Tensile stiffness

Cuticle tensile stiffness was measured as the slope of the tangent line between 10-50% of the stress-strain curve (Fig. S1). This resulted in significantly greater stiffness under relatively low loading conditions for *G. lateralis*. If the steepest regions of the curves are considered, the adjusted cuticle stiffness of *C. sapidus* increases to 184 ± 161 MPa, but is still significantly less than that of *G. lateralis*, 2737 ± 692 MPa (Mann-Whitney, U = 0.0, N = 7, P < 0.001).

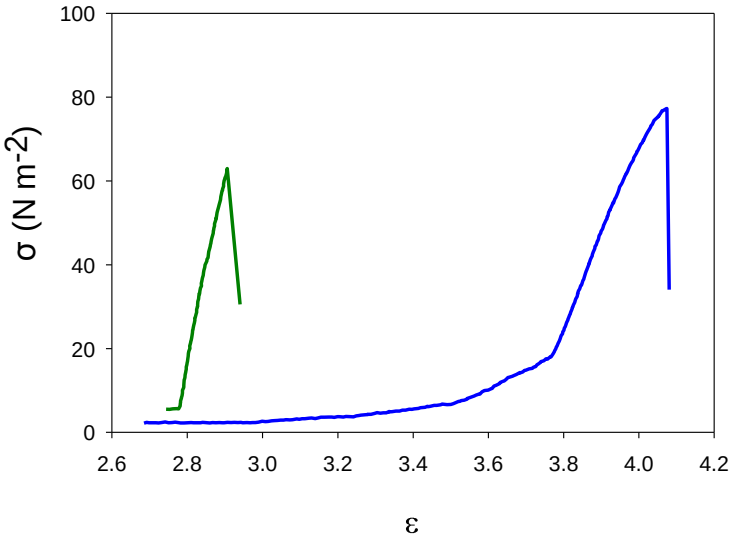

Figure S1. Sample stress-strain curves for *C. sapidus* (blue) and *G. lateralis* (green).

Buckling behavior

The meropodites of *C. sapidus* tended to fail by longitudinal buckling along the anterior surface (Fig. S2).

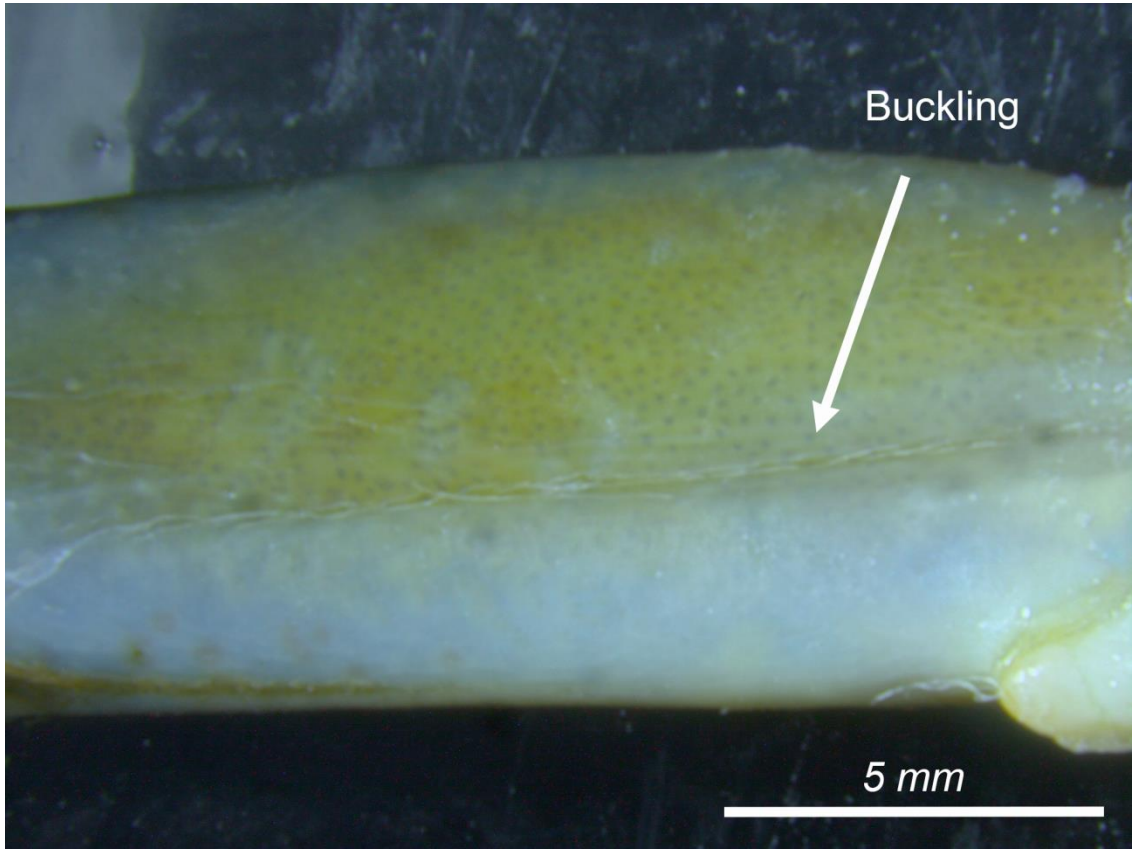

Figure S2. Buckling of *C. sapidus* merus. Local buckling occurred in a longitudinal direction along the anterior surface of the merus. The coxal-basal joint, out of view, is on the right side of the image.

Table S1. Summary of RMA and OLS regression values for rigid crabs using the complete data set for *C. sapidus*. Regression slopes, intercepts, and confidence intervals were calculated for RMA. R^2, intercepts, and P values were calculated for OLS. b_0 is the predicted scaling exponent for isometry. *b* is the RMA or OLS scaling exponent. Values in bold reflect significant differences. * is significant difference from the truncated data set, † is significant difference from predicted isometry, ‡ is significant difference between species.

				RMA				OLS			
Species	**N**	**Variable**	$b_{(0)}$	***b***	**95% CI**	**Intercept**	**95% CI**	***b***	**R^2**	**Intercept**	**P value**
C. sapidus	24	Carapace width	0.33	**0.347†**	0.342, 0.351	1.296	1.289, 1.303	0.348	0.999	1.296	**0.01**
	24	Merus length	0.33	0.332	0.319, 0.346	0.710	0.690, 0.730	0.331	0.992	0.713	**0.01**
	24	Merus height	0.33	**0.306†**	0.294, 0.319	0.308	0.289, 0.326	0.305	0.991	0.31	**0.01**
	24	Merus width	0.33	0.298	0.291, 0.341	-0.015	-0.039, 0.008	0.296	0.986	-0.012	**0.01**
	24	Merus L/D_{height}	0	**0.040*†‡**	0.028, 0.055	**0.381***	0.358, 0.398	0.026	0.416	0.403	**0.01**
	24	Merus L/D_{width}	0	**0.049†‡**	0.036, 0.067	**0.703***	0.676, 0.722	0.035	0.499	0.724	**0.01**
	24	Cuticle $thickness_{height}$	0.33	0.559	0.295, 0.560	-1.661	-1.789, -1.550	0.529	0.896	-1.616	**0.01**
	24	Cuticle $thickness_{width}$	0.33	0.308	0.243, 0.391	-1.277	-1.401, -1.179	0.258	0.704	-1.203	**0.01**
	24	T/D	0	**0.290†**	0.220, 0.382	-2.026	-2.165, -1.920	0.224	0.597	-1.927	**0.01**
	24	I	1.33	**1.276‡**	1.181, 1.379	**-1.356‡**	-1.511, -1.212	1.256	0.969	-1.326	**0.01**
	7	E	0.33	**3.171†**	1.233, 8.152	-4.767	-14.69, -0.906	0.999	0.099	-0.440	0.32
	7	EI	1.33	3.104	1.190, 8.093	**0.079‡**	-10.840, 4.267	0.786	0.064	5.150	0.21
	7	σ_{cr}	0.66	**-0.784†‡**	-2.034, -0.302	**3.982‡**	3.022, 6.473	-0.217	0.077	2.852	0.25
G. lateralis	15	Carapace width	0.33	0.310	0.255, 0.377	**1.189‡**	1.082, 1.278	0.293	0.893	1.217	**0.01**
	15	Merus length	0.33	0.346	0.225, 0.531	0.768	0.609, 1.171	0.232	0.452	0.950	**0.01**
	15	Merus height	0.33	0.253	0.154, 0.414	0.454	0.194, 0.612	0.13	0.266	0.651	**0.04**
	15	Merus width	0.33	0.282	0.189, 0.420	0.129	-0.094, 0.278	0.205	0.532	0.251	**0.01**
	15	Merus L/D_{height}	0	**0.182†‡**	0.113, 0.293	**0.171‡**	-0.008, 0.282	0.102	0.315	0.171	**0.04**
	15	Merus L/D_{width}	0	**0.170†‡**	0.097, 0.298	**0.468‡**	0.262, 0.586	0.027	0.025	0.699	0.31
	15	Cuticle $thickness_{height}$	0.33	0.415	0.245, 0.702	**-1.083‡**	-1.544, -0.810	0.165	0.158	-0.681	0.15
	15	Cuticle $thickness_{width}$	0.33	**0.557†**	0.340, 0.912	**-1.460‡**	-2.032, -1.110	0.286	0.263	-1.023	0.07
	15	T/D	0	**0.593†**	0.340, 1.032	-2.230	-2.936, -1.823	0.134	0.051	-1.491	0.24
	15	I	1.33	**0.770†‡**	0.511, 1.159	**-0.071‡**	-0.698, 0.345	0.548	0.506	0.286	**0.01**
	7	E	0.33	**-0.701†‡**	-1.794, -0.274	**4.663**	3.963, 6.457	-0.231	0.109	3.893	0.32
	8	EI`	1.33	1.630	0.727, 3.660	**3.810‡**	0.489, 5.290	0.711	0.190	5.316	0.19
	7	σ_{cr}	0.66	**1.821†‡**	0.686, 4.836	**-0.758‡**	-5.704, 1.104	0.239	0.017	1.838	0.47