

Guide to Writing a Scientific Paper

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Southern California Academy of Sciences Research Training Program

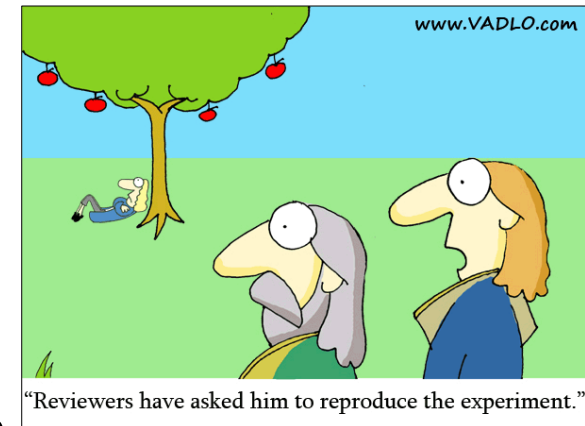
OC SAN
ORANGE COUNTY SANITATION DISTRICT

Purpose and Benefits of Publishing

My manuscript is written in



- Disseminate results = advance science
- Contains info that others can use to ***replicate/verify*** the study
- Career advancement
- Professional recognition
- Opportunities for collaboration
- Inspiration for future research

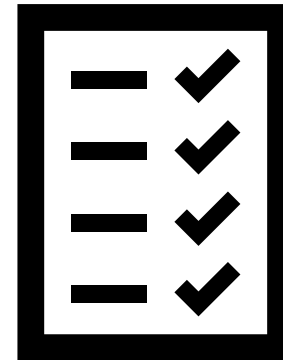


Follow *Bulletin of the SCAS* guidelines

<https://meridian.allenpress.com/scasbulletin/pages/Manuscript-Preparation-Guidelines>

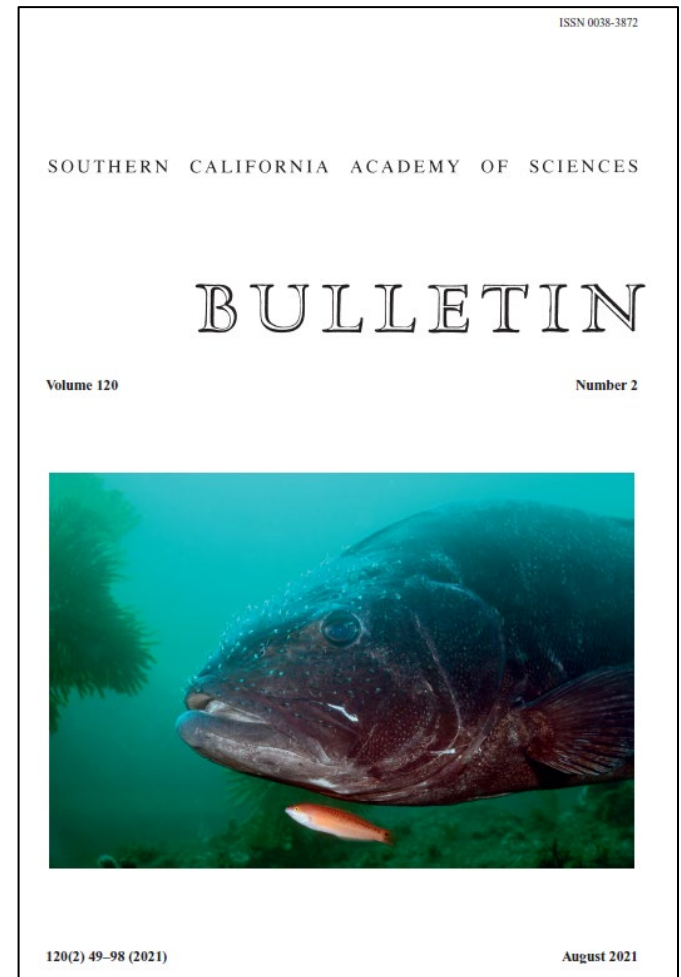
Information includes:

- Language (English)
- File type (MS Word)
- Page size (Letter)
- Margin size
- Font style/size
- Spacing and text alignment
- Sections (Introduction, Methods, etc.)
- Literature cited requirements
- Table format
- Figure requirements



General structure of a scientific paper

- Title
- Author(s) & Address(es)
- Abstract
- Introduction
- Materials and Methods
- Results
- Discussion
- Acknowledgements
- Literature Cited



Gives ***logical flow*** to content and facilitates info ***retrieval***

Introduction (Why did you do it?)

- First provide the ***context*** of the study

Fandel et al. 2015. **Effects of ocean recreational users on coastal bottlenose dolphins (*Tursiops truncatus*) in the Santa Monica Bay, California.** Bull. Southern California Acad. Sci., 114:63-75.

Bottlenose dolphins (*Tursiops truncatus*, hereafter bottlenose dolphins) are known to inhabit both pelagic waters and coastal regions, including bays and tidal creeks (Leatherwood et al. 1983). In the Pacific Ocean, a coastal and an offshore population of this species are currently recognized, showing morphological, osteological, and molecular differentiations (LeDuc and Curry 1998; Rossbach and Herzing 1999). **Studies have suggested that coastal bottlenose dolphins are highly mobile within the inshore waters of the Santa Monica Bay, but also spend a large amount of time foraging and feeding in the bay** (Bearzi 2005). Further, this species utilizes the region as a regular transit corridor between foraging hotspots along the California coast (Defran and Weller 1999; Bearzi 2005). **An estimated 50 million tourists visit the Santa Monica Bay beaches each year¹, many to partake in recreational activities including swimming, surfing, kayaking, and stand up paddle boarding. Swimmers, surfers, kayakers, and stand up paddle boarders are collectively defined as Ocean Recreational Users; hereafter ORUs. The year-round presence of both ORUs and bottlenose dolphins in the coastal waters of this region increases the likelihood of encounters between them.**

Introduction (cont.)

- First provide the ***context*** of the study

ORU presence has been proven to have adverse effects on dolphins in other areas worldwide. The occurrence of any vessel type, motorized or non-motorized, caused disturbances to dolphin behavior in Scotland (Pirotta et al. 2015). In New Zealand, Constantine (2001) observed sensitization and increased levels of avoidance with prolonged exposure to swimmers. Constantine (2002) also observed a decrease in bottlenose dolphin resting behavior when swimmers approached them in the wild. In Hawai'i, increased swimmer and kayak traffic led to decreased resting behaviors in spinner dolphins (*Stenella longirostris*; Samuels et al. 2000; Danil et al. 2005; Timmel et al. 2008; Ostman-Lind 2009). Spinner dolphins in Hawai'i also exhibited increased aerial behavior within their resting areas in correlation with the high number of swimmers in the area (Courbis and Timmel 2009). Indo-pacific dolphins (*Tursiops aduncus*) in Zanzibar displayed more frequent erratic (non-directional) behaviors in response to the increased presence of swimmers and boats (Stensland and Berggren 2007). Similarly, a study in West Cracoft Island, British Columbia found that when kayakers were present, killer whales (*Orcinus orca*) displayed avoidance behaviors, potentially resulting in changes to time spent feeding (Williams et al. 2011). Variations in behavioral states and decreased resting and feeding behaviors may cause a change in energetic demand, leading to changes in the lifetime fitness of the animal (Pirotta et al 2015; Williams 2011).

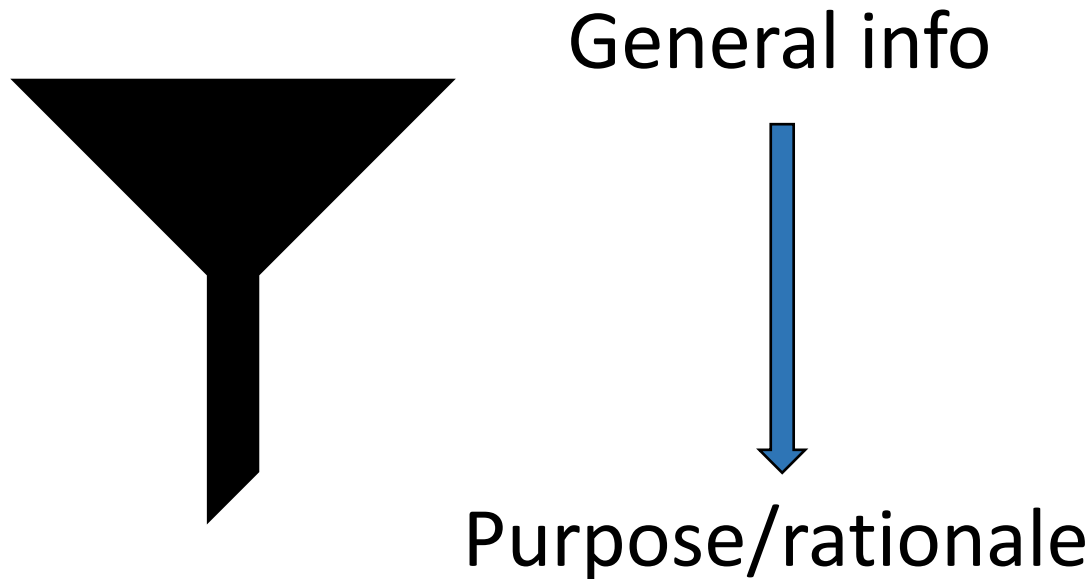
Introduction (cont.)

- End with ***purpose*** of the study
 - May include hypothesis (hypotheses) or question(s)

Based on the negative effects of these encounters between ORUs and cetaceans documented in other areas worldwide, the National Marine Fisheries Service (NMFS) has expressed concern that humans swimming with wild dolphins in the U.S. may qualify as harassment, leading to the disruption to their natural behavior (Spradlin et al. 1999). In an attempt to curb this disruption, the NMFS has advised vessels and swimmers to avoid approaching the animals at distance of less than 50 meters. Both ORUs and bottlenose dolphins have been frequenting the Santa Monica Bay since the 1930s and the tourism presence along this shoreline has increased, especially in recent times. The impact of ORU activities on bottlenose dolphins, however, has not yet been investigated in this area. This preliminary study describes the potential behavioral effects on coastal bottlenose dolphins of encounters with ORUs in this region, and provides suggestions for management and conservation measures aimed to mitigate the impacts on these animals.

Introduction (cont.)

- First provide the ***context*** of the study
- End with ***purpose*** of the study



Introduction (cont.)

- ***Paraphrase*** the info in ***your own words*** **AND** ***cite*** those sources using ***author-date method***

1 source, 1 author

From Fandel et al. (2015)

prolonged exposure to swimmers. Constantine (2002) also observed a decrease in bottlenose dolphin resting behavior when swimmers approached them in the wild. In Hawai'i, increased swimmer and kayak traffic led to decreased resting behaviors in spinner dolphins (*Stenella longirostris*; Samuels et al. 2000; Danil et al. 2005; Timmel et al. 2008; Ostman-Lind 2009). Spinner dolphins in Hawai'i also exhibited increased aerial behavior within their resting areas in correlation with the high number of swimmers in the area (Courbis and Timmel 2009). Indo-pacific dolphins (*Tursiops aduncus*) in

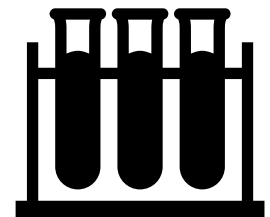
1 source, 2 authors

>1 source, mostly >2 authors

See Slides 47-53 for citation rules!

Methods (How did you do it?)

- Provide ***chronological*** description of ***how the study was carried out***
- Include relevant info such as:
 - i. organism(s) studied
 - ii. description of study site
 - iii. description of experimental design (e.g., control/treatments)
 - iv. special equipment used (e.g., scanning electron microscope)
 - v. statistical methods used (e.g., ANOVA)



Methods (cont.)

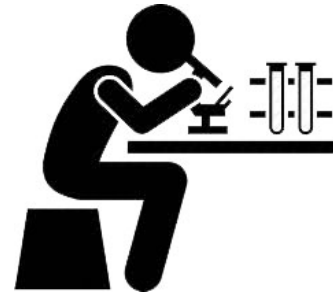
- You may want to organize this section into subsections

Example:

➤ *Field sampling*



➤ *Laboratory methods*



➤ *Data analyses*



Methods (cont.)

- Should be written in ***passive voice*** and in the ***past tense***

Coastal surveys (distance <1 km from shore) were conducted from February 1997 to September 2012 (excluding July 2002–August 2005, 2008 and 2010; Table 1), generally in the morning and early afternoon and in good weather conditions (Beaufort scale 2 or less, sea state 0 and visibility >300 m). Coastal surveys were conducted from 7m (1997–2000) and 10m powerboats (2001–2002, 2006–2007), and two 17m sailboats (2005–2006, 2009–2012), at an average speed of 18km h^{-1} . Boat speed was reduced in the presence of dolphins, and sudden speed or directional changes were avoided. Trained research

From Fandel et al. (2015)

Methods (cont.)



- Include ***Figures*** (e.g., picture, map, diagram) if necessary
 - i. Are ***numbered sequentially*** (ex. **Fig. 1**, **Fig. 2**)
 - ii. Typically ***cited within parentheses*** in the text

upwelling off southern California and northern Baja California (Leising et al. 2014). Despite the lack of even a moderate El Niño, the remainder of 2014 and early 2015 was marked by warmer than normal SSTs along the entire west coast of North America (**Fig. 1**) (Leising et al.

From Goddard et al. (2016)

Another way of citing a figure...

Molecular results are presented first, followed by species accounts containing information on comparative morphology, distribution and habitat to provide a baseline characterization of each taxon within the context of the groupings **shown in Fig. 3**.

From Woodward et al. (2017)

Methods (cont.)

Include a
figure caption
(place at the
bottom of
the figure)

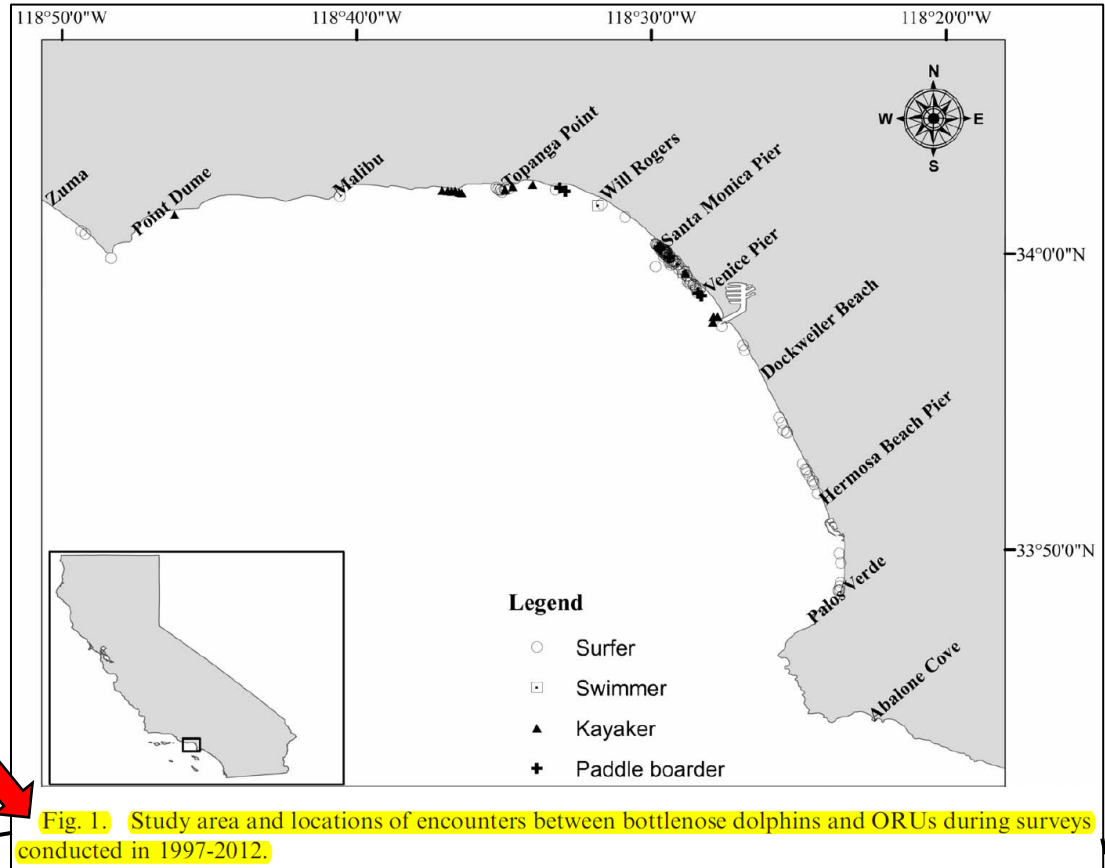


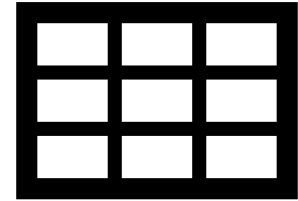
Fig. 1. Study area and locations of encounters between bottlenose dolphins and ORUs during surveys conducted in 1997-2012.

From Fandel et al. (2015)

***Use “Fig.”, NOT “Figure” in the caption!**

Methods (cont.)

- Include ***Tables*** if necessary
 - i. Also ***numbered sequentially*** (ex. **Table 1**, **Table 2...**)
 - ii. Also cited ***within parentheses*** in the text



From 1 February 2012 to 26 February 2014, fishes and macrophyte surveys were conducted from the beginning to end of the study. Invertebrate surveys were conducted beginning on 22 June 2012 and continued until the end of the study. Surveys were conducted on a total of 38 days (Table 1). We note that the natural habitat was sand and eelgrass. Over the course of the study,

From Love et al. (2017)

Methods (cont.)

iii. Include a **caption** (place at **top** of Table)

Table 1. Summary of research effort for coastal surveys in Santa Monica Bay conducted from 1997 to 2012. No data were collected: July 2002–August 2005, 2008, and 2010. BD=bottlenose dolphins.

	1997	1998	1999	2000	2001	2002	2005	2006	2007	2009	2011	2012	Totals
N of surveys	16	55	39	33	27	9	3	14	8	3	6	7	220
N of sightings	7	58	32	16	18	6	6	21	16	5	13	11	209
Survey hours	123	214	155	119	121	60	16	23	41	11	29	25	937
Number of 5 min samples	68	722	345	212	273	38	68	147	135	19	182	72	2,281
Hours of BD observation	6	60	29	18	23	3	6	12	11	2	15	6	190

From Fandel et al. (2015)

iv. “Table” is **NOT abbreviated** in the caption

v. Use only ***horizontal lines*** to separate sections of Table

Results (What did you find?)

- Present **key** results in a logical sequence
 - i. Report only ***facts/trends*** (no data interpretation)
 - ii. Highlight results that answer the question under investigation

During the study period, 145 encounters were recorded between 72 bottlenose dolphin schools and ORUs throughout the survey area (34.45%, $n=209$ sightings; Fig. 1, Table 2). An average of nine dolphins were involved in each encounter (SD=4.66, SE=0.03, range 2-19 individuals, $n=145$ encounters). Few encounters lasted more than five minutes (4.55%, $n=176$ encounters). It was common for a single bottlenose dolphin focal group to experience two or more encounters with an ORU during observation (40.28%, $n=72$ schools; Table 2). Multiple ORUs were encountered by 16.67% of focal

From Fandel et al. (2015)

- Usually contains no citations
- Present key results in ***Tables*** and/or ***Figures***

Results (cont.)

- Do **NOT** report raw data values
(summarize as means, %, etc.)

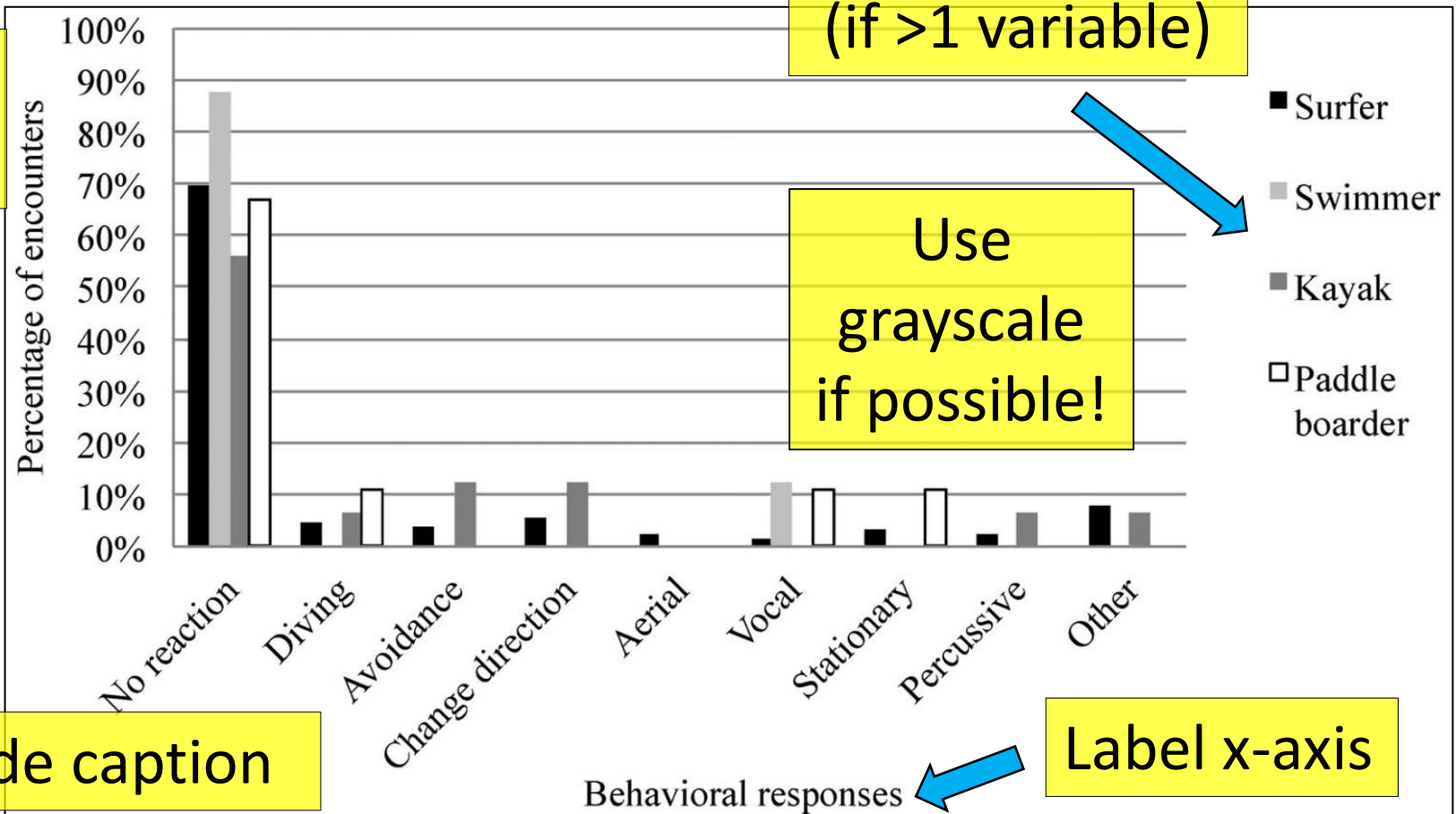
Table 1. Estimated larval durations, settlement sizes (standard length), and growth rates of the Arrow Goby (*Clevelandia ios*) and Tidewater Goby (*Eucyclogobius newberryi*) pooled over all study sites ($n = 8$ and 10 study sites for the two species, respectively).

Species	Larval duration		Settlement		Growth rate	<i>N</i>
	Range (days)	Mean \pm SD (days)	Otolith radius (μm)	Length (mm)	Mean \pm SD ($\mu\text{m}/\text{day}^{-1}$)	
<i>E. newberryi</i>	18 - 31	23.95 \pm 2.71	75.62 \pm 6.40	12.38 \pm 0.36	2.86 \pm 0.23	406
<i>C. ios</i>	20 - 33	26.11 \pm 2.40	77.61 \pm 6.37	10.00 \pm 0.71	2.60 \pm 0.22	317

From Spies et al. (2014)

Results (cont.)

- For **graphs** (= Figures):



Include caption

Fig. 4. Reactions (or lack of) to an encounter with one or more surfer, kayaker, stand-up paddle boarder, and/or swimmer during a 5-minute behavioral interval.

Discussion (What do your results mean?)

- Present your *interpretation* of results, significance of the study, and any limitations

Surfers were the most common ORU encountered by dolphins in the study area. This result is likely due to the fact that Southern California has been a top US surf destination since the 1930's (Irwin 1973) and the sport continues to grow in popularity. On the contrary, swimmers were only occasionally involved in encounters with dolphins along this coastline. This may be explained by the presence of these ORUs close to the beach while coastal bottlenose dolphins tend to move slightly more offshore. In other areas

From Fandel et al. (2015)

Discussion (cont.)

- ***Compare*** results with findings from previous studies

As expected, our preliminary results indicated that the proximity of ORUs to dolphins during encounters was the best predictor of whether a behavioral reaction would be elicited from the dolphin. If one or more dolphin and an ORU came within three meters of one another during an encounter, a behavioral change was likely to occur. Increased dolphin behavioral changes as a result of close encounters with ORUs are consistent with Bedjer et al. (1999) findings, which determined that the distance between an ORU and dolphins during an encounter was the most reliable predictor of a change in dolphin behavior. Williams (2011) also found that orcas (*Orcinus orca*) were more likely to exhibit

From Fandel et al. (2015)

Discussion (cont.)

- State your ***conclusion(s)*** and propose ***future*** investigations if warranted

In conclusion, this preliminary investigation suggests the need of regular monitoring of coastal bottlenose dolphins and encounters with ORUs to determine potential changes in these animals' behavior. Also, it suggests the necessity of implementing public education program and management measures to ensure that dolphins remain undisturbed by the growing number and diversity of anthropogenic presence in the bay.

From Fandel et al. (2015)

Conclusions

From Brattstrom (2013)

1. The original range of the horned lizard was throughout Southern California but with no historical or recent records from the Los Angeles-Orange county basin and the Pomona, Ontario, San Bernardino area except along river flood plains and isolated hills. There are no historical or recent records or the area about Temecula.
2. The horned lizard occurs in the coastal and inland physiographic provinces and in the extension of the latter into the Little San Bernardino Mountains to Joshua Tree National Park.
3. The horned lizard localities occur in habitats including some urban habitats.

Acknowledgements (Who helped you out?)

- ***Thank*** people who assisted with the study (e.g., those who helped in the lab or reviewed the paper), as well as the funding agency

Acknowledgements

We thank Brian Colgate and Jeff Cecilia of the Santa Barbara Fish Market, Santa Barbara, CA for bringing this rare specimen to our attention and making it available for study. Thanks also go out to Holly Hawk from California State University Northridge (CSUN) and Gary Burke of the California Gill Netters Association for their collective efforts in obtaining and transporting the head of the specimen. Bart Bagdasaryan helped prepare and photograph the otolith sections. Mark Steele (CSUN) provided the microscope, video camera, and imaging software necessary for the ageing work. Radiocarbon measurements were performed by National Ocean Sciences Accelerator Mass Spectrometry Facility at the Woods Hole Oceanographic Institution. Ed DeMartini and two anonymous reviewers provided very insightful comments on the manuscript. Funds for this work were provided by the Nearshore Marine Fish Research Program, Department of Biology, California State University Northridge.

Literature Cited (Whose work did you refer to?)

- Include ***alphabetical list***, by first author's last name, of ***all references cited*** in body of paper

Literature cited

- Allredge, A.L. 1972. Abandoned larvacean houses: a unique food source in the pelagic environment. *Science*, 177:885–887.
- Alston, S., G.A. Boxshall, and J.W. Lewis. 1996. The life-cycle of *Ergasilus briani* Markewitsch, 1993 (Copepoda: Poecilostomatoida). *Syst. Parasitol.*, 35:79–110.
- Bowman, T.E., and L.S. Kornicker. 1967. Two new crustaceans: the parasitic copepod *Sphaeronelopsis monothrix* (Choniostomatidae) and its myodocopid ostracod host *Parasterosope pollex* (Cylindroleberidae) from the southern New England coast. *Proc. U. S. Nat. Mus.*, 123:1–28.
- Boxshall, G.A. 2005. Crustacean parasites (Copepoda). Pp. 123–138 in *Marine Parasitology* (K. Rohde, ed.). CABI Publishing, Wallingford and CSIRO Publishing, Collingwood, 592 pp.
- , and S.H. Halsey. 2004. *An introduction to copepod diversity*. The Ray Society, London, 966 pp.

From Ohtsuka et al. (2018)

Literature Cited (cont.)

- Include ***alphabetical list***, by first author's last name, of ***all references cited*** in body of paper

Journal article

Literature cited

Allredge, A.L. 1972. Abandoned larvacean houses: a unique food source in the pelagic environment. *Science*, 177:885–887.

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From Ohtsuka et al. (2018)

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From Ohtsuka et al. (2018)

Book Chapter

Literature Cited (cont.)

- Include ***alphabetical list***, by first author's last name, of ***all references cited*** in body of paper

Literature cited

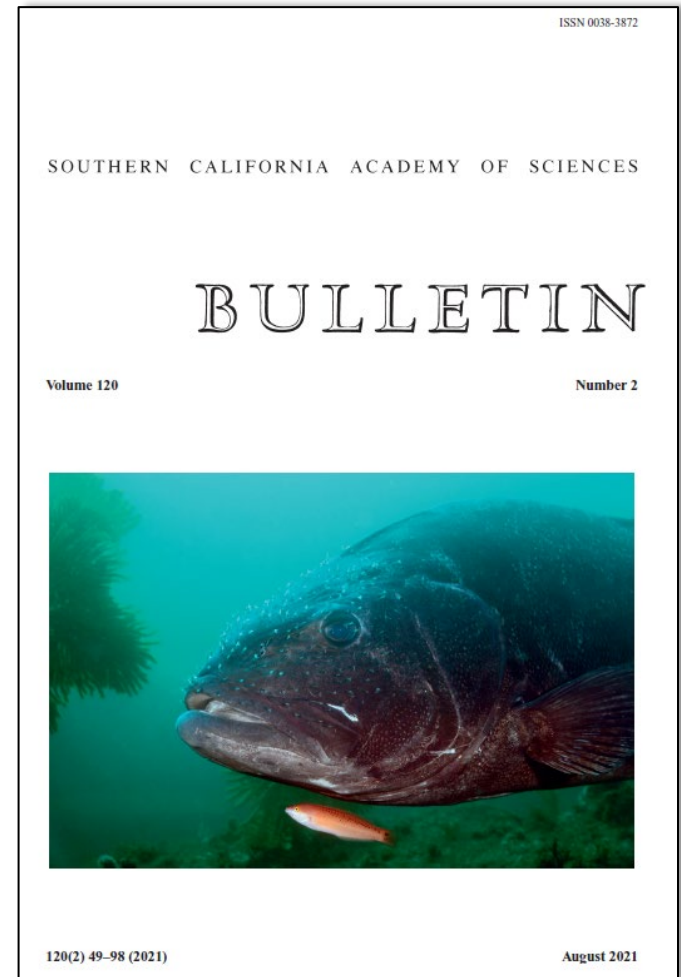
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- , and S.H. Halsey. 2004. *An introduction to copepod diversity*. The Ray Society, London, 966 pp.

From Ohtsuka et al. (2018)

See Slides 54-60 for literature cited rules!

General structure of a scientific paper

- Title
- Author(s) & Address(es)
- Abstract
- Introduction
- Materials and Methods
- Results
- Discussion
- Acknowledgements
- Literature Cited



Title (What is the paper about?)

- Devise a succinct title (≤ 20 words) that describes the **content** of the paper

The Return of the King of the Kelp Forest: Distribution, Abundance, and Biomass of Giant Sea Bass (*Stereolepis gigas*) off Santa Catalina Island, California, 2014-2015

From House et al. (2016)

- A good title grabs the reader's **attention**
- Using **key words** in your title will help readers find your paper via online database searches (e.g., Web of Science, Science Direct, PubMed, Google Scholar)

Author(s) and address(es) (Who did the work?)

Typically the person who contributed the most to the study is listed first and the person who did the least is listed last



Parker H. House*, Brian L.F. Clark, and Larry G. Allen

*California State University, Northridge, Department of Biology, 18111 Nordhoff St.,
Northridge, CA, 91330*

From House et al. (2016)



All three authors are affiliated with this institution

* = ***corresponding author***

Author(s) and address(es) (cont.)

If the authors are affiliated with different institutions, then use ***superscript numbers*** to designate authors' institutional address

For example...

Michelle L. Barton¹*, Ivan D. Medel², Karina K. Johnston², and Christine R. Whitcraft¹
¹*California State University Long Beach*
²*Santa Monica Bay Restoration Commission*

From Barton et al. (2016)

Abstract (What did you do in a nutshell?)

- Provide a ***succinct summary*** of the paper (**≤250 words** & written in ***past tense***) that includes:
 - i. a brief introduction
 - ii. question(s) investigated/purpose of study
 - iii. methods used
 - iv. main findings
 - v. conclusions

Abstract (cont.)

- A breakdown of the Abstract...

Abstract.—It is rare to find evidence of top predators recovering after being negatively affected by overfishing. However, recent findings suggest a nascent return of the critically endangered giant sea bass (*Stereolepis gigas*) to southern California. To provide the first population assessment of giant sea bass, surveys were conducted during the 2014/2015 summers off Santa Catalina Island, CA. Eight sites were surveyed on both the windward and leeward side of Santa Catalina Island every two weeks from June through August. Of the eight sites, three aggregations were identified at Goat Harbor, The V's, and Little Harbor, CA. These three aggregation sites, the largest containing 24 individuals, contained a mean stock biomass of 19.6 kg/1000 m² over both summers. Over the course of both summers the giant sea bass population was primarily made up of 1.2 - 1.3 m TL individuals with several small and newly mature fish observed in aggregations. Comparison to historical data for the island suggests giant sea bass are recovering, but have not reached pre-exploitation levels.

From House et al. (2016)

Introduction

Abstract (cont.)

- A breakdown of the Abstract...

Abstract.—It is rare to find evidence of top predators recovering after being negatively affected by overfishing. However, recent findings suggest a nascent return of the critically endangered giant sea bass (*Stereolepis gigas*) to southern California. To provide the first population assessment of giant sea bass, surveys were conducted during the 2014/2015 summers off Santa Catalina Island, CA. Eight sites were surveyed on both the windward and leeward side of Santa Catalina Island every two weeks from June through August. Of the eight sites, three aggregations were identified at Goat Harbor, The V's, and Little Harbor, CA. These three aggregation sites, the largest containing 24 individuals, contained a mean stock biomass of 19.6 kg/1000 m² over both summers. Over the course of both summers the giant sea bass population was primarily made up of 1.2 - 1.3 m TL individuals with several small and newly mature fish observed in aggregations. Comparison to historical data for the island suggests giant sea bass are recovering, but have not reached pre-exploitation levels.

From House et al. (2016)

Purpose of study

Abstract (cont.)

- A breakdown of the Abstract...

Abstract.—It is rare to find evidence of top predators recovering after being negatively affected by overfishing. However, recent findings suggest a nascent return of the critically endangered giant sea bass (*Stereolepis gigas*) to southern California. To provide the first population assessment of giant sea bass, surveys were conducted during the 2014/2015 summers off Santa Catalina Island, CA. Eight sites were surveyed on both the windward and leeward side of Santa Catalina Island every two weeks from June through August. Of the eight sites, three aggregations were identified at Goat Harbor, The V's, and Little Harbor, CA. These three aggregation sites, the largest containing 24 individuals, contained a mean stock biomass of 19.6 kg/1000 m² over both summers. Over the course of both summers the giant sea bass population was primarily made up of 1.2 - 1.3 m TL individuals with several small and newly mature fish observed in aggregations. Comparison to historical data for the island suggests giant sea bass are recovering, but have not reached pre-exploitation levels.

From House et al. (2016)

Methods

Abstract (cont.)

- A breakdown of the Abstract...

Abstract.—It is rare to find evidence of top predators recovering after being negatively affected by overfishing. However, recent findings suggest a nascent return of the critically endangered giant sea bass (*Stereolepis gigas*) to southern California. To provide the first population assessment of giant sea bass, surveys were conducted during the 2014/2015 summers off Santa Catalina Island, CA. Eight sites were surveyed on both the windward and leeward side of Santa Catalina Island every two weeks from June through August. Of the eight sites, three aggregations were identified at Goat Harbor, The V's, and Little Harbor, CA. These three aggregation sites, the largest containing 24 individuals, contained a mean stock biomass of 19.6 kg/1000 m² over both summers. Over the course of both summers the giant sea bass population was primarily made up of 1.2 - 1.3 m TL individuals with several small and newly mature fish observed in aggregations. Comparison to historical data for the island suggests giant sea bass are recovering, but have not reached pre-exploitation levels.

From House et al. (2016)

Main results

Abstract (cont.)

- A breakdown of the Abstract...

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From House et al. (2016)

Conclusion

Abstract (cont.)

- One of the ***most important sections*** of a paper because:
 - it may be the only section that is freely available online (journal website, Web of Science, etc.)
 - it helps readers decide whether to continue reading the paper or not

***Abstract submission deadline
for the 2026 SCAS Annual Meeting:
TBD in March 2026**

Dos and Don'ts

- Suggest writing your paper ***in this order***:
 - i. Materials and Methods
 - ii. Results
 - iii. Discussion
 - iv. Introduction
 - v. Abstract
 - vi. Literature Cited
 - vii. Title & Authors + Affiliations
 - viii. Acknowledgements

Dos and Don'ts (cont.)

- Use the ***metric system*** (e.g., cm, kg, °C)
- A paper needs to ***flow***
- Prepare 1st draft ***sooner*** rather than later
- Ask your co-author(s), mentors, teachers, and peers to ***review*** your paper
- ***Proofread*** your paper before submission
- **Deadline for paper submission to Kimo:
April 30, 2026!**

Dos and Don'ts (cont.)

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The screenshot shows the website for the Southern California Academy of Sciences Bulletin. The header includes a search bar, navigation links (HOME, ISSUES, FOR AUTHORS, SMILODON NEWSLETTER, HELP), and a logo. The main content area is titled 'Issues' and displays 'Volume 124, Issue 2' for August 2025. Three articles are listed with their titles, authors, and options to view the abstract, full article, or PDF.

Issues

Select Decade: 2020 Select Year: 2025 Select Issue: August - Volume 124, Issue 2

Volume 124, Issue 2
August 2025

Do Bighorn Sheep Use Desert Tortoise Burrow Spoil Piles as Mineral Licks in Southern California?
Jeffrey E. Lovich,^{1,*} Danielle Cleveland,² Charles B. Yackulic,¹ Kristy L. Cummings,¹ Shellie R. Puffer,¹ Molly J. Bechtel,³ Christopher R. Tracy,⁴ William J. Hoese,⁵ Gerardo Avila,⁵ Megan Peukert,⁵ and Samantha Hubbard⁵

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The Southwestern Pond Turtle (*Actinemys pallida*) in Baja California, Mexico: New Localities and Persistent Threats
Jorge H. Valdez-Villavicencio, Anny Peralta-García, Bradford D. Hollingsworth, Patricia Galina-Tessaro, Robert N. Fisher, Jeff A. Alvarez, Rafael A. Lara-Resendiz

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Quantifying Mulch Decomposition Rates in Southern California: Carbon Perspectives for a Perceived Sustainable Landscaping Practice
Molly Landon, Anisa Lopez-Ruiz, Anthony Rondón, Elana Denver, Alyssa Lesso, Hannah Collom, Sam Reichard, Anna K. M. Bowen, Cinzia Fissore, George L. Vourlitis, Mia Maltz, Erin J. Questad, James Blauth, Dustin VanOverbeke, Wallace M. Meyer, III

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Do Bighorn Sheep Use Desert Tortoise Burrow Spoil Piles as Mineral Licks in Southern California?

Jeffrey E. Lovich,^{1,*} Danielle Cleveland,² Charles B. Yackulic,¹ Kristy L. Cummings,¹ Shellie R. Puffer,¹ Molly J. Bechtel,³ Christopher R. Tracy,⁴ William J. Hoese,⁵ Gerardo Avila,⁵ Megan Peukert,⁵ and Samantha Hubbard⁵

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Abstract.—In a previous study, bighorn sheep (*Ovis canadensis*) were periodically photographed by trail cameras when they visited desert tortoise (*Gopherus agassizii*) burrows in the San Bernardino Mountains near Palm Springs, California, USA. The authors suggested that bighorn sheep may utilize the excavated spoil material from burrows as a mineral lick. To test that supposition, we collected soil samples from the spoil piles and undisturbed surface soil up to 1 m away at two desert tortoise study sites with bighorn sheep at the aforementioned site and another nearby site. We hypothesized that sodium concentrations would be greater in spoil than in nearby surface soil samples. Common major cations were quantified in soil samples using inductively coupled plasma-mass spectrometry following microwave-assisted digestion to solubilize the fraction of elements that could become biologically or environmentally available. Mean sodium concentrations were greater in burrow spoil samples than in undisturbed soil samples at both sites, likely due to aqueous leaching of sodium from surface to subsurface soil horizons. Although we did not collect evidence of geophagy by bighorn sheep, the behavior is well known. However, trail camera photographs of bighorn sheep with their head next to the entrance of tortoise burrows suggests that they may periodically utilize sodium and other elements brought to the surface by desert tortoises that are otherwise unavailable to bighorn sheep on the surface.

All animals need access to various elements, minerals, and other nutrients in their diets to support life functions such as growth and neuro-muscular function. The use of so-called mineral licks (also called salt licks) by ruminants and other ungulates to obtain essential elements including sodium and other minerals that are not readily available in their herbivorous diet is well known. Food plants for ungulates can be low in sodium and other cations and those and other important elements also vary seasonally in vegetation (Ayotte et al. 2006; Weeks and

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Additional Resources



SCAS's **Research Training Program** webpage
([Research Training Program Paper and Poster Materials \(nhm.org\)](https://www.nhm.org/research-training-program))

<https://www.springer.com/us/authors-editors/authorandreviewertutorials/writing-a-journal-manuscript>

<https://www.elsevier.com/connect/11-steps-to-structuring-a-science-paper-editors-will-take-seriously>

<http://writing.colostate.edu/guides/guide.cfm?guideid=83>

Turbek et al. (2016) Scientific writing made easy: a step-by-step guide to undergraduate writing in the biological sciences. *Bulletin of the Ecological Society of America* 97:417-426.

<https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/bes2.1258>

Email: dtang@ocsan.gov

Questions?

Rules for citing sources

- When you use information from primary literature (and other sources), you must paraphrase the info in ***your own words***, as well as ***cite*** those sources
 - i. Use author-date method of citation:
 - If the ***author is the subject*** of the sentence, include author's last name and enclose the year in parentheses

Example 1 (*single author*):

Ortiz (2014) also observed very few aggressive interactions between *S. niger* and *S. griseus* in her local study areas. Regardless of the mechanism, the loss of *S. griseus* in these areas –

Rules for citing sources (cont.)

- i. Use author-date method of citation:
 - If the ***author is the subject*** of the sentence, include author's last name and enclose the year in parentheses

Example 2 (*two authors*):

Yamasaki and Maeda (2007) documented a 78-146 day larval duration in *Stiphodon percnopterygionus*, a stream-associated goby found in Okinawa Island, southern Japan.

From Spies et al. (2014)

***Use “and”, NOT “&” between last names**

Rules for citing sources (cont.)

- i. Use author-date method of citation:
 - If the ***author is the subject*** of the sentence, include author's last name and enclose the year in parentheses

Example 3 (*more than two authors*):

Jeong et al. (2008) found that as the volume of runoff entering Talbert Salt Marsh declined, the wetland was better able to attenuate FIB loads and coastal water quality improved.

From Myers and Ambrose (2015)

*Use “**et al.**” (abbreviation of Latin phrase *et alia* = “and others”) after last name of first author

Rules for citing sources (cont.)

- i. Use author-date method of citation:
 - If the ***author is NOT the subject*** of the sentence, enclose author's last name & year in parentheses (*usually* at end of sentence)

Example 1 (*one source*):

when salinity was raised from 6‰ to 26‰. Presumably this intolerance to seawater in young tidewater gobies is related to the isolated nature of their lagoonal habitats during the summer peak reproductive months (Swenson 1999). Thus, dispersal appears limited

From Spies et al. (2014)

***Do NOT include a comma after author's last name**

Rules for citing sources (cont.)

- i. Use author-date method of citation:
 - If the ***author is NOT the subject*** of the sentence, enclose author's last name & year in parentheses (*usually* at end of sentence)

Example 2 (*more than one source*):

As a comparison, in areas where swim-with-the-dolphin programs are allowed, this type of encounter typically was 35-60 minutes in duration (Constantine and Baker 1996; Samuels et al. 2003).

From Fandel et al. (2015)

- *List sources in ***chronological*** order and use ***semi-colon*** to separate sources

Rules for citing sources (cont.)

- i. Use author-date method of citation:
 - If the ***author is NOT the subject*** of the sentence, enclose author's last name & year in parentheses (*usually* at end of sentence)

Example 3 (≥ 2 sources with ***same publication year***):

radiocarbon dating has since been applied successfully to the otoliths of many species of teleost fishes, some of which are deep-water species with larval or juvenile phases in the mixed-layer, to validate estimated age (e.g. Andrews et al. 2007; Ewing et al. 2007; Neilson and Campana 2008). Of paramount importance for a successful application of

From Allen and Andrews (2012)

*List sources with same year in ***alphabetical*** order

Rules for citing sources (cont.)

i. Use author-date method of citation:

- If the ***author is NOT the subject*** of the sentence, enclose author's last name & year in parentheses (*usually* at end of sentence)

Example 4

(≥2 more sources *with same author(s) AND year*):

Dispersal of the Tidewater Goby is associated with high streamflow events (Lafferty et al. 1999^{a,b}), which cause breaching of the estuary mouth, permitting dispersal (Earl et al. 2010). Breaching events occur most frequently during winter months when

From Spies et al. (2014)

*Use “a,b,c...” designations after year. Do **NOT** add a **space** between year and “a,b,c...” designations

Rules for Literature Cited

- Include ***alphabetical list*** (by first author's last name) of ***all references cited*** in the body of the paper
 - i. Use ***correct citation style*** for the type of source

Example: Journal article

From Bonham and Silbiger (2024)

Author(s)



Title of article



Name of
journal



Page
numbers*



Caves, E.M. 2021. The behavioral ecology of marine cleaning mutualisms. Biol Rev, 96:2584–2601.

Year of Publication



Volume number



*Use an en dash "–" to connect page ranges!

Rules for Literature Cited (cont.)

- Include ***alphabetical list*** (by first author's last name) of ***all references cited*** in the body of the paper
 - i. Use ***correct citation style*** for the type of source

Example: Book

Author(s)



Title of book



Publisher



Bentley, P.J. 1971. Endocrines and Osmoregulation. Springer Verlag.



Year of Publication

From Weick and Brattstrom (2020)

Rules for Literature Cited (cont.)

- ii. For ***two or more cited works with the same author(s)***, use 2 consecutive em dashes instead of repeating author name(s)

Stevens, M. n.d. Plant guide: Pacific silverweed. Baton Rouge, Louisiana: USDA NRCS National Plant Data Center.

———. 1994. Plant guide: White sage. Baton Rouge, Louisiana: USDA NRCS National Plant Data Center.

From Barton et al. (2016)

Wall, M. 2009. General seed collection guidelines: For California native plant species. Rancho Santa Ana Botanic Garden. Accessed February 24, 2015. <http://www.rsabg.org/>.

———, and J. Macdonald. 2009. Processing seeds of California native plants for conservation, storage, and restoration. Claremont, California: Rancho Santa Ana Botanic Garden Seed Program.

From Barton et al. (2016)

Rules for Literature Cited (cont.)

- iii. For ***two or more cited works with the same author(s) AND date***, maintain the “a, b, c...” style and use 2 consecutive em dashes instead of repeating author name(s)

Young, B. 2001^a. Propagation protocol for production of container *Atriplex californica* moq. plants (treeband #5). San Francisco, California: Native Plant Network.
———. 2001^b. Propagation protocol for production of container *Croton californicus* muell.-arg. plants (2 inch pot). San Francisco, California: Native Plant Network.

From Barton et al. (2016)

Marion, G.M., P.S.J. Verburg, B. Stevenson, and J.A. Arnone. 2008^a. Soluble element distributions in a Mojave Desert soil. *Soil Sci. Soc. Am. J.*, 72:1815–1823.
———, ———, E.V. McDonald, and J.A. Arnone. 2008^b. Modeling salt movement through a Mojave Desert soil. *J. Arid Environ.*, 72:1012–1033.

From Lovich et al. (2025)

Rules for Literature Cited (cont.)

iv. Avoid making these errors...

Do not use full journal title

Incorrect!

Pirotta, E., Merchant, N.D., Thompson, P.M., Barton, T.R., and Lusseau, D. 2015. Quantifying the effect of boat disturbance on bottlenose dolphin foraging activity. **Biological Conservation**, 181:82–89.
Reif, J.S. 2011. Animal sentinels for environmental and public health. *Public Health Reports*, 126(Suppl 1):50.
Rossbach, K.A. and Herzing, D.L. 1999. Inshore and offshore bottlenose dolphin (*Tursiops truncatus*) communities distinguished by association patterns near Grand Bahama Island, Bahamas. **Can. J. Zool.** 77:581–92.

Correctly abbreviated!

From Fandel et al. (2015)

Exception: a journal name consisting of *one word* must not be abbreviated. For example...

Lance, J.R. 1966. New distributional records of some northeastern Pacific Opisthobranchiata (Mollusca: Gastropoda) with descriptions of two new species. **Veliger**, 9:69–81.

McDonald, G.R. 1983. A review of the nudibranchs of the California coast. **Malacologia**, 24:114–276.

From Goddard et al. (2016)

Rules for Literature Cited (cont.)

iii. Avoid making these errors...

Do not include spaces between abbreviated names

Incorrect!

Merritt, D. J., and K. W. Dixon. 2011. Restoration seed banks. *Science*, 332:21–22.

From Barton et al. (2016).

Correct!

Bruno, J.F., J.J. Stachowicz, and M.D. Bertness. 2003. Inclusion of facilitation into ecological theory. *TREE*, 18:119–125.

From Bonham and Silbiger (2024)

Do not include journal issue number

Allen, L.G., and A.H. Andrews. 2012. Bomb radiocarbon dating and estimated longevity of giant sea bass (*Stereolepis gigas*). *Bull. So. Calif. Acad. Sci.*, 111(1):1–14.

From House et al. (2016)

Rules for Literature Cited (cont.)

iii. Avoid making these errors...

In the article title, use ***initial capital letters only*** in the first word of the title, as well as for proper nouns and genus names!

Millen, S.V.1983. Range extensions of opisthobranchs in the northeastern Pacific. Veliger, 25:383–386.
——— and A. Hermosillo. 2007. The Genus *Flabellina* Voight, 1834 (Mollusca: Opisthobranchia) from Bahía de Banderas (Pacific Coast of Mexico) with Ecological Observations, the Description of a New Species, and the Redescription of *Flabellina cynara*. Proc. Calif. Acad. Sci., 85:543–559.

From Goddard et al. (2016)

○ = letter should be lower case.

CONSISTENCY is important!