PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON KING AND TANNER CRABS. By ALASKA SEA GRANT COLLEGE PROGRAM. Fairbanks: University of Alaska Fairbanks, 1990. 633 p., illus., tables. Softbound. US$14.00.

In November 1989 an international symposium on the biology and management of king and Tanner crabs was held in Anchorage, Alaska. Agency, university, and industry representatives from five nations (U.S., Canada, U.S.S.R., Japan, and Argentina) met for three days to discuss the status of fishable populations, biological research, and management practices relative to these crabs. The conference was the eighth of the Lowell Wakefield series, designed to promote technology transfer among various segments of the fishing industry.

This was articulated in the opening remarks by Dr. John Costlow (Duke University), who described the societal benefits conferred by such information exchanges, extolling their role in the management and conservation of our coastal resources. More than 50 technical papers described various aspects of the natural histories, ecologies, and fisheries for king and Tanner crabs. The concluding session at the symposium was an open workshop discussion where participants expressed their concerns for research needs and, quite candidly, their philosophies regarding the management of these lucrative fisheries.

The symposium proceedings is a collection of most of the technical papers presented at the symposium, including a transcript of the closing workshop. Collectively, the papers provide a valuable single-source reference for all professionals participating in research and management of these or similar crustacean resources. The document organizes the manuscripts into five categories: life history, feeding and growth, mortality, population structure and dynamics, and stock assessment and management. The contents are not meant to be comprehensive reviews; and individual contributions vary widely in content. Individually, the manuscripts are of an autonomous nature, having been prepared in standard scientific formats. As such, they provide excellent sources regarding a multitude of field and analytical techniques currently in use in the study of crab populations. Editorially, the papers vary in writing quality and style. Some would benefit from additional peer review. However, considering the number of papers involved, the international nature of the meeting, the relatively fast publication schedule, and the price of the book, the overall quality is very good.

The meeting was heavily attended by U.S. scientists studying Alaskan crabs. As a result, a majority of the papers address king crab resources and issues pertaining to the Gulf of Alaska and Bering Sea. Considering the past and potential value of this fishery, these papers are particularly timely.

Several species of commercially harvested crabs are included by the king and Tanner crab taxonomic designations. Commercial quantities of Lithodidae (king) and Majidae (snow and Tanner) crabs are widely distributed in temperate and higher latitude seas of the northern and, to a lesser extent, southern hemispheres. Major fisheries are located in inland waters of southeast Alaska, on shelf areas of the Gulf of Alaska, Bering Sea and the Sea of Japan, and, in Canada, off British Columbia and in the Gulf of St. Lawrence. A southern form of king crab (and two congeners) are harvested in sub-Antarctic waters of Chile and Argentina.

Apparently, few species occur in sufficient numbers or densities to support viable commercial fisheries. The existing fisheries exploit populations of four species of king crab and two species of Tanner crabs. Within the king crab group, red king crabs are without question the most famous and biologically well known. However, at least six other, lesser known, congeners are currently harvested or are probable targets of expanding fisheries. During the early 1980s red king crab populations declined throughout Alaska; they remain depressed today. This decline quickly led the fishing industry to shift to more abundant but less valuable Tanner crab resources. This is evidenced by the rapid economic growth in the snow crab fisheries that has occurred during the past decade. Although several species are captured, *C. bairdi* and *C. opilio* crabs constitute the bulk of all landings.

The unifying theme of the symposium was the socioeconomic and biological information needed to bring stability to the seafood industry. High interannual variation in resource abundance typifies the king and Tanner crab fisheries of the world. They have historically followed economic cycles of "boom or bust," and it is during periods of diminished resource abundance that fishery effects become most profound. The stock fluctuations are pervasive in the seafood industries, affecting individual and corporate incomes, capitalization, and the marketplace. In a sense these fluctuations are reflective of the dynamic nature of marine ecosystems, where shifts in abundance follow the complex interplay of abiotic and biotic factors responsible for exceptional year class successes or failures. At the species level, the growth and decline of populations underlie the biological and economical instability that pervades both the management and harvest sectors of the fishing industry.

Achievement of increased economic and regulatory stability may be possible with improved knowledge of the causes, magnitudes, and periodicities in recruitment and with foresight of the economic effects of resource management. The management of crab stocks requires, among other things, reliable information about the magnitude and condition of the resource at any given time. This has traditionally been accomplished by means of broad-scale resource surveys designed to provide data on the size, sex, and relative abundance of fishable stocks. Landing statistics as a surrogate for stock abundance should also be monitored to examine trends within exploited populations. Since variability is pervasive in the marine environment, long-term records of biological and oceanographic data are necessary to document change and assess the significance of fishery activities.

A shared goal of management and industry alike is for biological stability within the king and Tanner crab populations. If realized, exploited populations would be able to maintain and perpetuate themselves while annual harvests remain relatively constant in the face of variable recruitment. Various strategies are employed to protect stocks; and most commonly, a quota system limiting catches of certain sizes is employed. The size restriction generally applies to male crabs old enough to have mated at least once prior to recruitment into the fishery. However, the determination of age in crabs is imprecise. Further, field and laboratory observations provide conflicting results as to the effective size male crabs must be in the wild for successful first mating. The determination of morphometric maturity in male *C. opilio* crabs is also uncertain and may be better indicated by claw size than by conventional measures of carapace width. In each instance, these problems have direct bearing on the determination of the reproductive potential of these populations. Since there is a tendency to overfish, questions persist about possible fishery effects on declining or depressed stocks.

A number of numerical models are used to describe relationships between age and growth and stock abundance in crabs. The effects of temperature-dependent growth, varying size, and sex restrictions on the management strategies for red king crab as explored in modeling efforts are described in a number of papers. A comparison of the predictive capabilities of traditional spawner-recruit and cohort analysis models used to forecast year class strengths in red king crab suggests biological and statistical advantages to the latter approach. Evidently, cohort analysis more accurately describes the parent-recruitment relationship over the lifetime of the crab.

Crabs have interannual variations in abundance that range over an order of magnitude at the exploited stage. These variations have led biologists to seek explanations for cycles within the dynamics of local crab populations and in their relationships to habitat attributes. The book contains numerous examples of recent studies investigating various determinants of year class success. They include field studies concerning the 1) migration and movement behaviors of crabs, 2) the role of ocean temperatures and currents on ontogenic development and larval drift, and 3) food habits and growth in crabs. In the laboratory, experiments concerning the effects of 1) temperature and salinity on the growth of larval and juvenile crabs and 2) diet on growth in crabs have been recently conducted to explore environmental influ-

ences in a broader sense. The nearly synchronous decline of Alaskan king crab populations in the early 1980s has sparked scientific inquiry about disease and parasitism in crabs. Three extended abstracts provide preliminary information about potentially widespread role of epizootics as a factor influencing stock abundance. New advances in genetic stock identification techniques and protection of nursery areas of young crabs may aid in the rebuilding of depressed stocks.

Habitat protection, particularly for that of young crabs, while universally recognized as being important, is not always practiced. It is disappointing that this issue and others pertaining to the protection of stocks were not fully explored at the meeting. Without exception, information is lacking about juvenile crabs (of all species) and their habitat requirements. With few exceptions little has been done to ensure environmental quality or well-being of young crabs distributed in these areas. In the western Bering Sea, the U.S.S.R. prohibits trawling in nearshore environments important to reproducing and rearing king crabs. Similarly, the Japanese have identified a nursery for *C. opilio* crabs and have taken appropriate protective measures. The policies of other nations regarding the size and seasonal catch restrictions prescribed for industry often represent the extent of biological protection. Groundfishery effects on benthic habitats and populations may be substantial. In the U.S. and other nations, bycatch — the number of crabs captured in bottom-sweeping trawls — is capped by management but continues to be a major source of mortality. Perhaps such issues will be addressed in future symposia.

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THE SOUTHERN ICE-CONTINENT. By ERICH v. DRYGALSKI. Bluntisham, Huntingdon, UK: Bluntisham Books, 1989. £49.95; US$95.00.

About a century ago, when the Deutsche Südpolarexpedition was planned and finally carried out, the polar regions of our earth were still terra incognita. Drygalski's narrative of this German South Polar Expedition from 1901 to 1903 on board the research ship *Gauss* gives an expansive account of the plentiful discoveries that were still to be made in the Southern Ocean and on the Continent. Although a comprehensive synopsis (20 volumes) of the results of the *Gauss* expedition has been published, the cruise report by Drygalski, the expedition leader, is still fascinating to read.

The first three chapters give an insight into the scientific planning, funding, selection of the expedition members and fitting out of the ship. There was some cooperative planning with Scott's *Discovery* expedition, which was bound for the Pacific sector, whereas the *Gauss* was to approach the ice from the Indian Ocean. There had been some preceeding reconnaissance cruises to the Kerguelen in 1874 to set up a meteorological and magnetic station. The *Valdivia*'s German Deep Sea Expedition in 1888/89 from Cape Town went close to Enderby Land and was regarded as very successful. The cruise plans of the *Gauss* were strongly influenced by G.v. Neumeyer, who favoured magnetic measurements on the Kerguelen and proposed a warm water current flowing southward across Antarctica to join the Weddell Sea.

The cost of the expedition could not be met by private subscriptions, but was finally secured by the Reichstag, as the dispatch of a Südpolarexpedition had become a matter of national honour in many European nations. Is there a parallel to be seen in the present? The *Gauss* was finally built at the Howaldt shipyard in Kiel to the apparent satisfaction of the expedition members.

For a quarter of the book there follows a detailed description of the cruise, starting with its departure from Kiel (August 1901) to the day when the *Gauss* was beset in the ice (February 1902). The expedition started with the disclosure of serious shortcomings in the ship and its equipment. This part of the book also contains exhaustive descriptions of the different port calls, including biological, geological and political considerations (the Boer War raged in South Africa). The scientific highlights were the confirmation of the Romanche Deep and the discovery of the Crozet-Kerguelen trench, with cold Antarctic water at depth.

The central part of the book deals with the real Antarctic adventure. The seizure of the ship in the ice was followed by intensive activities to set up a winter station and consequent collection of meteorological, magnetic, astronomic, geodetic, glaciological, oceanographic and biological data from various huts and the ship. Continuous loss and failure of equipment was met with ingenious inventions: construction of a tide gauge; the building of lamps for burning oil from seal blubber according to Meyers Konservationslexikon; setting up a windmill for generation of electricity; "hiring" an emperor penguin to carry a line under water from bow to stern of the ship.

Several expeditions on sledges were carried out to the coast, 90 km away from the ship, and farther inland to the Gaussberg. The dogs were taken over from the Kerguelen Station, to which they had been shipped from Kamchatka via Australia. One sledge party almost got lost in a blizzard when returning to the ship. Drygalski describes all these activities, sometimes exhaustively and sometimes only briefly, in a light-hearted, matter-of-fact style but also with some sense of irony and humour. From his account spirits were high throughout among the expedition members. Only in November/December 1902, when no hope of getting out of the ice was in sight, did the excitement about the new discoveries subside; the prospect of staying a second winter in the ice dampened the mood. Many plans were made about how to get the ship out of the ice (e.g., blasting icebergs until they capsize to make it out of the ice in their wake) or to set out to Knox Land, 900 km away, for a rendezvous with a relief party in the austral summer of 1903/04.

However, in February 1903 the ice broke and *Gauss* drifted helplessly in the pack in a westerly direction before it was completely free in April 1903. The scientific work went on and the reader, waiting excitedly for the ship to get free, has to put up with intermingled remarks about phytoplankton and benthos populations or about the role of nitrifying and denitrifying bacteria in relation to Karl Brandt's theories — business as usual. Drygalski had seriously planned a second winter station and found it the hardest decision not to carry this out and to sail to the Kerguelen for safety reasons.

The journey back to Kiel is described similarly as the journey down south at the beginning (full of details about South Africa, where the Boer War had just ended), as are the reports about the island where the ship called into port (e.g., a photograph of the grave of Bonaparte on St. Helena).

Drygalski was deeply disappointed by the rejection of his proposal to set out for Antarctica again from Cape Town and his instructions to sail back to Germany as soon as possible. The *Gauss* expedition was regarded as a failure. News of the exploits and surveys of Scott's *Discovery* expedition had broken in Germany. In comparison the *Gauss* had broken no record; *Discovery* had finally reached 82°S in the Ross Sea, whereas *Gauss* was beset just north of the polar circle. Drygalski regarded his expedition as part of an international plan, and he had worked in his area as effectively as other expeditions in different regions, but "the fact that the coast lay where we found it was noted with regret by some critics, because it was situated at an insufficient high latitude." How do we measure the success of an expedition today?

The tasks of the *Gauss* were plentiful. It had to explore an unknown coast, it had to carry out magnetic measurements for the sake of safer navigation in the Southern Ocean, and it conducted an impressive sampling program for a variety of parameters, despite a long list of minor mishaps. It was the second ship, after the *Belgica*, captured in the ice for an entire year. On reading this book on a warm