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IS THE SCIENTIFIC VALUE OF A BIOLOGICAL COLLECTION MEASURABLE?

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Natural science collections can be estimated for their scientific, cultural and financial values. How should the scientific value of a biological collection be assessed? That the specimens last and are in good condition is more necessary for any collection than any quantification of its value. The total number of specimens and the total number of species in biological collections do not tell us anything about the value of individual specimens in the collection and they are hardly comparable among collections of different taxa. The basic purpose of biological collections is to be a source of data for biological research. Therefore, the amount and quality of scientific publications based on specimens from a particular collection could be a good guide to the value of the collection in question, and, in most cases, a good indication of its total value.

Key words: biological collection, value of collections, scientific publications

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Prirodoslovne zbirke imaju svoju znanstvenu, kulturnu i financijsku vrijednost. Što može biti izmjerljiva znanstvena vrijednost bioloških zbirki? Dugotrajnost primjeraka u zbirci i njihova dobra očuvanost više su preduvjeti nego li mjerilo njene vrijednosti. Ukupan broj primjeraka i ukupan broj vrsta u biološkim zbirkama ne govore nam ništa o vrijednosti pojedinih primjeraka i teško su usporedivi između zbirki različitih svojti. Osnovna svrha bioloških zbiraka je da budu izvor podataka za biološka istraživanja. Iz toga slijedi da je broj i kvaliteta znanstvenih publikacija temeljena na primjercima iz određene zbirke dobro mjerilo poznate vrijednosti zbirke, a u većini slučajeva i dobra indikacija njene ukupne vrijednosti.

Ključne riječi: biološka zbirka, vrijednost zbirki, znanstvene publikacije

In general, scientific biological collections contain biological materials, mostly preserved complete specimens of living organisms, specimens treated by different methods as well as parts or products of organisms, like shells, eggs or nests, collected and preserved for scientific purposes by museums, universities or other scientific institutions. The term »scientific biological collections« is basically unnecessary, be-

cause all natural history collections should be kept for that goal. It is used only because potential readers, including in my experience many biologists and even museum employees in Croatia, misinterpret the term »collection« and understand it to mean the museum's permanent exhibition, as already discussed by KOVAČIĆ (2001).

The differentiation between museums and scientific institutions is unnecessary in some countries, because in these countries natural history museums are at the same time scientific institutions or are an integral part of scientific institutions or universities (ŠTEVČIĆ, 1998). By contrast, in Croatia all public museums are cultural institutions i.e. organised and financed by the state Ministry of Culture or departments of culture of counties or cities and not by the Ministry of Science. Keeping biological collections in museums as they are currently defined in Croatia or in scientific institutions or universities both have advantages as well as disadvantages. However, this subject was already commented on with respect to ichthyological collections (Kovačić, 2006) and because it is a very important issue, it should be discussed separately.

Natural science collections can be estimated for their scientific, cultural or educational and financial values. However, an analysis of scientific activities in Croatian museums by KOVAČIĆ (2002) indicated that, in contrast to their legal status, and in comparison to art or historical collections, natural history museums produce the highest output in the form of technical and scientific publications. What are possible explanations? An art museum depends on the beauty of its objects, and no further science-based interpretation of its objects is essential. The importance or the value of biological collections depends on a science-based interpretation of its objects (e.g. taxonomic or other biological research). The main value of art collections is their cultural, financial and educational value. In contrast, the scientific value of biological collections is normally much more important than their financial value. This shows a deep difference between the natural history museums and other kinds of museums. The result of this difference is that the purpose and the specific scientific methodology of natural history museums usually are not or are very poorly understood in the public or by politicians who make decisions on state, county or city funds for culture. If the scientific value of a biological collection is so important, how should it be estimated? Is it possible to find criteria for evaluating the scientific value of a biological collection?

KOVAČIĆ (2006) listed three goals of good work with biological collections: 1) the permanent preservation of specimens, 2) a continuous increase in the number of specimens, 3) established value i.e the results of scientific investigation and interpretation of specimens. Metaphorically speaking, in biological terms, these three goals of good work in biological collections could be labeled as »health« (preservation), »growth« (collecting) and »development« (interpretation). What about the relations of these three goals with the scientific value of collections?

The good condition of specimens depends on the circumstances and methods used for collecting, the fixation and later keeping of the preserved material. Unfortunately, most curators who have visited different collections know that in many collections around the world a lot of material is in poor condition. My personal experience with the animals I mostly work with, small-sized fishes of the family Gobiidae, is that in many cases sensitive specimens have often suffered from un-

skilled collection or fixation and inadequate preservation, resulting in poor condition, no later good keeping being of any help. However, long-term and professional preservation of specimens and their good condition are important prerequisites for the scientific use of any collection and not the measure of its scientific value.

The increase of the total number of specimens in a collection is a good measure for collecting activity. On the other hand, the total number of specimens does not provide insight into the scientific value of individual specimens. An extreme case would be, for example, when a curator for ichthyology collects a large number of fish belonging to common species from the nearby fish market in a single day – a considerable input of new specimens for his collection but probably of very small scientific value. Therefore, the sheer number of specimens is a very poor measure for the scientific value of a biological collection. For comparing the significance of collections for the same taxon, species diversity may be a much better indicator (Fig. 1). However, how should we compare the number of species as a measure of value for collections of different taxa? Imagine a comparison between a herpetological and an entomological collection! A possible answer could be the use of ratios, i.e. the number of species of a particular taxon in the collection vs. the total number of species of the same taxon which are scientifically described. This could be a good measure for the scientific significance of collections as sources of comparative materials for particular taxa. For instance, if you are working with a particular species and have managed to find all known congeneric specimens as source of comparative material in a single collection, what a saving of time and money when that collection is close to you. The next question will be what should be the limit of the area for the total number of species in a taxon: global, national or local area? There are large and very small museums, those which organize long distance fieldwork far outside of their home country and those which do long-term local collecting in their immediate neighborhood. Both can result in precious collections. Thus,

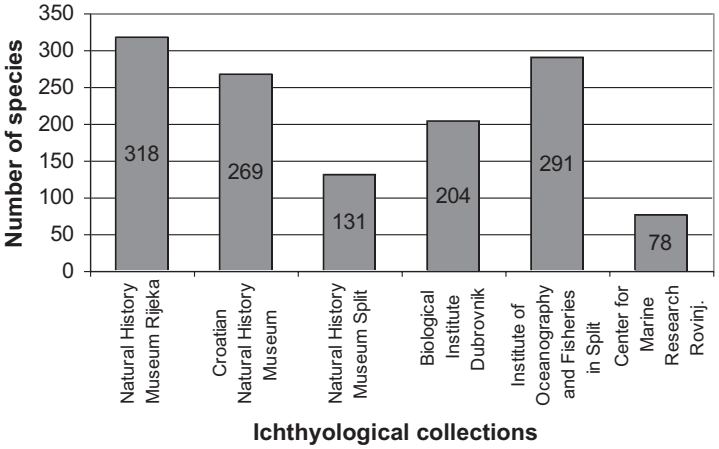

Fig. 1. The number of species in the ichthyological collections in Croatia (published in KOVAČIĆ, 2006).

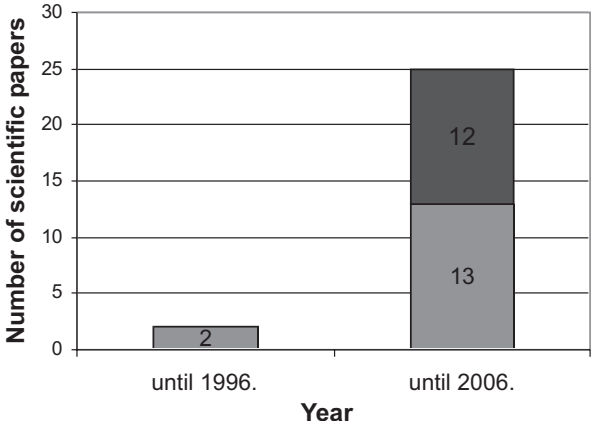

Fig. 2. The number of scientific papers published on material from the ichthyological collection of Natural History Museum Rijeka: ■ CC cited journals, ■ other journals (published in KOVAČIĆ, 2006).

there appears to be no objective comparative measurement of the real scientific value of a biological collection. In the process of estimation different arguments could be used, which could lead to different conclusions.

The third goal that should be reached by biological collections, according to KOVAČIĆ (2006), is the proved value of individual specimens. The measure of the value of a specimen, object or group of objects is related to how well the object satisfies its purpose. The basic purpose of biological collections is the information connected with specimens capable of being extracted from the geographical origin, morphology, anatomy, molecules etc. for biological research, and that – after publication – can be used as evidence for the data and to check or to repeat results (see more in MAYR & ASHLOCK, 1991). The EARL OF CRANBROOK (1997) has listed the key roles of natural science collections for research: (a) to preserve type material; (b) to verify published research on particular organisms; (c) representing the source for further taxonomic research by determining the variation of and the limits between species; (d) representing an invaluable database on the geographical distribution, historical and current range and on the phenology of species; and (e) as new research techniques become available type specimens offer the only possibility to compare and to verify the presence of newly recognized features in the species concerned. The collections also serve as the database on the biodiversity of particular geographical regions. The best known example of material from collections used in biological researches is the type specimen used to identify and to describe a new species. Type specimens are scientifically the most important materials persevered in natural science collections (JERAM, 1997). Biological collections are further necessary for the identification of species from new samples by professionals. In both cases, it is always the same collection that is used for different purposes.

The basic purpose of biological collections is to be a source of data for biological research. Therefore, the amount and quality of scientific publications based on spec-

imens from particular collection could be a good measure of the value of that collection. KOVAČIĆ (2006) has given an example of the increase of the scientific value of the ichthyological collection of the Natural History Museum in Rijeka over a ten year period, using data on the number of scientific papers published relating to the specimens from that collection (Fig. 2). An additional advantage of this measure is that the amount and quality of scientific publications can be evaluated using standard scientometric tools as an objective method. By using these international standards it will be further possible to compare the evaluation of different biological collections across different taxa. The use of several different measures to evaluate the scientific value of a collection, as proposed by JERAM (1997), will make a comparison between different collections much more difficult. JERAM (1997) distinguished two categories of materials which are of scientific value in natural science collections: material which is integrated into the fabric of science (=scientifically important material) and material which facilitates scientific work (=material of value to science). In his division scientifically important materials are subject material (like type material), while contributory material is material which is used in a scientific investigation, but which is not the primary subject of the investigation. JERAM (1997) has proposed for different subcategories of scientifically important material several quantitative measures of scientific value: (a) the number of taxa with type material, (b) the number of specimens included in publications, or (c) the number of publications in which the material was used.

However, an important constraint to the use of the amount and quality of scientific publications as a measure of value for a given collection has to be taken into consideration. The number and quality of scientific papers published relating to material from a collection might be its known scientific value but in no way its total scientific value. It is not possible to evaluate the total value of biological collec-

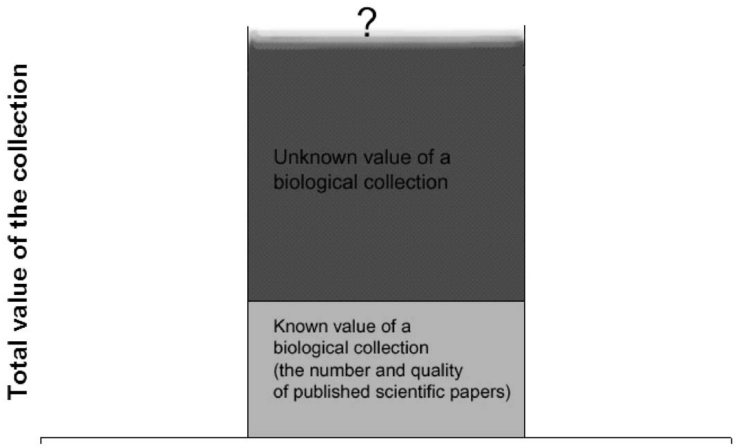

Fig. 3. The known scientific value (the number and quality of scientific papers published on material from a collection) and the unknown scientific value (the future use of the material from a collection for scientific works) of a biological collection.

tions objectively, because this value is composed of known value and of unknown value, i.e. the future use of material from the same collection for scientific research (Fig. 3). The problem of objects of known scientific importance that verify the results of research and the problem of whole collections as potential resources for driving future research is also noticed by KNELL (1997). Unpublished or undescribed materials in collections should not be treated as scientifically unimportant, because we cannot predict their future use or significance for science. JERAM (1997) included in his category of material of value to science, besides the material required as standards and reference materials, also materials which are of potential scientific importance. However, if we are not dealing with extreme cases, like a precious collection full of undescribed species still unpacked from long distance fieldwork performed many years before, the scientific activity documented by published papers may be a good indicator for the total scientific potential of a collection. Therefore, the amount and quality of scientific publications based on specimens from a particular collection is a good measure of the known value of a collection in question, and, in the most cases, a good indication of its total value.

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