

Student name: KEY

This 20-minute quiz is worth 5 points. I have extra paper, if you need. Write your name on every extra page and staple them together with this cover page.

1) **Definitions:** Define the following terms using the words provided (in brackets). Make sure you use the key word, to get full credit (+0.2 each)

- Seabirds (food): Birds that derive their energy/food (primarily) from the marine environment.

- Systematics (study): The study of the diversification of living organisms, past and present, and the relationships between living organisms through time.

- Convergent evolution (constraints): Convergent evolution occurs when environmental constraints lead to similar adaptations in species with different evolutionary histories.

- Biogeography (study): The study of the distribution of species and ecosystems across time and space.

2) List the 3 ecological factors drive seabird distribution; give an example for each (+0.20 each):

Marine environment – e.g. food distribution and patchiness, ocean winds / water temperature, ocean climate (variability from year to year and over the longer term)

Land environment – e.g. limited foraging range during breeding (must return to land for breeding) and local conditions on the land that allow or inhibit breeding (snow / ice cover, types of soil amenable for burrowing, vegetation cover)

Humans – e.g. habitat destruction and degradation, both on land (development, harvesting, introduced predators and plants) and at-sea (pollution, fishing and bycatch).

3) **Life History:** The more these four traits emphasized in a particular seabird species, the more pelagic (oceanic) the species' habits tend to be (+0.10 each).

1. Small clutch sizes
2. Delayed maturity
3. Slow chick growth – leading to a long breeding season
4. Extreme longevity

According to David Lack's work, what two ecological factors have caused these adaptations, especially in oceanic species (+0.25 each):

1. Patchy food in a dynamic marine environment – feed is widely dispersed and rather unpredictable in time and space.
2. Food must be delivered back to chicks that are in the nest, a fixed location far from the food sources.

4) **Taxonomy:** For each of these generic birds, provide the name of their order and of the families in that order. **Hint:** there are 5 orders and 15 families, and each is worth +0.1 points, for 2 points total.

Bird	Name of order	Name of families in order
Penguin	Sphenisciformes	Spheniscidae
Booby	Suliformes	Sulidae Phalacrocoracidae Fregatidae
Petrel	Procellariiformes	Procellariidae Diomedidae Pelacanoididae Hydrobatidae
Pelican	Pelecaniformes	Pelecanidae Phaethontidae
Gull	Charadriiformes	Alcidae Laridae Stercorariidae Sternidae Rhynchopidae

- 4) **Brief Essay:** Please describe two reasons why the study of seabird taxonomy is complicated.
Hint: Can you think of an ecological and an evolutionary reason? (0.25 each)

Convergent evolution – distantly related taxa may exhibit similar physiological, morphological, and behavioral adaptations (have similar ecologies) in response to similar selective pressures (ecological constraints). e.g. alcids and diving petrels, alcids and penguins

Closely related taxa may exhibit very different adaptations (have different ecologies) due to different adaptations for making a living in the marine environment, e.g. sulids plunge and frigatebirds are kleptoparasites, diving petrels dive and petrels forage at the surface.

Because seabirds are not a mono-phyletic group (i.e., there have been multiple “jumps” of terrestrial species into the marine environment), closely related taxa may not all be adapted to living in the marine environment, e.g. the order Charadriiformes contains seabird and landbird families, the California gull could be considered a land-bird because it breeds in Mono Lake.

Disagreements over how to define seabirds – there are many ecological (e.g. some include species that seasonally derive food from the marine environment) and evolutionary/taxonomic definitions (e.g. to include or not to include the order Charadriiformes as seabirds)

Genetic studies have redefined the field of taxonomy, which was once based primarily on morphological studies. More recently, behavioral traits are being used to create phylogenies, further complicating the picture of seabird relatedness.