

SEMESTER AT SEA COURSE SYLLABUS

Colorado State University, Academic Partner

Voyage:	Fall 2019
Discipline:	Fish/Wildlife/Conservation Biology
Course Number and Title:	FW 304 Conservation of Marine Megafauna
Division:	Upper
Faculty Name:	Dr. Paul F. Doherty, Jr.
Semester Credit Hours:	3

Prerequisites: One (1) introductory animal biology course

COURSE DESCRIPTION

Whales, sharks, squids, sea turtles, albatrosses... oh my! FW 304 will be an engaging introduction to marine megafauna, ecology, and conservation. We will first examine the physical dimensions of the world's ocean and describe ocean zones based on the ecosystems found within them. We will then explore the evolution of life in the oceans and how large marine animals have adapted to the challenges of a cold, dark, and deep ocean. Throughout the class we will highlight how scientists study the oceans and the large animals that live in them, providing glimpses of new technologies that boost our understanding of marine ecology. The course will also cover challenges we face in sustaining and conserving oceans for the future. For example, we will learn how issues such as bycatch and climate change are affecting ocean species and how we can better conserve our charismatic marine megafauna. What better place to take such a class than on a ship?!

LEARNING OBJECTIVES

By the end of this course, you will:

1. Recognize the physical dimensions of the oceans and describe ocean zones based on the ecosystems found within them.
2. Describe various anatomical, physiological and behavioral adaptations that have evolved in marine megafauna species for life in the ocean.
3. Articulate important aspects of the biology and ecology of marine megafauna species, including foraging and reproductive ecology, and how they are studied.
4. Explain principal methodologies used in marine megafauna population assessment.
5. Identify both historical and current threats to marine megafauna species around the world including bycatch, ocean noise and climate change.
6. Synthesize and critique current marine megafauna conservation measures or management case studies, including problem identification, research approaches used, conservation actions taken and monitoring their effectiveness.

REQUIRED TEXTBOOKS

None

TOPICAL OUTLINE OF COURSE

Depart Amsterdam, The Netherlands – September 9

A1–September 11:

Topic: Introduction to marine megafauna, basic evolution, how to critically review scientific literature

Readings: Mann et al. 2008. Why do dolphins carry sponges?; Lewison et al. 2014. Global patterns of marine organisms

Video clips: A census of the ocean

Assignment:

A2–September 13:

Topic: Ocean environment and ocean basics – Seawater, ocean currents, dimensions of the ocean

Readings: Doughty et al. 2015. Global nutrient transport in a world of giants; di Sciara 2016. Marine Mammals in the Mediterranean

Video clips:

Assignment: Discussion Lead Group 1

Gdansk, Poland – September 15-20

A3–September 21:

Topic: Functional morphology and bioenergetics

Readings: Fontaine. 2016. Harbor porpoises in the Mediterranean Sea and adjacent regions; Esteban et al. 2016. Conservation status of killer whales in the Strait of Gibraltar

Video clips:

Assignment: Discussion Lead Group 2

A4–September 23:

Topic: ecophysiology, thermoregulation, diving physiology

Readings: di Sciara and Kotomatas. 2016. Are Mediterranean Monk Seals being left to save themselves?; Scovazzi. 2016. International legal framework for marine mammal conservation in the Mediterranean Sea

Video clips:

Assignment: Discussion Lead Group 3

A5–September 25:

Topic: Foraging ecology, trophic ecology and ecosystem roles

Readings: Casini et al. 2012. Predator transitory spillover induces trophic cascades; Steneck 2012. Apex predators and trophic cascades in large marine ecosystems

Video clips: Tagging Tuna, Superfish Bluefin Tuna

Assignment: Discussion Lead Group 4, Submit Megafauna List 1 and essay

Lisbon, Portugal – September 26-28

Cadiz, Spain – September 29 – October 1

[FIELD CLASS – WHALE WATCHING and TUNA in SOUTHERN SPAIN – OCT 1]

A6–October 3:

Topic: Evolution of megafauna; Life history/life cycles

Seabirds and Penguins

Readings: Gingerich 2009. New Whale; Foote et al. 2015. Convergent evolution of genomes of marine mammals

Video clips: Track of the tuna

Assignment: Discussion Lead Group 5

A7–October 5:

Topic: Population dynamics

Readings: Veran et al. 2007. Quantifying the impact of longline fisheries on albatross; Cubaynes et al. 2010. To breed or not with El Nino events

Video clips:

Assignment: Discussion Lead Group 6, Submit Field Class assignment

Dubrovnik, Croatia – October 6-10

A8–October 12:

Topic: Movement and migration

Readings: Schreiber et al. 2004. Dispersal and survival of tropicbirds

Video clips:

Assignment: Discussion Lead Group 7

A9–October 14:

Topic: Exam 1

Casablanca, Morocco – October 15-20

A10–October 22:

Topic: Cephalopods (e.g., squid)

Readings: Nilsson et al. 2012. Advantage of giant eyes in squid; Li et al. 2017. Variation in Peruvian squid

Video clips: Amazing octopus; Primeval squid; How we found the giant squid; Inside Nature's Giants: Giant Squid

Assignment: Discussion Lead Group 8

A11–October 25:

Topic: Bony Fishes, Sharks

Readings: Madigan et al. 2017. East not least for bluefin tuna; Hsu et al. 2015. Tuna and swordfish catch

Video clips: A shark-deterrent wet suit; How do you save a shark?; Jacques Cousteau – sharks; Swim with giant sunfish; Cousteau Ocean Adventure (PBS); Sharkwater; Inside Nature’s Giants: Great White Shark
Assignment: Discussion Lead Group 9

A12–October 27:

Topic: Sea turtles

Readings: Baker et al. 2015. Sea turtle rehab success among size and species; Christianen et al. 2019. Megaherbivores and invasive grasses in the Caribbean

Video clips: Survival of the sea turtle

Assignment: Discussion Lead Group 10, Submit Megafauna List 2 and essay

Tema, Ghana – October 28-30

Takoradi, Ghana – October 31 – November 1

A13–November 3:

Topic: Marine mammals (manatees, dugongs, sea cows; seals, sea lions, otters, polar bears)

Readings: Hunter et al. 2010. Polar bears and climate change.

Video clips: Manatees, Jacques Cousteau - Sea elephant; Jacques Cousteau – walrus; Jacques Cousteau – otter; Jacques Cousteau – mermaid; Nat Geo – Polar Bears

Assignment: Discussion Lead Group 11

A14–November 6:

Topic: Marine Mammals (whales and dolphins)

Readings: Roman et al. 2014. Whales as marine ecosystem engineers; Tyne et al. 2016. Evaluating monitoring methods for cetaceans; Thomas et al. 2016. Status of world's baleen whales

Video clips: Davoren Lab video; Killer Whale attacked a blue whale; Orca hunting seal; Super Killer Whale; Sperm whale dealing with the unexpected; Jacques Cousteau – whales; Jacques Cousteau - desert whales; Inside the killer whale matriarchy (cartoon); Why are blue whales so enormous?; Why do whales sing?; Why should you care about whale fall?; Inside Nature’s Giants: Sperm Whale; In the Company of Whales; World of Discovery: Blue Whale

Assignment: Discussion Lead Group 12

A15–November 8:

Topic: Seabirds and Penguins

Readings: Huang et al. 2017. Sooty tern survival spills, fisheries, hurricanes; Barbraud and Weimerskirch 2001. Penguins and climate change;

Video clips: Antarctic Penguins; City of 400000 Penguins, Bass Rock Gannet Colony; Wings of the albatross; Flying with gannets; March of the Penguins

Assignment: Discussion Lead Group 13

Salvador, Brazil – November 10-15

A16–November 16:

Topic: Exam 2

A17–November 18:

Topic: Marine biodiversity and conservation

Readings: Selig, E.R., et al. 2014. Global Priorities for Marine Biodiversity Conservation; Klein, C.J. et al. 2015. Shortfalls in the global protected area network at representing marine biodiversity

Video clips: Protect our oceans - Sylvia Earle; What are animals feeling - Carl Safina; The oceans glory and horror

Assignment:

A18–November 20:

Topic: Case studies: Technical monitoring, endangered right whales

Readings: Miller, B. S., and E. J. Miller. 2018. The seasonal occupancy and diel behaviour of Antarctic sperm whales revealed by acoustic monitoring; Taylor, B. L., et al. 2017. Extinction is Imminent for Mexico's Endemic Porpoise Unless Fishery Bycatch is Eliminated

Video clips:

Assignment:

A19–November 23:

Topic: Whaling

Readings: Drew, J., et al. 2016. Collateral damage to marine and terrestrial ecosystems from Yankee whaling in the 19th century

Video clips: Into the deep

Assignment: Submit Megafauna List 3 and essay

Port of Spain, Trinidad and Tobago – November 24

A20–November 26:

Topic: Bycatch and impact of fisheries

Readings: Read et al. 2005. Bycatch of marine mammals in fisheries.

Video clips: What is bycatch?; Journey to Planet Earth (Damon); End of the Line; The Cove

Assignment:

A21–November 28:

Topic: National and international management of marine fisheries

Readings: Barner, A. K., et al. 2015. Solutions for Recovering and Sustaining the Bounty of the Ocean

Video clips: Insight: The whaling ban, Tuna convention, What is the IWC, CCAMLR 101

Assignment:

A22–December 1:

Topic: The plastic footprint

Readings: What plastic would you ban?

Video clips: Cleaning up the plastic, Meet Wisdom; Plastic Ocean

Assignment: Submit E³ essay

Guayaquil, Ecuador – December 2-7

A23—December 9:

Topic: BioAcoustics and management of sound

Readings: Holt et al. 2008. Killer whales increase call amplitude in response to vessel noise.

Video clips:

Assignment: Discussion Lead Group 14

Puntarenas, Costa Rica – December 11-15

A24—December 16

Topic: Rising seas and the future of coastal megafauna

Readings:

Video clips:

Assignment: Submit Megafauna List 4 and essay

A25—December 19:

Topic: Final Exam

Arrive San Diego, California – December 23

Discussion Lead

During many class periods we will have an in-class discussion focused on papers from the scientific literature. Typically, a team of 2 students will be assigned to lead each discussion section. The lead students are expected to submit 3-5 discussion questions on the reading for posting on Moodle no later than the class period before the discussion. Each student in the course must come to each discussion section prepared to discuss these questions and critique the paper(s). At the start of the discussion, the lead students will provide a concise overview of the paper. In the summary, you should: 1) review the major points of the paper, 2) highlight novel results and conclusions, 3) relate the paper to other readings or discussions in class or your own knowledge, and 4) raise questions or objections you have with the methods, results, and/or conclusions. Following the summary, the lead students should then be prepared to actively generate and facilitate discussion for the rest of the allocated time. You will be assigned a grade for leading the discussion.

E³ Essay

Each student will submit an essay based on watching a movie from each of 3 lists (Entertainment, Emotion, Education). The essay will compare how, and how accurately, science and scientists are portrayed. The essay will also compare what the goal of the movies are and the relative role and merit of an entertainment, emotion, and education foci. More details (and movies) will be provided in class.

FIELD WORK

Semester at Sea field experiences allow for an unparalleled opportunity to compare, contrast, and synthesize the different cultures and countries encountered over the course of the voyage. In addition to the one field class, students will complete independent field assignments that span multiple countries.

Field Class:

The field class for this course is on **Tuesday, 1 October 2019 in Cadiz, Spain.**

Field Class attendance is mandatory for all students enrolled in this course. Do not book individual travel plans or a Semester at Sea sponsored trip on the day of your field class.

Field Classes constitute at least 20% of the contact hours for each course and are developed and led by the instructor.

Field Class Title: Whale Watching and Tuna in Southern Spain

Field Class Description:

From the port of Cadiz, we will travel to Tarifa on Spain's southern tip and board a whale-watching vessel. During the ~2-hour cruise in the Strait of Gibraltar, we may see ocean sunfish, common and bottlenose dolphins, pilot whales, killer whales, and possible larger whale species (e.g., sperm, fin whales). On board, we will meet a professional naturalist dedicated to the study of cetaceans in the Strait of Gibraltar and the Gulf of Cadiz. We will learn about the marine mammals we see and will also discuss both current and historical methods and issues with fisheries in the area, including the tuna fishery. On the way back from Tarifa, we will stop off for a visit to the Ruins of Baelo Claudia, an ancient Roman town that thrived 2000 years ago near the current seaside town of Belonia. Baelo Claudia derived its wealth from the tuna fishing industry, from which they produced garum, a fish paste that was a sought-after delicacy throughout the Roman Empire. In addition to the impressive temple, forum, and basilica, the ruins of the large fish-salting factory are the perfect backdrop for a discussion of the importance of the tuna fishery both today and in ancient times, and to review current tuna fishing techniques and fishery issues.

Objectives:

1. Gain first-hand appreciation of, and identification skills for marine megafauna (specifically whales, dolphins) in southern Spain as well as their adaptations for living in a marine environment.
2. Compare the importance of tuna fisheries over two millennia and review modern fishery and conservation issues.
3. Comprehend current conservation challenges for cetaceans and tuna such as those relating to mortality due to fisheries interactions, ship strikes, disease, pollution.
4. Discuss/present possible solutions to these problems.

Field Class Assignment: Due Oct 5 (A7)

Students will submit an essay relating material from the first 5 lectures on marine megafauna in the Mediterranean to what we see and comment how marine mammal

populations in the Mediterranean have changed over time and predict the future of marine mammal management there.

Independent Field Assignments – Marine Megafauna List and species essays

Each student will maintain a Marine Megafauna List and they will submit the list 4 times during the voyage. At each submission students will also highlight one species they saw and comment on interesting adaptations, behavior, ecology of the species as well as conservation issues. Further details will be provided in class and evaluation will be based on completeness and quality.

METHODS OF EVALUATION

<u>Item</u>	<u>% of Final Grade</u>
Discussion Lead	10%
E ³ Essay	15%
Field class and field class assignment	20%
Megafauna List + essays	5%
Exam 1	12%
Exam 2	13%
Final Exam	15%
Participation and Attendance	10%

GRADING SCALE

The following Grading Scale is utilized for student evaluation. Pass/Fail is not an option for Semester at Sea coursework. Note that C-, D+ and D- grades are also not assigned on Semester at Sea in accordance with the grading system at Colorado State University (the SAS partner institution).

Pluses and minuses will not be used in this course.

<u>Excellent</u>	<u>Good</u>	<u>Satisfactory/Poor</u>	<u>Failing</u>
97-100%: A	87-89%: B	77-79%: C	Less than 60%: F

ATTENDANCE/ENGAGEMENT IN THE ACADEMIC PROGRAM

Attendance in all Semester at Sea classes, including the Field Class, is mandatory. Students must inform their instructors prior to any unanticipated absence and take the initiative to make up missed work in a timely fashion. Instructors must make reasonable efforts to enable students to make up work which must be accomplished under the instructor's supervision (e.g., examinations, laboratories). In the event of a conflict in regard to this policy, individuals may appeal using established CSU procedures.

LEARNING ACCOMMODATIONS

Semester at Sea® provides academic accommodations for students with diagnosed learning disabilities, in accordance with ADA guidelines. Students who will need accommodations in a class, should contact ISE to discuss their individual needs. Any accommodation must be discussed in a timely manner prior to implementation.

A letter from students' home institutions verifying the accommodations received on their home campuses (dated within the last three years) is required before any accommodation is provided on the ship. Students must submit verification of accommodations to academic@isevoyages.org as soon as possible, but no later than two months prior to the voyage. More details can be found within the Course Registration Packet, as posted to the [Courses and Field Classes page](#) no later than one month prior to registration.

STUDENT CONDUCT CODE

The foundation of a university is truth and knowledge, each of which relies in a fundamental manner upon academic integrity and is diminished significantly by academic misconduct. Academic integrity is conceptualized as doing and taking credit for one's own work. A pervasive attitude promoting academic integrity enhances the sense of community and adds value to the educational process. All within the University are affected by the cooperative commitment to academic integrity. All Semester at Sea courses adhere to this Academic Integrity Policy and Student Conduct Code.

Depending on the nature of the assignment or exam, the faculty member may require a written declaration of the following honor pledge: "I have not given, received, or used any unauthorized assistance on this exam/assignment."

RESERVE BOOKS FOR THE LIBRARY

These books would be good to have in the Semester at Sea library on the ship, but none are required.

Author	Title	Publisher	ISBN	Date/Edition
Stow, D.	Oceans - a very short introduction	Oxford	199655073	2017
Mladenov, P.V.	Marine biology: a very short introduction	Oxford	199695059	2013
Caine, A.	Marine biology for the non-biologist	Andrew Caine Epublishing	NA	2015
Miller, J. & Miller, L.	Walrus	Reaktion Books	1780232918	2014

Roman, J.	Whale	Reaktion Books	1861892462	2012
Pyenson, N.	Spying on whales: the past, present and future of earth's most awesome creatures	Viking	735224560	2018
Staaf, D.	Squid empire: the rise and fall of the Cephalopods	ForeEdge	1611689236	2017
Brooke, M. & Pearson, B.	Far from land: the mysterious lives of seabirds	Princeton	691174180	2018
Benchley, P.	The girl of the Sea of Cortez: A novel	Ballantine	NA	2013
Aitchison, J.	The shark and the albatross	Greystone	1771642181	2016
Safina, C.	Voyage of the turtle	Henry Holt	805078916	2006
Safina, C.	Eye of the albatross	Holt	805062297	2003
Safina, C.	Song for the blue ocean	Holt	805061223	1999
Francis, G.	Empire Antarctica	Counterpoint	1619022591	2013
Doughty, R.W.	The albatross and the fish: linked lives in the open seas	Univ. of Texas Press	292726821	2011
Carson, R.	Under the sea wind	Open Road Media	NA	2011
Montaigne, F.	Fraser's penguins	Henry Holt	NA	2010
Williams, W.	Kraken: the curious exciting and slightly disturbing science of squid	Abrahms Image	810984652	2011
Hoelzel, A.R.	Marine Mammal Biology: an evolutionary approach	Wiley-Blackwell	632052325	2002
Wursig, B. Thewissen, J.G.M., Kovacs, K.M.	Encyclopedia of marine mammals	Academic Press	012804327X	2017
Jefferson, T.A. et al.	Marine Mammals of the world: a comprehensive guide to their identification	Academic Press	124095429	2015

Richard Ellis	Tuna: A love story	Knopf		2008
Danna Staaf	Squid Empire: The Rise and Fall of Cephalopods	ForeEdge	978-1-61168-923-5	2017
John Aitchison	The Shark and the Albatross: a Wildlife Filmmaker Reveals Why Nature Matters to Us All	GreyStone		2016
Robin Doughty	The Albatross and Fish: Linked Lives in the Open Seas	Univ. of Texas Press	978-0292726826	2011
Adam Nicolson	The Seabird's Cry: The Lives and Loves of the Planet's Great Ocean Voyagers	Henry Holt	9781250134189	2018
Michael Brooke	Far from Land: The Mysterious Lives of Seabirds	Princeton University Press	9780691174181	2018

FILM REQUEST

I own these movies and students will need to use them for a writing assignment. I don't plan on showing them in class – but I will check them out to students to watch on their own.

Title	Distributor
The Life Aquatic	Miramax
Finding Nemo	Walt Disney Studios
Jacques Cousteau's Voyage to the edge of the world	Synergy Ent
Jean-Michel Cousteau: Ocean Adventures PBS Explorer Coll.	PBS
Jacques Cousteau Odyssey warm blooded sea mammals	PBS
Journey to planet Earth: The state of the ocean's animals	Screenscope, Inc
Sharkwater	WarnerBrothers
Star Trek 4	Paramount
The End of the Line	Docurama
Deep Blue Sea /DBS 2	WarnerBrothers
Inside Nature's Giants: Great White Shark	PBS
Inside Nature's Giants: Sperm Whale	PBS
Sharknado 1-4	Kaleidoscope Home Entertainment

Cooked	NFTS
Golden Seal	MGM
Blue Planet Collection	BBC
Free Willy 1-4	WarnerBrothers
Plastic Ocean	Passion River
Blackfish	Magnolia Home Entertainment
Invasion of the Killer Whales	PBS
In the Company of Whales	Discovery - Gaiam
World of Discovery: Blue Whale - Largest Animal on Earth	TGG Direct
Marlin at the Gate	Bayview Entertainment
Wicked Tuna: Season 1	20th Century Fox
Turtle: The Incredible Journey	Hannover House
Beast	Shout! Factory / Timeless Media
Orca	Paramount
Great White Shark: A Living Legend	BBC
Inside Nature's Giants: Giant Squid	PBS
Happy Feet/Happy Feet 2/March of the Penguins	WarnerBrothers
Moby Dick	Vivendi Entertainment
20000 Leagues Under the Sea	Walt Disney Studios
The Whale	Docurama
Dolphin's Gift	LightworksAV
Jaws	Universal
Jaws 2, 3, Revenge	Universal
Into the Deep: America, Whaling & the World	PBS
The Shallows	Sony
Finding Dory	Walt Disney Studios
The Cove	Lions Gate
Meg	Warner
Saltwater Atomic Shark	Itn Distribution
Dolphin Tale/DT 2	Warner

ELECTRONIC COURSE MATERIALS

I will have students read these articles. I have copies and I will post them in the course folder and in Moodle.

Anderson, P. K. 2001. Marine mammals in the next one hundred years: twilight for a pleistocene megafauna. *Journal of Mammalogy* 83:623-629.

Anthony, R. G. et al. 2008. Bald eagles and sea otters in the Aleutian Archipelago: indirect effects of trophic cascades. *Ecology* 89:2725-2735.

- Baker, L. et al. 2015. Sea turtle rehabilitation success increases with body size and differs among species. *Endangered Species Research* 29:13-21.
- Barbraud, C., and H. Weimerskirch. 2001. Emperor penguins and climate change. *Nature* 411:183-186.
- Barner, A. K., et al. 2015. Solutions for Recovering and Sustaining the Bounty of the Ocean.
- Casini, M. et al. 2012. Predator transitory spillover induces trophic cascades in ecological sinks. *Proceedings of the National Academy of Sciences of the United States of America* 109:8185-8189.
- Christianen, M., et al. 2019. Megaherbivores may impact expansion of invasive seagrass in the Caribbean. *Journal of Ecology* 107:45-57.
- Clasen, J. L., and J. B. Shurin. 2015. Kelp forest size alters microbial community structure and function on Vancouver Island, Canada. *Ecology* 96:862-872.
- Coll, M. et al. 2013. Assessing the trophic position and ecological role of squids in marine ecosystems by means of food-web models. *Deep Sea Research II* 95:21-36.
- Cousteau.org. 2018. Silent World.
- Cubaynes, S. et al. Schreiber, and O. Gimenez. 2011. To breed or not to breed: a seabird's response to extreme climatic events. *Biology Letters* 7:303-306.
- Drew, J., et al. 2016. Collateral damage to marine and terrestrial ecosystems from Yankee whaling in the 19th century. *Ecology and Evolution* 6:8181-8192.
- Doughty, C. E. et al. 2015. Global nutrient transport in a world of giants. *Proceedings of the National Academy of Sciences of the United States of America* 113:868-873.
- Estes, J. A. et al. 2009. Causes and consequences of marine mammal population declines in southwest Alaska: a food-web perspective. *Philos Trans R Soc Lond B Biol Sci* 364:1647-1658.
- Foley, C. M. R. 2013. Management implications of fishing up, down, or through the marine food web. *Marine Policy* 37:176-182.
- Footo, A. D. et al. 2015. Convergent evolution of the genomes of marine mammals. *Nat Genet* 47:272-275.
- Gingerich, P. D. et al. 2009. New protocetid whale from the middle eocene of pakistan: birth on land, precocial development, and sexual dimorphism. *Plos One* 4:e4366.
- Grubbs, R. D. et al. 2016. Critical assessment and ramifications of a purported marine trophic cascade. *Sci Rep* 6:20970.

- Heithaus, M. R. et al. 2008. Predicting ecological consequences of marine top predator declines. *Trends Ecol Evol* 23:202-210.
- Holt, M.M. et al. 2009. Speaking up: Killer whales (*Orcinus orca*) increase their call amplitude in response to vessel noise. *J Acoust Soc Am* 125:EL27-32.
- Hsu, A. C. et al. 2015. Tuna and swordfish catch in the U.S. northwest Atlantic longline fishery in relation to mesoscale eddies. *Fish Oceanogr* 24:508-520.
- Huang, R. M. et al. 2017. Sooty tern (*Onychoprion fuscatus*) survival, oil spills, shrimp fisheries, and hurricanes. *PeerJ* 5:e3287.
- Hunter, C. M. et al. 2010. Climate change threatens polar bear populations: a stochastic demographic analysis. *Ecology* 91:2883-2897.
- Ideas.TED.Com. 2018. What plastic item would you love to ban? 15 ocean experts (and TED speakers) tell us.
- Jiao, J. et al. 2016. Random movement of predators can eliminate trophic cascades in marine protected areas. *Ecosphere* 7:1 - 17.
- Klein, C. J., et al. 2015. Shortfalls in the global protected area network at representing marine biodiversity. *Scientific Reports* 5:17539.
- Lafferty, K. D., and T. H. Suchanek. 2016. Revisiting Paine's 1966 Sea Star Removal Experiment, the Most-Cited Empirical Article in the *American Naturalist*. *Am Nat* 188:365-378.
- Leleu, K. 2012. Mapping habitats in a marine reserve show how a 30-year trophic cascade altered ecosystem function. *Biological Conservation* 155:193-201.
- Lewison, R. L. et al. 2014. Global patterns of marine mammal, seabird, and sea turtle bycatch reveal taxa-specific and cumulative megafauna hotspots. *Proc Natl Acad Sci U S A* 111:5271-5276.
- Li, Y. et al. 2017. Inter-annual variability in trophic patterns of jumbo squid (*Dosidicus gigas*) off the exclusive economic zone of Peru, implications from stable isotope values in gladius. *Fisheries Research* 187:22-30.
- Libralato, S. et al. 2005. A method for identifying keystone species in food web models. *Ecological Modelling* 195:153-171.
- Madigan, D. J. et al. 2017. East not least for Pacific bluefin tuna. *Science* 357:356-357.
- Mann, J. 2008. Why do dolphins carry sponges? *Plos One* 3:e3868.
doi:3810.1371/journal.pone.0003868.

- Margheri, L. et al. 2012. Soft robotic arm inspired by the octopus: I. From biological functions to artificial requirements. *Bioinspir Biomim* 7:025004.
- Miller, B. S., and E. J. Miller. 2018. The seasonal occupancy and diel behaviour of Antarctic sperm whales revealed by acoustic monitoring. *Scientific Reports* 8:5429.
- Nilsson, D. E. et al. 2012. A unique advantage for giant eyes in giant squid. *Curr Biol* 22:683-688.
- Nowacek, D. P. et al. 2011. Super-aggregations of krill and humpback whales in Wilhelmina Bay, Antarctic Peninsula. *Plos One* 6:e19173.
- Nowacek, D. P. et al. 2016. Studying cetacean behaviour new technological approaches and conservation applications. *Animal Behaviour* 120:235-244.
- Osterblom, H. et al. 2006. Fish, seabirds and trophic cascades in the Baltic Sea. *Marine Ecology-Progress Series* 323:233-238.
- O'Sullivan, D., and M. Emmerson. 2011. Marine reserve designation, trophic cascades and altered community dynamics. *Marine Ecology-Progress Series* 440:115-125.
- Peckarsky, B. L. et al. 2008. Revisiting the classics: considering nonconsumptive effects in textbook examples of predator-prey interactions. *Ecology* 89:2416-2425.
- Paine, R. T. 1966. Food Web Complexity and Species Diversity. *The American Naturalist* 100:65-75.
- Read, A. J. et al. 2006. Bycatch of marine mammals in the US and Global Fisheries. *Conservation Biology* 20:163-169.
- Reisewitz, S. E. et al. 2006. Indirect food web interactions: sea otters and kelp forest fishes in the Aleutian archipelago. *Oecologia* 146:623-631.
- Rodas-Trejo, J. et al. 2008. Distribution and conservation of the West Indian manatee (*Trichechus manatus manatus*) in the Catazajá wetlands of northeast Chiapas, México. *Tropical Conservation Science* 1:321-333.
- Roman, J. et al. 2014. Whales as marine ecosystem engineers. *Frontiers in Ecology and the Environment* 12:377-385.
- Schenkman, L. 2018. How a snot-collecting marine drone is giving us an exciting new view of whale life. Page 10 Ideas.Ted.com.
- Schreiber, et al. et al. 2004. Dispersal and survival rates of adult and juvenile Red-tailed tropicbirds (*Phaethon rubricauda*) exposed to potential contaminants. *Animal Biodiversity and Conservation* 27:532-540.

- Selig, E. R., et al. 2014. Global Priorities for Marine Biodiversity Conservation. Plos One 9:e82898.
- Steneck, R. S. 2012. Apex predators and trophic cascades in large marine ecosystems: learning from serendipity. Proc Natl Acad Sci U S A 109:7953-7954.
- Stevens, J. D. et al. 2010. Satellite tagging of blue sharks (*Prionace glauca*) and other pelagic sharks off eastern Australia: depth behaviour, temperature experience and movements. Marine Biology 157:575-591.
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ADDITIONAL RESOURCES

I will use some YouTube video clips in my lectures and as support material. I have copies and will use in lecture, post in the course folder, or on Moodle.

A census of the ocean
Track of the tuna
Amazing octopus
Primeval squid
How we found the giant squid
Track the Tuna
A shark-deterrent wet suit
How do you save a shark?
Jacques Cousteau - sleeping sharks
Jacques Cousteau - sharks
Swim with giant sunfish
Tagging tuna

Superfish Bluefin Tuna
Survival of the sea turtle
Manatees
Jacques Cousteau - Sea elephant
Jacques Cousteau - walrus
Jacques Cousteau - otter
Jacques Cousteau - mermaid
Davoren Lab video
Killer Whale attacked a blue whale
Orca hunting seal
Super Killer Whale
Sperm whale dealing with the unexpected
Jacques Cousteau - whales
Jacques Cousteau - desert whales
Inside the killer whale matriarchy (cartoon)
Why are blue whales so enormous?
Why do whales sing?
Why should you care about whale poo?
Penguins
Gannet Colony
Wings of the albatross
Flying with Gannets (short)
Protect our oceans - Sylvia Earle
what are animals feeling - Carl Safina
The oceans glory and horror
What is bycatch?
Insight The whaling ban
Tuna convention
What is the IWC
CCAMLR 101
Cleaning up the plastic (60 minutes)
Meet Wisdom (60 minutes)