Some remarks on current research on western Palearctic water frogs

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From the 11\(^{\text{th}}\)–15\(^{\text{th}}\) of October 1999 the 3\(^{\text{rd}}\) International Symposium on western Palearctic water frogs took place at the Museum of Natural History of the Humboldt University, Berlin. 35 scientists from 14 European countries presented and discussed their current studies on this frog group which has attracted the attention of evolutionary biologists and population geneticists for more than 30 years. The symposium included five scientific sessions on (1) systematics and biogeography, (2) ecology and ethology, (3) developmental biology and cytogenetics, (4) hybridogenesis and hybridolysis, and (5) population ecology and genetics. The presented results demonstrated the enormous increase of knowledge since the 2\(^{\text{nd}}\) water frog symposium (Wrocław, Poland) in 1994.

New techniques, such as DNA-sequencing and the development and use of microsatellites, had, and still has, an important impact on water frog research. For instance, the analysis of mitochondrial genes led to new hypotheses on the systematics of the western Palearctic water frog complex. Undescribed species are assumed to live in central Asia, in Anatolia, and on Cyprus. In general, systematic work on this frog group seems to be impossible without considering molecular data. Needless to say other character sets such as bioacoustic parameters or morphometric features should also be analysed to obtain additional information. However, at this point it has to be emphasised once again that bioacoustic investigations cannot be a substitute for molecular analyses. In water frog systematics the overestimation of bioacoustic data inevitably results in invalid taxonomic decisions as the example of “Rana balcanica” (Schneider et al. 1993) clearly demonstrates.

Furthermore, there still exist some unsolved problems concerning the correct scientific naming of the known water frog taxa. For example, up to now we cannot decide whether the name Rana ridibunda is valid for European or Asian lake frogs, because we do not have genetic data of R. ridibunda from its type locality. In general, a correct affiliation of scientific names to western Palearctic water frog species requires the analysis of material from all type localities.

The western Palearctic water frog complex seems to be a suitable model for studying genetic diversity as an integral part of biodiversity. In the past most attention was paid to the unique population genetics of central European water frogs, the so called Rana esculenta complex. The existence of different hybridogenetic population systems, which consist of specific population types with particular genotypic compositions, reflects the high variability and complexity of the reproductive modes in western Palearctic water frogs. Furthermore, it is known that each population itself represents a separate evolutionary unit despite the population system to which it belongs. Hence, not all insights obtained from one population can be transmitted automatically to all other populations of the system. In this respect, it must also be investigated whether introgression and genetic recombination is a general phenomenon in central European water frogs or if it is specific for only special population types. Concerning this question, new results are expected from the application of microsatellites, which provide a more sensitive insight into the genetics of water frogs compared to the more conservative allozyme approach.

A further question is whether the transfer of mitochondrial DNA or of nuclear genes from the Rana lessonae gene pool into the R. ridibunda gene pool via backcrosses between R. ridibunda and R. esculenta was a decisive precondition for the expansion of R. ridibunda from south to central Europe and thus for the establishment of R. ridibunda-R. esculenta populations in central Europe.

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However, our current knowledge concerning the ecological and genetic factors which determine the structure and dynamics of single systems and population types is still very poor. It is not yet clear whether and if so, which fundamental conditions one system may change to another. Do R. esculenta individuals, which live syntopically with R. lessonae, differ genetically from those, which join common populations together with R. ridibunda? Furthermore, the genetic factors, mechanisms, and processes, which cause the hybridogenetic modes of reproduction in many R. esculenta individuals are still unknown.

At this point we would also like to stress some problems concerning the terminology used to characterize water frog populations with respect to their genotypic structures and reproductive modes. In the literature, the terms "complex" and "system" are often applied. The term "complex" was primarily introduced to summarize the different European water frog forms sensu stricto, i.e., R. ridibunda, R. lessonae, and R. esculenta. Today, it is usually used to subsume all western Palearctic water frog species and associated hybrid forms. We propose, to apply the term "complex" only for the whole western Palearctic water frog group (WPWF-complex), but not for specific forms or species. Terms as "R. esculenta-R. lessonae complex" (e.g. Zahn 1997) or "R. esculenta-R. ridibunda complex" should be avoided generally.

The term "system" was introduced by Uzzell & Berger (1975) to characterize populations with different genotypic structures. These authors focused on differences in the composition of populations concerning the occurrence of the parental species R. ridibunda and R. lessonae and their natural hybridogenetic hybrid R. esculenta. It was differentiated between an L-E system (interactions between R. lessonae and R. esculenta) and an R-E system (interactions between R. ridibunda and R. esculenta). In the following years, two further hybridogenetic water frog forms (Rana grazi and Rana hispanica) were found, which occur together with Rana perezi and Rana bergeri, respectively. They form the P-G (R. perezi + R. grazi) and the B-H (R. bergeri + R. hispanica) system.

In some cases hybridogenetic hybrids live together with both parental species as in R. perezi-R. ridibunda-R. grazi populations or in R. lessonae-R. ridibunda-R. esculenta populations. Consequently, two further systems should be recognized: the P-R-G system and the L-R-E system. However, it cannot be excluded that these systems represent a pre-stage of the P-G and the L-E system, respectively, as it seems possible that pure R. esculenta populations, which are often subsumed under the term E-system, represent an end-stage of the L-E or the R-E system. Nevertheless, because of many peculiarities and apparently independent evolution it seems appropriate to also designate these types of populations system status.

Furthermore, we propose to avoid the creation of "new" system-specific population types without a fundamental data basis concerning an appropriate sample size as well as sufficient knowledge about dynamic processes. For example, a differentiation between R. lessonae-R. esculenta and R. esculenta-R. lessonae populations according to the proportion of the different genotypes would assume that there is a clear dominance of one form and the proportion of the respective form remains stable over a longer period of time. For most water frog populations such information is not available. Moreover, how do we classify populations with a ratio R. lessonae : R. esculenta of about 1:1? In general, a detailed subdivision of population systems into discrete population types makes only sense, if there are clear and constant characters as well as a solid data basis. Otherwise, it creates more confusion than a real increase in knowledge.

In this volume only selected papers on systematics, biogeography, population genetics, and ecology are presented. Contributions on ethology are published elsewhere. For further information we would like to refer to the webpage of the water frog information pool at http://evolution.genetics.washington.edu/waterfrogs.html.

Finally, we wish to thank our sponsors, most of all the Deutsche Forschungsgemeinschaft (Bonn), for financial support of the symposium. We are also grateful to Jason Dunlop (Berlin), David Unwin (Berlin), and Peter Giere (Berlin) for reading some of the manuscripts and improving the English.

Berlin/Marburg (Germany), November 2000

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