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Marine and Freshwater Research

Supplementary Material

Predicting the current and future suitable-habitat distribution of tropical adult and juvenile targeted fishes in multi-sector fisheries of central Queensland, Australia

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MaxEnt analysis

Table S1. List and descriptions of environmental parameters used during initial construction of species distribution models and implementation of correlation analysis for assessing variable importance.

Environmental Parameters	Abbreviation	Unit	Spatial resolution (m)	Temporal Resolution
Sea surface temperature anomaly (BOM)	SST	°C	100	2004, 2006, 2009, 2013, 2015, 2017, 2019
Mean temperature (IMOS)	Temp (mean)	°C	100	2004-2015
Mean salinity (IMOS)	Psal (mean)	ppm	100	2004-2015
Bathymetry	Bathymetry	DEM	100	2017
Dissolved oxygen	DO	µM	100	2016
Mangrove distribution	Mangrove	Presence point	100	2004, 2006, 2009, 2013, 2015, 2017, 2019
Seagrass distribution	Seagrass	Presence point	100	1984-2014
Landsat Vegetation fractional cover (PV, NPV, BS)	Fractional cover mosaic	Presence	100	2004, 2006, 2009, 2013, 2015, 2017, 2019

Table S2. Finfish and elasmobranch species and variables of greatest importance in the spatio-temporal distribution under climate change from the MaxEnt analysis, Central Queensland coast.

Species	Common name	IUCN Red List status	Important variables
Lates calcarifer	Barramundi	Least Concern	bathymetry and salinity
Lutjanus sebae	Red emperor	Least Concern	bathymetry and SST early period
Lethrinis miniatus	Red-throat emperor	Least Concern	SST early period and DO
Platycephalus fuscus	Dusky flathead	Not Evaluated	bathymetry and SST entire period
Pseudorhombus arsius	Largetooth flounder	Not Evaluated	SST entire period
Pomadasys kaakan	Barred javelin	Least Concern	SST entire period and DO
Protonibea diacanthus	Black jewfish	Near Threatened	bathymetry and fractional cover 2004-2006
Scomberomorus semifasciatus	Grey mackerel	Least Concern	salinity and DO
Epinephelus fasciatus	Blacktip rockcod	Least Concern	SST latter period, bathymetry, and fractional cover 2006
Epinephelus fuscoguttatus	Flowery rockcod	Vulnerable	bathymetry and SST latter period
Epinephelus coioides	Goldspotted rockcod	Least Concern	fractional cover 2006 and salinity
Carcharhinus sorrah	Spot-tail shark	Near Threatened	bathymetry and SST latter period
Lutjanus fulviflamma	Blackspot snapper	Least Concern	bathymetry and SST latter period
Lutjanus russellii	Moses snapper	Least Concern	bathymetry and fractional cover 2019
Lutjanus carponotatus	Stripey snapper	Least Concern	bathymetry and DO
Diagramma pictum	Painted sweetlip	Not Evaluated	bathymetry and SST early period
Eleutheronema tetradactylum	Blue threadfin	Not Evaluated, Endangered in Persian Gulf	bathymetry, SST latter period, and DO
Polydactylus macrochir	King threadfin	Not Evaluated	mangrove distribution and fractional cover 2009
Caranx ignobilis	Giant trevally	Least Concern	bathymetry and SST entire period
Caranx sexfasciatus	Bigeye trevally	Least Concern	SST latter period and salinity
Choerodon cephalotes	Purple tuskfish	Least Concern	SST entire period and fractional cover 2006

Table S3. Commercially and recreationally valuable estuarine, finfish species included in the GAM analysis, Central Queensland coast.

Species	**Common name**
Lates calcarifer	Barramundi
Lethrinis miniatus	Red-throat emperor
Pomadasys kaakan	Barred javelin
Protonibea diacanthus	Black jewfish
Scomberomorus semifasciatus	Grey mackerel
Lutjanus carponotatus	Stripey snapper
Eleutheronema tetradactylum	Blue threadfin salmon
Polydactylus macrochir	King threadfin salmon
Mugil cephalus	Sea mullet
Grammatorcynus bicarinatus	Shark mackerel

Table S4. Variables used in the GAM models.

Variable	Abbreviation	Unit
Longitude (spatial location)	Longitude	degrees
Latitude (spatial location)	Latitude	degrees
Month (temporal)	Month	month
Year (temporal)	Year	year
Number of days fished	Days	days
Weight of catch	Weight_kg	kg
Mean temperature (IMOS)	Temp_mean	°C
Mean salinity (IMOS)	Psal_mean	ppm
Catch per unit effort	CPUE	kg/day

Table S5. The CMIP6 Global Climate Models used in the MaxEnt analysis

Model name	Modelling Centre (or Group)	Institute ID
GISS-E2-1-G	National Aeronautics and Space Administration Goddard Institute for Space Studies	NASA GISS
GFDL-CM4	NOAA Geophysical Fluid Dynamics Laboratory	NOAA GFDL

Table S6. Correlation matrix for the 19 individual variables used in the MaxEnt analysis.

Layer	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	1	-0.02099	0.06619	-0.52945	-0.72887	-0.70409	-0.70632	-0.70882	-0.73854	-0.72566	-0.73183	-0.01176	-0.0523	-0.12342	-0.06378	0.06043	-0.13142	-0.08356	-0.08345
2	-0.02099	1	-0.03543	0.0013	-0.06141	-0.06032	-0.06038	-0.06032	-0.05467	-0.05499	-0.04812	-0.00063	0.02914	0.01082	0.05104	0.10944	0.03576	0.04677	0.03601
3	0.06619	-0.03543	1	-0.54923	0.09478	0.05884	0.0656	0.06206	0.06091	0.04637	0.07724	0.00839	-0.18638	-0.20046	-0.06677	-0.12471	-0.05675	-0.06448	-0.02404
4	-0.52945	0.0013	-0.54923	1	0.4566	0.44456	0.45154	0.45848	0.45645	0.43785	0.39746	-0.01554	0.08987	0.09473	0.09926	-0.02607	0.12691	0.10833	0.14845
5	-0.72887	-0.06141	0.09478	0.4566	1	0.96189	0.96356	0.96261	0.96324	0.94865	0.94286	-0.00803	0.03256	0.14881	0.05684	-0.16575	0.1438	0.04291	0.09173
6	-0.70409	-0.06032	0.05884	0.44456	0.96189	1	0.99647	0.99353	0.93694	0.93028	0.91166	-0.01479	0.05805	0.17269	0.06644	-0.15201	0.15071	0.0499	0.08895
7	-0.70632	-0.06038	0.0656	0.45154	0.96356	0.99647	1	0.99475	0.93832	0.9299	0.91081	-0.01454	0.05536	0.17296	0.06494	-0.15618	0.15067	0.0481	0.08907
8	-0.70882	-0.06032	0.06206	0.45848	0.96261	0.99353	0.99475	1	0.93737	0.92778	0.91027	-0.01464	0.05522	0.17984	0.06382	-0.15693	0.15	0.04765	0.08889
9	-0.73854	-0.05467	0.06091	0.45645	0.96324	0.93694	0.93832	0.93737	1	0.96643	0.9659	-0.00338	0.05293	0.17882	0.06185	-0.1482	0.14802	0.04486	0.08737
10	-0.72566	-0.05499	0.04637	0.43785	0.94865	0.93028	0.9299	0.92778	0.96643	1	0.95875	0.00098	0.06054	0.18412	0.06413	-0.14557	0.14561	0.04282	0.0781
11	-0.73183	-0.04812	0.07724	0.39746	0.94286	0.91166	0.91081	0.91027	0.9659	0.95875	1	0.00423	0.05493	0.18162	0.05818	-0.13609	0.13749	0.04114	0.07003
12	-0.01176	-0.00063	0.00839	-0.01554	-0.00803	-0.01479	-0.01454	-0.01464	-0.00338	0.00098	0.00423	1	-0.00251	-0.00136	-0.00183	-0.00394	0.00053	-0.00305	-0.00599
13	-0.0523	0.02914	-0.18638	0.08987	0.03256	0.05805	0.05536	0.05522	0.05293	0.06054	0.05493	-0.00251	1	0.35387	0.2065	0.28632	0.22046	0.21325	0.16016
14	-0.12342	0.01082	-0.20046	0.09473	0.14881	0.17269	0.17296	0.17984	0.17882	0.18412	0.18162	-0.00136	0.35387	1	0.17947	0.21092	0.21174	0.17358	0.13091
15	-0.06378	0.05104	-0.06677	0.09926	0.05684	0.06644	0.06494	0.06382	0.06185	0.06413	0.05818	-0.00183	0.2065	0.17947	1	0.27371	0.204	0.20535	0.20546
16	0.06043	0.10944	-0.12471	-0.02607	-0.16575	-0.15201	-0.15618	-0.15693	-0.1482	-0.14557	-0.13609	-0.00394	0.28632	0.21092	0.27371	1	0.21758	0.30141	0.25235
17	-0.13142	0.03576	-0.05675	0.12691	0.1438	0.15071	0.15067	0.15	0.14802	0.14561	0.13749	0.00053	0.22046	0.21174	0.204	0.21758	1	0.21675	0.20419
18	-0.08356	0.04677	-0.06448	0.10833	0.04291	0.0499	0.0481	0.04765	0.04486	0.04282	0.04114	-0.00305	0.21325	0.17358	0.20535	0.30141	0.21675	1	0.2232
19	-0.08345	0.03601	-0.02404	0.14845	0.09173	0.08895	0.08907	0.08889	0.08737	0.0781	0.07003	-0.00599	0.16016	0.13091	0.20546	0.25235	0.20419	0.2232	1

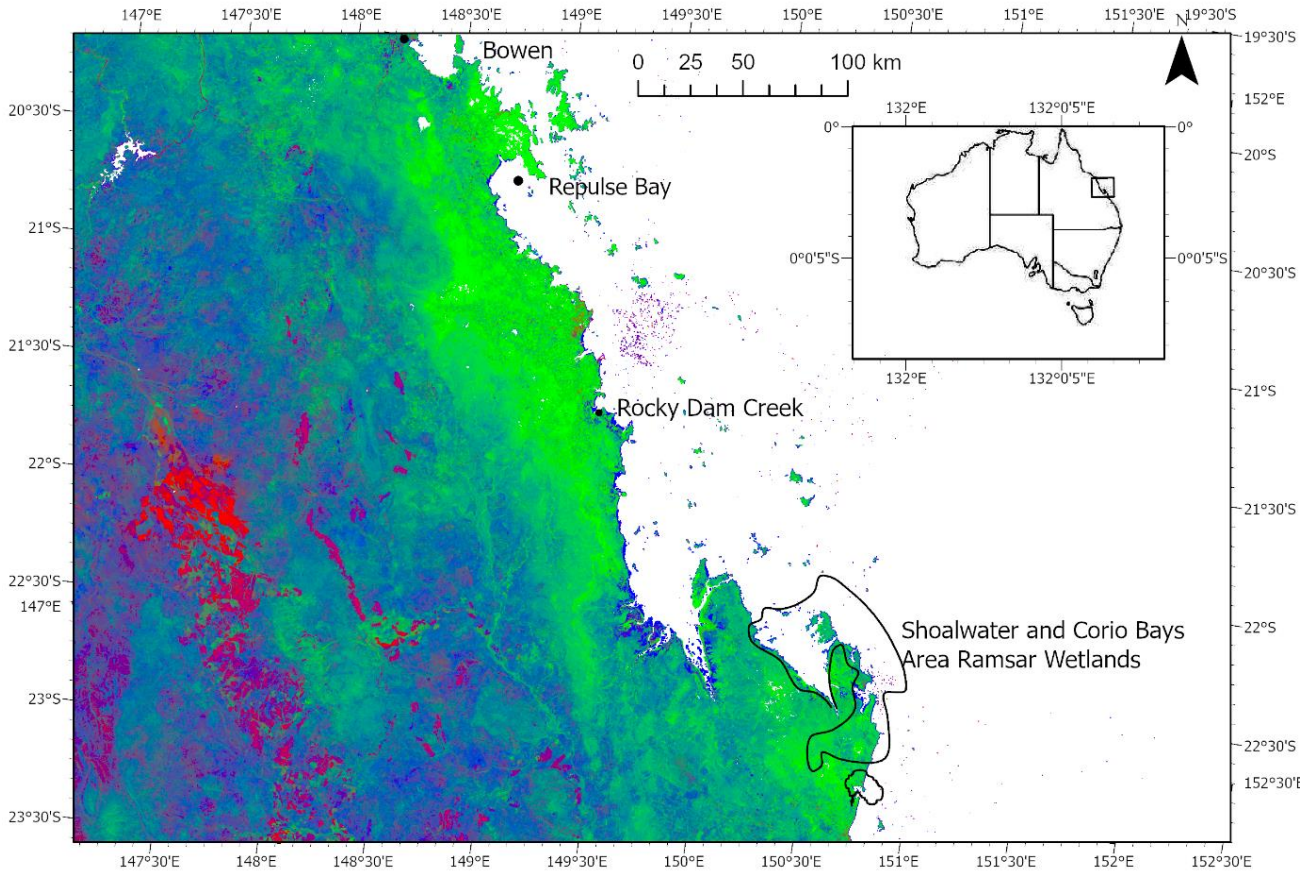


Figure S1. Study site-Bowen to Shoalwater and Corio Bays Area Ramsar Wetland, Central Queensland-Landsat fractional cover image visualised by using the Band 1-red (bare ground and rock), Band 2-green (vegetation), Band 3-blue (non-green vegetation indicative of drier habitats with less vegetative cover), provided by AusCover (see https://nccarf.jcu.edu.au/terrestrialbiodiversity/index.php/General/auscover.html).

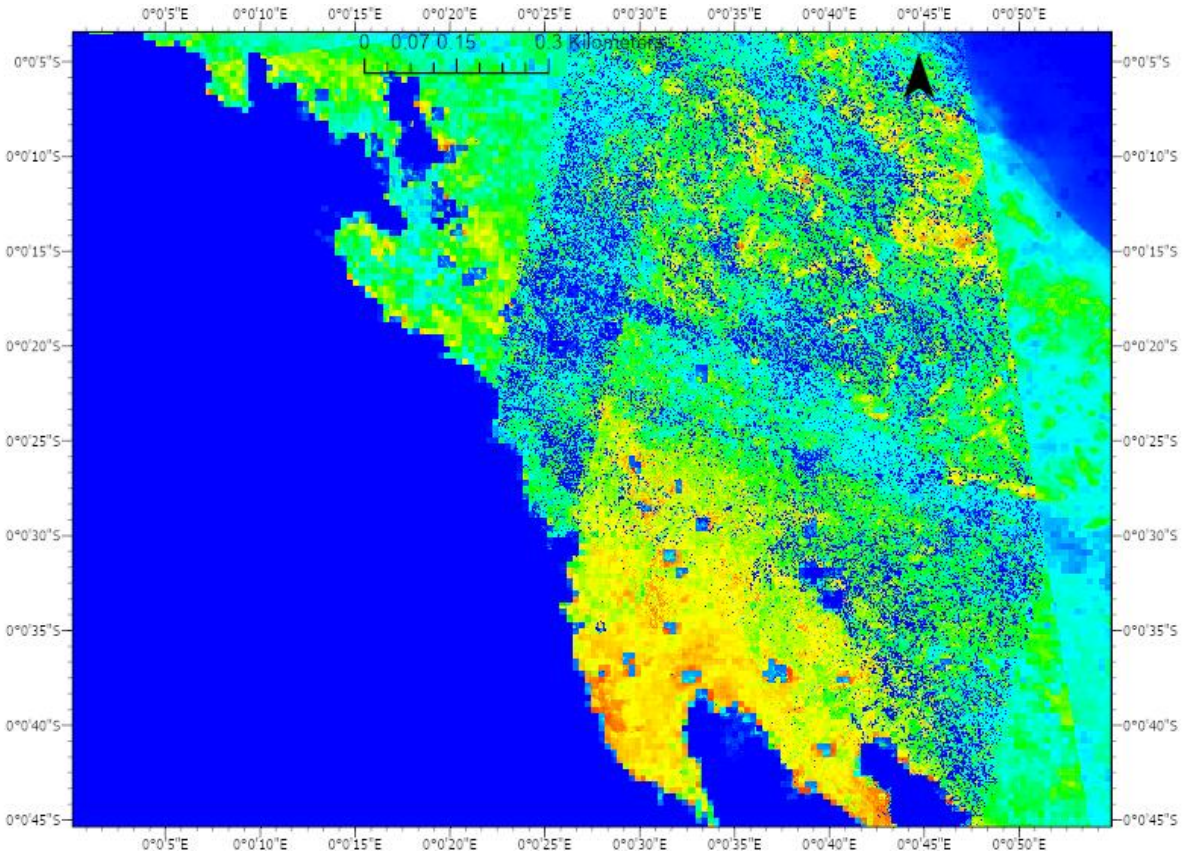


Figure S2. Dusky flathead (*Platydephalus fuscus*) spatio-temporal distribution in the current (2004-2019) climate. Warmer colours indicate areas predicted by the MaxEnt model as more likely to be suitable habitats for tropical, estuarine, fish species. The solid blue colour is the land mass westward of the coastline in the study region-Bowen to Shoalwater and Corio Bays Area Ramsar Wetland, Central Queensland. The straight lines in the image are an artefact of the Landsat fractional cover mosaic (Geoscience Australia 2020).

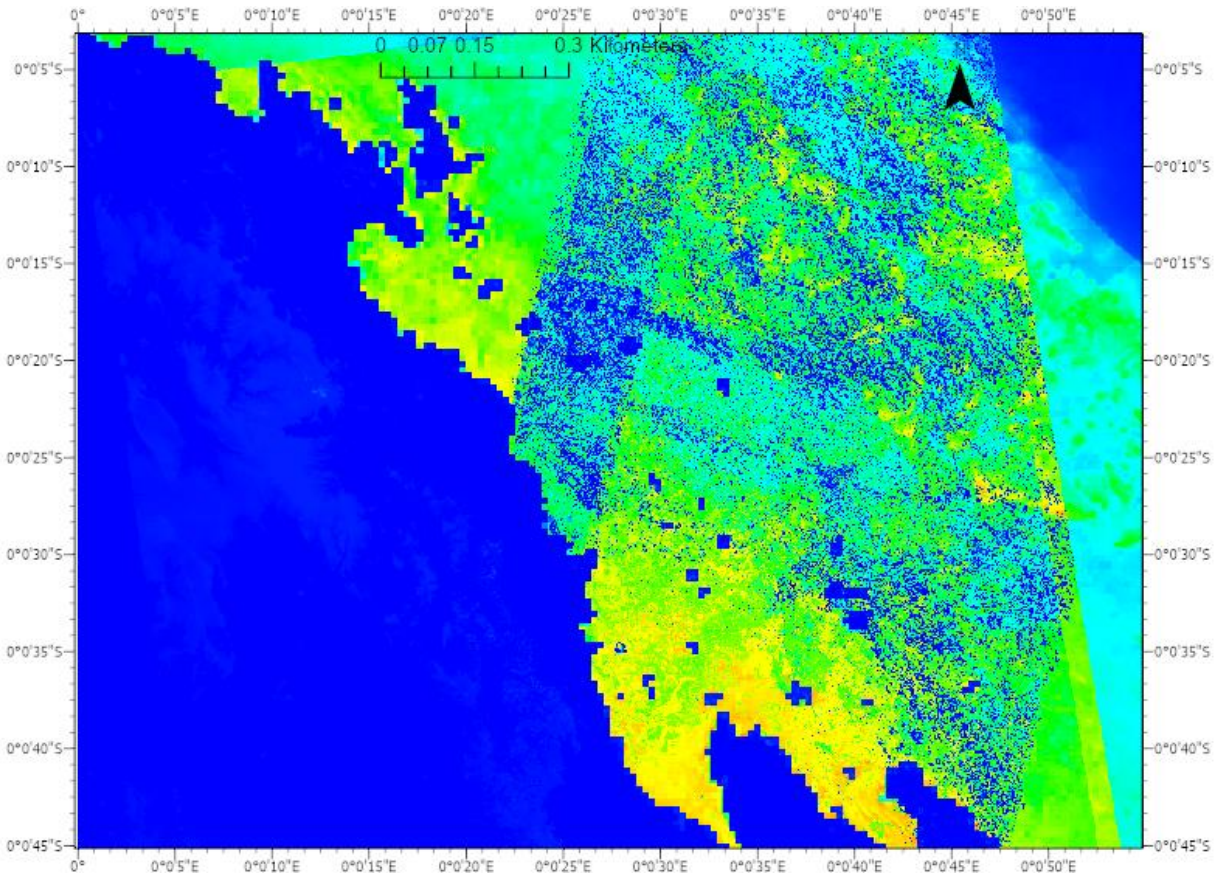


Figure S3. Dusky flathead (*Platycephalus fuscus*) spatio-temporal distribution under future climate conditions. Warmer colours indicate areas predicted by the MaxEnt model as more likely to be suitable habitats for tropical, estuarine, fish species. The solid blue colour is the land mass westward of the coastline in the study region-Bowen to Shoalwater and Corio Bays Area Ramsar Wetland, Central Queensland. The straight lines in the image are an artefact of the Landsat fractional cover mosaic (Geoscience Australia 2020).

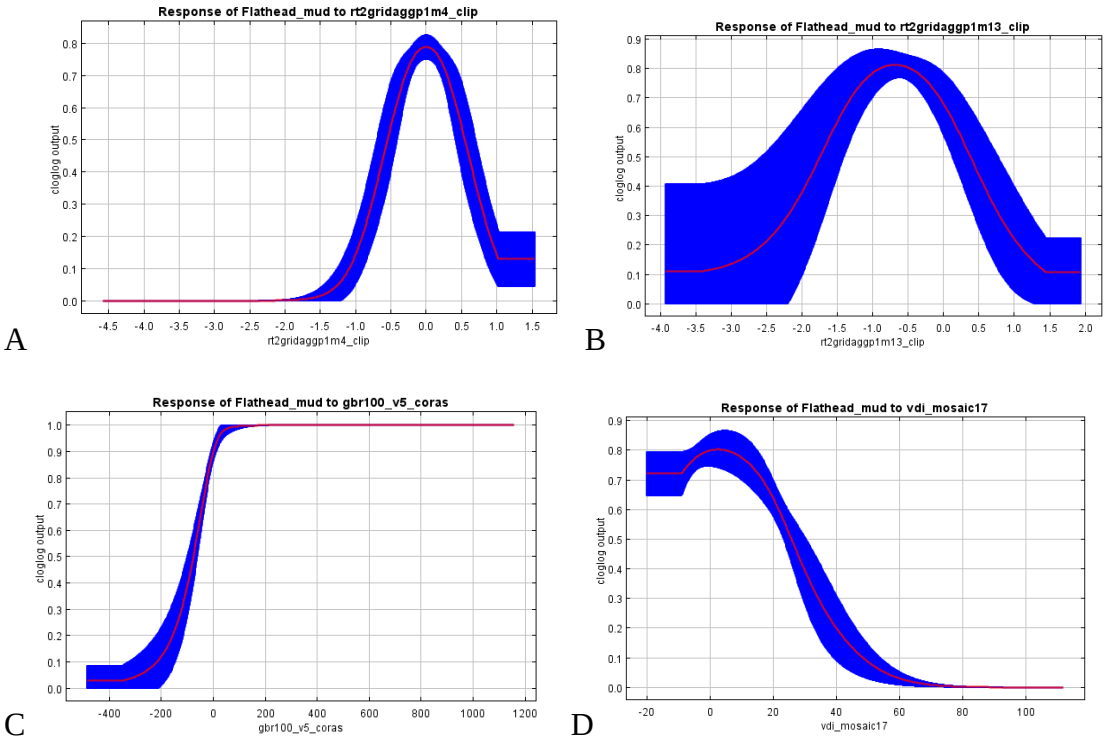


Figure S4. Dusky flathead (*Platycephalus fuscus*) marginal response curves of (A) SST early period of the 21st century, (B) SST latter period of the 21st century, (C) bathymetry, and (D) fractional cover 2017, when all other environmental variables are kept at average sample value over the set of presence localities, Central Queensland coast.

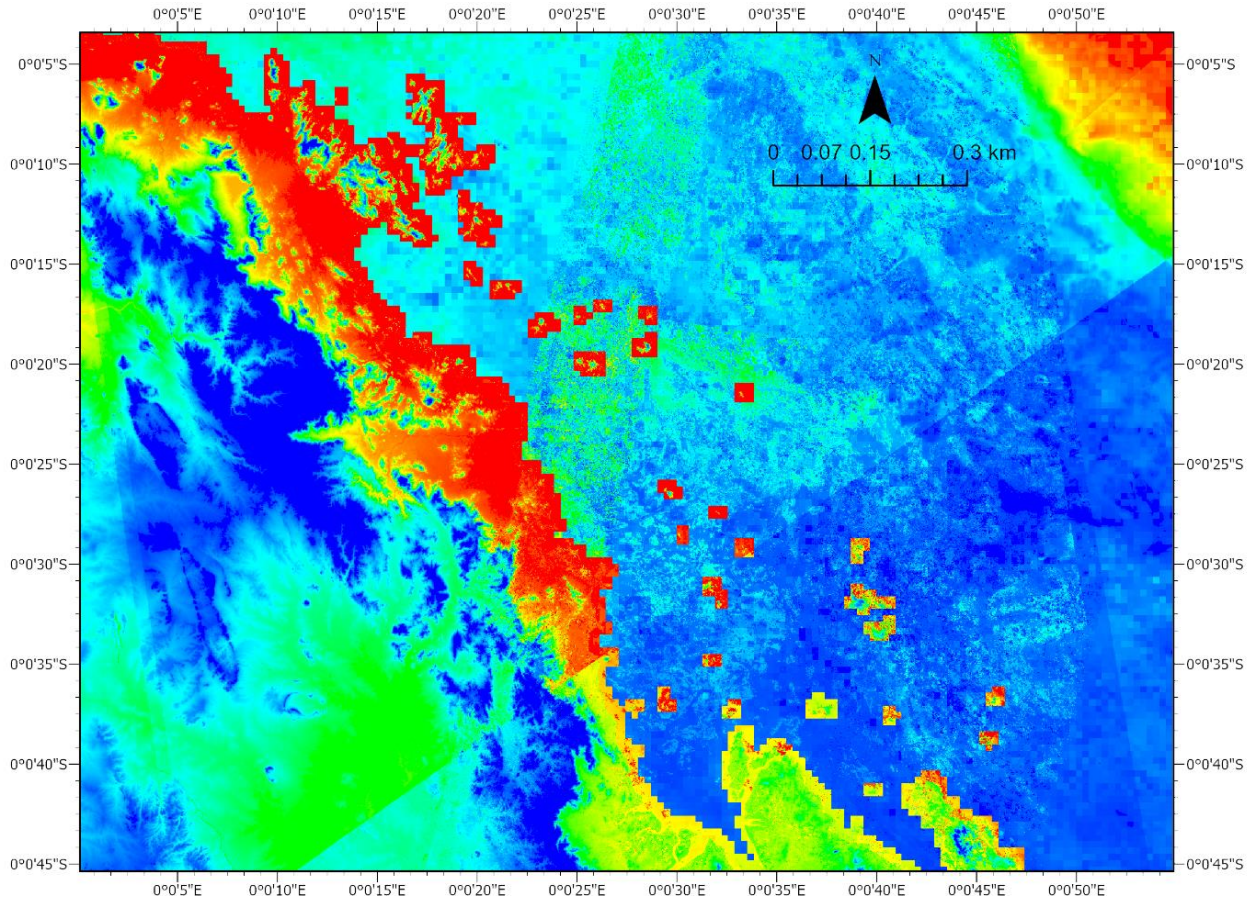


Figure S5. Blue threadfin salmon (*Eleutheronema tetradactylum*) spatio-temporal distribution in the current (2004-2019) climate. Warmer colours indicate areas predicted by the MaxEnt model as more likely to be suitable habitats for tropical, estuarine, fish species in the study region-Bowen to Shoalwater and Corio Bays Area Ramsar Wetland, Central Queensland. The straight lines in the image are an artefact of the Landsat fractional cover mosaic (Geoscience Australia 2020).

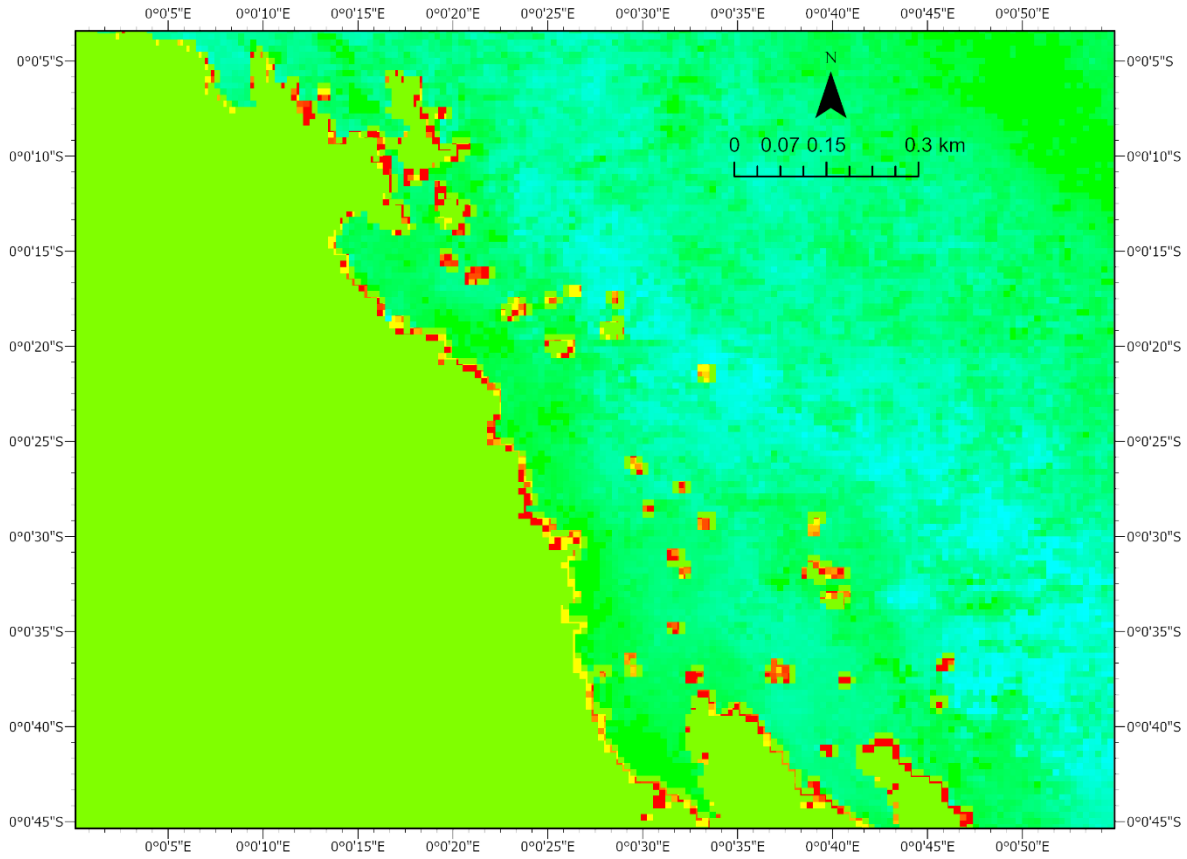
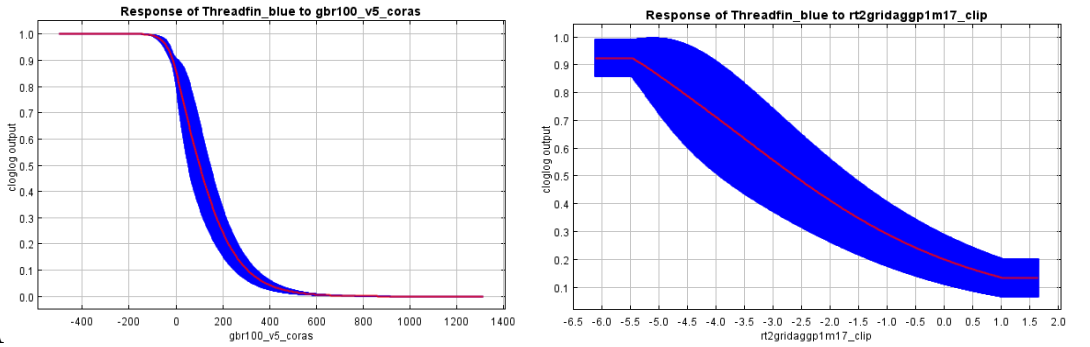
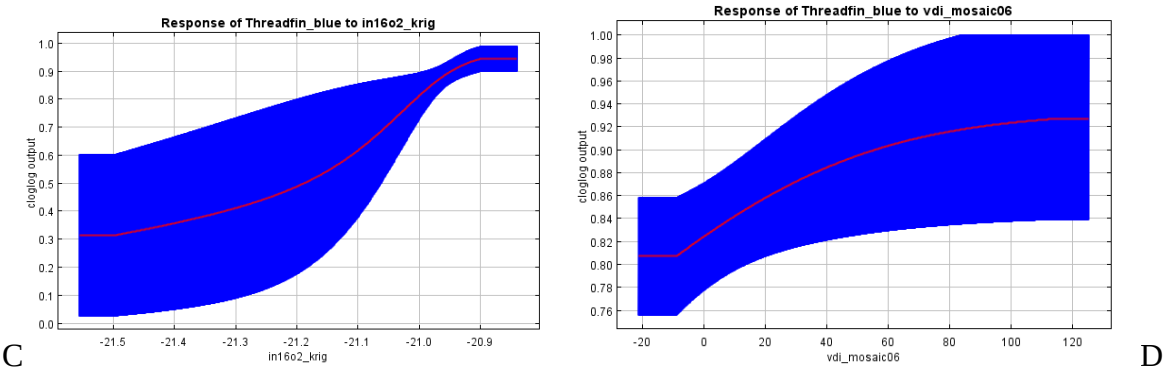


Figure S6. Blue threadfin salmon (*Eleutheronema tetradactylum*) spatio-temporal distribution under future climate conditions. Warmer colours indicate areas predicted by the MaxEnt model as more likely to be suitable habitats for tropical, estuarine, fish species in the study region-Bowen to Shoalwater and Corio Bays Area Ramsar Wetland, Central Queensland. The straight lines in the image are an artefact of the Landsat fractional cover mosaic (Geoscience Australia 2020).

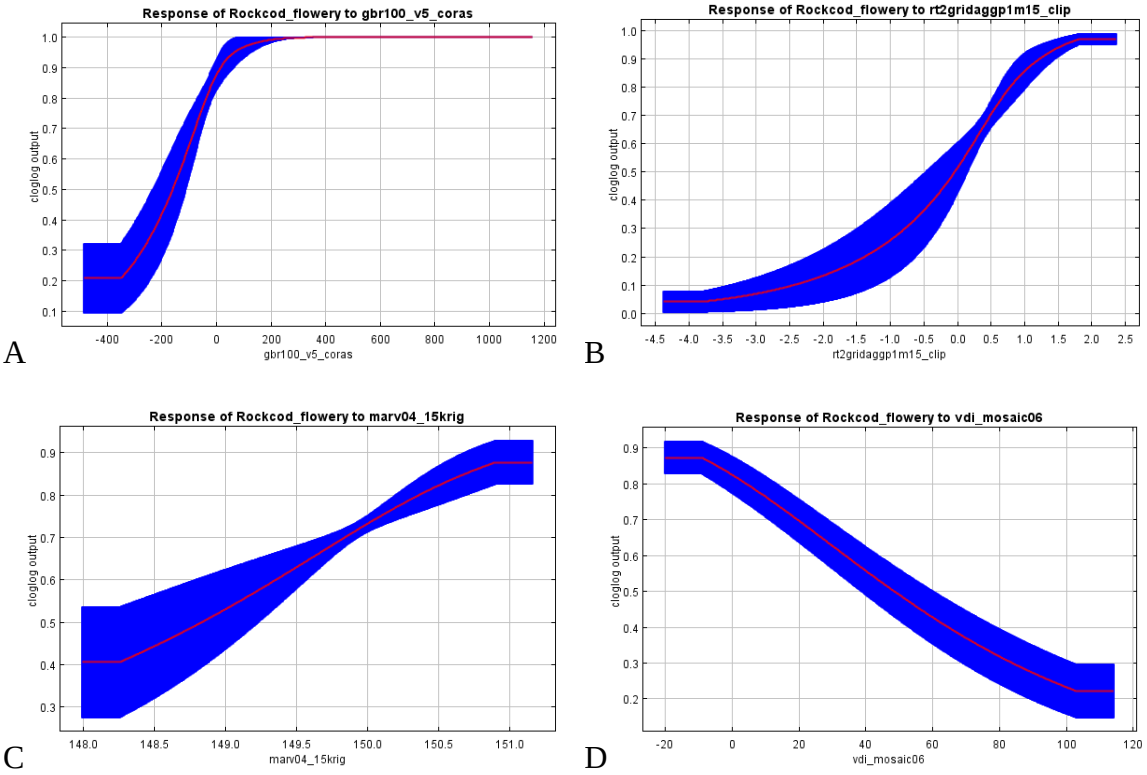


A B



C D

Figure S7. Blue threadfin salmon (*Eleutheronema tetradactylum*) marginal response curves of (A) bathymetry, (B) SST latter period of the 21st century, (C) dissolved O_2, and (D) fractional cover 2006, when all other environmental variables are kept at average sample value over the set of presence localities, Central Queensland coast.



A B

C D

Figure S8. Flowery rockcod (*Epinephelus fuscoguttatus*) marginal response curves of (A)) bathymetry, (B) SST latter period of the 21st century, (C) salinity, and (D) fractional cover 2006, when all other environmental variables are kept at average sample value over the set of presence localities, Central Queensland coast.

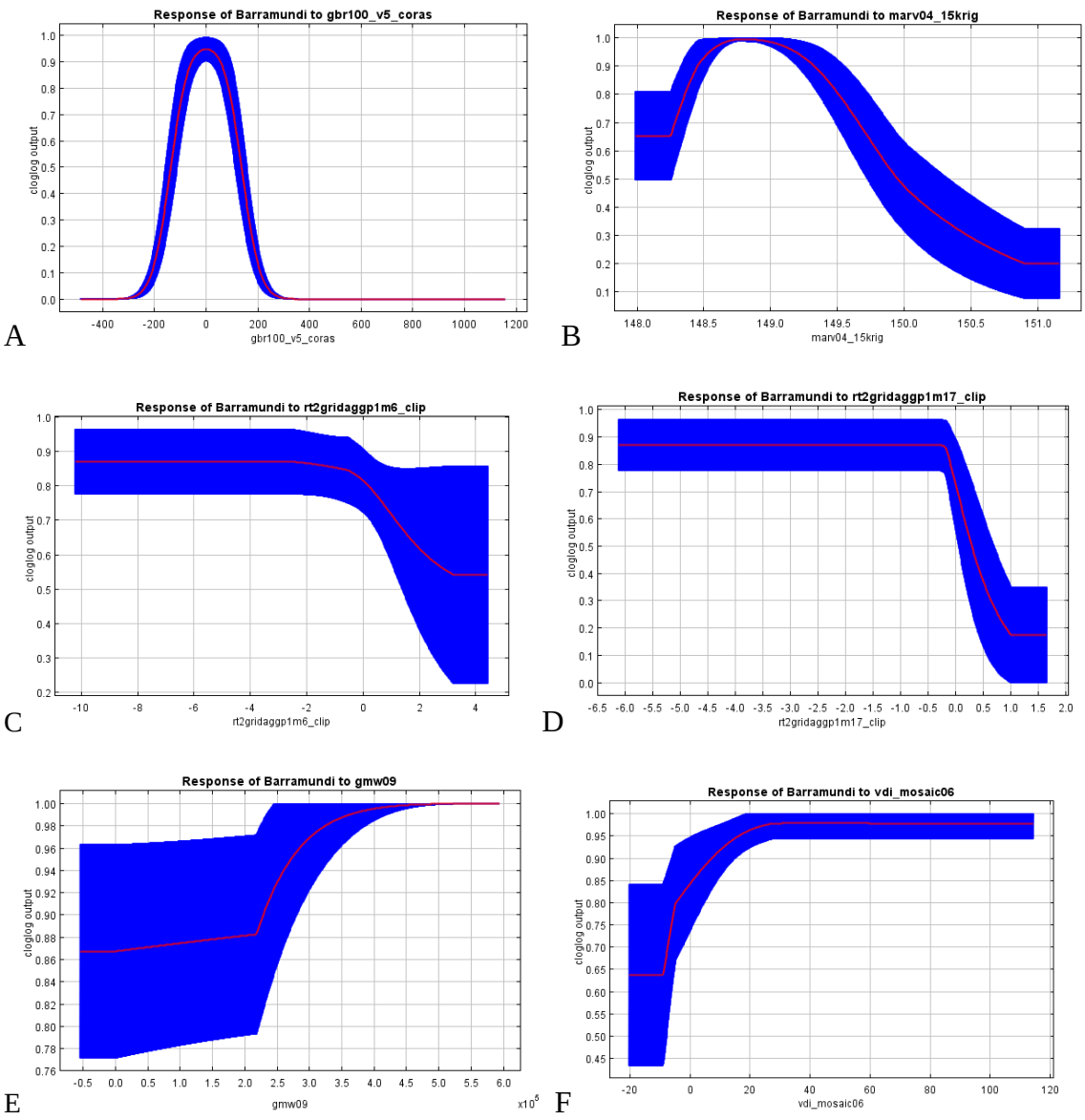


Figure S9. Barramundi (*Lates calcarifer*) marginal response curves of (A) bathymetry, (B) salinity, (C) SST early period of the 21st century (D) SST latter period of the 21st century, (E) distribution of mangroves, and (F) fractional cover 2006, when all other environmental variables are kept at average sample value over the set of presence localities, Central Queensland coast.

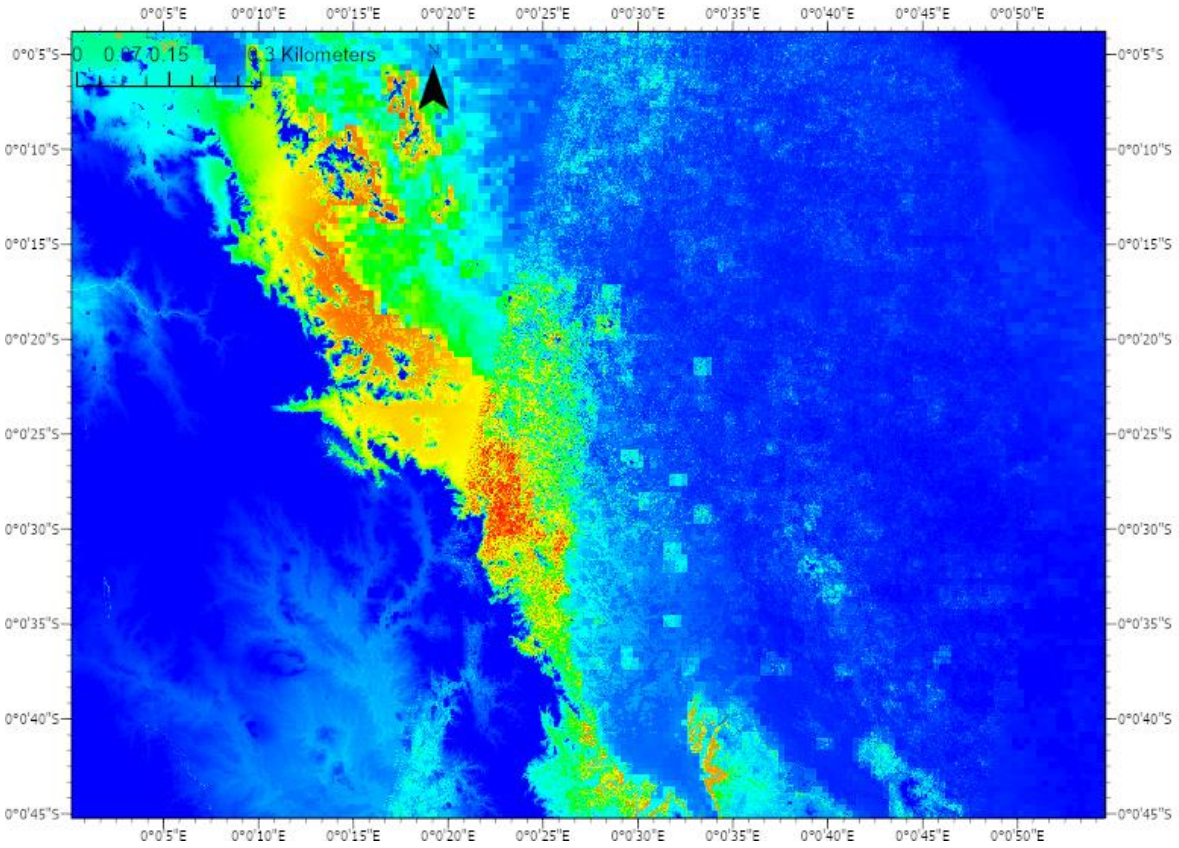


Figure S10. Barramundi (*Lates calcarifer*) spatio-temporal distribution (orange and red colour) in the recent past and current (2004-2019) climate, Central Queensland coast.

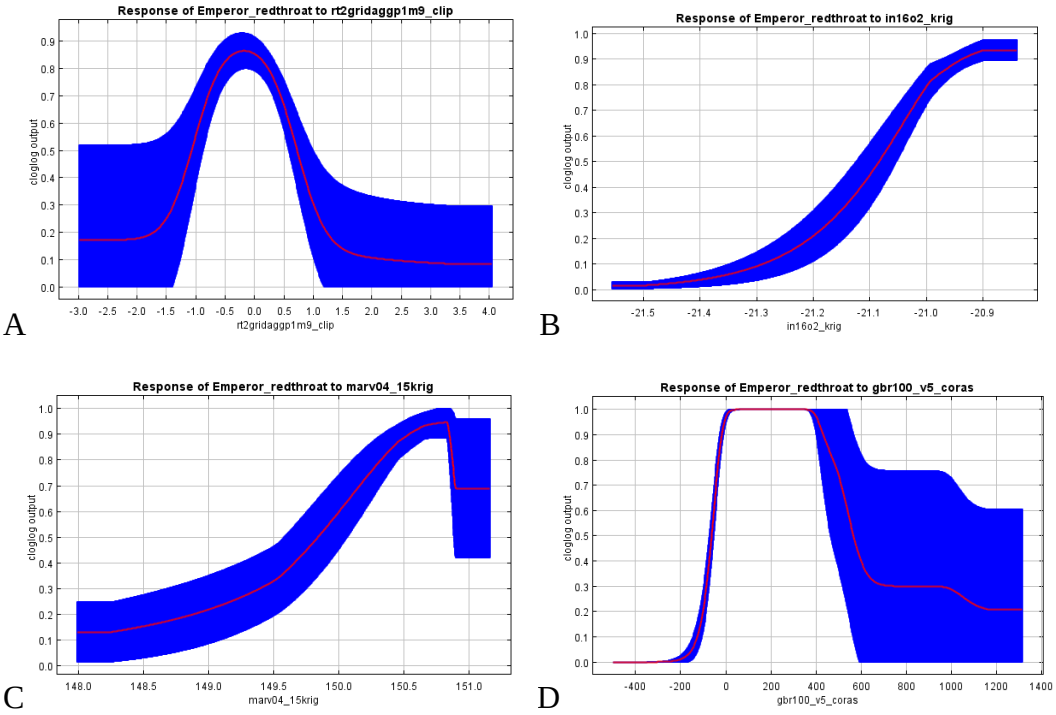


Figure S11. Red-throat emperor (*Lethrinus miniatus*)marginal response curves of (A) SST earlier period of the 21st century, (B) dissolved O_2, (C) salinity, and (D) bathymetry, when all other environmental variables are kept at average sample value over the set of presence localities, Central Queensland coast.

GAM analysis

Table S7. Correlation matrix for variables used in the GAM analysis.

	Longitude	Year	Month	Days	Latitude	Temp_mean	Psal_mean	Weight_kg	CPUE
Longitude	1	-0.37	-0.18	0.04	-0.11	-0.19	0.21	-0.11	-0.01
Year	-0.37	1	-0.1	0.02	0.01	0.07	-0.08	0.28	0.25
Month	-0.18	-0.1	1	-0.02	0.01	0.05	-0.02	0.05	0.02
Days	0.04	0.02	-0.02	1	-0.69	-0.04	-0.03	-0.1	-0.31
Latitude	-0.11	0.01	0.01	-0.69	1	0.04	0	0.13	0.18
Temp_mean	-0.19	0.07	0.05	-0.04	0.04	1	-0.42	0.03	0.02
Psal_mean	0.21	-0.08	-0.02	-0.03	0	-0.42	1	-0.01	0.02
Weight_kg	-0.11	0.28	0.05	-0.1	0.13	0.03	-0.01	1	0.89
CPUE	-0.01	0.25	0.02	-0.31	0.18	0.02	0.02	0.89	1

Table S8. GAM models constructed as (1) spatio-temporal and (2) oceanographic, for exploring factors potentially influencing the distribution of tropical, finfish and elasmobranch species on the Central Queensland coast.

Model Name	Code	Model	AIC	Deviance explained
Spatio-temporal Model	Model 1	CPUE ~ ti(Month) + ti(Year) + ti(Days) + ti(Weight_kg) + ti(Longitude) + ti(Latitude.x) + ti(Longitude, Latitude.x)	77,172.34	95.6%
	Model 2	CPUE ~ ti(Longitude, by = Month.x) + ti(Latitude.x) + ti(Temp_mean) + ti(Weight_kg, bs = "cr", k = 12)	78,018.60	95.3%
	Model 3	CPUE ~ ti(Month, Longitude) + ti(Weight_kg) + ti(Temp_mean) + ti(Psal_mean)	83,002.16	91.9%
Oceanographic Model	Model 7	CPUE ~ ti(Month) + ti(Year.x) + ti(Days) + ti(Weight_kg) + ti(Temp_mean)	80,167.19	94%
	Model 8	CPUE ~ ti(Month) + ti(Year.x) + ti(Days) + ti(Weight_kg) + ti(Psal_mean)	80,181.51	94%
	Model 9	CPUE ~ Month + Year + ti(Weight_kg, bs = "cr", k = 12) + ti(Temp_mean)	82,909.17	92%
Oceanographic Model for *Lates calcarifer*	Model 12	CPUE ~ Month + Year + ti(Weight_kg, bs = "cr", k = 3) + ti(Temp_mean)	6,126.944	96.6%
	Model 13	CPUE ~ Month + ti(Weight_kg, Temp_mean, bs = c("cr", "ps"), k = c(6, 7)	6,128.939	95.6%
	Model 14	CPUE ~ Month + Year.y + ti(Weight_kg, Psal_mean, bs = c("cr", "ps"), k = c(6, 7)	6,687.734	91.3%
Oceanographic Model for *Epinephelus miniatus*	Model 16	CPUE ~ Month + Year + ti(Weight_kg, bs = "cr", k = 12) + ti(Temp_mean)	37,577.84	94.2%
	Model 17	CPUE ~ Month + Year + ti(Weight_kg, bs = "cr", k = 12) + ti(Psal_mean)	37,655.66	94.1%
	Model 18	CPUE ~ Month + Year + ti(Weight_kg, Psal_mean, bs = c("cr", "ps"), k = c(12, 7)	40,909.21	88.2%
Oceanographic Model for *Eleutheronema tetradactylum*,	Model 19	CPUE ~ Month + Year + ti(Weight_kg, bs = "cr", k = 3) + ti(Temp_mean)	7,084.402	72.8%
	Model 20	CPUE ~ Month + Year + ti(Weight_kg, bs = "cr", k = 3) + ti(Psal_mean)	7,120.738	71.6%

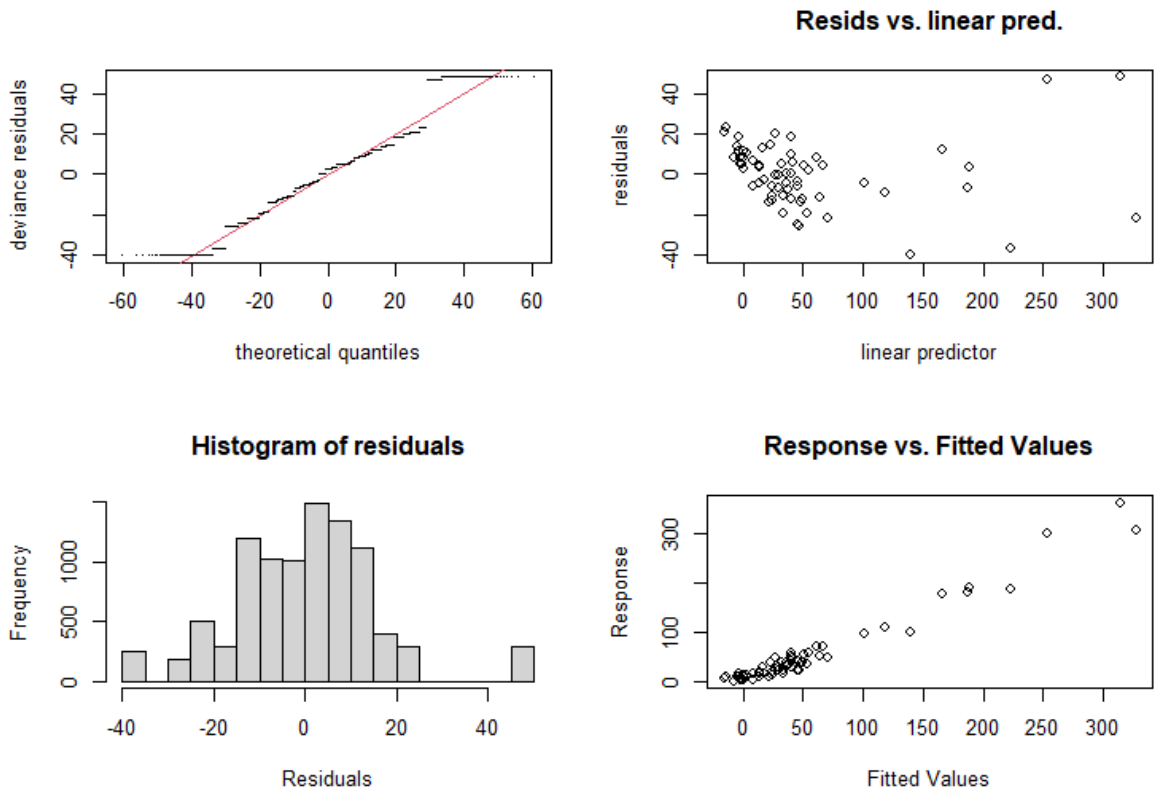


Figure S12. Model 1 QQ-plot, histogram, residuals vs. linear predictors, and response *v.* fitted values for 10 estuarine, finfish species with GAM spatio-temporal model, Central Queensland coast.

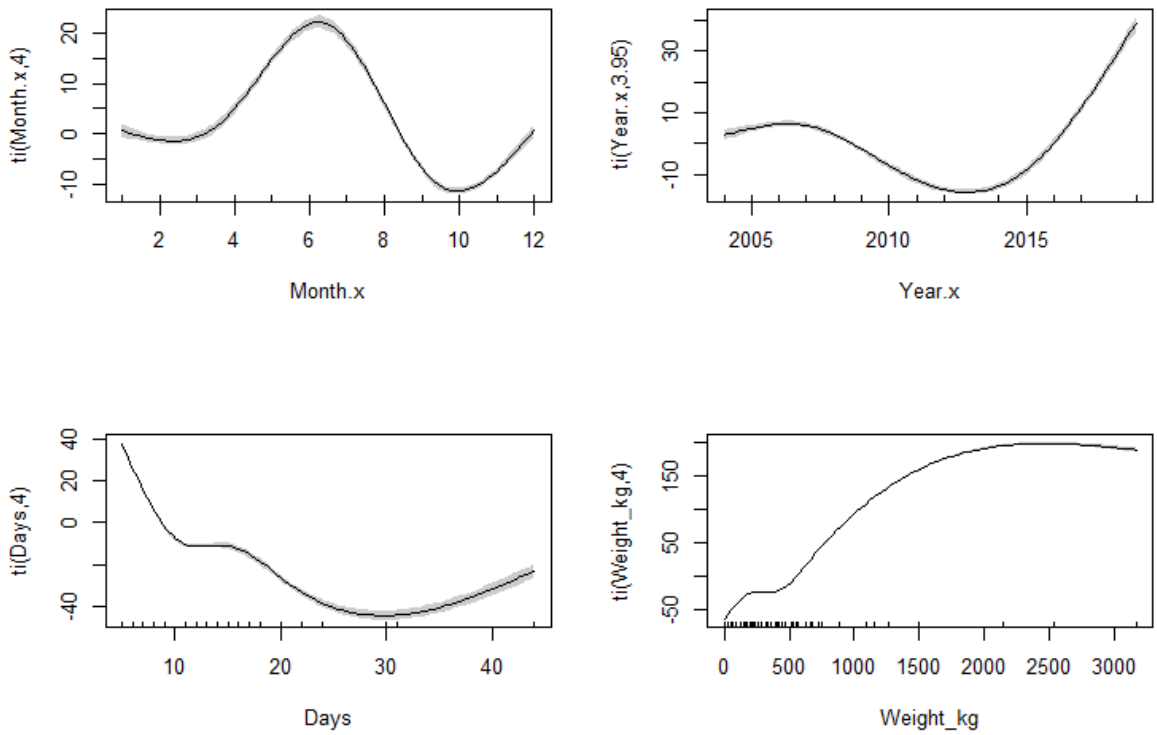


Figure S13. Model 1 relationship between 10 estuarine, finfish species CPUE and explanatory variables derived from the GAM. Shaded areas indicate 95% confidence intervals. Spatio-temporal model, Central Queensland coast.

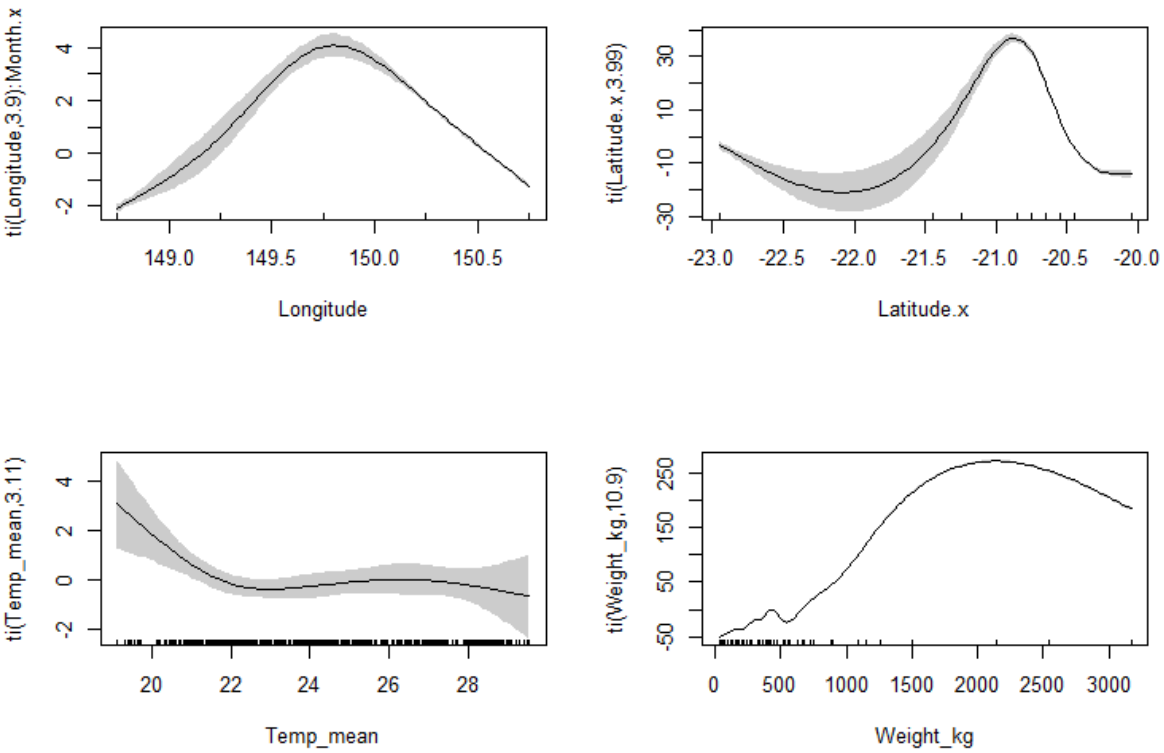


Figure S14. Model 2 relationship between 10 estuarine, finfish species CPUE and explanatory variables derived from the GAM. Shaded areas indicate 95% confidence intervals. Spatio-temporal model, Central Queensland coast.

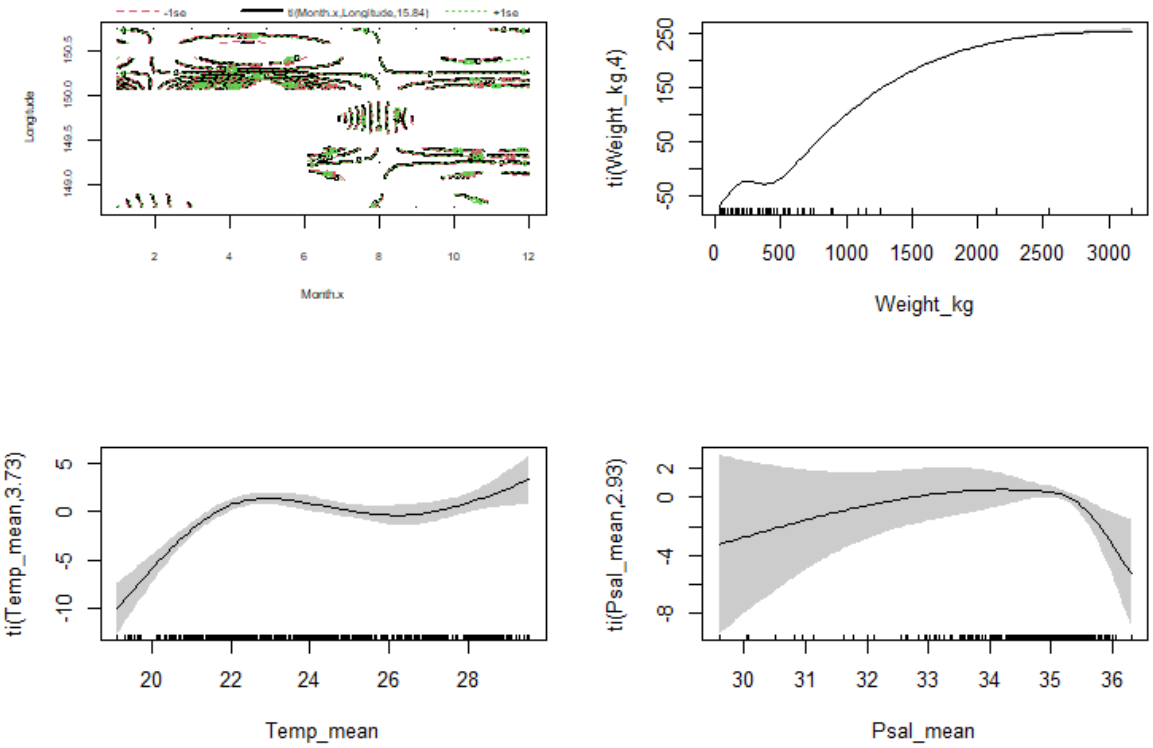


Figure S15. Model 3 relationship between 10 estuarine, finfish species CPUE and explanatory variables derived from the GAM. Shaded areas indicate 95% confidence intervals. The rug plot shows the relative density of data points for month and longitude. Spatio-temporal model, Central Queensland coast.

Table S9. Model 1, preferred spatio-temporal GAM model for 10 estuarine, finfish species of commercial value, Central Queensland coast.

Family: gaussian
Link function: identity

Formula:
CPUE ~ ti(Month.x) + ti(Year.x) + ti(Days) + ti(Weight_kg) + ti(Longitude) + ti(Latitude.x) + ti(Longitude, Latitude.x)

Parametric coefficients:

	Estimate	s.e.	*t*-value	Pr(>|t|)
(Intercept)	40.7924	0.8483	48.09	<2e-16 ***

Approximate significance of smooth terms:

	$d.f._e$	$d.f._{ref}$	*F*	*P*-value
ti(Month.x)	3.998	4.000	401.4	<2e-16 ***
ti(Year.x)	3.949	3.998	529.8	<2e-16 ***
ti(Days)	4.000	4.000	949.1	<2e-16 ***
ti(Weight_kg)	3.999	4.000	16855.9	<2e-16 ***
ti(Longitude)	4.000	4.000	133.3	<2e-16 ***
ti(Latitude.x)	4.000	4.000	105.7	<2e-16 ***
ti(Longitude,Latitude.x)	3.968	4.000	371.5	<2e-16 ***

Probabilities are significant at: ***, $P < 0.001$; **, $P < 0.01$; *, $P < 0.05$. $R^2_{adj} = 0.956$. Deviance explained = 95.6%. GCV = 245.29 Scale est. = 244.53. $n = 9403$

Table S10. Model 2, second most highly ranked GAM spatio-temporal model for 10 estuarine, finfish species of commercial value, with a smooth on the bivariate term and mean temperature as an environmental factor, Central Queensland coast.

Family: gaussian
Link function: identity

Formula:

CPUE ~ ti(Longitude, by = Month.x) + ti(Latitude.x) + ti(Temp_mean) + ti (Weight_kg, bs = "cr", k = 12)

Parametric coefficients:

	Estimate	s.e.	*t*-value	Pr(>|t|)
(Intercept)	53.0606	0.1795	295.6	<2e-16 ***

Approximate significance of smooth terms:

	$d.f._e$	$d.f._{ref}$	*F*	*P*-value
ti(Longitude):Month.x	3.897	3.991	945.225	<2e-16 ***
ti(Latitude.x)	3.995	4.000	785.541	<2e-16 ***
ti(Temp_mean)	3.106	3.608	3.679	0.0114 *
ti(Weight_kg)	10.902	10.996	14533.711	<2e-16 ***

Probabilities are significant at: ***, $P < 0.001$; **, $P < 0.01$; *, $P < 0.05$. $R^2_{(adj)} = 0.952$. Deviance explained = 95.3%. REML = 39056. Scale est. = 267.03. $n = 9257$

Table S11. Model 3, third most highly ranked GAM spatio-temporal model for 10 estuarine, finfish species of commercial value, with an interaction of month and longitude, and environmental factors, mean temperature and salinity, Central Queensland coast.

Family: gaussian
Link function: identity

Formula:
CPUE ~ ti(Month.x, Longitude) + ti(Weight_kg) + ti(Temp_mean) + ti(Psal_mean)

Parametric coefficients:

	Estimate	s.e.	*t*-value	Pr(>|t|)
(Intercept)	54.8172	0.2609	210.1	<2e-16 ***

Approximate significance of smooth terms:

	d.f.$_e$	d.f.$_{ref}$	*F*	*P*-value
ti(Month.x,Longitude)	15.843	15.979	375.638	<2e-16 ***
ti(Weight_kg)	3.998	4.000	21790.529	<2e-16 ***
ti(Temp_mean)	3.732	3.958	18.761	<2e-16 ***
ti(Psal_mean)	2.927	3.352	2.303	0.0428 *

Probabilities are significant at: ***, $P < 0.001$; **, $P < 0.01$; *, $P < 0.05$. $R^2_{(adj)} = 0.919$. Deviance explained = 91.9%. REML = 41584 Scale est. = 457.23. $n = 9257$

Table S12. Model 7 most highly ranked GAM oceanographic model for 10 estuarine, finfish species of commercial value, featuring a smooth on mean temperature, Central Queensland coast.

Family: gaussian
Link function: identity

Formula:
CPUE ~ ti(Month.x) + ti(Year.x) + ti(Days) + ti(Weight_kg) + ti(Temp_mean)

Parametric coefficients:

	Estimate	s.e.	*t* value	Pr(>|t|)
(Intercept)	54.2319	0.1908	284.3	<2e-16 ***

Approximate significance of smooth terms:

	$d.f._e$	$d.f._{ref}$	*F*	*P*-value
ti(Month.x)	3.986	4.000	186.906	< 2e-16 ***
ti(Year.x)	3.957	3.999	261.023	< 2e-16 ***
ti(Days)	3.970	3.999	1247.833	< 2e-16 ***
ti(Weight_kg)	3.996	4.000	16975.407	< 2e-16 ***
ti(Temp_mean)	3.277	3.734	6.276	9.06e-05 ***

Probabilities are significant at: ***, $P < 0.001$; **, $P < 0.01$; *, $P < 0.05$. $R^2_{(adj)} = 0.94$. Deviance explained = 94%. REML = 40109 Scale est. = 336.9. $n = 9257$

Table S13. Model 8 second most highly ranked oceanographic model for 10 estuarine, finfish species of commercial value, featuring a smooth on salinity, Central Queensland coast.

Family: gaussian
Link function: identity

Formula:
CPUE ~ ti(Month.x) + ti(Year.x) + ti(Days) + ti(Weight_kg) + ti(Psal_mean)

Parametric coefficients:

	Estimate	s.e.	*t*-value	Pr(>|t|)
(Intercept)	54.232	0.191	284	<2e-16 ***

Approximate significance of smooth terms:

	$d.f._e$	$d.f._{ref}$	*F*	*P*-value
ti(Month.x)	3.986	4.000	188.44	<2e-16 ***
ti(Year.x)	3.958	3.999	258.10	<2e-16 ***
ti(Days)	3.971	3.999	1235.68	<2e-16 ***
ti(Weight_kg)	3.996	4.000	16926.76	<2e-16 ***
ti(Psal_mean)	1.026	1.051	6.16	0.013 *

Probabilities are significant at: ***, $P < 0.001$; **, $P < 0.01$; *, $P < 0.05$. $R^2_{(adj)} =$ 0.94. Deviance explained = 94%. -REML = 40114 Scale est. = 337.53. $n = 9257$

Table S14. Model 12 *Lates calcarifer* oceanographic model

Family: gaussian
Link function: identity

Formula:
Approximate significance of smooth terms:

	d.f.$_e$	d.f.$_{ref}$	*F*	*P*-value
ti(Weight_kg)	1.994	2.000	8149.58	<2e-16 ***
ti(Temp_mean)	3.368	3.798	12.55	<2e-16 ***

Probabilities are significant at: ***, $P < 0.001$; **, $P < 0.01$; *, $P < 0.05$. $R^2_{(adj)} = 0.954$. Deviance explained = 95.6%. -REML = 3007.8 Scale est. = 133.18. $n = 789$

Table S15. Model 16 *Lethrinus miniatus* oceanographic model

Family: gaussian
Link function: identity

Formula:
CPUE ~ Month.x + Year.x + ti(Weight_kg, bs = "cr", k = 12) + ti(Temp_mean)

Parametric coefficients:

	Estimate	s.e.	*t* value	Pr(>|t|)
(Intercept)	1870.09118	138.12297	13.54	<2e-16 ***
Month.x	-2.92067	0.10172	-28.71	<2e-16 ***
Year.x	-0.89366	0.06872	-13.01	<2e-16 ***

Approximate significance of smooth terms:

	$d.f._e$	$d.f._{ref}$	*F*	*P*-value
ti(Weight_kg)	10.803	10.980	6221.05	<2e-16 ***
ti(Temp_mean)	3.777	3.972	23.04	<2e-16 ***

Probabilities are significant at: ***, $P < 0.001$; **, $P < 0.01$; *, $P < 0.05$. $R^2_{adj} = 0.942$. Deviance explained = 94.2%. REML = 18818. Scale est. = 242.21. n = 4510

Table S16. Model 19 *Eleutheronema tetradactylum* oceanographic model

Family: gaussian
Link function: identity

Formula:
CPUE ~ Month.y + Year.y + ti(Weight_kg, bs = "cr", k = 3) + ti(Temp_mean)

Approximate significance of smooth terms:

	$d.f._e$	$d.f._{ref}$	F	*P*-value
ti(Weight_kg)	1.996	2.000	814.47	<2e-16 ***
ti(Temp_mean)	2.622	3.214	15.67	<2e-16 ***

Probabilities are significant at: ***, $P < 0.001$; **, $P < 0.01$; *, $P < 0.05$. $R^2_{adj} = 0.72$. Deviance explained = 72.8%. REML = 3481.5. Scale est. = 265.97. n = 838

References

Geoscience Australia (2020) 'Digital Earth Australia, Fractional Cover. Vol. 2020.' (Geoscience Australia: Canberra, ACT, Australia)