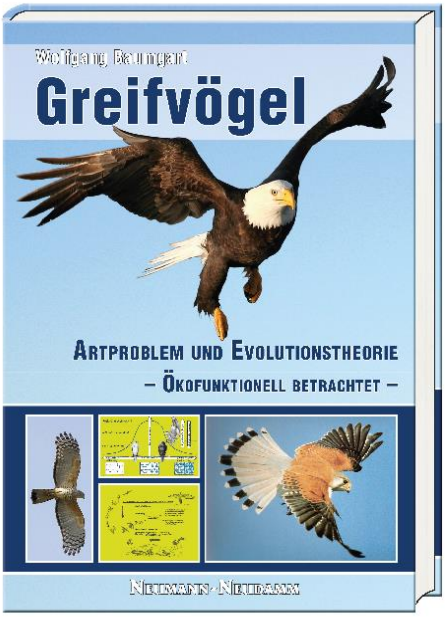

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Birds of Prey: species problem and the theory of evolution
an eco-functional approach

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Abstract:
Looking back to 60 years spent with Birds of Prey, starting in the 50ies with dedicated field observations on this remarkable species group in the region of Dresden and extending this activity worldwide over the years, I here present my conclusions on the impact of eco-functional and performance-related aspects on some fundamental questions of evolutionary theory. Of my almost 200 ornithological publications, about 130 focus on birds of prey.

The introductory overview demonstrates essential deficiencies in contemporary concepts of species and evolution, mainly due to the absence of a species definition which incorporates aspects of both phylogenetic descent and performance quality. This shortfall leads to an evolutionistic (gradualistic) interpretation of biological developmental processes and misconceptions about the actual existence of "types". Thereby, open outcome discussion of some principle questions is almost impossible and the importance of species qualities in the course of biological developmental processes remains elusive.

Among the species studied here in more detail, larger falcons like Saker and Peregrine Falcon are of particular importance. Vultures are often used for control (as are buzzards and kites) because of their very different habits. Conclusions drawn from specific observations often remind of Otto Kleinschmidt's scientific work on raptors. His "Formenkreise" are substantiated by eco-functional characters. Often of polyphyletic origin, they do not represent systematically relevant taxa but units of comparable functional characteristics and performance qualities. An eco-functional point of view provides important new interpretational approaches beyond the "Formenkreis theory" which is obsolete with respect to phylogenetic aspects.

A comparison of functional and performance quality aspects reveals how the two groups of hawks and falcons (Accipitriformes and Falconiformes) share many functional analogies in their predatory traits, categories of size, reversed sexual dimorphism (RSD), and signal function of their plumage coloration by convergent development without close kinship relations. Preference for visual signals to acoustic and kinematic signals is explained by lower energy costs.

Evolution and speciation of raptors appear as targeted processes towards exploitation of unused resources which exert "pulling forces" indicating (ecological) needs for new species. This allows for considerations on functional evolution of *raptor* species beyond mere reconstruction of

historical processes, and yields causal explanations for conditions and results of directionally guided evolution. In the center of interest is the development of driving capacities in pursuit flight. While only moderately developed in ancient Accipitriformes, which exist since about 55 mya (million years ago), these capacities were boosted in the 20 my history of the modern Accipitriformes allowing them to conquer the open field created by the appearance of the grasses and spreading of grasslands around the world. However, they are not really able to hunt in free air space since they can only perform short high-speed interval flights and then need phases for regeneration. This finally was accomplished by the *Falco*-species with their outstanding endurance flight capacities, emerging from a very different situation in the pleistocene. The energy-consuming propulsion system limits their body weight to about 2 kg. Species exceeding this limit are only found in the Accipitriformes.

Functionality-driven evolutionary changes are less characterized by slowly proceeding chromosomal rearrangements but by increasingly divergent performance parameters. Minor genetic differences and often inconspicuous structural changes may cause crucial shifts in function and efficiency. This reconfirms Stresemanns' almost forgotten early 20th century revolution in ornithology essentially saying: every structure has a function enabling it to execute a specific performance.

Area borders determined by limited performance capacities will be exceeded by pre-adapted individuals best meeting the requirements of the new environment, initiated by a suction effect of unused resources. Hereby, geographic isolation is actively established and favors assortative mating of similarly high-performing individuals, a process which obviously allows for rapid transformation of functional characters towards new species entities defined by performance quality. Integration of eco-functional rules into our concepts of evolution turns out to be a fundamental requirement for an urgently necessary third Darwinian revolution.

There is nothing like a „general evolution" towards a highest-developed raptor, since every species-specific hunting habitat (EFP) forms has different requirements for locomotory performance. The super-speed flight of the Peregrine Falcon hunting in open airspace, the acceleration capacities of the Goshawk in landscapes overgrown with high vegetation the ground-hunting Buzzard's ability to starve in times of hardship, they all may be of equal value to the respective species.

Enhancement in performance quality primarily occurs in the context of eco-functional positions (EFPs) which are clearly defined by performance and efficiency parameters. They represent the second compartment of species reality in a way comparable to job profiles in human societies. This allows us to understand the stability of "Realgattungen" (Natural Kinds in the sense of [Zitat]), groups not of genealogical but purely con-functional nature which only coincide in their performance profiles.

Presently, differentiations of this kind are mainly restricted to structural-morphological data but not on performance tests, which could be easily conducted with raptors in falconry. Actual molecular methods do not only demonstrate kin relations exactly but also can exclude such relations. This enables us to discriminate between kin-related con-specific homologis in structure and performance on one hand and analogies arisen from parallel development on the other hand.

Fundamental EFPs occurring world-wide, but occupied by raptor species of different phylogenetic origin in regionally differentiated patterns are:

- extremely fast pursuit hunters in the open airspace (Peregrine and Hobby),

- pursuit hunters in flying near ground level in the open field (Hierofalcons and Merlin) or landscape with bush- and tree coverage (goshawks and sparrowhawks) which are not as fast but more manoeuvrable and with higher active acceleration power,
- ground hunters with or without need of perches (buzzards, kestrels and harriers)

Based on truly existing „Formenkreise“, raptors can be classified not only in a phyletic but independently in an eco-functional system with regard to performance and efficiency criteria. Species may thus be defined as optimized and stabilized “Leistungseinheiten” (units of similar qualitative and quantitative complex locomotory performance parameters) of monophyletic origin and genetic compatibility. The common quality of its members is therefore not derived from single morphological, behavioral, genetic or other features but from a complex, optimized fundamental performance profile for exploitation of specific resources, morphologically represented by types.

The quality status defined in this way, in contrast to hitherto adopted concepts of gradual-evolutionary processes, allows us to interpret their development as discontinuous in a dialectic sense and is in accordance with our general (holistic?) understanding of the world which intuitively explains developmental and evolutionary changes by quality differences.

Species always show a huge variety of performance features which are subject to complex optimization processes with regard to effectivity and efficiency. Most of them are freely variable. Those features determining type specific fundamental performance characters in a qualitative manner, however, constitute an interdependent systemically correlated unit. Changes in a single character will change the whole system. This causes self-stabilization and self-demarcation of species defined by common performance characters. Accordingly, the type “actively hunting raptor” is the morphological manifestation of a fundamental performance potential of module character, with respect to effectivity and complex optimized locomotory traits.

There are several groups of raptors each having systemically stabilized performance profiles:

1. in hunters attacking in flight, endurance, flying speed, acceleration capacity and manoeuvrability are interdependent, all having negative correlation with body weight.
2. ground hunters can be divided into perching and gliding species with different flight characteristics. A key role plays the relation between body mass and starving ability, or between gliding capacity and manoeuvrability, respectively.
3. in scavengers the relation between gliding capacity and manouevrability, combined with starving ability, is crucial.

The speciation is always associated with restructuring of the performance profile. Dual and multiple functions of structures are critical to overcome the inefficiency and instability gap between species-specific optimal solutions by alternative performance optimization in a range of possible performance profiles. No such gaps are found between subspecies because differences in performance are only of quantative character. Therefore, emergence of subspecies is fluid and not qualitatively discrete as is speciation. With respect to performance, there are striking parallels between species in biological and profession in social contexts.

Speciation is significantly induced by the available range of resources, and initially a specific EFP can only be occupied by a single species. If, however, confunctional species meet in the course of territory expansions, they will often not mutually exclude each other but coexist in manifold and especially temporal correlations. These principles will not be ascertained in a merely systematic approach. Therefore a “species theory” is needed which analyses the framework of the recent species presentation from an eco-functional point of view. It is

essentially different from merely phylogenetic systematics and should be established separately as a scientific discipline of its own.

Generalizing these considerations and conclusions, we can formulate six key principles which should be valid beyond the scope of research on raptors:

1. Suction effects coming from ecological resources and demanding specific skills for exploitation selectively induce implementation of clearly defined, species-specific categories of function and performance.
2. These categories can be described independently from phylogenetic systematics in a second, eco-functional classification system comprising species and species groups, on the basis of their eco-functional positions (EFPs).
3. Separation of typological, systemically interconnected characters from non-typological, freely variable characters, real existence of types and typological classification as a consequence of performance optimization processes thus become explicable.
4. The basic performance potential for resource exploitation appears as a species-characterizing quality trait common to all species members with very low variability. This is well represented by the coefficient of variation (v), morphological variation usually being less than 3%.
5. With regard to their dual character, species are definable as optimized and stabilized performance entities which delineate and classify themselves. This explains the existence of "missing links" (gaps) between species or species-specific performance entities, respectively.
6. Biological evolution involves species as qualitative entities of dialectics. This allows us to discard merely gradualistic-evolutionary concepts and to adopt biological evolution as a causally motivated process with discrete steps, driven by alternative optimization of performance in the framework of a general understanding of the world, and not just as a sequence of random events.

The foundation for this point of view was laid in the early 20th century by Otto Kleinschmidt in his Formenkreis conception and by Erwin Stresemann in his revolution of ornithology; their approaches were, however, neglected and often misinterpreted in the course of upcoming genetics. We must clearly differentiate between Formenkreis conception and Formenkreis-theory: Kleinschmidt's Formenkreis conception is not religiously motivated but can be seen as criticism of evolutionary concepts which only allow for continuous processes. In his meticulous morphometric studies he always found gaps between species. In contrast, the Formenkreis theory can no longer be viewed today as an alternative to evolutionary theory, although integrating some of their currently valid elements like adaptive radiation. Moreover, explanation of evolutionary gaps by eco-functional aspects renders the Formenkreis theory obsolete. Formenkreise are, however, indispensable for our understanding of Natural Kinds and confunctional species groups as defined above.

It is also an issue of national interest to recall these ideas. In the US, for example, there is no comprehension of this important approach to the species problem since typology discussions have no tradition. Moreover, it needs to clarify not only mutability and evolution of species, but also rules controlling their recent framework of variability and the resulting stability of their appearance.
The molecular reorganization of the birds of prey systematics also has nomenclatural consequences. Proposals for appropriate changes related to German raptor names are submitted.

GREIFVÖGEL

Artproblem und Evolutionstheorie

– Ökofunktionell betrachtet –

Der Autor, Jahrgang 1940 und von Beruf Tierarzt, ist seit früher Jugend begeisterter, vor allem den Greifvögelnverbundener Ornithologe. In diesem Buch werden nundie Ergebnisse und Einsichten seiner nunmehr sechs Jahrzehnte zurück reichenden Erkundungen dargelegt. Im Mittelpunkt stehen dabei die Großfalken mit ihren gut ermittelbaren lokomotorischen Leistungsdifferenzierungen, die zugleich als Referenzarten umfassende Vergleiche mit anderen Greifvogelgruppen wie den Habichten, Bussarden oder Geiern stützen. Sein tierärztlich geprägtes Funktional- und Leistungsverständnis ermöglicht es dem Autor auch, Gesetzmäßigkeiten der artlichen Existenz und Artbildung außerhalb des genetischen Bereiches zu erfassen und dazu Modellvorstellungen zu entwickeln. Arten lassen sich so – ökofunktionell betrachtet – als optimierte und stabilisierte Leistungseinheiten definieren, die durch Instabilitäts- und Ineffektivitätslücken selbstreguliert von einander getrennt sind. So wird auch erkennbar, wo ein „Artbedarf“ erwächst und wie gut vorangepasste Individuen die zur Artbildung erforderliche geographische Isolation geradezu gerichtet erlangen können. Die evolutionshistorisch junge Gattung *Falco* bietet dafür anschauliche Beispiele.

Ausgehend vom dualen Charakter artlicher Realität sieht der Autor in der Integration ökofunktioneller Aspekte in unser Evolutionsverständnis eine Zukunftsaufgabe. Das sollte Gegenstand einer dritten Darwinschen Revolution sein. Indem er die Leser auf seine weltumspannenden „greifvogelkundlichen Inspektionen“ mitnimmt, lässt er sie zugleich daran teilhaben, wie – vermittelt durch Gedankenexperimente – Freiland- Beobachtungen und überregional vergleichende Wertungen zur Lösung dieser Grundsatzproblemen

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