

Joanna PIETRZAK-ZAWADKA • Jan ZAWADKA

THE FOREST ARBORETS AND THEIR ACTIVITIES FOR FOREST AND NATURE EDUCATION

Joanna **Pietrzak-Zawadka**, PhD Eng. – *Faculty of Forestry in Hajnowka*
Jan **Zawadka**, PhD – *Warsaw University of Life Sciences – SGGW*

Correspondence address:
Faculty of Forestry in Hajnowka
Piłsudskiego street 1A, Hajnówka, 17-200, Polska
e-mail: j.pietrzak@pb.edu.pl

ABSTRACT: Over the centuries, arboreta and botanical gardens have performed a variety of functions, the most important being the collection and sharing of the various plant collections. Initially, these collections mainly included medicinal plants for the education of future physicians or pharmacists. The aim of this article is to show the significant role of these units in the forest and nature education. Conducting scientific research and making collections for educational and research purposes is carried out by botanical gardens primarily by providing access to the public to harvest in a manner that will not endanger the collection. Formal education is carried out in these units mainly through links with universities and through the organization of special educational activities (equivalent to museum lessons) for schools.

KEY WORDS: arboretum, informal education, forest education, biodiversity conservation, State Forests

Introduction

Arboretum, dendrological garden, dendrarium (Latin *arbor*, *arboris* – tree) – the trees and shrubs are usually collected and usually researched. Arborets often carry out scientific research on morphology, anatomy, ecology, physiology and genetics of woody plants and the possibility of acclimatization of alien species (Szweykowska, Szweykowski, 2003). They are tested in them. The possibility of growing exotic species in foreign climatic conditions, the pace of their growth and the creation of new varieties and hybrids.

According to some definitions arboretum is a special kind of botanical garden whose principles of creation and functioning in Poland are defined in the Nature Protection Act 16 April 2004 (Ustawa, 2004). According to other sources, the arboretum is an area for the collection of trees and shrubs (Kiełbaska, 1991).

The species was formerly planted in arboretum collections mainly for aesthetic reasons. Contemporary collections collect different species according to ecological criteria (forming groups with similar habitat requirements) or systematic (grouping species and related species) (Mochtak, 1989).

Arboreta can serve as a gene bank that collects unique populations and clones of particularly valuable tree species, to be used for forest restoration after natural disasters or pest infestations.

Arboreta can also be included in botanical gardens or exist as a stand-alone facility. The first European gardens in Pisa and Padua (Italy), were the medical gardens. With the development of science (at the beginning of the systematics), the importance of showing the relationship of plants was taken up. Over time, botanical gardens, in addition to the purely utilitarian function of providing plant material, have gained a new role in representing the diversity of the plant world. Because of institutional unions, they were usually part of universities and began to function as centers of botanical science, with classic botanists, taxonomists, florists, plant physiologists and phytogeographers. Some of the gardens, such as the Royal Botanic Gardens Kew and the Botanical Garden in Berlin-Dahlem, have earned themselves the status of independent research institutions leading the way in the world of research. Others, like the botanical gardens of the University of Warsaw or the Jagiellonian University, have given rise to numerous university institutes or cathedrals specializing in various branches of botany. Impressive gardens were already established in ancient India, China, Egypt and Mesopotamia (Gelderen et al., 1994; Russell et al.; Tommer 2010).

Aristotle, a Greek scholar and philosopher, lived at the turn of the 4th and 3rd centuries for scientific purposes, and his father, Teofrasta, from Eresos,

founded the botanical garden, which founded a magnificent collection of plants at the Lyceum of Athens.

In Poland the first planned dendrological collections were built around the Royal Castle in Warsaw, the oldest botanical gardens were established at the Jagiellonian University (1783), Wrocław University (1811) and the University of Warsaw (1818). The first typical dendrological park was the Arboretum in Kórnik near Poznań (1826) (Zarzyński, Tomusiak, 2015; Olejnik, 2002; Łukasiewicz, Puchalski, 2002).

With the development of molecular techniques used for a growing number of other research purposes, it has turned out that access to suitable plant material can be a serious technical problem – such as uncovered herbarium collections and collections of live plants collected in arboreta and botanical gardens. One of the important challenges of modern biology has also been documenting and attempting to conserve the biological diversity of our planet, and without the botanical gardens, which

In their collections they maintain almost one third of the described species of seed plants, making it impossible. Moreover, the gardens have become refugees for about 10 thousand dying and endangered species of plants.

Currently, there are almost 2,200 botanical gardens in the world, of which most (about 60%) are in temperate regions (North America, Europe, the former Soviet Union). According to estimated data in their collections, there are about 80,000 species of vascular plants, mainly gymno- and angiosperms (about 160,000 taxa – varieties, subspecies, cultivars), totaling about 6 million of them. Their herbarium collections are even larger, and they are estimated at around 150 million sheets. Especially valuable are, for example, crop collections – in the gardens where the majority of cultivars or taxa closely related to them are planted or stored (in the form of gene banks), the plants are considered to be endangered or dying (according to IUCN on the world red plant list there are about 34 thousand of the species, and 10 000 of them are grown in botanical gardens) (Werblan-Jakubiec, Zych, 2007; Nowak, 1999).

In 2017 in Poland there were 31 arborets and botanical gardens belonging to various scientific institutions and 13 administered by The State Forests (Zarzyński, Tomusiak, 2015; www.danepubliczne.gov.pl). Some of them were founded in the 19th century. Their primary task was to check how alien species of trees can develop in different climates of Poland. Particular attention was paid to the Douglas fir and the exotic species of fir with which it was then European forestry were boud highhope.

Purpose, material and methods of research

The aim of the study is to present the role of forest arborea in undertaking activities in the field of natural and forestry education. Various arboretum information was analyzed for the purposes of this study. These were statistical data of the Central Statistic Office, data presented in scientific publications and other numerical figures on the subject. The work was focused on 13 arborets administered by The State Forests in Poland.

Research results

Arboreta and botanical gardens are located in the whole country, but the largest ones are located in the Wielkopolska, Pomeranian, Silesian and Kujawsko-Pomorskie voivodships. The largest number of forest sites was recorded in the Pomeranian Voivodship (figure 1).

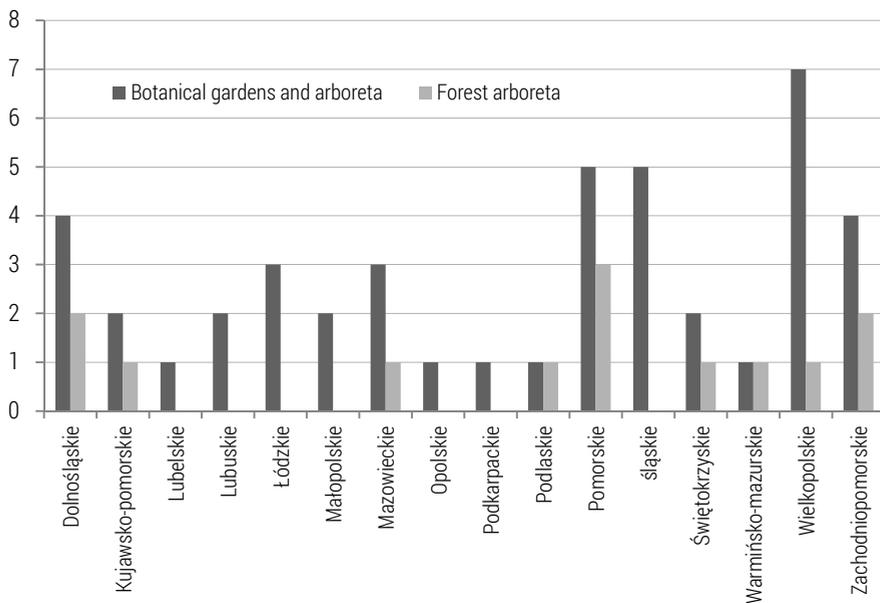


Figure 1. Botanical gardens and forest arborets in Poland in 2017

Source: author's own study based on available sources.

In the area of forest arboretum, mainly trees and shrubs are grown for research purposes. in ecology, acclimatization and breeding. The main advantage of this place is that in a small area we can review the vegetation originat-

ing from different parts of the world and assembled into teams that we will not meet in any natural environment.

Forest arboretum are institutions that, due to their place of origin, status and ownership or relationship to forest experimentation are connected in different ways to forestry (Tumiłowicz, 2010). It is important to emphasize the importance of The State Forests in creating arborea. The State Forests have a statutory duty to conduct forest and nature education, which consists of organizing educational centers with lecture halls, museum collections, didactic pathways, plant gardens at the premises of forest districts or forestry, while the establishment of arboretums goes far beyond these duties and deserves great recognition. The initiative is usually carried out by local foresters. Consultants are usually academics (most forest arborets have scientific supervisors or scientific councilors) (Tumiłowicz, 2010, 1994; Zarzyński, Tomusiak, 2015).

The oldest forest arboretum in Poland – Arboretum in Lipno – has founded in 1783. Among 13 forest arboreta (table 1), the two oldest ones, in Wirty (1875) and Glinna (1880), were established in former nurseries. The Wirtach Arboretum was partly built in existing stands. In addition to the dendrological collections, the Forest Experimental Areas were established from the beginning with trees of foreign origin to examine their suitability for forest management, and since 1979 similar surfaces are assumed in Zielonka. In the arboretum in Syców, in addition to dendrological collections on an area of 70 hectares, a large collection of so-called. selected trees (with the best phenotypic characteristics i.e. healthiness, trunk quality, crown type, stand in the tree with larger dimensions of the breed and height), collected under the „Program of preservation of gene resources of forest trees in Poland” (Tumiłowicz, 2010).

Table 1. Forest arboreta in Poland in 2017

L.p.	Forest arboretum	Voivodship	Year	Area (ha)	Status of botanical garden
1	Park-arboretum Ośrodka Kultury Leśnej in Gołuchow	Wielkopolskie	1894	158,05	-
2	Arboretum Leśne im. Prof. Stefana Białoboka in Sycow Forest Inspectorate	Dolnośląskie	1993	150	+
3	Arboretum in Wirty	Pomorskie	1973	46,32	+
4	Leśne Arboretum Warmii i Mazur in Kudypy im. Polskiego Towarzystwa Leśnego	Warmińsko-mazurskie	1989	15,69	+
5	Ogród Dendrologiczny in Glinna	Zachodniopomorskie	1970	5,57	+
6	Leśny Ogród Botaniczny in Marszewo	Pomorskie	2008	49,69	+
7	Leśne Arboretum im. Powstańców 1863 r. in Kopna Góra	Podlaskie	1988	25	-
8	Arboretum Leśnego Banku Genów Kostrzyca in Miłkowo	Dolnośląskie	1995	12	-
9	Arboretum Lasów Puszczy Iłżeckiej in Marcule	Mazowieckie	2006	7,9	+
10	Botanical Garden in Karnieszewice	Zachodniopomorskie	1881	4,79	+
11	Arboretum in Lipno	Kujawsko-pomorskie	1782	4,18	-
12	Arboretum Leśników Kartuskich in Kartuzy	Pomorskie	2011	4,03	-
13	Arboretum im. Władysława Kapuścińskiego in Drugnia Forest District	Świętokrzyskie	2008	0,8	-
	Summ			428,76	-

Source: author's own study based on www.danepubliczne.gov.pl [20-09-2017] and others available sources.

The Arboretum in Rogów (Łódzkie Voivodship) is also included in arboreta whose activity is related to forestry. Since its inception (1925) it has been under the Faculty of Forestry of the Warsaw University of Life Sciences – SGGW.

More than half of the forest arboreta have botanical status, given by the minister of the environment. These units do not surrender to the botanical gardens, and in some cases the botanical garden is a matter of time (the procedure for appointing botanical gardens is complicated and time-consuming) (Zarzyński, Tomusiak, 2015).

In the case of arboreta established in the forest, the age of the stand is known and available in the forest management offices. Forest arboreta are particularly valuable in regions where there are no other such facilities, e.g.

located in northern Poland and in various sub-zones of climate, hence to some extent fill this gap, e.g. in Kopna Góra in Supraśl Forest District, in Kudypach in Kudypy Forest District, in Wirty in Kaliska Forest District and in Glinna in Gryfino Forest District.

Apart from the collector's and scientific functions, the most developed function of forest arboretems seems to be an educational function. This activity mainly includes educational and exhibition activities, taking the form of lessons in the field and specially prepared chambers of education, leadership, cooperation with schools and publishing houses. According to the „Regulations... 1998” (Regulamin Rady..., 1998) arboreta should be made available for sightseeing within the scope determined by the management. The manager's ambition is to prepare the arboretum to accommodate as many visitors as possible, providing them with comprehensive information about the garden and the leisure conditions. The forest arboretum is a place to conduct nature education through the popularization and transfer of botanical knowledge with special regard to the protection of species of plants, animals and fungi and the protection of biological diversity. Natural and forest education is conducted in a passive manner by providing a collection of forest arboretems and in an active way by organizing educational classes for organized groups.

Educational activities conducted in the forest arboretum are organized according to the following principles: classes for professional groups, i.e.: trade groups, students and representatives of other organizations and institutions, excluding educational and educational institutions are organized and implemented by the forestry arboretum or its employees. Classes for organized children's and young people's groups, together with carers, are carried out by the nature and forestry educator assigned by the forest inspectorate as part of the educational activity. Each participant can talk about the practice of the activities and, for example, to see and try the tools used in the forestry and forestry industry today (e.g. Arboretum in Syców, Kudypy) (table 2).

All of the analyzed facilities offer nature-related classes (often conducted in the field), educational activities for youth, workshops and events popularizing forests and forestry. The most popular form of activity are lessons, educational workshops, screenings of nature films and seminars, conferences, talks. Often they are also integrated classes (e.g. combining multimedia presentations with practical exercises) so that their form is as attractive as possible (table 3).

Table 2. Collection of plants in selected forest arboretums

Arboretum	Plants collections	Educational activities and infrastructure
Arboretum in Stradomia Dolna	Collection of about 1200 species and varieties of trees and bushes from different parts of the world and a unique collection of Polish selected trees (among others the best in Europe pine from Rychtalskie Forest), azalea park, alpine garden with collection of plants, water and protected plants.	Complex of five ponds with bridges and bridges, educational trail and activities for school youth, nursery school ornamental plants.
Arboretum in Kudypy	Collections of trees and shrubs with over 700 species and varieties. The most abundant are represented by clones (over 30 species), iris (29 species) and dry and wild roses. There are collections of juniper, spruce, fir, and other conifer species, including a collection of native trees and shrubs of about 300 species and varieties. Natural forest – it is the most interesting natural part of the old natural forest with monumental trees.	Cooperation with scientific institutions in Poland. Organization of numerous lectures, lectures and the implementation of research programs. Numerous didactic boards, exhibitions and exhibits prepared for younger visitors, among others. Exhibitions of all types of bird and wood booths of different species of trees. Colorful plaques present issues related to the ecology of the forest and its processes. Added bridges and bridges led, among others. over a piece of the swamp forest. Geological Lapidarium – a collection of stones and boulders from Warmia and Mazury. Educational board with natural exhibitions and expositions concerning the former work of foresters.
Arboretum Leśników Kartuskich in Kartuzy	23 species of forest trees, mostly in the age of 100-170 years. These include: giant bramble, green fir, common beech, small lime, maple sycamore, common fir, pine plug. Visitors can follow the process of wood decay.	Nature Education Path. Jerzy Schwengla. For educational purposes, 50 plates were hung with names and 120 trees were numbered. Especially picturesque is the aged beech specimen, called „beech stilts” because of the protruding from the ground and branching roots.
Arboretum in Lipno	„Lipno” Nature and Landscape Park in which there is a Dendrological Park. Numerous species of temperate trees in North America, Asia, Southern Europe, the park has an interesting collection of azaleas and rhododendrons. There is one of the oldest and largest in Poland, giant hedgehogs.	Natural and educational path in the „Lipno” Nature and Landscape Complex, natural path in the dendrological garden.
Arboretum in Drugnia	71 species of coniferous trees and shrubs from the northern hemisphere. Next to the national trees you can admire here. 12 species of pines, Siberian microbe, chinese and japanese spruce, spruce, fir and larch, giant mammoth. Trees were planted in small groups to facilitate their free observation.	Trees were planted in small groups to facilitate their free observation. In addition to the decorative and educational functions, it is possible to track their growth and to evaluate the potential of individual species in local climatic conditions. Interest in the arboretum is a so-called avenue. „Bendyktynek”, ie trees bred from seeds consecrated personally by Pope Benedict XVI during his visit to Warsaw on 26 May 2006.
Arboretum in Wirty	450 species of trees and shrubs; 110-year-old oak stand with an area of 1.01 ha – exclusive seed stand; alpinarium on an area of 0.44 ha	Scientific and educational institution of Kaliska Forest Inspectorate. Scientific supervision is carried out by the Department of Dendrology and the Formation of Green Areas of West Pomeranian Technical University in Szczecin; Previously, the Institute of Dendrology of the Polish Academy of Sciences in Kórnik participated actively in the arboretum.

Source: author's own study based on available sources.

Table 3. Examples of forms of environmental education in the Arboretum in Kopa Góra

Form of education of nature and forest	Realization
Outdoor activities	The project „Forest Folk and Forests” School trips Adult tours
Classes in the educational chamber „Forest school” and in the Museum of Knyszyn Forest History	The project „Forest Folk and Forests” Organizing classes for schools Organizing activities for adults
Educational folders	„Arboretum in Kopa Góra”
Individual education	Information contained in educational and information boards

Source: author's own work.

Arboreta develops and publishes short folders and extensive guides, albums, postcards and souvenirs. Larger and older arborets, with more staff, have fixed tour guides, smaller guides are available upon prior arrangement of arrival dates. At the entrance to the arboret are information boards, which give general information about the garden, as well as regulations, opening times, ticket prices, etc. At the counter, you can buy folders and guides at the entrance. Trees and shrubs should have labels with plant names. In some arbours, larger boards are also set up with selected interesting trees, with more specific characteristics of the species (e.g. Lipno, Kopa Góra, Kudypy).

For the convenience of the visitors in the arboret, there are numerous benches and trash baskets, as well as rain shelters, tables and toilets. Most of the forest arboreas are located outside the city and the countryside (among others: Glinna Karnieszewice, Lipno, Marszewo, Sites).

In many arboretas, there are small natural collections (collections of cones, boards and other botanical exhibits) and educational rooms, as well as a place for bonfires, playgrounds for children. The Spring and Autumn Holidays (e.g. Gołuchów), Open Days (e.g. Syców, Miłkowo, Marszewo), rhododendrons (e.g. Syców) and other festivities like picnics, exhibitions, concerts (e.g. Gołuchów, Miłkowo, Marcule, Karnieszewice). An interesting example of educational activities is the arboretum in Kudypach. Due to the lack of this type of facility in this part of the country and the poorly diversified species rich dendrofolium. Arboretum species make it possible to know and observe the ubiquitous trees, bushes and herbaceous plants. In various forms of forestry education can participate even to 10 ths. each year (www.lasy.gov.pl).

Educational activities are carried out in complementary stages: lecture or lesson (exercise room, green class), exploration of species and communities in arboretum, followed by self-observation on natural and educational paths. The next stage consists of fixing and supplementing the messages sup-

ported by folders, books, films, presentations (library, lecture room) and promoting participants' participation in numerous competitions. During this type of activity, green lessons, field exercises and research are intertwined to create a much more comprehensive content than if they were functioning separately. Arboreta included in this teaching and cognitive process are much more efficiently used as a didactic-scientific and tourist-recreational facility (www.lasy.gov.pl).

Arboreta cooperates, among others, with schools, community centers, non-governmental organizations and organize joint educational and recreational events and sports (e.g. Kudypy, Karnieszewice, Marcule, Kopna Góra, Miłkowo). The actions of the arborets are based on the conviction that the proper and effective protection of these natural resources that still remain to us depends on the level of knowledge of society and of consciousness shaped towards the sustainable use of environmental resources. The most common are the forest communities, which enable active learning of issues requiring greater involvement, improvement of observation and description (field lessons, team games).

Library collections are also available in the arboretums. The vast majority of volumes concern broadly understood conservation. The collections of botany, zoology and nature of the region are distinguished within the collection of natural collections. In order to consolidate tasks, individual facilities cooperate within the Council of Botanical Gardens and Arborets in Poland (www.robia.pl).

Summary

In the arboretum, scientific goals and objectives are put in the first place. This concerns the professional conduct and maintenance of documented plant collections and their extension and the collection of long-term observations and measurements which are the basis for scientific publications. In addition to the scientific aspects, it is important to educate and popularize botanical and forestry knowledge among the public. The educational offer in each of the facilities is provided, as well as brochures and other publications and guides for tour guides.

Arboreta forest also aims to bring closer to the activities of The State Forests to protect natural forest resources through educational activities and initiatives to protect natural resources – such as the active conservation of genetic resources by the preservation of endangered and endangered plant species. Gardens are also monitored for the variability of individual trees and shrubs and the possibility of growing them beyond the natural range of

occurrence. Arboreta visits school trips, students and organized groups of tourists, it is also an interesting destination for family trips.

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The contribution of the authors

Joanna Pietrzak-Zawadka: conception 50%, literature review 50%, acquisition of data 50%, analysis and interpretation of data 50%

Jan Zawadka: conception 50%, literature review 50%, acquisition of data 50%, analysis and interpretation of data 50%

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