Supplementary Material

Text S1. *Influence of incubation temperature on early growth*

Early growth rates of juvenile *P. umbrina* are likely influenced by the incubation regime they experienced in the captive breeding facility at the Perth Zoo (details in Mitchell *et al*. 2016). Consequently, specific growth rates (SGR's – see methods) were calculated for captive-reared juveniles hatching from 2011-2014 inclusive over their first year of growth (hatching → start of year 1 aestivation) and over a three-year period (hatching → start of year 3 aestivation). Analysis of covariance (with hatching year as a covariate) showed that the incubation regime had a significant effect on growth over both timeframes (1 year: [F (3, 119) = 11.81, $p < 0.001$; 3 years: [F (3, 81) = 4.58, $p = 0.005$]) (Figure S1). Incubation at 24+/-2 °C produced significantly better first year growth than at constant 24 °C ($p = 0.034$) and constant 29°C ($p < 0.001$), but growth rates were not significantly different to those from the 29+/-2 °C regime. The pattern was similar over the longer three-year timeframe, but the only significant difference was higher growth rates of juveniles incubated at 24+/-2 °C relative to 29+/-2 °C ($p = 0.002$).

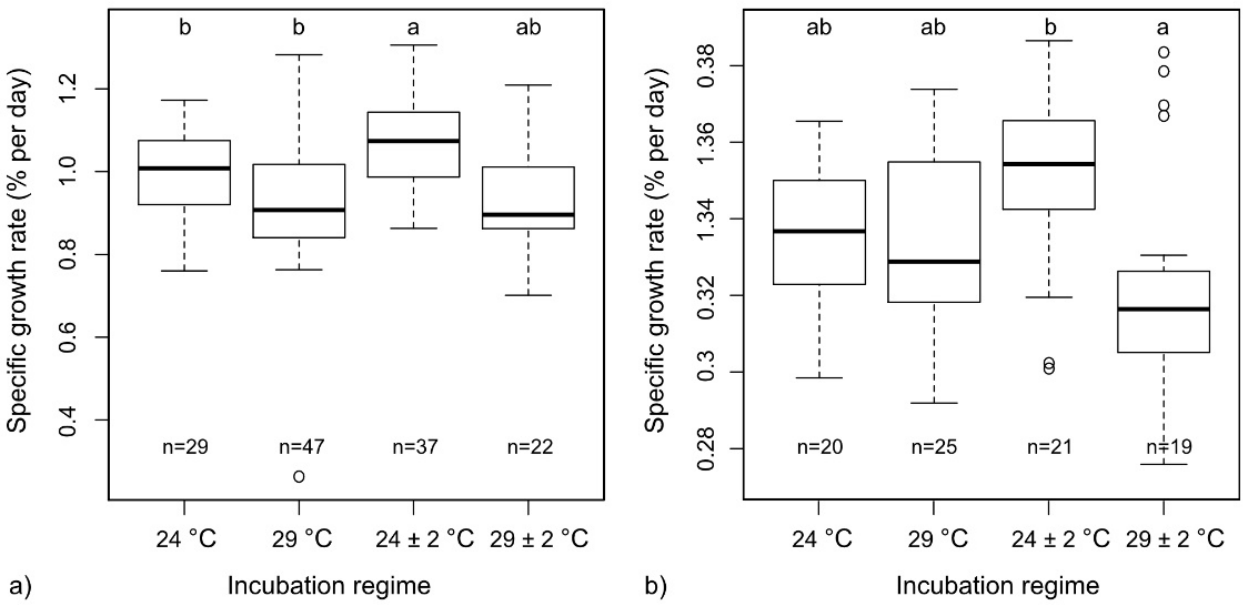

Figure S1. Box-plots showing the specific growth rate of captive *P. umbrina* at Perth Zoo (including 35 individuals used in this study) during a) their first year of growth and b) over three years of growth, under four incubation regimes* (constant or daily cycling temperatures). Lower and upper box boundaries are 25th and 75th percentiles respectively and the thicker line inside box is the median. Lower and upper error lines are 10th and 90th percentiles respectively, and open circles show data falling outside the 90th percentile. Different letters indicate significant differences in growth rates between incubation regimes.

*In addition to the four incubation regimes defined here, nests in the captive breeding colony are occasionally not detected. Consequently hatchings sometimes hatch naturally inside breeding ponds, but thereafter experience standard husbandry protocols.

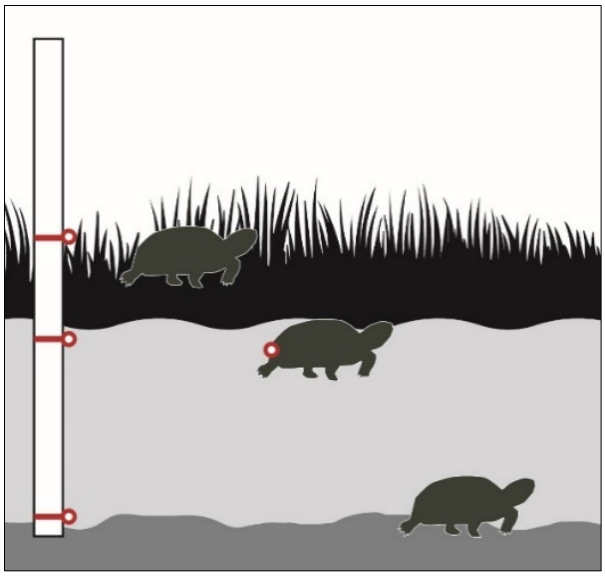

Figure S2. Schematic of the thermal microclimates monitored at each site; basking; shallow water; and deep water. Temperature loggers (red circles) were waterproofed with black PlastiDip and attached to a picket, with the basking microclimate (top) set above the water level, and the shallow water microclimate logger attached to a float. Loggers recorded temperatures at the same times as the loggers attached to turtles

Text S2. *Climate trend analysis*

Climate trend analysis showed that minimum and maximum temperatures have been increasing at all translocation sites, with higher rates of increases at Moore River and Meerup (approx. 0.14 and 0.19 °C per decade respectively; Table S1). The CDFM analysis for annual rainfall suggested that declines began around 2000 in the East Augusta region (Figure S3), around 1965 in the Meerup region (Figure S4), and rainfall declined at Moore River from 1998-2015 (Figure S5).

Relative to long-term averages, 2016 was a year of lower rainfall and lower air temperatures at East Augusta; but a year of higher rainfall, higher maximum air temperatures, but lower minimum temperatures for Meerup (Figure S4; Table A2). Moore River was generally cooler than average, especially from July –December, but there were insufficient long term climate records for evaluation of anomalies. In 2016 annual rainfall at Moore River was relatively high, but slightly below average from July-December (Table S2).

Table S1. Autoregressive integrated moving average (ARIMA) analysis of long-term climate trends at translocation sites.

Translocation site	Nearest weather station*	Climate components	Period	Trend (mm or °C per decade)
East Augusta	Cape Leeuwin (8 km, 1897→)	Rainfall total	Annual	-12.18
		Rainfall anomalies	Annual	-3.016
		Rainfall anomalies	Jul-Dec	-2.348
		Max air temperature anomalies	Annual	0.065
		Max air temperature anomalies	Jul-Dec	0.046
		Min air temperature anomalies	Annual	0.058
		Min air temperature anomalies	Jul-Dec	0.039
Meerup	Northcliffe (8 km, 1926→)	Rainfall total	Annual	-48.59
		Rainfall anomalies	Annual	-48.59
		Rainfall anomalies	Jul-Dec	-18.24
	Pemberton (21 km, 1941→)	Max air temperature anomalies	Annual	0.245
		Max air temperature anomalies	Jul-Dec	0.228
		Min air temperature anomalies	Annual	0.131
		Min air temperature anomalies	Jul-Dec	0.152
Moore River	Baramba (13 km, 1970→)	Rainfall total	Annual	-10.73
		Rainfall total	Jul-Dec	2.623
	Lancelin (31km, 1966→)	Max air temperature	Annual	0.146
		Max air temperature	Jul-Dec	0.123
		Min air temperature	Annual	0.141
		Min air temperature	Jul-Dec	0.150

*Distance from translocation sites is shown in brackets, along with the year the weather station began operating.

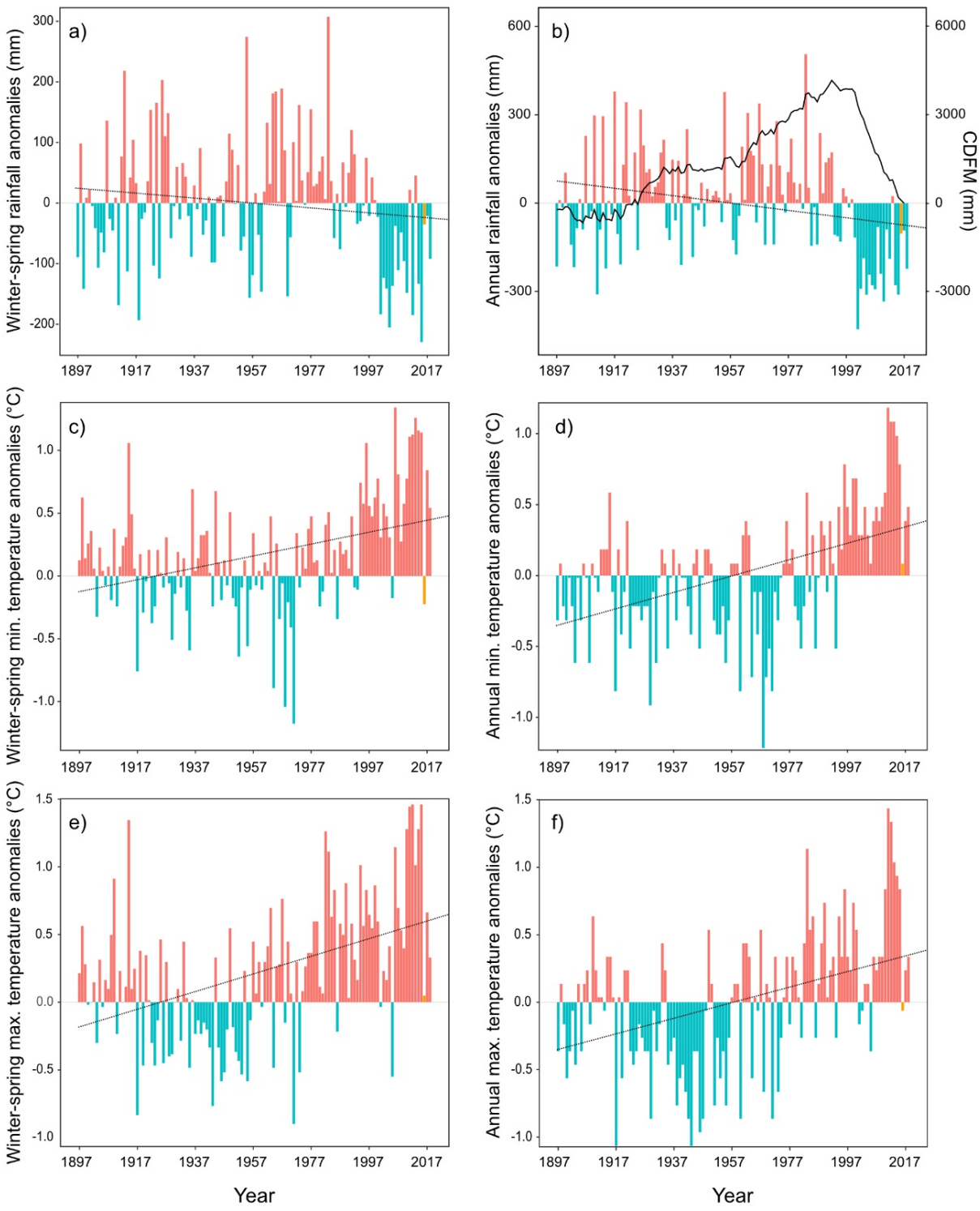

Figure S3. Long-term rainfall (a-b) and air temperature (c-f) trends in the East Augusta region, based on data from the Cape Leeuwin weather station (1897-2018). Bars represent normalised anomalies from the standard averages based on the1961-1990 climate. The dashed black line indicates the linear trend, and the solid black line in panel b represents the cumulative deviation from the mean**.** Panels on the left show data from July-December (the typical activity period of *P. umbrina*), and panels on the right show annualised data. Data from 2016 are coloured in yellow to highlight when the assisted colonisation trials occurred.

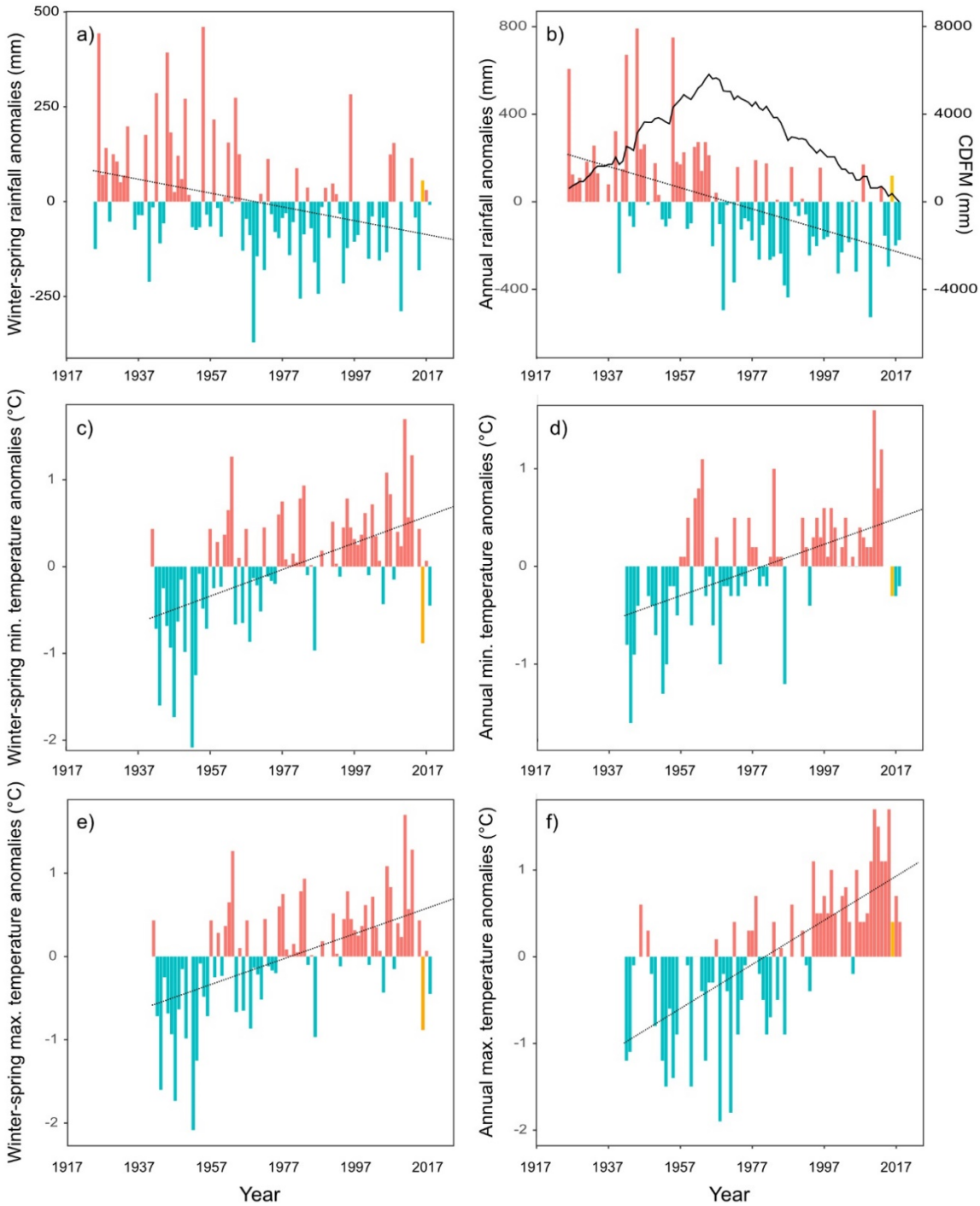

Figure S4. Long-term rainfall (a-b) and air temperature (c-f) trends in the Meerup region. Rainfall trends are based on Northcliffe weather station data (1926-2018), and air temperature trends are based on Pemberton weather Station data (1941-2018). Bars represent normalised anomalies from the standard averages based on the1961-1990 climate. The dashed black line indicates the linear trend, and the solid black line in panel b) represents the cumulative deviation from the mean**.** Panels on the left show data from July-December (the typical activity period of *P. umbrina*), and panels on the right show annualised data. Data from 2016 are coloured in yellow to highlight when the assisted colonisation trials occurred.

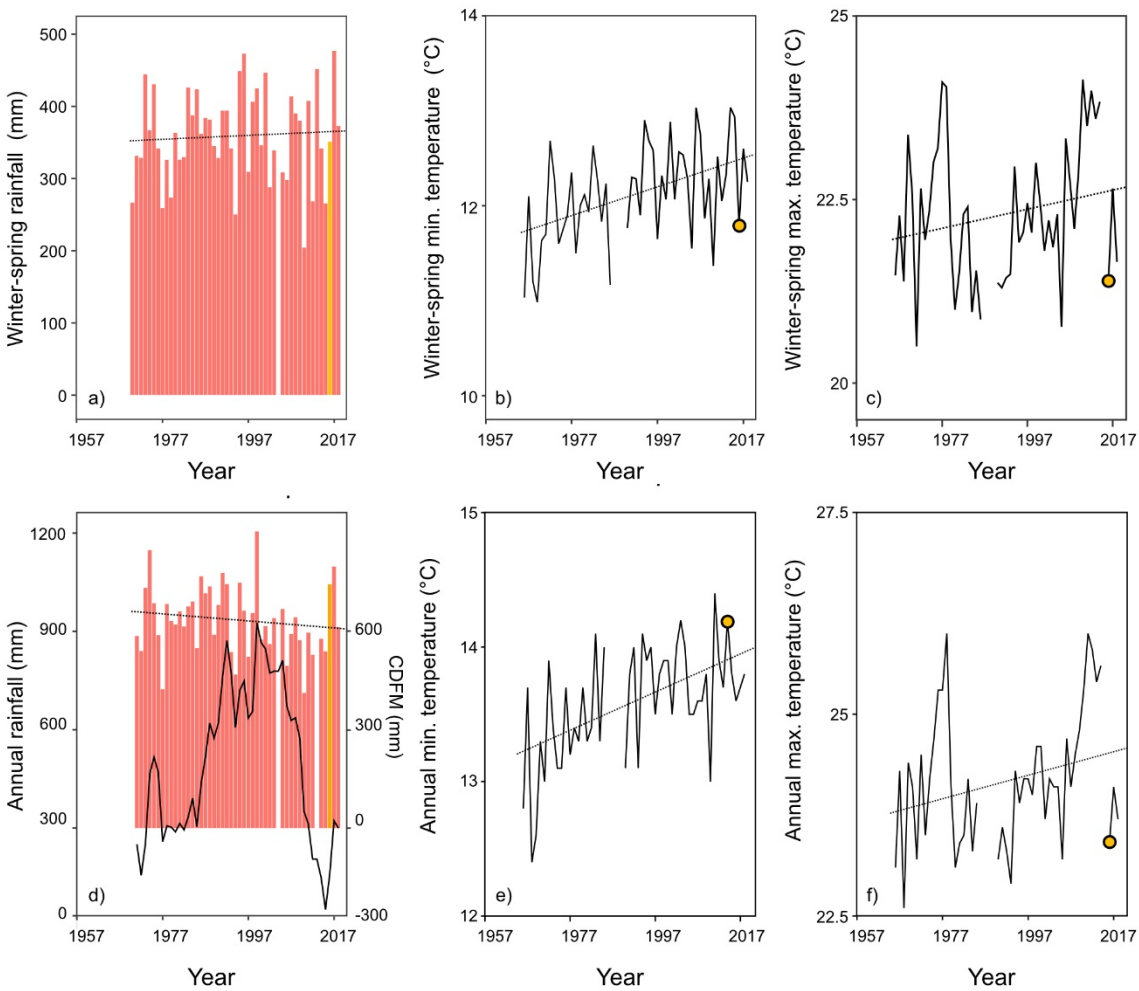

Figure S5. Long-term rainfall and air temperature data from the Moore River region. Rainfall data (a,d) are from the Baramba weather station (1970-2018), and air temperature data (b-c, e-f) are from the Lancelin weather Station (1966-2018). Dashed black lines indicates the trends, and the solid black line in d) shows the CDFM. Data from 2016 are coloured in yellow to highlight when the assisted colonisation trials occurred.

Table S2. Comparison of rainfall and air temperatures in 2016 with the long-term average (1961-90)* from weather stations located near translocation sites.

Translocation site (weather station ID)		Rainfall (mm)		Min. temp (°C)		Max. temp (°C)	
		Jul-Dec	Annual	Jul-Dec	Annual	Jul-Dec	Annual
East Augusta	Mean 1961-90	583	1048	12.7	14.0	18.5	19.9
(Cape Leeuwin)	Anomaly 2016	-91	-192	-0.2	+0.2	-0.3	-0.2
Meerup	Mean 1961-90	714	124				
(Northcliffe)	Anomaly 2016	+106	+20				
(Pemberton)	Mean 1961-90			8.9	10.1	18.3	20.1
	Anomaly 2016			-1.0	-0.3	+0.7	+0.7
Moore River	Mean 1970-2018	359	635				
(Baramba*)	Difference 2016	-8	+108				
(Lancelin*)	Mean 1966-2018			12.1	13.6	22.3	24.2
	Difference 2016			-0.4	0.0	-0.9	-0.8

* weather data were not available from 1961 for the Moore River region, so 2016 is reported as the difference from the mean of all available data, rather than as an anomaly.

Table S3. The evaluated set of linear regression models predicting the specific growth rate (SGR) of juvenile *P. umbrina.* Variables were removed sequentially via backward stepwise elimination, with the variable with the largest p-value removed first. The model with most support is indicated in bold. Degrees of freedom, log-likelihood, and Akaike weights (W*i*) are shown for each model,

Candidate model	df	logLik	W*i*
SGR ~ site + age + inc.reg + mass + SGR_yr1 + CTE	13	50.44	$1.49e^{-09}$
SGR ~ site + age + inc.reg + mass + SGR_yr1	12	50.13	$1.64e^{-07}$
SGR ~ site + inc.reg + mass + SGR_yr1	9	39.73	$2.34e^{-07}$
SGR ~ site + inc.reg + SGR_yr1	8	39.65	$2.99e^{-06}$
SGR ~ site + inc.reg	8	44.50	0.008
SGR ~ site	**4**	**44.44**	**0.99**

site = translocation site, age = age at release (years), inc.reg = incubation temperature regime in captive breeding facility at the Perth Zoo, mass = mass at release, SGR_yr1 = specific growth rate in first year of captivity, CTE = constant temperature equivalent, based on shallow water temperatures during each turtle's growth period at the translocation site.

Note: the same best model (SGR ~ site) was selected using an alternative method that ranked all possible regression models. Six alternative models had an AIC_C difference (Δi) < 6 (the 95% confidence model set), with SGR ~ CTE being the second best supported model with a Δi of 1.98.