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Supplementary Materials for

Empirical observations of the spawning migration of European eels: The long and dangerous road to the Sargasso Sea

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The PDF file includes:

- fig. S8. Principle and validation of behavioral geolocation.
- fig. S9. Analysis of the total number of length-measured European eel leptocephali in the ICES database.
- table S1. Details of reconstructed migrations of eels that reached the ocean.
- table S2. Assessment of effect of tag and release country on speed, migration duration, and migration distance of eels.
- table S3. The speed of European eels.
- table S4a. The fate of eels that reached oceanic waters.
- table S4b. The fate of all released eels for which data sets were recovered.
- table S5. Summary of literature used to assess escapement date.
- table S6. Silver eel escapement timing in the River Gudena, Denmark.
- table S7. Release locations and numbers of eels released during the study.
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- table S8b. Summary metrics of eels for which migratory data were recovered (±1 SD).
- Legend for table S9

Other Supplementary Material for this manuscript includes the following:
(available at advances.sciencemag.org/cgi/content/full/2/10/e1501694/DC1)

- table S9 (Microsoft Excel format). Metrics of all eels tagged (n = 707).

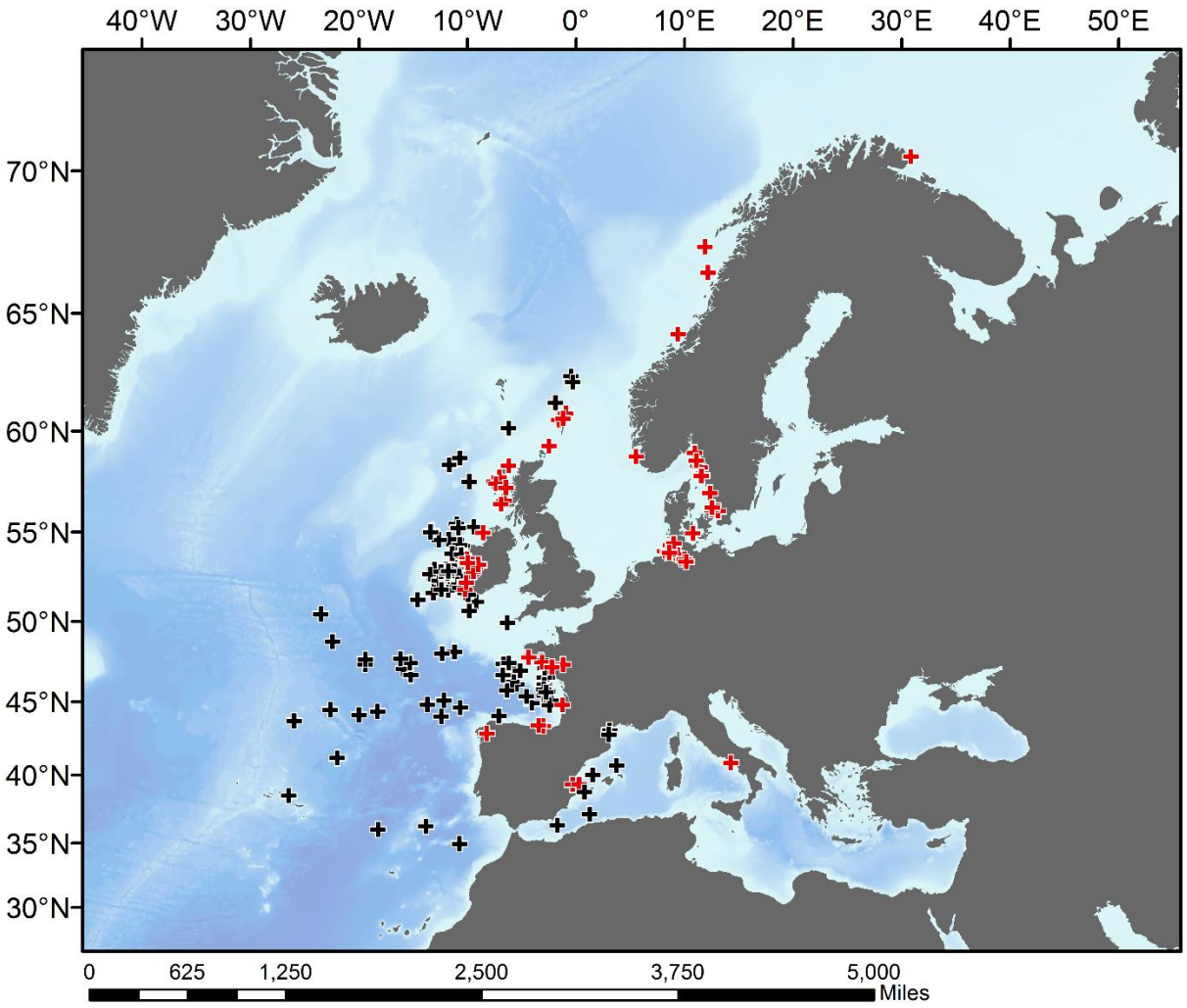

fig. S1. DSTs recovery positions are shown by red crosses, whereas PSAT pop-off positions are shown by black crosses. Pop-off or recovery positions of tags do not always correspond to the terminal positions of eels that carried the tags shown separately in fig. S2 because they are unadjusted for surface drift after premature release or displacement due to predation.

fig. S2a. Migration and end points of eels released from the Baltic Sea. Points joined by lines and ending in black crosses are reconstructions of the migrations of eels that escaped the coastal margins (n=23) before tag pop-up or predation. Coloured crosses not joined by lines to the release location show the reporting positions of tags that released prematurely, or were attached to eels that were eaten by predators (n=13). These data did not provide any information about migratory capability of eels and are only included here for completeness. Note that the pop-up positions of tags attached to eels that suffered early predation (i.e. before the terminal position of the eel could be determined by hydrographic data) were often taken or drifted a considerable distance offshore before the tags reported. See citation (18) for further details.

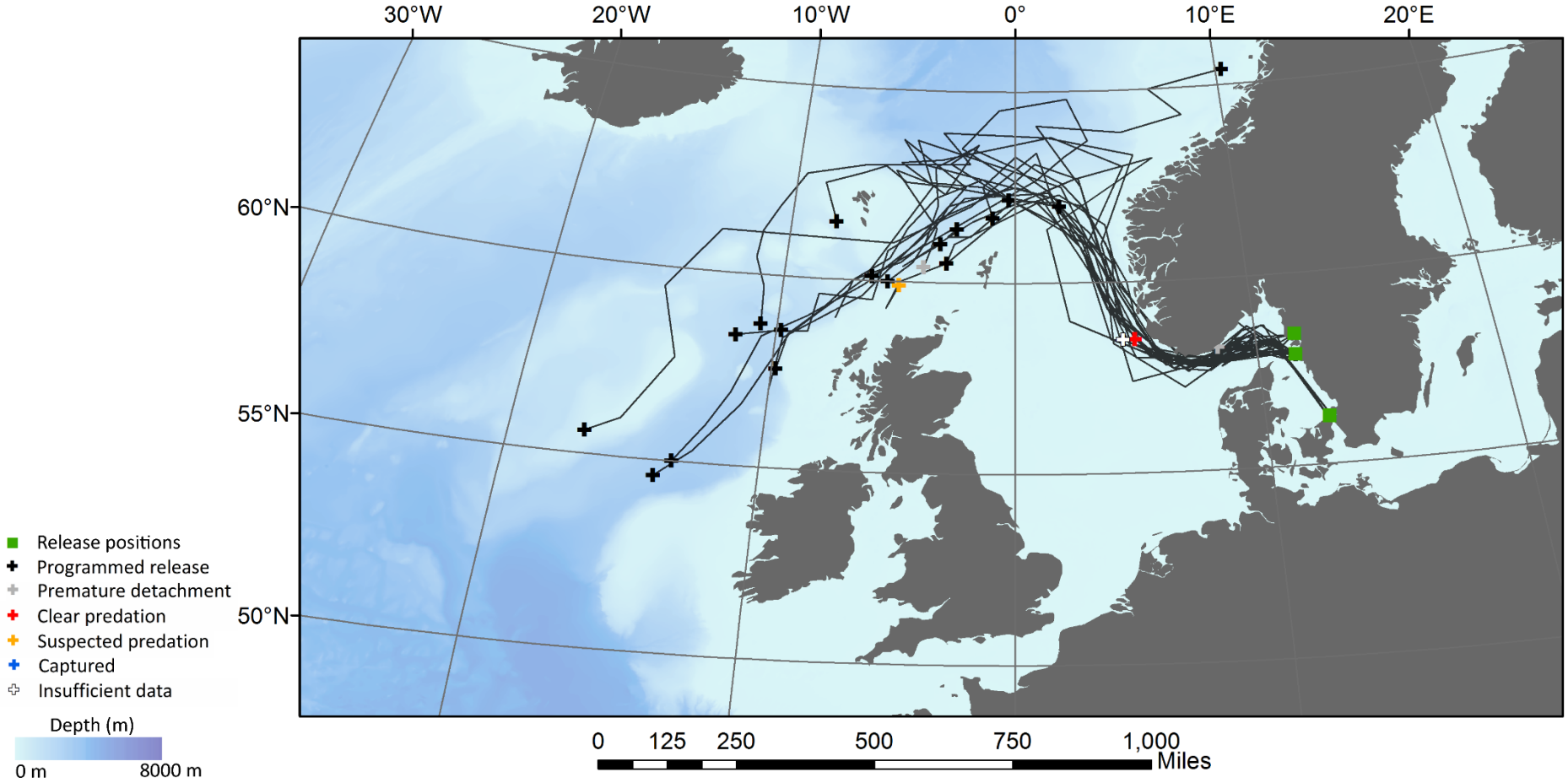

fig. S2b. Migration and end points of eels released from Ireland. Shading of sea areas shows bathymetry. Points joined by lines and ending in black crosses are reconstructions of the migrations of eels that escaped the coastal margins before tag pop-up or predation (n=44). Coloured crosses not joined by lines to the release location show the reporting positions of tags that released prematurely, or were carried by eels that suffered predation (n=80). These data did not provide any information about migratory capability of eels and are only included here for completeness. Note that the pop-up positions of tags attached to eels that suffered early predation (i.e. before the terminal position of the eel could be determined by hydrographic data) were often taken or drifted a considerable distance offshore before the tags reported.

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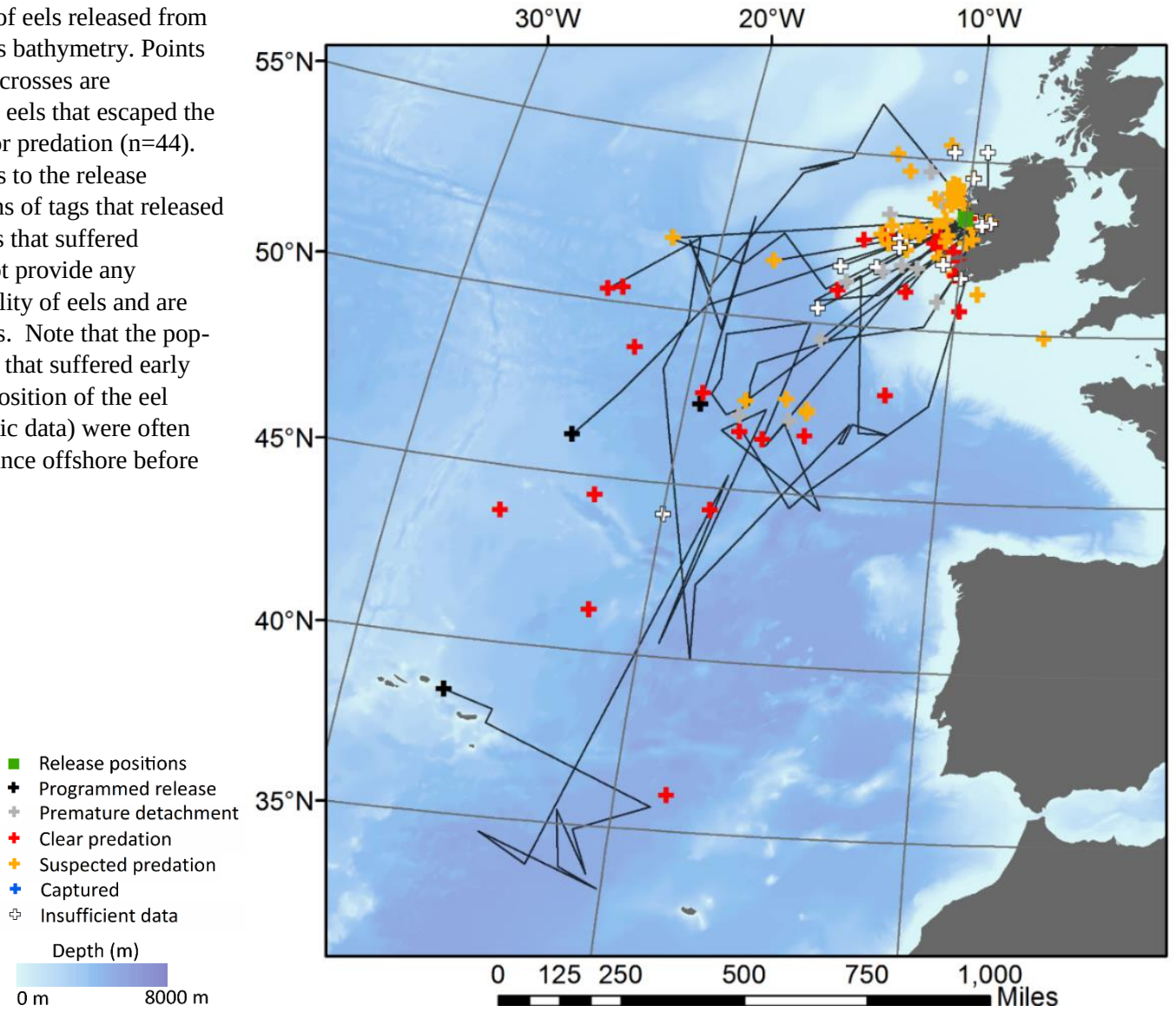


fig. S2c. Migration and end points of eels released from western France. Points joined by lines and ending in black crosses are reconstructions of the migrations of eels that escaped the coastal margins (n=7) before tag pop-up or predation. Coloured crosses not joined by lines to the release location show the reporting positions of tags that released prematurely, or were carried by eels that suffered predation (n=34). These data did not provide any information about migratory capability of eels and are only included here for completeness. Note that the pop-up positions of tags attached to eels that suffered early predation (i.e. before the terminal position of the eel could be determined by hydrographic data) were often taken or drifted a considerable distance offshore before they reported.

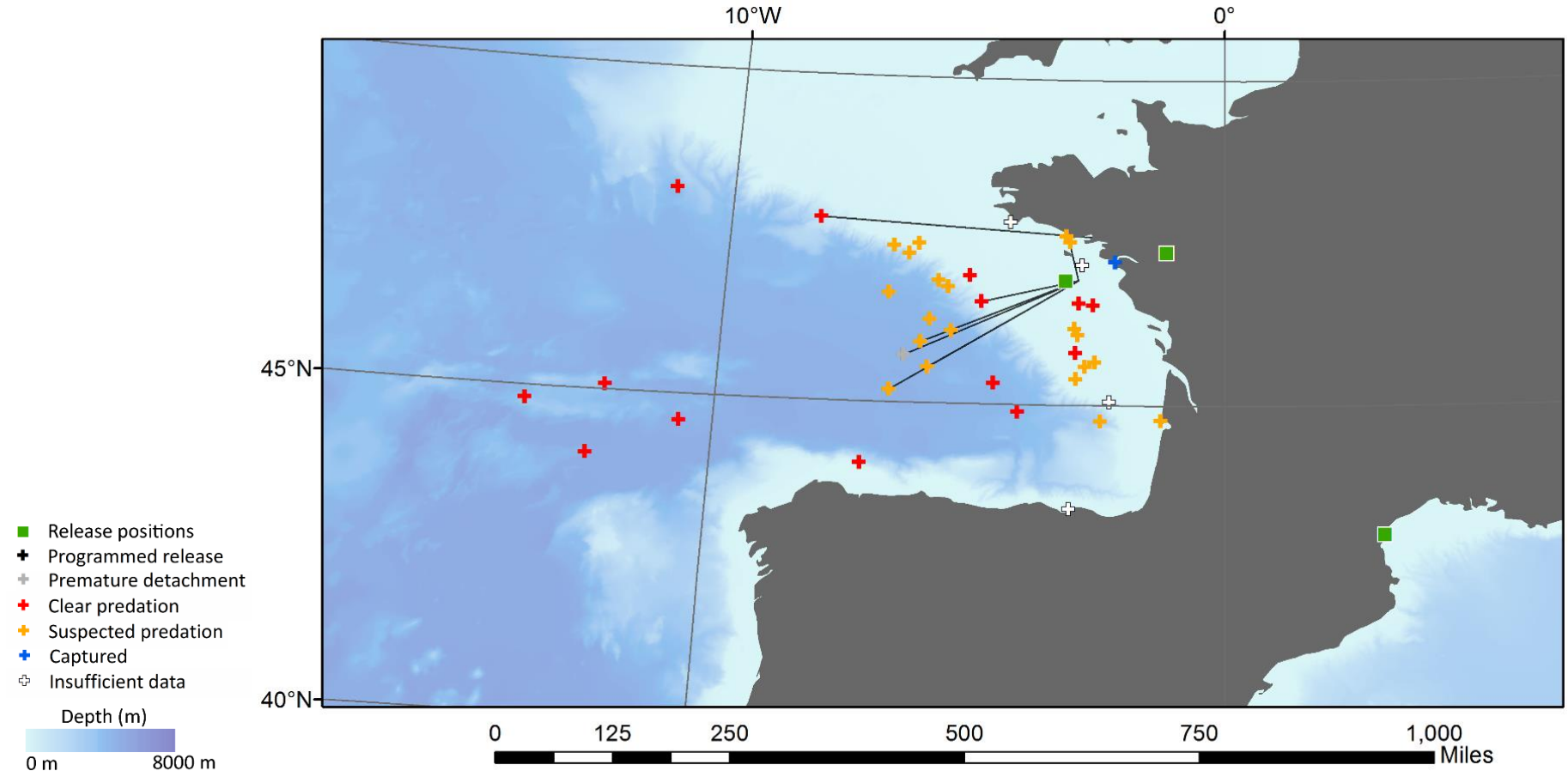


fig. S2d. Migration and end points of eels released from Germany. Points joined by lines and ending in black crosses are reconstructions of the migrations of eels that escaped the coastal margins (n=5) before tag pop-up or predation. Coloured crosses not joined by lines to the release location show the reporting positions of tags that released prematurely, or were carried by eels that suffered predation (n=2). These data did not provide any information about migratory capability of eels and are only included here for completeness. Note that the pop-up positions of tags attached to eels that suffered early predation (i.e. before the terminal position of the eel could be determined by hydrographic data) were often taken a considerable distance offshore before the tags reported.

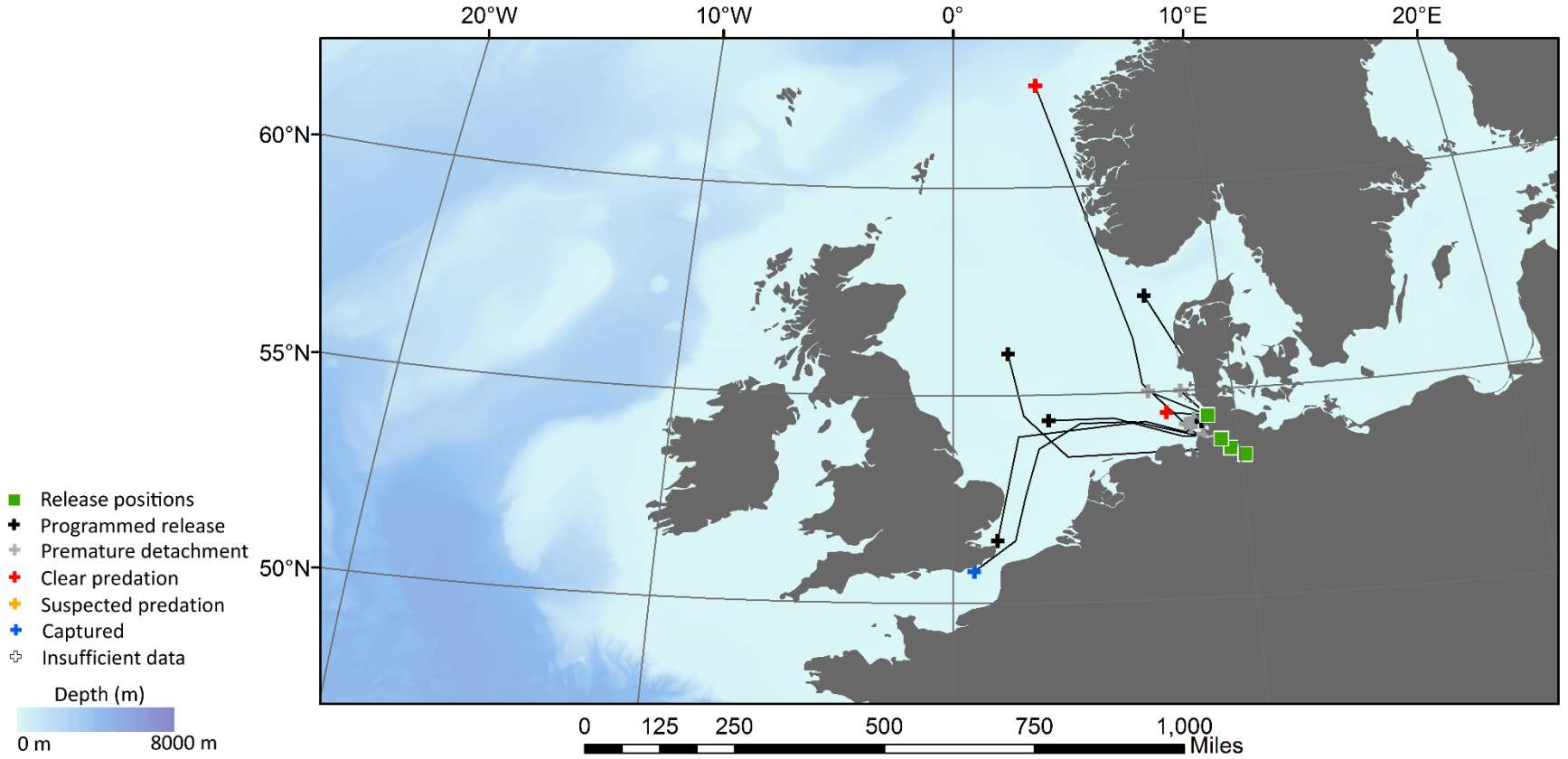
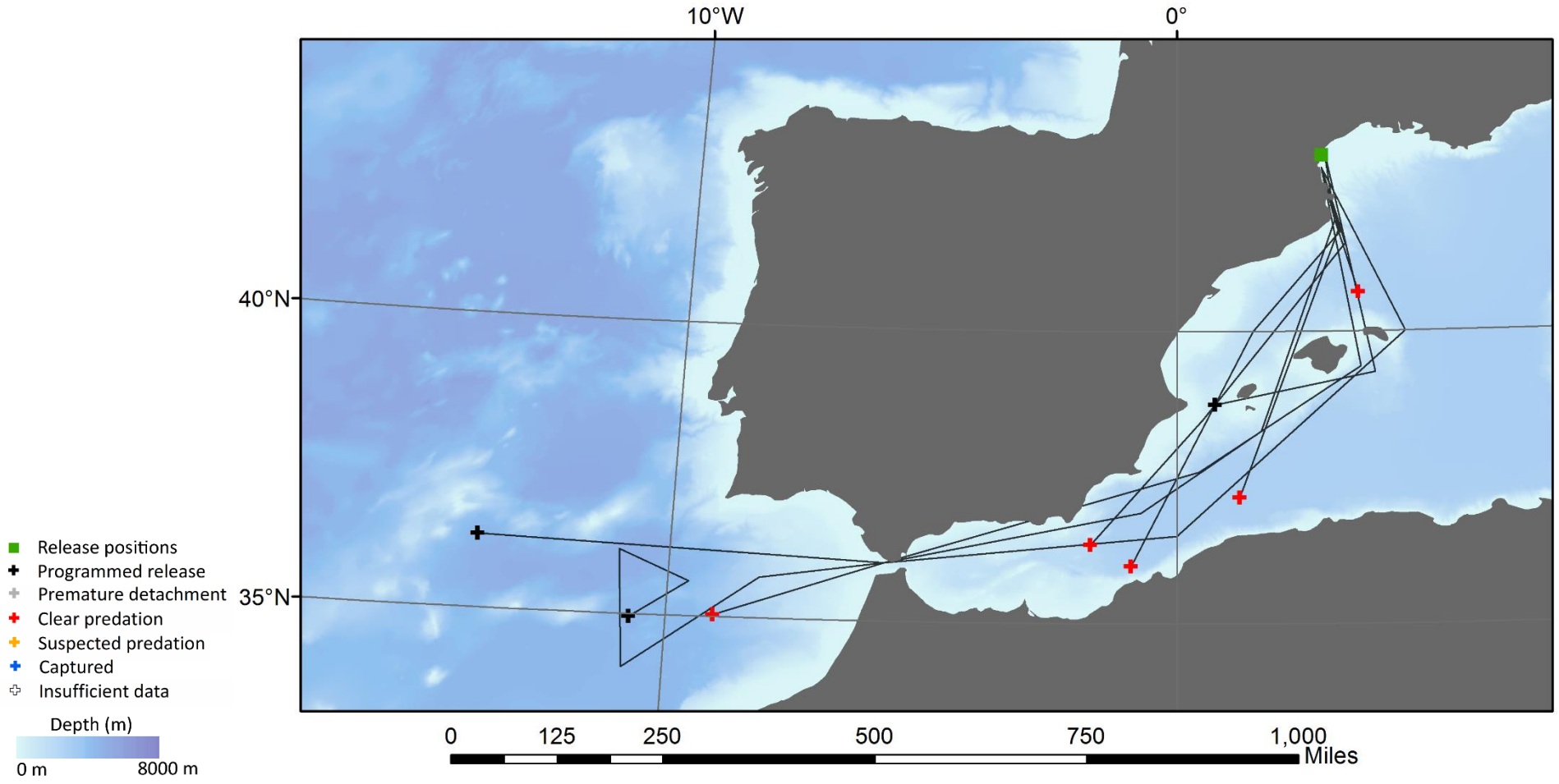


fig. S2e. Migration and end points of eels released from the Mediterranean coast. Points joined by lines and ending in black crosses are reconstructions of the migrations of eels that escaped the coastal margins (n=8) before tag pop-up or predation. See citation (84) for more details.



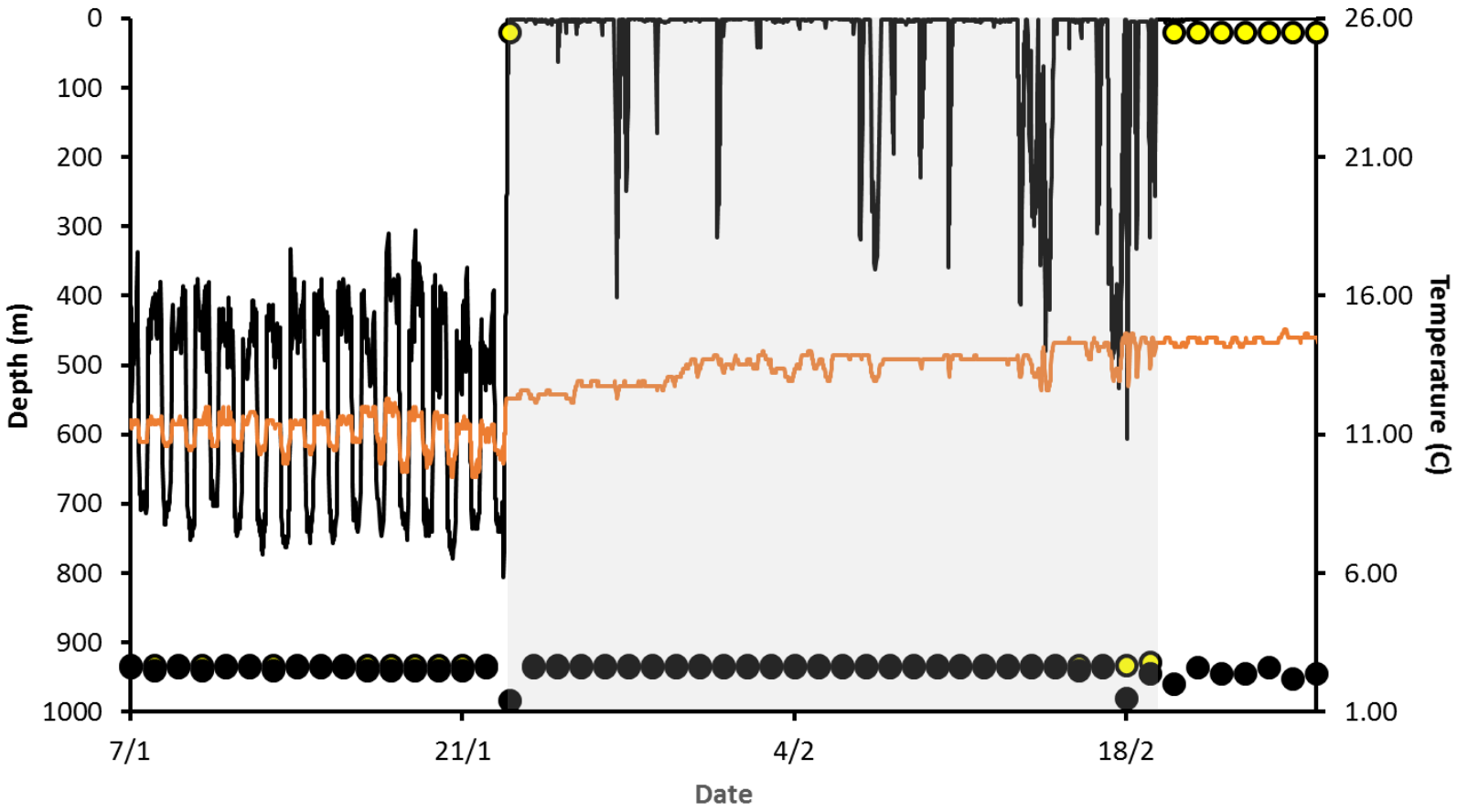


fig. S3a. Example of an eel (PSAT #89310, released from Ireland) being preyed upon by a (assumed) pelagic fish. The eel started a period of normal diurnal migration cycling between 300 m and 700 m when it was eaten and taken to the surface. There, the tag was swallowed with the eel and the depth record shows sporadic surface oriented dive behaviour. Temperature recorded by the tag does not rise above that expected for surface waters. Circular symbols show the daily light data recorded by the tag (values ranged from 1 to 255, and have been proportionally rescaled to fit the temperature axis). Black-filled symbols indicate minimum light values, while yellow indicate maxima.

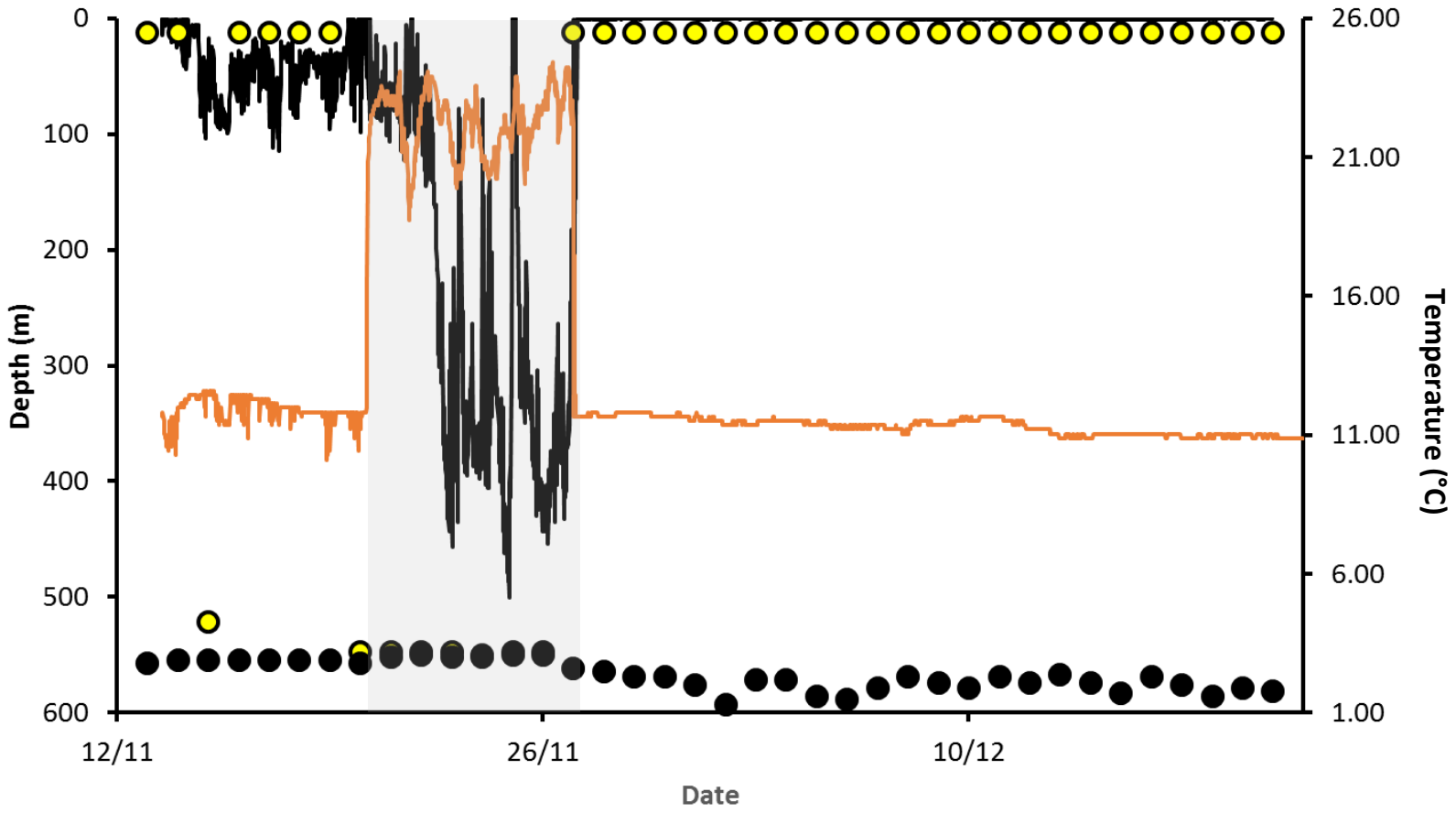


fig. S3b. Example of an eel (PSAT #49644, released from Ireland) being preyed upon by an endothermic fish. The predation event occured away from the surface and the tag subsequently remained most of the time too deep for registration of daylight. However, no light was registered by the tag when at the surface, and the record of temperature is consistent with the stomach temperature of a lamnid shark (elevated by approximately 10°C above ambient). Circular symbols show the daily light data recorded by the tag (values ranged from 1 to 255, and have been proportionally rescaled to fit the temperature axis). Black-filled symbols indicate minimum light values, while yellow indicate maxima.

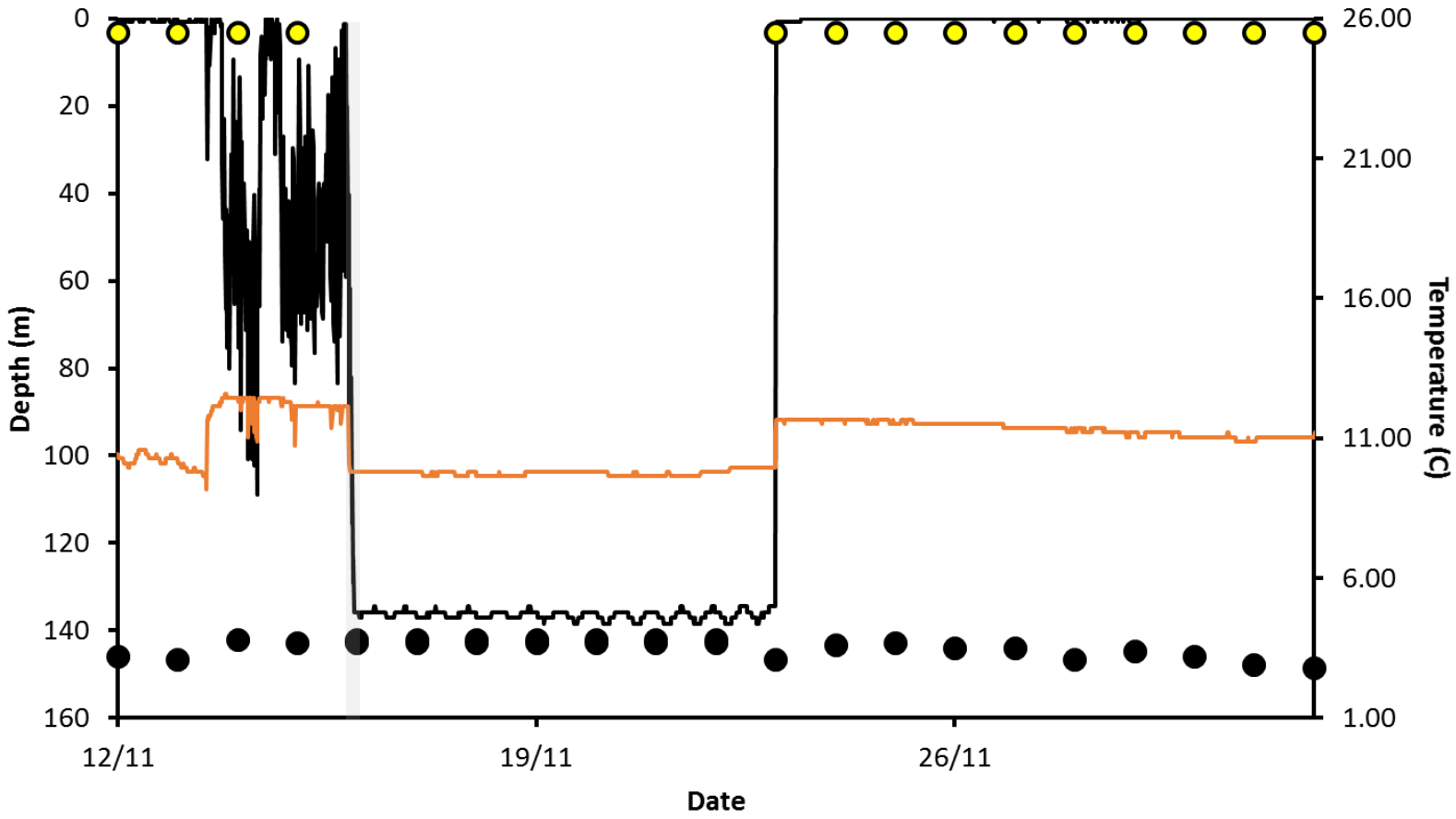


fig. S3c. Example of an eel (PSAT #101445, released from Ireland) being preyed upon by a coastal pelagic predator. The tag pressure sensor recorded a sudden drop to the bottom during normal coastal escape behaviour. This was followed by 10 d at the same depth with a tidal pressure variation, indicating that the tag was resting on the seabed. The tag rose to the surface after the failsafe period (10 d), suggesting that the tag was still attached to the eel when it was resting at the seabed (i..e. the eel was killed and only partially eaten during the predation event). Circular symbols show the daily light data recorded by the tag (values ranged from 1 to 255, and have been proportionally rescaled to fit the temperature axis). Black-filled symbols indicate minimum light values, while yellow indicate maxima.

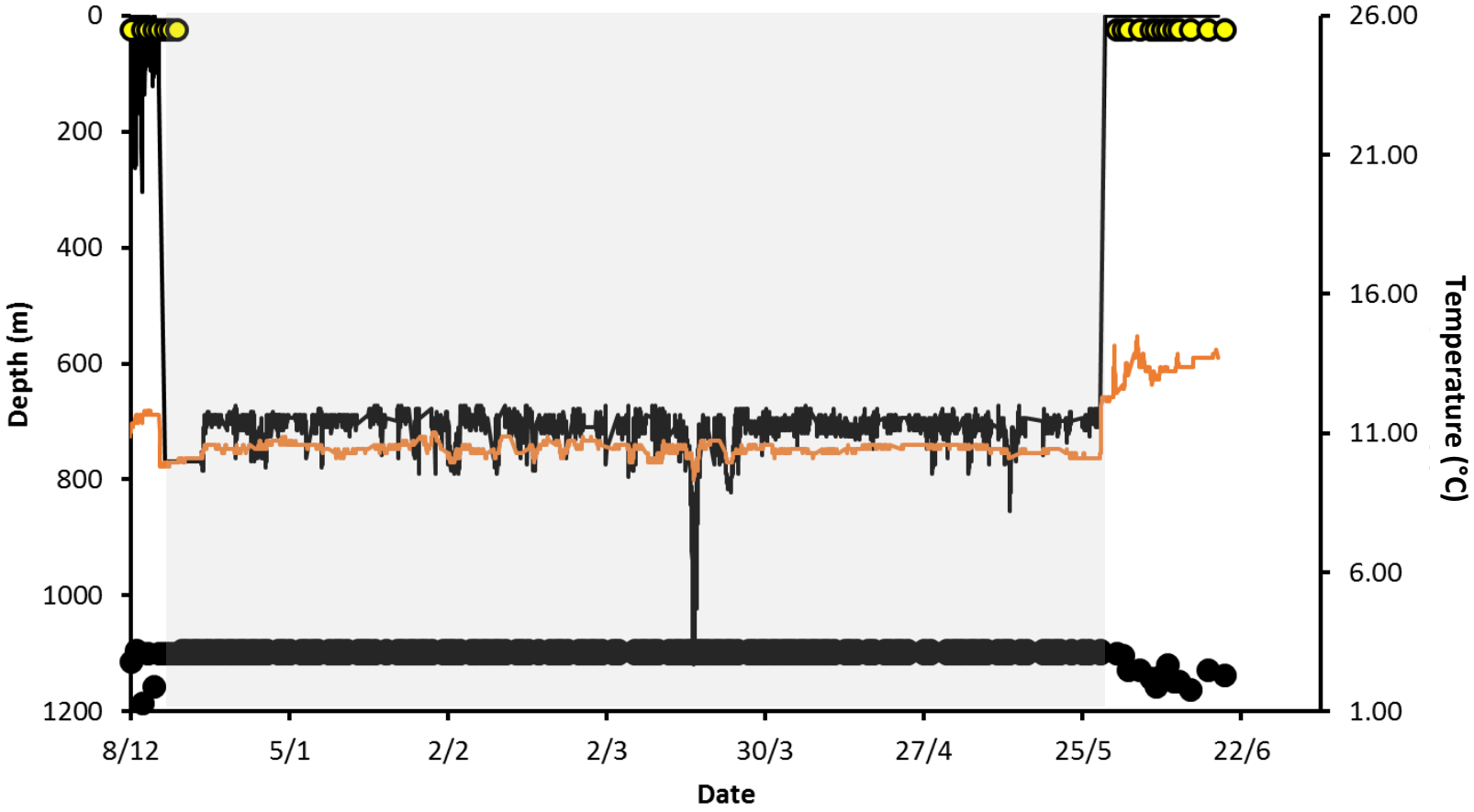


fig. S3d. Example of an eel (PSAT #83156, released from Ireland) being preyed upon by a deep living fish. After a period with "normal" eel behaviour the eel dropped to the bottom where it remains for 8 d. After this the tag stayed at an average depth of 700 m with irregular dives up and down for a period of six months. The maximum recorded depth was 1120 m. Circular symbols show the daily light data recorded by the tag (values ranged from 1 to 255, and have been proportionally rescaled to fit the temperature axis). Black-filled symbols indicate minimum light values, while yellow indicate maxima.

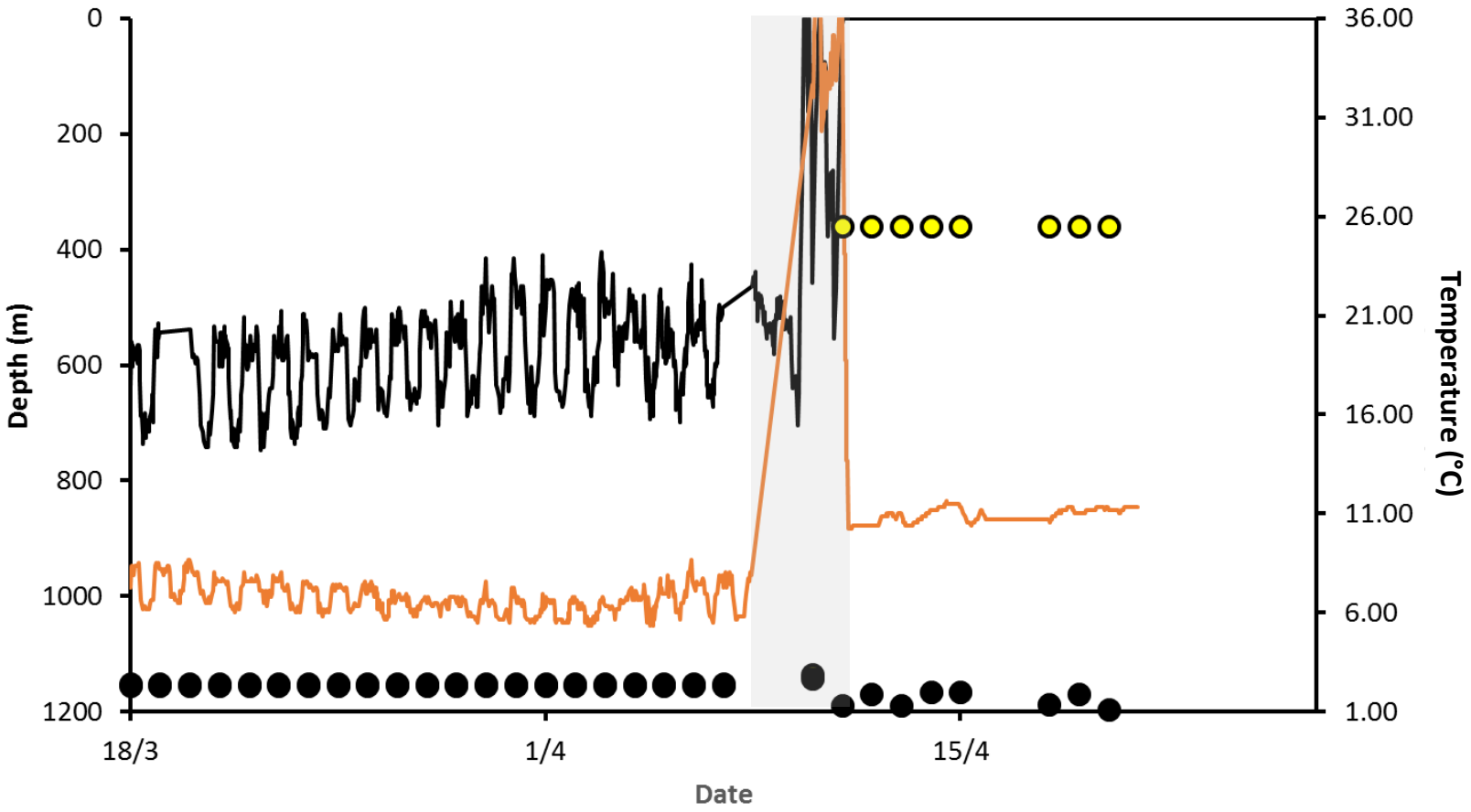


fig. S3e. Example of an eel (PSAT #49559, released from Ireland) being preyed upon by a marine mammal. Outside the shelf and before the predation events the diurnal vertical migrations and range of the eel were consistent with previous observations of ocean-migrating eels. There was a sudden rise in temperature to >35°C and the tag recorded a reduction in depth to the surface. The predator showed bouts of deep dives with inter-surface intervals. The median duration of such dives was 11–12 min and the interval at the surface between dives varied between 5 and 7 min. Circular symbols show the daily light data recorded by the tag (values ranged from 1 to 255, and have been proportionally rescaled to fit the temperature axis). Black-filled symbols indicate minimum light values, while yellow indicate maxima.

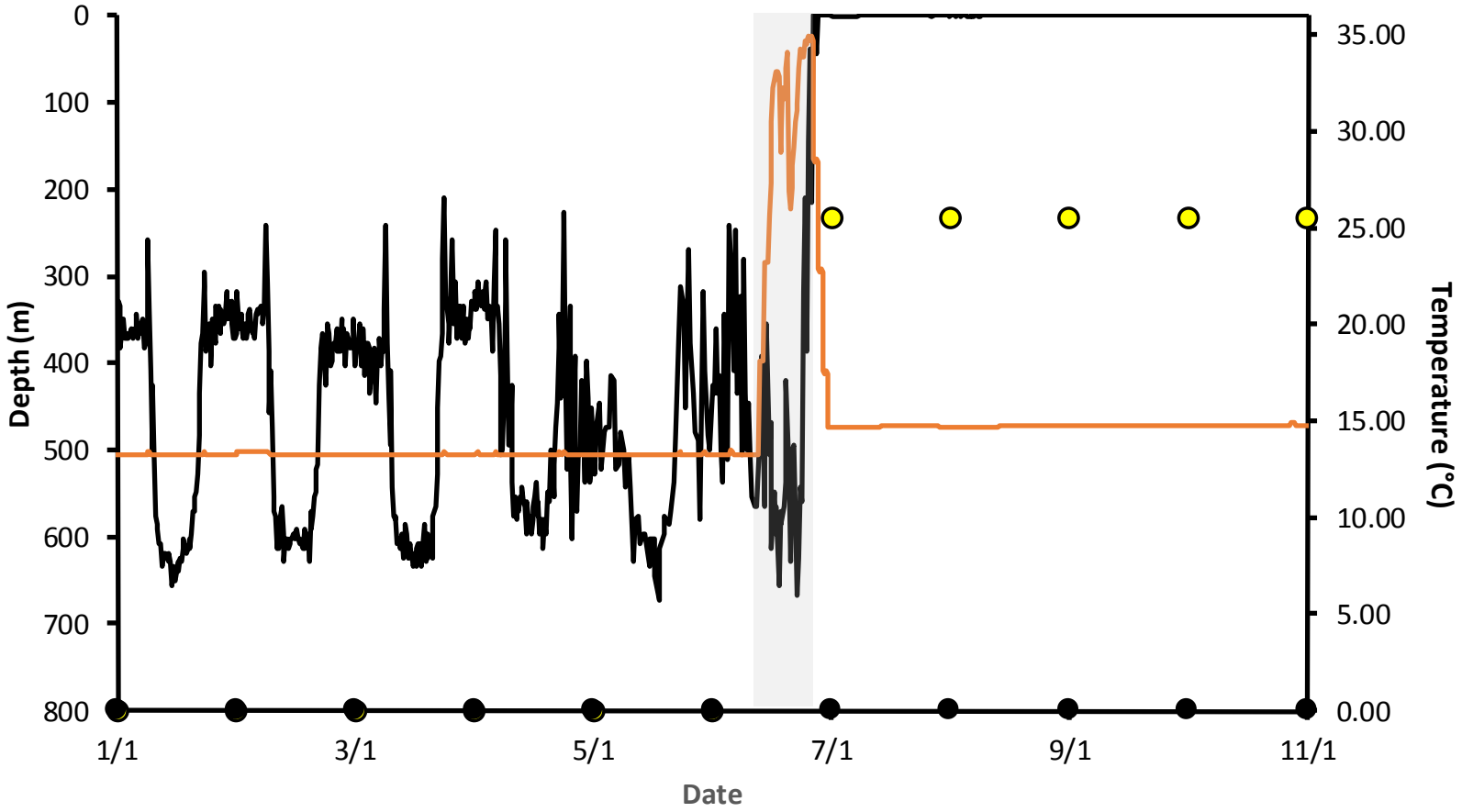


fig. S3f. Example of an eel (PSAT #133984, released from southern France) being preyed upon by an unknown endotherm. The eel was behaving normally until a sudden change in dive pattern and an increase in temperature to above 30°C. However, after predation, the predator remained at depth for approximately 12 h, ruling out predation by a marine mammal. The maximum recorded body temperature of the predator was 35°C. Circular symbols show the daily light data recorded by the tag (values ranged from 1 to 255, and have been proportionally rescaled to fit the temperature axis). Black-filled symbols indicate minimum light values, while yellow indicate maxima.

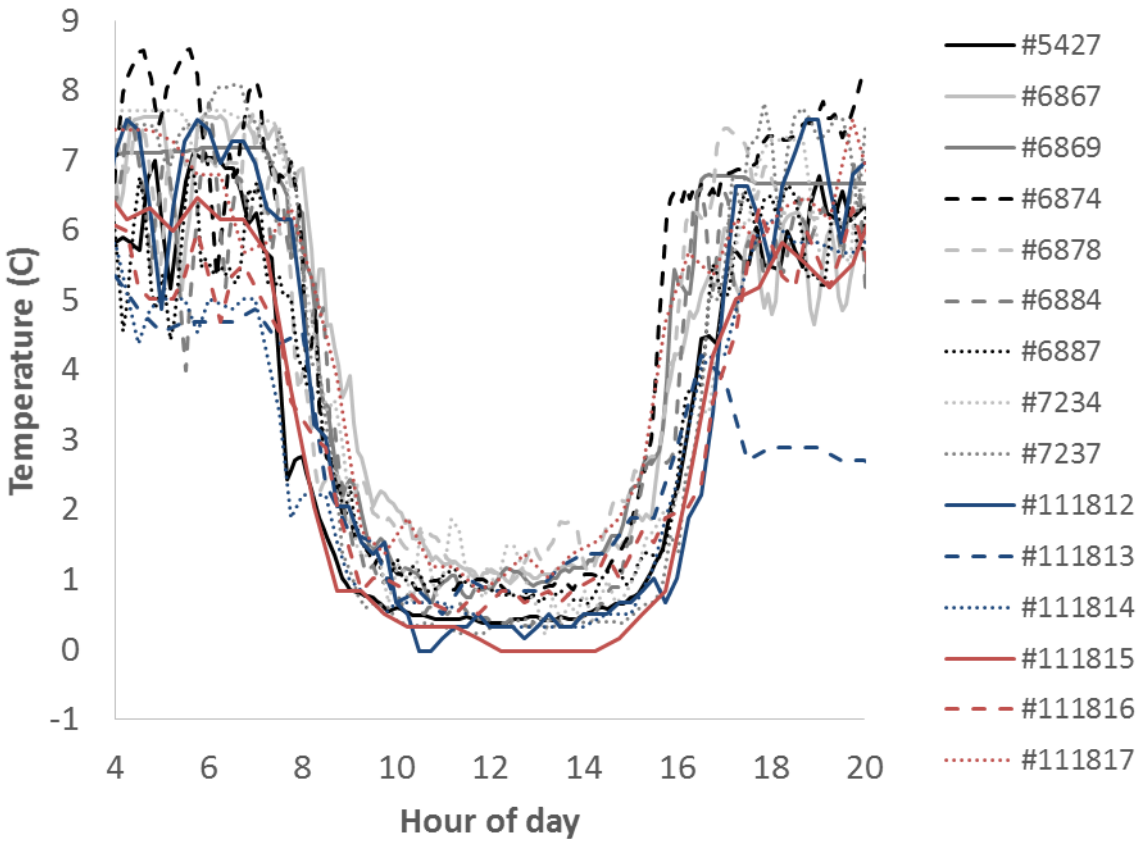


fig. S4. Example of daytime thermal experience of eels during migration along the Norwegian trench/deep in the Norwegian. Each line represents a day of temperature experience from a different individual. Grey and black lines are data from DST tagged fish, coloured lines are from PSAT tagged fish.

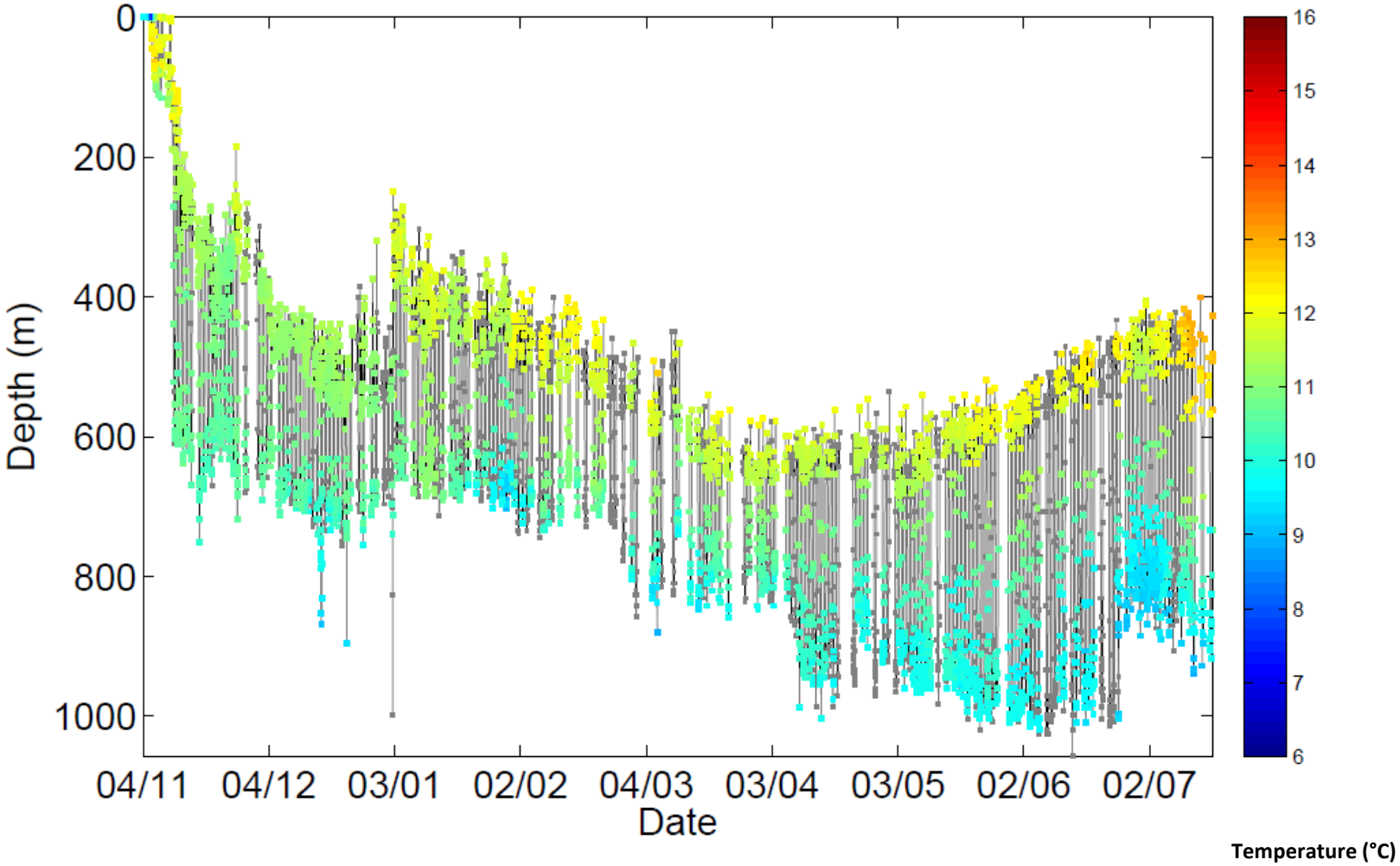


fig. S5. Depth and temperature time series from PSAT #83140. The tag remained attached to the eel for 276 d before detaching as programmed. The eel was released from Ireland in 2008, and the pop-up position was close to the Azores, at a surface temperature of 22°C. Depth data are coloured by temperature values.

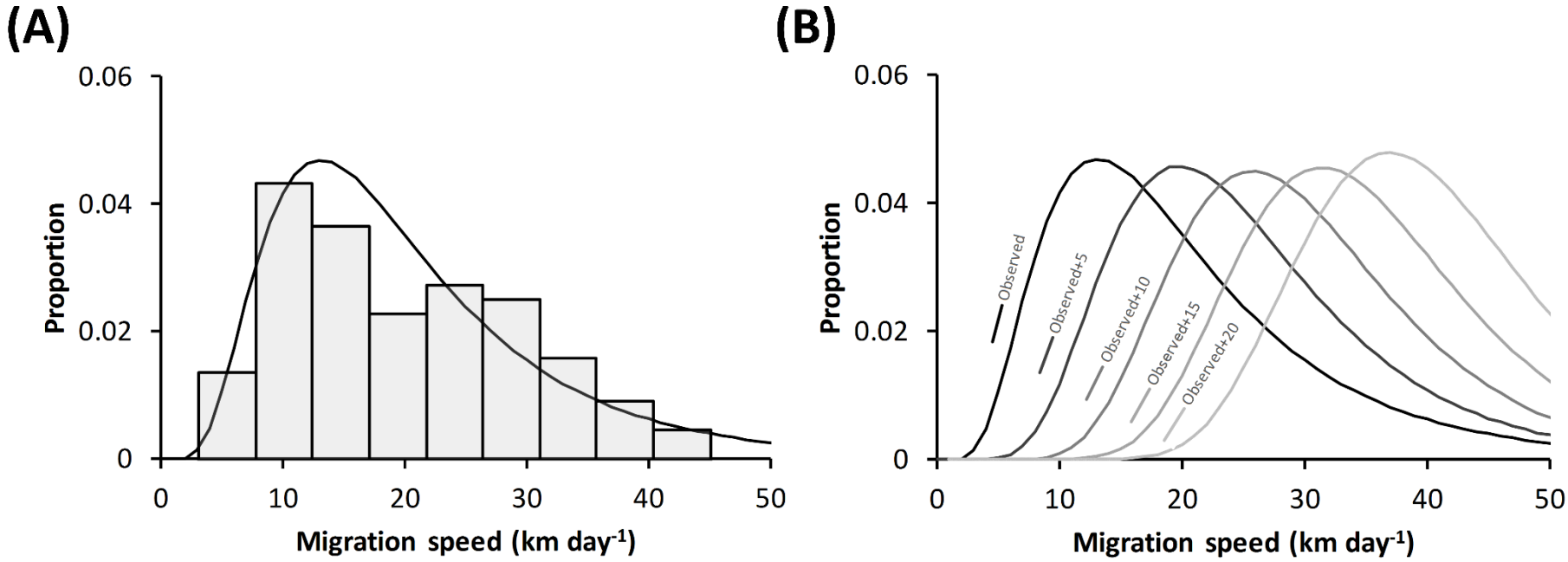


fig. S6. Relative frequency distribution of swimming speed. (**a**) observed migration speeds and the best fitting log-normal distribution; (**b**) example migration speed distributions used to calculate the proportion of eels able to arrive at the spawning area in the Sargasso Sea in time for peak spawning. The distributions were truncated at 52km day-1, which represents the expected daily swimming speed of an 80 cm long European eel swimming at 0.75 body lengths s^{-1}. Truncated distributions were normalised prior to calculation of the proportion of successful arrivals.

(A)

(B)

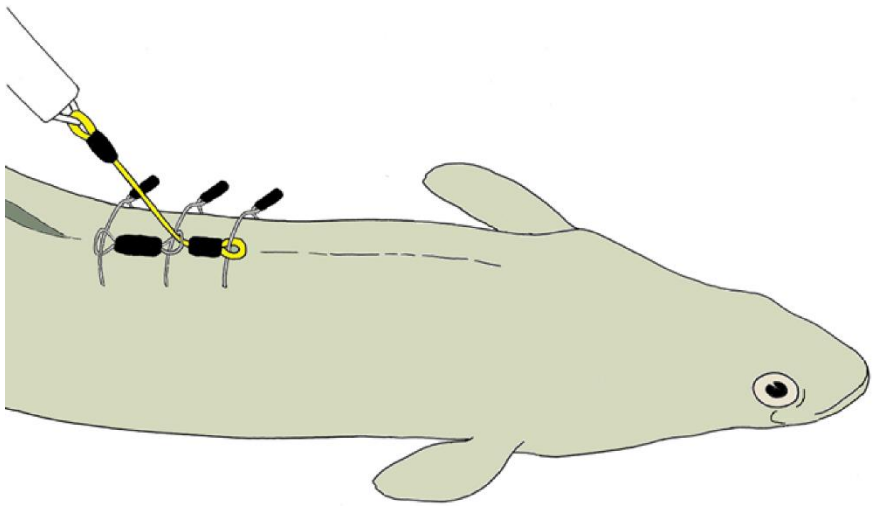


fig. S7. Electronic tag types and attachment technique. (**a**) Tag types used in the study (from left to right): Microwave Telemetry X-tag, Cefas Technology Ltd pop-off archival tag v2, Cefas Technology Ltd internal drift archival tag and Cefas Technology Ltd pop-off archival tag v1; (**b**) the 'Westerberg' tag attachment method. Eel drawing by Lene Jacobsen (DTU-Aqua).

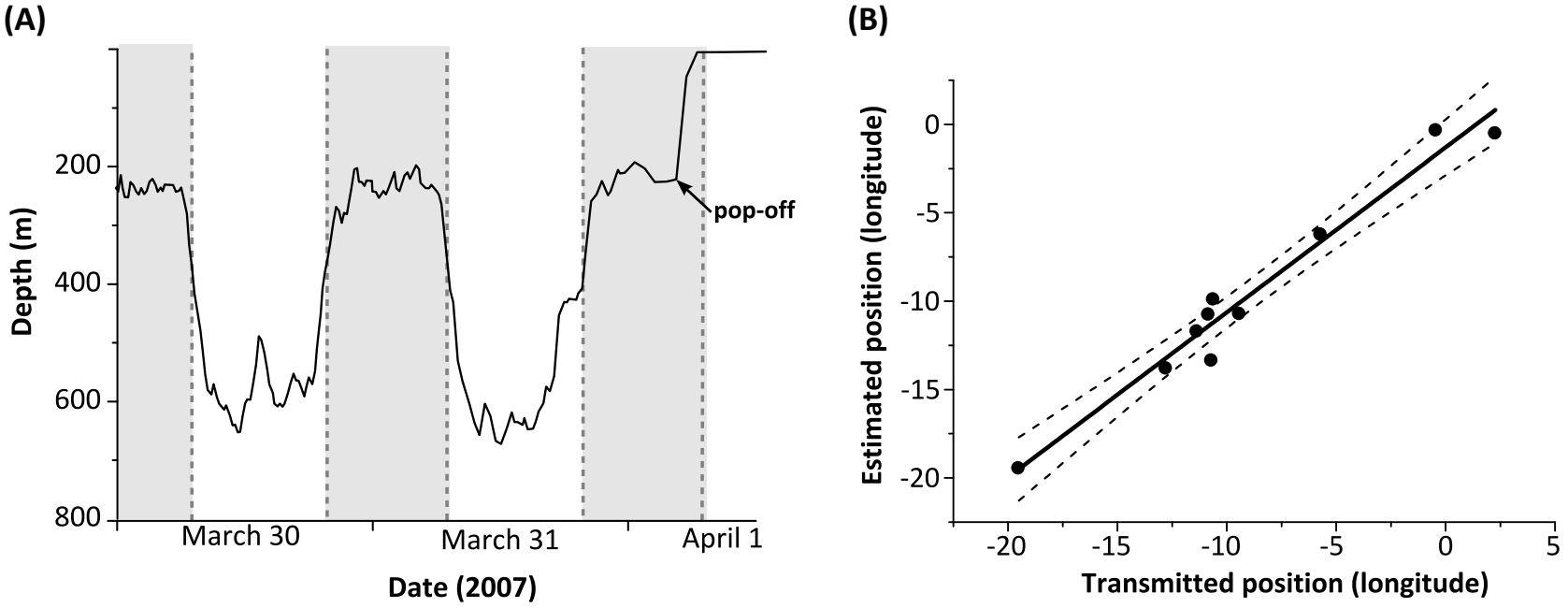


fig. S8. Principle and validation of behavioral geolocation. (**a**) illustration of synchronicity of large vertical movements with dawn and dusk (from tag #71074), shaded areas represent night periods and dashed lines represent dawn and dusk times at the pop-off position; (**b**) estimated longitude versus transmitted longitude (negative numbers denote degrees west). The solid line shows the fitted linear regression (estimated position=1.03341*transmitted position+1.02292, R^2=0.96, $F_{1,8}$=211.9, p<0.001).

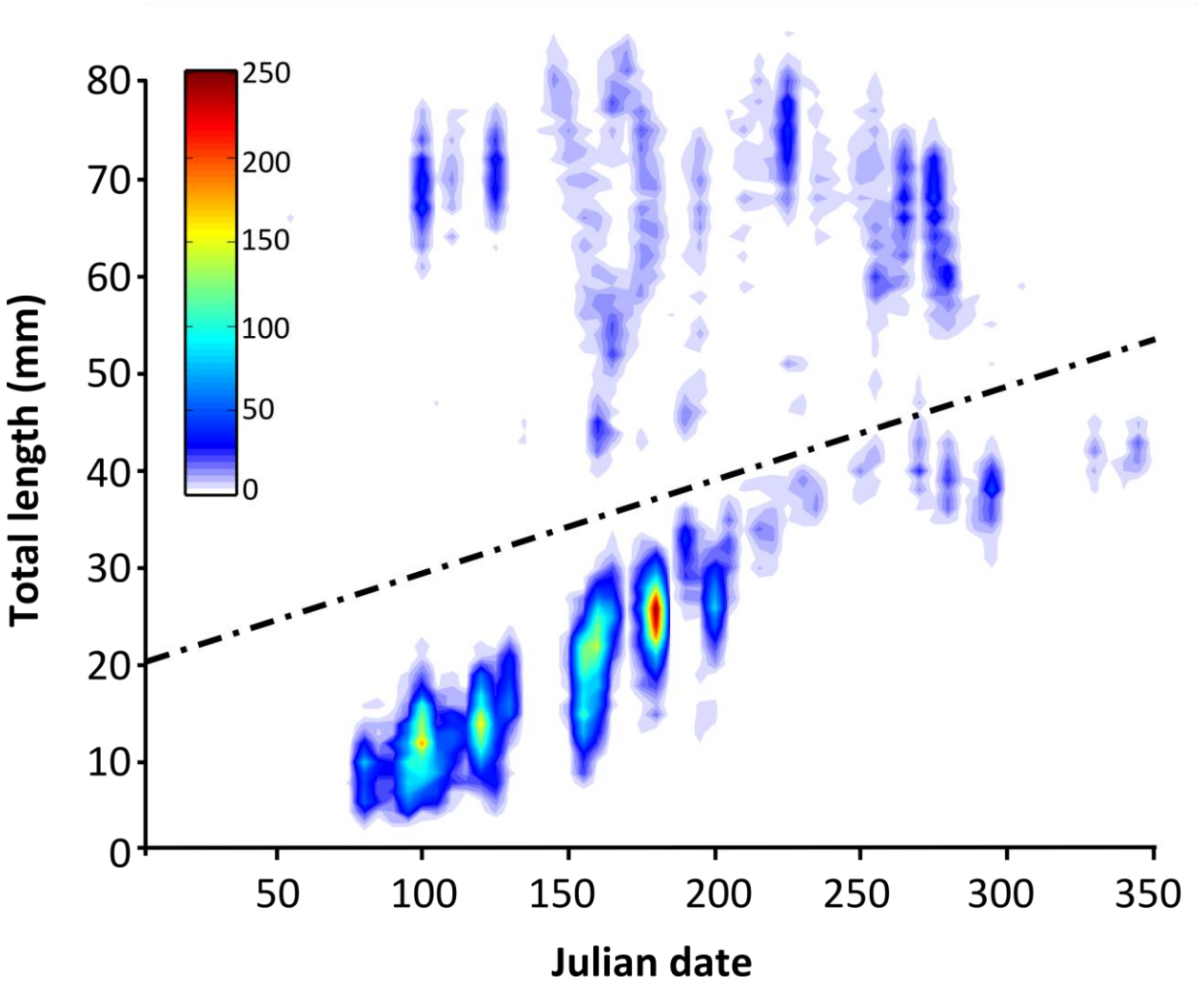


fig. S9. Analysis of the total number of length-measured European eel leptocephali in the ICES database. Data were binned into 1 mm length and 5 d time bins, then contoured to show the number of larvae within each size bin (legend provides key). The dashed line (given by the equation TL=20.3+0.094*day) shows the separation between the cohort of the season and individuals born in previous years.

table S1. Details of reconstructed migrations of eels that reached the ocean. Tag numbers preceded by 'A' are DST tags, whilst all others are PSAT. DST tags marked * were implanted tags, all others were externally attached. Oceanic speeds were only calculated for those eels that reached the ocean, and for which the full migratory paths could be reconstructed.

Tag	Release region	Release location	Length (m)	Start date	Duration (d)	Path	Distance (full, km)	Speed (full, km d^{-1})	Distance (oceanic, km)	Speed (oceanic, km d^{-1})	Fate
A07235	Baltic Sea	Kattegat, Marstrand	0.921	27/10/2011	47	Full	602	17.2	412	27.5	Unknown
A07224	Baltic Sea	Kattegat, Marstrand	0.832	27/10/2011	58	Full	527	9.2	494	12	Pop-off
A06840	Baltic Sea	Gullmarenfjord, Lysekil	0.957	12/10/2010	55	Full	688	12.4	530	35.4	Predation
A06874	Baltic Sea	Gullmarenfjord, Lysekil	0.877	13/10/2010	58	Full	1237	21.3	1083	30.9	Pop-off
A06869	Baltic Sea	Gullmarenfjord, Lysekil	0.937	12/10/2010	58	Full	1257	21.7	1104	33.5	Pop-off
A06878	Baltic Sea	Gullmarenfjord, Lysekil	0.898	13/10/2010	58	Full	1376	23.7	1219	28.4	Pop-off
111809	Baltic Sea	Kattegat, Marstrand	0.906	27/10/2011	157	Full	2207	14.1	1309	9.4	Pop-off
111804	Baltic Sea	Kattegat, Marstrand	0.949	27/10/2011	98	Full	1471	15	1375	18.6	Pop-off
A06867	Baltic Sea	Øresund, Øresund	0.959	11/11/2010	59	Full	1709	29	1505	32	Pop-off
111812	Baltic Sea	Kattegat, Marstrand	0.853	27/10/2011	157	Full	1795	11.4	1603	11.6	Pop-off
111817	Baltic Sea	Kattegat, Marstrand	0.974	28/10/2011	83	Full	1738	20.9	1621	31.2	Pop-off
A07217	Baltic Sea	Kattegat, Marstrand	0.916	28/10/2011	79	Full	1737	20.7	1648	34.3	Pop-off
A03486*	Baltic Sea	Øresund, Øresund	0.869	26/11/2008	78	Full	1984	25.6	1683	24.4	Predation
A06887	Baltic Sea	Øresund, Øresund	0.962	11/11/2010	86	Full	2056	24	1769	24.9	Suspected predation
111815	Baltic Sea	Kattegat, Marstrand	1.06	28/10/2011	156	Full	2107	13.5	1831	13.2	Pop-off
A05427*	Baltic Sea	Kattegat, Marstrand	0.895	28/10/2011	135	Full	1993	14.8	1928	18.7	Pop-off
111814	Baltic Sea	Kattegat, Marstrand	0.89	27/10/2011	157	Full	2037	13	1958	13.9	Pop-off
111813	Baltic Sea	Kattegat, Marstrand	0.977	27/10/2011	157	Full	2256	14.4	2106	14.4	Pop-off
111816	Baltic Sea	Kattegat, Marstrand	1.005	28/10/2011	156	Full	2386	15.3	2154	18	Pop-off
A07234	Baltic Sea	Kattegat, Marstrand	0.78	27/10/2011	140	Full	2366	16.9	2333	21.6	Pop-off
A07237	Baltic Sea	Kattegat, Marstrand	0.917	27/10/2011	140	Full	2488	17.8	2337	18.6	Pop-off

Tag	Release region	Release location	Length (m)	Start date	Duration (d)	Path	Distance (full, km)	Speed (full, km d^{-1})	Distance (oceanic, km)	Speed (oceanic, km d^{-1})	Fate
A06884	Baltic Sea	Øresund, Øresund	1.038	11/11/2010	106	Full	2887	27.2	2638	26.9	Pop-off
A07228	Baltic Sea	Kattegat, Marstrand	0.833	27/10/2011	79	Full	864	10.9	na	na	Pop-off
A07062	Bay of Biscay	La Loire, Ancenis	1.05	24/11/2010	25	End to end	705	28.100	na	na	Predation
89306	Bay of Biscay	La Loire (offshore), Bay of Biscay	1.029	14/12/2008	10	End to end	294	30.4	na	na	Pop-off
89305	Bay of Biscay	La Loire (offshore), Bay of Biscay	0.983	14/12/2008	11	End to end	151	14.4	na	na	Predation
83177	Bay of Biscay	La Loire (offshore), Bay of Biscay	1.114	14/12/2008	8	End to end	261	32.7	na	na	Suspected predation
83153	Bay of Biscay	La Loire (offshore), Bay of Biscay	1	14/12/2008	8	End to end	342	44.5	na	na	Suspected predation
83152	Bay of Biscay	La Loire (offshore), Bay of Biscay	1.02	14/12/2008	7	End to end	273	38.1	na	na	Suspected predation
83151	Bay of Biscay	La Loire (offshore), Bay of Biscay	0.951	14/12/2008	12	End to end	77	6.6	na	na	Suspected predation
111832	Celtic Sea	Galway Bay (offshore)	0.905	21/11/2011	49	Full	1053	21.4	610	13.5	Suspected predation
89310	Celtic Sea	Corrib, Galway harbour	0.968	02/12/2008	52	Full	1437	27.7	830	28.7	Predation
71076	Celtic Sea	Corrib, Galway harbour	0.875	26/11/2006	82	Full	1511	18.5	1053	14.6	Pop-off
A07056	Celtic Sea	Corrib, Galway harbour	0.913	13/11/2010	40	Full	1714	42.5	1195	33.8	Pop-off
A05262*	Celtic Sea	Corrib, Galway harbour	0.833	20/10/2009	84	Full	1993	23.7	1613	26.8	Predation
71074	Celtic Sea	Corrib, Galway harbour	0.9	26/11/2006	126	Full	2928	23.2	2440	23.9	Pop-off
49559	Celtic Sea	Corrib, Galway harbour	0.926	13/11/2010	148	Full	4115	27.9	3769	28.3	Predation
83140	Celtic Sea	Corrib, Galway harbour	0.977	04/11/2008	273	Full	6982	25.6	6709	25.4	Pop-off
49581	Celtic Sea	Corrib, Galway harbour	0.922	13/11/2010	15	End to end	559	37.5	na	na	Pop-off
71080	Celtic Sea	Corrib, Galway harbour	0.945	25/11/2006	20	End to end	545	26.6	na	na	Unknown
111830	Celtic Sea	Galway Bay (offshore)	0.865	21/11/2011	18	End to end	415	22.8	na	na	Predation
111828	Celtic Sea	Galway Bay (offshore)	0.98	21/11/2011	9	End to end	283	32.9	na	na	Predation
111826	Celtic Sea	Galway Bay (offshore)	1.015	21/11/2011	8	End to end	285	35.1	na	na	Unknown

Tag	Release region	Release location	Length (m)	Start date	Duration (d)	Path	Distance (full, km)	Speed (full, km d^{-1})	Distance (oceanic, km)	Speed (oceanic, km d^{-1})	Fate
111824	Celtic Sea	Galway Bay (offshore)	1.01	21/11/2011	8	End to end	88	10.8	na	na	Predation
111821	Celtic Sea	Galway Bay (offshore)	0.9	21/11/2011	10	End to end	116	12.2	na	na	Predation
111820	Celtic Sea	Galway Bay (offshore)	0.905	21/11/2011	8	End to end	110	14.7	na	na	Predation
101437	Celtic Sea	Corrib, Galway harbour	1.027	13/11/2010	11	End to end	120	11.1	na	na	Predation
101424	Celtic Sea	Corrib, Galway harbour	0.897	13/11/2010	9	End to end	96	11	na	na	Unknown
89317	Celtic Sea	Corrib, Galway harbour	0.95	02/12/2008	11	End to end	152	14.2	na	na	Unknown
89316	Celtic Sea	Corrib, Galway harbour	0.875	02/12/2008	11	End to end	155	14.2	na	na	Suspected predation
89315	Celtic Sea	Corrib, Galway harbour	1	02/12/2008	11	End to end	120	11.3	na	na	Suspected predation
89314	Celtic Sea	Corrib, Galway harbour	0.97	02/12/2008	11	End to end	131	11.7	na	na	Suspected predation
89308	Celtic Sea	Corrib, Galway harbour	0.987	02/12/2008	13	End to end	140	10.6	na	na	Suspected predation
83173	Celtic Sea	Corrib, Galway harbour	0.922	02/12/2008	11	End to end	132	12.3	na	na	Pop-off
83170	Celtic Sea	Corrib, Galway harbour	0.952	02/12/2008	8	End to end	178	22.2	na	na	Suspected predation
83167	Celtic Sea	Corrib, Galway harbour	0.987	02/12/2008	16	End to end	593	37.7	na	na	Suspected predation
83159	Celtic Sea	Corrib, Galway harbour	1.03	02/12/2008	8	End to end	84	10.9	na	na	Suspected predation
83156	Celtic Sea	Corrib, Galway harbour	1.038	02/12/2008	11	End to end	284	26.3	na	na	Suspected predation
83142	Celtic Sea	Corrib, Galway harbour	0.904	04/11/2008	9	End to end	195	22.8	na	na	Unknown
83139	Celtic Sea	Corrib, Galway harbour	0.953	04/11/2008	15	End to end	171	11.8	na	na	Suspected predation
83136	Celtic Sea	Corrib, Galway harbour	0.911	04/11/2008	9	End to end	125	14.3	na	na	Predation
83135	Celtic Sea	Corrib, Galway harbour	0.971	04/11/2008	10	End to end	115	12.1	na	na	Suspected predation
83129	Celtic Sea	Corrib, Galway harbour	1.032	04/11/2008	13	End to end	129	9.8	na	na	Suspected predation
83124	Celtic Sea	Corrib, Galway harbour	1.008	04/11/2008	14	End to end	130	9.1	na	na	Suspected predation
83121	Celtic Sea	Corrib, Galway harbour	0.995	04/11/2008	10	End to end	133	13.3	na	na	Predation

Tag	Release region	Release location	Length (m)	Start date	Duration (d)	Path	Distance (full, km)	Speed (full, km d^{-1})	Distance (oceanic, km)	Speed (oceanic, km d^{-1})	Fate
83111	Celtic Sea	Corrib, Galway harbour	1.094	04/11/2008	17	End to end	229	13.7	na	na	Unknown
71086	Celtic Sea	Corrib, Galway harbour	1.02	25/11/2006	30	End to end	879	29.2	na	na	Suspected predation
71085	Celtic Sea	Corrib, Galway harbour	0.945	25/11/2006	11	End to end	238	22.3	na	na	Unknown
71077	Celtic Sea	Corrib, Galway harbour	1.005	25/11/2006	9	End to end	148	16.2	na	na	Pop-off
71075	Celtic Sea	Corrib, Galway harbour	1.06	26/11/2006	36	End to end	260	7.3	na	na	Pop-off
71072	Celtic Sea	Corrib, Galway harbour	0.93	26/11/2006	18	End to end	294	16.2	na	na	Pop-off
71071	Celtic Sea	Corrib, Galway harbour	0.98	27/10/2006	8	End to end	270	32.2	na	na	Predation
49644	Celtic Sea	Corrib, Galway harbour	1.022	13/11/2010	7	End to end	294	40.2	na	na	Predation
49426	Celtic Sea	Corrib, Galway harbour	0.973	13/11/2010	8	End to end	382	47.2	na	na	Unknown
A09424	North Sea	Elbe, Glückstadt	0.77	28/11/2012	27	Full	155	12.9	na	na	Pop-off
A09411	North Sea	Eider, Reimersbude	0.804	13/10/2012	12	Full	349	29.1	na	na	Pop-off
A09377	North Sea	Eider, Reimersbude	0.845	26/10/2012	33	Full	675	19.9	na	na	Pop-off
A09393	North Sea	Elbe, Wedel	0.714	14/11/2012	33	Full	695	21.1	na	na	Pop-off
A09374	North Sea	Elbe, Wedel	0.762	15/11/2012	34	Full	794	24.1	na	na	Pop-off
133986	western Mediterranean	Port-La-Nouvelle, France	0.918	10/12/2013	181	Full	2296	12.7	928	7.4	Pop-off
133980	western Mediterranean	Port-La-Nouvelle, France	0.908	09/12/2013	107	Full	1642	15.3	1249	21.8	Predation
133979	western Mediterranean	Port-La-Nouvelle, France	0.952	09/12/2013	183	Full	2157	11.8	1905	14.4	Pop-off
133985	western Mediterranean	Port-La-Nouvelle, France	0.987	10/12/2013	181	End to end	719	4.0	na	na	Pop-off
133984	western Mediterranean	Port-La-Nouvelle, France	0.865	09/12/2013	33	End to end	240	7.4	na	na	Predation
133983	western Mediterranean	Port-La-Nouvelle, France	0.998	09/12/2013	110	End to end	992	9.0	na	na	Predation
133982	western Mediterranean	Port-La-Nouvelle, France	0.96	09/12/2013	144	End to end	636	4.4	na	na	Predation
133981	western Mediterranean	Port-La-Nouvelle, France	0.934	09/12/2013	88	End to end	1053	12.0	na	na	Predation

table S2. Assessment of effect of tag and release country on speed, migration duration, and migration distance of eels.

Speed over ground	**Df**	**Sum squares**	**Mean square**	**F value**	**Pr (>F)**
Tag Type	1	103.8	103.774	1.0603	0.3061
Location	1	4.4	4.413	0.0451	0.8324
Tag type*location	1	3.6	3.582	0.0366	0.8487
Residuals	83	8123.4	97.872		

Duration	**Df**	**Sum squares**	**Mean square**	**F value**	**Pr (>F)**
Tag Type	1	3287	3286.9	0.9588	0.33033
Location	1	834	833.5	0.2431	0.62325
Tag type*location	1	13900	13900.3	4.0549	0.04728
Residuals	83	284527	3428		

Distance	**Df**	**Sum squares**	**Mean square**	**F value**	**Pr (>F)**
Tag Type	1	4444710	4444710	3.9113	0.05128
Location	1	1025430	1025430	0.9024	0.34490
Tag type*location	1	2585178	2585178	2.2750	0.13528
Residuals	83	94318347	1136366		

table S3. The speed of European eels. The migration speed or swimming speed values taken from literature used to compare to the migration speeds observed in this study. Citations are listed in the full paper.

Tag type	Type of study	Speed (km d^{-1})	Citation number
Ultrasonic	Field	36	67
Ultrasonic	Field	13	65
Ultrasonic	Field	15	62
Ultrasonic	Field	16	65
Ultrasonic	Field	16	66
Ultrasonic	Field	25	69
Ultrasonic	Field	25	64
Ultrasonic	Field	27	68
Archival	Field	31	14
Unencumbered	Laboratory	32	76
Unencumbered	Laboratory	32	11
Unencumbered	Laboratory	35	71
Unencumbered	Laboratory	43	74
Unencumbered	Laboratory	31	70
Unencumbered	Laboratory	43	72
Unencumbered	Laboratory	59	75
Unencumbered	Laboratory	55	73

table S4a. The fate of eels that reached oceanic waters. Datasets recovered from eels tagged in Spain (n=5) are not included.

	Release location					
	Bay of Biscay	**Celtic Sea**	**Med. Sea**	**North Sea**	**Baltic**	**Total**
Pop-off						
Premature	1	7	0	2	2	10
Scheduled	0	2	3	1	17	27
Predation						
Strong evidence of predation	2	13	5	1	2	22
Suspected pelagic predation	4	9	0	0	1	14
Suspected benthic predation	0	5	0	0	0	5
Caught by fisherman	0	0	0	1	0	0
Unknown	**0**	8	0	0	0	8
Grand Total	**7**	**45**	**8**	**5**	**22**	**87**

table S4b. The fate of all released eels for which data sets were recovered. Data sets recovered from eels tagged in Spain (5) are not included. *(includes 14 eels that didn't leave Lake Malaren)

	Release location					
	Bay of Biscay	**Celtic Sea**	**Med. Sea**	**North Sea**	**Baltic**	**Total**
Pop-off						
Premature	1	9	0	12	2	24
Scheduled	1	2	2	3	17	27
Predation						
Strong evidence of predation	13	19	5	1	1	38
Suspected pelagic predation	16	36	0	0	3	55
Suspected benthic predation	1	8	0	0	1	10
Caught by fisherman/ found at release location	3	1	0	1	16	30
Unknown	4	17	0	0	8	29
Grand Total	**7**	**45**	**8**	**5**	**22**	**87**

table S5. Summary of literature used to assess escapement date. Eel escapement was assessed by month, for all months of the year unless stated otherwise.

Country	Catchment	Latitude (N)	Km to Sargasso	Study period	Estimation method	Location in catchment	Fishery dependent?	% escaping Sept. to Dec	Citation
Spain	Ulla rio	42.43	5100	1999-2011	fish trap	40 km from the river mouth	No	78.3	Cobo et al 2014
France	Nive, barrage Halsou	43.24	5600	1999 & 2001	silver eel trap	23 km from the sea	No	100	Gosset et al., 2005
France	Fumemorte, Camargue	43.3	6600	2001-2007	fyke nets	25 km from the sea	No	46.3	Crivelli, unpubl. data.
France	Loire, Varades	47.23	5600	1987-2006	fishing gear	130 km from the sea	Yes (Sept to Feb)	98	Acou et al, 2009
France	Fremur	48.34	5600	1996-2004	silver eel trap	5 km from the sea	No	43.5	Acou et al., 2008
France	Oir	48.37	5600	2000-2005	silver eel trap	10 km from the sea	No	99.8	Trancart et al., 2013
Ireland	lower Shannon	52.5	5300	1965-1987	fishing gear	Not known	Yes	77.3	Moriarty, 1990
Ireland	Burrishoole	53.55	5300	1985-1988	silver eel trap	5 km from the sea	No	94.8	Poole et al 1990
Germany	Schwentine	54.17	7500	2009-2011	silver eel trap	9 km upstream the river mouth	No	66.9	Marohn et al 2014
Germany	Warnow	54.3	7500	2008-2011	stow nets	River mouth	No	37.4	Reckordt et al., 2014
UK	Windermere, Cunsey Beck	54.4	5800	1940-1944	silver eel trap	30 km from the sea	No	61.4	Frost, 1945
Ireland	lower Bann, Lough Neagh	54.75	5500	1961-1969	fishing gear	55 km from the sea	Yes (June to Dec)	90.6	Parsons et al, 1977
Sweden	Baltic Sea ICES 40G4	55.75	7450	1999-2007	silver eel trap	coastal fishery	No	84.5	Swedish catch statistics

Country	Catchment	Latitude (N)	Km to Sargasso	Study period	Estimation method	Location in catchment	Fishery dependent?	% escaping Sept. to Dec	Citation
Denmark	Gudena	56.21	6000	2006	PIT tagging	River mouth	No	61	Jepsen & Pedersen, unpublished
Sweden	Baltic Sea ICES 41G2	56.25	7140	1999-2006	silver eel trap	coastal fishery	No	85.5	Swedish catch statistics
Sweden	Baltic Sea ICES 42G6	56.75	7600	1999-2008	silver eel trap	coastal fishery	No	55.6	Swedish catch statistics
Scotland	Girnock Burn, Dee	57.18	6100	1967-1981	silver eel trap	70 km from the tidal limit	No	53.6	Chadwick et al, 2007
Sweden	Baltic Sea ICES 45G6	58.25	7800	1999-2009	silver eel trap	coastal fishery	No	23.8	Swedish catch statistics
Norway	Imsa	58.58	6500	1975-1981	silver eel trap	trap located at the outlet	No	94.1	Hvidsten, 1985
Norway	Halselva	70.2	7200	2000-2010	wolf trap	200 m from the river mouth	No	82.3	Davidsen et al., 2011

table S6. Silver eel escapement timing in the River Gudena, Denmark. Eels were implanted with PIT tags in September 2006 at a permanent eel trap at Vestbirk hydropower station, and detected at a downstream receiver station situated at Tange hydropower station, approximately 55 km downstream. A total of 219 eels were detected. Details of the experimental sites can be found in (55).

Month	Proportion of detections (%)
September	0.9
October	4.1
November	15.1
December	32
January	26
February	0.0
March	0.9
April	5.5
May	7.8
June	5.0
July	2.7
August	0.0

table S7. Release locations and numbers of eels released during the study.

River and location	Latitude	Longitude	Country	Ecoregion	Number
Gullmarenfjord, Lysekil	58.42	11.65	Sweden	Baltic Sea	50
The Idefjord, Krokstrand	59.00	11.43	Sweden	Baltic Sea	20
Kattegat, Marstrand	57.89	11.58	Sweden	Baltic Sea	49
Øresund, Øresund	56.24	12.55	Sweden	Baltic Sea	69
La Loire, Ancenis	47.63	-1.18	France	Bay of Biscay	31
La Loire (offshore), Bay of Biscay	46.92	-2.93	France	Bay of Biscay	86
Galway Bay (offshore)	53.32	-10	Ireland	Celtic Sea	181
Corrib, Galway harbour	53.21	-9.19	Ireland	Celtic Sea	57
Eider, Reimersbude	54.38	9.01	Germany	North Sea	30
Elbe, Wedel	53.57	9.7	Germany	North Sea	14
Elbe, Glückstadt	53.79	9.4	Germany	North Sea	9
Elbe, Winsen	53.4	10.17	Germany	North Sea	22
Port-La-Nouvelle	43.01	3.06	France	Western Mediterranean	23
Albufera, Valencia	39.31	-0.29	Spain	Western Mediterranean	66
			Total		707

table S8.

a. Summary metrics of tagged eels. All values are means (± one standard deviation). Fat content was not measured in eels tagged in Germany.

Ecoregion	i-DST	e-DST	PSAT	Total	N back	Length (mm)	Weight (g)	Fat (%)	Pankhurst	Fin index
North Sea	0	75	0	75	17	771 ± 61	929 ± 290		11.1	5.2
Bay of Biscay	65	16	36	117	38	988 ± 44	1961 ± 241	20.1 ± 2.0	11.8	4.7
Celtic Sea	20	119	98	237	92	919 ± 73	1635 ± 444	20.5 ± 2.4	11.1	4.6
Western Mediterranean	76	5	8	89	8	830 ± 68	1289 ± 361	20.3 ± 2.4	10.95	5.0
Baltic Sea	74	100	15	189	48	922 ± 66	1601 ± 359	24.0 ± 2.3	9.8	4.8
Total	**115**	**435**	**157**	**707**	**206**	**904 ± 90**	**1564 ± 464**	**21.0 ± 2.7**	**10.8**	**4.8**

b. Summary metrics of eels for which migratory data were recovered (± 1 SD). Fat content was not measured in eels tagged in Germany.

Location	Total	PSAT	Length (mm)	Weight (g)	Fat (%)	Pankhurst	Fin index
North Sea	5	0	779 ± 49	954 ± 232		11.9	5.2
Bay of Biscay	7	6	1021 ± 52	2132 ± 236	20.1 ± 1.4	13.2	4.7
Celtic Sea	44	42	961 ± 57	1992 ± 339	20.1 ± 2.7	11.8	4.8
Western Mediterranean	8	8	940 ± 44	1900 ± 393	16.5 ± 0.9	12.7	5.0
Baltic Sea	23	8	922 ± 67	1599 ± 361	23.6 ± 2.0	10.3	4.9
Grand Total	**87**	**65**	**944 ± 75**	**1831 ± 433**	**20.7 ± 3.2**	**11.5**	**4.8**

table S9. Metrics of all eels tagged (*n* = 707). Provided separately as an excel file (708 rows x 10 columns).