Using spatio-temporal models of line transect abundance estimates for trend estimation

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GLOBAL DISCOVERIES FOR TOMORROW'S WORLD

Common Dolphins

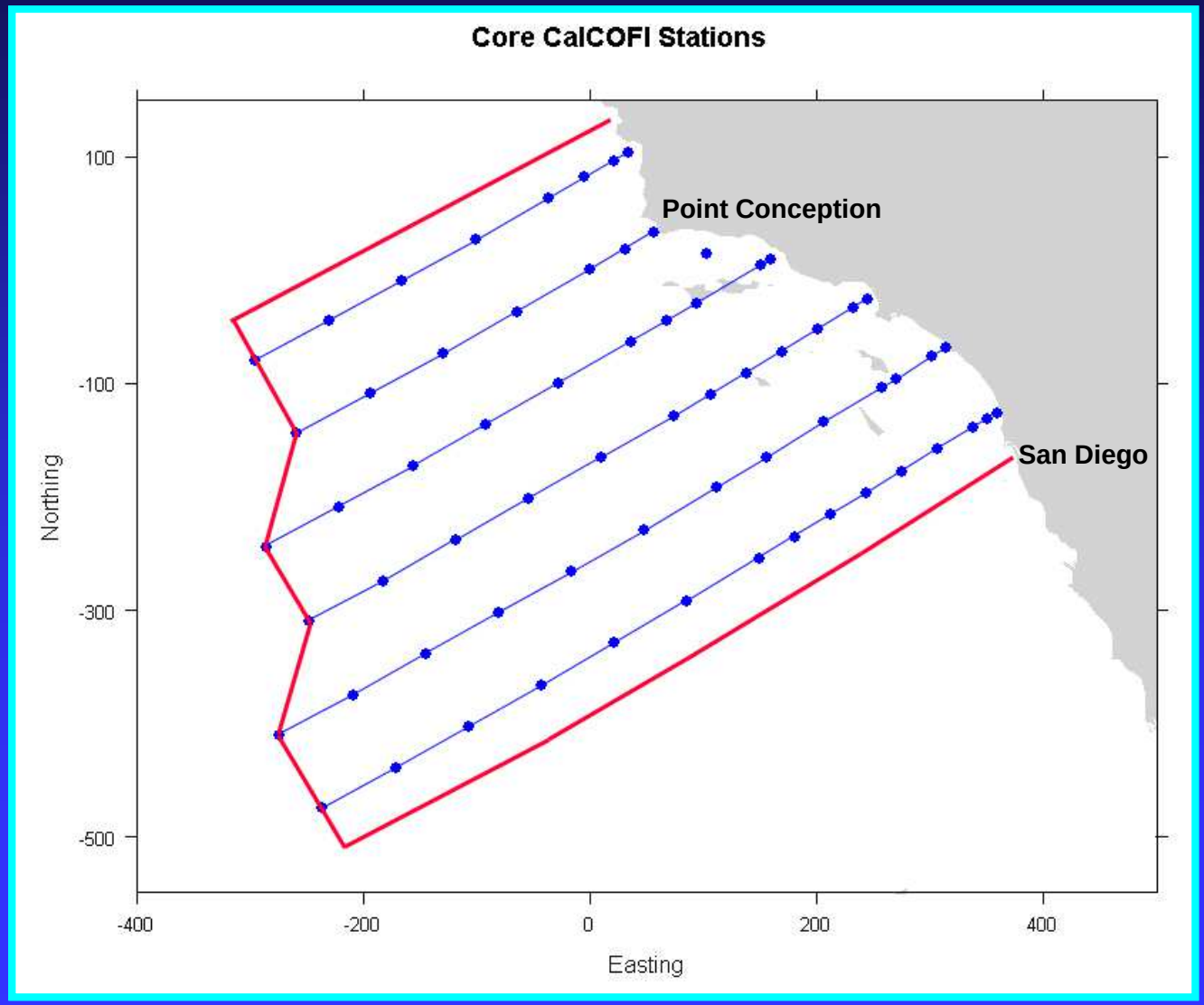
Jim Cotton, courtesy NOAA

Short-beaked

Susanne Yin, courtesy NOAA

Long-beaked

Study Area


Core CalCOFI Stations
Point Conception
San Diego
100
-100
-300
-500
Northing
-400
-200
0
200
400
Easting

Conventional Distance Sampling

1. Estimate effective strip half width: ESW

2. Estimate encounter rate at the line

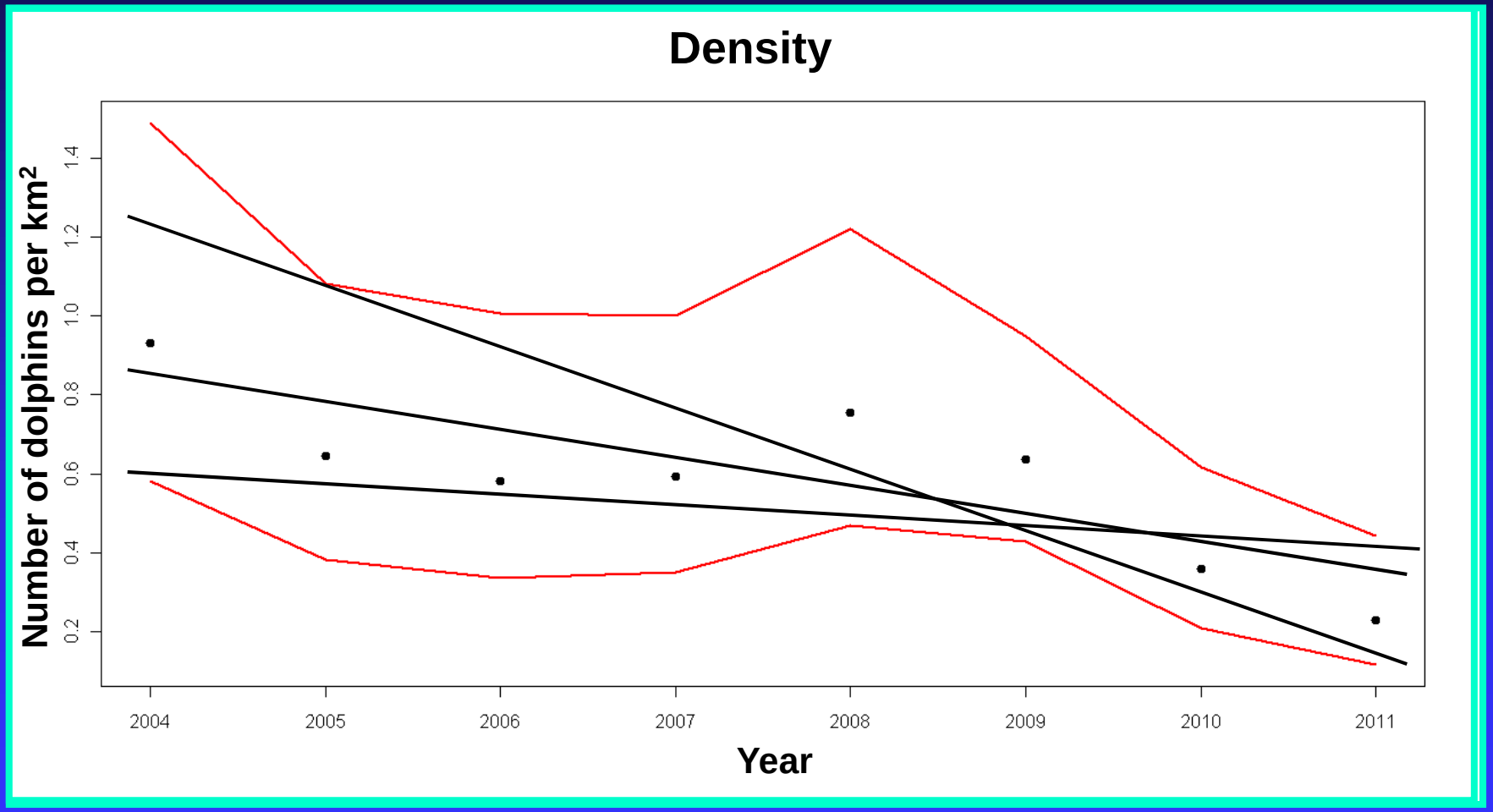
Density of groups in the study area

3. Estimate expected group size

Density of animals in the study area

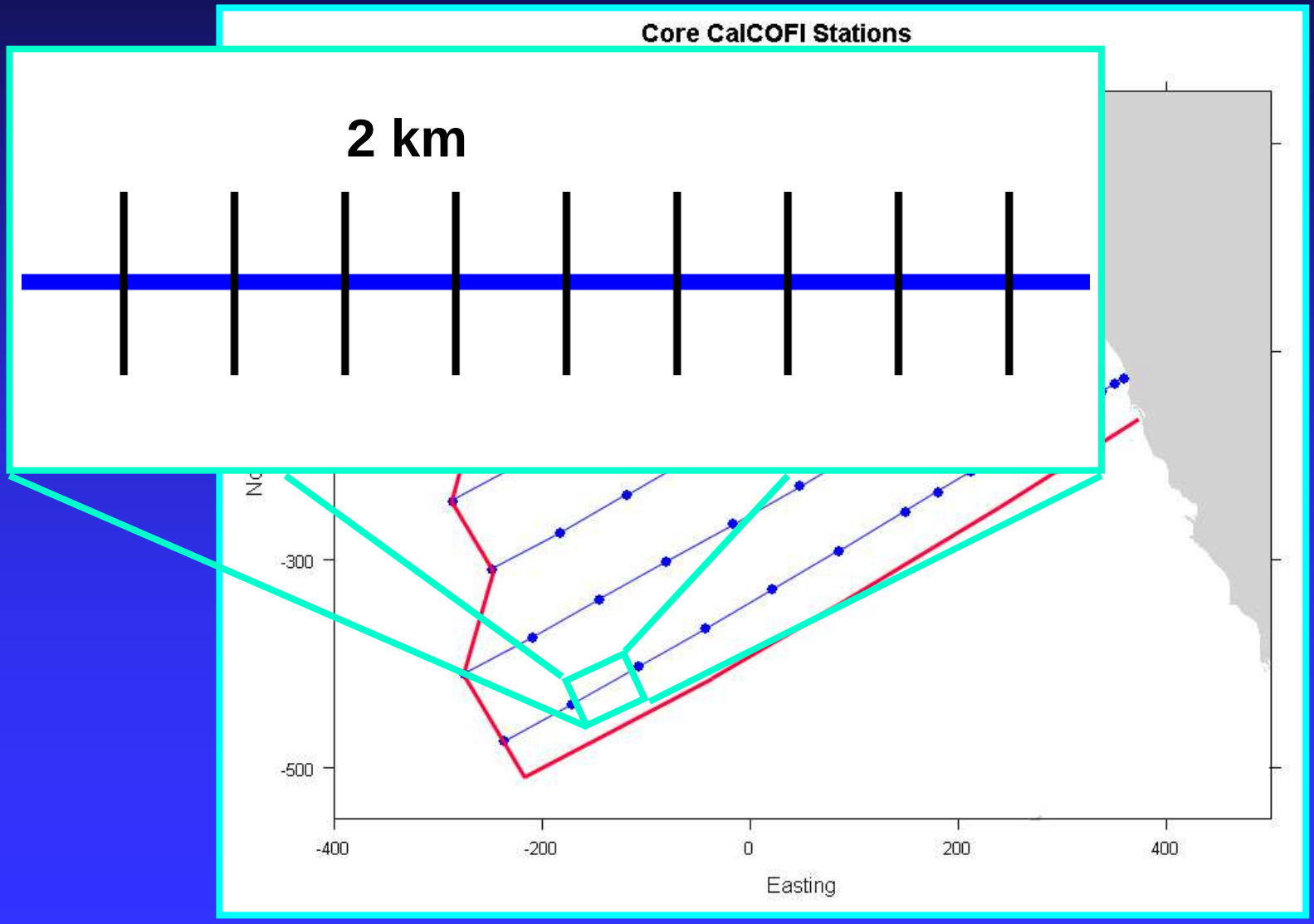
Buckland et al. 2001

Average Density per Year



$$\hat{D}_t = \beta_0 + \beta_1 t + \varepsilon_t$$

Density Surface Modelling



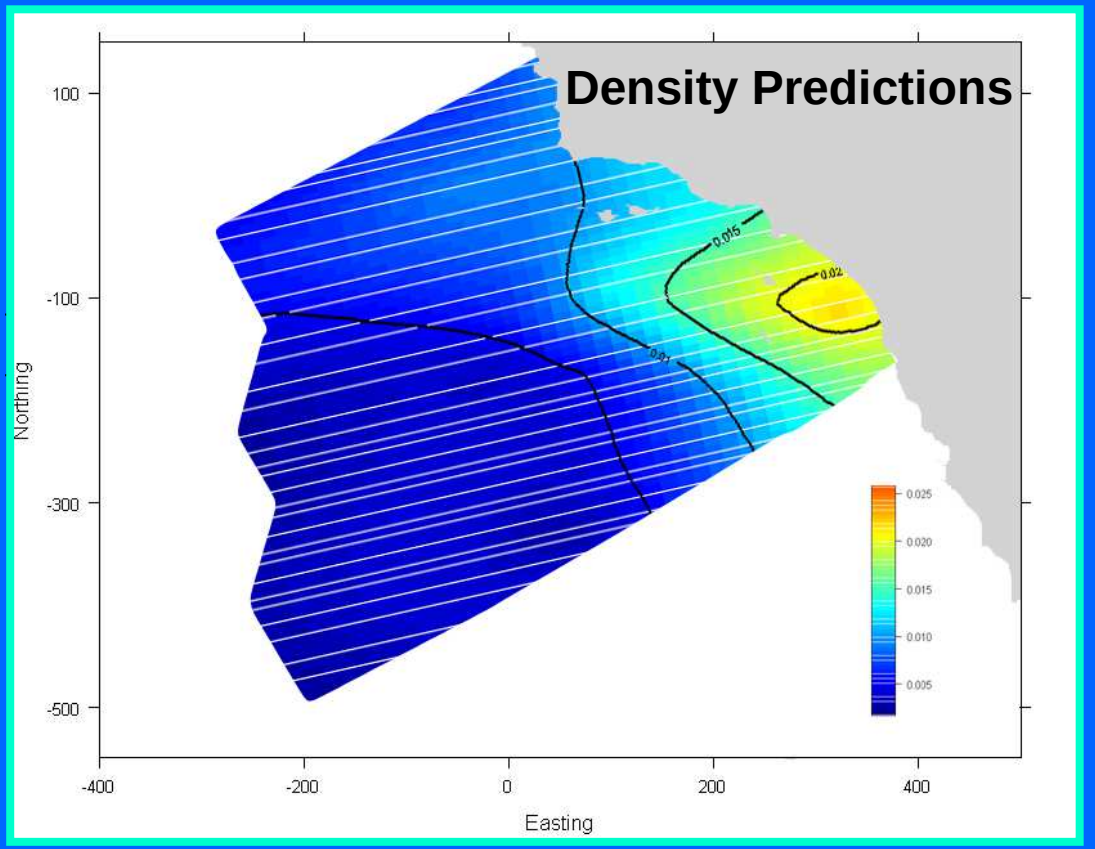
Density Surface Modelling

$$\hat{D}_t = \exp(\beta_0 + oceo) + \varepsilon_t$$

$$\hat{D}_t = \frac{n_t}{a}$$

$$n_t = \exp(\beta_0 + oceo +$$

$$a = 2 * L * ESW$$



Density Surface Modelling

1. Estimate effective strip half width: ESW

a = 2 * L *ESW

2. Estimate density of groups at the segment

Using oceanographic covariates

3. Estimate average group size

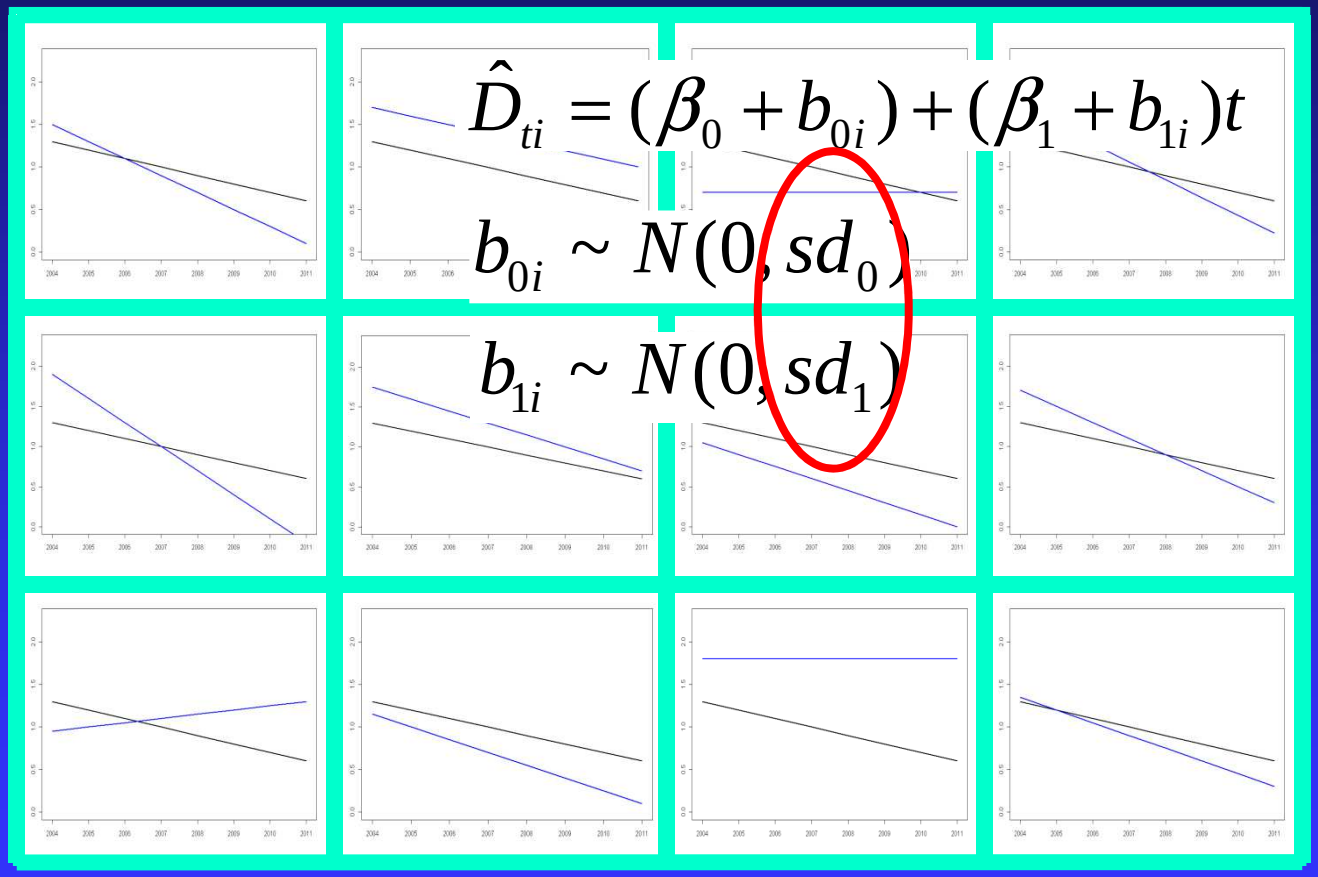
Scale up to density of individual animals

$$n_{ti} = \exp(\beta_0 + b_{0i} + (\beta_1 + b_{1i}) * t + oceo + \log(a)) + \varepsilon_t$$

Hedley and Buckland 2004

Thomas et al. 2004

Variable Trends at different Sites



$$\hat{D}_{ti} = (\beta_0 + b_{0i}) + (\beta_1 + b_{1i})t$$

$$b_{0i} \sim N(0, sd_0)$$

$$b_{1i} \sim N(0, sd_1)$$

Study area

Group Density

Fixed effects:	Random Effects:
Year	Year (Intercept and slope)
Season	
Depth	
SST	
SAL	
Chlorophyll a	
Oxygen	
Thermocline	

Year Effect

Coefficient value for fixed effect Year:

-0.097 $p < 0.001$

Year 2004: exp(-0.097 * 1) = 0.91

Standard deviation for random effect Year:

Intercept: 1.29

Slope: 0.21

Future Work

- **Include variation in group size (spatial and/or temporal trend)**
- **Test less abundant species**
- **Different spatio-temporal correlation structures**
- **Include include smooth functions (GAMM)**
- **Use Bayesian methods**

References

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