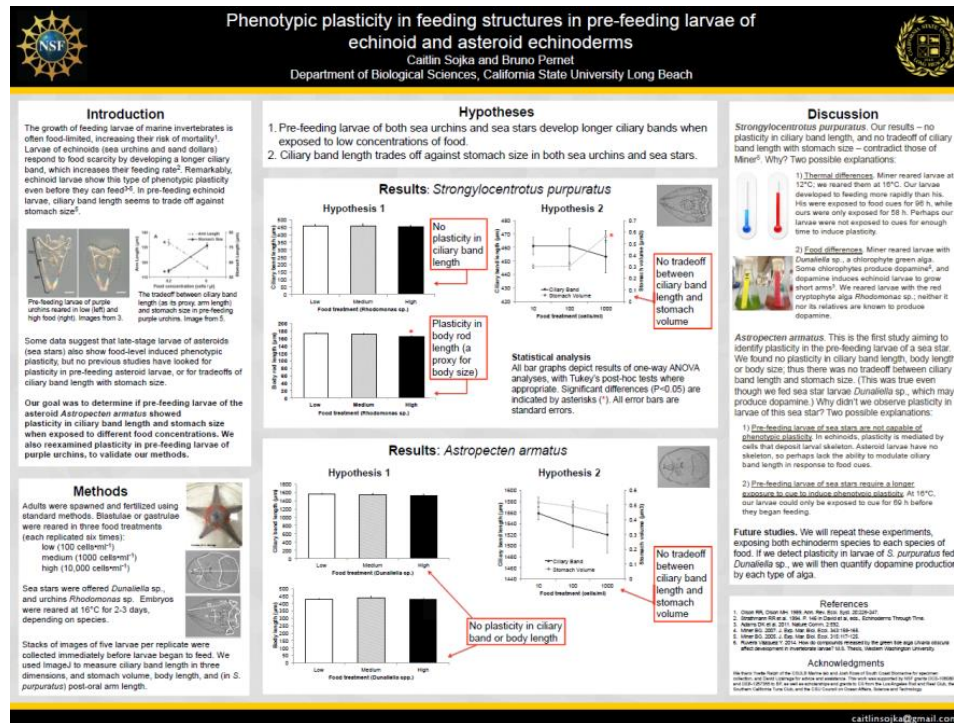


Tips on making a scientific poster

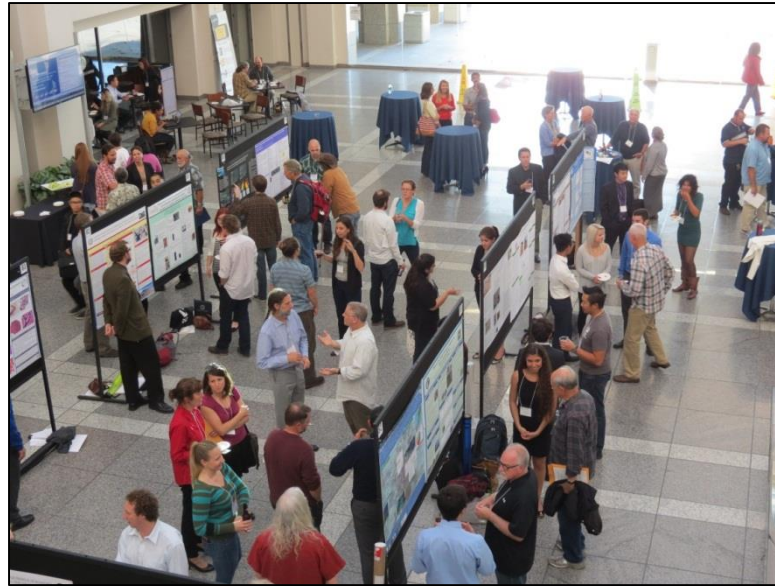
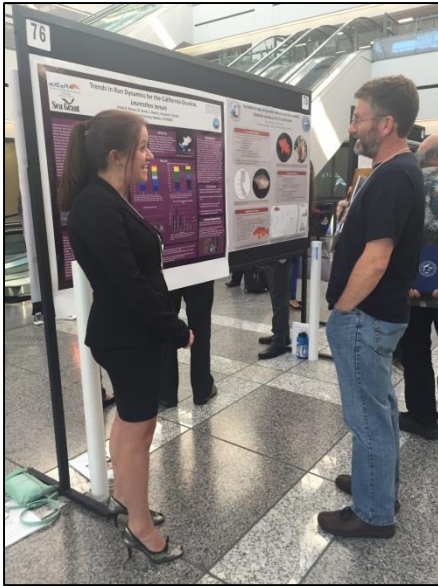


Julianne Kalman Passarelli, PhD
 Cabrillo Marine Aquarium



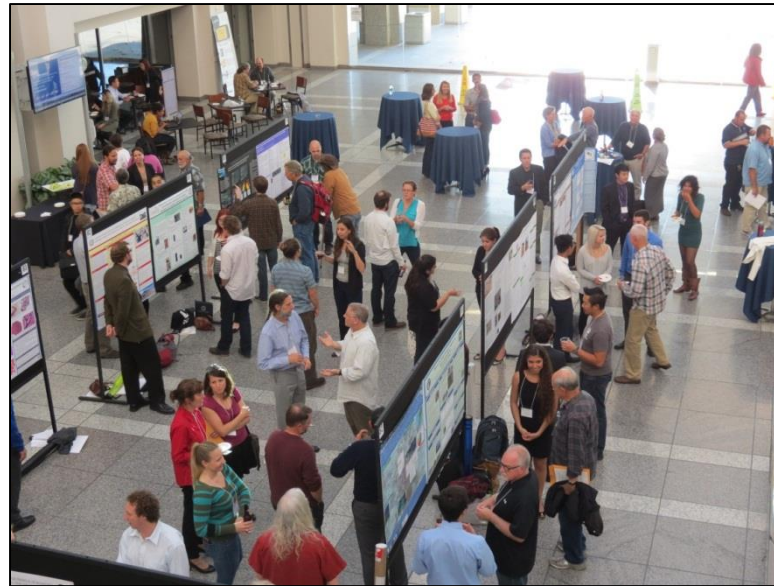
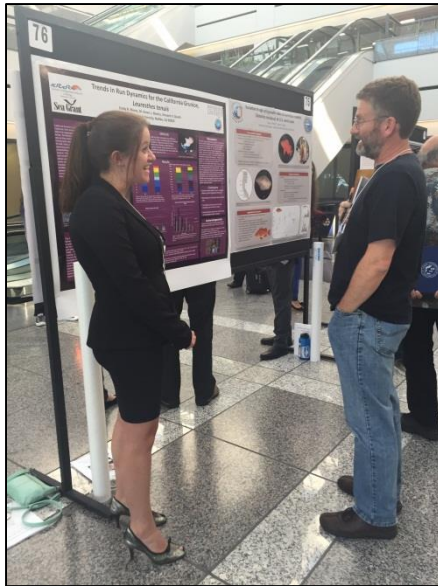
Purpose of a scientific poster

- Tool for *conveying* new discoveries
- Social, interactive way to talk about your research
- **Poster presentation** vs. Oral presentation
- You will be presenting at the **SCAS Annual Meeting on Saturday, May 4, 2024 at Chapman University** (time TBD ~5pm)



Purpose of a scientific poster

- Ok to use same poster for multiple conferences (such as AAAS), but not ok to use in multiple years at same conference
- Poster should be self-explanatory so that you are free to discuss and answer questions from your colleagues
- Keep the presentation as simple as possible, with *minimal text*

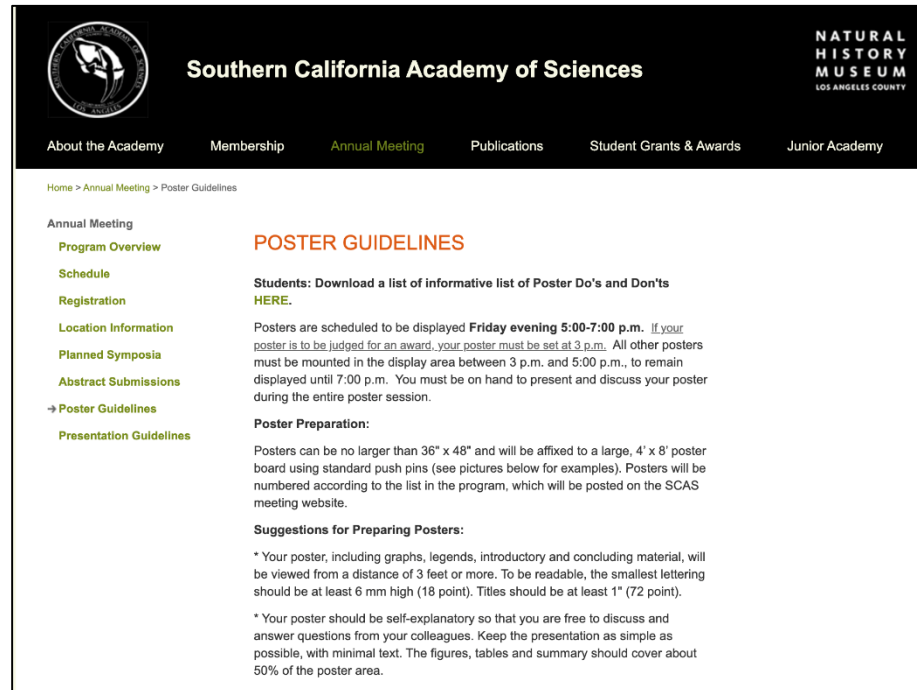


SCAS Annual Meeting Poster Preparation

- no larger than 36" high x 48" wide, displayed on boards/easels
- pins/clips to attach posters to boards will be available
- posters numbered according to list in program

Always check the requirements for the meeting you are attending!

SCAS = landscape



The screenshot shows the website for the Southern California Academy of Sciences (SCAS) Natural History Museum. The page is titled "POSTER GUIDELINES" and provides detailed instructions for poster preparation. The navigation menu includes "About the Academy", "Membership", "Annual Meeting", "Publications", "Student Grants & Awards", and "Junior Academy". The "Annual Meeting" section is active, with a sub-menu listing "Program Overview", "Schedule", "Registration", "Location Information", "Planned Symposia", "Abstract Submissions", "Poster Guidelines", and "Presentation Guidelines". The "Poster Guidelines" section includes a link to a list of "Poster Do's and Don'ts" and a "Poster Preparation" section. The "Poster Preparation" section states that posters should be no larger than 36" x 48" and affixed to a 4' x 8' board. It also provides "Suggestions for Preparing Posters", including that the poster should be self-explanatory and that the presentation should be as simple as possible.

Southern California Academy of Sciences

NATURAL HISTORY MUSEUM
LOS ANGELES COUNTY

About the Academy Membership Annual Meeting Publications Student Grants & Awards Junior Academy

Home > Annual Meeting > Poster Guidelines

Annual Meeting

- Program Overview
- Schedule
- Registration
- Location Information
- Planned Symposia
- Abstract Submissions
- Poster Guidelines
- Presentation Guidelines

POSTER GUIDELINES

Students: Download a list of informative list of Poster Do's and Don'ts [HERE](#).

Posters are scheduled to be displayed **Friday evening 5:00-7:00 p.m.** If your poster is to be judged for an award, your poster must be set at 3 p.m. All other posters must be mounted in the display area between 3 p.m. and 5:00 p.m., to remain displayed until 7:00 p.m. You must be on hand to present and discuss your poster during the entire poster session.

Poster Preparation:

Posters can be no larger than 36" x 48" and will be affixed to a large, 4' x 8' poster board using standard push pins (see pictures below for examples). Posters will be numbered according to the list in the program, which will be posted on the SCAS meeting website.

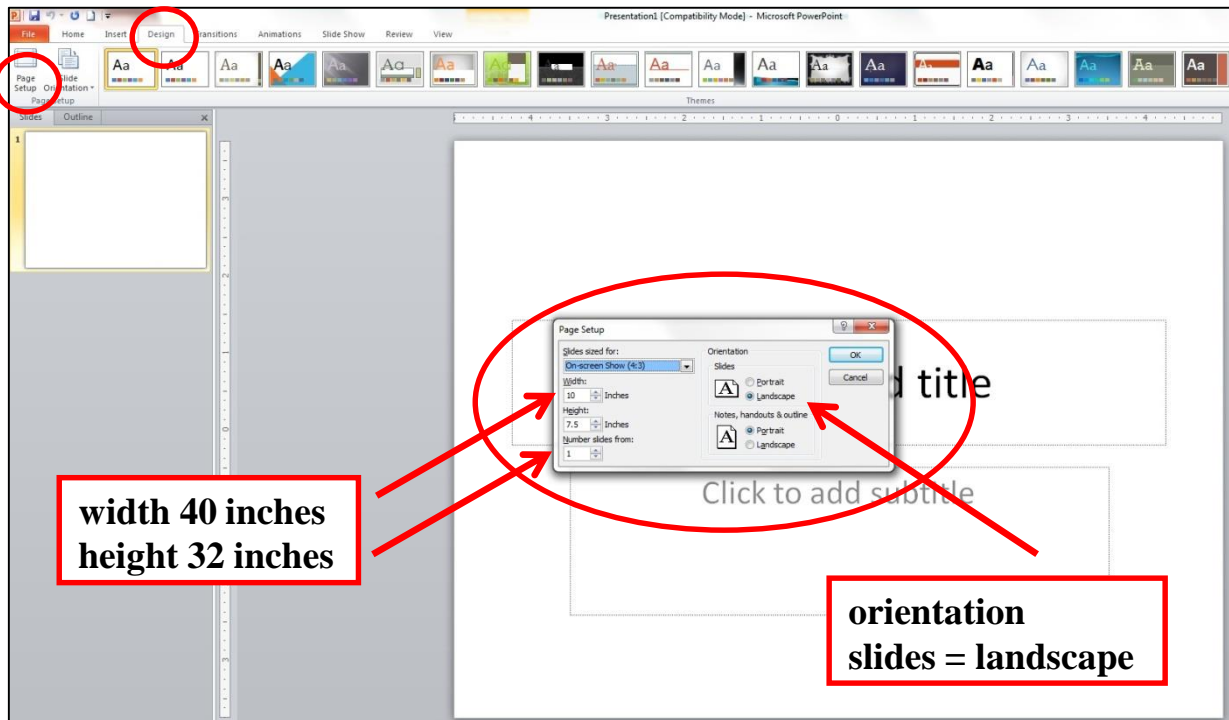
Suggestions for Preparing Posters:

- * Your poster, including graphs, legends, introductory and concluding material, will be viewed from a distance of 3 feet or more. To be readable, the smallest lettering should be at least 6 mm high (18 point). Titles should be at least 1" (72 point).
- * Your poster should be self-explanatory so that you are free to discuss and answer questions from your colleagues. Keep the presentation as simple as possible, with minimal text. The figures, tables and summary should cover about 50% of the poster area.

<http://scas.nhm.org/annual-meeting/poster.html>

How to create a scientific poster

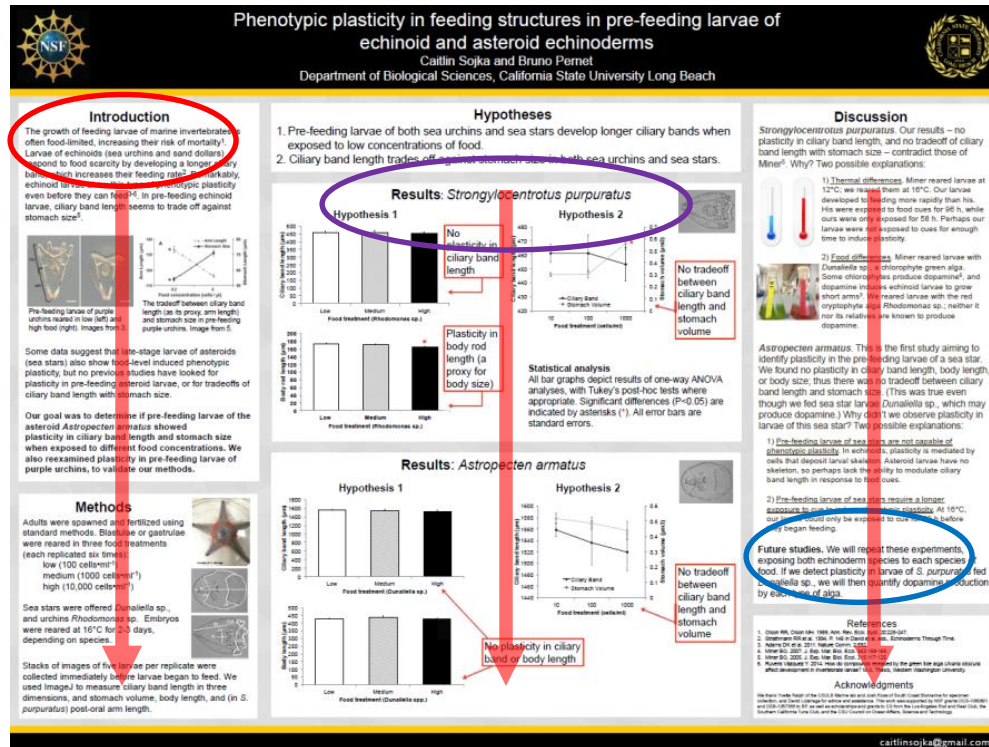
- Using Powerpoint (or equivalent) go to Design → Page Setup (earlier than Office 2010: File → Page Setup)
- Enter size of slide (suggested: 32 inches high, 40 inches wide; landscape)
- Click on actual slide (not slide scroll on left) to change % shown (% fit)
- Then use, view → fit to window
- Use text boxes to create the different sections of your poster.



Arrange your poster in columns rather than in rows.

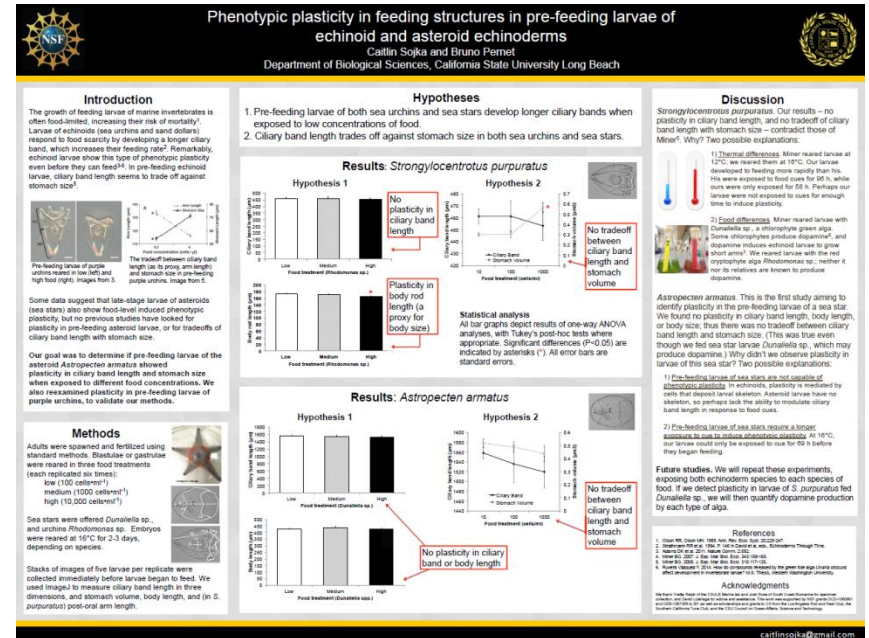
The **introduction** should be placed at the upper left, and a **conclusion** at the lower right, both in large type (20 point minimum).

Results should include figures/photos (caption below) or tables (caption above)



Sections of a scientific poster


- Title
- Authors & Affiliations
- Abstract
- Introduction
- Materials & Methods
- Results
- Discussion
- Acknowledgements
- Literature Cited (References)



<http://scas.nhm.org/annual-meeting/poster.html>

Sizes and Title

- Your poster will be viewed from a distance of 3 feet or more. To be readable, the smallest lettering should be at least 6 mm high (**18 point**).
- Title should be at least 1" (**72 point**)



Bomb radiocarbon dating and estimated longevity of Giant Sea Bass (*Stereolepis gigas*)

**Bomb radiocarbon dating and estimated longevity of
Giant Sea Bass (*Stereolepis gigas*)**

Tips:

- Try not to wrap major names
- NEVER wrap scientific names

Authors and Affiliations (Who did the work?)

Larry G. Allen¹ and Allen H. Andrews²

¹*Department of Biology, California State University, Northridge, CA 91330-8303,
larry.allen@csun.edu*

²*NOAA Fisheries, Pacific Islands Fisheries Science Center, 99-193 Aiea Heights Drive
#417, Aiea, Hawaii 96701*

- Use ***superscript*** to designate authors' institution (only if more than 1 institution).
- Talk to co-authors!
- May include email address to indicate who is ***corresponding author*** (that is you!).

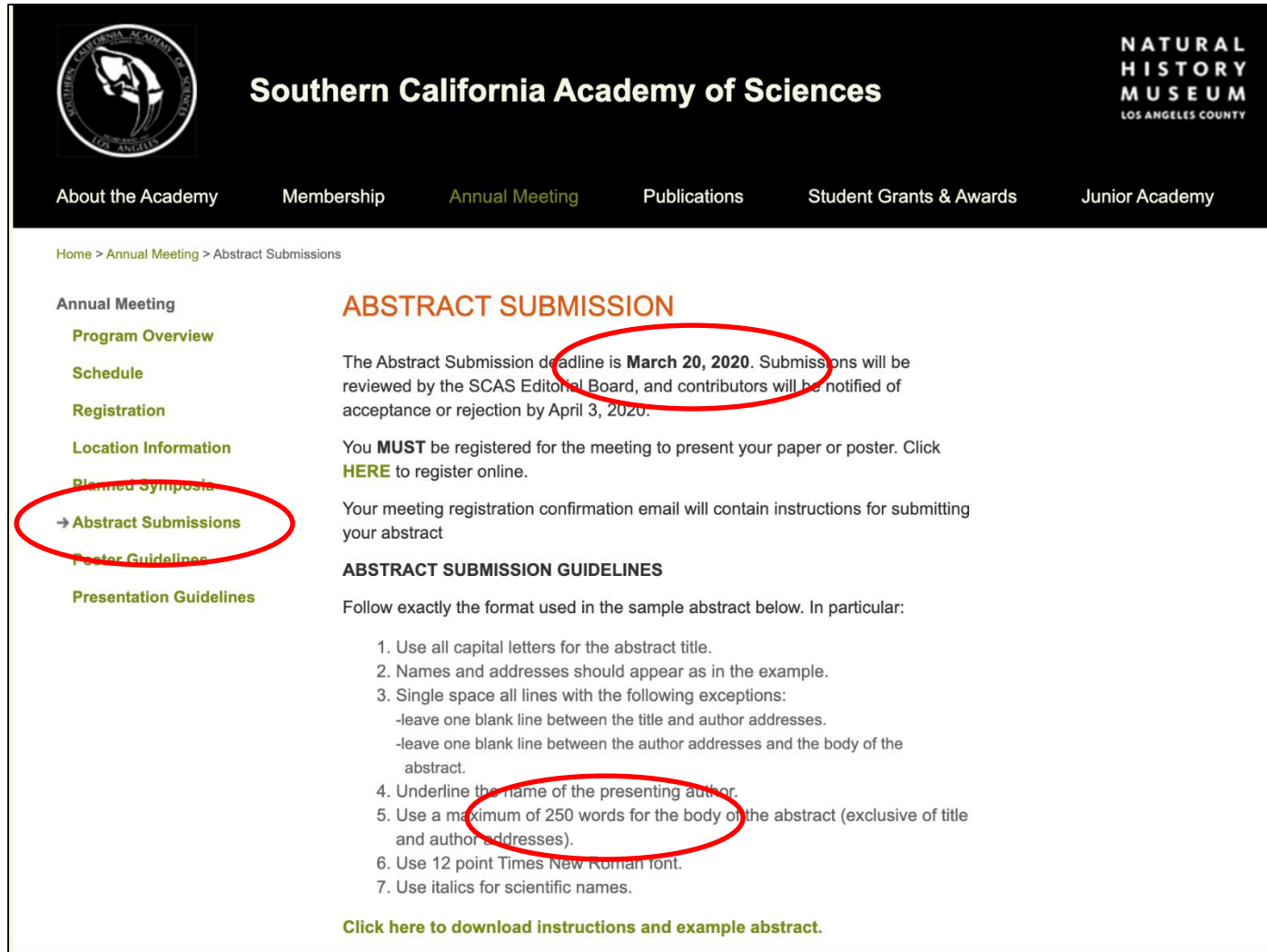
Abstract



- Should be the same abstract submitted
- 250 words max!
- Sometimes omitted on actual poster

Abstract.—In January 2010, a massive giant sea bass (500 lbs, 227 kg; near maximum reported size of 557 lbs, 253 kg) was captured off Santa Cruz Island by commercial gill-netters. This specimen presented a unique opportunity to estimate and validate of the potential longevity of the largest nearshore teleost of the northeastern Pacific. A transverse section of the sagittal otolith produced consistent counts of 62 opaque annuli along two different axes of the ventral sulcus region, translating into an estimated birth year of 1948. This age estimate was supported by measurements of radiocarbon (^{14}C) in the other sagittal otolith core (within the first year of growth), relative to $\Delta^{14}\text{C}$ reference records used for bomb radiocarbon dating. Two otolith core samples produced $\Delta^{14}\text{C}$ values that were classified as pre-bomb (prior to ~1958–59), indicating a minimum lifespan of 51 years. It is likely that giant sea bass can live more than 60 or 70 years based on growth zone counts, but there is no evidence in the literature or this study to support longevity of 100 years.

***Abstract submission deadline
for the SCAS 2024 Annual Meeting:
TBD March, 2024 @ midnight!**

Abstract (instructions on SCAS website!)



 **Southern California Academy of Sciences** 

[About the Academy](#) [Membership](#) [Annual Meeting](#) [Publications](#) [Student Grants & Awards](#) [Junior Academy](#)

[Home](#) > [Annual Meeting](#) > [Abstract Submissions](#)

Annual Meeting

- [Program Overview](#)
- [Schedule](#)
- [Registration](#)
- [Location Information](#)
- [Planned Symposia](#)
- Abstract Submissions**
- [Poster Guidelines](#)
- [Presentation Guidelines](#)

ABSTRACT SUBMISSION

The Abstract Submission deadline is **March 20, 2020**. Submissions will be reviewed by the SCAS Editorial Board, and contributors will be notified of acceptance or rejection by April 3, 2020.

You **MUST** be registered for the meeting to present your paper or poster. Click [HERE](#) to register online.

Your meeting registration confirmation email will contain instructions for submitting your abstract

ABSTRACT SUBMISSION GUIDELINES

Follow exactly the format used in the sample abstract below. In particular:

1. Use all capital letters for the abstract title.
2. Names and addresses should appear as in the example.
3. Single space all lines with the following exceptions:
 - leave one blank line between the title and author addresses.
 - leave one blank line between the author addresses and the body of the abstract.
4. Underline the name of the presenting author.
5. Use a maximum of 250 words for the body of the abstract (exclusive of title and author addresses).
6. Use 12 point Times New Roman font.
7. Use italics for scientific names.

[Click here to download instructions and example abstract.](#)

<https://scas.nhm.org/annual-meeting/abstract.html>

Introduction

- Should be concise

Methods

- Can be bulleted, but does not have to

Phenotypic plasticity in feeding structures in pre-feeding larvae of echinoid and asteroid echinoderms
Caitlin Sojka and Bruno Pernet
Department of Biological Sciences, California State University Long Beach

Introduction
The growth of feeding larvae of marine invertebrates is an food-limited, increasing their risk of mortality. Larvae of echinoids (sea urchins and sand dollars) respond to food scarcity by developing a longer ciliary band, which increases their feeding rate. Remarkably, echinoid larvae show this type of phenotypic plasticity even before they can feed^{1,2}. In pre-feeding echinoid larvae, ciliary band length seems to trade off against stomach size².

The tradeoff between ciliary band length (as its proxy, arm length) and stomach size in pre-feeding purple urchins. Image from 5.

Pre-feeding larvae of purple urchins reared in low (left) and high food (right). Images from 5.

Some data suggest that late-stage larvae of asteroids (sea stars) also show food-level induced phenotypic plasticity, but no previous studies have looked for plasticity in pre-feeding asteroid larvae, or for tradeoffs of ciliary band length with stomach size.

Our goal was to determine if pre-feeding larvae of the asteroid *Astropecten armatus* showed plasticity in ciliary band length and stomach size when exposed to different food concentrations. We also examined plasticity in pre-feeding larvae of purple urchins, to validate our methods.

Methods
Larvae were spawned and fertilized using standard methods. Blastulae or gastrulae were reared in three food treatments (each replicated six times): low (100 cells \cdot ml⁻¹), medium (1000 cells \cdot ml⁻¹), high (10,000 cells \cdot ml⁻¹). Sea stars were offered *Dunaliella* sp., and urchins *Rhodomonas* sp. Embryos were reared at 16°C for 2-3 days, depending on species.

Stacks of images of five larvae per replicate were collected immediately before larvae began to feed. We used ImageJ to measure ciliary band length in three dimensions, and stomach volume, body length, and (in *S. purpuratus*) post-oral arm length.

Hypotheses
1. Pre-feeding larvae of both sea urchins and sea stars develop longer ciliary bands when exposed to low concentrations of food.
2. Ciliary band length trades off against stomach size in both sea urchins and sea stars.

Results: *Strongylocentrotus purpuratus*

Hypothesis 1
Ciliary band length (mm) vs. Food treatment (Rhodomonas sp.)

Food treatment	Ciliary band length (mm)
Low	~140
Medium	~140
High	~140

No plasticity in ciliary band length

Plasticity in body rod length (a proxy for body size)

Hypothesis 2
Ciliary Band (mm) vs. Stomach Volume (mm³) vs. Food treatment (Rhodomonas)

No tradeoff between ciliary band length and stomach volume

Statistical analysis
All bar graphs depict results of one-way ANOVA analyses, with Tukey's post hoc tests where appropriate. Significant differences (P<0.05) are indicated by asterisks (*). All error bars are standard errors.

Results: *Astropecten armatus*

Hypothesis 1
Ciliary band length (mm) vs. Food treatment (*Dunaliella* sp.)

Food treatment	Ciliary band length (mm)
Low	~140
Medium	~140
High	~140

No plasticity in ciliary band or body length

Hypothesis 2
Ciliary Band (mm) vs. Stomach Volume (mm³) vs. Food treatment (Dunaliella)

No tradeoff between ciliary band length and stomach volume

Discussion
Strongylocentrotus purpuratus. Our results – no plasticity in ciliary band length, and no tradeoff of ciliary band length with stomach size – contradict those of Miner². Why? Two possible explanations:
1) **Thermal differences**. Miner reared larvae at 12°C; we reared them at 16°C. Our larvae developed to feeding more rapidly than his. His were exposed to food cues for 56 h, while ours were only exposed for 26 h. Perhaps our larvae were not exposed to cues for enough time to induce plasticity.
2) **Food differences**. Miner reared larvae with *Dunaliella* sp., a chlorophyte green alga. Some chlorophytes produce dopamine³ and dopamine induces echinoid larvae to grow short arms⁴. We reared larvae with the red cryptophyte alga *Rhodomonas* sp., neither a nor its relatives are known to produce dopamine.

Astropecten armatus. This is the first study aiming to identify plasticity in the pre-feeding larvae of a sea star. We found no plasticity in ciliary band length, body length, or body size; thus there was no tradeoff between ciliary band length and stomach size. (This was true even though we fed sea star larvae *Dunaliella* sp., which may produce dopamine.) Why didn't we observe plasticity in larvae of this sea star? Two possible explanations:
1) **Pre-feeding larvae of sea stars are not capable of phenotypic plasticity**. In echinoids, plasticity is mediated by cells that deposit larval skeleton. Asteroid larvae have no skeleton, so perhaps lack the ability to modulate ciliary band length in response to food cues.
2) **Pre-feeding larvae of sea stars require a longer exposure to cues to induce phenotypic plasticity**. At 16°C, our larvae could only be exposed to cues for 50 h before they began feeding.

Future studies. We will repeat these experiments, exposing both echinoderm species to each species of food. If we detect plasticity in larvae of *S. purpuratus* fed *Dunaliella* sp., we will then quantify dopamine production by each type of alga.

References
1. Clark ME, Clark AB, Clark P, Clark J, Clark M, Clark S. Echinoderms Through Time. 2008. Cambridge University Press. 2008. 2. Miner RA. 2007. J. Exp. Mar. Biol. Ecol. 342:149-164. 3. Brown BE. 2002. J. Exp. Mar. Biol. Ecol. 267:149-164. 4. Brown BE. 2002. J. Exp. Mar. Biol. Ecol. 267:149-164.

Acknowledgments
We thank Caitlin Sojka for the 2013 Summer and 2014 Fall Internships for research assistants, and Caitlin Sojka for advice and assistance. This work was supported by NSF grant IOB-0944043 and by the California Sea Grant Program, supported by the National Oceanic and Atmospheric Administration, through the University of California, Long Beach, and the U.S. Coast and Geodetic Survey.

caitlinsojka@gmail.com

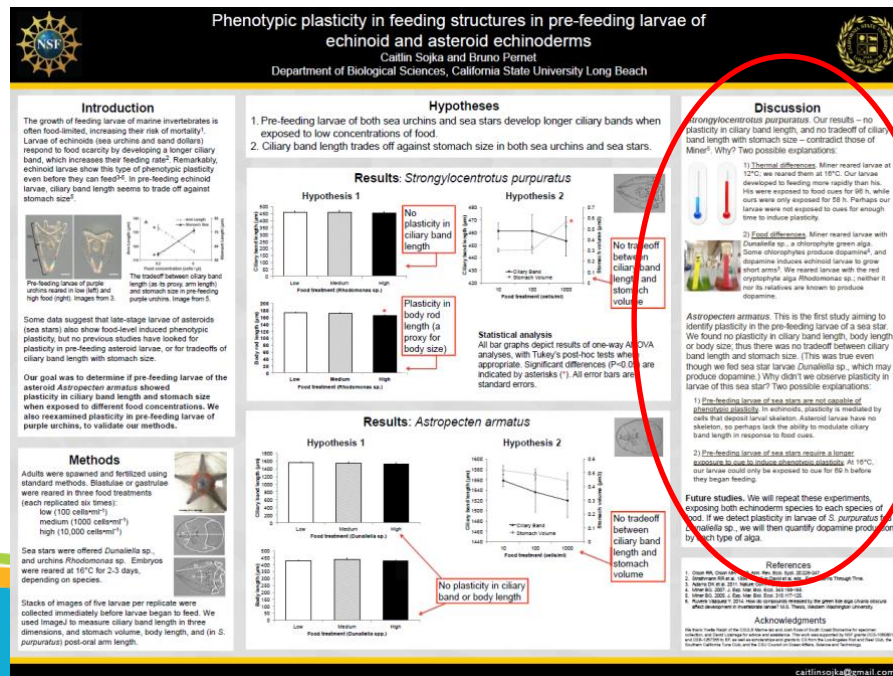
Results

- Present **key** results in a logical sequence.
 - i. Do **NOT** include your data interpretation!
 - ii. Highlight results that answer the question under investigation.
- Usually contains no citations.
- Summarize results in **Tables** and/or **Figures**.
 - i. Tables are also **numbered sequentially** (e.g., Table 1, Table 2...).
 - ii. Also cited **within parentheses** in the text.

Two samples were successfully extracted from the otolith core of the massive *S. gigas* specimen (Table 1). The mass of these samples was low, but measurable by AMS;

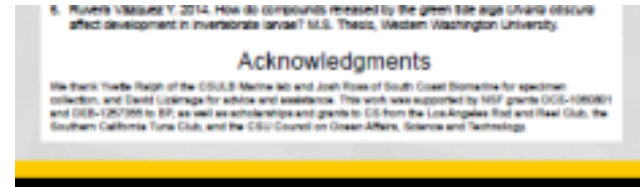
Discussion

- Present your *interpretation* of results.
- *Compare* results with findings from previous studies.
- State your *conclusions*.
- Propose *future* investigations.



Acknowledgements and Literature Cited

- Can be smaller font
(if space is an issue)



Prepare a draft of your poster and obtain input from colleagues, friends, or family before the meeting to help make a well organized, informative, and effective poster.

Then print at a FedEx Office, Kinkos or equivalent.

Matte finish posters are more easily viewed than glossy surface.



Phenotypic plasticity in feeding structures in pre-feeding larvae of echinoid and asteroid echinoderms

Caitlin Sojka and Bruno Pernet

Department of Biological Sciences, California State University Long Beach

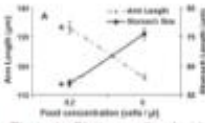


Introduction

The growth of feeding larvae of marine invertebrates is often food-limited, increasing their risk of mortality¹. Larvae of echinoids (sea urchins and sand dollars) respond to food scarcity by developing a longer ciliary band, which increases their feeding rate². Remarkably, echinoid larvae show this type of phenotypic plasticity even before they can feed³⁻⁵. In pre-feeding echinoid larvae, ciliary band length seems to trade off against stomach size⁶.



Pre-feeding larvae of purple urchins reared in low (left) and high food (right). Images from 3.



The tradeoff between ciliary band length (as its proxy, arm length) and stomach size in pre-feeding purple urchins. Image from 5.

Some data suggest that late-stage larvae of asteroids (sea stars) also show food-level induced phenotypic plasticity, but no previous studies have looked for plasticity in pre-feeding asteroid larvae, or for tradeoffs of ciliary band length with stomach size.

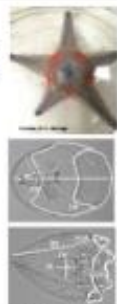
Our goal was to determine if pre-feeding larvae of the asteroid *Astropecten armatus* showed plasticity in ciliary band length and stomach size when exposed to different food concentrations. We also reexamined plasticity in pre-feeding larvae of purple urchins, to validate our methods.

Methods

Adults were spawned and fertilized using standard methods. Blastulae or gastrulae were reared in three food treatments (each replicated six times):
low (100 cells·ml⁻¹)
medium (1000 cells·ml⁻¹)
high (10,000 cells·ml⁻¹)

Sea stars were offered *Dunaliella* sp., and urchins *Rhodomonas* sp. Embryos were reared at 16°C for 2-3 days, depending on species.

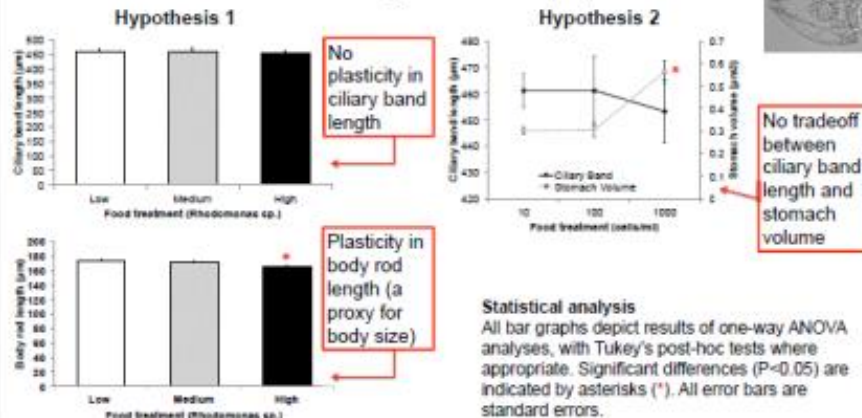
Stacks of images of five larvae per replicate were collected immediately before larvae began to feed. We used ImageJ to measure ciliary band length in three dimensions, and stomach volume, body length, and (in *S. purpuratus*) post-oral arm length.



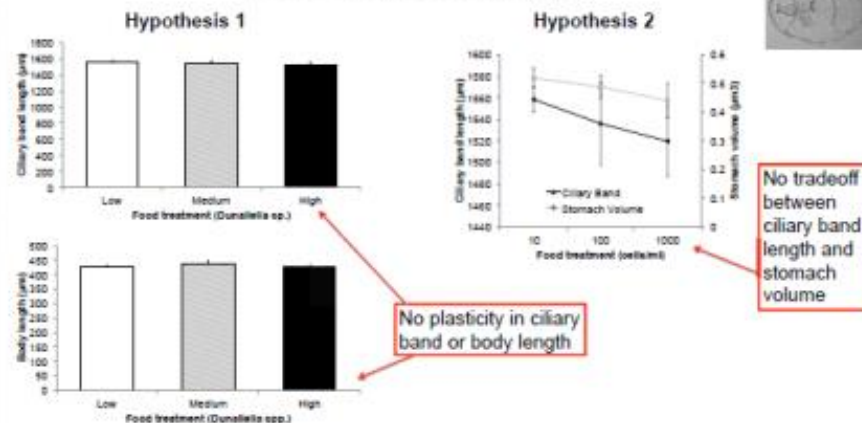
Hypotheses

1. Pre-feeding larvae of both sea urchins and sea stars develop longer ciliary bands when exposed to low concentrations of food.
2. Ciliary band length trades off against stomach size in both sea urchins and sea stars.

Results: *Strongylocentrotus purpuratus*



Results: *Astropecten armatus*



Discussion

Strongylocentrotus purpuratus. Our results – no plasticity in ciliary band length, and no tradeoff of ciliary band length with stomach size – contradict those of Miner⁵. Why? Two possible explanations:

- 1) **Thermal differences.** Miner reared larvae at 12°C; we reared them at 16°C. Our larvae developed to feeding more rapidly than his. His were exposed to food cues for 96 h, while ours were only exposed for 58 h. Perhaps our larvae were not exposed to cues for enough time to induce plasticity.
- 2) **Food differences.** Miner reared larvae with *Dunaliella* sp., a chlorophyte green alga. Some chlorophytes produce dopamine⁷, and dopamine induces echinoid larvae to grow short arms⁸. We reared larvae with the red cryptophyte alga *Rhodomonas* sp.; neither it nor its relatives are known to produce dopamine.

Astropecten armatus. This is the first study aiming to identify plasticity in the pre-feeding larvae of a sea star. We found no plasticity in ciliary band length, body length, or body size; thus there was no tradeoff between ciliary band length and stomach size. (This was true even though we fed sea star larvae *Dunaliella* sp., which may produce dopamine.) Why didn't we observe plasticity in larvae of this sea star? Two possible explanations:

- 1) **Pre-feeding larvae of sea stars are not capable of phenotypic plasticity.** In echinoids, plasticity is mediated by cells that deposit larval skeleton. Asteroid larvae have no skeleton, so perhaps lack the ability to modulate ciliary band length in response to food cues.
- 2) **Pre-feeding larvae of sea stars require a longer exposure to cue to induce phenotypic plasticity.** At 16°C, our larvae could only be exposed to cue for 60 h before they began feeding.

Future studies. We will repeat these experiments, exposing both echinoderm species to each species of food. If we detect plasticity in larvae of *S. purpuratus* fed *Dunaliella* sp., we will then quantify dopamine production by each type of alga.

References

1. Crowl WA, Crowl NW. 1989. *Ann. Rev. Ecol. Syst.* 20:229-247.
2. Strathmann RR et al. 1994. *P. 146 in David et al., eds., Echinoderms Through Time.*
3. Adams DR et al. 2011. *Nature Comm.* 2:292.
4. Miner BG. 2007. *J. Exp. Mar. Biol. Ecol.* 343:169-188.
5. Miner BG. 2005. *J. Exp. Mar. Biol. Ecol.* 315:117-125.
6. Ruvetskiy Y. 2014. How do compounds released by the green flag alga *Ulva lactuca* affect development in invertebrate larvae? M.S. Thesis, Western Washington University.

Acknowledgments

We thank the staff of the CSULB Marine Lab and Josh Fries of South Coast Diver for specimen collection, and David Longacre for advice and assistance. This work was supported by NSF grant (DUE-1008061) and DUE-1267395 to BS, as well as scholarships and grants to CS from the Long Beach Post and Feed Club, the Southern California Tuna Club, and the CSU Council on Ocean Affairs, Science and Technology.

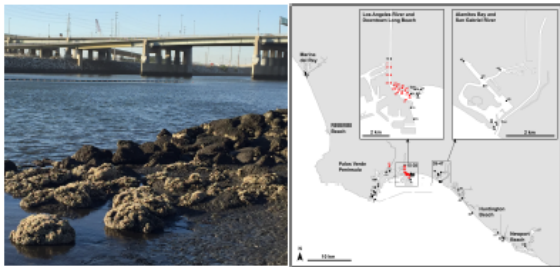
Salinity tolerance of larvae, juveniles, and adults of the non-indigenous annelid *Ficopomatus enigmaticus*

Jessica Peria, Valerie Langland, and Bruno Pernet

Department of Biological Sciences, California State University Long Beach, CA 90840

Introduction

A large population of the non-indigenous, reef-forming serpulid *Ficopomatus enigmaticus* occupies the intertidal zone of the lower ~3 km of the Los Angeles River¹. A smaller population is also established in the Port of LA. Besides these populations, both of which are in habitats with dry season salinities of ~24-32 psu, the worm is absent from other apparently suitable habitats in LA and Orange Counties.



Ficopomatus enigmaticus has feeding larvae that spend ≥ 5 days in the plankton². These may disperse from established populations to other sites. We are interested in understanding the factors that have restricted *F. enigmaticus* to only two relatively low-salinity southern California sites. As a first step, we examined the tolerance of larvae, juveniles, and adults to water of different salinities.

We hypothesized that at least one life history stage of *F. enigmaticus* is physiologically intolerant of full-salinity seawater, limiting its spread to other sites in southern California.

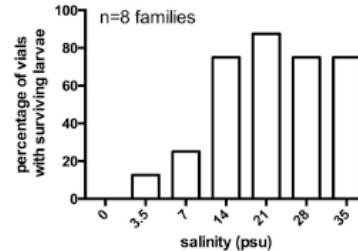
Methods

Collection. We collected adults from the mouth of the LA River. We obtained larvae by spawning adults and fertilizing eggs. Larvae were cultured at collection salinity (6-26 psu) at 20-22°C, with 3×10^5 cells·ml⁻¹ *Isochrysis*. We offered 7 d old larvae fragments of adult tube to induce settlement. Juveniles were cultured with *Isochrysis* for 6 d.

Salinity tolerance experiments. Animals were incubated in water of either 0, 3.5, 7, 14, 21, 28, or 35 psu at 20-22°C, without food. Zero psu water was deionized water; other reduced salinity treatments were made by diluting filtered seawater with deionized water. Before exposure, adults were incubated in calcein³ to establish a fluorescent mark in the tube. Survivorship was assessed daily for 11 d for larvae, and 14 d for adults. Juvenile survival was assessed once, 2 d after exposure. After 14 d, growth (as tube length added beyond the calcein mark) was assessed in surviving adults.

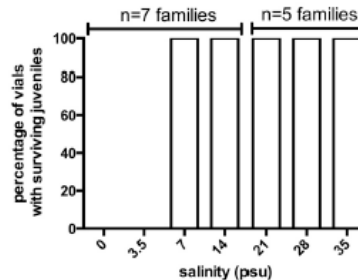
Result 1: larval salinity tolerance

Larvae from 8 families were tested at each salinity. Salinity affected survival (χ^2 test, $p < 0.001$). All larvae exposed to 0 psu died within two hours. Survival over 11 d was low in 3.5 and 7 psu seawater, but high at salinities ≥ 14 psu.



Result 2: juvenile salinity tolerance

Juveniles from 5-7 families were tested at each salinity. Salinity affected survival (χ^2 test, $p < 0.0001$). All juveniles exposed to 0 psu water died within two hours. After two days, all juveniles in 3.5 psu seawater had died. Survival was 100% at salinities ≥ 7 psu.



Actually a photo of a juvenile of *Hydroides elegans*, taken by Dr. Pei-Yuan Qian! But juveniles of *F. enigmaticus* look just like this...

References

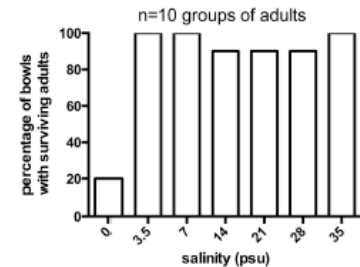
1. Pernet et al. 2016. *BiolInvasions Records* 5:13-19.
2. Gabilondo et al. 2013. *Biofouling* 29: 869-878.
3. Collin & Voltzow 1998. *Journal of Morphology* 235:77-89.
4. Dittman et al. 2009. Report for the South Australian Murray-Darling Basin Natural Resources Management Board, Adelaide.

Acknowledgments

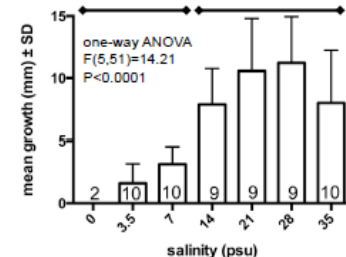
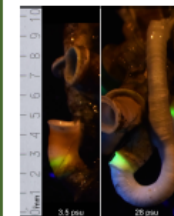
We thank D. Lizarraga for help in collecting worms and for advice on the poster, and Y. Ralph for help in temporarily housing adult worms. This work was supported by NSF grants OCE-1060801 and DEB-1257355 to BP.

Result 3: adult salinity tolerance

Ten groups of field-collected adults were tested at each salinity. Salinity affected survival (χ^2 test, $p < 0.0001$). Adults exposed to 0 psu had low survivorship, but survival was high at salinities of ≥ 3.5 psu.



We also examined growth of surviving adults at each salinity, in the absence of food. Salinity affected growth. Length added was high at salinities of ≥ 14 psu. The number at the base of each bar is sample size for that treatment.



Conclusions

Dispersal of *Ficopomatus enigmaticus* is unlikely to be limited by salinity stress. Full-salinity seawater did not pose a physiological challenge to larvae, juveniles, or adults: all three stages survived (and for adults, grew) well at all salinities ≥ 14 psu. Thus short-term acute salinity stress is unlikely to pose a barrier to the dispersal of planktonic larvae or of juveniles or adults (as fouling organisms on boats) among sites with suitable adult habitat in southern California.

Why isn't *F. enigmaticus* already present at nearby sites that have appropriate salinities (e.g., San Gabriel River, Huntington Harbor)? One possibility is that currents in the vicinity of the large LA River population may restrict larval dispersal. Alternatively, the conditions at nearby sites – both abiotic (e.g., substrate) and biotic (e.g., competitors) – may be preventing establishment of juveniles.

Prevalence and Intensity of Porcellidiid Copepods Associated with Blueband Hermit Crab (*Pagurus samuelis*) at Six Southern California Locations, and Their Potential Relationship to the Co-Symbiotic Limpet (*Crepidula williamsi*)

Jade Morris¹ and Julianne Kalman Passarelli²

¹John A. Rowland High School, Rowland Heights, CA, USA

²Cabrillo Marine Aquarium, San Pedro, CA, USA



Figure 1. Six sampling localities around the Palos Verdes Peninsula, CA, USA; including Malaga Cove, Golden Cove, Founders Park, White Point, Point Fermin, and Cabrillo Outer Beach.

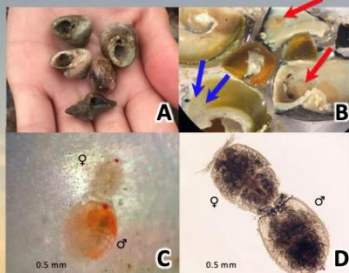


Figure 2. (A) Hermit crabs (*Pagurus samuelis*) in various shells. (B) Cracked shells revealing porcellidiid copepods (blue arrows) and slipper shell limpet (red arrows). (C) Live porcellidiid copepod mating pair on shell surface. (D) Preserved porcellidiid copepod mating pair through a light microscope.

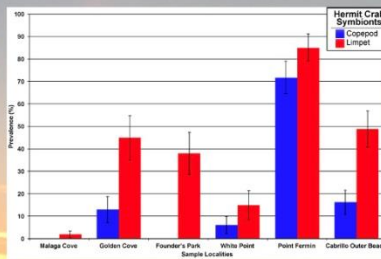


Figure 3. Prevalence of copepod and limpet symbionts in hermit crab shells at six localities along the Palos Verdes Peninsula. (Malaga Cove n=160, Golden Cove n=100, Founders Park n=100, White Point n=100, Point Fermin n=180, Cabrillo Outer Beach n=160, 95% CI Copepp-Pearson).

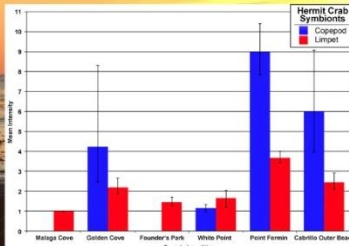


Figure 4. Mean intensity of copepod and limpet symbionts in hermit crab shells at six localities along the Palos Verdes Peninsula. (Malaga Cove n=160, Golden Cove n=100, Founders Park n=100, White Point n=100, Point Fermin n=180, Cabrillo Outer Beach n=160, 95% CI Bootstrap-BCa)

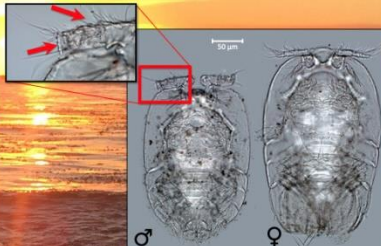


Figure 5. High magnification microscope image of unidentified male and female porcellidiid copepods. Zoom-in box showing details of the male antennule with articulating distal segment and setae arrangements. (Photos courtesy of Dr. D. Tang, OCSU)

Abstract

The symbiotic relationship between copepods belonging to the family Porcellidiidae and their hermit crab hosts in the eastern Pacific remains poorly known. The present study marks a two-year investigation into the prevalence and intensity of an unidentified species of porcellidiid copepod associated with the blueband hermit crab (*Pagurus samuelis*). Three sites along the Palos Verdes Peninsula were studied in Year 1 (Malaga Cove, Point Fermin, and Cabrillo Outer Beach). In the second year, three additional localities were added (Golden Cove, Founders Park, White Point). From October 2016 to February 2018, we sampled 800 hermit crabs dwelling in a variety of gastropod shells. The number of symbiotic copepods was recorded along with the presence of an additional symbiont, the gastropod *Crepidula williamsi*, living inside the host shell. The overall prevalence and mean intensity of copepods remains significantly higher at Point Fermin (71.7%, 9.0) compared to Cabrillo Outer Beach (16.2%, 6.0), Golden Cove (13.0%, 4.2), Founders Park (13.0%, 11.5), White Point (6.0%, 1.2), or Malaga Cove (0%, 0) (Fisher's Exact, $p < 0.0001$). Seasonal variability in copepod prevalence and mean intensity varied at Point Fermin in particular (Fisher's Exact, $p < 0.0001$). Further, a significant relationship was observed between the intensity of copepods and the presence of limpets (Pearson Correlation = 0.543, $p < 0.001$). The results of this two-year study reveal greater insight into the ecology of porcellidiid copepods on hermit crab hosts in the eastern Pacific.

Introduction

- Copepods are a highly ubiquitous group of diverse crustaceans found in virtually all aquatic systems (Huys and Boxshall 1991).
- The occurrence of porcellidiid copepods is known in the western Pacific and the Indian Ocean, it has never been reported in the eastern Pacific or the Atlantic.
- We report further data on prevalence and intensity of an unknown porcellidiid copepod living symbiotically with pagurid hermit crabs, along Palos Verdes, California, USA.

Materials and Methods

Fieldwork

- Sample localities – Malaga Cove, Golden Cove Founders Park, White Point, Point Fermin, Cabrillo Outer Beach (Figure 1)
- Twenty hermit crabs collected randomly in tidepools during low tide, October 2016 through February 2018

Laboratory

- Crabs maintained alive at Cabrillo Marine Aquarium
- Record hermit crab species, carapace length, shell species, shell width (Figure 2)
- Shells cracked, fragments examined with dissecting microscope.
- Copepods counted, relaxed in $MgSO_4$, preserved in 70% EtOH
- Presence of limpets, *Crepidula williamsi* recorded.

Data Analysis

- Analysis conducted using Quantitative Parasitology 3.0 software
- Prevalence and intensity of copepods recorded (Bush et al.1997)
- Prevalence (%) = $\frac{\# \text{ infected hosts}}{\text{total \# hosts examined}} \times 100$
- Mean Intensity (%) = $\frac{\text{total \# symbionts}}{\text{total \# infected hosts}} \times 100$
- Compare localities and sample periods (Fisher's Exact Test)
- Pearson correlation of copepod and limpet prevalence using the Microsoft Excel statistical tool packet.

References

Bush, A.O., K.D. Lafferty, J.M. Lotz, and A.W. Shostak. 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited, *Journal of Parasitology* 83: 575-583.
 Ho, J. 1986. Harpacticoid copepods of the genera *Sunaristes* and *Porcellidium* associated with hermit crabs in Japan. Report of the Sado Marine Biological Station, Niigata University 16: 21–38.
 Huys, R., 2016. Harpacticoid copepods-their symbiotic associations and biogenic substrata: a review, *Zootaxa* 4174 (1): 448-729.
 Huys, R. and G.A. Boxshall, 1991. Copepod Evolution. The Ray Society, London: 468 pp.

Results

- 97.3% of hermit crabs were identified as *Pagurus samuelis*
- Highly significant relationship found between limpet and copepod prevalence (N=800, Pearson Correlation = 0.543, $p < 0.001$)

Copepod and Limpet Prevalence & Intensity

- Copepod prevalence varied at six sampling localities (Figure 3)
- Highest prevalence at Point Fermin, generally between 65-100% (except in October 2017 when prevalence was only 15%)
- Limpets at Cabrillo Outer Beach were also abundant; two of the eight months being greater than 85%
- Golden Cove, Founders Park, and White Point, limpets were at lower abundances, ranging from 5-60%
- Limpet prevalence was lowest at Malaga Cove, with two of the six months being at 5% (not observed in other six sampling months)
- Prevalence of copepods and limpets at Point Fermin much higher compared to other five localities (Fisher's exact test, $p < 0.0001$) (Figure 3)
- Point Fermin copepod prevalence varied among the sampling periods; 72.5% (Oct 2016), 100.0% (Dec 2016), 80.0% (Feb 2017), 70% (Jun 2017), 70% (Aug 2017), 15% Oct 2017, 100% (Dec 2017), and 65% (Feb 2018) (Fisher's exact test, $p < 0.0001$)
- Point Fermin limpet prevalence was 92.5% (Oct 2016), 90.0% (Dec 2016), 90.0% (Feb 2017), 10% (Jun 2017), 70% (Aug 2017), 75% (Oct 2017), 90% (Dec 2017), and 80% (Feb 2018) (Fisher's exact test, $p = 0.318$)
- Seasonal trends of copepods observed at Point Fermin (peaks in Dec 2016 and Dec 2017) when prevalence was 100%
- Significant relationship between limpet and copepod prevalence (N=800, Pearson Correlation = 0.543, $p < 0.001$)
- Mean intensity of copepods at all localities was variable and differed significantly (Mood's median test, $p = 0.004$) (Figure 4)
- Mean intensity ranged from 0 at Malaga Cove and Founders Park, to 9.0 per host at Point Fermin. Also 4.2 at Golden Cove, 1.2 at White Point, and 6.0 at Cabrillo Outer Beach (Figure 4)
- Mean intensity of copepods at Point Fermin varied between each sampling period. Greatest intensity was 41 per host (Dec 2017)

Discussion

- Although the range is extended for these copepods, they remain localized at Point Fermin
- Energetic effect on hermit crabs by copepods remains unknown
- There is a strong significant correlation between the limpet *C. williamsi* with copepod prevalence (N=800, Pearson Correlation = 0.543, $p < 0.001$)
- Species doesn't key to *Porcellidium* or *Kioloaria*; more research is required to confirm identification of the copepod (Figure 5)
- This is the first report of porcellidiid copepods in the eastern Pacific

Future Research

- Further investigation and consultation with the copepodologist community is needed to determine if erecting a new species (or genus) has merit.
- Full description and illustration of the species will be completed to assign it a formal name.

Acknowledgements

We thank Bruno Passarelli (UCLA), Kimo Morris (Santa Ana College), Danny Tang (OCSU), Rony Huys and Geoff Boxshall (NIHM, London), Bruno Pernet (CSULB), Ralph Appy (Cabrillo Marine Aquarium), and Cabrillo Marine Aquarium. This project was made possible through the SCJAS Research Training Program.

Porcellidiid Copepods Associated with Hermit Crabs (*Pagurus* spp.) in Southern California



Jade Morris¹ and Julianne Kalman Passarelli²

¹University of California, Santa Barbara, CA, USA

²Cabrillo Marine Aquarium, San Pedro, CA, USA



Introduction

- Copepods are highly ubiquitous group of diverse crustaceans found in virtually all aquatic systems (Huys and Boxshall, 1991)
- Occurrence of porcellidiid copepods known in western Pacific and Indian Ocean
- Never reported in the eastern Pacific or the Atlantic
- We report further data on prevalence and intensity of an unknown species of porcellidiid copepod living symbiotically with pagurid hermit crabs, along the Southern California coastline, California, USA.

Materials and Methods

Fieldwork

- Sample localities along Southern California coast (Fig. 1)
- Twenty hermit crabs collected in tidepools during low tide
- Seasonal Collections, October 2016 - August 2019

Laboratory

- Crabs maintained alive in lab
- Morphometrics recorded
- Shells cracked and examined under dissecting microscope
- Copepods counted, relaxed in MgSO₄ solution
- Placed into labeled vials of 90% ethanol
- Presence of limpet *Crepidula williamsi* recorded

Data Analysis

- Quantitative Parasitology 3.0 software used to analyze binomial data
- Prevalence and intensity of copepods recorded (Bush et al. 1997)
- Prevalence (%) = $\frac{\text{\# infected hosts}}{\text{total \# hosts examined}} \times 100$
- Mean Intensity (%) = $\frac{\text{total \# symbionts}}{\text{total \# infected hosts}} \times 100$
- Comparisons made between localities and sampling periods (Fisher's Exact Test)
- Pearson correlation of symbiont prevalence performed using Microsoft Excel statistical tool packet

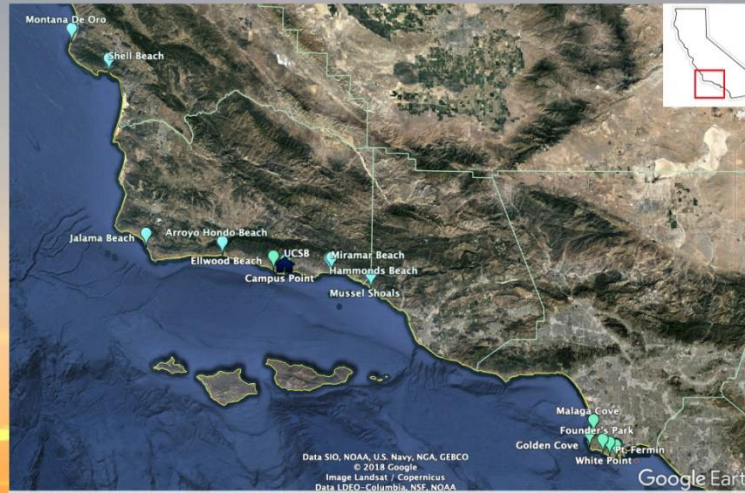


Figure 1. Fourteen sampling localities along the Southern California coastline CA, USA.

Results

- 97.3% of hermit crabs are *Pagurus samuelis*
- Significant relationship found between two symbionts prevalence (N=800, Pearson Correlation = 0.543, p<0.001)
- Highest prevalence always at Point Fermin for symbionts (Fisher's exact test, p<0.0001)
- Limpets at Cabrillo Outer Beach were also abundant
- Golden Cove, Founders Park, and White Point, limpets at much lower abundances
- Limpet prevalence was lowest at Malaga Cove
- Seasonal trends of copepods observed at Point Fermin
- Mean intensity of copepod symbionts at all localities varied (Mood's median test, p=0.004)
- Point Fermin mean intensity of copepod symbionts varied between sampling periods
- Highest intensity of symbionts per host at 58 copepods at Cabrillo Outer Beach in April 2019
- Significant relationship found between symbiont prevalence (N=800, Pearson Correlation = 0.543, p<0.001)

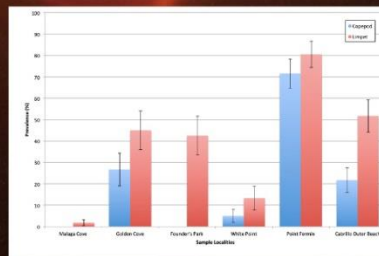


Figure 3. Prevalence of copepod and limpet symbionts in hermit crab shells at six localities along the Palos Verdes Peninsula. (Malaga Cove n=160, Golden Cove n=100, Founders Park n=100, White Point n=100, Point Fermin n=180, Cabrillo Outer Beach n=160, 95% CI Clopper-Pearson).

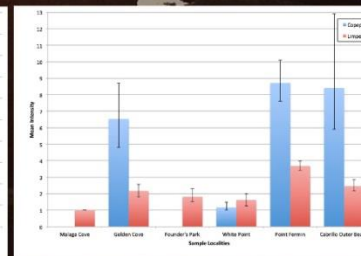


Figure 4. Mean intensity of copepod and limpet symbionts in hermit crab shells at six localities along the Palos Verdes Peninsula. (Malaga Cove n=160, Golden Cove n=100, Founders Park n=100, White Point n=100, Point Fermin n=180, Cabrillo Outer Beach n=160, 95% CI Bootstrap BCA)

Discussion

- Results suggest copepods are still especially localized at Point Fermin
- Energetic effect on hermit crabs by copepods remains unknown
- The presence of the slipper snail *C. williamsi* has a significant relationship with copepod prevalence (N=800, Pearson Correlation = 0.543, p<0.001)
- Unidentified species does not clearly key to a known genus

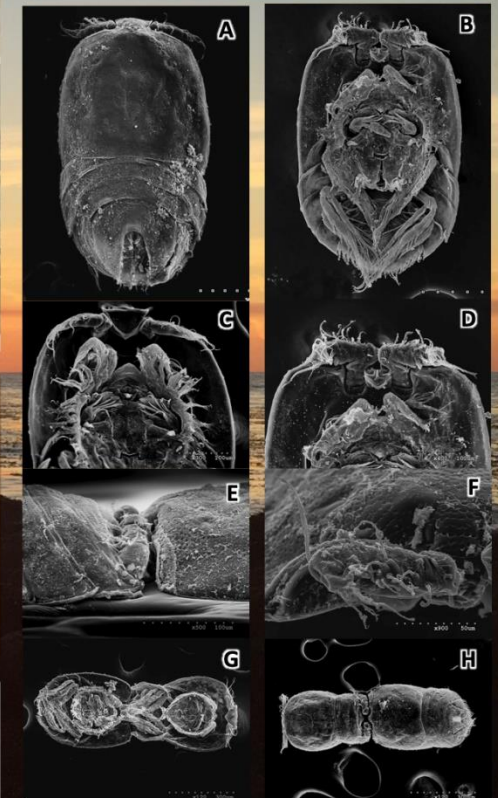


Figure 5. (A) Female adult copepod. (B) Male adult copepod. (C) Female antennule. (D) Male antennule. (E) Copulatory attachment close up. (F) Male antennule close up. (G) In copula ventral view. (H) In copula dorsal view.

Future Research

- Further investigation and consultation with members of the copepodologist community will be necessary to determine if erecting a new genus has merit
- Full description of the species to assign it a formal name
- Illustrations of the copepod

Acknowledgements

We thank Rony Huys and Geoff Boxshall (NHM, London), Danny Tang (OCSB), Bruno Pernet (CSULB), Ralph Appy and Lindsey Williamson (Cabrillo Marine Aquarium), Adam Wall (LANHM), Bruno Passarelli (UCLA), Kimo Morris (Santa Ana College), and Armand Kuris (UCSB).

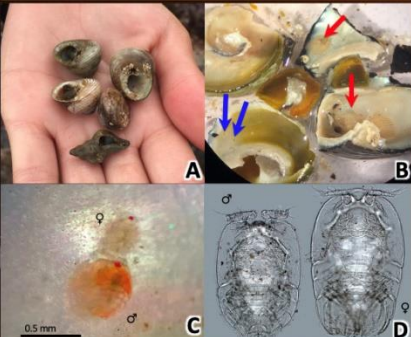


Figure 2. (A) Hermit crabs (*Pagurus samuelis*) in various shells. (B) Cracked shells revealing copepods (blue arrows) and limpet (red arrows). (C) Live porcellidiid copepod mating pair on shell surface. (D) Preserved porcellidiid copepod pair through a light microscope.

References

- Bush, A.O., K.D. Lafferty, J.M. Lotz, and A.W. Shostak, 1997. Parasitology meets ecology on its own terms: Margolis et al. revisited. *Journal of Parasitology* 83: 575-583.
- Ho, J. 1986. Harpacticoid copepods of the genera *Sunariestes* and *Porcellidium* associated with hermit crabs in Japan. Report of the Sado Marine Biological Station, Niigata University 16: 21-38.
- Huys, R., 2016. Harpacticoid copepods-their symbiotic associations and biogenic substrata: a review. *Zootaxa* 4174 (1): 448-729.
- Huys, R. and G.A. Boxshall, 1991. *Copepod Evolution*. The Ray Society, London: 468 pp.

ECTOPARASITES OF THE CALIFORNIA SCORPIONFISH, *SCORPAENA GUTTATA*, IN THE SOUTHERN CALIFORNIA BIGHT

Julianne E. Kalman

Department of Ecology and Evolutionary Biology
University of California Los Angeles
and
Orange County Sanitation District
Ocean Monitoring Program



Abstract

It is unclear to what degree parasites cause stress to their host and what long term damage occurs to host physiological responses. Chronic stress can inhibit an organism's normal physiological response to the environment. The California scorpionfish, *Scorpaena guttata*, is common in the Southern California Bight (SCB) and is frequently infested with ectoparasites. Of the 216 individuals sampled throughout the SCB, 210 were parasitized for an overall prevalence of 97.2% with an overall mean intensity of 48.2. This host harbored as many as eight species of parasites ranging in prevalence from 0.5%, *Elothusa californica* (Isopoda: Cymothoidea) to 88.4%, *Lepeophtheirus rotundipes* (Copepoda: Caligidae). The mean intensity of individual parasite species on *S. guttata* ranged from 1.0, *Holobomolochus spinulus*, *E. californica*, and *Elothusa vulgaris* (Copepoda: Bomolochidae, Isopoda: Cymothoidea, respectively) to 54.3, *Naobranchia scorpaenae* (Copepoda: Lernaeopodidae). The range of intensity of the parasitic copepod *N. scorpaenae* was from 0 to 321 individuals on a single fish. It was not uncommon to find fish with more than 100 individuals of this copepod parasitizing the gill filaments. The prevalence of *N. scorpaenae* at 78.2% was equally prominent. *Naobranchia scorpaenae* is a lernaepodid copepod that is highly adapted to attach to the host's gill filaments using its modified maxilla. Most of the individuals recovered in this study had visible blood in the gut, presumably from the host's gill tissue. Infestation levels of ectoparasites were compared from scorpionfish collected at various predetermined stations in southern California, including those collected near wastewater outfalls.

Materials and Methods

Study Site

- SCB: Southern California Bight 2003 Regional Monitoring Project
- Bight '03

- Fishes collected by otter trawl
- July through October 2003

Fish Collection

- Fishes were separated into buckets by species
- Conspecifics placed in a plastic bag and frozen

Ectoparasite Collection

- Ectoparasites preserved in 70% ETOH
- Attachment sites: body surface, eyes, fins, gill cavity, gill filaments

Isopods

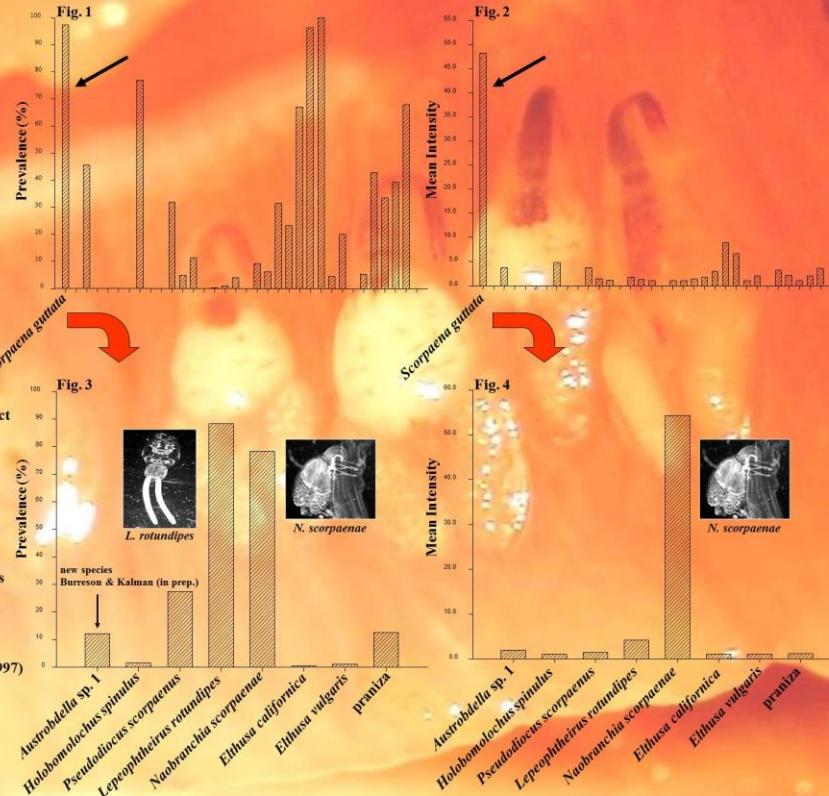
- Leeches
- Copepods

Isopods

- Parasite infections (prevalence and mean intensity) Bush et al. (1997)

- Prevalence (%) = $\frac{\text{\# of infected hosts}}{\text{total \# of hosts examined}} \times 100$

- Mean intensity = $\frac{\text{total \# of parasites}}{\text{total \# of infected hosts}}$



Results and Discussion

Scorpaena guttata

- Second highest prevalence: 97.2% (Fig. 1)
- Highest mean intensity: 48.2 (Fig. 2)
- Eight species of parasites (Figs. 3 & 4)
- Prevalence from 0.5% (*E. californica*) to 88.4% (*L. rotundipes*) (Fig. 3)
- Mean intensity from 1.0 (*H. spinulus*, *E. californica*, *E. vulgaris*) to 54.3 (*N. scorpaenae*) (Fig. 4)

The parasitic copepod *Naobranchia scorpaenae*

- A lernaepodid copepod that is highly adapted to attach to the host's gill filaments using its modified maxilla (Kabata, 1979). Most of the individuals recovered in this study had visible blood in the gut, presumably from feeding on the host's gill tissue.
- 9,173 individuals
- 169 of 216 hosts sampled (78.2%, 54.3)
- From 0 to 321 individuals on a single fish
- Not uncommon to find individual fish with more than 100 individuals parasitizing the gill filaments.

Why the California scorpionfish?

- *S. guttata* is larger than most fishes in this study, thus providing a larger attachment area upon which a planktonic larval parasite may settle. Studies have shown accumulation of parasites with age, concluding that larger individuals of a given species, therefore older individuals, tend to have more parasites (Boxshall, 1974; Kalman, 2006).
- *S. guttata* is demersal (living on or near the bottom), does not bury in the sediment, and has larger oral and gill cavities compared to most benthic fishes. With a larger available surface area for a parasite to attach, this fish may be more accessible to ectoparasites compared to the other fishes. Furthermore, it is likely *S. guttata* is infected with *N. scorpaenae* while resting on the bottom and actively pumping their buccal cavity during respiration. As water is drawn into the mouth and over the gill filaments for oxygen exchange, the infective stage of *N. scorpaenae* is also drawn into the mouth and is pushed over the gills. The copepod opportunistically then attaches and completes its life cycle on the gill filaments of *S. guttata*.

Further research

- It is interesting to note that another species also belonging to the genus *Naobranchia* was collected in this study, *Naobranchia occidentalis*. This copepod parasitizes the gill filaments of sanddabs (*Citharichthys sordidus* and *Citharichthys xanthostigma*). However, the prevalence and intensity (0.9%, 1.2 and 12.0%, 2.0 for *C. sordidus* and *C. xanthostigma*, respectively) is nowhere near as high as *N. scorpaenae*. This profound variation in prevalence and mean intensity of two closely related copepods deserves further study.
- It is unclear to what degree parasites cause stress to their host and what long-term damage occurs to host physiological responses. Chronic stress can inhibit an organism's normal physiological response to the environment. Thus, fishes may be subjected to two major forms of environmental stress in the SCB: parasites and poor water quality.

Acknowledgements

This project was supported by UCLA, OCSB, SCCWRP, and SCAS. I thank Donald G. Buth (UCLA), M. James Allen (SCCWRP), Jeffrey L. Armstrong (OCSB), George Robertson (OCSB), Joel W. Martin (LACM), Austin J. MacInnis (UCLA), Cheryl Ann Zimmer (UCLA), and Lawrence Ash (UCLA).

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orientation = portrait

Always check the requirements for the meeting you are attending!

SCAS = landscape

Discovery of the enigmatic parasitic copepod *Acanthochondria cyclopsetta* Pearse, 1952 (Cyclopoida, Chondracanthidae) on an eastern Pacific flatfish, *Xystreurus liolepis* Jordan & Gilbert

Julianne E. Kalman¹ and Danny Tang²

¹Cabrillo Marine Aquarium and ²The University of Western Australia



Abstract

The parasitic copepod *Acanthochondria cyclopsetta* Pearse, 1952 (Cyclopoida: Chondracanthidae), hitherto reported only from the Mexican flounder, *Cyclopsetta chittendeni* Bean, from Padre Island in the Gulf of Mexico, is presented based on specimens collected within the gill cavity of the fantail sole, *Xystreurus liolepis* Jordan & Gilbert, caught in the Southern California Bight. To the best of our knowledge, *A. cyclopsetta* has never been reported from the Pacific Ocean. Thus, *X. liolepis*, which occurs only in the eastern Pacific from Monterey Bay in California, U.S.A., to the Gulf of California, Mexico, represents a new host record for this copepod species. Fifty-one individuals, consisting of 5 non-ovigerous females (3 with a male attached on genitoabdomen) and 27 ovigerous females (16 with a male attached on genitoabdomen), were removed from 15 of 26 hosts sampled (57.7% prevalence, 2.1 mean intensity). *Acanthochondria cyclopsetta* is morphologically most similar to *A. soleae* (Krøyer, 1838), but can be distinguished from the latter taxon by the following character states in the transformed adult female: (1) flask-shaped trunk without lateral indentations, (2) relatively broader posterolateral processes on the trunk, (3) Type B-V antennule, (4) relatively shorter protopod on legs 1 and 2, and (5) relatively longer and thinner rami on legs 1 and 2.

Materials and Methods

Study Site

- From Point Conception, California, to USA/Mexico border, a part of the Southern California Bight 2003 Regional Monitoring Project (July through October, 2003)

Fantail sole, *Xystreurus liolepis* (Fig. 1)

- Collected by otter trawl and then frozen onboard
- Thawed & inspected for parasitic copepods in the laboratory

Acanthochondria cyclopsetta

- Soaked in lactic acid prior to examination
- Selected specimens measured using a calibrated eyepiece micrometer

Parasite epidemiology (sensu Bush et al., 1997)

- Prevalence (%) = (# infected hosts / total # hosts examined) X 100
- Mean intensity = total # parasites / total # infected hosts



Figure 1. *Xystreurus liolepis* (fantail sole), the host of *Acanthochondria cyclopsetta* Pearse in southern California.

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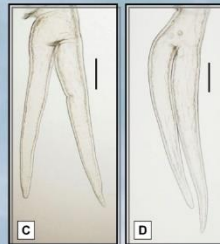
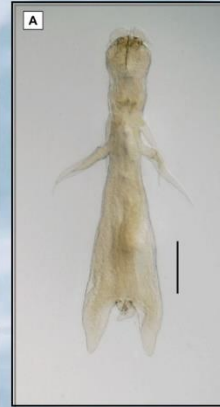


Figure 2. *Acanthochondria cyclopsetta* Pearse, female. A, habitus, dorsal; B, antennule, ventral; C, left leg 1, ventral; D, left leg 2, ventral. Scale-bars: A, 1.00 mm; B, 100 μ m; C & D, 200 μ m.

Results

- Abundance: 51 individuals (32 females, 19 males)
- Prevalence: 57.7% (15 of 26 hosts)
- Mean Intensity: 2.1 (up to 5 parasitic females on a single fish)
- Attachment site: Gill cavity (floor of cavity, under gills)
- Voucher: Natural History Museum of Los Angeles County (LACM CR 2003-022.1)

Acanthochondria cyclopsetta was established by Pearse (1952) based on specimens removed from the Mexican flounder, *Cyclopsetta chittendeni* Bean, captured off Padre Island, Texas, in the Gulf of Mexico. The original description of *A. cyclopsetta* was regrettably incomplete. Ho (1971) was unable to fully redescribe this species, as the only extant material available for study is the holotype female permanently mounted dorsal side up on a slide.

We attribute our specimens from the fantail sole to *A. cyclopsetta* based on the information provided in Ho (1971) and Kalman (2003). Our specimens have long and slender biramous legs (Figs. 2C, D) in common with *A. cyclopsetta*. Admittedly, there are some differences between the eastern Pacific and Gulf of Mexico material. According to Ho's (1971) concise description and illustrations of *A. cyclopsetta*, the body length is 10.58 mm, the trunk is uniformly broad, the pair of posterolateral processes on the trunk are about 1.5 times longer than the genitoabdomen and the antennules appear to be of the Type B-I category. In contrast, the body length ranges from 5.75-7.60 mm ($n = 5$), the trunk is broader at the posterior end, the posterolateral processes are about 3.6 times longer than the genitoabdomen and the antennules are Type B-V in our specimens (Figs. 2A, B). Nevertheless, we believe it is appropriate at this stage to assign our specimens to *A. cyclopsetta* given that the body shape and antennular structure of the type specimen may be distorted artificially by cover slip compression. Examination of new *A. cyclopsetta* material from the type host is certainly warranted.

Discussion

Acanthochondria cyclopsetta, as currently recognized by us, is morphologically most similar to *A. soleae* (Krøyer, 1838). The latter taxon is host-specific to the common sole, *Solea solea* (Linnaeus) (Family Soleidae), and is confined to the northeastern Atlantic (Kabata, 1979). Comparisons with Kabata's (1979) illustrations of *A. soleae* reveal that *A. cyclopsetta* can be distinguished from *A. soleae* by having in the transformed adult female: (1) a flask-shaped trunk lacking lateral indentations, (2) relatively broader posterolateral processes on the trunk, (3) Type B-V antennule, (4) relatively shorter protopod on legs 1 and 2, and (5) relatively longer and thinner rami on legs 1 and 2.

The Mexican flounder occurs only in the western Atlantic, from the northwestern Gulf of Mexico to Brazil. The fantail sole, on the other hand, occurs solely in the eastern Pacific, from California to the Gulf of California, Mexico. The copepod species presented herein from the Southern California Bight is host-specific to the fantail sole as it has not been found on 15 other pleuronectiform species (Kalman, 2006). If our eastern Pacific copepods are later shown unequivocally to be conspecific with *A. cyclopsetta* (after examination of specimens from the Gulf of Mexico), it would, therefore, be interesting that *A. cyclopsetta* has been found only on these two allopatric flatfish species, both belonging to the Family Paralichthyidae. This suggests that these hosts may have shared a common ancestor prior to the amalgamation of North and South America via the formation of the Isthmus of Panama (ca. 3 million years ago).

Acknowledgements

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Too much text!



A new species of *Lepeophtheirus* (Copepoda: Caligidae) infecting three kelpfish species (Clinidae) from southern California

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Julia K. Kruman¹, Peter S. Minard¹, and Danny Tang²
¹Cabrillo Marine Aquarium, San Francisco, CA; ²San Francisco District



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Abstract

A new copepod species, *Lepeophtheirus schaadti* n. sp., is established based on female and male specimens removed from the body surface of the Giant Kelpfish, *Heterostichus rostratus*, and Striped Kelpfish, *Gibbonsia metzi* (Clinidae) captured at Inner Cabrillo Beach in southern California, USA. In addition, examination of 13 specimens previously identified by Wilson (1935) as *L. schaadti* n. sp. The new species differs from its congeners by a combination of characters that include: female with a genital complex more than half the length of the cephalothorax and bears posterolateral lobes; abdomen that is less than one-quarter the length of the genital complex, a maxillary dentiform process bearing a thin ridge on the inner tine and lacking a basal knob, no myxal process on the maxilliped, apically rounded tines on the sternal furca, the spine on the first exopodal segment of leg 3 inserted distally on the basal swelling, a 3-segmented leg 4 exopod, and a broad inner lobe of leg 5 that does not extend beyond the posterior margin of the genital complex; and male with three accessory claws on the antennal endopod and no myxal process on the maxilliped. *Lepeophtheirus schaadti* n. sp. is the fourth ectoparasitic species reported from the Giant Kelpfish and Spotted Kelpfish.

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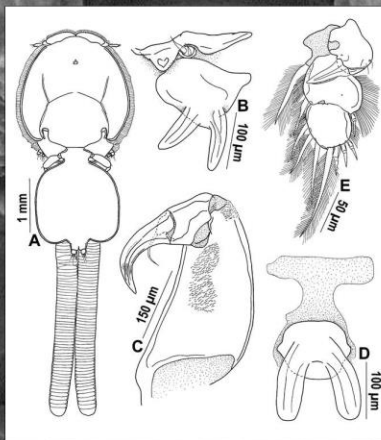


Fig. 1. *Lepeophtheirus schaadti* n. sp., adult female. A) Habitus, dorsal; B) Maxillule, ventral; C) Maxilliped, anterior; D) Sternal furca, ventral; E) Leg 3 exopod, ventral.

Introduction

- Seventeen species of *Lepeophtheirus* were previously reported from 16 fish families along the California coast.
- Giant Kelpfish (*Heterostichus rostratus*) and Striped Kelpfish (*Gibbonsia metzi*) (Clinidae) collected during Cabrillo Marine Aquarium's Inner Cabrillo Beach Survey were infected with an unidentified species of *Lepeophtheirus*.
- The aims of this study were to (1) identify the *Lepeophtheirus* specimens from Inner Cabrillo Beach, and (2) compare them with *Lepeophtheirus parviventris* Wilson, 1905 specimens collected by Wilson (1935) from the Giant Kelpfish in Newport Bay, California.

Materials and Methods

- Copepod specimens were collected from the body surface of 86 Giant Kelpfish and one Striped Kelpfish caught by beach seine at three stations along Inner Cabrillo Beach during the 2011–2014 Inner Cabrillo Beach Survey.
- Wilson's (1935) voucher specimens of *L. parviventris* deposited in the Smithsonian Institution, Washington, D.C., were examined.

Results and Discussion

- The *Lepeophtheirus* specimens from Inner Cabrillo Beach, as well as those of Wilson (1935), are conspecific. They represent a new species, named *Lepeophtheirus schaadti* to honor Mike Schaadt, the Director of the Cabrillo Marine Aquarium.
- Prevalence and mean intensity, respectively:
 - Giant Kelpfish: 13.13% and 2.7.
 - Striped Kelpfish: 0.04% and 2.0.
- The correct host of Wilson's (1935) *Lepeophtheirus* specimens was the Spotted Kelpfish (*Gibbonsia elegans*) as indicated on the vial label.
- Lepeophtheirus schaadti* n. sp. represents the first account of an ectoparasitic species from the Striped Kelpfish and Spotted Kelpfish, as well as the fourth ectoparasitic species reported from the Giant Kelpfish.
- Lepeophtheirus schaadti* n. sp. differs from its congeners by a combination of characters that include:

FEMALE CHARACTERS

- Genital complex is more than half the length of the cephalothorax and bears posterolateral lobes (Fig. 1A).
- Abdomen is composed of one somite and is less than one-quarter the length of the genital complex (Fig. 1A).
- Maxillary dentiform process bears a thin ridge on the inner tine and lacks a basal knob (Fig. 1B).
- Maxilliped lacks a myxal process (Fig. 1C).
- Sternal furca with apically rounded tines (Fig. 1D).
- Spine on the first exopodal segment of leg 3 is inserted distally on the basal swelling (Fig. 1E).
- Leg 4 exopod is 3-segmented (Fig. 2A).
- Leg 5 with a broad inner lobe that does not extend beyond the posterior margin of the genital complex (Fig. 2B).

MALE CHARACTERS

- Abdomen is about half the length of the genital complex (Fig. 2C).
- Antennal endopod bears three accessory claws (Fig. 2D).
- No myxal process on the maxilliped (Fig. 2E).

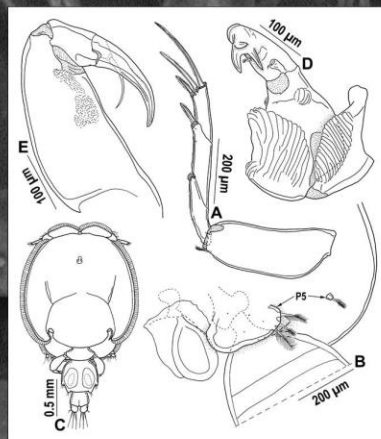


Fig. 2. *Lepeophtheirus schaadti* n. sp., adult female (A-E) and adult male (C-E). A) Leg 4, anterior; B) Leg 5 (P5), ventral; C) Habitus, dorsal; D) Antenna, anterolateral; E) Maxilliped, anterior.

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UCLA

Metazoan parasites of California grunion, *Leuresthes tenuis*, in southern California

Bruno Passarelli



Cabrillo Marine Aquarium

DEPARTMENT OF ECOLOGY AND EVOLUTIONARY BIOLOGY, BUTH LAB, UCLA

INTRODUCTION

The California grunion *Leuresthes tenuis* is a beach-spawning fish endemic to California, U.S.A., and Baja California, Mexico (Martin, 2015). *Leuresthes tenuis* is perhaps the most iconic marine fish of California due to its reproductive habits (Fig. 1a). During spring and summer months, thousands of people go to the beach late at night to watch these fish reproduce. These events are called "grunion runs" (Fig. 1b).



Figure 1 (a) California grunion females (upright) and males (wrapped) during a spawning event and (b) grunion run at Cabrillo Beach, San Pedro, CA. Photo credit: Mark Collin/Alamy

The core of the geographic range of *L. tenuis* is southern California, between Santa Barbara and San Diego. In this highly urbanized area, anthropogenic factors such as coastal construction, beach grooming, and pollution negatively impact the sandy beaches where grunion spawn (Fig. 2).



Figure 2 (a) Coastal development showing coastal "squeeze" and (b) beach grooming in southern California. Photo credit: Monique Myers

While broad patterns of the relationship of *L. tenuis* with their parasites are known, important details still need to be investigated. Parasites have been reported infecting *L. tenuis* (Olson, 1955; Olson, 1979) but these reports are from over forty years ago and need to be reviewed and updated. Previously reported parasites include monogeneans, digeneans, and crustaceans. Six crustaceans have been reported to infect *L. tenuis*: a branchiuran *Argulus melanostictus*, three copepods *Bomolochus cuneatus*, *Caligus olsoni*, and *Clavellopsis* sp., and two isopods *Elthusa (=Lironeca) californica* and *Nerocila acuminata (=californica)*. At least two of the copepods, *C. olsoni* and *B. cuneatus* need to be re-described to meet today's description standards.

This project will identify, review, and determine quantitative descriptors (prevalence, mean intensity, and abundance) of metazoan parasites infecting *L. tenuis* at five localities in southern California.

METHODS

- L. tenuis* were collected by hand during spawning events from 4 localities in southern California (Fig. 3) in March 2016.
- Specimens were placed in individual plastic bags and frozen until inspection.
- Ten specimens from each locality were visually examined for ectoparasites on body surface, fins, oral and gill cavities, and gills using a dissection microscope.
- Specimens were then examined with a dissection microscope for endoparasites in the coelomic cavity, mesenteries, brain, and viscera.
- After visual inspection, dissected parts were further examined for ectoparasites with the double-netting method (Madinabeitia and Nagasawa, 2013).
- Parasite species were tentatively identified and prevalence (number of hosts infected divided by the number of hosts examined) was determined for each taxon (Bush et al., 1997).



Figure 3. Map of *L. tenuis* sampling localities in southern California. Seal Beach data will be incorporated to this study after 2017.

DISCUSSION

- At least seven species of parasites have been found infecting *L. tenuis* in southern California in 2016 (Table 1).
- Species are similar to what have been reported in previous samplings from 1954 (Fig. 4a) and 2015 (Fig. 4b).
- Many more hosts were collected and will be inspected for parasites. Data will be analyzed for spatial and temporal patterns in the distribution of parasites of *L. tenuis*.
- One sampling locality, Seal Beach, was added to the study in 2017 for comparison with parasites found in Cabrillo Beach.

FUTURE STUDIES

- Data from samplings performed between April 2016 and June 2017 and future samplings in 2018 and 2019 will be incorporated to this study.
- Quantitative predictors of parasite populations (prevalence, mean intensity, and mean abundance) will be determined for all parasites according to Bush et al. 1997.

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RESULTS

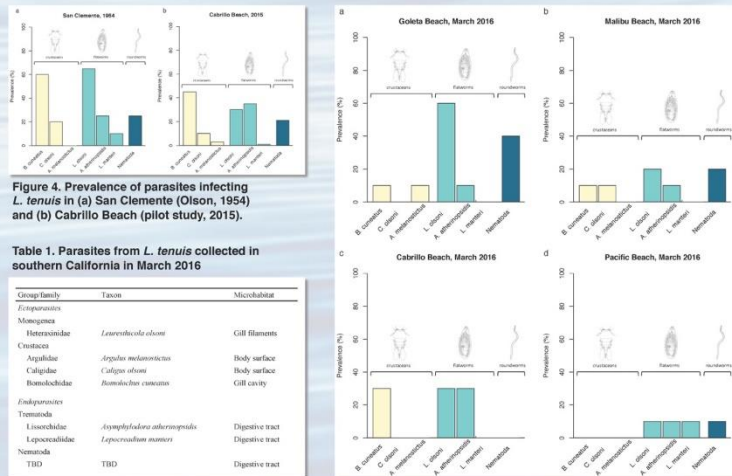


Figure 5. Prevalence of parasites infecting *L. tenuis* in (a) Goleta Beach, (b) Malibu Beach, (c) Cabrillo Beach and (d) Pacific Beach in March 2016.

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Any questions?

julianne.passarelli@lacity.org

