Supplemental Information

Supplemental Tables

Table S1. Estimated state-dependent distribution parameters from the four-state Hidden Markov Model (HMM) applied to 5-minute subsampled GPS tracks of commercial Dungeness crab vessels. Step length distributions are characterized by mean (m), standard deviation (SD), and zero-mass probability. Turning angle distributions were modeled using von Mises distributions and are summarized by mean direction (radians) and concentration parameter (κ), where larger κ values indicate more directed movement. Behavioral states were classified as stationary (State 1), maneuvering (State 2), crabbing (State 3), and traveling (State 4).

Step length distribution parameters

Behavioral State	Mean (m)	SD (m)	Zero-mass
State 1 (Stationary)	45.63	48.19	0.0023
State 2 (Maneuvering)	524.90	374.05	0.0001
State 3 (Crabbing)	376.35	133.61	<0.0001
State 4 (Traveling)	896.23	106.02	<0.0001

Turning angle distribution parameters (von Mises)

Behavioral State	Mean Direction (rad)	Concentration (κ)
State 1 (Stationary)	-0.060	0.11
State 2 (Maneuvering)	-0.021	1.10
State 3 (Crabbing)	-0.003	39.19
State 4 (Traveling)	0.000	118.25

Table S2. Full model set for predicting the likelihood of crabbing (crab ~), ranked from lowest ΔAICc to highest, with different relevant combinations of explanatory variables distance from port (d2port), depth, % sand (sand), and month. Number of parameters (K) and log likelihood (LL) also given.

Model	K	ΔAICc	LL
crab ~ coast_block + depth*d2port + I(depth^2)*_d2port_ + _month_*d2port + sand	40	0.00	–14695.44
crab ~ coast_block + depth*d2port + I(depth^2)**d2port* + *month**d2port	39	110.99	–14751.94
crab ~ coast_block + depth + I(depth^2) + month*d2port + sand	38	147.74	–14771.31
crab ~ coast_block + depth + I(depth^2) + month*d2port	37	205.57	–14801.23
crab ~ coast_block + depth + month*d2port + sand	37	286.28	–14841.58
crab ~ coast_block + depth*d2port + I(depth^2)*d2port + sand + month	33	335.80	–14870.35
crab ~ coast_block + depth + month*d2port	36	369.97	–14884.43

Model	**K**	**ΔAICc**	**LL**
crab ~ coast_block + depth + I(depth^2) + d2port + sand + month	31	408.62	–14908.76
crab ~ coast_block + depth*d2port + I(depth^2)*d2port + month	32	451.07	–14928.99
crab ~ coast_block + depth + I(depth^2) + d2port + month	30	483.82	–14947.36
crab ~ coast_block + depth*d2port + month + sand	31	517.61	–14963.26
crab ~ coast_block + depth + d2port + sand + month	30	547.13	–14979.02
crab ~ coast_block + depth*d2port + I(depth^2)*d2port + sand	26	616.61	–15017.76
crab ~ coast_block + depth*d2port + sand + month	30	647.66	–15029.28
crab ~ coast_block + depth + d2port + month	29	651.36	–15032.13
crab ~ coast_block + depth + I(depth^2) + sand + d2port	24	682.58	–15052.75
crab ~ coast_block + depth*d2port + I(depth^2)*d2port	25	704.90	–15062.91
crab ~ coast_block + depth + I(depth^2) + sand + month	30	722.48	–15066.69
crab ~ coast_block + depth + I(depth^2) + d2port	23	737.24	–15081.07
crab ~ coast_block + depth + I(depth^2) + month	29	765.91	–15089.41
crab ~ coast_block + depth*d2port + sand	24	780.83	–15101.87
crab ~ coast_block + depth + d2port + sand	23	807.04	–15115.98
crab ~ coast_block + depth*d2port	23	882.80	–15153.85
crab ~ coast_block + depth + d2port	22	886.87	–15156.89
crab ~ coast_block + depth + sand + month	29	887.45	–15150.18
crab ~ coast_block + depth + month	28	953.22	–15184.06
crab ~ coast_block + depth + I(depth^2) + sand	23	961.67	–15193.29
crab ~ coast_block + depth + I(depth^2)	22	991.26	–15209.09
crab ~ coast_block + depth + sand	22	1112.05	–15269.48
crab ~ coast_block + depth	21	1160.69	–15294.80

Supplemental Figures

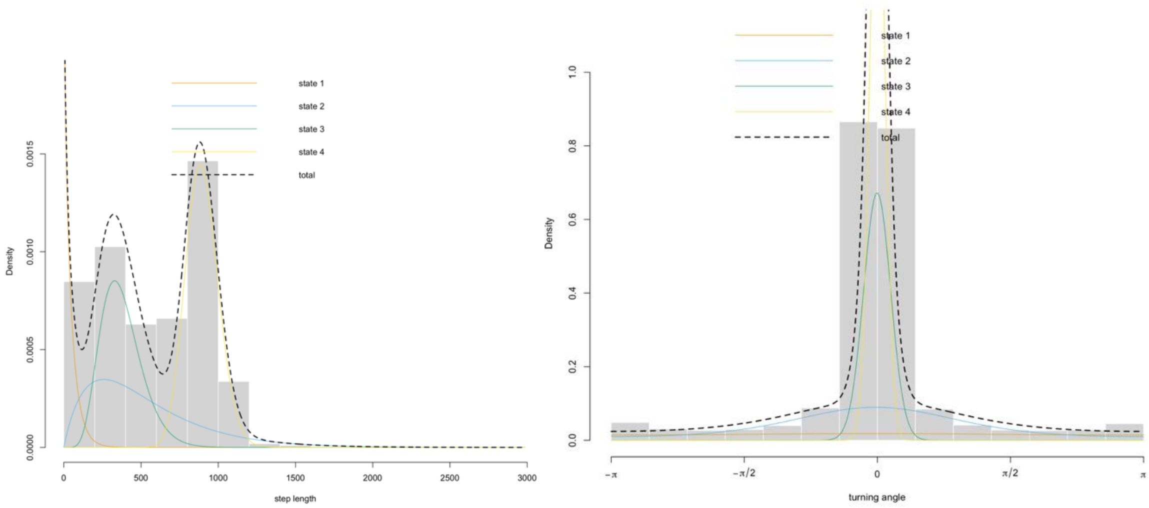

Figure S1. State-dependent step length and turning angle distributions from the four-state Hidden Markov Model (HMM) applied to 5-minute subsampled GPS tracks of commercial Dungeness crab vessels. Step lengths (m) distinguish stationary, maneuvering, crabbing, and traveling behaviors based on differences in movement magnitude, while turning angles (radians) describe directional persistence using von Mises distributions.

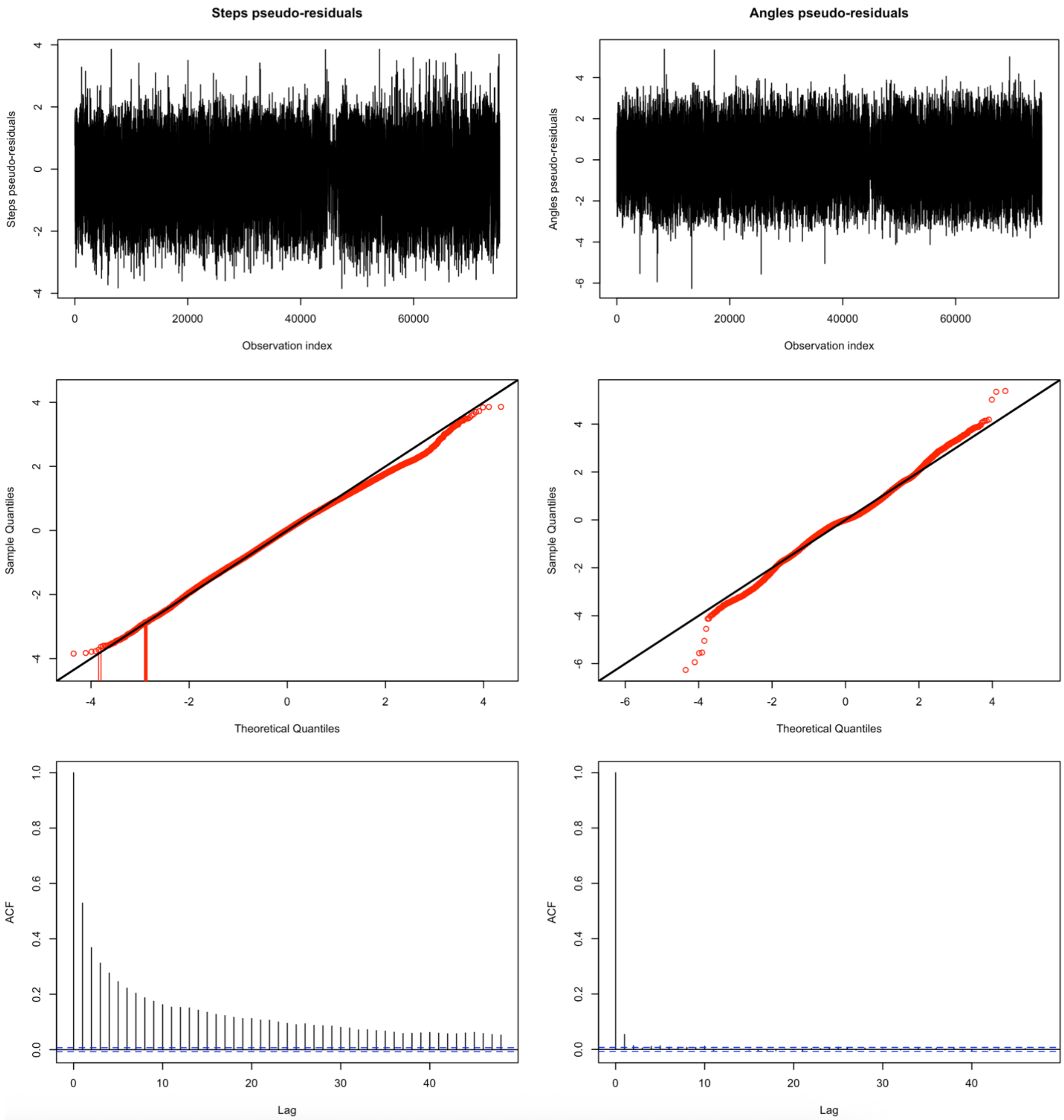

Figure S2. Diagnostic plots evaluating goodness of fit for the four-state Hidden Markov Model (HMM). Pseudo-residual histograms assess agreement between observed and state-dependent distributions. Quantile–quantile (QQ) plots compare pseudo-residuals to the expected normal distribution to evaluate departures from model assumptions. Autocorrelation function (ACF) plots of pseudo-residuals examine remaining temporal dependence at successive lags.

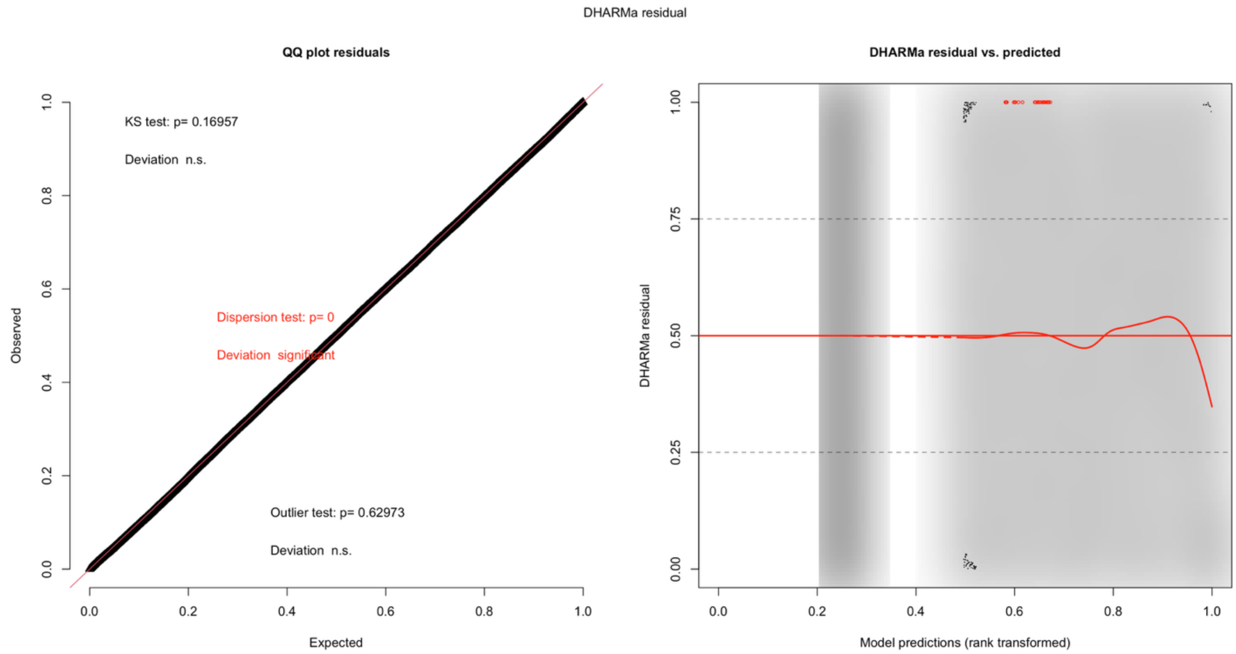

Figure S3. Diagnostic plots for the top-ranked generalized linear model (GLM; binomial family with logit link) predicting crabbing probability. Quantile–quantile (QQ) plots of simulated residuals assess deviations from the expected distribution under the fitted model. DHARMa residual diagnostics evaluate overall model fit, dispersion, and potential structure in residuals relative to fitted values.