

## Antarctic Biology— Indian Contributions and Perspectives

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Antarctica, having exceptional natural features, is reportedly the most lifeless continent on the earth. It is remarkable that any life at all, survives the environment of extremely low temperatures, tremendous biennial fluctuations in photoperiodicity; dryness and lack of organic soil. However, the human ingenuity through incessant adventurous explorations, under the most inhospitable conditions, has revealed a wide spectrum of biotic manifestations, of a special type, within the expansive biogeographic provinces of continental Antarctic, maritime Antarctic and the subantarctic.

As a matter of fact, biological studies heralded the beginning of the modern Antarctic research. Most of the earlier investigations pertained mainly to qualitative characterization, viz. occurrence, distribution, taxonomy and zoogeography. However, after the realization about the potential importance of Antarctic krill as a source of protein for humans, (Pequegnat 1958), the Antarctic biology received the most realistic impetus towards diversification with quantitative aspects, as a priority sector.

### **Areas of Research & State of Knowledge**

The last 30 years or so have witnessed the blossoming of Antarctic biology into a foremost and most pursued area of Antarctic explorations.

Almost till 1960's, most of the biological themes had a short history in ecology, physiology and biogeography and accordingly the survey work besides being qualitative was of a very preliminary nature. However, in the years from 1960 to 1965, a

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distinct widening and deepening of the research efforts were discernible. The greatest interest among biologists was to concentrate on relationship between biota and the rigorous environmental set-up. Adaptations of species and ecosystems to an area of extreme cold and to the long period of darkness, during the gruelling polar winter, became the central theme of Antarctic biology, in the ensuing years.

Accordingly, the biologists started concentrating on the productivity studies—photosynthetic activity, energy flow and transfer efficiency in the Antarctic food chain. Increasing demand for protein foods, made the biologists to devote whole heartedly to the highly productive Antarctic and Southern Ocean, with its astonishingly high standing crop of krill resources and its potential economic importance.

Thus, the biological research of post 1970's is centering around Antarctic Ecosystems and Exploitable Resources. Detailed studies, on the ecosystem with particular emphasis on the food web relationship and the interaction between krill and its food base, the phytoplankton, are undertaken. Besides, krill biology, the stocks of Krill, squids and fishes are assessed for the possible harvesting. Programmes on sea birds and marine mammals, for paying special attention to the needs to maintain and protect a well-balanced Antarctic ecosystems, have been initiated. Biological, chemical and physical oceanographers are jointly investigating the conditions governing primary production and the fate of phytoplankton. Researches on physiological ecology of terrestrial, limnetic, glacial and marine biota, with significant emphasis on the biochemical basis of adaptations to extreme cold conditions and prolonged darkness during winter are being pursued, besides strengthening the taxonomic and biogeographic studies.

### India's Contribution

The Indian Scientific Expeditions to Antarctica, offered an unique opportunity for initiating and pursuing, a series of biological investigations in a relatively unexplored sector of Antarctic continent and the encircling Southern Ocean. The area lying between 37 to 72°S latitude and 5 to 45°E longitude, is scientifically little known and covers a variety of diverse ecosystems viz. Oasis or dry valley; freshwater lakes; icy sea shelf; fast ice and polynya; pack ice; open ocean and the environs of a number of subantarctic islands (Parulekar 1983).

Deploying the trophic ecology—energy flow approach, Indian biologists have attempted to study and characterize the composition, distribution, relative abundance, production rate and resource potential of different ecosystems and their contribution to Antarctic food web and exploitable living resources. Such type of ecosystem approach is reliable as it stresses the interdependence of components, both biotic and environmental, involved, therein.

Biotic components studied include bacteria (Prabhu Matondkar & Gomes 1983); mosses and lichens (Wafar & Untawale 1983); epontic algae (Prabhu Matondkar & Qasim 1983); phytoplankton (Goes & Devassy 1983); zooplankton (Goşwami 1983); benthos and nekton (Parulekar, Ansari & Harkantra 1983); krill

(Ingole, Prabhu Matondkar & Parulekar 1984); sea birds and marine mammals (Parulekar 1983). Life process characterization, encompassed, chlorophyll and pheophytin pigment content; quantification of photosynthesis and respiratory process; estimation of particulate organic carbon (POC); measurement of live carbon or adenosine triphosphate (ATP); biochemical composition of detritus in marine sediments (Verlencar, Singbal & Parulekar, 1983); biomass and/or standing crop estimate; determination of the magnitude and rate of production and its utilization at different trophic levels in the terrestrial, limnetic, glacial and marine ecosystems.

So far, the biological investigations were restricted to the austral summer. However, with the India's first manned research station at Dakshin Gangotri (Antarctica) becoming operational from early 1984, detailed investigations, on the physiological adaptations of Antarctic flora and fauna, during the most stressful, dark winter period, have been taken-up and shall be augmented and diversified in the ensuing years.

#### **Future Programmes And Priorities**

The terrestrial and glacial Antarctic ecosystems, being constrained by the paucity of warmth, moist air and free water, restrict the survival and evolution of organisms (Llano 1972). The low level of activity of decomposers contributes little to soil formation and, hence the soil, wherever present, is virtually without humus—an essential ingredient for colonization of organic form (Bakus 1978). Thus, the continental ecosystems are relatively simple and impoverished.

In contrast, the marine Antarctic ecosystem comprises of one of the most productive regions on earth (Holdgate 1967). Active upwelling of nutrients, at the beginning of austral summer, triggers off a prolific, multispecies short food chain, with Antarctic krill as the key organism. With the depletion of whale stocks, the existence of krill resources, as a major potential source of protein for human (Mackintosh 1970), has become a reality.

Antarctic biology is now moving beyond the purely descriptive phase and the stage is now set for more detailed quantitative estimates of exploitable living resources and for experimental investigations towards the proper understanding of environmental and biotic characteristics.

Some of the priority areas, that spring to mind, are :

- exploratory fishing for krill and other self generating resources, for the assessment of exploitable yield.
- physiological and molecular biological investigations on the key organisms from different ecosystems.
- detailed investigations on the organic detritus, as a source of food and also for the proper understanding of food chain relationship on a quantitative and energetic basis.

- estimation of turn over rates and assessment of the role of micro-organisms as a source of food and also,
- interdependence between the fast ice, pack ice and open sea ecosystem, in relation to differences in the annual cycle of biological productivity.
- interrelationship between continental, maritime and subantarctic ecosystems.

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