Larga seal *Phoca largha* photo by TAZAWA Michihiro

Primary production activity by organisms such as phytoplankton occur earlier in the waters around Shiretoko Peninsula than in any other place in the Sea of Okhotsk, the melting and breakdown of ice also occurs earlier here than in the rest of the Sea of Okhotsk. This period of high-level primary production coincides with the shoals of fish fry and the weaning of seal pups that need a good quality and abundant food source. As a result, the plankton plays an important role in the life cycle of marine wildlife. For example, fry of walleye pollack and chum salmon as well as pups of the larga seal all feed upon the zooplankton that proliferate with the melting of sea ice. In addition, salmon fry that swim downstream into the ocean have been observed to follow the abundant levels of phytoplankton and zooplankton along the ice edge to higher latitude areas as they feed and grow on this food source (Takahashi, 2002). The coastal waters of the Shiretoko Peninsula are an important starting point of the food chain for the integrated ecosystem that consists of the ecosystems of sea, river and land.

As described above, the coastal waters of the Shiretoko Peninsula support an abundant food source for high-level producers and promote a diverse biota by producing a high level of food compared to the surrounding ocean which is not covered with ice. Furthermore, this rich food source is supplied at the right time. The nominated site is an outstanding example representing this mechanism.

3a. 5 Plants

The majority of the vegetation covering the Shiretoko Peninsula, including the nominated site, is in virgin condition. While the altitude changes is only some 1,600 meters from the coast to the mountain peaks, alpine plants such as Japanese stone pine *Pinus pumila* and other alpine plant communities are developed at relatively low altitudes, and diverse vegetation is distributed vertically at the site. In addition, the flora contains both northern and southern species and therefore, it is rich in species diversity.

3a. 5. 1 Vegetation communities

With regard to horizontal distribution of the forest vegetation in the low altitude areas of the Shiretoko Peninsula, it is a Pan-Mixed Forest Zone according to Tatewaki (1958) and consists of a mosaic of three types of forests:

1. The cool temperate deciduous broad-leaved forest with species such as Japanese oak *Quercus mongolica* var. *grosseserrata,* painted maple *Acer mono* and Japanese linden *Tilia japonica,*
2. The subarctic evergreen coniferous forest with species such as Sakhalin fir *Abies sachalinensis,* Yezo spruce *Picea jezoensis* and Sakhalin spruce *Picea glehnii,* and
3. The mixed forest which is a combination of the above cool temperate deciduous broad-leaved forest and subarctic evergreen coniferous forest.

The forest belongs to the "Manchu-Japanese mixed forest" biogeographic province of Udvardy which covers nearly all of Hokkaido excluding Kuromatsunai lowland zone and areas south of this zone, as well as southern parts of the Far East including southern Kuril Islands,

southern Sakhalin, Ussuri Sikhote-Alin and northeastern parts of China. Pan-Mixed Forest Zones and Manchu-Japanese mixed forests exist in northern and northeastern parts of Europe as well as the eastern United States, however, Pan-Mixed Forest Zone of Hokkaido is clearly different from those of other areas due to the following characteristics (Ito and Kojima, 1987):

1. The flora is composed of a wide range of species.
2. Stratification is well developed.
3. There are relatively large number of woody vines and epiphytic plants in the forest.
4. The forest floor is almost completely covered by dwarf bamboos.

In addition, the Pan-Mixed Forest Zone of Hokkaido is unlike that of the Russian Primorskii krai which is located in the same biogeographical province. Compared with the forest of Russia, the forest of Hokkaido lack *Pinus koraiensis* which is a major component in the forest of Russian Primorskii while the forest of Hokkaido contains a greater volume of deciduous broadleaf trees. In addition, the forest of Hokkaido contains a large number of species and the volume of each species is also different between the two areas (Okitsu, 1999; 2001). These differences can also apply to the low altitude forests at Shiretoko Peninsula.

Mixed forest photo by MACHIDA Yasuyoshi

The vegetation of the Shiretoko Peninsula is of high scientific value since in addition to the characteristics of vegetation geography described above, it is preserved in virgin condition and displays the following characteristics (Samejima and Sato, K., 1981; Sato, K. *et al*., 1985):

1. A variety of vegetation, ranging from montane/cool-temperate to alpine/arctic plant communities is distributed vertically in a narrow range of altitudes from the coastal area (0 m) to mountain peaks reaching 1,250 meters to 1,660 meters.
2. Alpine/arctic and subalpine/subarctic plant communities are developed on the seashore.
3. A wide range of vegetation, including a solfatara community (plant community which tolerates acidic soils near sulfur fumaroles) is observed below the timberline.
4. The timberline is at 1,100 meters and above this altitude, there is alpine vegetation such as Japanese stone pine scrub and various alpine plant communities despite the low altitude.

As an example of the vertical distribution of vegetation, at the highest mountain in the peninsula, Mt. Rausu, the upper limit for the cool temperate deciduous broad-leaved forest is at the altitude of approximately 750 meters and the timberline is at approximately 1,100 meters. There is montane vegetation up to 750 meters, subalpine vegetation above 750 meters to 1,100 meters and alpine vegetation (Japanese stone pine zone) at 1,100 meters and above.

Mt. Rausu photo by MACHIDA Yasuyoshi

In the coastal area of the Shiretoko Peninsula, the vegetation consists mainly of alpine/arctic to subalpine/subarctic plants which covers areas such as rocky coasts and the surrounding area with little development of soil. There are *Stellaria ruscifolia* community, *Sedum rosea - Primula modesta* var. *fauriei* community and *Sedum kamtschaticum - Artemisia schmidtiana* community on rough rocky coasts, while in areas surrounding the rocky coasts with some soil developed on steep faces,

there are tall-herb communities such as *Saussurea riederi* var. *yezoensis* - *Achillea ptarmica* var. *macrocephala* community. At the tip of the peninsula, Shiretoko Cape, there is an extensive area of sea-eroded tableland. *Empetrum nigrum* var. *japonica* communities carpet the edges of the tableland facing northwest, which are swept by the winter seasonal winds, and there are *Allium schoenoprasum* var. *yezomonticola* communities on the gravel beds in between. These communities resemble the combination of dwarf scrub of "heath" and rough herb communities found on alpine wind-exposed sites in Europe. While on top of the tableland, there are montane tall-herb communities consisting of *Artemisia montana*, *Filipendula camtschatica* and so on, while near the edges, there are subalpine tall-herb communities consisting mainly *Polygonum bistorta* and *Aconitum maximum* (Sato, K., 1981b). However, these communities are in decline due to foraging by Yezo sika deer *Cervus nippon yesoensis* which have concentrated in the Shiretoko Peninsula in the last decade.

Examples of plant communities that are not zonally distributed below the timberline are solfatara and wetland vegetation. In the solfatara surrounded by mixed forest on the mountainside of Mt. Iou and Mt. Rausu, there is vegetation composed of alpine plants such as Japanese stone pine, *Ledum palustre* ssp. *diversipilosum*, *Empetrum nigrum* var. *japonica* and *Gaultheria miqueliana* and temperate zone plants such as *Miscanthus sinensis* and *Hydrangea paniculata*. In the area around Lake Rausu (altitude approx. 740 m) and the Shiretoko-goko lakes (altitude 239 m), there are high moors, low moors and marsh/swamp vegetation such as *Nuphar pumilum* and *Menyanthes trifoliate*.

The area above the timberline is extensively covered by Japanese stone pine scrub. In Honshu (the main island of Japan), Japanese stone pine scrub usually occurs above altitudes of 2,000 meters but at Shiretoko

Japanese stone pine *Pinus pumila* scrub photo by MURATA Ryosuke

Peninsula, they occur at 950 meters at some places (Okitsu, 1987) and as low as 570 meters at Mt. Shiretoko (altitude 1,254 m) (Sato, K., 1998). In several locations along the ridges in the montane zone (altitude approximately 300 m to 400 m), there are some local communities of Japanese stone pine. It is considered that the effects of the winter seasonal winds combined with topographical factors create harsh conditions that favor such vegetation patterns.

The alpine vegetation of the Shiretoko mountain range creates a stunning and beautiful landscape, despite the relatively low altitude of the vegetation. Large communities of alpine plants are found particularly on Mt. Onnebetsu, Mt. Chinishibetsu and along the ridge from Mt. Rausu to Mt. Iou, in addition to areas around Mt. Shiretoko. In wind-exposed sites there is less snow cover on the ground, preventing the development of Japanese stone pine scrub. In these areas, there are *Arcterica nana - Loiseleuria procumbens* community (dwarf scrub on alpine wind-exposed site) and *Viola kitamiana* community (alpine herbaceous communities including the endemic *Viola kitamiana* and *Arenaria merckioides* which only grows in Hokkaido on wind-exposed gravelfield). *Viola kitamiana* community is of special interest as they are unique to the Shiretoko mountain range and are only found in wind-exposed gravelfield such as volcanic gravelfield of Mt. Iou, Mt. Higashi, Mt. Chienbetsu and Mt. Minami and the wind-exposed saddle between Mt. Onnebetsu and Mt. Chinishibetsu. On the snow-patches, there are *Sanguisorba stipulata - Juncus beringensis* communities (herbaceous communities on the edge of flowing water from snow-patches), *Phyllodoce* communities (dwarf scrub on snow-patches consisting of *Phyllodoce caerulea*, *P. aleutica*, *P. caerulea* forma *yesoensis* and so on), *Saxifraga merkii - Carex flavocuspis* communities (herbaceous communities on the gravel grounds at the bottom of snow-patches). In areas with avalanches, there is *Saussurea riederi* var. *yezoensis - Carex scita* var. *riishirensis* community (alpine/subalpine forb communities, tall-herb community on moist snow-patches). The high moors of Futatsu pond (altitude 1,320 m) and Shiretoko swamp (altitude 920 m) are both located above the timberline and they contain alpine plants such as *Bryanthus gmelinii*, *Loiseleuria procumbens* and *Juniperus communis* var. *montana* in addition to Sphagnum species (Sato, K., 1981a).

With regard to the seaweed vegetation at Shiretoko Peninsula, there is a clear habitat segregation of seaweed species between shallow and deep water areas due to the following factors: there are sheer cliffs along the coastline; there are few artificial structure on the seashore; there is no land erosion by livestock which is causing murky water to runoff into the sea; there is little impact of human activity. For example, on the extensively studied east coast of the Shiretoko Peninsula, seaweed species are distributed in zonation, starting from the seashore with *Colpomenia sinuosa* and then onto *Silvetia babingtonii*, *Fucus distichus* ssp. *evanescens*, *Analipus japonicus*, *Analipus filiformis*, *Chondrus yendoi* and *Chordaria flagelliformis*. Among these species, *S. babingtonii* and *F. d. evanescens* develop large conspicuous communities and most of the flat rock beds near the shore are covered with these two species. There are also significant communities of *Halosaccion firmum* which is a cold current species in the intertidal zone of the flat shore in Moireushi bay (Kurogi *et al.*, 1985).

Primula cuneifolia photo by Shiretoko Museum

Geum pentapetalum
photo by Ministry of the Environment

Saxifraga merkii
photo by Ministry of the Environment

Pentstemon frutescens
photo by Ministry of the Environment

3a. 5. 2 Flora - terrestrial and marine

The vascular plant flora on land and the seaweed flora of the Shiretoko Peninsula contain a unique mixture and distribution of northern and southern species.

The vascular plant flora is diverse as there are many northern species in alpine plants, while in plants excluding alpine plants, southern species co-exist in large proportion. The flora contains 104 families, 817 species, 59 varieties and 18 breeds and alpine plants (Kawano, 1971) account for more than one quarter of them with 233 species (Sato, K. *et al.*, 1985).

The species in the alpine flora of the Shiretoko Peninsula have the highest proportion of northern plant groups and the lowest proportion of southern plant groups from East Asia among the "Four major mountain ranges in Hokkaido", that consist of Mt. Daisetsu, Hidaka mountain range and the Yuubari mountains together with Shiretoko Peninsula. The northern plant group species are distributed mainly in the tundra of the polar areas of the northern hemisphere i.e. the polar areas in Eurasia or Asia-North America, the North Pacific region and Northeast Asia or North Asia. The southern limit for most of these species is Hokkaido or the mountain areas of Honshu. It is suggested that Hokkaido's alpine flora was developed under the influences from three different routes: The northeast route from Kamchatka/North America via the Kuril Islands; the north route from the far eastern area of the continent via Sakhalin; and the south route via the Korean Peninsula and Honshu (Tatewaki, 1963; 1967; Watanabe, 1971). The fact that the alpine flora of the Shiretoko Peninsula contains many species which belong to the northern plant group thought to have migrated via the Kuril Islands and Sakhalin during Ice period supports the above theory.

In addition, the following species are excellent examples of the isolated distribution of the Shiretoko alpine flora:

- *Artemisia laciniata*: A species of arctic element; the domestic distribution is limited to Mt. Oohira, Rebun Island and Shiretoko Cape in Hokkaido.
- *Chrysanthemum vulgare* var. *boreale*: A species of Eurasiatic element; the domestic distribution is limited to Rishiri and Rebun Islands and Shiretoko Peninsula.
- *Aconitum maximum*: A species of northern Pacific element; the domestic distribution is limited to Shiretoko Peninsula.
- *Astragalus japonicus*: A species of northern Pacific element; the domestic distribution is limited to Mt. Shari and Shiretoko Peninsula.
- *Cochlearia oblongifolia*: A species of northern Pacific element; the domestic distribution is limited to Nemuro and coastal cliffs of Shiretoko Peninsula.
- *Stellaria ruscifolia*: A species of Asiatic element (North eastern Asia-Himalayan element); the domestic distribution is limited to mountain zones in mid-parts of Honshu and several locations in Hokkaido.
- *Arenaria merckioides*: A species of Japanese element; the domestic distribution is limited to Akan and Shiretoko Mountain range in Hokkaido.

Viola kitamiana photo by MURATA Ryosuke

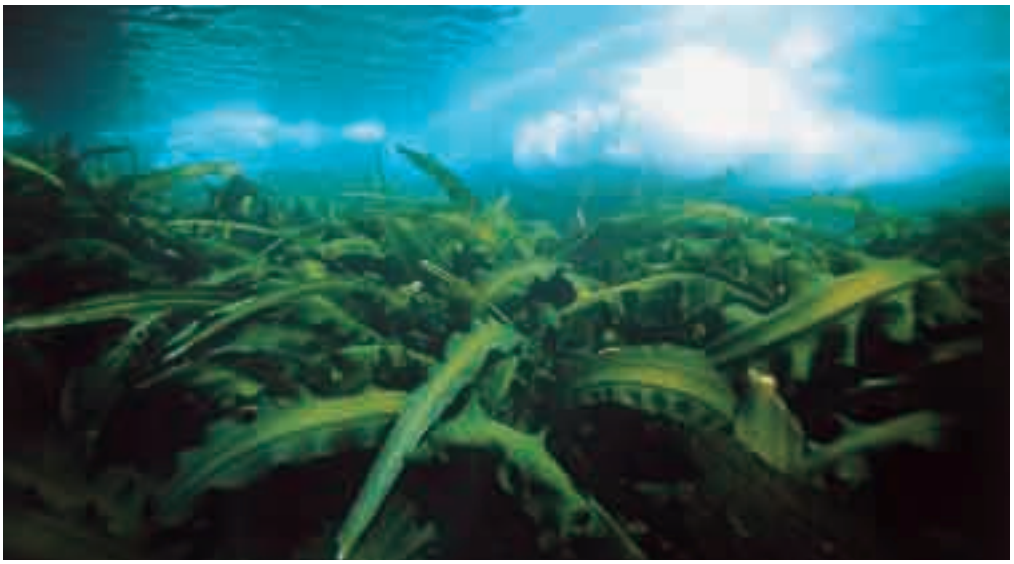
Another significant species is the *Viola kitamiana* which is endemic to the Shiretoko Mountain range.

On the other hand, the vascular plant flora excluding the alpine plants contains many southern species, and among them, there are some species with isolated distribution. The following are examples of isolated distribution in Shiretoko Peninsula:

- *Apocynum venetum* var. *basikurumon* (listed as "Endangered" on Ministry of the Environment Red List: EN, MoE Red List) (Tohyama, 1958), which is distributed on the Sea of Japan-side coastline from Tohoku area to Hokkaido, is limited to coastal cliffs;
- temperate zone plants such as *Daphniphyllum macropodum* var. *humile*, *Calanthe tricarinata* (EN, MoE Red List), *Calanthe nipponica* (EN, MoE Red List) and *Ilex crenata* var. *paludosa*, that cover northwards along the heavy snowfall areas on the Sea of Japan-side of Hokkaido, are limited to forests in the montane zone (Tatewaki, 1954; Sato, K. *et al.*, 1985); and
- large trees of Katsura tree *Cercidiphyllum japonicum* (LR, IUCN Red List), which is endemic to Japan, in the montane zone.

It is considered that the differences in climate and topography between western and eastern parts of the peninsula also have an effect on the distribution of plants. Distribution of temperate zone ferns such as *Asplenium scolopendrium*, *Asplenium incisum* and *Osmunda japonica* are limited to the Sea of Okhotsk side while *Athyrium yokoscense* grows only on the Nemuro Strait side (Sato, T. *et al.*, 1997). Similarly, *Daphniphyllum macropodum* var. *humile* is only distributed on the Sea of Okhotsk side of Mt. Rausu (Nakagawa, 1988).

In the coastal waters of the Shiretoko Peninsula, there are both cold current-based seaweeds (which distribute also around the Kuril Islands and Sakhalin) and warm current-based seaweeds (which are mainly distributed around Hokkaido and further south). The seaweed flora is unique in that it contains many species of warm current-based seaweeds in spite of being situated in a seasonal sea ice area. Among the 134 species (Chlorophyceae 28; Phaeophyceae 41; and Rhodophyceae 65) of seaweed recorded along the Rausu coast and the area around Utoro (Kurogi *et al.*, 1985), there are 32 species of warm current-based seaweed, which is the same level as the 29 species of cold current based



Kelp forest photo by KURASAWA Eiichi

seaweed. It is considered that this unique distribution is a result of the following conditions: the southern shift of the Soya warm current in summer; the southern shift of the East Sakhalin Current (cold current) in winter; and the both currents end up approximately in this area. While the coastal waters of the Shiretoko Peninsula belong to the temperate zone in terms of seaweed distribution, it can be classified as a boundary temperate zone strongly influenced by cold currents.

The coastal waters of the Shiretoko Peninsula are also habitats for some rare seaweeds. *Cymathaere japonica* (listed as "Rare" on Fisheries Agency Data book: R, FA Data book) is an isolated species with a limited distribution range. The domestic habitat is limited to the coastal area of Rausu town (Kawashima, 1994). *Akkesiphycus lubricum* is a primitive type of kelp, which is found only in a limited area. The southern limit for this species is in Kushiro, eastern part of Hokkaido. In 1944, it was found in Akkeshi and later, in 1968, distribution near Shiretoko Peninsula was confirmed (Kurogi, 1968; Kurogi and Yamada, 1970).

3a. 6 Animals

The nominated site supports a diverse population of animal species, combining northern species from Sakhalin and southern species from Honshu. In addition, almost all the terrestrial mammals and birds that historically inhabited Hokkaido are preserved at the nominated site due to its pristine virgin nature.

3a.6. 1 Terrestrial mammals

Terrestrial mammals that inhabit the Shiretoko Peninsula are classified in six orders, 12 families and 35 species (Shiretoko Museum, 2000). Among them, three species of one family of Chiroptera are listed as Endangered (EN) or Lower Risk (LR) in the IUCN Red List, and further five species of the same family and one species of Insectivora, total of nine species of two orders, are listed as Endangered (EN) or Vulnerable (VU) in the Red List of the Ministry of the Environment.

The topography of the Shiretoko Peninsula is complex and there are various types of vegetation within a narrow range of altitudes from the coastline to the mountain peaks of approximately 1,600 meters above sea

Brown bear *Ursus arctos* photo by Shiretoko Nature Foundation