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Spatial distribution and life history traits of two sympatric, cryptic species of sole in the Adriatic Sea basin

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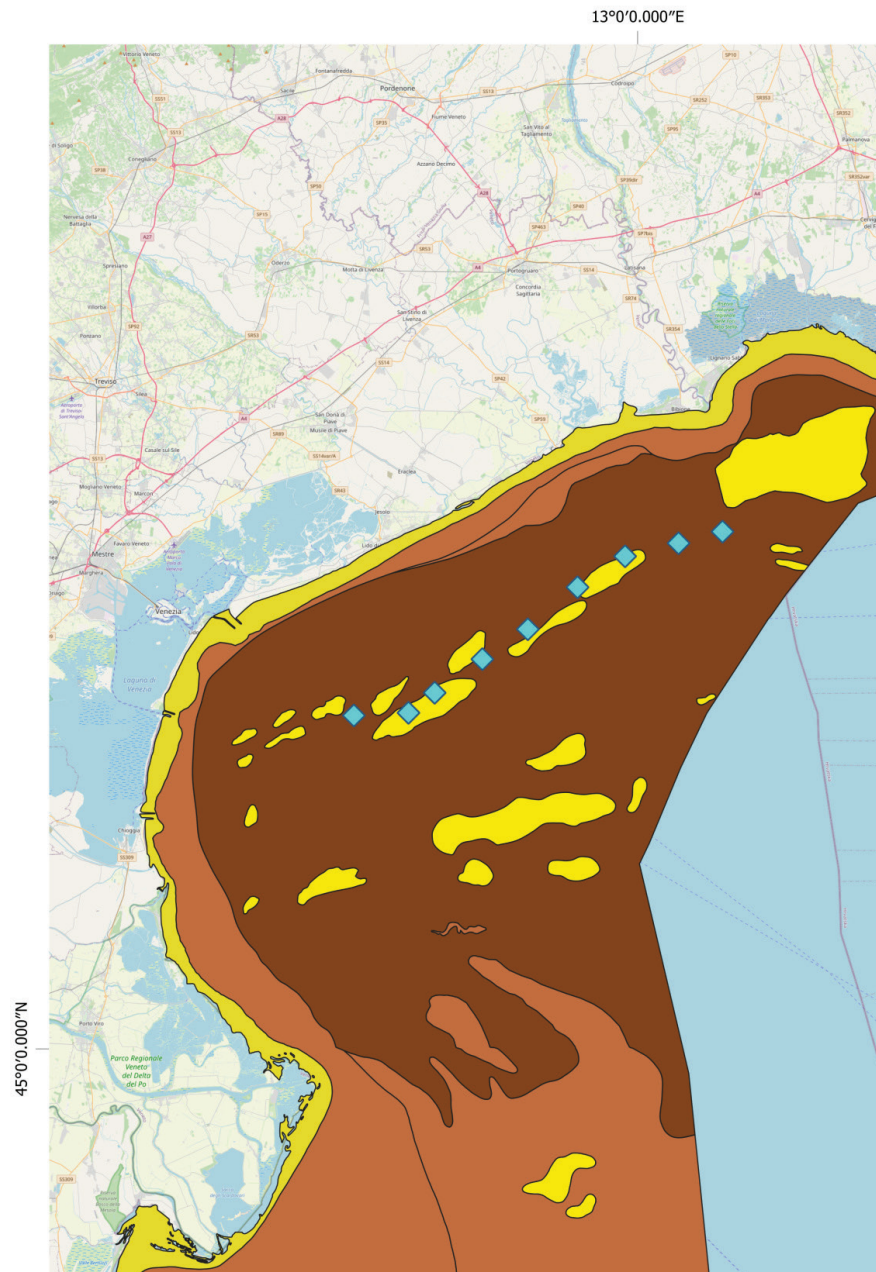


Fig. S1: Spatial distribution of medium sand sediments indicated by fishermen (light blue diamond) superimposed on the map of sediments (layer modified from CARG (Cartografia geologica e geomatica). Carte geologiche dei mari italiani (foglio NL-33-7 Venezia). Produced by CNR ISMAR and digitalized by ISPRA). Background layer from OpenStreetMap (openstreetmap.org/ copyright).

Table S1. *Solea aegyptiaca* and *Solea solea* indices of abundance (N km⁻²) and biomass (kg km⁻²) by depth strata (0-30 m, 30-50 m, 50-120 m) recorded within SoleMon trawl-surveys (2011-2022), S.D. = standard deviation.

Survey	Stratum (m)	<i>Solea aegyptiaca</i>		<i>Solea solea</i>		% N index SA/Tot	% B index SA/Tot
		N km ⁻² ± S.D.	kg km ⁻² ± S.D.	N km ⁻² ± S.D.	kg km ⁻² ± S.D.		
2011	0-30	14.18 ± 8.98	1.53 ± 1.38	1254.25 ± 320.26	87.08 ± 16.32	1.12	1.73
	30-50	0	0	128.78 ± 31.47	20.92 ± 6.25	0	0
	50-120	0	0	9.86 ± 10.13	1.8 ± 2.22	0	0
2012	0-30	12.74 ± 8.32	0.61 ± 0.4	1366.72 ± 270.56	114.99 ± 17.79	0.92	0.53
	30-50	0	0	275.86 ± 58.72	42.57 ± 9.51	0	0
	50-120	0	0	33.3 ± 12.73	7.33 ± 2.69	0	0
2013	0-30	9.86 ± 5.1	0.66 ± 0.34	2252.23 ± 427.13	127.94 ± 19.33	0.44	0.51
	30-50	0	0	362.75 ± 79.25	52.61 ± 12.37	0	0
	50-120	0	0	63.36 ± 36.11	9.85 ± 7.34	0	0
2014	0-30	14.71 ± 11.1	1.15 ± 0.85	2351.41 ± 672.76	206.1 ± 40.01	0.62	0.55
	30-50	0	0	614.21 ± 153.35	81.67 ± 19.52	0	0
	50-120	0	0	138.45 ± 85.49	20.7 ± 10.63	0	0
2015	0-30	14.18 ± 7.82	0.89 ± 0.42	1611.46 ± 455.34	117.06 ± 24.01	0.87	0.76
	30-50	1.81 ± 1.76	0.18 ± 0.18	455.11 ± 95.43	68.91 ± 15.05	0.4	0.27
	50-120	0	0	158.52 ± 72.15	29.14 ± 12.09	0	0
2016	0-30	3.75 ± 2.14	0.47 ± 0.33	1692.86 ± 235.09	160.74 ± 17.51	0.22	0.29
	30-50	0	0	463.59 ± 72.29	63 ± 9.39	0	0
	50-120	0	0	112.95 ± 52.62	18.53 ± 7.68	0	0
2017	0-30	2.3 ± 1.7	0.27 ± 0.28	1319.57 ± 245.28	112.95 ± 15.78	0.17	0.24
	30-50	0	0	407.49 ± 96.92	54.6 ± 12.23	0	0
	50-120	0	0	148.92 ± 60.46	29.61 ± 10.47	0	0
2018	0-30	10.26 ± 6.57	0.65 ± 0.35	2172.08 ± 416.34	194.7 ± 31.23	0.47	0.33
	30-50	0	0	579.09 ± 110.54	81.14 ± 15.03	0	0
	50-120	0	0	114.57 ± 53.78	20.93 ± 10.45	0	0
2019	0-30	7.58 ± 5.82	0.42 ± 0.28	1835.52 ± 537.78	136.88 ± 24.9	0.41	0.31
	30-50	0	0	571.54 ± 128.22	81.76 ± 19.48	0	0
	50-120	0	0	194.52 ± 84.38	37.93 ± 16.1	0	0
2020	0-30	32.04 ± 18.81	2.5 ± 1.33	2158.12 ± 462.55	148.3 ± 25.89	1.46	1.66
	30-50	0	0	778.55 ± 194.54	90.5 ± 22.39	0	0
	50-120	0	0	60.77 ± 33.42	12.19 ± 6.39	0	0
2021	0-30	17.85 ± 7.32	2.42 ± 1.09	2109.39 ± 460.4	181.61 ± 35	0.84	1.31
	30-50	0	0	549.28 ± 98.92	71.59 ± 12.74	0	0
	50-120	0	0	120.7 ± 52	21.28 ± 8.51	0	0
2022	0-30	11.56 ± 11.12	1.06 ± 0.93	2123.12 ± 266.16	203.88 ± 21.24	0.54	0.52
	30-50	0	0	594.52 ± 221.07	79.04 ± 21.57	0	0
	50-120	0	0	234.53 ± 98.69	38.85 ± 14.59	0	0

Table S2. Total catches (kg) of both sole species and percentage of Egyptian soles in some daily commercial fishing landings monitored during the study (GNS = gillnetters; OTB = otter trawlers; TBB = *rapido* trawlers; SA= *S. aegyptiaca*; SS = *S. solea*).

Gear	SA catches (kg)	SS catches (kg)	Total landings (kg)	% SA/Tot
GNS	2.400	6.924	9.324	25.7
GNS	0.455	9.880	10.335	4.4
GNS	2.182	14.400	16.582	13.2
GNS	0.253	12.849	13.102	1.9
GNS	3.000	22.000	25.000	12.0
GNS	3.600	35.000	38.600	9.3
GNS	1.012	48.988	50.000	2.0
GNS	1.121	28.879	30.000	3.7
GNS	9.568	70.432	80.000	12.0
GNS	8.681	16.319	25.000	34.7
GNS	4.681	9.319	14.000	33.4
GNS	6.653	18.705	25.358	26.2
GNS	3.700	10.200	13.900	26.6
GNS	1.500	7.000	8.500	17.6
OTB	4.040	4.950	8.990	44.9
OTB	11.000	9.909	20.909	52.6
OTB	18.880	3.264	22.144	85.3
OTB	16.000	4.000	20.000	80.0
OTB	0.255	10.955	11.210	2.3
OTB	11.046	5.872	16.918	65.3
OTB	0.646	20.916	21.562	3.0
OTB	15.500	21.590	37.090	41.8
OTB	1.340	10.560	11.900	11.3
OTB	8.674	21.826	30.500	28.4
OTB	7.625	2.375	10.000	76.3
OTB	16.131	7.869	24.000	67.2
OTB	6.403	13.097	19.500	32.8
OTB	26.138	9.694	35.832	72.9
TBB	0.190	221.000	221.190	0.1
TBB	0.140	81.100	81.240	0.2
TBB	0.083	95.583	95.666	0.1
TBB	0.630	114.870	115.500	0.5

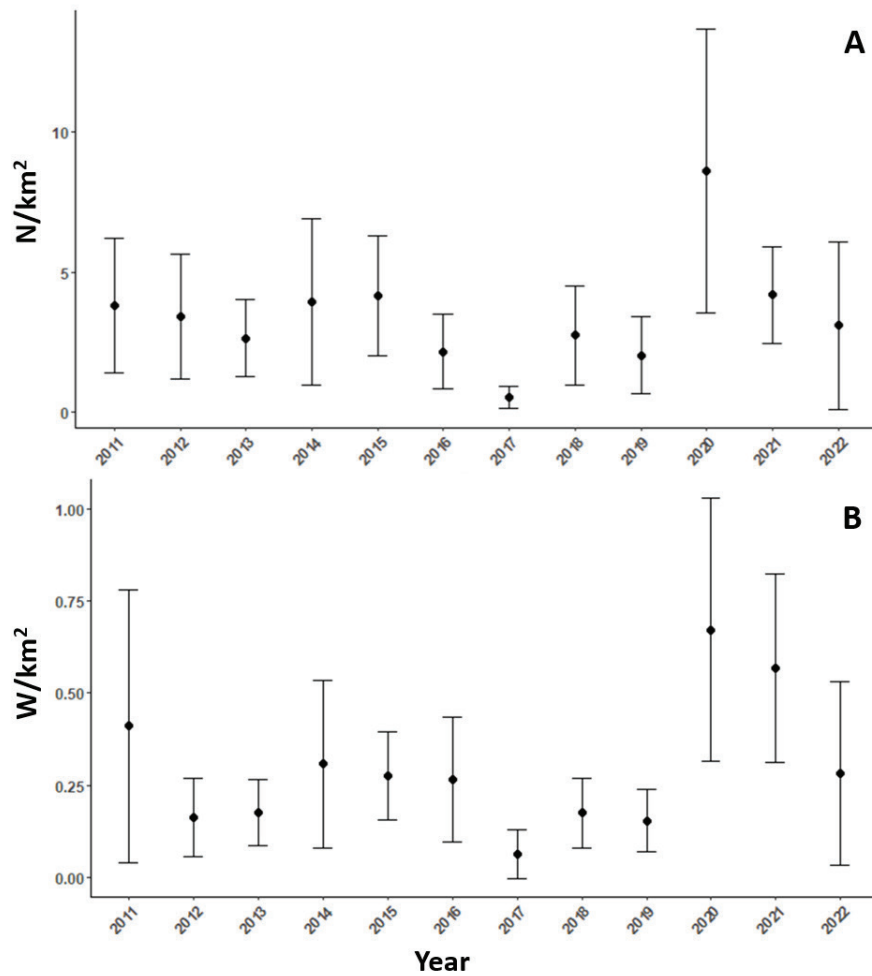


Fig. S2: Egyptian sole A) abundance index (N km⁻²) and B) biomass index (kg km⁻²) from SoleMon surveys 2011-2022.

Table S3. Mean coefficient of variation (CV) and index of average percentage error (APE) as measures of age reading precision between the two readers.

	Egyptian sole		Common sole	
	CV	APE	CV	APE
Whole otoliths	5.2%	3.6%	3.3%	2.3%
Sectioned otoliths	1.5%	1.1%	2.1%	1.5%

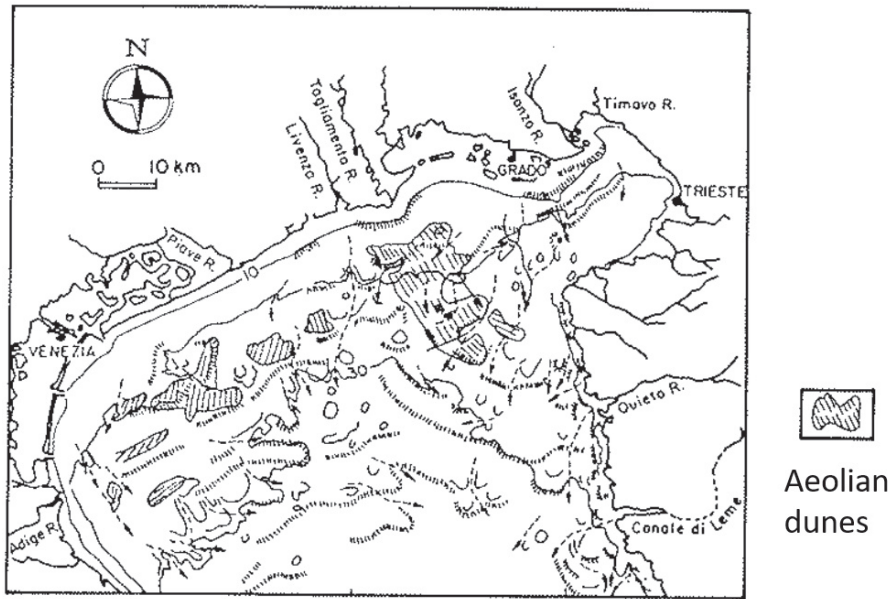


Fig. S3: Reconstruction of the submarine morphology of the northern Adriatic continental shelf (modified from Brambati & Venzo 1967, in Brambati 1992).

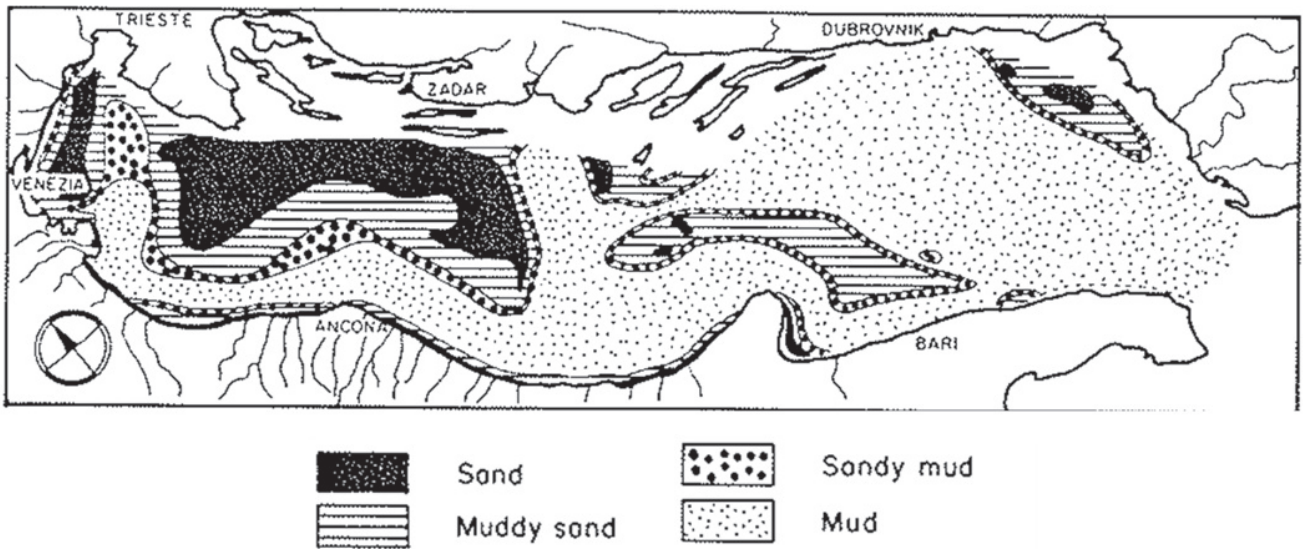


Fig. S4: Sediment distribution across the Adriatic Sea (modified from Pigorini 1968, in Brambati 1992).

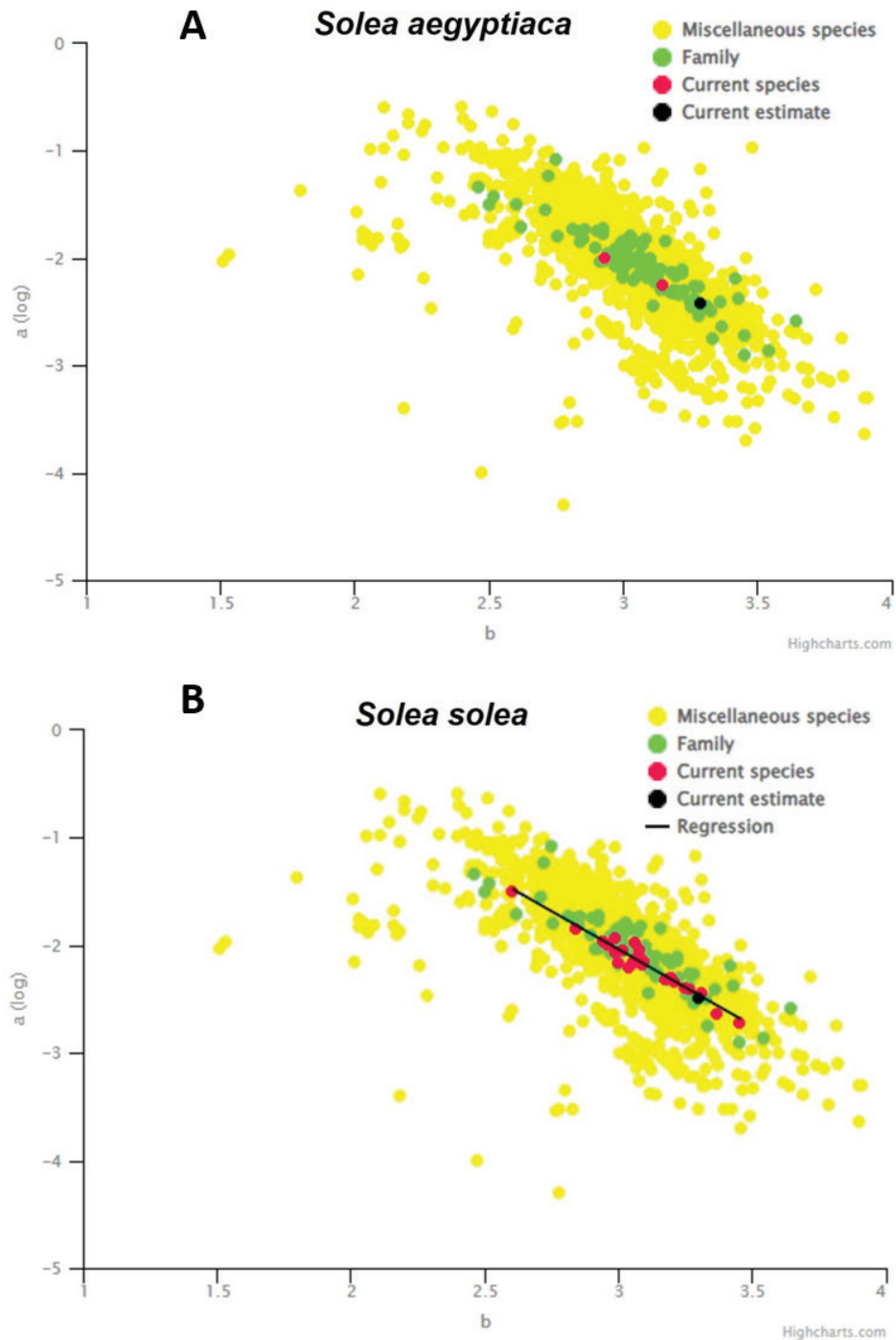


Fig. S5: Scatterplots of log a vs b from available WLRs studies (modified from FishBase <https://fishbase.se>. Accessed on 03 October 2023). Dots represent the samples from this study (black), other estimates of the same species (red - 2 studies for Egyptian sole (A) and 27 studies for the common sole (B)), other soleids (green), and other bony fishes (yellow).

Table S4. Growth parameters (*a* and *b*) of *S. solea* from different localities and sampling years; coefficient of determination (R^2); number of specimens (*n*); total length (TL).

Locality and years	<i>a</i>	<i>b</i>	Sex	TL range (cm)	R^2	<i>n</i>	Reference
North Sea, coast of Germany, 1918	0.0071	3.095	mixed	21-43	0.954	325	Duncker (1923)
North Sea, sub-area IV, 2011	0.0050	3.2	mixed	10-42	0.975	334	Froese & Sampang (2013)
North-eastern Atlantic Ocean, 2013-2015	0.004	3.251	unsexed	9-49	-	945	Mahé <i>et al.</i> (2018)
Nazaré to St André, Portugal, 1997	0.0071	3.092	unsexed	20.5-46	0.908	58	Mendes <i>et al.</i> (2004)
Arade estuary, central Algarve, Portugal, 2004-2007	0.0078	3.08	unsexed	10.5-38.9	0.969	-	Veiga <i>et al.</i> (2009)
North-western Med, French Catalan coast, 2007-2010	0.01	2.96	unsexed	15-45	0.932	406	Crec'hriou <i>et al.</i> (2013)
Northern and Central Adriatic Sea, Italy, 1982	0.0069	3.084	unsexed	15-30	-	-	Piccinetti & Giovanardi (1984)
Northern and Central Adriatic Sea, Italy, 1982-1984	0.0043	3.236	unsexed	11.5-35.5	-	-	Frogliia & Giannetti (1985)
Northern and Central Adriatic Sea, Italy, 1999-2009	0.007	3.057	unsexed	12.2-37.4	0.967	5401	Bolognini <i>et al.</i> (2013)
River Mirna estuary, Croatia, 2000-2004	0.0019	3.453	unsexed	19.8-32.5	0.946	2130	Dulčić & Glamuzina (2006)
Marmara Sea, Turkey, 2011-2014	0.0143	2.838	unsexed	9.1-31.2	0.975	36	Daban <i>et al.</i> (2020)
North Aegean Sea, Saros Bay, Turkey, 2005-2006	0.0038	3.247	unsexed	14.7-39.2	0.973	79	Ismen <i>et al.</i> (2007)
Southern Aegean Sea, Turkey, 2009-2010	0.0023	3.369	unsexed	18.6-33.7	0.920	171	Bilge <i>et al.</i> (2014)
Eastern Mediterranean Sea, Iskenderun Bay, Turkey, 2000-2001	0.0117	2.988	Male	8.8-25	0.922	550	Türkmen (2003)
Eastern Mediterranean Sea, Iskenderun Bay, Turkey, 2000-2001	0.0091	3.077	Female	10.5-28.2	0.947	533	Türkmen (2003)
Eastern Mediterranean, Egypt, 2008-2010 and 2017-2018	0.0066	3.092	unsexed	11-39	0.910	478	Mehanna & Farouk (2021)

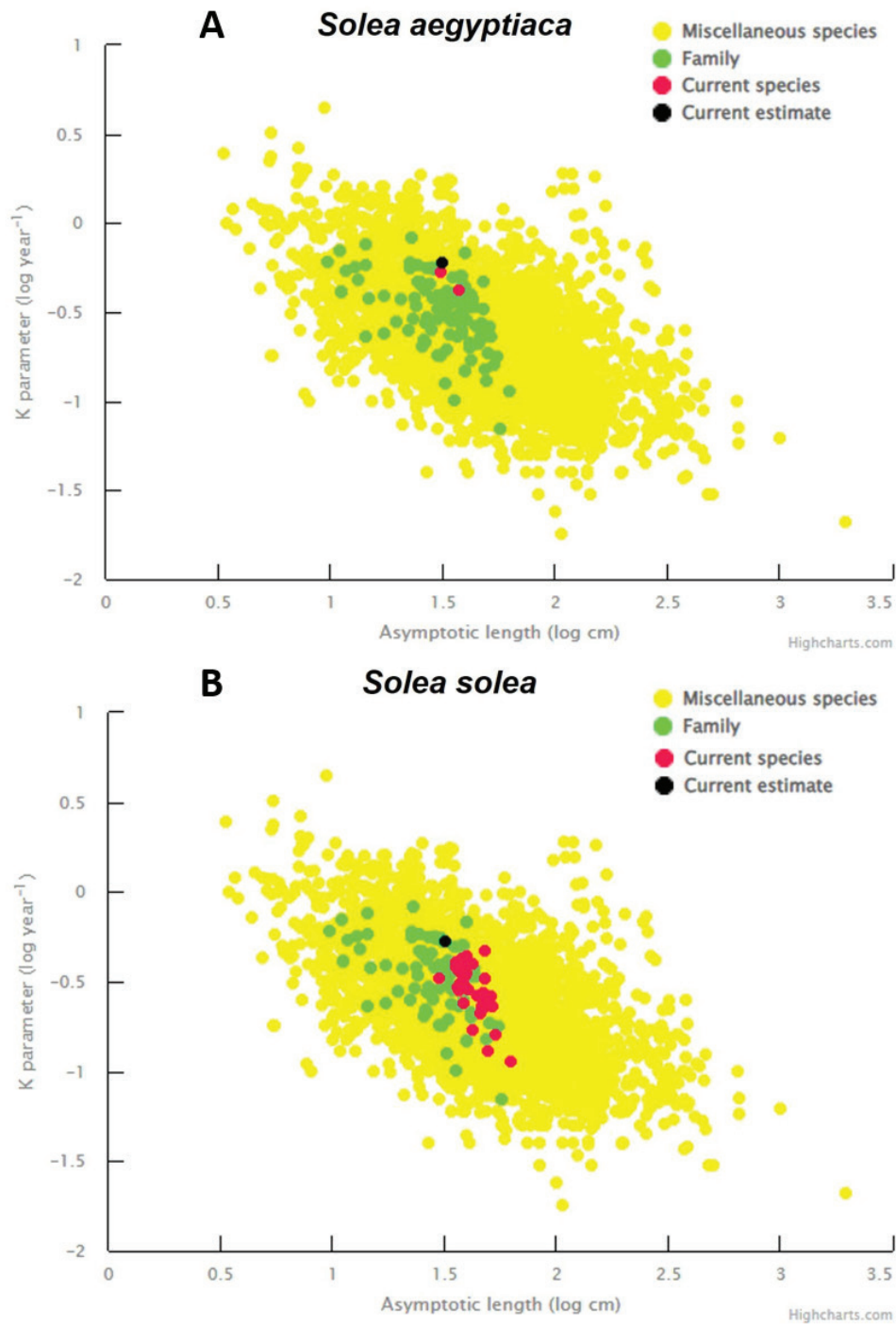


Fig. S6: Scatterplots of k parameter vs asymptotic length from available studies (modified from FishBase <https://fishbase.se>. Accessed on 03 October 2023). Dots refer to the samples from this study (black), other estimates of the same species (red - 2 studies for Egyptian sole (A) and 32 studies for the common sole (B)), other soleids (green), and other bony fishes (yellow).

Table S5. von Bertalanffy growth curve parameters and growth performance index of common and Egyptian sole from different localities and sampling years (modified from FishBase <https://fishbase.se>. Accessed on 03 October 2023); Max age = maximum age estimated (s = sectioned otoliths, w = whole otoliths, na = information not available).

Locality and Years	L_{∞} (cm)	k (1 y ⁻¹)	t_0 (years)	Sex	\emptyset'	Max age	Ref.
Common sole							
North Sea, Denmark	39	0.4	-	unsexed	2.78	>8 (na)	Beverton & Holt (1959)
North Sea, Denmark, 1960-1970	37.4	0.31	-	unsexed	2.64	-	Nielsen (1973)
Celtic Sea, UK, 1975-94	49.8	0.13	-	unsexed	2.51	-	Jennings <i>et al.</i> (1998)
North Sea, UK, 1975-94	51.5	0.262	-	unsexed	2.84	-	Jennings <i>et al.</i> (1998)
Dutch ports, Netherlands, 1972	46.6	0.255	-1.4	F	2.74	15 (s)	De Veen (1976)
Dutch ports, Netherlands, 1972	36.9	0.282	-2.3	M	2.58	14 (s)	De Veen (1976)
Douarnenez Bay, Brittany, France, 1975-1988	48.2	0.329	0.08	F	2.88	26 (s)	Deniel (1990)
Douarnenez Bay, Brittany, France, 1975-1988	42.4	0.397	0.09	M	2.85	24 (s)	Deniel (1990)
Portugal, 2003-2005	52.1	0.23	-0.11	F	2.8	9 (w)	Teixeira & Cabral (2010)
Portugal, 2003-2005	46.7	0.21	-1.57	M	2.64	8 (w)	Teixeira & Cabral (2010)
Tagus estuary, Portugal	48.3	0.47	-	unsexed	3.04	-	Costa (1990)
Castellón coast, Spain	46.4	0.22	-0.75	F	2.68	9 (s)	Ramos (1982)
Castellón coast, Spain	38.8	0.24	-1.09	M	2.56	7 (s)	Ramos (1982)
Gulf of Lion, France	47.2	0.274	-	F	2.79	-	de Elquezabal (1978)
Gulf of Lion, France	53.8	0.16	-	M	2.67	-	de Elquezabal (1978)
Gulf of Lion, France	48.8	0.24	-0.77	mixed	2.76	9 (w)	Vianet (1989)
Central Tyrrhenian Sea, Italy	35.8	0.406	-	mixed	2.72	-	Wurtz & Matricardi (2020)
Northern and Central Adriatic, Italy, 1982	40.1	0.68	-	unsexed	3.04	-	Piccinetti & Giovanardi (1984)
Northern and Central Adriatic, Italy, 1982-1984	38.3	0.492	-3.57	mixed	2.86	5 (w)	Frogliã & Giannetti (1985)
Northern and Central Adriatic, Italy, 2010	39.6	0.44	-0.46	unsexed	2.84	-	Colloca <i>et al.</i> (2013)
Izmir Bay, Aegean Sea, Turkey	42.5	0.17	-1.96	F	2.49	6 (w)	Hossucu <i>et al.</i> (1999)
Izmir Bay, Aegean Sea, Turkey	31.1	0.33	-1.04	M	2.50	6 (w)	Hossucu <i>et al.</i> (1999)
Bardawil Lagoon, Egypt, 1987	30	0.33	-1.51	mixed	2.47	6 (na)	El-Gammal <i>et al.</i> (1994)
Alexandria, Egypt, 2011-2013	36.2	0.63	-0.01	F	2.91	4 (w)	Mehanna <i>et al.</i> (2015)
Alexandria, Egypt, 2011-2013	34.7	0.55	-0.07	M	2.82	4 (w)	Mehanna <i>et al.</i> (2015)
Egyptian sole							
Southeast Mediterranean, Egypt, 2004-2005	30.9	0.53	-0.33	mixed	2.7	4 (w)	Mehanna (2007)
Bardawil Lagoon, Egypt, 2010	37.5	0.42	-0.4	mixed	2.77	3 (w)	Gabr (2015)