Acta Sci. Pol.
Silv. Colendar. Rat. Ind. Lignar. 6(1) 2007, 13-25

AN ECOLOGICAL AND GEOGRAPHICAL CHARACTERISTIC OF VASCULAR FLORA IN THE UPPER TRACT OF THE KOSA RIVER VALLEY AND LAKE CZAPLE (ZACHODNIOPOMORSKIE PROVINCE)

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Abstract. Investigations were conducted in the upper tract of the Kosa River valley and Lake Czaple (Zachodniopomorskie province). A total of 200 vascular plant species belonging to 69 families were recorded. Forty seven of the reported species are legally protected or are found on the lists of threatened and vanishing species (e.g. *Achillea ptarmica, Asplenium trichomanes*, *Epipactis helleborine*, *Polypodium vulgare*). The dominant role in the tree layer is played by *Alnus glutinosa*, *Quercus robur* and *Fraxinus excelsior.* In the shrub layer abundant specimens of *Frangula alnus, Corylus avellana, Sambucus nigra* and *Viburnum opulus* are found, along with self-sown *F. excelsior*, *Acer pseudoplatanus* and *Picea abies*. In the herbaceous layer the most commonly found species include *Calamagrostis canescens* and taxa from genus *Carex.* Reported species most frequently represent communities from the following classes: *Alnetea glutinosae*, *Querco-Fageta*, *Quercetea robori-petraeae*, *Vaccinio-Piceetea*, as well as *Phragmitetea.* It was found that the biggest number of species prefer positions with moderate light and semi-shaded positions on fresh and moist, organic and mineral soils.

Key words: vascular flora, Lake Czaple, Kosa River, Dębno district

INTRODUCTION

The variable surface features and considerably diversified habitat conditions make the plant cover of Western Pomerania the richest in Poland. The diversity of forest, aquatic, peat or even steppe biotopes in that region for many years has attracted considerable numbers of naturalists. The most important literature sources on the flora of Western Pomerania include studies by Marsson, Ascherson and Graebner. At the turn of the 20th century an immense contribution to the knowledge on the natural value of this

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region and the promotion of nature conservation was also made by Winkelmann, the creator of three editions of "Flora of the Pomerania region" and Holzfuss, the author of numerous studies and monographs on this region [Przyroda... 2002]. Moreover, in the years 1920-1940 throughout the Western Pomerania region numerous investigations were conducted and their results were presented in studies by Kulesza (1920), Decker (1924), Wodziczko (1925), Frase (1930, 1935), Rafalski and Urbański (1932), Oźminówna (1933), Krawiec (1935), as well as Wodziczko, Krawiec and Urbański [1938; after Ginące i zagrożone... 1995].

After WWII scientists started to inventory the losses of nature resources in the Pomerania region. The inventory of western Pomeranian flora, prepared in 1950 by Czubiński, recorded 1575 species, which at that time constituted approx. 70% of the wild plants growing in Poland. Moreover, in the Western Pomerania region numerous botanical studies of regional importance were also conducted [Celka and Jackowiak 1998, Ziarnek et al. 2003]. Among them, due to the location of investigations in the vicinity of the Dębno forest district [a part of which is the subject of this study], the following need to be mentioned: studies by Czubiński [1947] and the Jasnowska and Jasnowski [1997] devoted – among other things – to the Bagno Chłopiny reserve; a study by Jermaczek and Stańko [1999] from the area of the Gudzisz peatbog; a study by Ćwikliński and Jasnowski [1997] on globe flower meadows connected e.g. with the Myślibórz Lake District; studies by the Jasnowski and Jankowski [1960] on calciphilous vegetation in the area around Lake Tchórzyno; floristic remarks by Żukowski [1967] connected e.g. with the environs of Kostrzyn, and a study by Bacieczko [2000], concerning the vegetation cover in the Skalisty Jar reserve, written by Libbert. Probably the tremendous number of very valuable natural objects in the Myślibórz Lake District resulted in a situation when many of them have not yet been analysed in terms of their plant cover. Such insufficiently studied regions include the Kosa River valley and Lake Czaple (Zachodniopomorskie province, the district of Dębno).

The aim of the study was to prepare the current list of flora of the above mentioned object, to present its ecological characteristics and determine local threats to plants of the area.

METHODS

Detailed floristic investigations were conducted in 2003 and 2004. Additionally, the study incorporates certain observations coming from earlier years, starting from 1998.

Nomenclature of plants was given following Rutkowski [2004]. For each species reported in the field its estimated occurrence frequency was recorded, according to the modified scale adopted after Piotrowska et al. [1997]: 1) a very rare species – 1-3 stands, 2) rare – 4-9 stands, 3) rather frequent – 10-14 stands, 4) frequent – 15-20 stands, 5) very frequent – 21-40 stands, 6) common – over 40 stands, respectively.

On the basis of studies by Zarzycki et al. [2002], Ginące i zagrożone... [1995], Jasnowska and Jasnowski [1997], Kujawa-Pawlaczyk and Pawlaczyk [2001], Fukarek [1991], Benkert and Klemm [1993], as well as the Ordinance of the Minister of the Environment on species of wild growing, legally protected plants [Rozporządzenie... 2004], their protection status and species threat category were determined for individual taxa, adopting: E – a species especially threatened with extinction in the natural envi-

ronment in Poland; V – at risk of extinction in Poland; V1 – endangered in Western Pomerania and the Wielkopolska region; R – rare in Western Pomerania and the Wielkopolska region; I – with an undefined threat in Western Pomerania and the Wielkopolska region; V2 – strongly endangered in peatland communities; R1 – endangered in peatland communities; Ex – extinct, dying out, at risk, potentially endangered or rare, which stands should be mapped during field studies in Western Pomerania; E1 – locally rare and endangered, which should be mapped during field studies, if in a given area there are fewer than 20 of its stands; Ex1 – extinct and lost in Mecklenburg; V3 – at risk in Mecklenburg; R2 – an endangered species in Mecklenburg; Ex2 – extinct and lost in Brandenburg; E2 – dying out, threatened with extinction in Brandenburg; V4 – at risk, strongly endangered in Brandenburg; R3 – threatened in Brandenburg; Oc – covered by complete legal protection in Poland; Oc1 – covered by partial protection.

The following data were determined on the basis of a study by Zarzycki et al. [2002]:

- life form (according to the Raunkiaer system: M – megaphanerophytes, N – nanophanerophytes, Ch – arborous chamephytes, C – herbaceous chamephytes, H – hemicryptophytes, G – geophytes, T – therophytes, Hy – hydrophytes, li – lianas, ep – epiphytes, pp – semiparasites, p – parasites),
- the number of stands in Poland (2 – a small number, up to 100 stands; 3 – a large number of stands primarily in one region; 4 – a large number of stands in many regions; 5 – a common species throughout the country),
- dynamic trends in Poland in the last decades (–2 – a large drop in the number of stands; –1 – a decrease in the number of stands or a marked loss of specimens in stands; +1 – an increase in the number of stands, a distinct increase in the number of specimens in stands; +2 – a large increase and occupation of new stands; –/+ – stands disappear and new stands appear),
- light index (1 – deep shade; 2 – moderate shade; 3 – semi-shade; 4 – moderate light; 5 – full light),
- thermal index (l – the coldest regions of the country; 2 – moderately cold regions; 3 – moderately cool climatic conditions; 4 – moderately warm climatic conditions, most of the lowlands; 5 – the warmest regions and microhabitats),
- trophic index (l – extremely oligotrophic soils; 2 – oligotrophic; 3 – mesotrophic; 4 – eutrophic; 5 – extremely fertile, excessively fertilized),
- organic matter index (l – soils poor in organic matter; 2 – mineral humus soils; 3 – soils rich in organic matter),
- soil grain size index (1 – rocks and crevices; 2 – rock debris, scree, gravel; 3 – sand; 4 – sandy clays and silty soils; 5 – heavy loams and clay soils),
- soil moisture index (2 – dry; 3 – fresh; 4 – moist; 5 – wet; 6 – water),
- soil acidity index (1 – strongly acid soils, $pH < 4$; 2 – acid, $4 < pH < 5$; 3 – moderately acid, $5 < pH < 6$; 4 – neutral, $6 < pH < 7$; 5 – alkaline, $pH > 7$),
- phytosociological classification – major taxa were analysed, in which a given species grows most frequently (relations, orders, classes of associations). The adopted phytosociological approach is consistent with a study by Matuszkiewicz [2002].

Moreover, the affiliation of a given part of flora to histo-geographical groups was determined, distinguishing the following categories of introduced species [Jackowiak 1993]: Sp – semi-synantropic spontaneophyte, Ap – synantropic spontaneophyte (apophytes), Kn – kenophyte, Arch – archeophyte, Ep – ephemerophyte, Ar – agriophyte.

A CHARACTERISTIC OF THE AREA OF THE STUDY

The analysed area is located 9 km north of the town of Dębno and approx. 4 km north-east of the village of Smolnica (Zachodniopomorskie province, the Myślibórz county, the Dębno district). The object administratively belongs to the Szczecin Operation Area of State Forests, the Dębno division, locality Dębno, the Grzymiradz forest district. Its range includes parts of the following compartments (subcompartments are given in parentheses): 7 (h), 8 (b, c, g, j), 14 (d), 15 (h, i), 16 (b, f, g, h), 17 (a, b), 27 (g, h, i, j and fragment g), 28 (d), 29 (a, g, fragment d and f), 44 (fragment c and d), 45 (a, b), 46 (a), as well as Lake Czaple, Kosa River and lands of the village of Smolnica. The total area of these lands is 73.65 ha, out of which the area of Lake Czaple is 26.10 ha, while the lands of the village account for 14.50 ha.

According to the physico-geographical regionalization [Kondracki 2000] this area is located in the sub-province of the South Baltic Lake District (314), in the region of the South Pomeranian Lake district (314.6), in the mesoregion of the Gorzów Plain (314.61). In terms of natural forest regionalization [Trampler et al. 1990] this area is located in the Baltic region (I), in the Myślibórz-Wałcz province (I.3), in the mesoregion of the Gorzów Plain (I.3.b). According to the geobotanical regionalization [Matuszkiewicz 1993] this area belongs to the region of outwash forelands of the Central Pomeranian Lake Districts (A.5), the Gorzów subregion (A.5.a), the Gorzów district (A.5.a.1). In turn, according to the climatic regionalization (Woś 1994) the analysed area is situated in the Western Pomeranian region (VI).

The characterized area in its range covers a fragment of a narrow, V-shaped valley of the Kosa River, and Lake Czaple located in a melt-out hollow. The area around the analysed site is formed by slightly undulating outwash plateaus [Kondracki 2000]. The highest point of the analysed area is located at 65 m above sea level [Atlas... 1996].

Thermal characteristics of the analysed area classify it in the warmest region of Poland. Average annual air temperatures are 8.4-9.2°C. Thermal conditions are the main factors determining the length of the vegetation season, which in this part of Poland lasts approx. 230 days and is the longest nationwide [Operat... 2001].

Annual precipitation totals are on average 550 mm. The biggest amount of precipitation falls in late spring and summer, which with a relatively mild and generally warm climate create good conditions for the growth and development of the plant cover.

Peat-muck and bog soils predominate in the whole area. Peat-muck soils were formed from bog-peat soils, after drainage disrupting the process of peat accumulation. They represent the most fertile trophic variant of these soils formed from lowmoor peats, which is connected with sites of typical alder swamp forests and ash-alder swamp forests. Podzolic soils formed from slightly loamy sands on the sides of the valley and around Lake Czaple [Operat… 2001].

The present status of the plant cover of the Kosa River valley and Lake Czaple was modified not only by the effect of natural factors, but also human activity [Operat... 2001]. Starting from the 19th century in Pomerania, as well as the entire formerly Polish territory under Prussian rule, the normal forest model was applied, consisting in the selection of economically the most advantageous tree species, cutting age and management system. Such a procedure contributed to the monotypization and pinetization of tree stands. Additionally, species geographically alien in that area were introduced, e.g. *Pseudotsuga menziesii*, *Pinus strobus*, *Larix decidua* and *Robinia psuedoaccacia*. Due

to the adverse topographic conditions (the river valley walls and the lake shore, numerous marshes), disadvantageous for silviculture, the analysed area was only slightly affected by these processes. For this reason natural vegetation remained in numerous positions. At present forests growing in the area of the study are water-protecting forests [Program... 2003].

In the vast majority of the floor of the Kosa river valley and in the littoral zone of Lake Czaple in the tree layer the predominant species is *Alnus glutinosa*, which forms communities with *Betula pendula*, *B. pubescens* and *Fraxinus excelsior*, as well as *Picea abies*. In the shrub layer most commonly found species include *Frangula alnus*, *Sorbus aucuparia, Sambucus nigra* and *Humulus lupulus*. In places, in compartments 8b and 8c, the community of elm-ash riparian forest was formed with the predominant share in the tree layer of *Quercus robur* and an admixture of *Ulmus glabra*, *U. minor*, *Tilia cordata*, *Acer platanoides* and *A. pseudoplatanus*; while in the shrub layer with a high share of *Carpinus betulus, P. abies, Corylus avellana*, *F. alnus* and *S. nigra.* An equally interesting forest community is found in compartment 8g, where 90% of the tree stand is formed by *Q. robur*, whereas the other part of this layer is composed of *A. glutinosa*.

Tree stands growing on the sides of the Kosa river valley and the escarpment around Lake Czaple are of different nature. An increase was recorded in the percentage of coniferous species, such as *Pinus sylvestris*, *Larix decidua*, *Pseudotsuga menziesii* and *Picea abies. Quercus rubra*, *Robinia pseudoacacia*, *Acer pseudoplatanus*, *A. platanoides* and *Fagus sylvatica*, were also represented in large numbers, while single specimens of *Q. robur*, *Q. petraea, Tilia cordata* and *Ulmus glabra* were recorded. Along the entire valley sides and the escarpment tree stands were mixed and it was difficult to isolate a species predominant in that layer.

In the forest floor layer on the floor of the Kosa river valley the highest cover percentage was recorded for *Calamagrostis canescens*, *Urtica dioica*, *Impatiens nolitangere* and species from genus *Carex* sp. In turn, on the valley sides the share of these species decreases and no taxon may be distinguished with the highest share in this part of the area.

The character of the land of the Smolnica village is completely different. Sedge grass meadows with several sedge species predominate here along with reed rushes, constituting approx. 1/4 area, where the dominant species is *Phragmites australis*.

RESULTS

List of vascular flora in the upper tract of the Kosa river valley and lake Czaple in accordance with affiliation to the family

Aceraceae: *Acer platanoides* L., *A. pseudoplatanus* L.
Adoxaceae: *Adoxa moschatellina* L.
Alismataceae: *Alisma plantago-aquatica* L., *Sagittaria sagittifolia* L.
Amaryllidaceae: *Galanthus nivalis* L.
Apiaceae: *Aegopodium podagraria* L., *Anthriscus sylvestris* (L.) Hoffm., *Berula erecta* (Huds.) Coville, *Heracleum sphondylium* L., *Peucedanum palustre* (L.) Moench, *Selinum carvifolia* (L.) L.

Araceae: *Acorus calamus* L., *Calla palustris* L.
Aspidiaceae: *Dryopteris dilatata* (Hoffm.) A. Gray, *D. filix-mas* (L.) Schott.
Aspleniaceae: *Asplenium trichomanes* L.
Asteraceae: *Achillea millefolium* L. (s. str.), *A. ptarmica* L., *Arctium tomentosum* Mill., *Bidens tripartita* L., *Cirsium oleraceum* (L.) Scop., *C. palustre* (L.) Scop., *Crepis paludosa* (L.) Moench, *Eupatorium cannabinum* L., *Galinsoga parviflora* Cav., *Hieracium murorum* L. coll., *H. pilosella* L., *Lapsana communis* L., *Mycelis muralis* (L.) Dum., *Petasites hybridus* (L.) G., M. et Sch., *Taraxacum officinale* Weber (*Wiggers*) coll., *Tussilago farfara* L.
Athyriaceae: *Athyrium filix-femina* (L.) Roth.
Balsaminaceae: *Impatiens noli-tangere* L. (niecierpek pospolity), *I. parviflora* DC.
Betulaceae: *Alnus glutinosa* (L.) Gaertn., *Betula pendula* Roth, *B. pubescens* Ehrh.
Boraginaceae: *Myosotis palustris* (L.) L. em. Rchb.
Brassicaceae: *Alliaria petiolata* (Bieb.) Cav. et Grande, *Capsella bursa-pastoris* (L.) Med., *Cardamine amara* L.
Campanulaceae: *Campanula patula* L., *C. persicifolia* L.
Cannabaceae: *Humulus lupulus* L.
Caprifoliaceae: *Sambucus nigra* L., *Viburnum opulus* L.
Caryophyllaceae: *Lychnis flos-cuculi* L., *Moehringia trinervia* (L.) Clariv., *Myosoton aquaticum* (L.) Moench, *Silene latifolia* Poiret ssp. *alba* (Mill.) Greut. et Buret, *Stellaria media* (L.) Vill.
Celastraceae: *Euonymus europaeus* L.
Clusiaceae: *Hypericum maculatum* Crantz, *H. perforatum* L.
Cornaceae: *Cornus sanguinea* L.
Corylaceae: *Carpinus betulus* L., *Corylus avellana* L.
Crassulaceae: *Sedum maximum* (L.) Hoffm.
Cupressaceae: *Juniperus communis* L.
Cyperaceae: *Carex acutiformis* Ehrh., *C. digitata* L., *C. elongata* L., *C. nigra* Reichard., *Scirpus sylvaticus* L.
Equisetaceae: *Equisetum fluviatile* L. em. Ehrh., *E. hyemale* L., *E. pratense* Ehrh., *E. palustre* L., *E. sylvaticum* L.
Ericaceae: *Calluna vulgaris* (L.) Hull, *Vaccinium myrtillus* L., *V. vitis-idaea* L.
Euphorbiaceae: *Euphorbia cyparissias* L., *Mercurialis perennis* L.
Fabaceae: *Lathyrus pratensis* L., *Robinia pseudacacia* L., *Vicia cracca* L.
Fagaceae: *Fagus sylvatica* L., *Quercus petraea* (Matt.) Liebl., *Q. robur* L., *Q. rubra* L.
Geraniaceae: *Geranium palustre* L., *G. robertianum* L.
Grossulariaceae: *Ribes nigrum* L., *Ribes spicatum* Robson, *R. uva-crispa* L.
Hydrocharitaceae: *Hydrocharis morsus-ranae* L.
Hypolepidaceae: *Pteridium aquilinum* (L.) Kuhn.
Iridaceae: *Iris pseudacorus* L.
Juncaceae: *Juncus bufonius* L., *J. effusus* L., *Luzula pilosa* (L.) Willd.
Lamiaceae: *Ajuga reptans* L., *Galeopsis pubescens* Besser, *Glechoma hederacea* L., *Lamium album* L., *L. maculatum* L., *Lycopus europaeus* L., *Mentha aquatica* L., *Prunella vulgaris* L., *Scutellaria galericulata* L., *Stachys palustris* L., *S. sylvatica* L.
Lemnaceae: *Lemna minor* L., *L. trisulca* L.
Liliaceae: *Convallaria majalis* L., *Gagea pratensis* (Pers.) Dum., *Maianthemum bifolium* (L.) F. W. Schmidt, *Paris quadrifolia* L.

Loranthaceae: *Viscum album* L.
Lythraceae: *Lythrum salicaria* L.
Nymphaeaceae: *Nuphar lutea* (L.) Sibth. et Sm., *Nymphaea alba* L.
Oleaceae: *Fraxinus excelsior* L.
Onagraceae: *Circaea lutetiana* L., *Epilobium angustifolium* L., *E. palustre* L., *E. roseum* Schreber.
Orchidaceae: *Epipactis helleborine* (L.) Crantz.
Oxalidaceae: *Oxalis acetosella* L., *O. europaea* Jordan.
Papaveraceae: *Chelidonium majus* L.
Pinaceae: *Larix decidua* Mill., *Picea abies* (L.) Karsten., *Pinus strobus*, *P. sylvestris* L., *Pseudotsuga menziesii* (Mirbel) Franco
Plantaginaceae: *Plantago lanceolata* L., *P. major* L.
Poaceae: *Agrostis canina* L., *Anthoxanthum odoratum* (L.) P. B., *Brachypodium sylvaticum* (Huds.) P. B., *Calamagrostis canescens* (Weber) Roth, *Dactylis glomerata* L., *Deschampsia flexuosa* (L.) Trin., *Elymus caninus* (L.) L., *Festuca ovina* L., *F. pratensis* Huds., *Melica nutans* L., *Phragmites australis* (Cav.) Trin. ex Steud., *Poa nemoralis* L.
Polygonaceae: *Polygonum amphibium* L., *P. bistorta* L., *Rumex acetosa* L., *R. aquaticus* L., *R. hydrolapathum* Huds.
Polypodiaceae: *Polypodium vulgare* L.
Primulaceae: *Lysimachia nummularia* L., *L. thyrsiflora* L., *L. vulgaris* L.
Ranunculaceae: *Anemone nemorosa* L., *Caltha palustris* L., *Ranunculus acris* L., *R. ficaria* L., *R. lanuginosus* L., *R. repens* L., *R. sceleratus* L.
Rhamnaceae: *Frangula alnus* Mill.
Rosaceae: *Agrimonia eupatoria* L., *Crataegus monogyna* Jacq., *Filipendula ulmaria* (L.) Maxim., *Fragaria vesca* L., *Geum rivale* L., *G. urbanum* L., *Potentilla anserina* L., *P. erecta* (L.) Raeusch., *P. palustris* (L.) Scop., *Prunus padus* L., *P. serotina* Ehrh., *Pyrus pyraster* Burgsd., *Rubus idaeus* L., *R. plicatus* W. et N., *Sorbus aucuparia* L.
Rubiaceae: *Galium aparine* L., *G. palustre* L. (s. str.), *G. uliginosum* L.
Salicaceae: *Populus tremula* L., *Salix cinerea* L., *S. pentandra* L.
Saxifragaceae: *Chrysosplenium alternifolium* L.
Scrophulariaceae: *Lathraea squamaria* L., *Scrophularia nodosa* L., *Veronica beccabunga* L., *V. chamaedrys* L., *V. hederifolia* L.
Solanaceae: *Solanum dulcamara* L.
Sparganiaceae: *Sparganium erectum* L.
Thelypteridaceae: *Thelypteris palustris* Schott.
Tiliaceae: *Tilia cordata* Mill.
Ulmaceae: *Ulmus glabra* Huds., *U. minor* Mill.
Urticaceae: *Urtica dioica* L., *U. urens* L.
Valerianaceae: *Valeriana officinalis* L. (s. str.), *V. simplicifolia* Kabath.
Violaceae: *Viola odorata* L., *V. reichenbachiana* Jordan ex Bor.

Flora of vascular plants in the upper tract of the Kosa River valley and Lake Czaple consists of 200 species belonging to 69 families. The most numerous families include *Asteraceae* (16 species – 8% flora), *Rosaceae* (15 – 7.5%), *Poaceae* (12 – 6%), *Lamiaceae* (11 – 5.5%) and *Apiaceae* (6 – 3%). Species belonging to these families ac-

count jointly for 30% object flora. The other families comprise 70% flora, out of which 26 families (13%) are represented by 1 species.

The most abundant life forms according to the Raunkiaer system are hemicryptophytes – 45% flora. A considerable group is composed of cryptophytes (24.8%) and phanerophytes (19.3%); followed by therophytes (6.7%), chamephytes (3.4%), while semiparasites and parasites are found extremely rarely (0.8%).

Over 80% flora of the object consisted of species recorded in at least 10 stands (including 26 rather frequent species, 50 frequent, 25 very frequent and 64 common). A total of 11 species were classified as rare plants, while 24 – very rare. At the same time, according to Zarzycki et al. [2002] they are mostly common species nationwide (125 taxa), or with a large number of stands in many regions of Poland (56 species). Moreover, although 5 species (*Asplenium trichomanes*, *Festuca ovina*, *Gagea pratensis*, *Rumex aquaticus*, *Valeriana simplicifolia*) have numerous stands, they are located primarily in one region of the country.

Throughout Poland populations of the analysed species in most places exhibit high dynamics, with an increase in the number of stands with a marked increase in specimens in individual stands [Zarzycki et al. 2002]. In turn, populations of 18% species are found to regress, including especially *Salix pentandra*, *Ulmus minor*, *Caltha palustris* and *Galium palustre*.

In the area of the study 8 species were found (4% flora) covered by complete (*Polypodium vulgare* and *Epipactis helleborine*) or partial legal protection (*Convallaria majalis*, *Frangula alnus*, *Nuphar lutea*, *Nymphea alba*, *Ribes nigrum*, *Viburnum opulus*). Moreover, there was 1 species – *Asplenium trichomanes* – threatened with extinction nationwide [Zarzycki et al. 2002] and 2 – *Gagea pratensis* and *Hydrocharis morsus-ranae* – threatened with dying out nationwide. According to Jasnowska and Jasnowski [1977] *A. trichomanes*, as well as *Achillea ptarmica*, *Calla palustris* i *Lysimachia thyrsiflora*, also observed here, are species threatened in peatland communities in Poland.

Additionally, in the Kosa River valley and around Lake Czaple 14% flora (28 taxa) are classified by Atlas... [1995] as well as Kujawa-Pawlaczyk and Pawlaczyk [2001] as taxa with varying degrees of threat within Western Pomerania (category V1: *Rumex aquaticus* i *Valeriana simplicifolia*; R: *Acer platanoides*; Ex: *Berula erecta*, *Convallaria majalis*, *Dryopteris dilatata*, *Epipactis helleborine*, *Equisetum hyemale*, *Gagea pratensis*, *Lathraea squamaria*, *Lysimachia thyrsiflora*, *Nuphar lutea*, *Nymphaea alba*, *Paris quadrifolia*, *Petasites hybridus*, *Polygonum bistorta*, *Polypodium vulgare*, *Ranunculus lanuginosus*; E1 – *Achillea ptarmica*, *Asplenium trichomanes*, *Calla palustris*, *Elymus caninus*, *Epilobium roseum*, *Frangula alnus*, *Hydrocharis morsus-ranae*, *Mercurialis perennis*, *Ribes nigrum*, *Selinum carvifolia*).

A total of 18.5% flora (36 species) of the investigated object in regions neighbouring with Pomerania, i.e. in Mecklenburg and Brandenburg [Fukarek 1991, Benkert and Klemm 1993] are classified to the group of threatened taxa (category Ex1 – *Asplenium trichomanes*, V3 – *Galeopsis rubescens*, *Lychnis flos-cuculi*, *Polygonum bistorta*; R2 – *Achillea ptarmica*, *Campanula patula*, *Chelidonium majus*, *Crepis paludosa*, *Gagea pratensis*, *Galium uliginosum*, *Hydrocharis morsus-ranae*, *Hypericum maculatum*, *Selinum carvifolia*, *Viscum album*; Ex2 – *Equisetum pratense*; V4 – *Polygonum bistorta*, *Rumex aquaticus*, *Selinum carvifolia*; R3 – *Achillea ptarmica*, *Ajuga reptans*, *Anthoxanthum odoratum*, *Calla palustris*, *Caltha palustris*, *Campanula patula*, *Cardamine amara*, *Crepis paludosa*, *Epilobium palustre*, *Geranium palustre*, *Hydrocharis morsus-*

-ranae, *Hypericum maculatum*, *Juniperus communis*, *Lychnis flos-cuculi*, *Lycopus europaeus*, *Paris quadrifolia*, *Ulmus glabra*, *U. minor*).

The most numerous group in the analysed object consists of species preferring moderate light (43.4% flora), or living in semi-shade (31.3%). Plants requiring full light (13.6%) or shading (11.7%) are less abundant. The thermal index indicates in local communities of the Kosa River valley and Lake Czaple the highest share of species growing under moderately warm (46% flora) or moderately cool (39%) climatic conditions.

In terms of the trophic index species of meso- or eutrophic soils predominate (50% and 36% flora, respectively). While analysing the organic matter index the highest share was found for species growing on mineral-humus soils (66% flora), followed by those growing on soils rich in humus (29%) and much less often – on soils poor in organic matter (5%). The trophic index and the organic matter index are distinctly positively correlated with the soil grain size index, for which the biggest number was recorded of species connected with sandy loams and silty soils (53%) and with heavy loams and clays (35%), and less frequently with sands (18%). More than 50% species of the analysed object in order to develop require a moderately acid reaction of subsoil, less often acid (19%) or neutral (21%). The characterized flora consists of taxa growing on fresh (36%) and moist soils (33%), and at times wet soils (17%). Sites extreme in terms of moisture content conditions are occupied by 16 species (5%) living in water and 24 species (8%) growing on dry soils.

While analysing histo-geographical groups it was found that spontaneophytes (97 species – 48.5%) and apophytes (86 – 43%) predominate in the flora of this area. Kenophytes accounts here only for 6.5% flora (13 species). Moreover, archeophytes (*Capsella bursa-pastoris* and *Lamium album*), ephemerophytes (*Galanthus nivalis*) and agriophytes (*Urtica urens*) are observed occasionally.

In the investigated area species connected with the *Querco-Fageta* class (83 – 42% flora) are represented in biggest numbers, among which a considerable group consists of species characteristic for order *Fagetalia sylvaticae* (19 species) and relation *Alno-Ulmion* (47). Almost 1/4 flora of the object consist of species from class *Alnetea glutinosae* (36). Moreover, the following classes are represented by 10 to 22 species: *Vaccinio-Piceetea* (11%), *Quercetea robori-petraeae* (7.5%), *Artemisietea vulgaris* (6.5%) and *Molinio-Arrhenetheretea* (5%).

DISCUSSION OF RESULTS AND CONCLUSIONS

Ecosystems of the analysed object are not isolated by natural boundaries from the surrounding areas. Thus, the introduction of new species is relatively easy, both on land and water. However, the flora of the area of the study is characterized by a small share of alien species. Native species comprise a total of 91.5% flora of the area of the study, while alien species – 8.5%, respectively. However, within native species a high percentage of apophytes needs to be stressed (43%), i.e. plants closely correlated with human activity.

While analysing flora in terms of the percentage of life forms (according to the Raunkiaer classification), the predominance of hemicryptophytes (45%) needs to be stated, which roughly corresponds to the share of this group of plants in the flora of

Poland (54%) [Szata roślinna... 1964, Matuszkiewicz 1999]. Phanerophytes, determining the physiognomy of a forest community, constitute a group of 19% (nationwide their share is 8%). In turn, cryptophytes account for 25% species within the area of the study and exceed in their number the corresponding index for the whole country, amounting to 15%. Cryptophytes are represented mainly by geophytes constituting an important component of spring flora. The group of hydrophytes is also numerous, which results from the presence of a lake and a river in that area. Annual plants constitute 7% flora and this index is by ±12% lower than nationwide. The lowest percentage, similarly as it is the case of the entire Poland's territory (4%), is found for chamephytes, including 3% species recorded in that area.

Plant species reported in big numbers represent classes of *Querco-Fagetea* and *Alnetea glutinosae*. These species constitute 59.5% of the flora of the object. A large number of species from these classes on the floor of the Kosa River valley and in the littoral zone of Lake Czaple is consistent with the reported plant association of currant-alder swamp forest (*Ribeso nigri-Alnetum*, the drained variant) turning into ash-alder riparian forest (*Fraxino-Alnetum*) [Elaborat... 2003]. Generally taxa representing the two above mentioned classes are found next to each other in the investigated area. Only in compartments 8b and 8c species from class *Querco-Fagetea* distinctly predominate (*Acer platanoides*, *Aegopodium podagraria*, *Ajuga reptans*, *Anemone nemorosa*, *Athyrium filix-femina*, *Corylus avellana*, etc.). In places, primarily in farmlands, willow scrubs may be found, forming communities from class *Salicetea purpureae*. Moreover, in village grounds representatives of class *Phragmitetea* were recorded. In turn, on sides of the Kosa river valley there are species, representing classes *Quercetea robori-petraeae* and *Vaccinio-Piceetea*.

The ecological characteristics of the flora of this area, conducted using ecological index numbers of Zarzycki et al. [2002], showed that the biggest number of species growing there prefer positions with moderate light or semi-shaded, with meso- or eutrophic soils, fresh and moist, organic-mineral, with a slightly acid reaction. Moreover, they are species of moderately warm or moderately cool climate.

Although the analysed area is rather small there are several legally protected species, as well as several others, which are found on different lists of threatened species. Based on indexes of dynamic trends in the last decades [Zarzycki et al. 2002] two species need to be mentioned in this respect: *Salix pentandra* and *Ulmus minor*, which number of stands in Poland has been decreasing markedly. A total of 27 species were classified by Kujawa-Pawlaczyk and Pawlaczyk [2001] as taxa, which stands need to be mapped during field studies (surveys and environmental evaluations). A high number of species (83 taxa, 41.5% flora) – rare, threatened or dying out nationwide, in particular regions or in the area of the study – indicates a high floristic value of the analysed area. It needs to be added here that among the 35 rare and very rare species in the analysed area, 20 are defined by different authors as rare, dying out or threatened species nationwide, in Western Pomerania, the Wielkopolska region or eastern Land of Germany [Ginące... 1995, Fukarek 1991, Benkert and Klemm 1993].

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CHARAKTERYSTYKA EKOLOGICZNO-GEOGRAFICZNA FLORY NACZYNIOWEJ GÓRNEGO ODCINKA DOLINY RZEKI KOSY I JEZIORA CZAPLE (WOJEWÓDZTWO ZACHODNIOPOMORSKIE)

Streszczenie. Badania przeprowadzono w obrębie górnego odcinka doliny rzeki Kosy i jeziora Czaple (woj. zachodniopomorskie). Zanotowano 200 gatunków roślin naczyniowych należących do 69 rodzin. Czterdzieści siedem występujących tutaj gatunków jest objętych ochroną prawną lub znajduje się na listach gatunków zagrożonych i ginących (np. *Achillea ptarmica, Asplenium trichomanes*, *Epipactis helleborine*, *Polypodium vulga-*

re). Dominującą rolę w warstwie drzew odgrywają *Alnus glutinosa*, *Quercus robur* i *Fraxinus excelsior*. W warstwie krzewów licznie występują: *Frangula alnus, Corylus avellana, Sambucus nigra* i *Viburnum opulus* oraz samosiewy *F. excelsior*, *Acer pseudoplatanus* i *Picea abies*. W warstwie zielnej najczęściej spotykanymi gatunkami są *Calamagrostis canescens* i taksony z rodzaju *Carex.* Zanotowane gatunki najczęściej reprezentują zbiorowiska z klasy *Alnetea glutinosae*, *Querco-Fageta*, *Quercetea robori-petraeae*, *Vaccinio-Piceetea*, a także *Phragmitetea.* Stwierdzono, że najwięcej gatunków preferuje stanowiska o umiarkowanym świetle i stanowiska półcieniste z glebami świeżymi i wilgotnymi, organiczno-mineralnymi.

Słowa kluczowe: flora naczyniowa, jezioro Czaple, rzeka Kosa, gmina Dębno

Accepted for print – Zaakceptowano do druku: 15.01.2007

For citation – Do cytowania: Jędras L., Maciejewska-Rutkowska I., 2007. An ecological and geographical characteristic of vascular flora in the upper tract of the Kosa River valley and Lake Czaple (Zachodniopomorskie province). Acta Sci. Pol., Silv. Colendar. Rat. Ind. Lignar. 6(1), 13-25.