

REVIEW

by Prof. Dr. Snejana Petrova Moncheva, member of the Scientific Jury, according to Order No. № 99/03.04.2023 of the Director of IO-BAS – retired

according to the procedure for occupying the academic position "Professor", Field of higher education: code 4. "Natural Sciences, Mathematics and Informatics", Professional field 4.3. "Biological Sciences", Scientific specialty: "Hydrobiology", Scientific field: "Genetics of hydrobionts", published in the State Gazette No. 12/03.02.2023.

Dr. Petya Pavlova Ivanova, assoc. prof. in Dep. "Marine Biology and Ecology" at IO-BAS, is the only candidate in the open competition.

1. General data on the candidate's career and thematic development and the submitted materials

Dr. Ivanova was born on 17.10.1969. In 1992, she graduated from Biological Faculty of the "St. Kliment Ohridski" University as a Master in Biology with a specialization in "Hydrobiology and Water Conservation". In the same year, she was appointed as a biologist - curator in the Natural History Museum, Varna. In 1993, she began her scientific career at the Institute of Fisheries Resources-Varna, where in the period 1994-2000 she successively obtained the academic rank research associate III-I degree, during 1995-1996 she conducts practical classes at the Technical University - Varna, Specialty "Ecology" in the disciplines "General Biology" and "Zoology". In 2003, she defended her doctoral degree in the specialty "Hydrobiology" on the topic "Taxonomy and population infrastructure of some species of the families Cobitidae, Atherinidae and Clupeidae (Pisces) in Bulgaria" at the Institute of Zoology, BAS, under the supervision of the eminent ichthyologist-geneticist Prof. Ivan Dobrovolev, who played an important role in her research career. In 2007, she obtained the academic position of assoc. prof. in the specialty "Genetics". From 01.09.2010, she was recruited at IO-BAS as the head of the newly equipped genetics laboratory at the Dep. "Biology and Ecology of the Sea", which she successfully developed as a new research field at IO-BAS and continues her career growth until now. Through specializations in renowned European laboratories (Naples-Italy, Libekhov - Czech Republic, Lisbon-Portugal), participation in international courses and workshops, she advanced her professional competences in the field of genetics, which she successfully applies in her research and mentoring practice. In parallel with her scientific career, she also participated in the scientific and administrative management of the institutes as Head of the "Ichthyology" Dep. and the "Population Genetics" Laboratory (2004-2010) and as Deputy Director of the IFR (2007-2010) and Scientific Secretary (2015), deputy chairman of the Scientific Council (2012-2015), member of the Scientific Council of IO-BAS since 2011. Along with the intensive research and publication activity, she is involved in a large number of scientific international and national fora and expert working groups devoted to biodiversity of ichthyofauna and sustainable exploitation of commercial fish species, coordinates/participates in the implementation of national and international projects as well as in supervision of graduates and PhDs.

Dr. Ivanova presents a list with a total of 100 titles. Of these, 8 publications (6.1-8) are related to the PhD degree, 35 (6.2_9-43) - are related to the competition for the academic position of "associate professor" and are not subject to review under the current competition, but are taken into account in the general characteristic of the candidate.

In the current competition, Dr. Ivanova participates with 57 titles. Of these, 30 scientific publications (B.7_1-9, D.7_1-21) are part of the Reference for compliance with the minimum national requirements and those of IO-BAS, referenced in WEB of SCIENCE and SCOPUS. Albeit the scientific value of the material in publication No. D.8, I have some doubts about the category "book chapter or collective monograph" (as evidenced by the title "Black Sea State of Environment **Report**", lack of reviewers) and therefore it is excluded from the indicators of compliance. In addition 19 publications not referenced in the world databases (G23-G42) and 3 selected scientific and technical reports with ISBNs are presented, which are also subject to analysis as an important component of the applicant's scientific and expert activity.

Of the scientific articles, 29 were published in specialized scientific journals and periodicals, and 1 is a full text from international conferences (D.7.20), ranked by quartiles as follows: Q1-4, Q2-7, Q3-12, Q4-6, and 1 - referenced, with SJR. A significant share of the articles have been published in important national and foreign journals such as *Molecular ecology*, *Molecular Phylogenetics and Evolution*, *Harmful Algae*, *Aquatic Invasions*, *Frontiers in Marine Science*, *Acta Zoologica Bulgarica*, etc., most of them with "open access".

The entire scientific production of Assoc. Prof. Ivanova is in English, all articles and reports in full text are co-authored, which I view positively, given the scientific problematic, implying a multidisciplinary approach. In 29 of the publications, Dr. Ivanova has a leading role as first/second author, with a clearly distinguishable contribution of an equivalent co-author.

2. When reviewing the submitted documents and materials, I believe that **no plagiarism data** is found in the submitted publications/works.

3. Main research topics and most important scientific achievements

Dr. Ivanova's research activity is distinguished by an enduring interest in the field of population genetics and molecular taxonomy and in particular the application of genetic markers to establish and refine the taxonomy of marine and freshwater fish species and other biota for the assessment and conservation of their biodiversity; assessment of interspecific hybridization as one of the negative effects on biodiversity; study of the genetic connectivity of hydrobionts, in the context of their resistance to natural and anthropogenic stressors; a multidisciplinary approach in studying the population-genetic structure of commercial fish species, as a scientific basis for sustainable exploitation of stocks; assessment of populations of non-native/invasive species and development of strategies for early diagnosis in compliance with European legislative initiatives; genetic identification of progeny from endangered native fish species in the field of aquaculture. An emphasized important aspect is advancement of research methodology and application of specific and innovative approaches (next-generation sequencing, analyzes of environmental DNA - eDNA).

The scope of Assoc. Prof. Ivanova's scientific output also deserves attention in relation to:

- geographical areas and types of water bodies - various sea basins besides the Black Sea (Caspian, Mediterranean, Aegean, Marmara, Adriatic), rivers, lakes, dams;
- the variety of hydrobionts - fish fauna (gobies, bonito, turbot, anchovy, mullet, carp, wrasses, sturgeon), zoobenthos (black mussel, rapana), plankton (phytoplankton and zooplankton)
- the size of data sets and time range - 2091 samples from 21 anchovy catches for the period 1980-2006; 753 gobies from the Black and Baltic Seas and Canada; analyzed trends in catches of carp (1925–2010) and the population structure for the period 1956–2011, etc.

I accept the self-assessment of the contributions as sufficiently detailed and credible, in compliance with the scope of the candidate's scientific and applied results and achievements. Of particular significance, with an original character are considered the scientific achievements in the following areas:

3.1. Study of the biogeographic distribution and phylogeny of endemic fish species in their modern range. Original phylogeographic evidence was obtained for the degree of genetic differentiation of the endemic species *Rutilus frisii* (Nordmann, 1840) in the Black and Caspian Seas, and the formulated hypothesis about the mutual role of migrations under the changing natural connection between the two basins and gene flow, as an important source of genetic variation for the evolutionary response to climate change; in studies of phylogenetic relatedness in the genus *Atherina* in North-East Atlantic and Mediterranean Sea, two recognized species (*A. hepsetus* and *A. presbyter*) are proven and the thesis that the three additional lineages (clades) in *A. boyeri* are three valid species is supported; presented new data on the relatively high proportion of Mediterranean endemics and different scenarios for the molecular divergence and survival of species in limited refugia (B.1, B.3).

3.2. Development/Application of genetic markers to clarify the taxonomy and assess the biodiversity of marine species - an original approach (complex of genetic methods and new markers to assess restriction fragment length polymorphism) for precise identification in the genus *Cobitis* and the taxonomic position of two undescribed species as established (*C. pontica* and *C. taurica*) and three species as diploid hybrids (*C. elongatoides-taenia*, *C. elongatoides-tanaitica* and *C. elongatoides-aurica*); original data to clarify the taxonomy of gobies - interspecific hybridization between *Neogobius (Apollonia) fluviatilis* and *Neogobius syrman* established for the first time; established genetic markers for the identification of the endangered species *Knipowitschia longicauda* and *Knipowitschia caucasica*; confirmed hypothesis that *N. fluviatilis* and *N. melanostomus* belong to the *Apollonia* subgenus and proved the efficiency of the four new enzyme systems (ADH, GPI, GLUDH and G3PDH) as protein biomarkers; the taxonomy of *Pomatoschistus marmoratus* clarified; first morphometric and genetic data on the presence of the endangered freshwater species *Umbra cramerii* in the Black Sea; distinguishing between the two species carp (*Alosa immaculata* and *A. caspia*) and the rarer species *A. fallax* in the Black Sea through original species-specific markers; established allozyme markers for accurate identification of the five IUCN Red List species of wrasses; established genetic marker (LDH*B locus) to distinguish the two genera *Symphodus* (*Crenilabrus*) and *Ctenolabrus* and proposal to change the conservation status of *S. tinca* and *C. rupestris* to "vulnerable"; for the first time, three natural hybrids were identified in the sturgeons of different offspring in the Black Sea and the Danube

(*Acipenser gueldenstaedti* x *Acipenser ruthenus*; *Acipenser ruthenus* x *Acipenser stellatus* and *Huso huso* x *Acipenser ruthenus*) interpreted as a potential risk of genetic pollution and a threat to their biodiversity ; established two species-specific spectra in turbot with the potential for species identification corresponding to morphological differences; established the genetic divergence and phylogenetic relationship of the two species of mullet *Mullus barbatus* (Black Sea) and *M. surmuletus* (Mediterranean Sea) and proved their existence as two separate species and for the first time their hybrids were registered in both basins; proved effectiveness of a mtDNA marker (cytochrome C oxidase III) for species identification in the genus *Scophthalmus* and established the validity, distribution and phylogenetic relationships of three turbot species (*Scophthalmus maeoticus*, *S. maximus* and *S. Rhombus*) from the Black and Marmara seas (B.2 , D.7.2, D.6, D.7.1, D.8, D.7.8, D.23, D.24, D.31, D.36).

As a co-author in publications Г.7.10, Г.38, Г.7.12, Г.7.20, I will underline the contribution of Dr. Ivanova to the successful application of molecular genetic methods in the analysis of the biodiversity of phytoplankton and phytoplankton cysts, still relatively poor developed area in the Black Sea and their importance for the identification of new species, especially potentially toxic included in the list of HABs.

3.3. Application of genetic and morphometric markers for analysis of population genetic structure, stock assessment and effective management - new information on intraspecific populations in *Barbus cyclolepis* and higher genetic similarity between *B. sperchiensis* and *B. strumicae* compared with *B. cyclolepis* (B.4); The spectrum of new data on the population genetic structure of turbot (*S. maximus*) from the Black and Marmara Seas (allozyme analyzes and microsatellite mtDNA (COIII and CR) markers and a multidisciplinary approach) do not suggest enough clear phylogeographic genetic differentiation of populations in the Black Sea, preconditioning the suspected role of hydrodynamic factors in spreading the larval stages and formulation of adequate strategies for long-term monitoring and conservation (B.7, D.7.13, D.7.15, D.32, D.40). The original complex data on the population genetic structure of the mullet (*Mullus barbatus*), the correlation of low haplotype and nucleotide diversity at the COI marker with higher catches in the northern waters of the Black Sea and the values of the effective population size and the M-coefficient argue for a hypothetical connection of the low degree of genetic diversity with a combination of overexploitation of the stock, habitat fragmentation and natural fluctuations in the population size (FNI project, No. KPI-06-H41 /7/). The three genetically distinct populations of bonito (*Sarda sarda*) (mitochondrial DNA D-loop gene sequencing): the Black and Marmara Seas, in the Aegean and Mediterranean coasts of Turkey and from the Adriatic Sea, are an important contribution to introduction of adequate exploitation (D.7.5). Testing of genetic markers (11 non-enzymatic and 16 enzymatic loci) in populations of *Neogobius melanostomus* (*A. melanostomus*) to assess morphological and biochemical-genetic variability under salinity changes proved high plasticity, respectively potential to colonize new habitats, as well as the specificity of two polymorphic enzyme systems (esterases and malate dehydrogenase) to identify populations of the species (D.7.7). By analyzing the allelic frequencies of the polymorphic esterase loci of the anchovy from the Black and Azov Seas, mixed populations of the Azov and Black Sea anchovies were established for the first time, a basis for the hypothesis that the wintering migration of the

Azov anchovy also takes place along the western Black Sea coast, and the northwestern part of it is an additional water area for breeding (D.30). Original data on the genetic diversity in the carp (*Carassius gibelio*) prove the applicability of the gene frequencies of the polymorphic loci of the common muscle proteins and five enzyme systems as genetic markers for distinguishing populations of the species in Bulgaria, and the analysis of the genetic distances between the populations - the vector of the spread of the species from the Danube river to the internal reservoirs (D.7.3, D.25 and D.27). Specific markers (esterases) indicate high genetic diversity and low genetic differentiation in populations of the black mussel (*Mytilus galloprovincialis*), probably the result of unrestricted gene flow associated with the pelagic larval phases of the life cycle (D.37); new data on polymorphic variations in some loci (HB-1*, HB-2*, PROT-1*, PROT-2*, PROT-3*, ADH*, EST-3*, MDH-1*, MEP-1*, MEP-2*, PGM-2* and SDH*) proved as markers for distinguishing populations of *Alosa immaculata* (B.8 and B.9), and the polymorphic loci established for the first time (EST-3*, EST-4*, LDH-B*, sMEP-1*, sMEP-2* and MDH-1*) - for assessment of the population infrastructure in the gobies (*Neogobius (Apollonia) melanostomus*, *Gobius niger*, *Pomatoschistus marmoratus* and *Knipowitschia caucasica* (D.7.2).

3.4. Special attention deserves the assessment of the ecological state of the fish populations in the **Natura 2000** sites of the Bulgarian Black Sea (*Psetta maxima*, *Sprattus sprattus*, *Alosa immaculata*, *Engraulis encrasicolus* and *Trachurus mediterraneus ponticus*) and the proposed options for changes in the strategies for monitoring and conservation of stocks (G. 7.6).

3.5. A revised and updated list of the ichthyofauna in the Black Sea at basin scale and the gobiid ichthyofauna (Gobiidae) in Bulgaria, including their conservation status (D.7.4, D.28) are also an important contribution to the protection of the biodiversity of the ichthyofauna.

3.6. Contribution to the research of invasive and non-native species as a key ecological problem for the Black Sea. Studies of the morphological variability of the invasive species *Neogobius melanostomus* from different water bodies and the established similar morphological changes of the populations from distant geographical areas (Danube River and the Great Lakes) are in support of the concept of the role of morphological adaptation for the invasive success of the species (D.7.16); assessed the current status of the populations of six non-native species from different taxonomic groups (zooplankton - *Mnemiopsis leidyi*, *B. ovata*, *A. tonsa* and *O. davisae*, benthos - *Rapana venosa* and the fish *Liza haematocheila* in Varna Bay (D.7.9); new data for the identification of *Liza haematocheila* along the Bulgarian coast as markers for identification, stock monitoring and assessment of its potential impact on local mullet species (D.33); Prepared list of non-native fish species, including the year and place of their first appearance in national waters (D.29); validated list (D.7.19) of the biodiversity of foreign species from the marine waters of Bulgaria and Romania, the first catalog of invasive/potentially invasive alien species in the countries part of the Eastern and Southern European Network on Invasive Alien Species (ESENIA) (D.7.11) are new knowledge and the basis for a science-based implementation of European policies on EU non-native species.

3.7. Contribution to the development of present-day mariculture in Bulgaria The key criteria for determining the geospatial suitability of areas for the development of mariculture in the context

of the modern concept of AZA (allocated areas for aquaculture) and implementation of the European Directive on spatial marine planning have been derived for the first time, as advanced strategy for the development of mariculture in the Black Sea and identified 5 areas with potential for sturgeon breeding (D.7.17).

3.8. Contribution to the assessment of the state and dynamics of living and non-living resources and their exploitation in the Black Sea region. A large-scale assessment of the status, changes and exploitation of marine living (anadromous, pelagic and key demersal species of commercial fish, molluscs and algae) and non-living resources (sand mining, oil/gas exploration) in the Black Sea is presented, for the period 2009-2014 and the necessary measures for the recovery and sustainable development of fisheries, in accordance with the common fisheries policy of the EU (CFP) (D.8).

4. Scientific - applied achievements

4.1. Undoubtedly, the studies related to refining the taxonomy and population structure of marine biota, including non-native species, also have an important methodological and applied contribution to sustainable management and exploitation, mariculture development, biodiversity conservation and implementation of European environmental policies (*underlined in item 3*). In addition, the following scientific-applied aspects deserve attention: in fishes such as *Acipenser ruthenus*, which require restocking, the selected markers are a key factor in control of the stocks, prevention of interspecific hybridization and genetic pollution (G.34); the applied next-generation sequencing for the analysis of the "visible" and "hidden" diversity of microalgae off the Bulgarian coast has potential as a tool for more effective programs for monitoring the plankton community in the Black Sea and assessment the ecological risk of harmful blooms (D.7.10 , D.7.12, D.38 and D.39); the deposited genetic sequences of turbot and phytoplankton species are a contribution to the enrichment of the world genetic database (www.ncbi.nlm.nih.gov/genbank/) (B.7, D.7.10, D.7.13, D.7.14, D.7.15 , D.40)

4.2. Biotechnology has been developed for obtaining pure hemocyanin and biologically active components from the hemocyanin of rapana (*Rapana thomasiana*) with application as safe immunomodulators (B.5, D.26)

4.3. New present-day data for assessment of marine litter and hot spots of its disposal in the Bulgarian sector of the Black Sea have been provided, as a basis for creating a strategy for management and mitigation of impact on marine ecosystems and human health (D.7.18) and developed legal recommendations for dealing with plastic pollution in the Danube region (Scientific and technical report, Raykov et al., 2021).

5. Project, expert activity and citations

Recognition of Assoc. Prof. Ivanova's expert competence is her participation in a number of advisory bodies and working groups to various ministries, departments and international organizations - Member of the interdepartmental coordination working group to the Convention on Biological Diversity, MoEW; National Interdepartmental Working Group at the MoEW in

relation to Regulation (EU) No. 1143/20, Member of the Scientific and Technical Council for Fisheries and Aquaculture-Ministry of Agriculture, Expert Council for "Livestock Breeding", AA; Member of the working group on protection of sturgeon populations in the Danube and the Black Sea (DSTF); Aquatic Genetic Resources for Food and Agriculture, FAO, Balkan Environmental Association (BAENA) with a significant contribution to the development of strategic documents of national and regional importance (Measures for the protection of sturgeon fish species in the Bulgarian area of the Danube River and the Black Sea, Statements regarding the ban on sturgeon catch in the Bulgarian part of the Danube River and the Black Sea; project for stocking methodology by IARA, biological species intended for protection under Natura 2000 in the Black Sea; national reports to the CBD and FAO).

Respectful is the membership of the candidate in the editorial boards of 4 international scientific journals, guest editor of special issues of *Frontiers of Marine Science* and *Journal of Marine Sciences and Engineering*, Bulgarian representative of the European Reference Genome Atlas (ERGA), as well as the impressive number of reviews of 51 scientific articles and 2 books in the last 9 years only, for more than 15 international journals, which is an indisputable recognition of the international scientific reputation of Dr. Ivanova.

Dr. Ivanova's large-scale project activity in the period 2011-2023 is also impressive. She has participated in the implementation of a total of 41 projects, of which 19 national scientific projects (MES, NSF) and contractual tasks of IO-BAS, financed by IARA-MH, PUDOOS, MoEW and 22 international ones, of different sources of funding (FP of the EC, H2020, MARE, EASME, INTERREG, CBC- Black Sea, inter-academic exchange (EBD), etc.). She has coordinated 2 of the national projects and in 3 of the international ones - she was coordinated the research team of IO-BAS. Evidence of Dr. Ivanova's effective contribution to projects and expert groups is the co-authorship in a number of joint publications (over 90% of scientific articles), interim and final scientific and technical reports. The funds raised by the projects coordinated by the applicant are BGN 276,000. I would especially like to emphasize the stable collaborations that Dr. Ivanova managed to create and maintain over the years, both with specialists from various institutions in Bulgaria (BAS, AA, SU, PU, MU-Varna), on a regional (from all Black Sea countries) and on an international scale, which is not only a personal self-esteem, but also a contribution to the reputation of IO-BAS as a respected research center on a national and international level.

The self-assessment list of citations in scientific publications includes 373 citations of 45 publications, of which referenced and indexed in the scientific database SCOPUS - 273 of 39 publications in journals with IF and/or SJR and 35 - in books and conference proceedings, and the remaining 65 citations are in scientific publications not indexed in international databases. Some of the articles have been cited between 22-73 times, an indisputable certificate of the quality and relevance of Assoc. Ivanova's scientific production and recognition by the international scientific community.

On the occasion of the 40th anniversary of IO-BAS, she was **awarded the Medal of Honor** of the institute.

6. Training of young scientists

Dr. Ivanova is the supervisor of 2 diploma students and 2 doctoral students - Venelin Nikolov (dismissed, with the right to defend the thesis in 2014) and Nina Dzembekova (as a co-supervisor), who successfully defended her thesis in 2018. I consider the co-authorship of a university textbook "Practical guide to exercises in ichthyology: microinvasive methods for field and laboratory studies of fish" to be a significant contribution to academic education in the field of biological sciences (zoology, ichthyology, aquaculture) and the reviews and statements prepared by Dr. Ivanova on procedures for scientific degrees (11) and academic positions (7) at various institutes and universities - for investment in creating scientific capacity not only at IO-BAS, but also at the national level.

I am glad that I have a direct credit for attracting Petya Ivanova to the IO-BAN team. My personal impressions within our joint scientific activity on projects and in the process of shared mentorship of PhD student Nina Dzembekova. are for a responsible colleague and collaborator, a motivated, competent and consistent researcher in her scientific interests, with an indisputable contribution to the successful development of the genetics of hydrobionts as a new field of research in the institute and raising the level of scientific research in IO-BAS and the Black Sea.

7. Assessment of the applicant's compliance with the minimum national requirements, quantitative criteria and scientometric indicators

The analysis of Dr. Ivanova scientific performance shows that it not only fully covers, but significantly exceeds the minimum national requirements for the position "Professor" under Art. 2b, para. 2 and 3, respectively, Art. 2b, para. 5, ZRASRB and PURPONSZAD of IO-BAS (Appendix to Art. 1a), regarding all groups of criteria with a total number of points more than 3 times higher than the normative minimum.

Compliance with the minimum required points by groups of criteria for AP "Professor"

Group	Criteria	Min points	P. Ivanova
A	1.PhD thesis	50	50
B	4. Habilitation thesis - scientific publications referenced and indexed in international scientific databases (Web of Science and Scopus)/ publications B1-9.	100	148
Г	7.Scientific publications referenced and indexed in international scientific databases (Web of Science and Scopus) not included in the и Habilitation thesis (publications G7.1-21)	220	(369- 15) 354
Д	11. Citations in scientific publications, monographs, collective reprints and patents referenced and indexed in international scientific database Scopus	120	546
E	Total points of criteria 13-20	150	827.2
Total points		640	1925.2

CONCLUSION

Dr. Ivanova's accomplishment presents up-to-date scientific and applied achievements with original contributions corresponding to an established expert with a clearly defined research profile in applying genetic methods for the study of hydrobionts and their population structure for the protection of biodiversity and the sustainable management of stocks, with recognized reputation at national and international level. The documents submitted for participation in the competition fully correspond to the mandatory and specific criteria for the academic position "professor"

All the above give ground for my positive assessment and strong recommendation to the Honorable members of the Jury to vote **FOR** the promotion decision of Dr. Petya Pavlova Ivanova to the academic post "Professor" in the Field of higher education: code 4. "Natural Sciences, Mathematics and Informatics", Professional field 4.3. "Biological Sciences", Scientific specialty: "Hydrobiology", Scientific field: "Genetics of hydrobionts" and to propose to the Scientific Council of IO-BAS a positive statement for her appointment.

23.05.2023

Varna

Reviewer:

/prof. S. Moncheva /