New frontiers in biologging science

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SUPPLEMENTARY REFERENCES

The following bibliography is intended to help interested readers access the vast literature on biologging technology and its field application.

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SUPPLEMENTARY TABLES

Table S1. Summary statistics for the third international conference on biologging science (Biologging III), and two earlier meetings. Three (non-independent) measures indicate that collaborative projects in this field have been increasing in size. The focus of the meetings remained on marine applications (*cf.* §1 and §3). Note that all information was extracted from the conferences' abstract booklets, i.e., late changes could not be considered (e.g., for Biologging III, 100 talks are included in the booklet, but only 96 were delivered).

	Biologging I	Biologging II	Biologging III[a]
year	2003	2005	2008
location	Tokyo, Japan	St. Andrews, UK	Pacific Grove, USA
sessions (talks only)	7	6	8[b]
abstracts (talks/posters)	100 (52/48)	93 (53/40)	143 (100/43)
authors per abstract (median, mean ± SE)[c]	3.0, 3.4 ± 0.2	4.0, 4.2 ± 0.3	5.0, 5.1 ± 0.3
affiliations per abstract (median, mean ± SE)[d]	2.0, 2.1 ± 0.1	2.0, 2.5 ± 0.2	3.0, 2.8 ± 0.1
authors per affiliation (median, mean ± SE)[e]	1.5, 1.7 ± 0.1	1.5, 1.9 ± 0.1	2.0, 2.0 ± 0.1
abstracts mentioning study system	92	89	137
of which aquatic[f]	75%	85%	85%
of which flying sea birds	20%	13%[h]	9%[h]
of which terrestrial[g]	5%	1%	6%

[a] The conference was attended by 209 delegates from 20 different nations (D. Kohrs, pers. comm.).

[b] Session topics: (1) biologging and climate change; (2) monitoring organismal physiology; (3) linking ecology and oceanography; (4) new frontiers in biologging data analysis and visualization; (5) new frontiers in electronic tag technology; (6) conservation and management applications of biologging science; (7) at sea observation and laboratory modelling of animal behaviour; (8) marine life and ocean observatory networks.

[c] Kruskal-Wallis test, $H_2 = 23.16$, $p < 0.0001$; *post-hoc* Mann-Whitney *U*-tests are significant, at a Bonferroni-corrected $\alpha = 0.017$, for I *vs.* III and II *vs.* III.

[d] This count includes multiple, and new, affiliations of authors. Kruskal-Wallis test, $H_2 = 13.17$, $p = 0.001$; a *post-hoc* Mann-Whitney *U*-test is significant, at a Bonferroni-corrected $\alpha = 0.017$, for I *vs.* III.

[e] This statistic is based on dividing, for each abstract, the number of authors by the number of affiliations. Kruskal-Wallis test, $H_2 = 7.72$, $p = 0.021$; a *post-hoc* Mann-Whitney *U*-test is significant, at a Bonferroni-corrected $\alpha = 0.017$, for I *vs.* III.

[f] Abstracts are only considered if they make unambiguous reference to aquatic study systems (species mentioned; empirical data mentioned; broader discussion/review); this category combines marine and freshwater systems and includes penguins.

[g] Abstracts are only considered if they make unambiguous reference to terrestrial study systems; this category includes one abstract on polar bears.

[h] If abstracts are added here that mention both aquatic and sea-bird systems, the values increase to 16% (II) and 11% (III), respectively.

Table S2. Full results of a keyword search conducted with the abstract booklets of the first three biologging conferences (2003, Toyko, Japan, *n* = 100 abstracts; 2005, St. Andrews, UK, *n* = 93 abstracts; 2008, Pacific Grove, USA, *n* = 143 abstracts). For further details on methodology, see caption and footnotes of table 1. Each table cell contains three values: (i) percentage of titles that contained a particular keyword at least once; (ii) percentage of abstracts that contained a particular keyword at least once; and (iii) number of times a keyword was mentioned in abstracts that contained that keyword.

categories and keywords	conference								
	2003			2005			2008		
	i	ii	iii	i	ii	iii	i	ii	iii
(*a*) tagging technology									
satellite (tracking, not remote sensing)	10.0	25.0	1.6	7.5	29.0	1.4	2.8	22.4	1.6
Argos	1.0	8.0	1.4	3.2	14.0	1.2	4.9	10.5	2.8
GPS	4.0	6.0	2.3	2.2	9.7	2.0	7.7	14.7	2.8
Fastloc	n/a	n/a	n/a	n/a	n/a	n/a	1.4	6.3	1.6
acceler* (as in accelerometer)	4.0	14.0	1.9	3.2	16.1	1.6	8.4	20.3	2.7
video (animal-borne imaging)	2.0	5.0	2.4	1.1	3.2	2.0	1.4	2.1	4.3
camera (animal-borne imaging)	1.0	7.0	1.4	0.0	3.2	1.7	2.1	2.8	2.0
imag* (animal-borne imaging)	1.0	2.0	5.0	2.2	2.2	3.5	0.0	1.4	2.5
CTD	0.0	2.0	1.5	1.1	2.2	2.5	2.8	6.3	1.9
SRDL	0.0	2.0	1.5	0.0	2.2	1.0	0.7	3.5	2.4
(*b*) analysis and research approach									
state* (as in state-space model)	0.0	0.0	n/a	0.0	2.2	1.0	0.7	5.6	1.1
ODBA	n/a	n/a	n/a	n/a	n/a	n/a	0.0	2.1	4.3
hypoth* (as in hypothesis)	0.0	4.0	1.5	0.0	9.7	1.1	0.0	10.5	1.3
model* (as in theoretical model)	2.0	16.0	1.8	1.1	17.2	1.6	4.2	23.1	2.2
experim* (as in experiment)	0.0	10.0	1.5	0.0	9.7	1.0	1.4	9.1	1.5
calibr* (as in calibration)	0.0	1.0	1.0	0.0	2.2	1.0	0.0	4.9	1.6
automat* (as in automated analysis)	0.0	3.0	1.3	0.0	4.3	1.0	0.7	2.8	1.8
(*c*) research topics									
physiol* (as in physiology)	2.0	17.0	1.4	4.3	12.9	1.3	2.8	10.5	1.3
behav* (as in behaviour)	23.0	52.0	2.1	20.4	64.5	2.2	14.7	66.4	2.2
forag* (as in foraging)	18.0	41.0	2.9	17.2	47.3	3.8	12.6	48.3	3.2
habitat	4.0	13.0	2.2	1.1	11.8	1.5	9.8	33.6	2.3
conserv* (as in conservation biology)	0.0	4.0	1.3	1.1	4.3	1.5	2.1	9.1	1.2
climat* (as in climate change)	0.0	0.0	n/a	0.0	1.1	2.0	0.0	7.0	1.2
climat* (as in macro climate)	0.0	2.0	1.0	1.1	2.2	2.5	0.0	11.2	1.4
predat* (as in predation)	2.0	12.0	1.4	0.0	16.1	1.6	5.6	18.9	2.1
ecol* (as in ecology)	5.0	16.0	1.2	3.2	9.7	1.2	4.2	24.5	1.3
welfare	1.0	1.0	4.0	0.0	0.0	n/a	0.0	0.0	n/a
ethic* (as in ethical issues)	0.0	1.0	1.0	0.0	1.1	1.0	0.0	0.0	n/a

Table S3. A selection of large-scale collaborative biologging projects (listed in alphabetical order).

project acronym	project name	abstract (page)	website (www)
AATAMS	Australian Acoustic Tracking and Monitoring System	35	n/a
ACT	Atlantic Cooperative Telemetry	24	n/a
ARTS	Automated Radio Telemetry System	n/a	princeton.edu/~wikelski/research
CFTC	California Fish Tracking Consortium	n/a	n/a
	Codyssey	6	codyssey.co.uk
EELIAD	European Eels in the Atlantic: Assessment of Their Decline	6	eeliad.com
FACT	Florida Atlantic Coast Telemetry Project	n/a	n/a
ICARUS	International Cooperation for Animal Research Using Space	n/a	IcarusInitiative.org
	Movebank	n/a	movebank.org
OTN	Ocean Tracking Network	24, 37, 57	oceantrackingnetwork.org
POST	Pacific Ocean Shelf Tracking Project	37, 57	postcoml.org
TAG	Tag-A-Giant Foundation	1	tagagiant.org
TOPP	Tagging of Pacific Pelagics	e.g., 1, 16	topp.org