Secondary Adaptation of Tetrapods to Life in Water, J.-M. Mazin & V. de Buffrénil (eds.): pp. 119-139, 14 figs., 2 tabs.

Biodiversity and adaptations of extant marine birds: an overview

Georges HÉMERY*

Abstract

This introductive overview on the biology and ecology of marine birds is mainly focussed at describing the factors supposed to have a direct influence on their survival and reproductive rates. Hence, after a brief account of marine birds biodiversity as compared to that of terrestrial forms, their adaptive characteristics are considered: morphological features (especially wing morphology and fliying patterns), migrations, foraging and breeding behaviours, impact on marine ecosystems, survivorship and general ecological strategies.

Introduction

A great variety of bird species can eventually be observed at sea, especially during their migrations; however, the concept of *marine bird* cannot relevantly be applied to all of them for this mere reason. Several definitions of a marine bird could be proposed, with respect to either morphological, ecological or behavioural aspects. Beyond these preferential points of view, all definitions would nevertheless converge to one basic key-characteristic that can be taken as a definition of a marine bird species: all specimens must entirely depend on the sea for feeding during their whole (or at least the most important part of) their life cycle (reproduction, migration, wintering, moulting, etc.). This fundamental energetic criterion governs a series of subsequent, more or less pronounced morphological, physiological, behavioural or demographic adaptations of birds to the oceanic environment.
Marine birds are known to occur in three main biogeographic zones. In the *littoral zone*, they remain close to, and in sight of, the shoreline, where they land each day, at least for sleeping (e.g. cormorants). In the *inshore* (or *neritic*) zone, characterised by a high biologic productivity, the birds are distributed above the continental shelf (depth less than 200 m). They can stay there during several months without returning to land, as exemplified by the guillemots (*Uria* sp.). The *offshore* (or *oceanic*) zone, with a depth more than 200 m, begins beyond the continental shelf. It is the realm of highly efficient soaring flyers, able to wander over hundred kilometres, returning to land just for breeding during some months (e.g. the various albatross, *Diomedea* sp.).

It is noteworthy that a single bird species can eventually be present in several contiguous zones. Such cases show that a classification too rigidly based on specific habitats may prove to be irrelevant in some instances.

* Muséum National d'Histoire Naturelle, Station Maritime de Recherche, C.R.P.O., Plateau de l'Atalaye, F-64202 Biarritz, France.

Biological diversity of extant marine birds

Taxonomic overview

Among extant bird faunas, the total number of marine species is between 285 and 290 (for an exhaustive systematic overview, see int. al. HARRISON, 1983; TUCK and HEINZEL, 1985). They belong to 4 orders (6 if sub-orders are taken into account), 14 families and 63 genera (Table 1). This biological diversity may seem rather poor, as compared to the 28 orders and some 8600 species representing the Class Aves in the extant world fauna. The three quarters of marine species are included in the orders Procellariiformes and Charadriiformes *sensu lato*; whereas the Pelecaniformes are less than 20 %, and the Sphenisciformes 6 % only, of marine forms (Fig. 1).

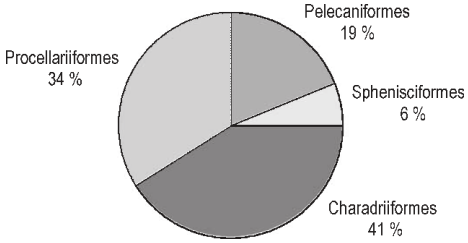
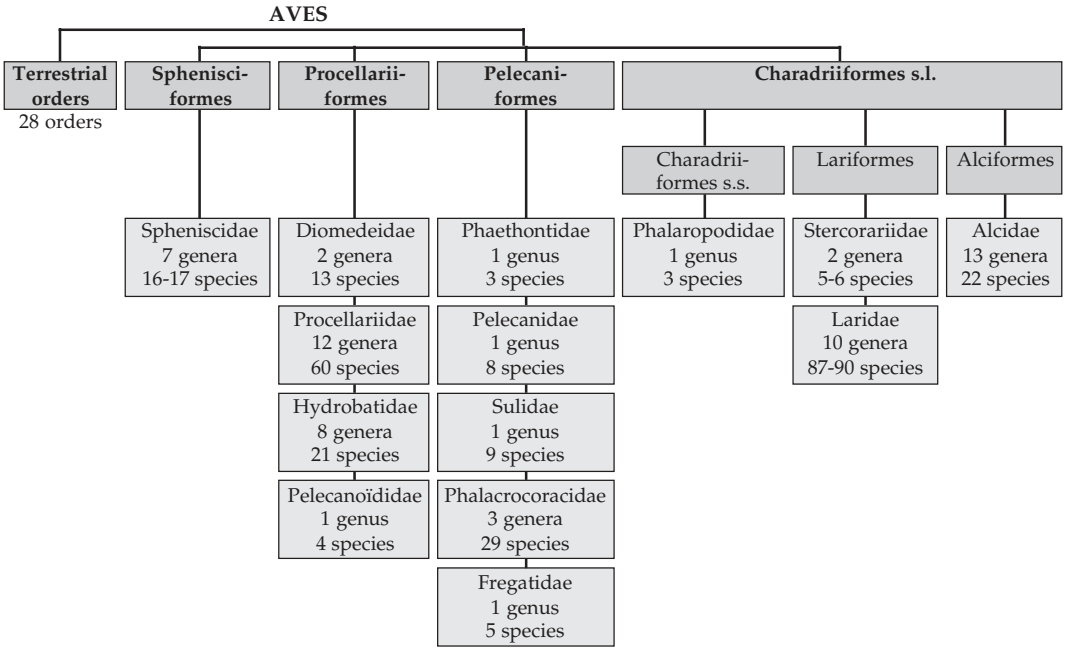


Fig. 1. Relative importance (in %) of the four orders of marine birds.

Table 1. Place and numbers of orders, families and species of seabirds in the class Aves.



285-290 species	16-17 species	98 species	54 species	3 species	92-96 species	22 species
63 genera 14 families	7 genera 1 family	23 genera 4 families	7 genera 5 families	1 genus 1 family	12 genera 2 families	13 genera 1 family
% marine species	5.6 %	34.3 %	19.0 %	1.1 %	32.2 %	7.7 %

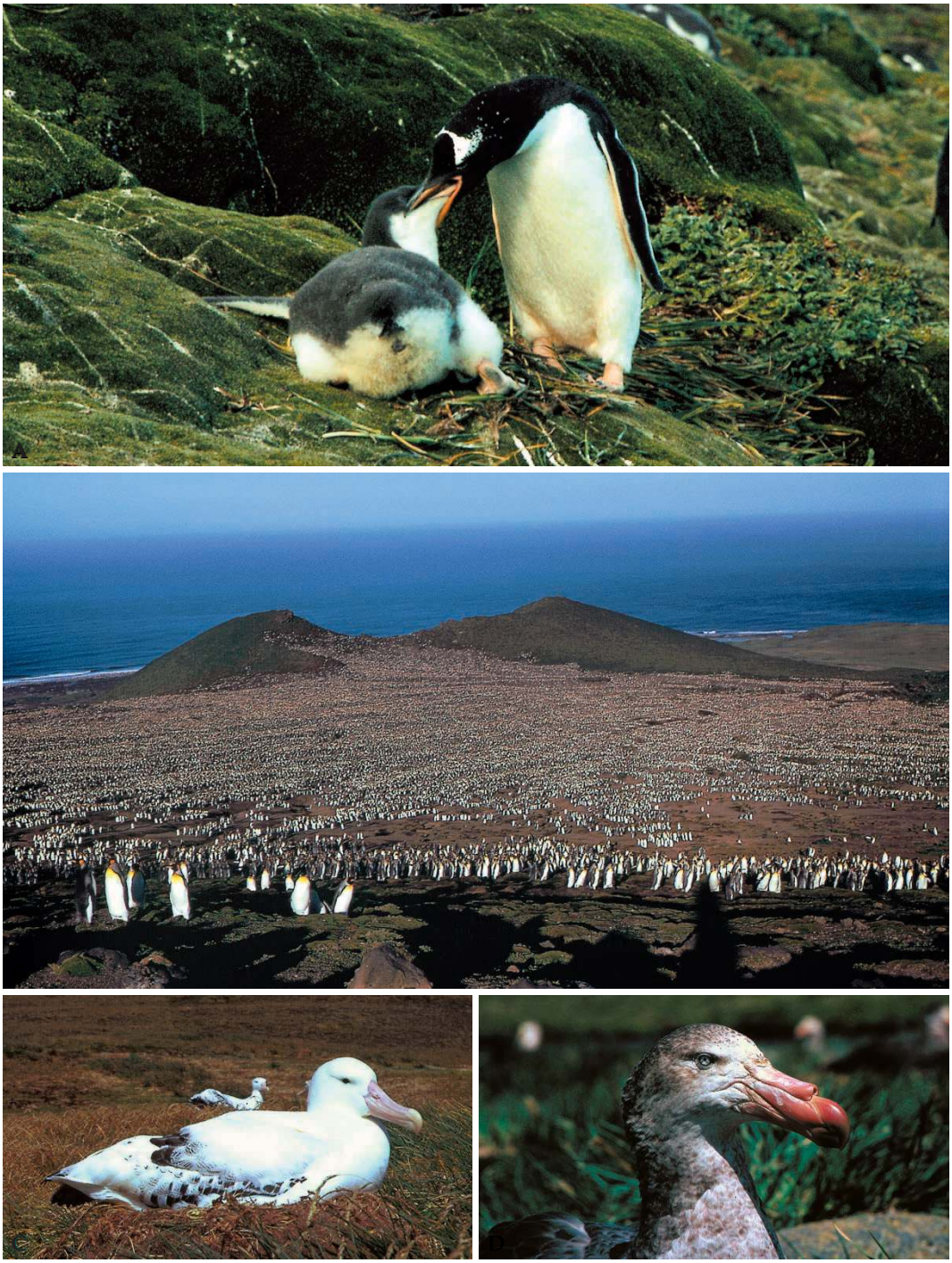


Fig. 2. Some examples of the Sphenisciformes and the Procellariiformes (nomenclature refers to HARRISON, 1983). **A,** adult and young of Gentoo penguin, *Pygoscelis papua* (Spheniscidae); **B,** huge colony of King penguin, *Aptenodytes patagonicus* (Spheniscidae); **C,** Wandering albatross, *Diomedea exulans* (Diomedeidae); **D,** Northern giant petrel, *Macronectes halli* (Procellariidae).