The Ontological Status of Species

and

The Dilemma of New Biological Essentialism

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Abstract

Species is one of the most basic concepts for almost all branches of biology, and it is also one of the most controversial concepts. An important aspect of "the species problem" is the question of "what the ontological status of species is".

Traditionally, the answer to the issue about "the ontological status of species" is biological essentialism. Biological essentialism claims that species is a "natural kind", which argues that all and only the members of a species have a common essence. Each species is separated from all others by a sharp discontinuity. However, Darwin's evolutionary theory argues that species are gradual, and the boundaries between species are vague. This view conflicts with biological essentialism. With the continuous transmission of Darwin's theories, biological essentialism was gradually abandoned by philosophers and scientists.

In recent years, some philosophers try to resurrect biological essentialism by using new biological resources. Their theories are known as New Biological Essentialism, which mainly includes three different approaches: The Barcode Theory of DNA, Relational Essentialism, and HPC Theory. However, there are so many defects in their theories that they don't provide a successful defense for biological essentialism.

By analyzing these theories, I try to point out that the dilemma and failure of new biological essentialism dues to the conflict between its ontological presupposition and modern biological practice. The conflict leads to the tension between essentialism and biology. Further, I argue that the best way to eliminate the tension between biology and essentialism is to regard species as “heterogeneous kinds”. This new understanding of species abandons biological essentialism at the ontological level but retains the value of epistemology of regarding the species as “natural kinds”.

Keywords: species, essentialism, new biological essentialism, heterogeneous kinds

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Species are not only the basic unit of biological classification but also of biodiversity and biological evolution. One of the fundamental questions facing biologists and philosophers is "What is the nature of species?" This question consists of three different sub-questions: 1. the ontological question of species: is a species an individual or a natural class? 2. the definitional question of species: is the definition of species monistic or pluralistic? 3. the real question of species: does the term 'species' refer to a real category of existence? (Ereshefsky, 2013) In these 3 questions, this paper will focus on the 'ontological question of species'. In this context, the paper focuses on only one of these options: biological essentialism, and on its new form, new biological essentialism. The subject of this essay is therefore the "new biological essentialism" approach to the "ontological problem of species".

Species, Essentialism, and Gradualism

Essentialism in biology can be traced back as far as Plato's "idea". Plato believed that everything has an idea, which is the essence of the thing. It was Aristotle, the father of taxonomy, who applied essentialist ideas to biology. He also believed that everything has an essence, but that the essence of a thing is not its idea but "the power to achieve a certain purpose (Ereshefsky, 2001). For Aristotle, the essence of species is their teleological function. For example, the essence of human beings is the capacity for reason, and the purpose of the capacity for reason is to make human beings what they are. This view was called "teleological essentialist" (Ereshefsky, 2001). Thereafter, Aristotle's essentialist ideas about living things gradually developed into a tradition of study that did not change until the Middle Ages.

According to the Bible's interpretation, God created the world. In the biological world, species are the units created by God so that once these species are created, they never change again. Thus, the fixity and eternal immutability of the species became firmly established (Mayr, 1982). Influenced by the Christian thoughts of the creation of species, taxonomists have developed the concept of "essentialist species". This concept holds that each species is characterized by its unchanging nature and distinguished from other species by distinct discontinuities (Mayr, 1982). In the view of essentialists, species are populations of similar individuals that share a common essence. Variation is the result of the imperfect expression of the essence. In practical taxonomic work, taxonomists always identify the morphological characteristics of an organism as a fixed “pattern”, and then compare the morphological characteristics of other organisms with the “pattern”. If they are like the pattern, they belong to the same species, otherwise, they are not the same species.

Linnaeus' taxonomic work was also heavily influenced by Christian creationist thoughts. He regarded hierarchical taxonomic structure as an expression of the structure of nature. In his taxonomic work, he considered the number of existing species to be the same as the number of species created by God. Linnaeus further refined the essentialist concept of species, which set out four characteristics of species: (1) species consist of similar individuals with a common essence; (2) each species is distinguished from others by distinct discontinuities; (3) each species is constant and unchanging; (4) there are strict limits to the variation that can occur in any one species (Mayr, 1982). Linnaeus' theory was widely adopted by later taxonomists.

Darwinian evolutionary theory posed a sharp challenge to the essentialist concept of species. According to Darwin's evolutionary theory, biological evolution is a gradual, slow, and continuous process with no significant interspecies breaks. He argued that the term species is arbitrarily used for convenience between a group of closely related individuals that are like each other. There is no essential difference between a species and its variant (Darwin, 1909). This idea of the gradual variation of species has dealt a strong blow to the claims of biological essentialism. In contemporary times, "biologists and biological philosophers argue that species essentialism is incompatible with the modern Darwinian theory.” (Okasha, 2002). Based on Darwin's gradualism, biological philosopher David L. Hull (1965) has developed an argument to refute biological essentialism. His argument states that species are gradual so the boundaries between species are blurred. Species cannot be defined because there are no clear boundaries between species. Therefore, species have no essence. In the face of various criticisms, traditional biological essentialism faded from the biological scene.

The Tenets of Essentialism

The concept of "essentialism" has so many different meanings and controversies that it is difficult to give a precise definition. Here, for the convenience of discussion, I will use Ereshefsky's definition of essentialism. He summarized three tenets of essentialism (Ereshefsky, 2007)：

(1) All members of a kind and only members of that kind share a common essence.

(2) The essence of a kind is what causes the relevant typical characteristics of the members of that kind.

(3) We can explain and predict relevant typical characteristics by understanding the nature of a kind.

Tenet (1) requires that the essential properties of a kind are both sufficient and necessary for identifying the members of the kind. An essential property is possessed by all members of a kind and only by all members of that kind. The tenet requires that essentialism must give the "identity conditions" of a kind. The essential properties of a kind are the identity conditions. For example, the molecular formula of water is H_2O, so H_2O is the essential property and the identity condition of the water. We can identify a substance as water by the identity condition of H_2O. Any substance with the molecular formula H_2O is water, otherwise, it is not water. Tenet (2) requires that the essence of a kind must be able to causally lead to other relevant typical characteristics. The essence of a kind is the “intrinsic property” or “intrinsic structure”. For example, the essence of gold is the atomic structure of gold. The atomic structure of gold causally leads to other properties such as the ability to conduct electricity and to be soluble in acids (Nanay, 2011). Tenet (3) requires that the essence of a kind must be explanatory and predictive, which means that the essence of a kind must explain and predicate the typical characteristics of all members of the kind. For example, H_2O, as the essence of water, must be explanatory and predictive of the typical characteristics of water (colorless, odorless, transparent, etc.).

Anti-Biological Essentialists' Consensus and the Rise of New Biological Essentialism

Darwin's evolutionary theory has gradually caused traditional biological essentialism to lose its market in biology. Scholars have reached some anti-biological essentialism consensus, which consists of three main parts. All members of a species do not share a unique set of properties. Thus, a species cannot be distinguished from other species by a certain set of unique attributes.

(A) If all members of a species do not share a set of intrinsic properties (especially genetic properties), then those properties cannot be essential (Okasha, 2002, p.196).

(B) Species cannot be defined by intrinsic properties, but they can be defined by extrinsic properties. For example, in modern biological taxonomy, species are mostly defined by relational properties. For example, Elliott Sober (1999, p.153) argued that two organisms belong to the same species not by their similarity but because of their historical links.

The New biological essentialism is a response to the consensus in anti-biological essentialism. I try to divide new biological essentialism into three approaches. The first approach is a response to consensus A and consensus B, which asserts that there is an intrinsic essence of species. However, the essence is not a set of properties that are sufficient and necessary but is acquired through specific social interactions. This approach is represented by the Bar Code Theory of DNA. The second approach is a further development of consensus B and consensus C, which argues that the essence of species is not intrinsic but relational. This approach is represented by Relational Essentialism. The third approach accepts consensus a and consensus C and rejects consensus B, which argues that the essential properties of species can be both intrinsic and extrinsic, and those essential properties are neither sufficient nor necessary for a species. This approach is represented by the theory of HPC Theory.

Three Approaches to New Biological Essentialism

The Bar Code Theory of DNA

The DNA barcoding technique is a new biological classification method that has emerged with the development of molecular biology. In 2003, Paul Hebert proposed to use a specific sequence of 650bp of the mitochondrion cytochrome C oxidase subunit I (CO I) genes as a basis for microbial identification. The theoretical assumption is that each species has a unique DNA barcoding (Herbert & Gregory, 2005). If the CO I genes of known species are collected to create a barcode database, when the CO I genes of unknown species are entered into the database for comparison and retrieval, new species will be identified quickly. In effect, such a process is a "naming ritual". With the establishment of communities, such as the DNA Barcoding Consortium, where the initial name is passed on and established between members of the community through social interaction.

DNA barcodes refer directly to a particular species as a "proper name" and do not need to be associated with any attribute of the species. This way of referring does not change even if the properties of the species change. The proper name is given and then fixed through constant communication between members of the community like consortium for the barcode of life (Hebert & Gregory, 2005). Thus, the proper name remains unchanged even if the attributes change. In this way, there is a necessary and unchanging link between the name of the species and the object to which it refers. The fact that the proper name is invariant fulfills the essentialist requirement for an invariant essence. In this way, biological essentialism can be saved.

Relational Essentialism

Samir Okasha's relational essentialism is an alternative path to the new biological essentialism, which is based on the development of biological taxonomy. A typical feature of the development of biological taxonomy is the beginning of the use of "relational properties" instead of "intrinsic properties” as criteria for biological classification. For example, the biological species concept uses reproductive isolation as a criterion for distinguishing between species. The ecological species concept, on the other hand, uses the occupation of a particular ecological niche as a criterion for distinguishing between species (Ereshefsky, 2010).

I will now use the concept of biological species as an example to illustrate the claims of relational essentialism. In the biological species concept, the criterion for distinguishing between species is "reproductive isolation", which means that all members of a species share the property of being able to “mate with other members of the group and reproduce fertile offspring”, but different species do not share this property. Since this property is shared only by the species, the species can be defined by this property. So this property is sufficient and necessary for the species. This relational property satisfies one of the tenets of essentialism that all members of a kind, and only members of the kind, share some basic traits. These traits are the essence of the species. Thus, relational essentialists argue that by understanding this essence as a relational property rather than an intrinsic property, biological essentialism can avoid some of the theoretical difficulties of traditional essentialism.

Homeostatic Property Cluster (HPC) Theory

What The Bar Code Theory of DNA and Relation Essentialism have in common is that whether they insist on “intrinsic essence” or “relational essence”, both theories require that the essential properties of a species are both sufficient and necessary for all members of the species. HPC theory, however, suggests that the essential properties of a species can be both intrinsic and extrinsic. The essential properties of a species do not need to be sufficient and necessary for the members of the species. The key to essentialism is the predictive and explanatory role of the essence.

Richard Boyd was the first to use HPC to define natural kinds. A biological species is an HPC, which has two basic components:

(I) All members of an HPC kind share a cluster of co-occurring/ co-instantiate similarities

(Boyd, 1991). This cluster of similarities may be neither sufficient nor necessary for the members, but it must be sufficiently stable so that we can generalize and predict these properties effectively.

(II) The similarity of all members of an HPC kind can be explained by some homeostatic mechanisms. It is important to note that homeostatic mechanisms are not unique. Homeostatic mechanisms can be either intrinsic or extrinsic. They need not be necessary or sufficient for the members of a species. Moreover, homeostatic mechanisms are changeable.

For proponents of the HPC theory, the homeostatic mechanism is the essence of the species, as the HPC kind can play an inductive and explanatory role in the same way that the essence does in traditional essentialism (Ereshefsky, 2010, p.675). In contrast to traditional essentialism, however, the HPC theory balances "natural flexibility" with "explanatory integrity" (Wilson, Barker & Brigandt, 2007). Natural flexibility emphasizes the intrinsic heterogeneity of natural kinds, suggesting that they are not composed of identical members. This feature emphasizes the plurality of natural kinds. Explanatory integrity requires that natural kinds must have some combination of features, which can be used to explain and predict their heterogeneity. The HPC theory makes more compromises and concessions than other versions of new biological essentialism since it retains the connotations of biological essentialism only in the sense of causal explanation.

An Analysis of the Dilemma of New Biological Essentialism

Two Basic Tasks of Biological Essentialism

In the previous sections, we have analyzed the three tenets of essentialism, which are: (1) that all and only the members of a kind share an essence; (2) that the essence of a kind is what causes the relevant typical features of the members of the kind; (3) that the essence of a kind can be used to explain and predict the relevant typical features.

Traditional biological essentialism just replaced the “kind” with “species” in the above tenets: (1) each species has a unique and common essence; (2) the essence of a species can provide a causal explanation. This means that essence is not unique and common but can also provide a causal explanation. Thus, successful biological essentialism must succeed in both tasks. Many scholars have specified these two tasks. For example, Ereshefsky (2010) summarizes the two tasks of biological essentialism as the following two questions:

1) Classification question: Why is organism O a member of species S?

2) Characteristic question: Why do members of species S typically possess characteristic T?

Okasha (2002) argues that these two issues correspond to the semantic and causal explanatory roles of inner structure as stressed by Kripke and Putnam.

For the convenience of discussion, I will refer to these two tasks as the "classification task" and the "explanation task". The accomplishment of the "classification task" is both a philosophical and a taxonomic requirement. When biological essentialism asserts that species have certain essential properties, such essential properties become a criterion for species classification. The “explanation task” emphasizes the causal explanatory role of species essence, which means that essence can explain the typical surface features associated with species.

Having analyzed these two tasks, we can see the problems with traditional biological essentialism. First, let us look at the classification task. Traditional biological essentialists, represented by Linnaeus, believed that the essence of a species is the morphological or anatomical characteristics of the species, and therefore morphological similarities between individual organisms are the basis for classification. However, morphological, or anatomical characters are fallible. Morphological differences may exist between individuals of the same species, and males and females of the same species may differ significantly from each other. It’s difficult to find unique and common morphological characters as a criterion for classification. Darwinian evolution is a threat to traditional biological essentialism because it led people to realize that morphological variation in species is universal. Morphological characteristics that can be used as a criterion for classification do not exist. Therefore, using morphological features as the essence of a species cannot fulfill the classification task.

The explanation task and the classification task are linked. If traditional biological essentialism cannot fulfill the classification task, i.e., the essence of a species is not a morphological feature, then morphological features do not have a causal explanatory function. Thus, traditional biological essentialism cannot fulfill the explanation task either.

The Failure of New Biological Essentialism

New biological essentialism adapts and revises the logic of traditional biological essentialism in three different schemes, all of which are theoretically unsuccessful.

The first scheme is represented by The Bar Code Theory of DNA, which replaces morphological traits with genetic traits as the essence of the species. Modern developments in genetics have shown that morphological traits are merely expressions of organisms. Expressions are the result of genotypic interactions. Therefore, the intrinsic genetic traits that are the more fundamental properties. Replacing species essences with genetic traits instead of fallible morphological traits might solve the theoretical dilemma of traditional biological essentialism.

The dilemma of the bar code theory of DNA. In the bar code theory of DNA, this new essence is DNA barcoding. However, DNA barcoding, as a new species essence, can perform the classification task well, but not the explanation task. DNA barcoding technology was originally developed as a method of biological classification, and its function is to provide a DNA classification system. In a specific taxonomic operation, DNA barcoding technology can accomplish the task of classification by comparing the "genetic distance" of specific DNA sequences between different populations.

The reason why this theory fails to fulfill the explanation task is that DNA barcoding is only an accidental marker of species and that there is no unique and common DNA molecular structure for a species. Firstly, there is no unique DNA molecular structure for species. Most biological species only have the same or similar DNA molecular structure to each other. For example, the DNA statistical difference between humans and chimpanzees is only 2%, which means that the DNA similarity is 98%. Humans are much more like chimpanzees than they are different. Yet, intuitively, we are fundamentally different from chimpanzees, and these differences cannot be explained by differences in the structure of DNA molecules. Second, there is also no identical DNA molecular structure between individuals within a species. Due to the genetic polymorphism of organisms, there are varying degrees of genetic differences between individuals. Each individual has a unique DNA molecular structure. Therefore, DNA barcoding cannot fulfill both the classification task and the explanation task at the same time.

The dilemma of relational essentialism. The second scheme is represented by relational essentialism, which proposes a new relational essence of species while abandoning the explanation task. Relational essentialism holds that the essence of a species is a relational property. The relational essence is relational properties shared by all members of a species and is only shared by that species. For example, if the attribute 'the ability to mate with other members of its group and reproduce fertile offspring' is taken as the essence of a species, then this attribute is shared by members of a species and owned only by that species. Thus, the classification task set by essentialism can be accomplished.

However, relational essentialism does not fulfill the explanation task. There is no causal link between "relational essences" and the morphological characteristics of a species. The relational properties of a species cannot cause the morphological characteristics of the members of that species. On this point, Okasha (2002) states it is the genotype and developmental environment of the organism that provides a causal explanation for the morphological traits. The ability to reproduce with certain other organisms is not a causal explanation for morphological traits. Morphological features are indicative of this ability.

Critics of the program argue that it is the explanation task that is crucial to biological essentialism. An essence that cannot provide a causal explanation cannot be called an essence. Relational essentialism thus faces the same difficulty as The Bar Code Theory of DNA, namely, the inability to fulfill the explanatory task.

The dilemma of HPC theory. The third scheme is represented by HPC Theory, which argues that the explanation task is central to biological essentialism, and we can diminish the importance of the classification task. They claim that the essence of a species is a cluster of genetic and relational properties mixed. This cluster is neither necessary nor sufficient for a particular species. The essence of a species is regarded as essential because it plays a causal explanatory role. However, a cluster of attributes may explain the typical characteristics of a species, but it is difficult to determine what exactly this cluster of attributes is (Ereshefsky, 2013). Furthermore, HPC Theory suffers from the problem of the explanatory loop. The theory suggests that all members of an HPC kind share a cluster of co-occurring similarities that are not necessary and that vary over time. The explanation for the cluster similarity feature is a homeostatic mechanism, which also varies over time. The question is how do we determine which mechanism is the one for a particular HPC kind (Ereshefsky, 2010, p.677)?

One answer is that since homeostatic mechanisms are responsible for a cluster of similarities, we can find the "homeostatic mechanism" of the HPC kind from this cluster of similarities. If this is the case, Ereshefsky (2010) argues, HPC Theory is caught in an explanatory loop: to find which homeostatic mechanism is the essence of an HPC class, we need to find mechanisms that can produce covarying similarities in the class. But these covarying similarities are time-varying, and we need to determine which covarying similarities are the similarities of the kind. The only way is to find which similarities are generated by the homeostatic mechanisms of the kind. However, it will bring us back to the original question: which homeostatic mechanism is the essence of an HPC class (Ereshefsky, 2010)?

Based on the above analysis, we can see that, regardless of the use of any new essential property, new biological essentialism is always unable to accomplish both the classification task and the explanation task at the same time. Okasha (2002, p. 204) argues that in physics and chemistry, essential properties play both semantic and explanatory roles, whereas, in biology, it is not the same property that takes on the semantic and explanatory roles. Thus, New biological essentialism cannot accomplish two tasks set by essentialism at the same time. According to our analysis, even if one task is abandoned, the theory still faces a dilemma.

Intrinsic Tension of New Biological Essentialism

The three different approaches to new biological essentialism all attempt to redefine essence and use a new concept of essence to fulfill the two main essentialist tasks. Unfortunately, they all fail. In other words, there is always a tension between "an essence redefined by the new biological essentialism" and "essence defined by essentialism".

The tension, I argue, is between the empirical evidence of biology and the metaphysical presuppositions of essentialism. Modern essentialism is closely linked to scientific experience, and it is thought that we can construct metaphysics by drawing on the findings of scientific experience. For example, water is a liquid with characteristics such as colorlessness and transparency, which are only nominal essences of water. A liquid with these characteristics may not be water, and a liquid without these characteristics may also be water. The real essence of water is its "inner structure", i.e., H_2O. H_2O as the essential property of water is the result of scientific discovery, so the task of science is to discover the true nature of things. Since the modern essentialist view fits in well with the empirical discoveries of physics and chemistry, it should, as a metaphysical view, apply to everything.

The essentialist view, however, does not fit perfectly with the empirical evidence of biology. There is always a tension between the essences identified in biological practice and those set out by essentialism, which makes the new biological essentialism face theoretical dilemmas repeatedly. The tension between the practice of biology and the metaphysical presupposition of essentialism is thus the reason for the failure of the new biological essentialism. This tension is ultimately a tension between biology and essentialism. Essentialism cannot apply to biology, and this is the reason why the various approaches to new biological essentialism have failed.

"Heterogeneous Kinds"

Modern Biologists' Views about the Nature of Species

First, I will briefly explain the traditional biological essentialist understanding of species. They argue that species are natural kinds. Each species has a particular "pattern", which is shared by all members of a species. Members of a species share the same or similar characteristics with each other. In other words, there is homogeneity between the different members of a species. The variability that exists in a species is only the result of an imperfect expression of its essence and should be ignored. This understanding is known as pattern thinking (Sober, 1980, p350-383).

Darwin's emphasis on variability has directly influenced modern biologists' understanding of the nature of species. Modern biologists have argued that there is no "pattern". Each species has unique characteristics, i.e., the diversity of its members. There is variation within each species. Individuals differ from each other, and there is no "pattern" that is shared by all individuals. This idea is known as group thinking (Mayr, 1982).

The notion of diversity of species members, or heterogeneity of species, advocated by group thinking counter the biological essentialist claim that members of species are homogeneous. Ernst Mayr (1982) argued that the study of diversity would eventually shake the foundations of essentialism.

Modern biologists and biological essentialists have opposed understandings of species. What's more, because modern biologists accept group thinking, most of them consider species to be "individuals" rather than "kinds". The "kind ideas" emphasize that species have a structure characterized by similarity. The members of a kind must be identical or similar. They do not need to be connected causally with each other. The "individual idea" emphasizes that species have a structure characterized by causal connections. The species is an 'individual', and one part of the individual need not be like another part, but there must be an appropriate causal connection. The "individual ideas" are compatible with "group thinking ". Thus, the basic consensus among modern biologists is that species are individuals and not natural kinds.

"Heterogenous Kinds"

Modern biological philosophers argue that "individual ideas" should replace "kind ideas" in the question of how to understand the nature of species. Biological essentialism can be abandoned altogether. However, the traditional biological essentialists were not entirely wrong in their assertions about the nature of species. Their understanding of species begins with an intuition about natural kinds. When we see different species in concrete biological practice, we often rely on simple intuitions to identify their differences and generalize, which is often very effective. It suggests that intuitive similarity as a criterion for classification still has epistemological value. Then, how do we retain this "natural kinds" intuition within the theoretical framework of modern biology?

I argue that we can retain the "kind ideas" only in an epistemological sense, by limiting its application. Treating species as individuals in an ontological sense. In this way, species are not only 'kinds', but also 'individuals'. To take these two features into account, we can use the concept of "heterogeneous kinds". On the one hand, the concept of "heterogeneous kinds" considers species as kinds, but only in the epistemological sense of natural kinds, or nominally natural kinds. On the other hand, the concept of "heterogeneous kinds" considers species to be ontologically individual and constitutionally heterogeneous.

The concept of "heterogeneous kinds" has three advantages. Firstly, "heterogeneous kinds" preserve our intuition about the natural kind of species. The concept regards species as a natural kind at the epistemological level, but not an essentialist natural kind. "Heterogeneous kind" is a "natural kind without essence", which allows us to use similarity as a criterion for the classification of species. Secondly, "heterogeneous kinds" do not carry the burden of biological essentialism. The concept can be understood as a kind of nominal essentialism that does not require the two major tasks of essentialism to be fulfilled. Third, 'heterogeneous kinds' are compatible with modern biology. The concept still ontologically asserts that species are heterogeneous and that there is no essence.

With this concept, we can not only generalize about the characteristics of species but also retain “natural kinds” intuitions. Most importantly, it fits in with the theory and practice of modern biology.

Conclusion

In the pre-Darwinian period of biology, biologists, whose understanding of species was influenced by ancient Greek philosophers and medieval Christian creationist thought, mostly held a biologically essentialist view. Although this view was gradually abandoned after the introduction of Darwin's evolutionary ideas. Proponents of the new biological essentialism attempted to adapt and salvage essentialism by incorporating the theoretical achievements of modern biology. However, all three approaches to new biological essentialism were unsuccessful.

My analysis of new biological essentialism suggests that the failure of new biological essentialism lies in the tension between the empirical evidence of biology and the metaphysical presuppositions of essentialism. According to the general requirements of essentialism, there must be an essence of the species, which can fulfill a particular task. However, the essence of a species as determined by the biological empirical evidence cannot fulfill the two major tasks set by essentialism. Thus, even if the new biological essentialism offers a new understanding of the essence of the species and relaxation of the definition of essentialism, they still cannot save essentialism.

The tension between the biological practice and the metaphysical presupposition of essentialism is fundamentally a tension between biology and essentialism. Biological essentialism is at best a nominal essentialism, not real essentialism. Essentialism can be applied to physics and chemistry, but it cannot be applied to biology.

Modern biologists hold the opposite view to that of biological essentialists. The former considers species to be “individuals” and the latter considers species to be “kinds”. I try to understand species as "heterogeneous kinds" by knowing them as "individuals" at the ontological level while continuing to regard them as "natural kinds" at the epistemological level. This new understanding of species preserves our “natural kinds intuitions” about species and fits with biological practice.

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