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REVIEW

of research and teaching activities

of Assoc. prof. Petya Pavlova Ivanova, PhD

about the competition for the academic position

"Professor"

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The current review is prepared in compliance with Order No.99/03.04.2023. of the Director of IO - BAS as a member of the Scientific Jury for the conduct of competition for the academic position "professor" in the field of high education 4. Natural sciences, Mathematics and informatics, professional line 4.3. Biological sciences (Hydrobiology - "Genetics of hydrobionts" for the needs of IO-BAS, announced in State Gazette no. 12 of 02/03/2023.

The only candidate in the competition is Assoc. Prof. Petya Ivanova, an employee of IO-BAS.

This review was prepared on the basis of a decision of the Scientific Jury, adopted at a meeting of April 12, 2023. The documentation submitted by the candidate meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (with the amendments of February 25, 2020), the Regulations for the Application of the Law on the Development of the Academic Staff (SG No. 19/02/2019), as well as the Regulations for the conditions and procedures for acquiring scientific degrees and occupying academic positions at IO-BAS. The technical documentation is designed and arranged in accordance with the inventory in the Application for participation in the competition. The documentation submitted by the candidate meets the requirements of both the Law on the Development of the Academic Staff in the Republic of Bulgaria (with the amendments of 25 February 2020), the Regulations for the Application of the Law on the Development of the Academic Staff (State Gazette of 19.02.2019 d.), as well as the Regulations on the terms and conditions for acquiring scientific degrees and occupying academic positions IO-BAS.

Short professional biography of the candidate

Petya Pavlova Ivanova (born on 17.10.1969) graduated from Sofia University "Kliment Ohridski" in 1992 with a master's degree in "Hydrobiology and Water Conservation" after defending a thesis on "Genetic polymorphism of myogens and muscle esterases" in the Black Sea saffron *Trachurus mediterraneus ponticus*", prepared at the Institute of Fish Resources - Varna and protected in the Department of "General and Applied Hydrobiology" (formerly "Ichthyology and Fish Farming") of the Faculty of Biology of the SU. In 2003, after successfully defending a dissertation on "Taxonomy and population infrastructure of some species of the families Cobitidae, Atherinidae and Clupeidae (Pisces) in Bulgaria", she received

the scientific and educational degree "doctor", which was awarded to her by the National Academy of Sciences at the Institute of Zoology, BAS and confirmed by VAK.
The professional development of Petya Ivanova goes through successive occupation of various positions (senior research assistant Ist., II., III., head of the "Ichthyology" Section, associate professor, deputy director) at the Institute of Fish Resources at the SSA. After 2010, Petya Ivanova began working as an "associate professor" at the Institute of Oceanology at the BAS, where she held the positions of scientific secretary, deputy chairman of the Scientific Council, and is currently a member of the National Assembly of the IO (BAS).

Evaluation of the candidate's activity

Teaching activity

Associate Professor Petya Ivanova gave exercises in the period 1995-1996 at the Technical University - Varna to students majoring in "Ecology" in the disciplines "General Biology" and "Zoology".

She is the supervisor of two graduates - one from the Faculty of Biology of the University of St. Kliment Ohridski" and one from Thrace University, Stara Zagora.

Petya Ivanova was the supervisor of two doctoral students, one of whom successfully defended, and the other was dismissed with the right to defend.

Co-authored an exercise guide for students (undergraduate and graduate) in ichthyology.

Research activity

The main research profile of Assoc. prof. Petya Ivanova is in the field of research of hydrobionts (marine and freshwater) in main aspects: genetic structure of populations, species identification, ecological problems related to pollution of the Black Sea. The main objects of these studies are the representatives of the ichthyofauna.

These studies find expression in a high publication activity and the development of numerous research projects. Assoc. Prof. Ivanova has a total of over **90 scientific publications** (articles, books, book chapters). To participate in the current competition for a professor, the candidate has submitted 35 scientific works (refereed articles, books, book chapters, study aids), which are co-authors and are on the subject of the current competition. Scientific articles (30 in number) have been published in specialized and renowned international scientific publications, referenced and indexed in WoS/SCOPUS, such as Molecular Ecology, Journal of Fish Biology, Molecular Phylogenetics and Evolution, Frontiers in Marine Science, Biotechnology and Biotechnology equipment, Environmental Protection and Ecology, Acta Zoologica Bulgarica and others.

The distribution of all the articles with which the candidate participates in the competition are with quartiles as follows: with Q1 – 4 articles, with Q2 – 7 articles, with Q3 – 12 articles, with Q4 – 6 articles. One paper (scientific conference report) has no defined quartile, only SJR.

By indicators: B4 includes 9 articles forming 148 items distributed by quartiles: with Q1 - 2, with Q2 - 1 article, with Q3 - 2 articles, with Q4 - 4 articles; D7 includes a total of 21 articles forming 354 items – with Q1 – 2 articles, with Q2 – 6 articles, with Q3 – 10 articles, with Q4 – 2 articles. **The total IF** of scientific publications is **35.83** and **SJR = 16.433.**

Associate Professor Petya Ivanova is the first co-author in six of the scientific papers presented for the competition, in 6 she is the second, and in 9 she is the third. In a significant part of the publications, the author teams are made up of more than 5 co-authors. These data demonstrate the ability of Prof. Petya Ivanova for fruitful cooperation with a number of colleagues, specialists in the field of her research and for teamwork - in modern science, joint work is already a natural phenomenon and is highly valued all over the world, especially when developing environmental topics, data are collected for large-scale projects where implementation by a small team of researchers is difficult to implement or even impossible.

Proof of the importance of Assoc. Prof. Ivanova's published research is their citation. The total number of noticed citations of all publications in referenced and indexed in world-famous databases with scientific information (Web of Science and Scopus) of Assoc. Prof. Petya Ivanova (without self-citations) **is 273, h-index = 11** (Web of Sciences). The candidate's publications are also cited in 100 other scientific works, but not indexed by Web of Science and Scopus and therefore not carrying points for this indicator.

Most cited paper is: "Divergence with gene flow between ponto-caspian refugia in an anadromous cyprinid *Rutilus frisii* revealed by multiple gene phylogeography" co-authored with Kotlik, P, Markova, S., Choleva, L., Bogutskaya , N., Ekmekci, F., published in the journal Molecular ecology. It is cited 73 times or 26% of all citations in indexed by databases.

I accept the report presented by Assoc. Prof. Petya Ivanova about the contributions of her scientific publications, which are grouped into those with original scientific contribution and scientific-applied nature. Among the more significant scientific and scientific-applied contributions, according to the main scientific directions in which the candidate works, I would indicate the following:

1) Study of the biogeographic distribution of endemic fish species in their modern range and the phylogenetic relationship between them.

For the first time, molecular genetic studies have established phylogeographic evidence that the Black and Caspian Seas supported separate populations of *R. frisii* during the last glaciation, but exchanged genes in both directions as a result of significant gene flow. The phylogenetic relationships within the genus *Atherina* in the North-East Atlantic and the Mediterranean, and its subdivision into five clearly distinguishable groups: two recognized species (*A. hepsetus* and *A. presbyter*) and three additional lineages (clades) in the species *A. boyeri* are established. Differences in body coloration and ecology, combined with large genetic distances, support the proposition that these clades are three valid species.

2) Establishment of molecular genetic markers for identification of parental species and hybrid biotypes.

The taxonomic position of two undescribed species - *C. pontica* and *Cobitis taurica* - was established based on the application of a complex research approach. New markers for restriction fragment length polymorphism assessment were developed and applied, allowing precise identification of parental species and their genomes in the known hybrid biotypes of the complex. Two species of stickleback, *C. elongatoides* and *C. taenia*, have been found to occur in most of "non-Mediterranean" Europe, with *C. elongatoides* inhabiting the Danube basin and the upper reaches of the Oder and Elbe rivers, but extending its southern distribution limit to the Kamchia River. The species was not found in the right Danube tributaries, but it was established that the species C. albicoloris/strumicae occurs in the Vit and Yantra rivers. Three types of primary hybridizations leading to diploid hybrids (*C. elongatoides-taenia, C. elongatoides-tanaitica and C. elongatoides-taurica*) have been identified, occurring in zones of reproductive contact between the parental taxa.

3) Application of genetic markers to refine the taxonomic affiliation of marine hydrobionts and assess biodiversity.

Research in this direction includes the development and application of genetic markers that are used in conjunction with morphological analysis to clarify the taxonomic status of a number of species of hydrobionts. This includes the morphological and genetic-biochemical description of the species *Pomatoschistus marmoratus*, which contributes to solving the problem regarding the taxonomic status of the species, as well as a similar description of the endangered freshwater species of kelp (*Umbra crameri*) in the Black Sea. On the basis of genetic-biochemical analysis of 12 enzymes and total muscle proteins and haemoglobin, a comparison was made between two species of carrageenan fish (*A. immaculata* and *A. caspia*) from the Bulgarian Black Sea and the Danube River. For the first time, species-specific markers were established to distinguish the two species, as well as those to identify the rarer Black Sea species *A. fallax*. For the first time, a comparison was made between twelve species of poplars from the Bulgarian Black Sea coast, coastal lakes and rivers based on genetic-biochemical analyses. Interspecific hybridization between the species *Neogobius (Apollonia) fluviatilis* and *Neogobius syrman* was found for the first time in Lake Mandra. First data on the genetic-biochemical characterization of *Knipowitschia longecaudata* were obtained. Genetic markers for the identification of the endangered species of tadpoles *K. longecaudata* and *K. caucasica* have been established. Allozyme markers were established for the identification of five species of green fish along the Bulgarian Black Sea coast, included in the IUCN Red List of threatened species. A genetic marker was established to distinguish the two genera Symphodus (Crenilabrus) and Ctenolabrus. It is suggested that *S. tinca* and *C. rupestris* are rarely distributed along the Bulgarian Black Sea coast and can be proposed for "vulnerable species" status. For the first time, three natural sturgeon hybrids have been identified in the Bulgarian water area of the Black Sea and the Danube River, on a morphological and genetic level, which is considered a negative indicator of the state of their populations. The genetic divergence and the phylogenetic relationship between two species of mullet - *Mullus barbatus* from the western part of the Black Sea (Varna) and *M. surmuletus* from the Mediterranean Sea were established. Hybrids between *M. barbatus* and *M. surmuletus* were recorded for the first time in the Mediterranean and Black

Seas (Russia). The validity, distribution and phylogenetic relationships of three turbot species - *Scophthalmus maeoticus, S. maximus* and *S. rhombus* from the Black Sea (Turkish, Bulgarian and Russian coasts) and the Turkish coast of the Sea of Marmara have been established. Genetic data are also supported by morphometric variation in turbot species. 12 species of planktonic organisms identified as harmful were found, some of which (e.g. *Cochlodinium polykrikoides, Karenia bicuneiformis* and *Karlodinium veneficum*) were not previously reported in the Bulgarian Black Sea water area. The conducted research contributes to the assessment of the possibility of including metagenetic analyses in programs for monitoring the plankton community in the Black Sea. 180 species of microalgae were identified from different regions of the Black Sea, assessed using DNA metabarcoding, and the majority of these species were reported for the first time for the Black Sea. The genetic diversity of the genus *Pseudonitzschia* off the Bulgarian coast of the Black Sea was analyzed. Based on molecular analysis, three species of this genus have been identified in the Varna Bay, one of which is potentially toxic. Using molecular identification, the species *P. linea* Lundholm, Hasle and G.A.Fryxell, 2002 was first identified in the Black Sea.

4) Application of genetic and morphometric markers to assess the population-genetic structure with a contribution to the accurate assessment of stocks, application of effective fishing management and species conservation measures.

It was established intraspecific differences between populations of the black barbel species *Barbus cyclolepis* from localities in Bulgaria, Macedonia and Greece were established based on allozyme analyzes of total muscle proteins and six enzyme systems. The species *Barbus sperchiensis* and *Barbus strumicae* have been found to be genetically more closely related to each other than each of them individually to the species *Barbus cyclolepis*. For the first time, a multidisciplinary approach (molecular-genetic and morphological) was applied to assess the population-genetic structure of turbot off the Bulgarian coast of the Black Sea, and new data were obtained on the population-genetic structure of turbot (*S. maximus*) from Black and Marmaris seas based on allozyme analyses, as well as five to seven microsatellites and one/two mtDNA markers. A comparative analysis of morphometric and meristic characteristics of turbot specimens (*Scophthalmus maximus* L.) from the regions of Shabla, Shkorpilovtsi, Nessebar and Tsarevo on the Bulgarian Black Sea coast was also carried out. Data were analyzed to assess the genetic diversity and population-genetic structure of the mullet (*Mullus barbatus*) along the Bulgarian Black Sea coast (Bulgarevo and Tsarevo) by analyzing two mitochondrial and nine microsatellite primers. A lack of genetic structuring was found among the analyzed populations, possibly indicating the presence of a single stock of the species. Found values of effective population size (Ne) and M-factor below critical threshold values for the species likely reflect changes in populations due to a combination of high fishing pressure, habitat fragmentation and naturally occurring fluctuations in population size. Given the increasing catches of this species, the obtained data contribute to the future rational use and protection of this economically valuable species. The genetic structure of eleven populations of the economically valuable bonito species (*Sarda sarda*) from the Black, Marmara, Aegean, Mediterranean and Adriatic seas was investigated, based on sequencing of the D-loop gene of mitochondrial DNA. Three

genetically distinct populations have been identified: in the Black Sea and Marmara Sea, in the Aegean Sea and along the Mediterranean coast of Turkey, and the population from the Adriatic Sea (along the Croatian coast). The population-genetic structure of the anchovy from the Black Sea (Bulgarian, Turkish, Ukrainian and Georgian coasts) and the Sea of Azov was analyzed by applying genetic-biochemical markers. The genetic diversity of ten populations of silver carp (*Carassius gibelio*) in Bulgaria was analyzed for the first time and it was found that gene frequencies of polymorphic loci of common muscle proteins and five enzyme systems can be used as genetic markers to distinguish populations of the species in Bulgaria. Esterases were analyzed as specific markers to assess the genetic diversity of the black mussel (*Mytillys galloprovintialis*) populations from two areas along the northern Bulgarian Black Sea coast. A high level of genetic diversity was found in the studied populations and a low level of genetic differentiation, indicating unrestricted gene flow between them.

5) Assessment of the state of fish populations in NATURA 2000 areas.

An assessment of the ecological status of fish populations of five species of fish (*Psetta maxima, Sprattus sprattus, Alosa immaculata, Engraulis encrasicolus* and *Trachurus mediterraneus ponticus*) in the Natura 2000 areas of the Bulgarian Black Sea was made. Studies have been carried out on the growth patterns, migration routes, spawning grounds and feeding of the anadromous *A. immaculata*.

6) Systematization and updating of the available information regarding the species composition of the Black Sea ichthyofauna.

The list of the ichthyofauna in the Black Sea has been revised according to the available data in the Black Sea countries and according to their conservation status. The current state of the gobiid ichthyofauna (Gobiidae) in Bulgaria has been established, including 24 species of gobies inhabiting the Black Sea, its rivers and coastal lakes, the Danube River and its tributaries, the Maritsa and Tundzha rivers.

7) Assessment of invasive and alien species.

The morphological variability of the European (and North American) invasive species round goby (*Neogobius melanostomus*) from native Black Sea and invasive populations from marine and freshwater ecosystems belonging to the Black Sea, Baltic Sea and Great Lakes basins (USA and Canada) was studied. The state of the populations of six alien species from different taxonomic groups was assessed (zooplankton - *Mnemiopsi leidyi, B. ovata, A. tonsa* and O. davisae, benthos - *R. venosa* and one type of fish - *Liza haematocheila*). Updated and validated list of alien species for the Bulgarian and Romanian Black Sea coast. It has been found that their numbers have been increasing steadily over the past 50 years for both countries. The alien species list includes 37 species for Romania and 26 for Bulgaria, with the highest number of alien species belonging to the phylum Arthropoda for both countries. New data (morphometric, meristic and genetic-biochemical) were obtained for the identification of the invasive species of mullet *Liza haematocheila* (Temminck & Schlegel, 1845) along the Bulgarian Black Sea coast.

8) Scientific-applied contributions.

Among the more important contributions of a scientific and applied nature and not mentioned in the "original scientific contribution" section are the developed biotechnology for the preparation of biologically active components of *Rapana thomasiana* hemocyanin and their use as safe immunomodulators and the study of the most common groups marine waste and the hot spots of their deposition on the bottom in the Bulgarian sector of the Black Sea.

A contribution to academic education and the prepared textbook: "Practical Guide to Exercises in Ichthyology: Micro invasive Methods for Field and Laboratory Studies of Fishes" with a wide range of users in the field of biological sciences (majors studying zoology, ichthyology, aquaculture) and other disciplines.

Expert, organizational and administrative activity of the candidate:

Assoc. Prof. Ivanova has participated in 17 national and 19 international scientific and educational projects, financed by both national (FNI, Operational Program "Environment 2007-2013" and others) and international funds (European Fund for Marine Research and fisheries, the Financial Mechanism of the European Economic Area and others). She was the head of 2 national projects and 3 international projects. Their number clearly shows that Associate Prof. Ivanova conducts active research activities and is a sought-after partner in research teams with her knowledge in the field of ichthyology and the protection of the biodiversity of marine ecosystems. All this testifies to her active scientific-organizational and expert activity, and to her ability to work in a team.

In the period 2012–2022, Assoc. Prof. Ivanova was included 7 times as a member of scientific juries in competitions for acquiring academic positions (associate professor and professor) and "Doctor" and the scientific degree "Doctor of Sciences" (in 12 juries).

Assoc. Prof. Ivanova's expert work can also be judged by the reviews she prepared of articles in renowned scientific journals. In recent years (2012–2022), she has reviewed 55 journal articles in: *Acta Zoologica Bulgarica*, *Biotechnology & Biotechnological Equipment*, *Journal Fishery Research*, *International Journal of Fisheries and Aquaculture*), *Journal of Costal Research*, *Journal Ecology and Natural Environment*, *Journal of Environmental Sciences*, *Turkish Journal of Fisheries and Aquatic Sciences*, *Biochemical Systematics and Ecology*, *ZooNotes*, *Biharean Biologist*, *BioScience and Biotechnology*, *Molecular ecology*, *Journal of Ichthyology* and many others. She is also a reviewer of two textbooks.

Assoc. Prof. Ivanova participates in the editorial board of the journals: *Journal Marine and Life Sciences; Journal GenAqua; Journal Natural and Engineering Sciences; Journal of Limnology and Freshwater Fisheries Research.*

She is the editor of a journal *Frontiers of Marine Science; Journal of Marine Sciences and Engineering*.

Associate Professor Ivanova is a member of national and international working groups and commissions: Member of the interdepartmental coordination working group for the Convention

on Biological Diversity; National interdepartmental working group at the Ministry of Education and Culture in relation to Regulation (EU) No. 1143/20; Member of the Scientific and Technical Council for Fisheries and Aquaculture at the Minister of Agriculture and Food (2007-2010); Animal Husbandry Expert Council, SSA (2008-2010); Member of the working group for the protection of sturgeon populations in the Danube and the Black Sea - Danube Sturgeon Task Force (DSTF); Aquatic Genetic Resources for Food and Agriculture, FAO.

Actively participates in Bulgarian and international scientific and non-governmental organizations such as: International Association for Danube Research (IAD), American Fisheries Society (AFS), World Sturgeon Conservation Society (W.S.C.S.), BAENA, Balkan Environmental Association Danube Sturgeon Task Force (DSTF), the Union of scientists Varna.

Associate Professor Ivanova is a recipient of the Medal of Honour of IO-BAS.

All these scientific achievements and expert activity give me reason to conclude that the candidate's research activity and profile correspond to the announced competition. The scientific contributions and achievements of Associate Professor Ivanova have already received appreciation and recognition not only in our country, but also by the international biological community.

The reference on the fulfilment of the minimum national requirements by the applicant under Art. 2b of the RASRB for scientific area 4. Natural sciences, mathematics and informatics; professional direction 4.3. Biological Sciences shows a range of points that cover, and in most cases exceed, the required minimum number of points for the criteria.

The fulfillment of the minimum national requirements in terms of indicators for occupying the position of "Professor" is as follows:

The indicator from group "A" is covered by 50 items; According to the group "B" indicator, no points are required for this position; Group "B" indicators are covered by 148 points (out of 100 required); Group "D" indicators are covered by 369 points (with 220 required);

The indicators from group "D" are covered by 546 items (with 120 required). Group of indicators "E" are covered with 827.2 points (out of 150 required).

Total points by group of indicators A+B+D+D+E is equal to 1940.2 points (with 640 required). **This shows that the candidate fully meets and three times exceeds the requirements of the low.**

Critical remarks and recommendations

Critical remarks: I have no critical remarks about the candidate's scientific production in general. The candidate's publications are of high quality, have been published in specialized scientific journals and have been subject to peer review.

Recommendations: I would recommend the candidate to continue active publishing, seeking to further increase the visibility of their research through a focus on publishing in WoS/Scopus

first and second quartile journals. Another recommendation is to include in the candidate's research team more students from different educational levels, but mostly doctoral students. This will create conditions for continuity and confirmation of a scientific school in the field of genetic research of hydrobionts in our country.

Personal impressions of the candidate for professorship

I have known Petya Ivanova personally almost from the very beginning of her scientific activity. For me, she is an active, motivated, dedicated and well-rounded researcher with a clearly defined research profile in the field of ichthyology, biochemical and molecular analysis. The main thing that characterizes her is the wide scope of her research activity and her active role as an expert, with authority and recognition both at home and abroad, inspirer, organizer and driver of various scientific researches, projects and activities related to the topic of the protection of the biodiversity of the Black Sea.

CONCLUSION

The documents and materials presented by Assoc. Prof. Petya Ivanova comply with all the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for the Implementation of the low and the relevant Regulations on the terms and conditions for acquiring scientific degrees and occupying academic positions in IO-BAS. In the competition, Assoc. Prof. Petya Ivanova has provided sufficient evidentiary materials that show that she meets the requirements for holding the position of "professor". The candidate's profile fully corresponds to the thematic profile for which the competition was announced. The candidate's scientific and scientific-applied results show that she is an established scientist in her field and as a professor will be able to contribute to the successful development of the unit. My acquaintance with the materials and scientific works of Assoc. Prof. Ivanova submitted for the competition, and my analysis of their significance and the scientific, scientific-applied and methodical contributions contained in them, to give a positive assessment for her candidacy and to recommend to the respected members of the Scientific Jury to prepare a report-proposal to the Scientific Council of IO-BAS for the election of Assoc. Prof. Petya Ivanova to the academic position of "professor" in: field of higher education 4. Natural sciences, mathematics and informatics, professional direction 4.3. Biological Sciences (Hydrobiology - Genetics of hydrobionts).

19.05.2023

Sofia

Reviewer:

(Prof Eliza Uzuznova, PhD)