Part II

SYMPOSIUM OF THE CALCOFI CONFERENCE

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THE 1996 HAKE SYMPOSIUM

Hake is one of the principal groundfishes of the world because of the large catch (the global take approaches 2 million tons annually); the high quality of the flesh, which is prized by the food-processing industry; and an apparent resistance to overfishing (Alheit and Pitcher 1995). Because of this global importance, our announcement of a CalCOFI symposium on hake drew a remarkable response. Participants came from Spain, Namibia, Norway, New Zealand, Mexico, and Canada, as well as from the east and west coasts of the United States. The symposium consisted of 6 poster presentations and 21 oral presentations, 11 of which appear as papers in this issue of *CalCOFI Reports*.

The idea of holding a CalCOFI symposium on the biology, ecology, and population dynamics of hake grew out of a plan we developed for a coastwide research program on Pacific hake, *Merluccius productus*. Our plan involved academic and fishery institutions extending from the Pacific Biological Station (Nanaimo, Canada) in the north to CICIMAR (La Paz, Mexico) in the south. The symposium documented the current involvement of many institutions in hake research, and indicated a great opportunity for integrating separate research areas into a comprehensive, basin-scale program on ocean forcing, productivity, and migration. Pacific hake are the largest (2–3 million tons) and most valuable fish population on the west coast of the conterminous United States.

The symposium clearly indicated that an integrated research program focusing on Pacific hake could yield practical methods for forecasting hake recruitment and migration and also would help clarify allocation issues between the United States and Canada. Areas likely to break new ground are studies of subsurface (50–100 m) zooplankton production systems (critical for larval hake); development of new biophysical models dealing with all life stages and changes in habitat boundaries; improved understanding of the euphausiid production systems along the West Coast (necessary for hake as well as many other species of fish and mammals); and a coordinated coastwide (population-scale) approach to recruitment dynamics.

Our evening discussion session crystallized several research avenues. Long-term shifts in Pacific hake biomass could be manifested in two ways: (1) the frequency of strong year classes could be increased; or (2) strong year classes could continue at the same frequency, but the magnitude of the year class could be higher. Evidence suggests that both mechanisms may be influencing Pacific hake recruitment. The fact that strong year classes never occur during cool ocean conditions may limit the frequency of strong year classes during cool ocean regimes. The strongest year classes on record (1980 and 1984) occurred during the recent period of warm ocean conditions.

Distribution studies of Pacific hake revealed that larvae are distributed between 75 and 150 m below the surface, an environment where food is limited. The infrequent nature of strong year classes may be associated with occasional years of above average production in subsurface waters. Although Pacific hake spawn over a broad area, survivors may be concentrated in patches along the shelf break and slope. Thus the hake may have adopted a strategy of broadcast spawning to increase the probability that larvae will encounter a patch of suitable prey. Slow-growing larvae have lower rates of survival, and larval growth rates indicate marked interannual differences, which may be associated with the availability of prey patches. Strong year classes tend to be associated with accelerated growth rates. Recent analysis of hake juvenile and adult diets supports the hypothesis that cannibalism is an important element in the recruitment process. Migration studies presented during the symposium helped modify the existing conceptualization of Pacific hake migration and ontogeny. In recent years, one-year-olds have been captured off the coasts of Washington and Oregon. Studies of the spawning distribution suggest a stratification of fish by size-at-age. Research also showed that the center of spawning

concentration is influenced by subsurface temperature; the fish spawn farther south in cool years.

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LITERATURE CITED

Alheit, J., and T. J. Pitcher. 1995. Hake: biology, fisheries and markets. London's Chapman & Hall, 477 pp.

John R. Hunter
Anne B. Hollowed