

Steele J H. *The structure of marine ecosystems.*

Cambridge, MA: Harvard University Press, 1974. 128 p.

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This monograph analyses the flow of energy through marine food webs and compares the results with terrestrial systems. A computer simulation is used to investigate a specific system, the North Sea, and to test results against data. [The *SCI*® indicates that this book has been cited in over 295 publications.]

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This monograph was started at the suggestion of E.O. Wilson of Harvard University and written in a garden hut in Scotland. Both were essential elements. In this work, I tried to bring together two strands in ecological theory—the ideas of energy flow through the food web and the use of simple numerical models to portray some of the dynamics of these systems. By plotting the major links in one marine food web, the North Sea, and then calculating the energy flow in calories through this system, I showed that the input from primary production was just sufficient to account for the output, as fish harvest at the top of the trophic structure.

Such calculations show where the energy goes and sets constraints on alternative webs, but it does not say how the flow is regulated. The model attempted to demonstrate this regulation as dependent on nutrient limitation at the level of basic production—combined with grazing and predation at higher trophic levels—and led to predictions of seasonal patterns and population variation. Both of these themes are still topics of study. As major changes in marine food webs are observed, we need criteria to determine the limits on the new community structure. Further, can the ideas of simple trophic ladders be used as basic elements in marine ecosystems extending to multispecies models?¹ Thus, these original ideas are subject to considerable controversy.

My estimates of primary production may have been too low by a factor of two, and this would remove some of the constraints. There is now much more consideration of microbial systems that recycle nutrients, particularly in open ocean oligotrophic areas.² These new directions conflict with basic assumptions in my work. As far as the number of citations is concerned, I am fortunate that the ideas in my monograph are quoted as a basis for refutation as often, or more often, than in terms of support. I think this is very healthy and hope that it may continue. One theme that has not been considered as much as I would wish and that I still try to pursue is the comparison of marine and terrestrial systems.³

1. Frost B W. Grazing control of phytoplankton stock in the open subarctic Pacific Ocean: a model assessing the role of mesozooplankton, particularly the large calanoid copepods *Neocalanus* spp. *Mar. Ecol.—Progr. Ser.* 39:49-68, 1987.
2. Goldman J C & Caron D A. Experimental studies on an omnivorous microflagellate: implications for grazing and nutrient regeneration in the marine microbial food chain. *Deep-Sea Res. Pt. A—Oceanog. Res.* 32:889-915, 1985.
3. Steele J H. A comparison of terrestrial and marine ecological systems. *Nature* 313:355-8, 1985.