# SEA BUCKTHORN *HIPPOPHAË RHAMNOIDES* L. – TAXONOMY, DISTRIBUTION AND INTRODUCTION IN BALTIC STATES

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The taxonomy, distribution and ecology of the sea buckthorn *Hippophaë rhamnoides* L. are overviewed. A history and prospectives of sea buckthorn introduction in Baltics is described. Valuation of the economic benefit and aspects of commercial growing are given.

Keywords: *Hippophaë rhamnoides* L., taxonomy, ecology, introduction, commercial growing.

There are three species in the genus *Hippophaë* – *H. rhamnoides* L., *H. salicifolia* D.Don. and *H. tibetana* Schlecht.

*H salicifolia* grow on southern slopes of Great Himalaya Range, altitude ca. 1 500 – 3 000 m. Fruits are edible, leaves used in Bhutan for making tea, fruits also for polishing gold and silver.

*H. tibetana is* distributed in the Great Himalaya Range, on higher altitudes, ca. 3 050 – 4 700 m. Fruits are edible, also used as a medicine for stomach ache.

*H. rhamnoides* L. consists of nine subspecies as follows:

*H.rhamnoides* L. ssp. *rhamnoides* grow wild along the south coast of the Baltic Sea and the coast of the Gulf of Bothnia, the coasts of Denmark and the west coast of Sweden, the Atlantic coast of Norway, isolated inland localities in Norway, along the coasts of the North Sea and the English Channel. Introduced along the coasts of the British Isles. A solitary occurence on the coast of Loire-Atlantique, France, possibly introduced. This subspecies is morphologically fairly distinct, because of the thick. twisted, knobby branches and large, usually cylindric berries. It deviates from others ecologically as well, being almost exclusively a seashore plant, that is reflected in the synonym *Hippophaë litoralis* Salisb.

*H.rhamnoides* L. ssp. *fluviatilis* v. Soest is found in the Alps and adjacent areas, extending into the Apennines, the Pyrenees, and the Rhine valley, alt. from ca. 100 to 1 900 m.

*H.rhamnoides* L. ssp. *carpatica* Rousi is distributed in Carpathian Mountains, Transylvanian Alps, the valley and the mouths of the Danube and its tributary, the Drava, alt. 0 – ca. 380 m. On sandy or alluvial soil in river valleys and on the shore of the Black Sea.

*H.rhamnoides* L. ssp. *caucasica* Rousi grow in the Caucasus Mountains, Georgia, Azerbaijan, Armenia, eastern parts of Turkey, Black Sea coast at Varna, Bulgaria, alt. 0 – ca. 3 000 m.

*H. rhamnoides* L. ssp. *turkestanica* Rousi is found growing wild in mountainous areas and uplands in the Tadzhik, Kirgiz, eastern Uzbek and eastern Kazakh, western parts of the Himalayas, alt. ca. 600 – 4 200 m. In Afghanistan sometimes as hedges around the fields.

*H. rhamnoides* L. ssp. *mongolica* Rousi is located in mountainous western parts of Outer Mongolia, Altai Mountains, montainous parts of the Tomsk, Yeniseysk, Tuva, Irkutsk and Buryat Mongol regions, alt. ca. 500 – 1 800 m. The economically most valuable occurrences in Russia seem to represent this subspecies. Particularly those of the Altai region are also superior in respect of the quality of the fruits as compared with the other races from Russia.

*H. rhamnoides* L. ssp. *sinensis* Rousi is distributed in northern China, western part of inner Mongolia, alt. ca. 800 – 3 600 m.

*H. rhamnoides*L. ssp. *yunnanensis* Rousi grow in northwestern parts of Yunnan and southeastern corner of Tibet, alt. ca. 2 200 – 3 700 m.

*H. rhamnoides* L. ssp. *gyantsensis* Rousi is located in Tibet, on alt. ca. 3 500 – 5 000 m.

There is an interesting parallel in distribution and ecology between *Hippophaë* and *Myricaria germanica* L., that also grows in mountanous river valleys, have the center of origin in Central Asia, a gap in their distribution east of the Caspian Sea and disjunct occurences in Central Europe and Fennoscandia. They have probably had a similar history, and the *Myricaria – Hippophaë* thickets in the river valleys of Eurasia represent fragments of an ancient Tertiary vegetation of Paleoasia.

The differentiation of genus probably took place after the last glaciation. Palynological records from various parts of Europe consistently show that *H. rhamnoides* was a widespread pioneer species in the open Late-glacial plant communities of Europe as long as 3 000 years from the retreatment of glacier. It obviously occupied a large and more or less continous area, and shifted its position as the ice sheet retreated, it can be seen in pollen records. A colony of *H. rhamnoides* must slowly shift its position in order to remain alive, as its dying older parts supress new growth from beneath. It is therefore constantly dependent on open soil, where it is more or less free of competition from other large shade-tolerant plants. Conditions after the glaciation must have met with the requirements of *Hippophaë* very well. With the invasion of the forests, *Hippophaë*, beeing a poor competitor, was pushed to seashores where these were available. In the region of mountains, it migrated to higher altitudes as the ice sheet retreated and pushed away from the lower latitudes when these were occupied by forests.

Nevertheless there is an inexplicable discontinuity in the distribution of wild *H. rhamnoides* ssp. *rhamnoides* stands at the Baltic Sea along the seashore of the Baltic States. One reason may be that *Hippophaë rhamnoides* L. very rarely is

found to be spread naturally by seeds due to its extremely high light demand, respectively very poor competition ability of seed sprouts. Another cause whould be the pollination problems of the single occasional dioecious seedlings. Besides the flesh of *Hippophaë* fruits has a strong inhibitory effect on germination. The flesh is long-lasting, partly because the ascorbic acid prevents decay and partly because of the tough outer skin. The fruits should be eaten by birds first, and in this way have the flesh removed. Thus, the wider distribution of *Hippophaëe* is probably depending on the routs of migratory birds.

Because the new plants demand a high light intensity, renewal of the thickets normally takes place vegetatively by root suckers outside those areas already colonized. *Hippophaë* thickets therefore often have a lower-growing rejuvenation border fringing the oder thicket. Vegetative development takes place more rapidly on the southern margins.

First trials of sea buckthorn introduction in Latvia and Lithuania took place in the seventies of last century, when seedlings from Kaliningrad region were grown along the roadsides as windbreakers and planted for recovering of used sand pits and dolomite quarries. The largest, ca. 100 ha recovered quarry in Baltics is located in Lithhuania, near Naujoji Akmene.There were several attempts later to introduce in Baltics such russian continental varieties as 'Maslichnaya', 'Dar Katuni', 'Vitaminnaya', 'Chuiskaya', 'Obilnaya' etc. This group of varieties is originated of *Hippophaë rhamnoides* L. ssp.. *mongolica*, therefore could not adapt to inconstant Baltic maritime climate with frequent late winter thaws. Similar abortive introduction attempt of *ssp. mongolica* has been recorded in the eastern coast of Canada, where it took three years to perish several plantations in Quebec region.

In 1984 another introduction trial in Latvia and Estonia took place, using different group of varieties, originated by prof. T. Trofimov in Moscow State University. As these varieties have been bred by crossings among *H.rhamnoides ssp. mongolica, ssp. rhamnoides* and *ssp. fluviatilis*, the adaptation was more successful.These hybrids have kept big berry size, high yield, long pedicel and few thorns from *ssp. mongolica* strains, beeing more adapted to temperate maritime climate due to presence of *ssp. rhamnoides* genes and have inherited high content of vitamin C from *ssp. fluviatilis*. Later on some of these varieties have been once more baccrossed with *ssp. rhamnoides* to strengthen adaptability to maritime climate.

Another range of commercial varieties suitable for maritime temperate climate has been created by Dr. Albrecht in Germany. Varieties 'Leikora', 'Hergo', 'Dorana', 'Frugana', 'Pollmix' etc. have been selected from the wild stands of *H. rhamnoides* L. ssp. *rhamnoides* along the sea shore of Germany, thus representing a pure maritime group, fully adapted to Baltic climatic conditions, with quite high vitamin C content, but still small berries with very thick peel and less fruit pulp content in comparison with large and fleshy berries of hybrids with *ssp. mongolica* genes.

Similar selection attempts were performed in Finland, resulting in such vrieties as 'Terhi', 'Riisa', 'Rudolf' etc.

A very interesting and promissing trial to cross the *ssp.mongolica* with nordic wild *ssp. rhamnoides* from Finland is made by N. Demidova in the Northern Research Institute of Forestry of the Federal Forest Service of Russia. The general purpose of this project is to push northward the splendid qualities of *ssp. mongolica* strains making possible growing high yielding varieties with large beries, long pedicels and few thorns in coastal sites of high latitudes. This project is further developing in the Kvarken region, Sweden and Finland.

During the late nineties of the last century the ecology of the adapted group of varieties has been studied in Latvia by A.Brūvelis, K. Blūms and L.Aaspollu in Estonia. Observations were made in 120 plots of commercial plantations in Estonia and Latvia, the average size of the plantation 2,8 ha.

General conclusions of these studies are as follows:

1. The most limiting factor of the *H. rhamnoides* L. vegetative growth is water supply. The most vigurous plantations were observed in lowlands on alluvial soils near rivers, lakes and ponds. Slightly drained slopes are best to prevent roots from oxigen choking.
2. No essential positive correlation between the growth and soil nutrient content, incl. trace elements has been found on different agricultural soils. The growth habit was noticeably depressed only on very poor sandy plots. However for the commercial growing the more or less rich sandy loam soils should be choosen, as the most value of *Hippophae* berries is determined by their rich bioactive components, that can not be synthesized without the presence of different chemical elements.
3. The topsoil complete natural cover by regularly mowed different caulescent plants essentially decreases the wilt disease *Verticillium dahliae* Kleb. rates on *Hippophaë* plants. It can be explained by the benefits of biodiversity – roots of each plant have their immune discharges preventing infection of different soil pathogens, incl. fungi. Probably it helps to turn down as well *Verticillium.*
4. Soil pH tolerance of the *Hippophaë rhamnoides* ssp. *rhamnoides* group of varieties lies between pH 5,7 and pH 7,5, but the sea buckthorn wilt disease *Verticillium dahliae* growth is promoted by alcaline environment (proved by the Dr. biol. Anita Lielpetere), thus for disease preventig reasons sites with pH 6,0 – 6,5 should be choosen for sea buckthorn plantations.
5. No essential animal caused damages were observed, except some occasional bark rubdown of roebucks marking outlines of their territories by scratching bushes with scent glands on horns.

The wide adaptation, fast growth, strong coppicing and suckering habits coupled with efficient nitrogen fixation with *Frankia* root nodules make sea buckthorn particularly suitable for planting in degraded soils. Sea buckthorn can control soil erosion efectively. In Latvia sea buckthorn has proved highly beneficial for fixation of moving sands on the public beach of city Ventspils, where seedlings of domesticated *Hippophaë rhamnoides* ssp. *rhamnoides* range of varieties were planted in 1999 and 2000.

The leaves, berries and seeds of sea buckthorn have high nutritional and medicinal values and contain vitamins C, B1, B2, E, F, K, P, provitamin A, organic acids and many other bioactive compounds. Its pulp and seeds contain essential oil important for its medicinal value. Therefore sea buckthorn is grown as a commercial crop in Latvia, where about 80 ha of plantations have been established from 1999 to 2004 and Estonia where about 500 ha plantations were made from 2001 to 2004.

Total commercial harvest amount of seda buckthorn berries in Baltic States in 2004 was about 300 tons. Berries were stored in Estonia with a purpose to make products for the local market, as well have been processed and exported to South Korea.

There is an Association of sea buckthorn growers in Latvia operating since 2002 and a sea buckthorn production union „A-Mari" in Estonia active since 2000.

## REFERENCES

**Rousi A. 1971.** The genus *Hippophaë* L. A taxonomic study. *Ann. Bot. Fennici* **8**: 177 – 227.

**Skogen A. 1972.** The *Hippophaë rhamnoides* alluvial forest at Leinora, central Norway. A phytosociological and ecological study. *K. norske Vidensk. Selsk. Skr.* **4**, 1 – 115.

**Bruvelis A. 2003.** Sea buckthorn development in Baltic States. *Proceedings of the 1 st Congress of the International Seabuckthorn Association.* September 14-18, 2003, Berlin. 64 – 66.

## Pabērzu smiltsērkšķa *Hippophaë rhamnoides* L. taksonomija, izplatība un introdukcija Baltijas valstīs

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Kopsavilkums

Raksturvārdi: *Hippophae rhamnoides* L., taksonomija, ekoloģija, introdukcija, komercaudzēšana.

Rakstā aplūkota pabērzu smiltsērkšķa *Hippophae rhamnoides L.* taksonomija, izplatība un ekoloģija. Aprakstīta smiltsērkšķu introdukcijas vēsture Baltijas valstīs un smiltsērkšķu kultūras attīstības perspektīvas. Vērtēti smiltsērkšķu komercaudzēšanas ekonomiskie aspekti.