# A digital catalogue of primary type specimens in German ornithological collections - a three year project running within GBIF - Germany - Vertebrata

**R. van den Elzen, S. Frahnert & C. Quaisser**

Elzen, R. van den, S. Frahnert & C. Quaisser. A digital catalogue of primary type specimens in German ornithological collections - a three year project running within GBIF - Germany - Vertebrata.
Zool. Med. Leiden 79-3 (9), 30-ix-2005, 97-105.— ISSN 0024-0672.
Renate van den Elzen, Zoologisches Forschungsinstitut und Museum A. Koenig, Adenauerallee 160, D-53113 Bonn, Germany (e-mail: r.elzen.zfmk@uni-bonn.de).
Sylke Frahnert & Christiane Quaisser, Museum für Naturkunde Berlin, Invalidenstr. 43, D-10115 Berlin, Germany (e-mail: sylke.frahnert@museum.hu-berlin.de; christiane.quaisser@museum.hu-berlin.de).

Keywords: vertebrate; type catalogue; museum data network; virtual museum; type history.
The Global Biodiversity Information Facility (GBIF) is an international initiative that aims to enable the worldwide exchange of biodiversity-related data through the internet. Within a three year project funded as a German contribution to GBIF the information about primary types of birds (and other vertebrates) in German collections will be made available through the internet (http://www.gbif.de). This information includes the original description, status (syntypes, holotypes, etc.), current taxonomic classification, collecting data, mode of preparation, current location as well as digital images of type specimens. So far, 900 of the expected 4000 primary type taxa of birds have been investigated and digitised. It is expected that by the end of the project 50 to 75% of all primary types in German collections will be digitised. This information will be linked with other type catalogues and biodiversity databases through the GBIF network to build a "virtual museum".

## General remarks

Natural history collections are treasure-rooms of primary data. Well-documented and well-labelled preserved organisms provide information on pheno- and genotype as well as on distribution in time and space. In a world of climatic changes and a globally increasing human impact on nature the importance of specimens in collections for the documentation of biodiversity is increasing. They are vouchers for taxic and evolutionary diversity of a certain time horizon and a platform for addressing scientific and conservation issues (Ade et al., 2001; Collar, 1999; Frahnert, 2001; Peterson et al., 1998, 2002; Stiles, 1995). In European collections five million skins of birds are housed: the worldwide estimate gives at least 12 million (Roselaar, 2003). Together with skeletons, alcohol specimens, eggs and nests they supply a solid basis for primary scientific biodiversity studies.

Yet these valuable collection data are only partly accessible due to lacking facilities, financial support and coordination. This gap is bridged by the Global Biodiversity Information Facility (GBIF), an international initiative that aims to enable the worldwide exchange of biodiversity-related data through the Internet. The primary goal is to set up a network of scientific biodiversity databases. This network will enable users to access the great variety of biodiversity-related information existing worldwide (at species level) and to use the data for individual purposes. Potential users are the scientific community and human society in general. GBIF International started in 2001; at the moment 25 countries are voting members.

In detail, the initiative encourages "… and supports the development of worldwide capacity to access the vast amount of biodiversity data held in natural history museum collections, libraries and databanks. Technical support is given to evolving an interoperable network of biodiversity databases and information technology tools using web services and Grid technologies…" (http://www.gbif.org).

The German contribution to GBIF consists of seven nodes including Procaryota and Viruses, Plants and Protists, Mycota, Evertebrata 1 (Insecta), Evertebrata 2 (Mollusca, Chelicerata, Myriapoda), Evertebrata 3 (marine organisms) and Vertebrata. Their programme is manifold, comprising checklists, general collection data, distribution maps, digital photographs, taxonomic registers and type catalogues. The German nodes are technically supervised and organised by the Botanical Garden and Botanical Museum Berlin-Dahlem (Prof. Dr W. Berendsohn). The subnode GBIF-D-Vertebrata is coordinated by the Zoological Research Institution and Museum Alexander Koenig Bonn (Prof. Dr C.M. Naumann/Dr R. v. d. Elzen). It comprises all vertebrate classes: mammals, birds, amphibians/reptiles, and fishes. The IT-partners, SysTax (Systematic Botany and Ecology, University Ulm, Dr J. Hoppe) and V.I.M. (Verlag für interaktive Medien GbR, Gaggenau, Dr N. Hirneisen) will give support for the internet presentation. A first project within GBIF-D-Vertebrata began in 2003 and is scheduled to run for three years. The main goal of this project is the compilation of a digital type catalogue, including digital images of specimens and labels. About 12,000 primary types of vertebrates are expected to be present in German natural history collections, among these almost 4000 bird taxa. It is estimated that within this first GBIF project 50 to 75% of these primary types will be digitised. Therefore, all large German ornithological collections are in-

Table 1: Institutions included in the GBIF-type-project for birds, estimated numbers of primary type specimens (taxa) and present work status (+ investigation in progress).

| Institution | Estimated number of type-taxa | number of type-taxa digitised | number of type specimens | Number of type specimens photographed |
|---|---|---|---|---|
| MHH | 200 | | | |
| MTD | 200 | | | |
| SMF | 250 | | | |
| SMNS | 120 | 95 | 132 | 132 |
| SNMB | 50 | 36 | 80 | 0 |
| UMB | 270 | 237 | 283 | 283 |
| ZFMK | 400 | 232 | 278 | 278 |
| ZMB | 2000 | 521+ | 1267+ | 775+ |
| ZMH | 100 | 139 | 230 | 139 |
| ZSM | 300 | | | |
| Total | 3890 | 1260 | 2270 | 1607 |

MHH – Museum Heineanum Halberstadt; MTD – Staatliche Naturhistorische Sammlungen Dresden; NMW – Naturhistorisches Museum Wien; SMF – Naturmuseum und Forschungsinstitut Senckenberg Frankfurt; SMNS – Staatliches Museum für Naturkunde Stuttgart; SNMB – Staatliches Naturhistorisches Museum Braunschweig; UMB – Überseemuseum Bremen; ZFMK – Zoologisches Forschungsinstitut und Museum Alexander Koenig; ZMB – Museum für Naturkunde Berlin; ZMH – Zoologisches Institut und Zoologisches Museum Hamburg; ZSM – Zoologisches Staatssammlung München.

cluded in this project (tab. 1). In addition to the digitised specimens, a second aim of the project is to create an infrastructure to link type information from German collections with international type catalogues as well as with other biodiversity databases.

## Aims and background of the bird type catalogue

The worldwide loss of biodiversity at both geographic and taxonomic levels has found a political response, reflected in increased funding for biodiversity and taxonomy programmes. New molecular methods have led to a new interest in species limits and taxonomy as well as systematic research. Taxonomy is a tool of fundamental importance to meeting the whole spectrum of biodiversity at both its levels as taxic or phylogenetic diversity (diversity of species) and evolutionary diversity (diversity of life forms). In this context, primary types play an important role as name-bearing specimens (ICZN, 1999). The importance of type specimens requires global availability of the information about types. Therefore, aim and scope of the project is to provide a digital catalogue of bird types held in German collections including the following information:

- number of accessible type specimens
- original description, status (syntypes, holotypes, etc.)
- validity and actual taxonomical classification
- collecting data (date, location, collector, previous collections)
- mode of preparation (skin, mount, wet specimen, etc.)
- storage of the type (museum, institution, private etc.)
- whereabouts of further types of the same taxon (= type series)
- digital images of type specimens.

For the first time access will be given to basic information about type specimens to others besides the scientific expert. Users from all over the world can get immediate information where a certain type specimen is stored and a first impression of its morphology without time consuming correspondence and the institutional uncertainty. Thus efficiency of type-based research will increase for both the scientist and also non-taxonomists, to the same extent as the quality of species identification. Moreover, the unique and valuable type specimens are only handled by the specialist for phenotypic comparisons and not for collecting label data and are better protected this way.

A first nationwide survey for existing data on type specimens revealed that 4000 bird taxa are present in Germany (tab. 1). For less than 10% neither card records nor catalogues were available, while 80% was summarized on card indexes of different qualities. No database or digital type catalogue yet existed and the 10% of bird types that were published are either dating back more than 50 years (e.g. Steinbacher, 1949, 1954) or are incomplete (e.g. Eck, 1970; Mauersberger & Neumann, 1985, 1986). They provide neither images nor information on the actual taxonomic status (e.g. Hinkelmann, 1990; Rheinwald & van den Elzen, 1984).

The majority of bird type specimens with an estimate of at least 2000 taxa are held at the Museum für Naturkunde Berlin. The other half is spread over nine other institutions (tab. 1). This situation, that collections are held by numerous museums of similar size and importance, is due to the federal landscape in Germany both in historical and recent times. By digitising this scattered information, it can be published on the WWW

as one "Virtual Museum", facilitating access and providing a "virtual centralisation" (Lampe & Riede, 2001).

## Bird type catalogue – present status (October 2004)

After more than one and a half years nearly 1300 types (taxa) of the expected 4000 have been investigated and digitised (tab. 1). In the museums of Bonn, Braunschweig, Bremen, Hamburg and Stuttgart the digitisation of the types (partly including photography) is complete. Digitisation in the museums of Berlin (see below), Frankfurt and Munich is in progress. For the collections in Halberstadt and Dresden digitisation is planned within the next year.

Taxonomists often conduct their studies mainly in a single collection which makes such collections to have a special focus on types of certain authors (tab. 2). For instance, in Stuttgart most new taxa were described by T. von Heuglin (67%) and in Braunschweig by R. Blasius (~70%). As there has been exchange of types between collections, the GBIF-network will help to find such types and clarify their status. For example, it was known that the museums in Stuttgart and Vienna (NMW) have large collections of types described by von Heuglin (van den Elzen & Koenig, 1983; Schifter, 1991), but some of his types were now also found in Berlin. Thus, the digitisation of types creates a new potential for co-operation which will be realised at least among German collections.

Table 2: Authors with an important number of described types in the collection.

| ZMB | ZFMK | SNMB | ZMH | SMNS |
|---|---|---|---|---|
| J. Cabanis | A. v. Jordans | W. Blasius | F.H.O. Finsch | T. v. Heuglin |
| M.H.C. Lichtenstein | O. Kleinschmidt | | A. Fischer | |
| A. Reichenow | A. Koenig | | G. Hartlaub | |
| E. Stresemann | | | A. Reichenow | |

As the largest ornithological collection in Germany with a significant number of types is housed in the Museum für Naturkunde Berlin, the main emphasis of the project is focused there. So far, information of more than 500 taxa of Non-Passeriformes (about 1300 specimens) has been collected here. According to the guidelines of GBIF Germany, species-rich orders from tropical regions and/or "hot-spots" were digitised first (e.g. Psittaciformes, Trochiliformes) (tab. 3).

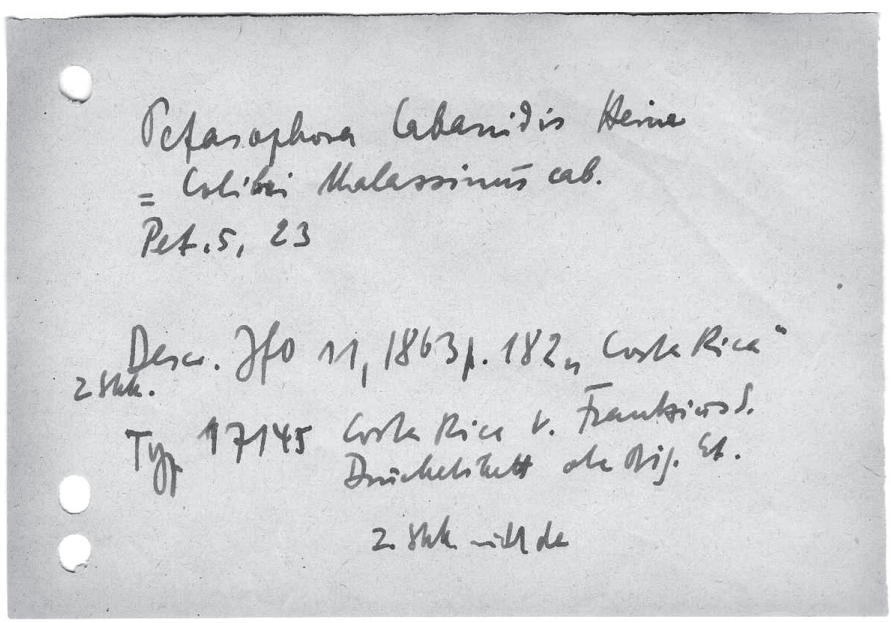
## Bird types at the Berlin Museum – historical background and current problems

About 90% of the Berlin type specimens had been registered between 1949 and 1950 by Wilhelm Meise on handwritten record cards (fig. 1). Meise's notes had to be compared with the original descriptions, were checked for collecting data, classification and current taxonomic status, and were entered into the database.

Fig. 1. Typical record card of Wilhelm Meise: *Petasophora Cabanidis* Heine, 1863 (= *Colibri thalassinus cabanidis* (Heine, 1863) based upon Peter's Checklist Vol. 5: 23), described in J. Orn.. 11, 1863: 183; type location according to the original description: "Costa Rica"; "type" [type material within the Berlin collection]: ZMB 17145, Loc. Costa Rica, Leg. v. Frantzius, without original label; second type specimen missing [but now recovered: ZMB 17146, mounted skin, Loc. Costa Rica, Leg. v. Frantzius, without original label]. ▶

Table 3: Types digitised at the ZMB (systematic order).

| Family | number of type-taxa digitised | number of holo- and syntypes (specimens) | number of paratypes (specimens) |
|---|---|---|---|
| Falconidae | 19 | 47 | 0 |
| Accipitridae | 57 | 97 | 15 |
| Columbidae | 63 | 138 | 43 |
| Psittacidae | 82 | 134 | 108 |
| Musophagidae | 17 | 36 | 12 |
| Cuculidae | 38 | 55 | 32 |
| Tytonidae | 4 | 7 | 2 |
| Strigidae | 39 | 65 | 3 |
| Podargidae | 1 | 1 | 0 |
| Nyctibiidae | 1 | 1 | 0 |
| Caprimulgidae | 14 | 33 | 0 |
| Apodidae | 39 | 52 | 34 |
| Hemiprocnidae | 1 | 1 | 14 |
| Trochilidae | 43 | 93 | 2 |
| Coliidae | 12 | 17 | 6 |
| Trogonidae | 10 | 18 | 0 |
| Coraciidae | 9 | 34 | 9 |
| Alcedinidae | 25 | 36 | 13 |
| Momotidae | 4 | 10 | 0 |
| Meropidae | 8 | 16 | 4 |
| Upupidae | 3 | 5 | 0 |
| Phoeniculidae | 8 | 32 | 0 |
| Bucerotidae | 15 | 20 | 25 |
| Galbulidae | 4 | 9 | 0 |
| Bucconidae | 6 | 16 | 0 |



From the beginning it was clear that knowledge of the history of a collection is a prerequisite to deal with the types in that collection. In this respect one person plays a central role at the Berlin Museum: Martin Hinrich Carl Lichtenstein (1780-1857). He succeeded Karl Illiger as director of the Zoological Museum of Berlin from 1813 till his death in 1857 (Stresemann, 1960). His era was one of the most successful but also one of the most complicated for the collection.

Despite of a financially very difficult situation, Lichtenstein not only opened the museum to the public and founded the Zoological Garden of Berlin, he also expanded the collection enormously. Understanding the importance of opening relations, he built up a network of contacts and acquired traders and colonists in all parts of the world. From 1815 onwards to the early 1850s extensive consignments especially from America and Africa arrived in Berlin. The number of birds increased about ten times, from 1941 specimens in 1813 to 15211 in 1854, the number of taxa grew from 931 to 4434 (Stresemann, 1960). Most of the bird specimens came to the museum between 1818 and the early 1840s. Numerous well-known collectors and scientists worked on account of the Berlin Museum during that time, e.g. Friedrich Sellow in Brazil (1817-1831), Ferdinand Deppe in Mexico (1825-1830), Richard Schomburgk in British Guiana (1840-1844), Leopold Mundt & le Maire (1817-1823) and Ludwig Krebs (1821-1840) in South Africa and Wilhelm Hemprich & Christian Gottfried Ehrenberg (1821-1826) in North Africa, Sinai and Arabia (Stresemann, 1922).

The fee for the expansion of the collection was very high and an important part of the material was sold immediately to finance further expeditions and the housing of the collection. Unfortunately, a scientific review of the material wasn't Lichtenstein's affair. Perhaps for better handling of the large number of specimens, perhaps hoping to gain taxonomic priority before selling them, he gave new names to all specimens which seemed to be unknown to him without consulting English or French literature. Hundreds of new names are thus to be found in the ZMB collection catalogue, in Lichtenstein's "Nomenclator avium" (Lichtenstein, 1854) and in countless sales catalogues. However, only a few of these names are available under the ICZN (1999), because relevant descriptions do exist only in three sales catalogues (Mauersberger, 1988):

- "Verzeichniß der Doubletten des zoologischen Museums der Königl. Universität zu Berlin" (Lichtenstein, 1823);
- "Preis-Verzeichniß der Säugethiere, Vögel, Amphibien, Fische und Krebse, welche von den Herren Deppe und Schiede in Mexico gesammelt worden" (Deppe, 1830);
- "Verzeichniß einer Sammlung von Säugethieren und Vögeln aus dem Kaffernlande" (Lichtenstein, 1842).

The first catalogue contains specimens, for example of Sellow and Hemprich & Ehrenberg, the second mammals, birds, fish and crustaceans collected by Deppe and Schiede in Mexico, the last catalogue lists mammals and birds which were collected by Krebs in South Africa.

Lichtenstein's actions had a number of evident consequences and caused severe problems:

1. He was not so short-sighted to sell all his newly named specimens, but always held some back in the museum. Thus, he had in fact not only larger series of types (=

syntypes) than mentioned in his publications, the material was also scattered over different institutions after sale. Today the whereabouts of types sold more than 150 years ago are hard to trace. According to handwritten notes in the catalogues, material has been sent to Leiden (Temminck) and Vienna, where syntypes have been located, but also to Bremen (Hartlaub), Göttingen, Wroclaw, etc., and several private collectors. Consequently, today only an international linking of all data can supply further information.

2. Another problem was caused by the replacement of labels. Skins and mounts meant to be for sale were given new and clean labels. The original ones were removed and exchanged for standardized collection labels. As a result, labels of all specimens collected by Ludwig Krebs now equally quote "Kaffernland". Specimens collected by Hemprich & Ehrenberg seem only to originate from "Abyssinia" or "Nubia". Because of this important original information has been lost forever. Today original data can only be reconstructed by a detailed study of acquisition catalogues, correspondence or diaries of the collectors (see Stresemann, 1954a, 1954b).
3. Despite their "primary" unavailability, other authors, for example C.J. Temminck (in Temminck & Laugier de Chartrouse, 1820-1839), H. Schlegel (1862-1881) and G.P. Hekstra (1982), used Lichtenstein's specimens and manuscript names for their own descriptions and made them available many years later.

Besides this, Lichtenstein was very cooperative to other scientists and opened up his collection for them. Many took advantage of these opportunities (Stresemann, 1922). Consequently, this is why the Berlin Museum now holds types of, for instance, Johann Jacob von Tschudi, Alexander von Nordmann, Coenraad Jacob Temminck and probably Christian Ludwig Brehm.

As the correspondence reveals, a busy exchange has been developed with Brehm during the 1820s (Muggelberg, 1969) and parts of his collection came to the Berlin Museum in 1830 and 1833. In 1832, Brehm stayed in Berlin and worked in the collection for several days (Muggelberg, 1969). It is therefore likely that type material of three vultures, described by Brehm in the Isis von Oken in 1840, is also located in Berlin, including an Egyptian Vulture *Neophron percnopterus* which was collected by Krebs in South Africa and described by C.L. Brehm as *Cathartes Capensis* Brehm, 1840 (Isis von Oken: 599). The value is not only the type specimen itself, being one of the few of C.L. Brehm in Berlin, but also the fact that the Egyptian Vulture has decreased dramatically south of the Sahara and no longer occurs in South Africa (Ferguson-Lees & Christie, 2001) makes the type of importance when reconstructing historical distribution patterns and changes in biodiversity.

## Prospect

By the end of 2005, half of the 2000 primary types presumed to be housed in the Berlin museum will be databased. Together with 1500 types deriving from other institutions they will form a solid platform for avian biodiversity studies, biogeographical and nature conservation issues.

Meanwhile, in March 2003 GBIF opened its own central portal at http://www.gbif.de that enables a simultaneous search in distributed and worldwide scattered databases.

The information about the bird types collected within GBIF is already available through the website www.gbif-vertebrata.de. In the long term, when historical, organismic, molecular, genetic, ecological and ecosystem level databases will be linked to the system, the "virtual museum" will no longer be a vision but a reality. According to the GBIF philosophy, a worldwide unification of databases "…will facilitate and enable data mining of unprecedented utility and scientific merit". The digital catalogue of primary type specimens in German ornithological collections as part of a German Vertebrate type catalogue offers a small but an important component within that virtual museum.

## References

Ade, M., S. Frahnert & Ch. Stark, 2001. Analysing databases of Southern African material at the Museum für Naturkunde in Berlin.— Mitt. Mus. Naturkde. Berlin, Zool. Reihe 77(2): 325-331.

Collar, N.J., 1999. New species, high standards and the case of *Laniarius liberatus*.— Ibis 141: 358-367.

Deppe, W., 1830. Preis-Verzeichniß der Säugethiere, Vögel, Amphibien, Fische und Krebse, welche von den Herren Deppe und Schiede in Mexico gesammelt worden, und bei dem unterzeichneten Bevollmächtigten in Berlin gegen baare Zahlung in Preuß. Courant zu erhalten sind.— Museum für Naturkunde der Humboldt-Universität zu Berlin, Historische Bild- und Schriftgutsammlungen, Bestand: Zool. Mus., Signatur: ZMB, S I, Deppe u. Schiede, Preisverzeichnis, Bl. 1-3.

Eck, S., 1970. Von O. Kleinschmidt benannte oder mitbenannte geographische Tier- und Menschenformen.— Zool. Abh. Staatl. Mus. Tierkde. Dresden 31: 63-84.

Elzen, R. van den & C. König, 1983. Vögel des (Süd-)Sudan: taxonomische und tiergeographische Bemerkungen.— Bonner zool. Beitr. 34: 1-3.

Elzen, R. van den, 1984. Katalog der Typusexemplare.— In: G. Rheinwald, (Herausgeber): Die Wirbeltiersammlungen des Museums Alexander Koenig. Bonner zool. Monogr. 19: 81-150.

Ferguson-Lees, J. & D.A. Christie, 2001. Raptors of the World: 1-992.— London.

Frahnert, S. 2001 Databasing in ornithologischen Sammlungen als Grundlage für Studien zu Veränderungen von Biodiversität.— J. Orn. 142, Sonderheft 1: 191.

Hekstra, G.P., 1982. "I don't give a hoot…" A revision of the American screech owls (Otus; Strigidae).— Academisch Proefschrift Vrije Universiteit: 1-131. Amsterdam.

Hinkelmann, C., 1990. Die Typusexemplare der von Wilhelm Blasius beschriebenen Vögel.— Braunschw. naturkdl. Schriften 3: 609-628.

ICZN, 1999. International Code of Zoological Nomenclature (4th ed.): i-xxix, 1-306.— London

Lampe, K.-H. & Riede, K., 2001. An information infrastructure for German insect collections including multimedia and GIS Tools. 43-48.— In: H. Saarenmaa & E.S. Nielsen, (eds), Towards a global biological information infrastructure: Challenges, opportunities, synergies, and the role of entomology. Techn. Rep. 70, Copenhagen.

Lichtenstein, H., 1823. Verzeichniß der Doubletten des zoologischen Museums der Königl. Universität zu Berlin nebst Beschreibung vieler bisher unbekannter Arten von Säugethieren, Vögeln, Amphibien und Fischen. I-X: 1-118.— Berlin.

Lichtenstein, H., 1842. Verzeichniß einer Sammlung von Säugthieren und Vögeln aus dem Kaffernlande nebst einer Käfersammlung: 1-24.— Berlin.

Lichtenstein, H., 1854. Nomenclator Avium Musei Zoologici Berolinensis. I-VIII: 1-123.— Berlin.

Mauersberger, M. & J. Neumann, 1985. Notizen über Typen der Vogelsammlung des Zoologischen Museums Berlin I.— Mitt. Zool. Mus. Berlin 61, Suppl.: Ann. Orn. 9: 145-149.

Mauersberger, M. & J. Neumann, 1986. Notizen über Typen der Vogelsammlung des Zoologischen Museums Berlin II.— Mitt. Zool. Mus. Berlin 62, Suppl.: Ann. Orn. 10: 137-142.

Mauersberger, G., 1988. Über Lichtensteinsche Vogelnamen und ihre Typen.— Mitt. Zool. Mus. Berlin 64, Suppl.: Ann. Orn. 12: 129-148.

Muggelberg, H., 1969. Christian Ludwig Brehms Briefe an Martin Hinrich Carl Lichtenstein, 1822–1834.— Mitt. Zool. Mus. Berlin 45: 187-209.

Peterson, A.T., A.G. Navarro-Sigüenza & H. Benítez-Díaz, 1998. The need for continued scientific collecting: A geographic analysis of Mexican bird specimens.— Ibis 140: 288-294.

Peterson, A.T., L.G. Ball & K.C. Cohoon, 2002. Predicting distributions of tropical birds.— Ibis 144: e27–e32.

Roselaar, K., 2003. An inventary of major European bird collections: 253-337.— In: N.J. Collar, C.T. Fisher & C.J. Feare (eds), Why museums matter: Avian archives in an age of extinction. Bull. B.O.C. 123A.

Schifter, H 1991. Typen von Theodor von Heuglin beschriebener Vögel in der Vogelsammlung des Naturhistorischen Museums Wien.— Ann. Naturhist. Mus. Wien, ser. B Botany & Zoology 92: 59-76.

Schlegel, H., 1862-1881. Muséum d'Histore Naturelle des Pays-Bas. 8 vol.— Leiden.

Steinbacher, J., 1949. Kritisches Verzeichnis von Eduard Rüppell's und Ph. J. Cretzschmar's Vogel-Typen.— Senckenbergiana 30: 99-124.

Steinbacher, J., 1954. Die Typen der Vogelsammlung von F.H. von Kittlitz.— Senckenbergiana 34: 301-305.

Stiles, G., 1995. Museums and bird conservation.— World Birdw. 17: 24.

Stresemann, E., 1922. Die Entwicklung der Vogelsammlung des Berliner Museums unter Illiger und Lichtenstein.— J. Orn. 70: 498-503.

Stresemann, E., 1954a. Hemprich und Ehrenberg – Reisen zweier naturforschender Freunde im Orient geschildert in ihren Briefen aus den Jahren 1819–1826.— Abh. Dt. Akad. Wiss. Berlin, Klasse Mathem. Allgem. Naturwiss. 1: 1-177.

Stresemann, E., 1954b. Über die von Ludwig Krebs 1820-1838 in Süd-Afrika gesammelten Vögel.— Ann. Mus. Congo Tervuren, in 4°, Zool., 1: 77-82.

Stresemann, E., 1960. Hinrich Lichtenstein – Lebensbild des ersten Zoologen der Berliner Universität.— Forschen und Wirken, Festschr. 150-Jahr-Feier Humboldt Univ. Berlin, Bd. I: 73-96.

Temminck, C.J. & M. Laugier de Chartrouse, 1820-1839. Nouveau recueil de planches coloriées d'oiseaux, pour servir de suite et de complement aux planches enluminées de Buffon. 102 livr., 600 pls.— Paris.

Received: 12.v.2004
Accepted: 2.iv.2005
Edited: C.S. Roselaar, R.W.R.J. Dekker & C. van Achterberg