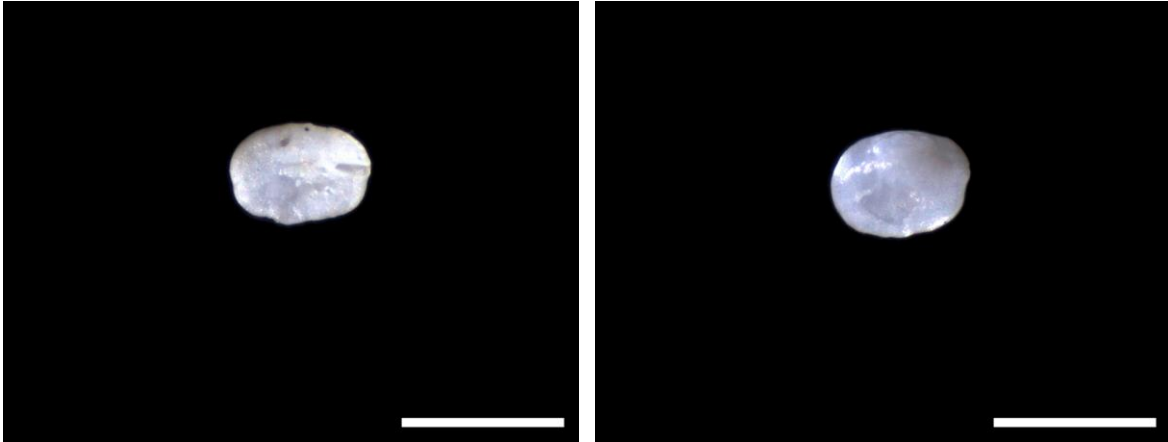


**ID: 1954; MAL: 0.91 mm; SL: 214 mm**

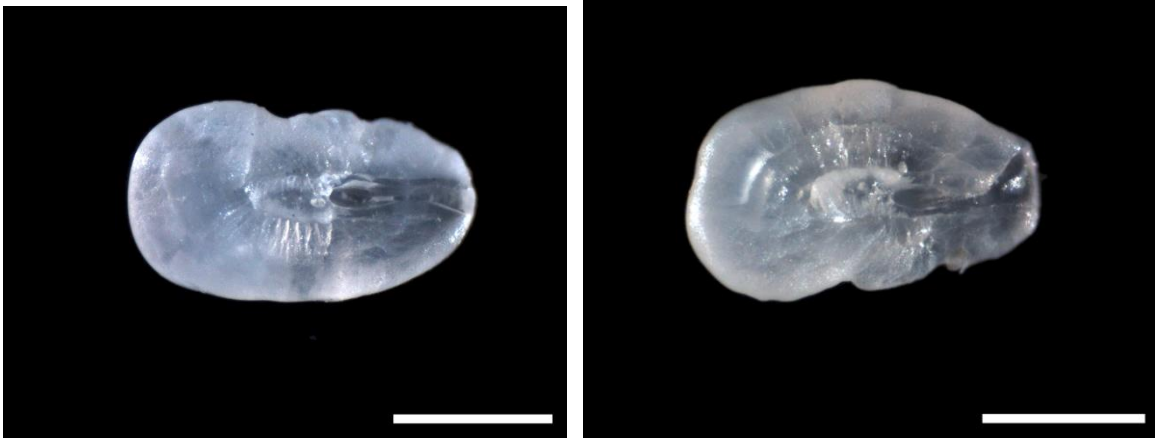
**Family: Stomiidae (cont'd)**

*Idiacanthus antrostomus*

(Pacific blackdragon)



**ID: 105; MAL: 0.45 mm; SL: 91 mm**



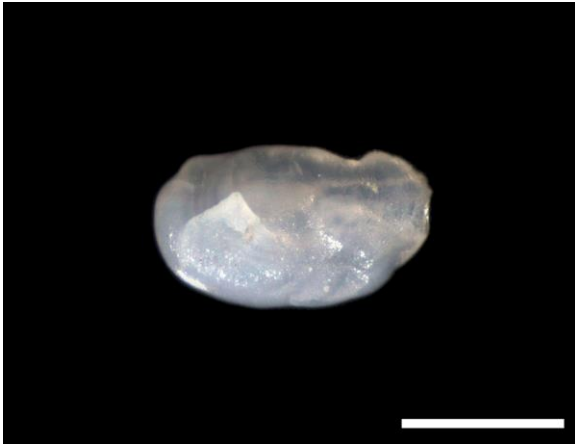
**ID: 135; MAL: 1.14 mm; SL: 329 mm**



**ID: 1594; MAL: 0.96 mm; SL: nd**

*Idiacanthus antrostomus* (cont'd)

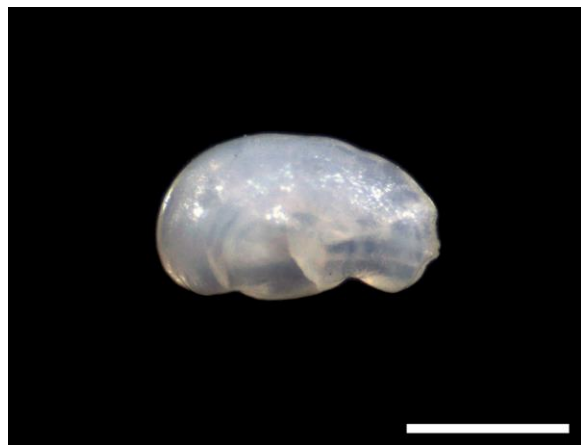
(Pacific blackdragon)



**ID: 1595; MAL: 0.88 mm; SL: nd**



**ID: 1596; MAL: 1.04 mm; SL: nd**



**ID: 1598; MAL: 0.90 mm; SL: nd**

*Idiacanthus antrostomus* (cont'd)

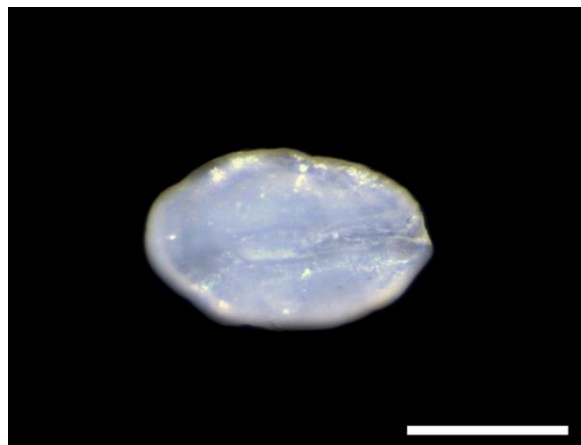
(Pacific blackdragon)



**ID: 1600; MAL: 1.15 mm; SL: nd**



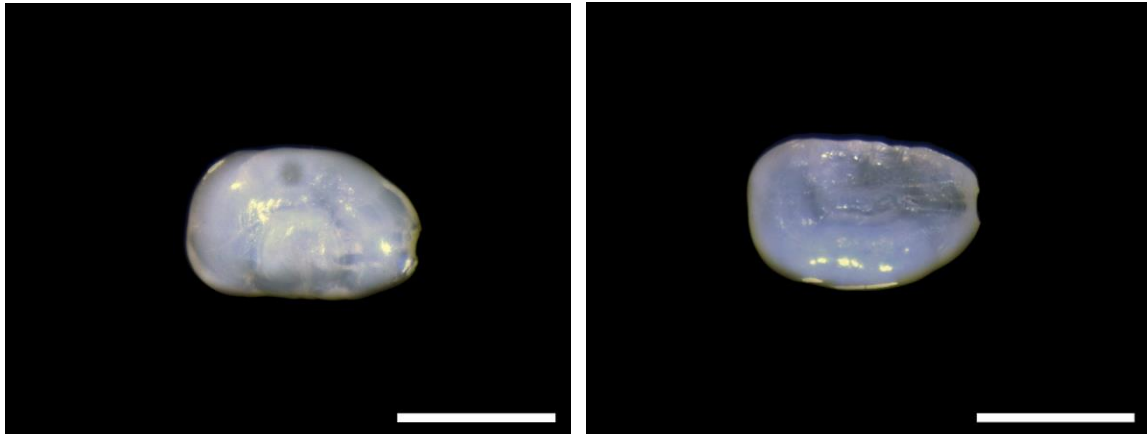
**ID: 1961; MAL: 1.16 mm; SL: nd**



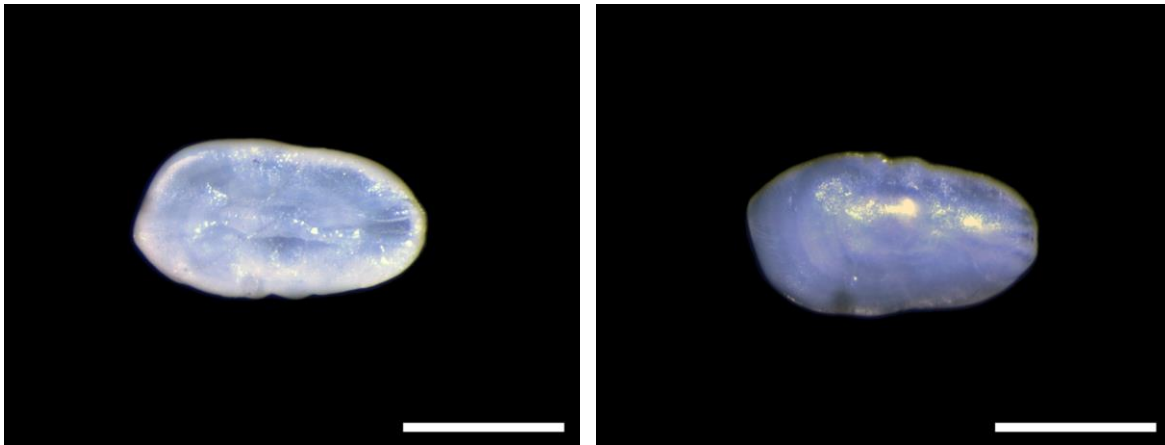
**ID: 1966; MAL: 0.90 mm; SL: nd**

*Idiacanthus antrostomus* (cont'd)

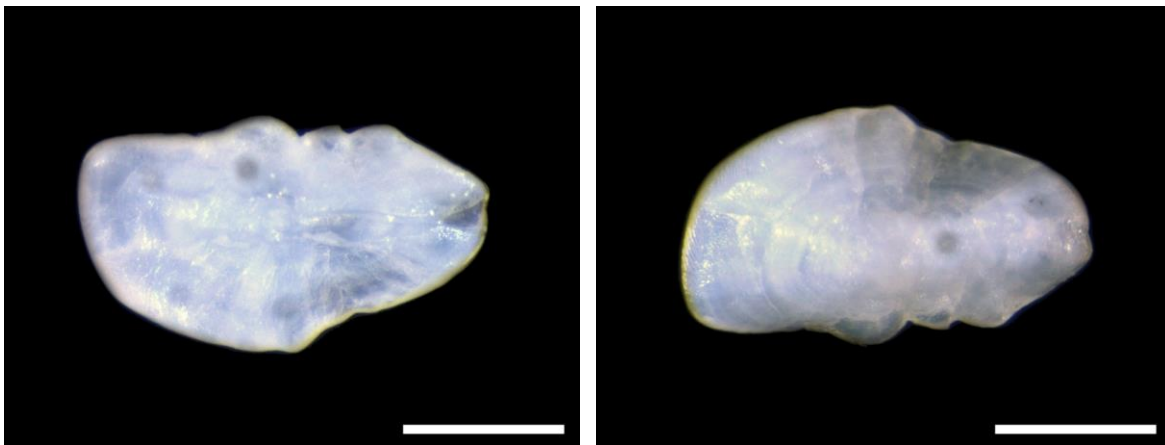
(Pacific blackdragon)



**ID: 1970; MAL: 0.79 mm; SL: 220 mm**



**ID: 1971; MAL: 0.93 mm; SL: 257 mm**



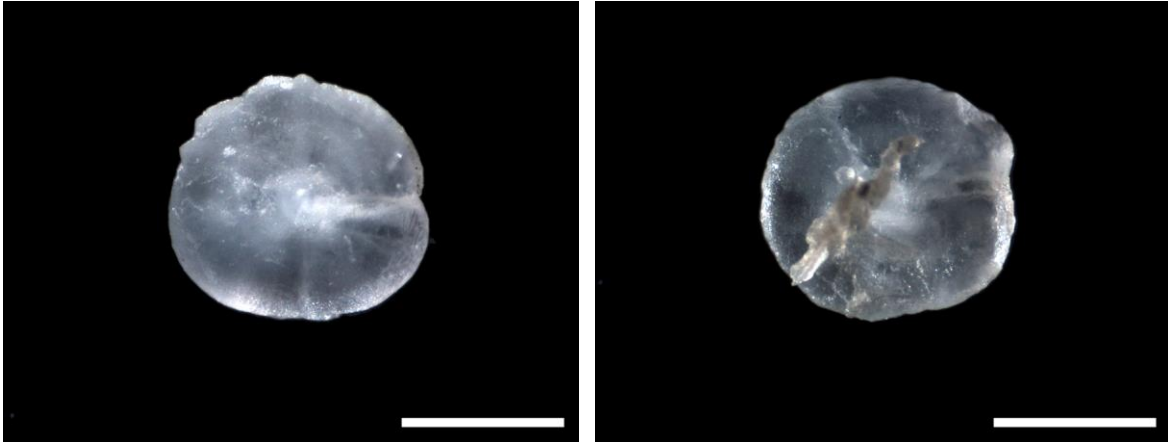
**ID: 1972; MAL: 1.31 mm; SL: 352 mm**



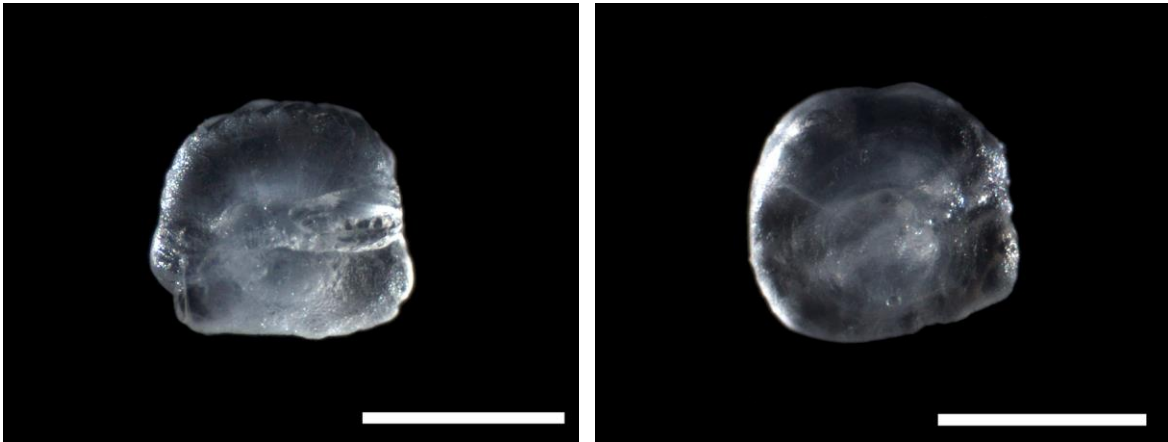
**Family: Stomiidae (cont'd)**

*Stomias atriventer*

(Black-belly dragonfish)



**ID: 141: MAL: 0.82 mm; SL: 187 mm**

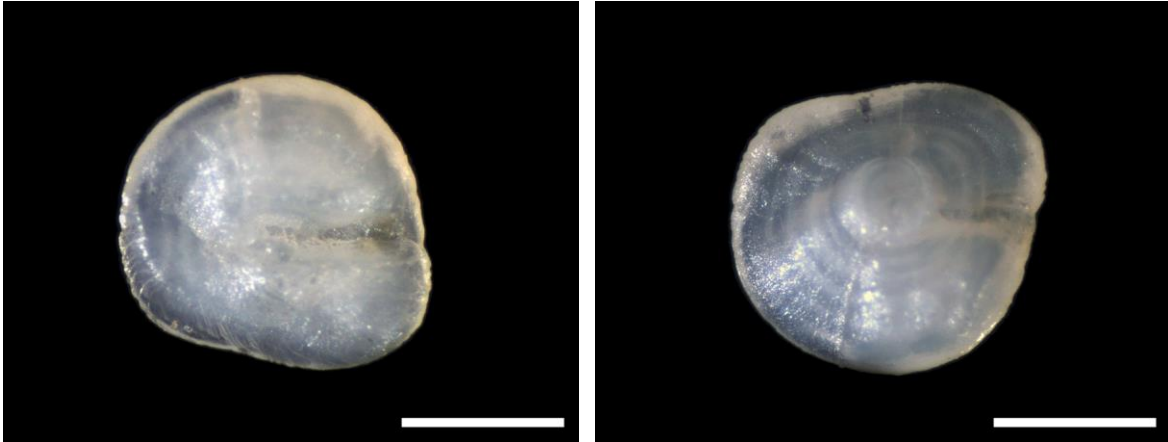


**ID: 564: MAL: nd; SL: nd**

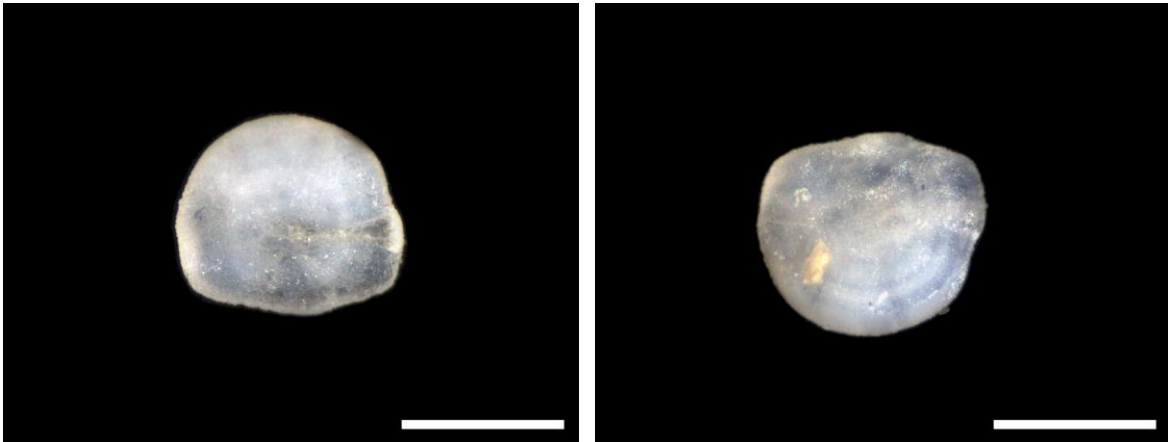
**Family: Stomiidae (cont'd)**

*Tactostoma macropus*

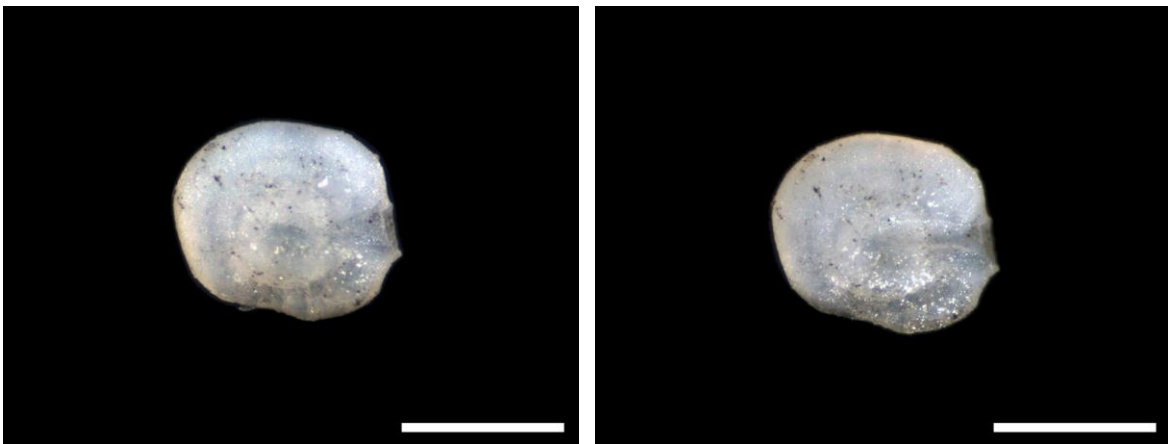
(Longfin dragonfish)



**ID: 1645; MAL: 1.01 mm; SL: nd**



**ID: 1646; MAL: 0.72 mm; SL: nd**



**ID: 1647; MAL: 0.71 mm; SL: nd**

*Tactostoma macropus* (cont'd)

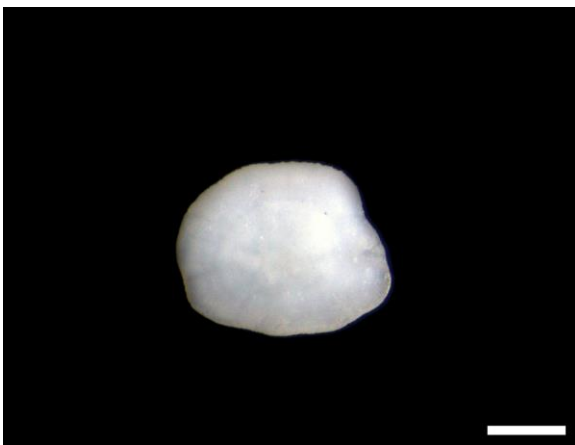
(Longfin dragonfish)



**ID: 1648; MAL: 0.78 mm; SL: nd**



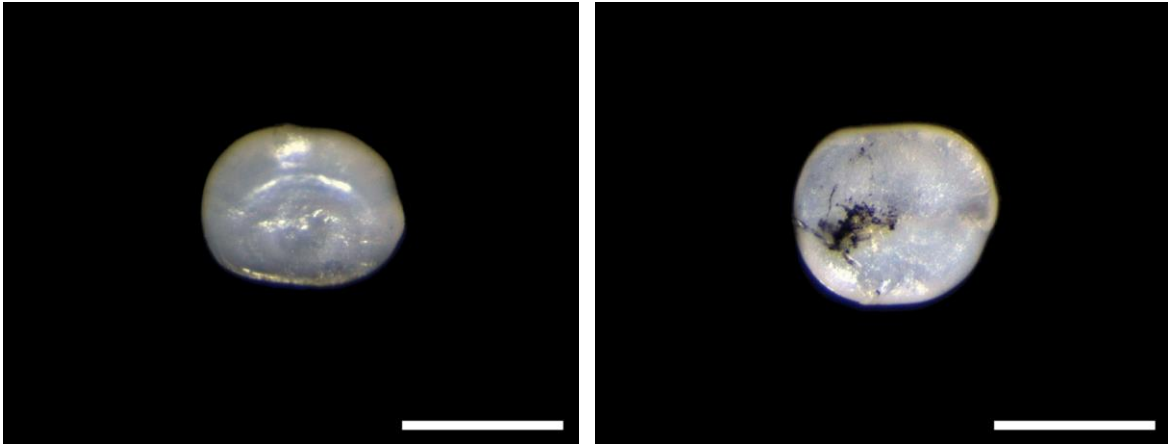
**ID: 1649; MAL: 0.78 mm; SL: nd**



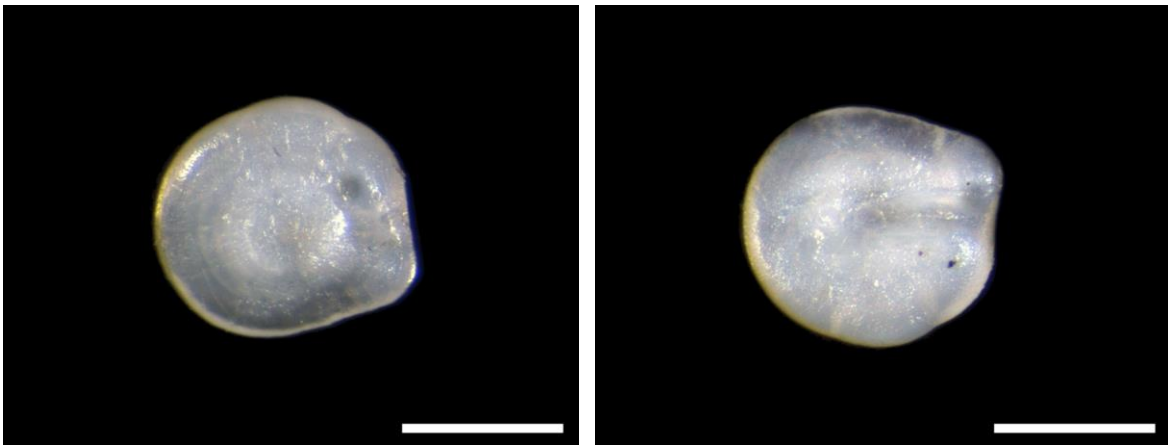
**ID: 1875; MAL: 0.67 mm; SL: nd**

*Tactostoma macropus* (cont'd)

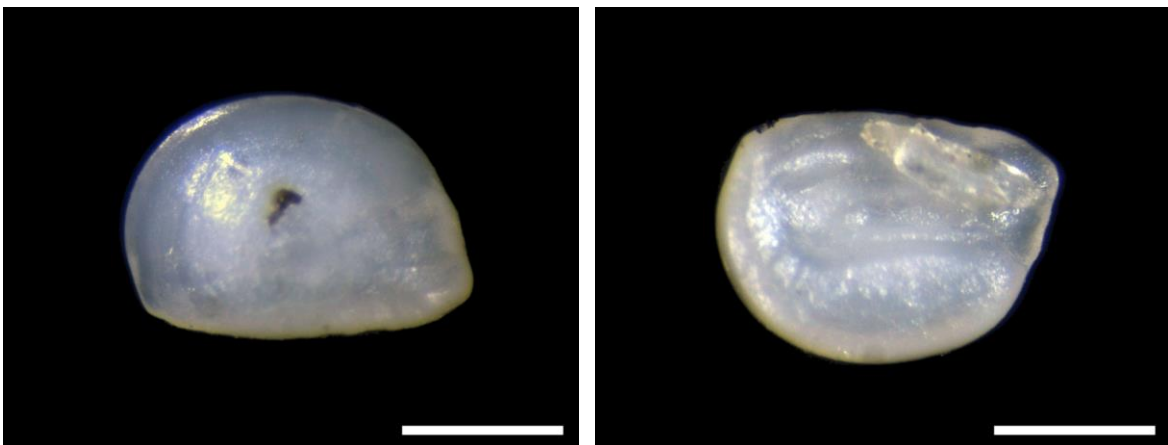
(Longfin dragonfish)



**ID: 1876; MAL: 0.66 mm; SL: 148 mm**



**ID: 1877; MAL: 0.84 mm; SL: 185 mm**



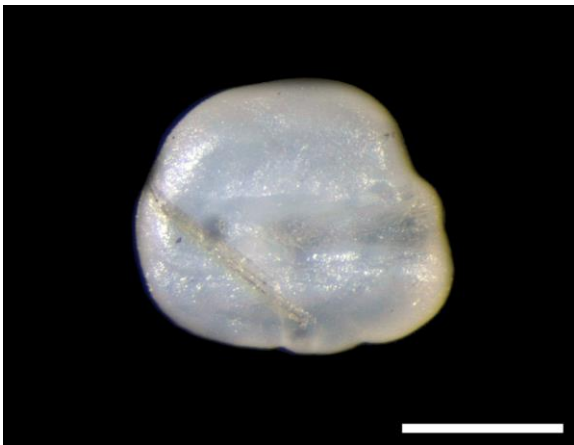
**ID: 1878; MAL: 1.11 mm; SL: nd**

*Tactostoma macropus* (cont'd)

(Longfin dragonfish)



**ID: 1879; MAL: 1.08 mm; SL: nd**



**ID: 1880; MAL: 1.00 mm; SL: nd**



**ID: 1881; MAL: 1.03 mm; SL: nd**