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CONFERENCE MATERIALS

The Concept of Ontogenesis Polyvariance and Modern Evolutionary Morphology

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Abstract—The possibilities of using the concept of ontogeny polyvariance in evolutionary morphology are considered. The concept is aimed at identifying the full range of options associated with various aspects concerning the organization of living organisms. In conjunction with the analysis of the correlation structure of traits and methods of population meronomy, the proposed approach can help to elucidate the modus of the evolution of structural diversity.

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INTRODUCTION

Interest in morphology contributed to the progressive development of evolutionary biology in the 20th century (Serebryakova, 1972, 1983; Meyen, 1973, 1984; Vorobyova and Meyen, 1988; Vorobyova, 1991; Mamkaev, 1991, 1996; etc.). However, the active development of molecular phylogenetics at the turn of the 21st century resulted in a decrease in the prestige of evolutionary morphology (Timonin, 2001; etc.). Currently, the situation has become critical (Rasnitsyn, 2014; Ivanova-Kazas, 2016; Notov, 2016; etc.). Nevertheless, some studies allow us to hope for the renewal of attention to the studies of structural evolution (Timonin, 2011; Mamkaev, 2011; Pozhidaev, 2015; Kosevich, 2015; Rasnitsyn et al., 2015; Notov, 2016, 2017; Rutishauser, 2016; Kuznetsova and Timonin, 2017; Matyuhin, 2017; Nuraliev et al., 2017; Pardo et al., 2017; Simpson et al., 2017; Harrison and Morriss, 2018; etc.). In this regard, the analysis of concepts that could contribute to strengthening the positions of evolutionary morphology is relevant. In our opinion, the concept of ontogeny polyvariance, or, more generally, developmental polyvariance (Zhukova, 1986, 1995, 2008; *Polivariantnost'*..., 2006; Notov and Zhukova, 2013) deserves attention.

The appearance of the concepts of the polyvariance of individual development of an organism (Sabinin, 1963; Vorontsova and Zaugol'nova, 1978; Zhukova, 1986; etc.) was largely associated with the study of plant ontogeny. In zoology, they appeared later (Makarov, 1991; Olenev and Grigorkina, 1998; Olenev, 2002; etc.). The concept of polyvariance has formed as an approach to analyzing population heterogeneity (Zhukova and Komarov, 1990; Zhukova, 1995). Today, it has acquired the status of a general biological paradigm that considers polyvariance as a universal property of living objects of different levels of organization (*Polivariantnost'*..., 2006; Notov and Zhukova, 2013, 2016).

The purpose of this study was to assess the possibility of using the concept of polyvariance in evolutionary studies and to analyze its methodological basics and relations with other approaches.

GENERAL CHARACTERISTICS OF THE CONCEPT OF POLYVARIANCE

Within the framework of the concept of polyvariance, ontogeny is understood as the entire process of individual development, from the zygote or other germ (diaspora) to natural death at the final stages due to aging (Zhukova, 1995). A universal scheme of periodization of ontogeny with a high level of detail has been adopted (Uranov, 1975; Zhukova, 1995; Zhukova and Zubkova, 2016; etc.). For seed plants, 4–5 periods and 11–12 ontogenetic states are commonly distinguished (Zhukova, 1995; Zhukova and Zubkova, 2016).

The concept is aimed at identifying all the possible differences between individuals in a population. They are considered as the result of manifestation of ontogeny polyvariance. The specificity of plant ontogeny is taken into account. Due to active lifelong morphogenesis, its plasticity reaches a high level. Developmental pathways are highly diverse (Zhukova, 1995; Notov, 1999). Common variants include the "loss" of certain developmental states, disturbance of their sequence, and variation in the degree of completeness of ontogeny. In the course ontogeny, the life form may often change and the organism may lose its integrity and be divided into parts (particulated) to form daughter individuals (Zhukova, 1995, 2008; etc.).

Variants are systematized in accordance with the general principles of the system analysis of an organism and its ontogeny (Zhukova, 1995, 2008; Notov and Zhukova, 2013; etc.). Classification takes into account the relation to the universal aspects of organization, the affiliation to a certain structural level, the scale of individual differences of the course of ontogeny, and the nature of the relationships with the other variants. The main aspects of organization are associated with the corresponding supertypes of polyvariance (structural, functional, and dynamic) and ontogenetic pathways. The supertypes include the polyvariance of breeding and reproduction cycles. The specificity of the external relationships of an object is considered within the environmental polyvariance supertype. The relationship of differences with a certain structural level (molecular, cellular, and organismal) is reflected in the name of some types (e.g., biochemical, anatomical, and morphological polyvariance). Within a morphological type, the polyvariance of life forms corresponds to the organismal level (*Polivariantnost'* ..., 2006; Zhukova, 2008; etc.). The polyvariance of the rates of individual development and the polyvariance of the pathways of ontogeny differ in the scale of changes occurring in the course of ontogeny. In the first case, the dynamics of the formation of certain ontogenetic states varies, whereas in the last case the typical course of ontogeny is significantly transformed. Variants may be independent, interrelated, or hierarchically subordinated, which significantly complicates the development of classification (Notov and Zhukova, 2016). The nature of relationships is revealed in the analysis of the range of polyvariance of a particular object. In one of the latest variants of the classification of ontogeny polyvariance, 7 supertypes and 11 types are distinguished (Notov and Zhukova 2013, 2016).

The approach proposed reflects the specificity of the organization and individual development of not only plants but also other modular living organisms (Notov, 1999, 2015, 2016). It can also be applied to unitary organisms. The development of the general classification of types of polyvariance has begun (Notov and Zhukova, 2013, 2016).

Thus, the concept provides a holistic view of the variety of forms of polyvariance and is focused on the in-depth analysis of all possible manifestations of variability in ontogeny. This takes into account the variants of various scales and degrees of complexity, which are associated with different aspects of organization and structural levels. The concept is used as an approach to evaluate the heterogeneity of populations (*Polivariantnost'* ..., 2006). It is relevant to compare it to other approaches in the study of variability and diversity.

ANOTHER APPROACH TO THE ANALYSIS OF VARIABILITY

In the framework of our objective, areas that are related to studying the variability of individual development and evolutionary problems are worth noting. Of particular interest are those approaches that can be used to determine the modus of evolution of the structural diversity.

The basic method of evolutionary morphology is comparative morphology. Structural and morphological studies performed in the 1970s–1980s led to the development of the meronomic approach (Meyen, 1978; Vorobyova and Meyen, 1988; etc.). It was focused on analysis of the nomothetic aspect of morphological evolution (Meyen, 1973, 1990; etc.). Development of this area made it possible to rethink a wide range of philosophical and methodological problems (Chaikovskii, 1990; Chebanov, 2017). Frontal analysis of extensive data on modern and fossil organisms was performed (Meyen, 1973, 1984, 1987; etc.). It helped to reveal the nontrivial modus of morphological evolution and the phenomenon of transitional polymorphism (Meyen, 1987, 1988; etc.). Using the structural and morphological approach, the common modes of structural transformations were identified, and the ideas about the stages of evolution of morphofunctional systems, the method of morphological ranges, and the principle of the initial archetypal diversity were developed (Mamkaev, 1991, 1996, 2004, 2011; Vorobyova, 2006; etc.). Due to the active development of evo-devo, the attention of researchers has focused on the transformation mechanisms and the ontogeny transformation pathways associated with them (Vorobyova, 2006, 2007, 2010; Shishkin, 2010; Ozernyuk and Isaeva, 2016; etc.).

Studies on the variability and polymorphism of populations, which were conventional for the synthetic theory of evolution, led to the emergence of phenetics (Yablokov, 1980; etc.) Group analysis of variability was aimed at identifying the specific features of microevolutionary processes. The patterns of formation of homologous traits in ontogeny were also studied (Vorobyova and Medvedeva, 1980). Today, the relationship to macroevolutionary problems is of interest. The population meronomy is actively being developed (Vasil'ev, 2005; Vasil'ev and Vasil'eva, 2009; etc.). It synthesized the ideas of the epigenetic theory of evolution, nomogenesis (as understood by Meyen), and evolutionary ecology. The analysis of epigenetic divergence of taxa of different ranks and phylogenetic relationships as well as the studies of transitional polymorphism for a large number of structures began to be conducted actively. Studies of the epigenetic aspects of transitional polymorphism have made it possible to relate the mechanisms of micro- and macroevolutionary transformations of morphogenesis (Vasil'ev and Vasil'eva, 2009). From the standpoint of evolutionary morphology, the pro-

Table 1. Comparative characteristics of approaches to the analysis of variability

Characteristic	Ontogeny polyvariance concept	Population meronomy	Structural and morphological approach
Objects	Organism, population, species	Population, species, superspecies rank taxa	Species, superspecies rank taxa, and their archetypes
Study subject	Variability of ontogeny and diversity of its variants	Variability of phenes and phenetic compositions, diversity of phenotypes	Variability of merons and archetypes and diversity of refrains
Tasks	Identification and analysis of the full range of ontogenetic variants that involve all aspects of the organization of biosystems	Identification of the patterns of homologous variability of morphological structures	Comprehensive analysis of the structural diversity, identification of patterns and modes of its evolutionary transformation
Relationship with the polyvariance of ontogeny	The variability of ontogeny is the key aspect of analysis, and polyvariance is the main idea and the main content of the concept	The study of variability as one of the results of ontogenetic variability is indirectly related to the analysis of ontogeny polyvariance; the population specifics of developmental programs is revealed	The methodological basis includes the concept of the evolution of ontogeny and the phylembryogenesis theory; the notion of the diversity of creods is consistent with the idea of the ontogeny polyvariance
Correlation system	Not analyzed	A required element of research	The key object of morphofunctional and historical analysis
Microevolutionary problems	Not considered, but the results are significant for the assessment of the mobilization reserve of variability	The main method of analysis of microevolutionary processes	Interesting as a component of the general methodology of typological analysis
Macroevolutionary problems	Not considered, but the results may be of interest to its analysis	Allows identification of correlations between microevolutionary and macroevolutionary processes and clarification of phylogenetic relationships	Methodical basis for identification of the general patterns of macroevolution
Significance for evolutionary morphology	In combination with the analysis of correlations and taxon archetypes, may facilitate the identification of the modes of morphological evolution	Helps to assess the parallelisms of the evolutionary role and morphological innovations and solve homologization problems	The main approach to the analysis of results and modes of morphological evolution, its mechanisms and patterns

posed methods to identify the homology, evolutionary role of parallelisms, and morphological innovations are more significant.

It is relevant to compare different approaches. Of particular importance is the determination of the degree of similarity of their purposes and methodological specifics. This analysis would allow assessing the possibility of synthesis of various approaches.

THE POSSIBILITY OF SYNTHESIS OF VARIOUS APPROACHES

There are three approaches to the analysis of diversity and variability: the concept of ontogeny polyvariance, the population meronomy, and the structural and morphological approach. Of these, only the latter has been widely used in evolutionary morphology (Vorobyova and Meyen, 1988; Mamkaev, 1991; etc.). When comparing the approaches (Table 1), it is considered in the variant that is used in evolutionary studies—in the context of Meyen's meronomy (Meyen, 1973, 1978; etc.) combined with the concept of ontogeny evolution (Schmalhausen, 1982; Shishkin, 1987, 2010; etc.) and morphofunctional analysis (Vorobyova, 2007). In all three approaches, system methodology is employed (Vorobyova, 2006; Vasil'ev and Vasil'eva, 2009; Notov and Zhukova, 2013, 2016; etc.).

Specificity is determined primarily by the characteristic features of objects, study subjects, and purposes, the nature of relationships with the polyvariance of ontogeny and micro- and macroevolutionary problems, and the evolutionary morphology (Table 1). Unlike other approaches, the polyvariance concept considers not only the variability of structures but also the diversity of variants associated with all aspects of the study of organisms (Table 1). The full range of variants provides the basis for cooperation with genetics and developmental biology. This synthesis will make it possible to identify the nature of the relationship of each variant with the development process. The results obtained by geneticists confirmed the considerable diversity of the mechanisms underlying variability of any type (Tikhodeev, 2012, 2013). The variants of ontogenetic variability are especially heterogeneous (Tikhodeev, 2013). It is not strongly associated with any particular form of inheritance or with certain molecular mechanisms and can be combined with various elements of hereditary and nonhereditary variability.

The basis for the identification of the mechanisms of evolutionary transformations is the concept of the evolution of ontogeny (Schmalhausen, 1982; Shishkin, 1987, 2010; Ozernyuk and Isaeva, 2016; etc.). The general ideas about the population, ontogeny, and diversity of its variants are consistent with the basic provisions of the concept of polyvariance and population meronomy. In evolutionary studies, a population was initially considered as a self-regulated polymorphic system (Schmalhausen, 1968). It was assumed that supraindividual biological systems within a species have certain levels of genetic and modification polymorphism, ratios between different sexes and between age forms, life span and its stages, fecundity, generation change rate, and many other features of organization characterizing evolutionary plasticity (Schmalhausen, 1968, p. 174). In fact, along with the structural polyvariance, the polyvariance of the ways of breeding and reproduction and rates of ontogeny was mentioned in an implicit form, without using the terminology of the polyvariance concept. It was also emphasized that modifications may manifest themselves throughout the ontogeny of each individual, starting from the zygote and to the rest of its life (Schmalhausen, 1968, p. 33). The similarity of the key provisions determines the interoperability of approaches. The ideas about the mechanisms of variability (polyvariance) of ontogeny and its evolutionary role may contribute to the development of the theoretical basis of each approach. Currently, they are sufficiently fully formed only within the concept of the evolution of ontogeny and are taken into account when identifying the modes of morphological evolution (Table 1), but without using the terminology of the polyvariance concept.

Typological studies based on the structural and morphological approach are characterized by the highest level of abstraction. Their objects are merons, archetypes; the meronomic diversity of high-rank taxa is determined (Table 1). Of key importance is the analysis of the variability of these objects; the ranges of polyvariance within a major taxonomic group are actually considered. In studies of the morphological evolution, the importance of the ideas of the possible pathways of transformation of morphogenesis and ontogeny is emphasized (Vorobyova and Meyen, 1988; Timonin, 2011; etc.). From the standpoint of the cooperation of the structural and morphological direction with other approaches, the ranges of variability of the structures and variants of the pathways of ontogeny obtained using these approaches are of interest. Such ranges facilitate construction of the archetype and assessment of the variability of the taxon radical and the level and character of variability of merons. The directional variability of archetypal traits is the basis for the divergence of taxa (Lyubarskii, 1996).

The capabilities of each of the three approaches are significantly expanded by the study of correlations. However, they have not yet been considered within the framework of the polyvariance concept (Table 1). Analysis of the correlation system shows sufficiently adequately the specifics of the relationships between different characteristics and variants. It creates a basis for the construction of the archetype (Lyubarskii, 1996). Data on correlations help to correlate the stability and variability and consider the problem of integrity (Rostov, 2002).

The polyvariance concept is open for cooperation with other approaches. It will allow extending its scope to a certain degree. The full ranges of variants may be useful to assess the mobilization capacity of variability (Table 1) and to identify archetypes and examples of transitional polymorphism. The solution of these problems is significant in the context of micro- and macroevolutionary problems.

POLYVARIANCE RANGES AND EVOLUTIONARY MORPHOLOGY

The creation of a coherent theory of ontogeny is one of the key objectives of evolutionary morphology on its way to a new synthesis (Vorobyova, 1991, p. 256). How can the potential of interdisciplinary connections in the polyvariance concept be realized?

For establishing the modes of morphological evolution, the manifestations of stability and variability are equally interesting. The use of the structural and morphological approach implies identification of the archetypes of high-rank taxa and implementation of large-scale meronomic analysis. When using the polyvariance concepts, the necessary level of abstraction can be achieved by ordering the individual ranges of polyvariance with allowance for the specificity of the correlation system and from obtaining the integrated spectrum by using their stepwise synthesis.

To develop the methodological bases of accounting data on the polyvariance ranges in evolutionary morphology, ad hoc analysis of large taxa with considerable structural diversity is relevant. Of particular inter-

Table 2. The polyvariance range and the nature of correlation of traits in grasses

Characteristics	Shoot type		Polyvariance types
	nonrosette	rosette forming	
Number of scale-like leaves	Many	Few	1
Bud capacity	More	Less	1, 2
Shoot development duration	Monocyclic	Di and polycyclic	1, 4, 8
Differentiation of shoots	One type	Different types	1, 3, 4, 6, 8
Branching of shoots	Often scattered	Concentrated, tillering	1, 6
Shoot formation	Extravaginal	Extra- and intravaginal	1, 4
Internal rhythm of shoot development	Large-quantum	Small-quantum	8, 9
Formation of renewal shoots	Single	Prolonged, repeated	4, 8
Tillering rhythm	Postgenerative	Pregenerative	1, 4, 6, 8
Ontogeny rate	Slow, with gradual shoot strengthening	Often fast, with flowering primary shoot	5, 6, 8, 11
Life forms	Perennial herbs, annual plants, trees, shrubs	Perennial herbs, annual plants	1, 3–6, 8, 10, 11
Ecotopes	Usually forest	Meadow, open biotopes	1, 4, 6, 8, 10, 11

Polyvariance supertypes and types correspond to the previously published ones (Notov and Zhukova, 2013, with modifications): 1, structural–morphological; 2, anatomical; 3, dimensional; 4, dynamic–phenorhythmological; 5, ontogenic rate; 6, modes of reproduction; 7, polyvariance of life cycles; 8, functional–physiological; 9, biochemical; 10, ecological positions; and 11, completeness and type of ontogeny. The character of the correlation of traits corresponds to that described previously (Serebryakova, 1968, 1971).

est are the groups in which the modes of evolutionary transformations are identified, the correlation system is studied, and the population heterogeneity is estimated from the standpoint of the polyvariance concept. In this case, the involvement of data on different types of polyvariance facilitates clarifying and detailing the modes found and identifying the mechanisms of structural transformation.

Such model taxa include, for example, grasses (Poaceae) and the subtribe Alchemillinae Rothm. (Rosaceae). Each of these groups has been the object of complex analysis (Serebryakova, 1968, 1971, 1974; Zhukova, 1986, 1995; Notov and Kusnetzova, 2004; Kurchenko, 2010; etc.). They are interesting in terms of the structure of the correlation systems.

Many structural and rhythmological features of grasses are correlated with the shoot structure (Serebryakova, 1968, 1971, 1974). It determines the specificity of the structure and growth rhythm at all stages of shoot morphogenesis and is associated with the main programs of formation of the shoot system, including the general algorithm of its development in ontogeny (Table 2). The emergence of the rosette-forming forms is determined by the peculiarities of the ecological differentiation of species (Serebryakova, 1968, 1971). All this made it possible to propose an original system of life forms of grasses, which is based on the notion of their biomorphological evolution. The shoot type, rather than the conventional division into woody and herbaceous forms, was selected as the fundamental trait (Serebryakova, 1971). Relating the data on the correlation relationships and the variability of traits helped to identify the modes of structural evolution and the general tendencies (Serebryakova, 1968, 1971, 1974).

No less important is the shoot structure for the members of the subtribe Alchemillinae, with which the main features of the leaf and bud are correlated (Table 3). The evolution of architectural models and life forms was associated with the transformation of the type of shoots (Notov and Kusnetzova, 2004).

As a result of gradual generalization of the data on the polyvariance of the members of these taxonomic groups (Zhukova and Komarov, 1990; Zhukova, 1995, 2008; Notov and Kusnetzova, 2004; Notov and Andreeva, 2013; Zhukova et al., 2015; etc.) and the data of special studies, we obtained integrated polyvariance ranges. They were correlated with the information about the correlation of traits (Tables 2, 3). In this article, it was possible to provide information only on the types of polyvariance identified without going into detail on the variants. The analysis of polyvariance ranges made it possible to assess the degree of integrity of the correlation system and to determine the specificity of correlations between the stability and variability of structures and processes that are associated with various aspects of organization and that manifest themselves in the respective types of polyvariance. For each trait of the correlation constellation, a correlation with a larger or smaller number of other traits and cer-

Table 3. Polyvariance range and the nature of the correlation of traits in the subtribe Alchemillinae

Characteristics	Shoot type		Polyvariance types
	nonrosette	rosette	
Shoot development duration	Monocyclic	Polycyclic	1, 3, 8
Differentiation of shoots	One type shoots	Many types shoots	1, 3, 4, 6, 8, 9
Petiole and lamina	Petiole short, lamina base truncated or tapered	Petiole long, lamina base heart-shaped	1, 8
Stipules	Usually slightly adnate to petiole	Almost entirely adnate to petiole	1
Leaf sheath	Closed	Often open, rarely closed to varying degrees	1
Leaf primordia in bud	Developing stipules cover the lamina	Developing stipules do not cover the lamina	1, 2, 8
Rhythm of development of leaf primordium	 Phase of faster growth of developing stipules is present	 Phase of faster growth developing stipules is absent	1, 2, 8
Life forms	Shrubs, subshrubs, annual plants	Perennial herbs, rarely dwarf subshrubs	1, 3, 4, 5, 6, 7, 8, 10, 11

Designations of polyvariance types are the same as in Table 2. The character of correlation of traits corresponds to that described previously (Notov and Kusnetzova, 2004).

tain polyvariance types was established (Tables 2, 3). Sophisticated traits and characteristics were correlated with nearly all types of polyvariance. For example, shoot differentiation correlated with the manifestation of a complex of interrelated traits associated with various aspects of organization. The types of polyvariance identified (morphological, rhythmological, reproduction methods, physiological, etc.) were related to the same aspects (Tables 2, 3).

The results obtained are interesting from the point of view of possible areas of cooperation between different approaches. The combination of the correlation analysis with the assessment of polyvariance ranges provides the opportunity to reflect the multidimensionality and subordination of structure–function relationships, including the pathways of ontogeny. This method can be used for detailing ideas about the mobilization reserve of variability. Complex studies of polyvariance using the population meronomy methods can enhance the predictive value of each approach. Statistical data analysis makes it possible to obtain the frequency characteristics of the polyvariance ranges.

Data on the polyvariance of biomorphs may be of special interest for evolutionary morphology. The life form coordinates the maximum number of different correlations (Tables 2, 3). Its variability can be regarded as an independent type of polyvariance (*Polivariantnost'*..., 2006; Zhukova, 2008; etc.). Many other types of polyvariance are also correlated with biomorphological features. However, the most important types in terms of different ontogenetic trajectories, such as the polyvariance of life cycles, ontogenetic pathways, and ecological standpoints, are mainly related to the specificity of the life form. Although the polyvariance of the life cycle is most fully manifested in lower plants, it can also be found in seed plants. Due to the occurrence of regular apomixis, different variants of reduced life cycles (examples of this type of polyvariance) are implemented in different groups. This polyvariance was identified in members of the section Brevicaulon Rothm., genus *Alchemilla* L. (Glazunova, 2000). It should be noted that all species of this section are completely identical in terms of the architectural models and life forms and have the same type of structure of shoots, leaves, and buds (Notov and Kusnetzova, 2004). Due to the regular apomixis, they acquired common features of the correlation structure and variability of flower traits (Glazunova and Myatlev, 1990).

The biomorphological characteristics correlate to a greater extent with the most large-scale reorganizations of ontogeny and the overall development program. Data on their variability are particularly important in studies of the modes of transformation of life forms and architectural models (Serebryakova, 1971, 1972, etc.). From the standpoint of evolutionary morphology, it is relevant to perform an ad hoc analysis of the biomorphs of grasses and members of Alchemillinae that are considered within the framework of demographic classification. Diverse information on the polyvariance of these groups of life forms has already been collected. Despite the prevalence of monocentric forms in grasses with rosette-forming shoots, polycentric variants can be found even in the firm bunchgrasses (Zhukova, 1995, 2008; etc.). Identification of the transformation modus of these types of biomorphs will make it possible to correlate the structural evolution with the formation of different demographic strategies.

These examples demonstrate the possibility of using the polyvariance range data in evolutionary morphology and the feasibility of cooperation of the polyvariance concept with other approaches. Data on polyvariance help to assess the level of plasticity of the structural and functional organization. They complement the characterization of the mobilization reserve of variability. The correlation of polyvariance ranges with the features of correlation systems is relevant in identifying the archetypes of taxa and the structural transformation modes. Information about polyvariance is of great importance in studies of the morphological evolution of modular organisms with open growth and high ontogenetic plasticity. It may expand the capabilities of analysis of the evolution of life forms and architectural models, because their morphological specificity is associated with the general ontogenetic programs. The study of the structural diversity from the standpoint of the polyvariance concept will help to detail the principle of the initial morphofunctional archetypical diversity (Mamkaev, 2004) using botanical objects as an example and to reveal the mechanisms connecting onto- and phylogeneses.

CONCLUSIONS

Thus, the cooperation of the ontogeny polyvariance concept with other approaches to assessing variability and structural diversity is relevant. It will make it possible to bring together the efforts of various experts and will become the basis for an interdisciplinary synthesis of knowledge, which will expand the capabilities of each approach. The analysis of integrated polyvariance ranges in conjunction with the data on the correlation system structure, typology methods, and population meronomy may facilitate the identification of the modes of morphological evolution. Such complex studies will promote the use of the polyvariance concept in evolutionary biology. They are also important in terms of strengthening the positions of modern evolutionary morphology.

COMPLIANCE WITH ETHICAL STANDARDS

The authors declare that they have no conflict of interest. This article does not contain any studies involving animals or human participants performed by any of the authors.

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