Tracking in seabirds
1. Introduction: seabird ecology
2. Seabirds at sea: Methods and examples of seabird tracking
3. Seabirds as indicators
Two thirds of the planet are oceans, but home to only 3% of bird species.
Two thirds of the planet are oceans, but home to only 3% of bird species.

**Challenges of marine habitats**
- Patchy, unpredictable food
- No protection from rain and wind
- Breeding impossible

**Adaptations, e.g.**
- Subcutaneous fat
- Large stomach, e.g. can carry Fulmar 20% of body mass in food
- Near waterproof plumage
- Salt water excretion for drinking water
- Long pelagic flights or deep benthic dives
Seabirds

Tracking

Indicators

Two thirds of the planet are oceans, but home to only 3% of bird species.

- sparseness, patchiness, and unpredictability of marine resources
- Marine Habitats
- limited number of suitable nesting places

Density-dependent depletion of prey stocks around colonies

OR

Pelagic seabirds: transport food to the breeding colony from distant foraging areas
Although seabirds belong to several families that are not all closely related, they have comparable breeding and life history parameters, being colonial, long-lived, and exhibiting little or no sex dimorphism.
Exploit the marine food web

Climate, nutrients

competitors

Nahrungs-netz

Predators, parasited

competitors

Breed on land

Nesthabitat Partner

Invasive species, Light pollution

Habitat loss

Climate change, ocean acidification, → Changes in the food web

(Regime changes)

pollution, disturbance, bycatch

http://www.ecomare.nl
DATABASE: www.seabirdtracking.org
> 7 Mio data points, 17,000 seabirds of 104 species, 105 research groups
Seabirds

Tracking

Indicators
Radiotracking (1960s)

Light (<1g for seabirds)

short recording (days-weeks)

Ca. 1-2 km → Colony attendance
Provisioning rate:
1 - 8 days
Geolocation:

Light (1g for seabirds)
Long recording (1-5 years)
Often combined with immersion
Or dive depth (Lotek)

~ 150 km, equinox excluded
Need to recover
Seabirds Tracking Indicators

![Light sensor image](image)

**Fig. 6.** Double circumpolar movements of a male Crozet wandering albatross during the sabbatical period. The bird did two circumpolar trips around Antarctica, rapidly during the first tour (red), and then stopping off at eastern New Zealand in the second tour (yellow).

2 species of prions in SW Atlantic

Antarctic Prion
(*Pachyptila desolata*)
Antarktis-Walvogel
= Taubensturmvogel

Thin-billed Prion
(*Pachyptila belcheri*)
Dünnschnabel-Walvogel
2 species of prions in SW Atlantic

MK10 Geolocators (1g, British Antarctic Survey, Cambridge, UK)

25 *P. belcheri* (Thin-billed prions, 130g)
   New Island, Falkland/Malvinas
20 recaptured

14 *P. desolata* (Antarctic prions, 160g)
   Bird Island, South Georgia
   (Joan Navarro, U Barcelona
   Richard Phillips, BAS)
10 recaptured
Thin-billed Prion

- Breeding area
- Non-breeding area

Map showing distribution of Thin-billed Prions with breeding and non-breeding areas. The map includes geographical markers such as the Sub-antarctic Front, Polar Front, and Ice extent October (max). The map covers the South Atlantic Ocean region with specific areas highlighted for breeder and non-breeding sites.
Antarctic Prion

- Breeding area
- Non-breeding area

Sub-antarctic Front
Polar Front
Ice extent October (max)
Seabirds Tracking Indicators


Migration tracks
- New Island: outward
- Return
- Mayes: outward
- Return

Breeding sites
- New Island
- Mayes
- Polar Front

Scale: 0 1,500 3,000 km
Most important parameter:

Quillfeldt et al. 2013 PLOS One, 2015 Biology Letters
Seabirds Tracking Indicators

Actave webtool e.g. Thin-billed prions
GPS (2000s):

- Limited number of data points ca. 5 m
- Heavier (from 6g for seabirds)
- Needs satellite reception
- Recapture or download to base station
Seabirds

Tracking

Indicators

Rockhopper penguin

Felsenpinguin
Seabirds Tracking Indicators

Rockhopper P.

Gentoo P.

GPS-TD: Temporal and spatial segregation

Masello et al. 2010 Ecosphere
Satellite tracking (1990s)

No recapture necessary
200 m under best conditions

Heavier (from 5g solar, 20g battery)
Needs satellite reception (and solar)
Most costly method
June 2017:
**ICARUS**
Prototype: 5g (aim: 1g)
500-700 EUR
Incl. acceleration
56° N - 56° S
Climate change, ocean acidification, → Changes in the food web (Regime changes) pollution, disturbance, bycatch

Grecian et al. 2016
Biol Letters

Marine Important Bird Areas

→ Marine Protected areas
Multicolaony tracking reveals potential threats to little auks wintering in the North Atlantic from marine pollution and shrinking sea ice cover.

Little auk (Krabbentaucher)

Tracking
- key areas (blue+red)
- e.g. off Newfoundland

overlap extensively with areas of intensive human activities, including oil and gas extraction (grey) and shipping (blue lines)
Advantages of Biomonitoring:

- Reflects availability in the food web
- Higher concentration (bioaccumulation) enables exact measurements
- Several time scales and sites accessible

Persistent organic pollutants (POPs)

Legacy POPs
Emerging POPs

Blood, eggs, fat

Heavy metals
Mercury, Aluminium

Microplastics

Feathers

Pawel Kuczynski, 2010
Combination of At-Sea Activity, Geolocation and Feather Stable Isotopes Documents Where and When Seabirds Molt

Yves Cherel¹*, Petra Quillfeldt², Karine Delord¹ and Henri Weimerskirch¹

Mattern et al. 2015 Methods Ecol Evol: www.actave.net
Combination of At-Sea Activity, Geolocation and Feather Stable Isotopes Documents Where and When Seabirds Molt

Yves Cherel¹*, Petra Quillfeldt², Karine Delord¹ and Henri Weimerskirch¹
Combination of At-Sea Activity, Geolocation and Feather Stable Isotopes Documents Where and When Seabirds Molt

Yves Cherel 1*, Petra Quillfeldt 2, Karine Delord 1 and Henri Weimerskirch 1

Carravieri et al. 2014 Environmental Pollution
Streaked shearwaters (Weißgesicht-Sturmtaucher)

Contaminants in Tracked Seabirds Showing Regional Patterns of Marine Pollution

Cities 1-4 Hakodate, Muroran, Tomakomai, Kushiro

Ito et al. 2013
Contaminants in Tracked Seabirds Showing Regional Patterns of Marine Pollution
Ito et al. 2013

<table>
<thead>
<tr>
<th>Persistent organic pollutants (POPs)</th>
<th>AW-P</th>
<th>AW-J</th>
<th>area</th>
<th>sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCBs</td>
<td>469 ± 177</td>
<td>25 ± 68</td>
<td>$F_{(1,7)} = 12.990, P = 0.009$</td>
<td>$F_{(1,7)} = 0.315, P = 0.592$</td>
</tr>
<tr>
<td>HCHs</td>
<td>45 ± 40</td>
<td>15 ± 30</td>
<td>$F_{(1,7)} = 4.657, P = 0.068$</td>
<td>$F_{(1,7)} = 2.540, P = 0.155$</td>
</tr>
<tr>
<td>DDTs</td>
<td>700 ± 380</td>
<td>87 ± 271</td>
<td>$F_{(1,7)} = 7.819, P = 0.027$</td>
<td>$F_{(1,7)} = 1.520, P = 0.257$</td>
</tr>
</tbody>
</table>

PCB group (26 substances) | Hexachlorocyclohexanes (α-, β-, γ-, δ-HCHs) | DDT group (DDT, DDE, DDD)
Vielen Dank

**Finanzielle Unterstützung**
DFG, MPG, NERC (UK), OTEP (UK), Falkland Islands Government ...