

1. Name and surname

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2. Possessed diplomas, degrees scientific/art with the name, place and year of recovery and the thesis title

M.Sc. of Biology (environmental biology), Faculty of Biology, Geography and Oceanology, University of Gdańsk, Gdańsk 1992, dissertation: Distribution of Orchidaceae species on West Pomerania.

Ph.D. of Biology (environmental biology), Faculty of Biology, University of Gdańsk, Gdańsk 2001, dissertation: Taxonomic revision of tropical genus *Crepidium* Bl. *emend.* Szlach. (Orchidales, Orchidaceae, Malaxidinae).

3. Education background and work history:

1987-1992 – Study at Faculty of Biology, Geography and Oceanology, University of Gdańsk.

M.Sc. of Biology (environmental biology).

1993-1996 - Coastal Water Protection Division of the Institute of Meteorology and Water Management in Gdansk (Marine Division)

1996-2001 - doctoral student at Faculty of Biology, Geography and Oceanology, Gdańsk University. Ph.D.

2001-31.03.2002 - assistant in Laboratory of Plant Taxonomy and Geography, Department of Plant Taxonomy and Nature Conservation, Faculty of Biology, Gdańsk University

01.04.-30.09.2002 - lector in Laboratory of Plant Taxonomy and Geography, Department of Plant Taxonomy and Nature Conservation, Faculty of Biology, Gdańsk University

from 01.11.2002 - adiunct at Laboratory of Plant Taxonomy and Geography, Department of Plant Taxonomy and Nature Conservation, Faculty of Biology, Gdańsk University.

4. Indication of achievement under. under Art. paragraph. 2 of the Act of 14 March 2003 on Academic Degrees and Scientific Title and Degrees and Title in Art (Journal of Laws No. 65, item. 595, as amended.):

a) title of achievement scientific / art,
book **Taxonomic redefinition of the subtribe Malaxidinae (Orchidales, Malaxideae)**

General author: Hanna B. Margońska

Co-authors: A.K. Kowalkowska, M. Górniak, P. Rutkowski

Book published in 2012, in Koeltz Scientific Books

c) discussion of the scientific goal / artistic above work / works and the results achieved with a discussion of their possible use

The subtribe Malaxidinae sensu lato (Orchidales, Malaxideae) is really cosmopolitan, being found all over the world excluding the Antarctic, and in all climatic regions except the coldest and driest. The largest number is found in tropical regions, especially in the tropical Americas, Africa and S E Asia.

The Malaxidinae sensu lato is a very diverse group both in terms of environmental requirements and the degree of morphological diversity. It comprise terrestrial, rarely lithophytic species, and also epiphytic plants e.g. showing a high degree of specialization and advancement in the development. There are often in inaccessible and poorly studied areas. Many of them are endemic, rare plants, with a lesser or greater risk of extinction.

Taking into account the scale and severity of the degradation and devastation of habitats in which they live, it is almost certain that many taxa died and will die before they can be discovered, described and analyzed. The subtribe Malaxidinae, even for the Orchidales, is undergoing an extremely active phase of speciation as is evidenced by e.g. a high degree of variability, often insufficient reproductive isolation between taxa of different rank (low genetic barrier). In natural environmental conditions this last is compensated for by ecological or phenological barriers.

These relatively small orchids (20 cm height - rarely exceed 50 cm in height), less attractive orchids ornamentally, but having in some parts of the importance of natural medicine and cosmetics industry. These plants are of interest beyond the local population mainly of scientists and collectors. Until recently, it was a very poorly known group Orchidales.

Until the work „*Systema Orchidarium*” by Szlachetko (1995.) almost all kinds were of artificial / polymorphic. Of these, nearly one in five has been described in the last 50 years, and many are probably still awaiting discovery in inaccessible areas of districts where these orchids are common. The reason for this was not only the difficulty in obtaining research materials, unavailability of their habitats, but also often small in size (for example, only a few millimeter) their flowers and generative structures (which are important diagnostic features of these plants) and thereby hindering their correct identification and determination.

The basic taxonomic problem within the Malaxidinae sensu lato were:

- is the lack of clear and unequivocal criteria for distinguishing the genera; enigmatic character of many protologues, and/or specification of their type-specimens, (especially in older protologues).;
- many of the species were included within a genus on the basis of superficial similarity and cursory examination, without adequate investigation of important taxonomic features within this group of orchids (e.g. the size of the flowers);
- confusing and long history (dating back to the times of Linné *Species Plantarum* 1753) of taxonomy and nomenclature of many taxa - including: taxa have been described several times under different names or different taxa have been described under the same specific epithet; multiple "wandering" taxa such as species between different genera;
- difficulty in: access to the plants (often living in difficult to reach habitats); obtaining research materials (very delicate and short-lived flowers); dispersion and loss of many type-specimens or specimens on so-called "mixed / packaged" herbarium sheets; and the fact that some taxa of the Malaxidinae are known from a single or only a few specimens; protologues of some taxa were published in a very rare nowadays publications (eg for today only single specimens of books are exist, e.g. works by Rafinesque);
- or technical problems (the need to good optical equipment), age and condition of the type-specimen (ability to conduct in most cases only by classical taxonomic studies, or even the need to reconstruct the flowers), etc.

Malaxidinae sensu lato in its long history and the richness of taxa (nowadays in databases like Tropicos (Missouri Botanical Garden electronic databases), Index Kewensis or IPNI (The International Plant Names Index) including synonyms, concerning nearly 2000 taxa) had only two comprehensive taxonomic revisions: Ridley's from 1886 and 1888 (then all known taxa) and Schlechter's from 1911 (19914) (although impressive in quality and number of species included the only New Guinea).

As I mentioned many taxa of the Malaxidinae sensu lato are endemic, rare plants, to a lesser or greater risk of extinction, requiring different forms of protection.

Even while working on my doctoral dissertation on only a small group of *Crepidium*, it turned out that taxonomic revision not only of this genus (already as a whole taxa), but the subtribe sensu lato has not only a scientific sense but also practical. It is impossible to protect any organisms, develop systemic and legislative protection programs of them without their proper identification, determination, etc. Therefore, the main objective of my research over the last 10 years has become taxonomic revision of the subtribe Malaxidinae sensu lato and as complete as possible systematization of knowledge about these plants.

The aim of the study of the subtribe Malaxidinae was a complete taxonomic revision:

- verification of the component species of each genus and its infrageneric taxa and their relationships, similarities;
- taxonomic revision and checking the name in accordance with the ICBN (International Code of Botanical Nomenclature, after 2012 “ICN” – International Code of Nomenclature for algae, fungi and plants) all taxa known to science ever to be the subtribe sensu lato included of all available taxonomic materials and methods (classic/conventional taxonomy based on biometrics, morphology and anatomy at standard, macro and ultra macro levels as well as phenetic and genetic taxonomies);
- clear and univocal characteristics of each taxa according to protologues and type-specimens as obligatory basement (not later interpretations, e.g. *Malaxis andicola*); an indication of the most important diagnostic features (also in with regard to the requirements of field work), the development of diagnostic keys;
- location and clarification of the status of type-specimens, lectotypification and neotypification where explicit confirmation of the original type-materials is lacking;

Additionally to my laboratory works, I had the opportunity alone and in collaboration with local researchers to conduct research in various locations of these orchids, lead their experimental breeding, as far as possible I decided to:

- determine the variation within taxa (expressed biometric range given in the taxonomic descriptions of individual taxa);
- collect of all available information about the taxa studied, e.g. their ecology, biology, distribution and abundance of both living plants and preserved materials;
- identify the main risk factor and estimate its extent.

All accessible taxonomic materials were examined: above all, dried herbarium specimens, also those preserved in liquid collections (Kew Mixture, Copenhagen Mixture etc.), living plants natural habitat and from experimental breeding and bibliographic data as well.

In the course of the revision about 13 500 samples were reviewed. The materials examined were from 38 institutional herbaria: A, AAU, AK, AMES, B, BISH, BM, BO (at Cibinong Science Center), BP, BR, C (including the Seidenfaden Collection), CHR, E, F, FI (including the Webbienum and Beccarianum Collections), G, GB, GH, HBG, K (including the *Lindleyanum Collection*), L, LINN, MO, P (including the *Lamarckianum Collection*), PAP, PERTH, POZ, SEL, SING, TJ, U, UGDA, UPS, US, W (including the *H.G.L. Reichenbachianum Collection*), WAG, WU, Z and additionally the Bogor Kebun Raya Cultivated Collections (Java). Where the institutions listed above house specimens preserved in liquid collections (Kew or Copenhagen Mixture) these were studied in addition to their dried materials.

Specimens from e.g.: EA, BKF, COI, COL, HAL, JE, LE, LIL, LL, M, MA, MEXU, NHSLD, NY, PMA, PORT, PRE, RSA, S, SP and TEX (21) were researched via e.g.: copies (high-resolution photographs and scans), the taxonomic records of Dr G. Seidenfaden, Dr N. Hale and Prof. Dr D.L. Szlachetko and sometimes only indirectly via databases, e.g. the Swiss Orchid Foundation at the Jany Renz Herbarium; eFlora; HUH (some specimens); The Virtual Herbarium The New York Botanical Garden (some specimens).

I obtained access to private taxonomic collections, documentations and records from e.g. J.B. Comber, Dr. N. Hale (P), Dr G. Seidenfaden (C-GS), Prof. Dr D.L. Szlachetko (UGDA-DLS), Dr R. Gonzales Tamayo (IBUG), Dr P. O'Byrne, M. Jutta, W. Suarez and R. Schneider.

The studies were augmented by my own collection (HBM: dried, wet and living materials) and by my own digital database – *Archivum Orchidalium* (over 30 000 records). The Herbaria acronyms are cited according to *Index Herbariorum* (Holmgren et al. 1990). For each species, only the type-collection or paratypes cited in protologues have been cited. Where possible, for accurate identification, the Herbaria acronyms are accompanied by barcodes or access numbers (especially for the older specimens). The authors' names abbreviations of the taxa follow Brummitt and Powell (1992).

Living orchid collections associated with the Herbaria and Institutional Botanical Gardens visited were additionally verified. Separate living collections, e.g. the G. Seidenfaden Orchid Collection (at present part of København Botanisk Have & Museum), those of Prof. Dr D.L. Szlachetko (Gdańsk) and La collection d'orchidees de Jardin du Luxemburg (Paris), were examined as well.

Orchids in natural stands were observed in e.g. Europe, French Polynesia (2 seasons), the Hawaiian Islands, the Malay Peninsula, Indonesia, Indochina and China.

A very important part of the work was the nomenclatural and taxonomic studies on the basis of literature data (particularly protologues) and original iconographies and archives (as handwritten notes, documents, correspondence which enabling often display “holo” types despite of the enigmatic protologues). Bibliographic studies were conducted at all scientific institutions visited or communicated with, particularly the Library collections from Les Conservatoire et Jardin Botaniques de la Ville de Genève, General and Botanical sections of the Natural History Museum in London, Universität Wien, Naturhistorisches Museum Wien, Edinburgh Royal Botanic Garden, Royal Botanic Gardens at Kew, Freie Universität Berlin-Dahlem Botanischer Garten und Botanisches Museum, Deutsche Akademie der Naturforscher Leopoldina, General and Botanical Muséum national d’Histoire naturelle de Paris and Gdańsk University. In many of these institutions, I was able to get access to unique copy of an old publications, the old books (pre-1800 years) or handwritten documents, catalogs, etc.

Representatives of all the genera, infrageneric taxa, species and infraspecific taxa of the subtribe have been reviewed. In a few cases, where it was not possible to reach any preserved or living specimens of a species or infraspecific taxon, verification was based on literature data, especially protologues and original iconographies.

The complete set of original diagnoses and iconographies was assembled. It allowed me not only correct interpretations of the taxa studied, but also accurate and reliable indications of the type-specimens.

Indication of the statute of the type-specimens, it means the indication of the main type-specimen - "holo" type – as the basis of which the description of the taxon was made and its copies (isotypes) is an important part of each serious taxonomic revision, because it allow a clear and correct interpretation of the taxon.

For some species, especially the elderly, because of ambiguity protologues or notes on herbarium sheets, a few, and sometimes teens (often different) specimens on “mixed” herbarium sheets, it was possible to identify the main types - 'holo' type – only on a basis of archival documents (deposited in some Herbariach, the Botanical Gardens and private collections), such as correspondence authors of the taxon, the taxon authors and the curators of herbaria, private notes, etc.

1700 validly published species (according to ICBN2005 and ICN 2012) within the Malaxidinae sensu stricto were verified. For 117 (and 171 their synonyms) of these evidence

of their belonging to the Malaxidinae was inadequate and they have been definitely excluded from the subtribe (listed as "excluded taxa").

Affiliation to the Malaxidinae sensu stricto of 12 genera, 19 taxa above species level, 387 species and their 1050 synonymic taxa, over 30 unpublished names and 17 infraspecific taxa have been confirmed. As a result of these studies, I have proposed a new specific epithet for 2 species (nom. nov., according to Art. 11.4., ICBN 2005), 9 new nomenclatural combinations and status (comb. & stat. nov.), 37 new nomenclatural combinations (comb. nov., an additional 5 for representatives of the Liparidinae sensu stricto) and 20 new synonyms of accepted species names.

Within the Malaxidinae sensu stricto a variety of factors such as enigmatic protologues and/or specification of their type-specimens, loss of type-collections etc. have failed to establish the status of 22 taxa (listed as "incertae sedis taxa").

I was able to locate over 3500 type-specimens (and 42 paratypes), of which I verified over 3370, including more than 3210 type-specimens of taxa belonging to the Malaxidinae sensu stricto.

I decided, according to recommendations of ICBN (International Code of Botanical Nomenclature, 2005 Vienna, "ICN" – International Code of Nomenclature for algae, fungi and plants, 2012 Melbourne) and after consulting with experts of nomenclatory and taxonomy plant, that under the original wording of the Code such as:

- For new species or infraspecific taxon names, mention of a single specimen, or gathering or illustration, even if that element was not explicitly designated as type, was acceptable as an indication of the type (Art. 37.3. ICBN 2005) – the taxonomic material (specimen etc.) is correctly recognized as the main type (names as holotype, lectotype etc. functioning since 1958), and its lektotypifikacija is redundant; only if the existence of the main type-specimen, on the basis of which the description of the taxon was made ("holo" type) clearly was not confirmed, lectotype was chosen. Similarly, in the event that the whole type-collection (when the number of such specimens was known) was lost / destroyed the neotype was chosen.

- recommendation 9A (ICBN 2005): Lectotypes were designated with an understanding of the author's method of working (9A.1.); In choosing lectotypes, all aspects of the protologue should be considered as a basic guide (9A.2.); Any indication of intent by the author of a name should be given preference (unless such indication is contrary to the protologue), such indications as manuscript notes, annotations on herbarium sheets, recognizable figures and epithets (9.A.3.); specimens housed in the institution where the authors were known to have

worked were the holotypes, or that the specimens were part of authors' private collections (unless there was evidence that further material of the same gatherings was used) (9A.4.).

Specimens for lectotypes and neotypes were chosen in accordance with strict criteria. All the features of the specimen must be consistent with protologues (interpretation of the author / authors taxon), and place of collection of the neotype set as close as possible to the place of origin of the original specimen. Both lectotypes and neotypes have been selected using only good quality preserved specimens with lots of flowers (whose elements are one of the most important diagnostic features in subtribe). In just a few cases, where the relevant type-specimens or any other well-preserved specimens could not be located, have the species been lectotypified by high quality illustrations (mostly made by the author of the species). I hope that in the future it will be possible to exchange them on the specimens of plants, although they are very rare orchids and often known only from the place of origin of the type-collection.

Summarising, 225 taxa have been lectotypified (and 38 lectotypes for the taxa excluded from the Malaxidinae sensu stricto) and 17 neotypified.

Following the enlargement of the scope of the work for the whole subtribe Malaxidinae sensu lato, based on classical taxonomic methods, comparison of the morphology, anatomy and embryology of the vegetative parts (mostly forms of shoots, leaves and vegetative elements of flowers) as well as generative structures, two distinct lines of evolution can be distinguished in the subtribe Malaxidinae sensu lato. The result of phenetical analysis (UPGMA and distance, made with co-operation with prof. dr hab. P. Rutkowski) on basis of 96, selected generative and vegetative characters, proved division of the taxa within the Malaxidinae sensu lato into two well-separated groups: the Malaxidinae sensu stricto and the Liparidinae sensu stricto.

Anther position on the gynostemium has been considered as an important taxonomic character (Freudenstein et al. 2002). In the subtribe Malaxidinae sensu lato, both anther positions are observed: erect, when it is parallel to the axis of gynostemium column and to stigma (*Malaxis* sensu lato) and incumbent, when it is orthogonal to the axis of gynostemium column and to stigma (*Liparis* sensu lato). It thus seems that within the Malaxideae sensu lato the primary factor determining evolution of these orchids is not so much different habitat conditions, an epiphytic or terrestrial form of life, but primarily pollinator pressure. At generic level within the Malaxidinae, pollinator pressure. Within the both evolutionary lines is also shown a strong correlation of the anther position to the gynostemium and the stage of flower resupination: *Liparis* sensu lato (=Liparidinae sensu stricto) including almost all plants with 180° resupinate

flowers (lip directed downwards = landing place for pollinators, dorsal deposition of pollina) and *Malaxis* sensu lato (=Malaxidinae sensu stricto) including almost all plants with 360° resupinate flowers (lip directed upwards and it is not landing place for pollinators, ventral deposition of pollina).

The both groups correspond to the original interpretation of Malaxidinae sensu stricto and Liparidinae sensu stricto, therefore I decided to propose the separation of the both of them and restyutation of the latter.

Within the subtribe Malaxidinae sensu stricto 12 genera with 387 species can be classified: *Malaxis* Sol. ex Sw. (1788.), *Microstylis* (Nutt.) Eaton (1822.) emend. Szlach. & Marg. (2006.), *Dienia* Lindl. (1824.), *Crepidium* Blume (1825) emend. Szlach. (1995.), *Hammarbya* Kuntze (1891.), *Risleya* King & Pantl. (1898.), *Pseudoliparis* Finet (1907.) emend. & redef. Szlach. & Marg. (1999), *Glossochilopsis* Szlach. (1995.), *Seidenfia* Szlach.(1995.), *Tamayorkis* Szlach. (1995.), *Saurolophorkis* Marg. & Szlach. (2001.), *Seidenforchis* Marg. (2006.).

Because in this group, there are several taxa "exceptional" in relation to these criteria (*Microstylis monophyllos* subsp. *brachypoda*, *Microstylis muscifera* (Lindl.) subsp. *stelostachya* (Tang&Wang) Marg., *Microstylis yunnanensis* i *Tamayorkis*) with 180° resupinate flowers, I selected another diagnostic features: gynostemium column short up to 2-3 times as long as the anther; anther locules opening ventrally or apically (never laterally); stigma opening apically and situated inside a deep pocket; nectary in a cavity, 2-3 chambered, usually distinctly limbate or 1-chambered (between the parallel lip blade lamellae or obscurely limbate, never globular).

Furthermore Malaxidinae sensu stricto leaf blades are plicate (exceptionally conduplicate); always without a transverse scar between the leaf blades and their bases; lip with a distinctly reduced hypochile, while the epichile can be 3-lobed (middle and 2 lateral lobes) or 1-lobed.

The Liparidinae comprises 11 genera with at least a 300 species: *Stichorkis* Thouars (1809.) emend. Szlach., Marg. & Kułak (2008.), *Liparis* L.C.Rich. ((1817) 1818), *Orestias* Ridl. (1887.), *Crossoglossa* Dressl.&Dodson (1993.), *Kornasia* Szlach.(1995.), *Lisowskia* Szlach. (1995.), *Disticholiparis* Marg. & Szlach. (2004.), *Oberonioides* Szlach. (1995.), *Alatiliparis* Marg. & Szlach. (2000.), *Platystyliparis* Marg. (2007.), *Crossoliparis* Marg. (2009.).

Within this subtribe I proposed a new generic division, infrageneric together with appropriate combinations and statutes, and lectotypes. They represent the next stage of work on the Liparidinae sensu stricto, which the final goal will be to complete taxonomic revision also this taxon. I selected another diagnostic features: gynostemium column elongated, from 2-3 times

or more as long as the anther (except *Crossoglossa* and *Crossoliparis* where the gynostemium length is similar to the anther length); anther locules opening ventrally or laterally (never apically); stigma opening ventrally (inside a deep concavity not a pocket); nectary usually a smooth area around the lip base and its basal callus/calli/lamellae if they exist, or globular; always have narrow, (ob)lanceolate to linear petals; floral bracts always erect; lip distinctly divided on the well-developed hypochile and epichile, downwardly recurved between them (the curvation auriculate, geniculate, smooth to augmentative) especially becoming more distinct at anthesis; and staminodes abbreviated, at most similar in length to the anther (except some *Platystyliparis* and *Stichorkis* type-section & sect. *Platyglossum*).

As I mentioned the Liparidinae usually have flowers 180° resupinate, except epiphytes such as *Alatliparis*, *Platystyliparis* and *Crossoglossa* which have lip directed down always, despite how they grow. The resupination is determined the early bud stages and based on gravitational forces which is dependent on auxins, as a hormones regulating geotropism (Ames 1938; Arditti 2002; Hill 1939; Nyman et al., 1984; Ernst and Arditti, 1994). Within Malaxideae, it is a unique feature! and occurs only in these epiphytes. In their case, regardless of whether the plant is hanging down or rising straight up, their lip will be directed downwardly.

Results of our molecular analyzes based on an estimation of relationship / similarities between the studied taxa on the basis on the analysis of variation of ITS markers (131 rDNA samples which 28 were from own UG and my collections whereas 83 from Gen-bank and Cameron data). They indicated there are two main distinct clades comprising generally epiphytic or terrestrial plants, both from the Old and the New World. The planned follow-up studies involving a larger number of samples, broadly representing all types and sections, as well as other markers should help clear up a lot of correlation between the different groups within the Malaxidinae sensu lato.

Comparative analysis of the occurrence of the Liparidinae and the Malaxidinae would suggest that the Liparidinae, taken as a whole, may be considered older than the Malaxidinae. The Liparidinae occurs on all continents, including Africa (except of Antarctica of course) whereas the Malaxidinae sensu stricto has never been reported in mainland Africa. The closest to African mainland is *Seidenfia seychellarum* (Kraenzl.) Szlach. which occurs in the Seychelles Islands.

The absence of the Malaxidinae sensu stricto in Africa may be due to factors inhabiting the spread of the species from SE Asia (probable place of origin of the subtribe) such as dry

climate and dry habitat of the Middle East and the retreat to the east the ocean monsoon stream in the area N of Madagascar (near the Seychelles Islands). These would have constituted impassable barriers for them. These phenomena probably account for the absence of some Liparidinae such as the Asiatic *Disticholiparis* and *Platystyliparis* in mainland Africa, as well. Representatives of these latter genera, being highly specialized both in their epiphytic form of life and pollination strategy are recognized as the most advanced members of the Liparidinae. The *Disticholiparis* species closest to Africa are *Disticholiparis disticha* (Thouars) Marg. & Szlach. and *Disticholiparis gregaria* (Lindl.) Marg. & Szlach. (with their W limit range in the Mascarene Islands), whereas within *Platystyliparis* only *Platystyliparis dryadum* (Schltr.) Marg. is the only non-Asian species of the genus, occurring solely in Madagascar.

To this day, not much is known about pollination strategy, forms of attractant, pollinators of representatives of the Malaxideae. Although the orchids' morphological structures, particularly the generative ones are well-known. Pollination processes are crucial to the natural reproduction of these plants in their natural positions, and thus on the ability of the natural ecosystem restoration. Evolution, speciation processes of Orchidales, also among others Malaxideae, are the result of a very strong pressure of pollinators.

Observations in natural habitats and cultures (my own and with the help of local experts), including of role of a macro and ultra macro features (researches with Dr A.K. Kowalkowska) and comparative studies with other Orchidales allowed me to develop the concept of pollination strategies of the Malaxidinae sensu lato. I furthermore gathered information on the various forms and structures of attractants encountered in these orchids (research not only morphological, anatomical but also biochemical). Continuation of this work will allow me to verify of hypotheses concerning the orchids strategy and course of the pollination processes (also verification/determination of the orchids pollinators, taking account of these insects in protective procedures) and to estimate the degree of participation of the various forms of autogamy in the reproductive processes of the Malaxidinae sensu lato. Widely known and confirmed phenomenon and most commonly affected to temperate orchids is autogamy (within Malaxideae e.g. *Liparis loeselii*). It occurs also in tropical species, especially if they are growing at the edges of their ranges and/or in location particularly difficult for them or their pollinators. For the first time, in the case of several species of tropical the Malaxidinae sensu stricto I confirmed and documented the existence of autogamy in the form of a stimulus-induced, spontaneous movement of pollinia in mature, non-fertilized

flowers. This occurs mostly in *Crepidium resupinatum* (Forst.f.) Szlach., *Dienia ophrydis* (König) Seidenf. & Ormerod and *Microstylis muscifera* (Lindl.) Ridl.

Rare phenomenon “hydrogamy” in the form of rain-assisted self-pollination has so far been observed in e.g. *Liparis loeselii*. For the first time, I confirmed and documented the existence of it also in *Liparis hawaiiensis* H. Mann (own observations).

Mimicry of the inflorescences or flowers of members of other plant families is rather frequent in the Malaxideae. Representatives of *Malaxis* sect. *Umbelulatae* mimic the calathidia of the Asteraceae, those of *Malaxis* sect. *Spicatae* subsect. *Pedilaea* have spadix-like inflorescences and or as suggested also by O’Byrne and Vermeulen (2006), some species of *Crepidium* sect. *Hololobus* imitate the flowers of buttercups (Ranunculaceae). In my opinion also representative of *Pseudoliparis* mimic the flowers of buttercups.

Colour change in flowers (or their parts), depending on the stage of its development, especially after pollination has been observed in many orchids species. Many representatives of the Malaxidinae, especially from the genera *Crepidium*, *Dienia*, *Seidenfia* and *Seidenforchis* have developed an unusual, very specific relationship with their pollinators because only flowers fully developed and ready for pollination display the intense, “right” colour and clear pictures on their tepals.

Up to now there is a lack of any published data relating to the Malaxideae concerning the colour effects visible in short or long wave ultraviolet light, though, for many insects taking part in pollination, these are of major significance. On the basis of my own, though still preliminary, data, it seems that these colour effects are highly important elements of the orchids’ nectar-guides (involving raphides and/or glycosides cells, their arrangement, location etc.) in signalling the flowers’ availability for pollination.

For first time with the Malaxideae sensu lato, was confirmed and documented (co-operation with Dr A.K. Kowalkowska) the existence of osmophores on the apical part of the tepals surfaces.

Malaxidinae brought my attention also because of another unique feature - a high degree of variability. The flowers of many species, especially those from tropics (e.g. some of *Crepidium*), can show variability, not only among specimens from different habitats or stands, but also within one population, even within one inflorescence (!, somatic mutations).

Observations, both their growing under natural conditions (during a few vegetative seasons) and under cultivation (in controlled conditions) demonstrate variability within the flowers, particularly in the distal elements of the lip. Lip shape may be changed, not fully developed

or extended or may be differently coloured. The distal teeth of the lip may be lost or differently formed.

Thus, they are probably a group of plants vulnerable to recently observed climate changes and human activities which have modified their environmental and habitat conditions.

This observation is important not only from the point of view of taxonomy, because in this group of plants describing new taxa from one flower (frequent occurrence in the past Reichenbach, J.J. Smith, although the latter has already noted this phenomenon and began to verify his own taxa), specimens which first time blooming in captivity (similarly frequent situation in the past, but with a place and today! e.g. *Crepidium myosotis* Clem. & Jones (1996), *Malaxis auriculata* P. O'Byrne & J.J. Verm. 2006) usually carries a high risk of error.

Similarly, plant determination can not be based on the verification of a single flower.

Several flowers within each inflorescence from different parts of the raceme should be examined in detail.

The phenomenon of variability, particular for the distal elements of the lip (especially teeth of lateral lobes and/or mid-one) has an impact on pollination processes by providing flowers for the non-dedicated pollinators and the possibility of the creation of hybrids.

The observed during my own research (and confirmed by local researchers) the sensitivity/impresibility of the Malaxidinae sensu stricto for many transformations in their habitat resulting not only from direct human activities, but also caused global change, indicate that some species may find use, at least as their local bioindicators.

Due to the fact, mentioned the possibility of morphological variation (somatic mutations) in some taxa of the Malaxidinae sensu stricto, I recommend the use of a set of diagnostic features of high taxonomic and diagnostic value: the most clear and stable (according to the observations - the least modified). Diagnostic features observable both in the material preserved (e.g. in a herbarium sheet) and living material (e.g. during field works).

Thus's the most important distinguishing features within the Malaxidinae on generic level I would consider to be e.g.: the morphology of the generative structures; plant habit, especially the form of the shoot (rhizome, stem, pseudobulb, their nodding and arrangement) and leaves (plicate, conduplicate etc.); structure of the inflorescence (racemose, abbreviated – subumbellate, very dense - cylindrical); lip general outline (absence or presence of basal auricles, their form, epichyle 1- 3-lobed), morphology of the nectary (number of chambers, ornamentations), etc.

At species level, for individual taxa, the most significant would seem to be a combination of at least a few of the most constant morphological features such as: ornamentation of the central part of the lip (convexities and concavities around the nectary); development of the distal parts of the lip (absence or presence and form of teeth or lobes) and the basal parts (absence or presence and form of auricles, basal callus/calli) etc.

Each taxon in the rank of a genus to a series is presented in uniform way and including: complete nomenclature data, accepted and the rest names (e.g. list of synonyms) and their typology; description of taxonomic characteristics (with reflecting it iconography), an indication of several, the most important diagnostic features ("diagnostics characters "); historical outline and the key to determining the internal taxa.

At specific and infra specific level, the scheme of data presentation for each taxa is including: complete nomenclature data, accepted and the rest names (e.g. list of synonyms, unpublished names) and their verified typology; description of taxonomic characteristics (if it was possible with reflecting it iconography), including the taxa variability (e.g. as biometric ranges); ecological date, geographical data with information about the plentifulness, importance to ecosystems, hazard, etc.; and additional notes such as the color of living plants, their flowers, the similarities to other taxa, use, culture conditions, frequency of specimens in the cultures or the preserved collections, etc.

Practical utility of diagnostic features, but also the whole book, I based not only on my own knowledge and experience, but also on the current consultation with persons having direct contact with these orchids (e.g. during field works, cataloging taxonomic materials, and developing strategies for their protection). For all their comments, observations, signaling problems I am very grateful to them. Also everyone else whose support, cooperation and assistance enabled and facilitated the creation of this elaboration.

John B. Montgomery

5. Discussion of other scientific - research (artistic) achievements

The subject of my Ph.D. thesis was development of data for taxonomic revision of the genus *Crepidium* a kind of taxonomic data Bl. *emend.* Szlach. (a few hundred species of 3 main sections Orchidales, Malaxidinae) with using classic taxonomic methods (biometrics, morphology, anatomy), numeric (fenetic) and genetic. I was revised over 3,500 specimens from 16 herbariów, botanical gardens and natural stands and all preserved historical and contemporaneous bibliography and iconography.

During this period (up to Ph.D., 2001) I am an author and co-author of 25 papers published (*impact factor* – **1.47**, PKtMNI_{SW} - **124**), in which:

- I proposed as author and co-author 6 new genera (*Alatliparis* Marg. & Szlach., *Saurolophorkis* Marg. & Szlach. (Malaxidinae), *Spuricianthus* Szlach. & Marg. and *Jouyella* Szlach. & Marg. (Thelymitroideae), *Lueranthos* Szlach. & Marg., *Zosterophyllanthos* Szlach. & Marg. (Pleurothallidinae)), reestablished and redefined genus *Pseudoliparis* Finet *emend.* Szlach. & Marg.;
- I described as author and co-author 29 new species (18 within the genus *Crepidium*, 7 within the genus *Pseudoliparis*, 1 within the genus *Fingardia*, 1 within the genus *Dienia*, 1 within the genus *Crossoglossa*, 1 within the genus *Spuricianthus*)
- I proposed as author and co-author 141 *nom.nov.* and *comb. nov.* on different levels (14 within the genus *Crepidium*, 7 within the genus *Pseudoliparis*, 2 within the genus *Alatliparis* (Malaxidinae), 4 within the genus *Jouyella*, 2 within the genus *Geoblasta* (Thelymitroideae), 1 within the genus *Ancistrochilus*, 1 within the genus *Appendiculopsis* (Epidendroideae); 1 sectional and 4 specific within the genus *Pseudacoridium* (Epidendroideae), 1 generic, 33 specific and 1 *nom.nov.* within *Peltopus* (Bulbophyllinae), 1 generic *nom.nov.* and 2 specific within *Gyalanthos*, 1 specific within the genus *Lueranthos*, 1 generic and 2 specific within *Masdevalliantha*, 1 generic *nom.nov.* and 1 specific within *Mirandopsis*, 1 generic *nom.nov.* and 1 specific within *Mystacorchis*, 7 specific within *Rhynchopera*, 53 specific within *Zosterophyllanthos* (Pleurothallidinae)).
- I designated lectotypes for 3 species of the genus *Crepidium* Bl.

During this period, I participated as a performer in a four team grants funded by both the University of Gdansk and the Committee for Scientific Research, and also in the two conferences (one international).

After Ph.D. (in and after 2001 until today) I am an author and co-author of 58 papers published (excluding the scientific achievement) (*impact factor* – **9.702**, P_{KtMNISW} - **329**, Number of citations, without autocytations: **7**, Hirsch Index: **2**), in which:

- I proposed as author and co-author 3 new genera (*Seidenforchis* Marg. (Malaxidinae), *Crossoliparis* Marg. (Liparidinae), *Smithanthe* Szlach. & Marg. (Habenariinae)), reestablished and redefined 2 genera *Microstylis* (Nutt.) Eaton *emend.* Szlach. & Marg., *Stichorkis* Thouars *emend.* Szlach., Marg. & Kułak;

- I described as author and co-author 22 new taxa on different infrageneric levels (2 species and 2 subsections within the genus *Crepidium*, 3 species within the genus *Pseudoliparis*, 1 species within the genus *Seidenfia*, 1 species within the genus *Tamayorkis* (Malaxidinae), 2 species within the genus *Stichorkis*, 1 variety within the genus *Liparis* (Liparidinae), 1 species within the genus *Epidendrum*, 1 species within the genus *Takulumena* (Epidendrinae), 1 species within the genus *Veyretella* (Habenariinae), 1 species within the genus *Holothrix* (Orchidoideae), 1 species within the genus *Stellilabium* (Telipogoneae), 1 variety and 1 subspecies within the genus *Habenaria* (Habenariinae), 1 variety within the genus *Dactylorhiza*, 1 form within *Anacamptis pyramidalis* (Orchidinae), 1 subspecies within the genus *Bulbophyllum* (Bulbophyllinae))

- I proposed as author and co-author 177 *nom. nov.* and *comb. nov.* on different levels (19 specific, 1 sectional, 1 subsectional within the genus *Crepidium*, 4 specific, 1 subspecific, 5 varietal within the genus *Microstylis*, 11 specific, 1 varietal within the genus *Pseudoliparis*, 3 specific within the genus *Seidenforchis*, 1 specific within the genus *Seidnefia* (Malaxidinae), 1 specific within the *Oberonioides*, 1 specific within the *Crossoliparis*, 1 generic i 38 specific for *Disticholiparis*, 73 1 specific within the *Stichorkis*, 1 subspecific within the genus *Liparis*, 1 specific and 2 varietal within the genus *Lisowskia*, 1 specific within the genus *Orestias*, 1 generic and 17 specific for *Platystyliparis* (Liparidinae), 3 specific and 1 subspecific within the genus *Smithanthe* (Habenariinae), additionally *tens syn. nov.* and new records for species of Orchidales.

- I designated lectotypes for: 6 species of the genus *Crepidium* Bl.; 4 species of the genus *Pseudoliparis*, 1 species of the genus *Glossochilopsis*, 1 species of the genus *Seidenfia* (Malaxidinae), 5 species, 1 subspecies of the genus *Liparis*, 2 species of the genus *Lisowskia*,

1 species of the genus *Oberonioides*, 1 species of the genus *Stichorkis* (Liparidinae), 3 species of the genus *Oberonia* (Oberoniinae), 1 species of the genus *Corysanthes* (Corybasinae), 1 species of the genus *Peristylus* (Herminiinae), 2 species of the genus *Habenaria* (Habenariinae), 2 species of the genus *Moerenhoutia* (Goodyerinae), 3 species of the genus *Corymborkis* (Tropidiinae), 6 species of the genus *Nervilia* (Nerviliinae), 5 (synonymic taxa) for 2 species and 1 for variety of the genus *Calanthe*, 1 species and 2 forms of the genus *Phaius*, 4 species of the genus *Spathoglottis* (Bletiinae), 5 species of the genus *Eria* (Eriinae), 8 species of the genus *Phreatia* (Thelasiinae), 1 species of the genus *Bulbophyllum*, 2 species of the genus *Cirrhopetalum* (Bulbophyllinae), 4 species of the genus *Dendrobium*, 1 species of the genus *Dockrillia* (Dendrobiinae), 1 species of the genus *Microtatorchis*, 6 species of the genus *Taeniophyllum* (Taeniophyllinae), 6 species of the genus *Parapteroceras* (Phalaenopsidinae), 2 species of the genus *Arundina* (Arundiinae), 1 species of the genus *Vanilla* (Vanillinae).

Preparing taxonomic revisions podplemienia Malaxidinae sensu lato (the scientific achievement) I have observed the existence of two different evolutionary lines within it. This fact was confirmed by classical taxonomic methods, comparison of the morphology, anatomy and embryology of the vegetative parts as well as generative structures, also by the result of phenetical analysis on basis of 96, selected generative and vegetative characters (UPGMA and distance). Thus, separation from the subtribe Malaxidinae sensu lato taxa belonging to the subtribe Malaxidinae sensu stricto required verification of all ever taxa included in the former. Therefore I gathered and verified taxonomic and nomenclatural data of the representatives of the restituted the subtribe Liparidinae sensu stricto. Data for complete taxonomic revision of the subtribe Liparidinae sensu stricto have been prepared for some of its genera as: *Orestias* Ridl., *Kornasia* Szlach., *Lisowskia* Szlach., *Disticholiparis* Marg. & Szlach., *Oberonioides* Szlach., *Alatiliparis* Marg. & Szlach., *Platystyliparis* Marg., *Crossoliparis* Marg. Works on the complete taxonomic revisions other genera of as: *Stichorkis* Thouars restyt. Szlach., Marg. & Kułak, *Liparis* L.C.Rich., *Crossoglossa* Dressl. & Dodson are still in progress.

In the same period, under the direction of prof. dr hab. D. L. Szlachetko I took part in the realization of scientific projects such as „Genera Orchidacearum ” (Vol. 2. Subfamily Vanilloideae, in prep.), „Gynostemium Orchidacearum ” (Vol. 2. Orchidaceae-Epidendroideae, 2002, printed), „Orchid Flora of tropical, Central Africa”(Vol. 2. in prep.).

I also realized my own scientific projects: „Orchid flora of Tahiti (Iles de la Societe, 2011, printed)”, „Floristic and phytogeographical analysis of representatives of Orchidales at Mo'orea Island(French Polynesia, book in prep.)”. Moreover, in collaborating with a number of local experts, I explore taxonomy and biodiversity of the Orchidales, especially from other parts of the tropical Pacific Islands (Raiatea, Tahaa, Bora Bora, Markizy, Hawaje, atoles itp.), Orchidées de la îles de la orientale Afrique (Reunion, Mauritius i neighbouring Archipelagos), Malaysia, Indonesia and Philippines etc..

I research biodiversity, strategies of polinations within Orchidales (at the micro and ultra macro structures levels, with Dr. AK Kowalkowska University of Gdańsk), so tropical and temperate zones, the impact of these strategies on modifications / variations of the Orchidales, the processes of speciation of these plants, and how they affect on methods to protect endangered species.

These projects I realized with support of the team grants (5; as the leader – 3; as the major performer – 2) and individual grants (5), national (University – 3; Ministerial – 4) and international (5; as the leader – 4; as the major performer – 1).

I presented the results during the 9 congresses, scientific festivals, conferences and seminars. I take an active role in the promotion of: knowledge especially about Orchidales, but also other plants, the problems of plants protection, researching methods applied in taxonomy ("Laboratory of Nature") and during of field works (floristic, taxonomic), and forms of documentation of a obtained data (also outside the temperate zone, in cooperation with the local people and experts).

I cooperate with over 60 scientific, forein an national institutions (acronyms accordind to *Index Herbariorum* (Holmgren et al. 1990), e.g.: A, AAU, AK, AMES, B, BISH, BM, BO (w Cibinong Science Center) and the Bogor Kebun Raya Cultivated Preserved Collections (Java), BP, BR, C, CHR, E, F, FI, G, GB, GH, HBG, K, L, LINN, MO, P, PAP, PERTH, POZ, SEL, SING, TJ, U, UGDA, UPS, US, W, WAG, WU, Z (38); and additionally by correspondence e.g.: EA, BKF, COI, COL, HAL, JE, LE, LIL, LL, M, MA, MEXU, NHSLD, NY, PMA, PORT, PRE, RSA, S, SP and TEX.

I am also cooperating with over than 20 Botanical Gardens e.g.: Bogor Kebun Raya, Copenhagen Botanical Garden, Edinburg Royal Botanical Garden, Goteborg Botanical Garden, Jardin Botaniques de la Ville de Genève, Kew Royal Botanical Gardens, Leiden Botanical Garden, La collection d'orchidees de Jardin du Luxemburg (Paris), Singapore Botanical Garden, Universität Wien Botanic Garten and Botanischer Garten und Botanisches Museum Berlin-Dahlem.

