Ecological and Biogeographical Aspects of the Chilean Fjord Region

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Fjord Regions

Fjord regions are coastal landscapes that have generally been created by the erosive power of glaciers. They are only present along higher latitude coasts with mountainous hinterlands. Only here precipitation is high enough and temperatures are low enough to allow snowfall to build up into ice fields, and glaciers to develop close to the shore. While most fjord areas were covered with giant ice fields during periods of glaciation, in subsequent warm periods the glaciers retreated and many of the glacial valleys filled with sea water, forming the fjords. The retreat of the ice allowed plants and animals to recolonise the land and the newly formed marine habitats. Several fjord regions extend over large latitudinal gradients, with the most poleward glaciers still reaching sea level. This situation allows observation of different stages in biological succession after ice retreat. The abrasion of glaciers, and also the erosion by water runoff that results from the abundant rainfall in these areas, causes cutting and fractionation of the coast, giving fjord regions a highly structured shoreline (Fig. 1).

Fig. 1

The Chilean Fjord Region

The Chilean Fjord Region is probably the most extreme example of coastal structuring. In contrast to most other fjord regions in the world, it involves two mountain ranges—the Patagonian Andes in the east and the Coastal Mountain Range in the west. South of 42° the Andes are deeply crenulated through the fjords along the continental coast. Two giant inland ice fields still feed long glaciers, the southernmost of which calve directly into the sea. South


Fig. 2


Fig. 3

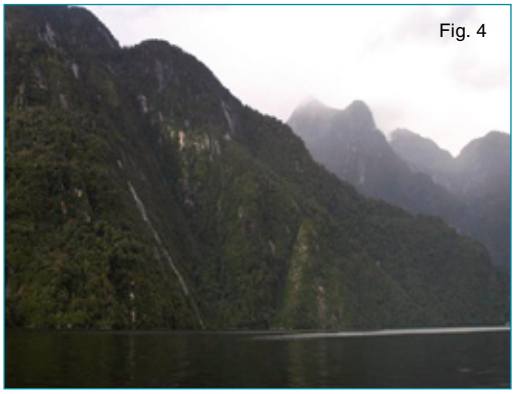
Fig. 4

of 42°, the valleys of the Coastal Mountain Range are mostly flooded with sea water, forming a dense labyrinth of channels, fjords and little islands. This pattern extends over more than 1,500 km from Puerto Montt (42° S) to Cape Horn (56° S). The Chilean Oceanographic Institute (SHOA) estimated a total coastline of the Chilean Fjord Region of more than 80,000 km, a distance equivalent to twice around the globe!

Due to the humid climate with precipitation that can locally exceed 6,000 mm per year, the bare rock and other material that is left behind by glaciers is colonised relatively quickly, first by simpler organisms and subsequently by higher plants. Volcanic ash layers help to boost this process by providing substrate and nutrients. The steep slopes and heavy rains, on the other hand, permit inorganic soils to built up only in the valley floors; other locations are generally characterized by deep black organic soils of varying thickness.

Superficial water runs off quickly from the steep slopes. During heavy rains, small ephemeral creeks arise every few meters along the slopes. Rivers in these areas are numerous and comparatively short, but water flow is often highly torrential. The run-off carries large amounts of inorganic and organic material into the fjords and channels. Inorganic material ranges from dissolved nutrients over glacial silt to gravel and boulders, and organic material from dissolved tannins and organic acids over leaves to branches and trees (Fig. 2).

Landslides and avalanches are frequent elements of natural erosion. They can erase the complete living community along their way, and this is dumped into valley floors, rivers, or directly into the sea. The newly generated clear areas allow the recolonisation process to start over again. Vertical stratification patterns of the vegetation along a steep hillside of a fjord indicate different stages of biological succession after landslide events (Fig. 3). In addition to the constant input through run-off, these erratic events bring huge amounts of organic and inorganic material into marine coastal habitats. Many landslides continue under water and erase benthic life, allowing analogous succession processes as on land (Fig. 4).

Physical and Chemical Factors

Due to the high ratio of coastline to water surface in the Chilean Fjord Region, terrestrial-marine interactions or terrestrial-marine coupling are extremely important for the processes and dynamics in the marine environment. Initial studies indicate a substantial contribution of terrestrial nitrogen to the nutrient cycles in marine