Supplementary Materials for

The environmental niche of tuna purse seine fisheries in the Western and Central Pacific Ocean based on different fishery data.

Shenglong Yang[1,2,*] ,Linlin Yu [1,3] ,Fei Wang[1,2], Tianfei Chen[1,2], Yingjie Fei[3], Shengmao Zhang[1,2],Wei Fan[1,2*]

*Correspondence: ysl6782195@126.com;fanwee@126.com

This PDF file includes:

Figure S1. The fishing effort and number of fishing vessels during 2012-2020.

Figure S2. The spatial distribution of MPA and EEZ locations.

Figure S3. The spatial distribution of commercial fishery data during 2015-2020

Figure S4. The average importance scores for different MaxEnt models

Figure S5. Jackknife test results of the variable importance derived for each month in the GFW_0.25° model. The blue and green bars correspond to the effect on model gained by using and sequentially removing each variable from the model, respectively.

Figure S6. Jackknife test results of the variable importance derived for each month in the GFW_0.5° model.The blue and green bars correspond to the effect on model gained by using and sequentially removing each variable from the model, respectively.

Figure S7. Jackknife test results of the variable importance derived for each month in the GFW_1° model. The blue and green bars correspond to the effect on model gained by using and sequentially removing each variable from the model, respectively.

Figure S8. Jacknife test results of variable importance derived for each month in the WPFCF model .The blue and green bars correspond to the effect on model gained by using and sequentially removing each variable from the model, respectively.

Figure S9. Response curves for important variables in all months in the GFW_0.25° model.

Figure S10. Response curves for important variables in all months in the GFW_0.5° model.

Figure S11. Response curves for important variables in all months in the GFW_1° model.

Figure S12. Response curves for important variables in all month in the WPCFC model.

Figure S13. Frequency distribution of important variables based on EF data at the 0.25° spatial scale

Figure S14. Frequency distribution of important variables based on EF data at the 0.5° spatial scale

Figure S15. Frequency distribution of important variables based on EF data at the 1° spatial scale

Figure S16. Frequency distribution of important variables based on commercial fishery data at the 1° spatial scale

Figure S17. The spatial distribution of fishing locations (black dots) overlain on habitat suitability maps for each month during 2015-2019 in the GFW_0.25° model.

Figure S18. The spatial distribution of fishing locations (black dots) overlain on habitat suitability maps for each month in 2020 in the GFW_0.25° model.

Figure S19. The spatial distribution of fishing locations (black dots) overlain on habitat suitability maps for each month during 2015-2019 in the GFW_0.5° model.

Figure S20. The spatial distribution of fishing locations (black dots) overlain on habitat suitability maps for each month in 2020 in the GFW_0.5° model.

Figure S21. The spatial distribution of fishing locations (black dots) overlain on habitat suitability maps for each month during 2015-2019 in the GFW_1° model.
Figure S22. The spatial distribution of fishing data locations (black dots) overlain on habitat suitability maps for each month in 2020 in the GFW_1° model.
Figure S23. The spatial distribution of fishery data locations (black dots) overlain on habitat suitability maps for each month during 2015-2019 based on fishery data.
Figure S24. The spatial distribution of fishery locations (black dots) overlain on habitat suitability maps for each month in 2020 based on fishery data.
Figure S25. The spatial distribution of sample data in the GFW_0.25° model based on FE data.Red dots show the presence locations used for training, while violet dots show test locations.
Figure S26. The spatial distribution of sample data in the GFW_0.5° model based on FE data.Red dots show the presence locations used for training, while violet dots show test locations.
Figure S27. The spatial distribution of sample data in the GFW_1° model based on FE data.Red dots show the presence locations used for training, while violet dots show test locations.
Figure S28. The spatial distribution of sample data in the GFW_1° model based on fishery data.Red dots show the presence locations used for training, while violet dots show test locations..
Table S1. Summary of environmental data and description
Table S2. Summary of VIF statistics.
Table S3 Contribution of each factor in each month for the GFW_0.25° model.
Table S4 Contribution of each factor in each month for the GFW_0.5° model.
Table S5 Contribution of each factor in each month for the GFW_1° model.
Table S6 Contribution of each factor in each month for the WPCFC model.
Table S7. Summary statistics derived from different models without masks.
Table S8. The relative average contributions of the variables to the Maxent model without masks.

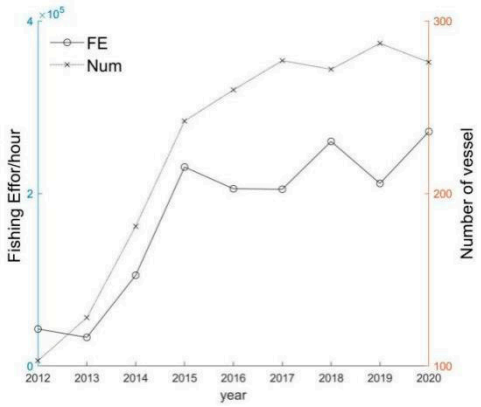

Figure S1. The fishing effort and number of fishing vessels during 2012-2020

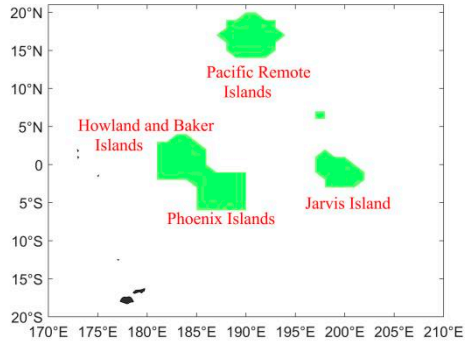

Figure S2. The spatial distribution of MPA and EEZ locations

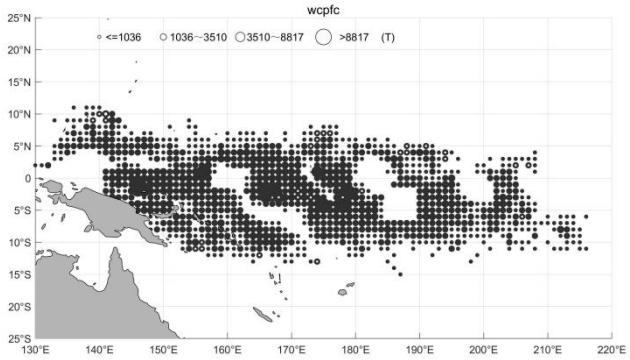

Figure S3. The spatial distribution of commercial fishery data during 2015-2020

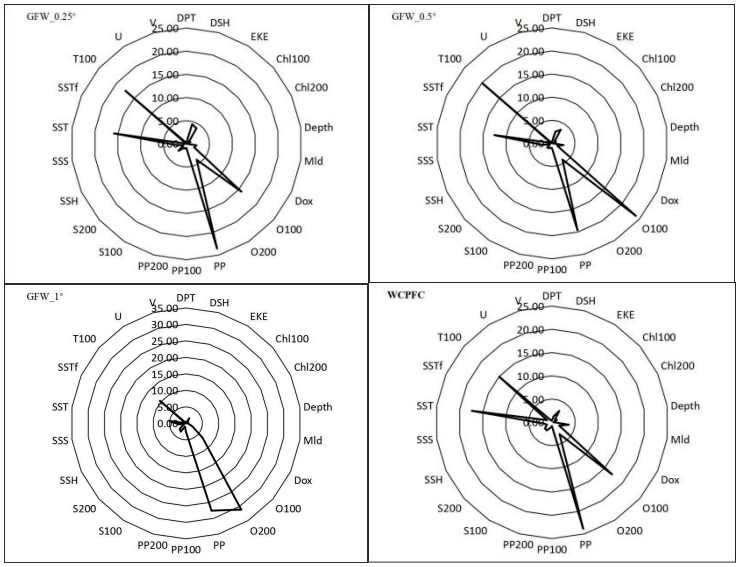

Figure S4. The average importance scores for different MaxEnt models

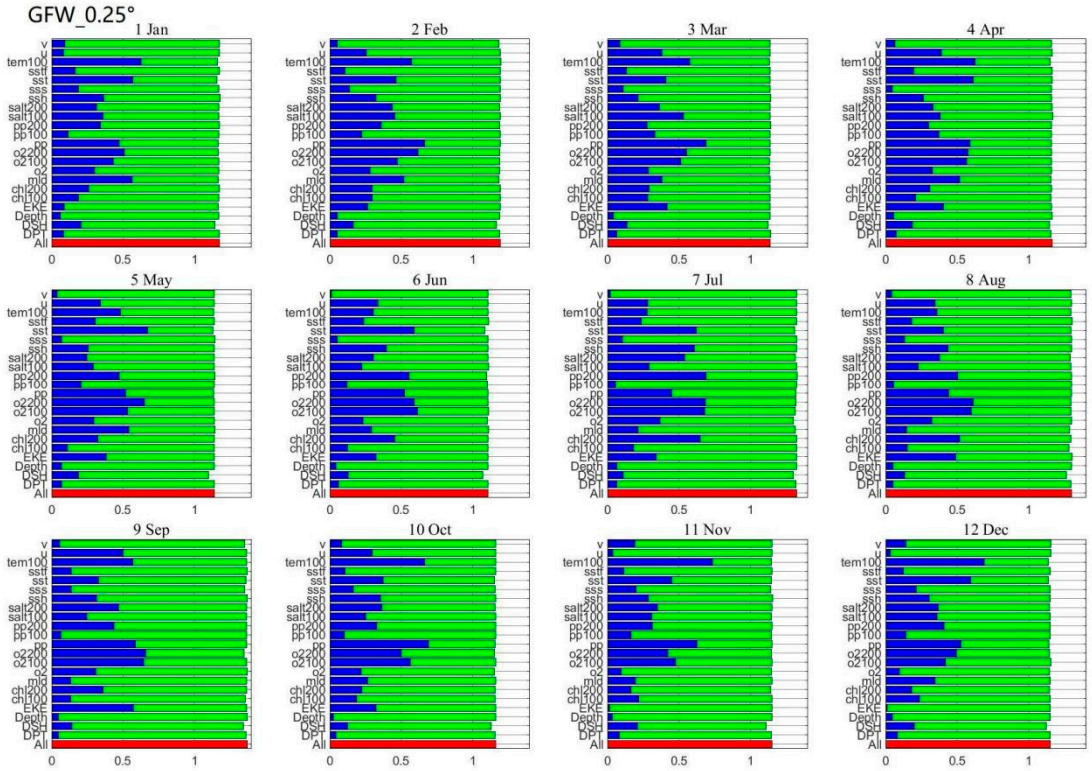

Figure S5. Jackknife test results of the variable importance derived for each month in the GFW_0.25° model. The blue and green bars correspond to the effect on model gained by using and sequentially removing each variable from the model, respectively.

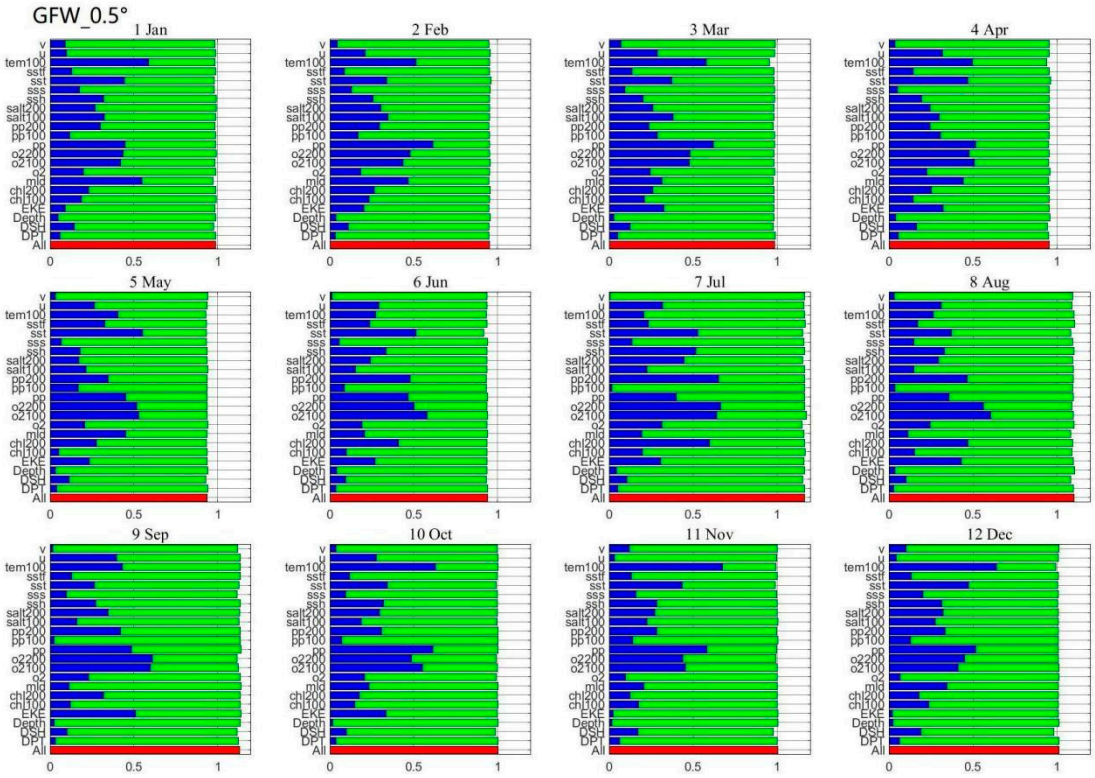

Figure S6. Jackknife test results of the variable importance derived for each month in the GFW_0.5° model.The blue and green bars correspond to the effect on model gained by using and sequentially removing each variable from the model, respectively.

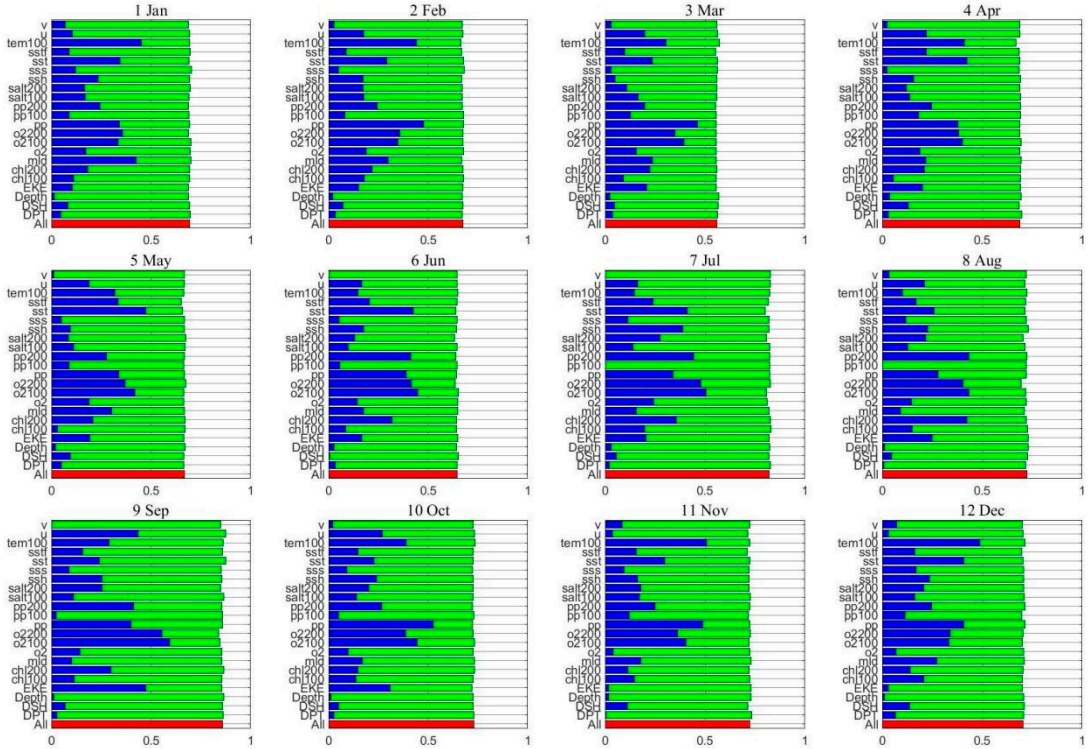

Figure S7. Jackknife test results of the variable importance derived for each month in the GFW_1° model. The blue and green bars correspond to the effect on model gained by using and sequentially removing each variable from the model, respectively.

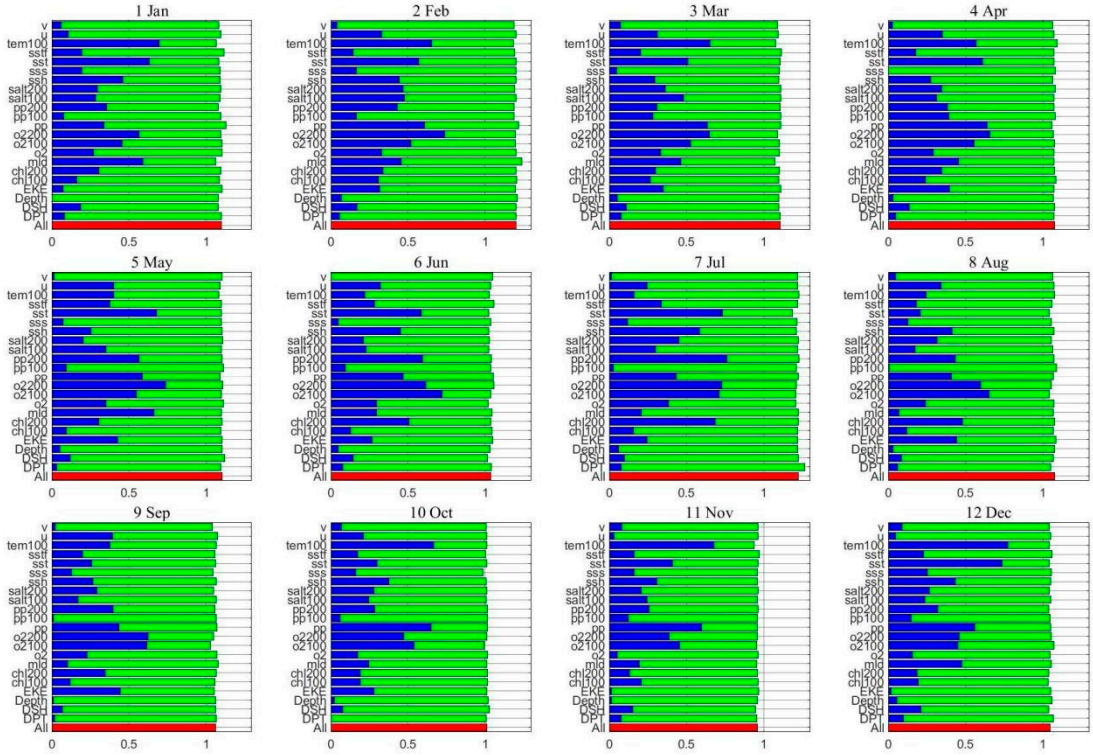

Figure S8. Jacknife test results of variable importance derived for each month in the WPFCF model .The blue and green bars correspond to the effect on model gained by using and sequentially removing each variable from the model, respectively.

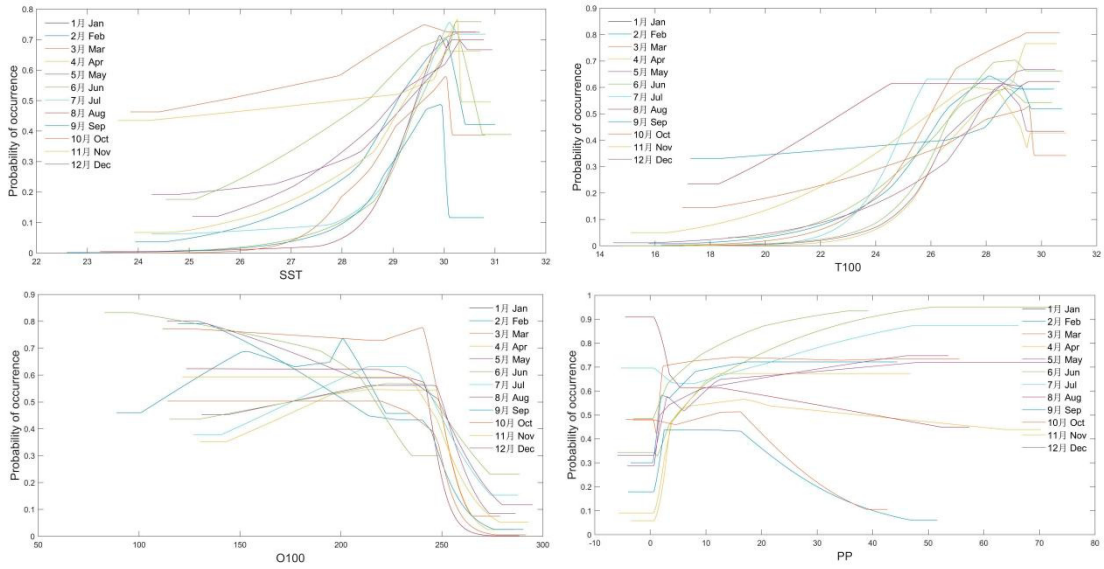

Figure S9. Response curves for important variables in all months in the GFW_0.25° model.

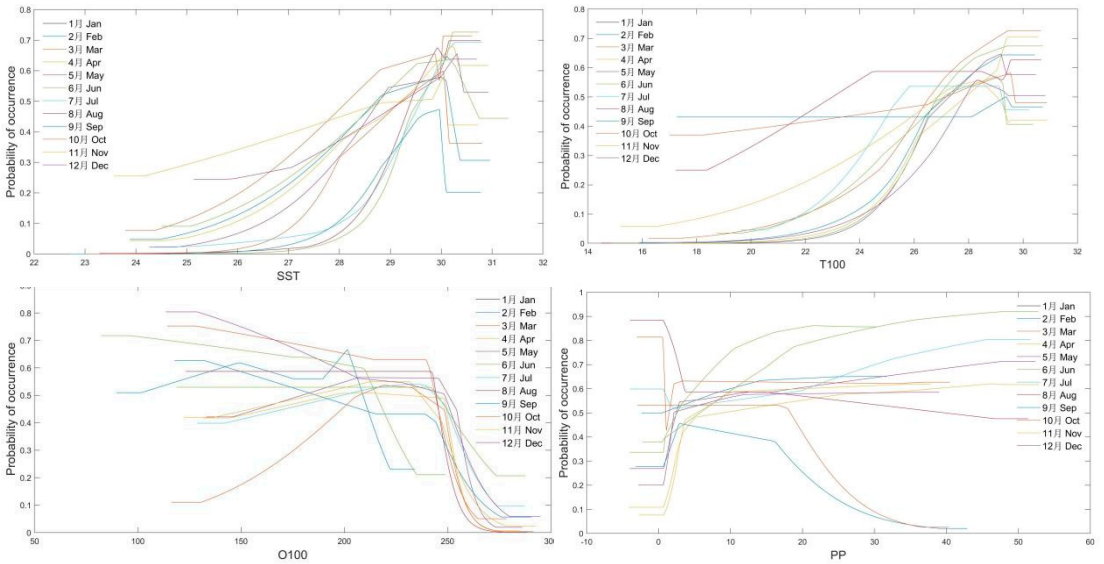

Figure S10. Response curves for important variables in all months in the GFW_0.5° model.

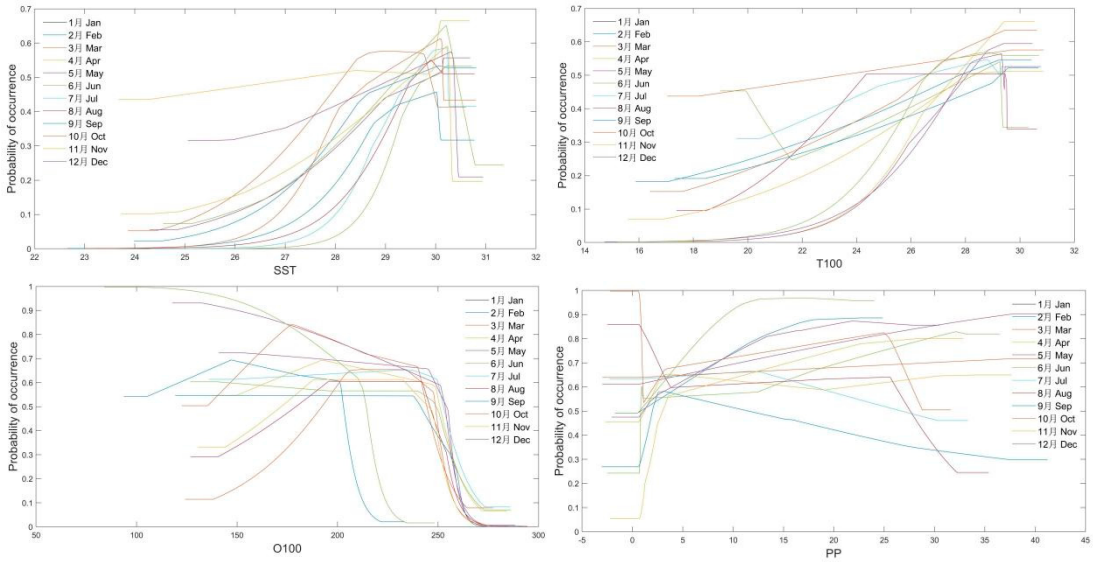

Figure S11. Response curves for important variables in all months in the GFW_1° model.

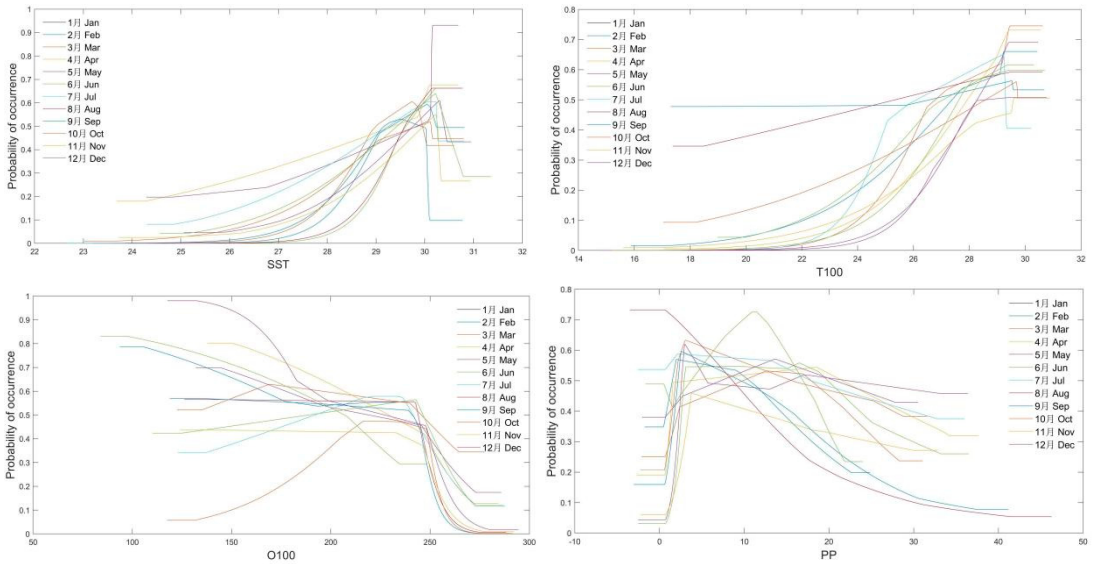

Figure S12. Response curves for important variables in all month in the WPCFC model.

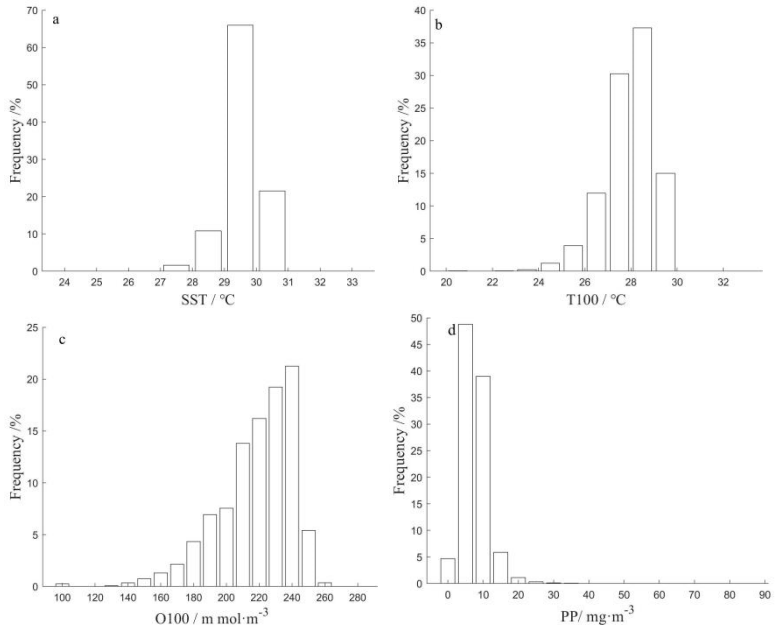

Figure S13. Frequency distribution of important variables based on EF data at the 0.25° spatial scale.

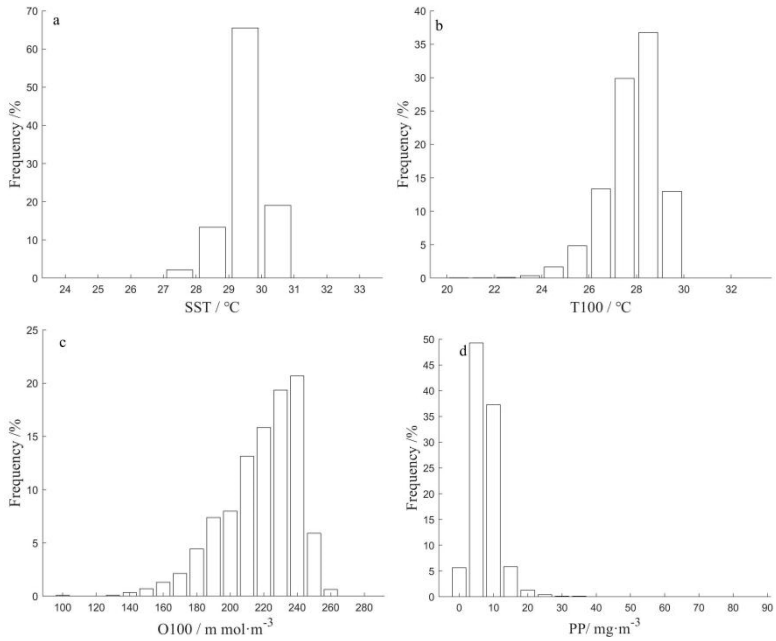

Figure S14. Frequency distribution of important variables based on EF data at the 0.5° spatial scale.

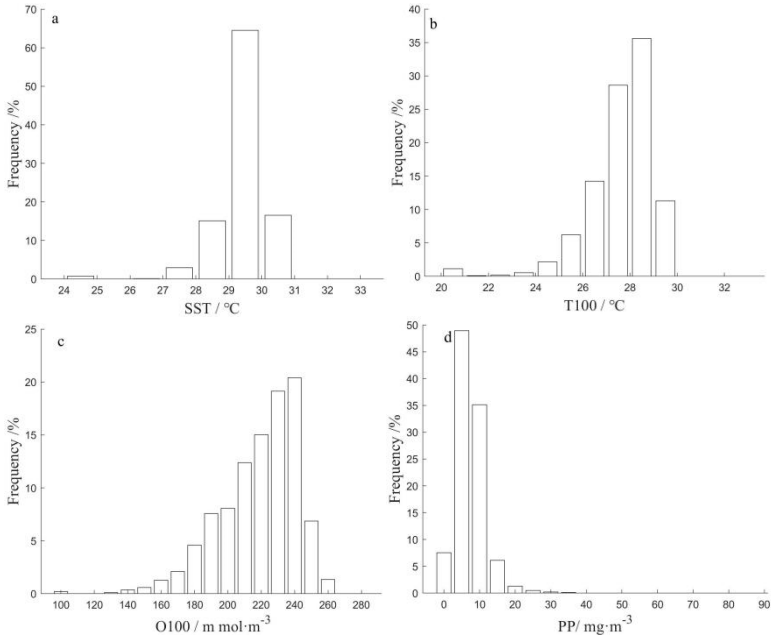

Figure S15. Frequency distribution of important variables based on EF data at the 1° spatial scale.

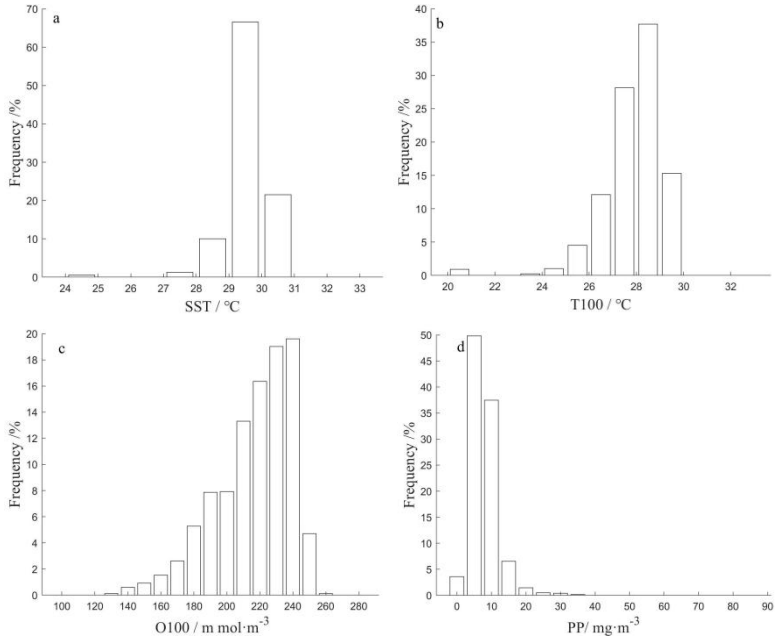

Figure S16. Frequency distribution of important variables based on commercial fishery data at the 1° spatial scale.

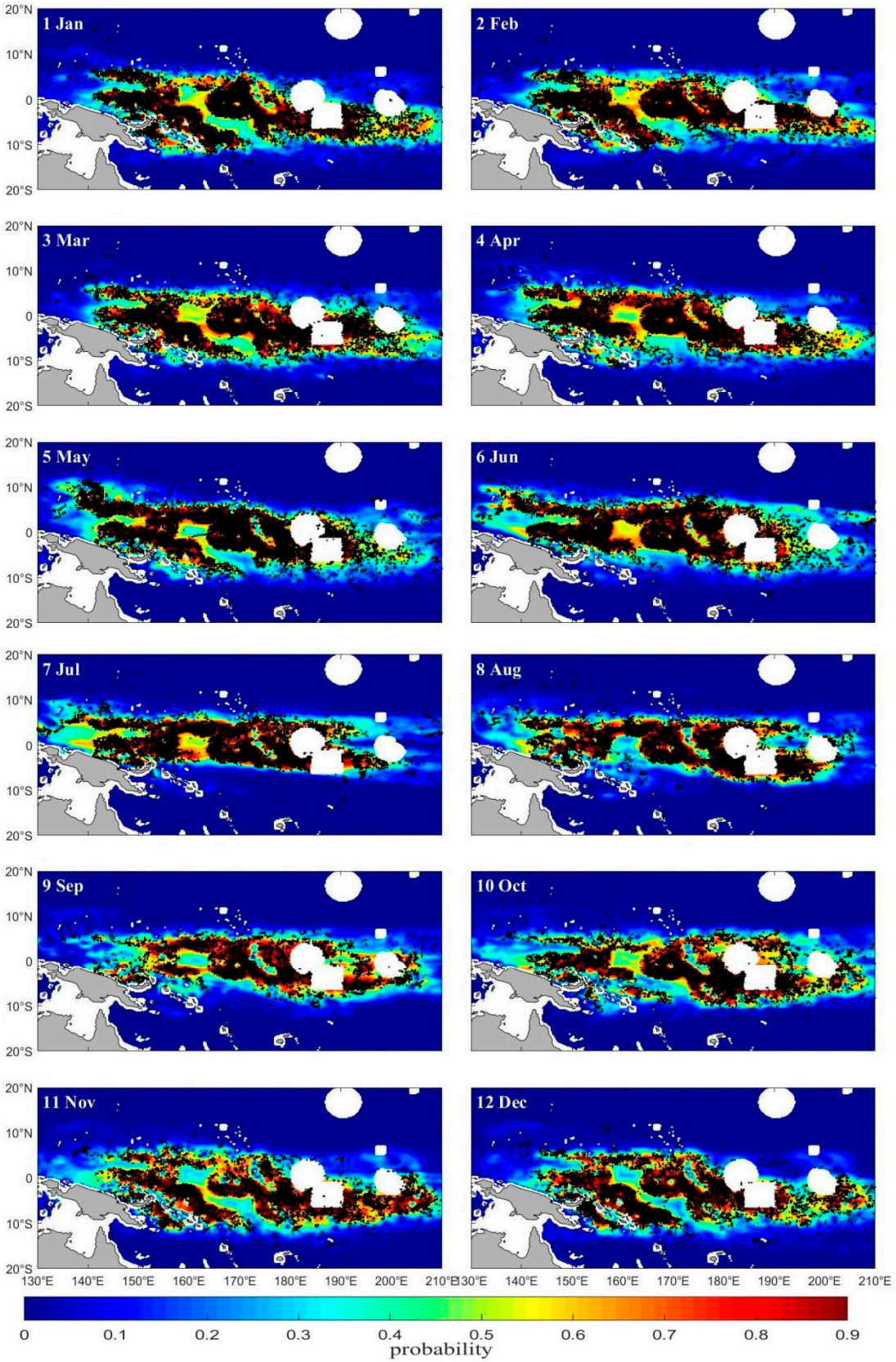

Figure S17. The spatial distribution of fishing locations (black dots) overlain on habitat suitability maps for each month during 2015-2019 in the GFW_0.25° model.

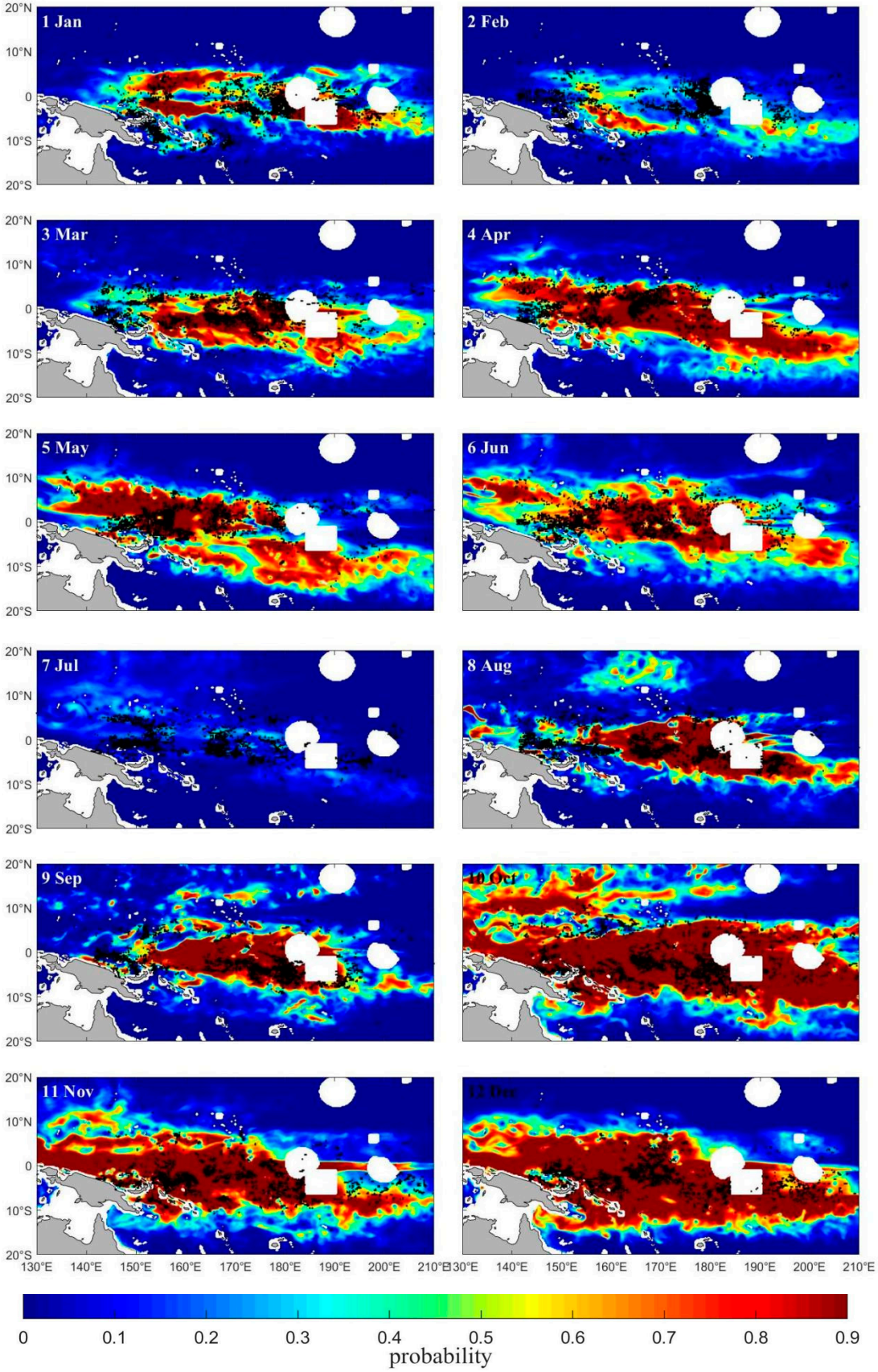

Figure S18. The spatial distribution of fishing locations (black dots) overlain on habitat suitability maps for each month in 2020 in the GFW_0.25° model.

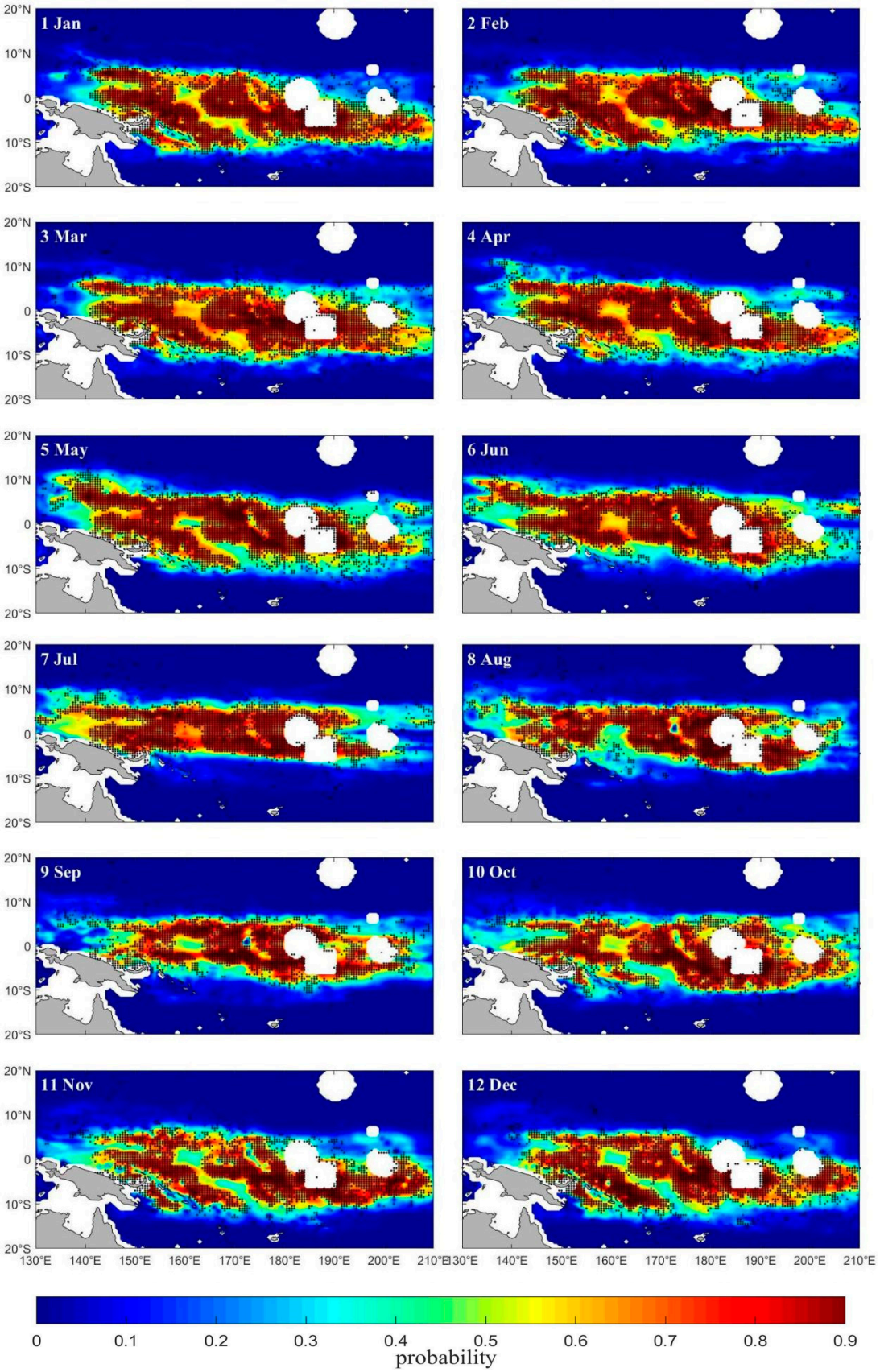

Figure S19. The spatial distribution of fishing locations (black dots) overlain on habitat suitability maps for each month during 2015-2019 in the GFW_0.5° model.

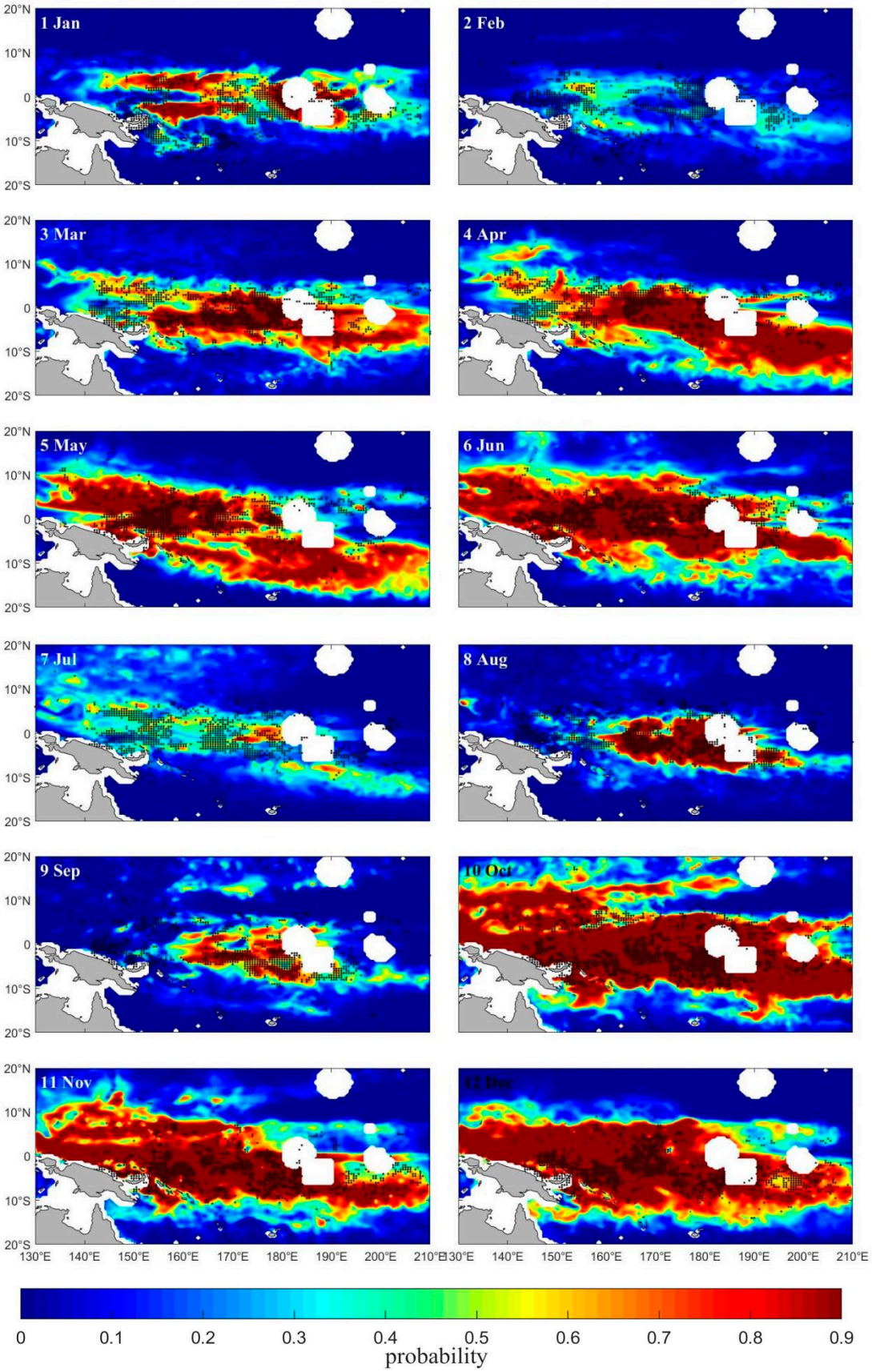

Figure S20. The spatial distribution of fishing locations (black dots) overlain on habitat suitability maps for each month in 2020 in the GFW_0.5° model.

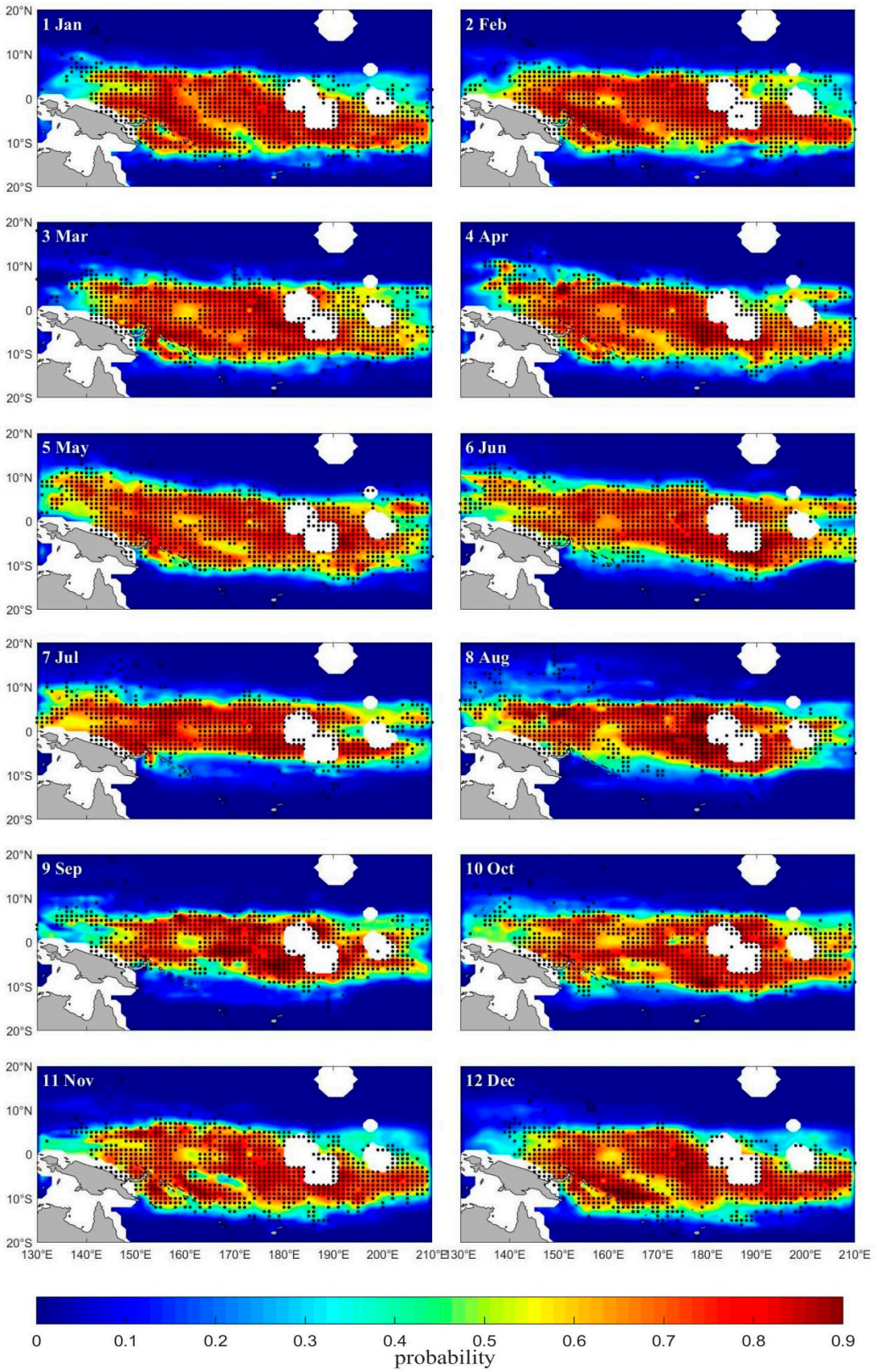

Figure S21. The spatial distribution of fishing locations (black dots) overlain on habitat suitability maps for each month during 2015-2019 in the GFW_1° model.

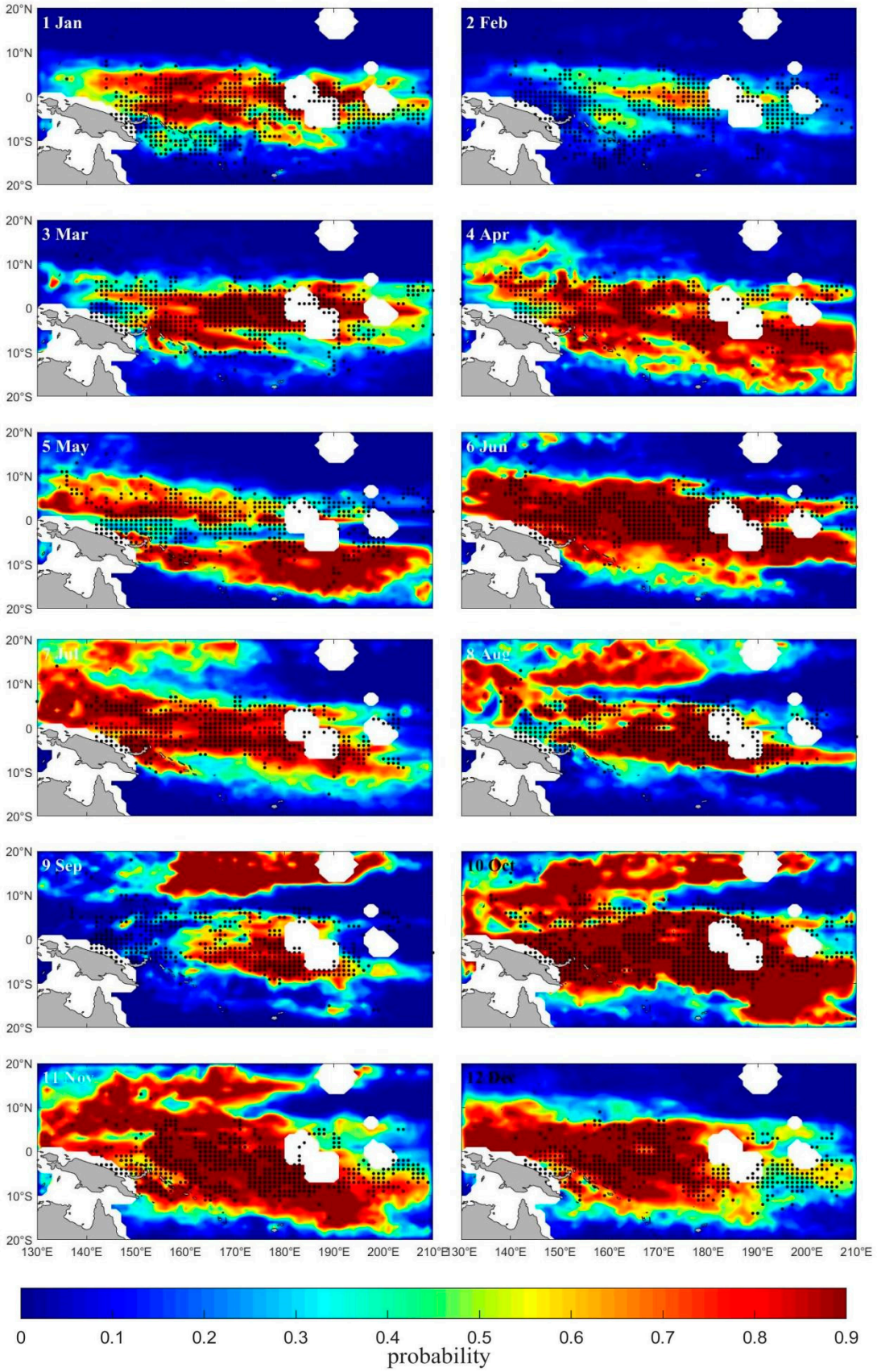

Figure S22. The spatial distribution of fishing data locations (black dots) overlain on habitat suitability maps for each month in 2020 in the GFW_1° model.

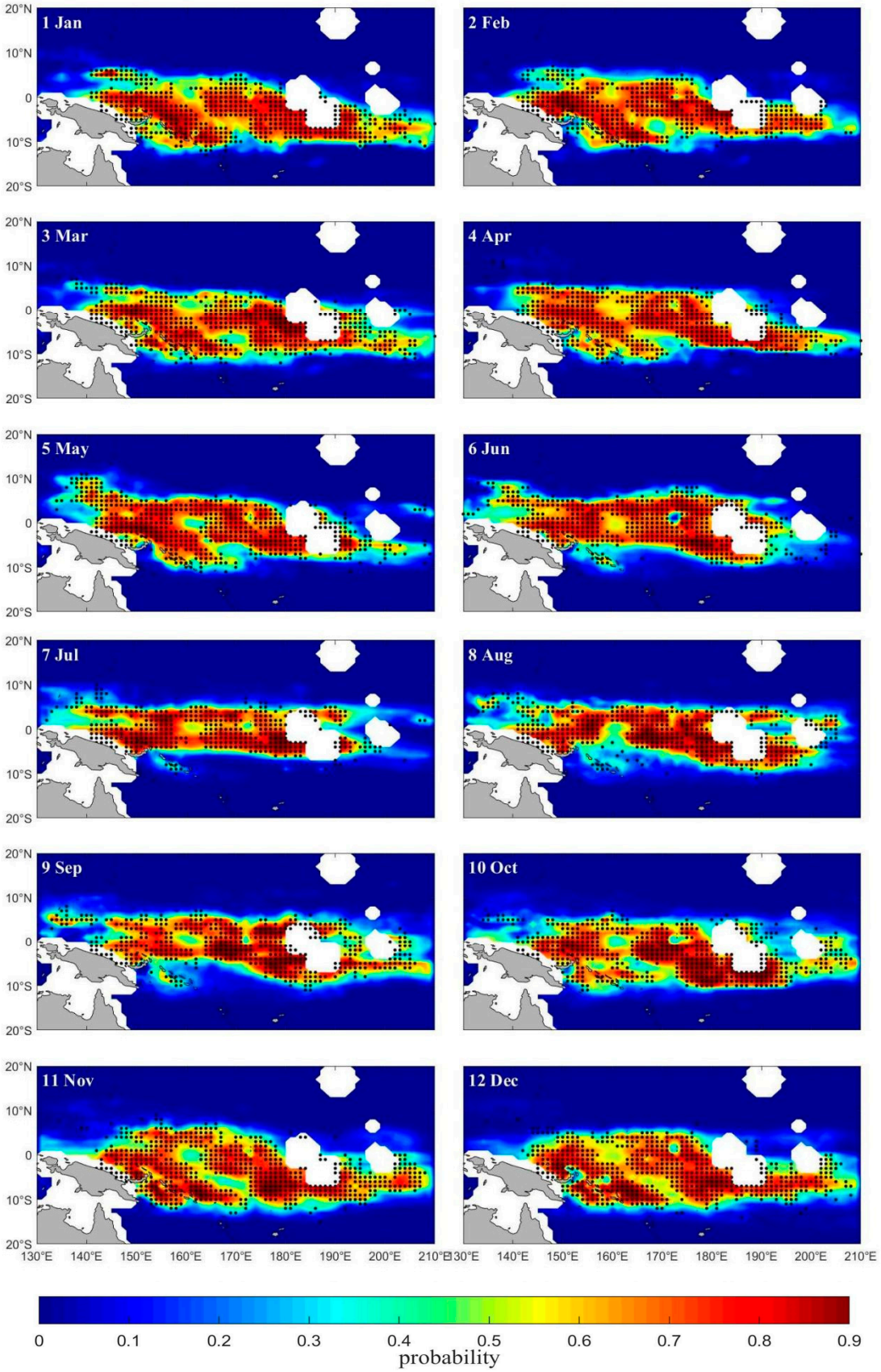

Figure S23. The spatial distribution of fishery data locations (black dots) overlain on habitat suitability maps for each month during 2015-2019 based on fishery data.

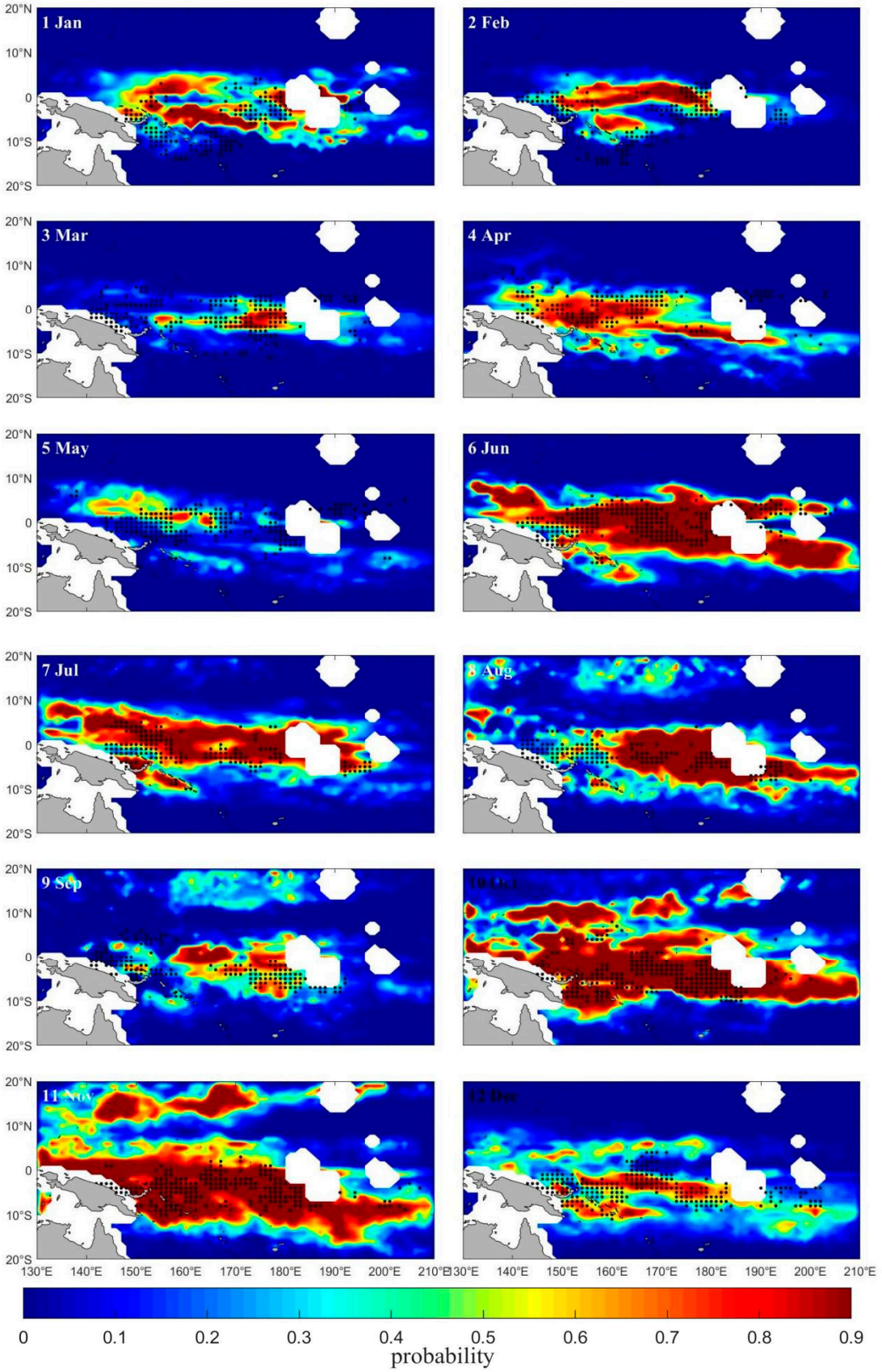

Figure S24. The spatial distribution of fishery locations (black dots) overlain on habitat suitability maps for each month in 2020 based on fishery data.

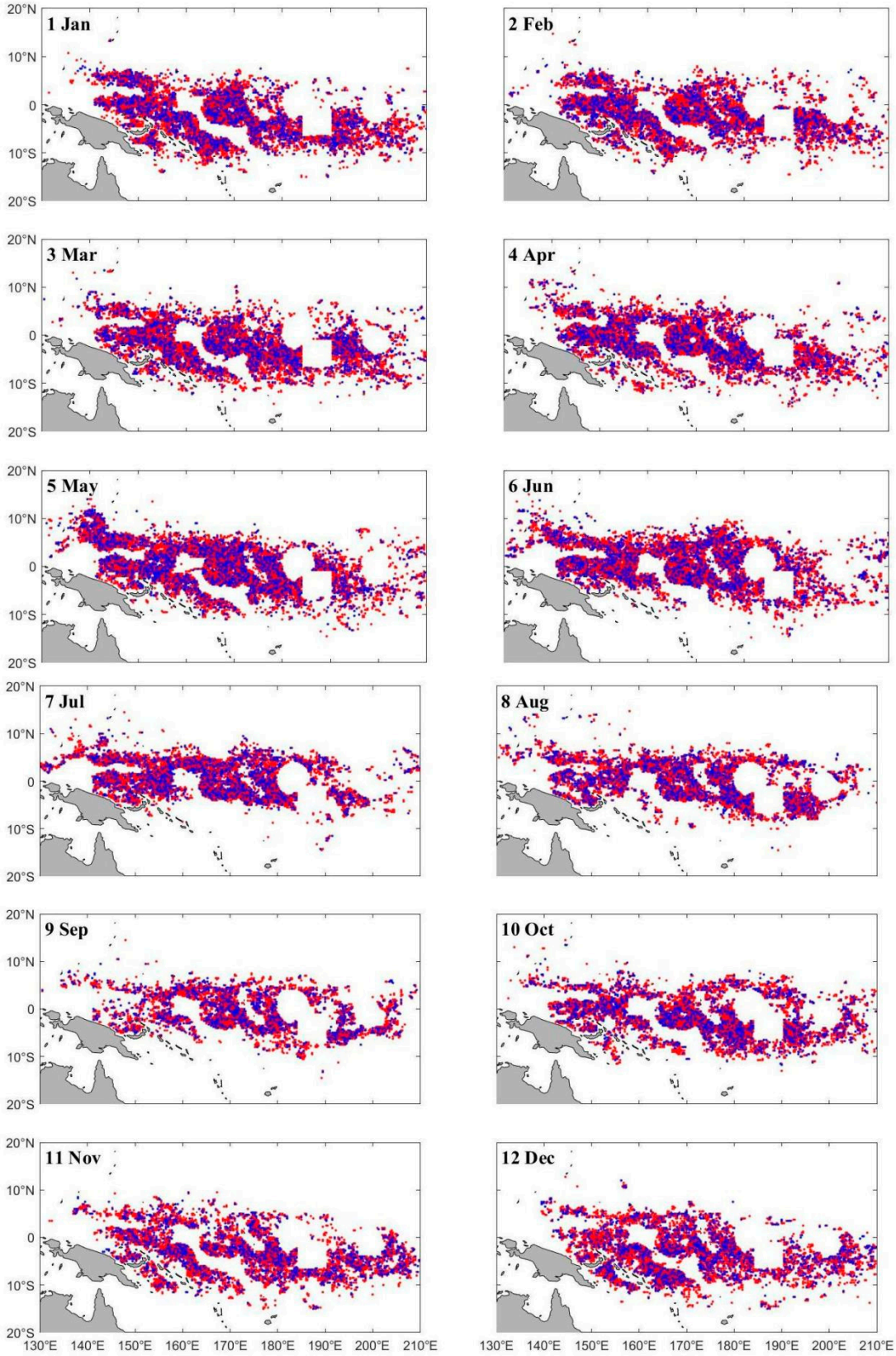

Figure S25 The spatial distribution of sample data in the GFW_0.25° model based on FE data.Red dots show the presence locations used for training, while violet dots show test locations.

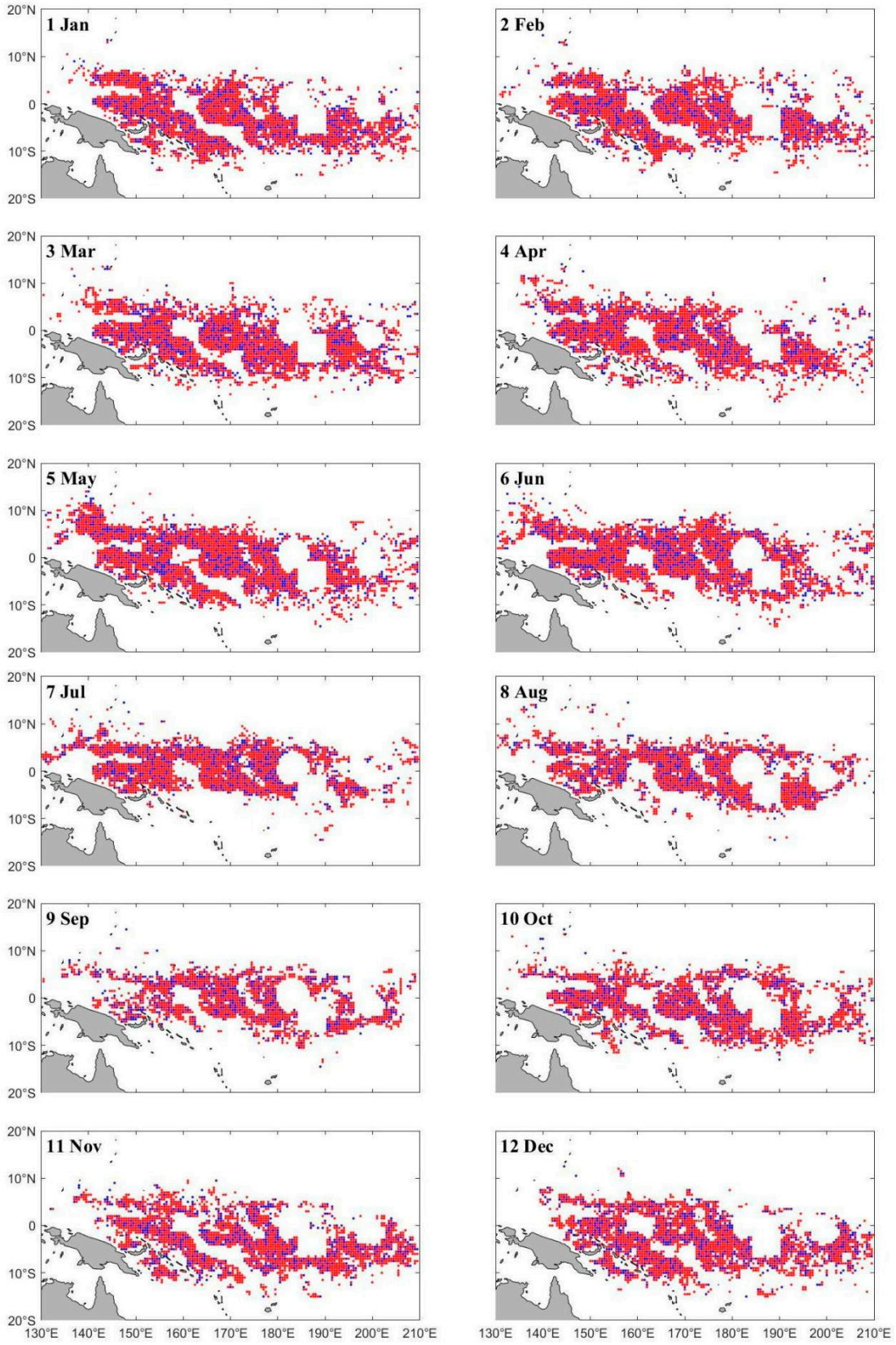

Figure S26 The spatial distribution of sample data in the GFW_0.5° model based on FE data.Red dots show the presence locations used for training, while violet dots show test locations.

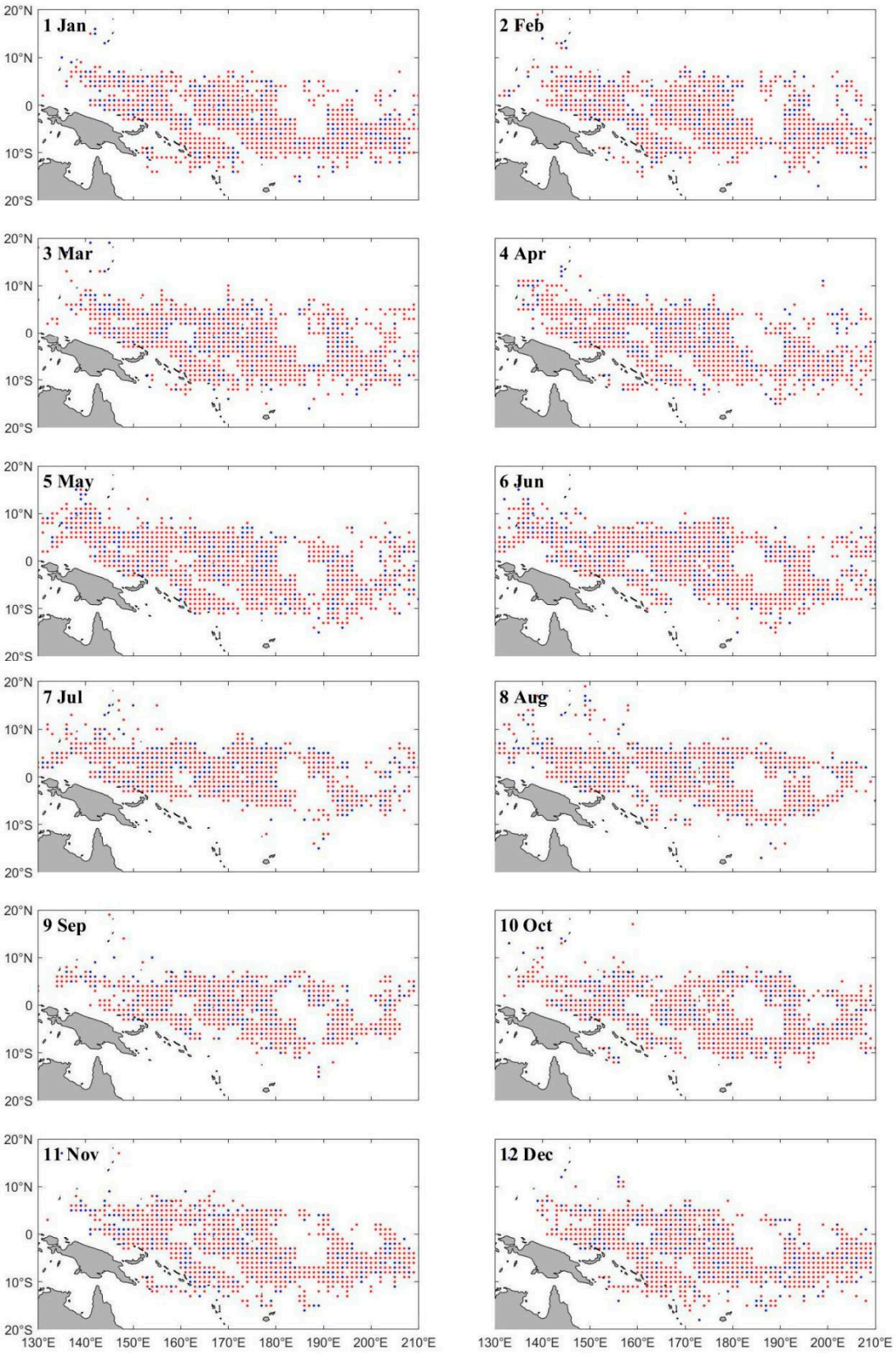

Figure S27 The spatial distribution of sample data in the GFW_1° model based on FE data.Red dots show the presence locations used for training, while violet dots show test locations.

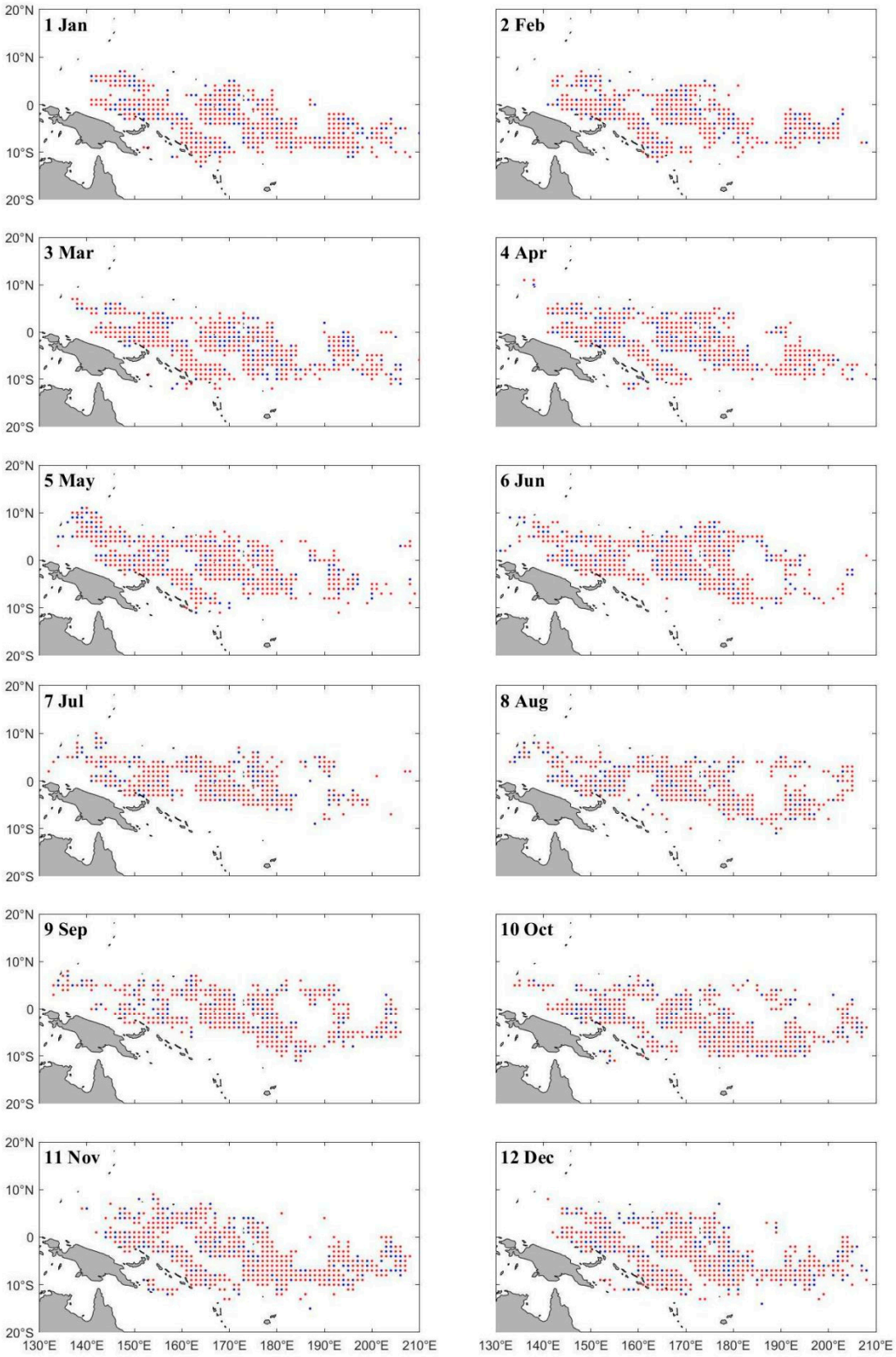

Figure S28 The spatial distribution of sample data in the GFW_1° model based on fishery data.Red dots show the presence locations used for training, while violet dots show test locations.

Table S1. Summary of environmental data and description.

Abbreviation	Variable explained	Unit	Spatial resolution
SST	Sea surface temperature	degrees_C	0.083° ×0.083°
SSH	Sea surface height	m	0.083° ×0.083°
SSS	Sea surface salinity	$1e^{-3}$	0.083° ×0.083°
Mld	Mixed layer depth	m	0.083° ×0.083°
U	Geostrophic zonal velocity	m/s	0.083° ×0.083°
V	Geostrophic meridional velocity	m/s	0.083° ×0.083°
Dox	Dissolved oxygen	$mmol \cdot m^{-3}$	0.25° ×0.25°
PP	Total Primary Production	$mg \cdot m^{-3} \cdot day^{-1}$	0.25° ×0.25°
Chl	Sea surface total Chlorophyll	$mg \cdot m^{-3}$	0.25° ×0.25°
T100	The temperature at 92.33 metres	degrees_C	0.083° ×0.083°
S100	The salinity at 92.33 metres	$1e^{-3}$	0.083° ×0.083°
O100	The oxygen concentration at 97.04 metres	$mmol \cdot m^{-3}$	0.25° ×0.25°
PP100	Total Primary Production 97.04 metres	$mg \cdot m^{-3}$	0.25° ×0.25°
Chl100	The total Chlorophyll at 97.04 metres	$mg \cdot m^{-3}$	0.25° ×0.25°
T200	The temperature at 186.12 metres	degrees_C	0.083° ×0.083°
S200	The salinity at 186.12 metres	$1e^{-3}$	0.083° ×0.083°
O200	The oxygen concentration at 199.79 metres	$mmol \cdot m^{-3}$	0.25° ×0.25°
PP200	Total Primary Production at 199.79 metres	$mg \cdot m^{-3}$	0.25° ×0.25°
chl200	The total Chlorophyll at 199.79 metres	$mg \cdot m^{-3}$	0.25° ×0.25°
Depth	Bathymetry	m	0.083° ×0.083°
DSH	Distance to nearest shore	km	0.01° ×0.01°
DPT	Distance to nearest port	km	0.01° ×0.01°

Table S2. Summary of VIF statistics.

variables	therm	SST	Chl	PP	T200	S200	SSH	S100	Chl100	SSS	T100
VIF	39.91	35.51	26.63	21.18	17.07	15.28	8.37	5.63	5.42	5.04	4.53
variables	PP200	PP100	Chl200	O100	Dox	O200	Mld	U	V	EKE	SSTf
VIF	3.92	3.89	3.87	3.26	2.94	2.38	1.89	1.46	1.16	1.17	1.12

Table S3 Contribution of each factor in each month for the GFW_0.25° model.

	1	2	3	4	5	6	7	8	9	10	11	12
DPT	0.70	0.22	0.68	0.32	0.20	0.03	0.25	0.19	0.42	0.36	0.90	0.17
DSH	5.24	3.37	2.59	4.00	5.47	3.70	2.24	2.36	2.76	5.04	7.22	8.99
EKE	2.29	0.64	1.84	4.90	0.57	0.96	0.23	12.13	18.03	4.30	1.19	0.98

Chl100	0.34	0.46	0.08	0.15	0.83	1.10	0.36	2.95	1.05	0.41	0.02	0.55
Chl200	0.24	0.52	0.16	0.54	1.19	1.64	2.27	2.93	0.31	0.19	0.32	0.90
EKE	0.32	0.14	0.05	0.01	0.00	0.04	0.01	0.04	0.38	0.05	0.05	0.09
Mld	2.70	2.22	4.28	2.38	7.15	1.25	0.18	0.80	3.02	0.48	0.15	1.67
Dox	0.36	2.06	0.97	4.21	0.56	1.30	5.38	0.94	0.89	2.45	1.64	1.30
O100	7.81	2.41	6.39	7.37	10.32	34.37	37.90	34.50	19.85	6.36	11.17	10.44
O200	1.91	1.24	0.28	0.33	7.44	0.23	9.36	12.99	6.12	3.90	1.21	3.99
PP	22.29	49.99	45.48	30.23	23.75	6.50	0.66	0.37	12.41	50.03	27.98	12.41
PP100	0.79	0.71	0.73	0.85	1.29	3.47	0.72	1.46	0.23	0.04	0.27	0.43
PP200	0.84	0.70	0.37	0.71	0.36	4.77	0.78	0.51	1.85	0.27	0.68	0.69
S100	1.57	1.01	1.87	0.97	0.91	1.15	0.04	0.26	1.48	1.44	1.60	0.54
S200	0.62	2.76	0.77	1.08	1.44	1.48	6.48	0.93	2.15	2.08	4.29	3.26
SSH	0.40	1.07	0.00	0.54	3.09	2.52	0.27	0.05	0.06	0.24	0.01	0.10
SSS	2.60	0.45	1.23	1.11	2.24	0.60	2.56	3.12	2.62	2.79	1.97	3.23
SST	28.06	15.28	7.29	22.16	28.12	29.30	29.70	15.02	4.44	5.15	2.71	2.72
SSTf	0.01	0.28	0.20	0.40	0.13	0.00	0.03	0.00	0.03	0.04	0.03	0.01
T100	20.61	14.12	20.19	17.42	4.84	5.58	0.40	7.68	20.85	14.26	36.50	47.44
U	0.17	0.06	4.51	0.02	0.10	0.02	0.20	0.09	0.10	0.02	0.08	0.04
V	0.14	0.31	0.03	0.30	0.01	0.00	0.01	0.70	0.98	0.12	0.00	0.01

Table S4 Contribution of each factor in each month for the GFW_0.5° model.

	1	2	3	4	5	6	7	8	9	10	11	12
DPT	0.35	0.49	0.38	0.33	0.11	0.08	0.41	0.20	0.34	0.35	0.37	0.09
DSH	3.61	2.20	1.13	2.67	3.13	1.06	0.61	1.50	0.98	2.76	6.23	5.98
EKE	0.97	0.78	1.60	1.14	0.08	0.59	0.20	11.59	19.80	3.85	0.68	0.81
Chl100	0.81	0.23	0.97	0.39	0.82	1.40	0.42	1.80	0.91	0.60	0.03	0.88
Chl200	0.64	1.95	0.49	1.24	0.98	1.30	1.06	2.48	0.29	0.21	0.73	0.15
EKE	0.29	0.23	0.21	0.01	0.00	0.02	0.02	0.03	0.02	0.01	0.10	0.06
Mld	4.07	1.23	6.56	6.22	3.04	1.99	0.87	0.99	2.35	0.34	0.46	1.86
Dox	0.67	0.23	1.25	1.94	1.16	0.86	3.55	0.32	1.42	1.33	0.49	2.37
O100	20.12	9.80	16.78	19.18	19.35	43.48	42.77	40.14	33.28	13.57	15.10	13.86
O200	0.71	0.70	0.70	0.61	5.99	4.85	12.36	11.68	6.46	2.95	1.57	1.85
PP	13.69	44.84	42.01	24.47	16.17	0.19	0.90	0.24	1.40	47.28	29.85	13.94
PP100	0.75	0.82	0.33	0.62	4.74	1.68	0.70	1.06	0.51	0.02	0.60	0.54
PP200	1.02	0.60	0.17	0.10	1.42	2.65	2.37	1.19	0.91	0.56	0.02	0.74
S100	0.63	0.05	0.64	2.55	2.42	0.11	0.89	1.10	0.57	2.13	3.18	0.60
S200	0.96	0.81	0.31	0.38	0.04	1.46	5.00	2.72	1.97	0.45	1.63	0.51
SSH	0.06	0.82	0.46	0.11	0.16	3.46	0.13	0.13	0.00	0.05	0.06	0.26
SSS	2.63	2.20	0.63	0.65	1.09	2.30	2.11	3.53	2.63	4.26	1.74	2.11
SST	11.79	11.49	3.09	16.81	32.26	27.18	24.71	12.63	2.71	3.56	2.06	2.09
SSTf	0.10	0.48	0.33	0.11	0.49	0.00	0.19	0.41	0.23	0.37	0.47	0.15
T100	35.96	19.37	21.64	20.44	6.26	5.25	0.66	5.76	22.48	15.26	34.43	51.11
U	0.06	0.41	0.25	0.01	0.27	0.02	0.05	0.19	0.28	0.03	0.16	0.02
V	0.10	0.29	0.09	0.03	0.04	0.07	0.02	0.30	0.46	0.07	0.04	0.01

Table S5 Contribution of each factor in each month for the GFW_1° model.

	1	2	3	4	5	6	7	8	9	10	11	12
DPT	0.06	0.75	0.23	0.45	0.10	0.09	0.09	0.08	0.51	0.73	0.95	0.14
DSH	0.90	1.67	0.28	1.34	1.57	0.32	0.34	0.34	0.26	0.18	2.73	1.84
EKE	1.54	0.31	0.84	2.02	0.07	0.55	0.24	8.33	17.08	1.11	0.35	0.44
Chl100	0.19	0.27	0.29	0.95	2.68	0.69	0.67	2.26	1.08	0.34	0.89	0.79
Chl200	0.52	0.21	0.54	2.22	4.13	1.27	1.59	0.88	0.31	0.59	0.06	0.02
EKE	0.06	0.56	0.63	0.70	0.52	0.12	0.06	0.34	0.06	0.28	0.42	0.34
Mld	4.88	0.42	1.23	5.04	4.43	0.97	1.69	0.21	1.10	1.20	1.07	2.46
Dox	0.44	2.33	1.72	1.53	1.18	3.90	2.00	0.01	0.86	1.73	1.90	1.39
O100	37.45	25.05	29.79	42.30	38.79	48.71	46.68	46.26	42.51	32.85	18.44	23.56
O200	0.73	3.50	1.46	0.54	3.83	8.85	15.48	7.38	5.87	5.31	2.08	0.45
PP	5.64	34.66	27.93	2.78	0.32	0.06	0.50	0.10	0.03	33.52	27.57	9.61
PP100	1.75	0.68	0.54	0.37	0.29	0.36	0.32	1.43	0.69	0.14	0.76	0.82
PP200	0.74	0.24	0.23	0.04	0.03	0.92	3.39	0.48	0.55	0.86	0.27	0.91
S100	0.36	0.50	0.82	2.06	1.02	0.96	0.17	2.28	1.89	3.65	4.63	3.54
S200	0.77	0.43	0.85	4.04	0.93	2.54	3.40	1.26	1.13	0.31	0.39	2.49
SSH	0.42	0.05	0.23	0.04	0.31	0.60	0.13	0.33	0.05	0.94	0.01	0.33
SSS	2.18	2.32	1.50	1.10	0.85	1.41	2.86	3.68	2.96	1.28	1.53	0.93
SST	8.29	6.87	7.76	9.35	31.59	20.42	19.27	16.11	4.39	2.71	4.15	2.87
SSTf	1.04	0.86	0.85	1.69	2.73	0.11	0.57	0.92	1.05	1.28	2.13	1.75
T100	31.85	18.13	21.69	20.96	3.78	7.12	0.38	6.82	16.43	10.68	29.36	45.07
U	0.05	0.07	0.32	0.08	0.84	0.05	0.02	0.22	1.17	0.19	0.29	0.09
V	0.14	0.12	0.26	0.40	0.03	0.00	0.14	0.27	0.04	0.11	0.02	0.15

Table S6 Contribution of each factor in each month for the WPCFC model.

	1	2	3	4	5	6	7	8	9	10	11	12
DPT	0.53	0.28	0.18	0.25	0.10	0.14	1.68	0.45	0.32	0.18	0.53	1.17
DSH	1.29	1.21	0.86	0.58	2.42	0.67	0.83	0.52	0.22	2.60	4.68	0.84
EKE	0.77	0.69	0.84	1.39	0.51	1.98	0.66	9.64	16.69	0.33	0.16	1.04
Chl100	0.65	0.29	0.22	0.75	0.28	0.56	0.49	2.87	2.40	0.57	0.92	0.11
Chl200	0.62	0.35	0.28	0.01	2.22	0.41	5.34	1.49	1.11	0.48	0.49	0.63
EKE	0.09	0.16	0.75	0.01	0.06	1.02	0.38	0.10	0.17	0.49	0.53	0.13
Mld	3.90	4.90	15.62	3.97	5.90	2.82	0.54	0.92	1.76	1.02	0.75	1.84
Dox	0.56	0.33	1.29	1.90	0.18	0.85	6.64	3.24	0.99	1.22	3.08	0.38
O100	1.10	2.00	9.80	5.75	3.22	41.03	34.32	43.46	32.03	5.27	12.57	14.40
O200	0.25	0.24	1.10	1.23	6.42	0.20	4.60	9.97	5.86	1.30	1.46	3.66
PP	29.17	49.19	37.84	33.55	32.28	3.01	0.21	0.31	2.92	55.65	26.53	15.49
PP100	1.32	0.96	0.92	0.30	1.15	1.82	0.82	0.46	0.74	0.34	0.96	0.16
PP200	0.37	0.41	0.38	0.15	1.07	6.09	4.79	0.42	0.51	0.18	0.03	0.32
S100	2.69	0.11	1.23	0.01	2.59	1.72	1.20	0.38	1.91	3.90	3.44	5.44
S200	2.61	6.47	0.63	2.18	0.25	1.84	1.68	1.79	1.71	0.25	3.88	0.67
SSH	0.12	0.31	0.09	4.32	4.07	2.06	1.98	0.00	0.93	0.27	0.03	0.10
SSS	0.81	0.90	1.15	1.55	0.61	1.04	1.46	3.57	2.91	5.03	1.22	1.28
SST	28.66	23.12	16.77	24.77	28.44	24.15	30.16	10.61	2.69	5.66	7.29	6.26
SSTf	0.27	1.73	0.62	0.70	1.60	0.48	0.82	0.54	3.08	1.60	0.87	1.48

T100	23.28	5.74	7.03	15.03	5.38	7.75	1.22	7.53	18.99	12.77	30.41	44.29
U	0.69	0.18	2.21	1.42	0.49	0.04	0.11	0.50	1.13	0.77	0.12	0.13
V	0.23	0.42	0.20	0.17	0.75	0.31	0.08	1.23	0.93	0.13	0.05	0.17

Table S7. Summary statistics derived from different models without mask .

		Month	1	2	3	4	5	6	7	8	9	10	11	12
GFW	0.25°	AUC	0.886	0.889	0.881	0.885	0.882	0.878	0.902	0.900	0.908	0.885	0.884	0.883
		SD	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	0.5°	AUC	0.854	0.852	0.852	0.848	0.847	0.851	0.876	0.873	0.875	0.854	0.855	0.863
		SD	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
	1°	AUC	0.801	0.795	0.783	0.788	0.786	0.775	0.828	0.809	0.829	0.792	0.800	0.807
		SD	0.011	0.012	0.012	0.011	0.011	0.011	0.011	0.011	0.011	0.012	0.011	0.011
WCPFC	1°	AUC	0.867	0.880	0.875	0.891	0.867	0.881	0.875	0.877	0.861	0.859	0.846	0.867
		SD	0.009	0.009	0.009	0.009	0.009	0.009	0.011	0.010	0.010	0.010	0.010	0.010

Table S8. The relative average contributions of the variables to the Maxent model without masks.

variable	Percent contribution			
	GFW_0.25°	GFW_0.5°	GFW_1°	WCPFC
DPT	0.99	0.54	0.35	0.81
DSH	3.97	2.80	0.01	0.87
EKE	3.41	2.74	0.81	2.49
Chl100	0.79	0.86	0.47	0.95
Chl200	0.84	0.74	1.14	0.78
depth	0.13	0.14	0.08	0.20
Mld	1.97	2.15	0.85	3.30
Dox	1.54	1.15	2.13	1.96
O100	16.70	25.23	7.69	18.03
O200	3.65	4.04	30.54	3.45
PP	22.10	18.74	26.04	16.66
PP100	0.62	0.72	2.47	4.77
PP200	1.15	0.79	0.81	1.52
S100	1.21	1.30	3.32	1.32
S200	2.44	1.39	2.72	2.44
SSH	1.09	0.81	0.43	0.97
SSS	1.94	1.65	2.04	1.32
SST	18.93	15.37	6.45	20.17
SSTf	0.12	0.28	0.30	1.31
T100	16.03	18.24	10.84	14.18
U	0.11	0.17	0.31	2.30
V	0.27	0.15	0.20	0.20