APPENDIX MS3. IMPACTS OF DEPLETING FORAGE SPECIES IN THE CALIFORNIA CURRENT

ISAAC C. KAPLAN, CHRISTOPHER J. BROWN, ELIZABETH A. FULTON, IRIS A. GRAY, JOHN C. FIELD, AND ANTHONY D.M. SMITH

The full version of this work is published as:

KAPLAN, I. C., BROWN, C. J., FULTON, E. A., GRAY, I. A., FIELD, J. C., & SMITH, A. D. Impacts of depleting forage species in the California Current. Environmental Conservation, 1-14. http://dx.doi.org/10.1017/S0376892913000052

The work is available through the link above, on the California Current Integrated Ecosystem Assessment website, or by email request to the first author (Isaac.Kaplan@noaa.gov).

SUMMARY

Human demands for food and fish meal are often in direct competition with forage needs of marine mammals, birds, and piscivorous harvested fish. Here we used two well-developed ecosystem models for the California Current on the U.S. West Coast to test the impacts on other parts of the ecosystem of harvesting euphausiids, forage fish, mackerel, and mesopelagic fish such as myctophids. We estimated the abundance that would lead to maximum sustainable yield for these four groups individually, but found that depleting forage groups to these levels can have both positive and negative effects on other species in the California Current. The most common impacts were on predators of forage groups, some of which showed declines of >20% under the scenarios that involved depletion of forage groups to 40% of unfished levels. Depletion of euphausiids and forage fish, which each comprise > 10% of system biomass, had the largest impact on other species. Depleting euphausiids to 40% of unfished levels altered the abundance of 13-30% of the other functional groups by >20%; while depleting forage fish to 40% altered the abundance of 20-50% of the other functional groups by >20%. Our work here emphasizes the trade-offs between the harvest of forage groups and the ability of the California Current to sustain other trophic levels. Though higher trophic level species such as groundfish are often managed on the basis of reference points that can reduce biomass to below half of unfished levels, this level of forage species removal is likely to impact the abundance of other target species, protected species, and the structure of the ecosystem.

Integrated Ecosystem Assessment of the California Current

Phase II Report 2012

August 2013

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

Edited by Phillip S. Levin[1], Brian K. Wells[2], and Mindi B. Sheer[1]

From contributions by the editors and these authors:

Kelly S. Andrews[1], Lisa T. Ballance[2], Caren Barcelo[3], Jay P. Barlow[2], Marlene A. Bellman[1], Steven J. Bograd[2], Richard D. Brodeur[1], Christopher J. Brown, Susan J. Chivers[2], Jason M. Cope[1], Paul R. Crone[2], Sophie De Beukelaer[5], Yvonne DeReynier[6], Andrew DeVogelaere[5], Rikki Dunsmore[7], Robert L. Emmet[1], Blake E. Feist[1], John C. Field[2], Daniel Fiskse[8], Michael J. Ford[1], Kurt L. Fresh[1], Elizabeth A. Fulton[4], Vladlena V. Gertseva[1], Thomas P. Good[1], Iris A. Gray[1], Melissa A. Haltuch[1], Owen S. Hamel[1], M. Bradley Hanson[1], Kevin T. Hill[2], Dan S. Holland[1], Ruth Howell[1], Elliott L. Hazen[2], Noble Hendrix[10], Isaac C. Kaplan[1], Jeff L. Laake[11], Jerry Leonard[1], Joshua Lindsay[12], Mark S. Lowry[2], Mark A. Lovewell[13], Kristin Marshall[1], Sam McClatchie[2], Sharon R. Melin[11], Jeffrey E. Moore[2], Dawn P. Noren[1], Karma C. Norman[1], Wayne L. Perryman[2], William T. Peterson[1], Jay Peterson[1], Mark L. Plummer[1], Jessica V. Redfern[2] , Jameal F. Samhouri[1], Isaac D. Schroeder[2], Anthony D. Smith[9], William J. Sydeman[14], Barbara L. Taylor[2], Ian G. Taylor[1], Sarah A. Thompson[14], Andrew R. Thompson[2], Cynthia Thomson[2], Nick Tolimieri[1], Thomas C. Wainwright[1], Ed Weber[2], David W. Weller[2], Gregory D. Williams[1], Thomas H. Williams[1], Lisa Wooninck[15], Jeanette E. Zamon[1]

1. Northwest Fisheries Science Center
National Marine Fisheries Service
2725 Montlake Boulevard East
Seattle, Washington 98112

2. Southwest Fisheries Science Center
National Marine Fisheries Service
8901 La Jolla Shores Drive
La Jolla, California 92037

3. Oregon State University
College of Earth, Ocean and Atmospheric Science
104 CEOAS Administration Building
Corvallis, Oregon 97331

4. Climate Adaptation Flagship, CSIRO Marine and Atmospheric Research, Ecosciences Precinct, GPO Box 2583, Brisbane, Queensland 4102, Australia. And School of Biological Sciences, The University of Queensland, St Lucia QLD 4072, Australia.

5. Monterey Bay National Marine Sanctuary
National Ocean Service, Office of Marine Sanctuaries
99 Pacific Street, Building 455A
Monterey, California 93940

6. Northwest Regional Office
National Marine Fisheries Service
7600 Sandpoint Way N.E.
Seattle, Washington 98115

7. Monterey Bay and Channel Islands Sanctuary Foundation
99 Pacific Street, Suite 455 E
Monterey, California 93940

8. University of Washington
Seattle, Washington 98195

9. CSIRO Wealth from Oceans Flagship, Division of Marine and Atmospheric Research, GPO Box 1538, Hobart, Tas. 7001, Australia (4),9

10. R2 Resource Consultants, Inc.,
15250 NE 95th Street,
Redmond, WA 98052

11. Alaska Fisheries Science Center
National Marine Fisheries Servic e
7600 Sandpoint Way N.E.
Seattle, Washington 98115

12. Southwest Regional Office
National Marine Fisheries Service
501 W. Ocean Boulevard
Long Beach, California 90802

13. West Coast Governors Alliance on Ocean Health, and Sea Grant
110 Shaffer Road
Santa Cruz, California 95060

14. Farallon Institute
Petaluma, California 94952

15. Office of Marine Sanctuaries
West Coast Regional Office
99 Pacific Street, Bldg 100 – Suite F
Monterey, California 93940

This is a web-based report and meant to be accessed online. Please note that this PDF version does not include some transitional material included on the website. Please reference as follows:

Full report :

Levin, P.S., B.K. Wells, M.B. Sheer (Eds). 2013. California Current Integrated Ecosystem Assessment: Phase II Report. Available from ***http://www.noaa.gov/iea/CCIEA-Report/index***.

Chapter (example):

K.S. Andrews, G.D. Williams, and V.V. Gertseva. 2013. Anthropogenic drivers and pressures, In: Levin, P.S., Wells, B.K., and M.B. Sheer, (Eds.), California Current Integrated Ecosystem Assessment: Phase II Report. Available from ***http://www.noaa.gov/iea/CCIEA-Report/index***.

Appendix, example for MS5:

Gray, I.A., I.C. Kaplan, I.G. Taylor, D.S. Holland, and J. Leonard. 2013. Biological and economic effects of catch changes due to the Pacific Coast Groundfish individual quota system, Appendix MS5, Appendix to: Management testing and scenarios in the California Current, In: Levin, P.S., Wells, B.K., and M.B. Sheer (Eds.). California Current Integrated Ecosystem Assessment: Phase II Report. Available from ***http://www.noaa.gov/iea/CCIEA-Report/index***.