



Downscaling foraging activity: The impact of Argos-based sampling schemes on movement behavior identification in whale tracking data

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Ladd Irvine

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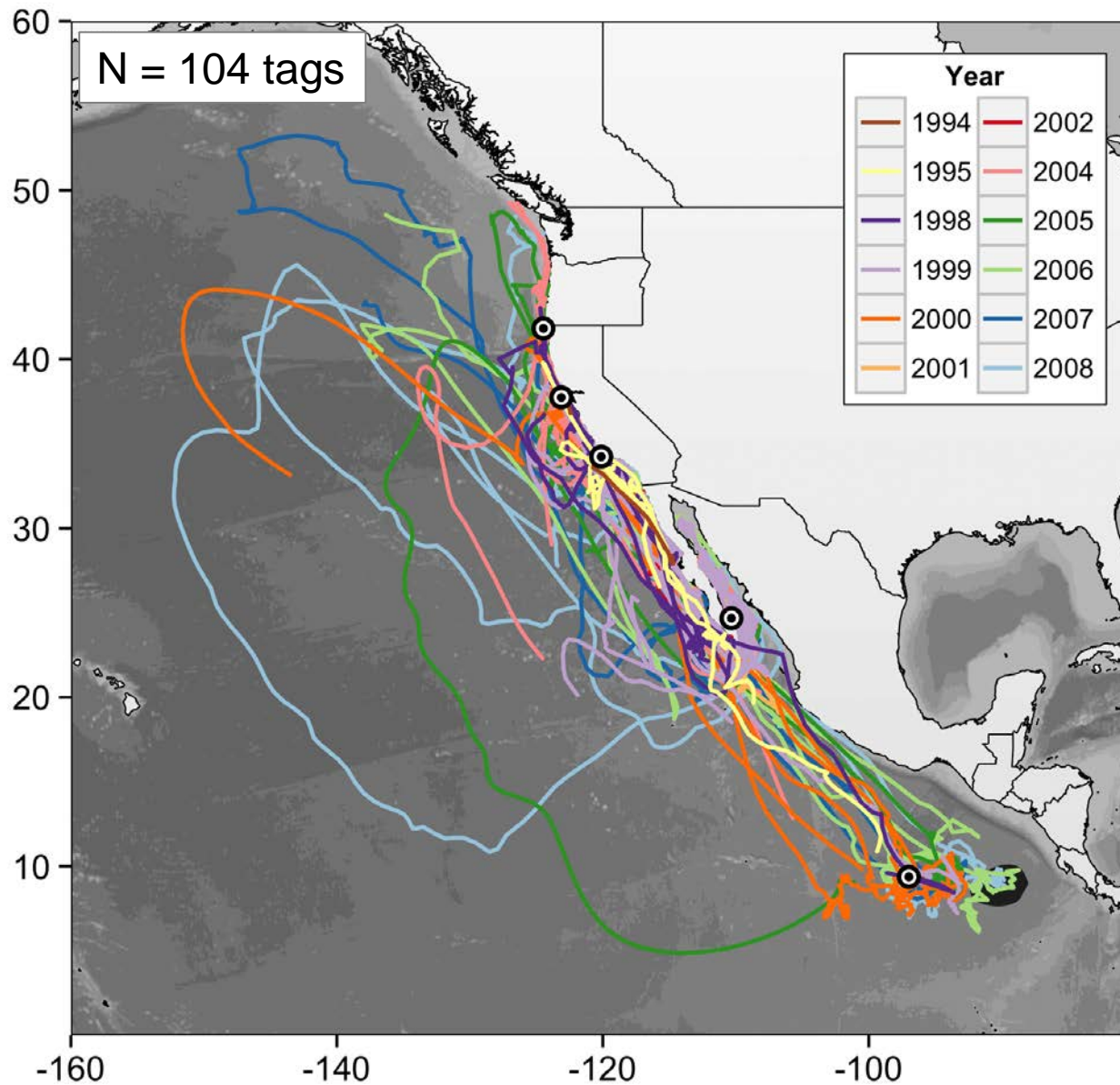
Marine Mammal Institute

Oregon State University

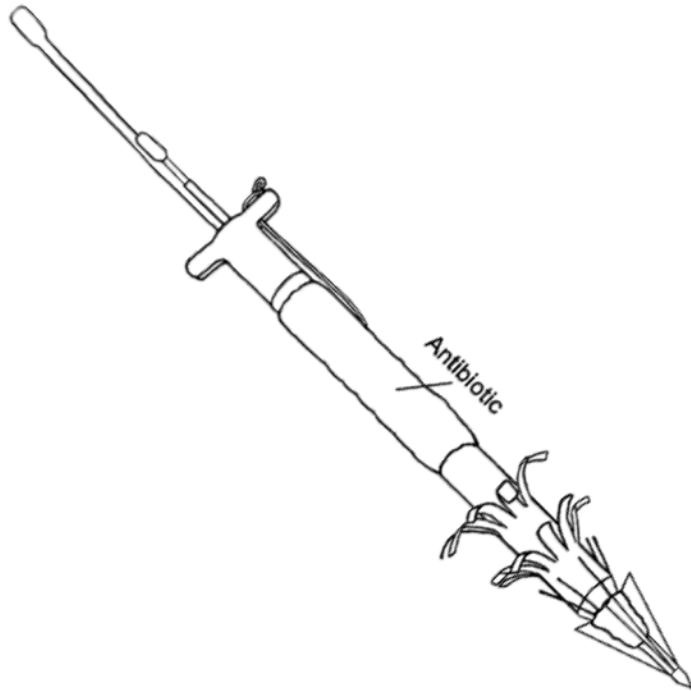
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21st SMM Biennial Conference on Marine Mammals
Ecology Session, Tues 15 Dec 2015, 14:15-14:30h
San Francisco, CA

OSU blue whale tracking, 1994-2008



Location-only Argos tags



Platform: SPOT6 (Wildlife Computers), ST-27 (Telonics)

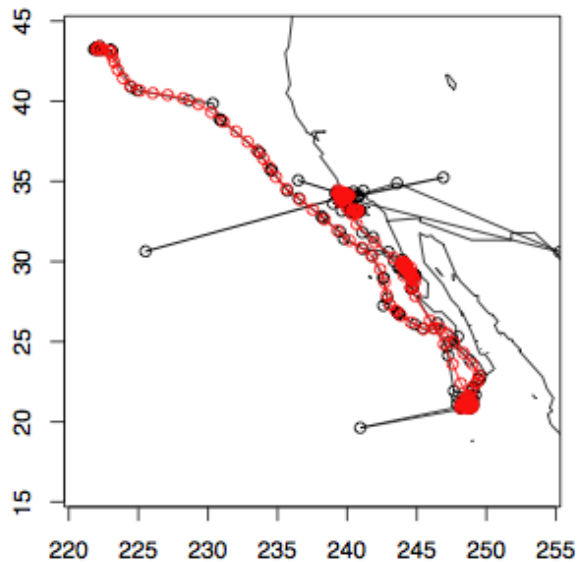
Location type: Argos

Duration: multi-month

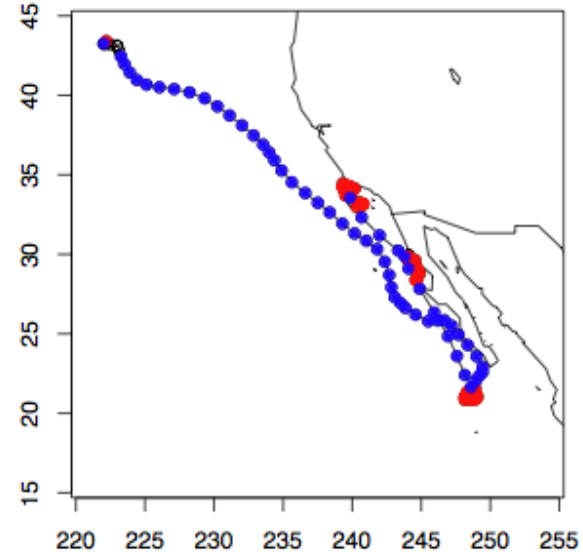
Sampling: duty cycled (4h on / 20h off)

State-space modeling

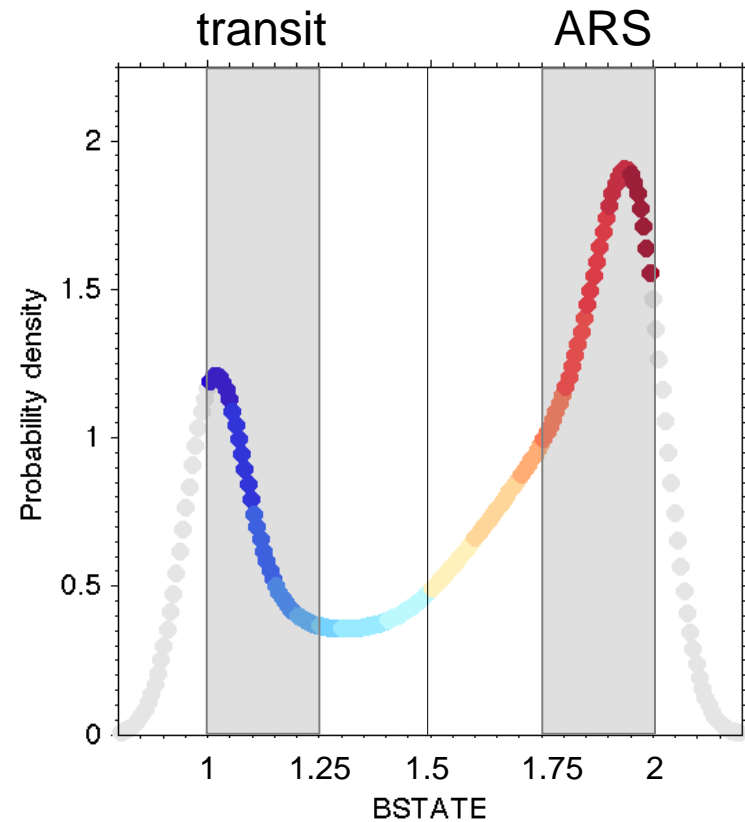
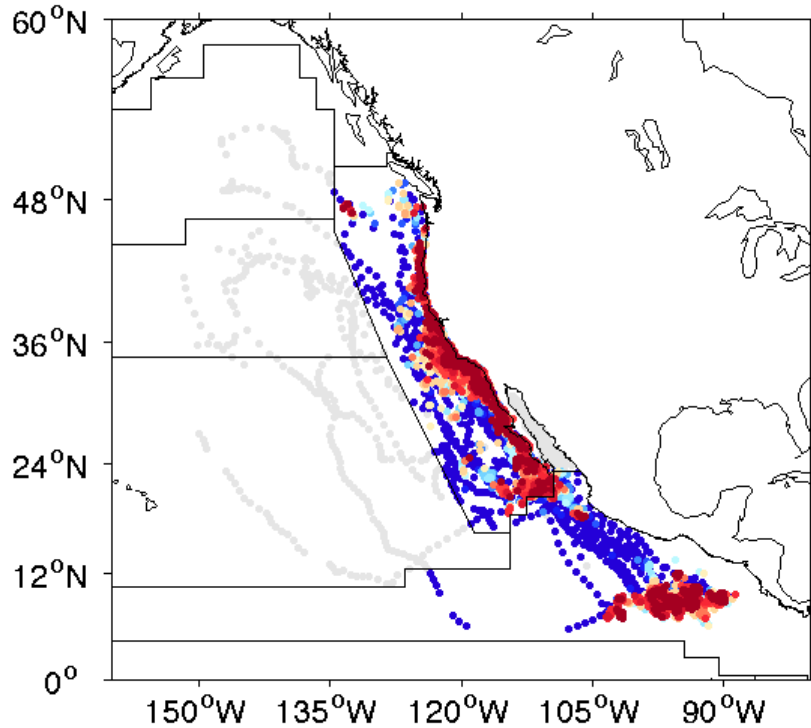
Satellite / SSM locations



Transiting, ARS

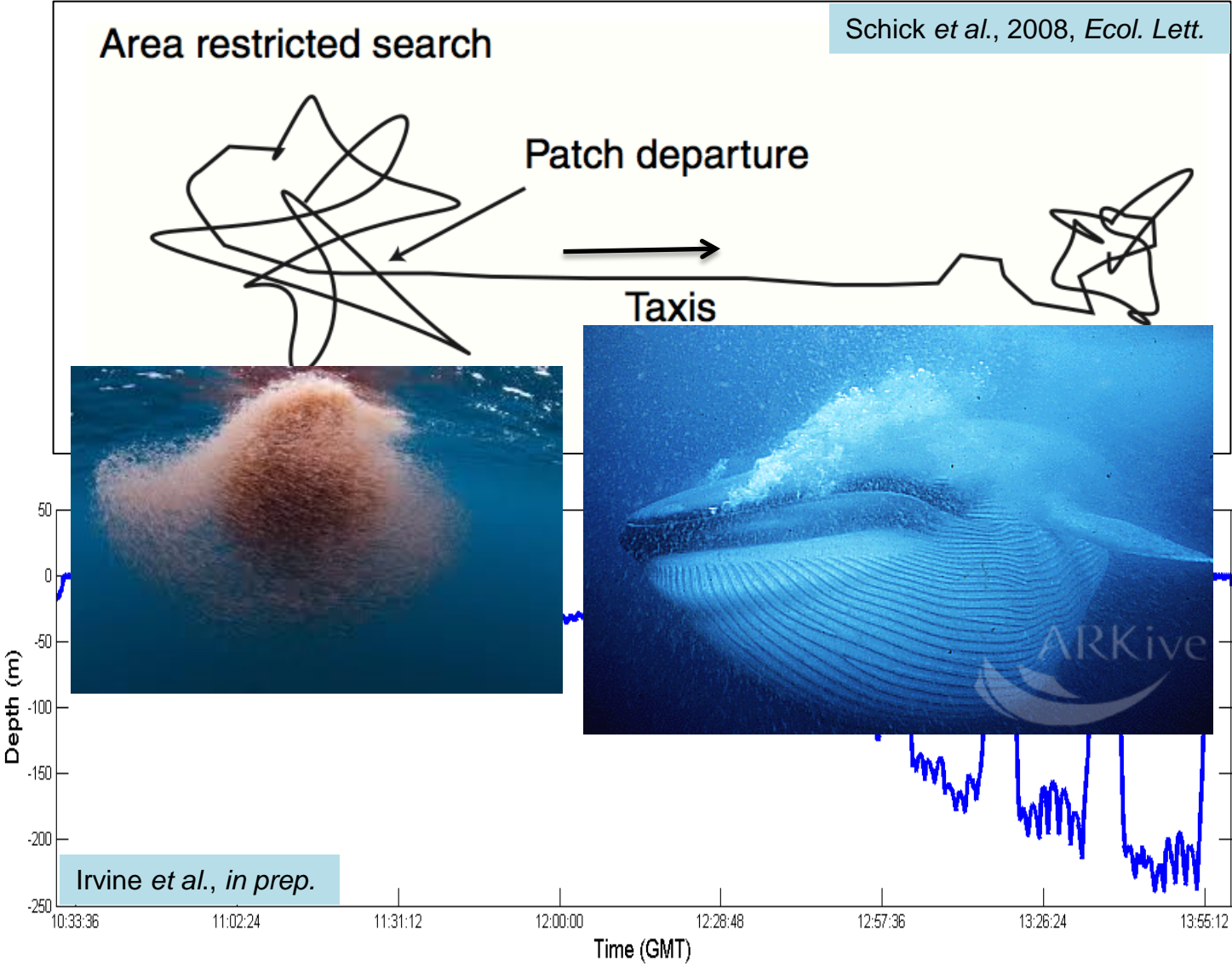


State-space modeling

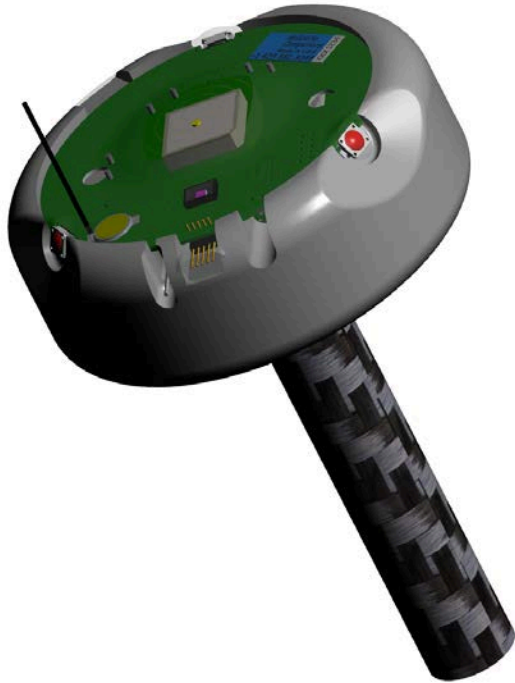


N = 104 tags, 1994-2008
SSM output at 1 loc/d, 10K locs

Movement behavior



Intermediate-duration tags: Advanced Dive Duration (ADB)



Platform: MK-10 PAT (Wildlife Computers)

Location type: Argos & FastLoc GPS

Duration: multi-week

Sampling: 1 Hz (TDR, 3-axial accelerometer, magnetometer, temperature)

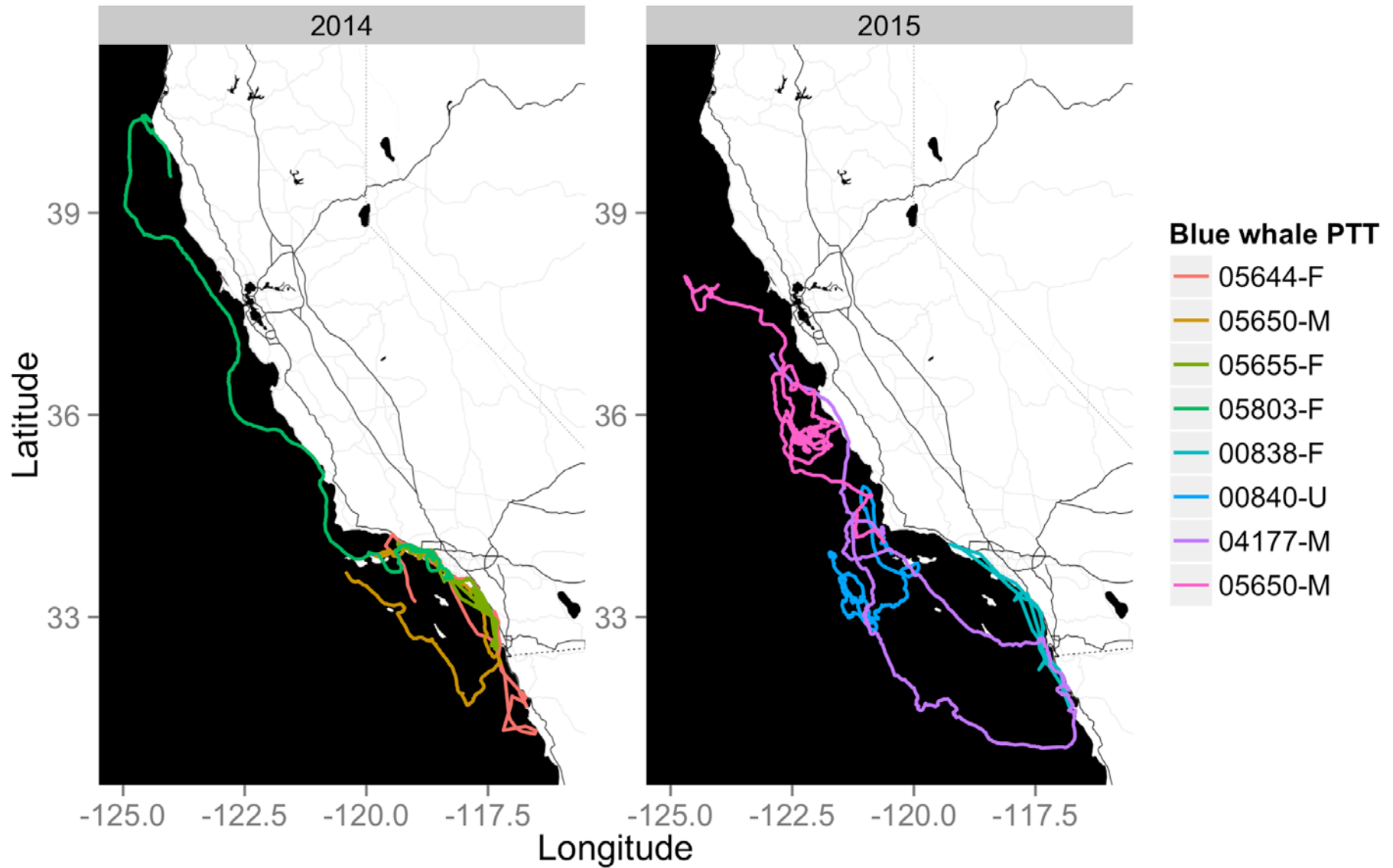
Objective

Validate behavioral modes identified by SSMs with dive data from ADB tags

Approach

- Estimate SSM locations and behavioral mode from the Argos data at 1, 2, 3, and 4 locs/d
- Compare to the number of foraging lunges summarized for the corresponding periods (24, 12, 8, and 6 h) from the dive data

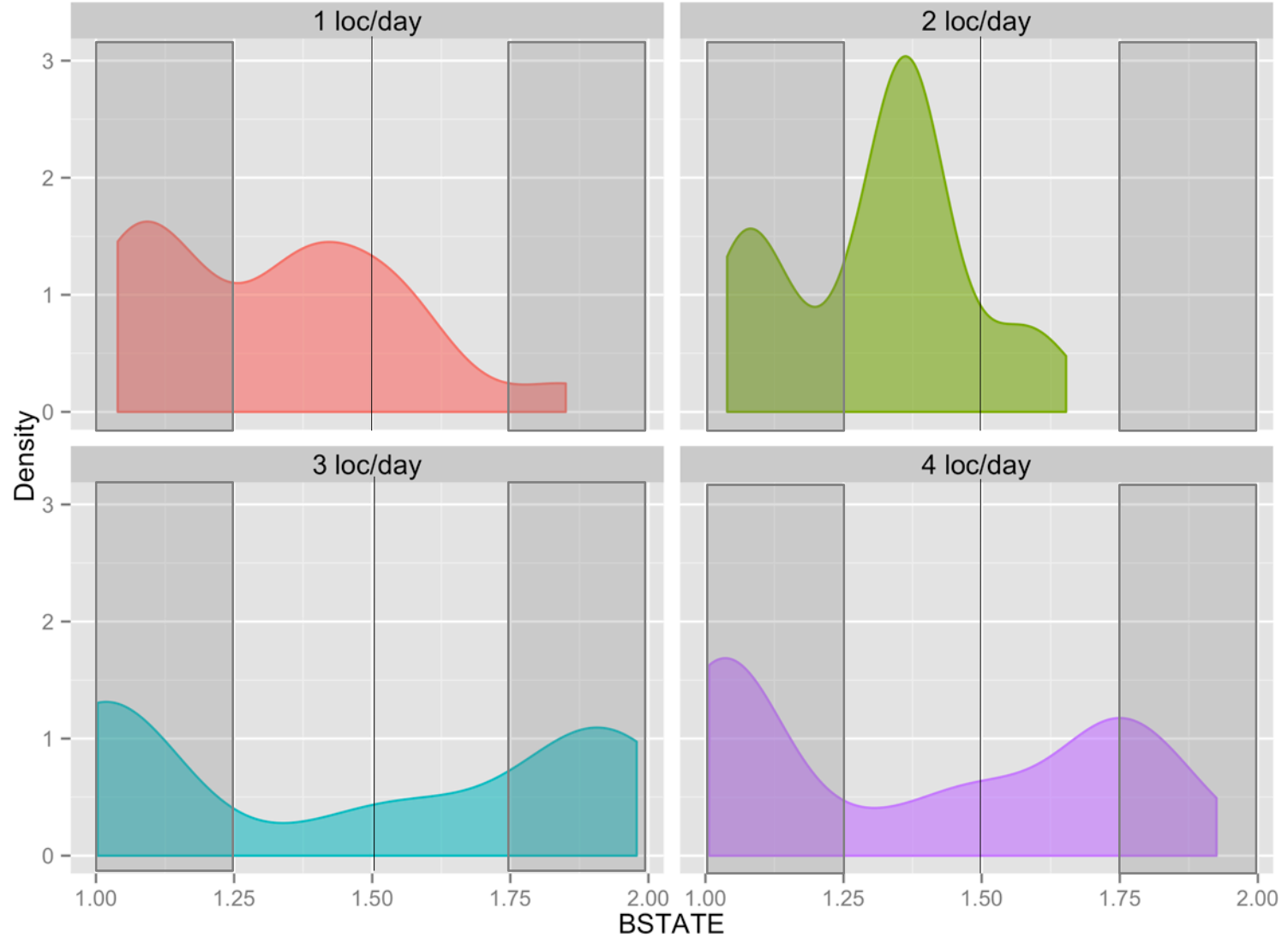
2014-15 ADB tag deployments



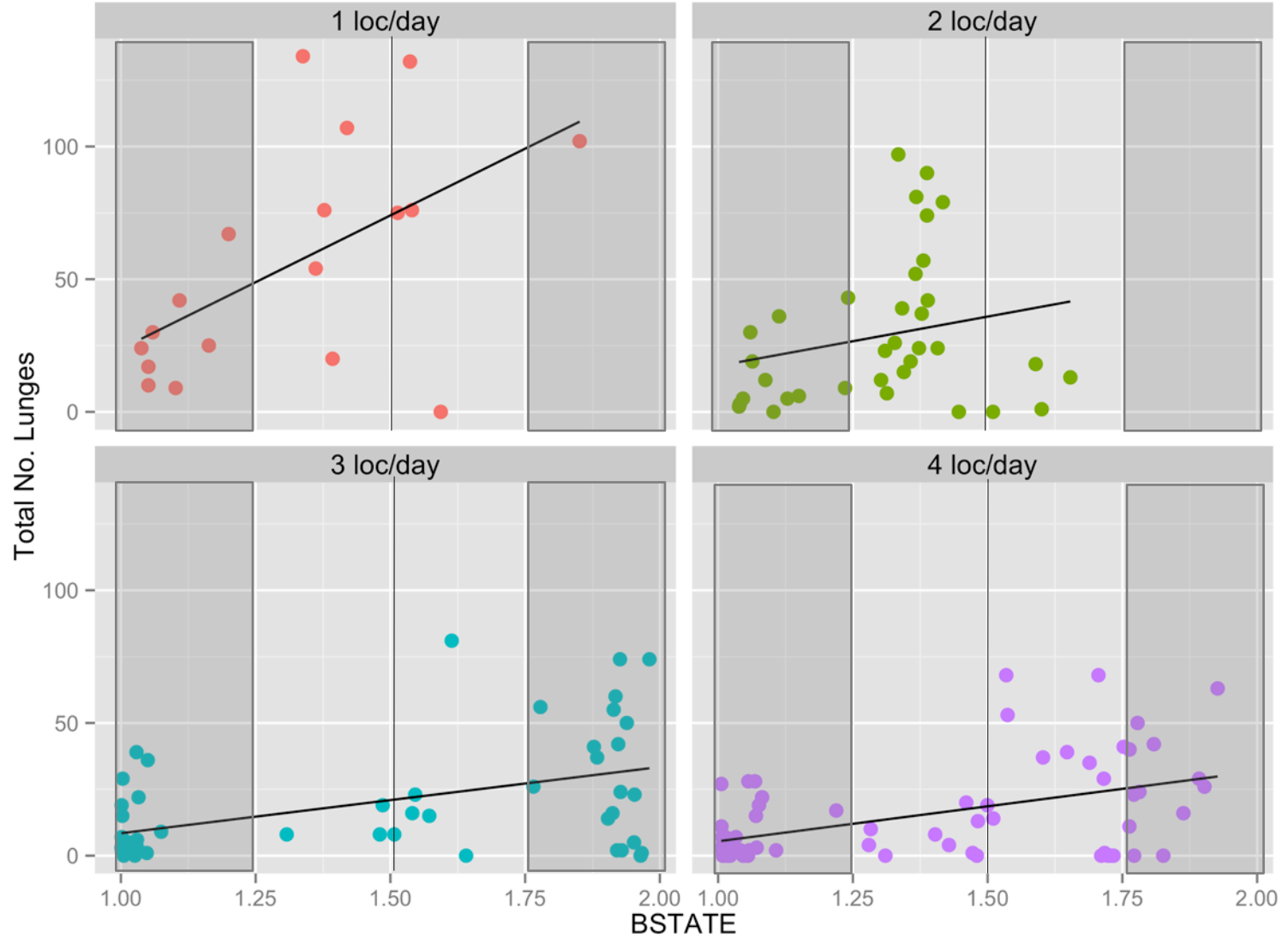
2014-15 ADB tag deployments

Year	Tag ID	Sex	Duration	Argos		GPS		Dives	Dives/d	Distance	Linearity
				Locs	Loc/d	Locs	Loc/d				Index
2014	05644	Female	19	334	16.7	183	9.7	1068	56.2	1419	0.06
2014	05650	Male	20	340	17.0	2278	115	2276	113.9	1677	0.08
2014	05655	Female	20	299	14.2	799	40.3	2918	147.3	1563	0.13
2014	05803	Female	18	215	10.8	2539	139.1	1832	100.3	2036	0.37
2015	00840	Unkn	25	271	10.8	1633	62.8	2075	83.7	1417	0.07
2015	04177	Male	28	334	11.5	1520	53.8	2794	101.6	2213	0.17
2015	05650	Male	29	464	15.0	2246	80.9	2280	78.9	2328	0.22
			23	348.4	14.5	1600	72	2178	97	1722	

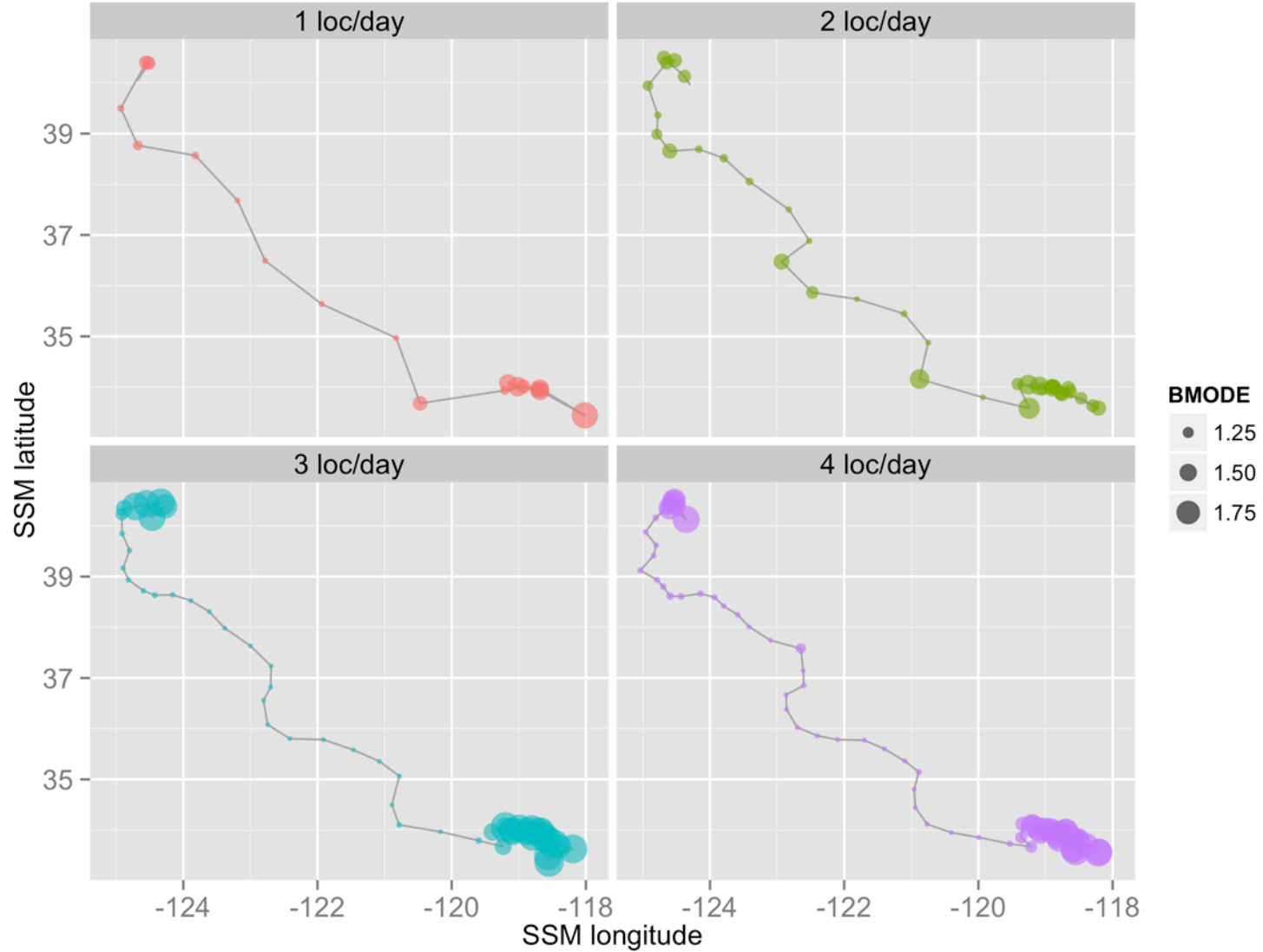
Tag 5803-F: movement behavior



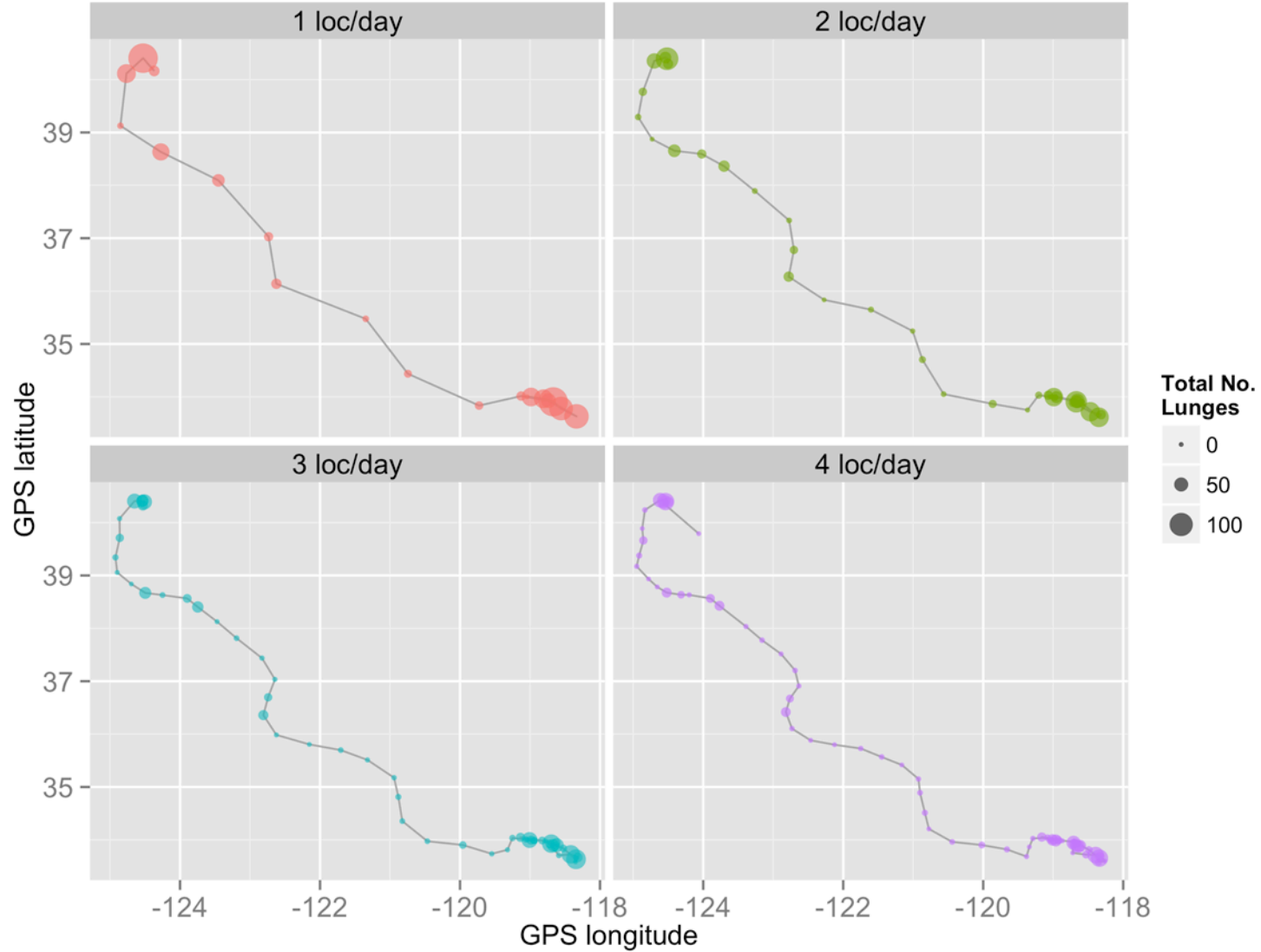
Tag 5803-F: movement behavior



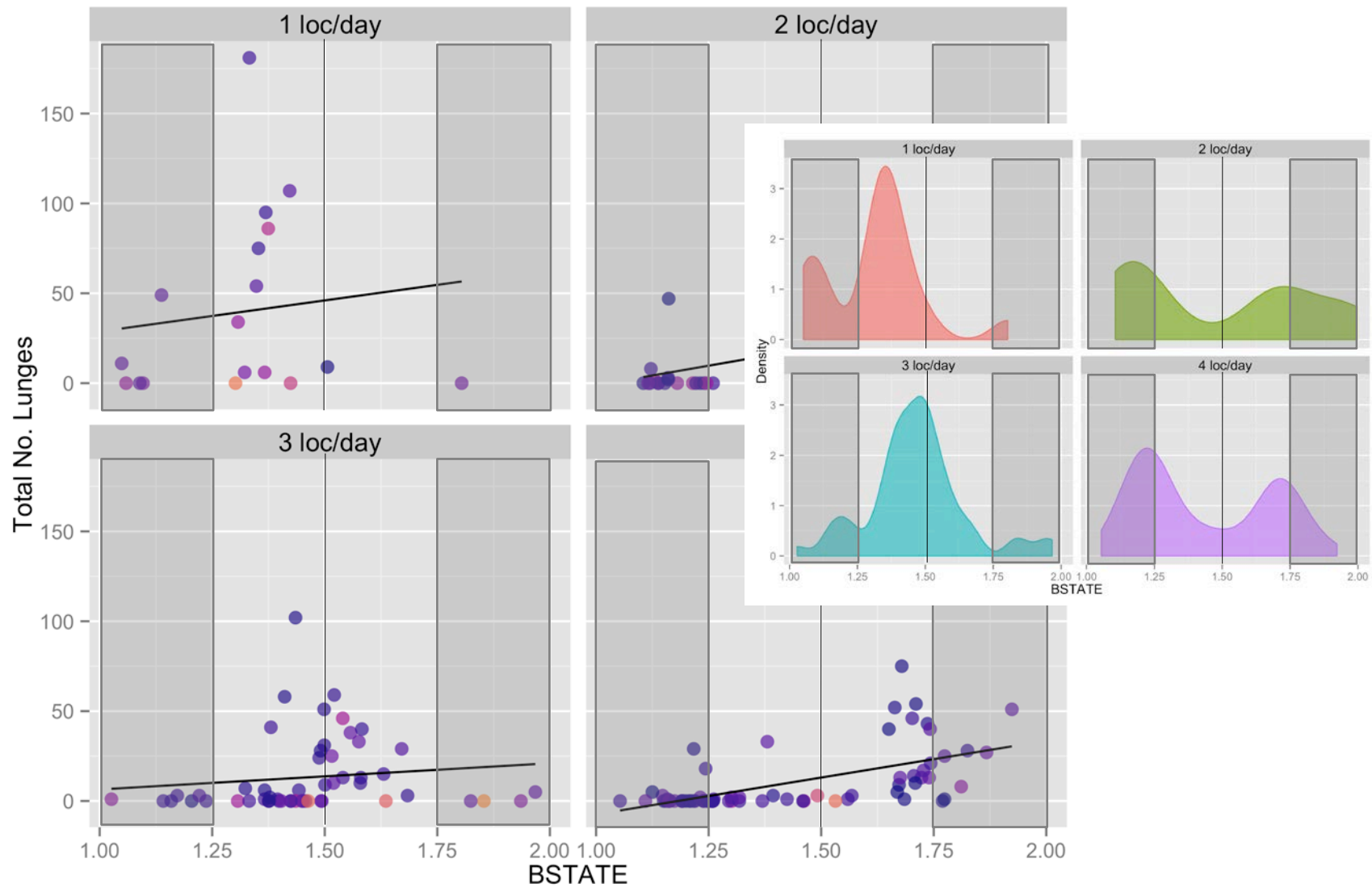
Tag 5803-F: movement behavior



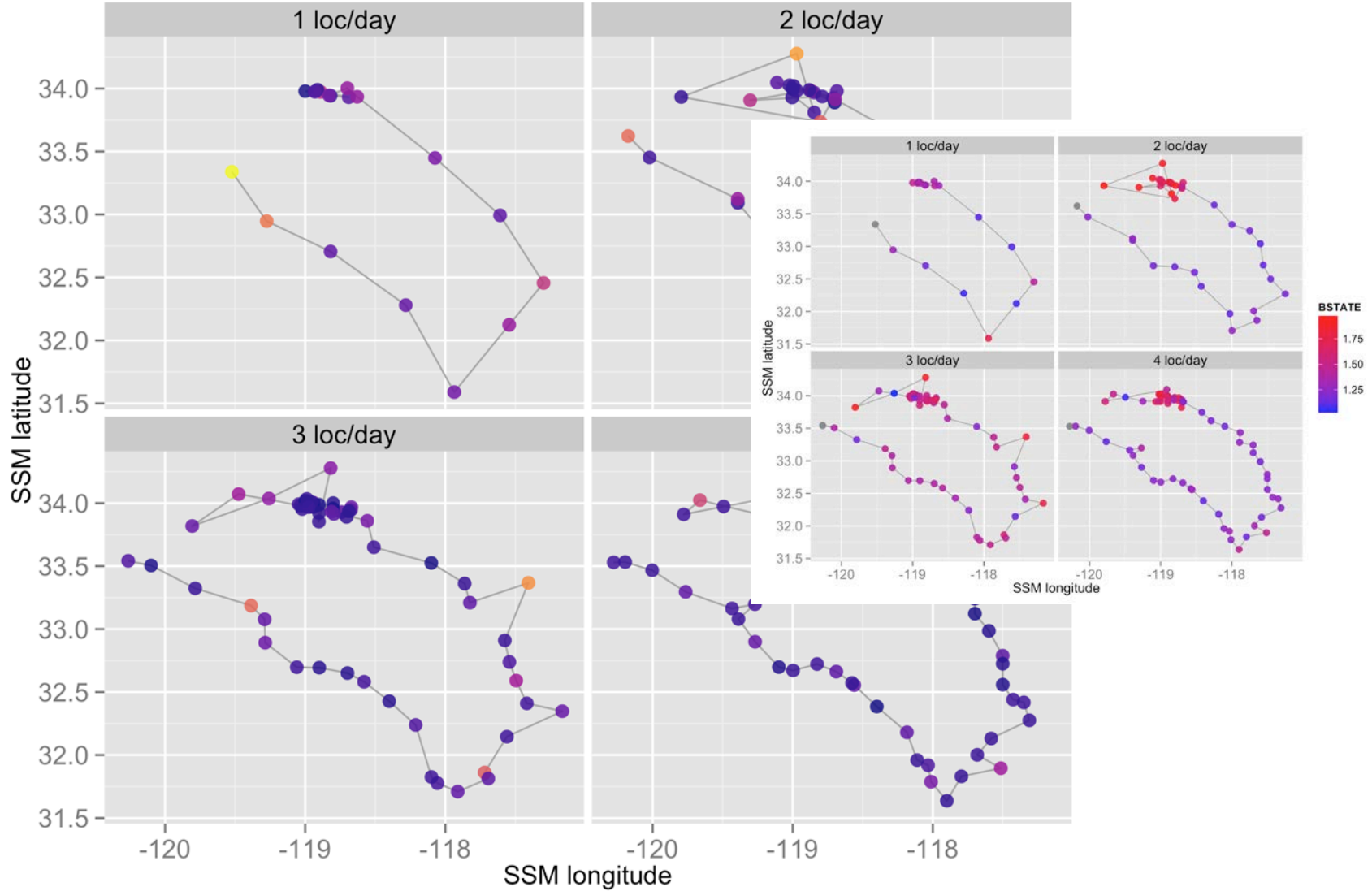
Tag 5803-F: foraging activity



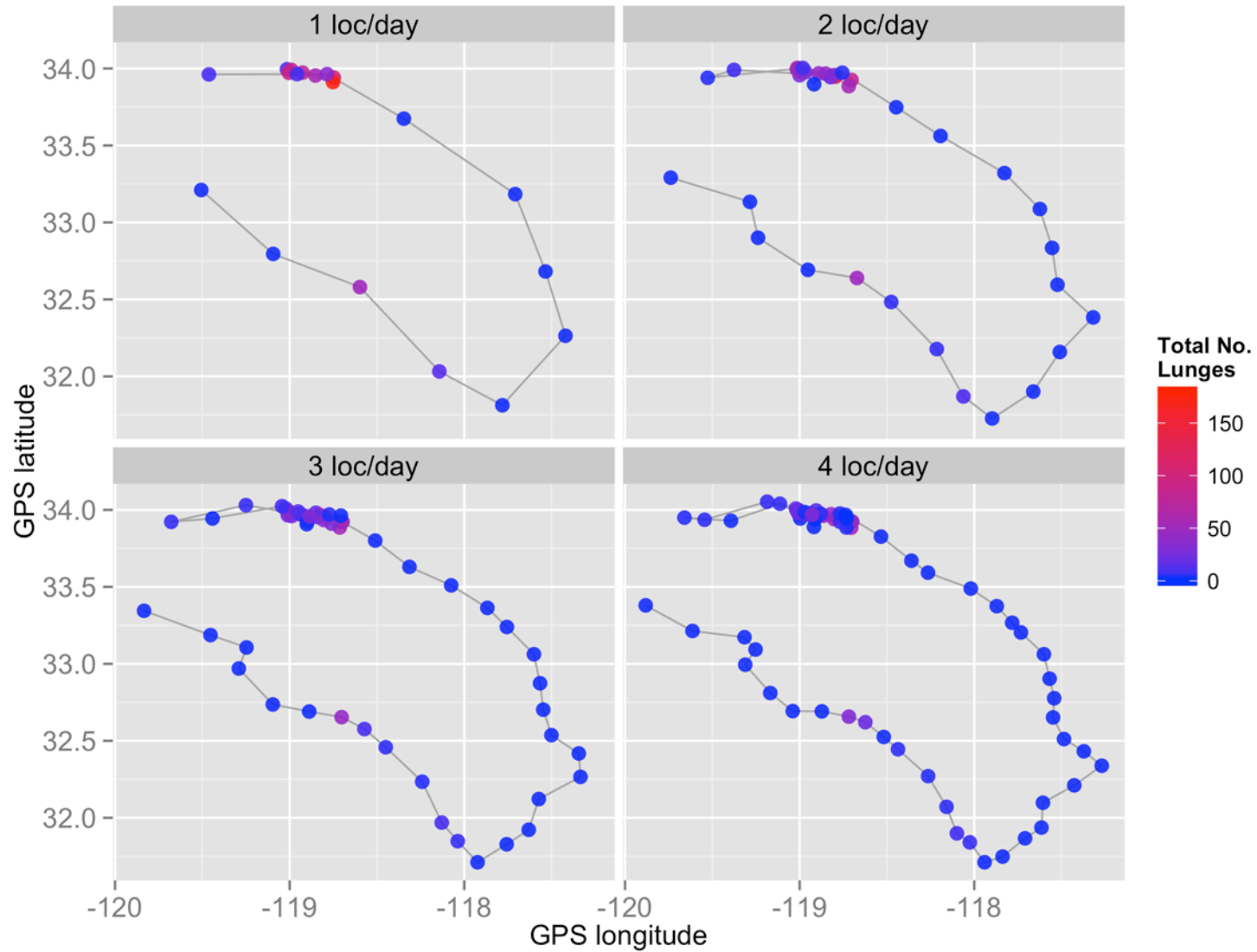
Tag 5650-M: movement behavior



Tag 5650-M: movement behavior



Tag 5650-M: foraging activity





Conclusions

- Behavioral modes estimated from SSMs *generally* captured the observed patterns of foraging activity at all output resolutions
- The 1-loc/d resolution typically output from Argos tracks is adequate for the characterization of persistent foraging activity over large scales
- Regardless of sampling resolution, low-intensity/brief foraging activity may not be captured by S-SSMs, especially during linear portions of a track



Conclusions

- Behavioral mode estimates were highly sensitive to the number and class accuracy of the input locations.
- Spurious behavioral modes may arise from track geometry.
- Sampling schemes may not always return the assumed bimodal distribution of S-SSMs.
- The sampling scheme should be specified based on the data meeting these requirements
- “Behavioral state” compared favorably with the observed levels of foraging activity under these conditions, making it a useful response variable.

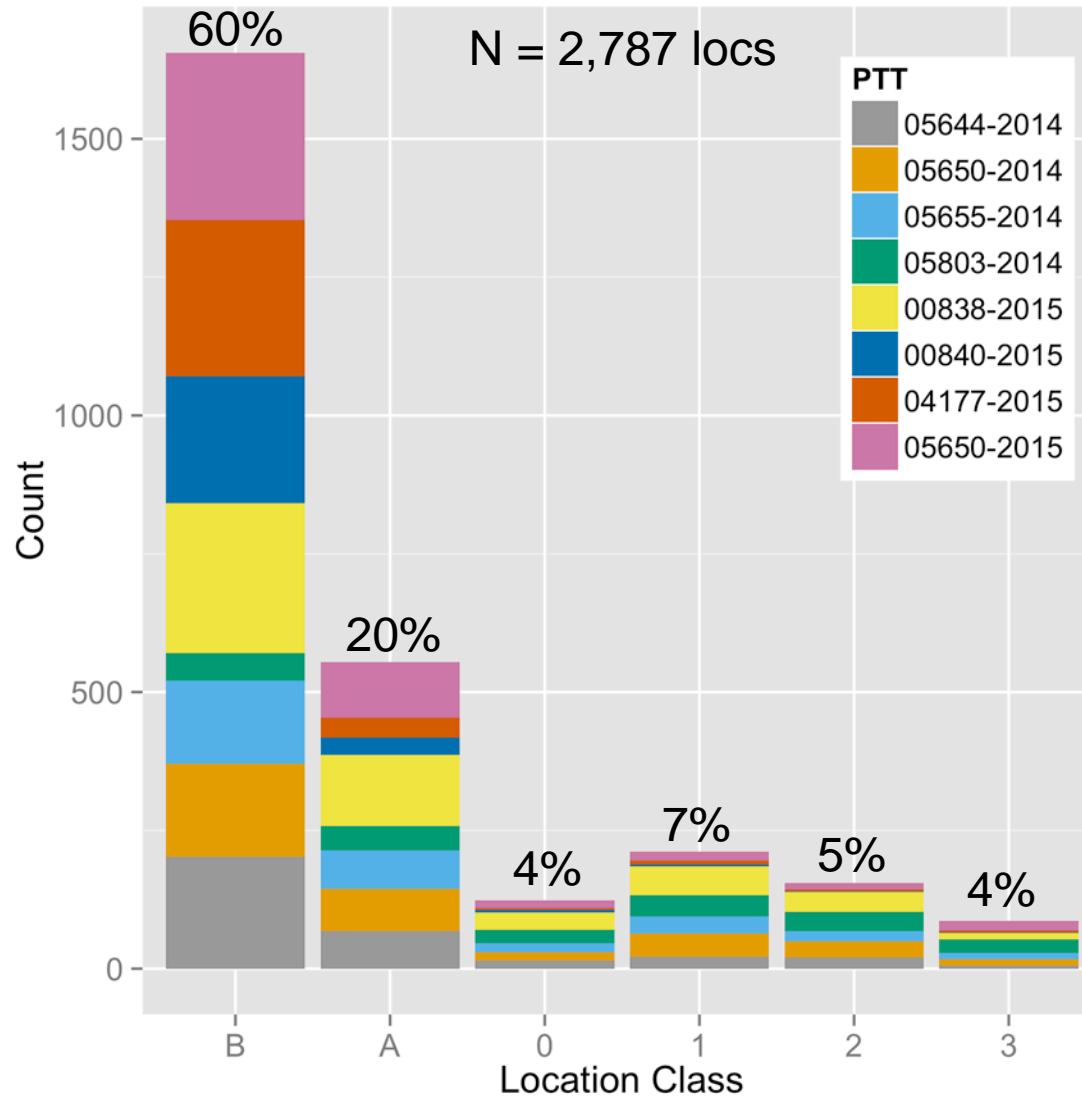
Acknowledgments

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- **NAVFAC Pacific & HDR for project/contract management**

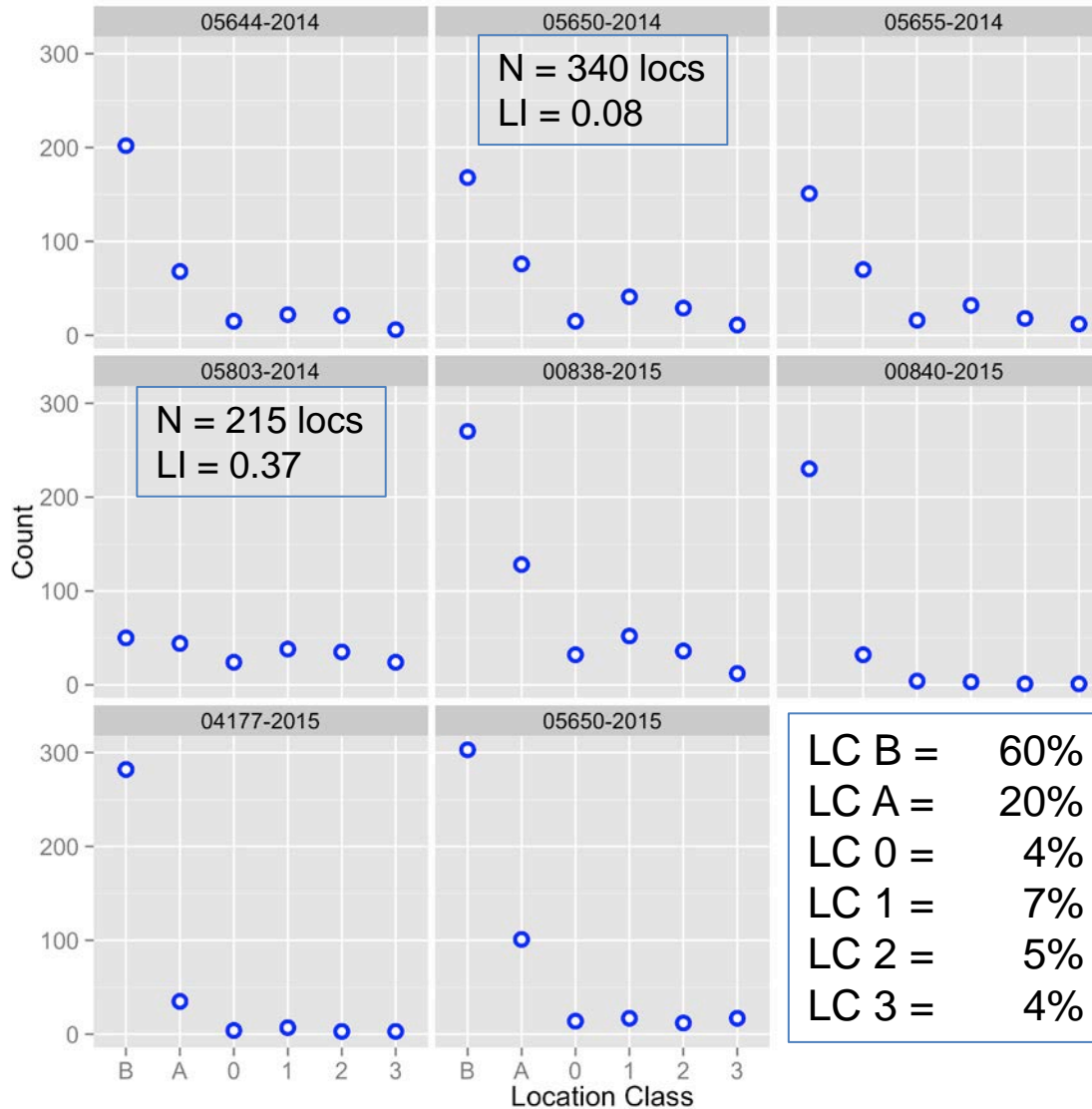
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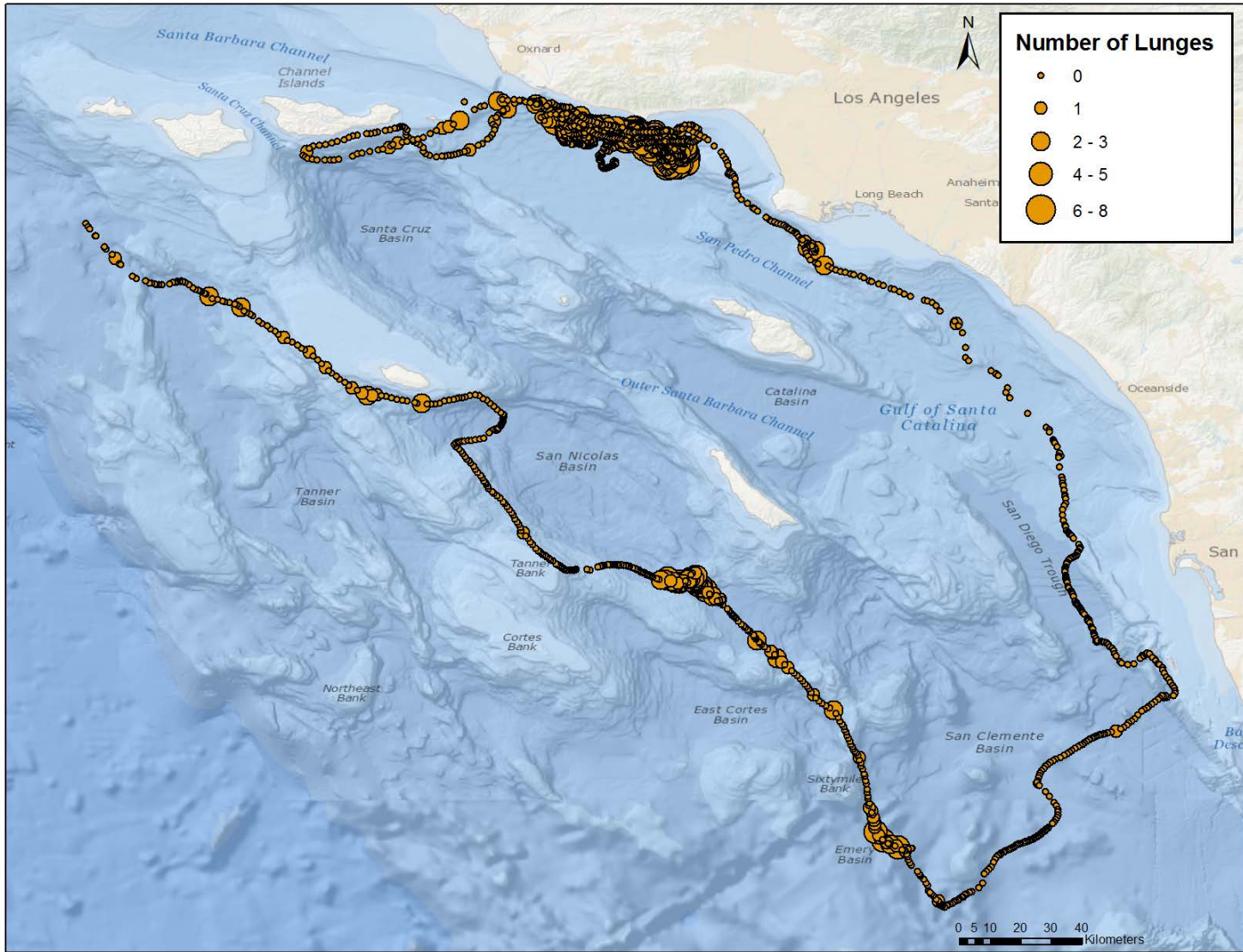


Argos location classes

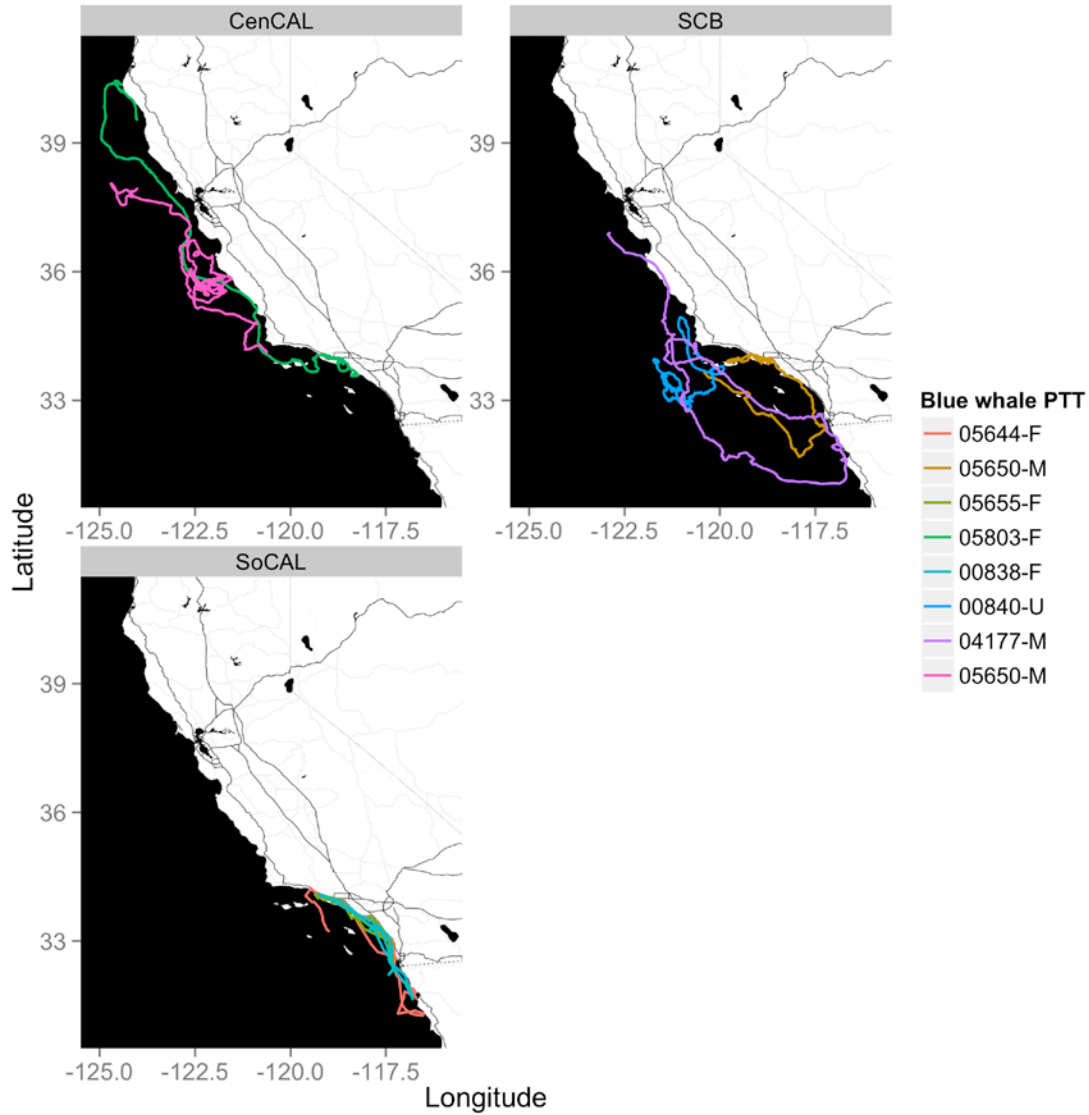


Argos location classes





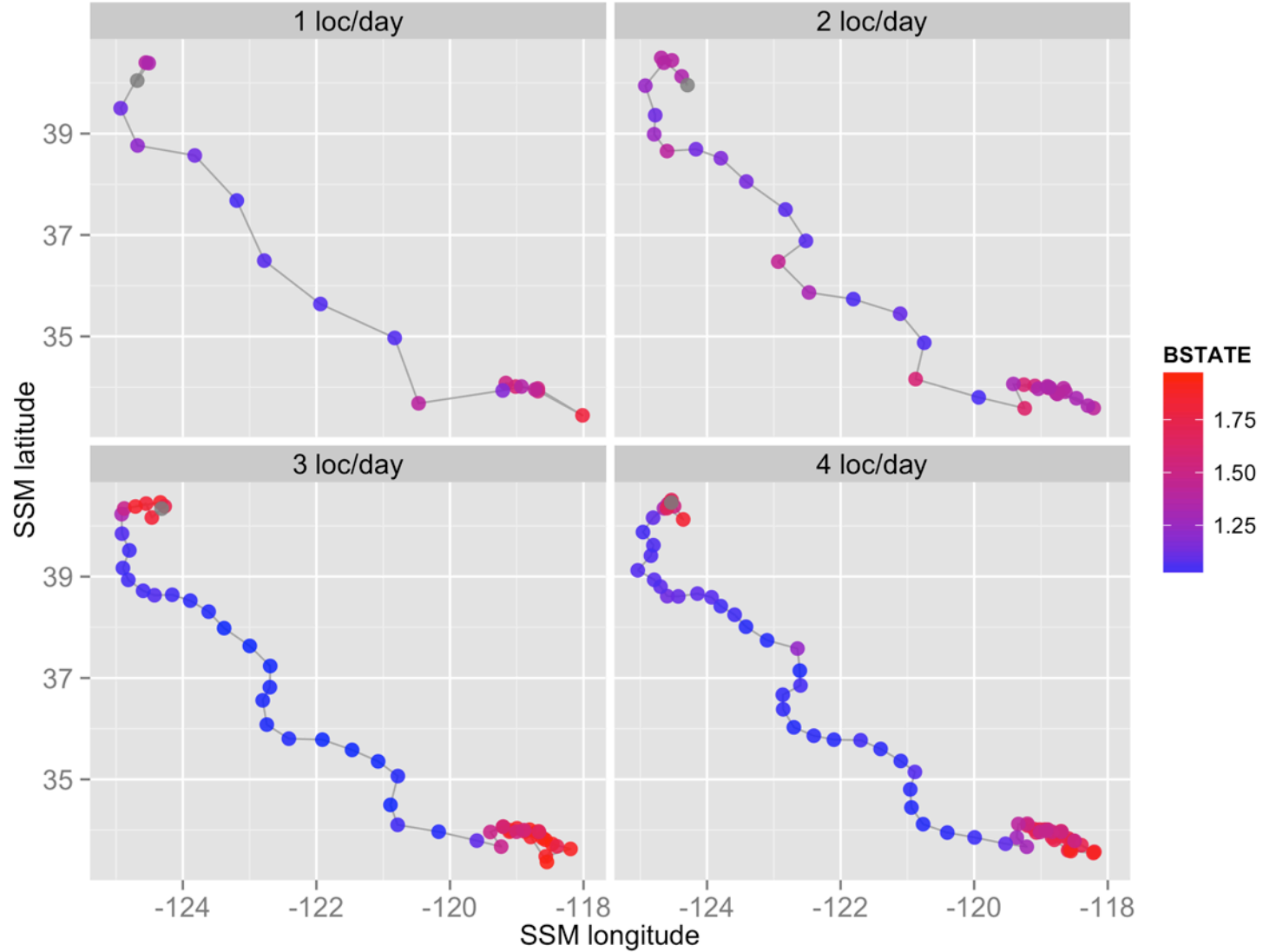
2014-15 ADB tag deployments



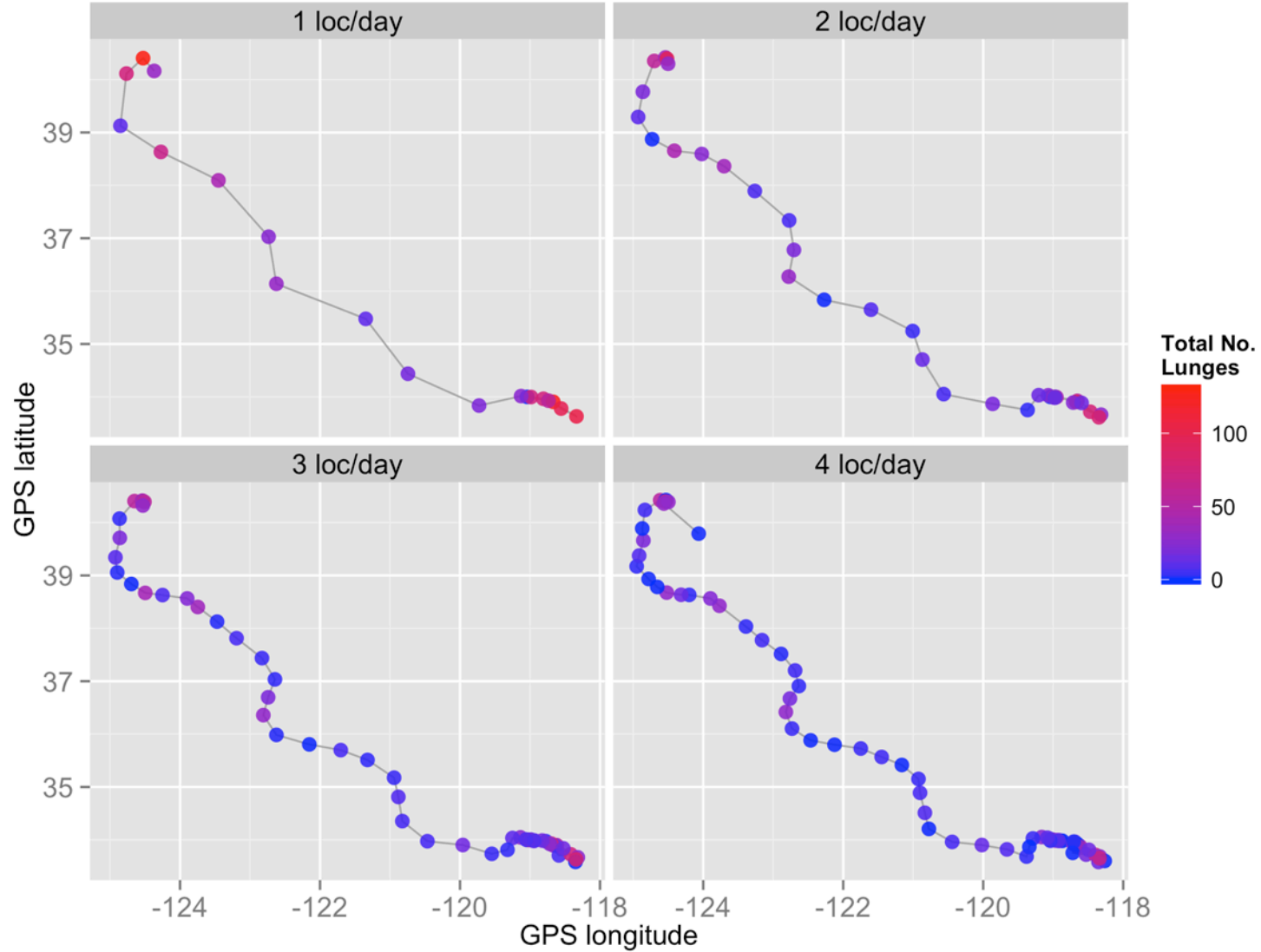
2014-15 ADB tag deployments

	Tag ID	Year	Sex	Duration	Argos		GPS		Distance	Linearity Index
					Locs	Loc/d	Locs	Loc/d		
CenCAL	05803	2014	Female	20	215	10.8	2539	127.0	2036.0	0.37
	05650	2015	Male	31	464	15.0	2246	78.9	2328.3	0.22
SCB	05650	2014	Male	20	340	17.0	2278	113.9	1676.8	0.08
	00840	2015	Unkn	26	271	10.8	1633	62.8	1417.2	0.07
	04177	2015	Male	29	334	11.5	1520	52.4	2212.6	0.17
SoCAL	05644	2014	Female	20	334	16.7	183	9.2	1419.2	0.06
	05655	2014	Female	20	299	14.2	799	40.0	1563.4	0.13
	00838*	2015	Female	25	530	19.6	71	2.8	*2135.4	*0.05
					348.		1408.			
					23.9	4	14.5	6	60.9	1722

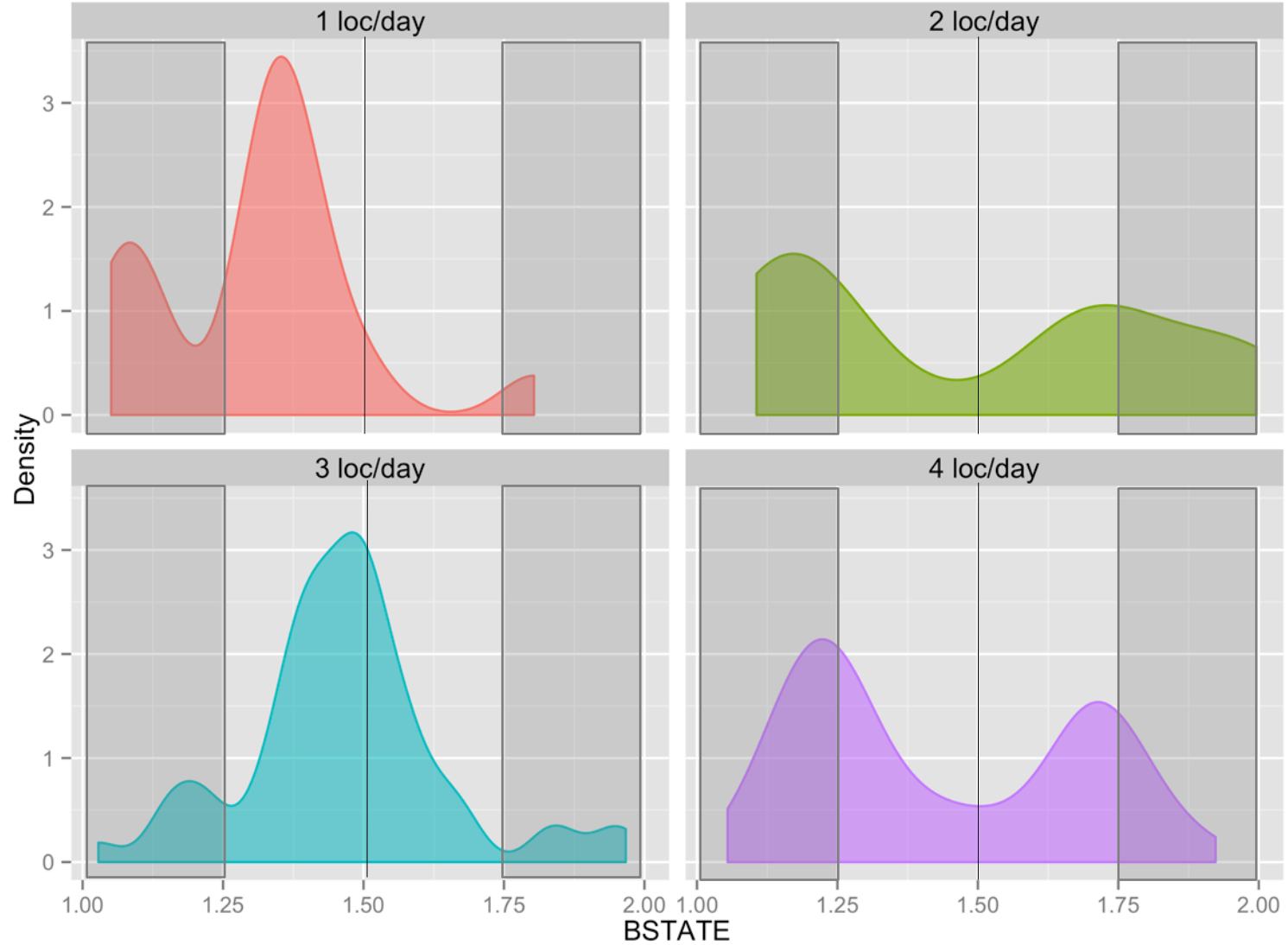
Tag 5803-F: movement behavior



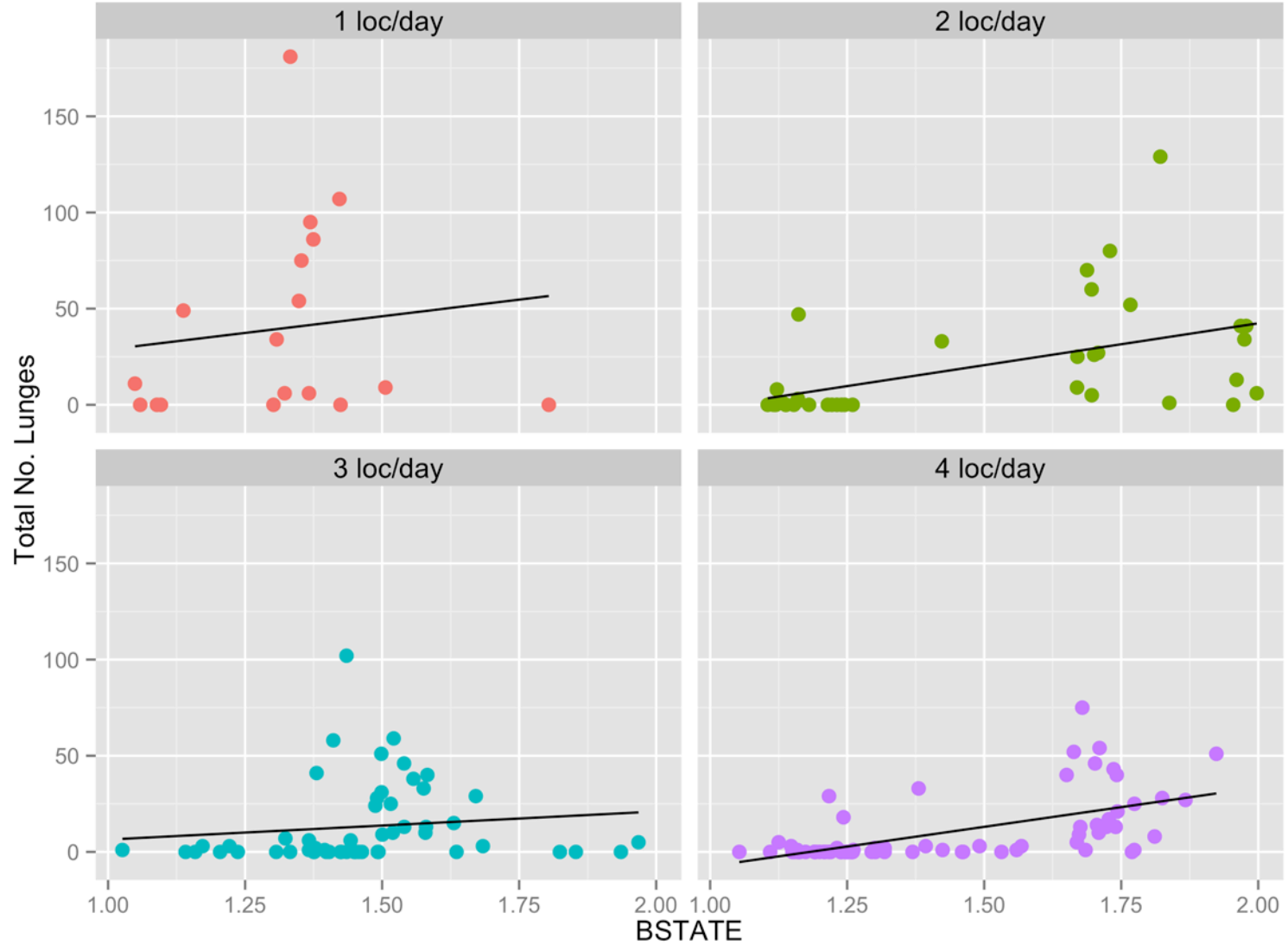
Tag 5803-F: foraging activity



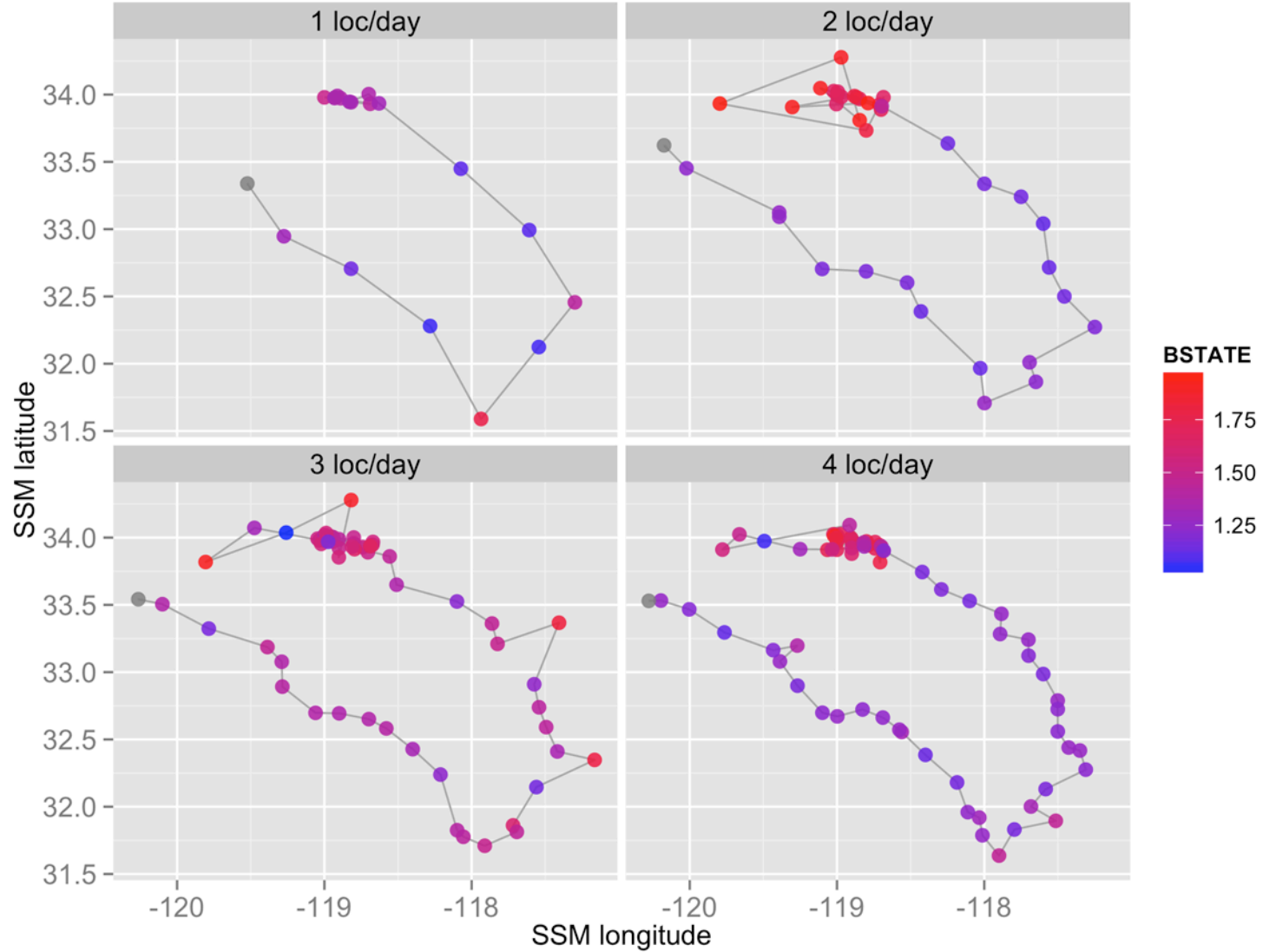
Tag 5650-M: movement behavior



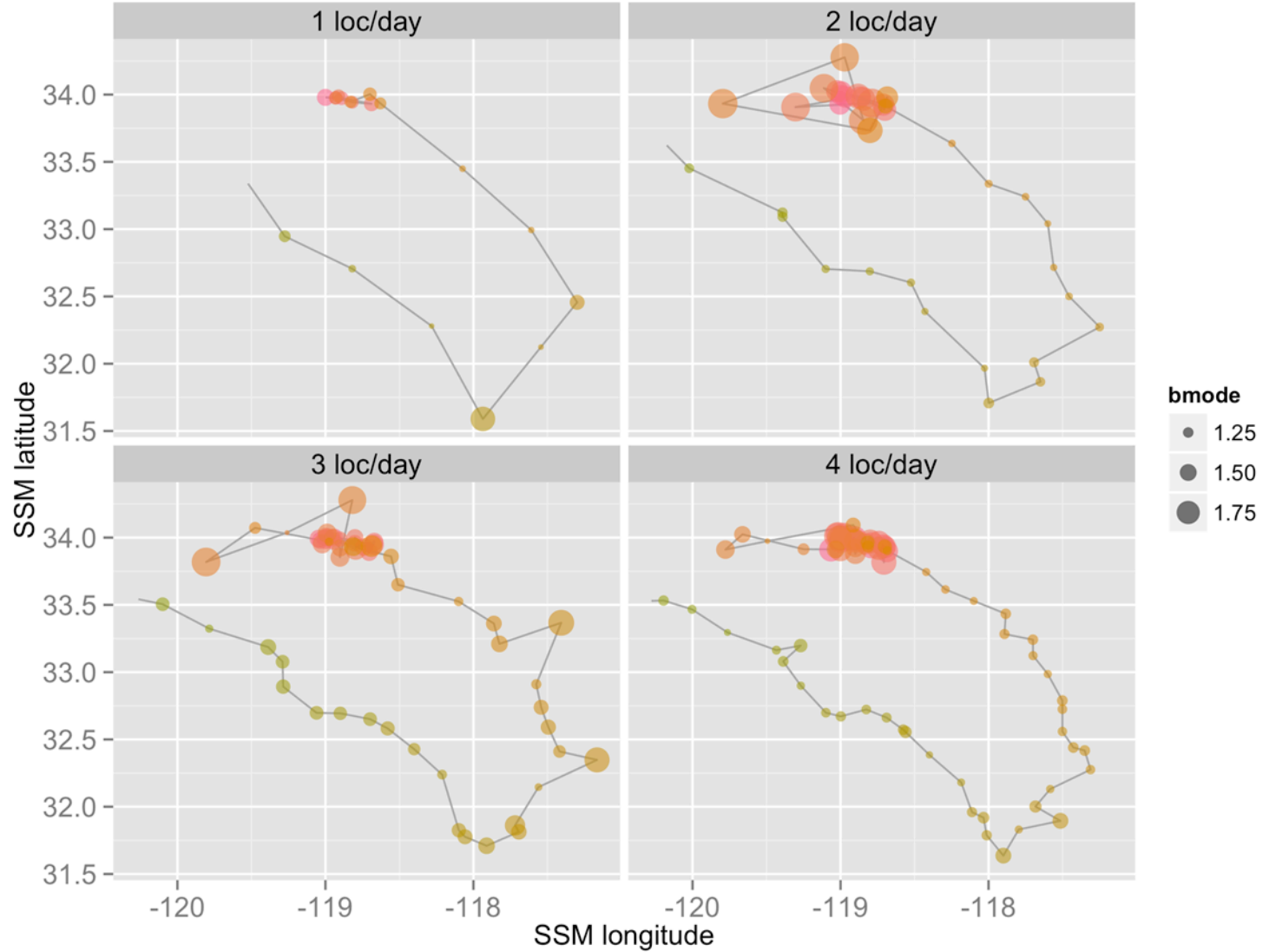
Tag 5650-M: movement behavior



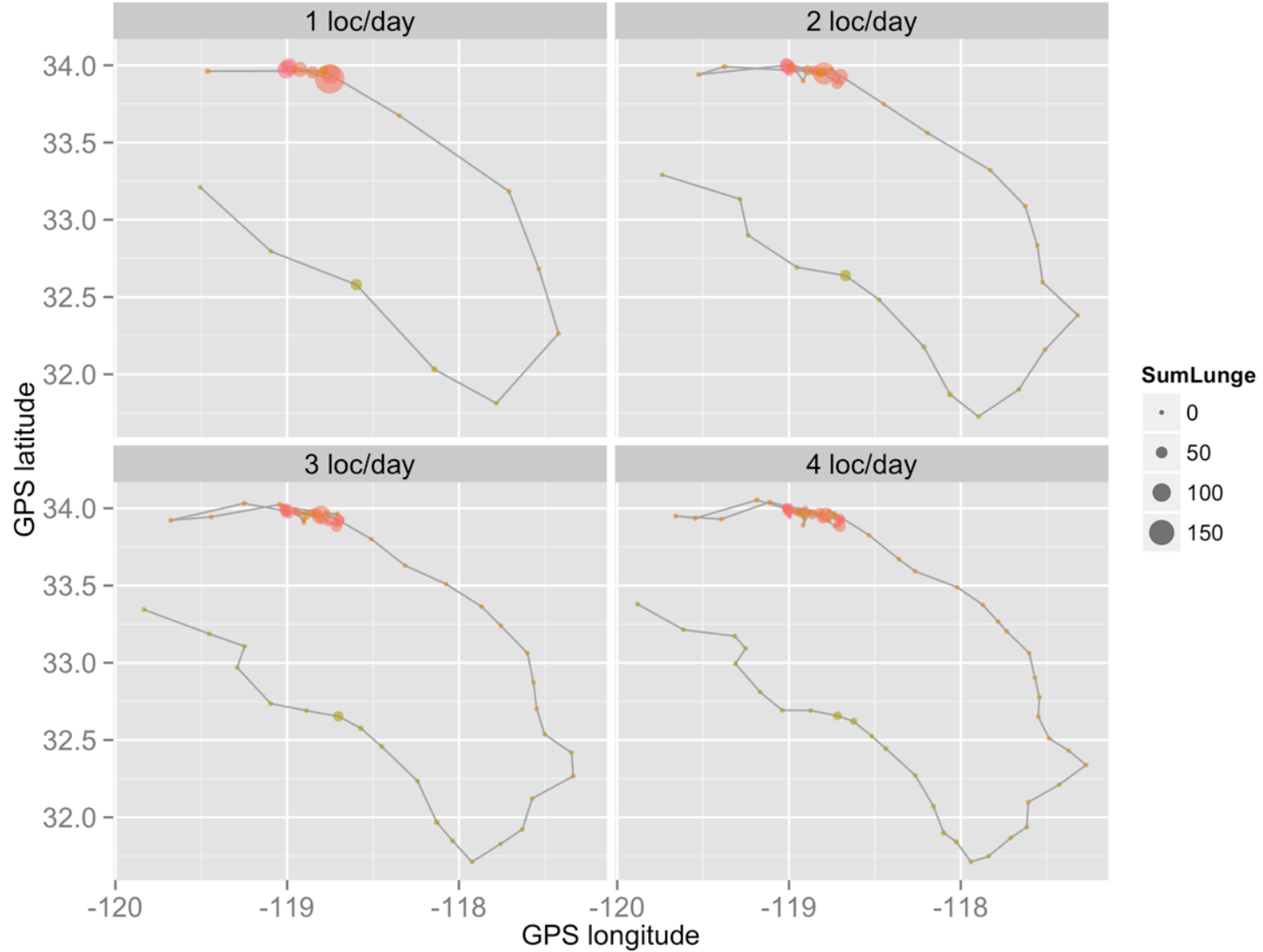
Tag 5650-M: movement behavior



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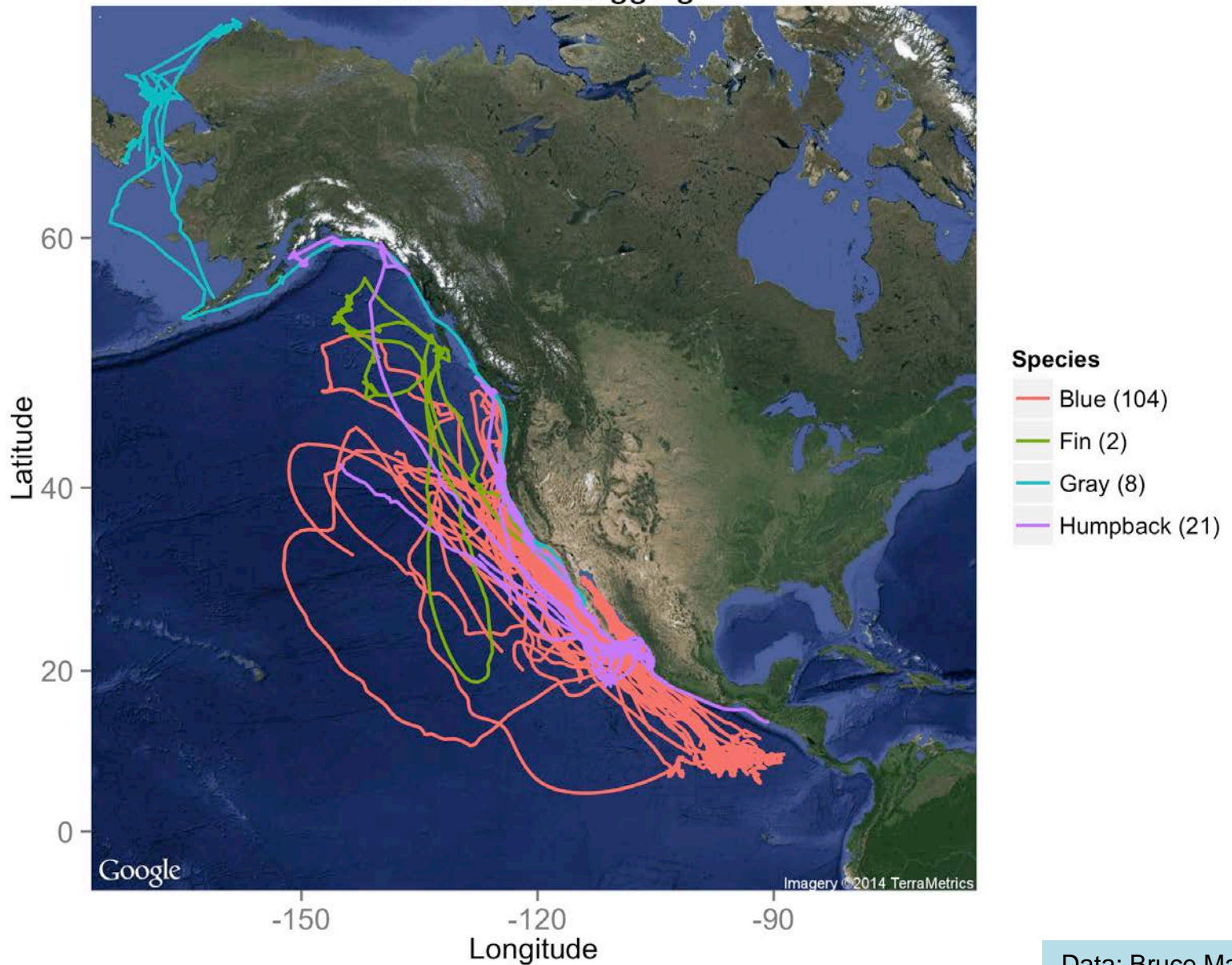


Tag 5650-M: foraging activity



Satellite-tracked whale migrations

OSU Whale Tagging





" I'VE ALWAYS BEEN SO BUSY, I'VE NEVER TAKEN THE TIME TO
STOP AND ACTUALLY SMELL ONE. "