



Supplementary Figure 1. Excretion of N and P per seabird: (A) adults, and (B) chicks.

Supplementary Table 1. Size of nitrogen major compartments/reservoirs and fluxes between them.

Compartment/reservoir	Mass of N (Ggx10 ⁹)	Reference
Atmospheric N ₂	3950	15; 5
Nitrogen in sedimentary rocks	0.9996	9
Ocean:		5
N ₂	20	
NO ₃ ⁻	0.57	
Organic soils	0.19	9
Land biota	0.00010	9
Marine biota	0.00050	9
Nitrogen sequestered in ice	0.000000260	21

Compartment/reservoir	Fluxes of N (Gg y ⁻¹ x10 ³)	Reference
Atmospheric N ₂ fixed by biological process	58	18; 4
Nitrogen fixation in oceans	140	20
Lightning	5	4
Nitrogen fixation by agricultural crops	50-70	6
Legume cultivation	40	1
Rice cultivation	5.0	1
Nitrogen buried in deep ocean sediments	20	20
N ₂ O emissions from ocean to atmosphere	0.5-5.5	19; 4
Nitrogen input into the ocean by rivers	66	14
Nitrogen input into the ocean by ground water	4	19
Atmospheric deposition on ocean	8.4	5
N transfer from surface ocean to land via fishing activities	3.7	10
Ornithotrofication. Transfer of N from surface ocean to land by seabirds. Total N:		This study
Breeding seabirds	0.60	
Total population	3.80	
Labile (leachable)	0.07	

Supplementary Table 2. Major compartments/reservoirs of phosphorous in the Earth's surface and fluxes between the different compartments (adapted from 12).

Compartment/reservoir	Mass of P (Gg$\times 10^6$)	Reference
Land soil (soil<60 cm depth)	96.1-206	8; 13
Land biota	2.6-3.0	8; 13
Surface ocean (<300m depth)	2.6	8; 13
Oceanic biota	0.050-0.138	8; 13; 7; 9
Atmospheric P	0.00003	13; 7; 9
Domestic animals	0.0323	Present study using data from 3 and 17
Compartment/reservoir	Fluxes of P (Gg P y⁻¹$\times 10^3$)	Reference
Rock/sediment → soil (weathering, soil accumulation)	20	11; 9
Soil → rock/sediment (deep burial, lithification)	9.3-19	8; 9
Soil → land biota	62-200	8; 7
Soil → surface ocean (present- day river dissolved P):		
Dissolved inorganic P	0.8-1.4	2; 12
Dissolved organic P	0.2	
Soil → surface ocean (present- day total river P)	17.3-20.1	2; 12
Atmosphere → land soil	3.10	9
Atmosphere → surface ocean	0.60 - 1.50	13; 7
Surface ocean → atmosphere	0.31	13; 7
Surface ocean → land (fisheries)	0.32	9
Ornithotrophication. Transfer of P from surface ocean to land by seabirds. Total P:		This study
Breeding seabirds	0.10	
Total population	0.63	
Labile (leachable) P	0.02	

Supplementary Table 3. Mean concentrations of total and labile (soluble) N and P (mg kg^{-1}) in seabird faecal materials.

Element	Charadriiformes (mg kg^{-1})	Reference	Pelecaniiformes (mg kg^{-1})	Reference	Procellariiformes (mg kg^{-1})	Reference	Sphenisciformes (mg kg^{-1})	Reference
Total N	67708	2,3,4,5,6,7,8,9	105400	4	175833	13,14	113781	3,16,17,19
Labile N	5715	2,6,7,8,9	13340	*	31860	13	12982	16,17
Total P	24782	2,4,5,6,7,8,9,10,11	92933	4	17600	13,14,15	45244	19,20,21
Labile P	6613	7,8,9,10,11	15000	10	3768	*	9685	*

Labile N comprises NO_3^- and NH_4^+ soluble in water or neutral salts (e.g., KCl or MgCl_2 1M), whereas labile P includes also the phosphate soluble in Mehlich 3 extractant (0.2N CH_3COOH -0.25N NH_4NO_3 -0.015N NH_4F -0.013N HNO_3 -0.001M EDTA). *No data available for the N and P labile forms. For these particular cases, the labile forms of N and P were calculated based on average labile values of these two elements that were applied to the total seabird population.

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